



Foil Damage Resistance Test for Door Trim and Other Interior Components

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 Scope. The scope of this test is for door trim and other interior trim, where a foil covering is used over a base substrate in an area of high customer contact. Most common contactable areas are shown in Figure A15, where the surface has a tight radius or a deep draw (stressing the foil).

1.1.1 Background: This test was developed to understand customer induced damage occurring on door trim panels in warranty in GM North America and to understand part handling damage. The knowledge is documented in this GMW specification for global use. Many foil covered door trim panels were being returned with nicks, cuts, or tears to the foil. A Design for Six Sigma (DFSS) project was initiated to understand the damage and how to prevent it from occurring. It was determined, through the DFSS that the damage was not abusive in nature, yet the material, although validated to current GM specifications, was not withstanding the normal customer usage. The DFSS process developed this specification as a way to test for and reduce warranty. Although the test recommends passing the prescribed impact at 2 J, this should be used as a guideline by the Design Engineer as well as the Validation Engineer. Impact levels less than 2 J may be acceptable, if there is little chance of customer contact. It has been found that material conforming to the 2 J level should have minimal warranty for customer induced damage.

1.1.2 Summary.

1.1.2.1 Per GMW14093, parts are impacted with a 50 ± 1 mm hemispherical head, normal to the surface. This test is not severe enough to indicate PolyVinyl Chloride (PVC)/Thermoplastic Olefin (TPO)/Foil skin splitting.

1.1.2.2 The purpose of this test method is to compare which systems can survive a concentrated impact (close to that of a dull blade) when pitched at a 30 degree angle (as measured from angle normal to surface).

1.1.2.3 Part should be impacted at three different impact levels. For example: 0.5 J, 1 J, and 2 J. However, requirements should be; only to pass at 2 J or at a lower level agreed to by the Design Release and Validation Engineers (Rating 1 or 2 as defined in the test).

Note: Impact must be controlled in such a way that the test sample is only impacted one time per impact point (avoid rebounds).

1.1.2.4 Design should be tested five times per joule level and the test will call for multiple test parts. Five test samples are required to perform at a maximum of 3 impact levels as described in 1.1.2.3.

1.1.2.5 Benchmarking for the initial study comprised of a 0.85 mm skin with 7.5 mm of underlying foam (cast skin, foam-in-place construction). This design was hit repeatedly in the same area without any evidence of splitting or indentation.

1.1.2.6 Typical systems that are being compared are comprised of a skin thickness in the range of 0.7 mm and a foam thickness less than 1.5 mm i.e., low pressure molded parts, vacuum wrapped substrates, or Glass Reinforced Urethane (GRU).

1.1.2.7 Increased skin thickness has been found to be more robust versus increasing underlying foam thickness.

1.2 Mission/Theme. To establish the amount of concentrated impact energy a foil covered interior trim component can withstand before splitting of the top skin ensues.

1.3 Classification. Not applicable.

GM Confidential

© Copyright 2013 General Motors Company All Rights Reserved

November 2013

Page 1 of 13

Documents

Document Sharing Hub

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3059

GMW14093

2.3 Additional References.

None

3 Test Preparation and Evaluation

3.1 Resources.

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.

3.1.3 Facilities. Not applicable.

3.1.4 Equipment. Impact apparatus (see Figure A1) or equivalent design that allows for vertical drop onto a part angled at 30 degrees and has a reference scale at one side (for measuring drop heights). Impact Head with a 0.85 mm (0.0335 in) radius with enough mass (see Figure A2, Figure A3 and Figure A4) and an apparatus with enough vertical distance to generate 0.5 J to 4 J of energy. See how to build a similar fixture described in Appendix B (see Figure B1, Figure B2 and Figure B3).

3.1.5 Test Vehicle/Test Piece. Calibrated, reference materials are not applicable for this test.

3.1.6 Test Time.

Calendar time: 3 days

Test hours: 4 hours

Coordination hours: 4 hours

3.1.7 Test Required Information. Not applicable.

3.1.8 Personnel/Skills. Not applicable.

3.2 Preparation.

3.2.1 Allow parts to condition overnight in standard laboratory conditions (see 3.3.1).

3.2.2 Cut interior trim down in such a fashion as to be narrow enough to fit into impact apparatus (see Figure A1 and Figure A5).

3.2.3 Part should also be supported underneath if substrate is obviously flexing under impact level, or a less flexible section should be cut (see Figure A6).

3.2.4 Test areas should be selected for locations with sharpest radii, deepest draws, in high customer contact areas as defined by the GM Responsible Design Release Engineer and Figure A15.

3.2.5 Test area should be situated so that impact head is hitting normal to surface with minimized tilt in the lateral direction (see Figure A7). Blocks of wood suffice as shims.

3.2.6 The test part should be propped so that it cannot slide forward when being impacted. Angle plates or a bent strip of metal can be clamped into place to give front end support (see Figure A8).

3.2.7 Either end of test specimen should be roughly square so that it sits flush against front shims and supports (see Figure A8 and Figure A9)

3.3 Conditions.

3.3.1 Environmental Conditions. If not otherwise stated, the tests shall be performed at $+23 \pm 3$ °C.

GM Confidential

© Copyright 2013 General Motors Company All Rights Reserved

November 2013

Page 2 of 13

Documents
Document Sharing Hub

3.3.2 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. See the GM responsible Design Release and Validation Engineers.

3.4 Instructions. Not applicable.

3.5 Data. Not applicable.

3.6 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.

3.7 Documentation. Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM department prior to the start of delivery of production level components or materials.

Any change to the component or material, e.g., design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

3.7.1 Test Results.

3.7.1.1 Currently, requirement is to have no splitting at 2 J (Rating of 1 or 2). Indentation of skin and/or substrate is acceptable for the compliance of this standard (see Figure A12 for part dip example).

3.7.1.2 Once impact testing is completed, allow parts to sit overnight and use the Table 1 rating scale (where skin splitting has been divided into two subgroups).

Table 1: Impact Testing Rating Scale

Rating	Condition or Behavior
1	No splitting
2	Varying degrees of indentation with no splitting (see Figure A11)
3	Varying degrees of indentation with SLIGHT splitting (see Figure A13)
4	Varying degrees of indentation with NOTICEABLE to SEVERE splitting (see Figure A14)

3.7.1.3 Slight is defined as only being able to see splitting upon close inspection of the part.

3.7.1.4 Noticeable is defined as being obvious at close inspection and at a distance.

3.7.1.5 A rating of two allows for indentation of the test area.

3.7.1.6 Test is needed on parts where the Design Release Engineer (DRE) expects high customer contact, such as armrest radius, or upper beltline corners. For more details, see Figure A15 or contact the Design Release Engineer.

3.7.1.7 Reference Appendix A, Table A1, data table file shows typical test data. Table A2 is the example summary of results.

3.7.1.8 Final arbiter for the evaluation shall be the GM Materials Engineer in cases of disagreement.

4 Requirements and Procedure

4.1 Installation Position.

4.1.1 Gently position impact head on part noting zero position of impact head. Calculate drop height based upon desired joule level and mass of impact head. Height calculated per GMW14093 Apparatus A – Falling Ball Test.

GM Confidential

© Copyright 2013 General Motors Company All Rights Reserved

November 2013

Page 3 of 13

Documents
Document Sharing Hub

4.1.2 Ideally, part is clamped down tight before every impact. However, front end support, shim support, and hand pressure should suffice to keep part steady. Raise impactor to calculated height for desired energy level and release to impact part.

4.1.3 Move to next impact location and repeat. Unless underlying substrate is being cracked from impacts, a 12.7 mm distance between impact locations will suffice (see Figure A10).

4.1.4 Consider sharp changes in slope along impact region which might cause same joule level to perform differently along same edge.

5 Provisions for Shipping

Not applicable.

6 Notes

6.1 Glossary.

Foil: Thin material covering (with or without foam backing) over plastic substrate, typically made of PVC, TPO, or Thermoplastic PolyUrethane (TPU).

6.2 Acronyms, Abbreviations, and Symbols.

DFSS	Design for Six Sigma
DRE	Design Release Engineer
GRU	Glass Reinforced Urethane
GSSLT	Global Subsystem Leadership Team
ID	Impact Dented
J	Joules
PVC	PolyVinyl Chloride
TPO	Thermoplastic Olefin
TPU	Thermoplastic PolyUrethane

7 Additional Paragraphs

7.1 All parts or systems supplied to this standard must comply with the requirements of GMW3059, **Restricted and Reportable Substances for Parts**.

8 Coding System

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

GMW15589

9 Release and Revisions

This standard was originated in April 2007. It was first approved by the Door Trim GSSLT in November 2007. It was first published in November 2007.

Issue	Publication Date	Description (Organization)
1	NOV 2007	Initial publication.
2	NOV 2013	5 Year Refresh. (Interior – Door Trim Global Subsystem Leadership Team)

GM Confidential

© Copyright 2013 General Motors Company All Rights Reserved

November 2013

Page 4 of 13