

Sealing devices and the need for PFAS

Currently, there are no viable alternatives for fluoropolymers that are used in sealing devices. However, PFAS (per- and poly-fluoroalkyl substances) are under fire due to their effects on human health and the environment. According to the ESA, a generic PFAS ban is totally inappropriate as fluoropolymers are of lesser concern than the majority of PFAS. There is no alternative product available in Sealing Devices and banning PFAS would result in unprecedented leaks and damage to the environment.

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About the authors



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Sealing devices are engineered products specifically designed to prevent gases or liquids escaping to atmosphere.

They are used in processes which deliver water and electricity to your home, all forms of transport from bicycles to planes, in engines, washing machines, taps, throughout chemical plants, oil refineries, power stations to food processing plants.

These devices utilise a range of fluoropolymers which are stable at high temperatures and are largely inert to aggressive chemicals. There is no alternative to the fluoropolymers used in sealing devices which can cater for such environments or work as effectively to prevent the release of process fluids or gases to the environment.

To ban them would grind society to a halt, planes would not fly, water would not reach your home, gas and electricity supplies would stop and cars would fail. A proposed generic ban for all PFAS products as proposed by the EU and Federal bodies in the U.S. is necessary to prevent the bio accumulation of them throughout the world but for sealing devices specifically it would have a wide-ranging negative impact on society and increase the level of emissions to atmosphere that the

industry has fought to reduce over the last 70 years.

Widespread use

Sealing devices retain media (powders, gas and liquids) inside hardware (process or storage equipment). Media within non-moving equipment are secured by “static seals” such as gaskets, whereas pistons and rotating equipment such as bearings and gearbox use “dynamic seals”. Hazardous, toxic, flammable, corrosive and reactive chemicals are media found in different industries all of which require high-performance seals to be used efficiently and safely. Seals are used in aggressive environments where they can be exposed to conditions, such as, wear, abrasion, radiation, and extremes of temperature.

Different types of materials; metals, Inorganics such as ceramics and graphite, and polymers (plastics and cross-linked elastomers) are used in industrial seals. In each case the seal material is selected based on the specific application requirements.

Seal materials must:

1. Withstand the environmental conditions of the application, including, media, temperature, pressure, speed, and abrasion

	ETFE	FEP/TFE/FPA	FLPE	FLPP	HDPE	LDPE	PC	PETG	PP	PVC	TPE***
Acids, Dilute or Weak	E	E	E	E	E	E	E	G	E	E	G
Acids, **Strong/Concentrated	E	E	G	G	G	G	G	N	G	G	F
Alcohols, Aliphatic	E	E	E	E	E	E	G	G	E	G	E
Aldehydes	E	E	G	G	G	G	G	G	G	G	G
Bases/Alkali	E	E	F	E	E	E	N	N	E	E	F
Esters	G	E	G	G	G	G	N	G	G	N	N
Hydrocarbons, Aliphatic	E	E	E	G	G	F	G	G	G	G	E
Hydrocarbons, Aromatic	G	E	E	N	N	N	N	N	N	N	N
Hydrocarbons, Halogenated	G	E	G	F	N	N	N	N	N	N	F
Ketones, Aromatic	G	E	G	G	N	N	N	N	N	F	N
Oxidizing Agents, Strong	E	E	F	F	F	F	F	F	F	G	N

*Not for tubing chemical resistance (except PVC) **Except for oxidizing acids (See oxidizing agents, strong) ***TPE gaskets

EXCELLENT	GOOD	FAIR	NOT RECOMMENDED
30 days of constant exposure causes no damage. Plastic may tolerate for 30 years.	Little or no damage after 30 days of constant exposure to the reagent.	Some effect after 7 days of constant exposure to the reagent. The effect may be crazing, cracking, loss of strength or discoloration.	Immediate damage may occur. Depending on the plastic, the effect may be severe crazing, cracking, loss of strength or discoloration, deformation, dissolution or permeation loss.

Classes of Substances at 20° C, Chemical Compatibility Chart - LDPE, HDPE, PP, Teflon Resistance (calpacalab.com)

demanding industrial sealing due to their mechanical properties (strength and comparative softness) combined with chemical stability, thermal stability, low permeation, and low surface energy.

Polymers (plastics and elastomers) are manufactured from monomers which react together to form the repeating unit of the polymer. Fluoropolymers are manufactured from low molecular weight PFAS monomers and in some cases using PFAS process agents. It is an important consideration that a class ban on low molecular weight PFAS is in effect also a ban on fluoropolymers (Fluoroplastics & Fluoroelastomers).

The use of low molecular weight PFAS raw materials is limited to the manufacturing locations of the fluoropolymer and fluoroelastomer. It is therefore recommended that PFAS monomers in the polymer supply chain are exempted from any PFAS ban and that different controls are considered which enable their safe and continued use.

Use of fluoroplastics and fluoroelastomers

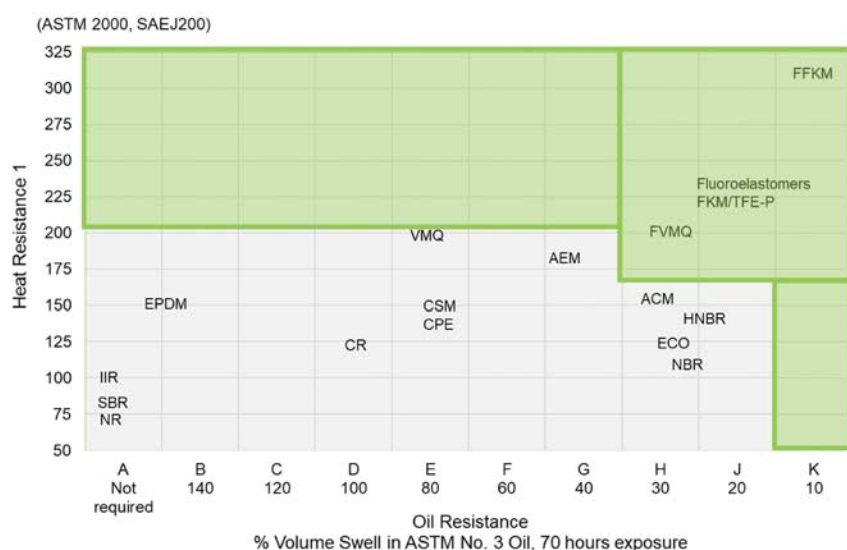
Fluoroplastics (i.e., PTFE, PFA, ...) are the only plastics that combine both the broadest chemical resistance with the highest operating temperature with an acceptable compliance to counter surface and therefore are used when other alternative plastics cannot offer the required chemical & thermal resistance combination for industrial applications. Many references are available in the public domain that highlight this:

The well accepted ASTM D2000 chart below represents the fluoroelastomer families available on the market and rates them against heat and oil resistance. The green shaded area represents materials with the best chemical resistance and best thermal stability, all of which are fluorinated.

Above 200°C only fluoroelastomers come into consideration for elastomeric sealing applications and at lower temperature, the drive for using fluoroelastomer is mostly linked to the broad chemical resistance.

Controversial

Per- and Polyfluoroalkyl Substances (PFAS) is a broad "Class" of materials under scrutiny for health and environmental concerns. Governments and regions are seeking to regulate the use of PFAS, which could lead to restriction in their use, stringent control measures,



¹ Maximum temps at which vulcanizates can be aged for 70 hours with changes in tensile strength $\leq \pm 30\%$, elongation $\leq -50\%$ and hardness $\leq \pm 15$ points

2. Not damage other equipment (hardware) in which the seal is housed
3. Be compliant with the counter surface to maximize sealing efficiency

Unique mechanical properties

Prevention of damage to hardware such as flanges, pipes, valves, and containers necessitates that contact seals are comprised of softer materials than the hardware into which they provide the seal. This prevents physical damage to

hardware such as scoring or wear. For this reason, graphite, plastics and elastomers are favored. Demanding applications, such as the prevention of fugitive emissions in the petrochemical industry or with toxic media and with high system pressures, require sealing materials with sufficient mechanical strength to withstand the system pressure and that have extremely low permeability to the media. Fluoropolymers (fluoroplastics and fluoroelastomers) have unique importance for

or a ban of this entire class of materials. REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) in the EU are seeking to restrict the use of PFAS and the placing on the market of products containing PFAS in the EU as far as possible.

Controversially, the scope of REACH for proposed PFAS regulation includes both small molecules and polymers. The inclusion of small molecules in the scope for PFAS is understandable; small molecules are subject to REACH registration as they each have a unique defined chemical structure, known physical properties, and their health and environmental impact can be assessed. Small molecular weight PFAS include surfactants, plasticisers, and chemical reagents used in the manufacture of other chemicals including monomers for PFAS polymers.

Complex

By comparison, when REACH was developed, requesting registration for polymers was deemed too difficult, because of the complexity of the polymer market, in terms of the size and variability of polymers on the market. For a polymer to be of “low

concern” certain criteria had to be met, including;

- High number average molecular weight of the polymer
- Negligible presence of low molecular weight materials including oligomer and residual monomer content
- Resistance of the polymer to degradation
- No functional groups in the polymer that are known to be harmful

Polymeric PFAS, also called fluoropolymers, used in the sealing industry include fluoroplastics such as PTFE which are components of gaskets and compression packings, and cross-linked fluoroelastomers (rubbers) with application as O-rings and custom geometry seals.

Irreplaceable

Fluoropolymer seals which fall within scope of PFAS are irreplaceable in certain industries and a blanket ban or regulation of these polymeric PFAS will have a profound negative impact on society (health, welfare, and standard of living).

Larger molecular weight materials, such as polymers and cross-linked rubbers are non-bioavailable. PFAS

polymers are considered to be “polymers of low concern” (PLC). They are critical to global development and pose no concern to public safety, yet the current REACH definition of PFAS groups these polymers together with low molecular weight PFAS of known concern such as PFOA and PFOS.

Banning the use of fluoropolymers articles and the use of low molecular weight PFAS intermediates at the fluoroplastic manufacturing locations would step the science of sealing backward to the 1950s timeframe. The ESA asks that PFAS fluoropolymer (Fluoroplastic & Fluoroelastomer) materials are exempted from the proposed regulation. A more detailed position paper, including case histories, regarding PFAS can be found on the ESA website (www.europeansealing.com).

References

ESA Fugitive Emissions Reduction Document

ESA PFAS Position Paper

BDI PFAS Position Paper

EMICO

Your reliable valve source



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