



Hydrographics for Exterior Applications

1 Scope

1.1 Material Description. The Hydrographics (HG) process consists of a water soluble decorative film which deposits an ink pattern onto a plastic part. The ink pattern is a continuous layer covering the entire plastic part. A protective clearcoat must be applied after ink transfer to meet wear resistance, Ultraviolet (UV) stability, and all other performance requirements of this specification. An example of an exterior plastic part with Hydrographic ink system: Molded plastic/baked adhesion promoter/primer/baked basecoat/Hydrographic inks/baked clearcoat.

Hydrographic ink system layering can vary from the preceding example. If the basecoat layer is absent or offers low UV protection, then a UV-stabilized grade of substrate must be used and validated for durability with the production intent finish. Substrates can be various plastic materials.

1.2 Symbols. Not applicable.

1.3 Applicability. These Hydrographic printed designs can be used on outside rearview mirror shells, appliques, and other exterior trim parts. This specification covers the initial qualification (technology approval) and performance requirements (finished part) for exterior Hydrographic printing.

2 References

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

2.1 External Standards/Specifications.

ASTM D7869	SAE J2527	SAE J1545
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2.2 GM Standards/Specifications.

9986478	GMW14270	GMW14797	GMW15919
GMW3005	GMW14333	GMW14829	GMW16847
GMW3059	GMW14700	GMW14873	GMW17434
GMW3221	GMW14701	GMW15545	
GMW14124	GMW14729	GMW15891	

3 Requirements

Unless otherwise specified, test panels shall be representative of production intent substrates and coatings. See Appendix A, Table A1 and Data Sheet A1 for construction sheet and test data summary.

Submission requirements in 3.4 for technology approval are for adhesion promoters/primers, basecoats, and clearcoats previously approved to existing 998 specifications. Substrates must be previously approved to existing GMWs or regional specifications.

Each combination of specific substrate, adhesion promoter/primer basecoat, Hydrographic ink pattern, and clearcoat applied to a part or plaque must be tested and approved to this specification. Any new pigment or pigment combination, used in the basecoats or inks, not previously used in any GM color, or any new pigment or pigment combination not previously used in the proposed resin system, must have two (2) years (minimum) Florida exposure data per GMW17434 submitted, and approved by Materials Engineering.

Additionally, each specific substrate, adhesion promoter/primer basecoat, Hydrographic ink pattern, and clearcoat combination approved to this specification must be tested to and approved to GMW14797, Approved Paint on Parts System (APOPS), on parts processed through a production intent process, as a total system.

After the entire pigment library and Hydrographic ink system is granted technology approval, new colors are entered into the Appearance database for color development requiring 2500 kJ Xenon accelerated weathering.

3.1 Requirements on Test Specimens. Condition Samples for at least 72 h at GMW3221, Code A conditions prior to testing, unless otherwise specified.

3.2 Submission Letter. Prior to qualification testing, the supplier must submit documentation to the appropriate Materials Engineer listing the manufacture and product codes of the ink(s) used in the HG being considered for approval to this specification. In addition, the manufacture and product codes of the ink(s) used in the HG must be included in Table A6 of GMW14797, APOPS.

3.3 Panel Preparation. Prior to start of panel preparation, contact the responsible engineer to ensure proper selection of substrate, adhesion promoter/primer, basecoat, Hydrographic inks, and clearcoat. All coatings will be applied at target films and bakes unless otherwise specified.

3.3.1 Sample Size. The number of samples for each test shall be three (3) per ink pattern, unless the responsible engineer and supplier agree on a different number for specific tests, prior to the start of testing. All coating layers shall be fully identified with source, product code, batch number, bake description, and film build.

3.3.2 Test Substrates. Test substrates shall be production intent material.

3.4 Submission Requirements. The test requirements for the specific combination of substrate, adhesion promoter/primer, basecoat, Hydrographic ink pattern, and clearcoat are as follows. Refer to Appendix A, Data Sheet A1 for construction sheet and Table A1 for test data summary.

3.4.1 Initial Tape Adhesion (GMW14829, crosshatch). Maximum rating of 1.

3.4.2 Adequacy of Cure (GMW15891). Maximum rating of 0.

3.4.3 240 h Humidity (GMW14729, Option A) followed by tape adhesion (GMW14829, crosshatch). No appearance change. Maximum rating of 1.

3.4.4 Chip Resistance (GMW14700, Method B). Minimum rating of 9.

3.4.5 Gasoline Resistance (thermoplastic olefin (TPO) substrates only), (GMW14333-B). Immersion test to 15 minutes, 30 minutes, 45 minutes, and 60 minutes. Maximum coating removal of 20% after 15 minutes. Report results after 30 minutes, 45 minutes, and 60 minutes.

3.4.6 Chemical Resistance (not required if clearcoat is approved to an “existing 998” specification), (GMW14701). All materials rated 10 except as follows:

- Rating 8 – egg albumin
- Rating 4 – acid train pH 3
- Rating 6 – sulfuric acid pH 4
- Rating 2 – sulfuric acid pH 0
- Rating 4 – brake fluid

3.4.7 Moisture Cold Cycle (GMW14124, Cycle A, 15 cycles) plus 24 h humidity (GMW14729, Option A), followed by tape adhesion (GMW14829, crosshatch). No appearance change. Maximum rating of 1.

3.4.8 Thermal Shock (for TPO substrates only), (GMW15919). No removal of coating.

3.4.9 Test the following sections of GMW17434:

3.4.9.1 Paragraph 3.3.2 UV Transmission Filmbuilds GMW15545.

3.4.9.2 Paragraph 3.1.3 UV Fortification Package.

3.4.9.3 Paragraph 3.2 Test Panel Preparation and Report.

3.4.10 Weathering:

3.4.10.1 Xenon Arc Weatherometer (SAE J2527) Extended UV Filter Combination. Optional: ASTM D7869. Each ink pattern and/or new ink colors prepared per 3.1 shall be exposed to 2500 kJ/m², 3500 kJ/m², and 4500 kJ/m² per SAE J2527, extended UV filters. After each exposure time period, expose to 96 h humidity (GMW14729) plus tape adhesion (GMW14829). No appearance change, maximum rating of 1. Gloss loss after 2500 kJ/m² is 15% (polished and unpolished) maximum, and after 4500 kJ/m² is 20% (polished and unpolished) maximum. See 3.5 for visual examination requirements. Also run a control.

3.4.10.2 Florida Open Rack Direct Weathering Exposure (GMW14873). Each ink pattern and/or new ink colors prepared per 3.2 shall be subjected to 12 months, 24 months, 36 months, 48 months, and 60 months exposure at 5 degrees facing south in Florida. After each exposure time period, expose to 96 h humidity (GMW14729) plus tape adhesion (GMW14829). No appearance change, maximum rating of 1. Gloss loss after 24 months Florida exposure shall be 20% (unpolished) and 10% (polished) maximum after 24 months, and 35% (unpolished) and 30% (polished) maximum after 60 months.

The following exposure times are for information only:

- 36 months
- 48 month.
- 60 months

3.5 Visual Examination. Wash weathered specimens prior to making measurements and observations. Wash with scrubbing action, using a sponge that is saturated with a solution consisting of soap and deionized water at $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$. Exposed parts shall not exhibit any indications of surface tackiness or embrittlement, change in hardness, blooming, blistering or other factors that might affect the function or appearance of the part. The color change shall not exceed a ΔE of ≤ 3.0 units. If color change cannot be measured instrumentally due to the ink pattern, a visual evaluation can be used.

The color change shall be measured per SAE J1545 (CIELAB color space, 10 degrees observer, metering orifice $\leq 10\text{ mm}$, Illuminant D65, specular component included). Visual color change that is considered objectionable shall override the ΔE measurement.

Part must not exhibit objectionable color change. Slight on-tone color fade is acceptable.

Note: Completion of 36 months, 48 months, and 60 months Florida testing is not required for technology approval. The Florida testing, however, shall be ongoing with a minimum of 24 months Florida, 4500 kJ/m² Xenon exposures, and all accelerated tests completed before technology approval is granted. Contact Materials Engineering if weathering panels with objectionable results are returned after 36 months, 48 months, and 60 months Florida testing.

3.6 Natural Weathering Test Location Areas. Any of the following locations are considered equivalent as a test sample location. Reference GMW16847 for latest approved equivalents. Obtain agreement from the regional GM Engineering group prior to sending test samples out for exposure.

- Miami or Southern Area, Florida, USA
- Allunga, Queensland, Australia
- Cruz Alta, Brazil

3.7 The combination of specific substrate, primer, basecoat, Hydrographic ink pattern, and clearcoat applied to a part in a production intent process must be tested and approved to GMW14797 (APOPS) (part performance) as a total system. Each ink pattern and/or new colors must be exposed to Xenon accelerated weathering, and open rack weathering in Florida. For new basecoat/clearcoat systems, full approval to GMW3005 is required.

3.8 All materials supplied to this standard must comply with GMW3059, **Restricted and Reportable Substances**, including the requirement to submit a full material composition disclosure to GM via the International Material Data System (IMDS) or via a completed GMW3059 report form.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

5.2 Language. In the event of conflict between the English and domestic language, the English language shall take precedence.

5.3 Inspection and Rejection. Samples of components or materials released to a GM material specification shall be tested for conformity with the requirements of this material specification and approved by the responsible Engineering department prior to commencement of delivery of bulk supplies.