

120 Ignition System

GENERAL	120-1
Ignition firing order	120-2
Disabling ignition system	120-2
Warnings and Cautions	120-3
DIGITAL MOTOR ELECTRONICS (DME)	
IGNITION SYSTEM	120-4
Ignition coils	120-4
Crankshaft sensor	120-6
Camshaft sensors	120-7
Knock sensors	120-8
Troubleshooting	120-9
On-board diagnostics	120-9
Misfire detection	120-9
Oscilloscope diagnostic diagrams	120-9
IGNITION COIL SERVICE	120-12
Ignition coil, replacing (M54 engine)	120-12
Ignition coil, replacing (N52, N54 engine)	120-12
Ignition coil, replacing (V8 engine)	120-13
CRANKSHAFT SENSOR SERVICE	120-14
Crankshaft sensor, replacing (M54 engine)	120-14
Crankshaft sensor, replacing (N52, N54 engine)	120-15
Crankshaft sensor, replacing (V8 engine)	120-15

CAMSHAFT SENSOR SERVICE	120-16
Intake camshaft sensor, replacing (M54 engine)	120-16
Exhaust camshaft sensor, replacing (M54 engine)	120-17
Intake camshaft sensor, replacing (N52, N54 engine)	120-17
Exhaust camshaft sensor, replacing (N52, N54 engine)	120-18
Camshaft sensor, replacing (V8 engine)	120-18
KNOCK SENSOR SERVICE	120-19
Knock sensors, replacing (M54 engine)	120-19
Knock sensors, replacing (N52 engine)	120-20
Knock sensors, replacing (N54 engine)	120-21
Knock sensor, replacing (V8 engine)	120-22

TABLE

a. Ignition firing order	120-2
b. 5 Series engine management applications ..	120-4
c. Ignition secondary voltage diagnostics	120-9

GENERAL

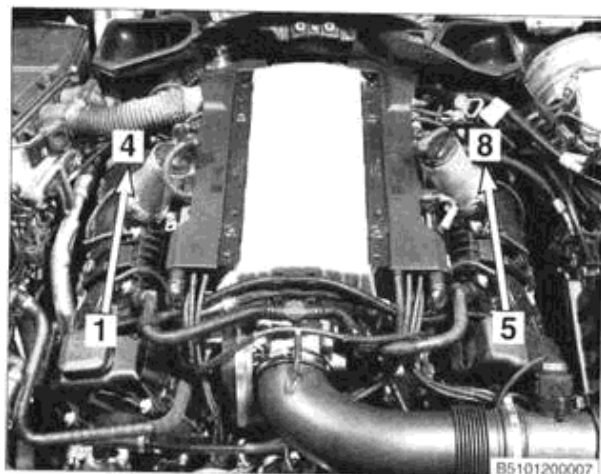
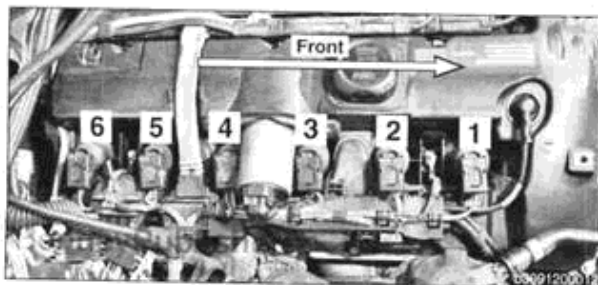
This repair group covers ignition component troubleshooting and replacement.

See also:

- 020 Maintenance for spark plug replacement
- 100 Engine-General for engine applications
- 130, 131, 132, 133 Fuel Injection
- ECL Electrical Component Locations
- ELE Electrical Wiring Diagrams
- OBD On-Board Diagnostics

120-2 Ignition System

Ignition firing order



Ignition firing order

Table a. Ignition firing order

6-cylinder engine	1-5-3-6-2-4
V8 engine	1-5-4-8-6-3-7-2

◀ **6-cylinder engine:** Cylinder 1 is at the front of the engine.

◀ **V8 N62 engine:**

- Cylinder 1 is at right (passenger side) front.
- Cylinders 1 - 4 are the right bank
- Cylinders 5 - 8 are the left bank.

Disabling ignition system

The ignition system operates in a lethal voltage range. Disable the ignition system any time engine service or repair work is being done that requires the ignition to be switched ON.

One way of disabling the ignition is by removing the DME main relay. The relay is located in the electronics box (E-box) in the right rear of the engine compartment. DME fuse, relay and power supply information is in **130, 131, 132, 133 Fuel Injection** or **ECL Electrical Component Locations**.

CAUTION—

- Relay locations vary. Use care when identifying relays. See **ECL Electrical Component Locations**.

Warnings and Cautions

WARNING—

- Do not touch or disconnect any cables from the ignition coils while the engine is running or being cranked by the starter.
- 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.
- Connect and disconnect the DME system wiring and test equipment leads when the ignition is OFF.
- Before operating the starter without starting the engine (for example when testing compression), disable the ignition. See **Disabling ignition system** in this repair group.

CAUTION—

- Do not attempt to disable the ignition by removing the coils from the spark plugs.
- Do not connect any test equipment that delivers a 12-volt power supply to terminal 15 (+) of the ignition coil. The current flow may damage the engine control module (ECM). Connect test equipment only as specified by BMW or the equipment maker.
- Connect or disconnect ignition system wires, multiple wire connectors and ignition test equipment leads only while the ignition is OFF. Switch multimeter functions or measurement ranges with test probes disconnected.
- Do not disconnect the battery while the engine is running.
- Prior to disconnecting the battery cables, read the battery disconnection cautions in **001 Warnings and Cautions**.
- Wait at least 1 minute after switching the ignition OFF before removing the ECM connector. If the connector is removed before this time, residual power in the system relay may damage the control module.
- Use a digital multimeter for electrical tests. Use an LED test light for quick tests.
- To avoid electrochemical corrosion to engine components made of aluminum-magnesium alloy, do not use steel fasteners in place of aluminum. For reliable identification, test fasteners with a magnet for aluminum composition.
- Replace aluminum fasteners each time they are loosened.
- Follow torque instructions, including angle of rotation specifications, when installing aluminum fasteners.

120-4 Ignition System

Ignition coils

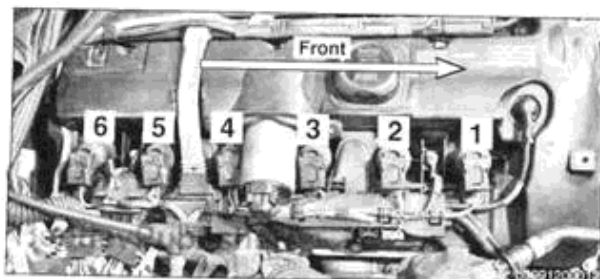
DIGITAL MOTOR ELECTRONICS (DME) IGNITION SYSTEM

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 b**.

Most DME functions are described in **130, 131, 132, 133 Fuel Injection**. In the topics that follow, functions that are traditionally associated with ignition are given fuller treatment.

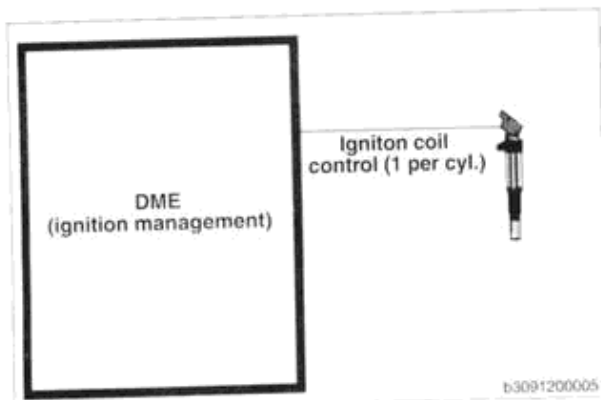
Table b. 5 Series engine management applications

Year, model	Engine code	Engine management	Features
2004-2005			
Sedan: 525i, 530i	M54	Siemens DME MS 45.1	Dual VANOS
Sedan: 545i	N62	Bosch DME ME 9.2.1	Valvetronic, VANOS
2006-2007			
Sedan, Sports Wagon: 525i, 525xi, 530i, 530xi	N52	Siemens MSV70 SULEV II	Valvetronic, VANOS
Sedan: 550i	N62TU	Bosch DME ME 9.2.2	Valvetronic, VANOS
2008-2010			
Sedan, Sports Wagon: 528i, 528xi,	N52KP	Siemens MSV80 ULEV II	Valvetronic, VANOS
Sedan, Sports Wagon: 535i, 535x, 535i xDrive	N54	Siemens MSD81	VANOS
Sedan: 550i	N62TU	Bosch DME ME 9.2.2	Valvetronic, VANOS

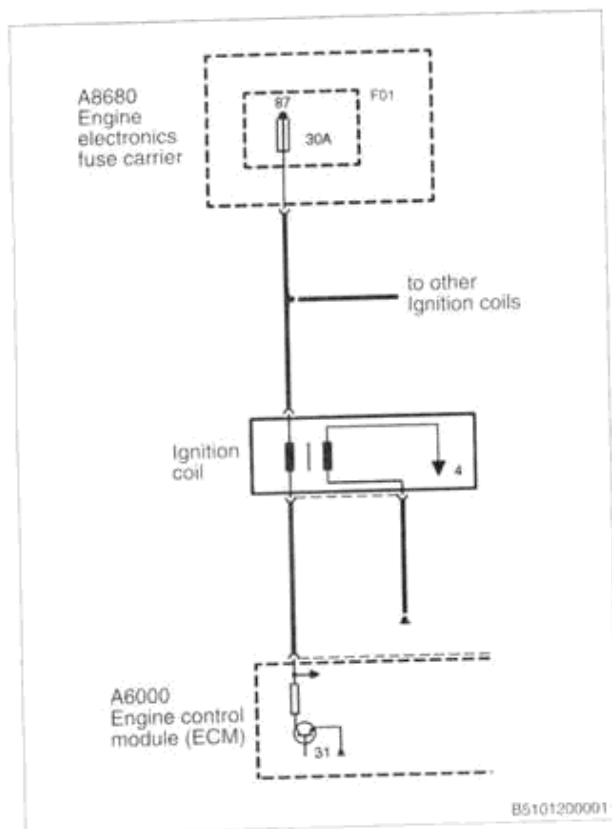


Ignition coils

- 5 Series engines use a distributorless ignition system with individual ignition coils (**numbered**) for each cylinder. There is no distributor cap or ignition rotor. (N52 engine shown in photo.)



Each coil is separately controlled and monitored by the ECM.



When the ignition is switched ON, the ECM receives wake-up (KL 15w) via the bus network and a hardwire KL15 wake-up signal directly from the car access system (CAS). It then energizes the ECM main relay to supply power to the engine electronics fuse carrier and to the ignition coils.

CAUTION—

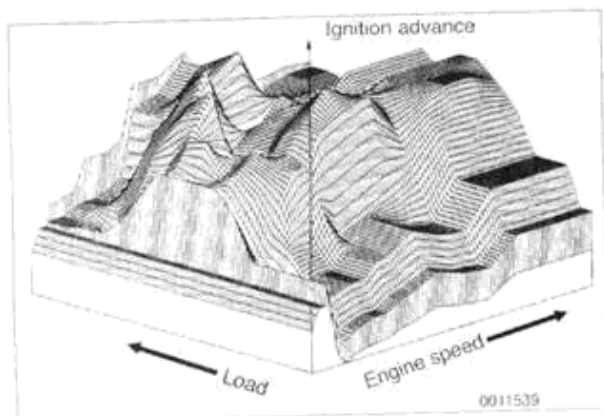
- Maintain a high level of cleanliness when servicing ignition coils. Fuel / oil residue can cause a breakdown in the electrical resistance qualities of silicone used in production. This in turn can result in ignition coil failure.

NOTE—

- Schematic diagrams shown are for illustrative purposes only. See **ELE Electrical Wiring Diagrams** for engine management specific wiring information.

Ignition timing is electronically mapped and not adjustable. The ECM uses engine load, engine speed, coolant temperature, knock detection, and intake air temperature as the basic inputs for timing control.

A three-dimensional map similar to the one shown is digitally stored in the ECM. The initial ignition point is determined by the crankshaft sensor during cranking. Once the engine is running, the ECM refers to the stored map to continually adjust ignition timing based on operating conditions.



120-6 Ignition System

Crankshaft sensor

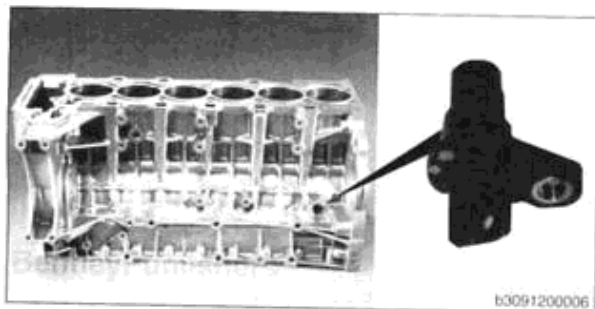
Crankshaft sensor

The crankshaft sensor detects crankshaft position and rotation speed via a toothed pulse wheel mounted on flywheel. If the ECM does not receive an impulse signal from the crankshaft sensor during cranking, the engine does not start. If the OBD II system misfire detection protocol detects a catalyst damaging fault due to a malfunction in crankshaft sensor components, the malfunction indicator light (MIL) is illuminated.

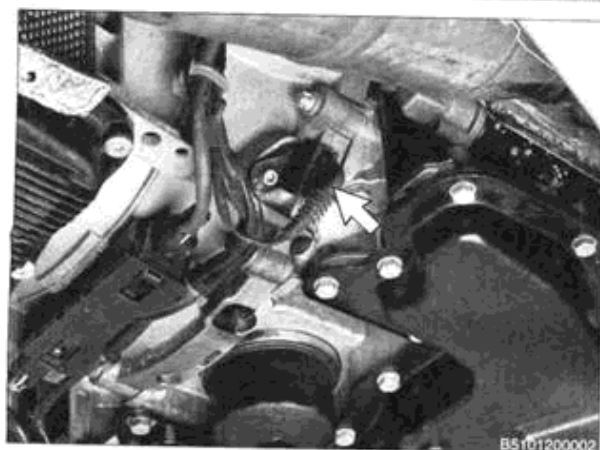
The crankshaft position sensor is supplied 12 volts from the engine electronics fuses and ground from the ECM. It produces a 5 volt square wave signal to the ECM.



⚡ M54 engine: Crankshaft sensor (**arrow**) is at left rear of cylinder block below starter.



⚡ N52, N54 engine: Crankshaft sensor (**arrow**) is at left rear of cylinder block below starter.



⚡ V8 engine: Crankshaft sensor (**arrow**) is on right of transmission bell housing.

The crankshaft sensor is also referred to as engine speed / reference sensor.

Camshaft sensors

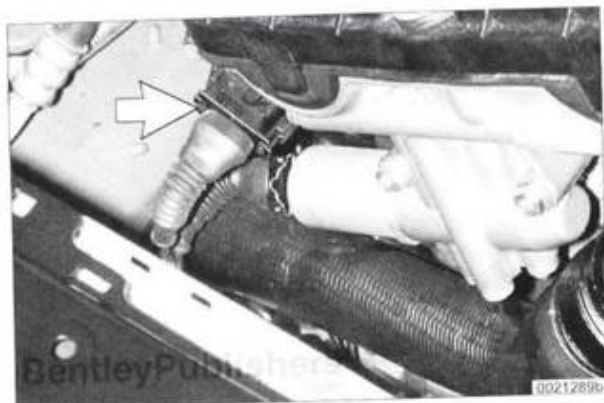
Each camshaft sensor responds to an impulse wheel mounted at the end of the camshaft. The signal from camshaft sensors are used by the ECM for cylinder recognition, spark timing, sequential fuel injection, VANOS (camshaft timing) and Valvetronic (variable valve lift) control. If a fault with the camshaft sensor is detected the malfunction indicator light (MIL) is illuminated.

The camshaft position sensor is supplied 12 volts from the engine electronics fuses and ground from the ECM. It produces a 5 volt square wave signal to the ECM.



- M54 engine intake camshaft sensor (**arrow**): Underneath crankcase breather hose, left side of cylinder head.

- M54 engine exhaust camshaft sensor (**arrow**): Right front of cylinder head.



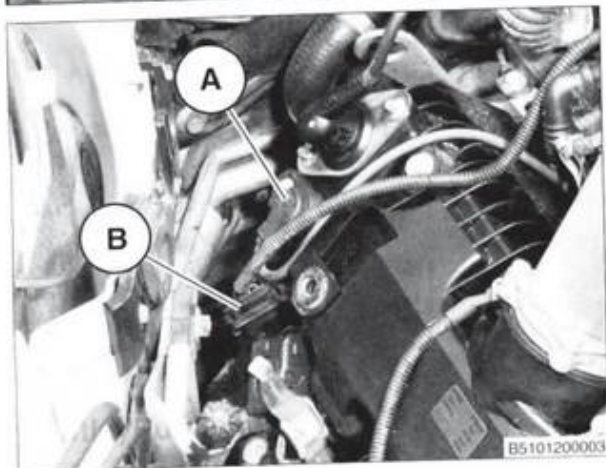
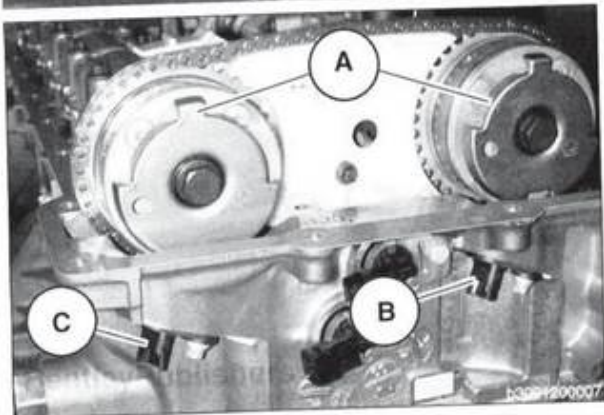
- N52, N54 engine:
 - Intake camshaft sensor (**B**): Left front of cylinder head.
 - Exhaust camshaft sensor (**C**): Right front of cylinder head.

NOTE —

- N52, N54 engine: A malfunctioning or sticking VANOS solenoid may set camshaft position sensor fault codes. If you suspect this, swap VANOS solenoid from bank with fault code to the other bank. If the camshaft position sensor fault code follows the location of the solenoid, the solenoid is at fault.

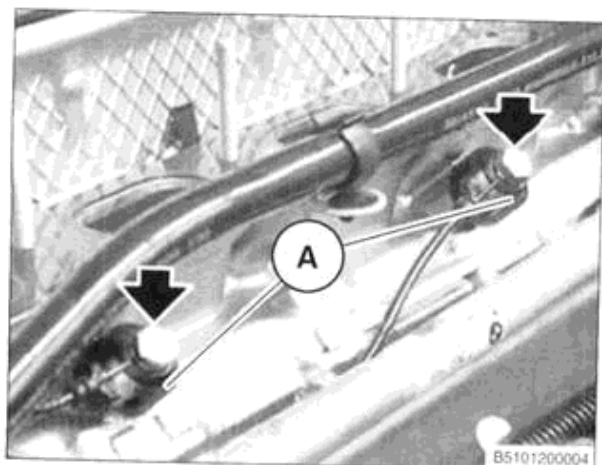
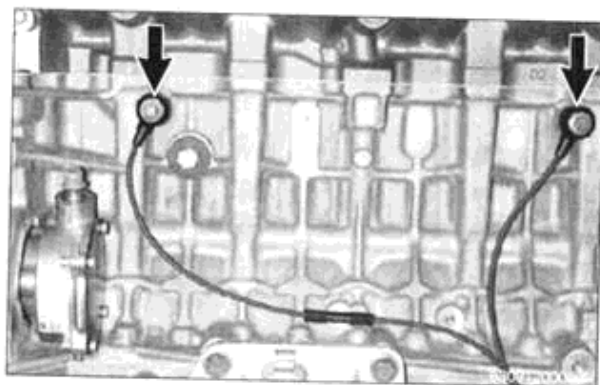
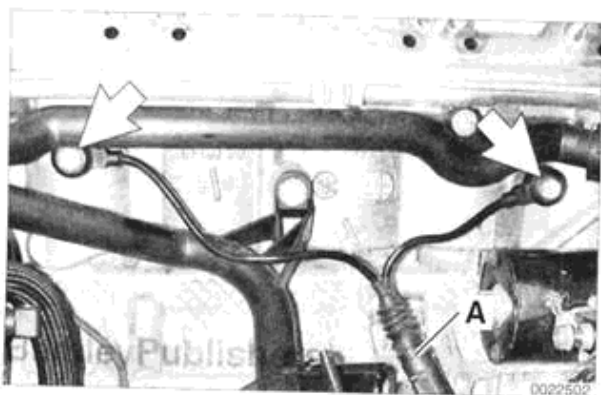
The camshaft sensor is also called the cylinder identification sensor.

- V8 engine: Intake (**A**) and exhaust (**B**) camshaft sensors are located on the front top of each cylinder head.



120-8 Ignition System

Knock sensors



Knock sensors

Knock sensors monitor the combustion chambers for engine-damaging knock. A knock sensor is a piezoelectric microphone tuned to the frequencies of engine knock or detonation. If engine knock is detected, ignition spark is retarded by the ECM. If a fault with the knock sensor is detected the malfunction indicator light (MIL) is illuminated

◀ M54 engine: Knock sensors are bolted to left side of cylinder block under intake manifold.

◀ N52, N54 engine: Knock sensors are bolted to left side of cylinder block under intake manifold (**arrows**). They share an electrical connector and have to be replaced as a pair.

◀ V8 engine: 4 sensors (**A**), 2 per bank of cylinders, are under intake manifold.

TROUBLESHOOTING

On-board diagnostics

- If faults arise, or if the malfunction indicator light (MIL) is illuminated, begin troubleshooting by connecting a BMW scan tool to the data link connector (DLC or OBD II plug). For information on how to access diagnostic trouble codes (DTCs), see **020 Maintenance**.

Misfire detection

Engine misfire in one or more cylinders may be caused by malfunctions in various subsystems. The OBD II system incorporated into the engine management systems is designed to detect and warn of misfire faults during engine operation. See **OBD On-Board Diagnostics**.

WARNING —

- Ignition misfires can cause high hydrocarbon exhaust emissions and catalytic converter damage. For this reason, if a severe misfire is detected, the fuel injector to the specific cylinder is switched OFF and the MIL is illuminated. A misfire may also overheat the catalytic converter(s), a fire hazard.

Oscilloscope diagnostic diagrams

One way to diagnose faulty engine management components or functions is to use an oscilloscope to analyze spark quality with the engine running.

- BMW engines covered in this manual use a rod type ignition coil. Install BMW special tool 12 7 050 in series with coil to test secondary ignition voltage.

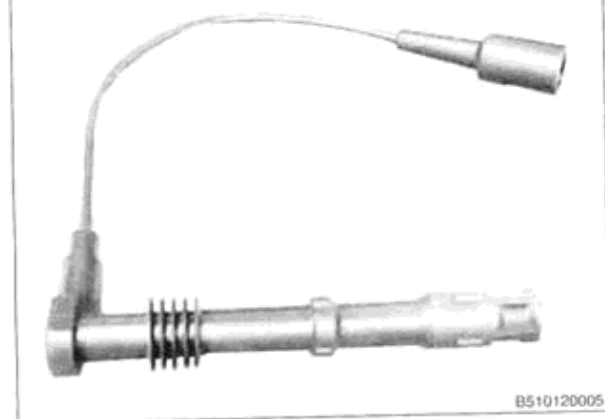
See **Table c** for a list of common ignition coil voltage faults and related causes.

Table c. Ignition secondary voltage diagnostics

	Secondary voltage low	Secondary voltage high
Spark plug electrode gap	Too small	Too big
Spark plug electrode condition		Worn / burnt
Spark plug electrode temperature	Too high	Too low
Engine compression	Too low	Too high
Spark plug wires		Faulty
Fuel air mixture		Too lean

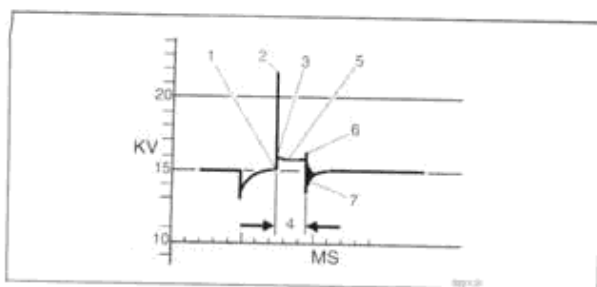


12 7 050



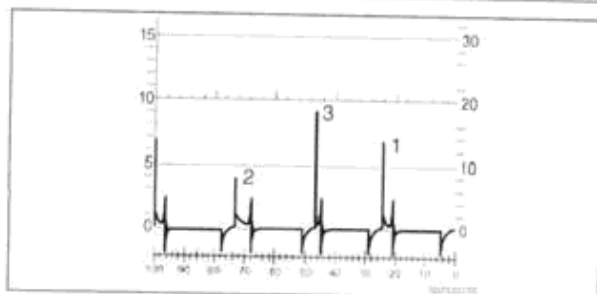
120-10 Ignition System

Oscilloscope diagnostic diagrams



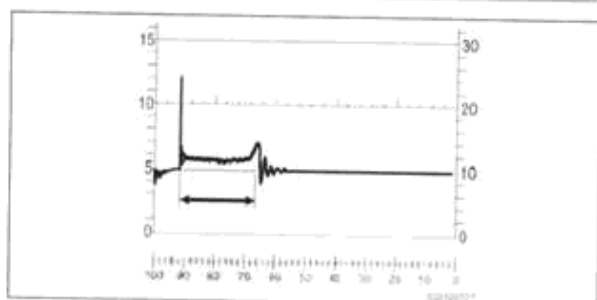
Normal scope trace of spark at idle

1. Start of ignition voltage peak
2. Level of ignition voltage
3. Level of combustion voltage
4. Period of combustion
5. Combustion curve characteristics
6. Start of spark decay
7. Termination oscillations

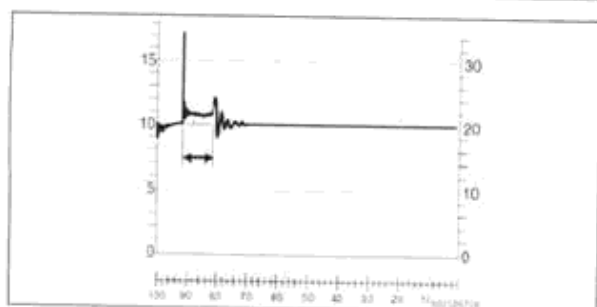


Ignition spark at idle speed

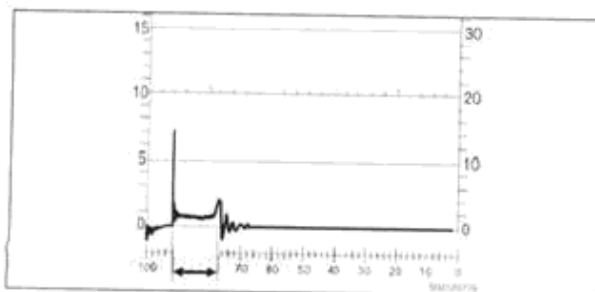
1. Normal ignition voltage peak: Good spark plug
2. Low voltage peak: Closed plug gap
3. High voltage peak: Open plug gap



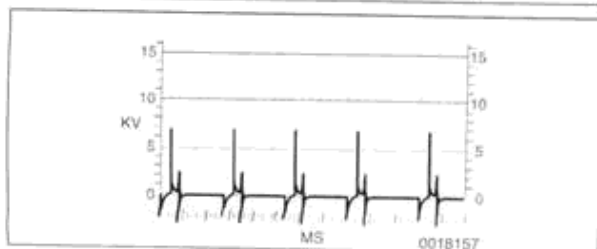
Long combustion period: Small spark plug gap



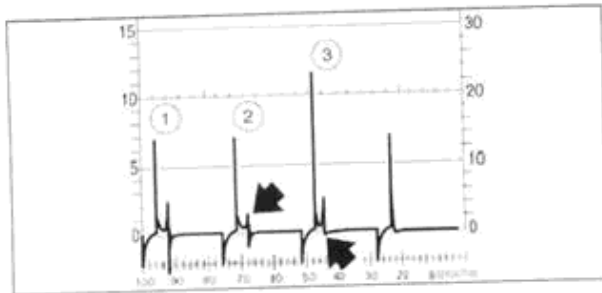
Short combustion period: Large spark plug gap



Normal combustion period at idle

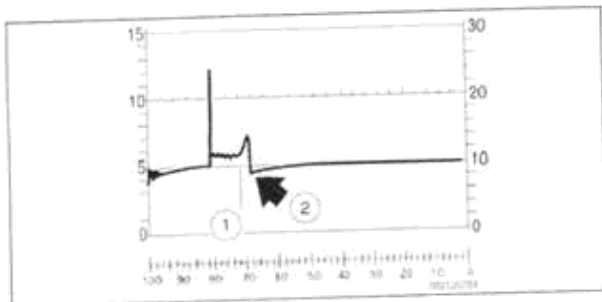


Normal oscilloscope pattern for ignition system at idle



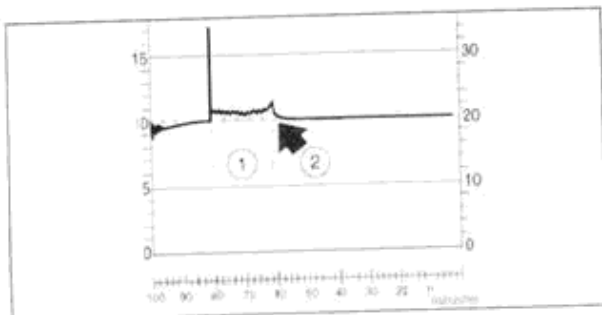
Ignition voltage peaks at idle

1. Normal ignition peaks
2. Downward peak (**arrow**) shortened: Ignition coil defective
3. Downward peak (**arrow**) missing completely: Ignition coil defective



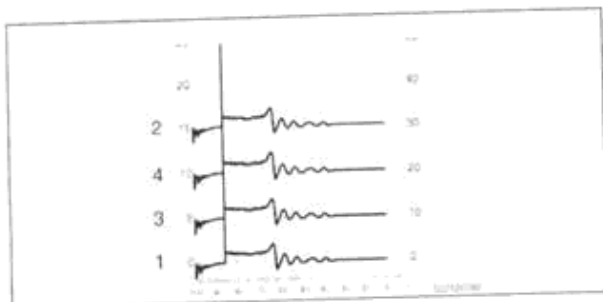
Defective ignition coil

1. Short spark period
2. Spark voltage line (**arrow**) with very slight drop

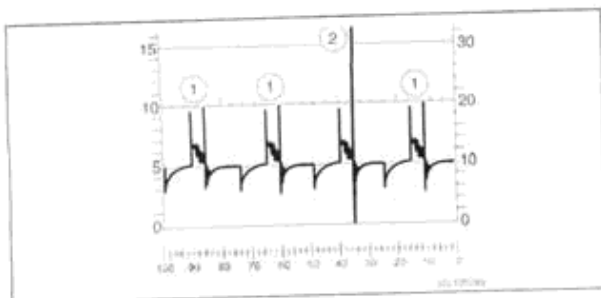


Defective ignition coil

1. Normal combustion period
2. Spark voltage line (**arrow**) absent



Normal secondary voltage patterns (4-cylinder pattern shown)



Ignition voltage peaks in response to sudden acceleration load:

1. Normal ignition pattern. Beginning of dying out pattern is not much higher than ignition voltage peak.
2. Beginning of dying out pattern considerably higher than ignition voltage peak. Fault in injection system:
 - Lean fuel mixture
 - Defective fuel injector
 - Low compression in cylinder

120-12 Ignition System

Ignition coil, replacing (M54 engine)

IGNITION COIL SERVICE

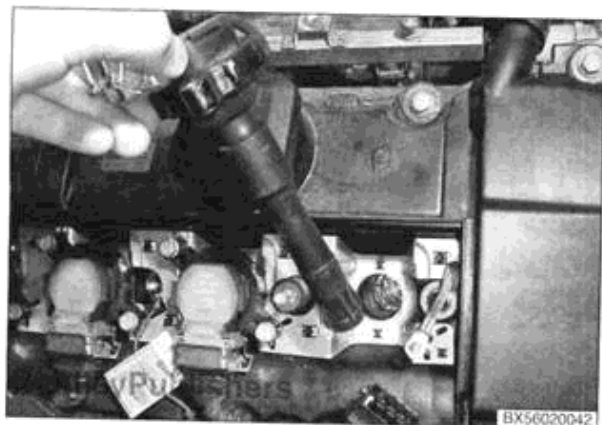
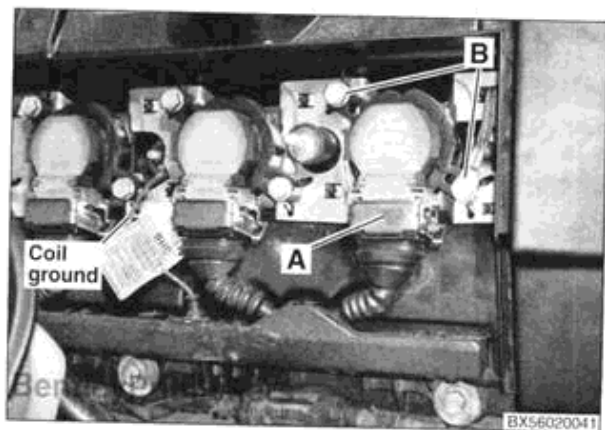
There is a separate ignition coil above each spark plug. Spark plug replacement is covered in **020 Maintenance**.

CAUTION—

- Maintain a high level of cleanliness when servicing ignition coils. Fuel / oil residue can cause a breakdown in the electrical resistance qualities of silicone used in production. This in turn can result in ignition coil failure.

Ignition coil, replacing (M54 engine)

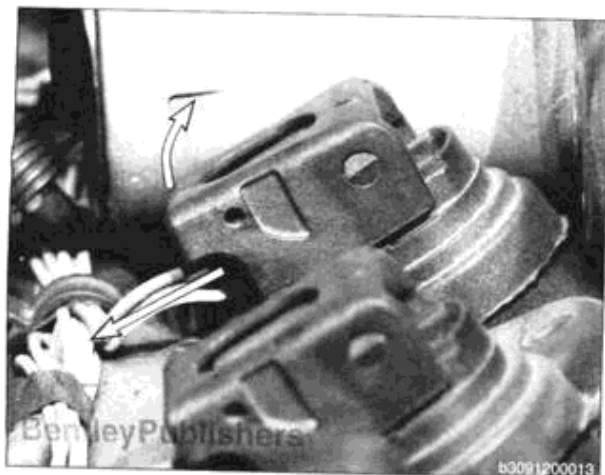
- Make sure ignition is switched OFF.
- Remove ignition coils cover. See **020 Maintenance**.
- Lift up on lock (A) and release ignition coil electrical connector.
- Remove fasteners (B). Note position of coil ground wire.



- Remove ignition coil by pulling straight up and off spark plug.
- Installation is reverse of removal. Be sure to reattach ground cables or wires.
- Check and clear fault codes from ECM memory.

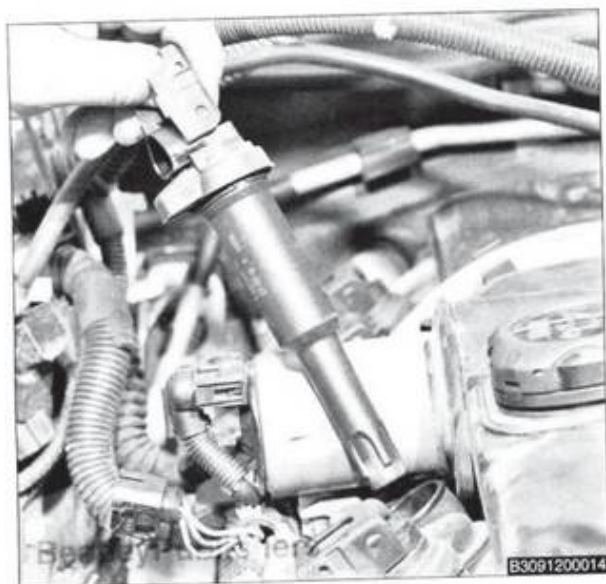
Ignition coil, replacing (N52, N54 engine)

- Make sure ignition is switched OFF.
- Remove ignition coil cover. See **020 Maintenance**.
- Unlock (curved arrow) ignition coil connector. Pull (straight arrow) connector off coil.



Ignition System 120-13

Ignition coil, replacing (V8 engine)

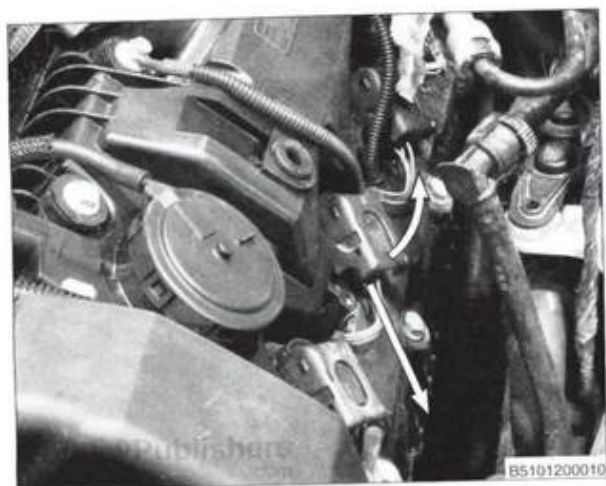
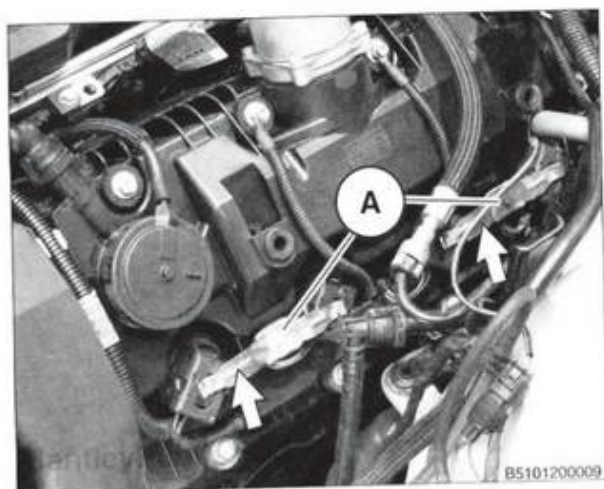


- Slide rod-shaped ignition coil straight out of spark plug hole.
- Installation is reverse of removal.
- Check and clear fault codes from ECM memory.

120

Ignition coil, replacing (V8 engine)

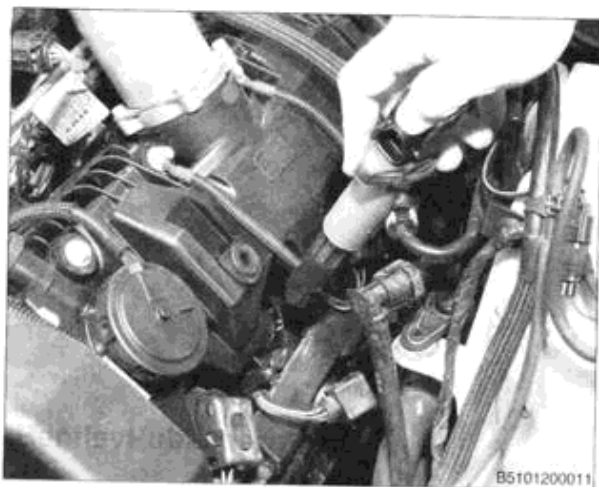
- Make sure ignition is switched OFF.
- Remove ignition coils cover. See **020 Maintenance**.
- Remove ignition coil hold-down bracket fasteners (**A**) and remove hold-down brackets (**arrows**). Left side shown, right is similar.



- Unlock (**curved arrow**) ignition coil connector. Pull (**straight arrow**) connector off coil.

120-14 Ignition System

Crankshaft sensor, replacing (M54 engine)



- Slide rod-shaped ignition coil straight out of spark plug hole.
- Installation is reverse of removal.
- Check and clear fault codes from ECM memory.

CRANKSHAFT SENSOR SERVICE

Crankshaft sensor, replacing (M54 engine)

Crankshaft sensor in M54 engine is on left rear of engine block, underneath intake manifold and starter motor.

- Make sure ignition is OFF.
- Raise car and support in a safe manner.

WARNING—

- Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove front end reinforcement plate. See **310 Front Suspension**.

➤ Working underneath starter:

- Cut off wire tie securing crankshaft sensor harness connector (**arrow**) to sensor.
- Disconnect harness connector.



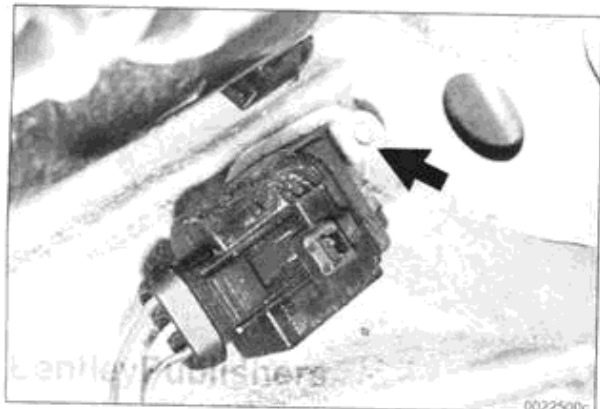
➤ Remove sensor mounting fastener (**arrow**) and remove sensor from cylinder block.

- Installation is reverse of removal.
- Use new sealing O-ring when installing sensor.
- Replace self-locking mounting bolt.
- Be sure wiring is rerouted as before.

Tightening torque

Crankshaft sensor to engine block (M6, replace with new)	10 Nm (7 ft-lb)
--	-----------------

- Check and clear fault codes from ECM memory.



Crankshaft sensor, replacing (N52, N54 engine)

Crankshaft sensor is on left rear of engine block, underneath intake manifold and starter motor.

- Make sure ignition is OFF.
- Raise car and support in a safe manner.

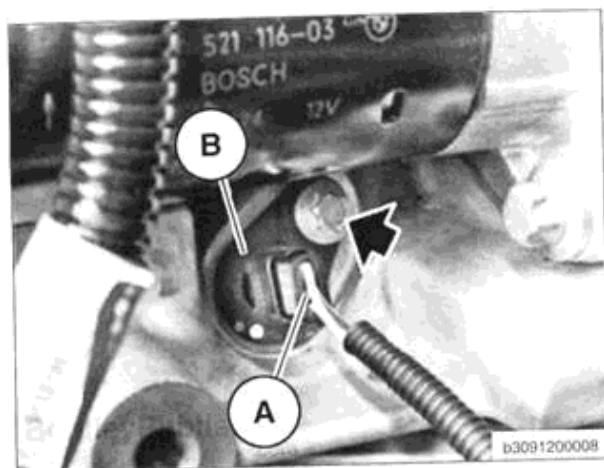
WARNING —

- Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove front end reinforcement plate. See **310 Front Suspension**.

Working underneath starter:

- Disconnect crankshaft sensor harness connector (A) from sensor (B).
- Remove sensor mounting fastener (arrow) and remove sensor from cylinder block. Be prepared to catch dripping oil.
- Installation is reverse of removal. Remember to:
 - Use new sealing O-ring when installing sensor.
 - Replace mounting bolt.
 - Be sure wiring is routed as before.
 - Check and clear fault codes from ECM memory.



Tightening torque

Crankshaft sensor to engine block (M6, replace with new)	8 Nm (6 ft-lb)
--	----------------

Crankshaft sensor, replacing (V8 engine)

Crankshaft sensor is on right bottom of transmission housing.

- Make sure ignition is OFF.
- Raise car and support in a safe manner.

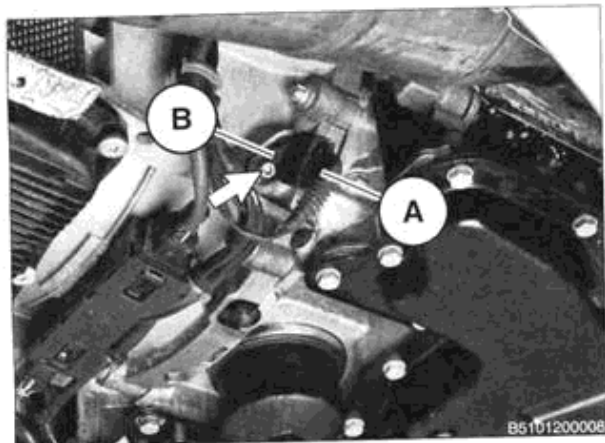
WARNING —

- Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove front end reinforcement plate. See **310 Front Suspension**.

Working underneath starter:

- Disconnect crankshaft sensor harness connector (A) from sensor (B).
- Remove sensor mounting fastener (arrow) and remove sensor from cylinder block. Be prepared to catch dripping oil.



120-16 Ignition System

Intake camshaft sensor, replacing (M54 engine)

- Installation is reverse of removal. Remember to:
 - Use new sealing O-ring when installing sensor.
 - Replace mounting bolt.
 - Be sure wiring is routed as before.
 - Check and clear fault codes from ECM memory.

Tightening torque

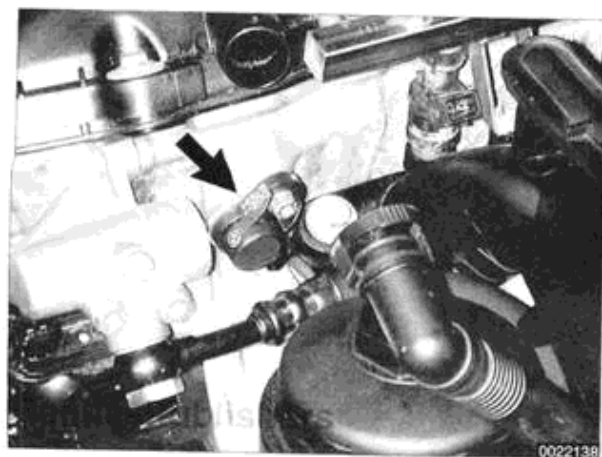
Crankshaft sensor to engine block (M6, replace with new)	8 Nm (6 ft-lb)
---	----------------

CAMSHAFT SENSOR SERVICE

Intake camshaft sensor, replacing (M54 engine)

Intake camshaft sensor on M54 engine is mounted at left side of cylinder head near front.

- Make sure ignition is OFF.
- Remove upper engine covers. See **020 Maintenance**.
- Remove air filter housing and ducts. See **130 Fuel Injection**.
- ◀ Working at left side of cylinder head:
 - Detach engine vent hose from cylinder head cover by pinching spring clips (**arrows**).
 - Detach VANOS solenoid electrical connector (**A**).
 - Unscrew VANOS solenoid.
 - If necessary, unfasten oil supply line on VANOS adjustment unit. Be prepared to catch dripping oil.



- ◀ Remove camshaft sensor mounting bolt. Remove sensor (**arrow**) from cylinder head.
- Reach under intake manifold to disconnect camshaft sensor harness.

NOTE —

- Prior to removal, attach a stiff piece of wire to connector to aid in routing of harness during reinstallation.

- Installation is reverse of removal. Remember to:
 - Replace camshaft sensor mounting bolt.
 - Use new sealing O-rings when installing sensor, VANOS solenoid and VANOS oil supply line.
 - Be sure sensor harness is rerouted as before.

Tightening torques	
Intake camshaft sensor to cylinder head (M6, replace bolt)	10 Nm (7 ft-lb)
Oil supply line to VANOS unit (banjo bolt)	32 Nm (24 ft-lb)
VANOS solenoid to VANOS unit	30 Nm (22 ft-lb)

- Check and clear fault codes from ECM memory.

Exhaust camshaft sensor, replacing (M54 engine)

Exhaust camshaft sensor on M54 engine is mounted at right side of cylinder head near front.

- Make sure ignition is OFF.
- Working at front of engine on exhaust (right) side, detach exhaust camshaft sensor electrical harness connector (arrow).
- Remove sensor mounting bolt and remove sensor. Be prepared to catch dripping oil
- Installation is reverse of removal.
 - Replace camshaft sensor mounting bolt.
 - Use new sealing O-ring when installing sensor.

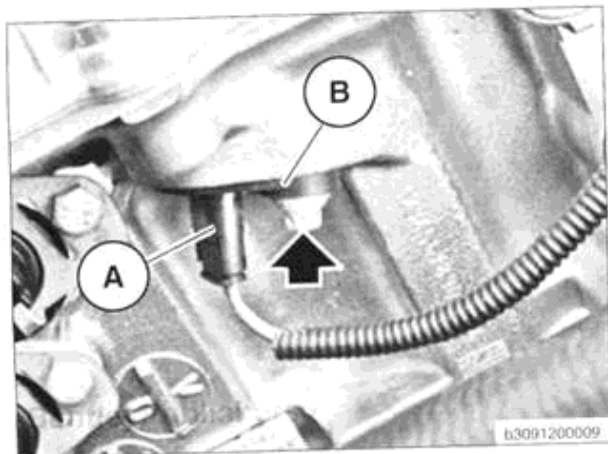
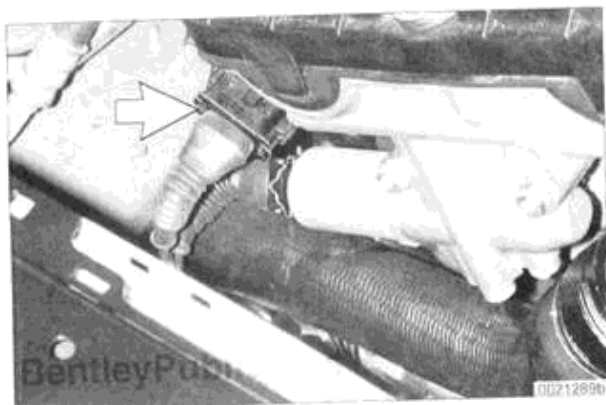
Tightening torque	
Exhaust camshaft sensor to cylinder head (M6, replace bolt)	10 Nm (7 ft-lb)

- Check and clear fault codes from ECM memory.

Intake camshaft sensor, replacing (N52, N54 engine)

Intake camshaft sensor is mounted to left front of cylinder head.

- Make sure ignition is OFF.
- Remove upper engine covers. See **020 Maintenance**.
- Remove air filter housing and ducts. See **131, 132 Fuel Injection**.
- Detach camshaft sensor electrical connector (A).
- Remove camshaft sensor mounting bolt (arrow). Remove sensor (B) from cylinder head. Be prepared to catch dripping oil.



120-18 Ignition System

Exhaust camshaft sensor, replacing (N52, N54 engine)

- Installation is reverse of removal. Remember to:
 - Replace camshaft sensor mounting bolt.
 - Use new sealing O-rings when installing sensor.
 - Be sure sensor harness is routed as before.
 - Check and clear fault codes from ECM memory.

Tightening torques

Intake camshaft sensor to cylinder head (M6, replace with new)	9 Nm (6.5 ft-lb)
--	------------------

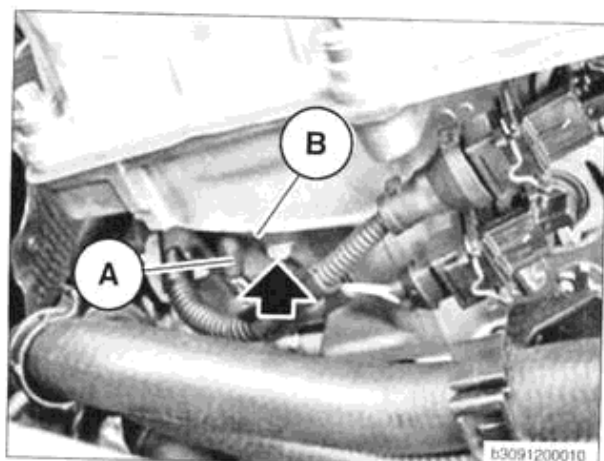
Exhaust camshaft sensor, replacing (N52, N54 engine)

Exhaust camshaft sensor is mounted to right front of cylinder head.

- Make sure ignition is OFF.
- Remove upper engine covers. See **020 Maintenance**.
- Remove air filter housing and ducts. See **131, 132 Fuel Injection**.
- ◀ Detach camshaft sensor electrical connector (A).
- Remove camshaft sensor mounting bolt (arrow). Remove sensor (B) from cylinder head. Be prepared to catch dripping oil.
- Installation is reverse of removal. Remember to:
 - Replace camshaft sensor mounting bolt.
 - Use new sealing O-rings when installing sensor.
 - Be sure sensor harness is routed as before.
 - Check and clear fault codes from ECM memory.

Tightening torques

Intake camshaft sensor to cylinder head (M6, replace bolt)	9 Nm (6.5 ft-lb)
--	------------------



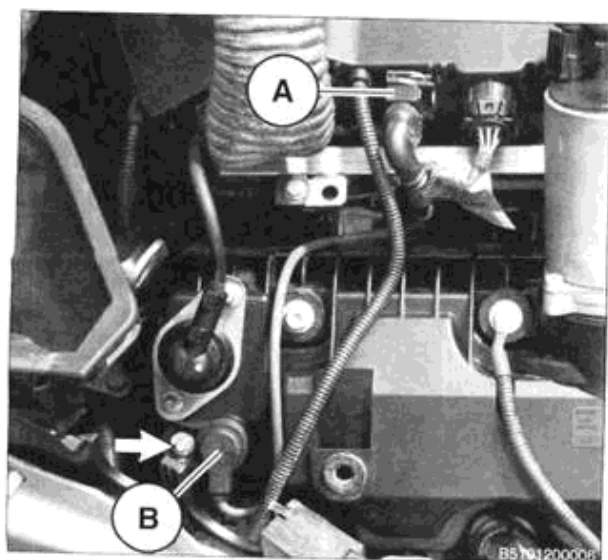
Camshaft sensor, replacing (V8 engine)

V8 engine: Intake and exhaust camshaft sensors are located on the front top of each cylinder head. Right side intake camshaft sensor replacement is shown. Others are similar.

- Make sure ignition is OFF.
- Remove upper engine covers. See **020 Maintenance**.

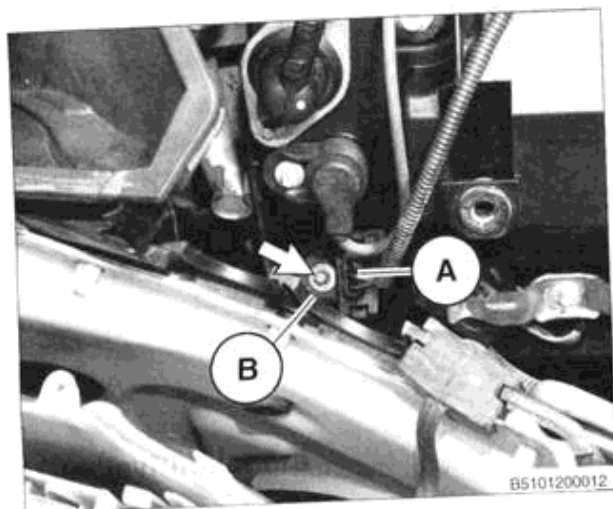
Intake camshaft sensor

- ◀ Detach camshaft sensor electrical connector (A).
- Remove camshaft sensor mounting bolt (arrow). Remove sensor (B) from cylinder head. Be prepared to catch dripping oil.



Ignition System 120-19

Knock sensors, replacing (M54 engine)



◀ Detach camshaft sensor electrical connector (A).

— Remove camshaft sensor mounting bolt (arrow). Remove sensor (B) from cylinder head. Be prepared to catch dripping oil.

- Installation is reverse of removal. Remember to:
 - Replace camshaft sensor mounting bolt.
 - Use new sealing O-rings when installing sensor.
 - Be sure sensor harness is routed as before.
 - Check and clear fault codes from ECM memory.

120

KNOCK SENSOR SERVICE

Knock sensors, replacing (M54 engine)

M54 engine knock sensors are under the intake manifold on the left side of the cylinder head.

- Disconnect negative (-) battery cable and cover battery terminal to keep cable from accidentally contacting terminal.

CAUTION—

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

- With engine fully cooled, remove intake manifold. See 130 Fuel Injection.

◀ Disconnect knock sensor electrical harness connector (A) on left side of engine block.

- Remove knock sensor mounting bolts (arrows) on side of cylinder block.
- Remove sensors.

CAUTION—

- Note the installed angle of the knock sensor on the block before removing it. Reinstall the sensor in the same position. Be sure to use a torque wrench when tightening the sensor mounting bolt.

◀ Clean knock sensor contact surface on engine block and sensor (arrows) before installing knock sensor.

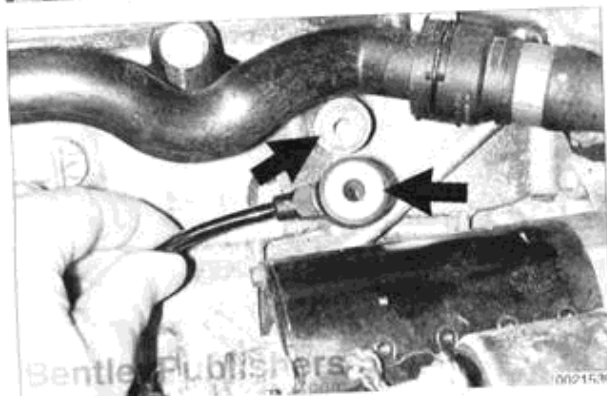
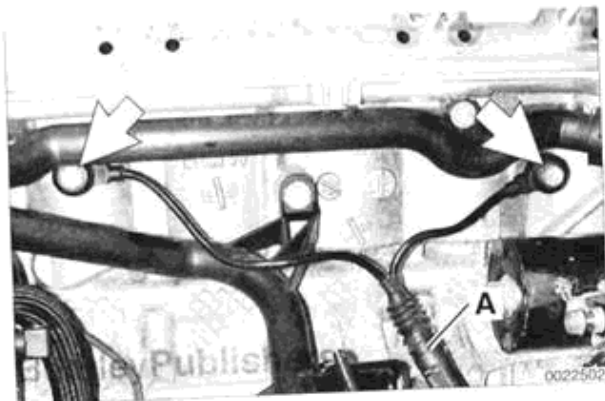
CAUTION—

- Do not overtighten knock sensors.

Tightening torque

Knock sensor to engine block (M8)	20 Nm (15 ft-lb)
-----------------------------------	------------------

- Check and clear fault codes from ECM memory.



120-20 Ignition System

Knock sensors, replacing (N52 engine)

Knock sensors, replacing (N52 engine)

N52 engine knock sensors are under the intake manifold on the left side of the cylinder head.

- Disconnect negative (-) battery cable and cover battery terminal to keep cable from accidentally contacting terminal.

CAUTION—

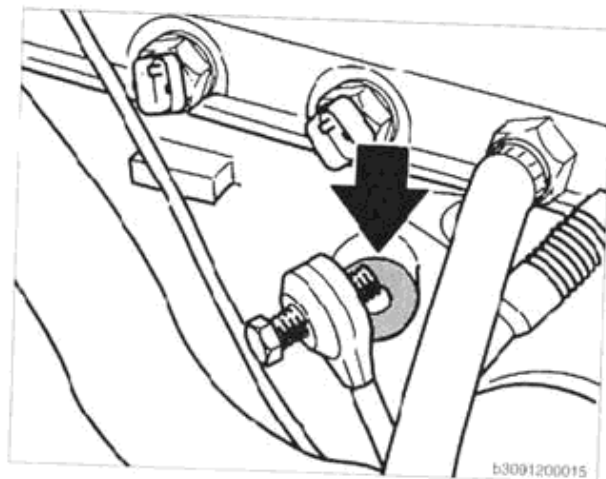
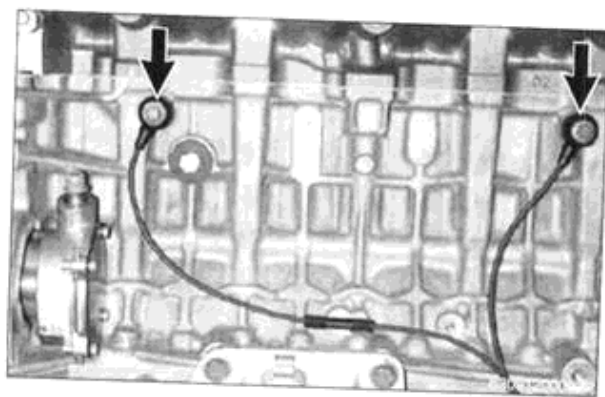
- Prior to disconnecting the battery, read the battery disconnection cautions given in **001 Warnings and Cautions**.

- With engine fully cooled, remove intake manifold. See **131 Fuel Injection**.

- ◀ Disconnect knock sensor electrical harness connector.
- Remove knock sensor mounting bolts (**arrows**) on side of cylinder block. Remove sensors.

CAUTION—

- Note the installed angle of the knock sensor on the block before removing it. Reinstall the sensor in the same position. Be sure to use a torque wrench when tightening the sensor mounting bolt.



- ◀ Clean knock sensor contact surface on engine block and sensor (**arrow**) before installing knock sensor.

CAUTION—

- Do not overtighten knock sensors.

Tightening torques

Knock sensor to engine block (use new aluminum M8 fasteners)

- Stage 1
- Stage 2

7 Nm (63 in-lb)
additional 90°

- Installation is reverse of removal. Remember to:
 - Replace knock sensor mounting bolt.
 - Be sure sensor harness is routed as before.
- Check and clear fault codes from ECM memory.

Knock sensors, replacing (N54 engine)

N54 engine knock sensors are under the intake manifold on the left side of the cylinder head.

- Disconnect negative (-) battery cable and cover battery terminal to keep cable from accidentally contacting terminal.

CAUTION—

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

- With engine fully cooled, remove intake manifold. See **132 Fuel Injection**.

- ◀ Disconnect electrical connectors (A), remove and seal high pressure fuel pump fuel supply line connections. Be prepared to catch dripping fuel.

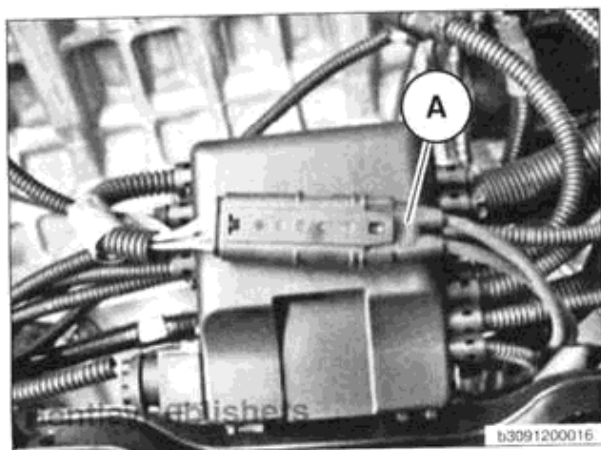
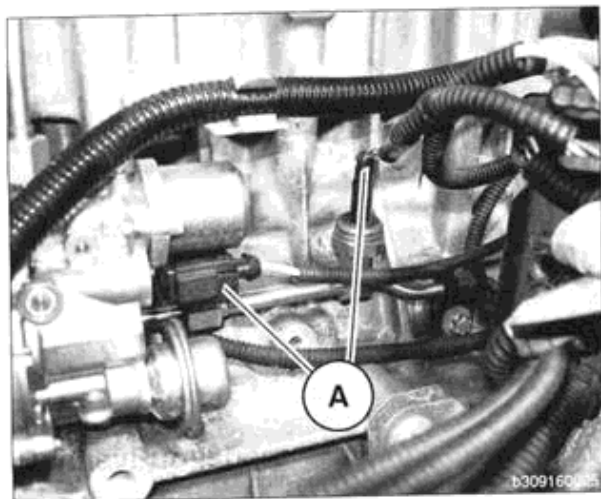
WARNING—

- The fuel system is designed to retain pressure even when the ignition is OFF. When working with the fuel system, remove fuel lines slowly to allow residual fuel pressure to dissipate. Avoid spraying fuel. Use shop towels to capture leaking fuel.
- Electric fuel pump starts automatically when door is opened.
- Carry out installation work on fuel system with coolant temperature below 40°C (104°F).

CAUTION—

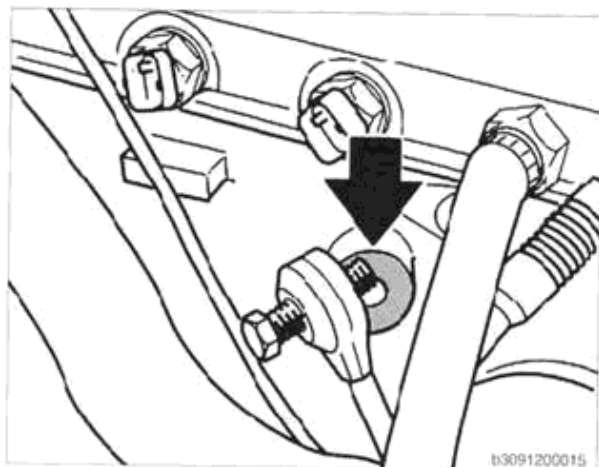
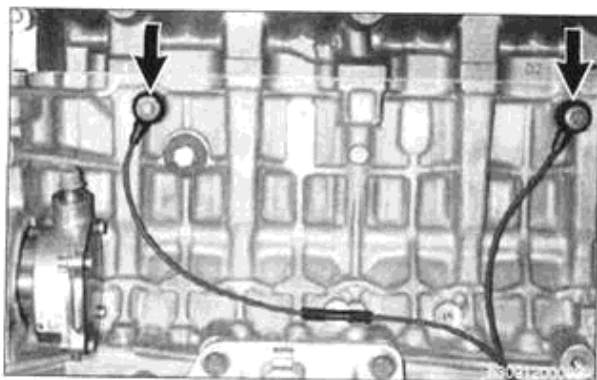
- When working with high pressure fuel lines observe clean working habits. Any dirt or debris introduced into system will cause malfunctions.

- ◀ Disconnect knock sensor electrical connector (A) on left side of engine block.



120-22 Ignition System

Knock sensor, replacing (V8 engine)



- Remove knock sensor mounting bolts (**arrows**) on side of cylinder block. Remove sensors.

CAUTION—

- Note the installed angle of the knock sensor on the block before removing it. Reinstall the sensor in the same position. Be sure to use a torque wrench when tightening the sensor mounting bolt.

- Clean knock sensor contact surface on engine block and sensor (**arrow**) before installing knock sensor.

CAUTION—

- Do not overtighten knock sensors.

Tightening torques

Knock sensor to engine block (use new aluminum M8 fasteners)	
• Stage 1	7 Nm (63 in-lb)
• Stage 2	additional 90°
Fuel line nut to high pressure pump (coat thread with transmission fluid)	30 Nm (22 ft-lb)
Fuel line mounting bracket to engine block	8 Nm (87.5 in-lb)

- Installation is reverse of removal. Remember to:
 - Replace knock sensor mounting bolt.
 - Be sure sensor harness is rerouted as before.
 - Check for fuel system leaks.
 - Check and clear fault codes from ECM memory.

Knock sensor, replacing (V8 engine)

V8 engine is equipped with 4 sensors, 2 per bank of cylinders, installed under intake manifold.

- Disconnect negative (-) battery cable and cover battery terminal to keep cable from accidentally contacting terminal.

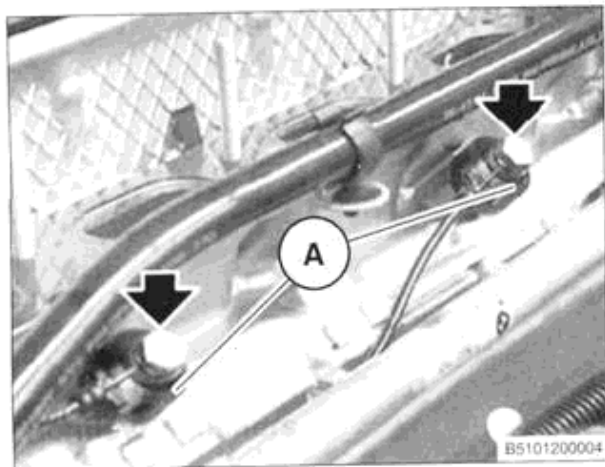
CAUTION—

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

- With engine fully cooled, remove intake manifold. See **133 Fuel Injection**.

Ignition System 120-23

Knock sensor, replacing (V8 engine)

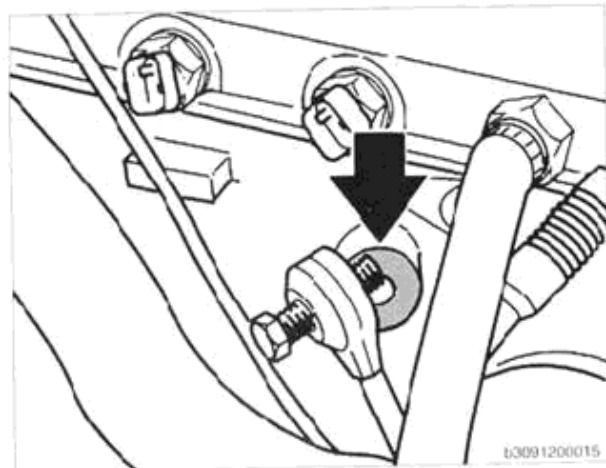


➤ Disconnect knock sensor electrical harness connector.

- Remove knock sensor mounting bolts (**arrows**) on side of cylinder block. Remove sensors (**A**).

CAUTION—

- Note the installed angle of the knock sensor on the block before removing it. Reinstall the sensor in the same position. Be sure to use a torque wrench when tightening the sensor mounting bolt.



➤ Clean knock sensor contact surface on engine block and sensor (**arrow**) before installing knock sensor.

CAUTION—

- Do not overtighten knock sensors.

Tightening torques

Knock sensor to engine block (M8 replace with new)	21 Nm (14.7 ft-lb)
---	--------------------

- Installation is reverse of removal. Remember to:
 - Replace knock sensor mounting bolt.
 - Be sure sensor harness is routed as before.
 - Check and clear fault codes from ECM memory.



