



Structural Bonding Tape for Clip Attachment

1 Scope

1.1 Material Description. Heat curable structural bonding tape with integrated pressure sensitive adhesive. The tape is typically protected with a suitable release liner.

- **Type I** tape is intended for medium/high bake plants.
- **Type II** tape is intended for low bake plants. Contact engineering for specific plant bake schedules.

1.2 Symbols. Not applicable.

1.3 Applicability. This specification covers the durability and adhesion performance requirements for curing structural bonding tapes for exterior trim applications. The adhesive material is used primarily for the attachment of roof ditch molding clips to roof ditches. Other applications may include the attachment of appliques or other trim parts.

1.4 Remarks. This specification covers the laboratory test requirements for GM Approved Adhesive Applications (AAA), Production Part Approval Process (PPAP), processing conditions and routine quality control. In regions other than General Motors North America (GMNA), the AAA process is optional.

1.4.1 In addition to the substrate/adhesive/substrate combinations, approvals are also specific to the facility that does the adhesive bonding.

2 References

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

2.1 External Standards/Specifications.

ISO/IEC 17025 ISO/TS 16949

2.2 GM Standards/Specifications.

GMW3005 GMW3221 GMW14729 GMW15851
GMW3059 GMW14124

2.3 Additional References.

- Statement of Requirements

3 Requirements

3.1 All tests shall be performed at $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and $50\% \pm 5\%$ relative humidity (RH) unless otherwise specified. The standard curing protocol shall be to heat the test sample at $165\text{ }^{\circ}\text{C}$ for 20 minutes plus $140\text{ }^{\circ}\text{C}$ for 25 minutes (medium bake/high bake), or $130\text{ }^{\circ}\text{C}$ for 20 minutes plus $121\text{ }^{\circ}\text{C}$ for 20 minutes (low bake). Electrodeposition coated (E-Coat) panels and bake conditions, must be agreed upon by the regionally responsible GM engineering group. All materials and process conditions must accompany test data in issued reports.

3.1.1 Requirements on Test Specimens. Reference GMW3221.

3.1.1.1 Sample Preparation. The bonded part must be conditioned for 72 h per GMW3221 Code A, prior to environmental exposure unless otherwise stated.

3.2 Test Preparation and Evaluation.

3.2.1 Facilities.

3.2.1.1 For AAA testing, if tests are performed outside of GM, all testing shall be performed in an accredited laboratory. Laboratory accreditations to ISO/IEC 17025 or data accepted by the GM Materials Engineer are

acceptable. Table A1 in Appendix A must also be completed and submitted to the responsible GM Materials Engineer prior to the onset of testing.

3.2.1.2 For PPAP testing, if tests are performed outside of GM, use a laboratory from an organization that is either third party registered to ISO/TS 16949, or laboratory accreditations to ISO/IEC 17025, or use data accepted by the GM Materials Engineer.

3.2.1.3 All testing is the responsibility of the Tier 1 supplier. In-house test data can also be used.

3.2.2 Plant Specific Testing. This testing must be performed for each combination of design, substrate material, paint, adhesion promoter, adhesive, and manufacturing location. See 3.3.8 through 3.3.8.3 for details. Perform AAA testing as indicated in Appendix A, Data Sheet A1, (AAA approval and AAA number is required for PPAP).

3.2.2.1 If regrind is allowed, all specimens for testing must be obtained from production parts that are made from the maximum allowable regrind as stated on the drawing.

3.2.2.2 Each test must be completed on a minimum of three (3) samples, each obtained from separate parts.

3.2.2.3 When testing per 3.2.2.2 is completed, the tested parts, or specimens cut from the parts, and test report, will be reviewed by the responsible GM Materials Engineer and entered into the AAA database, and an AAA number will be given. An option to entering the data into the AAA database, and giving an AAA number, is to document the data in a test report.

Note: Full AAA approval may be given at this time depending on test results.

3.3 Generic Adhesive Testing.

3.3.1 Shear Samples. Prepare test samples by placing a piece of tape 10 mm × 20 mm between the E-Coat shear strips (20 mm × 51 mm × 0.8 mm). Using a 2 kg roller, press once from one (1) end to the other. A separate set of test samples are to be used for each test environment per each test condition.

3.3.2 Pluck Samples. Prepare test samples by placing a piece of tape of 10 mm × 20 mm between E-Coat plates (25.4 mm × 25.4 mm × 0.8 mm). Using a 2 kg roller, press once from one (1) end to the other. A separate set of test samples are to be used for each test environment per each test condition.

3.3.3 Liner Release Strength. Liner release strength shall be a maximum of 7.5 N/10 mm when tested via 180 degrees peel at a speed of 50 mm/minute.

3.3.4 Shear Strength. Measure the shear strength by using a tensile tester. The test speed shall be 50 mm/minute.

3.3.4.1 Initial Adhesive Shear Strength. Condition the test sample for 20 minutes at 23 °C ± 2 °C and 50% RH ± 5% RH. Shear strength measured after this condition shall be a minimum of 0.4 MPa.

3.3.4.2 Shear Strength of Cured Material. Bake a test piece under the standard curing protocol (3.0), then condition the test sample for 1 h at 23 °C ± 2 °C and 50% RH ± 5% RH. Shear strength measured after these conditions shall be a minimum of 4.3 MPa.

3.3.4.3 Shear Strength of Over-Baked Material. Bake test piece at 190 °C for 60 minutes plus 140 °C for 20 minutes (Type I), or 158 °C for 90 minutes plus 130 °C for 20 minutes (Type II). Then condition the test sample for 1 h at 23 °C ± 2 °C and 50% RH ± 5% RH and measure shear strength. Shear strength shall be a minimum of 4.3 MPa.

3.3.4.4 Shear Strength of Under-Baked Material. Bake test piece at 158 °C for 15 minutes plus 130 °C for 20 minutes (Type I), or 125 °C for 15 minutes plus 121 °C for 20 minutes (Type II). Then condition the test sample for 1 h at 23 °C ± 2 °C and 50% RH ± 5% RH and measure shear strength. Shear strength shall be a minimum of 4.3 MPa.

3.3.4.5 Hot Shear Strength of Cured Material. Bake a test piece under the standard curing protocol, then condition the test sample for 1 h at 85 °C ± 3 °C and measure shear strength. Shear strength measured at this temperature shall be a minimum of 1.4 MPa.

3.3.4.6 Cold Shear Strength of Cured Material. Bake a test piece under the standard curing protocol, then condition the test sample for 1 h at -30 °C ± 2 °C and measure shear strength. Shear strength measured at this temperature shall be a minimum of 2.8 MPa.

3.3.5 Aging Durability Shear Strength.

3.3.5.1 Accelerated Aging Shear Strength. Bake a test sample under the standard curing protocol (3.0). Allow sample to remain at a temperature of 80 °C ± 3 °C for seven (7) days, and then condition the test sample for

1 h at 23 °C ± 2 °C and 50% RH ± 5% RH and measure shear strength. The shear strength measured under these conditions shall be a minimum of 4.3 MPa.

3.3.5.2 Humidity Resistance after Curing. Bake a test sample under the standard curing protocol (3.0). Expose the samples to 168 h humidity per GMW14729, and then condition the test sample for 1 h at 23 °C ± 2 °C and 50% RH ± 5% RH and measure shear strength. The shear strength measured under these conditions shall be a minimum of 4.3 MPa.

3.3.5.3 Environmental Cycle Shear Strength. Bake a test sample under the standard curing protocol (3.0). Perform two (2) environmental cycles in accordance with GMW14124 Cycle C, replace high temperature of 70 °C with 80 °C, then condition the test sample at 23 °C ± 2 °C and 50% RH ± 5% RH for 1 h prior to shear adhesion. The shear strength measured under these conditions shall be a minimum of 4.3 MPa.

3.3.6 Pluck Strength. Measure the pluck strength by using a tensile tester. The test speed shall be 50 mm/minute.

3.3.6.1 Initial Pluck Strength. Condition the test sample for 20 minutes at 23 °C ± 2 °C and 50% RH ± 5% RH. Pluck strength measured after this condition shall be a minimum of 0.3 MPa.

3.3.6.2 Pluck Strength of Cured Material. Bake a test piece under the standard curing protocol (3.0), then condition the test sample for 1 h at 23 °C ± 2 °C and 50% RH ± 5% RH. Pluck strength measured after these conditions shall be a minimum of 1.7 MPa.

3.3.6.3 Pluck Strength of Over-Baked Material. Bake test piece at 190 °C for 60 minutes plus 140 °C for 20 minutes (Type I), or 158 °C for 90 minutes plus 130 °C for 20 minutes (Type II). Then condition the test sample for 1 h at 23 °C ± 2 °C and 50% RH ± 5% RH and measure pluck strength. Pluck strength shall be a minimum of 1.7 MPa.

3.3.6.4 Pluck Strength of Under-Baked Material. Bake test piece at 158 °C for 15 minutes plus 130 °C for 20 minutes (Type I), or 125 °C for 15 minutes plus 121 °C for 20 minutes (Type II). Then condition the test sample for 1 h at 23 °C ± 2 °C and 50% RH ± 5% RH and measure pluck strength. Pluck strength shall be a minimum of 1.7 MPa.

3.3.6.5 Hot Pluck Strength of Cured Material. Bake a test piece under the standard curing protocol (3.0), then condition the test sample for 1 h at 85 °C ± 3 °C and measure pluck strength. Pluck strength measured at this temperature shall be a minimum of 1.1 MPa.

3.3.7 Aging Durability Pluck Strength.

3.3.7.1 Accelerated Aging Pluck Strength. Bake a test sample under the standard curing protocol (3.0). Allow the sample to remain at a temperature of 80 °C ± 3 °C for 7 days, and then condition the test sample for 1 h at 23 °C ± 2 °C and 50% RH ± 5% RH and measure pluck strength. The pluck strength measured under these conditions shall be a minimum of 1.7 MPa.

3.3.7.2 Humidity Resistance after Curing. Bake a test sample under the standard curing protocol (3.0). Expose the samples to 168 h humidity per GMW14729, then condition the test sample for 1 h at 23 °C ± 2 °C and 50% RH ± 5% RH and measure pluck strength. The pluck strength measured under these conditions shall be a minimum of 1.7 MPa.

3.3.7.3 Environmental Cycle Pluck Strength. Bake a test sample under the standard curing protocol (3.0). Perform five (5) Environmental cycles in accordance with GMW14124 Cycle W (GM Europe), or two (2) environmental cycles in accordance with GMW14124 Cycle C, but replace high temperature of 70 °C with 80 °C (GMNA), then condition the test sample at 23 °C ± 2 °C and 50% RH ± 5% RH for 1 h. The pluck strength measured under these conditions shall be a minimum of 1.7 MPa.

3.3.8 Plant Specific Sample Testing.

3.3.8.1 Peel Samples. Prepare test samples by placing a production intent roof ditch molding clip with tape onto a 50 mm or 100 mm × 300 mm steel test panel with layering representing the specific plant. Examples of layering are E-Coat, or E-Coat and sealer tape, or E-Coat and pumpable sealer, or E-Coat and sealer tape and primer surfacer. Using a 2 kg roller (or as recommended by the tape supplier), press once from one (1) end to the other. Bake using the plant specific times, and temperatures. A separate set of test samples are to be used for each test environment per each test condition. Run tests in triplicate (minimum). Allow a 2 h room temperature dwell after bake before testing. Fixture the clip on one (1) end and run a 90 degree peel test at 50 mm/minute on an Instron (or equivalent) constant rate of extension test machine. Record the peak load and the failure mode. The minimum acceptable peel strength is 89 N. **Optional:** run a shear test if a peel strength test cannot be run.

3.3.8.2 Pluck Samples. Prepare test samples by placing a production intent roof ditch molding clip with tape onto a 50 mm or 100 mm × 300 mm steel test panel with layering representing the specific plant. Examples of layering are E-Coat, or E-Coat and sealer tape, or E-Coat and pumpable sealer, or E-Coat and sealer tape and primer surfacer. Using a 2 kg roller (or as recommended by the tape supplier), press once from one (1) end to the other. Bake using the plant specific times, and temperatures. A separate set of test samples are to be used for each test environment per each test condition. Run tests in triplicate (minimum). Allow a 2 h room temperature dwell after bake before testing. Fixture the clip and run a pluck test (pulling normal to the test panel surface) at 50 mm/minute on an Instron (or equivalent) constant rate of extension test machine. Record the peak load, and the failure mode. The minimum acceptable pluck strength is 222 N.

3.3.8.3 Run peel, and pluck tests after the following environmental conditions:

- At room temperature.
- 168 h humidity per GMW14729.
- 168 h oven aging at 80 °C ± 3 °C.
- Five (5) cycles of GMW14124 Cycle W – General Motors Europe (GME), or two (2) cycles of GMW14124 Cycle C, replace high temperature of 70 °C with 80 °C (GMNA).

3.3.9 Bake Chart Creation. A bake cart shall be created for each product. See GMW3005 for an example of a bake chart. Use bake temperatures on the y-axis, and bake times (minutes at metal temperature) on the x-axis. Shear strength data should be used to generate the bake chart. Include an optimum performance range, a marginal performance range, and a poor performance range. Identify effects of overbake, and underbake conditions. Identify the target bake conditions. Review bake chart creation test plan with the responsible engineer before starting. The completed bake chart must be signed, and dated by the responsible GM engineer, and the supplier. Use initial conditions only. For regions other than GMNA, bake chart creation is optional.

3.3.10 Shelf Life. Material must meet all of the requirements in this specification after 30 days storage at 23 °C, 50% RH, or 90 days at 5 °C.

3.3.11 Test Conditions. Tests shall be conducted using the latest issue of the test methods indicated. Suitable precautions should be taken to ensure that applicable safe limits are not exceeded when conducting test procedures, processes and/or handling the materials required by this specification.

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

3.3.13 Changes in Processing. After the initial AAA or release has been established, any change in processing parameters, as recorded on Appendix A, Data Sheet A2; requires prior approval of the responsible GM Materials Engineer.

3.3.13.1 In addition, any changes to the data originally recorded on Appendix A, Data Sheet A1, and PPAP requirements from GMW16195, where the data does not meet the minimum requirements, also requires discussion, and evaluation, with the responsible GM Materials Engineer.

3.3.13.2 Unless 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.

3.3.14 Test Results. Test reports shall be written per the Requirements for Test Report in ISO/IEC 17025. Additionally, a test report containing the following shall be submitted to the GM Materials Engineer (per Appendix A, Table A3: AAA Checklist).

3.3.14.1 Data Sheet A1 (Appendix A) – GM AAA Requirements and Test Data Form completed and signed. Enlarge as required.

3.3.14.2 Data Sheet A2 (Appendix A) – Roof Ditch Molding Clip Bonding Process Form completed and signed by facility management.

3.3.14.3 Data Sheet A3 (Appendix A) - AAA Request Form.

3.3.14.4 A copy of the Registration or Scope of Accreditation for each test facility that provided data.

3.3.14.5 Copy of material requirements as listed in part drawing notes from the latest print or math file.

3.3.14.6 Tested parts for review by the responsible GM Materials Engineer (see 3.2.2).

3.3.14.7 All tested samples shall be retained by the supplier for review by the appropriate GM Materials Engineer until AAA approval is obtained.

3.3.15 Deviations from Test Procedure. Deviations from the requirements of the test procedures shall have been agreed upon with GM. Such requirements shall be specified on component drawings, test certificates, reports, etc.

3.3.16 PPAP Testing. Perform testing as indicated in Appendix A, Data Sheet A4 for components, unless otherwise noted by the GM Materials Engineer. A printout of the AAA approval will be required with the PPAP package.

3.3.17 Daily Quality Control Testing. Testing as stated in this specification, at a minimum, is to be followed unless otherwise noted by GM Supplier Quality or in the Statement of Requirements. All tests as listed in Appendix A, Table A4, must be run at every shift, and the daily test date to be reported.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

5.2 Language. In the event of conflict between the English and domestic language, the English language shall take precedence.

5.3 Inspection and Rejection. Samples of components or materials released to a GM material specification shall be tested for conformity with the requirements of this material specification and approved by the responsible Engineering department prior to commencement of delivery of bulk supplies.

A new approval must be received for any changes, e.g., properties, manufacturing process, location of manufacture, etc. If not otherwise agreed, all testing and documentation normally required for initial release must be completed.

It is the responsibility of the supplier to inform the customer in a timely manner, without solicitation, and to include documentation of all modifications of materials and/or processes and to apply for a new release.

5.4 Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS). For new product submissions, or when a change in chemical composition of an existing product has occurred, a complete copy of the Material Safety Data Sheet/Safety Data Sheet must be submitted in compliance with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) requirements or other country-specific MSDS/SDS requirements.

5.5 All materials supplied to this standard must comply with the requirements of the International Material Data System (IMDS) and GMW3059, **Restricted and Reportable Substances**.