Chemical resistance of PEEK at high temperature

Chemical	°C	°F	Rating
Acetic acid	200	420	□
Ammonia gas	200	420	■
Carbon monoxide gas	200	420	■
Ethylene glycol	200	420	□
Ethylene glycol (50%)	140	284	■
Hydrogen sulphide gas	200	420	■
Liquid ammonia	200	420	□
Methane	200	420	■
Methylethylketone	200	420	■
Nitrobenzene	200	420	■
Phosphoric acid (50%)	200	420	■
Sodium hydroxide solution	200	420	■
Sulphuric acid (50%)	200	420	□
Sulphur dioxide gas	200	420	■

Chemical characteristics of PEEK®

PEEK exhibits excellent resistance to a wide range of organic and inorganic chemicals. The compatibility of PEEK with many chemicals at 20°C (68°F) has been investigated and the results for unreinforced grades are given in the table below.

PEEK is compatible with almost any of the solvents used in HPLC. The only solvents which will attack PEEK are concentrated nitric acid and sulphuric acids. However, PEEK tubing can safely withstand 20-30% nitric acid when passivating a system.

Methylene chloride, DMSO, and THF may cause swelling in PEEK. The highest temperature we recommend for PEEK is 100°C. The tubing will maintain the stated pressure rating up to this temperature.

Chemical resistance of PEEK and other polymers

A

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Acetaldehyde	■	■	–	–	–	■	–	■	–	■	■
Acetic acid (20 %)	■	■	■	■	■	■	■	■	■	□	■
Acetic acid (80 %)	■	■	■	■	■	■	–	■	■	–	–
Acetic acid (glacial)	■	■	■	■	■	■	■	■	■	■	■
Acetone	■	■	□	■	■	■	■	■	■	■	■
Acetonitrile	■	■	–	–	■	■	■	■	■	□	■
Acrylic acid	■	–	–	–	■	■	–	■	–	–	–
Ammonia, anhydrous	■	□	–	–	■	■	–	■	–	–	–
Ammonia (10 %)	■	□	□	■	■	■	■	■	■	–	–
Ammonia (Liquid)	□	■	–	–	■	■	–	■	–	–	–
Ammonium hydroxide	■	–	■	■	■	■	■	■	■	–	–
Aqua regia	■	■	–	–	■	■	–	■	–	■	■
Aromatic hydrocarbons	■	–	□	■	■	■	–	■	–	–	–

B

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Benzene	■	■	□	■	■	■	■	■	■	–	–
Benzoic acid	■	–	–	–	■	■	–	■	–	–	–
Benzaldehyde	■	–	–	–	■	■	–	■	–	–	–
Bromine/dibromoethane	■	–	–	–	■	■	–	■	–	–	–
Bromine (dry)	■	–	–	–	■	■	–	■	–	–	–
Bromine (wet)	■	□	–	–	■	■	–	■	–	■	■
Boric acid	■	–	–	–	■	■	–	■	–	–	–
Butanol	■	–	■	■	■	■	■	■	■	–	–

LEGEND

- ■ Suitable
- □ Marginal; dependent on application
- ■ Not recommended
- – No data available

C

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Calcium hydroxide	■	–	–	–	■	■	–	■	–	–	–
Carbon tetrachloride	■	–	–	–	■	■	–	■	–	–	–
Chlorine (gas)	■	■	–	–	■	■	–	■	–	■	■
Chlorine (liquid)	■	■	–	–	■	■	–	■	–	–	–
Chloroacetic acid	■	–	□	□	■	■	■	■	■	–	–
Chlorobenzene	■	■	–	–	■	■	–	■	–	–	–
Chloroform	■	■	□	□	■	■	■	■	■	–	–
Cyclohexane	■	■	□	■	■	■	■	■	■	–	–
Cyclohexanone	■	■	■	■	■	■	■	■	■	■	■

D

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Diethylamine	■	–	■	■	–	■	■	■	■	–	–
Diethylether	■	■	–	–	■	■	–	■	–	–	–
Diethylformamide	■	■	■	■	■	■	■	■	■	■	■
Dioxane	■	■	–	–	■	■	■	■	–	–	–

E

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Ethanol	■	■	□	■	■	■	■	■	■	■	■
Ether	■	■	□	■	■	■	■	■	■	–	–
Ethyl acetate	■	■	□	■	■	■	■	■	■	■	■
Ethylene chloride	–	■	□	□	■	■	■	■	■	–	–
Ethlene glycol	■	■	■	■	■	■	■	■	■	■	■

H

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Heptane	■	□	□	□	■	■	■	■	■	■	■
Hexane	■	■	□	□	■	■	■	■	■	–	–
Hydrobromic acid (100%)	■	–	□	□	■	■	–	■	■	–	–
Hydrobromic acid (20%)	■	–	□	■	–	■	■	■	■	–	–
Hydrochloric acid (100%)	■	–	–	□	■	■	■	■	■	–	–
Hydrochloric acid (20%)	■	–	■	□	■	■	■	■	■	–	–
Hydrofluoric acid (100%)	■	–	–	□	■	■	■	■	■	–	–
Hydrofluoric acid (20%)	–	–	■	■	■	■	■	■	■	–	–
Hydrogen peroxide (100%)	■	–	□	□	■	■	–	■	■	–	–
Hydrogen peroxide (50%)	■	–	□	□	–	■	■	■	■	–	–
Hydrogen peroxide (10%)	■	–	■	■	■	■	■	■	■	–	–

I

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Iso-octane	■	–	–	■	■	■	–	■	■	–	–
Isopropanol	■	□	■	■	■	■	–	■	■	□	■
Isopropyl ether	–	■	■	□	–	■	–	■	■	–	–

K

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Ketones	■	–	□	□	■	■	–	■	■	–	–

GENERAL REFERENCE

M

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Methanol	■	■	■	■	■	■	■	■	■	■	■
Methyl dichloride	–	□	–	■	–	■	–	■	–	–	–
Methyl ethylketone	■	■	□	□	■	■	■	■	■	–	–
Methlyene chloride	□	□	□	□	■	■	■	■	■	■	■

N

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Nitric acid (100%)	■	–	□	■	■	■	■	■	■	–	–
Nitric acid (20%)	■	–	□	■	■	■	■	■	■	–	–

P

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Pentane	■	–	■	■	–	■	–	■	■	–	–
Perchloric acid	■	–	□	□	–	□	–	□	■	–	–
Phenol (dilute)	■	–	–	–	■	■	–	■	–	–	–
Phenol (concentrated)	■	–	–	–	■	■	–	■	–	–	–
Phosphoric acid (100%)	■	–	□	■	■	■	■	■	■	–	–
Phosphoric acid (40%)	■	–	■	■	■	■	■	■	■	–	–
Potassium hydroxide (dilute)	■	–	–	–	■	■	–	■	–	–	–
Potassium hydroxide (70%)	■	–	–	–	■	■	–	■	–	–	–
Propanol	■	□	–	–	–	■	–	■	–	■	■
Pyridine	■	–	□	■	■	■	■	■	■	–	–

S

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Sodium hydroxide (80%)	■	□	□	■	■	■	–	■	■	–	–
Sodium hydroxide (20%)	■	□	■	■	■	■	■	■	■	–	–
Sulfuric acid (100%)	■	■	□	□	■	■	■	■	■	–	–
Sulfuric acid (75%)	■	□	■	■	■	■	■	■	■	–	–
Sulfuric acid (40%)	■	■	■	■	■	■	■	■	■	–	–

T

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Tetrahydrofuran	□		□	□	■	■	■	■	■	–	–
Toluene	■		□	□	■	■	■	■	■	–	–
Trichloroacetic acid	■		■	■	■	■	■	■	■	–	–
Trichloroethane	■		–	□	–	■	–	■	■	–	–
Trichloroethylene	■		–	–	■	■	–	■	–	–	–
Triethylamine	–		–	■	–	■	■	■	■	–	–

W

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Water	■	■	■	■	■	■	■	■	■	■	■
Water (distilled)	■	–	■	■	■	■	■	■	■	–	–

X

Resistance at 20°C	PEEK	PA	PE	PP	PPS	FEP	ETFE	PFA	PTFE	NBR	EPDM
Xylene	■	–	–	–	■	■	–	■	–	–	–

LEGEND

- ■ Suitable
- □ Marginal; dependent on application
- ■ Not recommended
- – No data available

Properties of polymers

CTFE
Chlorotrifluoroethylene, is the generic name for the material produced as Kel-F®. It is very resistant to all chemicals except THF and some halogenated solvents, and is resistant to all inorganic corrosive liquids, including oxidizing acids. CTFE can be used at temperatures up to 100°C. Swells in ketones.

EPDM
Ethylene Propylene Diene Monomer. Ethylene-propylene synthetic rubbers offer excellent heat resistance as well as resistance to aging from oxidation, ozone, and weather due to their stable, saturated polymer backbone structure. As non-polar elastomers, they have good electrical resistivity as well as resistance to polar solvents such as water, acids, alkanes, phosphates, esters, and many ketones and alcohols.

ETFE
Ethyltrifluoroethylene is the generic name for the material such as Tefzel®. A fluoropolymer used for sealing surfaces, it is resistant to most chemical attack; however, some chlorinated chemicals will cause a physical swelling of ETFE tubing.

FEP
Fluorinated ethylene propylene is another member of the fluorocarbon family with similar chemical properties. It is generally more rigid than PTFE, with somewhat increased tensile strength. It is typically more transparent than PTFE, slightly less porous, and less permeable to oxygen. FEP is not as subject to compressive creep at room temperature as PTFE, and because of its slightly higher coefficient of friction is easier to retain in a compression fitting.

FFKM
FFKM (perfluorinated rubber) is a perfluoroelastomer, a class of materials such as Kalrez®. It is chemically resistant to polar solvents, organic solvents, inorganic and organic acids and bases, fuels, oils, lubricants, inorganic salts, aldehydes, metal halogen compounds, chlorine, sodium hydroxide, aromatics, alcohols, steam, and strong oxidizing agents. The normal temperature service range is -40°C to 315°C, with up to 343°C in intermittent service.

PEEK™
Considered relatively inert and biocompatible, polyetheretherketone tubing can withstand temperatures up to 100°C. Under the right circumstances, .005" - .020" ID tubing can be used up to 5000 psi for a limited time, and 0.030" to 3000 psi. Larger IDs are typically good to 500 psi. These limits will be substantially reduced at elevated temperatures and in contact with some solvents or acids.

Its mechanical properties allow PEEK to be used instead of stainless in many situations and in some environments where stainless would be too reactive. However, PEEK can be somewhat absorptive of solvents and analytes, notably methylene chloride, DMSO, THF, and high concentrations of sulfuric and nitric acid. This tubing is highly prone to "kinking", or sealing off, if held in a sharp bend over time.

PFA
Perfluoroalkoxy is a fluorocarbon with chemical and mechanical properties similar to FEP. More rigid than either PTFE or FEP. Commonly used for injection molded parts.

PPS
Polyphenylene sulphide is the generic name for the material produced as Fortron®, Ryton®, and Techtron®. It is very resistant to all solvents, acids, and bases.

PTFE
Polytetrafluoroethylene is the generic name for the class of materials such as Teflon®. It offers superior chemical resistance but is limited in pressure and temperature capabilities. Because it's so easy to handle, it is often used in low pressure situations where stainless steel might cause adsorption. PTFE tubing is relatively porous, and compounds of low molecular weight can diffuse through the tubing wall.

Polyacetal
Polyacetal or polyoxymethylene (POM) is the generic name for the material produced as Delrin®. It is an engineering polymer with high mechanical strength and rigidity, excellent dimensional stability and excellent resistance to moisture and solvents. It has a wide useful temperature range in air of -50°C to +90°C. It is not suitable for use with acids, alkalis, or oxidizing agents, and has limited resistance to dichloromethane and methyl ethyl ketone.

Continued, next page.

GENERAL REFERENCE

Polyamide
Polyamide is a thermoplastic polymer also known as nylon. Nylon has very good physical properties, but moisture can have a significant effect. It exhibits very good heat resistance and excellent chemical and wear resistance.

Polyethylene
Polyethylene is a semi-crystalline material with excellent chemical resistance, plus good fatigue and wear resistance. Polyethylenes provide good resistance to organic solvents and staining, and have low moisture absorption rates.

Polypropylene
Widely used polymer for non-wetted parts. Attacked by strong oxidizers as well as aromatic and chlorinated hydrocarbons.

PVDF
PVDF, or polyvinylidene fluoride, has excellent resistance to most mineral and organic acids, aliphatic and aromatic hydrocarbons, and halogenated solvents. Poor resistance to acetone, MEK, THF, and potassium and sodium hydroxide. Often supplied as Kynar®.

Properties of metals

Stainless steel, Type 316
This is the standard tubing material for chromatography, suitable for a wide variety of applications. It is cold drawn seamless, not welded, with close tolerances held on both ID and OD. We neither recommend nor offer Type 304 stainless steel for analytical applications.

Austenitic stainless steels may be used for most chromatographic applications. Type 316 is most commonly used for HPLC because of its superior chloride ion resistance.

Stainless steel, Type 303
Recommended for GC use and general purpose connections, combining excellent machining characteristics with good resistance to corrosion and high temperature oxidation. Susceptible to attach by chlorides, iodides, and bromides.

Titanium
Although it is more difficult to machine than common alloys containing aluminum and vanadium, VICI uses Grade 2 pure titanium in order to avoid possible contamination of the sample stream with these metals. Good for organic and inorganic salts except aluminum and calcium chlorides, and all alkalis except boiling concentrated potassium hydroxide.

Good with dilute, low temperature formic, lactic, sulfuric, hydrochloric, and phosphoric acids, but rapidly attacked by hydrofluoric acid. Good with dilute nitric acid at low temperatures; corrodes at high concentrations and temperatures. Can ignite with fuming nitric acid. Attacked by oxalic acid, concentrated phosphoric acid, hot trichloroacetic acid, and zinc chloride.