



Polyamide 6 - Carbon Fiber Reinforced, Heat Stabilized, Weatherable, Compression Moldable

1 Scope

1.1 Material Description. This specification describes Carbon Fiber (CF) reinforced, heat stabilized, weatherable Polyamide 6 (PA6), i.e., Nylon 6, which is used in compression moldable components.

1.2 Symbols. The material abbreviations according to ISO 11469 are shown in Table 1.

1.3 Applicability. Typical applications include the following: Composite pickup boxes and other structural parts.

1.4 Remarks. The classification into groups is according to the different ranges of carbon fiber content. Additional carbon ranges will be added as needed.

2 References

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

2.1 External Standards/Specifications.

ASTM D3410	ISO 188	ISO 4892-1/2	JIS K7164
ASTM D6869	ISO 527-4	ISO 6603-1/2	SAE J1545
ASTM D695	ISO 1172	ISO 11357-3	SAE J1976
ASTM E831	ISO 1183	ISO 11359-2	SAE J2527
ISO 75-1/2	ISO 2577	ISO 11469	
ISO 179/1eA	ISO 3146	ISO 15512	

2.2 GM Standards/Specifications.

GMW3013	GMW3221	GMW14270	GMW14335
GMW3059			

3 Requirements

Materials approved to this specification shall meet the requirements of GMW3013 General Requirements of Certification Testing and Approval of Plastic Materials.

3.1 Requirements on Test Specimens. Reference GMW3221. Unless otherwise specified, all specimens for testing shall be obtained from molded plaques with a thickness of 2.5 mm $\pm$ 0.5 mm. The specimens shall be molded using temperatures and pressures typical of those used in production. Tensile test bars shall conform to the requirements of JIS K7164.

All values indicated herein are based on material considered to be in the dry-as-molded state with moisture content of 0.2% maximum (ASTM D6869, ISO 15512 Method A or Method B, or GMW14335). If needed, the test specimens shall be dried at 120 °C for 48 h and sealed in moisture proof containers.

In addition, tests specified at temperatures below or above 23 °C $\pm$ 2 °C shall be conducted at the specified temperature using specimens conditioned at the specified temperature for 4 h minimum.

The values specified in Table 1 shall be met by test specimens in natural, black or in a standard sampled color if natural and black are not available. The values specified in Table 2 shall be met by a typical exterior color for approval to the specification and/or test specimens in specific colors as required during color development.

3.2 Requirements on Delivery. Important physical, mechanical and thermal properties that characterize the material are summarized in Table 1 and Table 2. The color shall be specified on drawings, in material specifications and otherwise.

3.3 Compound Properties. See Table 1 and Table 2. The following are also required for full standard approval. The minimum number of lots per test required for the following properties is one in natural: Poisson's Ratio, Coefficient of Linear Thermal Expansion (CLTE), mold shrinkage, stress strain curve at multiple temperatures, e.g., -30 °C, 23 °C, 85 °C. See GMW3013 for all test procedures and parameters.

3.4 Performance Requirements. Performance requirements shall be specified on part drawings or in component specifications. All parts manufactured from molding components shall be resistant to the media contacted, such as aliphatic and aromatic hydrocarbons, fuels, lubricants, oils, greases and alcohols, at the place of use.

3.5 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 Properties (Natural and Black)

Property ^{Note 1}	Standard	Unit	Nominal Carbon Fiber Content	
			35% Volume Fraction (Vf) GMW17180P-PA6-CF35	25% Vf GMW17180P-PA6-CF25
			Value	Value
International Organization for Standardization (ISO) Symbol	ISO 11469	-	>PA6-CF35<	>PA6-CF25<
Carbon Fiber Content	ISO 1172, inert atmosphere required	% by volume	35 ± 3	25 ± 4
Density	ISO 1183	g/cm ³	Target Range 1.32 to 1.40	Target Range 1.26 to 1.33
Moisture Content	ISO 15512, Method A or Method B or GMW14335	%	≤ 0.2	≤ 0.2
Tensile Modulus	ISO 527-4, test speed 2 mm/minute, between 0.05 and 0.25% strain	GPa	≥ 23 Note: Machine Direction (MD)/Transverse Direction (TD), r ≤ 1.4	≥ 14 Note: MD/TD, r ≤ 1.4
Tensile Stress at Break	ISO 527-4, test speed 2 mm/minute	MPa	≥ 300 Note: MD/TD, r ≤ 1.3	≥ 184 Note: MD/TD, r ≤ 1.3
Tensile Stress at Break after Heat Aging, 1000 h at 160 °C	ISO 527-4, ISO 188	% Retention	≥ 75	≥ 75
Tensile Strain at Break	ISO 527-4	%	≥ 1.2	≥ 1.1