



Poly(Phenylene Sulfide) – 40% Glass Fiber Reinforced

1 Scope

1.1 Material Description. This standard specifies requirements of injection moldable 40% glass fiber reinforced poly(phenylene sulfide) for various applications.

1.2 Symbols. The material abbreviation according to ISO 1043 is PPS-GF40 and to ISO 11469 is >PPS-GF40<.

1.3 Applicability. Engine Coolant Valves, Transmission Pistons and Structure Components, Fuel Pump Cover, Hot Air Duct, Halogen Lamp Socket, Ashtray, Electrical Connectors including high temperature high voltage connectors.

1.4 Remarks. The standard specifies PPS-GF40 for three (3) categories:

- General purpose, GMW17521P-PPS-GF40.
- Hydrolysis resistant, GMW17521P-PPS-GF40HR, for demanding coolant applications.
- Electrical insulating grade, GMW17521P-PPS-GF40E, for high temperature high voltage electrical insulation.

2 References

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

2.1 External Standards/Specifications.

ASTM E831	ISO 75-2	ISO 3146	ISO 11469
ASTM E1252	ISO 179-1	ISO 3451-1	ISO 23529
IEC 60112	ISO 294	ISO 6721	UL 94
IEC 60216-4-1	ISO 527	ISO 11357	
IEC 60243-1	ISO 1043	ISO 11358-1	
IEC 60695-11-10	ISO 1183	ISO 11359-2	

2.2 GM Standards/Specifications.

GMW3013	GMW3221	GMW15468	GMW18109
GMW3059	GMW14270		

2.3 Additional References. Not applicable.

3 Requirements

3.1 Requirements on Test. Specimens. Unless otherwise mutually agreed, test specimens shall be injection molded in accordance to ISO 294 with the conditions for injection molding per the resin manufacturer. Specimens shall be conditioned in accordance to GMW3221, Code A for at least 40 h prior to tests.

3.2 Requirements on Materials. The material under consideration shall fulfill the requirements defined in this specification and the accompanying submission template with test methods and lot requirements defined in GMW3013.

3.2.1 Material Properties. The material approved under this specification shall demonstrate properties defined in Table 1.

3.2.2 Heat Resistance Requirements. The material shall demonstrate mechanical properties specified in Table 1 after heat aging at 220 °C for 1000 h. The aging oven and sample arrangements shall comply with IEC 60216-4-1. The specimens shall be hung vertically in the oven supported on non-essential locations of the

sample. The mechanical properties after 168 h of heat aging are also recommended to be measured for references.

3.2.3 Engine Coolant Resistance Requirements. For materials used for demanding coolant applications, the material shall also possess coolant resistance defined in Table 2 when aged in accordance to GMW15468 for 1000 h in addition to Table 1 requirements. The material shall be coded with GMW17521P-PPS-GF40HR for its hydrolysis resistance once approved.

3.2.4 Electrical Insulation Properties. For materials to be used for high temperature high voltage electrical insulation, the material shall also possess insulation properties meeting the requirements specified in Table 3 in addition to Table 1 requirements. The material shall be coded with GMW17521P-PPS-GF40E once approved. The volumetric resistivity and dielectric strength shall be tested to GMW18109 and IEC 60243-1, respectively, with mutually agreed sample and electrode arrangements. The comparative tracking index shall be tested in accordance to IEC 60112.

3.2.5 Material Properties for Finite Element Analysis (FEA). Tensile properties of the material shall be measured at the temperatures -40 °C or -30 °C, 23 °C, 80 °C or 85 °C, 110 °C, 125 °C or 130 °C, 150 °C, 180 °C, 200 °C, and 225 °C in accordance to General Motors Materials Property Database (GMMPD) requirements in the submission template accompanying this standard. The specimens shall be equilibrated at the testing temperature prior to the test in accordance to ISO 23529. Submit stress-strain data in accordance to GMMPD format in the accompanying template.

Coefficient of Linear Thermal Expansion (CLTE) shall be measured in accordance to ISO 11359-2 for both flow and cross-flow direction from -45 °C to 230 °C. Report sample length vs. temperature in accordance to GMMPD requirements.

Report Poisson's ratio at 23 °C in accordance to ISO 527.

3.2.6 Dynamic Mechanical Analysis (DMA). Dynamic mechanical properties of the material shall be measured as a function of temperature from -40 °C to 250 °C at 1 Hz frequency 2 °C/minute in air in accordance to ISO 6721, non-resonance test method. Strain level should be in the linear response range. Report storage modulus, loss modulus, and loss tangent as functions of temperature. Report T_g , T_{onset} , T_{endset} based on ISO 6721-11.

3.2.7 Additional Requirements.

- Fourier-Transform Infrared Spectrum (FTIR), ASTM E1252, 400 cm^{-1} to 4000 cm^{-1} .
- Differential Scanning Calorimetry (DSC) thermogram, ISO 11357, 23 °C to 350 °C. Report transition temperatures and heat of fusion.
- Thermogravimetric Analysis (TGA) thermogram, ISO 11358-1, room temperature to 900 °C with purging atmosphere transition from N_2 to Air at 650 °C to 700 °C. Report weight losses and final residual content.

3.3 Requirements on Delivery. Lot release certificate as specified in the accompanied GMW Plastic Submission Template shall accompany each shipment.

3.4 Performance Requirements. Performance requirements shall be specified on part drawings or in component specifications, including colors.

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: Material Properties ^{Note 1}

Property	Standard	Units	Requirements
ISO Symbol for Material	ISO 1043		PPS-GF40
ISO Symbol for Part	ISO 11469		>PPS-GF40<
Density	ISO 1183, Method A	g/cm^3	1.62 to 1.71
Ash	ISO 3451-1 Method A or ISO 11358-1	%	37 to 44
Tensile Modulus	ISO 527	MPa	12000 to 18000