



Polymethyl Methacrylate

1 Scope

1.1 Material Description. This specification describes material types of a transparent and integrally-colored Poly(methyl methacrylate) (PMMA) which are used in injection molded components. Code letter and number, in addition to GMW3013 guidelines that apply to this specification, are listed in Table 1.

1.1.1 Paintability. Approved paint systems that can be used on this material are listed, e.g., in the General Motors Approved Paint on Parts Systems (GM APOPS) database. General descriptions of the different group classifications is found in Table 5.

1.1.2 Types. The classification into groups is according to the different properties as described in Tables 1 and 2. Weathering requirements for natural and compounded colors are listed in Table 3.

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

1.3 Applicability. Typical applications include exterior and interior lenses, emblems, and other transparencies and second surface opaque materials. This material specification is not for use with first surface high gloss black exterior/interior trim applications.

2 References

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

2.1 External Standards/Specifications.

ASTM D523	ECE R19	ISO 75-2	ISO 4892-1
ASTM D955	ECE R23	ISO 179/1eU	ISO 4892-2
ASTM D1003	ECE R31	ISO 294-1	ISO 7724-1
ASTM E831	ECE R38	ISO 294-3	ISO 8257-2
ECE R1	ECE R48	ISO 294-4	ISO 11359-2
ECE R3	ECE R77	ISO 306	ISO 11469
ECE R4	ECE R87	ISO 527	SAE J576 (JUL 1991)
ECE R5	ECE R91	ISO 1133	SAE J1545
ECE R6	FMVSS 108	ISO 1183	SAE J2527
ECE R7	ISO 75-1	ISO 3167	

2.2 GM Standards/Specifications.

GMW3013	GMW3221	GMW14650	GMW15635
GMW3059	GMW3235	GMW15634	GMW16853
GMW3205	GMW14444		

2.3 Additional References.

TMC003 Material Safety Data Sheet guidance documents (available at www.gmsupplypower.com).

3 Requirements

3.1 Requirements on Test Specimens. Unless otherwise specified, injection molding of test specimens shall be accomplished per ISO 294-1, with the conditions for injection molding from ISO 8257-2. Test methods and specimen dimensions are also to be in accordance with ISO 8257-2 with the following additions: Use ISO 3167, Type 1A, thickness 4 mm, for tensile and flexural properties.

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

The values specified in Tables 1 and 2 shall be met by test specimens in natural/crystal, the values specified in Tables 3 and 4 shall be met by natural/crystal and integrally-colored test specimens, respectively. For integrally-colored grades where other additive systems (e.g., stabilizer) are used, the impact values shall not decrease more than 10% from the specified minimum value.

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

3.3 Requirements on Delivery. Important physical, mechanical and thermal properties that characterize the material are summarized in Tables 1, 2, 3 and 4.

Note: For each product, the requirements shall be documented using the latest Certification Template and Certification Statement according to GMW3013. The color shall be specified on drawings, in material specifications and otherwise.

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

3.5 Compound Properties. For compound property requirements, natural and integrally-colored, refer to Tables 1, 2, 3, and 4. The property values listed in Table 2 are a general range for each group listed and shall be considered as information only since the actual property values are resin grade specific. Recommended tolerances from the resin grade specific mean values are given for each property.

Full specification approval also requires general material properties as listed in 3.5.1.

3.5.1 Other Data. The minimum number of lots per test required is one in natural: Poisson's Ratio, Stress Strain Curve at +23 °C, +80 °C, -30 °C; Differential Scanning Calorimeter (DSC) Curve; and Infrared Spectroscopy Curve. It is preferred to include the Dynamic Mechanical Analysis (DMA) Curve.

3.6 Performance Requirements. Performance requirements, e.g., flammability, fogging, resistance to odor, and any other applicable component performance requirements shall be specified on part drawings or in component specifications.

All finished parts for Interior applications shall meet the requirements according to GMW14444.

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

All finished lenses/parts for Exterior Lighting must meet the legal requirements of Federal Motor Vehicle Safety Standards (FMVSS 108) and the Economic Commission for Europe (ECE) Regulatory Requirements - Lighting and Light Signaling Devices -- ECE R1, ECE R3, ECE R4, ECE R5, ECE R6, ECE R7, ECE R19, ECE R23, ECE R31, ECE R38, ECE R48, ECE R77, ECE R87, ECE R91.

Table 1: Compound Property Requirements - Type Codes (Natural)

Property	Standard Note 1	Unit	T1	T2/T2HF	T3	T4	T5
Density	ISO 1183	g/cm ³	1.19 ± 0.04	1.19 ± 0.04	1.18 ± 0.04	1.17 ± 0.04	1.15 ± 0.04
Tensile Modulus	ISO 527	MPa	≥ 3000	≥ 2500	≥ 2500	≥ 2000	≥ 1500
Tensile Stress at Break	ISO 527	MPa	≥ 40	≥ 50	≥ 50	≥ 45	≥ 30
Charpy Unnotched Impact Strength at +23 °C	ISO 179/1eU	kJ/m ²	≥ 10	≥ 10	≥ 10	≥ 30	≥ 40 ^{Note 3}
Charpy Unnotched Impact Strength at -30 °C	ISO 179/1eU	kJ/m ²	Report	Report	Report	Report	Report
Heat Deflection Temperature (HDT) 1.8 MPa	ISO 75-1, ISO 75-2 Method A Unannealed	°C	Report	Report	Report	Report	Report
Heat Deflection Temperature (HDT) 1.8 MPa	ISO 75-1, ISO 75-2 Annealed	°C	≥ 104	≥ 96	≥ 86	≥ 85	≥ 75

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