



Side, Front, and Rear Closures System Freeze Performance 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. To determine a door system's overall performance when it is subjected to various dry and wet conditions at freezing temperatures.

1.2 Applicability. This procedure applies to all passenger cars, light duty trucks, and medium duty trucks having conventional swing open side doors, hoods, liftgates, endgates, midgates, liftglass, tonneau covers (pickup box and car), decklids, and fuel doors/charge ports. This procedure may also be applied to sliding side doors, sliding rear windows and sunroofs.

Note: This test procedure describes how to test all front, rear, and side closure systems of a vehicle at the same time. When only one or some of the closures systems need to be tested, this procedure can still be used and only the applicable portions of the test procedure and data checks should be performed.

1.3 Remarks. A door system that performs well at a normal room temperature of $22^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($72^{\circ}\text{F} \pm 3^{\circ}\text{F}$) does not necessarily perform well when temperatures fall below freezing or when moisture is involved and freezes a given door system solid. Everything from the seal contact surface with the door glass, seal material composition, seal coating characteristics, flocking characteristics, window regulator stall force capabilities, water flow paths inside of the door, etc., can have an effect on the ability for a system to perform adequately at cold environments. This procedure is an attempt to understand how variables such as these, and many more, contribute to the overall performance of any given door system.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14269	GMW15084	GMW15820
GMW14803	GMW15179	GMW15831
GMW15081	GMW15799	GMW15938

2.3 Additional References.

- CG180 5 Phase Document
- CG968 55.01.01 Front Side Door, 55.01.02 Rear Side Door Technical Specification Template
- CG2912 Closures Subsystem Freeze Test Pre-Test Checklist External Supplement to GMW15085
- Decklid Subsystem Technical Specification (SSTS)
- Front and Rear Side Door Global SSTS
- Front End Sheet Metal SSTS
- Fuel Door/Charge Port SSTS
- GM1829 Analysis Development Validation Plan and Report (ADVP&R) which is located in the SSTS

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- GM Security Guidelines: <https://gmweb.gm.com/HR/Security/Pages/FutureGuide.aspx>
- Liftgate SSTS
- Sunroof Component Technical Specification (CTS)
- Tonneau Cover SSTS
- Vehicle Technical Specifications (VTS)

3 Resources

3.1 Facilities.

a. **Major Facility.** The major facility should provide the environmental conditions as required in 4.2 of this procedure as well as contain a minor facility within as described in (b).

b. **Minor Facility.**

1. Environmental chamber capable of maintaining a constant test temperature of -40 °C (-40 °F).
2. Environmental chamber must circulate air in a diffused fashion that does not cause a wind across the vehicle, (i.e., < 0.2 m/s), thus drying out the vehicle premature of actual freezing events. For example, air velocity readings in all General Motors North America (GMNA) Body Test Lab environmental chambers were 0 m/s in all directions when measured in the center of each chamber. Various locations near the corners read 0.3 m/s to 0.4 m/s, but these locations do not affect the vehicle under freeze test.

Note: For information on environmental chamber design and how a wind speed of 0 m/s is achieved, contact the Technical Lead Engineer within the General Motors Structural Development Laboratories Department.

3. Pressure washer unit (3.2.2.4).
4. Water supply and drain area within the vicinity of the environmental chamber.
5. Vehicle holding area within the vicinity of the environmental chamber where the vehicle can be held at normal room temperature conditions during the execution of the test (4.2.1.2).

Note: When performed efficiently, this test will require 3.1 days (74 h) of time in which the test property will actually be in the environmental chamber. This is based on the example test timing. Total calendar duration of the test, however, is over a 7.5 day period.

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.

Note: The following list includes fixturing and instrumentation used to perform this test. Other equipment may be substituted at the discretion of the testing facility as long as it provides the same data and/or data record with equivalent accuracy as specified herein or by the requestor.

Note: Additional equipment may be required when performing the test procedures listed in 2.2. Review these procedures and obtain additional equipment as necessary. For the most part, this includes force gages, torque wrenches, and a velocity or closing energy measuring device.

3.2.1 Fixturing.

3.2.1.1 Adapter to connect a torque wrench to the door key for measuring key lock and unlock torque values.

3.2.1.2 Force gage adapters, (i.e., hooks, etc.,) for measuring inside and outside handle efforts.

3.2.1.3 For Manual Window Applications Only. Manual window spindle adapter for torque gun torque measurements (3.2.2.11).

3.2.1.4 Appropriate force gage adapter for measuring inside manual lock actuator operating efforts and front and rear closure hold open and opening efforts. There are a wide range of manual lock configurations, thus find the appropriate adapter to measure the force on the type of system that you have, (i.e., linear force or torque).

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3.2.1.5 Fifteen (15) mm ($\frac{5}{8}$ in) Inner Diameter (I.D.) standard garden hose with a fine adjustment gate or ball valve to adjust the water flow rate in the range of 350 mL/minute (12 oz/minute) and a course adjustment gate or ball valve to adjust the water flow rate in the range of 15 L/minute (507 oz/minute).

3.2.1.6 Adequate lighting, such as a flashlight, to observe various freeze characteristics of the system (e.g., looking between the glass and outer belt seal belt strips in order to see the freeze contact surface area, etc.)

3.2.2 Instrumentation.

3.2.2.1 For Power Window Applications Only. Power Window Performance Controller or equivalent. This is a computer controlled data acquisition system that monitors window regulator voltage and current as a function of travel time, along with also measuring glass stall force. The end result is a graphical printout of these performance variables. Measurements can be taken by either, 1) maintaining a constant voltage at the window regulator motor or by, 2) setting a supply voltage with a known line resistance/impedance value. Option 1 will be used throughout this procedure. This system is part of the Body Test Laboratory's standard test equipment.

3.2.2.2 Force gage(s) within the range(s) of the load(s) required to perform the required performance check(s).

Note: Multiple force gages will be required for this test, (e.g., force gage for measuring handle efforts; force gage for measuring effort required to ajar a frozen door, etc.) Typically, a 100 N force gage is adequate for handle effort measurement, while a 500 N force gage is sometimes required to measure the ajar force of a door that is frozen shut. Pick a realistic force gage for a given measurement, (e.g., it would not make sense to use a 500 N force gage to record an effort of 10 N).

3.2.2.3 Torque wrench(s) within the range(s) of the torque(s) required to perform the required performance check(s).

3.2.2.4 A pressure washer unit that delivers 10 342 kPa (1500 psi) in a straight line fan spray pattern at a flow rate of 11.4 L/minute (3 gal/minute). These are values that represent the do it yourself car wash systems that use a hand held wand.

3.2.2.5 Door closing fixture (slam cannon) or equivalent to measure minimum door closing energies.

Note: Velocity can also be used as a measurement to determine the minimum closing characteristics of a door. If a slam cannon fixture is not available, then contact the requesting engineer to obtain slam energy vs. velocity data curve.

3.2.2.6 Method for establishing the water flow rate at both the low and high ends, (i.e., 250 mL/minute and 15 L/minute), such as an in line flow rate meter or a stop watch and container with milliliter/ounce markings, etc.

3.2.2.7 Digital camera for photographing various freeze events, (i.e., the amount of surface area of an outer belt seal that freezes to the glass surface, a broken part, etc.)

3.2.2.8 A Power Supply/Source. When testing on a full vehicle, the vehicle will have its own power source, (i.e., the battery). However, in order to compare test results from one vehicle to another, it is essential that the power source, (i.e., battery) be able to maintain a constant voltage source and supply enough current to do so (recommended 50 A minimum). As an example, it would not be desirable to report that a given window did not function in one of the test conditions, when in actuality the vehicle battery was only producing a subpar 11 V of supply power. For reasons such as this, a remote sensing power supply should be connected directly to the battery terminals during full vehicle testing to ensure that there is a consistent voltage supply available. The power supply may also be used to test engine on conditions, without ever having to start the vehicle. This power supply is also needed when conducting tests on test properties that do not have full electrical systems in place, (e.g., maintaining voltage at the window motor or power lock motor connector).

3.2.2.9 For full vehicle testing only, a volt meter will be required for measuring the voltage drop between the voltage source, (i.e., power supply connected at the battery) and each window regulator. This measurement will be taken during those conditions when the window will not cycle while under load.

3.2.2.10 Spray bottle with milliliter markings.

3.2.2.11 For manual window applications only, manual window performance console, or equivalent, which includes a time base XY plotter, torque transducer, and torque gun.

3.2.2.12 Metric scale.

3.2.2.13 Digital camera or video recorder.

3.3 Test Vehicle/Test Piece.

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3.3.1 For this test, a fully trimmed vehicle or body is preferred. However, it is understood that a fully trimmed vehicle is typically not available at the time this test is conducted within the Vehicle Development Process (VDP). A partially assembled vehicle body may be used provided that the door subsystem and all of the parts that interface with the door are present on the body.

Note: Some door performance characteristics taken on a partial body may vary from those on a complete vehicle. One such example is the minimum slam energy required to fully latch the doors. This value may be lower on the partial body because the vented body will not induce the typical resistance to door closing caused by passenger compartment pressurization (commonly referred to as air bind). So when documenting the minimum closing value, document also the state of the test property.

3.3.2 It is essential that all closure assemblies, along with the closure to body assemblies be dimensionally reviewed and certified before testing begins. This certification should be conducted by the Lead Closures System, Lead Glass Guidance, and Lead Weatherstrip Engineers.

Note: Glass position, door fit, etc., are all examples of key dimensional characteristics that should be verified before conducting freeze testing. As an example, the cross car position of the glass relative to an outer belt seal can be a large contributor to how the outer belt seal lays against the glass surface and how much freeze surface area of the seal contacts the glass.

Note: Refer to Pretest Checklist for Test Ready Properties in Global Document Management (GDM) document number CG2912.

3.3.3 All components/systems used in testing shall be within drawing specifications and have supporting data prior to start of test.

3.4 Test Time. The following is an estimate of the amount of time (man hours and facility hours) needed to perform this procedure.

These times consider preparation time, actual test time, and analysis of data in capturing a total calendar time. Report writing, proper approval(s), processing, etc., are not part of these times.

Calendar time:	7.5 d
Test hours: (Technician)	8 h
Coordination hours: (Engineer)	34 h
Actual Environmental Chamber Time: (if performed per the example test timing below)	74 h

When the front and rear closures and side closures are tested at the same time on the same vehicle, two people are required – one to take the side closure measurements and one to take the front and rear closures measurement. The timing for an example test has been included and should be the basis for validation planning and facility timing.

Example Test Timing:

Monday: Test Specimen dimensional characteristics are all verified, and performance checks are measured during the day (Step 1: 4.3.2). At the end of the day, the test specimen is placed into the environmental chamber at -40 °C (-40 °F) for an overnight soak (Step 2: 4.3.3).

Tuesday: Record performance characteristics from Step 2, move the test specimen out of the environmental chamber for 15 minutes, and then place the test specimen back into the chamber for 4 h at -30 °C (-22 °F) (Step 3: 4.3.4). After 4 h, perform performance checks from Step 3, and then remove the test specimen from the environmental chamber for it to dry overnight. In the meantime, set the environmental chamber temperature to -12 °C (10 °F).

Wednesday: Trickle water over the test specimen (Step 4: 4.3.5), and move the test specimen into the environmental chamber at -12 °C (10 °F). After 4 h, record performance characteristics, move the test specimen out of the environmental chamber, perform the power washer application (Step 5: 4.3.6), and place the test specimen back into the environmental chamber at -12 °C (10 °F) overnight.

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Thursday: Record performance characteristics from Step 5, remove the test specimen from the environmental chamber for 15 minutes, apply water with a water hose and then place the test specimen back into the chamber for 2 h at -30 °C (-22 °F) (Step 6: 4.3.7). At the end of 2 h, perform those checks listed in 4.3.7, remove the vehicle from the chamber, repeat the water hose application a second time, and move the test specimen back into the chamber for another 2 h (Step 7: 4.3.8). At the end of 2 h, perform those checks listed in 4.3.7, remove the vehicle from the chamber, repeat the water hose application a third time, and move the test specimen back into the chamber overnight, (i.e., minimum of 2 h) (Step 8: 4.3.9).

Friday: Perform those checks listed in 4.3.7, and then remove the test specimen from the environmental chamber for 15 minutes, apply power washer application for 2.5 minutes on each door, and then place the test property back into the chamber at -30 °C for a minimum of 4 h (Step 9: 4.3.10). At the end of the 4 h, confirm functionality of each window regulator system, and then remove the test property from the environmental chamber, move the windows to the full down position, open the doors, and let the vehicle dry out over the weekend.

Monday: Record the final set of performance measurements on the dry vehicle.

3.5 Test Required Information. The requesting engineer is responsible for providing the SSTS documentation that provides the proper specifications for the test.

Depending on which subsystem is being evaluated and which level of parts or systems are being tested, consider if any of the following may need to be addressed prior to performing this freeze test: tolerance stack ups, build variations, misalignment, minimum/maximum fastener torque(s), lubrication, symmetry (Left Hand vs. Right Hand), mold or die source, etc.

The following specifications or information are required to run this test.

Note: For Side Closure Systems, refer to the Side Closures SSTS, CG968, table 3.2.1.7.8.1-II, for freeze test specifications and requirements. Actual measurement of some components and subsystems in certain steps of the freeze procedure may not be necessary, as a must function requirement may be adequate for validation.

3.5.1 Product Security. Security protocol for the test vehicle must be followed per GM Security Guidelines.

3.5.2 Notification. GM Validation shall be notified of test failures within 24 h period of occurrence.

3.5.3 Five (5) Phase. Supplier to develop five phase document (CG180) for all test failures.

3.5.4 For full vehicle testing where the system uses a battery as its power source, the battery voltage values need to be specified for both engine off and engine on conditions. Table 1 shows the voltage values that have been agreed to by the Window Regulator Subsystem Leadership Team (SSLT).

Table 1: Full Vehicle Battery Voltage Values

Condition	Voltage
Engine Off	12.0 V
Engine On	13.5 V

3.5.5 When a full vehicle is not available, there must be guidelines for how to apply the voltage to the system. There has been much discussion about setting a source voltage and using a known wire impedance value between the power source and the window regulator motors because this duplicates the real world situation of voltage drops in the system between the source voltage and the window regulator. As an alternative, however, a steady voltage will be maintained at the motor terminals, (e.g., window motor, power lock motor, etc.) when conducting functionality and performance checks throughout this procedure. Table 2 documents these recommended voltage values and performance criteria for all freeze testing.

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Table 2: Voltage Values: Testing on a Buck

Condition	Temp.	Steady Voltage at Window Regulator Motor	Requirement
Engine Off	ALL	10.5 V	Refer to Component Technical Specification
Engine On	ALL	12.5 V	

3.5.6 Door Key Lock torque specifications.

3.5.7 Door Inside (I/S) and Outside (O/S) handle effort specifications.

3.5.8 Maximum door ajar force for a door that is frozen shut.

Note: This value should never exceed the maximum outside handle strength value.

3.5.9 Efforts to move the doors in and out of the check link hold open positions via the outside handle position on the door.

3.5.10 Door manual lock effort specifications.

3.5.11 Minimum door slam energy/velocity required to fully latch each of the doors. This value should be provided for both a condition that includes cabin air bind and a condition where cabin air bind does not exist. These values will differ, and thus, the test engineer needs to compare the test property, (i.e., full air bind) and/or test buck (no air bind) under test to the appropriate requirement value.

Note: If using a minimum velocity value, then the requesting engineer must supply slam energy vs. closing velocity curve.

3.5.12 Outside Rearview Mirror effort specifications (for manually adjusted mirrors).

3.5.13 Dimensional characteristics of the test property, such as glass position, door fit/flushness, etc., i.e., those characteristics that effect freeze performance.

3.5.14 Seal characteristics such as flocking density, flocking height, seal coatings, etc., for the various seals on test. This information will be valuable in the event that a given window or door becomes frozen.

3.5.15 If testing a manual window system, then the minimum/maximum allowable spindle torque values need to be known.

3.5.16 For Front and Rear Closures, refer to the SSTs and Table 2 to understand all the specifications that are required. For fuel door/charge ports/sunroof and rear sliding windows, refer to the respective SSTs.

3.6 Personnel/Skills. Prior experience in setting up and running similar tests and experience in the use of the referenced test equipment is crucial to the overall quality of results produced by this test. An individual performing this test for the first time should have an experienced mentor working with them.

4 Procedure

4.1 Preparation.

4.1.1 Sample Inspection. The Lead Door System, Lead Front and Rear Closures Engineers, Lead Glass Guidance, and Lead Weatherstrip Engineers should inspect the test items to ensure that all material listed in 3.3 is of the correct design level and assembled properly.

4.1.2 Sample Preparation. This test is normally run on the test subject in an as received condition. If it is requested to be run in a specifically adjusted condition, follow the applicable procedure(s).

4.1.2.1 Adjust door positioning as necessary in accordance with the Door System/Door Alignment to Body Determination test procedure (GMW15938).

4.1.2.2 Trim pad removal and reassembly may be necessary in order to install wiring that will be needed to perform Door Window System Performance testing, as well as controlling power lock actuations.

4.1.2.3 Clean the door glass.

4.1.3 Facilities and/or Equipment Preparation. Record the instrumentation calibration information on Data Sheet A1 or an equivalent document.

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4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 Since this is a freeze test, a significant portion of the testing is done at subfreezing temperatures, anywhere from -12 °C to -40 °C (10 °F to -40 °F). When the test property is not in the environmental chamber, however, it is expected that it will be conditioning/thawing/drying, etc., in the major testing facility environment as described in 4.2.1.2.

4.2.1.2 The typical environmental conditions are the temperature, humidity, and pressure at the major test facility (3.1). Unless otherwise noted, these conditions are a temperature of 22 °C ± 3 °C (72 °F ± 3 °F), a relative humidity of 40% ± 20% and an atmospheric pressure equivalent to the local barometric pressure (variable during any given day and from day to day).

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. It is crucial that this procedure is not deviated from. If there are questions or recommendations regarding this procedure, the author should be contacted. The author will be responsible for reviewing and driving any proposed changes to the procedure through the appropriate groups, etc.

Many of the evaluation steps in this procedure ask for the test engineer to measure specific performance criteria. When performing this procedure, however, refer to the SSTS as an indicator as to whether a measurement or simply a functional check is required.

Only after the side door opening measurements have been taken should the hood be opened by using the hood inside release lever.

The rear closures should be opened using the outside release (rear closure key cylinder or touchpad) if applicable. Only if this feature does not exist on the vehicle should the key fob or an interior release button/lever be used to unlatch the rear closure.

Tonneaus are a type of rear closures and should be included when the terms Closures or Front and Rear Closures are used in this document. Pickup tonneaus must be included in the test even if the endgate can be opened without opening the tonneau.

Fuel door and charge ports must be checked for water accumulating and freezing within the housing that prevents the door from being pushed inward to open (push/push systems). Refer to fuel door/charge port SSTS for fuel door criteria.

Sliding Rear windows shall be opened only after all door checks have been completed.

Sunroof shall be opened only after all door checks have been completed.

4.3.1 Setup Instructions.

4.3.1.1 Ensure that all equipment connections have been established, (i.e., the ability to connect the Window Performance Equipment to the doors window regulators, power supply connections, etc.) Any wiring to the vehicle battery must be run from under the hood so it does not impact the performance of the hood seal and the hood opening and closing efforts.

4.3.2 Step 1 Test Operation Instructions. At 22 °C ± 3 °C (72 °F ± 3 °F) (normal room temperature). When performing a comprehensive freeze test evaluation, it is important to first understand the performance characteristics of the system outside of the cold environment, (i.e., at the normal comfortable room temperature of the major test facility). Perform the following performance measurements and functional checks listed in 4.3.2.1 thru 4.3.2.12 at this time, and document these measurements under Step 1 on Data Sheet A2.

Note: Many of these measurements are associated with a Subsystem Technical Specification, so refer to the correct SSTS to understand how the recorded measurements compare to the requirements that have been set.

4.3.2.1 Verify functionality of each door's power lock/unlock system. In addition, verify Fuel Door/Charge Ports that have an electrically operated locking system.

4.3.2.1.1 If testing on a full vehicle with a battery power source, first connect the remote sensing power supply described in 3.2.2.8 to the battery and set the power supply to 12 V as listed in Table 1. This simulates an engine off condition, but guarantees a minimum of 12 V supply for this evaluation in the event the vehicle has a weak battery. As described in 4.3.1.1, any wiring to the vehicle battery must be run from under the hood.

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4.3.2.1.2 If testing is conducted on a buck that has no battery power source, then connect the remote sensing power supply directly to the power lock actuator motor and set the power supply to maintain 10.5 V at the power lock actuator motor (engine off condition). Refer to Table 2.

4.3.2.2 For Side Doors with Key Lock Cylinders, measure the torque required to unlock and lock each door. Refer to test procedure GMW15831.

4.3.2.3 Measure the door unlatching effort for the outside side door handles. Refer to test procedure GMW15084.

4.3.2.4 If the door system being tested has indexing glass, then measure the amount of indexing for each piece of glass by following steps 4.3.2.4.1 thru 4.3.2.4.3.

4.3.2.4.1 If testing on a full vehicle with a battery power source, then connects the power supply described in 3.2.2.8 to the battery and set the power supply to 12 V (engine off condition). As described in 4.3.1.1, any wiring to the vehicle battery must be run from under the hood.

4.3.2.4.2 If testing on a buck that has no power source then connects the power supply directly to the window regulator motor and set the power supply to maintain 10.5 V at the motor, (i.e., engine off condition).

4.3.2.4.3 Measure the indexing distance of each window. This is typically done by using a wax pencil, (i.e., china marker) to draw a line at the beltline, both before and after the indexing, and then measuring the distance between the two lines when the glass is full up.

4.3.2.5 Measure the efforts required to move the door into and out of the various detent positions as the door is opened and closed. Refer to test procedure GMW14803.

4.3.2.6 Verify functionality of the door glass for each of the doors at this time, followed by measuring the window regulator system performance characteristics as each of the windows cycles up and down. Perform two separate performance checks, the first at 10.5 V and the second at 12.5 V; each at the motor terminals (Table 2). Remember that these performance measurements are accomplished using the Power Window Performance Controller specified in 3.2.2.1. Refer to test procedure GMW15081.

4.3.2.7 Measure the door unlatching effort for the inside door handles. Refer to test procedure GMW15084.

4.3.2.8 Measure each door's manual lock effort, i.e., linear force, torque, etc., refer to test procedure GMW15820.

4.3.2.9 For those doors that possess a child security lock feature, perform the following two steps to confirm that this feature functions properly.

4.3.2.9.1 Open door, engage child lock feature, enter vehicle, and close door.

4.3.2.9.2 With door closed, actuate the inside handle; the door should not open. Actuate the outside handle; the door should open.

4.3.2.10 For those doors with power Outside Rear View Mirrors (OSRVM), verify functionality of the power mirror. For those doors with manually adjusted OSRVMS, measure the effort required to move the OSRVM glass in the four main directions (left, right, up, and down). Refer to test procedure GMW15799.

4.3.2.11 Measure the minimum closing effort and/or velocity of each door. Refer to test procedure GMW14269.

4.3.2.12 Measure all Front and Rear Closures items that are identified in Table 2. Refer to test procedure GMW15179. In addition, measure Fuel Door/Charge Parts/Sunroofs and Sliding Windows items that are identified in Data Sheet A2.

4.3.2.13 As applicable, note any irregular sounds or erratic operation indicating a potential problem with design, manufacture, or assembly, and verify any observations with the requesting engineer.

4.3.2.14 If testing on a full vehicle, remove the power supply from the battery before starting the vehicle and moving it into the environmental chamber. Not following this step may damage the power supply.

4.3.3 Step 2 Test Operation Instructions. Dry vehicle at -40 °C (-40 °F).

Note: When performing evaluations in the cold room environment, it is important to follow the test sequence specified below, so as to not have one measurement affect another.

4.3.3.1 Ensure that the door systems on the test vehicle, buck, etc., are completely dry, i.e., belt seal flocking, primary sealing surfaces, etc.

4.3.3.2 Clean the door glass, and wipe completely dry.

4.3.3.3 Place the dry test property into the environmental chamber with all closures fully closed/latched, the left hand (LH) door(s) unlocked, the right hand (RH) door(s) locked, and the windows in the full up position. Both the

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test property and the environmental chamber should be at the current temperature and humidity of the major test facility, (i.e., $22\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$) ($72\text{ }^{\circ}\text{F} \pm 3\text{ }^{\circ}\text{F}$), and allowed to ramp down to the $-40\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$) together. This allows for more consistency in the vehicle freeze process when considering the major facility humidity fluctuations throughout the various calendar seasons. It also allows for a completely defrosted environmental chamber prior to the start of the freeze test, an important aspect for some minor test facilities.

4.3.3.4 After a minimum 8 h test property conditioning period in the $-40\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$) environment, it is time to evaluate all of the performance checks that were conducted prior to the test property entering the cold environment. Thus, perform 4.3.2.1 thru 4.3.2.12 at this point in time and in sequential order, and then proceed to 4.3.3.5. Record the measurement results under Step 2 on Data Sheet A2.

Note: When verifying functionality of the power lock system in 4.3.2.1, make this verification by a visual check of the manual lock mechanism moving back and forth when the power lock system is actuated. **Do not verify this functionality by attempting to open the door to prove that the door successfully locked or unlocked. This will negate other critical measurements that follow this step. Perform the full power lock functional check, (i.e., confirm successful locking/unlocking by opening doors, etc.), at the end of all of the checks.**

4.3.3.5 If the minimum door closing energies were successfully measured for each door in 4.3.2.11 and 4.3.2.12, then it is inferred that each door must have successfully latched closed. At higher door slam energies in the cold environment, however, there is a chance that a given latch may respond too slowly and not successfully latch the door, (i.e., the door bounces back open upon being slammed). To verify that this is not the case, and to be consistent in this test, slam each door to a speed or energy of: 27 J for side doors, 1.4 m/s for decklids, 1.09 rad/s for liftgates and liftglass, 1.1 rad/s for hoods with counterbalance, 450 mm open for hoods with prop rods, and 3.1 rad/s for endgates to confirm that each door successfully latches fully closed. This slam test does not apply to tonneaus.

Note: If a door bounces back open upon being slammed, try slamming the door at energy lower than the speeds/energies described in 4.3.3.5 until the appropriate energy is found where the door successfully latches fully closed; document this energy. A door that struggles to latch indicates an issue that needs immediate discussion with validation and design personnel.

4.3.4 Step 3 Test Operation Instructions. Fifteen minutes thaw, then $-30\text{ }^{\circ}\text{C}$ ($-22\text{ }^{\circ}\text{F}$).

4.3.4.1 Set the environmental chamber temperature to $-30\text{ }^{\circ}\text{C}$ ($-22\text{ }^{\circ}\text{F}$).

Note: If testing on a full vehicle, remove the power supply from the battery before starting the vehicle. Not following this step may damage the power supply.

4.3.4.2 Remove the test property from the environmental chamber. Allow the test property to thaw for 15 minutes ± 0.5 minutes with the front, rear, and side closures closed and the windows fully up. This thawing allows the system to sweat and form a combination of frost and condensation.

4.3.4.3 At the end of the 15 minutes thaw period, ensure that the LH doors are unlocked, the RH doors are locked, and move the test property back into the $-30\text{ }^{\circ}\text{C}$ ($-22\text{ }^{\circ}\text{F}$) environment.

4.3.4.4 After a minimum 4 h test property conditioning period in the $-30\text{ }^{\circ}\text{C}$ ($-22\text{ }^{\circ}\text{F}$) environment, it is time to evaluate all of the performance checks once again. Thus, perform 4.3.2.1 thru 4.3.2.12 at this point in time and in sequential order. Document these measurements under Step 3 on Data Sheet A2. Also perform 4.3.3.5 to confirm that each door successfully latches when slammed at an energy or speed shown in 4.3.3.5. Record information in Data Sheet A2 for Fuel Doors/Charge Ports/Sunroof and Sliding Windows.

Note: When performing the window functionality testing for this step of the freeze test, it is permissible to gently separate any frozen areas of the inner beltline seal from the glass prior to confirming functionality. This is applicable in those cases where the cabin of the test property is not sealed off from the outside and high moisture content had formed on the inside of the glass during the thaw period, thus causing a non-representative icing situation on the inside of the glass.

Note: If during the performance checks, a component does not meet its specification, or if a functional check fails, then the test engineer should make every effort to identify the cause, not simply state in the data report that something does not function or does not meet a requirement.

Example: The door glass is frozen/seized in the full up position.

The following is an example of the type of assessment that needs to be made during this freeze test procedure. Photos are encouraged.

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