GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW16363

Polyphthalamide - Glass Fiber Reinforced, Impact Modified, Heat Stabilized, Transmission Fluid Resistant, Hot Water Moldable

1 Scope

1.1 Material Description. This standard covers properties of various types of glass fiber reinforced, impact modified, heat stabilized polyphthalamide (PPA), injection moldable, hot water moldable.

1.2 Symbols. The material abbreviations according to SAE J1344, ISO 11469 and ISO 1043 are shown in Table 1.

1.3 Applicability. Typical applications include the following: Fluid connectors, transmission thrust washers.

1.4 Remarks. The classification into groups is according to the different ranges of glass fiber content. See Replaced Specifications table at the end of Section 9.

2 References

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

2.1 External Standards/Specifications.

ASTM D6869	ISO 527-1/2	ISO 3451	ISO 15512
ISO 75	ISO 1043	ISO 3795	ISO 22088-3
ISO 179/1eA	ISO 1183	ISO 6721	SAE J1344
ISO 188	ISO 1874-1/2	ISO 11357-3	
ISO 294	ISO 3146	ISO 11469	

2.2 GM Standards/Specifications.

GMW3013	GMW3221	GMW14335	GMW16652
GMW3059	GMW3232	GMW16444	

3 Requirements

3.1 Requirements on Test Specimens.

Unless otherwise specified, injection molding of test specimens shall be accomplished per ISO 294 with the conditions for injection molding from ISO 1874-1.

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 B, or GMW14335). Immediately after molding, specimens shall be sealed in moisture-proof containers and stored at 22 °C ± 3 °C for at least 24 h prior to test as specified in ISO 1874-2. 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 below or above 22 °C ± 3 °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.

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.

3.3 Compound Properties (Natural and Black). See Table 1. The following are also required for full standard approval. The minimum number of lots per test required is one in natural: Poisson's Ratio, Differential Scanning

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Calorimetry Curve, Infrared Scan, Coefficient of Linear Thermal Expansion (CLTE), and Mold Shrinkage. See GMW3013 and the relevant template for all test procedures and parameters.

3.4 Heat Aging Requirements. The materials approved to this standard shall meet the tensile and impact property retention requirements specified in Table 1. Specimens may be fully supported during heat aging. Alterations shall not be made inside the length L specified in ISO 527-1/2 (the initial distance between grips) to suspend specimens.

3.5 Requirements for Transmission Fluid Resistance. The tensile and impact properties of the material in this standard shall meet transmission fluid resistance requirements specified in Table 1. Test fluid shall be Dexron® VI in accordance with GMW16444.

Test requirements are as follows:

a. Samples shall be aged in suitable vented vessels.

b. Minimum fluid to sample ratio shall be 150 mL to three (3) specimens.

c. A minimum of five (5) specimens shall be tested per condition.

d. Samples shall have insignificant contact with the vessel. For tensile tests, contact is allowed outside length L specified in ISO 527-1/2.

e. Alterations shall not be made inside the length L specified in ISO 527-1/2 to suspend specimens.

f. For proof tests at 22 °C ± 5 °C, samples shall be brought to room temperature in the aging fluid or in fresh transmission fluid (for room temperature testing).

g. Samples may be tested within 30 minutes without conditioning. After 30 minutes, samples must be stored in a conditioned environment (22 °C ± 5 °C and 50% ± 5% Relative Humidity (RH)) for up to 14 days. Samples shall then be wiped with filter paper or a lint free cloth before testing.

h. Tensile stress at break and elongation at break for environmental stress cracking resistance shall be determined using ISO 527-1/2 with Type 1 specimens.

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

Table 1: Compound Properties (Natural and Black)

			Nominal Glass Fiber Reinforcement Percentage	
			15%	**30%**
Property	Standard	Units	Range	Range
SAE Symbol	SAE J1344	-	>PPA-I-GF15<	>PPA-I-GF30<
ISO Symbol	ISO 11469 ISO 1043	-	PA6T/66-I-GF15	PA6T/66-I-GF30
Ash	ISO 3451	%	12 to 18	27 to 32
Density	ISO 1183	g/cm^3	Target Range 1.15 to 1.25	Target Range 1.30 to 1.40
Glass Transition (Dynamic Mechanical Analysis (DMA))	ISO 6721 or equivalent test methods 5 °C/minute, 1 Hz	°C	Report value and curve	
Tensile Modulus	ISO 527-1/2 Type 1 Specimen	MPa	4400 to 6500	7500 to 10 000
Tensile Stress at Break	ISO 527-1/2 Type 1 Specimen	MPa	≥ 100	≥ 150
Tensile Elongation at Break	ISO 527-1/2 Type 1 Specimen	%	≥ 3.2	≥ 2.3

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