



Anti-Condensation Coatings for Exterior Lighting Applications

1 Scope

1.1 Material Description. This specification covers the qualification requirements for a clear anti-condensation coating to be used on the inside surface of the outer lens of an exterior lamp assembly. The coating shall prevent or disguise all traces of moisture buildup on the inside of the outer lens.

1.1.1 Material qualified to this standard is based on the anti-condensation coating performance. Coating technology is unique to each coating supplier. The material description of each coating technology is required at the time of approval.

These coatings are part of a total coated product system and must meet the requirements set forth in this specification and those shown on engineering drawings.

1.1.2 Initial approval of an anti-condensation coating per this specification must be evaluated and approved for each substrate.

1.1.3 This specification shall be used in conjunction with the Approved Paint on Parts System (APOPS), a section of GM Approved Materials Source List, which identifies approved substrate, cleaning, and coating combinations

Note: GM APOPS is required for the Production Part Approval Process (PPAP) of the exterior lamp assembly.

1.1.4 Types. Anti-condensation coatings to this specification were developed for the following substrates:

- **Type A:** Polycarbonate (PC) substrates, maximum cure temperature (thermal exposure) of 120 °C. (e.g., GMW16729)
- **Type B:** Poly(methyl methacrylate) (PMMA) substrates, maximum cure temperature (thermal exposure) of 80 °C. (e.g., GMW16335)

1.2 Symbols. Not applicable.

1.3 Applicability. These functional coatings can be used on the inside surface of a PC or PMMA outer lens of automotive lamp assembly.

1.4 Remarks. 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.

ASTM D1003-92	FMVSS 108	ISO/IEC 17025	SAE J576-91
ASTM E308	ISO 527-2	ISO/TS 16949	

2.2 GM Standards/Specifications.

GMW3059	GMW14270	GMW14829	GMW16335
GMW3221	GMW14650	GMW15790	GMW16729
GMW14124	GMW14729	GMW15891	GMW17414

3 Requirements

3.1 Requirements on Test Specimens. Unless otherwise specified, the materials shall be tested under standard conditions per GMW3221, Code A.

3.1.1 Facilities. For a new supplier to GM, all testing shall be performed in an accredited laboratory. Laboratory accreditations to ISO/IEC 17025 are acceptable. A current supplier planning to use a non-ISO/IEC 17025-approved laboratory shall receive approval, prior to testing, from the GM Engineer responsible for the specific technology. Generally, the unaccredited laboratory should be in a facility that has a quality system approval to ISO/TS 16949.

3.1.2 Test Piece. The number of samples for each test shall be three per coating unless the responsible 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 source, product code, and film build.

3.1.2.1 For initial source approval of the anti-condensation coating, the test specimens can be panels or component parts. If test panels are used, the recommended panel size is 100 x 150 mm.

3.1.2.2 The substrate must be clean and free of surface defects which would affect performance or appearance.

3.1.2.3 Appearance. The panel appearance must meet or exceed all requirements designated in GMW17414, Exterior Plastic Lens Quality Appearance Requirements.

3.1.3 Test Conditions.

3.1.3.1 Unless otherwise specified, coated samples shall be subjected to testing after a minimum aging period of 72 to 96 h following the baking or drying cycle. A shorter aging period may be used, provided it is recognized that this represents a more severe condition of test and that results obtained at different aging times fewer than 72 h are not a good basis for comparing the relative performance characteristics of coating finishes.

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

3.1.3.3 Expose the test specimens to specified environment. There shall not be a lapse of more than two minutes in transferring the test specimens from one environment to another. There is to be no chamber ramp times between cycle conditions unless specified.

3.1.3.4 Unless otherwise specified, the tolerance on exposure time is ± 5 minutes.

3.2 Submission. The detailed information in Appendix A, Data Sheet 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 approved region(s). The documentation is to be in English.

Each combination of specific anti-condensation coating and substrate, must be tested and approved as a system. The individual components are not interchangeable and are approved for use only with combinations of anti-condensation coating and substrate of the total coating system which were used in qualification testing.

3.2.1 Material Identification. All coatings used in the submission must be identified by product code, batch number and batch date. 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 Coating.

3.3.1 Infrared Chemical Fingerprint. The supplier must provide infrared data to document the fingerprint of the recommended formula. All materials subsequently supplied under the designated specification/material code must correspond to the reference spectrum when compared under the same conditions. GM may conduct infrared spectrophotometry analysis of the materials supplied to this specification. The Infrared (IR) spectra of cured coating established for initial approval shall constitute a reference standard and shall be part of the submission package.

3.3.2 Stress Resistance (GMW15790, Evaluating the Resistance of Plastics to Chemical Reagents). The coating must not craze PMMA or PC at 0.5% strain when tested at room temperature for 24 h. Inspection shall be done both by an unaided eye and by microscopic evaluation at 20X, and shall not exceed a 20% change in yield tensile strength when tested per ISO 527-2. This test is only required for initial coating approval.

3.3.3 Film Build. Specific film build targets and upper/lower limits are established by initial screening by the coating supplier. The film build on the component/plaques used for approval shall be within the recommended targets supplied by the approved anti-condensation coating supplier.

3.3.4 Cure. The surface of the part must be within the range of time and temperature specified by the supplier for cure. Temperature in oven and ambient temperature must be regulated to meet this requirement without exceeding over/under bake specifications. Cure must be checked by the method recommended by the approved

anti-condensation coating supplier. The submission package shall contain processing and testing details recommended for appropriate cure.

3.3.4.1 Method A: Solvent Rub Method for Determining Cure of Painted Metal or Plastic Substrates per GMW15891. The coating supplier shall indicate the appropriate solvents and rating designation as part of the submission package.

3.3.4.2 Method B: Dip Test. Submerge sample into warm, clean, deionized water ($40\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for $4\text{ h} \pm 0.5\text{ h}$). Coated surface shall not whiten or show any visual blemishes or other physical defects.

3.3.5 Tape Adhesion Test for Paint Finishes (GMW14829). Initial adhesion shall be a minimum rating of 0, for 100% coating retention in as-received condition.

3.3.6 Initial Steam. To determine complete coating coverage of the lens surface, place the coated surface a maximum of $20\text{ cm} \pm 2\text{ cm}$ above a clean, potable water bath which is heated and maintained at $60\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. The water bath should have sidewalls that extend 8 cm to 12 cm above the water level, so that there is 8 cm to 12 cm between the top of the sidewalls and the test specimen, in order to direct the steam to the lens surface. See Figure 1. The coated side of the lens shall not show any signs of fogging during 10 s to 20 s of direct steam exposure. The entire surface of the lens shall be exposed to steam. Several test iterations may be needed to test a lens to ensure that all locations of the lens receive steam exposure.

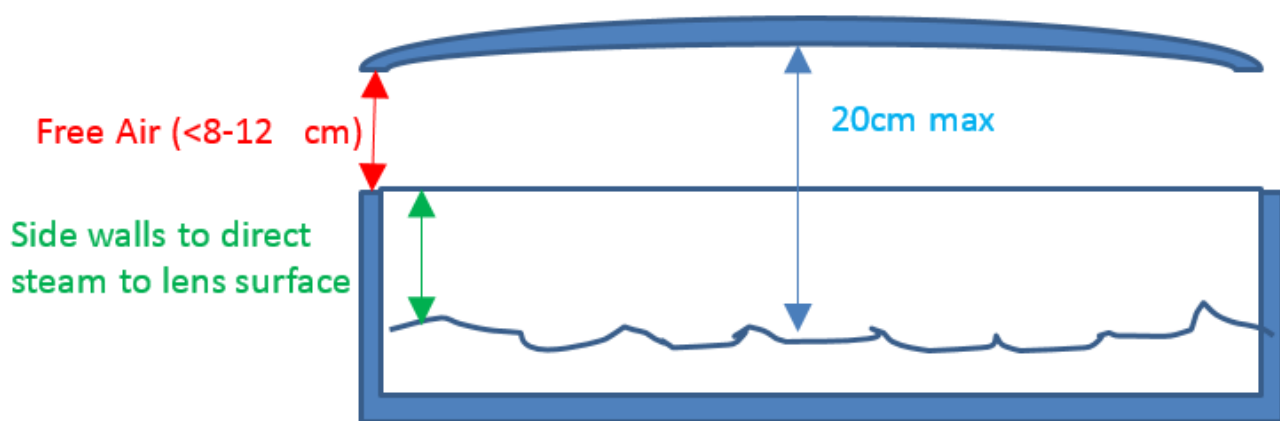


Figure 1: Schematic of Steam Test Setup

3.4 Durability Performance. To determine long-term durability of the anti-condensation coating, conduct the steam test as described in 3.3.6 after each environmental exposure test in paragraph 3.4. Reference results as post-exposure steam test. The samples shall show no signs of fogging or whitening or any surface blemish.

3.4.1 High Humidity. To determine the long-term durability performance of the anti-condensation coating, expose the coated side to humidity conditions per GMW14729, Method A, with the exception of $60\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, for 336 h . Test specimens shall be suspended in vehicle position when using components or vertical for plaque testing, with the plane of the coating surface parallel to the direction of the fog flow. If the lens holds water, angle it 5° from the vehicle position to allow the water to run off. After exposure, the samples shall be rinsed with clean water but not wiped. There shall be no change in appearance. For each specimen, document any change in color, blistering, watermarks, etc. Evaluate the appearance of the specimens no less than five minutes and no more than ten minutes after removal from test, as the effects from water exposure can change within a short time. Rate the specimens again after a recovery period of 24 h . Then conduct the steam test according to 3.3.6. The sample shall show no signs of fogging.

3.4.2 Heat Resistance. Coating shall withstand temperatures as indicated by type designation for 240 h without cracks, haze, discoloration, or any other visual or physical defects.

- Type A: $120\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$
- Type B: $80\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$

Inspection shall be done both by an unaided eye and by microscopic evaluation (magnification: $20\times$), then conduct the steam test in 3.3.6. The sample shall show no signs of fogging.