



Light Deflection Polymethyl Methacrylate

1 Scope

1.1 Material Description. This specification describes a Poly(methyl methacrylate) (PMMA) material which appears crystal clear and completely transparent when unlit and uniformly illuminated with LED light sources aimed through the edge of the geometry. Light deflection particles are added to traditional grades of PMMA to achieve this appearance.

1.1.1 Paintability. Approved paint systems that can be used on this material are listed in the General Motors Approved Paint on Parts Systems (GM APOPS) database.

1.1.2 Types. The classification into groups, as referenced in Table 1, is according to the distance of uniform illumination through the sample light path length using a single Light Emitting Diode (LED) light source.

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

1.3 Applicability. Typical applications include exterior lighting light pipe, light guide, light curtain applications, as well as interior ambient lighting, emblems, and other specialty applications.

2 References

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

2.1 External Standards/Specifications.

ASTM D955	ECE R 19	ISO 75-1	ISO 1183
ASTM D1003	ECE R 23	ISO 75-2	ISO 3167
ASTM E831	ECE R 31	ISO 179/1eU	ISO 4892-1
ECE R 1	ECE R 38	ISO 294-1	ISO 4892-2
ECE R 3	ECE R 48	ISO 294-3	ISO 8257-2
ECE R 4	ECE R 77	ISO 294-4	ISO 11359-2
ECE R 5	ECE R 87	ISO 306	ISO 11469
ECE R 6	ECE R 91	ISO 527	SAE J576 JUL91
ECE R 7	FMVSS 108	ISO 1133	SAE J2527

2.2 GM Standards/Specifications.

GMW3013	GMW3221	GMW14444	GMW15635
GMW3059	GMW3235	GMW14650	GMW16853
GMW3205	GMW14124	GMW15634	

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.

The values specified in Tables 1 and 2 shall be met by test specimens in natural/crystal.

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.

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

3.4 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.

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

3.6 Compound Properties. For compound property requirements, refer to Tables 1 and 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 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.

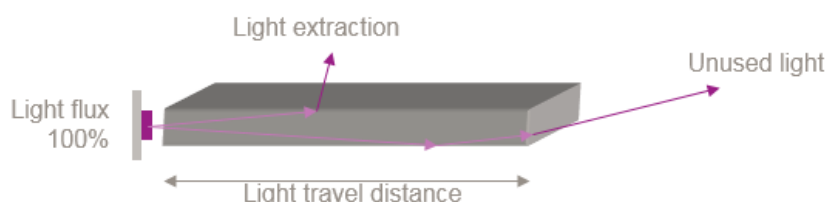
3.7 Performance Requirements. Performance requirements, e.g., flammability and any other applicable component performance requirements shall be specified on part drawings or in component specifications.

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 R 1, ECE R 3, ECE R 4, ECE R 5, ECE R 6, ECE R 7, ECE R 19, ECE R 23, ECE R 31, ECE R 38, ECE R 48, ECE R 77, ECE R 87, ECE R 91.

**Table 1: Material Classifications by Light Travel Distance
(Natural Using White Light Emitting Diode (LED))**



Property	Standard	Unit	LD12	LD24	LD48	LD96
Light Travel Distance LED single side	Note 1	cm	Up to 6	6 to 12	12 to 24	24 to 48
Light Travel Distance LED double side	Note 1	cm	Up to 12	12 to 24	24 to 48	48 to 96
Luminous Transmittance	ASTM D1003 Procedure B 3.2 mm thick sheet	%	90	91	91	92
Haze		%	< 8	< 4	< 2	< 1

Note 1: Proprietary test method. From the entrance of the light into the light guide to more distant locations from the LED, the luminance is always declining. The homogeneity is defined as the minimum luminance divided by the average luminance. For the light guide design, a compromise between extraction efficiency and homogeneity needs to be determined. Close development with the resin supplier is required for each application. Variations might occur when using complex shaped light guides.