



Polyolefin Alloy – Weather Resistant, 1700 MPa Flexural Modulus, High Flow

GMW3221

1 Scope

1.1 Material Description. This standard covers the properties of a nominal 1700 MPa flexural modulus polyolefin alloy, high flow, pellet form, injection molding compound. For the purpose of this specification, polyolefin alloy is defined as an alloy of polypropylene plastic and EP (ethylene/propylene) or EPDM (ethylene/propylene diene monomer) rubber.

1.1.1 Additional Characteristics. Materials certified to this standard may have additional characteristics, e.g. paintable, elastomer modified, etc. Possible additional characteristics are defined in GMW3013.

1.2 Symbols. The material abbreviation according to ISO 11469 is > PP+EPDM-M<.

1.3 Typical Applications. Typical applications include the following: bumper fascias and rockers for mold-in-color (MIC) applications for accent colors, and two tone accent colored painted fascia, where the MIC portion is the accent color.

2 References

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

2.1 External Standards/Specifications.

ASTM E 228	ISO 1133
ASTM E 831	ISO 1183
ASTM D 3763	ISO 1873-2
ISO 75-1/2/3	ISO 3167
ISO 178	ISO 3451-1
ISO 179	ISO 6603
ISO 180	ISO 11359
ISO 294	ISO 11469
ISO 306	SAE J1545
ISO 527-1/2	SAE J1976

2.2 GM Standards/Specifications.

GM9327P	GMW14444
GMW3001	GMW14650
GMW3013	GMW14651
GMW3059	GMW14688

3 Requirements

Materials approved to this standard shall meet the requirements of GMW3013, General Requirements for Handling of Technical Terms of Delivery for Plastics.

3.1 Requirements on Delivery. Important physical, mechanical and thermal properties that characterize the material are summarized in Table 1 and Table 2.

Note: The requirements to Table 1 and Table 2 shall be documented for self-certification of the product according to GMW3013. The color shall be specified on drawings, in material specifications and otherwise.

3.2 Requirements on Test Specimens. Unless otherwise specified, injection molding of test specimens shall be accomplished per ISO 294 with the conditions for injection molding from ISO 1873-2. Test methods and specimen dimensions are also to be in accordance with ISO 1873-2 with the following additions: use ISO 3167, Type A, thickness 4 mm, for tensile and flexural properties.

All tests shall be performed on specimens 40 hours minimum after molding and immediately following a conditioning period of 24 hours minimum in a controlled atmosphere per GMW3221, Code A, unless otherwise specified. All tests shall be performed on unannealed specimens.

The values specified in Table 1 and Table 2 shall be met by test specimens in natural or black. 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.

3.2.1 Chemical Requirements. All parts manufactured from molding compounds shall be resistant to the media they contact at their place of use.

3.2.2 Requirements on Materials. See Table 1 and Table 2.

3.3 Performance Requirements. Performance requirements e.g., flammability, fogging or

resistance to odor shall be specified on part drawings or in component specifications.

All finished parts for Interior applications shall meet the requirements according to GMW14444 and GMW14651. This shall be noted on the Certification Statement with Code Letter U.

All finished parts for Exterior applications shall meet the requirements according to GMW14650.

This shall be noted on the Certification Statement with Code Letter L.

3.4 Additional Material Testing. Materials approved to this specification will be required to have basic material properties generated so warp analysis modeling can be conducted. See GM Material Engineer for details.

Table 1: Compound Properties (Black or Natural)

Properties	Standard	Unit	Values
Mineral Filler Content (Ash)	ISO 3451-1, Method A at +600°C	% by mass	Mean = 19 Range = 14 to 24
Density	ISO 1183, Method A	g/cm ³	1.00 to 1.04
Melt Flow Rate MFR 230/2.16	ISO 1133	g/10 minutes	Mean = 23 Range = 19 to 27
Melt Volume-Flow Rate MVR 230/2.16	ISO 1133	cm ³ /10 minutes	Mean = 26.7 Range = 22.1 to 31.4
Flexural Modulus	ISO 178, 80 x 10 x 4 mm specimen, 2 mm/minute test speed, 64 mm support span	MPa	Mean = 1700 Range = 1550 to 1850
Tensile Modulus	ISO 527-1/2, specimen 1A, 1 mm/ minute test speed	MPa	Report Results
Tensile Stress at Yield	ISO 527-1/2, specimen 1A, 50 mm/ minute test speed	MPa	≥ 13
Multiaxial Impact Strength at +23°C	ASTM D 3763, specimen C, 2.2 m/s impact velocity	J at max load	≥ 15 All failures must be ductile
Multiaxial Impact Strength at -30°C	ASTM D 3763, specimen C, 2.2 m/s impact velocity	J at max load	≥ 15 All failures must be ductile
Multiaxial Impact Strength at +23°C	ISO 6603-2/40/20/C/4.4. Sample to be either square 60 mm x 60 mm minimum, or circle 60 mm diameter minimum. Sample thickness to be 2 mm ± 0.1 mm.	J	Report Energy at Maximum Force and Type of Failure
Multiaxial Impact Strength at -30°C (or lowest temp. where only type YD or YS failures are observed)	ISO 6603-2/40/20/C/4.4. Sample to be either square 60 mm x 60 mm minimum, or circle 60 mm diameter minimum. Sample thickness to be 2 mm ± 0.1 mm.	J	Report Energy at Maximum Force and Type of Failure Report Test Temp.
Notched Izod at +23°C	ISO 180/1eA	kJ/m ²	≥ 45
Notched Izod at -30°C	ISO 180/1eA	kJ/m ²	≥ 5.0
Notched Charpy Impact at +23°C	ISO 179/1eA	kJ/m ²	≥ 50
Notched Charpy Impact at -30°C	ISO 179/1eA	kJ/m ²	≥ 5
Vicat Softening Temperature VST/A/50	ISO 306	°C	≥ +120
HDT, Method A	ISO 75-1, ISO 75-2, ISO 75-3	°C	≥ +50

Properties	Standard	Unit	Values
CLTE, longitudinal, +23 to +80°C; -30 to +100 °C for ASTM E 831 and ASTM E 228	ISO 11359 or ASTM E 831 or ASTM E 228	1/K	$\leq 55 \times 10^{-6}$
Shrink, 48 hours after molding	ISO 294, plaque size 4" x 6"x 0.125"	%	Target Mean = 0.6 Range = 0.525 to 0.675
Shrink, After Bake, 1 h at 82°C	ISO 294, plaque size 4" x 6"x 0.125"	%	Target Mean = 0.7 Range = 0.625 to 0.775
Shrink, After Bake, 1 h at 121°C	ISO 294, plaque size 4" x 6" x 0.125"	%	Target Mean = 0.8 Range = 0.725 to 0.875

Table 2: Compound Properties (Integrally Colored)

Properties	Standard	Unit	Value
Multiaxial Impact Strength at +23°C	ASTM D3763, specimen C, 2.2 m/s impact velocity	J at max load	≥ 15 All failures must be ductile
Multiaxial Impact Strength at -30°C	ASTM D3763, specimen C, 2.2 m/s impact velocity	J at max load	≥ 15 All failures must be ductile
Multiaxial Impact Strength at +23°C	ISO 6603-2/40/20/C/4.4. Sample to be either square 60 mm x 60 mm minimum, or circle 60 mm diameter minimum. Sample thickness to be 2 mm \pm 0.1 mm.	J	Report Energy at Maximum Force and Type of Failure
Multiaxial Impact Strength at -30°C (or lowest temp. where only type YD or YS failures are observed)	ISO 6603-2/40/20/C/4.4. Sample to be either square 60 mm x 60 mm minimum, or circle 60 mm diameter minimum. Sample thickness to be 2 mm \pm 0.1 mm.	J	Report Energy at Maximum Force and Type of Failure Report Test Temp.
Natural Weather Resistance ^{Note 2} Color Change Surface Defects	5 years exposure to direct weather in Arizona and Florida per SAE J1976 Procedure A. Measure color as defined in Note 1 below. Correlation of 5 years Natural Weathering to Accelerated Weather Resistance is required.	ΔE	≤ 3.0 No objectionable defects allowed.
Accelerated Weather Resistance ^{Note 1, Note 2} Color Change Surface Defects	Test to GMW14650 (Weather-Ometer Resistance) Class 1	ΔE	≤ 3.0 No objectionable defects allowed.
Accelerated Weather Resistance ^{Note 1, Note 2} Color Change Surface Defects	Test to GMW14650 (Weather-Ometer Resistance) Class 3	ΔE	≤ 0.75 No objectionable defects allowed.
Scratch Resistance	Five Finger Scratch Test per GMN3943. Sample plaque to be GM Exterior Color Submission Plaque (reference GM9327P).		Arm #2 (15 Newton load) shall have a rating ≤ 3 , and no whitening or objectionable defects.

Properties	Standard	Unit	Value
Scratch Resistance	GMW14688-A-10 Newtons. Sample plaque for GMNA to be GM Exterior Color Submission Plaque (reference GM9327P). Sample plaque for all other regions to match the master plaques with the grains, colors and gloss levels as defined in the ARD-Sheet of the corresponding GM program.	ΔL	Report Results

Note 1: For integrally colored compounds, the color of each test specimen shall be measured per SAE J1545, CIELAB color space, 10 degrees observer, illuminant D65, specular included, sphere geometry, before and after exposures. In case of conflict between accelerated and natural weathering, natural weathering takes precedent. Prior to making measurements and observations on weathered specimens, wash the specimens with a solution consisting of 2 g No. 7 Car Wash Concentrate (distributed by Armor All Products, Aliso Viejo, CA 92656) and 1 L deionized water @ 22 ± 3°C. Use a soft sponge saturated with the solution and scrub the samples with a firm action.

Note 2: In case of conflict between accelerated weathering and natural weathering, natural weathering results take precedence.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 All materials supplied to this standard must comply with the requirements of GMW3001, **Rules and Regulations for Material Specifications.**

5.2 All materials supplied to this standard must comply with the requirements of GMW3059, **Restricted and Reportable Substances for Parts.**

6 Approved Sources

Engineering qualifications of an approved source are required for this standard. Only sources listed in the GM Materials File (i.e., GM Supply Power) under this standard number have been qualified by engineering as meeting the requirements of this standard.

For other GM locations, the responsible engineering group should be contacted to obtain the approved source in that individual country.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

APOPS GM Approved Paint on Parts Systems

ARD Appearance Requirements Drawing

EP Ethylene/propylene

EPDM Ethylene/propylene diene monomer

MIC Mold in Color

MFR Melt Flow Rate

MPa Megapascals

MVR Melt Volume Flow Rate

7.3 Safety. 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.

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Material per GMW15188

9 Release and Revisions

9.1 Release. This standard originated in February 2006, replacing GMP.E/P.157. It was first approved by Global Materials Engineering in March 2007. It was first published in November 2007.