



Multi-Purpose Sealer, Global, Pumpable, Paintable; Generic Qualification

1 Scope

This specification details the requirements of a multi-purpose sealer that is high appearance paintable, pumpable, and has improved application capability. This multi-purpose sealer will also be compatible with the three (3)-wet compact painting process which uses waterborne basecoat plus Two-Component (2K) clearcoat topcoat systems. The material is applied in the paint shop after the electrodeposition coating (e-coat) bake, before primer surfacer, and must be capable of being either manually or robotically applied. The material is intended to seal interior and exterior body joints against water, dust, air intrusion, and corrosion. The material must be compatible with primer surfacer and topcoat systems.

1.1 Material Description. The material must be a smooth and homogeneous mixture free of air, lumps, unmixed particles, or foreign materials.

1.1.1 It must be capable of being dispensed with approved and validated production displacement pumping and application equipment including: single point streaming, ribbon tip (flat stream), atomized spraying and automated hem sealing.

1.1.2 It must not have a noxious or toxic odor in either the uncured or cured state.

1.1.3 In addition, the material must not adversely affect those personnel handling it.

1.1.4 The material must adhere to all approved production e-coats. It must not have corrosion-causing ingredients.

1.1.5 The material must be capable of bridging varying gap sizes up to 6 mm in size (see 3.1.7).

1.2 Symbols. Not applicable.

1.3 Applicability. This multi-purpose sealer shall be used for sealing interior, underbody and hem (including door, hood and deck lid hem) seams with the possibility of also being used as an anti-chip rocker/underbody coating on a vehicle body. The sealer may also be used to seal non-exposed roof ditch seams on a vehicle body.

2 References

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

2.1 External Standards/Specifications.

ASTM D412	EN ISO 1524	ISO/TS 16949	Z4 DIN
ASTM D2196	EPA Method 24	SAE J1523	
ASTM D2369	ISO 2813	SAE J1524	
ASTM D1475	ISO 3219	SAE J1864	

2.2 GM Standards/Specifications.

9984515	GMW3025	GMW14270	GMW15634
9986524	GMW3059	GMW14444	GMW16695
9986525	GMW3154	GMW14700	GMW16701
GMW3016	GMW3205	GMW14729	GMW16853
GMW3019	GMW3235	GMW14829	
GMW3022	GMW14124	GMW15487	

2.3 Additional References.

Advanced Product Quality Planning (APQP)

3 Requirements

Specific material requirements and appropriate test methods are listed under the individual properties and are summarized in Table 5. All bake schedules are specified in time at substrate temperature and listed in Table 2, Table 3 and Table 4.

3.1 Requirements on Delivery.

3.1.1 Specific Gravity (ASTM D1475). Maximum is 1.32 specific gravity (11 lb/gal).

3.1.2 Odor (GMW3205 Codings A and 1). Prepare a cured film of sealer that is 3 mm $\pm$ 0.5 mm thick baked at the appropriate nominal bake conditions in Table 4. Cut test specimens from this cured film of material, and condition for seven days at 23 °C $\pm$ 5 °C before initiating the test procedure. Evaluate using the Wet Condition – Coding A and volume ratio Coding 5 from Table 1 in GMW3205. The material shall have a tolerable or better odor and a minimum rating of six (6).

3.1.3 Fogging (GMW3235-A-Y3-T2-90% Minimum). Prepare a cured film of sealer 3 mm $\pm$ 0.5 mm thick baked at the appropriate nominal bake conditions in Table 4. Cut test specimens from this cured film of material, and condition for seven days at 23 °C $\pm$ 5 °C before initiating the test procedure. Evaluate using GMW3235 Method B; Gravimetric Method. Report results.

3.1.4 Volatile and Semi-Volatile Organic Compounds (SVOC) from Interior Materials (GMW15634). Prepare a cured film of sealer 3 mm $\pm$ 0.5 mm thick baked at the appropriate nominal bake conditions in Table 4. Cut test specimens from this cured film of material, and condition for seven days at 23 °C $\pm$ 5 °C before initiating the test procedure. After this conditioning, packaging is done as described in this specification for other test materials. Evaluate SVOC using 60 minutes at 120 °C per GMW15634.

3.1.5 Volatile Organic Compound (VOC) Determination (EPA Method 24, Using ASTM D2369). Target material performance should be 35.9 kg/m³ (0.3 lb/gal) or less. The final VOC of the product, including all weights, calculations, and runs, are to be identified and reported as data in the submission book.

3.1.5.1 Productive Material Review (PMRv) must be approved and may drive plant specific Oven Solvent Loading (OSL) test depending on plant specific air permitting requirements prior to launch.

3.1.5.2 Condensing Volatiles Test (GMW3016). Three percent (3%) maximum allowed when baked as follows and tested according to GMW3016:

- 9986525; High Bake and Powder Bake: 20 minutes at 165 °C $\pm$ 5 °C.
- 9986524; Low Bake: 20 minutes at 130 °C $\pm$ 5 °C and three (3)-Wet Bake: 10 minutes at 149 °C $\pm$ 5 °C.

3.1.6 Viscosity. The viscosity shall be determined and reported using the following three (3) methods (see 3.1.6.1 thru 3.1.6.3). All viscosity aging profiles for the three (3) different viscosity methods mentioned below need to be documented and collected at the following frequencies in days for the first 10 production batches:

- Collect and document viscosity aging profiles at the following frequencies in days: day zero (0), day one (1), day three (3), day seven (7), day 14, day 21, day 30, day 60, and day 90.

3.1.6.1 Press Flow Viscosity (SAE J1524).

- Orifice: 1.32 mm.
- Pressure: 414 kPa.
- Sample Weight: 20 g.
- Sample Test Temperature: 25 °C $\pm$ 0.5 °C.
- The Key Product Characteristic (KPC) requirement is at 72 h from batch manufacture. The KPC viscosity requirement shall be 15.5 s $\pm$ 2.5 s.

In addition, when stored in proper conditions, the rate at which the viscosity increases with age **shall not exceed** the following guidelines:

- Viscosity at 30 days: $\leq$ 72 h value +20%.
- Viscosity at 60 days: $\leq$ 72 h value +40%.
- Viscosity at 90 days: $\leq$ 72 h value +60%.

3.1.6.1.1 In no case should the material viscosity exceed 29 s at the end of the 90 day shelf life of the material.

3.1.6.1.2 The initial and aging press flow viscosity data shall be provided in both numerical and graphic format in the material submission book.

3.1.6.2 Brookfield Viscosity (ASTM D2196).

- Spindle Size: Number seven (7).
- Rotational Speed: 20 rpm.
- Rotation Time to Reading: one (1) minute.
- Sample Test Temperature: 25 °C ± 0.5 °C.

3.1.6.2.1 The Brookfield Viscosity shall be documented for tracking purposes and should also be included on the certificate of analysis of every production batch as a reporting number only. After 30 days of use in a plant we will determine if more control is needed depending on application consistency in the plant. If needed, a KPC value requirement shall be set at that time.

3.1.6.2.2 The initial and aging Brookfield viscosity data shall be provided in both numerical and graphic format in the material submission book.

3.1.6.3 Rotational Viscometer. Determine the viscosity using a rotational viscometer (ISO 3219 and Z4 DIN cup and spindle).

- Rotation Speed: 0 rpm to 130 rpm.
- Sample Test Temperature: 25 °C ± 0.5 °C.

Table 1: Viscometer Program

Test Description	Test Time (s)	Start Speed (rpm)	End Speed (rpm)
Wait Period	300	0	0
Ascending	120	0	130
Hold Cycle	180	130	130
Descending	120	130	0

3.1.6.3.1 The relative viscosity, descending Bingham Viscosity, and Yield Point at 72 h after batch manufacture shall be documented for every batch manufactured for tracking purposes only.

3.1.6.3.2 When stored in proper conditions, the viscosity increase with age shall be documented per the instruction mentioned above in line 3.1.6 to determine the aging profiles of the following parameters:

- Relative Viscosity.
- Descending Bingham.
- Yield Point.

The measured and calculated data, along with the curves generated, shall be included as data in the submission book.

3.1.7 Bridging Capability. Must be capable of bridging varying gaps up to 6 mm wide in three (3) styles; vertical, horizontal, and circular (hole) and also during automated application in three (3) planes; vertical, horizontal, and inverted. See Figure 1.

Figure 1: Bridging Capability



3.1.8 Particle Size (EN ISO 1524). Maximum 120 μm .

3.1.9 Color. Color of the sealer must not alter, interfere, or hurt topcoat color appearance and must contrast Electrodeposition Paint Operations (ELPO) surface color for easy identification of sealer.

3.2 Performance Requirements.

3.2.1 Adhesion (GMW3019). One full set of test panels (baked according to Table 2 and Table 3) must be prepared using a major production technology from each GM approved source of electrocoat. This must also include technologies from all GM regions globally. The electrocoat panels for this testing must be prepared and processed in an actual assembly plant.

The material must be capable of demonstrating at least a minimum of fine line cohesion performance after the first primer/sealer bake.

All times shown below in Table 2, Table 3, and Table 4 are time at metal temperature and therefore the ramp time needs to be added during testing. Ramp time is typically an additional seven (7) minutes for most laboratory ovens.

Table 2: Primer/Sealer Oven Bakes for Adhesion (with Nominal Baked E-Coat)

Bake System	Low Limit (Minimum)	Target (Nominal)	High Limit (Maximum)
Low Bake (9986524)	15 minute at 125 °C (257 °F)	20 minute at 130 °C (266 °F)	90 minute at 158 °C (316 °F)
Three (3)-Wet Bake (9986524)	10 minute 140 °C (284 °F)	10 minute at 149 °C (300 °F)	
High (and Powder) Bake (9986525)	15 minute at 158 °C (316 °F)	20 minute at 165 °C (329 °F)	60 minute at 190 °C (374 °F)

Table 3: ELPO and Primer/Sealer Oven Bakes for Adhesion (with Overbaked E-Coat)

Bake System	Electrocoat (ELPO) Bake	Primer/Sealer Bake (Low Limit)
Low Bake (9986524)	60 minute at 190 °C (374 °F)	15 minute at 125 °C (257 °F)
Three (3)-Wet Bake (9986524)		10 minute at 140 °C (284 °F)
High (and Powder) Bake (9986525)		15 minute at 158 °C (316 °F)

3.2.1.1 When baked as described in Table 2 and Table 3, the material must not crack or lose adhesion to the substrate during or after exposure to the following conditions (see 3.2.1.1a thru 3.2.1.1c). In addition, the material must demonstrate at least a minimum of fine line cohesive adhesion when peeled from the substrate.

- Initial Adhesion:** After cooling to ambient temperatures
- Humidity:** After 96 h at 40 °C and 100% relative humidity.
- Exterior Cycle (GMW14124, Cycle F):** Eight (8) cycles.

3.2.1.2 Lap Shear Adhesion Test. When baked as described in Table 2 and Table 3 above, run lap shear testing on initial and after exterior cycle (see 3.2.1.1c) using SAE J1523. Use the following parameters (see 3.2.1.2a thru 3.2.1.2c) for this test:

- a. Square is 25 mm x 25 mm area covered with multi-purpose sealer with no entrapped air bubbles.
- b. Film is 1 mm thick.
- c. Pull Rate = 25 mm per minute.

Must show cohesive failure and strength results shall be documented at time of approval and used as a fingerprint to ensure sealer continues to show minimum/same strength and cohesion failure using small coupons of size 25 mm wide x 100 mm long with sealer applied on a 25 mm x 25mm square area and sandwiched between two small coupons at a film thickness of 1 mm.

3.2.2 Elongation (ASTM D412 Method A, Using Die C Dumbbell). Material baked as described in Table 2 must exhibit no less than 75% elongation. This applies to all bakes (minimum, nominal, and maximum).

3.2.3 Mandrel Bend at -30 °C (GMW3154). Must not lose any adhesion, peel off the substrate or have deep cracks that penetrate down to the substrate during and after the mandrel bend at -30 °C.

3.2.4 Porosity. The material must exhibit no signs of trapped air from either an external observation or a cross-sectional view after being baked according to Table 2 (maximum bakes only).

3.2.5 Degradation Resistance. Apply two beads of sealer 1 mm thick x 40 mm wide x 200 mm long to the surface of a phosphated steel panel (inspect panel first to ensure it is free of surface corrosion). Bake panel as follows:

- For 9986525: Bake 1 h at 200 °C.
- For 9986524: Bake 1 h at 150 °C.

After baking, remove panel from oven and allow it to cool to room temperature before proceeding.

3.2.5.1 After Bake. Remove one sealer bead from the panel and inspect the surface of the panel. There must not be any corrosion on the surface of the panel where the sealer had been.

3.2.5.2 After Humidity. Expose the panel with the remaining sealer bead to 40 °C at ≥ 98% humidity for 240 h.

3.2.5.3 After exposure, remove the remaining sealer from the panel and inspect the surface of the panel. There must be no corrosion on the panel surface where the sealer had been.

3.2.6 Chip Resistance (GMW14700). Panels shall be prepared using production e-coat and film builds tested are 200 µm and 500 µm. Bake temperatures per 3.2 and Table 2. Expose test panels to test environments listed in 3.2.7.1 prior to running chip resistance. When running the gravelometer test both the test panel and gravel should be conditioned per method B and method C of the test procedure. The sealer film shall not develop any chips, lifting or adhesion loss after the gravelometer test per GMW14700 using five (5) pints of gravel at the temperature called out in Method B and method C of the test procedure. The panels are then exposed to twelve (8) cycles of GMW14124 Cycle F and must not exhibit any adverse effects.

3.2.7 Abrasion Resistance (GMW15487). Use steel sand, angular (4 mm diameter to 5 mm diameter.) from Eisenwerk Wurth GmbH, Bad Friedrichshall. Testing shall be stopped at the very first sign of wear through to substrate. Samples are tested unpainted.

- a. Substrate is production E-Coat.
- b. Film Builds for test are 200 µm and 500 µm.
- c. Bake temperatures per 3.2 and Table 2.

3.2.7.1 Test Environments.

- a. **Initial:** After 24 h at 25 °C ± 5 °C.
- b. **Heat Aging:**
 - 24 h at 23 °C ± 5 °C.
 - 120 h at 80 °C ± 5 °C.
 - 24 h at 25 °C ± 5 °C.
- c. **Humidity:**
 - 24 h at 25 °C ± 5 °C
 - 240 h per humidity in (GMW14729).

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