



Crowbar Test Procedure for Structurally Bonded Plastics Featured on Exterior Lighting Devices

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. This document defines the mechanical performance requirements, testing conditions, and procedures used to determine the integrity of structurally bonded plastics, featured on exterior lighting devices.

1.2 Foreword. Not applicable.

1.3 Applicability. This procedure applies to all exterior lighting assemblies that feature structurally bonded plastics and will appear on passenger cars, Multi-purpose Passenger Vehicles (MPV), and trucks.

2 References

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

2.1 External Standards/Specifications.

ISO 10365 ISO/IEC 17025

2.2 GM Standards/Specifications.

GMW3221

3 Resources

3.1 Facilities. The test facilities shall be accredited to ISO/IEC 17025 or by the International Laboratory Accreditation Cooperation.

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 Temperature and humidity controlled chamber.

3.2.2 Water soak chamber.

3.2.3 Crowbars.

3.2.4 Band saw.

3.2.5 Vise grips.

3.2.6 A camera.

3.3 Test Vehicle/Test Piece. Exterior lighting samples of production quality (examples include head lamps, tail lamps, fog lamps, reflectors, center high mounted stop lamps (CHMSL), etc.)

3.4 Test Time.

Calendar time: 8 days

Test hours: 168 hours + pulls

Coordination hours: 24 hours

3.5 Test Required Information. Not required.

3.6 Personnel/Skills. Not required.

4 Procedure

4.1 Test Sample Preparation. Test at least six sample parts which includes both left hand (LH) and right hand (RH) samples that shall be obtained off of the intended production line equipment and set production process. Unless otherwise specified, four samples shall be tested in the as-received condition and two samples shall be tested without being exposed to the in-process leak check. **If available, additional samples conditioned per GMW3221, Code A, for 72 h after end of line should be submitted for performance comparison.** During production of the test samples, three samples of each substrate should be tested on line for surface energy levels at six locations within the bond joint prior to applying the adhesive and within five minutes of the completion of the surface treatment. The minimum value shall be reported and any variations >5 dyne/cm (0.005 Nm) shall be mapped on a lamp picture formatted within the report.

4.1.1 Sectioned Sample Preparation. Unless otherwise specified, assembly samples shall be subjected to sample preparation and the testing after the adhesive suppliers recommended time to full cure of the specific adhesive (typically a minimum aging period of 7 to 14 days). A shorter aging period may be used, provided it is recognized that it represents a more severe condition of test and that results obtained at different aging times are not a good basis for comparing the relative performance characteristics of the joint. Cut the samples into smaller sections using a band saw or equivalent tool. Each sample section should be random across all samples and possess approximately between 50 mm and 100 mm of continuous bond line. Do not cut through any uncommon features or large structural variations along the sample's bond line (example: steep angles, sharp points, quick curves, etc.) Instead, cut around these areas so that the feature or shape is captured in a single section or as few as possible. Leave sufficient substrate length (suggested minimum width 40 mm) beyond the bond line of each section to provide adequate gripping area. To ensure testing of the adhesive exclusively, remove any screws/bolts and cut any clips that further secure the bonded substrates.

4.1.1.1 Cutting Precautions. Ensure cutting the sample introduces no cracks, fractures, or other faults within the adhesive or substrate. (For example, sections may need to be cut slowly to avoid melting the adhesive or excessive vibration to the joint.)

4.1.1.2 Section Labeling. Each test section must be labeled to indicate its original position in the uncut part (part sample mapping). Labeling should also identify which sections belong to which of the six uncut parts. (For example: three sample parts are each cut into four sections. Sections for sample "A" could be labeled "A1," "A2," "A3," and "A4." The corresponding sections of sample "B" would then be labeled "B1," "B2," "B3," and "B4." The sections of test sample "C" would follow the same pattern.)

4.2 Conditions. Place sample sections in the following environmental conditions for the specified duration. Do not put all the sections from one assembly sample in the same environmental condition. In each environmental condition, each assembly needs to be present and, in combination, represent an entire assembled sample (i.e., one lamp assembly goes through all conditions listed in 4.2.1).

4.2.1 Environmental Conditions.

- Ambient conditions for 48 h at 23 °C and 50% relative humidity.
- Water soak for 168 h at 55 °C. Test wet at 23 °C.
- Water soak for 168 h at 55 °C. Test dry at 23 °C.
- Hot climate at 82 °C for 48 h (hot pull shall occur within three minutes of removal from environment).

Note: Test wet indicates samples are still wet but tested at room temperature (within 15 minutes of removal from water). Test dry means after a 24 h ambient recovery.

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 Agreement and approval to deviations required by the applicable GM Engineers (approval shall include both Design Engineering and Validation Engineering).

4.3 Instructions.

4.3.1 Force the assembly apart using a crowbar, screwdriver, or other pry tool. As failure propagates, ensure that the tips of any prying tools do not cut into the adhesive and/or substrates. Force the failure across the

width of the bond joint, as opposed to parallel to the length. This concentrates the cleaving load on one small area at a time. Alternatively, clamp vise grips to both substrates and pull until failure.

4.3.2 Instron Pulling. If the sections cannot be separated by crowbar or hand, an Instron testing machine may be used to force failure. The closest edge of each gripping hand must be within 40 mm of the adhesive bond. Smaller part sections are recommended for Instron method, approximately between 40 mm and 60 mm of continuous bond line.

Photos are required, which show front view, side view, and any additional descriptive angles, to provide proof that the adhesive joint was under load, which is visually demonstrated with the tongue of joint parallel to the pull direction.

4.4 Performance Criteria. After all test environments, all samples shall yield a minimum of 75% cohesive failure of the adhesive at the bonded joint area, substrate failure, or mixed failures covering across 100% of the bond joint. Mixed failures may include thin film cohesive failure and light fiber tear as defined in ISO 10365.

5 Data

5.1 Calculations. Calculate the percentage of each failure mode for each section and each substrate (lens and housing separately) by comparing the estimated failure area to the bonded area (bonded area/design footprint) x 100).

Then, as reference, calculate the overall percentage for each original lamp sample (Sample "A" overall percentage from A1, A2, A3, A4 as described in 4.1.1.2 Section Labeling).

5.2 Interpretation of Results. Expected failure modes are detailed in ISO 10365. If stock breaks (SB) comprise more than half of all failures, the crowbar test must be repeated, ensuring that all loading is focused on the adhesive joint.

5.3 Test Documentation.

5.3.1 Identify and report the test parts (by program, part number and description) and the parts' materials (both substrate grade specifics and color, adhesive grade and color, and coatings present, and surface treatment method and surface energy report out).

5.3.2. Document the sectioning process with text and photographs. Identify where each section is located on the full lighting fixture by text and photograph.

5.3.3. Document the crowbar test method with text and supporting photographs, Figures A1, A2, A3, A4, and A5.

5.3.4 Tabulate each part with its sections, environmental exposure, labeling, force of failure (if tested with an Instron machine). See Table A1. Also note the actual environmental conditions under which each part was pulled and any delay time, if applicable.

5.3.5. Describe each failure in as much detail as possible. Calculate percentage of each failure mode based on estimate of actual bond area. Identifying which substrate was affected if thin film cohesive failure or adhesive failure was observed, and where one failure mode transitions to another. Also describe where on the lamp the sample failure occurred.

5.3.6. If reporting for root cause analysis, include detail visual comparisons of leaked area versus known good areas.

5.3.7. Note any observed patterns and/or any anomalies.

5.4 Sample Review. Samples shall be reviewed by the responsible GM Design Engineer and GM Validation Engineer.

5.5 Sample Retention. Samples shall be retained by the supplier for any future reviews by GM Engineering until start of regular production (SORP) +90 days, or until any root cause investigation has final approval and closure in the GM systems, whichever may apply (i.e., Part Report Tracking System (PRTS), or Quality Review Document (QRD) meeting minutes).

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.