



PVC, Integral Colored, Exterior Weatherable, Stain Resistant, Extrusion and Injection Molding Compounds

1 Scope

1.1 Material Description. This specification covers the properties of an integrally colored, exterior weatherable and stain resistant, (when required), Polyvinyl Chloride (PVC) molding compound. These materials can be processed by extrusion and/or injection molding processes. Materials are delineated by "Type" indicating Shore hardness, "Grade", indicating molding process and "Class", indicating stain resistance for white and other light colors, e.g., Silver Metallic, requires stain resistance. See Table A1, Table A2, and Table A3 in Appendix A.

1.2 Symbols. The material abbreviation according to ISO 11469 is > PVC <.

1.3 Applicability. Typical exterior trim applications include, but are not restricted to the following: Mold-in-color body side, windshield reveal, and roof ditch moldings.

1.4 Remarks.

1.4.1 Identification. PVC materials approved to this specification will be called out on the engineering drawing indicating all three attributes shown in Tables A1 through A3, e.g., GMW16084, Type 4, Grade E, Class B indicates a (40 ± 5) Shore D hardness, extrudable PVC not requiring stain resistance. In addition, if the nominal Shore hardness for a component is different than nominal Type stated herein, it shall be called out specifically on the engineering drawing, e.g., Type 4 = (40 ± 5) Shore D, but 42 Shore D is being used, $(42 \pm X)$ Shore D hardness shall be called out. GMW16084 types carrying an "LG" suffix as in, "Type 2LG", indicates the material is a low gloss version.

2 References

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

2.1 External Standards/Specifications.

ISO 37	ISO 868	ISO 7724-1	SAE J1767
ISO 176	ISO 1183	ISO 11469	SAE J1976
ISO 188	ISO 2813	SAE J323	
ISO 527	ISO 3451-1	SAE J1545	

2.2 GM Standards/Specifications.

9981062	GMW3221	GMW14650	GMW16128
GMW3013	GMW6992	GMW14873	GMW16847
GMW3059	GMW14270	GMW16124	

3 Requirements

3.1 Requirements on Test Specimens. Reference GMW3221.

Tests shall be conducted using the latest issue of the test procedures 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.

3.1.1 Test specimens shall be die cut from fan gated injection or compression molded plaques having a nominal thickness of $3.2 \text{ mm} \pm 0.2 \text{ mm}$. If injection molded, die cut specimens are to be tested with the long axis of the test specimen perpendicular to the direction of flow. Plaque dimensions must be sufficient to permit this.

3.1.2 Test samples shall be aged a minimum of 40 h after molding and 24 h immediately following a conditioning period per GMW3221, Code A, unless otherwise specified. All tests shall be performed on unannealed

specimens. In addition, tests specified at temperatures below or above $+23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ shall be conducted at the specified temperature using specimens conditioned at the specified temperature for 4 h minimum.

3.1.3 The minimum values specified in the property tables must be met by test specimens in natural, black, or in a standard sampled color if natural or black are not available. For colored grades where other pigment and additive systems (e.g., stabilizer) are used, the impact values shall not decrease more than 10% from the specified minimum value.

3.1.4 Low Gloss PVC. GMW16084 types carrying an "LG" suffix as in, "Type 2LG", and indicates the material is a low gloss version. The term "low gloss" in GMW16084 identifies exterior PVC that meets PGH or less according to the GM Global Gloss Palette.

3.1.4.1 Visual Appearance Assessment - Gloss. When a low gloss material candidate is submitted for GMW16084 approval, the gloss level must be confirmed via production tool molding trial as agreed to by GM Materials Engineering. PVC trial sample gloss shall be confirmed using the GM Global Gloss Palette and GMW6992, Visual Appearance Assessment. Refer to Appendix B, Figure B1, Global Gloss Palette – Plan for Primary Gloss Masters. Gloss qualification must be confirmed by the GM Appearance, Define and Develop Team.

3.2 Compound Properties. See Table 1 and Table 2.

3.2.1 Asphalt Stain Resistance. Asphalt stain, as defined by class in Table A3, is required for all white and light colored exterior PVC as these are susceptible to yellowing from road materials during vehicle life. **Note:** This test should be performed in a ventilated hood. This test can be performed on molded lab samples, parts or sections of parts with a 50 mm × 50 mm minimum exposable area. Three (3) samples per color are to be tested. Requirement: $\Delta E \leq 3.0$.

3.2.1.1 Procedure. Dip test samples into a 50/50 solution by volume of non-emulsified asphalt cement (refer to Marathon Oil AC-20 or equivalent) and unleaded gasoline for 10 s. Suspend the test samples vertically for 15 minutes allowing the solution to drain and evaporate for a further 15 minutes. Clean the test samples thoroughly with Naphtha 9981062 or equivalent.

3.2.1.2 Color Evaluation. Measure the L^* , a^* , b^* color values of test samples before and after exposure per measured per ISO 7724-1 or SAE J1545, (CIELAB color space, 10 degree observer, illuminant D65, specular component included on the color standard). Report the color differences (ΔL^* , Δa^* , Δb^* , ΔE^*) per SAE J1767. Observe the tested sample and report any objectionable defects. $((\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2)^{1/2} = \Delta E^*$ is the correct equation to be used for SAE J1767. Requirement: The color change shall not exceed three (3) units, ΔE of ≤ 3.0 . If the visual color change is considered objectionable, it shall take precedence over the ΔE measurement.

3.2.2 Accelerated Weathering Resistance, GMW14650. Technologies must have a minimum Xenon exposure of GMW14650, Class 2.

3.2.2.1 Evaluation. Unless otherwise specified, inspect a minimum of mid and full exposed test samples for color and gloss change. Measure test samples prior to exposure. After exposure, wash samples with scrubbing action using a clean sponge or low lint paint shop quality rag saturated with deionized water at $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for no more than one minute, and let air dry overnight.

3.2.2.1.1 Gloss. Measure exposed sample gloss per ISO 2813. Report test procedures, measurement angles and test equipment used. Wash weathered specimens prior to making measurements and observations. Requirement: 80% gloss retention is required after exposure and wash.

3.2.2.1.2 Color. See "Color Evaluation" 3.2.1.2 in "Asphalt Stain Resistance" 3.2.1.

3.2.3 Natural, Outdoor Weathering of Automotive Exterior Materials for 3, 6, 12 and 24 Months Exposure per SAE J1976, Procedure A. Technologies must have a minimum of 24 months natural solar exposure history to be considered for approval to this specification.

3.2.3.1 Evaluation. Evaluate test samples at the exposures of 3 months, 6 months, 12 months, and 24 months exposure. A retained test sample or part shall be kept for color and gloss comparison to exposed samples. Exposed test samples must meet the gloss and color requirements as called out previously under "Accelerated Weathering" in 3.2.2 and 3.2.2.1. Outdoor weathering exposure performance takes precedence over accelerated weathering tests.

3.2.3.2 Alternate Natural Weathering Test Location Areas, GMW16847. Alternate natural weathering sites may be used according to GMW16847. Obtain agreement from the regional GM Engineering group prior to sending test samples out for exposure.

3.3 Requirements on Delivery. Physical, mechanical, and thermal properties that characterize the material are summarized in Table 1.

Note: For each product, the requirements to Table 1 shall be documented by Certification Statement according to GMW3013. The color and gloss shall be specified on drawings, in material specifications and otherwise.

Table 1: Compound Properties (Black) ^{Note 1}

Property	Test Procedure	Unit	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Type 8
Shore Hardness	ISO 868, 15 s delay	A or D	70 ± 5 A	80 ± 5 A	90 ± 5 A	40 ± 5 D	50 ± 5 D	60 ± 5 D	70 ± 5 D	80 ± 5 D
Density	ISO 1183	g/cm ³	1.19 to 1.28	1.20 to 1.40	1.25 to 1.35	1.20 to 1.40	1.20 to 1.40	1.20 to 1.40	1.20 to 1.40	1.18 to 1.40
Tensile Stress at Break	ISO 37, Type 1 dumbbell, 500 mm/minute	MPa	≥ 10	≥ 10	≥ 10	NA	NA	NA	NA	NA
Tensile Stress at Break	ISO 527, Type 1A dumbbell, 500 mm/minute	MPa	NA	NA	NA	≥ 12	≥ 15.5	≥ 16.5	≥ 16.5	≥ 30
Elongation at Break	ISO 37, Type 1 dumbbell, 500 mm/minute	%	≥ 300	≥ 250	≥ 200	NA	NA	NA	NA	NA
Elongation at Break	ISO 527, Type 1A dumbbell, 500 mm/minute	%	≥ 300	≥ 250	≥ 200	≥ 100	≥ 75	≥ 75	N/A	N/A
Filler Content	ISO 3451-1, Method A	%	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20	0 to 20
Volatile Loss	ISO 176	%	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3
Mixed Fungal Resistance	GMW16128	Pass/Fail	Pass							
Pink Stain	GMW16124	No Stain	No Stain							
Asphalt Stain	50% W/W Solution	ΔE	ΔE ≤ 1.5 No objectionable defects allowed							
Cold Flexibility Mandrel Test	SAE J323, Method A. Use Table 3 for mandrel size selection based upon hardness. 3.2 mm ± 0.2 mm sample thickness	N/A	No Cracks							
Properties After Heat Age Exposure	ISO 188, Method B, 168 h at 85 °C followed by indicated property testing	%	± 25% maximum of Hardness, Tensile Stress at Break, Elongation at Break. No tackiness Note: Perform indicated property testing at +23 °C ± 2 °C. Use original mechanical property test procedures.							

Note 1: Properties shown are guidelines for each type material. Nominal values are defined in the material certification submission package at the time of approval.

N/A = Not applicable

W/W = Weigh-by-Weight