



Fuel Level Sensing Accuracy and Reserve Volumes

1 Scope

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. To determine:

- Fuel gauge reading versus usable fuel volume
- Fuel level sender unit resistance versus usable fuel volume
- Low-fuel warning device – usable fuel volume when activated

1.2 Foreword. This procedure examines the fuel level measuring components individually within a system. It does this by:

1.2.1 Evaluating the ability of the fuel sender to determine the amount of fuel in the tank, and

1.2.2 Determining the accuracy of the instrument cluster fuel gauge (with the vehicle power distribution system) to display fuel level when given the input resistance from the fuel level sender unit.

1.3 Applicability. All vehicles with fuel level measuring systems.

2 References

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

2.1 External Standards/Specifications.

SAE J398

2.2 GM Standards/Specifications.

GMW14474

GMW14508

2.3 Additional References. None.

3 Resources

3.1 Facilities. A facility with a level floor and provisions to handle fuel spillage, disposal and vapor. It must also have vehicle grounding straps to minimize static charge build-up.

3.2 Equipment.

3.2.1 Tank Drain.

3.2.1.1 In-Tank Fuel Pump Design. Equipment may be needed to run pump without vehicle running if the facilities do not allow a vehicle's engine to be running. In this case, equipment may need to be vapor-proof or remotely located to guard against fuel ignition.

3.2.1.2 Remote Fuel Pump Design. Equipment to drain fuel tank through the fuel supply line.

3.2.2 Two devices capable of measuring current and voltage accurately to 0.2% full scale. These will be used to measure current through and voltage across the fuel level sending unit.

Two devices are required for each fuel level sender unit (i.e., if there is a secondary fuel tank).

3.2.3 Short electrical lead with banana plugs to be used to bypass the current measuring multimeter during portions of the test.

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3.2.4 Equipment for measuring fuel removed from the tank.

3.2.5 Optional. Fuel dispensing equipment meeting the requirements of procedure GMW14508.

3.2.6 A copy of procedure GMW14508 (Fuel Tank Capacity and Filling Performance) may be useful as a reference.

3.2.7 A laptop computer or equivalent device to read the vehicle and fuel level information.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time.

3.4.1 The following is an estimate on the amount of time (work hours) needed to perform this procedure.

Preparation, other downtime, actual test, and analysis of data are considered in capturing a total calendar time.

Calendar time: 2 days

Test hours: 6 hours

Coordination hours: 4 hours

3.5 Test Required Information. Production or test intent vehicle equipped with:

- Fuel tank
- Fuel tank attachment hardware and torque (to assure proper tank shape)
- Sending unit
- Instrument cluster fuel gauge
- Associated vehicle wiring
- Tank venting system
- Fuel input module, if applicable. This might be the electronic module that has input(s) for the fuel sender(s) (e.g., Powertrain Control Module (PCM), cluster, or other controller)
- Low fuel level warning devices
- Vehicle heights within specifications
- Curb mass
- Any other components of the fuel level measuring system

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation.

4.1.1 The engineer shall record on Data Sheet B1:

4.1.1.1 Test and vehicle information.

4.1.1.2 Determine if vehicle engine is required to be running for accurate fuel gauge readings. This procedure specifies ignition **ON** and engine **OFF** for testing, due to limitations of some facilities for testing with engines running. If engine is required to be running, for fuel sensing, then modify this procedure accordingly.

4.1.1.3 If a vehicle uses dual tanks which result in a deadband area from dual fuel sending units, then record appropriate adjustments to test conditions. For example, some vehicles may use a time filter to estimate the fuel used in this deadband area (this may require slower fuel drain). Another example might be that some vehicles might estimate fuel use by injector on-time (in which case the engine must be running for tests).

4.1.1.4 Record buffer wait time if a period of time is necessary for the system electronics to properly read the fuel gauge.

4.1.2 Do not use a "green" or unconditioned fuel tank. Any fuel tanks used for this test procedure should be conditioned to achieve a stabilized volume and also proper performance of vent valves.

4.1.2.1 A metallic fuel tank should be conditioned by filling it completely and then emptying it prior to doing other fills.

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4.1.2.2 A plastic fuel tank should be conditioned by installing the tank in the test fixture, filling it with fuel to the estimated customer usable volume, and soaking it at room temperature for at least one (1) month. This procedure is similar to the method described in SAE J398.

An alternative method for conditioning a plastic fuel tank is to install the tank in the test fixture, fill it with 21 °C (70 °F) fuel to the estimated customer usable volume, and place the tank/fixture in a thermal chamber at 60 °C (140 °F) for eight (8) hours. Allow the tank to vent. Turn off chamber heat after the 8 hour soak. Leave tank/fixture in the chamber as it cools for approximately 16 hours. Remove tank/fixture from chamber after the 24 hour cycle of heating and cooling is complete.

4.1.3 Run vehicle to highway dynamic unusable capacity per GMW14474.

4.1.4 Place vehicle on level ground and perform a three (3)-click fill per GMW14508.

4.1.5 Connect power supply in parallel with vehicle battery and connect multimeters to system.

4.1.6 If vehicle shares an indicator lamp for low-fuel with other warning signals, then disconnect any sensors (other than the low fuel sensor) that may illuminate the lamp with ignition **ON** and engine **OFF**.

4.1.7 Set up equipment to remove fuel from the fuel feed line unless fuel pump is a jet pump design. If fuel pump is a jet pump design, then set up equipment to remove fuel from the fuel return line.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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 Measurement conditions. The following shall apply to each measurement made at all tank volumes.

4.3.1.1. The ignition shall be in the **ON** position and engine **OFF**, unless otherwise specified by engineering in Section 4.1.1.

4.3.1.2 There shall be 68 kg (150 lb) ballast in the driver's seat. If an observer is used instead of ballast, the observer's weight should be 68 ± 18 kg (150 ± 40 lb).

4.3.1.3 The power supply to the battery shall be set at 14.5 V.

4.3.1.4 All electrical loads sharing a ground with the fuel level sender and the fuel gauge (reference 4.1.1), shall be energized. It is particularly important that the fuel pump be running if it shares an electrical ground.

4.3.1.5 Prior to recording fuel gauge reading, a short lead shall be placed across the multimeter inputs measuring current. This will bypass the additional resistance added by the ammeter circuit of the multimeter.

4.3.1.6 Enough time must be allowed, see 4.1.1.4, after moving fuel, for any buffer system to allow proper reading of the gauge.

4.3.2 Beginning at actual fuel capacity, slowly pump fuel from the tank in increments defined in Table A1. At each increment of fuel volume, determine and record the following on Data Sheet B2.

4.3.2.1 Voltage across the fuel level sending unit.

4.3.2.2. Resistance of the fuel level sending unit.

4.3.2.3 Battery voltage (only for fuel level sending units on a 12 V circuit).

4.3.2.4 Fuel level data reported by the Engine Control Module (ECM).

4.3.2.5 Fuel level gauge reading (may use engineer supplied data sheet), including:

- When any part of the fuel gauge indicator has first moved off the full mark
- When the fuel gauge indicator dial/pointer has centered on the empty mark
- Whether the low-fuel indicator is energized

4.3.3 Data Presentation. Record test results on the data sheets.

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