



Poly(Methyl Methacrylate)

1 Scope

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/Material Description. This specification describes material types of a transparent, translucent, and opaque integrally colored Poly(methyl methacrylate) (PMMA) which are used in injection form for molded components.

1.1.1 Paintability. Plastics used for painted applications are required to meet paint performance requirements for new plastic materials per GMW16172. Additionally, painted plastic parts are required to meet painted plastic parts performance requirements per GMW14797.

1.1.2 Types. The classification into types is according to the physical, mechanical and thermal properties as listed in Table 1.

1.1.3 Suffixes. Application suffixes and requirements for interior, exterior, and lens applications are found in Table 2.

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.

2 References

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

2.1 External Standards/Specifications.

ASTM D955	ISO 294-1	ISO 1183	ISO 11469
ASTM D1003	ISO 294-3	ISO 3795	SAE J576
ASTM E831	ISO 294-4	ISO 4892-1	SAE J1545
ISO 75-1	ISO 306	ISO 4892-2	SAE J1976
ISO 75-2	ISO 527	ISO 8257-2	SAE J2527
ISO 179-1/1eU	ISO 1133	ISO 11359-2	

2.2 GM Standards/Specifications.

GMW3013	GMW3232	GMW14444	GMW16853
GMW3059	GMW3235	GMW14650	
GMW3205	GMW3417	GMW14797	
GMW3221	GMW14270	GMW16172	

2.3 Additional References.

Plastic Submission Template

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:

- 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 Table 1 shall be met by test specimens in natural/crystal. The values specified in Table 2 shall be met by natural/crystal and integrally-colored test specimens. 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 Emissions Testing of Interior Materials and Parts. For all Code E designated parts per GMW14444, reference GMW16853 for emissions testing of interior materials and parts.

3.3 Material Requirements. Materials approved to this specification shall meet the requirements of GMW3013.

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

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.

No shipments shall be made by any supplier until representative initial production samples have been approved by the appropriate materials engineering department(s) as meeting the requirements of this specification.

3.5 Chemical Requirements. All parts manufactured from molding compounds shall be resistant to the media contacted at the place of use.

3.6 Compound Properties. For compound property requirements, natural and integrally-colored, refer to Table 1 and Table 2.

Full specification approval also requires general material properties as listed in 3.6.1.

3.6.1 Other Data. The minimum number of lots per test required for the following properties is one in natural:

- Poisson's ratio.
- Stress strain curve at multiple temperatures: -30 °C, +23 °C, and +85 °C. See the GMMPD tab on Plastic Submission Template for test parameters (contact specification owning group named in Section 6 for access).
- Coefficient of Thermal Expansion (CTE) data. See GMMPD tab on Plastic Submission Template for test parameters (contact specification owning group named in Section 6 for access).
- Differential Scanning Calorimetry (DSC) curve.
- Dynamic Mechanical Analysis (DMA) curve.
- Fourier Transform Infrared (FTIR) spectroscopy transmission and absorbance curve.

See the Acrylic tab on the Plastic Submission Template for the test procedures (contact specification owning group named in Section 6 for access).

Reference GMW3013 for all test procedures and parameters.

3.7 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 shall meet all applicable regulatory requirements, e.g., in the United States of America, Federal Motor Vehicle Safety Standard (FMVSS) FMVSS 108 and in Canada, Canadian Motor Vehicle Safety Standard (CMVSS), CMVSS 108.

3.8 All materials supplied to this standard must comply with GMW3059, **Restricted and Reportable Substances**, including the requirement to obtain a GM-approved International Material Data System (IMDS) submission.

Table 1: Compound Property Requirements: Type Codes (Natural/Crystal)

Property	Standard ^{Note 1}	Unit	T1	T2	T2HF	T3	T4	T5
Type Description	-	-	High Heat	Medium Heat	Medium Heat, High Flow	General Purpose	Impact Modified	High Impact Modified
Density	ISO 1183	g/cm ³	1.18 to 1.20	1.18 to 1.21	1.18 to 1.20	1.17 to 1.19	1.17 to 1.19	1.17 to 1.19
Tensile Modulus	ISO 527	MPa	≥ 2900	≥ 2900	≥ 2600	≥ 2650	≥ 2200	≥ 1700
Tensile Stress at Break	ISO 527	MPa	≥ 64	≥ 53	≥ 51	≥ 52	≥ 54	≥ 44
Charpy Unnotched Impact Strength at +23 °C	ISO 179-1/1eU	kJ/m ²	≥ 12	≥ 16	≥ 14	≥ 12	≥ 18	≥ 24
Charpy Unnotched Impact Strength at -30 °C	ISO 179-1/1eU	kJ/m ²	Report	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	Report
Heat Deflection Temperature (HDT) 1.8 MPa	ISO 75-1, ISO 75-2 Annealed	°C	≥ 97	≥ 97	≥ 96	≥ 86	≥ 80	≥ 74
Vicat Softening Temperature Heating Rate 50 °C/h Load 50 N	ISO 306	°C	≥ 107	≥ 102	≥ 103	≥ 95	≥ 89	≥ 83
Luminous Transmittance	ASTM D1003 Procedure B 3.2 mm thick sheet	%	≥ 90	≥ 91	≥ 91	≥ 91	≥ 90	≥ 89
Haze		%	≤ 1	≤ 1	≤ 1	≤ 1	≤ 3	≤ 3
Melt Mass Flow Rate (MFR) 230 °C/3.8 kg	ISO 1133	g/10 minutes	0.8 to 2.6	1.35 to 3.6	2.1 to 4.3	1.2 to 5.8	1.5 to 4.0	Report
Shrink, 48 h after molding	ISO 294-3, ISO 294-4 or ASTM D955	%	0.15 to 0.55	0.15 to 0.7	0.15 to 0.7	0.25 to 0.7	0.3 to 0.7	0.3 to 0.8
Coefficient of Linear Thermal Expansion (CLTE): Flow Direction	ASTM E831 or ISO 11359-2	10 ⁻⁶ mm/mm/°C	45 to 100	50 to 90	50 to 90	55 to 85	60 to 110	70 to 120

Note 1: Standard test specimen and test setup shall follow GMW3013.