



## Polyamide 6 - UV Stabilized, Heat Stabilized

### 1 Scope

**1.1 Material Description.** This standard covers the properties of ultraviolet (UV) stabilized, heat stabilized, injection moldable polyamide 6 (nylon 6).

**1.2 Symbols.** The material abbreviation according to ISO 11469 is >PA6<.

**1.3 Applicability.** Typical applications include visible interior components that require higher strength and heat resistance.

### 2 References

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

#### 2.1 External Standards/Specifications.

|             |            |             |           |
|-------------|------------|-------------|-----------|
| ASTM E831   | ISO 294    | ISO 3146    | ISO 11469 |
| ISO 75-2    | ISO 527    | ISO 3795    | ISO 15512 |
| ISO 179/1eA | ISO 1183   | ISO 11357-3 | SAE J1545 |
| ISO 188     | ISO 1874-2 | ISO 11359-2 |           |

#### 2.2 GM Standards/Specifications.

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

### 3 Requirements

**3.1 Requirements on Test Specimens.** Reference GMW3221. Unless otherwise specified, injection molding of test specimens shall be accomplished per ISO 294 with the conditions for injection molding from ISO 1874-2. Test methods and specimen dimensions are also to be in accordance with ISO 1874-2.

All values indicated herein are based on material considered to be in the dry-as-molded state with moisture content of 0.2% maximum (ISO 15512 Method A or B, or GMW14335). Immediately after molding, per ISO 1874-2, specimens shall be sealed in moisture-proof containers and stored at  $22\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$  for at least 24 h. All tests shall be performed on unannealed specimens immediately after their removal from the containers in a controlled atmosphere per GMW3221, Code A, unless otherwise specified. In addition, tests specified at temperatures  $< 22\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$  or  $> 22\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$  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.

**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 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 (for example  $-30\text{ }^{\circ}\text{C}$ ,  $23\text{ }^{\circ}\text{C}$ ,  $110\text{ }^{\circ}\text{C}$ ). 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 compounds shall be resistant to the media they

contact, such as aliphatic and aromatic hydrocarbons, fuels, lubricants, oils, greases and alcohols, at their places of use.

**Table 1: Compound Properties (Natural and Black)**

| Property <sup>Note 1</sup>                                                                        | Standard                                                                                                                       | Unit                      | Value                                                    |
|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------------|
| ISO Symbol                                                                                        | ISO 11469                                                                                                                      | -                         | >PA6<                                                    |
| Density                                                                                           | ISO 1183                                                                                                                       | g/cm <sup>3</sup>         | Target Range<br>1.11 to 1.15                             |
| Moisture Content                                                                                  | ISO 15512, Method A or B or GMW14335                                                                                           | %                         | ≤ 0.2                                                    |
| Tensile Modulus                                                                                   | ISO 527, 1 mm/minute                                                                                                           | MPa                       | 2300 to 3300                                             |
| Tensile Stress at Break                                                                           | ISO 527, 50 mm/minute                                                                                                          | MPa                       | ≥ 70                                                     |
| Tensile Stress at Break after Heat Aging, 1000 h at 110 °C                                        | ISO 527, 50 mm/minute<br>ISO 188                                                                                               | % Retention               | ≥ 75                                                     |
| Strain at Yield                                                                                   | ISO 527, 50 mm/minute                                                                                                          | %                         | ≥ 3.5                                                    |
| Strain at Break                                                                                   | ISO 527, 50 mm/minute                                                                                                          | %                         | ≥ 20                                                     |
| Notched Charpy Impact Strength at +22 °C<br>at -30 °C                                             | ISO 179/1eA                                                                                                                    | kJ/m <sup>2</sup>         | ≥ 3.5<br>≥ 1.5                                           |
| Notched Charpy Impact Strength after Heat Aging, 1000 h at 110 °C, Notch specimens prior to aging | ISO 179/1eA<br>ISO 188                                                                                                         | % Retention               | ≥ 75                                                     |
| Melting Temperature                                                                               | ISO 3146 or<br>ISO 11357-3                                                                                                     | °C                        | Target Range<br>215 to 230                               |
| Heat Deflection Temperature Under Load, 1.8 MPa                                                   | ISO 75-2                                                                                                                       | °C                        | ≥ 50                                                     |
| Coefficient of Linear Thermal Expansion (CLTE)<br>Parallel to Flow<br>Perpendicular to Flow       | ASTM E831 or<br>ISO 11359-2, Thermal Mechanical Analysis (TMA), Mean secant value over the temperature range -30 °C to +160 °C | 10 <sup>-6</sup> mm/mm/°C | Target Value<br>≤ 100<br>≤ 130                           |
| Emission Testing of Interior Materials:<br>For initial approval, test 1 lot in black.             | GMW16853                                                                                                                       | -                         | -                                                        |
| - Odor                                                                                            | GMW3205-B3                                                                                                                     | Rating                    | ≥ 6                                                      |
| - Fogging                                                                                         | GMW3235-B-Y1-T2                                                                                                                | mg                        | Requirements: See GMW16853                               |
| - Emissions                                                                                       | GMW15634<br>VOC Value <sup>Note 2</sup><br>SVOC Value <sup>Note 2</sup>                                                        | µg/g<br>µg/g              | Requirements: See GMW16853<br>Requirements: See GMW16853 |

**Note 1:** Standard test specimen and test setup should follow GMW3013.

**Note 2:** VOC = Volatile Organic Compound, SVOC = Semi-Volatile Organic Compound.