GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW16582

Polyamide 6 - Glass Fiber Reinforced, Heat Stabilized, UV Stabilized

1 Scope

1.1 Material Description. This specification describes glass fiber reinforced, heat stabilized, Ultraviolet (UV) stabilized, injection moldable Polyamide 6 (Nylon 6). Resins approved to this specification should contain organic heat stabilizers.

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

1.3 Applicability. Interior color matched components, e.g., seat handles, bezels, sunroof components.

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

2 References

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

2.1 External Standards/Specifications.

ASTM E831	ISO 527	ISO 11357-3	SAE J1545
ISO 75-2	ISO 1183	ISO 11359-2	SAE J1885
ISO 179-1/1eA	ISO 3146	ISO 11469	
ISO 188	ISO 3451	ISO 15512	
ISO 294	ISO 3795	ISO 16396-2	

2.2 GM Standards/Specifications.

GMW3013	GMW3232	GMW14270	GMW15634
GMW3059	GMW3235	GMW14334	GMW16853
GMW3205	GMW3417	GMW14335	
GMW3221	GMW14162	GMW14444	

3 Requirements

3.1 Requirements on Test Specimens. Materials approved to this specification shall meet the requirements of GMW3013.

Unless otherwise specified, injection molding of test specimens shall be accomplished per ISO 294 with the conditions for injection molding from ISO 16396-2. Test methods and specimen dimensions are also to be in accordance with ISO 16396-2.

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. Immediately after molding, per ISO 16396-2, specimens shall be sealed in moisture-proof containers and stored at 23 °C ± 2 °C for at least 24 h. All tests shall be performed on unannealed specimens immediately after removal from the containers in a controlled atmosphere per GMW3221, Code A, unless otherwise specified. In addition, tests specified at temperatures below or above 23 °C ± 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 or black are not available. The values specified in Table 2 shall be met by four typical interior colors, black, gray, tan/neutral, and either red or blue, for approval to the specification and by test specimens in specific

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colors as required during color development. See the Polyamide tab on the Plastics Submission Template and GMW3013 for test details and parameters.

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 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.

3.4 Compound Properties (Natural, Black and Integrally Colored). See Table 1 and Table 2. The following are also required for full approval. The minimum number of lots per test required is one unless otherwise specified. See the Polyamide tab on the Plastics Submission Template and GMW3013 for test details and parameters.

- Poisson's Ratio
- Stress/strain data points and curves at the following temperatures: -30 °C, +23 °C, +85 °C, +110 °C, +125 °C, +150 °C

Note: See GMMPD tab on Plastics Submission Template (located in GM SupplyPower) for test details.

- Coefficient of Linear Thermal Expansion (CLTE) data

Note: See GMMPD tab on Plastics Submission Template (located in GM SupplyPower) for test details.

- Differential Scanning Calorimetry (DSC) curve
- Fourier Transform Infrared (FTIR) spectroscopy curve
- Mold shrinkage

3.5 Initial Source Approval. 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.

3.6 Requirements on Parts. Parts of this material type shall have a water content at delivery, when tested per GMW14335 or ISO 15512, Method A or Method B, of at least:

- 1.5% by mass for material types reinforced up to 20% by mass.
- 1.0% by mass for material types reinforced over 20% by mass.

Deviations from this shall be specifically indicated on the part drawings.

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

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 Properties (Natural and Black)

Property [Note 1]	Standard	Unit	Nominal Glass Content					
			15%	25%	30%	35%	50%	60%
			Value	Value	Value	Value	Value	Value
International Organization for Standardization (ISO) Symbol	ISO 11469		>PA6-GF15<	>PA6-GF25<	>PA6-GF30<	>PA6-GF35<	>PA6-GF50<	>PA6-GF60<
Ash	ISO 3451	% by mass	13 to 17	22 to 28	27 to 33	32 to 38	47 to 53	57 to 63

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Property Note 1	Standard	Unit	Nominal Glass Content					
			15%	25%	30%	35%	50%	60%
			Value	Value	Value	Value	Value	Value
Density	ISO 1183	g/cm^3	Target Range 1.20 to 1.26	Target Range 1.28 to 1.34	Target Range 1.32 to 1.38	Target Range 1.37 to 1.43	Target Range 1.53 to 1.59	Target Range 1.66 to 1.72
Moisture Content	ISO 15512 Method A or Method B or GMW14335	%	≤ 0.2					
Tensile Modulus	ISO 527	MPa	5000 to 6750	7250 to 8750	8500 to 11 000	9500 to 12 500	14 000 to 17 000	17 500 to 24 000
Tensile Stress at Break	ISO 527	MPa	≥ 110	≥ 150	≥ 150	≥ 175	≥ 200	≥ 225
Tensile Stress at Break after Heat Aging Note 2	ISO 527 ISO 188	% Retention	≥ 75					
Strain at Break	ISO 527	%	≥ 2.5	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0	≥ 1.5
Notched Charpy Impact Strength at +22 °C at -30 °C	ISO 179-1/1eA	kJ/m^2	≥ 4 ≥ 3	≥ 5 ≥ 4	≥ 6 ≥ 5	≥ 7 ≥ 6	≥ 12 ≥ 9	≥ 11 ≥ 10
Notched Charpy Impact Strength after Heat Aging Note 2	ISO 179-1/1eA ISO 188	% Retention	≥ 75					
Melting Temperature	ISO 3146 or ISO 11357-3	°C	Target Range 210 to 225	Target Range 210 to 225	Target Range 210 to 225	Target Range 210 to 225	Target Range 210 to 225	Target Range 210 to 225
Heat Deflection Temperature Under Load, 1.8 MPa	ISO 75-2	°C	≥ 185	≥ 190	≥ 195	≥ 200	≥ 200	≥ 200
Emission Testing of Interior Materials: For initial approval, test one lot in black.	GMW16853	-	-					
Odor	GMW3205-B3	Rating	≥ 6					
Fogging	GMW3235-B-Y2-T2	mg	Requirements see GMW16853					

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