TECHNICAL PAPER

Specifying mechanical seals in the PFAS transition:

What pump and turbomachinery engineers need to know now

Ryan McNulty

Precision Polymer Engineering

www.prepol.com

Precision Polymer Engineering

For as long as most engineers have been specifying seals, the decision came down to two questions: will it perform, and what does it cost? A third now sits alongside them: Will this material still be available, supportable and defensible for the full operating life of the equipment?

That third question exists because of PFAS. The proposed EU-wide restriction on per- and polyfluoroalkyl substances has put fluoroelastomers - the FKM and FFKM materials sealing the most demanding pump and turbomachinery duties - under regulatory review. These materials are not going to vanish overnight. But procurement teams are asking about them, auditors are asking about them, and an engineer signing off a seal specification today is depending on that material being made, sold and supported well into the 2030s.

This article covers what has actually changed, the questions worth adding to your specification process, and how to keep reliability and total cost of ownership at the centre of the decision while the regulatory picture settles.

Reliability is still the decision that matters

Let's start with what hasn't changed. Elastomer seals in pumps, compressors and mechanical seals operate under conditions that punish any weakness: High temperatures, aggressive process media, pressure cycling and, in gas duties, the risk of rapid gas decompression. When a secondary seal fails, the consequences are rarely confined to the seal. Unplanned downtime, strip-down, replacement labour, requalification, lost production - the seal is usually the cheapest item on the invoice that follows.

PPE has watched this play out for decades. One marine diesel manufacturer came to PPE facing unplanned dry docks costing £100,000 a day, traced back to fuel injection valve seals that couldn't stand the duty. Three North Sea platforms faced closure over gas leaks on reciprocating compressors until the sealing material and geometry were changed. What every one of these failures has in common: The seal is a small component with a disproportionate hold over uptime.

PFAS doesn't change any of that. But what it *does* change is the definition of a good specification. A seal that performs faultlessly but sits on a material with an uncertain supply or compliance future is no longer a low-risk choice. Large operators answer to auditors and shareholders, and both react badly to the same things: Unmanaged risk and unscheduled downtime. The specification decision has become a resilience decision as well as a performance one.

The regulatory position

As of July 2026, the proposed universal PFAS restriction under EU REACH, submitted in January 2023, has reached the final phase of scientific evaluation. ECHA's Risk Assessment Committee adopted its opinion on 2 March 2026; the Socio-Economic Analysis Committee published its draft opinion later that month, and the final consultation on it closed on 25 May 2026. ECHA's consolidated opinion goes to the European Commission by the end of 2026, and if the current trajectory holds, restrictions could begin to apply from around 2029.

Two points matter for rotating equipment:

First, the committee opinions support an EU-wide restriction with only time-limited derogations, so the assumption that fluoropolymers will simply be exempted is no longer safe - even though sealing applications were formally recognised as a distinct sector in the restriction process in late 2024.

Second, most fluoropolymers - FKM, FEPM and FFKM - meet the OECD criteria for polymers of low concern: They are non-toxic, not bioavailable, non-water-soluble and non-mobile. The nearer-term issue is not the polymer itself but the fluorinated surfactants historically used as processing aids in the synthesis of some FKM base polymers. That part of the supply chain is already changing, and it is the part a well-prepared specifier can act on now.

The new seal specification questions

None of this calls for panic - just a slightly longer checklist. For rotating equipment, seal specification now needs to answer five questions:

1. **Performance.** Will the material perform across the full duty cycle - temperature range, media, pressure cycling, decompression events - not just at nominal conditions?
2. **Supply.** Can it be sourced reliably for the service life of the equipment, and does the supplier have visibility of its own raw material supply?
3. **Substitution.** If the regulatory or sourcing picture shifts, is there a validated alternative, and who carries the burden of proving equivalence?
4. **Evidence.** What independent test data and application history sit behind the performance claims?
5. **Support.** Will the supplier stay involved before, during and after installation, or does responsibility end at the loading bay?

To engineers, these questions are familiar. What's changed is needing them answered all at once - and that several of them are really questions about the supplier, not the seal.

Why the cheap option gets expensive

At some point in every specification review, someone proposes a cheaper seal. Sometimes it's the right decision. But the saving is only real if the substitute performs, and demanding rotating equipment exposes unproven materials fast.

The purchase price of an O-ring is trivial next to what surrounds it. A premature seal failure brings replacement labour, downtime, requalification and production losses that can dwarf any saving on the component itself. Compression set doesn't fail on day one. It fails eighteen months in, and it turns a planned seal change into an unplanned outage.

This cuts both ways in the PFAS context. Rushing onto an under-validated 'PFAS-free' material to get ahead of regulation carries the same hidden costs as any other unproven substitution. Staying put on a material with a shaky supply outlook has costs of its own. The answer in both cases is the same: Judge the decision on total cost of ownership across the operating life, and ask for evidence rather than assurances.

PPE's role in the transition

Our role is to reduce the risk of that decision from both directions.

On the transition itself, we're converting our affected FKM grades to fluorosurfactant-free versions, known as NFS polymers, as part of the PFAS Sustainability Program. New material codes make the change fully traceable - V91J becomes V91JF, for example, and the programme is aligned with the Fluoropolymers Product Group's voluntary commitment to cut non-polymeric PFAS emissions from fluoropolymer manufacturing.

The claim that matters to an engineer is equivalence, and we can back it with actual data. Published comparisons of V91JF against the original V91J show close correlation across physical properties, compression set, thermo-analytical data and rapid gas decompression performance, all within typical value ranges, together with equivalent behaviour in applicative testing and in processing, on both O-rings and more complex geometries. The practical consequence: Continuity of supply through the transition without a step change in performance, and a documented basis for requalification rather than a leap of faith. Where an application needs data that doesn't yet exist, our in-house elastomer materials laboratory can generate it against the specific duty.

On the performance side, the portfolio was built for the applications TPS engineers deal with daily. Perlast® G77X, an FFKM developed specifically for mechanical seal O-rings in rotating equipment, seals at up to 350°C (662°F) with low compression set and outstanding seal force retention - the combination that makes repairs less frequent, which is where seals actually save money. The supporting test data runs to compression set trials out to 1,000 hours, compressive stress relaxation and comparative chemical compatibility studies.

Behind the materials sits an application engineering model rather than a catalogue operation. Materials scientists and application engineers are involved from specification through design (including finite element analysis where the geometry warrants it), installation and life in service. Twenty-five years in the energy sector means we've usually seen your failure before - which makes the root cause quicker to trace and the fix easier to find.

What to look for in a sealing partner during the transition

Whoever you buy seals from, now is a good time to expect more. Four things separate a partner from a parts supplier:

- **Technical support past the purchase order.** Requalification is where sealing problems surface. Support should run from specification through installation and life in service, from someone prepared to look at the application rather than just the part number.
- **In-house materials capability.** A supplier with its own elastomer laboratory can test equivalence against your duty cycle. One without can only relay assurances from further up the chain.
- **An active position on PFAS, with parts you can order.** A published transition roadmap backed by launched fluorosurfactant-free grades and equivalence data.
- **Both material paths, made in more than one place.** Optimised fluorinated materials where the duty demands them, credible alternatives where it doesn't, and manufacturing in both the UK and the US at

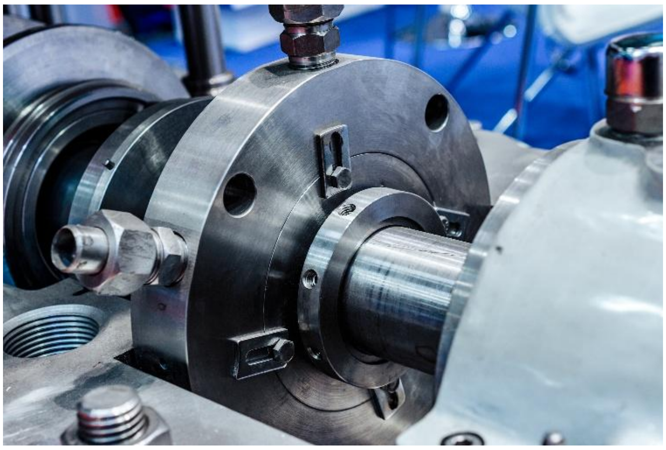
a time when regional rules and supply chains are pulling in different directions.

Specify for the life of the equipment

Specify for performance and resilience together. The best seal choice is no longer just the one that works today - it's the one that can still be sourced, supported and defended to an auditor across the full operating life of the equipment. There is enough test data available now that this does not have to rest on trust.

If PFAS sits anywhere on your risk register, the practical first step is a small one: A review of your current sealing bill of materials.

Talk to a PPE application engineer about a seal specification review or a PFAS-readiness assessment, and find out where you are already covered - and where you are not - while it is still a choice rather than a legal requirement.



Global Headquarters

Precision Polymer Engineering

Greenbank Road

Blackburn

BB1 3EA

England

T: +44 (0)1254 295 400

E: prepol.sales@idexcorp.com

Americas

Precision Polymer Engineering LLC

3201 S Blue Bell Road

Brenham

TX 77833

United States

T: +1 979 353 7350

E: prepol.sales-usa@idexcorp.com

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