



Usable Fuel Volume vs. Level Sensor Resistance

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. The purpose of this standard is to determine the volume of usable fuel in the fuel tank at each value of level sensor resistance. This test is used for the development of an initial fuel gauge calibration.

1.2 Applicability. Passenger cars and light or medium duty trucks with gasoline, including ethanol fuel blends, and diesel fuel systems.

1.3 Remarks. This is a test of the fuel storage system, including the fuel tank shell, fuel pump, and fuel level sensor. The fuel pump is used to extract fuel from the tank and deposit it into a measuring device. While draining the tank, the cumulative volume of drained fuel is recorded at each change in level sensor resistance. Calculations at the end of test convert the data into a summary of usable fuel volume in the tank for each value of level sensor resistance.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14474 (ID) GMW14508

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

3 Resources

3.1 Facilities. Laboratory capable of recording data while dispensing and draining fuel.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Test Fuel. Gasoline, diesel, ethanol blends or Stoddard are acceptable.

3.2.2 Fuel Dispenser. Use nozzle and fuel flow rate as specified by G-1 fills in GMW14508 for gasoline fuel systems. Use nozzle and fuel flow rate as specified by D-1 fills in GMW14508 for diesel fuel systems.

3.2.3 Power Supply. Use variable 0 V to 12 V power source to power the fuel pump(s). Depending upon pump current draw, the power supply may need to supply up to 15 A current.

3.2.4 Flow Restrictor. A restrictor device should be placed in the fuel line that is attached to the fuel pump outlet. The purpose of the flow restrictor is to create sufficient backpressure on the fuel pump to properly operate the pressure regulator and any jet pumps.

3.2.5 Fuel Measuring Device. A graduated cylinder with measurement increments of 0.1 L (100 mL) or smaller is required.

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3.2.6 Fuel Level Height Measurement (Optional). A means of measuring fuel height in the tank(s) with accuracy of $\pm 0.05\%$.

3.3 Test Vehicle/Test Piece.

3.3.1 Test Fixture. The test fixture should simulate fuel tank mounting in an actual vehicle. Correct fuel tank straps and mounting hardware should be used. Also ensure that any shields or isolators that mount between the straps and the tank, or between the tank and the vehicle body, are present. Fuel tank orientation with reference to ground is critical and must be correct. Setup for fuel system testing should simulate the actual vehicle configuration, e.g., account for an internal pump, suction type fuel feed system, or other type system configuration.

3.4 Test Time.

Calendar time: 1 d

Test time: 6 h

Coordination time: 2 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Laboratory testing personnel with fuel system test experience.

4 Procedure

4.1 Preparation.

4.1.1 Instrumentation. Electrical resistance measurement, with a minimum resolution of 0.1 Ohm (Ω), is required at each fuel level.

4.1.2 Test Setup.

4.1.2.1 Fuel Tank Conditioning. See GMW14508.

4.1.2.2 Fuel Pump Module (FPM) Verification. Perform resistance versus height check on all FPM before test and document in test report.

4.1.2.3 Fuel Level Height Measurement (Optional). Install vertical height device(s) into the tank. one (1) on each side for a saddle tank, as close to the Fuel Level Sensor (FLS) float as possible without touching it.

4.1.2.4 Electrical Connections. Use the external electrical connectors on the fuel pump module(s) to connect wires for recording the electrical resistance of the fuel level sensor(s) and supply voltage of 0 Volts Direct Current (VDC) to 12 VDC to the fuel pump. Do not make or break live connections.

Note: Prior to starting the test and while the tank is properly installed in the test fixture, ensure the fuel level sender arm goes to the empty and full stops.

4.1.2.5 Fuel Line and Calibrated Test Basin. The hose or line between the fuel pump module and the receptacle into which fuel will be drained should be fuel resistant. Any metal components in the fuel flow path must be electrically grounded to dissipate static charge. Use of a large graduated cylinder as the fuel storage receptacle is recommended as it can both store the drained fuel and provide a cumulative volume measurement during the test.

Note: In 4.1.2.6 through 4.1.2.9, for dual tank systems with low pressure pump in secondary tank, test each tank separately as in testing a single basin tank.

4.1.2.6 Set Flow Rate Mechanical Returnless Fuel System (MRFS). Install a manually-adjustable flow restriction device in the fuel hose between the fuel pump module and the storage receptacle. Dispense 15 L to 19 L (4 gal to 5 gal) of fuel into tank to ensure that fuel level sensor moves from zero (0). On dual basin tanks, dispense enough fuel so that the secondary sensor moves from zero (0). Energize fuel pump. Adjust flow, 134 L/h for single basin or 65 L/h for dual basin, unless otherwise specified by the requester. After setting the flow rate, allow fuel pump to operate until all remaining usable fuel has drained without running pump dry for more than 5 minutes. De-energize pump when tank is empty. Leave flow setting as is.

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4.1.2.7 Set Flow Rate Electronic Returnless Fuel System (ERFS). Install a manually adjustable flow restriction device in the fuel hose between the fuel pump module and the storage receptacle. Dispense fuel into the tank until it contains up to one half ($\frac{1}{2}$) of its usable capacity. Energize the fuel pump. Adjust pump voltage and restricted flow to that specified by requester. After setting the flow, allow fuel pump to operate until all remaining usable fuel has drained. De-energize pump when tank is empty. Leave voltage and flow settings as is.

4.1.2.8 Set Flow Rate Diesel System (Suction System). Install external fuel pump with a bypass to the return fuel line. The primary line will then continue to the storage receptacle. Dispense fuel into the tank until it contains up to one half ($\frac{1}{2}$) of its usable capacity. Energize the fuel pump. Adjust flow of both primary and bypass valves to achieve proper operation or to that specified by requester. After setting the flow, allow fuel pump to operate until all remaining usable fuel has drained. Deenergize pump when tank is empty. Leave voltage and flow settings as is.

4.1.2.9 Set Flow Rate Diesel System (Feed Line Driven). Install a manually adjustable flow restriction device in the fuel hose between the fuel pump module and the storage receptacle. Dispense 15 L to 19 L (4 gal to 5 gal) of fuel into tank to ensure that fuel level sensor moves from zero. On dual basin tanks dispense enough fuel so that the secondary sensor moves from zero (0). Energize fuel pump. Adjust flow, 160 L/h for single basin or 80 L/h for dual basin, unless otherwise specified by the requester. After setting the flow rate, allow fuel pump to operate until all remaining usable fuel has drained without running pump dry for more than 5 minutes. Deenergize pump when tank is empty. Leave flow setting as is.

4.2 Conditions.

4.2.1 Environmental Conditions. The temperature of the test room and the test fuel should be maintained at a constant level within ± 1 °C to avoid causing thermal expansion or contraction of the liquid fuel.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Fill Tank. Fill the tank using the 3-Click Fill Method from GMW14508. The dispensed fuel should have the same temperature as the test room to avoid thermal expansion or contraction of the fuel during the test.

Note: Optionally, instead of a 3-Click Fill, fill to volume as dictated by the engineer, or to advertised fill capacity plus dynamic unusable.

4.3.2 Drain Fuel and Record Level Sensor Output. Record the electrical resistance of the fuel level sensor(s) when the tank is full, as well as the indicated fuel level height (optional). Keep the flow restrictor set at the level determined in 4.1.2.6, 4.1.2.7, or 4.1.2.8 and energize the fuel pump to start draining the tank.

4.3.2.1 Fuel Systems with One (1) Fuel Level Sensor.

4.3.2.1.1 Monitor the electrical resistance of the fuel level sensor while the fuel is draining.

4.3.2.1.2 Each time the sensor changes resistance, record the new resistance value and the cumulative volume of fuel that has been drained at the time of the change as well as (optional) the indicated fuel level height.

4.3.2.1.3 When the tank is completely drained, deenergize the pump. Measure with a graduated cylinder the undrained volume of fuel remaining in the tank and record this value.

4.3.2.2 Fuel Systems with Multiple Level Sensors (Single Tank with Dual Basins).

4.3.2.2.1 Monitor the electrical resistance of each fuel level sensor while the fuel is draining.

4.3.2.2.2 Each time any of the sensors change resistance, record the resistance value of all sensors at that time and the cumulative volume of fuel that has been drained when the change occurred, as well as (optional) the indicated fuel level height in both basins.

4.3.2.2.3 When the tank is completely drained, deenergize the pump. Measure with a graduated cylinder the undrained volume of fuel remaining in the tank and record this value.

4.3.2.3 Dual Tank Fuel Systems. Test each tank separately using the method described in 4.3.2.1.

4.3.2.4 Diesel Fuel Systems. Refer to 4.3.2.1 or 4.3.2.2 for the procedure which describes the vehicle diesel system architecture. The setup for diesel system testing should simulate the actual vehicle configuration, e.g., account for an internal pump, suction type fuel feed system, or other type system configuration.

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