Materials Guide for Fluidic Applications

A Comprehensive Resource for Selecting the Best Materials for Your Fluidic Application

IDEX HEALTH & SCIENCE

Intelligent Solutions for Life®

Fluidics | Optics | Consumables | Assemblies

Introduction

The right material is key to building fluidic systems that perform reliably and last — even in the most challenging environments. At IDEX Health & Science, we understand the critical role materials play in delivering precision and consistency. Our Materials Guide provides the information you need to select materials that confidently meet your application's demands.

We bring a unique combination of material expertise and deep industry knowledge to everything we do. This unique blend allows us to develop fluidic components and subsystems that enable you to achieve breakthrough discoveries and trusted results in a wide array of life science applications. From tubing and fittings to precision manifolds and complete fluidic subsystems, every IDEX Health & Science component is designed to optimize performance and reliability. With our Materials Guide, you can navigate material options to ensure you're making decisions that align with the specific requirements of your fluidic systems.

Table of Contents

INTRODUCTION

MATERIALS

REFERENCES

Purpose of this Guide

This Materials Guide helps you navigate the complexities of material selection for your fluidic systems. Offering detailed insights into the materials used in IDEX Health & Science components, each material highlights its key properties and provides information on aspects like chemical resistance, temperature stability, or durability. This guide simplifies your decision-making process, saving time and helping you select materials that meet your system's unique needs, making your work more efficient and productive.

Designed for end-users and system designers alike, this resource is tailored to provide the information you need to ensure your fluidic systems operate reliably and deliver precision performance in any environment.

How to Use this Guide

1 Start with the Material Categories and Properties Key

Explore the Top-Level Categories – Plastics, Elastomers, and Metals – color-coded for easy reference. Use the icons to quickly identify key properties like chemical resistance, durability, and flexibility that matter most for your application.

2 Explore the Material Pages

Review detailed descriptions of each material, including key properties and practical applications, to help you choose the best fit for your specific needs.

3 Leverage the Chemical Compatibility Chart

Use this chart to quickly verify how different materials perform in specific fluidic environments. It's an essential tool for selecting materials that will withstand the chemicals and conditions your system requires.

4 Reach Out for Support

Get guidance from our team of experts with personalized recommendations to help you select the right material for your application.

Expertise

Your Partner in Optofluidic Solutions

We do more than supply components — we engineer intelligent solutions that bring optofluidic paths to life. With decades of proven expertise and a deep understanding of how materials perform in real-world applications, we design and deliver fluidic and optical products that meet the highest standards of precision and reliability.

Why Choose IDEX Health & Science?

Strategic Partnership
Innovation happens together. By partnering with us, you gain a trusted collaborator with component, subsystem, and application expertise. We work to optimize your system's design and deliver the best solution for your needs.

Breakthrough Solutions
Your vision leads the way. Our integrated optofluidic components and innovative engineering simplify complex paths, enabling better performance and faster time to market.

Material Knowledge
We understand how material properties – like chemical resistance, temperature stability, and durability – ensure reliable performance in even the most challenging applications.

Proven Expertise
From concept to production, we streamline instrument development with in-house design and validated components, creating optimized solutions that deliver consistent, reliable results.

Committed to Your Success
Your success is our priority. Whether advancing diagnostic instruments or life science technologies, we help you build systems that enrich lives, protect the planet, and improve global health.

READY TO OPTIMIZE YOUR SYSTEM'S PERFORMANCE?

Contact our team to explore the right solutions for your application at:
idex-hs.com/contact

Understanding Material Categories and Properties

Choosing the right material is critical to the performance and reliability of fluidic and optical systems. This guide provides an overview of the material categories and key properties to help you identify the best options for your specific application needs.

Each material is grouped into a top-level category — Plastic, Elastomer, or Metal — and further defined by its unique properties, such as Chemical Resistance, Temperature Stability, or Transparency. The following icons and color coding will help you quickly associate these properties with the materials in this guide. By understanding these material types and their unique properties, you can make informed decisions for your system's requirements, whether you need strength, durability, biocompatibility, or other essential characteristics.

Top Level Categories

PLASTICS

Durable, lightweight materials offering a wide range of properties such as chemical resistance, temperature stability, and transparency. Plastics are ideal for fluidic systems requiring precision and reliability.

METALS

Strong, durable materials with superior corrosion resistance and biocompatibility, making them suitable for high-stress or demanding fluidic and optical applications.

ELASTOMERS

Flexible, resilient materials designed for sealing and gasketing in dynamic environments. Elastomers provide excellent chemical resistance and adaptability.

Unique Properties

CHEMICAL RESISTANCE

Indicates the material's ability to withstand exposure to aggressive chemicals, ensuring longevity in harsh environments.

CORROSION RESISTANCE

Specifies the material's resilience to degradation caused by moisture, salts, and other corrosive elements.

TEMPERATURE STABILITY

Refers to the material's performance across a wide range of temperatures, from extreme heat to cryogenic conditions.

TRANSPARENCY

Denotes the material's optical clarity, critical for applications requiring visibility or light transmission.

DURABILITY

Represents the material's long-term performance, resisting wear and tear in demanding environments.

FLEXIBILITY

Describes the material's ability to bend or stretch without losing its shape, crucial for dynamic sealing or tubing applications.

BIO-COMPATIBILITY

Indicates that the material is safe for use in medical and life science applications, where contact with biological samples is required.

WEAR RESISTANCE

Highlights the material's ability to withstand friction and abrasion, extending product life in high-friction systems.

MECHANICAL STRENGTH

Reflects the material's ability to withstand physical forces, ensuring structural integrity in high-pressure or high-stress applications

316 Stainless Steel

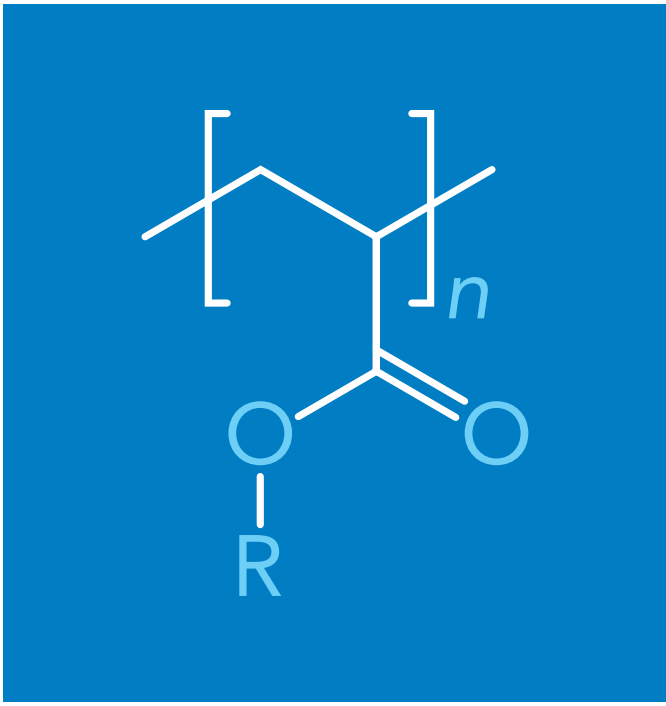
316 Stainless Steel is one of the most popular manufacturing materials currently being used in chromatography applications. It offers tremendous physical strength as well as the best chemical resistance of all of the 300-series stainless steels. Because of the metallic nature of this material, it is best to compare the chemical being used with a database listing to determine if any interaction is suspected.

Properties

Temperature Range	Up to 250 °C
Thread Strength	Excellent
Oxygen Permeability	N/A
pH Range	1 – 14
Sterilization Techniques	Gamma irradiation; ethylene oxide; thermal
Autoclavable?	Y

Acrylic

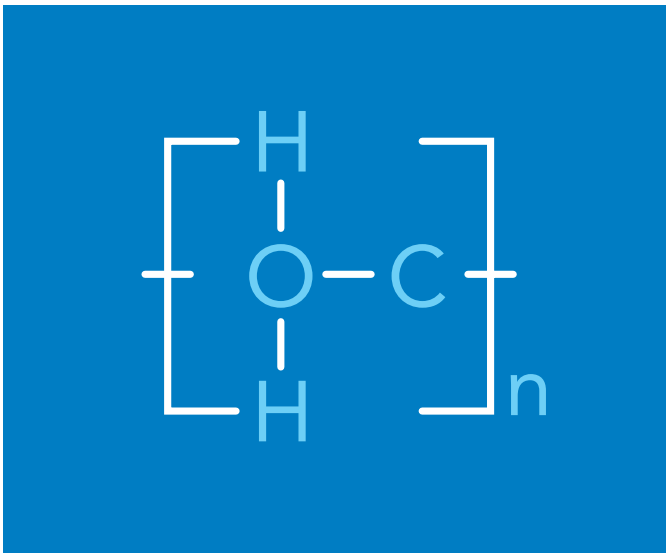
Acrylic is a widely used polymer that is primarily known for its transparency and high strength.



Properties

Temperature Range	Up to 50 °C
Thread Strength	Good
Oxygen Permeability	748 cc / 100 in^2 * 24 h * atm / mil @ 25 °C
pH Range	1 – 14
Sterilization Techniques	Ethylene oxide, thermal
Autoclavable?	Y

Delrin®
(Polyoxymethylene)



Delrin® is a rugged polymer that serves as an excellent choice for long-term mechanical stability for products such as fittings and threaded adapters. It is important to note that Delrin, while being strong mechanically, cannot tolerate to be in the presence of acidic or basic solutions for long periods of time, as the polymer will degrade. It is best to use Delrin with neutral pH aqueous solutions or organic solutions for guaranteed best performance.

Properties

Temperature Range	Up to 60 °C
Thread Strength	Excellent
Oxygen Permeability	N/A
pH Range	6 to 8
Sterilization Techniques	
Autoclavable?	Y

Delrin® Extended Properties

General	Condition	Test Method	Units	Typical Value
Density	—	ASTM D792	g/cc	1.42
Melt Flow	—	1.05 kg/190 °C	g/10 min	1
Water Absorption	24 hour	ASTM D570	—	—
Moisture Absorption at Equilibrium	50% RH	ASTM D570	%	0.22
Water Absorption at Saturation	Immersion	ASTM D570/ ISO 62	%	0.9
Hardness, Rockwell M	—	ASTM D785	—	94
Hardness, Rockwell R	—	ASTM D785	—	120

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	Ultimate	ASTM D638	MPa (psi)	69 (10,008)
Elongation	break	ASTM D638	%	75
Modulus of Elasticity	GPa	ASTM D638	406 ksi	2.8
Flexural Modulus	GPa	ASTM D790	421 ksi	2.9
Flexural YieldStrength	—	ASTM D790	MPa (psi)	99
Izod Impact Strength	J/cm	ASTM D256	2.3 ft-lb/in	1.23
	Unnotched, J/cm no break	ASTM D256	1,871 ft-lb/in	999
Izod Impact Low Temp	Notched, J/cm at -40 °C	ASTM D256	1.8 ft-lb/in	0.96
Tensile Impact Strength	kJ/m^2	ASTM D1822	170 $ft\text{-}lb/in^2$	358
Compressive Yield Strength	—	ASTM D695	MPa (psi)	124 (17,985)
Shear Strength	—	ASTM D732	MPa (psi)	66 (9,573)
Fatigue Strength	Flexural fatigue endurance limit, 50% RH,	ASTM D672	MPa (psi)	32 (4,641)
Fatigue Strength	Flexural fatigue endurance limit, 50% RH, 1E+6 cycles	ASTM D672	MPa (psi)	32 (4,641)
Poissons Ratio	—	—	—	0.35
Coefficient of Friction	Dynamic vs. carbon steel, 50 mm/s (2 in/s)	2MPa	—	0.35

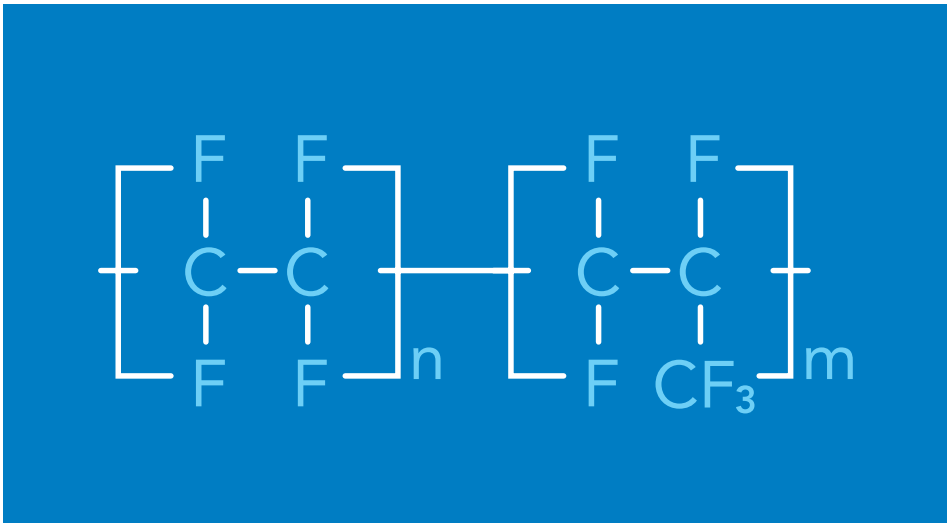
Delrin® Extended Properties (Continued)

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Thermal Expansion	linear 20 °C linear 100 °C	µm/m- °C µm/m- °C	60 µin/in- °F 83 µin/in- °F	122 149
Deflection Temperature	at 0.46 MPa, °C at 1.8 MPa, °C	ASTM D648 ASTM D648	336 °F 257 °F	169 125
Melting Point °C	°C	ASTM D3418	347 °F	175
Maximum Service Temperature	Deflection Temp at 1.8 MPa	—	257 °F	125
Thermal Conductivity	W/m-K	—	2.8BTU-in/ hr-ft^2- °F	0.4
Flammability, UL94	(5=V-0;4=V-1;3=V-2;1=HB)	UL94	HB	1(HB)

Electrical	Condition	Test Method	Units	Typical Value
Electrical Resistivity	—	ASTM D257	ohm-cm	1E+15
Dielectric Constant	At 1MHz	ASTM D150	—	3.7
Dielectric Strength, kV/mm	2.3 mm (90 mils); Short Time	ASTM D149	500 kV/in	19.7
Dissipation Factor	At 1 MHz	ASTM D150	—	0.005
Arc Resistance	—	ASTM D495	sec	220

FEP

FEP (Fluorinated Ethylene Propylene) is a nice, melt-processed alternative to PTFE. FEP exhibits many similar properties to the more familiar PTFE, while being melt-processable, allowing for a lower gas permeability and improved optical clarity.



Properties

Temperature Range	Up to 50 °C
Thread Strength	Good
Oxygen Permeability	748 cc / 100 in^2 * 24 h * atm / mil @ 25 °C
pH Range	0 – 14
Sterilization Techniques	Ethylene oxide, thermal
Autoclavable?	Y

FEP Extended Properties

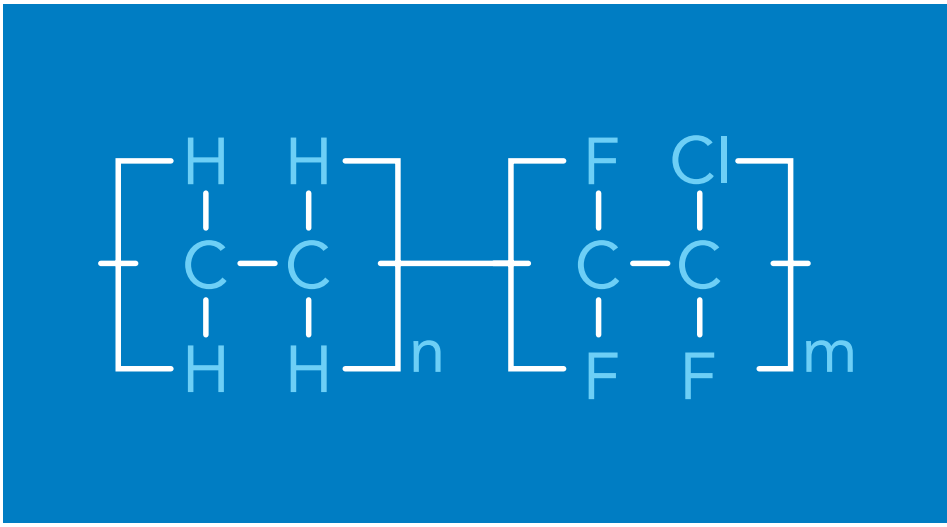
General	Condition	Test Method	Units	Typical Value
Water Absorption	24 hr.	ASTM D570	%	0.004
Weather and Chemical Resistance	—	—	—	outstanding
Limiting Oxygen Index	—	ASTM D2863	%	93

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	23 °C (73 °F)	ASTM D2116	MPa (psi)	23 (3,400)
Specific Gravity	—	ASTM D792	—	2.13 – 2.17
Ultimate Elongation	23 °C (73 °F)	ASTM D2116	%	300
Flexural Modulus	23 °C (73 °F)	ASTM D790	MPa (psi)	586 (90,000)
Impact Strength	23 °C (73 °F)	ASTM D256	J/m(ft-lb/in)	586 (90,000)
Hardness Durometer	—	ASTM D2240	Shore D	56
Comprehensive Strength	—	ASTM D695	MPa(psi)	21(3,100)
Linear Coefficient of Expansion	0 – 100 °C 32 – 212 °F	— —	mm/mm/ °C in/in/ °F	13.5×10^{-5} 7.5×10^{-5}

Thermal		Test Method	Units	Typical Value
Nominal Melting Point	—	DTA-E168	°C (°F)	255 – 265 (49 – 510)
Flow Rate	—	ASTM D2116	g/10 min	7
Upper Service Temperature	—	UL746	°C (°F)	204 (400)

Electrical	Condition	Test Method	Units	Typical Value
Dielectric Strength	0.25 mm (0.010 in)	ASTM D149	kV/mm (V/mil)	80 (2,000)
Dielectric Constant	1 MHz, 23 °C (73 °F)	ASTM D1531	—	2.02
Dissipation Factor	1 MHz, 23 °C (73 °F)	ASTM D1531	—	0.0007
Volume Resistivity	—	ASTM D257	Tohm-m (ohm-cm)	$>10^{3}$ (10^{17})
Arc Resistance	—	ASTM D495	Seconds	No Track

Halar®



Halar® (ETCFE) is a chemical relative to PTFE, sharing its excellent chemical resistance properties. There are only a few chemicals that react with Halar, including tetrahydrofuran (THF) and pyridine. Several chemicals will have reduced resistance with elevated temperatures, please see the chemical compatibility section for more information.

Properties

Temperature Range	Up to 50 °C
Thread Strength	N/A
Oxygen Permeability	25 cc / 100 in^2 * 24 h * atm / mil @ 25 °C
pH Range	1 – 14
Sterilization Techniques	Gamma irradiation; thermal
Autoclavable?	Y

Halar® Extended Properties

General	Condition	Test Method	Units	Typical Value
Density	—	ASTM D792	g/cc	1.68
Melt Flow	—	1.05 kg/190 °C	g/10 min	2
Water Absorption	24 hour	ASTM D570	—	0.10
Moisture Absorption at Equilibrium	50% RH	ASTM D570	%	<0.01
Hardness, Shore D	—	ASTM D2240	—	75
Hardness, Rockwell R	—	ASTM D785	—	90

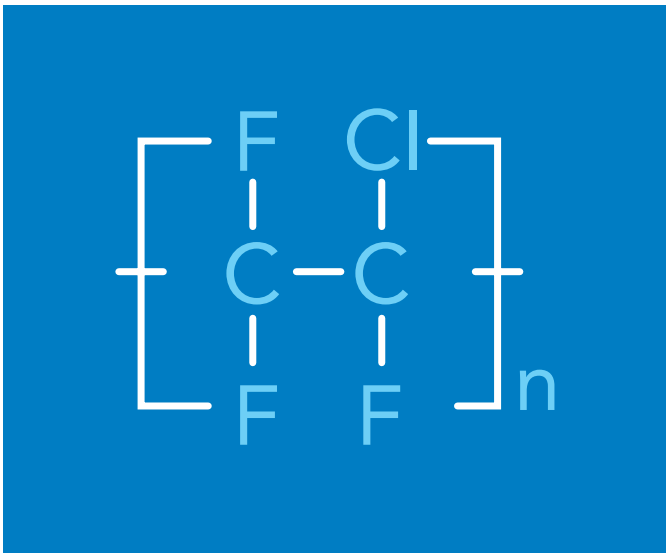
Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	Yield	ASTM D638	MPa (psi)	30 (4,300)
Tensile Strength	Break	ASTM D638	MPa (psi)	54 (7,800)
Elongation	Yield	ASTM D638	%	5
Elongation	Break	ASTM D638	%	250
Modulus of Elasticity	—	ASTM D638	GPa (ksi)	1.6 (240)
Flexural Modulus	—	ASTM D790	GPa (ksi)	1.7 (245)
Flexural Yield Strength	—	ASTM D790	MPa (psi)	47 (6,800)
Izod Impact Strength	—	ASTM D256	J/cm	No break
Izod Impact Low Temp	Notched, at -40 °C	ASTM D256	J/m (ftlb/in)	207 (2.0)
Coefficient of Friction	Dynamic vs. carbon steel, 50 mm/s (2 in/s)	ASTM D1894	—	0.2

Halar® Extended Properties (Continued)

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Thermal Expansion	Linear 20 °C	—	µin/in- °F	56
Deflection Temperature	At 1.8 MPa	ASTM D648	°C (°F)	63 (145)
Melting Point °C	—	ASTM D3418	°C (°F)	240 (464)
Maximum Service Temperature	Deflection Temp at 1.8 MPa	—	°C (°F)	148 (300)
Thermal Conductivity	—	—	(W/m-K) BTU-in/ hr-ft^2- °F	1.05 (1.09)
Flammability	UL-94 @3.1 mm	UL94	Class	V-0

Electrical	Condition	Test Method	Units	Typical Value
Electrical Resistivity	—	ASTM D257	ohm-cm	5.5E+16
Dielectric Constant	At 1MHz	ASTM D150	—	2.57
Dielectric Strength, kV/mm	3.2 mm (90 mils); Short Time	ASTM D149	Volts/mil (kV/mm)	350 (14)
Dissipation Factor	At 1 MHz	ASTM D150	—	0.013
Arc Resistance	—	ASTM D495	Sec	50

PCTFE (PolyChloroTri-FluoroEthylene)



Chemicals which interact with PCTFE polymer are not pH dependent; rather, interaction is more determined by other physical properties of the chemical(s) in question. In general, only THF and a few halogenated solvents will react with this polymer: DMSO.

Properties

Temperature Range	Up to 80 °C
Thread Strength	Good
Oxygen Permeability	12 cc / 100 in^2 * 24 h * atm / mil @ 25 °C
pH Range	0 – 14
Sterilization Techniques	Gamma irradiation; ethylene oxide; thermal
Autoclavable?	Y

PCTFE Extended Properties

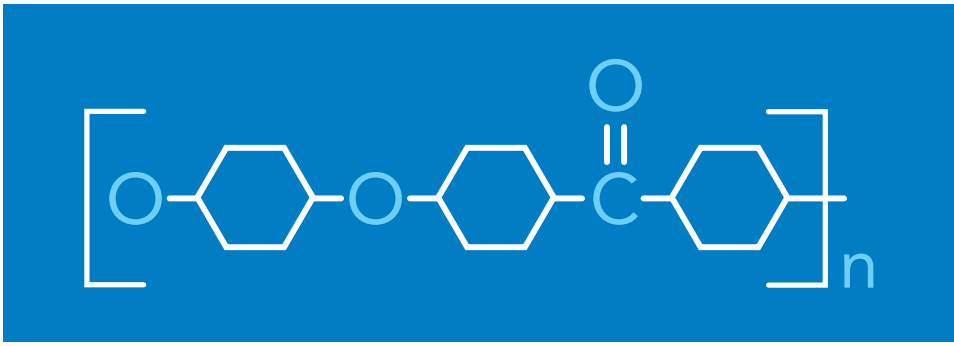
General	Condition	Test Method	Units	Typical Value
Water Absorption	24 Hour	ASTM D570	%	<0.01
Density	—	ASTM D792 ASTM D792	lb/in^3 lb/in^3	0.076 2.1

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	—	ASTM D638	psi	5,700
Tensile Modulus	—	ASTM D638	psi	207,000
Tensile Elongation	At break	ASTM D638	%	150
Flexural Strength	—	ASTM D790	psi	8,500
Flexural Modulus	—	ASTM D790	psi	180,000
Compressive Strength	—	ASTM D695	psi	5,500
Compressive Modulus	—	ASTM D696	psi	180,000
Hardness	Shore D	ASTM D785	—	D75 – 80
IZOD	Notched Impact	PTM55010	ft-lb/in	5

Thermal	Condition	Test Method	Units	Typical Value
Melting Point °C	—	ASTM D3418	°C (°F)	212 (415)
Coefficient of Linear Thermal Expansion	—	ASTM D696	$x10^{-5}$ in/in/ °F	7.0
Heat Deflection Temp	At 264 psi	ASTM D648	°C (°F)	—
Thermal Conductivity	—	C177 C177	$x10^{-4}$cal/cm-sec- °C BTU-in/ft^2-hr- °F	3.44 1.0
Maximum Operating Temperature	—	—	°C (°F)	177 (305)

Electrical	Condition	Test Method	Units	Typical Value
Dielectric Strength	Short time, 1/8" thick	ASTM D149	V/mil	500
Dielectric Constant	At 1 MHz	ASTM D150	—	—
Dissipation Factor	At 1 MHz	ASTM D150	—	—
Volume Resistivity	At 50% RH	ASTM D257	ohm-cm	10^{18}

PEEK
(Polyetheretherketone)



Chemicals which interact with PEEK polymer are not pH dependent; rather, interaction is more determined by other physical properties of the chemical(s) in question. Not recommended for use with nitric acid; sulfuric acid; halogenated acids, such as hydrofluoric, hydrobromic, and hydroiodic acids (hydrochloric acid is approved for most applications); and pure halogenated gases. Additionally, due to a swelling effect, be cautious in using the following solvents with PEEK tubing: methylene chloride, THF, and DMSO.

Properties

Temperature Range	Up to 100 °C (tubing); up to 125 °C (fittings)
Thread Strength	Excellent
Oxygen Permeability	14 cc / 100 in^2 * 24 h * atm / mil @ 25 °C
pH Range	0 – 14
Sterilization Techniques	Gamma irradiation; ethylene oxide; thermal
Autoclavable?	Y

PEEK Extended Properties

General	Condition	Test Method	Units	Typical Value
Relative Density	(Crystalline) (Amorphous)	ASTM D792 ASTM D792	— —	1.30 1.26
Typical Level of Crystallinity	—	—	%	30 – 35
Mold Shrinkage	—	—	%	1.0 – 1.8
Water Absorption	24 hr. @ 73 °F Equilibrium @ 73 °F	ASTM D570 ISO R62A	% %	0.50 0.50

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	At 73 °F (yield) At 482 °F (yield)	ASTM D638 (5 mm/min) ASTM D638 (5 mm/min)	psi psi	14,000 1,750
Elongation at Break	At 73 °F	ASTM D638 (5 mm/min)	%	>50
Elongation at Yield	At 73 °F	ASTM D638 (5 mm/min)	%	4.9
Flexural Modulus	At 73 °F At 248 °F At 482 °F	ASTM D790 ASTM D790 ASTM D790	psi psi psi	594,000 580,100 43,500
Flexural Strength	At 73 °F At 248 °F At 482 °F	ASTM D790 ASTM D790 ASTM D790	psi psi psi	24,650 14,500 1,800
IZOD Impact Strength	At 73 °F Notched Unnotched	ASTM D256	ft.-lb./in.	1.57 No Break

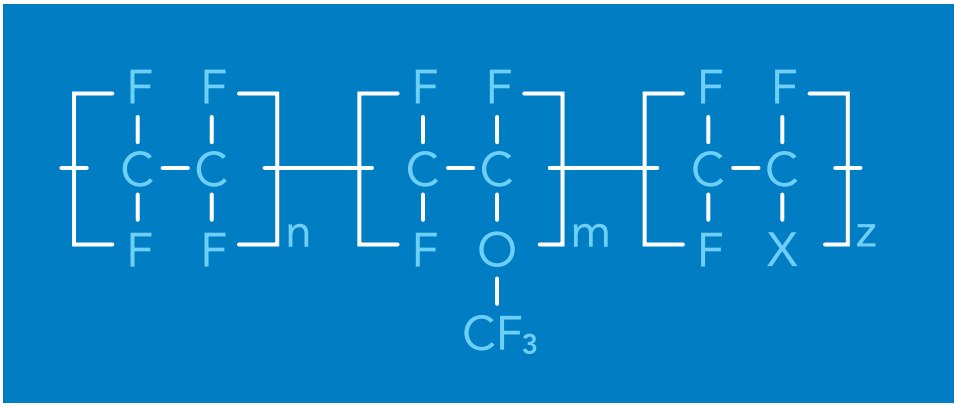
Thermal	Condition	Test Method	Units	Typical Value
Melting Point	—	DSC	°F (°C)	644 (340)
Glass Transition Temperature, Tg (onset value)	—	DSC	°F (°C)	289 (143)
Melt Flow Index	400 °C/2.16 kg	ASTM D1238	g/10 min.	4
Coefficient of Thermal Expansion	<Tg >Tg	ASTM D696 ASTM D696	10^{-5} °F^{-1}	2.6 6
Heat Deflection Temperature, 264 psi	—	ASTM D648	°F (°C)	320 (160)
UL Continuous Use Temperature	Mechanical Electrical	—	—	464 (240) 500 (260)

PEEK Extended Properties (Continued)

Sterilization	Condition	Test Method	Units	Typical Value
200 Steam Cycles at 280 °F	Short time, 1/8" thick	—	—	No Effect
1000 Mrads Gamma Radiation	—	—	—	No Effect
Chemicals (ethylene oxide, etc.)	—	—	—	No Effect
Heat up to 500 °F	—	—	—	No Effect

Electrical	Condition	Test Method	Units	Typical Value
Dielectric Strength (50µ film)	—	ASTM D149	KV/cm	190
Dielectric Constant	50 Hz-10 kHz, 0 – 300 °F 50 Hz, 392 °F	—	—	3.20 – 3.30 4.50

Perlast®



Perlast® Perfluoroelastomer is a special type of rubber material designed to offer the unique chemical resistance of PTFE. It shares with PTFE a polymer backbone consisting of carbon atoms protected by fluorine atoms, making it very inert to chemical attack.
As a rubber, therefore, it is resilient, so it doesn't creep or flow but retains sealing force over a long period. Perlast can be used in long-term conditions and has a very low oxygen permeability. It also stretches – aiding installation.

Properties

Temperature Range	Maximum operating temp: +280 °C (+536 °F) Minimum operating temp: -35 °C (-31 °F)
Oxygen Permeability	N/A
pH Range	0 – 14
Sterilization Techniques	Et-0, Gamma irradiation, thermal
Autoclavable?	Y

Perlast® Extended Properties

Physical Properties	Condition	Test Method	Units	Typical Value
Hardness (points)	(=ISO 48)	ASTM D 1415	°IRHD	69
Tensile Strength	(=ISO 37)	ASTM D 412	MPa	9.0
Elongation at Break	(=ISO 37)	ASTM D 412	%	190
100% Modulus	(=ISO 37)	ASTM D 412	MPa	4.0

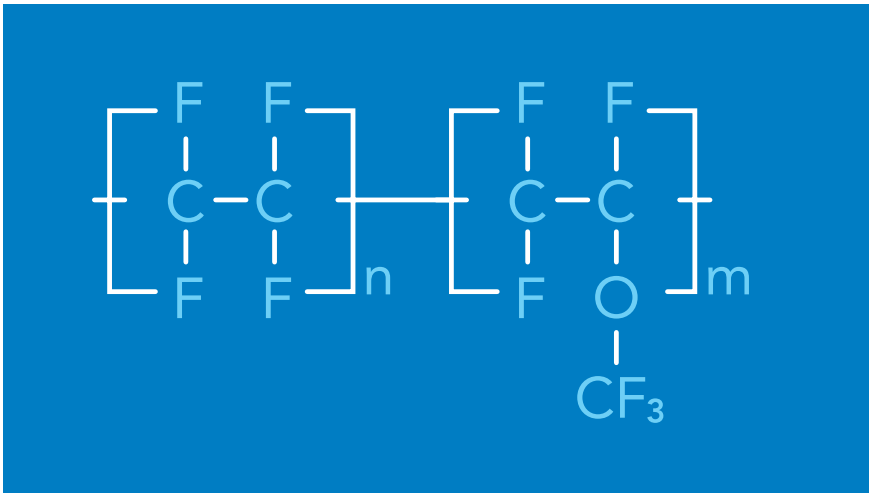
Compression Set, Method B	Condition	Test Method	Units	Typical Value
24 hours at 200 °C (392 °F)	(=ISO 815)	ASTM D 395	%	21

Heat Resistance:	Condition	Test Method	Units	Typical Value
72 hours at 250 °C (482 °F)	(=ISO 188)	ASTM D 573		
Hardness change (points)	(=ISO 48)	ASTM D 1415	°IRHD	-7
Tensile strength change	(=ISO 37)	ASTM D 412	%	3.5
Elongation at break change	(=ISO 37)	ASTM D 412	%	+12

Low Temperature Properties		Test Method	Units	Typical Value
TR10		ASTM D 1329	°C (°F)	-12 (-4)

PFA

PFA is another good, general replacement for PTFE. PFA, while being more expensive than FEP, offers a higher maximum recommended use temperature for more demanding temperature applications. It is also offers less impurities for sensitive fluidics applications.



Properties

Temperature Range	Up to 80 °C
Thread Strength	Good
Oxygen Permeability	881 cc / 100 in^2 * 24 h * atm / mil @ 25 °C
pH Range	0 – 14
Sterilization Techniques	Ethylene oxide, thermal
Autoclavable?	Y

PFA Extended Properties

General	Condition	Test Method	Units	Typical Value
Water Absorption	24 hr.	D570	%	<0.03
Weather and Chemical Resistance	—	—	—	outstanding
Limiting Oxygen Index	—	D2863	%	>93

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	23 °C (73 °F) 250 °C (482 °F) 23 °C (73 °F)(yield)	D3307 D3307 D3307	MPa (psi) MPa (psi) MPa (psi)	25 (3,600) 14 (1,800) 13.8 (2,000)
Ultimate Elongation	23 °C (73 °F) 250 °C (482 °F)	D790 D790	% %	300 480
Flexural Modulus	23 °C (73 °F) 250 °C (482 °F)	D3307 D3307	MPa (psi) MPa (psi)	590 (85,000) 55 (8,000)
Specific Gravity	—	D792	—	2.12 – 2.17
Hardness Durometer	—	D2240	—	D55
MIT Folding Endurance	0.18 – 0.20 mm (.007 – .008 in.)	D2176	Cycles	15,000

Thermal	Condition	Test Method	Units	Typical Value
Nominal Melting Point	—	DTA-E168	°C (°F)	302 – 310 (575 – 590)
Coefficient of Thermal Expansion	21 – 100 °C 70 – 212 °F 100 – 149 °C 212 – 300 °F 149 – 208 °C 300 – 408 °F	D696 D696 D696 D696 D696 D696	mm/mm/ °C in./in./ °F mm/mm/ °C in./in./ °F mm/mm/ °C in./in./ °F	14×10^{-5} 7.6×10^{-5} 17×10^{-5} 9.2×10^{-5} 21×10^{-5} 11.5×10^{-5}
Upper Service Temperature	—	—	°C (°F)	260 (500)
Flow Rate	—	D3307 D3307 D3307	g/10 min g/10 min g/10 min	12 – 15 (B) 15 – 18 (A) 18 – 21 (D)

Electrical	Condition	Test Method	Units	Typical Value
Dielectric Strength	Short time, 0.25 mm (0.10 in)	D149	kV/mm (V/mil)	80 (2,000)
Dielectric Constant	60 – 10^6 Hz	D150	—	2.03
Dissipation Factor	60 – 10^6 Hz	D150	—	0.0001
Volume Resistivity	—	D-257	ohm-cm	10^{18}

HPFA and HPFA+

HPFA and HPFA+ differ from PFA simply in the amount of impurities left behind in the polymer matrix. Already one of the cleanest polymers on the market, PFA still had too many impurities for such industries as the medical and semiconductor industries. For these types of specialized needs, a higher purity form of PFA was developed. Differing only in the level of impurities, HPFA and HPFA+ offer all the same benefits of regular PFA.

Properties

Temperature Range	Up to 80 °C
Thread Strength	Good
Oxygen Permeability	881 cc / 100 in^2 * 24 h * atm / mil @ 25 °C
pH Range	0 – 14
Sterilization Techniques	Ethylene oxide, gamma irradiation, thermal
Autoclavable?	Y

HPFA and HPFA+ Extended Properties

General	Condition	Test Method	Units	Typical Value
Water Absorption	24 hr.	D570	%	<0.05
Weather and Chemical Resistance	—	—	—	outstanding
Limiting Oxygen Index	—	D2863	%	>95

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	23 °C (73 °F) 250 °C (482 °F) 23 °C (73 °F)(yield)	D3307 D3307 D3307	MPa (psi) MPa (psi) MPa (psi)	25 (3,600) 14 (1,800) 13.8 (2,000)
Ultimate Elongation	23 °C (73 °F) 250 °C (482 °F)	D3307 D3307	% %	300 480
Flexural Modulus	23 °C (73 °F) 250 °C (482 °F)	D790 D790	MPa (psi) MPa (psi)	590 (85,000) 55 (8,000)
Specific Gravity	—	D792	—	2.12 – 2.17
Hardness Durometer	—	D2240	—	D55
MIT Folding Endurance	0.18 – 0.20 mm (.007 – .008 in.)	D2176	Cycles	15,000

Thermal	Condition	Test Method	Units	Typical Value
Nominal Melting Point	—	DTA-E168	°C (°F)	302 – 310 (575 – 590)
Coefficient of Thermal Expansion	21 – 100 °C 70 – 212 °F 100 – 149 °C 212 – 300 °F 149 – 208 °C 300 – 408 °F	D696 D696 D696 D696 D696 D696	mm/mm/ °C in./in./ °F mm/mm/ °C in./in./ °F mm/mm/ °C in./in./ °F	14×10^{-5} 7.6×10^{-5} 17×10^{-5} 9.2×10^{-5} 21×10^{-5} 11.5×10^{-5}
Upper Service Temperature	—	—	°F / °C	260 (500)

Electrical	Condition	Test Method	Units	Typical Value
Dielectric Strength	Short time, 0.25 mm (0.10 in)	D149	kV/mm (V/mil)	80 (2,000)
Dielectric Constant	60 – 106 Hz	D150	—	2.03
Dissipation Factor	60 – 106 Hz	D150	—	0.0001
Volume Resistivity	—	D-257	ohm.cm	10^{18}

PK
(Polyketone)

PK is a proprietary polymer blend comprised mainly of PEEK (Polyetheretherketone), page 20. PK demonstrates the superior chemical resistance of PEEK. However, the proprietary blend will allow a fitting to attain higher pressures while reducing the cold flow properties of pure PEEK.

CAUTION: Some fittings molded of PK are known to be conductive. Use caution when employing PK fittings in high-voltage applications.

Properties

Temperature Range	Temperature limit for PK is 200 °C, 392 °F
Thread Strength	Excellent
pH Range	0 – 14
Sterilization Techniques	Gamma irradiation; ethylene oxide; thermal
Autoclavable?	Y

PK Extended Properties

General		Test Method	Units	Typical Value
Relative Density	—	ASTM D792	—	1.45
Mold Shrinkage	—	—	mil/in	2-8

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	At 73 °F (yield)	ASTM D638	psi	30,000
Elongation at Yield	At 73 °F	ASTM D638 (5mm/min)	%	1.5
Flexural Modulus:	At 73 °F	ASTM D790	psi	2,300,000
Flexural Strength	At 73 °F	ASTM D790	psi	44,000
IZOD Impact Strength	At 73 °F Notched Unnotched	ASTM D256	ft.-lb./in.	1.2 11

Thermal		Test Method	Units	Typical Value
Coefficient of Thermal Expansion		ASTM D696	10^{-5} °F–	4
Heat Deflection Temperature, 264 psi		ASTM D648	°F (°C)	634 (334)

Polyethylene

Polyethylene tubing has good chemical resistance.

CAUTION: Take caution when using chlorinated solvents and some cyclic compounds.

Properties

Temperature Range	Up to 100 °C
Thread Strength	N/A
Oxygen Permeability	500 cc-mil / 100 in^2 * 24 h * atm cc-mil / 100 in^2 * 24 h * atm
pH Range	1-10
Sterilization Techniques	Gamma irradiation, ethylene oxide
Autoclavable?	N

Polyethylene Extended Properties

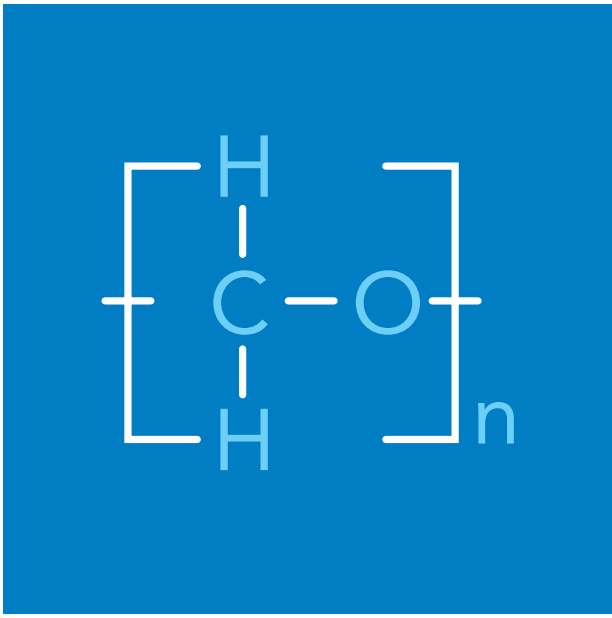
General	Condition	Test Method	Units	Typical Value
Density	—	ASTM D792	g/cc	0.92
Melt Flow	—	1.05kg / 190 °C	g/10 min.	6.6
Water Absorption	24 hour	ASTM D570	%	0.1
Hardness, Shore D	—	ASTM D2240	—	54

Mechanical	Condition	Test Method	Units	Typical Value
Elongation	Break	ASTM D638	%	610
Modulus of Elasticity	—	ASTM D638	GPa (ksi)	1.5 (2.2)
Flexural Modulus	—	ASTM D790	GPa (ksi)	35.3 (51.2)
Flexural Yield Strength	—	ATSM D790	MPa (psi)	11.8 (1710)
Izod Impact Strength	Notched, room temp.	ATSM D256	ft-lb/in	8.5

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Thermal Expansion	Linear 20 °C	—	µm/m- °C	10.1
Deflection Temperature	At 0.46 MPa	ASTM D648	°C (°F)	45 (316)
Maximum Service Temperature	Deflection Temp At 1.8 MPa	—	°C(°F)	158 (316)
Vicat Softening Temperature	—	ASTM D1525	°C (°F)	98 (208)

Polyoxymethylene (POM or Acetal)

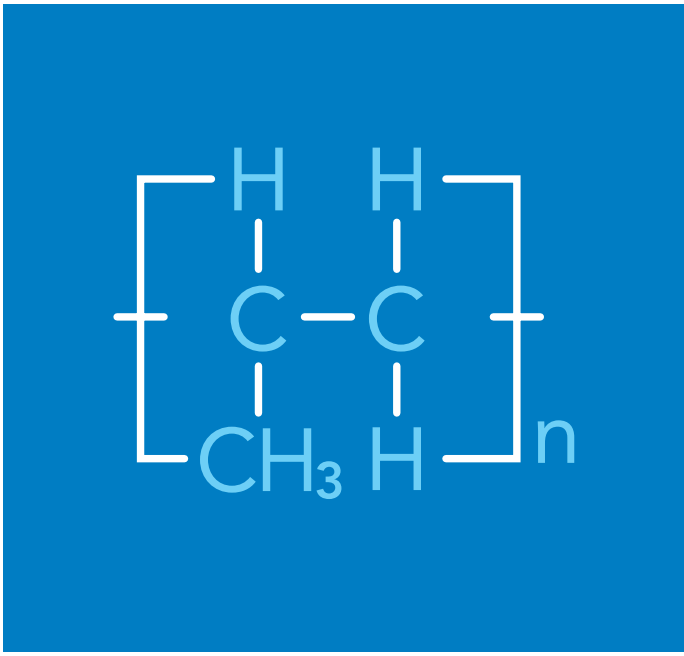
Polyoxymethylene (POM) has a wide variety of applications in industrial fields and often used in wet engineering environments. Characterized by high stiffness, low friction, and dimensional stability, POM is also known as acetal, polyacetal, or polyformaldehyde.



Properties

Temperature Range	Up to 80°C
Chemical Resistance	High resistance to oils and most organic solvents
pH Range	4 – 9
Autoclavable?	Y

Polypropylene



Polypropylene is used across many industries as a good, general-use polymer. It offers resistance to many standard chemical solutions across the full pH range, making it a product of choice for many applications. There are chemicals that will interact with polypropylene, either degrading it, discoloring it, or causing it to crack, and as such, it is important to ensure that the chemical solutions being used are compatible with this polymer. Such chemicals include chlorinated and aromatic solutions, as well as some organic solvents.

Properties

Temperature Range	Up to 40 °C
Thread Strength	Fair
Oxygen Permeability	N/A
pH Range	0 – 14
Sterilization Techniques	Ethylene oxide
Autoclavable?	Y

Polypropylene Extended Properties

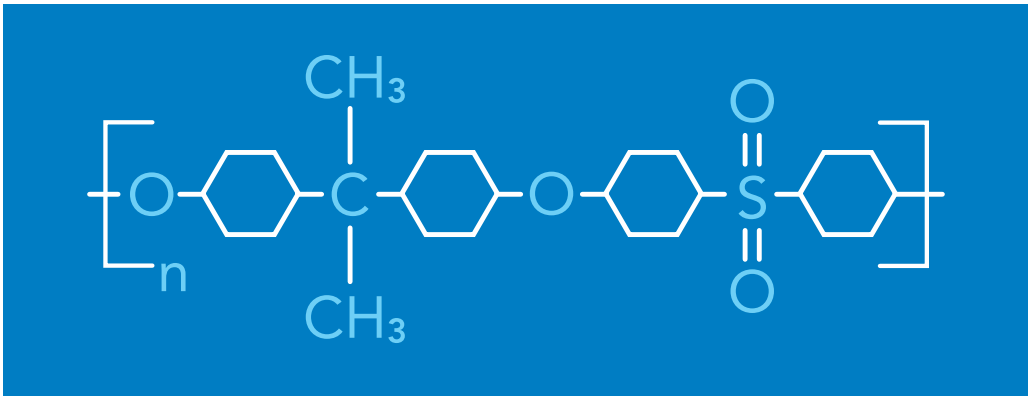
General	Condition	Test Method	Units	Typical Value
Water Absorption	24 hours Sat.	ASTM D570 ASTM D570	% %	0.03 0.2
Density	—	ASTM D792B	g/cc	0.9
Melt Flow Rate	230 °C / 2.16kg	ASTM D1238	g/10 min.	11
Haze	—	ASTM D1003A	%	10
Hardness, Rockwell R	—	ASTM D785	—	77

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	Ultimate	ASTM D638	MPa (psi)	30 (4,351)
Flexural Modulus	GPa	ASTM D790A	GPa (ksi)	1 (145)
Impact Strength	—	ASTM D256A	ft-lb/in	1.2
Elongation	Yield	ATSM D638	%	13

Thermal	Condition	Test Method	Units	Typical Value
Heat Deflection Temp	At .46 MPa, °C	ASTM D648	°F	183
Maximum Continuous Temperature	—	ASTM D794	°F	220

Polysulfone

In general, polysulfone is chemically resistant and can be used in many applications. There are some chemicals, however, that should not be used. Primarily, chlorinated organic solutions should be avoided, as should some alcohols and some aromatic hydrocarbons.



Properties

Temperature Range	Up to 100 °C
Thread Strength	Excellent
Oxygen Permeability	230 cc / 100 in^2 * 24h * atm / mil @ 25 °C
pH Range	0 – 14
Sterilization Techniques	—
Autoclavable?	Y

Polysulfone Extended Properties

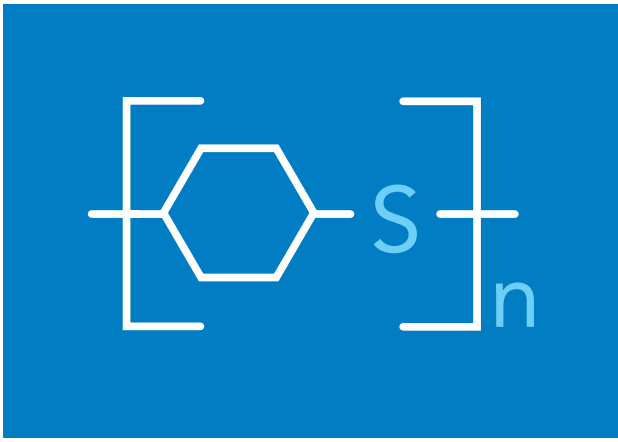
General	Condition	Test Method	Units	Typical Value
Water Absorption	24 hours	ASTM D570	%	0.03
Density	—	ASTM D792	g/cc	1.24

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	Yield	ASTM D638	psi	10,153
Elongation	Break 50 – 100% Yield	ATSM D638 ATSM D638	% %	75 6
Modulus of Elasticity	GPa	ASTM D638	ksi	360
Flexural Modulus	GPa	ATSM D790	ksi	390
Flexural Yield Strength	MPa	ATSM D790	ksi	15,374
Impact Strength	Izod, J/cm Notched	ATSM D256	ft-lb/in	1.3
Tensile Impact Strength	kJ/m^2	—	$ft\text{-}lb/in^2$	200

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Linear Thermal Expansion	20 °C Tansvers to Flow, µm/m- °C	In flow; ASTM E381 ASTM E381	µin/in- °F µin/in- °F	31 31
Maximum Continuous	Temperature	UL Relative Thermal Index, Electrical per UL 746B. Mechanical with impact 140 °C (280 °F); Mechanical without impact 160 °C(320 °F)	°F	320
UL RTI	Electrical, °C Mechanical with Impact, °C Mechanical without impact, °C	At 0.51mm At 0.51mm At 0.51mm	°F °F °F	320 284 284
Flammability UL94	5=V-0; 4=V-1; 3=V-2; 1=HB	HB @ 1.47mm	HB	1

Electrical	Condition	Test Method	Units	Typical Value
Electrical Resistivity	—	ASTM D257	ohm-cm	5E+16
Dielectric Constant	At 1kHz Low Frequency, 1kHz	ASTM D150 ASTM D150	— —	
Strength	—	ASTM D149	kV/in	432
Dissipation Factor	At 1kHz Low Frequency, 1kHz	ASTM D150 ASTM D150	kHz kHz	0.0015 0.0015

PPS (Polyphenylene Sulfide)



PPS (polyphenylene sulfide) is a highly chemical resistant polymer for room temperature and slightly elevated temperature applications. Great care should be taken, however, when using the polymer in elevated temperatures, as studies have shown the polymer to lose much of its chemical resistance properties when the temperature is too high. Additionally, the chemicals that show an effect with PPS are not pH dependent; however it is recommended to investigate specific compatibility prior to using strong acids or bases and some halogenated organic solutions.

Properties

Temperature Range	Up to 50 °C
Thread Strength	Excellent
Oxygen Permeability	N/A
pH Range	0 – 14
Sterilization Techniques	—
Autoclavable?	Y

PPS Extended Properties

General	Condition	Test Method	Units	Typical Value
Density	—	ASTM D792	g/cc	1.70
Water Absorption	24 hour immersion	—	%	0.02
Moisture Absorption at Equilibrium	Saturated immersion	—	%	0.02
Hardness, Rockwell M	—	ASTM D785	—	94
Hardness, Rockwell R	—	ASTM D785	—	125
Hardness, Rockwell D	—	ASTM D2240	—	86

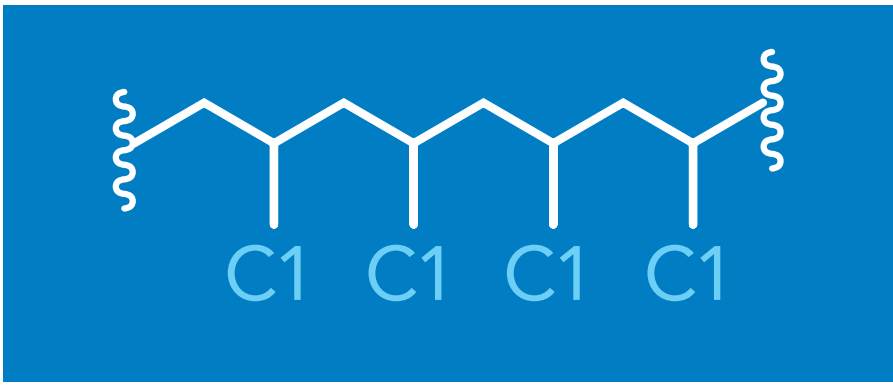
Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	Ultimate	ASTM D638	MPa (psi)	90 (13,053)
Elongation	Break	ASTM D638	%	2
Modulus of Elasticity	GPa	ASTM D638	725 ksi	5
Flexural Modulus	GPa	ASTM D790	1000 ksi	6.9
Flexural Yield Strength	—	ASTM D790	MPa (psi)	165 (23,061)
IZOD Impact Strength	J/cm	ASTM D256 Type A	0.99 ft.-lb./in.	0.53
Compressive Yield Strength	—	ASTM D256 10% Def	MPa (psi)	165 (23,061)
Compressive Modulus	GPa	ASTM D695	1,305 ksi	9
K (wear) Factor	10–10 in^3-min / lb-ft-hr	PTM55010	–	999
Limiting Pressure Velocity	MPa-m/sec	PTM55010	3,426 psi-ft/min	0.12

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Thermal Expansion	Linear 20 °C, µm/m- °C	ASTM E837 (TMA)	25 µin/in- °F	45
Deflection Temperature	At 1.8 MPa, °C	ASTM D648	489 °F	254
Melting Point °C		ASTM D3418	540 °F	282
Maximum Service Temperature	Air, °C	Contiuous Service without load	450 °F	232
Thermal Conductivity	W/m-K	–	2.1 BTU-in/ hr-ft^2– °F	0.3
Flammability, UL94	(5=V-0; 4=V-1; 3=V-2; 1=HB	V-0 UL 94	5	5 (V-0)

Electrical	Condition	Test Method	Units	Typical Value
Electrical Resistivity	Lower Limit	ASTM D257	1E+15 ohm-cm	5(V-0)
Dielectric Strength	Short Term	ASTM D149 (2)	386 kV/in	15.2

Polyvinyl Chloride (PVC)

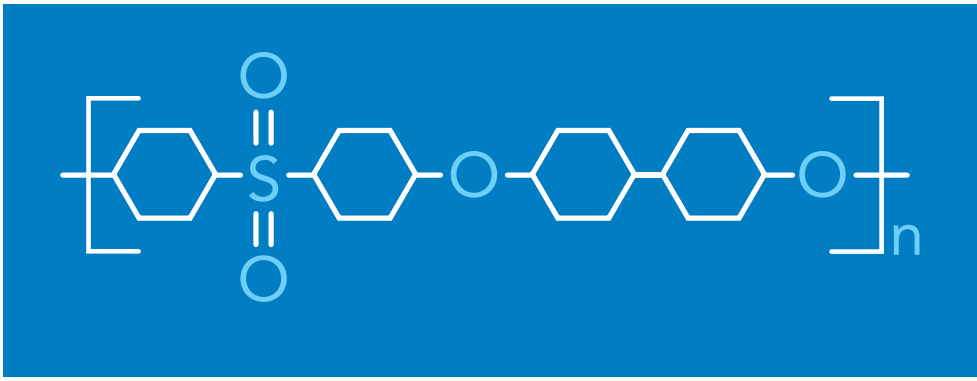
Polyvinyl chloride (PVC) is a polymer formed by polymerization of vinyl chloride. It has a high hardness, mechanical and insulative properties with high corrosion and chemical resistance. It is highly machinable allowing close tolerances and versatile in medical and industrial applications.



Properties

Temperature Range	Up to 50°C
Chemical Resistance	Not resistant to aromatic hydrocarbons
pH Range	0 – 14
Autoclavable?	N

Radel® R



Radel® R (polyphenylsulfone) tubing offers very high burst pressure and good chemical compatibility. This amorphous polymer can withstand repeated autoclave sterilization cycles because of its excellent thermal properties. Our Radel tubing is transparent, making visual monitoring of flow possible in high-pressure tubing. Chemicals that react with Radel are not pH dependent, please consult the chemical compatibility section of the website for more information on specific chemicals.

Properties

Temperature Range	Up to 100 °C
Thread Strength	N/A
Oxygen Permeability	N/A
pH Range	1 – 14
Sterilization Techniques	Thermal, gamma irradiation
Autoclavable?	Y

Radel® R Extended Properties

General	Condition	Test Method	Units	Typical Value
Density	—	ASTM D792	g/cc	1.29
Melt Flow	—	1.05 kg / 190 °C	g/10 min	11.5
Water Absorption	24 hour	ASTM D570	%	0.37
Water Absorption at Saturation	Immersion	ASTM D570/ ISO 62	%	1.10
Hardness, Rockwell M	—	ASTM D785	—	80
Hardness, Rockwell R	—	ASTM D785	—	120

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	Ultimate	ASTM D638	MPa (psi)	70 (10,100)
Elongation	Break	ASTM D638	%	60 – 120
Modulus of Elasticity	—	ASTM D638	GPa (ksi)	2.4 (345)
Flexural Modulus	—	ASTM D790	GPa (ksi)	2.4 (350)
Flexural Yield Strength	—	ASTM D790	MPa (psi)	106 (15,500)
Izod Impact Strength	—	ASTM D256	J/cm (ft-lb/in)	6.9 (13)
	Unnotched	ASTM D256		No break
Tensile Impact Strength	—	ASTM D1822	kJ/m2 (ft-lb/in^2)	400 (190)
Compressive Yield Strength	—	ASTM D695	MPa (psi)	92 (13,400)
Shear Strength	—	ASTM D732	MPa (psi)	62 (9,000)
Poissons Ratio	—	—	—	0.42

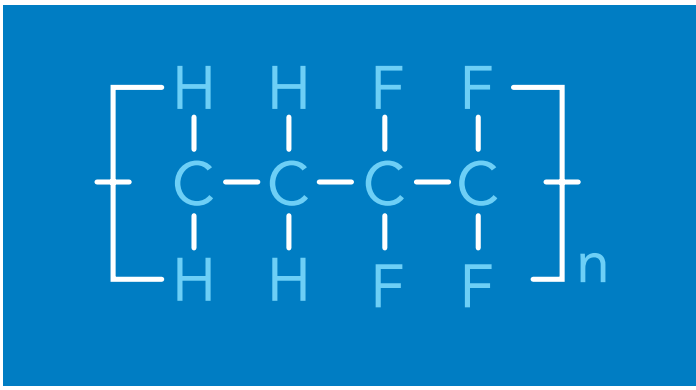
Radel® R Extended Properties (Continued)

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Thermal Expansion	Linear 20 °C	—	ppm- °C (ppm- °F)	56 (31)
Deflection Temperature	At 1.8 MPa	ASTM D648	°C (°F)	207 (405)
Melting Point	—	ASTM D3418	°C (°F)	345 – 400 (650 – 750)
Maximum Service Temperature	Deflection Temp at 1.8 MPa	—	°C (°F)	150 (300)
Thermal Conductivity	—	—	BTU-in/ hr-ft^2- °F	2.4
Flammability Rating, UL94	(5=V-0;4=V-1;3=V-2;1=HB)	UL94	mm (in)	0.75 (0.030)

Electrical	Condition	Test Method	Units	Typical Value
Electrical Resistivity	—	ASTM D257	ohm-cm	1E+15
Dielectric Constant	At 60 Hz	ASTM D150	—	3.4
Dielectric Strength, kV/mm	3.2 mm (0.125 in); Short Time	ASTM D149	V/mil	360
Dissipation Factor	At 1 MHz	ASTM D150	—	0.002

Tefzel® ETFE
(Ethylene TetrafluoroEthylene)

Tefzel® is a molecular relative of PTFE, and as such, is highly chemically resistant. It has proven to be an excellent material for sealing surfaces and for applications where aggressive solvents are being used and durable tubing is necessary for the application. Tefzel is also used for threaded products, particularly in our low pressure line of products and adapters.



CAUTION: Caution must be taken when using some chlorinated solvents with Tefzel, as they may interact and degrade or swell the polymer slightly.

Properties

Temperature Range	Up to 80 °C
Thread Strength	Good
Oxygen Permeability	100 cc / 100 in^2 * 24h * atm / mil @ 25 °C
pH Range	0 – 14
Sterilization Techniques	Ethylene oxide
Autoclavable?	Y

Tefzel® Extended Properties

General	Condition	Test Method	Units	Typical Value
Water Absorption	24 h	ASTM D570	%	0.007
Weather and Chemical Resistance	—	—	—	Excellent
Limiting Oxygen Index	—	ASTM D2863	%	30 – 32
Bulk Density	—	DuPont	g/L	1,300
Flame Rating	—	UL 94	—	V-0

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	23 °C (73 °F)	ASTM D638	MPa (psi)	40 (6,000)
Specific Gravity	—	ASTM D792	—	1.7
Ultimate Elongation	23 °C (73 °F)	ASTM D638	%	300
Flexural Modulus	23 °C (73 °F)	ASTM D790	MPa (psi)	1,000 (145,000)
Impact Strength	23 °C (73 °F)	ASTM D256	J/m (ft-lb/in)	No Break
Compressive Strength	—	ASTM D695	MPa (psi)	38 (5,500)
Linear Coefficient of Expansion	0 – 00 °C 32 – 212 °F	ASTM D696 ASTM D696	mm/mm/ °C in/in/ °F	12.6×10^{-5} 7.0×10^{-5}

Thermal	Condition	Test Method	Units	Typical Value
Nominal Melting Point	—	ASTM D3418	°C (°F)	255 – 280 (491 – 536)
Flow Rate	—	ASTM D3159	g/10 min	11
Upper Service Temperature	—	UL746	°C (°F)	155 (311)

Electrical	Condition	Test Method	Units	Typical Value
Dielectric Strength	0.25 mm (0.010 in)	ASTM D149	kV/mm (V/0.001 mil)	70 (1,800)
Dielectric Constant	1 MHz, 23 °C (73 °F)	ASTM D1531	—	2.5 – 2.6
Dissipation Factor	1 MHz, 23 °C (73 °F)	ASTM D1531	—	0.0054
Volume Resistivity	—	ASTM D257	Tohm-m (ohm-cm)	1×10^{3} (1×10^{17})

Titanium

Titanium products were created initially as a biocompatible alternative to stainless steel — something that did not have ferrous components. While being a metal and therefore offering a higher temperature rating than polymers can offer, titanium does not exhibit the same strong chemical resistance that stainless steel does, and is particularly susceptible to attack by strong acidic or basic solutions. There are many other solvents that will interact with titanium, so it is recommended that a chemical compatibility chart be consulted.

Properties

Temperature Range	Up to 250 °C
Thread Strength	Excellent
Oxygen Permeability	N/A
pH Range	1 – 12
Sterilization Techniques	Gamma irradiation; ethylene oxide; thermal
Autoclavable?	Y

Titanium Extended Properties

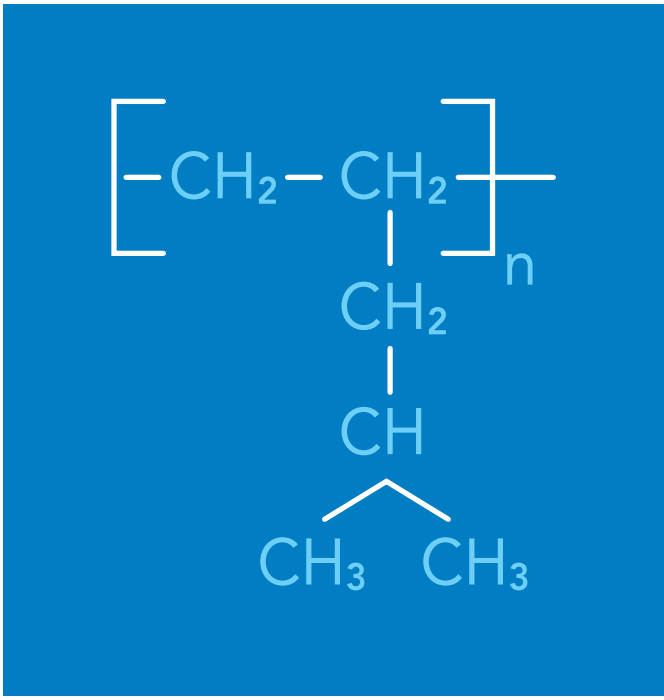
TITANIUM: GRADE 2 / CONDITION: ANNEALED

Mechanical – Meets ASTM F67	Test Method	Units	Typical Value
Tensile Strength	—	Mpa (ksi)	345 (50)
Yield Strength	—	Mpa (ksi)	275 (40)
Elongation min (la)	—	—	20

Composition – Meets ASTM F67	Test Method	Units	Typical Value
Carbon	—	—	0.10
Nitrogen	—	—	0.03
Hydrogen	—	—	0.0125
Iron	—	—	0.3
Oxygen	—	—	0.25
Titanium	—	—	Balance

TPX®
(Polymethylpentene)

TPX® (polymethylpentene) is used sparingly in the IDEX Health & Science product line. It offers good chemical compatibility across the full pH range. However, it is suspect to attack by halogenated chemicals and a number of organic solutions as well. Additionally, research has shown that, as the operating temperature reaches and exceeds 60 °C, the resistance to chemical attack is lowered considerably.



Properties

Temperature Range	Up to 50 °C
Thread Strength	Excellent
Oxygen Permeability	206 cc / 100 in^2 * 24 h * atm / mil @ 25 °C
pH Range	0 – 14
Sterilization Techniques	—
Autoclavable?	Y

TPX Extended Properties

General	Condition	Test Method	Units	Typical Value
Density	—	ASTM D792	g/cc	1.28
Melt Flow	—	1.05kg/190 °C	g/10 min	9
Water Absorption	24 hour	ASTM D570	%	0.25
Mold Shrinkage	—	—	%	0.5
Water Absorption at Saturation	Immersion	ASTM D570/ ISO 62	%	1.25
Hardness, Rockwell M	—	ASTM D785	—	112
Hardness, Rockwell R	—	ASTM D785	—	125

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	Ultimate	ASTM D638	MPa (psi)	105 (15,228)
Elongation	Break	ASTM D638	%	80
Modulus of Elasticity	—	ASTM D638	GPa (ksi)	2.9 (420)
Flexural Modulus	—	ASTM D790	GPa (ksi)	3.3 (479)
Flexural Yield Strength	—	ASTM D790	MPa (psi)	150 (21,700)
Izod Impact Strength	Notched, at 23 °C	ASTM D256	J/cm	0.53
Izod Impact Strength	Unnotched, at 23 °C	ASTM D256	J/cm	1.34
Compressive Yield Strength	—	ASTM D695	MPa (psi)	151 (22,000)
Shear Strength	—	ASTM D732	MPa (psi)	103 (15,000)
Fatigue Strength	Flexural fatigue endurance limit, 50% RH,	ASTM D672	MPa (psi)	32 (4,641)
Fatigue Strength	Flexural fatigue endurance limit, 50% RH, 1E+6 cycles	ASTM D672	MPa (psi)	32 (4,641)
Poissons Ratio	—	—	—	0.35
Coefficient of Friction	Dynamic vs. carbon steel, 50mm/s (2in/s)	—	—	0.42

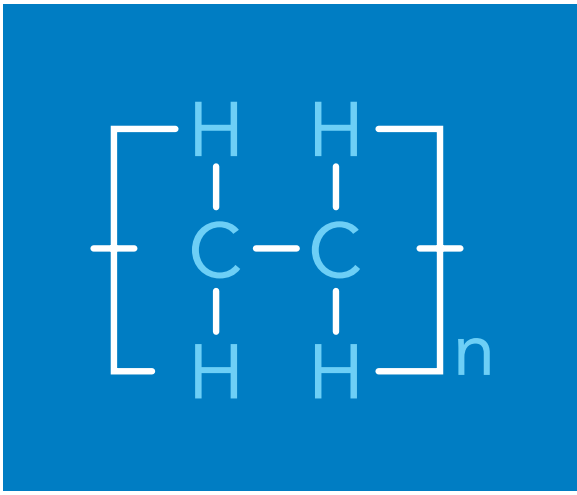
TPX Extended Properties (Continued)

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Thermal Expansion	Linear 20 °C	—	µin/in- °F	31
Deflection Temperature	At 1.8 MPa	ASTM D648	°F (°C)	392 (200)
Melting Point	—	ASTM D3418	°F (°C)	639-798 (337-426)
Thermal Conductivity	—	—	BTU-in/hr-ft^2- °F (W/m-K)	0.90 (0.22)
Flammability Rating, UL94	(5=V-0;4=V-1;3=V-2;1=HB)	UL94	B	1 (HB)

Electrical	Condition	Test Method	Units	Typical Value
Electrical Resistivity	—	ASTM D257	ohm-cm	1E+15
Dielectric Constant	At 1MHz	ASTM D150	—	3.7
Dielectric Strength, kV/mm	2.3mm (90 mils); Short Time	ASTM D149	500 kV/in	19.7
Dissipation Factor	At 1 MHz	ASTM D150	—	0.005
Arc Resistance	—	ASTM D495	sec	220

UHMWPE (Ultra High Molecular Weight Polyethylene)

UHMWPE (ultra high molecular weight polyethylene) is a commonly-used polymer which offers resistance to many chemical solutions, particularly aqueous-based ones. The polymer is durable and ideal for use in many "room temperature" applications. Care should be taken when using anything that is manufactured from UHMWPE in conjunction with some organic solutions as well as chlorinated solvents and nitric acid.



Properties

Temperature Range	Up to 50 °C
Thread Strength	N/A
Oxygen Permeability	N/A
pH Range	0 – 14
Sterilization Techniques	—
Autoclavable?	Y

UHMWPE Extended Properties

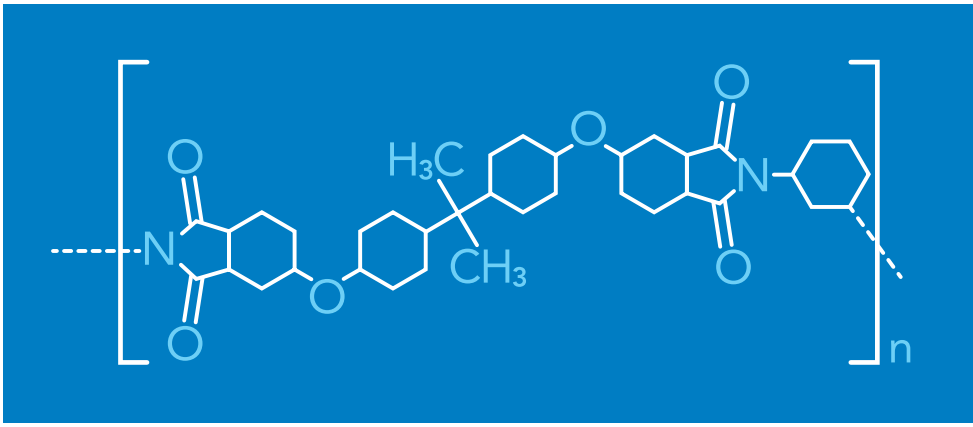
General	Condition	Test Method	Units	Typical Value
Water Absorption	24 h	D570	%	0.001
Density	lb/in^3 (g/cm^3)	D792	—	0.034 (0.93)

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	—	D638	psi	3,100
Tensile Modulus	—	D638	psi	125,000
Flexural Modulus	—	D790	psi	125,000
Compressive Strength	—	D695	psi	2,000
Hardness	Shore D	D785	—	D62-D66
IZOD	Notched Impact	D256	ft-lb/in	No Break

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Thermal Expansion	—	D696	10^5 in/in/ °F	11.1
Heat Deflection Temperature	At 66psi	D648	°C (°F)	95 (203)
Max operating Temperature	—	—	°C (°F)	82 (180)
Thermal Conductivity	x10^{-4} cal/cm-sec- °C BTU-in/ft^2-hr- °F	C177 C177	°C °F	10.06 2.92
Flammability Rating	—	UL94	—	H-B

Electrical	Condition	Test Method	Units	Typical Value
Dielectric Strength	(V/mil)	D149	—	900
Dielectric Constant	At 50 KHz	D150	—	2.3
Dissipation Factor	At 50 KHz	D150	—	0.0002
Volume Resistivity	(ohm-cm) at 50% RH	D257	—	>5 x 10^{16}

Ultem®
(Polyetherimide)



Ultem® (polyetherimide) is an amorphous polymer with a high temperature resistance and excellent chemical compatibility. IDEX Health & Science extrudes tubing from this material, that is transparent and exhibits good kind resistance. Ultem meets the requirements for ISO10993, FDA and USP Class VI certification.

Properties

Temperature Range	Up to 125 °C
Thread Strength	N/A
Oxygen Permeability	37 cc / 100 in^2 * 24 h * atm / mil @ 25 °C
pH Range	1 – 10
Sterilization Techniques	Gamma radiation, ethylene oxide, dry heat
Autoclavable?	Y

Ultem® Extended Properties

General	Condition	Test Method	Units	Typical Value
Density	—	ASTM D792	g/cc	1.28
Melt Flow	—	1.05 kg / 190 °C	g/10 min	9
Water Absorption	24 hour	ASTM D570	%	0.25
Mold Shrinkage	—	—	%	0.5
Water Absorption at Saturation	Immersion	ASTM D570/ ISO 62	%	1.25
Hardness, Rockwell M	—	ASTM D785	—	112
Hardness, Rockwell R	—	ASTM D785	—	125

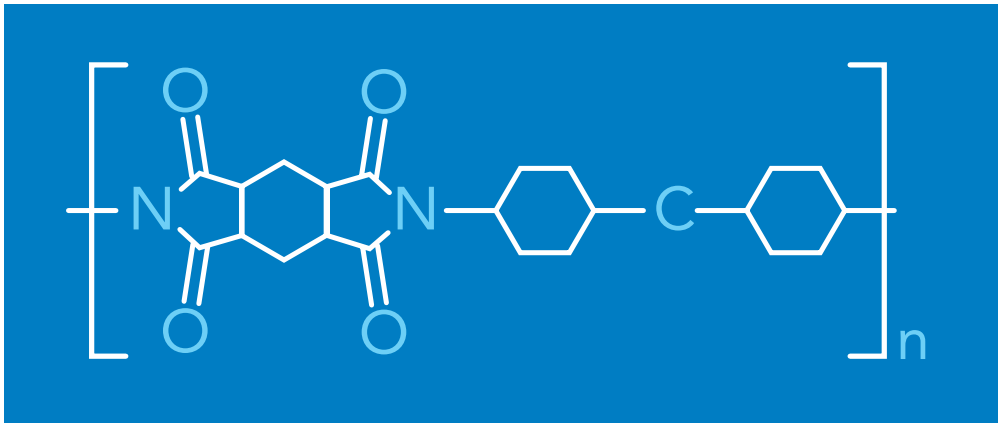
Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	Ultimate	ASTM D638	MPa (psi)	105 (15,228)
Elongation	Break	ASTM D638	%	80
Modulus of Elasticity	—	ASTM D638	GPa (ksi)	2.9 (420)
Flexural Modulus	—	ASTM D790	GPa (ksi)	3.3 (479)
Flexural Yield Strength	—	ASTM D790	MPa (psi)	150 (21,700)
Izod Impact Strength	Notched, at 23 °C	ASTM D256	J/cm	0.53
Izod Impact Strength	Unnotched, at 23 °C	ASTM D256	J/cm	1.34
Compressive Yield Strength	—	ASTM D695	MPa (psi)	151 (22,000)
Shear Strength	—	ASTM D732	MPa (psi)	103 (15,000)
Fatigue Strength	Flexural fatigue endurance limit, 50% RH,	ASTM D672	MPa (psi)	32 (4,641)
Fatigue Strength	Flexural fatigue endurance limit, 50% RH, 1E+6 cycles	ASTM D672	MPa (psi)	32 (4,641)
Poissons Ratio	—	—	—	0.35
Coefficient of Friction	Dynamic vs. carbon steel, 50 mm/s (2 in/s)	—	—	0.42

Ultem® Extended Properties (Continued)

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Thermal Expansion	Linear 20 °C		µin/in- °F	31
Deflection Temperature	At 1.8 MPa	ASTM D648	°F (°C)	392 (200)
Melting Point	—	ASTM D3418	°F (°C)	639 – 798 (337 – 426)
Thermal Conductivity	—	—	BTU-in/hr-ft^2- °F (W/m-K)	0.90 (0.22)
Flammability Rating, UL94	(5=V-0;4=V-1;3=V-2;1=HB)	UL94	B	1(HB)

Electrical	Condition	Test Method	Units	Typical Value
Electrical Resistivity	—	ASTM D257	ohm-cm	1E+15
Dielectric Constant	At 1MHz	ASTM D150	—	3.7
Dielectric Strength, kV/mm	2.3 mm (90 mils); Short Time	ASTM D149	500 kV/in	19.7
Dissipation Factor	At 1 MHz	ASTM D150	—	0.005
Arc Resistance	—	ASTM D495	Sec	220

Vespel®



Vespel® is a frequently-used polyimide material, often found in use with valves. While often adequate for use in systems where the chemicals do not go out of the pH range of 1 to 10, Vespel is susceptible to alkaline attack. This means that ammonia, hydrazines, amines, and any solution that surpasses pH 10 should be avoided. Also, strong oxidizing agents should be avoided or at least used with caution.

Properties

Temperature Range	Up to 200 °C
Thread Strength	Excellent
Oxygen Permeability	N/A
pH Range	1 – 10
Sterilization Techniques	Gamma irradiation
Autoclavable?	Y

Vespel® Extended Properties

General	Condition	Test Method	Units	Typical Value
Water Absorption	For 24 h immersion	ISO 62	%	24
Density	—	ISO 1183	g/cc	1.43
Mositure Absorption	At Equilibrium	50% RH	%	1.2
Hardness	Rockwell M	ISO 2039-2	—	100

Mechanical	Condition	Test Method	Units	Typical Value
Tensile Strength	Ultimate	ISO 527	MPa (psi)	86 (12,473)
Elongation %	Break	ISO 527	%	75
Modulus of Elasticity	GPa	ISO 527 in Tension	ksi	319
Impact Strength	Charpy, J/cm^2	ISO 179/1eA	ft-lb/in^2	1.7
Impact	Unnotched Charpy, J/cm^2	No break per ISO 179, 1eU	ft-lb/in^2	4,755
Compressive Yield Strength	—	At 1%; ISO 604	psi	3,336

Thermal	Condition	Test Method	Units	Typical Value
Coefficient of Thermal Expansion	20 °C, µm/m- °C 100 °C, µm/m- °C	Avg value between 23 & 100 °C Avg value between 23 & 150 °C	µin/in- °F µin/in- °F	25 25
Deflection Temperature	At 1.8MPa, °C	ISO 75 method A	°F	680
Maximum Service Temperature	Air, °C 450 °C for short periods 240 °C for 20,000 hours continuous	— — —	— °F °F	— 842 842
Thermal Conductivity	BTU-in/ft^2-hr- °F	—	°F	2.4
Oxygen Index	—	ISO 4589	%	53
Flammability Rating, UL94	5=V-0;4=V-1;3=V-2;1=HB	At 1.5 & at 3 mm thickness	V-0	5

Vespel® Extended Properties (Continued)

Electrical	Condition	Test Method	Units	Typical Value
Electrical Resistivity	—	IEC 93	ohm-cm	1E+61
Surface Resistance	—	IEC 93	ohm	1E+15
Dielectric Constant	1 MHz Low Frequency, 100 Hz	IEC 250 IEC 250	— —	3.6 3.6
Dielectric Strength	kV/mm	IEC 243	kV/in	711
Dissipation Factor	1 MHz Low Frequency, 100 Hz	IEC 250 IEC 250	— —	0.003 0.002

Chemical Compatibility Chart

This chemical compatibility chart allows you to check which materials are compatible with the chemicals you are currently using or planning to use, as well as view the compatibility ratings for materials you intend to use.

	Delrin®	Halar®	PCTFE	PEEK‡	Perfluoro-elastomer	Polypro-pylene	PPS[1]	Radel® R	FEP / PFA[2]	Tefzel®	UHMWPE	Ultem®
Chemical Family												
Aromatics	R	R[1]	R	R	R	NR	R	M	R	R	NR	R
Chlorinated	M	R	M	M	M	NR	M	M	R	R	M	M
Ketones	R	R[1]	R	R	R	M	R	M	R	R	M	M
Aldehydes	R	R[1]	R	R	R	R	R	M	R	R	R	M
Ethers	R	M	M	M	R	NR	R	M	R	R	M	M
Amines	M	M	R	R	R	R	R	M	R	M	M	N/A
Aliphatic Solutions	R	R	R	R	R	M	R	R	R	R	M	M
Organic Acids	NR	R	R	M	R	M	R	R	R	R	M	M
Inorganic Acids	NR	R	R	M	R	M	M	M	R	M	M	M
Bases	NR	R	R	R	R	R	R	R	R	R	R	M
Sulfonated Compounds	R	R	R	M	R	M	R	M	R	R	M	M
Thread Strength*	**Excellent**	**N/A**	**Good**	**Excellent**	**N/A**	**Fair**	**Excellent**	**N/A**	**Good**	**Good**	**Good**	**N/A**
Max. Recommended Operating Temp. (°C)									FEP PFA			
Fittings	60	N/A	80	125**	200***	40	50	N/A	N/A 80	80	50	N/A
Tubing	N/A	50	N/A	100**		N/A	N/A	100***	50 80	80	N/A	125

1 Chemical resistance assumes room temperature use. Elevated temperatures may result in a significant reduction in chemical resistance.

2 While the chemical compatibility of FEP & PFA is virtually identical, please note the temperature limit differences.

R Recommended

M Some solvents in this category are satisfactory, others are not. In addition, maximum concentration can vary with the specific product type and chemical. Please contact IDEX Health & Science for further information.

NR Chemicals in this category are generally not recommended for use with this polymer.

N/A Information not available.

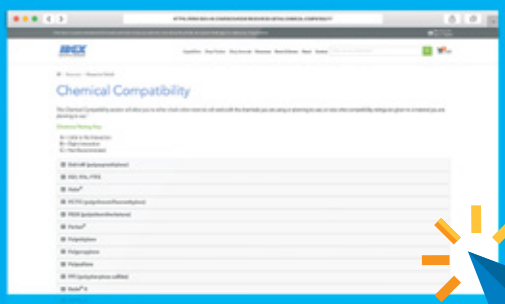
* Shear Strength

** In some cases, PEEK fittings can be used to higher temperatures. Please contact IDEX Health & Science for specific information.

*** Radel is an amorphous polymer, and as such, its upper limit service temperature is application and chemical dependent, and may be higher than 100° C in some cases.

*** Perfluoroelastomer material can be used in applications at even higher temperatures; however, its successful use is typically limited to the performance limitations of the tubing and the components used with it.

‡ In some circumstances, acetonitrile has been reported to swell and occasionally burst PEEK tubing. Exercise caution when using high concentrations of acetonitrile at or near the maximum pressure of this tubing.



For more Polymer information, view our full Chemical Compatibility section on our website:
www.idex-hs.com/compatibility

Material Properties Index

The Material Properties Index helps you quickly identify materials that meet your specific application requirements. Organized by key properties, this section provides a comprehensive cross-reference to guide your material selection process.

Material Categories

PLASTICS:

METALS:

ELASTOMERS:

Biocompatibility

Chemical Resistance

Corrosion Resistance

Durability

316 Stainless Steel (page 8)
Delrin® (Polyoxymethylene) (page 10)
HPFA and HPFA+ (page 27)
PCTFE (PolyChloroTriFluoroEthylene) (page 18)
PEEK (Polyetheretherketone) (page 20)
Perlast® (page 23)
PFA (page 25)
PK (Polyketone) (page 29)
Polyethylene (page 31)
Polyoxymethylene (POM or Acetal) (page 33)
Polypropylene (page 34)
PPS (Polyphenylene Sulfide) (page 38)
Polysulfone (page 36)
Polyvinyl Chloride (PVC) (page 40)
Radel® R (page 41)
Tefzel® ETFE (Ethylene TetrafluoroEthylene) (page 44)
Titanium (page 46)
TPX® (Polymethylpentene) (page 48)
UHMWPE (Ultra High Molecular Weight Polyethylene) (page 51)
Ultem® (Polyetherimide) (page 53)
Vespel® (page 56)

Flexibility

Delrin® (Polyoxymethylene) (page 10)
FEP (page 13)
Halar® (page 15)
HPFA and HPFA+ (page 27)
Perlast® (page 23)
PFA (page 25)
PK (Polyketone) (page 29)
Polyethylene (page 31)
Polyoxymethylene (POM or Acetal) (page 33)
Polypropylene (page 34)
Polyvinyl Chloride (PVC) (page 40)
Tefzel® ETFE (Ethylene TetrafluoroEthylene) (page 44)
TPX® (Polymethylpentene) (page 48)
UHMWPE (Ultra High Molecular Weight Polyethylene) (page 51)

Mechanical Strength

316 Stainless Steel (page 8)
Acrylic (page 9)
Delrin® (Polyoxymethylene) (page 10)
PEEK (Polyetheretherketone) (page 20)
PCTFE (PolyChloroTriFluoroEthylene) (page 18)
PK (Polyketone) (page 29)
Polyethylene (page 31)
Polyoxymethylene (POM or Acetal) (page 33)
Polysulfone (page 36)
PPS (Polyphenylene Sulfide) (page 38)
Radel® R (page 41)
Titanium (page 46)
TPX® (Polymethylpentene) (page 48)
Ultem® (Polyetherimide) (page 53)
Vespel® (page 56)

Temperature Stability

HIGH (200°C AND ABOVE):

316 Stainless Steel (page 8)
Acrylic (page 9)
Perlast® (page 23)
PK (Polyketone) (page 29)
Titanium (page 46)
Vespel® (page 56)

MODERATE (80°C TO 199°C):

PEEK (Polyetheretherketone) (page 20)
Polyethylene (page 31)
Polysulfone (page 36)
Radel® R (page 41)
Tefzel® ETFE (Ethylene TetrafluoroEthylene) (page 44)
Ultem® (Polyetherimide) (page 53)

LOW (BELOW 80°C):

Delrin® (Polyoxymethylene) (page 10)
FEP (page 13)
Halar® (page 15)
PCTFE (PolyChloroTriFluoroEthylene) (page 18)
PFA (page 25)
HPFA and HPFA+ (page 27)
Polyoxymethylene (POM or Acetal) (page 33)
Polypropylene (page 34)
PPS (Polyphenylene Sulfide) (page 38)
Polyvinyl Chloride (PVC) (page 40)
TPX® (Polymethylpentene) (page 48)
UHMWPE (Ultra High Molecular Weight Polyethylene) (page 51)

Transparency

Acrylic (page 9)
FEP (page 13)
HPFA and HPFA+ (page 27)
PFA (page 25)
Polypropylene (page 34)
Polysulfone (page 36)
Polyvinyl Chloride (PVC) (page 40)
Radel® R (page 41)
Tefzel® ETFE (Ethylene TetrafluoroEthylene) (page 44)
TPX® (Polymethylpentene) (page 48)
Ultem® (Polyetherimide) (page 53)

Wear Resistance

316 Stainless Steel (page 8)
Delrin® (Polyoxymethylene) (page 10)
PEEK (Polyetheretherketone) (page 20)
PPS (Polyphenylene Sulfide) (page 38)
Polyethylene (page 31)
Polyoxymethylene (POM or Acetal) (page 33)
Polysulfone (page 36)
UHMWPE (Ultra High Molecular Weight Polyethylene) (page 51)
Radel® R (page 41)
Ultem® (Polyetherimide) (page 53)
Vespel® (page 56)

Glossary of Terms

316 Stainless Steel: See page 8.

Acrylic: See page 9.

Arc Resistance: The ability of a material to resist electrical breakdown when exposed to high-voltage electric arcs.

Autoclavable: Indicates whether a material can withstand high temperatures and pressures used in autoclave sterilization processes.

Chemical Family: A group of materials that share similar chemical structures and properties, often impacting their performance i n certain applications.

Chemical Resistance: A material's ability to withstand exposure to aggressive chemicals without degrading.

Coefficient of Thermal Expansion: The rate at which a material expands or contracts when exposed to temperature changes.

Conductivity: A material's ability to conduct heat (thermal conductivity) or electricity (electrical conductivity).

Corrosion Resistance: A material's ability to resist degradation caused by moisture, salts, or other corrosive elements.

Delrin® (Polyoxymethylene): See page 10.

Dielectric Constant: A measure of a material's ability to store electrical energy in an electric field.

Dielectric Strength: The maximum electric field a material can withstand without electrical breakdown.

Dissipation Factor: A measure of energy loss in a material when used in electrical applications.

Durability: The ability of a material to perform reliably over time, resisting wear and tear.

FEP: See page 13.

Fittings: Mechanical components used to join tubing, pipes, or other fluidic pathways, ensuring secure and leak-free connections.

Flexibility: The property of a material that allows it to bend or stretch without breaking or losing its shape.

Flexural Modulus: A measure of a material's stiffness or resistance to bending when a force is applied.

Flexural Yield Strength: The stress at which a material begins to deform permanently under bending conditions.

Halar® (ECTFE): See page 15.

Hardness: A material's ability to resist indentation or scratching, typically measured on scales like Shore or Rockwell.

HPFA and HPFA+: See page 27.

Mechanical Properties: Characteristics that define how a material responds to physical forces, including tensile strength, flexural strength, and impact resistance.

Oxygen Permeability: The rate at which oxygen can pass through a material, expressed in standardized units.

PCTFE (PolyChloroTriFluoroEthylene): See page 18.

PEEK (Polyetheretherketone): See page 20.

Perlast®: See page 23.

pH Range: The range of acidity or alkalinity that a material can tolerate without degradation.

Poisson's Ratio: A measure of how a material deforms in directions perpendicular to applied stress, describing its ability to contract or expand.

PFA: See page 25.

PK (Polyketone): See page 29.

Polyethylene: See page 31.

Polyoxymethylene (POM or Acetal): See page 33.

Polypropylene: See page 34.

Polysulfone: See page 36.

Polyvinyl Chloride (PVC): See page 40.

Porosity: The presence of small voids or pores in a material, which may impact strength, permeability, or chemical resistance.

PPS (Polyphenylene Sulfide): See page 38.

Pressure Rating: The maximum pressure a material or component can safely withstand without failing.

Radel® R: See page 41.

Sterilization Techniques: Methods for sterilizing materials, including autoclaving (steam), gamma irradiation, and ethylene oxide treatments.

Temperature Stability: A material's ability to maintain performance across a range of temperatures, including extreme heat or cryogenic conditions.

Thermal Properties: A group of characteristics, including thermal conductivity, expansion, and resistance, that define how materials respond to heat.

Tefzel® ETFE: See page 44.

Titanium: See page 46.

TPX® (Polymethylpentene): See page 48.

Transparency: The optical clarity of a material, which is critical for applications requiring visibility or light transmission.

Tubing: Hollow components designed to transport fluids or gases, often chosen based on material properties like chemical resistance and flexibility.

UHMWPE (Ultra High Molecular Weight Polyethylene): See page 51.

Ultem®: See page 53.

UV Stability: The ability of a material to resist degradation when exposed to ultraviolet light.

Vespel®: See page 56.

Viscosity: A measure of a fluid's resistance to flow, which can impact fluid handling and system performance.

Water Absorption: The measure of how much water a material can absorb over time, typically expressed as a percentage of its weight.

Wear Resistance: The ability of a material to resist damage caused by friction or abrasion.

Yield Strength: The stress at which a material begins to deform permanently.

IDEX HEALTH & SCIENCE

For ordering, technical support, and contact information please visit www.idex-hs.com