# Fluoropolymers (PTFE, FEP, PFA, PVDF and Modified ETFE)

TYPICAL PROPERTIES OF FLUOROPOLYMERS

| ASTM or UL Test | Property | PTFE | FEP | PFA | PVDF | Modified ETFE |
|---|---|---|---|---|---|---|
| | MECHANICAL | | | | | |
| D638 | Tensile strength (psi) | 3,350 | 3,000 | 4,000 | 5,200-7,400 | 6,500 |
| D638 | Elongation (%) | 300 | 300 | 300 | 100-300 | 275 |
| D638 | Tensile modulus ($10^5$ psi) | 0.5 | — | — | 1.6 | 1.2 |
| D790 | Flexural strength (psi) | No break | No break | No break | No break | No break |
| D790 | Flexural modulus ($10^5$ psi) | 0.5-0.9 | 0.95 | 0.95 | 2.0 | 2.0 |
| D256 | Impact strength, Izod (ft-lb/in of notch) | 3.5 | No break | No break | 3-4 | No break |
| D785 | Hardness | | | | | |
| | Rockwell | — | — | — | — | R50 |
| | Shore D | 50-65 | 55 | 60 | 80 | — |
| | THERMAL | | | | | |
| C177 | Thermal conductivity (Btu-in/hr-ft$^2$-°F) | 1.7 | 1.4 | 1.8 | 0.7-0.9 | 1.65 |
| D696 | Coefficient of thermal expansion ($10^{-5}$ in/in-°F) | 5.5-8.4 | 4.6-5.8 | 6.7 | 8.0-8.5 | 5.2 |
| D648 | Deflection temperature (°F) | | | | | |
| | At 264 psi | 132 | 124 | 118 | 195 | 165 |
| | At 66 psi | 250 | 158 | 164 | 300 | 220 |
| UL 94 | Flammability rating | V-0 | V-0 | V-0 | V-0 | V-0 |
| | ELECTRICAL | | | | | |
| D149 | Dielectric strength (V/mil) | | | | | |
| | Short time, 1/8-in thk | 500-600 | 500-600 | 500-600 | 260 | 400-500 |
| D150 | Dielectric constant | | | | | |
| | At 1 kHz | 2.1 | 2.1 | 2.1 | 7.5 | 2.6 |
| D150 | Dissipation factor | | | | | |
| | At 1 kHz | 0.00005 | 0.00005 | 0.0003 | 0.019 | 0.0008 |
| D257 | Volume resistivity (ohm-cm) | | | | | |
| | At 73°F, 50% RH | $>10^{18}$ | $>10^{18}$ | $>10^{18}$ | $2\times10^{14}$ | $10^{16}$ |
| D495 | Arc resistance (s) | >300 | >180 | >180 | 50-70 | 75 |
| | OPTICAL | | | | | |
| D542 | Refractive index | 1.350 | 1.344 | 1.350 | 1.42 | 1.403 |
| D1003 | Transmittance (%), 1-mil film | — | >95 | >95 | >90 | — |
| | FRICTIONAL | | | | | |
| — | Coefficient of friction | | | | | |
| | Against steel (100 psi, 10 fpm) | 0.050 | 0.330 | 0.214 | 0.14 | 0.400 |

*Crystalline compound. †Below and above 135°F.

TYPICAL PROPERTIES OF FLUOROPOLYMERS

| ISO or UL Test | Property | PTFE | FEP | PFA | PVDF | Modified ETFE |
|---|---|---|---|---|---|---|
| | MECHANICAL | | | | | |
| ISO527 | Tensile strength (MPa) | 22 | 21 | 27 | 36-51 | 45 |
| ASTM D638 | Elongation (%) | 300 | 300 | 300 | 100-300 | 275 |
| ISO527 | Tensile modulus ($10^3$ MPa) | 0.344 | — | — | 1.10 | 0.83 |
| ISO178 | Flexural strength (MPa) | No break | No break | No break | No break | No break |
| ISO178 | Flexural modulus (MPa) | 344-620 | 655 | 655 | 1,378 | 1,378 |
| ISO180 | Notched izod impact strength (J/m) | 187 | No break | No break | 160-214 | No break |
| ISO2039 | Hardness | | | | | |
| | Rockwell | — | — | — | — | R50 |
| | Shore D | 50-65 | 55 | 60 | 80 | — |
| | THERMAL | | | | | |
| ISO8302 | Thermal conductivity (W/(mK)) | 0.25 | 0.25 | — | — | 0.23 |
| ISO11359 | Coefficient of thermal expansion ($10^{-4}$ m/m°C) | 0.99-1.51 | 0.82-1.04 | 1.20 | 1.40-1.50 | 1.20 |
| ISO75 | Deflection temperature (°C) | | | | | |
| | At 1.80 MPa | 56 | 51 | 48 | 91 | 74 |
| | At 0.45 MPa | 121 | 70 | 73 | 149 | 104 |
| UL 94 | Flammability rating | V-0 | V-0 | V-0 | V-0 | V-0 |
| | ELECTRICAL | | | | | |
| IEC243 | Dielectric strength (kV/mm) | | | | | |
| | Short time, 3mm thk | 19.7-23.6 | 19.7-23.6 | 19.7-23.6 | 10.24 | 15.7-19.7 |
| IEC250 | Dielectric constant | | | | | |
| | At 1 kHz | 2.1 | 2.1 | 2.1 | 7.5 | 2.6 |
| IEC250 | Dissipation factor | | | | | |
| | At 1 kHz | 0.00005 | 0.00005 | 0.0003 | 0.019 | 0.0008 |
| IEC93 | Volume resistivity (ohm-cm) | | | | | |
| | At 23°C, 50% RH | $>10^{18}$ | $>10^{18}$ | $>10^{18}$ | $2\times10^{14}$ | $10^{16}$ |
| ASTM D495 | Arc resistance (s) | >300 | >180 | >180 | 50-70 | 75 |
| | OPTICAL | | | | | |
| ISO489 | Refractive index | 1.350 | 1.344 | 1.350 | 1.42 | 1.403 |
| ASTM D1003 | Transmittance (%), 0,0254mm film | — | >95 | >95 | >90 | — |

*Crystalline compound. †Below and above 57°C.