Why you should rethink your PTFE/Teflon® Tri-clamp® sanitary gaskets

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Polytetrafluoroethylene, better known as PTFE, or by its brand name Teflon®, is commonly used as a sanitary gasket in pipe connectors within process lines. PTFE gaskets are often used in demanding sanitary environments where traditional elastomers such as EPDM, NBR and Silicone are not suitable. But if your PTFE gaskets are failing, causing downtime and disruption, what can you do?

Let's start by considering why PTFE may have been selected in the first place. The most common advantages of using PTFE gaskets include:-

- **Chemical resistance**

PTFE is chemically inert and impervious to almost all industrial chemicals. This universal corrosion resistance includes strong acids, bases, solvents and a range of media used to clean process lines.

- **Hydrophobia and low porosity**

PTFE is non-porous and hydrophobic, which means it repels water and other liquids. This 'non-stick' attribute makes it an ideal option for sanitary gaskets that require resistance to process media and cleaning solutions.

- **Low friction**

The surface of a PTFE gasket feels slippery because its key property is low coefficient of friction. PTFE contains a high level of inherent lubricity which makes it perform well in dry applications or where fluids are particularly aggressive.

- **Broad temperature capability**

PTFE's temperature capability of -200°C to +260° (-325°F to +500°F) is well beyond the range of most elastomers. This broad capability makes PTFE a versatile material that can withstand a wide range of applications from cryogenic environments up to high temperature steam.

- **Dimensional accuracy**

PTFE gaskets are usually machined from a solid billet of material, typically with a hardness around 55-65 Shore D. This manufacturing method results in precision components that are very dimensionally accurate.

- **FDA Compliance**

Many PTFE materials are FDA compliant and considered safe for use in food and drug processing applications. Virgin PTFE, which does not contain any fillers, is often used for sanitary gaskets. PTFE can often be compliant with other regulatory standards such as 3A 18-03, USP Class VI and WRAS (potable water).

- **Long life expectancy**

With an almost unlimited shelf life, PTFE doesn't degrade with age and is unaffected by UV light, so age control is not typically necessary. Applications requiring extended service intervals in corrosive environments can benefit from PTFE's resistance properties which will remain indefinitely.

With such an impressive list of advantages PTFE sounds like the material of choice for demanding sanitary gaskets, what's the problem? Well anyone that has ever used PTFE sanitary gaskets will know that it's not all plain sailing. Very often PTFE gaskets leak causing loss of production, downtime and unplanned maintenance. Next, we will look at the two main reasons for this.

Disadvantages of PTFE/Teflon® Gaskets

1) Hardness

PTFE is a thermoplastic polymer with a typical hardness of 55-65 Shore D. When compared to elastomer gaskets that are typically around 70 Shore A (a softer scale), the higher hardness negatively affects sealing, as the material doesn't conform to the mating hardware surfaces as easily. This can result in tiny gaps between gasket and metalwork, which in time can develop into a leak.

2) Inelasticity

PTFE does not have any memory or elasticity, so when it is deformed, it stays deformed and doesn't revert back to its undeformed state. This lack of memory results in creep and cold flow where the gasket slowly deforms over time, taking on the shape of its housing. Unlike elastomers PTFE does not return to its original shape and this lack of elasticity prevents any sealing force. When an elastomer gasket is compressed, it will push back against the metalwork creating a much more effective seal.

So what's the alternative? What if we could have all the advantages of PTFE but in an elastomer?
Yes, well actually you can, it's called perfluoroelastomer, otherwise known as FFKM.

PTFE and FFKM are closely related and share many of the same properties and attributes. However, FFKM overcomes the two main disadvantages of PTFE, namely hardness and elasticity.

PTFE versus Perfluoroelastomer (FFKM)

FFKMs are effectively a rubber form of PTFE, they exhibit outstanding high temperature properties and are the most chemically resistant elastomer available, they are superior to all other elastomers.

We can see below how similar the two materials are by looking at their chemical structure. The fluorine atoms protect a carbon backbone, which results in a very resilient polymer structure. This is what gives both PTFE and FFKM materials excellent chemical resistance.

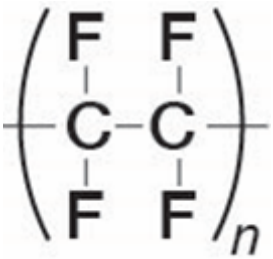


Figure 1 - PTFE polymer structure

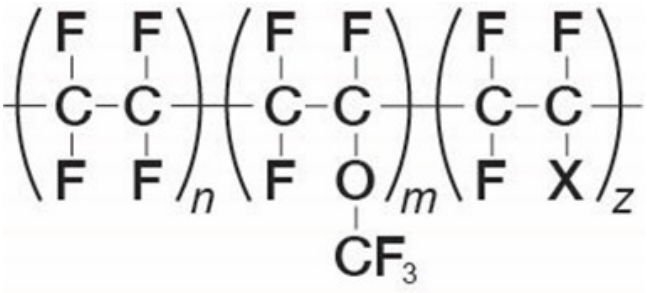


Figure 2 - FFKM polymer structure

Chemical resistance

FFKM materials provide universal chemical resistance across a broad range of media, making them ideal for use in demanding applications. Resistant to cleaning fluids commonly used in process lines, FFKMs can also withstand stage II sterilisation using high temperature steam. Table 1 below shows the comparative chemical resistance of PTFE, FFKM and other elastomers.

Temperature capability

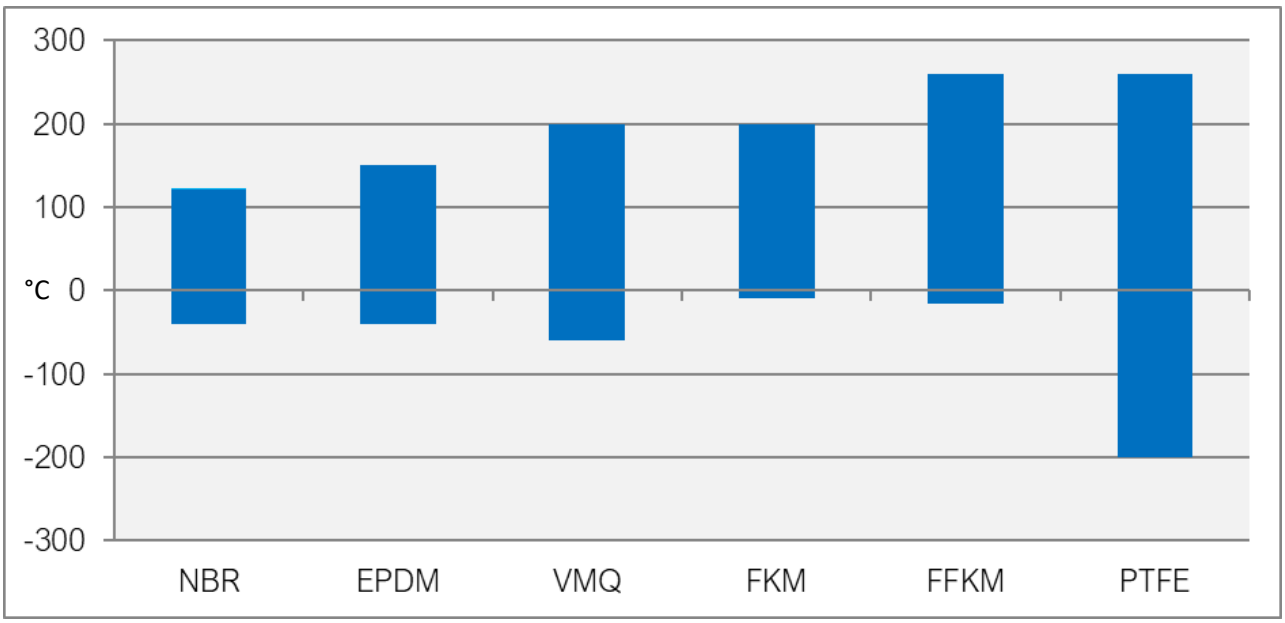
FFKM offers comparable high temperature performance to that of PTFE. FFKM elastomers typically provide an operating temperature range of -15°C to +260°C (+5°F to +500°F). Although FFKM can't withstand the lower temperatures that PTFE can, most sanitary gasket applications are well within its temperature capability, so this is not an issue. Graph 1 below compares the typical operating temperature ranges of PTFE, FFKM and other elastomers.

Table 1 — Chemical compatibility of elastomer gasket materials

Media	FFKM	FKM	EPDM	VMQ	PTFE
Caustic soda	1	2	2	3	1
Hot water	1	1	1	1	1
Nitric acid (conc.)	1	2	4	4	1
Phosphoric acid	1	1	2	4	1
Sodium hypochlorite (20%)	1	1	2	2	1
Steam (to 175°C)	1	1	2	4	1
3% Ethanol	1	1	1	1	1

1 = Excellent, 2 = Good, 3 = Doubtful, 4 = Do not use
Based on volume swell at room temperature: 1 = <10%, 2 = 10-20%, 3 = 20-40%, 4 = >40%

Graph 1 — Comparative operating temperatures of elastomers and PTFE



FDA compliance

Compliance with industry standards is an important consideration for food contact applications and particularly gaskets used within food and beverage processing environments. Selected FFKM material grades are compliant with FDA regulations and in addition are certified to 3A 18-03 Sanitary Standards and USP Class VI.

The best of both worlds

FFKM sanitary gaskets are a viable alternative to problematic PTFE/Teflon® gaskets. The ideal choice for demanding applications, FFKM gaskets combine the universal chemical resistance and high temperature capability of PTFE, with the benefit of superior mechanical properties and long-term sealing performance from an elastomer. Improved reliability, reduced downtime, extended maintenance intervals and lower cost of ownership are all achievable by switching to FFKM.

FFKM sanitary gaskets are the ultimate solution for replacing failing PTFE gaskets.
How could you benefit from switching your PTFE gaskets to FFKM?

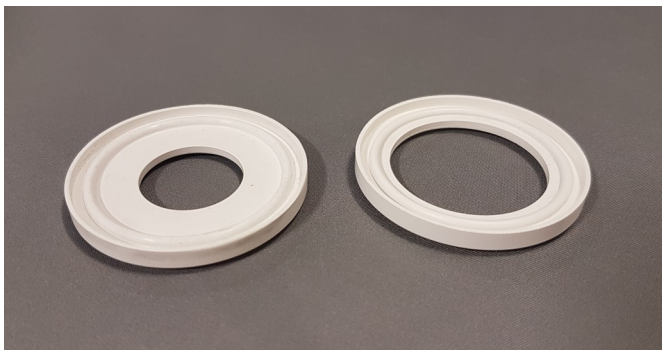


Figure 3 - Perlast® G74S FFKM sanitary gaskets

FFKM sanitary gaskets from PPE

Precision Polymer Engineering (PPE) manufactures HyClamp™ sanitary gaskets to BS, ISO and DIN standard sizes, in a range of elastomer materials including white FFKM.

Perlast® G74S is PPE's FFKM material that has been developed for food, dairy and pharma applications and is compliant with FDA, 3A 18-03, USP Class VI and EC1935/ EC2023 (see material datasheet).

More information on the range of HyClamp™ sanitary gaskets can be found on the PPE website: www.prepol.com

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