



Extrude-In-Place (XIP) Anti-flutter/Sealer Materials Specification

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 standard is intended to cover the material and performance requirements of an extrudable and expandable material that can be used as an anti-flutter adhesive or a body shop sealer. The material is received in pellet form and is fed to a robotically positionable extruder. After application onto a part surface, the material solidifies through cooling. It is anticipated that assemblies incorporating these materials will pass through the ecoat paint bake oven. At temperature in the bake oven, the XIP materials will expand and bond to contacted surfaces.

1.2 Symbols. Not applicable.

1.3 Applicability.

1.3.1 Anti-flutter. Bonding of inner and outer panels to eliminate metal contacts act as a vibration dampener and can give the assembly part stiffness, for example, inner and outer panel of hood, tailgate, door, roof bow to roof, fuel filler and wheel arch.

1.3.2 Sealer. The material is intended for use in the body shop to seal body joints against water, dust and air intrusion. High-expanding versions of these sealers are also intended to fill cross sections in body cavities and reduce airborne noise. The sealer material will expand and cure in the Paint Shop Electrocoat or Electrodeposition (ELPO) oven.

Note: Due to new Electrocoat oven design, "2-step", an additional lower temperature hold is required. Temperature and time could impact the performance of XIP body shop expandable sealers; therefore, in addition to the testing completed in this specification (specifically 4.3.1), all XIP body shop sealers need to be tested at the target plant and in target locations of a vehicle to verify proper expansion and performance prior to launch.

1.4 Remarks.

1.4.1 These materials are not intended to be weldable or fuel resistant or applied in the Paint Shop.

1.4.2 Approvals. Material candidates shall not be used for GM production vehicles without full approval by GM Materials Engineering. XIP materials meeting these requirements shall be listed as "Approved" in the GM Approved Source List. When used as anti-flutter adhesives, the material can only be used in production (Production Approval) when there is an accompanying "AAA" number, (Approved Adhesive Application number) for the intended application. The AAA number will require testing to this specification for each unique combination of substrates + surface treatment, etc., intended to be used in vehicle production, or as specified by the approving Materials Engineer. The AAA number can be used as surrogate for multiple bond joint configurations or multiple assembly plant locations as determined by the approving GM Materials Engineer.

1.4.3 Test Data Submission. Technical Approval and AAA submissions shall be submitted on the Standard Data Template. Contact the approving GM Materials Engineer for an electronic copy of the Standard Test Data Submission Template.

1.4.4 Dispense. The XIP material must be capable of being metered, mixed and dispensed using production equipment specifically designed for this purpose.

1.4.5 Paint Bake. Materials approved to this specification shall be compatible with production paint systems and cannot be adversely affected by paint oven bake schedules.

1.4.6 Submission Package. A submission package must be submitted for final approval of a material to this specification. The submission package shall contain a submission letter, product data sheet, panel preparation data, test data and results, bake charts, and Production Part Approval Process (PPAP) warrant data. Test panel performance shall be photographically documented, able to be transferred electronically, and retained with the submission package.

2 References

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

2.1 External Standards/Specifications.

ASTM D570	ASTM D1875	ASTM E831	ISO 10365
ASTM D638	ASTM D1876	EPA Method 24	
ASTM D790	ASTM D2369	ISO 1183-1	
ASTM D792	ASTM E502	ISO 4587	

2.2 GM Standards/Specifications.

9986265	GMW3025	GMW14706	GMW15735
9986321	GMW3059	GMW14729	GMW16152
GMW2	GMW3154	GMW14872	GMW16584
GMW8	GMW3205	GMW15192	GMW16700
GMW11	GMW3286	GMW15477	GMW16723
GMW3008	GMW14124	GMW15481	GMW16853
GMW3011	GMW14270	GMW15634	GMW17056
GMW3016	GMW14444	GMW15635	

2.3 Additional References.

Not applicable.

3 Requirements

Unless otherwise specified, the following requirements must be met. All testing shall be performed with materials that are representative of production processes.

3.1 Classification of Strengths and Expansion Performance.

XIP material shall be classified as follows:

- Expansion – (see Table 2).
- Strength – (see Table 3).
- Strength and Expansion performance classifications are described in Table 4.

3.2. Material Properties.

– Non-expanded dry pellets (see Table 1).

Table 1: Material Properties

Property	Value	Test Method
Color	As specified by the approving GM Materials Engineer.	Visual
Moisture Absorption	<2%	ASTM D570
Solids Content	>99%	ASTM D2369
Density	1.15 ± 0.05	ASTM D1875
Flash Point	>200 °C	ASTM E502
Homogeneity	Material must be homogeneous dry and free flowing. Free of dirt or other foreign material.	Visual
Volumetric Expansion	(see Table 2)	GMW15481

3.3 Physical Properties.

3.3.1 Specific Gravity (ISO 1183-1 (Density), Part 1, Method B). The specific gravity of the uncured material shall be reported. A specific gravity range will be set at the time of approval and become a requirement for the material. A typical specific gravity is 1.2 in the uncured state.

3.3.2 Odor. The material shall have a neutral odor that is not unpleasant in the uncured condition.

3.3.3 Plant Emissions Volatile Organic Compounds (VOC) (GMW3016, EPA Method 24). GMW3016 is required for all regions. EPA Method 24 is additionally required for the United States and Canada. VOC shall be 2% by mass, maximum. If reported VOC exceeds 2% by mass, the composition of the VOC must be declared. For the United States, Hazardous Air Pollutants (HAP) shall be 1% by mass, maximum, based on the Material Safety Data Sheet (MSDS) formula. Evaluate after minimum and maximum bakes per Table 1, followed by 2 h at (23 °C ± 5 °C). Specific local plant review and approval is required prior to each new plant implementation of this material.

3.3.4 Passenger Compartment Emissions.

3.3.4.1 Volatile and Semi-Volatile Organic Compounds (SVOC) from Interior Materials (GMW15634). Test sample shall be baked at target bake per Table 1 and then conditioned for 7 d at (23 °C ± 5 °C) before initiating the test procedure. After this conditioning, packaging is done as described for other test materials in GMW15634. Evaluate SVOC using 60 minutes at 120 °C per GMW15634.

3.3.4.2 Aldehyde and Ketone Emissions from Interior Materials (GMW15635). Test sample shall be baked at target bake per Table 1 and tested within 7 d after baking.

3.3.5 Odor after Bake (GMW3205) (Complete after 3.1.4.1 and 3.1.4.2). The material shall have a tolerable odor with a minimum rating of six (6). The test sample shall be baked at target bake per Table 1, then conditioned for 7 d at (23 °C ± 5 °C) before initiating the test. Use test volume ratio per GMW3205, Table 1, Coding 4 (1:500 ratio), and Wet Condition, Coding A.

3.4 Flame Resistance (GMW16723). Materials that are self-extinguishing within 60 s when tested per GMW16723 shall be designated with the SE suffix (SE – Self-Extinguishing).

3.5 Volumetric Expansion (GMW15481). Volumetric expansion shall be evaluated according to GMW15481. The volumetric expansion range shall be used to determine the approval category per Table 2.

Table 2: Volumetric Expansion

Volumetric Expansion Code	Volumetric Expansion
Low Expansion (LE)	≤ 500% at Minimum Cure
Medium Expansion (ME)	500% to 1000% at Minimum Cure
High Expansion (HE)	1000% to 2000% at Minimum Cure

3.6 Material Properties – Expanded Material.

3.6.1 Application Performance. When used as an anti-flutter adhesive, the material shall meet the requirements of this specification except where noted. When used as a sealer, the material shall meet the requirements of this specification except where noted.

3.6.2 Substrates. Testing shall be completed on GM approved production substrates as specified by the approving GM Materials Engineer. For oily metal, use one (1) challenging approved lubricant as specified by the approving GM Material Engineer. Degreasing and oiling according to GMW15477. Oil coating weight shall be 3 g/m² for corrosion protection oils/lubricants and 1.25 g/m² for dry lubes. Oils shall not exceed a storage time of one (1) year and shall be stored in opaque and inert bins.

Production or AAA approval will require testing to this specification each unique combination of substrates, substrate + oil, substrate + surface treatment, etc., intended to be used in vehicle production, or as specified by the approving GM Material Engineer.

Note 1: After application of the material, the oily metal panels shall be processed through pretreatment and Electrodeposition (ELPO) prior to baking and exposure according to 4.2. Use any GM approved pretreatment (GMW3011) ELPO (GMW3008) at target film thickness, as specified by the approving GM Material Engineer. Other substrates identified and required by the regional material engineering group or the regional material specification.

Note 2: Neutral Salt Spray (NSS) testing according to 3.9.4.2 and Cyclic Corrosion Laboratory Test according to 3.9.4.3 is not required with oily Cold Rolled Steel (CRS) or polymeric substrates.

3.7 Bond Strength, Adhesion, and Corrosion. Anti-flutter adhesive candidates shall be evaluated for strength, separation mode and corrosion protection. Sample testing shall be done in sample sets. Five (5) samples shall constitute a set.

3.7.1 Lap Shear (ISO 4587). All anti-flutter adhesive candidates shall be evaluated using the lap shear configuration. Lap shear testing shall be done to establish tensile shear strength and separation mode of the adhesive. Lap shear shall be tested according to ISO 4587 for the test conditions outlined in 3.9. For initial testing at 23 °C, the only acceptable separation mode of the adhesive shall be cohesive within the adhesive layer. Adhesive separation of the adhesive layer to a test substrate shall be deemed unacceptable.

The minimum required lap shear strength shall be maintained, both initially, and after environmental exposure. There may not be any evidence of “undercutting” corrosion of the bond site after environmental exposure. After any environmental exposure, the cohesive separation mode shall not be < 80%.

Adhesive separation of any layer, e.g., metal coating, adhesion promoter, etc., in the test samples other than the adhesive/test substrate interface, or stock break, shall be deemed a “non-test” of the adhesive, and therefore unacceptable for adhesive evaluation in regard to this specification.

Test specimen sizes according to ISO 4587 with a bond gap of 1.0 mm ± 0.1 mm. In deviation to this norm, other individual sample sizes, e.g., 20 mm × 100 mm, with a bond flat of 20 mm × 20 mm, are acceptable.

Lap shears shall be tensile tested (pulled) at a rate of 100 mm/minute.

The lap shear range shall be used to determine the approval category according to Table 3.

Table 3: Lap Shear

Lap Shear Code	Lap Shear Strength
Low Strength (LS)	< 0.2 MPa
Medium Strength (MS)	0.2 MPa to 1.5 MPa
High Strength (HS)	> 1.5 MPa

Table 4: Classifications

	Expansion Degree per GMW15481	Lap Shear Strength per ISO 4587
Low Expansion-High Strength (LE-HS)	up to 500%	> 1.5 MPa
Low Expansion-Medium Strength (LE-MS)	up to 500%	> 0.2 MPa but < 1.5 MPa
Medium Expansion-High Strength (ME-HS)	> 500% but < 1000%	> 1.5 MPa
Medium Expansion-Medium Strength (ME-MS)	> 500% but < 1000%	> 0.2 MPa but < 1.5 MPa
Medium Expansion-Low Strength (ME-LS)	> 500% but < 1000%	< 0.2 MPa
High Expansion-Medium Strength (HE-MS)	> 1000% but < 2000%	> 0.2 MPa but < 1.5 MPa
High Expansion-Low Strength (HE-LS)	> 1000% but < 2000%	< 0.2 MPa

3.7.2 Adhesion (GMW14706) and Corrosion. All anti-flutter adhesive candidates shall be evaluated using the Adhesion and Corrosion configuration.