



Polycarbonate - Weather Resistant

1 Scope

1.1 Material Description. This specification describes material types of polycarbonate copolymer that offer all the attributes of standard polycarbonate (PC) resin with enhanced weather resistance without the aid of a protective coating. Code numbers distinguish between different levels of weatherability based on color formulation and the applications requirements. Two resin melt flow rates are available. For high flow grades, a suffix indicating low molecular weight shall be added, see Table 3. This specification is based on GMW3013 per ISO 7391-1/2 recommendations.

1.1.1 Paintability. Approved decorative 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 standard properties are described in Table 1, the different levels of weather resistance properties are described in Table 2 and resin melt flow options are listed in Table 3. If no type designation is defined, Type 1 (T1), of highest level of weatherability, and standard resin melt flow, applies as the default standard.

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

1.3 Typical Applications. Typical applications include interior and exterior applications that are exposed to sunlight without an Ultraviolet (UV) protective coating. Not intended for use in optical lens applications for regulated exterior lighting, refer to GMW16729.

2 References

2.1 External Standards/Specifications.

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

ASTM D523	ISO 188	ISO 1133	ISO 7391-2
ASTM D955	ISO 294-1	ISO 1183	ISO 7724-1
ASTM D1003	ISO 294-3	ISO 3167	ISO 11359-2
ASTM D3763	ISO 294-4	ISO 4892-1	ISO 11469
ASTM E831	ISO 306	ISO 4892-2	SAE J1545
ISO 75-1	ISO 527	ISO 6603-1	SAE J1976
ISO 75-2	ISO 527-1	ISO 6603-2	SAE J2527
ISO 179/1eA	ISO 527-2	ISO 7391-1	

2.2 GM Standards/Specifications.

GMW3013	GMW3221	GMW14650	GMW16729
GMW3059	GMW14444		

2.3 Additional References.

- GM APOPS Database
- GM Appearance Engineering Database
- 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 7391-2. Test methods and specimen dimensions are also to be in accordance with ISO 7391-2 with the following additions: use ISO 3167, Type 1A, thickness 4 mm for tensile and flexural properties.

All tests shall be performed on specimens 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 noted.

The values specified in Table 1, 2 and 3 shall be met by test specimens in natural and black. Integrally colored grades shall be tested to Type 1 requirements listed in Table 2, weatherability requirements, regardless of final approval type. Integrally colored approvals shall be recorded in the GM Appearance Engineering Database. Where other additive systems (e.g., stabilizers) are used; the impact values and impact after heat aging shall not decrease more than 10% from the specified minimum value.

All types may be formulated with internal mold release, provided the physical properties of the compound remain within the specified limits and the mold release does not interfere with the appearance or function of the part to be molded, including any post-molding decorative process.

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, thermal, and weather resistance properties that characterize the material are summarized in Table 1, Table 2 and Table 3.

Note: For each product, the requirements shall be documented using the latest Certification Template and Certification Statement according to GMW3013.

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. Full specification approval requires the properties defined in Table 1, Table 2, Table 3 and in 3.5.1. The values listed in the compound property tables (Table 1, Table 2, Table 3) shall represent the minimum three (3) sigma calculated values.

3.5.1 Other Data. The minimum number of lots per test required is one in natural for: Poisson's Ratio, Stress Strain Curve at +23 °C, +120 °C, -30 °C; Differential Scanning Calorimeter (DSC) Curve; Multiaxial Impact Curve, and Infrared Spectroscopy Curve. It is preferred to include Dynamic Mechanical Analysis (DMA) Curve.

3.6 Performance Requirements. Additional 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.

Table 1: Compound Property Requirements (Natural or Black)

Property	Standard ^{Note 1}	Unit	T1 and T2
Density	ISO 1183	g/cm ³	1.20 to 1.24
Tensile Modulus	ISO 527-1/ISO 527-2	MPa	≥ 2000
Tensile Stress at Yield	ISO 527	MPa	≥ 60
Tensile Properties after Heat Aging for 1000 h (90 °C) ^{Note 2}	ISO 188	Retention of initial properties	≥ 75%
Charpy Notched Impact at 23 °C	ISO 179/1eA	kJ/m ²	≥ 6
Charpy Notched Impact at -40 °C	ISO 179/1eA	kJ/m ²	≥ 3.5
Charpy Notched Impact at 23 °C after Heat Aging for 1000 h (90 °C)	ISO 188	Retention of initial properties	≥ 75%
Multiaxial Impact at 23 °C, Total Energy	ASTM D3763, Speed = 6.6 m/s Specimen C: 100 mm × 100 mm × 3.2 mm or ISO 6603-1 and ISO 6603-2 Speed = 4.4 m/s Diameter: 60 mm × 2 mm or 60 mm × 60 mm × 2 mm	J	≥ 50
Vicat Softening Temperature Heating rate 50 °C/h, Load 50 N	ISO 306	°C	≥ 130
Heat Deflection Temperature Under Load/Method B (HDT/B) 0.45 MPa	ISO 75-1 ISO 75-2	°C	Report
Heat Deflection Temperature Under Load/Method A (HDT/A) 1.8 MPa	ISO 75-1 ISO 75-2	°C	≥ 111
Mold Shrink (information only) ^{Note 3}	ISO 294-3, ISO 294-4 or ASTM D955 Required plaque size ^{Note 4} 101.6 mm × 152.0 mm × 3.2 mm (4 in × 6 in × 0.125 in)	%	Report ^{Note 5}
Coefficient of Linear Thermal Expansion (CLTE) - Flow Direction (information only) ^{Note 3}	ASTM E831 or ISO 11359-2	10 ⁻⁶ mm/mm/°C	50 to 80
Luminous Transmittance ^{Note 6}	ASTM D1003 Procedure B, 3.2 mm thick	%	≥ 84
Haze ^{Note 6}	ASTM D1003 Procedure B, 3.2 mm thick	% maximum	≤ 2
Emission Testing of Interior Materials For initial approval, test one lot in black and one lot in natural	GMW16853		
Odor	GMW3205-B3	Rating	≥ 6