



Performance Requirements of an Exterior Lighting Structural Adhesive

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/Material Description. This specification covers the material approval and performance requirements of an exterior lighting structural adhesive used to bond and seal the lens to housing.

1.1.1 The structural adhesive must be thermosetting (reactive hot melt, moisture-cure urethane, two-part urethane, two-part silicone, etc.) The material shall not cause crazing of acrylic or polycarbonate.

1.1.2 Additional mechanical retention (metal clips, plastic snap-in fasteners, fixtures, etc.) shall be used to retain the part in position during cure.

1.1.3 There are two classes of adhesive systems: Class I and Class II, which are based on application performance requirements and are not interchangeable. If no class designation or type designation is specified, Class I adhesive system applies as the default standard for exterior lighting.

- Class I. Structural adhesives primarily used to bond a lens and housing of an exterior lamp assembly. These materials may also be used for other suitable exterior lighting applications.
- Class II. Structural adhesives, typical two-part silicone, for high-temperature applications (over 110 °C) and/or applications that do not exceed a bond joint greater than linear length of 500 mm (e.g., small Daytime Running Lamps).

1.2 Symbols. Not applicable.

1.3 Applicability. This material is used to bond/seal lighting assembly lenses to housings.

1.4 Remarks. Engineering qualifications of an approved system (adhesive, substrates, surface treatments or coatings) must be documented as a combination in the GM Material Approved Source List. If Adhesive Application Approval (AAA) is required, GMW15625 shall be added to the part drawing or math data.

2 References

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

2.1 External Standards/Specifications.

ASTM D1780	ISO 75-2	SAE J1525	SAE J2527
ISO 75-1	ISO 4892		

2.2 GM Standards/Specifications.

GMW3059	GMW3235	GMW14729	GMW15790
GMW3116	GMW14124	GMW15625	GMW16259
GMW3221	GMW14270	GMW15735	

2.3 Additional References.

- Standard Plaque Inc., Melvindale, Michigan

3 Requirements

See Appendix A, Table A1, for a listing of part performance requirements. Each test shall be performed in triplicate. Requirements are separated according to the following process stages:

- **Adhesive approval:** For a new adhesive not previously approved by GM
- **Lamp Combination approval:** For a change in lens or housing material or surface treatment for an approved adhesive

3.1 Requirements on Test Specimens. Unless otherwise specified, the materials shall be tested under standard conditions per GMW3221, Code A. Samples shall be tested after reaching full cure, unless otherwise specified in the test method.

3.2 Requirements on Delivery. Materials shall be received in the plants as part of an assembly or with fasteners so they may be attached to body structures in the assembly plants.

3.2.1 Chemical Requirements.

3.2.1.1 Color. To be called out on the part drawing, if required.

3.2.1.2 Shelf Life, GMW15735. Material conditioned using potential storage conditions must be capable of passing all the requirements of GMW15735.

3.2.2 Performance Requirements.

3.2.2.1 Adhesion. Test method: Test specimens for adhesion strength testing shall be either tongue and groove or lap shear. The tongue and groove plaques shall consist of materials molded by a GM approved source as recommended. (Contact Standard Plaque Inc. (313-383-7233) and reference mold numbers 12A and B for samples or equivalent). Lap shear specimens shall be prepared according to SAE J1525. Lap shear specimen overlap shall be 25 mm (1 in) with a minimum of 0.5 mm bond thickness, maintained by wire or glass beads.

Substrates used in testing shall be those used in the production assembly. They are to include any coatings (paint, hard coat, coatings, adhesion promoters, etc.) or treatments (flame, plasma, solvent wipe, etc.) that would be part of the production intent process.

If treatments are used, reports shall indicate the type of treatment used along with minimum surface energy produced, within ± 6 dyn/cm (dyne per centimeter), of the test specimens used for the certification testing.

If coatings or treatments are not used, clean the surfaces to be bonded with a hot, soapy water solution. The soap shall be free rinsing, similar to that used for glassware. After cleaning, the plaques are blown dry and aged per GMW3221, Code A, for 24 h to ensure dryness. Test the assemblies at a crosshead speed of 12.7 mm/minute on a universal tensile test machine capable of measuring loads at an accuracy of 1%.

Note: Proper alignment of the test assembly is critical. Every effort should be made to maintain uniform tension across the bond area. Cleavage and/or peel of the bond area could yield inaccurate results. Document all concerns of alignment and relate to specific sample number tested. Evaluate a minimum of five (5) assemblies per condition for the initial approval of an adhesive formulation. Additional substrate approvals on an approved formulation require a minimum of three (3) assemblies per condition. Report failure mode and peak load in Newtons.

3.2.2.1.1 Adhesion Strength. All samples must meet the minimum load specified and demonstrate 100% cohesive failure (which may include thin film cohesive failure) or substrate failure in all test conditions as described in Table 1.

Condition specimens for a minimum of 30 minutes at the specified temperature prior to adhesion strength test. Test specimen within 5 minutes of removal from environment.

Table 1: Initial Testing Conditions and Requirements

Condition	Class I	Class II
	Force (N)	Force (N)
Initial (test at 22 °C)	900	600
Hot (test at 82 °C)	400	400
Hot (test at 110 °C) ^{Note 1}	Not applicable	400
Cold (test at -30 °C)	1000	1000

Note 1: If production substrates are not suitable for test temperature listed for Class II adhesives requirements, substrate specific testing shall be done at 10 °C (15 °F) below materials heat deflection temperature (HDT) at 1.8 MPa per ISO 75-1, ISO 75-2, Method A, or at 82 °C whichever is higher, along with high temperature testing using substrate per GMW16259, P-PC-HT-T3, or an alternative material approved by the appropriate Materials Engineering department(s).

Note 2:

HDT = Heat Deflection Temperature

MPa = Megapascal

N = Newtons

3.2.2.1.2 Environmental Aging. All samples must meet the minimum load specified and demonstrate 100% cohesive failure (which may include thin film cohesive failure), or substrate failure in all test conditions as described in Table 2.

Condition per GMW3221, Code A, for a minimum of 24 h after exposure, then test at GMW3221, Code A, conditions.

Table 2: Environmental Aging Conditions and Requirements

Condition	Class I	Class II
	Force (N)	Force (N)
Humidity (GMW14729, 14 d)	1000	600
Water immersion (14 d at 32 °C)	900	500
Exterior cycle (GMW14124, Cycle K, 13 cycles)	900	600
Corrosion cycle (GMW14124, Cycle F, 2 cycles) ^{Note 1}	900	600
Oven aging (14 d at 88 °C)	1000	600
Oven aging (42 d at 110 °C) ^{Note 2}	Not applicable	400 ^{Note 3}
Weatherability (exposure to exterior xenon arc weatherometer per SAE J2527 – 2500 kJ/m ² or ISO 4892 – 3000 kJ/m ²) ^{Note 5}	1000	600

Note 1: Required new substrate families and metal interfaces only.

Note 2: If production substrates are not suitable for test temperature listed for Class II adhesives, substrate specific testing shall be done at 10 °C (15 °F) below materials heat deflection temperature (HDT) at 1.8 MPa per ISO 75-1, ISO 75-2, Method A, or at 88 °C whichever is higher, along with high temperature testing using GMW16259 P-PC-HT-T3 or alternative material approved by the appropriate Materials Engineering department(s).

Note 3: Values after heat exposure must not be < 50% of initial values or listed minimum.

Note 4: kJ = Kilojoules

Note 5: Required for initial approval per substrate resin family.

3.2.2.1.3 Green Strength/Strength Development. Document the rate of solidification by measuring and graphing the adhesion strength, refer to 3.2.2.1.1, initial adhesion, using lap shear specimens prepared according to SAE J1525 and other pull conditions listed in 3.2.2.1. Prepare samples and measure adhesion strength over the following increments of cure time 5 minutes, 10 minutes, 30 minutes, 60 minutes, 240 minutes, and 24 h, 48 h, 72 h, and 1 week, 1.5 weeks, and 2 weeks. Intervals can be adjusted based on technology tack