



Sunroof Drain Hose System Test Procedures

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. Evaluation of the sunroof drain hose performance.

1.2 Applicability. This test procedure applies to all passenger vehicles with a sunroof module requiring drain hoses for water management. This applies to all sunroof systems as defined in the Vehicle Technical Specifications (VTS), Subsystem Technical Specification (SSTS), or Component Technical Specifications (CTS).

1.3 Remarks. This document is the GM Worldwide Sunroof Drain Hose Testing Standard. Its purpose is to establish a common test methodology for testing the Sunroof Module Drain Hoses to ensure that a high quality world class system is consistently developed and produced. This is a living document and any suggestions or revisions will be reviewed and/or updated annually by the Sunroof Global Subsystem Leadership Team (GSSLT).

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3600

2.3 Additional References.

- CG180 5-Phase Document.
- GM Security Guidelines. <https://gmweb.gm.com/HR/Security/Pages/FutureGuide.aspx>.
- GM1829 Analysis Development and Validation Plan and Report.
- Program Specific Component Technical Specification (CTS).
- Subsystem Technical Specifications (SSTS).
- Vehicle Technical Specification (VTS).

3 Resources

3.1 Facilities. The test facilities shall be accredited to ISO/IEC standards or by the International Laboratory Accreditation Cooperation. However, all measuring variables as specified in this specification shall be determined correctly with respect to its physical definition.

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 Test fixture (representative of interfacing components/body) or vehicle body.

3.2.2 Hose routing in the body or fixture must be representative of the installed hose design position for the specific program.

3.2.3 Environmental/Thermal chamber with the following requirements:

- Temperature Range (-40 °C to +95 °C) and continuously adjustable
- Controlled humidity
- Recirculating air temperature cabinet
- Test room, suitable for the execution of the test
- Permissible temperature accuracy: ± 3 °C
- Explosion proof

3.2.4 Vibration table.

3.2.5 Permanent marker.

3.2.6 Instron or similar tensile machine with the following:

- Load Capacity of 250 N
- Speed Range of 50 mm/minute to 100 mm/minute
- Test Area suitable for the required tests

3.2.7 Force gauge.

3.2.8 Digital camera.

3.2.9 Test samples.

3.3 Test Vehicle/Test Piece. Test samples shall be of production intent design and material for design validation (DV); or, production intent design and materials manufactured with production processes (home line) for product validation (PV). Any changes to the components or material, e.g., design, fit, form, function, properties, manufacturing process, and/or location of manufacture require revalidation. GM shall approve validation methods for product/process changes before the supplier is committed to the change. Refer to GMW3600.

3.3.1 Material. The required material quality of the bonded lips, extruded profiles, extrusions and encapsulations are also designated by the relevant material specifications in the drawing.

3.3.2 Unless otherwise specified, three (3) samples of components, or systems, shall be tested.

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

3.3.4 ALL test samples **MUST** be conditioned per 4.1.1.

3.4 Test Time.

Calendar time: 10 d

Test hours: 72 h

Coordination hours: 8 h

3.5 Test Required Information. Requirements from the SSTS or respective specifications are necessary in order to execute test methods in this document (Table A1 and Table A2 for a list of variables required).

Note: Equipment and test sample detail is included in Section 4 of this document.

3.5.1 GM Validation is to be notified of test failures within a 24 h period of occurrence.

3.5.1.1 Supplier to develop a 5-Phase Document (CG180) for all test failures.

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

3.6 Personnel/Skills. The test facility shall have sufficient personnel having the necessary education, training, technical knowledge, and experience for performing the required tests.

4 Procedure

4.1 Preparation.

4.1.1 Fixtures. Unless otherwise specified, mount the test sample on a fixture of welded construction designed to place the test sample in its vehicle orientation. Mount with the production attachment strategy or, equivalent.

Locating features and body metal interface must be represented in the fixture design. Position the fixture retention points to the test base such that the fixture can be removed without removing the sunroof. The GM Validation Engineer and GM Designing Engineer shall approve the design.

4.1.2 Test Samples. All test samples shall be design intent and meet all functional and dimensional requirements. Samples must have all design intent components that might affect performance. These include clips, grommets, connectors, hoses, sunroof spouts (or representation), etc. Preliminary tests may need to be made to evaluate whether a particular component may be worst case, e.g., connectors. The GM Validation Engineer and GM Designing Engineer shall approve any exceptions prior to the start of testing.

4.2 Conditions. Conditions are according to the relevant test procedure. All conditions specified shall be targeted toward the specified value with any given tolerance ($\pm$) used to compensate for variation. During testing, conditions specified shall not be adjusted within the tolerance unless it is to maintain the particular test condition within the specified tolerance. If such an adjustment is made, it shall be approved by the applicable GM engineer prior to the start of any testing. Unless otherwise specified, perform tests in the as received condition without special preconditioning.

4.2.1 Environmental Conditions.

4.2.1.1 Temperature and Voltage Definitions. Symbol definitions required for test methods contained in this procedure are listed in Table A1. Actual requirement values for the symbols shall be obtained from the Subsystem Technical Specification (SSTS) or the respective specification and recorded on Table A3. If not otherwise specified, tests shall be performed at $T_{room} = 23 \pm 3$ °C. If various temperature ranges for the tests are specified, the procedure shall be constructed, if not otherwise specified, in a way that all tests shall be performed first at $T_{room} = 23 \pm 3$ °C, then at high temperature and lastly at low temperature. If not specified, the test parameter for relative humidity (RH) shall be set at $50 \pm 5\%$ and voltage set to U_{nom} .

4.2.1.2 System Performance Conditions. Symbol definitions required for test methods contained in this procedure are listed in Table A2. Actual requirement values for the symbols shall be obtained from the SSTS or the respective specification and recorded on Table A3.

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 Drain Hose Environmental Test Procedure.

4.3.1.1 Purpose. To verify the drain hose performs under environmental conditions.

4.3.1.2 Equipment.

4.3.1.2.1 Environmental chamber.

4.3.1.2.2 Vibration table.

4.3.1.2.3 Holding fixture.

4.3.1.3 Samples. All test require 6 samples unless otherwise specified in the program specific SSTS.

4.3.1.4 Procedure.

4.3.1.4.1 The drain hoses are to be installed in the fixture/body in the design position.

4.3.1.4.2 The insertion force should be recorded at this point. Also, three samples should be run to measure the retention force of the connector.

4.3.1.4.3 Once installed the drain hoses are to be marked with a permanent marker. These marks are to be added to all points that are being inspected. Reference points should be established before testing to identify growth or shrinkage of the hose under environmental conditions.

4.3.1.4.4 The test fixture/body shall be placed in the environmental chamber and cycled to the prescribed test procedure in Appendix B. This test is to be run, with each design iteration, which represents a sample.

Note: This procedure is to be run statically and under road load inputs (provided by GM).

4.3.1.5 Acceptance Criteria. The measured values must correspond to the requirements of the program specific SSTS or the respective specification.

4.3.2 Drain Hose Retention and Installation Tests.

4.3.2.1 Purpose. To verify the mechanical retention and removal force of drain hoses in the Sunroof Module system.

4.3.2.2 Equipment. Test setup capable of applying axial pull forces and push forces to the drain hoses; shall be used for measurement at T_{min} and T_{HT} . The test setup shall be approved by the GM Validation Engineer and specified on the GM1829 test reports.

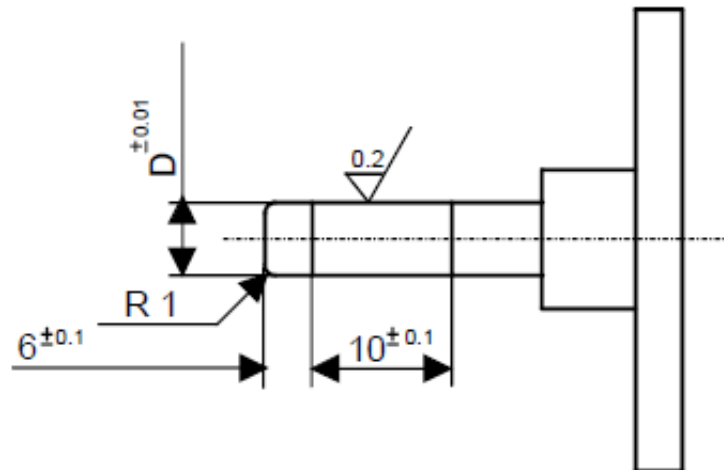
4.3.2.2.1 Tension/compression test bench with holding fixture. A portable test bench utilizing a handheld force gauge may be required to test to environmental extremes.

Note If a force gauge is used the sample size must be doubled.

4.3.2.2.2 Load adapter, 100 N.

4.3.2.2.3 Load adapter to pull drain hose.

4.3.2.2.4 Steel mandrel of appropriate diameter for testing push-on force, as shown in Figure 1.



D = Inside hose diameter +1.0 mm.
Mean roughness value $R_a = 0.2 \mu\text{m}$.
Maximum roughness value $R_{max} = 1.0 \mu\text{m}$.

Figure 1: Mandrel for Push-on Force

4.3.2.3 Sample Size. Six (6) hose samples at each drain spout, at each temperature shall be tested.

4.3.2.4 Procedure.

4.3.2.4.1 Cut the sunroof module frame into multiple sections, each to contain a water drain spout, to install in the test bench.

4.3.2.4.2 Cut hose test samples. The hose sections used to determine push-on force shall have a length of 60 mm, and those used to determine pull-off force shall have a length of 100 mm. Measure and record the hose diameters on Data Sheet A6.

4.3.2.4.3 Mount a Sunroof Module frame section with drain spout in the test equipment examples in Figure 2 at T_{room} (ambient); with hoses not attached. Dwell for 60 minutes allowing frame section and drain hose samples to stabilize.

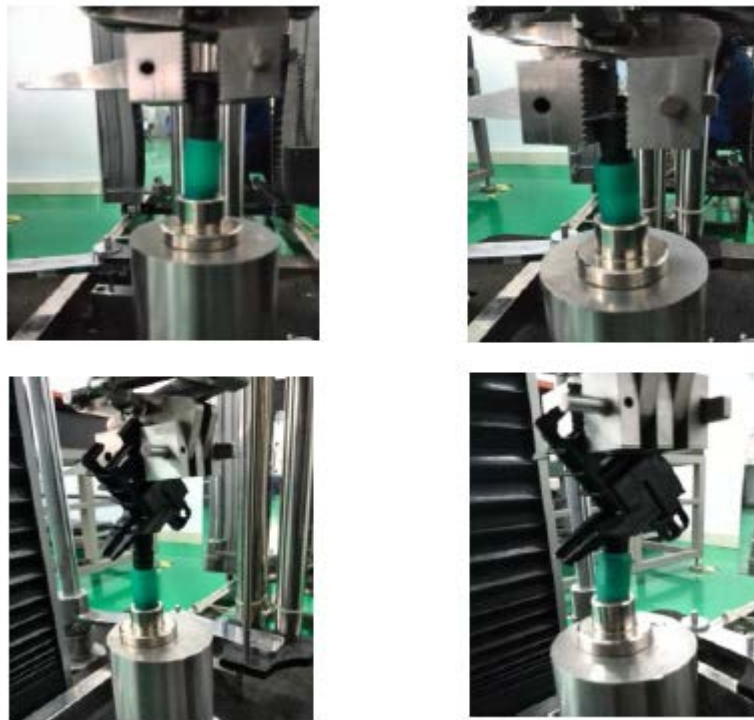


Figure 2: Example of Test Equipment

4.3.2.4.4 Mount one 60 mm section of hose, by hand, 5 mm onto the water spout of the Sunroof Module frame section.

4.3.2.4.5 Using the force gauge or other bench compression device with mandrel attached, push the hose section on to the spout an additional 10 mm at a speed of 25 mm/minute $\pm$ 5 mm/minute. Hose shall be pushed axially in line with the spout (see Figure 3). The maximum force shall be measured and recorded on Data Sheet A6.

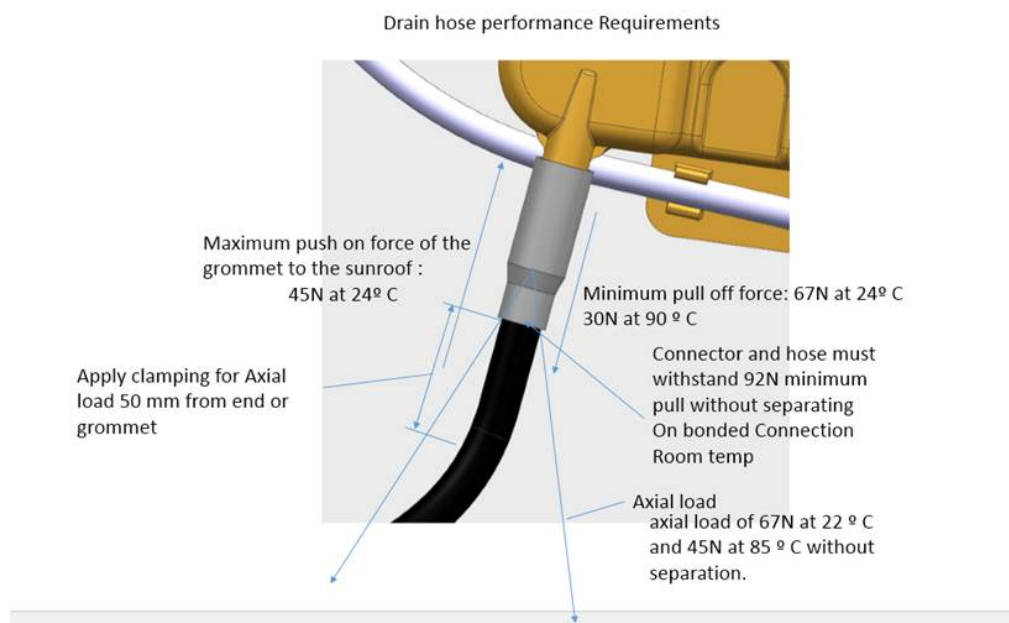


Figure 3: Drain Hose Test Loading Conditions

© Copyright 2016 General Motors Company All Rights Reserved

4.3.2.4.6 Repeat 4.3.2.4.3 thru 4.3.2.4.5 using 5 new hose samples.

4.3.2.4.7 At T_{room} , mount one 100 mm section of hose, by hand, 20 mm onto the water spout of the Sunroof Module frame section or to the fully installed design position if it is less than 20 mm.

4.3.2.4.8 Using the force gauge or other bench tension device with force adapter attached, remove the hose section from the spout at a speed of 100 mm/minute $\pm$ 10 mm/minute. The direction of pull shall be kept axial to the drain spout throughout the range of travel. The maximum force shall be measured and recorded on Data Sheet A6.

4.3.2.4.9 Repeat 4.3.2.4.7 thru 4.3.2.4.8 using 5 new hose samples.

4.3.2.4.10 Repeat 4.3.2.4.3 thru 4.3.2.4.9 as required for each of the remaining Sunroof Module frame sections, at T_{room} .

4.3.2.4.11 Mount a Sunroof Module frame section with drain spout in the test equipment at T_{HT} ; with hoses not attached. Dwell for 60 minutes allowing parts to stabilize.

4.3.2.4.12 Mount one 100 mm section of hose, by hand, 20 mm onto the water spout of the Sunroof Module frame section or to the fully installed design position if it is less than 20 mm.

4.3.2.4.13 Using the force gauge or other bench compression device, remove the hose section from the spout at a speed of 100 mm/minute $\pm$ 10 mm/minute. The direction of pull shall be kept axial (refer to Figure 3) to the drain spout throughout the range of travel (refer to Figure 4). The maximum force shall be measured and recorded on Data Sheet A6.

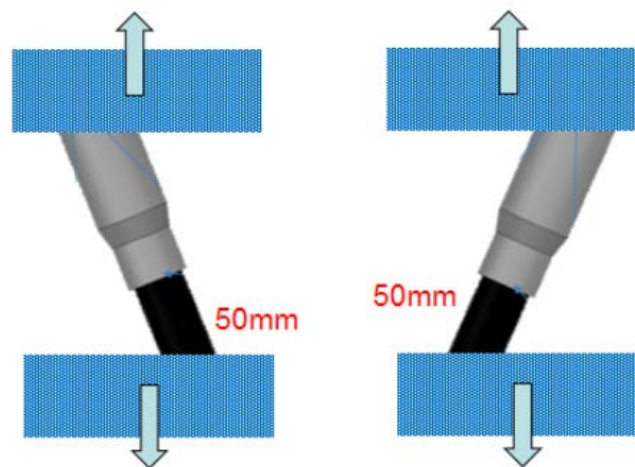


Figure 4: Axial loading of the Drain Hose

4.3.2.4.14 Repeat 4.3.2.4.12 thru 4.3.2.4.13 using 5 new hose samples.

4.3.2.4.15 Repeat 4.3.2.4.11 thru 4.3.2.4.13 as required for each of the remaining Sunroof Module frame sections, at T_{HT} .

4.3.2.5 Acceptance Criteria. The measured values must correspond to the requirements of the SSTs or the respective specification.

4.3.3 Drain Hose to Body Attachments/Clips Retention and Installation Test.

4.3.3.1 Purpose. To verify the Drain Hose Attachments or Clips meet the retention requirements of the program specific SSTs.

4.3.3.2 Equipment.

4.3.3.2.1 Safety Equipment: Safety Glasses.

4.3.3.2.2 Holding Fixture. Designed to adequately hold the test samples in the required configuration Figure 5.