



## **PTFE**

PTFE (Polytetrafluoroethylene) offers the following characteristics over thermoplastic and thermoset compounds, making it a unique problem solving solution for sealing applications:

- **Low coefficient of friction**

The low coefficient of friction (.06) of PTFE material results from low interfacial forces between its surface and other materials that come in contact. This behavior of PTFE material eliminates any possibility of stick-slip effects in dynamic sealing applications.

- **Wide temperature range**

PTFE's high melting point and morphological characteristics allow components made from the resin to be used continuously at service temperatures to 600°F (315°C). For sealing cryogenic fluids below -450°F (-268°C), special designs using PTFE and other fluoropolymers are available.

- Chemically inert
- Dry running capability
- Resist temperature cycling
- High surface speeds
- Low water absorption
- Low dielectric constant and dissipation factor

## **Enhancing Performance of PTFE with Fillers**

In fluid power applications, it can be beneficial to add fillers to PTFE compounds in order to enhance its physical characteristics. Specific fillers can be incorporated to provide improved compression strength, wear, and creep and extrusion resistance.

## **Non-Filled PTFE**

### **0100 Virgin PTFE**

Virgin PTFE has no fillers and is considered FDA and potable water safe.

## **Filled PTFE**

### **0102 Modified Virgin PTFE**

Virgin PTFE modified with custom pigmentation features similar basic properties as virgin, but offers increased wear and creep resistance and lower gas permeability.

### **0120 - Mineral Filled PTFE**

Mineral is ideal for improved higher temperatures and offers low abrasion to soft surfaces. PTFE with this filler can easily be qualified to FDA and other food grade specifications.

### **0203 – Fiberglass Filled**

Glass fiber is the most common filler with a positive impact on creep performance of PTFE. Glass fiber adds wear resistance and offers good compression strength.

### **0204 / 0205 – Molybdenum Disulfide and Fiberglass Filled**

Molybdenum disulfide (MoS<sub>2</sub>) increases the hardness of the seal surface while decreasing friction. It is normally used in small proportions and combined with other fillers such as glass. MoS<sub>2</sub> is inert towards most chemicals.

### **0301 – Graphite Filled**

Graphite filled PTFE has an extremely low coefficient of friction due to the low friction characteristics of graphite. Graphite is chemically inert. Graphite imparts excellent wear properties and high PV values to PTFE.

### **0307 – Carbon Graphite Filled**

Carbon reduces creep, increases hardness and elevates the thermal conductivity of PTFE. Carbon graphite compounds have good wear resistance and perform well in non-lubricated applications.

### **0401 / 0402 – Bronze Filled**

Bronze is a self lubricated, long-wearing material that offers superior frictional characteristics and high temperature capabilities.

### **0501 / 0502 – Carbon Fiber Filled**

Carbon fiber lowers creep, increases flex and compressive modulus and raises hardness. Coefficient of thermal expansion is lowered and thermal conductivity is higher for compounds of carbon fiber filled PTFE. This is ideal for automotive applications in shock absorbers and water pumps.

### **0601 – Aromatic Polyester Filled**

Aromatic polyester is excellent for high temperatures and has excellent wear resistance against soft, dynamic surfaces. This filler is not recommended for sealing applications involving steam.

**Table 3-4. Typical Physical Properties — PTFE**

Parker Material Code	Material	Color	Typical Applications & Description	Service Temperature Range °F (°C)	Tensile Strength in psi at Break (bar)	Elongation in %	Hardness Shore D
Non-Filled PTFE							
0100	Virgin PTFE	White	Excellent for cryogenic applications. Good for gases.	-425 to 450 (-254 to 233)	4575 (316)	400	60
Filled PTFE							
0102	Modified PTFE	Turquoise	Lower creep, reduced permeability and good wear resistance.	-320 to 450 (-195 to 282)	4600 (317)	390	60
0120	Mineral Filled PTFE	White	Excellent low abrasion to soft surfaces & improved upper temperature performances. FDA materials.	-360 to 550 (-218 to 288)	4070 (281)	270	65
0203	Fiberglass Filled PTFE	Gold	Excellent compressive strength and good wear resistance.	-200 to 575 (-129 to 302)	3480 (240)	190	67
0204	Fiberglass & Moly Filled PTFE	Gray	Excellent for extreme conditions such as high pressure, temperature and longer wear life on hardened dynamic surfaces.	-200 to 575 (-129 to 302)	3100 (214)	245	62
0205	Fiberglass & Moly Filled PTFE	Gray	Improved compressive strength and wear in rotary applications	-200 to 575 (-129 to 302)	3480 (240)	190	67
0301	Graphite Filled PTFE	Black	Excellent for corrosive service. Low abrasion to soft shafts. Good in unlubricated service.	-250 to 550 (-157 to 288)	3200 (221)	260	60
0307	Carbon-Graphite Filled PTFE	Black	Excellent wear resistance and reduces creep.	-360 to 575 (-218 to 302)	2250 (155)	100	64
0401	Bronze Filled PTFE	Bronze	Excellent extrusion resistance and high compressive loads.	-200 to 575 (-129 to 302)	3200 (221)	250	63
0502	Carbon Fiber Filled PTFE	Brown	Good for strong alkali and hydrofluoric acid. Good in water service.	-200 to 550 (-129 to 288)	3200 (221)	312	60
0601	Aromatic Polyester Filled PTFE	Tan	Excellent high temperature capabilities and excellent wear resistance.	-200 to 575 (-129 to 302)	2500 (172)	200	61

**Table 3-4. Typical Physical Properties — PTFE (cont'd)**

Parker Material Code	Coefficient of Friction	Thermal Conductivity (in W/mK)	Coefficient of Thermal Expansion (in/in <sup>3</sup> F x 10 <sup>-5</sup> at 203°F)	Permanent Deformation Under Load (70°F 2000 psi in %)	Chemical Compatibility Rating	Wear Resistance Rating	High Pressure Extrusion Resistance Rating	FDA/NSF Compliant
Non-Filled PTFE								
0100	0.05 - 0.10	0.30	11	7.0	5	1	1	Y
Filled PTFE								
0102	0.05 - 0.10	0.29	11	6.9	5	2	2	Y
0120	0.08 - 0.12	0.23	11	4.2	5	3	4	Y
0203	0.08 - 0.12	0.27	10	6.0	5	5	5	N
0204	0.08 - 0.12	0.28	11	6.0	5	4	4	N
0205	0.08 - 0.12	0.27	10	6.0	5	5	5	N
0301	0.07 - 0.09	0.39	11	3.5	5	4	3	N
0307	0.08 - 0.11	0.35	8	2.5	5	4	4	N
0401	0.18 - 0.22	0.45	10	4.4	4	4	4	N
0502	0.09 - 0.12	0.31	13	1.8	4	5	5	N
0601	0.09 - 0.13	0.32	9	5.5	4	4	4	N

**Note:** We emphasize that this tabulation should be used as a guide only.

The above data is based primarily on laboratory and service tests, but does not take into account all variables that can be encountered in actual use. Therefore, it is always advisable to test the material under actual service conditions before specifying. If this is not practical, tests should be devised that simulate service conditions as closely as possible.

## Materials

The following table lists material codes that apply to the rubber energizer used with PTFE fluid power seals. List the corresponding material code in the appropriate location in the part number. Parker has a full range of rubber compounds to suit various temperature, pressure and chemical compatibility requirements. If your application requires an alternate rubber compound, not listed, please consult a Parker application engineer.

**Table 3-5. Typical Application Ranges & Recommendations — Rubber Energizers for PTFE fluid power seals**

Material Code	Material Description	Shore A Hardness	Temperature Range	Recommended Use	Not Recommend For Use
A	Nitrile (NBR)	70	-30°F to 250°F (-34°C to 121°C)	<ul style="list-style-type: none"> <li>Petroleum oils and fluids</li> <li>Diesel fuel and fuel oils</li> <li>Cold water</li> <li>Silicone oil and grease</li> <li>Mineral oil and grease</li> <li>Vegetable oil</li> <li>HFA, HFB and HFC fluids</li> </ul>	<ul style="list-style-type: none"> <li>Aromatic hydrocarbons</li> <li>Chlorinated hydrocarbons</li> <li>Polar solvents (MEK, ketone, acetone)</li> <li>Phosphate ester fluids</li> <li>Strong acids</li> <li>Automotive brake fluid</li> </ul>
B	Low Temperature Nitrile (NBR)	75	-65°F to 225°F (-55°C to 107°C)	<ul style="list-style-type: none"> <li>Potable water</li> <li>Food service</li> </ul>	
C	Clean Grade Nitrile (NBR)	70	-30°F to 250°F (-34°C to 121°C)	<ul style="list-style-type: none"> <li>Diesel fuel and fuel oils</li> <li>Dilute acids and bases</li> </ul>	
D	Hydrogenated Nitrile (HNBR)	70	-23°F to 300°F (-32°C to 149°C)	<ul style="list-style-type: none"> <li>Petroleum oils and fluids</li> <li>Cold water</li> <li>Silicone greases and oils</li> <li>Aliphatic hydrocarbons</li> <li>Aromatic hydrocarbons</li> <li>Fuels</li> <li>Fuels with methanol content</li> </ul>	
F	Fluorocarbon (FKM)	70	-15°F to 400°F (-26°C to 205°C)	<ul style="list-style-type: none"> <li>Engine and transmission oil</li> <li>Animal and vegetable oil and grease</li> <li>Brake fluid</li> <li>Fire-resistant hydraulic fluid</li> <li>Ozone, aging and weather resistant</li> </ul>	<ul style="list-style-type: none"> <li>Glycol based brake fluids</li> <li>Ammonia gas, amines, alkalis</li> <li>Superheated steam</li> <li>Low molecular organic acids</li> </ul>
H	Silicone HT (VMQ)	70	-65°F to 450°F (-55°C to 232°C)	<ul style="list-style-type: none"> <li>Hot water</li> <li>Glycol based brake fluids</li> <li>Many organic and inorganic acids</li> <li>Cleaning agents</li> <li>Soda and potassium alkalis</li> <li>Phosphate ester based fluids</li> <li>Many polar solvents</li> </ul>	<ul style="list-style-type: none"> <li>Petroleum oils and fluids</li> <li>Mineral oil products</li> </ul>
K	Ethylene Propylene Rubber (EPDM)	70	-70°F to 250°F (-57°C to 121°C)	<ul style="list-style-type: none"> <li>Superheated steam</li> <li>Acids and Alkalis</li> <li>Aromatic mineral oil</li> <li>Hydrocarbon-based fuels</li> <li>Aromatic hydrocarbons</li> </ul>	
L	Ethylene Propylene Rubber (EPDM)	80	-70°F to 250°F (-57°C to 121°C)		

The following table is a list of back up ring materials for use with PTFE fluid power seals. List the corresponding back up ring material code in the appropriate location in the part number.

**Table 3-6. Typical Application Ranges & Recommendations — Back-up rings for PTFE fluid power seals**

Material Code	Material Description	Pressure Rating *	Temperature Range	Recommended Use
A	Nylon, Molybdenum Di-Sulfide Filled	7,500 psi (517 bar)	-40°F to 250°F (-40°C to 121°C)	<ul style="list-style-type: none"> <li>Petroleum oils and fluids</li> <li>Diesel fuel and fuel oils</li> <li>Phosphate ester fluids</li> <li>Silicone oil and grease</li> <li>Mineral oil and grease</li> </ul>
B	Nylon Glass Filled	7,500 psi (517 bar)	-40°F to 275°F (-40°C to 135°C)	<ul style="list-style-type: none"> <li>Reduced water absorption</li> <li>Improved thermal stability</li> </ul>
C	Acetal	6,000 psi (414 bar)	-40°F to 250°F (-40°C to 121°C)	<ul style="list-style-type: none"> <li>HFA, HFB and HFC fluids</li> <li>Water</li> <li>Petroleum oils and fluids</li> <li>Diesel fuel and fuel oils</li> <li>Mineral oil and grease</li> </ul>
D	PTFE PPS Filled	5000 psi (345 bar)	-100°F to 450°F (-73°C to 232°C)	<ul style="list-style-type: none"> <li>Extended temperature, pressure and media resistance</li> </ul>
E	PEEK Virgin	10,000 psi (690 bar)	-40°F to 450°F (-40°C to 232°C)	<ul style="list-style-type: none"> <li>Extended temperature, pressure and media resistance</li> </ul>

\* Pressure ratings are a general guide only. Pressure ratings are reduced if wear rings are used.

**Table 3-7. Standard (■) vs. Optional (□) materials for PTFE fluid power seal profiles**

PTFE Material Code	PTFE Fluid Power Seal Profile														
	S5	R5	CT	CQ	OE	CP	OA	OD	ON	CR	OC	AD	OQ	OR	
0100						□				□		□			
0102						□	■	□		□	■				
0120	□	□			□	□		□	□	□			□	□	
0203	■	■		□	□				□						
0204			□				□				□		□	□	
0205													■	■	
0301					□				□				□	□	
0307			□		□			□	□				□	□	
0401	□	□	■	■	■	■		■	■	■	□	■			
0502												□	□	□	
0601					□				□						