



Anticorrosion Wax for Cavities and Underbody and Engine Compartment - Generic Qualification

1 Scope

This standard explains the general material performance, compatibility, and processing requirements for international corporate approval of wax-based corrosion prevention fluids.

1.1 Material Description. Materials qualified to this standard shall meet the performance shown in Appendix B, Table B1 (Cavity Wax) or Appendix A, Table B2 (Underbody Coating Wax) or Appendix A, Table B3 (Engine Compartment Wax).

Suppliers must demonstrate the technology as being production capable to reduce undue risk prior to release in a production facility. Any material development issues, such as chemical or performance values that fall outside of specified ranges, must be discussed with the appropriate material engineer for resolution. Material must successfully complete a production trial in a target facility prior to release for other facilities.

1.2 Symbols. Not applicable.

1.3 Applicability. This standard applies to wax-based corrosion prevention materials that are intended for use on automotive vehicles. These coatings must provide additional corrosion prevention for:

- Cavities, or
- Underbody and Chassis, or
- Engine Compartment of Completely Painted Car Bodies.

1.4 Remarks.

1.4.1 Special Requirement. Materials that utilize an oxidative cure process require a protective gas atmosphere in the head space of the container during shipping and storage to prevent curing.

1.4.2 Additionally materials that utilize an oxidative cure process may require a gel oven followed by a cooling stage to accelerate the cure process and prevent wax drips throughout the vehicle assembly process.

2 References

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

2.1 External Standards/Specifications.

ASTM D93	ISO 1183	ISO 2719	ISO 3251
ASTM E70	ISO 1520	ISO 3219	ISO/TS 16949

2.2 GM Standards/Specifications.

GMW2	GMW3205	GMW14124	GMW14729
GMW3059	GMW3286	GMW14270	GMW14872

2.3 Additional References.

- Advanced Product Quality Plan (APQP)
- Local Specifications
- S&IH TS 3.4-160-02 Material Safety Data Sheet guidance documents (available at www.gmsupplypower.com)

3 Requirements

3.1 Chemical Fingerprint. GM may conduct analysis of the materials supplied to this specification. Analysis may also be performed on representative panels. The analysis established for initial approval shall constitute a reference standard and shall be part of the submission package. Information on the technology's ingredient formulation ranges and key manufacturing control characteristics must be provided as part of the submission package. If a product change is proposed that is outside the technology formulation limits, the responsible engineer must be notified. All ingredient ranges, key manufacturing control limits, and certificate of analysis ranges must pass standard gage repeatability and reproducibility study.

3.2 Delivery Documentation. The supplier shall be responsible for submitting a certificate of analysis with each batch of material arriving at a point of use.

3.3 Physical Requirements.

3.3.1 Product Information. The engineer responsible for technical qualification shall be contacted prior to test initiation. A product data sheet, product composition and all related product processing information must be submitted for review at that time.

3.3.2 Mini-Submissions. Some approvals will require mini submissions when only minor changes are made to previously approved wax materials. Tests may be added or deleted according to the type and amount of material modifications. These shall be determined prior to testing by agreement between the supplier and responsible engineers.

3.3.3 Sample Size and Panel Substrate. The number of samples for each test shall be two (2), unless the responsible engineer and the supplier agree on a different number for specific tests, prior to the start of testing. All substrates, pre-treatments, and coating layers shall be fully identified with source, product code, batch number, bake description and film build. Use cold rolled steel (CRS) panels, non-galvanized, for testing.

3.3.4 Conditioning. Valid for all wax types. The samples shall be subject to an aging period (see 3.3.4.1 through 3.3.4.3) of at least:

3.3.4.1 Five (5) days at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ following the bake cycle for 100% solids content materials. The bake cycle shall last two (2) minutes at target bake temperature, defined by material supplier (i.e., the metal temperature) followed by the cooling to ambient temperature.

3.3.4.2 Seven (7) days at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for solventborne materials.

3.3.4.3 Three (3) days at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for waterborne materials.

3.3.5 Storage Requirements. Valid for all wax types. The materials approved to this standard must be stable for 180 days, at $10\text{ }^{\circ}\text{C}$ to $30\text{ }^{\circ}\text{C}$ ($50\text{ }^{\circ}\text{F}$ to $85\text{ }^{\circ}\text{F}$), as defined by the ability to pass all initial test requirements after 180 days storage in the application facility (i.e., assembly plant). If there is any disagreement with these requirements, the supplier must contact the responsible engineer.

3.4 Requirements on Delivery.

3.4.1 Appearance. Valid for all wax types. Even if the common color is yellow-brown, other colors may be agreed between the supplier and the responsible engineers. See Appendix B, Table B1 through Table B3 for details.

3.4.2 Odor (GMW3205). Valid for all wax types. The acceptance rating is usage dependent and must comply with the limits shown in Appendix B, Table B1 through Table B3. It also must be differentiated between the smell of the raw material (possible nuisance for the workers) and the smell of the material after application and drying (possible nuisance for the customer).

3.4.3 Prohibited Ingredients. Valid for all wax types. Silicone and benzene are prohibited.

3.4.4 Homogeneity. Valid for all wax types. The product must not separate when stored for up to the specified shelf life. A thin oil film on the surface is acceptable. There may be some agitating requirement based on usage and/or supplier's recommendation.

3.4.5 Impurities. Valid for all wax types. No air, lumps, unmixed particles or foreign materials.

3.4.6 Solids. Valid for all wax types. The solid content shall be determined using ISO 3251. See Appendix B, Table B1 through Table B3 for limits. The deviations from this standard, see Table 1 must be taken into consideration.

Table 1: Deviations from ISO 3251

ISO 3251 Reference	Deviation
4.1	For Wax: Flat-bottomed dish, of metal or glass, 50 mm $\pm$ 5 mm in diameter, height of rim $\geq$ 5 mm.
4.3	Air Oven: The oven shall be fitted with natural convection with a perforated shelf placed at one third of the height of the oven. Ovens with forced-ventilation equipment are inapplicable.
7	Supplementary test conditions.

3.4.6.1 Test Parameters for Waxes. See Table 2.

Table 2: Parameters for Solid Content Determination

Period of Heating	Temperature	Mass of Test Portion	Product
120 minutes	120 °C	2.0 g $\pm$ 0.1 g	Solventborne Waxes
60 minutes	105 °C	2.0 g $\pm$ 0.1 g	100% Solids Content Waxes, Waterborne Waxes

3.4.7 Flashpoint. Not applicable for waterborne waxes. Test method according to ISO 2719 or ASTM D93, procedure B. See Appendix B, Table B1 through Table B3 for limits.

3.4.8 Potential Hydrogen (pH) Value. Only applicable for waterborne materials. Test method according to ASTM E70. See Appendix B, Table B1 through Table B3 for limits.

3.4.9 Density (ISO 1183, Part 1, Method B). Valid for all wax types. The density of the uncured material shall be reported. A density range will be set at the time of approval and become a requirement for the material.

3.4.10 Conditions on Delivery. Valid for all wax types. Temperature during shipment and on delivery: 10 °C to 30 °C (50 °F to 85 °F). Materials that utilize an oxidative cure process require carbon dioxide (CO₂) or nitrogen (N₂) atmosphere in the head space of the delivery container during shipping and storage to prevent curing.

3.5 Processing Requirements.

3.5.1 Processing Consistency. Valid for all wax types. Must be capable of being processed in the plant's facilities in the "as delivered" condition, i.e., undiluted. The product specific requirement will be set at the time of approval, and will become a requirement for all subsequent batches of this material. The supplier must perform pump and/or spray test (see Appendix A, Sections A4 and A5) prior to the delivery. Test results must be shown in the certificate of analysis.

3.5.2 Processing Temperature. Must be sprayable at standard temperatures. See Appendix B, Table B1 through Table B3 for requirements.

3.5.3 Vertical Slide Resistance. Valid for all wax types. Spray wax on a vertical panel (coated with cathodic electrodeposition primer (ELPO)) in one single operation. Determine dry film thickness that withstands sliding down, forming runners or forming drops. See Appendix B, Table B1 through Table B3 for requirements.

3.5.4 Miscibility. (See Appendix A, Section A6). Valid for all wax types prior to making a conversion; plant specific test. The products of different suppliers but of the same product family must be miscible without coagulation or change of viscosity.

3.5.5 Penetration. Only applicable for cavity waxes. Penetration means the ability of corrosion prevention waxes to reach cavities, folds, flanges and seams. See Appendix B, Table B1 for requirements.

3.5.6 Running Length (See Appendix A, Section A1). Only applicable for cavity waxes. The abstract reading permits conclusions on spray ability, penetration and drop behavior. See Appendix B, Table B1 for requirements.

3.5.7 Gelification Behavior (See Appendix A, Section A2). Only applicable for 100% solids content waxes. For cavity waxes with 100% solids content a thermal curing after application is required. See Appendix B, Table B1 for requirements.

3.5.8 Viscosity (ISO 3219). Valid for all wax types. Shear rate ramp: (0) 1/s to (760) 1/s. Sample temperature is 23 °C.

3.5.8.1 Use a rheometer with a suitable cylinder measuring system. See Table 3.

3.5.8.2 The resulting "relative viscosity" is calculated by dividing the shear stress value by maximum shear rate. See Appendix B, Table B1 through Table B3 for requirements.

Table 3: Rheometer Program

	Time	Start Shear Rate	End Shear Rate
Waiting Period	300 s	(0) 1/s	(0) 1/s
Ascending Cycle	300 s	(0) 1/s	(760) 1/s
Hold Cycle	600 s	(760) 1/s	(760) 1/s
Descending Cycle	300 s	(760) 1/s	(0) 1/s

3.5.9 Product/Process Relationship. The supplier shall provide detailed information on product-specific key product characteristics and plant process-related key control characteristics. These shall be provided in a graphic format that shows the correlation between material properties and application parameters and their effects.

3.5.10 Bake Chart (Time versus Temperature). The chart is to identify the optimum performance range for the material, as well as areas where performance begins to deviate from specification requirements. In addition, the chart should indicate which material characteristics are affected and how. Actual data used to generate this bake chart should also be made available for review.

3.6 Performance Requirements.

3.6.1 Heat Stability of the Dried Film. Valid for all wax types. A dry film of defined thickness (conditioned per 3.3.4) must not drip or sag when exposed vertically for 4 h at 90 °C. See Appendix B, Table B1 through Table B3 for film thickness requirements.

3.6.2 Spray Water Resistance (See Appendix A, Section A3). Applicable for cavity waxes and underbody waxes. Waxes in cavities and on underbody must be capable to withstand spray water immediately after leaving the assembly line. Both the wetness and the impact energy could contribute to coating defects. See Appendix B, Table B1 and Table B2 for requirements.

3.6.3 Material Compatibility.

3.6.3.1 Service Materials. With a dry film of 30 µm minimum (conditioned per 3.3.4), there must not be a quality loss (e.g., washing out, slipping of the 2nd film) when re-coated with corresponding aftermarket product.

3.6.3.2 Other Materials. After 48 h at 23 °C ± 5 °C and 96 h of GMW14729 (Option A or B), the dried wax must not cause any visible changes (e.g., swelling) or a quality loss with the material. The wax is brushed onto the tested parts (dry film thickness ≈ 50 µm (plus two (2) minutes at target curing temperature (metal temperature) for 100% solids content materials in a way that waxed and non-waxed areas can be compared with each other. To evaluate the differences between waxed and non-waxed areas, remove the wax film with an approved solvent (e.g., petroleum ether).

3.6.3.3 The following are typical material groups and some examples for compatibility tests. The full list of materials to be tested can be found in the local specifications.

- CRS, zinc coated steel with and without organic thin film coating
- Aluminum
- Electrocoat, the color grey (for car body) and black (for chassis parts)
- Poly Vinyl Chloride (PVC) (seam sealer and underbody coating)
- Body Shop Adhesives

- Baffles
- Sound Deadener
- Paint Materials (basecoat and clearcoat)
- Duroplastics (e.g., air filter, fender liner)
- Elastomers (e.g., brake hose, door seal, and radiator hose)

3.6.3.4 Cleanability. Wax shall be easily and completely removable from surfaces that may be unintentionally coated due to their proximity to intended application areas. Highly textured surfaces are exempt from this requirement. Supplier shall recommend cleaning solvent and provide a cleaning procedure.

3.6.4 Corrosion Prevention Properties.

3.6.4.1 Corrosion Panel Preparation. Clean panels. Use bare CRS panels according to GMW2. Clean panels thoroughly by storing in mineral spirits for 48 h $\pm$ 1 h and rubbing with an approved cleaning solvent and a brush or cloth. Alternatively, use an ultrasonic cleaner.

3.6.4.1.1 Apply Wax. Spray the wax with a dry film thickness of: 25 μ m $\pm$ 2/-0 μ m and 50 μ m $\pm$ 2/-0 μ m.

3.6.4.1.2 Conditioning per 3.3.4.

3.6.4.2 Corrosion Performance. Rim areas of 2 mm are excluded from the evaluation.

3.6.4.2.1 There shall be no corrosion of the base metal or other evidence that the wax film has been penetrated or weakened. No thinning of the wax film.

3.6.4.2.2 There shall be no lifting, peeling or loss of adhesion of the wax film.

3.6.4.2.3 The wax film may adsorb a little humidity, but humidity shall be released after 24 h storage at 23 °C $\pm$ 5 °C.

3.6.4.3 Salt Spray Fog Corrosion Test (GMW3286). Valid for all wax types. Expose scribed panels, prepared per 3.6.4.1, (25 μ m and 50 μ m). Evaluate per 3.6.4.2. For exposure times and requirements, see Appendix B, Table B1 through Table B3.

3.6.4.4 Cyclic Climate Test (GMW14124, Cycle U). Valid for all wax types. Expose panels prepared per 3.6.4.1, (25 μ m and 50 μ m). Evaluate per 3.6.4.2. For exposure times see Appendix B, Table B1 through Table B3.

3.6.4.5 Cyclic Corrosion Laboratory Test (GMW14872). Valid for all wax types. Expose panels prepared per 3.6.4.1, (25 μ m and 50 μ m). For test parameters see Appendix B, Table B1 through Table B3.

3.6.4.6 High Humidity Environments (GMW14729, Option A or B). Valid for all wax types. Expose panels prepared per 3.6.4.1, (25 μ m and 50 μ m). Evaluate per 3.6.4.2. For exposure times, see Appendix B, Table B1 through Table B3.

3.6.5 Behavior at Low Temperatures.

3.6.5.1 Apply 65 μ m $\pm$ 15 μ m wet film. (For 100% solids content material, add two (2) minutes at the target bake temperature (metal temperature)).

3.6.5.1.1 Start low temperature exposure after 5 h at 23 °C $\pm$ 5 °C (cavity wax only).

3.6.5.1.2 Start low temperature exposure after five (5) minutes at 23 °C $\pm$ 5 °C (underbody and engine compartment waxes only).

3.6.5.2 Apply 50 μ m dry film.

3.6.5.3 Expose test panel for 24 h at -25 °C. Evaluate wax film condition.

3.6.5.4 Bend panel 180 degrees over a cylinder arbor (32 mm diameter) which was stored at the same temperature. The bending action shall be completed in <5 s.

3.6.5.5 Evaluate wax performance with a tenfold (10x) magnifying glass. There shall be no lifting, peeling or loss of adhesion of the wax film.

3.6.6 Thermal Cycling (GMW14124, Cycle W). Valid for all wax types. Apply 25 μ m and 50 μ m dry film per 3.6.4.1. Expose panels for three (3) cycles.

3.6.6.1 Within 15 minutes after removing panel from environmental cycle, bend panel 180 degrees over a cylinder arbor 32 mm diameter at 23 °C $\pm$ 5 °C. The bending action shall be completed in <5 s.

3.6.6.1.1 There shall be **no** lifting, peeling or loss of adhesion of the wax film.