Performance Requirements for Exterior Plastic Parts

1 Introduction

1.1 Scope. This specification covers the performance requirements of plastic parts used in exterior automotive applications. The parts may be functional within themselves or they may be a subassembly of, or attached to, metallic, decorative or functional parts.

Note: Additional requirements for coated or painted plastic parts are given in the relevant paint performance specifications, not by this specification.

Note: Some sections reference both, GMW test method and local test methods; as soon as the GMW is available, it supersedes the local test methods.

2 References

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

2.1 External Standards/Specifications.

EN 590 ISO 7724-1
EN 14214 SAE J1545
ISO 4892-1 SAE J1960
ISO 4892-2

2.2 GM Standards/Specifications.

9981062 GM1 60264
9981285 GM1 60266
9981729 GMN3943
9982223 GMN10059
9982224 GMW3001
GM4476P GMW3059
GM9126 GMW3221
GM9508P GMW14093
GM9900P GMW14332
GME 00002 GMW14458
GME 60268 GMW14713
GMI 60206 HN 0164
GMI 60254 L 000 0555
GMI 60263 L 000 0556

3 Requirements


Note: Only for unpainted parts with exposure to direct or indirect sunlight.

3.1.1 ISO – Procedure. Test as per the conditions of ISO 4892-1 and ISO 4892-2 (Xenon Arc Weather-Ometer):

- Inner- and Outerfilter: Borosilicate
- Radiant exposure: 0.50 W/m² at 340 nm
- Test program Cam No. 7:
  - 102 ± 0.5 minutes light only
  - 18 ± 0.5 minutes light and spray
- Black-standard temperature: ±80 ± 3°C

3.1.1.1 Visual Evaluation. 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 ± 3°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.

The color change shall be measured per ISO 7724-1 or SAE J1545 (CIELAB color space, 10° observer, metering optical ≤ 10 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.

3.1.1.2 Examination with Microscope (enlargement: fiftyfold). Test pieces shall show no cracks, no pores or other damages of surface.

3.1.2 SAE Procedure. Test as per the conditions of SAE J1960.

3.1.2.1 Inspect per 3.1.1.1 and, if needed, 3.1.1.2.
Table 1: Exposure Limits

<table>
<thead>
<tr>
<th>Application</th>
<th>Class</th>
<th>Test Method</th>
<th>Radiant Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts exposed to direct sunlight above belt line with large horizontal</td>
<td>1</td>
<td>SAE J1960</td>
<td>≥ 4500 kJ/m²</td>
</tr>
<tr>
<td>surfaces, e.g., tonneau covers</td>
<td></td>
<td>ISO 4892-1/2</td>
<td>≥ 5400 kJ/m²</td>
</tr>
<tr>
<td>Parts exposed to direct sunlight above belt line with midsize horizontal</td>
<td>2</td>
<td>SAE J1960</td>
<td>≥ 3500 kJ/m²</td>
</tr>
<tr>
<td>surfaces and parts that have both vertical and horizontal surfaces, e.g.,</td>
<td></td>
<td>ISO 4892-1/2</td>
<td>≥ 4200 kJ/m²</td>
</tr>
<tr>
<td>cowl, appliques</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other parts exposed to direct sunlight above belt line and all parts</td>
<td>3</td>
<td>SAE J1960</td>
<td>≥ 2500 kJ/m²</td>
</tr>
<tr>
<td>exposed to direct sunlight below belt line, e.g., antenna housing, mirror</td>
<td></td>
<td>ISO 4892-1/2</td>
<td>≥ 3000 kJ/m²</td>
</tr>
<tr>
<td>housing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hidden parts not exposed to direct sunlight, e.g., fenderliner</td>
<td>4</td>
<td>SAE J1960</td>
<td>≥ 1250 kJ/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISO 4892-1/2</td>
<td>≥ 1500 kJ/m²</td>
</tr>
</tbody>
</table>

Note: In case no class is assigned, Class 3 applies as the default standard for the radiant energy. To ensure timely Production Part Approval Process (PPAP), at the discretion of the GM engineers, plaques or surrogate parts may be weathered instead of the actual production parts. If allowed, these plaques or surrogate parts must have been processed similarly to the production parts (e.g., injection molded, vacuum formed, grained, etc.).

3.2 Resistance of Material to Heat Ageing. Test pieces shall be exposed for 168 ± 2 h (7 days) in an air circulating oven operating at:
- above beltline parts +90 ± 3°C
- below beltline parts +80 ± 3°C

3.2.1 Requirement. Test pieces shall show no significant surface changes, particularly changes in color or gloss, no embrittlement, increase in hardness, no objectionable shrinkage or other changes detrimental to serviceability.

3.3 Resistance to Temperature – Humidity Cycle (Dimensional Stability). Test pieces shall be assembled to jigs or forms so as to simulate as closely as possible actual service conditions. The complete test assembly shall then be subjected to the following test cycle:

3.3.1 The test cycle may be commenced at any of the individual stages provided the full cycle is sequentially completed.

This cycle shall be carried out two times without interruption:
- 17 ± 0.5 h at -30 ± 3°C
- 72 ± 1 h at +80 ± 3°C
- 24 ± 1 h at +40 ± 3°C and 93 ± 5% RH (relative humidity)
- 7 ± 0.5 h at -30 ± 3°C
- 24 ± 1 h at +40 ± 3°C and 93 ± 5% RH
- 24 ± 1 h at +22 ± 3°C

3.3.2 Requirement. Test pieces shall show no cracking, crazing, appreciable color changes, discoloration, cloudiness, blistering, objectionable shrinkage, deformation, loss of adhesion to the substrate between layers of the composite or other changes detrimental to serviceability. Test pieces shall comply with the dimensions specified on the drawing after completion of the test.

3.4 Resistance to Humidity. Test pieces shall be exposed for 168 ± 2 h in a humidity cabinet operating at +40 ± 3°C and 93 ± 5% RH. The parts shall be evaluated after conditioning to GMW3221, Code A.

3.4.1 Requirement. Test pieces shall show no significant surface changes, particularly changes in color or gloss, or other changes detrimental to serviceability. Test pieces shall comply with the dimensions specified on the drawing after completion of the test.


Note: Only for unpainted parts in direct stone impact area, e.g., grilles, fascias, etc. Contact the approving GM organization to determine which of the following sections to execute.

3.5.1 Stone Impact (GME 60268 – C3 – Grade 2). Tests shall be conducted on test pieces:
- In the as received condition.
- After resistance of material to heat ageing (see paragraph 3.2).
- After resistance to temperature cycling (see paragraph 3.3).

3.5.1.1 Requirement. Grade 2 per GME 60268.

3.5.2 Stone Impact (GM9508P). Tests shall be conducted on test pieces:
- In the as received condition.
• After resistance of material to heat ageing (see paragraph 3.2).
• After resistance to temperature cycling (see paragraph 3.3).

3.5.2.1 Requirement. Slight indentation marks caused by impact permissible or a rating of 7 or better on the GM scale in GM9508P.

3.5.3 Scratch and Mar (GMN3943). Body Trim, including body side moldings, claddings, wheel flares and pillar appliqués shall be subjected to the 5 Finger Scratch test per GMN3943. Test to be performed on 3 samples cut from production parts.

3.5.3.1 Requirement. Arm #2 (15 Newton tip load) shall have a rating of 3 or better and show no whitening or objectional surface defects.

Note: Only for parts, which in assembly are directly in contact with unpainted metal surfaces (i.e. chrome plating, aluminium, stainless steel etc.) but excluding inserts. Tests shall be conducted on full assemblies including neighbored parts as in the vehicle.

3.6.1 The approving region will identify which of the following requirements applies:
• Salt Spray Fog Testing to GMI 60206 H (= 144 h) - Grade 2
• CASS Testing to GM4476P, 48 h

3.6.2 Requirement. There shall be no appreciable surface deterioration, shrinkage, increase in hardness, color or gloss changes, cracking, loss of adhesion etc. to the plastic component after test. Additionally the plastic shall not have reacted with the metal surface to promote corrosion.

3.7 Resistance to Sulfur Dioxide Staining (GMI 60263).
Note: Only for parts near the exhaust system.
Resistance to sulfur dioxide staining to GMI 60263.

3.8 Resistance to Sulfide Staining. (GMW14332/GMI 60264).
Note: Only for parts near the exhaust system.
Resistance to sulfide staining to GMI 60264.

3.9 Fuel Resistance.
Note: Only for parts near the tank filler inlet.

3.9.1 Test fluids. Use Gasoline and Diesel fuels representative for the region the vehicle is marketed.

GME Test Fluids:
• Gasoline test fuel: 42.25% by volume toluene
  25.35% by volume iso-octane (2,2,4 trimethy/pentane)
12.68% by volume di-isobutylene technical
4.22% by volume absolute ethanol
15% by volume methanol
0.5% by volume water
20 ppm acid (calculated as formic acid).
• Diesel test fuel:
  95% by volume Diesel to EN 590
  5% by volume Fatty Acid Methyl Ester (FAME) to EN 14214.

GMNA Test Fluids:
• 45% by volume toluene (9981729) and
  55 % by volume Varnish Makers and Painters (VM&P) naphtha (9981062).

3.9.2 Procedure. For each test fluid immerse the part for 10 s in the test fluid and follow with a 20 s evaporation period. Repeat the cycle 10 times.

3.9.3 Requirement. There shall be no color change, loss of bond, material degradation, or tackiness following the last 20 s evaporation period.

3.10 Impact Resistance (GMW14093).
Note: Test shall be conducted on components.
If no specific area of the part is assigned on the drawing to meet the impact requirements, the entire part must meet these requirements. Impact resistance to GMW14093 - 3/5J min.
• In the as received condition.
• After resistance of material to heat ageing (see paragraph 3.2).
• After resistance to temperature cycling (see paragraph 3.3).

3.11 Resistance to Dewaxing. (Transit Coating).
Note: Only for parts which are waxed during production.

3.11.1 Test piece. As possible complete component otherwise section 300 x 100 mm.

3.11.2 Test wax (protective wax).
GME only:
• L 000 0555 (solvent based)
• L 000 0556 (hydro based)
GMNA & LAAM only:
• 9982223
All other: Use plant defined wax.

3.11.3 Procedure. Transit each protective wax to coat on test pieces.
Store test pieces for 24 ± 1 h at +23 ± 5°C and 50 ± 6% RH.

3.11.4 Dewaxing.
GME only:
• Followed by dewaxing with steam jet cleaner according to Service Product Information "Corrosion Protection"
• Hot water temperature: (+80 ± 3)°C
• Distance nozzle to test piece: ≥ 30 cm
• Petroleum contents: ≤ 3%
• Aromatics contents of petroleum: ≤ 1%
GMNA & LAAM only:
• Aromatics contents of petroleum: ≤ 1%
All other: Use plant defined dewaxing procedure.

3.11.5 Visual Evaluation. Test pieces shall show after drying no significant surface changes, particularly changes in color or gloss or other changes detrimental to serviceability.

3.11.6 Examination with microscope (enlargement: fiftyfold). Test pieces shall show no cracks, no pores or other damages of surface.

3.12 Compatibility. (HN 0164/GMI 60254).
Note: Only for parts made from polymer materials with plasticizer (e.g., Polyvinyl Chloride (PVC), Cellulose Acetate Butyrate (CAB) having direct contact to painted surfaces.

3.12.1 The test shall be executed with the most common contacting material. If not listed below, contact the approving region for detail information.
For GM Holden: The most common contacting material will be steel panels painted with Holden Exterior paint systems: (i) Acrylic clear coat (HN 1601-644) and (ii) Polyester topcoat (HN 1601-463).

Table 2: Test Method

<table>
<thead>
<tr>
<th>Global Platforms and/or vehicle marketed in &quot;High UV Regions&quot; (US, Central/South America, Australia, Africa, Middle East, Asia Pacific)</th>
<th>Test to HN 0164 B2XY Staining Grade 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional Platforms and/or vehicle marketed in &quot;Low UV Regions&quot; (Europe, Canada, Japan, China)</td>
<td>Test to GMI 60254 B1XY Staining Grade 1</td>
</tr>
</tbody>
</table>

3.12.2 Requirement. The test pieces of the contact material (painted surface) shall show no evidence of contact or migration staining.

Note: No testing for parts in non visible areas.

The approving region will identify which of the following requirements applies:
• Resistance to cleaning agents to GMI 60266 Rating 1.
• GM9900P
• GM9126P Method B
• GMN10059
Test media for GMI 60266 Method are:
• Protective wax (e.g., L 000 0555, L 000 0556).
• Commercial car shampoo (e.g., Sonax 314300, 1% solution of 9981285 detergent).
• Commercial paintwork cleaning product (e.g., Sonax 302200).
• Mixture of 50% water and 50% commercial washer fluid (e.g., B 040 1990).

4 Validation

4.1 Test Samples. Unless otherwise specified in the relevant test method for the property concerned, either the complete component or a section therefrom shall be used for test pieces. Unless otherwise specified in the appropriate test methods at least one test piece shall be tested.

4.1.1 Test pieces shall not be tested within 72 h of manufacture.

4.1.2 Conditioning. Unless otherwise stated in respective test procedures, all samples are to be conditioned prior to each requirement test to GMW3221, Code A.

4.2 Raw Material Specification Conformance. The components of the assembly shall meet the individual material specifications shown on the engineering drawing in addition to meeting the requirements of this performance specification.

4.3 Documentation. Samples of components or material released to this specification shall be tested for conformity with the requirements of this specification and approved by the responsible GM Department prior to the start of delivery of production level components or materials.

Any change to the component or material e.g., design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases a shorter test can be
agreed to between the responsible GM Department and the supplier.

4.3.1 Test Results.
4.3.1.1 Test Report. The test report has to have the same outline and numbering as this test specification.

4.3.2 Deviations from Test Procedure. Deviations from the requirements of this specification or other additional requirements shall have been agreed upon and shall be specified on the individual component drawings, material specifications etc. and shall be noted in all test certificates, reports etc.

5 Provisions for Shipping
Not applicable.

6 Notes
6.1 Glossary Not applicable.

6.2 Acronyms, Abbreviations, and Symbols.
CAB Cellulose Acetate Butyrate
CTS Component Technical Specification
FAME Fatty Acid Methyl Ester
ISO International Organization for Standardization
PPAP Production Part Approval Process
PVC Polyvinyl Chloride
RH Relative Humidity
UV Ultraviolet
VM&P Varnish Makers and Painters
VTS Vehicle Technical Specification

7 Additional Paragraphs
7.1 All materials supplied to this specification must comply with the requirements of GMW3001, Rules and Regulations for Material Specifications.
8.1 All materials supplied to this specification must comply with the requirements of GMW3059, Restricted and Reportable Substances for Parts.

8 Coding System
This specification shall be referenced in other documents, drawings, VTS, CTS, etc. as follows:
GMW14650

9 Release and Revisions
9.1 Release. This general specification originated in October 2005. It was first approved by the Global Plastics Team in April 2006. It was first published in August 2006.
It supersedes all regional exterior plastic part performance specifications for use on Global Engineered Parts including but not limited to: GME 00002.