BVAA PFAS in industrial valves and actuators-a special use case

1. Introduction

The British Valve and Actuator Association (BVAA) is a trade association that represents the interests of over 180 members involved in the supply of valves, actuators, services, components and materials to UK and European industry. Our members employ over 10,000 people and contribute sales revenue of $4bn annually to the economies of the UK and European Union, many members are subsidiaries of larger European or multi-national organisations.

The BVAA has recognised that the proposed PFAS restriction in its current form has the potential to cause significant damage to the manufacturing industry of the European Union by unnecessarily restricting the use of fluoropolymers and fluoroelastomers in industrial valves and actuators. In response to the ECHA consultation the BVAA has collected industry specific data on this issue, which is presented in this document in combination with an alternative proposal to exempt industrial valves and actuators that contain polymeric PFAS from the proposed restrictions.

It is outside of the scope of work of the BVAA, but it should also be recognised that much of the information presented here is equally applicable to all pressure equipment such as pumps and instruments etc. The BVAA recommend that consideration is given to applying the exemption requested in this document to all pressure equipment.

2. Exemption of polymeric PFAS used in industrial valves and actuators

Industrial valves are involved in the processing and creation of virtually every type of manufactured item in the world with a global market size of $70 Billion[1] in 2021, nearly 25% of this being in Europe. Polymeric PFAS is expensive to manufacture, and so industrial valves and actuators employ these materials only where they are necessary to provide acceptable performance required by the process conditions. They play a vital sealing role by protecting humans and the environment from the potentially dangerous emission of process fluids across multiple industries, therefore it is not appropriate to group the restrictions and derogations to be applied to industrial valves and actuators, by simply considering isolated end uses. In many of the applications that polymeric PFAS are used there is no alternative material that will perform to the same level and protect the environment as effectively.

The BVAA propose that the use of fluoropolymers and fluoroelastomers in industrial valves and actuators are considered as a single use case. Regardless of the industry or process that the valve is used in, the use of these materials in industrial valves should be excluded from the requirements of paragraphs 1 and 2, as stated on page 4 of the Annex XV restriction report. This exclusion is justified on the grounds that fluoropolymers and fluoroelastomers are harmless to humans and the environment and they can be safely recycled at the end of life under the responsibility of the end user's business.

The only area of potential environmental concern regarding fluoropolymers and fluoroelastomers is the material manufacturer's use of non-polymeric fluorinated PFAS surfactants in the polymerisation process. The material suppliers of fluoropolymer and fluoroelastomer materials are already taking steps to eliminate the use of any harmful non-polymeric PFAS material from the manufacturing process. As recognised in A.2.1.5.1 on p11 of Annex A of the restriction proposal, 50-60% of fluoropolymers are already manufactured without using these fluorinated polymerisation aids. Some material manufacturers[3] in the market already claim to be manufacturing fluoropolymers without using fluorinated surfactants. The BVAA support the development of further controls to encourage, where possible, the global adoption of non-fluorinated polymerisation aids in the polymeric PFAS manufacturing process, within a timescale that is practically achievable by the industry.

Fluoropolymers and fluoroelastomers are used within the pressure envelope of industrial valves and actuators so they do not present any health or environmental risks during their operating lifetime because they have no contact with humans or the external environment. The only potential risk presented by polymeric PFAS used in industrial valves is the potential to persist in the environment during the end of life phase. A total, or time derogated ban, of polymeric PFAS used in industrial valves is not appropriate because the concerns regarding persistence in the environment raised in the Annex XV restriction report can be managed effectively by waste stream regulation.

At end of life, the PFAS used in industrial valves and actuators can, within the business to business waste disposal environment, be separated and controlled and then re-cycled or alternatively incinerated by municipal waste incinerators. Both of these solutions are proposed in the UK HSE RMOA report[2] recently published by the UK health and safety executive.

3. Polymeric PFAS used in industrial valves and actuators

Fluoropolymer and fluoroelastomer materials are used in a wide variety of industrial valves and actuators as seals, gaskets, guides, seats, diaphragms, linings and bearings. Virgin and filled PTFE materials are perhaps the most commonly used because of their combination of strength and load bearing capability, resilience and low coefficient of friction. These properties combine with excellent resistance to a wide range of chemicals and a broad operating temperature band make them versatile and suitable for the most arduous applications.

Polymeric PFAS is used in all types of industrial valves with part turn valves such as ball, plug and butterfly valves generally containing the most material however, it is also used extensively in linear valve types such as globe valves. Figure 1 shows the $12 billion sales revenue of more than 28 million industrial valves supplied into EU in 2021 (excluding the UK). This data is broken down by major valve type and highlights the proportion and volume of valves containing polymeric PFAS. On average 90% of all industrial valves sold into Europe contained PFAS with an average mass of PFAS components of just under 132g. Therefore, the total mass of polymeric PFAS in industrial valves entering the EU market annually is estimated at approximately 3,370 tonnes.

Valve Types	Total Sales Value 2021 ($M)	Total Unit Sales	% Total Sales Containing PFAS	Total Unit Sales Containing PFAS	Average Mass of PFAS/Valve (Kg)	PFAS Total Mass (tonnes)
Ball & Plug	**3,328**	4,462,793	100%	4,462,793	0.677	3,020
Butterfly	**1,757**	352,067	80%	280,780	0.924	259
Diaphragm	**262**	214,760	16%	34,003	0.086	3
Gate	**2,747**	192,842	42%	80,106	0.341	27
Globe	**3,888**	23,149,464	89%	20,610,053	0.003	56
Total	**11,984**	**28,371,926**	**90%**	**25,467,736**	**0.132**	**3,366**

Figure 1: 2021 EU sales by valve type including estimated weights of polymeric PFAS

Sales data[1] and PFAS valve quantities and average component masses estimated from BVAA member data and scaled to full EU market volumes.

The total PFAS mass supplied to the EU in industrial valves represents only 1.2% of the total polymeric PFAS tonnage stated in the mid-point estimate as detailed in Table 3 of the Annex XV restriction report. However, whilst this is a very small proportion of the total annual polymeric PFAS emissions in the EU, its use makes an invaluable contribution to the total industrial output of the European Union by enabling safe, high pressure integrity process operation of most the EU's manufacturing processes.

4. Examples of the use of polymeric PFAS in industrial valves and actuators

As previously stated, the high cost of polymeric PFAS materials has meant that they are only commonly used where their performance is significantly superior to the currently available alternatives. Typical alternative materials to polymeric PFAS are graphite in its various forms, thermoplastics such as nylon and polyketones like PEEK or elastomers like EPDM, nitrile or silicone. Polymeric PFAS significantly outperforms these materials in many applications across a broad range of industries which is why 90% of industrial valves sold into Europe make use of them in preference to these alternative materials.

This section provides some common examples of the uses of polymeric PFAS in modern industrial valve and actuator designs. The examples have been selected to illustrate the key material properties that make their use a fundamental aspect in attaining the current performance levels and efficiencies of many modern industrial processes.

4.1. Stem/shaft seals

Polymeric PFAS is widely used in vital sealing components, such as dynamic stem and shaft seals, which prevent dangerous environmental emissions to the environment. The low friction, high strength and resilience of polymeric PFAS materials result in excellent sealing performance with low wear rates, low operating loads and excellent chemical resistance, even at temperatures above 220°C.

Alternative materials are used for stem and shaft seals however, the leakage performance and friction levels of these alternative materials are inferior in many applications. ISO 15848-1[4] is a widely used international testing standard for the classification and qualification of fugitive emissions performance for industrial valves, and it contains comparative performance data between PTFE and flexible graphite stem/shaft seal systems. It states that the leakage performance for a graphite based system is typically rated at Class C, however a PTFE based system may be expected to achieve Class B performance. Class B performance requires a measured leakage mass flow rate 100 times less than the Class C requirements during the test.

If it were no longer permitted to use polymeric PFAS materials, then graphite based systems would need to be used as replacements in many cases, resulting in significant increases in pollution and operating energy requirements due to friction, both of which would have a negative effect on the environment. It is highly likely that the combined negative environmental effect of these two factors in terms of safety of operation and global warming potential would be significantly greater than continuing to use PTFE based stem/shaft seal systems with appropriate measures in place to ensure proper recycling or incineration at EOL as stated in section 10.

4.2. Part turn valve obturator seats

Both fluoropolymers and fluoroelastomers are extensively used in ball and butterfly valve designs. Reference to Figure 1 shows that typically all ball valves sold contain PFAS materials, with 80% of butterfly valves also using polymeric PFAS. The previous comments relating to shaft seals also apply to these part turn valve designs, but a further critical use of polymeric PFAS components is in the obturator seat design.

The ability of obturator seats to repeatably seal and allow the valve to control and isolate the process to the required leakage standard is fundamental to the reliable operation of the valve and the efficiency of the process in which it is installed. Premature wear or lack of sealing resilience results in deterioration of the sealing performance and often results in an increase in the forces necessary to operate the valve, invariably affecting process control and plant efficiency. High wear and premature seat leakage may result in increased environmental emissions due to process leakage and inevitable loss of product and revenue for the plant operator. In many cases an unscheduled plant shut down is necessary to repair the seat and obturator.

The inert nature of polymeric PFAS seat materials offers excellent chemical compatibility combined with a useable temperature range from below -200°C to in excess of 220°C, making them suitable for a wide range of fluid applications for which thermoplastics and elastomers are unsuitable. Additionally, the combination of excellent mechanical strength, particularly when combined with mineral fillers, and good sealing resilience coupled with a low coefficient of friction makes these materials ideal for use as low wear obturator seals. They are particularly effective when operating on high system pressures as they require minimal operating forces when compared with alternatives such as PEEK. Alternative polymeric sealing materials do not generally have the same range of properties meaning that they can only be successfully used in a narrow range of applications. In many cases polymeric PFAS materials are the only solution to meet the sealing requirements at the required conditions, particularly where high operating pressures and temperatures are combined with low operating force requirements.

Metallic obturator seats can be used as an alternative to resilient polymer based seating for various part turn valve designs that operate at high pressures and temperatures. However, these designs require significantly higher operating stresses in order to seal and are much more expensive to manufacture due to the materials and machining processes required. Typically, metallic seat designs used in ball valves may also rely upon elastomeric seals, many using fluoroelastomers, as part of the seat to body sealing mechanism so they are frequently not PFAS free alternatives.

4.3. Internal static seals and gaskets

Many industrial valve and actuator designs make use of static seals to manage internal pressure within the valve pressure envelope, particularly in areas like body to seat, guide and valve bonnet seals. Both fluoropolymers and fluoroelastomers are frequently used in these applications, dependent upon the required temperature and pressure conditions, because of the broad range of fluid compatibility that these extremely inert materials possess. As previously detailed under valve obturator seats the combination of temperature resistance, inert material properties, sealing resilience and mechanical strength mean that the use of polymeric PFAS in these applications is unrivalled by other materials, particular for high pressure gas applications. Unlike many elastomers, fluoroelastomers are widely recognised as sealing materials that are resistant to rapid gas decompression (RGD), sometimes known as explosive decompression, so they are widely specified for hazardous gas applications. This property is particularly important in the developing green hydrogen industry where RGD is a significant concern due to the small molecular size of the hydrogen and high operating pressure required.

4.4. Valve body liners

Liners made from fluoropolymers are widely used in industrial valves in order to protect the metallic body surfaces from corrosion. The linings generally cover all of the internal fluid wetted surfaces of the valve, allowing lower cost metallic materials that are isolated from the process fluid to be used to provide mechanical strength and pressure resistance. As a result, linings are typically the largest mass PFAS components to be used in industrial valve applications.

The alternative to a lined valve for many applications, should the lining material be prohibited from use, would be to use a fluid compatible, highly corrosion resistant material, possibly an austenitic stainless steel or even a high nickel alloy such as UNS N06625. This represents an extremely significant increase in cost when compared to the use of a lined cast iron or low carbon steel body material. The price difference between the use of a lined and an un-lined corrosion resistant valve is extremely significant, often amounting to a factor of 10 times or more in the case of nickel alloy valves.

Polymeric PFAS lined valves are extensively used in the chemical and process industries due to the extremely inert properties of the liner material. Elastomeric materials such as neoprene and butyl are traditionally used as low cost lining materials however, they are unsuitable for use with many highly corrosive chemicals such as sulphuric acid, ammonia and benzene where highly inert PFAS materials are typically the only available solution.

Polymeric PFAS lined valves are also widely used in industries where the process line needs to be hygienically clean and/or extremely inert when in contact with a range of different process media. Industries with high purity requirements such as the handling of etching solutions in the semiconductor industry and the pharmaceutical industry, as well as the hygienically clean requirements of the food and beverage industries, are all reliant upon the use of lined valves containing polymeric PFAS in order to meet the regulatory performance requirements. The inert behaviour of the PFAS materials used, combined with the smooth regular internal surface of the liner design, ensures that the required levels of fluid purity and ease of cleaning to maintain hygiene levels can be achieved.

4.5. Diaphragms

Diaphragms are used in industrial valves and actuators to convert pressure energy into linear movement as required in diaphragm valve, pressure regulating valve or a pilot operated safety valves to name but three. For simplicity this section is focussed on the diaphragm valve application but the points raised are relevant to other diaphragm applications.

Diaphragm valves use the diaphragm component to isolate the moving parts of the valve from contact with the fluid medium. This allows the other moving parts of the valve to remain clean and free from contamination from the fluid as well as providing the opportunity to use lower cost materials that do not need the same corrosion resistance as they would if they were permanently wetted by the process fluid. Diaphragm valves are frequently also fitted with liners in the body for the same reasons as detailed under lined valves in section 4.4.

Polymeric PFAS materials are used in diaphragms because they are extremely inert, making them compatible with a wide range of fluids, they also operate over a very wide temperature range of typically -40°C to 150°C or more which exceeds the capability of non-PFAS elastomer alternatives. The high mechanical strength and good fatigue performance of polymeric PFAS is also extremely important for reliable diaphragm performance over a wide range of conditions.

The diaphragm is the most critical component in a diaphragm valve because failure will result in loss of isolation and potentially leakage to the environment that could be extremely hazardous to human health and would certainly result in an unscheduled shut down of the plant with a significant cost impact. Predictable diaphragm performance is therefore critical if damaging premature diaphragm failures are to be avoided between scheduled diaphragm replacement intervals. Selecting the most compatible diaphragm material for the fluid and operating conditions is extremely critical to achieving this.

Figure 1 shows that 16% of diaphragm valve applications use the expensive option of polymeric PFAS for the diaphragm material, this is generally because no other alternative possesses the necessary range of properties. The very broad chemically compatibility of polymeric PFAS combined with the wide temperature range exceeds what is possible with other elastomeric materials.

4.6. Bushes, bearings and dynamic obturator seals

Polymeric PFAS is widely used for internal bushes, bearings and dynamic obturator seals in ball and plug, butterfly, globe and some gate valves as well as actuators. These fluid wetted components must be compatible with a wide range of process fluids and possess good mechanical strength over a wide range of temperatures with a low coefficient of friction to withstand the mechanical loads.

Consistent, reliable performance of these dynamic parts with minimal wear is very important to the overall performance of the valve and actuator. Premature wear or breakdown of the bearing/guiding surfaces will generally result in failure to function correctly, along with excessive leakage, an unplanned plant shut down will often be necessary to rectify. As previously discussed with some of the other component types, the broad range of properties of polymeric PFAS make it possible to use a single material for a very wide range of applications. If polymeric PFAS was not permitted to be used in these applications, then a wide range of alternative materials would be needed to operate in the range of conditions previously achieved with a single polymeric PFAS part. This will inevitably result in increased product costs through diversity of designs along with reduced performance in some instances due to compromise in the properties of the available materials.

5. Qualification of valve performance by type testing

As a safety critical industry, pressure equipment end users require that industrial valves and actuators undergo type testing in order to prove critical aspects of their performance. These type tests are applicable to the product design and so must be performed by each manufacturer. Two typical type tests that must be completed on a significant proportion of industrial valves are ISO 15848-1 covering qualification procedures for fugitive emission type testing of valves and ISO 10497 relating to fire type testing. As detailed in the previous section, polymeric PFAS materials are widely used for critical seal and seat components the performance of which is the main focus of these type tests.

The consequence of prohibiting the use of polymeric PFAS for these components would not only mean that the valve would need to be redesigned to use an alternative material, should a suitable one be found, but all of the type tests would also need to be repeated.

Both the fugitive emissions tests and the fire tests are hazardous tests that require specialised laboratory equipment so they are generally conducted in a limited number of test laboratories, often run by third party test organisations. The proposed restrictions, implemented over a short timescale would mean that a significant number of valves would need to be retested and requalified within the same period. Figure 2 shows that his would result in a cost for a typical valve manufacturer of $446k however, it would also result in a significant testing and approval bottleneck for the test houses and approval bodies. If all valve manufacturers in the EU were to complete this testing it would require 39,600 test days or 152 years of testing, significantly exceeding the existing test capacity within the EU. Figure 2 illustrates that the total test cost to the EU valve manufacturers is estimated at $268M.

This is a conservative estimate as it does not consider any cost increase associated with the significant spike in demand for test facilities that would be created. Inevitably there would be significant delays in gaining these approvals which would in turn result in delays in new industrial projects that relied upon the completion of the valves, many of which are likely to be part of the investment in the European Green Deal.

The cost of this qualification testing amounts to 2.2% of the total valve market sales in 2021 which is extremely significant to the industry and exceeds the typical annual R&D expenditure of many manufacturers. This enforced expenditure would significantly impact manufacturer's R&D budgets and therefore inhibit new product innovation.

Currently, the most vital and active area of R&D spend in the valve industry is the development of new product solutions to support zero carbon energy projects and the hydrogen economy. A requirement to requalify PFAS free existing products would significantly impact this work and effect the development of low carbon energy across the EU. The fact that competitors in non-EU markets may not need to repeat this testing for their core markets should also be recognised as a significant threat to the competitiveness and future potential of the $11.9B EU valve industry.

Activity	Cost (0,000s)	Testing Days
Fugitive emissions test costs per manufacturer	$ 248	
Fire testing costs per manufacturer	$ 198	
Total FE testing days		18,000
Total Fire testing days		21,600
Total all EU	**$ 267,791**	**39,600**

Figure 2: Total time and costs to requalify products for fugitive emissions and fire testing

Assuming 600 manufacturers with 3 product ranges each, 2 fugitive emissions & 6 fire tests required per range

6. No comparable alternative to polymeric PFAS materials

The use of fluoropolymer and fluoroelastomer PFAS materials in industrial valve construction is based upon the suitability of their performance, considering the actual fluid properties at the pressure and temperature of the application, rather than the industry in which the valve and actuator is being used as proposed in the restriction report. As detailed in section 4, there is no single material with the same or better range of properties meaning that there is no direct replacement for every application and generally performance, especially environmental leakage performance, and service life will be impacted.

Several alternative materials that are used in industrial valves and actuators have been compared to illustrate that there is currently no available non-PFAS polymer alternative that exhibits all of the desirable properties of polymeric PFAS.

6.1. Non-PFAS Polymers

Generally speaking, any material that is 'soft' enough to be an effective seal (UHMW-PE for example) has a restricted temperature range and limited chemical compatibility. However, PEEK and PPS are commonly used engineering plastics for liners, seals and seats etc partly because they are capable of operating at 250°C however, their chemical resistance is significantly inferior to fluoropolymers and limits their use. Additionally, the coefficient of friction of PEEK and PPS is significantly higher than fluoropolymers, resulting in the requirement for higher operating forces, inferior control performance and increased wear rates. PEEK also has a greater compressive modulus than polymeric PFAS meaning that it is unsuitable for use as a sealing material in many applications. Figure 3 below provides a graphical comparison of the properties of polymeric PFAS and

PEEK, highlighting that it is not a suitable replacement for all polymeric PFAS applications.

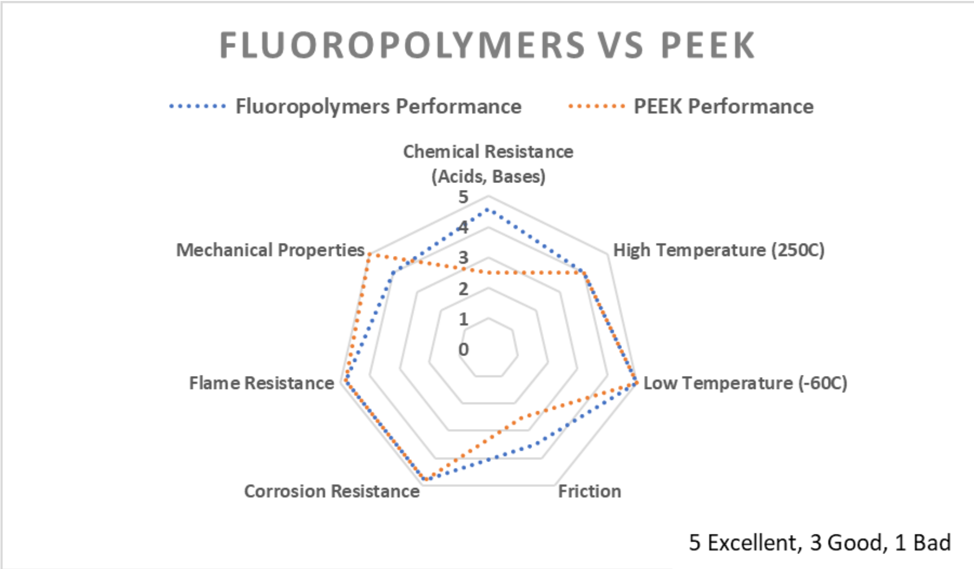

Figure 3: Comparison of the performance of Fluoropolymers and PEEK

Acetal is another polymer often used in industrial valves as it has excellent lubricity, however its operating temperature range is too low for many applications and its chemical resistance is significantly inferior to polymeric PFAS.

6.2. Non-PFAS elastomers

Elastomers such as Ethylene Propylene Diene Monomer (EPDM), Hydrogenated Nitrile Butadiene (H-NBR), and Silicone are often used in industrial valve sealing or diaphragm applications. However, most elastomers do not have the range of chemical resistance of fluoroelastomers, and reference to figure 4 shows that they are limited to applications that are below 150°C. Silicone is an exception to this, but it is significantly inferior to fluoroelastomers in terms of friction and wear, characteristics that can considerably reduce satisfactory service life. Unlike fluoroelastomers, many non-PFAS elastomers do not exhibit resistance to explosive gas decompression and so are unsuitable for use in sealing applications in high pressure gas environments.

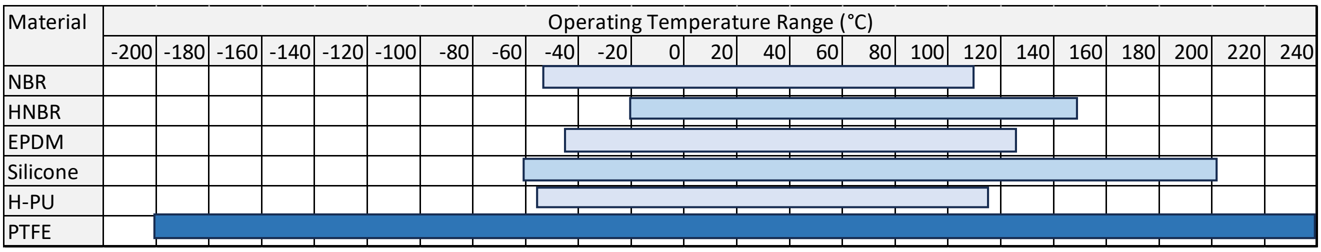

Figure 4: Comparison of the typical operating temperature range of non-PFAS elastomers and PTFE

6.3. Metallic seals

Metallic seals are available as alternatives to polymeric PFAS seals in some particularly high temperature or contaminated fluid applications, they are often "O" or "C" rings made in either stainless steel or nickel alloy 625, though other sections and materials are also used. These seals provide a high temperature alternative to fluoropolymers when operating above 250°C. However, they are considerably more expensive than PTFE seals and the requirements of the geometry and surface finishes used for the housing are also far more stringent further compounding the cost problem.

Whilst metal seals can be used in dynamic applications, when compared to polymeric PFAS solutions, they are only suitable for relatively low numbers of dynamic cycles before leakage performance starts to deteriorate. It is generally accepted that metallic sealing falls short of resilient, or "soft" sealing performance that uses materials such as PTFE, a good example of this is the higher leakage rates specified for metal to metal sealing in API 527[8], the widely accepted seat leakage standard for pressure relief valves used across oil and gas and the process industries.

The lack of suitable high performance alternatives to polymeric PFAS for many applications is a serious concern for industrial valve and actuator applications across all industries. For example, the safe operation of processes using hydrogen gas is a critical issue for the world's adoption of zero carbon technologies and the European Green Deal. Industrial valves containing fluoropolymers and fluoroelastomers stem/shaft seals are needed to perform a vital role in safely containing this explosive gas in the transport, electrolysis, gas transmission and storage, energy and petroleum and mining industries. The wide chemical compatibility, pressure and temperature operating range of polymeric PFAS in industrial valves and actuators makes them essential to enable the continued safe development of the low carbon economy.

7. Significant replacement costs for valve users

The polymeric PFAS components used in industrial valves that have been previously discussed are "wear parts" that need to be replaced during service activities over the lifetime of the valve and actuator. The supply of service parts for industrial valves in the EU was a $6B market in 2021[1], with a typical service life for these components of 3-5 years. As previously discussed, 90% of valves contain polymeric PFAS materials and failure to replace these parts during servicing will result in excessive and potentially dangerous environmental emissions due to leakage, inefficient valve operation and plants operating with poor product quality, reliability and efficiency levels.

The proposed exclusion of polymeric PFAS will result in many existing industrial valves and actuators becoming unserviceable due to a lack of suitable spare parts. In cases where alternative materials can be used, they are unlikely to be "drop in" replacements due to differences in material properties as previously discussed. Consequently, there is a risk that a significant proportion of industrial valves installed across many industries in Europe will need to be replaced, typically within a five year period of the implementation of the proposals. This will have a significant negative cost impact on manufacturing industries across all the EU in terms of capital investment and loss of production output. It is also unlikely that the industrial valve and actuators industry would be able to meet the potential demand for new products within a timescale that would satisfy the needs of the EU manufacturing industry.

As previously stated, these high cost fluoropolymers and fluoroelastomers are used in because they possess the best combination of material properties for the application when compared to alternative materials. Where it is currently possible to use alternative materials and accept a reduction in performance, it is likely to be necessary to modify the design of the valve in order to compensate for the different mechanical properties of the alternatives that must be used. In cases where this is a practical alternative to valve replacement, it is likely to result in extended plant shutdown times and service costs to allow conversion kits to be obtained and fitted to the valve and actuator.

8. Fluoropolymers and fluoroelastomers are non-hazardous

Fluoropolymers and fluoroelastomers, although included in the very broad Annex XV restriction report PFAS definition, have been extensively proved not to harm human health or the environment. Fluoropolymers and fluoroelastomers are recognised by the OECD as polymers of low concern and have been proven to be safe and non-environmentally damaging apart from their persistence.

These substances are long chain polymers of high molecular weight and as such they are chemically extremely inert, do not breakdown in the environment, are insoluble in water and not bio mobile. PTFE in particular is one of the most widely used and closely studied polymeric PFAS. It has been proven to be safe for medical use, including transplant surgery, and approved for food contact following numerous scientific studies[5].

9. Polymeric PFAS parts in valves and actuators are isolated from the external environment

One of the functions of an industrial valve is to prevent contact between the external environment and the process media by controlling and containing fluid flow. Because of this, polymeric PFAS components are not exposed to the external environment during their operational lifespan. Consequently, the use of PFAS in industrial valves and actuators only represents a risk of emissions to the environment during disposal at the end of life stage, it is recommended that restrictions concerning polymeric PFAS use in industrial valves and actuators should only be focussed on this phase of the life cycle.

10. End of life (EOL) treatment of polymeric PFAS components

Fluoropolymer and fluoroelastomer components in industrial valves are generally designed to be easily removable from the metallic parts of the valve to allow service operations. These components are often serviceable “wear parts” that may be replaced several times in the lifetime of the valve. It is already common practice to recycle the pressure envelope of an industrial valve at the end of its useful life due to the value and mass of the metallic materials used.

Removal of the PFAS components from the industrial valve at EOL is straight forward and will be undertaken by a suitably competent commercial organisation who is also responsible for controlling their waste streams in order to comply with local regulations. Therefore, the industrial valve polymeric PFAS waste stream is already fully controlled in a business to business environment, allowing any further necessary EOL waste stream controls to be easily implemented to ensure that environmentally responsible disposal occurs.

The disposal of polymeric PFAS components can safely take place by recycling or incineration as preferred alternatives to landfill. Studies[6] have been conducted to demonstrate that incineration in a municipal energy for waste plant can be safely achieved without harmful emissions to the environment. It has been possible to recycle polymeric PFAS for a number of years with this being an accepted practice amongst material manufacturers due to the cost of the material. More recently processes[7] have been developed to also enable "up-cycling" of fluoropolymers enabling them to be re-processed into virgin grade material.

A review of regulations related to the management of polymeric PFAS waste streams at EOL for industrial valves represents a more proportionate alternative to imposing a complete ban on the use of these indispensable materials.

11. Limited emissions

Industrial valve and actuator products by design protect personnel from exposure to the process medium and so do not emit PFAS to the environment during use. The only part of the lifecycle that results in emissions to humans and the environment is the end of life phase.

Figure 1 shows that an estimated 3,400 tonnes of PFAS waste from industrial valves in the EU is generated annually. This represents 1.2% of the total polymeric PFAS waste based on the restriction report's midpoint estimate. Industrial valves are not consumer products, so in the business to business environment it is possible to ensure that careful re-cycling, or appropriate disposal, of any PFAS contained is performed effectively by the development of existing management of waste control processes. This will ensure that these materials do not pose any risks to the environment through their persistence when used in industrial valves and actuators. Figure 5 shows the estimated annual PFAS emissions by end use market sector for PFAS used in industrial valves, based on the data in Figure 1 and the global sector sales split[1].

End Market	Percentage of Total	Est PFAS Emissions (kg)
Water and Waste Water	23%	780,826
Oil & Gas Refining	24%	801,020
Chemicals	23%	760,632
Power Generation	13%	444,263
General Industry	17%	578,888
Total	**100%**	**3,365,630**

Figure 5: Estimated annual polymeric PFAS emissions in EU from industrial valves by end use sector

Data assumes that PFAS emissions are split by market volumes based on 2021 global market ratios by end use sector[1] *and total PFAS emissions from Figure 1.*

12. Proposal to adopt a targeted approach guided by risk assessment

The current definition of PFAS within the proposal is very broad and creates a large group of affected substances, including PFAS that are recognised by the OECD as polymers of low concern and that have been proven[5] to be safe and non-environmentally damaging apart from their persistence. Proposing restrictions to such a large group of substances, without assessing the specific hazards in more detail, will only serve to deflect focus from prioritising the most urgently required measures against the proven hazards. The adoption of an approach based on risk assessment, but considering the substance and also the use case, would result in a more effective and targeted solution. This approach would allow a clearer focus on the risks posed to human health and the environment and would be likely to be more effective in prioritising action against the most damaging substances.

The UK HSE RMOA report[2] broadly comes to the same conclusions as stated above. This report recommends that PFAS restrictions should be focussed on the manufacture and placing on the market of consumer articles likely to be released to the air, water and soil or directly transferred to humans. It also recommends that restrictions need not be applied to low hazard groups such as fluoroplastics or fluoroelastomers, or to low risk uses such as in sealed/contained systems like pressure equipment. As discussed previously, the exclusion of industrial valves and actuators from the proposed restrictions on PFAS is completely aligned with these recommendations.

13. References

1 Oxford Economics Global Valve and Actuator Report 2022 https://resources.oxfordeconomics.com/valve-and-actuator-report2020?utm_campaign=Promotional%20Campaigns-DACH&utm_content=147017772&utm_medium

2 Analysis of the most appropriate regulatory management options (RMOA)- Poly- and perfluoroalkyl substances (PFAS) March 2023 UK REACH: Regulatory management option analysis (RMOA) (hse.gov.uk)

3 Gujarat Fluorochemicals Announcement 2022 GFL Announcement 30.11.22_new.pdf

4 ISO 15848-1: 2017 Industrial valves- Measurement, test and qualification procedures for fugitive emissions-Part1: Classification system and qualification procedures for type testing of valves. Table 1 Tightness classes for stem (or shaft) seals with helium.

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7 Closing the Recycling Loop-Up-cycling End-of-life Fluoroplastics- Plastic Insights Article 17/06/2014 Closing the Recycling Loop (kunststoffe.de)

8 API 527 Seat Tightness of Pressure Relief Valves