GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW17938

Polyphthalamide - Heat Stabilized, Impact Modified, Extrusion Grade

1 Scope

1.1 Material Description. This standard covers the properties of an unfilled, heat stabilized, plasticized, polyphthalamide (PPA), based on polyamide 11, which is either extruded or injection molded to form component.

1.2 Symbols. The material abbreviation according to ISO 11469 is >PPA-I<.

1.3 Applicability. Typical applications include Positive Crankcase Ventilation (PCV) tubes that require increased temperature resistance.

2 References

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

2.1 External Standards/Specifications.

ISO 75-1	ISO 294	ISO 1133	ISO 11357
ISO 179	ISO 527-1/2	ISO 1183	ISO 11469
ISO 188	ISO 868	ISO 1874-2	ISO 15512

2.2 GM Standards/Specifications.

GMW3013	GMW3221	GMW14270	GMW14335
GMW3059			

3 Requirements

3.1 Requirements on Test Specimens. Reference GMW3221.

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

Unless otherwise specified, injection molding of test specimens shall be accomplished per ISO 294 with the conditions for injection molding from 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, Method B, or GMW14335). Immediately after molding, specimens shall be sealed in moisture-proof containers and stored at 23 °C ± 2 °C for at least 24 h prior to test as specified in ISO 1874-2. All tests shall be performed on un-annealed 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 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 minimum values specified in the property tables must be met by test specimens in natural, black, or in a standard sampled color if natural or black are not available.

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3.2.1 Compound Properties (Natural, Black and Integrally Colored). See Table 1. The following are also required for full standard approval:

- Poisson's Ratio, Coefficient of Linear Thermal Expansion (CLTE).
- Mold Shrinkage, Stress Strain Curve at multiple temperatures (for example -30 °C, +23 °C, +120 °C, +170 °C, +200 °C).
- Shear Modulus Curve; Differential Scanning Calorimetry (DSC) Curve.
- Infrared Spectroscopy Curve. See GMW3013 for the test procedures.

3.3 Performance Requirements. Performance requirements shall be specified on part drawings or in component specifications.

Table 1: Compound Properties (Natural and Black)

Property	Standard	Units	Value
Density	ISO 1183	g/cm^3	Target Range 1.00 to 1.06
Hardness	ISO 868 Instantaneous	Shore D	72 ± 5
Tensile Modulus	ISO 527-1/2	MPa	715 to 1315
Tensile Stress at Break	ISO 527-1/2	MPa	≥ 26
Tensile Stress at Break after Heat Aging Note 1	ISO 188 ISO 527	% Retention	≥ 100
Tensile Strain at Break	ISO 527-1/2	%	≥ 100
Notched Charpy Impact Strength At +23 °C At -30 °C	ISO 179, Method 1eA	kJ/m^2	≥ 75.0 ≥ 13.0
Notched Charpy Impact after Heat Aging Note 2	ISO 188 ISO 179, Method 1eA	% Retention	≥ 75
Heat Deflection Temperature under Load 0.45 MPa	ISO 75-1/2	°C	≥ 72
Melting Point	ISO 11357	°C	≥ 250
Melt Flow Rate	ISO 1133	cm^3/10 minutes	1.5 to 5.0

Note 1: Specimens tested for tensile stress at B\break to ISO 527 after heat aging 1000 ± 5 h at +160 C° ± 5 °C per ISO 188 Method A (air oven method) shall have a minimum of 75% retention relative to unaged specimens tested concurrently.
Note 2: Specimens tested for Notched Charpy Impact per ISO 179, Method 1eA after heat aging 1000 ± 5 h at +160 °C ± 5 °C per ISO 188 Method A (air oven method) shall have a minimum of 75% retention relative to unaged specimens tested concurrently. Charpy impact specimens shall be notched prior to aging.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

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