GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW17148

Short Drive Icing Test for Gaseous Fueled Vehicles

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. To evaluate the susceptibility of a vehicle to powertrain icing under short drive conditions.

1.2 Applicability. Passenger cars and light duty trucks equipped with mono-fuel or bi-fuel systems. The gaseous fuel can be Compressed Natural Gas (CNG) or Liquefied Petroleum Gas (LPG).

1.3 Remarks. When vehicles are started and run for only short periods of time in cold weather, the probability of ice forming inside the throttle body, induction system, or Positive Crankcase Ventilation (PCV) system increases. The ice is formed when water vapor, formed as a combustion by-product or ingested into the engine from the intake air, does not have time to leave the engine system and instead condenses out as the engine cools. The common sources for water vapor are the intake air, the engine blow-by through the PCV system and from the Exhaust Gas Recirculation (EGR) system. The throttle body area is susceptible for two reasons; it is located close to the exit point for both PCV and EGR, and due to interior airflow, it is normally cooler than surrounding parts. Vehicles operating on CNG and LPG are more sensitive to icing because gaseous fuels produce more water vapor during combustion compared to gasoline.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW17150

3 Resources

3.1 Facilities. A vehicle test facility having a level, reasonable smooth track, designed for cold start and driveability evaluations. The soak area must allow a 90 degree turn in reverse driving maneuver. The test facility and track must be operational when the ambient temperature is from -29 °C to 0 °C (-20 °F to 32 °F).

The General Motors Cold Weather Development Center in Kapuskasing, Ontario, Canada, or the equivalent, is recommended.

This procedure can be used in a climate controlled room with a chassis dynamometer, but the results may not correlate directly with road test results.

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 Equipment for measuring the ambient temperature at the test facility.

3.2.2 Appropriate measurement equipment for reading and recording temperature from thermocouples.

3.2.3 Equipment for measuring time intervals between portions of the test.

3.2.4 Equipment for taking photographs under low light conditions.

Note: All instrumentation must be calibrated. Record instrumentation details and the date of calibration in the test records unless the information is otherwise preserved in the testing facility records.

3.3 Test Vehicle/Test Piece. The test vehicle must be equipped with production intent engine, cooling system, air intake system, fuel system(s), Heating, Ventilation, Air Conditioning (HVAC) system and any underhood heat shields or ductwork that could impact air flow patterns.

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3.4 Test Time.

Calendar time:	5 days to 6 days
Test hours:	10 hours to 12 hours
Coordination hours:	2 hours

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Engineering test personnel trained in the use of thermocouples and data acquisition, vehicle testing and environmental chambers. Prior experience in conducting similar tests is critical to achieving valid results.

4 Procedure

4.1 Preparation.

4.1.1 Vehicle Instrumentation. Install thermocouples to measure the temperatures at the following locations. Label as indicated.

a. Ambient air (AMB)
b. Engine coolant (COOL)
c. Engine oil (OIL)
d. Air inlet (AIR IN)
e. Induction system interior surface before throttle body (INDUC)
f. Throttle body interior surface (TB INT)
g. Intake manifold interior surface after throttle body (INTAKE)

Install a thermocouple readout or data acquisition equipment (if used). Confirm all connections are correct and that the equipment operates at low ambient temperatures.

4.1.2 Vehicle Preparation.

a. Confirm all engine, fuel, cooling, EGR, PCV, air induction and exhaust system components are production intent and installed correctly.
b. Confirm that the engine calibration and software are production intent.
c. If applicable, confirm that the CNG/LPG controller(s) calibration(s) and software are production intent.
d. Confirm that the engine coolant provides adequate protection for -40 °C (-40 °F).
e. Confirm correct operation of throttle system.
f. Install new spark plugs.
g. Install new air cleaner filter.
h. Fill fuel tank(s).

4.1.3 Oil Preparation. Change oil and filter. Add distilled water to crankcase oil at a rate of 50 cm^3/L of oil (5% of volume).

4.1.4 Test Preparation. After the completion of 4.1.3, prepare the vehicle for the start of testing by driving no more than 1.6 km (1 mi).

This serves to blend the oil and water mixture thoroughly. Park the vehicle in the soak area.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 Maximum Ambient Temperature. The ambient temperature during all the soak and test periods must be below 0 °C (32 °F).

4.2.1.2 Minimum Ambient Temperature. The ambient temperature for the initial test should be as low as will allow the test vehicle to start unassisted. For CNG and LPG this temperature may be as high as -12 °C (10 °F) depending on the vehicle cold start capabilities.

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 Allow vehicle to soak overnight for a minimum of 12 h and a maximum of 24 h. Install a 100% state of charge battery.

4.3.2 Record the soak time and all temperatures on Appendix A, Data Sheet A1.

4.3.3 Conduct the engine start and vehicle driving maneuvers described in the Instructions section of GMW17150 “Gaseous Fuel Engine Cold Start and Driveability – Subjective Evaluation”.

4.3.4 After the completion of the driving maneuvers, park the vehicle in the soak area and shut off the engine. Record the shut down time and all temperatures.

4.3.5 Allow the vehicle to soak during the day between 6 h and 8 h.

4.3.6 Repeat 4.3.2 thru 4.3.4.

4.3.7 Repeat 4.3.1 thru 4.3.6 until a total of ten GMW17150 tests have been conducted. Once the series of ten tests has started, do not interrupt the two starts/day sequence unless the ambient temperature drops below the point where the vehicle can start unassisted.

4.3.8 After the last GMW17150 test, or at any time an irregularity in throttle operation is detected, stop the vehicle as safely as possible and immediately remove the induction system and/or fuel delivery components to expose the throttle body. Record any observations of ice on the throttle body, throttle

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