

Application: Industrial Machinery

Fluororesin used: PTFE (CAS No. 9002-84-0)

Product Overview: Sealing materials (screws, piping, etc.)

Fluororesin is used as sealing materials for screws and piping in industrial machinery applications.

These applications require specifications such as self-bonding, tensile strength, chemical resistance, heat resistance, elasticity, pressure resistance, and purity, and fluororesin is employed as a member that meets all these required specifications.

At this time, no alternative product that simultaneously meets all of the above required characteristics has been found.

There are several types of sealing materials, including rubber seal, silicone seal, fluorine seal, and metal seal, each of which is selectively used depending on the use environment. After many studies in consideration of the use environment at each user company, fluorine seal is determined to be appropriate and is used. The social impact on the industry due to the loss of sealing materials that can be used in these selected applications would be significant.

For the above reason, we believe that no alternative is available and that regulatory exemption of this application from proposed restriction is reasonable.

Representative properties of fluororesin are shown in the following table.

List of properties of fluororesin

△ : Usable ○ : Superior
 ◎ : Very Superior ★ : Even more superior ◎

Characteristics	Unit	ASTM test method	PTFE	PFA	FEP	ETFE	PVDF	ECTFE	PCTFE
Melting point	℃	—	327	310	260	270	156~170	245	220
Specific gravity	—	D792	2.14~2.20	2.12~2.17	2.12~2.17	1.70	1.75~1.78	1.68~1.69	2.1~2.2
Tensile strength	MPa	D638	27.4~34.3	24.5~31.4	21.6~31.4	45.1	34.3~43.1	48	30.9~41.2
Elongation	%	D638	200~400	300	250~330	100~400	80~300	200~300	80~250
Compression strength	MPa	D695	11.8	16.7	15.2	49	66.6~96	—	31.4~51
Impact strength	J/m	D256A	160	No fracture	No fracture	No fracture	160~374	No fracture	133~144
Hardness (Rockwell)	—	D785	—	—	—	R50	R77~R3	—	R25~R5
Hardness (shore)	—	D2240	D50~55	D60	D55	D75	D75~77	D55	—
Bending elastic modulus	MPa	D790	550	600~690	650	1400	2000~2490	600~690	—
Tensile elastic modulus	MPa	D638	400~550	—	340	820	1310~1500	—	1030~2100
Dynamic friction coefficient	—	D6904M	0.10	0.2	0.3	0.4	0.29	—	0.37
Thermal conductivity	W/(m·K)	C177	0.25	0.25	0.25	0.24	0.19~0.13	0.16	0.20~0.22
Specific heat	J/(g·K)	—	1.0	1.0	1.2	1.9~2.0	1.4	—	0.92
Linear expansion coefficient	10 ⁻⁵ /℃	D696	10	12	8.3~10.5	5.9	7~14	8	4.5~7.0
Ball pressure temperature	℃	—	180	230	170	185	—	—	170
Heat distortion temperature 1.81MPa	℃	—	55	50	50	74	87~115	77	—
Heat distortion temperature 0.45MPa	℃	—	121	74	72	104	149	116	126
Highest working temperature	℃	(No load)	260	260	200	150~180	150	165~180	177~200
Volume resistivity	Ω·cm	D577 (50% RH, 23℃)	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	2×10 ¹⁴	>10 ¹⁴	1.2×10 ¹⁴
Dielectric breakdown strength (short term)	kV/mm (3.2mm厚)	D149	19	20	20~24	16	10	20	20~24
Dielectric constant	—	D150	<2.1	<2.1	2.1	2.6	8.4	2.6	2.24~2.8
Dielectric loss tangent	—	D150	<2.1	<2.1	2.1	2.6	8.4	2.6	2.3~2.8
Dielectric loss tangent	—	D150	<2.1	<2.1	2.1	2.6	6.43	2.6	2.3~2.5
Dielectric loss tangent	—	D150	<0.0002	<0.0002	<0.0002	0.0006	0.049	<0.0005	0.0012
Dielectric loss tangent	—	D150	<0.0002	<0.0002	<0.0002	0.0008	0.018	0.0015	0.023~0.027
Dielectric loss tangent	—	D150	<0.0002	0.0003	<0.0003	0.005	<0.015	0.009~0.017	—
Arc resistance	#	D495	>300	>300	>300	75	50~70	18	>360
Water absorption rate at 24 hours	%	D570	<0.01	<0.03	<0.01	0.029	0.04~0.06	0.01	0.00
Flammability	—	(UL-94)	V-0	V-0	V-0	V-0	V-0	V-0	V-0
Limiting oxygen index	—	D2863	>95	>95	>95	30	44	60	>95
No influence of direct sunlight	—	—	None	None	None	None	None	None	None
Acid	—	—	★	★	★	○	○	○	○
Alkali	—	—	★	★	★	○	○	○	○
Solvent	—	—	★	★	★	○	△	○	○

Elution test example of fluororesin

Eluate: concentrated nitric acid Elution temperature: room temperature

Elution time: 1+6+7 (days)

Processing method: PTFE paste extrusion method

PFA-screw extrusion method

Analytical method: ICP-MS method or flameless atomic absorption spectrometry

Unit: ppb

Element	PTFE						PFA					
	No.1			No.2			No.1			No.2		
	1 day	6 days	7 days	1 day	6 days	7 days	1 day	6 days	7 days	1 day	6 days	7 days
Li	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Be	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Na	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Al	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ti	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
V	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cr	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mn	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ni	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Co	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cu	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zn	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ga	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ge	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sr	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zr	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mo	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ag	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cd	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
In	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sn	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ba	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ta	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Tl	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bi	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fe	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ca	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	0.1
K	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Reference: VALQUA Handbook, Technical Section