



Sliding Resistance for Side Window Weatherstrips

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. This standard describes the method to measure sliding resistance for side window weatherstrips, including glass run channels and belt seals. Measurements for sliding resistance shall be taken on the full section (i.e., inner and outer glass run channel lips, inner and outer belts).

1.2 Applicability. This test procedure is applicable to all side window weatherstrips.

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

3 Resources

3.1 Facilities.

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 Weatherstrip Holding Fixture. The weatherstrip holding fixture shall be made of a rigid material (recommended to be aluminum, steel or hard Stereolithography Apparatus (SLA) material) and shall be 100 mm $\pm$ 1 mm in length. It is recommended that this fixture be common to the compression load deflection and load loss set holding fixtures.

3.2.2 Jeweler's Coping Saw, or other gentle means of cutting specimens without distortion.

3.2.3 Sliding Resistance Gage. The gage must pass the repeatability and reproducibility assessment. A correlation study ($\leq$ 10% correlation error) must be provided and approved by General Motors.

3.2.4 Test Glass Piece. Tempered automotive glass or safety glass of production representative thickness, and of sufficient length such that the seals do not exit the glass at the ends of cycling (no edge effect) (see Appendix A, Figure A4), and allows for the ability to collect a minimum of 100 mm of steady state data (no start-up or reverse motion noise), (see Appendix A, Figure A5).

3.3 Test Vehicle/Test Piece.

3.3.1 Test Specimens. Test specimens shall undergo dimensional testing per engineering drawing or math data file and be accepted prior to this test. Four (4) weatherstrip sections, each 100 mm $\pm$ 1 mm in length, shall be cut such that they are not significantly bent or deformed during cutting. (This may be performed using a jeweler's coping saw or other gentle means). Weatherstrip specimens shall be cut from the same extrusion.

3.3.2 Number of Test Specimens. Each set of test specimens shall consist of four (4) samples. Three (3) specimens shall be tested at $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. One specimen shall be tested at $-30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

3.4 Test Time. Not applicable.

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Per laboratory accreditation requirements.

4 Procedure

4.1 Preparation.

4.1.1 Setup/Installations. Views of the test setup are in Appendix A, Figure A1, Figure A2, and Figure A3.

4.1.1.1 Determination of Glass Position. Attach a template glass to the glass holding fixture.

4.1.1.2 Attach the weatherstrip holding fixture to the Sliding Test Fixture without the weatherstrip specimen.

4.1.1.3 The reference point for the glass relative position is determined by moving the weatherstrip holding fixture (without the weatherstrip specimen) until the glass inboard surface contacts with the weatherstrip holding fixture. Be sure that the glass and the fixture surface are parallel to one another.

4.1.1.4 Move the weatherstrip holding fixture such that the glass surface creates the nominal design gap to the fixture on both inboard and outboard side.

4.2 Conditions.

4.2.1 Environmental Conditions. The minimum time between manufacturing and testing shall be 72 h. The test pieces shall be maintained at a temperature of $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and $50\% \pm 5\%$ relative humidity for at least 24 h prior to test and shall be free from strain during this period.

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.

4.2.2.1 Test Condition A. Ambient ($+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$), with no further conditioning beyond what is specified in 4.2.1.

4.2.2.2 Test Condition B. Cold ($-30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$), cold testing samples will be ready to test when test setup and samples are maintained at temperature ($-30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$) for 30 minutes prior to start of the test.

4.3 Instructions. Testing to this standard shall be performed at both Test Condition A and Test Condition B.

4.3.1 Perform setup as defined in 4.1.1.

4.3.2 Move the weatherstrip holding fixture such that the glass will allow for the installation of the test specimen.

4.3.3 Install a test specimen onto the weatherstrip holding fixture.

4.3.4 Zero the sliding resistance load cell.

4.3.5 Move the weatherstrip holding fixture such that the glass engages with the seal for the designed engagement length.

4.3.6 Acquire the measurement data as follows:

4.3.6.1 Preflex the Lips Ten Cycles. One (1) cycle is obtained by positioning the weatherstrip holding fixture from the maximum outboard position to the maximum inboard position and then back to the maximum outboard position; this will cover the sealing range. Record the maximum outboard and inboard positions (round to the nearest 0.5 mm) and use this range for all the test specimens.

4.3.6.2 Position the weatherstrip holding fixture or glass (whichever moves, to create the desired lip displacement) at the maximum outboard position.

4.3.6.3 The seal shall traverse the length of the glass (minimum of 300 mm of travel) and return to the starting position three (3) times before the measurement is taken. Glass/seal shall travel at $100\text{ mm} \pm 5\text{ mm/second}$. At any point during the cycling of the glass/seal, the seal shall not become disengaged with the glass (no leading edge condition).

4.3.6.4 Record the glass/seal position in millimeters (mm), sliding resistance (N/100 mm), and glass thickness (mm). Sliding resistance values shall be taken every 1 mm for a continuous section of 100 mm while the machine is in steady state.

4.3.6.5 Move the weatherstrip holding fixture or glass 0.5 mm inboard and repeat 4.3.6.3 and 4.3.6.4.

4.3.6.6 Repeat 4.3.6.5 until the weatherstrip holding fixture or glass reaches the design maximum inboard position.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation. The following information shall be reported to the GM Design and Computer Aided Engineering (CAE) engineers:

5.3.1 Raw data for sliding resistance at each glass relative position (weatherstrip holding fixture position) at 0.5 mm increments at ambient and cold temperatures for the full section (with both sides). Nominal position and reference point shall be indicated in the raw data.

5.3.2 The full section data is used to illustrate the operating profile as shown in Appendix A, Table A1.

5.3.3 Calculated mean for sliding resistance at each glass relative position. A raw data example for a full section is shown in Appendix A, Table A2.

5.3.4 Plot for each specimen (average the forces at the same glass relative position). A plot example of sliding resistance vs. glass relative position (weatherstrip holding fixture position) for a full section is shown in Appendix A, Figure A6.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary.

Glass Relative Position: Glass position relative to the datum.

Nominal Position (Nominal): The design position of the sealing surface relative to the weatherstrip mounting datum.

Sealing Feature: The portion of the weatherstrip (i.e., run channel lips, seal bulb) that is deflected by glass or sheet metal.

Sealing Range: All possible sealing surface positions from the maximum outboard position to the maximum inboard position where the weatherstrip is designed to perform.

Sealing Surface: The portion of the rigid surface (glass or sheet metal) that deflects the sealing feature.

Sliding Resistance: The force that characterizes the effort to slide the glass against the seals.

Steady State: The region of data collection that does not include start or reversal transient data.

Zero Point: The reference point shown on the engineering drawing or math data file that enables functional and dimensional validation of the part under consideration. From this point, different functional and dimensional measurements are made.

7.2 Acronyms, Abbreviations, and Symbols.

CAE	Computer Aided Engineering
RT	Room Temperature
SLA	Stereolithography Apparatus