



Polyether-ether-ketone (PEEK) – Carbon Fiber Reinforced, Polytetrafluoroethylene (PTFE) Lubricated

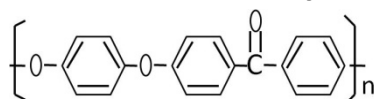
1 Scope

1.1 Material Description. This standard covers the properties of a 15% carbon fiber reinforced, 15% polytetrafluoroethylene (PTFE) lubricated polyether-ether-ketone (PEEK) material. The repeat unit of this aromatic, semi-crystalline PEEK polymer comprises oxy-1.4-phenylene-oxy-1.4-phenylene-carbonyl-1.4-phenylene as shown in Figure 1. This compound can be injection molded to various components.

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

1.3 Applicability. This material can be used for transmission seal and thrust washer applications on steel mating surfaces with a minimum of Rockwell C 28. Materials with high strength, high temperature resistance, good transmission fluid resistance and good wear resistance are expected. It is user's responsibility to validate its feasibility of running against soft mating surfaces, such as aluminum.

Figure 1: Chemical Structure of Polyetheretherketone



2 References

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

2.1 External Standards/Specifications.

ASTM D4065	ISO 179/1eA	ISO 527-2	ISO 11357
ASTM E1356	ISO 179/1eU	ISO 1183	ISO 11357-2
ISO 175	ISO 188	ISO 3146	ISO 11359-2
ISO 178	ISO 527-1	ISO 3167	ISO 11469

2.2 GM Standards/Specifications.

9986153	GMW3059	GMW14270	GMW16771
GMW3013	GMW3221		

2.3 Additional References.

Statement of Requirements (SOR)

3 Requirements

3.1 Requirements on Test Specimens. Reference GMW3221, Code A.

3.2 Initial Approval. The material shall fulfill the requirements defined per GMW3013, **General Requirement for Handling of Technical Terms of Delivery for Plastics** for formal approval under this specification. Data from defined number of lots for each property shall be submitted and meet the control limits defined in Table 1, Table 2, and Table 3.

3.3 Material Properties. Material properties defined in 3.3.1 are required for lot releasing. Material properties defined in 3.3.2 through 3.3.6 are required once for initial approval, or when there are any changes to ingredients, source of ingredients and/or manufacturing process.

3.3.1 Requirements on Material Delivery. Each lot of material to be used for GM applications must be certified and show the compliance to the requirements specified in Table 1 when shipped to part fabricators.

3.3.2 Heat Resistance and Fluid Resistance. Requirements under this section are defined in Table 2.

3.3.3 Other Material Properties. Requirements under this section are defined in Table 3.

3.3.4 Wear Resistance. Perform material wear test per GMW16771.

- Sequence A per GMW16771, is required for thrust washer applications. Material must not fail at pressure velocity (PV) lower than 10.51 MPa meter/second (300,000 psi foot/minute).
- Sequence B per GMW16771, is for sealing applications. Material must not fail at PV lower than 8.76 MPa meter/second (250,000 psi foot/minute).

3.3.5 Material Properties for FEA. Tensile properties of the material shall be measured in accordance to ISO527 at -40 °C, 23 °C, and 150 °C. Tests shall be performed using ISO 527-1A specimen, five (5) duplicates each, at 5 mm/minute. ASTM D638 toe compensation shall be applied to data. Submit stress-strain data in accordance to GMW3013/GMMPD format. Report tensile modulus and stress/strain at break.

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 180 °C. Report sample length vs. temperature in accordance to GMW3013/GMMPD requirements.

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

3.3.6 Dynamic Mechanical Analysis (DMA) Curve. Provide DMA curve conducted from room temperature to 250 °C at 1 Hz frequency 5 °C/minute in air per ASTM D4065. Strain level should be in the linear response range. Report storage modulus, loss modulus, and loss tangent as a function of temperature.

3.4 Performance Requirements. Performance requirements shall be specified on part drawings and the Statement of Requirements (SOR) of parts or components.

3.5 All materials supplied to this standard must comply with GMW3059, Restricted and Reportable Substances, including the requirement to submit a full material composition disclosure to GM via the International Material Data System (IMDS) or via a completed GMW3059 report form.

4 Manufacturing Process

This material is injection moldable. Molders should ensure a < 0.2% moisture level prior to mold parts.

Table 1: Material Properties Required on Material Delivery

Property	Standard	Units	Value
ISO Symbol	ISO 11469		>PEEK-(CF15-+PTFE15)<
Density	ISO 1183	g/cm ³	1.39 to 1.45
Flexural Strength	ISO 178	MPa	≥ 230
Flexural Modulus	ISO 178	MPa	≥ 11 500
Tensile Stress at Break	ISO 527-1, ISO 527-2	MPa	≥ 160
Tensile Strain at Break	ISO 527-1, ISO 527-2	%	≥ 1.3
Tensile Modulus	ISO 527-1, ISO 527-2	MPa	≥ 11 500
Notched Izod Impact Strength	ISO 180/1A	kJ/m ²	≥ 3.4
Notched Charpy Impact Strength (Optional to Izod)	ISO 179/1eA	kJ/m ²	≥ 3.4