



Cold Weather Exposure Simulation Test

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 recreate in a laboratory environment severe winter exposure and permit an evaluation of operating characteristics in cold weather.

1.2 Foreword. The test includes operating the vehicle on a chassis dynamometer using a simulation of the test modules that are performed in GMW15016. Modules simulated are Short Trip, City, Rural, Highway, Extended Idle, Extended Trip, and 36 Hour Extended Soak. The Accessories module is performed during other test modules as with GMW15016. This procedure is a simulation of the coldest requirements from GMW15016.

This simulation test will not find items that need the real world environment such as snow and ice, steering inputs, chassis twist, rough roads, corrosion, and operation on the roads that are encountered during execution of GMW15016. It also lacks the interface issues that may be found with a variety of drivers on a road test.

See Figure A1 for some of the known differences between GMW15016 and this procedure.

1.3 Applicability. This specification is applicable to passenger vehicles and light duty trucks. This standard is used to evaluate vehicles being sold in following Extreme Cold Countries:

Afghanistan	China	Kazakhstan	Russia
Armenia	Czech Republic	Kyrgyzstan	Sweden
Azerbaijan	Estonia	Latvia	Switzerland
Belarus	Finland	Lithuania	Tajikistan
Bosnia – Herzegovina	Georgia	Mongolia	Ukraine
Canada	Greenland	Norway	Unites States of America

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15016 GMW15444
GMW15213

2.3 Additional References.

- Test Drive Files – Located in Global Document Management (GDM) at:
<https://documents.naeng.gm.com/gdm3/drl/objectId/090163bc81de0f70/chronicleId/090163bc81de0f70&versionLabel=CURRENT>

3 Resources

3.1 Facilities. This test requires a full vehicle test chamber with a chassis dynamometer and the cooling capability to hold a constant -40 °C ambient during the soak period and -30 °C ambient during the drive portion of the Module. A suitable power cord may be required for an engine block heater if necessary.

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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. The following equipment may be needed as necessary:

- Battery charger.
- Thermocouples and temperature recording device.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time. The time required to execute this event varies dependent upon vehicle cool down rate. The test can be typically completed in 4 days if performed 24 hours per day.

3.5 Test Required Information. Check sheets are used to record all problems found during the test. If temperatures are required, they are recorded at desired time intervals.

3.6 Personnel/Skills. A Test Engineer is needed at the test facility to perform the simulated modules on the dynamometer. An operator is required for the manual drive to run modules. The operator also has to perform the accessories module and evaluate performance and/or failure of vehicle systems.

A technician or mechanic is needed if a part needs to be replaced.

4 Procedure

4.1 Preparation.

4.1.1 Engine oil and other lubricants should follow the manufacturer's recommendation for severe winter operation, unless otherwise requested for evaluation during this test.

4.1.2 Vehicles should be prepared prior to shipment to the test facility with engine coolant anti-freeze protection down to a temperature of -45 °C to prevent possible engine damage during transport to the test facility.

4.2 Conditions.

4.2.1 Environmental Conditions. The test chamber temperature used is -40 °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.

The test vehicle is run on the dynamometer without any ballast, other than an observer in the passenger seat if desired.

4.3 Instructions. The test modules are run per the sequence in Appendix B. The drive files for the test driver are accessed through GDM by accessing the following link. The supplier shall work with the GM Responsible Engineer to comprehend these requirements.

<https://documents.naeng.gm.com/gdm3/drl/objectId/090163bc81de0f70/chronicleId/090163bc81de0f70&versionLabel=CURRENT>

The files are zipped and the MS Word document named "Schedule List" within it briefly explains the list of modules that are to be run.

Thermocouples are to be installed in at least 3 areas of the vehicle 1) oil temperature, 2) coolant temperature, 3) passenger breath (interior cabin air temperature). Others may be added if there are known areas of focus.

A soak is defined as a period of vehicle inactivity intended to allow the vehicle component temperatures to approach ambient levels. The vehicle will not be moved or operated in any way. During a soak the vehicle hood can be opened and wind speeds set to 60 km/h to minimize cool down time for Extended and Short Soaks.

Extended soaks should be performed in a -40 °C cold chamber until the thermocouple measurements all reach -30 °C or less, then soak for 4 hours (minimum) and until thermocouple measurements all reach -35 °C or less.

Short soaks should be performed in a -40 °C cold chamber until the thermocouple measurements all reach -30 °C or less. Shorter times save money due to high cost of running the test chambers.

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The block heater is used for overnight and mid module soaks if it is determined that it is required to start with a block heater. The engine oil condensation exposure is an optional test that can be run if desired. See 4.3.1 for the test instructions.

The test modules are run per the instructions in 4.3.2. Accessories module is performed as instructed in 4.3.2. The Accessories module consists of four (4) parts (Pre-Start Cycling, Post-Start Cycling, Mid-Driving Module Cycling, and Post-Driving Module Cycling) which are intended to be executed independent of each other and could be reviewed in Section 4.3 of GMW15213.

4.3.1 Optional Engine Oil Condensation Exposure. Once during this test an oil change can be performed which includes the addition of water to the new oil. The quantity of water added will be at the rate of 62.5 mL/L (2 oz/qt.) of oil specified to fill the engine crankcase. The oil/water emulsion is to be prepared by means of manually stirring the full measure of water into 2 quarts of oil. The remaining portion of oil is then manually stirred into the emulsion, which is poured into the engine oil fill opening. The engine will then be operated for 2 minutes at 2000 rpm in park/neutral and the vehicle immediately driven to the overnight parking location at creep speed, followed by engine shutdown. This oil change is to precede a Highway Module that will be driven after the overnight soak of -20 °C. The water is to remain in the engine and be allowed to evaporate from the engine crankcase over the duration of the test.

4.3.2 Perform Each Module in the Test Sequence. Each module should be performed as directed in the Test Sequence shown in Appendix B.

4.3.2.1 Test Documentation. Record vehicle number, module, date and time, chamber temperature, and driver name on the data sheet. Any vehicle related issues are to be noted in the "Comments" section in the "Check Sheets" (Data Sheet B1).

4.3.2.2 Conduct Part A of GMW15213 Accessories. Prior to performing any module with the exception of Short Trip, perform Part A Pre-start Cycling of the Accessories module.

4.3.2.3 Check Neutral Start Switch in Drive. Ensure parking brake is engaged and check neutral start safety switch function by turning, or attempting to turn, the ignition key to the "Start" position with the automatic transmission gear selector in "Drive". Manual transmission vehicles should perform this check with the clutch engaged and the vehicle in a forward gear. Note on the data sheet if the engine cranks during this operation.

Note: It is necessary to turn the ignition key to the "unlock" position to enable "Drive" to be selected.

4.3.2.4 Check Neutral Start Switch in Reverse. Ensure parking brake is engaged and check neutral start safety switch function by turning, or attempting to turn, the ignition key to the "Start" position with the automatic transmission gear selector in "Reverse". Manual transmission vehicles should perform this check with the clutch engaged and the vehicle in reverse gear. Note on the data sheet if the engine cranks during this operation.

Note: It is necessary to turn the ignition key to the "unlock" position to enable "Reverse" to be selected.

4.3.2.5 Start Engine. Start the engine following the start procedure as indicated in the vehicle logbook. Record the starting time on the data sheet, Record duration of crank, number of start attempts, and duration of wait periods between cranks for all start attempts including if engine does not start. When starting a manual transmission, be sure to place the gear shifter in "Neutral" and disengage the clutch.

Record any stall(s) and engine restart time on the data sheet.

4.3.2.6 Check Brake Transmission Shift Interlock. On vehicles equipped with automatic transmission, check the brake transmission shift interlock by attempting to select a drive gear without applying the service brake. Note if interlock is not performing correctly. Release parking brake, Shift into "Drive" (first gear with manual transmission) and proceed with the driving route defined in the flowchart. Note any stalls or adverse drivability on the data sheet.

4.3.2.7 Conduct Part B of GMW15213 Accessories. After starting the engine on any module with the exception of Short Trip or Highway, perform Part B Post-start Cycling of the Accessories module.

4.3.2.8 Perform Driving Module and Conduct Part C of GMW15213 Accessories. Perform scheduled driving module as defined in designated drive files which could be accessed through GDM by accessing the following link. The supplier shall work with the GM Responsible Engineer to comprehend these requirements.

<https://documents.naeng.gm.com/gdm3/drl/objectId/090163bc81de0f70/chronicleId/090163bc81de0f70&versionLabel=CURRENT>

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Mid-way through performing any module with the exception of Short Trip, perform Part C Mid-Driving Cycling of the Accessories module.

4.3.2.9 End of Module. At the end of the module, turn off the vehicle. Shift to “Park” on automatic transmission. Shift manual transmission to “Neutral” and apply parking brake.

4.3.2.10 Conduct Part D of GMW15213 Accessories. After turning off the engine on any module with the exception of Short Trip, perform Part D Post-Driving Module Cycling of the Accessories module.

4.3.2.11 Lock All Doors. Lock all doors with power locks, if equipped, otherwise use manual locks. Ensure that interior and exterior lighting is off.

4.3.2.12 Perform Designated Soak.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation. All problems noted during the test are recorded on the check sheets shown in Data Sheet B1. Fill in the vehicle number, trip module, chamber temperature, soak time, and date/time. Check the “OK” box if no problem is found with a particular item. If a problem has been noted, it is the responsibility of the test engineer to notify the validation engineer for the system/component, and generate the Issue report.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary. Refer to GMW15444 “Durability Definitions and Instructions” for definitions of terms.

Extended Soak: A long soak at -40 °C meant to bring the vehicle temperatures very close to ambient.

Short Soak: A soak at an amount of time necessary to bring the thermocouple measurements all down to -30 °C.

Soak: Periods of vehicle inactivity intended to allow the vehicle component temperatures to approach ambient levels. The vehicle will not be moved or operated in any way.

7.2 Acronyms, Abbreviations, and Symbols.

ABS	Anti-Lock Braking System
GDM	Global Document Management
HVAC	Heating, Ventilation, and Air Conditioning
rpm	Revolutions per Minute
TCS	Traction Control System
WOT	Wide Open Throttle

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW16963

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