



## Diesel Exhaust Fluid (DEF) Cold Refill Detection

### 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 specification is to evaluate the ability to exit low-Diesel Exhaust Fluid (DEF) vehicle inducement warning states when the tank has been frozen. The use case would be when a vehicle with low-DEF has entered an inducement state and then subsequently parked overnight in a cold environment. The vehicle is tested to see if the inducement state can be disabled when filling the vehicle with liquid DEF.

**1.2 Applicability.** All passenger cars and light-duty trucks that are equipped with a DEF system.

### 2 References

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

#### 2.1 External Standards/Specifications.

ISO 22241-1

#### 2.2 GM Standards/Specifications.

GMW15784

#### 2.3 Additional References.

CG4519 (ID)

GM8762 (ID)

GMPT-5-014

(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.

**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.

**3.1.3** Climatic chamber large enough to freeze multiple DEF tanks capable to -25 °C is required.

**3.1.4** Vehicle Hoist capable of supporting vehicle weight is required.

#### 3.2 Equipment.

**3.2.1** Winter Diesel that meets GMPT-5-014 if required for ambient temperatures.

**3.2.2** Blankets or insulation to maintain cold tank temperatures during tank swaps if procedure is time consuming.

**3.2.3** Catch basins to collect dripping/spilling DEF.

**3.2.4** Instrumentation to measure DEF quality.

**3.2.5** Equipment to support vehicle to enable quick tank swaps.

**GM Confidential**

© Copyright 2017 General Motors Company All Rights Reserved

October 2017

Page 1 of 9

**3.2.6** Equipment to support extra tanks in vehicle position.

**3.2.7** Three (3) extra DEF tanks.

**3.2.8** Equipment to drain and fill the vehicle and DEF tanks with a measured quantity of DEF accurate to 200 mL.

**3.2.9** Equipment to measure the weight of each tank to confirm actual fill quantity.

**3.2.10** Jumper wiring harness for DEF Controller to body harness to allow connection to the vehicle while the tank system is not in vehicle position.

**3.2.11** Jumper wiring harness for DEF Supply line to DEF Tank Wiring Harness to allow connection to the vehicle while the tank system is not in vehicle position.

**3.2.12** Fill assembly for adding fluid to the tank using representative fill path components.

### **3.3 Test Vehicle/Test Piece.**

**3.3.1 Test Vehicle.** Program specific vehicle with instrumented Engine Control Module (ECM) and production representative DEF system, and equipment for interfacing with laptop used for data capture and operating parameter manipulation.

#### **3.3.2 DEF Quality.**

**3.3.2.1** For all tests, DEF quality shall meet ISO 22241-1 requirements.

**3.3.3 Fluid Level Measurement.** The subsystem shall meet the requirements for fluid refill detection, as listed in GMW15784 and CG4519.

**3.4 Test Time.** The following is an estimate on the amount of time needed to perform this procedure.

Calendar time: 6 days

Test time: 32 h

Coordination time: 16 h

**3.5 Test Required Information.** Connector Part Number (PN) for Body harness to DEF Controller is needed for Test Engineer (TE) to select appropriate jumper harness for test.

**3.6 Personnel/Skills.** Skilled performance or development engineer needs to be present.

## **4 Procedure**

### **4.1 Preparation.**

**4.1.1** Identify the maximum allowed vehicle loading, Gross Combined Mass Rating (GCMR) and Gross Vehicle Mass Rating (GVMR).

**4.1.2** Fill extra DEF tanks with DEF to 15% of rated capacity and support on fixtures in the climatic chamber that hold the tanks in vehicle position.

**4.1.3** Prepare vehicle to allow for ability to switch out DEF tank (i.e., use hand operated fasteners, such as wing nuts, create access panels where possible, position on hoist, etc.) If not possible to enable quick swap of tank in vehicle position, pursue developing mounting strategy for fast swap in non-original location, such as bed of truck or cargo area. Use jumper harnesses to achieve this.

**4.1.4** If ambient temperature is required, fill diesel fuel tank with a full tank of Winter Diesel. If quality of diesel is unknown, use diesel fuel anti-gel additive to ensure no freezing of diesel fuel occurs.

**4.1.5** Identify fluid level reset procedure from Calibration Engineer for manual setting of a low fluid level.

**4.1.6** Store a sufficient quantity of DEF at 0 °C to be used during the test for tank refilling.

**4.1.7** Confirm vehicle is reading low level and record value of DEF Level Warning Indication Request Extended Range.

### **4.2 Conditions.**

**4.2.1 Environmental Conditions.** Per defined test conditions.

**4.2.2 Test Conditions.** Deviations from the requirements of this standard shall have been agreed upon between the DEF Systems Engineer and System Validation Engineer. Such requirements shall be specified on component drawings, test certificates, reports, etc.

**GM Confidential**

© Copyright 2017 General Motors Company All Rights Reserved

October 2017

Page 2 of 9

**4.2.3 Cold Weather Conditions.** Test according to an internal tank temperature of -20 °C during refill testing. The tanks can be pre-frozen to a lower temperature to facilitate faster freezing so long as sufficient time is provided to allow the components to stabilize at -20 °C.

### 4.3 Instructions.

**4.3.1** Set cold chamber temperature to Cold Weather Test Condition.

**4.3.2** DEF tank temperature shall reach a stabilized state prior to the test.

**4.3.2.1** Turn ignition key to “accessory” mode and power up the instrumentation pack.

**Note:** Power the instrumentation pack from a separate power source other than the vehicle’s battery, if necessary.

**4.3.2.2** Record the following parameters for all test conditions (found in GM8762):

- Diesel Exhaust Fluid Level Percent.
- Diesel Exhaust Fluid Level Percent Validity.
- Reductant Service Tank Level.
- Reductant Service Tank Level Validity.
- Reductant Level Raw Value.
- Reductant Tank Temperature.
- Outside Air Temperature Emissions Related Corrected Value.
- DEF Level Warning Indication Request Extended Range.
- Estimated Thawed Mass of DEF.

**4.3.2.3** Perform tank swap with a pre-frozen tank.

**4.3.2.4** Verify all data channels are reading correctly and within the specified tolerance range.

**4.3.2.5** Ensure vehicle is in a level warning inducement state and record value of DEF Level Warning Indication Request Extended Range.

**4.3.2.6** Begin recording data for 1 minute without engine start.

**4.3.2.7** If necessary, use an additional power pack for starting the vehicle.

**4.3.2.8** Follow steps outlined in the test matrix in Appendix B, Data Sheet B1 for one (1) test.

**4.3.2.9** Shut off the test vehicle.

**4.3.2.10** Stop all data collection and save the test data file.

**4.3.2.11** Power down the vehicle.

**4.3.2.12** Repeat 4.3.2.3 through 4.3.2.11 for each test defined in the test matrix until each available extra tank has been used.

**NOTE:** If the vehicle recognized the refill and exited vehicle inducement, perform a fluid level reset to reset the vehicle’s DEF level to the starting volume of the frozen tanks.

**4.3.3** Once all tanks have been tested, each tank needs to be drained back down to the initial fill level, weighed to confirm proper fluid quantity, and then placed back into the cold chamber.

**Note:** Test 6 in Appendix B, Data Sheet B1 requires an additional 2 gals prior to freeze.

**GM Confidential**

© Copyright 2017 General Motors Company All Rights Reserved

October 2017

Page 3 of 9

**AVA** Documents  
Document Sharing Hub