ENGINE ELECTRICAL SYSTEM

12 1 080 REPAIR KIT

Minimum set: Mechanical tools

NOTE: For fitting spark plug connectors to ignition lead

Series: E36, E38

Storage location: K 103

SI number: 1 03 89 (037)

Order number: 12 1 080

Repair kit

Consisting of:

1 = 12 1 081 Pliers

3 = 12 1 083 Matrix set

NOTE: Cable 4 mm^2 /ignition cable

6=12 1 086 Mounting sleeve



Fig. 1: Identifying Special Tool - 12 1 080 Repair Kit
Courtesy of BMW OF NORTH AMERICA, INC.

12 1 120 LEVER

NOTE: Note: For unlocking edge connector on fuel injectors

Engine: S54

SI number: 1 15 00(609)

Order number: 12 1 120

Lever

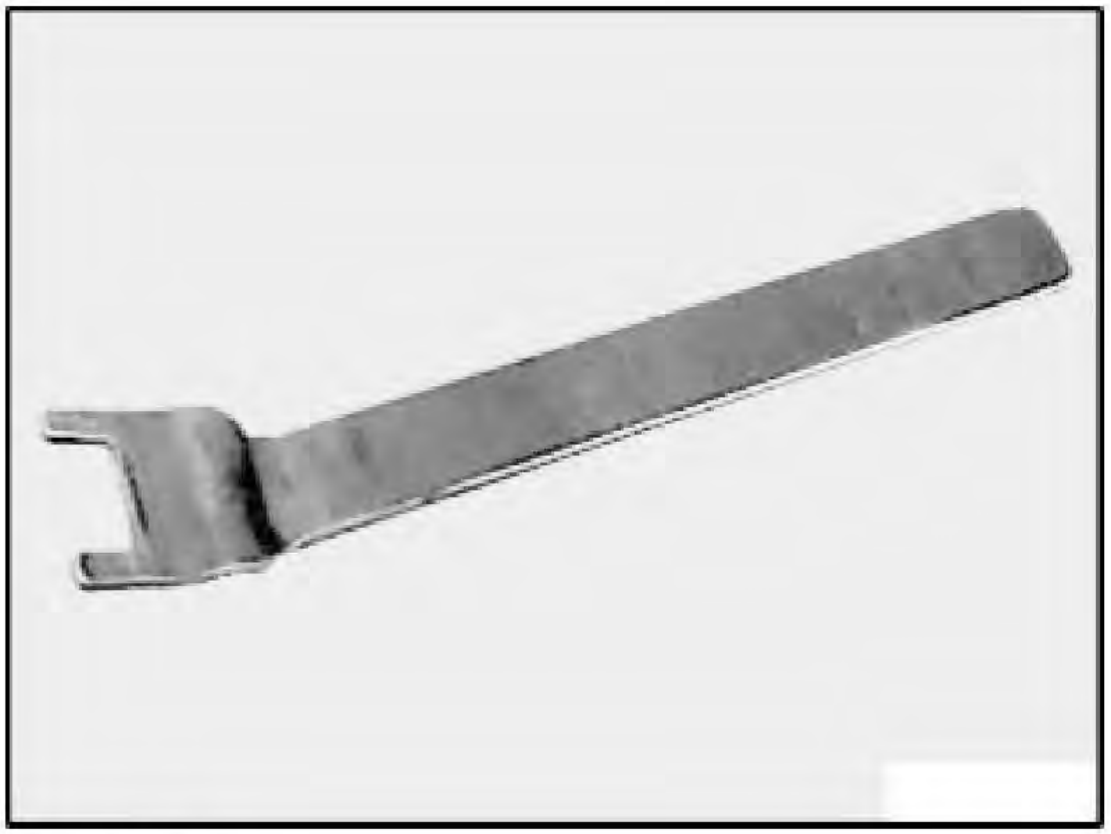


Fig. 2: Identifying Special Tool - 12 1 120 Lever
Courtesy of BMW OF NORTH AMERICA, INC.

12 1 305 ZERO-CODED COVER CAP FOR 52-PIN TEST BOX (12 1300/304)

NOTE: Note: New plugs in E61/E61/E63 and E64 on SGM control unit Cover cap 12 1 300/305 for diagnosis on wiring harness. From 08/2004 cover cap will be supplied with test box.

SI number: 2 07 04 (138)

Order number: 12 1 305

Zero-coded cover cap for 52-pin test box (12 1300/304)

12 6 050 SWITCHING UNIT

Minimum set: Measuring and testing equipment

In conjunction with:

12 6 411

Note: For activating solenoid valves in VANOS unit

Engine: S54, S62

Storage location: F 116

SI number: 1 01 99(416)

Order number: 12 6 050

Switching unit

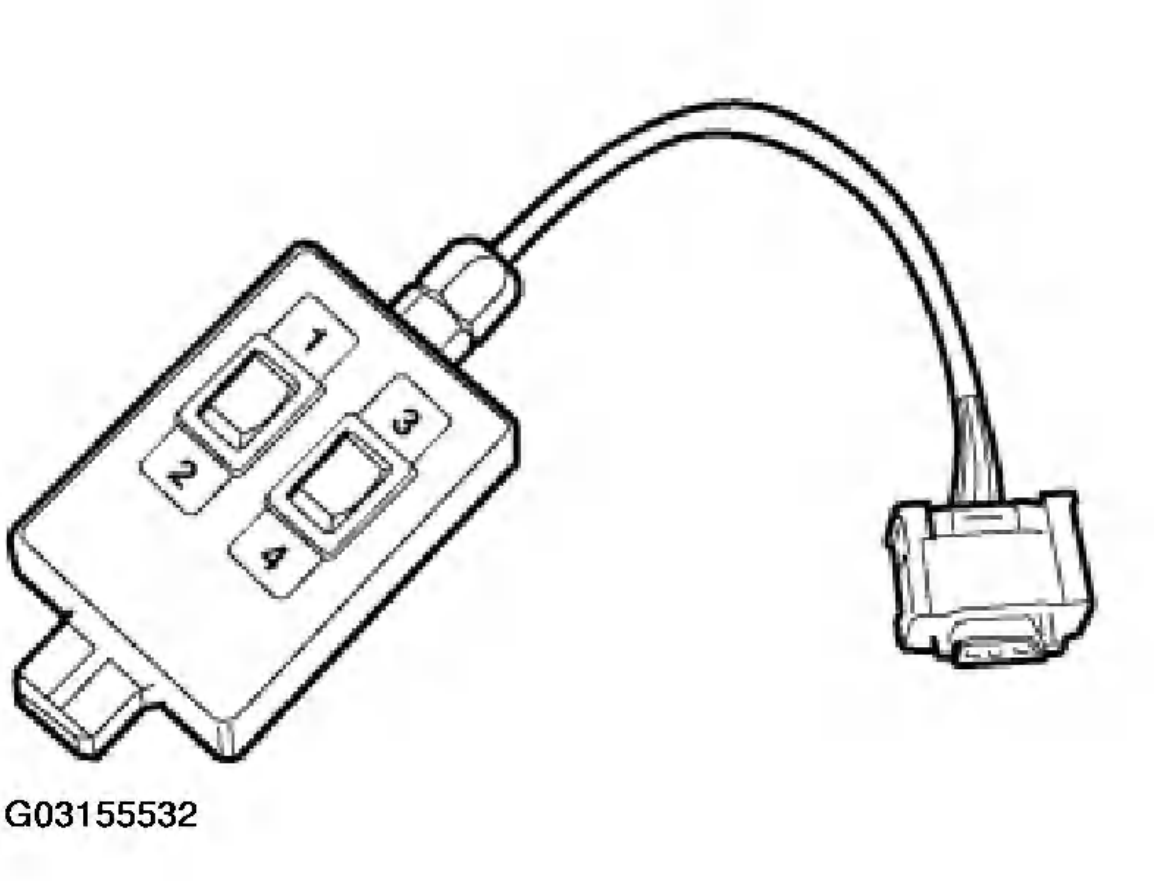


Fig. 3: Identifying Special Tool - Zero-Coded Cover Cap For 52-Pin Test Box (12 1300/304)
Courtesy of BMW OF NORTH AMERICA, INC.

12 6 410 ADAPTER LEAD AND SWITCHING UNIT

Minimum set: Measuring and testing equipment

NOTE: Note: For external operation of VANOS adjustment unit during assembly and for checking function of 4/2-way valve

Engine: M50, M52, S50B32, S54, S62

Storage location: F 111, F 115

SI number: 1 08 92(555)

Order number: 12 6 410

Adapter lead and switching unit

Consisting of:

12 6 411 Adapter lead with diode

NOTE: For non-interchangeable connection to a 12 volt power source, engine: M50, M52, S62, S54

12 6 412 Switching unit with cable connection

NOTE: Engine: S50B32

12 6 413 Polarity reversal protector

NOTE: Retrofit kit with polarity reversal protection diode for installation in adapter lead 12 6 411 for the purpose of adapting it to the power ratings of the switching unit 12 6 050.Identification: Red shrink-fit sleeve

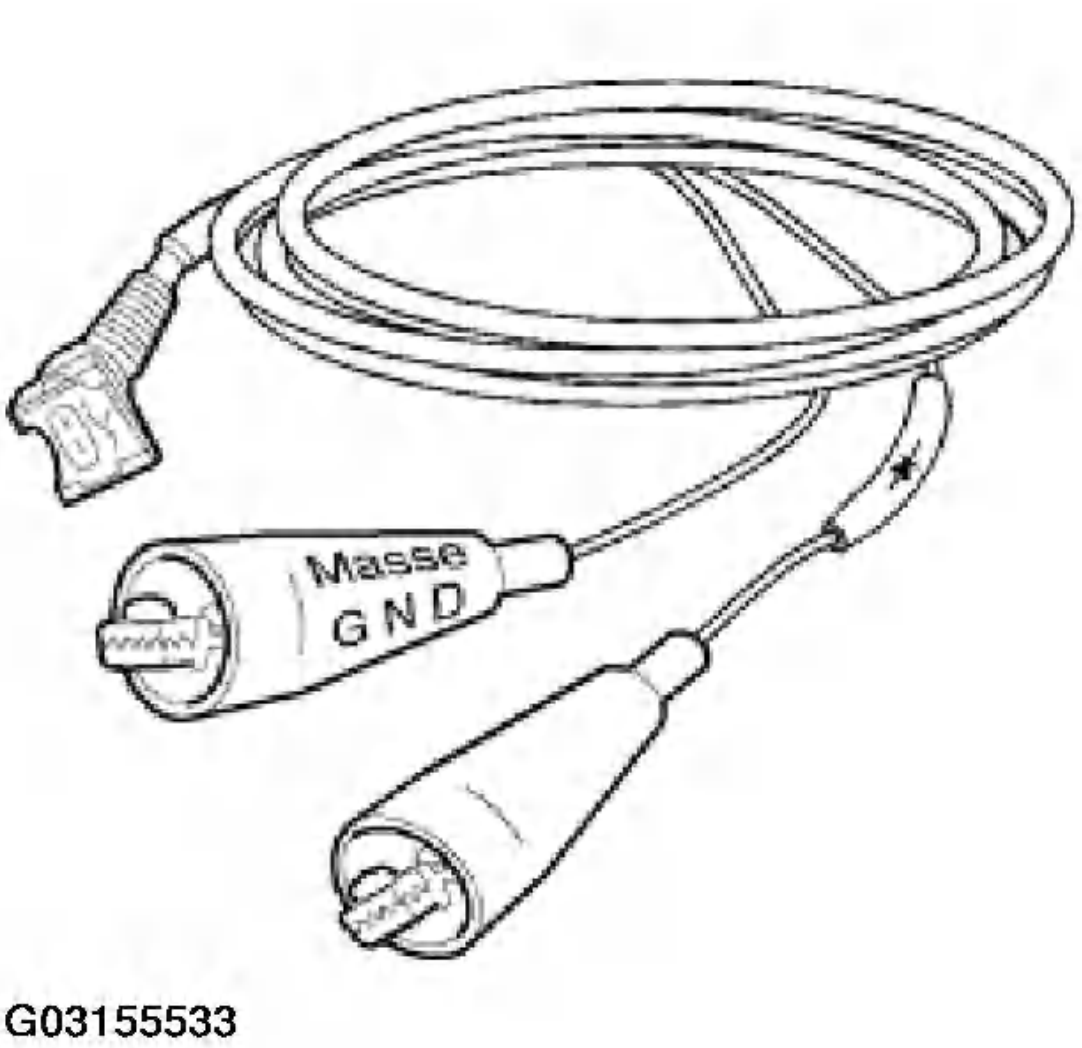


Fig. 4: Identifying Special Tool - Adapter Lead & Switching Unit
Courtesy of BMW OF NORTH AMERICA, INC.

12 7 050 ADAPTER LEAD

Minimum set: Measuring and testing equipment

NOTE: Note: For engines with rod-type ignition coils for measuring secondary voltage

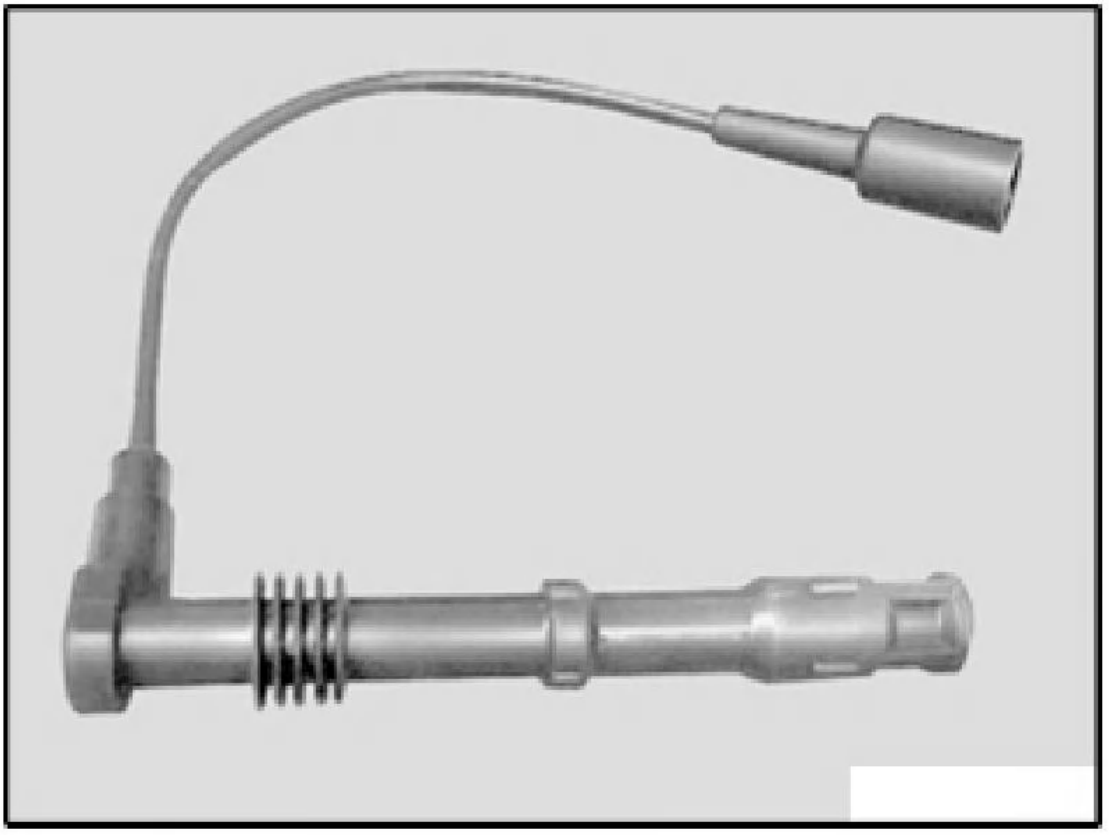
Engine: M54, M56, N40, N42, N46, N62, N73, S54

Storage location: F 104

SI number: 2 01 01(671)

Order number: 12 7 050

Adapter lead



G03155534

Fig. 5: Identifying Special Tool - Adapter Lead
Courtesy of BMW OF NORTH AMERICA, INC.

12 7 060 ANTI-STATIC MAT (ESD)

NOTE: Note: ESD (Electro Static Discharge) For protection against ESD during repairs to electronic components. (Replaces the sub-number 12 7 192 from EPROM tool kit 12 7 190)

Series: E36, E36/2, E36/3, E36/5, E36/7, E36/C, E36tou, E38, E38/3, E39, E39PL, E39tou, E46, E46/16, E46/2, E46/3, E46/5, E46/C, E52, E53, E60, E61, E63, E64, E65, E66, E67, E83, E85, E87, E90, R50, R52, R53, RR1

SI number: 2 06 04(128)

Order number: 12 7 060

Antistatic mat (ESD)

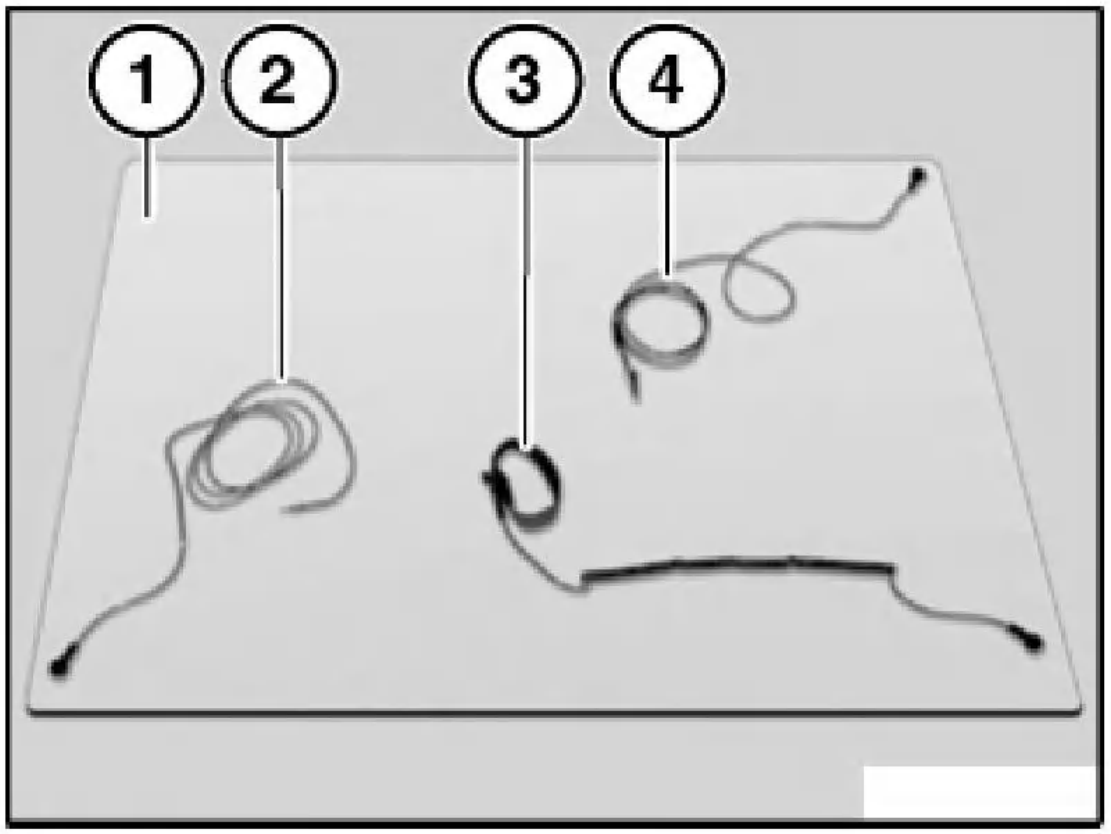


Fig. 6: Identifying Special Tool - Anti-Static Mat (ESD)
Courtesy of BMW OF NORTH AMERICA, INC.

12 7 121 COUNTERHOLDER WRENCH

COUNTERHOLDER WRENCH

In conjunction with:	Socket
Note:	Alternator N42 engine
Order number:	12 7 121
Â	Counterholder wrench

12 7 122 SOCKET

SOCKET

In conjunction with:	Counterholder wrench
Note:	Hazet 8808 lg 10
SI number:	1 28 03(051)
Order number:	12 7 122
Â	Socket

12 7 190 EPROM TOOLS/ID MARKING

EPROM TOOLS/ID MARKING

Storage location:	J 101
Order number:	12 7 190

Â	EPROM tools/ID marking
Consisting of:	
1 = 12 7 191	EPROM extractor pliers
2 = 12 7 192	Antistatic mat
NOTE: incl. arm band	

12 7 200 SET OF TOOLS

SET OF TOOLS

Note:	For opening & closing control unit box
Storage location:	J 106
Order number:	12 7 200
Â	Set of tools
Consisting of:	Â
1 = 12 7 201	Pliers
Â	NOTE: For bending open tab washers
2 = 12 7 202	Lever
Â	NOTE: For bending tab washers
3 = 12 7 203	Pliers
Â	NOTE: For closing tab washers
4 = 12 7 204	Torx socket T20
5 = 12 7 205	Torx socket T10
6 = 12 7 206	Fine pen
Â	NOTE: Black, waterproof
8 = 12 7 208	Slotted screwdriver 2 mm
9 = 12 7 209	Straightening tool
Â	NOTE: For EPROM connections

12 7 210 CONTROL UNIT SEAL

CONTROL UNIT SEAL

Storage location:	J 106
Order number:	12 7 210
Control unit seal	
Consisting of:	
1 = 12 7 211	Seal marks
2 = 12 7 212	Hole punch
NOTE:	

For seal mark dating

Article GUID: A00202800

IGNITION WIRES, SPARK

12 12 SPARK PLUGS

SPARK PLUGS - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Thread	Measure
1AZ Spark plugs (ungreased)	All	M12x1.25	23 +/- 3 Nm
Â	All	M14x1.25	30 +/- 3 Nm

ELECTRONIC SWITCHING

12 14 ELECTRONIC SHIFT UNITS OR CONTROL UNITS

ELECTRONIC SHIFT UNITS OR CONTROL UNITS - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Thread	Tightening Specification	Measure
1AZ TCI control unit	All	Â	Â	2.5 Nm
2AZ Knock sensor	E23	Â	Â	13 Nm
Â	All	Â	Â	20 Nm
3AZ Engine speed and reference mark sensor	All	M6	Replace microencapsulated screw	10 Nm
4AZ Cover on control unit box	All	Â	Â	4.4 Nm

ALTERNATOR WITH DRIVE

12 31 ALTERNATOR WITH DRIVE AND MOUNTING PARTS

ALTERNATOR WITH DRIVE AND MOUNTING PARTS - TIGHTENING TORQUE SPECIFICATIONS

Tightening Torques	Type	Thread	Measure
1AZ Wires to alternator	Â	Â	Â
Terminal D+	M10 / M20	Â	5 Nm
Â	All / others	M6	7 Nm
Terminal B+	S38 / B38	Â	8 Nm
Â	All / others	M8	13 Nm
2AZ Pulley	All	Â	45 Nm
3AZ Pulley (ribbed drive belt)	Alternator with cooling jacket	Â	80 Nm
Â	all others	Â	70 Nm
Â	N42, N46 Valeo	Â	75 Nm
Â	N42, N46 Bosch	Â	65 Nm
4AZ Rear holder	All	Â	3.5 Nm
5AZ Fillister head screw for wire holder	All	Â	3.5 Nm
6AZ Alternator on bearing block	M40/M42 / M43 / M44	Â	43 Nm
7AZ Alternator to	N42, N46, N62	M8	21 Nm

crankcase			
8AZ Belt pulley (ribbed V-belt) with freewheel (Ina) fitted to Bosch and Valeo alternators	N42	Â	80 Nm

REGULATOR

12 32 GOVERNOR

GOVERNOR - TIGHTENING TORQUE SPECIFICATIONS

Application Â	Type	thread	Value Â
1AZ Regulator switch	All	M4	2 Nm
Â	All	M5	4 Nm

STARTER AND MOUNTING

12 41 STARTER AND MOUNTING PARTS

STARTER AND MOUNTING PARTS - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Thread	Measure
1AZ Starter motor mounting to transmission bell housing	All	Â	45 Nm
2AZ Support to starter	All	M5	5 Nm
3AZ Support to crankcase	All	Â	47 Nm
4AZ Electrical leads to starter	Â	Â	Â
Â	All	M5	5 Nm
Â	All	M6	7 Nm
All		M8	13 Nm
5AZ Bolt connection, pole tube	All	M6	6 Nm
6AZ Heat shield to starter motor	Â	M6	6 Nm

STARTER LEAD

12 42 WIRES TO STARTER

WIRES TO STARTER - TIGHTENING TORQUE SPECIFICATIONS

Applications	Type	Thread	Measure
1AZ Battery positive connection point in/at distributor	E32 / E34 / E31 / E36 / E46 / E87	M8	20 Nm
Â	E39 / M57	M8	11 Nm z
Â	E38 / M67	M8 Â	11 Nm
Â	E46 / M47TU	M8 Â	11 Nm

Â	E60 / N62	M8	15 Nm
Â	E65 / N62 / N73	M8	15 Nm
2AZ Wiring harness on distributor	E36 / M41	M8	10 Nm

ENGINE WIRING LOOM

12 51 ENGINE WIRING HARNESS

ENGINE WIRING HARNESS - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Thread	Tightening Specification	Measure
1AZ Wiring harness on electrical cutout device	M51 / M41	M5	Â	2.5 Nm
2AZ Wiring harness on distributor	E36 / M41	M8	Â	10 Nm
3AZ Battery positive terminal to intake manifold	M57	M8	Â	7 Nm
4AZ Battery positive terminal in engine compartment	M62 / S62	M8	Â	10 Nm
Â	M57 / M67	M8	Â	10 Nm
Â	M54	M8	Â	21 Nm
5AZ Wiring harness to ground holder	M67	M6	Â	10 Nm
Â	M47TU	M6	Â	7 Nm
6AZ DDE wiring harness pick-off to battery positive terminal	M47TU / M57TU / M67	M6	Â	9 Nm
7AZ Injector guide strip to cylinder head cover	M47TU / M57TU	Â	Â	3.5 Nm

CONNECTORS PLUGS

12 52 PLUG CONNECTORS, TERMINALS

PLUG CONNECTORS, TERMINALS - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Thread	Tightening Specification	Measure
1AZ Holder for modules	E36	M6	Â	9 Nm
2AZ Ground connections Flange nut	E36	Â	Â	16 Nm
3AZ Cover on heating splash wall	E36	Â	Â	1.1 Nm
4AZ Battery positive cap to cylinder head cover	M67	M5	Â	6 Nm
5AZ Wiring harness (term.50) to starter motor	M57TU / M67	M6	Â	8 Nm

6AZ Wiring harness (term.30H) to starter motor	M57TU / M67	M5	Â	5 Nm
7AZ Battery positive lead (term.30) to alternator (B+)	M57TU / M67	M8	Â	15 Nm
8AZ Cable duct to cylinder head.	M57TU	M6x12	Â	4 Nm

OIL PRESSURE, OIL TEMPERATURES

12 61 OIL PRESSURE, OIL TEMPERATURE, OIL LEVEL DISPLAY

OIL PRESSURE, OIL TEMPERATURE, OIL LEVEL DISPLAY - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Thread	Tightening Specification	Measure
1AZ Oil-pressure switch/oil-temperature switch	All	M12x1.5	Â	27 Nm
2AZ Level switch for engine oil	N62 / N73 / M67TU	Â	Jointing torque 2 Nm	8.5 Nm

COOLANT TEMPERATURE

12 62 COOLANT TEMPERATURE

COOLANT TEMPERATURE - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Thread	Tightening Specification	Measure
1AZ Temperature sensor to water flange (glow time/coolant temperature gauge)	M21	Â	Â	18 Nm
Â	M51	Â	Â	13 Nm
2AZ Temperature switch (5.5 Â°C / 17 Â °C) to fuel filter/cylinder head	M21	Â	Â	18 Nm
3AZ Coolant temperature sensor (2-pin plug-in connection)	S38 / S50	Â	Â	13 Nm
Â	All / others	Â	Â	20 Nm
4AZ Remote thermometer sensor (2-pin plug-in connection)	All	Â	Â	20 Nm
Remote thermometer sensor (4-pin plug-in connection)	M62	Â	Â	16 Nm
Â	S62	M12 x 1.5	Â	14 Nm
5AZ Remote thermometer sensor on coolant flange	S50	Â	Â	18 Nm
6AZ Temperature	S38 / S50	Â	Â	13 Nm

sensor - air				
7AZ Temperature sensor - oil	S38 / S50	Â	Â	13 Nm

SENSOR FOR CONTROL UNIT

12 72 SENDERS FOR CONTROL UNIT

SENDERS FOR CONTROL UNIT - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Thread	Tightening Specification	Measure
1AZ Lever to pedal value sender	E32 / E34 / E31 / E36	Â	Â	9 Nm
2AZ Pedal value sender to pedal console	E32 / E34 / E31	Â	Â	5 Nm

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Article GUID: A00202650

IGNITION WIRES, SPARK PLUGS

12 12 IGNITION HARNESS, SPARK PLUGS M54

IGNITION HARNESS, SPARK PLUGS M54 TECHNICAL SPECIFICATION

Bosch FGR 7DQP	x
NGK BKR 6E QUP (High Power)	x

12 12 IGNITION HARNESS, SPARK PLUGS E36

IGNITION HARNESS, SPARK PLUGS E36 TECHNICAL SPECIFICATION

Electrode gap on spark plugs	.....	.....
All models except "M"	mm	$0.7^{+0.1}$
M models	mm	$0.6^{+0.1}$
All models with dual mass electrode All models with three-mass and four-mass electrode cannot be adjusted!	mm	$0.9^{+0.1}$
Cylinder identifying sensor	.....	.....
Coil resistance at 20Â°C	.....	.....
Pins 1 and 2	Ω	< 1
Firing sequence: 4 cylinders 1, 3, 4, 2 6 cylinders 1, 5, 3, 6, 2, 4 8 cylinders 1, 5, 4, 8, 6, 3, 7, 2 12 cylinders 1, 7, 5, 11, 3, 9, 6, 12, 2, 8, 4, 10	.....	.....

IGNITION COIL

12 13 IGNITION COIL E36

IGNITION COIL E36 TECHNICAL SPECIFICATION

Ignition coil for non-operating ignition distribution	.....	.....
Primary winding resistance	approx.Ω	0.8
Secondary winding resistance	.....	not measurable
Resistance of Bosch spark plug connector	approx. kΩ	1+/- 20%
Resistance of Bremi spark plug connector	approx. kΩ	1.8 +/- 20%

ELECTRONIC SWITCHING OR CONTROL UNIT

12 14 ELECTRONIC SHIFT UNITS OR CONTROL UNITS E36

ELECTRONIC SHIFT UNITS OR CONTROL UNITS E36 TECHNICAL SPECIFICATION

Pulse sender	.....	.....
Coil resistance at 20Â°C	.....	.....
All models	Ω	540 +/- 10%
With breakerless ignition distribution	Ω	1280 +/- 10%
Distance from inductive pulse sender/gear	mm	1.0 +/- 0.3

ALTERNATOR WITH DRIVE AND MOUNT

12 31 ALTERNATOR WITH DRIVE AND MOUNTING PARTS E36

ALTERNATOR WITH DRIVE AND MOUNTING PARTS E36 TECHNICAL SPECIFICATION

Rated voltage	V	14
Rated voltage	A/W	65/91070/98080/112090/1260105/1470115/1610140/1960150/2100
Shielded capacitor	µF	2.2 +/- 20%

REGULATOR

12 32 REGULATOR E36

REGULATOR E36 TECHNICAL SPECIFICATION

Regulated voltage at 1500 rpm engine speed/no electrical devices on (at 30Â°C to 60Â°C at regulator)	V	13.5... 14.2

STARTER WITH MOUNTING

12 41 STARTER MOTOR WITH BRACKET, SOLENOID SWITCH E36

STARTER MOTOR WITH BRACKET, SOLENOID SWITCH E36 TECHNICAL SPECIFICATION

Current consumption at term. 50 (with rated voltage)	.....	.....
With rated power of 1.4 KW	.....	.....
Pull-in winding	A	54.5
Hold-in winding	A	10.5
At rated power of 1.7 KW with intermediate transmission	.....	.....
Pull-in winding	A	51
Hold-in winding	A	9.5
With rated power of 1.8 KW	.....	.....
Pull-in winding	A	50
Hold-in winding	A	12
With rated power of 2.0 KW	.....	.....
Pull-in winding	A	54.5
Hold-in winding	A	10.5

12 41 STARTER MOTOR WITH BRACKET, SOLENOID SWITCH E36

STARTER MOTOR WITH BRACKET, SOLENOID SWITCH E36 TECHNICAL SPECIFICATION

Current consumption at term 50 (with rated voltage)	.....	.....
With rated power of 2.2 KW	.....	.....
Pull-in winding	A	58
Hold-in winding	A	13
At rated power of 2.2 KW with intermediate transmission	.....	.....
Pull-in winding	A	60
Hold-in winding	A	10
At rated power of 2.6 KW with intermediate transmission	.....	.....
Pull-in winding	A	50
Hold-in winding	A	12

12 41 STARTER AND MOUNTING PARTS E36

STARTER AND MOUNTING PARTS E36 TECHNICAL SPECIFICATION

Rated power	kW	.....
M40, M42, M43, M43TU, M52, M52TU, S50	kW	1.4
M41	kW	1.8
M50, M52, S52	kW	1.7
M51	kW	2.2
M57	kW	.....
M67	kW	.....
S62	kW	.....
Axial armature play	mm	0.1 ...0.2
Carbon brush length	at least mm	13
Testing voltage	V	12 +/- 0.3

OIL PRESSURE/OIL TEMPERATURE GAUGE

12 61 OIL PRESSURE, OIL TEMPERATURE, OIL LEVEL DISPLAY E36

OIL PRESSURE, OIL TEMPERATURE, OIL LEVEL DISPLAY E36 SPECIFICATION

Switch-on pressure	bar	0.2 ...0.5
Oil level switch Note: Max. 200 mA testing load. Measured against vehicle ground	.....	.....
Static at connection 1	.....	.....
Level okay	kΩ	+/- 1%
Level too low	Ω	0...0.2
Dynamic at connection 2	.....	.....
Level okay	Ω	0...0.2
Level too low	Ω	Ω

Article GUID: A00202372

TROUBLESHOOTING

12 00 CONTENTS OF ENGINE ELECTRICAL SYSTEM GENERAL

General Information -->Working on ignition system. Refer to 12 00 ... WORKING INSTRUCTIONS FOR IGNITION SYSTEM, DME (DIGITAL MOTOR ELECTRONICS) AND ENGINE ELECTRICS .

-->Removing and installing electronic control units. Refer to 12 00 ... WORKING INSTRUCTIONS FOR REMOVING AND INSTALLING ELECTRONIC CONTROL UNIT .

-->Welding work (overload protection of control units). Refer to 12 00 ...WELDING WORK (OVERLOAD PROTECTION OF CONTROL UNITS) .

-->Disconnecting and connecting battery. Refer to 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .

-->Disconnecting and connecting test equipment. Refer to 12 00 ... DISCONNECTING AND CONNECTING TEST EQUIPMENT .

-->Component inspection! Refer to 12 00... COMPONENT INSPECTION: .

-->External jump-starting aid. Refer to 12 00 ... EXTERNAL JUMP-STARTING AID .

12 00 ... BREAKERLESS IGNITION DISTRIBUTION

1. Engine must never be started after disconnection of the secondary circuit, i.e. disconnection of connectors on spark plugs and earth connection (terminal 4a).
2. There is dangerous high tension in or on:

   1.1. Ignition leads.

   1.2. Spark-Plug connectors.

   1.3. Spark plugs.

   1.4. Ignition coil terminal 4.

   CAUTION: Approx. 40 kV high tension.

3. Terminal 1 wire from ignition coil to DME control unit.

   CAUTION: Approx. 350 V high tension at terminal 1.

4. Battery as well as wires on alternator and starter may not be disconnected on a running engine.

12 00... COMPONENT INSPECTION:

NOTE: On all inspections and operations on the engine electrics and electronics, comply with prevailing national safety legislation and accident prevention regulations.

Always disconnect connectors of control units or components before checking electric wires.

Testing Aids:

The relevant wiring diagrams are filed in the Electrical Troubleshooting Manual folder for the 3 Series E36.

Always use correctly produced inspection lines, adapters, terminals and test tips.

Test values for checking components are contained in the Electrical Troubleshooting Manual.

For further technical information, refer to ENGINE ELECTRICAL SYSTEM - TECHNICAL DATA .

12 00 ... DISCONNECTING AND CONNECTING BATTERY

Safety instructions for handling vehicle battery. Refer to 61 00 ... SAFETY INSTRUCTIONS FOR HANDLING VEHICLE BATTERY .

Disconnect Battery:

If the battery is not disconnected when working on components, cable connections etc., faults can occur in the fault memories of the relevant control units.

If the repair instructions contain an instruction to disconnect the battery before carrying out a specific repair job, for safety reasons, always follow this instruction.

CAUTION: Disconnecting the vehicle battery will cancel the fault memories of control units. For this reason, before disconnecting the battery, always interrogate the fault memories and print out the faults on the printer attached to the BMW Service-Tester. Investigate stored faults. Once the battery has been disconnected, the radio can only be restarted with the radio code; for this reason, ask the customer for his/her radio code card beforehand. Note stored stations and restore them after connecting the battery. Stored settings of the on-board computer and clock will also be lost. On door closing systems with infrared operation, all keys must be receded.

12 00 ... EXTERNAL JUMP-STARTING AID

Do not start the engine with help of starting sprays.

Preparation:.

Conform with the following when starting engine with starting cable.

Ensure that starting cable wires are to appropriate cross-section size.

Only use fuse-protected starting cables.

Check whether the current supplying battery has 12V voltage.

If engine is started from battery of another vehicle, ensure that there is no contact between the bodies of both vehicles.

CAUTION: Never touch ignition system components under current - dangerous high tension!

Operation:

Always conform with the procedures to avoid injury to persons or damage to parts.

Select range P in vehicles with an automatic transmission and apply the parking brake.

Move the shift lever of vehicles with manual transmission into neutral and apply the parking brake.

Ensure that the starting cables cannot get caught in rotating parts, e.g. fan.

First connect both positive poles of the batteries with one starting cable (red).

Use the positive connection point in the engine compartment for vehicles with the battery in the trunk.

Then connect the second starting cable (black) between the negative pole of the current supplying battery and engine or body earth of the vehicle to be started.

CAUTION: Never connect the second starting cable (black) on the negative pole of the battery in the vehicle to be started. Produced gas could be ignited by sparks.

Danger of explosion!

If the battery in the vehicle supplying power is weak, start the engine of this vehicle and let it run at idling speed.

After the engine of the vehicle to be started has started up, first disconnect the starting cable on the negative pole/earth connection. Then remove the starting cable from the positive poles.

12 00 ... EXTERNAL JUMP-STARTING AID AND CAR TELEPHONE!

Siemens C 2:

When starting the vehicle engine with outside help from another vehicle, remember that overvoltage could damage the Siemens C 2 telephone. For this reason, always disconnect the sender and receiver from the electric system before using outside starting aids.

Siemens C 3 And Motorola C 451:

Senders and receivers of Siemens C 3 and Motorola C 451 telephones are protected against overvoltage, but calls may not be made or received during outside starting.

Always pay attention to the operating instructions of different type and different make telephones. In case of doubt disconnect the sender and receiver from the vehicle electric system.

12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY

Observe safety instructions for handling vehicle battery. Refer to 61 00 ... SAFETY INSTRUCTIONS FOR HANDLING VEHICLE BATTERY .

Before Disconnecting Battery:

Switch off ignition.

NOTE: If the ignition is not turned off when the battery is disconnected, fault memories may be set in some control units.

Important!

- There is a danger of mixing up battery leads: If the battery positive and negative leads are the same color and you are in doubt, follow the polarity to the battery, then mark and cover the leads.
- On vehicles with radio code: After disconnecting the battery, the radio code must be re-entered. Therefore obtain the radio code card from the customer beforehand. Note stored stations and restore them after connecting the battery.
- Stored settings of the on-board computer and clock will also be lost.
- All available central keys must be receded for cars with first generation infrared transmitter locking systems.

General Notes On Disconnecting Battery:

- Do not disconnect battery leads and leads from alternator and starter motor while engine is running.
- Cars with IBS on battery negative terminal:
- Do not under any circumstances pull/lever off pole shoes by force.
- Do not under any circumstances release socket-head cap screw of IBS.
- When work is carried out on the electrical system, faults may be caused in the fault memories of some control units when the battery is connected.

After Connecting Battery:

Important!

After a power supply interruption some equipment is disabled and must be reactivated.

For further information and instructions on vehicle-specific activation, please refer to PROCEDURE FOR INITIALIZATION .

12 00 ... DISCONNECTING AND CONNECTING TEST EQUIPMENT

When connecting and disconnecting:

- Service Tester.
- Testing Devices.
- Test Leads.
- When Replacing Control Units.

It is essential to turn off the ignition.

Follow instructions for removing and installing electronic control units. See 12 00 ... WORKING INSTRUCTIONS FOR REMOVING AND INSTALLING ELECTRONIC CONTROL UNIT .

Follow operating instructions for testing devices.

Make sure that connected test leads cannot make contact with rotating parts (e.g.: fans, ribbed V-belts, etc.).

12 00 ...WELDING WORK (OVERLOAD PROTECTION OF CONTROL UNITS)

When performing welding work on installed control units, to avoid any defects in the electronic control units, observe the following steps:

- Observe instructions for disconnecting and connecting battery. See 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .
- Detach terminal of battery negative lead from car battery and second battery if fitted. Cover negative terminal posts.
- If welding is to be performed near the battery/batteries, first remove battery/batteries from vehicle (flying sparks - combustion of explosive gas).
- Fit return clamp on welding unit as close as possible to welding point (maximum distance approx. 1 mm).
- Never connect return clamp to ground pin on body which has ground wires attached!

12 00 ... WORKING INSTRUCTIONS FOR IGNITION SYSTEM, DME (DIGITAL MOTOR ELECTRONICS) AND ENGINE ELECTRICS

CAUTION:

1. Always switch off ignition before working on ignition system.

Never touch components under current with engine running!

Dangerous high tension!

2. Always remove DME master relay for the compression test to avoid activation of ignition coils by ignition final stages of the DME control unit.

   Dangerous high tension!

3. Always switch off ignition before connecting /disconnecting Service Tester, other testers and adapters or replacing components!
4. The secondary side (high voltage side) of ignition system must be under load of at least 4 kohm.
5. Never start engine after removing distributor cap or disconnecting wire (terminal 4) on ignition coil (terminal 4).
6. Never connect a shielded capacitor or test light on ignition coil terminal 1.
7. Never connect ignition coil terminal 1 wire earth or battery positive.

   For this reason, terminal 1 wire may not be used to interlock starting when service installing a burglar alarm system.

12 00 ... WORKING INSTRUCTIONS FOR REMOVING AND INSTALLING ELECTRONIC CONTROL UNIT

CAUTION: Disconnecting the vehicle battery will cancel the fault memories of control units.

For this reason, before disconnecting the battery, connect up BMW SERVICE TESTER or DIS. DIS: (select Expert mode) interrogate fault memory and print out fault messages stored in memory. BMW SERVICE TESTER: Interrogate fault memory and print out fault messages stored in memory. Investigate stored faults.

Ignition must always be switched off before disconnecting or connecting control-unit connectors.

Removal and installation of components, relays, fuse, etc. could cause the storage of faults in fault memories of control units capable of self-diagnosis. For this reason, fault memories must always be interrogated after working on the electrical system. Stored faults must be investigated and cancelled.

When Replacing Control Unit Of DME/DDE (Digital Motor Electronics/ Digital Diesel Electronics), Pleased Note The Following Points:

Each control unit is programmed with certain basic values, which serve as mean values. The control unit receives different input values, depending on engine condition, which are compared with the stored values. The adaptive system compares the input values with the stored map values. Appropriate correction commands are sent to the concerned drive elements.

If, for example, the DME control unit would be without current for a long time (more than an hour), its adaptive system would lose the stored values. After re-commissioning a cancelled unit or installing a new control unit, the input values of the relevant engine must be read in and stored for the adaptive system.

This procedure could lead to erratic idling and disturbed overrunning of the engine after starting. Depending on the engine it could require some time before all values are adapted to the engine condition.

For this reason, follow the procedure described below before replacing or reinstalling a DME/DDE control unit:

1. Run engine to operating temperature if possible before replacing the control unit.
2. Remove control unit, install new control unit and drive vehicle.

12 13 NOTES ON CHECKING IGNITION SYSTEM

Troubleshooting --> Fault in fuel injection system. Refer to 12 13 ... FAULT IN FUEL INJECTION SYSTEM .

Spark plug faults --> Refer to 12 13 ... SPARK-PLUG FAULTS .

Ignition coil faults --> Refer to 12 13 ... IGNITION COIL FAULTS .

Further fault patterns with evaluation --> Refer to 12 13 ... FURTHER FAULT PATTERNS WITH EVALUATION .

Additional fault notes for troubleshooting --> Refer to 12 13 ... ADDITIONAL FAULT NOTES FOR TROUBLESHOOTING .

Oscillograms Normal oscillogram --> Refer to 12 13 ... NORMAL OSCILLOGRAM (M, S, W ENGINES ONLY) .

Oscillograms of ignition coils from different manufacturers --> Refer to 12 13 ... OSCILLOGRAMS OF IGNITION COILS FROM DIFFERENT MANUFACTURERS .

Check Secondary signal for stationary ignition distribution --> Refer to 12 13 ... CHECKING SECONDARY SIGNAL FOR STATIONARY IGNITION DISTRIBUTION .

IGNITION WIRES, SPARK

12 12 011 REPLACING ALL SPARK PLUGS

NOTE: For Special Tool identification, see SPECIAL TOOLS - Z3 .

Special Tools Required:

- 12 1 171
- 12 1 200

NOTE: This repair instruction is valid for the following engines:

- M52/M52TU/M54/M56

Necessary Preliminary Tasks:

- Remove ignition coils. Refer to 12 13 511 REPLACING IGNITION COIL (M52, M52TU, S52, S50US, M54) .

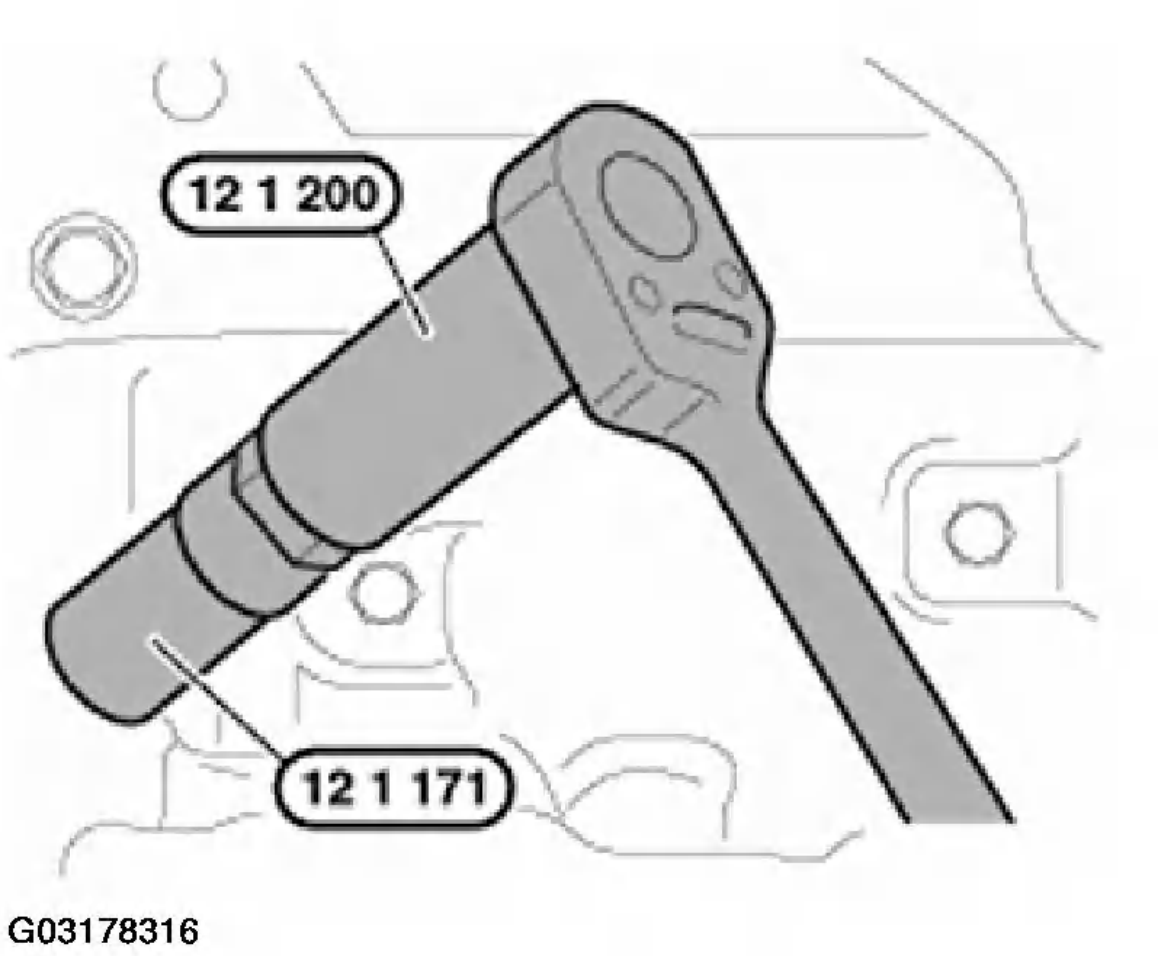


Fig. 1: Removing Spark Plugs With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Unscrew and remove spark plugs with special tool 12 1 171 in conjunction with special tool 12 1 200.

Installation:

If special tool 12 1 200 is not used, Tightening torque is 12 12 1AZ. Refer to 12 12 SPARK PLUGS .

IGNITION COIL

12 13 NOTES ON CHECKING IGNITION SYSTEM

Refer to 12 13 NOTES ON CHECKING IGNITION SYSTEM .

12 13 ... CHECKING SECONDARY SIGNAL FOR STATIONARY IGNITION DISTRIBUTION

NOTE: For Special Tool identification, see SPECIAL TOOLS - Z3 .

Special Tools Required:

- 12 7 030

Engine Test Step 10:

Remove ignition coil. Clip Special Tool 12 7 030 on relevant ignition coil to be tested. Clip high tension clip around ignition lead.

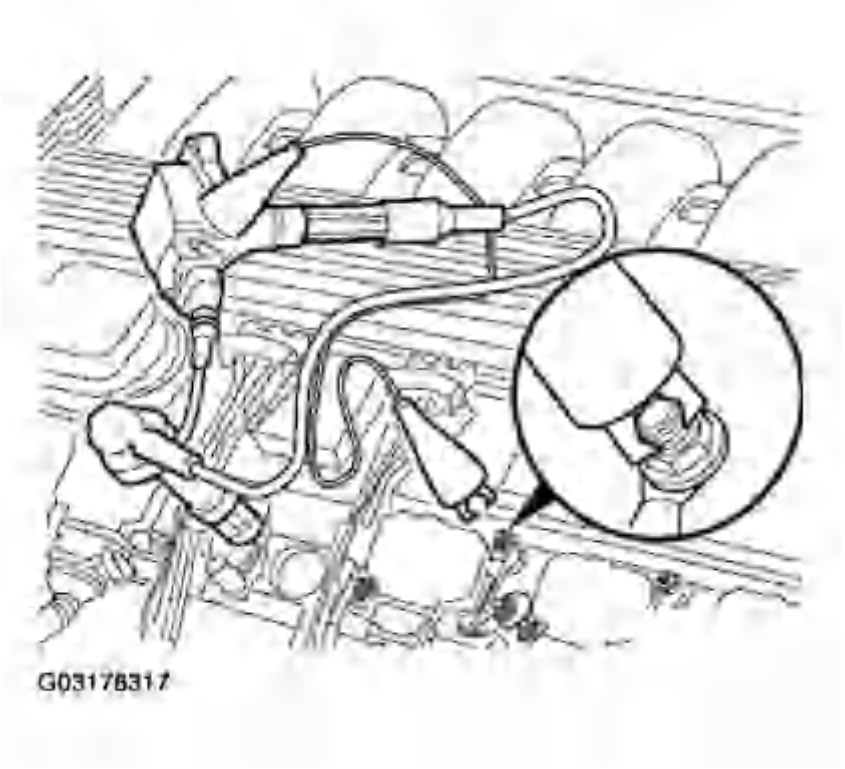


Fig. 2: Attaching High Tension Clip On Ignition Lead
Courtesy of BMW OF NORTH AMERICA, INC.

Connect earth lead of adapter to vehicle earth and ignition coil. Connect up diagnosis connector.

If trigger signal is not present (terminal 1), connect black clip of universal adapter cable to pin 1 of primary adapter cable.

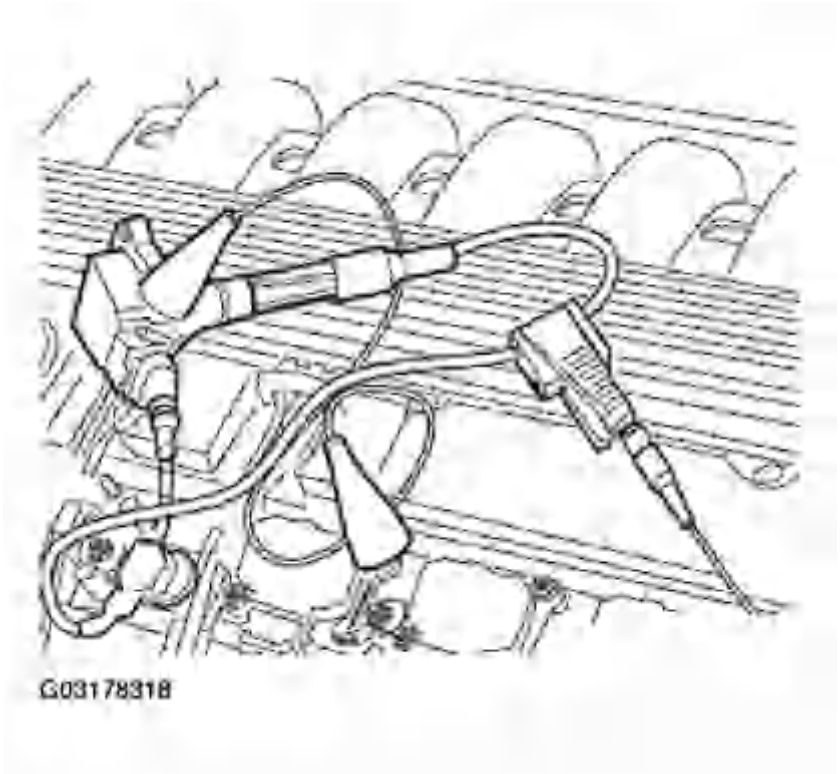


Fig. 3: Connecting Earth Lead Of Adapter To Vehicle Earth And Ignition Coil
Courtesy of BMW OF NORTH AMERICA, INC.

Produce a stationary signal by pressing key R on the tester.

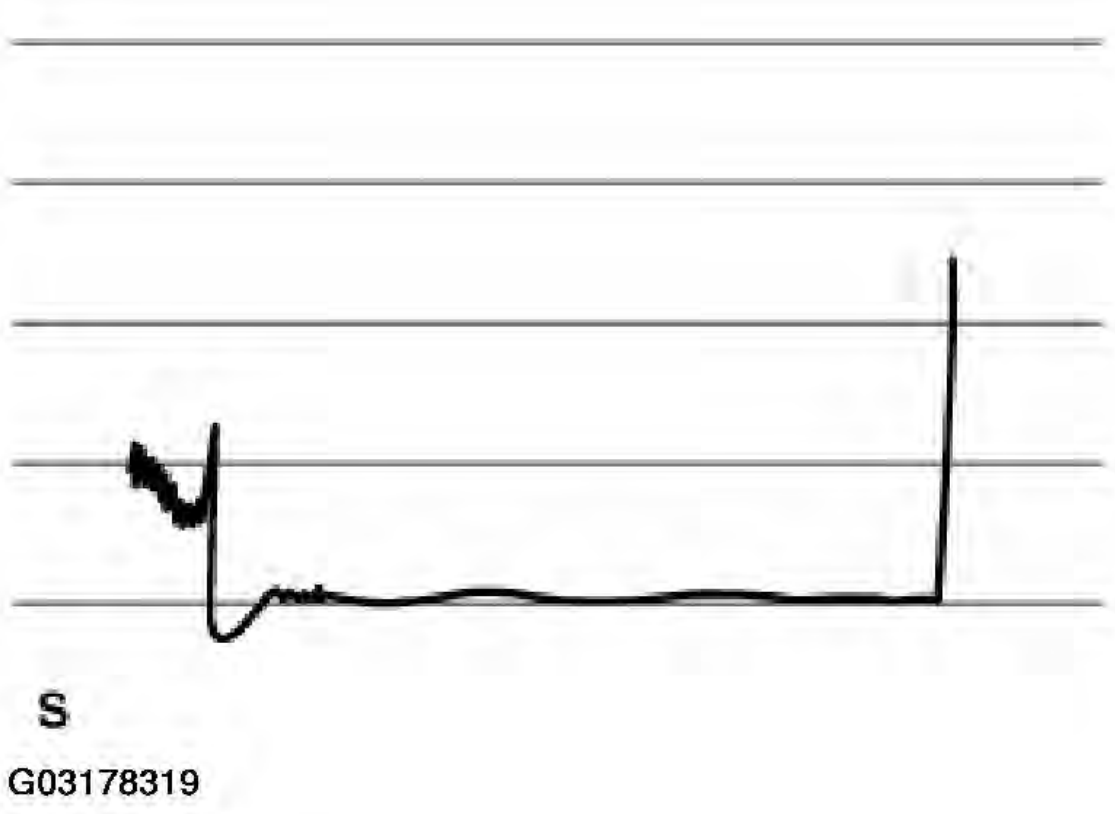


Fig. 4: Identifying Stationary Signal
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Neighboring ignition leads could produce interference on the screen of the oscilloscope.

Refer to the fault memories of engine control units for additional troubleshooting.

Interrogate fault memory and its fault reports.

12 13 ... NORMAL OSCILLOGRAM (M, S, W ENGINES ONLY)

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 decay process.
7. Termination oscillations.

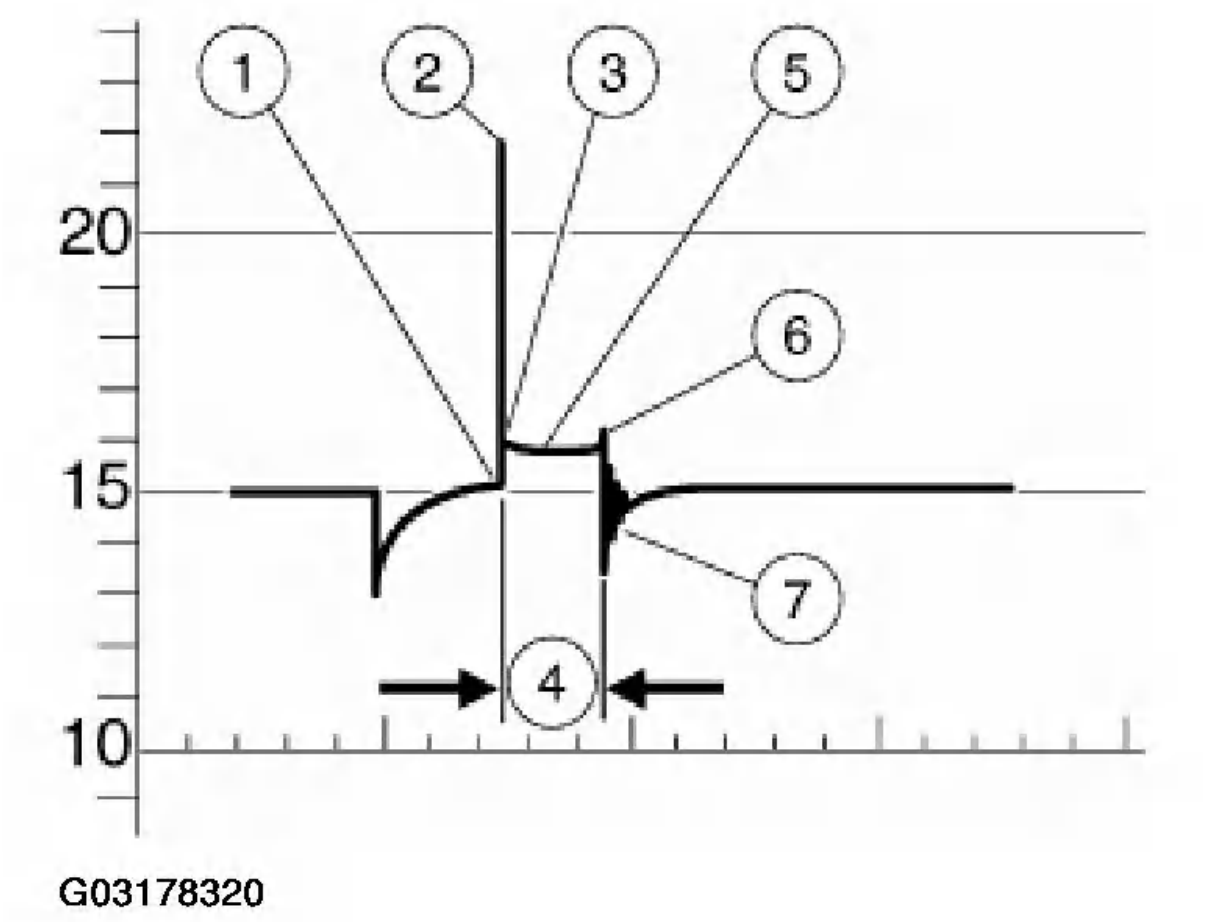


Fig. 5: Ignition Voltage Peak Oscillogram (M, S, W Engines Only) Graph
Courtesy of BMW OF NORTH AMERICA, INC.

Secondary voltage patterns, beside one another:

Evaluation of ignition voltage peaks at idle speed (this example shows an engine with 4 cylinders).

NOTE: The display of ignition voltage spikes is approx. 20-25% lower than the real value. The uniformity of all cylinders to each other is more important than the height of ignition voltage peaks. Differences of 3000 ... 4000 V are permitted. In event of greater differences, refer to 12 13 ... FURTHER FAULT PATTERNS WITH EVALUATION .

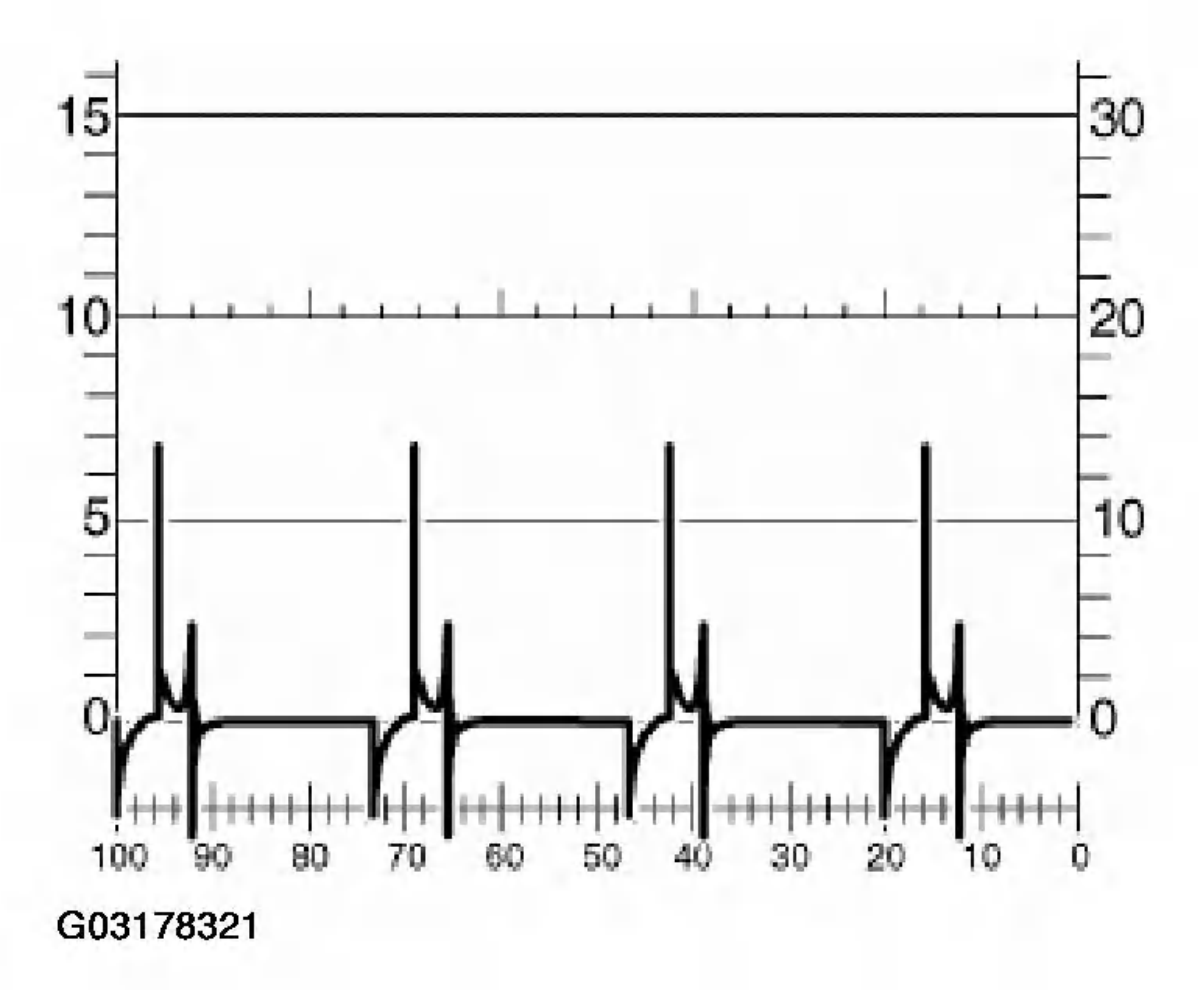


Fig. 6: Secondary Voltage Patterns Graph
Courtesy of BMW OF NORTH AMERICA, INC.

Evaluation of ignition voltage peaks at increased speed of approx. 2000 rpm (this example shows an engine with 4 cylinders).

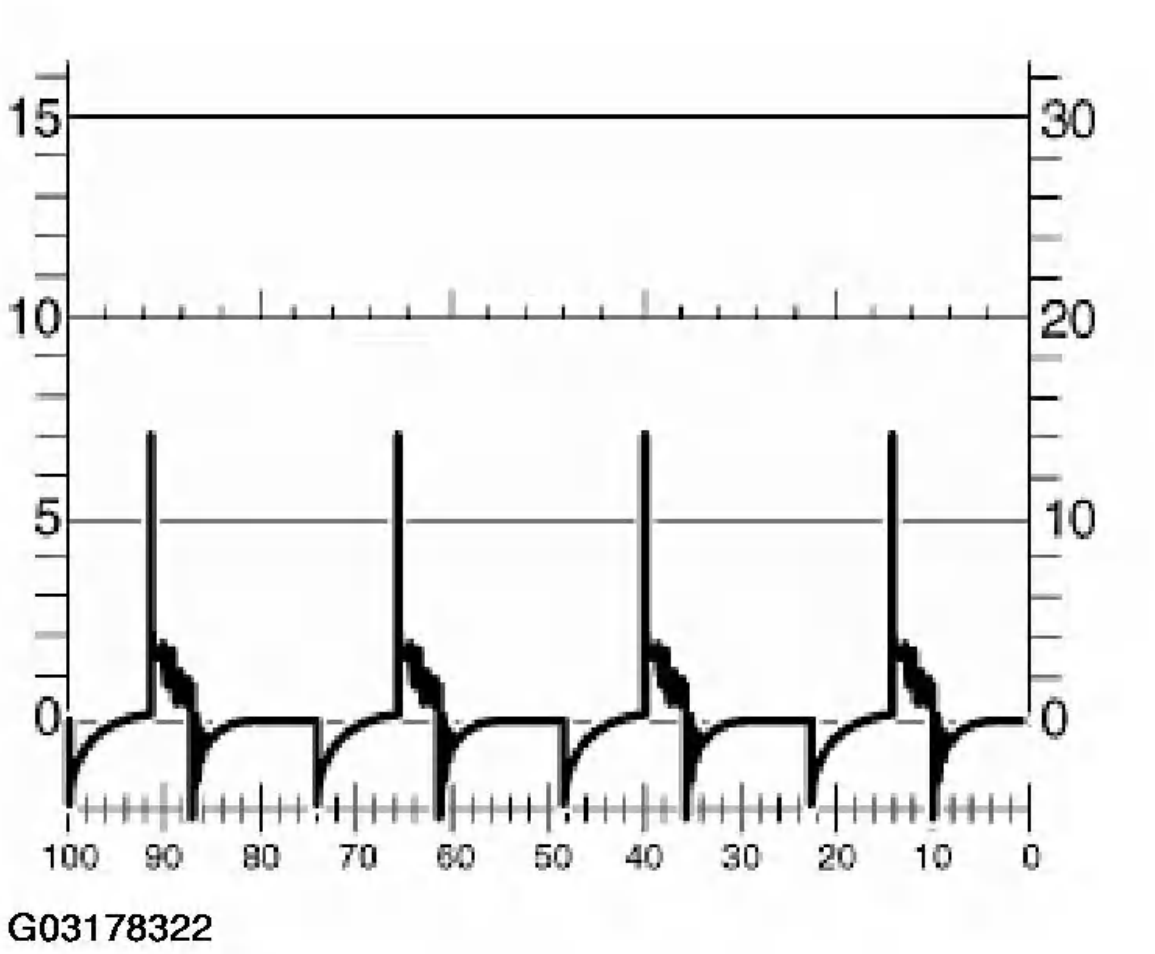


Fig. 7: Evaluation Of Ignition Voltage Peaks Graph
Courtesy of BMW OF NORTH AMERICA, INC.

Secondary voltage diagrams, superimposed:

Evaluation of combustion characteristics curve and decay characteristics at idle speed (this example shows a 4-cylinder engine).

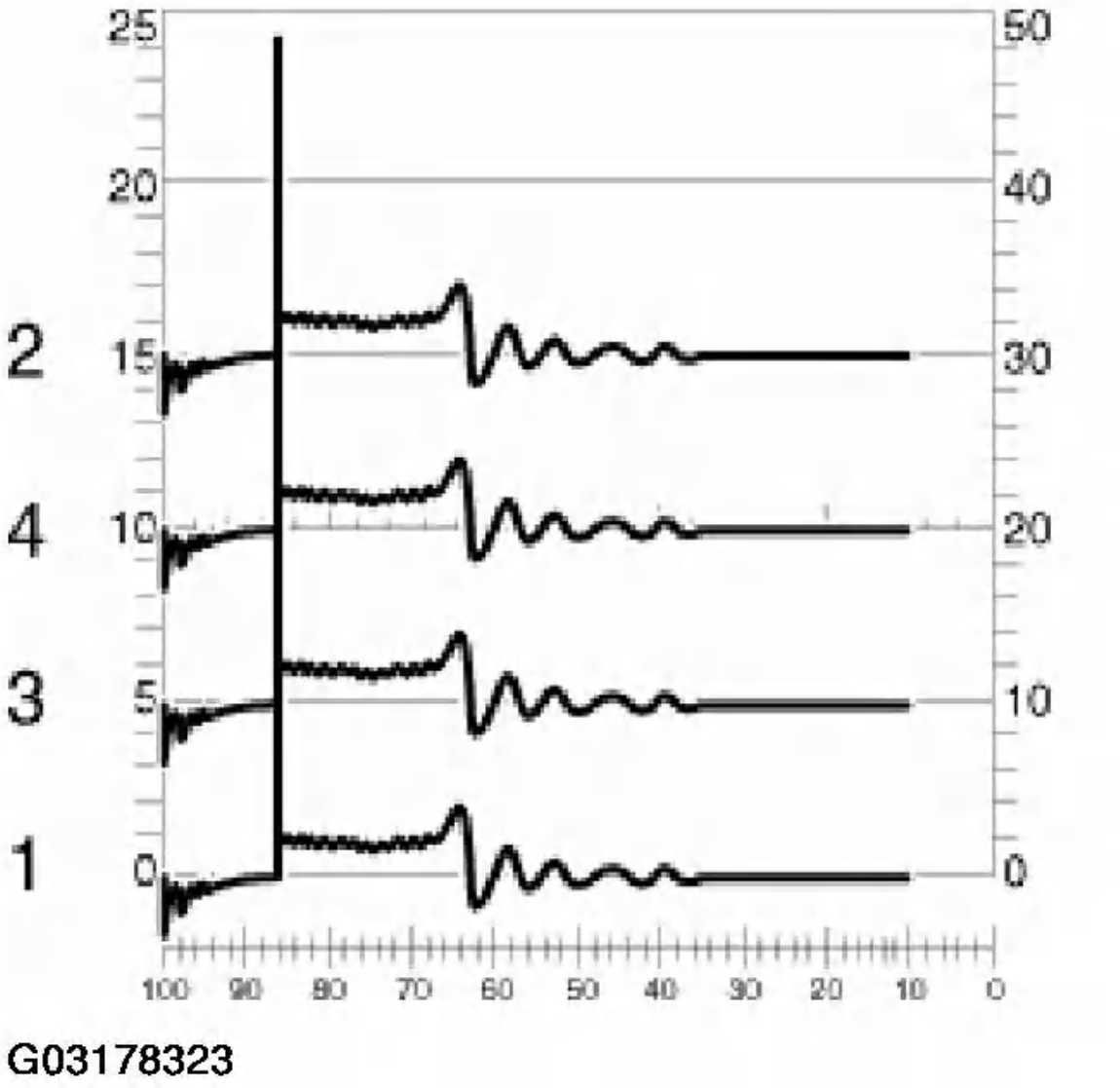


Fig. 8: Secondary Voltage Diagrams
Courtesy of BMW OF NORTH AMERICA, INC.

Secondary voltage diagrams, consecutive:

NOTE: Only the major differences in the ignition voltage patterns are revealed by this method of comparison.

The identified fault must be allocated to the relevant cylinder using the secondary voltage representation forms next to/on top of each other.

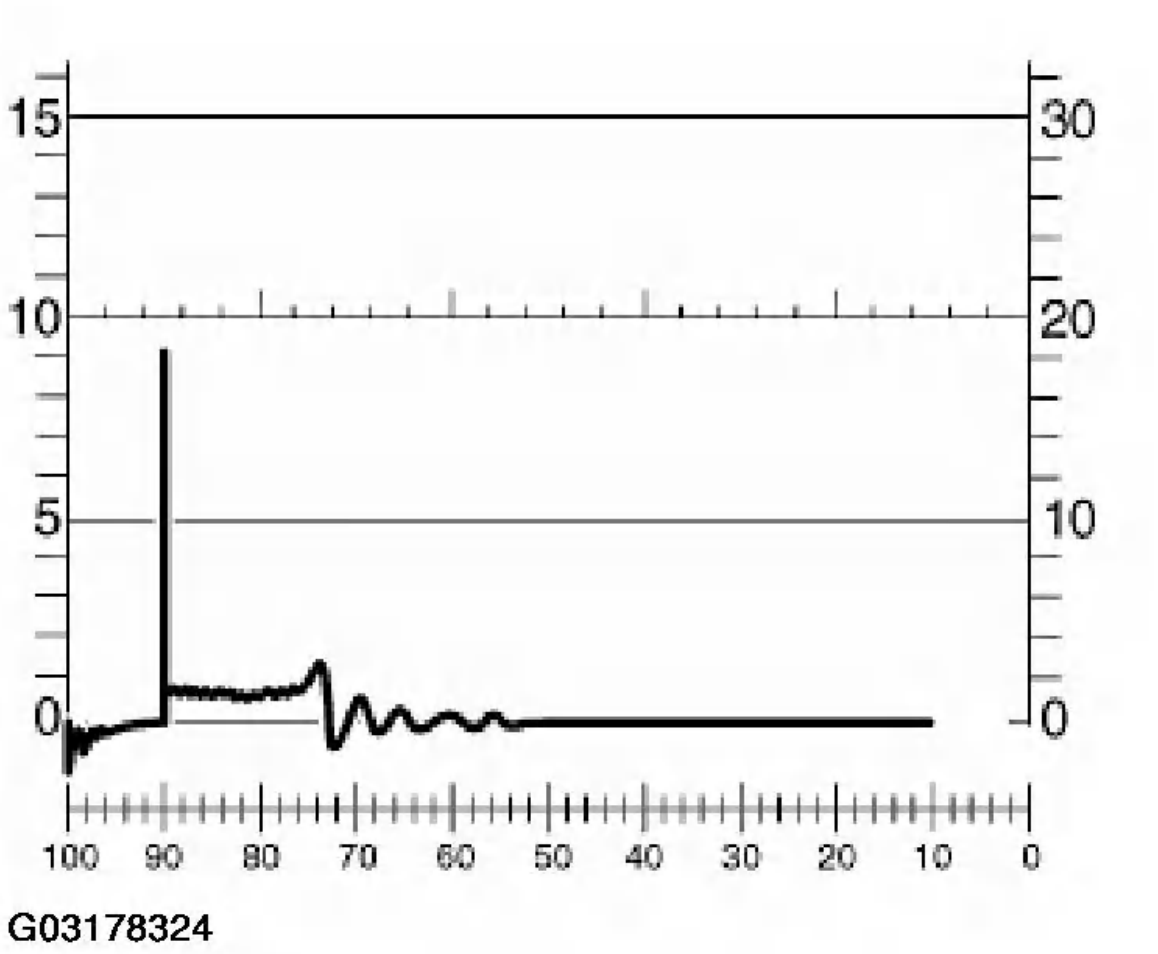


Fig. 9: Secondary Voltage Diagrams
Courtesy of BMW OF NORTH AMERICA, INC.

12 13 ... OSCILLOGRAMS OF IGNITION COILS FROM DIFFERENT MANUFACTURERS

Evaluation Of Ignition Voltage Peaks And Decay Characteristics At Idle Speed.

Make: Bremi

1. Normal ignition voltage spikes (6000-9000 V).
2. Normal start of attenuation processes.

Make: Beru

3. Normal ignition voltage peak.
4. High initial level of attenuation processes.

Make: May & Christe

5. Normal ignition voltage peak.
6. Low initial level of attenuation processes.

Make: Bosch

7. Low ignition voltage peak.
8. Normal start of attenuation processes.

Note: At high speeds, the ignition voltage peak falls very markedly relative to the peaks on units from other ignition coil manufacturers.

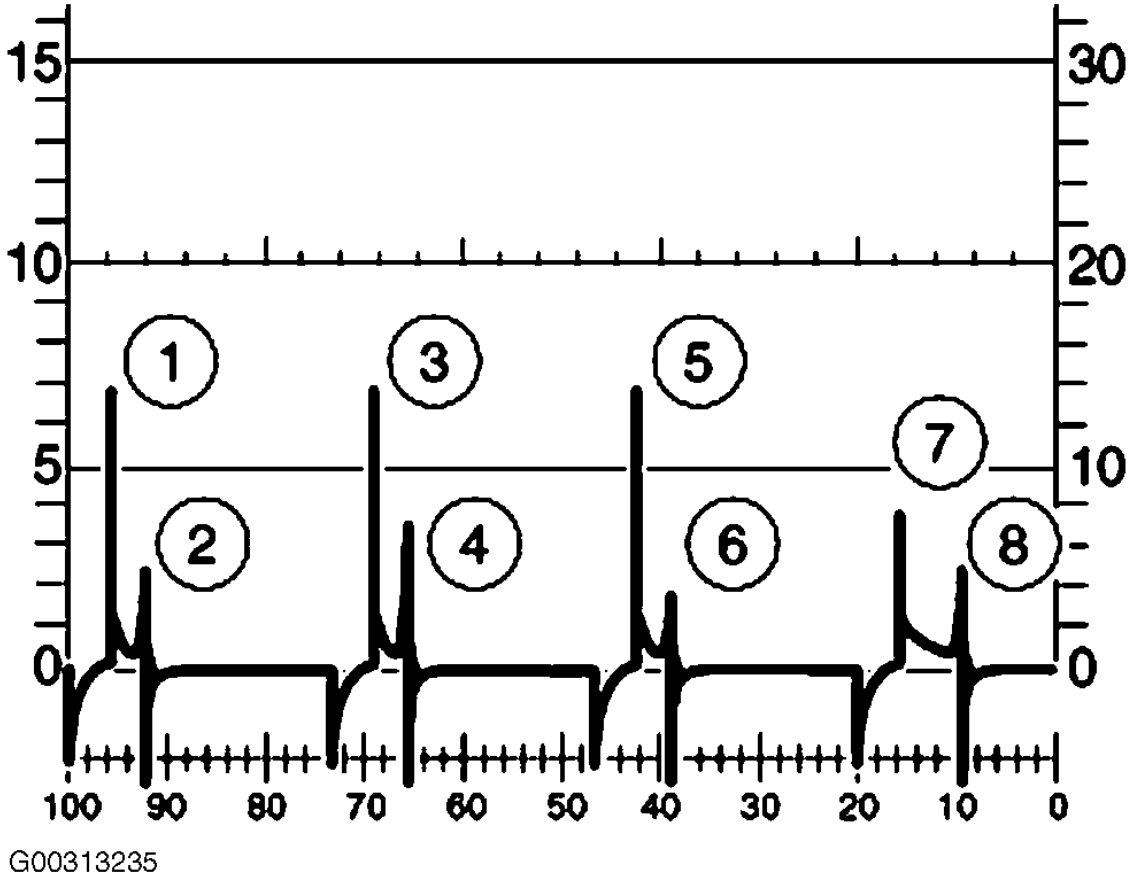


Fig. 10: Evaluation Of Different Ignition Coils (Idle Speed)
Courtesy of BMW OF NORTH AMERICA, INC.

Evaluation Of Combustion Voltage Characteristics At Raised Engine Speed Of Approx. 2500 RPM.

Make: Bremi

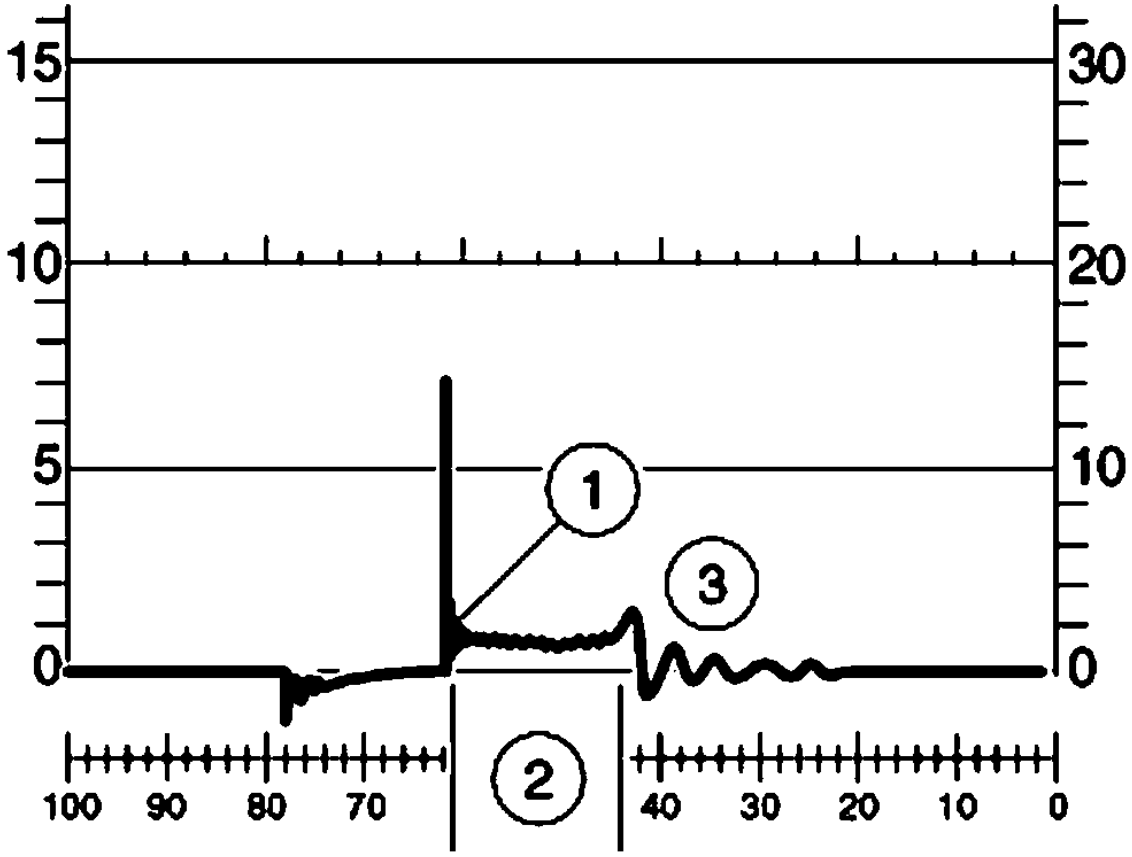


Fig. 11: Evaluation Of Different Ignition Coils At 2500 RPM (Bremi)
Courtesy of BMW OF NORTH AMERICA, INC.

1. Normal oscillation of the combustion voltage curve.
2. Normal combustion period.
3. 3 to 4 attenuations.

Make: Beru

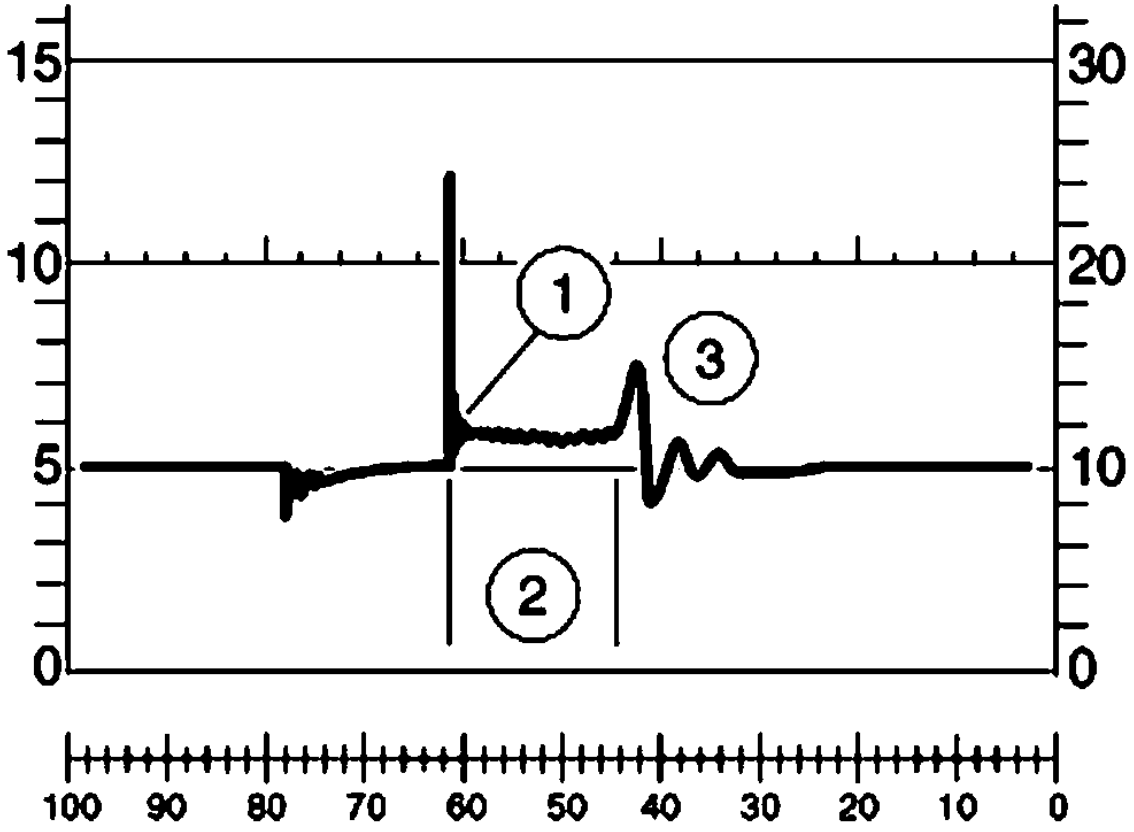


Fig. 12: Evaluation Of Different Ignition Coils At 2500 RPM (Beru)
Courtesy of BMW OF NORTH AMERICA, INC.

1. Normal oscillation of the combustion voltage curve.
2. Normal combustion period.
3. At least 3 decay oscillations.

Make: May & Christe

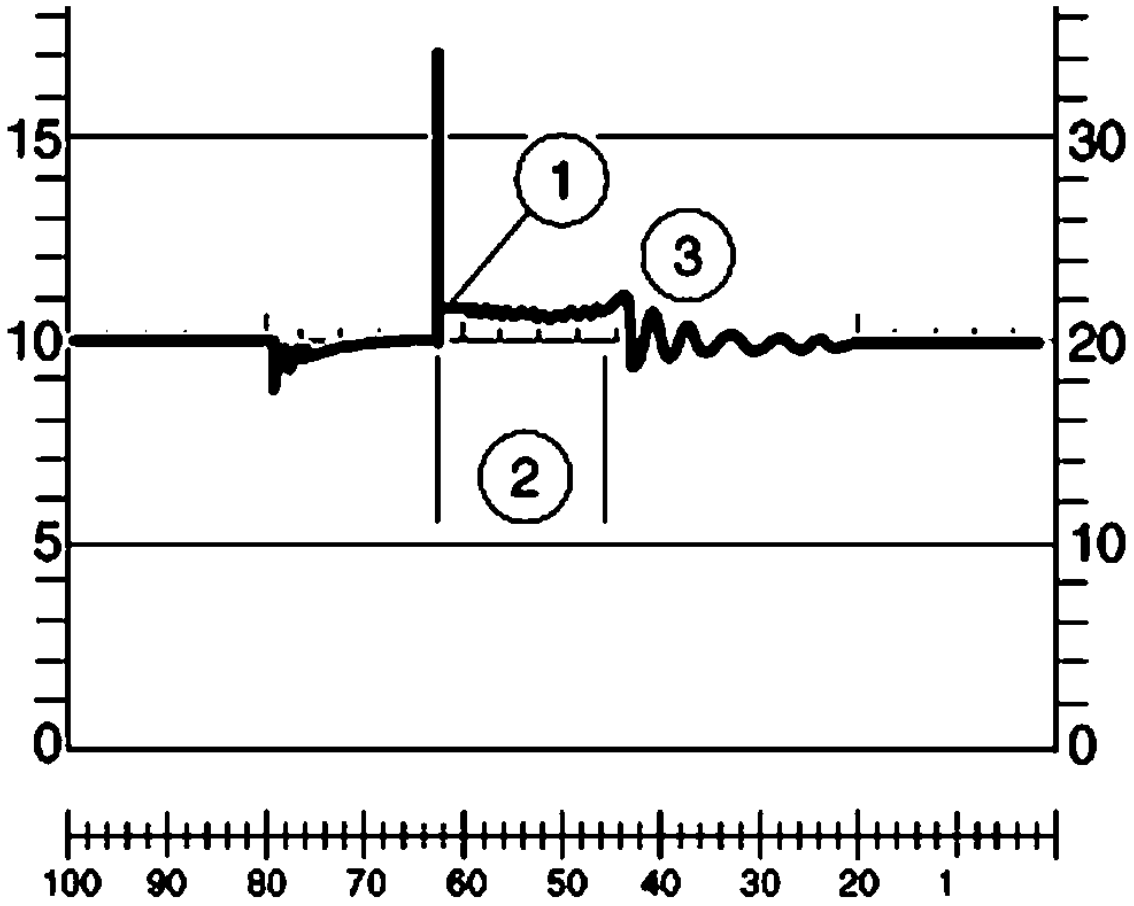


Fig. 13: Evaluation Of Different Ignition Coils At 2500 RPM (May & Cristie)
Courtesy of BMW OF NORTH AMERICA, INC.

1. No oscillation on combustion voltage curve.
2. Normal combustion period.
3. At least 5 decay oscillations.

Make: Bosch

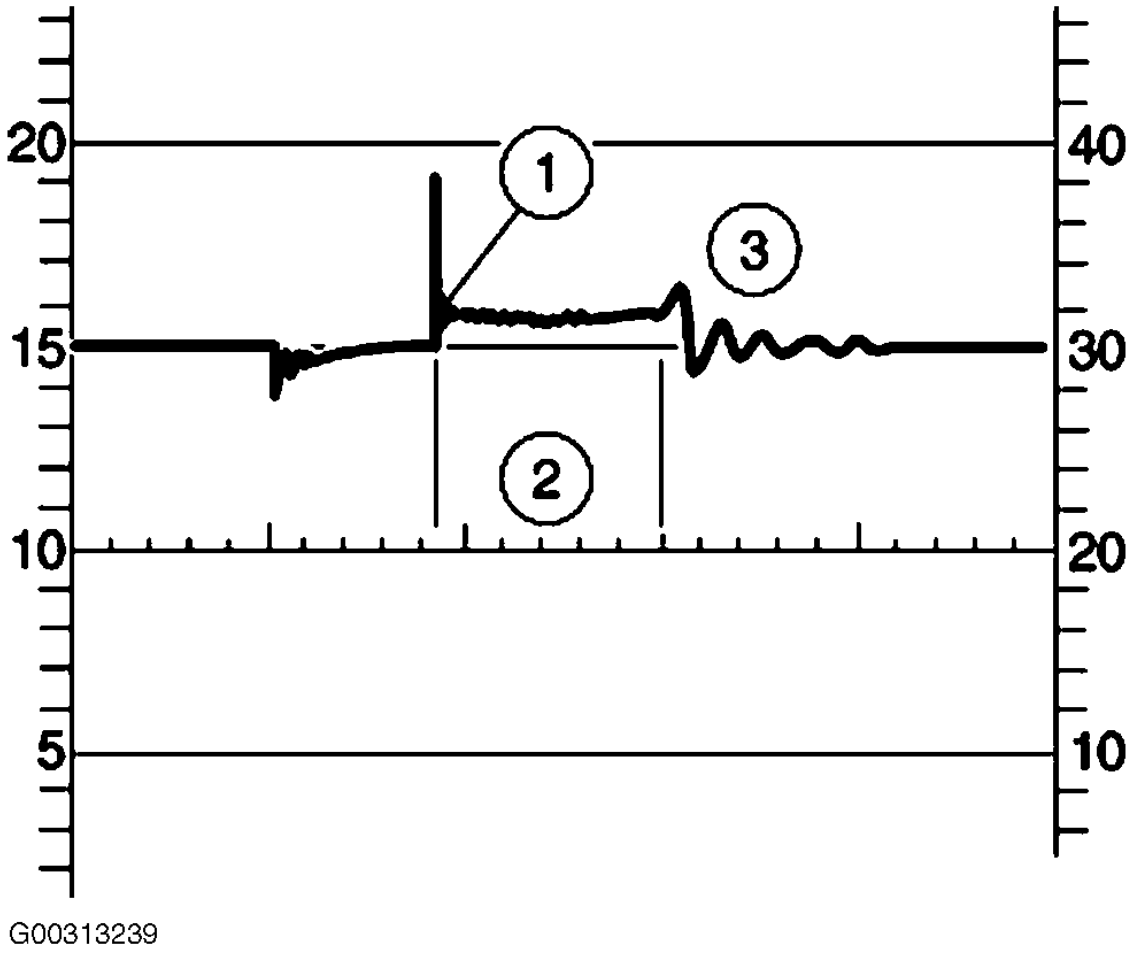


Fig. 14: Evaluation Of Different Ignition Coils At 2500 RPM (Bosch)
Courtesy of BMW OF NORTH AMERICA, INC.

1. Normal oscillation of the combustion voltage curve.
2. Long combustion period.
3. At least 3 decay oscillations.

12 13 ... FAULT IN FUEL INJECTION SYSTEM

Evaluation of ignition voltage peaks in response to sudden accelerator loads. See Fig. 15 .

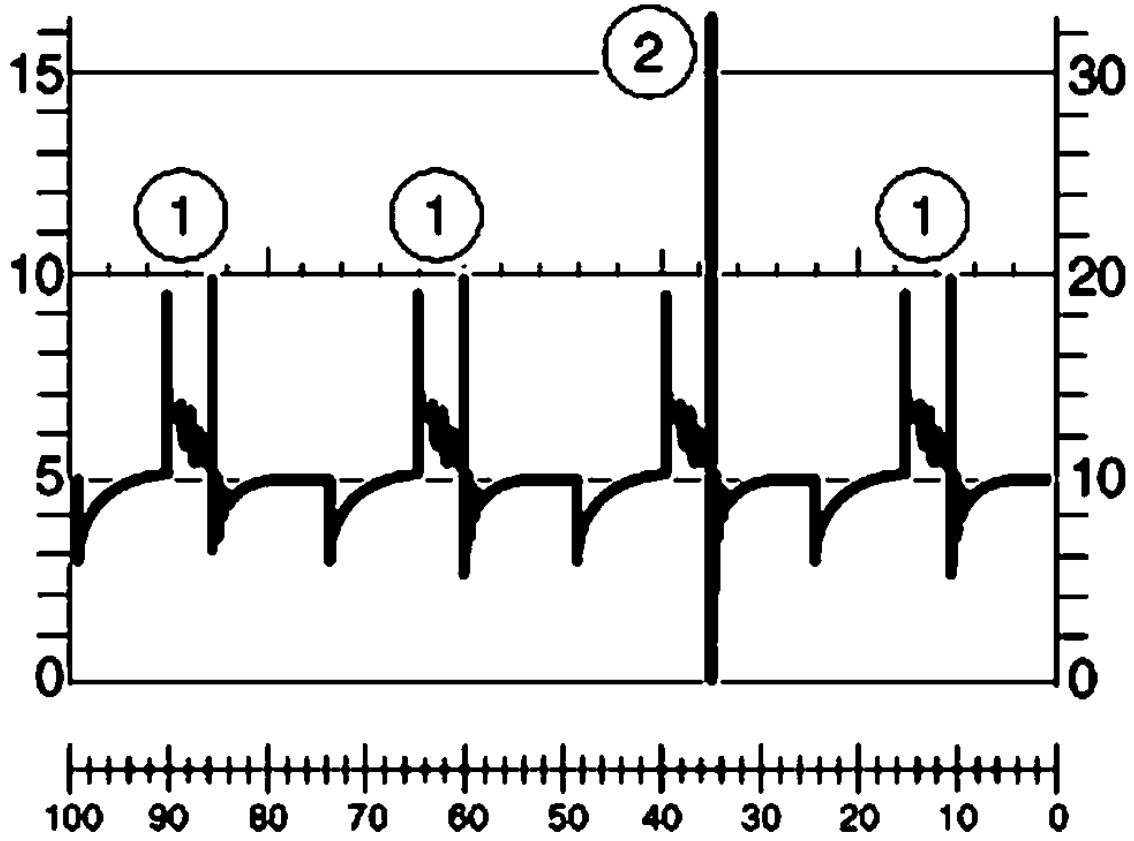


Fig. 15: Identifying Ignition System Faults With Oscilloscope
Courtesy of BMW OF NORTH AMERICA, INC.

1. Beginning of dying-out process is not much higher than ignition voltage peak. Ignition system is OK.
2. Beginning of dying-out process is considerably higher than ignition voltage peak.

   Fault in injection system:

   - Lean Mixture.
   - Defective Injection Valve.
   - Low Compressions.

12 13 ... SPARK-PLUG FAULTS

Evaluation of sparking period at idling speed.

1. Normal ignition voltage peak Spark plug is OK.
2. Low ignition voltage peak Small electrode gap.
3. High ignition voltage peak Large electrode gap.

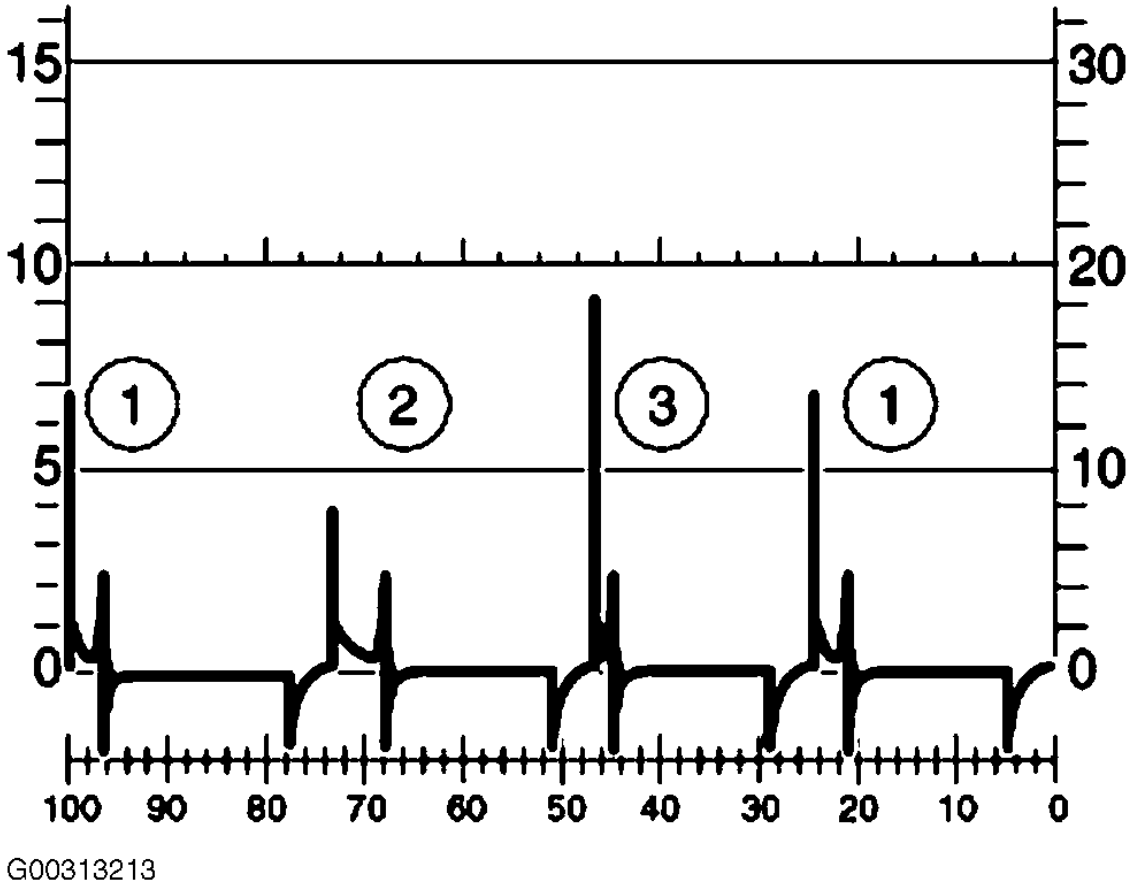


Fig. 16: Evaluation Of Sparking Period During Idling Period
Courtesy of BMW OF NORTH AMERICA, INC.

Evaluation of sparking period at idling speed:

Normal combustion period:

- Spark plug is OK

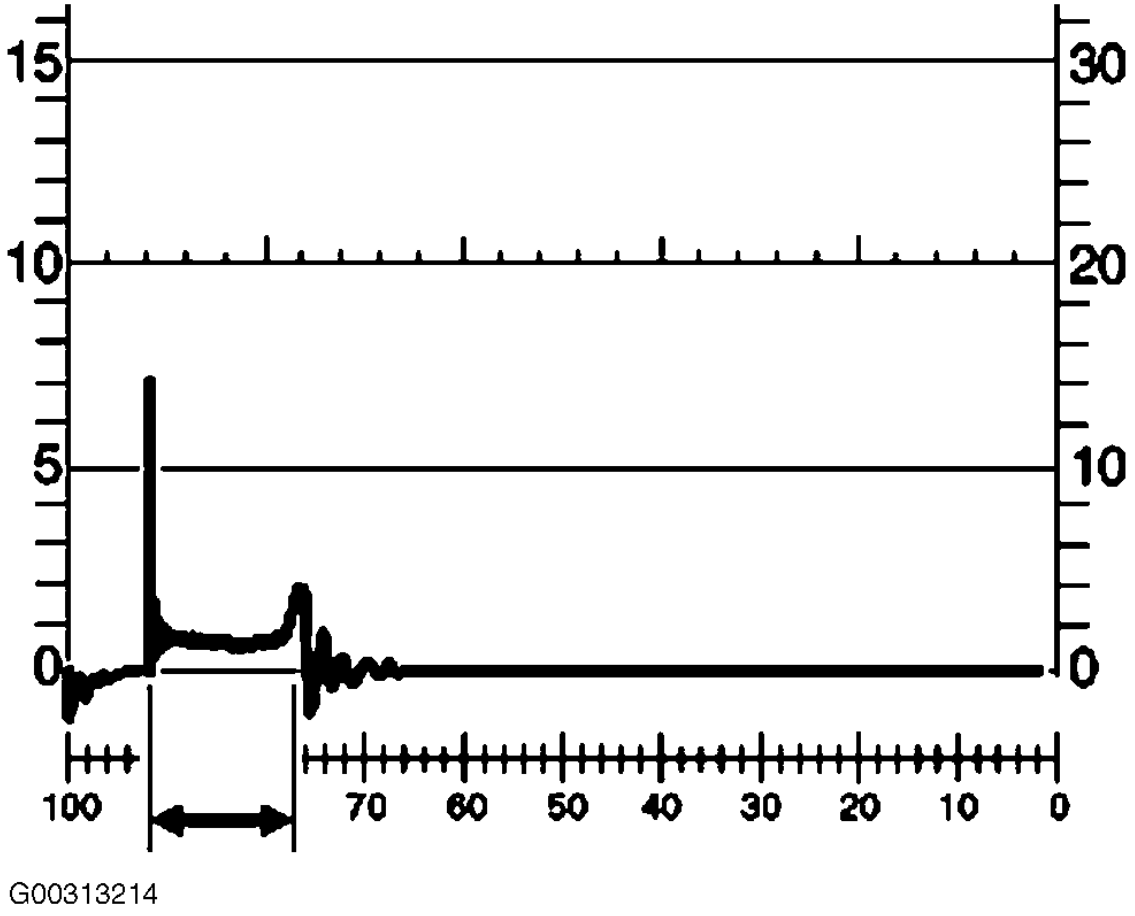


Fig. 17: Evaluation Of Sparking Period - Normal Combustion
Courtesy of BMW OF NORTH AMERICA, INC.

Long combustion period:

- Small electrode gap.

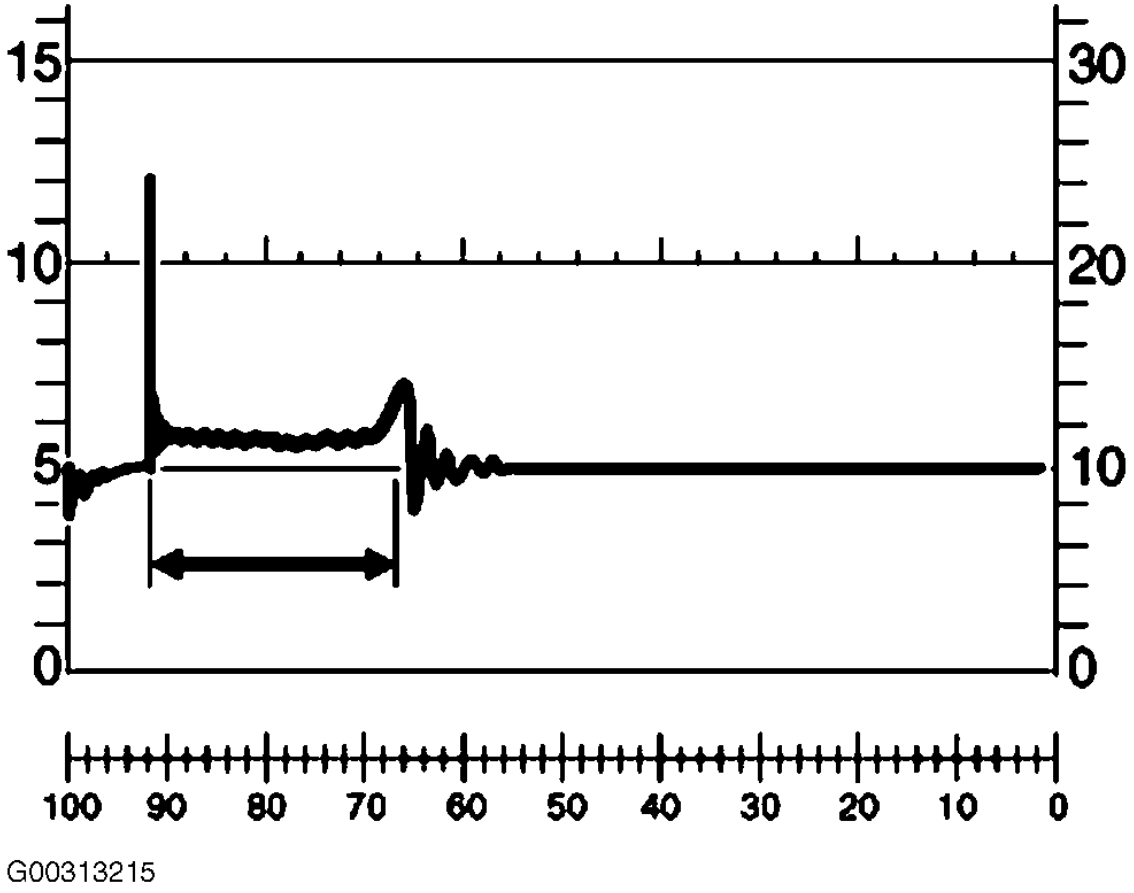


Fig. 18: Evaluation Of Sparking Period - Long Combustion Period
Courtesy of BMW OF NORTH AMERICA, INC.

Short sparking period:

- Large electrode gap.

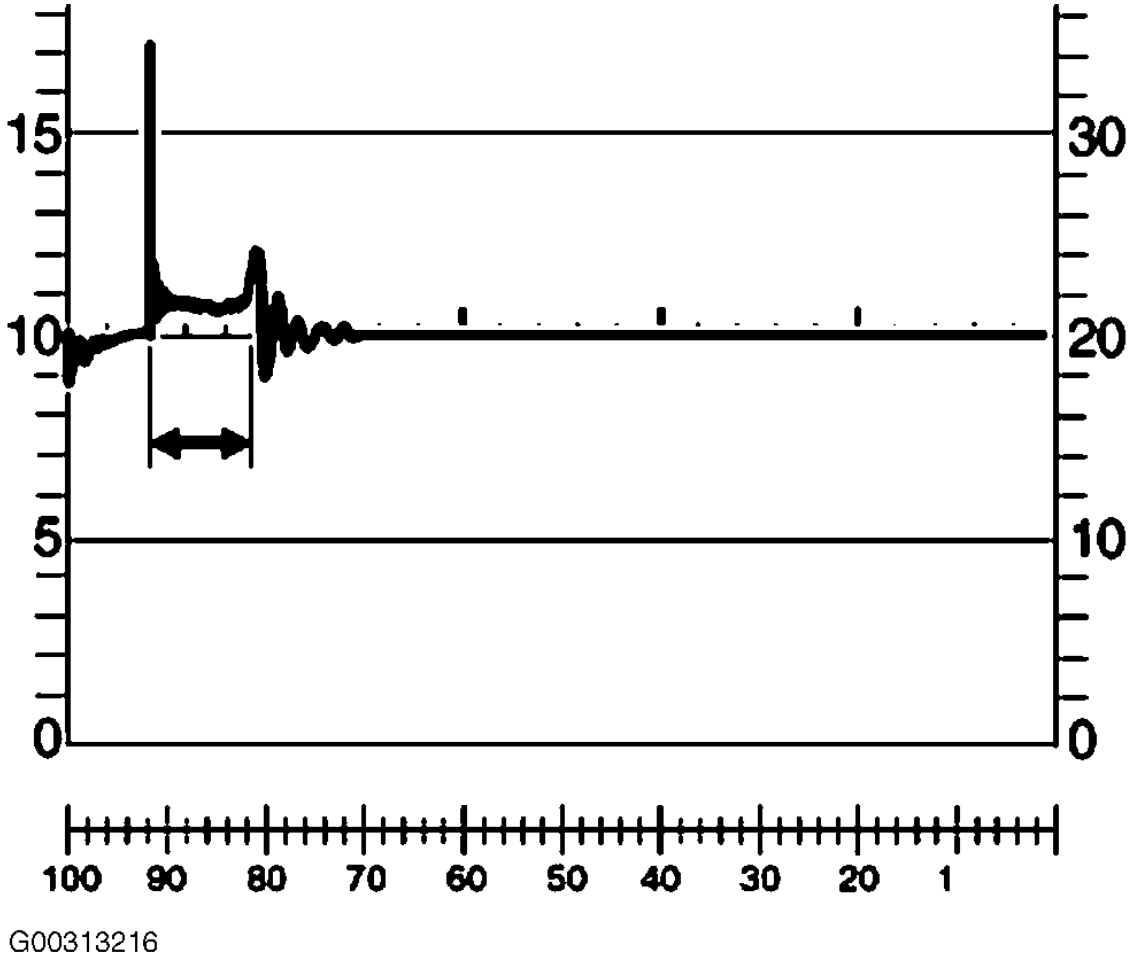


Fig. 19: Evaluation Of Sparking Period - Short Sparking Period
Courtesy of BMW OF NORTH AMERICA, INC.

12 13 ... IGNITION COIL FAULTS

Evaluation of ignition voltage peaks and attenuation process at idling speed:

1. Beginning of attenuation processes with normal peaks upwards and downwards.
2. Beginning of attenuation processes strongly shortened Ignition coil is defective.
3. Absence of initial downwards attenuation Ignition coil is defective.

NOTE: Higher ignition voltage peak is not always available.

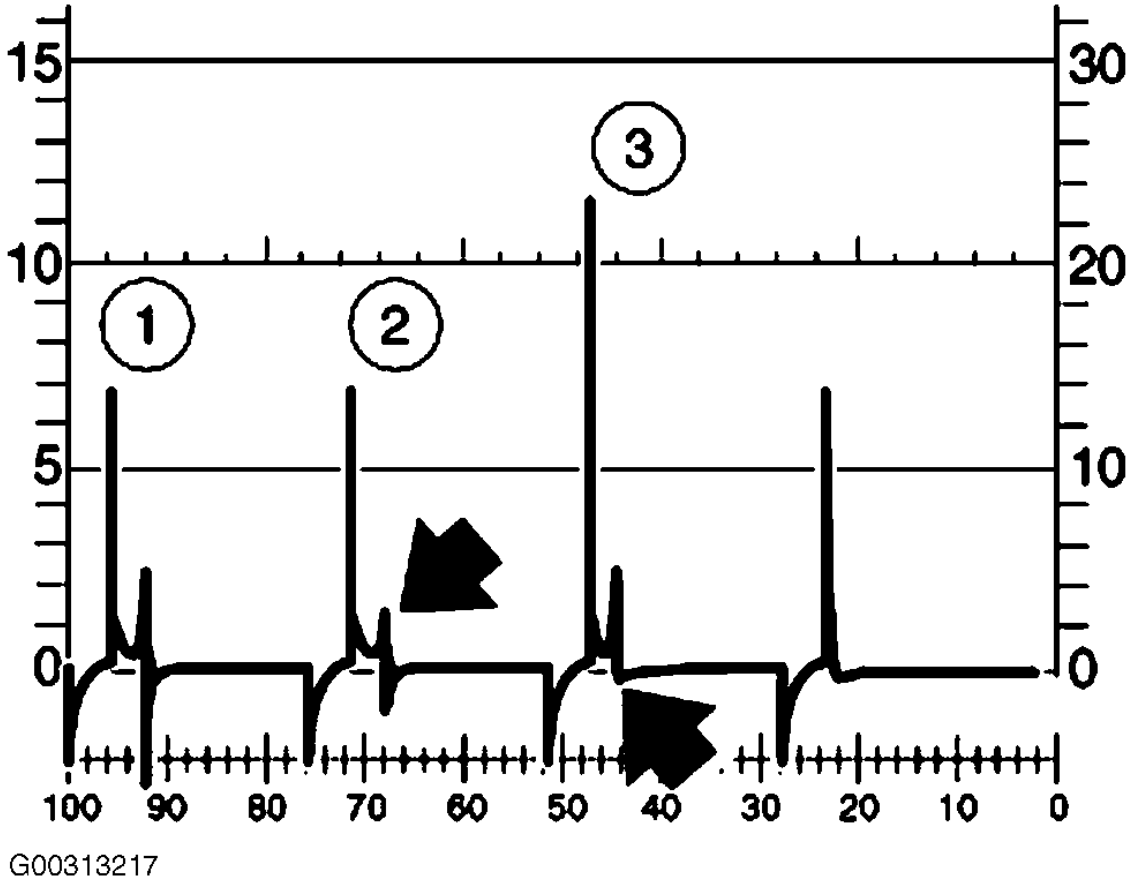


Fig. 20: Evaluation Of Ignition Voltage Peaks & Attenuation Process
Courtesy of BMW OF NORTH AMERICA, INC.

Evaluation of sparking voltage line at idling speed:

1. Normal combustion period.
2. Normal attenuations to sparking voltage line Ignition coil is OK.

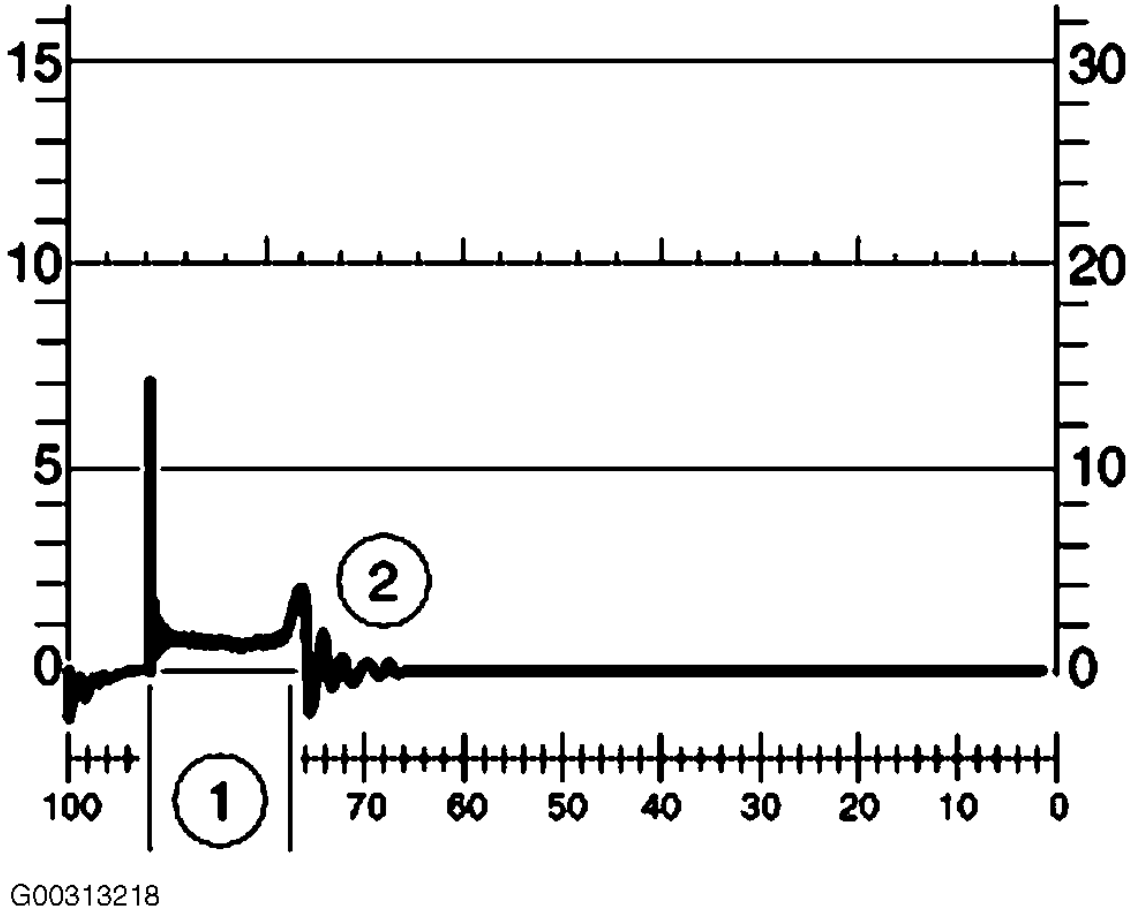


Fig. 21: Evaluation Of Sparking Voltage - Normal Combustion Period
Courtesy of BMW OF NORTH AMERICA, INC.

1. Shorter sparking period.
2. Attenuation to sparking voltage line is only slight. Ignition coil is defective.

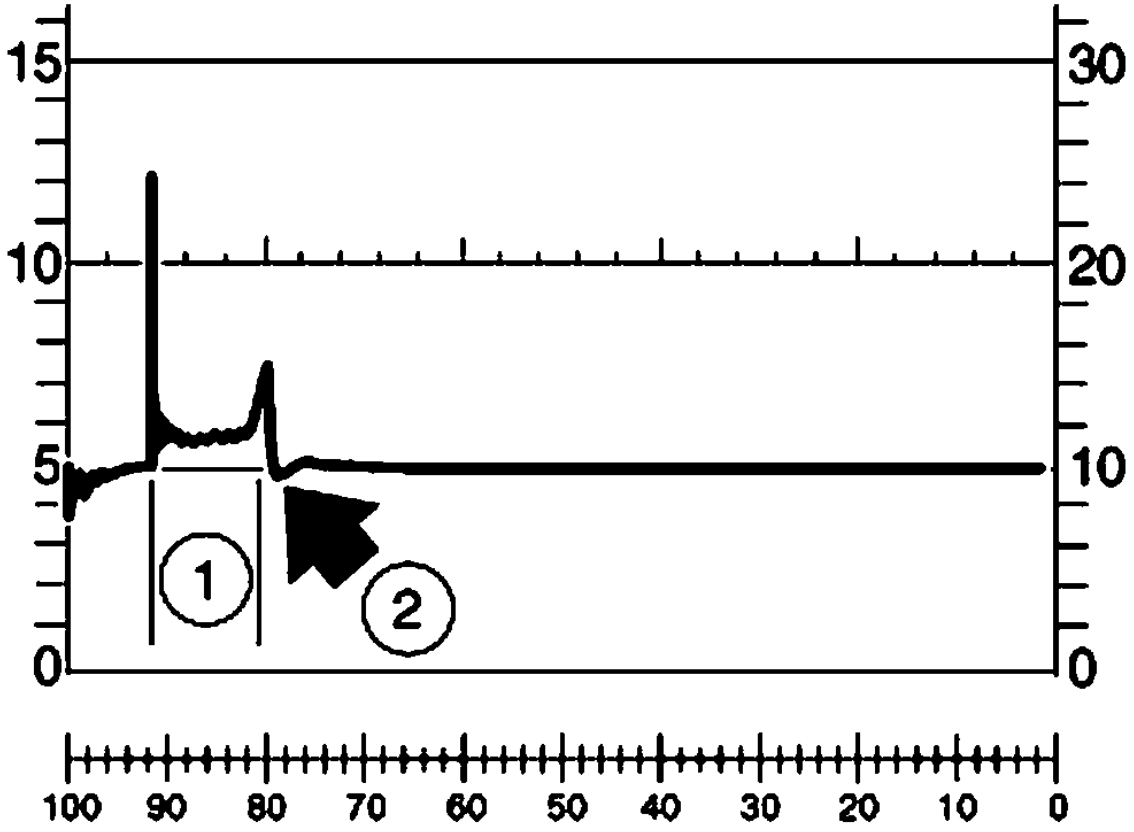


Fig. 22: Evaluation Of Sparking Voltage - Shorter Period
Courtesy of BMW OF NORTH AMERICA, INC.

1. Much shorter sparking period.
2. Attenuations to sparking voltage line absent. Ignition coil is defective.

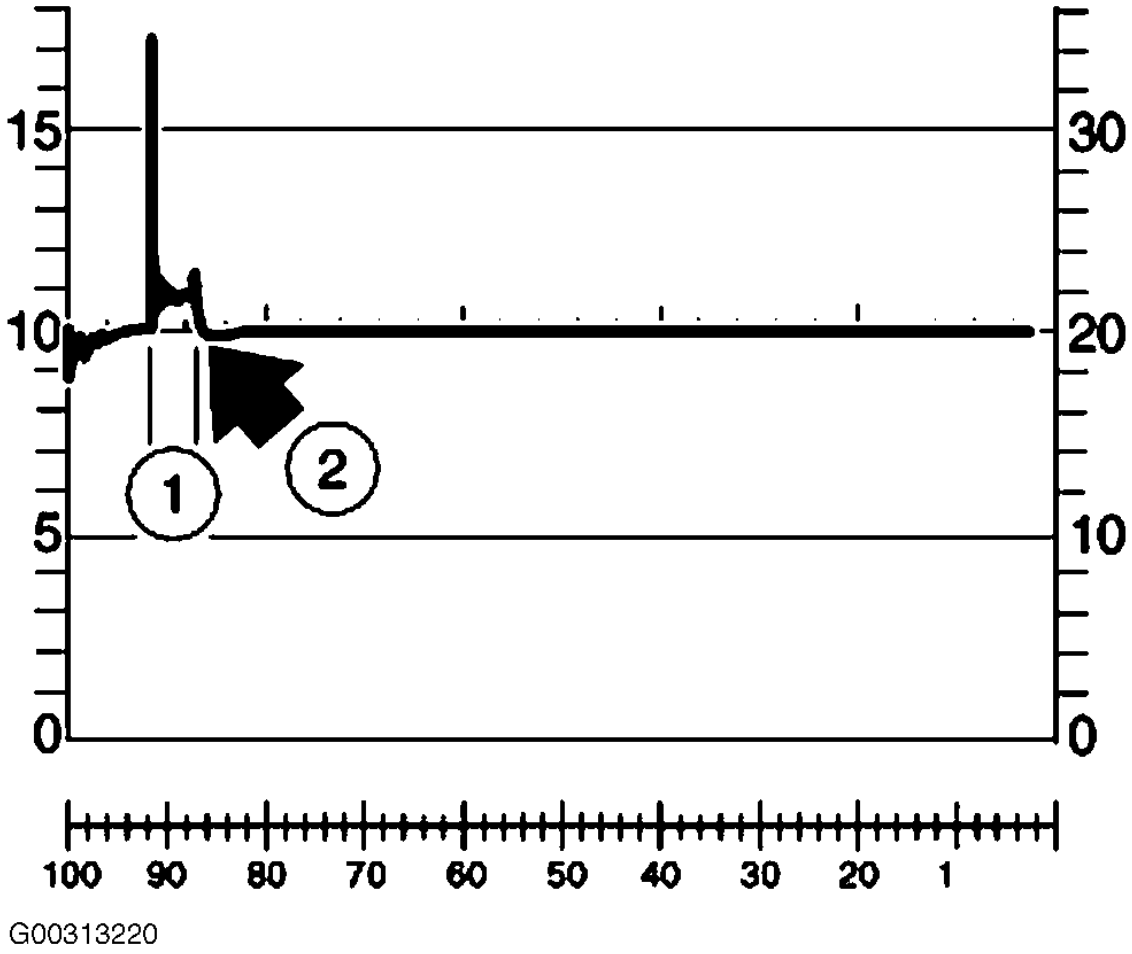


Fig. 23: Evaluation Of Sparking Voltage - Much Shorter Period
Courtesy of BMW OF NORTH AMERICA, INC.

No sparking voltage line. Ignition coil is defective.

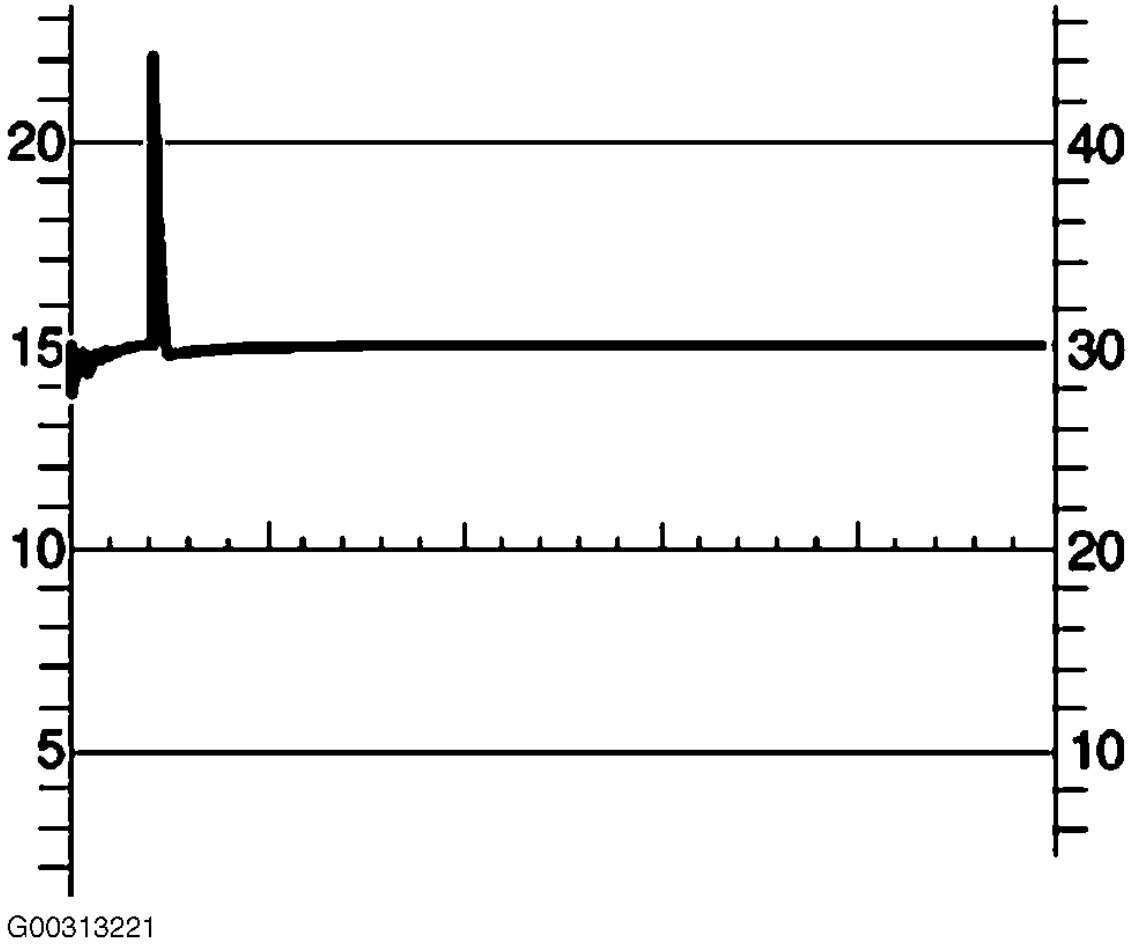


Fig. 24: Evaluation Of Sparking Voltage - No Sparking Voltage Line
Courtesy of BMW OF NORTH AMERICA, INC.

Evaluation of combustion voltage line at raised engine speeds approx. 1500 Min (1):

1. Normal combustion period.
2. Normal attenuations to sparking voltage line Ignition coil is OK.

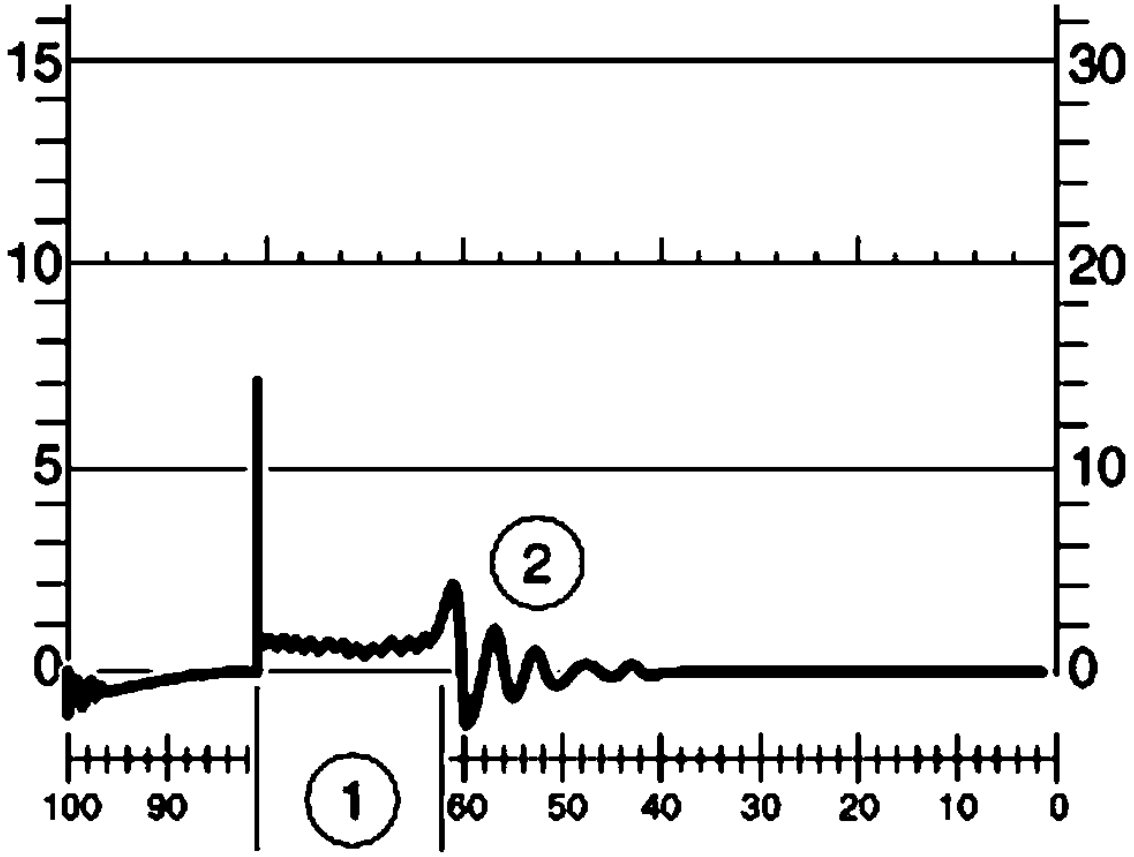


Fig. 25: Evaluation Of Combustion Voltage Line - Normal Combustion Period
Courtesy of BMW OF NORTH AMERICA, INC.

1. Shorter sparking period.
2. Attenuation to sparking voltage line is only slight. Ignition coil is defective.

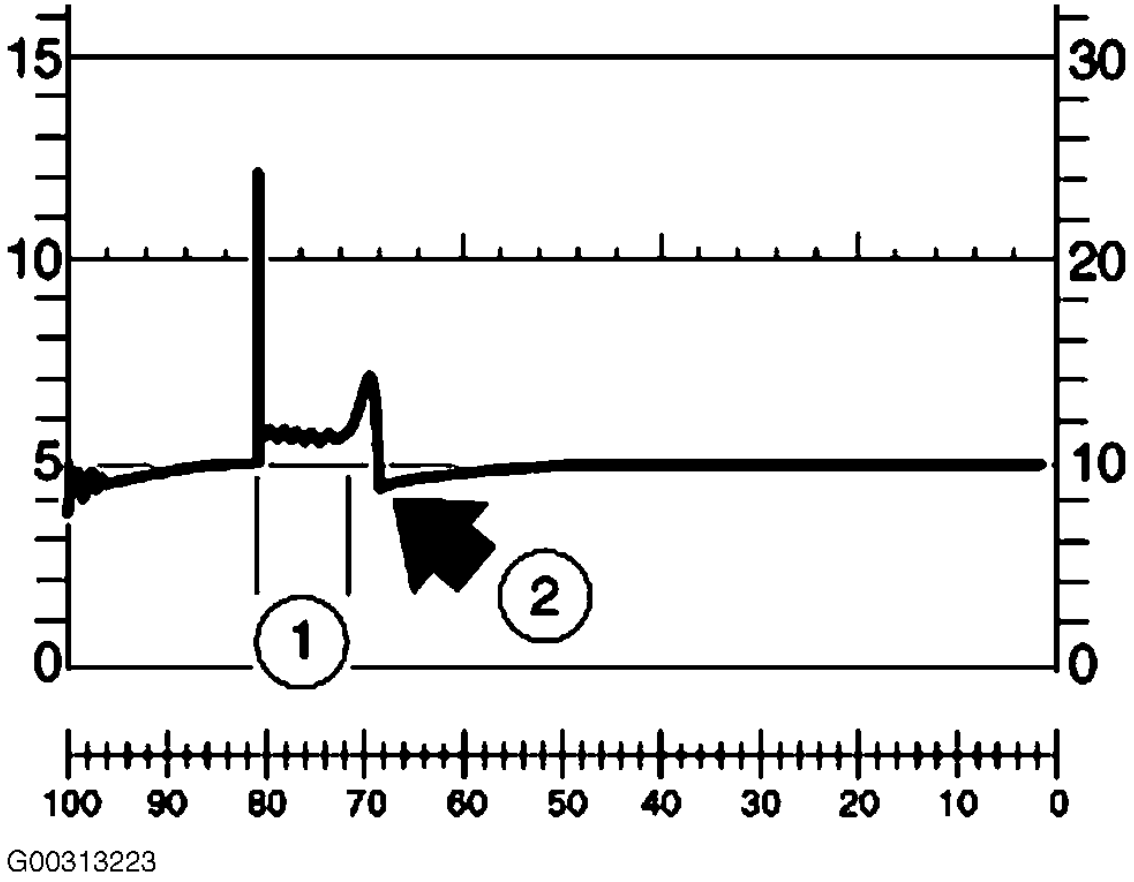


Fig. 26: Evaluation Of Combustion Voltage Line - Shorter Sparking Period
Courtesy of BMW OF NORTH AMERICA, INC.

1. Normal combustion period.
2. Attenuations to sparking voltage line absent. Ignition coil is defective.

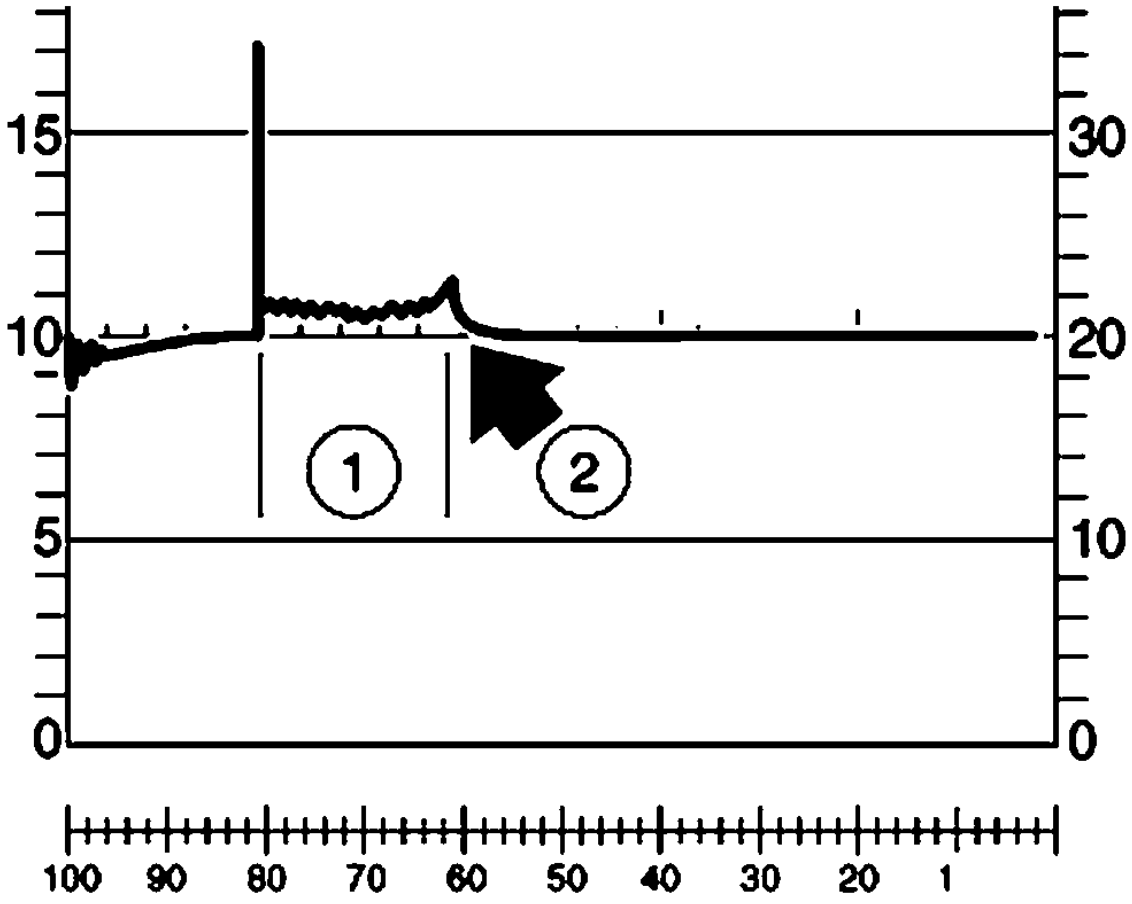


Fig. 27: Evaluation Of Combustion Voltage Line - Normal Combustion Period
Courtesy of BMW OF NORTH AMERICA, INC.

12 13 ... FURTHER FAULT PATTERNS WITH EVALUATION

Evaluation of sparking period and ignition voltage peaks at idling speed:

1. Normal combustion period.
2. Normal ignition voltage peak. Ignition system is OK.

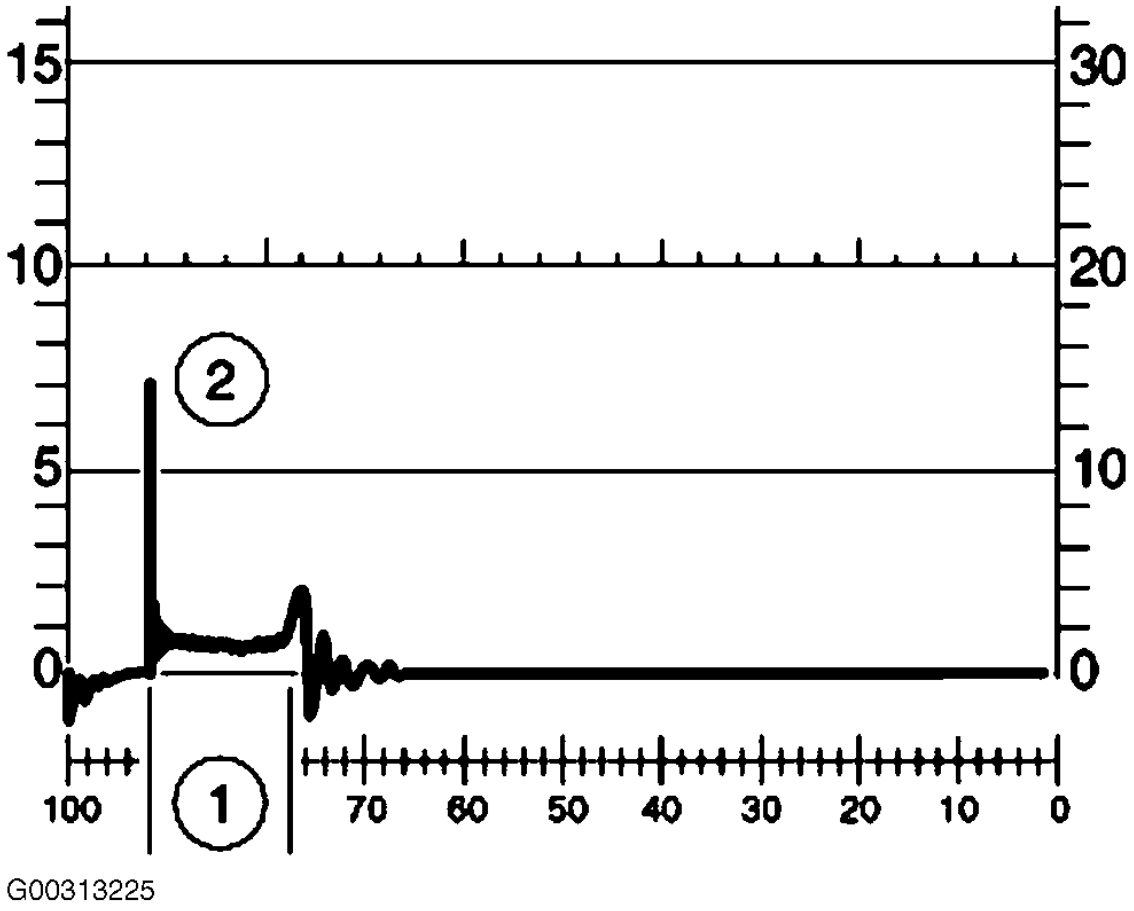


Fig. 28: Evaluation Of Sparking Period & Ignition Voltage Peaks At Idle Speed
Courtesy of BMW OF NORTH AMERICA, INC.

Long sparking period (1) with low ignition voltage peak (2). Indicates low compression.

Fluctuating sparking period: Indicates contamination on spark plug (shunt).

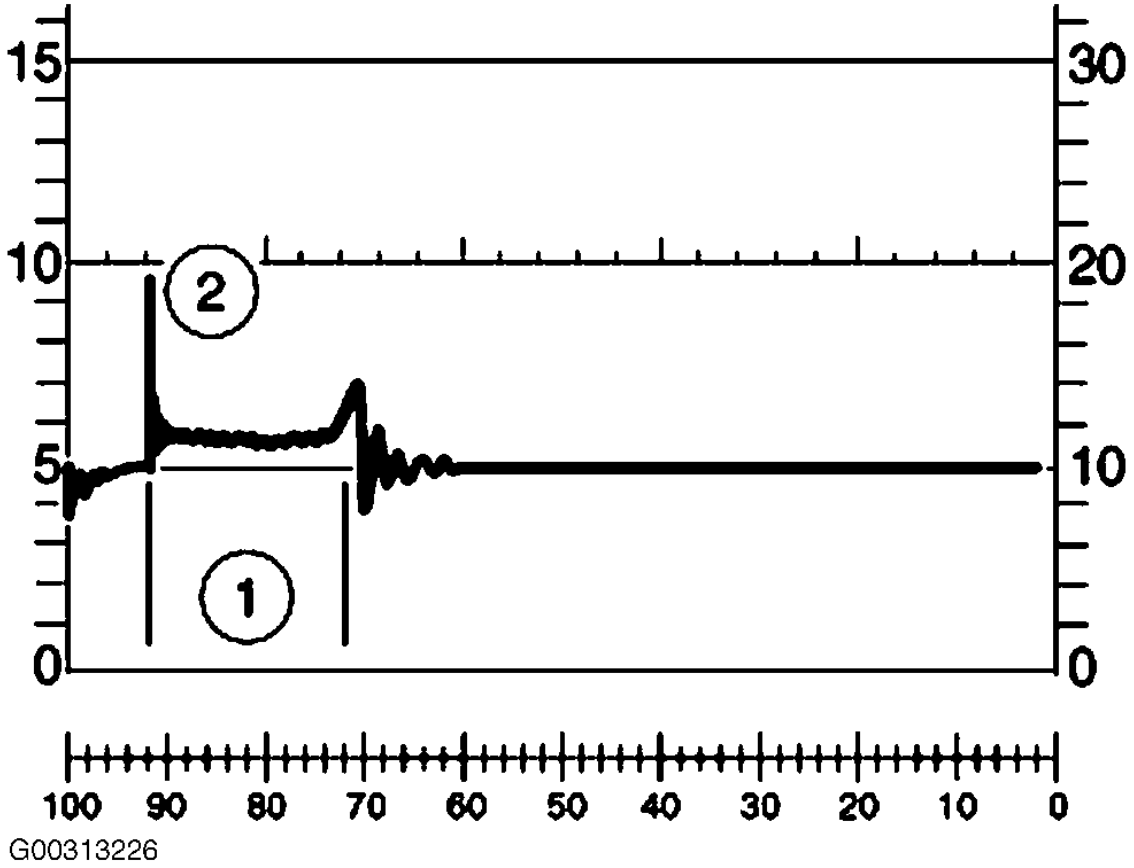


Fig. 29: Long Sparking Period With Low Ignition Voltage Peak
Courtesy of BMW OF NORTH AMERICA, INC.

Short sparking period (1) with high ignition voltage peak. Constant but short sparking period: Indicates defective ignition lead.

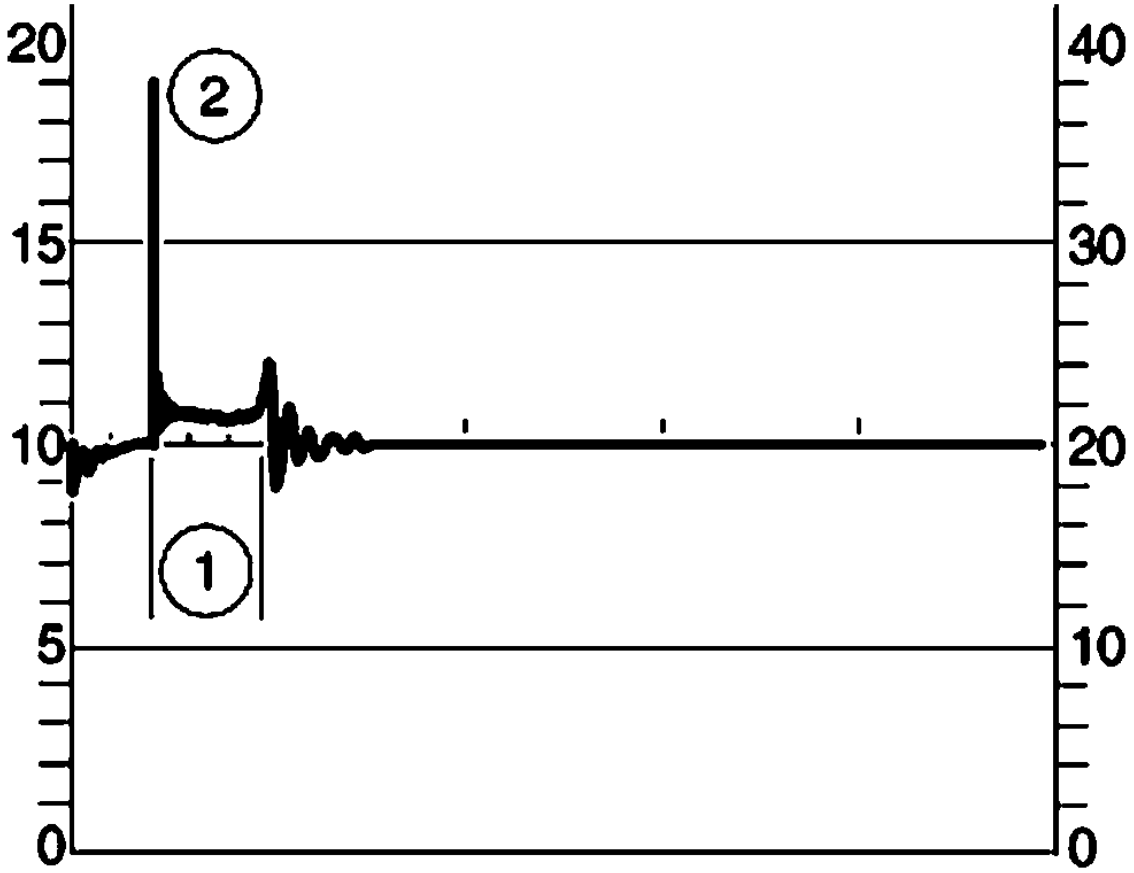


Fig. 30: Short Sparking Period With High Ignition Voltage Peak
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The sparking-voltage line could sometimes be missing completely and the ignition voltage peak could rise very high.

IGNITION VOLTAGE TOO HIGH

Electrode Gap	Large
Compression	High
Fuel Air Mixture	Lean
Electrode Temperature	Low
Electrode Condition	Burnt
Ignition Lead	Interrupted

IGNITION VOLTAGE TOO LOW

Electrode Gap	Small
Compression	Low
Fuel Air Mixture	Correct
Electrode Temperature	High
Electrode Condition	New

12 13 ... ADDITIONAL FAULT NOTES FOR TROUBLESHOOTING

Use the primary voltage test adapter, Special Tool 12 7 020 to troubleshoot the primary side of a separate ignition coil.

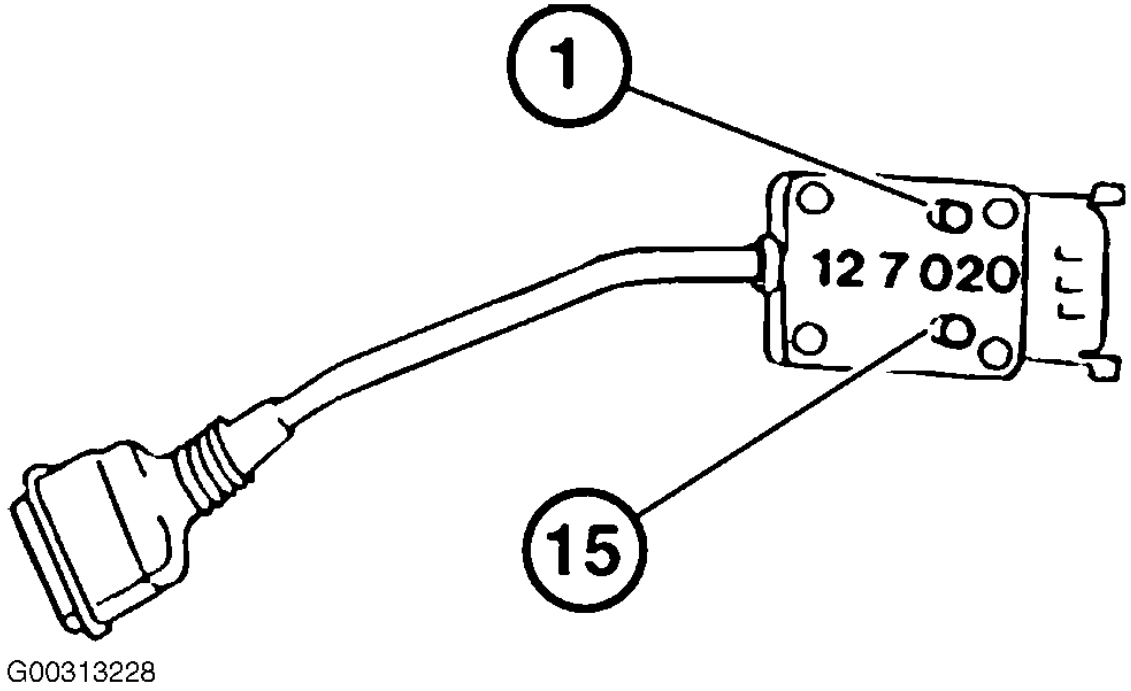


Fig. 31: Identifying Primary Voltage Tester
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: If terminal 1 signal is not present on pin 1 in the diagnosis connector, the external trigger signal for the BMW Service Tester can be prepared with the help of Special Tool 12 7 020.

Connect BMW SERVICE TESTER.

Select Engine Test Step 05.

Enter number of cylinders.

Connect universal adapter to tester.

Connect brown clip to vehicle earth.

Connect black clip to terminal 1 of Special Tool 12 7 020.

NOTE: If trigger signal is missing from diagnosis box on 6-cylinder engine, preselect two cylinder settings on BMW SERVICE TESTER.

The red inductive clip is not used as only the cylinder is being tested. For this reason, the engine speed display will be too low by factor 4.

Connect Special Tool 12 7 020 to the ignition coil being tested and the vehicle wiring harness.

Produce a stationary signal on the oscilloscope by pressing key R.

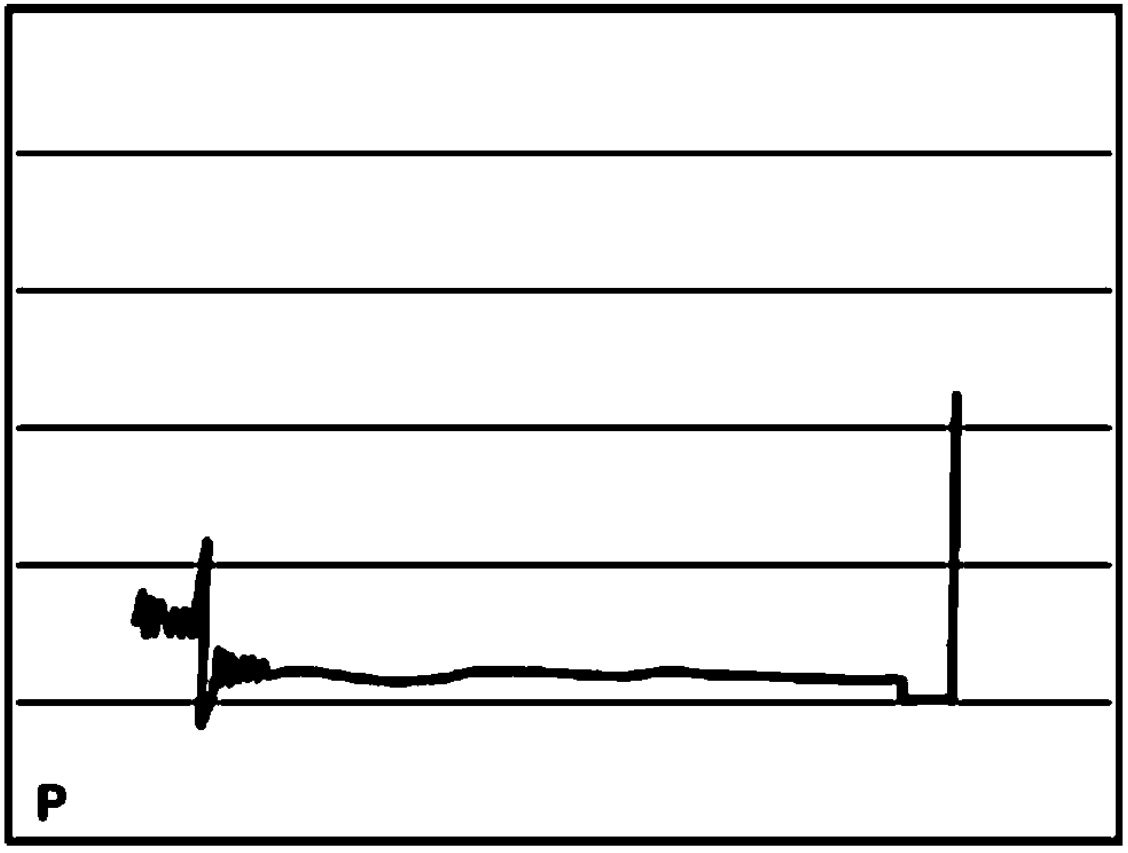


Fig. 32: Identifying Spark Line
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The sparking voltage line on the oscilloscope will be very nervous, as the fuel/air mixture swirl of a 4-valve engine will be greater than that of a 2-valve engine.

12 13 009 CHECKING ROD-TYPE IGNITION COILS (M54, M56, N40, N42, N45, N46, N52, N62, N73)

NOTE: For Special Tool identification, see SPECIAL TOOLS - Z3 .

Special Tools Required:

- 12 1 301
- 12 7 050

Necessary Preliminary Tasks:

- Read out fault memory in DME (Digital Motor Electronics)
- Remove M54/56 ignition coil cover.

Unlock plug fastener (1) of ignition coil.

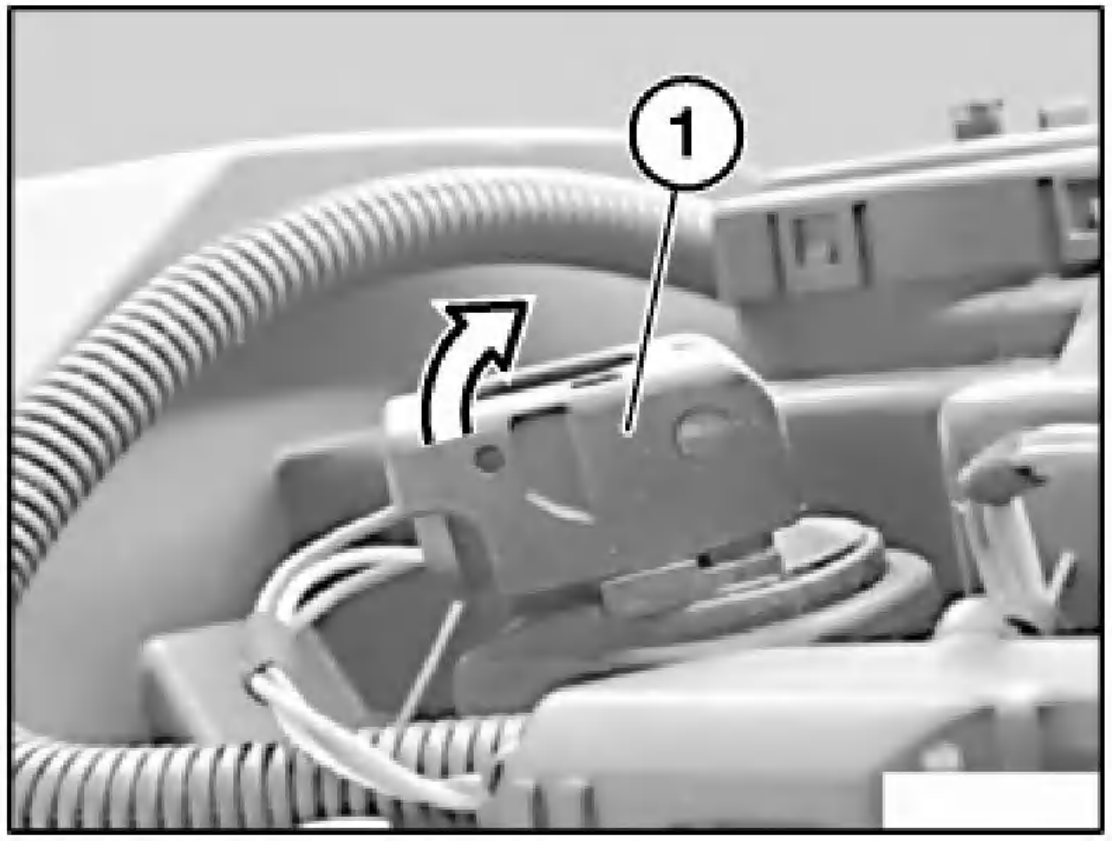


Fig. 33: Unlocking Plug Fastener Of Ignition Coil
Courtesy of BMW OF NORTH AMERICA, INC.

Detach plug (1) in direction of arrow.

Pull out ignition coil (2) towards top.

NOTE: Procedure applies to all rod-type ignition coils.

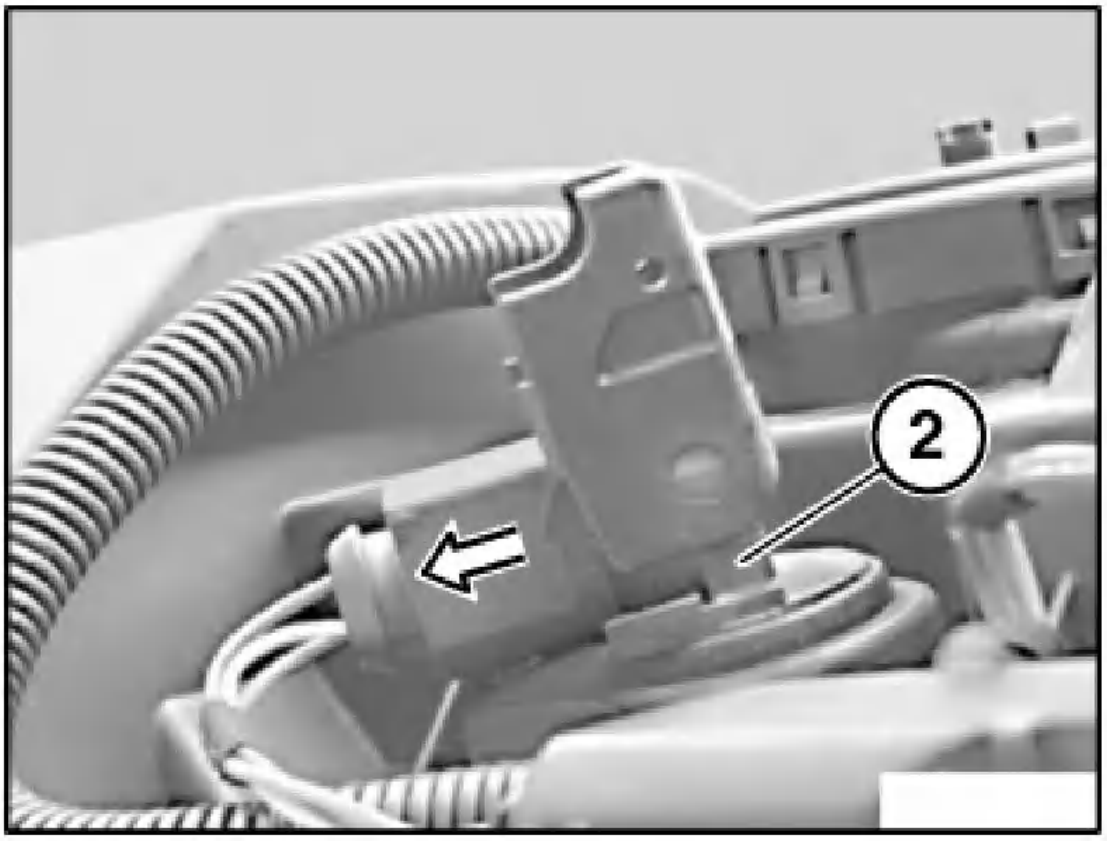


Fig. 34: Detaching Plug In Direction Of Arrow
Courtesy of BMW OF NORTH AMERICA, INC.

Install special tool 12 7 050.

Installation:

Special tool 12 7 050 is attached between spark plug and rod-type ignition coil.

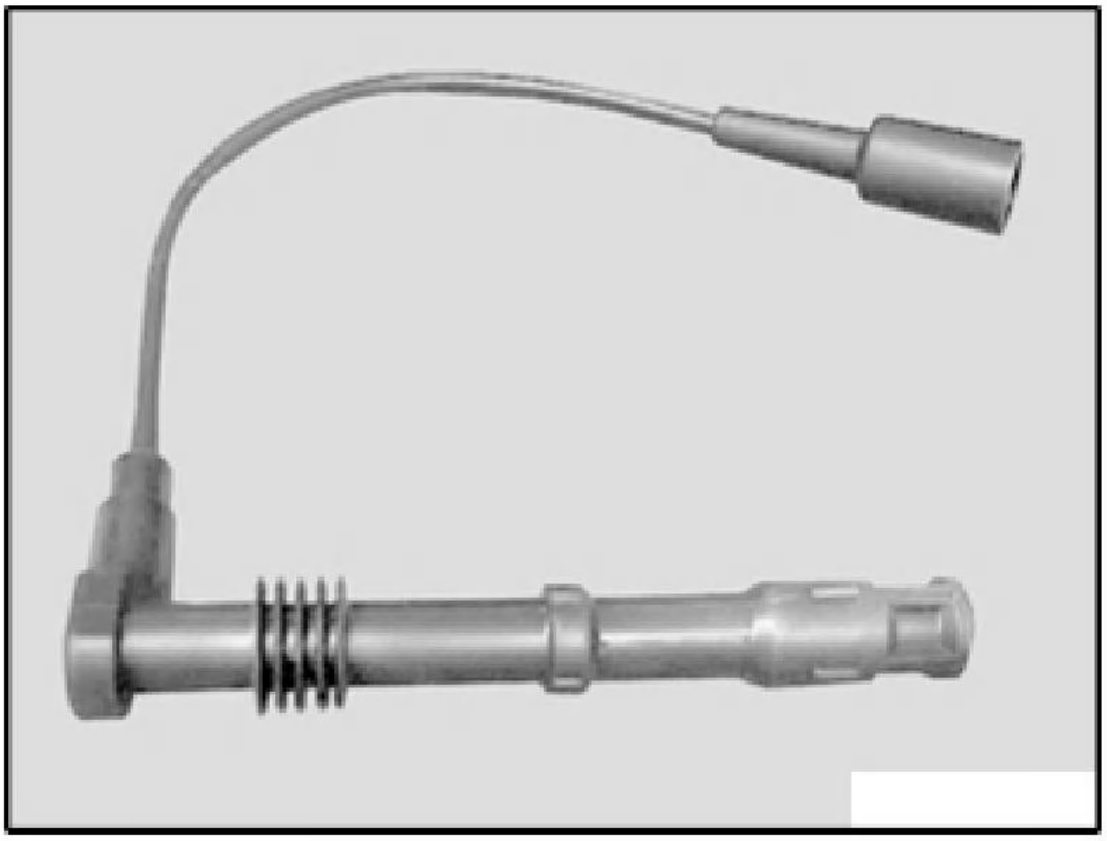


Fig. 35: Attaching Between Spark Plug And Rod-Type Ignition Coil
Courtesy of BMW OF NORTH AMERICA, INC.

Secondary Measurement:

Connect KV clip-on probe (1) of DIS Tester to special tool 12 7 050.

Procedure on DIS Tester:

- Select < Measurement>.
- Select < Preset measurements.
- Select < Secondary ignition signal>.
- Connect < TD cable to diagnostic head>.
- Select < static ignition distribution:".
- Select < Number of cylinders>.

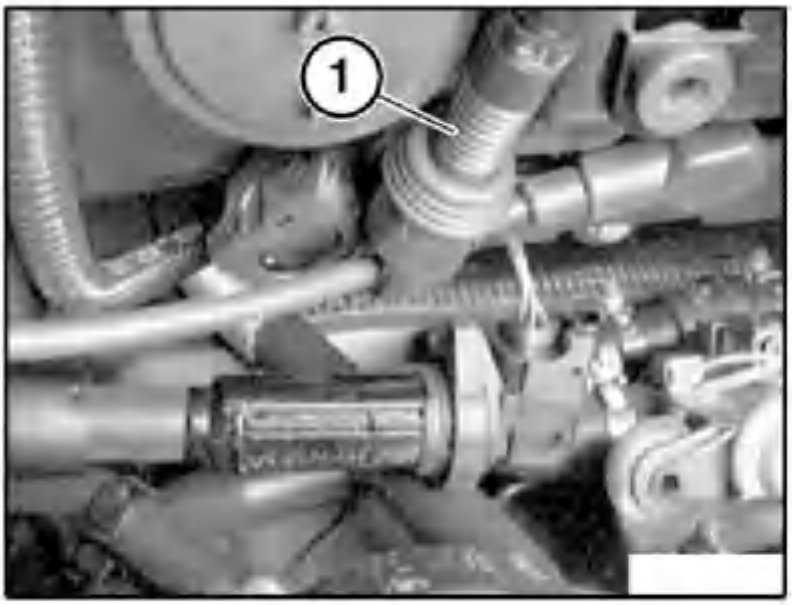


Fig. 36: Identifying Connecting KV Clip-On Probe
Courtesy of BMW OF NORTH AMERICA, INC.

For subsequent procedure, follow DIS instructions.

NOTE: Illustration shows: KV clip-on probe (1) US version.

Primary Measurement:

Connect 26-pin pin box with special tool 12 13 01 to connector (1) DME module 5.

Procedure on DIS Tester:

- Select < Measurement>.
- Select < Preset measurements>.
- Select < Ignition signal term. 1>.

For subsequent procedure, follow DIS instructions.

NOTE: Pin assignment ace. to connection scheme.

Illustration N42.

Important!

Ignition signal is a multiple spark ignition.

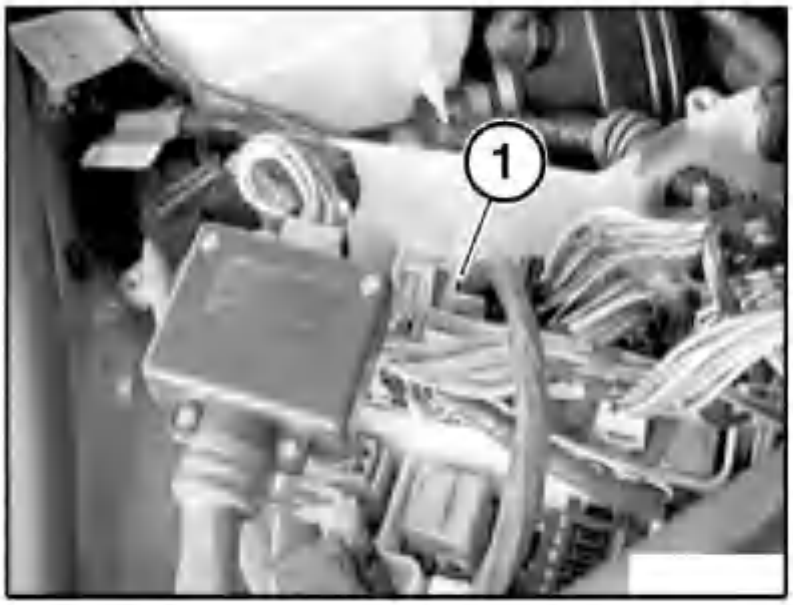


Fig. 37: Identifying Ignition Signal Is A Multiple Spark Ignition
Courtesy of BMW OF NORTH AMERICA, INC.

Illustration of multiple spark ignition:

1. Start of ignition peak.
2. Level of ignition voltage.
3. Level of sparking voltage.
4. Spark duration.
5. Sparking voltage curve.
6. Start of decay process.
7. Decay process.

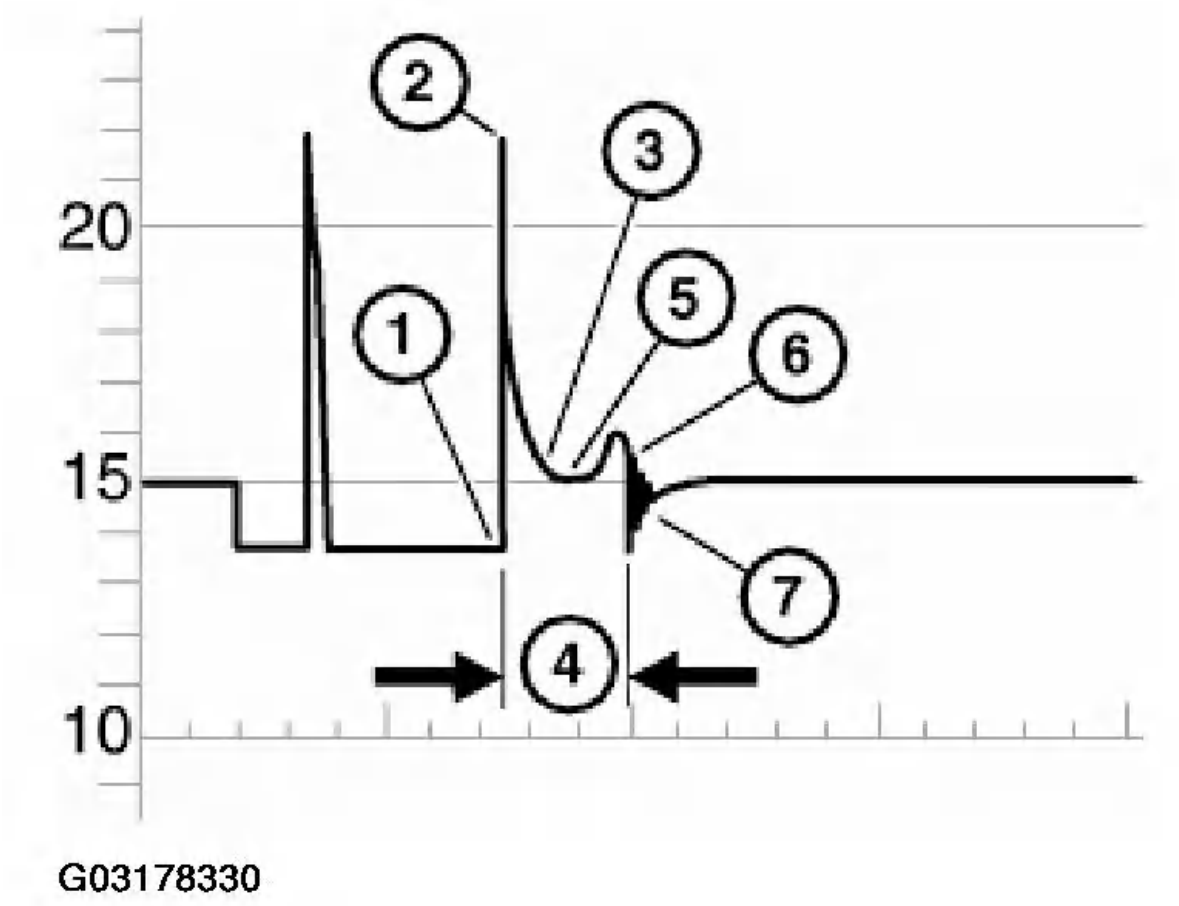


Fig. 38: Multiple Spark Ignition Graph
Courtesy of BMW OF NORTH AMERICA, INC.

M54 / M56 / N40 / N42 / N45 / N46 / N62 / N73:

The following ignition oscillogram applies to engines with multiple spark ignition from a production date of April 2001:

Depending on engine temperature (approx. -20Â° to 100Â°) and engine speed (< 2000 rpm.), some ignition voltage peaks (approx. 1-5 ignition peaks) can occur before the typical ignition voltage characteristic.

The additional ignition peaks play no role in diagnosis.

The last ignition peak (1) on the oscillogram is decisive.

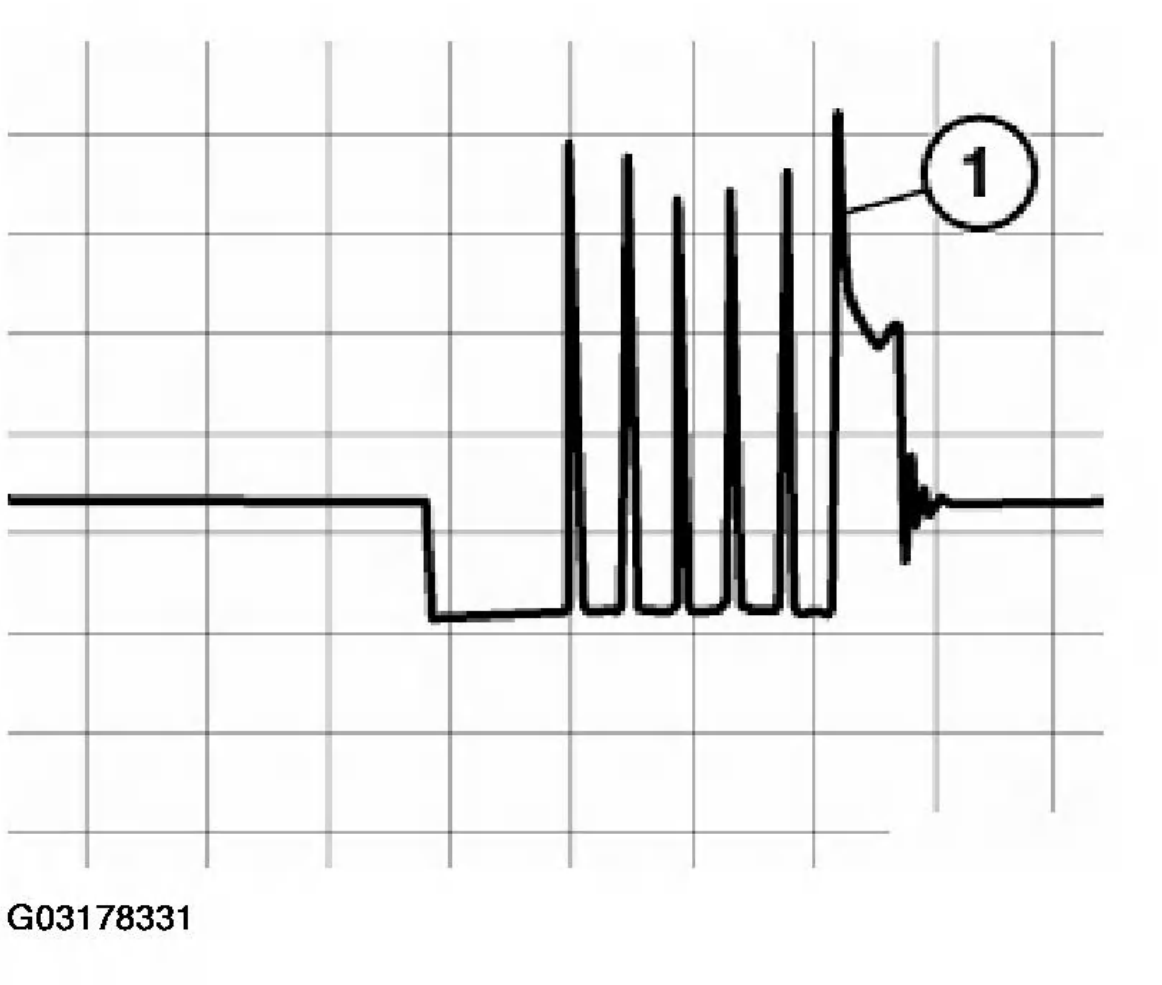


Fig. 39: Multiple Spark Ignition Oscillogram Graph
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The display of the ignition voltage peak is approx. 20-25 % lower than the real value. It is not the height of the ignition voltage peaks but rather the uniformity of all the cylinders that is important. Differences of 3000 to 4000 volts are permitted.

12 13 511 REPLACING IGNITION COIL (M52, M52TU, S52, S50US, M54)

Switch off ignition.

Remove cover for ignition coils.

Version With Single-Spark Ignition Coils:

Unlock connector of ignition coils.

Disconnect connector from ignition coils.

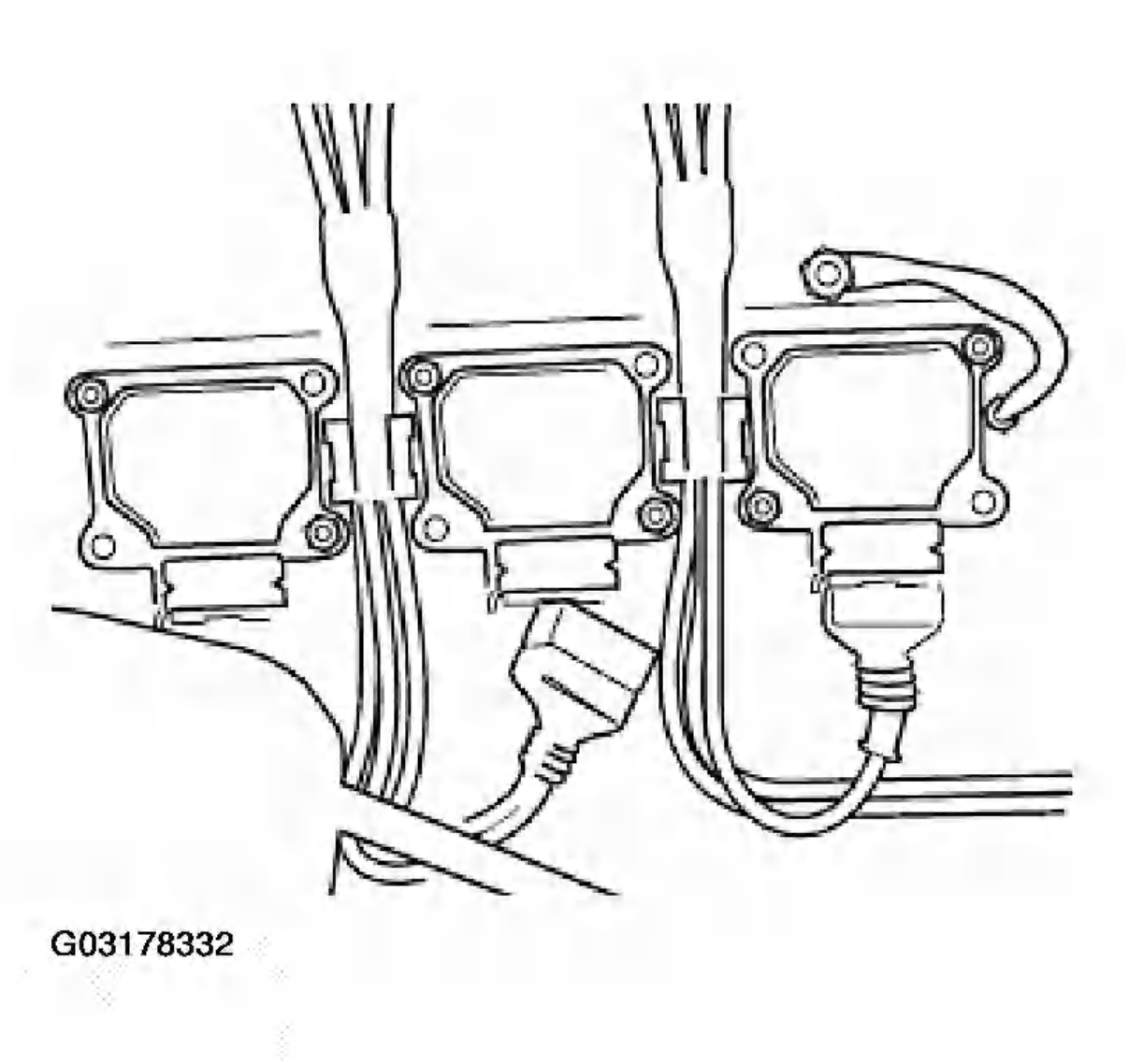


Fig. 40: Disconnecting Connector From Ignition Coils
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten screws on ignition coil.

Pull out ignition coil.

Installation:

Screw down grounding strap (1) to cylinder head cover mounting and to ignition coil for cylinders 1 and 6.

On metal covers:

Screw down grounding strap of cable duct to cylinder head cover mounting between cylinders 2 and 3.

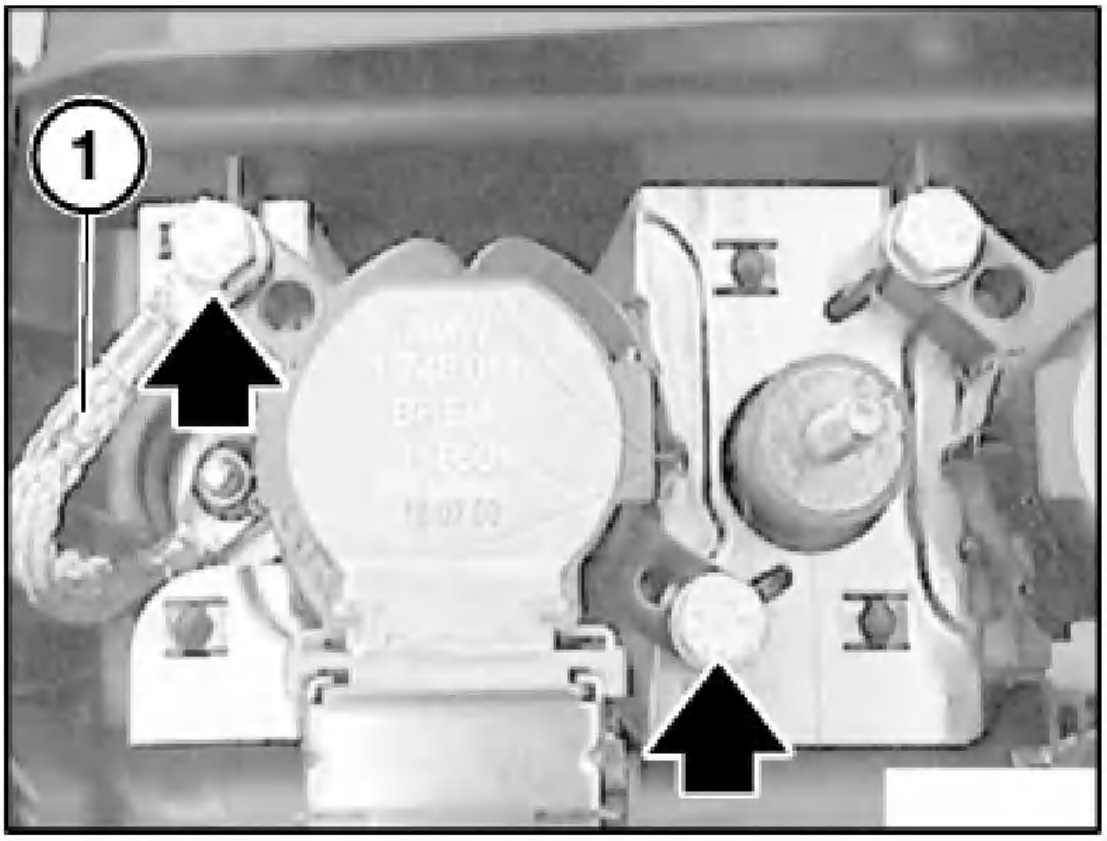


Fig. 41: Installing Down Grounding Strap To Cylinder Head Cover Mounting And To Ignition Coil
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Plastic cover M52TU, M54:

Screw down grounding strap (1) of connecting plate of ignition coils with retaining pin of ignition coil of cylinder 1.

Screw down grounding strap (2) of cable duct with connecting plate of ignition coils between cylinders 2 and 3.

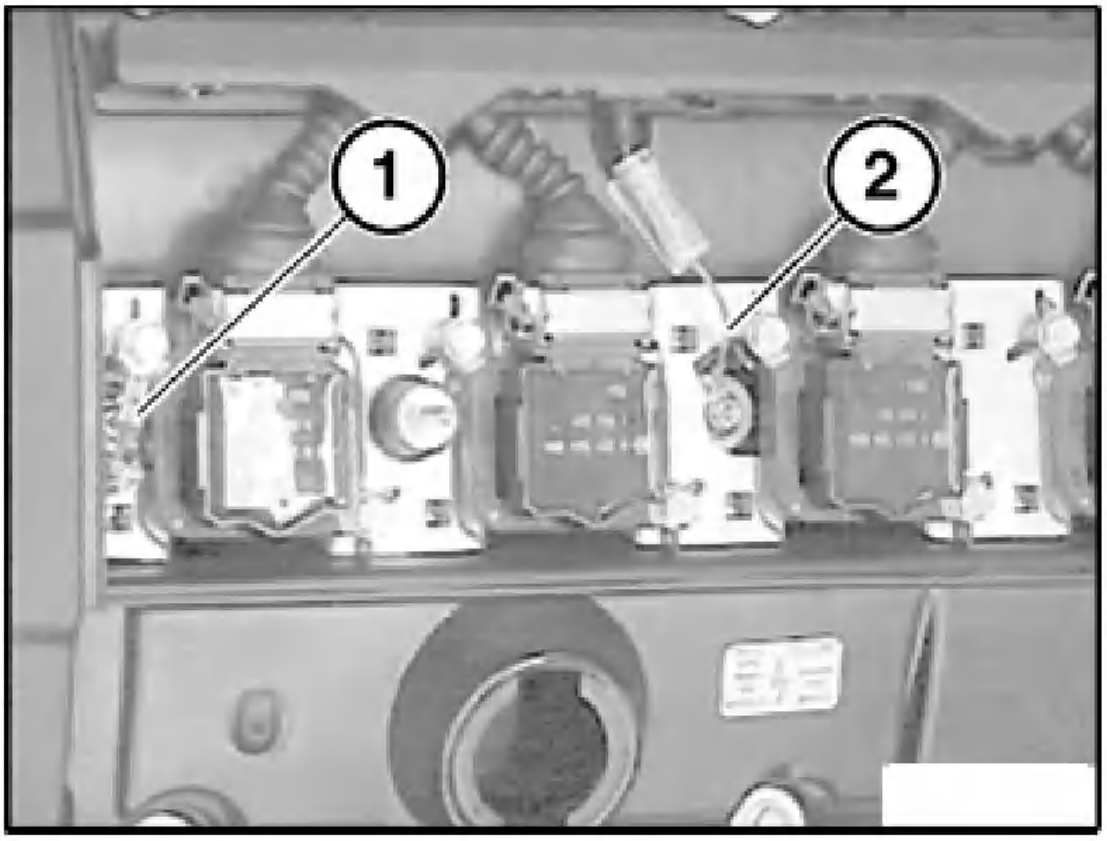


Fig. 42: Locating Grounding Straps And Connecting Plates
Courtesy of BMW OF NORTH AMERICA, INC.

Version With Rod-Type Ignition Coils:

Unlock plug retainer of ignition coil (1) and disconnect plug.

Pull ignition coil (1) up and out.

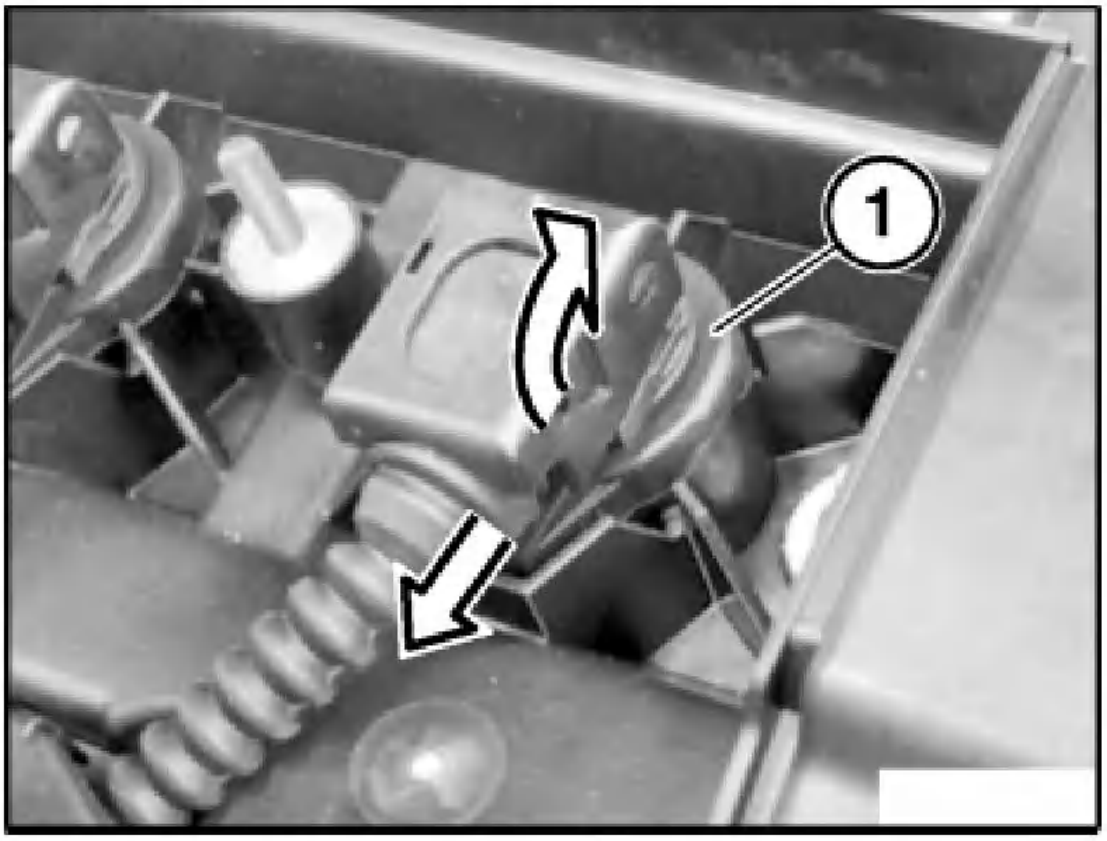


Fig. 43: Pulling Ignition Coil (1) Up And Out
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Check that rubber seal of ignition coil (1) is correctly seated.

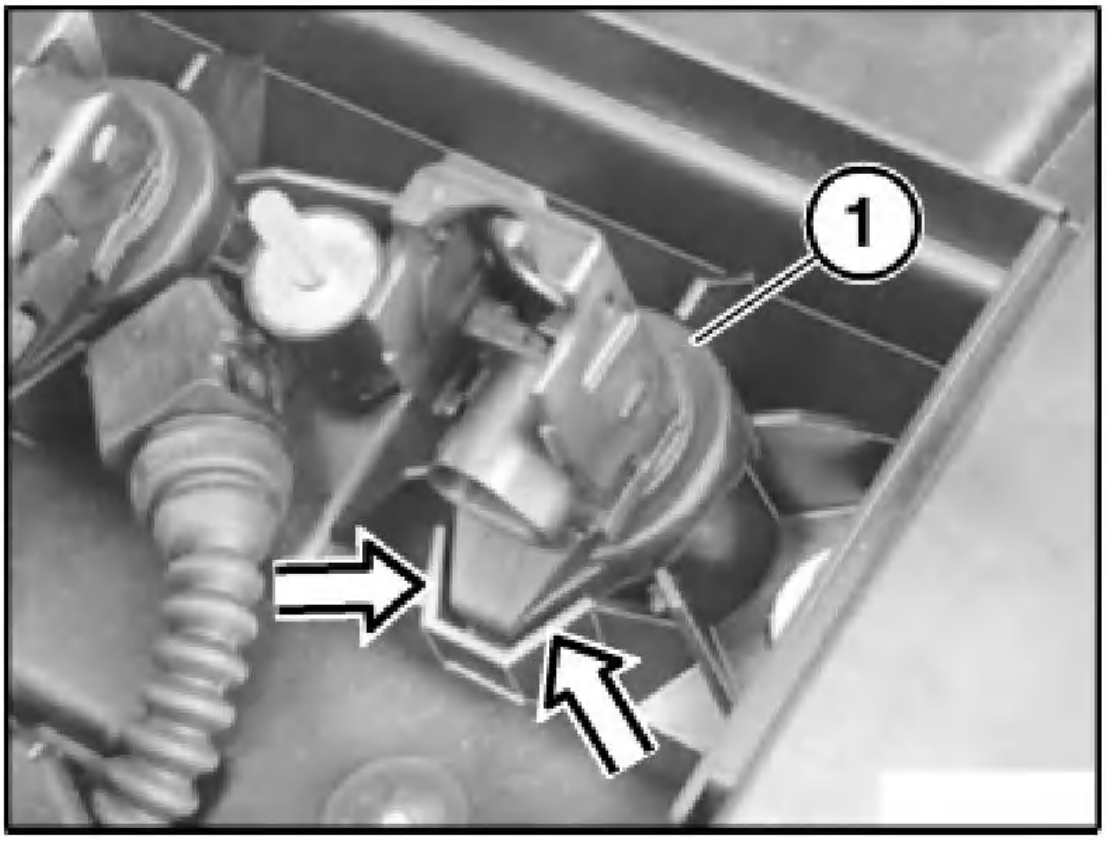


Fig. 44: Checking Rubber Seal Of Ignition Coil Is Correctly Seated
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Interrogate fault memory of DME control unit.

Check stored fault messages.

Now clear the fault memory.

12 13 520 REPLACING A SPARK PLUG CONNECTOR (M60, M62, M54)

Switch off ignition.

Remove ignition coils. Refer to 12 13 511 REPLACING IGNITION COIL (M52, M52TU, S52, S50US, M54) .

Detach ignition coil (1) from spark plug connector (2).

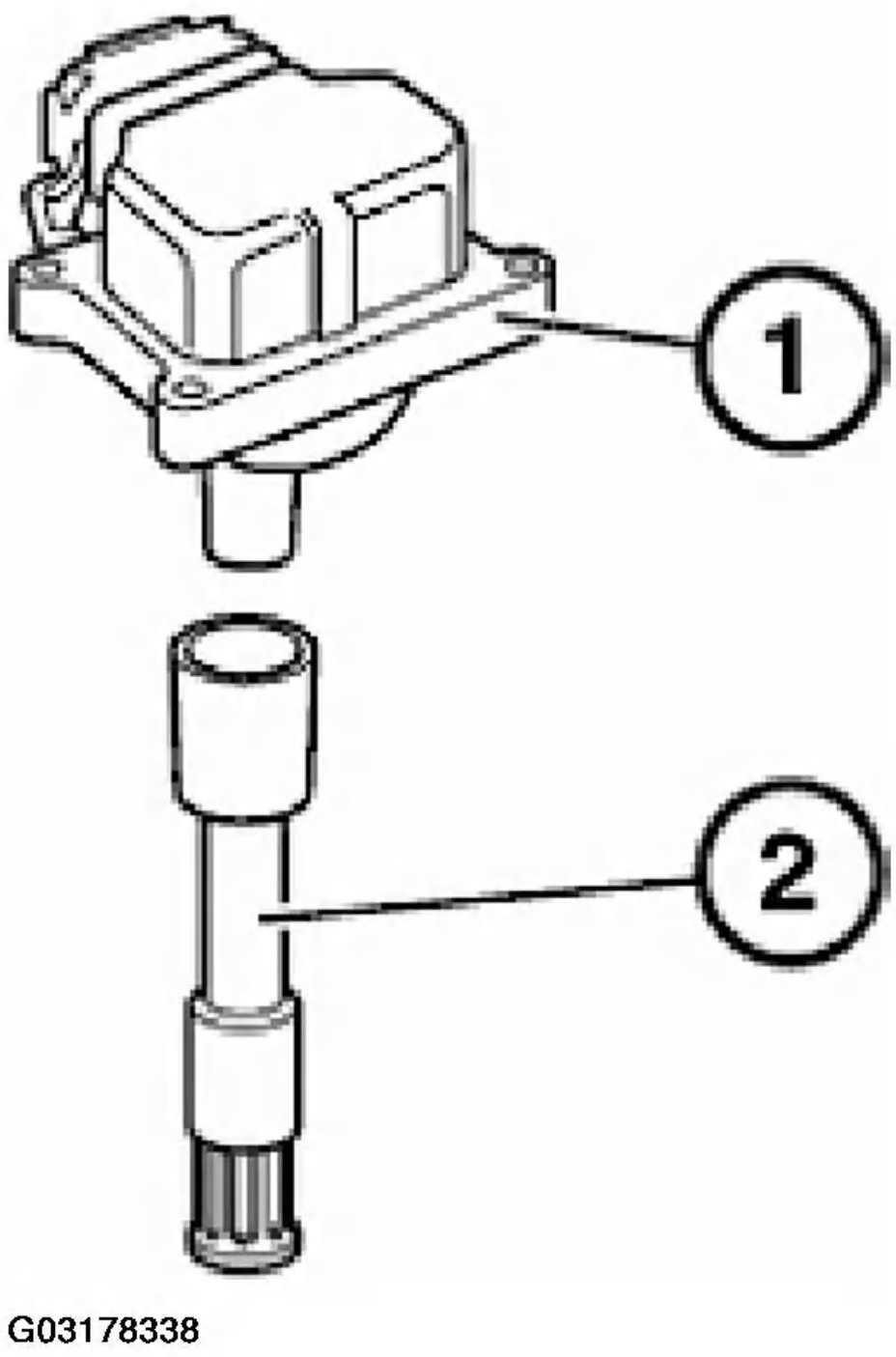


Fig. 45: Detaching Ignition Coil From Spark Plug Connector
Courtesy of BMW OF NORTH AMERICA, INC.

ELECTRONIC SWITCHING

12 14 521 REPLACING PULSE GENERATOR ON CRANKSHAFT (M54/M56)

Necessary Preliminary Tasks:

- Read out fault memory of DME control unit
- Switch off ignition

All models:

NOTE: Installation location of pulse generator for crankshaft is underneath starter motor.

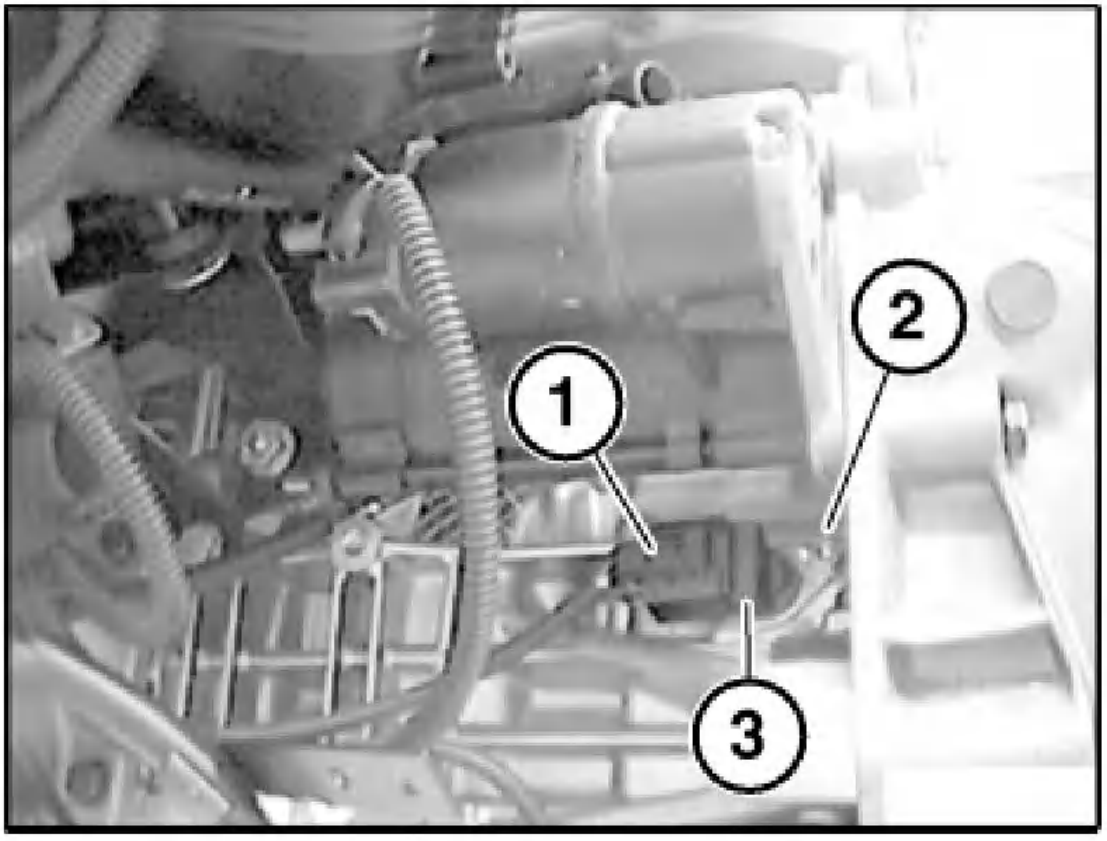
NOTE: For a better overview, this work step is shown on an engine that has been removed.

Unlock plug (1) and remove.

Unscrew bolt (2).

Remove pulse generator (3).

NOTE: Check stored fault messages.
Now clear the fault memory.



G03178339

Fig. 46: Removing Pulse Generator
Courtesy of BMW OF NORTH AMERICA, INC.

12 14 523 REPLACING PULSE GENERATOR ON INLET CAMSHAFT (M52TU / M54 / M56)

Necessary Preliminary Tasks:

- Check stored fault messages.
- Switch off ignition.

NOTE: Arrow shows installation position of pulse generator.

Remove solenoid valve (1) of VANOS adjustment unit for inlet camshaft.

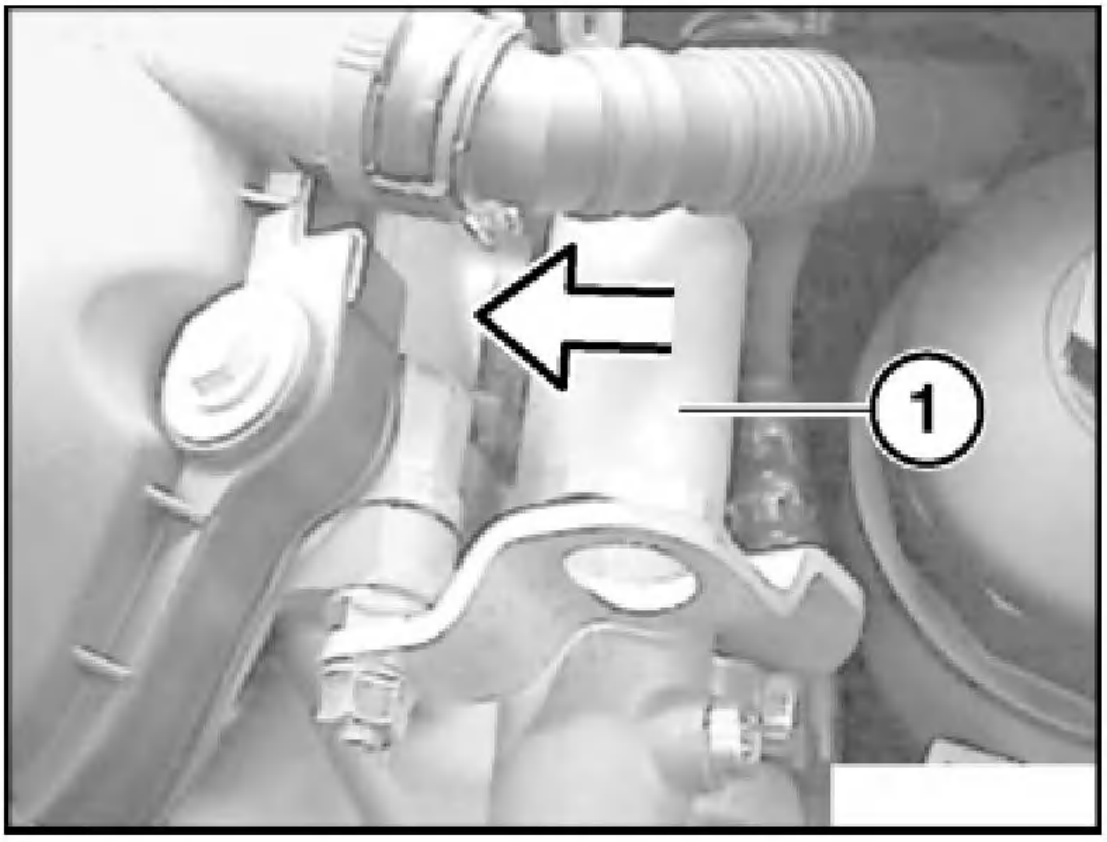


Fig. 47: Identifying Solenoid Valve Of VANOS Adjustment Unit For Inlet Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Replace sealing ring. Tightening torque 11 36 IAZ. Refer to 11 36 VARIABLE CAMSHAFT CONTROL .

Disconnect plug connection (1) on cable duct (2).

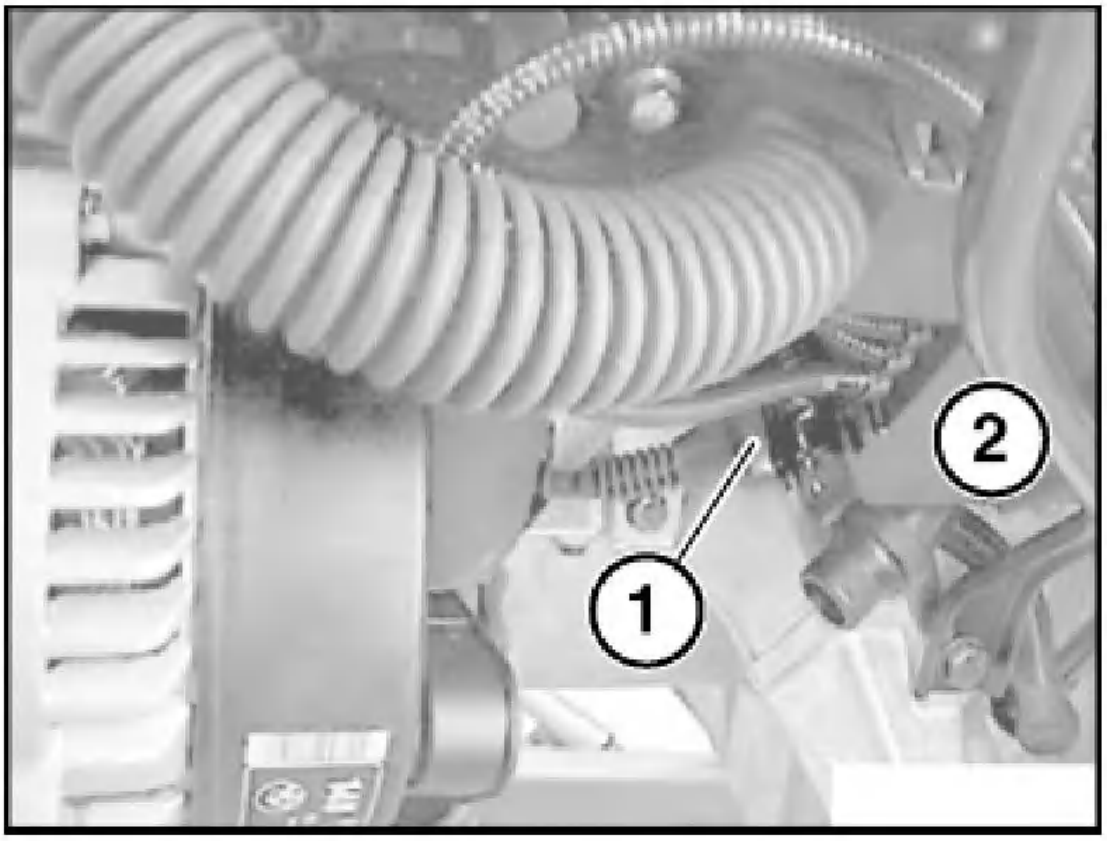


Fig. 48: Disconnecting Plug Connection On Cable Duct
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) on pulse generator (2).

Remove pulse generator (2) from cylinder head.

NOTE: To facilitate installation of pulse generator lead: Secure an approx. 50 cm long auxiliary lead to plug connection of pulse generator.

Feed out end of pulse generator lead but only to such an extent that the auxiliary lead remains in the original routing in the intake system.

Remove pulse generator with lead.

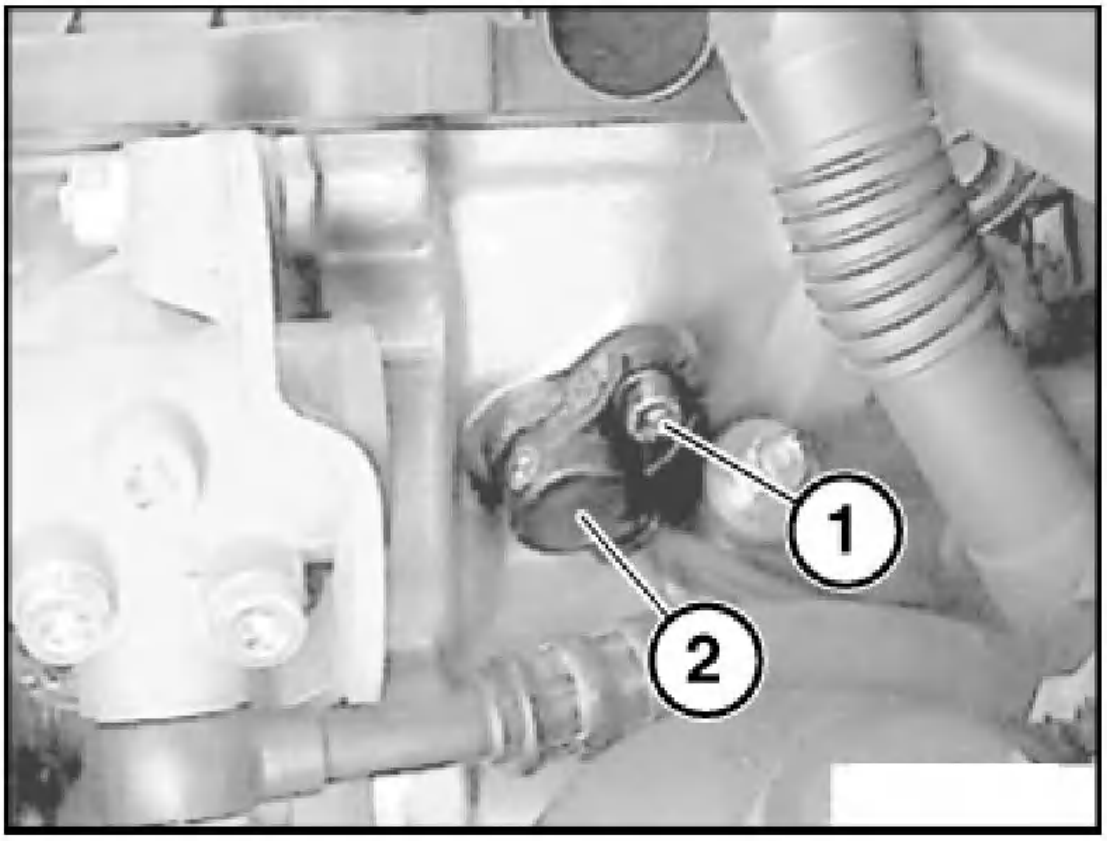


Fig. 49: Removing Pulse Generator With Lead
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect auxiliary lead from faulty pulse generator. Secure plug connection of new pulse generator to auxiliary lead.

Using auxiliary lead, feed new lead of pulse generator through to cable duct at bottom.

Installation:

Check sealing ring for possible damage, replace if necessary.

NOTE: Read out fault memory of DME control unit. Now clear the fault memory.

12 14 524 REPLACING PULSE GENERATOR ON EXHAUST CAMSHAFT (M52TU, M54, M56)

Necessary Preliminary Tasks:

- Check stored fault messages.
- Switch off ignition.

Location:

On cylinder head at front on exhaust side.

Unlock plug (1) and detach from pulse generator.

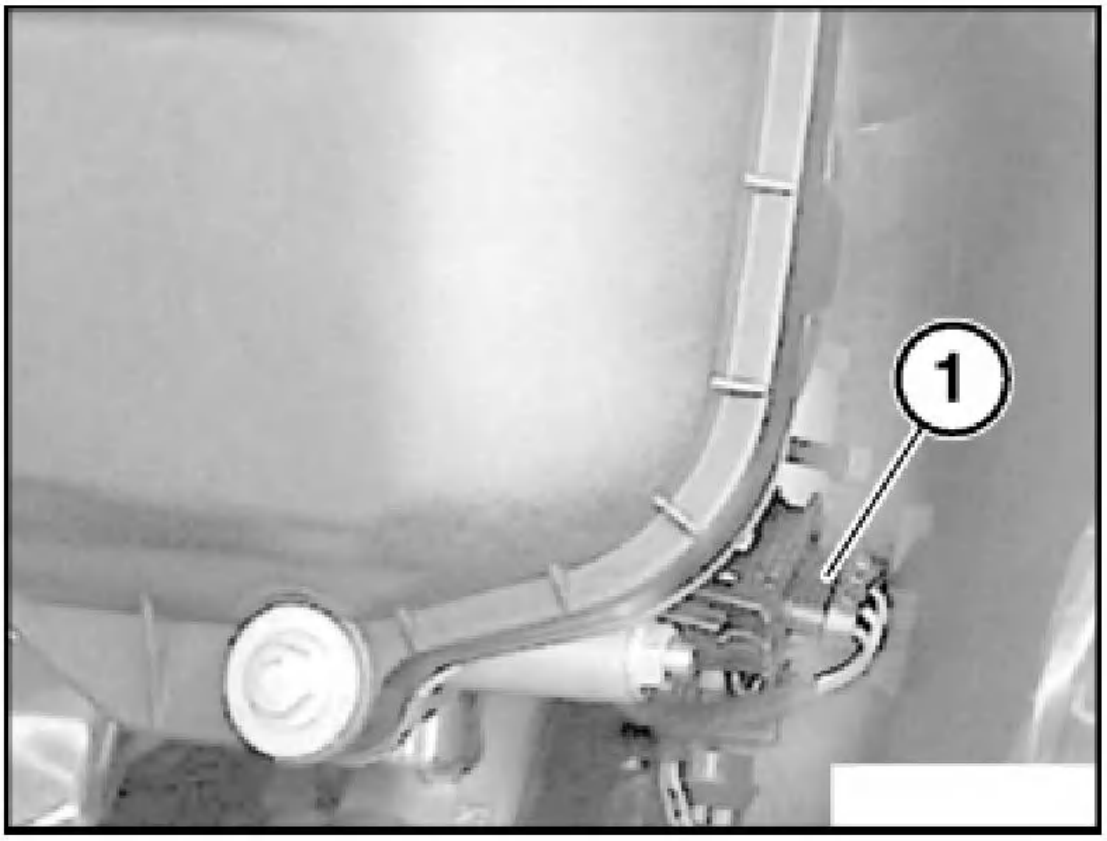


Fig. 50: Unlocking Plug And Detach From Pulse Generator
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) on cylinder head.

Remove pulse generator.

Installation:

Check sealing ring for possible damage, replace if necessary.

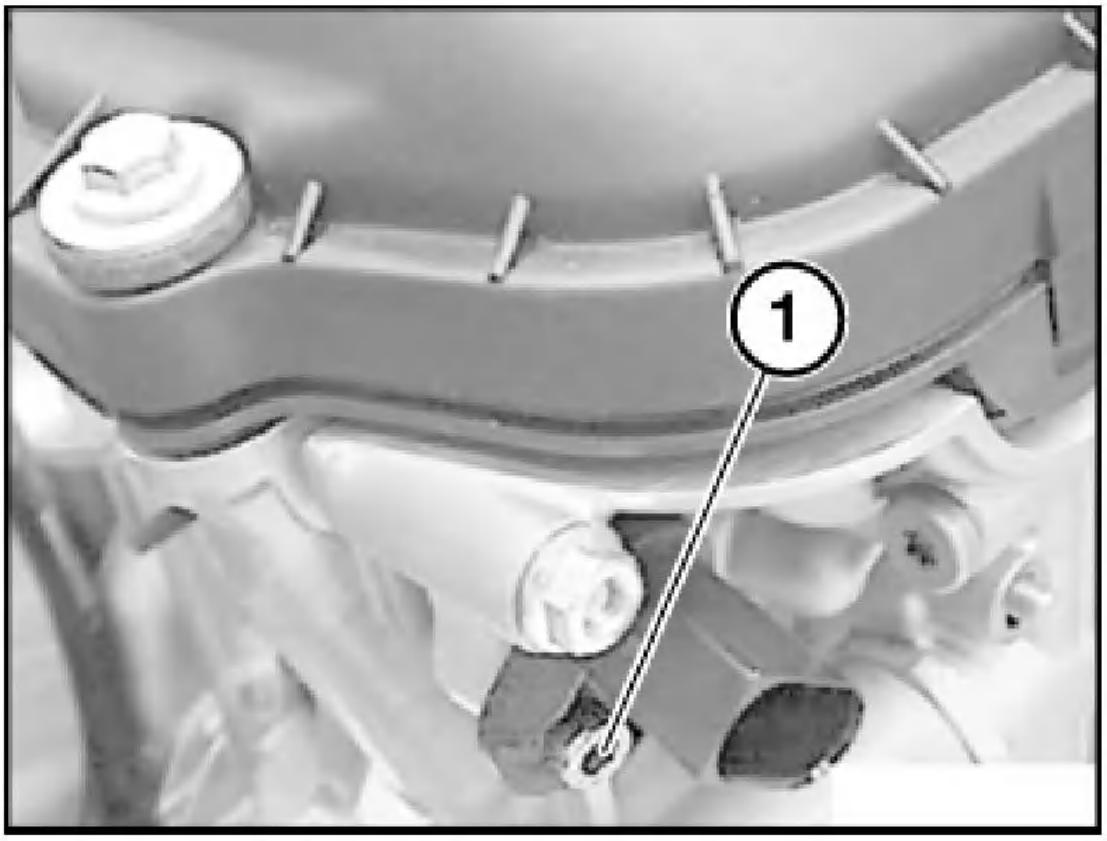


Fig. 51: Removing Pulse Generator
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Interrogate fault memory of DME control unit. Rectify faults. Now clear the fault memory.

12 14 550 REPLACING CONTROL UNIT (M54 / S54)

Follow instructions for removing and installing electronic control units. Refer to 12 00 ... WORKING INSTRUCTIONS FOR REMOVING AND INSTALLING ELECTRONIC CONTROL UNIT .

Read fault memory.

Turn off ignition.

Before replacing the control unit, you must comply with the following instructions:

- Code control unit. Refer to 12 14 700 CODING CONTROL MODULE (DME / DDE) .
- Program control unit. Refer to 12 14 705 PROGRAMMING CONTROL UNIT (DME / DDE) .

Release screw connection of electronics box (1).

Remove electronics box (1).

Installation:

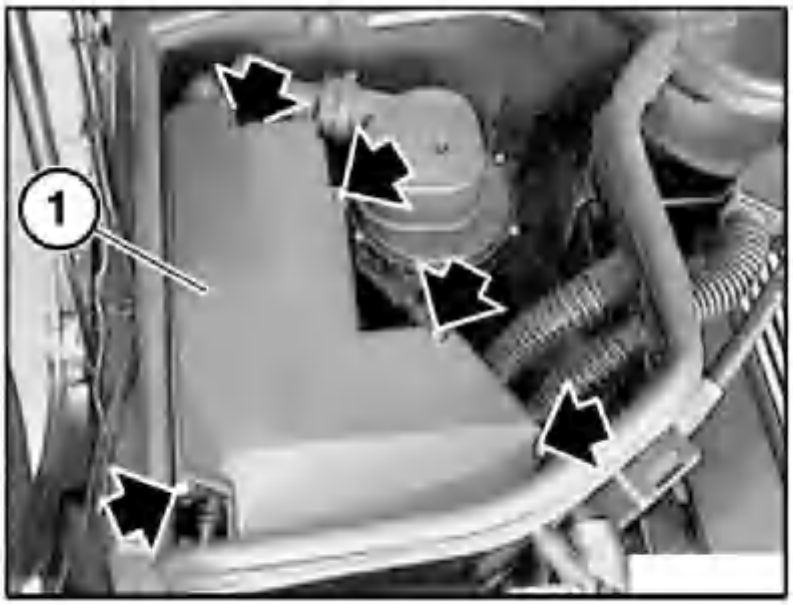


Fig. 52: Removing Electronics Box
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug (1) and detach from DME control unit.

Remove DME control unit.



Fig. 53: Removing DME Control Unit Plugs
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Interrogate fault memory of DME control unit. Check stored fault messages.

Rectify faults. Then clear fault memory.

12 14 600 REPLACING KNOCK SENSOR (M52TU, M54, M56)

Necessary Preliminary Tasks:

- Check stored fault messages.
- Switch off ignition.
- Remove intake air manifold. Refer to 11 61 050 REMOVING AND INSTALLING INTAKE AIR .

Unclip plug connection (1) from holder of cable duct (2) and disconnect.

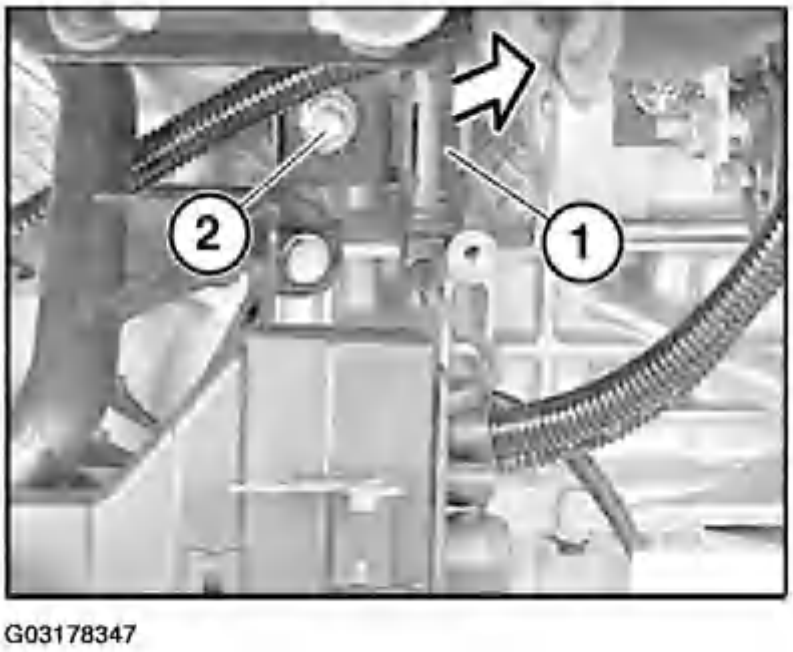


Fig. 54: Unclipping Plug Connection From Holder Of Cable Duct
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) and remove knock sensor for cylinder bank 1-3.

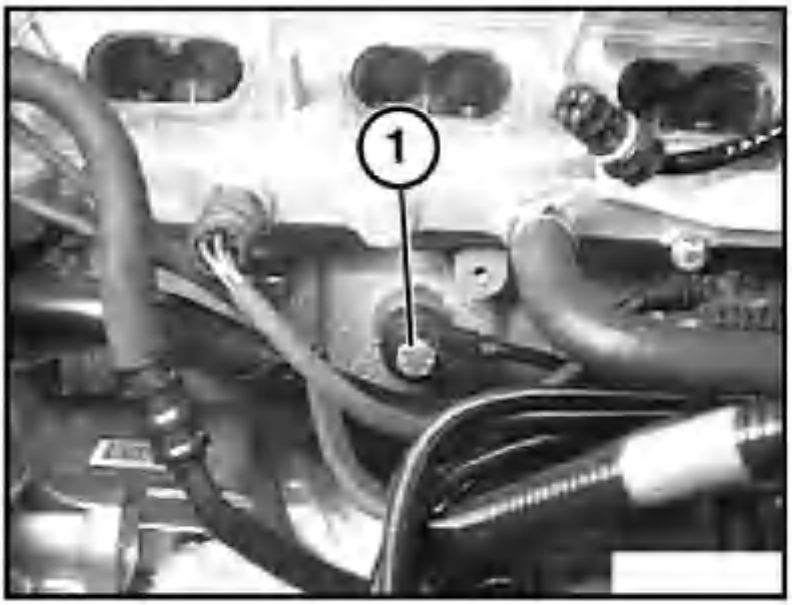


Fig. 55: Removing Knock Sensor Screw On Cylinder Bank 1-3
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (2) and remove knock sensor for cylinder bank 4-6.

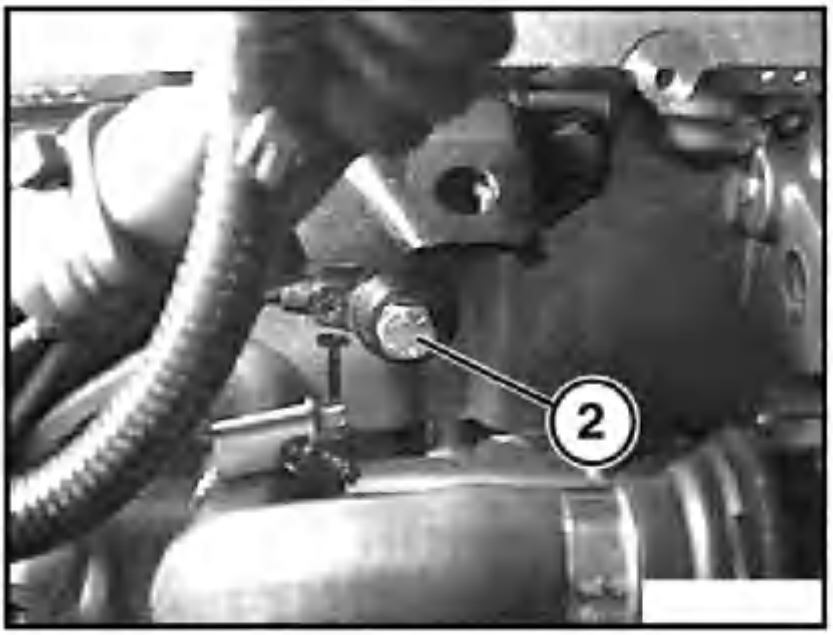


Fig. 56: Removing Knock Sensor Screw On Cylinder Bank 4-6
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Clean support face of knock sensors on engine block.

Tightening torque, 12 14 IAZ. Refer to 12 14 ELECTRONIC SHIFT UNITS OR CONTROL UNITS .

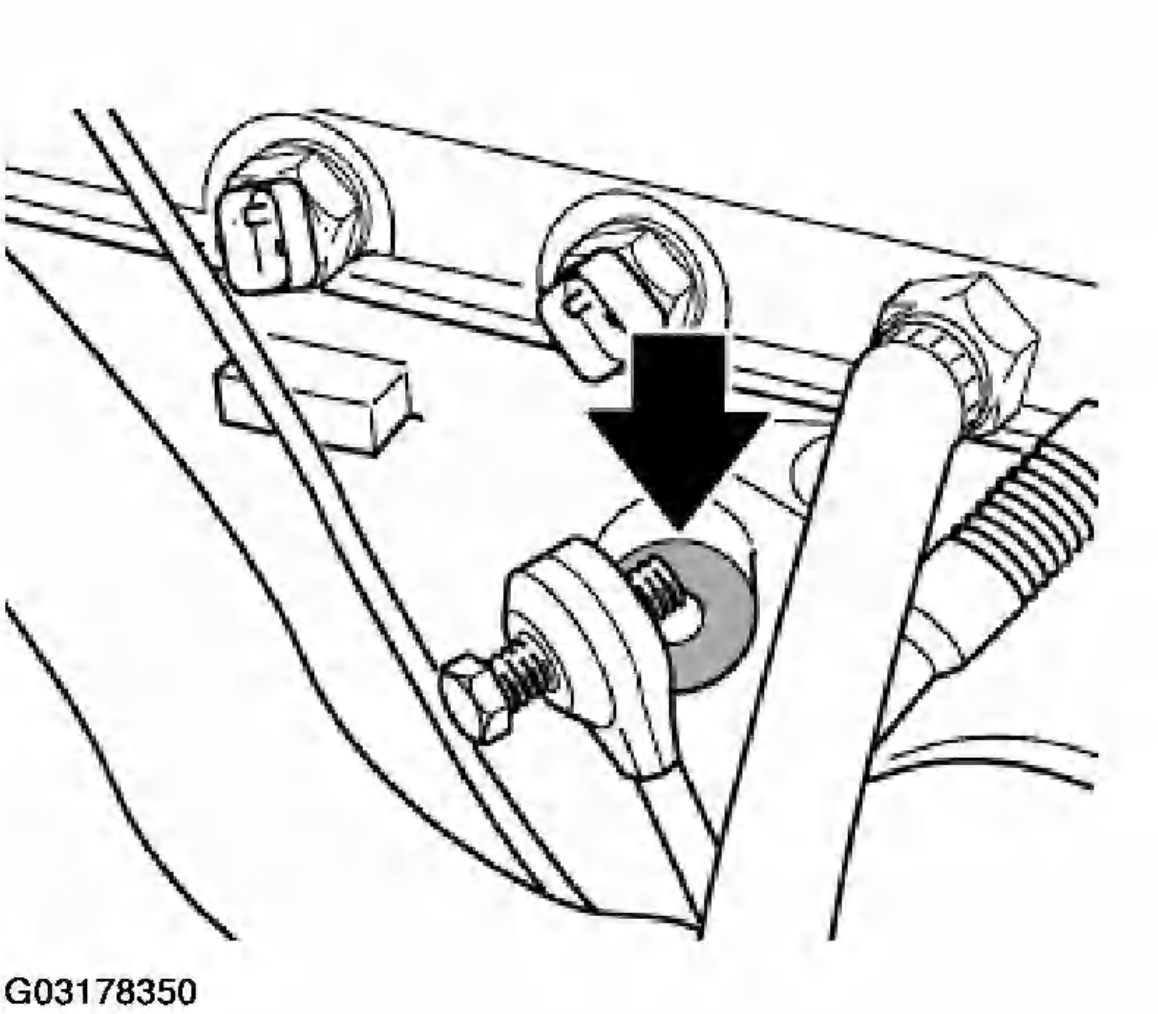


Fig. 57: Identifying Support Face Of Knock Sensors On Engine Block
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Read out fault memory of control unit of Digital Motor Electronics (DME).

Now clear the fault memory.

12 14 700 CODING CONTROL MODULE (DME / DDE)

Switch off ignition.

Connect MoDiC or DIS/GT1 Tester.

Switch on ignition.

Select "Coding" program.

For subsequent procedure, follow instructions in MoDiC or DIS/GT1 Tester.

Carry out adjustment of following control units:

- EWS (electronic immobilizer).
- DME (Digital Motor Electronics) or,

- DDE (Digital Diesel Electronics)

Refer to "Diagnosis and Coding" service information bulletins on subject of coding.

12 14 705 PROGRAMMING CONTROL UNIT (DME / DDE)

Switch off ignition.

Connect MoDiC or DIS/GT1 Tester.

Switch on ignition.

Select "Programming".

For subsequent procedure, follow instructions in MoDiC or DIS/GT1 Tester.

Carry out adjustment of following control units:

- EWS (electronic immobilizer).
- DME (Digital Motor Electronics) or,
- DDE (Digital Diesel Electronics).

Refer to "Diagnosis and Coding" service information bulletins on subject of programming.

12 63 520 REPLACING MAIN RELAY (M54 / S54)

Switch off ignition.

Connect DIS Tester.

Release screw connection of electronics box (1).

Remove electronics box (1).

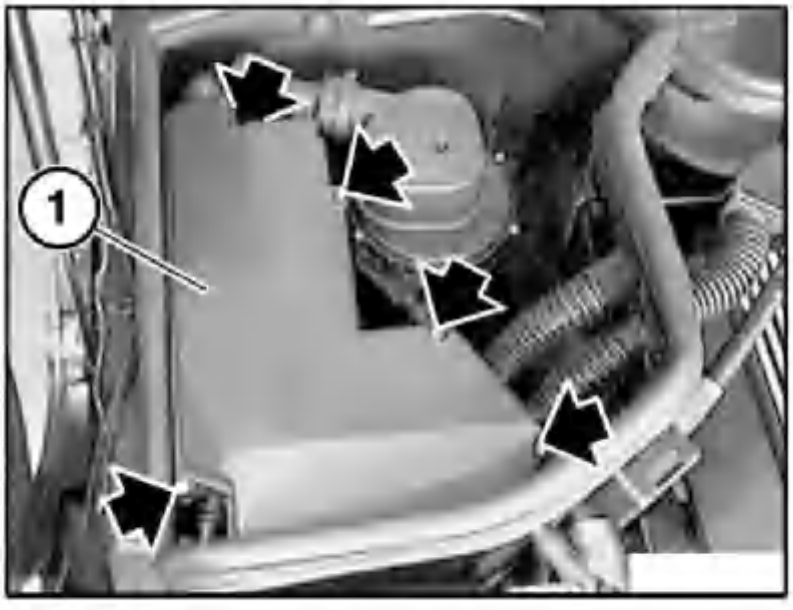


Fig. 58: Removing Electronics Box Screws
Courtesy of BMW OF NORTH AMERICA, INC.

Arrangement:

1. Main relay of Digital Motor Electronics.
2. Engine fuses of Digital Motor Electronics.

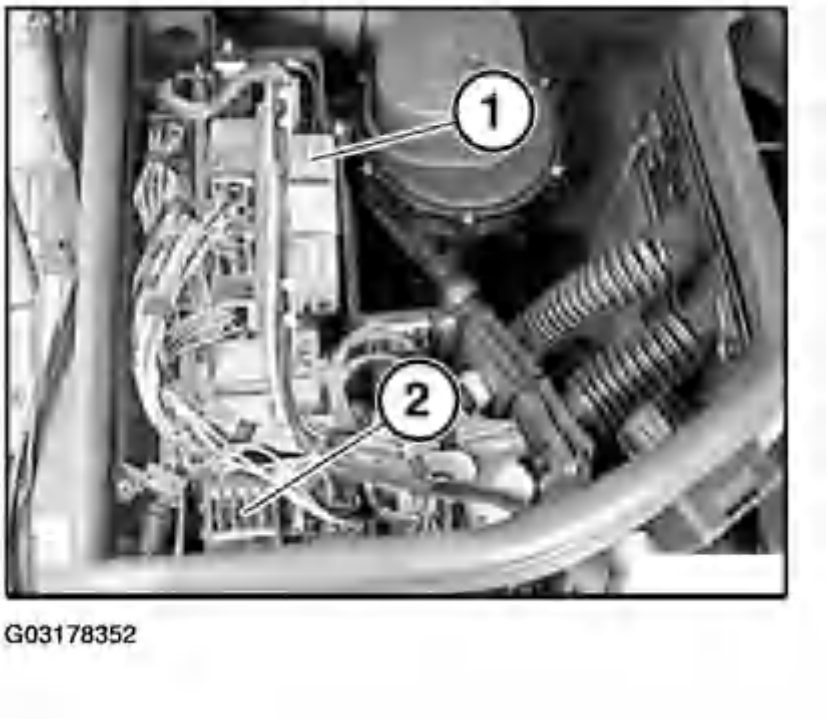


Fig. 59: Identifying Engine Fuses And Main Relay Of Digital Motor Electronics
Courtesy of BMW OF NORTH AMERICA, INC.

Notes On Troubleshooting:

If the starter motor cranks the engine during the starting sequence but the engine fails to fire, then:

1. Check engine fuses.
2. If fuses are blown, replace them completely with fuse holder.
3. Find out why fuses have blown.

   Continue troubleshooting as per DIS instructions.

61 35... NOTE ON REPLACING CODABLE/PROGRAMMABLE CONTROL UNITS

Replacement:

Carry out coding/programming.

Observe following IDC specifications:

- Programming.
- Coding.



Fig. 60: Identifying Codable/Programmable Control Units
Courtesy of BMW OF NORTH AMERICA, INC.

ALTERNATOR WITH DRIVE

12 31 ... REPLACING ALTERNATOR BELT PULLEY

NOTE: For Special Tool identification, see SPECIAL TOOLS - Z3 .

Special Tools Required:

- 12 7 110

Remove and install alternator drive belt.

Depending on alternator type, grip shaft with:

- Hexagon socket.
- Multi-Tooth socket or,
- Torx socket wrench.

Release nut with special tool 12 7 110.

Installation:

Tightening torque, 12 31 2AZ/12 31 3AZ. Refer to 12 31 ALTERNATOR WITH DRIVE AND

MOUNTING PART .

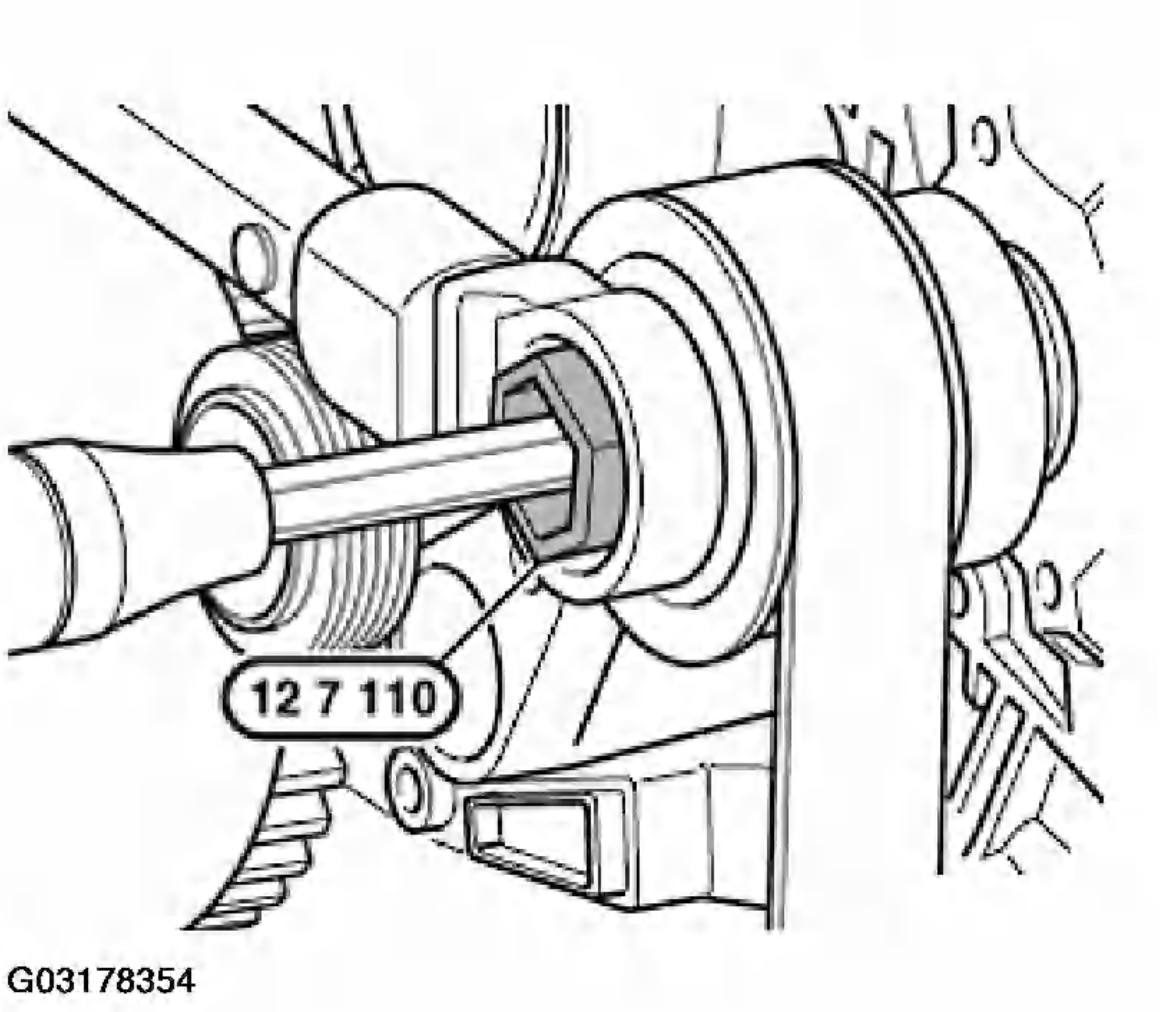


Fig. 61: Removing Pulley Nut
Courtesy of BMW OF NORTH AMERICA, INC.

12 31 009 CHECKING ALTERNATOR AND REGULATOR SWITCH

Test Requirements:

- Correct connections on charged battery.
- Correct connections on alternator and starter motor.
- Good ground connection between engine and body.
- Tightened drive belt.

Connect DIS Tester.

- Measurement.
- Checking alternator.

If charge indicator lamp is permanently lit:

Remove voltage regulator and check carbon brushes, replace if necessary.

Replace alternator regulator switch. Refer to 12 32 501 REPLACING VOLTAGE REGULATOR .

NOTE: Minimum length of carbon brushes "A" = 5 mm.

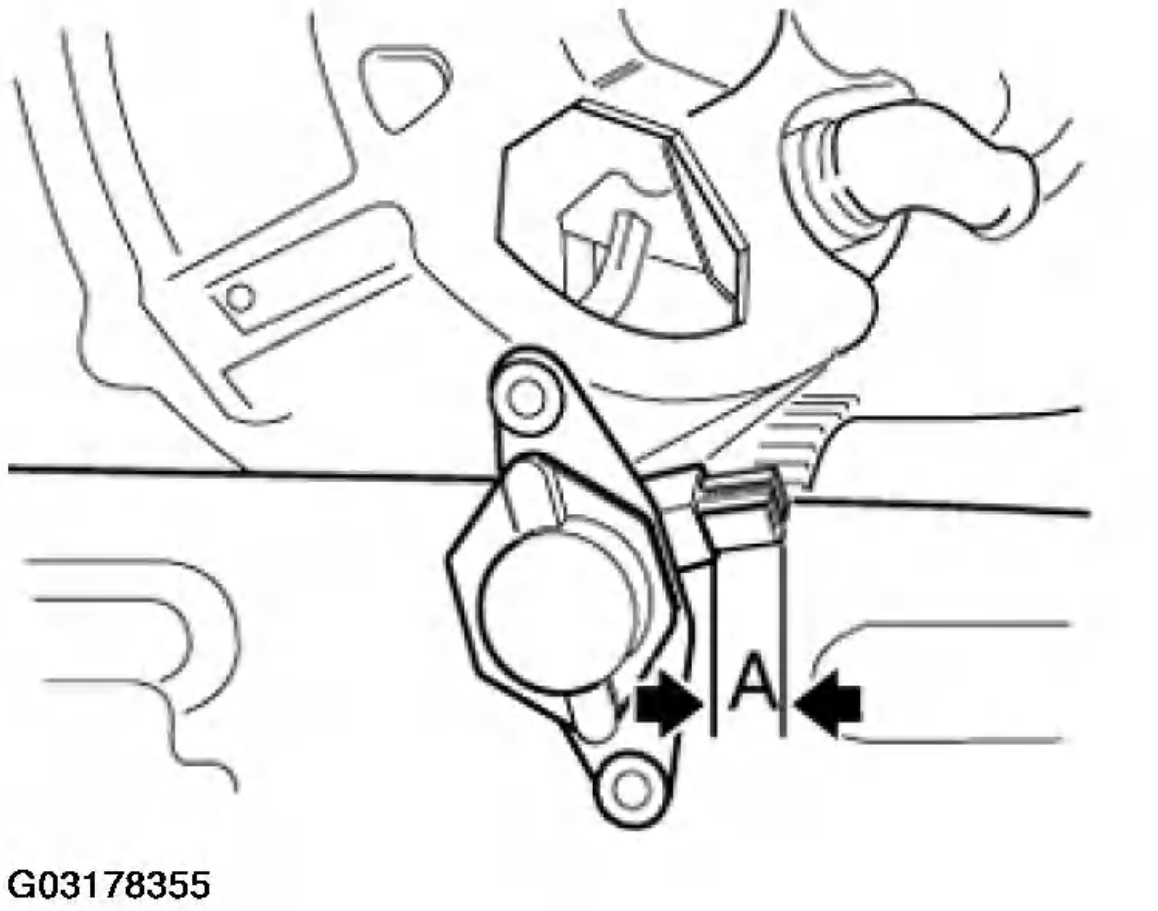


Fig. 62: Identifying Checking Carbon Brush Length
Courtesy of BMW OF NORTH AMERICA, INC.

If charge indicator lamp goes out while engine is running:

Check control voltage. Refer to 12 32 REGULATOR E36 .

Regulator switch must be replaced if control voltage is not achieved.

Replace alternator regulator switch. Refer to 12 32 501 REPLACING VOLTAGE REGULATOR .

Oscillogram For A Fault-Free Alternator:

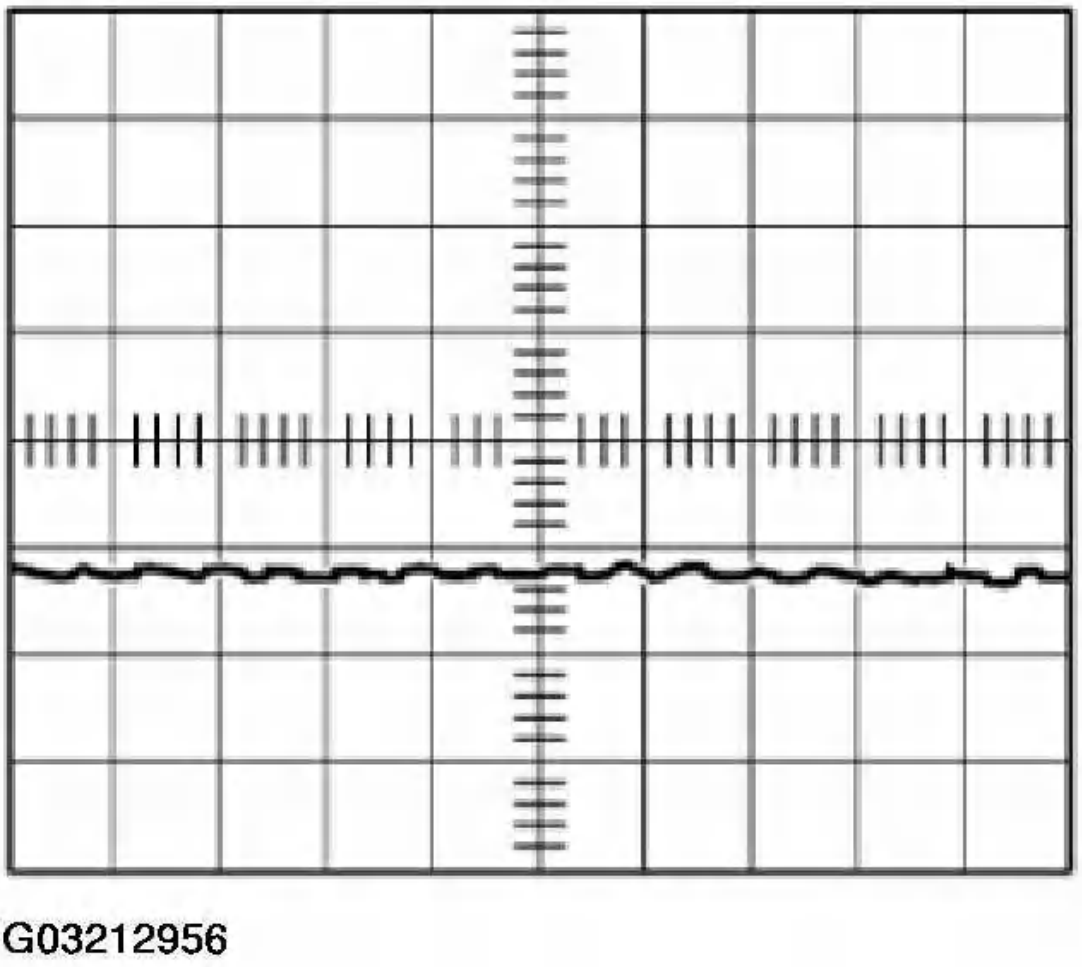


Fig. 63: Identifying Fault-Free Alternator Oscillogram
Courtesy of BMW OF NORTH AMERICA, INC.

Oscillogram For A Faulty Alternator:

One phase interrupted.

Repair/exchange alternator.

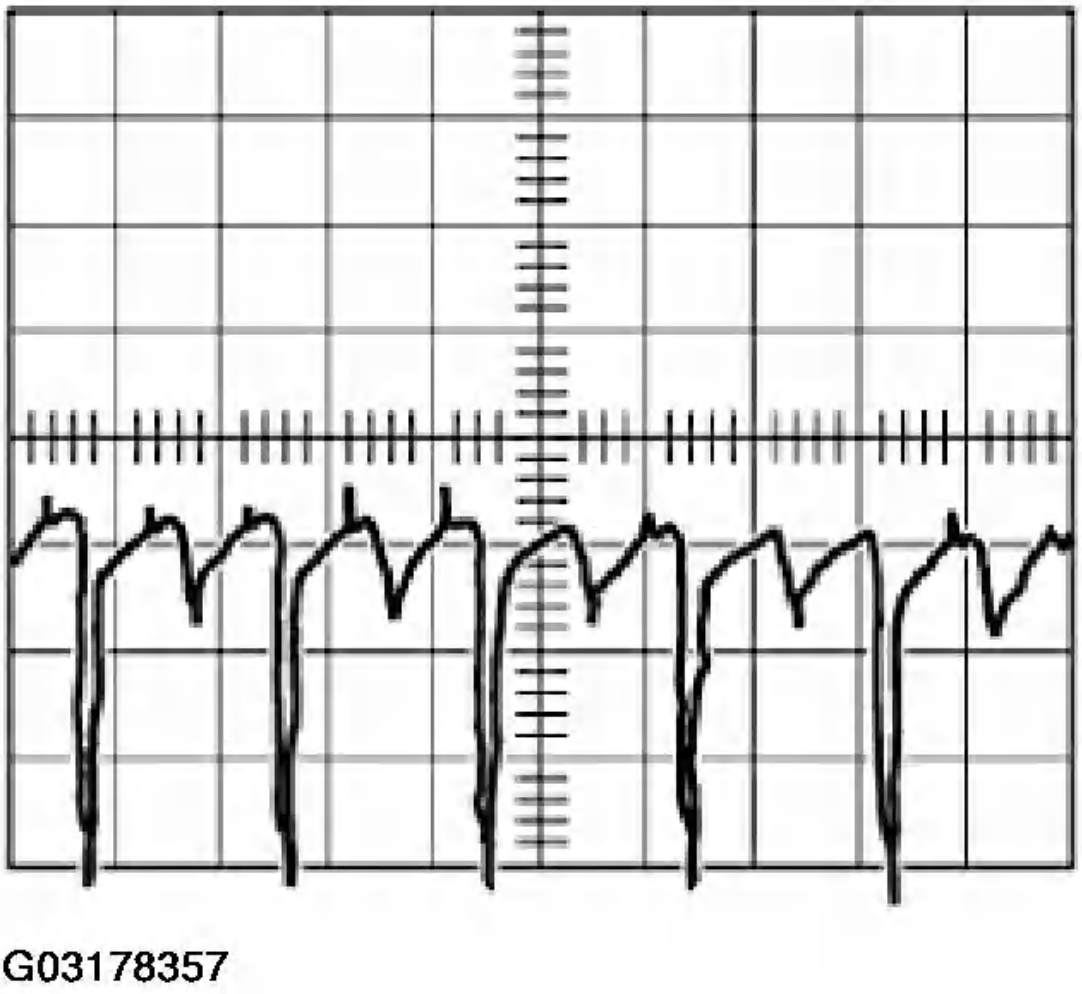


Fig. 64: Identifying Oscillogram One Phase Interrupted
Courtesy of BMW OF NORTH AMERICA, INC.

Interturn fault.

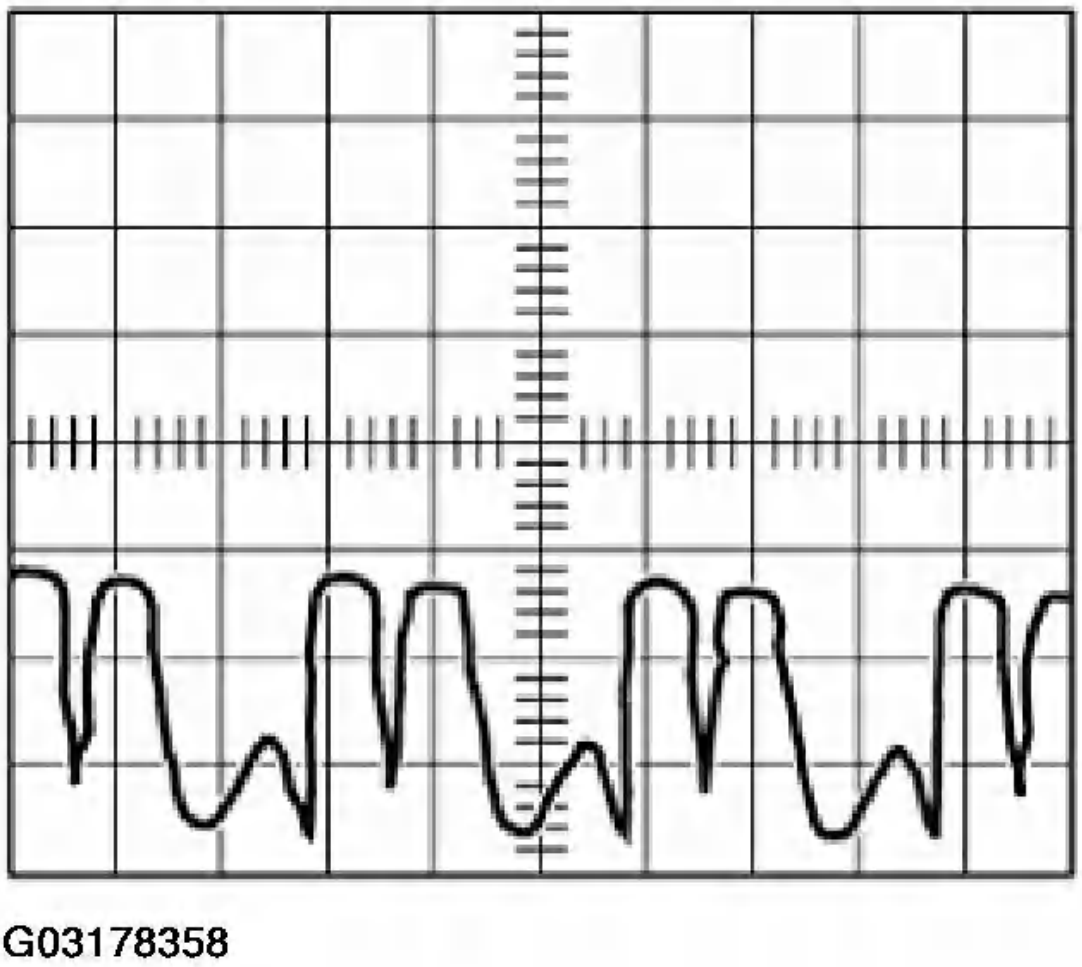


Fig. 65: Identifying Interturn Fault
Courtesy of BMW OF NORTH AMERICA, INC.

Repair/exchange alternator.

Open circuit in negative diode.

Repair/exchange alternator.

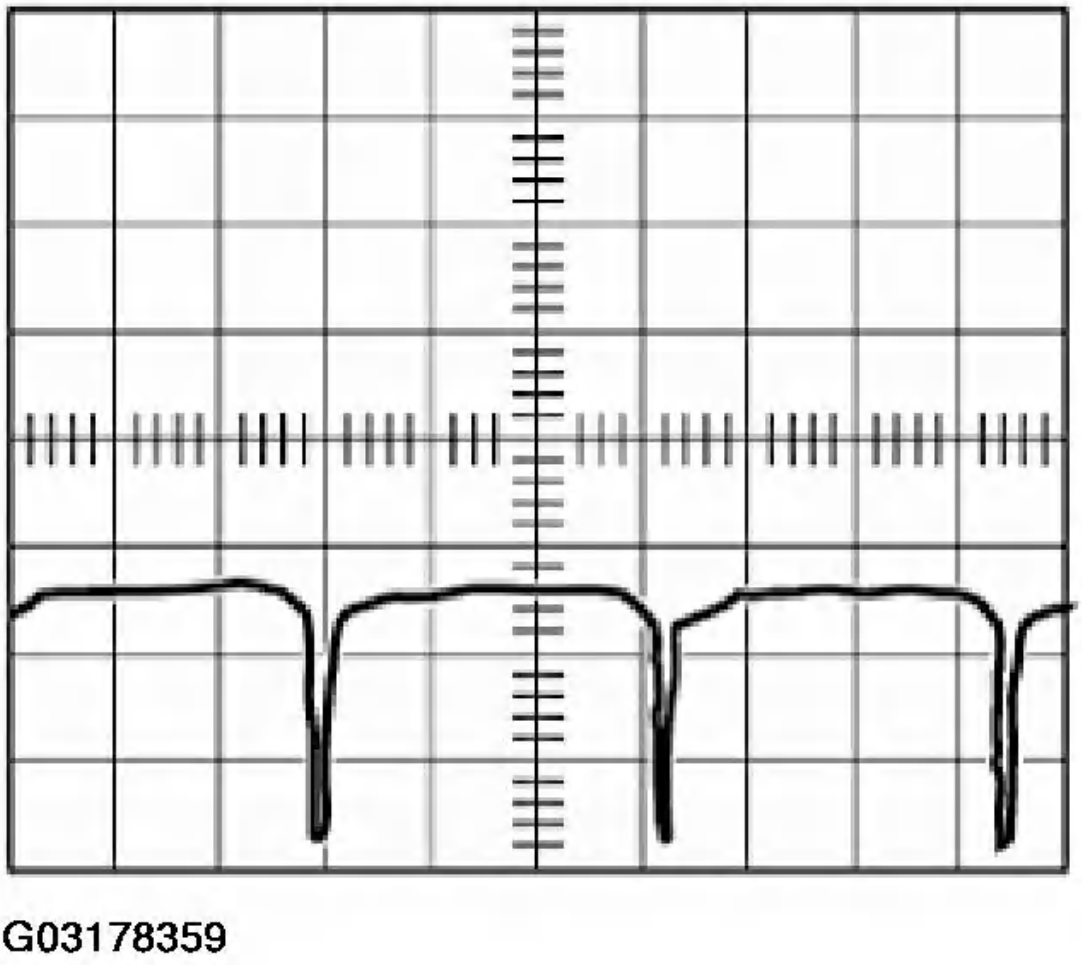


Fig. 66: Identifying Open Circuit In Negative Diode
Courtesy of BMW OF NORTH AMERICA, INC.

Short circuit in positive diode.

Repair/exchange alternator.

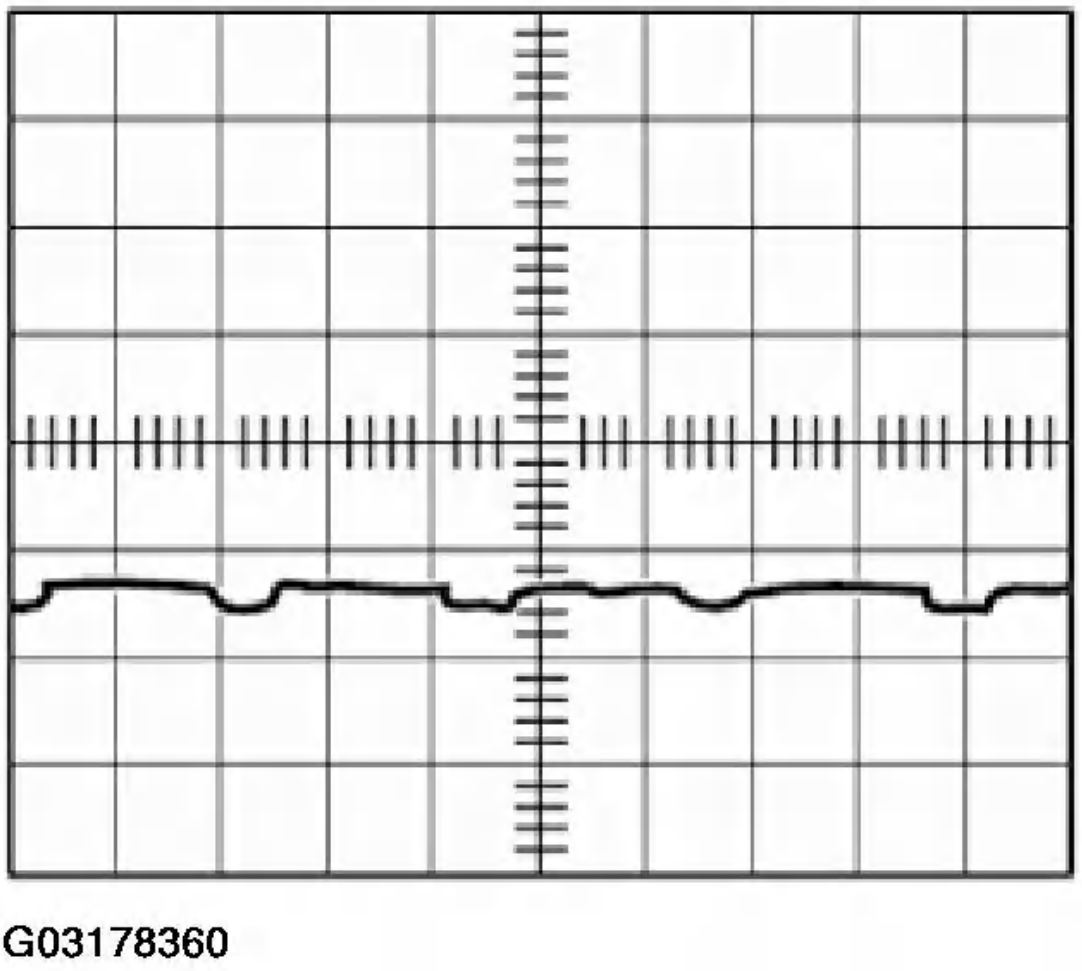


Fig. 67: Identifying Short Circuit In Positive Diode
Courtesy of BMW OF NORTH AMERICA, INC.

Open circuit in positive diode.

Repair/exchange alternator.

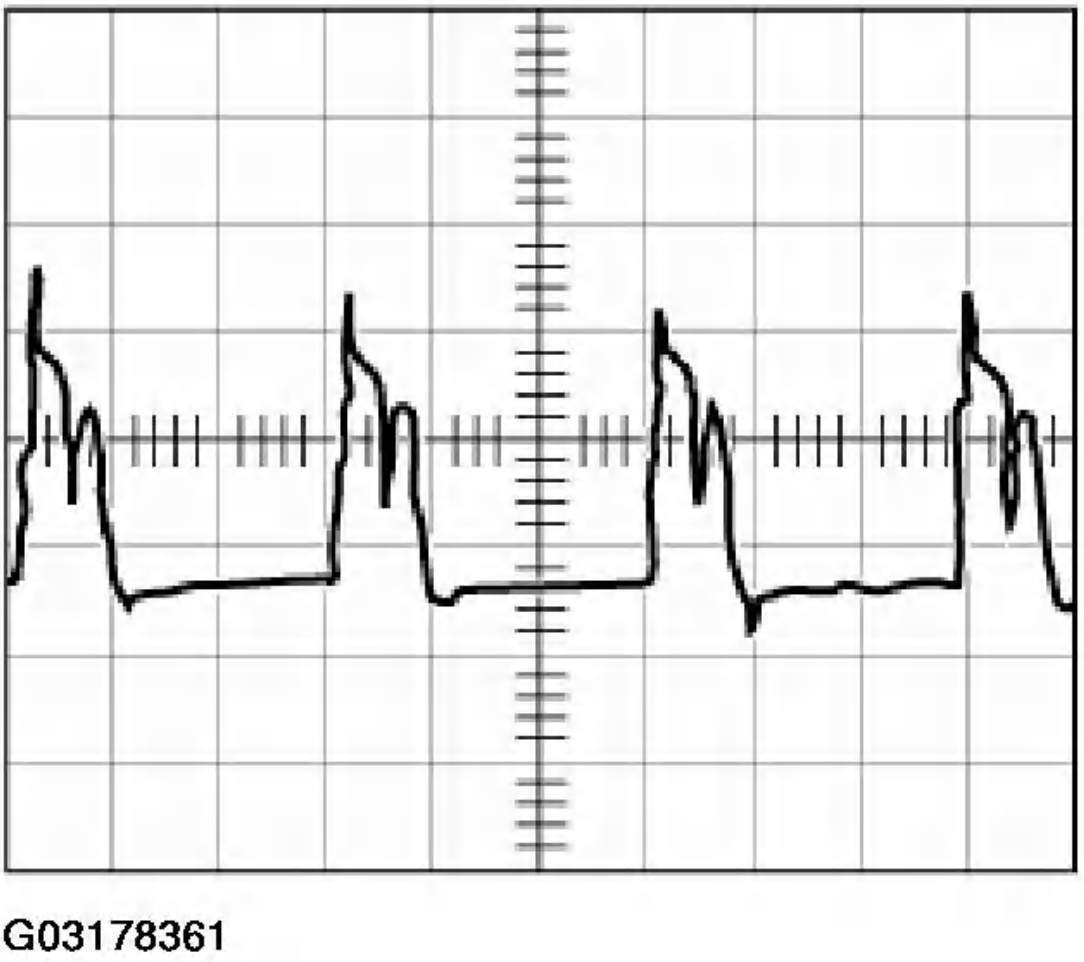


Fig. 68: Identifying Open Circuit In Positive Diode
Courtesy of BMW OF NORTH AMERICA, INC.

Open circuit in exciter diode.

Repair/exchange alternator.

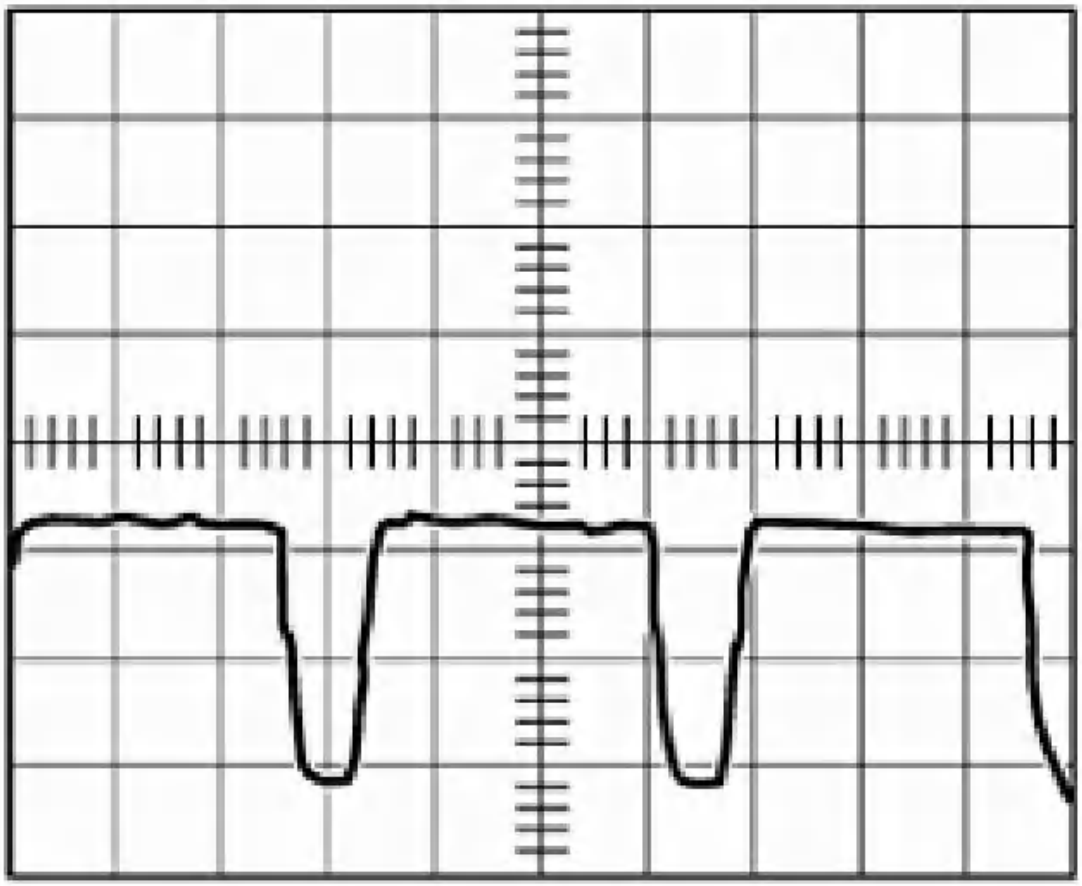


Fig. 69: Identifying Open Circuit In Exciter Diode
Courtesy of BMW OF NORTH AMERICA, INC.

12 31 020 REMOVING AND INSTALLING OR REPLACING ALTERNATOR (M52, M52TU, S50US, S52, M54, M56)

Necessary Preliminary Tasks:

- Read out stored fault messages.
- Switch off ignition.
- Follow instructions for disconnecting and connecting battery. Refer to 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .
- Disconnect and cover battery negative terminal.
- Remove suction filter housing. Refer to 13 71 000 REMOVING AND INSTALLING INTAKE FILTER HOUSING (M54) .
- Remove fan clutch. Refer to 11 52 020 REMOVING AND INSTALLING/REPLACING FAN CLUTCH (S52 / S54 / M52 / M52TU / M54 / M56) .
- Remove alternator drive belt. Refer to 11 28 010 REPLACING ALTERNATOR DRIVE BELT (M52 / S52 / M52TU / M54 / M56) .

If necessary, drain supply tank for power steering pump, remove with holder and place to one side.

NOTE: Lines on supply tank for power steering pump remain connected.

If fitted:

Remove air hose.

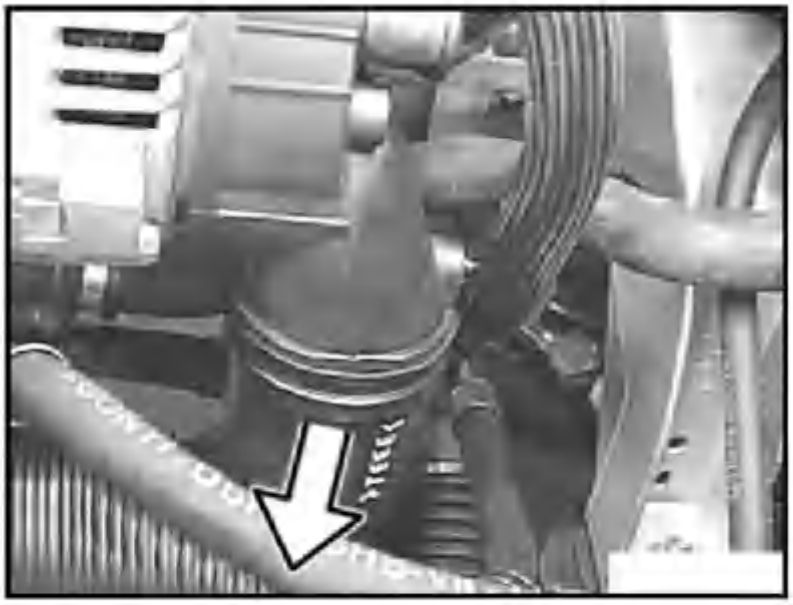


Fig. 70: Removing Air Hose
Courtesy of BMW OF NORTH AMERICA, INC.

Version 1

Take off cap on connections.

Disconnect plug connection (1).

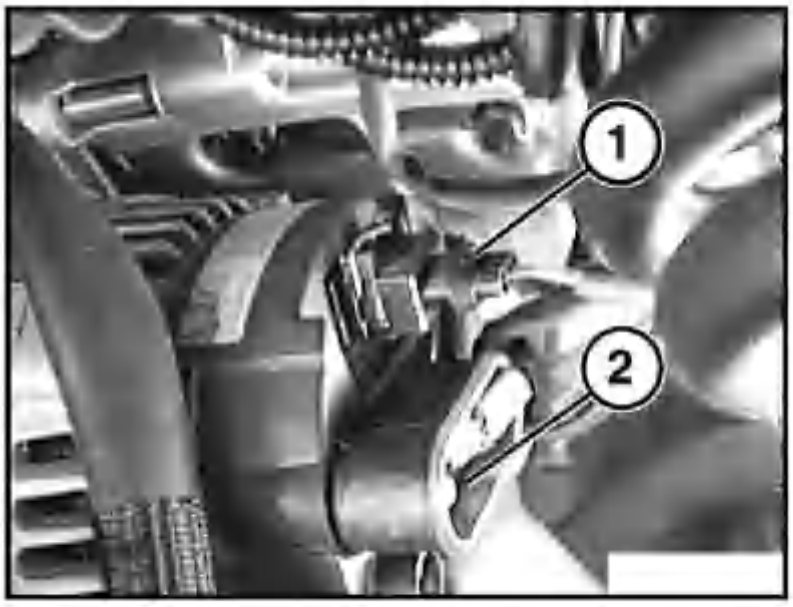


Fig. 71: Identifying Plug Connection
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut (2) and disconnect battery positive lead.

Tightening torque, 12 31 1AZ. Refer to 12 31 ALTERNATOR WITH DRIVE AND MOUNTING PART .

Version 2

Unlock and detach plug connection (1).

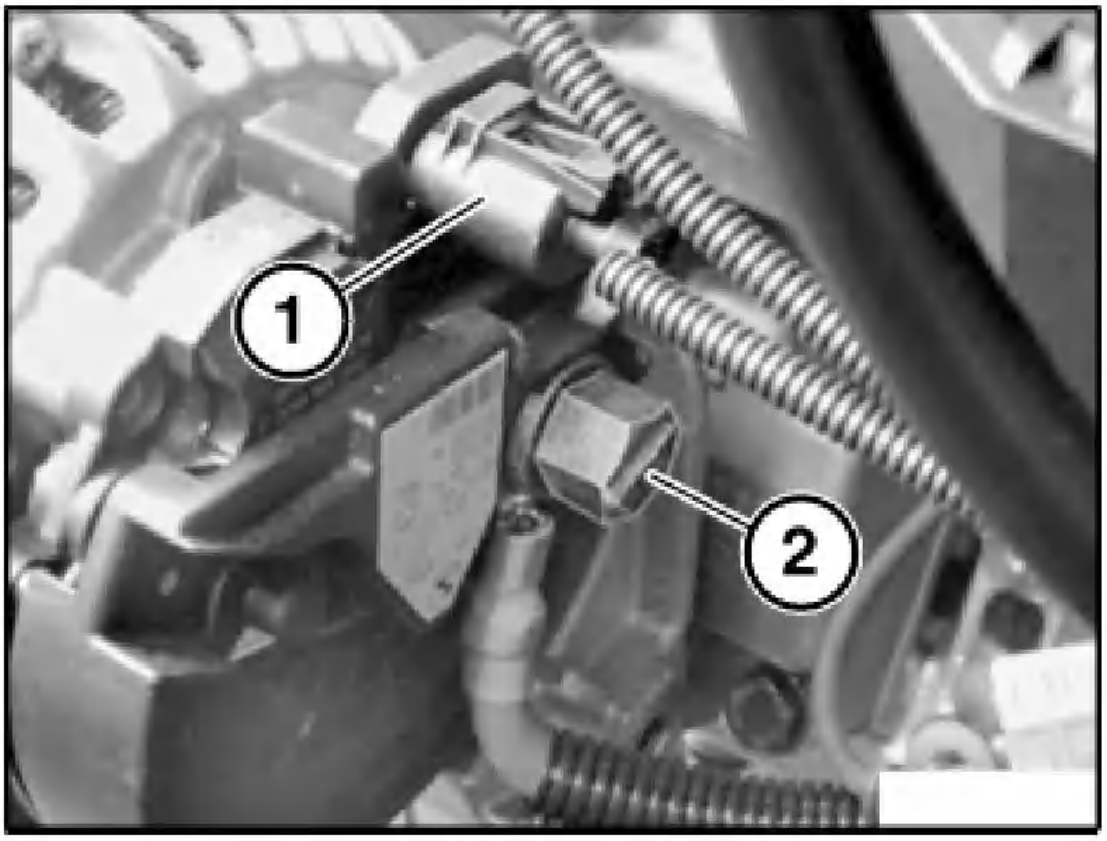


Fig. 72: Disconnecting Plug Connection
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut (2) and disconnect battery positive lead.

Tightening torque, 12 31 1AZ. Refer to 12 31 ALTERNATOR WITH DRIVE AND MOUNTING PART .

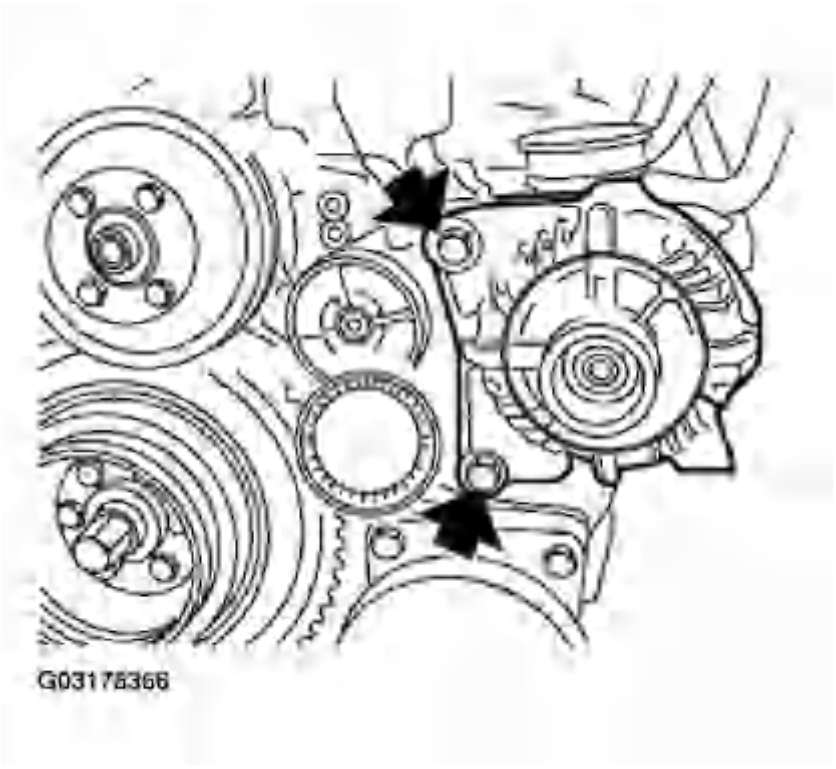


Fig. 73: Disconnecting Battery Positive Lead
Courtesy of BMW OF NORTH AMERICA, INC.

Version Without Idler Pulley:

Release alternator screws in succession while simultaneously gripping alternator firmly.

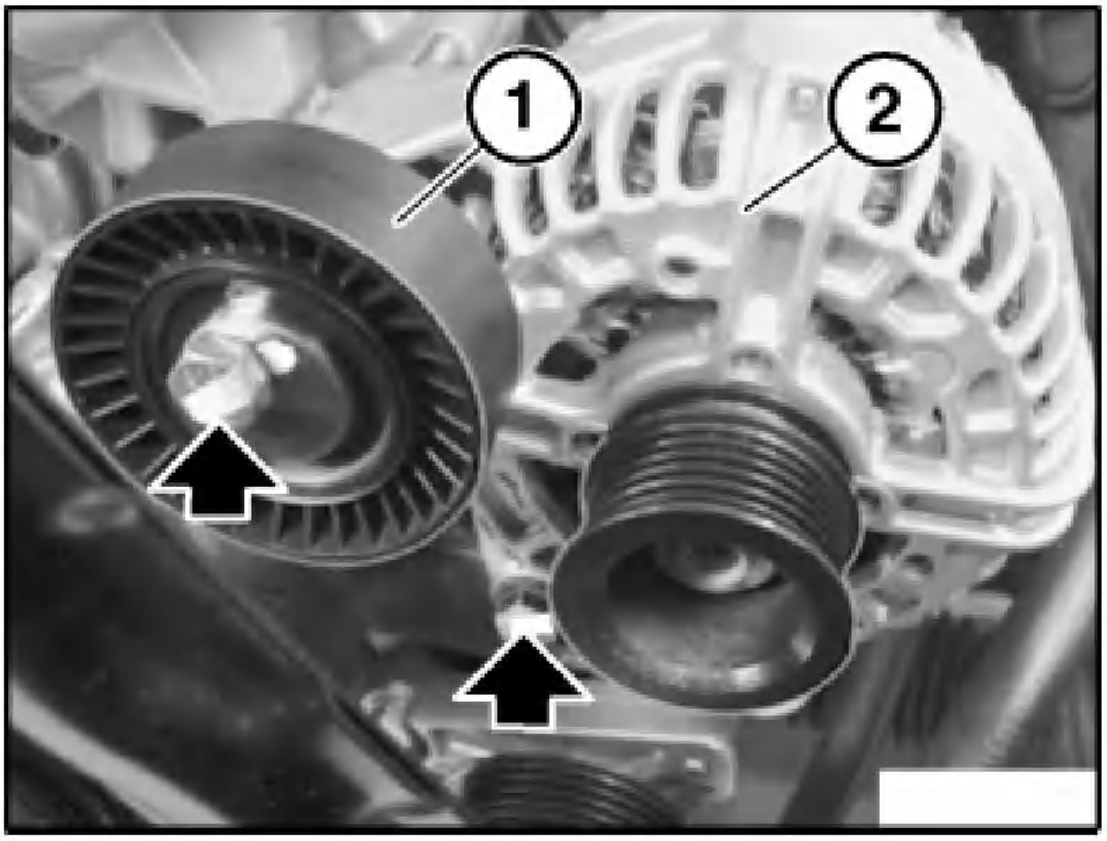


Fig. 74: Removing Alternator Screws
Courtesy of BMW OF NORTH AMERICA, INC.

Remove alternator.

Version with idler pulley:

Remove cover from idler pulley (1).

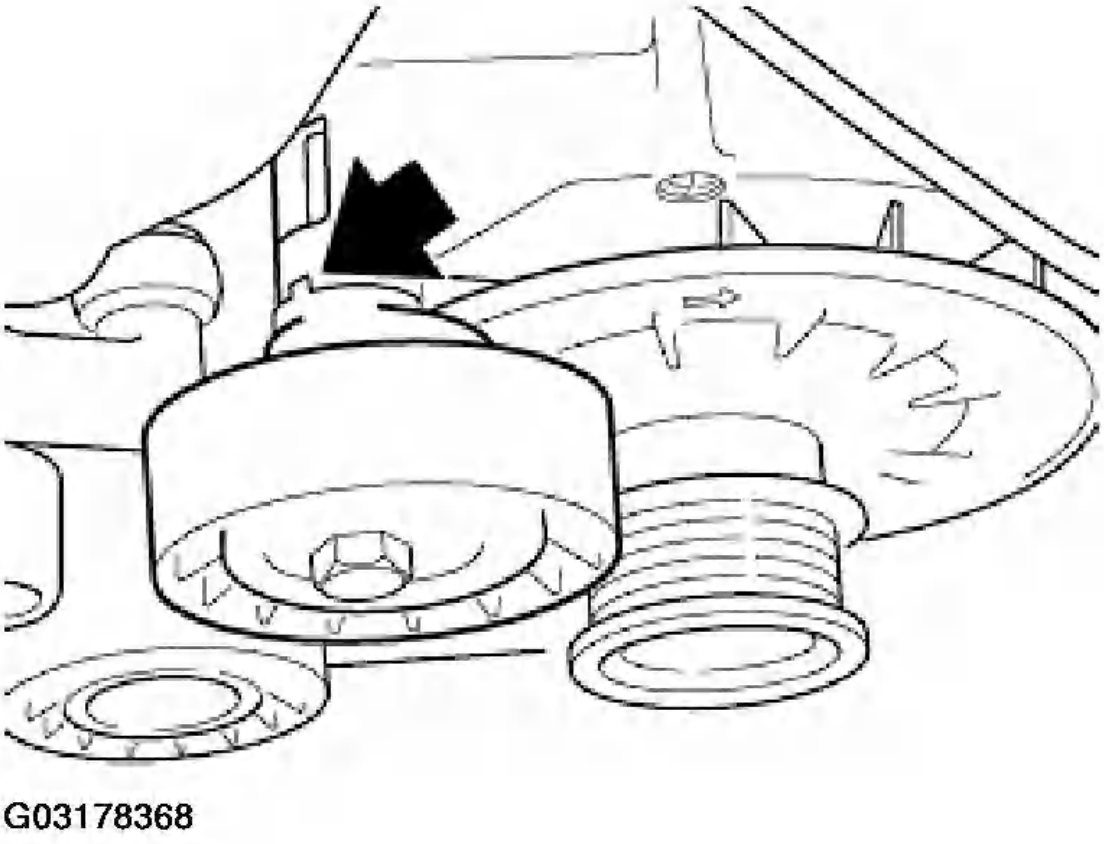


Fig. 75: Removing Idler Pulley Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw and remove idler pulley (1).

Release screw and remove alternator (2).

Version with idler pulley:

Installation:

Turning lock of tensioning roller must engage in alternator groove.

Interrogate fault memory of DME control unit.

Now clear the fault memory.

12 31 695 REPLACING DIODE PLATE (MOTOROLA ALTERNATOR)

NOTE: Alternator removed.

Unscrew capacitor and cover.

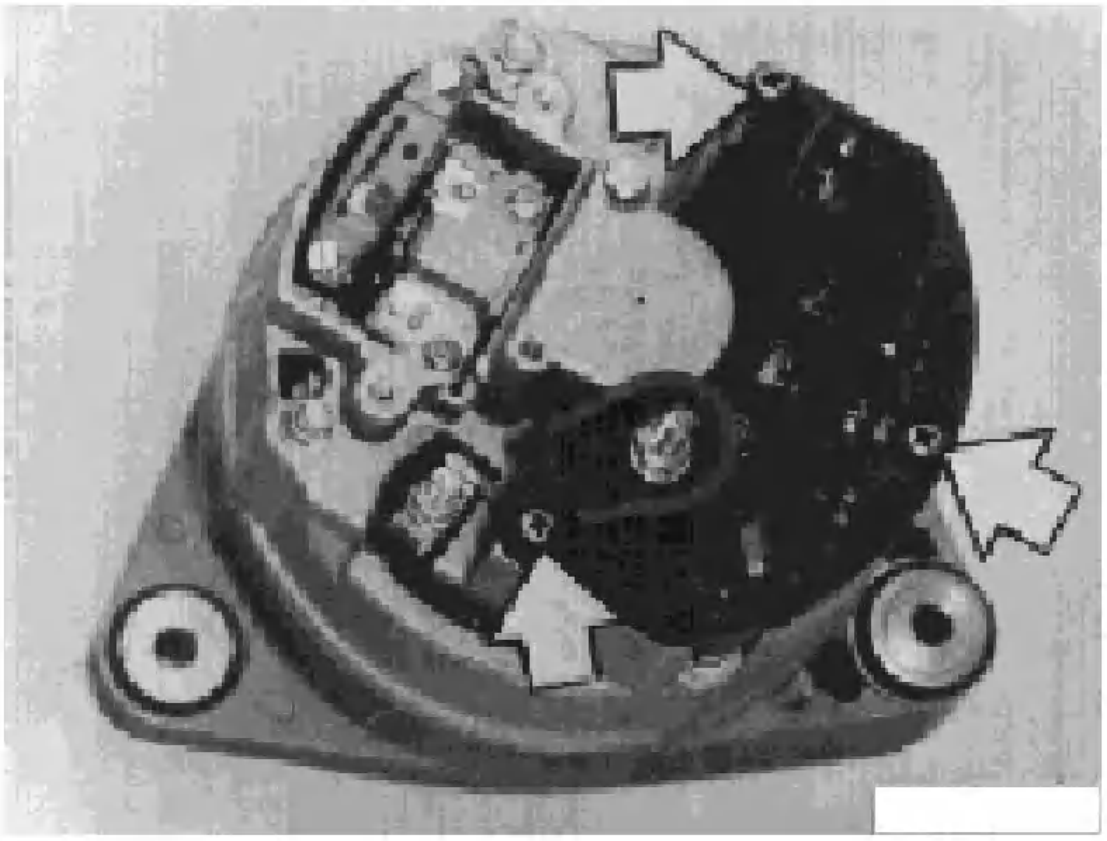


Fig. 76: Unscrewing Capacitor And Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Unsolder stator winding on diode plate.

CAUTION: Excessive heat from soldering iron would destroy diodes.

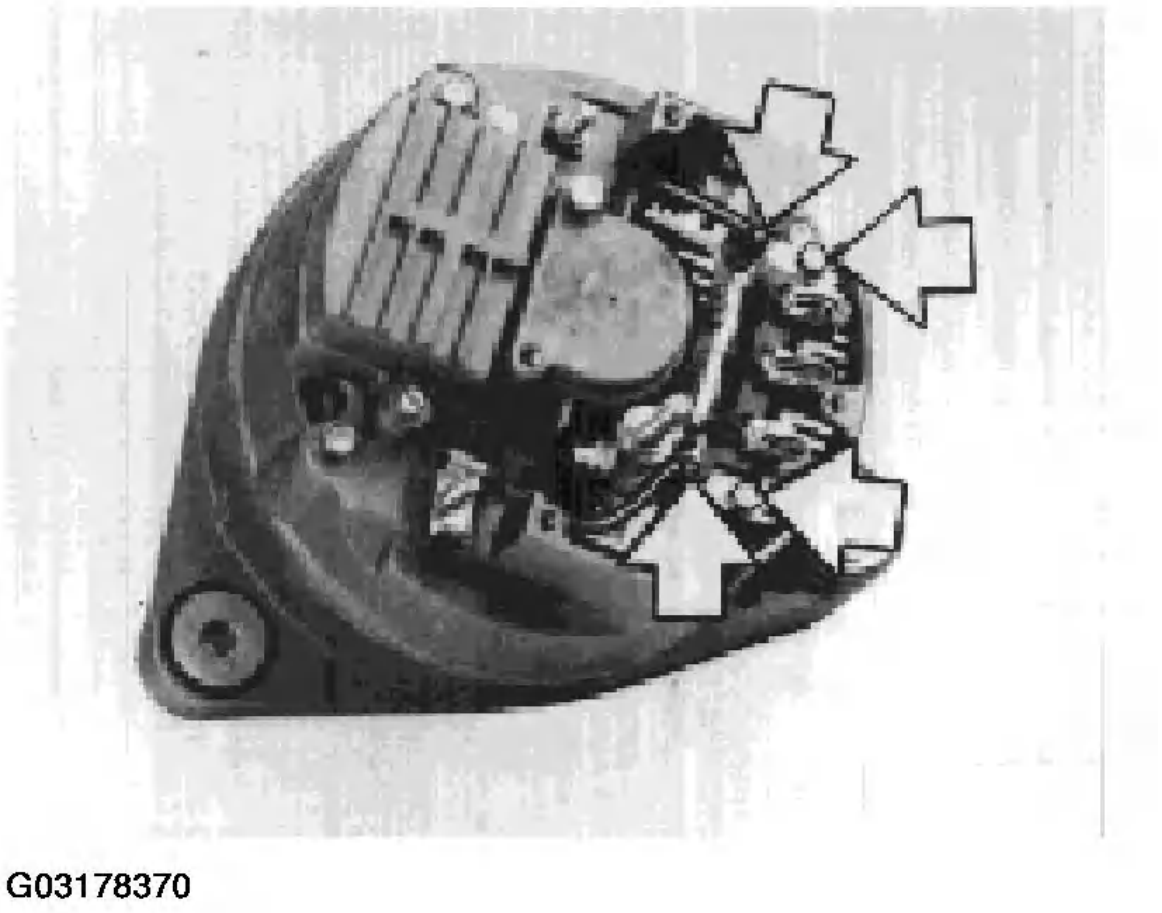


Fig. 77: Unsoldering Stator Winding On Diode Plate
Courtesy of BMW OF NORTH AMERICA, INC.

Unscrew screws and take off diode plate.

Installation:

Check that insulating sleeves are in satisfactory condition.

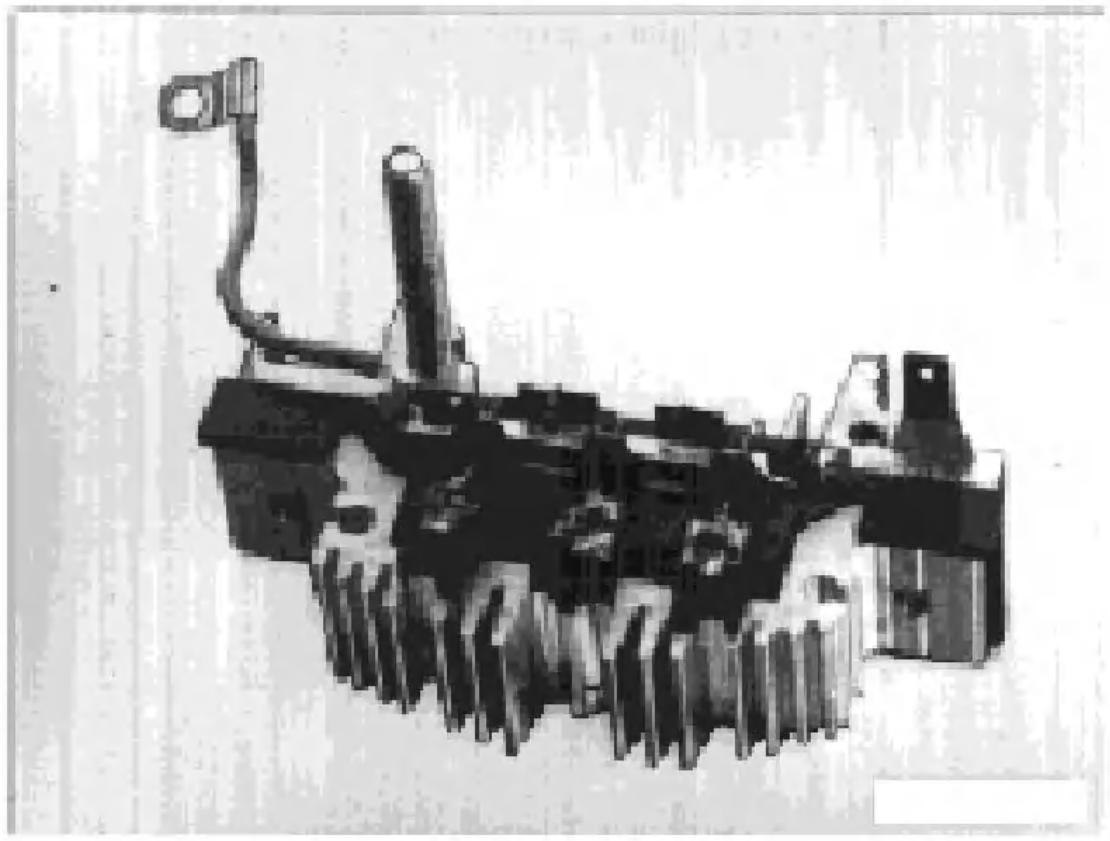


Fig. 78: Identifying Diode Plate
Courtesy of BMW OF NORTH AMERICA, INC.

REGULATOR

12 32 501 REPLACING VOLTAGE REGULATOR

General Data, refer to Refer to 12 00 ... DISCONNECTING AND CONNECTING TEST EQUIPMENT and 12 00... COMPONENT INSPECTION: and 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .

Read fault memory.

Disconnect battery ground wire.

Remove alternator, refer to 12 31 020 REMOVING AND INSTALLING OR REPLACING ALTERNATOR (M52, M52TU, S50US, S52, M54, M56) .

Release screws and remove cover.

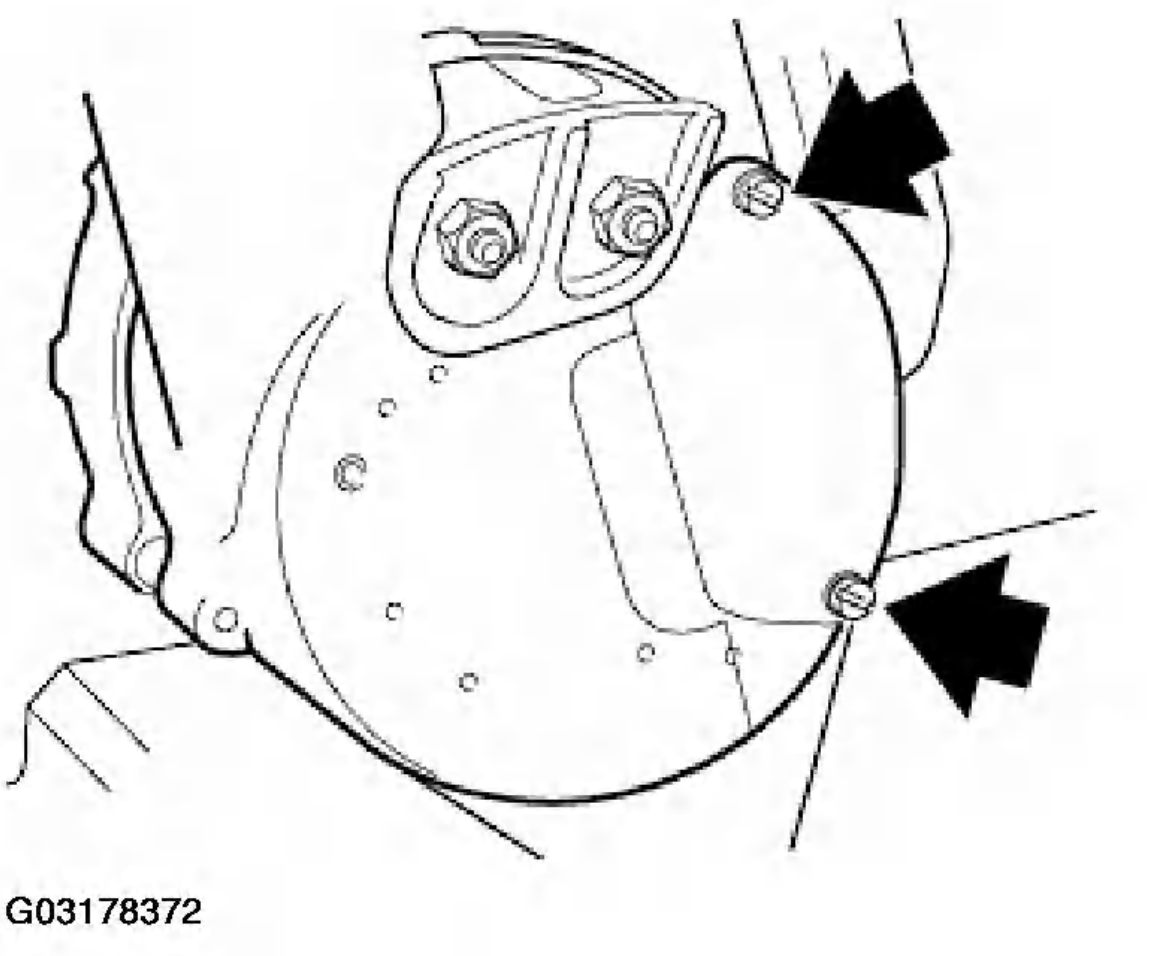


Fig. 79: Removing Voltage Regulator Cover Screws
Courtesy of BMW OF NORTH AMERICA, INC.

Remove voltage regulator.

Check collector ring for wear and recondition if necessary.

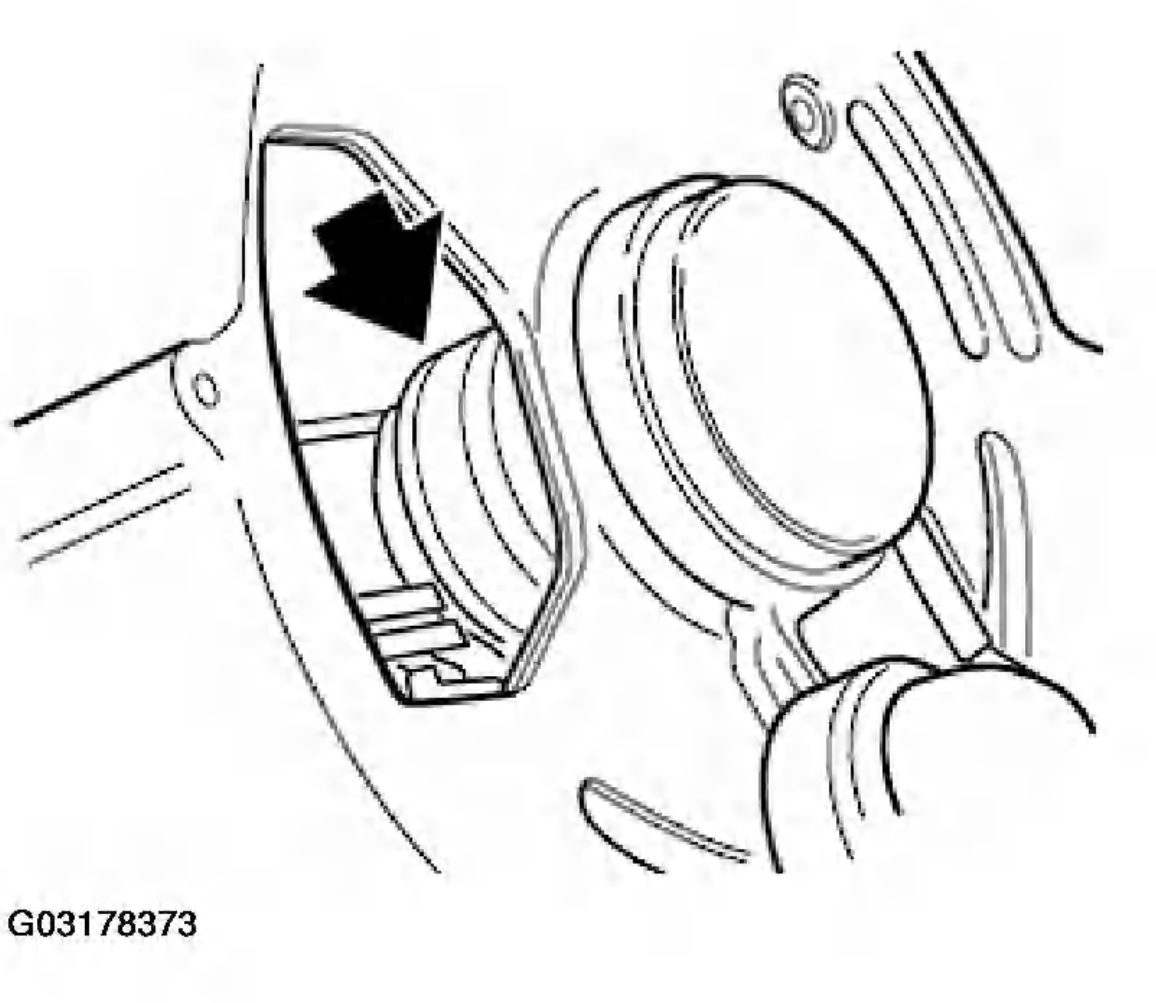


Fig. 80: Checking Collector Ring For Wear
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Clean contact surfaces and check contact-spring tension, bending to correct where indicated.

Distance A = at least 5 mm.

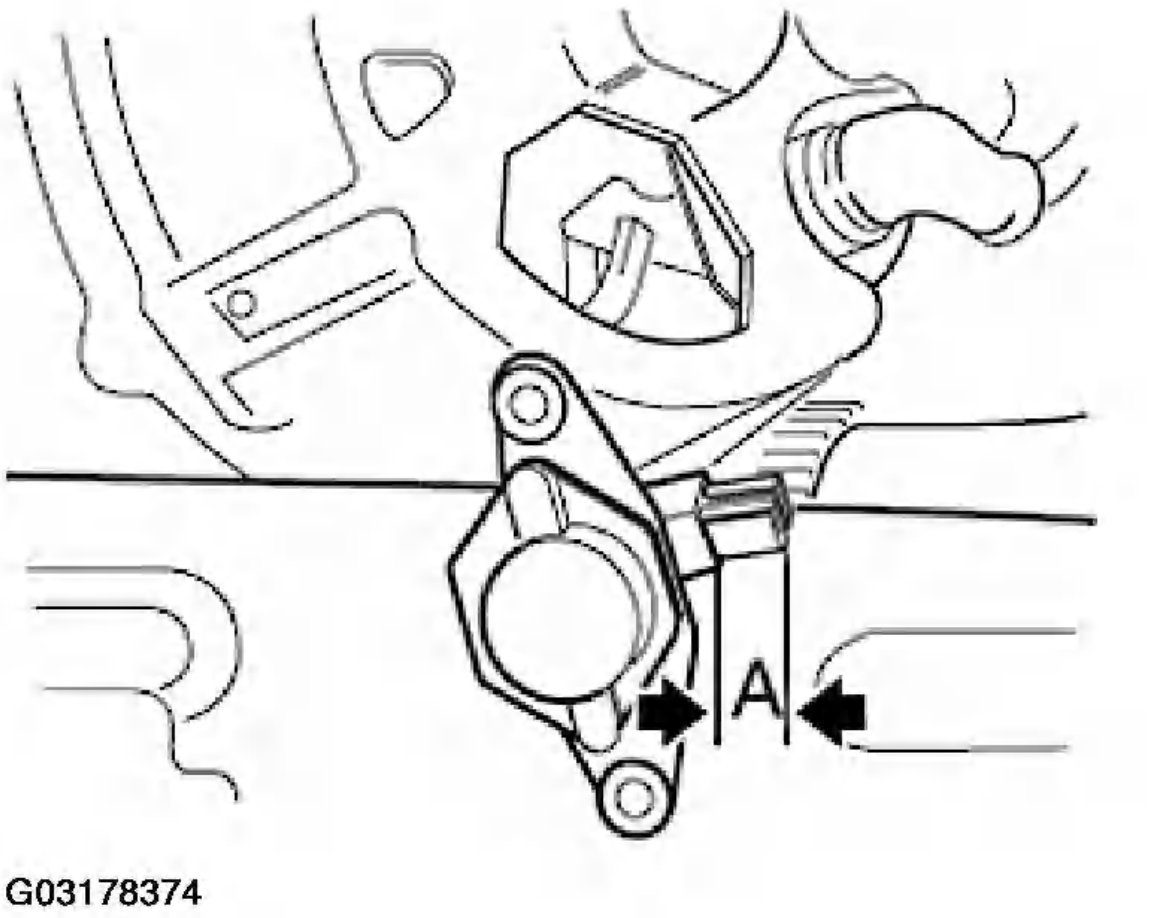


Fig. 81: Identifying Contact-Spring Tension
Courtesy of BMW OF NORTH AMERICA, INC.

12 32 501 REPLACING VOLTAGE REGULATOR (VALEO/BOSCH)

Read General Information in MG12. Refer to 12 00 ... DISCONNECTING AND CONNECTING TEST EQUIPMENT and 12 00... COMPONENT INSPECTION: .

Read fault memory.

Follow instructions for disconnecting and connecting battery. Refer to 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .

Disconnect battery ground wire.

Remove alternator. Refer to 12 31 020 REMOVING AND INSTALLING OR REPLACING ALTERNATOR (M52, M52TU, S50US, S52, M54, M56) .

Valeo alternator:

Release screws on cover.

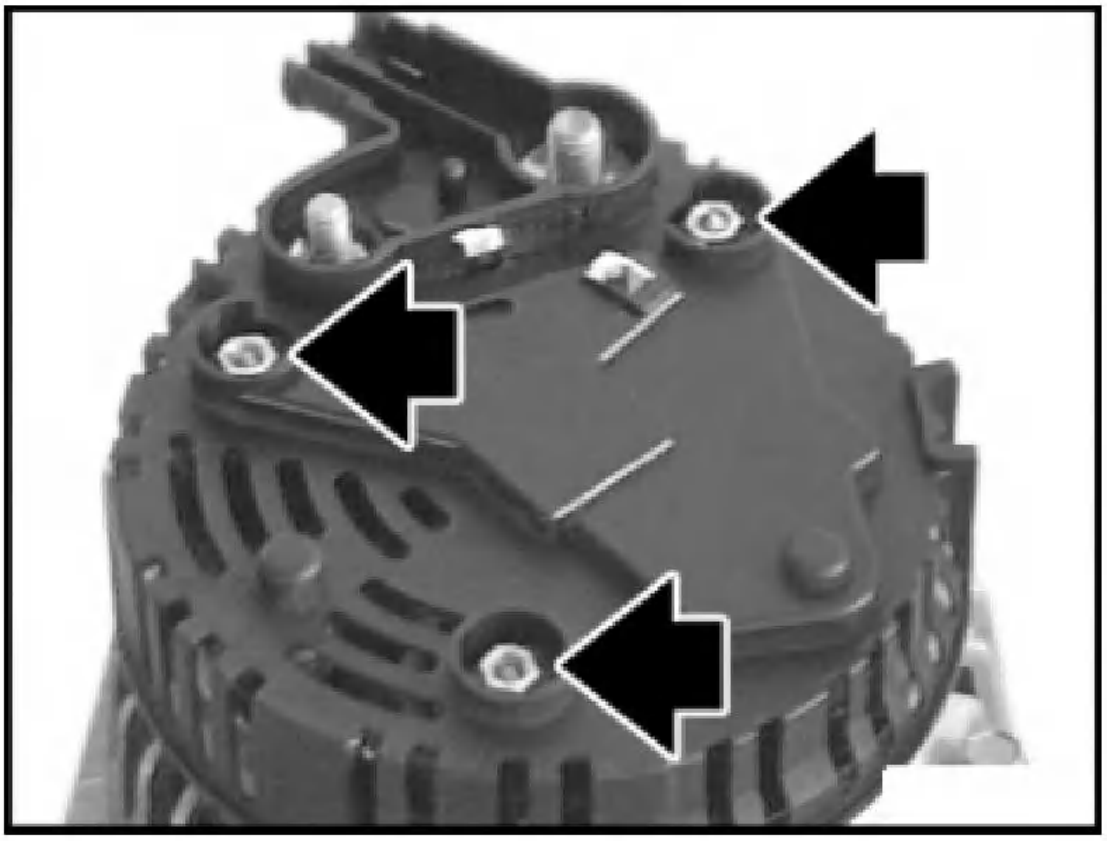
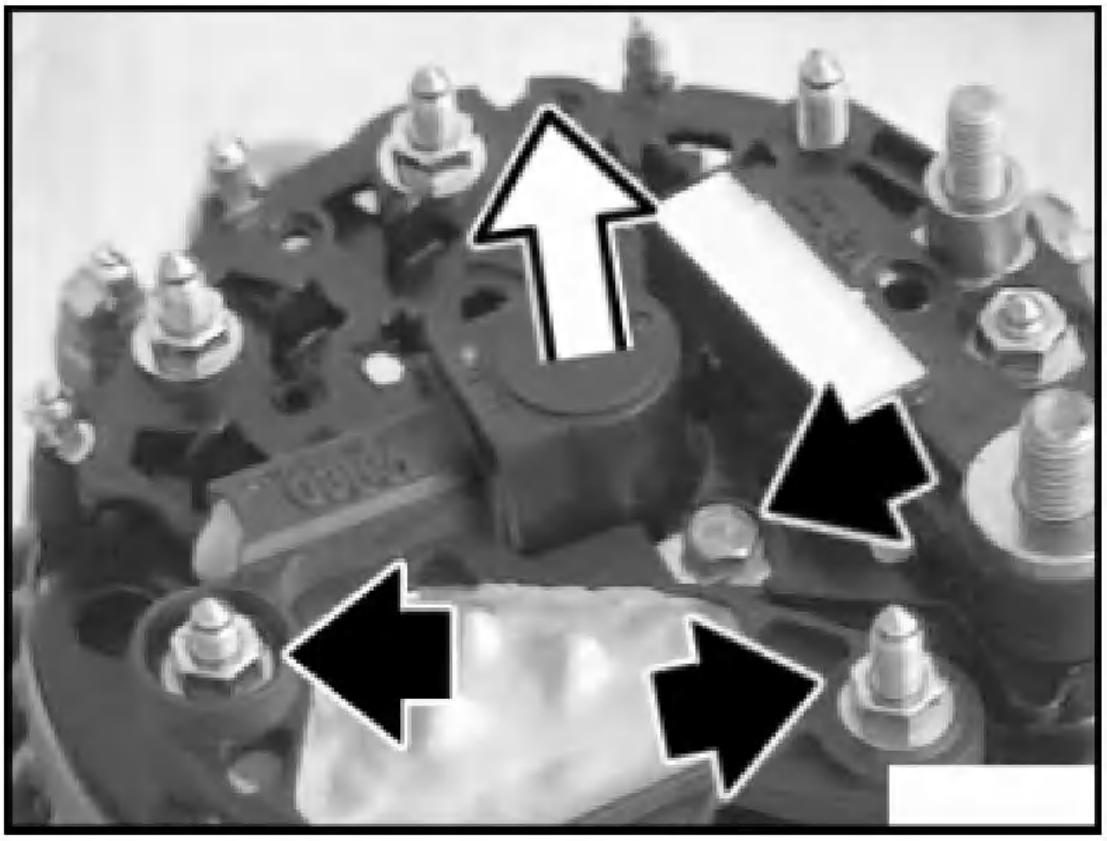


Fig. 82: Releasing Screws On Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws.



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Fig. 83: Removing Regulator Switch Screws
Courtesy of BMW OF NORTH AMERICA, INC.

Remove regulator switch.

Check contact surfaces of collector rings for wear and recondition if necessary.

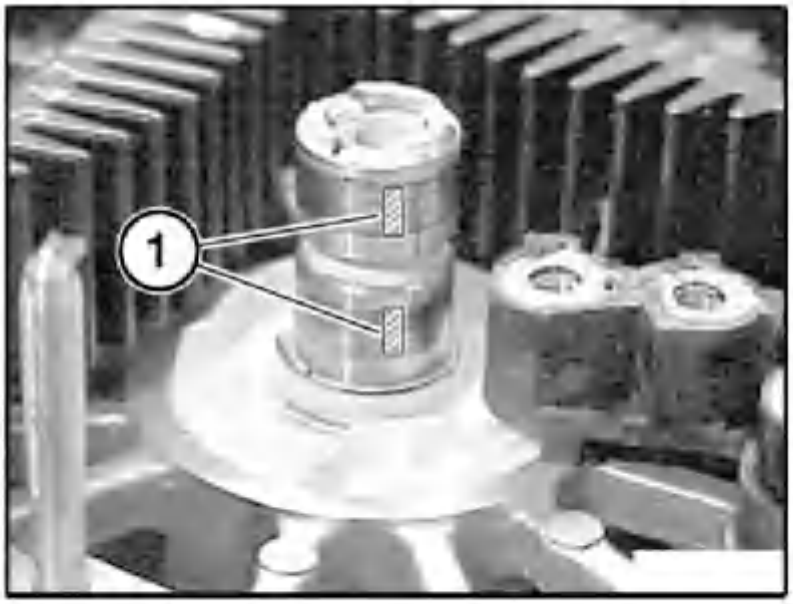


Fig. 84: Checking Contact Surfaces Of Collector Rings For Wear
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Install regulator switch with assembly cap.

Initially tighten nuts of regulator switch.

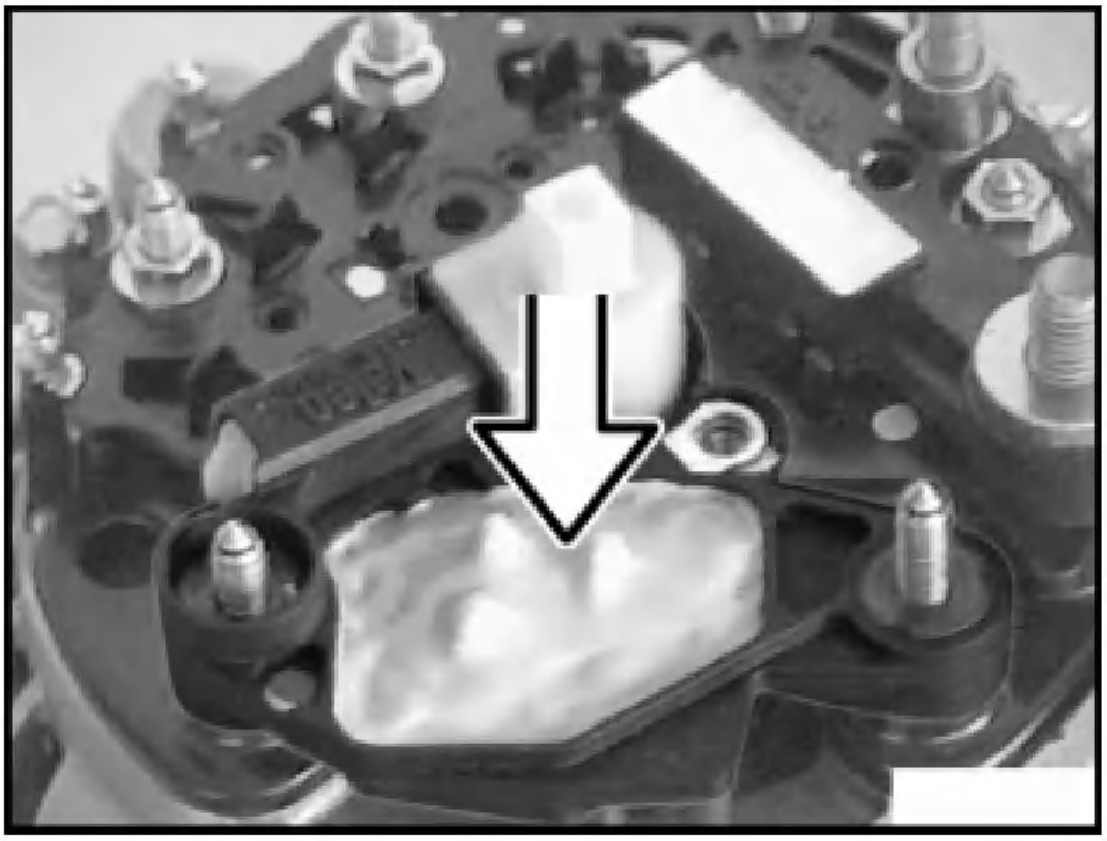


Fig. 85: Installing Regulator Switch With Assembly
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Remove assembly cap (1).

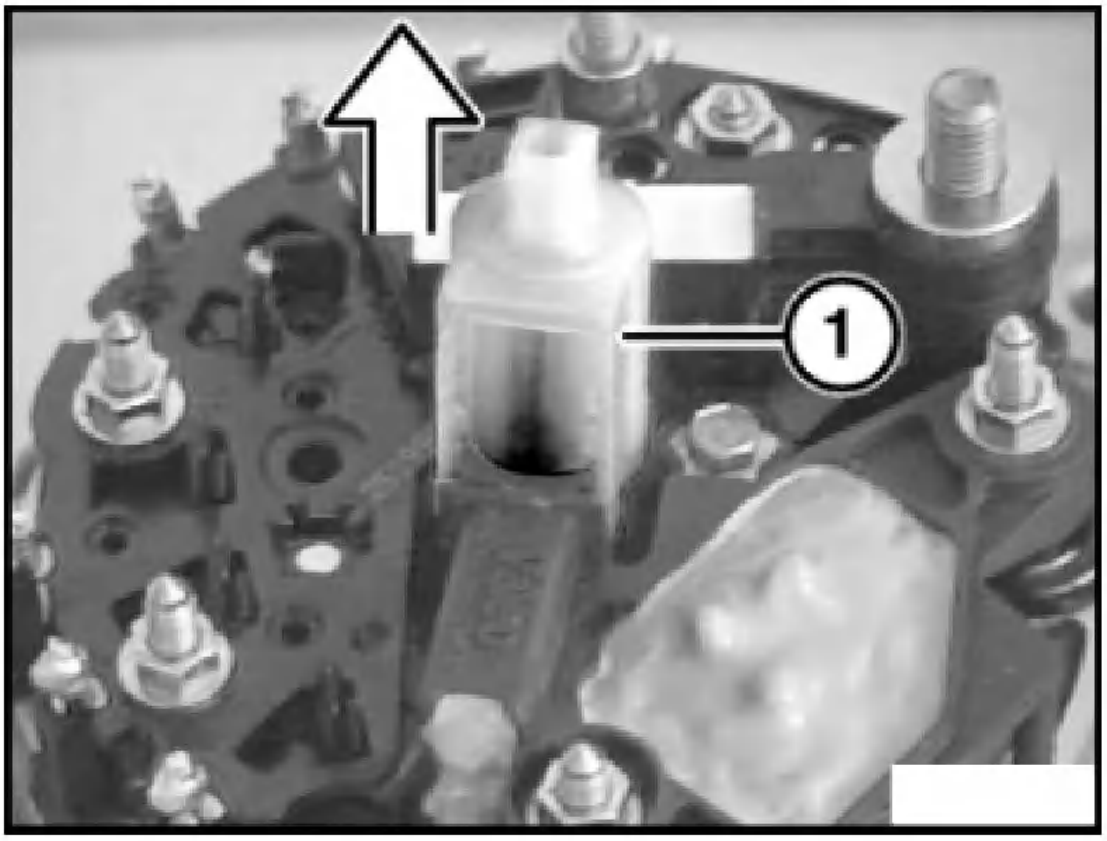


Fig. 86: Removing Assembly Cap
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Fit supplied cover cap (2).

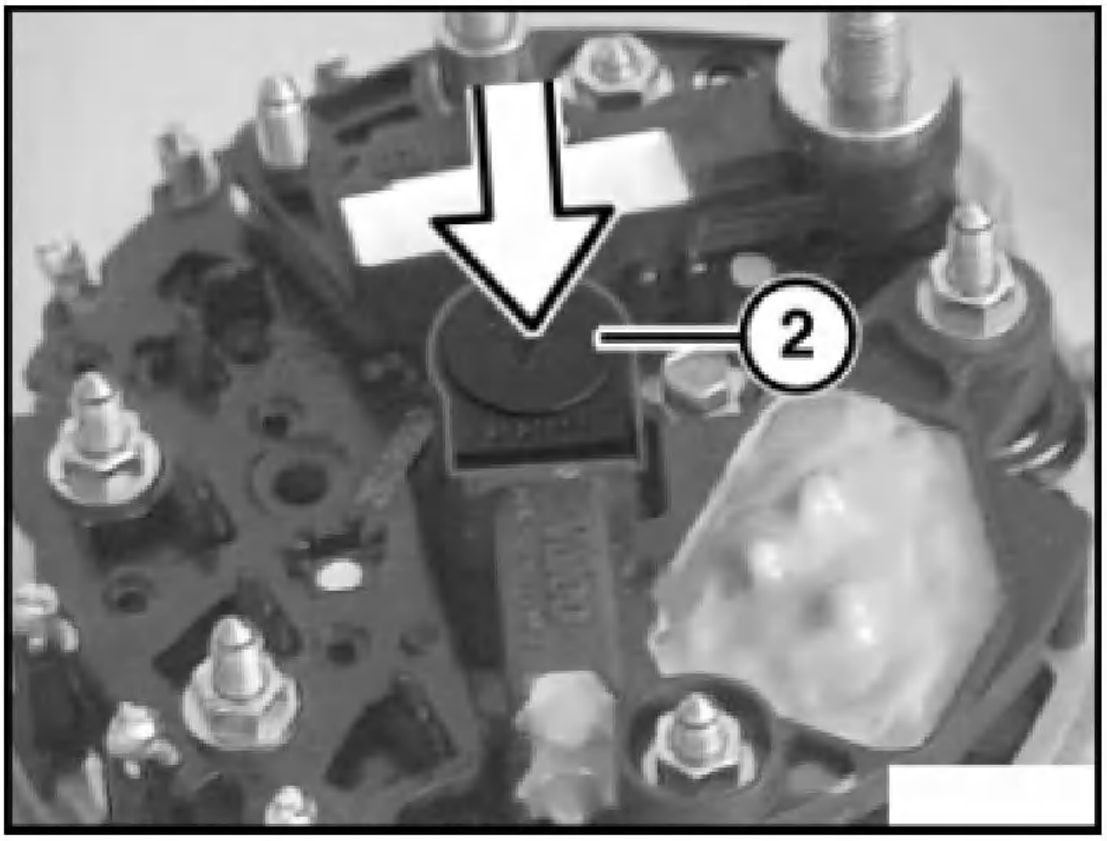


Fig. 87: Fitting Cover Cap
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down nuts and ground screw of regulator switch.

Tightening torque, 12 32 1AZ. Refer to 12 32 GOVERNOR .

Bosch Alternator:

Release screws on cover.

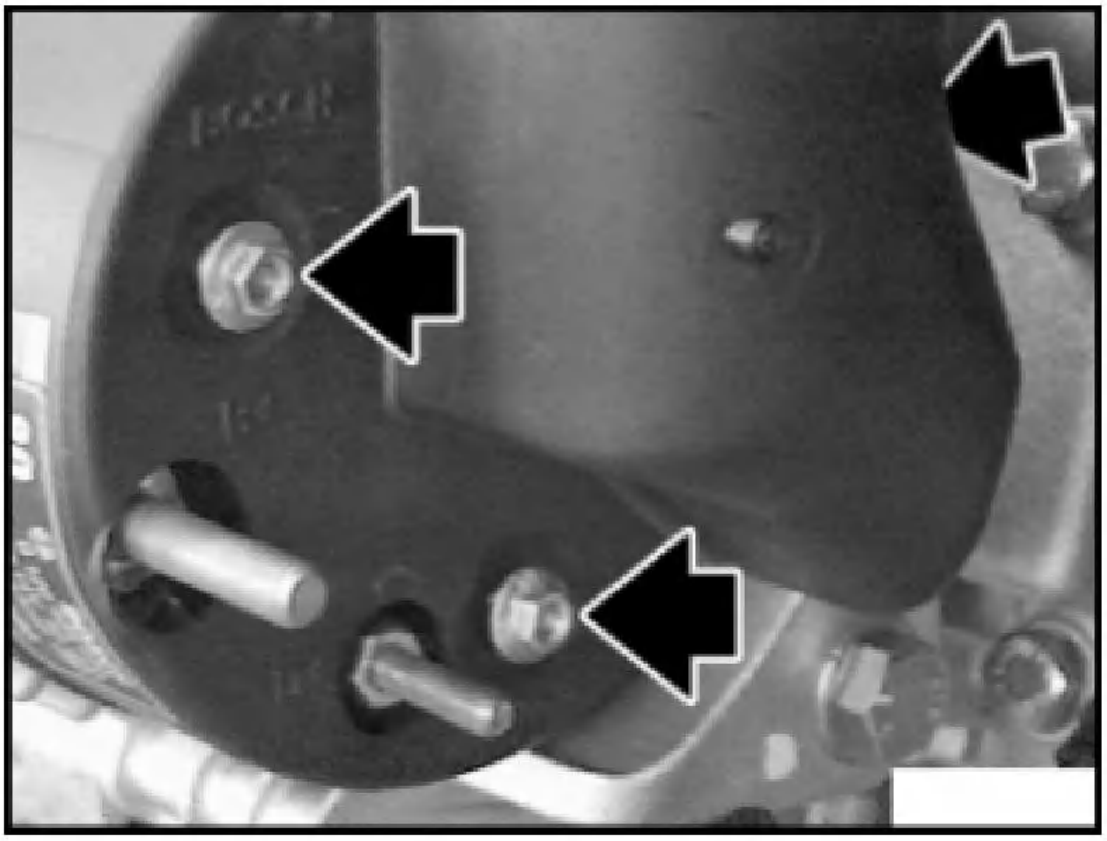


Fig. 88: Releasing Screws On Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws.

Remove regulator switch.

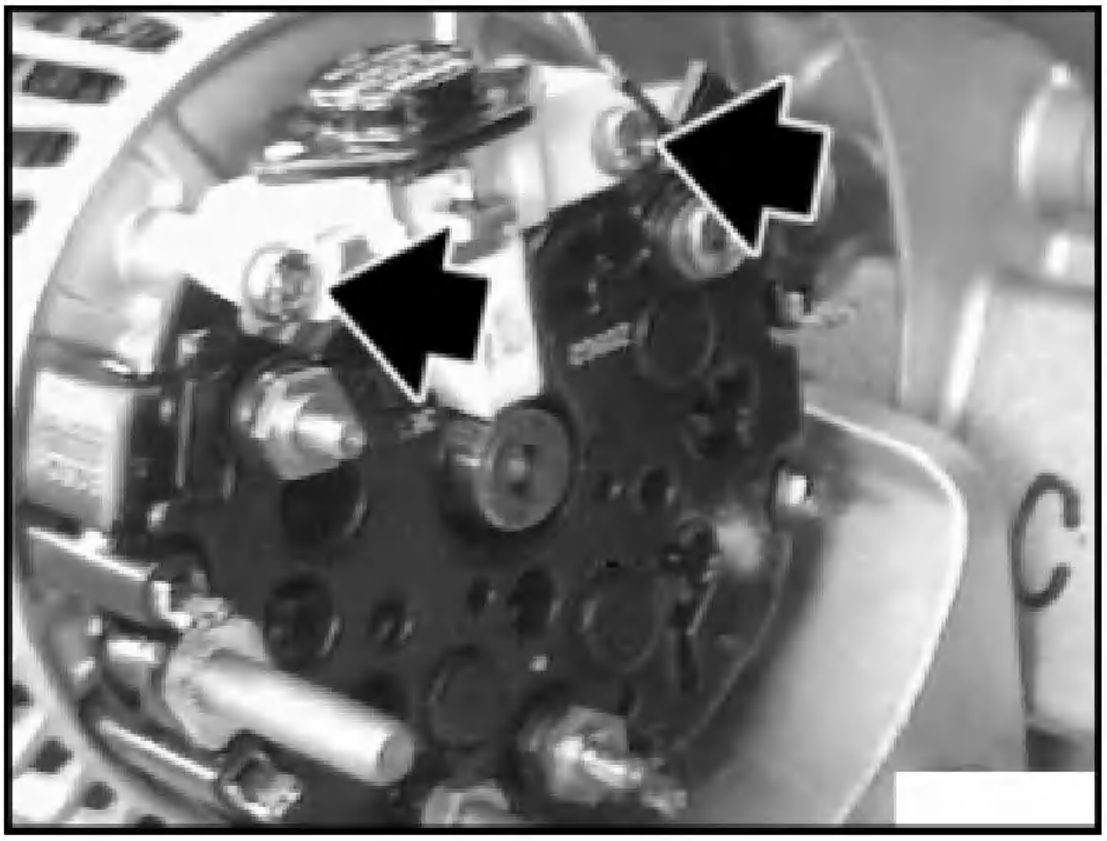


Fig. 89: Removing Regulator Switch
Courtesy of BMW OF NORTH AMERICA, INC.

Check contact surfaces of collector rings for wear and recondition if necessary.

STARTER WITH MOUNTING

12 41 020 REMOVING AND INSTALLING/REPLACING STARTER MOTOR (Z3 / M54)

Observe instructions for disconnecting and connecting battery. Refer to 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .

Disconnect battery negative lead from battery.

Perform following tasks from above:

Release nuts (1) and disconnect battery positive leads from starter motor.

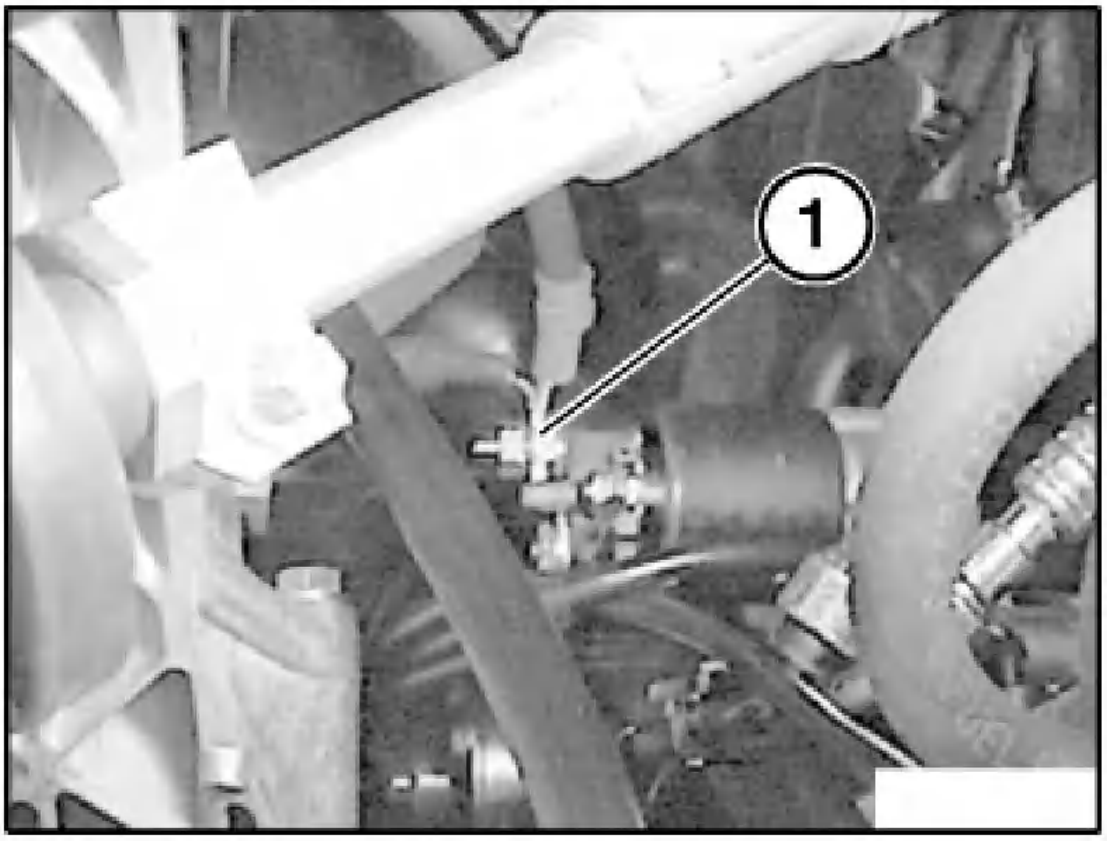


Fig. 90: Disconnecting Battery Positive Leads From Starter Motor
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Tightening torque, 12 41 4AZ. Refer to 12 41 STARTER AND MOUNTING PARTS .

Release nuts (1).

Installation:

Tightening torque, 12 41 4AZ. Refer to 12 41 STARTER AND MOUNTING PARTS .

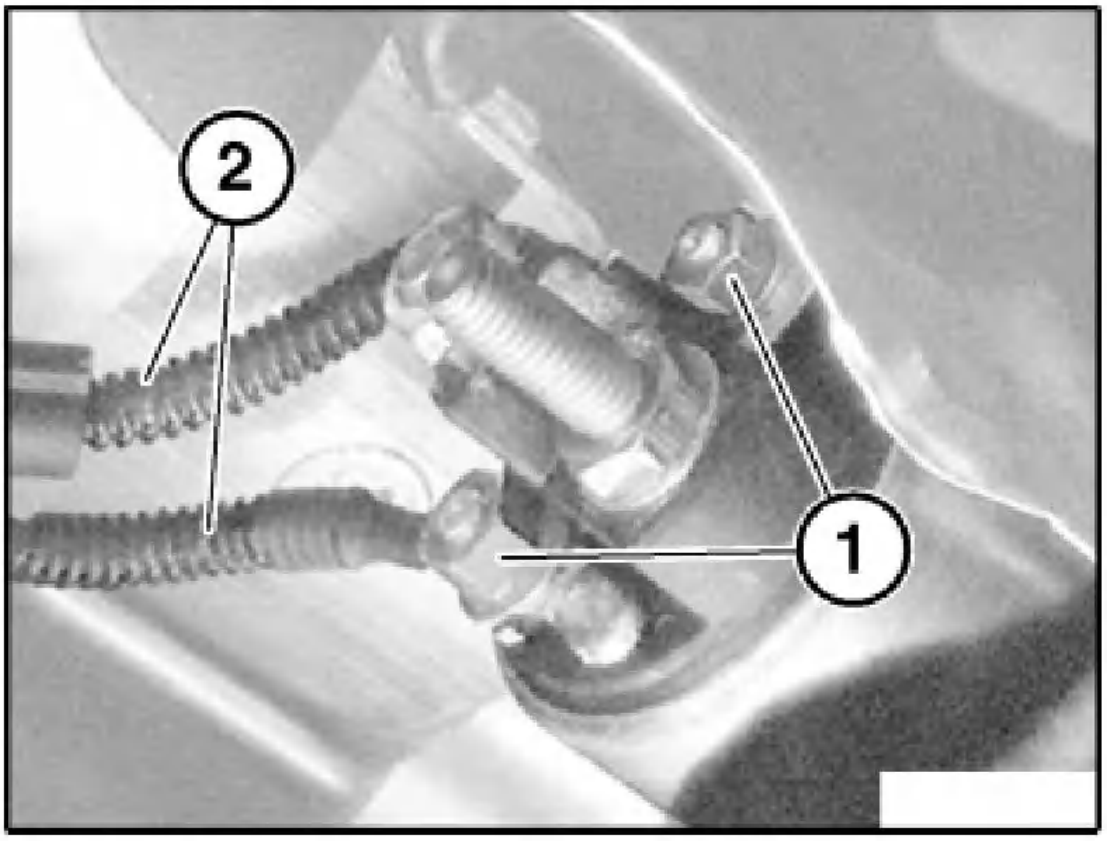


Fig. 91: Detaching Leads From Starter Motor
Courtesy of BMW OF NORTH AMERICA, INC.

Detach leads (2) from starter motor.

Detach cable duct (1) of B+ lead from firewall.

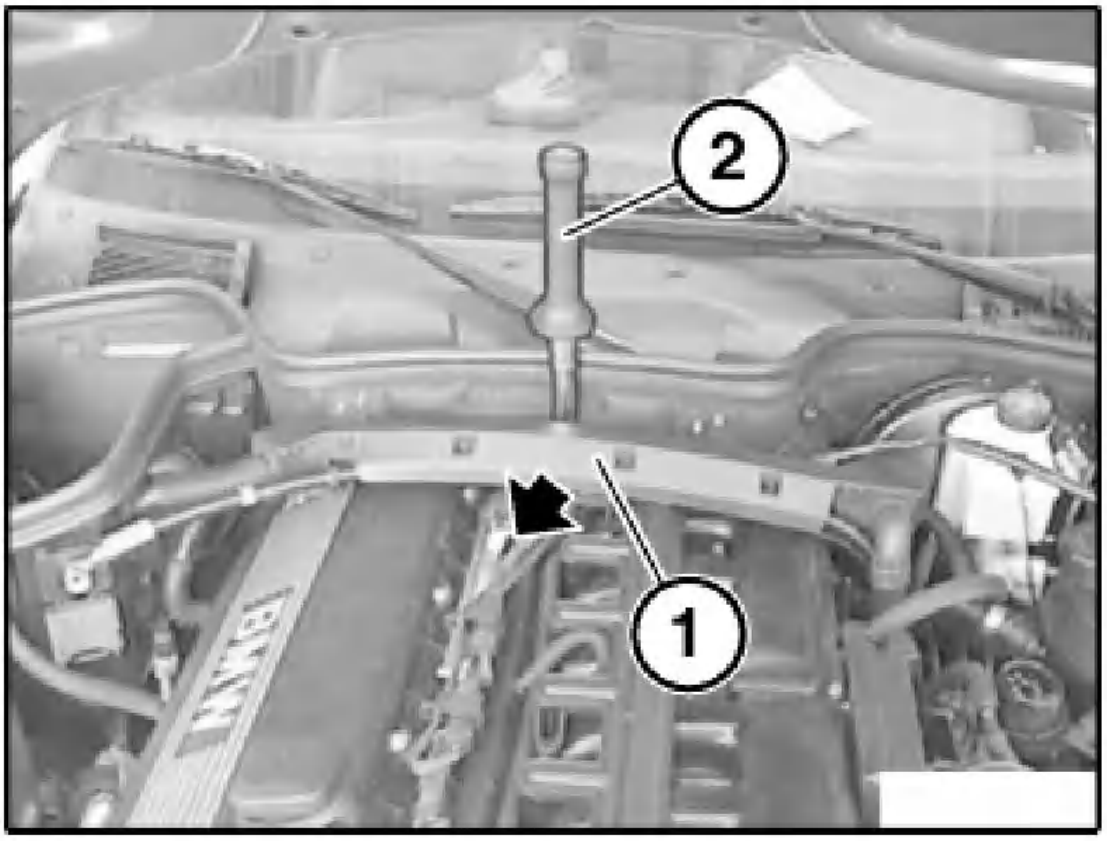


Fig. 92: Detaching Cable Duct Of B+ Lead From Firewall
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Detach heater valve from bracket in order to improve accessibility for torque tool (2).

Release starter motor screw (2) from upper vehicle side of transmission.

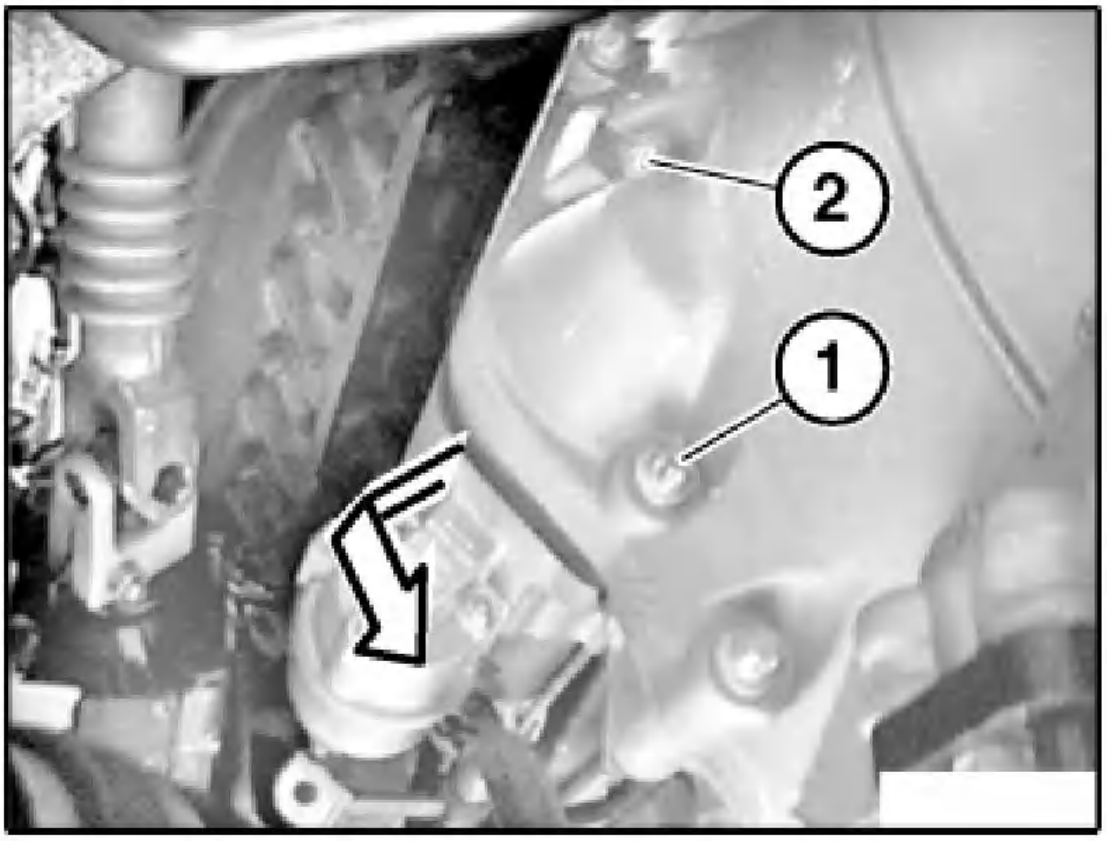


Fig. 93: Releasing Starter Motor Screw From Upper Vehicle Side Of Transmission
Courtesy of BMW OF NORTH AMERICA, INC.

Tightening torque, 12 41 1AZ. Refer to 12 41 STARTER AND MOUNTING PARTS .

Starter motor screw (1) is accessible from lower vehicle side. Working from transmission output end, release starter motor screw (1) with a long extension and a universal joint.

Tightening torque, 12 41 1AZ. Refer to 12 41 STARTER AND MOUNTING PARTS .

Lift out starter motor.

Installation:

Check starter motor pinion and ring gear for damage.

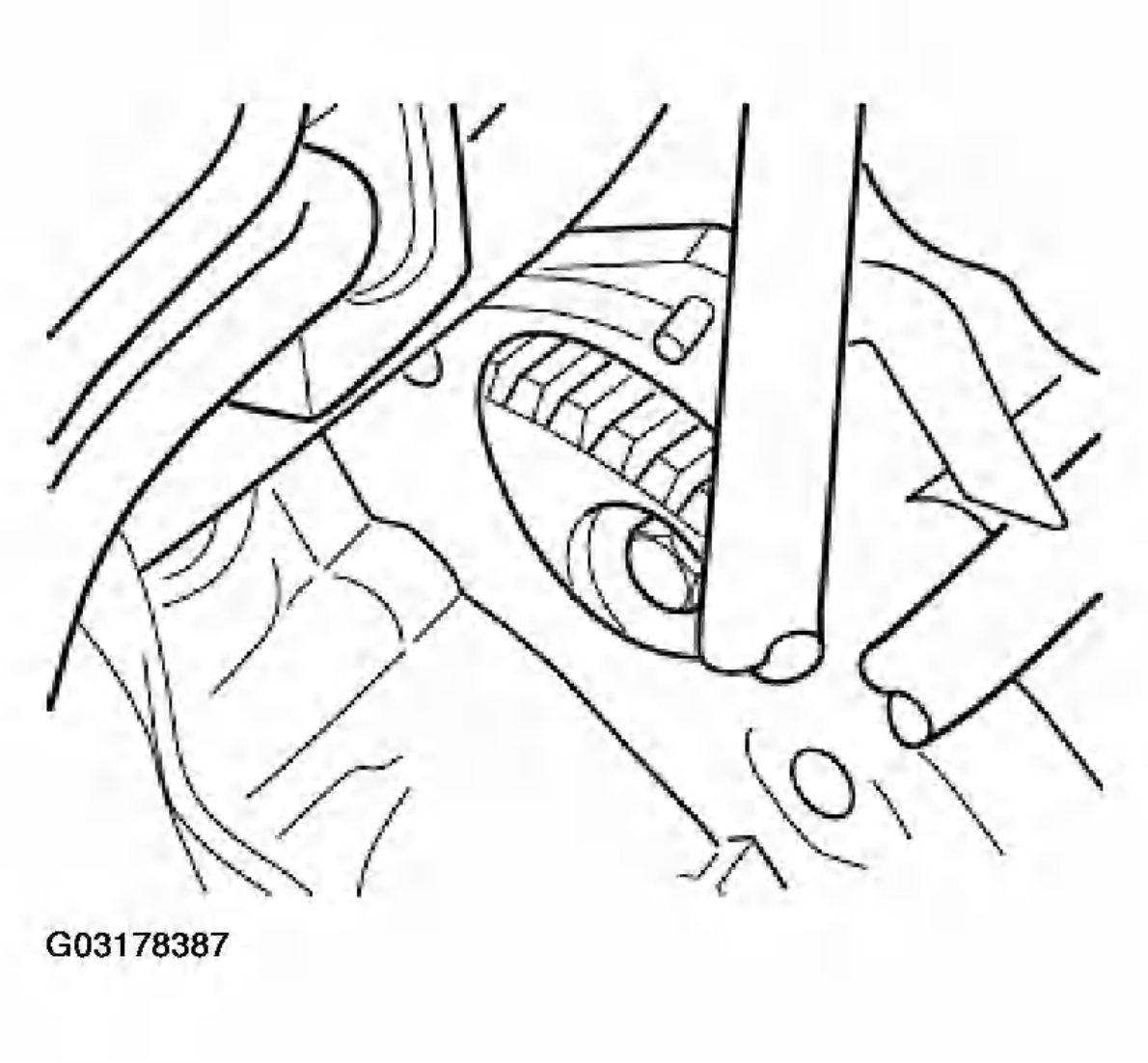


Fig. 94: Checking Starter Motor Pinion And Ring Gear For Damage
Courtesy of BMW OF NORTH AMERICA, INC.

12 41 041 REPLACING SOLENOID SWITCH

Turn off ignition.

Remove starter motor.

Release nut (1).

Remove cable lug (2).

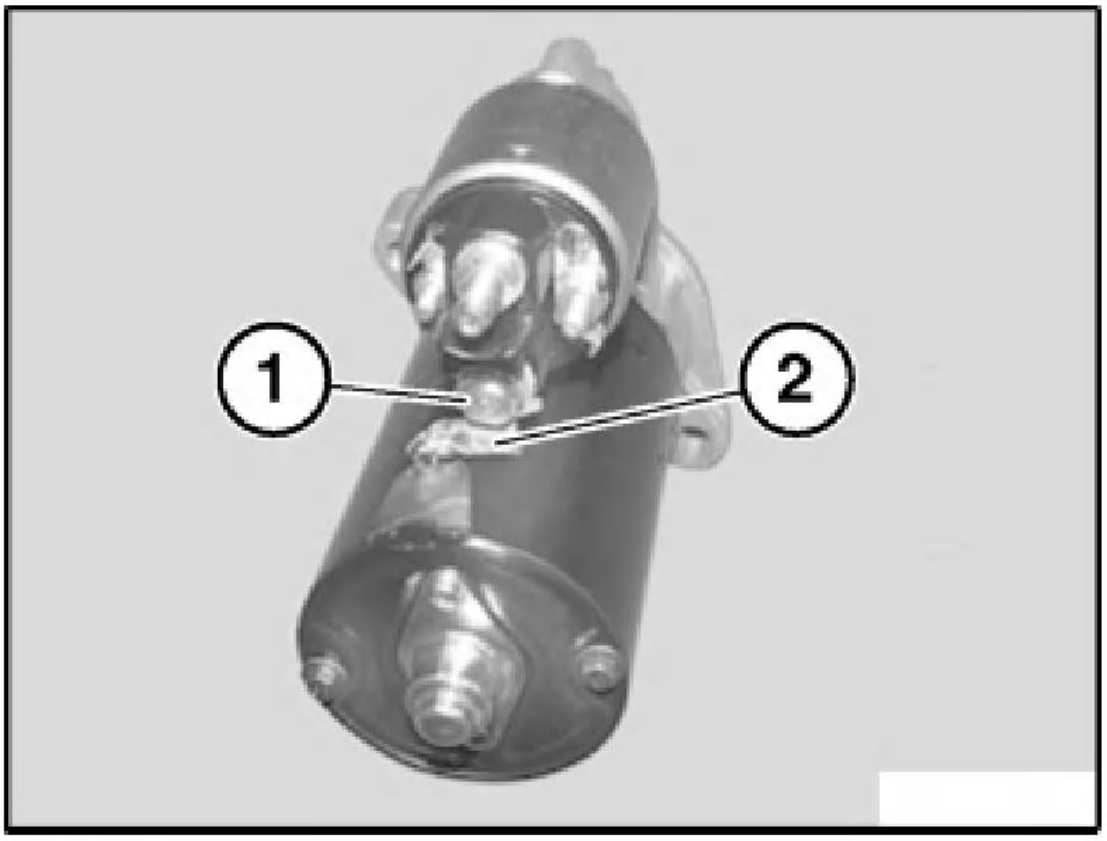


Fig. 95: Removing Cable Lug
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not turn cable lug (2) while tightening down - risk of short circuit to starter motor housing.Tightening torque, 12 41 4AZ. Refer to 12 41 STARTER AND MOUNTING PARTS .

Release screws (1).

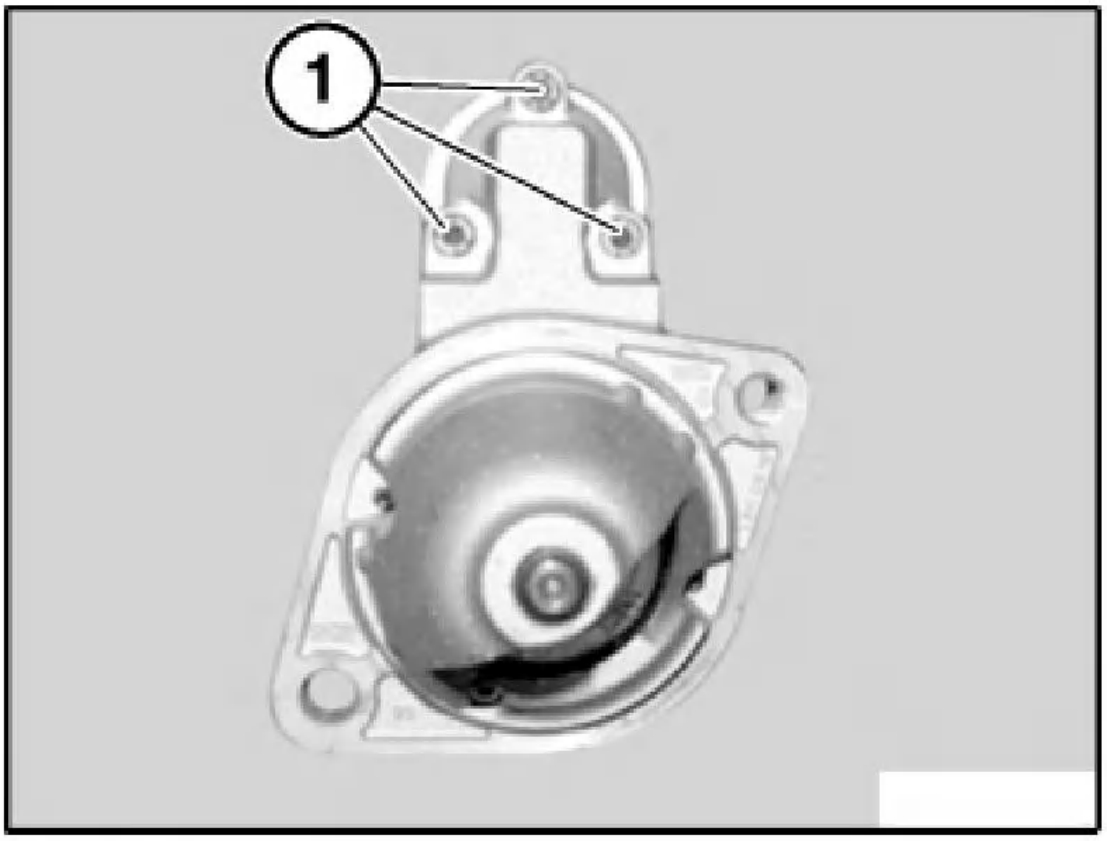


Fig. 96: Releasing Screws On Solenoid Switch
Courtesy of BMW OF NORTH AMERICA, INC.

Remove solenoid switch (1) and spring (2).

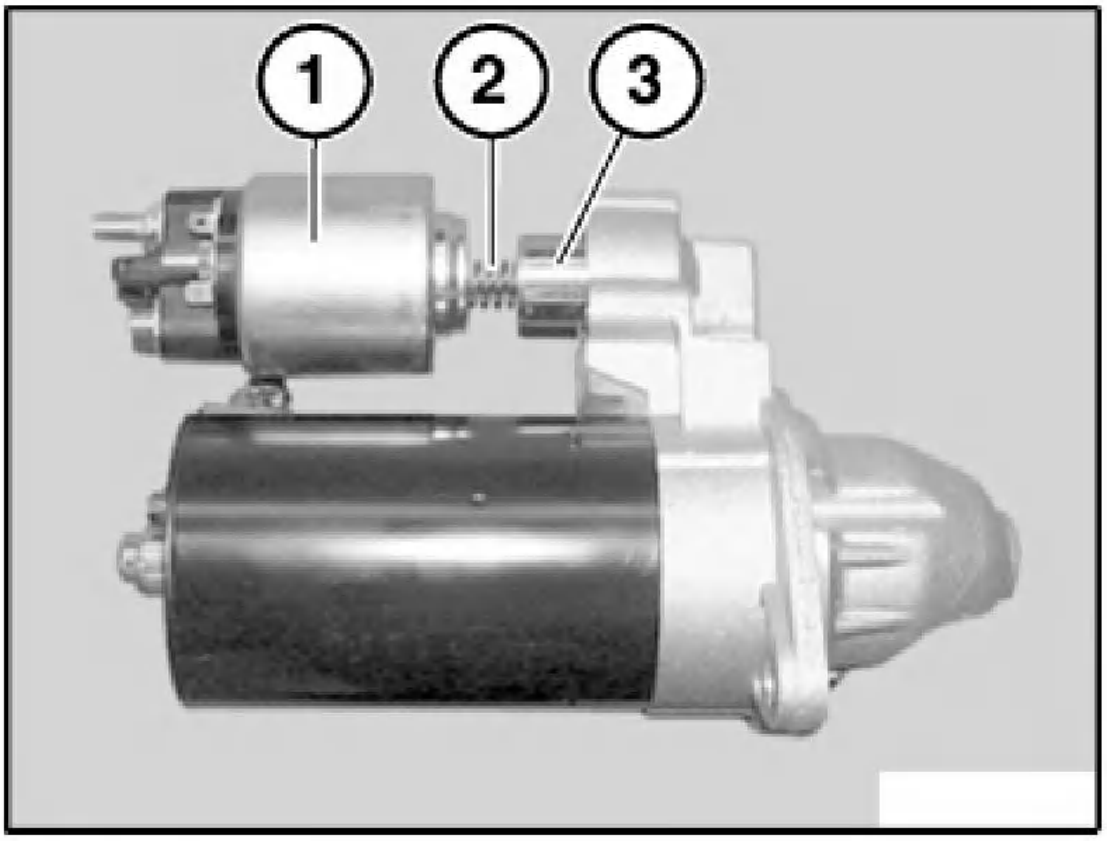


Fig. 97: Removing Solenoid Switch And Spring
Courtesy of BMW OF NORTH AMERICA, INC.

Unhook pin (3).

Installation:

Check pin (3) for wear and apply grease.

STARTER LEAD

12 42 510 REPLACING BATTERY POSITIVE LEAD Z3 M54 (BETWEEN STARTER MOTOR AND B+ SUPPORT POINT)

Read fault memory. Switch off ignition.

Observe safety instructions for handling vehicle battery. Refer to 61 00 ... SAFETY INSTRUCTIONS FOR HANDLING VEHICLE BATTERY .

Remove front underbody protection.

Observe instructions for disconnecting and connecting battery. Refer to 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .

Disconnect battery negative lead from battery and lay to one side.

Unclip battery positive lead by undoing clips.

Feed battery positive lead (1) out of cable duct.

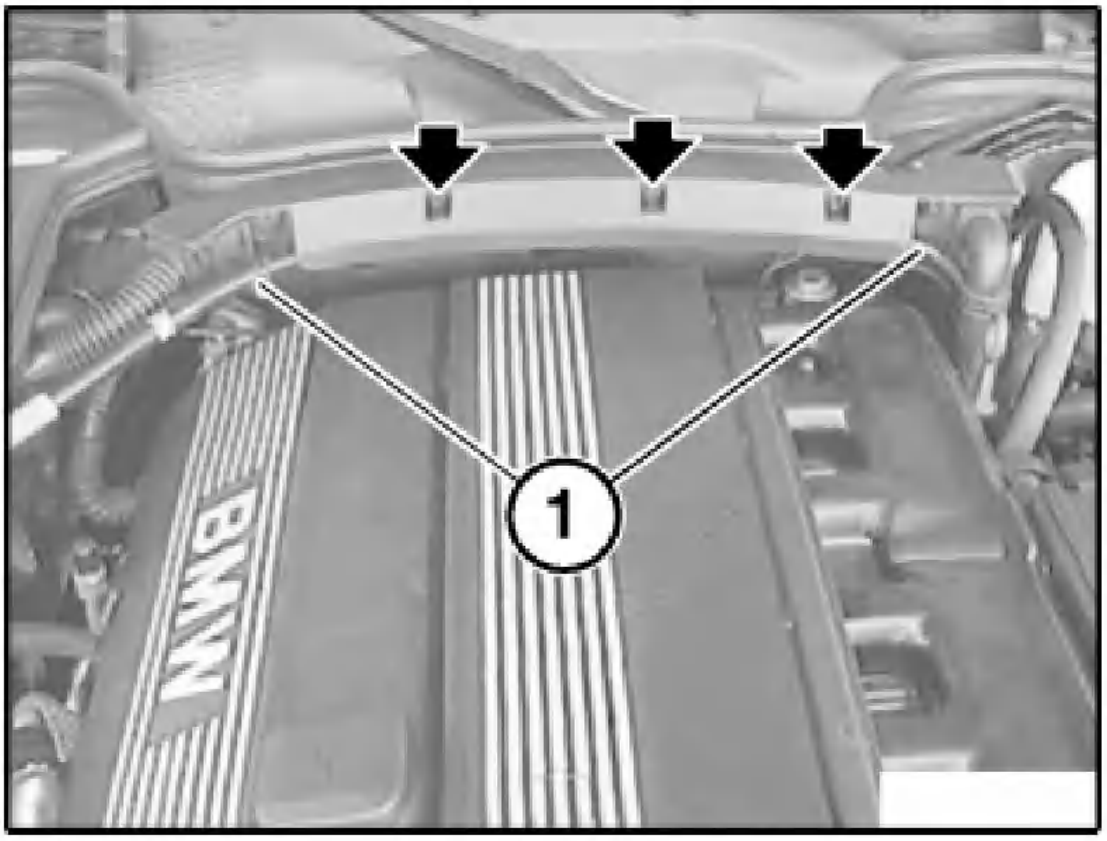


Fig. 98: Feeding Battery Positive Lead Out Of Cable Duct
Courtesy of BMW OF NORTH AMERICA, INC.

Fold cover cap (1) down.

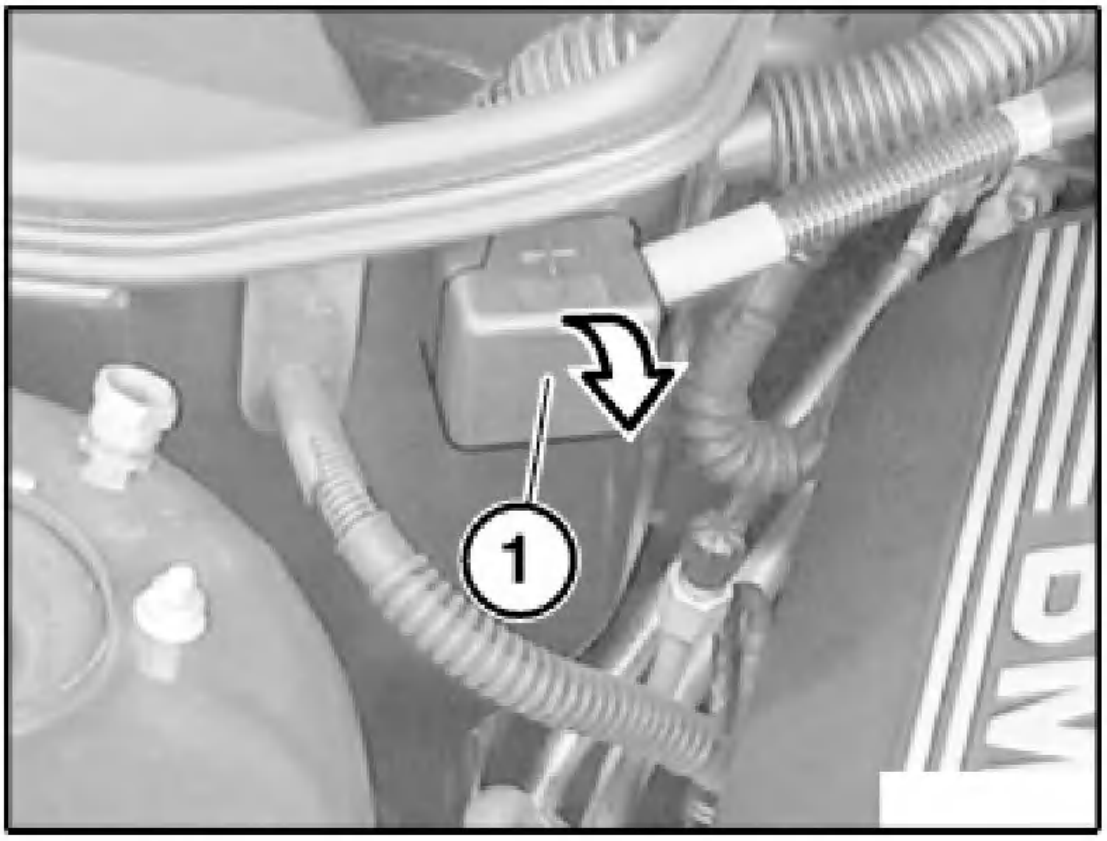


Fig. 99: Folding Cover Cap Down
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut (2).

Installation:

Tightening torque, 12 51 4AZ. Refer to 12 51 ENGINE WIRING HARNESS .

Disconnect battery positive lead (3) from connection point.

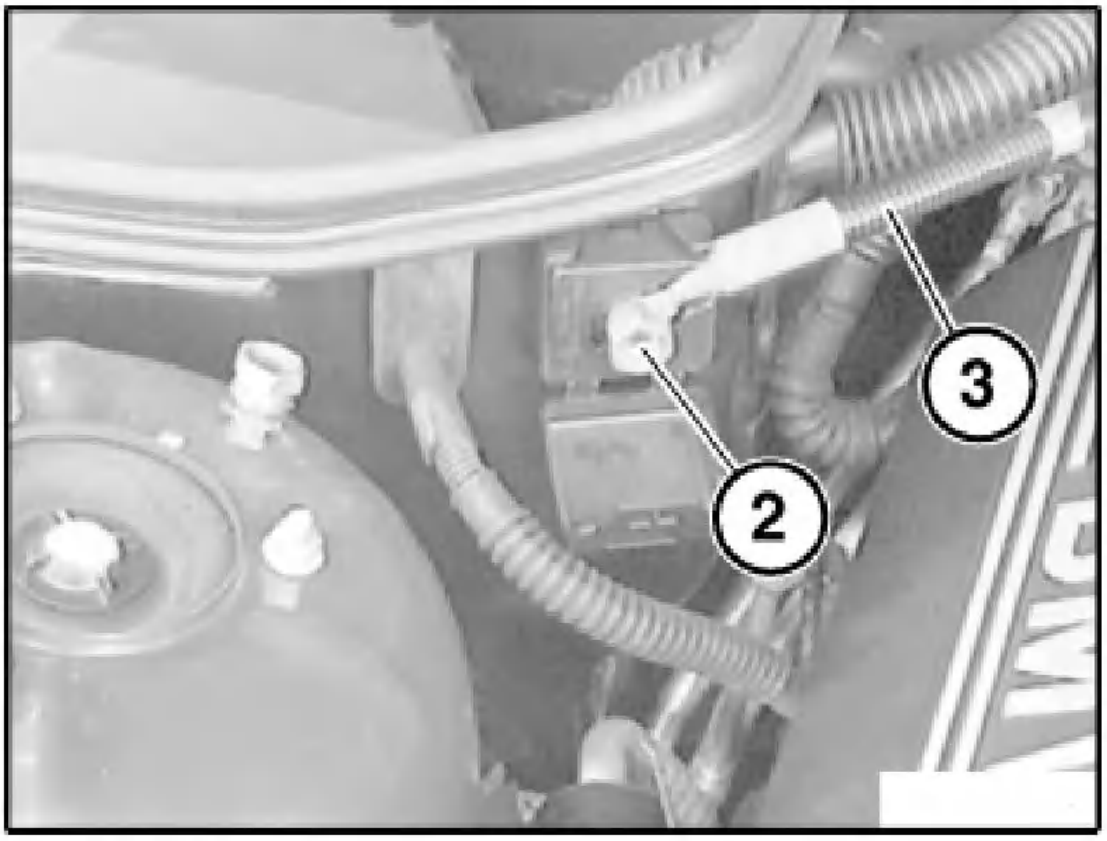


Fig. 100: Disconnecting Battery Positive Lead From Connection Point
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut (1).

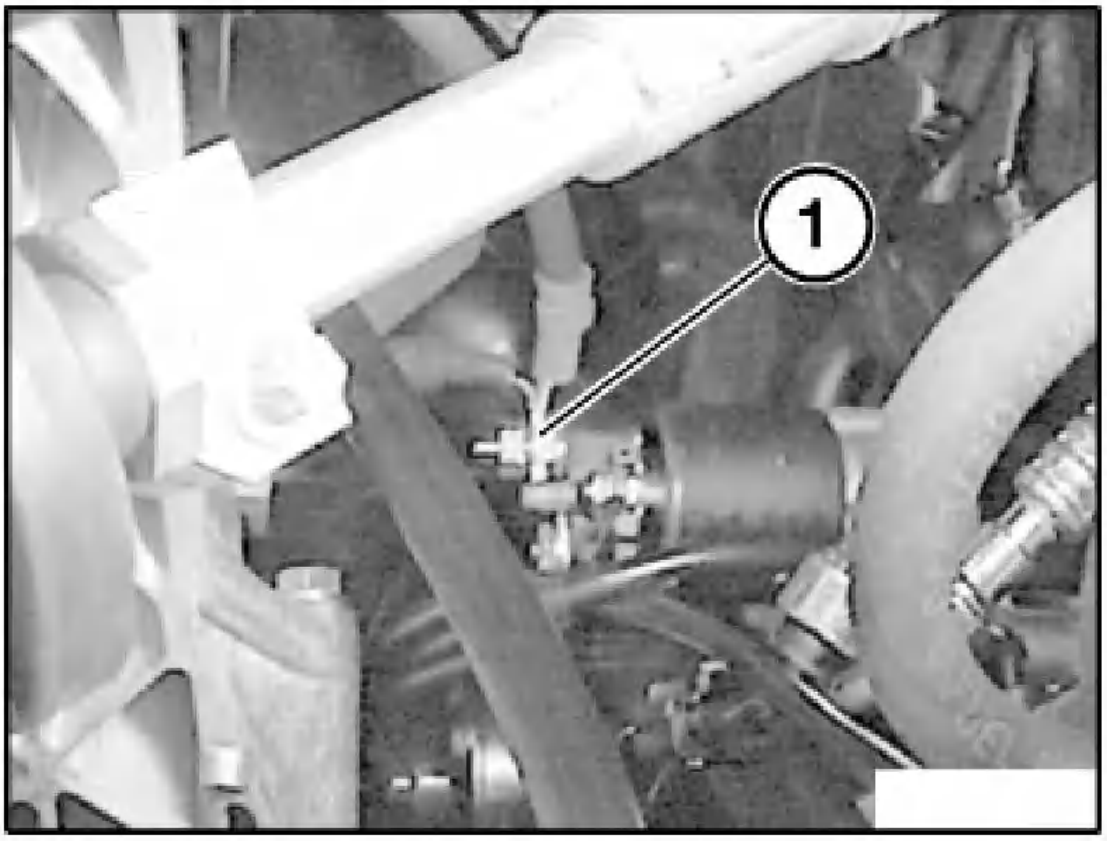


Fig. 101: Disconnecting Battery Positive Lead From Starter Motor
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Tightening torque, 12 41 4AZ. Refer to 12 41 STARTER AND MOUNTING PARTS .

Disconnect battery positive lead from starter motor.

NOTE: Interrogate fault memory of DME control unit.

Check stored fault messages.

Rectify faults.

Then clear fault memory.

12 42 540 REPLACING SAFETY BATTERY TERMINAL (SBK)

CAUTION: Observe safety regulations. Refer to AIR BAG SAFETY PRECAUTIONS for 2001 models, and AIR BAG SAFETY PRECAUTIONS for 2002 models. Investigate cause of triggering of safety battery terminal. To do so, read out fault memory of airbag control unit. Note fault messages stored in memory. Rectify faults. Then clear fault memory.

Use of safety battery terminal:

- From 4/99 in E36/Z3.
- In each of following new Series.

The different models have different installation locations:

Battery In Engine Compartment:

Safety battery terminal is replaced with cable up to battery positive support point.

Battery In Luggage Compartment Behind Side Trim Panel:

Remove side trim panel.

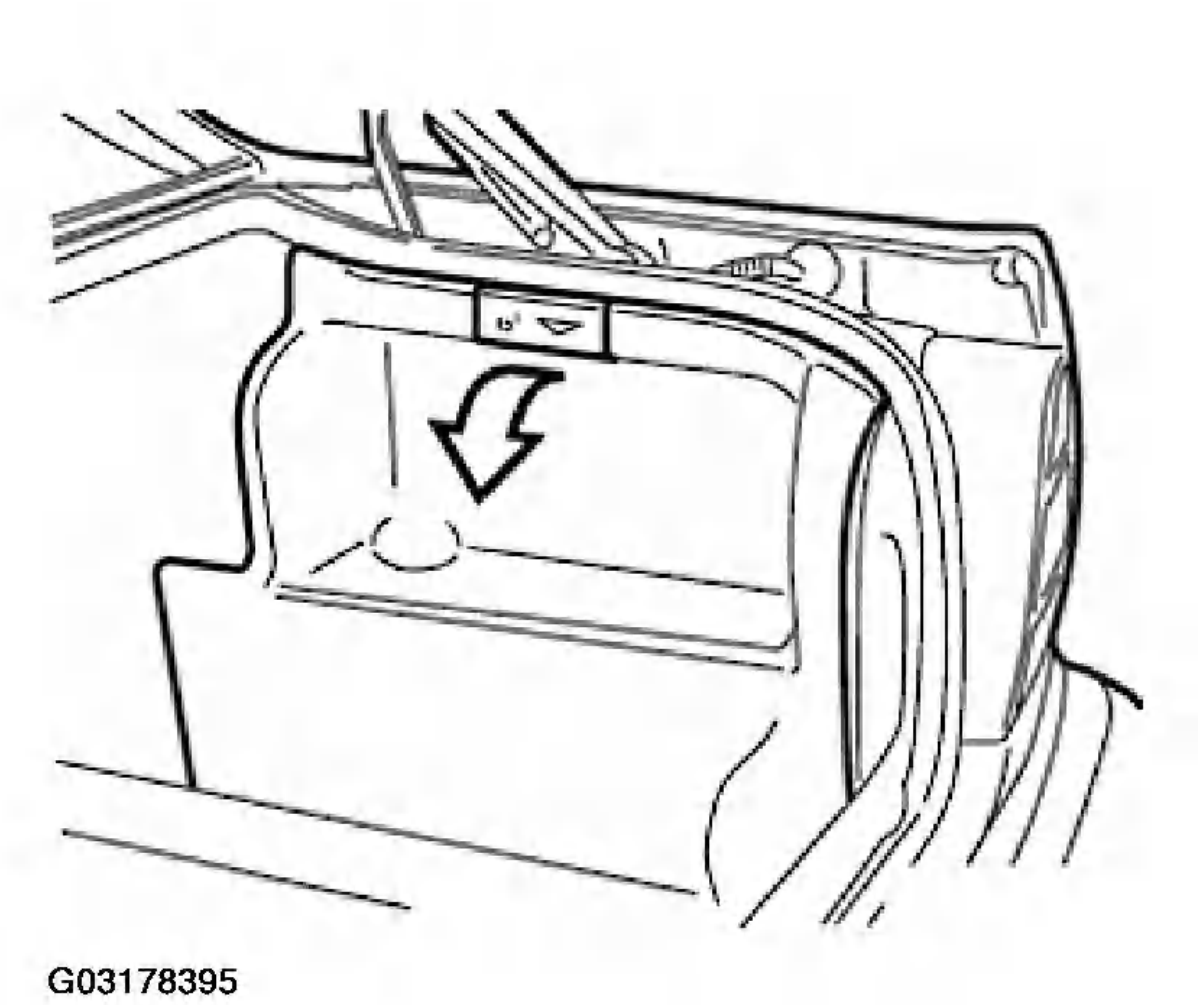


Fig. 102: Removing Side Trim Panel
Courtesy of BMW OF NORTH AMERICA, INC.

Follow instructions for disconnecting and connecting battery. Refer to 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .

Disconnect and cover battery negative lead.

Release front side trim panel partly and fold forward.

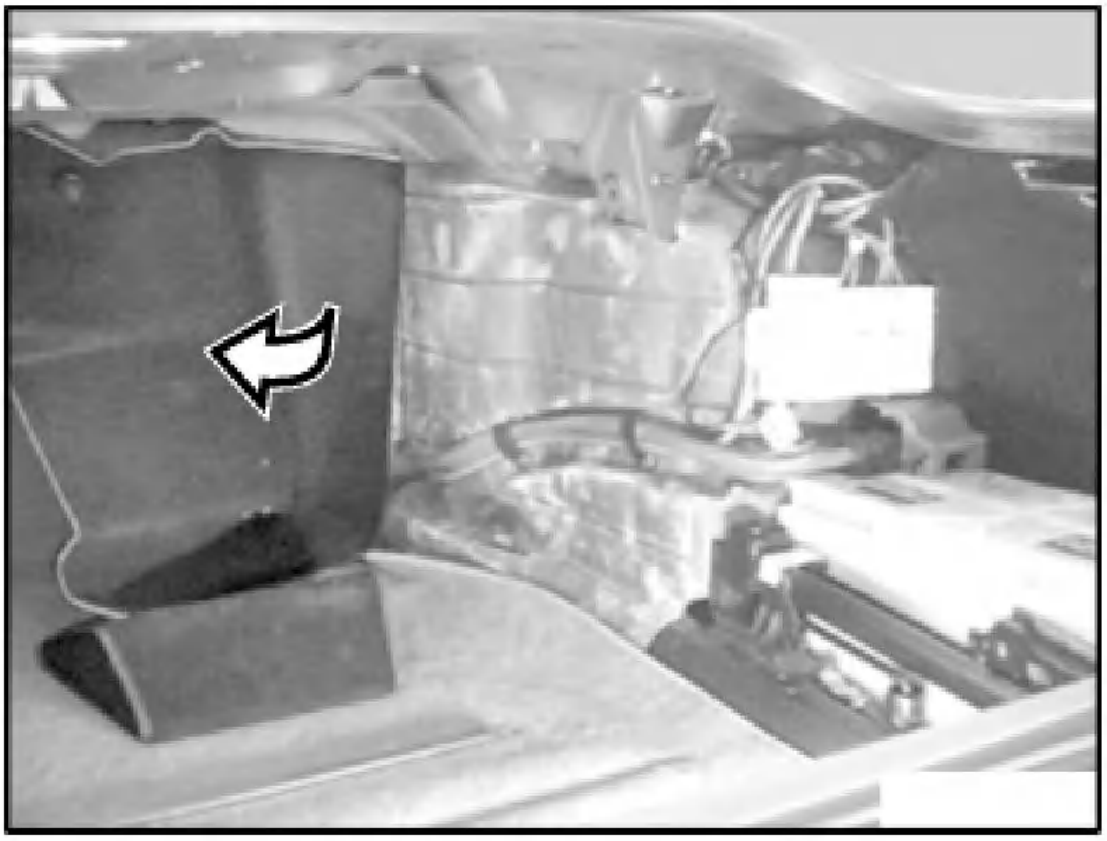


Fig. 103: Releasing Front Side Trim Panel
Courtesy of BMW OF NORTH AMERICA, INC.

Battery In Luggage Compartment Under Floor Trim Panel:

Follow instructions for disconnecting and connecting battery. Refer to 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .

Fold back floor trim panel (1).

Lift cover (2) on battery negative lead.

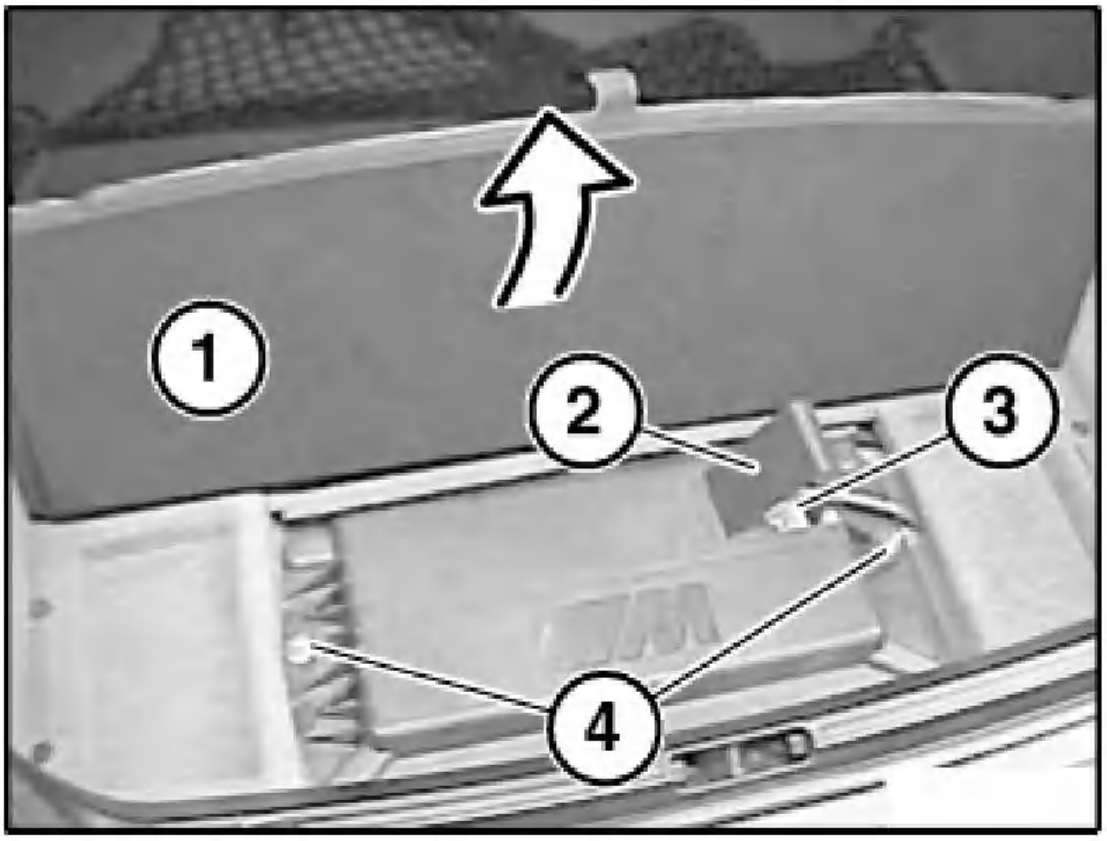


Fig. 104: Lifting Battery Negative Lead Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect and cover battery negative lead (3).

Release nuts (4).

Remove battery cover.

Battery In Luggage Compartment Under Spare Wheel:

Remove spare wheel.

Release screws.

CAUTION: Do not kink air pipes.

Set air supply system (1) to one side.

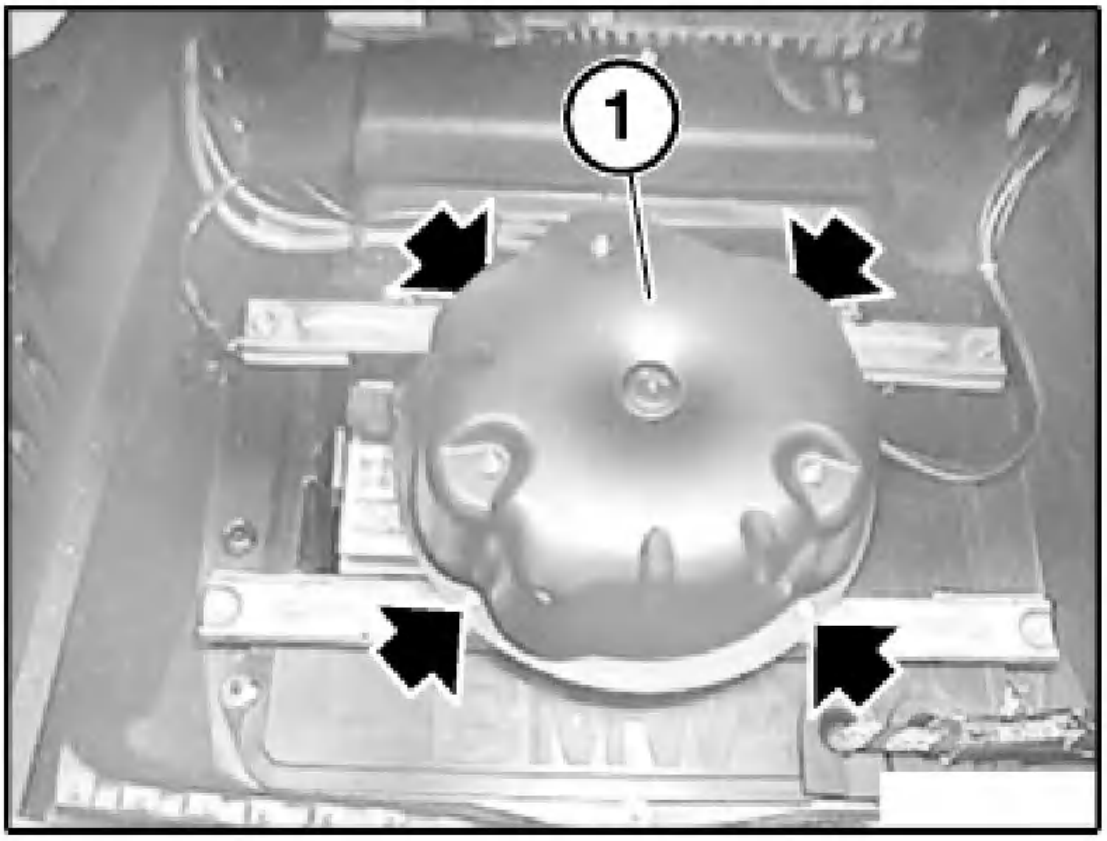


Fig. 105: View Of Air Supply System
Courtesy of BMW OF NORTH AMERICA, INC.

Follow instructions for disconnecting and connecting battery. Refer to 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .

Disconnect battery negative lead.

Disconnect supply cable (1) for vehicle electrical system.

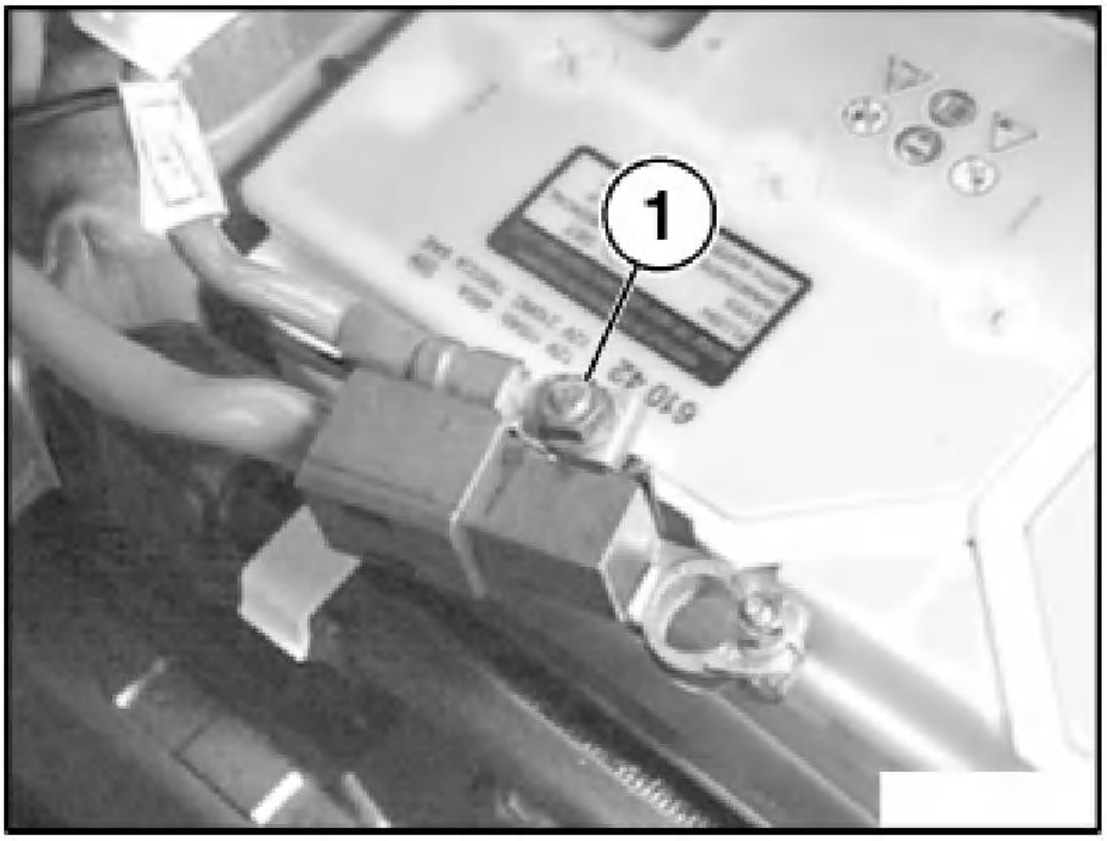


Fig. 106: Removing Supply Cable For Vehicle Electrical System
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Remove faulty fuses and carry out troubleshooting.

CAUTION: Pay attention to interface. The repair cable is always a standard length. The heavy-current connector of the repair cable has a larger diameter than the battery positive lead. In some Series (e.g. E46 touring), the heavy-current connector of the repair cable can lead to installation problems. This is the case when the interface is in the area of the close-fitting trim panels. Find matching interface (e.g. approx. 10 cm behind rear seat backrest in E46 touring

Lay repair cable parallel to battery positive lead.

Mark interface of battery positive lead at end of repair cable.

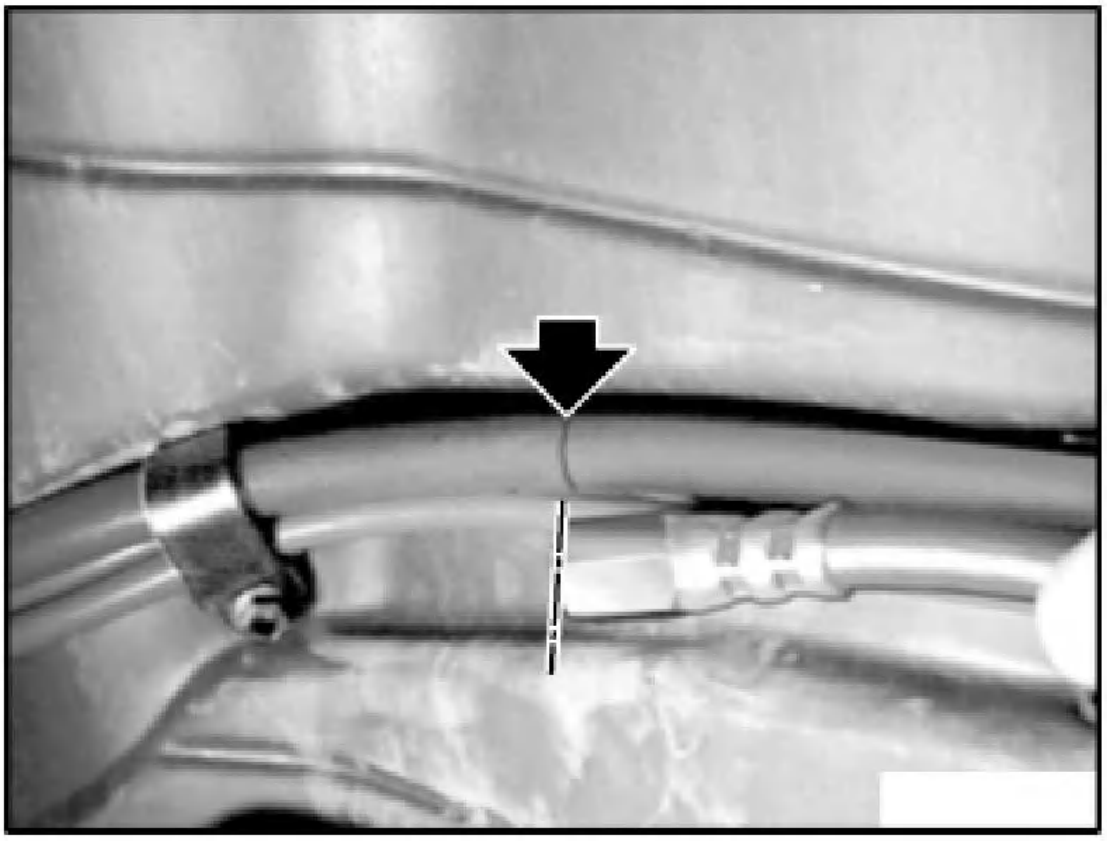


Fig. 107: Marking Interface of Repair Cable To Battery Positive Lead
Courtesy of BMW OF NORTH AMERICA, INC.

Release cable ties (1).

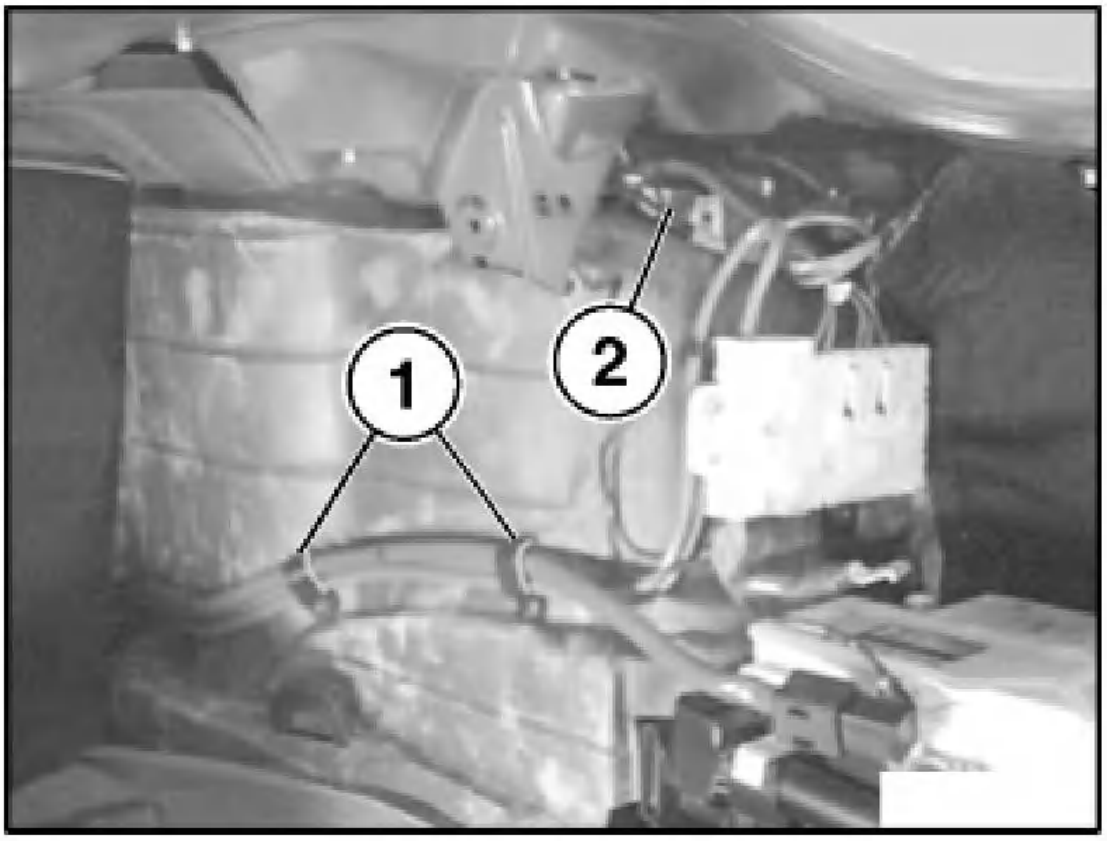


Fig. 108: Releasing Cable Ties
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (2).

CAUTION: Do not use bolt cutters or similar tools to cut through the cable. A cable end that has been squashed flat will no longer fit into the clamping sleeve.

Saw through battery positive cable at marked point with an iron saw.

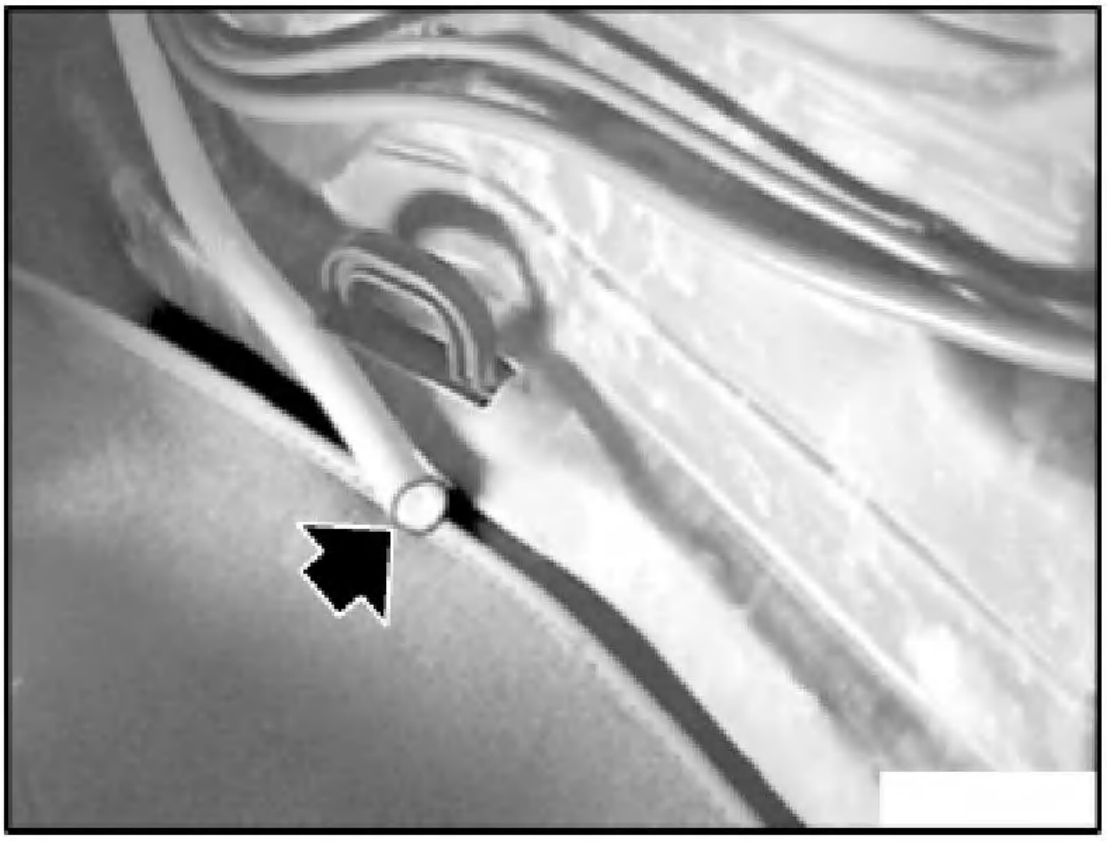


Fig. 109: Identifying Positive Battery Cable Cut At Marked Point
Courtesy of BMW OF NORTH AMERICA, INC.

Strip insulation - length (A) - from cable end.

Distance (A) = 15 mm.

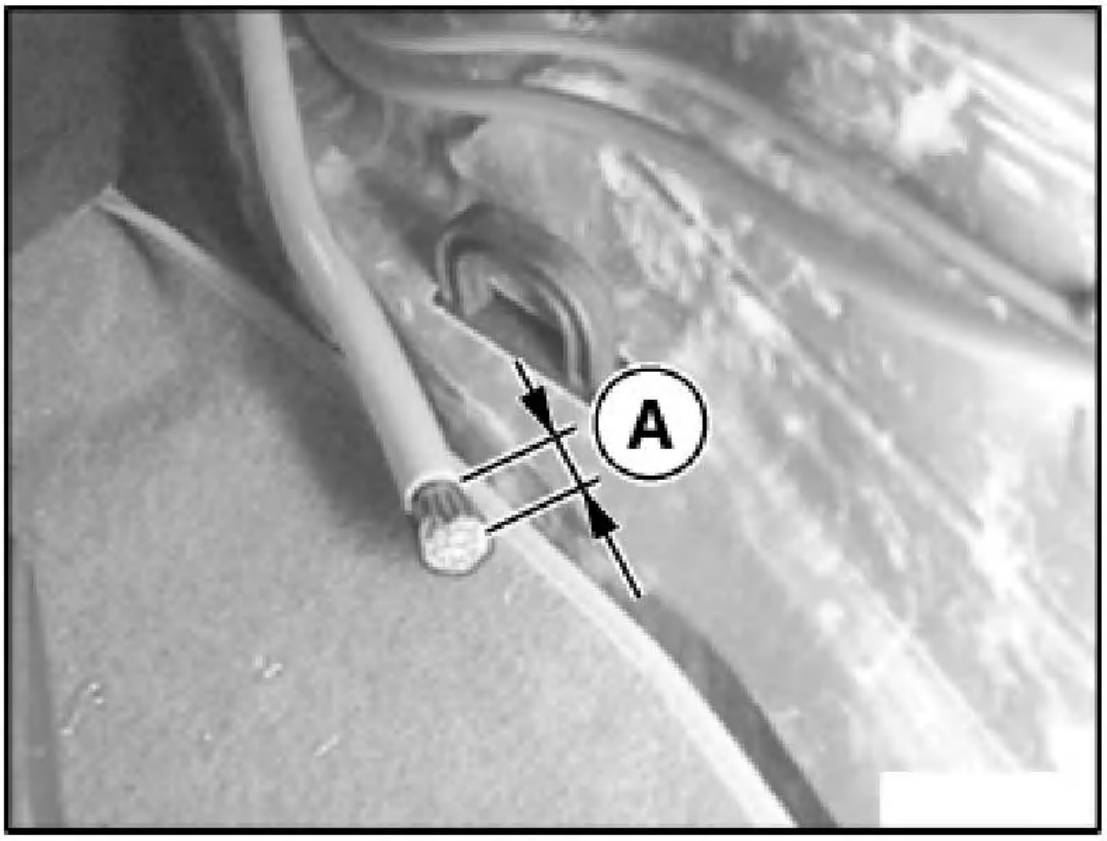


Fig. 110: Identifying Strip Insulation Length From Cable End
Courtesy of BMW OF NORTH AMERICA, INC.

Push heavy-current connector (1) over stripped cable end and screw into position.

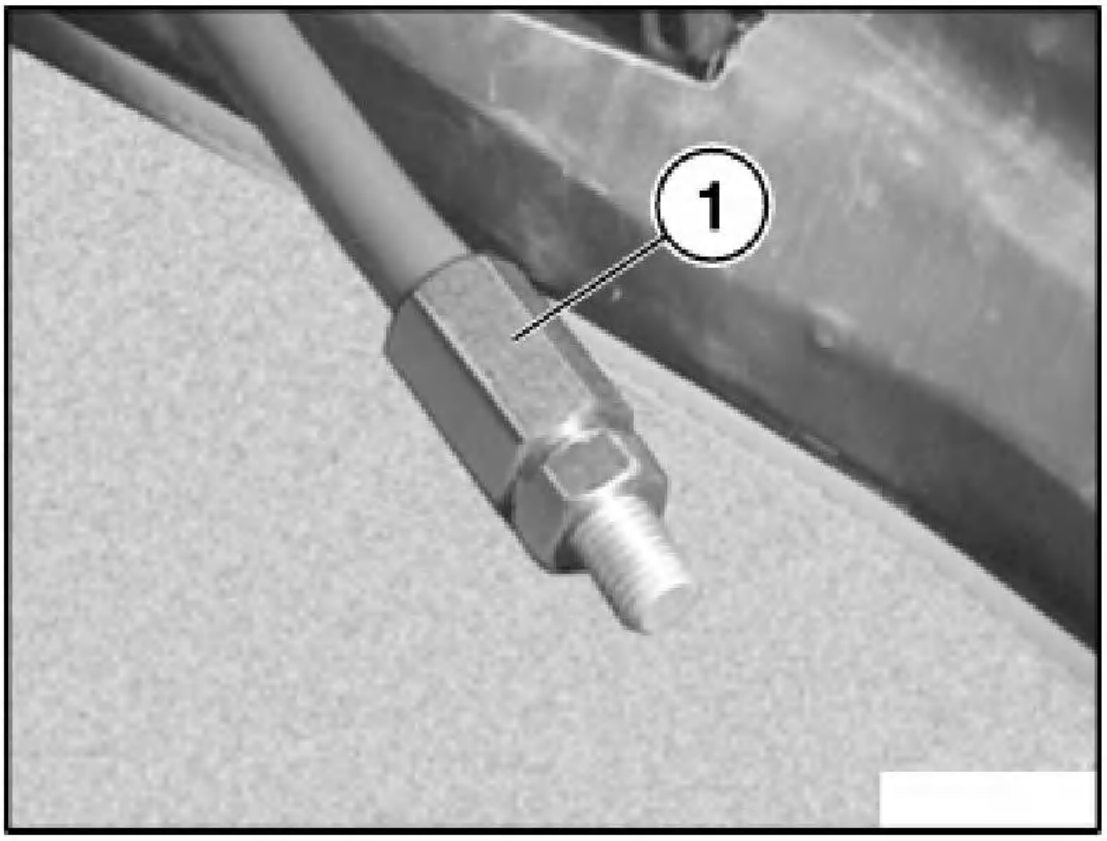


Fig. 111: Pushing Heavy-Current Connector (1) Over Stripped Cable
Courtesy of BMW OF NORTH AMERICA, INC.

Push shrink-fit hose (3) over repair cable.

Screw threaded sleeve (1) of repair cable (2) to heavy-current connector.

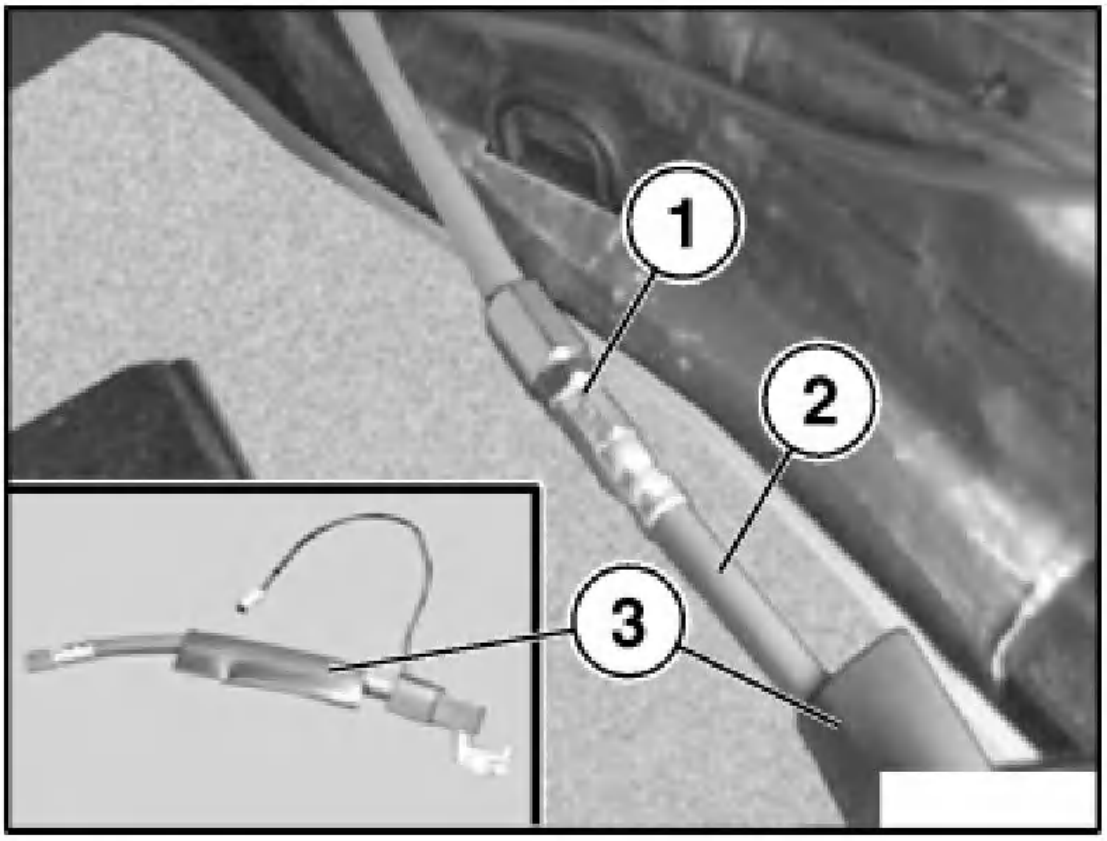


Fig. 112: Installing Threaded Sleeve Into Heavy-Current Connector
Courtesy of BMW OF NORTH AMERICA, INC.

Push shrink-fit hose (1) over connecting point and shrink on with a hot-air blower (2).

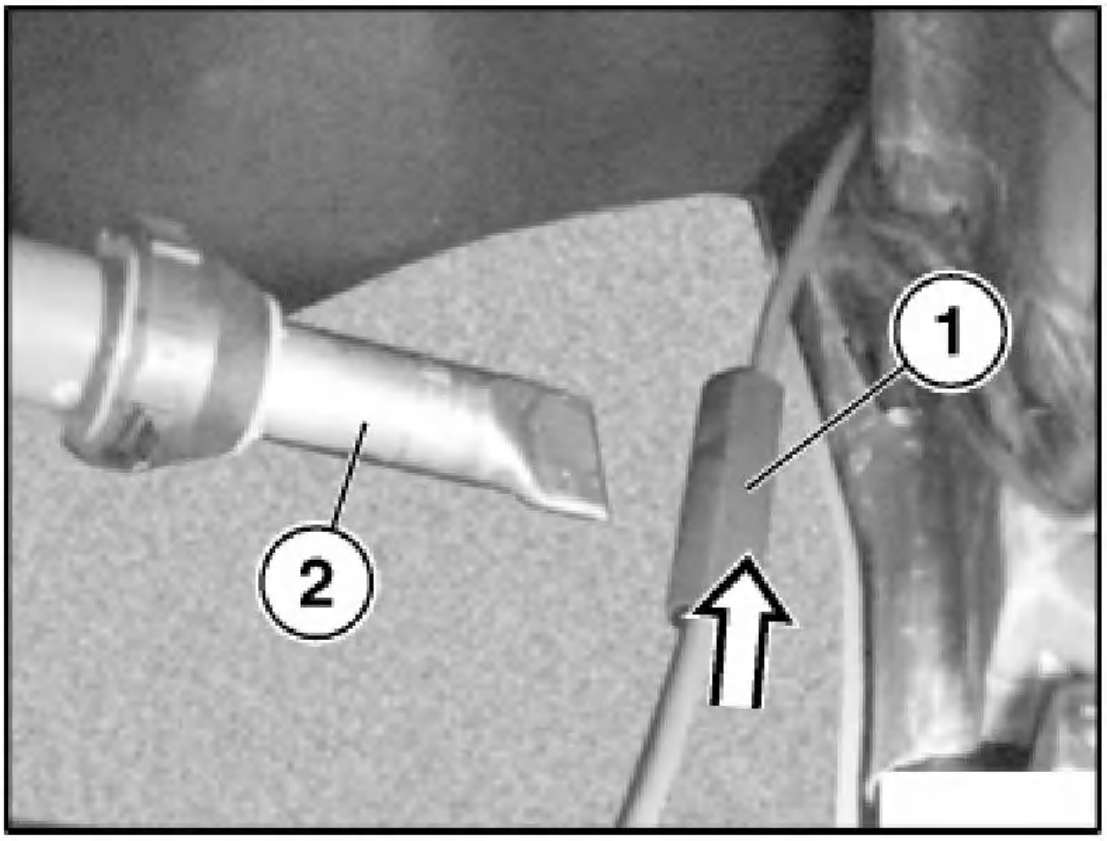


Fig. 113: Installing Shrink-Fit Hose Over Connecting Point
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Heat up shrink-fit hose until it has settled completely around the connection point.

When laying the repaired battery positive cable, observe the following:

- The shrink-fit hose must not be scuffed during any movement.
- The repair cable must not cause any disturbing noises during driving operation.

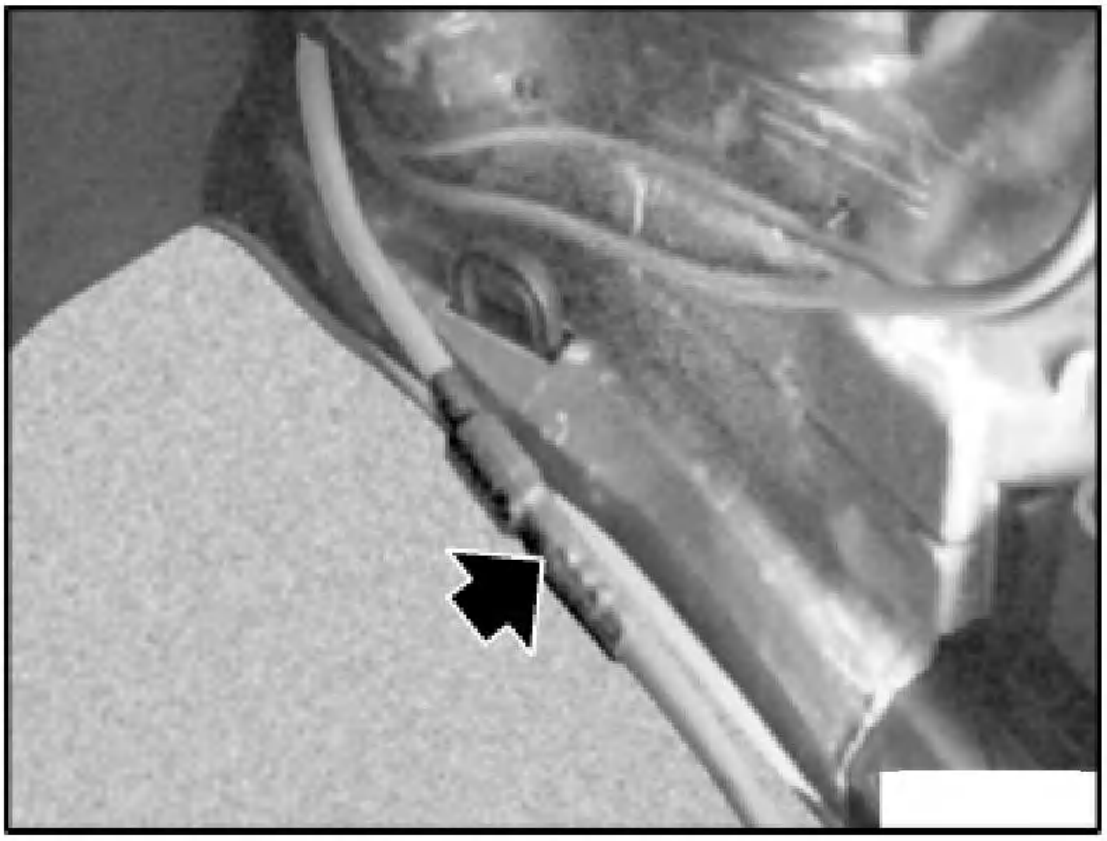


Fig. 114: Identifying Shrink-Fit Hose
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Offsetting cutting line by approx. 10 cm produces excess length of battery positive lead (1). Lay battery positive lead (1) without kinks or abrasions. (Shown on E46 touring.)

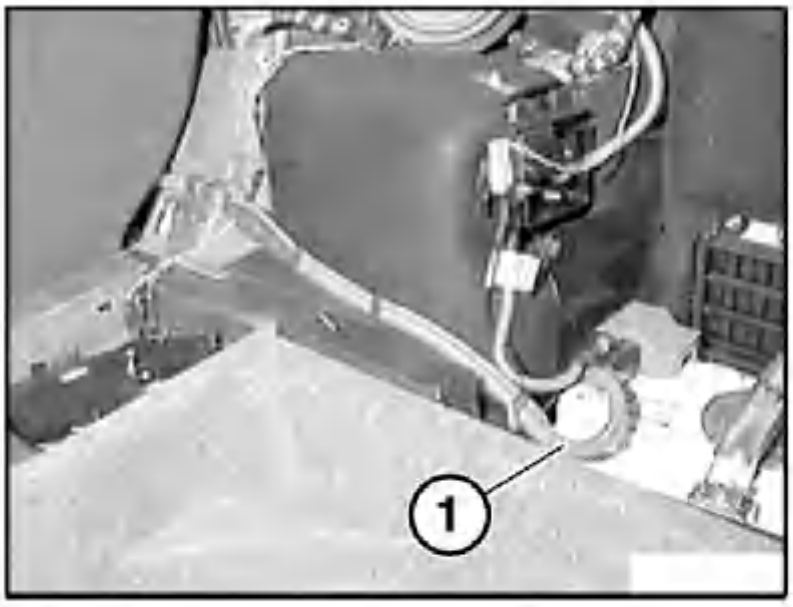


Fig. 115: Laying Battery Positive Lead Without Kinks Or Abrasions
Courtesy of BMW OF NORTH AMERICA, INC.

ENGINE WIRING LOOM

12 51 100 REPLACING WIRING HARNESS SECTION FOR IGNITION COILS (M54)

Interrogate fault memory of DME control unit.

Switch off ignition.

Follow instructions for disconnecting and connecting battery. Refer to 12 00 ... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY .

Disconnect battery negative lead from battery.

Z3, E39, E46, E53:

Remove cover for ignition coils.

Detach plug of wiring harness for ignition coils from DME control unit. Refer to 12 14 550 REPLACING CONTROL UNIT (M54 / S54) . Disconnect plug connection of wiring harness for ignition coils in electronics box.

NOTE: Do not remove DME control unit.

Detach grounding strap (2) of cable duct from connecting plate of ignition coils between cylinders 2 and 3.

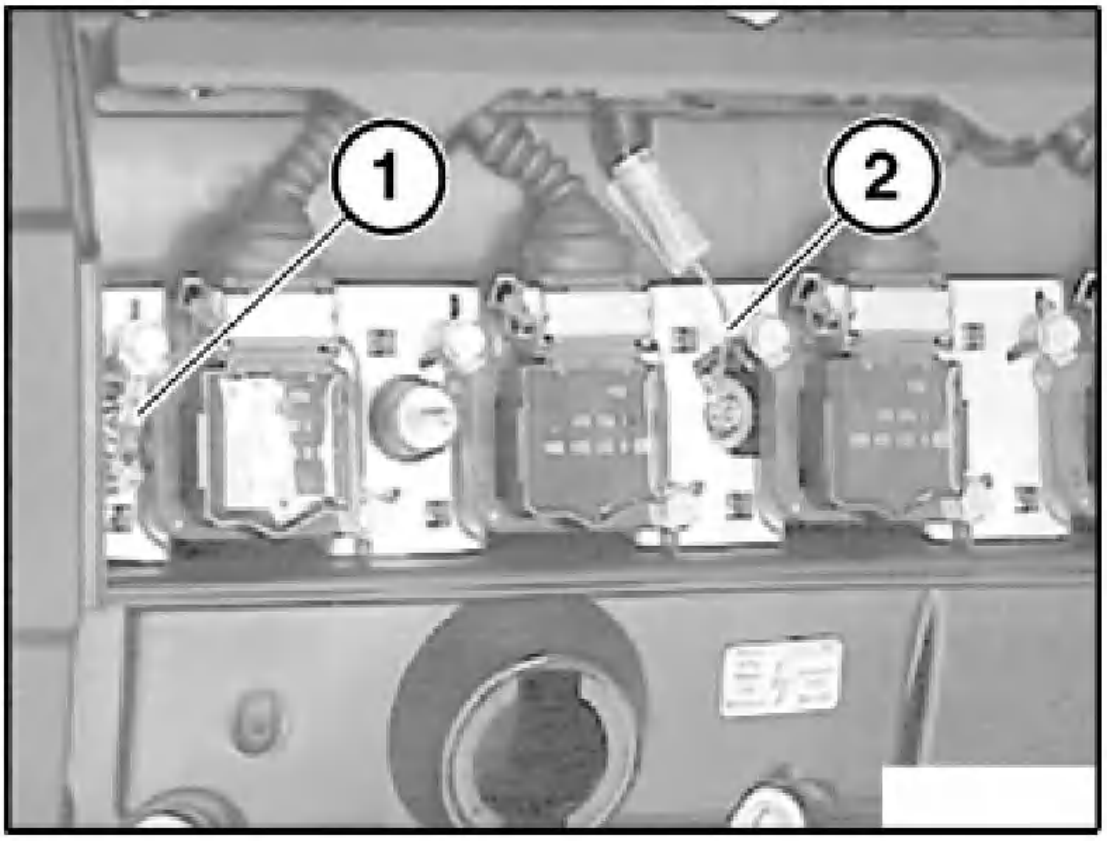


Fig. 116: Detaching Grounding Strap From Connecting Plate
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug (1) and detach from ignition coils.

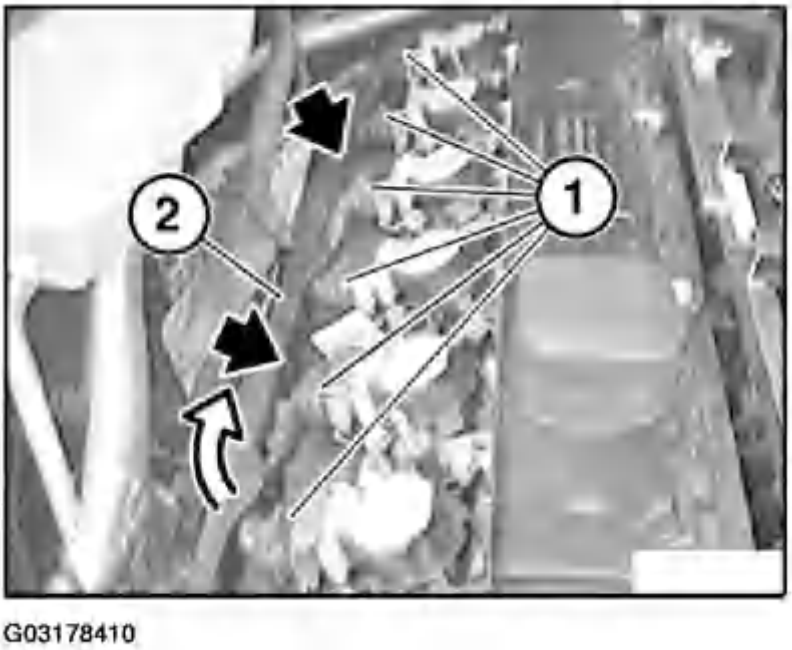


Fig. 117: Detaching Ignition Coils Plugs
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock cable strip (2) and remove towards top.

E46 and Z3 only:

NOTE: Shown on the E46. The same procedure applies to the Z3.

Pull off sealing strip (1).

Remove cable (3) together with profile seal (2) from partition wall towards top.

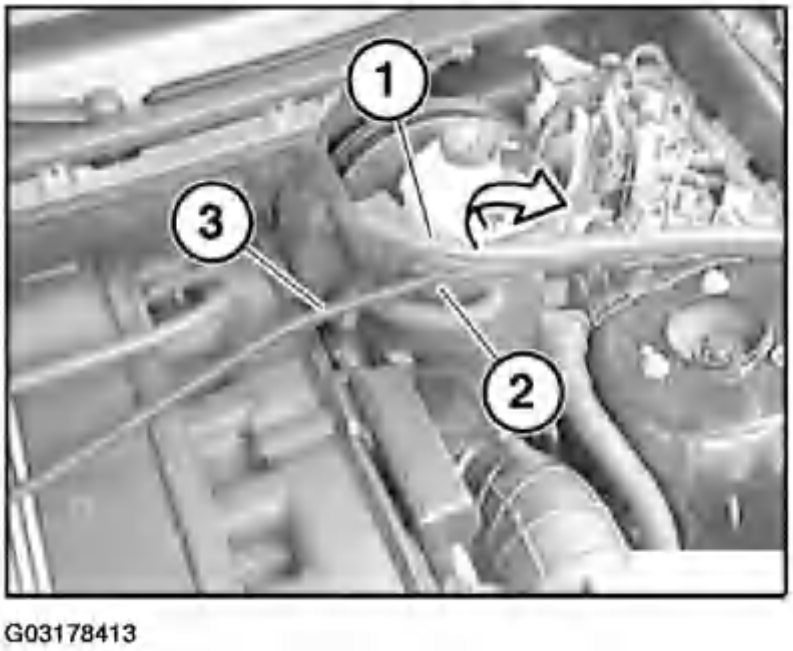


Fig. 118: Removing Cable With Profile Seal From Partition Wall
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

To prevent leaks, you must install profile seal (2) correctly.

Z3, E46, E53 and E39:

NOTE: Interrogate fault memory of DME control unit.

Check stored fault messages.

Rectify faults.

Then clear fault memory.

OIL PRESSURE-OIL TEMPERATURE

12 61 250 REMOVING AND INSTALLING/REPLACING OIL TEMPERATURE SWITCH (M52TU, M54, M56)

Switch off ignition.

Remove suction filter housing. Refer to 13 71 000 REMOVING AND INSTALLING INTAKE FILTER HOUSING (M54) .

Unfasten oil filter cover to enable engine oil in filter to flow back into the oil sump.

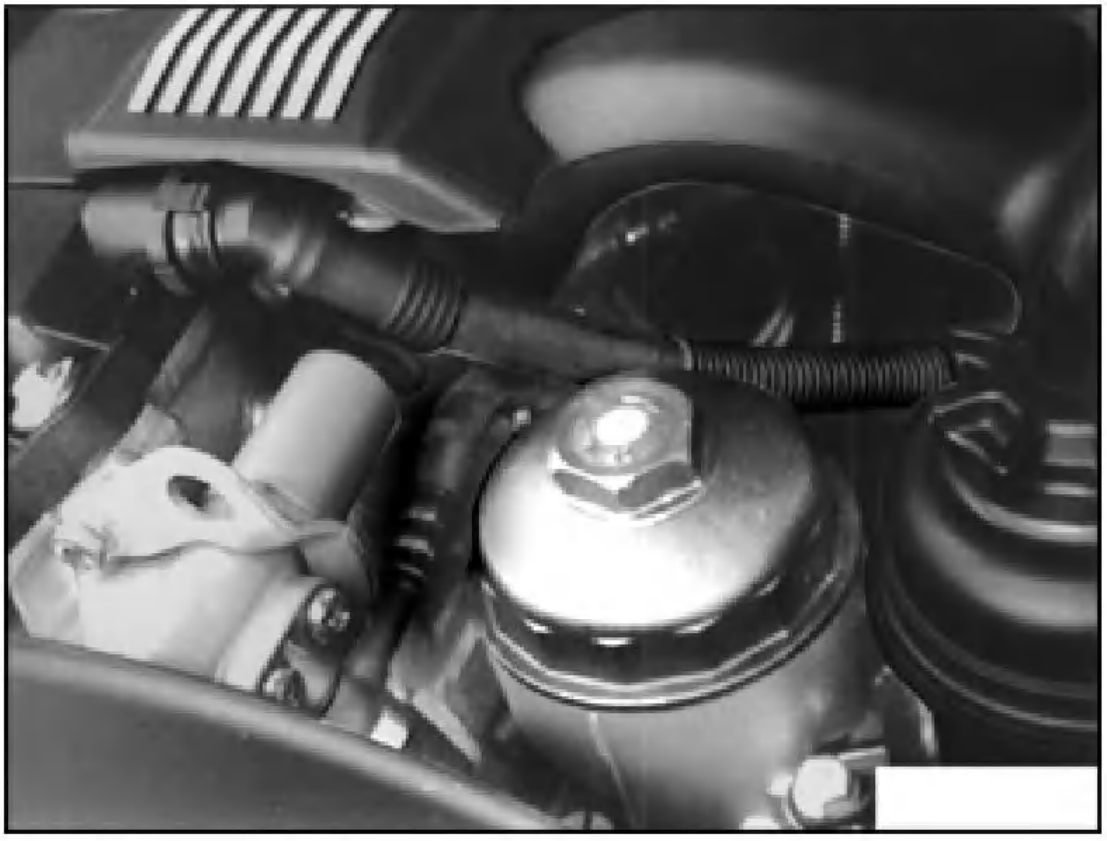


Fig. 119: Removing Oil Filter Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Refer to 00 00 250 BMW ENGINE OIL SERVICE INCL. SUPPLEMENTARY SERVICE (M54 / M56) .

Location: On base of oil-filter.

NOTE: Figure shows power steering pump supply tank removed.

Disconnect plug connection (1).

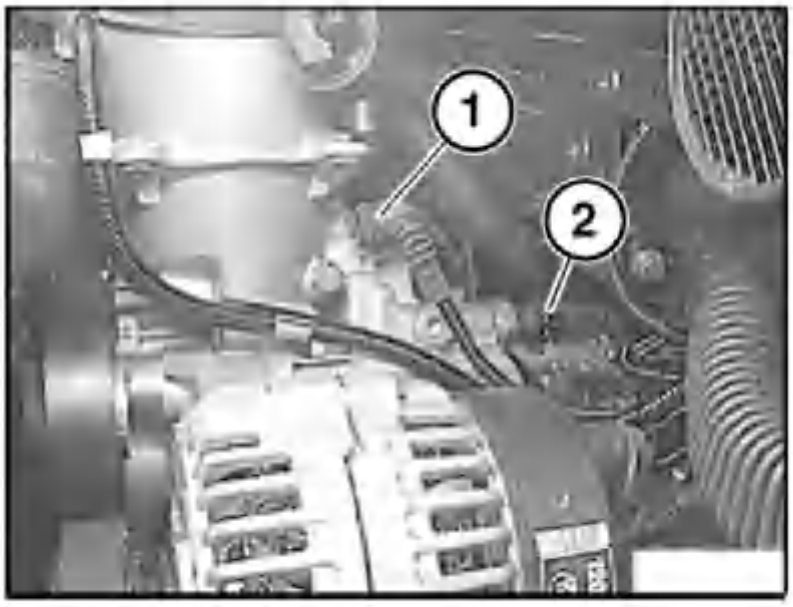


Fig. 120: Releasing Oil Temperature Switch Plug Connection
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: A few drops of oil escape when the oil temperature switch is released. Catch residual oil with cleaning cloth and dispose of oil.

Release oil temperature switch.

Installation:

Tightening torque, 12 61 1AZ. Refer to 12 61 OIL PRESSURE, OIL TEMPERATURE, OIL LEVEL .

12 61 280 REMOVING AND INSTALLING/REPLACING OIL PRESSURE SWITCH (M52TU, M54, M56)

Switch off ignition.

Remove suction filter housing. Refer to 13 71 000 REMOVING AND INSTALLING INTAKE FILTER HOUSING (M54) .

Unfasten oil filter cover to enable engine oil in filter to flow back into the oil sump.

Refer to 00 00 250 BMW ENGINE OIL SERVICE INCL. SUPPLEMENTARY SERVICE (M54 / M56) .

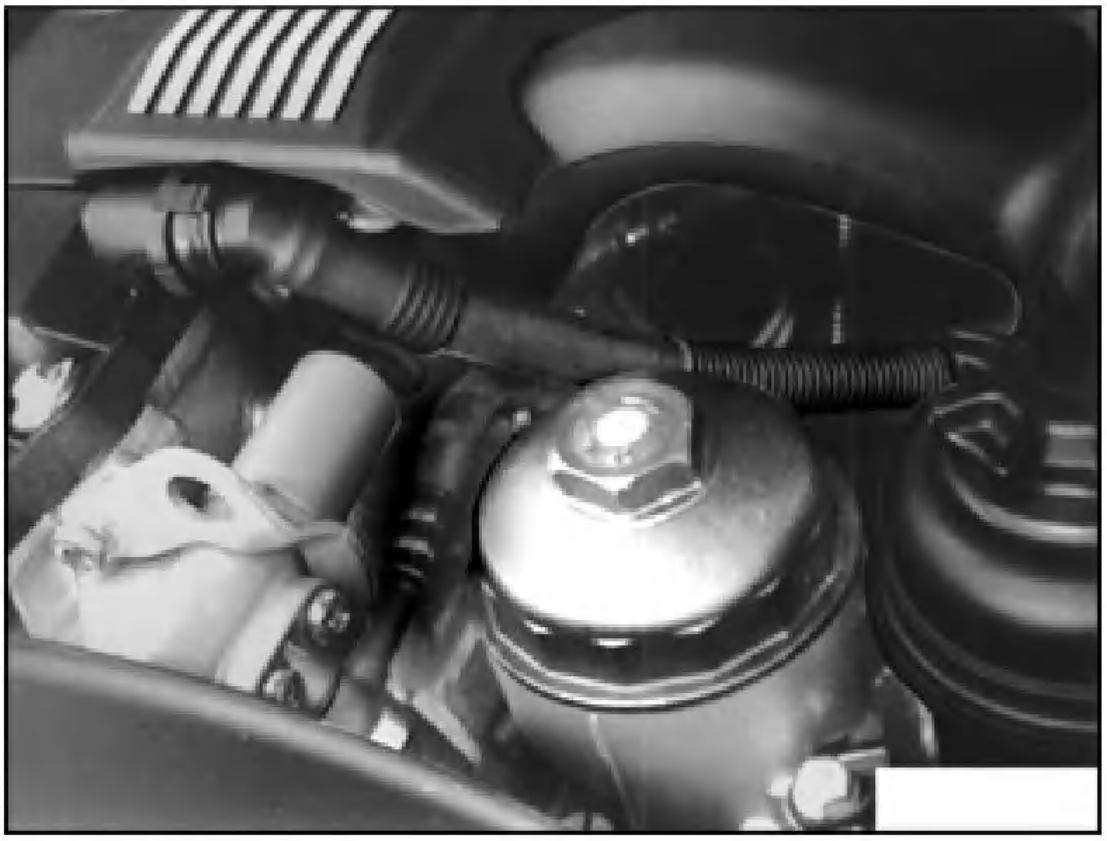


Fig. 121: Removing Oil Filter Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Location: On base of oil-filter.

NOTE: Figure shows power steering pump supply tank removed.

Disconnect plug connection (2).

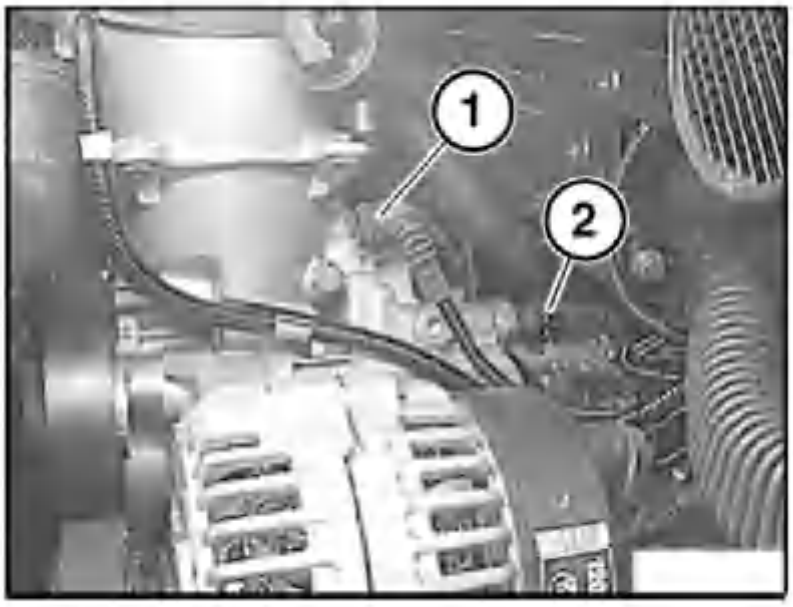


Fig. 122: Disconnecting Plug Connection
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: A few drops of oil escape when the oil pressure switch is released. Catch residual oil with cleaning cloth and dispose of oil.

Release oil pressure switch.

Installation:

Tightening torque, 12 61 1AZ. Refer to 12 61 OIL PRESSURE, OIL TEMPERATURE, OIL LEVEL .

12 61 285 REPLACING LEVEL SWITCH FOR ENGINE OIL (M62, M54, S54, M56)

Necessary Preliminary Tasks:

- Switch off ignition.
- Unfasten cover on full-flow oil filter to enable engine oil in filter to flow back into the oil sump.
- Drain engine oil.

Refer to 00 00 250 BMW ENGINE OIL SERVICE INCL. SUPPLEMENTARY SERVICE (M54 / M56) .

Remove reinforcement plate.

Disconnect plug connection (1).

Unscrew nuts (2).

Remove level switch (3).

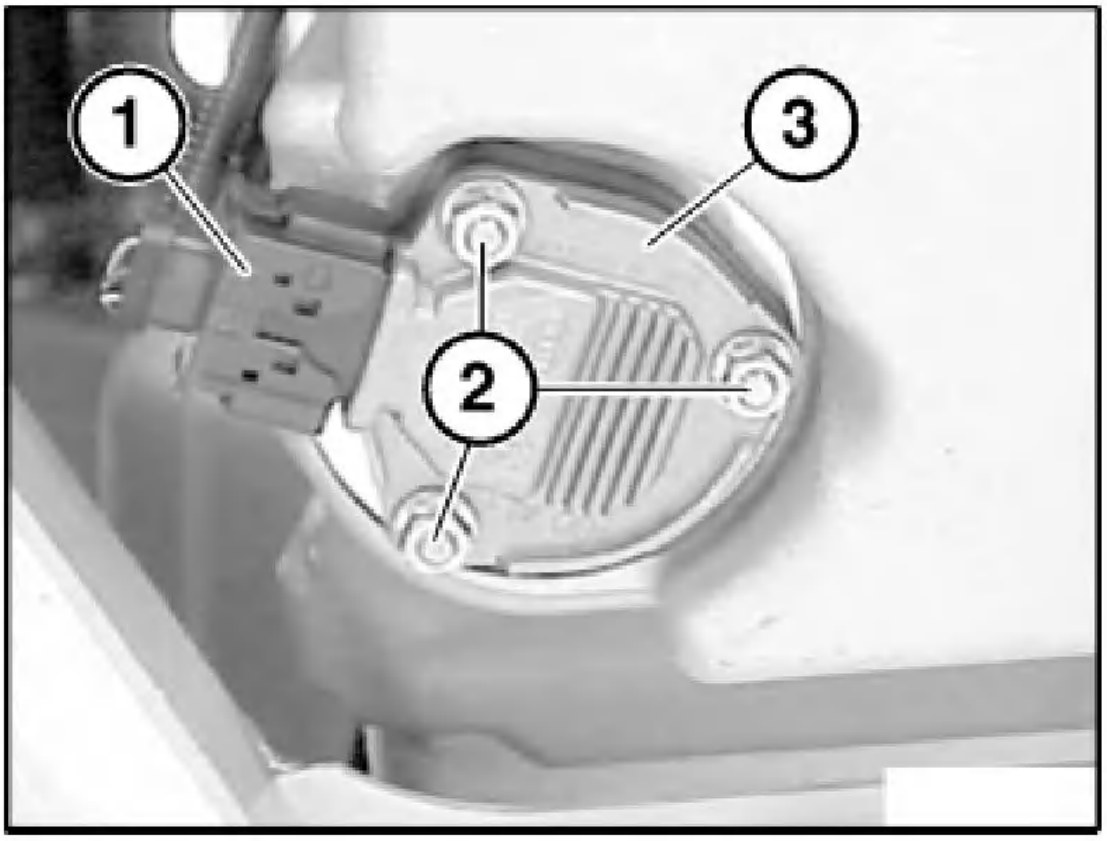


Fig. 123: Removing Level Switch
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Clean sealing surface on oil sump and replace seal of level switch.

Installation:

Screw on oil-filter cover tightly.

Tightening torque 11 42 2AZ. Refer to OIL FILTER AND LINES .

Top up engine oil. Refer to 00 00 250 BMW ENGINE OIL SERVICE INCL. SUPPLEMENTARY SERVICE (M54 / M56) .

12 61 285 REPLACING LEVEL SWITCH FOR ENGINE OIL (Z3 M54)

Turn off ignition.

Release oil filter cap so that engine oil from oil filter can flow back into oil pan.

Release screws.

Remove cruciform reinforcement (1).

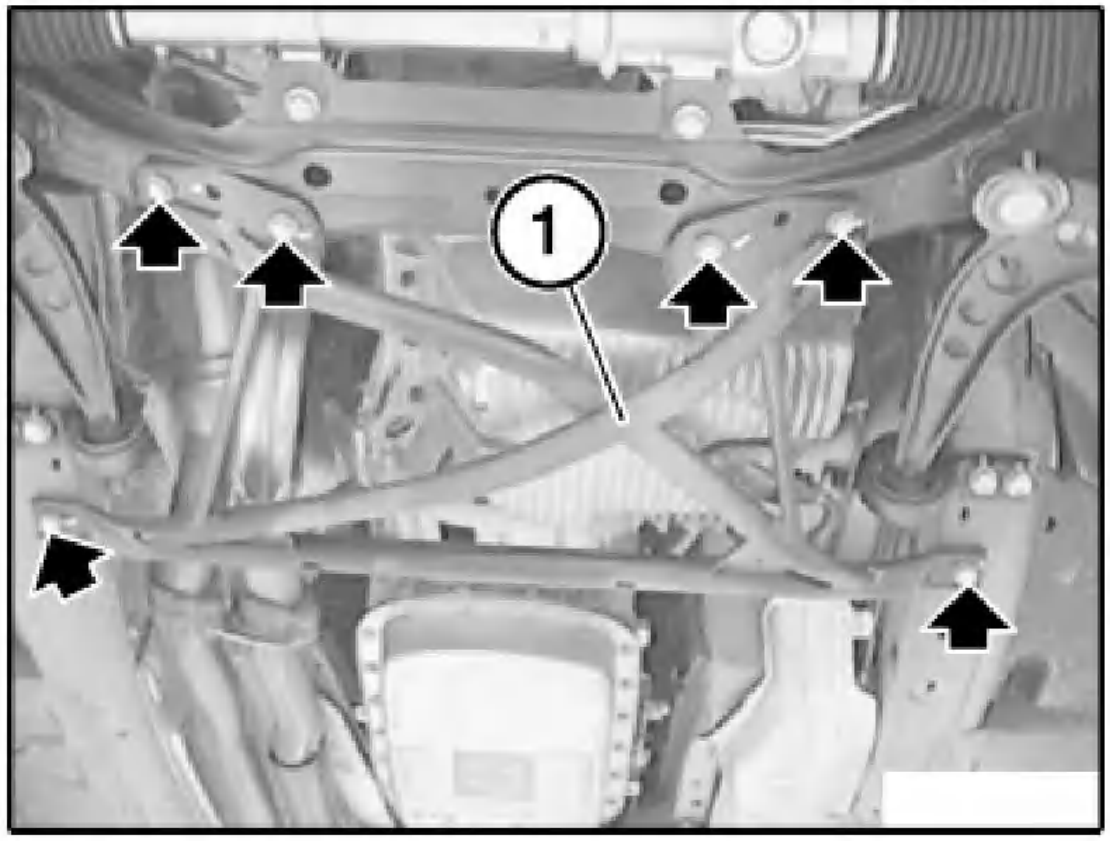


Fig. 124: Removing Cruciform Reinforcement
Courtesy of BMW OF NORTH AMERICA, INC.

Remove underbody paneling.

Drain engine oil.

Disconnect plug connection (1).

Release nuts (2).

Remove level switch (3).

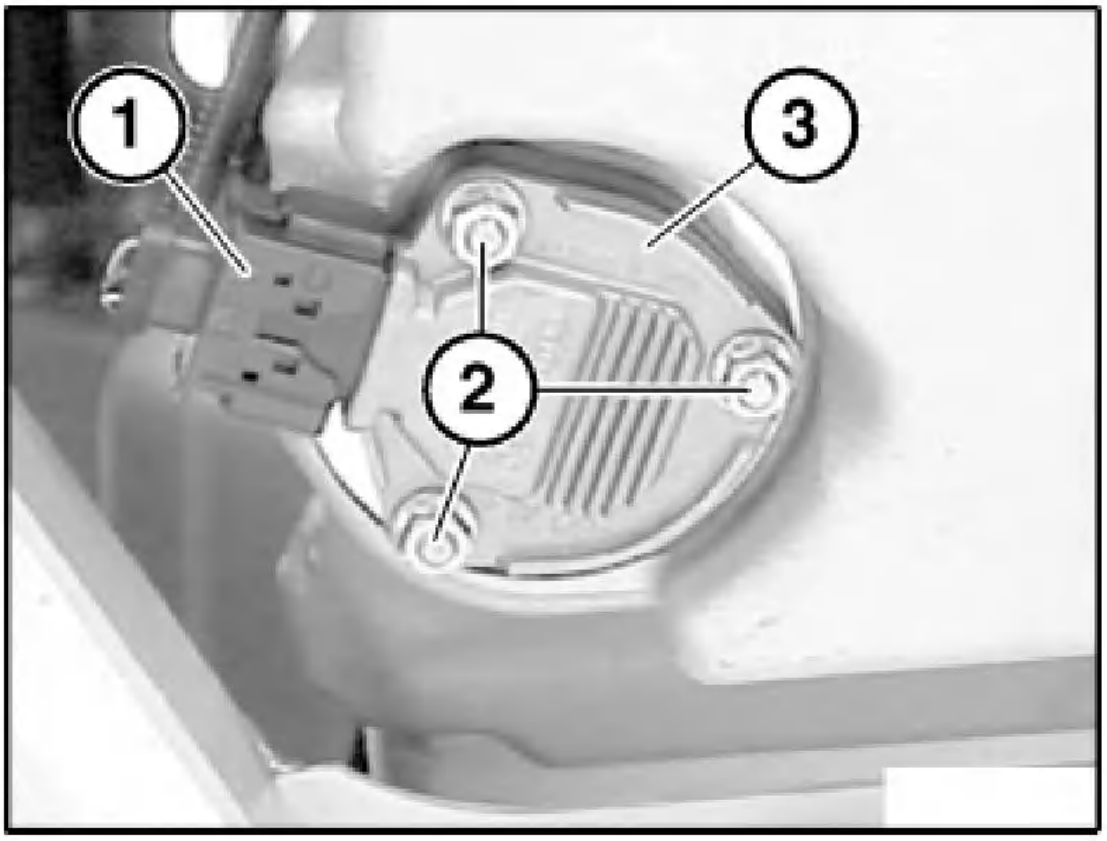


Fig. 125: Removing Level Switch
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Clean sealing surface on oil sump and replace level switch seal.

Installation:

Fill system with engine oil.

Resecure oil filter cap.

Tightening torque, 11 42 2AZ. Refer to OIL FILTER AND LINES .

SWITCH AND RELAYS

12 63 520 REPLACING MAIN RELAY (M54 / S54)

Switch off ignition.

Connect DIS Tester.

Release screw connection of electronics box (1).

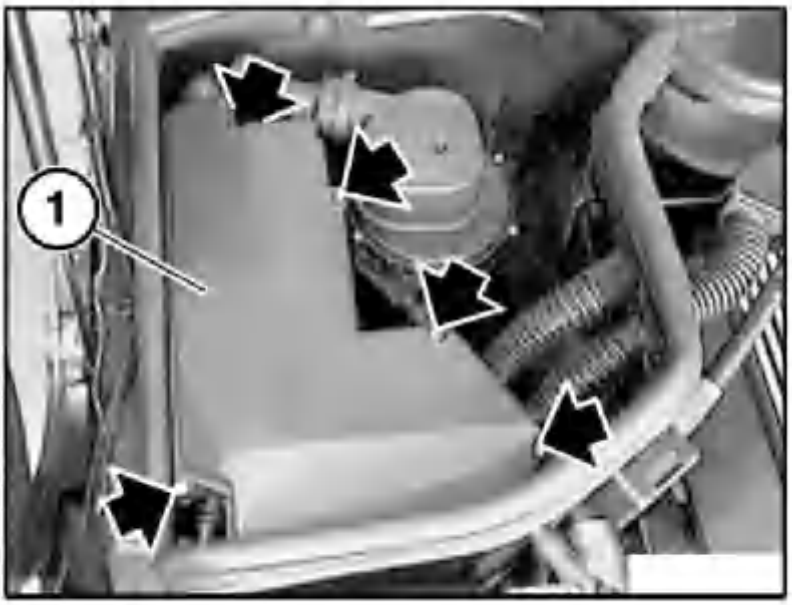


Fig. 126: Removing Electronics Box Screws
Courtesy of BMW OF NORTH AMERICA, INC.

Remove electronics box (1).

Arrangement:

1. Main relay of Digital Motor Electronics.
2. Engine fuses of Digital Motor Electronics.

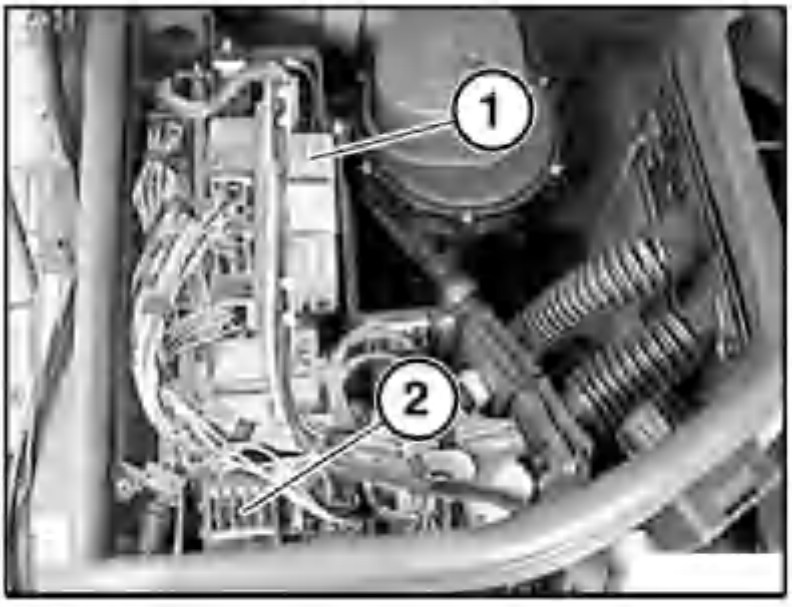


Fig. 127: Identifying Engine Fuses Of Digital Motor Electronics
Courtesy of BMW OF NORTH AMERICA, INC.

Notes On Troubleshooting:

If the starter motor cranks the engine during the starting sequence but the engine fails to fire, then:

1. Check engine fuses.
2. If fuses are blown, replace them completely with fuse holder.
3. Find out why fuses have blown.

Continue troubleshooting as per DIS instructions.

Article GUID: A00202355

2002-03 ENGINE PERFORMANCE

BMW Introduction

2002 MODEL COVERAGE

MODEL	BODY	ENGINE	FUEL SYSTEM	IGNITION SYSTEM
M-Coupe	E36	3.2L 6-Cyl. S54	Bosch MS S54	DIS
M-Roadster	E36	3.2L 6-Cyl. S54	Bosch MS S54	DIS
M3	E46	3.2L 6-Cyl. S54	Bosch MS S54	DIS
M5	E39	5.0L 8-Cyl. S62	Siemens MS S52	DIS
X5	E53	3.0L 6-Cyl. M54	Siemens MS 43	DIS
X5	E53	4.4L V8 M52	Bosch Motronic 7.2	DIS
X5	E53	4.6L V8 M62	Bosch Motronic 7.2	DIS
Z3	E36	2.5L 6-Cyl. M54	Siemens MS 43	DIS
Z3	E36	3.0L 6-Cyl. M54	Siemens MS 43	DIS
Z8	E52	5.0L V8 S62	Siemens MS S52	DIS
325i	E46	2.5L 6-Cyl. M54	Siemens MS 43	DIS
325Ci	E46	2.5L 6-Cyl. M54	Siemens MS 43	DIS
325xi	E46	2.5L 6-Cyl. M54	Siemens MS 43	DIS
330i	E46	3.0L 6-Cyl. M54	Siemens MS 43	DIS
330Ci	E46	3.0L 6-Cyl. M54	Siemens MS 43	DIS
330xi	E46	3.0L 6-Cyl. M54	Siemens MS 43	DIS
525i	E39	2.5L 6-Cyl. M54	Siemens MS 43	DIS
530i	E39	3.0L 6-Cyl. M54	Siemens MS 43	DIS
540i	E39	4.4L V8 M62	Bosch Motronic 7.2	DIS
745i	E65	4.4L V8 N62	Bosch Motronic 9.2	DIS
745Li	E66	4.4L V8 N62	Bosch Motronic 9.2	DIS

2003 MODEL COVERAGE

MODEL	BODY	ENGINE	FUEL SYSTEM	IGNITION SYSTEM
M3	E46	3.2L 6-Cyl. S54	Bosch MS S54	DIS
M5	E39	5.0L 8-Cyl. S62	Siemens MS S52	DIS
X5	E53	3.0L 6-Cyl. M54	Siemens MS 43	DIS
X5	E53	4.4L V8 M62	Bosch Motronic 7.2	DIS
X5	E53	4.6L V8 M62	Bosch Motronic 7.2	DIS
Z4	E85	2.5L 6-Cyl. M54	Siemens MS 45	DIS
Z4	E85	3.0L 6-Cyl. M54	Siemens MS 45	DIS
Z8	E52	5.0L V8 S62	Siemens MS S52	DIS
325i	E46	2.5L 6-Cyl. M54	Siemens MS 43	DIS
325Ci	E46	2.5L 6-Cyl. M54	Siemens MS 43	DIS
325xi	E46	2.5L 6-Cyl. M54	Siemens MS 43	DIS
330i	E46	3.0L 6-Cyl. M54	Siemens MS 43	DIS
330Ci	E46	3.0L 6-Cyl. M54	Siemens MS 43	DIS
330xi	E46	3.0L 6-Cyl. M54	Siemens MS 43	DIS
525i	E39	2.5L 6-Cyl. M54	Siemens MS 43	DIS
530i	E39	3.0L 6-Cyl. M54	Siemens MS 43	DIS
540i	E39	4.4L V8 M62	Bosch Motronic 7.2	DIS
745i	E65	4.4L V8 N62	Bosch Motronic ME9.2	DIS
745Li	E66	4.4L V8 N62	Bosch Motronic ME9.2	DIS

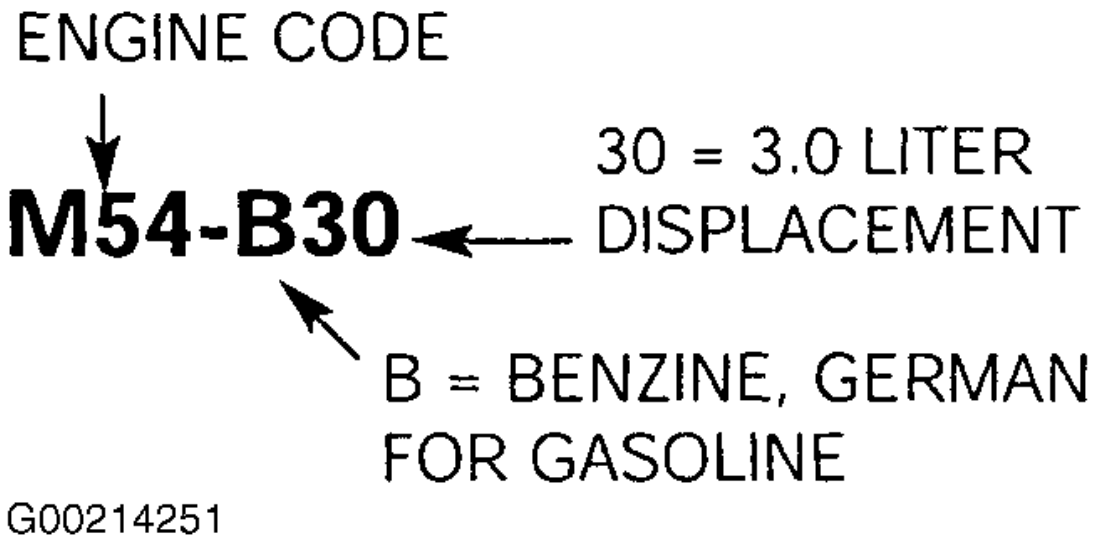


Fig. 1: BMW Engine Code/Displacement Identification
Courtesy of BMW OF NORTH AMERICA, INC.

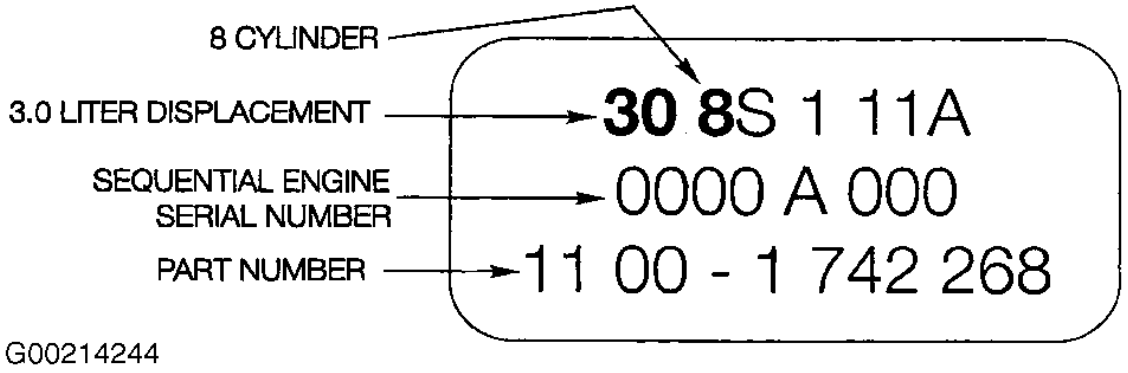


Fig. 2: BMW Engine Specification Plate Identification
Courtesy of BMW OF NORTH AMERICA, INC.

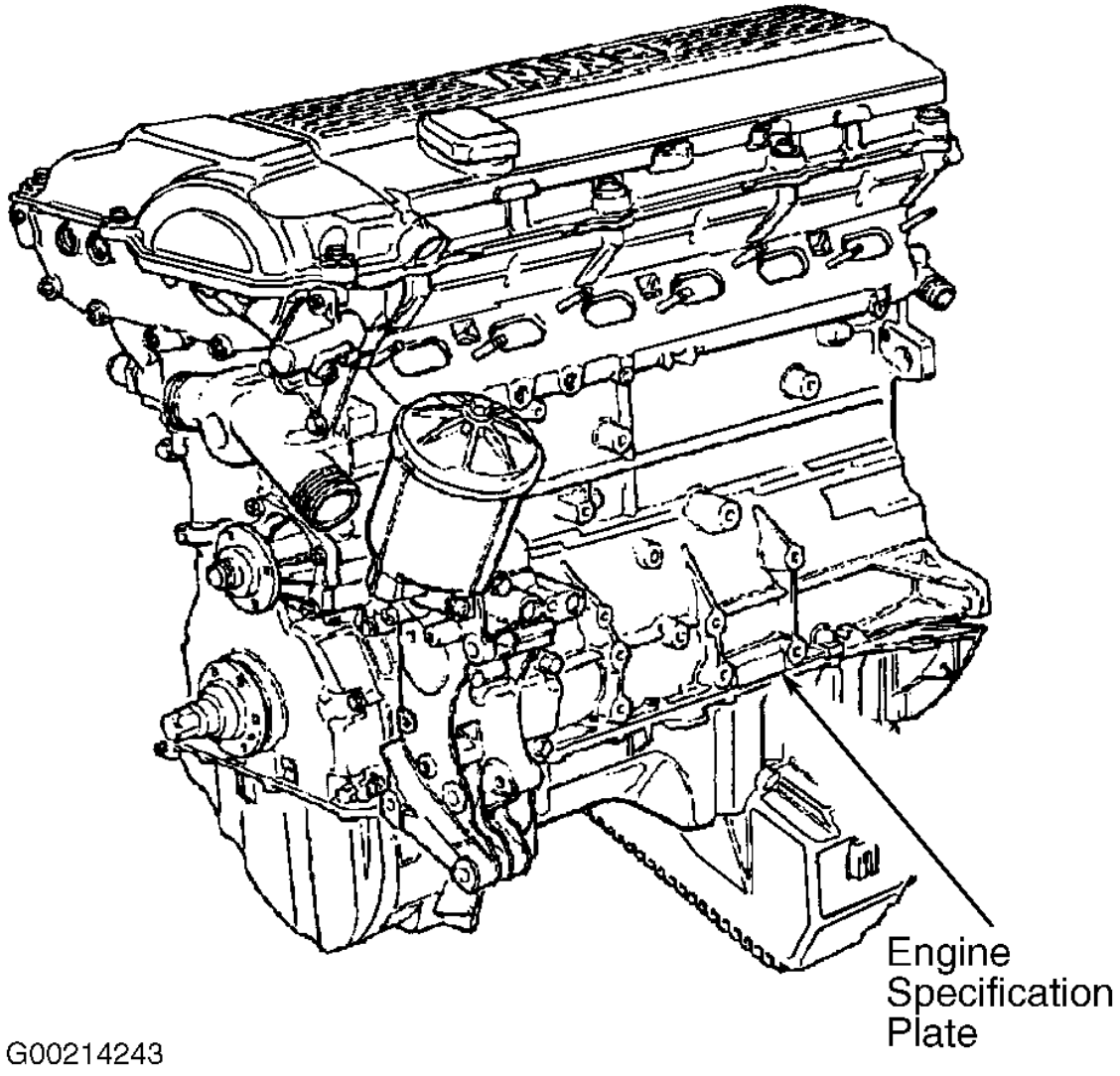


Fig. 3: BMW Engine Specification Plate (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

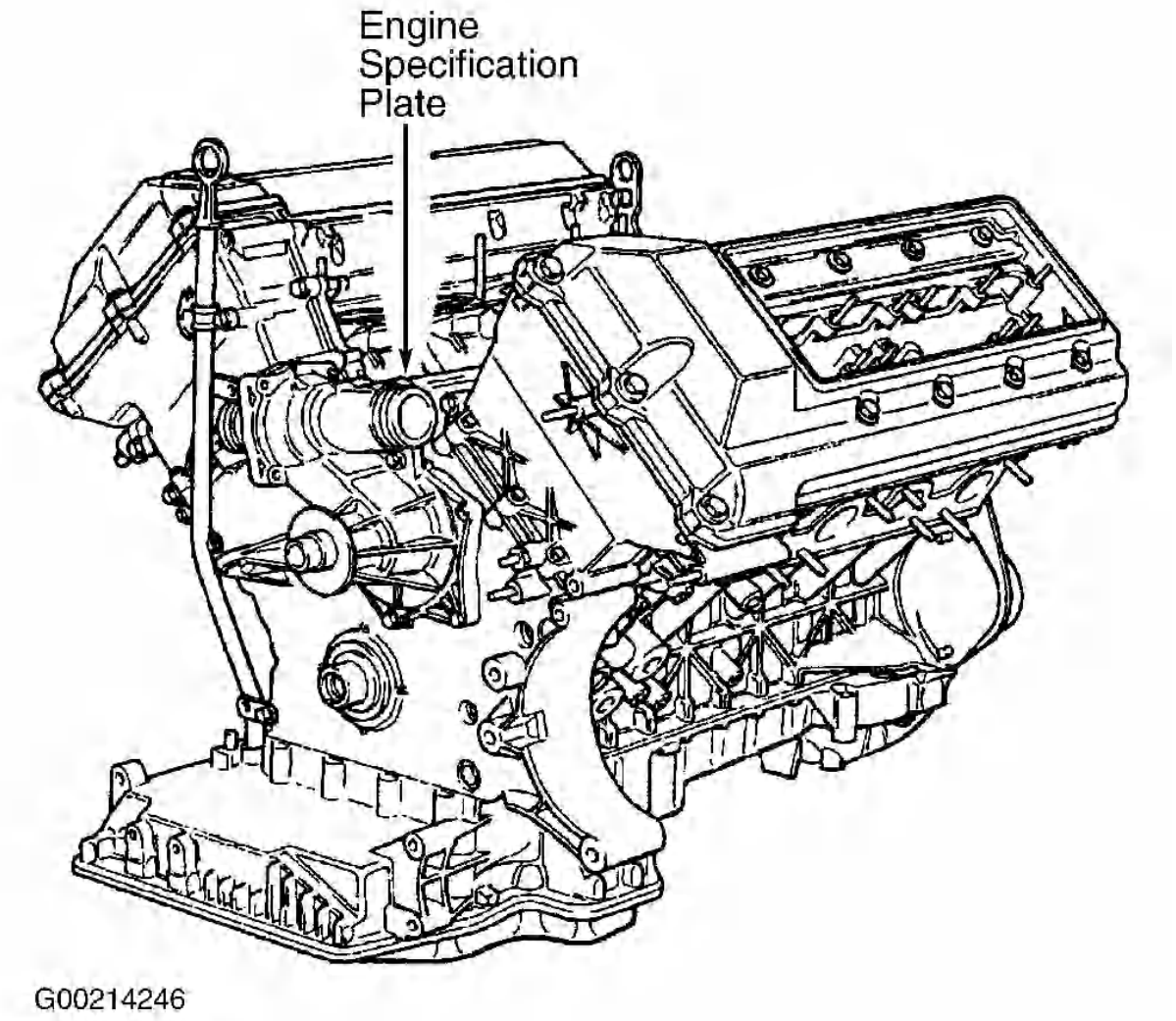


Fig. 4: BMW Engine Specification Plate (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

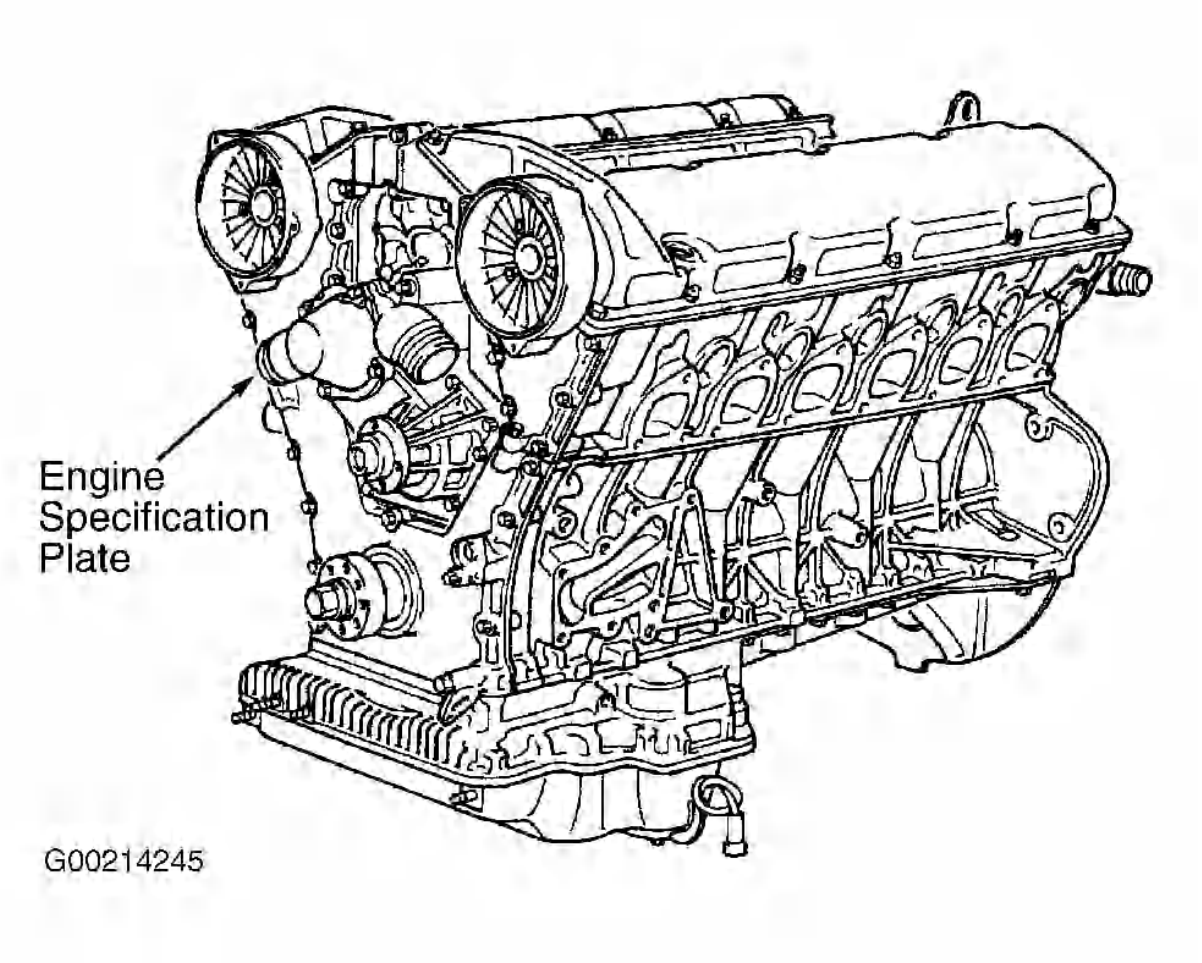


Fig. 5: BMW Engine Specification Plate (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

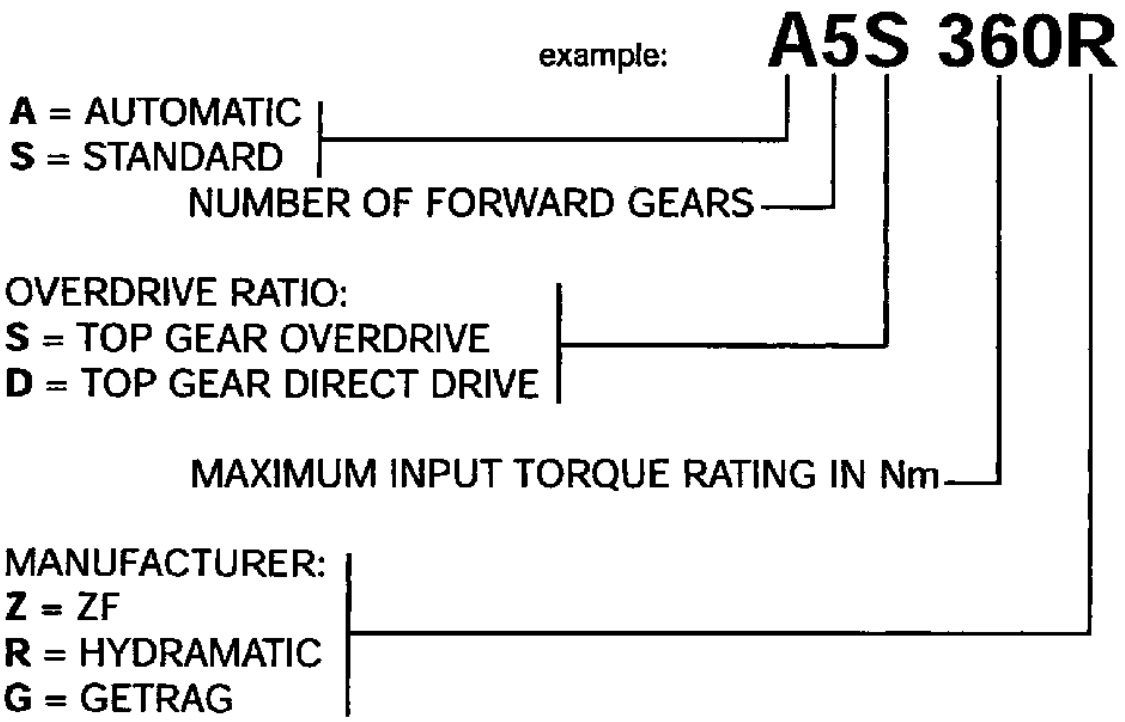


Fig. 6: BMW Transmission Identification Code (1 Of 2)
Courtesy of BMW OF NORTH AMERICA, INC.

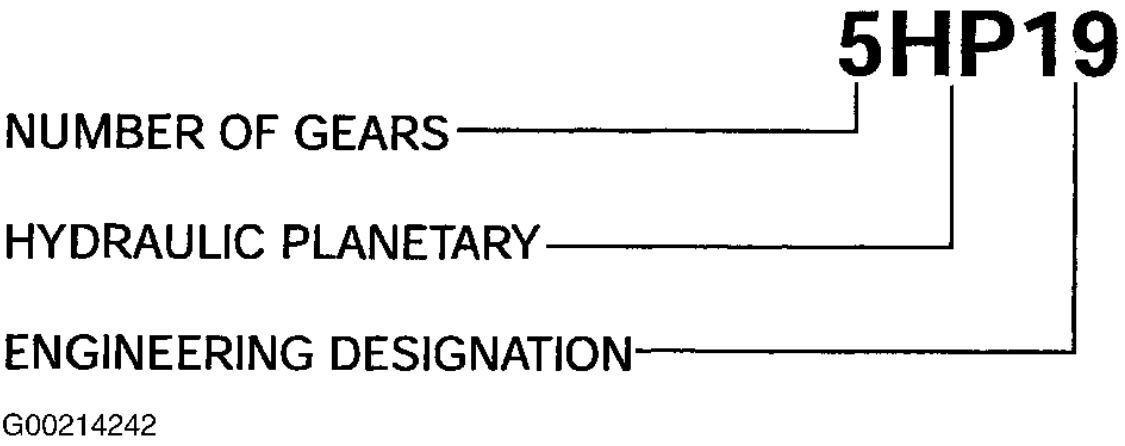


Fig. 7: BMW Transmission Identification Code (2 Of 2)
Courtesy of BMW OF NORTH AMERICA, INC.

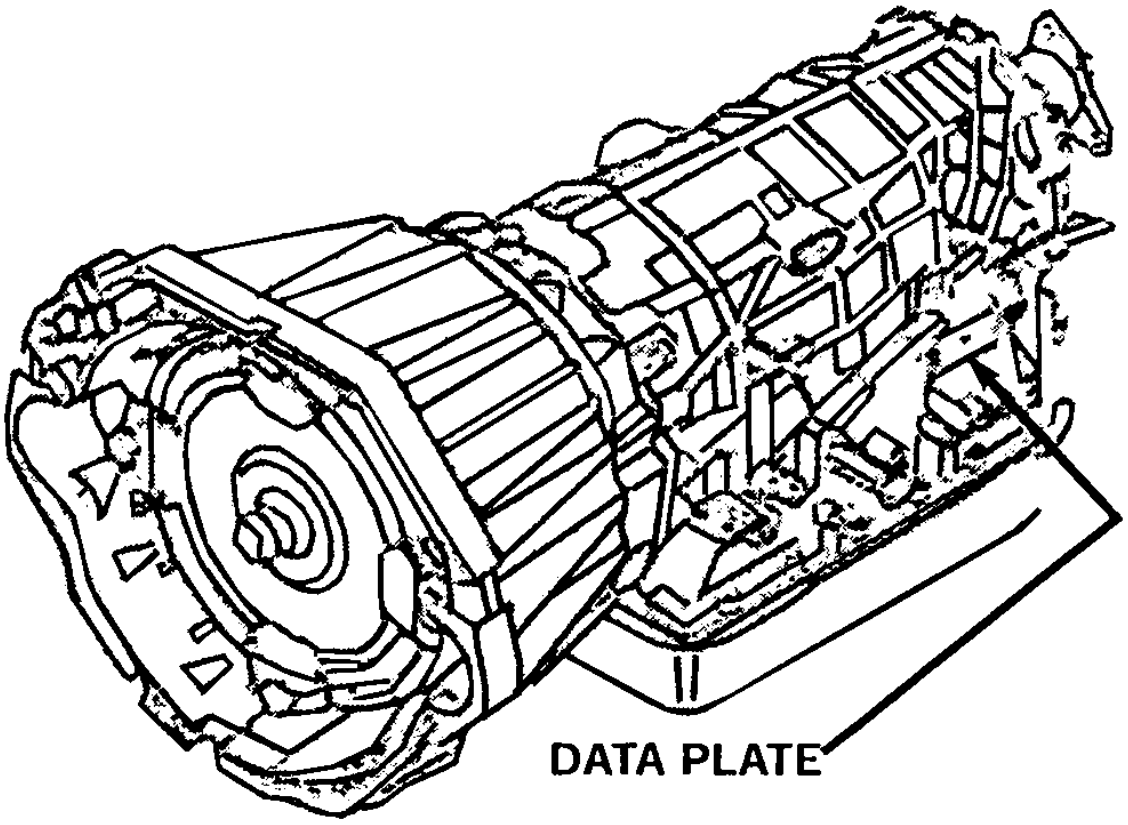


Fig. 8: BMW Transmission Specification Plate
Courtesy of BMW OF NORTH AMERICA, INC.

Trans. Model	Vehicle	Engine	Model Year
4HP 24 E9	750iL (E32) 850i, Ci	M70	1988-94 1990-94
A4S 310R	525i (E34)	M50, M50 TU	1990-92 1993-95
	325i,is,ic	M50 M50 TU	1992 1993-95
	318i,is,ic (ti 95)	M42	1992-95
A4S 270R	328i,(is,ic, -97) Z3 2.3/2.8 323is,ic	M52 M52/TU M52	1996-98 1997-2000 1998-99
	318i,(is,ic, -97),ti, Z3 1.9	M44	1996-99
	528i (E39)	M52/TU	1997-99
A5S 360R **390R**	323i/328i (E46) 325it (E46) 325xi/it/330xi (E46) Z3 2.5/3.0 528i (E39) 525i/530i (E39) X5 3.0i (E53)	M52TU M54 M54 M54 M52TU M54 M54	1999-2000 9/00-3/01 2001- 2001- 9/99-9/00 9/00-3/00 2001-
A5S 310Z	530i, it, (E34)	M60	1994-95
	M3	S50 US	1995
	M3	S52	1996-99
A5S 325Z	323i (E46) 325i/330i (E46) 525i/530i (E39)	M52TU M54 M54	3/00-9/00 6/00- 3/01-
A5S 440Z	840Ci (E31), 540i (E39), 740i/iL (E38) X5 4.4i	M62 M62/TU M62/TU M62TU	9/96-End prod. 1997- 1/97-2001 2000-
A5S 560Z	740i/iL (E32) 540i (E34)	M60	1993-94 1994-1995
	840Ci 740i/iL (E38)	M60	1994-1995 1995-1996
	750iL (E38)	M73/TU	1995-2001
	840Ci (E31)	M62	1996-8/96
	850Ci (E31)	M73	1995-End prod.

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Fig. 9: BMW Automatic Transmission Application Chart
Courtesy of BMW OF NORTH AMERICA, INC.

Trans. Model	Vehicles	Engines	Model Year
S5D 200G	318i/iC (E36)	M42	1992-1995
S5D 250G	318ti (E36/5) 318i/iC (E36) 325i/iC (E36) 323i (E46)	M42, M44 M44 M50/TU M52TU	1995-1999 1996 1992-1995 1999-
S5D 280Z	X5 3.0i (E53) 325xi (E46/16) 330xi (E46/16)	M54 M54 M54	2001- 2001- 2001-
S5D 310Z	M3 (E36) 525i (E34) 530i (E34)	S50 M50/TU M60	1995 1991-1995 1994-1995
S5D 320Z	323i/iC, 328i/iC (E36) M3 (E36) Z3 roadster/Coupe M roadster/Coupe 528i (E39) 328i (E46)	M52 S52 M52/TU S52 M52/TU M52TU	1996-1999 1996-1999 1997- 1998- 1997- 1999-
S6S 420G	540i (E34) 540i (E39) M5 (E39) Z8 (E52)	M60 M62/TU S62 S62	1994-1995 1997- 2000- 2000-
S6S 560G	850i/Ci 850Csi	M70, M73 S70	1991-1997 1994-1995

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Fig. 10: BMW Manual Transmission Application Chart
Courtesy of BMW OF NORTH AMERICA, INC.

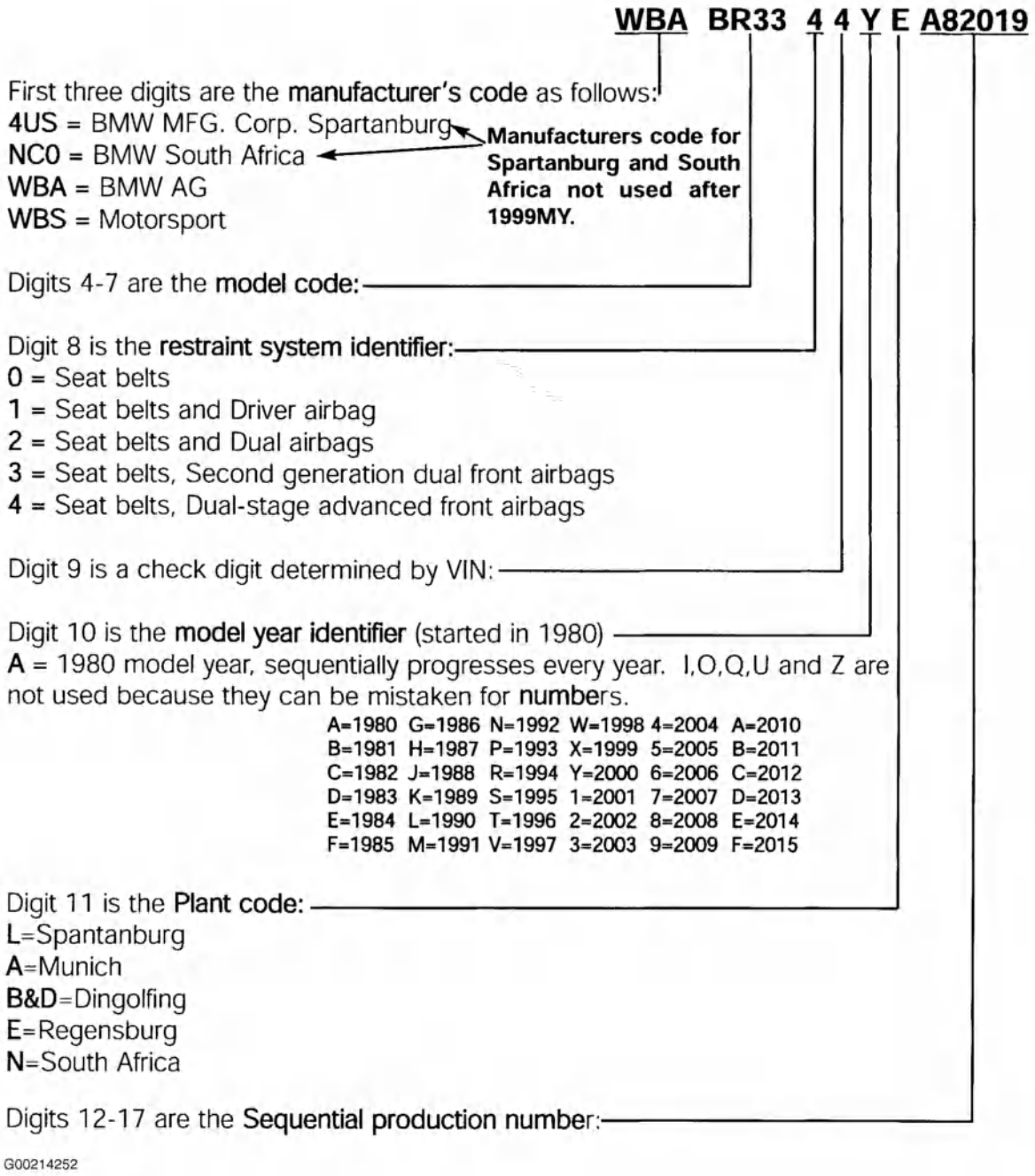


Fig. 11: VIN Definition
Courtesy of BMW OF NORTH AMERICA, INC.

MODEL/YEAR VIN CODE APPLICATIONS

MODEL/YEAR VIN CODE APPLICATION

VIN Code	Model Year
1	2001
2	2002
3	2003

Article GUID: A00151718

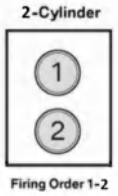
ENGINE PERFORMANCE

Firing Order & Cylinder Identification - BMW - All Models

FIRING ORDER & CYLINDER IDENTIFICATION

NOTE: This information is intended as a quick reference for firing order and cylinder identification only. The information provided covers many vehicles and may include some information that does not apply to the vehicle you have currently selected.

2 CYLINDER ENGINE

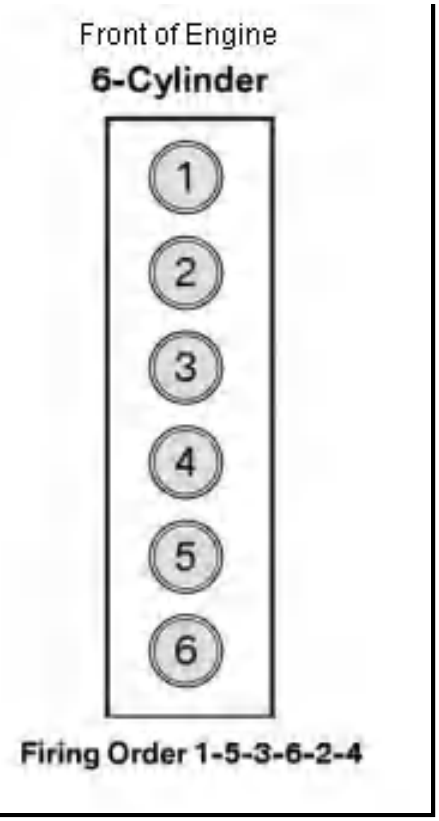
Engine Configuation	Firing Order	Cylinder Identification
In-Line 2	1-2	

4 CYLINDER ENGINE

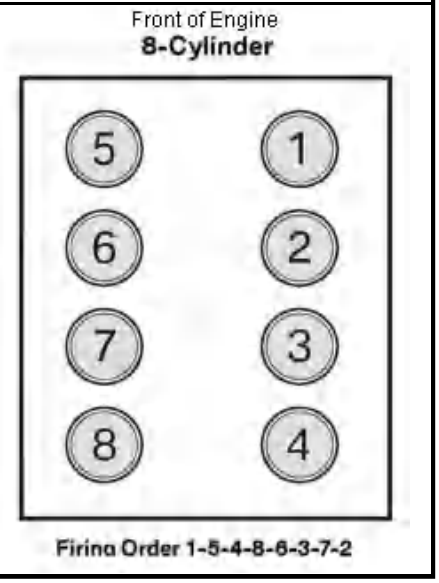
Engine Configuation	Firing Order	Cylinder Identification
In-Line 4	1-3-4-2	

6 CYLINDER ENGINE

Engine Configuation	Firing Order	Cylinder Identification

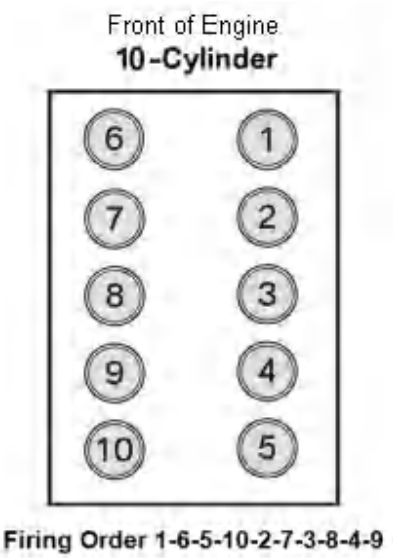
In-Line 6	1-5-3-6-2-4	

V8 ENGINE

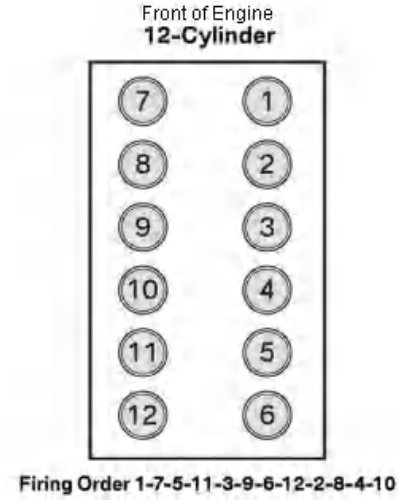
Engine Configuation	Firing Order	Cylinder Identification
V8	1-5-4-8-6-3-7-2	

V10 ENGINE

Engine Configuation	Firing Order	Cylinder Identification

V10	1-6-5-10-2-7-3-8-4-9	 Firing Order 1-6-5-10-2-7-3-8-4-9

V12 ENGINE

Engine Configuation	Firing Order	Cylinder Identification
V12	1-7-5-11-3-9-6-12-2-8-4-10	 Firing Order 1-7-5-11-3-9-6-12-2-8-4-10

Article GUID: A00342484

2002 ENGINE PERFORMANCE

Mode 6 Data - BMW & MINI

INTRODUCTION

Mode 6 is designed to allow access to the results of onboard diagnostic monitoring tests of specific components/systems that are not continuously monitored. These systems include the catalytic converter, EVAP system, oxygen sensor, oxygen sensor heater, EGR system, secondary AIR system, and sometimes misfire.

Mode 6 data is output from the PCM/ECM in hexadecimal form. The $ sign indicates a hexadecimal number. Depending on the software in the scanner, the output could be displayed in hexadecimal numbers (no conversion), raw data (conversion to decimal numbers), or measurable values (applying conversion factor to raw data).

Before reading mode 6 information, ensure that the monitor for the information you are accessing has run to completion. If the monitor is not complete, the mode 6 data will not be accurate.

MODE 6

Engine Type: W10B16, W11B16 (models: Cooper, Cooper S)

Engine Type: M54B25 LEV, M54B30 LEV (only Canada model: 320i)(models: Z3 2.5, 325i, 325Ci, 325Ci Cabr., 325i Tour., 325xi, 325xiT, 525i, 525i Tour, 330xi)

Engine Type: M54B30 ULEV (models: Z3 3.0, Z3 Coupe, 330i, 330Ci, 330i Cabr., 530i)

Engine Type: M54B30 ULEV (model: X5)

Test ID / Comp. ID	Monitored Component	Possible Range	Hex Code Factor
TID 1	**catalyst monitoring**		
CID1	catalyst monitoring of catalyst 1 sum of the determined ratios	0...65535	0...FFFF H
CID2	catalyst monitoring of catalyst 2 sum of the determined ratios	0...65535	0...FFFF H
TID 2	**oxygen sensor monitoring**		
CID1	weighted period time (maximum value) of oxygen sensor 1 Exhaust Bank 1	0...65535 ms	0...FFFF H
CID2	weighted period time (maximum value) of oxygen sensor 1 Exhaust Bank 2	0...65535 ms	0...FFFF H
CID3	weighted period time (minimum value) of oxygen sensor 1 Exhaust Bank 1	0...65535 ms	0...FFFF H
CID4	weighted period time (minimum value) of oxygen sensor 1 Exhaust Bank 2	0...65535 ms	0...FFFF H
CID5	weighted switching time for rich to lean of oxygen sensor 1 Exhaust Bank 1	0 ... 100 ms	0...3200 H
CID6	weighted switching time for rich to lean of oxygen sensor 1 Exhaust Bank 2	0 ... 100 ms	0...3200 H
CID7	weighted switching time for lean to rich of oxygen sensor 1 Exhaust Bank 1	0 ... 100 ms	0...3200 H
CID8	weighted switching time for lean to rich of oxygen sensor 1 Exhaust Bank 2	0 ... 100 ms	0...3200 H
TID 3	**secondary air system monitoring**		
CID5	count of lean mixture detection's of the oxygen sensor 1 Exhaust Bank 1	0 ... 65535	0...FFFF H
CID6	count of lean mixture detection's of the oxygen sensor 1 Exhaust Bank 2	0 ... 65535	0...FFFF H
TID 5	**evaporative system monitoring**		
CID1	functional check: change of trim	0 ... 2.0	0...FFFF H
CID2	functional check: hange of idle speed + air mass	0 ... 3200 %	0...7FFF H
CID3	reference current (upper boundary)	0 ... 590 mA	0 ... FFFFH
CID4	reference current (lower boundary)	0 ... 590 mA	0 ... FFFFH
CID5	minimal pump current after switching solenoid	0 ... 590 mA	0 ... FFFFH
CID6	pump current gross leak	0 ... 590 mA	0 ... FFFFH
CID7	pump current fine leak	0 ... 590 mA	0 ... FFFFH
CID8	pump current short cut	0 ... 590 mA	0 ... FFFFH

Fig. 1: Mini, BMW Mode 6 Data (1 Of 3)
Courtesy of BMW OF NORTH AMERICA, INC.

Engine Type: M62B44 LEV, N62B45 LEV (models: 540i, 540iS, 540iT, 745i, 745iL)

Engine Type: M62B44 LEV (model: X5)

Engine Type: M62B46 LEV (model: X5 4.6is)

Test ID / Comp. ID	Monitored Component	Possible Range	Hex Code Factor
TID 1	**catalyst monitoring**		
CID1	catalyst monitoring of catalyst 1 sum of the determined ratios	0...65535	0...FFFF H
CID2	catalyst monitoring of catalyst 2 sum of the determined ratios	0...65535	0...FFFF H
TID 3	**secondary air system monitoring**		
CID1	relative secondary air mass Bank 1	0...511,9922	0...FFFF H
CID4	relative secondary air mass Bank 2	0...511,9922	0...FFFF H
TID 5	**evaporative system monitoring**		
CID2	pump period time while leakage monitoring	0...655.35 s	0...FFFF H
CID1	changing of fuel trim after opening the purge valve	-63,9972...0...63,9972	0...7FFF...8000...FFFF H
CID8	idle speed change by opening the purge valve	-8191,75...0...8191,75	0...7FFF...8000...FFFF H

Fig. 2: BMW Mode 6 Data (2 Of 3)
Courtesy of BMW OF NORTH AMERICA, INC.

Engine Type: S62B49 TLEV (models: M5, Z8)

Engine Type: S54B32 LEV (models: M3, M3 Cabr., M Roadster, M Coupe)

Test ID / Comp. ID	Monitored Component	Possible Range	Hex Code Factor
TID 1	**catalyst monitoring**		
CID1	catalyst monitoring of catalyst 1 sum of the determined ratios	0...65535	0...FFFF H
CID2	catalyst monitoring of catalyst 2 sum of the determined ratios	0...65535	0...FFFF H
TID 2	**oxygen sensor monitoring**		
CID1	weighted period time (maximum value) of oxygen sensor 1 Exhaust Bank 1	0...65535 ms	0...FFFF H
CID2	weighted period time (maximum value) of oxygen sensor 1 Exhaust Bank 2	0...65535 ms	0...FFFF H
CID3	weighted period time (minimum value) of oxygen sensor 1 Exhaust Bank 1	0...65535 ms	0...FFFF H
CID4	weighted period time (minimum value) of oxygen sensor 1 Exhaust Bank 2	0...65535 ms	0...FFFF H
CID5	weighted switching time for rich to lean of oxygen sensor 1 Exhaust Bank 1	0 ... 100 ms	0...3200 H
CID6	weighted switching time for rich to lean of oxygen sensor 1 Exhaust Bank 2	0 ... 100 ms	0...3200 H
CID7	weighted switching time for lean to rich of oxygen sensor 1 Exhaust Bank 1	0 ... 100 ms	0...3200 H
CID8	weighted switching time for lean to rich of oxygen sensor 1 Exhaust Bank 2	0 ... 100 ms	0...3200 H
TID 3	**secondary air system monitoring**		
CID5	count of lean mixture detection's of the oxygen sensor 1 Exhaust Bank 1	0 ... 65535	0...FFFF H
CID6	count of lean mixture detection's of the oxygen sensor 1 Exhaust Bank 2	0 ... 65535	0...FFFF H
TID 5	**evaporative system monitoring**		
CID1	functional check: change of trim	0 ... 2.0	0...FFFF H
CID2	functional check: hange of idle speed + air mass	0 ... 3200 %	0...7FFF H
CID3	reference current (upper boundary)	0 ... 590 mA	0 ... FFFFH
CID4	reference current (lower boundary)	0 ... 590 mA	0 ... FFFFH
CID5	minimal pump current after switching solenoid	0 ... 590 mA	0 ... FFFFH
CID6	pump current gross leak	0 ... 590 mA	0 ... FFFFH
CID7	pump current fine leak	0 ... 590 mA	0 ... FFFFH
CID8	pump current short cut	0 ... 590 mA	0 ... FFFFH

Fig. 3: BMW Mode 6 Data (3 Of 3)
Courtesy of BMW OF NORTH AMERICA, INC.

Article GUID: A00257334

ENGINE MECHANICAL

Before performing any on-vehicle adjustments to fuel or ignition systems, ensure engine mechanical condition is okay.

VALVE CLEARANCE

NOTE: Engines with the exemption of Motorsport (S54) engine use hydraulic valve lifters and valve adjustment is not required. For Motorsport engine valve adjustment, see 11 34 004 ADJUSTING VALVE CLEARANCE (S54) .

IGNITION TIMING

Ignition timing is electronically controlled and is not adjustable.

IDLE SPEED & MIXTURE

NOTE: Mixture adjustment is not a part of normal tune-up procedure and should not be performed unless mixture control unit is replaced or vehicle fails emissions testing.

HOT-FILM AIR MASS METER (HFM)

Air volume input signal is produced electronically by the HFM which uses a heated metal film in the airflow stream. ECM relay provides the operating voltage. As airflows through HFM, the film is cooled changing the resistance which affects current flow through the circuit. The sensor produces a 1-5 volt varying signal. Based on this change the ECM monitors and regulates the amount of injected fuel. If this input is defective, a fault code will be set and Malfunction Indicator Light (MIL) will be illuminated when OBD-II criteria is achieved. ECM will operate engine using throttle position and engine RPM inputs. HFM is non-adjustable.

IDLE SPEED

1. Idle speed is controlled by an idle speed control valve. Ensure engine is at normal operating temperature, valve clearance is correct and all electrical accessories are off.
2. Connect dwell/tachometer to engine. Ensure idle speed is within specification. See IDLE SPEED & CO LEVEL table. If idle speed and CO level are not within specification, check idle speed control valve or intake manifold for air leaks. If problem is still present, check error memory.

IDLE SPEED & CO LEVEL

Application	Idle RPM (1)	(2) CO Level %
6-Cylinder & V8	650-750	.5
V12	(3)	(3)

(1) With A/C off and transmission in neutral.

(2) Maximum specification, measured at exhaust manifold. See ON-VEHICLE ADJUSTMENTS article for additional information.

(3) Information is not available.

IDLE MIXTURE & CO LEVEL

NOTE: This procedure does not apply to V12.

1. Disconnect oxygen sensor connector. Remove bolt from exhaust manifold and install CO Test Connector (13-0-090) with Adapter (13-0-100) on exhaust manifold. Connect CO meter and check idle mixture. Ensure CO level is within specification. See IDLE SPEED & CO LEVEL table.
2. If CO level exceeds specification, check fuel injectors, fuel pressure and coolant temperature sensor. If CO level is less than specification, check idle speed control hoses and connections and check for air leaks. Reconnect oxygen sensor.

THROTTLE VALVE

The throttle valve plate is electronically operated to regulate intake air flow by the ECM. The purpose is for precision throttle operation, OBD compliant for fault monitoring, DSC and cruise control. This integrated electronic throttle reduces extra control modules, wiring, and sensors. Adjusting electronic throttles is not permitted, the throttle assembly must be replaced as a unit. The adaptation values must be cleared and adaptation procedure must be performed using the DISplus/GT1.

THROTTLE POSITION SENSOR

Accelerator pedal module provides two variable voltage signals to the ECM that represents accelerator pedal position and rate of movement. Dual Hall Sensors are integral in the accelerator pedal module. The ECM compares the 2 values for plausibility. The module contains internal springs to return the accelerator pedal to the rest position.

The ECM provides voltage (5 volts) and ground for the Hall sensors. As the accelerator pedal is moved from rest to full throttle, the sensors produce a variable voltage signal:

- Hall sensor 1 (request) = 0.5 to 4.5 volts.
- Hall sensor 2 (plausibility) = 0.5 to 2.0 volts.

If the signals are not plausible, the ECM will use the lower of the two signals as the requested input. The throttle response will be slower and the maximum throttle response will be reduced. Throttle position sensor is not adjustable.

ACCELERATOR WITH ELECTRONIC ENGINE POWER CONTROL

NOTE: Following adjustment procedure is for Z3 models, but may apply to other models.

1. To adjust first idling position, loosen hexagon nut on pedal value sensor. Create .011" (.3 mm) gap between accelerator pedal shaft and idle stop. Tighten hexagon nut on pedal value sensor. Support lever on pedal value sensor while tightening.
2. To adjust full load position on manual transmission, actuate accelerator pedal as far as kickdown pressure point in pedal value sensor. In this position, adjust screw to bear on the accelerator pedal and lock it.
3. On automatic transmission vehicles, operate accelerator pedal as far as kickdown pressure point in pedal value sensor. In this position, adjust screw to have .19" (5 mm) distance between knurled head screw and accelerator pedal. Lock stop screw.
4. After adjusting, check pedal value sensor with BMW service tester or MoDiC. Switch ignition on. Move accelerator pedal to full load stop. Compare actual voltage value with the specified value. Move accelerator pedal to idling stop. Compare actual voltage value with the specified value. Correct adjustment if necessary. See PEDAL VALUE SENSOR VOLTAGE SPECIFICATIONS table.

PEDAL VALUE SENSOR VOLTAGE SPECIFICATIONS

Application	Specification
Idle Speed	45-353 mV
Full Throttle	

Automatic Transmission	3700-3950 mV
Manual Transmission	3150-3450 mV

Article GUID: A00151721

INTRODUCTION

Removal, overhaul and installation procedures are covered in this article. If component removal and installation is primarily an unbolt and bolt-on procedure, only a torque specification may be furnished.

NOTE: Removal and installation procedures are supplied for those models and/or engines with available information.

COMPUTERIZED ENGINE CONTROLS

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.

POWERTRAIN CONTROL MODULE (PCM) FOR DIGITAL MOTOR ELECTRONICS (DME) SYSTEM

NOTE: Disconnect battery before removing Digital Motor Electronics (DME) module (PCM). Disconnecting battery will clear PCM Diagnostic Trouble Codes (DTCs). Retrieve DTCs before disconnecting battery.

PCM stores certain basic driveability values. PCM also receives different input values, depending on engine condition, which are compared with stored values. PCM adaptive system compares input values with stored values. PCM replacement could cause poor engine performance before all values are adapted to engine condition.

Before exchanging PCM, ensure engine is at normal operating temperature. Remove old PCM, install new PCM and operate vehicle at different RPMs.

Removal & Installation (3-Series - Z3)

PCM is located in box in right rear of engine compartment. Remove PCM box cover. Disconnect electrical connector. Remove PCM. See Fig. 1. To install, reverse removal procedure.

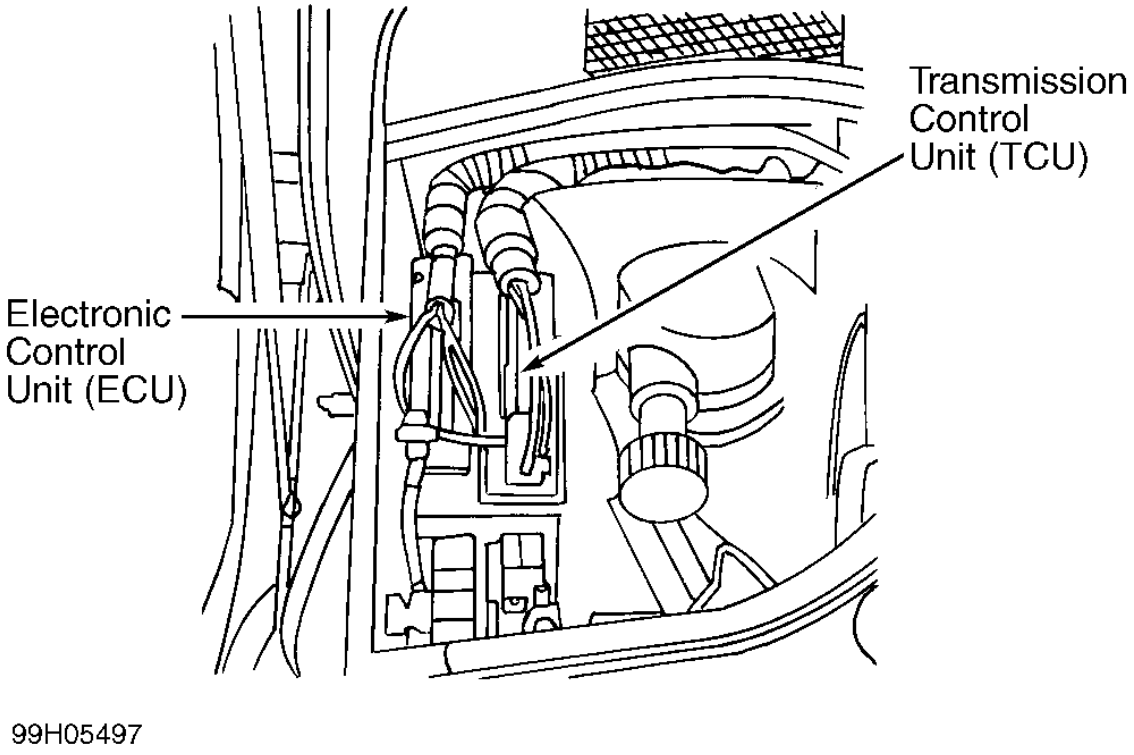


Fig. 1: Removing PCM (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: BMW 3-series vehicles utilize either a Bosch or Siemens PCM. PCMs cannot be interchanged.

Removal & Installation (3-Series - E46)

PCM is located in box in left rear corner of engine compartment. See Fig. 2. Remove 4 cover screws. Disconnect PCM connector. Remove PCM. See Fig. 3. To install, reverse removal procedure. Ensure wiring harness and cover are correctly installed to prevent water entry.

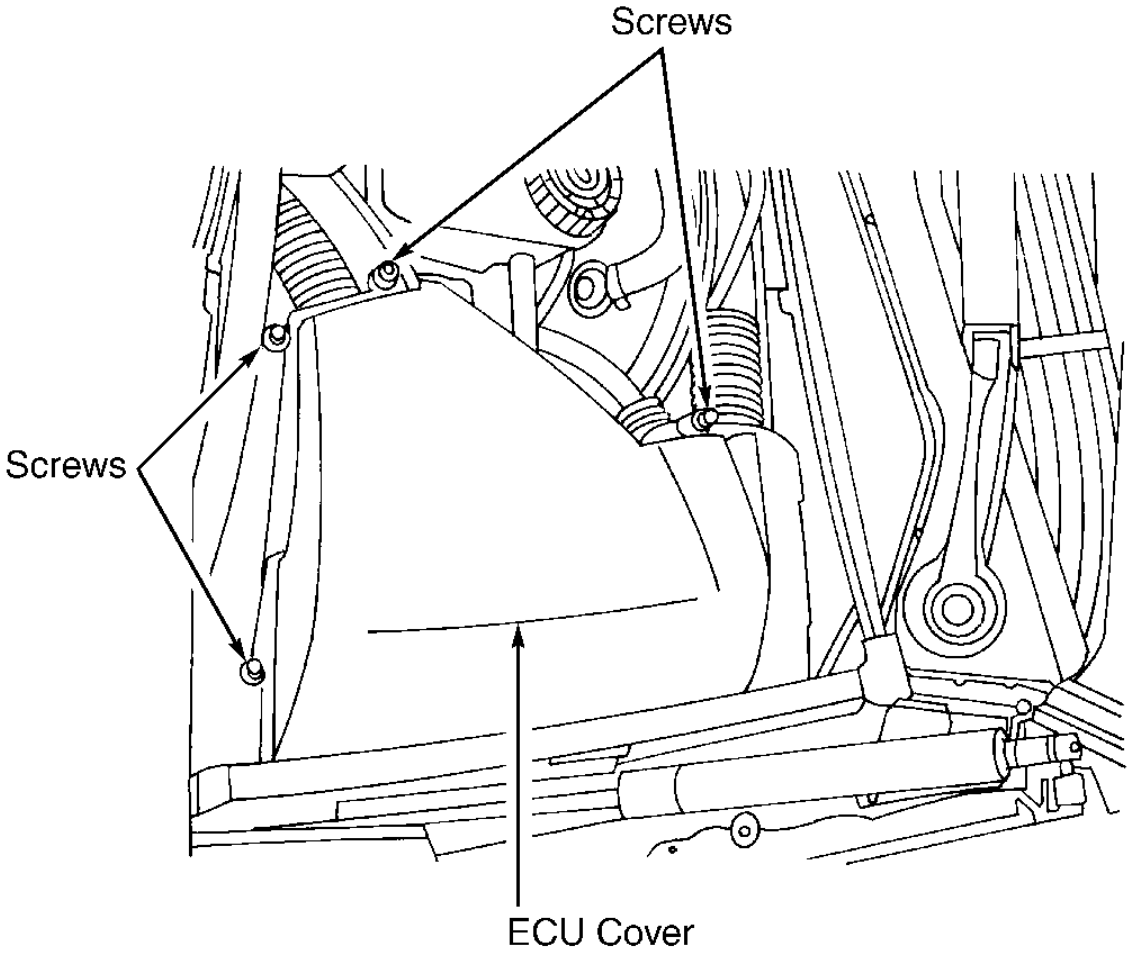


Fig. 2: Removing PCM Cover Screws (E46)
Courtesy of BMW OF NORTH AMERICA, INC.

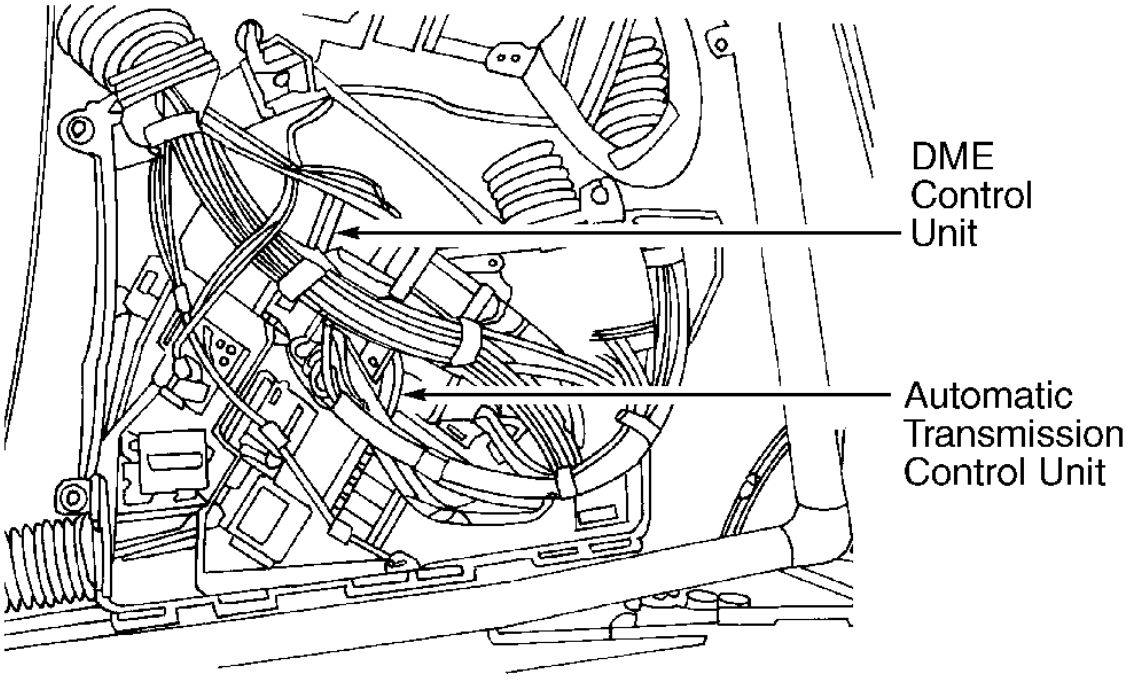
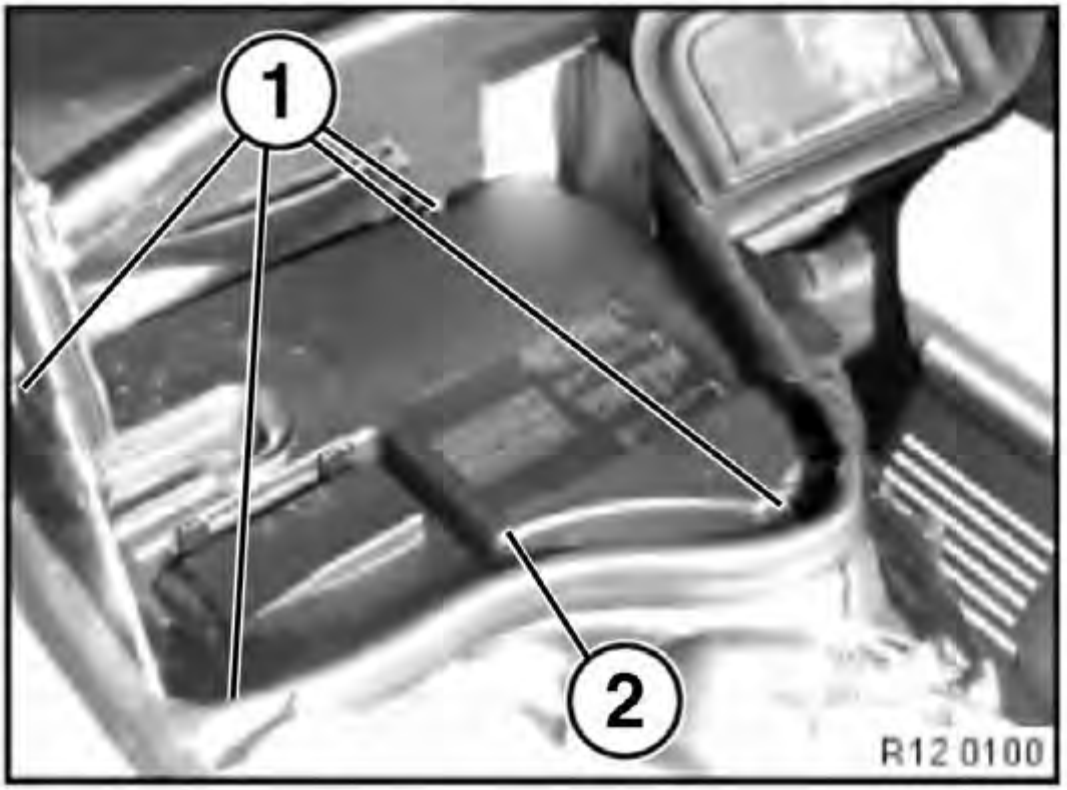


Fig. 3: Removing PCM (E46)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (5-Series & 7-Series)

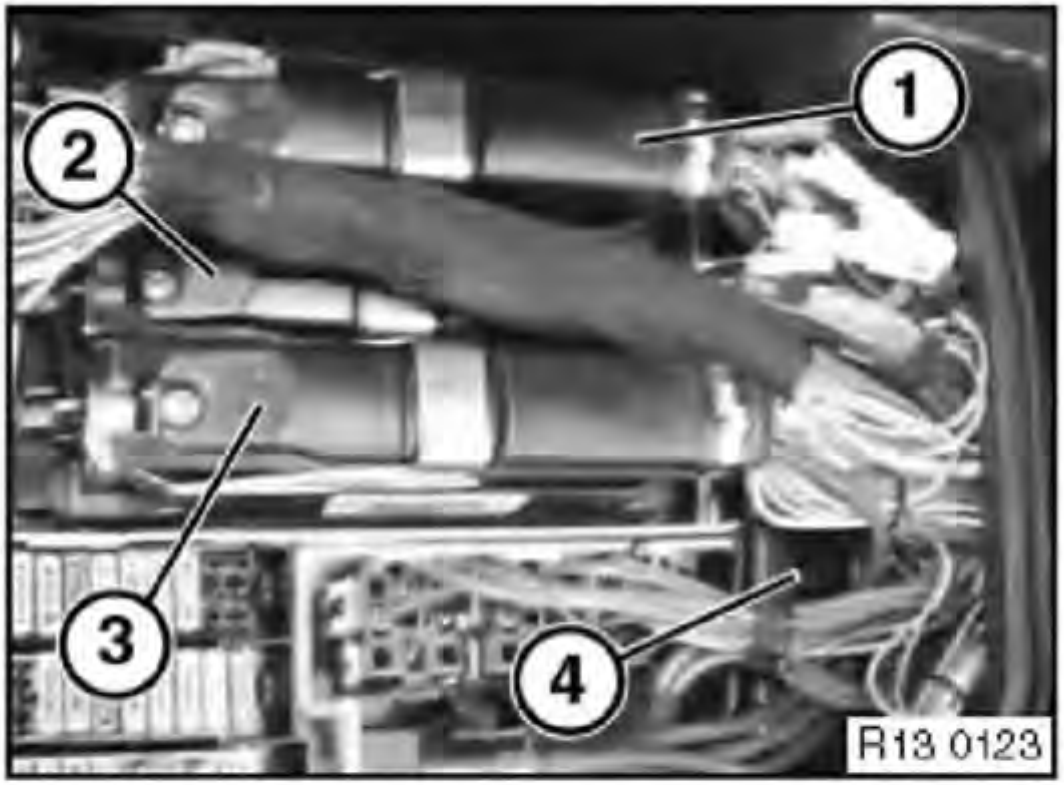
PCM is located in box in right rear corner of engine compartment. 7-Series V12 equipped vehicles use 2 PCMs. Open locking bracket on PCM/control unit box. Open filter housing cover. Unhook filter housing from hinges. Unhook retaining clip and pull filter housing upward. Remove filter housing. Remove 4 PCM/control unit cover bolts. For V12 illustration, see Fig. 4 and Fig. 5 . Disconnect PCM electrical connector. Remove PCM. To install, reverse removal procedure.



1. Bolts
2. Control Unit Box Cover

G00125127

Fig. 4: Removing Control Unit Box Cover (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. PCM (DME 1)
2. PCM (DME 2)
3. Electronic Transmission Control
4. Electronic Engine Power Control

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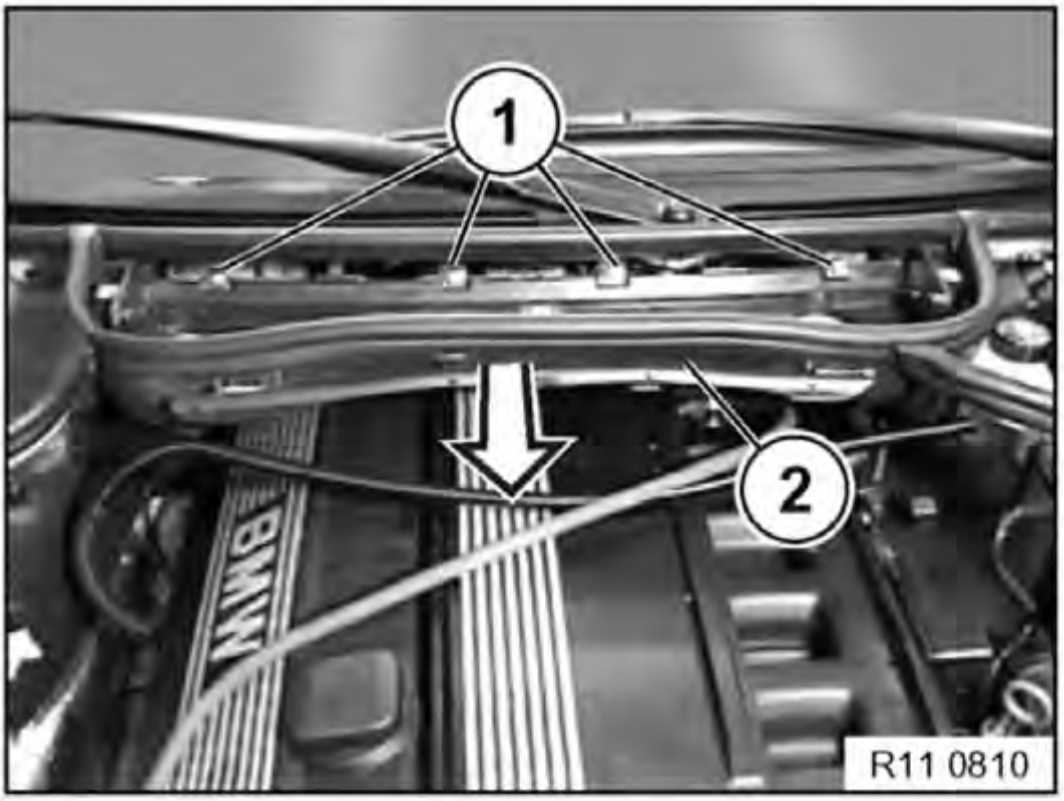
Fig. 5: Identifying PCM Control Units (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

ENGINE SENSORS & SWITCHES

OXYGEN SENSOR

Removal & Installation (6-Cylinder)

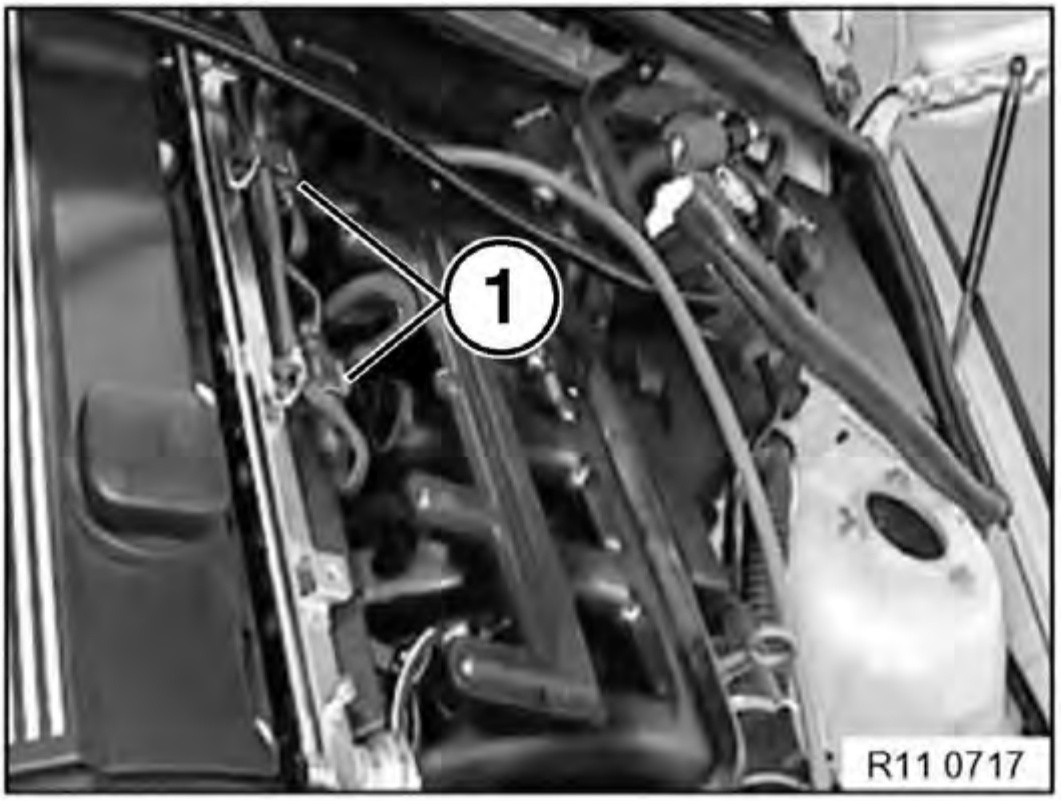
On E46, open cable duct on lower section of microfilter housing and feed out cables. Remove screws and lower section of microfilter housing. See Fig. 6. On all models, remove engine cover. See Fig. 34. Mark oxygen sensor connectors for reassembly reference. See Fig. 7. Unclip cable from retainer. Disconnect connector. Unclip cable on rear side of engine from cable guide. Remove oxygen sensor from cylinders No. 1-3 and No. 4-6 with Special Tool (11 7 030). Remove oxygen sensor. To install, reverse removal procedure. Coat threads with anti-seize compound and install. Tighten oxygen sensor to 41 ft. lbs. (55 N.m).



1. Screws
2. Microfilter Housing

G00131521

Fig. 6: Removing Microfilter Housing (E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Plug Connections

G00131522

Fig. 7: Identifying Oxygen Sensor Connectors (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8 & V12)

Turn ignition off. Unclip oxygen sensor cable from retainer. Disconnect connector. Remove oxygen sensor with Special Tool (11 7 030). See Fig. 8. To install, reverse removal procedure. Threads of new oxygen sensors are already coated with anti-sieze compound. If an oxygen sensor is reused, apply a thin coat of anti-sieze compound. Do not clean oxygen sensor section which protrudes into the exhaust line and ensure that it avoids all contact with lubricants. Note cable routing of oxygen sensor. Interrogate fault memory of control unit on Digital Engine Electronics (DME), check fault messages in memory, rectify faults and cancel fault memory. Information is not available from manufacturer.

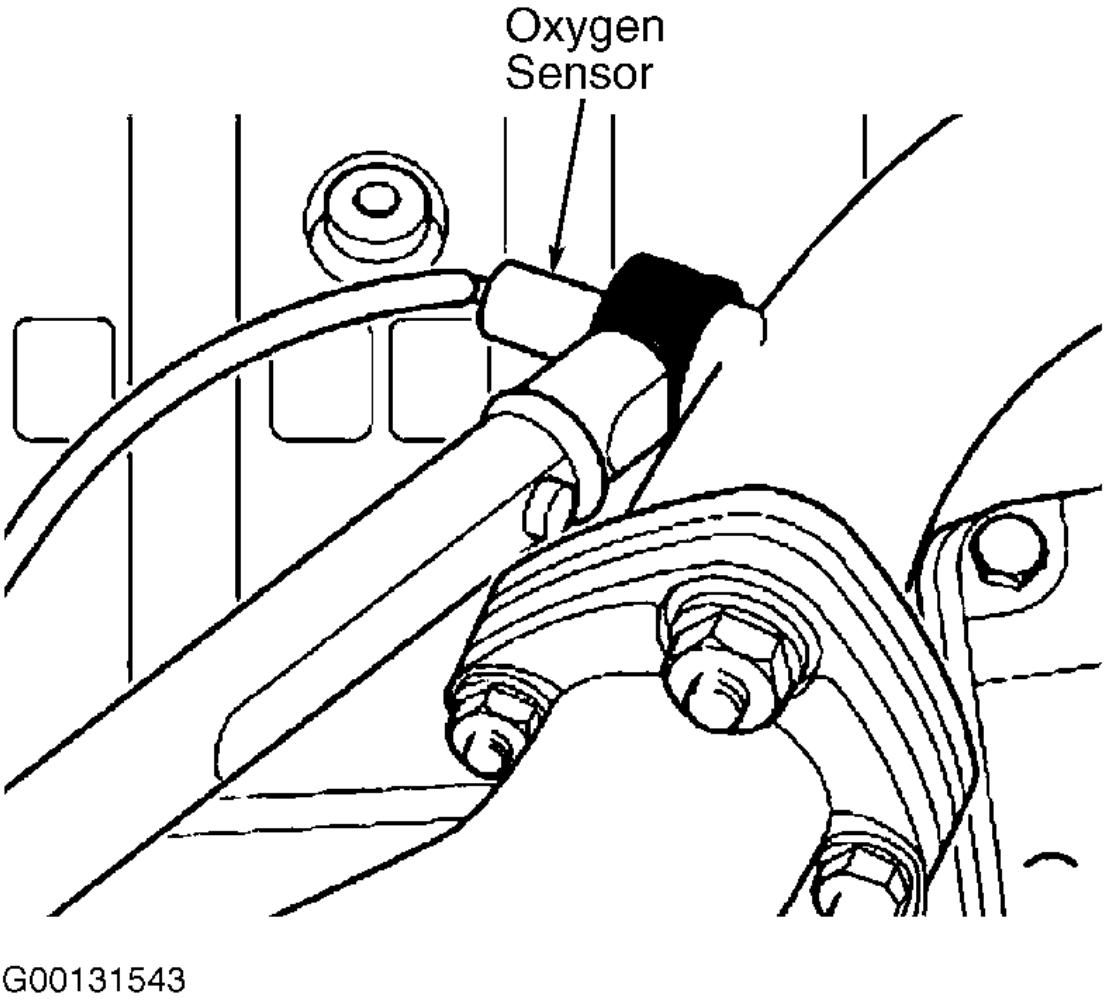
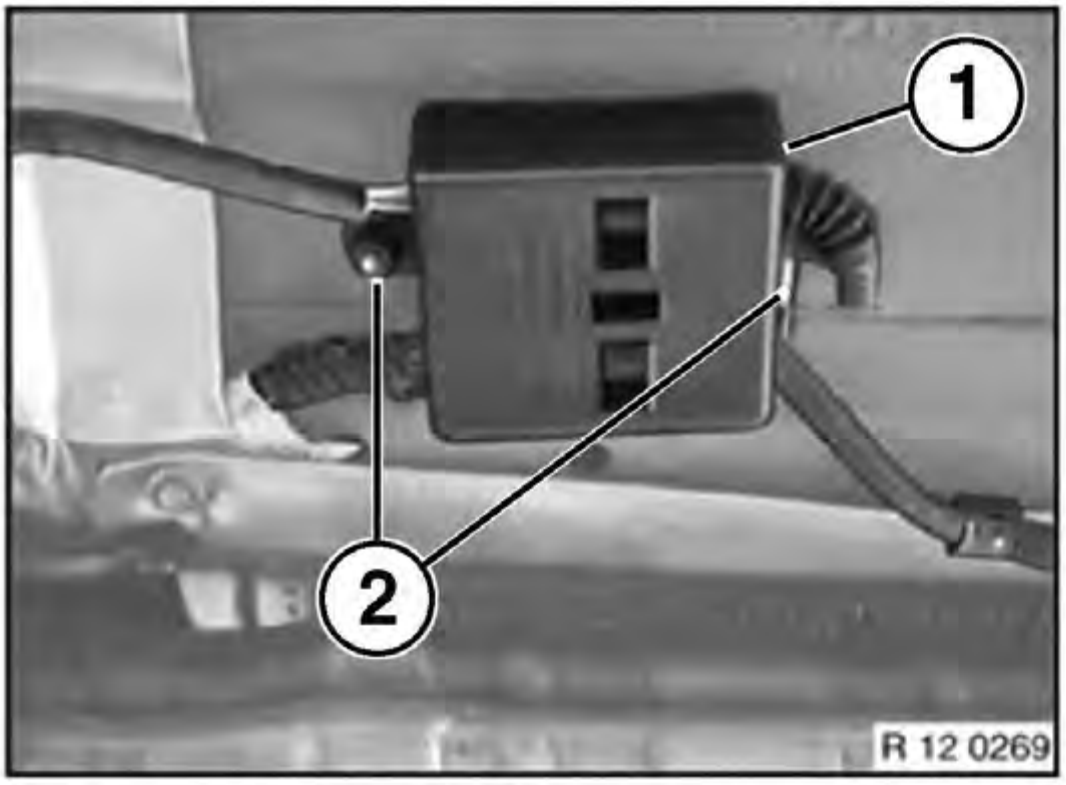


Fig. 8: Removing Oxygen Sensor (V8 & V12)
Courtesy of BMW OF NORTH AMERICA, INC.

OXYGEN SENSOR MONITOR (V12)

Removal & Installation

Turn ignition off. Remove nuts in cover. Disconnect electrical connector. Remove monitor. See Fig. 9. To install, reverse removal procedure.



1. Oxygen Monitor Sensor
2. Nuts

G00131550

Fig. 9: Identifying Oxygen Sensor Monitor (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

IGNITION SYSTEMS

CAMSHAFT POSITION SENSOR (CYLINDER IDENTIFICATION SENSOR)

Removal & Installation (6-Cylinder)

1. To remove exhaust camshaft sensor, go to next step. To remove intake camshaft sensor, remove intake air filter housing. Remove VANOS adjustment solenoid valve located next to oil filter housing. See 11 36 570 REPLACING SOLENOID VALVE FOR INLET SIDE ON VANOS ADJUSTMENT UNIT . Disconnect sensor electrical connector. Remove sensor screw. Remove sensor from cylinder head. See Fig. 10. To install, reverse removal procedure. Replace sealing ring as necessary.
2. Disconnect exhaust camshaft sensor connector on front of cylinder head. Remove sensor screw. Remove sensor from cylinder head. See Fig. 11. To install, reverse removal procedure. Replace sealing ring as necessary.

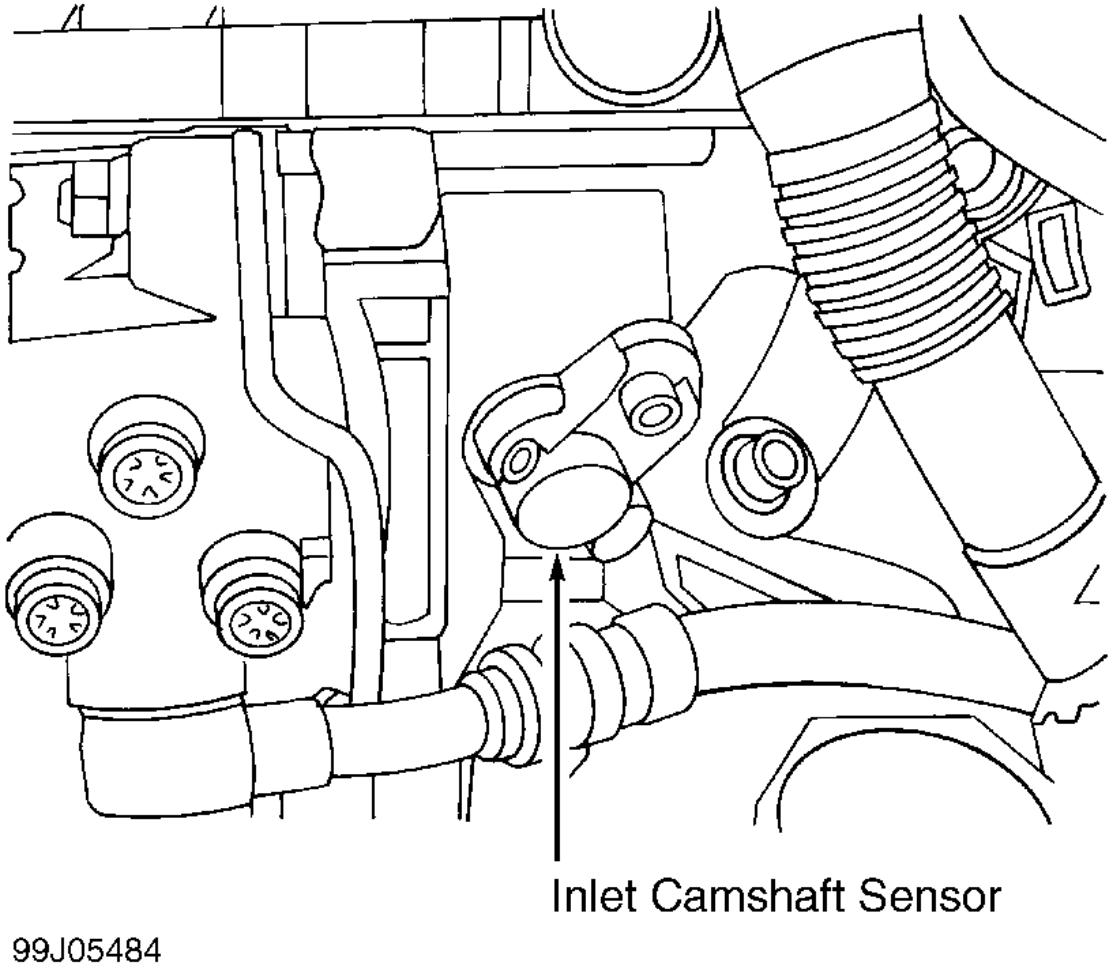


Fig. 10: Removing Intake Camshaft Sensor (E46)
Courtesy of BMW OF NORTH AMERICA, INC.

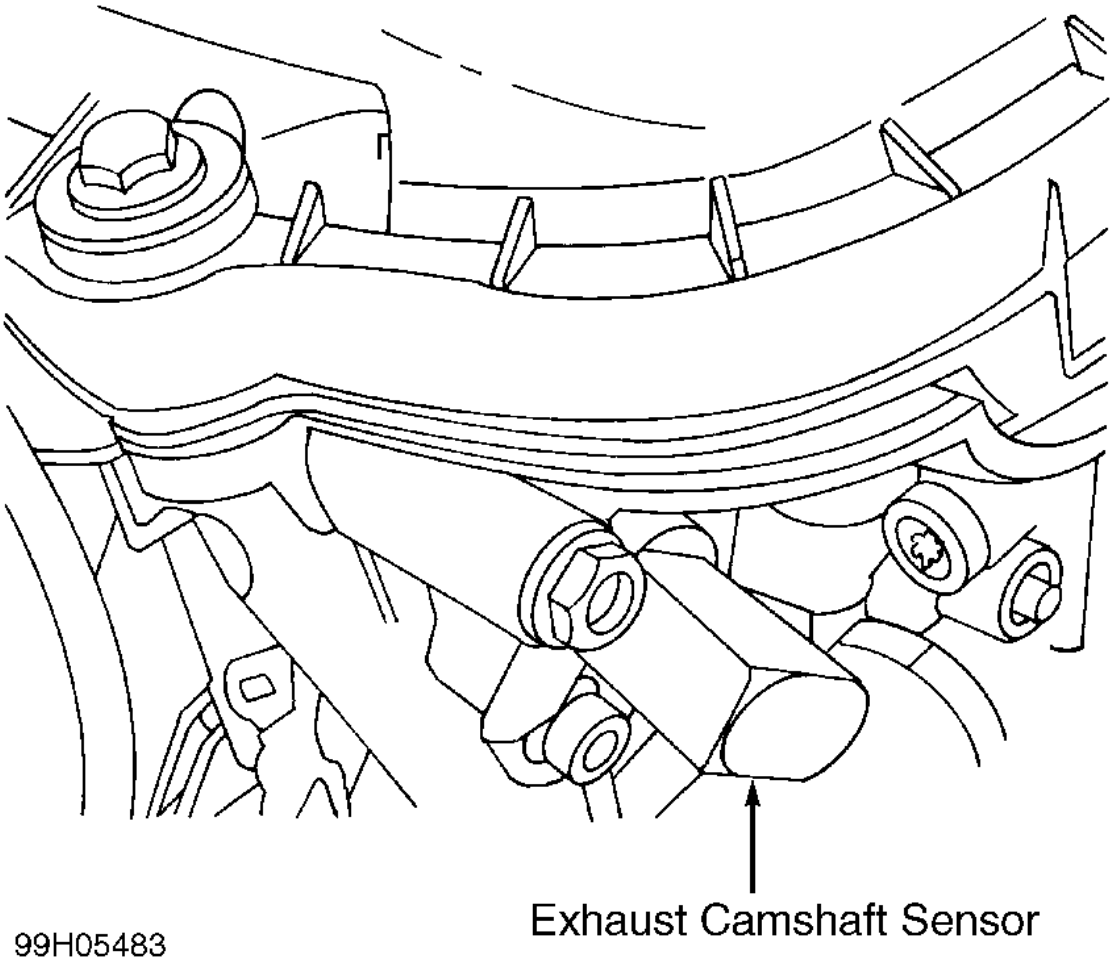


Fig. 11: Removing Exhaust Camshaft Sensor (E46)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8)

Remove engine cover. See Fig. 34. Locate sensor on front of right cylinder head. Remove sensor. See Fig. 12. Disconnect connector located on top of engine at harness conduit. To install, reverse removal procedure.

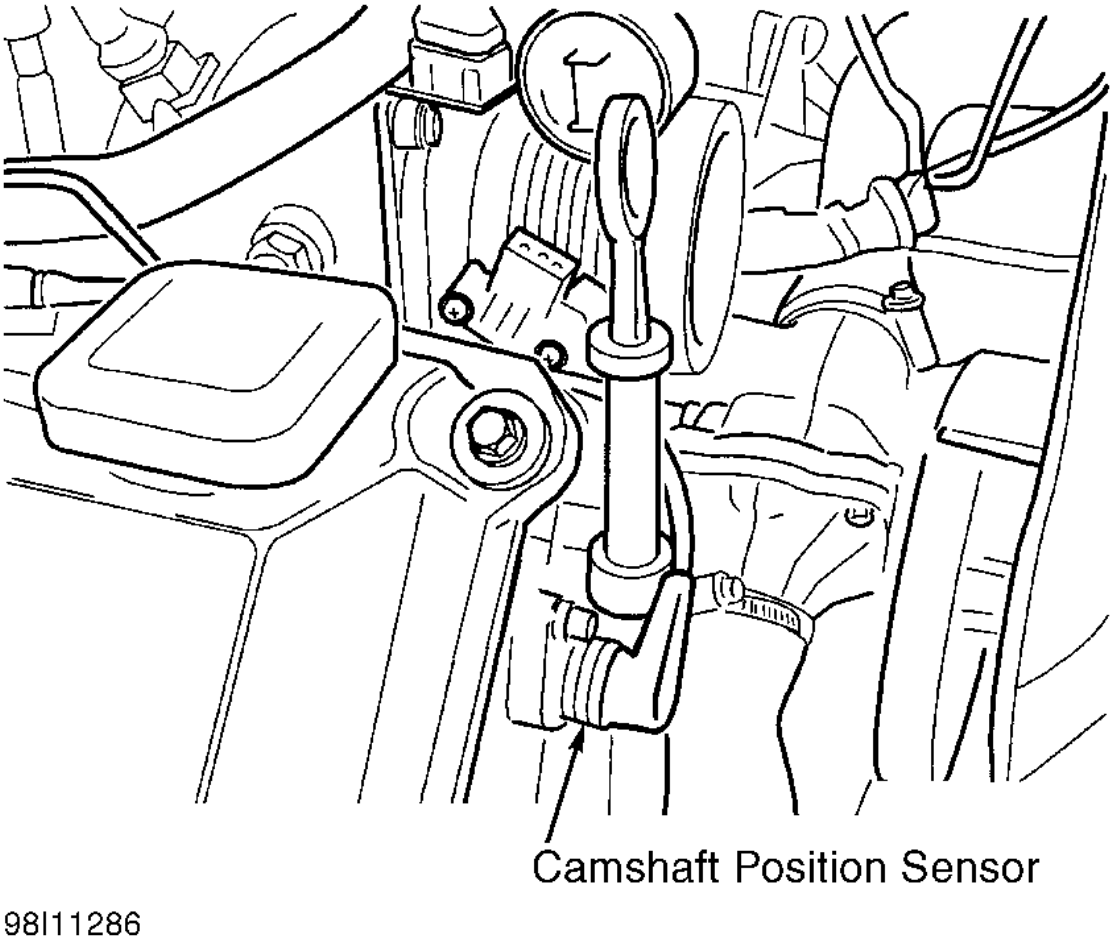
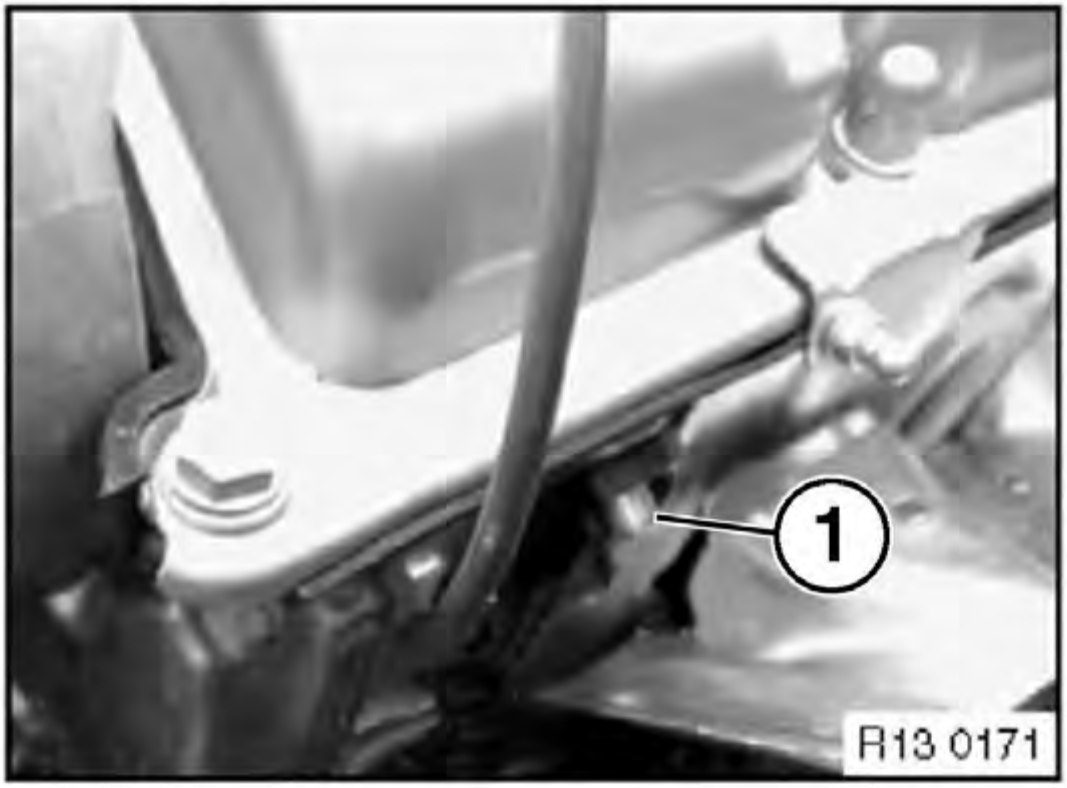


Fig. 12: Removing Camshaft Position Sensor (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

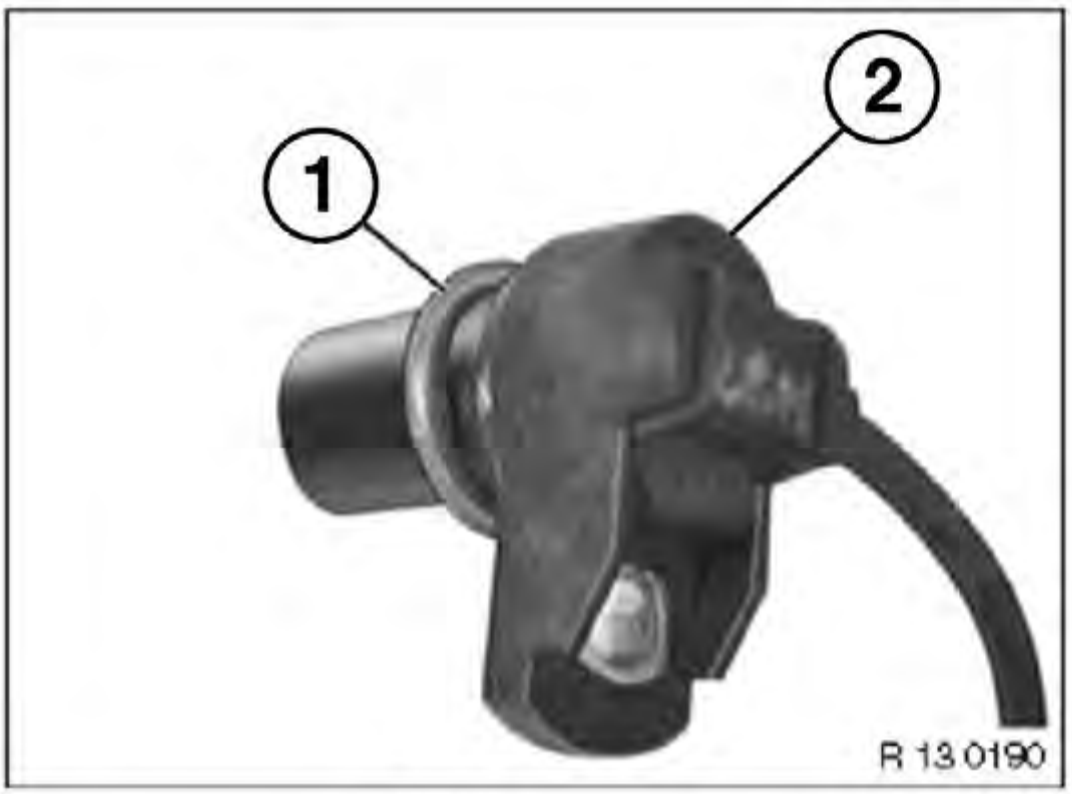
Turn ignition off. Remove distributor cap with left ignition wiring harness. Remove sensor bolt. Remove sensor. See Fig. 13. To install, reverse removal procedure. Check seal for damage. See Fig. 14. Replace seal as necessary.



1. Camshaft Sensor

G00125135

Fig. 13: Removing Camshaft Sensor (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Seal
2. Camshaft Sensor

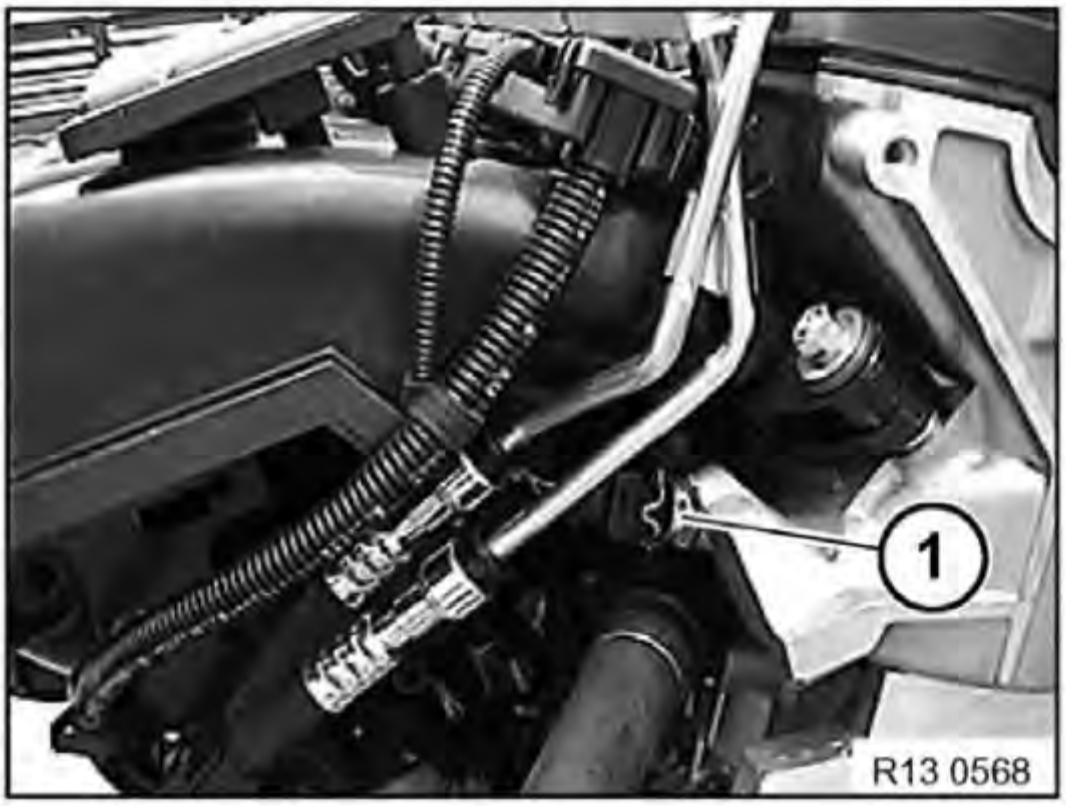
G00125136

Fig. 14: Identifying Camshaft Sensor & Seal (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

COOLANT TEMPERATURE SENSOR

Removal & Installation (6-Cylinder)

Coolant temperature sensor is located under intake air manifold in cylinder head on cylinder No. 6. See Fig. 15. Disconnect intake manifold. Disconnect electrical connector and unscrew temperature sensor. See Fig. 16. Remove coolant temperature sensor. To install, reverse removal procedure. Check coolant level and top up coolant if necessary. Read out fault memory of DME control module, check stored fault messages, rectify faults, and cancel fault memory.



1. Coolant Temperature Sensor

G00131524

Fig. 15: Locating Coolant Temperature Sensor (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.



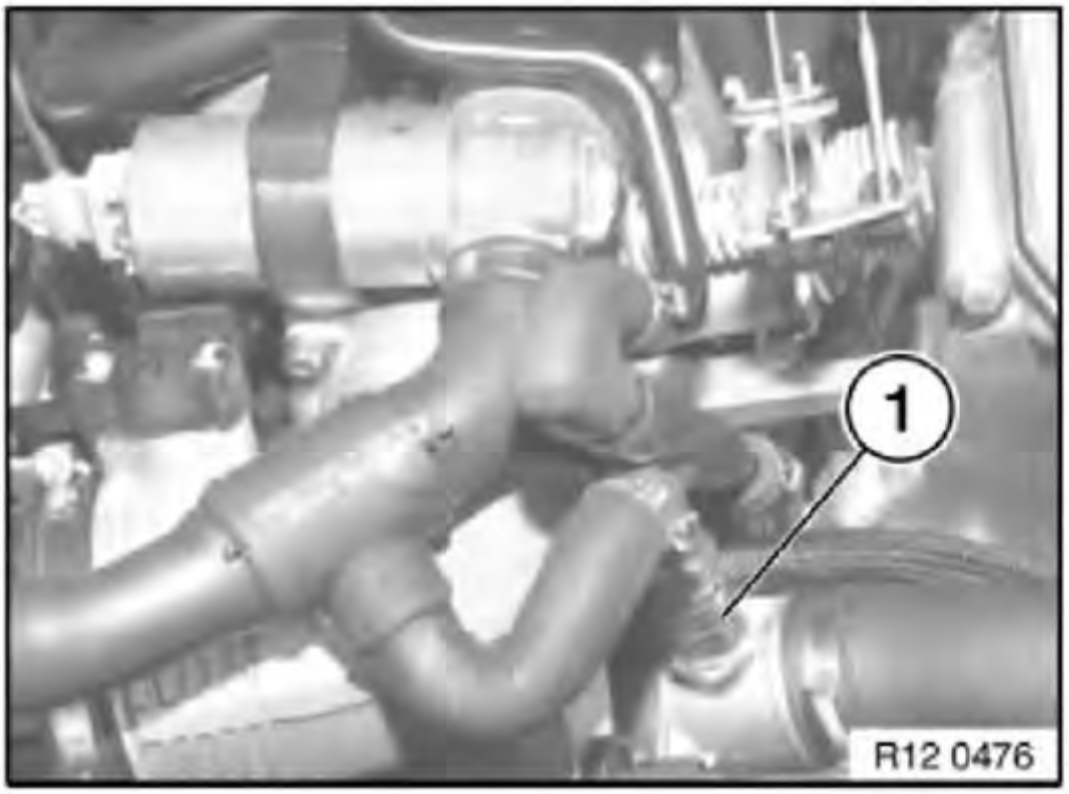
1. Electrical Connector

G00131525

Fig. 16: Identifying Coolant Temperature Sensor Electrical Connector (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8)

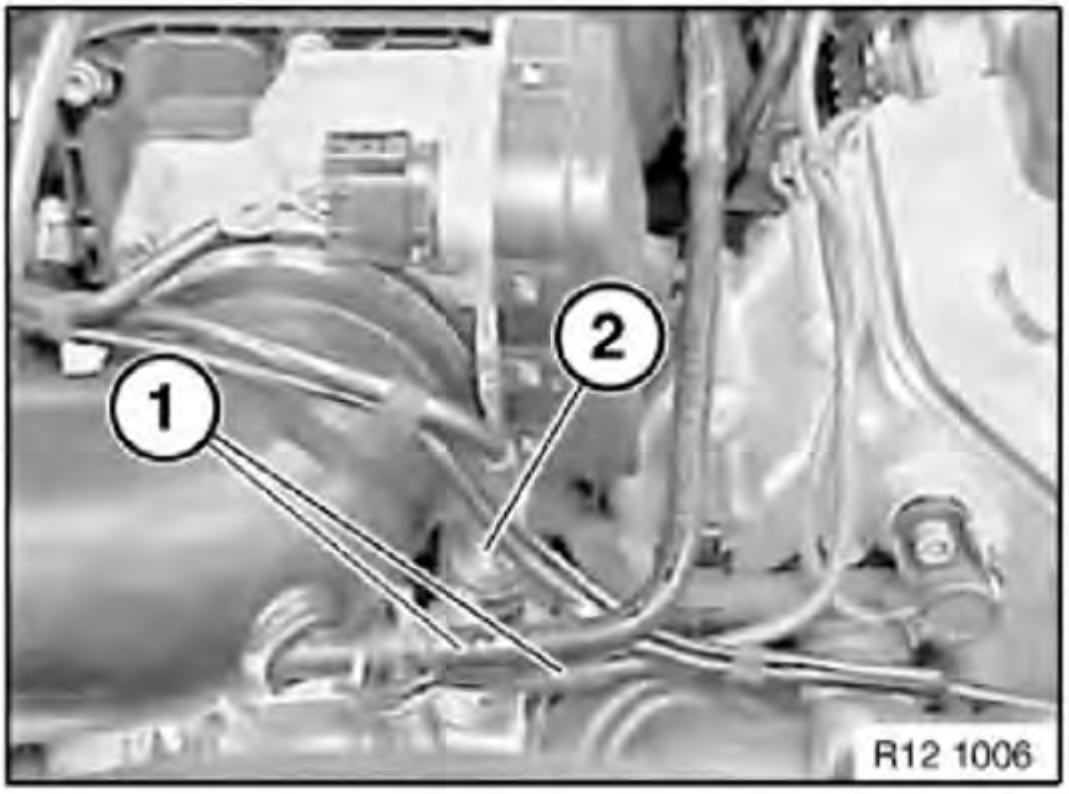
1. Turn ignition off. On vehicles with idle speed control valve, disconnect electrical connection. See Fig. 17. On vehicles without idle speed control valve, sensor is fitted on water pipe at front. Disconnect vacuum lines. Detach plug from sensor. See Fig. 18. On all vehicles, unscrew sensor. See Fig. 19. To install, reverse removal procedure.
2. Replace sealing ring. After completing work, fill and vent cooling system and check for leaks. Interrogate fault memory of DME control unit.



1. Plug Connection

G00131482

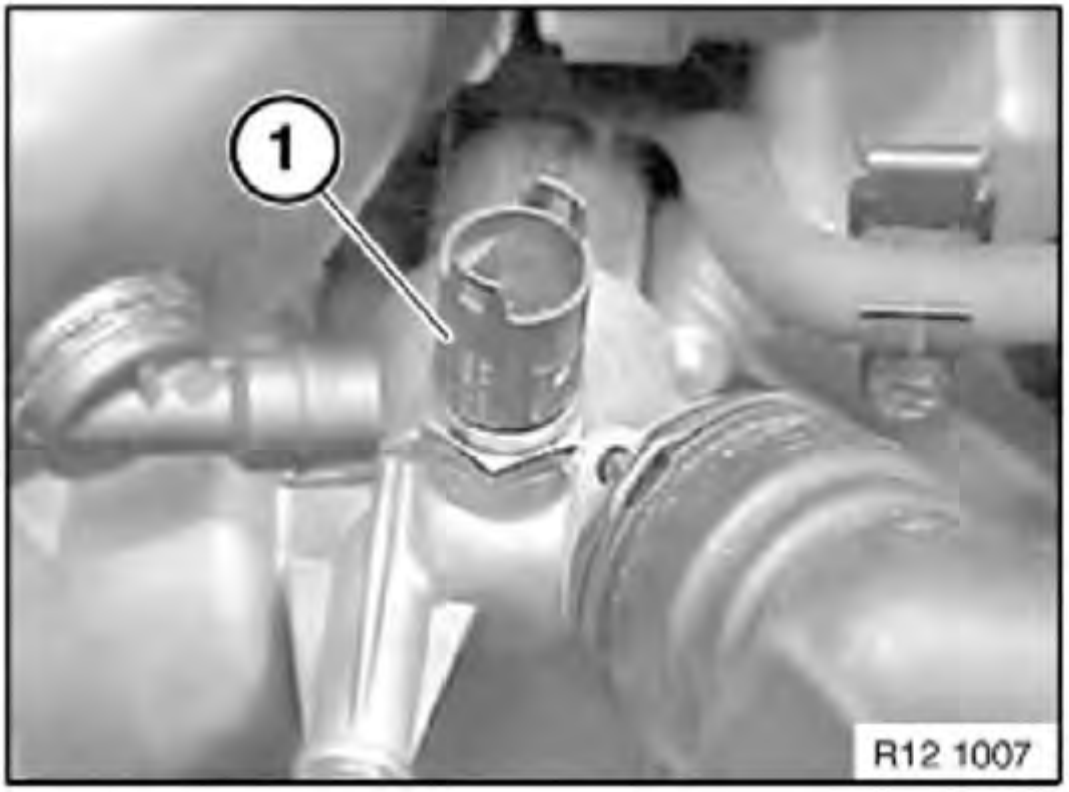
Fig. 17: Disconnecting Electrical Connector (V8)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Vacuum Lines
2. Plug

G00131483

Fig. 18: Disconnect Vacuum Lines & Sensor Plug (V8)
Courtesy of BMW OF NORTH AMERICA, INC.



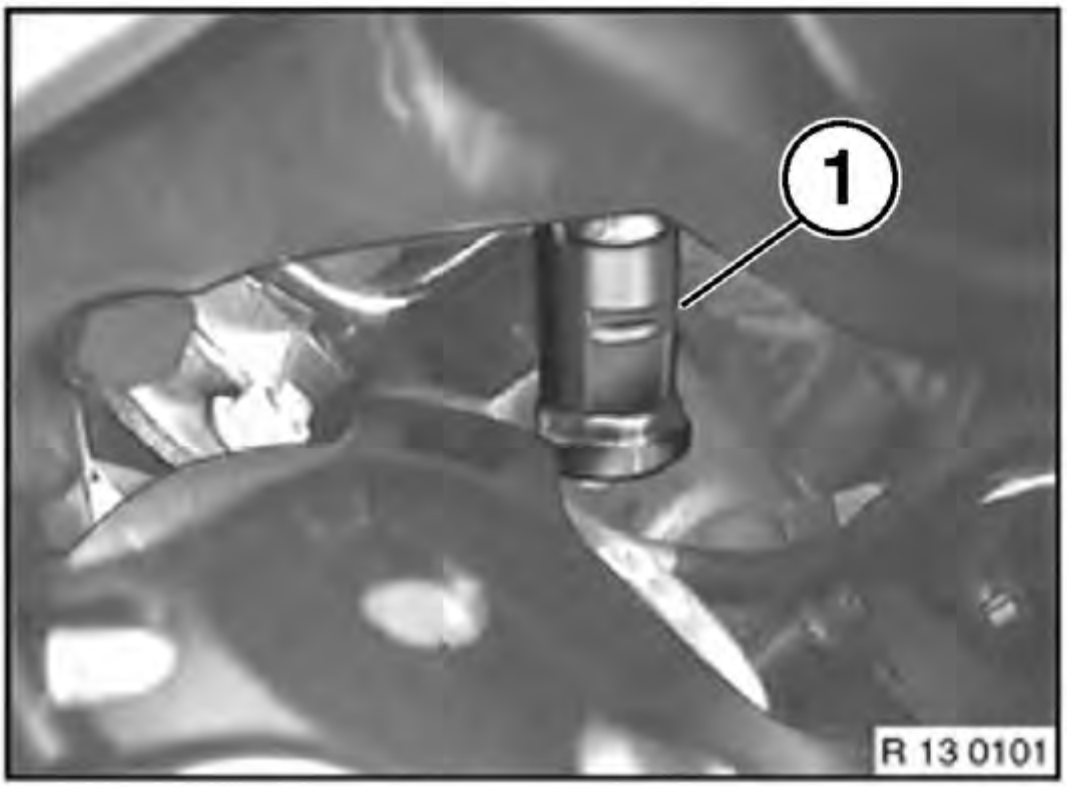
1. Coolant Temperature Sensor

G00131484

Fig. 19: Removing Coolant Temperature Sensor (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

Coolant temperature sensor is located under front cable duct on water pump housing. Turn ignition off. Remove non-return valve on cylinders No. 1-6. See NON-RETURN VALVE. Disconnect sensor electrical connector. Remove temperature sensor. See Fig. 20. To install, reverse removal procedure.



1. Coolant Temperature Sensor

G00125153

Fig. 20: Identifying Coolant Temperature Sensor (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

CRANKSHAFT POSITION SENSOR

Removal & Installation (6-Cylinder)

Crankshaft position sensor is located below starter. Remove cover under engine. Disconnect crankshaft position sensor connector. Remove crankshaft position sensor screw. Remove crankshaft position sensor. To install, reverse removal procedure. Replace sealing ring as necessary.

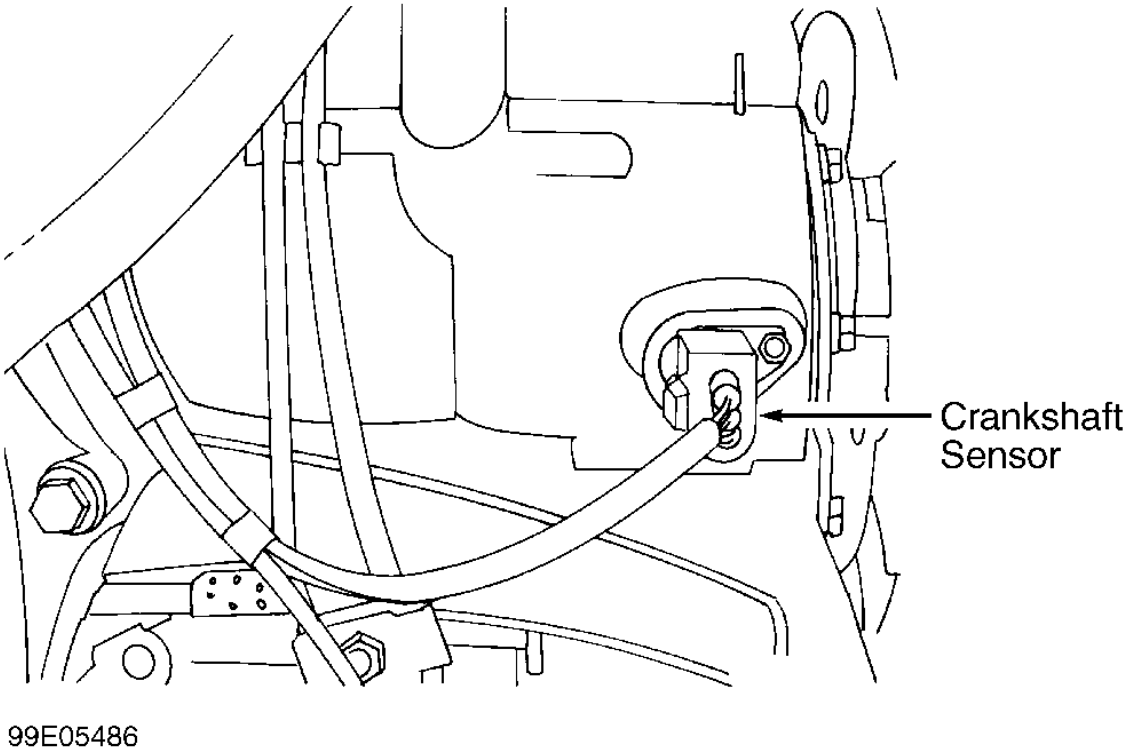


Fig. 21: Identifying Crankshaft Sensor (6-Cylinder)

Removal & Installation (V8)

Sensor is located on transmission housing, bottom right.

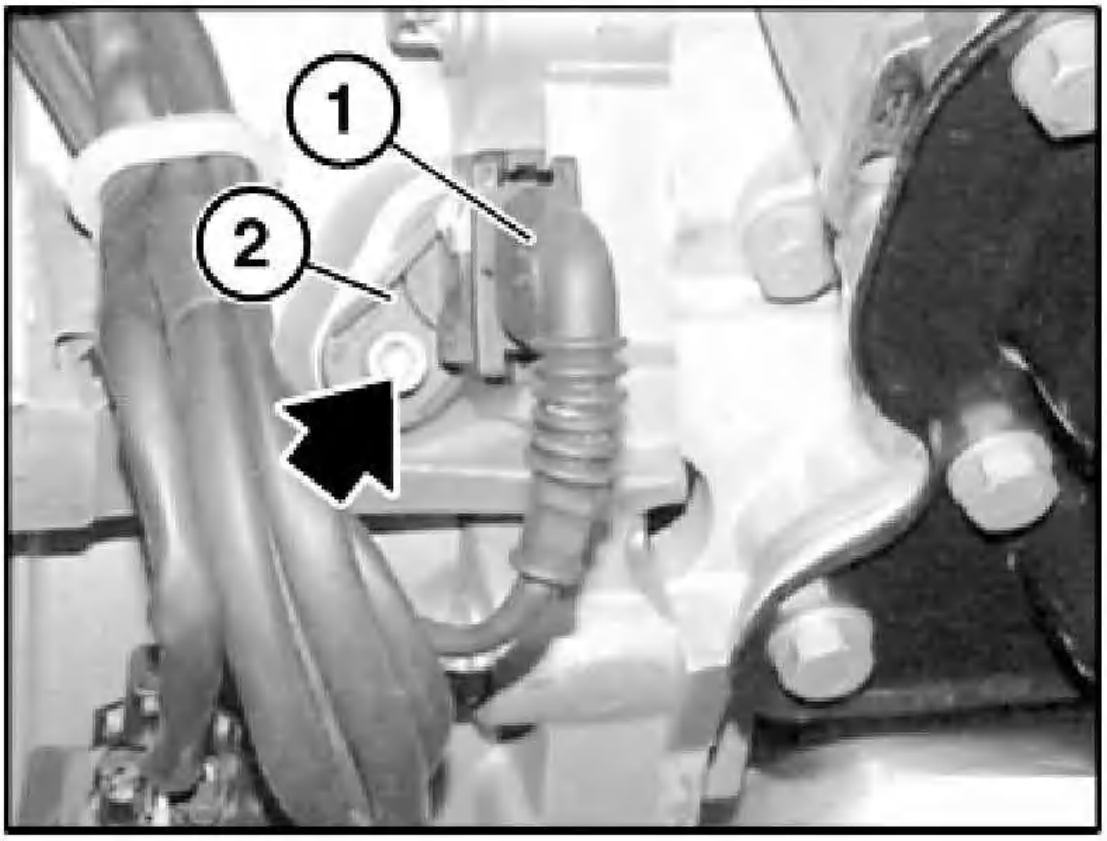


Fig. 22: Identifying Crankshaft Sensor (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

1. Turn ignition off. Remove rear splash guard. Disconnect plug connection on crankshaft sensor for DME No. 1 (cylinders No. 1-6) or DME No. 2 (cylinders No. 7-12). See Fig. 23 and Fig. 24 . Remove crankshaft sensor screw. See Fig. 25. Remove crankshaft sensor.

NOTE: If replacing transmission, flywheel or crankshaft position sensor, check whether one or more shims are installed between transmission housing and crankshaft sensor. If one or more shims are installed, distance between crankshaft sensor and pulse teeth must be measured.

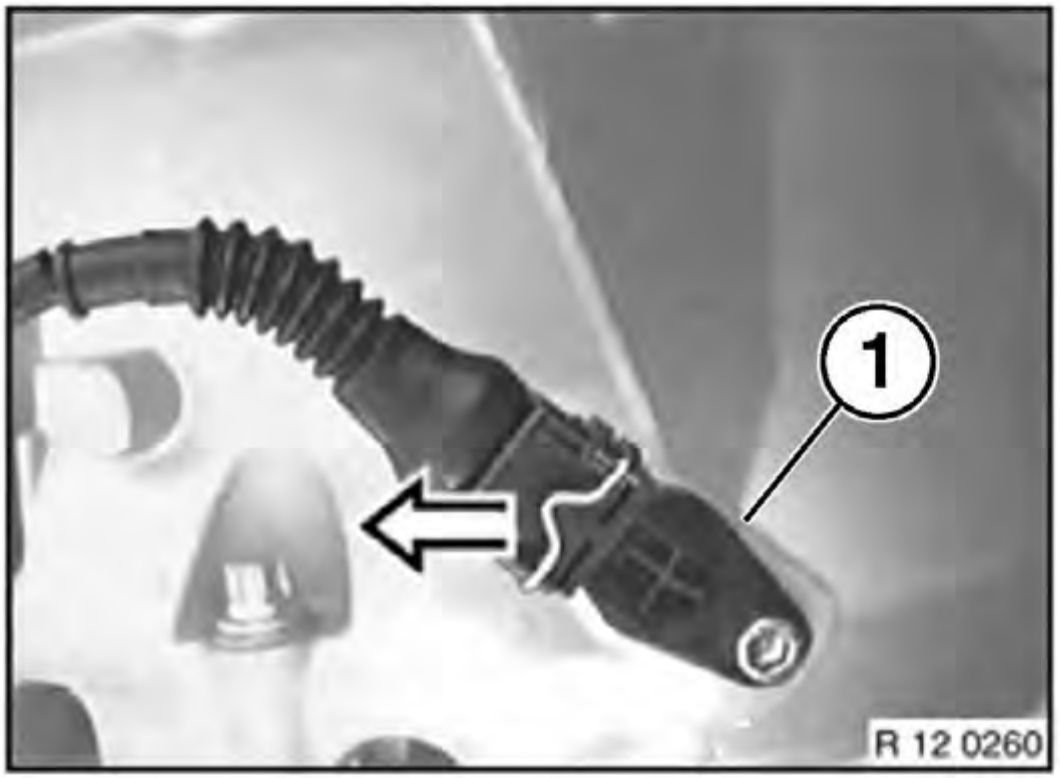
2. To install, reverse removal procedure. Turn engine on front central bolt so a full crankshaft position sensor pulse tooth can be seen through opening of removed sensor. Ensure pulse tooth is exactly centered in hole. See Fig. 26. Measure depth to pulse teeth of flywheel, then measure depth of pulse sensor. See Fig. 27 and Fig. 28 . Subtract depth of pulse sensor from depth of flywheel to achieve gap measurement. Using shims, adjust gap to.021" (.55 mm).



1. Crankshaft Sensor (Cylinders No. 1-6)

G00125129

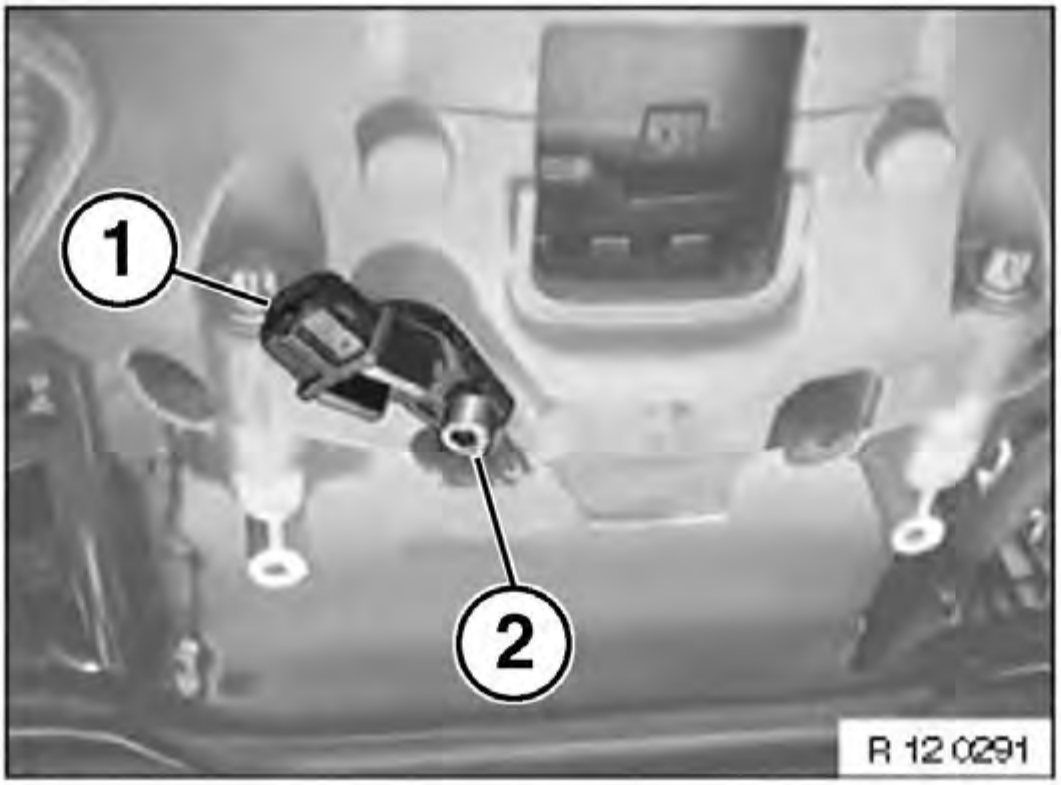
Fig. 23: Identifying Crankshaft Sensor (Cylinders No. 1-6)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Crankshaft Sensor (Cylinders No. 7-12)

G00125130

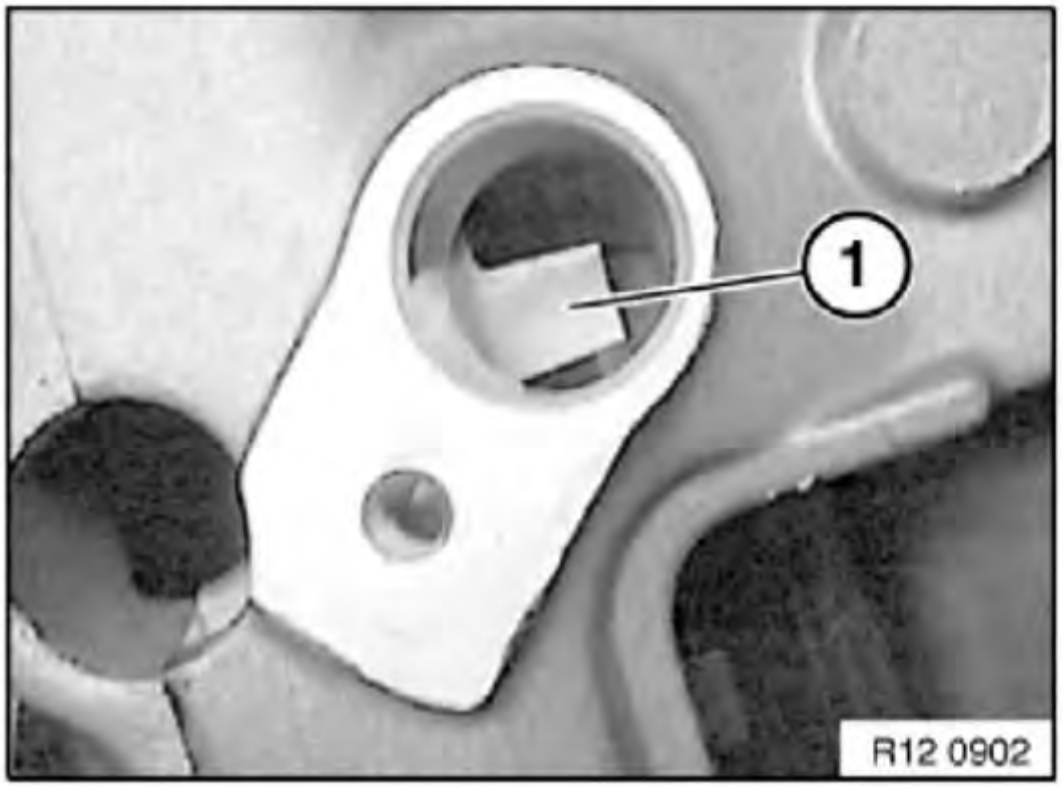
Fig. 24: Identifying Crankshaft Sensor (Cylinders No. 7-12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Crankshaft Sensor
2. Screw

G00125131

Fig. 25: Removing Crankshaft Sensor (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Pulse Tooth

G00125132

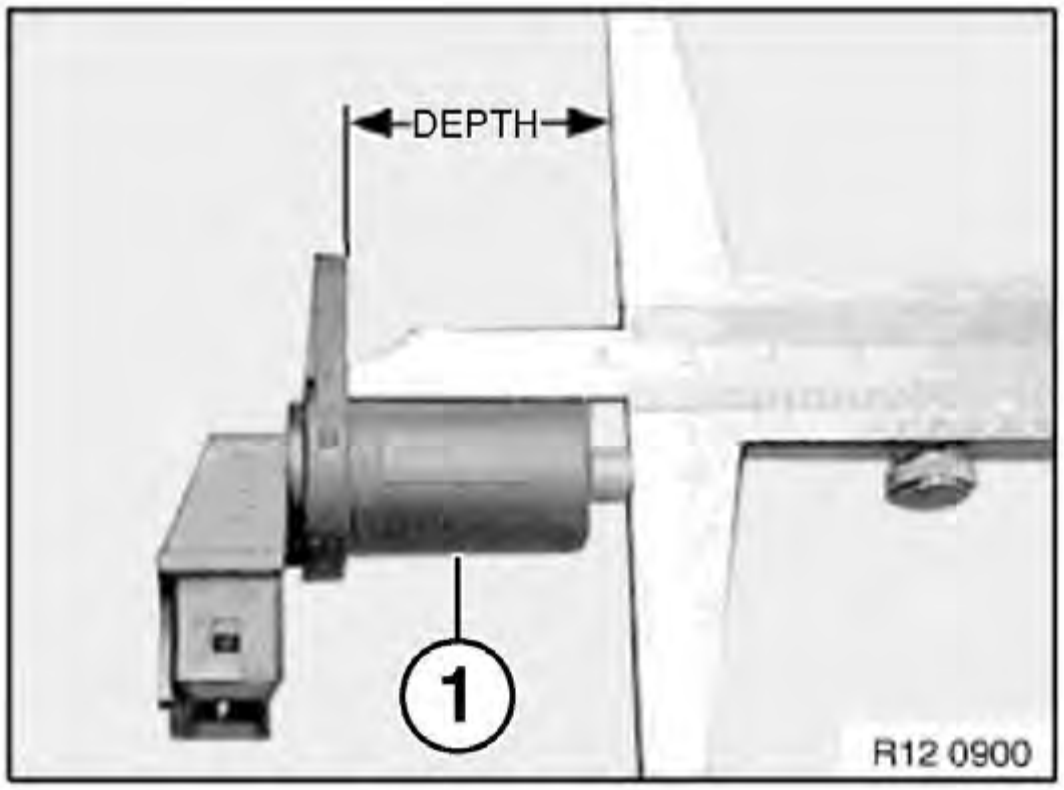
Fig. 26: Checking Pulse Tooth (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Pulse Tooth Depth

G00125133

Fig. 27: Measuring Pulse Tooth Depth (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Crankshaft Sensor

G00125134

Fig. 28: Measuring Pulse Sensor Depth (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

DIRECT IGNITION SYSTEM (DIS)

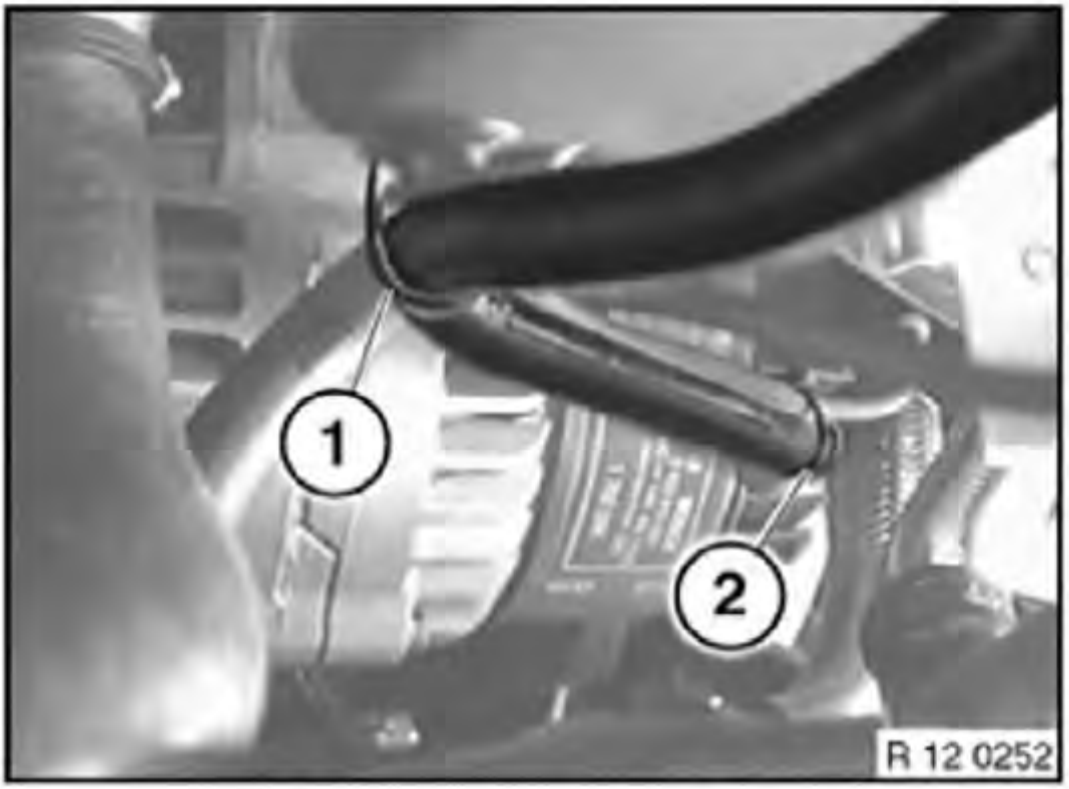
1. Ensure ignition is turned off before working on the ignition system. The engine will not start without a connected secondary circuit. When checking compression, remove Digital Motor Electronics (DME) Electronic Control Unit (PCM) relay. See DME & FUEL PUMP RELAY LOCATION table under FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEM.
2. Shielded capacitors may not be connected to terminal No. 1 of the ignition coil. Terminal No. 1 of the ignition coil may not be connected to ground or battery positive terminal, as this will damage ignition stages in DME control unit.
3. DO NOT connect DVOM or test light to terminal No. 1 of ignition coil while engine is running. High tension (350 volts) is present at coil terminal No. 4, secondary ignition leads, spark plugs and ignition coil terminal No. 1 to DME Powertrain Control Module (PCM).

NOTE: For location of DME master and fuel pump relays, see DME & FUEL PUMP RELAY LOCATION table under FUEL SYSTEM PRESSURE RELEASE under FUEL SYSTEMS.

DISTRIBUTOR CAP (V12)

Removal & Installation (Left Cap)

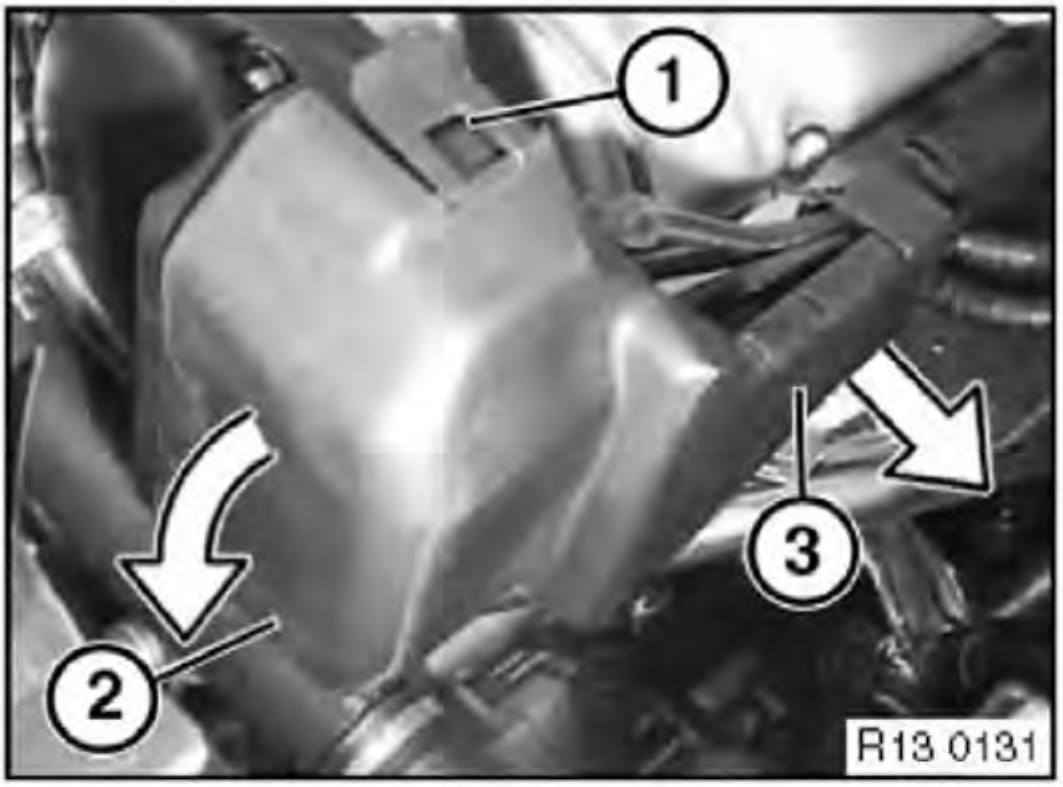
Turn ignition off. Remove fan. Unfasten clips on air filter box. Unfasten hose clip from auxiliary hose for air pump. Disconnect electrical connection. Remove upper section of suction filter housing with mass airflow sensor. Unfasten cable connectors. See Fig. 29. Unclip and remove left distributor cap cover. See Fig. 30. Pull off shielded connectors. Remove screws and distributor cap. See Fig. 31. To install, reverse removal procedure.



1. Cable Connector
2. Cable Connector

G00131501

Fig. 29: Unfastening Cable Connectors (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Clip
2. Clip
3. Clip

G00131502

Fig. 30: Identifying Distributor Cap Clips (Left Cap) (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

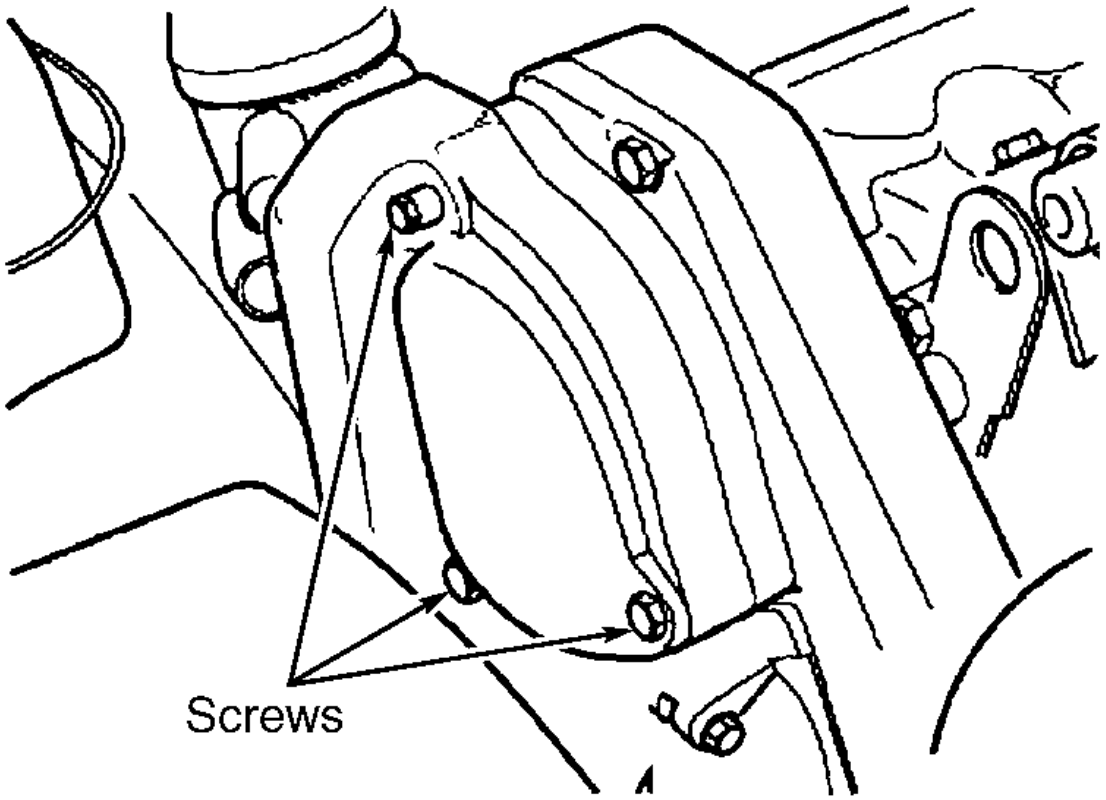
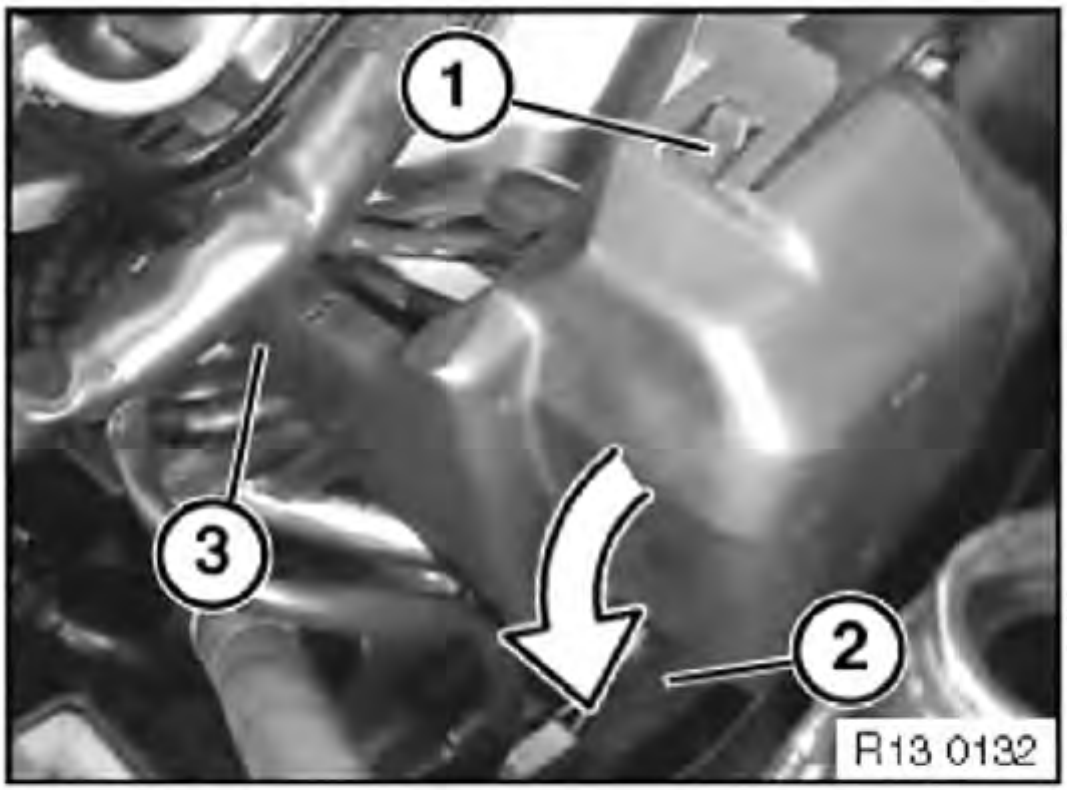


Fig. 31: Removing Distributor Cap Screws (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (Right Cap)

Turn ignition off. Remove fan. Remove non-return valve for cylinders No. 1-6. Disconnect electrical connection. Remove upper section of right intake filter housing with mass airflow sensor. Loosen retainers. Loosen hose clip on intake hose for air pump. Disconnect electrical connector. Unfasten hose clip. Unclip and remove right distributor cap cover. See Fig. 32. Pull off shielded connectors. Remove screws and distributor cap. See Fig. 31. To install, reverse removal procedure.



1. Clips
2. Clips
3. Clips

G00131504

Fig. 32: Identifying Distributor Cap Clips (Right Cap) (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

DISTRIBUTOR ROTOR (V12)

Removal & Installation

Remove distributor. See DISTRIBUTOR CAP (V12). Remove 3 rotor bolts. See Fig. 33. Remove rotor. To install, reverse removal procedure.

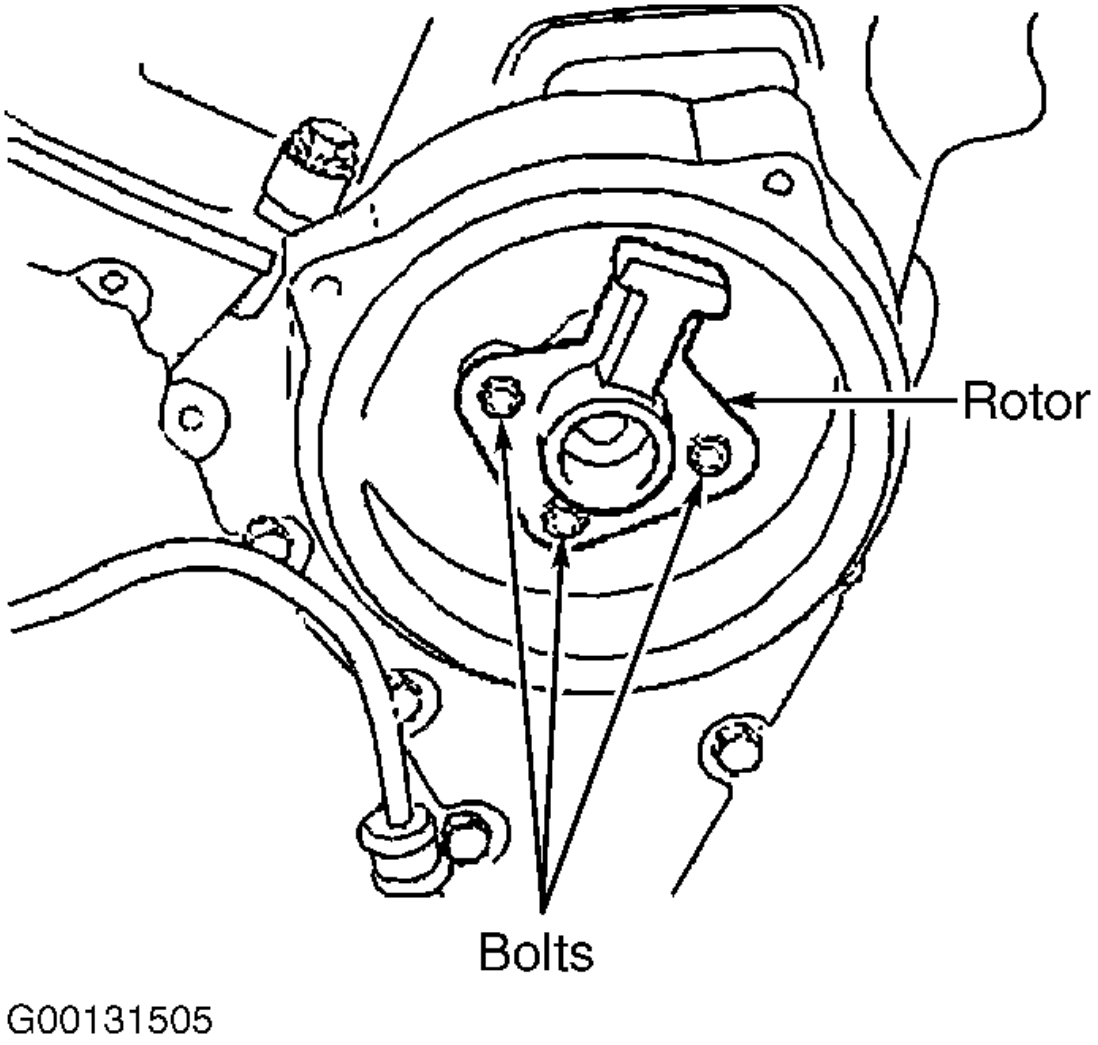


Fig. 33: Removing Distributor Rotor (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

IGNITION COILS

Removal & Installation (6-Cylinder)

1. Remove engine cover. See Fig. 34. Disconnect ignition coil connector. Remove ignition coil nuts. Remove ignition coil(s). See Fig. 35.
2. To install, reverse removal procedure. Install ground strap. See Fig. 36. Ensure ignition coil common ground lead is attached to front of cylinder head, near engine lift bracket.

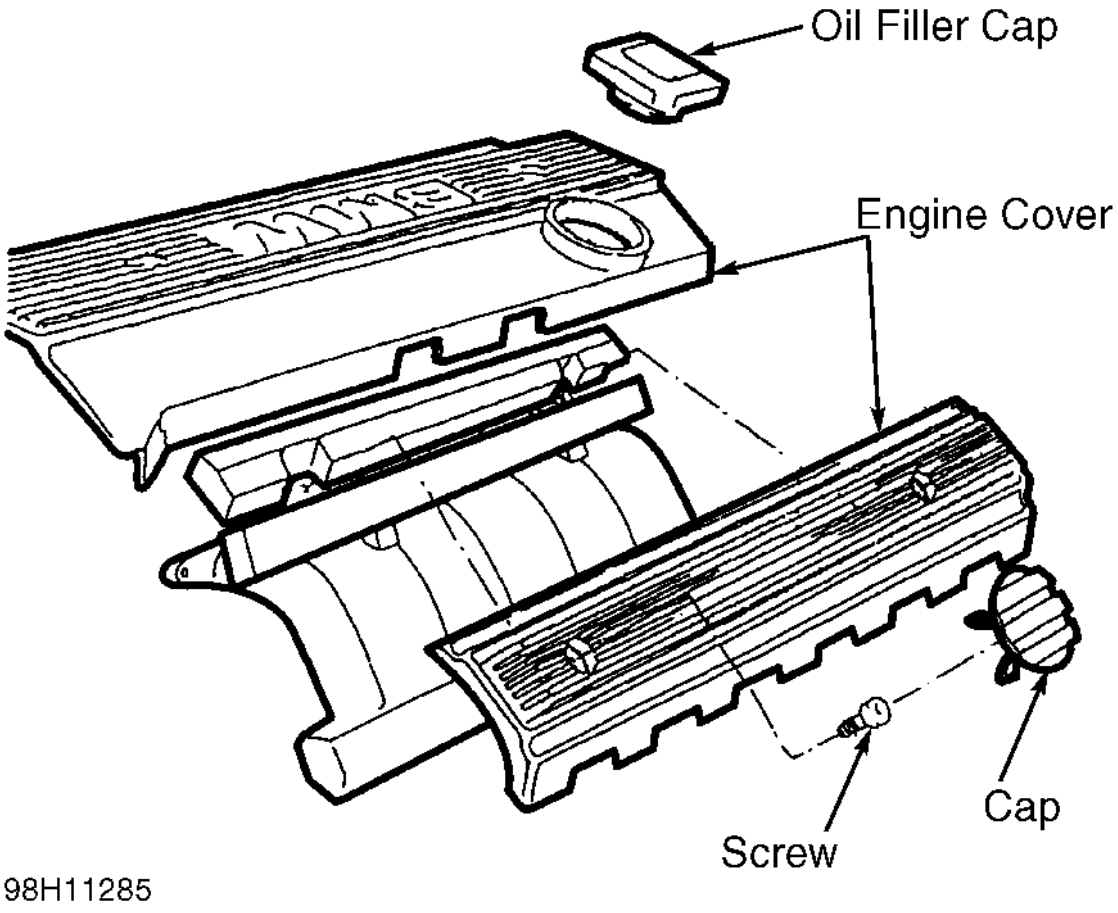


Fig. 34: Removing Engine Cover (6-Cylinder Shown; Others Are Similar)
Courtesy of BMW OF NORTH AMERICA, INC.

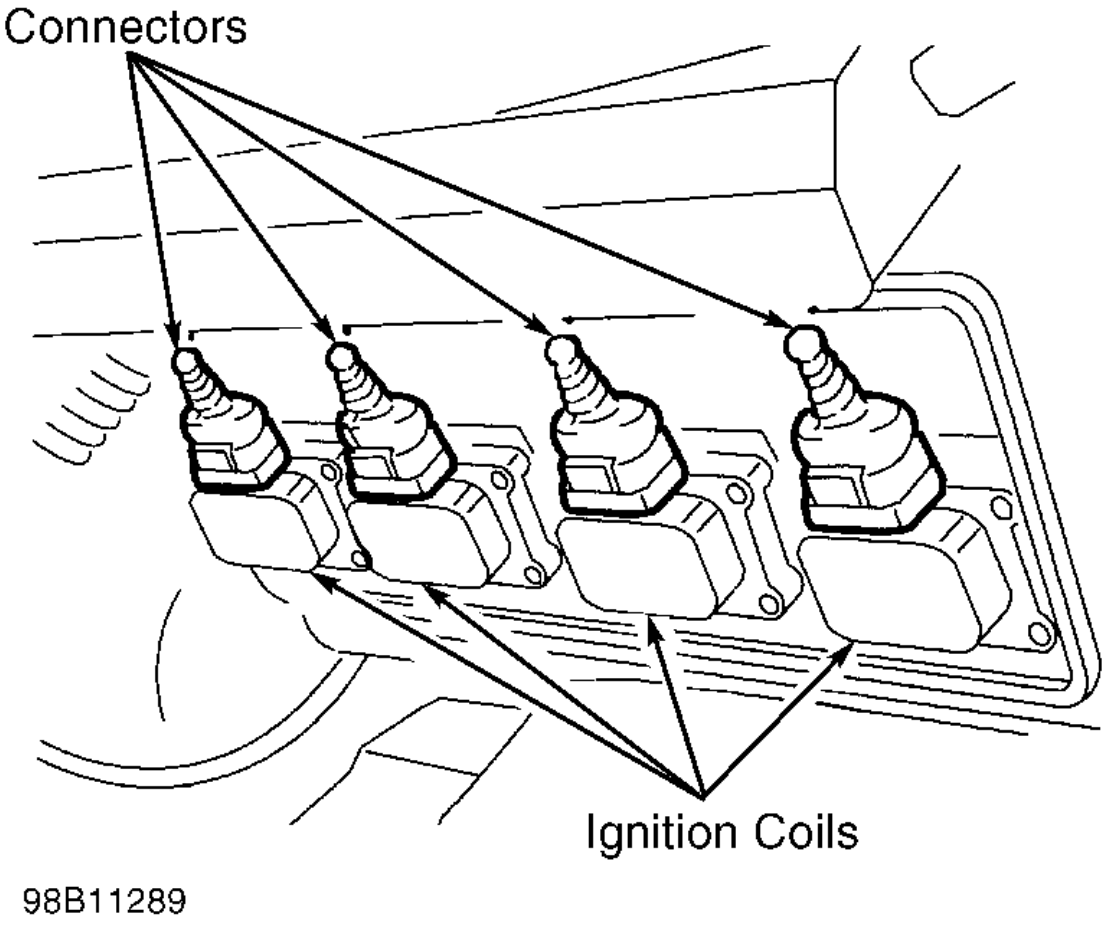


Fig. 35: Removing Ignition Coils (V8 Shown; Others Are Similar)
Courtesy of BMW OF NORTH AMERICA, INC.

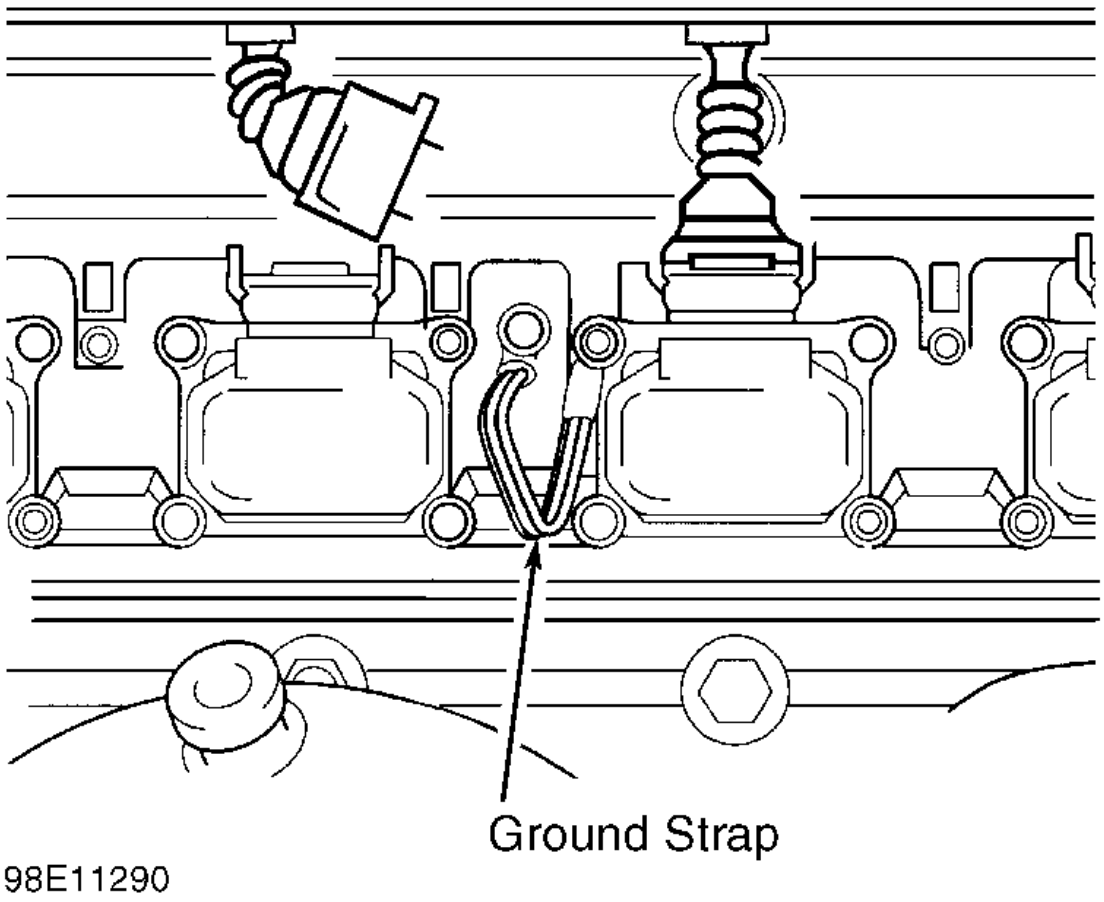


Fig. 36: Installing Ground Strap (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8)

Remove engine cover. See Fig. 34. Disconnect wiring connectors from coil. Remove ignition coil nuts. Remove ignition coil(s). See Fig. 35. To install, reverse removal procedure.

Removal & Installation (V12)

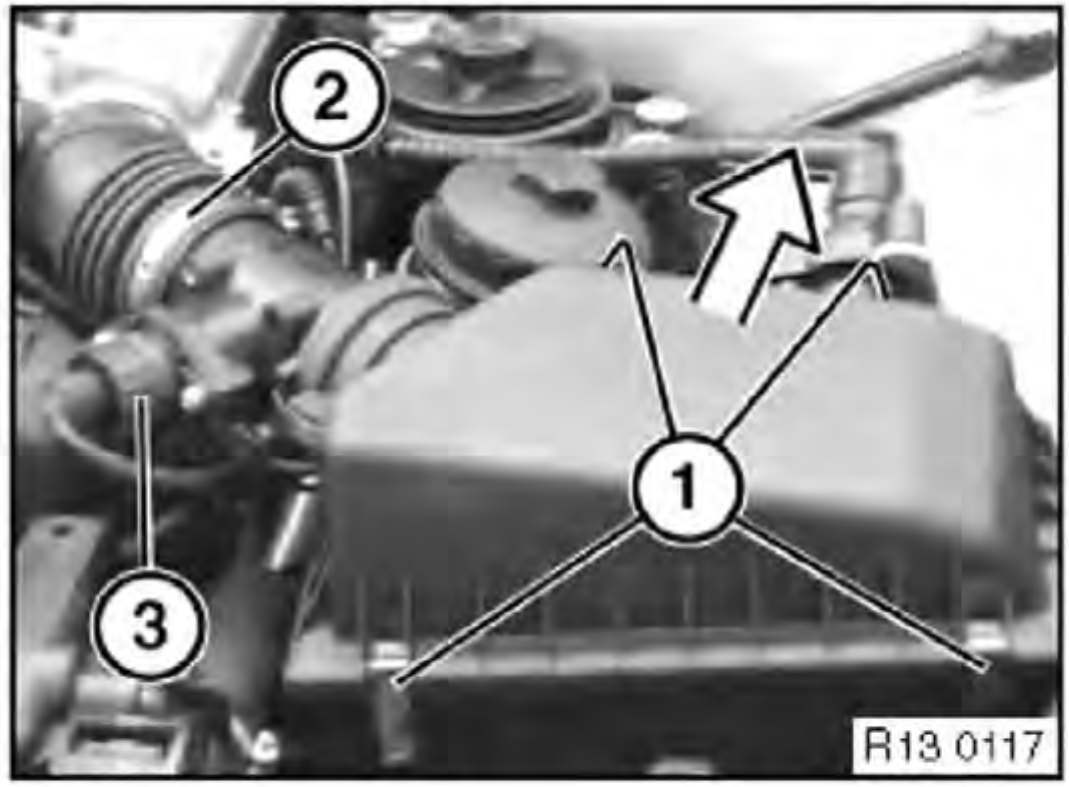
Disconnect electrical connections at left and right ignition coils. Remove sealing cap. Remove nuts. To install, reverse removal procedure.

IGNITION WIRING (V12)

Removal & Installation (Left Side)

1. Turn ignition off. Open clips on air filter housing. Unfasten hose clip. Disconnect electrical connector at mass airflow sensor. Remove upper section of suction filter housing with mass airflow sensor. Mark plug connectors No. 1 and 2 and remove. Remove plug connector, hose clip and air hose. Remove mass airflow sensor with upper section of intake filter. Unclip air hoses from bracket. Disconnect plug connector from solenoid valve.
2. If necessary, release cable ties and disconnect plug connector from alternator. Unfasten cable connector. Disconnect plug connector and pull solenoid valve out of bracket. Lay solenoid valve and air hose below engine. Unfasten screw connection of ignition wiring harness on manifold. Disconnect spark plug connectors. Unfasten cable connector on protective cap of distributor cap. Unfasten 3 clips and remove protective cap for distributor cap. See Fig. 37-Fig. 47 . Remove ignition wires as necessary. To install,

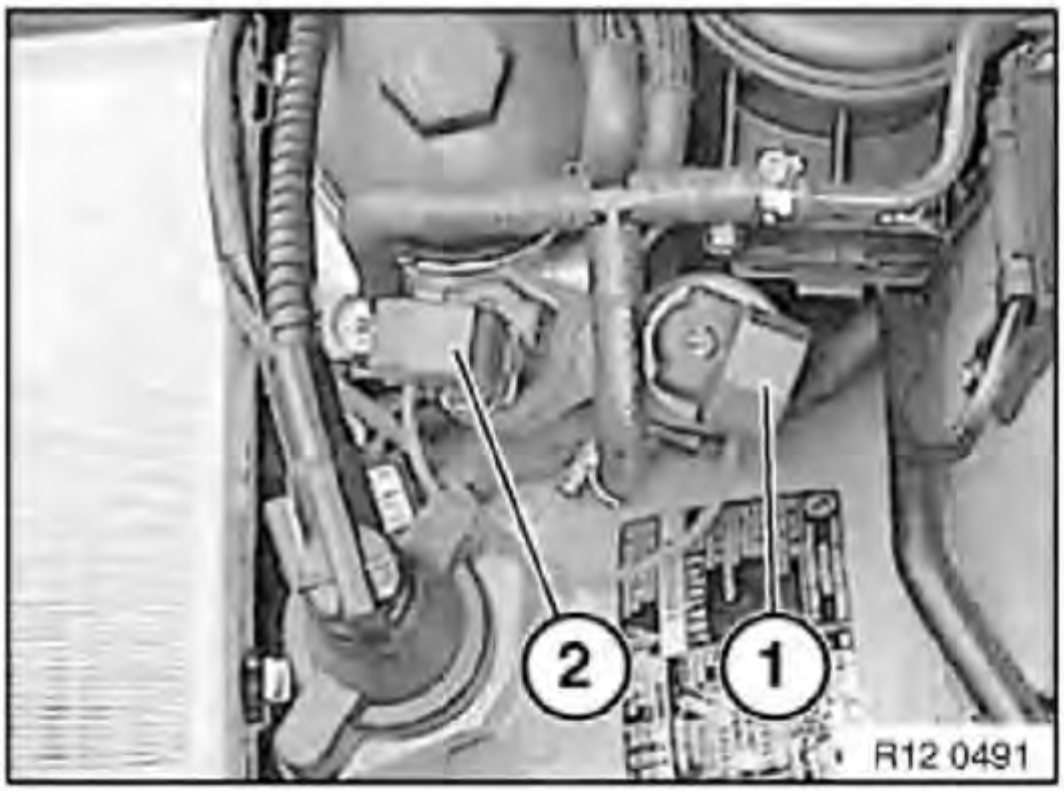
reverse removal procedure.



1. Clips
2. Hose Clip
3. Plug Connection

G00125106

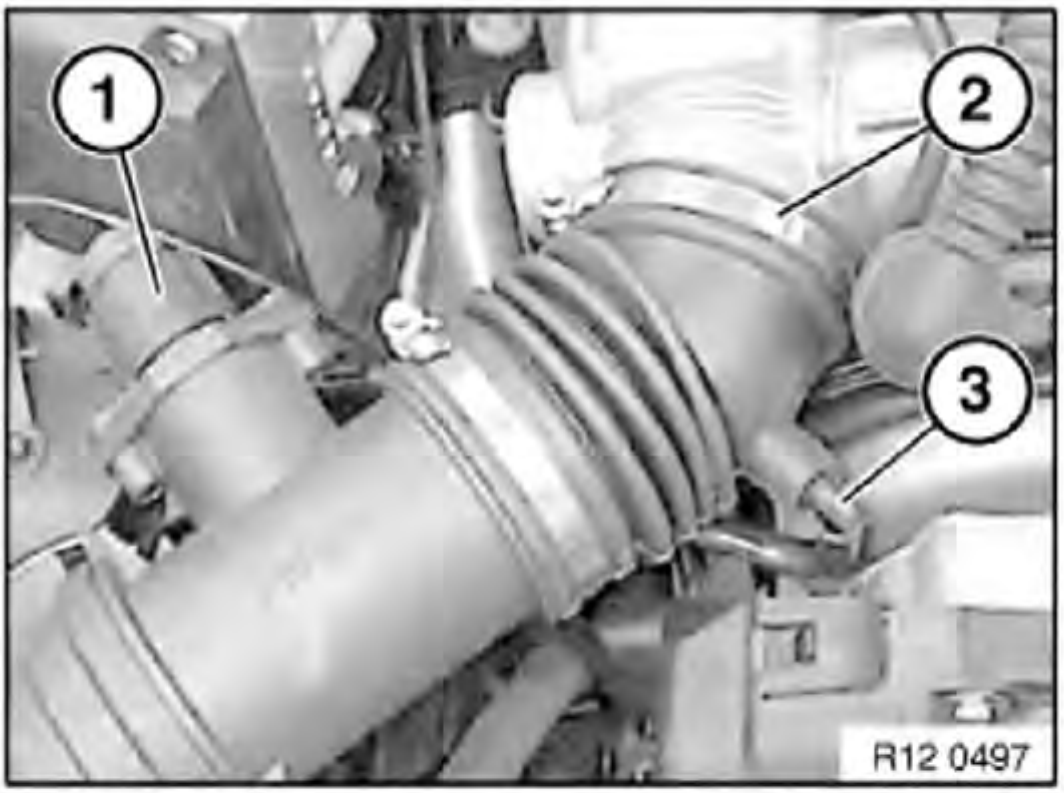
Fig. 37: Removing Air Filter Housing & Mass Airflow Sensor (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Plug Connector
2. Plug Connector

G00125107

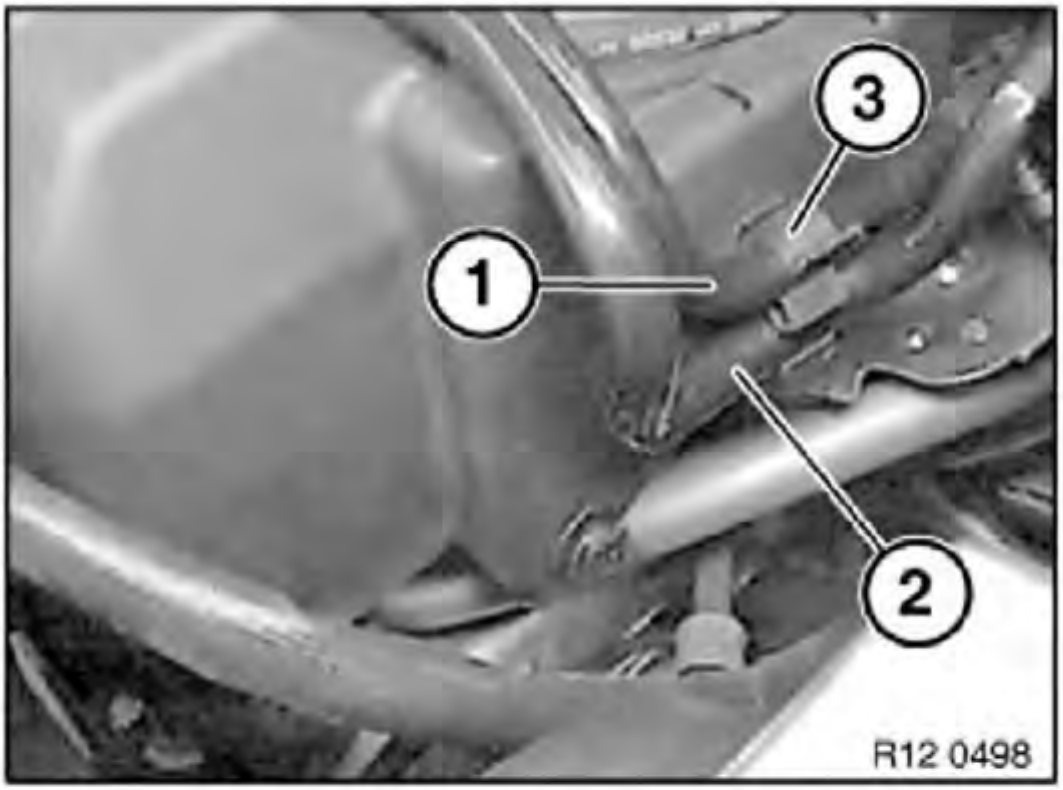
Fig. 38: Removing Plug Connectors No. 1 & 2 (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Plug Connector
2. Clip
3. Air Hose

G00125108

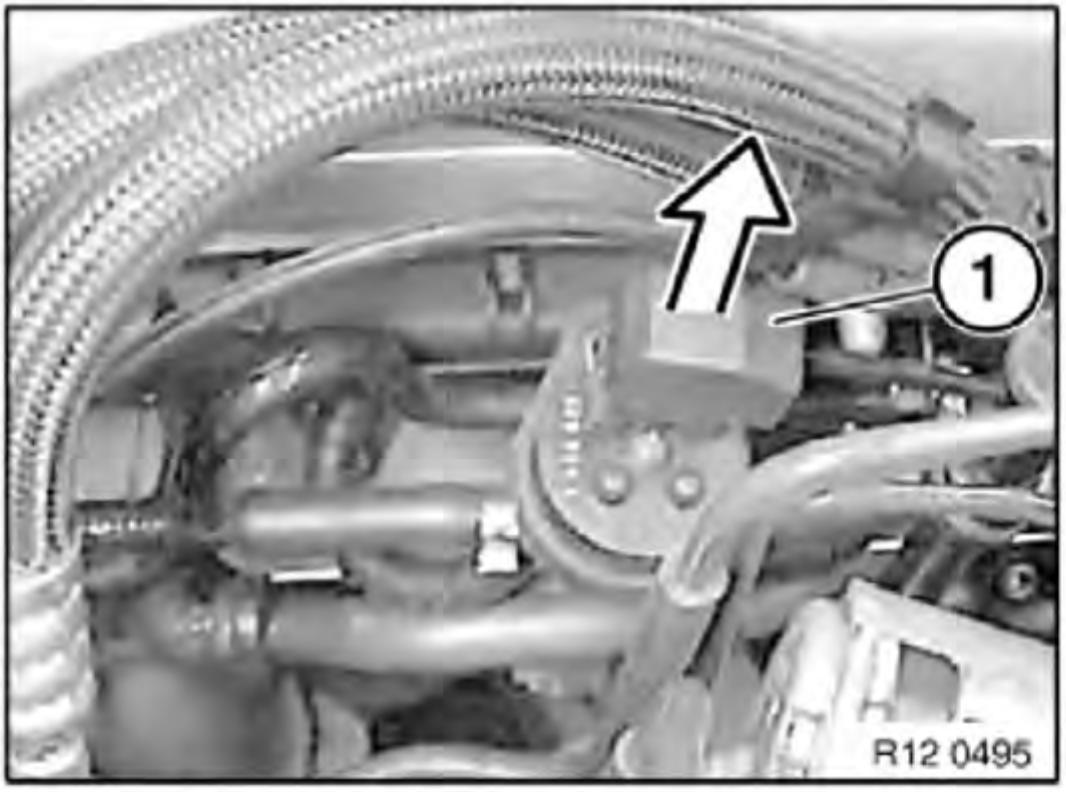
Fig. 39: Removing Plug Connector, Hose Clip & Air Hose (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Air Hose
2. Air Hose
3. Bracket

G00125109

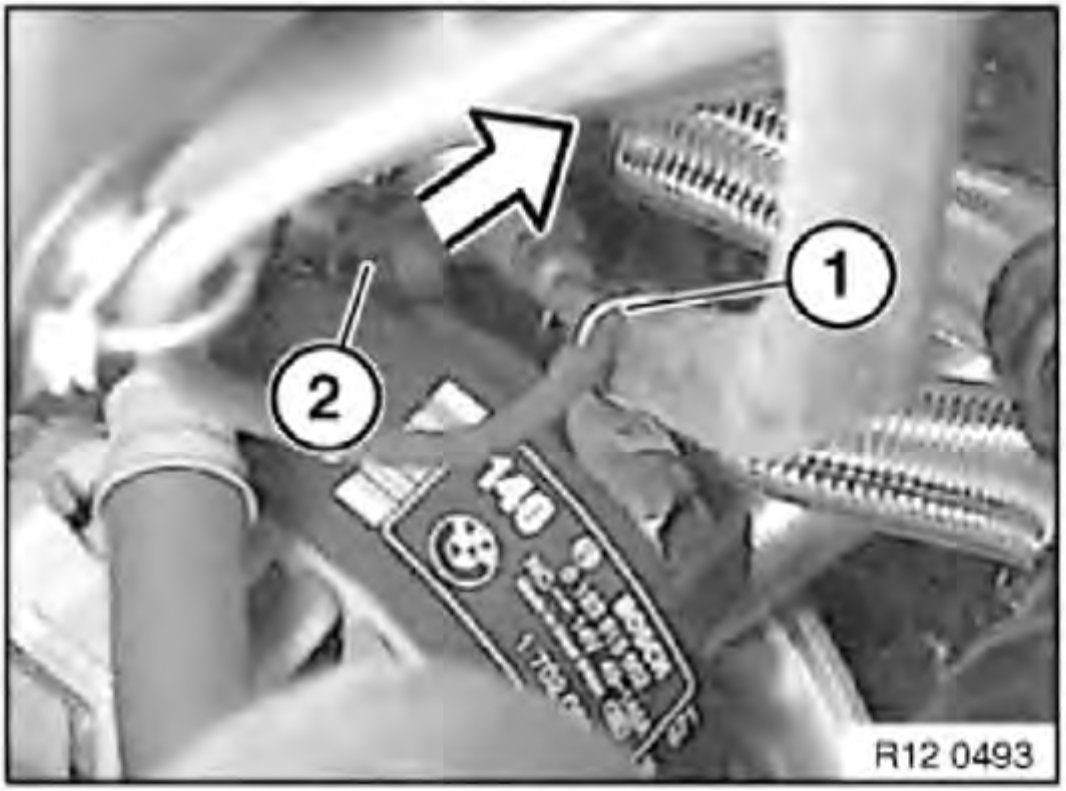
Fig. 40: Unclipping Air Hoses No. 1 & 2 From Bracket (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Connector

G00125110

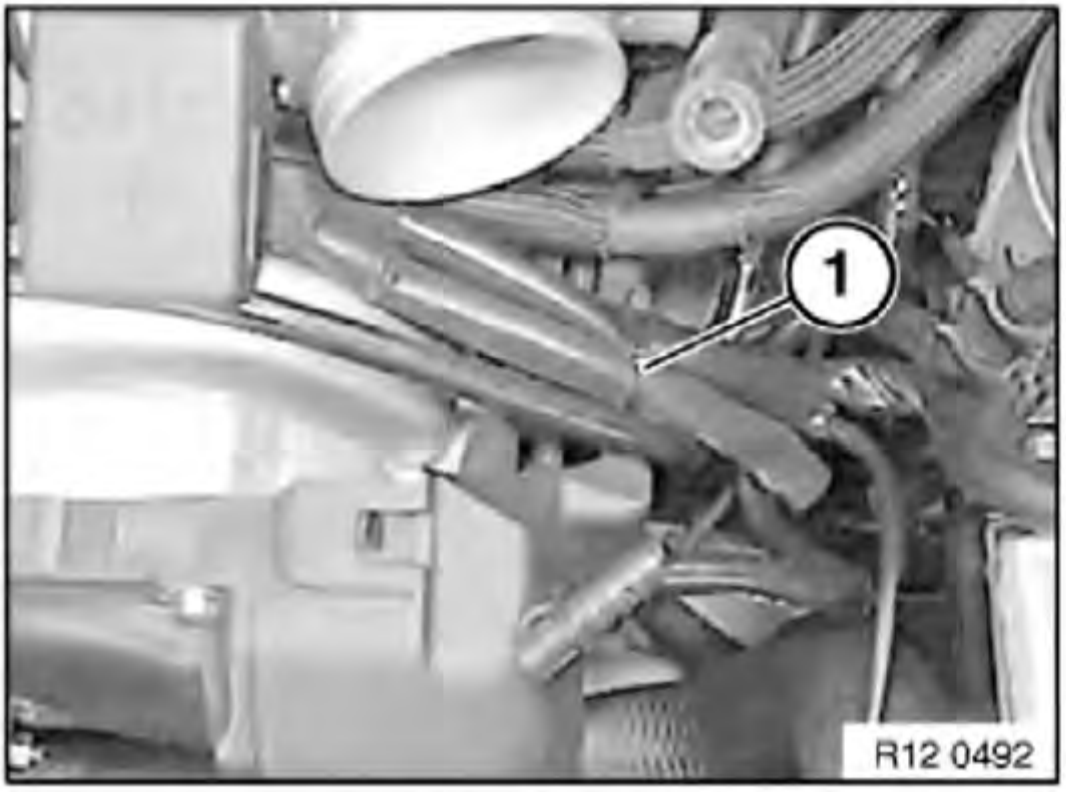
Fig. 41: Disconnecting Plug Connector From Solenoid Valve (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Cable Tie
2. Alternator Connector

G00125111

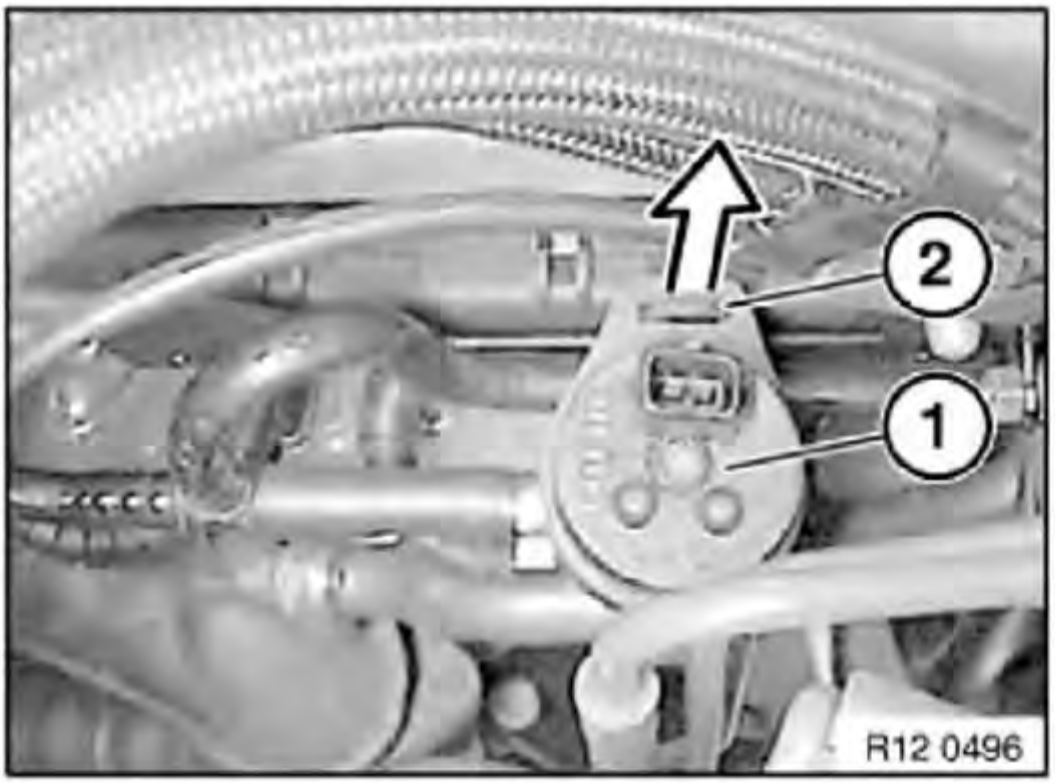
Fig. 42: Disconnecting Alternator Connector (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Cable Connector

G00125112

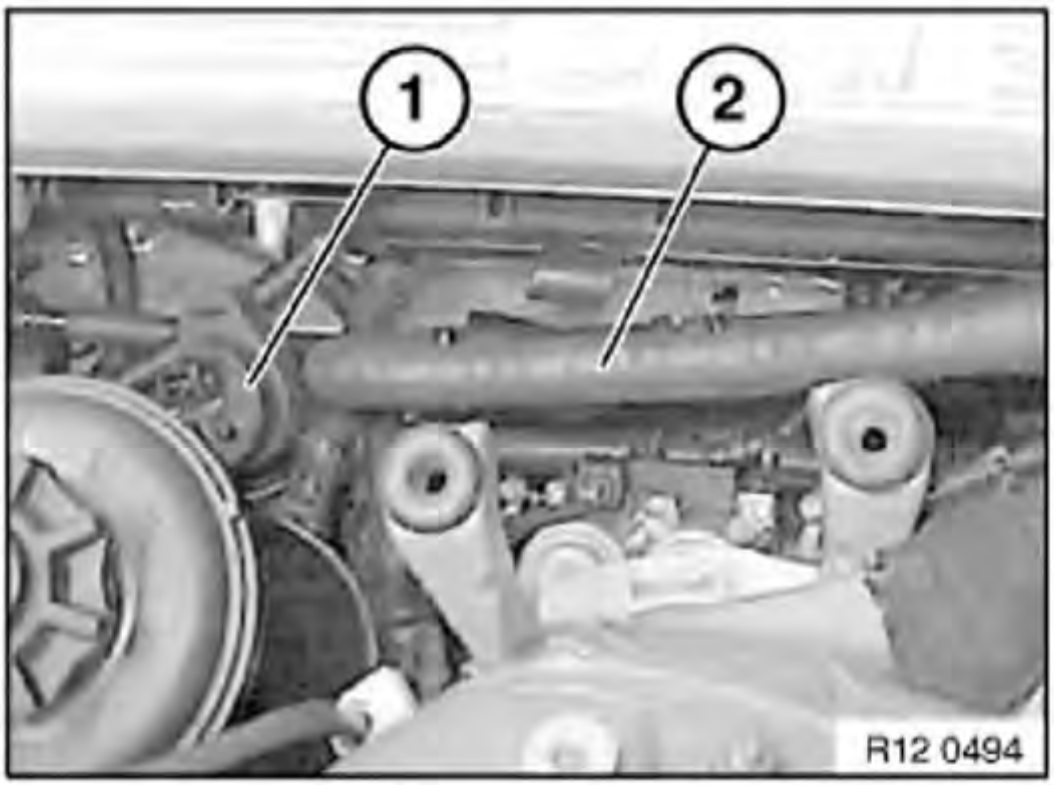
Fig. 43: Unfastening Cable Connector (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Plug Connector
2. Solenoid Valve

G00125113

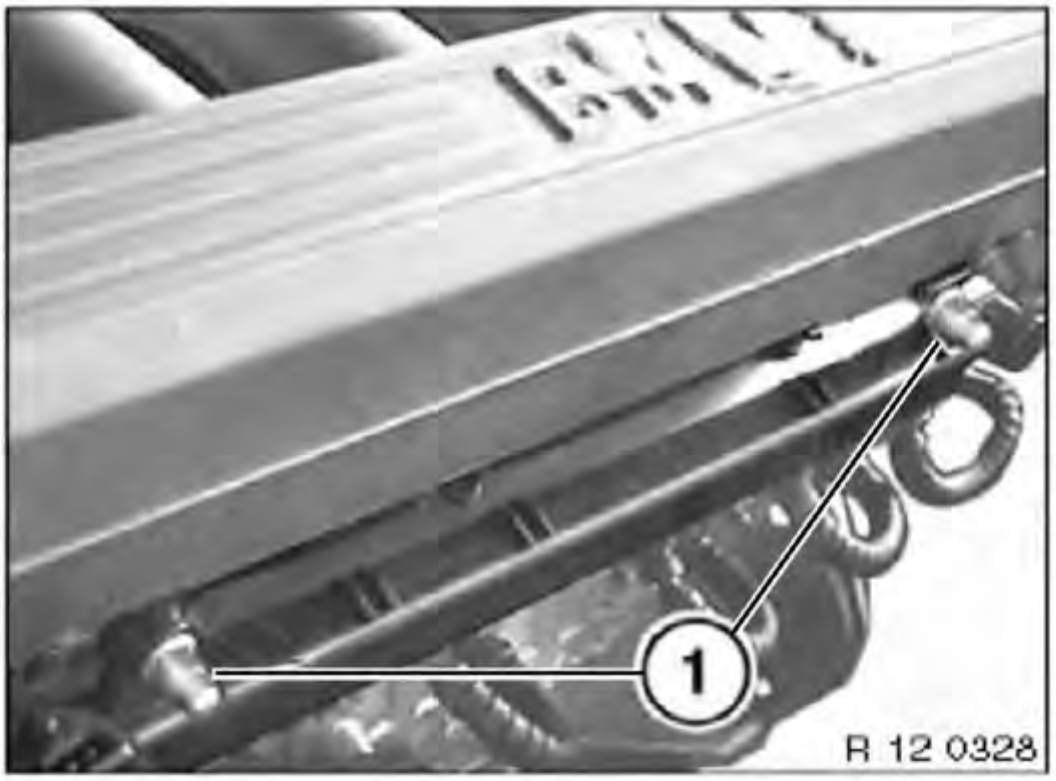
Fig. 44: Removing Solenoid Valve From Bracket (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Solenoid Valve
2. Air Hose

G00125114

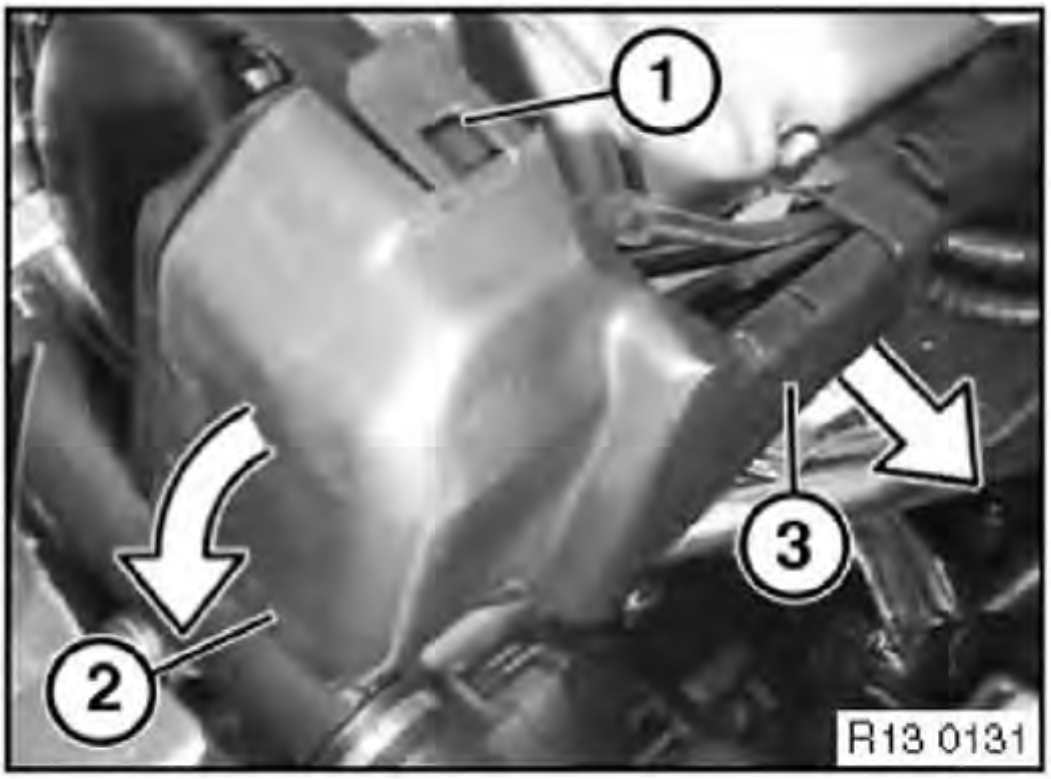
Fig. 45: Laying Solenoid Valve & Air Hose Below Engine (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Ignition Wiring Harness Screw Connection

G00125115

Fig. 46: Removing Ignition Wiring Harness (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



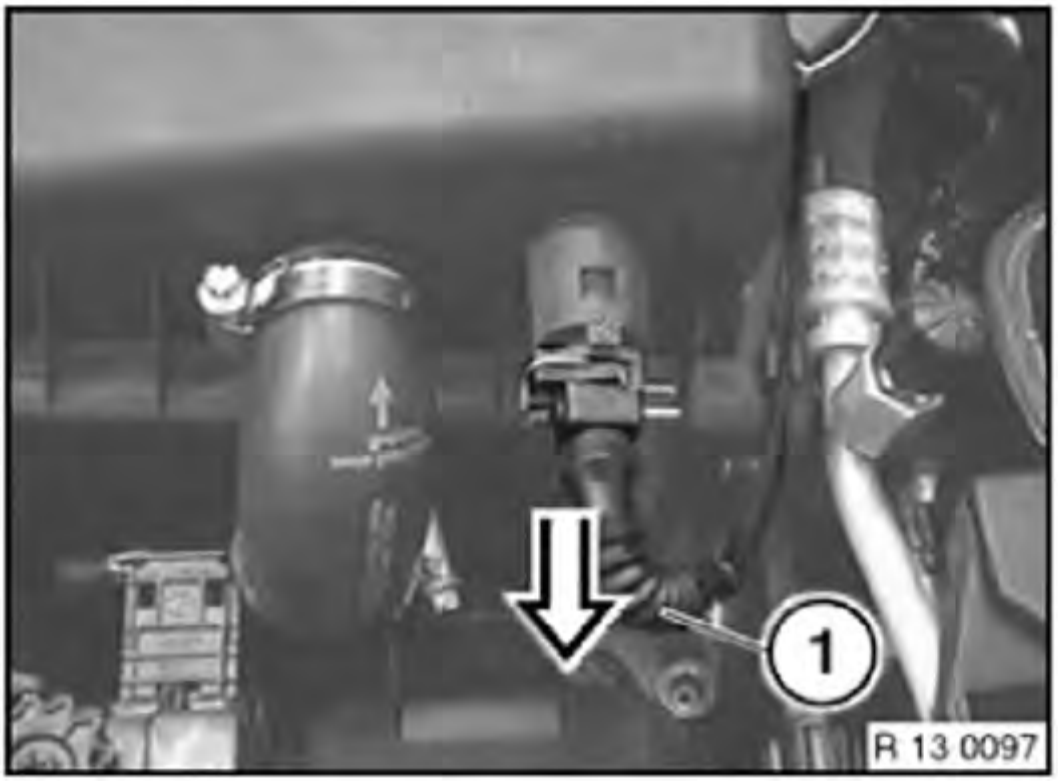
1. Clip
2. Clip
3. Clip

G00125116

Fig. 47: Unfastening Clips No. 1-3 On Protective Cap Of Distributor Cap (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (Right Side)

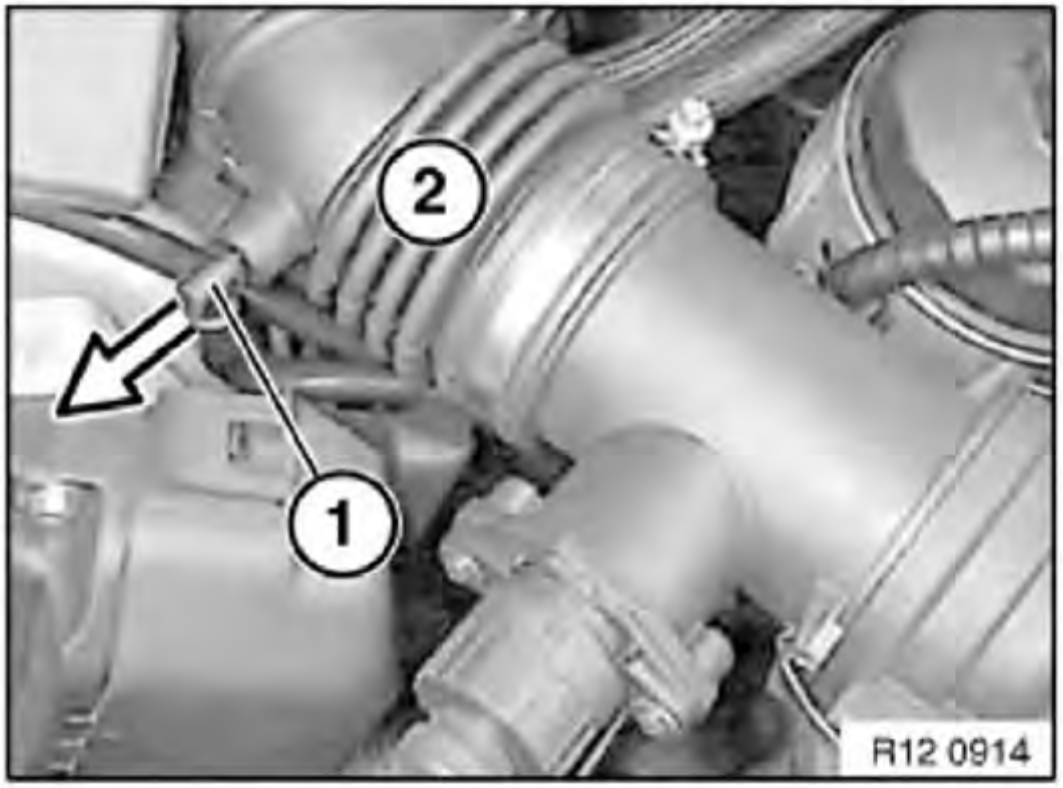
1. Turn ignition off. Press interlock and remove connector. See Fig. 48. Open clips on air filter housing. Unfasten hose clip from auxiliary hose for air pump. Pull off hose. Disconnect plug-in connection. Release hose clamp and withdraw hose. Remove upper section of suction filter housing style with mass airflow sensor. See Fig. 37. Pull air hose off air intake hose.
2. Unclip air hoses from bracket. Unclip diagnosis connector from bracket. Unfasten screw connection for ignition wiring harness from manifold. Remove spark plug connectors. Unfasten cable tie on protective cap for distributor cap. Unfasten 3 clips and remove protective cap for distributor cap. See Fig. 49-Fig. 52 . Remove ignition wires as necessary. To install, reverse removal procedure.



1. Connector

G00125121

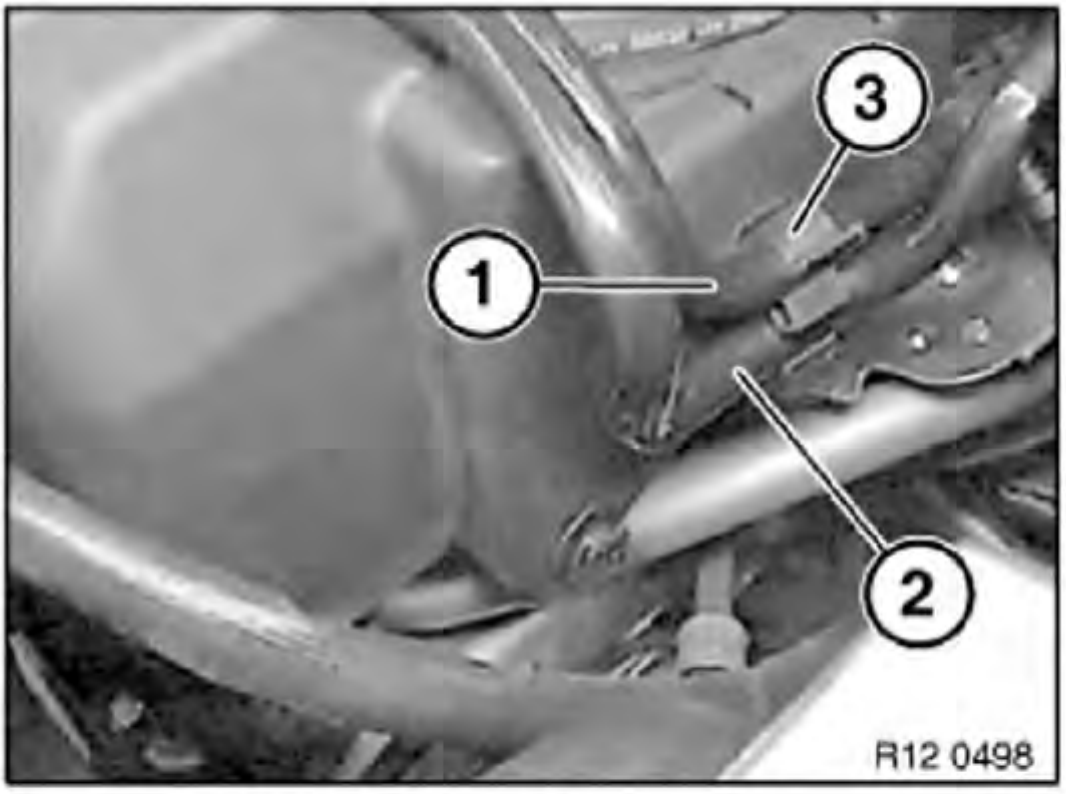
Fig. 48: Disconnecting Electrical Connector (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Air Hose
2. Air Intake Hose

G00125117

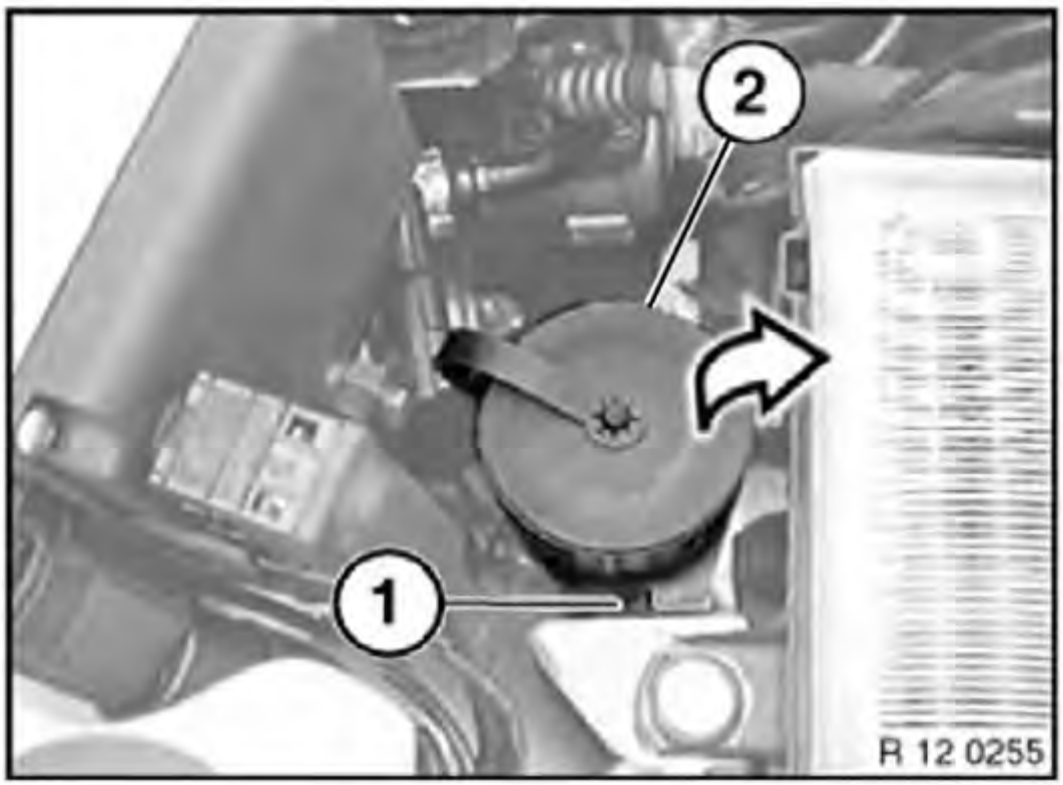
Fig. 49: Removing Air Hose From Air Intake Hose (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Air Hose
2. Air Hose
3. Bracket

G00125118

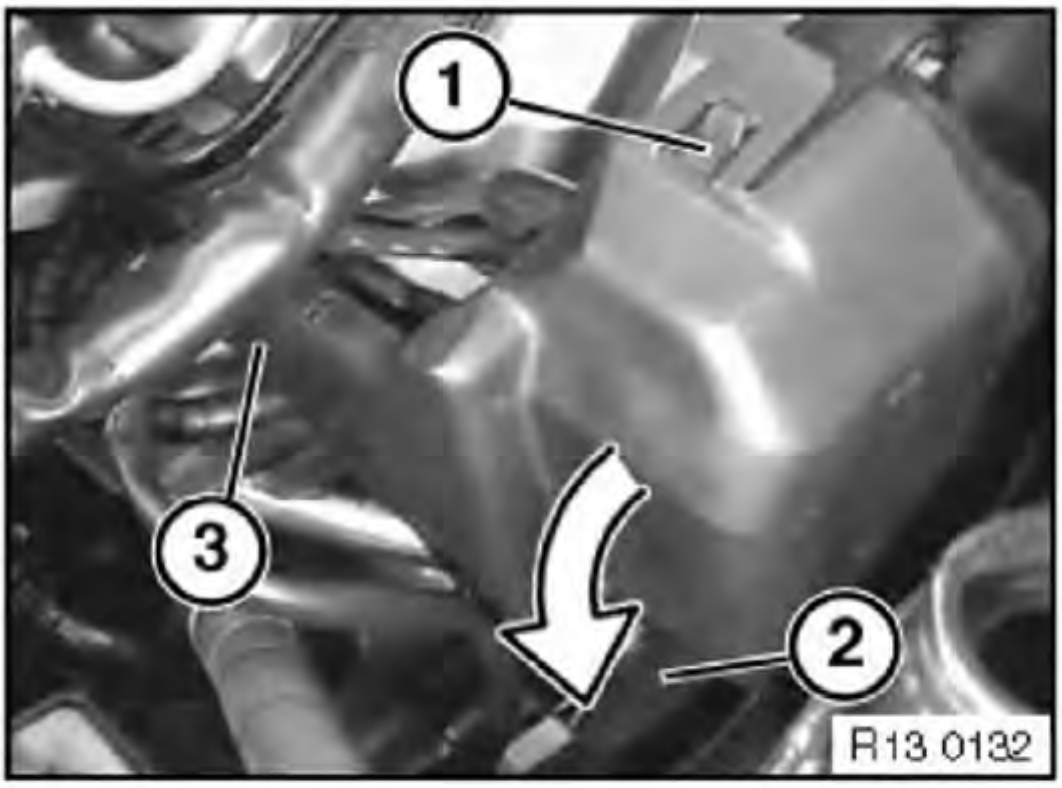
Fig. 50: Unclipping Air Hoses No. 1 & 2 From Bracket (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Clip
2. Diagnosis Connector

G00125119

Fig. 51: Unclipping Diagnosis Connector From Bracket (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Clip
2. Clip
3. Clip

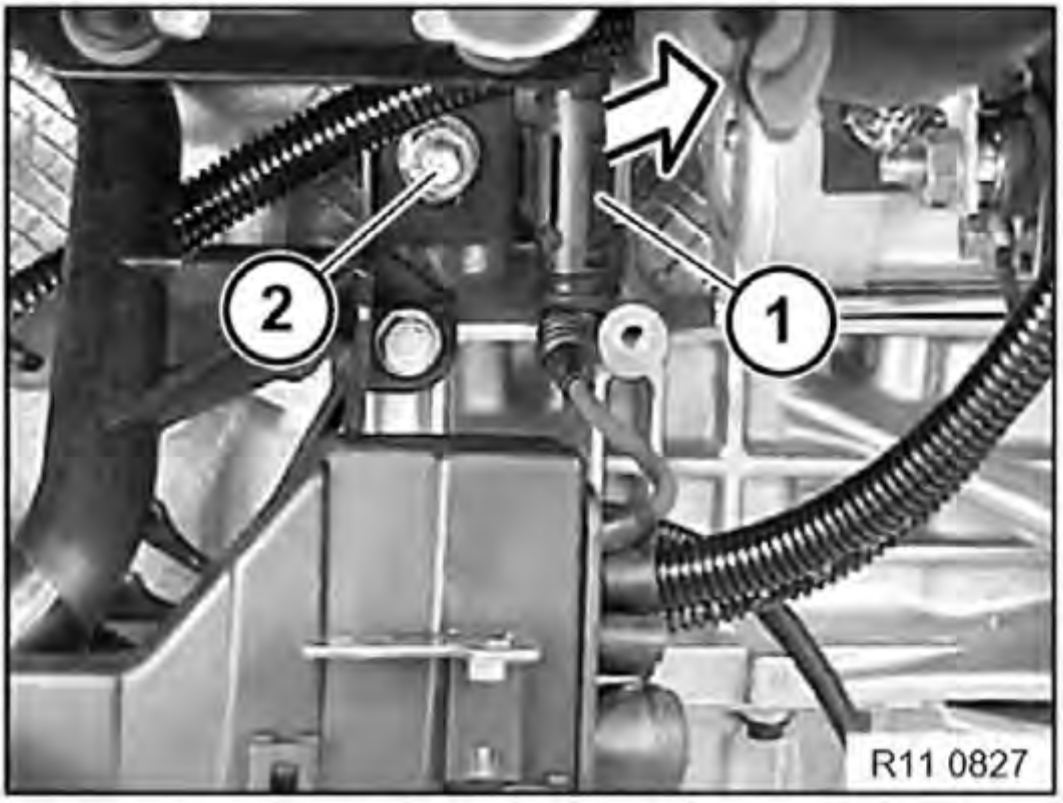
G00125120

Fig. 52: Unfastening Clips No. 1-3 On Distributor Cap (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

KNOCK SENSOR

Removal & Installation (6-Cylinder)

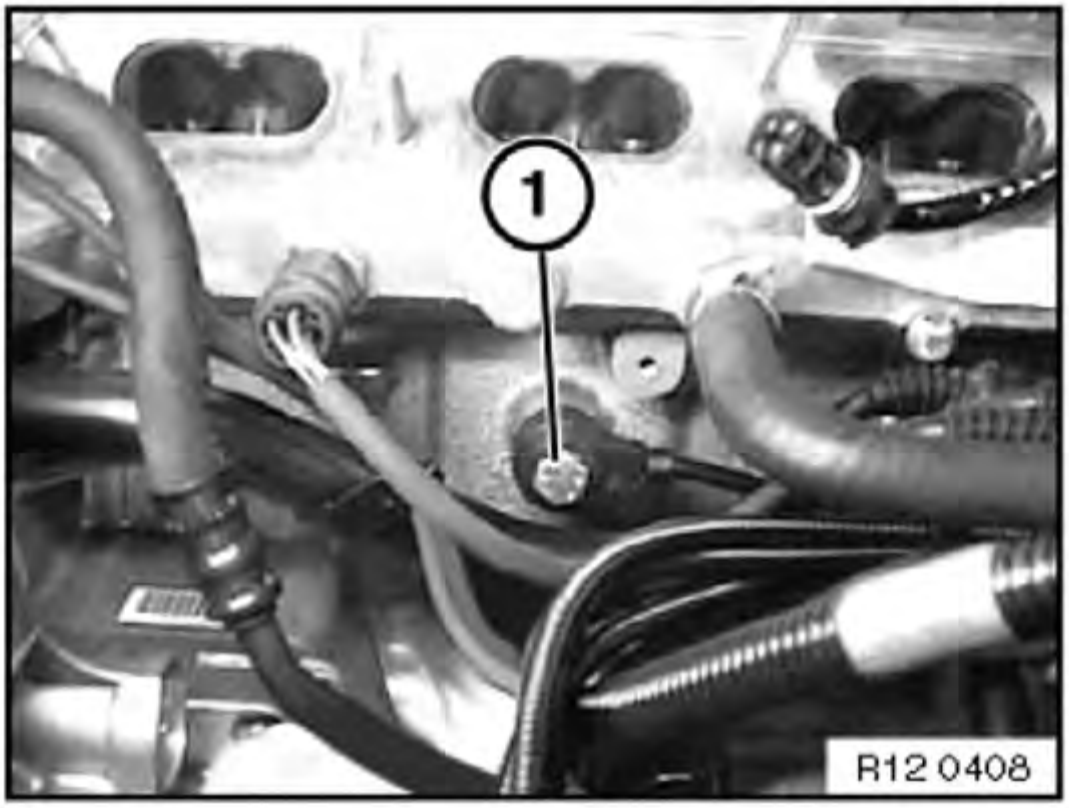
Remove air intake ducting. Disconnect electrical connection from retainer at cable duct. See Fig. 53. Remove bolt from knock sensor for cylinders No. 1-3, and bolt from knock sensor for cylinders No. 4-6. See Fig. 54 and Fig. 55 . Remove knock sensors, located on side of engine block. To install, reverse removal procedure. Clean knock sensor contact surface. When tightening knock sensors, ensure sensor and wiring do not interfere or chafe on brackets or other components. See TORQUE SPECIFICATIONS.



1. Electrical Connector
2. Cable Duct

G00131528

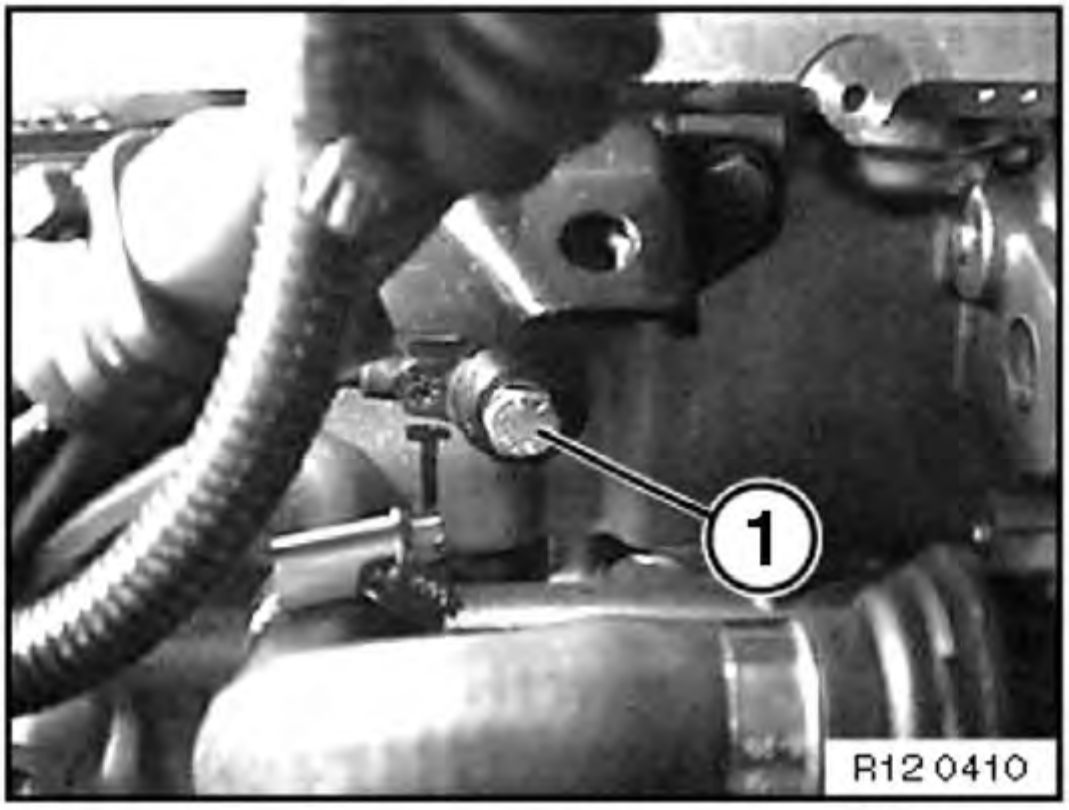
Fig. 53: Locating Knock Sensor Electrical Connector (6-Cyl.)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Bolt

G00131529

Fig. 54: Removing Knock Sensor (Cylinders No. 1-3) (6-Cyl.)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Bolt

G00131530

Fig. 55: Removing Knock Sensor (Cylinders No. 4-6) (6-Cyl.)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8)

1. Remove engine cover. See Fig. 34. Disconnect vacuum hoses to intake manifold and throttle body. Drain radiator and remove coolant expansion tank. Remove coolant manifold from rear of cylinder heads.
2. Disconnect fuel feed and fuel return lines at engine. Disconnect fuel lines and fuel tank vent line at engine carrier. Disconnect fuel line and wiring from top of fuel vapor canister.
3. Loosen hose clamps on idle speed controller and throttle body. Disconnect airflow sensor connector. Remove air cleaner housing/airflow sensor assembly. Raise and support vehicle. Disconnect oil level sensor connector. Disconnect and remove ignition coils.
4. Disconnect crankshaft position sensor and both knock sensor connectors. Disconnect intake air temperature sensor, idle speed potentiometer and idle speed controller connectors. Remove BMW engine diagnostic connector socket from bracket. Disconnect connector next to BMW diagnostic connector socket.
5. Remove bolt securing ignition coil ground wire (near engine lift bracket). Disconnect temperature gauge and temperature sensor connectors for DME (Black connector and White connector near engine lift bracket).
6. Completely disconnect throttle cable from engine. Remove intake manifold. Mark knock sensor connectors for reassembly reference. Remove knock sensor(s). See Fig. 56. To install, reverse removal procedure. Ensure knock sensors are connected to proper connectors. See TORQUE SPECIFICATIONS.

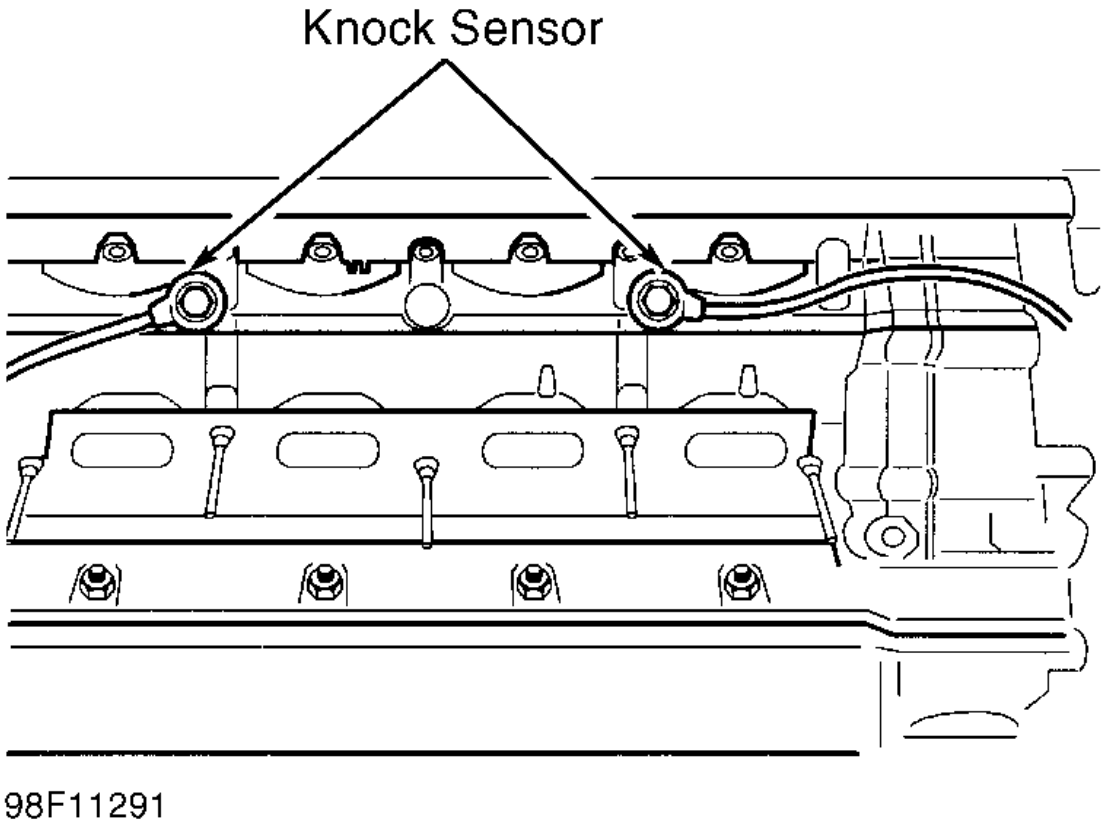
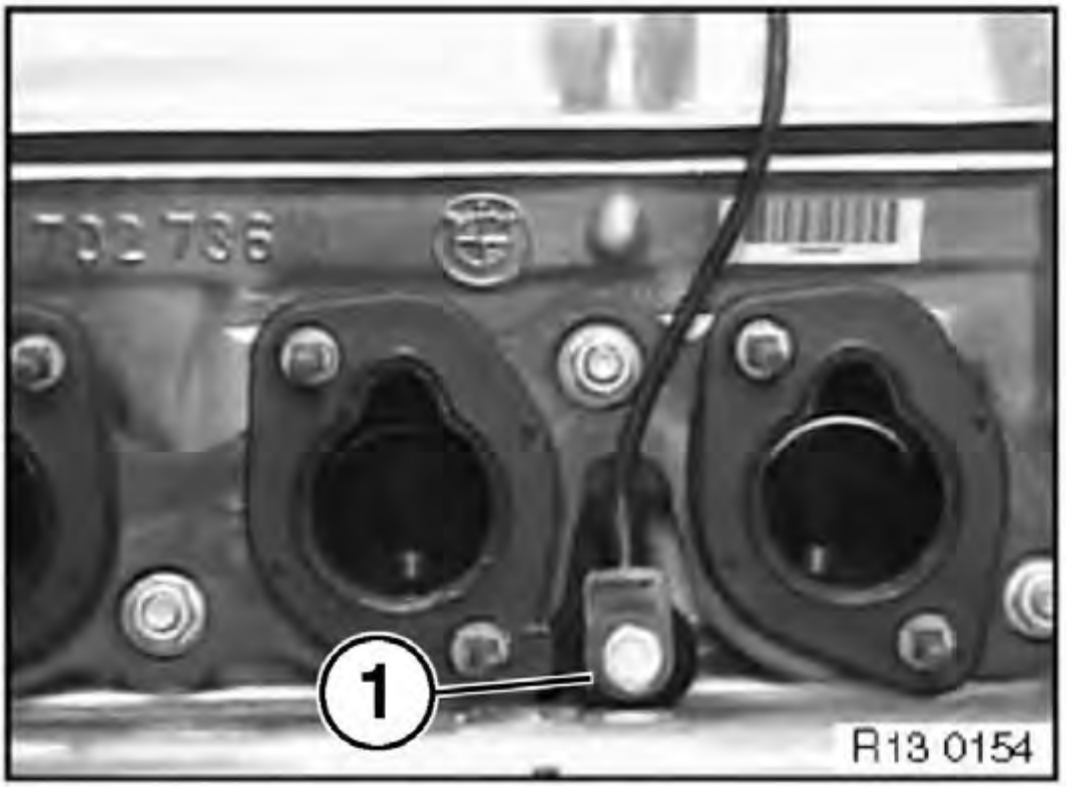


Fig. 56: Removing Knock Sensors (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

CAUTION: Incorrectly connecting knock sensor connectors may cause engine damage. Ensure line routing and plug connections match original routing.

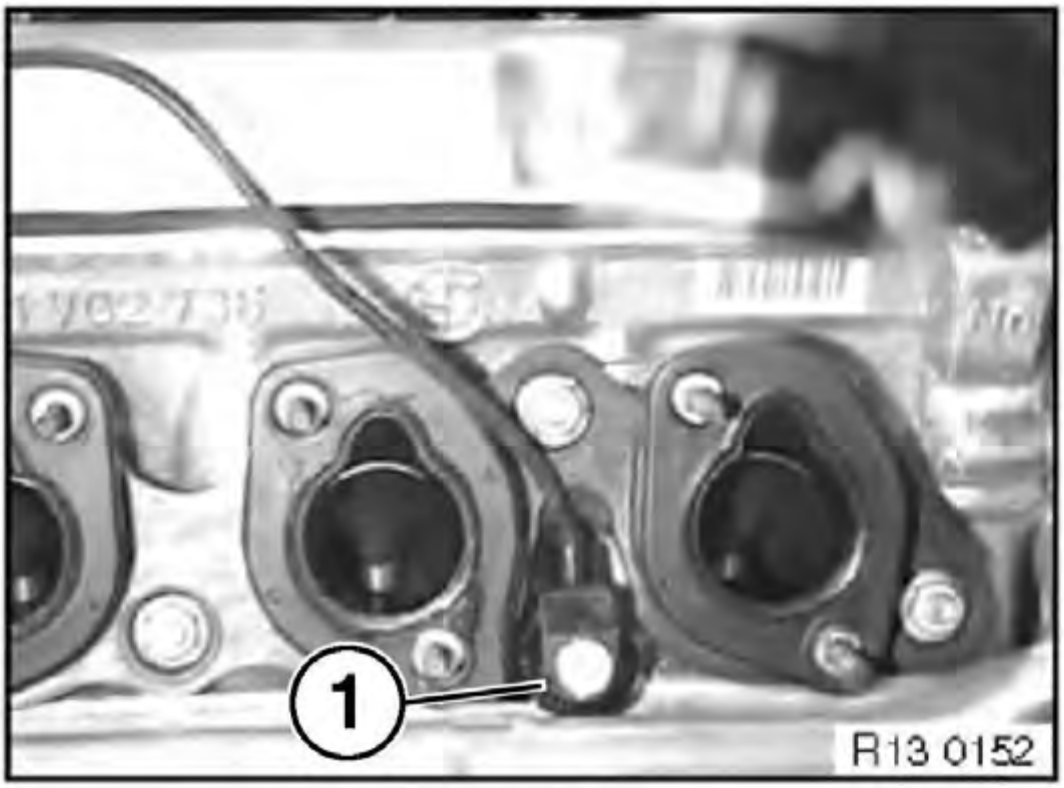
Turn ignition off. Remove appropriate intake manifold to access knock sensor. To remove knock sensor, remove bolt in center of sensor. See Fig. 57 and Fig. 58 . To install, reverse removal procedure. See TORQUE SPECIFICATIONS.



1. Knock Sensor

G00125137

Fig. 57: Removing Knock Sensor (Cylinders No. 1-3 Shown; Cylinders No. 7-9 Are Similar) (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Knock Sensor

G00125138

Fig. 58: Removing Knock Sensor (Cylinders No. 4-6 Shown; Cylinders No. 10-12 Are Similar) (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

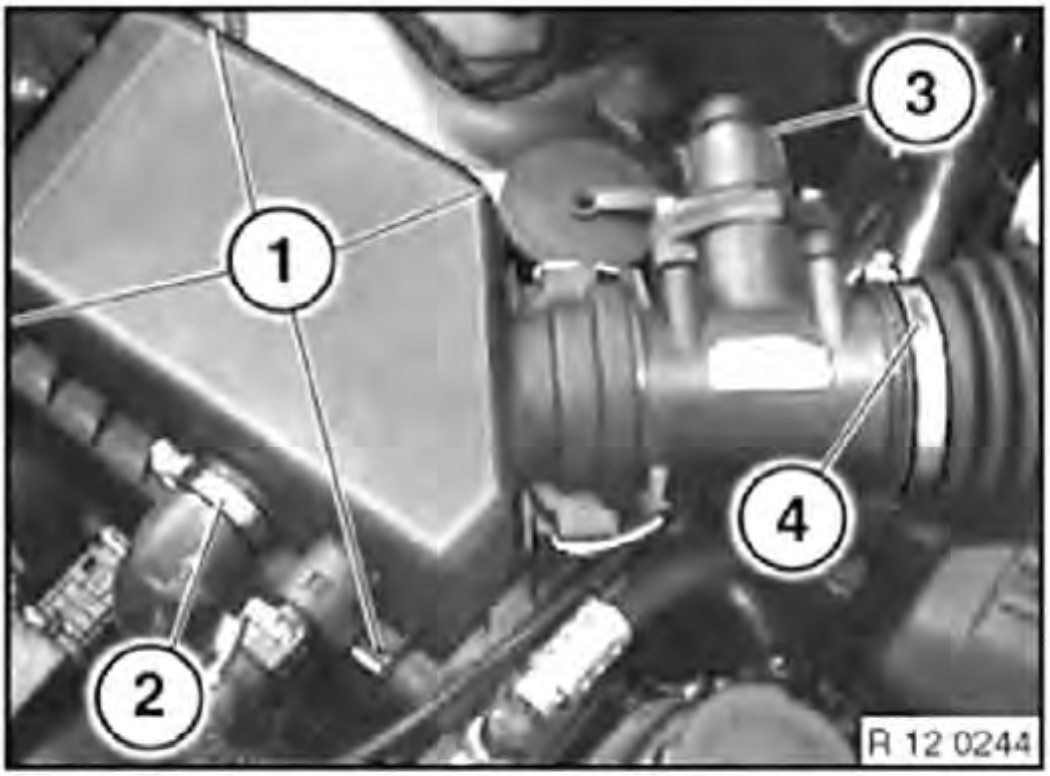
SPARK PLUGS

Removal & Installation (V8)

1. Switch ignition off. If engine acoustic cover is screwed down, remove seal caps and unfasten nuts. Remove acoustic cover. If acoustic cover has press-stud fasteners, open press-studs, one at a time, at the same time lifting the acoustic cover slightly. Once all 4 press-studs have been opened, remove acoustic cover. Remove sealing caps and unfasten nuts. Remove cover from ignition coils.
2. On all models, unfasten coil plug connection. Unfasten screws on ignition coils. Unscrew and remove spark plugs. To install, reverse removal procedure. Ground straps of cylinder head cover must be secured on ignition coils for cylinders No. 3 and 6. Position acoustic cover and install nuts or press downward until press-studs click into place.

Removal & Installation (V12)

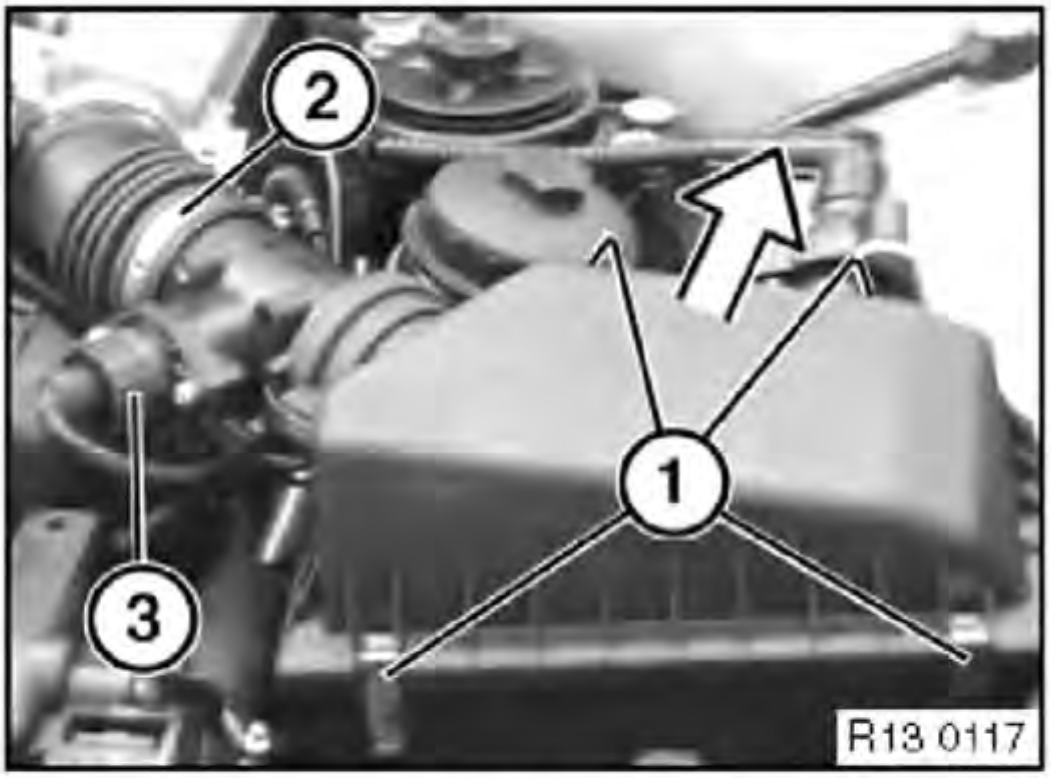
1. Turn ignition off. For cylinder bank 1-6, press interlock and remove connector on air filter box. See Fig. 48. Open clips on air filter box. Unfasten hose clip from auxiliary hose for air pump. Disconnect electrical connector. Unfasten hose clip. Remove upper section of suction filter housing with mass airflow sensor. On cylinder bank 7-12, open clips on air filter box. Unfasten hose clip. Disconnect electrical connector. Remove upper section of suction filter housing with mass airflow sensor.
2. Disconnect plug connections No. 1 and 2 from heating valve. Pull heating valves out of rubber mounts and lay below engine. Release cable ties and lay air hose below engine. See Fig. 59-Fig. 63 . Using Extension (12 7 131), remove spark plugs. To install, reverse removal procedure.



1. Clips
2. Clamp
3. Connector
4. Clamp

G00125122

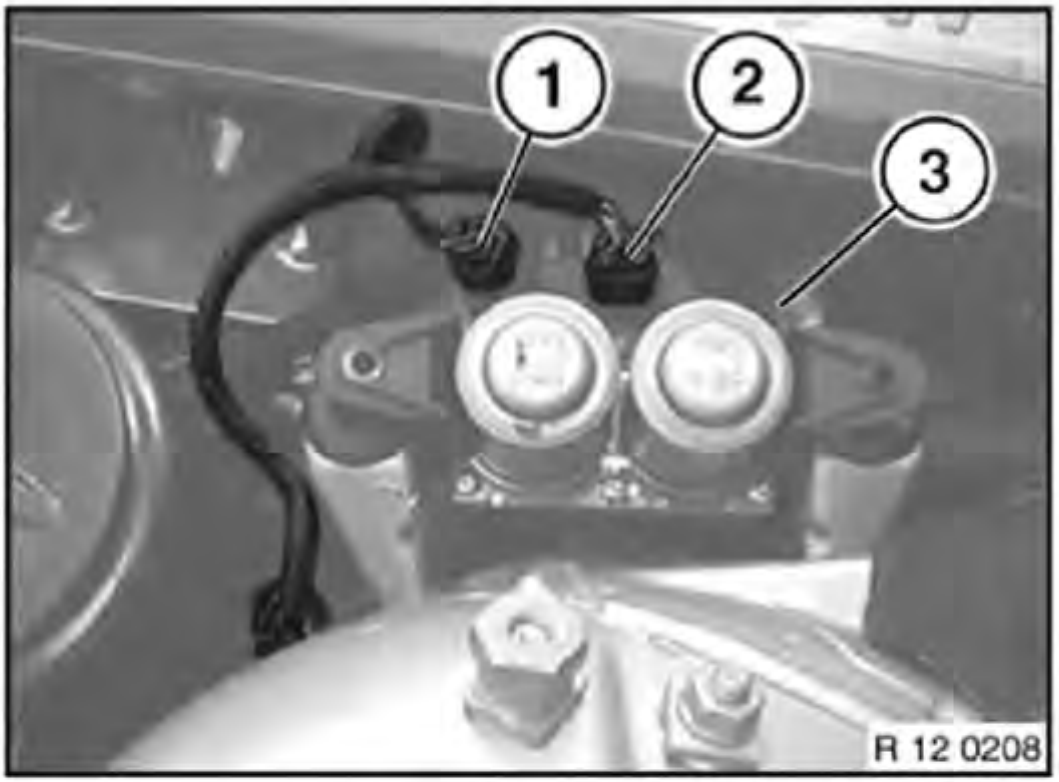
Fig. 59: Removing Air Filter Box (Cylinder Bank No. 1-6) (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Clips
2. Clamp
3. Connector

G00125123

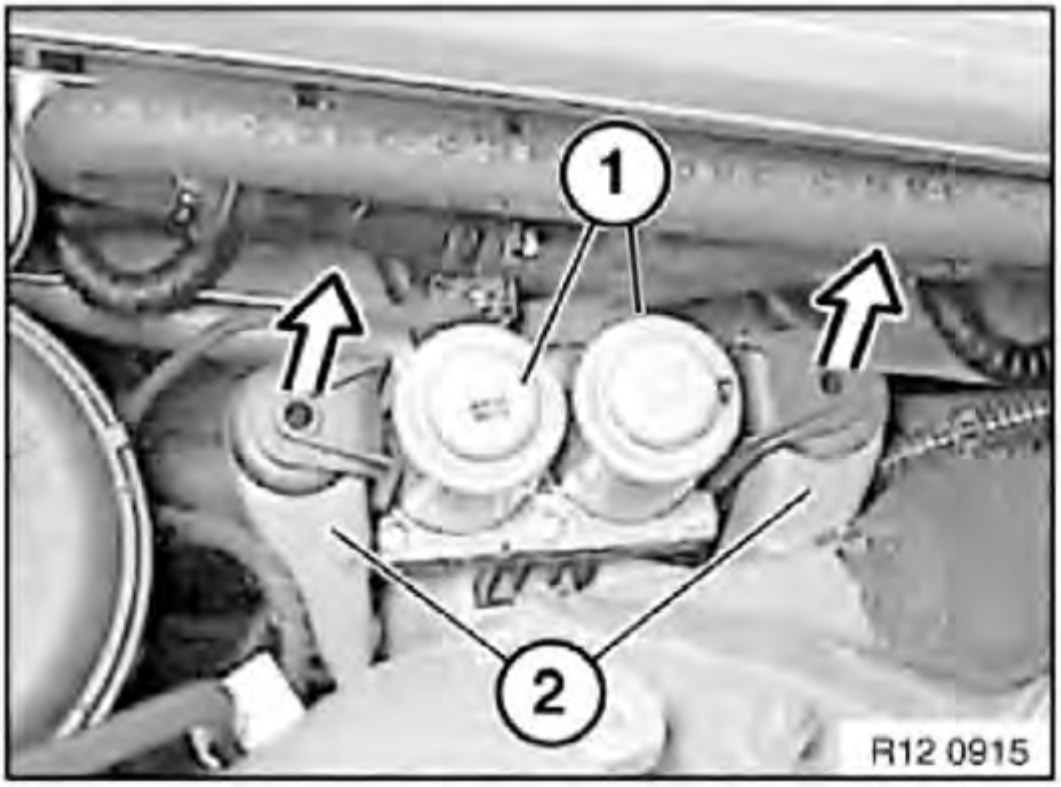
Fig. 60: Removing Air Filter Box (Cylinder Bank No. 7-12) (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Plug Connection
2. Plug Connection
3. Heating Valve

G00125124

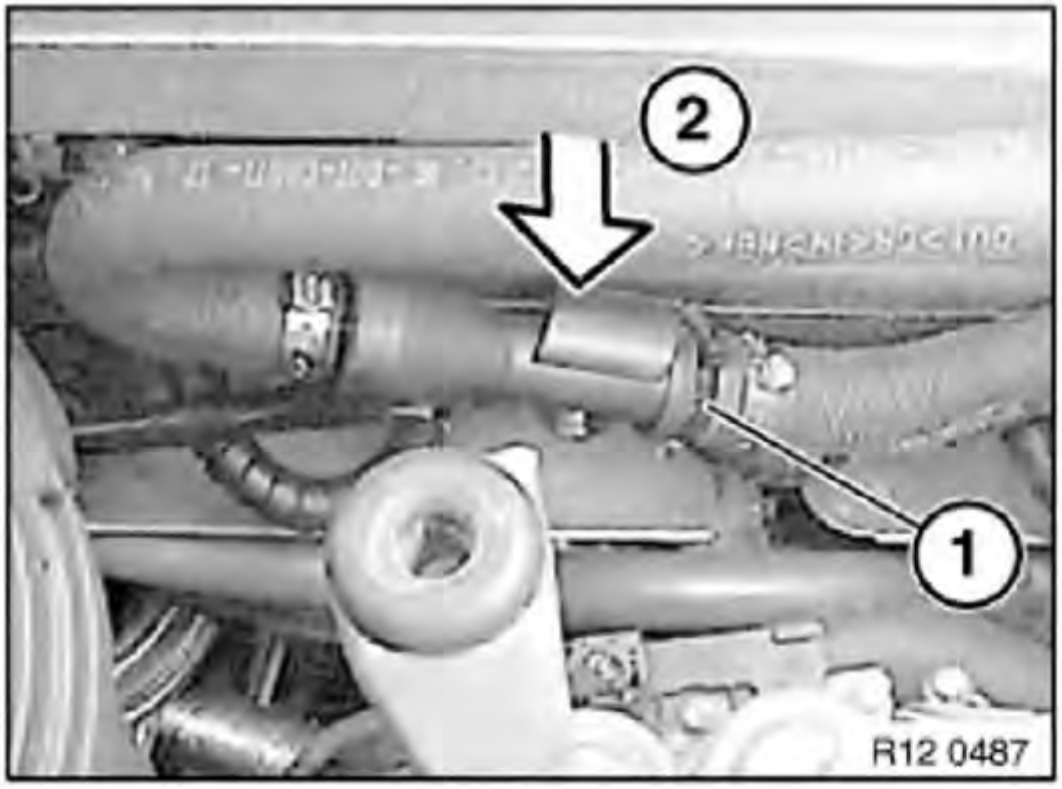
Fig. 61: Disconnecting Plug Connections No. 1 & 2 From Heating Valve (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Valves
2. Rubber Mounts

G00125125

Fig. 62: Removing Heating Valves From Rubber Mounts (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Cable Ties
2. Air Hose

G00125126

Fig. 63: Removing Cable Ties & Repositioning Air Hose (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL SYSTEMS

WARNING: Always relieve fuel pressure before disconnecting any fuel injection-related component. DO NOT allow fuel to contact engine or electrical components.

FUEL SYSTEM PRESSURE RELEASE

Fuel system pressure release procedure not available from manufacturer. It may be possible to remove fuel pump relay, start engine, and run engine until fuel pressure drops (engine stalls). See DME & FUEL PUMP RELAY LOCATION table.

DME & FUEL PUMP RELAY LOCATION (1)

Application	Location
3-Series	
Z3	
DME Relay	Right Rear Corner Of Engine Compartment, Next To DME PCM
Fuel Pump Relay	Under Left Side Of Instrument Panel, Next To Kick Panel
E46	
DME Relay	Left Rear Corner Of Engine

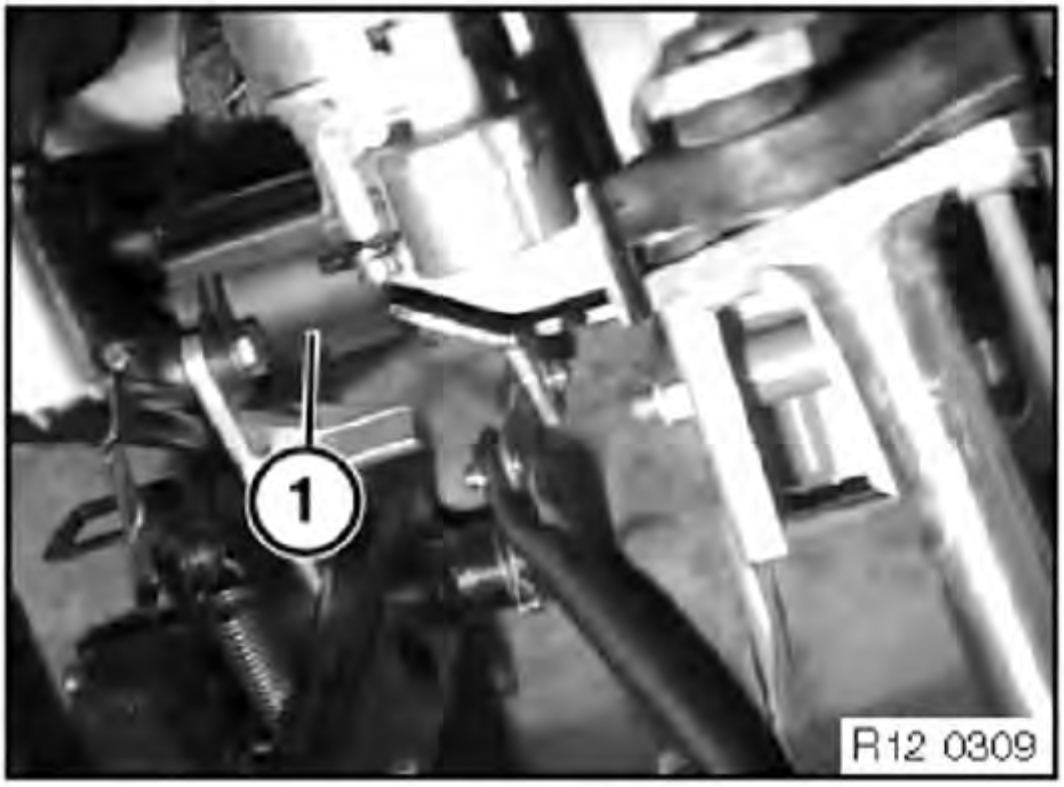
	Compartment, In Relay/PCM Box
Fuel Pump Relay	Behind Glove Box
5-Series & 7-Series	
DME Relay	Right Rear Corner Of Engine Compartment, Next To DME PCM
Fuel Pump Relay	Right Side Of Trunk
(1) For relay location illustration, see RELAYS under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article.	

ACCELERATOR SENSOR (V12)

NOTE: When accelerator sensor is disconnected, basic adaptation of accelerator sensor is required. Connect DIS and select diagnosis on EPC-III control unit. Follow procedure set out in DIS instructions.

Removal & Installation

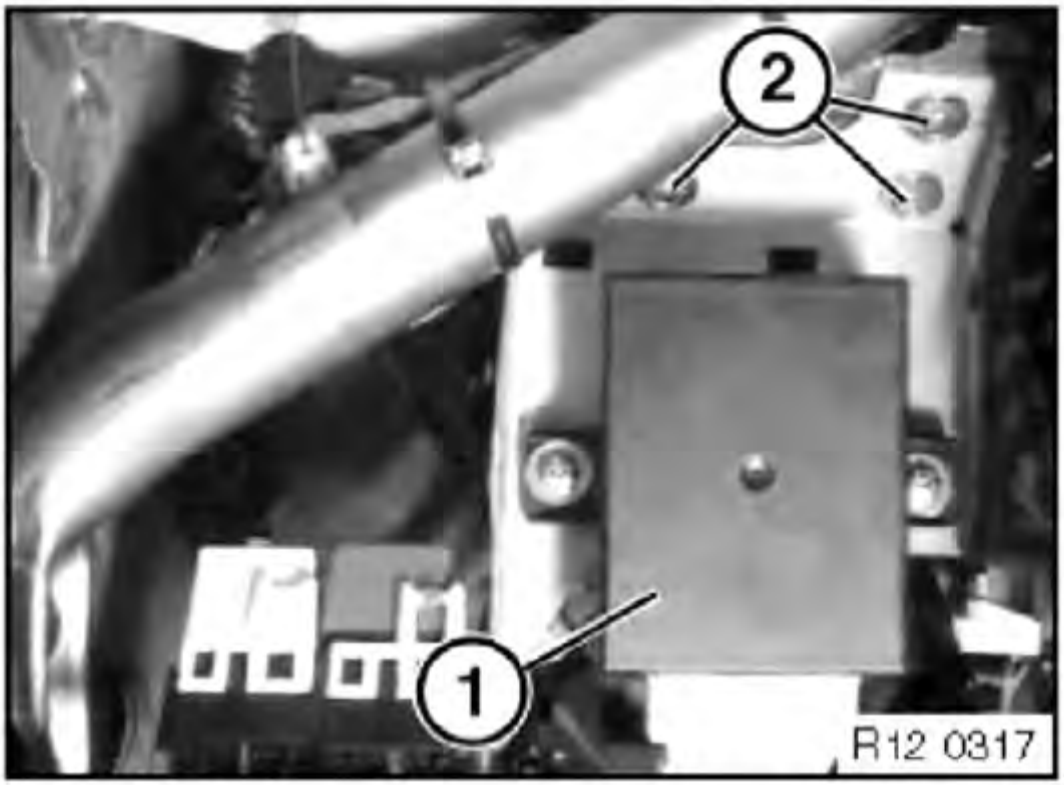
1. Turn ignition off. Remove lower trim from instrument panel. Press accelerator pedal by hand to avoid bending pedal tip and falsifying measured values. Accelerator sensor is installed on pedal block. See Fig. 64. Unscrew and remove control unit from bracket. See Fig. 65. Remove bracket. Remove retaining ring and unhook lever. See Fig. 66. Disconnect electrical connector. Remove screws. See Fig. 67.
2. To install, note position of pedal travel sensor and lever position. Lever No. 1 is factory-set and must not be released. See Fig. 68. If lever is released, entire sensor must be replaced. Install bracket with weld-in nuts. See Fig. 69. Check adjustment of kickdown switch.



1. Accelerator Sensor

G00131544

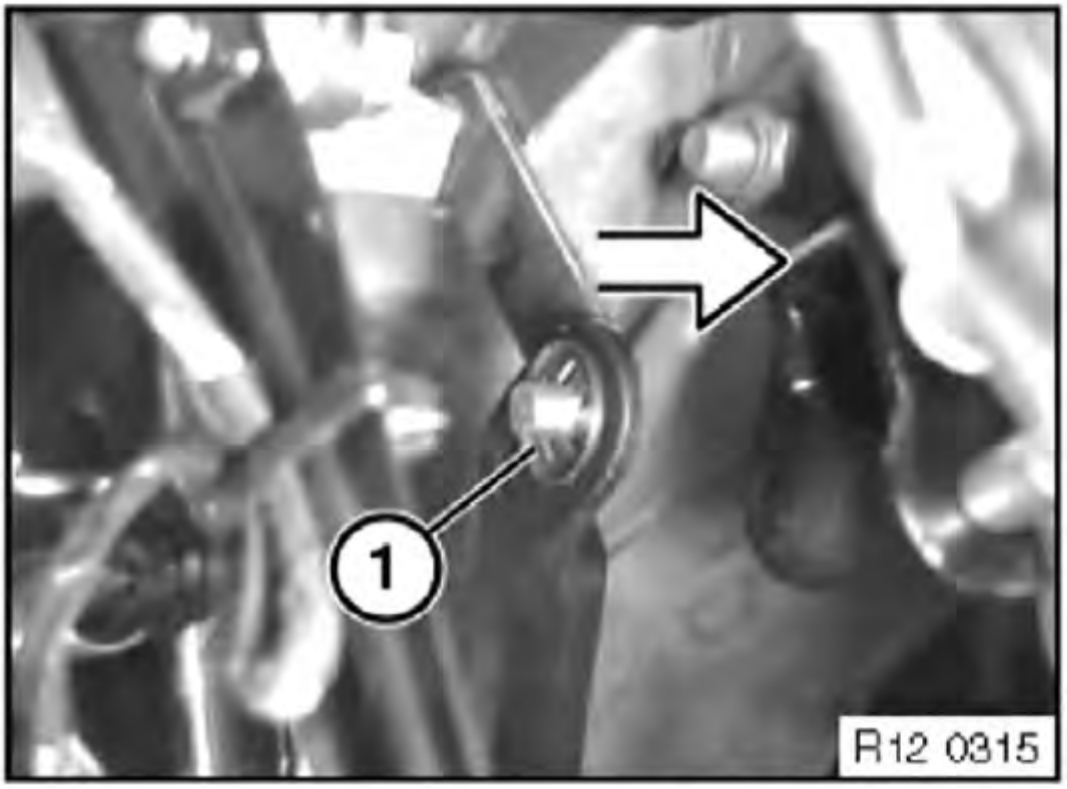
Fig. 64: Locating Accelerator Sensor (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Control Unit
2. Bolts

G00131545

Fig. 65: Removing Accelerator Sensor Control Unit (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Retaining Ring

G00131546

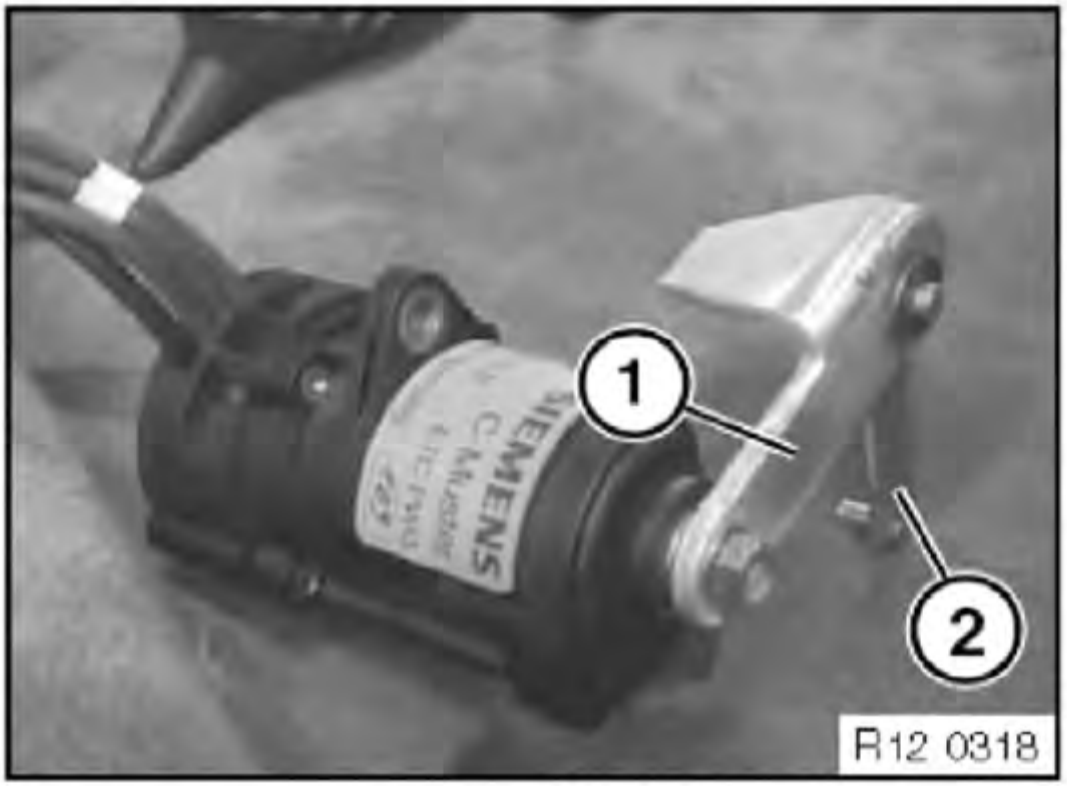
Fig. 66: Removing Retaining Ring (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Electrical Connector
2. Screws

G00131547

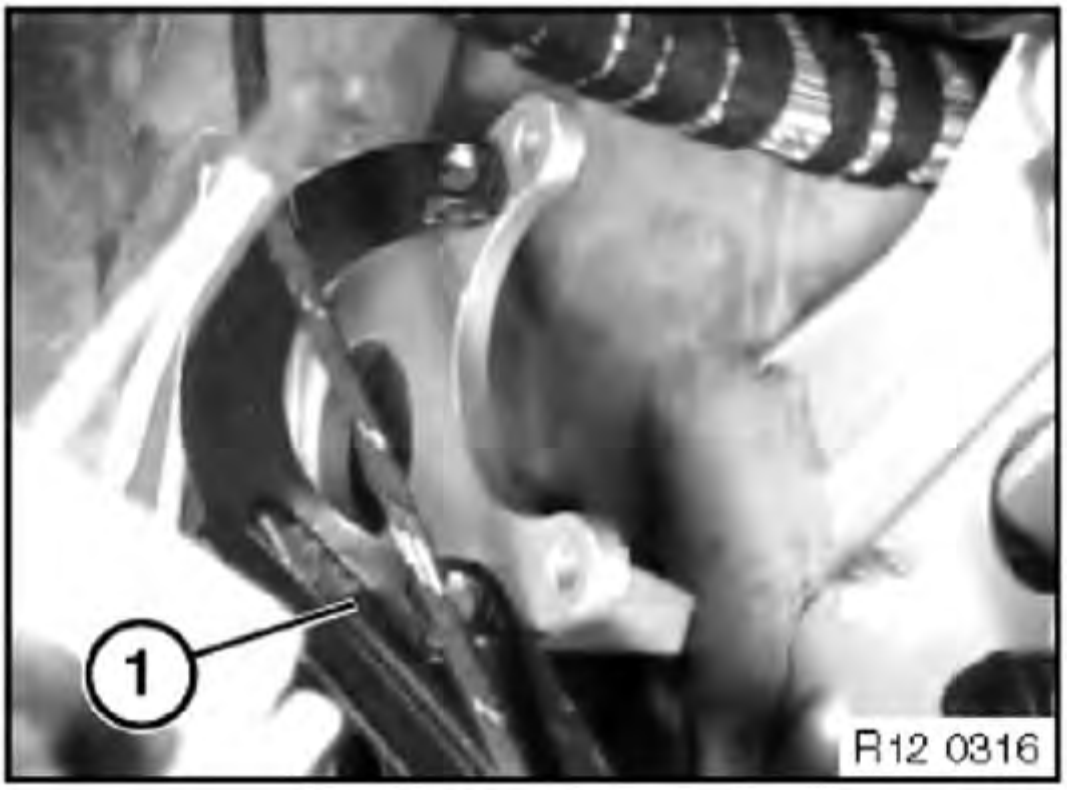
Fig. 67: Disconnecting Electrical Connector & Removing Screws (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Lever (No. 1)
2. Lever (No. 2)

G00131548

Fig. 68: Identifying Lever Position (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Bracket

G00131549

Fig. 69: Installing Bracket (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

EXPANSION TANK

Removal & Installation (3-Series - Z3)

Unfasten screws and nuts. Remove right rear wheel trim. Unfasten hose clips and remove hose. Remove 2 nuts. Press back of expansion tank upward and remove. Release hose clamps and remove hoses. To install, reverse removal procedure. See Fig. 70-Fig. 72

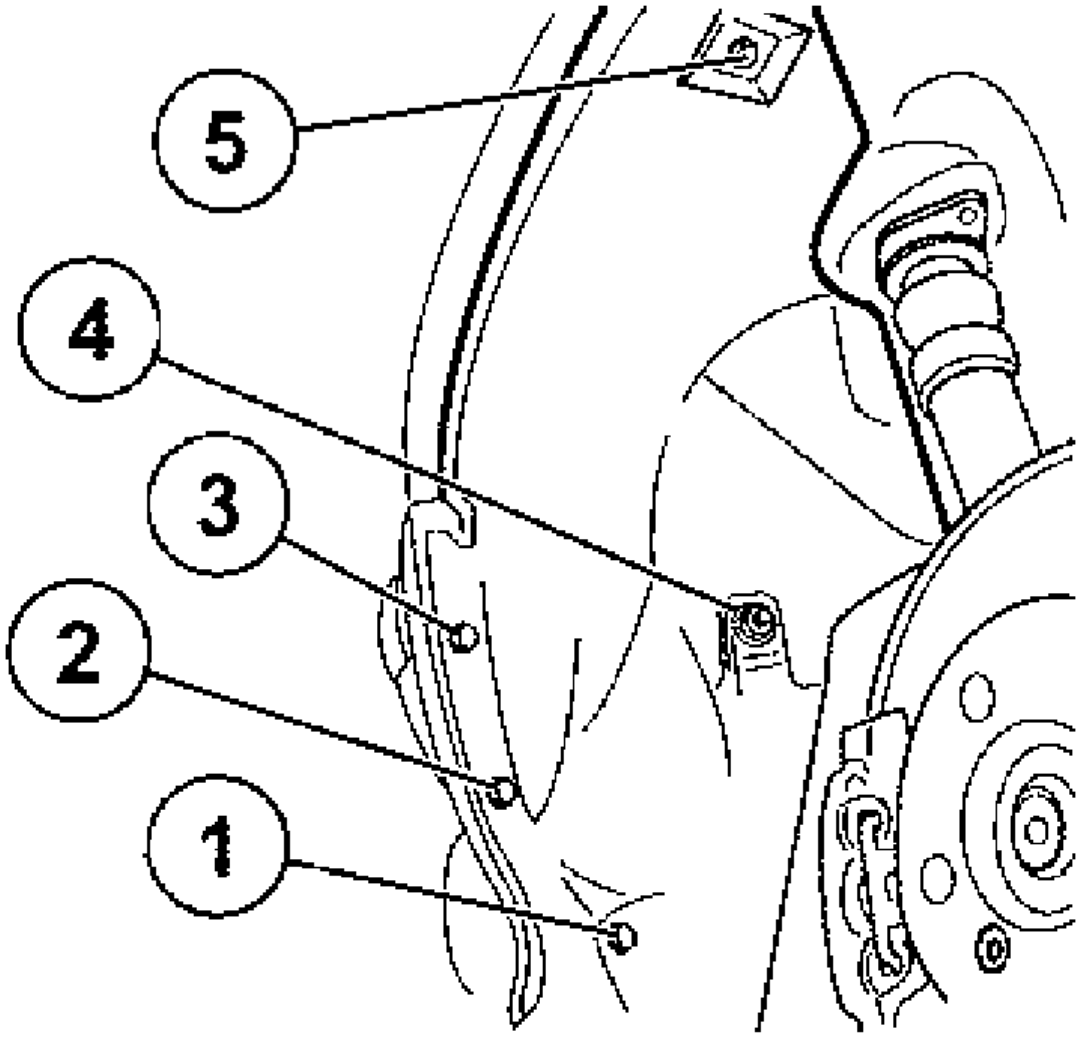


Fig. 70: Removing Right Rear Wheel Trim Screws & Nuts (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

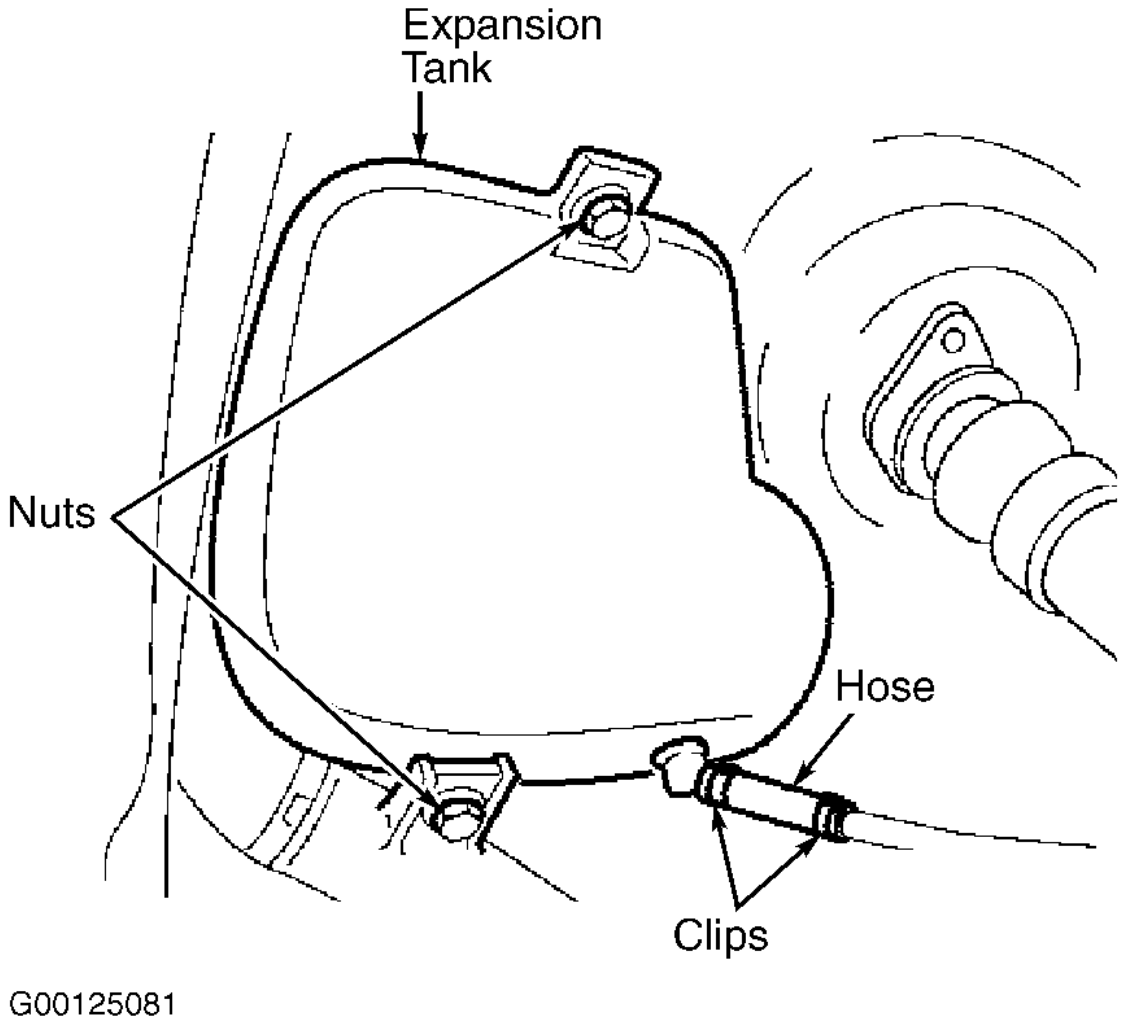


Fig. 71: Removing Expansion Tank Nuts & Hose (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

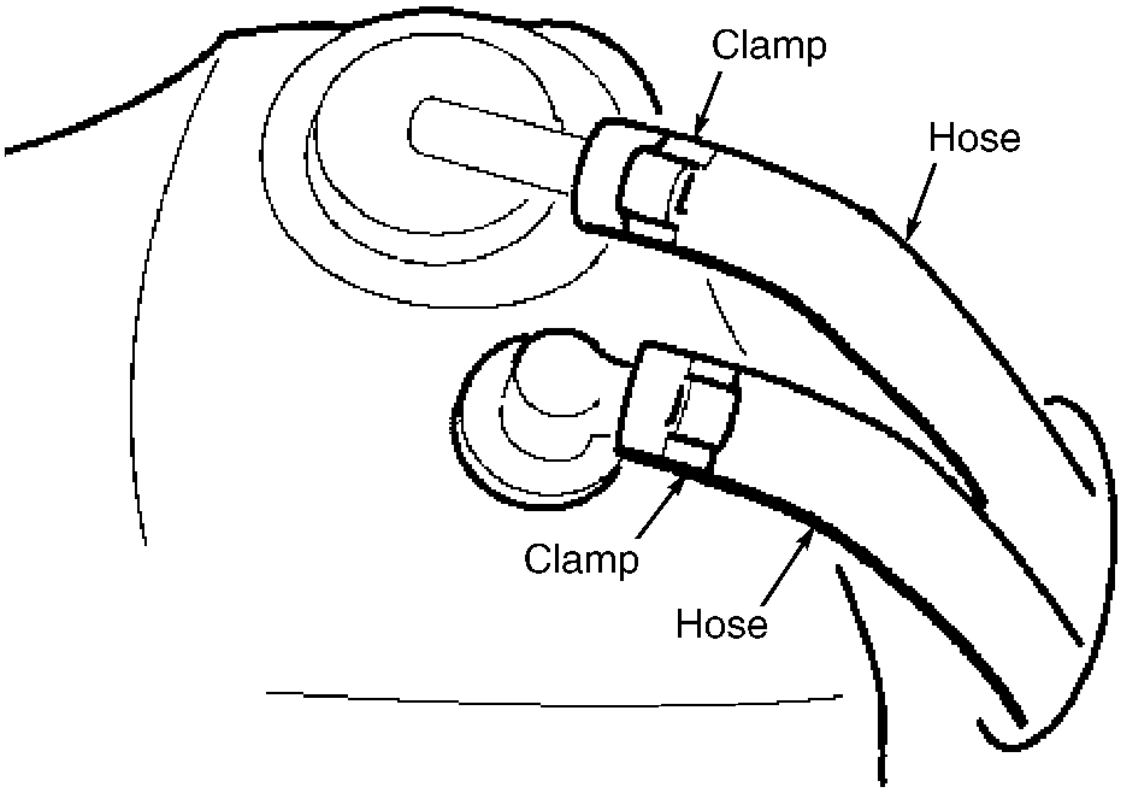
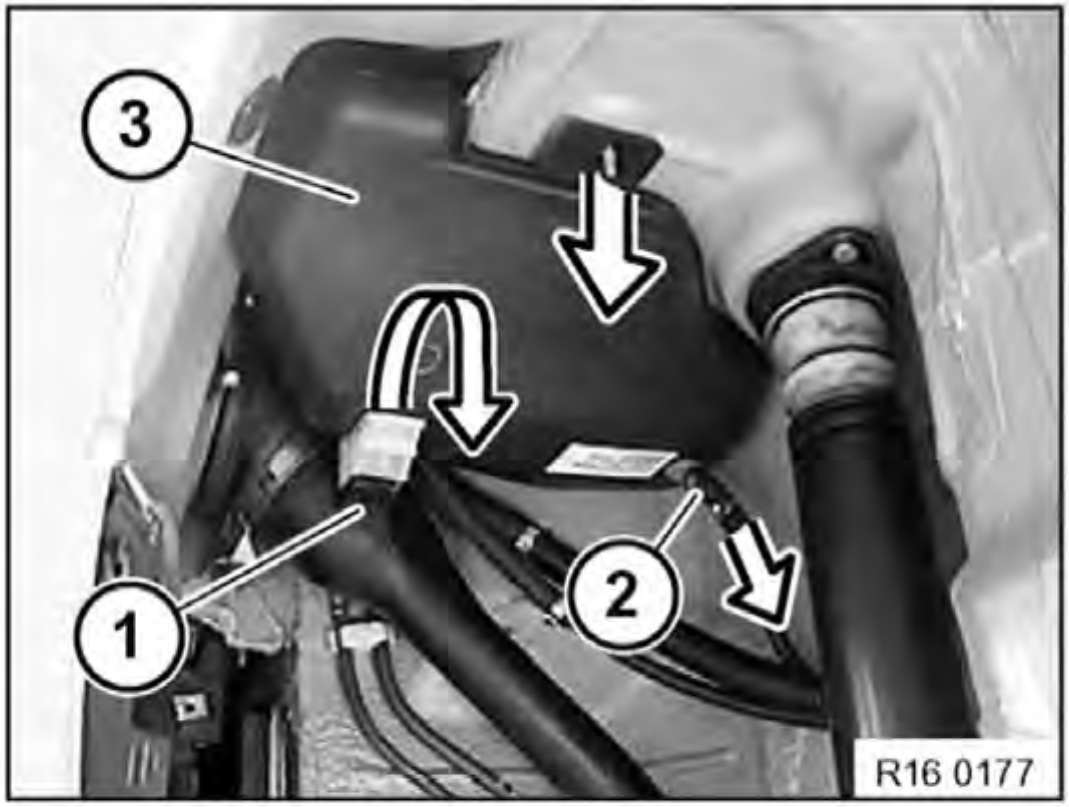


Fig. 72: Removing Hose Clamps & Hoses (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (3-Series - E46)

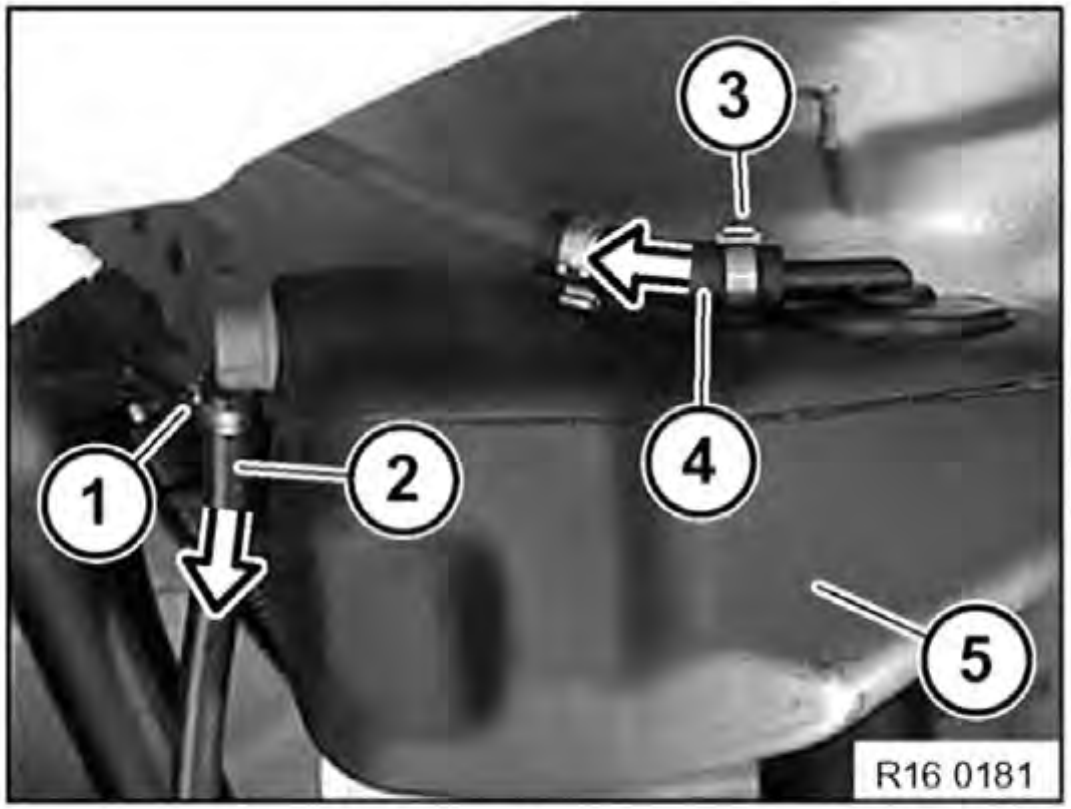
Remove right rear wheel and right rear wheel arch. Unfasten plastic nut. Unfasten hose clip and remove hose. Tilt expansion tank forward at bottom. See Fig. 73. Release hose clip and disconnect hose. Release hose clip and disconnect hose. Remove expansion tank. See Fig. 74. To install, reverse removal procedure.



1. Plastic Nut
2. Hose Clip
3. Expansion Tank

G00131526

Fig. 73: Removing Expansion Tank Plastic Nut & Hoses (E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Hose Clip
2. Hose
3. Hose Clip
4. Hose
5. Expansion Tank

G00131527

Fig. 74: Removing Expansion Tank (E46)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (5-Series)

Remove right rear wheel. Remove right rear wheel trim. See Fig. 75. Unfasten hose clips and remove hose. See Fig. 76. Remove 2 expansion tank bolts. See Fig. 77. Unclip lines in front of tank. See Fig. 78. Loosen lines to activated carbon filter at expansion tank. Remove expansion tank.

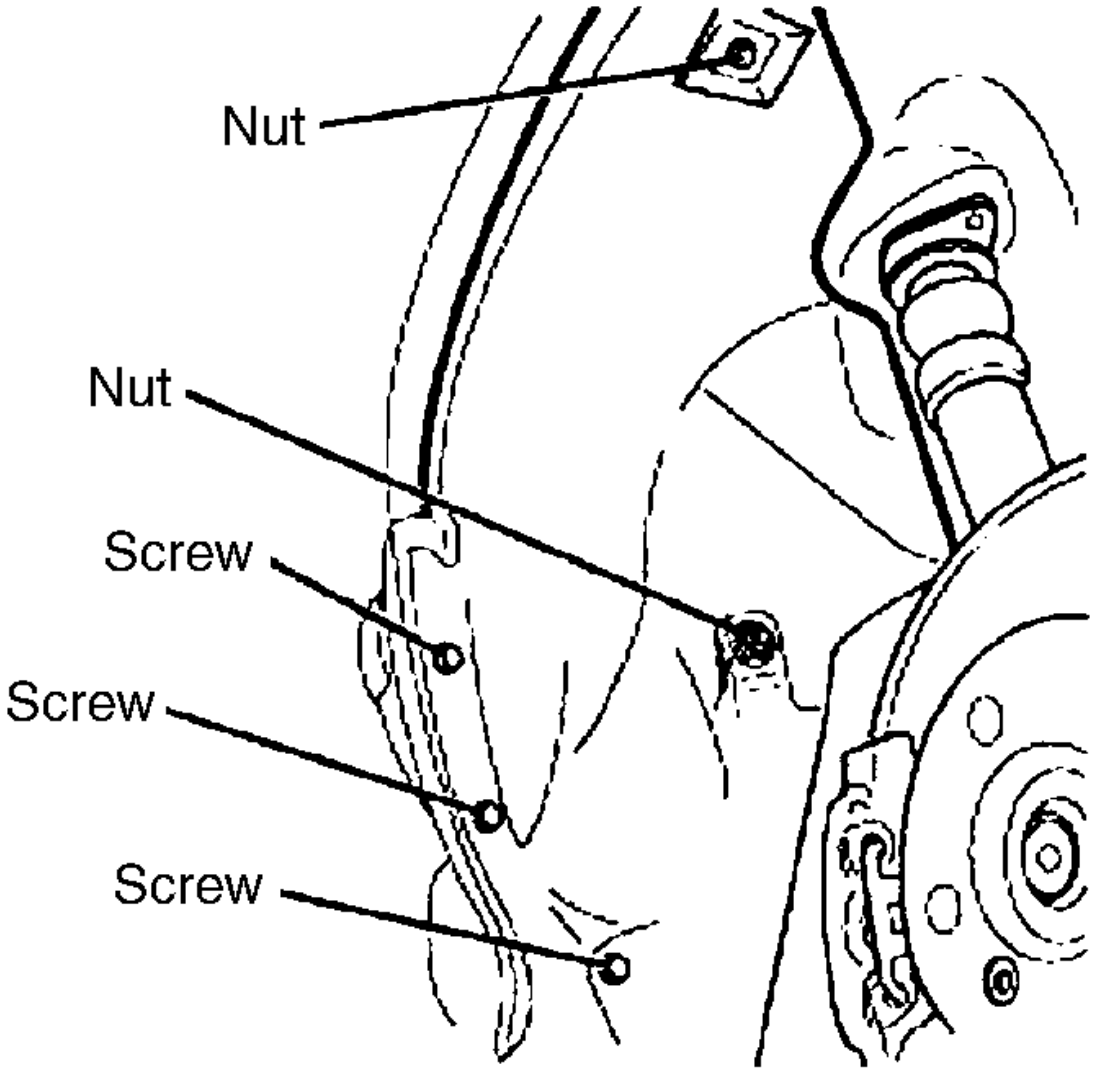


Fig. 75: Removing Right Rear Wheel Trim Nuts & Screws (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

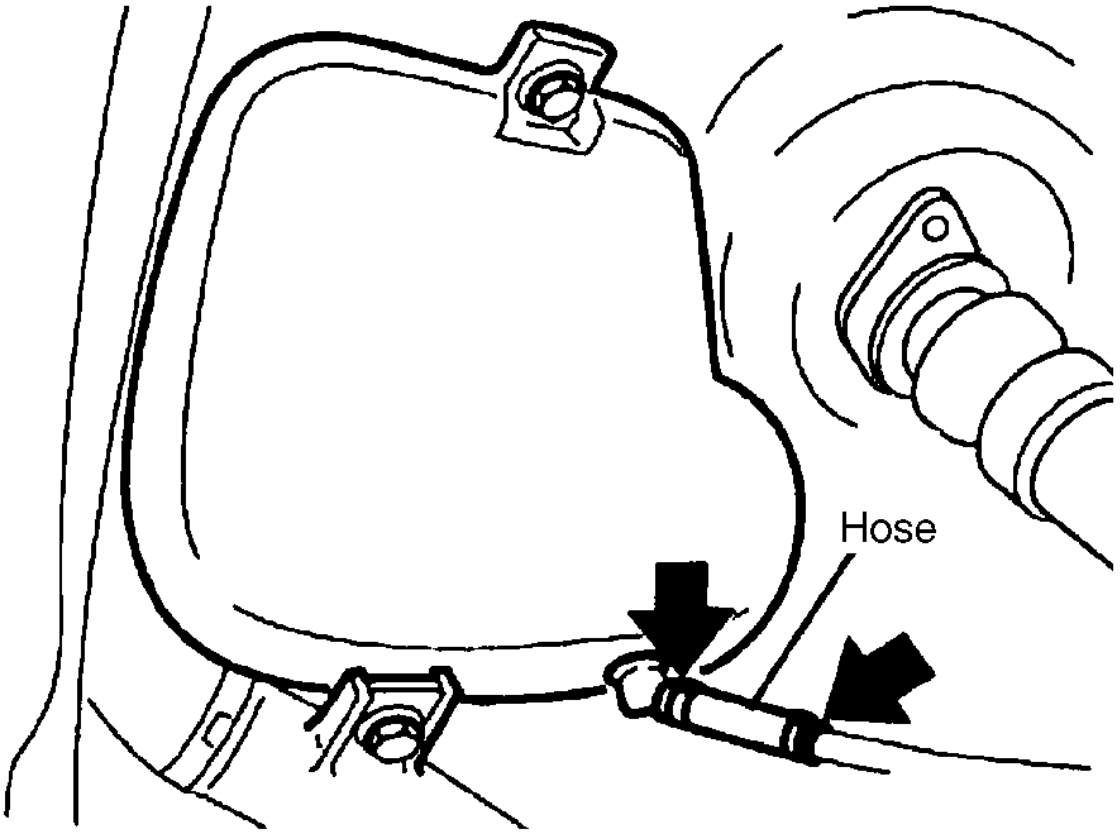


Fig. 76: Unfastening Hose Clips & Removing Hose (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

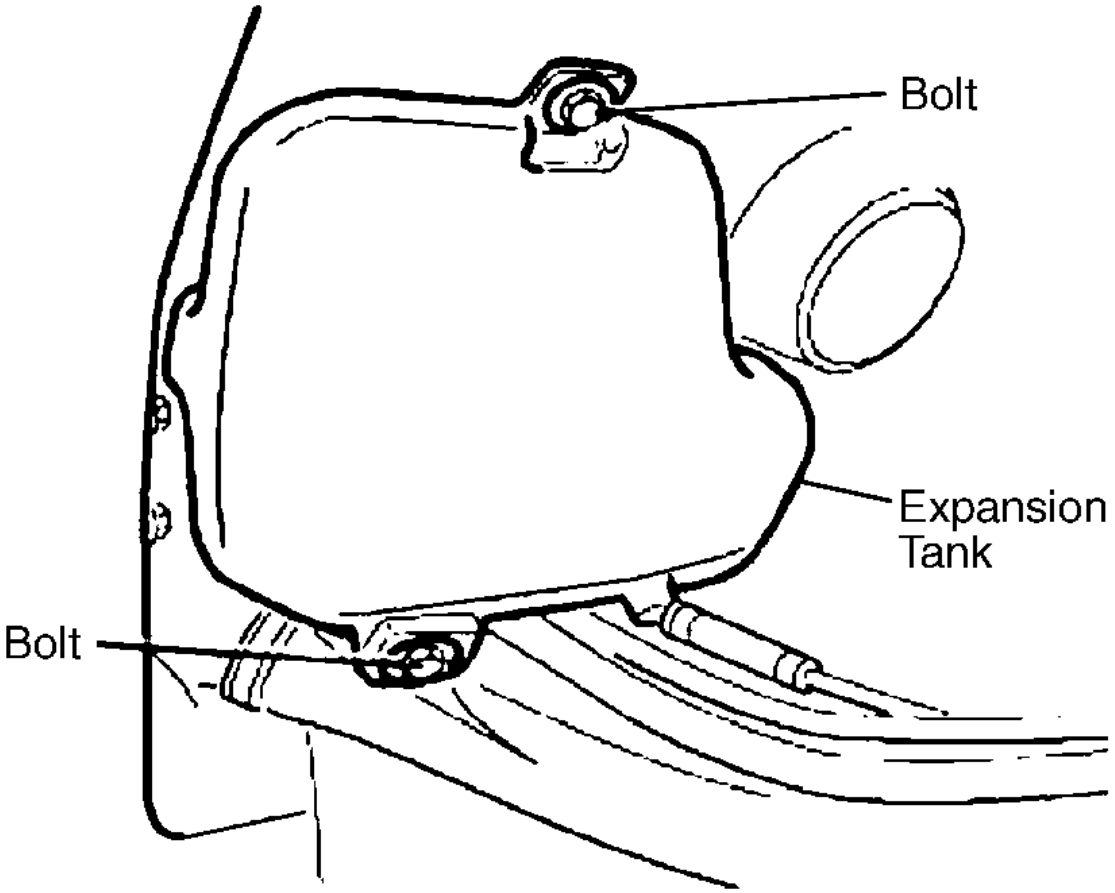


Fig. 77: Removing 2 Expansion Tank Bolts (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

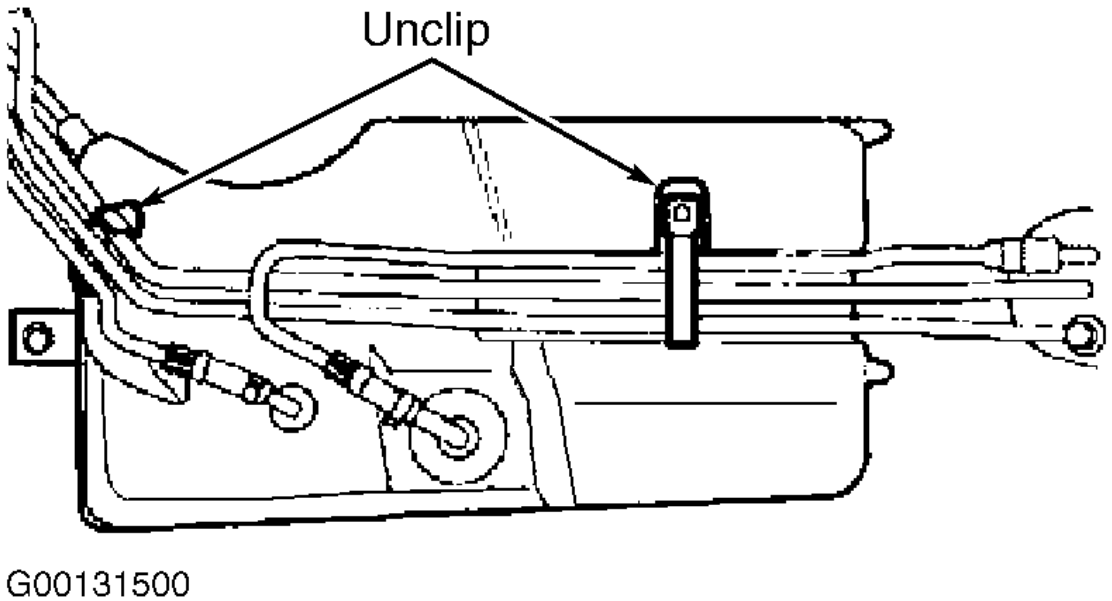


Fig. 78: Unclipping Lines In Front Of Tank (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (7-Series)

Remove left rear wheel. Remove left rear wheel trim. Remove return line. See Fig. 79. Unscrew and lower expansion tank. See Fig. 80. Disconnect connections No. 1 and 2. See Fig. 81. Unclip lines in front of tank. See Fig. 78. Loosen lines to activated carbon filter at expansion tank. Remove expansion tank.

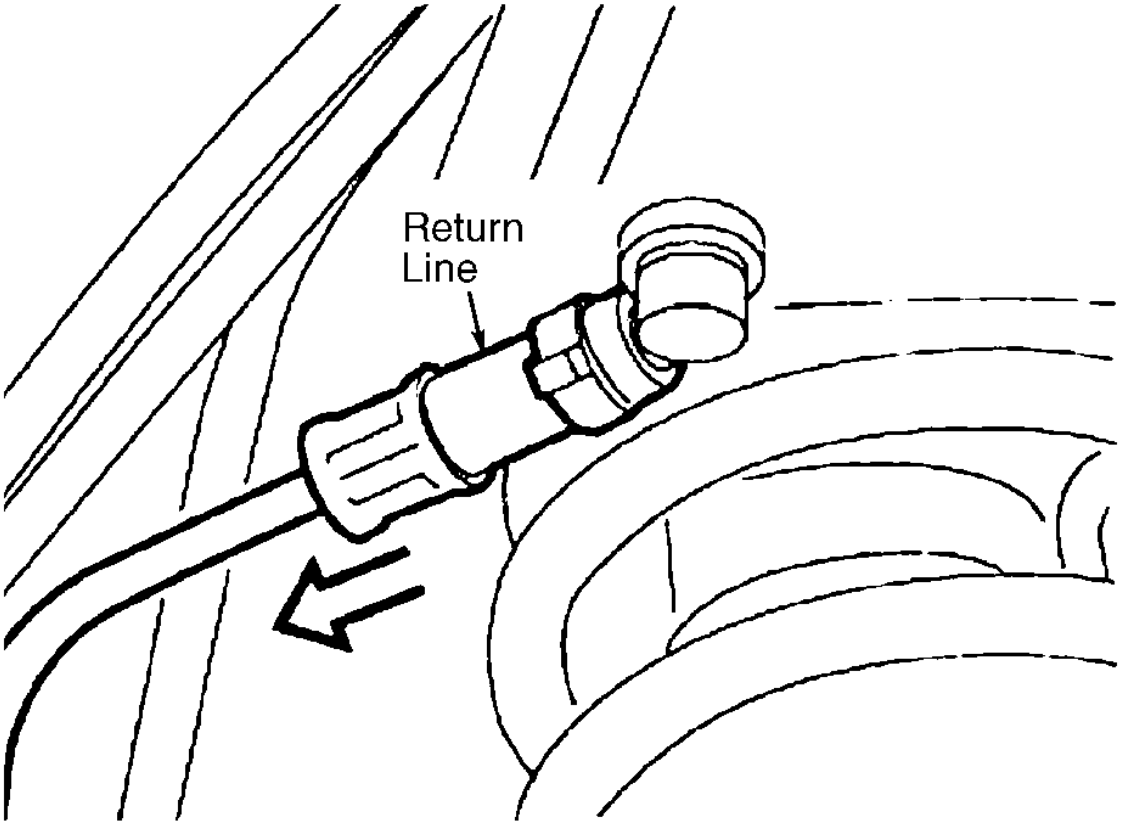


Fig. 79: Removing Return Line (7-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

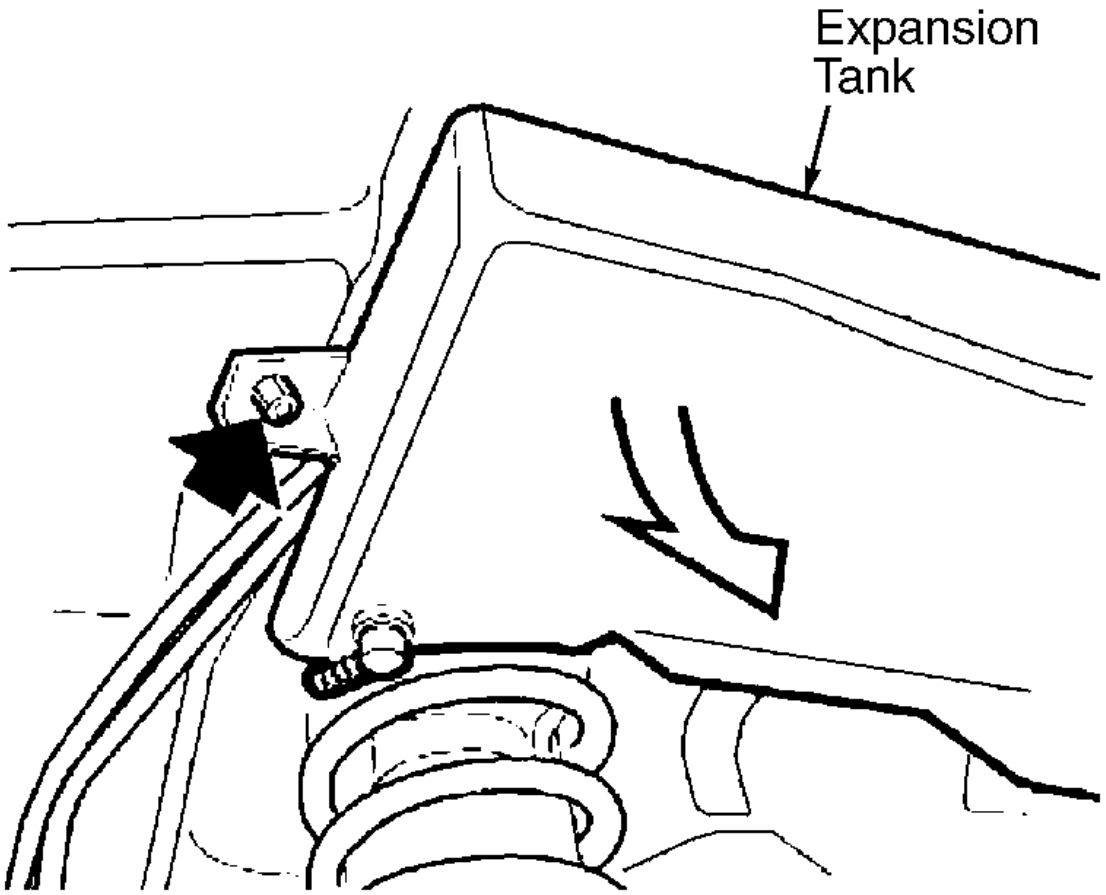
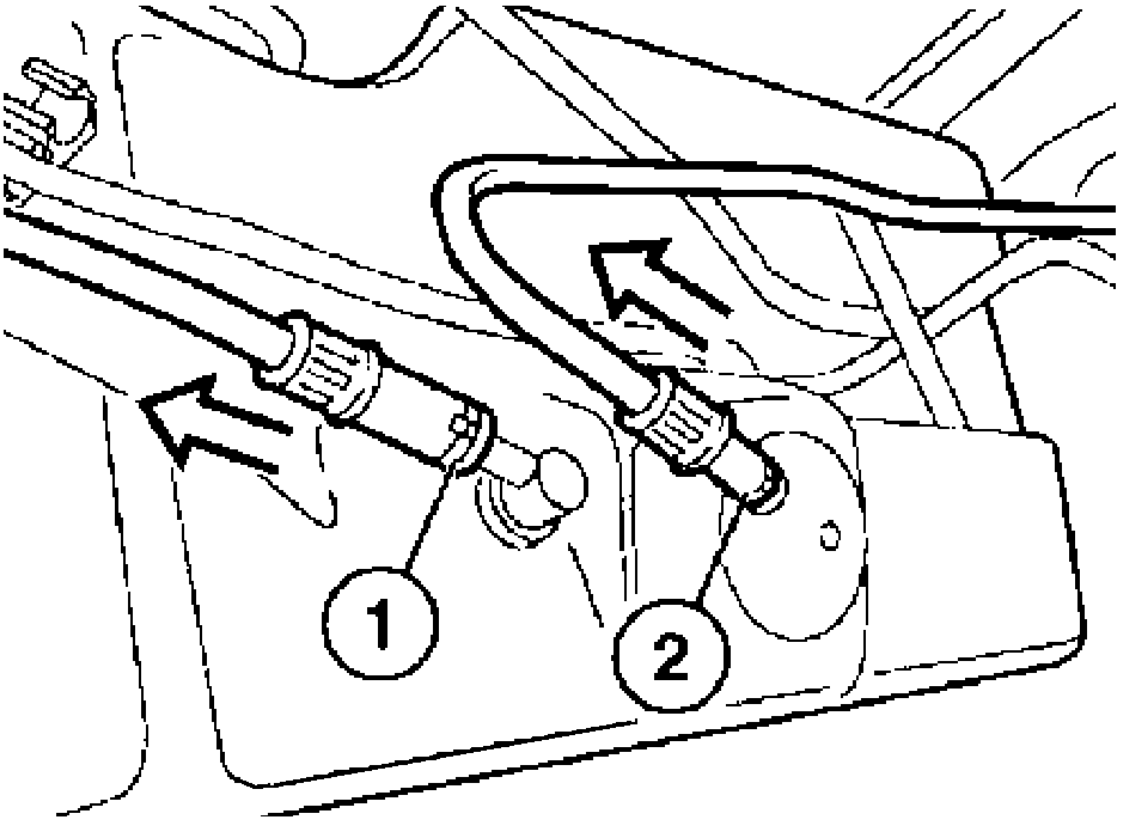


Fig. 80: Removing Expansion Tank (7-Series)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Connection
2. Connection

G00131499

Fig. 81: Disconnecting Connections No. 1 & 2 (7-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL FILTER

3-Series (Z3)

Filter on firewall of vehicle: Remove cover from fuel filter. Disconnect fuel delivery line with special tool 13 3 010 before and after the fuel filter. Unfasten hose clips and remove fuel line from fuel filter.

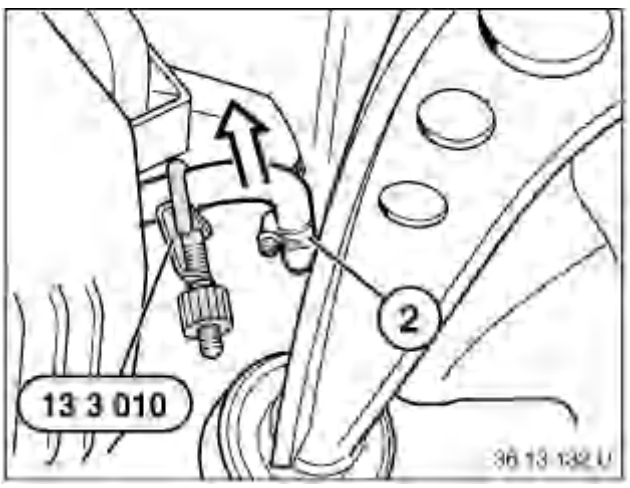


Fig. 82: Unfasten Hose Clips And Remove Fuel Line From Fuel Filter

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Catch and dispose off escaping fuel.

Unfasten screw and remove filter from bracket. Filter on underbody of vehicle: Unfasten screws and remove cover from fuel filter. Disconnect fuel inlet line at points (1) and (2) with special tool 13 3 010.



Fig. 83: Unfasten Screw & Remove Filter From Bracket
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Catch and dispose off escaping fuel.

Unfasten hose clips and remove fuel line from fuel filter. Fuel filter with quick release coupling. Push lock toward filter while pulling off fuel hose. Unfasten screw and remove filter from bracket.

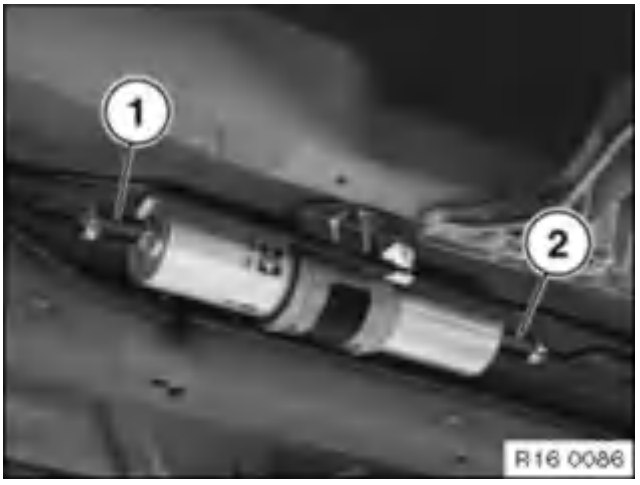


Fig. 84: Unfasten Hose Clips & Remove Fuel Line From Fuel Filter
Courtesy of BMW OF NORTH AMERICA, INC.

Installation: Check direction of flow (arrow). Arrow must point towards the injection valve strip.

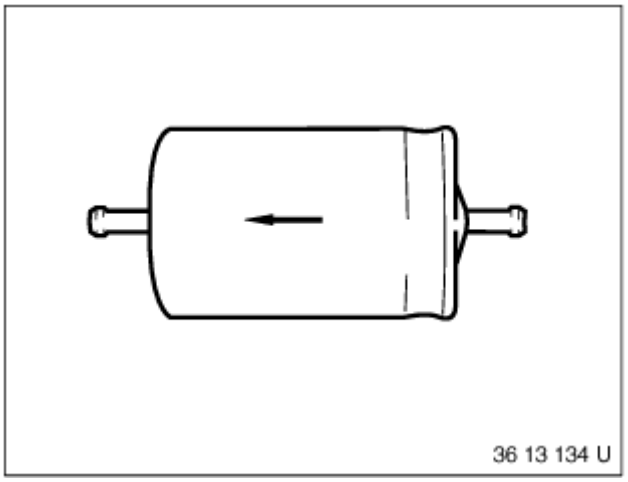


Fig. 85: Direction Of Flow
Courtesy of BMW OF NORTH AMERICA, INC.

3-Series (E46)

Turn off ignition. If installed: Remove engine underguard (1 and 2). Disconnect fuel feed line at points (1) with special tool 13 3 010.



Fig. 86: Removing Engine Underguard
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Catch and dispose of escaping fuel.

Release hose clips and disconnect fuel lines from fuel filter.

During installation, always replace hose clips and fuel hoses. Release screw (2) and remove filter from retainer.

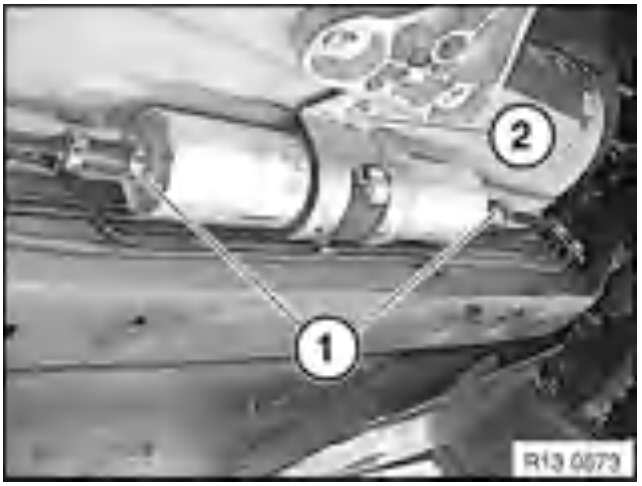


Fig. 87: Disconnect fuel feed line at points (1) with special tool 13 3 010
Courtesy of BMW OF NORTH AMERICA, INC.

Observe flow direction (arrow). Arrow must point in direction of fuel injector block.

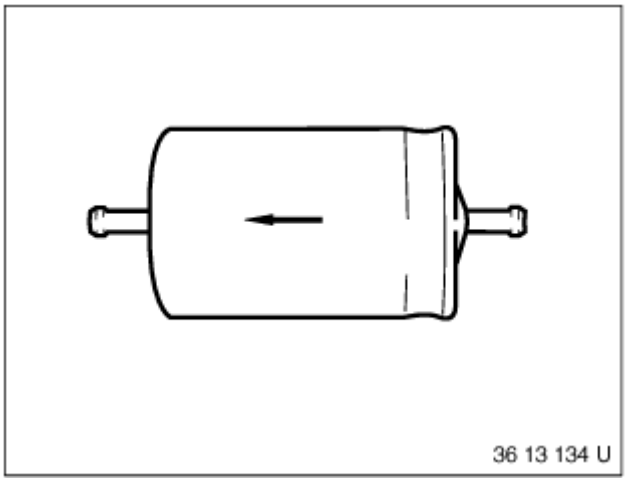


Fig. 88: Direction Of Filter Flow
Courtesy of BMW OF NORTH AMERICA, INC.

M52, M60, M62 & M73

Switch off ignition. Unfasten screws on lower trim (1).

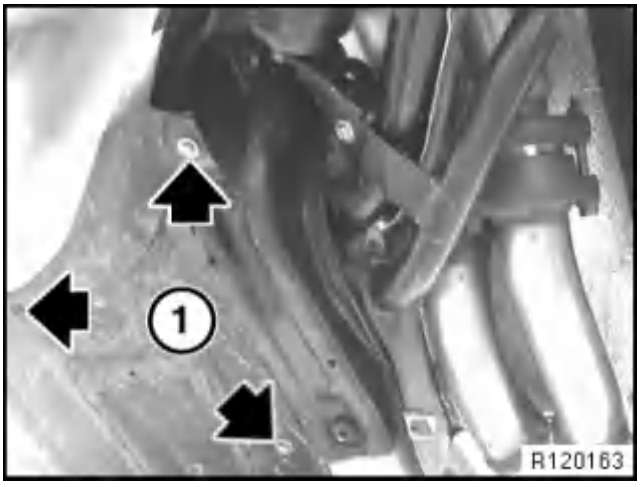


Fig. 89: Unfasten Screws On Lower Trim (1)
Courtesy of BMW OF NORTH AMERICA, INC.

Fold lower trim to one side.

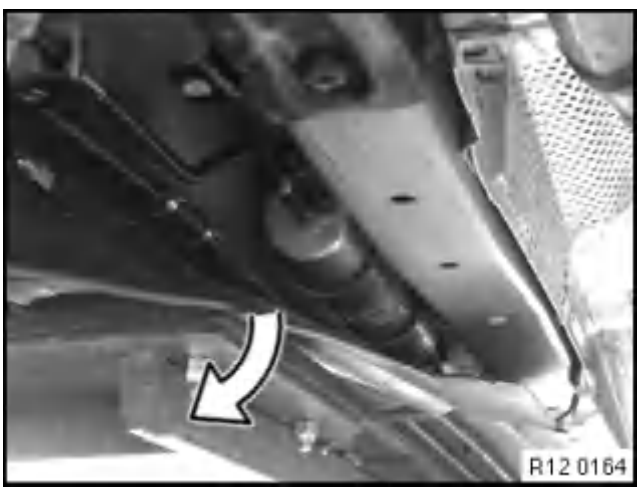


Fig. 90: Fold Lower Trim To One Side
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect fuel lines with special tool 13 3 010. Catch and dispose of escaping fuel.

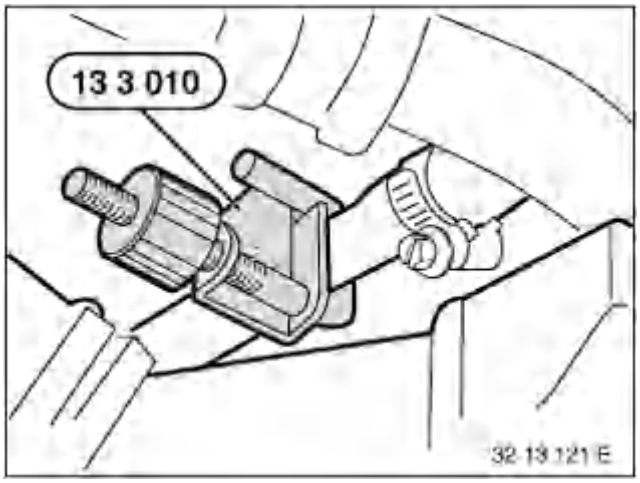


Fig. 91: Disconnect Fuel Lines With Special Tool 13 3 010
Courtesy of BMW OF NORTH AMERICA, INC.

Illustrated here without lower trim: Unfasten hose clips. Replace hose clips.

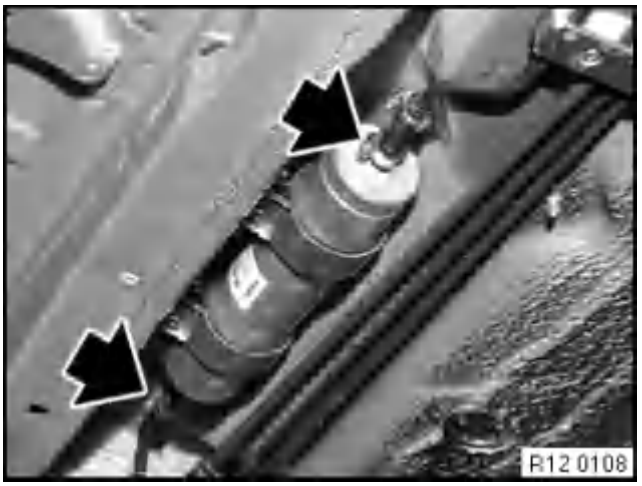


Fig. 92: Replace Hose Clips
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten screws. Remove fuel filter. Replace fuel filter.

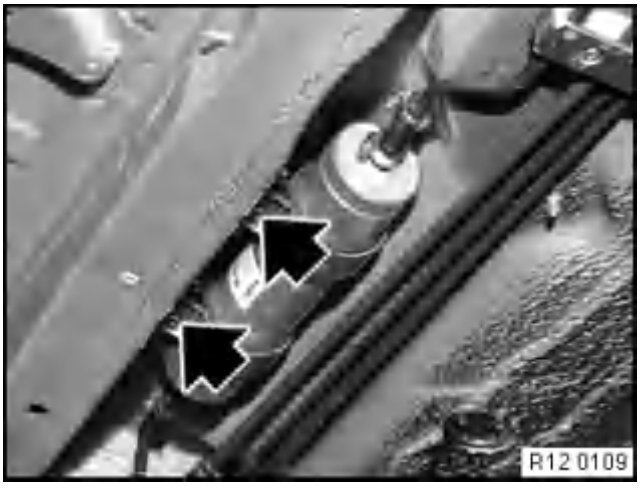


Fig. 93: Unfasten Screws

Courtesy of BMW OF NORTH AMERICA, INC.

Installation: Note installation direction of fuel filter. Direction of flow is marked with an arrow on the fuel filter. The arrow points towards the injector strip.



Fig. 94: Direction Of Flow Is Marked With An Arrow On The Fuel Filter
Courtesy of BMW OF NORTH AMERICA, INC.

The embossed designation "OUT " on outlet of fuel filter must be mounted facing the injector strip.



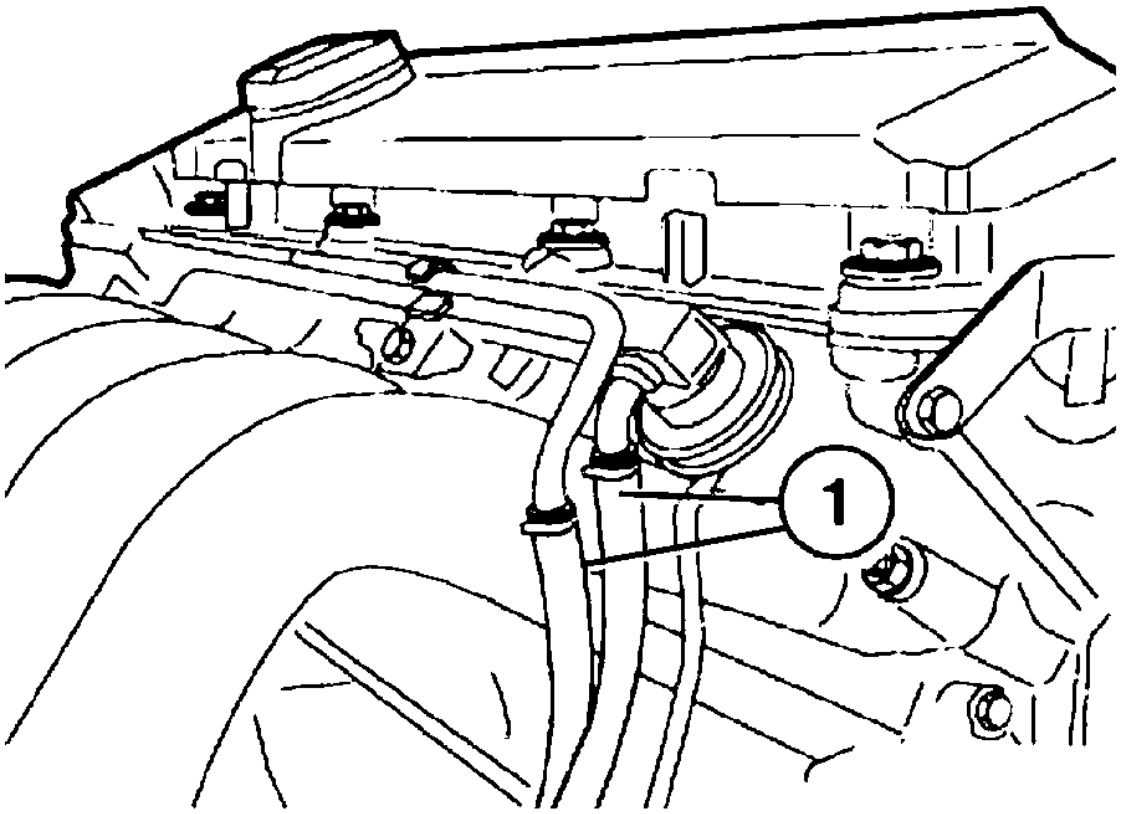
Fig. 95: "OUT" On Outlet Of Fuel Filter Must Be Mounted Facing Injector Strip
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL LINES

Removal & Installation

CAUTION: Fuel is under pressure. Manufacturer uses several type of fuel line fittings. See Fig. 96-Fig. 100 .

On versions with hose clips, remove hoses No. 1 and 2. On versions with compressed air connection, blow fuel back into tank with a short blast of air at compressed air connection. On fuel hoses without integrated unlocking facility, unlock fuel hoses with Special Tool (16 1 050) and detach hoses. On fuel hoses with integrated unlocking facility, press fuel hose downward and keep pressed. Press unlocking ring upward, keep pressed and detach fuel hose. On fuel hoses with quick-release fittings, seal off fuel hoses with Special Tool (13 5 281 and 13 5 282). To install, reverse removal procedure. On versions with hose clips, replace clips. On versions with and without integrated unlocking facility and quick release fittings, check "O" ring in fuel hose and sealing services for damage and replace as necessary. Coat "O" ring with anti-friction agent.



1. Fuel Hoses

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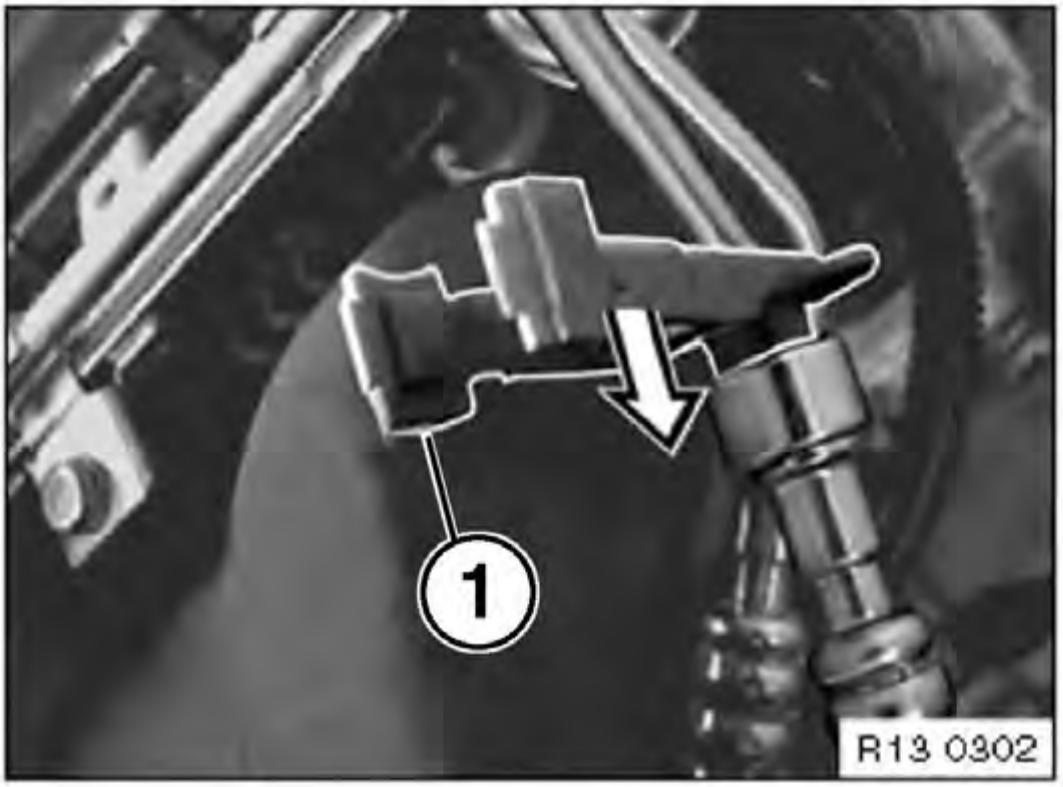
Fig. 96: Disconnecting Fuel Lines (Hose Clip Type)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Compressed Air Connection

G00125168

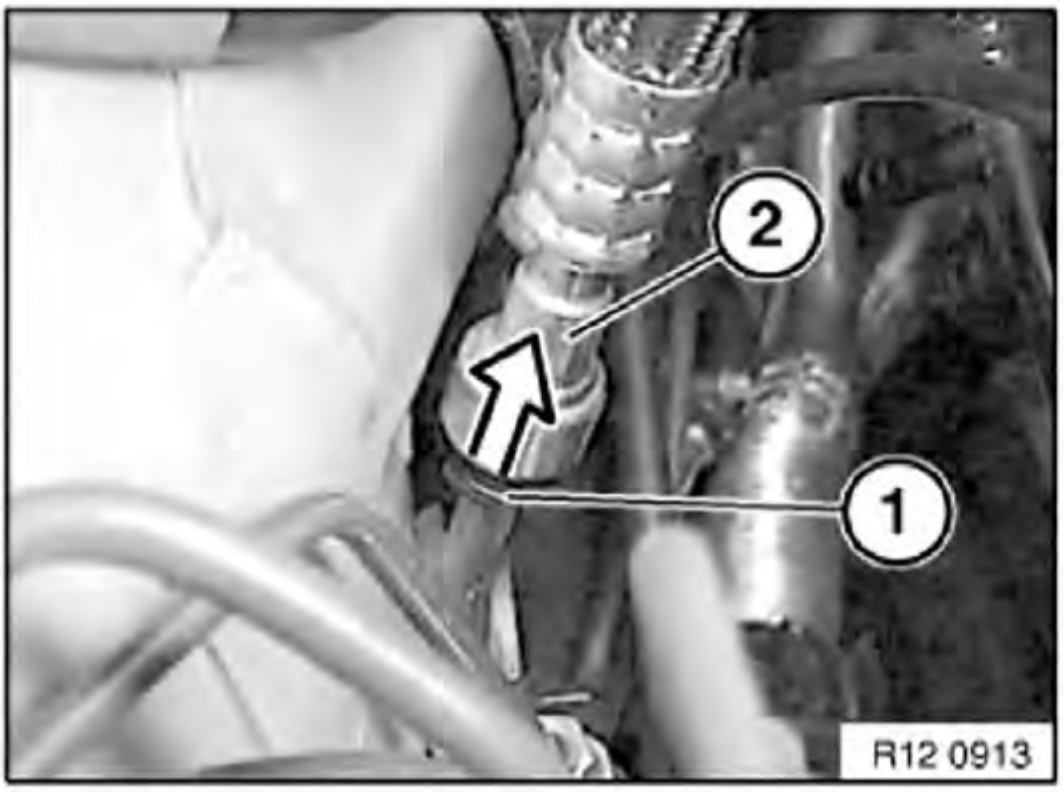
Fig. 97: Disconnecting Fuel Lines (Compressed Air Type)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Special Tool

G00131477

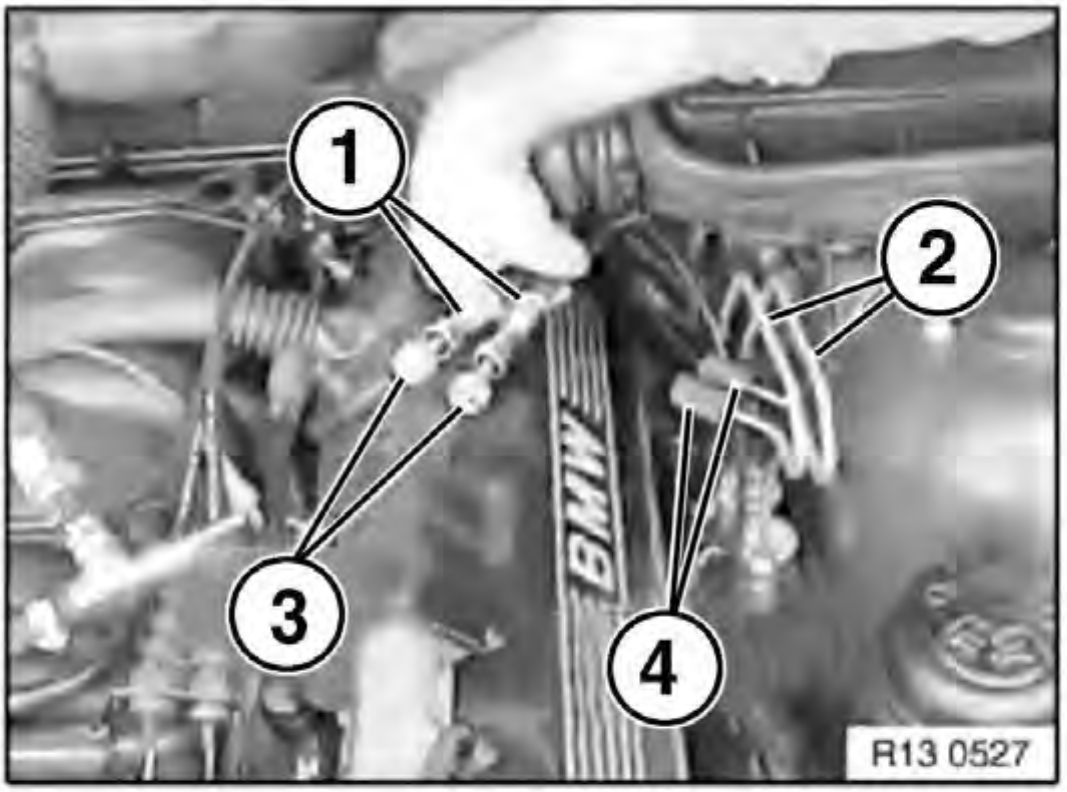
Fig. 98: Disconnecting Fuel Lines (Without Integrated Locking Device)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Release Ring
2. Fuel Hose

G00131478

Fig. 99: Disconnecting Fuel Lines (With Integrated Unlocking Device)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Fuel Hoses
2. Fuel Hoses
3. Special Tool
4. Special Tool

G00131479

Fig. 100: Disconnecting Fuel Lines (With Quick-Release Fittings)
Courtesy of BMW OF NORTH AMERICA, INC.

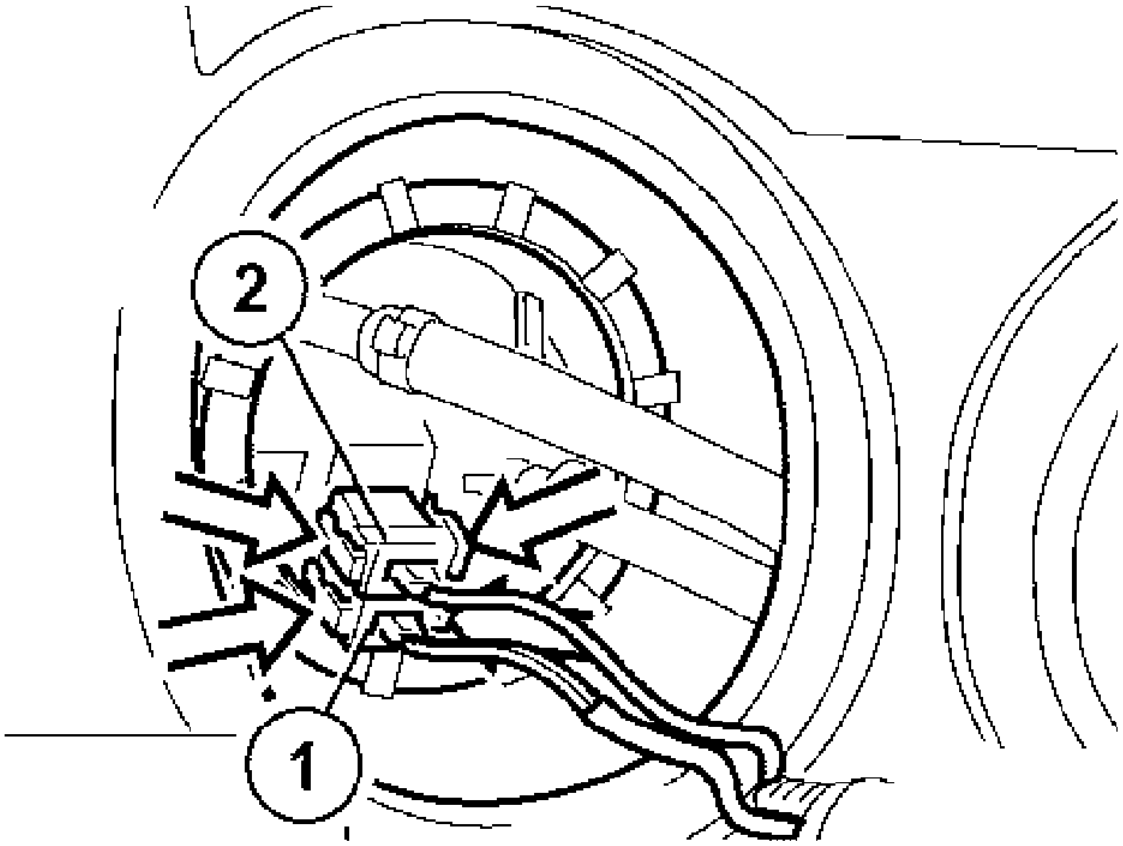
FUEL PUMP

Removal (6-Cylinder)

1. Fuel pump is integral with right fuel level sensor. Siphon out as much fuel as possible from fuel tank. Remove passenger seat cushion (Z3) or rear seat cushion (all others). Remove or cut insulation mat along perforated line and fold open.
2. Remove fuel pump access cover (if equipped). Press Green unlocking ring and detach fuel delivery hose (M3), or mark fuel hoses for installation reference and disconnect hoses (all others). Disconnect electrical connectors. See Fig. 101. Loosen screw cap with Special Tool (161020). Remove screw cap and sealing ring. See Fig. 102. Remove fuel pump assembly.

Installation

Ensure height sensor is pressed onto inside face of fuel baffle. Rotate screen and float into fuel tank. Ensure marker rib on fuel pump unit aligns with mark on fuel tank. See Fig. 103 and Fig. 104 . Install new sealing ring. Tighten screw cap. To complete installation, reverse removal procedure.



1. Fuel Pump Connector
2. Fuel Level Sensor Connector

G00125083

Fig. 101: Disconnecting Electrical Connectors (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

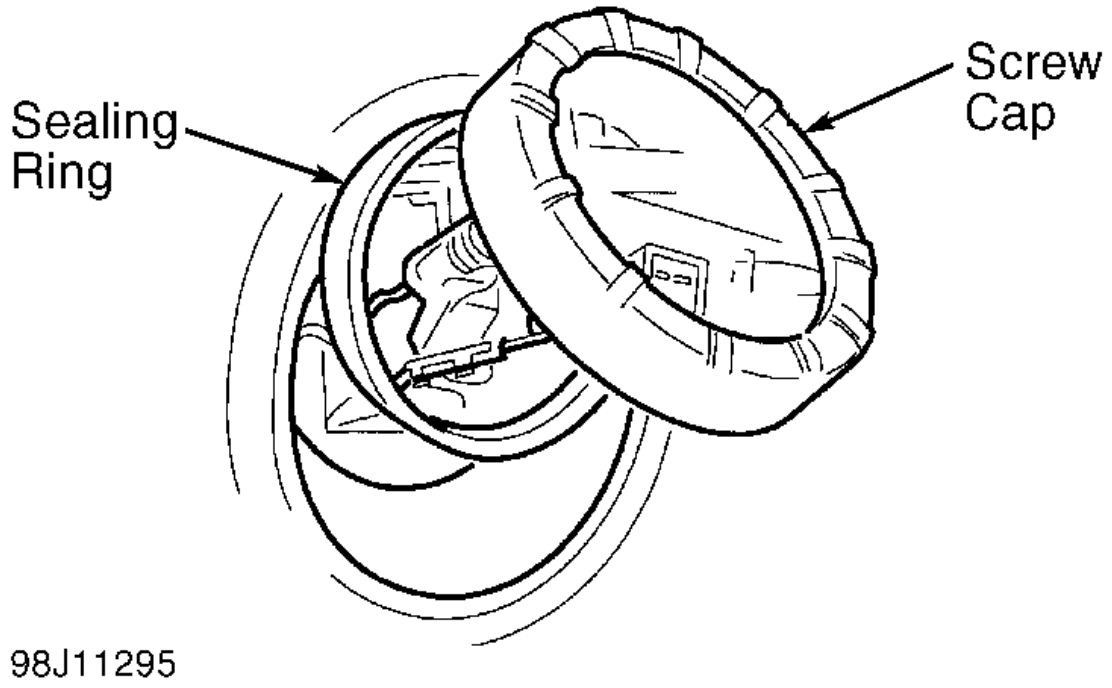


Fig. 102: Removing Screw Cap & Sealing Ring (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

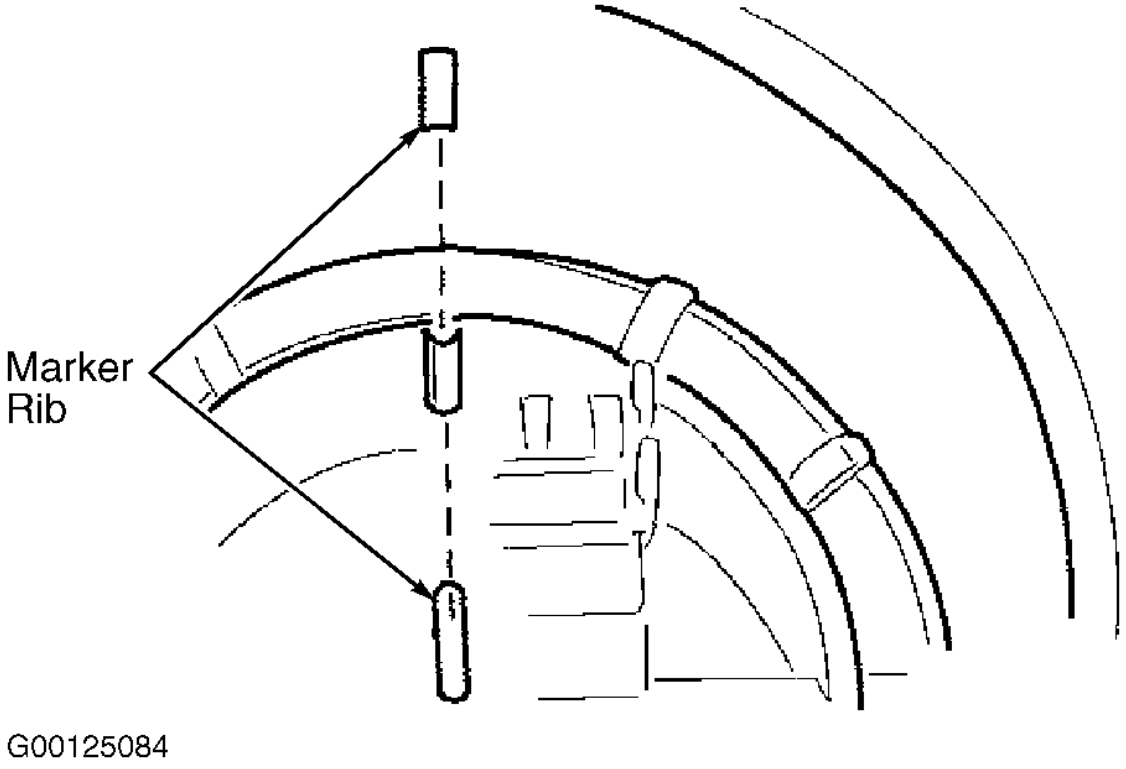


Fig. 103: Identifying Marker Rib (Right Unit) (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

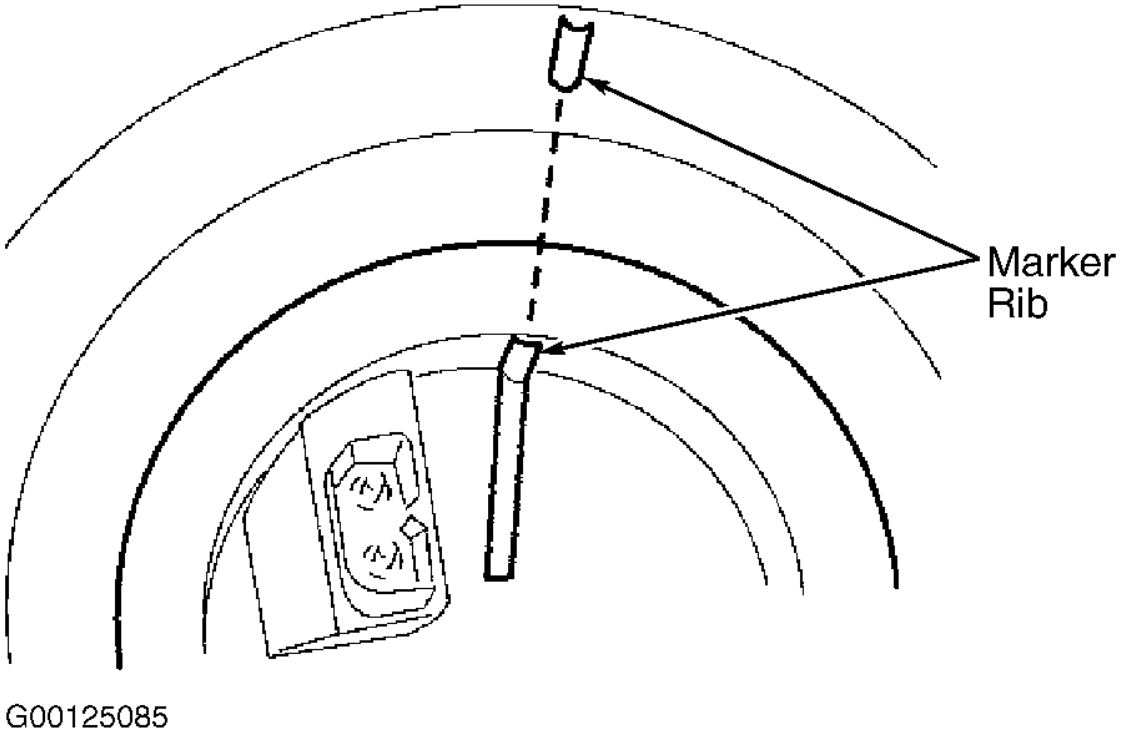


Fig. 104: Identifying Marker Rib (Left Unit) (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal (V8 & V12)

1. Siphon out as much fuel as possible from fuel tank. Remove rear seat. Remove or cut insulation mat along perforated line and fold open. Remove rubber grommet. See Fig. 105. Remove fuel pump/sending unit cover. Disconnect electrical connector.
2. Disconnect fuel line. See Fig. 106. Remove 8 lid nuts. Lift up lid as far as possible and swing it upward. Compress retaining hook on fuel pump Black housing. Remove fuel pump from fuel baffle White housing. Remove fuel pump and sender. See Fig. 107. Remove fuel pump from sender. Remove hose clamp and carefully remove spiral hose. Remove fuel pump.

Installation

1. To prevent torsional stress, align connector hose and cable between lid and fuel pump. See Fig. 108. Install unit in fuel tank, ensuring both retaining hooks are aligned.
2. Ensure "O" ring is correctly aligned on intake neck. Install lid and tighten 8 screws in a crosswise pattern. To complete installation, reverse removal procedure.

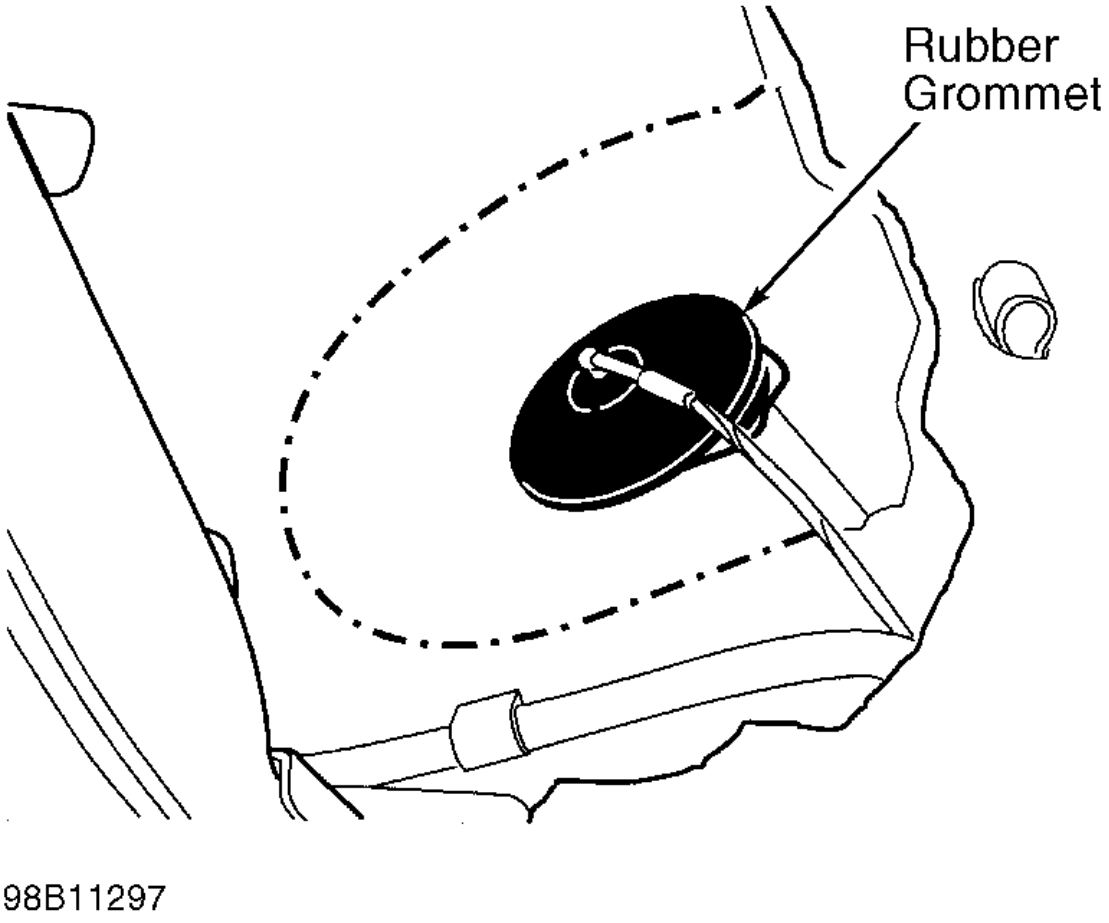


Fig. 105: Removing Rubber Grommet (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

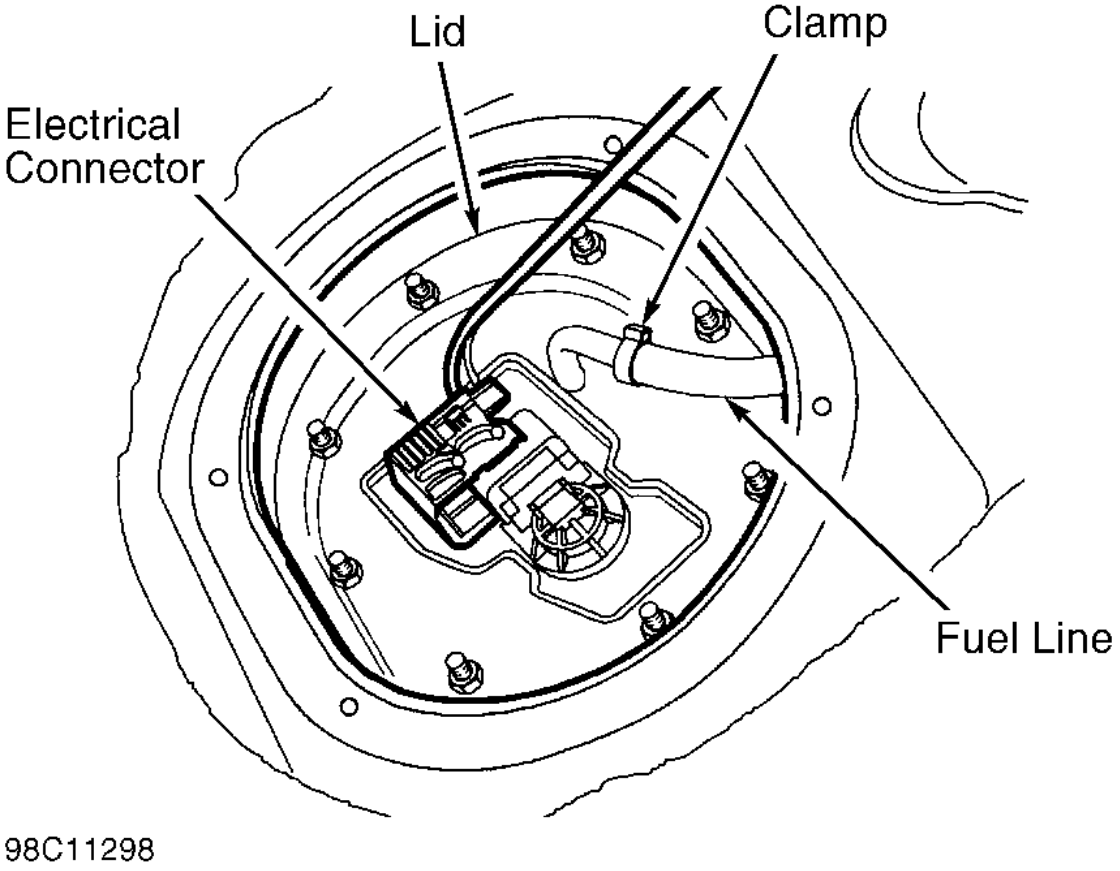


Fig. 106: Disconnecting Fuel Line (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

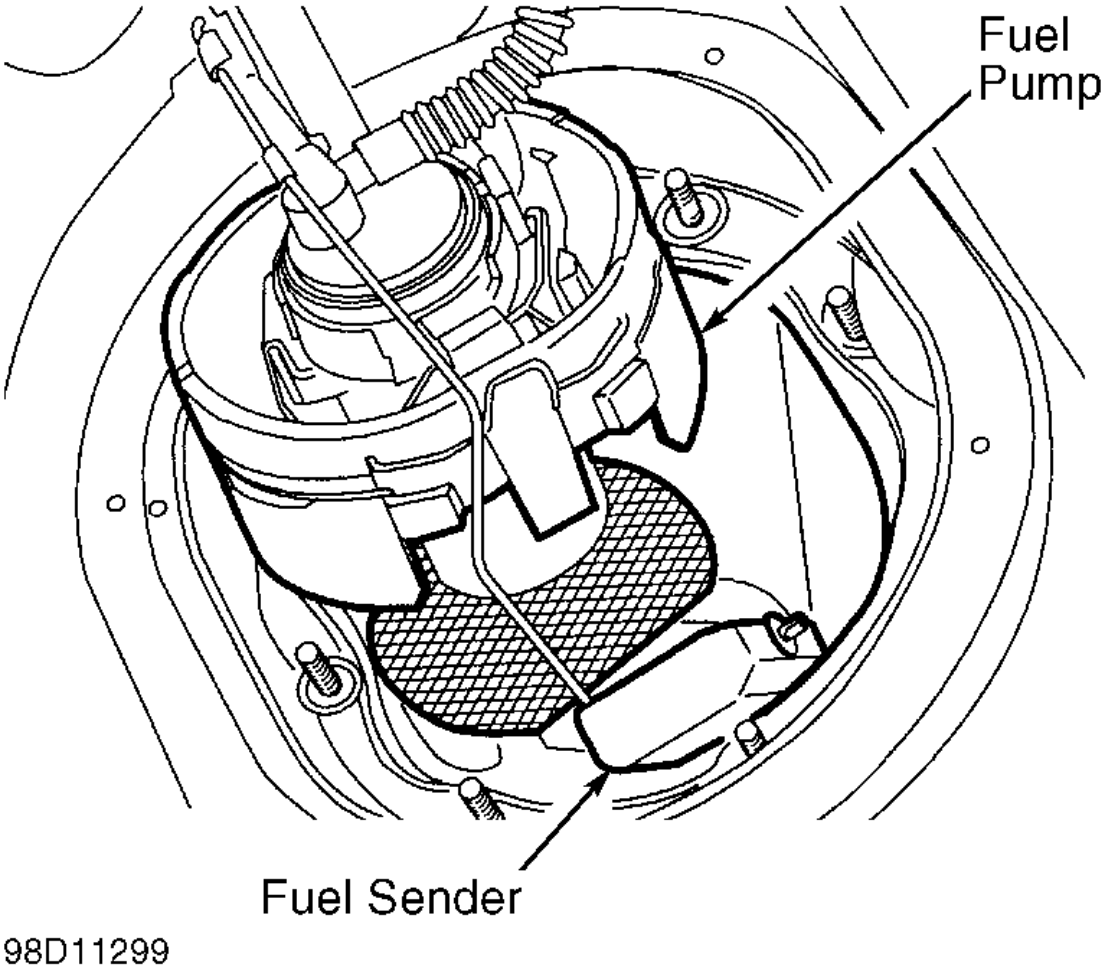


Fig. 107: Removing Fuel Pump & Sender (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

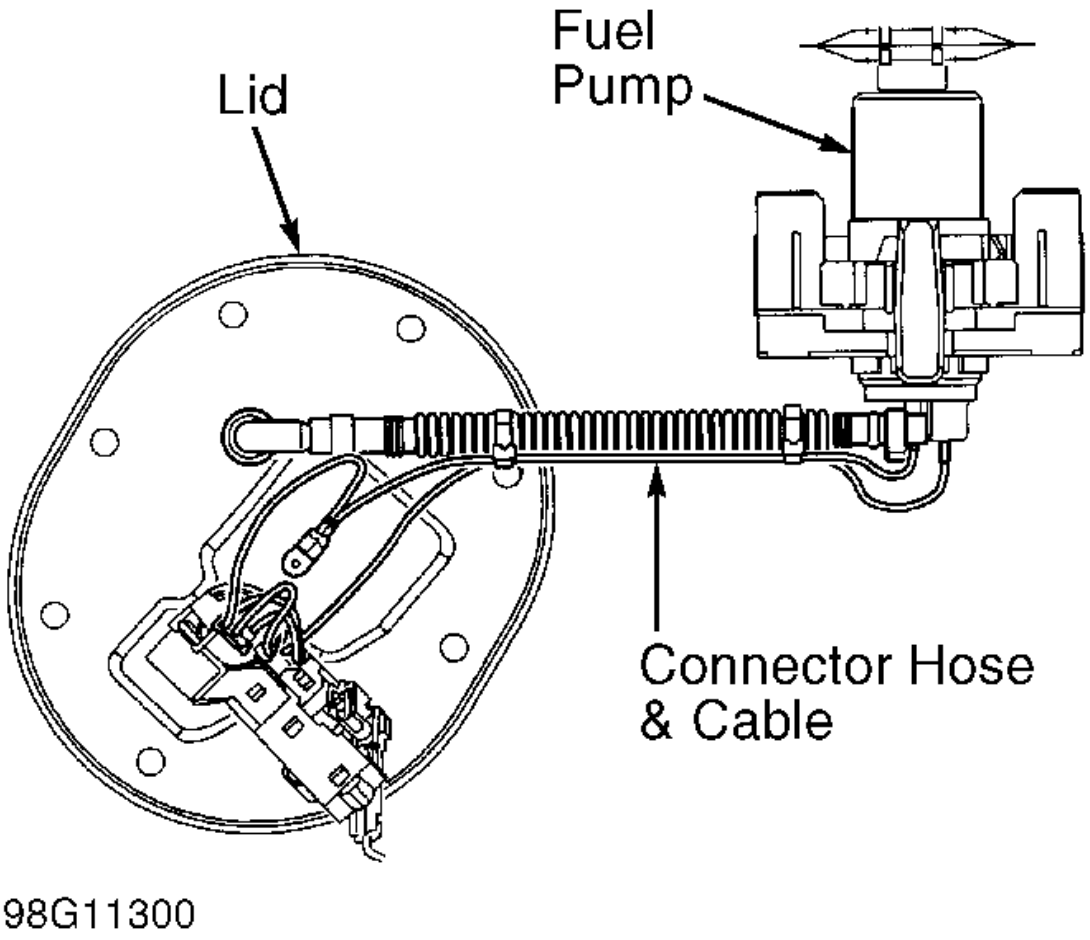


Fig. 108: Aligning Connector Hose & Cable Between Lid & Fuel Pump (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL PRESSURE REGULATOR

Removal & Installation (6-Cylinder)

NOTE: Fuel pressure regulator for 6-cylinder vehicles may be installed on fuel rail (type 1) or under vehicle (type 2).

Fuel pressure regulator is located on fuel rail. Open wire conduit on lower section of microfilter housing on cowl. Carefully feed wiring out of conduit. Remove 4 screws from microfilter housing. Remove lower section of microfilter housing. See Fig. 109. Remove engine cover. Disconnect vacuum hose from fuel pressure regulator. Note position of vacuum connector on fuel pressure regulator. Remove circlip. Remove fuel pressure regulator. To install, reverse removal procedure. Ensure lug on circlip engages in slot on injector fuel rail.

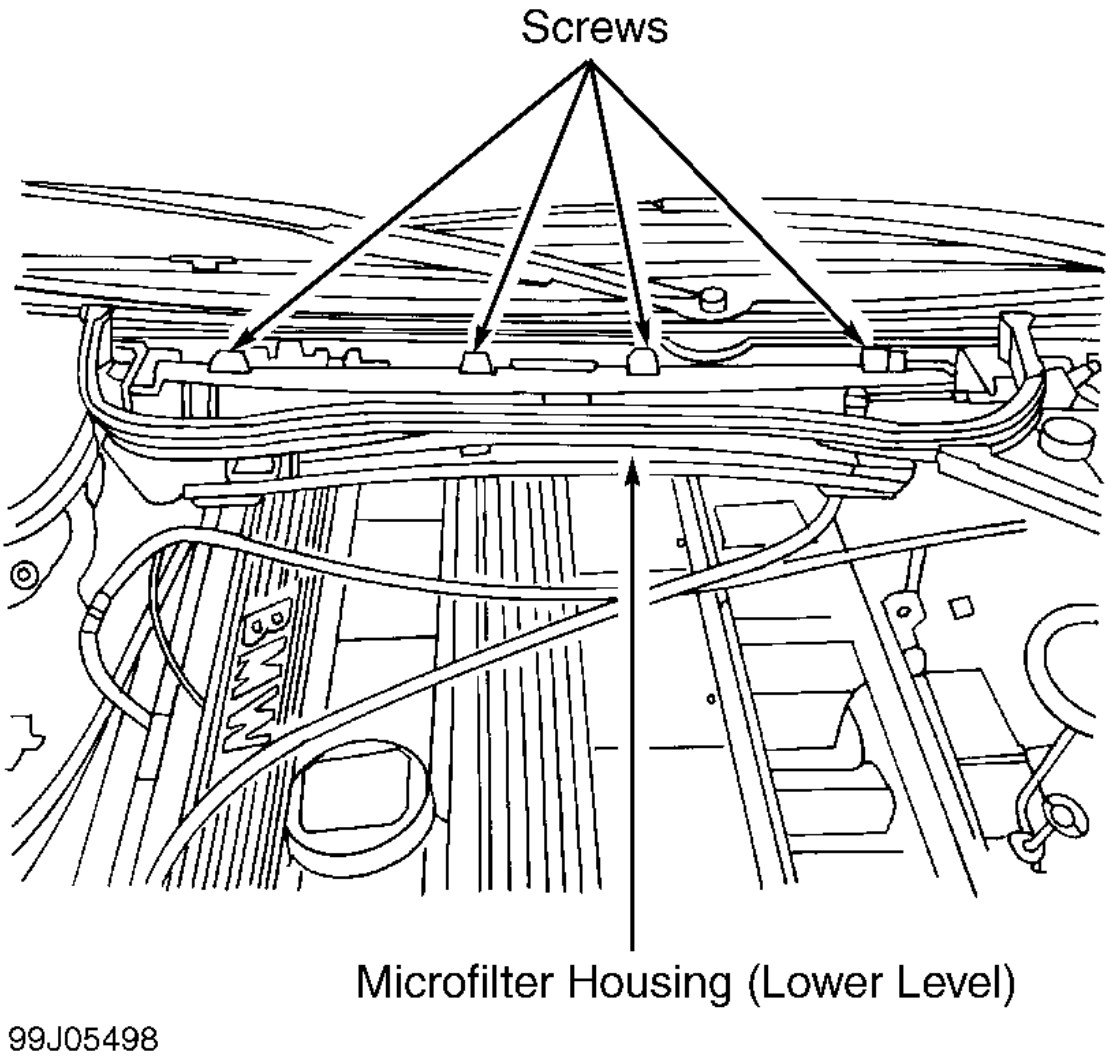


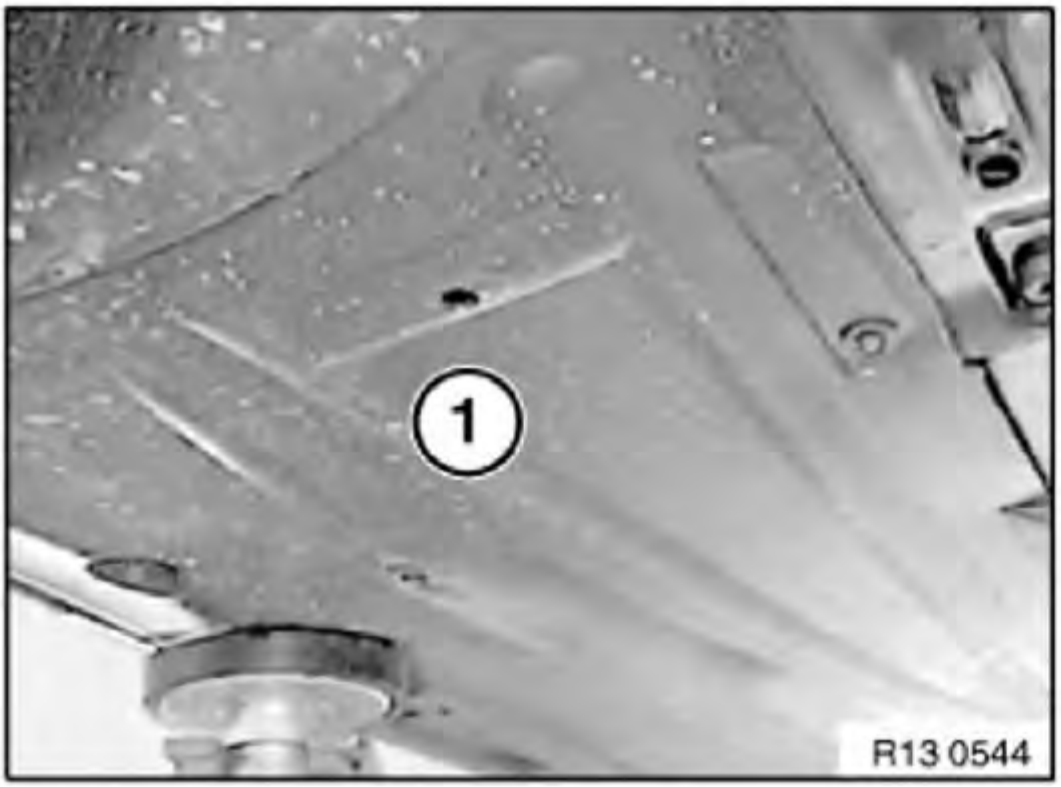
Fig. 109: Removing Microfilter Housing Cover (3-Series E46)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8)

1. Fuel pressure regulator is located at rear of intake manifold. Remove engine cover. See Fig. 34. Remove coolant expansion tank and BMW diagnostic connector (if necessary). Disconnect vacuum hose from pressure regulator. Remove circlip and pull pressure regulator out of fuel rail.
2. To install, reverse removal procedure. Replace "O" rings on regulator and lubricate with petroleum jelly. Install regulator in fuel rail. Compress circlip and engage tabs of circlip into fuel rail.

Removal & Installation (V12)

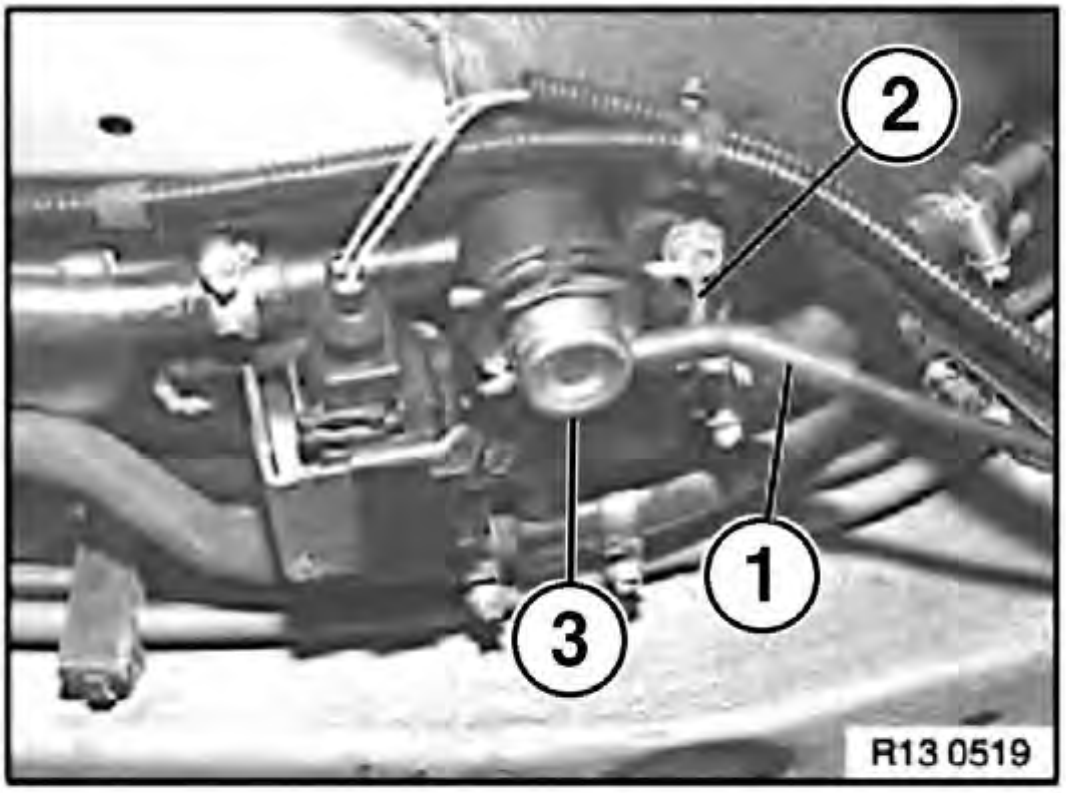
Release screws and clips on cover on underbody on passenger side. See Fig. 110. Remove cover. Catch and dispose of escaping fuel. Pull off vacuum hose. Pull out locking bracket. Remove fuel pressure regulator. See Fig. 111. To install, reverse removal procedure.



1. Underbody Cover

G00125139

Fig. 110: Removing Underbody Cover (7-Series)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Vacuum Hose
2. Locking Brackets
3. Pressure Regulator

G00125147

Fig. 111: Removing Pressure Regulator (7-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL RAIL & INJECTORS

Removal & Installation (3-Series - Z3)

1. Remove engine cover. See Fig. 34. Loosen hose clamp and disconnect fuel supply hose from fuel rail. Remove 2 bolts and pull connector plate off fuel injectors. See Fig. 113. Remove 4 bolts and disconnect fuel rail. Pull up on fuel rail and injectors.
2. Remove retainer from top of fuel injector. Remove fuel injector(s). To install, reverse removal procedure. Coat injector "O" rings with petroleum jelly.

Removal & Installation (3-Series - E46)

1. Open wire conduit on lower section of microfilter housing on cowl. Carefully feed wiring out of conduit. Remove 4 screws from microfilter housing. See Fig. 109. Remove lower section of microfilter housing. Remove engine cover. Disconnect low pressure hose from fuel pressure regulator valve. Disconnect intake air temperature sensor connector. Disconnect fuel injector terminal strip.

NOTE: Mark HO2S connectors and fuel lines for reassembly reference.

2. Unclip HO2S connectors from retainers. Disconnect HO2S connectors. Remove electrical plug retainers from injection block. Release fuel system pressure See FUEL SYSTEM PRESSURE RELEASE. Disconnect fuel lines at rear of cylinder head. Remove injection pipe screws. Remove injection pipe with fuel injectors.
3. Remove tab washer at fuel injector. Remove fuel injectors from injection pipe. To install, reverse removal

procedure. Coat injector "O" rings with petroleum jelly.

Removal & Installation (V8)

1. Release fuel system pressure. See FUEL SYSTEM PRESSURE RELEASE. Remove engine cover. See Fig. 34. Disconnect throttle cable at throttle body. Disconnect ignition coils and fuel injectors.
2. Disconnect fuel lines from fuel rail. Remove fuel rail mounting screws and pull off fuel rail with injectors. Remove retainer from top of fuel injector. Remove fuel injector(s). To install, reverse removal procedure. Coat injector "O" rings with petroleum jelly.

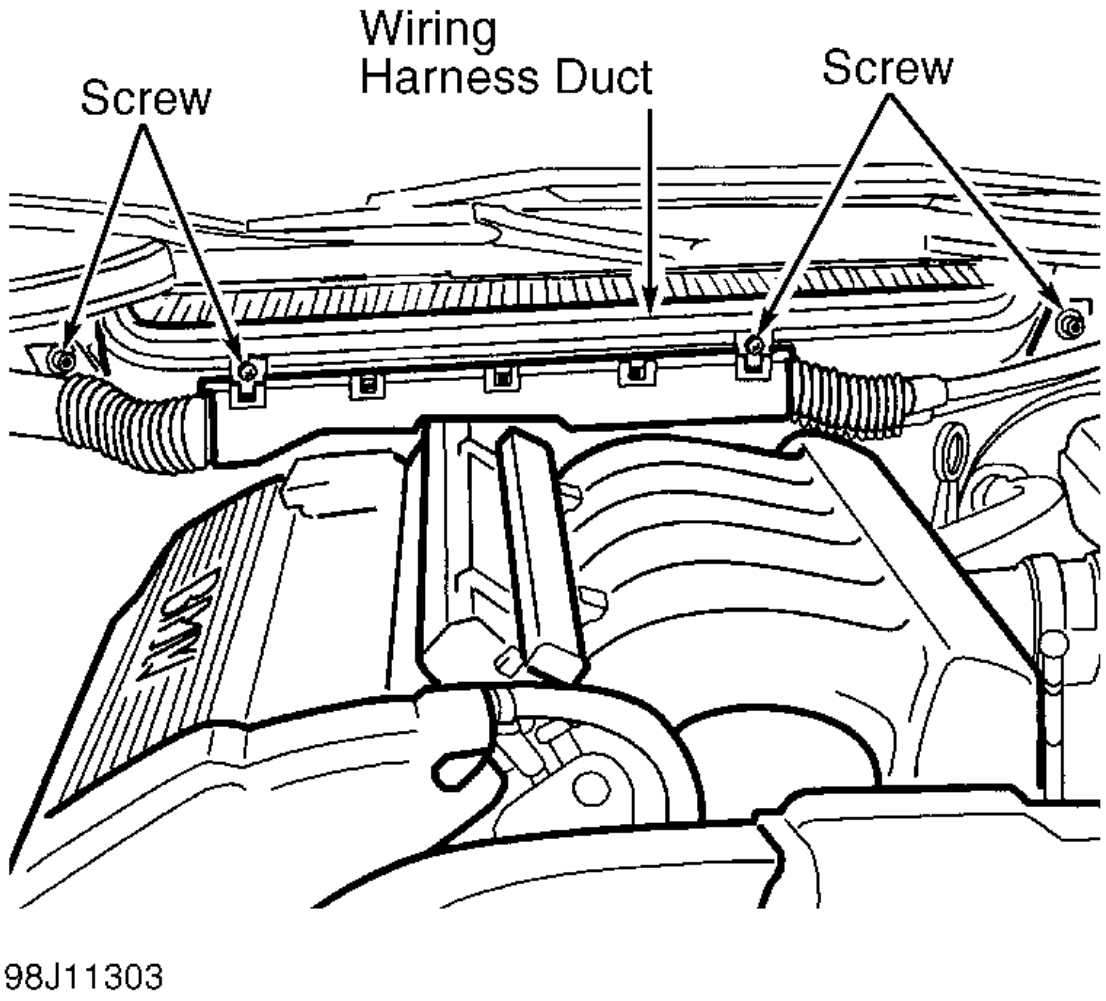


Fig. 112: Removing Wiring Harness Duct
Courtesy of BMW OF NORTH AMERICA, INC.

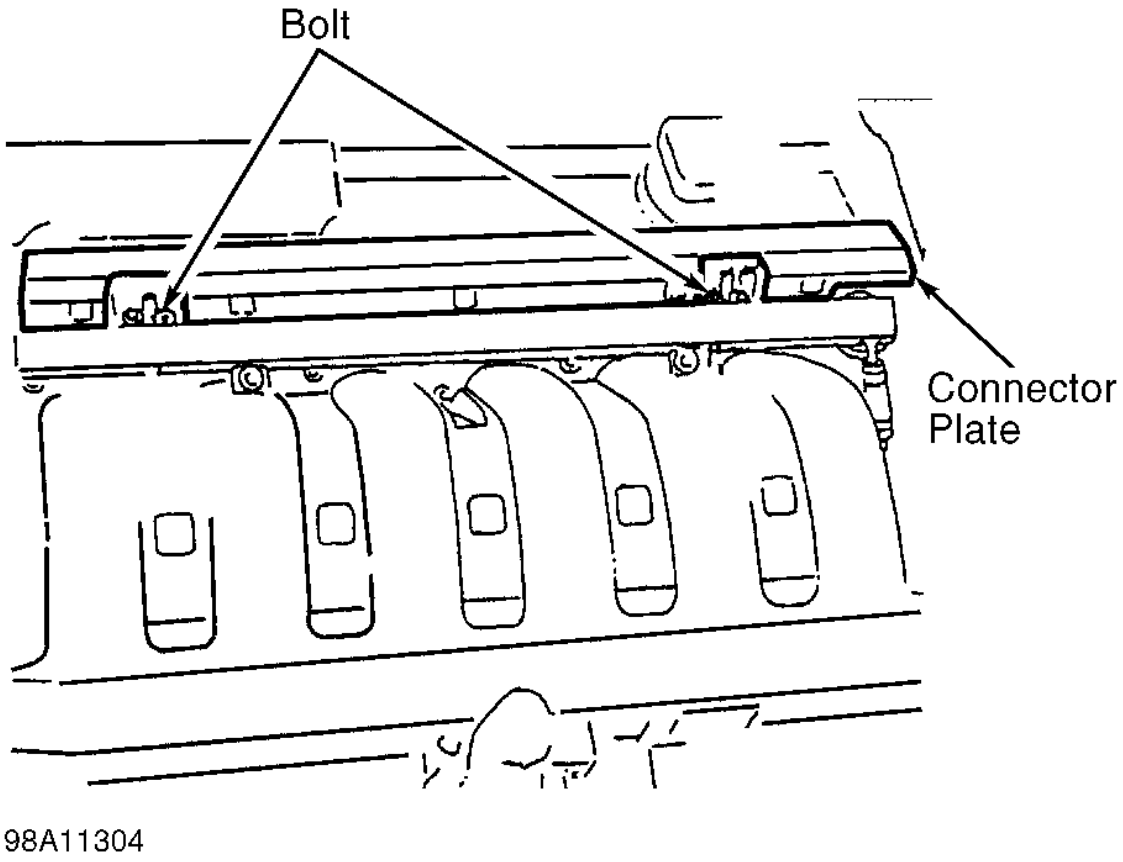
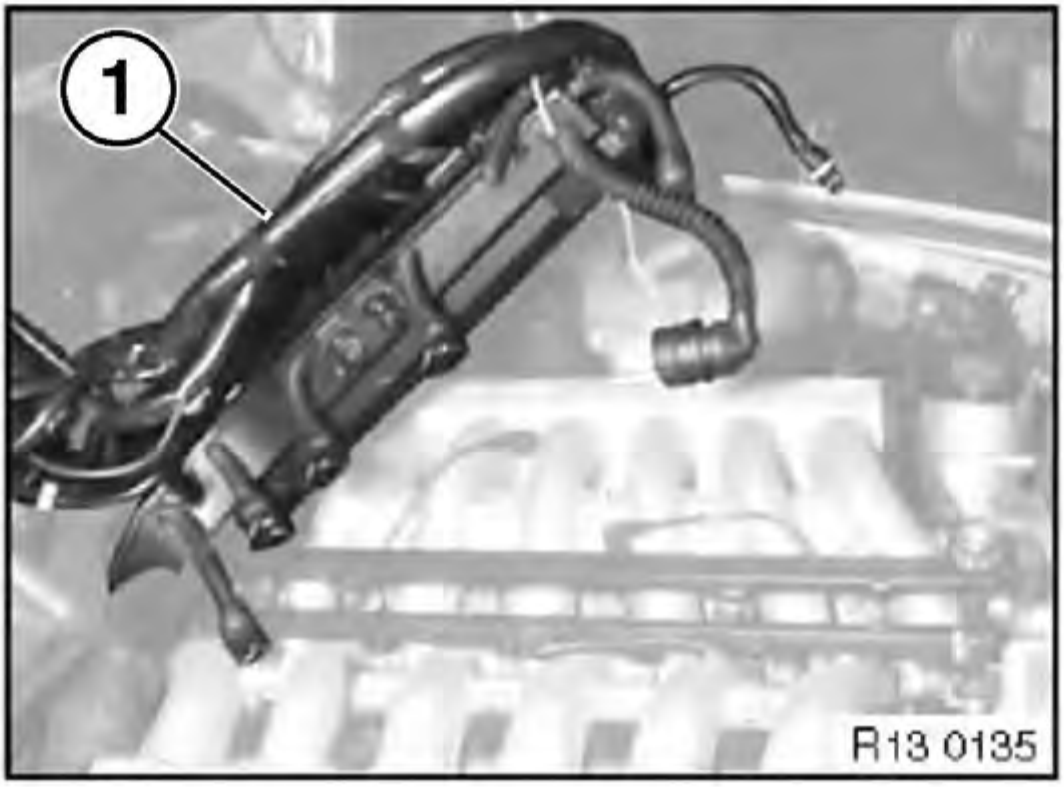


Fig. 113: Removing Connector Plate
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

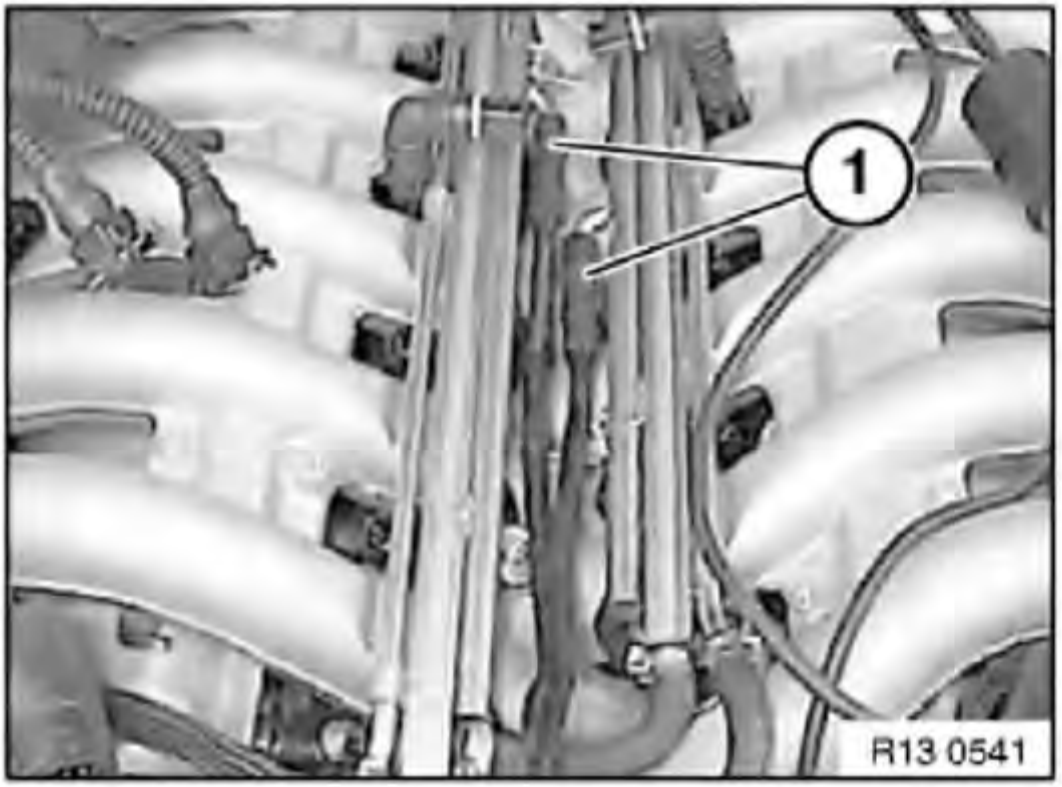
Turn ignition off. Remove wiring harness on engine. Lift harness upward and secure to hood. Pull supply air hoses for air-contained injection valves off injection valve strips. Loosen hose clips and pull off injection valve strips. Carefully pull off fuel hoses to release pressure. Catch escaping fuel in a container. Remove screws and injection valve strip with injection valves. Unclip and remove circlip. See Fig. 114-Fig. 118 . Remove injector valves. To install, reverse removal procedure. Check injector seals and replace as necessary. Coat seals with acid-free grease



1. Engine Wiring Harness

G00125159

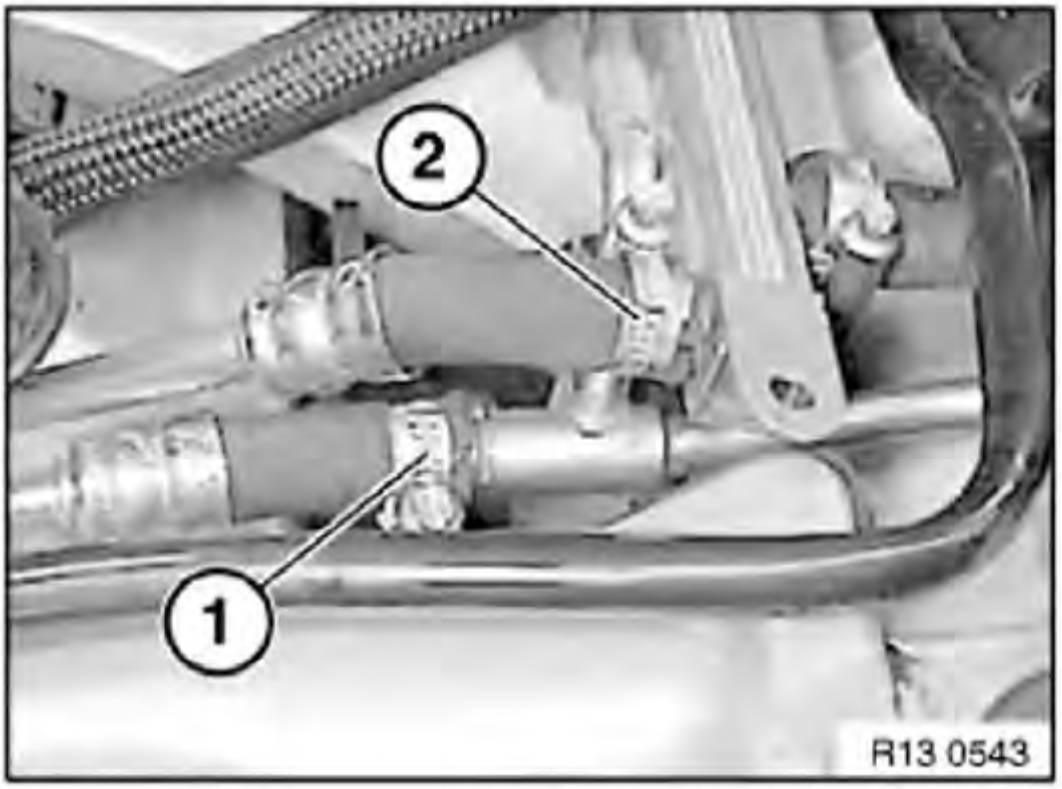
Fig. 114: Unfastening Engine Wiring Harness (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Supply Air Hoses

G00125160

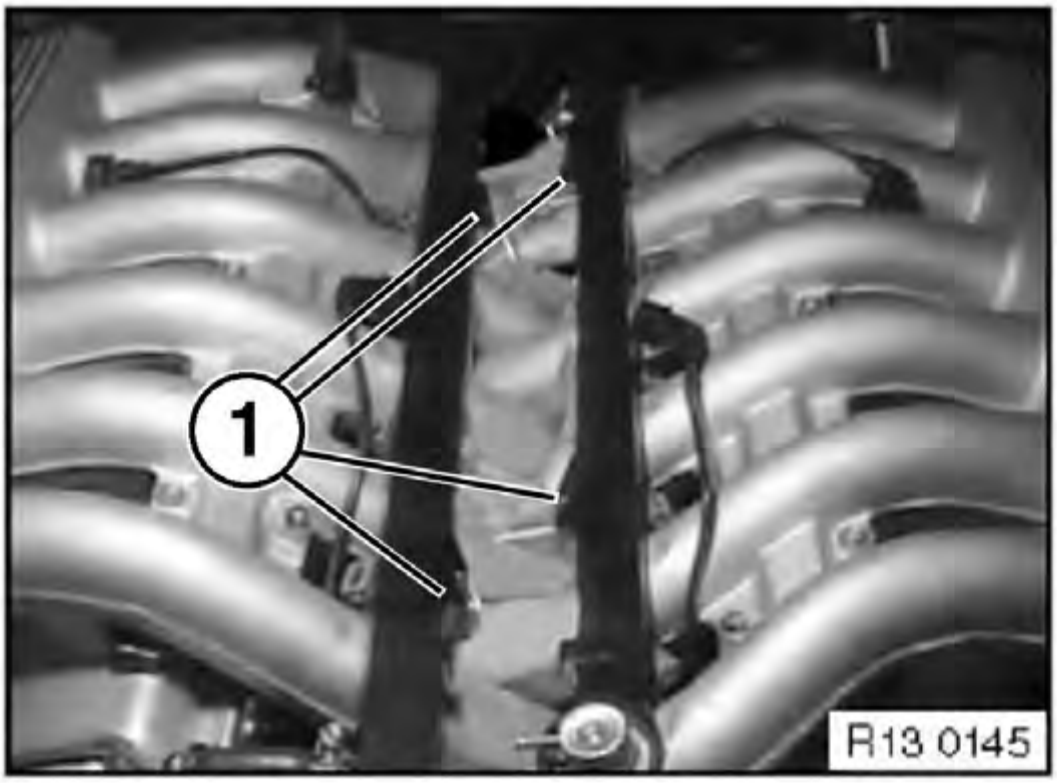
Fig. 115: Removing Supply Air Hoses (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Hose Clip
2. Hose Clip

G00125161

Fig. 116: Removing Injection Valve Strip Hose Clips (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Screws

G00125162

Fig. 117: Removing Injection Valve Strip Screws (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

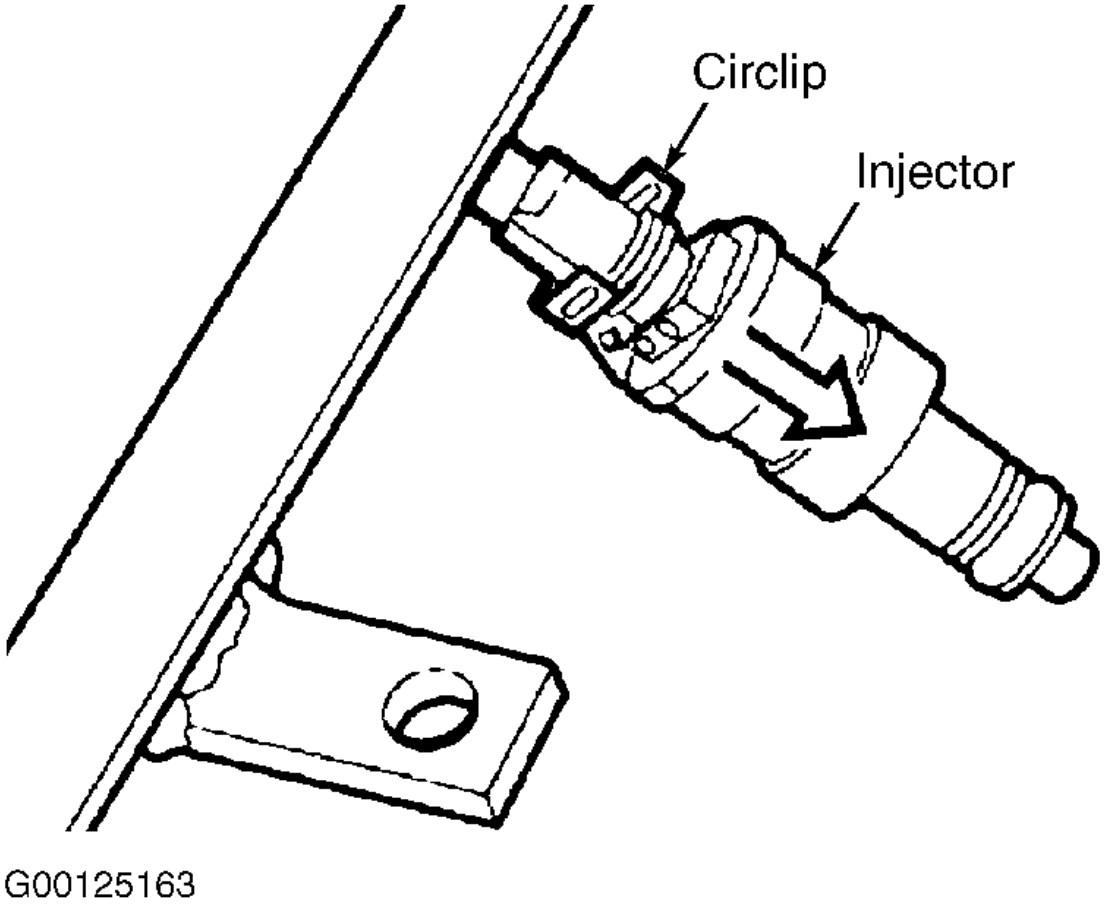
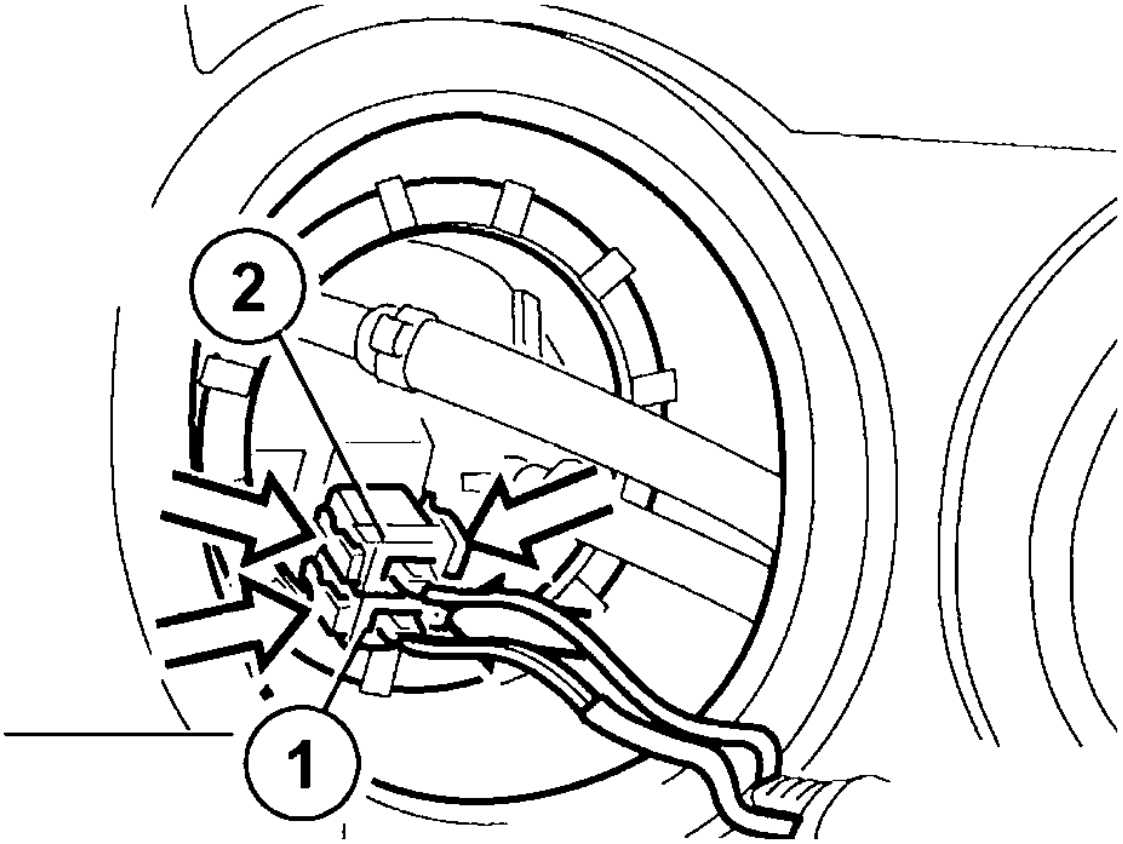


Fig. 118: Unclipping Injector Circlip (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL TANK

Removal & Installation (3-Series - Z3)

Remove fuel from fuel tank. On right tank section, disconnect fuel pump connection for fuel pump and fuel level sensor. On left tank section, disconnect fuel level sensor connection. Disconnect fuel return hose and tank compensating hose. Disconnect fuel hoses with special tool (13 3 010) and remove supply and return lines. Remove heat baffle plate screws. Remove heat baffle plate. Remove complete propeller shaft. Unfasten cable on handbrake lever. Press cable out of clips and pull through retaining brackets. Release hose clamp and remove fuel filler hose. Remove tank mounting screws, lower and remove tank. Disconnect tank vent pipe. Unclip vent pipe to carbon canister. Disconnect tank vent pipe. Disconnect filler vent pipe. Remove fuel tank. To install, reverse removal procedure. Replace all hose clamps. Install washers between retaining strap at right outside and crossmember (rear take-up) at front. See Fig. 119-Fig. 130 .



1. Fuel Pump Connector
2. Fuel Level Sensor Connector

G00125068

Fig. 119: Disconnecting Fuel Tank Connectors (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

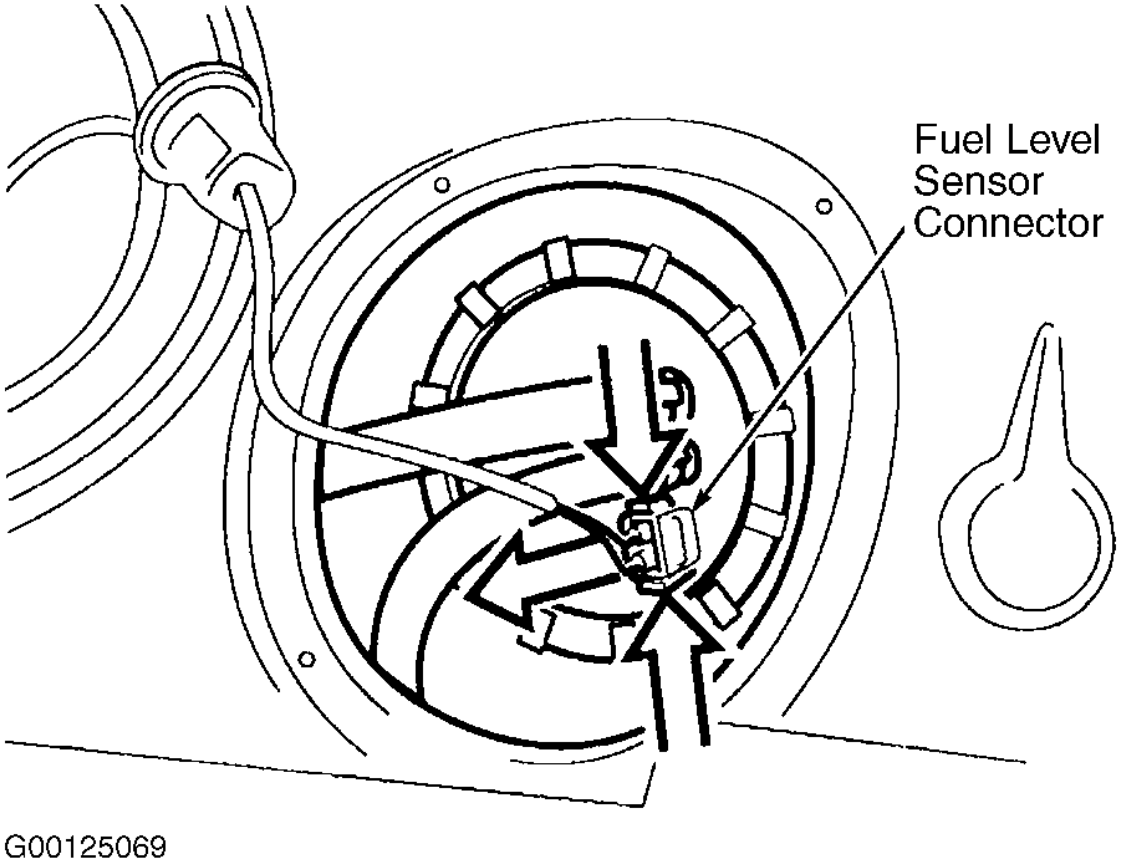
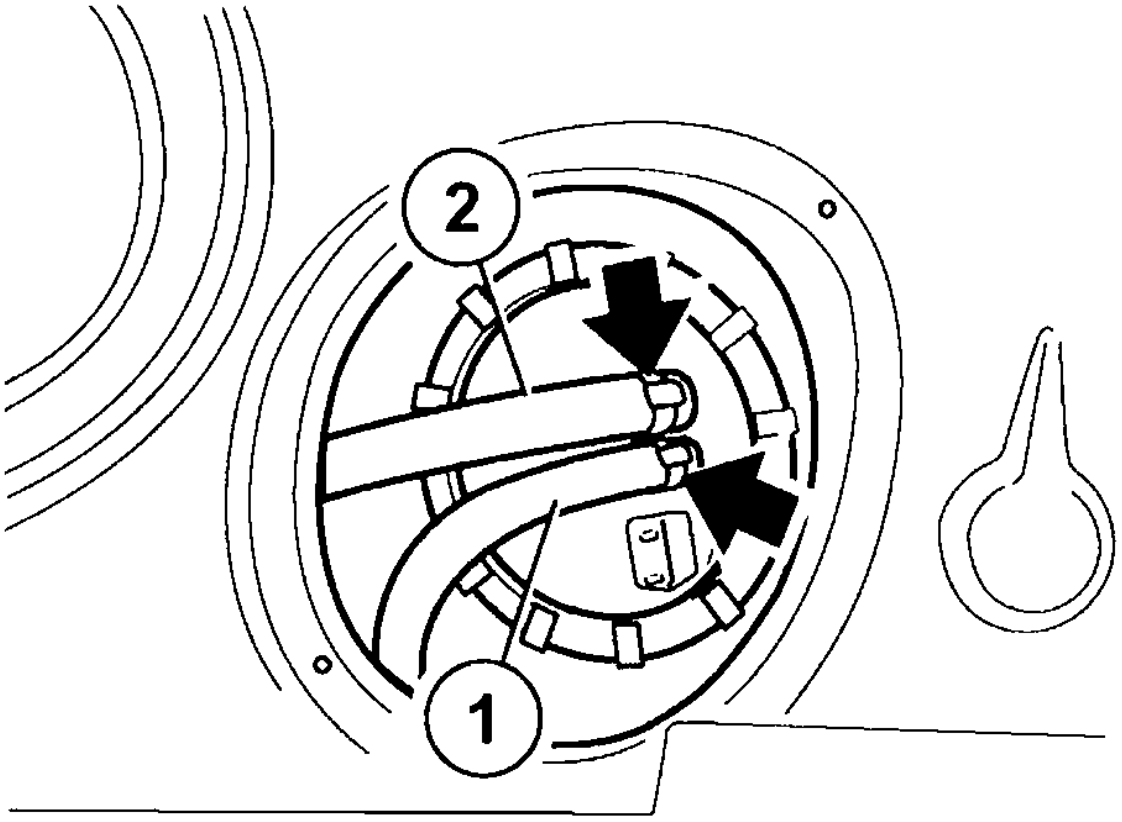


Fig. 120: Disconnecting Left Tank Section Fuel Level Sensor (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Fuel Return Hose
2. Tank Compensating Hose

G00125070

Fig. 121: Disconnecting Left Tank Section Fuel Return Hose & Tank Compensating Hose (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

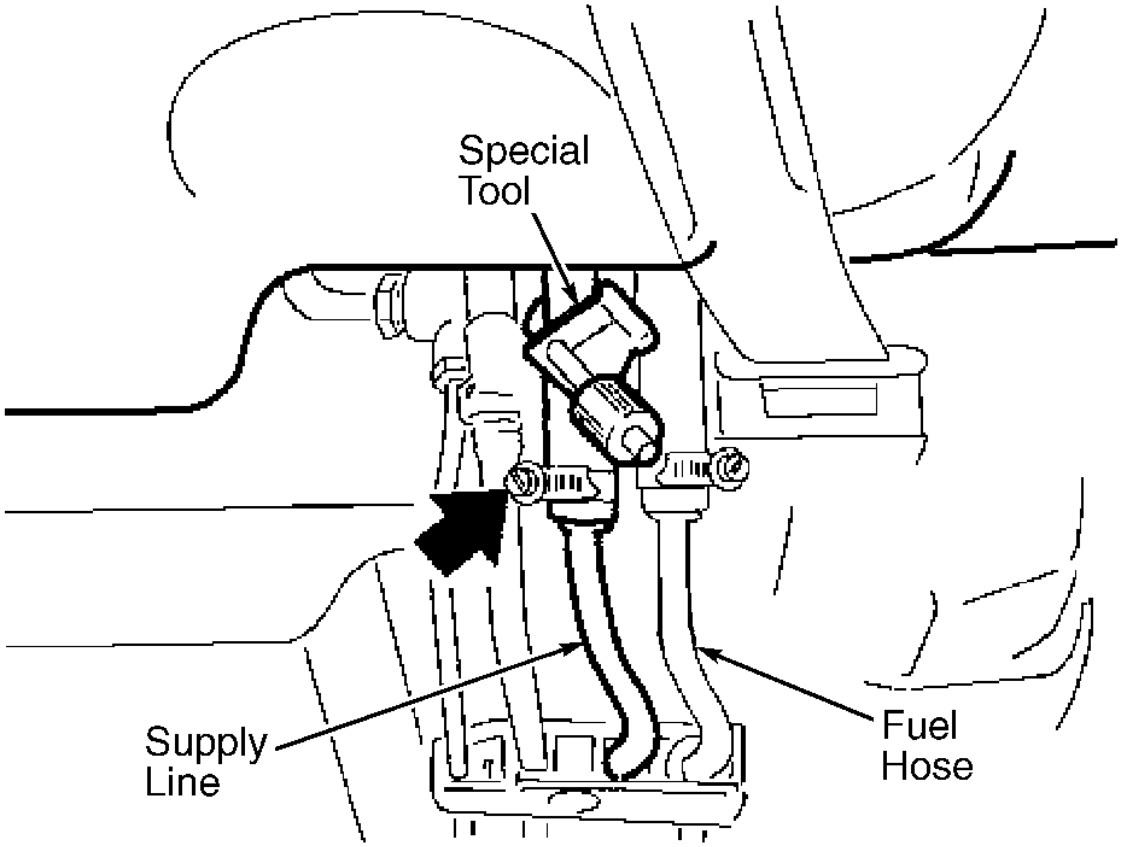


Fig. 122: Removing Supply Line & Fuel Hose (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

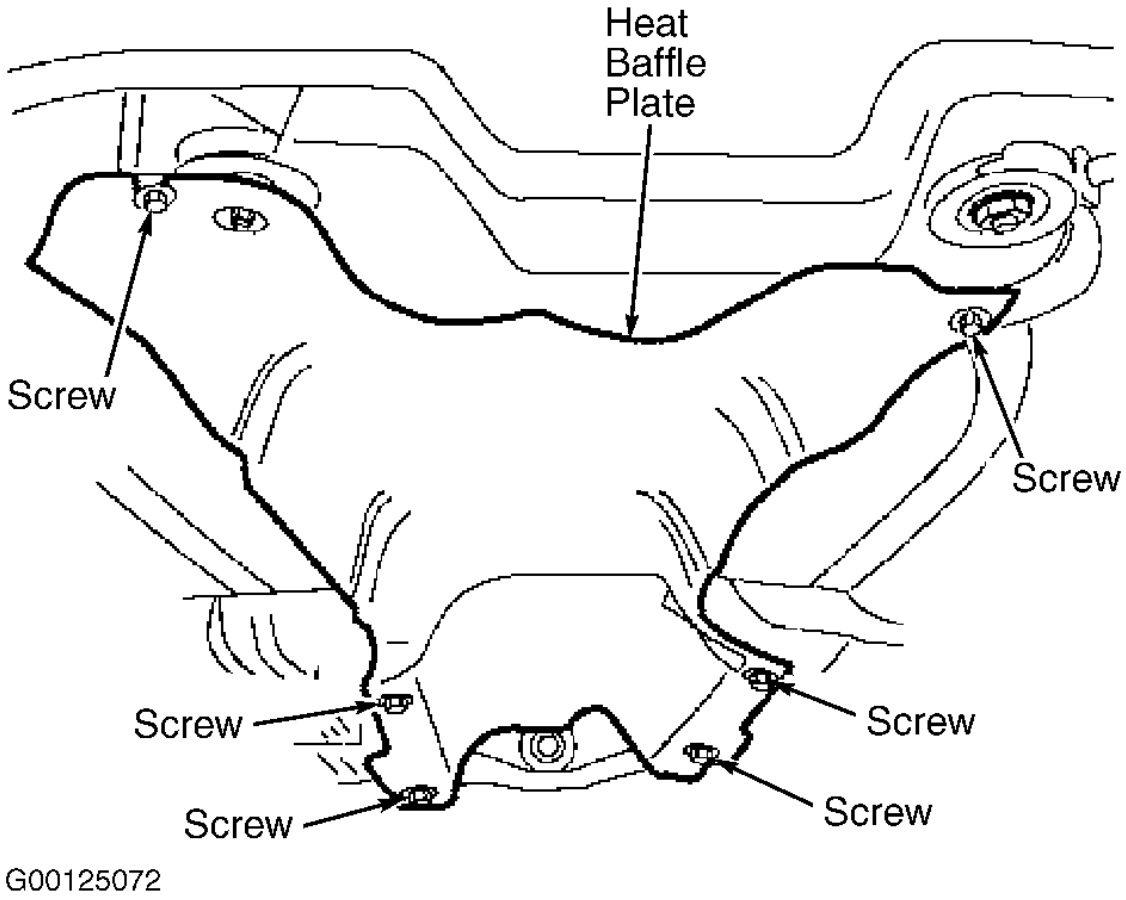


Fig. 123: Removing Heat Baffle Plate (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

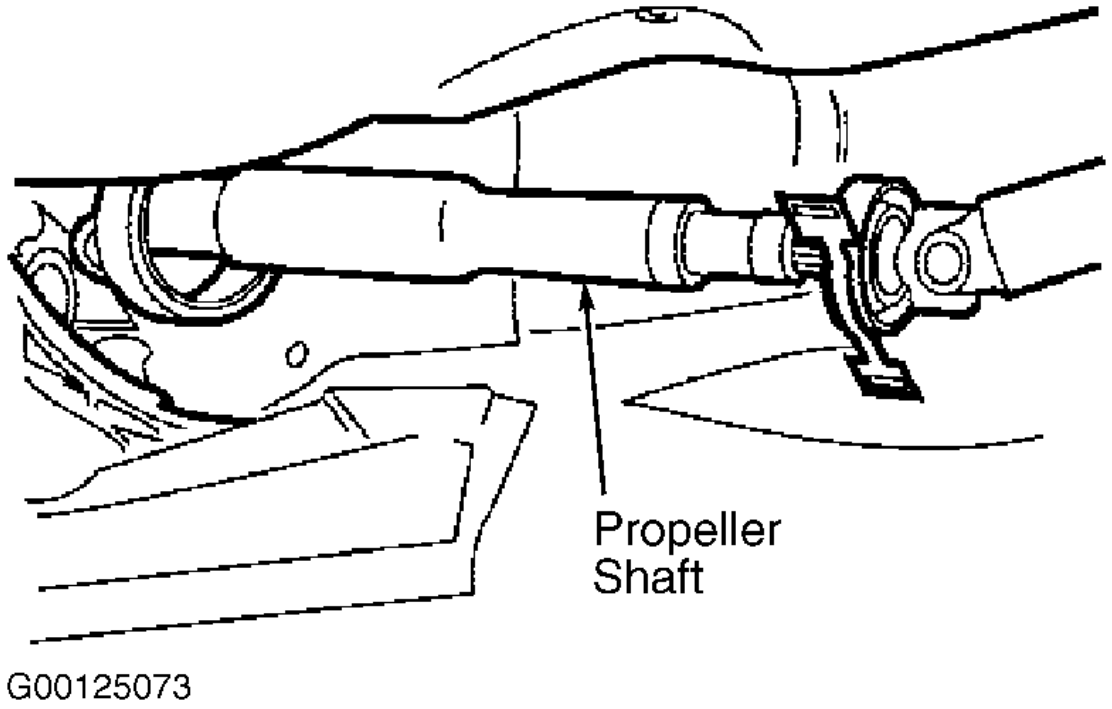


Fig. 124: Removing Propeller Shaft (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

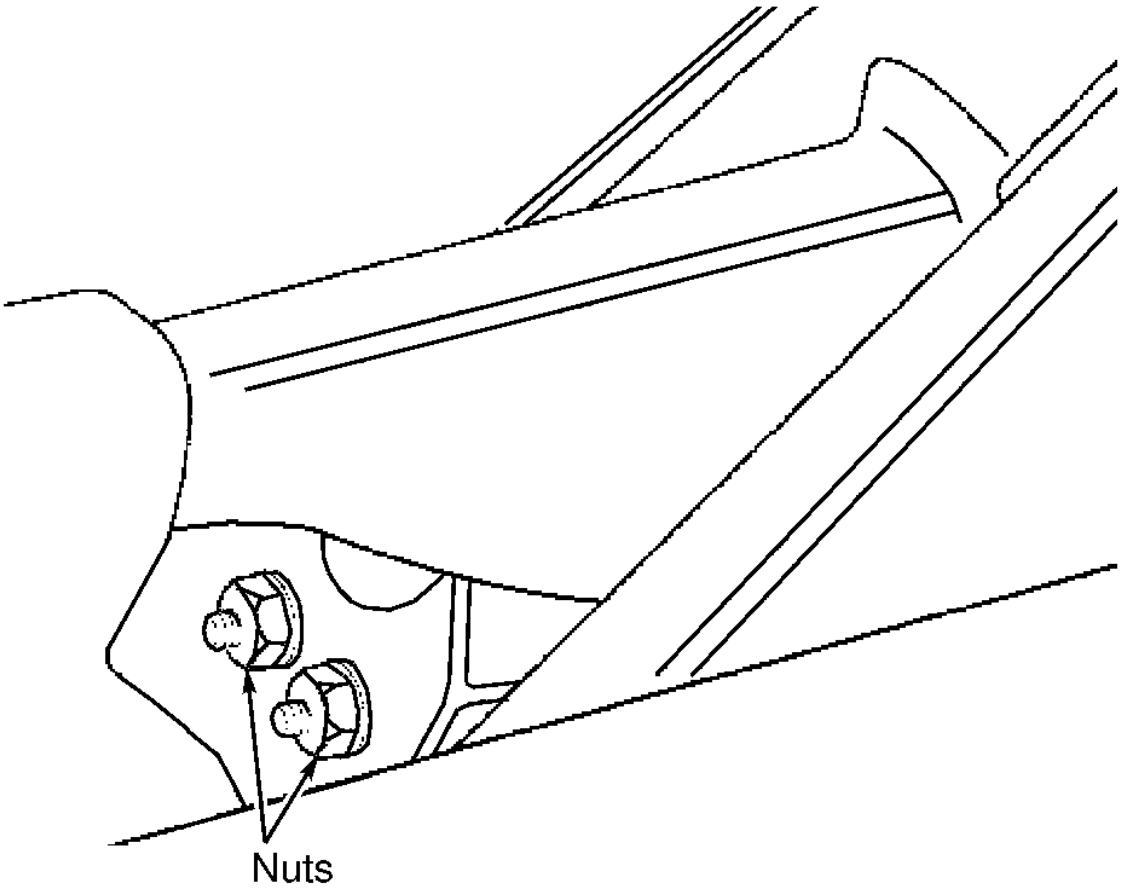


Fig. 125: Unfastening Bowden Cable On Handbrake Lever (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

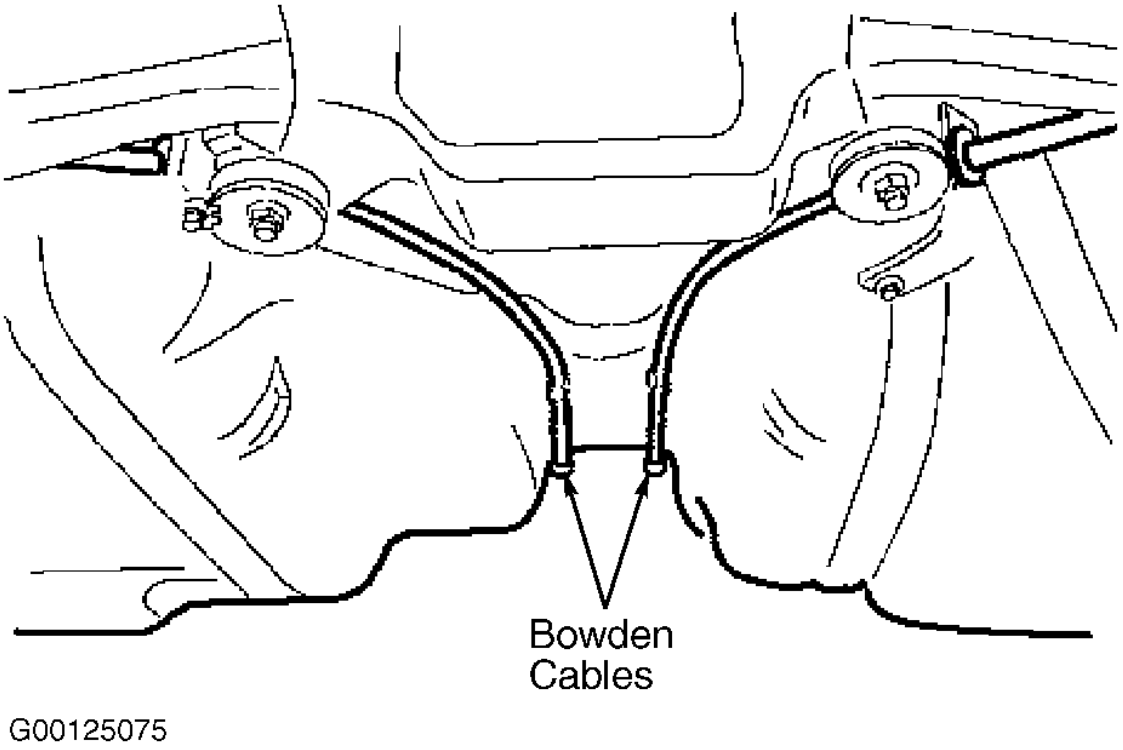


Fig. 126: Pressing Bowden Cable From Clips (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

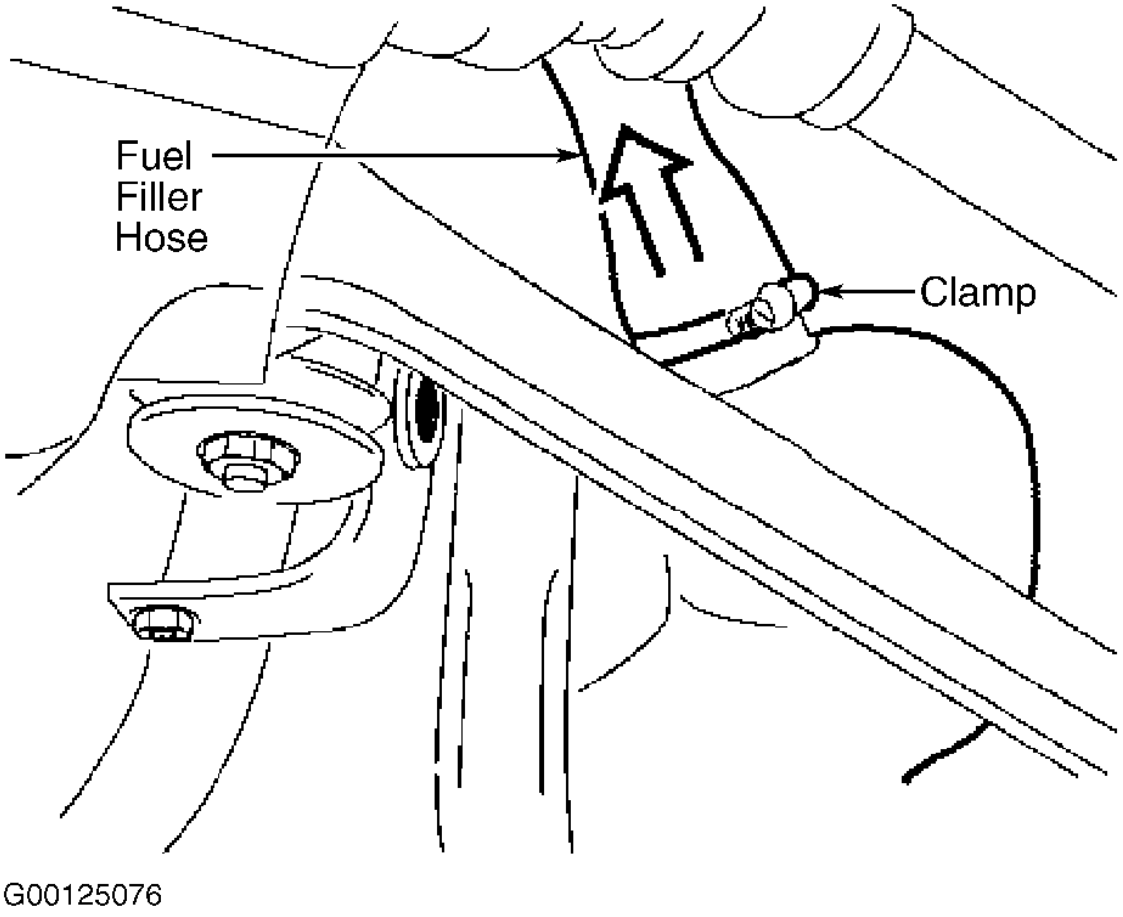


Fig. 127: Removing Clamp & Fuel Filler Hose (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

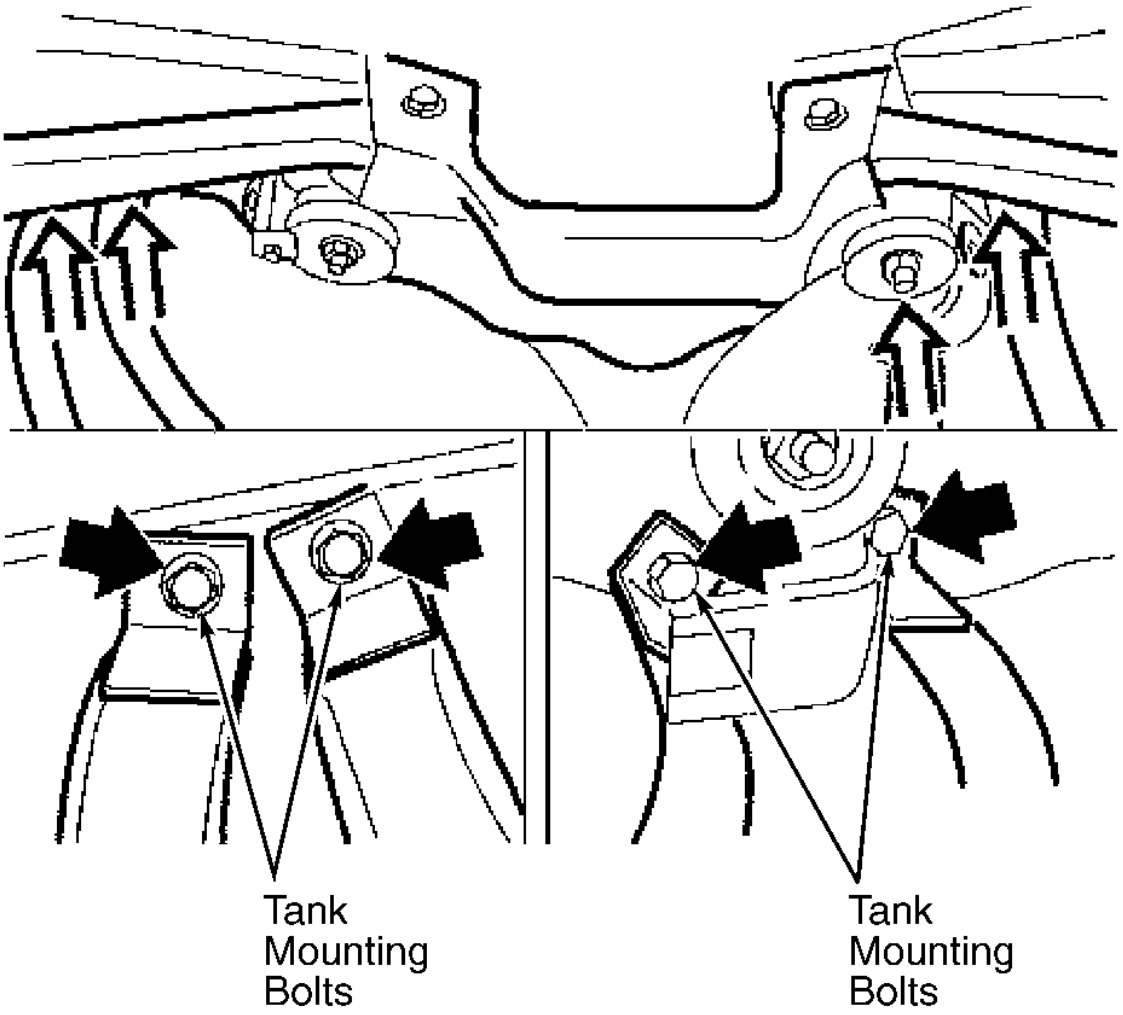


Fig. 128: Removing Tank Mounting Bolts (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

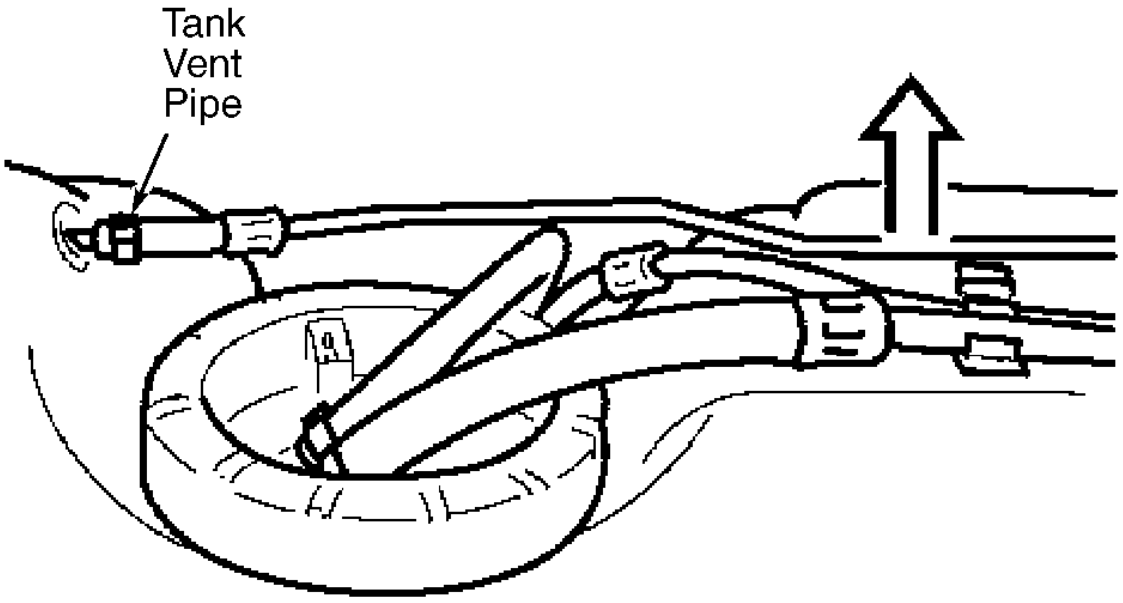


Fig. 129: Disconnecting Tank Vent Pipe (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

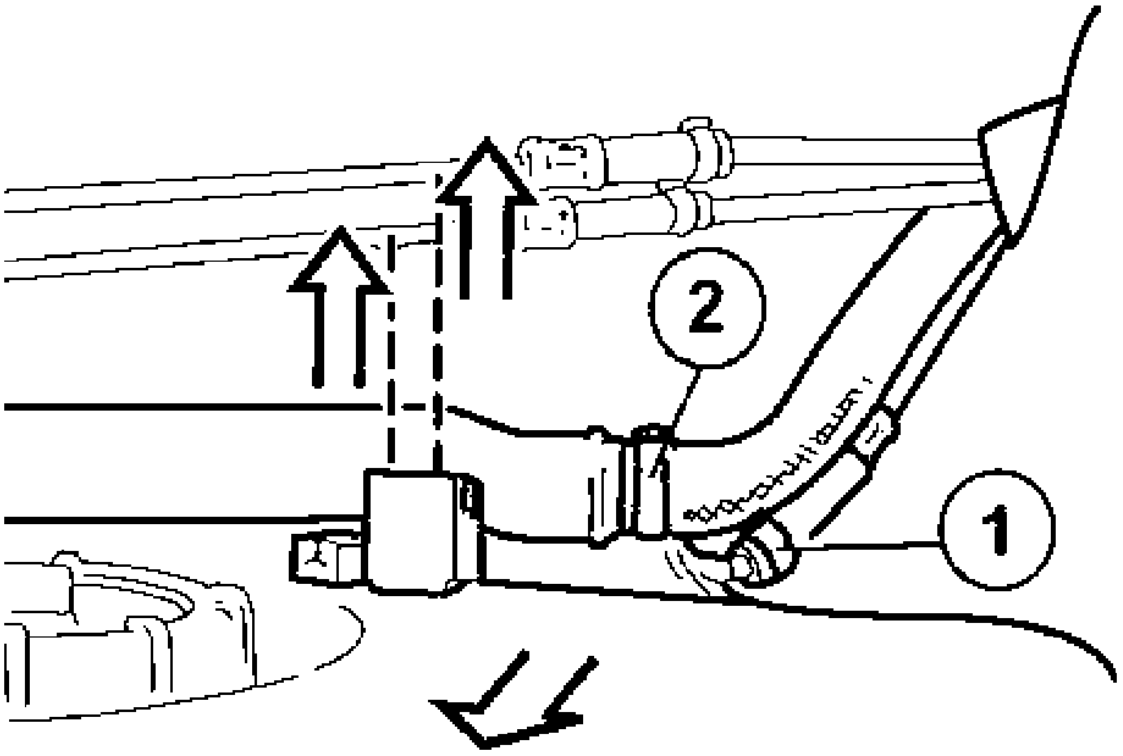
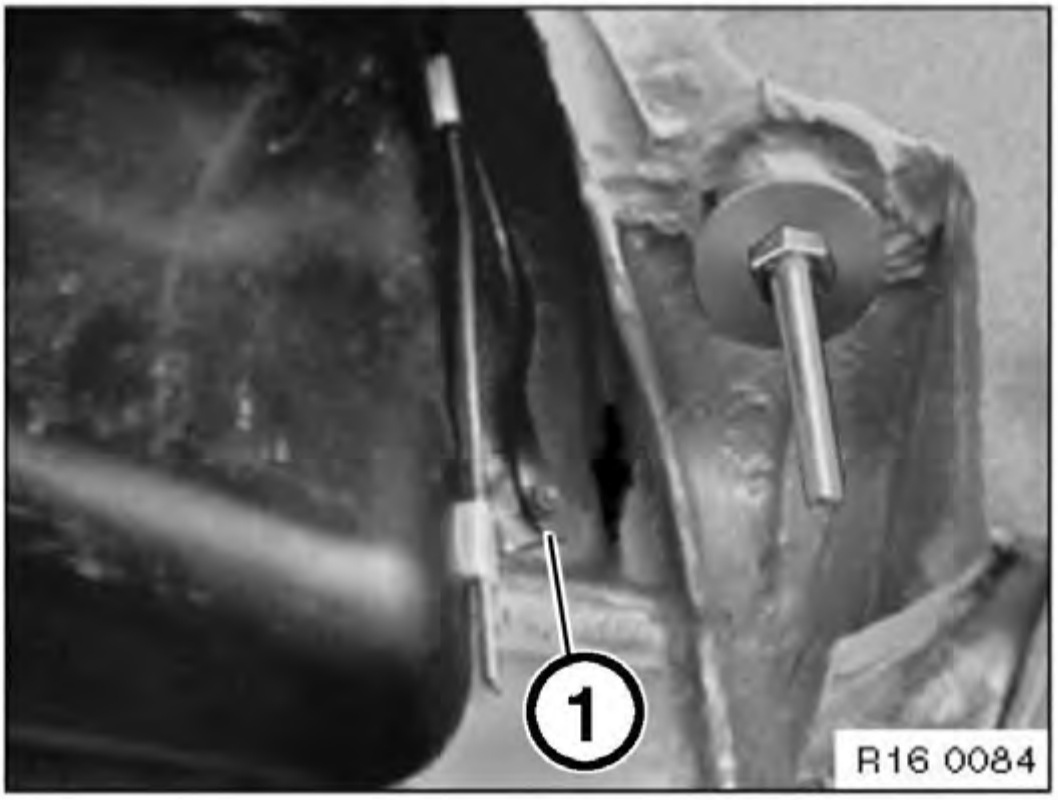


Fig. 130: Disconnecting Tank Vent Pipe & Filler Vent Pipe (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (M Roadster)

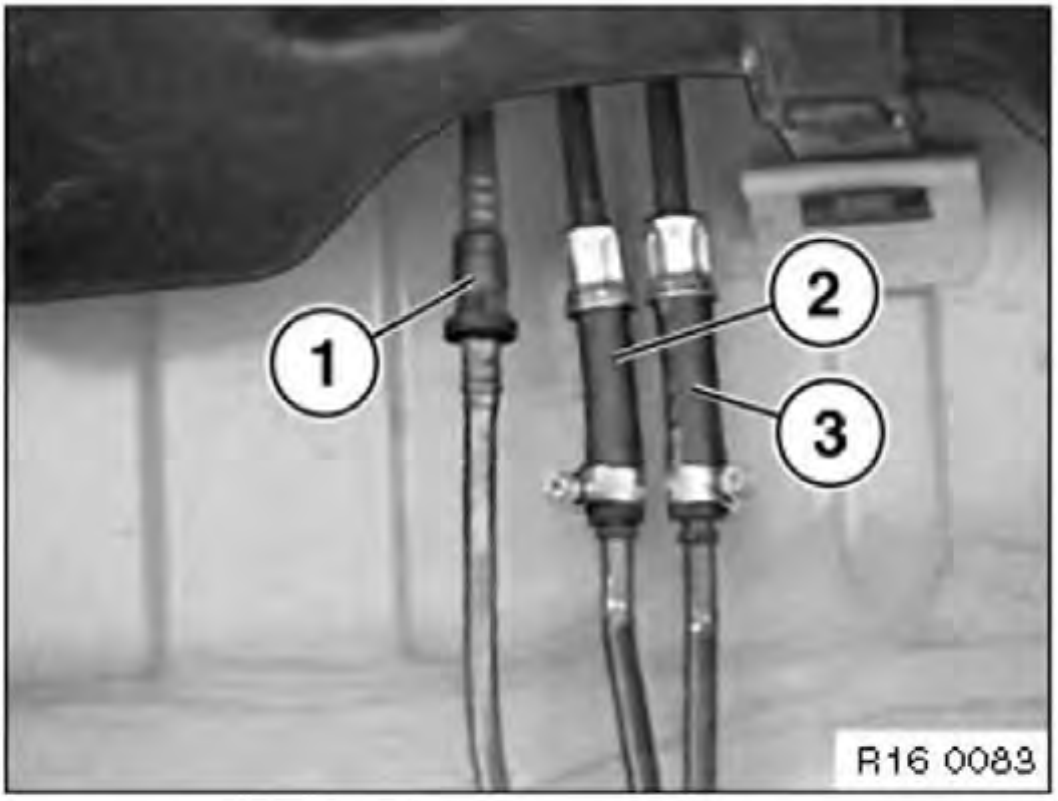
1. Remove fuel from fuel tank. Remove complete rear axle. See DIFFERENTIALS & AXLE SHAFTS article. Remove carbon canister. See CARBON FILTER. Unfasten ground strap. Using Special Tool (161040), unlock and remove connecting nipple from tank ventilation line. Disconnect fuel hose with Special Tool (133010) and remove supply line. See Fig. 122.
2. Disconnect fuel hose with Special Tool (133010) and remove return line. Remove bolts on clamping straps. Support fuel tank. Remove bolt at center of tank. Disconnect plug connection. Pull fuel tank down to remove. See Fig. 131-Fig. 135 To install, reverse removal procedure.



1. Ground Strap

G00125101

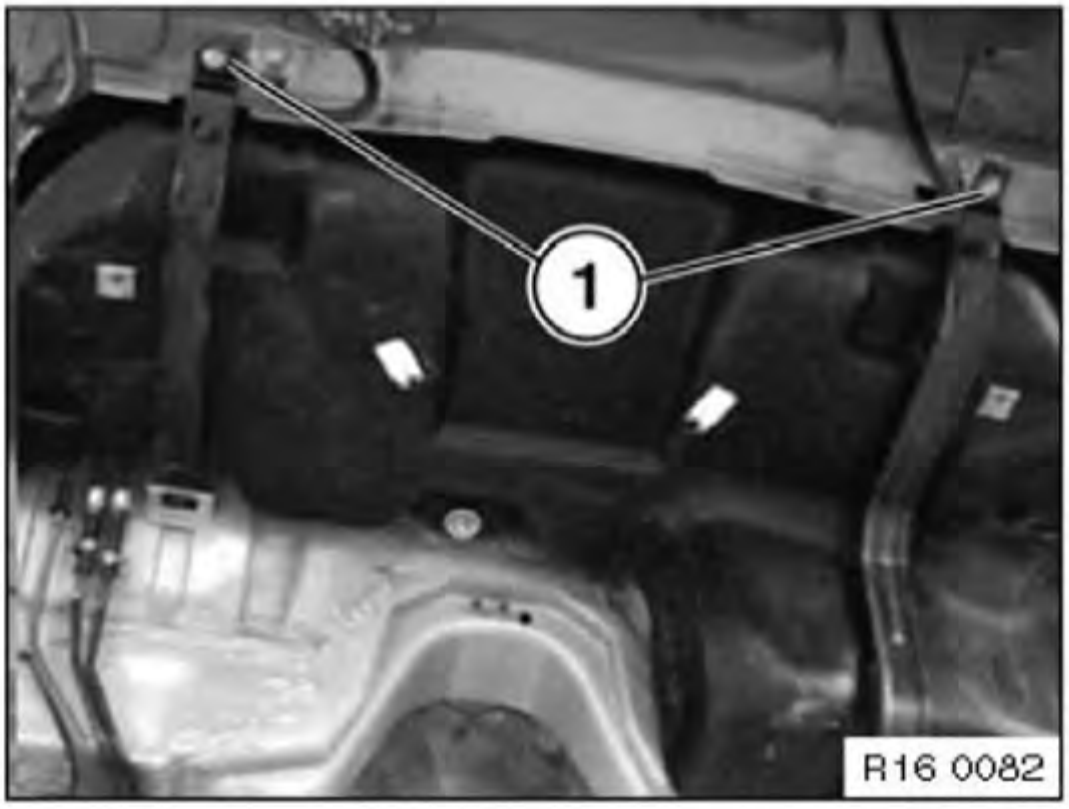
Fig. 131: Removing Ground Strap (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Ventilation Line
2. Inlet Line
3. Return Line

G00125102

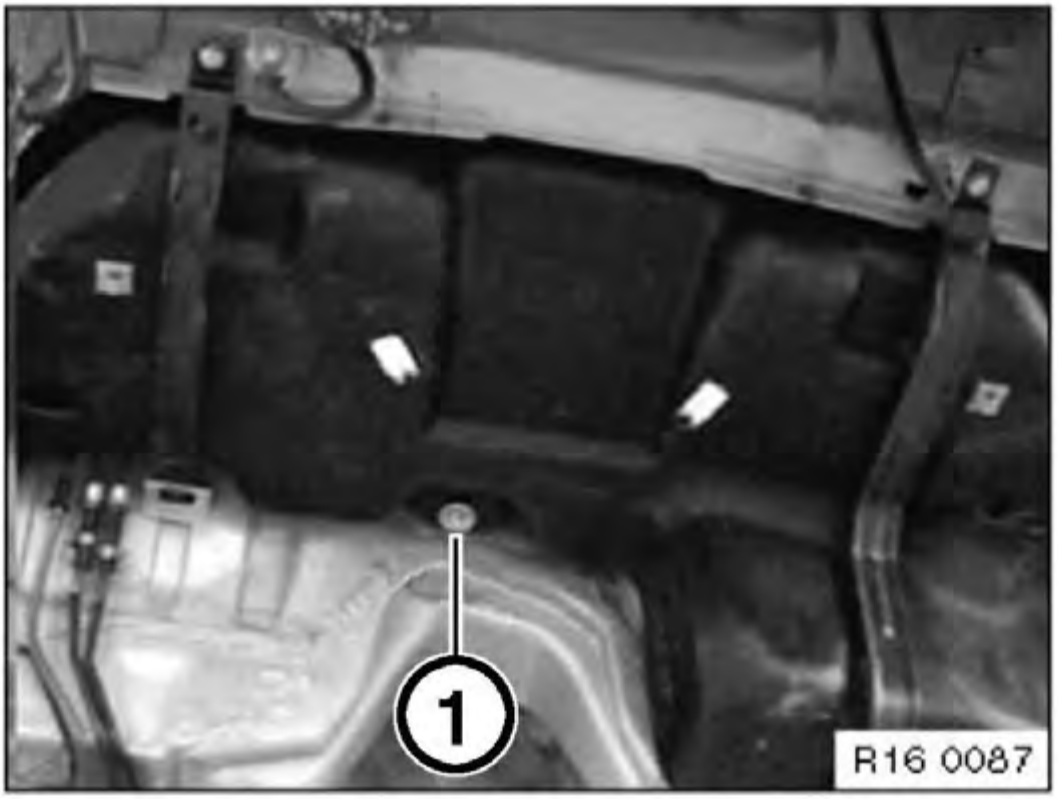
Fig. 132: Identifying Ventilation, Inlet & Return Lines (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Bolts

G00125103

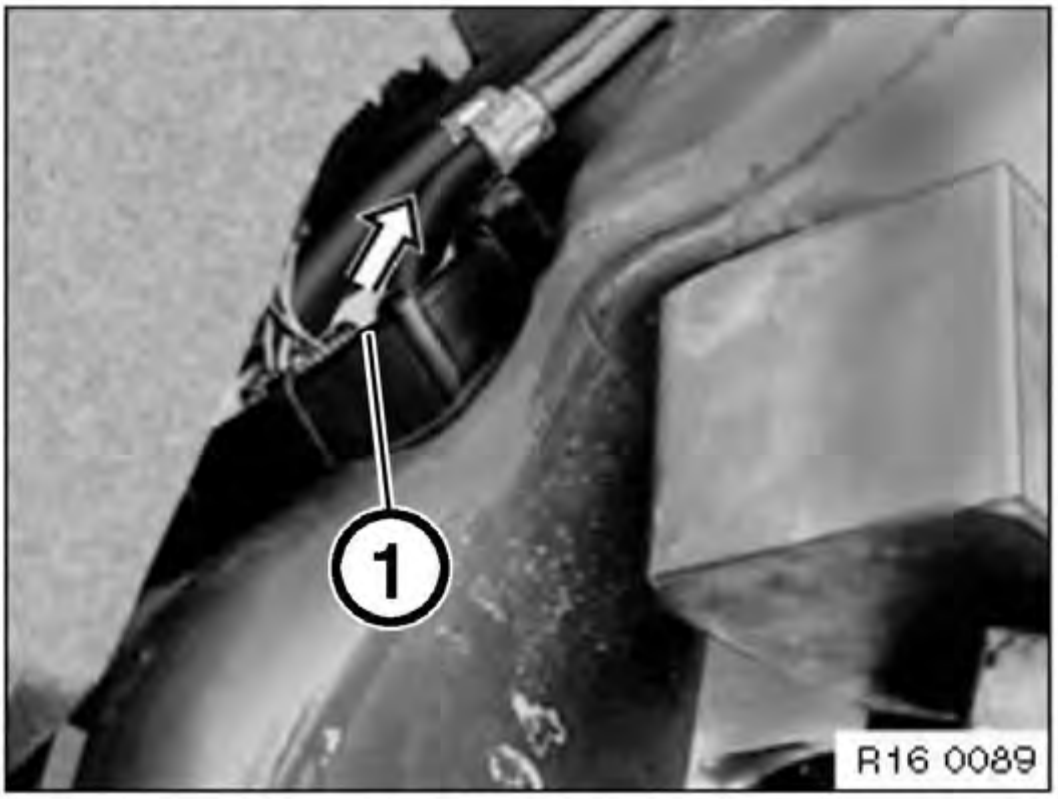
Fig. 133: Removing Bolts On Clamping Straps (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Bolt

G00125104

Fig. 134: Removing Bolt At Center Of Tank (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.



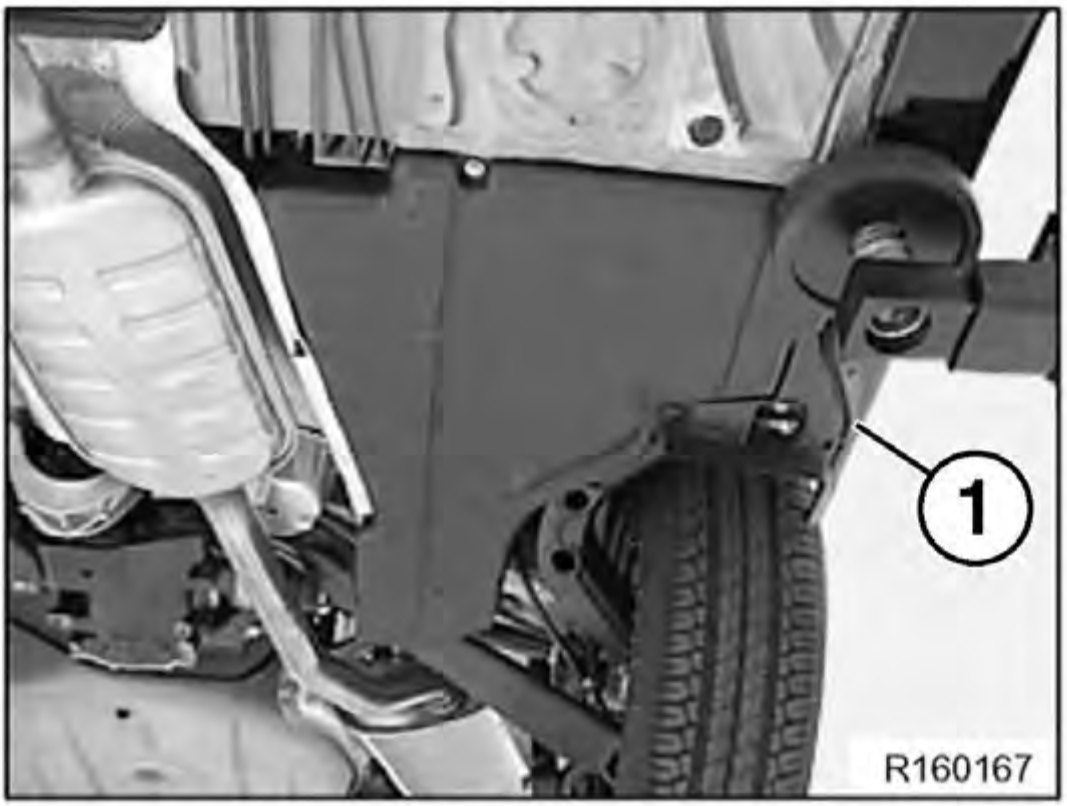
1. Plug Connection

G00125105

Fig. 135: Disconnecting Fuel Tank Plug Connection (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (3-Series - E46)

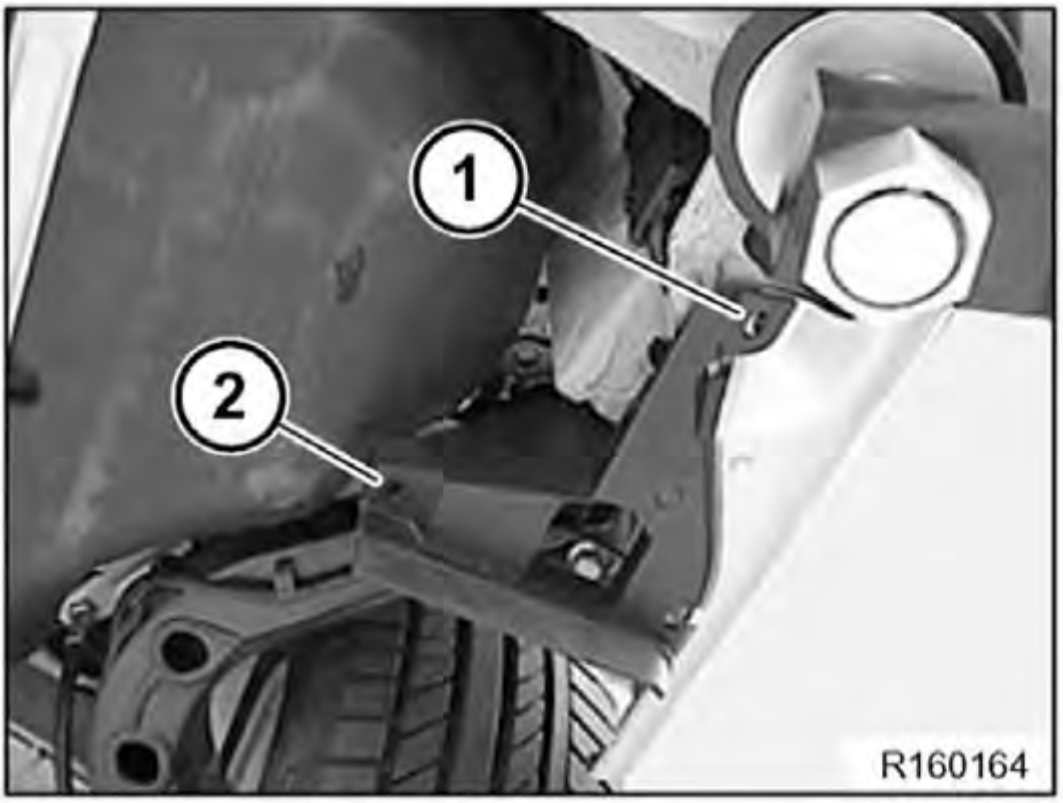
1. Remove fuel from fuel tank. Unfasten Bowden cable on handbrake lever. Remove exhaust system. Remove propeller shaft. Remove under-car tank trim on left side of vehicle. See Fig. 136.
2. Remove lip behind wheel on left side of vehicle. See Fig. 137. Remove tank trim on right. See Fig. 138. Remove lip on right. See Fig. 139. Remove handbrake cables from guide tubes. See Fig. 140.
3. Release hose clips and detach fuel feed and return lines. See Fig. 141. Release hose clip and detach fuel filler pipe/fuel tank connecting hose from fuel tank. See Fig. 142. Support tank over a wide area with lifting equipment. Unfasten hex nut. See Fig. 143. Release nut and remove retaining strap on both sides. See Fig. 144.
4. Lower fuel tank and disconnect electrical connections. Release hose clip and detach vent line. See Fig. 145. Remove fuel tank toward bottom. To install, reverse removal procedure. Note position of guide on lip during installation. Replace hose clips.



1. Tank Trim

G00131533

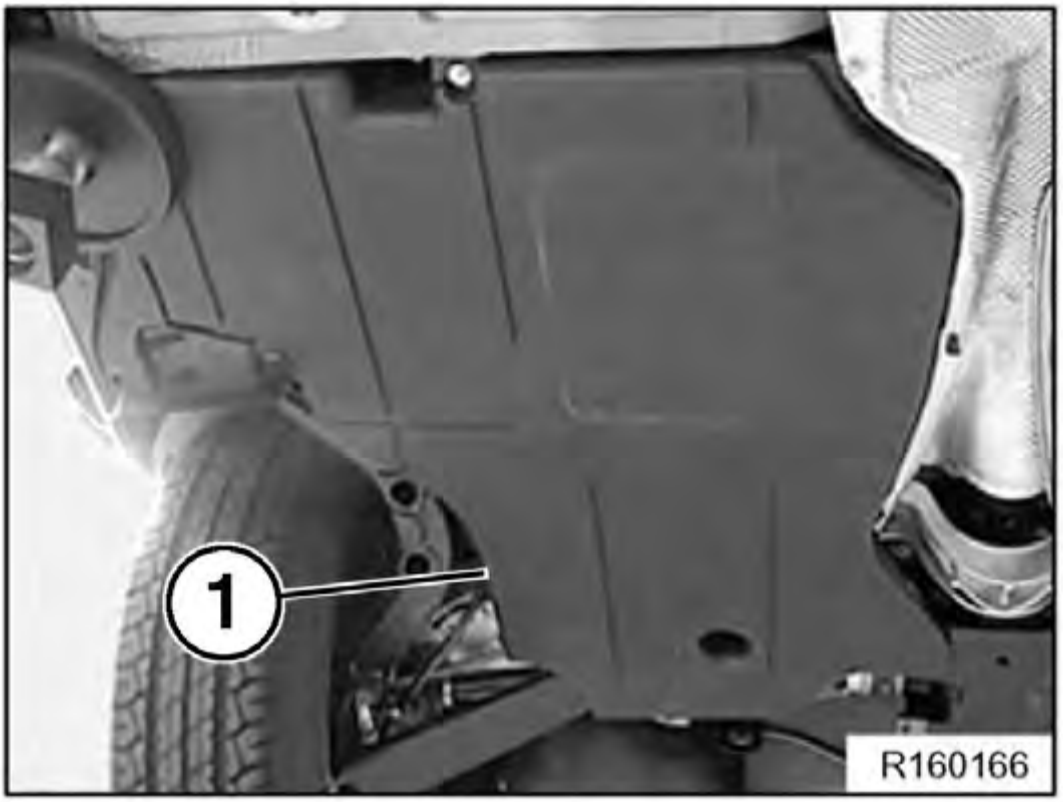
Fig. 136: Removing Fuel Tank Trim (Left) (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Guide
2. Lip

G00131534

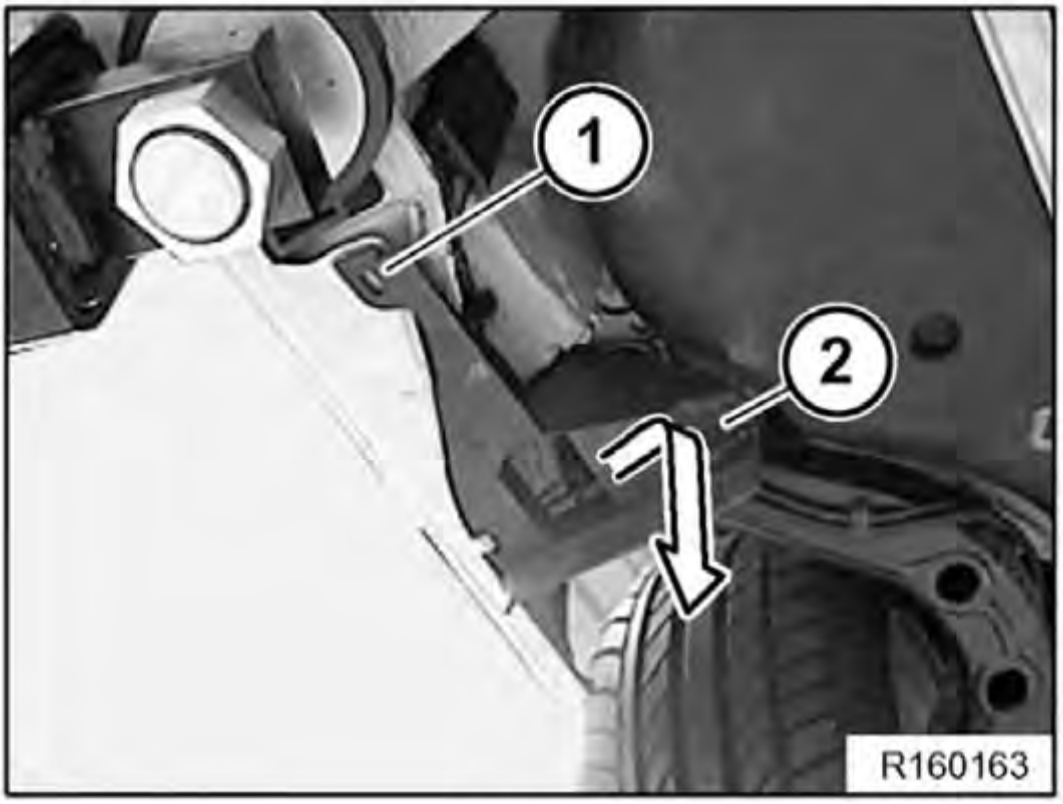
Fig. 137: Removing Lip On Left Side Of Vehicle (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Tank Trim

G00131535

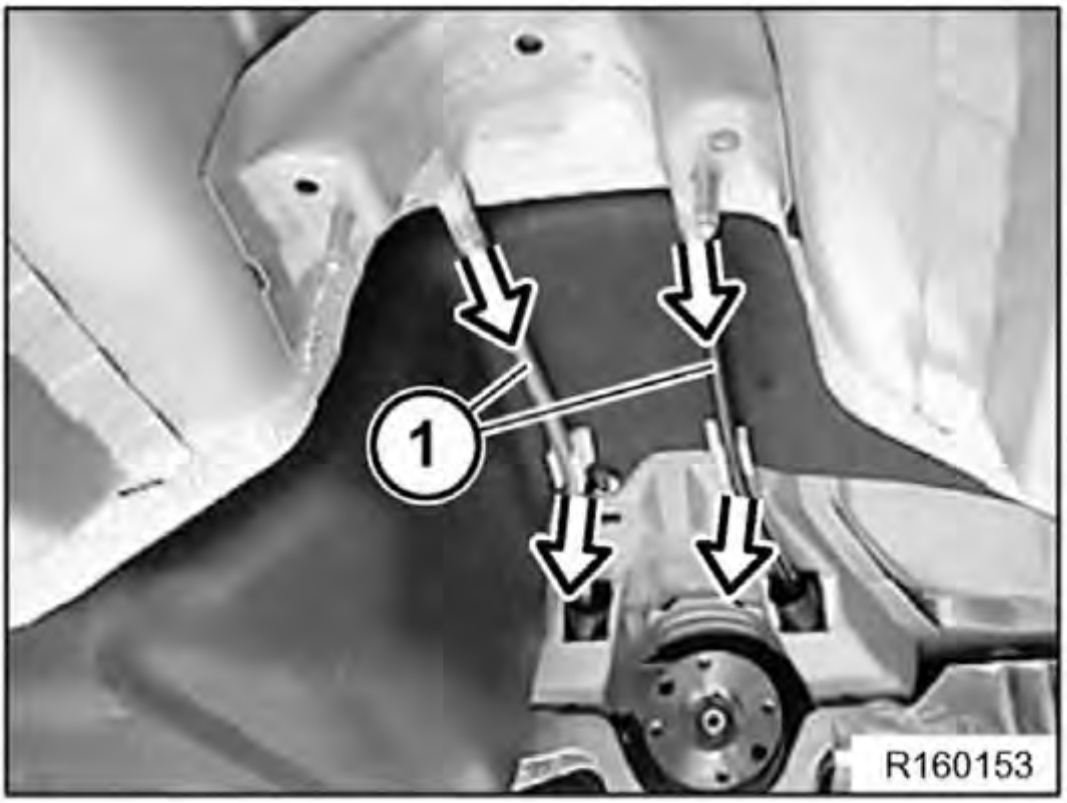
Fig. 138: Removing Fuel Tank Trim (Right) (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Guide
2. Lip

G00131536

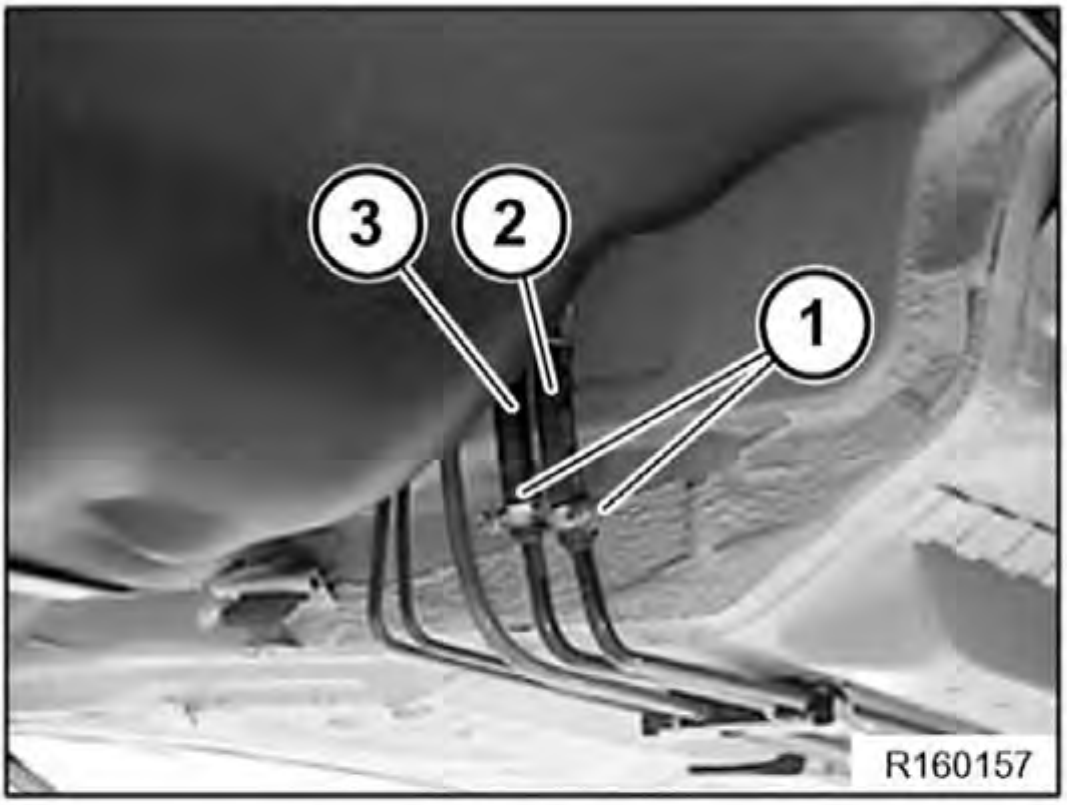
Fig. 139: Removing Lip On Right Side Of Vehicle (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Handbrake Cables

G00131537

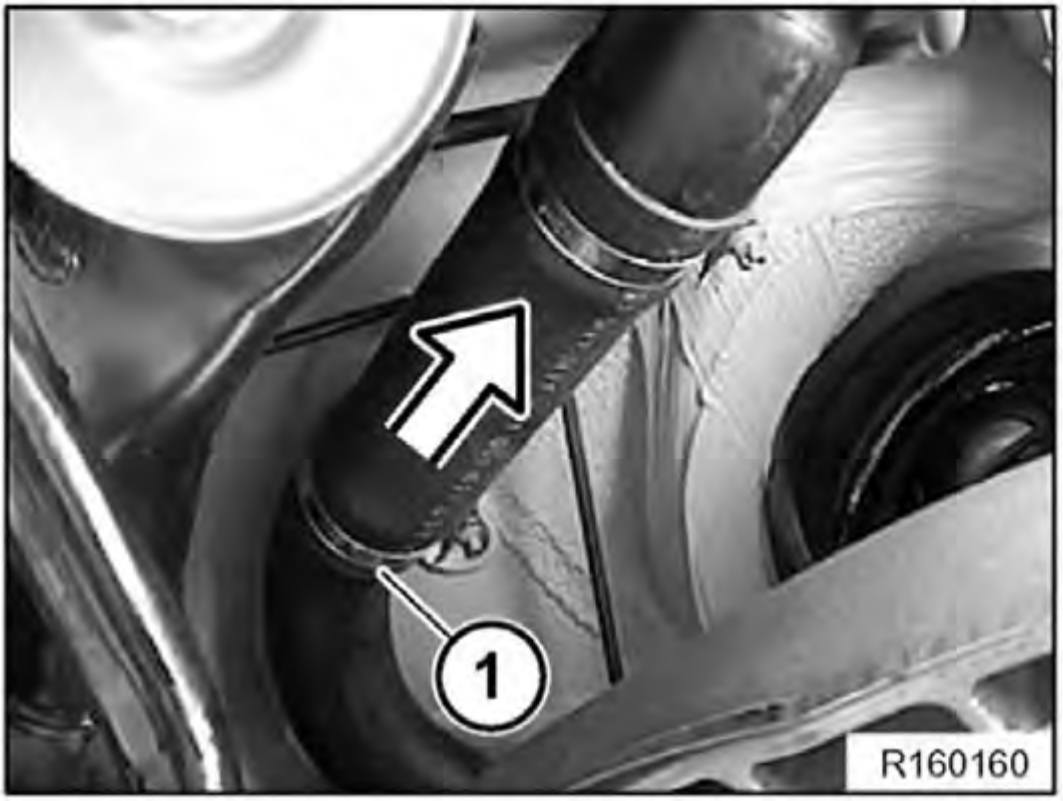
Fig. 140: Removing Handbrake Cables (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Clips
2. Feed Line
3. Return Line

G00131538

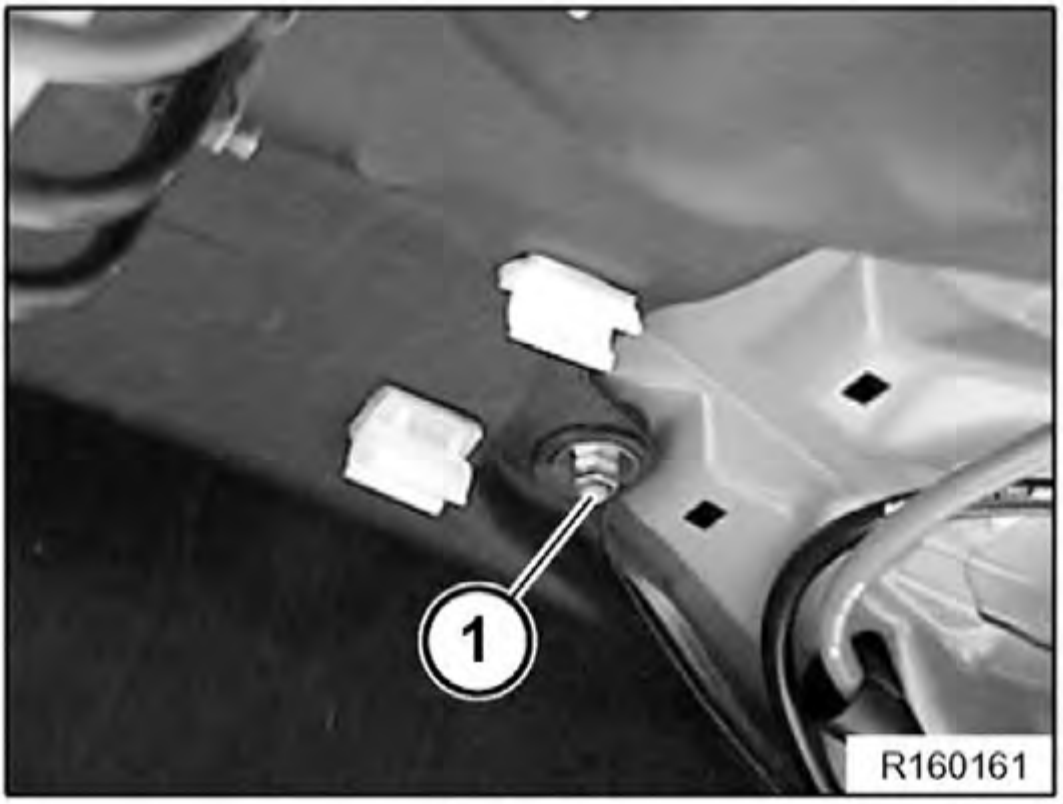
Fig. 141: Releasing Hose Clips & Detaching Fuel Lines (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Hose Clip

G00131539

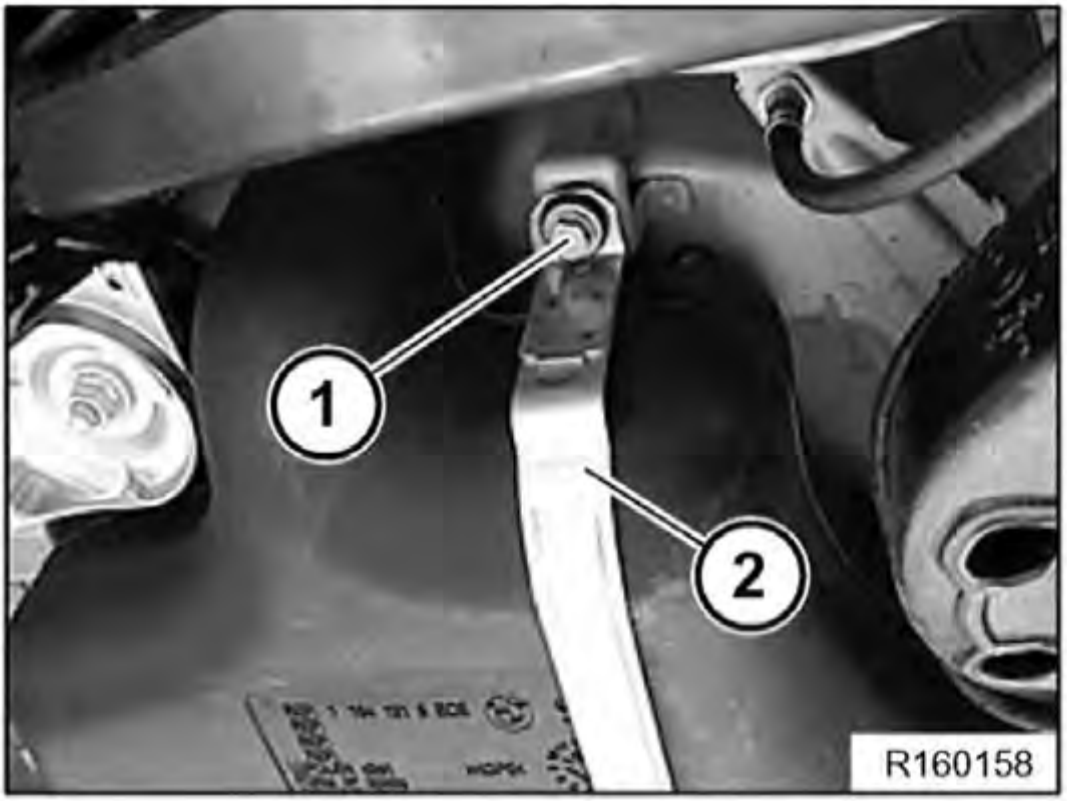
Fig. 142: Removing Fuel Filler Pipe/Fuel Tank Connecting Hose (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Hex Nut

G00131540

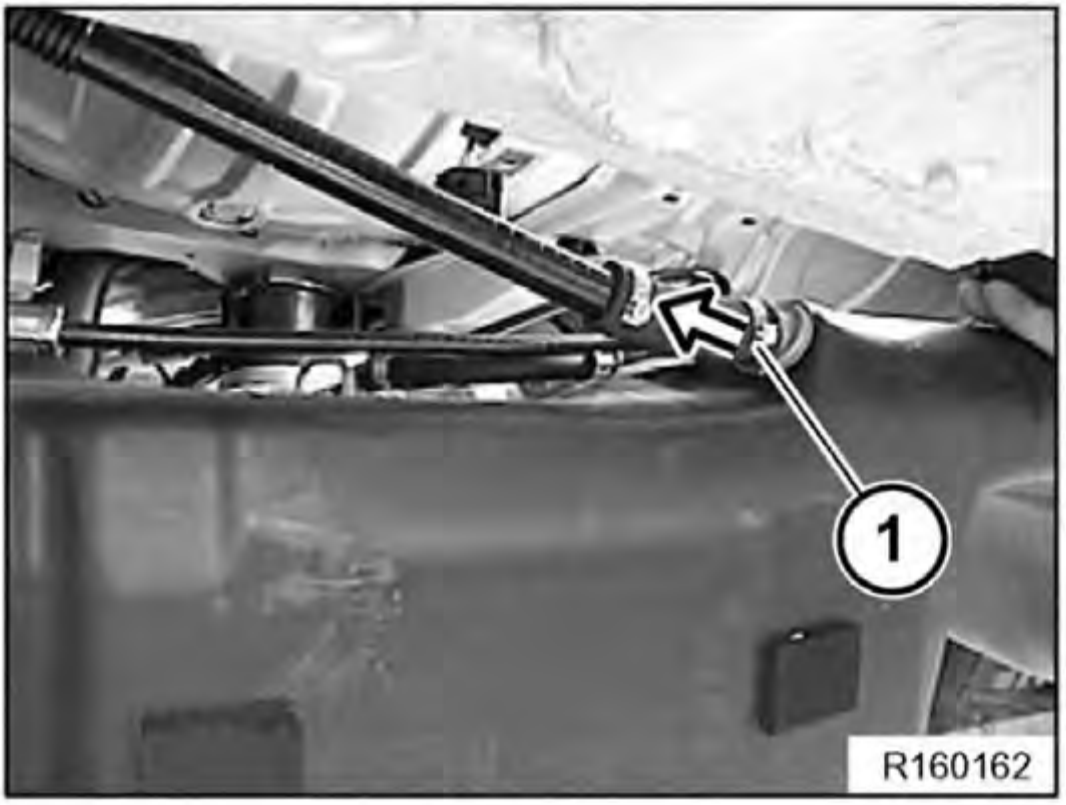
Fig. 143: Unfastening Hex Nut (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Nut
2. Retaining Strap

G00131541

Fig. 144: Removing Retaining Strap (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



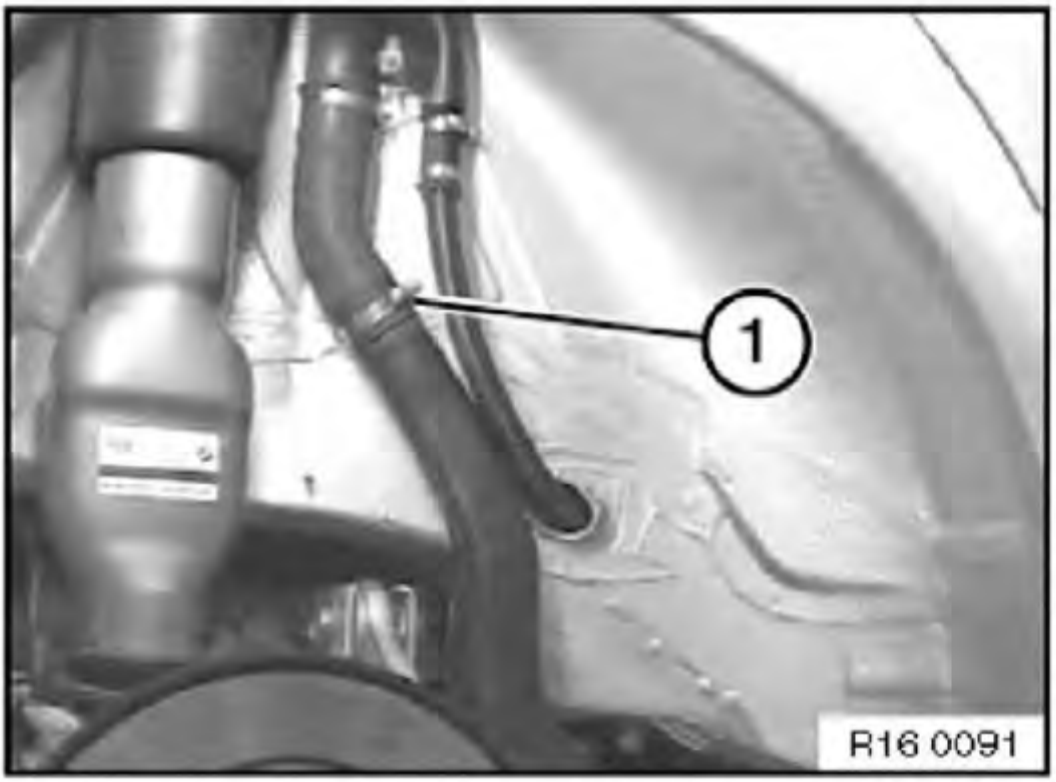
1. Hose Clip

G00131542

Fig. 145: Detaching Vent Line (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (5-Series)

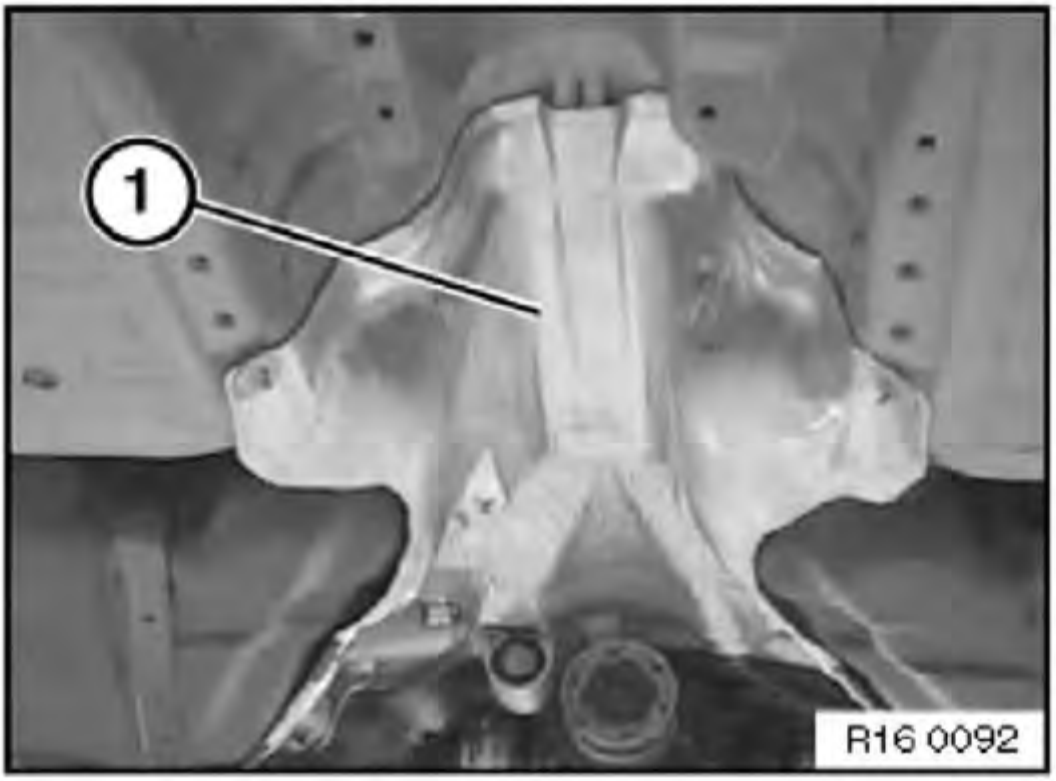
1. Fill fuel tank with at least 1.2 gallons (5 L) of fuel. Draw fuel out of fuel tank. With Special Tool (34 1 030), unfasten lock nuts. Twist lock nuts and adjustment nuts completely out of handbrake cables and pull Bowden cables downward out of their guide tubes. Remove right rear wheel. Remove right rear wheel arch trim. Unfasten hose clip and remove hose from tank. See Fig. 146. Remove propeller shaft completely. Remove heat shield from tank. See Fig. 147. Remove handbrake Bowden cables from guide tubes.
2. Unfasten screw and remove cover from rear axle bearing. See Fig. 148. Unfasten hose clips, mark fuel lines and remove hoses. Open hose clip with pliers and remove hose (park heating only). See Fig. 149. On all models, unfasten screws and remove clamping straps. See Fig. 150.
3. Support fuel tank. Unfasten bolts for left and right tank mounting, then lower tank until hose connections and plug connections are accessible. See Fig. 151. On left half of tank, disconnect connector from fuel level sensor, unfasten hose clips and remove tank vent lines. See Fig. 152.
4. On right half of tank, disconnect connector on fuel delivery unit. Unfasten hose clip and remove tank vent line. See Fig. 153. Lower fuel tank and remove downwards. To install, reverse removal procedure. Note location of rubber mount and washers on left and right tank. After the installation of the fuel tank and prior to first engine start-up, check the electrical resistance between ground lug (tank filling pipe) and wheel hub. Measured value should be approximately.6 ohms.



1. Hose Clip

G00131489

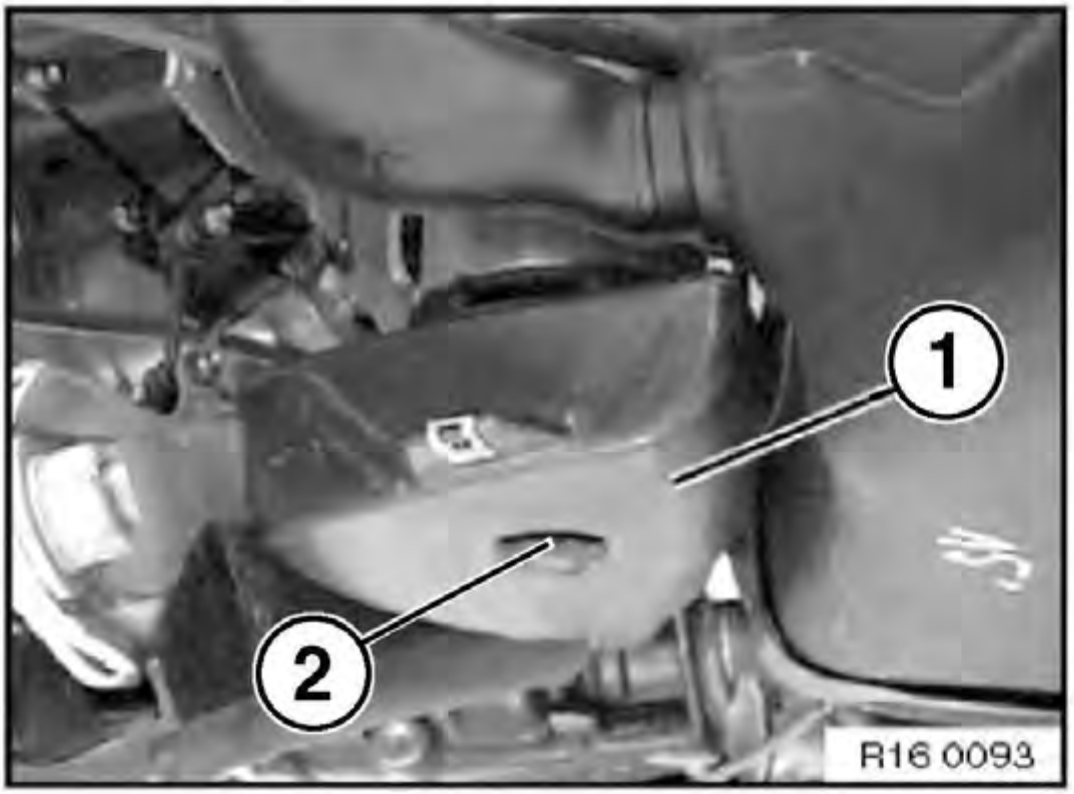
Fig. 146: Removing Hose Clip & Hose From Tank (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Heat Shield

G00131490

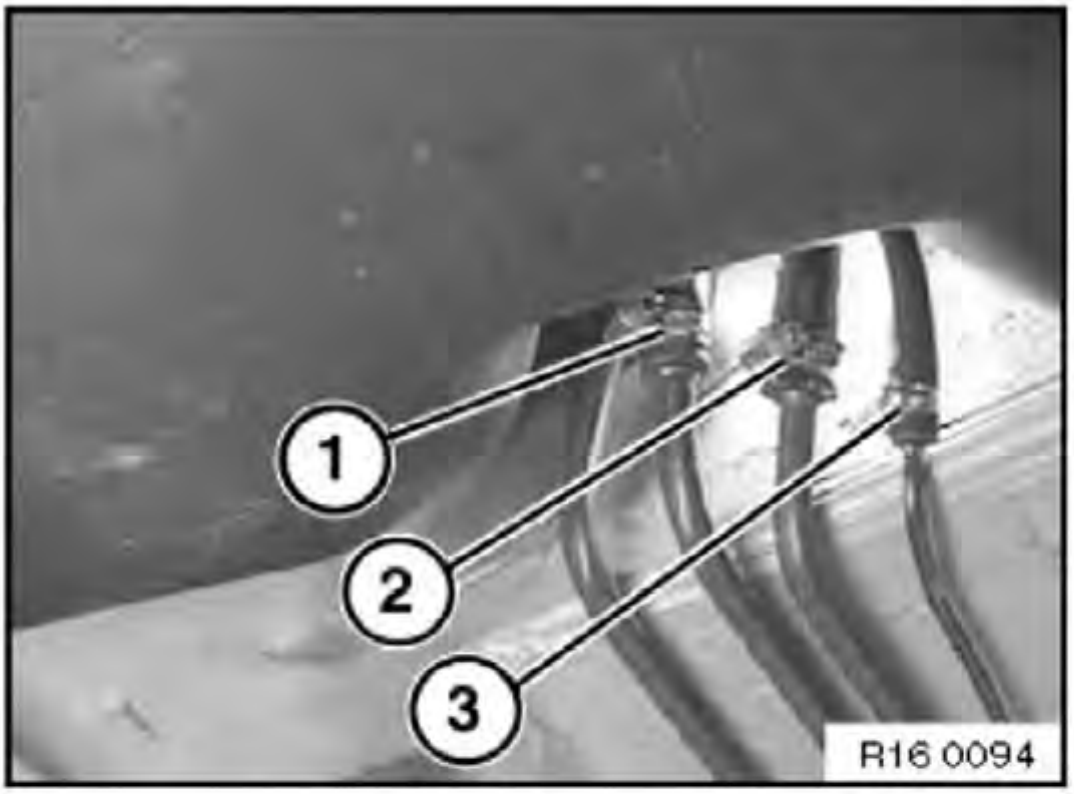
Fig. 147: Removing Heat Shield (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Rear Axle Bearing
2. Screw

G00131491

Fig. 148: Removing Cover From Rear Axle Bearing (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Return Hose
2. Inlet Hose
3. Park Heating Hose

G00131492

Fig. 149: Removing Return Hose, Inlet Hose & Park Heating Hose (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

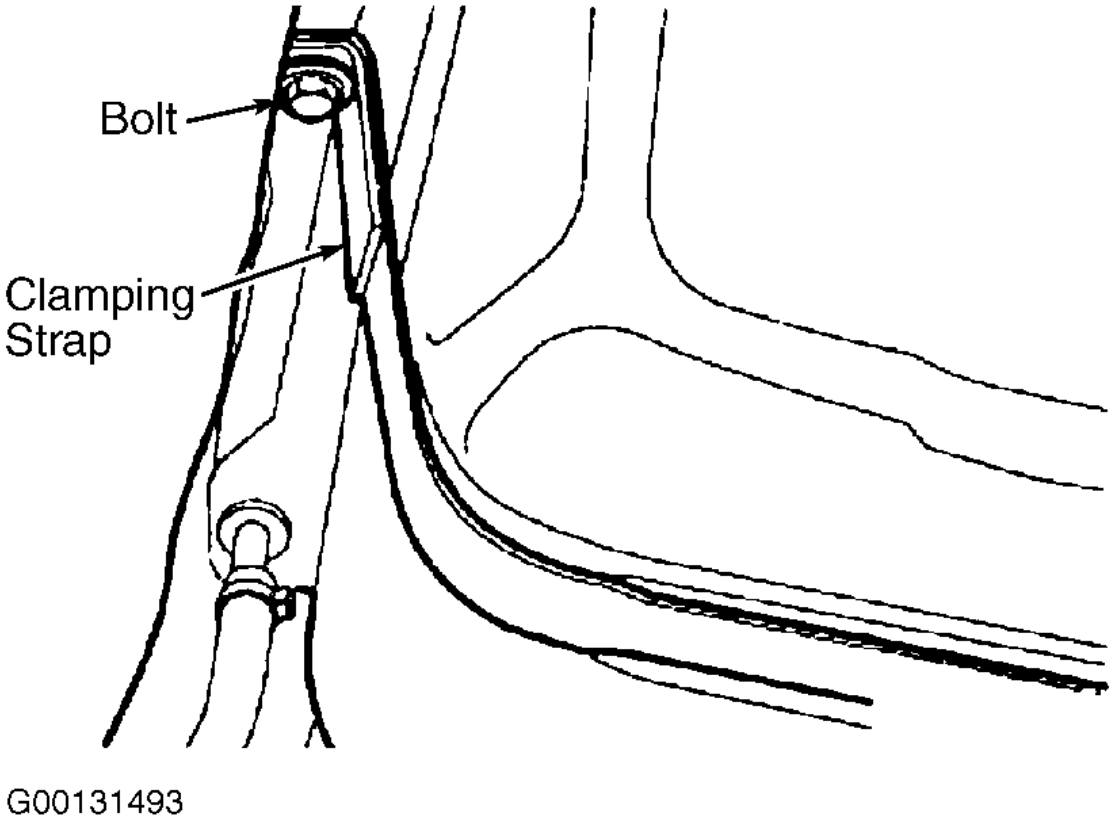


Fig. 150: Removing Clamping Strap (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

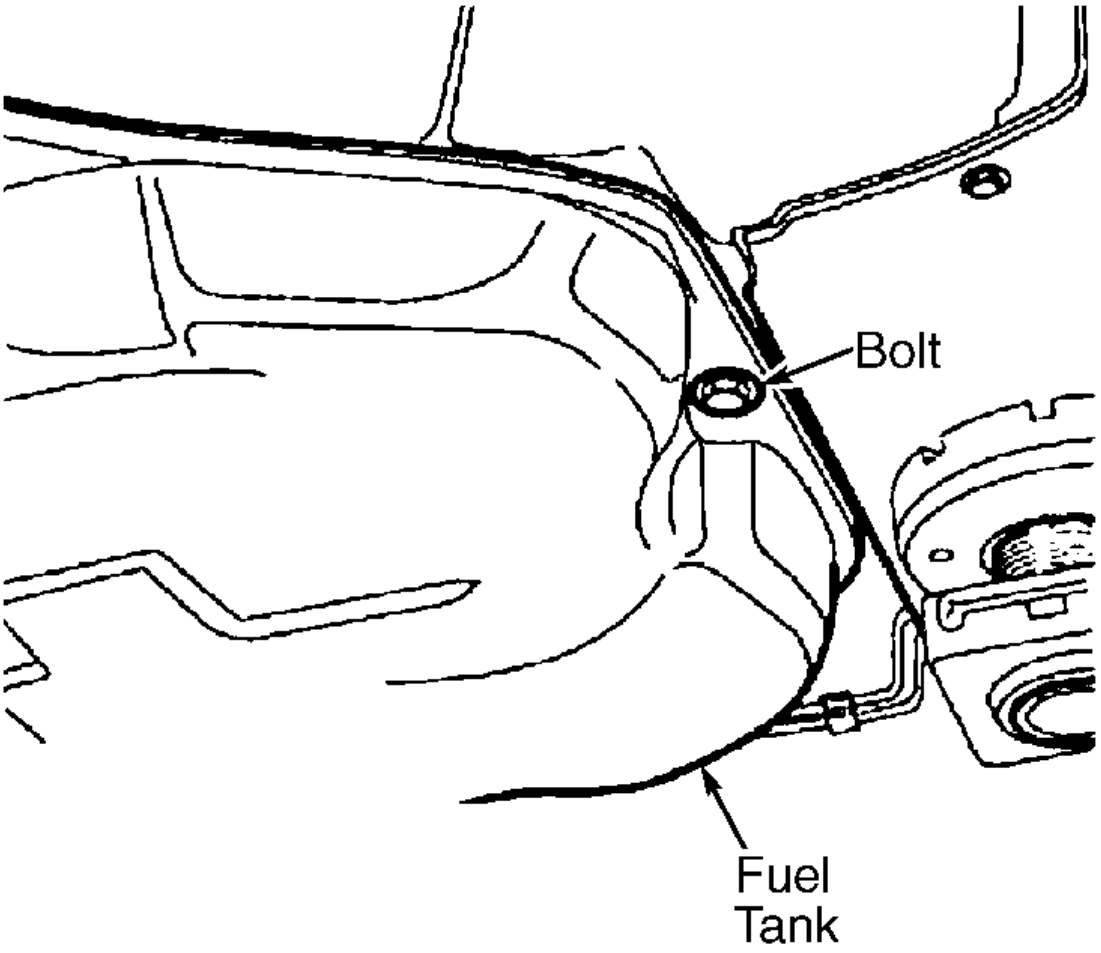
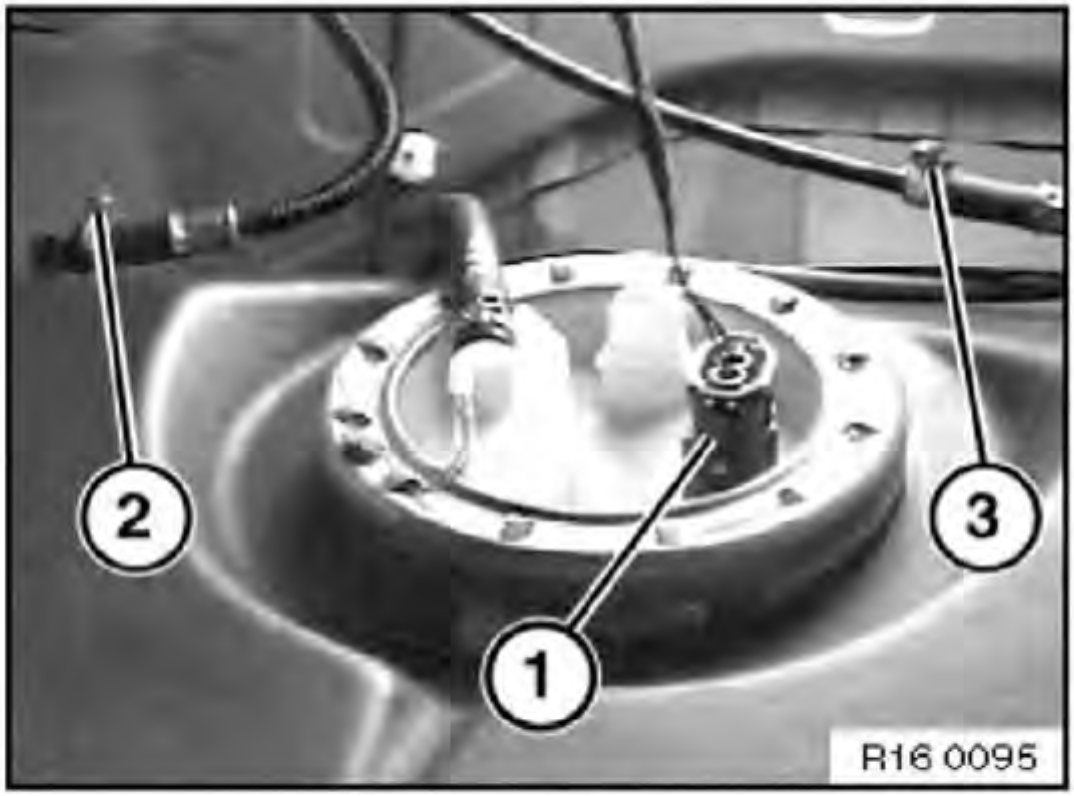


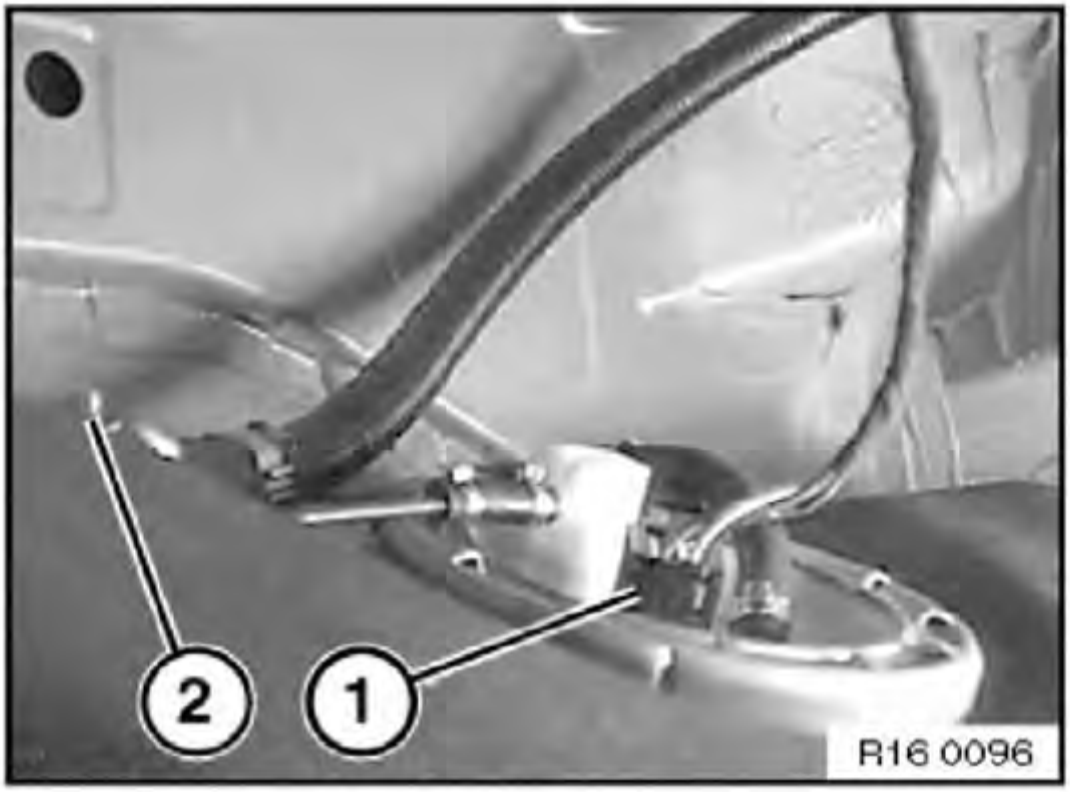
Fig. 151: Removing Tank Mounting Bolts (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Connector
2. Hose Clip
3. Hose Clip

G00131495

Fig. 152: Disconnecting Left Tank Fuel Level Sensor (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Connector
2. Hose Clip

G00131496

Fig. 153: Disconnecting Right Tank Fuel Level Sensor (5-Series)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (7-Series V8)

1. Fill fuel tank with at least 1.2 gallons (5 L) of fuel. Draw fuel out of fuel tank. With Special Tool (34 1 030), unfasten lock nuts. Twist lock nuts and adjustment nuts completely out of hand brake cables and pull Bowden cables downward out of their guide tubes. Remove right rear wheel. Remove right rear wheel arch trim. Unfasten hose clip and remove hose from tank. Remove propeller shaft. Remove heat shield from tank. Remove hand brake Bowden cables from guide tubes.
2. Unfasten screw and remove cover from rear axle bearing. Unfasten hose clips (one return line, 2 inlet lines), mark fuel lines and remove hoses. Open hose clip with pliers and remove hose. Unfasten screws and remove clamping straps.
3. Support fuel tank. Unfasten screws for left and right tank mounting, then lower tank until hose connections and plug connections are accessible. Disconnect connector from fuel level sensor, unfasten hose clips and remove tank vent lines.
4. On right half of tank, disconnect connector on fuel delivery unit. Disconnect hose clip and remove tank vent line. Lower the fuel tank and remove downward. After installation of fuel tank, and prior to first engine start-up, check electrical resistance between ground lug (tank filling pipe) and wheel hub. Measured value should be approximately.6 ohms.

Removal & Installation (7-Series V12)

1. Fill fuel tank with at least 1.2 gallons (5 L) of fuel. Draw fuel out of fuel tank. Disconnect fuel pipe with Special Tool (13 3 010) and open hose clamp. Disconnect left and right fuel level sensor connectors. See Fig. 154.
2. Remove propeller shaft completely. Disconnect cable. See Fig. 155. Unscrew and remove dipstick tube.

Remove left and right stone chip guards. See Fig. 156. Remove hydraulic lines. See Fig. 157. Replace fuel lines and hose clips. Remove filler hose clip and filler hose. See Fig. 158. Unscrew and remove clamping straps. See Fig. 150.

3. Support fuel tank. Unfasten left and right bolts. See Fig. 159. Slightly lower fuel tank and tilt it forward until lines can reach upper side of fuel tank. Loosen lines at upper left side of fuel tank. See Fig. 160. Loosen ventilation line at upper side of the fuel tank. See Fig. 161. Lower the fuel tank and remove downward.
4. To install, reverse removal procedure. Note location of rubber mount with spacer bushing. Wide collar on spacer bushing faces toward screw head. Note rubber supports at the back of fuel tank. See Fig. 162. Note locating wedges with rubber cover on floor assembly. After installation of fuel tank and prior to first engine start-up, check electrical resistance between ground lug (tank filling pipe) and wheel hub. Measured value should be approximately.6 ohms.

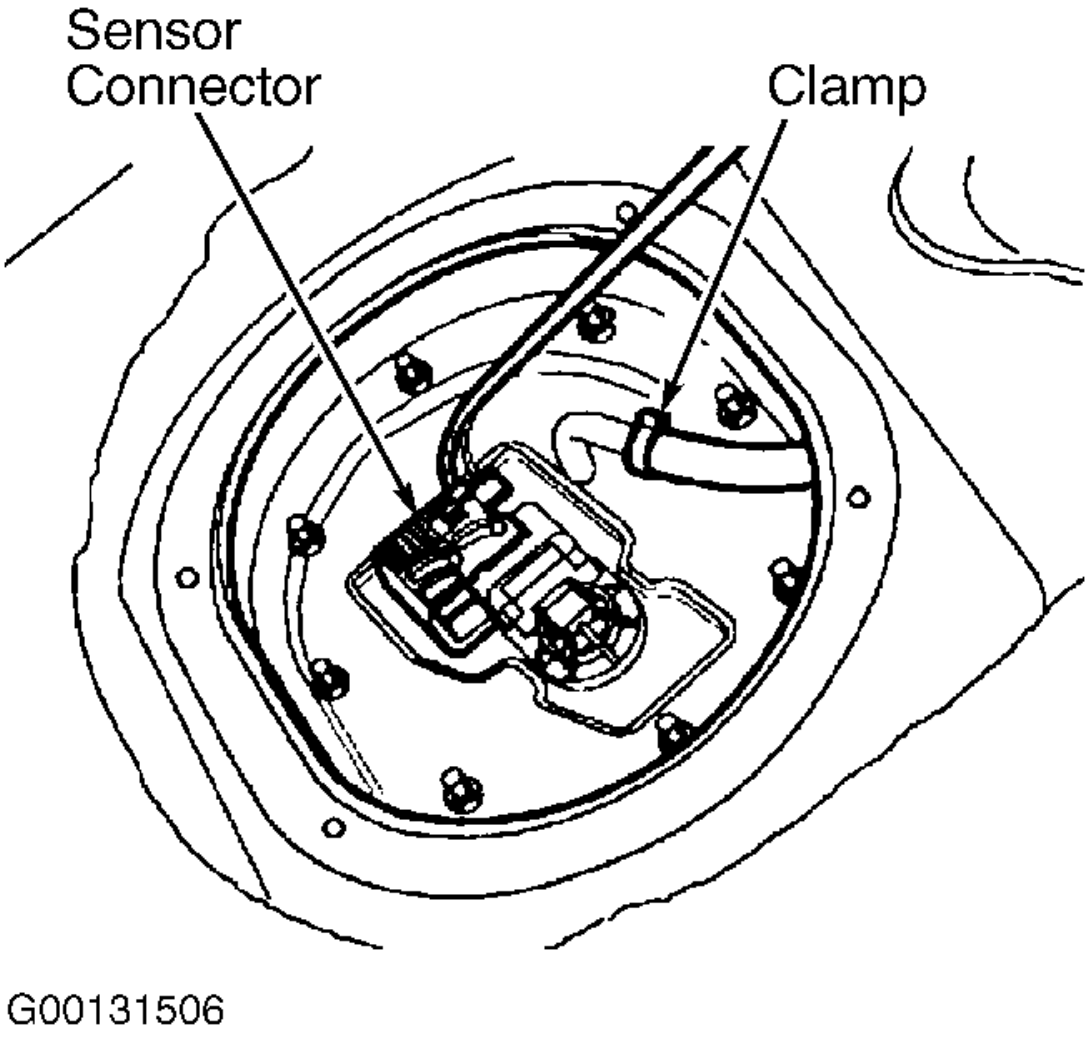


Fig. 154: Disconnecting Sensor Connectors & Removing Clamp (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.

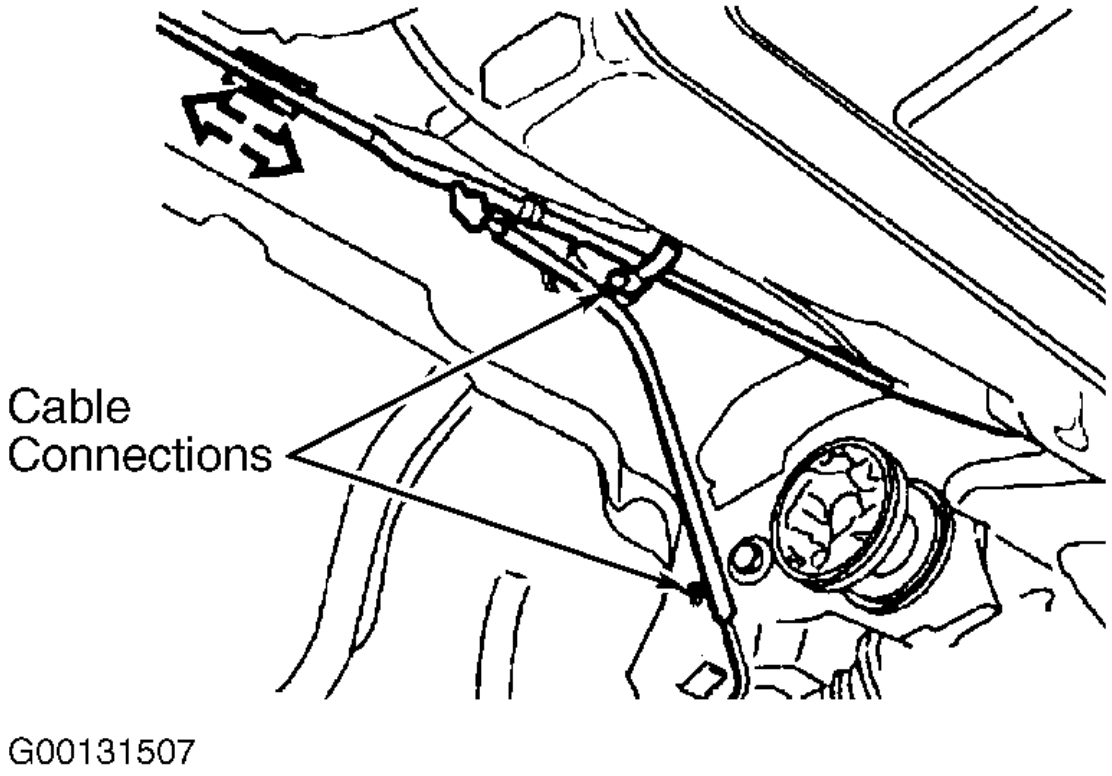


Fig. 155: Disconnecting Cable Connection (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.

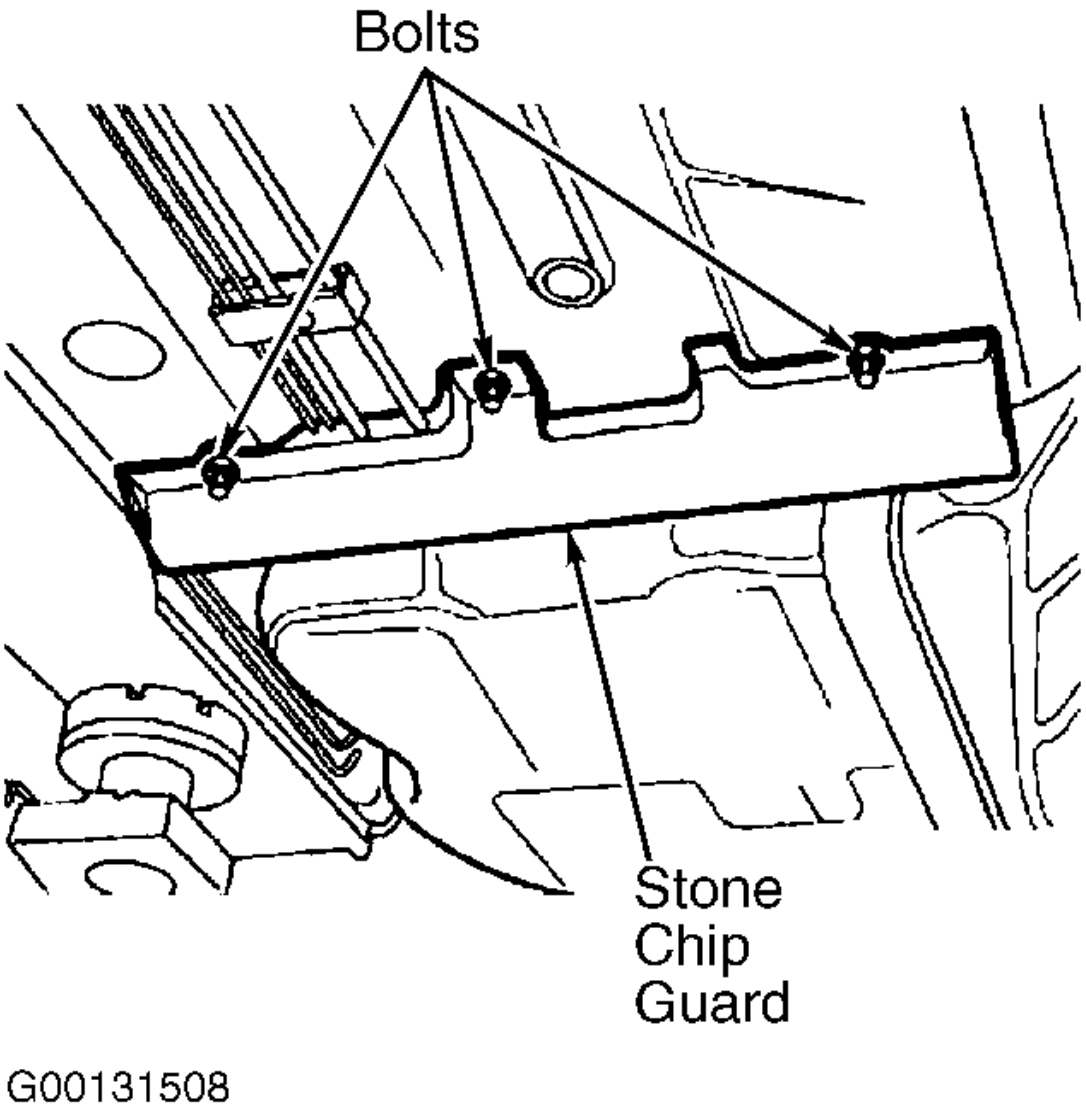
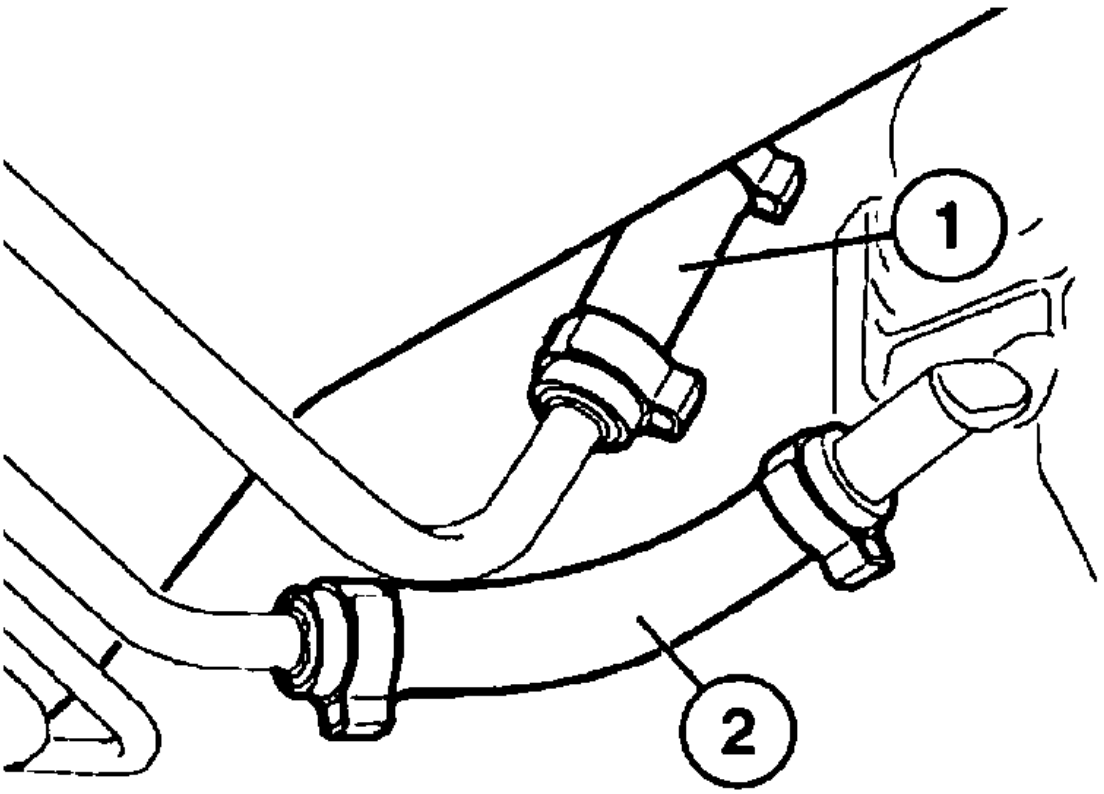


Fig. 156: Removing Stone Chip Guard (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Intake Line
2. Return Line

G00131509

Fig. 157: Removing Intake & Return Lines (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.

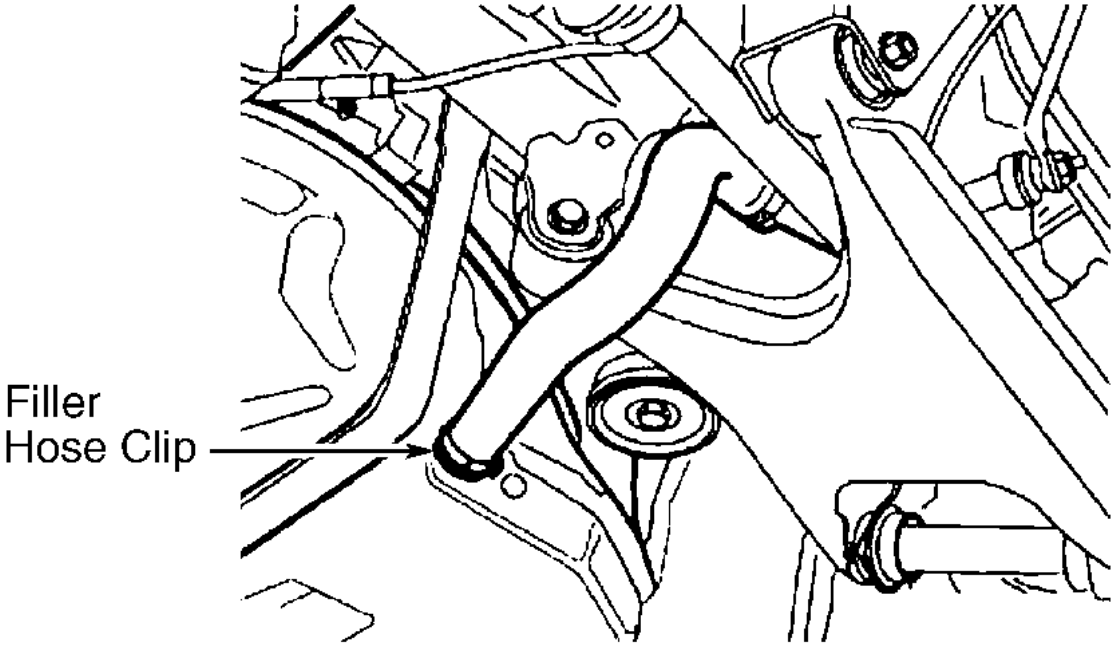


Fig. 158: Remove Filler Hose Clip (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.

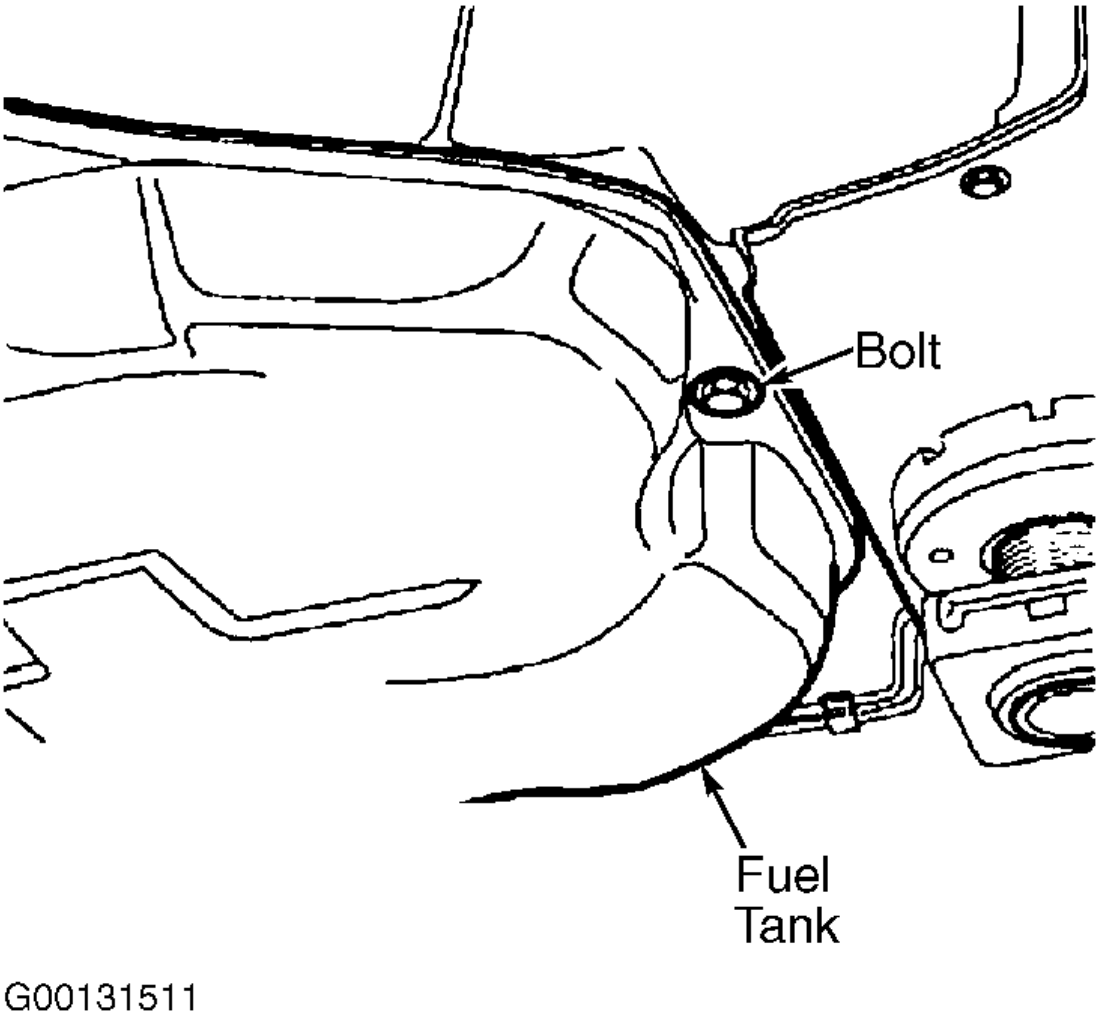
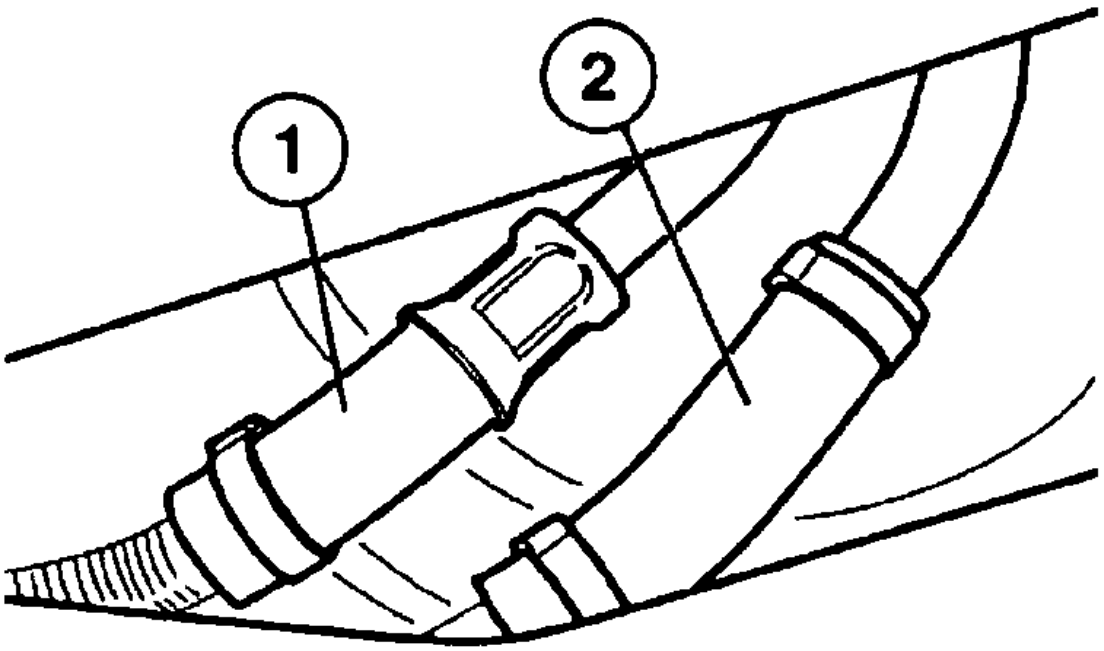


Fig. 159: Removing Fuel Tank Bolts (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Line To Active Carbon Filter
2. Line To Expansion Tank

G00131512

Fig. 160: Identifying Fuel Lines (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.

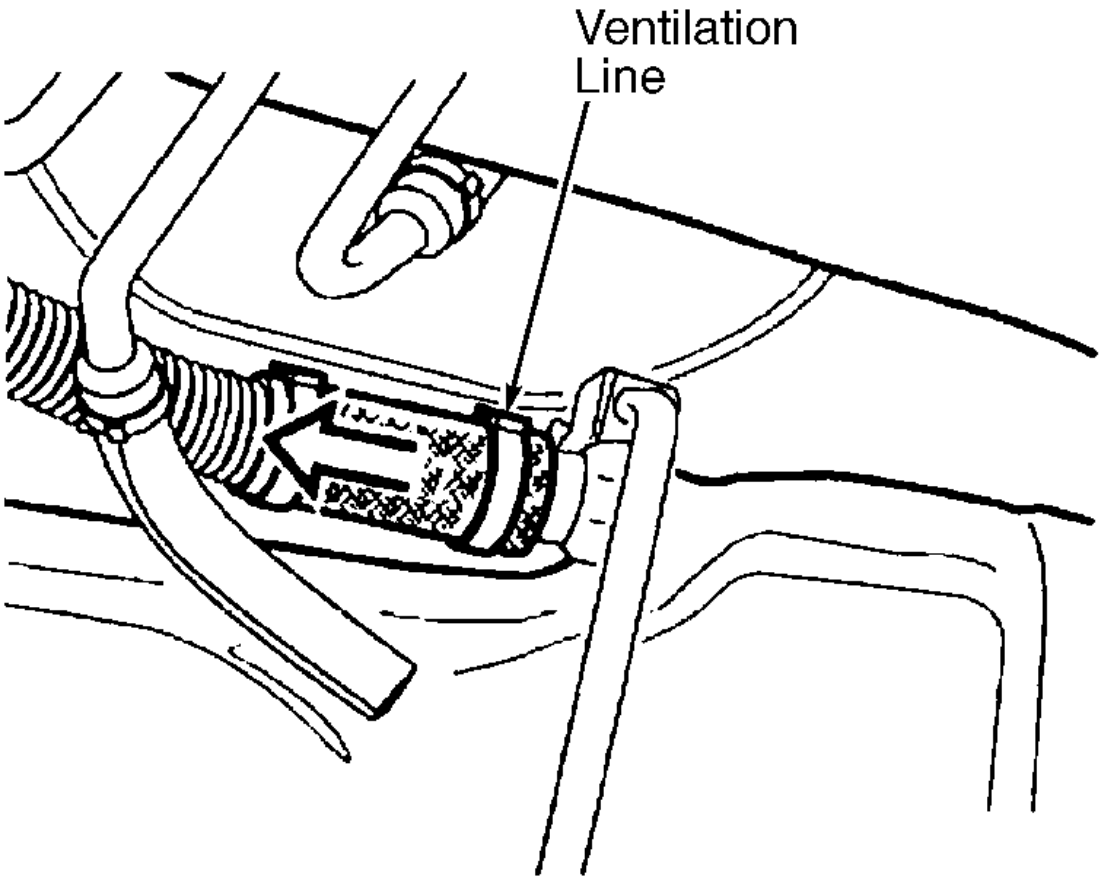


Fig. 161: Identifying Ventilation Line (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.

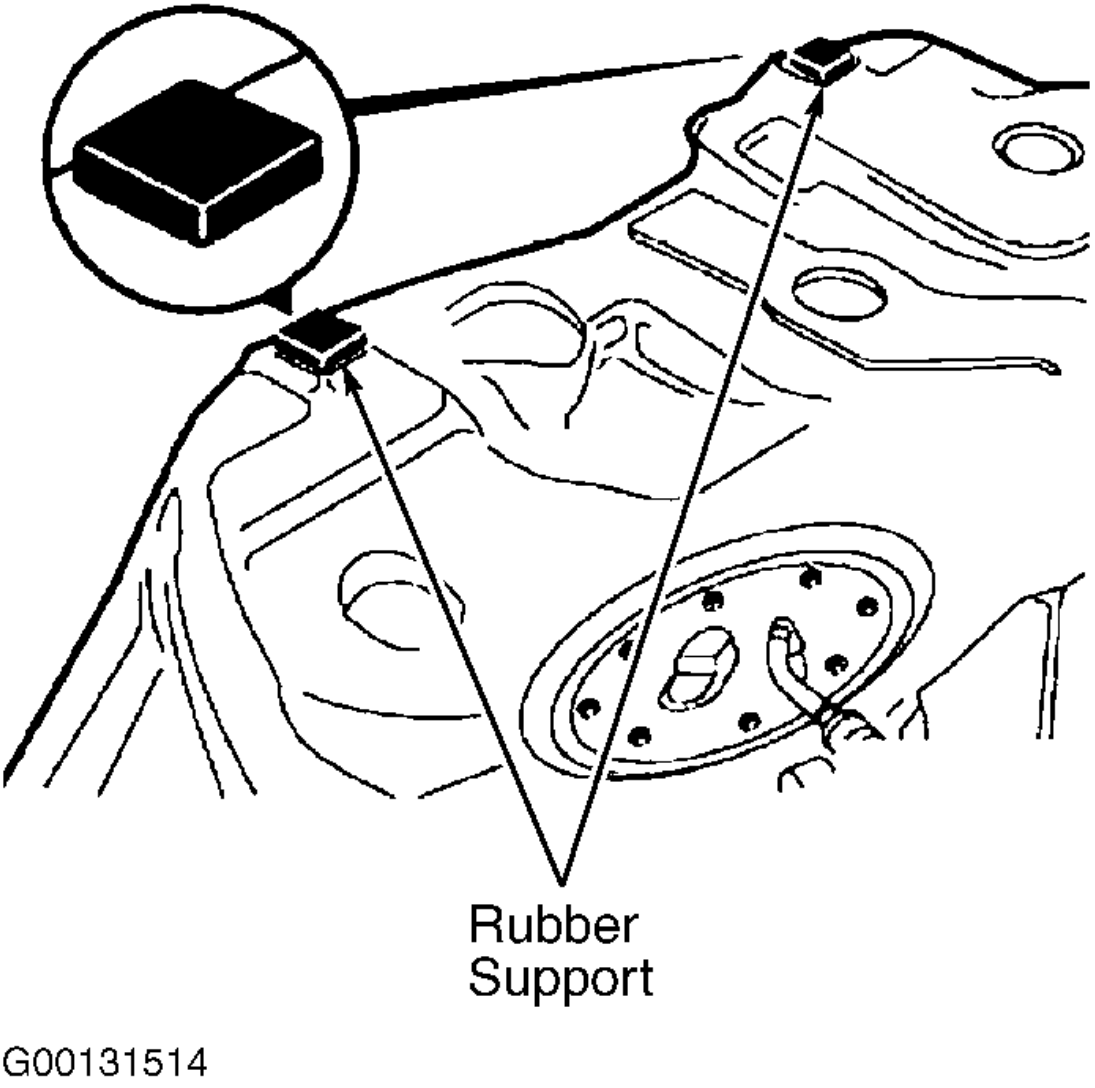


Fig. 162: Identifying Fuel Tank Rubber Supports (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.

IDLE SPEED CONTROL VALVE

Removal & Installation (6-Cylinder - E36)

Remove air filter housing. Remove throttle valve extension. Disconnect dip stick guide tube. Disconnect idle speed control valve electrical connector. Remove 2 bolts. Remove idle speed control valve. See Fig. 163. Remove gasket and rubber clip. To install, reverse removal procedure.

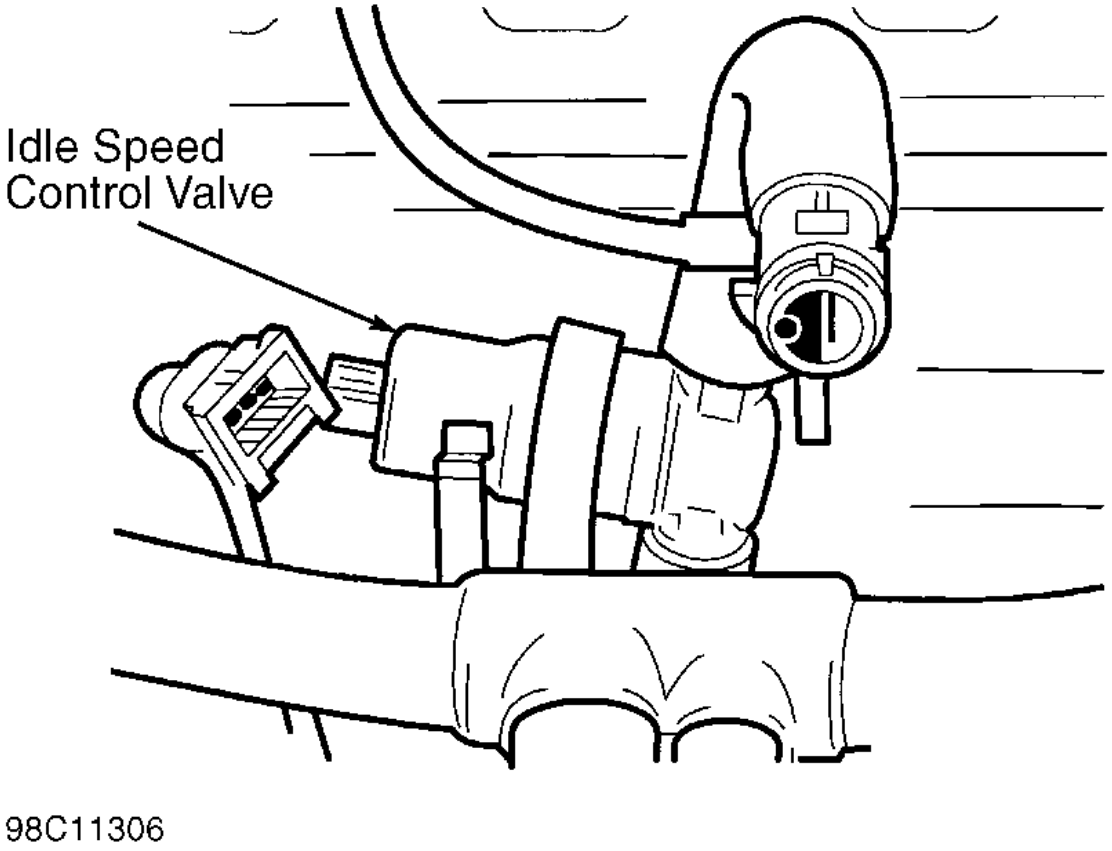


Fig. 163: Removing Idle Speed Control Valve (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (3-Series - E46)

Idle speed control valve is located under intake air manifold, above throttle body. Remove air filter housing. Remove Mass Airflow (MAF) sensor. Pull throttle cable upward out of retainer and unhook. Loosen hose clamps and detach intake hose ducting from throttle assembly and idle speed control valve. Disconnect resonance flap and idle speed control valve connectors. Loosen retaining screw on cable duct mounting. Loosen 2 idle speed control valve retaining screws. Remove idle speed control valve and retainer from intake air manifold. See Fig. 164. To install, reverse removal procedure. Replace idle speed control valve seal. Coat inside of seal with antiseize compound.

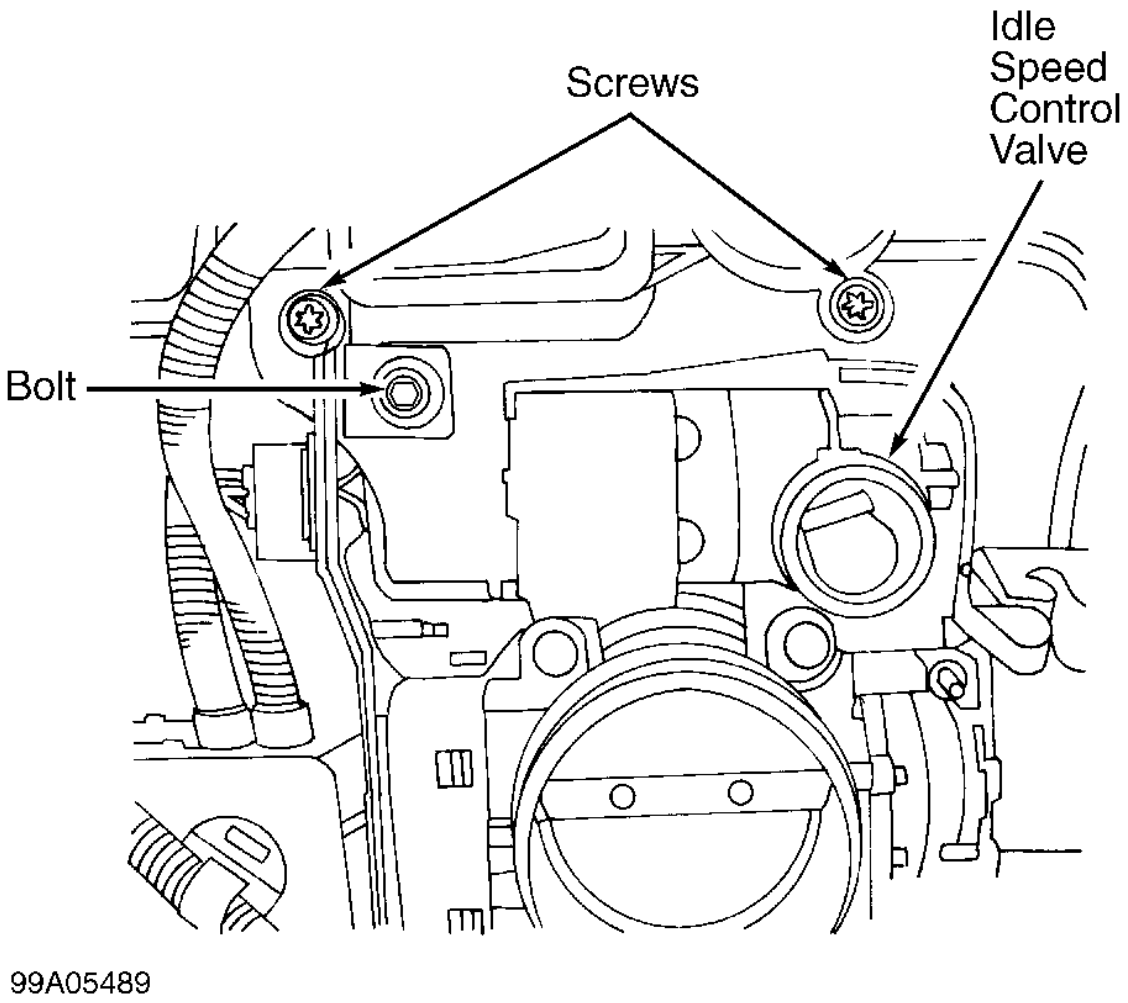


Fig. 164: Removing Idle Speed Control Valve (3-Series E46)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8)

Remove engine cover. See Fig. 34. Disconnect idle speed control valve electrical connector. Remove top of air cleaner. Remove idle speed control valve mounting strap. Pull actuator from throttle body. To install, reverse removal procedure.

INTAKE AIR TEMPERATURE SENSOR

Removal & Installation (3-Series - Z3)

Disconnect temperature sensor electrical connector. See Fig. 165. Press locking button and unclip temperature sensor. To install, reverse removal procedure.

Removal & Installation (3-Series - E46)

Open wiring conduit on lower section of microfilter housing on cowl. Feed out wiring from conduit. Remove 4 microfilter housing screws on cowl. Remove lower section of microfilter housing. See Fig. 109. Remove engine cover. Disconnect temperature sensor electrical connector. Press locking tab on side of temperature sensor. Remove temperature sensor from intake manifold. To install reverse removal procedure. To install, reverse removal procedure.

Removal & Installation (V8)

Remove throttle body. See THROTTLE BODY. Disconnect intake air temperature sensor electrical connector. Press locking tab on side of temperature sensor. Remove temperature sensor from intake manifold. To install, reverse removal procedure.

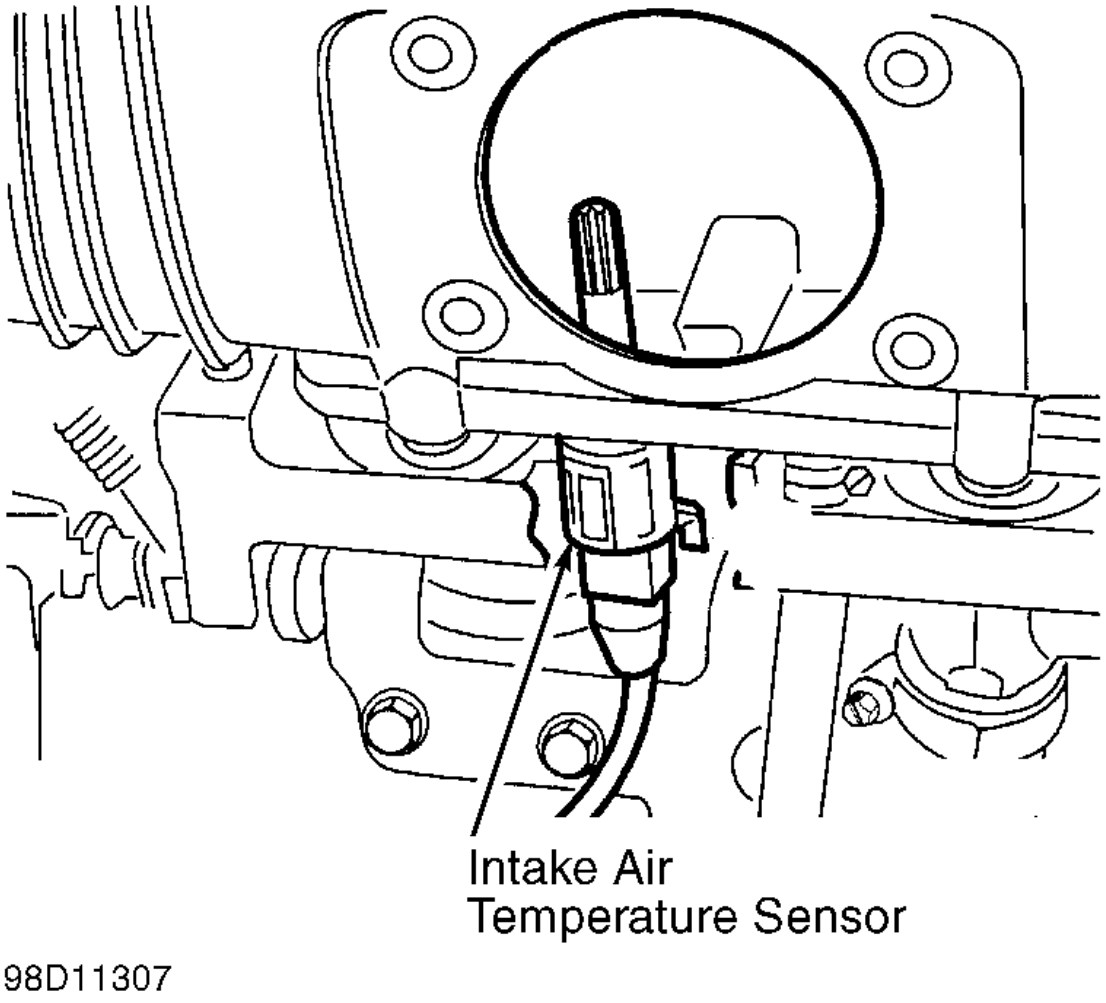
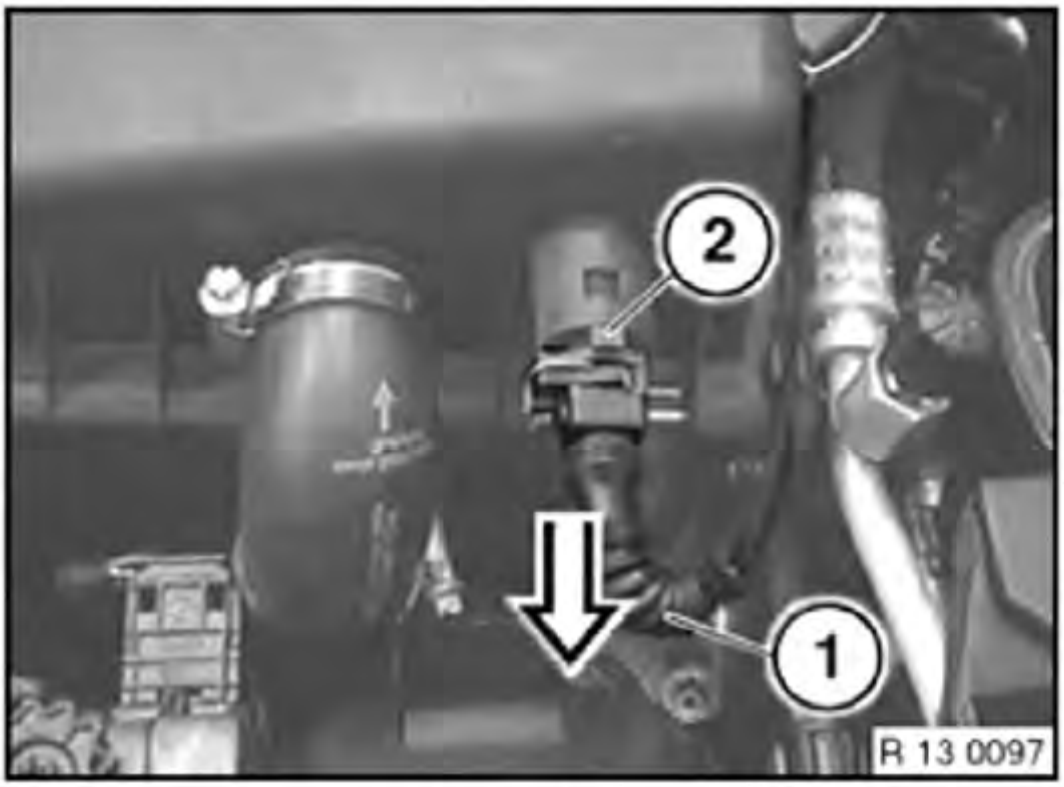


Fig. 165: Removing Intake Air Temperature Sensor (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

Turn ignition off. Press down retaining ring. Disconnect electrical connector. Unclip and remove temperature sensor. See Fig. 166. To install, reverse removal procedure.



1. Connector
2. Retaining Ring

G00125152

Fig. 166: Removing Intake Air Temperature Sensor (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

MASS AIRFLOW SENSOR

Removal & Installation (6-Cylinder)

Using scan tool, interrogate fault memory of DME control unit. Turn ignition off. Disconnect mass airflow sensor connector. Disconnect vacuum line from intake hose. Disconnect intake air hose clip. Disconnect clamps on intake filter housing. Remove intake hose with MAF sensor. See Fig. 167. To install, reverse removal procedure. Check gasket between MAF sensor and upper section of air filter housing for damage. Replace as necessary. Using scan tool, interrogate fault memory of DME control unit. Check for stored fault codes. Repair faults as necessary. Clear memory.

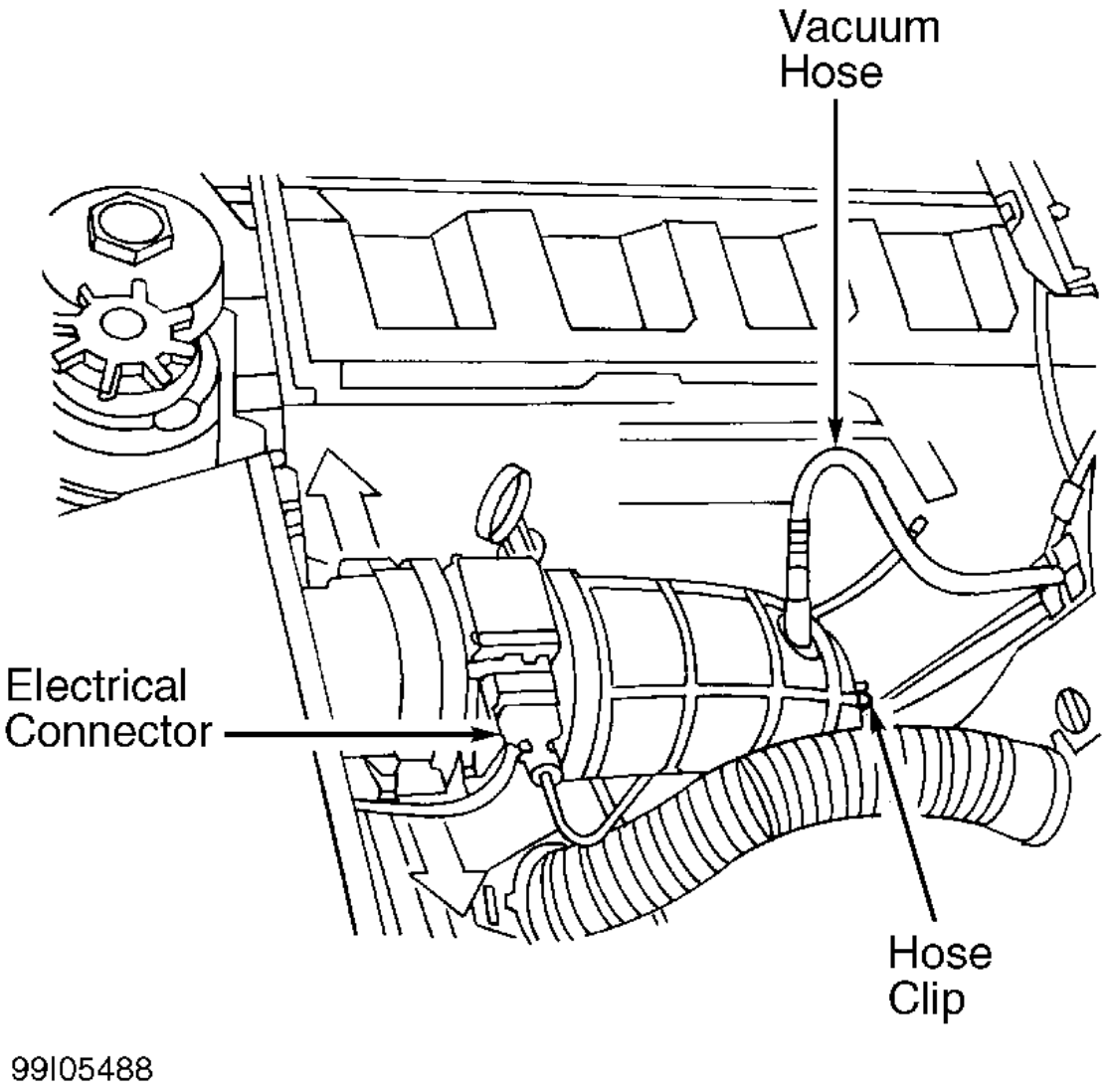


Fig. 167: Removing Mass Airflow Sensor (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8)

Using scan tool, interrogate fault memory of DME control unit. Turn ignition off. Loosen hose clamp and pull off air intake hose. Unclip and remove upper portion of air cleaner housing. Remove mass airflow sensor mounting bolts. To install, reverse removal procedure. Using scan tool, interrogate fault memory of DME control unit. Check for stored fault codes. Repair faults as necessary. Clear memory.

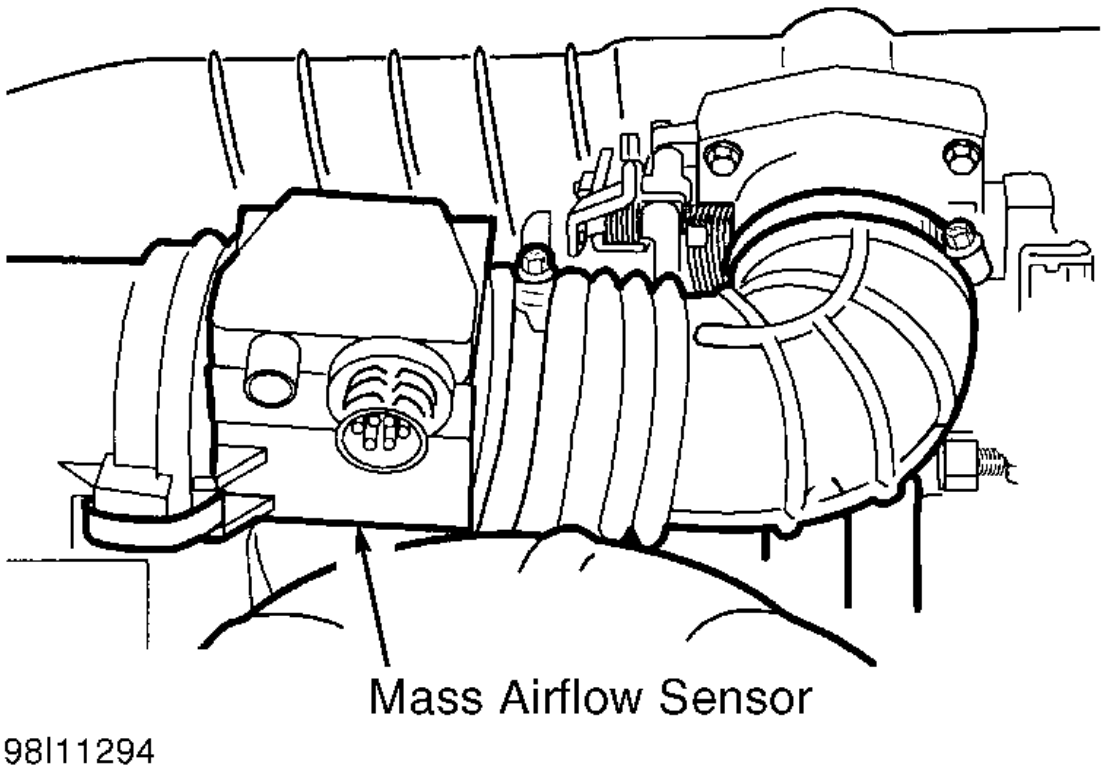
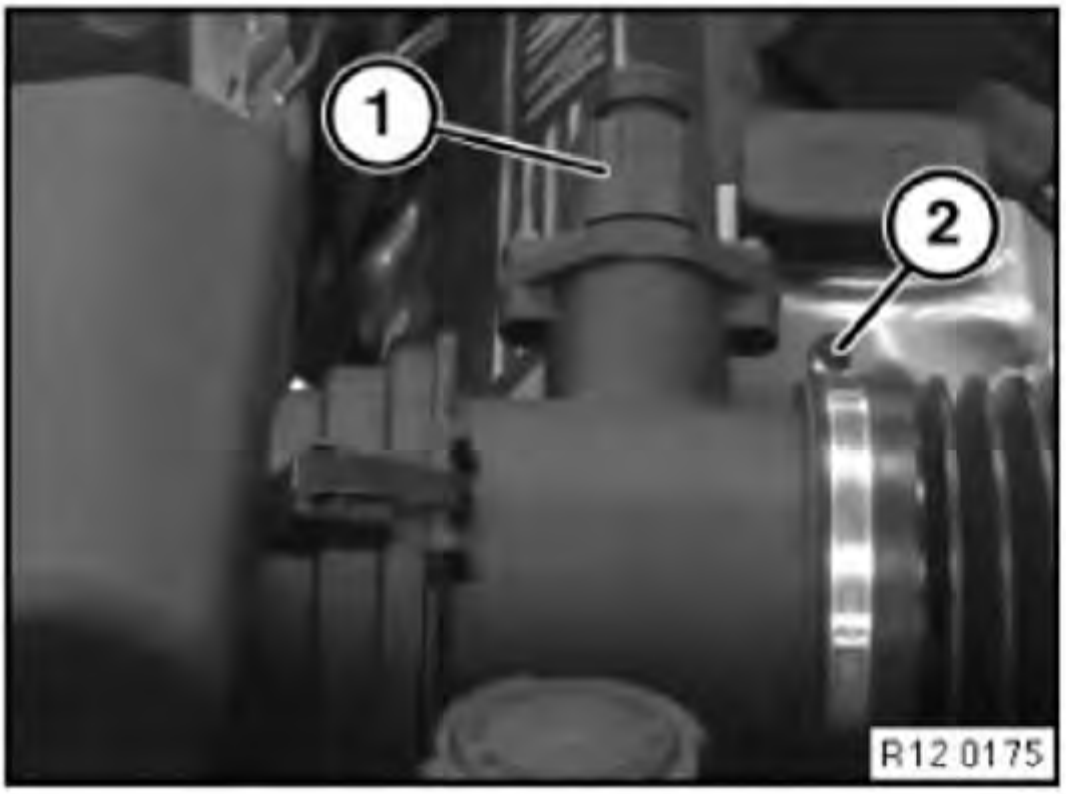


Fig. 168: Removing Mass Airflow Sensor (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

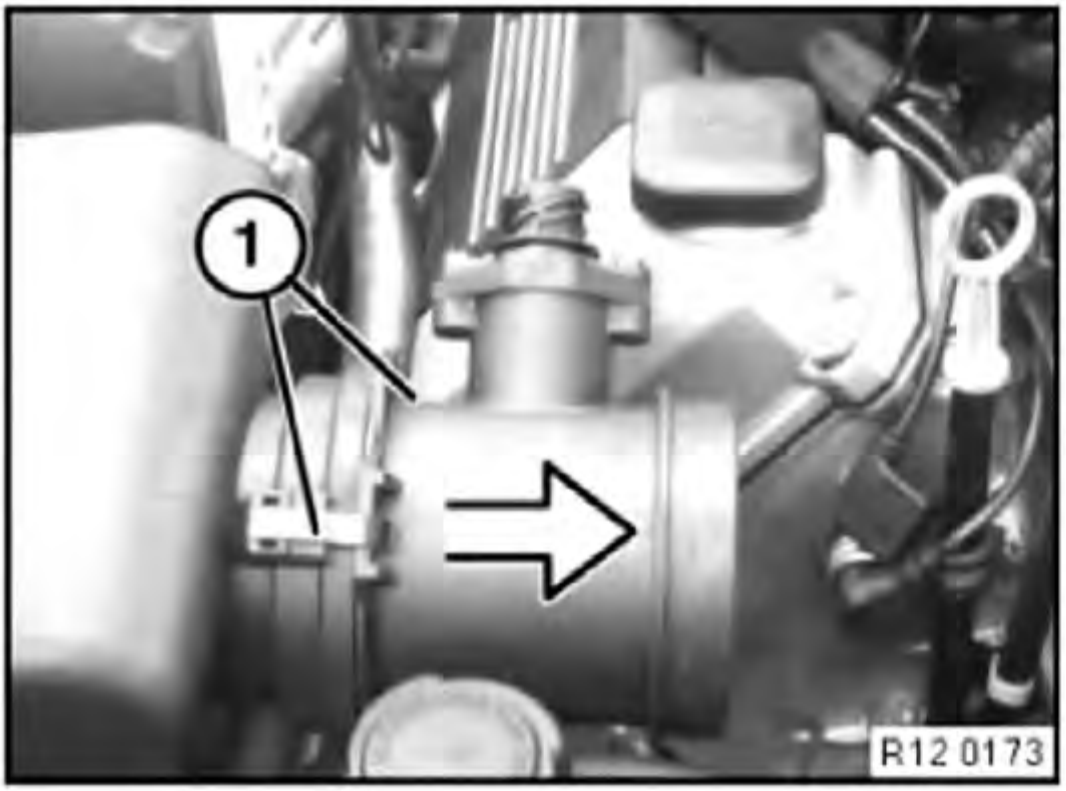
Using scan tool, interrogate fault memory of DME control unit. Turn ignition off. Disconnect mass airflow sensor connector. Loosen hose clip. See Fig. 169. Remove intake hose from mass airflow sensor. Remove clips and detach mass airflow sensor from air cleaner upper section. See Fig. 170. To install, reverse removal procedure. Check seal between mass airflow sensor and air cleaner upper section for damage. See Fig. 171. Replace as necessary. To ease assembly, coat seal with acid-free grease. Using scan tool, interrogate fault memory of DME control unit. Check for stored fault codes. Repair faults as necessary. Clear memory.



1. Connector
2. Hose Connector

G00125154

Fig. 169: Disconnecting Mass Airflow Sensor & Hose Connector (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Clips

G00125155

Fig. 170: Unclipping Mass Airflow Sensor (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Gasket

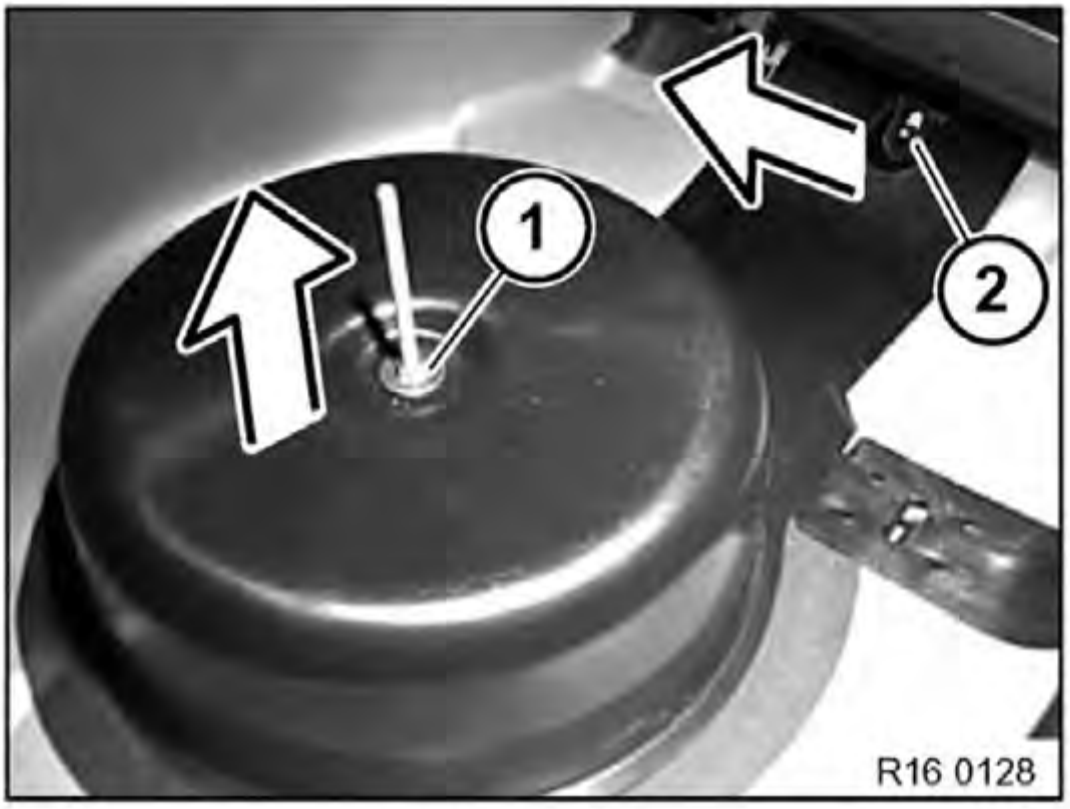
G00125156

Fig. 171: Checking Airflow Sensor Gasket (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

NON-RETURN VALVE

Removal & Installation (3-Series - Z3)

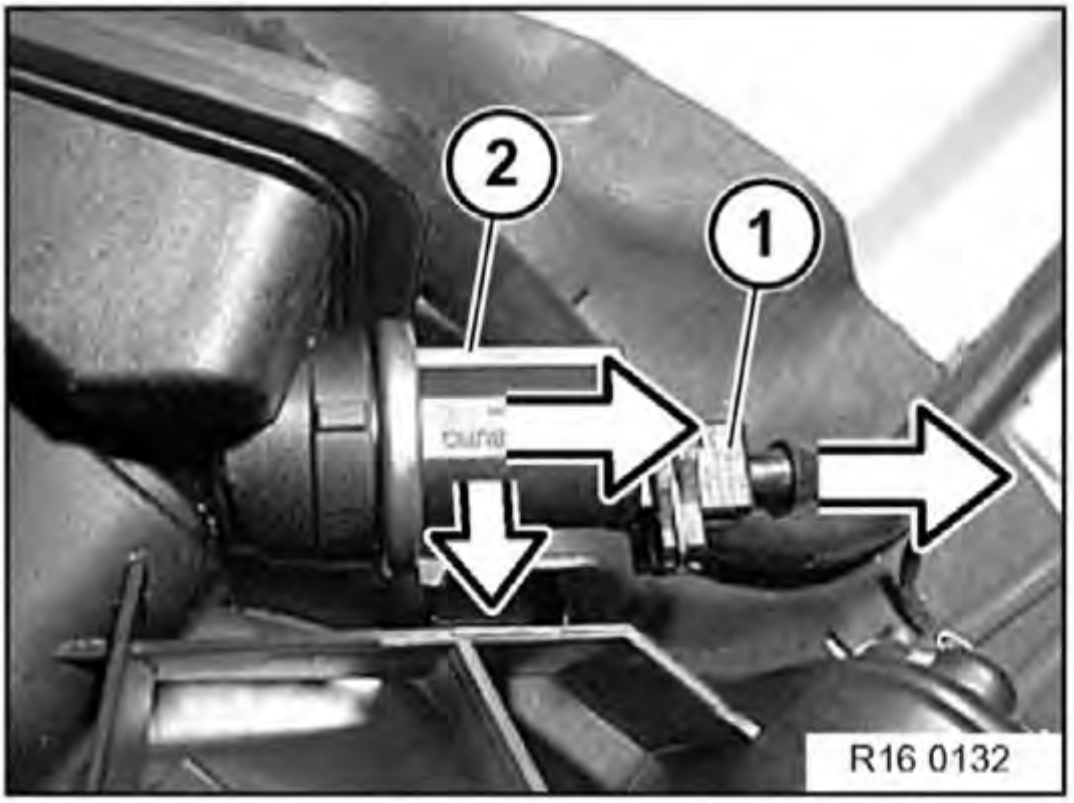
Unfasten hexagon nut and plastic nut. Tank off cover for activated carbon canister. Release plug connector and pull off activated carbon canister non-return valve. Press detent to side and pull activated carbon canister non-return valve out of activated carbon canister. To install, reverse removal procedure. Ensure position marks are aligned. Check sealing ring for damage and proper sealing. See Fig. 172-Fig. 174 .



1. Hexagon Nut
2. Plastic Nut

G00125097

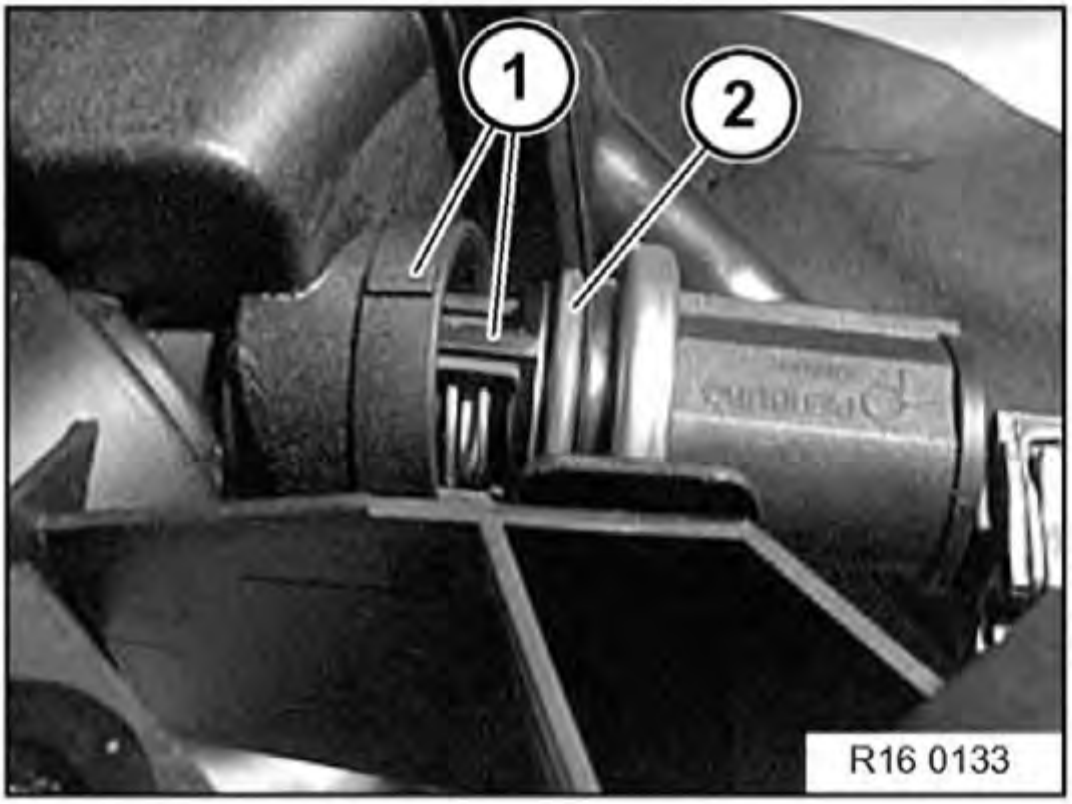
Fig. 172: Removing Hexagon & Plastic Nuts (3-Series - Z3)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Connector
2. Non-Return Valve

G00125098

Fig. 173: Removing Non-Return Valve (3-Series - Z3)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Position Marks
2. Sealing Ring

G00125099

Fig. 174: Checking Position Marks & Sealing Ring (3-Series - Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (M Roadster)

Unfasten plug connection and disconnect connector. Release screw and remove activated carbon filter non-return shut-off valve from carbon filter. See Fig. 175. To install, reverse removal procedure. Ensure connector is locked in place. Check sealing rings.

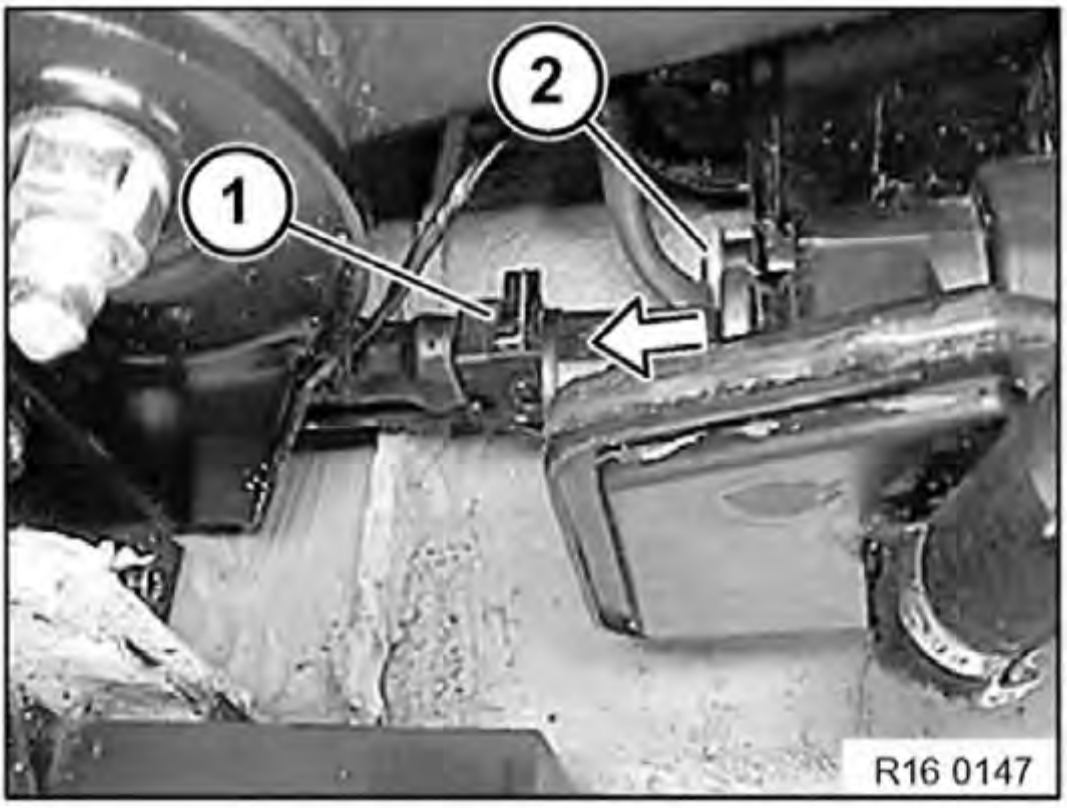


Fig. 175: Removing Activated Carbon Canister Non-Return Valve (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12 - Cylinders 1-6)

Open clips. Unfasten hose clip from inlet hose for air pump. Remove hose. Disconnect plug connection. Unfasten hose clip. Remove complete top right section of intake filter housing. Remove fan coupling with fan. Unclip and remove oil drip tray. Unfasten hose clip to non-return valve for cylinder bank 7-12 and remove pressure hose. Unfasten hose clip on non-return valve for cylinder bank 1-6 and remove pressure hose. Unclip bracket for coolant vent hose. Unfasten screws in non-return valve for cylinders 1-6 to pressure pipe. Remove non-return valve. Unfasten hose clip on pressure pipe for air pump. Remove hose. Unfasten pressure pipe from brackets and remove. To install, reverse removal procedure. Replace gaskets. Ensure spacer disc is fitted under bracket to water pump to prevent pressure pipe from being subjected to tension.

Removal & Installation (V12 - Cylinders 7-12)

Compress retainer and pull off electrical connector. Open clips. Unfasten hose clip on intake hose for air pump. Remove hose. Disconnect plug connection. Unfasten hose clip. Remove complete upper section of intake filter housing. Unclip and remove oil drip tray. Unfasten hose clip to non-return valve for cylinder bank 7-12 and remove pressure hose. Unfasten hose clip on non-return valve for cylinder bank 1-6 and remove pressure hose. Unfasten hose clip on pressure pipe for air pump. Remove hose. Unfasten screws in non-return valve for cylinders 7-12 on pressure pipe, then remove non-return valve. To install, reverse removal procedure. Replace gaskets. Ensure spacer disc is fitted under bracket to water pump to prevent pressure pipe from being subjected to tension.

THROTTLE BODY

Removal & Installation (6-Cylinder)

1. Remove air filter housing. Remove mass airflow sensor. See MASS AIRFLOW SENSOR. Disconnect oil pressure and oil temperature switch connectors located next to oil filter housing. Remove wiring conduit mount screws. Unclip fuel lines and oil level sensor wire from retainer on oil dipstick tube. Disconnect oil return line from oil dipstick tube. Loosen screw and remove oil dipstick tube.
2. Move wiring conduit aside and disconnect electrical connector on throttle. Remove 4 bolts, throttle body and gasket. See Fig. 176. To install, reverse removal procedure. Replace oil dipstick tube and throttle body "O" rings.

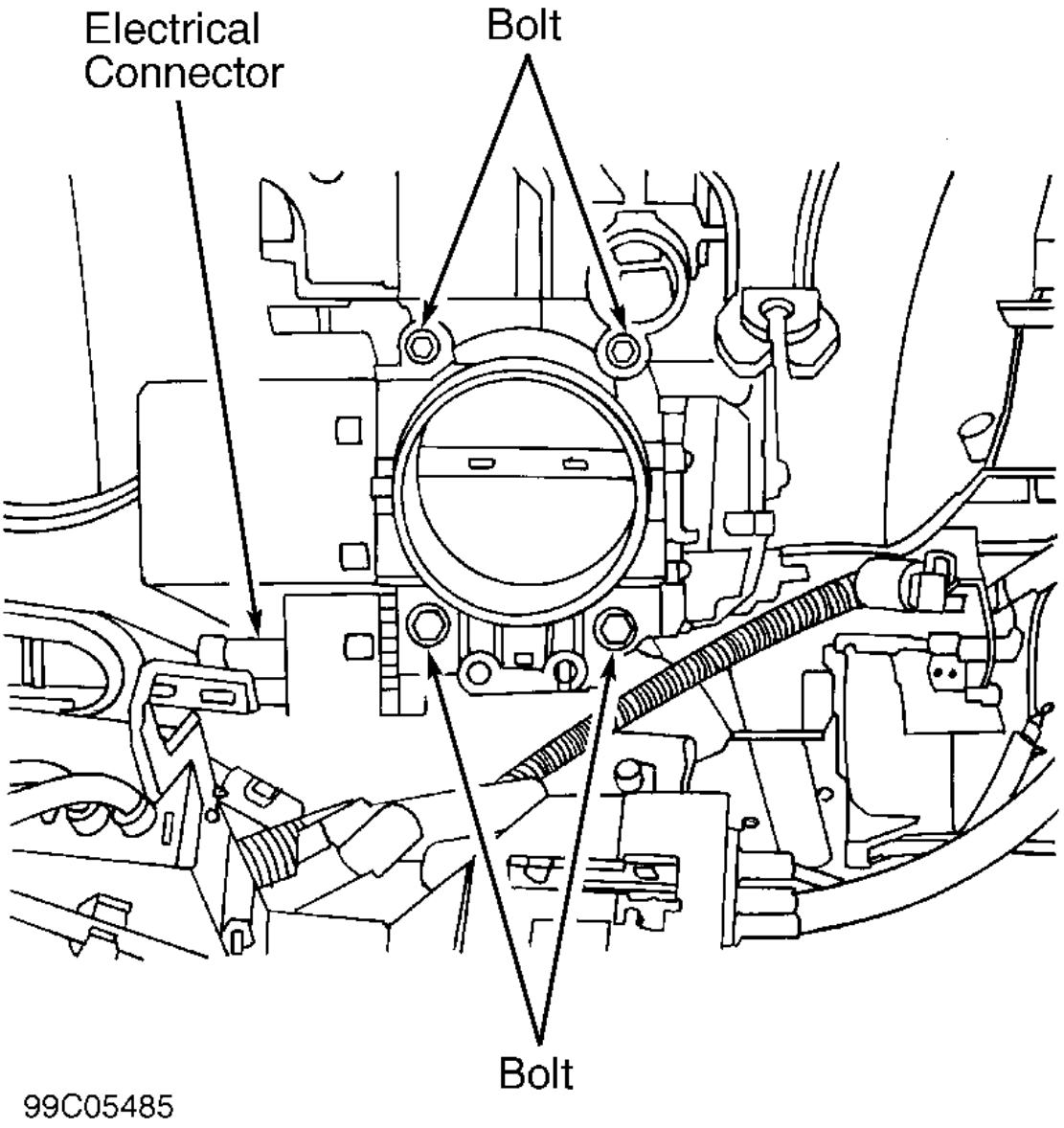
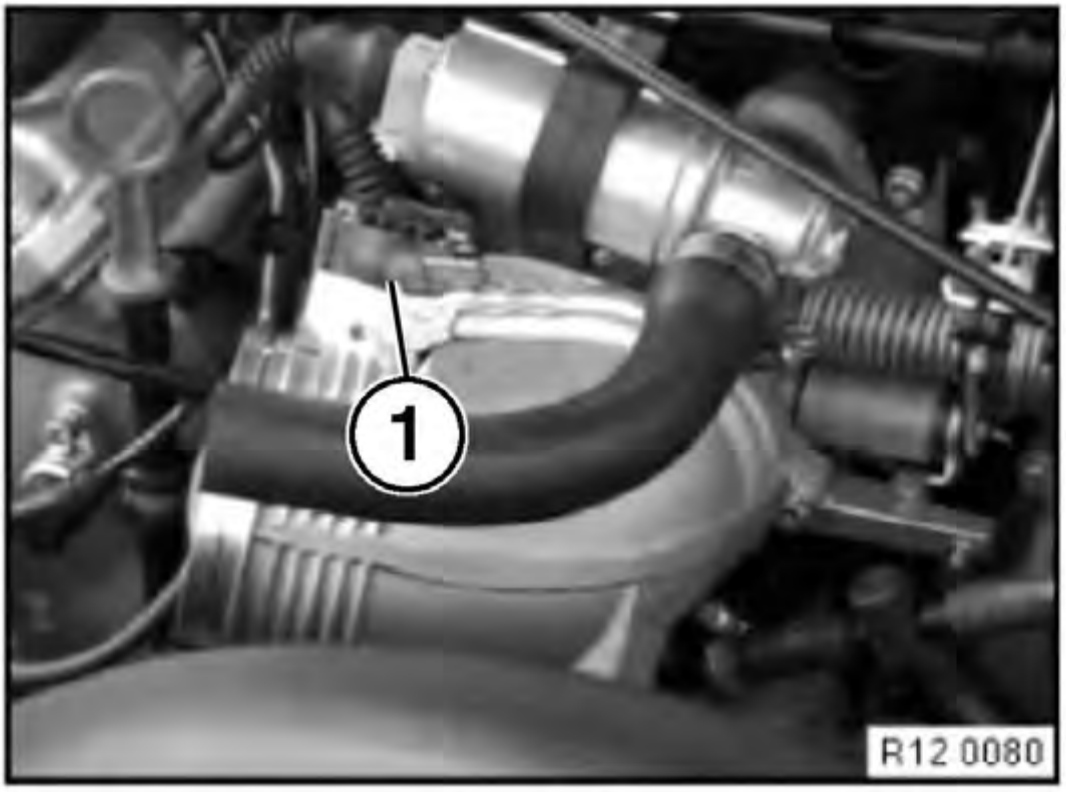


Fig. 176: Removing Throttle Body (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8)

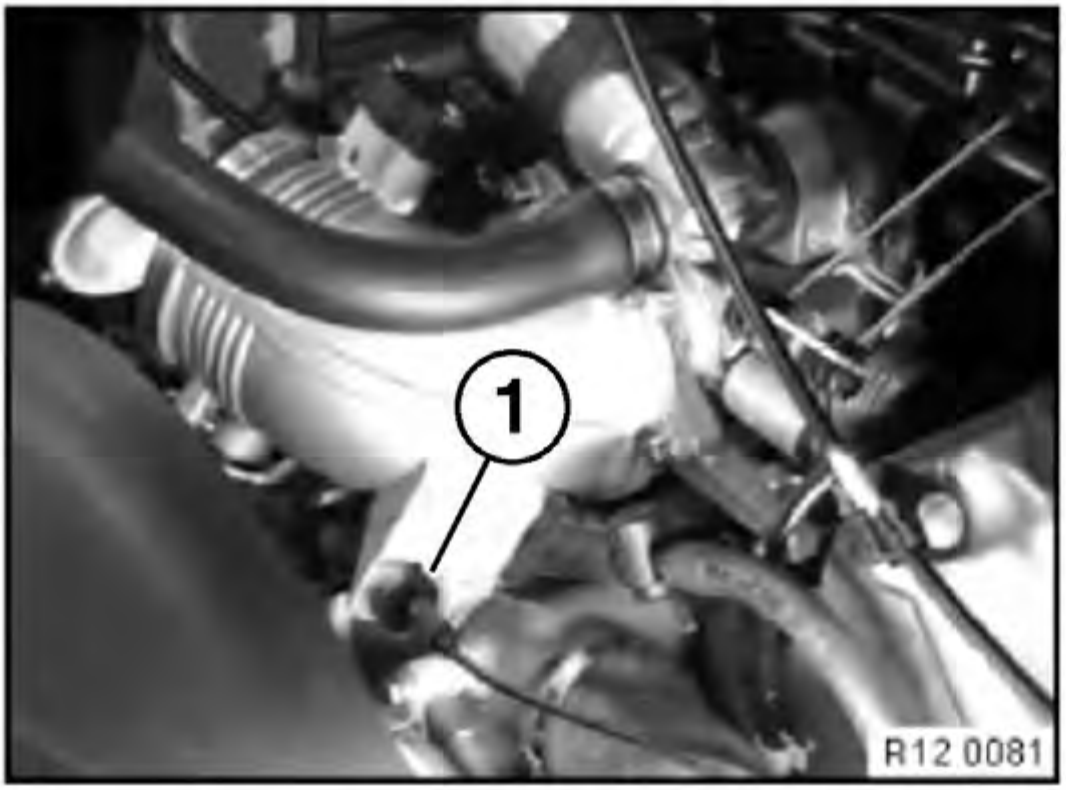
1. Remove engine cover. See Fig. 34. Disconnect mass airflow sensor, idle speed control actuator and throttle position sensor connectors. See Fig. 177. Remove top of air cleaner housing.
2. Disconnect throttle cable, hoses and idle speed control actuator from throttle body. See Fig. 178. Remove 6 throttle body bolts. See Fig. 179. Remove throttle body. To install, reverse removal procedure.



1. Connector

G00131480

Fig. 177: Disconnecting Idle Speed Control & Throttle Position Sensor Connectors (V8)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Cable

G00131481

Fig. 178: Disconnecting Throttle Cable (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

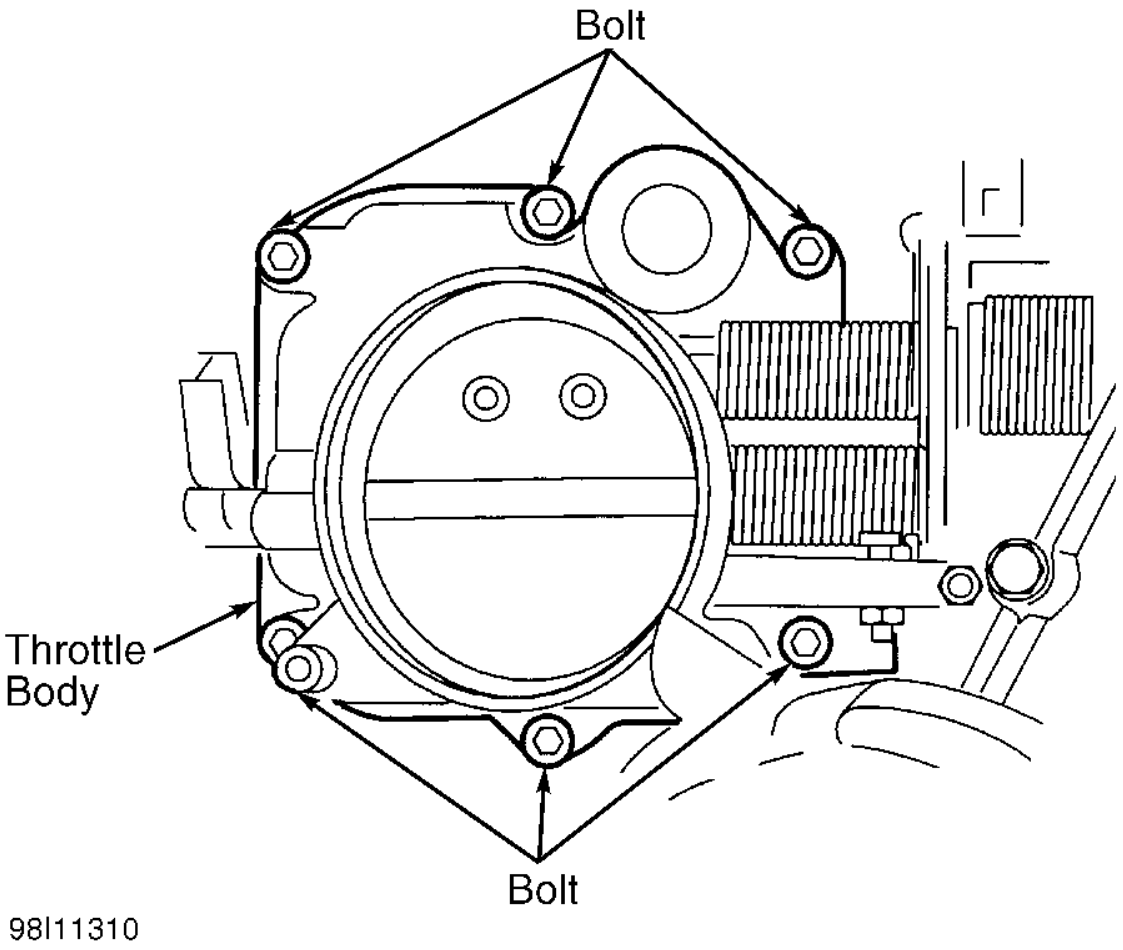
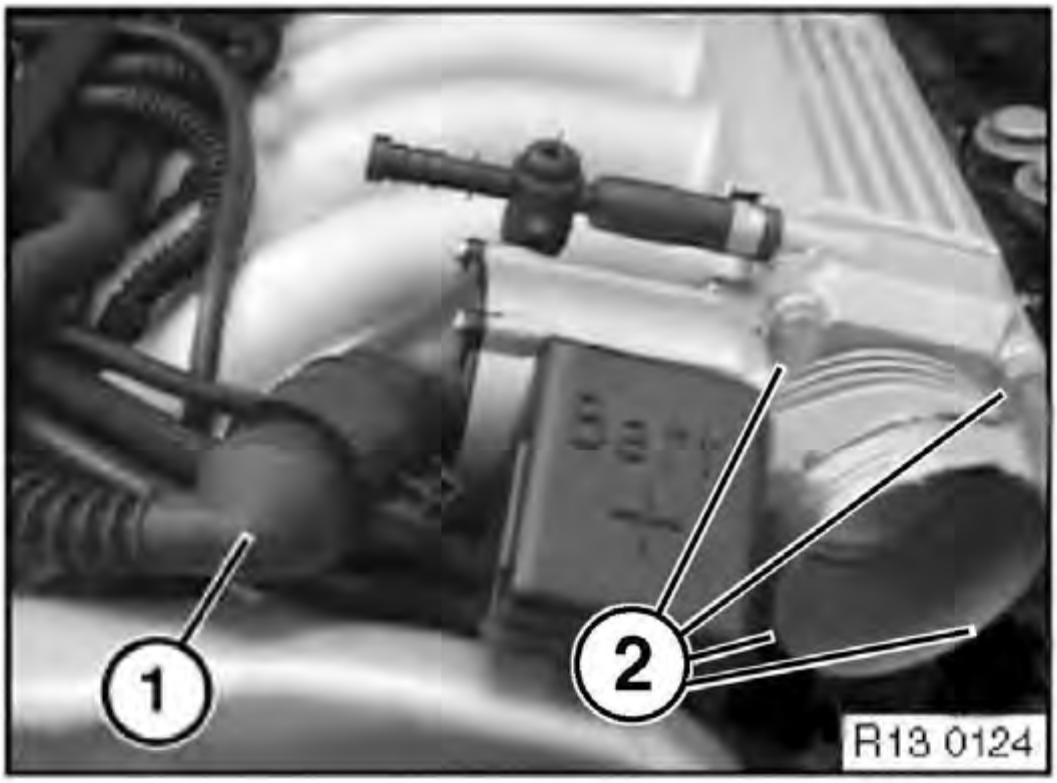


Fig. 179: Removing Throttle Body (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

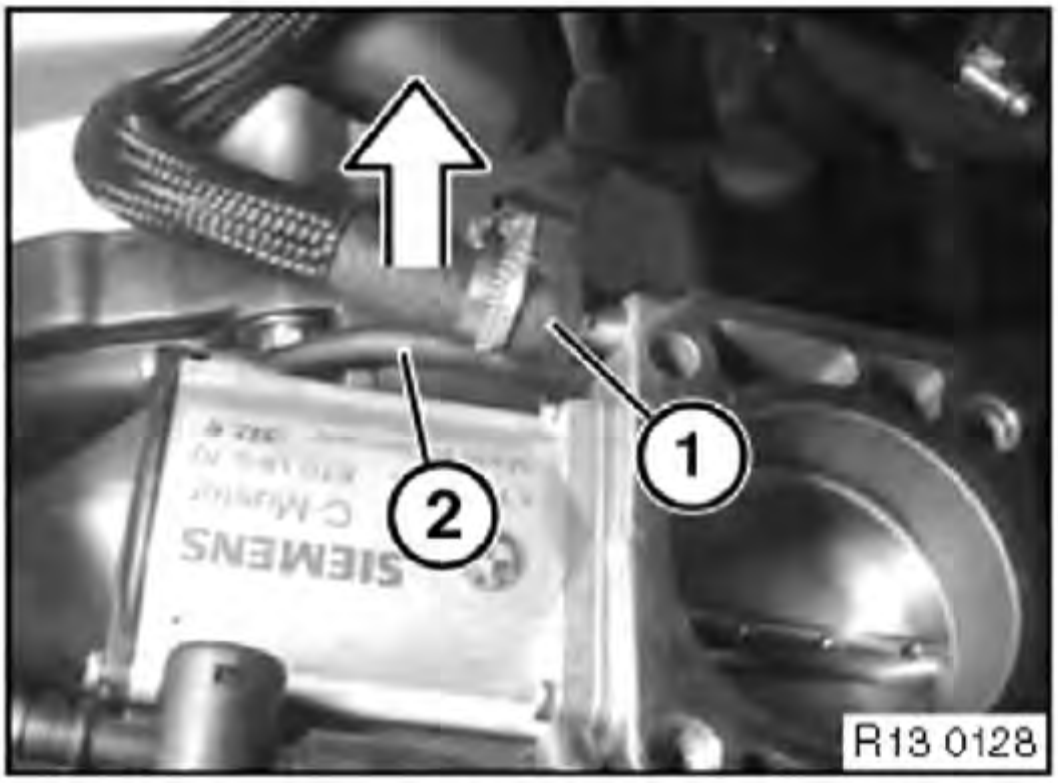
Turn ignition off. Disconnect batteries. Remove engine cover. To remove throttle body for cylinders 7-12, remove suction hose from throttle body. Disconnect electrical connector. Remove bolts. Remove bracket with positive battery terminal. Remove hose clamp and withdraw hose. Remove hose. If installed, remove faulty air valve. To remove throttle body on cylinders 1-6, remove suction hose on throttle body. Disconnect electrical connector. Remove bolts. Remove hose clip and remove hose. See Fig. 180-Fig. 183 . Remove air relief valve. To install, reverse removal procedure. Replace gasket, fuel hose to tank vent valve, and hose clips.



1. Electrical Connector
2. Bolts

G00125148

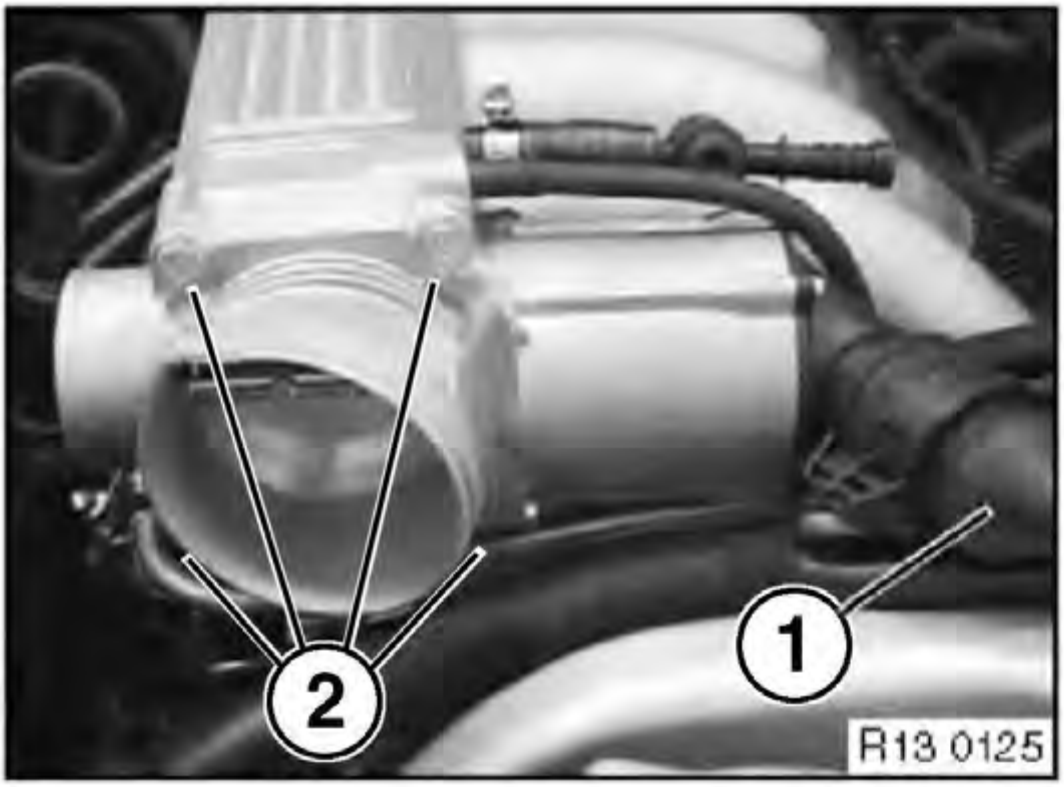
Fig. 180: Removing Throttle Body Bolts (Cylinders No. 7-12) (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Clamp
2. Hose

G00125149

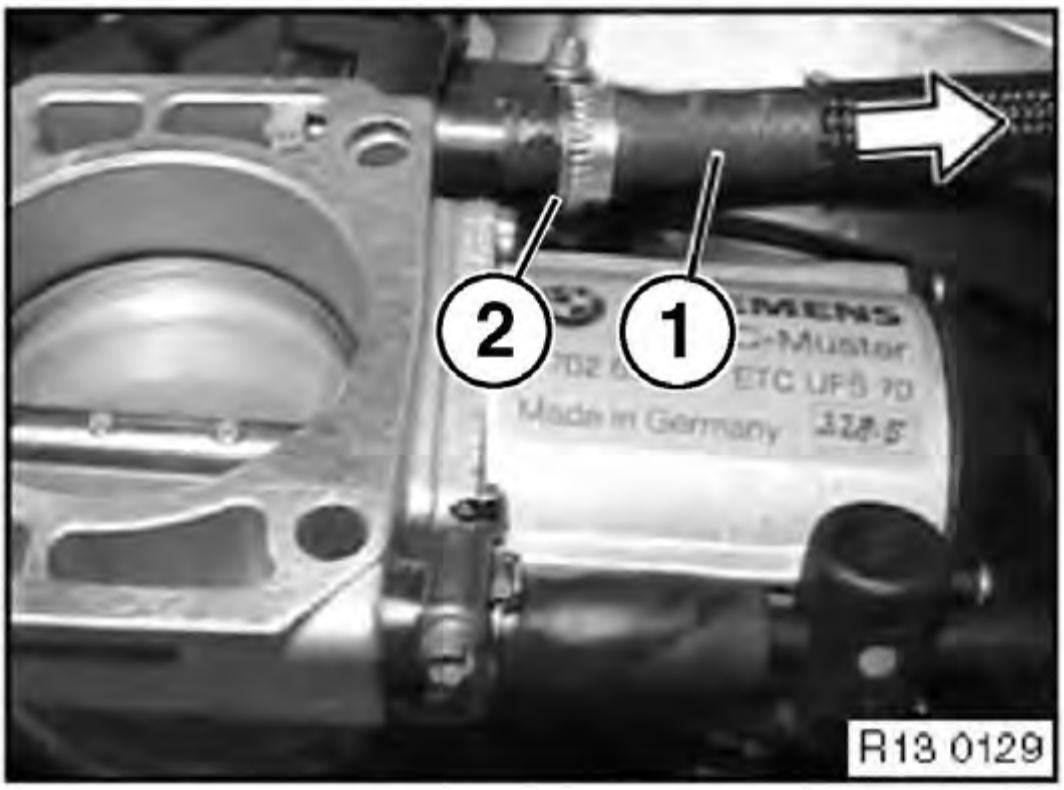
Fig. 181: Removing Fuel Hose & Clamp (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Electrical Connector
2. Bolts

G00125150

Fig. 182: Removing Throttle Body Bolts (Cylinders No. 1-6) (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Hose
2. Clamp

G00125151

Fig. 183: Removing Throttle Body Fuel Hose (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

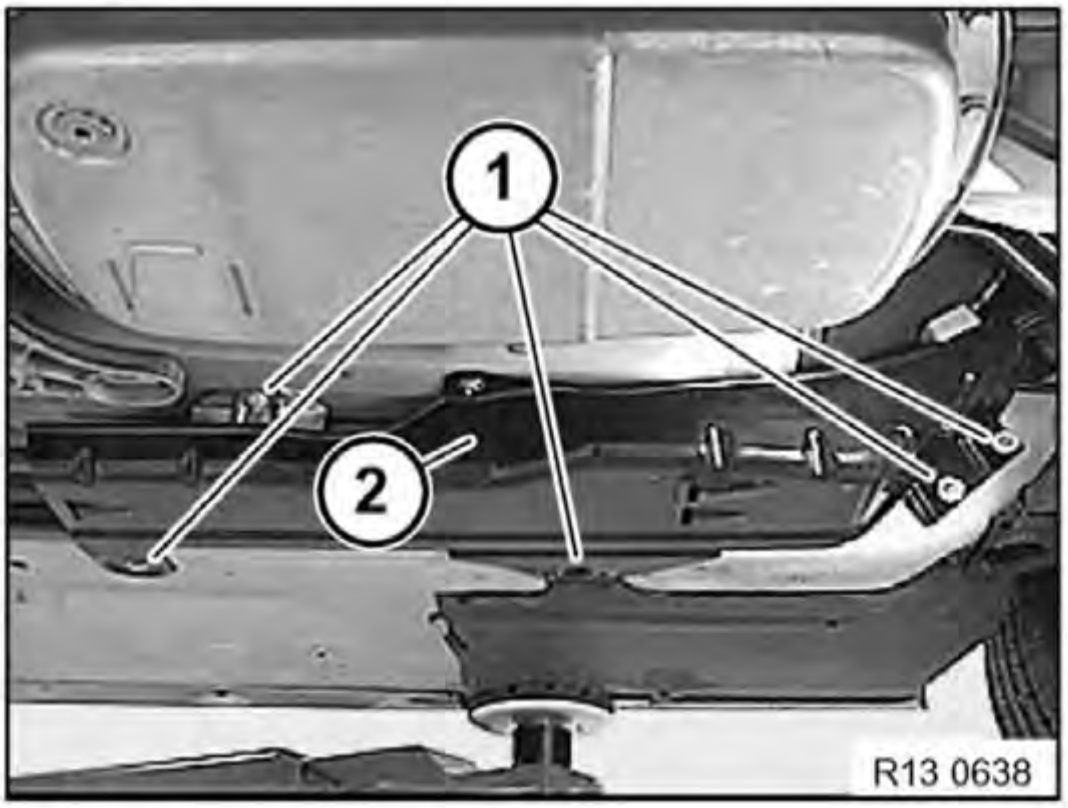
THROTTLE POSITION SENSOR

NOTE: For throttle position sensor information, go to THROTTLE BODY.

3/2 WAY VALVE (6-CYLINDER)

Removal & Installation

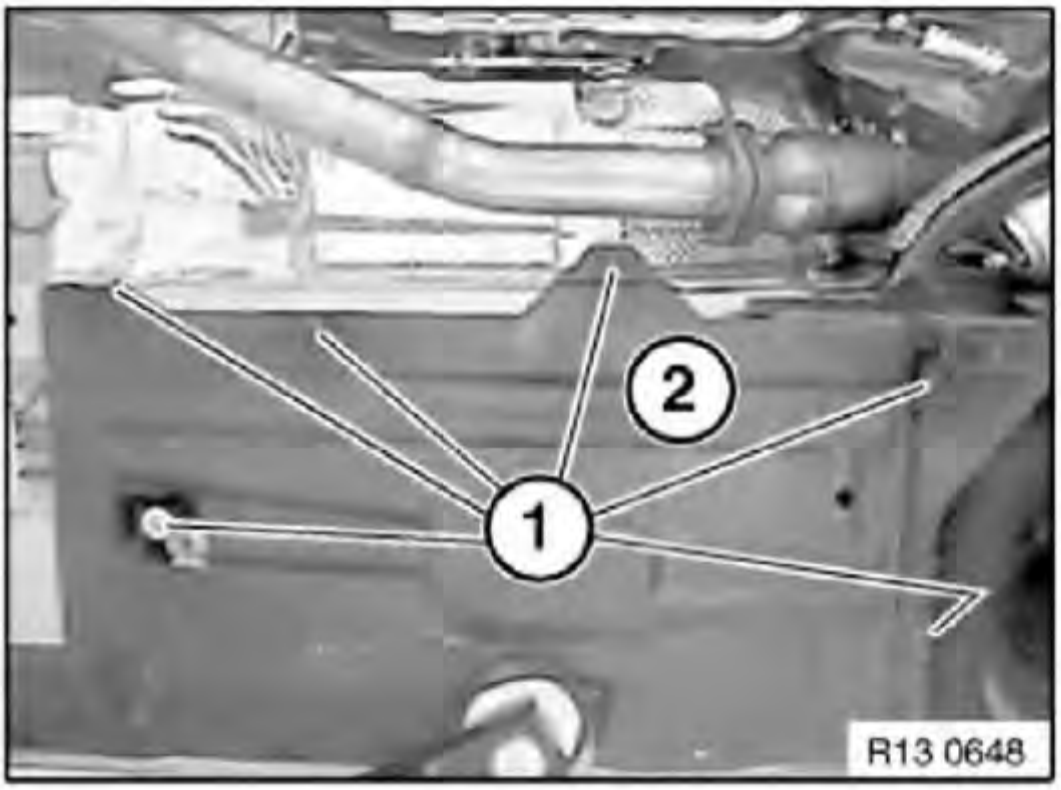
1. Remove bolts and cover under vehicle. Clamp fuel lines with Clamp (13 3 010).
2. Interrogate fault memory of DME control unit. Turn ignition off. On 3-Series, remove underbody cover. See Fig. 184. On 5-Series, remove front underbody cover on left side. See Fig. 185. On 7-Series, remove front underbody cover on right side. Release screws and clips. Remove cover. See Fig. 110.
3. On all models, seal off all fuel hoses using Clamp (13 3 010). See Fig. 186. Disconnect vacuum hose from pressure regulator. Remove hose clips No. 2-5 and remove fuel hoses. Catch escaping fuel. Disconnect electrical connector. Remove nuts and 3/2 way valve. See Fig. 187. To install, reverse removal procedure. On 3-Series, ensure seal is correctly located. See Fig. 188. Replace fuel lines and hose clips.



1. Bolts
2. Undercover

G00131531

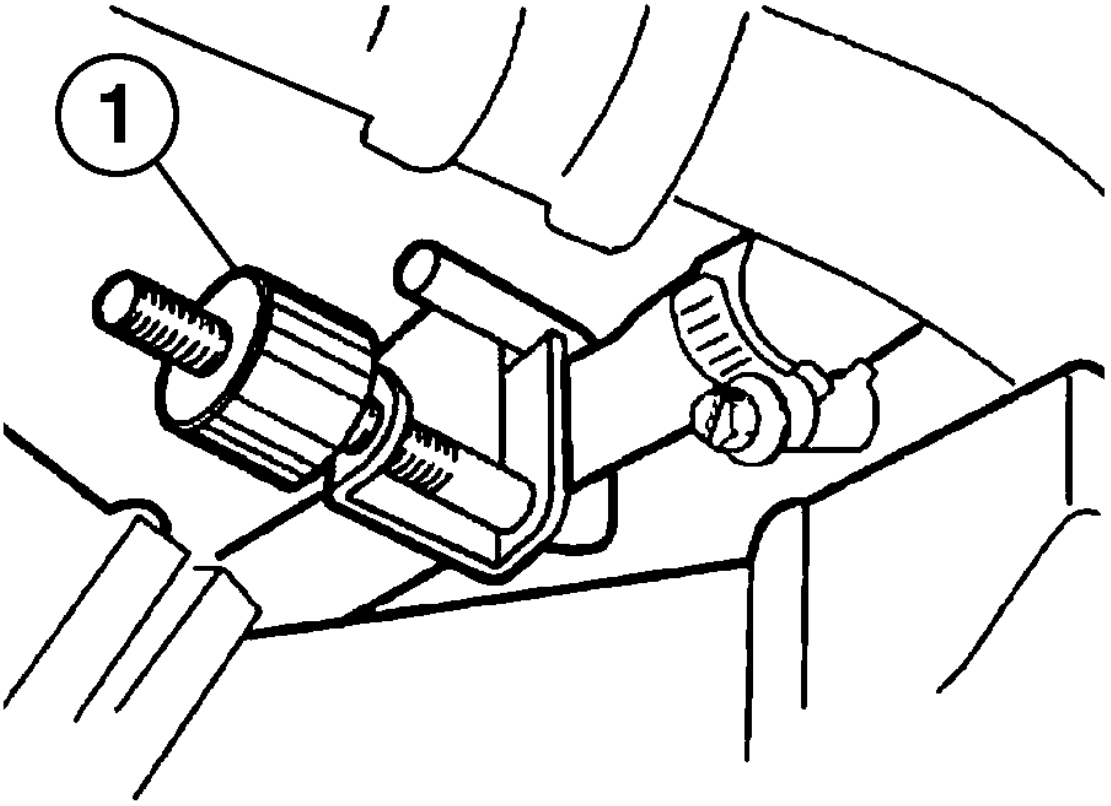
Fig. 184: Removing Underbody Cover (3-Series) (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Screws
2. Underbody Cover

G00125140

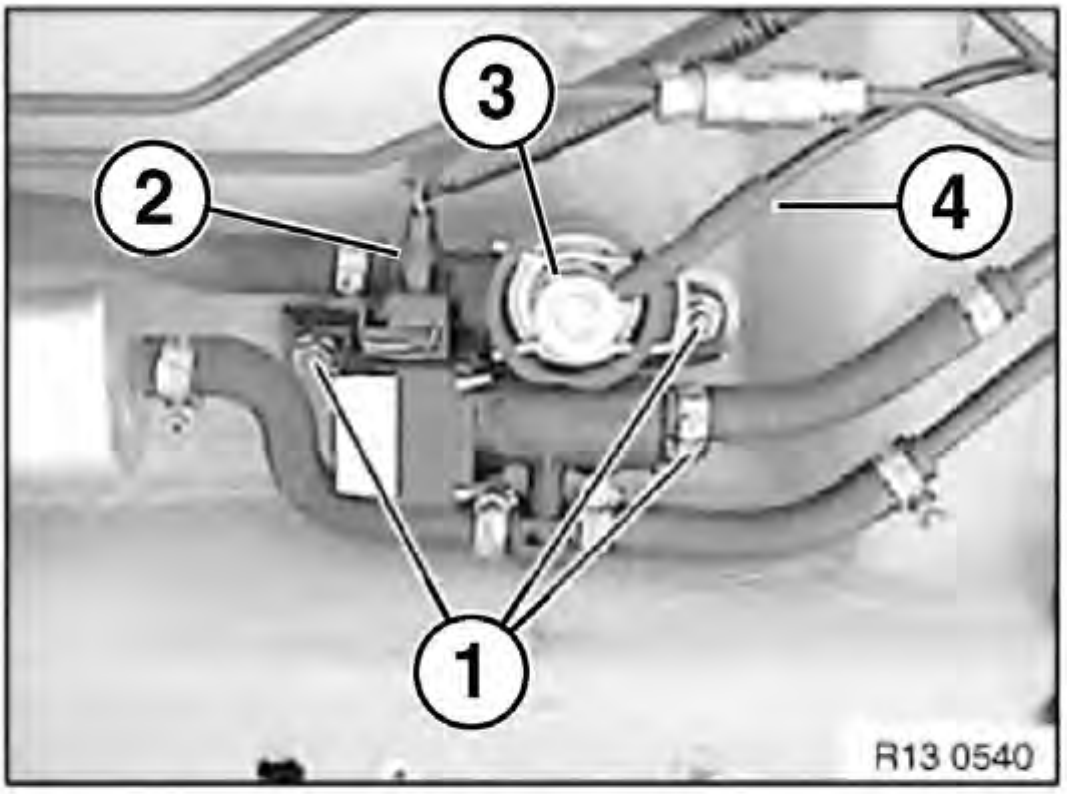
Fig. 185: Removing Underbody Cover (5-Series) (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Clamp

G00125141

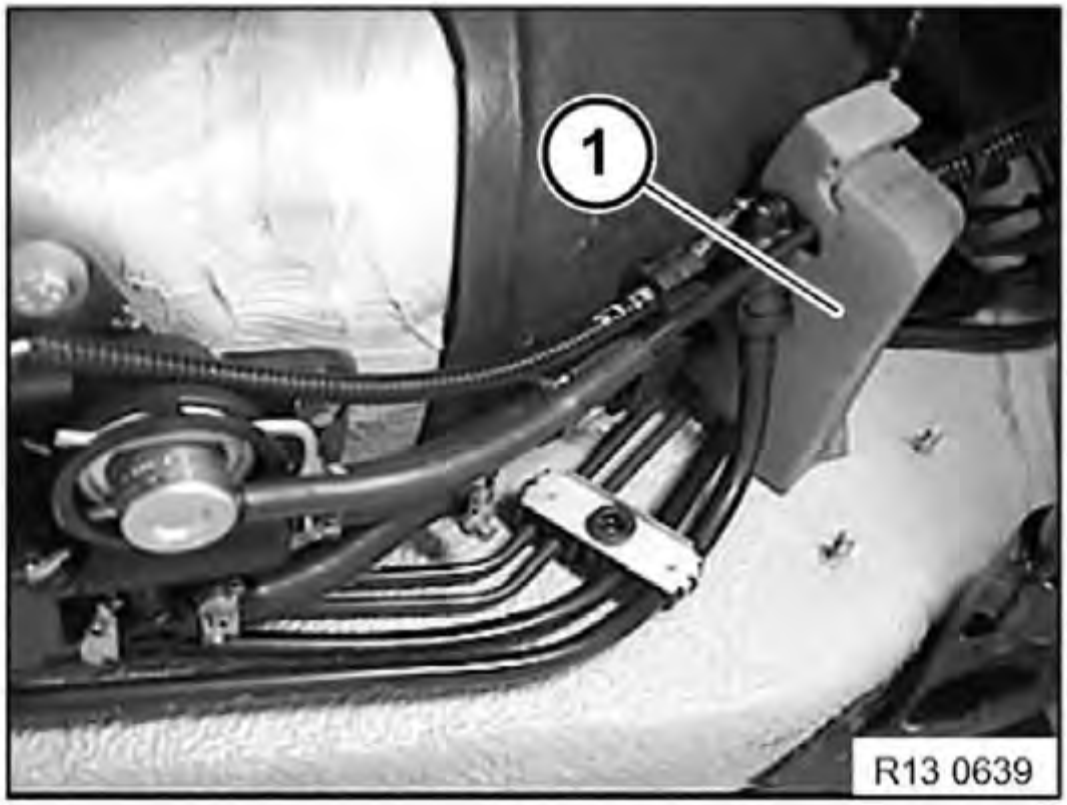
Fig. 186: Sealing Fuel Hoses With Clamp (13 3 010) (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Nuts
2. Plug Connection
3. 3/2 Way Valve
4. Vacuum Hose

G00125142

Fig. 187: Removing 3/2 Way Valve (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Seal

G00131532

Fig. 188: Locating Seal (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

EMISSION SYSTEMS & SUB-SYSTEMS

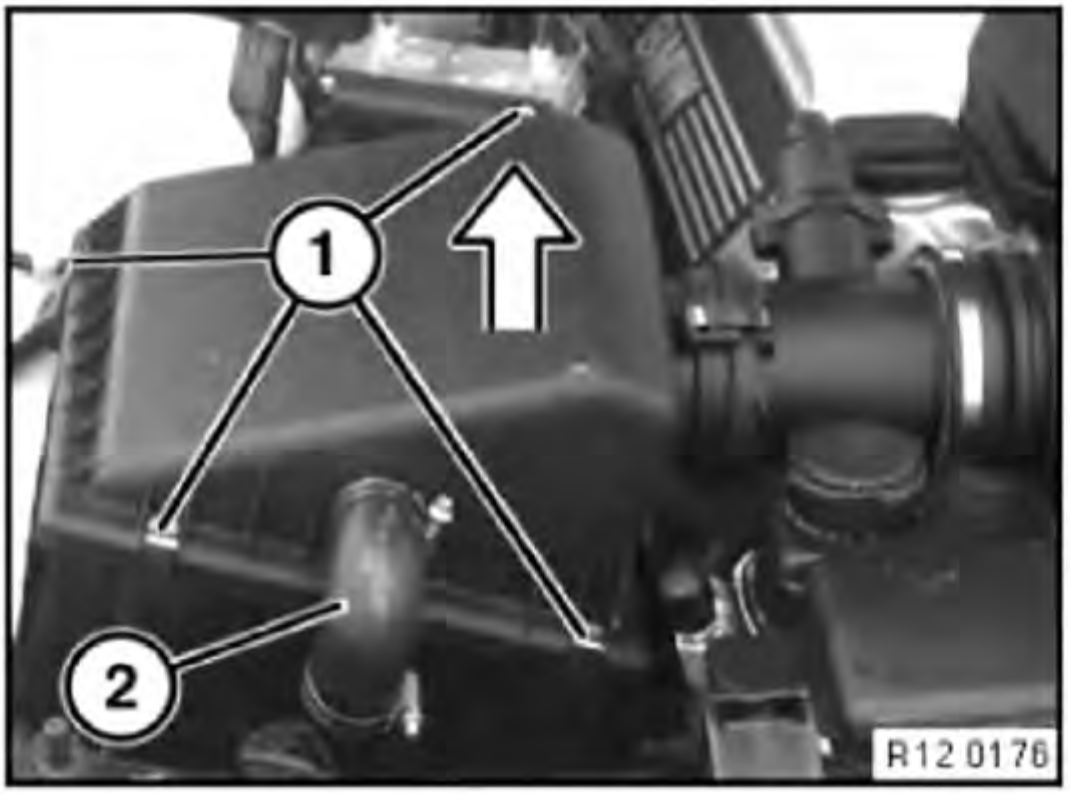
AIR FILTER ELEMENT

Removal & Installation (6-Cylinder)

Pull up cover. Remove filter insert. To install, reverse removal procedure. Clean outside air tray and clean air tray before installation of new air filter element. To install, reverse removal procedure.

Removal & Installation (V8)

Open clips on air filter housing. See Fig. 189. Disconnect plug connection on temperature sensor for intake air. Remove air filter insert. To install, reverse removal procedure.



1. Clips
2. Air Hose

G00131485

Fig. 189: Removing Air Filter Housing (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

Turn ignition off. For cylinder bank 1-6, press down interlock and disconnect plug connection. See Fig. 48. Open clips, release hose clamp and withdraw hose. Disconnect electrical connection. Lift off upper section of air filter housing and remove. See Fig. 59. For cylinder bank 7-12, open clips, release hose clamp and withdraw hose. Disconnect electrical connection. Lift off upper section of air filter housing and remove. See Fig. 60. Remove air filter insert. To install, reverse removal procedure.

AIR PUMP (V12)

Removal & Installation

Remove right intake filter housing. See RIGHT INTAKE FILTER HOUSING. Unfasten hose clip and remove hose. Unfasten hose clip on engine support. Unfasten screw. Remove bolts. Remove cover. Remove right foglights. Disconnect plugs. Unfasten hose clips and remove hoses. From top of vehicle, remove screws, pump and bracket by pulling downward. To install, reverse removal procedure.

CARBON FILTER

Removal & Installation (3-Series - Z3)

Release connection nipple with Special Tool (16 1 040) and pull off tank venting valve. Pull hose off carbon canister. Unclip filter vent. Release screws and remove activated carbon canister. See Fig. 190-Fig. 193 . To install, reverse removal procedure.

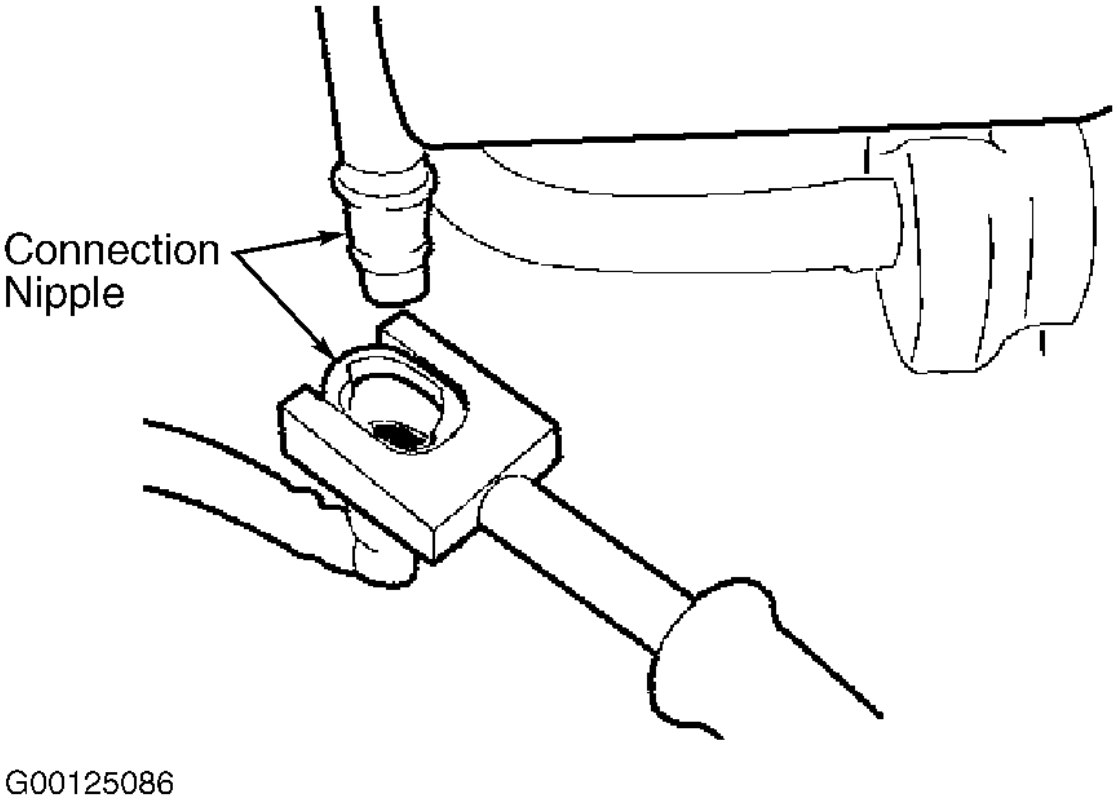


Fig. 190: Removing Connection Nipple (3-Series - Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

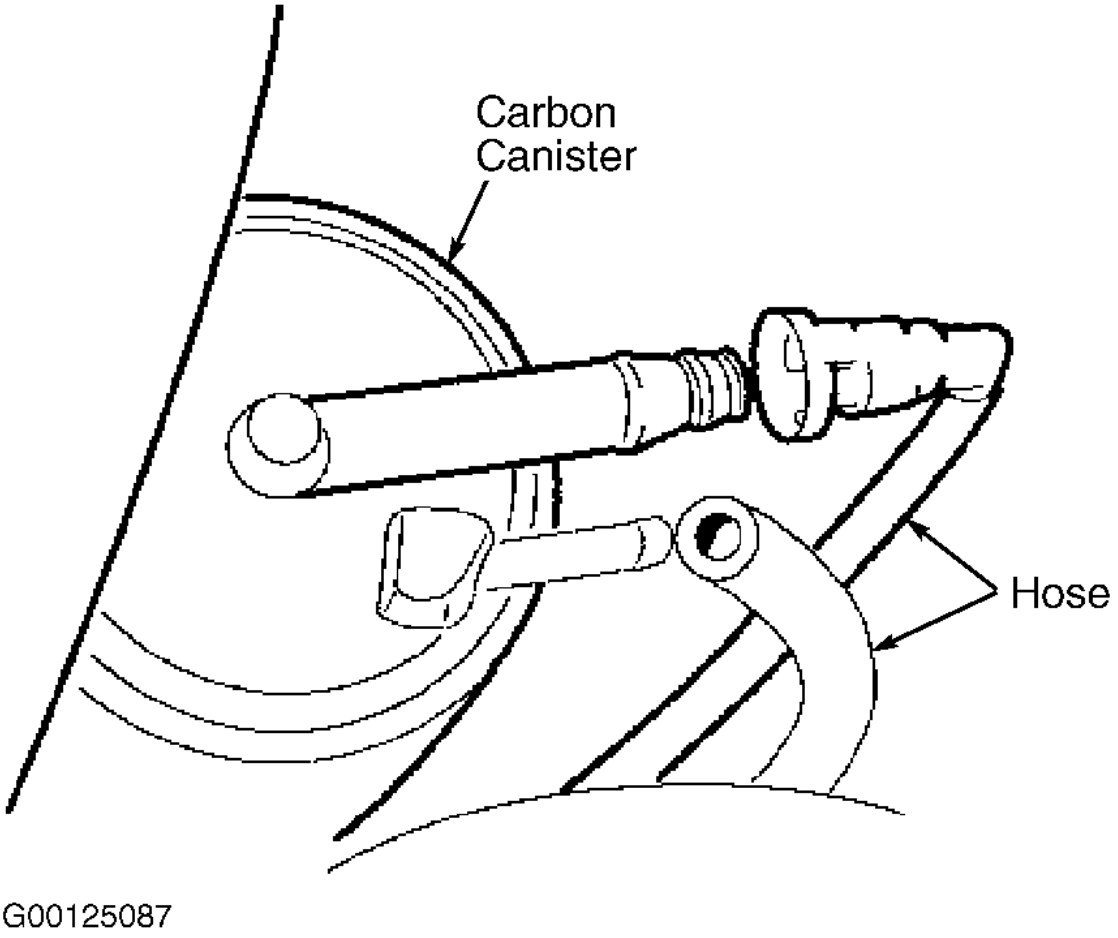


Fig. 191: Removing Hose From Carbon Canister (3-Series - Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

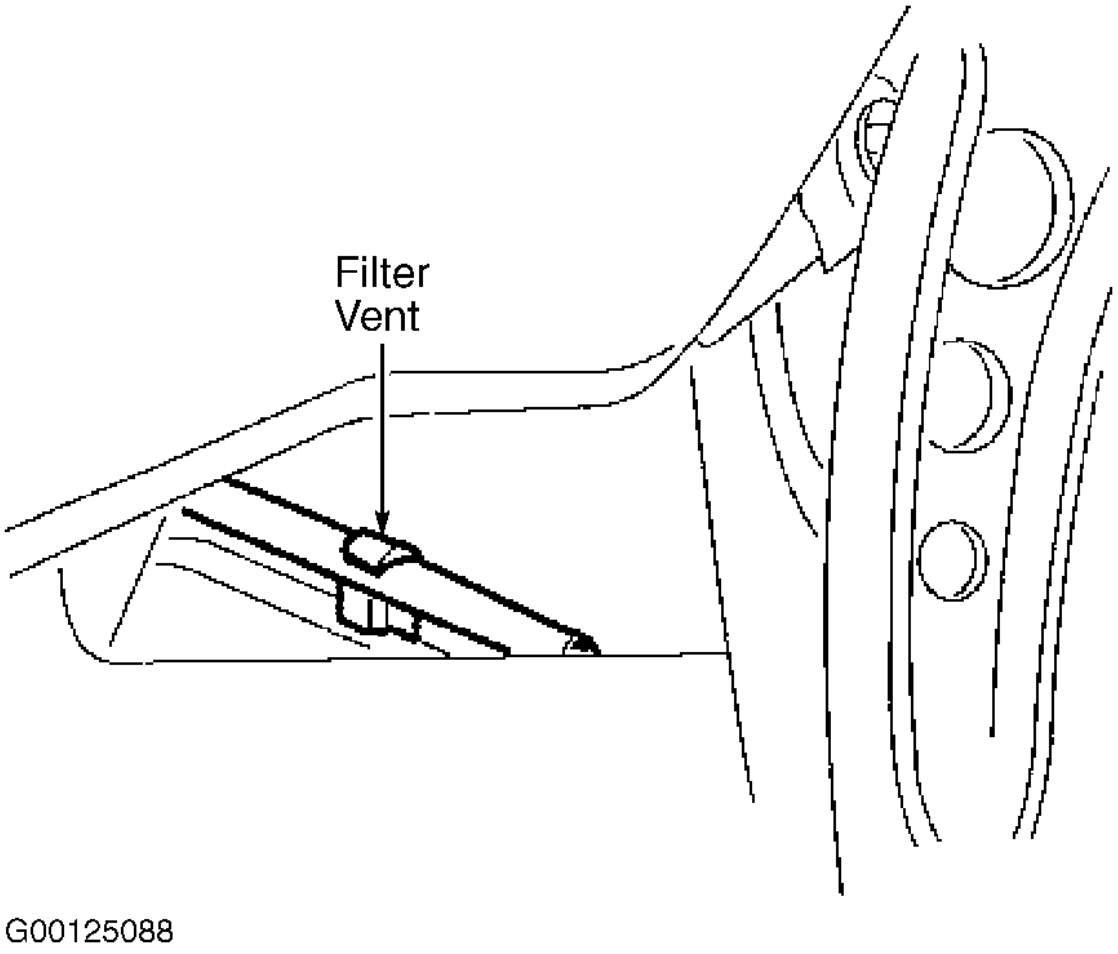


Fig. 192: Removing Filter Vent (3-Series - Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

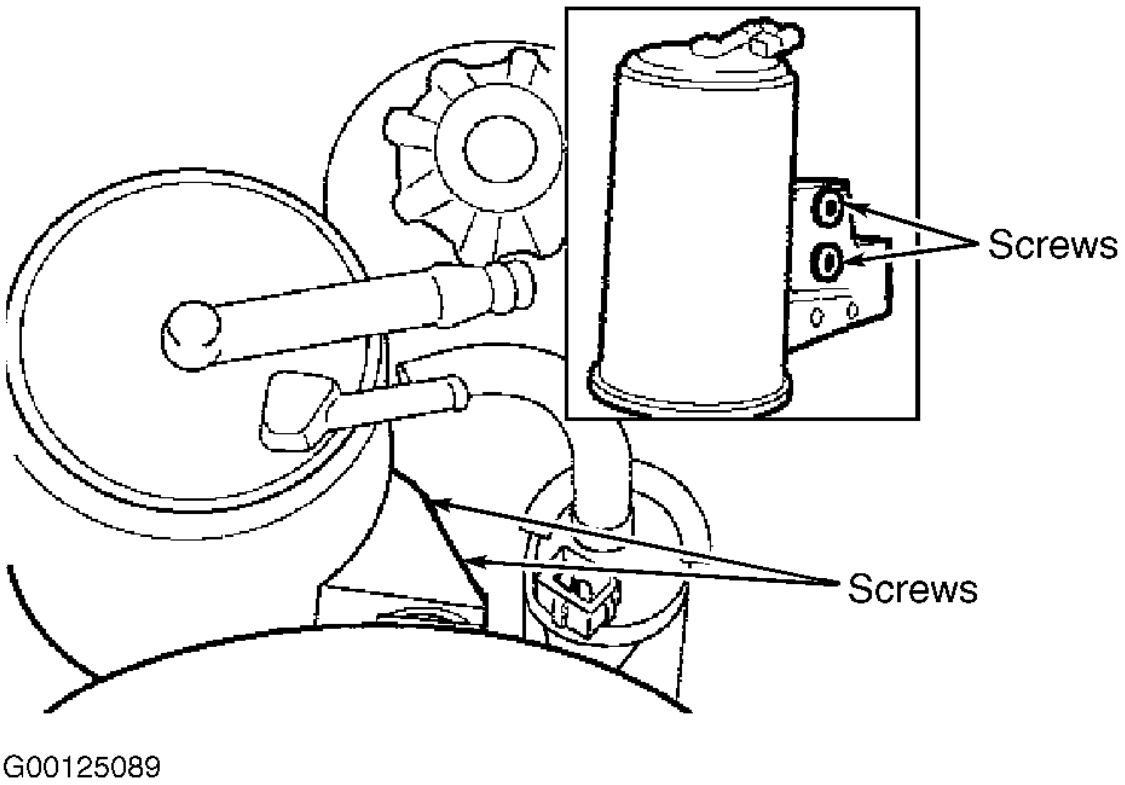
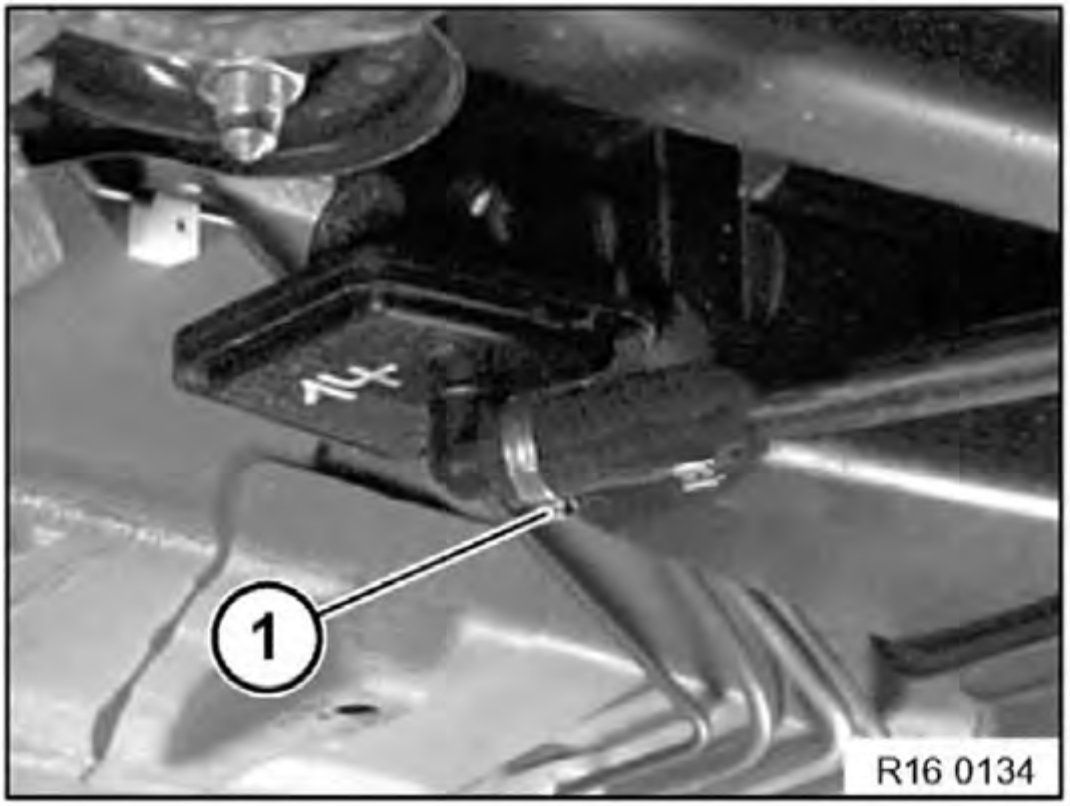


Fig. 193: Removing Carbon Canister Screws (3-Series - Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (M Roadster)

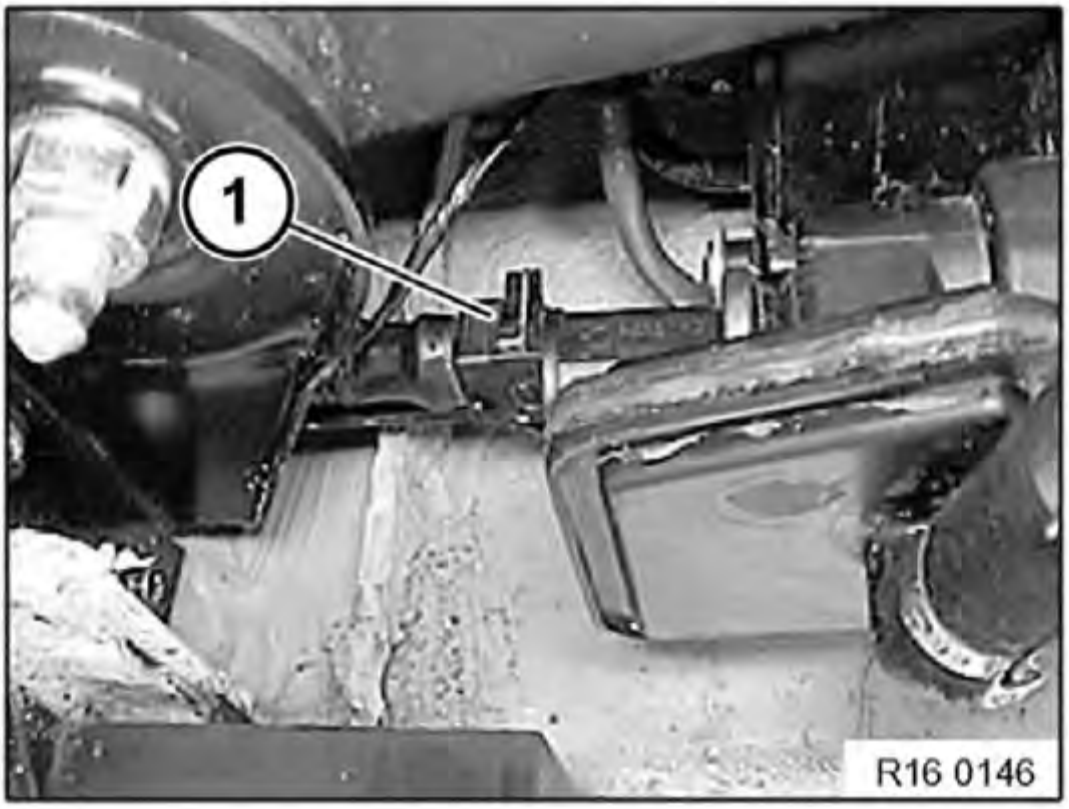
Open hose clip and pull off evaporation line. Unfasten plug connection and disconnect connector. Unfasten plastic nut. Unfasten hexagon bolt and take off clamping strap. Carefully lower activated carbon canister. Actuate unlocking fixture and pull off vent line. Unclip tank vent line and vent line on front side of activated carbon canister. Press together ring to release detent. Pull off tank vent line. Remove activated carbon canister. See Fig. 194-Fig. 199 . To install, reverse removal procedure. Replace hose clips. Ensure electrical connector is locked into place. Ensure vent lines are clipped in correct position.



1. Evaporation Line

G00125090

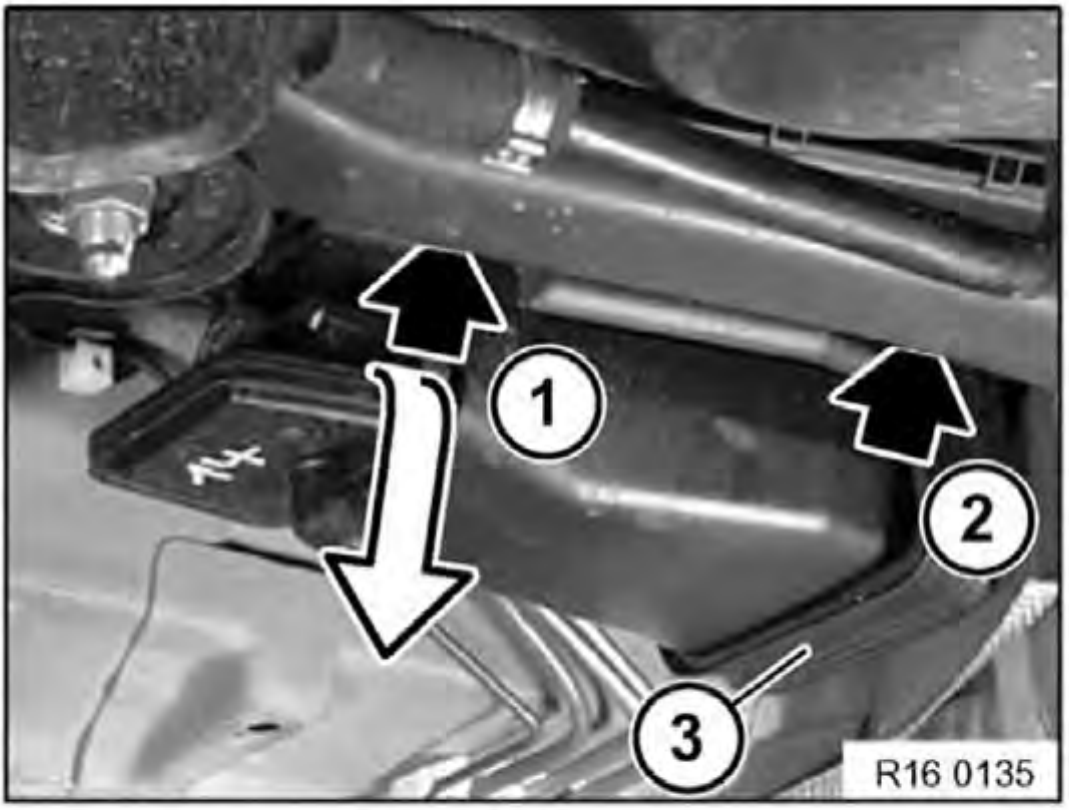
Fig. 194: Removing Evaporation Line (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Plug Connection

G00125091

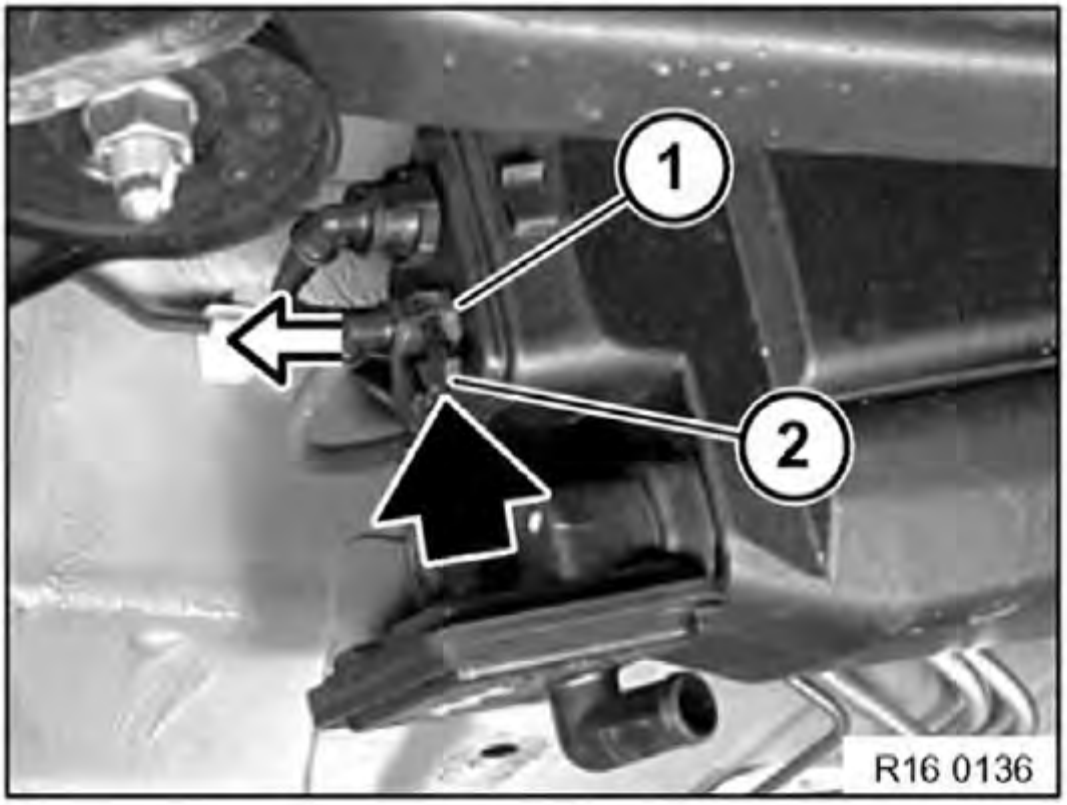
Fig. 195: Disconnecting Plug Connector (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Plastic Nut
2. Hexagon Bolt
3. Clamping Strap

G00125092

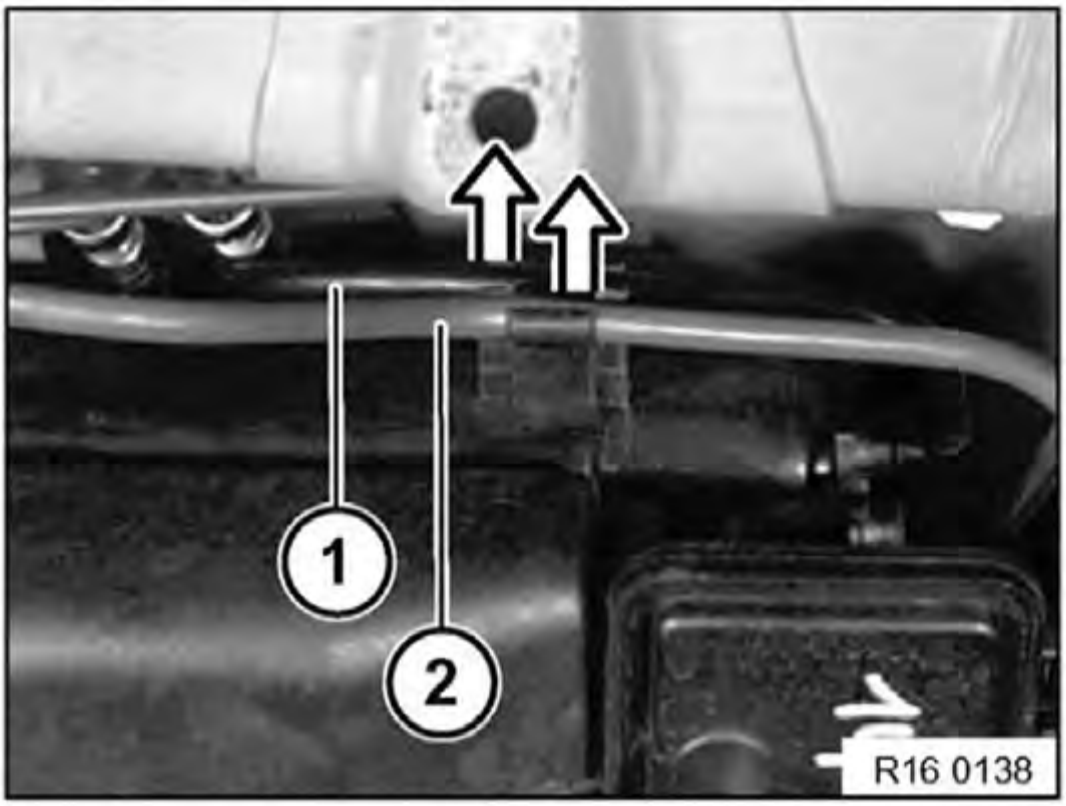
Fig. 196: Removing Clamping Strap (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Vent Line
2. Unlocking Fixture

G00125093

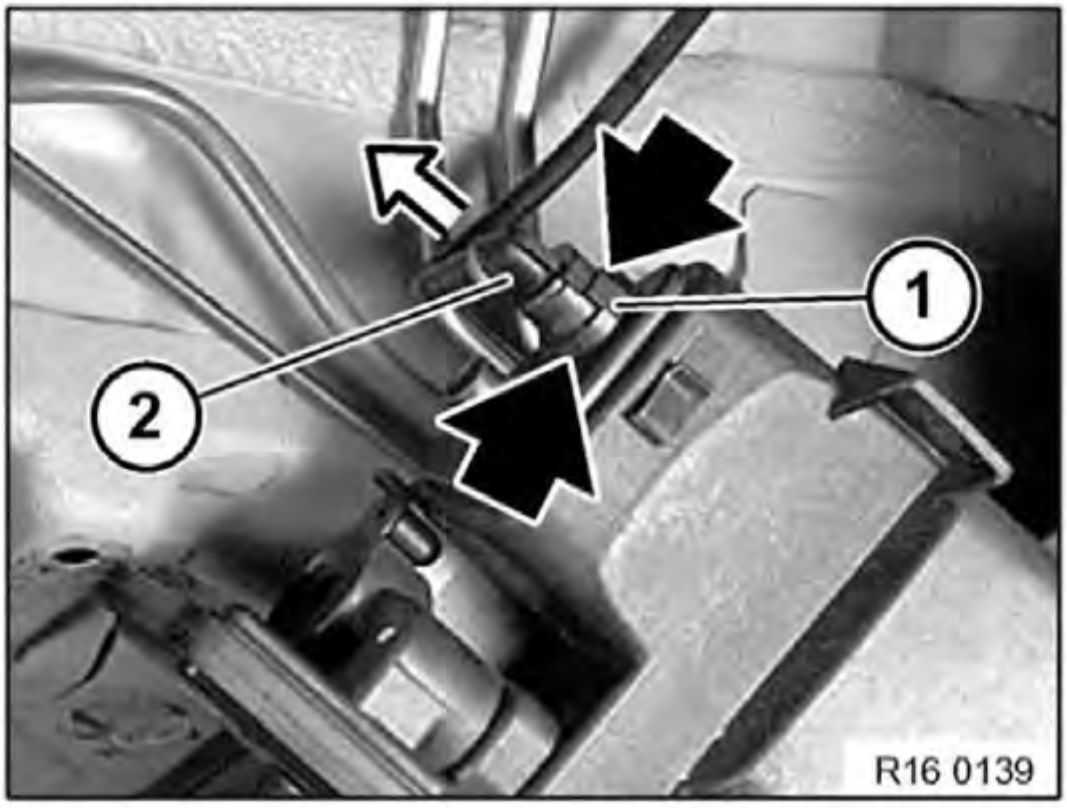
Fig. 197: Actuating Unlocking Fixture & Pulling Off Vent Line (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Tank Vent Line
2. Vent Line

G00125094

Fig. 198: Unclipping Tank Vent Lines (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.



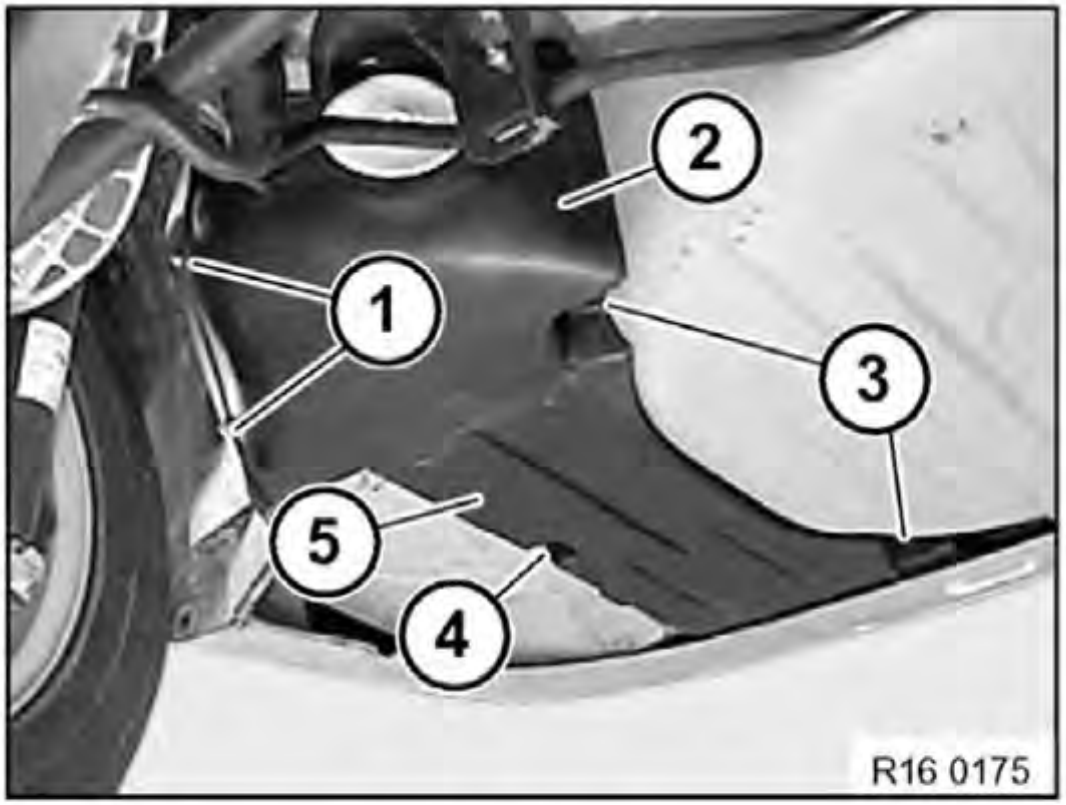
1. Ring
2. Tank Vent Line

G00125095

Fig. 199: Pressing Together Ring & Pulling Off Tank Vent Line (M Roadster)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (3-Series - E46 - With Leak Diagnosis Pump)

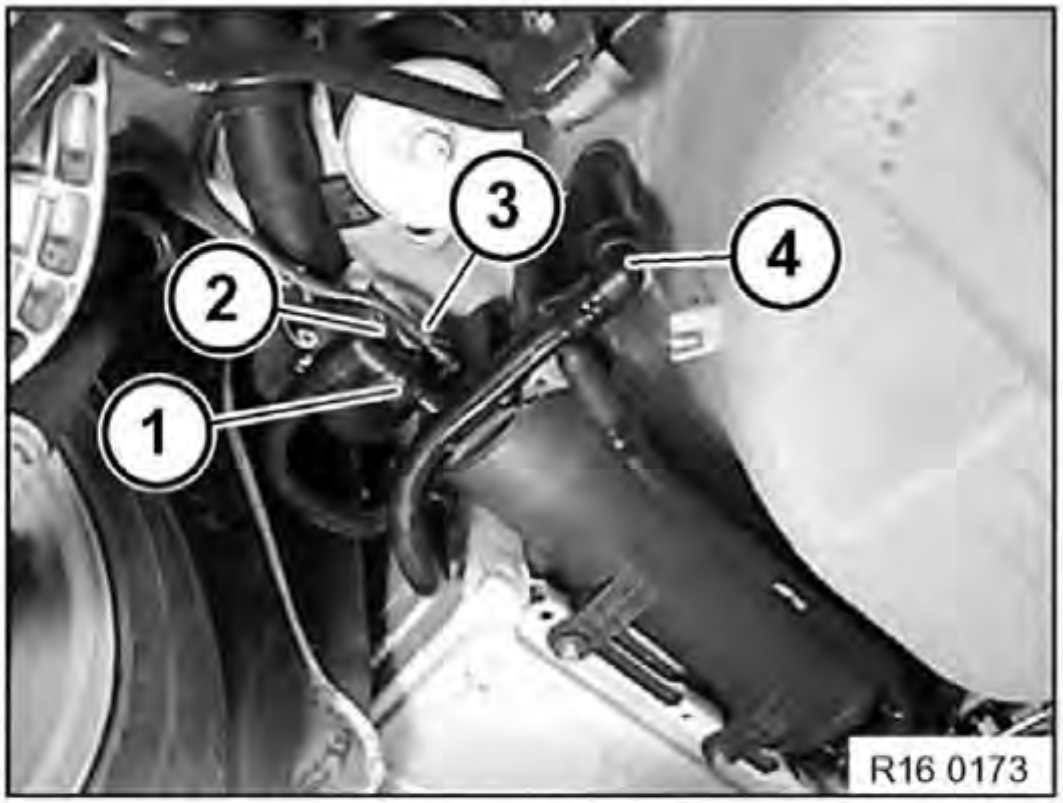
Remove screws and expansion rivet. Remove under-car cover. See Fig. 200. Disconnect vacuum line, scavenging air line, intake line for dust filter and line to expansion tank. See Fig. 201. Disconnect electrical connector. Remove bolts and remove carbon canister with leakage diagnosis pump toward bottom. See Fig. 202. To install, reverse removal procedure.



1. Screws
2. Expansion Rivet
3. Cover
4. Screw
5. Cover

G00131556

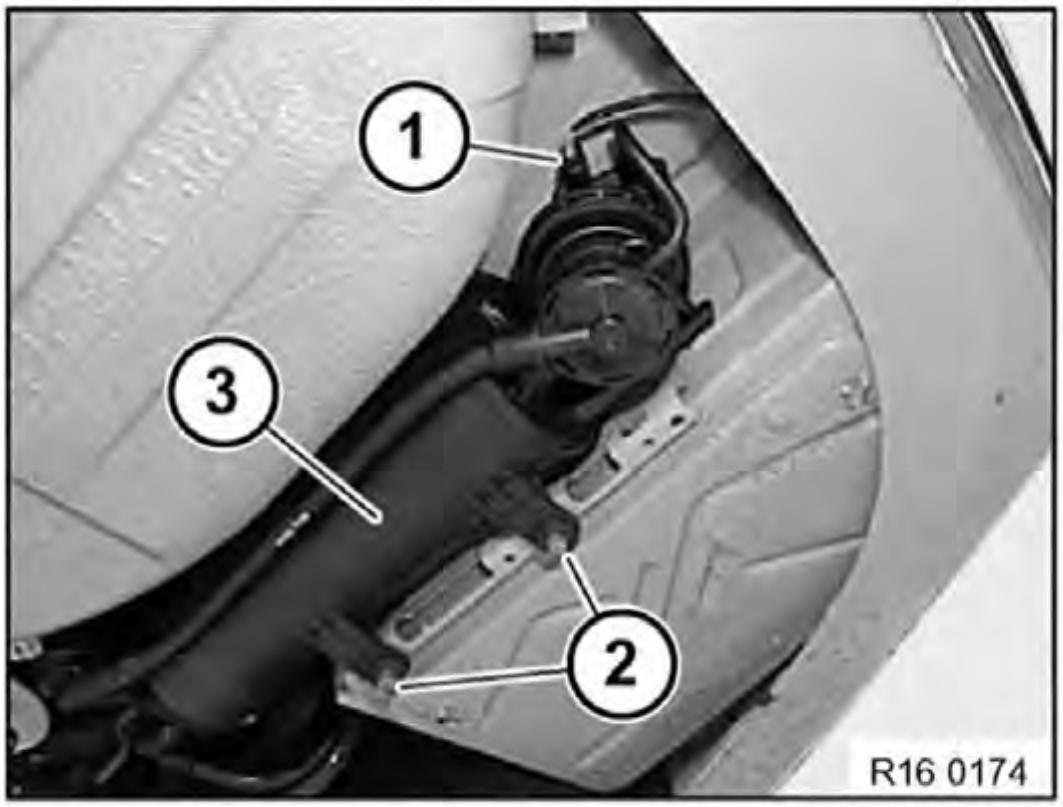
Fig. 200: Removing Under-Car Cover (3-Series - E46 - With Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Vacuum Line
2. Scavenging Air Line
3. Intake Line For Dust Filter
4. Line To Expansion Tank

G00131557

Fig. 201: Removing Vacuum Line, Scavenging Air Line, Intake Line For Dust Filter & Line To Expansion Tank (3-Series - E46 - With Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.



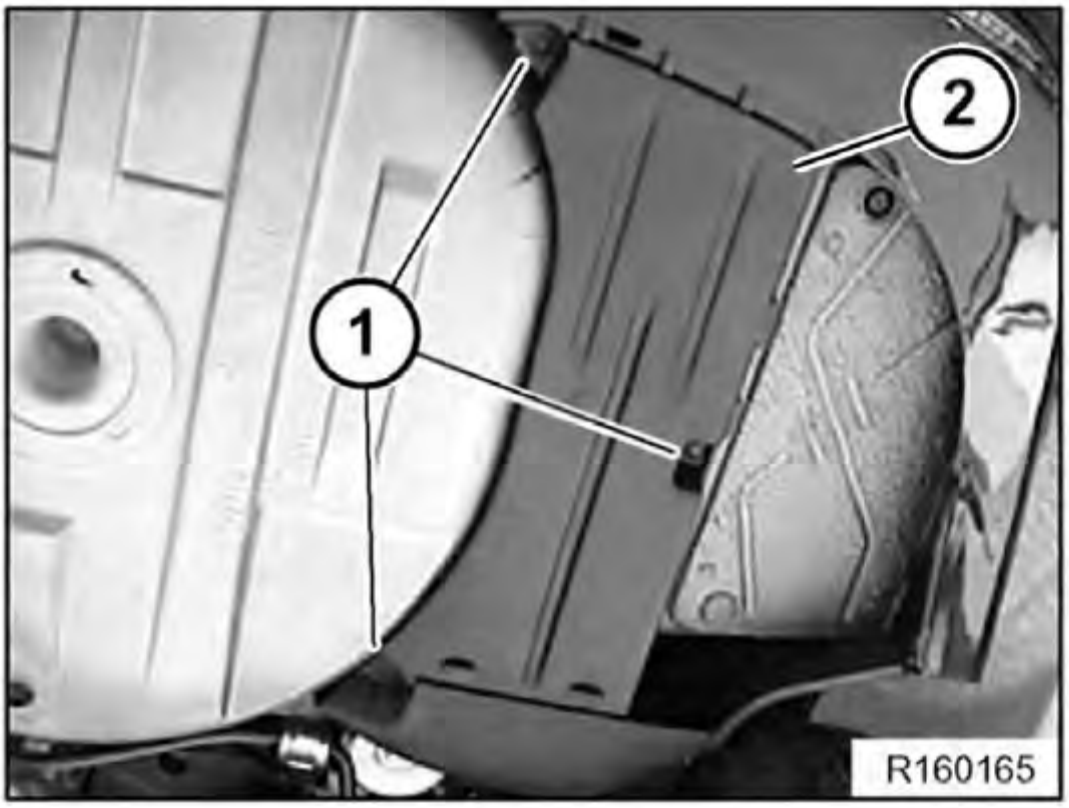
1. Electrical Connector
2. Screws
3. Carbon Canister

G00131558

Fig. 202: Removing Carbon Canister & Leakage Diagnosis Pump (3-Series - E46 - With Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (3-Series - E46 - Without Leak Diagnosis Pump)

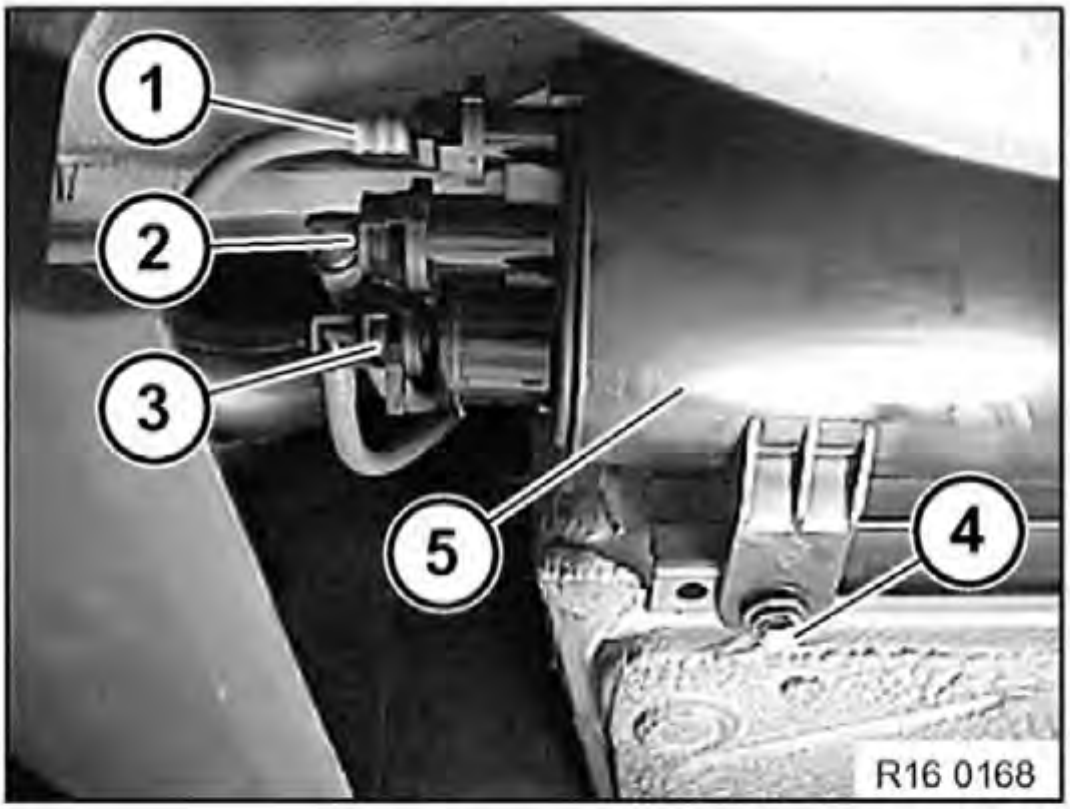
Remove screws and expansion rivet. Remove panel. See Fig. 203. Release locks on fuel lines. Disconnect lines. Remove bolt. Remove carbon canister. See Fig. 204. To install, reverse removal procedure.



1. Screws & Rivet
2. Panel

G00131554

Fig. 203: Removing Screws, Expansion Rivet & Panel (3-Series - E46 - Without Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Lock
2. Lock
3. Lock
4. Bolt
5. Carbon Canister

G00131555

Fig. 204: Removing Carbon Canister (3-Series - E46 - Without Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V8 & V12 - Without Leak Diagnosis Pump)

Remove left rear wheel Remove left rear wheel housing trim. Loosen activated carbon filter. See Fig. 205. Release connections for intake pipe and tank ventilation before pulling off with Special Tool (16 1 050). See Fig. 206. Disconnect ventilation hose, suction tube-to-engine hose and tank venting hose. See Fig. 207. To install, reverse removal procedure.

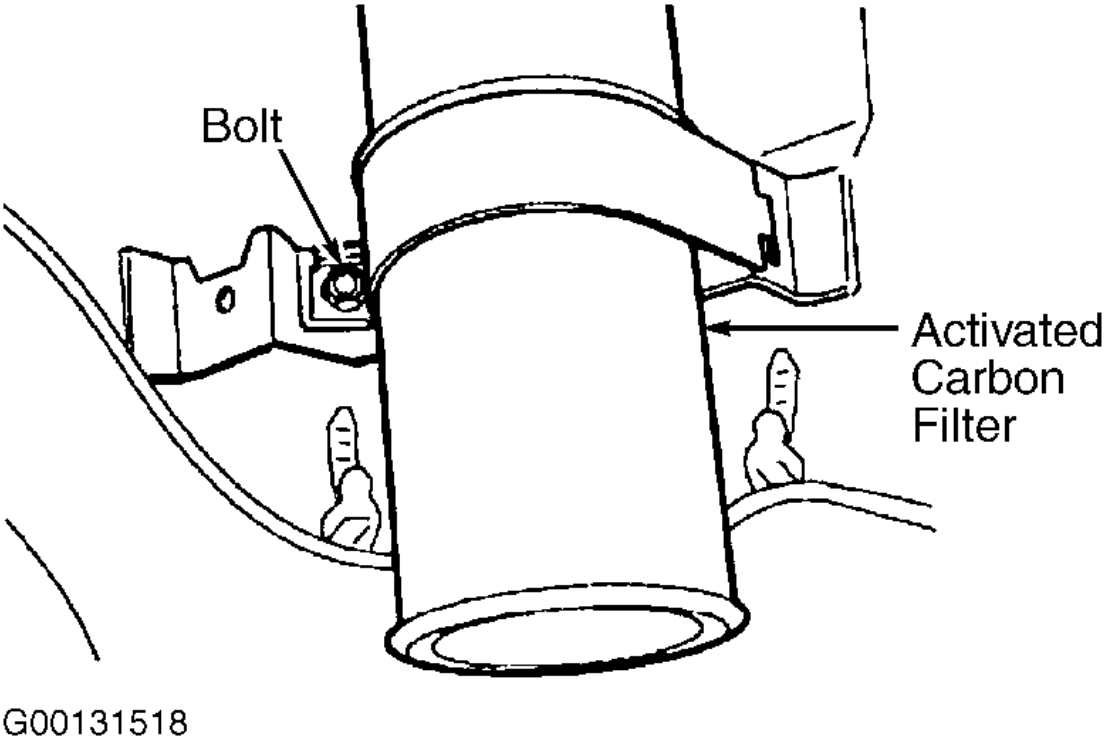


Fig. 205: Removing Activated Carbon Filter (V8 & V12 - Without Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.

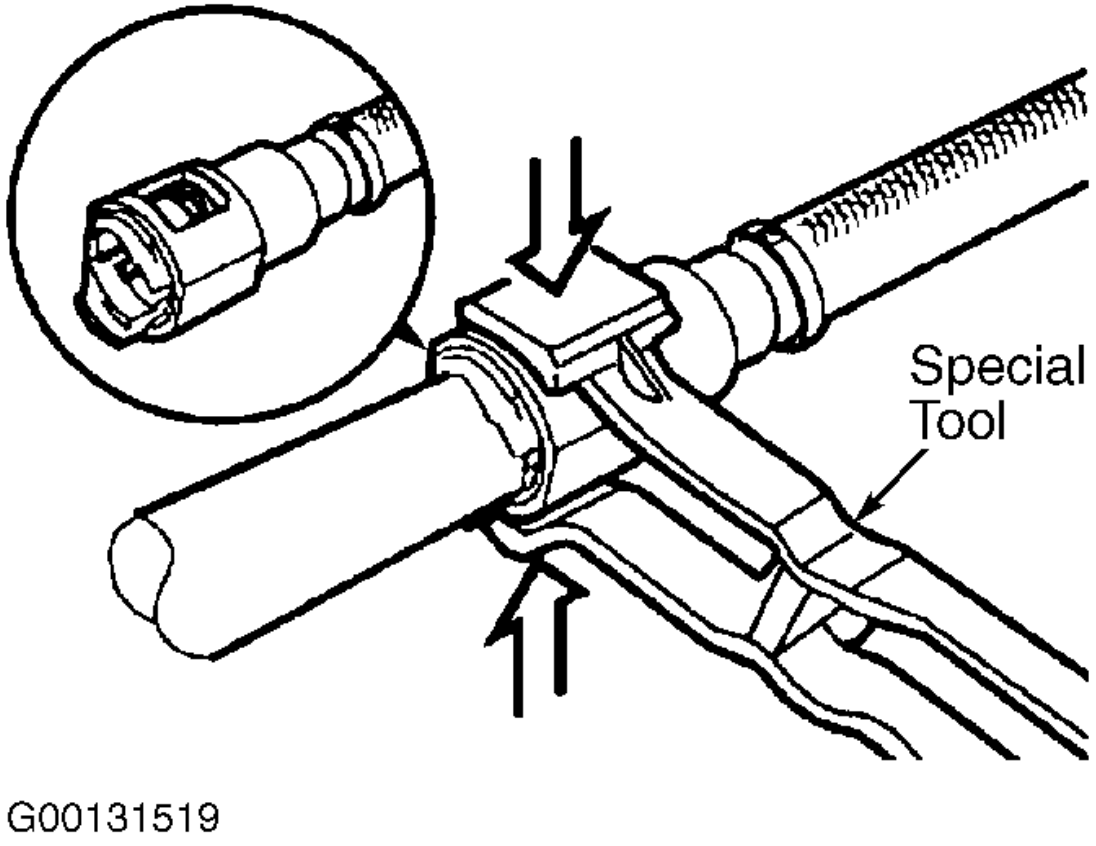


Fig. 206: Disconnecting Intake Pipe & Tank Ventilation Hoses (V8 & V12 - Without Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.

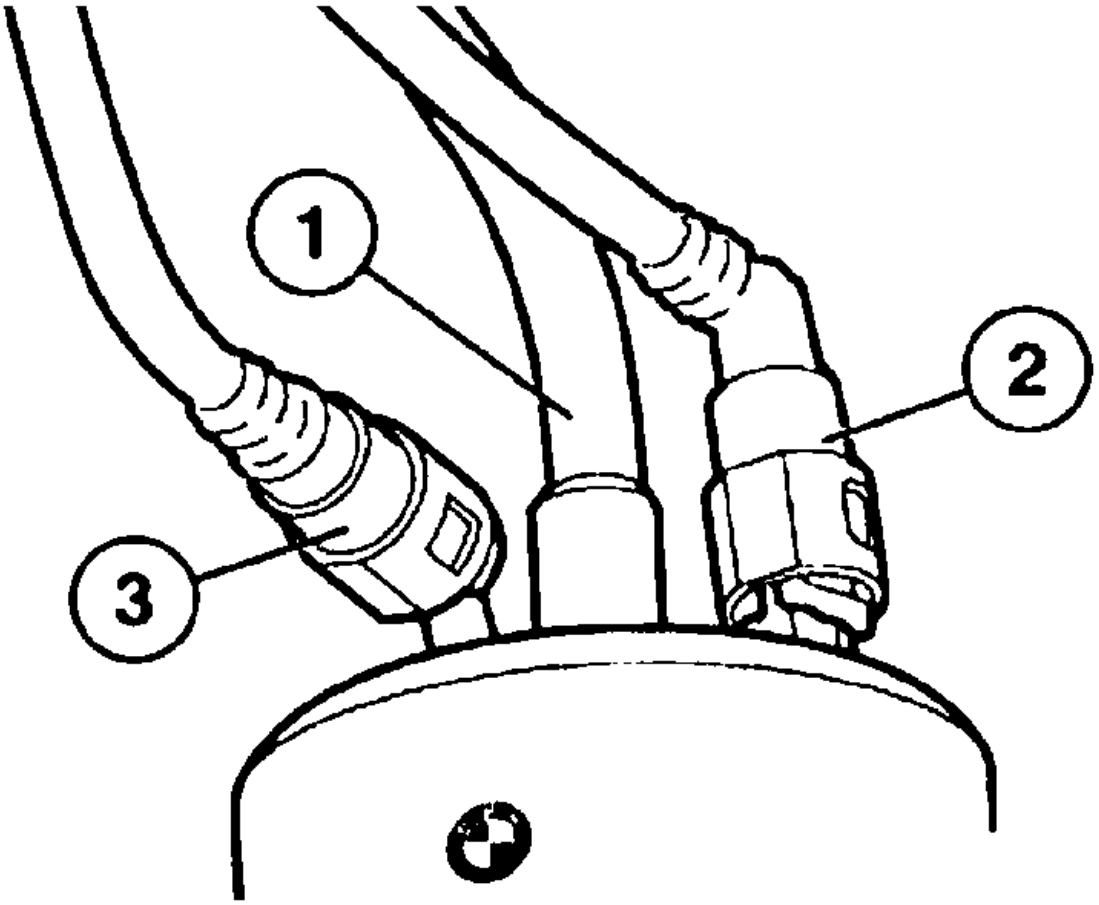
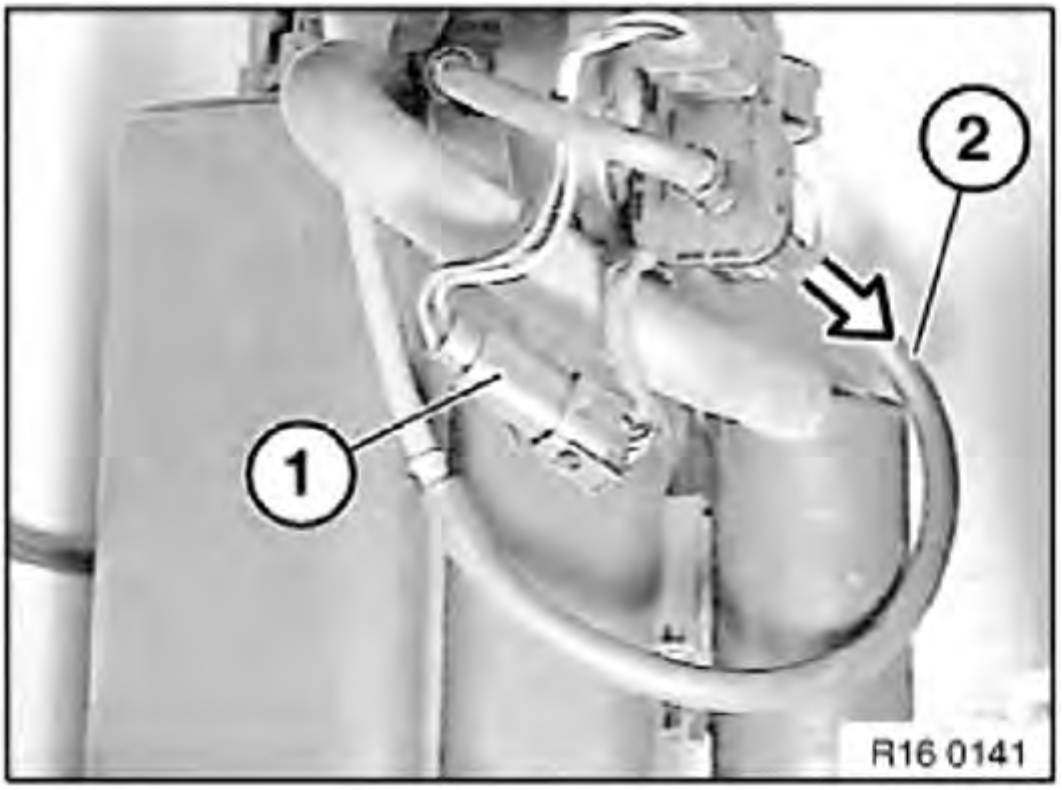


Fig. 207: Identifying Suction Tube, Ventilation & Tank Venting Hoses (V8 & V12 - Without Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12 - With Leak Diagnosis Pump)

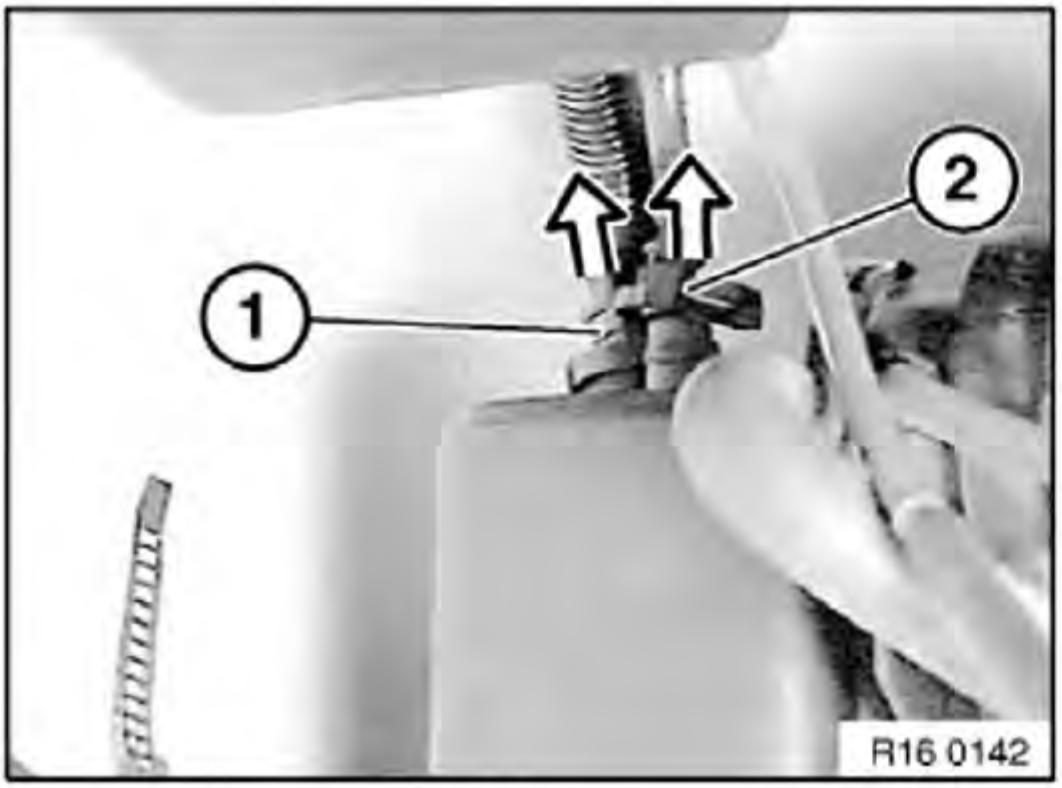
Remove left rear wheel. Remove left rear wheel housing trim. Pull plug connection and disconnect vacuum hose from leak diagnosis pump. See Fig. 208. Detach vent line and scavenging air line and disconnect it from activated carbon filter. See Fig. 209. Withdraw activated carbon filter from retaining bracket and remove toward front. See Fig. 210. To install, reverse removal procedure.



1. Plug Connection
2. Vacuum Hose

G00131515

Fig. 208: Disconnecting Vacuum Hose From Leak Diagnosis Pump (V12 - With Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Vent Line
2. Scavenging Air Line

G00131516

Fig. 209: Identifying Scavenging Air Line & Vent Line (V12 - With Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.

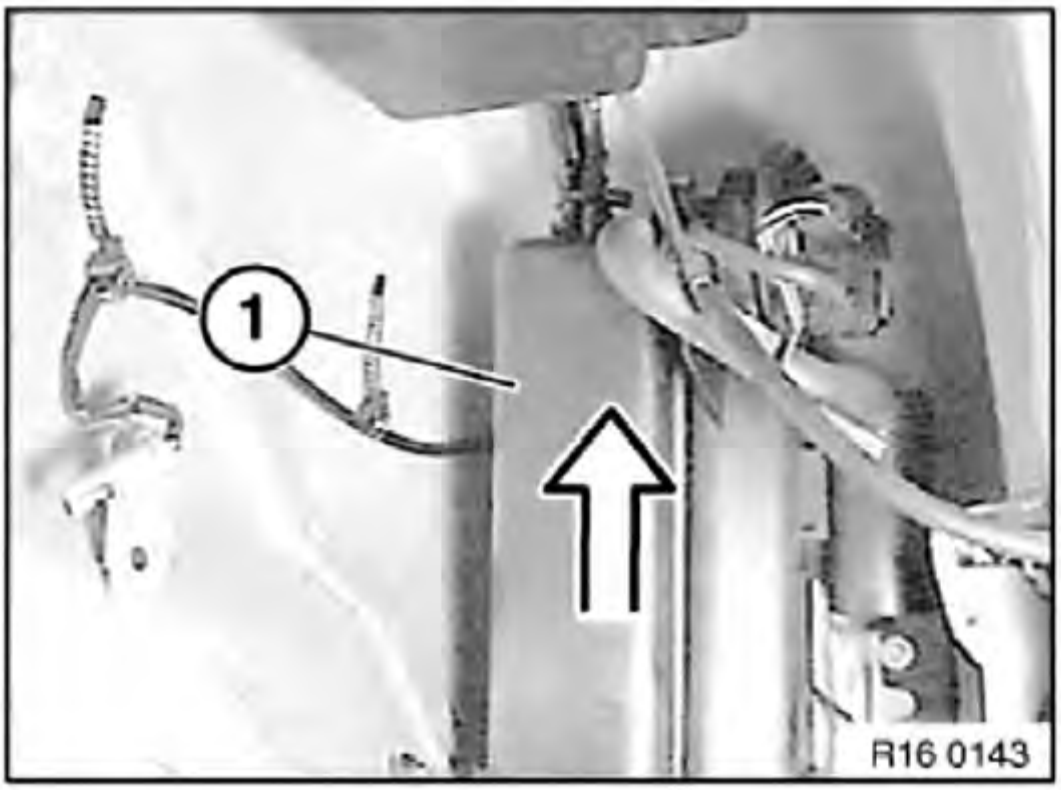


Fig. 210: Removing Activated Carbon Filter (V12 - With Leak Diagnosis Pump)
Courtesy of BMW OF NORTH AMERICA, INC.

ELECTRONIC CATALYTIC CONVERTER (V12)

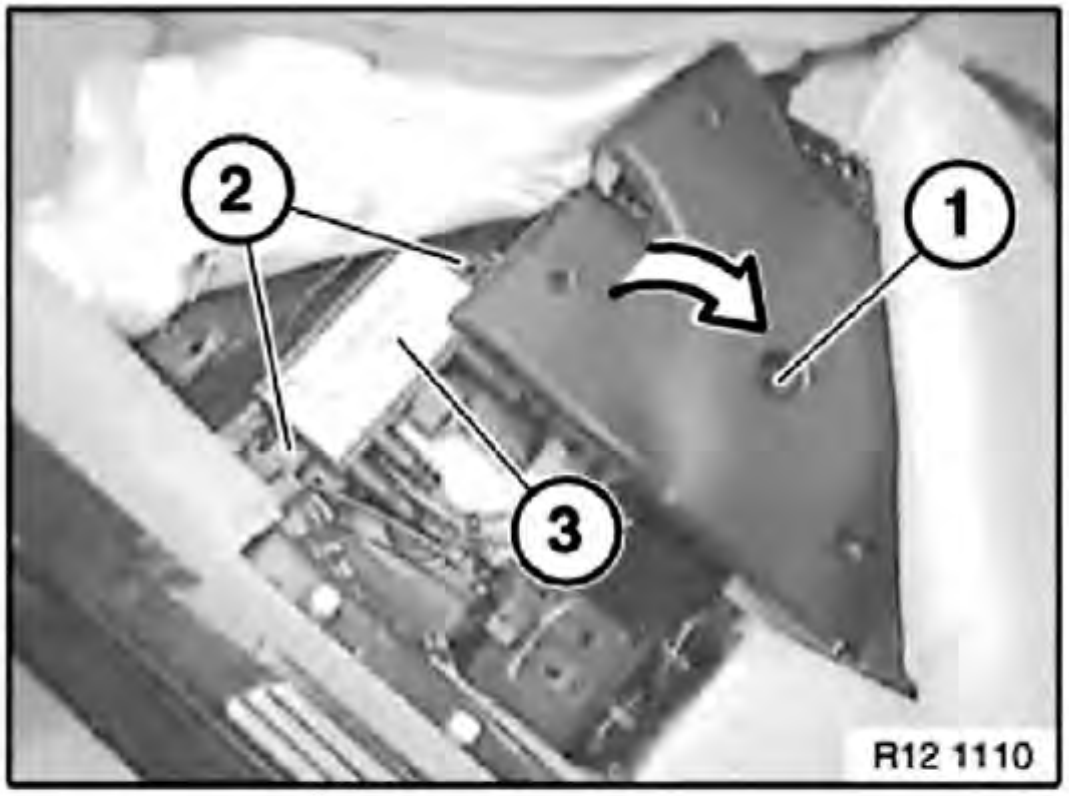
Removal & Installation

1. Turn ignition off. Remove nut and bolt. Remove cover. Disconnect plugs from retainer. Disconnect plug connections of positive leads for electronic catalytic converter. Remove nut on negative lead on body. Remove nut on negative lead on catalytic converter. Remove negative lead.
2. Cut through exhaust pipe between catalytic converter center muffler down welded seam with a grinder and deburr. Grind off remaining welded bead on center muffler.
3. To install, reverse removal procedure. Install new catalytic converter to center muffler with clamp. Ensure nuts point downward. Align exhaust system and clamping sleeve with sufficient distance from adjacent components.

ELECTRONIC CATALYTIC CONVERTER CONTROL UNIT (V12)

Removal & Installation

Turn ignition off. Disconnect batteries. Remove front right inner entrance cover strip. Remove "A" pillar finisher. Lift floor carpet at front and rear and lay aside. Lift out expansion rivet and lift air duct slightly. Disconnect control unit connector. Remove screws. Remove control unit. See Fig. 211. To install, reverse removal procedure.



1. Expansion Rivet
2. Screws
3. Control Unit

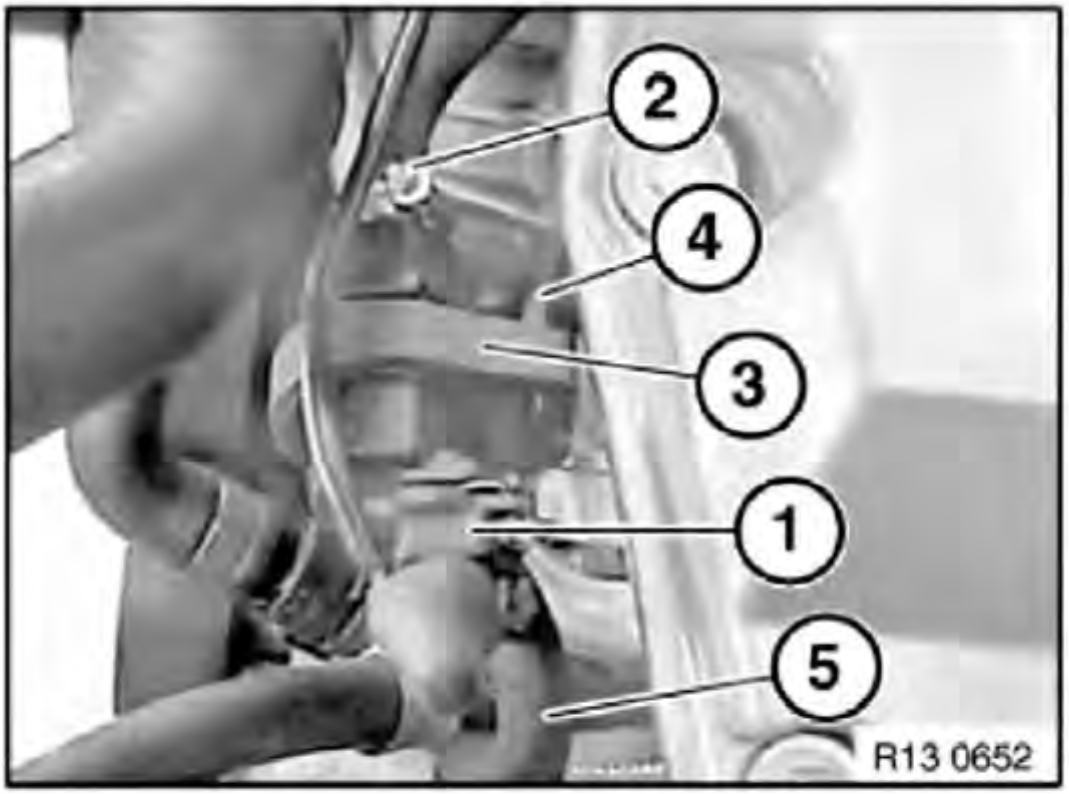
G00131523

Fig. 211: Removing Electronic Catalytic Converter (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL TANK VENT VALVE

Removal & Installation (V8)

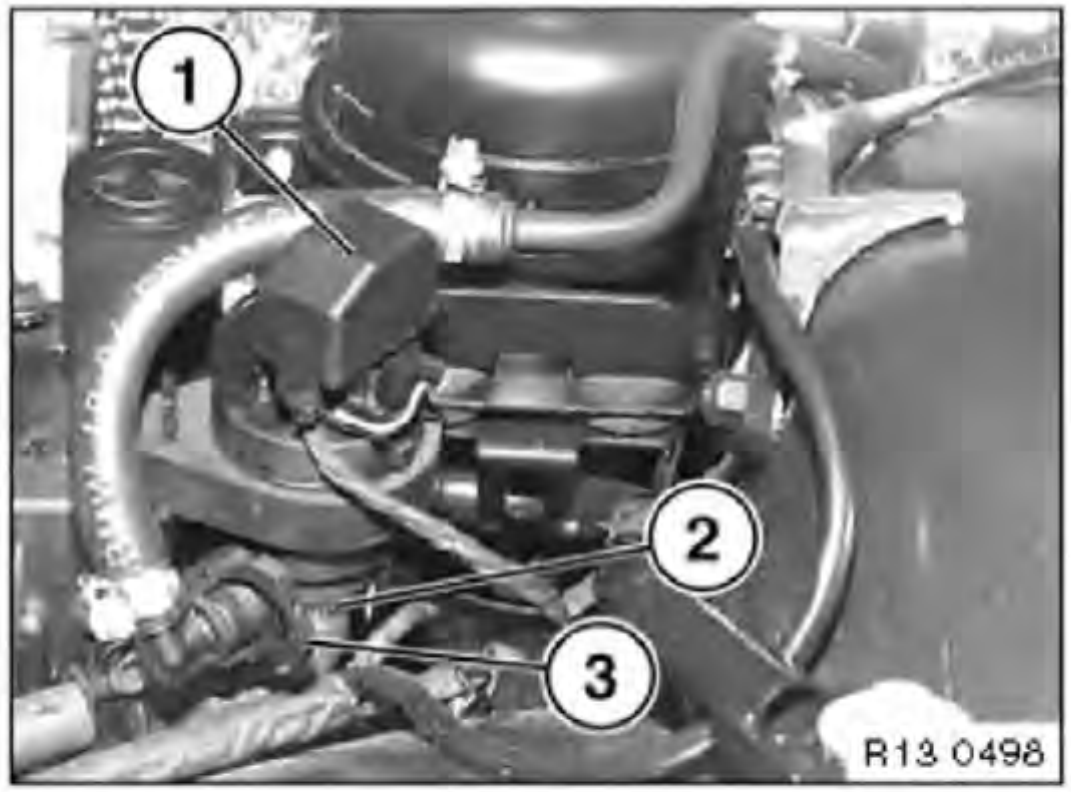
1. Turn ignition off. On some models, tank venting valve is fitted in front left wheel arch. See Fig. 212. Disconnect plug connection. Release hose clamp and detach fuel hose. Open fastener and detach hose. See Fig. 213.
2. On some other models, disconnect plug connection. Release hose clamp and detach hose. Remove tank venting valve from bracket. Open fastener and detach fuel hose. On all models, to install, reverse removal procedure. Always replace clip and fuel hose.



1. Plug Connection
2. Hose Clamp
3. Tank Venting Valve
4. Bracket
5. Fuel Hose

G00131488

Fig. 212: Locating Tank Vent Valve (V8)
Courtesy of BMW OF NORTH AMERICA, INC.



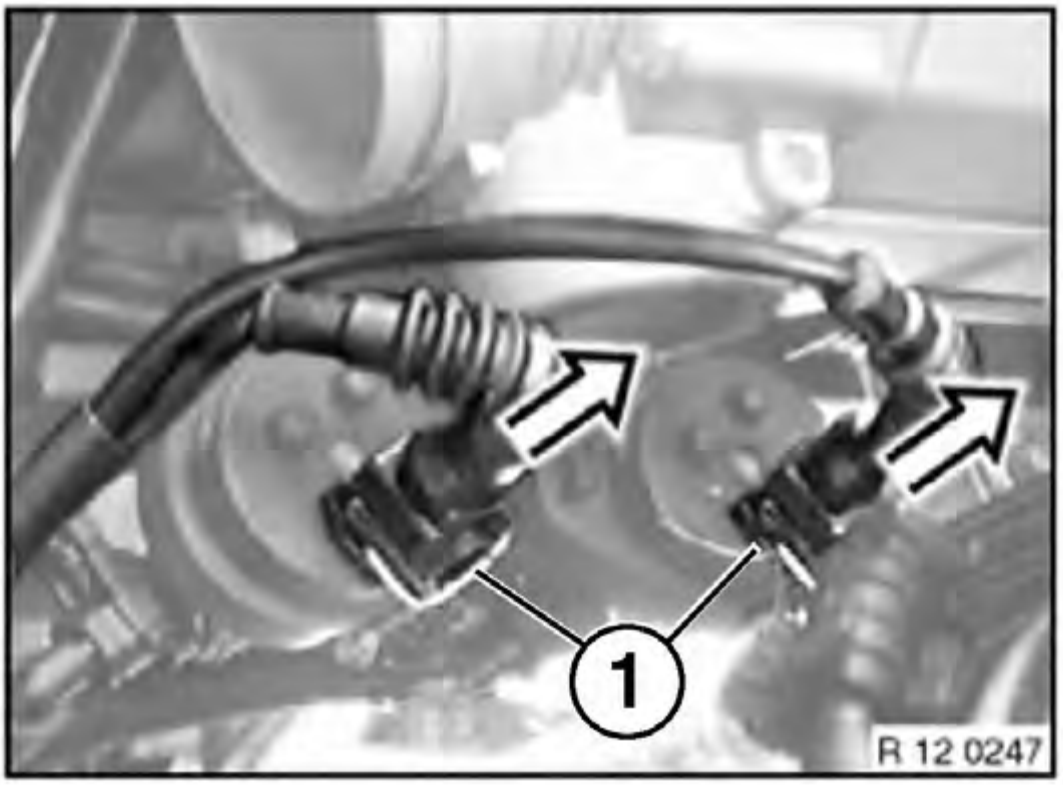
1. Plug Connection
2. Hose Clamp
3. Fastener

G00131487

Fig. 213: Removing Tank Vent Valve (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation (V12)

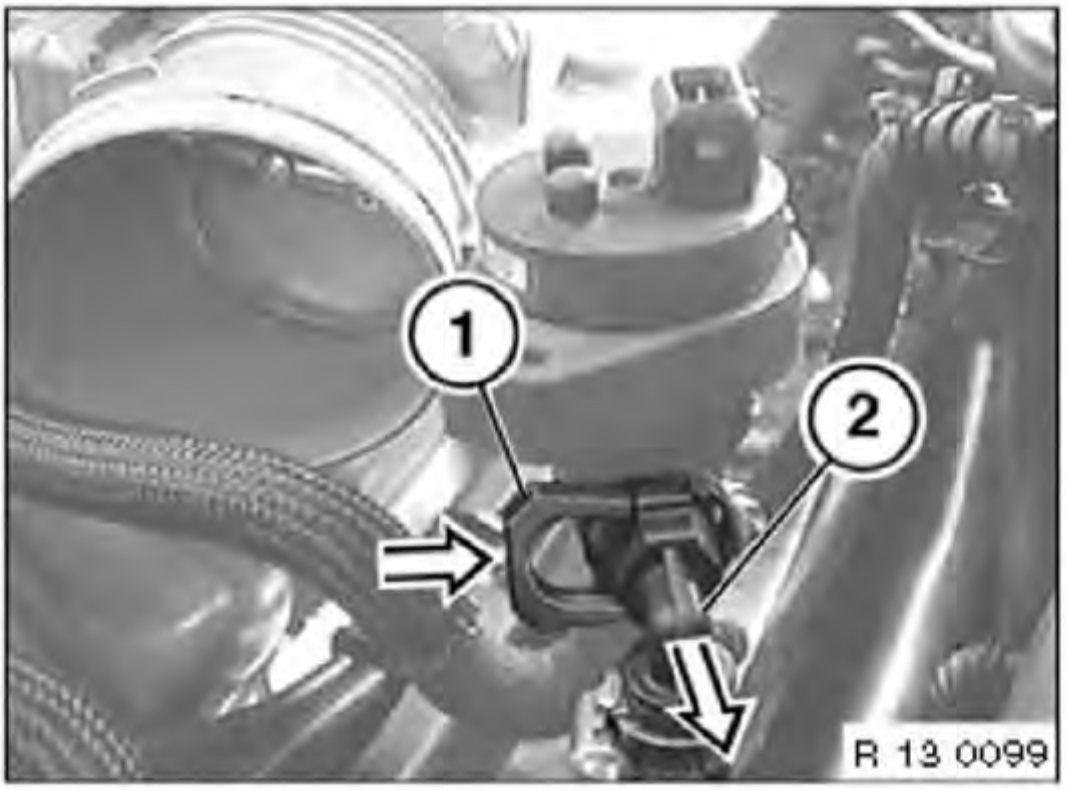
Turn ignition off. Remove both throttle bodies. See THROTTLE BODY. Mark plug connection on tank vent valve and disconnect. See Fig. 214. Open fast release connections on tank vent valve, press down interlock, and remove hose. See Fig. 215. Remove tank vent valves for cylinder banks No. 1-6 and 7-12 from bracket. See Fig. 216. Unfasten hose clips and remove hoses. To install, reverse removal procedure.



1. Plug Connections

G00125164

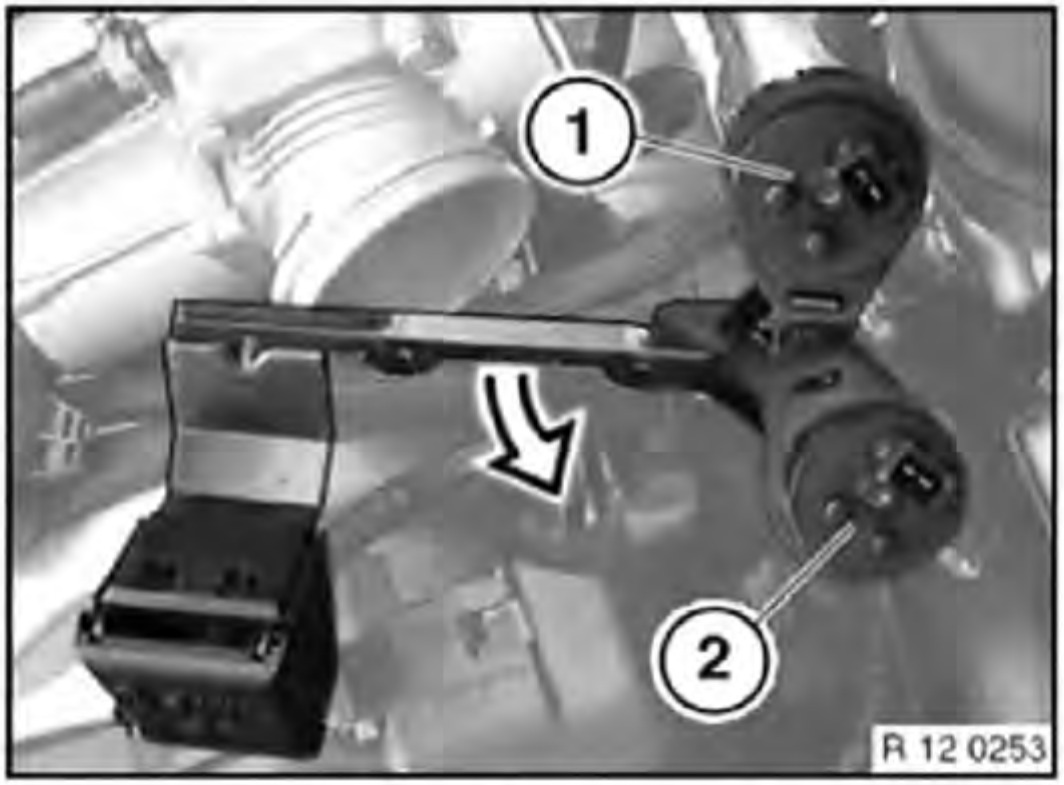
Fig. 214: Identifying Fuel Tank Vent Valve Plug Connection (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Interlock
2. Hose

G00125165

Fig. 215: Removing Tank Vent Valve Hose (V12)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Tank Vent Valve (Cylinders No. 1-6)
2. Tank Vent Valve (Cylinders No. 7-12)

G00125166

Fig. 216: Removing Tank Vent Valves (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

LEFT INTAKE FILTER HOUSING (V12)

Removal & Installation

Turn ignition off. Press interlock and cut through plug connection. Loosen retainers. Unfasten hose clip. Disconnect electrical connection. Unfasten hose clip and remove hose. Remove upper section of intake filter housing. Unfasten screw. Remove lower section of suction filter housing. To install, reverse removal procedure. Ensure screw head does not twist away when attaching air intake hose clip. It must be tight against stop. Fit hose with hose clip on wheel arch. Slide lower section of intake filter housing onto hose. Tighten hose clip.

RIGHT INTAKE FILTER HOUSING (V12)

Removal & Installation

Turn ignition off. Unfasten hose clip. Disconnect electrical connection. Unfasten hose clip and remove hose. Remove upper section of intake filter housing. Unfasten screw. Remove lower section of suction filter housing. To install, reverse removal procedure. Ensure screw head does not twist away when attaching air intake hose clip. It must be tight against stop. Fit hose with hose clip on wheel arch. Slide lower section of intake filter housing onto hose. Tighten hose clip.

SECONDARY AIR INJECTION PIPE (V12)

Removal & Installation (Cylinders 1-6)

Remove non-return valve for cylinders 1-6. Remove guide tube for dipstick. Remove right distributor cap. Remove spark plug connector for cylinders No. 1-6. Unfasten nut and remove ignition wiring harness. Unfasten

screw connection for heat baffle plate on exhaust manifold of cylinders 1-3. Unfasten flanges. To install, reverse removal procedure. Ensure gasket residue is cleaned off flanges. Replace gaskets. Install flange and gasket to exhaust manifold. Install gasket to flange.

Removal & Installation (Cylinders 7-12)

Remove non-return valve for cylinders 7-12. Remove left distributor cap. Remove spark plug connector for cylinders No. 7-12. Unfasten nuts and remove ignition wiring harness. Unfasten screw connection for heat baffle plate on exhaust manifold of cylinders 7-9. Unfasten flanges. To install, reverse removal procedure. Ensure gasket residue is cleaned off flanges. Replace gaskets. Install flange and gasket to exhaust manifold. Install gasket to flange.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Knock Sensor	14 (20)
Oxygen Sensor	41 (55)
	INCH Lbs. (N.m)
Camshaft Position Sensor	62 (7)
Crankshaft Position Sensor	62 (7)

Article GUID: A00011862

ENGINE PERFORMANCE

Service & Adjustment Specifications

INTRODUCTION

Use this article to quickly find specifications related to servicing and on-vehicle adjustments. This is a quick-reference article to use when you are familiar with an adjustment procedure and only need a specification.

BATTERY

BATTERY SPECIFICATIONS

Application	Amp Hr. Rating
3-Series	(1) 75
Z3	70
5-Series (6-Cylinder)	70
5-Series (V8)	90
7-Series	55 Or 110
(1) Convertible amp hour rating is 70.	

CAPACITIES

6-CYLINDER FLUID CAPACITIES

6-CYLINDER FLUID CAPACITIES

Application	Quantity
Crankcase (Includes Filter) (1)	
X5 & 330xi	8.0 Qts. (7.5L)
All Others	5.8 Qts. (5.5L)
Cooling System (2)	
M Roadster, M Coupe, X5, Z3 & 528i	11.4 Qts. (10.8L)
M3	6.3 Qts. (6.0L)
All Others	8.4 Qts. (7.9L)
Manual Transmission (Dexron-II) (2) (3)	1.3 Qts. (1.2L)
Automatic Transmission (2) (3) (4)	3.2 Qts. (3.0L)
Rear Axle (2) (3) (5)	1.5 Qts. (1.4L)

(1) M-Series vehicles generally use 10-60 synthetic oil. Check owners manual. All others use BMW High Performance 5W-30 Synthetic Oil.

(2) Quantity is approximate.

(3) Lifetime fluid. Fluid change is not necessary.

(4) See AUTOMATIC TRANSMISSION FLUID TYPE.

(5) All models use synthetic final drive oil. On models without multi-plate limited-slip differential, or with viscous differential lock, use BMW Synthetic Final Drive Oil (83 22 9 407 768). On models without viscous differential lock, use BMW Synthetic Final Drive Oil (83 22 1 470 080).

V8 FLUID CAPACITIES

V8 FLUID CAPACITIES

Application	Quantity
Crankcase (Includes Filter) (1)	

M5	6.9 Qts. (6.5L)
X5 & 750iL	8.5 Qts (8.0L)
All Others	8.0 Qts (7.5L)
Cooling System (2)	12.7 Qts. (12.0L)
Manual Transmission (Dexron-II) (2) (3)	1.3 Qts. (1.2L)
Automatic Transmission (2) (3) (4)	6.0 Qts. (5.7L)
Rear Axle (2) (3) (5)	
540i	1.8 Qts. (1.7L)
7-Series	2.0 Qts. (1.9L)

(1) Use BMW High Performance 5W-30 Synthetic Oil.

(2) Quantity is approximate.

(3) Lifetime fluid. Fluid change is not necessary.

(4) See AUTOMATIC TRANSMISSION FLUID TYPE.

(5) All models use synthetic final drive oil. On models without multi-plate limited-slip differential, or with viscous differential lock, use BMW Synthetic Final Drive Oil (83 22 9 407 768). On models without viscous differential lock, use BMW Synthetic Final Drive Oil (83 22 1 470 080).

V12 FLUID CAPACITIES

V12 FLUID CAPACITIES

Application	Quantity
Crankcase (Includes Filter) (1)	9.0 Qts. (8.5L)
Cooling System (2)	13.7 Qts. (13.0L)
Automatic Transmission (2) (3) (4)	6.0 Qts. (5.7L)
Rear Axle (2) (4) (5)	2.0 Qts. (1.9L)

(1) Use BMW High Performance 5W-30 Synthetic Oil.

(2) Quantity is approximate.

(3) See AUTOMATIC TRANSMISSION FLUID TYPE.

(4) Lifetime fluid. Fluid change is not necessary.

(5) All models use synthetic final drive oil. On models without multi-plate limited-slip differential, or with viscous differential lock, use BMW Synthetic Final Drive Oil (83 22 9 407 768). On models without viscous differential lock, use BMW Synthetic Final Drive Oil (83 22 1 470 080).

AUTOMATIC TRANSMISSION FLUID TYPE

NOTE: Automatic Transmission Fluid (ATF) was developed especially for automatic transmissions. It requires additives which are carefully matched with each other, a high viscosity index and a solidification point below -40Â°F (-40Â°C). Friction behavior of ATF in plate-type clutches under very different operating conditions is extremely important. Other important factors are:

- Wear protection
- Oil film shear resistance
- Adhesive property
- Oxidation resistance
- Corrosion inhibition
- Sludge prevention
- Temperature-dependent viscosity changes

- Compatibility with sealing materials

GM Transmissions (A5S360R/390R)

Transmission oil pan will be labeled with either Texaco ETL-7045 or Dexron-III. Fill or top off with proper fluid only. DO NOT mix Texaco ETL-7045 and Dexron-III fluids.

ZF 3HP22, 4HP22 & 4HP24

Transmission identification plate can be utilized to determine proper transmission fitted in vehicle. Transmission utilizes Castrol TQ or Texaco Havoline automatic transmission fluids of the Dexron-III formulation. DO NOT mix any other oil with this transmission fluid when doing repairs or topping off.

A5S325Z (5HP19) & A5S440Z (5HP24)

Transmission identification plate can be utilized to determine proper transmission fitted in vehicle. No subsequent transmission fluid changes are necessary. DO NOT mix any other oil with this transmission fluid when doing repairs or topping off. Use ESSO LT 71141 (BMW Part No. 83229407807).

GA6HP26Z

Transmission identification plate can be utilized to determine proper transmission fitted in vehicle. Transmission fluid has a condition based service interval of approximately 100,000 miles. DO NOT mix any other oil with this transmission fluid when doing repairs or topping off. Use Shell M-1375.4 (BMW Part No. 83220142516).

AUTOMATIC TRANSMISSION FLUID LEVEL CHECK

NOTE: Checking fluid level may be necessary if there is evidence of a leak, a complaint related to fluid level, or repairs made to transmission.

Transmission Without Dipstick

To top off transmission after a repair, put selector lever to setting "P". Vehicle must be horizontal and secured to prevent it from rolling away. Unfasten filler screw. Top off automatic transmission using filler neck attached to filler aperture until oil emerges at filler/overflow bore. See Fig. 1. Start engine. Top off automatic transmission again until oil emerges at filler/overflow bore. Screw in filler plug. See Fig. 2. Operate brake and, with engine at idle speed, shift transmission through all gears several times. Connect BMW's GROUP TESTER ONE (GT-1) or DISplus hardware system to vehicle and perform oil level check in accordance with manufacturer's instructions. Replace sealing ring. Tighten drain plug to 11 ft. lbs. (16 N.m).

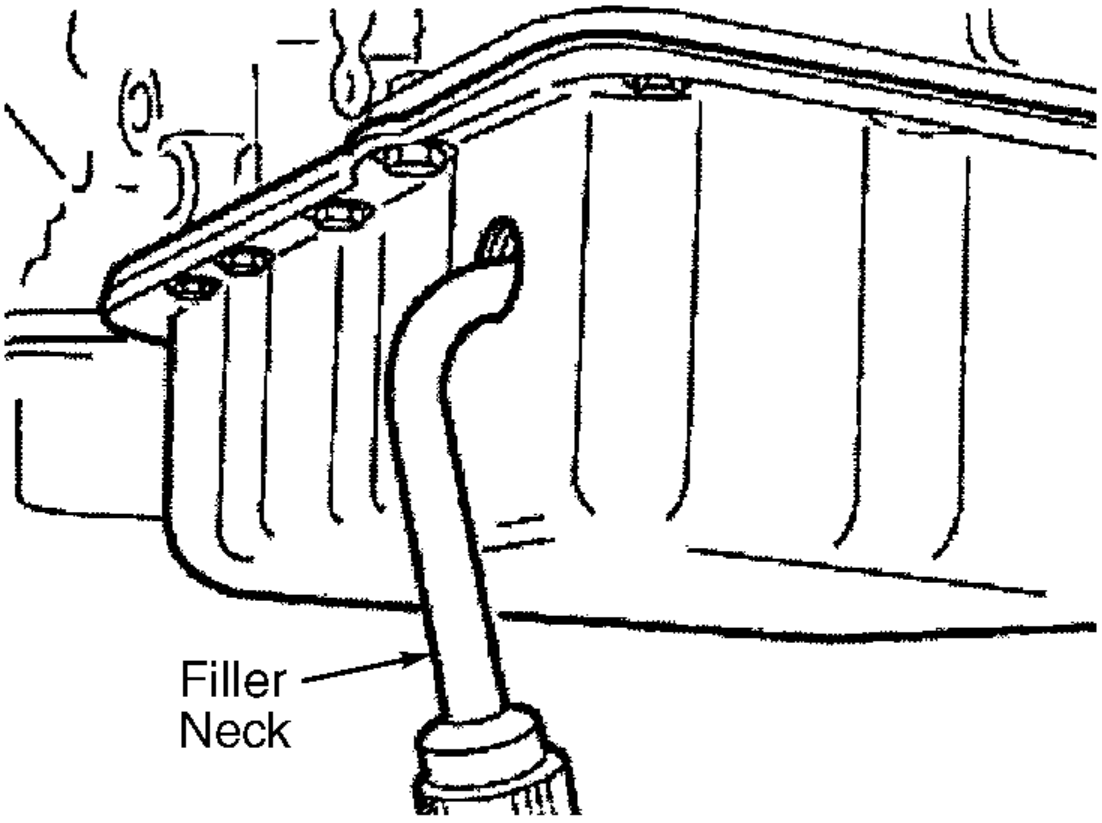


Fig. 1: Filling Automatic Transmission
Courtesy of BMW OF NORTH AMERICA, INC.

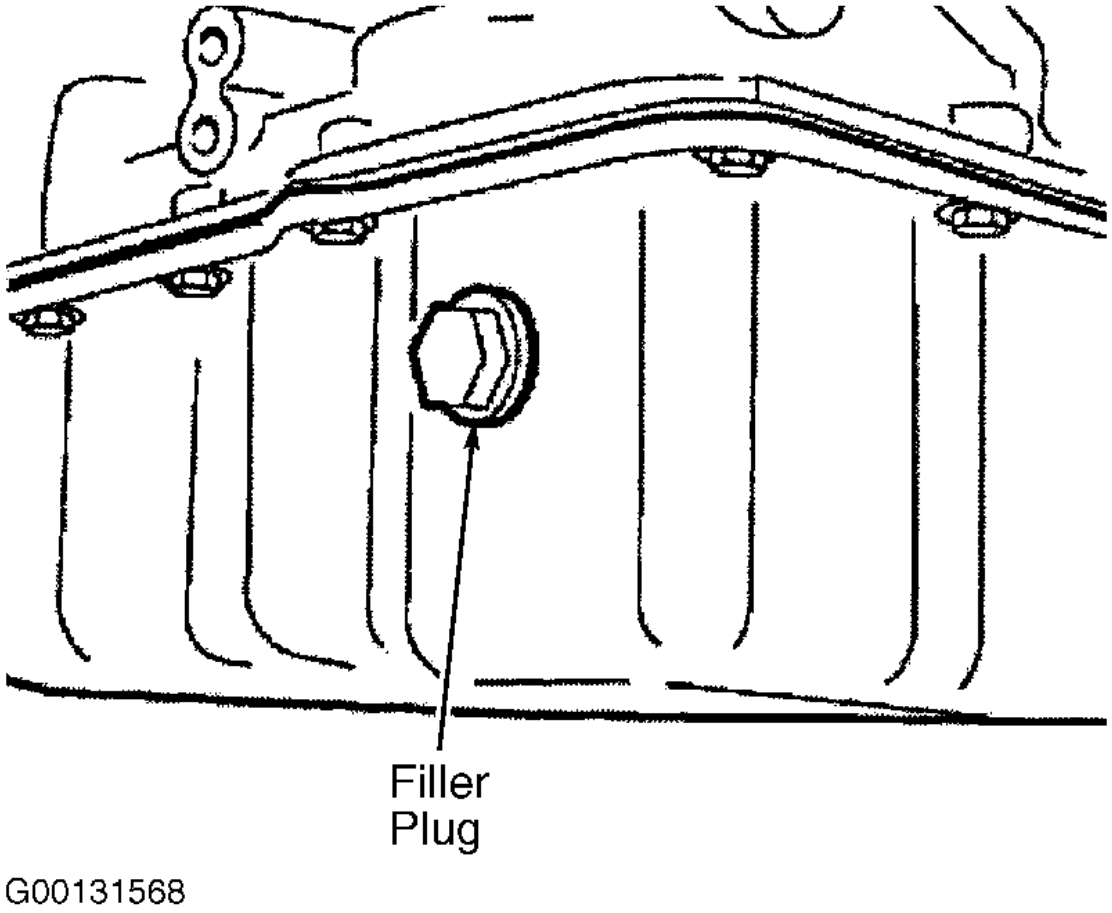


Fig. 2: Identifying Filler Plug
Courtesy of BMW OF NORTH AMERICA, INC.

QUICK-SERVICE

SERVICE INTERVALS & SPECIFICATIONS

Service Interval Indication

On all models except 7-series, service interval indicator consists either of colored LED blocks or actual mileage remaining until next service. Service indicator (which displays OIL SERVICE, INSPECTION I or INSPECTION II) can be reset using the reset mode in the instrument cluster. See SERVICE INTERVAL LIGHT RESET (ALL MODELS EXCEPT 7-SERIES).

The 7-series models use a Condition Based Service (CBS) service interval system, which displays a Service Need Display (SND). When ignition is on, Service Need Display appears under the speedometer in the instrument cluster for 10 seconds in the place where the fuel tank level is normally displayed. The first line corresponds to the mileage dependent service items. It specifies the mileage when the next service is due. If the mileage is exceeded (service overdue), it appears with a minus sign. The second line corresponds to the time dependent service items and is displayed by a clock symbol. It specifies the weeks/months/ years when the next service is due. If the service is overdue, it appears with a minus sign. The actual service item (with additional information) can be viewed in the control display. For 7-series reset procedure, see CONDITION BASED SERVICE (CBS) LIGHT RESET (7-SERIES). For 7-series service maintenance intervals, see 7-SERIES SERVICE MAINTENANCE CHECKLIST.

Service Interval Light Reset (All Models Except 7-Series)

Reset service light by performing the following:

- Ignition key must be in OFF position.
- Press and hold trip odometer reset button in the instrument cluster (left button), and turn ignition key to first position.
- Keep the button pressed for approximately 5 seconds until one of the following words appear in the display: "OIL SERVICE", or "INSPECTION", with "Reset".
- Release reset button and press it again until " reset" begins to flash in the display. See Fig. 3 and Fig. 4 .

Service due is shown with "reset" if coded minimum consumption limit has been reached and resetting is possible. If "reset" is not shown, minimum limit has not been reached and resetting is not possible.

- While "reset" is flashing, press left button briefly to reset service interval. After display has shown new interval, following will appear: "END SIA".

System can only be reset again after 2.5 gallons of fuel have been consumed.

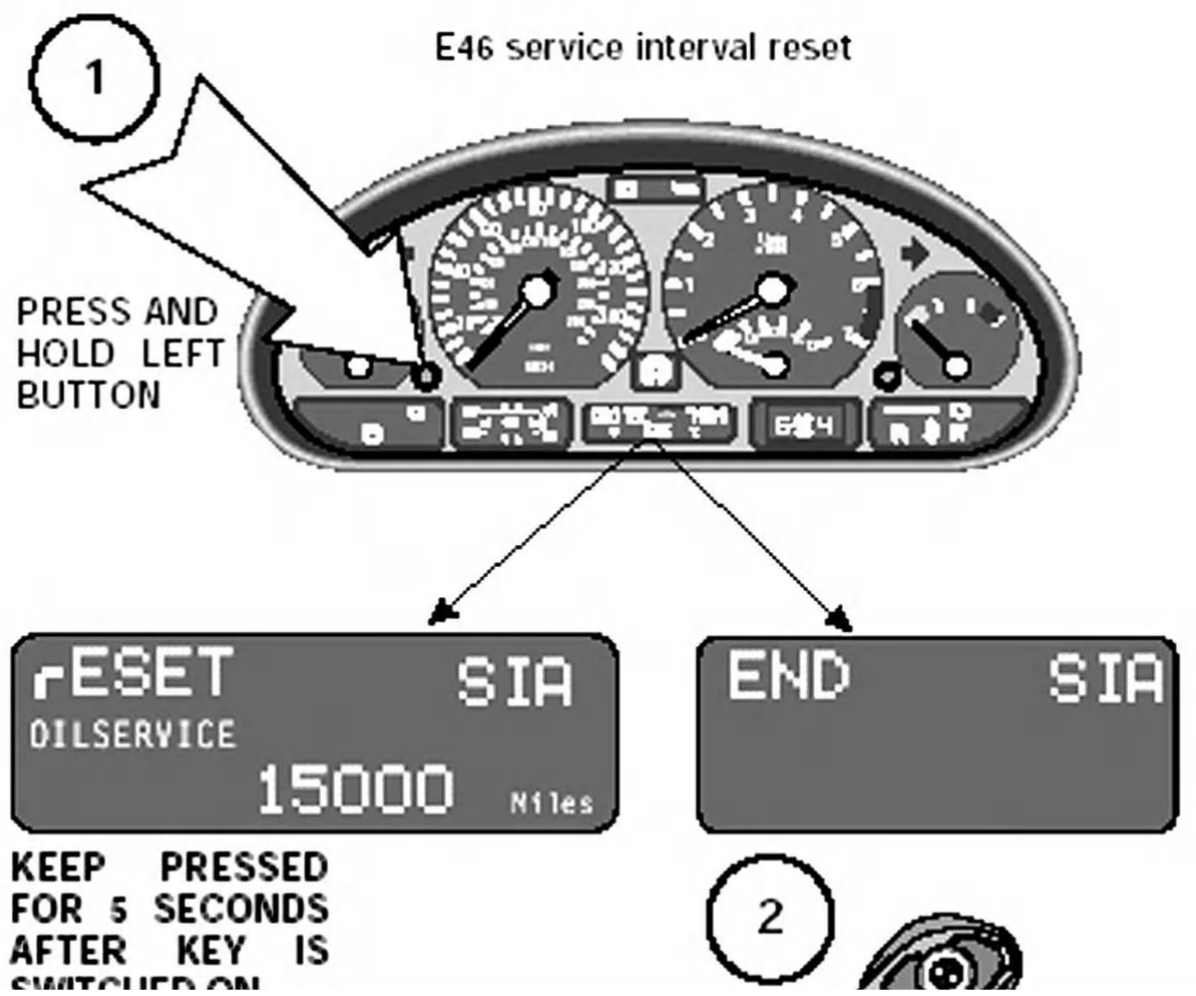


Fig. 3: Resetting Service Interval Light (E46)
Courtesy of BMW OF NORTH AMERICA, INC.

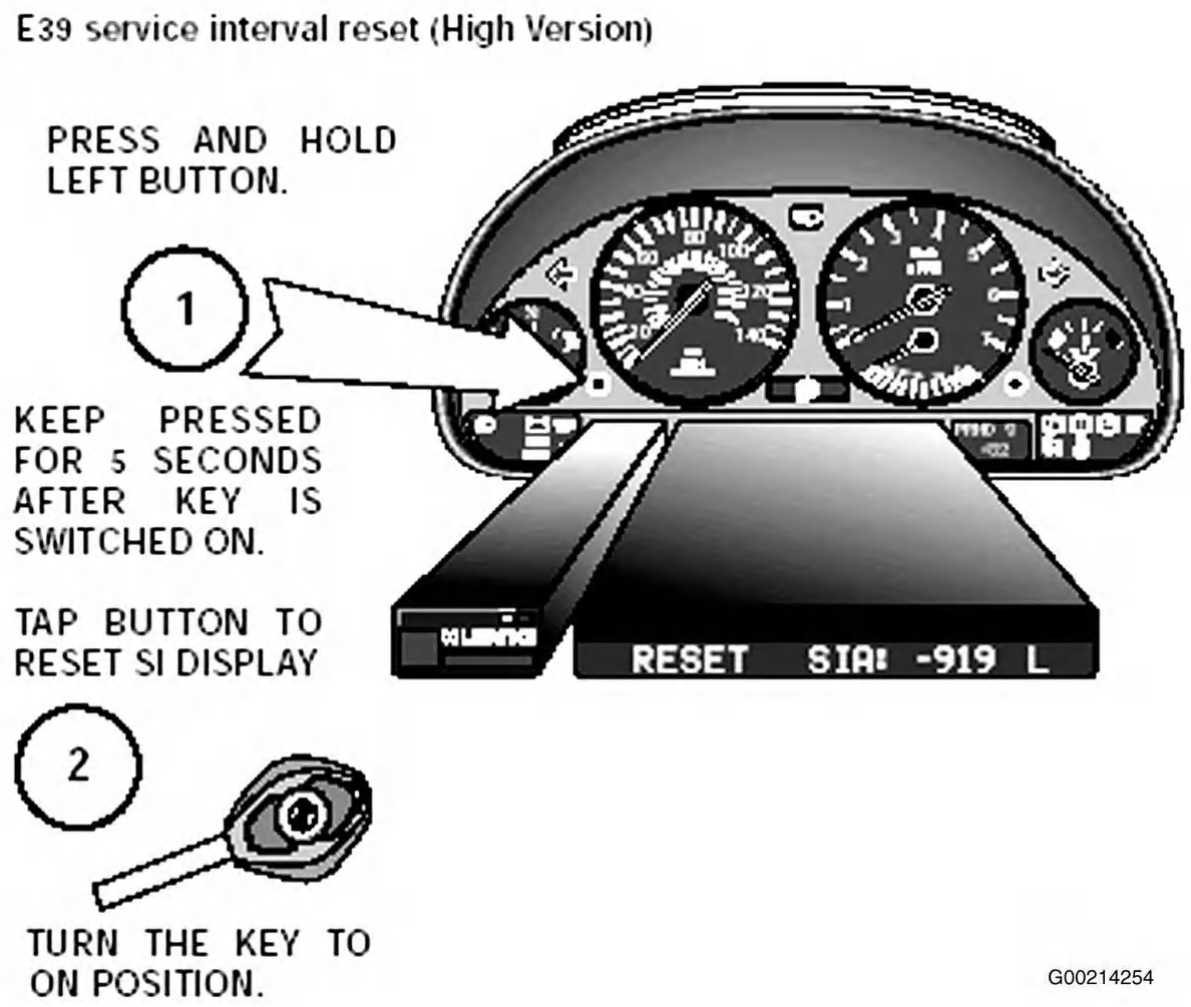


Fig. 4: Resetting Service Interval Light (E39)
Courtesy of BMW OF NORTH AMERICA, INC.

Condition Based Service (CBS) Light Reset (7-Series)

Service reset is accomplished using instrument cluster. On future models, diagnostic tester will reset indicator:

- To reset a service, press the reset button on the top left part of instrument cluster for more than 10 seconds with ignition ON. This brings you directly to reset mode.
- A menu appears in the speedometer. At the top is the BACK function, then the first 3 service items. See Fig. 5 and Fig. 6.

Residual wear or remaining time are specified (possibly with a minus sign). The "1" symbol means that you can reset service operation (early production vehicles may show an "F"), while a "0" indicates it is not resettable (the first 20 percent of the service interval is also protected against accidental reset). You can scroll through the service items by pressing the reset button or the lower button (CC button) on turn signal switch. When you have selected a service item, press reset button for more than 2 seconds to display a 2-line menu in tachometer. "Back" function is at top, resettable service item is below. Now select service item with reset button (or CC button) and press and hold reset button again. In a third menu line, further down, system confirms that reset volume was successful. Whole interval for service operation is shown in SERVICE NEED INDICATOR using control display. For additional information about Condition Based Service (CBS), see RESETTING & CORRECTING CONDITION BASED SERVICE under PROGRAMMING in SELF-DIAGNOSTICS article.



Fig. 5: Resetting Condition Based Service (CBS) Light (1 Of 2)
Courtesy of BMW OF NORTH AMERICA, INC.

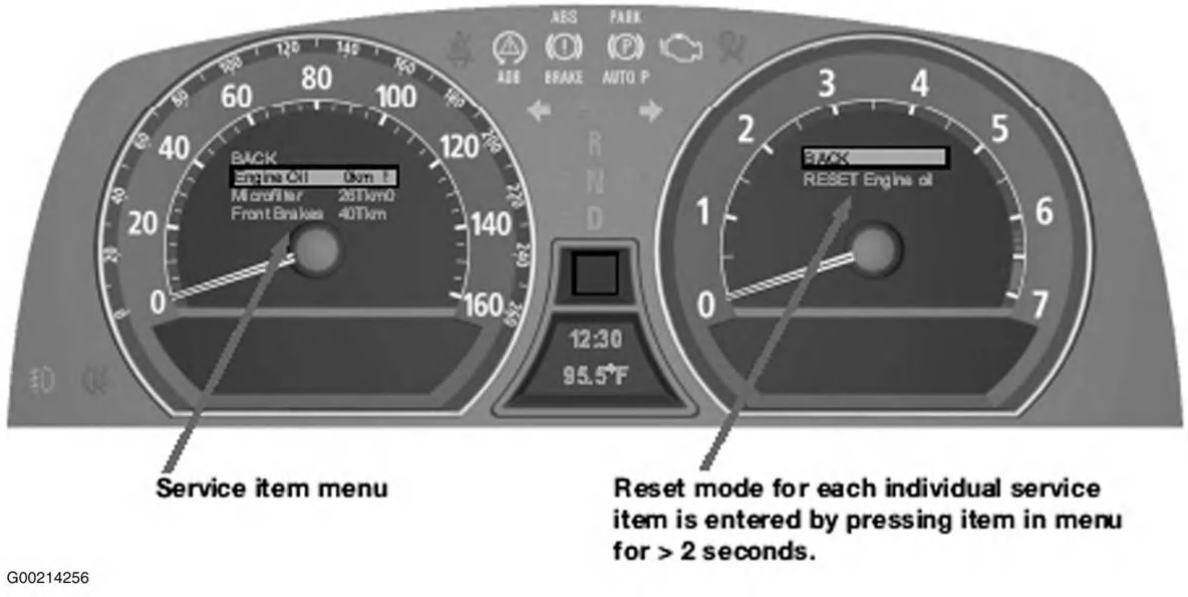


Fig. 6: Resetting Condition Based Service (CBS) Light (2 Of 2)
Courtesy of BMW OF NORTH AMERICA, INC.

7-Series Service Maintenance Checklist

Condition Based Service (CBS) will determine which of the possible maintenance services listed below are required for a particular service visit.

Standard Operations

- Brief diagnostic test.
- Verify Check Control messages.
- Check indicator and warning lights.
- Reset CBS display.

Engine Oil

- Change engine oil and oil filter. BMW recommends BMW High Performance 5W-30 synthetic oil (07 51 0 017 866).
- After every fourth engine oil change, replace air cleaner filter.

Microfilter

- Replace.

Front Brakes

- Brake pads: replace. Clean brake pad contact points in calipers.
- Brake discs: check surface and thickness.

Rear Brakes

- Brake pads: replace. Clean brake pad contact points in calipers.
- Brake discs: check surface and thickness.
- Parking brake: check condition, brake lining thickness and function.

Vehicle Check

- Check operation of horn, headlight flasher and hazard warning lights.
- Check instrument and control lighting, and heater-A/C blower.
- Check lighting system: turn signals, back-up, license plate, interior (inclding map reading lights), glovebox, flashlight, luggage area lights.
- Safety belts: check condition and function.
- Check windshield wiper and jet positions.
- Body: check for corrosion.
- Tires: check tread depth, wear pattern, outer condition, inflation pressure (including spare).
- Battery: check state of charge ("magic eye") and recharge if required.
- Power steering reservoir: check fluid level.
- Visually inspect all SRS airbag units for torn covers, obvious damage or attachment of stickers.
- Function of rear-view mirrors.
- Coolant: check fluid level and concentration.
- Windshield washer system: check fluid level and protection level.
- Brake system connections and lines: check for leaks, damage and correct positioning.
- Underbody: all visible parts including transmission, rear axle and fuel tank. Exhaust system: check for damage, leaks and corrosion.
- Steering components: check for clearance, leaks, damage and wear.
- Parking brake: check function.
- Final Inspection: road test with check of brakes, steering, shock absorbers (external) and transmission.
- Brake fluid: replace every 2 years.
- Coolant: replace every 4 years.
- Spark plugs: replace every 100,000 miles.
- Automatic transmission: replace ATF every 100,000 miles.

MECHANICAL CHECKS

ENGINE COMPRESSION

Check engine compression with engine at normal operating temperature at specified cranking speed, all spark plugs removed and throttle wide open. The DME master relay and/or fuel pump relay MUST be pulled out for compression test. See ON-VEHICLE ADJUSTMENTS article for additional information.

COMPRESSION SPECIFICATIONS

Application	Specification

Compression Pressure	
6-Cylinder & V8	142-156 psi (10-11 kg/cm^2)
V12	156 psi (11 kg/cm^2)

VALVE CLEARANCE

NOTE: Engines with the exemption of Motorsport (S54) engine use hydraulic valve lifters and valve adjustment is not required. For Motorsport engine valve adjustment, see 11 34 004 ADJUSTING VALVE CLEARANCE (S54) .

IGNITION SYSTEM

CRANKSHAFT (SPEED/POSITION PULSE) SENSOR

Operation of crankshaft (speed/position pulse) sensor can be accessed using BMW's GROUP TESTER ONE (GT-1) or DISplus hardware system.

IGNITION COIL

IGNITION COIL RESISTANCE - Ohms @ 68Â°F (20Â°C)

Primary (1)	Secondary
.8	Not Measurable
(1) Specification is approximate. Approximate resistance of Bosch connector is 1k ohms. Approximate resistance of Bremi connector is 1.8k ohms.	

SPARK PLUGS

NOTE: To change spark plugs on V12 engine, it is necessary to remove entire intake system.

SPARK PLUG TYPE

Application	Spark Plug
M Roadster & M Coupe	NGK BKR 7 A
M3	Bosch FGR8KQC
M5	NGK BQR6 EQUP
All Others	NGK BKR6 EQUP

SPARK PLUG SPECIFICATIONS

Application	Gap In. (mm)	Torque Ft. Lbs. (N.m)
Motorsport Engine	(1)	17 (23)
All Others	(1)	23 (31)
(1) Spark plug gap is not adjustable.		

FIRING ORDER

FIRING ORDER (1)

Application	Firing Order
6-Cylinder	1 - 5 - 3 - 6 - 2 - 4
V8	1 - 5 - 4 - 8 - 6 - 3 - 7 - 2
V12	1 - 7 - 5 - 11 - 3 - 9 - 6 - 12 - 2 - 8 - 4 - 10
(1) See Fig. 7-Fig. 9 .	

Firing Order (6-Cylinder)

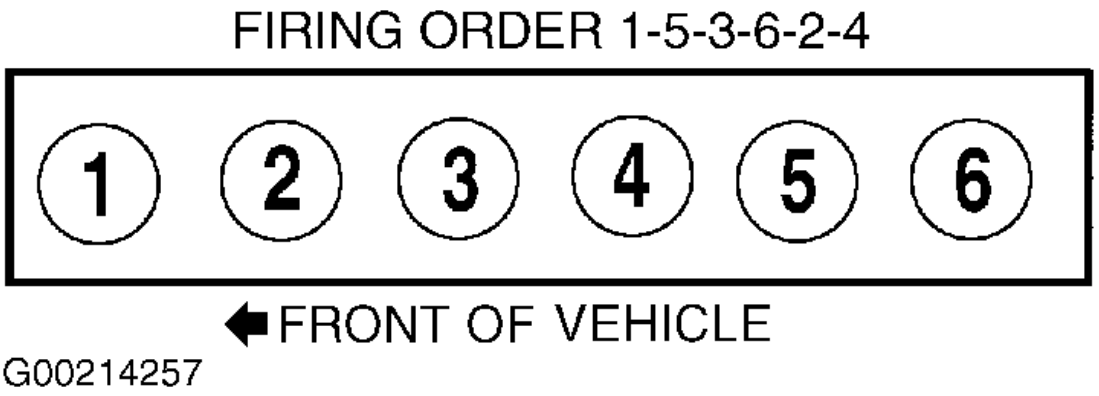


Fig. 7: Firing Order (6-Cylinder)
Courtesy of BMW OF NORTH AMERICA, INC.

Firing Order (V8)

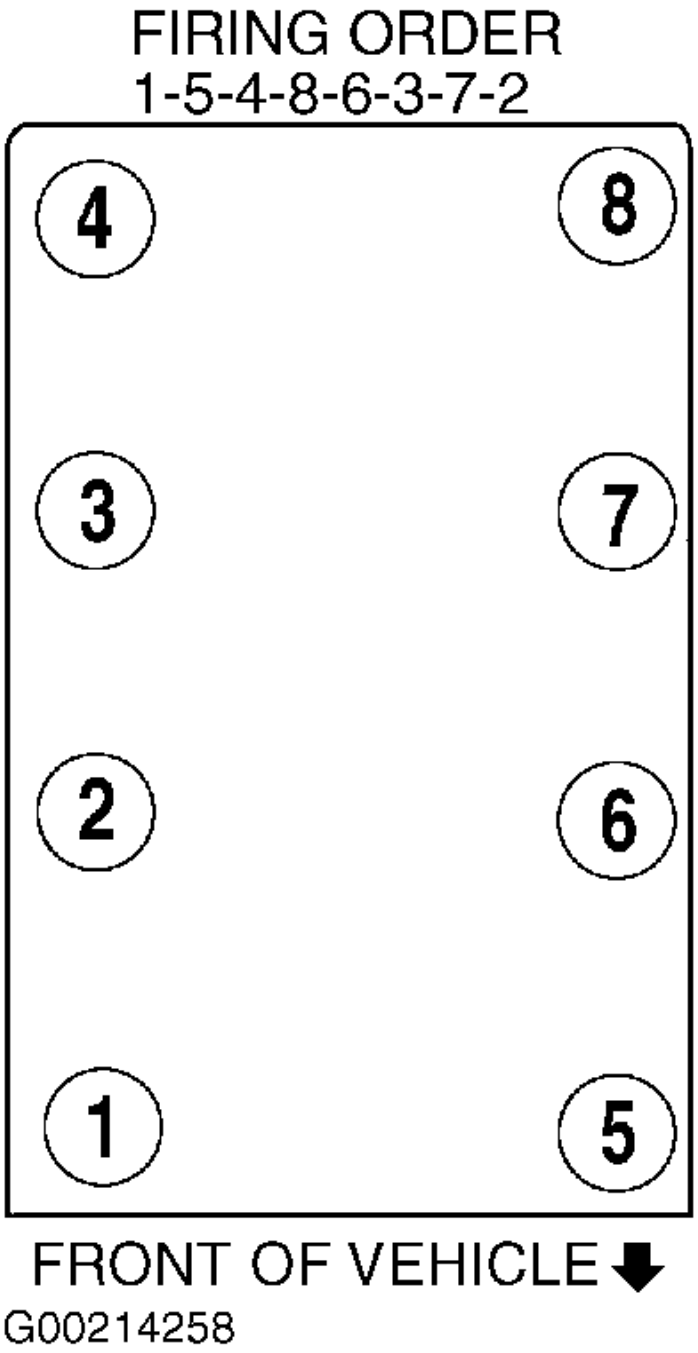


Fig. 8: Firing Order (V8)
Courtesy of BMW OF NORTH AMERICA, INC.

Firing Order (V12)

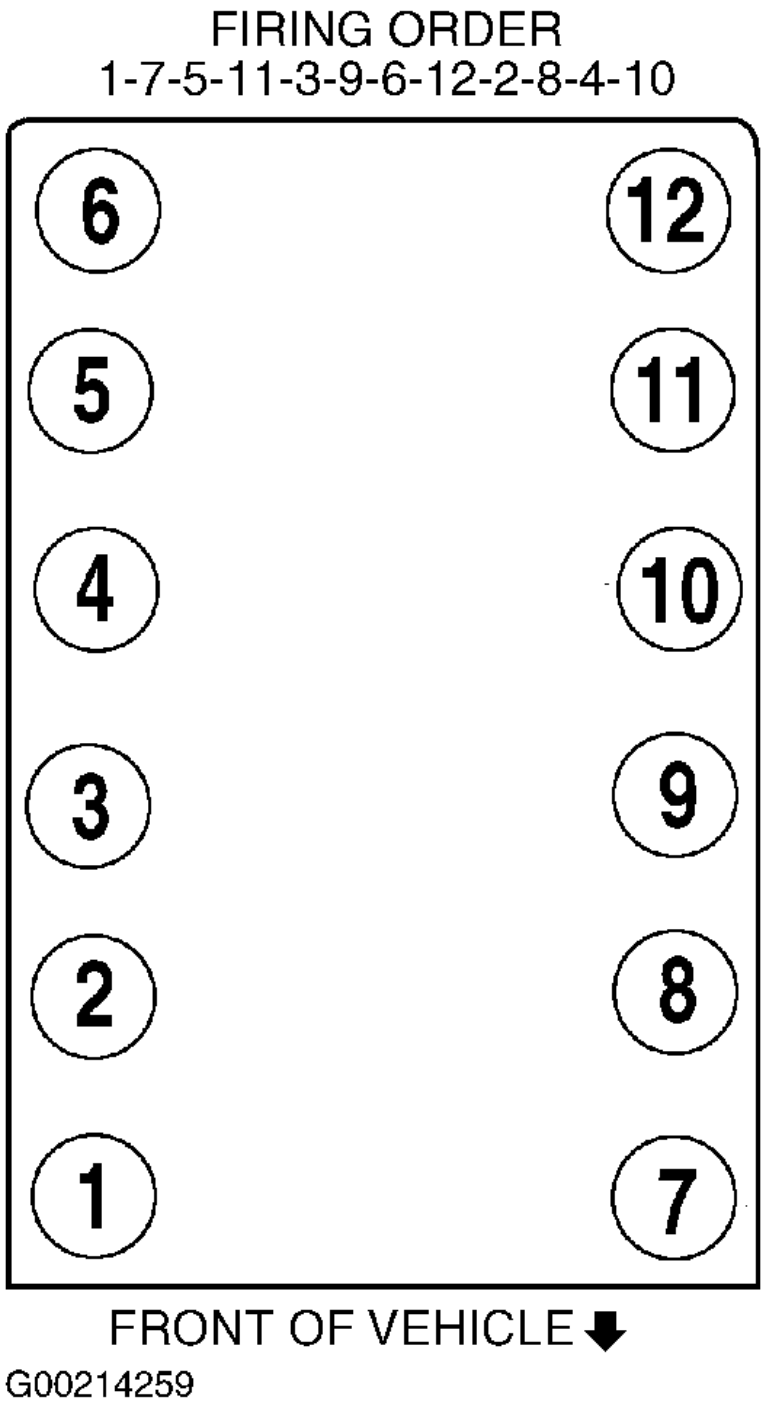


Fig. 9: Firing Order (V12)
Courtesy of BMW OF NORTH AMERICA, INC.

IGNITION TIMING

Ignition timing is electronically controlled and is not adjustable. Ignition timing can be accessed using BMW's GROUP TESTER ONE (GT-1) or DISplus hardware system.

FUEL SYSTEM

FUEL PUMP

NOTE: Fuel pump performance is a measurement of fuel pressure and volume availability, not regulated fuel pressure.

FUEL PUMP PERFORMANCE

Application	Pressure psi (kg/cm^2)	Min. Vol. In 30 Sec. Pts. (L)
6-Cylinder & V8 (Except M5)	50 (3.5)	1.85 (0.9)
M5	71 (5)	(1)
12-Cylinder	50 (3.5)	2.38 (1.13)
(1) Information is not available from manufacturer.		

INJECTOR RESISTANCE

INJECTOR RESISTANCE - Ohms @ 68Â°F (20Â°C)

Application	Ohms
All Models (1)	15-17
(1) Injector group resistance should be 7.5-8.5 ohms for V8 (each bank) and 5-6 ohms for 6-cylinder engine. V12 information is not available.	

IDLE SPEED & MIXTURE

Idle speed are mixture are electronically controlled and are not adjustable. Idle speed and mixture can be accessed using BMW's GROUP TESTER ONE (GT-1) or DISplus hardware system.

IDLE SPEED & CO LEVEL

Application	Idle RPM (1)	(2) CO Level %
6-Cylinder & V8	650-750	.5
V12	530-630	.5
(1) With A/C off and transmission in neutral.		
(2) Maximum specification, measured at exhaust manifold. See ON-VEHICLE ADJUSTMENTS article for additional information.		

IDLE SPEED CONTROL (ISC) VALVE

Z3

ISC VALVE RESISTANCE - Ohms @ 68Â°F (20Â°C)

Application (1)	Ohms
2-Terminal Connector	15-25
3-Terminal Connector	
Terminals No. 1 & 2	15-25
Terminals No. 1 & 3	35-45
(1) ISC valve may be a 2-terminal or 3-terminal type.	

Article GUID: A00151720

INTRODUCTION

NOTE: BMW troubleshooting charts, guides and aids for diagnosis are integrated into BMW-specific service tools. BMW does not have or supply stand-alone guides for testing or troubleshooting. All OBD-II equipped BMWs are designed to be programmed and coded electronically. Diagnosis, coding, and programming on any OBD-II BMW may be carried out with BMW's DISplus, Group Tester 1 (GT1) or similar scan tool.

Before testing separate components or systems, perform procedures in BASIC DIAGNOSTIC PROCEDURES article. Since many computer-controlled and monitored components set a trouble code if they malfunction, also perform procedures in SELF-DIAGNOSTICS - EXCEPT 7-SERIES or SELF DIAGNOSTICS - 7-SERIES article.

NOTE: BMW diagnostic hardware, such as DISplus/GT1 as well as a reputable hand held multimeter should be used when testing inputs and components. Slack Tube Manometer Test Tool (99 00 0 001 410) should be used to troubleshoot crankcase ventilation valves. It is best to make the checks at the ECM connection, as this method includes testing the wiring harness. The correct universal adapter for engine and model being tested should be used. This will ensure the pin connectors and the harness will not be damaged. When installing the universal adapter to the ECM (located in the electronics box in the engine compartment), make sure the ignition is switched off. On Siemens MS45, allow at least 3 minutes to elapse after the key was set to OFF position before disconnecting ECM/TCM. This will allow sufficient time to complete the DM TL test. Voltage may be present (up to 3 minutes) causing damage to the ECM/TCM if they are disconnected during this time period.

COMPUTERIZED ENGINE CONTROLS

DIGITAL MOTOR ELECTRONICS (DME) CONTROL UNIT

NOTE: Digital Motor Electronics (DME) control unit may also be referred to as Electronic Control Module (ECM).

Ground, Power & Input/Output Circuits

See PIN VOLTAGE CHARTS article to identify DME control unit ground circuits, power circuits and input/output circuits. To identify DME/ECM connector terminals, see Fig. 1-Fig. 4 . See DME CONTROL UNIT LOCATION table.

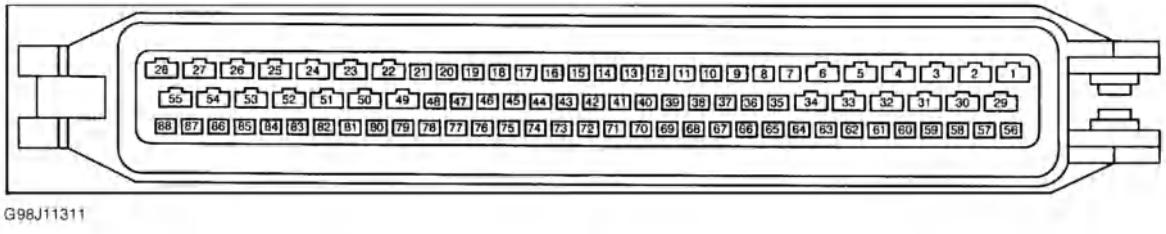


Fig. 1: Identifying DME/ECM 88-Pin Connector (Z3 Only)
Courtesy of BMW OF NORTH AMERICA, INC.

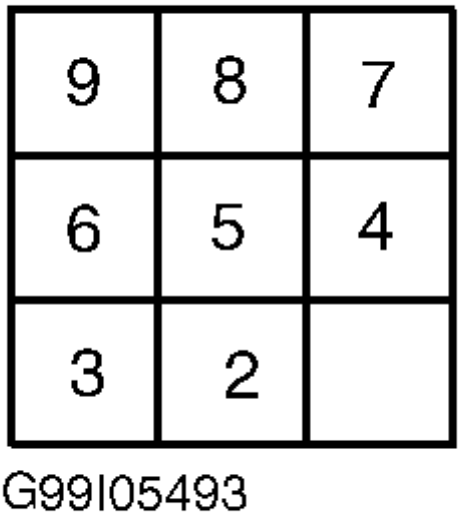


Fig. 2: Identifying DME/ECM 9-Pin Connector
Courtesy of BMW OF NORTH AMERICA, INC.

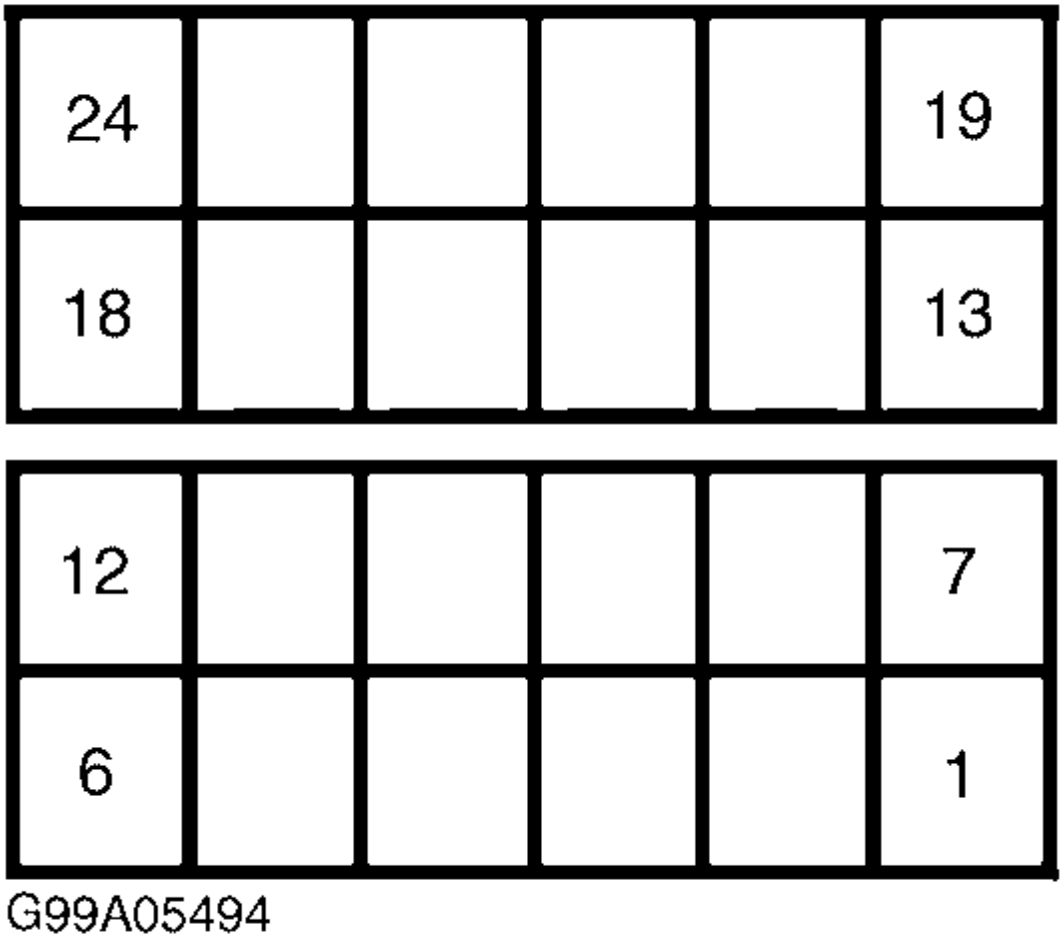


Fig. 3: Identifying DME/ECM 24-Pin Connector
Courtesy of BMW OF NORTH AMERICA, INC.

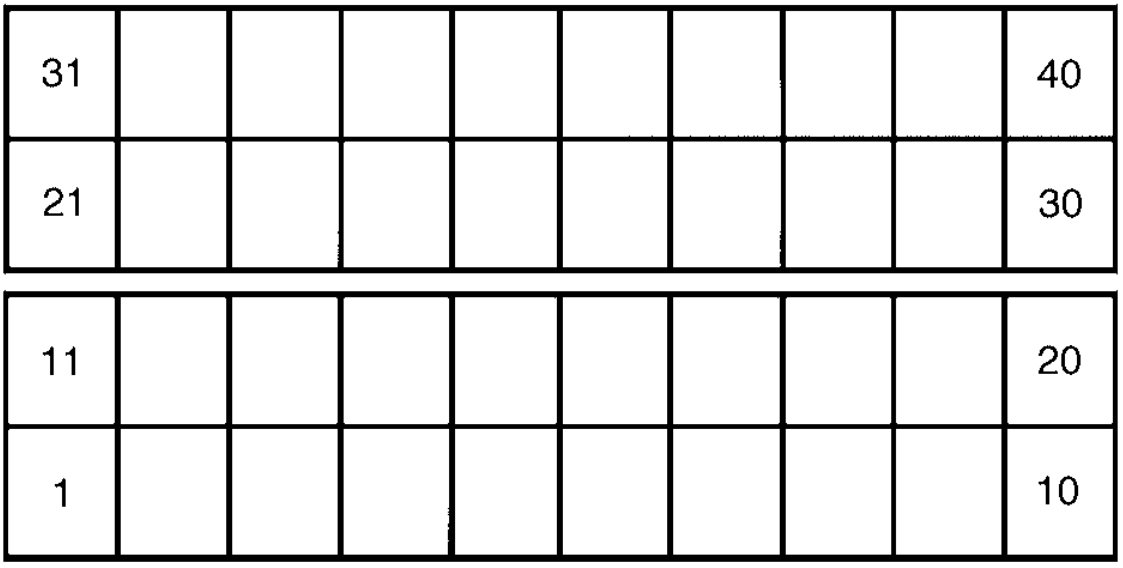


Fig. 4: Identifying DME/ECM 40-Pin Connector
Courtesy of BMW OF NORTH AMERICA, INC.

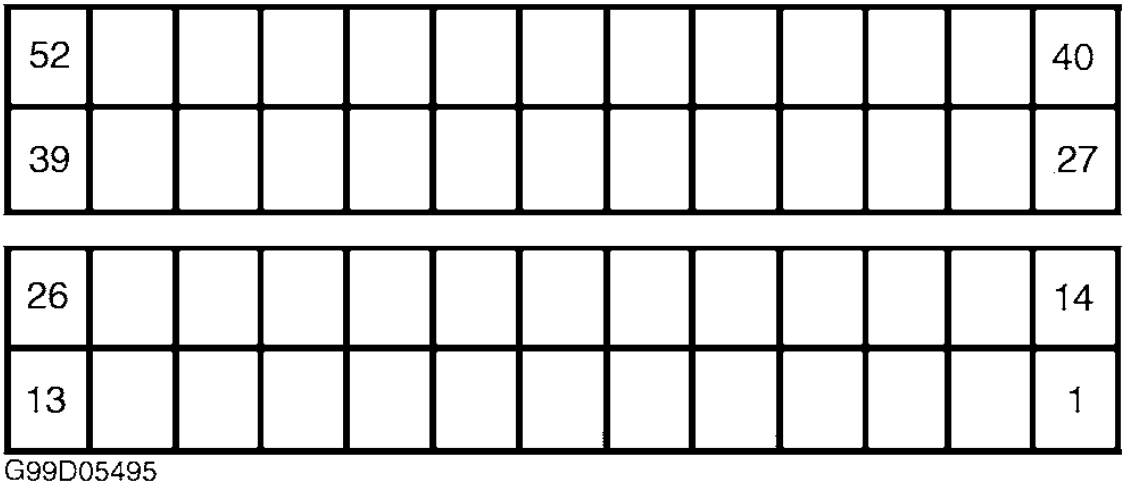


Fig. 5: Identifying DME/ECM 52-Pin Connector
Courtesy of BMW OF NORTH AMERICA, INC.

DME CONTROL UNIT LOCATION

Application	Location
3-Series	
Z3	In Right Rear Side Of Engine Compartment
All Others	Inside Box On Left Rear Corner Of Engine Compartment
All Others (1)	Inside Box On Right Rear Corner Of Engine Compartment, Behind Strut Tower
(1) V12 engine utilizes 2 ECM units in electronic box.	

ENGINE SENSORS & SWITCHES

SENSORS

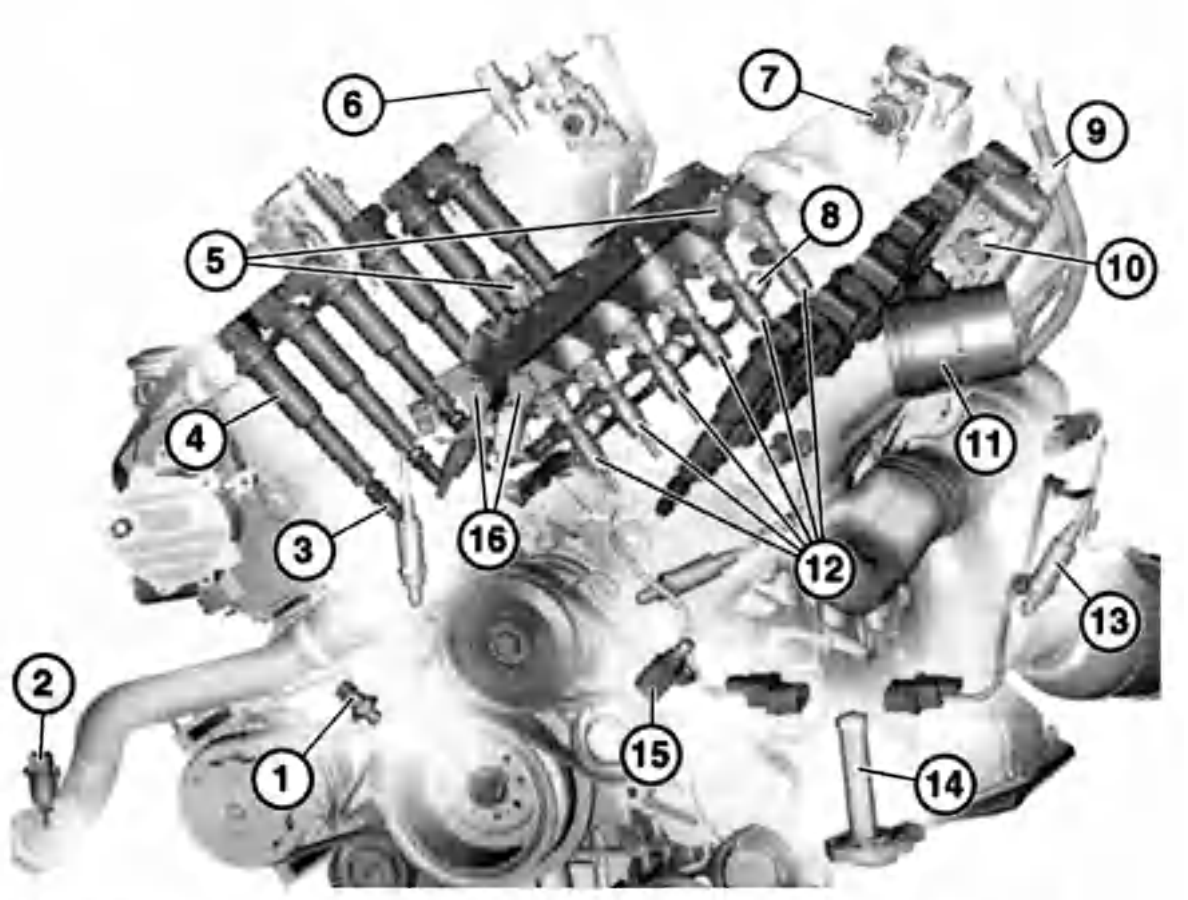
For sensor and switch location, see ENGINE SENSORS & SWITCHES table.

ENGINE SENSORS & SWITCHES

Application	Location
6-Cylinder (Z3)	
Camshaft Position Sensor	On Front Of Engine
Coolant Temperature Sensor	On Front Of Engine
Crankshaft Position Sensor	
"M" Version	Rear Left Side Of Engine Compartment
Z3 Version	On Front Of Engine
Dual Temperature Sensor (Coolant Temperature)	In Rear Of Engine Compartment
Evaporator Temperature Sensor	On Right Side Of Left Footwell
Hot Film Air Mass Meter	Left Side Of Engine Compartment
Intake Air Temperature Sensor	
"M" Version	Front Left Side Of Engine Compartment
Z3 Version	Rear Left Side Of Engine Compartment
Fuel Tank Pressure Sensor	Under Rear Storage Compartment
Heated Oxygen Sensor No. 1	Front Of Catalytic Converter
Heated Oxygen Sensor No. 2	Rear Of Catalytic Converter
Knock Sensors	
"M" Version	On Left Side Of Engine
Z3 Version	On Top Front Of Engine
6-Cylinder (Except Z3)	
Camshaft Position Sensor No. 1	On Front Left Side Of Engine
Camshaft Position Sensor No. 2	On Front Right Of Engine
Coolant Temperature Sensor	On Left Rear Side Of Engine, Under Exhaust Manifold
Crankshaft Position Sensor	On Left Rear Side Of Engine, Under Exhaust Manifold
Heated Oxygen Sensor No. 1	On Right Side Of

	Engine
Heated Oxygen Sensor No. 2	On Lower Right Side Of Engine
Hot Film Mass Airflow Sensor	
3-Series	On Left Side Of Engine, In Air Intake
5-Series	Lower Right Side Of Engine Front
Intake Air Temperature Sensor	Under Engine Cover, On Top Center Of Engine
Knock Sensors	At Rear Of Engine Under Exhaust Manifold
Oil Temperature Sensor	On Front Left Side Of Engine, Behind Oil Filter Housing
RPM Sensor	
3-Series	Under Driver's Seat Carpet
5-Series	Left Side Of Left Footwell, Under Carpet
Transverse Acceleration Sensor	On Left Side Of Left Footwell
V8	
Crankshaft Position Sensor	On Right Side Of Transmission
Heated Oxygen Sensor No. 1 In Front Of Catalytic Converter	Next To Left Side Of Transmission
Heated Oxygen Sensor No. 2 In Front Of Catalytic Converter	Next To Right Side Of Transmission
Heated Oxygen Sensor No. 1 Behind Catalytic Converter	In Center Of Exhaust System
Heated Oxygen Sensor No. 2 Behind Catalytic Converter	In Center Of Exhaust System
Hot Film Air Mass Meter	Lower Right Side Of Engine Front
RPM Sensor	Left Side Of Left Footwell, Under Carpet
V12	(1)

(1) See Fig. 6



1	Coolant temperature sensor, engine	9	Pulse generator, exhaust camshaft
2	Coolant temperature sensor, radiator outlet	10	HDEV high-pressure pump
3	Spark plugs	11	Air-mass sensor
4	Rod-type ignition coils	12	HDEV injection nozzles
5	Fuel pressure sensors	13	Oxygen sensor
6	Pulse generator, inlet camshaft	14	Oil level sensor
7	Eccentric shaft sensor	15	Crankshaft sensor
8	Knock sensors	16	Injection lines

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Fig. 6: Identifying V12 Sensor Locations
Courtesy of BMW OF NORTH AMERICA, INC.

COOLANT TEMPERATURE SENSOR

Coolant temperature sensor decreases in resistance as temperature rises and vice versa. ECM monitors the sensor voltage which varies as temperature changes the resistance value. As temperature rises, resistance through the sensor decreases, voltage drop of the sensor decreases, and input signal voltage also decreases (5-0 volts). Sensor should be tested using DISplus/GT1 multimeter. DISplus/GT1 multimeter ECM input should be 2.250 k/ohms at 68Â°F (20Â°C). Gauge input should be 6.7 k/ohms at 68Â°F (20Â°C).

CRANKSHAFT POSITION SENSOR

Crankshaft position/RPM sensor should be tested using DISplus/GT1 for power supply, DC voltage, status display, oscilloscope display found under preset measurements, and engine speed sensor signal.

FUEL TANK PRESSURE/LEAK DETECTION SENSOR

7-Series

1. Evaporative leakage detection is performed on fuel storage system by Tank Leakage Diagnostic Module (DM-TL) pump which contains an integral DC motor that is activated by ECM. ECM monitors pump motor operating current as the measurement for detecting leaks. DM-TL generates a pressure of.29-.43 psi (20-30 mbar) in the fuel tank and evaporative system. Electrical current required for this is calculated by ECM and serves as the indirect value for the tank pressure. The DM-TL carries out a reference measurement before each measurement. This is performed by building up a pressure for 10-15 seconds using an internal orifice of.019" (.5 mm) as a reference and ECM monitors current (20-30 mA) required by pump motor.
2. If a lower pressure is detected in pressure build-up (low current draw) as compared to reference measurement, this indicates a leak in fuel tank/evaporative system. If a higher pressure is detected (higher current draw), the system does not have a leak. The pump also contains an ECM controlled change over valve that is energized closed during a leak diagnosis test. The ECM only initiates a leak diagnosis test every second time the criteria is met. The criteria is as follows:
    - Engine off with ignition off.
    - ECM still in active state or what is known as "follow up mode". (ECM relay energized, ECM and components online for extended period after key off).
    - Prior to engine/ignition switch off condition, vehicle must have been driven for a minimum of 20 minutes.
    - Prior to minimum 20 minute drive, vehicle must have been off a minimum of 5 hours.
    - No faults in ECM for DM-TL/tank venting system.
    - Fuel tank capacity must be between 10-90 percent (safe approximation between 1/4-3/4 of a tank).
    - Ambient air temperature between 19-95Â°F (-7-35Â°C).
    - Altitude less than 8202 feet.
    - Battery voltage between 11.5-14.5 volts.
3. When these criteria are satisfied every second time, ECM will start FUEL SYSTEM LEAK DIAGNOSIS TEST. Test will typically be carried out once a day. The following morning, the test will run again.

HEATED OXYGEN SENSOR

X5 (6-Cylinder) & E46

The MS42.0 system uses Bosch LSH 25 oxygen sensors. Voltage range is between 0-800 mV.

Z4 & M3

Vehicles use Bosch LSH 25 oxygen sensors, The pre-cat oxygen sensors measure residual oxygen content of exhaust gas. The sensors produce a low voltage (0-1000 mV) proportional to the oxygen content that allows the ECM to monitor the air/fuel ratio.

7-Series (V8)

1. Sensor conductivity is efficient when the oxygen sensor is hot 1382Â°F (750Â°C). For this reason, sensor contains a heating element. This reduces warm up time and retains heat during low engine speed when exhaust temperature is cooler. Oxygen sensor heating elements receive power from Integrated Voltage Supply Module (IVM) and ground supply is pulse width modulated by the ECM. Monitored voltage signal is constantly changing due to combustion variations and normal exhaust pulsations.
    - At a value of lambda = 1, pump cell requires approximately 3 milliamps. Oxygen sensor signal voltage is approximately 1.5 volts. Reference cell voltage is approximately 450 millivolts.
    - At a lambda value of less than one (rich), oxygen sensor signal voltage is approximately.3 volt.
    - At a lambda value of greater than one (lean), oxygen sensor signal voltage is approximately 4.3 volts.
2. If necessary, ECM will correct air/fuel ratio by regulating injection time. ECM monitors length of time sensors are operating in lean, rich and rest conditions. Evaluation period of sensors is over a predefined number of oscillation cycles and pump cell amperage.

Bosch LSH 25 oxygen sensors produce a low voltage (0-1000 mV) proportional to the oxygen content exiting the catalytic converters. If exhaust has a lower oxygen content (rich mixture), there will be a large ion migration through the sensor, generating a higher voltage (950 mV). If the exhaust has a higher oxygen content (lean mixture), there will be a small ion migration through the sensor, generating a lower voltage (080 mV).

HOT-FILM AIR MASS SENSOR

Hot-film air mass sensor is non-adjustable. A faulty hot-film air mass sensor can make engine difficult to restart when engine is hot, engine starts then stalls, malfunction indicator light illuminated, or engine starts and runs only with accelerator pedal depressed. Hot-film air mass sensor can be tested with DISplus/GT1, DISplus/GT1 status page, and the DISplus/GT1 oscilloscope which requires taking the measurement with the ECM and the universal adapter connected to the circuit (engine running).

Visually inspect the sensor for damaged, missing or blocked screens. The screens affect air flow calibration. Also inspect sealing rings where sensor inserts in air filter housing and intake boot. Ensure pin connections are tight.

THROTTLE POSITION SENSOR

Throttle position sensor can be tested with BMW DISplus system or DISplus oscilloscope. When using oscilloscope, select from present measurement which requires taking the measurement with the ECM and the universal adapter connected to circuit. See Fig. 7.

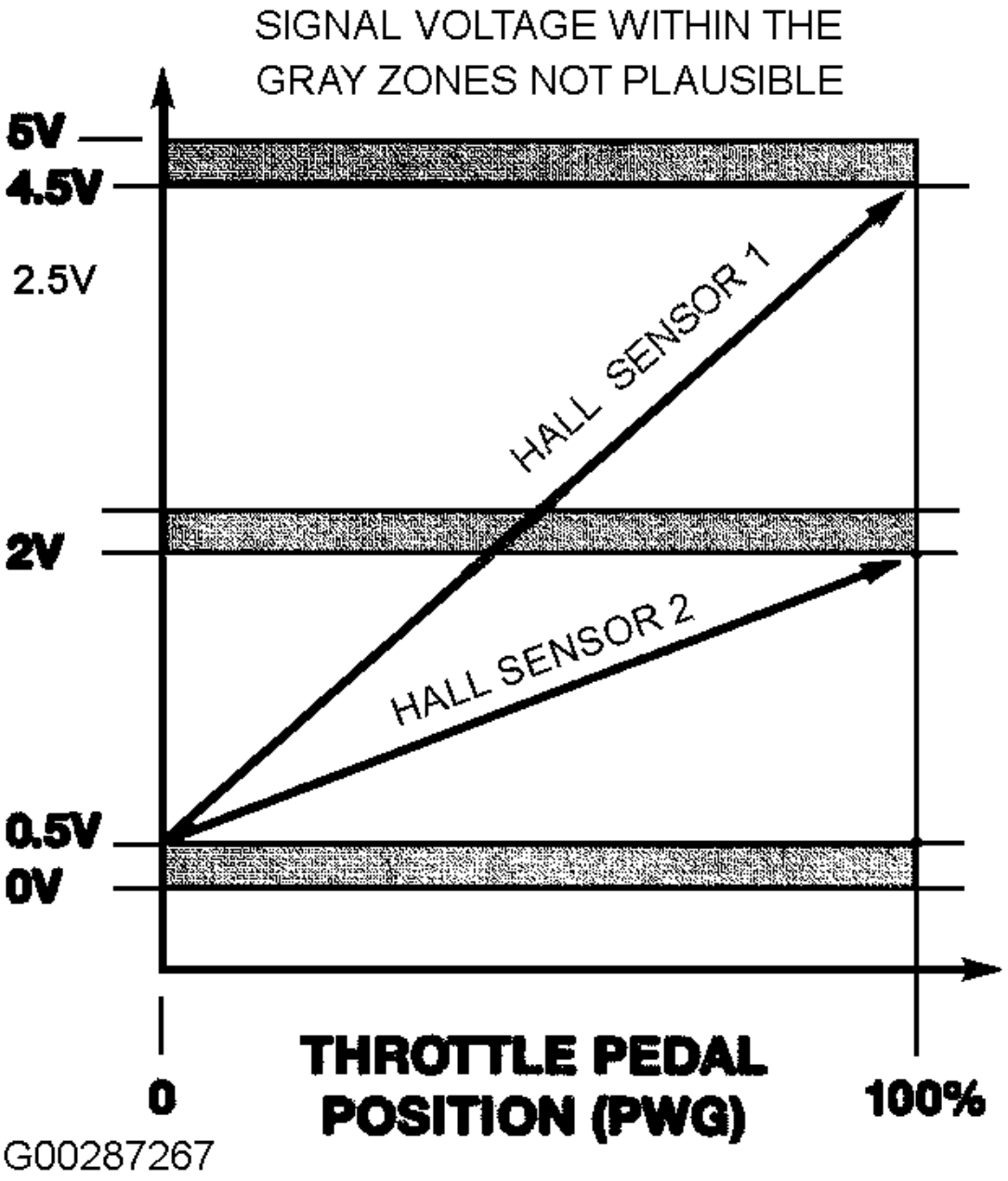


Fig. 7: Checking Throttle Position Sensor
Courtesy of BMW OF NORTH AMERICA, INC.

RELAYS & SOLENOIDS

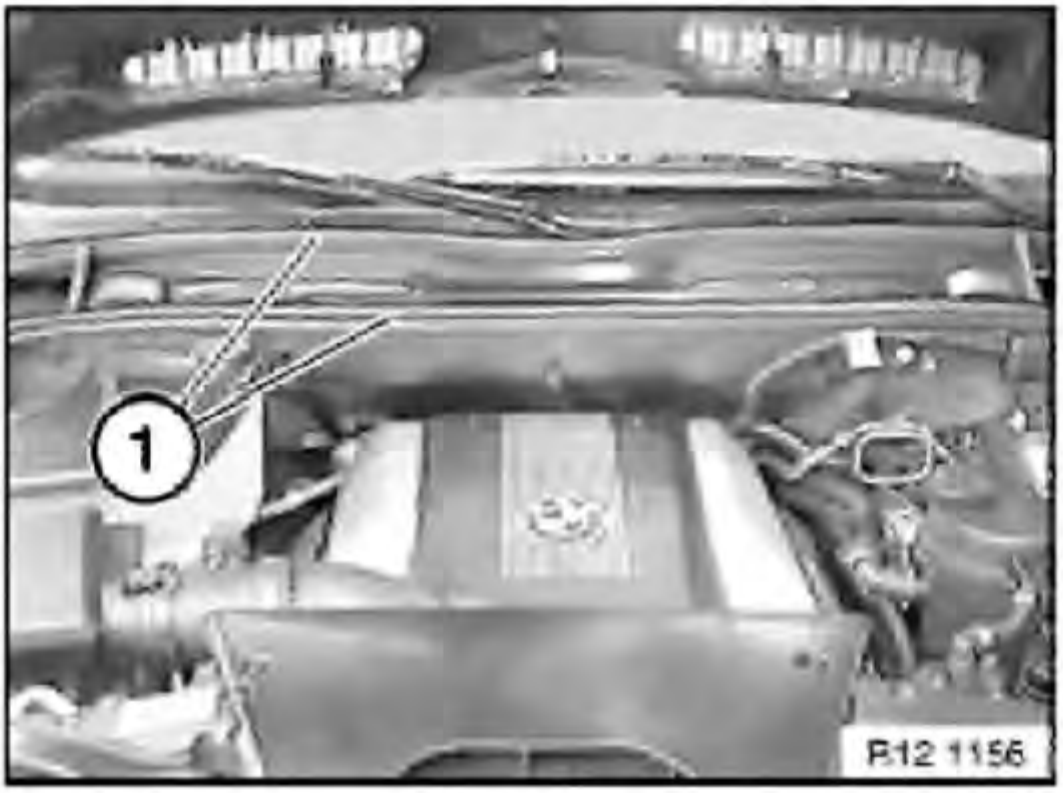
RELAYS

For fuel pump relay, see FUEL DELIVERY under FUEL SYSTEM. For relay location or location of relay box, see RELAY LOCATION table. See Fig. 8-Fig. 33 .

RELAY LOCATION

Application	Location
X5	
DME Relay	Right Rear Corner Of Engine

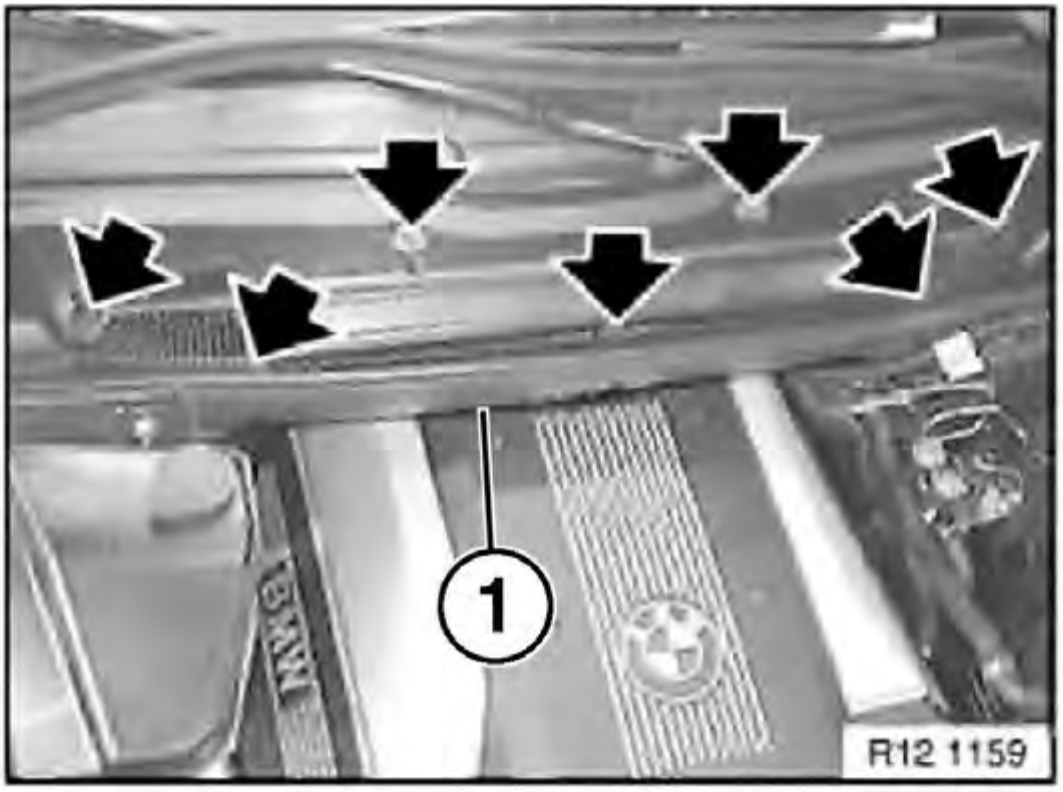
	Compartment, Next To DME
Fuel Pump Relay	Behind Glovebox
Z4	
Relay/Electronics Box	Left Rear Corner Of Engine Compartment
Fuel Pump Relay	Behind Glovebox
Z8	
DME Relay	Right Rear Corner Of Engine Compartment, Next To DME
Fuel Pump Relay	In Right Rear Of Storage Compartment
3-Series (Z3)	
DME Relay	Right Rear Corner Of Engine Compartment, Next To DME
Fuel Pump Relay	Under Left Side Of Instrument Panel, Next To Kick Panel
3-Series (E46)	
DME Relay	Left Rear Corner Of Engine Compartment, In Relay/DME Box
Fuel Pump Relay	Behind Glove Box
5-Series	
DME Relay	Right Rear Corner Of Engine Compartment, Next To DME
Fuel Pump Relay	Behind Glove Box, Behind Fuse Box
7-Series	
Relay/Electronics Box	In Engine Compartment.



1. Sealing Strips

G00131606

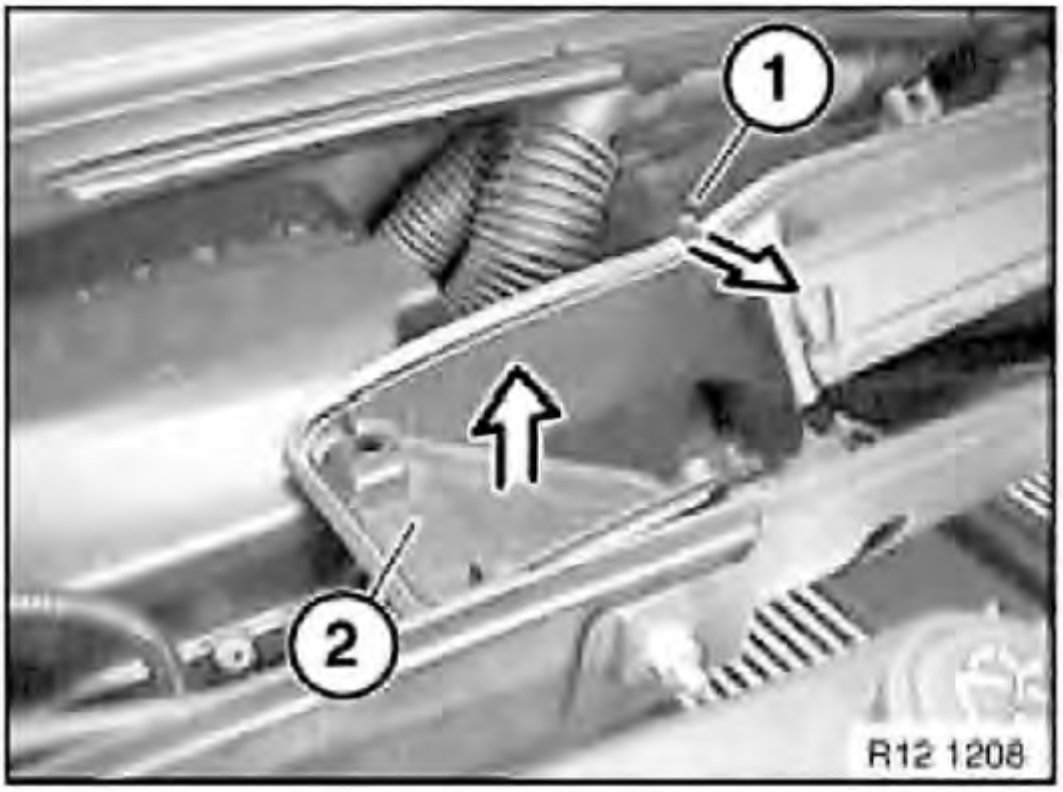
Fig. 8: Locating DME Relay; Removing Sealing Strips (X5)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Cover

G00131607

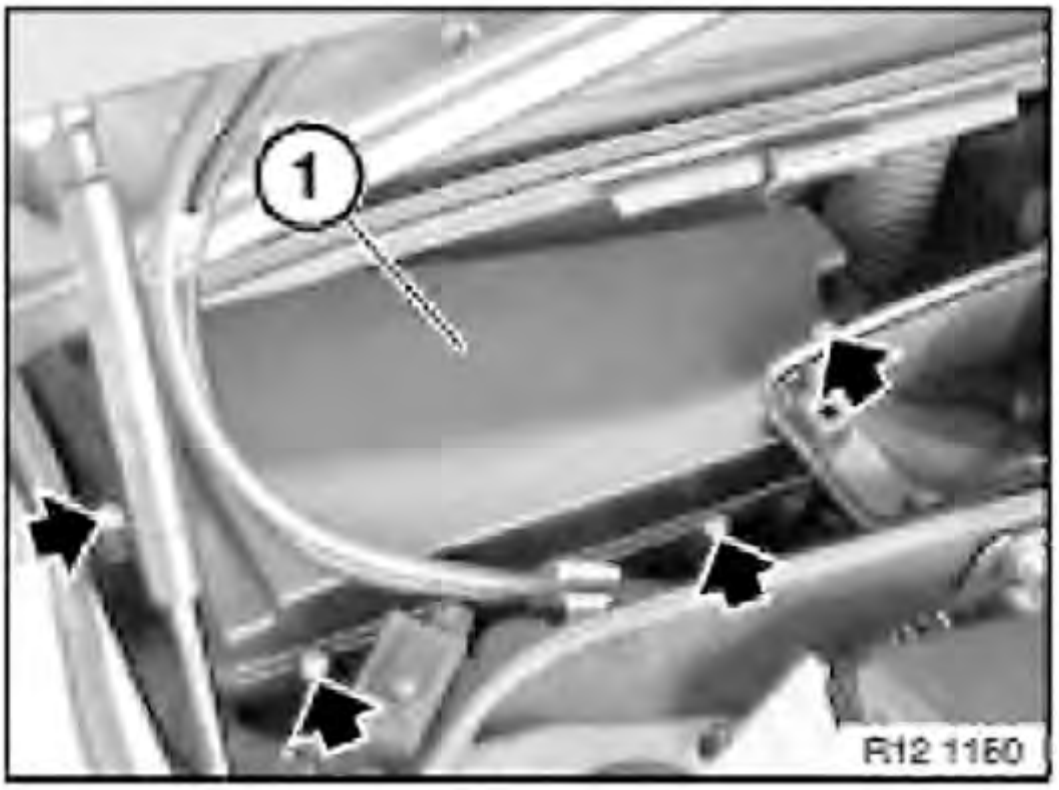
Fig. 9: Locating DME Relay; Removing Cover (X5)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Lock
2. Air Funnel

G00131608

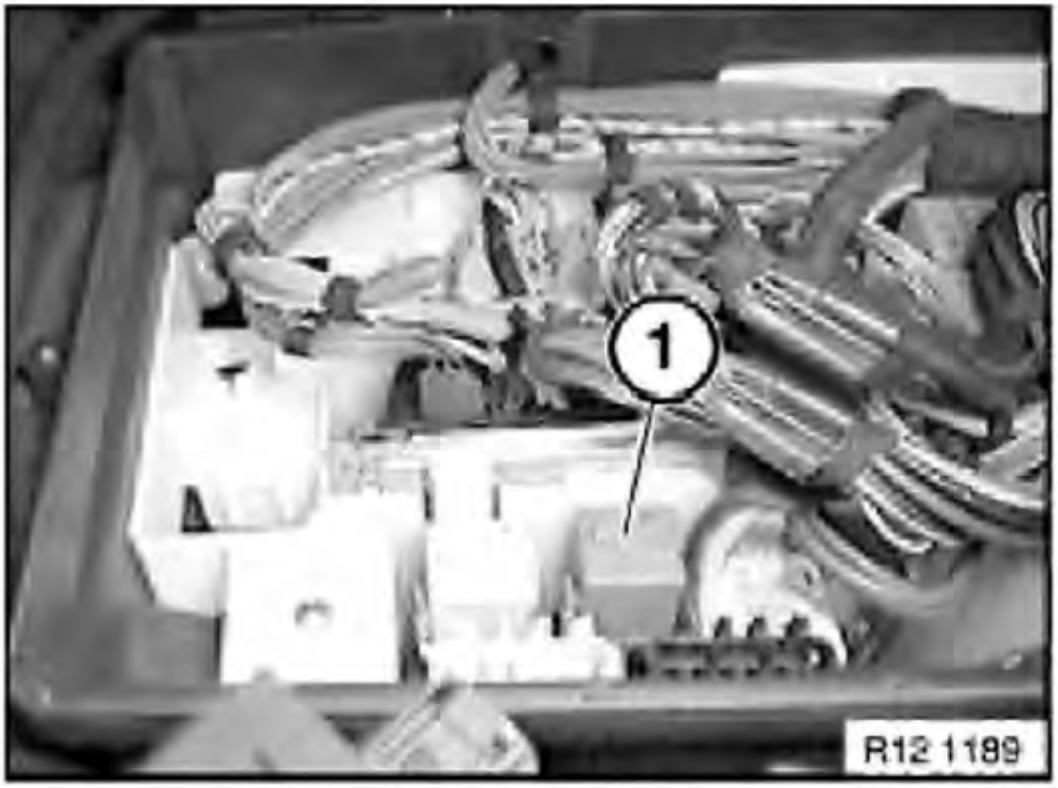
Fig. 10: Locating DME Relay; Removing Air Funnel (X5)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Control Unit Box Cover

G00131609

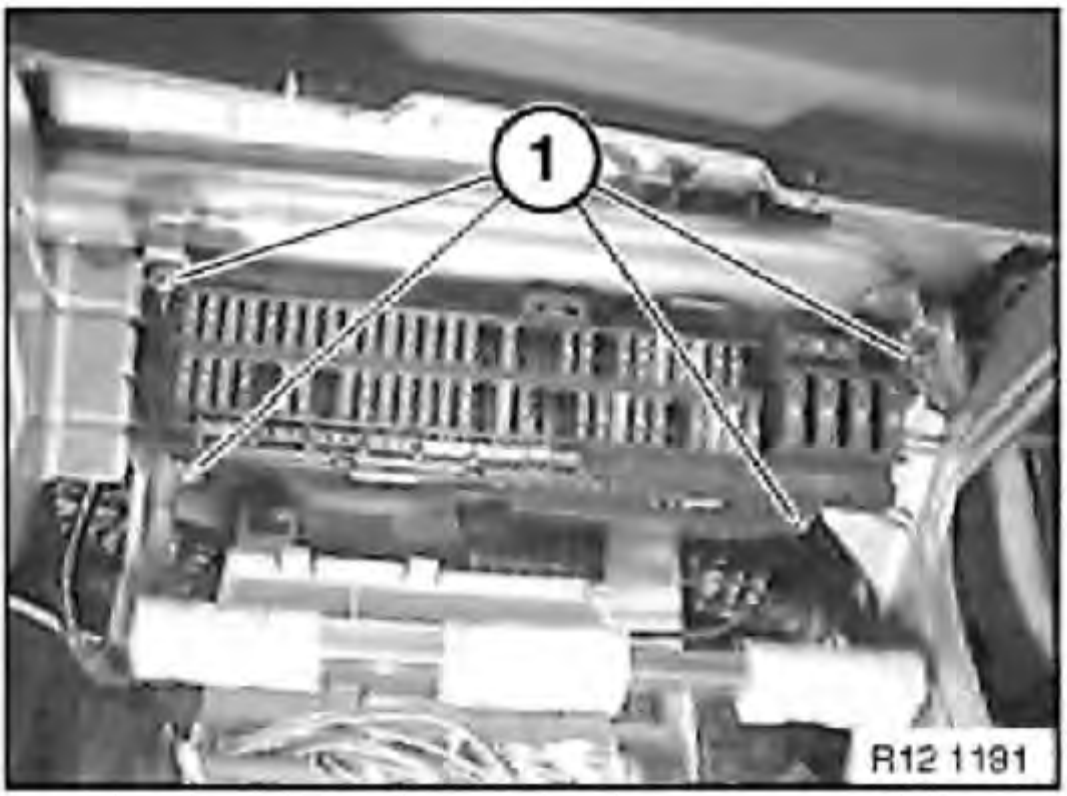
Fig. 11: Locating DME Relay; Removing Control Unit Box Cover (X5)
Courtesy of BMW OF NORTH AMERICA, INC.



1. DME Relay

G00131611

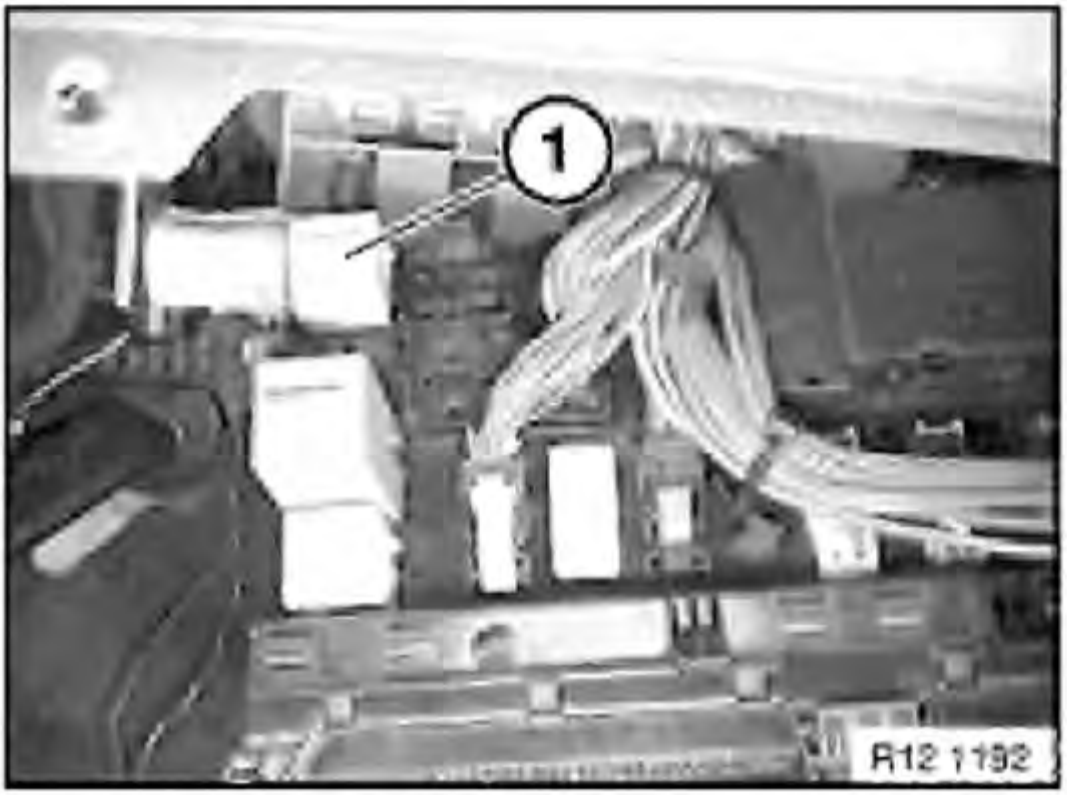
Fig. 12: Locating DME Relay In Relay/Fuse Box (X5)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Screws

G00131604

Fig. 13: Locating Fuel Pump Relay; Removing Fuse Box (X5)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Fuel Pump Relay

G00131605

Fig. 14: Locating Fuel Pump Relay Under Fuse Box (X5)
Courtesy of BMW OF NORTH AMERICA, INC.



1. DME Relay

G00131610

Fig. 15: Locating DME Relay (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Fuel Pump Relay

G00131612

Fig. 16: Locating Fuel Pump Relay (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

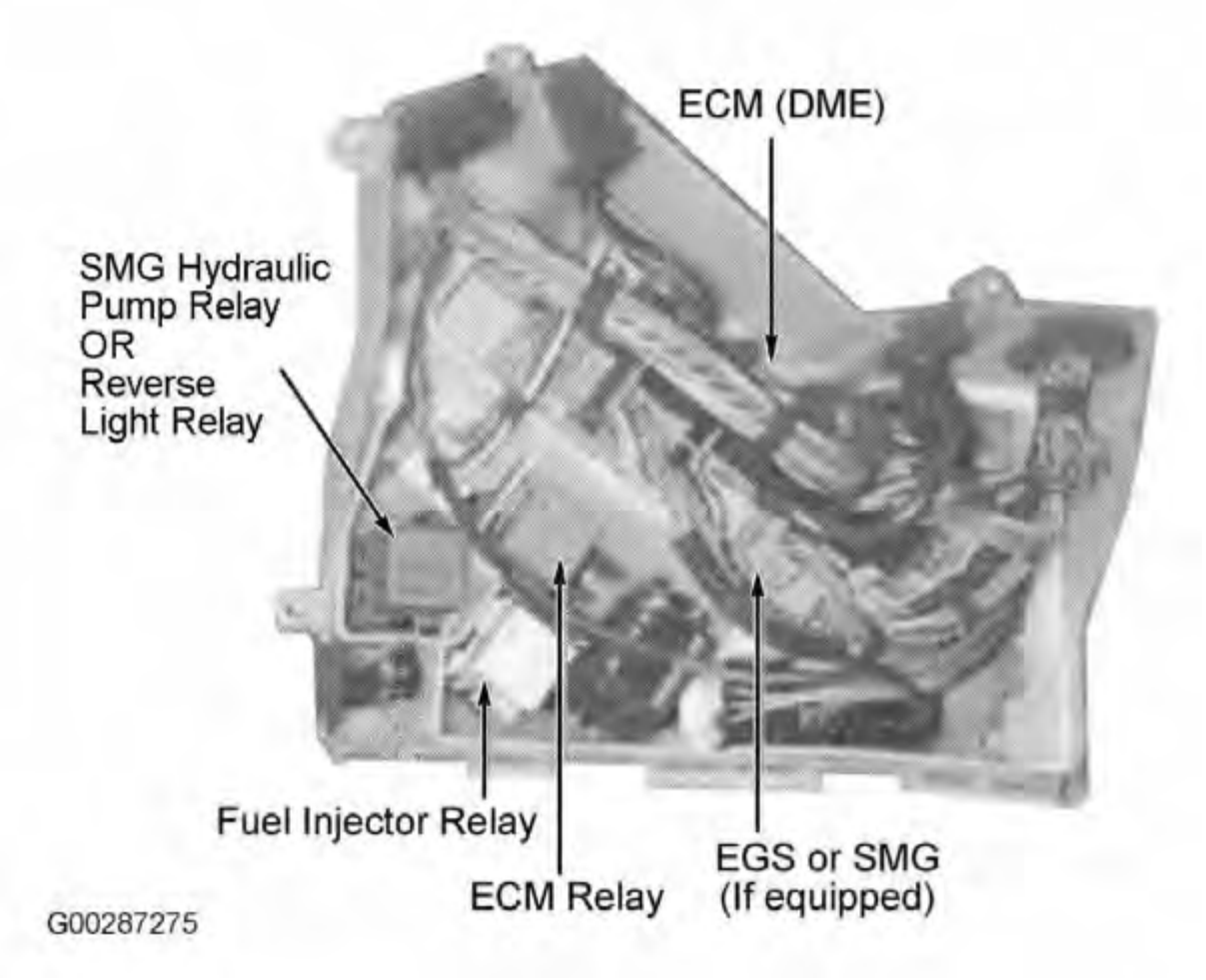
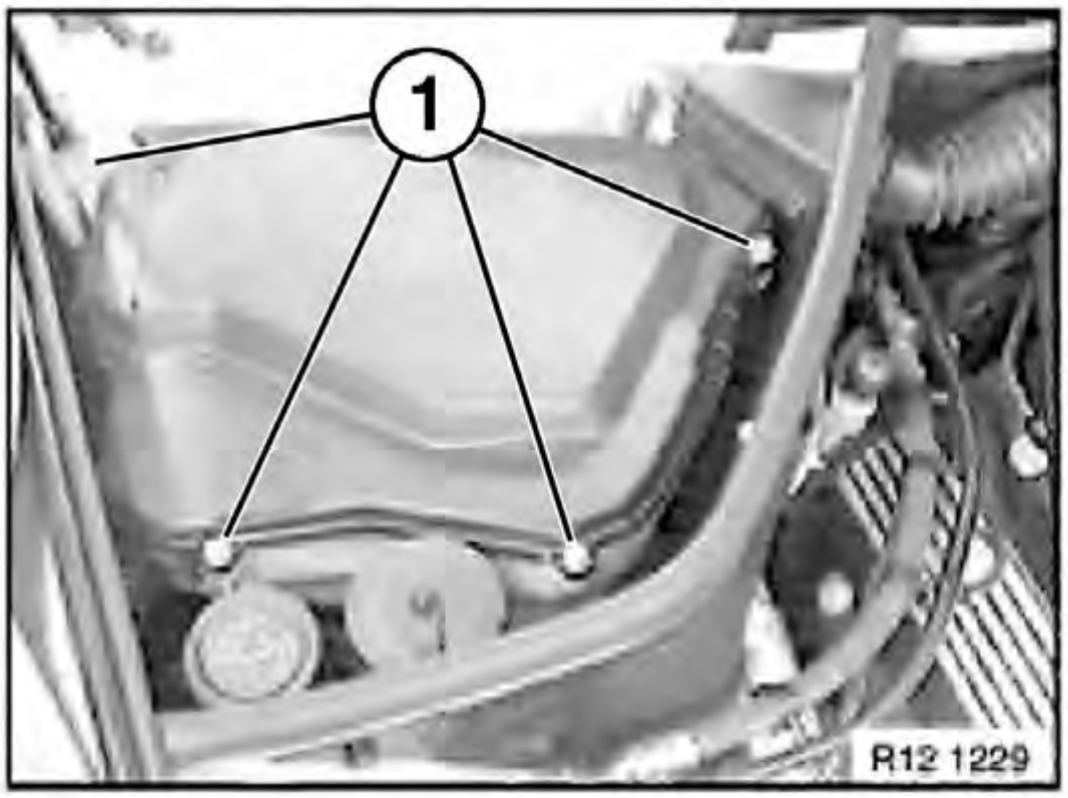


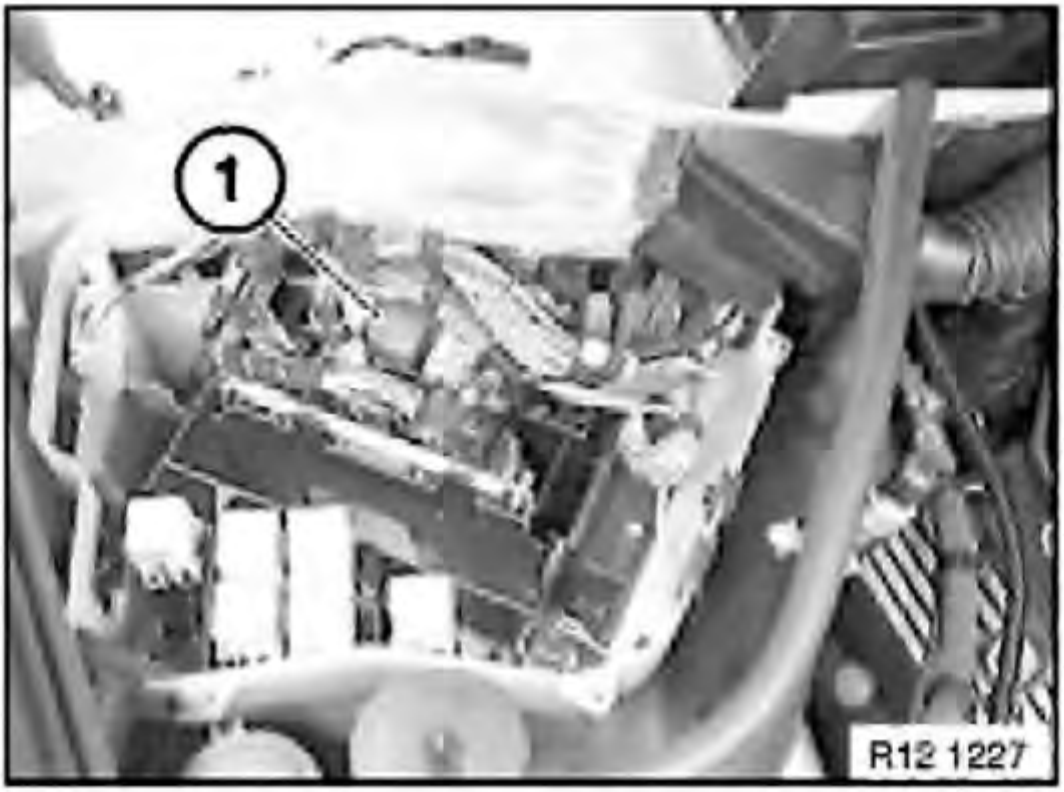
Fig. 17: Identifying Electronics Box (Z4)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Screws

G00131613

Fig. 18: Locating DME Relay; Removing Electronics Box Cover (Z8)
Courtesy of BMW OF NORTH AMERICA, INC.



1. DME Relay

G00131614

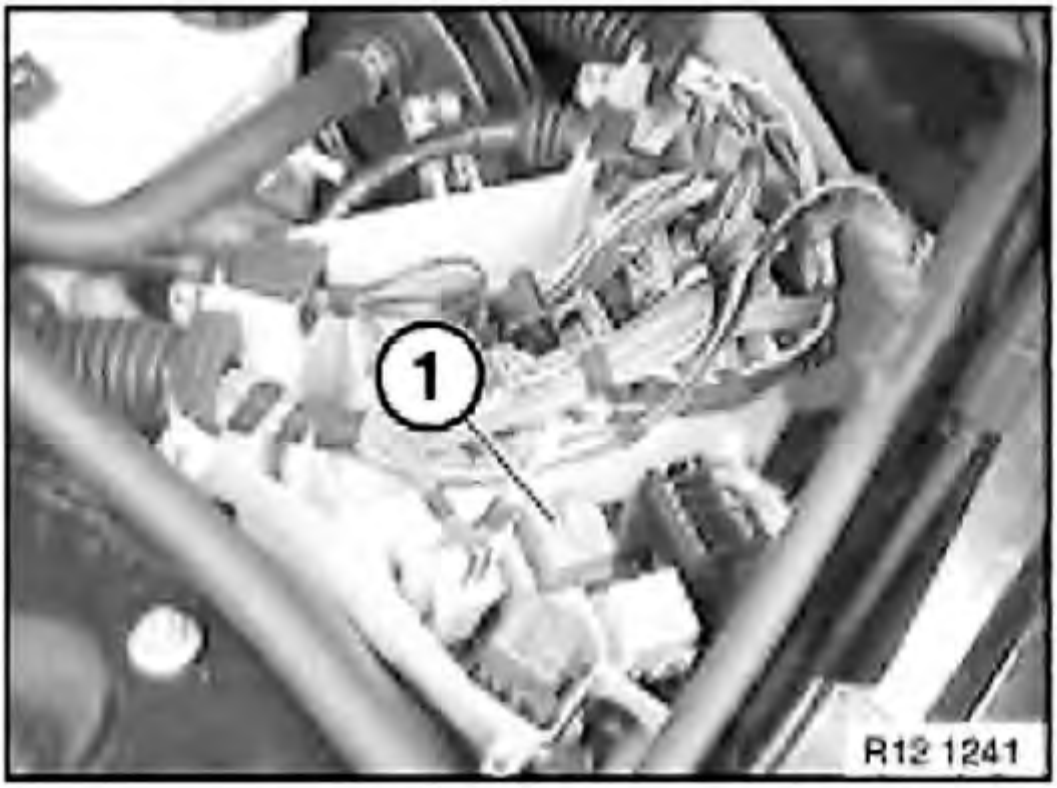
Fig. 19: Locating DME Relay (Z8)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Fuel Pump Relay

G00131615

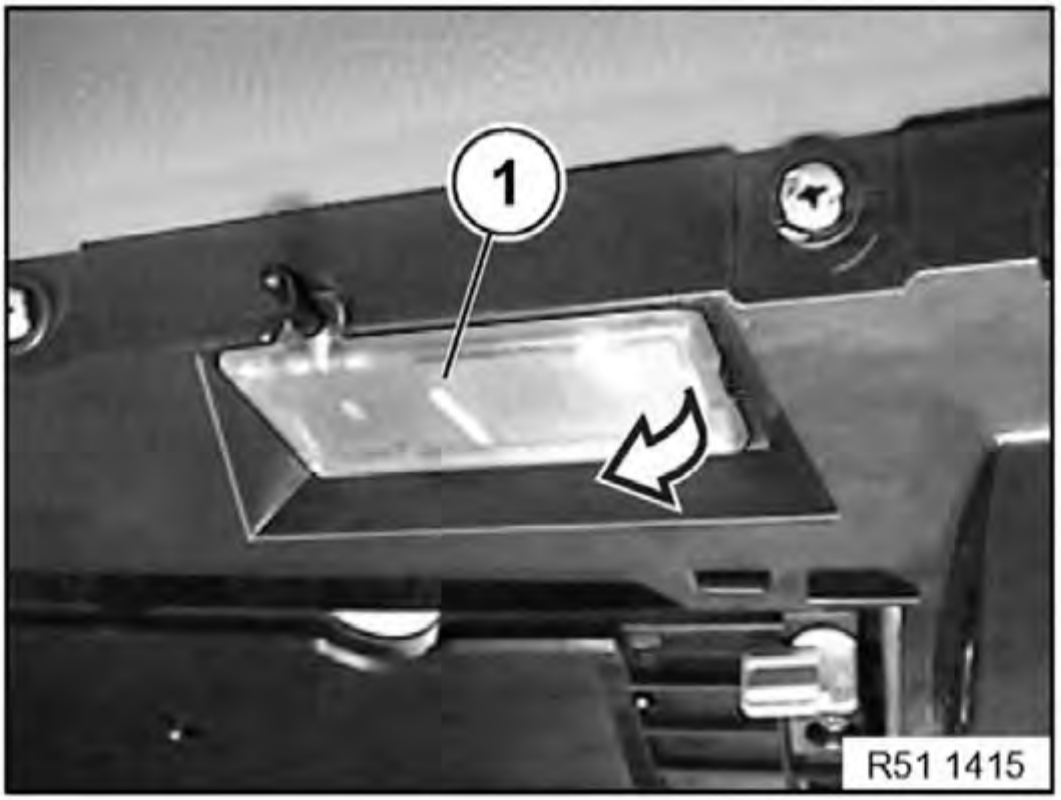
Fig. 20: Locating Fuel Pump Relay (Z8)
Courtesy of BMW OF NORTH AMERICA, INC.



1. DME Relay

G00131623

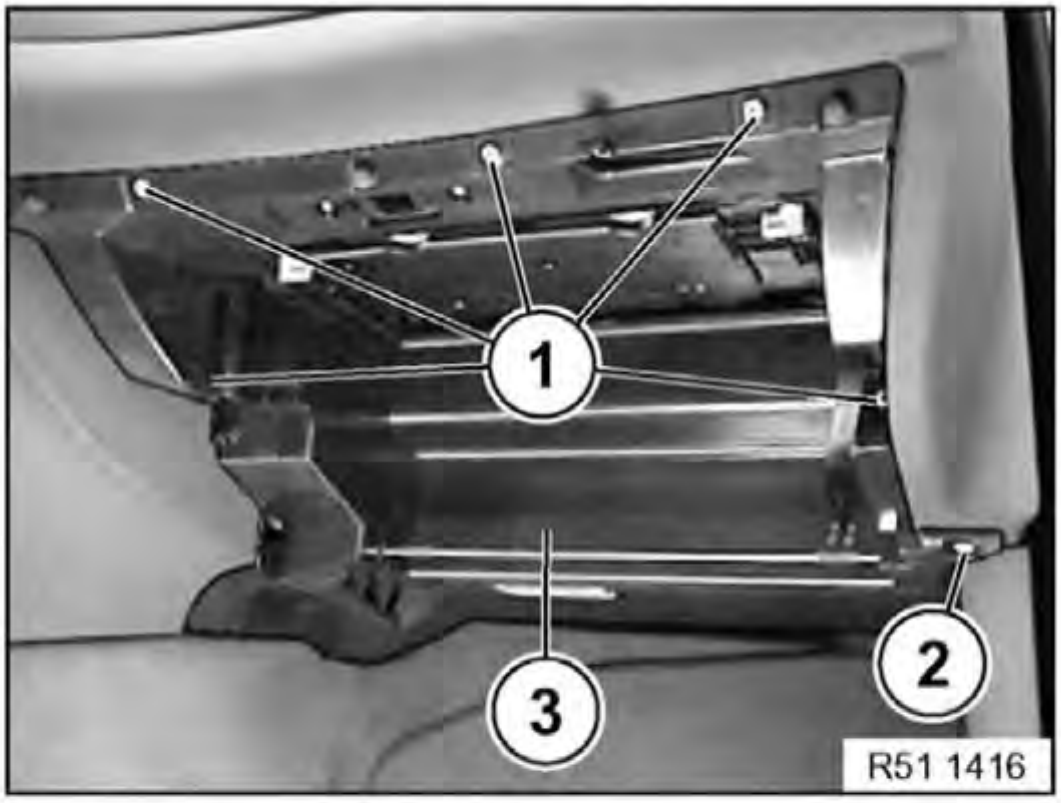
Fig. 21: Locating DME Relay (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Glovebox Light

G00131616

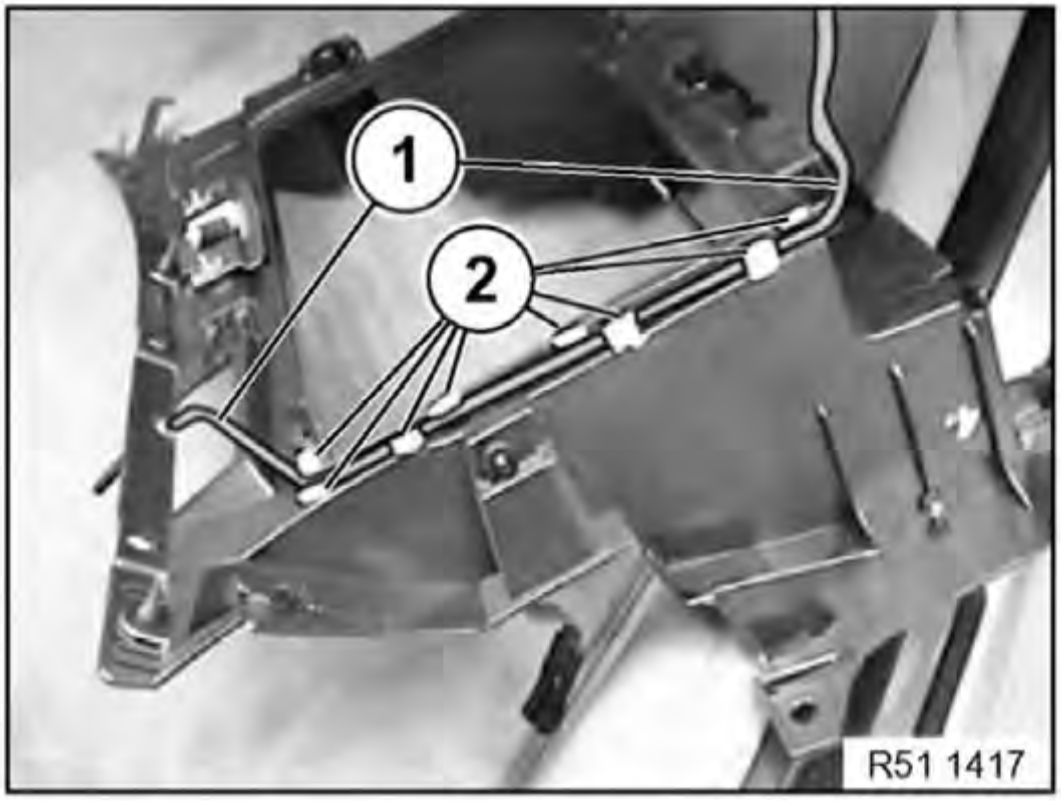
Fig. 22: Locating Fuel Pump Relay; Removing Glovebox Light (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Screws
2. Pin
3. Insert

G00131617

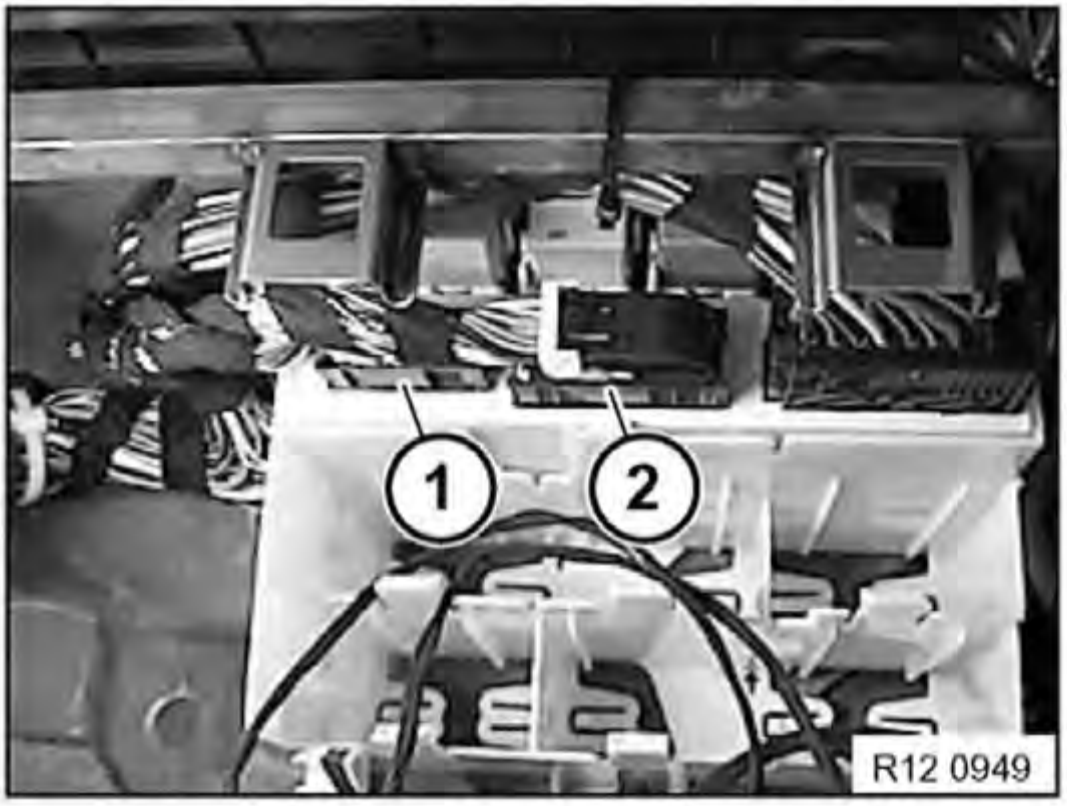
Fig. 23: Locating Fuel Pump Relay; Removing Insert (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Glovebox Light Wire
2. Guides

G00131618

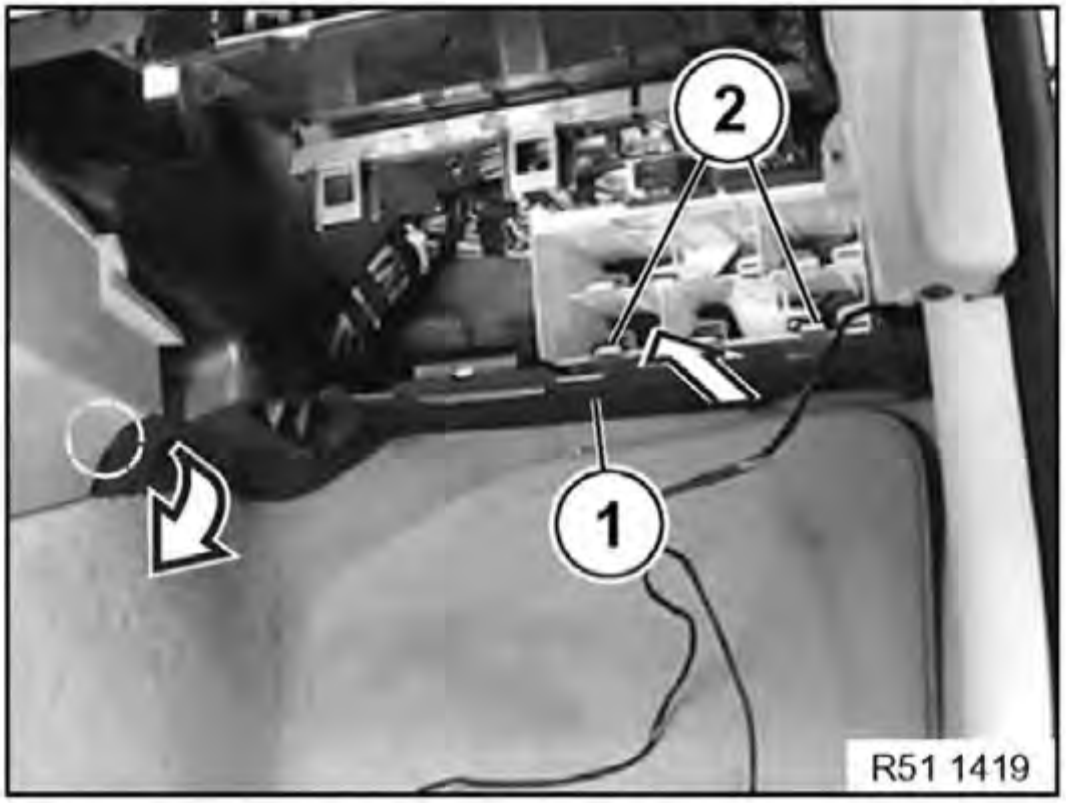
Fig. 24: Locating Fuel Pump Relay; Removing Light Wire From Guides (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Electrical Connector
2. Feed Out Wire From Guides

G00131619

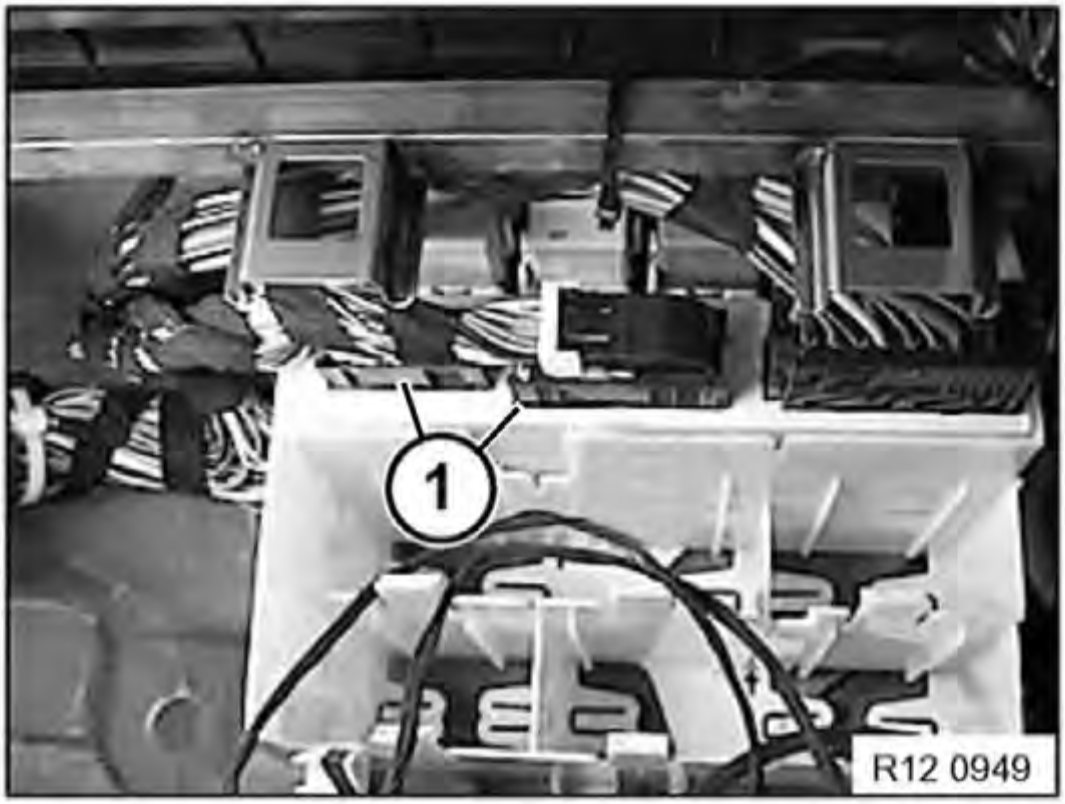
Fig. 25: Locating Fuel Pump Relay; Removing Wiring From Guides (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Press Panel To Rear
2. Guides

G00131620

Fig. 26: Locating Fuel Pump Relay; Pressing Panel Rearward (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. General Module Electrical Connections

G00131621

Fig. 27: Locating Fuel Pump Relay; Disconnecting General Module Electrical Connections (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.

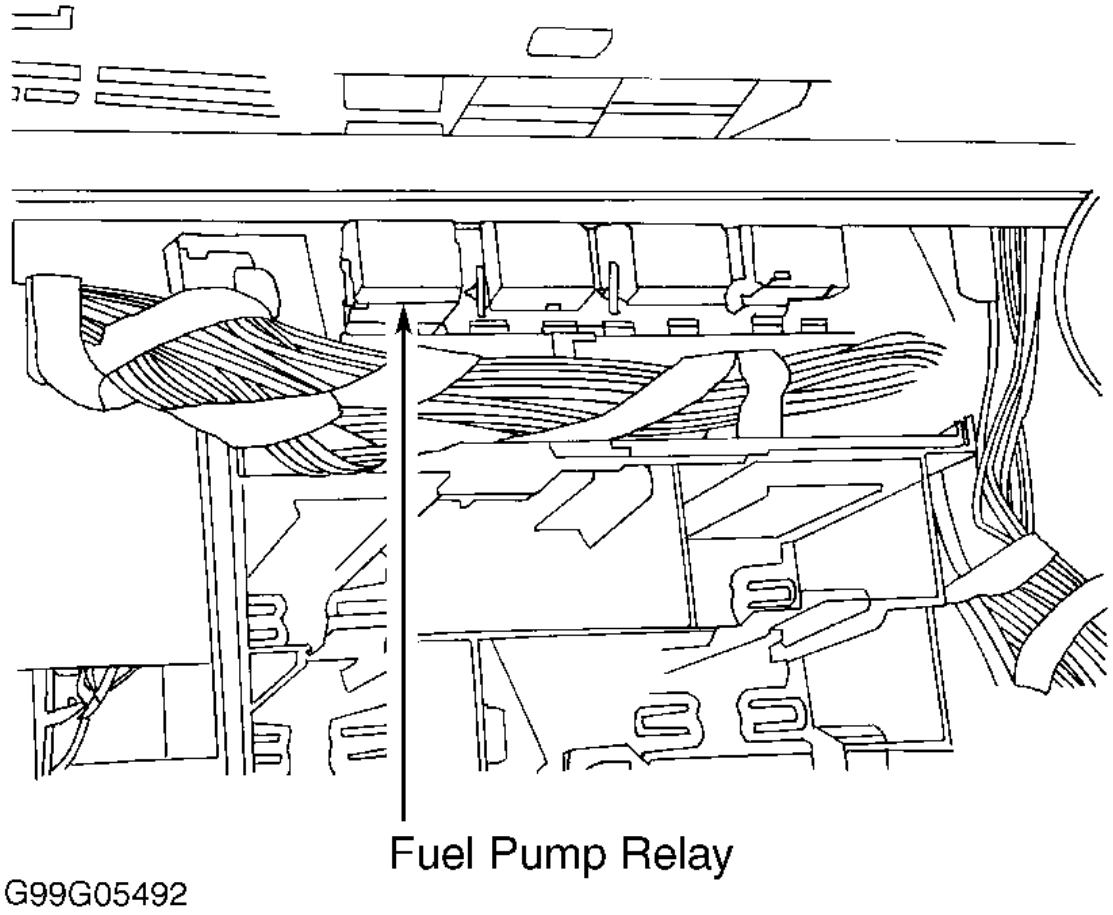
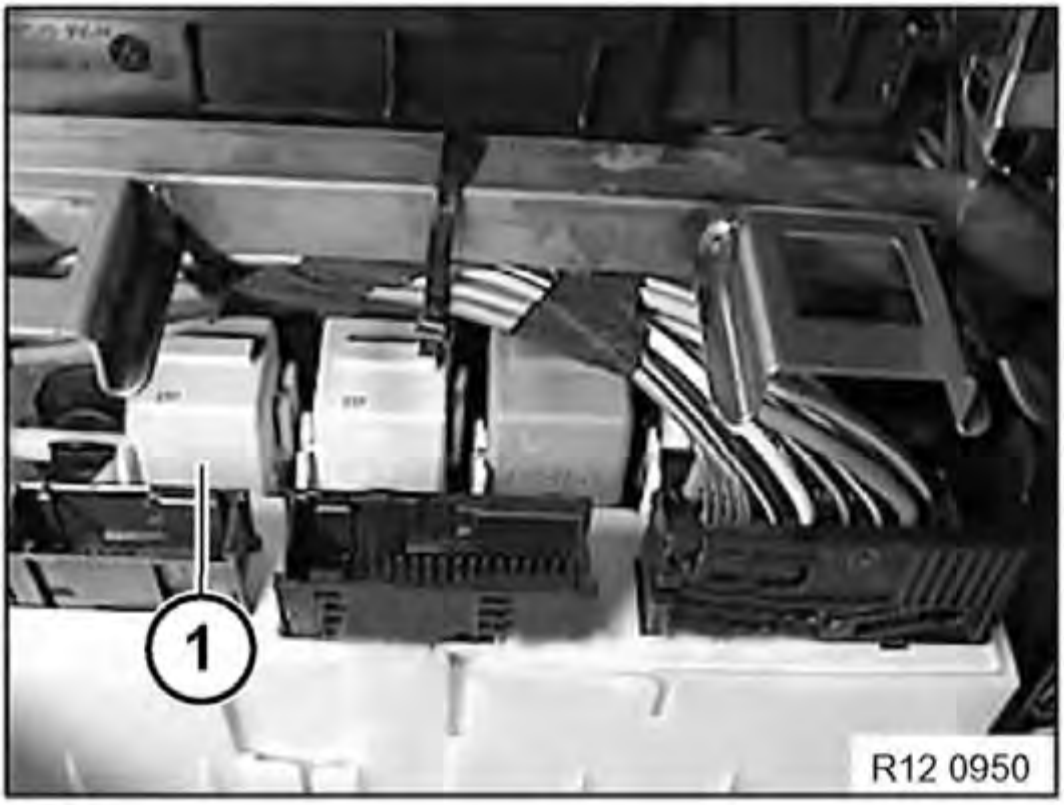


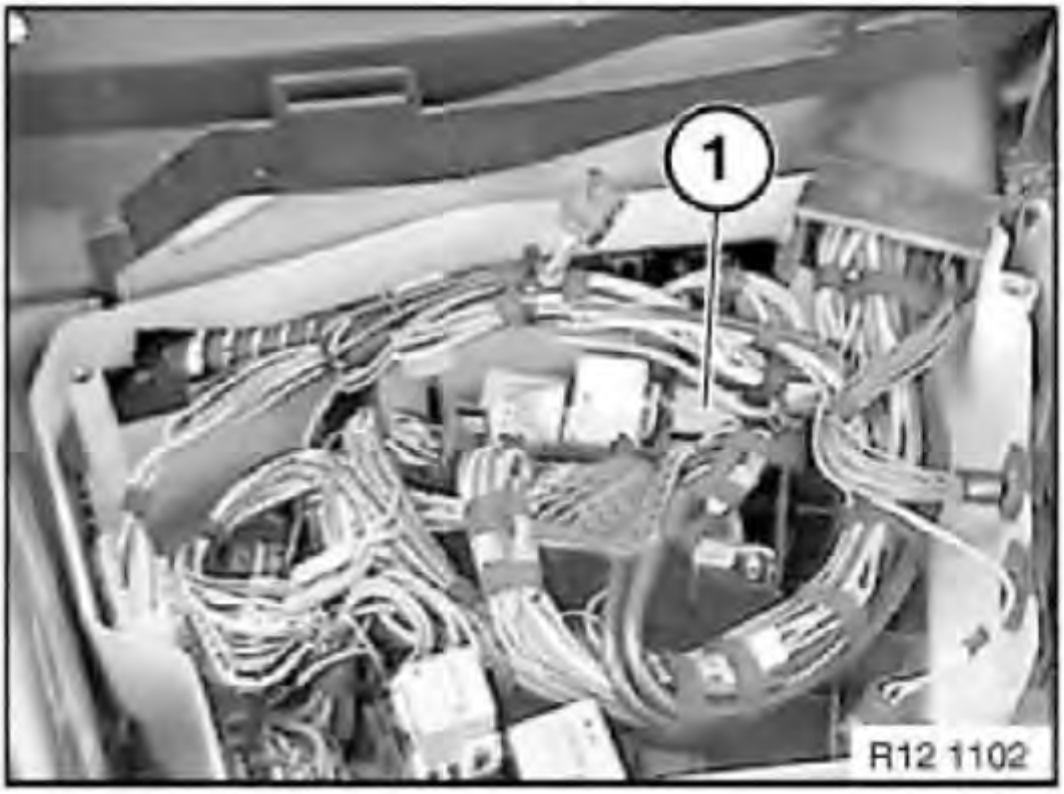
Fig. 28: Locating Fuel Pump Relay; Version No. 1 (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Fuel Pump Relay

G00131622

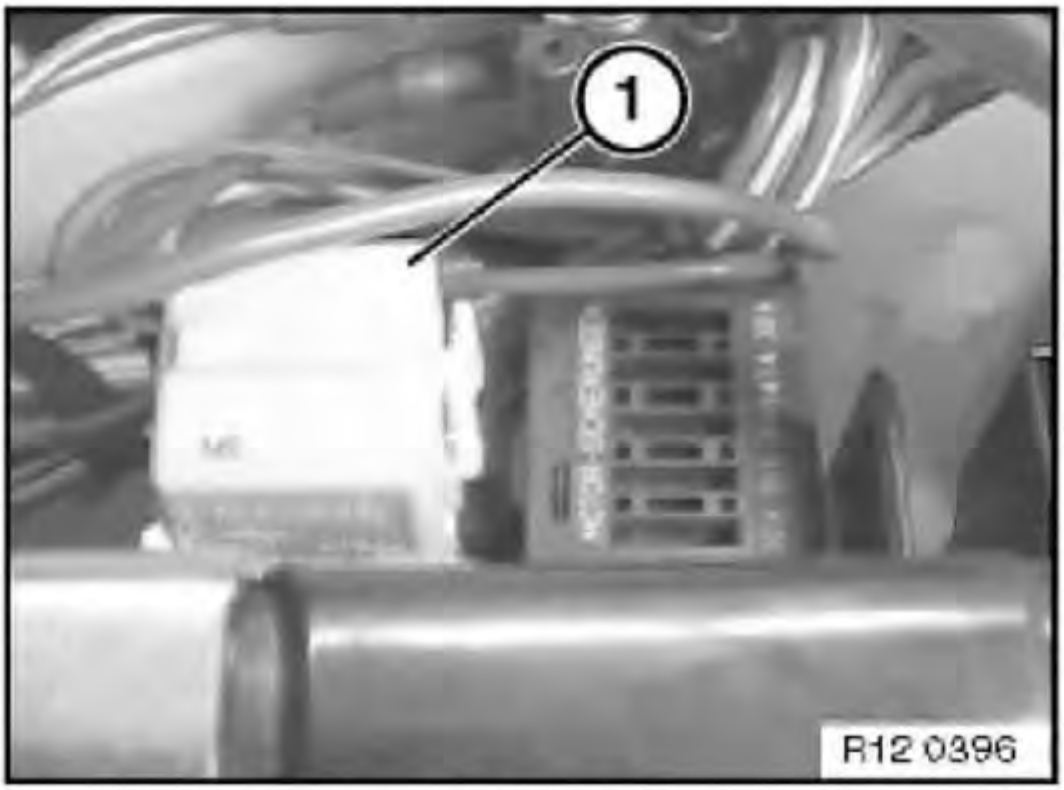
Fig. 29: Locating Fuel Pump Relay; Version No. 2 (3-Series - E46)
Courtesy of BMW OF NORTH AMERICA, INC.



1. DME Relay

G00131628

Fig. 30: Locating DME Relay (5-Series - M5)
Courtesy of BMW OF NORTH AMERICA, INC.



1. DME Relay

G00131627

Fig. 31: Locating DME Relay (5-Series - Except M5)
Courtesy of BMW OF NORTH AMERICA, INC.

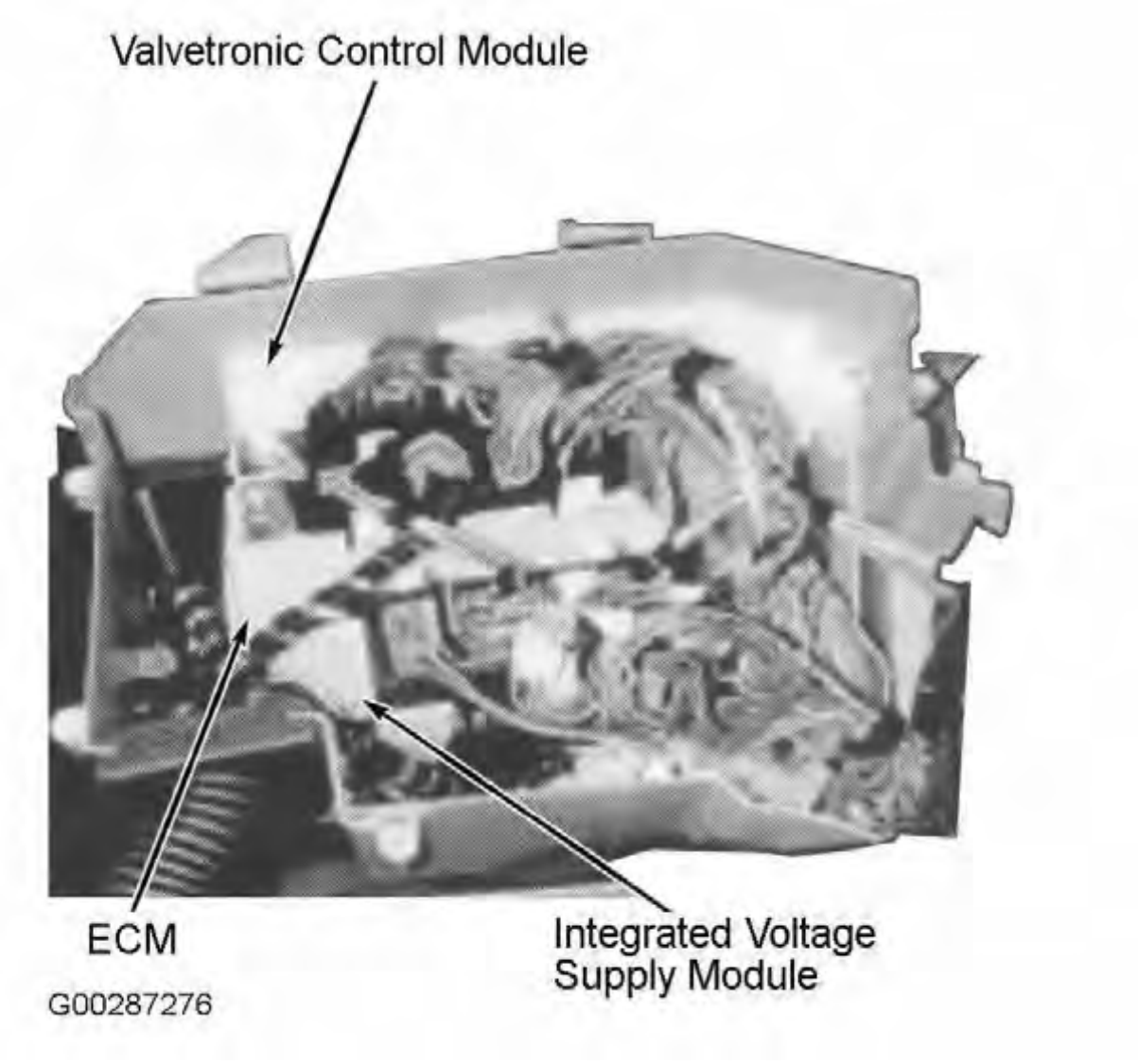


Fig. 32: Identifying Electronics Box (7-Series V8)
Courtesy of BMW OF NORTH AMERICA, INC.

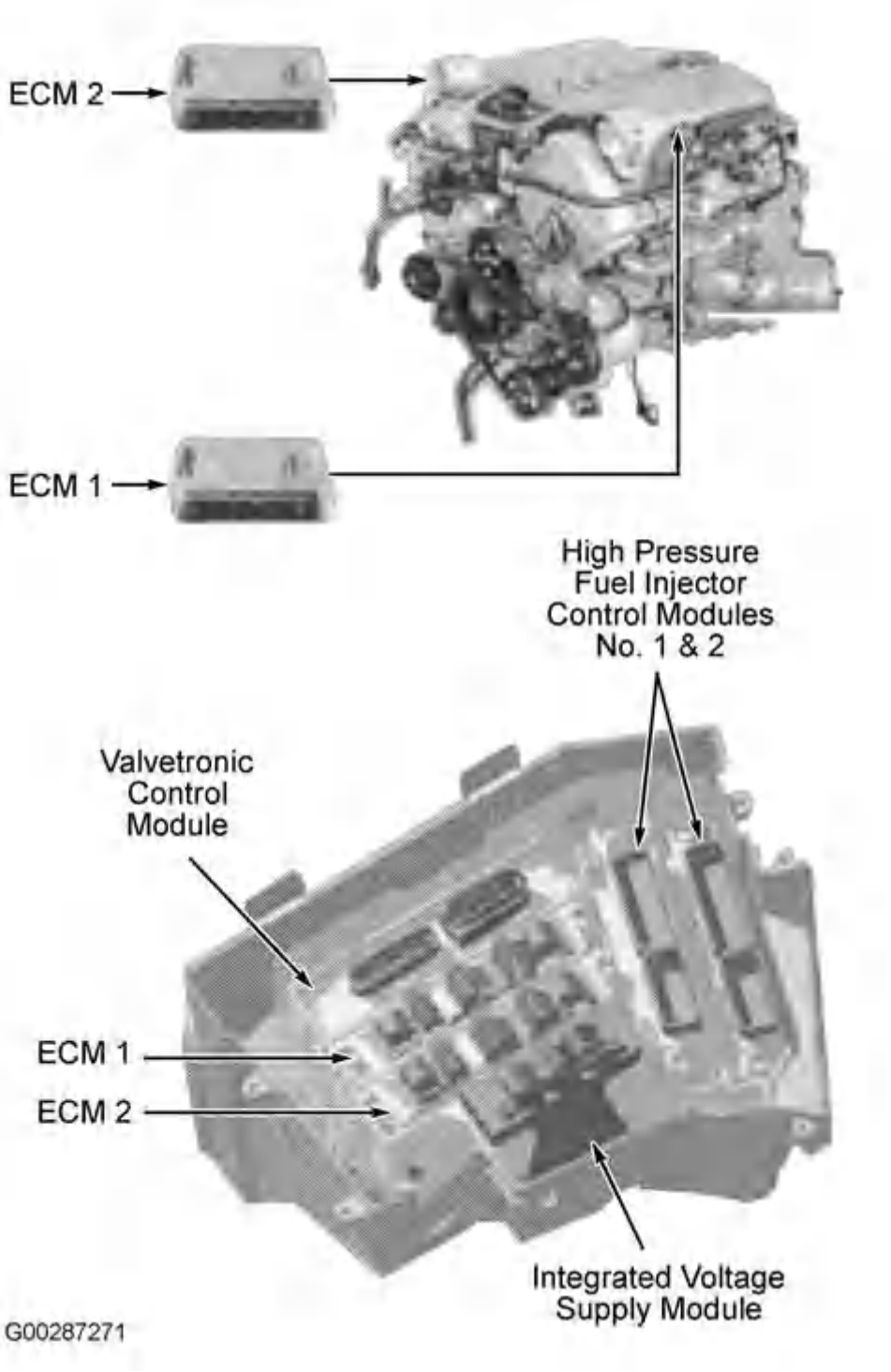


Fig. 33: Identifying Electronics Box (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL SYSTEM

FUEL DELIVERY

NOTE: For fuel system pressure testing, see BASIC DIAGNOSTIC PROCEDURES article.

Before any service work is performed on any fuel system related component, always adhere to the following:

- Observe relevant safety legislation pertaining to your area.
- Ensure adequate ventilation.
- Use exhaust extraction system where applicable (alleviate fumes).

- Do not operate the fuel pump unless it is properly installed in the fuel tank and is submersed in the fuel (fuel lubricates the pump).
- Always wear adequate protection clothing including eye protection.
- Use caution when working around a hot engine compartment.
- During fuel system repair that involves "sealing rings" always replace them with new copper rings only.
- BMW does not recommend any unauthorized modifications to the fuel system. The fuel system is designed to comply with strict federal safety and emissions regulations.
- Fuel quality should always be considered when diagnosing a driveability complaint. The type of fuel, proper AKI rating, impurities and moisture are not factored by the ECM.

Fuel Pump Relay

Remove fuel pump relay. See RELAY LOCATION table. Apply battery voltage to relay terminals No. 30 and 86. See Fig. 34. Ground relay terminal No. 85. Voltage should now exist at relay terminal No. 87. Replace relay if it does not work as indicated.

NOTE: If relay does not work on vehicle, check battery feed, DME master (main) relay, DME/Motronic control unit and ground circuits going to fuel pump relay. Only sockets No. 2, 4, 6 and 8 are used by relay.

Fuel Pressure Regulator

As operating mode of engine varies, so does amount of fuel it requires, ranging from low at idle speed to high at full throttle. This requirement is set with the help of pressure regulator. Pressure regulator governs fuel pressure, controlling it between low and high to suit requirements. Fine adjustment of fuel injection quantity is performed using fuel injection period controlled by DME. Vacuum in intake manifold provides load connection for pressure regulation. This vacuum is applied to diaphragm in pressure regulator. At idle speed or when coasting, a vacuum develops in intake pipe. Fuel pressure reduces by this amount, starting from nominal value. Nominal value is embossed in housing of pressure regulator. At full throttle, intake pipe is approximately zero and pressure regulator controls fuel pressure to nominal value embossed on housing.

1. Remove fuel pressure regulator. Note code number and nominal pressure on fuel pressure regulator body. Install BMW Service Tester (133060) with Connecting Hose (133064) in fuel feed left line.
2. Remove fuel pump relay. See RELAY LOCATION table. Connect jumper wire between relay base terminals No. 30 and 87. Read off fuel injection pressure on pressure gauge.
3. If fuel pressure drops rapidly, seal return line (upper line) with Clamp (133010) and briefly operate fuel pump. If injection pressure in now stable, pressure regulator is defective. If injection pressure drops, check for leak in front of pressure regulator.

Fuel Pressure Check (Lack Of Power)

Run engine at idle and check fuel pressure. See FUEL PRESSURE REGULATOR. Disconnect vacuum hose from fuel pressure regulator, simulating wide open throttle. If fuel pressure does not increase 5.8-10.1 psi (.40-.71 kg/cm^2), replace vacuum hose and repeat test. If fuel pressure still does not increase, replace fuel pressure regulator.

Fuel Pressure Check (Hard Start)

1. Run engine at idle then turn off. Note fuel pressure. Note fuel pressure again after 20-30 minutes. If fuel pressure decreases by greater than 7.2 psi (.5 kg/cm^2), turn engine on, wait for pressure to stabilize, then turn engine off and immediately clamp off intake line near pressure gauge with Clamp (133010). Note fuel pressure. Read fuel pressure again after 20-30 minutes.
2. If fuel pressure drops by less than 7.2 psi (.5 kg/cm^2), check for fault in fuel supply lines, in-tank supply hose, or defective non return valve in fuel pump. If fuel pressure again drops by more than 7.2 psi (.5 kg/cm^{cm2}), replace pressure regulator.

1. To check fuel pressure, install BMW Service Tester or DIS tester with connecting line and "T" Section (13 3 064) in the fuel delivery line between fuel filter and pressure regulator. Fuel in fuel lines is under 44 psi (3 bar). Catch and dispose of escaping fuel. See FUEL PRESSURE & DELIVERY PERFORMANCE table.
2. Disconnect fuel return line. Attach an extension hose. Place hose in Measuring Glass (133020). Remove fuel pump relay. Apply battery voltage to relay base terminals No. 30 and 87. See Fig. 34. See FUEL PRESSURE & DELIVERY PERFORMANCE table.

FUEL PRESSURE & DELIVERY PERFORMANCE

Application	Pressure psi (kg/cm^2)	Min. Vol. In 30 Sec. Pts. (L)
6-Cylinder & V8		
Except M5 & Z8	50 (3.5)	1.85 (0.9)
M5 & Z8	71 (5)	(1)
12-Cylinder	50 (3.5)	2.38 (1.13)
(1) Information is not available from manufacturer.		

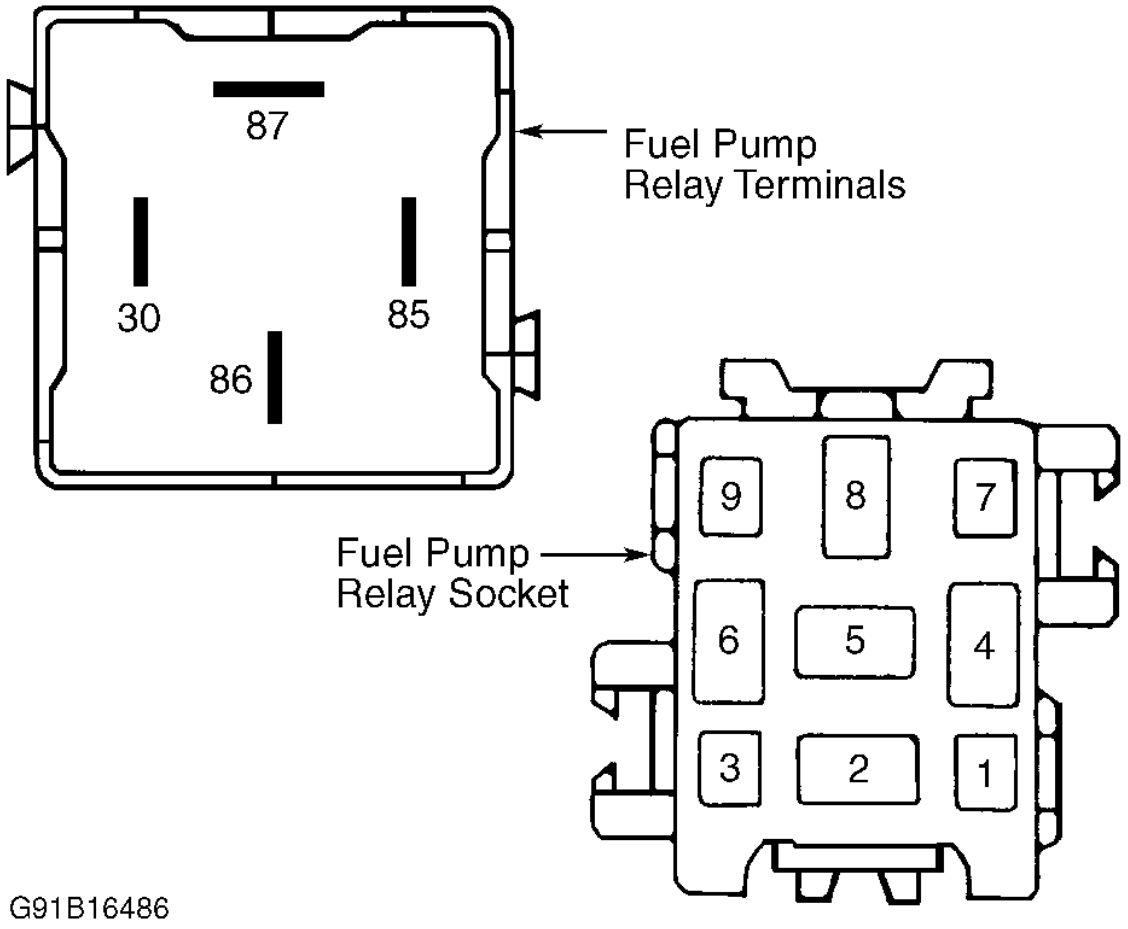


Fig. 34: Identifying Fuel Pump Relay Terminals & Socket
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL CONTROL

Preliminary Check

1. Injectors should be tested using DISplus/GT1 for resistance, power supply, status display-fuel injection signal, and ECM final stage transistor activation. These test functions are found under the oscilloscope preset list. Install universal adapter, diagnostic cable, negative lead to ECM ground and positive lead to the ground activation circuit for the injector. This test is performed with the engine cranking or running.
2. Fuel supply hardware should be visually inspected for damage that can affect pick-up, transfer, pressure and return. The fuel tank must be drained first before removing the service access cap to perform any repair. The fuel filter, fuel pressure regulator, electric fuel pump, right fuel level sensor and siphon jet are accessed through the service access cap. Remove the single 6-pin electrical connector (2 pins for the fuel pump, 2 for each level sensor-left/right). Remove the fuel supply line by releasing the quick release coupling. Fuel tank is secured by 2 straps to the body.

Fuel Injector

Individual fuel injector resistance should be 15-17 ohms. Injector group resistance should be 7.5-8.5 ohms for V8 and V12 (each bank) and 5-6 ohms for 6-cylinder engine.

Fuel Injector Leakage

1. Remove fuel injectors. Mark sequence of injector valves relative to cylinders on each injector valve. Clip injector valves into Holding Fixture (13 6 205). Connect special tool to injector valves. Connect Harness (13 6 206) to a 12-volt battery. This removes the remaining fuel from the injector valves. Lay a clean cloth under injector valves to catch remaining fuel. Connect holding fixture to compressed air connection at maximum 43 psi (3 bar). Residual fuel is now blown out of the injector valves.

   CAUTION: Carry out leak test only after remaining fuel has been blown out of injector valves.

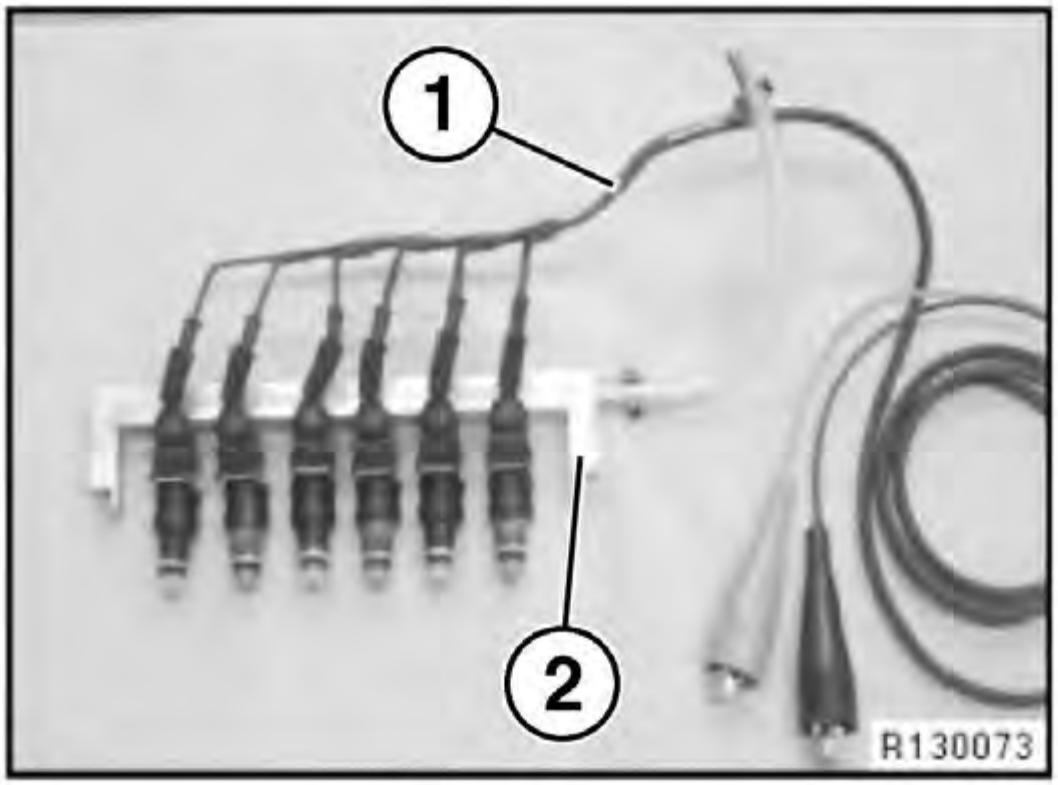
2. Separate harness from injector valves. Install injector valves with holding fixture in a container with hot water at 140-176Â°F (60-80Â°C). Regulate air pressure at connection No. 1 on holding fixture to 44 psi. Note volume of air emerging. Permitted volume of air emerging is 2 air bubbles per injector valve within a 15-second period. Injector valves with larger amounts of air emerging must be cleaned. Remove injector valves from water and dry with compressed air.

Fuel Injector Cleaning

1. Remove fuel injectors. Install injector valves in Holding Fixture (13 6 205). See Fig. 35. Connect Harness (13 6 206) to injector valves and to a 12-volt battery. This removes remaining fuel from injector valves. Lay a clean cloth under injector valves to catch remaining fuel. Connect holding fixture to compressed air connection (maximum 44 psi). See Fig. 36. Residual fuel is now blown out of injector valves.
2. Separate Harness (13 6 206) from injector valves. Install injectors with holding fixture in a container with hot water at 140-176Â°F (60-80Â°C). See Fig. 37. Regulate air pressure at connection on holding fixture to 44 psi. Note volume of air emerging from injectors. Permitted volume of air emerging from each injector is 2 air bubbles per injector within a 15-minute period. Injectors with a larger amount of air must be cleaned. Remove injectors from water and dry well with compressed air.
3. Use Ultrasonic Cleaning Unit (13 6 200) to clean injector valves. Attach injector valves to cleaning unit with holding fixture. Fill cleaning unit with Cleaning Concentrate (13 6 207). See Fig. 37. Perform cleaning procedure as specified by manufacturer. Perform leak test on cleaned injector valves. See FUEL INJECTOR LEAKAGE.

   CAUTION: Do not carry out leak test in cleaning concentrate but rather in a water bath.

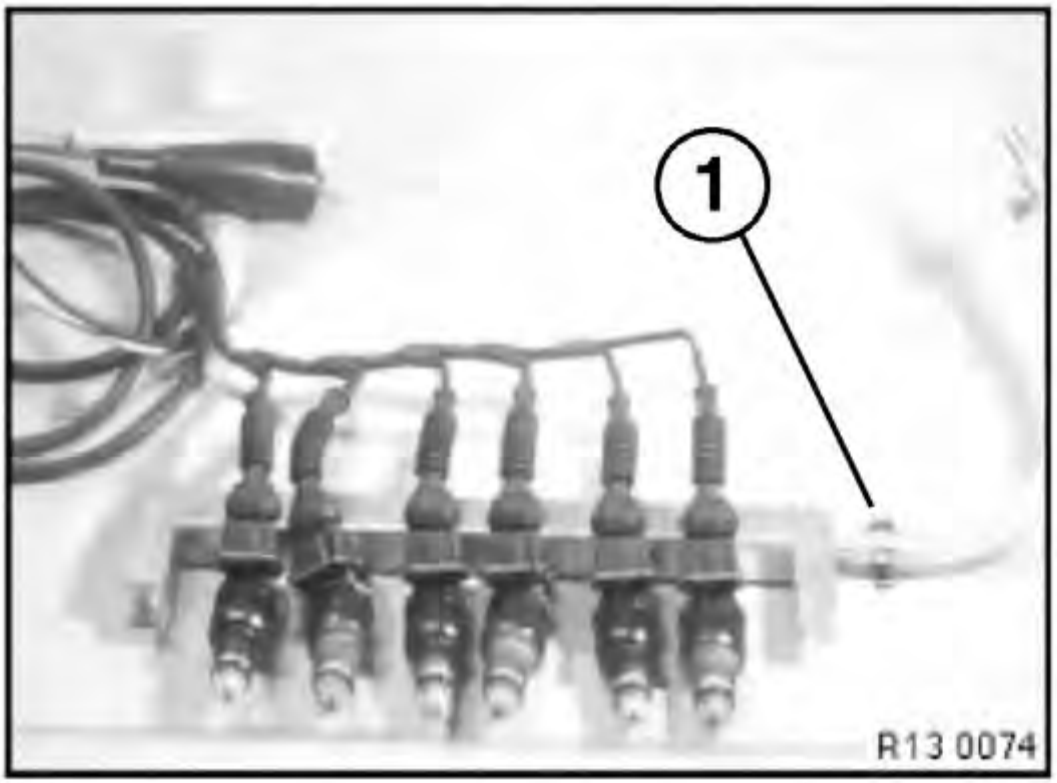
4. To remove preserving agent, rinse new injector valves with fuel only after about 5 minutes. Install injector valves immediately in engine and run engine. This flushes out any remaining cleaning concentrate, preventing injector valve corrosion. Due to the risk of corrosion, cleaned injector valves cannot be stored.



1. Harness
2. Holding Fixture

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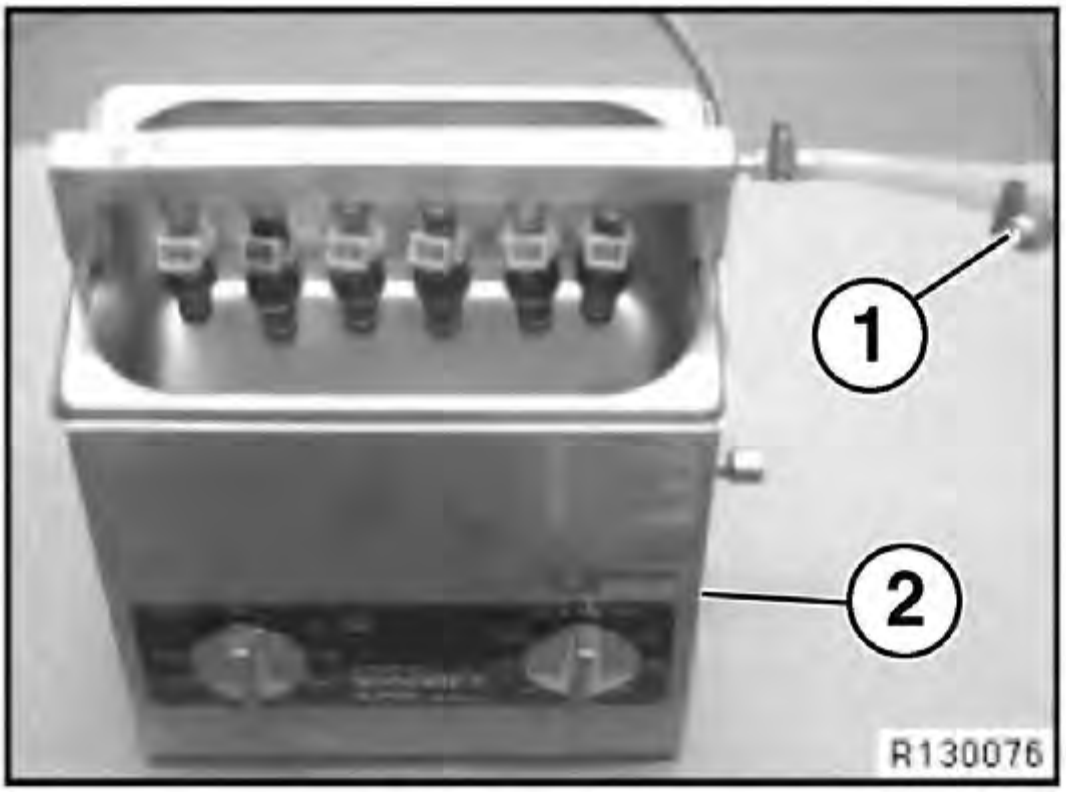
Fig. 35: Connecting Harness & Holding Fixture To Injector Valves
Courtesy of BMW OF NORTH AMERICA, INC.



1. Compressed Air Connection

G00131595

Fig. 36: Connecting Injector Valve Cleaning Compressed Air Connection
Courtesy of BMW OF NORTH AMERICA, INC.



1. Air Pressure Valve
2. Ultrasonic Cleaner

G00131594

Fig. 37: Installing Injectors In Hot Water Or Cleaning Solution
Courtesy of BMW OF NORTH AMERICA, INC.

IDLE CONTROL SYSTEM

IDLE AIR ACTUATOR VALVE

Idle air actuator valve and air circuit (passage ways) should be checked for physical obstructions. Visually inspect the sealing gasket, mounting bracket and air hose clamps. Resistance of the valve winding should be checked. ECM output and idle speed control valve operation can be tested by COMPONENT ACTIVATION on DISplus/GT1. Pulse width modulation ground outputs from the ECM can be tested using the DISplus/GT1 oscilloscope. If valve is blocked or contaminated, a fault code can also be present. See IDLE AIR ACTUATOR VALVE LOCATION table. Valve is either a 2-pin or 3-pin type. See Fig. 38 and Fig. 39 .

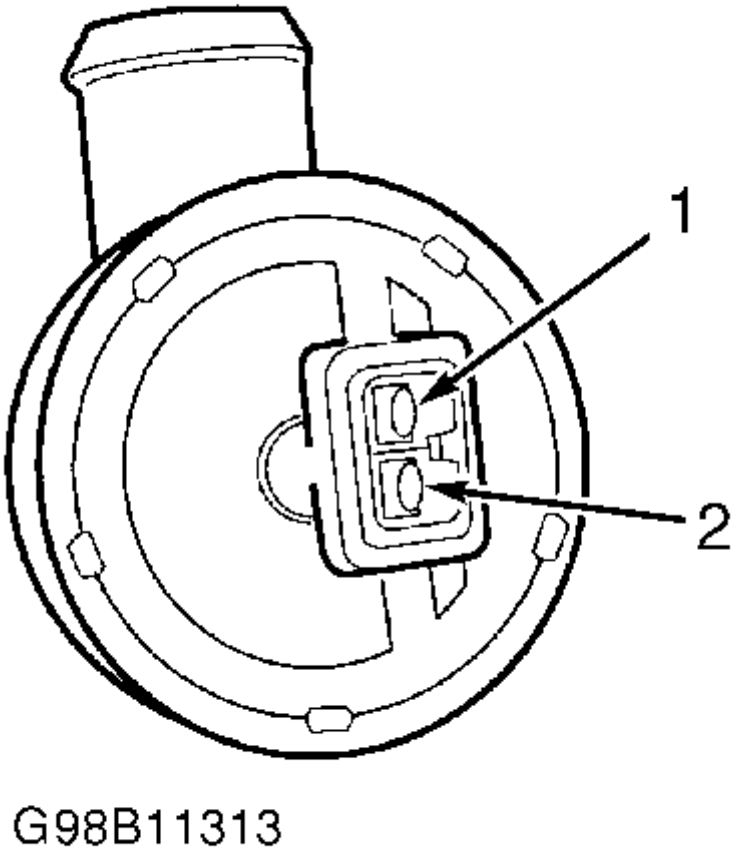


Fig. 38: Identifying Idle Air Actuator Valve 2-Pin Connector
Courtesy of BMW OF NORTH AMERICA, INC.

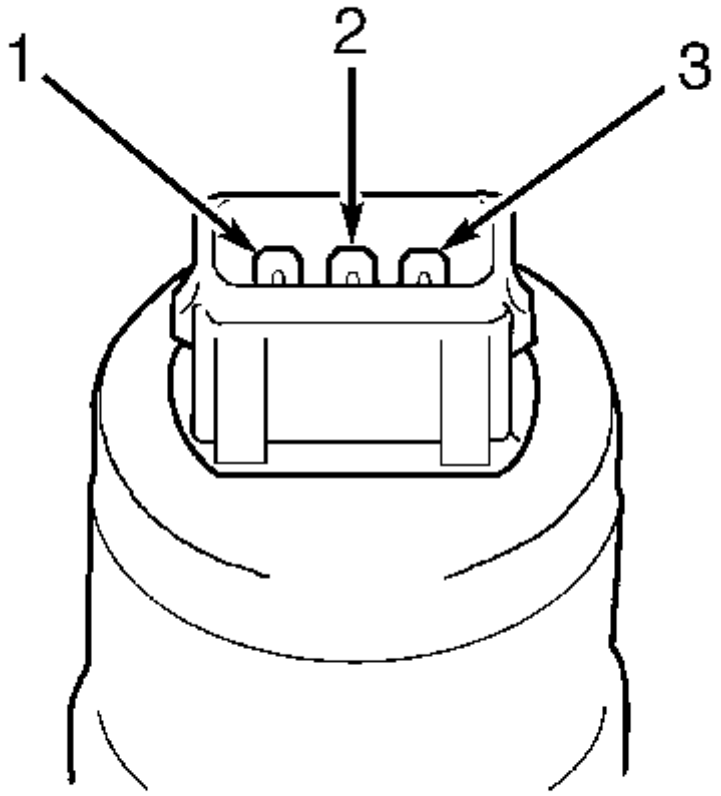


Fig. 39: Identifying Idle Air Actuator Valve 3-Pin Connector
Courtesy of BMW OF NORTH AMERICA, INC.

IDLE AIR ACTUATOR VALVE LOCATION

Application	Location
All Equipped Models	At Left Front Of Engine, Near Dipstick

IGNITION SYSTEM

NOTE: For basic ignition checks and oscilloscope pattern diagnosis, see BASIC DIAGNOSTIC PROCEDURES article.

DIRECT IGNITION SYSTEM

Ignition System Testing (Siemmens 2003)

If there is a fault in the secondary ignition, testing should include primary ignition and evaluation of secondary oscilloscope patterns. See BASIC DIAGNOSTIC PROCEDURES article.

Checking Rod-Type Ignition Coils

1. Using DISplus/GT1, read out fault memory in Digital Motor Electronics (DME). Remove sound absorption hood or ignition coil cover as necessary. Open control unit box. Unlock plug fastener of ignition coil. See Fig. 40. Detach plug in direction of arrow. Pull out ignition coil toward top. See Fig. 41.

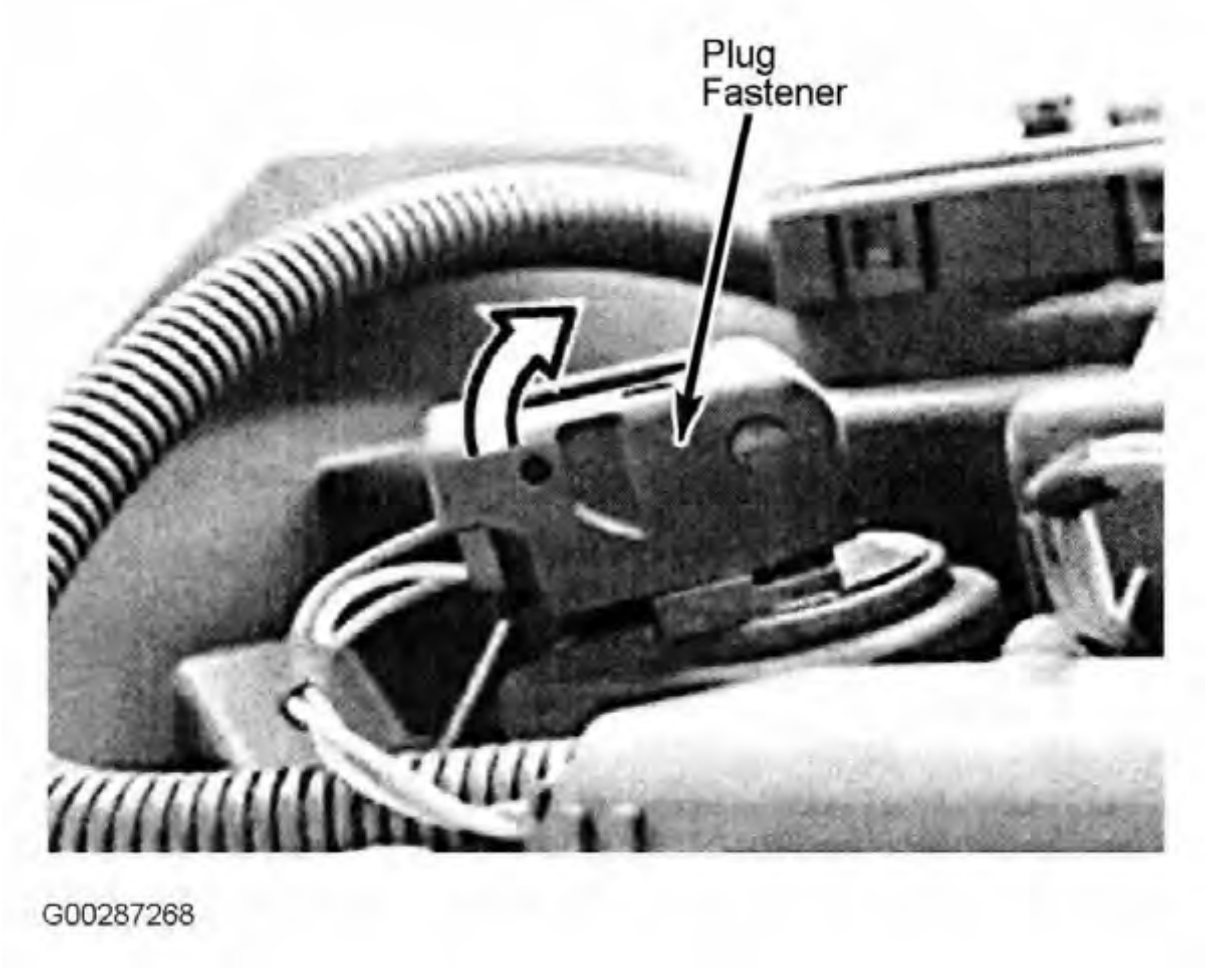


Fig. 40: Unlocking Plug Fastener Of Ignition Coil
Courtesy of BMW OF NORTH AMERICA, INC.

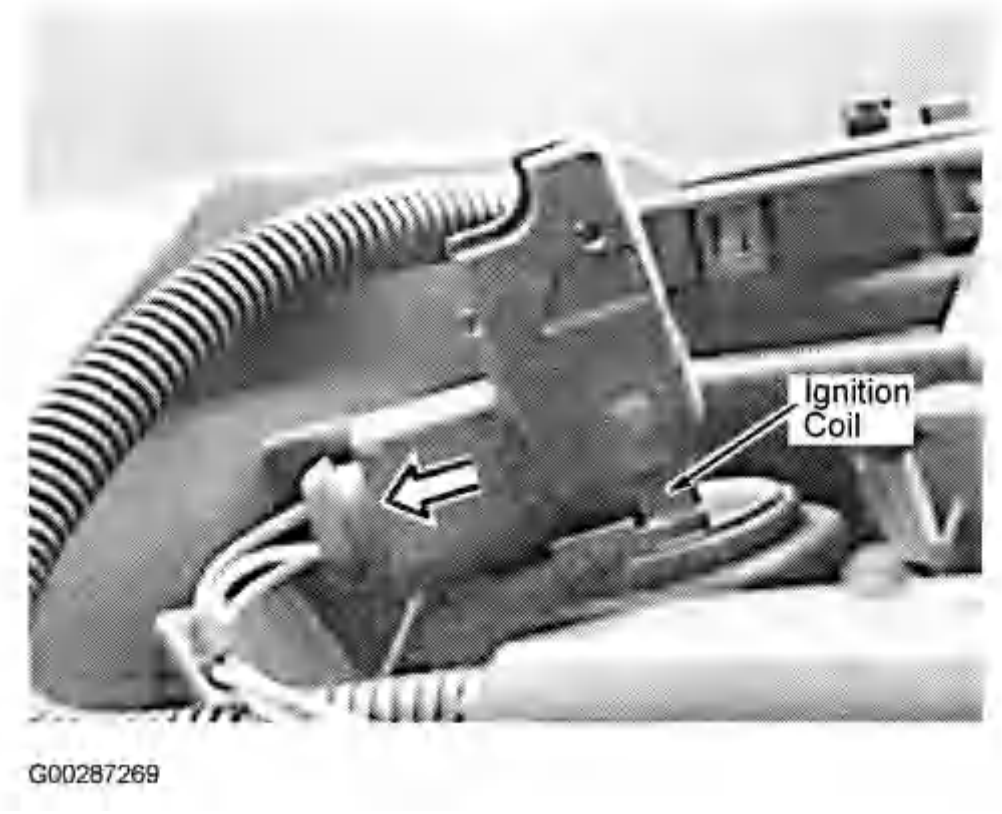


Fig. 41: Pulling Out Ignition Coil Toward Top
Courtesy of BMW OF NORTH AMERICA, INC.

2. Install Adapter Lead (127050) between spark plug and rod-type ignition coil. See Fig. 42. Connect clip-on trigger sensor of DIS Tester to adapter lead. See Fig. 43. Perform following procedure on DIS tester:
   - Select MEASUREMENT.
   - Select PRESET MEASUREMENT.
   - Select SECONDARY IGNITION SIGNAL.
   - Connect TD cable to diagnostic head.
   - Select STATIONARY IGNITION DISTRIBUTOR SYSTEM.
   - Select CYLINDER NUMBER.

   For subsequent procedure, follow DIS instructions.

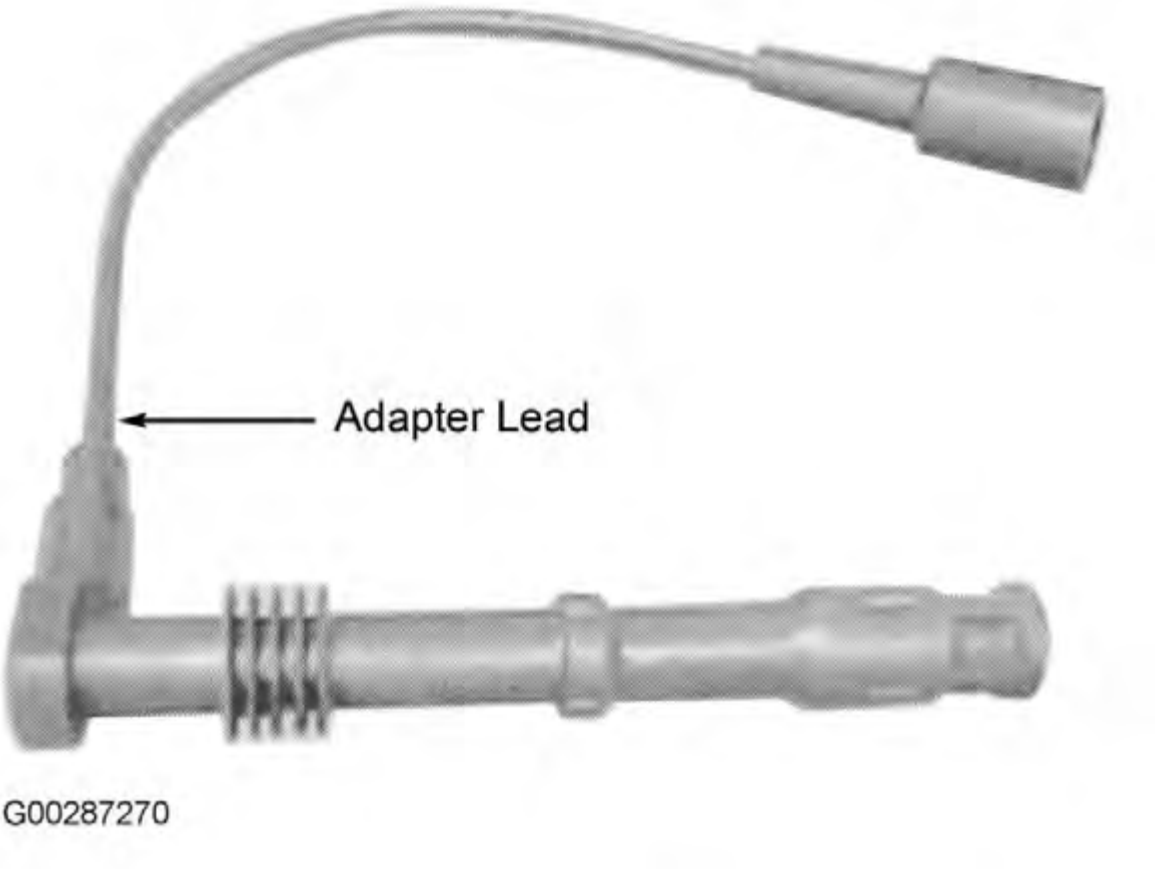


Fig. 42: Identifying Adapter Lead
Courtesy of BMW OF NORTH AMERICA, INC.

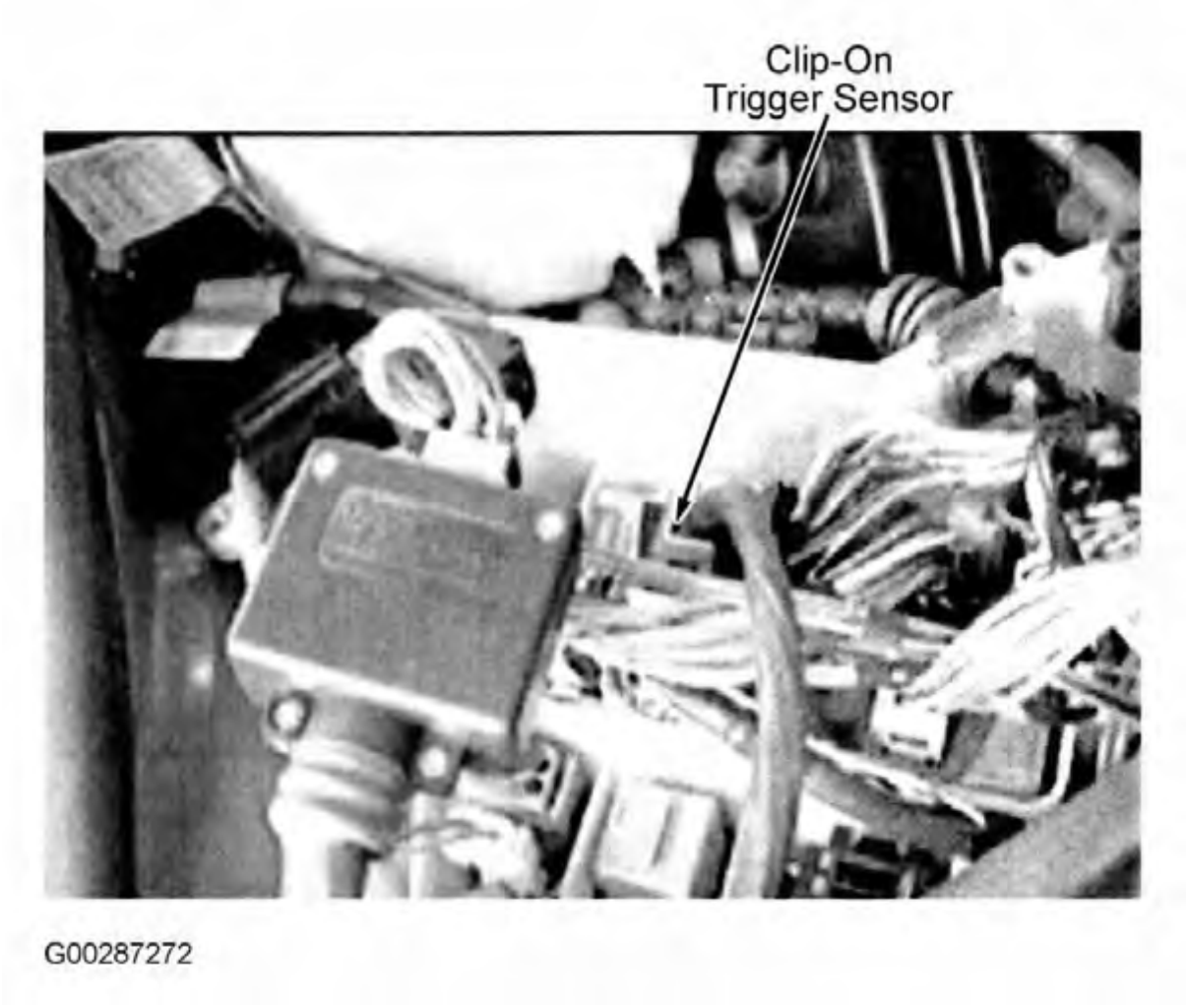


Fig. 43: Installing Clip-On Trigger Sensor
Courtesy of BMW OF NORTH AMERICA, INC.

3. Primary Measurement: Connect 26-pin pin box with Adapter Lead (121301) to connector of DME module. On DIS tester, perform following procedure:
   - Select MEASUREMENT.
   - Select PRESET MEASUREMENT.
   - Select IGNITION SIGNAL TERMINAL.

   For subsequent procedure, follow DIS instructions. Ignition signal is a multiple spark ignition. See Fig. 44.

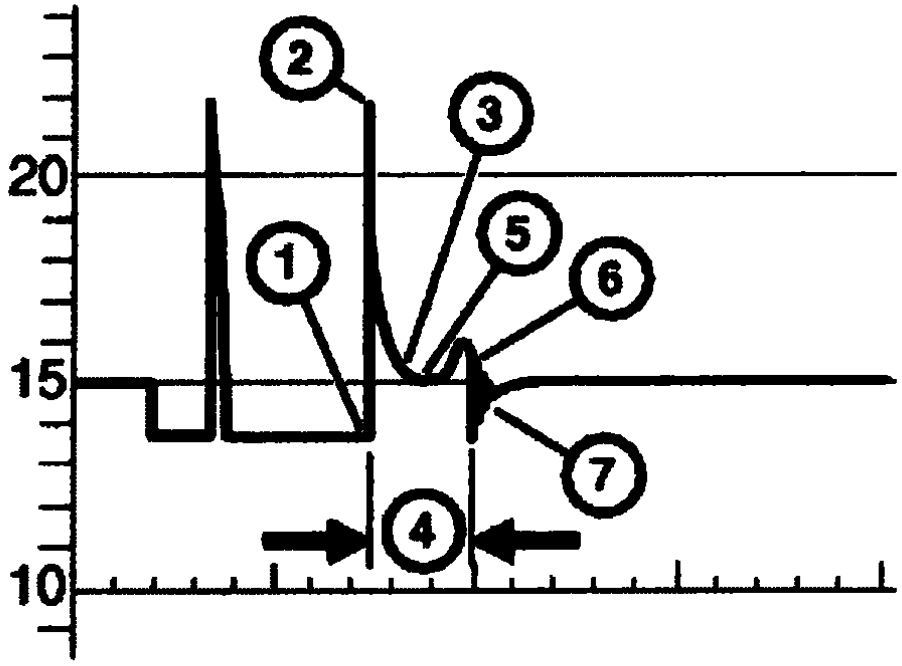


Illustration of multiple spark ignition

1 Start of ignition peak.

2 Level of ignition voltage.

3 Level of sparking voltage.

4 Spark duration.

5 Sparking voltage curve.

6 Start of decay process.

7 Decay process.

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Fig. 44: Identifying Multiple Spark Ignition
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Ignition oscillogram applies to engines with multiple spark ignition from a production date of 4-2001 and after. Depending on engine temperature of about -4 to 211Â°F (-20 to 100Â°C) and engine speed (less than 2000 RPM), some ignition voltage peaks (about 1-5 ignition peaks) can occur before the typical ignition voltage characteristic. The additional ignition peaks play a role in diagnosis. The last ignition peak on the oscillogram is decisive. See Fig. 45. The display of the ignition voltage peak is about 20-25 percent lower than the real value. It is not the height of the ignition voltage peaks but rather the uniformity of all the cylinders that is

important. Differences of 3000-4000 volts are permitted.

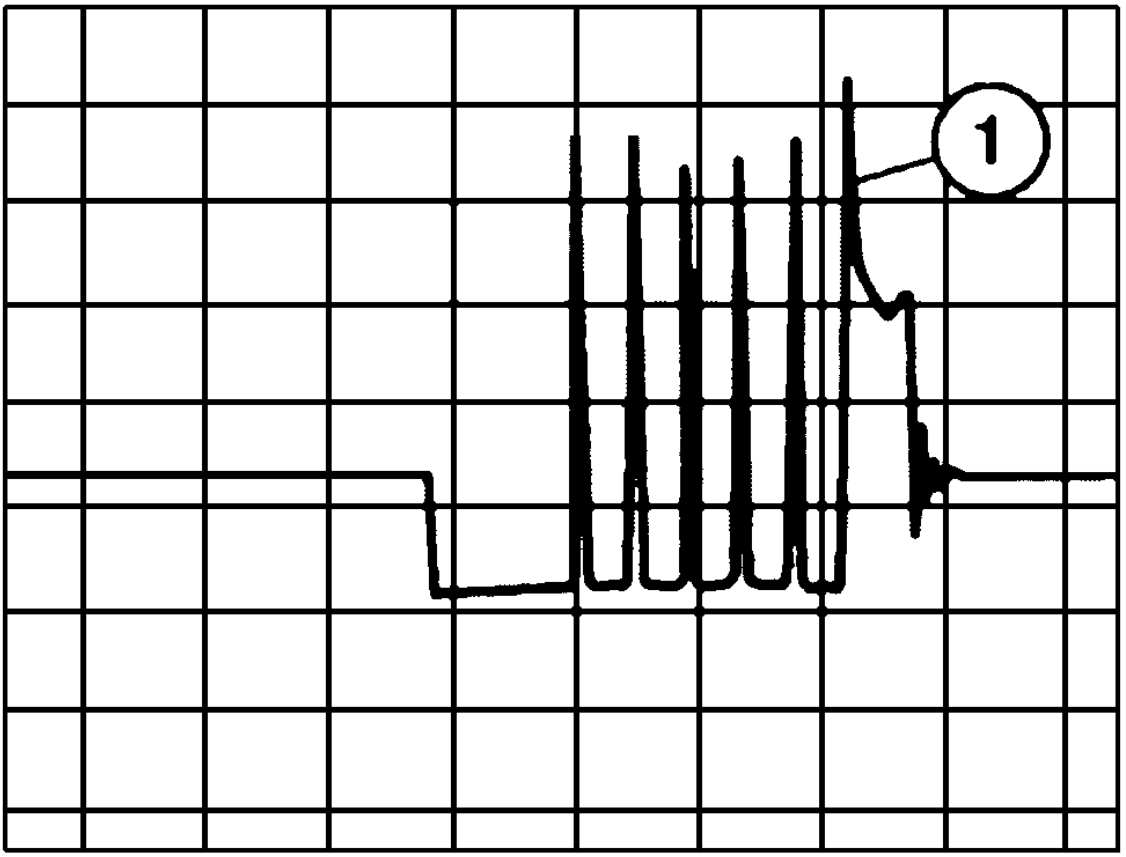


Fig. 45: Identifying Last Ignition Peak On Oscillogram
Courtesy of BMW OF NORTH AMERICA, INC.

Ignition Coil Resistance

Measure primary coil resistance between terminal No. 1 and terminal No. 15. See Fig. 46. Secondary coil resistance cannot be measured. See IGNITION COIL RESISTANCE table.

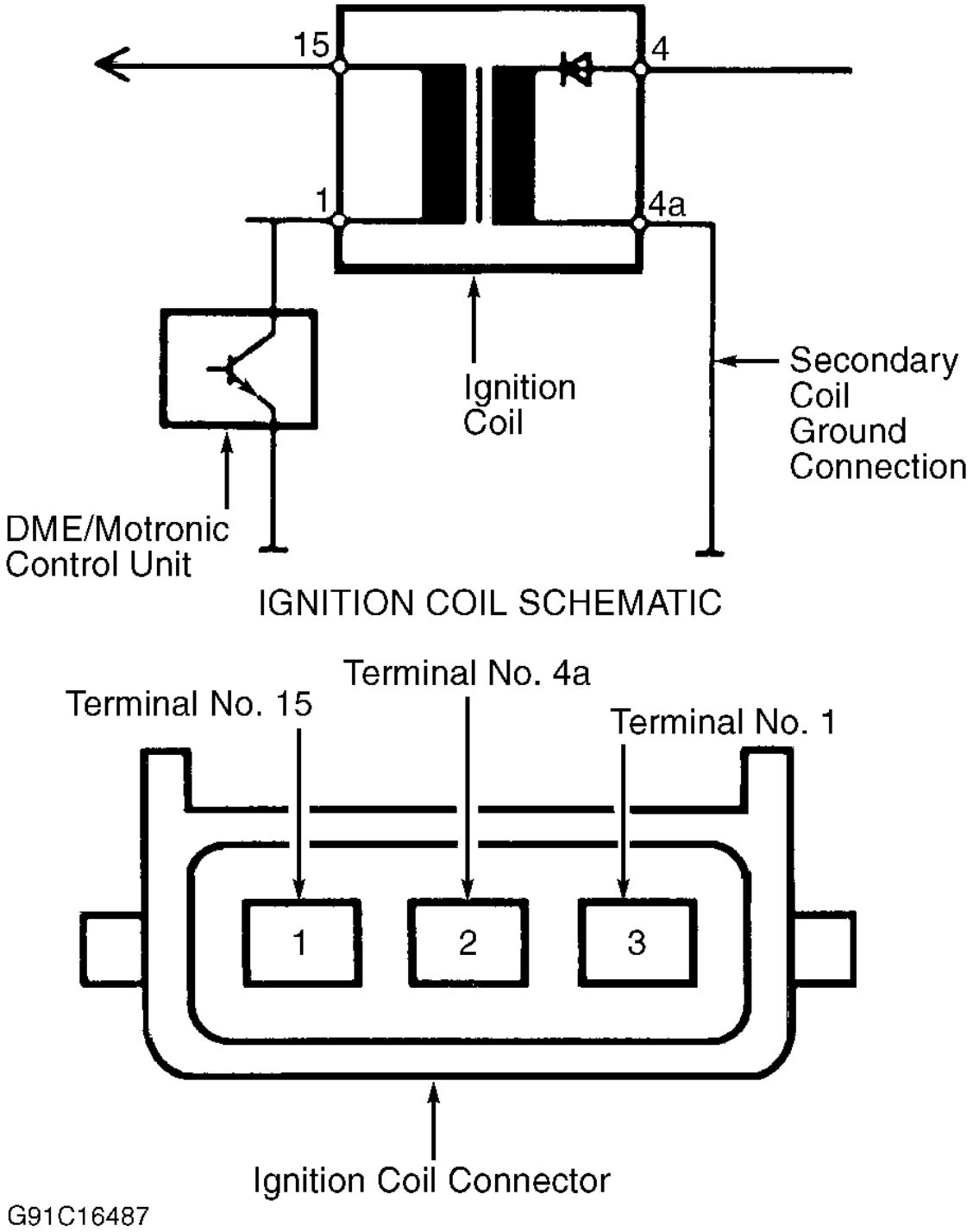


Fig. 46: DIS Ignition Coil Schematic & Terminal Identification
Courtesy of BMW OF NORTH AMERICA, INC.

Ignition Coil Primary Signal Check

1. Select cylinder mode on BMW SERVICE TESTER (Sun 2013 Engine Analyzer). Connect universal adapter lead on tester. Connect Brown lead to known good engine ground. See Fig. 47. Connect Black lead to terminal No. 1 on Adapter (127020).

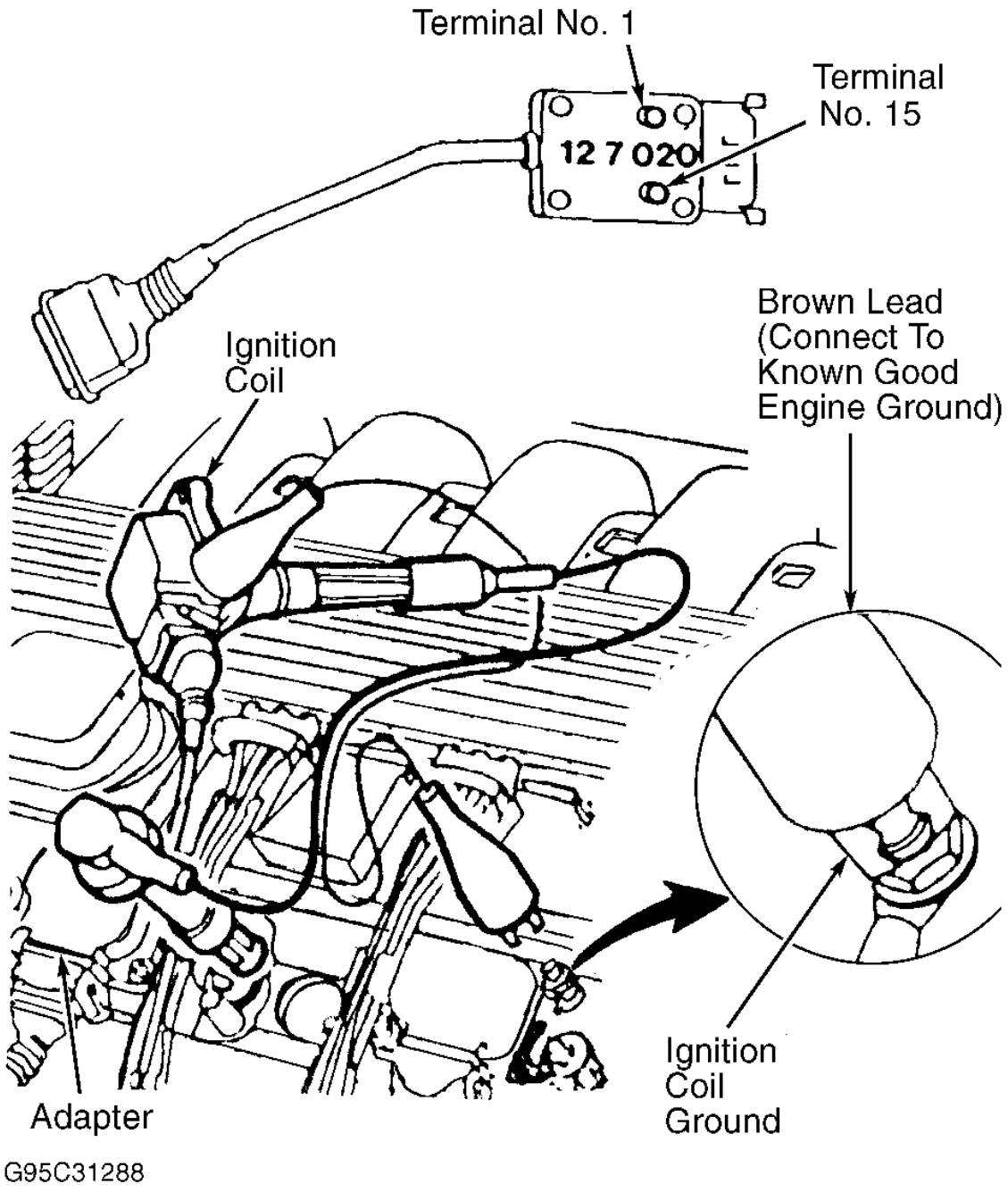


Fig. 47: Checking DIS Ignition Coil Primary Signal
Courtesy of BMW OF NORTH AMERICA, INC.

2. Connect adapter to ignition coil of cylinder being tested. Red lead is not used as only one cylinder can be measured. Engine speed displayed will be reduced by a factor of 4. Produce stopped signal on oscilloscope by pressing "R" button on tester. Combustion voltage line will be very erratic on oscilloscope pattern (this is normal).

Ignition Voltage Too High

Check for excessive spark plug electrode gap, high compression, lean air/fuel mixture, low electrode temperature, or burnt spark plug electrode.

Ignition Voltage Too Low

Check for insufficient spark plug electrode gap, low compression, or high electrode temperature.

Measure primary coil resistance between terminal No. 1 and terminal No. 15. See Fig. 48. Secondary coil resistance cannot be measured. See IGNITION COIL RESISTANCE table.

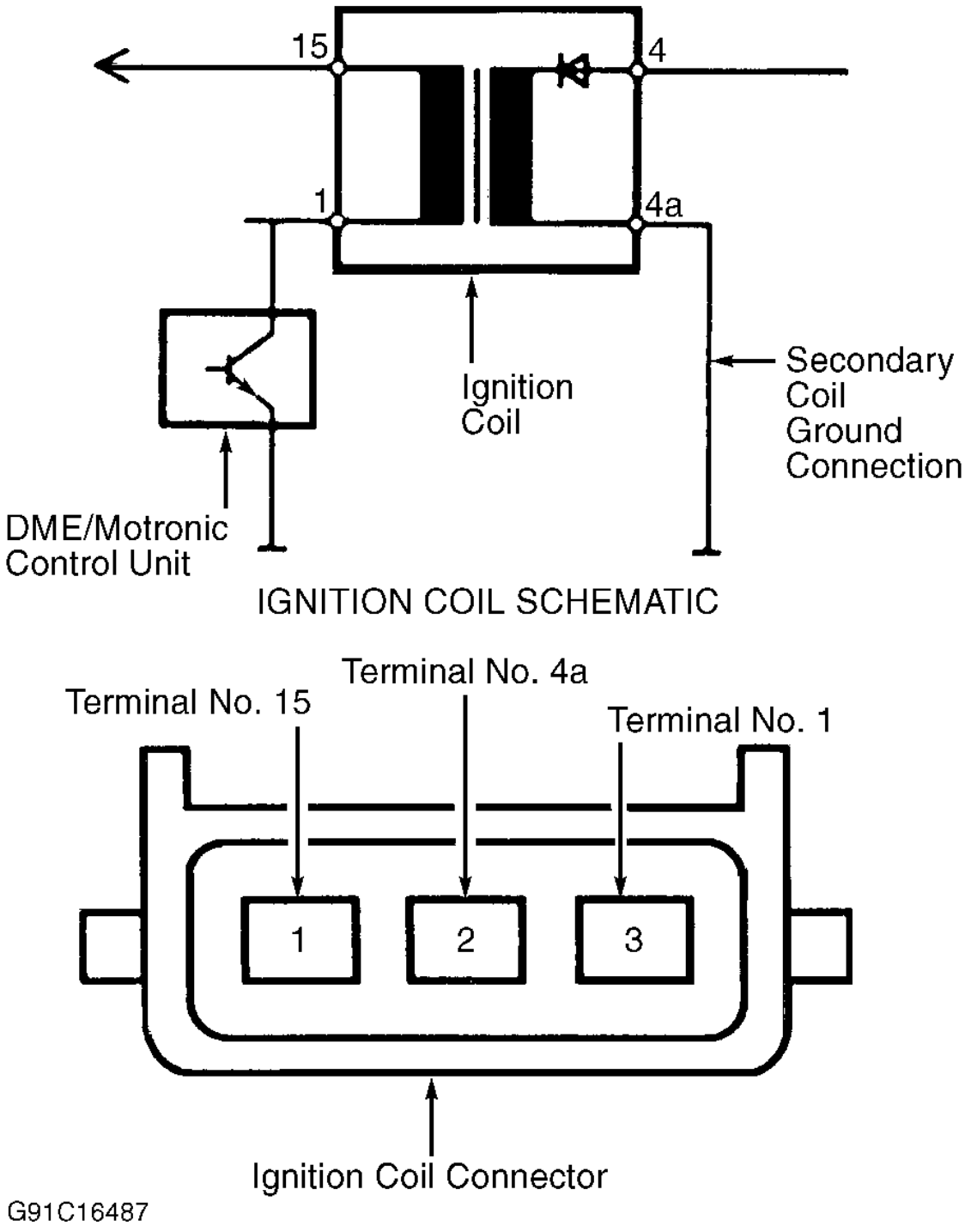


Fig. 48: Ignition Coil Terminal Identification
Courtesy of BMW OF NORTH AMERICA, INC.

IGNITION COIL RESISTANCE - Ohms @ 68Â°F (20Â°C)

Primary	Secondary
.8 (1)	Not Measurable
(1) Specification is approximate	

Ignition Coil Secondary Signal Check

1. Connect engine analyzer and Adapter (127020) as described in IGNITION COIL PRIMARY SIGNAL CHECK. Remove ignition coil. Connect a spark plug wire (between coil and spark plug) to cylinder being tested. Connect inductive pickup Blue lead, on lead to cylinder being tested. See Fig. 49.
2. Produce stopped signal on oscilloscope by pressing "R" button on tester. Display of ignition signal on oscilloscope will be strongest when inductive clip and Black lead are connected to same cylinder. Display on oscilloscope may be disturbed by neighboring ignition leads (this is normal).

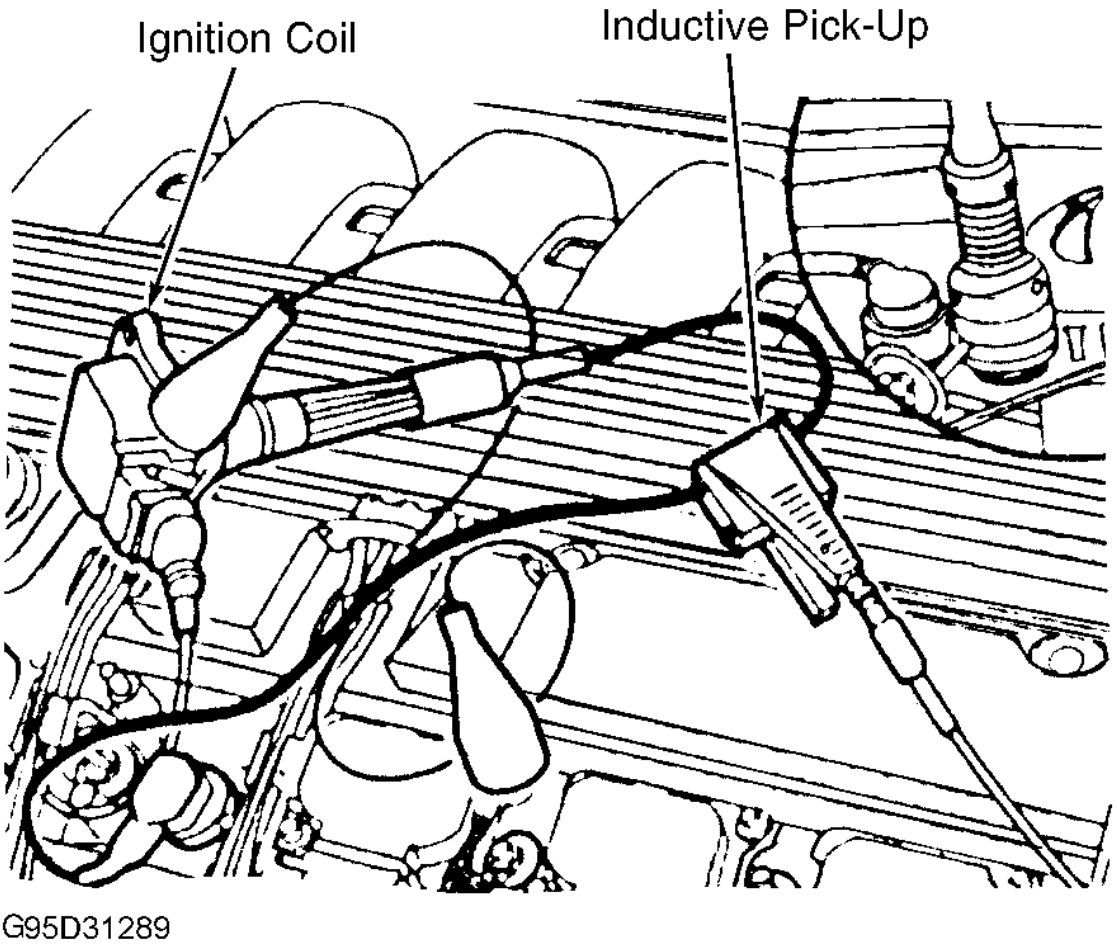


Fig. 49: Checking DIS Ignition Coil Secondary Signal
Courtesy of BMW OF NORTH AMERICA, INC.

EMISSION SYSTEMS & SUB-SYSTEMS

FUEL EVAPORATION

Fuel Cap Pressure Relief Valve Test

1. Set pressure regulator on Tester (16 1 171) fully in "-" direction. Connect tester via compressed air line to workshop/garage compressed air system with a pressure of 116-145 psi. Connect pressure sensor of BMW Diagnosis and Information System (DIS) with a measuring range of 0-50 psi (0-3.5 bar). Select Adapter (16 1 172 or 16 1 173) matching vehicle's filler cap and attach to quick-release coupling of tester. See Fig. 50 and Fig. 51 .

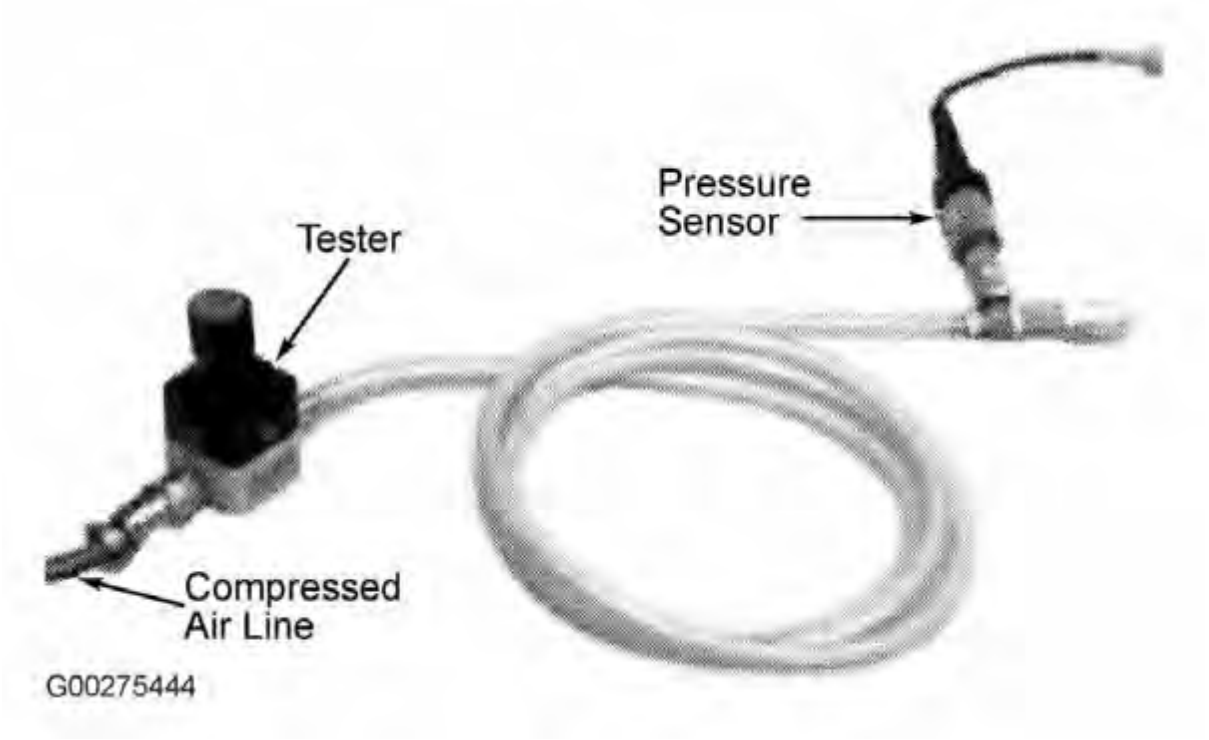


Fig. 50: Identifying Fuel Cap Pressure Relief Valve Tools (1 Of 2)
Courtesy of BMW OF NORTH AMERICA, INC.

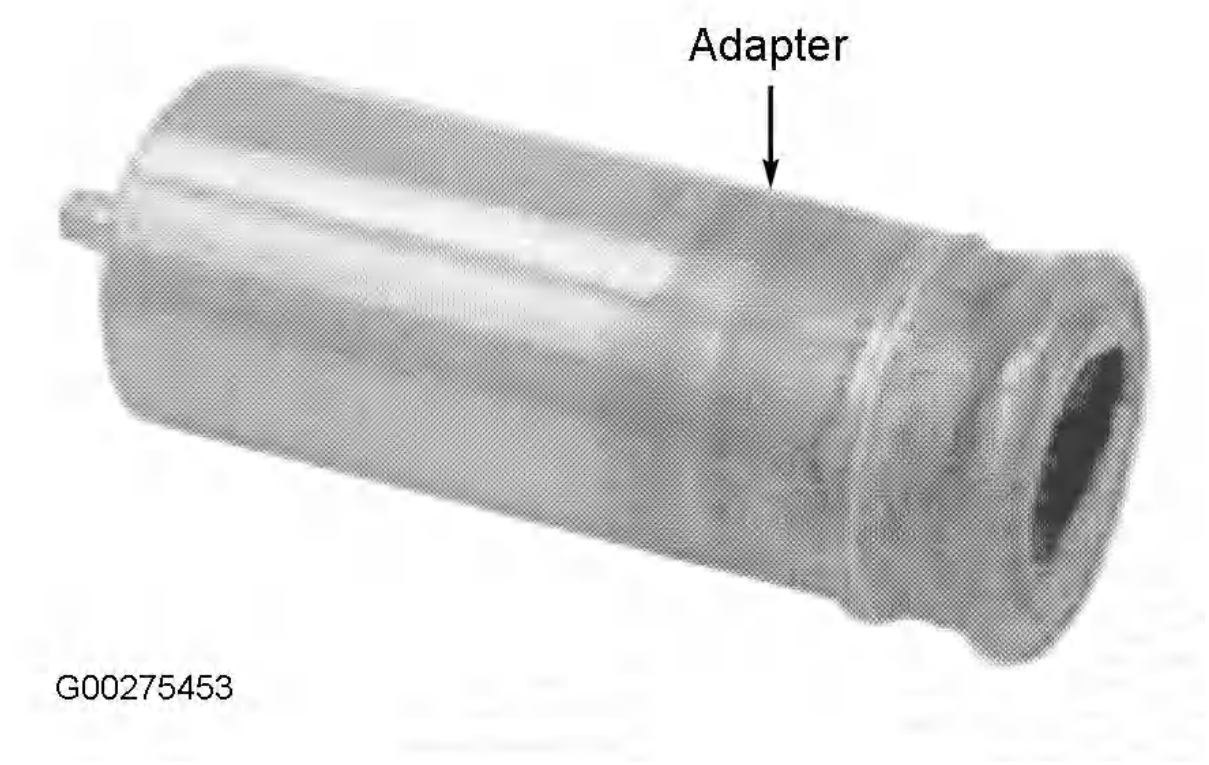


Fig. 51: Identifying Fuel Cap Pressure Relief Valve Tools (2 Of 2)
Courtesy of BMW OF NORTH AMERICA, INC.

2. Install filler cap on appropriate adapter. Only the absolute pressure is indicated in the display of the DIS. The current ambient air pressure is already displayed without additional pressurization.
3. Ensure testing equipment is okay by checking testing equipment for leaks. Select MEASUREMENT function on DIS. Increase pressure by 2.9 psi (.2 bar) with pressure regulator on tester. Using Hose Clip (13 3 010), disconnect delivery line from tester to fuel filler neck. Wait 60 seconds. Read off final pressure value and compare with starting pressure value. If pressure drop is greater than.174 psi (.012 bar) testing equipment is leaking. Check connection joints for leaks.

4. Check filler cap pressure relief valve by following same test procedure for checking testing equipment for leaks in step 3. Increase pressure by 4.3 psi (.3 bar) with pressure regulator on adapter. If pressure drop is greater than.174 psi (.012 bar), filler cap pressure relief valve is faulty. Replace filler cap.

Fuel Tank Vent (Evaporation) Control Valve

For location of fuel tank vent (evaporation) control valve on models where this information is available, see FUEL EVAPORATION CONTROL VALVE LOCATION table.

FUEL EVAPORATION CONTROL VALVE LOCATION

Application	Location
Z3 (E36/7)	On Left Side Of Engine Compartment
Z8 (E52)	Front Left Side Of Engine Compartment
3-Series (E46)	On Front Left Side Of Engine Compartment
5-Series	
6-Cylinder	Left Rear Side Of Engine Compartment
V8	Front Left Side Of Engine Compartment

FUEL TANK LEAKAGE

NOTE: If a leak in the tank ventilation system is indicated by CHECK ENGINE light in instrument cluster lighting up, a leak test must be carried out. Fault memory of DME control unit must be read out using BMW or generic scan tool. If sensors are okay, then begin leak test. Ensure following conditions are observed to obtain plausible measuring results:

- Contents of fuel tank: 25-75% full.
- Park vehicle at least 2 hours before test so fuel temperature is approximately that of ambient temperature. Ideal fuel temperature is approximately 50-68Â°F (10-20Â°C).
- Never refuel vehicle directly prior to leak test due to strong emission of gas by fresh fuel.

Draining & Filling Fuel Tank

1. Ensure adequate ventilation is present. Connect exhaust and extraction systems to exhaust tailpipe. Carefully withdraw extraction hose, avoiding damage to non return flap. Electric fuel pump must not operate without fuel. After repair work, but before starting engine for first time, fill fuel tank with minimum of.5 qt. (.5L) fuel through fuel filler pipe.
2. To draw off fuel, start engine and allow to run. Electric fuel supply pump will operate. Fuel is pumped via suction jet pump and tank expansion line from left to right side of fuel tank.

NOTE: Fuel can be drawn off from left and right tank halves through fuel filler pipe down to a small residual amount. Residual amount on left and right can continue to be drawn off after removal of fuel filter.

3. Push extraction hose of suction extractor unit into fuel filler pipe about 35 inches. Turn slightly if necessary. Draw off fuel with suction extractor unit as much as possible. Catch dripping fuel in a container. Remove fuel filter. Draw off residual fuel amount in right tank half through service opening. To draw off residual fuel on left side, feed extraction hose through service opening in tank above saddle into left tank half. Residual fuel amount can be drawn off.
4. To refill, push extraction hose of suction extractor unit about 35 inches into fuel filler pipe. Fill fuel from suction extractor unit.

NOTE: For leak detection, see Fig. 52 and Fig. 53 .

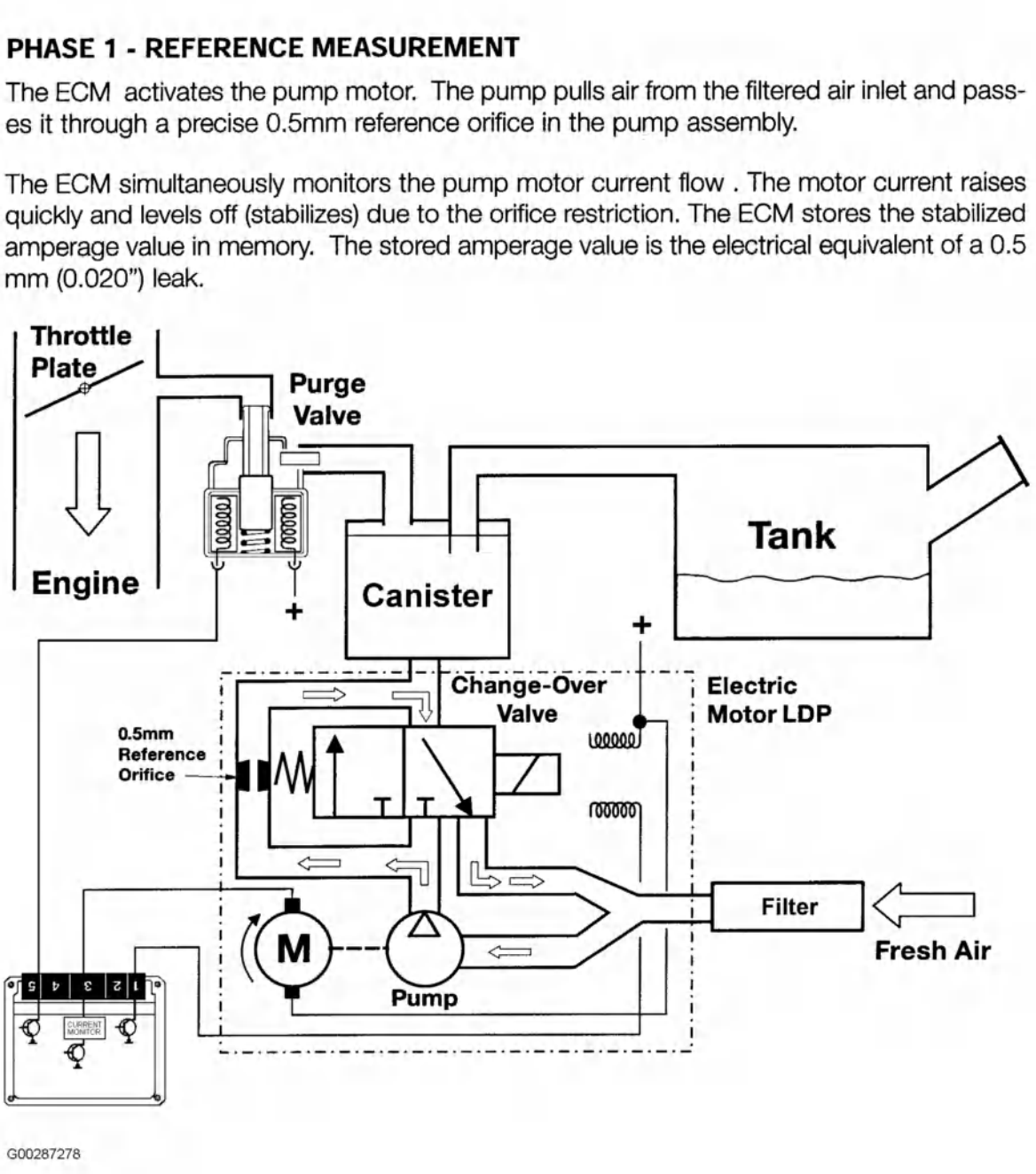


Fig. 52: Phase 1 - Reference Measurement (X5)
Courtesy of BMW OF NORTH AMERICA, INC.

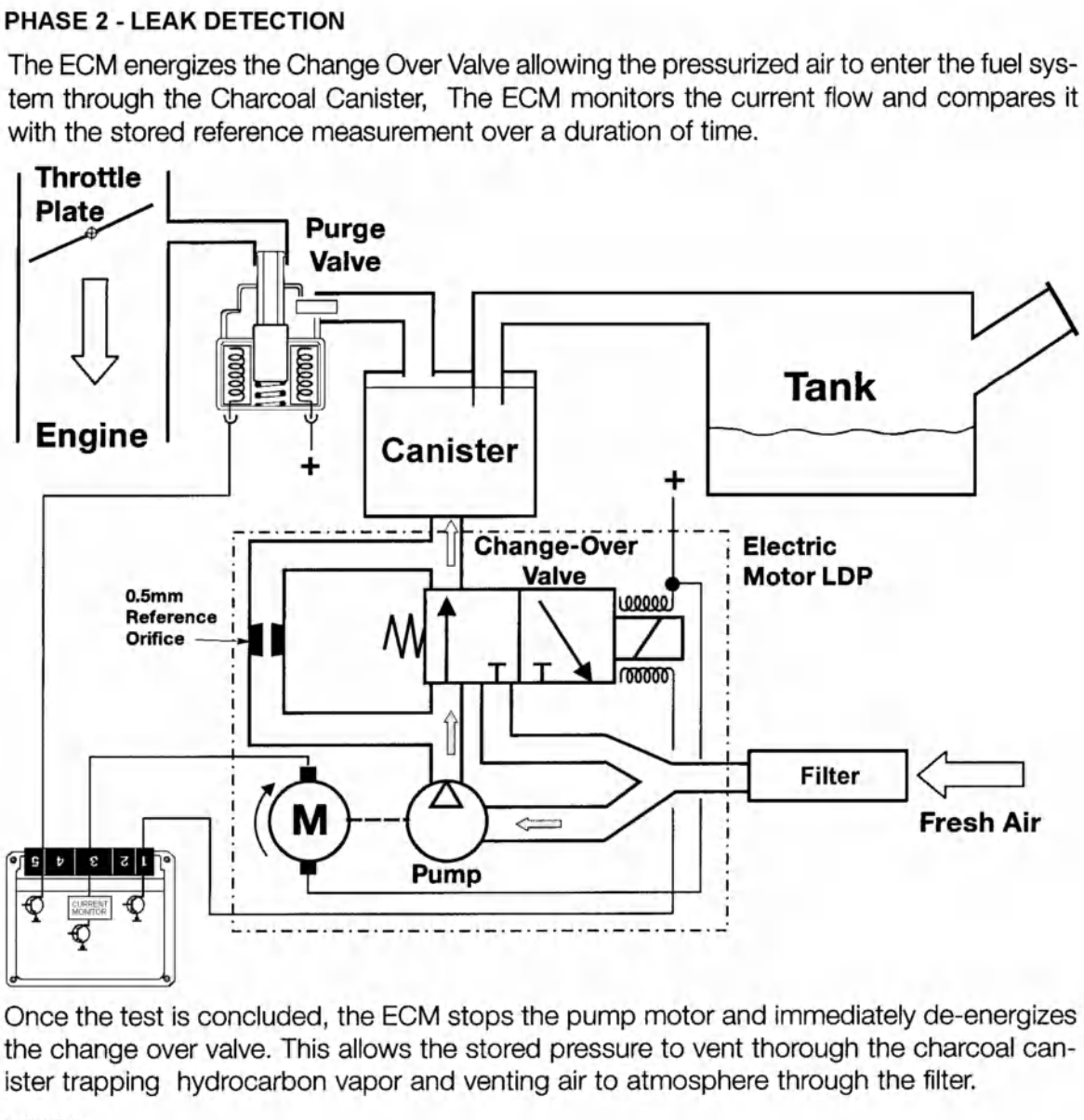


Fig. 53: Phase 2 - Leak Detection
Courtesy of BMW OF NORTH AMERICA, INC.

Checking Fuel Tank & Tank Venting System For Leaks With Tank Leakage Diagnosis Module (DM-TL) - Z3

1. A fault is indicated by CHECK ENGINE indicator light in instrument cluster lighting up. This may indicate a leak in the tank venting system. Information on this is provided by the fault memory of the DME control unit. Read out fault memory of DME control unit and carry out diagnosis in accordance with faults stored. A leak test with the DM-TL module is then carried out if:
   - The components of the DM-TL module are okay.
   - An error is stored in the DME fault memory (tank leak detected).
2. Adhere to following conditions in order to carry out a correct leak test:
   - Ensure content of fuel tank is greater than 90 percent.
   - Ensure reserve indicator light is off.

   Leave car in workshop for at least 2 hours so that fuel temperature equals workshop temperature as closely as possible (ideal fuel temperature is about 50-68Â°F (10-20Â°C). Do not under any circumstances fill up car with fresh fuel. Check that tank cap is correctly seated.

WARNING: During leak test, under no circumstances apply external pressurization

through tank filler neck as this may cause incorrect readings.

3. Clear DME fault memory. Using Diagnosis and Information System (DIS), go to FUNCTION AND COMPONENT SELECTION page by selecting COMPLETE VEHICLE, DRIVE, ENGINE MANAGEMENT, TANK SYSTEM TEST, DIAGNOSIS MODULE TANK LEAKAGE (DMTL). Adopt test module in test schedule. Switch to test schedule and implement tank leakage diagnosis module. Leakage test is carried out. If fault is recorded again in DME fault memory (tank leak detected), go to next step and carry out leak test.

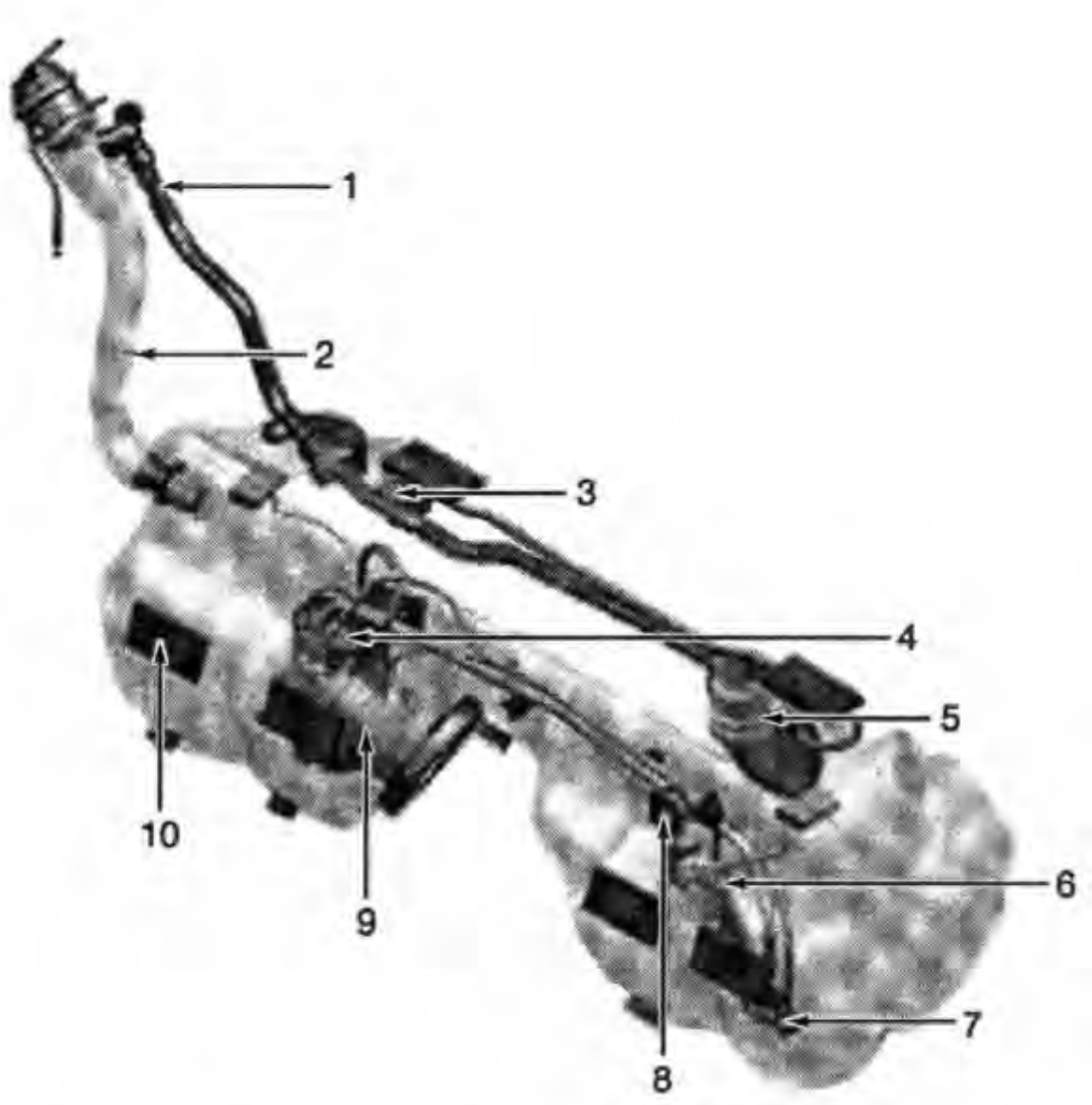
CAUTION: On vehicles with Tank Leak Diagnosis Modules (DM-TL), do not work with external pressurization as the tank venting system will leak under this condition. Because of emerging fuel vapors, carry out all work in well ventilated rooms, or use a suitable extractor system.

NOTE: Following procedure is only applicable to vehicles with tank leak diagnosis module (DM-TL).

4. To conduct leak test on fuel tank and tank ventilation system, in Diagnosis and Information System (DIS), go to FUNCTION AND COMPONENT SELECTION page by selecting: SERVICE FUNCTIONS, DRIVE, DIGITAL MOTOR ELECTRONICS AND ACTIVATION DMTL PUMP ADOPT TEST MODULE in test schedule. Switch to test schedule and implement ACTIVATION DMTL PUMP test module.
5. Tank leak diagnosis pump pressurizes fuel tank and tank venting system. Carry out leak test. Terminate test module after completing leak test. Tank leak diagnosis pump is automatically shut down after about 15 minutes due to risk of overheating. Allow pump to cool down for at least 15 minutes, then continue procedure. Leak test can be carried out with a leak detector. Follow leak test manufacturer's operating instructions. Possible causes of leaks are:
    - Tank cap leaking (check tank cap pressure relief valve). See FUEL CAP PRESSURE RELIEF VALVE TEST under FUEL EVAPORATION.
    - Tank venting lines leaking (fuel tank, carbon canister, or tank venting valve).
    - Tank ventilation valve leaky (engine compartment).
    - Fuel level sensor flange on tank leaking.

Checking Fuel Tank & Tank Venting System For Leaks With Tank Leakage Diagnosis Module (DM-TL) - Z4

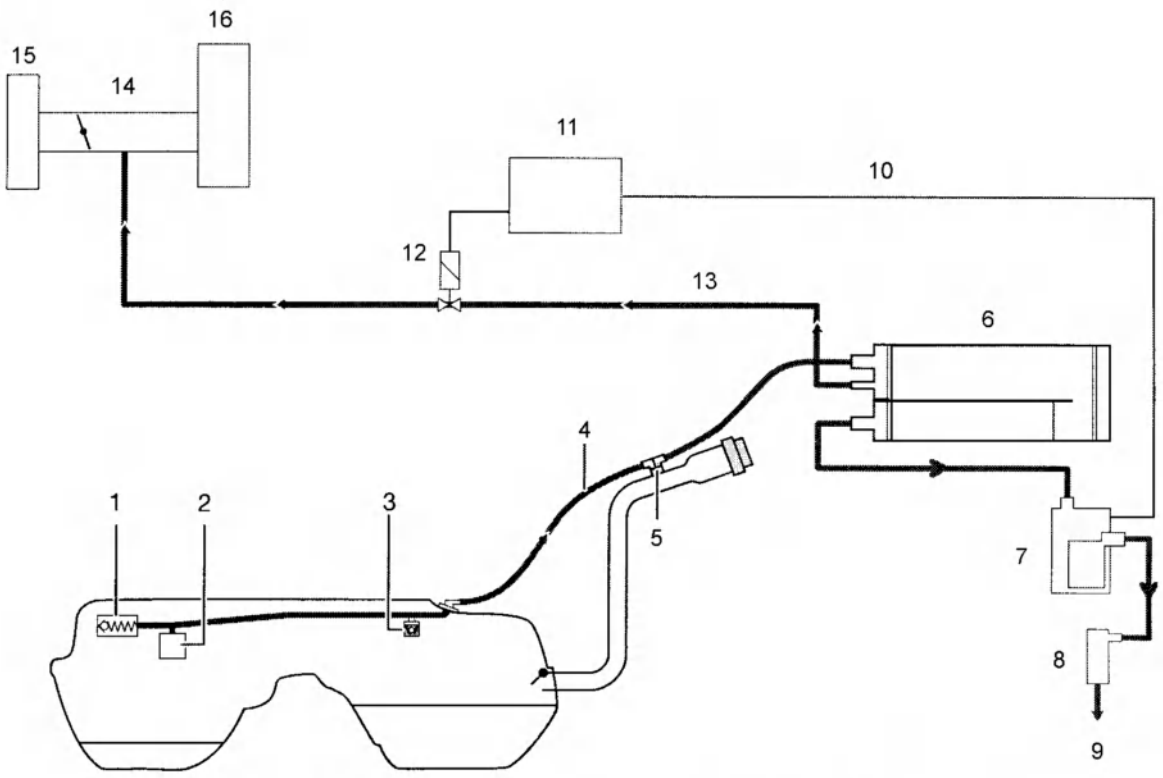
1. Do not work with external pressurization as tank venting system will leak. Because of escaping fuel vapors, these tasks should only be carried out in well ventilated rooms or with a suitable extractor facility provided. Using BMW Diagnosis and Information System (DIS), go to FUNCTION AND COMPONENT SELECTION page by selecting: SERVICE FUNCTIONS, DRIVE, DIGITAL MOTOR ELECTRONICS, ACTIVATION DMTL PUMP and ADOPT TEST MODULE in test schedule. Switch to test schedule and implement ACTIVATION DMTL PUMP TEST MODULE VENTING. See Fig. 54-Fig. 57 .



1. Ventilation line
2. Filler tube
3. Operating vent valve
4. Fuel pump assembly
5. Filling vent valve
6. Left fuel level sensor
7. Left syphon jet
8. Overpressure protection valve
9. Fuel filter and fuel pressure regulator
10. Anti-chafing pads (foam cushion)

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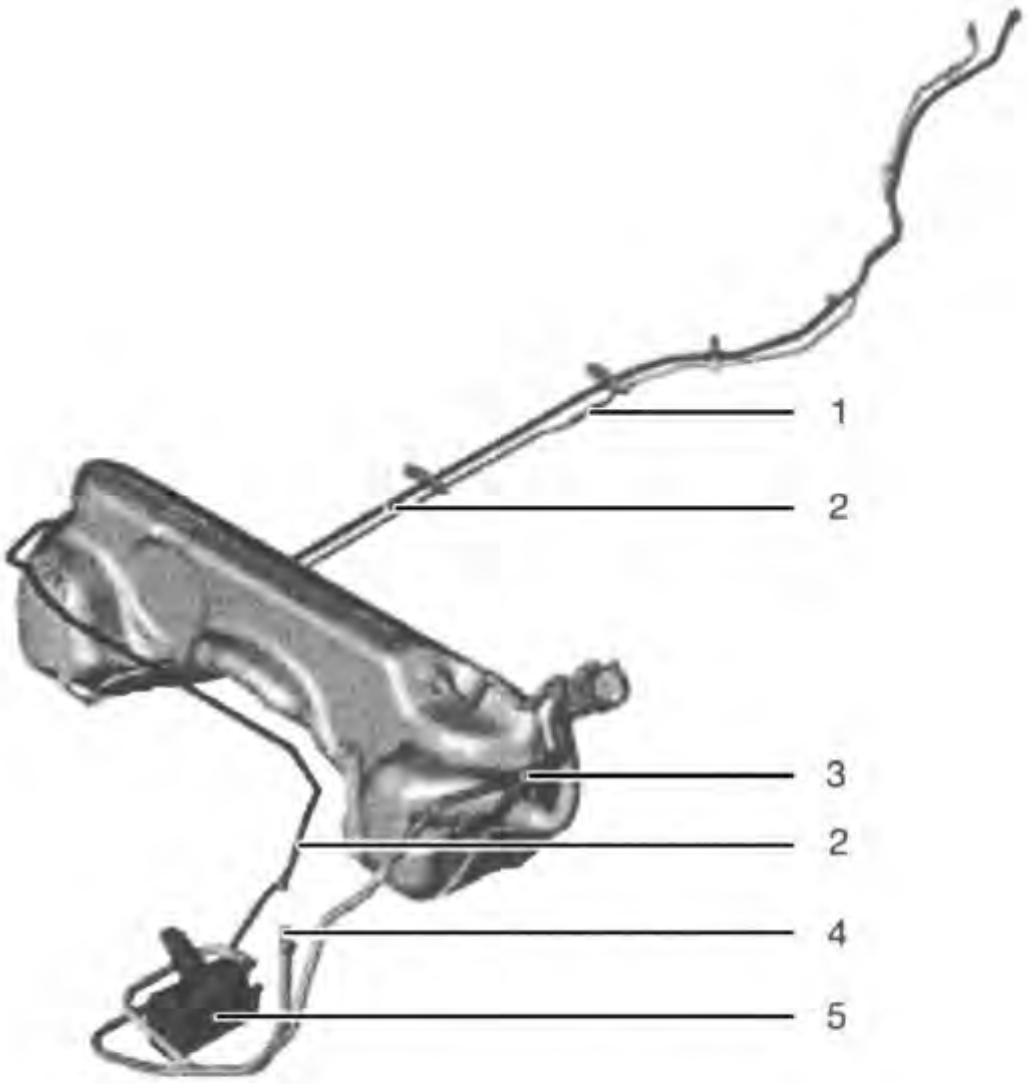
Fig. 54: Identifying Z4 Fuel System (1 Of 4)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Overpressure protection valve
2. Filling vent valve (rollover valve)
3. Operating vent valve
4. Ventilation line
5. Mushroom valve ("T" fitting)
6. Carbon canister
7. DM TL (leakage diagnosis pump)
8. Filter
9. Atmospheric vent line
10. DM TL (electrical control circuit)
11. ECM (DME)
12. Evaporative emission (purge) control valve
13. Evaporative emission (purge) line
14. Intake manifold
15. Engine air filter
16. M54 engine

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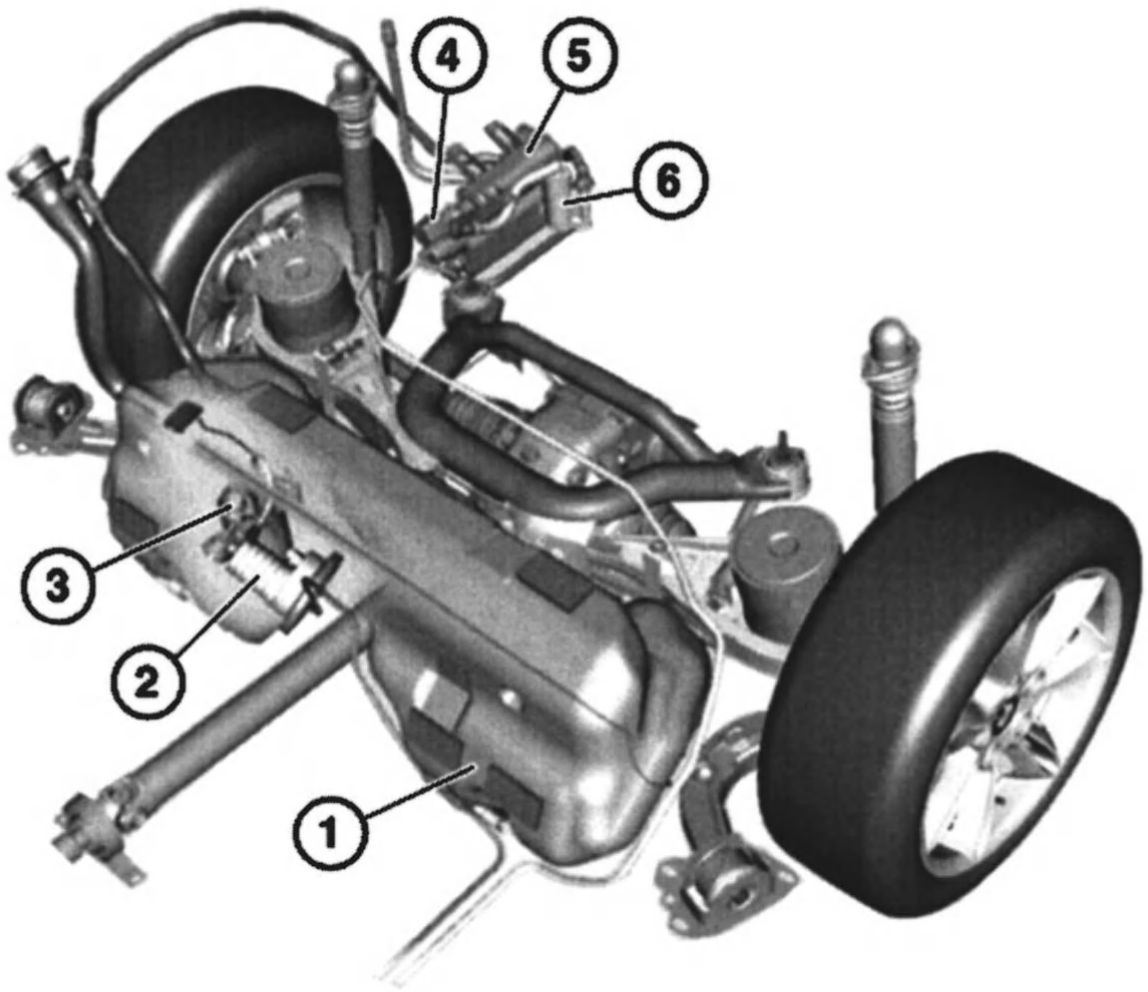
Fig. 55: Identifying Z4 Fuel System (2 Of 4)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Fuel supply line
2. Evaporative purge line
3. Evaporative vent line (to carbon canister)
4. Atmospheric vent line with filter
5. Carbon canister with DM TL pump

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Fig. 56: Identifying Z4 Fuel System (3 Of 4)
Courtesy of BMW OF NORTH AMERICA, INC.



1	Fuel tank	4	Carbon canister
2	Fuel filter / pressure controller	5	DM-TL
3	Fuel pump / sensor unit / suction jet pump	6	Dust filter

G00287283

Fig. 57: Identifying Z4 Fuel System (4 Of 4)
Courtesy of BMW OF NORTH AMERICA, INC.

2. Tank leak diagnosis pump pressurizes fuel tank and tank venting system. Carry out leak test. Terminate test module after completing leak test. Tank leak diagnosis pump will automatically shut down after about 15 minutes due to risk of overheating. Allow pump to cool down for at least 15 minutes, then continue procedure. Leak test can be carried out with a leak detector. Follow manufacturer's operating instructions. Possible causes of leaks are:
   - Tank cap leaking. See FUEL CAP PRESSURE RELIEF VALVE TEST under FUEL EVAPORATION.
   - Tank vent line leaking (fuel tank-carbon canister).
   - Tank vent line leaking (engine compartment).
   - Sealing ring on fuel filter leaking.

Checking Fuel Tank & Tank Venting System For Leaks With Tank Leakage Diagnosis Module (DM-TL) - Z8

1. For vehicles without tank leak diagnosis module, go to step 3. For vehicles with tank leak diagnosis module, go to next step.

CAUTION: On vehicles with tank leak diagnosis modules (DM-TL), do not work with external pressurization as the tank venting system will leak under this condition.

2. Select 4 EXPERT MODE function on Diagnosis and Information System (DIS). From menu, 2 ACTIVATE COMPONENTS, select function 127 ACTIVATION DMTL PUMP. DMTL PUMP appears in display. Pump is activated. Tank leak diagnosis pump pressurizes fuel tank and tank venting system.
3. On vehicles without tank leak diagnosis module, pressurize tank through filler neck. When leak-testing with a leak detector, follow manufacturer's operating instructions. On account of emerging fuel vapors, carry out all operations in well ventilated rooms, or use a suitable extractor system.
4. Possible causes of leaks may be:
   - Tank cap leaking (check tank cap pressure relief valve). See FUEL CAP PRESSURE RELIEF VALVE TEST under FUEL EVAPORATION.
   - Tank venting lines leaking (fuel tank, EVAP carbon canister or tank venting valve).
   - Tank venting valve leaking (engine compartment).
   - Fuel level sensor flange on tank leaking.

Checking Fuel Tank & Tank Venting System For Leaks With Tank Leakage Diagnosis Module (DM-TL) - 3-Series (E46)

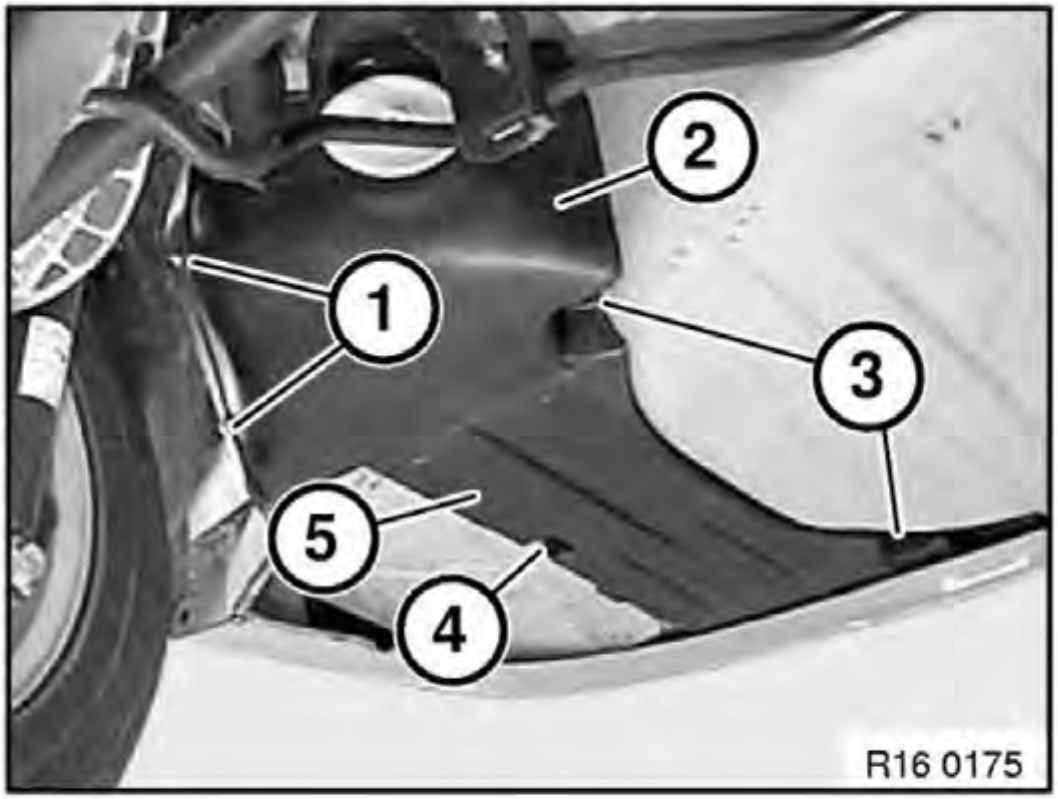
1. Remove screws and panel. Remove expansion rivet and panel. See Fig. 58. Unlock line and detach line from dust filter. See Fig. 59. Seal dust filter with special tool. Remove tank filler cap and connect Special Tool (16 1 150) to tank filler neck. See Fig. 60. Screw in rear towing eye and hook Special Tool (16 1 150) into it. Connect special tool to workshop compressed air system of 116-145 psi (8-10 bar) with compressed air hose. See Fig. 61. Connect pressure sensor with measuring range of 0-51 psi (0-3.5 bar).

NOTE: Ensure pressure regulator on Special Tool (16 1 150) is set completely in "-" direction and non return cock between pressure regulator and pressure sensor is closed. Select MEASURING TECHNOLOGY function on Diagnosis Information System (DIS).

2. Set measuring range in accordance with pressure sensor to 0-51 psi (0-3.5 bar). Open non return cock on Special Tool (16 1 150) and increase pressure in tank system by.72 psi (.050 bar) with the pressure regulator.

WARNING: Do not increase pressure by more than 1.45 psi (.100 bar), as damage to fuel tank and tank ventilation system is possible.

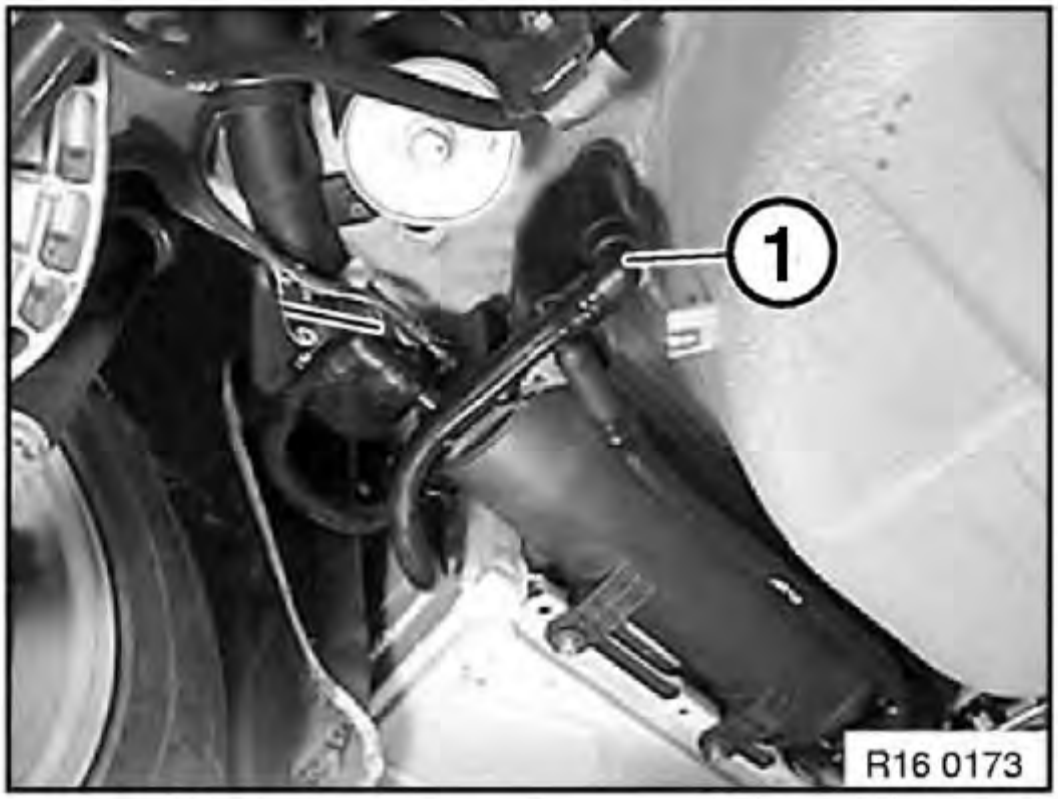
3. Close non return cock. Wait about 20 seconds for system to settle. Read off pressure value, then wait 60 seconds. Read off final pressure value and compare with starting pressure value. If pressure drop is within range of.116-1.7 psi (.008-.12 bar), measurement must be repeated to obtain a confirming result. If pressure drop in 60 seconds is greater than.145 psi (.010 bar), system is leaking.
4. Leak test can be carried out with a leak detector. Possible causes may be fuel filler cap leaking, tank ventilation line leaking (fuel tank-activated carbon canister-tank ventilation valve), tank ventilation valve leaking (engine compartment), tank sensor on fuel tank leaking or activated carbon canister non return valve leaking (spare wheel recess).



1. Screws
2. Panel
3. Screws
4. Rivet
5. Panel

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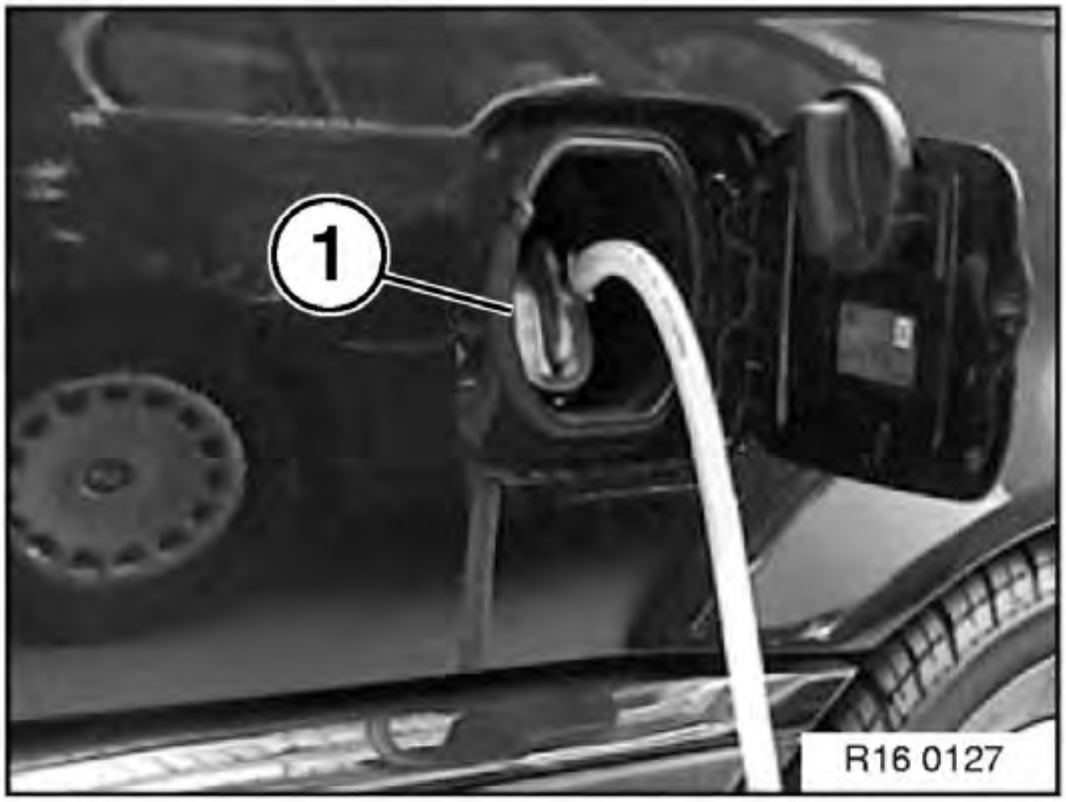
Fig. 58: Removing Under Car Panels
Courtesy of BMW OF NORTH AMERICA, INC.



1. Line

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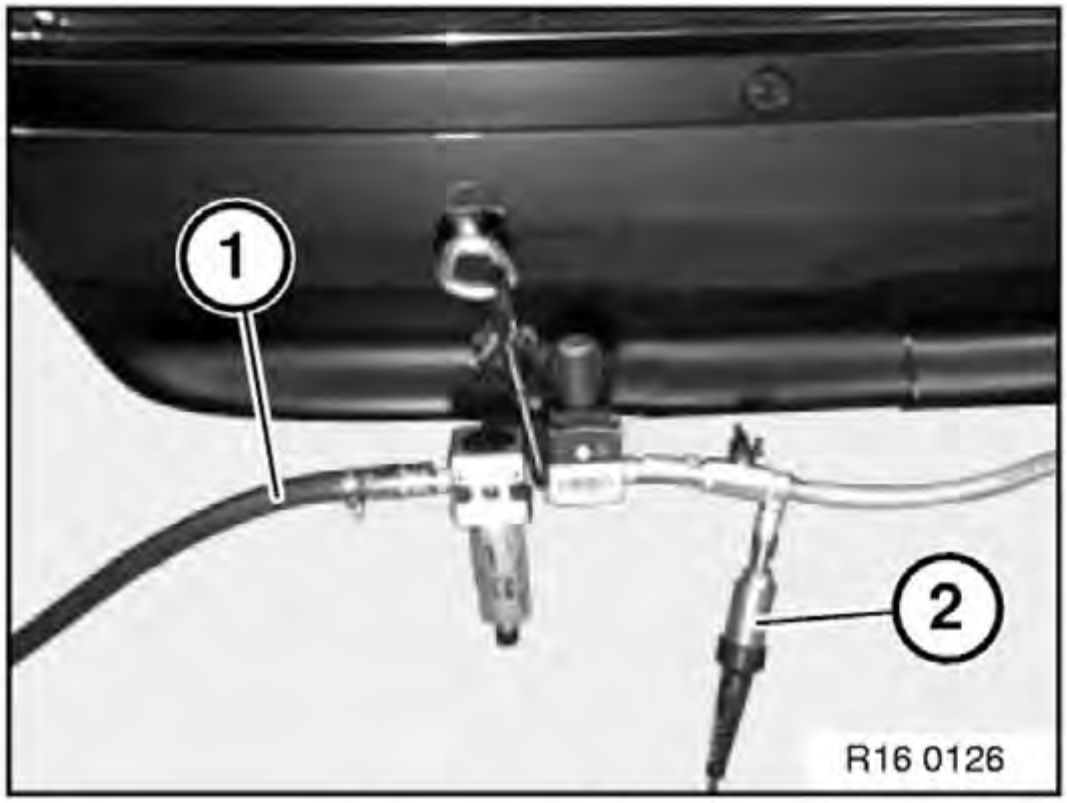
Fig. 59: Disconnecting Line From Dust Filter
Courtesy of BMW OF NORTH AMERICA, INC.



1. Special Tool

G00131598

Fig. 60: Removing Tank Filler Cap & Installing Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.



1. Compressed Air Hose
2. Pressure Sensor

G00131599

Fig. 61: Installing Compressed Air Hose & Pressure Sensor
Courtesy of BMW OF NORTH AMERICA, INC.

Checking Fuel Tank & Tank Venting System For Leaks With Tank Leakage Diagnosis Module (DM-TL) - 5-Series (E39) 6-Cylinder

1. If a leak in the tank ventilation system is indicated by CHECK ENGINE indicator lamp in the instrument cluster, a leak test must be carried out. First, fault memory of DME control unit must be read out and diagnosis conducted. If sensors are okay, then begin leak test. Following conditions must be observed to obtain plausible measuring results:
   - Ensure contents of fuel tank are 25-75 percent.
   - Park vehicle in workshop at least 2 hours before test so fuel temperature is about that of workshop temperature. Ideal fuel temperature is 50-68Â°F (10-20Â°C).
   - Never refuel the vehicle directly prior to leak test due to strong gas emission by fresh fuel.
2. To conduct leak test, remove luggage compartment mat and spare tire. Remove battery cover. Remove hexagon nut and plastic nut. See Fig. 62. Remove cover of activated carbon canister upward.
3. Disconnect electrical connector of activated carbon canister non return valve. See Fig. 63. Connect Special Tool (12 6 410/411) to activated carbon canister non return valve and vehicle battery. See Fig. 64. Activated carbon canister non return valve is closed by applying 12 volts. Ensure voltage is sufficient and do not reverse terminals. Remove tank filler cap and connect special tool (16 1 150) to tank filler neck. See Fig. 60.
4. Screw in rear towing eye and hook Special Tool (16 1 150) into it. Connect special tool to compressed air system of 116-145 psi (8-10 bar) with compressed air hose. See Fig. 61. Connect pressure sensor with measuring range of 0-51 psi (0-3.5 bar).

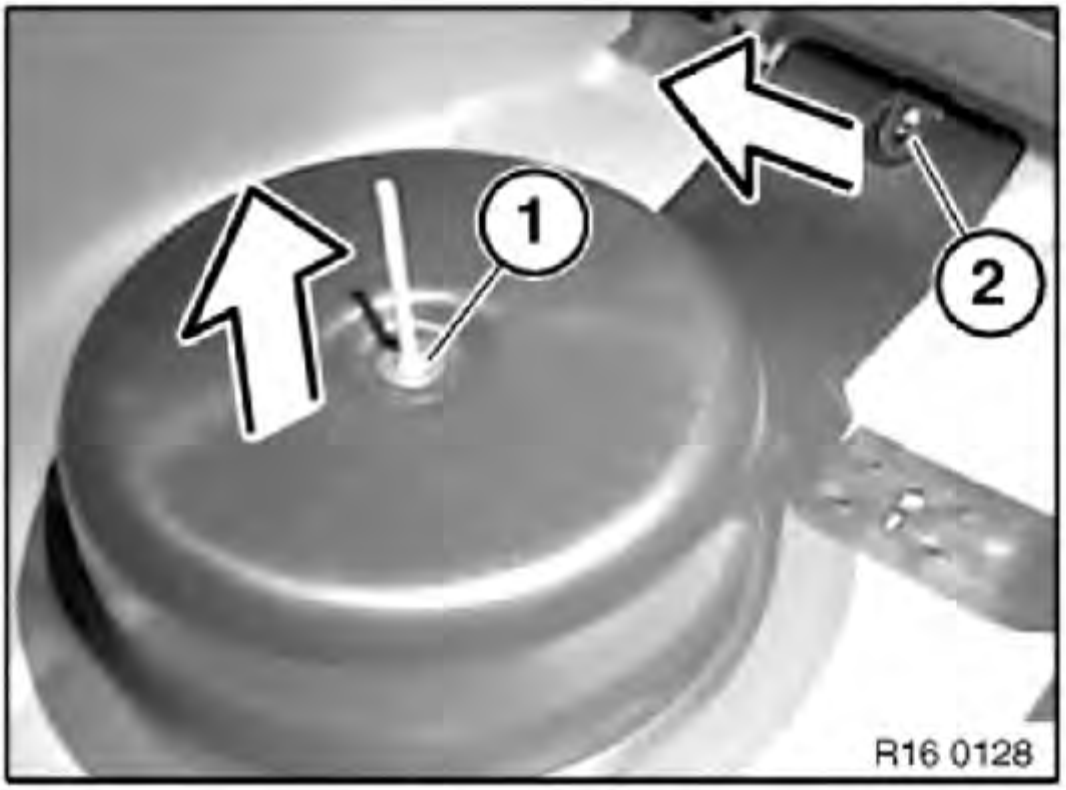
WARNING: Ensure pressure regulator on Special Tool (16 1 150) is set completely in

"-" direction and non return cock between the pressure regulator and pressure sensor is closed.

5. Select MEASURING TECHNOLOGY function on Diagnosis Information System (DIS). Set measuring range in accordance with pressure sensor to 0-51 psi (0-3.5 bar). Open non return cock on Special Tool (16 1 150) and increase pressure in tank system by.72 psi (.050 bar) with pressure regulator.

WARNING: Do not increase pressure by more than 1.45 psi (.10 bar), as damage to fuel tank and tank ventilation system is possible.

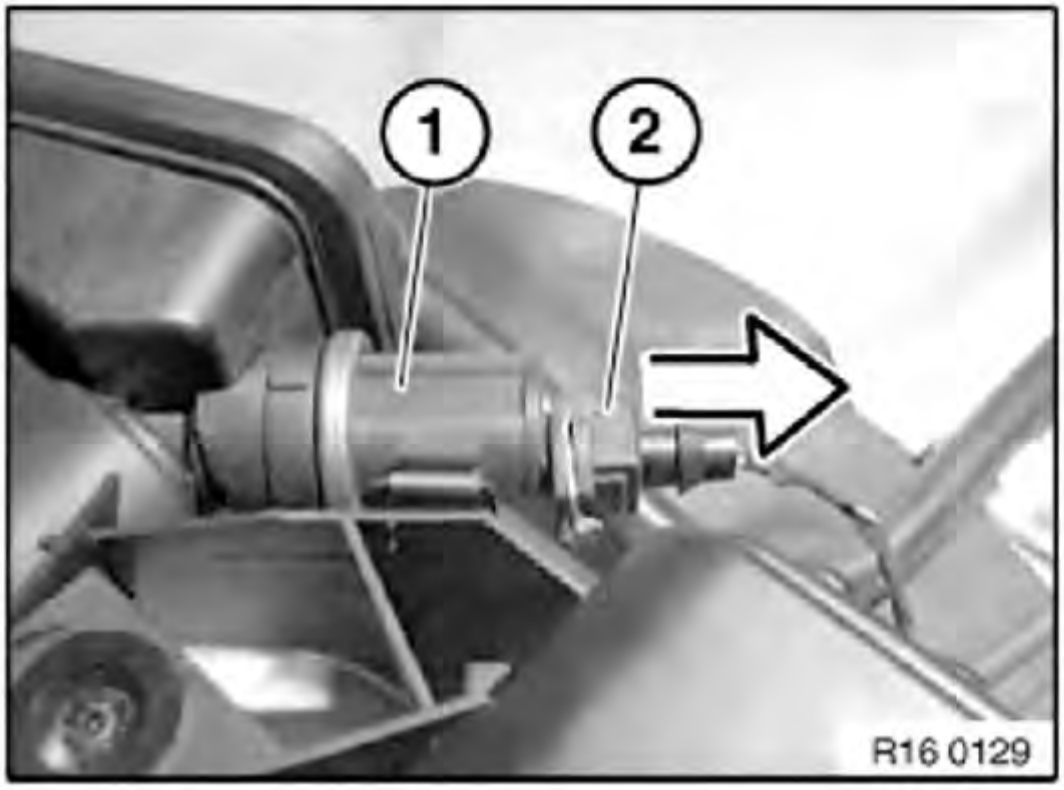
6. Close non return cock. Wait for about 20 seconds for system to settle. Read off pressure value, then wait 60 seconds. Read off final pressure value and compare with starting pressure value. If pressure drop is in area between.116-1.7 psi (.008-.012 bar), measurement must be repeated to obtain a confirming measurement. If pressure drop in 60 seconds is greater than.145 psi (.010 bar), system is leaking.
7. Leak test can be carried out with a leak detector. Possible causes may be fuel filler cap, tank ventilation line (fuel tank-activated carbon canister-tank ventilation valve), tank ventilation valve (engine compartment), tank sensor on fuel tank or activated carbon canister non return valve (spare tire recess).



1. Hexagon Nut
2. Plastic Nut

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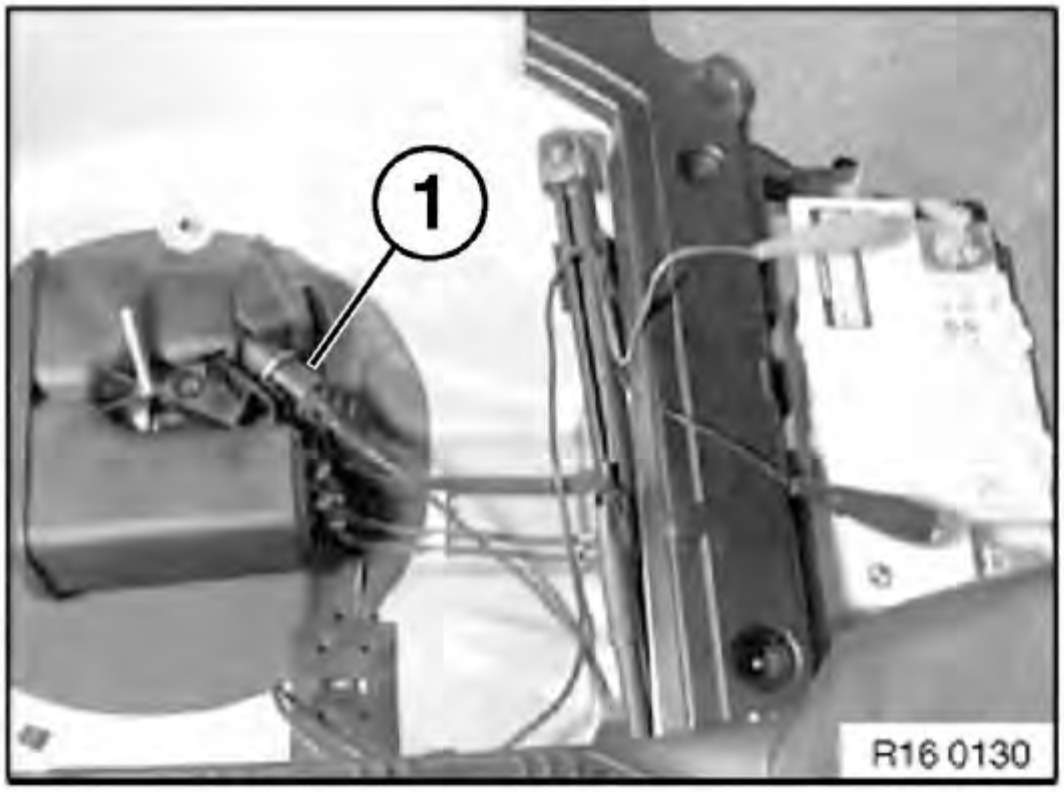
Fig. 62: Removing Hexagon Nut & Plastic Nut
Courtesy of BMW OF NORTH AMERICA, INC.



1. Non-Return Valve
2. Electrical Connector

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Fig. 63: Disconnecting Activated Carbon Canister Non Return Valve Connector
Courtesy of BMW OF NORTH AMERICA, INC.



1. Non-Return Valve

G00131602

Fig. 64: Applying Battery Voltage To Non Return Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Checking Fuel Tank & Tank Venting System For Leaks With Tank Leakage Diagnosis Module (DM-TL) - 5-Series (E39) V8

1. Remove left rear wheel. Remove left rear wheel housing trim. Remove leak diagnosis pump air cleaner from retaining bracket of activated carbon filter from below. See Fig. 65. Using hose clamp, seal with Special Tool (16 1 161).
2. Remove tank filler cap and connect Special Tool (16 1 150) to tank filler neck. See Fig. 60. Screw in rear towing eye and hook Special Tool (16 1 150) into it. Connect special tool to compressed air system of 116-145 psi (8-10 bar) with compressed air hose. Connect pressure sensor with measuring range of 0-51 psi (0-3.5 bar). See Fig. 61.

WARNING: Ensure pressure regulator on Special Tool (16 1 150) is set completely in "-" direction and non return cock between pressure regulator and pressure sensor is closed.

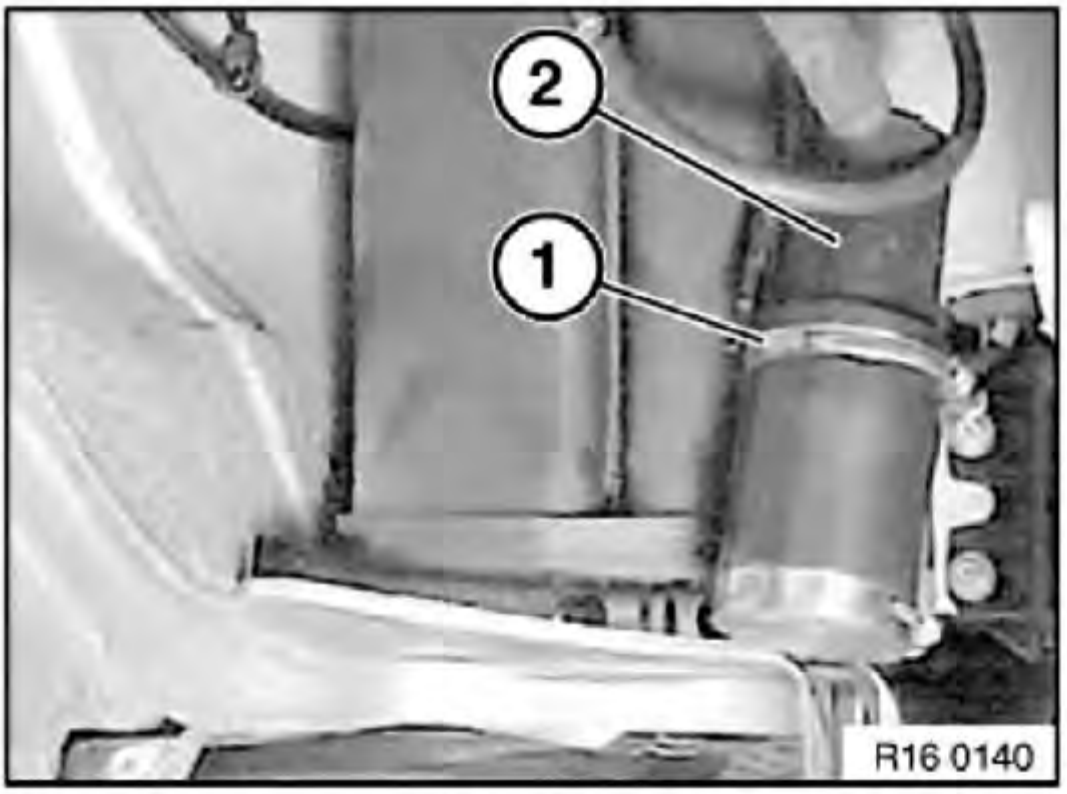
3. Select MEASURING TECHNOLOGY function on Diagnosis and Information System (DIS). Set measuring range in accordance with pressure sensor to 0-51 psi (0-3.5 bar). Open non return cock on Special Tool (16 1 150) and increase pressure in tank system by.72 psi (.05 bar) with pressure regulator.

WARNING: Do not increase pressure by more than 1.45 psi (.10 bar) as damage to fuel tank and tank ventilation system is possible.

4. Close non return cock. Wait for about 20 seconds for system to settle, read off pressure value, then wait for 60 seconds. Read off final pressure value and compare with starting pressure value. If pressure drop is.116-1.7 psi (.008-.12 bar), measurement must be repeated to obtain a confirming result. If pressure

drop in 60 seconds is greater than.145 psi (.010 bar), system is leaking.

5. Leak test can be carried out with a leak detector. Possible causes may be fuel filler cap leaking, tank ventilation line leaking (fuel tank-activated carbon canister-tank ventilation valve), tank ventilation valve leaking (engine compartment), tank sensor on fuel tank leaking or activated carbon canister non return valve leaking (spare wheel recess).



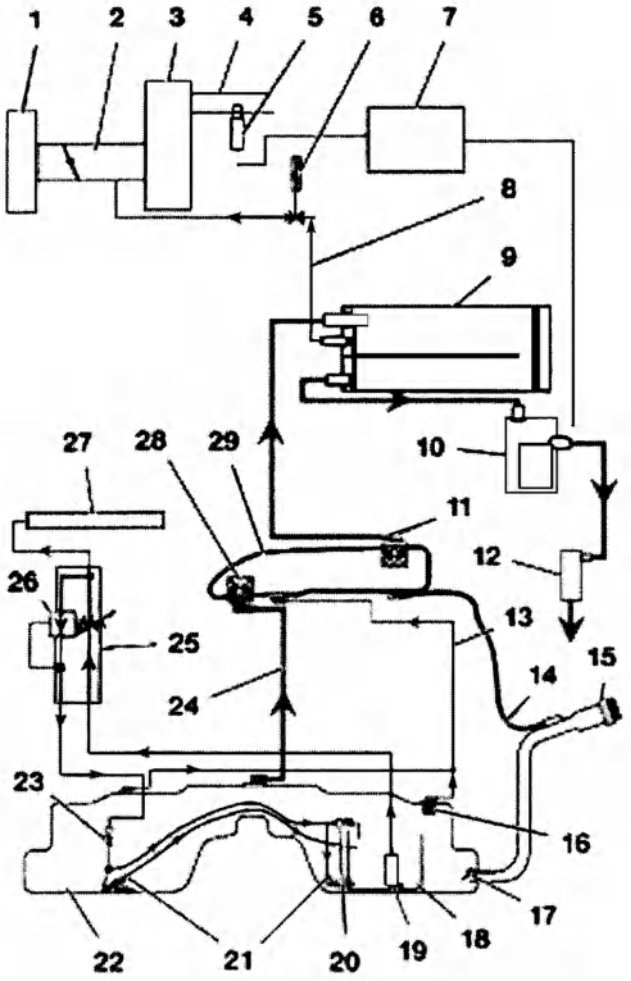
1. Hose Clamp
2. Air Cleaner

G00131603

Fig. 65: Removing Leak Diagnosis Pump Air Cleaner
Courtesy of BMW OF NORTH AMERICA, INC.

Checking Fuel Tank & Tank Venting System For Leaks With Tank Leakage Diagnosis Module (DM-TL) - 7-Series (E65/66)

1. An OBD fault is indicated by CHECK ENGINE light in instrument cluster. This may indicate a leak in the tank venting system. Information on this is provided by the fault memory of the DME control unit. Read out fault memory of DME control unit and carry out diagnosis in accordance with faults stored. See Fig. 66 and Fig. 67 . A leak test with the DM-TL module is then carried out if:
   - The components of the DM-TL module are okay.
   - A error is stored in the DME fault memory (tank leak detected).

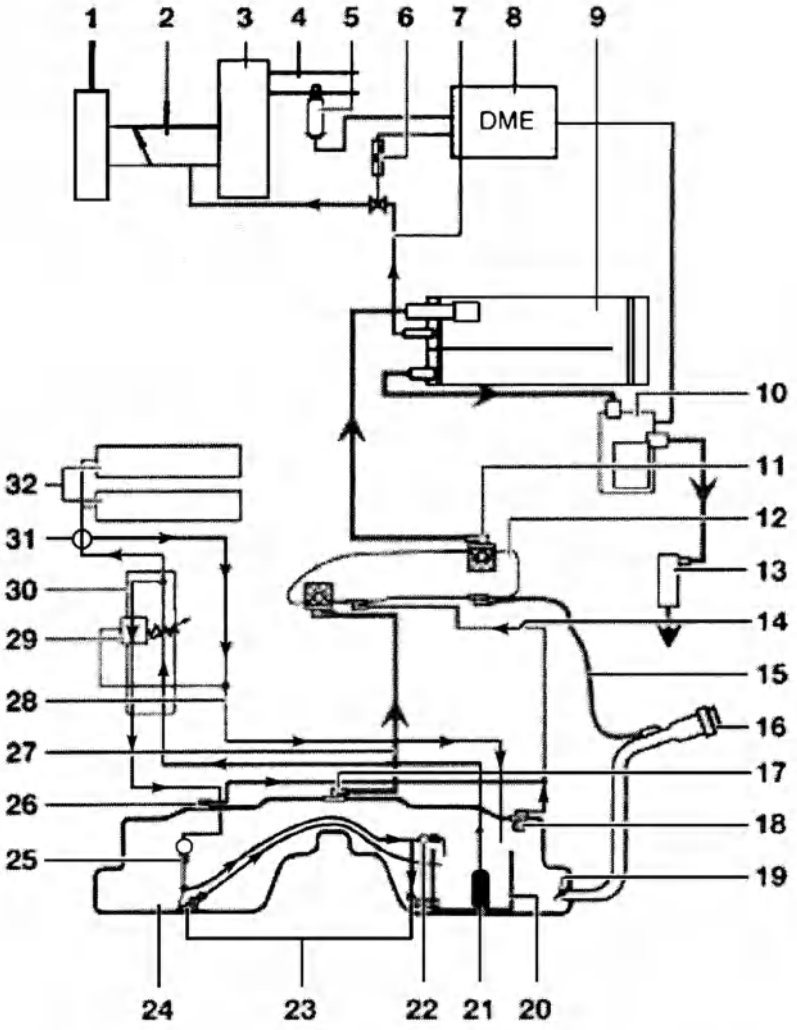


Fuel System

1. Air cleaner
2. Intake manifold
3. Engine
4. Exhaust system
5. Oxygen sensor
6. Evaporative emission valve (TEV)
7. ECM
8. Purge vapors
9. Carbon Canister
10. Fuel tank leak diagnostic module (DM TL)
11. Roll-over valve
12. Dust filter
13. Service Ventilation
14. Pressure test lead
15. Fuel tank cap
16. Service vent valve (float valve)
17. Anti-spitback flap
18. Surge chamber (fuel pump baffling)
19. Electric fuel pump (EKP)
20. Pressure relief valve
21. Suction jet pumps
22. Fuel Tank
23. Outlet protection valve
24. Refueling breather
25. Fuel filter
26. Fuel pressure regulator (3.5 bar)
27. Injection rail
28. Float valve
29. Liquid/vapor expansion tank
30. Filler vent valve

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Fig. 66: Identifying Fuel System Components (7-Series V8)
Courtesy of BMW OF NORTH AMERICA, INC.



1. Air cleaner
2. Intake manifold
3. Engine
4. Exhaust system
5. Oxygen sensor
6. Evaporative emission valve (TEV)
7. Purge vapors
8. MED 9.2.1 ECM
9. Carbon Canister
10. Fuel tank leak diagnostic module (DM TL)
11. Roll-over valve
12. Liquid/vapor expansion tank
13. Dust filter
14. Service ventilation
15. Pressure test lead
16. Fuel tank filler cap
17. Filler vent valve
18. Service vent valve (float valve)
19. Anti-spitback flap
20. Surge chamber (fuel pump baffling)
21. Electric fuel pump (EKP)
22. Pressure relief valve
23. Suction jet pumps
24. Fuel Tank
25. Outlet protection valve
26. Service vent valve (float valve)
27. Refueling breather
28. Leakage line
29. Fuel pressure regulator (6 bar)
30. Fuel filter
31. High pressure fuel pump (HDP)
32. Fuel rails

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Fig. 67: Identifying Fuel System Components (7-Series V12)
Courtesy of BMW OF NORTH AMERICA, INC.

2. To carry out a correct leak test, ensure content of fuel tank is less than 90 percent and reserve indicator lamp is off. Leave car in workshop for at least 2 hours so that fuel temperature comes into line with workshop temperature. Ideal fuel temperature is approximately 50-68Â°F (10-20Â°C). Do not under any circumstances fill up car with fresh fuel as there is a strong exhalation of fresh fuel. Check that tank cap is correctly seated.

WARNING: During leak test, under no circumstance apply external pressurization through the tank filler neck as this may cause an incorrect reading.

3. Clear DME fault memory. In Diagnosis and Information System (DIS), go to FUNCTION AND COMPONENT SELECTION page. Carry out tank leakage diagnostic module. If a fault is stored again in DME fault memory (tank leak detected), carry out leak testing. Go to CONDUCTING LEAK TEST ON FUEL TANK & TANK VENTILATION SYSTEM.

Conducting Leak Test On Fuel Tank & Tank Ventilation System

1. For vehicles without tank leak diagnosis module, go to next step. For vehicles with tank leak diagnosis module, on Diagnosis and Information System (DIS), select CONTROL UNIT FUNCTIONS for DME MOTOR ELECTRONICS ME9 control unit. Select COMPONENT ACTIVATION from FUNCTIONS column. From SUBFRAMES column, select TANK LEAK DIAGNOSIS MODULE: ACTIVATE PUMP function. Press ACTIVATE button. Tank leak diagnosis pump pressurizes the fuel tank and tank venting system for 30 seconds. If pressure is required for longer than 30 seconds, you must press the ACTIVATE button again after 30 seconds. Go to step 3.
2. For vehicles without tank leak diagnosis module, pressurize through filler neck. When leak testing with a leak detector, follow manufacturer's operating instructions. Observe country-specific accident prevention and occupational safety regulations. Go to next step.
3. Possible causes of tank leakage may be tank cap leaking (check tank cap pressure relief valve), tank venting lines leaking (fuel tank, carbon canister or tank venting valve), tank venting valve leaking (engine compartment), or fuel level sensor flange on tank leaking.

Article GUID: A00151726

2002-03 ENGINE PERFORMANCE

Trouble Shooting - No Codes

INTRODUCTION

Before diagnosing symptoms or intermittent faults, follow proper workflow. See TESTING PROCEDURE under SELF-DIAGNOSTICS - EXCEPT 7-SERIES or SELF-DIAGNOSTICS - 7 SERIES article. If no Diagnostic Trouble Codes (DTCs) are present and a no start condition exists, proceed to BASIC DIAGNOSTIC PROCEDURES article. If no DTCs are present and a driveability condition exists, diagnosis by symptom (i.e., ROUGH IDLE, ENGINE STALLS, etc.).

NOTE: Some driveability problems may have been corrected by manufacturer with a revised computer calibration chip or computer control unit. Check with manufacturer for latest chip or computer application.

Use intermittent test procedures to locate driveability problems that do not occur when the vehicle is being tested. These test procedures should also be used if a soft (intermittent) trouble code was present, but no problem was found during self-diagnostic testing.

Always personally verify customer complaint. Always verify that complaint is truly a system malfunction. Perform a quick test to determine if the vehicle systems have logged fault codes. Call up the faulted system or appropriate test schedule to verify the correct control module is installed in the car. Follow Diagnostic Information System (DIS or MoDiC) on screen instructions and perform all tests as specified. Use DIS/MoDiC and fault symptom diagnostic procedures as necessary. Follow appropriate test module procedures for systems that malfunction but fail to set faults in memory.

NOTE: For specific testing procedures, see SYSTEM & COMPONENT TESTING article. For specifications, see ON-VEHICLE ADJUSTMENTS or SERVICE & ADJUSTMENT SPECIFICATIONS article.

SYMPTOMS

SYMPTOM DIAGNOSIS

CAUTION: When battery is disconnected, vehicle computer may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting the battery.

Symptom checks cannot be used properly unless the problem occurs while the vehicle is being tested. To reduce diagnostic time, ensure steps in BASIC DIAGNOSTIC PROCEDURES , SELF-DIAGNOSTICS - EXCEPT 7-SERIES or SELF DIAGNOSTICS - 7-SERIES articles were performed before diagnosing a symptom. Following symptoms are available for diagnosis:

- Engine Does Not Start (Will Not Crank)
- Engine Cranks, But Fails To Start
- Engine Backfires
- Loss Of Power
- Detonation (Engine Knock)
- Stalls At Idle
- Engine Runs Rough (Off Idle)
- Rough Or Unstable Idle
- Engine Misfires All Conditions

- Poor Fuel Economy
- Excessive Emissions

ENGINE DOES NOT START (WILL NOT CRANK)

- Loose or corroded battery terminals.
- Ensure battery is fully charged.
- Starter motor inoperative.

ENGINE CRANKS, BUT FAILS TO START

- Starter motor rotating too slowly.
- Ignition system malfunction.
- DME/Motronic control unit malfunction.
- Insufficient fuel pressure.

ENGINE BACKFIRES

- Air leak into/from exhaust system.
- Intake manifold vacuum leak.
- Burned valve.
- Lean air/fuel mixture.
- Incorrect ignition timing.
- Incorrect valve timing.

LOSS OF POWER

- Insufficient fuel pressure.
- Restricted fuel filter.
- Restricted air filter.
- Ensure engine compression is okay.
- Ignition system malfunction.
- Burned or sticking valves.
- Restricted exhaust system.
- DME/Motronic control unit malfunction.
- Incorrect valve timing.

DETONATION (ENGINE KNOCK)

- Ignition timing too far advanced.
- Blown head gasket.
- Stuck thermostat (engine overheating).
- Lean fuel mixture.
- DME/Motronic control unit malfunction.
- No coolant in radiator/engine (engine overheating).
- Wrong octane fuel.

STALLS AT IDLE

- Insufficient fuel pressure.
- DME/Motronic control unit malfunction.

- Incorrect ignition timing.
- Blocked or restricted exhaust system.

ENGINE RUNS ROUGH (OFF IDLE)

- Fouled spark plugs.
- Burned or sticking valve.
- Ignition system malfunction.
- Intake manifold air leak.
- Fuel injector not operating.
- DME/Motronic control unit malfunction.
- Blown head gasket.

ROUGH OR UNSTABLE IDLE

- Fouled spark plugs.
- Burned or sticking valves.
- Intake manifold air leak.
- Incorrect valve timing.
- Ignition system malfunction.
- Fuel injector not operating.
- DME/Motronic control unit malfunction.
- Blown head gasket.

ENGINE MISFIRES - ALL CONDITIONS

NOTE: See Fig. 1 -Fig. 5 .

- Fouled spark plugs.
- Burned or sticking valves.
- Ignition system malfunction.
- Fuel injector not operating.
- DME/Motronic control unit malfunction.
- Blown head gasket.

OBD II - Misfire Faults

FAILED COMPONENT	POSSIBLE FAULT	MISFIRE EFFECT/LOCATION
Spark plug	electrode gap too small	affected cylinders
	electrodes missing	affected cylinders
	electrodes oil/fuel soaked	affected cylinders
	electrodes oil/feul soaked fouled	
	spark plug ceramic broken	affected cylinders
	oil level too high	most likely more than one cylinder affected
	oil foaming	
	oil level too high, oil/fuel fouled	
	heat range too cold	
	crank case ventilation defective	most likely more than one cylinder affected
Spark plug connector	wet, water or moisture	most likely more than one cylinder affected
	broken	affected cylindars
Ignition Coil	internal defect, arcing	affected cylinders
Connectors ignition	corrosion	one or more cylinders
	pin backed out	one or more cylinders
	plug loose	one or more cylinders
	loose wire from connector	one or more cylinders
Injection Valve	metal filing	on the affected cylinders
	leaking	on the affected cylinders
	carbon fouled	one or more cylinders
	dirty/contaminated	one or more cylinders
Injector connectors	corrosion	one or more cylinders
	pin backed out	one or more cylinders
	plug loose	one or more cylinders
	loose wire from connector	one or more cylinders
Intake manifold leaks	intake plenum, unmetere air leak (i.e. injector seals)	
Intake/Exhaust valve	carbon built up (intake)	most likely more than one cylinder affected
	burnt or damaged	on the affected cylinders
	overrev:intake or exhaust valves leaking (bent)	most likely more than one cylinder affected

FAILED COMPONENT	POSSIBLE FAULT	MISFIRE EFFECT/LOCATION
Camshaft	broken	most likely more than one cylinder affected
Piston	hole in piston crown/piston seized in bore	on the affected cylinders
Hydraulic lash adjusters (HVA)	defective: i.e. oil bore restricted/blocked	on the affected cylinders
	engine oil pressure built up too slow	
Fuel pressure	fuel pump, pressure too low	most likely cyl. 1-3 (front cylinders)
	fuel filter restricted/ blocked	most likely cyl. 1-3 (front cylinders)
	fuel pump, pressure build up too slow after start	most likely cyl. 1-3 (front cylinders)
	leaking fuel feed lines	most likely cyl. 1-3 (front cylinders)
	pressure regulator defective (metal filing)	most likely cyl. 1-3 (front cylinders)
	running loss valve defective	most likely cyl. 1-3 (front cylinders)
	fuel tank empty	most likely cyl. 1-3 (front cylinders)
	siphon jet pump and fuel tank empty	most likely cyl. 1-3 (front cylinders)
	water in fuel tank	most likely more than one cylinder affected
Fuel	high content oxygenated	one or more cylinders
	non anti carbon additives	one or more cylinders
Oxygen sensor	excessive mixture deviation	only the affected bank
Purge sytem	excessive rich mixture due to high ambient temperature	one or more banks
	blocked fuel tank vent inlet	all cylinders
Crank sensor/increment wheel	incorrect input signal for misfire detection	all cylinders
	increment wheel loose	all cylinders
	increment wheel damaged	affected segment
	gap between sensor and increment wheel	affected segment
	fly wheel damaged	
Catalyst damaged	exhaust back pressure on the affected bank	only the affected bank
DME	final stage ignition/injectors	all cylinder

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Fig. 1: Identifying OBD-II Misfire Faults
Courtesy of BMW OF NORTH AMERICA, INC.

Engine Misfire Diagnosis

Engine Misfire is the result of inefficient combustion in one or more cylinders. The causes of Engine Misfire are extensive but can be grouped into the following sub-systems. Consider the charts below as an additional diagnostic aid once the DISplus/MoDIC is connected, the correct fault symptom has been chosen and the fault memory has been interrogated. Follow the Test Module as displayed by the DISplus/MoDIC.

IGNITION SYSTEM

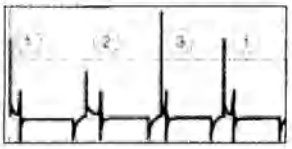
COMPONENT	POSSIBLE CONDITION	TEST	CORRECTION
Spark Plug:	• Incorrect spark plug installed • Electrode gap closed or too small • Electrode(s) missing • Oil or fuel fouled spark plug • Ceramic insulation cracked	Secondary Ignition DISplus Preset Measurement	• Verify correct spark plug • Replace if necessary • Swap with another cylinder
Secondary circuit: (wiring, M73-cap, rotor)	• Wet or moist due to water infiltration. • High resistance due to corrosion.		• Check water ingress, repair, replace • Check resistance value, replace
Ignition Coil(s):	• Secondary/Primary Circuits open or shorted. • Housing cracked, damaged.	Secondary and Primary	• Inspect and replace if necessary • Swap with another cylinder
Ignition Coil & Engine Harness Connectors	• Power supply, Primary control and ground (shunt signal) circuits impaired.	Primary Ignition & Term 4A feedback Preset Measurements	• Look for open, loose connector, corrosion, crossed or backed out pins (also consider ignition unloader or ECM relay on MY97 and newer cars). • Determine defective condition, repair or replace.

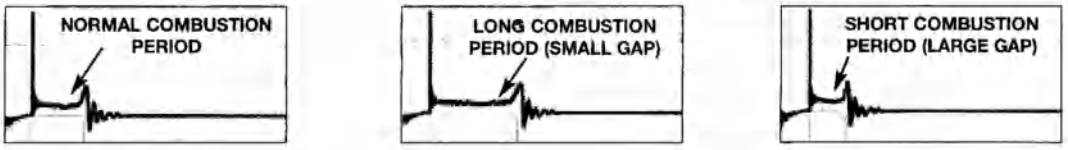
- A secondary ignition oscilloscope display provides vital information about the ignition system's condition.
- Use the following scope patterns as a guideline for ignition system diagnosis. Use the preset measurement function of DISplus.



Evaluation of secondary signal amplitude at idle speed.

1. Normal Ignition Voltage Peak: ***Spark Plug is OK***
2. Low Ignition Voltage Peak: ***Gap too small (defective)***
3. High Ignition voltage peak: ***Gap too large (defective)***





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Fig. 2: Diagnosing Engine Misfire (1 Of 4)
Courtesy of BMW OF NORTH AMERICA, INC.

IMPLAUSIBLE ECM CONTROL FUNCTION OR SENSOR INPUT SIGNALS

COMPONENT	POSSIBLE CONDITION	TEST	CORRECTION
Crankshaft Position Sensor or Increment Wheel:	• Implausible signal for misfire detection. • Increment wheel loose or damaged (internal on M44, M52 and M54, external on M62 & M73). • Air gap between sensor and wheel. • Noticeable at higher rpm.	• DISplus preset measurement.	• Determine defective sensor or increment wheel and replace.
Catalyst Damaged:	• Excessive exhaust back pressure (bank specific fault present, more noticeable under heavy load and high rpm).	• DISplus preset measurement of oxygen sensor. • Back pressure test.	• Determine catalyst condition, replace or repair as necessary.
Oxygen Sensor:	• Excessive mixture deviation, **possible vacuum leaks.**	• Monitor oxygen sensor signal via DIS preset.	• Swap sensor from other bank (if applicable) and see if fault transfers to other bank.
Engine Control Module	• Internal control module fault. • Misfire Reprogramming.	• Check fault memory.	• Highly unlikely but must be considered. • Check Model/Prod range - reprogram

When diagnosing a Misfire fault code, Remember:

"Misfire" is caused by a defect in the internal combustion engine or a defect in the control of the engine operation.

"Misfire" is the result of improper combustion (variation between cylinders) as measured at the crankshaft due to:

- Engine mechanical defects; breakage, wear, leakage or improper tolerances.
- Excessive mixture deviation; air (vacuum leaks), fuel and all the components that deliver air/fuel into the combustion chambers.
- Faulty ignition; primary, secondary including spark plugs.
- Faulty exhaust flow; affecting back pressure.
- Tolerance parameters; ECM programming.

A Misfire fault code(s) is the "symptom" of a faulty input for proper combustion.

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Fig. 3: Diagnosing Engine Misfire (2 Of 4)
Courtesy of BMW OF NORTH AMERICA, INC.

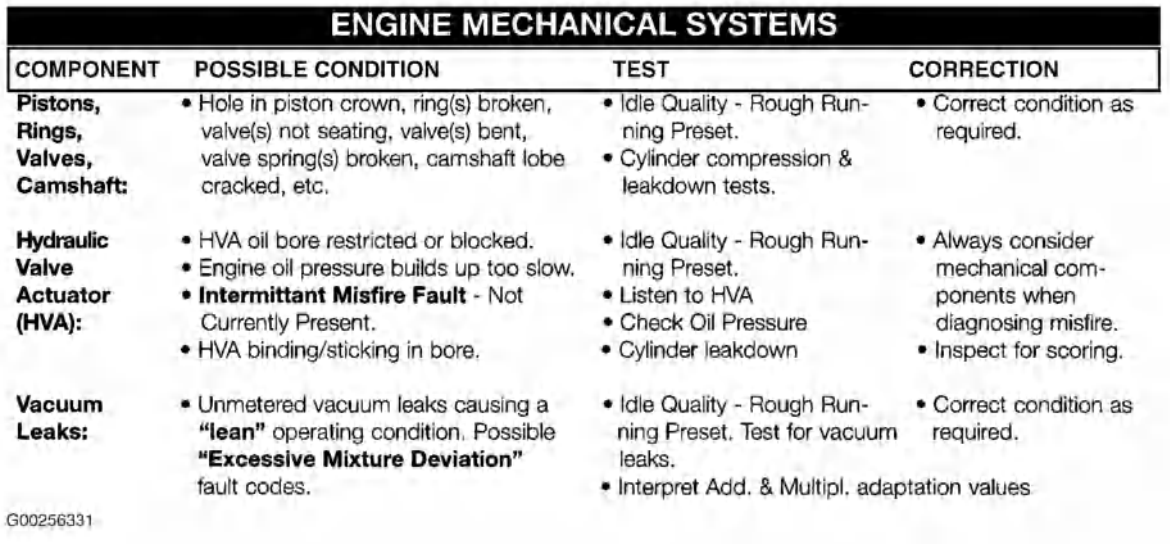


FUEL QUALITY, DELIVERY, INJECTION & EVAPORATIVE SYSTEMS

COMPONENT	POSSIBLE CONDITION	TEST	CORRECTION
Fuel (quality):	• Contaminated fuel. (water, other non combustible).		• Clean fuel system, replace fuel.
Fuel Delivery:	• Fuel pump delivery pressure low, restriction in fuel line to fuel rail or running loss valve. • Fuel filter restricted (clogged). • Low fuel in tank.	• Check fuel pressure & volume. • Check fuel pump power and ground	• Determine restriction/flow reduction, replace component as necessary. • Interpret Additive and Multiplicative adaptation values.
Running Loss Valve:	• Valve stuck in "small circuit" position.	• Check valve	• Display "diagnosis requests" in DISplus and test valve for proper function, replace valve as necessary.
Fuel Injectors:	• Leaking fuel injector pintle seats cause rich engine starts with hot ambient temperatures. • Blocked (dirty) injector(s).	• Ti Preset & status page. • Sec Ign scope pattern.	• Check injectors for leakiage. • Swap suspect injector with another cylinder. • Inspect injector, replace if necessary.
Fuel Pressure Regulator:	• Regulator defective, causes fluctuation in the injected quantity of fuel causing mixture adaptation faults.	• Fuel pressure	• Check nominal fuel pressure value with engine operating under varied speeds.
Evaporative System:	• Defective evaporative system vent causing fuel tank collapse and fuel starvation.	• DISplus status, Evap test with pressure tool, purge valve func. test.	• Check the fuel tank condition and vent line. • Check Fresh Air Valve on TLEV E36 vehicles or LDP/DM TL and filter on ORVR vehicles for proper system "breathing".

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Fig. 4: Diagnosing Engine Misfire (3 Of 4)
Courtesy of BMW OF NORTH AMERICA, INC.



ENGINE MECHANICAL SYSTEMS

COMPONENT	POSSIBLE CONDITION	TEST	CORRECTION
Pistons, Rings, Valves, Camshaft:	• Hole in piston crown, ring(s) broken, valve(s) not seating, valve(s) bent, valve spring(s) broken, camshaft lobe cracked, etc.	• Idle Quality - Rough Running Preset. • Cylinder compression & leakdown tests.	• Correct condition as required.
Hydraulic Valve Actuator (HVA):	• HVA oil bore restricted or blocked. • Engine oil pressure builds up too slow. • **Intermittant Misfire Fault** - Not Currently Present. • HVA binding/sticking in bore.	• Idle Quality - Rough Running Preset. • Listen to HVA • Check Oil Pressure • Cylinder leakdown	• Always consider mechanical components when diagnosing misfire. • Inspect for scoring.
Vacuum Leaks:	• Unmetered vacuum leaks causing a **"lean"** operating condition. Possible **"Excessive Mixture Deviation"** fault codes.	• Idle Quality - Rough Running Preset. Test for vacuum leaks. • Interpret Add. & Multipl. adaptation values	• Correct condition as required.

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Fig. 5: Diagnosing Engine Misfire (4 Of 4)
Courtesy of BMW OF NORTH AMERICA, INC.

POOR FUEL ECONOMY

- Leaking fuel injectors.

- Faulty oxygen sensor.
- DME/Motronic control unit malfunction.

EXCESSIVE EMISSIONS

- Leaking fuel injectors.
- DME/Motronic control unit malfunction.
- Faulty oxygen sensor.
- Faulty mass airflow sensor.
- Faulty temperature sensor.

INTERMITTENTS

PROBLEM DIAGNOSIS

Intermittent fault testing requires duplicating circuit or component failure to identify the problem. These procedures may lead to the computer setting a fault code (on some systems) which may help in diagnosis. If problem vehicle does not produce fault codes, monitor voltage or resistance values using a DVOM while attempting to reproduce conditions causing intermittent fault. A status change on DVOM indicates a fault has been located.

Use a DVOM to pinpoint faults. When monitoring voltage, ensure ignition is in ON position, or engine is running. Ensure ignition is in OFF position or negative battery cable is disconnected when monitoring circuit resistance. Status changes on DVOM during test procedures indicate area of fault.

TEST PROCEDURES

Intermittent Simulation

To reproduce the conditions creating an intermittent fault, use the following methods:

- Lightly vibrate component.
- Heat component.
- Wiggle or bend wiring harness.
- Spray component with water.
- Remove/apply vacuum source.

Monitor circuit/component voltage or resistance while simulating intermittent. If engine is running, monitor for self-diagnostic codes. Use test results to identify a faulty component or circuit.

Article GUID: A00151725

WIRING DIAGRAMS

NOTE: Wiring diagrams for 325i, 325Ci, 330i, 330Ci, 330xi, 530i, 540i, 745i, M3, M5 and X5 are not available from manufacturer.

M COUPE & M ROADSTER

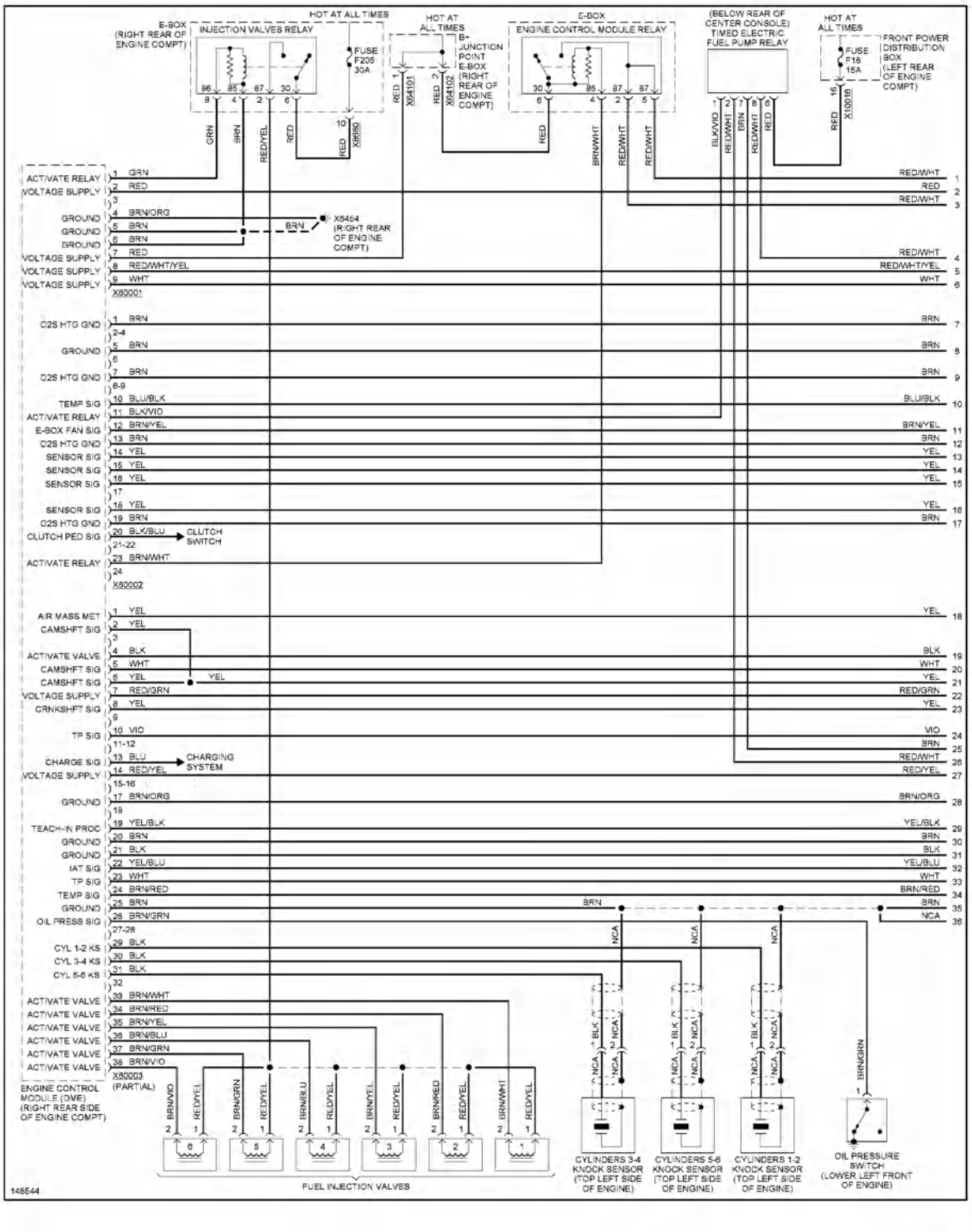


Fig. 1: Wiring Diagram (M Coupe & M Roadster 3.2L - 1 Of 4)

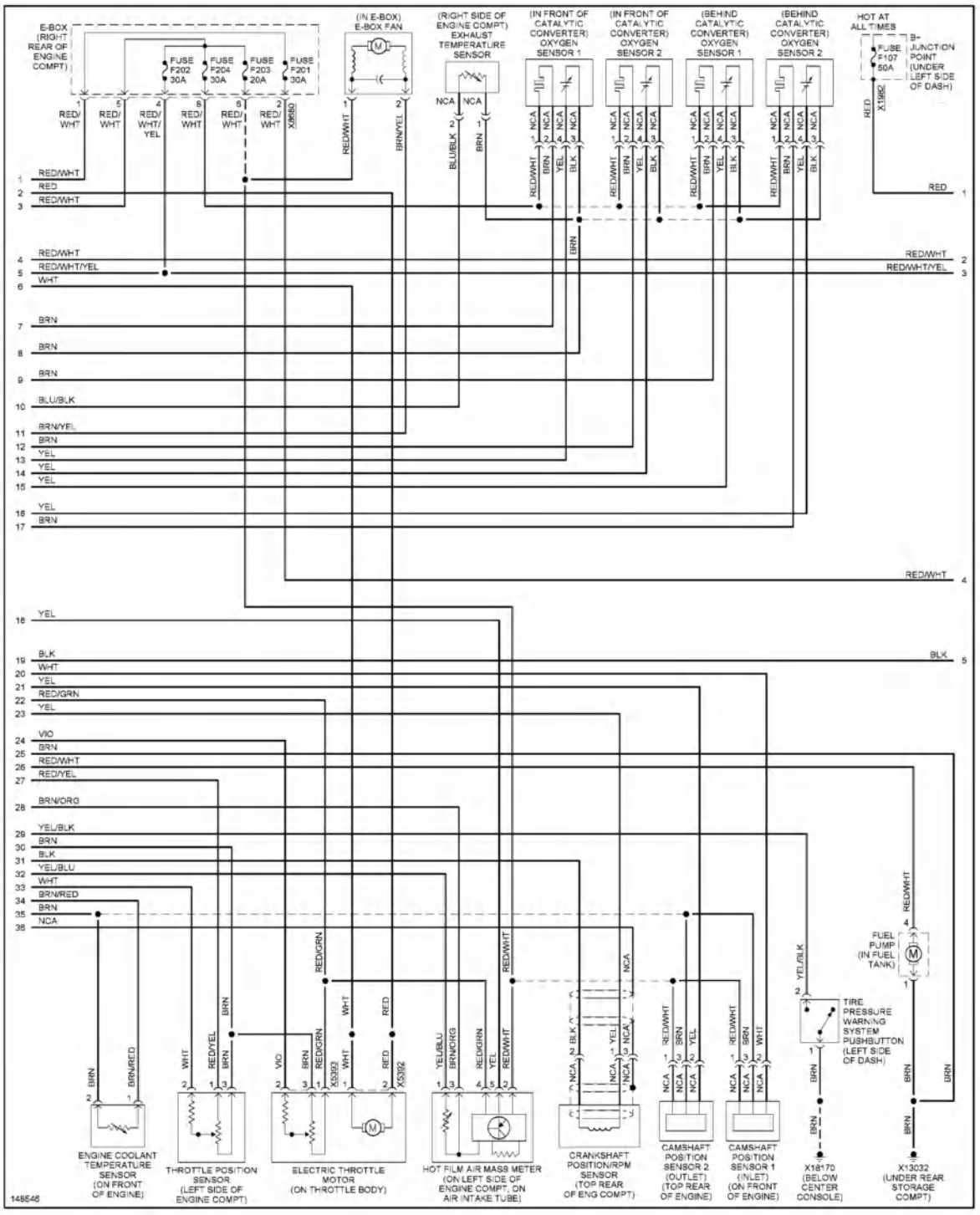


Fig. 2: Wiring Diagram (M Coupe & M Roadster 3.2L - 2 Of 4)

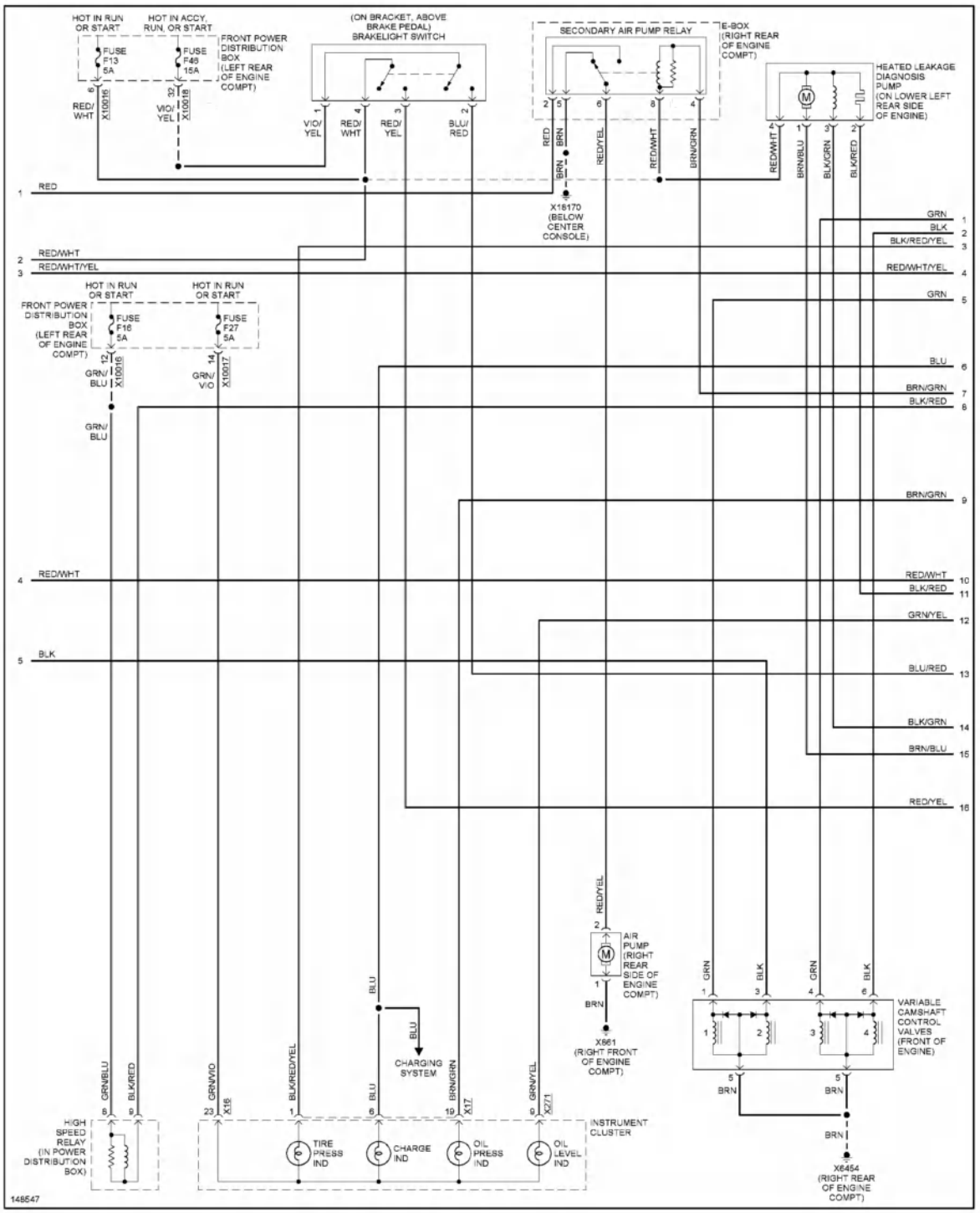


Fig. 3: Wiring Diagram (M Coupe & M Roadster 3.2L - 3 Of 4)

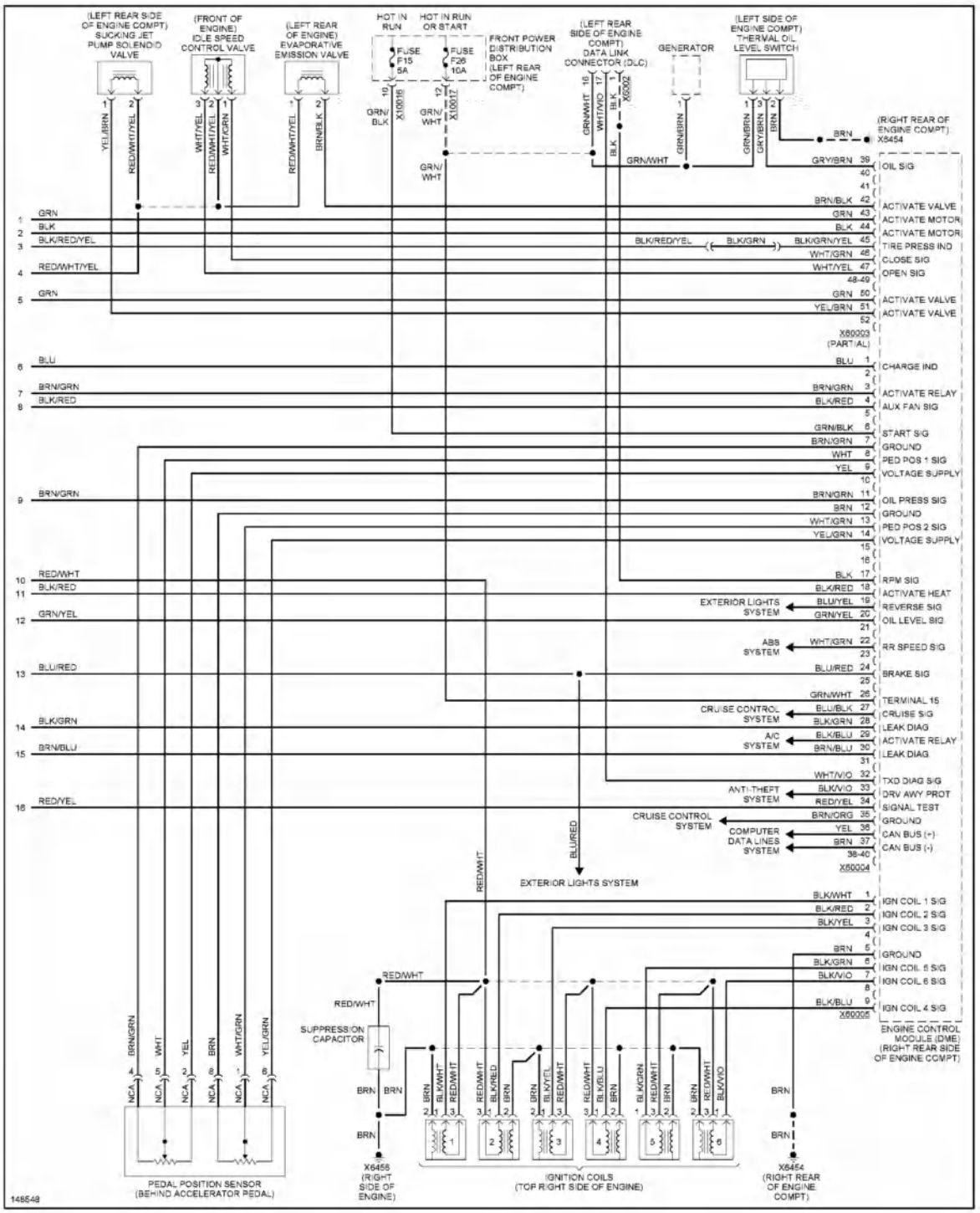


Fig. 4: Wiring Diagram (M Coupe & M Roadster 3.2L - 4 Of 4)

Z3

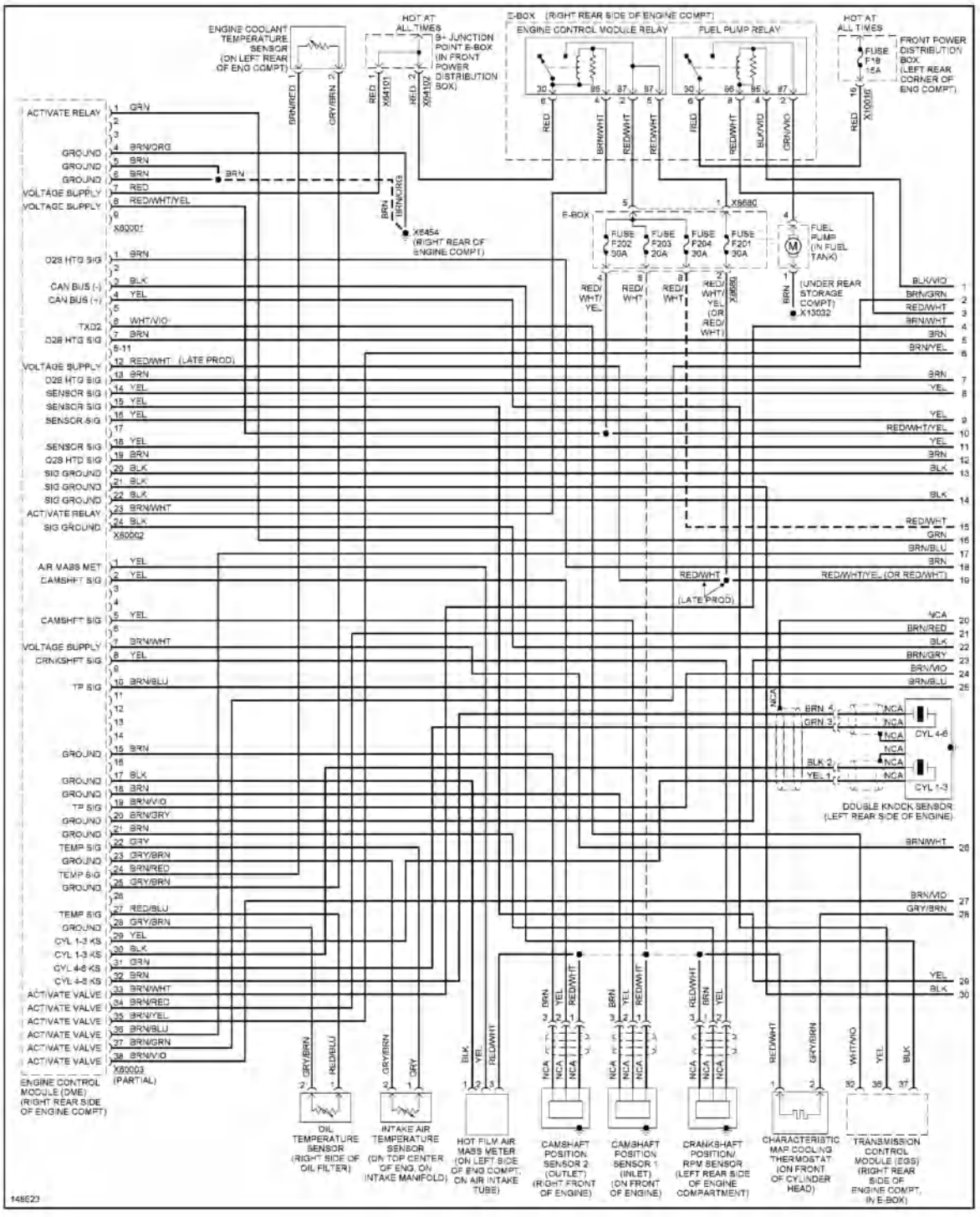


Fig. 5: Wiring Diagram (Z3 2.5L & 3.0L - 1 Of 3)

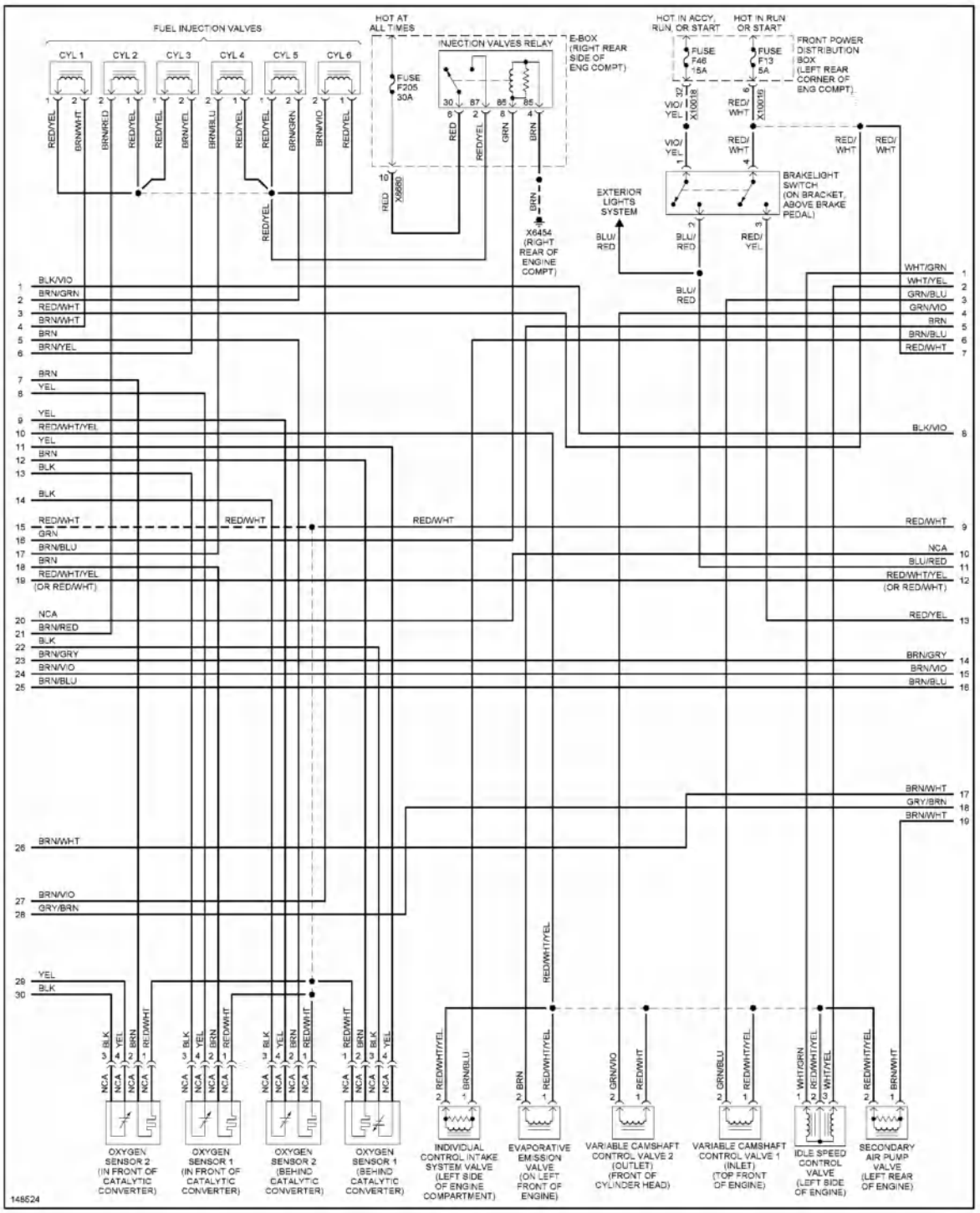


Fig. 6: Wiring Diagram (Z3 2.5L & 3.0L - 2 Of 3)

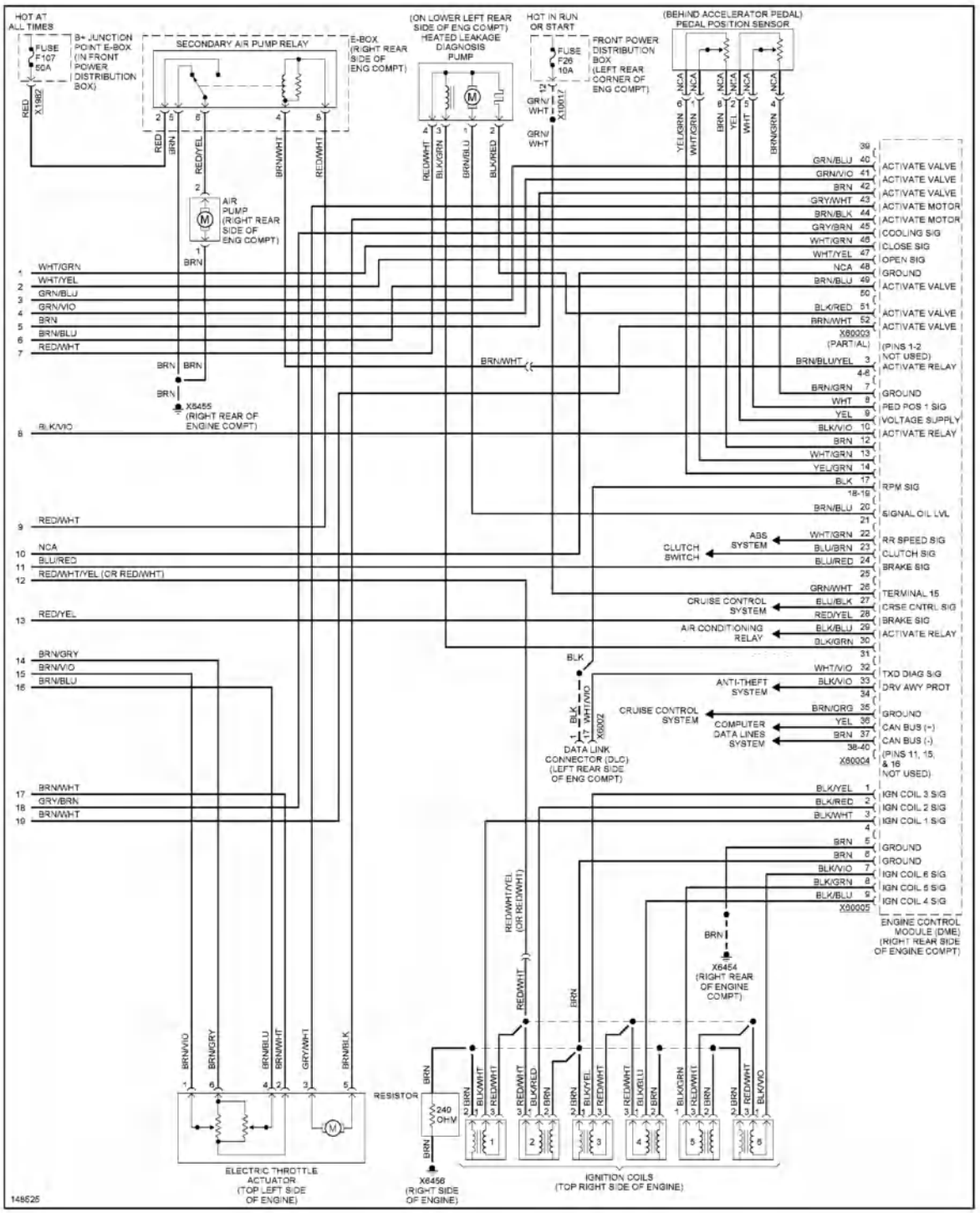


Fig. 7: Wiring Diagram (Z3 2.5L & 3.0L - 3 Of 3)

Article GUID: A00134924

ENGINE DIAGNOSIS

ENGINE DIAGNOSIS

When attempting to diagnose driveability complaints, always consider the basics. Regardless of the level of technology employed on an engine, it still needs a few basic things to occur in order to run properly. Whether the engine is very basic or uses so-called "New Generation" technology always refer to the basic principles first.

Any engine using four-cycle spark-ignition principles must meet the same fundamental conditions to run properly. Most engine related driveability problems fall into a few basic categories:

- No Start/No Crank
- Extending cranking before engine start
- Rough Running Cold Idle
- Rough Running Warm Idle
- Rough Running Under Load
- Lack of Power
- Check Engine Light (MIL)



Fig. 1: Sectional View Of Engine
Courtesy of BMW OF NORTH AMERICA, INC.

When referring to engine basics, all engines need fuel, air and spark to run. However, in order for a spark-ignition engine to run properly, a few things must be taken into consideration. The fuel, air, spark principle can be broken down further into the following categories:

- Sufficient engine compression with a leak-free combustion chamber.
- Sufficient amount of ignition voltage (spark) at the correct time.
- Proper fuel pressure and volume.
- Properly functioning fuel injection system (Engine management).
- Properly functioning air management system (Electronic throttle systems).
- Correct valve timing (VVT and VANOS).

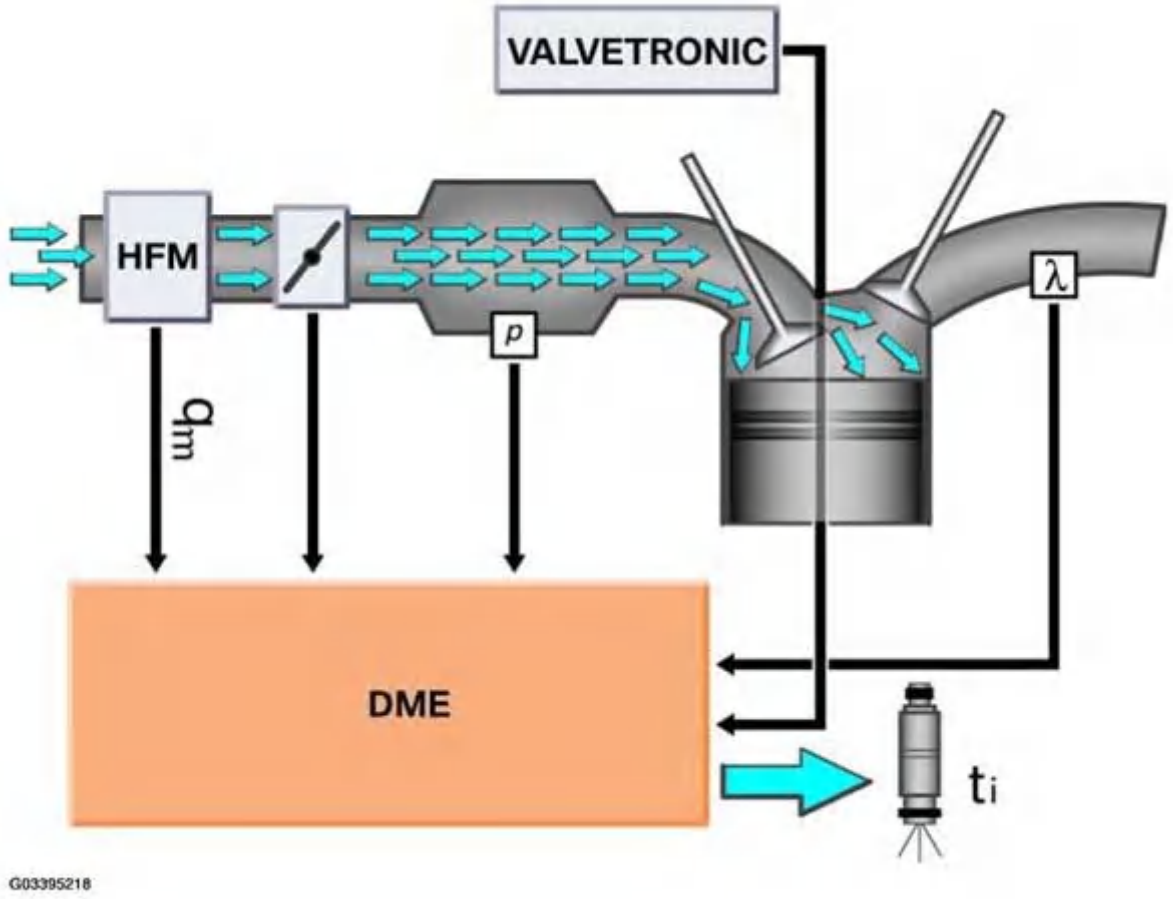


Fig. 2: Operation Of Valvetronic
Courtesy of BMW OF NORTH AMERICA, INC.

Compression Testing

In order for an engine to run smoothly and efficiently, the combustion chamber must be free of leakage. An engine with low compression in one or more cylinders is inefficient and will run rough or lack in performance. Low compression may or may not cause the MIL to illuminate.

Low compression can be caused by the following:

- Leaking valves caused by burned valves or seats. The valve guide can also be worn causing the valve not to seat properly. Valves can also be bent from piston contact (from over-rev).
- Piston Rings which can be worn from high mileage or poor maintenance. Also, the rings can be damaged from foreign material or improper installation.
- Cracks in cylinder head or engine block. Cracks can be caused by overheating resulting in misfires or rough running.
- Defective cylinder head gasket. The cylinder head gasket can fail due to overheating which can cause cylinder leakage resulting in misfire, low compression and rough running.
- Bent connecting rod. A connecting rod can be bent from a defective fuel injector or water ingress into the combustion chamber causing hydrostatic lock.

Compression testing can be performed using a conventional compression gauge. There are some preliminary tasks and safety precautions that must be carried out before starting the compression test:

- Remove the fuel pump fuse and or relay, start the vehicle and allow vehicle to stall out on residual fuel
- Disable ignition by unplugging all ignition coils and remove ALL sparkplugs.
- Connect battery charger to vehicle

- Ensure that the throttle is wide open during cranking
- Crank engine until compression gauge stops increasing. Be sure to crank engine equally between cylinders.
- Continue compression test on ALL cylinders so comparisons can be done. Record readings.
- If necessary, re-check cylinders with suspect readings.
- If some cylinder readings come up low, add a few drops of oil and re-check. This can differentiate between valves/rings.

Cylinder Leakage Testing

Once a problem cylinder is detected via a compression test or by other means, a cylinder leakage test is used to pinpoint the problem area.

The leakage test uses a gauge and compressed air to indicate the percentage of air loss. By listening and observing at key points, the problem can be narrowed down before the engine needs to be disassembled.

The piston (one or more) should be brought to TDC, compressed air should be introduced into the cylinder using the cylinder leakage tester. Be sure the engine does NOT rotate, if the engine rotates, the engine was not at true TDC.

Check the gauge on the tester, it should read in percentage of leakage. Check the engine specification for permissible leakdown. A general rule of thumb is 15 % or less for a good cylinder. However, some engine have a tighter tolerance. Most BMW engines should be at 8 % or less.

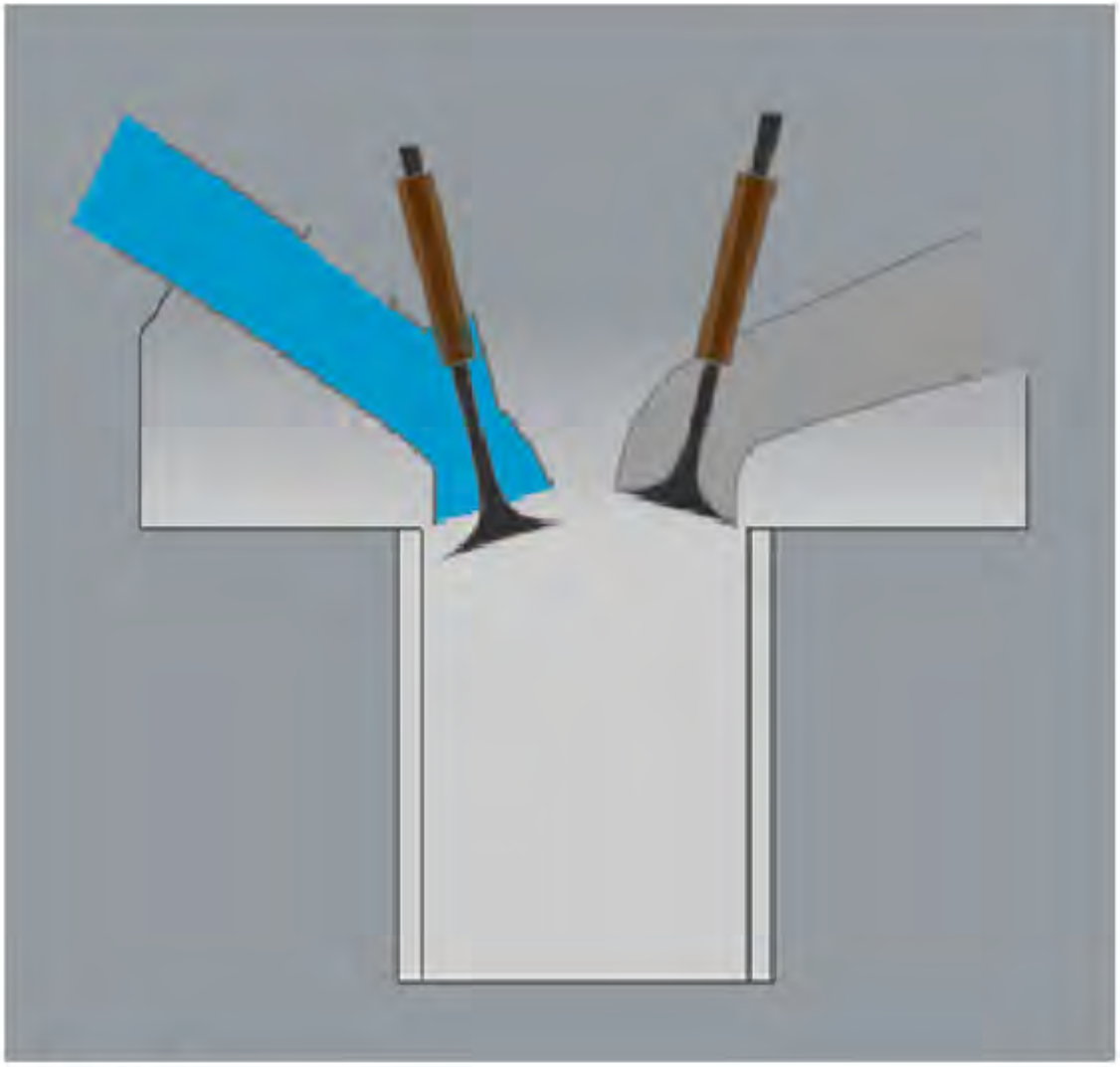


Fig. 3: Testing Cylinder Leakage
Courtesy of BMW OF NORTH AMERICA, INC.

If any cylinder shows excessive leakdown, check for leakage by listening or observing the following points:

- Listen for air (hissing) at the tailpipe. This would indicate leakage at the exhaust valves on that cylinder.
- Listen for air (hissing) at the throttle. This would indicate leakage at the intake valves on that cylinder. (Be sure throttle is wide open and listen at throttle opening)
- Open the oil cap and listen for air. This would indicate air leakage into the crankcase. This would be piston rings or cylinder bore concerns.
- Observe the coolant reservoir and or remove the radiator cap. Bubbles in the coolant would most likely indicate head gasket leakage or cracked block/head.

Workshop Hints on Cylinder Leakage Testing

When performing cylinder leakage tests, the following tips might be helpful:

Remove all spark plugs to allow easier rotation of the engine. (If this test is done after a compression test, the plugs should already be out).

- Perform the leakage test on all cylinders, not just the problem cylinder. This would indicate any other

problems which can be rectified. This eliminates any repeat repairs and wasted diagnostic time.

- Perform the leakage test in cylinder firing order starting with cylinder #1. It takes two revolutions of the engine to complete the leakage test. Start at cylinder #1 and rotate the engine to the next cylinder in the firing order. Divide the number of cylinders into 720, the result is the number of degrees that each cylinder fires. For example, if you divide a 6 cylinder into 720, this equals 120 degrees. If you start at cylinder 1 and rotate the engine 120 degrees in the direction of rotation, you can check the next cylinder in the firing order. This process eliminates the need to rotate the engine an excessive amount.

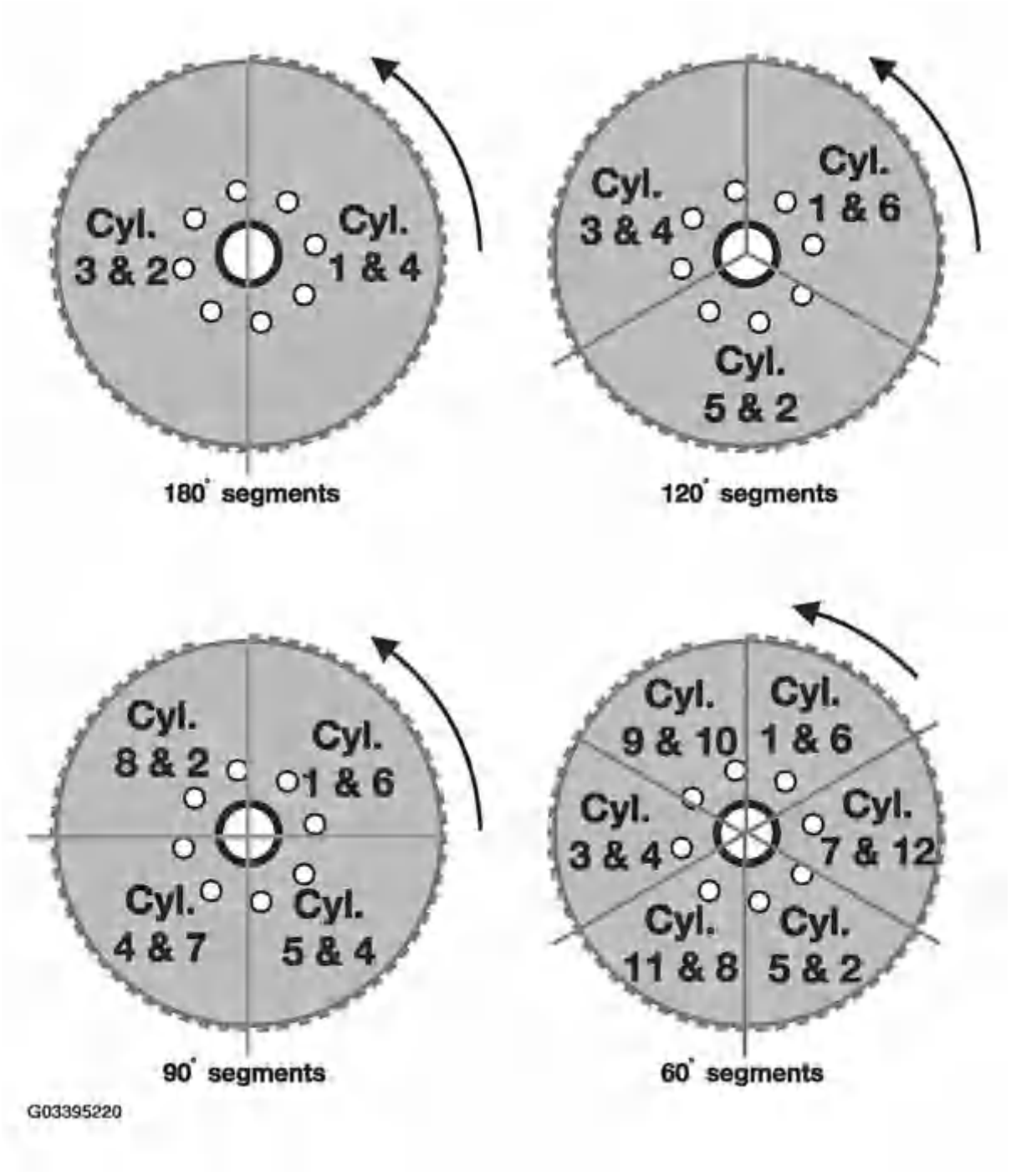


Fig. 4: Cylinder Leakage Testing Tips
Courtesy of BMW OF NORTH AMERICA, INC.

Cylinder Arrangement And Firing Order

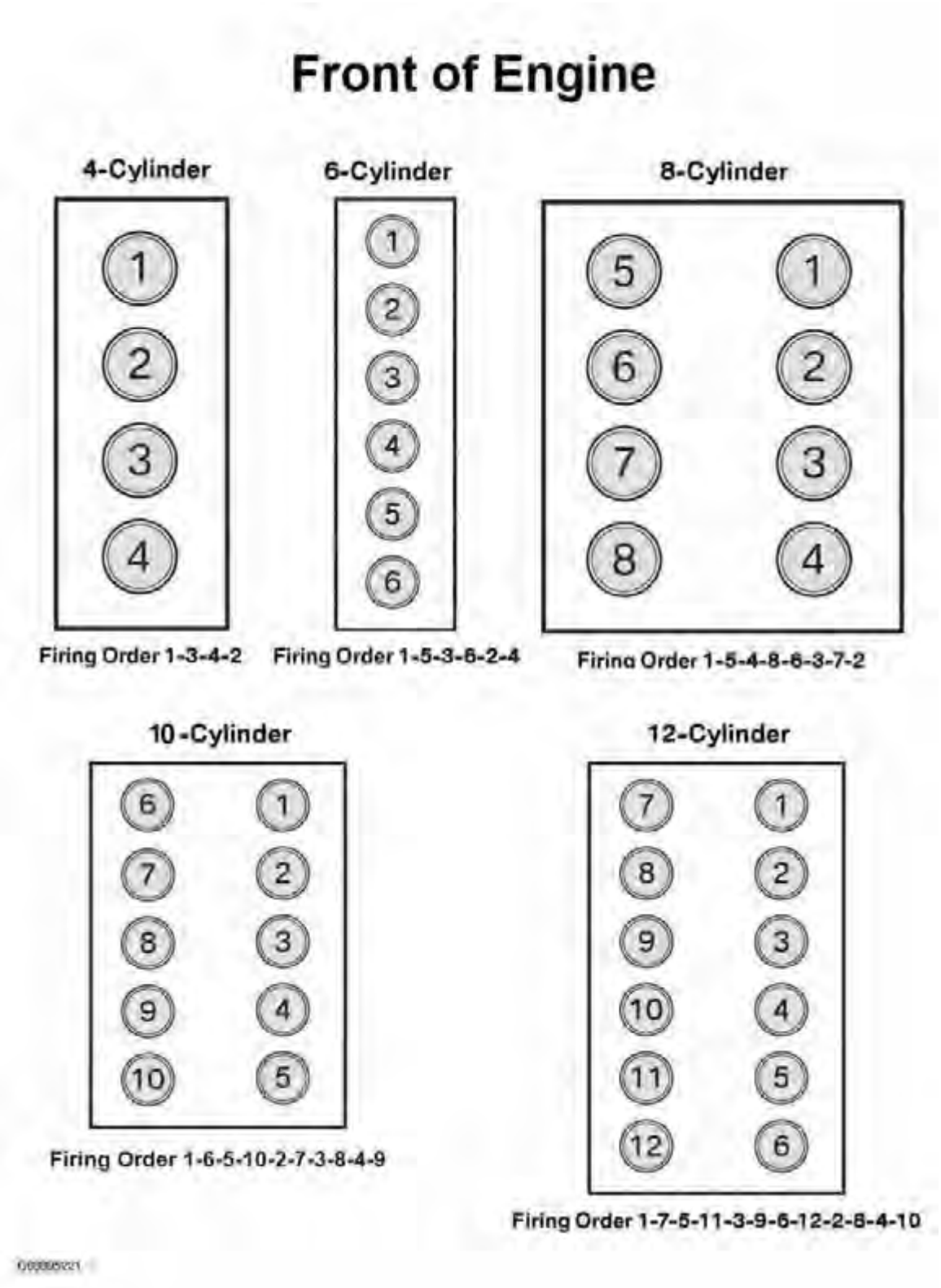


Fig. 5: Identifying Firing Order
Courtesy of BMW OF NORTH AMERICA, INC.

Ignition System Diagnosis

The ignition system on modern BMW engines consist of one ignition coil per cylinder. This arrangement is known as RZV, or Direct Stationary Ignition. The ignition coil receives fused power usually from the DME main relay or IVM (N62).

The ignition coil primary circuit is controlled (triggered) by the engine control module (ECM). The ECM controls dwell and ignition timing on all cylinders individually. Electrical circuit faults on the primary circuit are recorded in the ECM and can be read out using the DISplus or GT-1.

Most new engines use the "pencil" type coil. This design houses the coil windings for the primary and secondary circuit as well as the spark plug boot which includes the secondary circuit resistance.



Fig. 6: Identifying Pencil Coil
Courtesy of BMW OF NORTH AMERICA, INC.

Due to the compact design of the ignition coil, much of the diagnosis is simplified. Misfire faults and/or ignition related faults can be easily diagnosed by swapping the coils between cylinders. If the fault moves with the coil, then it is obvious that the coil is at fault. If the fault stays in the cylinder, then the spark plug can be moved etc.

This greatly simplifies engine diagnosis. However sometimes, the diagnosis is not always as simple as swapping parts.

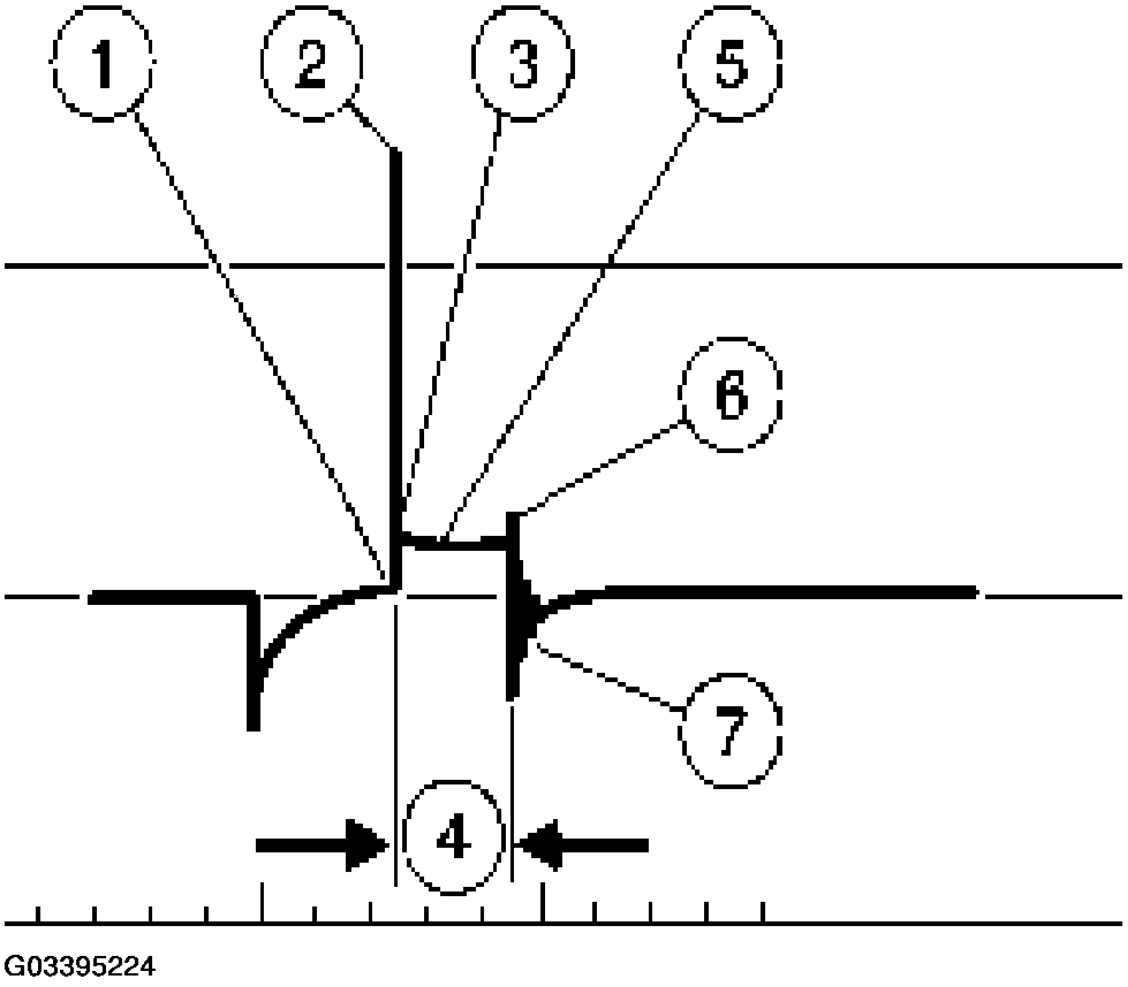


Fig. 7: Ignition Diagnosis Cyclic Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

This is where the oscilloscope function of the DISplus/GT-1 can aid in diagnosis. A good knowledge of fundamental ignition diagnosis can be helpful. The illustration above is broken down as follows.

1. This point represent the start of the ignition process, also known as "transistor off". The ECM turns off the primary circuit causing the magnetic field to collapse. This begins the production of the secondary voltage needed to fire the spark plug.
2. The is called the firing line as it represents the voltage needed to overcome the secondary resistance and cross the spark plug electrode gap. This voltage level will increase as secondary circuit resistance increases. Also lean mixture will cause this line to increase as well. On RZV ignition systems, this line should be around 3-5kV.
3. This line indicates the start of the combustion process. This is also referred to as the spark line. The line should start relatively level and should be about 1/3 to 1/2 of the height of the firing line. Also, there should be no rapid upward or downward slope.
4. This period of time represented here is the combustion period. This area indicates the integrity of the combustion event. Problems such as low compression, lean or rich mixture problem would be indicated here.
5. This line represent the voltage present during the combustion period. This line should be mostly level. Upward or downward sloping can indicate mixture or engine compression problems.
6. This point represents the end of the combustion process. Combustion has ended and the remaining voltage available is the coil will start to dissipate.
7. This is known as the coil or decay oscillation period. Any excess voltage not used in the combustion process will "decay" and dissipate. The number and pattern of the oscillations is dependent on the coil type. Different types of coils and different coil manufacturers will be a factor on this pattern. Anywhere from 2 to 6 oscillations may be seen here. If no oscillations are present, this would indicate ignition coil internal problems.

Most newer engine use a "multiple spark" discharge when the ignition coil is triggered. This is to aid in startup. When diagnosing these ignition systems, the additional peaks do not need to be factored into your diagnosis.

Referring to the illustration below, the relevant portion of the scope pattern is at point 1.

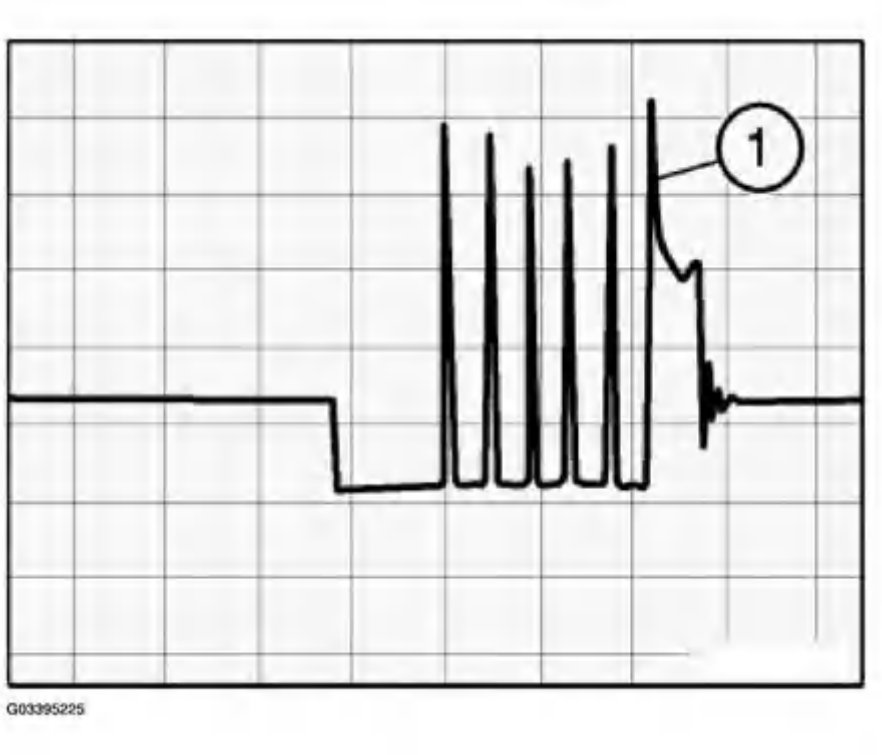


Fig. 8: Identifying Scope Pattern
Courtesy of BMW OF NORTH AMERICA, INC.

Fuel systems need to be checked for proper fuel pressure as well as sufficient volume. When diagnosing fuel system complaints, you must take into account the type of fuel system and how the fuel is delivered to the engine.

Malfunctions in the fuel system can cause driveability complaints which include:

- No start condition
- Hard start/extended cranking time
- Lack of power
- Check Engine (MIL) Light along with mixture related faults
- Excessive exhaust emissions (High CO and/or HC)

When a no start condition is experienced, it is important to start with the basics. Does the vehicle have any fuel in the tank? Don't assume that there is fuel, the fuel gauge or sender circuit may be faulty. Also, the siphon jet system may be defective. Check the fuel level using the instrument cluster test steps if necessary. Check to be sure that there is fuel available on the right side of the fuel tank.

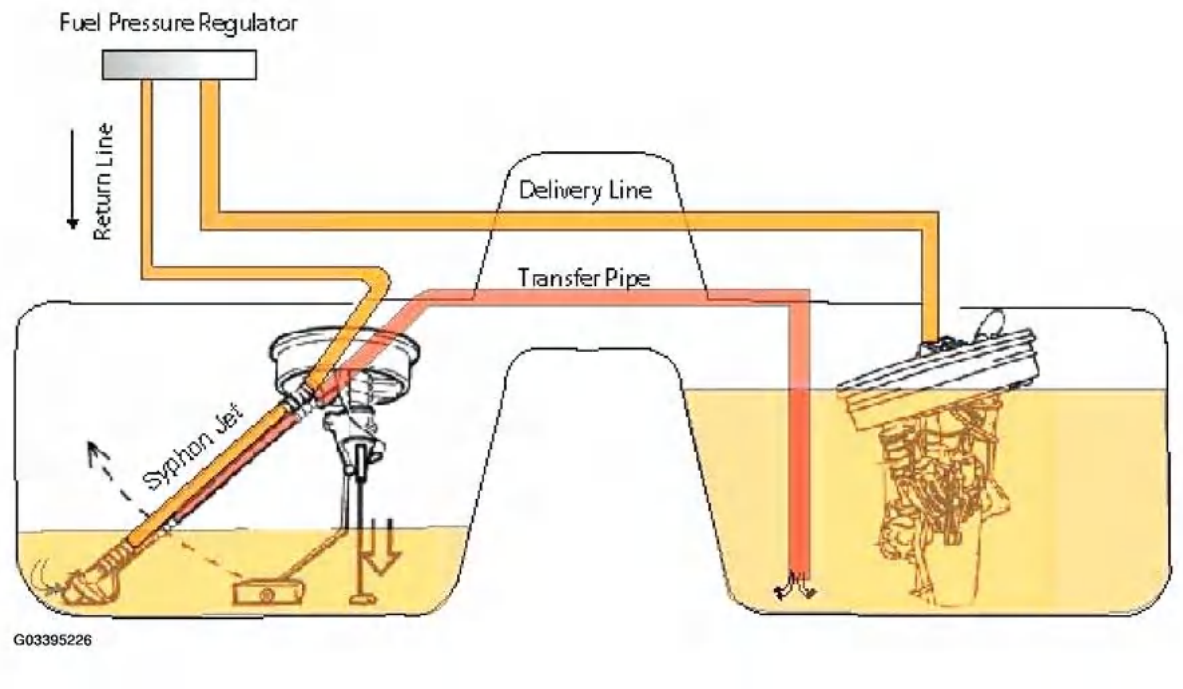


Fig. 9: Checking Fuel System
Courtesy of BMW OF NORTH AMERICA, INC.

Once is has been determined the there is fuel in the tank. The fuel system can be tested for proper pressure. Fuel pressure specifications vary between vehicles. Until recently, most fuel systems used a pressure of 3.5 bar. Some of the new systems use up to 5 or 6 bar. Direct injection systems use 6 bar for the fuel supply system and up to 120 bar pressure to the fuel injectors.

The fuel supply system should be tested using the appropriate fuel pressure gauge. Depending upon the vehicle, the testing methods and connections for the fuel pressure testing equipment differ.

Some vehicles have testing ports with a Schrader valve for easy hookup. Earlier vehicles did not have a test port. Testing fuel pressure required the use of a "T" connector to connect into the fuel system.

Most recently, M56 equipped (SULEV) vehicles have a sealed fuel system which require the use of a special tool.

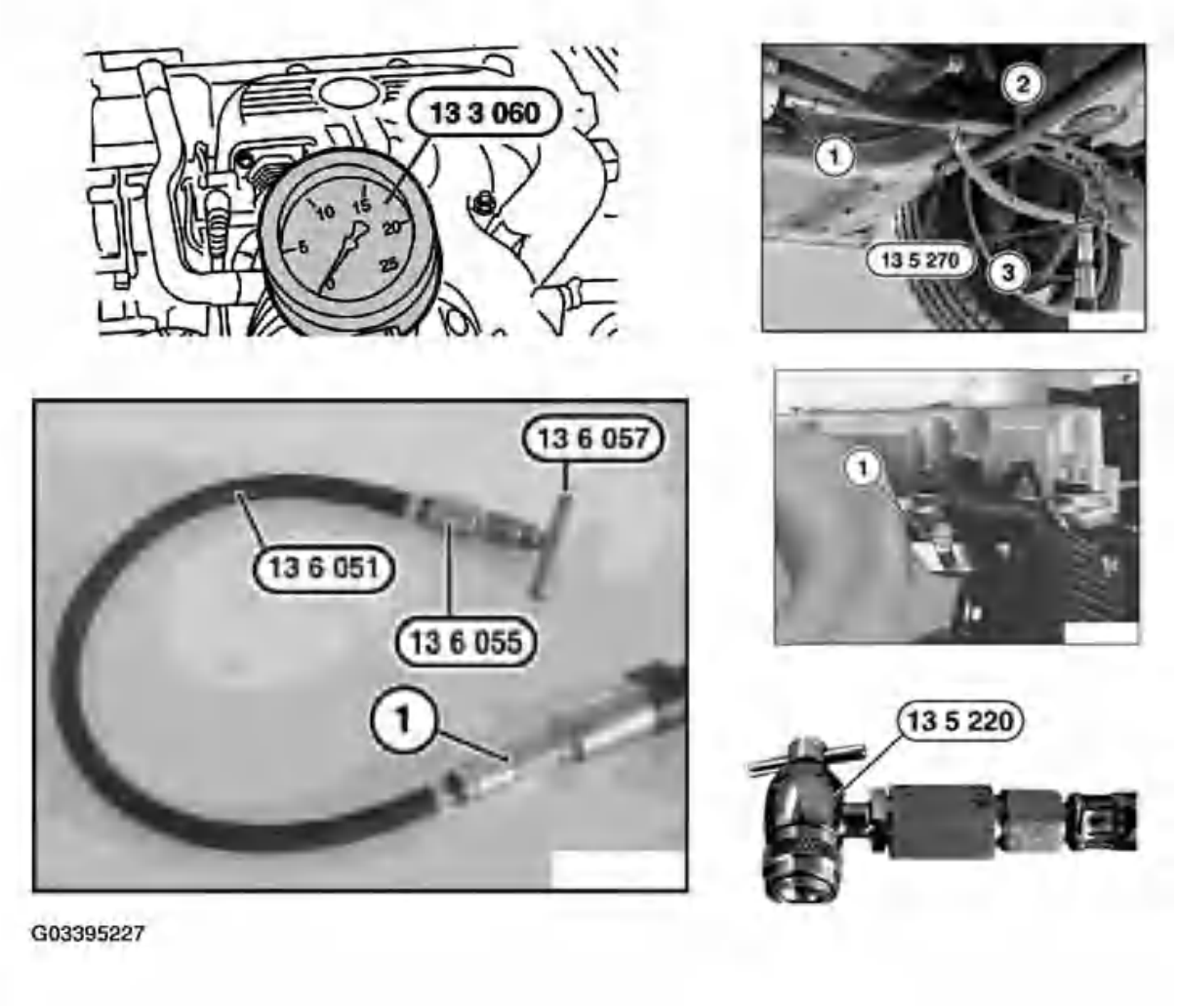


Fig. 10: Identifying "T" Connector
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Always observe all safety regulations when working on fuel systems. Obey all local and state fire safety laws regarding fuel handling. Always have the proper fire extinguisher on hand when performing testing and/or repair to the fuel system.

Once it has been determined that what the fuel pressure is, compare your reading to the proper specification. If the fuel pressure is low or zero, the fuel circuit must be checked over.

See if the fuel pump is energized. Check the voltage supply and ground to the fuel pump using proper electrical testing procedures (i.e voltage drop etc.). Make sure that you analyze the fuel pump circuit. Check the fuses, connections and appropriate relays.

Also, understand the operation of the fuel pump circuit. Older vehicles were somewhat straightforward, on the other hand, the newer vehicles are using more elaborate circuits for fuel pump operation.

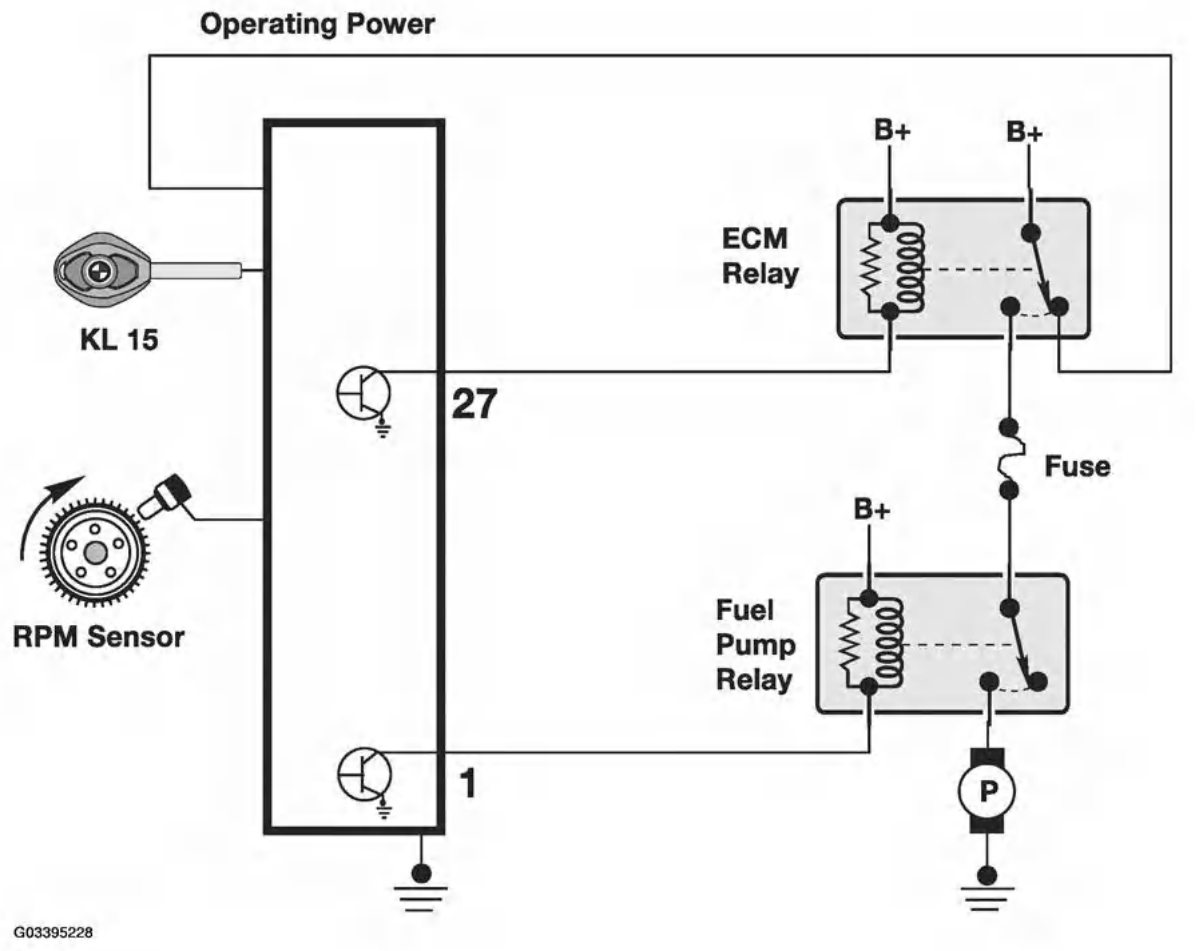


Fig. 11: Operating Power Circuit Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

Some vehicles, now use a control module to control the speed and flow rate of the fuel pump. The M3, M5 and vehicles equipped with the M56 engine use a fuel pump control module. The E65/E66 uses the SBSR to control the fuel pump. Take this into consideration when performing diagnosis on these vehicles.

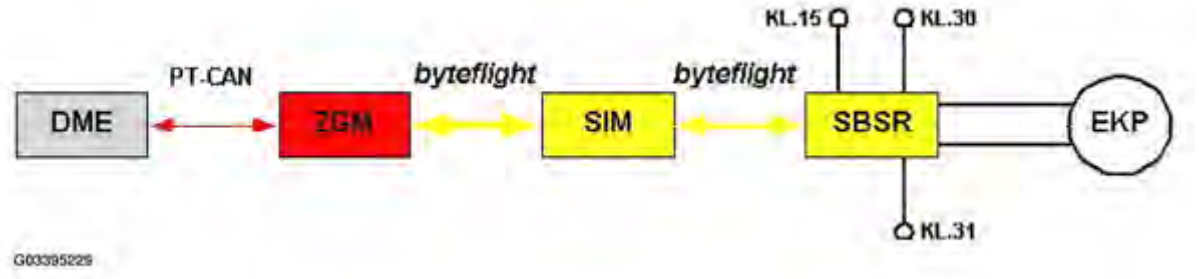


Fig. 12: Fuel Pump Control Module Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

Always use available resources such as wiring diagrams, SI Bulletins and training material to better understand circuit operation.

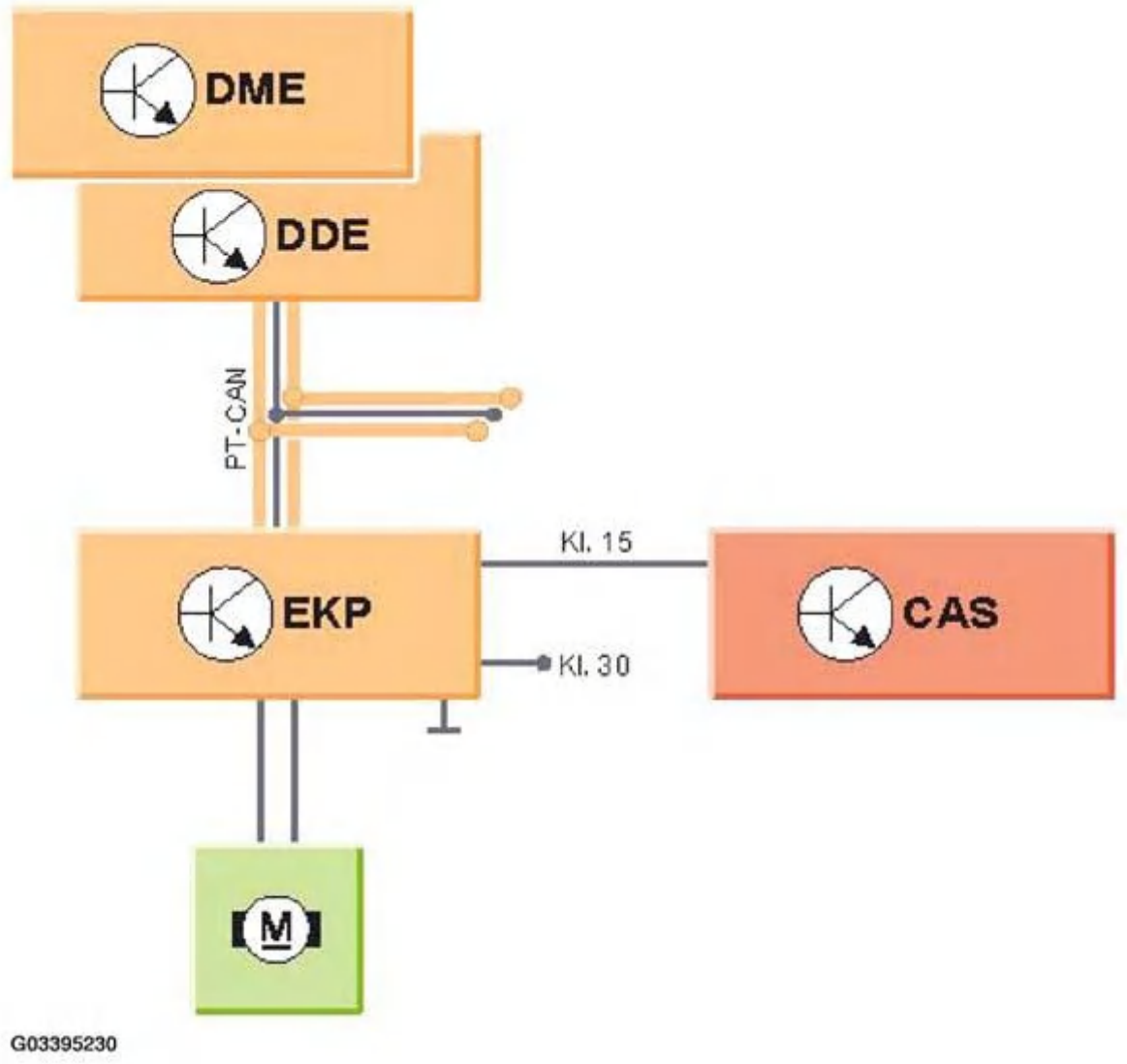


Fig. 13: Fuel System Circuit Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

Fuel Volume Testing

Some driveability concerns are related to incorrect fuel volume. Vehicles with lack of power complaints and mixture related fault codes may have insufficient fuel volume supplied to the fuel injection system. These vehicles may actually pass a fuel pressure test.

Fuel volume issues can be caused by faulty fuel pumps, fuel pressure regulators, clogged or restricted fuel filters and/or fuel lines.

If these driveability concerns are present, then a fuel volume test should be performed. A fuel volume test measures the amount of fuel delivered in a specific time frame.

The fuel pump is activated during this test using the proper test leads to ensure no arcing sparks are present. The fuel feed line is directed to a non-breakable (fuel-proof plastic) measuring can that has graduations for measurement.

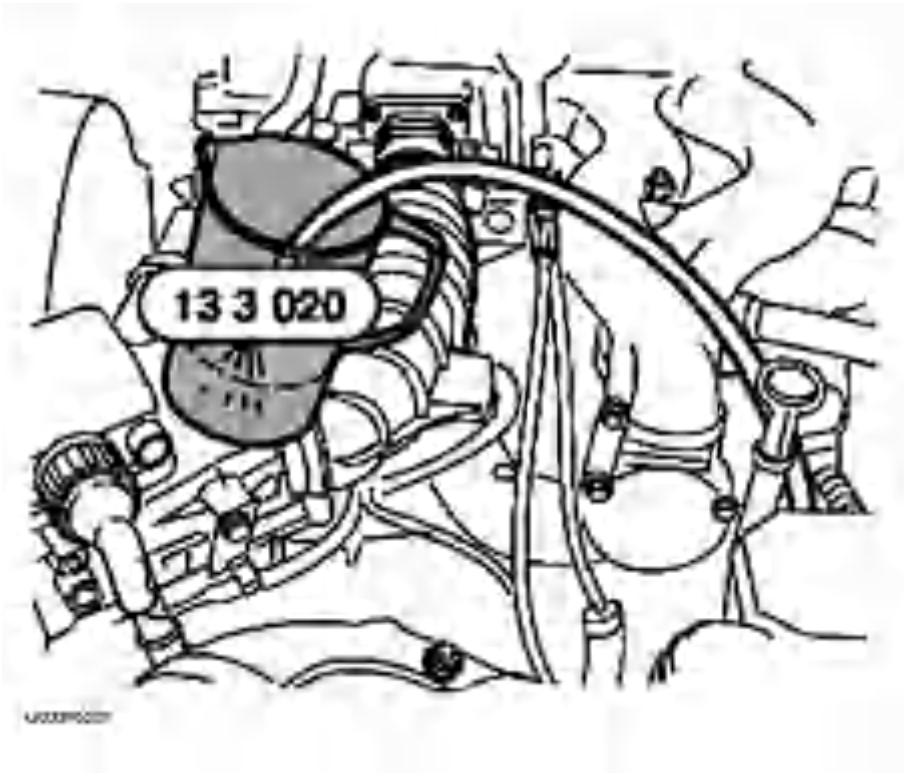


Fig. 14: Checking Fuel Volume Using Measuring Can
Courtesy of BMW OF NORTH AMERICA, INC.

A general specification for fuel volume would be approximately one liter in 30 seconds.

Residual Pressure

Fuel injection systems require a residual pressure to present after the engine is switched off. This allows the engine to start immediately after the vehicle has been parked.

If the residual fuel pressure diminishes after the vehicle has been shut off. Upon restart, there will be an extended cranking period before engine start. This is due to the fuel pump attempting to supply enough fuel for startup.

When the fuel system is at rest, there a three components which allow the fuel system to retain sufficient residual pressure. These items are, the fuel pump check valve, the fuel pressure regulator and the fuel injectors.

Fuel System - E32 with M60

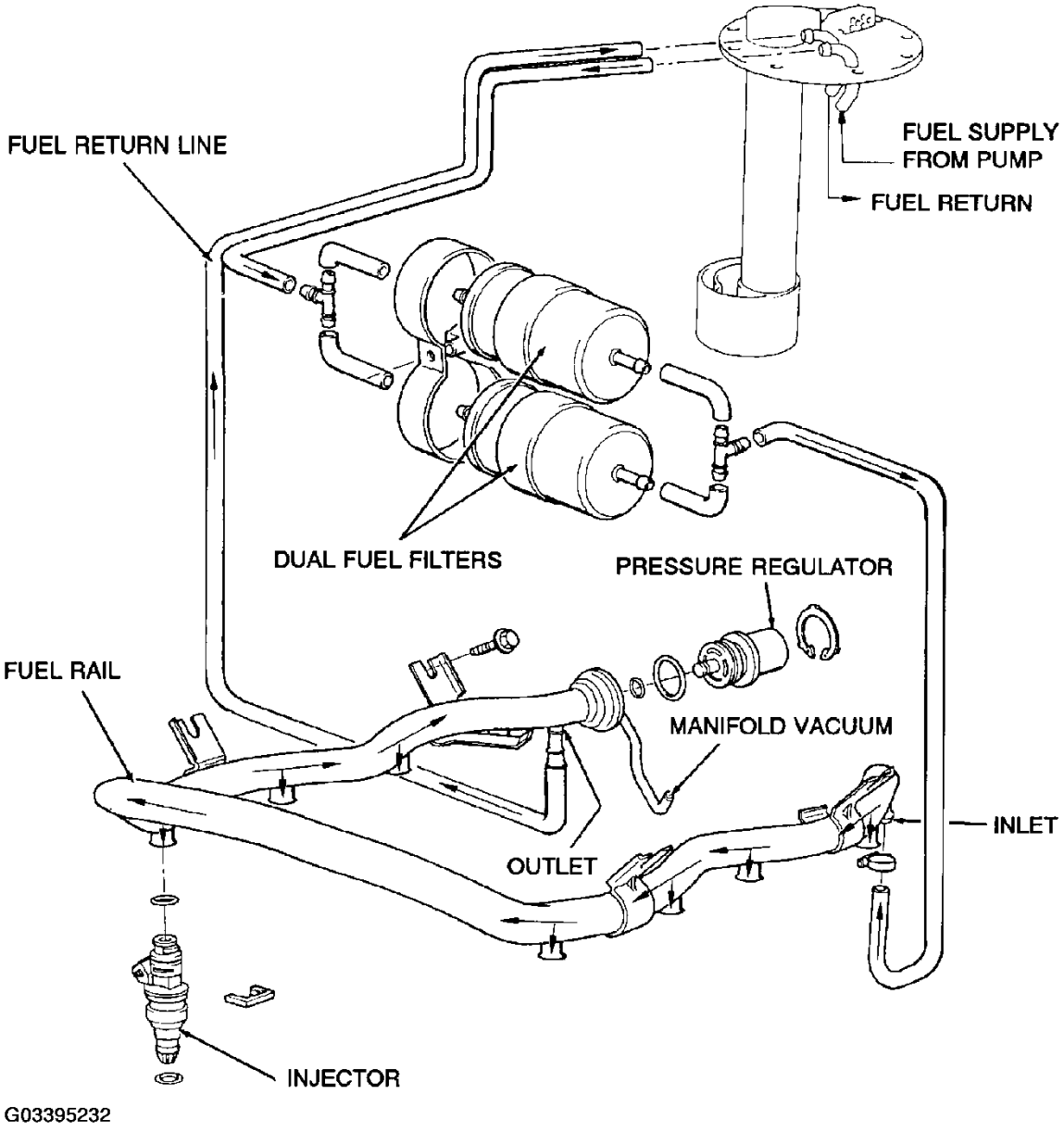


Fig. 15: Identifying Fuel System - E32 With M60 Components
Courtesy of BMW OF NORTH AMERICA, INC.

If any of these items are leaking and fail to hold pressure in the fuel rail, the vehicle will be difficult to start. The cranking time will be excessive and possibly not start at all. For example, If the fuel injectors are leaking, the vehicle will exhibit black smoke on startup.

Diagnosis of these concerns requires a fuel pressure gauge. The residual pressure is monitored on the fuel pressure gauge when the engine is shutoff. Diagnosis is determined by watching the drop in fuel pressure over time. The fuel pressure should not drop more than .5 bar in 30 minutes. If the pressure drops more than .5 bar, the concern should be investigated.

Fuel System - E39/E46 with M54

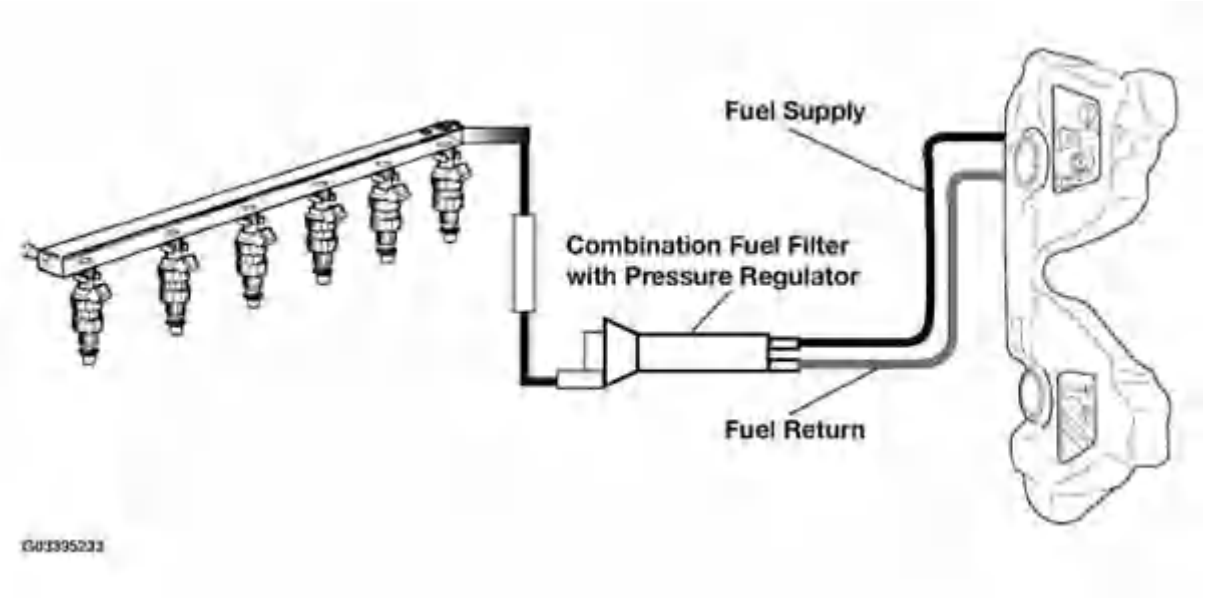
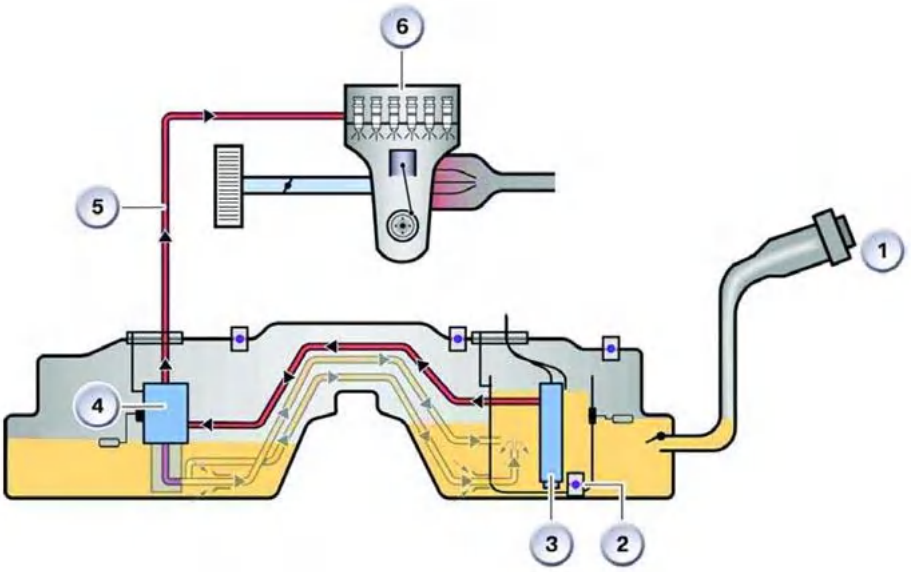


Fig. 16: Identifying Fuel System - E39/E46 With M54 System Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

Depending on the type of fuel system used, diagnosis will vary. On older fuel systems, diagnosis is simplified due to the ability to clamp off certain components to determine, the origin of the leakdown.

Fuel System - E60



Index	Explanation	Index	Explanation
1	Fuel Filler Pipe	4	Fuel Filter
2	Outlet Protection Valve	5	Feed Line
3	Electric Fuel Pump	6	Fuel Injectors/Fuel Rail

G03395234

Fig. 17: Identifying Fuel System - E60 Components
Courtesy of BMW OF NORTH AMERICA, INC.

Newer fuel system use a non-return type fuel system with some components mounted externally. Most recently, many of the new vehicle have most of the fuel system components mounted in the fuel tank. This includes the

fuel pump, fuel filter and fuel pressure regulator. The only fuel system component outside the fuel tank is the fuel feed line, fuel rail and fuel injectors.

This makes the diagnosis of residual pressure concerns more difficult. Diagnosis of this type of system sometimes requires process of elimination.

If one or more of the fuel injectors is suspected as the cause of the loss in residual fuel pressure. They can be tested using a special tool to "bubble test" the injectors.

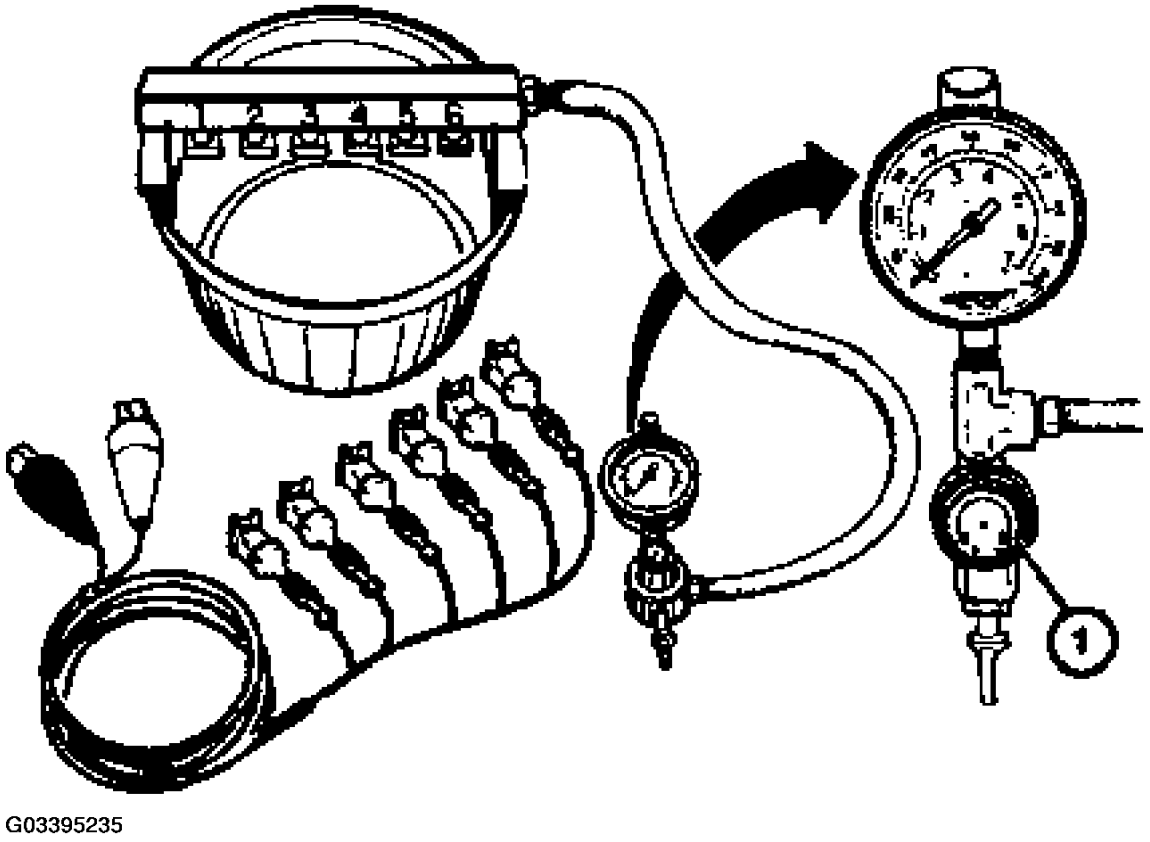


Fig. 18: Testing Bubbles In Injectors Using Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

First the injectors are connected to the test fuel rail supplied with the tool. Then, the fuel injectors are subjected to compressed air. The injectors are then triggered by the test harness to "blow out" any residual fuel.

The test harness is disconnected and the tips of the injectors are immersed in water. The injector tips are observed for any bubbles over time. Any excessive bubbles indicate a defective injector.

Engine Adaptation Values

Engine adaptation values can be broken down into two categories:

- Additive Mixture Adaptation - additive adaptation refers to "long term fuel trim". These adaptation are made by the ECM (DME) at idle during "closed loop" fuel control. These values are measured in milliseconds and are expressed in negative and positive values.
- Multiplicative Mixture Adaptation - multiplicative adaptation occurs during part load conditions and are performed by the ECM during "closed loop" fuel control. These values are measured in percent and are also expressed as negative and positive values. This is also referred to as "short term fuel trim".

Additive mixture adaptation corrects for variations in idle mixture. The ECM monitors the oxygen sensor signals to evaluate the exhaust mixture. When a lean (or rich) mixture is detected, the ECM increases (or

decreases) the injector "on-time" to correct accordingly.

As long as the fuel trim correction is not excessive, the ECM will not register a fault code. The ECM will correct in increments of +/- .1 ms. When the fuel trim correction exceeds a predetermined threshold value, the check engine light (MIL) will illuminate and store appropriate fault codes for additive mixture adaptation.

Additive values which are excessively positive, would indicate a lean condition. This can be caused by:

- Un-metered air leaks - such as broken vacuum lines or a leaky intake manifold or gasket.
- Faulty crankcase ventilation system - crankcase vent valve stuck open.
- Low fuel pressure - Faulty fuel pressure regulator or fuel pump.
- Faulty HFM - can be sending erroneous load signal information which would cause the ECM to falsely enrich the mixture.

Additive values which are excessively negative, would indicate a rich condition. This can be caused by:

- An air restriction - any restriction to airflow such as a clogged air filter would create a rich fuel mixture. (this may also be indicated by negative multiplication values)
- Faulty crankcase ventilation system - crankcase vent valve stuck closed.
- High fuel pressure - Possible faulty fuel pressure regulator or restricted return line
- Faulty HFM - can be sending erroneous load signal information which would cause the ECM to falsely lean out the mixture.

NOTE: Some newer engine management systems use the term mg/stroke or milligrams per stroke. Treat these values as you would millisecond values.

Multiplicative mixture adaptation corrects for variations in fuel mixture under part load conditions. The ECM monitors the oxygen sensor signals to evaluate the exhaust gas mixture. When a lean (or rich) mixture is detected the ECM adjusts the injector "on-time" accordingly over a "short term" period to adapt for the existing situation.

Multiplicative values are expressed in percent and can be negative or positive. Negative values indicate a rich mixture and positive values indicate a lean mixture. When the Multiplicative values exceed a predetermined threshold value, the check engine light (MIL) will illuminate and store relevant fault codes for Multiplicative adaptation.

When multiplicative values are excessively positive, a lean condition exists. The ECM is attempting to add fuel to maintain the proper fuel mixture (close to lambda value 1). This situation can be caused by a faulty HFM, low fuel volume, restricted fuel filter or faulty fuel pressure regulator.

When the values are negative, the ECM is attempting to lean out (remove fuel) the fuel mixture to compensate for a rich condition. This can be caused by:

- Excessive fuel pressure - from a faulty fuel pressure regulator or restriction in the return line.
- A faulty HFM - the HFM can be sending erroneous load signal information which would cause the ECM to falsely enrich the mixture.
- An Air restriction - any restriction to airflow such as a clogged air filter would create a rich fuel mixture.
- Any system failure which would cause the mixture to be falsely enriched. This could be caused by erroneous signal information from sensors such as the engine coolant temperature sensor or intake air temperature sensor.

Engine Misfire Diagnosis

Engines which have been produced since 1996 are OBDII complaint. The CARB/OBD regulations require the ECM to be capable of detecting misfires. Also, the ECM must be able to determine if the misfires increase engine emissions and/or are catalyst damaging.

The ECM detects engine misfires by monitoring crankshaft speed. The ECM receives the input from the crankshaft sensor and determines if there is a misfire present by comparing crankshaft speed variations between combustion events on each cylinder.

The crankshaft must rotate 720 degrees (2 rotations) to fire all of the cylinders in an engine regardless of the number of cylinders. Therefore each firing event is spaced apart and occurs at a specific time. By monitoring the crankshaft signal the ECM can determine which cylinder is misfiring and also the severity of the misfire.

Misfires are classified in 2 levels of severity:

- Misfires which increase emission levels - These misfires occur within an interval of 1000 crankshaft revolutions. The ECM counts and adds the detected misfire events for each cylinder. If the sum of all cylinder misfire incidents exceeds the predetermined value, a fault code will be stored and the "MIL" will be illuminated.

  If more than one cylinder is misfiring, all misfiring cylinders will be specified and the individual fault codes will be stored. The "MIL will be illuminated".

- Misfires which are catalyst damaging - These misfires are determined when the sum of the misfiring events occurs within 200 crankshaft revolutions. These misfires are considered catalyst damaging and the "MIL" will be illuminated.

The ECM will take the following measures - the oxygen sensor control will be switched to "open loop", a cylinder selective fault code will be stored for one or more cylinders and the relevant fuel injector(s) will be deactivated.

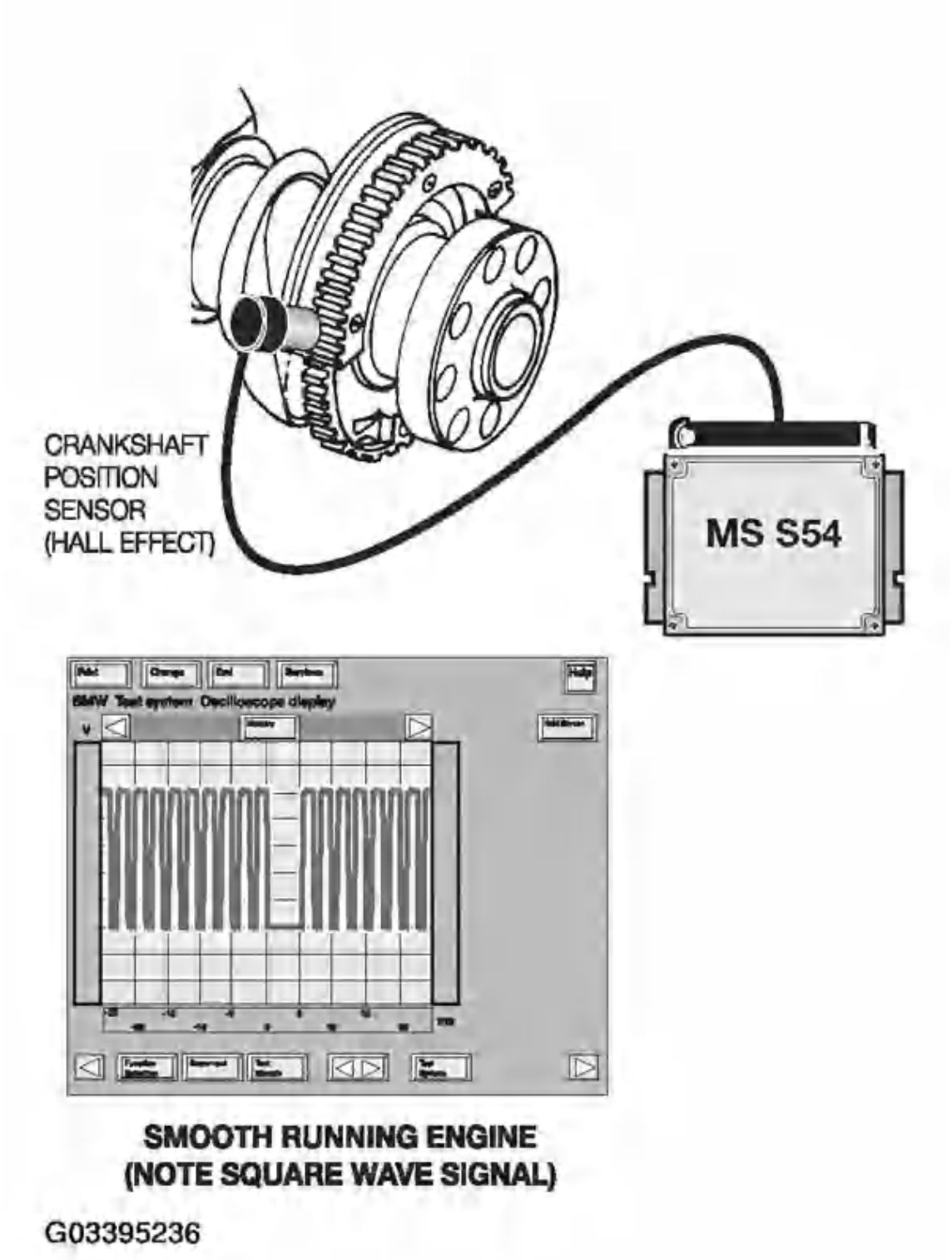


Fig. 19: Identifying Crankshaft Positioning Sensor
Courtesy of BMW OF NORTH AMERICA, INC.

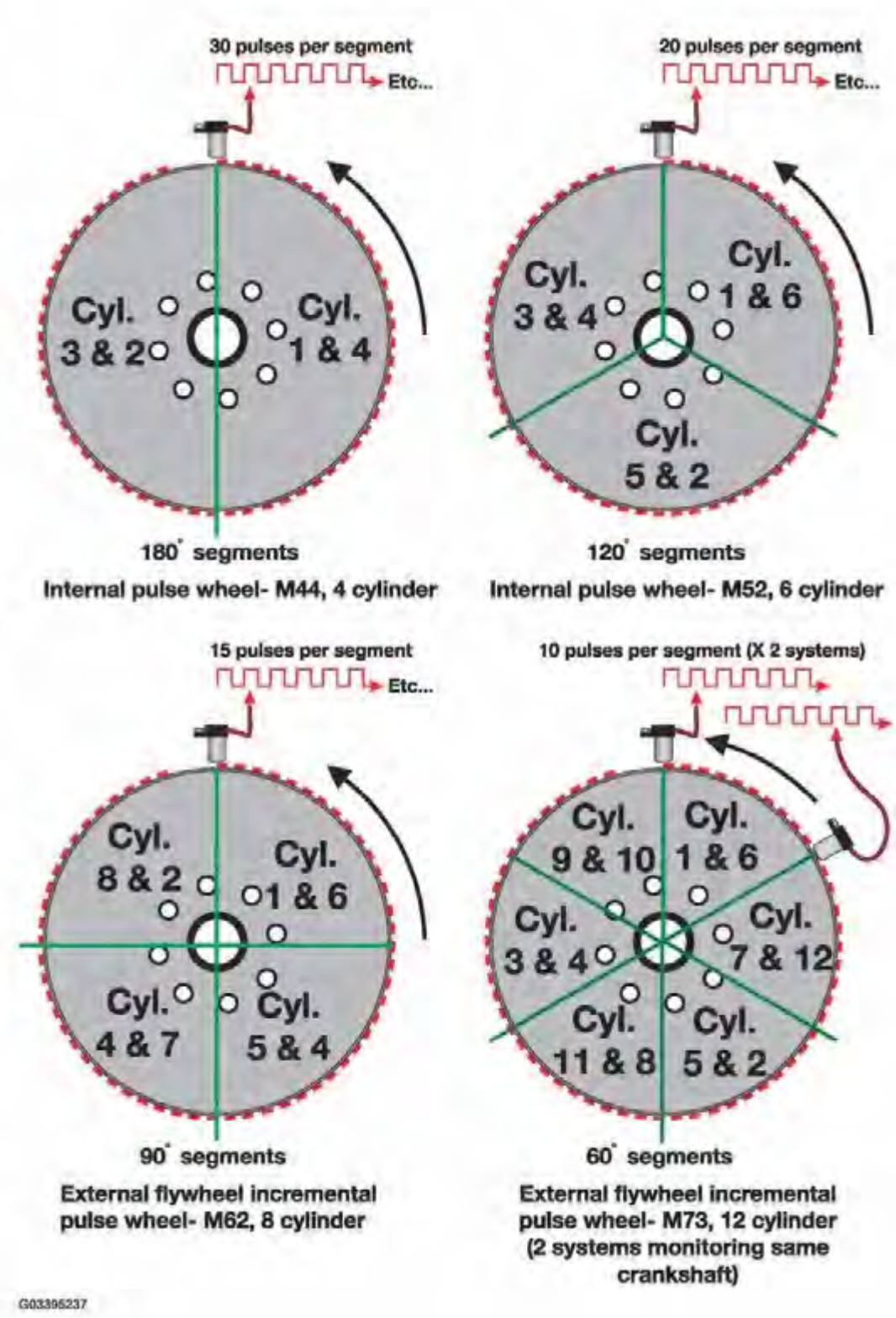


Fig. 20: Displaying Smooth Running Engine Waves
Courtesy of BMW OF NORTH AMERICA, INC.

The causes of engine misfires include:

- Ignition System - spark plugs, ignition coils, secondary circuit components and primary/secondary circuit wiring.
- Engine Mechanical - piston, piston rings, valves, camshaft and any valvetrain related components including Valvetronic. Valvetronic components include eccentric shaft, intermediate levers etc.

  The crankcase ventilation system should also be considered. This includes the crankcase ventilation valve and if applicable, the hose connections as well.

- Fuel System - fuel injectors, fuel pump, fuel filter and pressure regulator etc. This includes fuel quality as well. Other fuel system components include fuel tank vent valve (purge) as well as running losses components such as the 3/2 valve etc.
- Engine Electronics - any implausible input from a sensor such as the crankshaft sensor and camshaft sensor. Also any sensor which affects fuel mixture including HFM, coolant/intake air temperature sensors etc.
- Other items include the catalyst which could be restricted and/or the muffler.

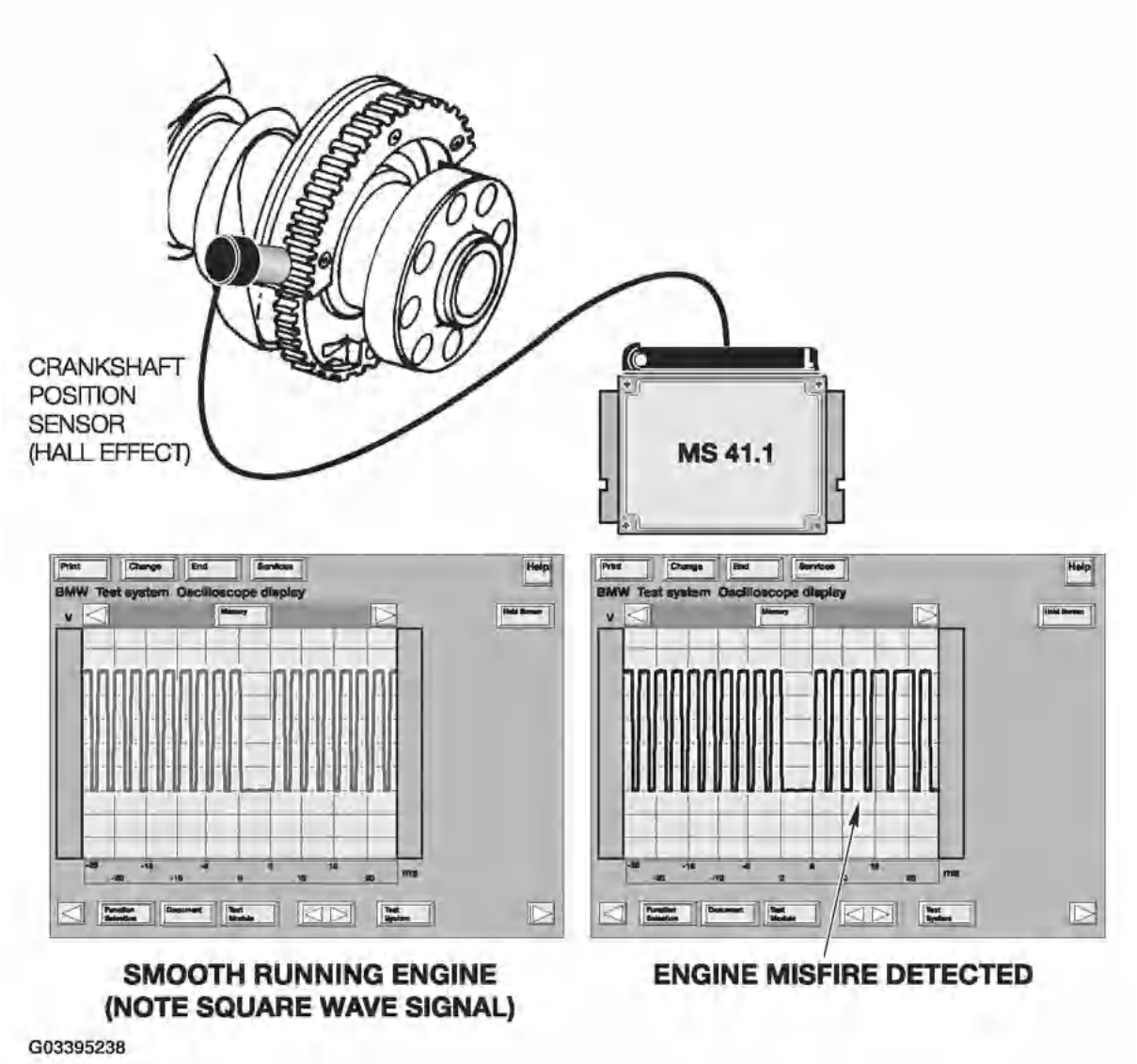


Fig. 21: Displaying Engine Misfire Waves
Courtesy of BMW OF NORTH AMERICA, INC.

Smooth Running Measurement

The DISplus/GT-1 are helpful in pinpointing the cause of an engine misfire. Once the short test is completed, the fault memory of the ECM can be read out to determine which cylinder or cylinders have set misfire faults. There may or may not be any faults present. The engine could be running rough, however no misfire thresholds may have been exceeded.

Engine smoothness can be further evaluated by looking at the smooth running values. In the "Control Unit Functions" screen under "Diagnosis Requests" there is a value indicated for each cylinder which can be compared for each cylinder. This value is an indication of crankshaft speed variations in each cylinder.

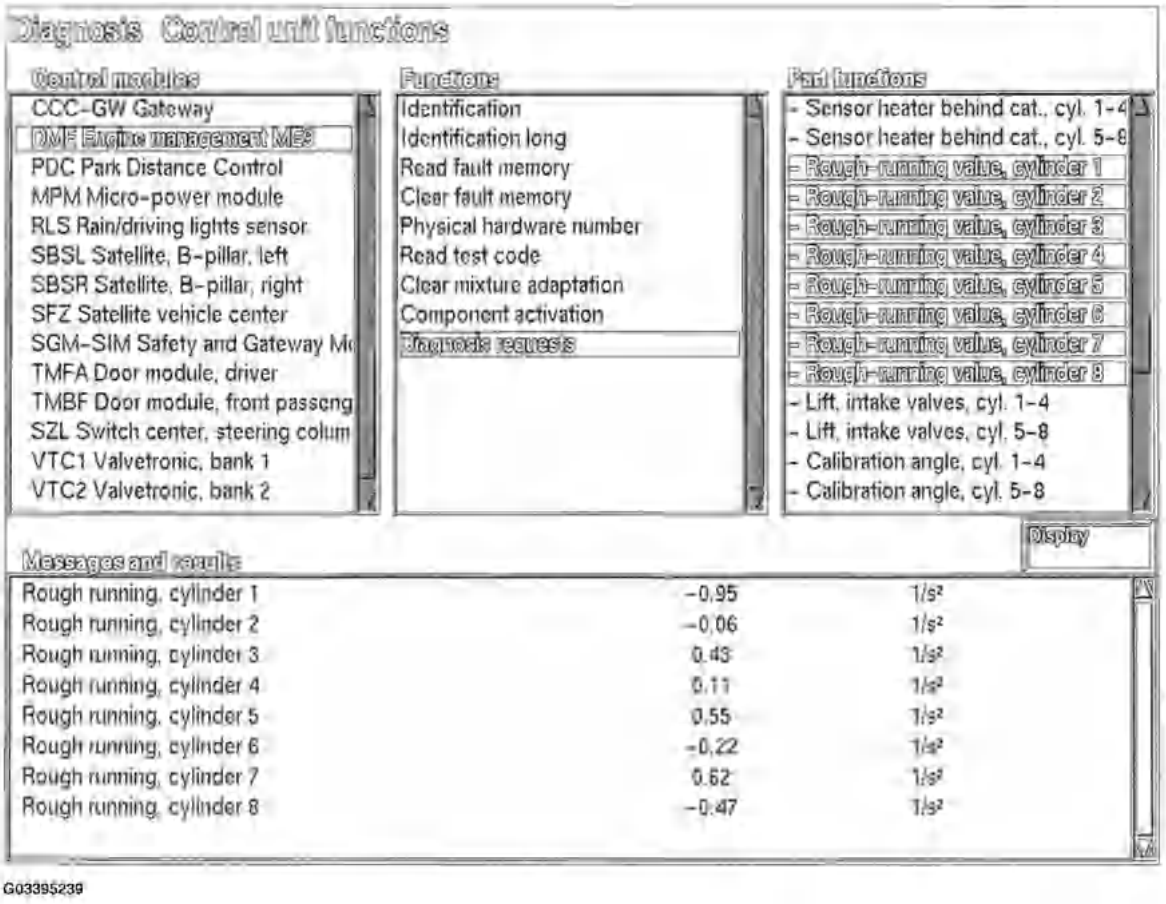


Fig. 22: Displaying Smooth Running Measurement
Courtesy of BMW OF NORTH AMERICA, INC.

Valvetronic N62

In addition to the usual valvetrain diagnosis, the Valvetronic system has some additional components which need to be taken into consideration during diagnosis. The tolerances on the eccentric shaft and intermediate levers are critical in maintaining proper cylinder filling especially at idle. Any deviations in tolerances of these components will contribute to rough running complaints.

The intermediate levers are available in 5 classifications, the classification numbers are marked on the levers. On the N62, each cylinder head must use intermediate levers with the same classification. It is not necessary to have the same classification between cylinder heads.

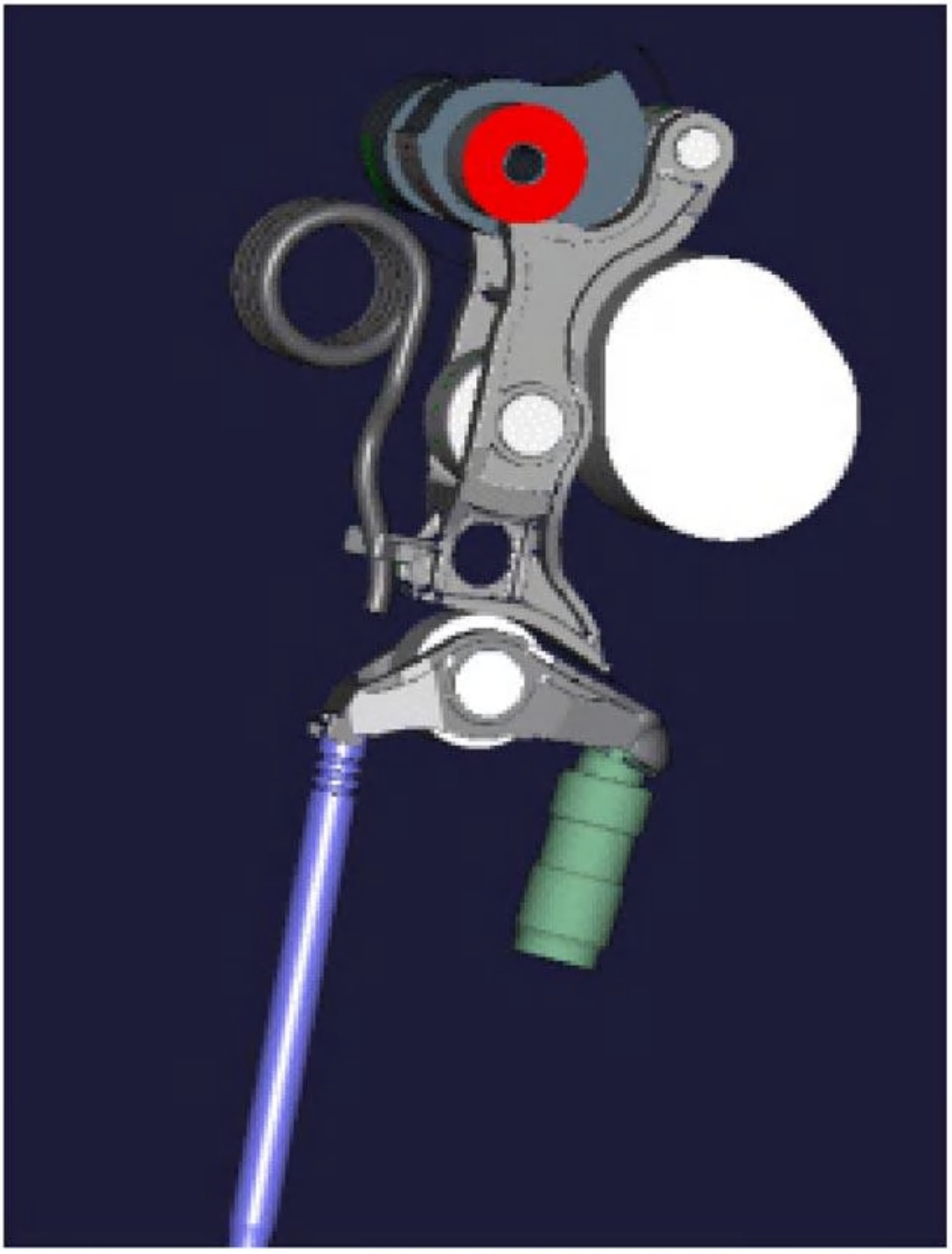


Fig. 23: Identifying Valvetronic N62
Courtesy of BMW OF NORTH AMERICA, INC.

Depending on the engine/vehicle, the minimum valve lift can be set from .3 to .8 mm. At these low valve lifts, any variation in tolerance will affect idle quality. When a diagnosis determines that there is a problem in the Valvetronic system, the components need to be inspected. The intermediate levers or eccentric shaft can be worn. The intermediate levers could be of the wrong classification.

The illustration below shows a worn eccentric shaft. The areas shown should be inspected for any wear. Grooves and scoring indicate a worn eccentric shaft which should be replaced.



Fig. 24: Identifying Camshaft Grooves
Courtesy of BMW OF NORTH AMERICA, INC.

The following pages contain testing information which will assist in the diagnosis of idle quality concerns on the N62.

N62 Engine Testing

The N62 engine features Valvetronic which requires some specialized diagnostic procedures. Due the variable valve lift feature, there are some additional steps regarding engine and compression testing.

MKA Adapter

The Multi-Channel Adapter (MKA) tool is used in conjunction with the DISplus to diagnose ignition and injection system concerns on the N62 engine. The MKA adapter is installed (in series) between the ECM and the engine harness at connectors 1, 3 and 5. In addition the four cables of MFK 2 are plugged into the MKA as well.



Fig. 25: Identifying MKA Adapter
Courtesy of BMW OF NORTH AMERICA, INC.

The MKA test module is found under the path > Service Functions > Drive > Engine Management ME9 > Test Runs > Ignition and Injection diagnosis N62.

The MKA engine test checks the integrity of the ignition system by looking at the primary ignition voltage on each cylinder.

The injection system is also checked by examining the voltage pattern of the injection circuit.

Compression Test N62

The compression can be tested on the N62 using the DISplus. The DISplus can perform a relative compression test and provide a comprehensive engine analysis report.

The compression test can be done at minimum valve lift as well as at maximum valve lift. This difference between these reading can assist in determining the root cause such as wear in Valvetronic components.



Fig. 26: Identifying DIS
Courtesy of BMW OF NORTH AMERICA, INC.

When performing this test the following connections/cables are needed:

- Diagnostic head (can be hardwired or wireless)
- TD Cable connection to diagnostic head
- 25 Bar Pressure transducer connected to pressure connection #2.
- Compression adapter (quick disconnect)
- 1000 Amp clamp

The test module will prompt you to warm up the engine to 90Â°C. Once warmed up, you will be directed to run the engine at idle to set the minimum valve lift. Follow the on screen prompts. Once the minimum valve lift has been obtained (0.2 to 0.4 mm), disconnect both VVT motors to lock in the minimum adjustment.

Once this step in completed, shut the engine off and remove the #1 spark plug. Install the compression adapter into the spark plug hole. (Note: any cylinder can be used as long as the DISplus is set to the cylinder in use). Follow prompts until test is completed.



Fig. 27: Identifying Compression Adapter
Courtesy of BMW OF NORTH AMERICA, INC.



Fig. 28: Identifying TD Cable
Courtesy of BMW OF NORTH AMERICA, INC.

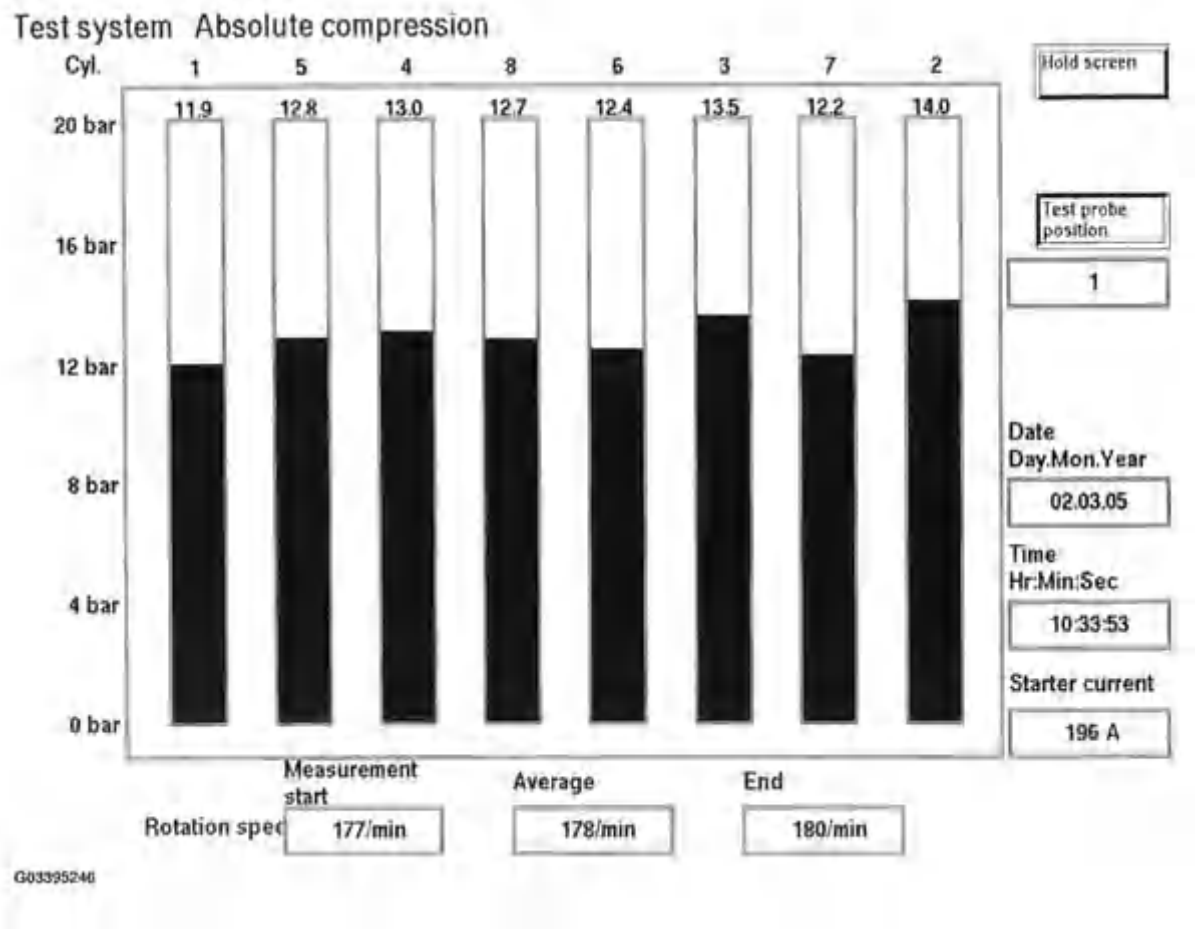


Fig. 29: Absolute Compression Bar Graph
Courtesy of BMW OF NORTH AMERICA, INC.

Once the test is completed, perform the same steps for the maximum valve lift. Compare the results, the results from the test at maximum valve lift should be slightly higher. Any cylinders that show low results on the minimum valve lift test which show improvements when the maximum valve lift test is performed should be checked for Valvetronic wear concerns.

During the final analysis potion of this test module, there may be on screen recommendations of repairs involving eccentric shaft or intermediate lever replacement. There may be a recommendation of changes to the classification of intermediate levers as well.

Manual Compression Test (N62)

Manual compression testing can also be done on the N62. However, the DISplus must still be used to set the minimum/maximum valve lift. To access the test module for manual compression testing, go to path > Service Functions > Drive > Engine Management ME9 > Test Runs > Compression Test.

Rough Running Diagnosis (N62)

Due to the design of the Valvetronic system, there are special diagnostic considerations when diagnosing rough running concerns on vehicles equipped with the N62 engine.

The following diagnostic flow chart should be used as a diagnostic aid when attempting to rectify idle quality complaints when the engine is at operating temperature.

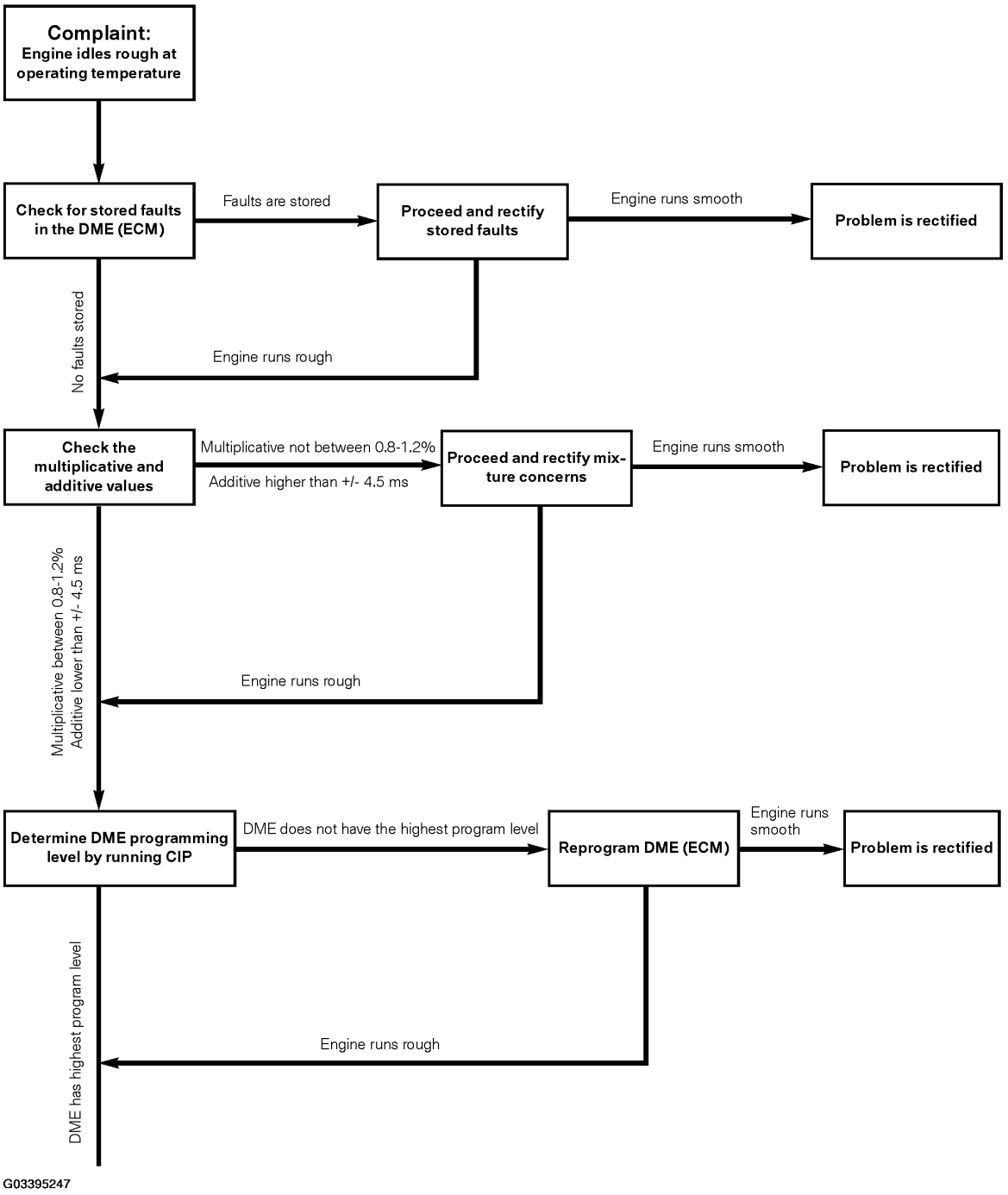


Fig. 30: Rough Running Diagnosis (N62) Diagnostic Flow Chart (1 Of 3)
Courtesy of BMW OF NORTH AMERICA, INC.

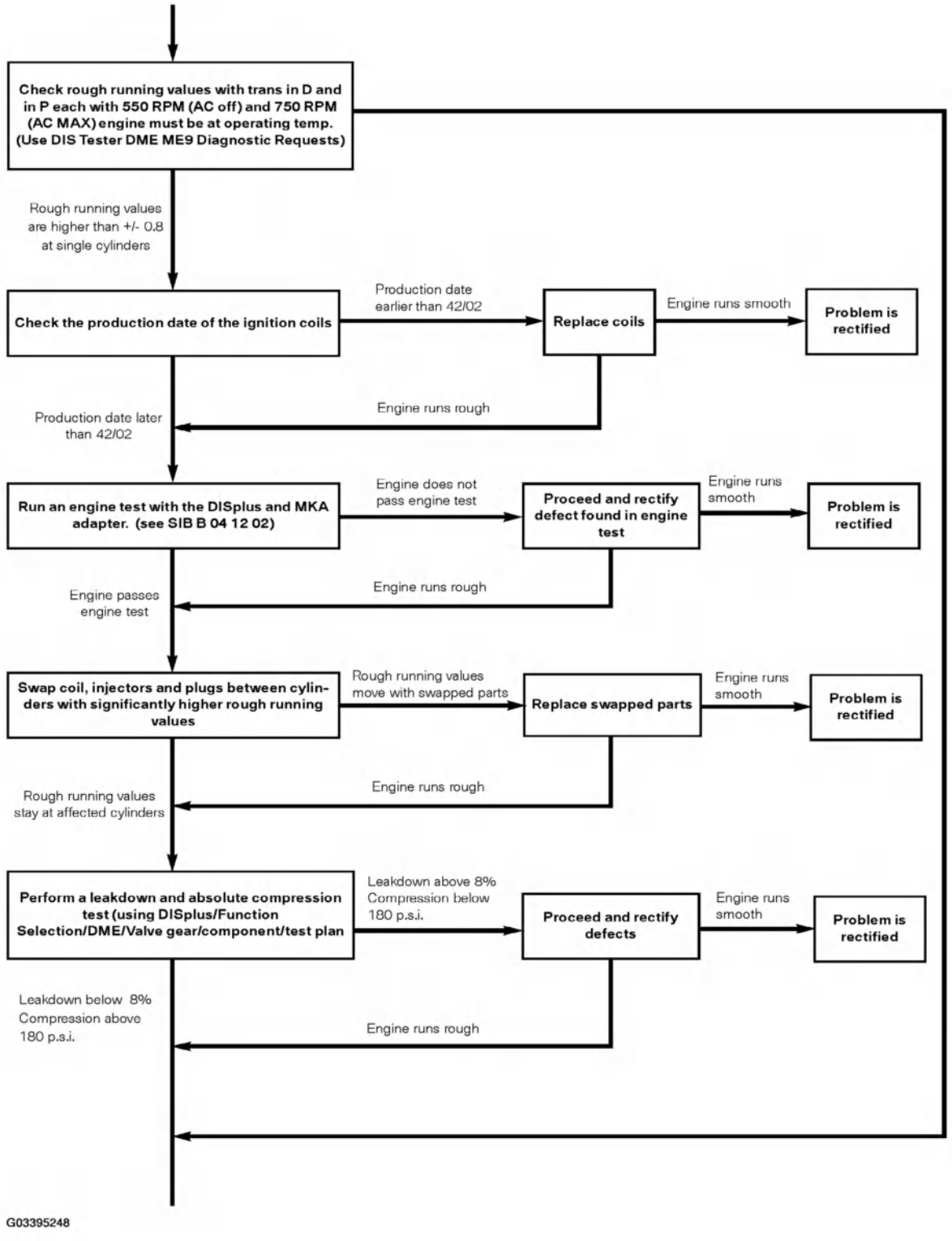


Fig. 31: Rough Running Diagnosis (N62) Diagnostic Flow Chart (2 Of 3)
Courtesy of BMW OF NORTH AMERICA, INC.

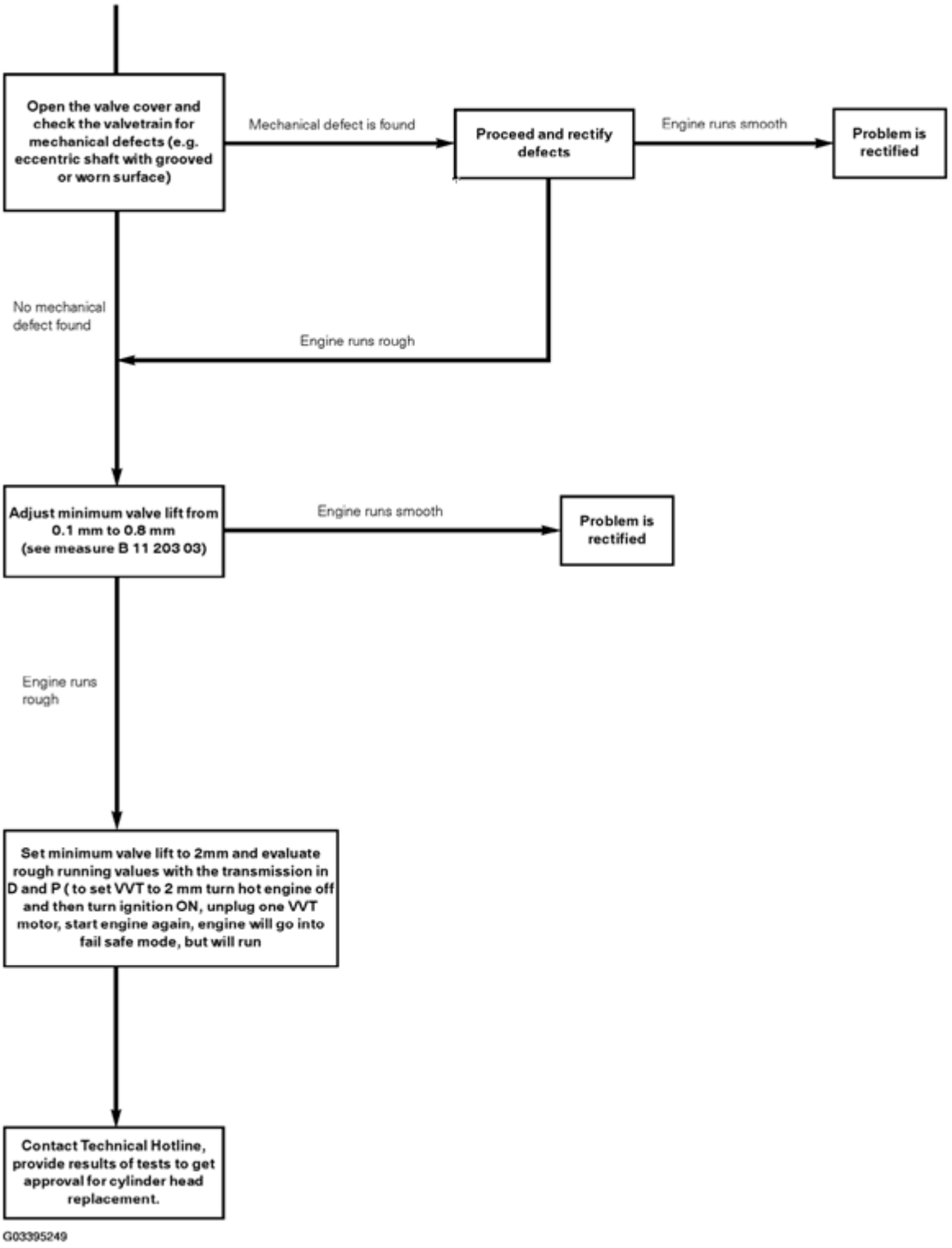


Fig. 32: Rough Running Diagnosis (N62) Diagnostic Flow Chart (3 Of 3)
Courtesy of BMW OF NORTH AMERICA, INC.

Article GUID: A00234320

UNDERSTANDING DIAGNOSTICS

Model: All

Production Date: All

Trial and error creates inconvenience for the Customer and the Service Department when mis-diagnosis or longer waits occur as the technician tries different repair attempts. This is against BMW's promise to the customer to "Fix it right the first time, on time, every time".

If the vehicle is not repaired efficiently the productivity of the technician suffers. Taking some time at the beginning to plan a diagnostic course of action can help give structure to what may appear in the beginning to be a chaotic situation.

As future systems increase in complexity so does their dependency on the Diagnosis Program as the principle tool for troubleshooting. However, the importance of understanding the calculated steps of a basic troubleshooting plan is just as important as before.

There will always be instances where the Test Modules provided by the DISplus need to be supplemented by a thoughtful diagnostic plan that is created by the skilled Technician. A parallel diagnostic plan that includes proper recording of test data along with the Diagnosis Program is a good habit to follow every time that troubleshooting is required.

A successful diagnostic plan will:

- Save repair time.
- Satisfy the customer by reducing vehicle down time.
- Increase Center profitability.
- Increase technician pride and earnings.

DIAGNOSTIC PLAN

The Diagnostic Plan consists of 5 steps:

- Verify the Customer Complaint - "Experience the Symptom!"
- Analyze the Problem.
- Isolate the Problem.
- Repair the Problem.
- Verify the Repair.

VERIFY THE COMPLAINT

Most troubleshooting starts the moment you receive a written description of the customer complaint. The complaint is the customer's description of a symptom that they are experiencing with the vehicle.

Symptom

A symptom is any circumstance, event or condition that accompanies something and indicates its existence or occurrence.

There may be multiple symptoms that are created with one problem.

An example is a defective thermostat: If the thermostat is stuck open the heater output will be insufficient, also,

if the engine can never reach operating temperature then fuel mileage and performance will suffer. Which one of these complaints (symptoms) would lead you to the problem faster?

What is important to remember is that the customer may only complain about one symptom. It is the job of the technician to be a detective and carefully observe. There may be another symptom not complained of that directly points to the root cause of the problem.

Steps to Verify The Complaint

- Before getting in the vehicle, review the R.O., confirm this is the correct vehicle.
- Is any additional information needed about the complaint? Certain questions to the customer can help narrow this step.
- Is the problem intermittent? What are the conditions (roads, temp., speed, etc.)? What is the frequency of the occurrence?
- Test drive if driveability related or the conditions require, duplicate conditions as stated by customer.
- Was the complaint reproduced?
- Is knowledge of system or vehicle sufficient?
- Review Reference Training material and owner's handbook for a description of feature operation.
- Research complaint in SIB's.
- Research past repair history on vehicle.

ANALYZE THE PROBLEM

After verification of the complaint, analyze the problem. Use all resource available to aid in system diagnostics:

- Vehicle Fault Memory.
- ETM, RM, SIB.
- Vehicle Repair History.
- Training Handouts.
- Round Table Information.
- Hotline.
- Known Good Vehicle.

Analyzing the problem allows for the development of a repair plan.

Steps in Analyzing The Problem

- Perform a Short Test.
- Does an SIB pertain to this vehicle?
- Refer to the Function Description for additional system information.
- Is a test plan available for this system?
- Use fault symptom selection.
- Perform Diagnosis Request.

ISOLATE THE PROBLEM

To isolate the problem is " to place apart from others".

The object here is to zoom in on the problem area. It is easy to be overwhelmed by a problem, just reaching for an ETM can add to the confusion. The DISplus provides automatic tests in test modules to aid in the determination of the exact area or cause of the problem.

The elimination of components from the diagnostic trail, shortens the path. The first question asked should be:

- Is the problem Hydraulic, Mechanical or Electrical?

Save time by NOT testing components that could not create the problem.

Steps in Isolating The Problem

- Use Test Modules.
- Perform electrical tests with the DISplus Measurement System or a DVOM.
- Consult fault charts in Repair or Diagnostic Procedures Articles.
- Control Module Self Diagnosis.
- Use appropriate special tools (e.g. battery draw tester, tank leakage adapters, breakout boxes, etc.).
- Substitute a known good part.

Workshop Hints:

If a TEST PLAN is not available for a particular situation do the following:

- Think about the system in its entirety.
- Be sure the normal operation is understood.
- Develop a PLAN.
- Use all available resources.
- Don't try to diagnose the entire system at once, break it into manageable chunks.
- Check the easy things first. It would waste time to install the Breakout Boxes to find a bad bulb.

When following a TEST PLAN:

- DON'T Skip steps.
- NEVER assume results without doing a step.
- Recheck your work.

REPAIR THE PROBLEM

Repair the problem using approved repair techniques and parts. Having verified, isolated and analyzed the problem the last step is to repair or replace the component. Before installing that shiny new part, take one last step back from the vehicle to ask a final set of questions.

- Could another component have caused this part to fail?
- Were all the instructions in the Test Plan or Diagnostic Procedures followed?
- Is there anything that might have been overlooked?

Confident that the proper diagnosis has been made, complete the repairs.

Steps to Repairing The Problem:

- Follow the instructions in the repair article.
- Follow specific guidelines for wire harness repair or replacement.
- Make proper adjustments after installing the part.
- Perform Coding or Programming if required.
- Make sure another problem is not created in performing this repair.

VERIFY THE REPAIR

Always recheck for the complaint under the same conditions used to verify. The object is to prove the problem does not resurface.

- Clear the fault codes.
- Test drive the car.
- Check for re-occurring fault codes.
- Clear adaptations if necessary.
- Recheck the part installation for missing bolts or tie wraps.

Workshop Hints:

- Follow repair or replacement procedures as detailed in appropriate article.
- Use only genuine BMW parts.

THE I.P.O. PRINCIPLE

Control Modules receive information from sensors advising them of certain operating conditions. This information is identified as Input to the control modules. The Input continually informs the control modules of conditions that may be changing.

The control module then process the Input information comparing it to programmed responses or commands based on every possible operating condition. The control module decides based on the programming and the Input conditions which Output signal to operate.

The control module, based on the processing that has occurred, then sends a signal to a component changing the status of that component. The components respond to the Output signal of the control module.

This is known as the I.P.O. Principle.

I.P.O.

- Status of switch is changed.
- Changing switch status is sent to processor.
- Processor looks at conditions which must be met.
- If the processor deems the conditions for switch status change are met, a relay is signaled via a ground signal.
- The relay is energized, the points are closed and the light bulb glows.

NOTE: The processor looked at other inputs before making the decision to activate the relay.

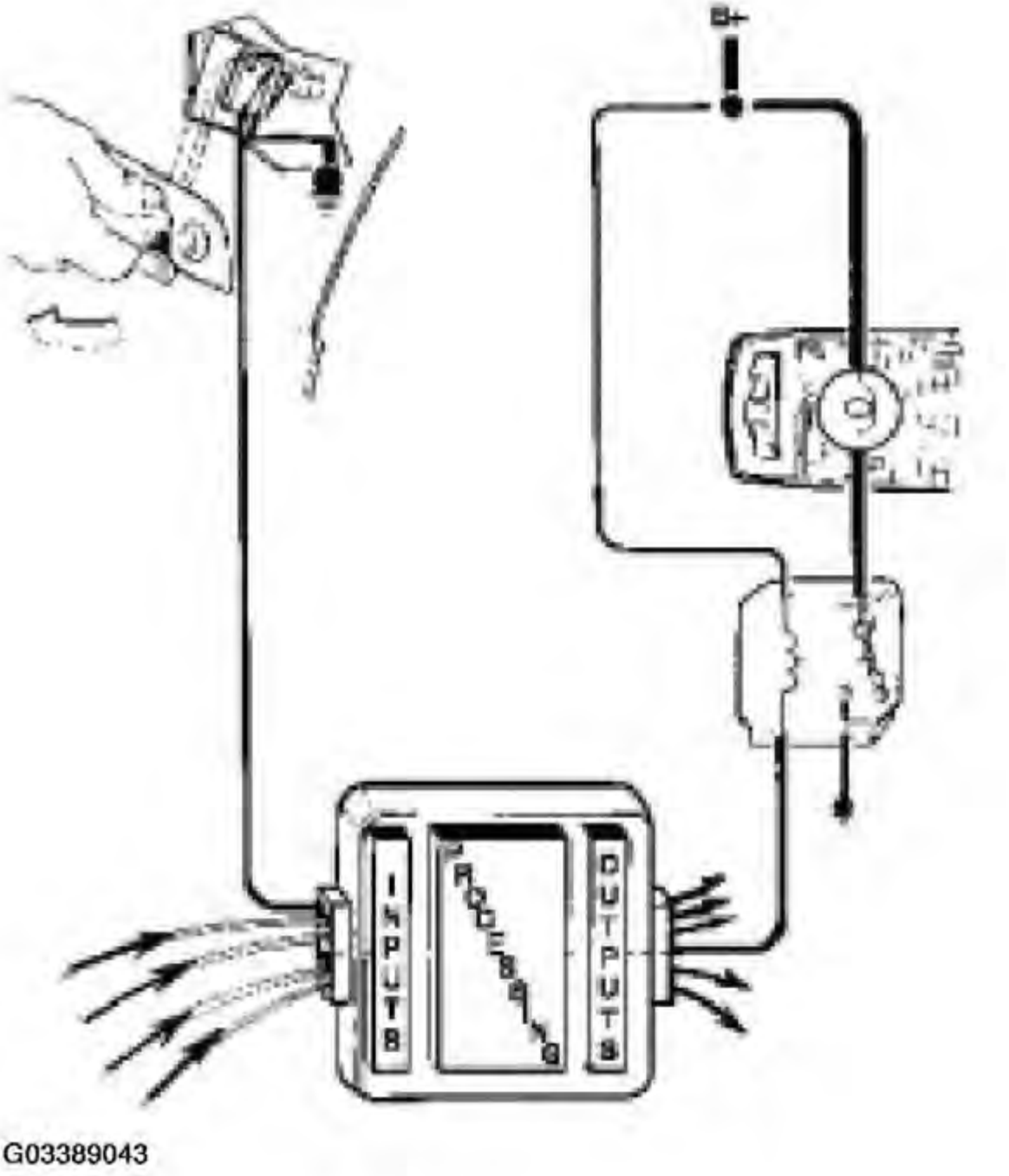


Fig. 1: Identifying I.P.O. Principle
Courtesy of BMW OF NORTH AMERICA, INC.

Any device controlled by a processor requires input to the alert the operating program of a condition. The program processes the input information and logically activates an output of a component.

All BMW control systems are explained by the IPO principle. It is the key to understanding all BMW control system technologies.

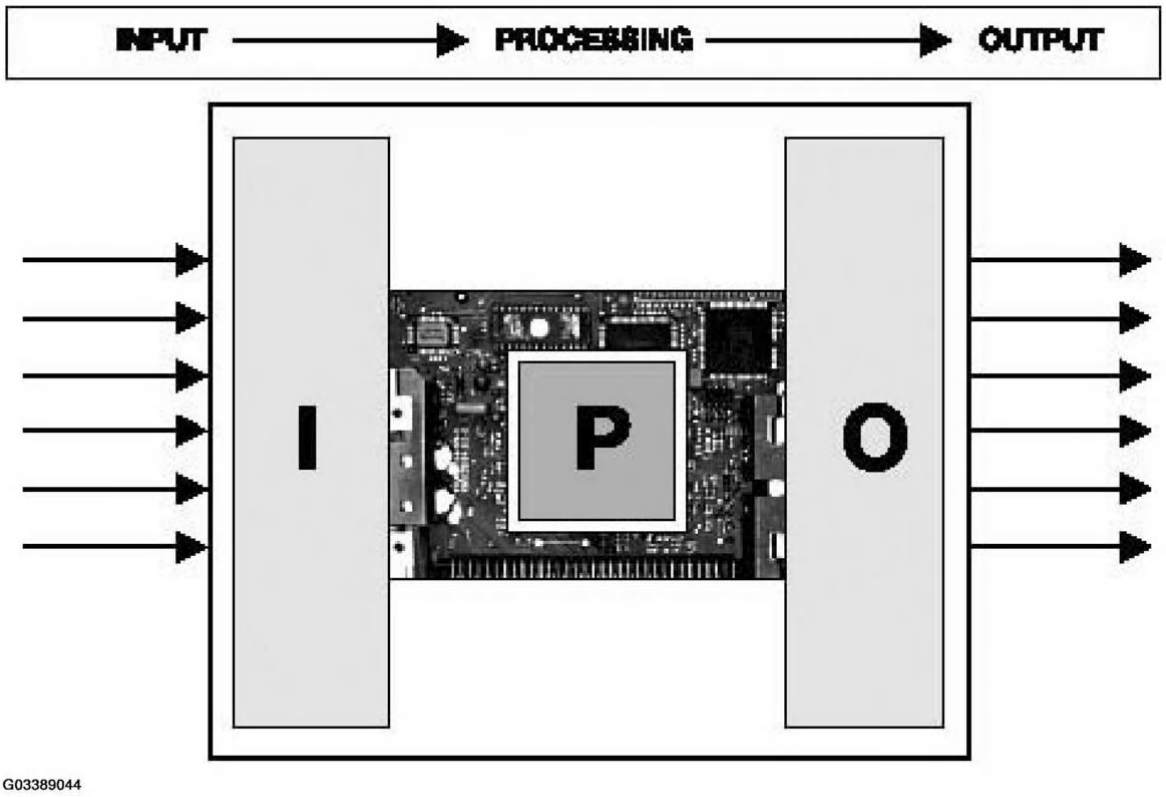


Fig. 2: I.P.O. Principle Display
Courtesy of BMW OF NORTH AMERICA, INC.

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