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Date: 26. May 2023

Confidential
KSB PFAS analysis and statement / part 1

Dear colleagues,

The following content is reflecting the KSB contribution part 1 to the ECHA consulation phase.

We will now focus on the detailed internal impact analysis (OI, TO, affected parts and products) and sharpen our feedback considering alternatives and socio economic impact for selected key applications.

Yours sincerely

KSB SE & Co. KGaA
Corporate Sustainability Communications

Jonas Bialk

Substance: Per- and polyfluoroalkyl substances (PFAS)
EC number: -
CAS number:
- Annex XV report Third Party Consultation From 22/03/2023 to 25/09/2023

General comments and answers to specific information requests
General comments:
KSB SE & Co. KGaA KSB is one of the world's leading manufacturers of industrial valves and pumps. KSB was founded in Frankenthal (Germany) in 1871 and has been one of the leading manufacturers of pumps and industrial valves for over 150 years.
With more than 15,000 employees worldwide and its own sales companies, production facilities and service companies, KSB develops and manufactures customized pumps for a wide variety of applications.
The product range of the experienced pump and valve manufacturer is used in the areas of building and industrial technology, chemical industry, mining, water transport and wastewater treatment as well as in power plant processes.

To analyse and respond to the PFAS restriction proposal, KSB has formed a project team consisting of experts from sustainability, product design, materials, purchasing, production, product management, corporate foresight, strategy and service.
The project steps include an analysis of affected KSB parts and materials, clustering them by main PFAS groups, evaluating material alternatives and impacts, identifying key applications and products, assessing socio-economic impacts, and describing end-of-life processes and recycling methods for PFAS components.
It will be much easier for KSB to identify materials that are used directly as components or parts of equipment/products. It is much more difficult to evaluate the indirect use of PFAS, e.g. for machining aids or lubricating fluids.

We see this planned restriction amount as a violation of the proportionality principle (no possibility to extend the foreseen 5- or 12-year exemptions if a possible alternative for PFAS does not become established on the market).
We see that this restriction is based on a contradictory rationale: The admission that no forecasting tools are available, while the proposal makes predictions for the concentration of PFAS in the environment. On the one hand, all members of the group are considered hazardous, while on the other hand, assessments have been made only for certain group members. Scientific evidence is lacking for many conclusions and uncertainties exist.

Specific information requests:
1. **Sectors and (sub-)uses**: Please specify the sectors and (sub-)uses to which your comment applies according to the sectors and (sub-)uses identified in the Annex XV restriction report (Table 9). If your comment applies to several sectors and (sub-)uses, please make sure to specify all of them.

We cannot find ourselves in the list of sectors, because the production of pumps and valves is not listed. It is impossible to classify pumps and valves in the predefined categories, because the mentioned sectors do not fit us.
The pumps and valves industry already had problems to provide information/data in the previous consultations, as needed categories were missing and the predefined categories fit only partially.

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Pumps and valves containing PFAS-containing components are used in a variety of sectors identified in the report in Annex XV, but also beyond.
The majority of PFAS chemicals in pumps and valves belong to the fluoropolymers group.
They are used in pumps and valves where resistance to chemicals, extreme temperatures (high and cryo) and/or wear is important.

Typical examples of pump and valve components containing fluoropolymers are:

1. **Static pump and valve seals: Fluoropolymer materials such as PTFE (polytetrafluoroethylene), PFA (perfluoroalkoxy) or FKM (Fluorocarbon elastomers) are used as pump and valve seal components. These materials provide excellent chemical and temperature resistance and low friction, which helps reduce energy consumption, extends pump and valve life, and also ensures a higher level of tightness during operation.**
2. **Dynamic seals: Fluoroelastomers, also known as FKM or FFKM, are unique materials for seals because they have high resistance to chemicals such as hydrocarbons, acids and bases and can withstand temperatures up to 200 °C. They also have low gas permeability, which makes them indispensable for applications where either the pumped medium must be kept free of contaminants or where the release of the pumped medium into the environment must be avoided at all costs. In addition to their chemical and thermal resistance, In addition to their chemical and thermal resistance, fluoroelastomers are the best solution to master the mechanical properties and the ageing which guarantees the long-lasting performance of pumps and valves. These properties make them irreplaceable and unique for the use in industrial pumps and valves, especially for applications where safety is a critical issue.**
3. **Product-lubricated bearings: fluoropolymer materials such as PTFE or blends of fluoropolymers with other materials such as metals, ceramics and other polymers are used as product-lubricated bearings because they offer excellent chemical resistance and low friction, which helps reduce wear and extend the life of the pumps and valves.**
4. **Pump and valve linings: Fluoropolymer liners are used in pumps and valves to protect internal components from corrosive chemicals or other aggressive fluids. These liners can be made from materials such as PTFE, PFA, FEP (fluorinated ethylene propylene) or PVDF (polyvinylidene fluoride).**
5. **Diaphragms: fluoropolymer diaphragms are commonly used in pumps and valves that handle aggressive chemicals or other fluids with often high temperature that can attack conventional elastomer diaphragms. PTFE and FEP diaphragms are often used in applications that require high purity or resistance to aggressive chemicals.**
6. **Coatings: Fluoropolymer coatings are applied to pump and valve components such as casings, impellers, housings, and fasteners to protect them from chemical attack, corrosion, or abrasion. For example, these coatings can be made of materials such as PFA (perfluoroalkoxy), ETFE (ethylene tetrafluoroethylene) or ECTFE (ethylenechlorotrifluoroethylene).**
7. **Cable jackets: Fluoropolymers are used for sheathing high-voltage cables of submersible pumps and valve actuators because they are resistant to UV radiation, have excellent insulating properties, and are resistant to moisture and water absorption.**

Overall, the excellent chemical resistance and durability of fluoropolymers make them indispensable for pump and valve applications:

1. **Chemical processing, where highly aggressive chemicals are present, because of their ability to withstand the corrosive effects of these chemicals, including their performance at elevated temperatures.**
2. **Oil and gas production, as they are resistant to hydrocarbons, high temperatures and high pressures that occur during drilling and production operations, or cryo temperatures that occur for liquefied gas transportation (for example, natural gaz or hydrogen).**
3. **Power generation due to their high temperature resistance even in the presence of atmospheric oxygen.**

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4. **Pharmaceutical applications in conventional and biotechnological processes because they are inert, non-reactive and can be sterilized.**
5. **Applications in the food and beverage industry, as they are non-stick and chemically inert, which is important for regular cleaning and disinfection processes, and the quality of food and beverages in contact with them is not negatively altered.**
6. **Applications in water and wastewater treatment where highly corrosive chemicals are present, such as water electrolysis for the separation of hydrogen and oxygen or water treatment in the electronics industry.**
7. **Pumping and circulation of potable water.**

This list of applications is certainly incomplete, as the use of PFAS-containing components in a pump and valve is not related to the sector, but rather to the fluid being pumped.
Therefore, an exemption for pump and valve applications or fluoropolymers in general is imperative to safeguard the production of key raw materials and commodities.

Ultimately, many other sectors are relevant, as pumps and valves are used throughout the supply chain, but are also dependent on the operation of the supply chain being produced.
Information on the details cannot be provided by the pumps and valves industry, but by the respective players in the supply chain.

An (incomplete) list of examples requiring PFAs :
- Electronics: pumps and valves use semiconductors and other electronics to function properly for their motor and automation functioning, or the semiconduction manufacturing processes requires ultrapure corrosive water and so pumps and valves with fluoropolymeric materials are required.
- Supply of energy: PFAS are needed in the energy sector, especially for renewable energy production (e.g in water electrolysis for hydrogen manufacturing).
- Machinery: Machines are required to produce any type of materials and components. These machines, e.g. die casting or compression molding machines for all types of thermoplastics, require fluorinated polymers and in some cases other PFAS (high temperatures that other materials cannot withstand, non-stick properties, temperature fluctuations...).
- Spare parts: Existing production equipment, often in use for 20, 30 or even more years, contains sliding parts made of PTFE, for example. It should be ensured that the lifetime of these machines is extended and not all processing machines are discarded (in line with the objectives of the Ecodesign Directive and resource efficiency targets).
- The air conditioning of production facilities (e.g. in electronics manufacturing) contains fluorinated gases for safety reasons.
- All the chemical industry processes require pumps and valves with fluoropolymeric materials to produce substances even if these substances are not PFAs based.

2. Emissions in the end-of-life phase: The environmental impact assessment does not cover emissions resulting from the end-of-life phase. To get a better understanding of the extent of the resulting underestimation, (sub-)use-specific information is requested on emissions across the different stages of the lifecycle of products, i.e. the manufacture phase, the use phase and the end-of-life phase. Please provide justifications for the representativeness of the provided information. In particular:
a. Please provide, at the (sub-)use level, an indication of the share of emissions (as percentages) attributable to these three different stages. An indication of annual emission volumes in the end-of-life phase at sector or sub-sector level would also be appreciated.
b. If possible, please provide for each (sub-)use what share of the waste (as percentages) is treated through incineration, landfilling and recycling. Please provide information to justify the estimates as well as information on the form of recycling referred to.

Manufacturing:

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In the manufacturing phase, fluorinated polymers are indispensable for molding or compression molding machines for all types of thermoplastics, which are also used as housings or covers for automation components for pumps, motors, sensors and drives.
The specific influences on manufacturing processes depend on the individual make-or-buy decisions associated with the above sub-applications. Typically, fluorinated polymers used as seals, bearings, cables and coatings are supplied by specialized companies rather than produced by pump and valve manufacturers.
Use phase:
No emissions are expected during the use phase of pumps and valves because fluorinated polymers are stable during their use phase.

End-of-life phase:
Pumps and valves containing PFAS materials are usually maintained by specialized companies, i.e., professionals. To avoid improper disposal of PFAS and PFAS-containing components, a proper traceability system can be implemented during operation and at the end of life, in line with already existing recycling procedures (WEEE, ...).
The digital product passport will allow better traceability and proper treatment of pumps and valves and of the components concerned at the end of their life.
At the moment it is difficult to give figures, but such a worldwide or European wide recycling organization is feasible.

3. **Emissions in the end-of-life phase**: With respect to waste management options, additional information is requested on the effectiveness of incineration under normal operational conditions (for different waste types, e.g. hazardous, municipal) with respect to the destruction of PFAS and the prevention of PFAS emissions.

Due to the requirements arising from WEEE, many pumps and valves are already returned to their manufacturers or other central collection points. The scope of collection should be further improved.
In addition, procedures should be established for the separate collection of PFAS-containing materials from these collected products and their recycling or, if necessary, disposal under appropriate conditions should be improved → As far as we know, under certain conditions (incineration in a certain temperature range) PFAS are not released into the environment, but the details are not known by the pump and valve industry yet.
In addition, further research should be conducted on recycling and reuse of fluorinated polymers, which is ultimately important to keep fluorine components in a controlled material flow.

Depending on the intended use, another problem arises with a possible (unsuitable) substitute :
In industry, fluorinated polymers can be used for many years, sometimes 20, 30 years or longer, while a substitute material needs to be replaced much more frequently (a weeks or month). The waste stream from these substitutes, including their contamination, would be much higher. More frequent replacement of substitute materials because of leakages or damages (wear or destruction of sealing components) will pose additional hazards to workers and/or require extensive safety measures for maintenance and handling, depending on the pumped media.

4. **Impacts on the recycling industry**: To get an understanding of the impacts of the proposed restriction on the recycling industry, information is requested on:
a. The impacts that the concentration limits proposed in paragraph 2 of the proposed restriction entry text (see table starting on page 4 of the summary of the Annex XV restriction report) have on the technical and economic feasibility of recycling processes (together with a clear indication on the waste streams to which the described impacts relate).
b. The measures that recyclers would need to take to achieve the proposed concentration limits.
c. The costs associated with these measures.

Unfortunately KSB does not have sufficient knowledge in the field of recycling. We rely on contributions from the recycling sector to get a complete picture.

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5. **Proposed derogations – Tonnage and emissions**: Paragraphs 5 and 6 of the proposed restriction entry text (see table starting on page 4 of the summary of the Annex XV restriction report) include several proposed derogations. For these proposed derogations, information is requested on the tonnage of PFAS used per year and the resulting emissions to the environment for the relevant use. Please provide justifications for the representativeness of the provided information.

KSB will collect data on the quantity, weight and type of fluoropolymers used in order to provide additional information in a second statement. We can already say that the weight share of fluoropolymers is quite low in our metallic composed equipment but is crucial for a big part of the volume and the turnover of KSB.

6. **Missing uses – Analysis of alternatives and socio-economic analysis**: Several PFAS uses have not been covered in detail in the Annex XV restriction report (see uses highlighted in blue and orange in Table A.1 of Annex A of the Annex XV restriction report). In addition, some relevant uses may not have been identified yet. For such uses, specific information is requested on alternatives and socio-economic impacts, covering the following elements:
a. The annual tonnage and emissions (at sub-sector level) and type of PFAS associated with the relevant use.
b. The key functionalities provided by PFAS for the relevant use.

Application (incomplete list with current status)	Use	Property	PFAS
Pumps and valves in Oil and Gas Industry Liquefied gas transportation, storage and production	Gaskets, seals, liners, wear parts in hydrocarbon upstream, midstream and downstream. Coatings of components in offshore applications	Resistance against hydrocarbons Temperature resistance Low friction coefficient Corrosion resistance and anti-galling properties	FKM, FFKM PTFE, PFA, PCTFE, ETFE
Pumps and valves in chemical process industry	Gaskets, seals, wear parts, diaphragms, liners, Bearings, inserts Coatings	Resistance against aggressive chemicals Temperature resistance Low friction coefficient	FKM, FFKM, PTFE, PVDF, PFA, ECTFE
Pumps and valves in food industry	Coatings, seals, gaskets, diaphragms, liners, bearings	Non-sticking properties Resistance against aggressive cleaning chemicals	PTFE, PFA, FKM
Pumps and valves in energy generation	Gaskets, seals, liners, bearings	High temperature resistance even in the presence of air borne oxygen	FKM, FFKM, PTFE, PFA, PCTFE
Pumps and valves in the pharmaceutical and biotechnological industry	Coatings, seals, gaskets, diaphragm, liners	Resistance to high temperatures and aggressive chemicals being used in CIP and SIP	PTFE, PVDF, FKM, FFKM, PFA

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Submersible pumps in dewatering	Seals, cable sheath	Low coefficient of friction Weathering resistance and low water uptake	PTFE, PVDF, FKM, FFKM, PFA
Pumps and valves in other industries - Wastewater treatment - Dosing - Mining industry - HVAC - Drinking water - Cryogenic applications - H2 production - Environmental mitigations - others	Seals, gaskets, diaphragms, liners, cables, coatings, wear parts, bearings, …	Resistance against chemicals, temperature, weather, or a combination thereof = safety reasons Use for tribological functionality = energy efficiency, duration, safety Use due to hygienic aspects = health	PTFE FKM FFKM FPE (PFPE) ETFE ECTFE PVDF PFA PCTFE
Spare parts for pumps and valves	Seals, gaskets, diaphragms, liners, cables, coatings, wear parts, bearings, …	Resistance against chemicals, temperature, weather, or a combination thereof = Safety Use for tribological functionality = energy efficiency, duration, safety Use due to hygienic aspects = health	PTFE FKM FFKM FPE (PFPE) ETFE ECTFE PVDF PFA PCTFE
Machining industry - production of (PFAS and NON-PFAS containing) materials - production of (assembled) products - spare parts	Seals, gaskets, coatings, production aids, sliding parts, …. To be specified by machines manufacturers	Temperature (changes), chemicals, steam, anti-stick properties, hygiene,…	PTFE FKM FFKM FPE (PFPE) ETFE ECTFE PVDF PFA PCTFE
Electronic industry - production of semi-conductors - production of other electronics	To be specified by electronics manufacturers.	Electronic industry - production of semi-conductors - production of other electronics	To be specified by electronics manufacturers.
Automation & Drives	Gaskets, seals, insulation for cables of electric motors and variable speed drives	- Temperature (changes), steam, anti-stick properties	ETFE ECTFE To be specified by electronics manufacturers.

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c. The number of companies in the sector estimated to be affected by the restriction.

Companies affected: almost all our customers.

Pumps and valves are essential for fluid-related applications to move and control liquids. The restriction will cause that:

- **they no longer perform the same function as before,**
- **earlier failures have to be expected,**
- **changes within processes and systems are required,**
- **a lot of B2B customers will not be able to sell their materials & products (e.g., in the chemical industry) that require pumps and valves with beneficial properties of fluorinated polymers**
- **Spare parts will be not substitutable in the same design**

For the very limited cases where less efficient alternatives would be an option, higher consumer prices must be expected as intensive maintenance periods without production will lead to reduced production capacity and lower competitiveness (→ this effect will spread along the supply chain),

Safety aspect: the current very limited alternatives lead to higher risks for workers, users and the environment:

- **e.g. in case of leakage (in plants where aggressive, toxic, volatile substances are pumped),**
- **if products made of alternative materials start to burn in certain applications (which is not possible with corresponding fluorinated polymers), in case of electrical accidents, if insulating materials cannot be further used and no equivalent alternatives are available.**

Compliance with other regulations could be difficult, if not impossible: a change in materials or design could result in non-compliance with other regulations, such as:

- **energy efficiency regulations,**
- **non-flammability of building products,**
- **carbon footprint reduction targets,**
- **renewable energy targets,**
- **ATEX,**
- **food contact,**
- **drinking water contact,**

The main problem in establishing clear numbers is that the pump and valve industry does not so much describe its own company, but rather the other companies using our products → example chemical industry: a special survey about the pump and valve industry brings less important information than the information coming from the users of the pumps and valves:

Sector/ Application/ Use	Pump and valve manufacturers either as producer or user (600 companies, 20 bio € turnover, 200.000 employees)	Industrial users/ customers	Consumers
Pump and valve industry	Worst case 100% → if suppliers cannot deliver (also NON-PFAS products) pump and valve manufacturers will not produce anything or, in few cases, may produce in very	Dependent on the application the impact on the user of the pump and valve (customer of the pump industry) may be more detrimental than on the pump and valve industry itself.	The disruption of the supply chains may lead to non-availability of essential goods.

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	degraded and dangerous conditions.		

The above table is issued from EUROPUMP association. The KSB figures are under investigation and will be provided in the second phase of KSB answer.

d. The availability, technical and economic feasibility, hazards and risks of alternatives for the relevant use, including information on the extent (in terms of market shares) to which alternative-based products are already offered on the EU market and whether any shortages in the supply of relevant alternatives are expected.

Here is concrete examples:
PTFE, PFA or PCTFE are used for their tightening properties at high and cryo temperatures. Alternatives from a practical point of view could be metallic seals, but they are not as efficient as the PFAs ones ; the leakage rate is significantly less performant, which means leakages to environment and users.

PTFE, PFA or PCTFE is also used for their sliding properties. The lead (Pb) could be an alternative if we do not take into account its hazardous properties, which cannot be considered. PTFE, PFA or PCTFE has been implemented for lead substitution, a step back is not conceivable. → this substitution would be a regrettable substitution in any case.

In most cases, the (very) expensive fluoropolymers are only used where either all alternatives would fail quickly and in many cases lead to safety problems, the fluorinated polymer ensures the function of the product/part (for an acceptable and longer duration) or where the conditions are not exactly known (e.g. composition of the wastewater changes regularly (oil, water, bacteria, antibiotics, other drugs, rainwater, pesticides, fertilizers...)).

e. For cases in which **alternatives are not yet available**, information on the status of R&D processes for finding suitable alternatives, including the extent of R&D initiatives in terms of time and/or financial investments, the likelihood of successful completion, the time expected to be required for substitution (including any relevant certification or regulatory approvals) and the major challenges encountered with alternatives which were considered but subsequently disregarded.

It is absolutely impossible to make a forecast. One main factor is the dependence on the chemical industry, if an alternative is found at all. We can only present a schedule for research and development with regard to the integration of alternatives in pumps and valves when these are developed and made available by the chemical industry.
So far, the focus has not been on finding a substitute. A design change, if at all possible, means both a long time to find a new suitable design that performs the intended functions and a long trial period, especially if different properties have to be qualified.
Degraded performance is expected in most trials, and different approaches must be evaluated. It may also result in increasing the complexity of the pump and valve series because many new designs are used instead of one.
For example, when metals are used instead of fluorinated polymers for sealing functions, the design must be revised, higher forces must be applied to achieve the same level of sealing, machining tolerances must be more precise, and the likelihood of seals loosening in a shorter time increases.
After disassembly, reuse of such metal seals is impossible.
In case polymer alternatives are identified, production process adaptions are required.
New moulding processes need to be established, including new tools (which might require PFAS in the process, if no alternatives in such processes are found). Where a fluoropolymer needs to be replaced by multiple polymers, the qualification time and the investments increase significantly.

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f. For cases in which **substitution is technically and economically feasible** but more time is required to substitute: i. the type and magnitude of costs (at company level and, if available, at sector level) associated with substitution (e.g. costs for new equipment or changes in operating costs);
ii. the time required for completing the substitution process (including any relevant certification or regulatory approvals);
iii. information on possible differences in functionality and the consequences for downstream users and consumers (e.g. estimations of expected early replacement needs or expected additional energy consumption);
iv. information on the benefits for alternative providers.

Where a substitute is available, it is already used, as the use of PFAS (material) leads to higher (initial) material costs, which most customers do not accept.
Where PFAS (fluorinated polymers) are used, this is the only solution as the lifetime, functionality (including energy efficiency) and safety (occupational safety, safe use, leak tightness, ...) are much better than other material solutions.

g. For cases in which **substitution is not technically or economically feasible**, information on what the socio-economic impacts would be for companies, consumers, and other affected actors. If available, please provide the annual value of EU sales and profits of the relevant sector, and employment numbers for the sector.

Impacts on the pump and valve industry include both upstream and downstream.
The complexity of the pump industry supply chain makes it impossible to quantify the socioeconomic impact on pump and valve manufacturing. The entire industry is affected. When parts of the supply chain fail, the entire pump and valve industry collapses. Pump and valve manufacturers will not receive materials from their supply chain (both PFAS-containing and NON-PFAS-containing materials) and will not be able to manufacture pumps and valves.

Pumps and valves are used throughout the supply chain as part of the manufacturing process and, conversely, receive their parts, materials, and energy from many actors along the supply chain who also use the pumps and valves.
Therefore, given the web of interactions between the downstream and upstream aspects of the pump and valve industry, estimating costs would be an extremely complex undertaking.

Pumps and valves are used in industry and/or the production of pumps and valves depends on:
- Production of chemical base materials
- Manufacturing of materials (PFAS-containing and NON-PFAS-containing)
- Production of components (including multi-material components such as electronics)
- Manufacturing of (assembled) products
- Manufacturing of machines for the different production steps
- Water treatment (including treatment of industrial wastewater)
- Energy production and transport (especially renewable energy)
- Recycling and waste disposal
- Other industries (food and feed production, where disinfection is required, pharmaceutical industry, ...).

Clearly, the impact of banning or severely restricting the use of PFASs goes far beyond a single industry or market sector. Essentially, this will set back a number of technologies to 1950s levels in terms of sealing, chemical resistance, heat resistance, environmental contamination, product purity, process contamination, and friction reduction.
More than 10,000 compounds are affected and certainly many times that number in terms of processes and applications. This precludes any practical attempt to create an "exemption."
Such a ban or restriction on PFAS compounds would result in large parts of European industry, such as the chemical, pharmaceutical, aircraft and automotive industries, to name a few, no longer being competitive in many international markets.
The social and economic impact in Europe is simply unimaginable and must be avoided.

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7. **Potential derogations marked for reconsideration – Analysis of alternatives and socio-economic analysis**: Paragraphs 5 and 6 of the proposed restriction entry text (see table starting on page 4 of the summary of the Annex XV restriction report) include several potential derogations for reconsideration after the consultation (in [square brackets]). These are uses of PFAS where the evidence underlying the assessment of the substitution potential was weak. The substitution potential is determined on the basis of i) whether technically and economically feasible alternatives have already been identified or alternative-based products are available on the market at the assumed entry into force of the proposed restriction, ii) whether known alternatives can be implemented before the transition period ends (taking into account time requirements for substitution and certification or regulatory approval), and iii) whether known alternatives are available in sufficient quantities on the market at the assumed entry into force to allow affected companies to substitute.

A summary of the available evidence as well as the key aspects based on which a derogation is potentially warranted are presented in Table 8 in the Annex XV restriction report, with further details being provided in the respective sections in Annex E.
To strengthen the justifications for a derogation for these uses, additional specific information is requested on alternatives and socio-economic impacts covering the elements described in points a) to g) in question 6 above.

Application (incomplete list with current status)	Use	Property	PFAS
Pumps and valves in Oil and Gas Industry Liquefied gas transportation, storage and production	Gaskets, seals, liners, wear parts in hydrocarbon upstream, midstream and downstream. Coatings of components in offshore applications	Resistance against hydrocarbons Temperature resistance Low friction coefficient Corrosion resistance and anti-galling properties	FKM, FFKM PTFE, PFA, PCTFE, ETFE
Pumps and valves in chemical process industry	Gaskets, seals, wear parts, diaphragms, liners, Bearings, inserts Coatings	Resistance against aggressive chemicals Temperature resistance Low friction coefficient	FKM, FFKM, PTFE, PVDF, PFA, ECTFE
Pumps and valves in food industry	Coatings, seals, gaskets, diaphragms, liners, bearings	Non-sticking properties Resistance against aggressive cleaning chemicals	PTFE, PFA, FKM
Pumps and valves in energy generation	Gaskets, seals, liners, bearings	High temperature resistance even in the presence of air borne oxygen	FKM, FFKM, PTFE, PFA, PCTFE
Pumps and valves in the pharmaceutical and biotechnological industry	Coatings, seals, gaskets, diaphragm, liners	Resistance to high temperatures and aggressive chemicals being used in CIP and SIP	PTFE, PVDF, FKM, FFKM, PFA
Submersible pumps in dewatering	Seals, cable sheath	Low coefficient of friction Weathering resistance and low water uptake	PTFE, PVDF, FKM, FFKM, PFA

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Pumps and valves in other industries **- Wastewater treatment** **- Dosing** **- Mining industry** **- HVAC** **- Drinking water** **- Cryogenic applications** **- H2 production** **- Environmental mitigations** **- others**	**Seals, gaskets, diaphragms, liners, cables, coatings, wear parts, bearings, …**	**Resistance against chemicals, temperature, weather, or a combination thereof = safety reasons** **Use for tribological functionality = energy efficiency, duration, safety** **Use due to hygienic aspects = health**	**PTFE** **FKM** **FFKM** **FPE** **(PFPE)** **ETFE** **ECTFE** **PVDF** **PFA** **PCTFE**
Spare parts for pumps and valves	**Seals, gaskets, diaphragms, liners, cables, coatings, wear parts, bearings, …**	**Resistance against chemicals, temperature, weather, or a combination thereof = Safety** **Use for tribological functionality = energy efficiency, duration, safety** **Use due to hygienic aspects = health**	**PTFE** **FKM** **FFKM** **FPE** **(PFPE)** **ETFE** **ECTFE** **PVDF** **PFA** **PCTFE**
Machining industry **- production of (PFAS and NON-PFAS containing) materials** **- production of (assembled) products** **- spare parts**	**Seals, gaskets, coatings, production aids, sliding parts, ….** **To be specified by machines manufacturers**	**Temperature (changes), chemicals, steam, anti-stick properties, hygiene,…**	**PTFE** **FKM** **FFKM** **FPE** **(PFPE)** **ETFE** **ECTFE** **PVDF** **PFA** **PCTFE**
Electronic industry **- production of semi-conductors** **- production of other electronics**	**To be specified by electronics manufacturers.**	**Electronic industry** **- production of semi-conductors** **- production of other electronics**	**To be specified by electronics manufacturers.**
Automation & Drives	**Gaskets, seals, insulation for cables of electric motors and variable speed drives**	**- Temperature (changes), steam, anti-stick properties**	**ETFE** **ECTFE** **To be specified by electronics manufacturers.**

8. **Other identified uses – Analysis of alternatives and socio-economic analysis**: Table 8 in the Annex XV restriction report provides a summary of the identified sectors and (sub-)uses of PFAS, their alternatives and the

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costs expected from a ban of PFAS. More details on the available evidence are provided in the respective sections in Annex E.

For many of the (sub-)uses, the information on alternatives and socio-economic impacts was generic and mainly qualitative. In particular, evidence on alternatives was inconclusive for some applications falling under the following (sub-)uses: technical textiles, electronics, the energy sector, PTFE thread sealing tape, non-polymeric PFAS processing aids for production of acrylic foam tape, window film manufacturing, and lubricants not used under harsh conditions.
More information is needed on alternatives and socio-economic impacts to conclude on substitution potential, proportionality, and the need for specific time-limited derogations. Therefore, specific information (if not already included in the Annex XV restriction report or covered in the questions above) is requested on alternatives and socio-economic impacts covering the elements listed in points a) to g) in question 6 above.

Application (incomplete list with current status)	Use	Property	PFAS
Pumps and valves in Oil and Gas Industry Liquefied gas transportation, storage and production	Gaskets, seals, liners, wear parts in hydrocarbon upstream, midstream and downstream. Coatings of components in offshore applications	Resistance against hydrocarbons Temperature resistance Low friction coefficient Corrosion resistance and anti-galling properties	FKM, FFKM PTFE, PFA, PCTFE, ETFE
Pumps and valves in chemical process industry	Gaskets, seals, wear parts, diaphragms, liners, Bearings, inserts Coatings	Resistance against aggressive chemicals Temperature resistance Low friction coefficient	FKM, FFKM, PTFE, PVDF, PFA, ECTFE
Pumps and valves in food industry	Coatings, seals, gaskets, diaphragms, liners, bearings	Non-sticking properties Resistance against aggressive cleaning chemicals	PTFE, PFA, FKM
Pumps and valves in energy generation	Gaskets, seals, liners, bearings	High temperature resistance even in the presence of air borne oxygen	FKM, FFKM, PTFE, PFA, PCTFE
Pumps and valves in the pharmaceutical and biotechnological industry	Coatings, seals, gaskets, diaphragm, liners	Resistance to high temperatures and aggressive chemicals being used in CIP and SIP	PTFE, PVDF, FKM, FFKM, PFA
Submersible pumps in dewatering	Seals, cable sheath	Low coefficient of friction Weathering resistance and low water uptake	PTFE, PVDF, FKM, FFKM, PFA
Pumps and valves in other industries - Wastewater treatment - Dosing - Mining industry	Seals, gaskets, diaphragms, liners, cables, coatings, wear parts, bearings, …	Resistance against chemicals, temperature, weather, or a combination thereof = safety reasons	PTFE FKM FFKM FPE (PFPE)

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- HVAC - Drinking water - Cryogenic applications - H2 production - Environmental mitigations - others		Use for tribological functionality = energy efficiency, duration, safety Use due to hygienic aspects = health	ETFE ECTFE PVDF PFA PCTFE
Spare parts for pumps and valves	Seals, gaskets, diaphragms, liners, cables, coatings, wear parts, bearings, …	Resistance against chemicals, temperature, weather, or a combination thereof = Safety Use for tribological functionality = energy efficiency, duration, safety Use due to hygienic aspects = health	PTFE FKM FFKM FPE (PFPE) ETFE ECTFE PVDF PFA PCTFE
Machining industry - production of (PFAS and NON-PFAS containing) materials - production of (assembled) products - spare parts	Seals, gaskets, coatings, production aids, sliding parts, …. To be specified by machines manufacturers	Temperature (changes), chemicals, steam, anti-stick properties, hygiene,…	PTFE FKM FFKM FPE (PFPE) ETFE ECTFE PVDF PFA PCTFE
Electronic industry - production of semi-conductors - production of other electronics	To be specified by electronics manufacturers.	Electronic industry - production of semi-conductors - production of other electronics	To be specified by electronics manufacturers.
Automation & Drives	Gaskets, seals, insulation for cables of electric motors and variable speed drives	- Temperature (changes), steam, anti-stick properties	ETFE ECTFE To be specified by electronics manufacturers.

9. **Degradation potential of specific PFAS sub-groups**: A few specific PFAS sub-groups are excluded from the scope of the restriction proposal because of a combination of key structural elements for which it can be expected that they will ultimately mineralize in the environment. RAC would appreciate to receive any further information that may be available regarding the potential degradation pathways, kinetics or produced metabolites in relevant environmental conditions and compartments for trifluoromethoxy, trifluoromethylamino- and difluoromethanedioxy-derivatives.

KSB has no information.

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10. **Analytical methods**: Annex E of the Annex XV restriction report contains an assessment of the availability of analytical methods for PFAS. Analytical methods are rapidly evolving. Please provide any new or additional information on new developments in analytics not yet considered in the Annex XV restriction report.

KSB has no information.

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