

3. Operate fuel pump as described earlier under **Operating fuel pump for tests**. Check that fuel pressure corresponds to specifications listed in **Table c**.

- If system pressure is low, repeat test while gradually pinching off return hose. Pressure should rise rapidly. If not, fuel pump is most likely faulty.
- If system pressure is too high, check return line from pressure regulator to tank. Check for kinks in hose. Blow compressed air through line to check for blockages. If no faults can be found, pressure regulator is most likely faulty. **See 130 Fuel Injection** for testing and replacement procedures.

WARNING —

Fuel under pressure is present during the test. Use hose clamps at all connections.

Table c. Fuel Pressure Specifications

Engine	Fuel pressure
4-cylinder M42/M44	3.0 ± 0.06 bar (43.5 ± 0.9 psi)
6-cylinder M50/S50US M52/S52US	3.0 ± 0.06 bar (43.5 ± 0.9 psi) 3.5 ± 0.06 bar (51 ± 0.9 psi)

CAUTION —

Do not use compressed air above 40 psi to blow out lines or components. Internal damage to components may result.

4. When finished, disconnect pressure gauge.

Fuel delivery volume, testing

1. Disconnect return line from fuel rail in engine compartment.
2. Connect a length of hose to fitting on fuel rail and place open end of hose in a suitable container for catching fuel (2-quart capacity).
3. Run fuel pump for exactly 30 seconds as described earlier under **Operating fuel pump for tests** and measure fuel collected. Refer to **Table d**.

Table d. Fuel Pump Delivery Specifications

Engine	Delivery rate (30 seconds @ 12V)
4-cylinder M42/M44	0.875 liter (0.93 qt)
6-cylinder M50/S50US M52/S52US	0.875 liter (0.93 qt) 1.12 liter (1.16 qt)

4. When finished testing, reconnect fuel line. Tighten all hose clamps.

NOTE —

It is common practice to replace the fuel filter any time the fuel pump unit is replaced.



NOTE —

On 1996 and later 4-cylinder cars, use BMW special tool 13 6 051 (hose with quick release coupling) to attach pressure gauge to Schrader valve fitting on top of the M44 fuel rail. See Fig. 13.

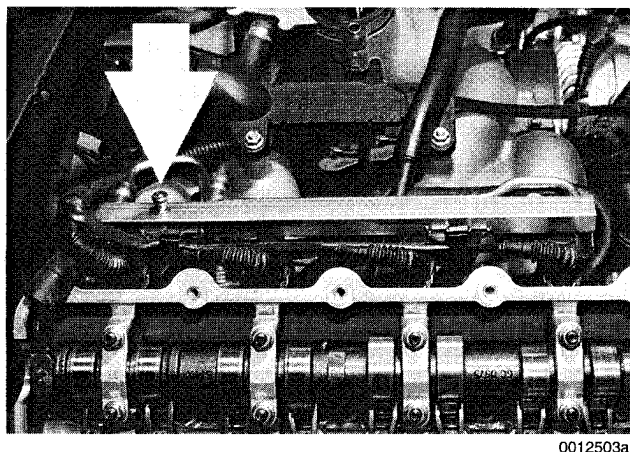


Fig. 13. Fuel rail showing location of Schrader valve fitting on M44 engine (arrow).

Later model 6-cylinder fuel systems require BMW special tool 16 1 050 to release fittings and connect the fuel gauge. See Fig. 14.

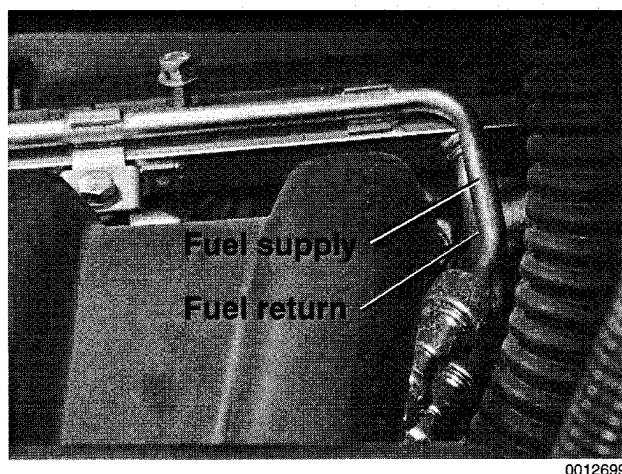


Fig. 14. Fuel lines at rear of intake manifold on M52 engine. Use BMW special tool 16 1 050 to release fittings.

If the special tools are not available, a length of fuel line and a T-fitting can be installed to the inlet fuel line and connected to a fuel gauge.

NOTE —

- Use BMW pressure gauge Part No. 13 3 060, or an equivalent. The fuel pressure gauge should have a range of 0 to 5 bar (0 to 75 psi) and must be securely connected to prevent it from coming loose under pressure.
- On cars with 6-cylinder engine, the top left-side engine cover will have to be removed to access the fuel rail.

System pressure, testing

System pressure is the pressure created by the fuel pump and maintained by the pressure regulator. See Fig. 15. System pressure is not adjustable.

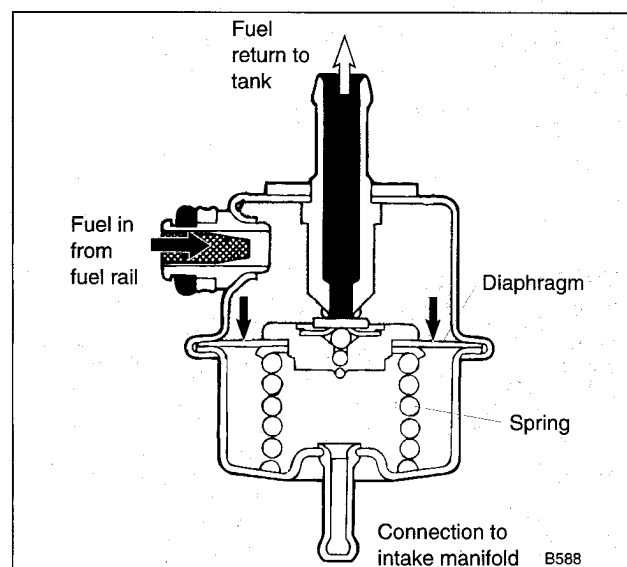
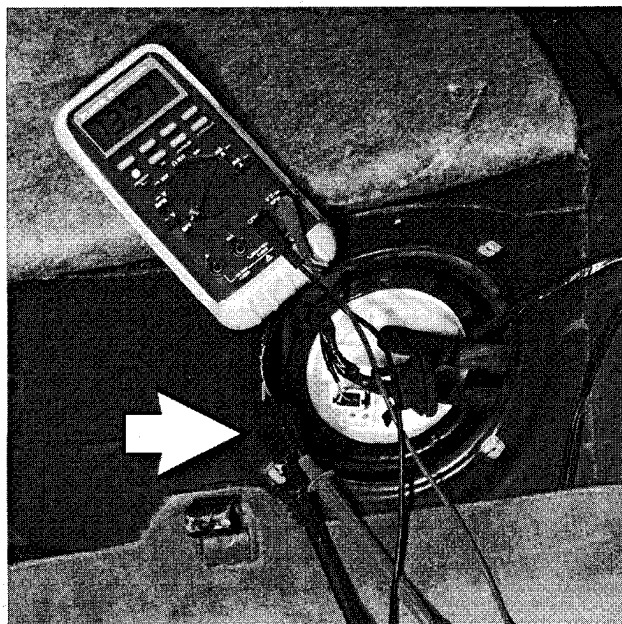


Fig. 15. Fuel pressure regulator. Fuel pressure deflects diaphragm to return fuel to tank when pressure reaches desired limit.

CAUTION —

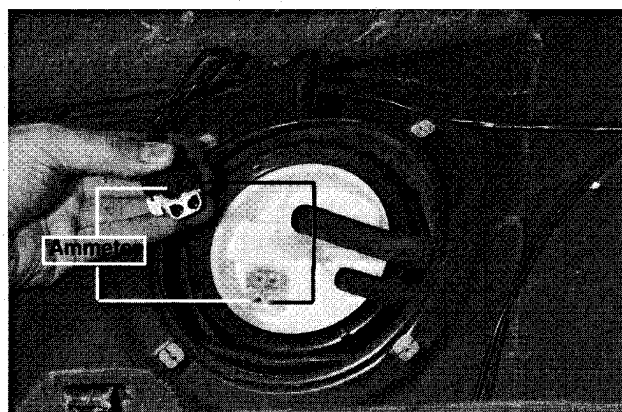
The fuel pump is capable of developing a higher pressure than that regulated by the pressure regulator. In the event the fuel pump check valve is faulty (stuck closed), make sure the fuel pressure does not rise above 6.0 bar (87 psi). Damage to the fuel lines or fuel system components could result.

1. Remove fuel tank filler cap.
2. Connect in-line a T-fitting and fuel pressure gauge to outlet hose at fuel pump.



0013188

Fig. 11. Voltage supply to fuel pump harness (black) connector being checked (arrow).



0013187

Fig. 12. Test fuel pump for current draw by attaching ammeter and jumper wire as shown.

CAUTION —

Do not allow the test leads to short to ground.

NOTE —

See **600 Electrical System—General** for information on electrical tests using a digital multimeter (DMM).

4. Run pump as described in **Operating fuel pump for tests**.

5. Compare ammeter reading with specification listed in **Table b**.

Table b. Fuel Pump Current

Maximum current consumption	5.0 amps
-----------------------------	----------

Fuel Delivery Tests

Checking fuel delivery is a fundamental part of troubleshooting and diagnosing the DME system. Fuel pressure directly influences fuel delivery. An accurate fuel pressure gauge will be needed to make the tests.

There are three significant fuel delivery values to be measured:

- **System pressure**—created by the fuel pump and maintained by the pressure regulator.
- **Fuel delivery volume**—created by the fuel pump and affected by restrictions, such as clogged fuel filter.
- **Residual pressure**—the pressure maintained in the closed system after the engine and fuel pump are shut off.

Procedures for measuring the first two quantities are described here.

Residual fuel pressure is checked using the procedure detailed in **130 Fuel Injection**.

Relieving fuel pressure and connecting fuel pressure gauge

WARNING —

- Gasoline is highly flammable and its vapors are explosive. Do not smoke or work on a car near heaters or other fire hazards when diagnosing and repairing fuel system problems. Have a fire extinguisher available in case of an emergency.
- When working on an open fuel system, wear suitable hand protection. Prolonged contact with fuel can cause illnesses and skin disorders.

CAUTION —

Cleanliness is essential when working with fuel circuit components. Thoroughly clean the unions before disconnecting fuel lines

To prevent fuel from spraying on a hot engine, system fuel pressure should be relieved before disconnecting fuel lines. One method is to tightly wrap a shop towel around a fuel line fitting and loosen or disconnect the fitting.

Measuring fuel pressure requires special tools. Earlier cars use pressure hose with clamps for fuel delivery. These can be attached to a fuel pressure gauge below the intake manifold.

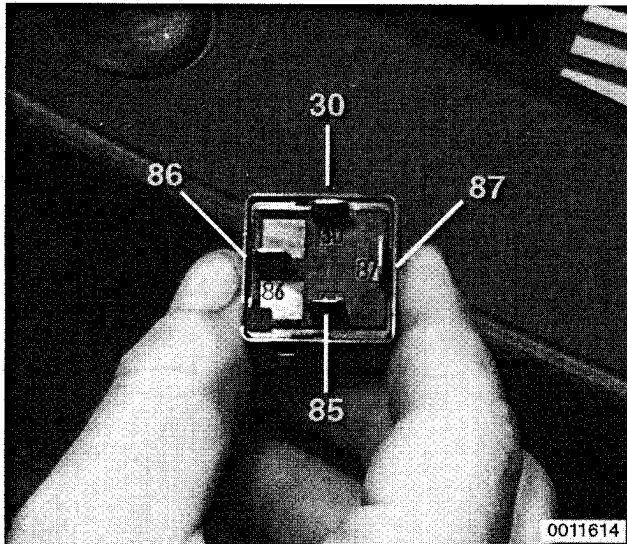


Fig. 9. Fuel pump relay terminal identification.

Fuel Pump Electrical Tests

Troubleshooting of any fuel pump fault should begin with checking the fuel pump fuse and the fuel pump relay. The DME main relay should also be checked.

NOTE —

Special tools are required for some of the tests described here.

Fuel pump electrical circuit, testing

The fuel pump electrical circuit diagram is shown in Fig. 10.

CAUTION —

Fuse and relay locations may vary. Use care when troubleshooting the electrical system at the fuse/relay panel. To resolve problems in identifying a relay, see an authorized BMW dealer.

1. Remove rear seat cushion, pull right side insulation mat back to expose fuel tank access cover. Remove cover to expose wiring connections.
2. Remove fuel pump relay and operate fuel pump as described under **Operating fuel pump for tests** earlier. Pump should run. Disconnect jumper wire when finished.
3. If fuel pump does not run, disconnect black harness connector from tank sender unit. With jumper wire connected as described in step 2 above, check for positive (+) battery voltage at harness connector terminals. See Fig. 11.

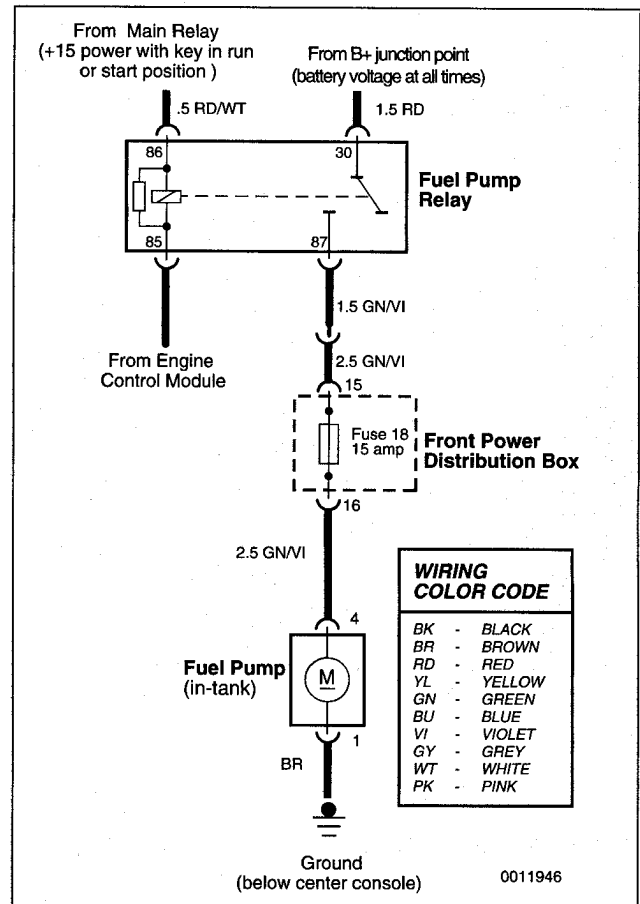


Fig. 10. Fuel pump electrical circuit.

4. If voltage and ground are present, fuel pump is probably faulty. If there is no voltage, check wiring from fuel pump relay and make sure relay is functioning correctly.

Fuel pump power consumption, testing

NOTE —

- To achieve accurate test results, the battery voltage at the connector should be approximately 13 volts. Charge the battery as necessary.
- A higher than normal power consumption usually indicates a worn fuel pump, which may cause intermittent fuel starvation due to pump overheating and seizure. The only remedy is pump replacement. Be sure to check that the return line and the pump pickup are not obstructed before replacing the pump.

1. Remove rear seat cushion, pull right side insulation mat back to expose fuel tank access cover. Remove cover to expose wiring connections.
2. Disconnect (black) harness connector from fuel pump.
3. Connect an ammeter and an insulated jumper wire between terminals in connector and corresponding pump terminals. See Fig. 12.

FUEL PUMP



0013142

Fig. 7. Fuel sender and pump assembly.

Fuel level sender (left side), removing and installing

The procedure for removing and replacing the left side fuel level sender is similar to that used for the right side. There is no fuel pump on the left side.

FUEL PUMP

The electric fuel pump is mounted in the fuel tank in tandem with the right side fuel level sender. The fuel pump delivers fuel at high pressure to the fuel injection system. A pressure regulator maintains system pressure. The quantity of fuel supplied exceeds demand, so excess fuel returns to the fuel tank via a return line. See **130 Fuel Injection** for more information on system pressure and the fuel pressure regulator.

NOTE —

Fuel pump removal procedures are given earlier under **Fuel level sender (right side) and fuel pump, removing and installing.**

Fuel Pump Fuse and Relay

The fuel pump is operated by a fuel pump relay located in the power distribution box. The fuel pump circuit is protected by fuse no. 18 located in the power distribution box. See Fig 8.

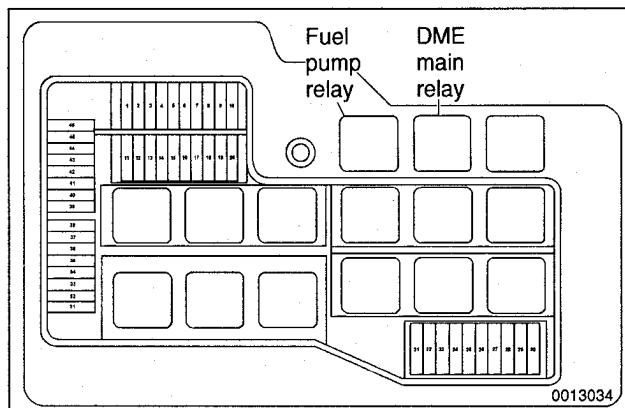


Fig. 8. Fuel pump relay location in power distribution box.

The DME engine control module (ECM) and the DME main relay supply power to the coil side of the fuel pump relay. During starting, the fuel pump runs as long as the ignition switch is in the start position and continues to run once the engine starts. If an electrical system fault interrupts power to the fuel pump, the engine will not run.

Operating fuel pump for tests

To operate the fuel pump for testing purposes without having to run the engine, the fuel pump relay can be bypassed to power the pump directly.

To run the fuel pump, remove the relay and connect the socket for relay terminal 30 to the socket for relay terminal no. 87 with a fused jumper wire. Relay terminal identification is shown in Fig. 9. After completing the tests, remove the jumper wire.

CAUTION —

Relay locations may vary. Use care when identifying relays and when troubleshooting the electrical system at the fuse/relay panel. The fuel pump relay is a four pin relay and has a 1.5 mm² red wire at terminal 30 in the relay socket. If in doubt, consult an authorized BMW dealer.

NOTE —

The jumper wire should be 1.5 mm² (14 ga.) and include an in-line fuse holder with a 16 amp fuse. To avoid fuse/relay panel damage from repeated connecting and disconnecting, also include a toggle switch. A heavy-duty jumper, BMW tool no. 61 3 050, is also available from an authorized BMW dealer.

If the pump does not run with the jumper installed, the fault could be in the fuel pump or the wiring to the pump. Check the pump and its wiring as described below.

FUEL PUMP

Fuel level senders, testing

The left and right fuel level sending units are wired in series. The fuel gauge receives a signal that is the average of the two input values.

1. Remove rear seat cushion, lift up insulation mats, and remove both fuel tank access covers.
2. Disconnect white plug on each sending unit. See Fig. 6.

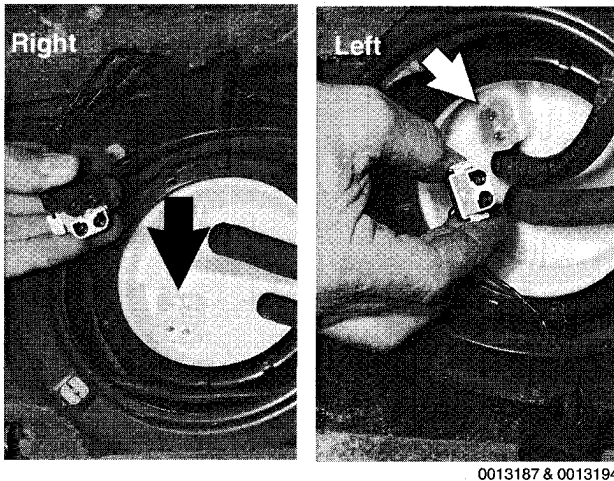


Fig. 6. Fuel pump/level sender terminal identification. Check resistance at terminals of white connectors (arrows).

3. Check resistance value of each sending unit. Values should be the same.
5. If values are different, remove sending units as described below, and check resistance values across terminals. **Table a** lists resistance values for senders at various float positions.

NOTE —

The compensating siphon pump (Fig. 1) maintains the fuel level between the right and left tank lobes. If the resistances are different between the left and right senders, remove the senders and visually inspect the level in each lobe. If the level is different, check the siphon compensating pump.

Table a. Fuel Level Sender Resistances

Float position	Test result (ohms)
Right side empty	10 ohm $\pm$ 2
Right side full	250 ohm $\pm$ 5
Left side empty	10 ohm $\pm$ 2
Left side full	250 ohm $\pm$ 5

Fuel level sender (right side) and fuel pump, removing and installing

1. Disconnect negative (–) cable from battery.

CAUTION —

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

2. Drain fuel from tank as described earlier.

WARNING —

Always unscrew the fuel tank cap to release pressure in the tank before working on the tank or lines.

3. Remove rear seat cushion and pull back insulation pad under right side.
4. Remove screws holding right fuel tank access cover. Remove cover.
5. Label fuel hoses. Disconnect hoses and harness connectors from fuel sending unit and fuel pump.
6. Unscrew threaded collar from fuel pump/fuel level sender. Slowly withdraw assembly from tank, allowing fuel to drain off. See Fig. 7.
 - If necessary, push level sender arm toward fuel pump assembly to facilitate removal.

NOTE —

BMW special tool no. 16 1 020 should be used to remove and install the threaded collar. Damage to the collar may result if the special tool is not used.

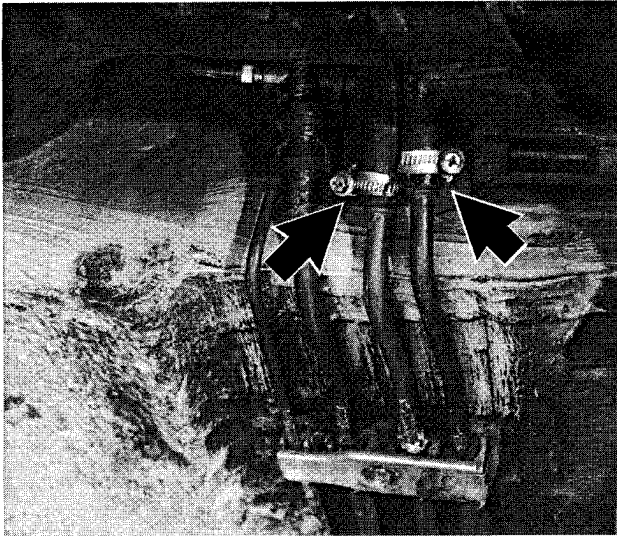
WARNING —

Fuel may be spilled. Do not smoke or work near heaters or other fire hazards.

7. Using a new sealing ring, install pump and sending unit, being sure that fuel line connections point in same direction as they came out.
8. Reconnect harness connector and hoses. Fill tank and check for leaks by running engine. Install access cover and its mounting screws. Reconnect negative (–) cable to battery.

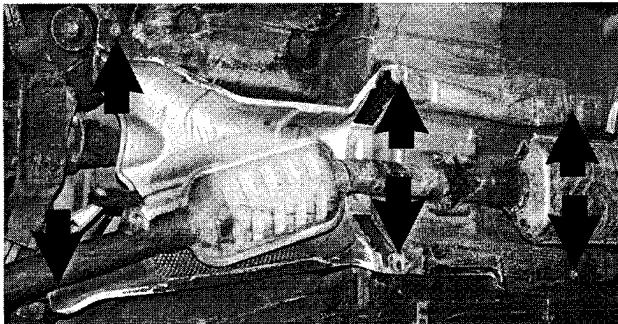
CAUTION —

Before starting the engine, fill the fuel tank with at least 1.5 gallons (5 liters) of fuel. The pump will be damaged if you run it without fuel.



0013191

Fig. 4. Pinch off supply and return fuel hoses (arrows) before disconnecting from rigid metal lines.



0013143

Fig. 5. After removing exhaust system, remove heat shield screws (arrows) and heat shield.

9. Working underneath car, loosen hose clamp and disconnect filler hose.
10. Support tank from below. Remove tank strap mounting bolts. Lower and remove tank, disconnecting right side vent and other hoses/electrical connectors as necessary.
11. Installation is reverse of removal.
 - Always use new seals, gaskets, O-rings, and hose clamps.
 - Inspect hoses and replace any that are chafed, dried out or cracked.
 - Inspect heat shield and replace if corroded.
 - Inspect rubber buffers and liners on fuel tank, support straps and on underside of body. Replace rubber parts that are hardened or damaged.

CAUTION —

- Before starting the engine, fill the fuel tank with at least 1.5 gallons (5 liters) of fuel to prevent damaging a dry fuel pump.
- If the filler neck has been removed from the body, be sure to reattach the neck's grounding screw (where applicable). Check electrical resistance between the ground tab and wheel hub. The resistance should be no higher than 0.6 ohms.

Tightening Torques

- Fuel tank to body 23 Nm (17 ft-lb)
- Hose clamps (10 mm-16 mm dia.) . . 2.0 Nm (18 in-lb)

Fuel Tank Evaporative Control System

The fuel tank evaporative control system is used to vent the fuel tank to a charcoal canister, which is then purged by engine vacuum during normal engine operation. This controls emission of raw hydrocarbons (fuel) to the atmosphere. See Fig. 1.

A fuel expansion tank, located under the right rear fender, traps overflow fuel and incorporates extra fuel tank plumbing.

Starting with 1996 models, OBD II standards require that the fuel tank evaporative control system be monitored for leaks. This is accomplished using the fuel tank pressure sensor, the vent shut off valve, and the evaporative purge valve.

NOTE —

On most early cars (1992-1995), the charcoal canister is in the engine compartment. On later cars, the charcoal canister is under the spare tire in the luggage compartment.

FUEL LEVEL SENDERS

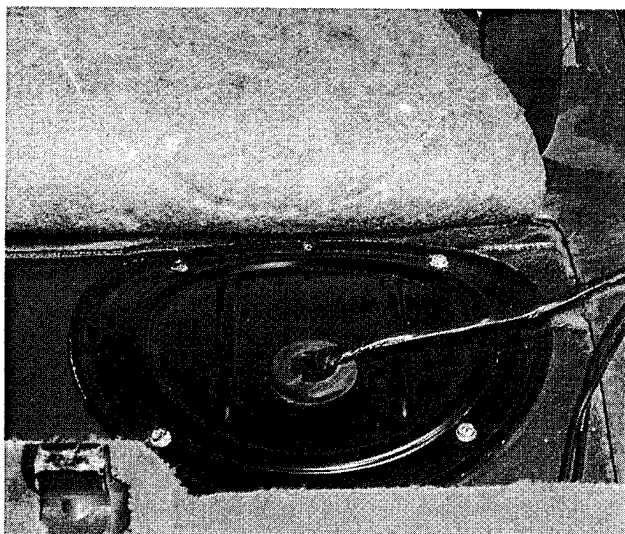
The E36 model uses a two-lobed fuel tank and each lobe of the tank has its own fuel level sending unit.

The right side fuel level sender is integrated with the fuel pump. Each sender has a float connected to a variable resistance for fuel level. When replacing the sender/pump assembly always replace hose clamps, gaskets and O-rings.

WARNING —

When removing the fuel level sender or the fuel pump, the fuel tank should be emptied.

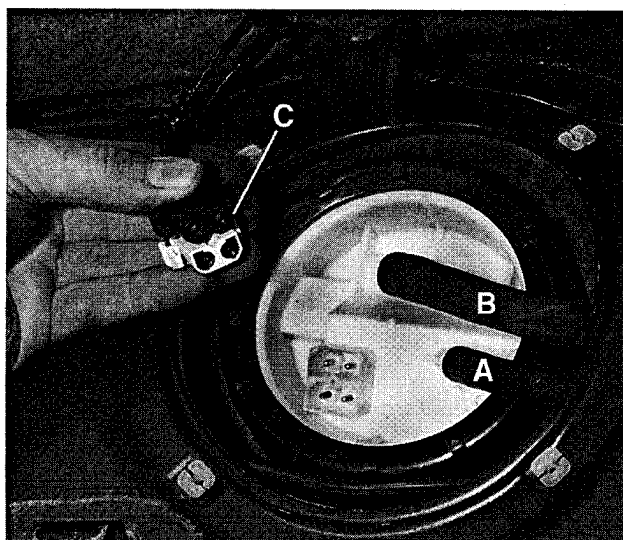
2. Remove fuel tank filler cap.
3. Remove rear seat cushion and pull back insulation mats to expose fuel tank access covers. See Fig. 2.



0013140

Fig. 2. Right side fuel tank access cover under rear seat cushion.

4. Remove right and left access covers to expose fuel hoses and electrical connections at tank.
5. Label fuel hoses. Then disconnect hoses and harness connectors from fuel sending units and fuel pump. See Fig. 3.



0013187

Fig. 3. Fuel pump/fuel level sender assembly in top of fuel tank (right side shown). Disconnect supply hose (A), return hose (B) and harness connector (C).

6. Unscrew threaded collars from fuel tank. Slowly withdraw fuel sender assemblies from tank, allowing fuel to drain off.

NOTE —

- If necessary, push fuel level sender arm toward fuel pump assembly to facilitate removal.
- BMW special tool no. 16 1 020 should be used to remove and install the threaded collar. Damage to the collar may result if the special tool is not used.
- Pump out contents of each tank lobe using approved pumping/extraction equipment and flexible fuel-grade hose.

WARNING —

Fuel may be spilled. Do not smoke or work near heaters or other fire hazards.

7. Installation of sending units is reverse of removal, noting the following:
 - Use new sealing rings when installing pump/sending unit assemblies.
 - Be sure that fuel line connections point in same direction as they came out.
 - Fill tank and check for leaks by running engine.

CAUTION —

Before starting the engine, fill the fuel tank with at least 1.5 gallons (5 liters) of fuel. The pump will be damaged if you run it without fuel.

Fuel tank, removing and installing

1. Disconnect negative (–) cable from battery.

CAUTION —

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

2. Remove fuel tank filler cap and drain tank as described earlier.
3. Working in left access tank access hole (under rear seat cushion), remove vent pipe from tank.
4. Working inside car, disconnect parking brake cable ends from parking brake lever. See **340 Brakes**.
5. Working underneath car, gently pry fuel lines away from retaining bracket in front of tank. Remove clamps and disconnect fuel hoses as shown in Fig. 4.
6. Remove exhaust system and heat shield as described in **180 Exhaust System**. See Fig. 5.
7. Remove driveshaft. See **260 Driveshaft**.
8. Pull parking brake cables backward away from bottom of fuel tank, disengaging them from brackets as needed.

160-2 FUEL TANK AND FUEL PUMP

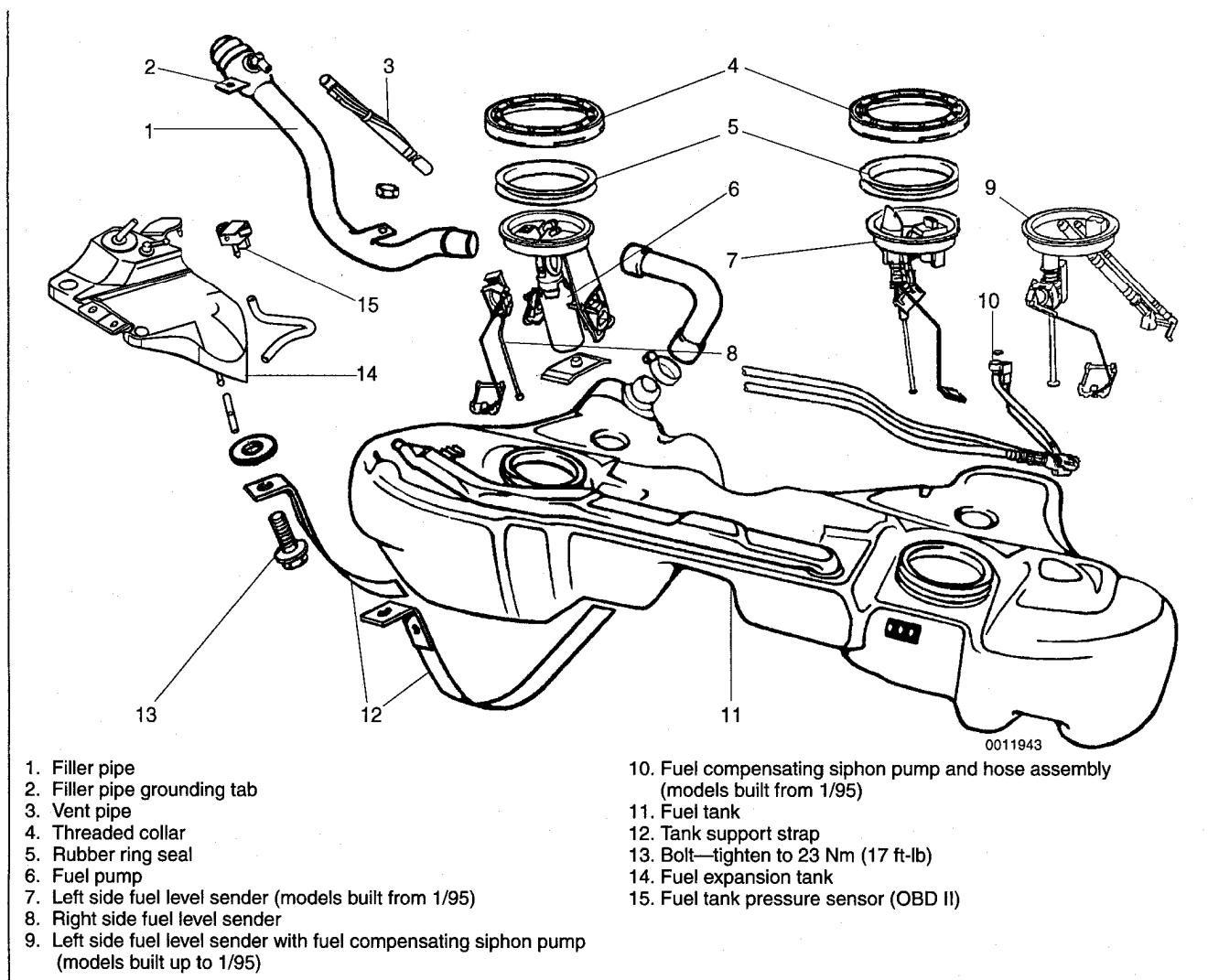


Fig. 1. E36 fuel tank assembly.

FUEL TANK AND LINES

The plastic fuel tank is mounted beneath the center of the car (beneath rear seat). Mounted in the fuel tank are the fuel pump and fuel level sending units. Connecting lines for the evaporative emission control system and expansion tank are also attached to the tank. When performing the procedures that follow, refer to Fig. 1.

Fuel tank capacity for E36 models

- All ex. 1996 M3 (3.0 L) 65 liters (17.0 gal)
- 1996 M3 (3.0 L) models 62 liters (16.4 gal)

Fuel tank, draining

The fuel tank should be drained into an approved storage unit or another car's fuel tank.

WARNING —

- Before removing the tank, be sure that all hot components such as the exhaust system, are completely cooled down.
- Fuel may be spilled. Do not smoke or work near heaters or other fire hazards.

1. Disconnect negative (–) cable from battery.

CAUTION —

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

160 Fuel Tank and Fuel Pump

GENERAL	160-1	Operating fuel pump for tests	160-6
FUEL TANK AND LINES	160-2	Fuel Pump Electrical Tests	160-7
Fuel tank, draining	160-2	Fuel pump electrical circuit, testing	160-7
Fuel tank, removing and installing	160-3	Fuel pump power consumption, testing	160-7
Fuel Tank Evaporative Control System	160-4	Fuel Delivery Tests	160-8
FUEL LEVEL SENDERS	160-4	Relieving fuel pressure and connecting fuel pressure gauge	160-8
Fuel level senders, testing	160-5	System pressure, testing	160-9
Fuel level sender and fuel pump (right side), removing and installing	160-5	Fuel delivery volume, testing	160-10
Fuel level sender (left side), removing and installing	160-6		
FUEL PUMP	160-6		
Fuel Pump Fuse and Relay	160-6		

TABLES

a. Fuel Level Sender Resistances	160-5
b. Fuel Pump Current	160-8
c. Fuel Pressure Specifications	160-10
d. Fuel Pump Delivery Specifications	160-10

GENERAL

This repair group covers service information specifically for the fuel supply system. Information on the fuel injection system is covered in **130 Fuel Injection**.

The cautions and warnings on this page should be observed when servicing the fuel system.

NOTE —

Fuel filter replacement is covered in **020 Maintenance Program**.

WARNING —

- The fuel system is designed to retain pressure even when the ignition is off. When working with the fuel system, loosen the fuel lines slowly to allow residual fuel pressure to dissipate gradually. Avoid spraying fuel.
- Before beginning any work on the fuel system, place a fire extinguisher in the vicinity of the work area.
- Fuel is highly flammable. When working around fuel, do not disconnect any wires that could cause electrical sparks. Do not smoke or work near heaters or other fire hazards.
- Always unscrew the fuel tank cap to release pressure in the tank before working on the tank or lines.
- Do not use a work light near any fuel. Fuel may spray onto the hot bulb causing a fire.
- Make sure the work area is properly ventilated.

CAUTION —

- Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.
- Before making any electrical tests with the ignition turned on, disable the ignition system as described in **120 Ignition System**. Be sure the battery is disconnected when replacing components.
- To prevent damage to the ignition system or the electronic fuel system components, including the control unit, always connect and disconnect wires and test equipment with the ignition off.
- Cleanliness is essential when working with the fuel system. Thoroughly clean the fuel line unions before disconnecting any of the lines.
- Use only clean tools. Keep removed parts clean and sealed or covered with a clean, lint-free cloth, especially if completion of the repair is delayed.
- Do not move the car while the fuel system is open.
- Avoid using high pressure compressed air to blow out lines and components. High pressure can rupture internal seals and gaskets.
- Always replace seals and O-rings.

GENERAL