GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW3041

Performance Requirements for Bonding and Sealing of Stationary Automotive Glass

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. The material is typically a one (1) component, warm or cold temperature applied, moisture cure, black polyurethane adhesive sealing compound. Two (2) component chemical cure systems can also be qualified under this requirement. These adhesives are used in conjunction with compatible glass side and body/substrate primers for bonding automotive glass to body openings. Based on compatibility, it may be used with or without a primer for bonding to specific paint systems, plastics, or metals.

1.2 Symbols. The material abbreviation according to ISO 11469 is <PUR>.

1.3 Applicability. Applications for materials approved to this specification include the bonding and sealing of fixed automotive glass. These are typically windshields, backlites, fixed liftgate, side and encapsulated glass. Materials approved to this requirement are generally intended for bonding the aforementioned automotive glass to painted body openings. Compatibility to other substrates is not restricted to, but may include Reaction Injection Molded (RIM), Polyvinyl Chloride (PVC), Sheet Molding Compound (SMC), or Thermoplastic Elastomer (TPE).

1.4 Remarks. None.

2 References

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

2.1 External Standards/Specifications.

ASTM D412	ASTM E145	ISO 868	VDA 278
ASTM D624	DIN 51 757	ISO 11469	
ASTM D638	DIN EN ISO 9142	SAE J243	
ASTM D1475	EPA Test Method 24	SAE J1524	

2.2 GM Standards/Specifications.

B 040 0180	GMW3417	GMW14873	GMW16569
GMW3059	GMW14124	GMW15329	GMW17345
GMW3205	GMW14162	GMW15481	GMW17350
GMW3221	GMW14270	GMW15735	L 000 0955
GMW3368	GMW14711	GMW15736	
GMW3371	GMW14729	GMW15959	

2.3 Additional References. Not applicable.

3 Requirements

3.1 Requirements on Test Specimens. Reference GMW3221.

3.1.1 Sample Conditioning. All samples are to be conditioned prior to each requirement test to GMW3221 Code A.

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3.2 Material Properties - Uncured. The adhesive sealing compound material properties referenced in (3.2.1 through 3.2.6) will be provided at the time of material approval and documented in the specific material specification when published.

3.2.1 Viscosity.

- Test at 22 °C ± 3 °C and 50% ± 5% Relative Humidity (RH).
- Conditions: Initial, 90 days, and 180 days.

3.2.1.1 Room Temperature Applied. Per SAE J1524.

3.2.1.1.1 Standard Viscosity. Conditioning Method A, Table 1 Rheometer orifice Number 2 at 440 kPa per SAE J1524.

3.2.1.1.2 High Viscosity. Conditioning Method A and orifice dimensions below 50 kPa per SAE J1524**.**

- Diameter = 4 mm
- Length = 18.8 mm

3.2.1.2 Warm Applied. Per DIN 51 757, Flow meter at 60 °C nozzle 4 mm, pressure 2.8 bar, 20 g.

3.2.2 Odor, GMW3205, Coding B. Odor shall be tested with a cured 1 cm × 1 cm cross section bead, 25 cm long, approximately 25 mL. The adhesive bead shall be extruded on a non-stick surface and allowed to cure for 7 days at 22 °C ± 3 °C and 50% ± 5% RH prior to access to testing. The minimum rating of the odor shall be six (6).

3.2.3 Color. Visual Inspection.

3.2.4 Volatile Organic Compound (VOC), Environmental Protection Agency (EPA) Test Method 24, Procedure B or VDA 278. Use of EPA Test Method 24 or VDA 278 is dependent of the regional use of material. EPA Test Method 24 can be used to specifically define VOC content and solids.

3.2.5 Specific Gravity. Per ASTM D1475.

3.2.6 Solids Content, EPA Test Method 24. Calculated solids content based upon VOC data gained from testing of EPA Test Method 24 per 3.2.4. Percent (%) Solids = 100% - VOC% (EPA Test Method 24).

3.3 Material Properties - Cured. The adhesive sealing compound material properties referenced in 3.3.1 through 3.3.5, will be provided at the time of material approval and documented in the specific GM material specification. Refer to 3.4.3 for Environmental Exposure Conditions.

3.3.1 Shore Hardness, ISO 868. All readings must fall within the specified tolerances as tested on a single sample at each of the following conditions:

- 168 h at 22 °C ± °C 3 °C and 50% RH cure.
- 4 h at -30 °C ± 3 °C after cure at 168 h at 22 °C ± 3 °C and 50% RH. Test at temperature. Maximum increase of 15 points over 168 h room temperature (RT) value is allowed.
- 336 h at 70 °C ± 3 °C after cure at 168 h at 22 °C ± 2 °C and 50% RH. Test at 22 °C ± 2 °C. Maximum increase of 15 points over 168 h RT value is allowed.

3.3.2 Modulus, GMW15329 (100 mm/minute and 10% Strain). Condition: Initial cure. See 3.4.3.1.

3.3.3 Elongation, ASTM D412, Method A, Die C. Conditions: Initial Cure. See 3.4.3.1.

3.3.4 Tensile Test for Fixed Glass Bonding, GMW15736. Cure samples at 22 °C ± 3 °C and 30% ± 5% RH. After 5.5 h, tensile strength shall be > 250 N.

3.3.5 Young's Modulus – ASTM D638.

3.4 Performance Requirements.

3.4.1 Uncured.

3.4.1.1 Cure Rate. GMW3371, Overlap Shear Adhesion (OLS). Prepare the test samples per GMW3371. The overlap shear samples must exhibit the following minimum shear strengths when cured at 22 °C ± 3 °C and 30% ± 5% RH. **Requirements:**

- Room Temperature Applied: ≥ 250 kPa at 3 h and ≥ 1750 kPa at 72 h.
- Warm Applied: ≥ 250 kPa at 3 h, ≥ 1000 kPa at 24 h, ≥ 2400 kPa at 72 h.

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3.4.1.2 Static Tensile and Shear Force, for Warm Applied Materials Only. The adhesive sealing compound shall be conditioned for 1 h at a temperature to be agreed upon by the material supplier and the responsible GM Engineering Group. Afterwards, the adhesive sealing compound shall be applied to two (2) aluminum test coupons 100 mm long × 20 mm wide × 4 mm thick. The adhesive application shall be 20 mm wide × 20 mm overlap × 5 mm thick. Five (5) minutes after application at 22 °C ± 3 °C, load the test sample in a longitudinal direction with a 500 g mass. Evaluate after 1 h. Requirement: No sliding or detachment of the adhesive bond.

3.4.2 Cured. Refer to 3.4.3 for Environmental Exposure Conditions.

3.4.2.1 Overlap Shear Adhesion, GMW3371. Expose to environmental exposure conditions, 3.4.3, with the exclusion of 3.4.3.7, Cold Cure for Quick Knife Adhesion (QKA).

- **Requirement:** Room Temperature Applied: 1750 kPa minimum after cure, 72 h at 22 °C ± 3 °C and 50% ± 5% RH. No adhesive separation from the test substrate.
- **Warm Applied:** 2400 kPa minimum after 168 h at 22 °C± 3 °C and 50% ± 5% RH. No adhesive separation from the test substrate.

3.4.2.2 Quick Knife Adhesion, GMW3368. Environmental Exposure Conditions per 3.4.3 through 3.4.3.4, Environmental Cycle I per GMW14124, and 3.4.3.7 to be run prior to adhesion testing.

Requirement: More than 75% cohesive separation of the adhesive between the bead cuts with no adhesive separation between the paint layers or test substrate. The percentage separation will be recorded as cumulative from bead cut to cut with the type separation noted. Continuous adhesive separation without recovery between the cuts shall be specifically noted.

3.4.2.3 Cataplasma, Adhesion during Exposure to Humidity, DIN EN ISO 9142. Exposed samples shall be assessed per GMW3368. Unless otherwise specified, test five (5) samples. Reference DIN EN ISO 9142 - Procedure E2 for supporting information.

3.4.2.3.1 Apply a 10 mm diameter bead of the adhesive to the specified application substrate. Cure for 7 days at 22 °C ± 3 °C and 50% ± 5% RH. Wrap the test samples in polishing gauze (B 040 0180) and soak in water. Pack the water soaked samples in airtight Aluminum foil. Seal the Aluminum foil as required to create the airtight container.

3.4.2.3.2 Expose the airtight contained sample(s) at 70 °C ± 3 °C for seven (7) days followed by -30 °C ± 3 °C for 16 h. Remove the samples from the Aluminum foil container and polishing gauze, and further age the samples at 22 °C ± 3 °C and 50% ± 5% RH for an additional 24 h. Assess per GMW3368.

Requirement: Cohesive failure of the polyurethane. Failure between the paint layers of the test sample is allowed.

3.4.2.4 Tunnel Formation Test.

3.4.2.4.1 A pane of glass with dimensions of 150 mm × 200 mm shall be wiped with a clean cloth soaked in glass cleaner, and then dried with a clean, non-fluffy cloth. Glass primer shall then be applied to the clean glass pane with felt and allowed to dry for 10 minutes to 15 minutes.

3.4.2.4.2 Adhesive shall be applied to the pane in the form of a triangle bead approximately 150 mm long, using a vertically held glue gun (nozzle: base 8 mm, height 10 mm). A minimum of three (3) beads shall be applied to one (1) pane.

3.4.2.4.3 A strip of sheet metal painted with coat (depending on the place of application, see material specification, drawing or parts list) dimensions 150 mm × 30 mm, shall be laid longitudinally on each triangle bead with the primer-coated, painted side down (L 000 0955), and the adhesive compressed between 5 mm and 6 mm.

3.4.2.4.4 The adhesive test sample shall be maintained at 22 °C ± 3 °C and 50% ± 5% relative air humidity for 3 h ± 15 minutes and then at 40 °C ± 3 °C and 95% ± 5% RH for 72 h ± 15 minutes.

3.4.2.4.5 After a storage time of 1 h ± 15 minutes at 22 °C ± 3 °C and 50% ± 5% relative air humidity, the sheet metal strips and glass, shall be detached from the adhesive by means of a knife, wire, etc. The glass/adhesive and glass/sheet metal contact points shall be checked for tunnel formation.

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