



## **Performance Requirements for Metallized Finish Coatings for Lighting Applications**

### **1 Scope**

This specification covers the performance requirements to be used for a metalized finish that is protected within an exterior lighting application. The metalized finish is created using Physical Vapor Deposition (PVD); i.e., vacuum evaporation, sputter deposition, arc vapor deposition, etc. The coating system may consist of all or a select combination of the following: basecoat, metallic layer, protective topcoat and tinted top coat.

**1.1 Material Description.** Coating technology shall be documented with each approval.

**1.2 Symbols.** Not applicable.

**1.3 Applicability.** Typical applications are exterior lighting reflectors, bezels and decorative components which are protected by a lens within an assembly.

**1.4 Remarks.**

**1.4.1** Coating approval per this specification is system specific; i.e., substrate, pretreatment, basecoat if required for Polyester Bulk Molding Compound (BMC) or metallic substrate, metallic layer and protective top coat or tinted top coat. The following describes system approval guidance for each type of coating.

- Metallic layer and in chamber protective topcoat Hexamethyldisiloxane, (HMDSO) have no material approval, application approved through the Approved Paint on Plastics Systems (APOPS) and/or Production Part Approval Process (PPAP) testing only.
- Tinted top coat approval is required for each colored tint on a single substrate and metallization process per GMW18024.

**1.4.2** Substrate must be approved to the appropriate GM material specification.

**1.4.3** APOPS Approvals shall be stored in the GM Materials Approved Source List (GMMASL), which lists approved substrate, cleaning, priming and topcoat combinations.

**1.4.4** This standard may involve hazardous materials, operations and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

### **2 References**

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

#### **2.1 External Standards/Specifications.**

|            |               |          |
|------------|---------------|----------|
| IATF 16949 | ISO/IEC 17025 | SAE J361 |
|------------|---------------|----------|

#### **2.2 GM Standards/Specifications.**

|         |          |          |          |
|---------|----------|----------|----------|
| GMW3059 | GMW14270 | GMW14729 | GMW15891 |
| GMW3221 | GMW14704 | GMW14829 | GMW18024 |

#### **2.3 Additional References.**

- Safety and Industrial Hygiene (S&IH) Technical Standard (TS), S&IH TS 3.4-160-02

### 3 Requirements

#### 3.1 Requirements on Test Specimens.

**3.1.1 Test Piece.** The number of samples for each test shall be three (3) per coating, unless the responsible GM Materials Engineer and supplier agree on a different number for specific tests prior to the start of testing. All substrates, pretreatments and coating layers shall be fully identified with raw material sources and product codes identified and, if applicable, film build per specimen.

**3.1.2 Surface Preparation.** The surface must be clean and free of surface defects which would affect performance or appearance. All pretreatments shall be fully identified per specimen.

**3.1.3 Application.** For basecoat and topcoat, reduce and apply coating uniformly to achieve dry film thickness as specified per supplier recommendations. The suppliers recommended film build range shall be noted in the Commercial Product Data Sheet within the submitted certification package.

For metallic layer, use a PVD; i.e., vacuum evaporation, sputter deposition, arc vapor deposition, etc. to thickness necessary to achieve both appearance and performance requirements.

**3.1.4 Cure.** Surface of the part must be within the range of time and temperature specified by the coating supplier for cure, and must be checked per GMW15891. Time in oven or Ultraviolet (UV) exposure and ambient temperature must be regulated to meet this requirement without exceeding over/under cure of certain coatings. The coating suppliers commercial product data sheet shall contain these details.

**3.1.5 Appearance.** Before environmental testing, the system finish must present a uniform appearance, and be free of visual or physical defects that would aesthetically cause the components to fail visual requirements.

**3.2** All materials supplied to this standard must comply with GMW3059, Restricted and Reportable Substances, including the requirement to obtain a GM-approved International Material Data System (IMDS) submission.

**3.3 Submission Package.** The detailed information in Appendix A, Table A1 must be included in the submission package. All data and documentation generated during the material development must be included and approved by the responsible GM Materials Engineer. An electronic copy must be prepared and distributed to the responsible engineer of the approving region(s). The documentation is to be in English and the local language of the lead GM region.

**3.3.1 Material Identification.** All coatings used in the submission must be identified by product code, batch number and batch date. Color name must be included where appropriate. All related surface preparation used must also be identified. All substrates used must be identified by source, product code and part number where appropriate.

**3.3.2 Process Identification.** A baseline and target range for film build and processing must be established prior to the submission for metallization layer and tinted topcoat, if applicable. Application equipment (source and model) and spray parameters used for the submission must be documented. Target and variance for mix ratio of two-component (2K) materials must be evaluated.

**3.4 Facilities.** All testing shall be performed in an accredited laboratory. Laboratory accreditations to ISO/IEC 17025 are acceptable or a facility that has a quality system approval to IATF 16949.

**3.5 Test Requirements.** Appendix B, Table B1 contains the complete test requirements for new technology submissions.

**3.5.1** For modifications outside the formulation limits of a previously approved technology, testing may be added or deleted by the responsible GM Materials Engineer.

#### 3.6 Test Conditions.

**3.6.1** Unless otherwise stated in respective test procedures, all samples shall be conditioned prior to each required test to GMW3221, Code A.

**3.6.2** Unless otherwise specified, samples shall be subjected to testing after a minimum aging period of 72 h following the coating, baking or drying cycle.

**3.6.3** Test panel/part orientation shall be such that it is not shingled or shielded by another test specimen or test equipment during exposure.

**3.6.4** Expose the test specimens to specified environment(s) in Appendix B, Table B1.

**3.6.5** Unless otherwise specified, the tolerance on exposure times and evaluation time is  $\pm 15$  minutes.

#### 3.7 Evaluation Criteria.

**3.7.1** Unless otherwise specified, the test specimens shall be subjected to the appearance and performance evaluation as specified in the individual test methods. If time to evaluation is not specified, the evaluation shall be conducted within an hour after exposure and again 24 h after exposure.

**3.7.2** Sample plaques or parts shall be inspected per SAE J361 at a reading distance. As a reference, a business card placed next to the part should be readable by the inspector.

**3.7.3 Appearance.** After environmental testing, the system finish must present a uniform appearance, and be free of visual or physical defects that would aesthetically cause the components to fail visual requirements. Boundary sample zones are based on viewing the lamp assembly from a standing position at approximately 1700 mm (67 in) from the ground and approximately 1000 mm (39 in) in distance from the lamp. Use the following guidelines for appearance requirements.

- Zone A: Surfaces visible through the lens or during normal operation at the vehicle position as describe. Examples include lamp floor, trim ring, bezel.
- Zone B: Surface not easily visible through the lens when viewed through vehicle position but visible through other areas and/or critical for photometric performance. Example include reflector, cavity separator.
- Zone C: Surfaces not easily visible and not critical for photometrics. Example include areas hidden by lens optics, colorants or diffusing surface features.

**Table 1: Appearance Criteria and Defect Limits**

|                                          | Zone A                 | Zone B                | Zone C                    |
|------------------------------------------|------------------------|-----------------------|---------------------------|
| <b>Discrete Defect</b> <sup>Note 1</sup> |                        |                       |                           |
| • <b>Quantity</b>                        | < 3                    | < 5                   | 10 <sup>Note 2</sup>      |
| • <b>Size</b>                            | < 0.75 mm <sup>2</sup> | < 1.5 mm <sup>2</sup> | < 3 mm <sup>2</sup>       |
| <b>Peeling</b>                           | No                     | No                    | No                        |
| <b>Hazing</b>                            | No <sup>Note 3</sup>   | No <sup>Note 3</sup>  | OK <sup>Note 2</sup>      |
| <b>Thin Coating</b>                      | No                     | No                    | OK <sup>Note 2</sup>      |
| <b>Burn/Off color</b>                    | No <sup>Note 3</sup>   | No <sup>Note 3</sup>  | Slight <sup>Note 3</sup>  |
| <b>Scratches</b>                         | None                   | None                  | Maximum width 0.5 mm wide |

**Note 1:** Defects include boiling/popping, voids, chips/separation, substrate read through or contamination due to dirt.

**Note 2:** This Condition Is acceptable when appearance of defect is not visible through the lens of the assembled lamp and has no effect on photometric performance.

**Note 3:** If appearance is questionable, boundary samples shall be established by the supplier and approved by the customer.

**3.7.4 Performance.** The system finish must pass all engineering performance requirements specified in Appendix B, Table B1.

**3.7.5 Humidity Test Variables:** For humidity testing, orient parts to prevent water from pooling on the metallized surface. If necessary, hanging of the parts may be necessary to prevent water pooling. Areas with deep pockets and areas with sharp edges may have some acceptable metal removal due to the design limitation of the topcoat.

## 4 Manufacturing Process

**4.1 Source Shipment Responsibility.** It will be the responsibility of the supplier to ensure that the material is not exposed to temperatures during shipment which would cause the material to fail to meet any of the requirements of this specification.

**4.2 Initial Source Approval.** No shipment shall be made by any supplier until representative initial production samples have been approved by GM Materials Engineering as meeting the requirements of this specification.

**4.2.1** Completed copies of the Material Safety Data Sheet (MSDS) meeting GM information requirements must be submitted with any new submissions or whenever a composition change has occurred.