



Diesel Exhaust Fluid (DEF) Thaw Performance - City Drive Test

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 test is to determine the following:

- Diesel Exhaust Fluid (DEF) availability during multiple simulated 1 h commute cycles in a cold environment.
- Total thawed DEF mass during short cold weather drive cycles.
- If vehicle meets requirements set out in CG4587 to initiate dosing after the required amount of time.
- If vehicle warning/inducement/Diagnostic Trouble Codes (DTC) strategy performs in accordance with GM8775 in the event insufficient DEF is thawed to continue dosing.

1.2 Applicability. All vehicles with DEF systems.

1.3 Remarks. This test will evaluate the ability of the tank to provide DEF after multiple small dosing quantities when a cavity formation may appear. It will also determine if an air pocket forms in the solid DEF around heaters, which could impede their ability to continue thawing the DEF.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- CG4587 (ID)
- CG5089: Diesel Exhaust Fluid (DEF) Thaw Performance Test Tables
- GM8775 (ID)
- DR.KP.KC

(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. Kapuskasing Cold Weather Development Center or equivalent facility with vehicle soak chambers.

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 Tank Drain.

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3.2.1.1 In-Tank DEF Pump. Equipment to activate DEF pump using device control capabilities through vehicle service tool interface.

3.2.1.2 Remote DEF Pump. Equipment to drain DEF tank through the DEF fill spud.

3.2.2 Equipment for measuring DEF added and removed from the tank with an accuracy of ± 0.05 L

3.2.3 Equipment to dispense DEF into the vehicle or tank with an accuracy of ± 0.05 L

3.2.4 Equipment to measure the weight of fluid thawed and removed from the tank with an accuracy of ± 1 g.

3.2.5 A laptop computer or equivalent device to read the vehicle and DEF level information and modify vehicle operating parameters. A NeoVI/Vehicle Spy software will be needed or similar for data capture.

3.3 Test Vehicle/Test Piece. Program specific vehicle with instrumented Engine Control Module (ECM) and DEF system, and equipment for interfacing with laptop used for data capture and operating parameter manipulation. The vehicle should include production representative:

- DEF tank.
- DEF tank attachment hardware and torque (to ensure proper tank shape).
- DEF tank assembly with controller.
- DEF Injector.
- Instrument cluster.
- DEF fill pipe assembly.
- DEF tank thermal and protective shields.

3.4 Test Time.

Calendar time: 13 days

Test time: 30 hours

Coordination time: 72 hours

Note: This 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.

3.5 Test Required Information. DEF Tank Rated Volume.

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

4 Procedure

4.1 Preparation.

4.1.1 The engineer shall use the V-Spy Auto Part Number program to identify what controllers are on the vehicle and request part numbers from those controllers.

4.1.2 The engineer shall print a copy of the readout and record test and vehicle information on Appendix A, Data Sheet A1.

4.1.3 Set up data capture device to record the following:

- Total DEF dosed.
- DEF estimated thawed mass.
- Pump pressure.
- Tank temperature.
- Ambient temperature.
- Estimated DEF Level.
- Tank Frozen status.
- If available, Tank and pump heater command, voltage, and current.
- Long Term Adaptation factor for DEF dosing.

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4.1.4 Prepare vehicle for quick/easy access to either DEF pump fluid outlet or DEF injector connection to aid in being able to quickly drain the system after completion of vehicle drive.

Note: Representative airflow around DEF tank should not be affected by this preparation.

4.1.5 Ensure DEF tank is empty of useable DEF (static un-useable DEF remains).

4.1.6 Place vehicle on level ground.

4.1.7 Fill DEF tank to fluid level as requested on test request or contact DEF Tank Design Release Engineer (DRE) for worst case thaw performance fluid level from subsystem testing. Record volume of DEF added.

4.1.8 Start vehicle to recognize fluid fill level.

4.1.9 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.

4.2 Conditions.

4.2.1 Environmental Conditions. Preferably, run at ambient temperatures below -13 °C. Do not run at ambient temperatures above -8 °C

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 Place vehicle in a thermal chamber set at -20 °C, until DEF is completely frozen. This can take up to 36 h depending on the vehicle tank size.

4.3.2 Ensure there are no active DTC on the vehicle or active warnings in the Driver Information Center (DIC) and the DEF system is operational. Begin to record data and continuously monitor.

4.3.3 Complete multiple city drive event defined in DR.KP.KC or equivalent, without completing the accessory cycle portions of the event, until 1 h of driving is completed. Record data on Appendix A, Data Sheet A2.

Note: Park vehicle on level ground after test to ensure representative unusable volume.

4.3.4 Make note of any DTCs, warnings, or inducements set during the test or any illumination of the Malfunction Indicator Lamp (MIL).

4.3.5 Turn Ignition/Key Off.

4.3.6 Wait at least 2 minutes for vehicle to purge heated DEF line.

4.3.7 Stop recording data and save all related files.

4.3.8 Place vehicle in a thermal chamber set at -20 °C and allow to soak for 8 h.

4.3.9 Repeat 4.3.2 through 4.3.8 and soak vehicle for 14 h to complete one (1) commute cycle.

4.3.10 Repeat until a total of five (5) commute cycles have been completed.

4.3.11 Turn vehicle to power-mode = accessory position.

4.3.12 Disconnect DEF supply line at tank.

4.3.13 Attach an alternate hose to DEF pump fluid outlet or disconnect DEF supply line from the DEF injector, whichever is easier depending on vehicle integration.

4.3.14 Pump all thawed useable DEF into a container using the service pump command and record mass.

4.3.15 Return modified parameters to default values and reconnect vehicle DEF supply line.

4.3.16 Turn vehicle to power-mode = off position.

4.3.17 Stop recording data and save all related files.

4.3.18 Completely thaw remaining DEF in tank.

4.3.19 Remove remaining useable DEF in tank and record volume (unusable remains in tank).

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

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