



Paint Performance Requirements for New Plastic Materials

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This standard details the paint performance requirements for new plastic materials.

1.1.1 This material specification defines interior and exterior paint performance requirements of new plastics being considered for approval in the GM Approved Paint on Parts (APOPS) database. The purpose of this specification is to define the proof of paintability requirement listed in GMW3013 for a new plastic to be approved to the GM Materials Approved Source List.

1.1.2 These tests are normally performed on plaques that were painted in a laboratory. Conformance to these requirements is the first step of the APOPS approval process. Additional steps include testing parts that were painted in production and monitoring quality during an extended production run. (See GMW14797.) It should also be noted that exterior painted components are required to meet painted part appearance requirements per GMW15777.

1.2 Applicability. This standard covers organic surface coatings on plastic parts and components used for exterior applications on motor vehicles, interior applications on motor vehicles, and also for painted components within the engine compartment.

2 References

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

2.1 External Standards/Specifications.

ASTM D3763	ISO 2808	SAE J1976	SAE J2527
ISO 75	ISO/IEC 17025		

2.2 GM Standards/Specifications.

9984801	GMW14333	GMW14797	GMW15919
GMW3013	GMW14445	GMW14829	GMW16133
GMW3059	GMW14698	GMW15520	GMW16745
GMW3221	GMW14700	GMW15777	GMW16746
GMW14124	GMW14729	GMW15891	GMW16847

3 Requirements

3.1 Facilities.

3.1.1 If tests are performed outside of GM, all testing shall be performed in an accredited laboratory. Laboratory accreditations to ISO/IEC 17025 are acceptable.

3.1.2 All testing is the responsibility of the resin supplier seeking GMW3013 approval to the GM Materials Approved Source List.

3.2 Test Specimens.

3.2.1 Test specimens shall be painted test plaques, or with permission of GM Engineering, painted parts. Normally, laboratory molded plaques are used to provide a uniform substrate. Test plaque dimensions shall be 100 mm minimum × 150 mm minimum × 3.2 mm ± 0.2 mm. Other thicknesses may be substituted, provided they are representative of intended part thickness. Plaques should be molded black in color.

3.2.2 With permission of GM Engineering, if painted production parts are used for this paintability testing, the results may also be used toward APOPS approval (pending the completion of the remaining GMW14797 requirements) only if the substrate, paints, and molding/painting process are the same as for production.

3.3 Control Plastic.

3.3.1 It is recommended that a control plastic material shall be included in the test program. The control plastic shall be from the same generic family as the experimental plastic, it must be a GM approved material, listed in an approved APOPS combination, and listed in the GM Materials Approved Source List as paintable. If such a control does not exist, GM Engineering will designate a control plastic. The control plastic shall be painted along with the experimental plastic.

3.4 Paint Materials.

3.4.1 All paint materials used shall be GM approved paint materials, approved to a 998 or GMW specification and listed in an approved APOPS combination. Contact the appropriate GM engineer to determine the proper adhesion promoters, primers, surfacers, and topcoats to use. Normally, both white (non-metallic) and light metallic topcoats are applied for exterior and a red or blue Type F paint and a dark grey metallic monocoat paint for interior are applied, but specific situations may dictate otherwise, and would require approval by the appropriate GM engineer.

3.4.2 Surfaces shall be cleaned prior to painting (9984801 power wash recommended for exterior). Paint materials shall be processed and cured using the normal conditions recommended in the suppliers' product data literature. Normally, paint processing is done in a laboratory to fully control all processing conditions.

3.4.3 Flame treatment, if used, shall meet GMW16133.

3.5 Test Conditions. Tests shall be conducted using the latest issue of the test methods indicated. Suitable precautions should be taken to ensure that applicable safe limits are not exceeded when conducting test procedures, processes and/or handling the materials required by this specification.

Unless otherwise specified, painted samples shall be subjected to the testing after a minimum aging period of 72 h following the baking or drying cycle. Testing shall be conducted immediately following a conditioning period of 24 h minimum per GMW3221 Code A, unless otherwise specified. All tests shall be run in triplicate.

3.6 Plaque Testing. Prepare plaques per the requirements in 3.4.1 through 3.4.3, and perform testing as indicated in Table 1 for exterior painted plastics, or Table 2 for interior painted plastics.

3.7 Test Report. The test report shall include paint processing data per Data Sheet A1 or Data Sheet A2 in Appendix A, and paint performance test results per Data Sheet A3 or Data Sheet A4 in Appendix A. Along with these completed Data Sheets, submit the following:

- Tested plaques, including adhesion tapes, cure cloths and film thickness mylars/shims
- Paint thickness measurements
- Paint supplier bake chart
- Datapaq run when the plaques were painted
- Multiaxial impact curves (if applicable)

Table 1: Exterior Painted Plastic Performance Requirements

Test Class	GM Specification	Requirements ^{Note 1}
Tape Adhesion	GMW14829 Method A	Maximum Rating of 1
Adequacy of Cure ^{Note 2} Test with Xylene.	GMW15891	Maximum Rating of 0 for systems with clearcoat Maximum Rating of 1 for monocoats
240 h Humidity followed by Tape Adhesion	GMW14729 (Method A or B) GMW14829 Method A	No appearance change Maximum Rating of 1
Chip Resistance	GMW14700 (Method (A or B) and C)	Minimum Rating of GM 9
Heat Resistance ^{Note 3, Note 4} Exterior at +70 °C; +Tape Adhesion +Chip Resistance	168 h GMW14829 Method A GMW14700-B	No appearance change Maximum Rating 1 Minimum Rating of GM 9
Mandrel Bend – Flexibility At +23 °C At -15 °C At -30 °C	GMW16746, Suffix M2	Minimum Rating of 8. Flexible substrates only (< 800 MPa Flexural Modulus)
Gasoline Resistance - Dip	GMW14333-A	Rating 2. No color change or paint removal to previous surface or lifting or peeling of paint film. No appearance change.
Gasoline Resistance-Immersion Thermoplastic Olefin (TPO) Substrates Only	GMW14333-B	Maximum paint removal of 20% after 15 minutes immersion.
Moisture Cold – Cycle A +24 h Humidity +Tape Adhesion	GMW14124 GMW14729 (Method A or B) GMW14829 Method A	No appearance change No appearance change Maximum Rating of 1
Multiaxial Impact ^{Note 5} Test at 2.2 m/s and at lowest temperature (0 °C, -5 °C, -10 °C or -15 °C) at which all ductile failures are observed	ASTM D3763	All ductile failures
Water Jet (For fascias only)	GMW16745-B	Maximum paint removal of 60 mm ²
Thermal Shock (For TPO Substrates Only)	GMW15919	No removal
Paint Thickness Measurements	ISO 2808	Must meet standard paint thickness requirements as specified on part prints or per GM Materials Engineering
Weather Resistance	See Note 6 and 7	
Weathering +Appearance	Visual inspection and gloss measurement	Equal to control
Weathering +Tape Adhesion	GMW14829 Method A	Maximum Rating of 1
Weathering 96 h Humidity followed by Tape Adhesion	GMW14729 (Method A or B) GMW14829 Method A	No appearance change Maximum Rating of 1

Note 1: In addition to the test values indicated, there shall be no deleterious effects (such as, but not limited to color change, gloss change, chalking, crazing, and tackiness) following the exposure periods.

Note 2: Perform this test first. If any samples fail, discard the entire sample set and prepare new test samples.

Note 3: Not required for thermoset substrate.

Note 4: After visual inspection, prior to performance testing, wash the painted surface with a 50:50 solution of isopropyl alcohol and water.

Note 5: Multiaxial impact is required for substrates intended for use on fascia systems. Test on plaques painted white and light metallic (single coats each of basecoat/clearcoat) and also white with two (2) recoats.

Note 6: Wash painted surfaces according to SAE J1976 prior to performance testing. Do not polish.

Note 7: Weather Resistance. Test to one (1) of the following:

- SAE J1976, 12 months exposure in Miami, Florida area. Alternate natural weathering sites may be used according to GMW16847. If alternate natural weathering sites are to be used, obtain agreement from the regional GM Engineering group prior to sending test samples out for exposure.
- SAE J2527, Extended Filter, or ASTM D7869, 2500 kJ/m² exposure to exterior Xenon arc Weatherometer

Table 2: Interior Plastics Requirements

Test	Test Procedure ^{Note 1}	Requirement ^{Note 1}
Cure	GMW15891, 92% minimum denatured ethyl alcohol	Rating ≤ 1 for monocoats, Rating = 0 for base/clear No paint film degradation when viewed at 10 x magnification. ^{Note 2}
Adhesion	GMW14829, Method A, use 1 mm spacing for all film thicknesses	≥ 95% paint retention, Rating 1. ^{Note 3}
Humidity/Adhesion	144 h GMW14729, option A or B, recover 1h at room temperature followed by GMW14829 Method A, 1mm spacing	≥ 95% paint retention, Rating 1. No objectionable defects ^{Note 4}
Oven Age/Adhesion ^{Note 5}	168 h oven exposure, recover 1h at room temperature, 24 h GMW14729, recover 1h at room temperature followed by GMW14829 Method A, 1 mm spacing	≥ 95% paint retention, Rating 1 No objectionable defects. ^{Note 4}
Sunscreen and Insect Repellent Resistance Test	GMW14445 followed by GMW14698, 1 mm hemispherical tip, 8N load	Rating ≤ 2 and no penetration of the painted surface when evaluated with and without 10 x magnification. ^{Note 6}
Reverse Multi-axial Impact Resistance ^{Note 7}	GMW15520, Multi-axial Instrumented Impact Test paragraph (ASTM D3763, -30 °C)	No more than 20% reduction in mean impact energy and sample break behavior must not change from ductile to brittle.
Film Thickness	Type F: ISO 2808 Method 4B, minimum of 3 measurements per part, report average as well as individual readings. All other types ^{Note 8} : ISO 2808 Method 4A or 4B, minimum of 3 measurements per part, report average as well as individual readings. Report location of each measurement on a part schematic.	Per engineering drawing/math file or, if not specified, the default values for film build are as follows: 25 µm ± 5 µm for Type C paints, 30 µm ± 5 µm for Type D paints, 50 µm ± 5 µm for Type F paints, 5 µm to 10 µm for adhesion promoters and 25 µm ± 5 µm for primers. Minimum default values for Type M and basecoat/clearcoat technologies are noted in the GM Materials Approved Source List for the specified coating.

Note 1: Film thickness testing should be conducted first. If results do not meet specified limits, do not proceed with further testing. New plaques must be painted that meet film thickness requirements.

Note 2: Evaluation of the crock cloth is not required. Slight gloss increase of the paint film for low gloss (PGC) surfaces is acceptable. Examples of degradation of the paint film include wrinkling, perforation or removal.

Note 3: Brittleness of the paint film, as evidenced by chipping or flaking while scribing the test lines, shall be cause for rejection.

Note 4: Examples of objectionable defects include but are not limited to evidence of blistering, water spotting, color change, gloss change, distortion or exudation.

Note 5: The oven age temperature shall be the highest of the three (3) temperatures (+85 °C, +95 °C, +105 °C) which is below the heat distortion temperature of the plastic material. The heat distortion temperature at 455 kPa shall be used. Heat distortion according to ISO 75 Method B. Contact the Materials Engineer for temperature confirmation.

Note 6: Examples of unacceptable change (rating > 2) are blisters, perforation, cracking or removal of any kind. In the absence of any of these negative visual reactions after testing at 8 N, a slight gloss change and slightly visible scribe line (mar) is acceptable and considered to be a rating ≤ 2. If the paint is stained but has not lost adhesion or lifted from the substrate, place one specimen per color in an oven at +80 °C for 4 h. Compare the baked specimen to an unbaked specimen. The baked should show decreased staining. The reviewing program Materials Engineer, in conjunction with (as appropriate) the regional Materials Engineer responsible for interior paint raw material approval has the final authority to determine the disposition of a sunscreen result for grained parts.

Note 7: Multi-axial Impact (MAI) is for painted deployable surfaces only or at the program Materials Engineer's request. Test only materials capable of ductile break behavior at -30 °C or lower.