

FPP4EU Compilation of

PFAS Use Gaps*
Intermediates
PCTFE (Fluoropolymer PolyChloroTriFluoroEthylene, CAS 9002-83-9 use in pharma packaging
PFAS-based solvent are used in automotive electronics to coat the printed circuit boards and LED lighting for moisture and corrosion protection. Fluids can also be used as carrier solvents for anti-fingerprint or anti-smudge coating materials for automotive display surface coatings. The following substance should be added as a coating for corrosion protection: CAS # 756-13-8.
Perfume dip tubes
Solar Radiative Film uses PVDF (CAS# 24937-79-9)
PFAS use in food contact materials in household appliances
All manufacturing processes depending on Fluoropolymer Pressure Piping Systems properties are missing

Use of fluoropolymers (PVDF) as
filtration elements

Fluoroalkyl-Silanes in anti-stick coatings

Fluor polymer coating for machinery and
drive technology for use in e.g. food
industry, pharma industry, cosmetics
industry

Sealings of electric, electronic and
mechanic equipment (other than that of
electronic components already
mentioned in the electronics' report
summary)

Fluoropolymer use in the aerospace &
defence industry

Fluoropolymer use in the chemical industry
Nano-coating of solder paste printing stencils
High Voltage DC Converter Valves
Fluoropolymers as fillers in other polymers for lubrication and wear prevention in all kind of equipment with moving parts
PFHxA related substances and fluoropolymers in inks and toners and in coatings
Fluoroelastomers for tubing, sealing and other flexible parts that come into contact with ink in printers
Equipment & Infrastructure - fluid handling systems, process vessels, pipes and fittings, tubing, valves and pumps, storage and transport containers, filters & sensors
PTFE and other fluoropolymers in printed boards
PFAS use in coatings
PFAS used in Lubricants

Technical textiles for NVH insulation in compressors for industrial machinery applications (large scale industrial tools and large-scale fixed installations as defined in Directive 2011/65/EU)*****

PFAS use in process technology and process engineering equipment

Filtration (HVAC, gas turbines, air pollution control systems, fuel filtration, hydraulic filtration, acoustic filtration) media**. Separation media (liquid/liquid or air/liquid separation applications)***.

PFAS use in Organic Rankine Cycle systems

PFAS used in Electronics & energy

Some F-Gas

PFAS use in instruments sleeve

PFAS use in In vitro Diagnostic Assays

Silicone rubber compound containing PTFE (CAS# 9002-84-0) is used in molding and extruding cable accessories

PFAS used in TULAC (Textiles, Upholstery, Leather, Apparel and Carpets):

Specific medical devices: respiratory equipment*, wound dressing and packaging of terminally sterilised medical devices. Single-use detergent-proof washbowls (not covered under the Medical Device Regulation). Laboratory and research equipment (not covered under the Medical Device Regulation).

PFAS are used as propellant for Adrox AV spray cans

PFAS used in Transportation, including military platforms/vehicles:

Foaming agent in foamed (cellular) light weight concrete.
PFAS used in metal plating and manufacturing of metal products
PFAS use in Env. Monitoring/Air Sampling
PFAS use in general mechanical and plant engineering (for example - Agriculture machinery - Air-handling technology - Cleaning systems - Compressors and vacuum technology - Engines and systems (not only for transportation sector) - Food processing and packaging machinery - Lifts and escalators - Machine tools - Material handling and intralogistics - Measuring and testing technology - Metallurgy - Mining - Plastics and rubber machinery - Power transmission engineering (not only for energy sector) - Precision tools - Pumps and systems - Robots and robotics - Textile machinery)
PFAS use in O-rings
Specific coatings for electronic devices: conformal coating, anti-solder coating. Printing applications

Technical textiles for NVH (noise, vibration, and harshness) insulation in means of transport****. Technical textiles for engine ignition protection and NVH insulation in non-road mobile machinery (as defined in Regulation 2016/1628)*****.
PFAS used in Defence
PFAS use in optical equipment
PFAS use in cryogenic storage tanks
Cable glands
Electronics
PFAS use in lasers

PFAS use in chlor-alkali production (chlorine and sodium hydroxide and potassium hydroxide) and HCl electrolysis
(Hydraulic) hoses
PFAS use in laboratory equipment
PFAS use in special purpose lamps and lamp systems
Energy

PFAS use in instruments and reagent products
Solid Waste Treatment PFAS use in chlor-alkali production (chlorine and sodium hydroxide and potassium hydroxide) and HCl electrolysis PFAS use in analytical equipment Heat transfer fluid for vapor phase soldering Friction linings of industrial brakes PFAS use in chlor-alkali production (chlorine and sodium hydroxide and potassium hydroxide) and HCl electrolysis PFAS use in chlor-alkali production (chlorine and sodium hydroxide or potassium hydroxide) or in HCl electrolysis

PFAS use in gas cylinders
PFAS use in vision equipment
Guide elements for moving (gliding, sliding) parts like pistons
Fluoroplastics in general
Transportation
Coatings
Device production
Filter membrane production

Filtration and separation media
Pharmaceutical Manufacturing
Eyeglasses (consumer)
In the use categories “F-gases”, “Electronics & Energy” and “Transportation” the use of fluoroketone is missing as a clean agent fire suppression fluid (e.g. CAS # 756-13-8).
Several PFAS uses in Personal Protective Equipment are missing from the studies, including: fall protection harness, hear protection units, protective coveralls, high performance filtration applications, valves, washers, o-rings and electrical components with coated wires, used in multiple personal safety products.

In the use category "Medical devices", the use of cooling liquids is mentioned, but the products with following CAS numbers are missing: CAS # 297730-93-9 and CAS # 1064698-37-8.

Fluoropolymer use in the chemical industry

The following substances should be added under Data Centres – immersion cooling of semi devices/servers: CAS# 382-28-5, CAS# 338-83-0, CAS #1064698-37-8, CAS# 382-28-5, CAS# 375-03-1, CAS# 163702-08-7/163702-07-6 and CAS# 756-13-8.

Fluoropolymer as a polymer additive during polyethylene manufacture

In the use category “Construction”, the use of foam blowing additives in the production of energy efficient building material should be added (e.g. CAS #3709-71-5).

In the use category "Electronics & Energy" and "F-gases", the electrical equipment application is mentioned, but the use of alternatives to sulfur hexafluoride (SF₆) in electrical switchgear, gas insulated lines and other gas-insulated equipment is missing. It is important to note the use of fluorinated ketone (CAS # 756-12-7) and fluorinated nitrile (CAS # 42532-60-5) as alternatives to sulfur hexafluoride (SF₆) in this application.

Use of fluoropolymers (PVDF) as filtration elements

Fluoropolymer use in the aerospace & defence industry
PFAS use in 3-D Printing equipment
PTFE Wax in coatings
Fluoropolymers based coatings use in metal roofing / panels
Medium & High Voltage Switchgear Power Transmission Technologies
Chemical Production

Fluorosurfactants in coatings
PFAS use in Hard Disk Drives (HDD)
PFAS use sealants for aerospace industry
PFAS use in ophthalmic intra-ocular
The following substances should be added under Heat transfer fluids: CAS# 63702-06-5/163702-05-4, CAS# 957209-18-6), CAS # 338-83-0 and CAS# 756-13-8.
Window films are missing from the current report.
PFAS use in ophthalmic solutions

PFAS use in Gasket & Seal Manufacturing Industry

PFPE (CAS# 69991-67-9) lubricant is used on silicone cable accessories

The following substances should be added as solvents for lubricants: CAS# 375-03-1, CAS# 163702-08-7/163702-07-6, CAS# 63702-06-5/163702-05-4.

PFAS-based heat transfer fluids in immersion cooling applications in automotive electronics applications (e.g. inverters, Electronic Control Unit (ECUs), on-board chargers, traction motors). The following substances should be added as heat transfer fluids for power electronics cooling: CAS# 163702-08-7/163702-07-6, CAS# 132182-92-4, CAS# 297730-93-9, CAS# 756-13-8, CAS# 1093615-61-2, CAS# 1064697-81-9.

Architectural Panel Tapes

The following substances should be added as testing fluids: CAS# 382-28-5, CAS# 382-28-5, CAS# 382-28-5.

The following substances should be added under Solvent/Solvent Cleaning of Electronics Components: CAS# 163702-08-7/163702-07-6, CAS# 163702-08-7/163702-07-6), CAS # 132182-92-4.

The following product listed in F-Gas Annex I is missing: CAS# 1064697-81-9. This product is typically used as a heat transfer agent. Other products used as heat transfer agents are: CAS# 338-83-0, CAS# 1064698-37-8, CAS# 1093615-61-2.

The application of cover gas is detailed, however, the use of fluoroketone is missing as a cover gas, specifically CAS # 756-13-8.

Heat shrink tubing with PVDF (CAS# 24937-79-9)
added under Coatings of electronic components: CAS# 163702-08-7/163702-

The following substances should be added as cleaning fluids: CAS# 163702-08-7/163702-07-6 and Novec 71DE fluid (azeotropic blend of t-DCE with Novec 7100 fluid (CAS# 163702-08-7/163702-07-6), Novec 71IPA fluid (azeotropic blend of Isopropanol and Novec 7100 fluid (CAS# 163702-08-7/163702-07-6), Novec 72DE fluid (azeotropic blend of t-DCE with Novec 7100 fluid (CAS# 163702-08-7/163702-07-6) and Novec 7200 fluid (CAS# 63702-06-5/163702-05-4), and Novec 73DE fluid (an azeotropic blend of t-DCE and Novec 7300 fluid (CAS # 132182-92-4)).

Description of specific PFAS use / benefits*
4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]: diphthalicanhydride (EC number: 214-170-0)Raw materials for liquid crystal polymers polyimide Raw materials in gas separation 2,2,3,3,3-Pentafluoropropanol (EC number: 207-012-7): Surfactant of the production of fluoropolymers 2,2,3,3-tetrafluoropropan-1-ol (EC number: 200-955-5) 1H,1H,7H-Dodecafluoro-1-heptanol (EC number: 206-406-6) HFIP (EC number: 213-059-4) HFP (EC number 116-15-4) Production of perfluorooctan C3VE (EC number: 216-600-2)
High-performance moisture barrier. Use of PCTFE in packaging for medicinal preparations, medical devices and molecular diagnostics
PFAS-based solvents are used in automotive electronics to coat the printed circuit boards and LED lighting for moisture and corrosion protection. They are also used for anti-fingerprint or anti-smudge coating materials for automotive display surface coatings.
Unique optical properties, chemical resistance to the ingredients of perfumes, very high cleanliness, no extractable into the liquid
Use of PFAS in form of polymers (e.g. PTFE, FEP, PFA, PVDF, FKM) for tubes and seals for the transport of fluids (e.g. water, milk, coffee, steam) because these materials combine heat resistance, pressure resistance and chemical resistance (important e.g. for the use of descaling agents) and internationally comply with food contact laws
Resistance against very aggressive chemicals at elevated temperatures makes FP-based Pressure Piping Systems unique

In the last 20 years, microfiltration ("MF") and ultrafiltration ("UF") have become ubiquitous in drinking water production and wastewater treatment all over the world due to their ability to remove harmful pathogens at >99.999%.

Polyvinylidene Fluoride (PVDF, CAS 24937-79-9) stands out as the clear preferred material for filtration elements due to several key features: a) this high purity plastic material meets the already stringent, and still evolving regulatory requirements for products used in drinking water production; b) it is resistant to a broad range of chemicals including solvents and more importantly in the water industry, to acids, bases and oxidants and c) it can be made into a hydrophilic material with improved long-term resistance to fouling. In conclusion, water and wastewater treatment need the kind of stability and long life that PVDF provides to make MF and UF and their undeniable public health benefits accessible to utilities around the world.

PFAS are used as anti stick coatings in MEMS application to achieve reliable functionality and up to now it was impossible to substitute these by other materials. Additionally PFAS anti stick coatings are necessary other technical or production equipment like stencils for electronic board production with high packaging density.

Anti-corrosion protection, protection against aggressive cleaning agents, disinfection, acids and alkaline, high-pressure cleaning etc.

e.g. made of FKM, FPM, PTFE and/or coated with PTFE

Fluoropolymers containing products are also used in the aerospace industry which includes e.g. civil and military aviation, defence and satellite systems. Those materials are used as wear and friction components in jet turbine engines for commercial and military aircraft. Such components are vane bushings, spacers, clamps, wear channels, and wear strips. The high temperature capability of these materials provides significant weight reduction in areas of the engine where metal components were once used allowing the engine to burn less fuel. The self-lubricating properties of parts made from this material technology provide improved wear and durability and low friction extending the maintenance cycles and improve safety performance.

Fluoroelastomers are used in seal applications to contain fluids in critical aerospace systems which require superior chemical resistance and a wide temperature service range when compared to other available elastomeric seal materials.

Fluoropolymer use in the chemical industry is not addressed at all in the summary reports or listed as a specific use category. In both the chemical industry and the petroleum/gas/mining industries, fluoroelastomers are, for example, used in seals and O-rings. Fluoroelastomers (such as FKM and FFKM) increase seal performance and reduce maintenance in extreme chemical and temperature environments. The seal is oftentimes the key failure point and is thus critical to overall equipment performance and to ensure safe operation. Key applications in chemical processing and the oil and gas industry are e.g. oil and gas downhole tools, valves, compressors, and pumps.

Necessary to achieve acceptable solder release in stencil printing, e.g. for electric boards with components of very different sizes

HVDC converter valves convert electric power from high voltage alternating current (AC) to high-voltage direct current (HVDC), or vice versa. Fluoropolymers (PTFE & PVDF & FEP/FKM) parts are widely used due to their physical and chemical properties. The 40+ year operation cycles under demanding environmental conditions (very high and low temperatures, high voltage currents) require non-conductive but also chemically stable materials for joints, coolant hoses, cables and many more parts that have proven this stability in the past 60-80 years of application.

Low friction

Low surface tension

Chemical resistance

Chemical resistance

Temperature resistance, low signal loss, dielectric constant, heat conductivity.

Dry film lubricants, hard coats on aluminium and various coatings (PTFE coatings, ethylene and chlorotrifluoroethylene copolymers)

PFAS-containing lubricants are used to lubricate bearings, moving parts and mechanical devices in aerospace and defence products. PFAS-containing lubricants are used in engines and gearboxes fitted to aerospace and defence products. PFAS-containing hydraulic fluids are used in hydraulic systems and/or actuators fitted to aerospace and defence products

Fluorotelomers

PFAS are used in:

- Agitated vessels
- Bellows
- Complete linings for process equipment
- Discharge pipes
- Fittings
- Membranes for filtration
- Pipes
- Protective rings for manholes
- Pumps
- Seals
- Spray pipes and spray lances for cleaning apparatus
- Stirrers
- Tanks/Containers
- valves / ball valves
- Wiper arms

PFAS have in process engineering benefits like:

- Chemical resistant
- Fabric repellent (e.g. to oil, water, dirt, etc.)
- Good sliding properties
- Inert / prevents flavour carry-over
- Sterilisable for hygiene requirements
- Suitable for contact with food and drinking water
- Temperature resistant
- Wear-resistant / Durability

Fluorotelomers

The high temperature steam Rankine cycle is widely used in the power generation industry, using high temperature waste heat sources and at these temperatures steam is an efficient working fluid and is stable. The use of organic compounds in the Organic Rankine Cycle enables the cost-effective extraction of energy from lower temperature heat sources (typically in the range 80°C to 200°C). Compared to steam, suitable working fluids for the Organic Rankine Cycle have high molecular weights and low boiling points. These fluids enable the extraction of energy from low temperature waste heat sources using less costly simpler design systems. The conversion rate from thermal to electrical power varies depending on the choice of the best working fluid for the waste stream, the selection and optimization of the best plant layout and components, and the effects of fluid properties on expander efficiency, but typically is between 10% and 15%, including the electrical power required to drive fans and pumps in the system[1].

[1] UNEP 2014 Report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee 2014 Assessment Report page 105

Cable insulation, particularly in high performance co-axial cables or cables where reliable, high-volume data transmission is essential.
Printed circuit boards and assemblies.

Gaskets and moulded products such as fluorocarbon O-rings used to seal casings for electronic assemblies within commercial aircraft and all types of military platforms.

High Temperature Film Capacitors.

Electronic displays and touch screens.

Lithium (Li) ion Batteries.

Polymer electrolyte membrane in Hydrogen fuel cells for range extension in electric aircraft.

F-Gas is used for cooling high-output electrical and electronic equipment in military platforms.

Halons are used for fire suppression in civil and military aircraft, however efforts are being made to phase them out. Most Halon 1301 alternatives (HFC-125, 2-BTP, NOVEC 1230, CF3i) and all Halon1211 alternatives (2-BTP and HFC-236) are PFAS.

Fluorinated solvents are used as cleaning agents for hydrogen tanks

PTFE Instruments sleeve, chemically and thermally stable

PFAS are present in IVD assays allowing to detect disease, conditions and infections.

The intrinsic PFAS are being sought: Used to cause a large decrease in the surface tension of the solutions during manufacturing allowing to successfully create coated layers of our assays.

We use less than 10kg/year.

PFAS is present in seating textiles / carpets used in commercial aircraft and in military platforms.

PFAS is present in clothing and equipment used by military personnel in hostile environments. Military personnel includes those operating in airborne, maritime and ground-based forces. Examples include and are not limited to: anti-g suits worn by military jet fighter pilots, other aircrew clothing, protective clothing, parachutes and drogues.

PFAS is present in drogues towed behind military platforms.

PFAS is present in fire/oil resistant acoustic insulation in military platforms.

Fluorotelomers

PFAS propellant is inflammable (Airbus Requirement)

Where military platforms/vehicles are similar to the transportation vehicles used by civilians, ASD has included missing PFAS uses here under 'Transportation'. Military platforms/vehicles include:

Military aircraft, including fast jets, training aircraft, large transports and helicopters.

Naval vessels: surface ships - including aircraft carriers - and submarines.

Land vehicles, such as tanks, weapons launchers and transportation vehicles for military personnel and munitions

Hydrogen is essential to achieving net zero CO2 emissions in the aerospace sector as follows:

Commercial aircraft used on medium-range flights will be powered by direct combustion of hydrogen. Fluoropolymers are integral to the functioning of electrolyzers, which in turn enable the transformation of renewable energy such as wind power into green hydrogen.

Electrically powered small aircraft on short-range flights will carry hydrogen fuel cells which generate on-board electricity from hydrogen. Fluoropolymers are indispensable to the electrochemical reaction which turns hydrogen and oxygen into electricity. Hydrogen fuel cells are composed of an anode and a cathode separated by a proton exchange membrane (PEM). The hydrogen molecules separate into protons and electrons at the anode and the PEM relies on fluoropolymers to allow the protons to permeate through to the cathode. The electrons cannot permeate the membrane and are forced to travel through an external circuit generating an electrical current.

Hydrogen fuel cells may be used in hybrid-electric configurations on larger, medium range aircraft.

Fluorotelomers
PTFE and PDVF tank liners are used for Hydrofluoric acid processes to ensure safety by protecting tanks against corrosion. PTFE is used for seals on transfer pumps and pipes used in chemical process lines. PFAS-containing anti-corrosion liquids are used to prevent corrosion of metal parts (not just steel).
PTFE Membrane Filters: Used when conducting gravimetric, chemical, &.or microscopic analysis of particulates. Resistant to corrosives & solvents Temperature resistant to 260°C The material is hydrophobic making it ideal for Aerosol sampling
PFAS are uses in several components that are covered by the use categories of product categories: - Food contact materials & packaging - Construction products - Medical devices - Metal plating & manufacturing of metal products - TULAC - F-gases - Electronics & energy - Transportation PFAS have in mechanical engineering benefits like: - Abrasion resistant - Chemical resistant - Fabric repellent (e.g. to oil, water, dirt, etc.) - Gas tightness in vacuum - Good dielectric properties - Good sliding properties - Inert / prevents flavour carry-over - Low frictional resistance - Mechanical resilience - Pressure resistant - Sterilisable for hygiene requirements - Suitable for contact with food and drinking water - Temperature resistant - Wear-resistant / Durability
for chemically stable sealing on a variety of medical instruments
Fluorotelomers

Fluorotelomers
Fluoropolymers are essential to the manufacture and functionality of high-performance outer surfaces on current and future Defence Platforms in the Air, Naval and Land environments. These surfaces are multifunctional, however their functionality cannot be disclosed as this is classified information. Fluoropolymers are used to manufacture pyrotechnic flares used as countermeasures for aircraft. Resins used in munitions manufacture contains PFAS.
Low Friction Polymers in optical instruments: Non-reactive / inert / chemically stable, low friction/low surface energy, thermally resistant. Lubricant: Non-reactive / inert / chemically stable, low friction/low surface energy, thermally resistant.
Lubricants on the fittings of the tanks: sealing material must be resistant e.g. made of PVDF
In the Electronics sector, fluoropolymers are used for wire and cable insulation due to their very low dielectric constant, strength, flexibility, temperature stability, UV resistance, and low particulation. This allows cables that use fluoropolymers to achieve unmatched performance in highly demanding applications such as aerospace, test & measurement, clean room production, extreme environments and high speed data transmission. - Additionally, In semiconductor manufacturing, fluoropolymer filters are used to process the aggressive chemicals needed to processes like chemical etching and photolithography. - fluoropolymers are also used as component in electronic devices beyond semiconductors themselves. They are used for thermal and electrical insulation gaskets. fluoropolymer vents are used in a wide variety of electronic components ranging from computers, mobile phones and smart watches to telecommunications infrastructure such as base stations. fluoropolymers are necessary to create durable, breathable barriers which prevent water entry and resist chemical, thermal and ultraviolet degradation
Wire and heat shrink: Ultra-low temperature resistant electrical insulation (-136°C); Thermally stable electrical isolation (high energy) Dust filter: Chemically inert Foil / tape: Sealing, hydrophobic compounds Tubing / hosing: Functional thermal stability for thermoregulation tasks from -125 to +425°C

ability

e.g. made of PTFE-FEP

Cable insulation: Extreme Chemical resistance to aggressive chemicals; does not interact with the reagents or biological cultures, or pharmaceuticals.

Coating of device surfaces: Extreme Chemical resistance to aggressive chemicals; does not interact with the reagents or biological cultures, or pharmaceuticals.

Stirring bar in laboratory mixing equipment: Extreme Chemical resistance to aggressive chemicals; does not interact with the reagents or biological cultures, or pharmaceuticals.

Tip fitting: Reduction of leading force, low surface energy, low friction

Diaphragm pump: Hydrophobic, oleophobic, low friction, low surface energy, inert, chemically stable, dimensionally stable

Sensors (e.g. temperature control): Thermally stable electrical isolation (high energy)

Tubing / hosing: Friction reduction: very low surface energy, biologically inert substance, chemically stable

Gaskets & Seals / O-rings: Resistance against UV radiation

PTFE filters are used throughout the energy sector to improve performance and reduce environmental emissions. Turbine filters are used to improve the efficiency and reduce downtime of natural gas turbines. Mercury filters are used at coal based power plants to remove mercury from exhaust gases. PTFE filter bags, including some with catalytic functionality, are used to reduce particulate and chemical emissions from waste-to-energy plants.

- Fluoropolymers are used to enable electronic components used for oil & gas exploration such wire and capacitors for downhole well applications.

All of these applications require materials that can withstand harsh chemical and temperatures while remaining strong and air permeable.

PFAS material is contained in various fittings such as O-rings, seals, tubing, and bottle caps. PTFE filters are used during production processes. PTFE membranes are in products for their favourable gas exchange properties. PTFE-coated O-rings are used in some valves due to their non-sticky/lubricant properties. The material PFAS is also in components that are part of the reagents portfolio, including the primary packaging for advanced staining reagent dispensers and special stains reagents. PFAS trifluoroacetic acid (TFA) and hexafluoroisopropanol are also present in applications. TFA is used in analytical and production processes. TFA is used in HPLC applications as an additive to the mobile phase. There are also many ingredients that are used as TFA salt. Some products in development are using PFAS substances but as of today, they are not on-market kits.
Fluoropolymers are used for the transformation of non-hazardous organic residues from households, industrial or agricultural generators into products which close the natural cycle to return valuable nutrients to soils contributing to soil health sustainably while supporting the carbon capture in the ground, addressing global challenges like climate change and food security.
In fluoropolymer components of gaskets, valves and pipework to transport chlor-alkali products. Used for durability and safety in the carriage of corrosive products.
Gaskets & Seals / O-rings: Functional thermal stability for thermoregulation tasks from -125 to +425°C, dimensionally stable, chemical, physical, mechanical resistance Connectors: Non-reactive inert chemically stable flexible thermally resistant Bearings: Non-reactive / inert / chemically stable, low friction/low surface energy, thermally resistant
Made of PFPE
Containing a small amount of PTFE in order to enable a good friction value also for high temperatures
In fluorinated refrigerant gases to improve energy efficiency in the purification of the chlorine gas
In fluoropolymer components of membranes/ diaphragms to separate chlorine/ hydrogen and sodium hydroxide or potassium hydroxide or in case of HCl electrolysis the chlorine from the hydrogen or oxygen. Improves resistance against the chemical solutions in the electrochemical cells, improves energy efficiency and improves safety as prevents explosive reactions occurring. Alternative mercury and asbestos technologies are prohibited under EU law.

Sealing of valves of the bottles: sealing material must be resistant
Coating for ophthalmic lenses: easy to clean, hydrophobic, oleophobic and scratch resistant. Rigid Gas Permeable Contact Lenses: better wetting characteristics; reduction of protein deposition and improvement of oxygen transmission Manufacture of contact lenses: High chemical resistance; biologically and chemically inert material, monomer compatible
e.g. made of composite material containing PTFE
Used for anticorrosion linings in tanks , heat exchangers, pumps, filters, diaphragms, towers: combination of chem and heat resistance Heat resistance up to 300 deg C Non-stick and non wetting performance
fluoropolymers are necessary for additional applications In aerospace that require temperature and chemical resistance, thermal stability and high strength. such applications include insulation for cables or gasket materials used In aircraft, spacecraft and satellites which are exposed to extreme conditions and require exceptional reliability. - Many components and systems In automobiles require protective vents made from fluoropolymers. These vents are used to seal critical systems like headlamps, drive trains, or batteries from dirt, oils and water while allowing gases to pass through for safe, reliable performance.
Coating on certain equipment, such as valves and piping, used in a wide variety of manufacturing processes. Merck use such equipment internally and also manufacture high-quality valves with PTFE coatings. Benefits of PFAS are the chemical stability
Gaskets and sealing devices Benefits of PFAS use: Chemical stability and oil/water repellence
Membranes are used in the discovery, development, and production of pharmaceutical and biopharmaceutical medications and therapies. These membranes are precisely manufactured to create a specific pore structure that is ideal for the sterilization and purification of parenteral drugs. The membranes are also used in a large number of testing and laboratory applications related to scientific research and development. The benefits are the durability, chemical stability as well as the oil and water repellent properties

C6 SFP: C6 repellents are applied on the interlaced points of fabrics. Not necessary to fully coat the points textile/non-wovens: water repellence, oil and grease repellence, alcohol/soil resistance SFP for filtration: treat filters in labs , hospitals, clean rooms (semicon), absorb moisture PTFE: prevent emissions in the chemical and power sectors. Impregnations of yarns, glass, cloth, filter bags, flexible ductwork
Use of PFAS in equipment and supplies used to manufacture pharmaceutical products. Processes to make pharmaceuticals require a high degree of cleanliness, purity, chemical stability and thermal resistance necessitating the use of fluoropolymers. They are commonly used in a variety of containers, tubing, filters and other processing equipment
Easy to clean top coat on eye glasses Less fingerprint adhesion on the lenses due to very easy cleanability Properties are important for the weather in the daily traffic Very thin surface, low material consumption
A fluoroketone fire suppression agent (CAS #756-13-8 with GWP<1) is used to suppress fires in enclosures that house high-value electronics or other assets that would be damaged by water sprinkler suppression systems. Common applications include electrical control rooms or underground substations, data centres, telecommunications switch rooms, computer control rooms, airport control towers, clean rooms, and computer-controlled manufacturing operations as well as in archives and museums with paper archives, historical documents, priceless works of art and antiquities where other fire protection fluids cannot be used. The fluoroketone fire suppression systems are also used in marine vessels. This material is a replacement for ozone depleting substances and compounds with high global warming potential (GWP) including halons and hydrofluorocarbons (HFCs). This product is a very low GWP (<1.0) clean extinguishing fire protection fluid. Non-PFAS fire protection agents can cause corrosion, can damage equipment or valuable artefacts, can be electrically conductive, are slower drying, can leave a residue, may have higher toxicity, may require high operating pressures, and may result in higher maintenance costs.
Use of PFAS is essential for achieving the required performance of the mentioned personal protective equipment products.

The mentioned (CAS #) PFAS products are used in many critical applications. They are used for cleaning of medical devices as cleaning solvents in vapor degreasing applications. In "neat" form, a fluid can be used for light duty cleaning, tube swelling and deposition. Azeotropic blends of PFAS substances with other chemicals offer higher solvency for more difficult cleaning. Cleaning applications include metal and plastic parts, such as orthopedic, dental and spinal implants, artificial hearts, heart valves, catheters, needles and stents. These fluids can also be used as rinsing agents. They can be used as solvents for deposition coatings for metal, plastic and elastomeric medical devices. Specific deposition applications include medical electronics, lancets, surgical and cutting blades, filters and PVCs tubing. One of the mentioned products, segregated hydrofluoroethers (HFEs), can also be used as reaction media or inert media and in microfluidics applications for medical testing applications.

These fluids are used as heat transfer agents in medical equipment (e.g. surgical lasers) and laboratory diagnostic devices and in freeze drying applications in the manufacture of pharmaceuticals. Another one is also used as heat transfer in laboratory diagnostic devices.

They are used for industrial use only and are not intended for use in a medical device or drug. When the product is used for applications where the finished device is implanted into the human body, no residual solvent may remain on the parts. These products are not intended for incorporation in medical and pharmaceutical products and applications in which the product will be temporarily or permanently implanted into humans or animals.

Fluoropolymer use in the chemical industry is not addressed at all in the summary reports or listed as a specific use category. In both the chemical industry and the petroleum/gas/mining industries, fluoroelastomers are, for example, used in seals and O-rings. Fluoroelastomers (such as FKM and FFKM) increase seal performance and reduce maintenance in extreme chemical and temperature environments. The seal is often the key point of failure and is therefore critical to the overall equipment performance and to ensure safe operation. Key applications in chemical processing and the oil and gas industry are, for example, downhole tools, valves, compressors, and pumps.

Fluorochemical heat transfer fluids can be used for liquid immersion cooling applications in data centres. Immersion cooling is a method for cooling data centre IT hardware by directly immersing the hardware in a non-conductive liquid. Heat generated by the electronic components is directly and efficiently transferred to the fluid. This reduces the need for interface materials, heat sinks, fans, shrouds, sheet metal and other components that are common in traditional cooling methods. Immersion cooling with these fluids offers many benefits compared to traditional air cooling, including increased thermal efficiency (i.e., lower power usage effectiveness or PUE) and increased performance and reliability of data centres. Immersion cooling also eliminates the need for complex airflow management. Optimized immersion-cooled data centres can lead to reductions in capital and operating expenses, as well as a reduction in construction time and complexity. The increased compute density from immersion cooling allows for more flexible data centre layouts and removes barriers to data centre location choices such as areas with high real estate costs or space limitations. Finally, immersion cooling with these fluids can help eliminate the trade-off between water usage, energy efficiency and cost by eliminating the need for chillers with economizers and complex controls used in air cooling. This helps eliminate the use of water needed to cool the data centre by, instead, utilizing natural water temperatures in many climates to allow for full capacity cooling without evaporation infrastructure.

Fluoropolymers are used in low concentrations as polymer additives during the polyethylene production process, as an essential component to eliminate melt fracture, aid extrusion and reduce operational temperature requirements, for the production of high performance polyethylene with superior properties. This specific use is different from the use of fluoropolymer polymer processing aids (PPAs).

In building materials, a PFAS-based foam additive (CAS# 3709-71-5) is used as a foam insulation additive due to its effectiveness in reducing the foam cell size and thus the thermal conductivity of polyurethane and other rigid foam formulations. It is used in the production of rigid insulation polyurethane foam products to meet the latest EU thermal conductivity specifications (e.g., DIN EN 13165). Typical usage rate for this product is as low as 0.5% of the total foam weight and this product is used in a closed manufacturing process. The foam additive is incorporated into the final foam product.

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Over the last 20 years, microfiltration ("MF") and ultrafiltration ("UF") have become ubiquitous in drinking water production and wastewater treatment worldwide due to their ability to remove harmful pathogens at >99.999%.

Polyvinylidene Fluoride (PVDF, CAS 24937-79-9) stands out as the clear preferred material for filtration elements due to several key features: a) this high purity plastic material meets the already stringent, and still evolving regulatory requirements for products used in drinking water production; b) it is resistant to a broad range of chemicals including solvents and, more importantly in the water industry, acids, bases and oxidants and c) it can be converted into a hydrophilic material with enhanced long-term resistance to fouling.

In conclusion, water and wastewater treatment needs the kind of stability and long service life that PVDF provides to make MF and UF and their undeniable public health benefits accessible to utilities around the world.

Fluoropolymer-containing products are also used in the aerospace industry which includes, for example, civil and military aviation, defence and satellite systems. These materials are used as wear and friction components in jet turbine engines for commercial and military aircraft. Such components are vane bushings, spacers, clamps, wear channels, and wear strips. The high temperature capability of these materials provides significant weight reduction in areas of the engine where metal components were previously used, allowing the engine to consume less fuel. The self-lubricating properties of parts made with this material technology provide increased wear and durability, as well as low friction that extends the maintenance cycles and improves safety performance. Fluoroelastomers are used in sealing applications to contain fluids in critical aerospace systems which require superior chemical resistance and a wide temperature service range when compared to other available elastomeric seal materials.

PFAS-based products fulfil specific technical requirements within most, if not all, types of 3-D Printing equipment. The materials are used in seals, gaskets, coated tubing and lubricants. In certain types of 3-D printing equipment, they are also used as laminate coatings on glass within the resin chamber to impart appropriate levels of light transparency and gas permeability.

Scratch resistance to maintain integrity of the metal or wood substrate

Extreme UV resistance - resulting in durable and longevity of building / construction products (over 40 years)

PFAS are used in combination with air (7-15% C5-FK) as dielectric insulation gas in gas insulated medium and high voltage switchgear as substitute to SF6.

Benefit: Substitution of 100% SF6 with GWP 23500 by <15% with GWP <1 keeping very similar design, reliability, dimensions and cost level.

C5-FK: 1,1,1,3,4,4,4-Heptafluoro-3-(trifluoromethyl)butan-2-one / CAS-No.: 756-12-7

C4FN: 2,3,3,3-Tetrafluoro-2-(trifluoromethyl)propionitrile /CAS-No.:422532-60-5

Fluoropolymers (PTFE & PVDF) parts are also necessary in these Technologies due to their physical and chemical properties. During operation chemical corrosion resistance and dielectric characteristics are required for 40+ years reliable operation cycles of the systems.

Fluoropolymers in particular are used in a multitude of applications related to chemical manufacturing to seal equipment and containers to prevent the release of hazardous chemicals or for filtration applications to prevent air or water emissions during industrial processes. These sealant and filtration products are used during the manufacturing of many chemical and other materials, like acids, chlorine, carbon black, cement, TiO₂, catalysts, mineral, polymers, fertilizers, pesticides, industrial & household cleaners, pulp & paper manufacturing and many others.

Lower surface tension in waterborne products to improve wetting, levelling and surface defects such as cratering
There are multiple critical uses of PFAS (e.g., PTFE, FKM, and others) in Hard Disk Drives (HDD), including lubricant on recording media surfaces, membranes for particle filtration, actuator crash stops, sealing gaskets, and other applications. / Only PFAS based materials meet the extreme particle, ionic and organic cleanliness requirements of materials used in the sealed internal HDD environment, as well as providing the required inertness, thermal stability, hydrophobicity, oleophobicity, and physical properties depending on the use such as compressibility, permeability, non-tackiness, as well as manufacturability.
Alternative for NPE coating sealants; NPE is on Annex XIV (AfA)
The PFAS used is TFEMA. It is a monomer incorporated into the
Heat transfer fluids
PBSF-enabled coatings are used in window film applications because these films deliver superior performance over standard polyester films in blast and impact events; yet still maintain a high level of optical clarity. The PBSF is used to aid in wetting out during the coating step. Window films are used in both automotive aftermarket as well as in public, commercial and residential buildings. For construction applications window films are used for the following properties: mitigates hazards from shattered glass during natural disasters, helps protect people from flying glass shards, one of the most common causes of blast-related injuries and fatalities, helps increase security and provide added protection against smash and grab burglaries, significantly blocks the amount of harmful UV rays.
A PTFE membrane is used in hydrogen peroxide based ophthalmic disinfecting solutions. It provides the necessary hydrophobicity to keep the aqueous contents from leaking from the container, while still being permeable to the oxygen released from the solution (during disinfection, H_2O_2 degrades into $H_2O + O_2$), thereby preventing over-pressurization of the container.

Sealing Applications: 1. Mechanical Seals & Seal Support Systems: Minimize/Eliminate equipment leakage Used in corrosion & high temperature applications Optimize mechanical seal performance & extend service life 2. Packing & Gaskets: Installation/Removal: The flexibility & stability of the PFAS-containing backbone prevents installation problems. Sealing Performance: The combination of PFAS & graphite delivers superior sealing & long service life due to the flexibility & strength offered by the PFAS & the thermal properties offered by the graphite. Chemical Resistance: PFAS/Graphite packing can be used across the 0 to 14 pH range except with strong oxidizers, fluorine, molten fluorides and a few others. Versatility: PFAS/Graphite packing can be used in a wide range of pump & valve sealing applications & service conditions including shaft speeds of 20-m/s. Applications include rotary pumps, centrifugal pumps, soot blower, mixers & any valve seeing temperatures less than 288 degrees C. Coatings/Dispersants: Friction control Abrasion resistance Fasteners: Used in corrosion & high temperature applications Filtration Systems: Provide high filtration efficiencies Used in corrosion & high temperature applications Monitoring & Measuring Equipment: Gauges - Resistant to cracking/breakage Sensors - Used in corrosion & high temperature applications
Solvents for lubricants
Immersion cooling applications in automotive electronics applications

PBSF-enabled Architectural Panel Tapes are used for many applications in the construction industry, including the manufacture of architectural panels for curtain walls, exterior building cladding and interior panel and trim attachment. In many situations, they replace liquid adhesives, sealants, welds and mechanical fasteners. They provide immediate handling strength during the fabrication process and do not shrink after curing, like with some liquid applied sealants. This shrinkage can result in isolated panel stress that may be visible on the exterior face of the architectural panel.
Testing fluids
Cleaning of Electronics Components
Heat transfer agents
Magnesium protection cover gas
Coatings of Electronic components
Cleaning Fluids



Indicate application 1. Industrial 2. Professional 3. Consumer (or a combination)	Sector of use (e.g. cosmetics, TULAC, petroleum & mining) (if applicable)
6FDA: Gas separation in different applications: aviation 5FA: surfactant HFIP: eye lenses, solvent, 3D printing: consumer C3VE: bio-degradable coatings	Transportation
Consumer	Pharma packaging
Industrial	Automotive
Cosmetics	
Industrial	Energy
Consumer (EEE)	Household appliances
Industrial / Professional	Building & Construction

Industrial / Professional	Water purification
Industrial / Professional/Consumer	Electronics, F-gases, Automotive
Industrial	Machinery, electric drive technology
Industrial / Professional	Machinery, electric drive technology
Industrial / Professional	Aerospace & defence industry

Industrial / Professional	Chemical industry
Industrial	Electronics
Industrial	Energy and Grid Infrastructure: (Transmission and distribution of electrical energy).
Industrial / Professional/Consumer	Electronics
Industrial / Professional/Consumer	Electronics
Industrial / Professional/Consumer	Electronics
Industrial	Electronics, manufacturing
Industrial / Professional/Consumer	Electronics
Consumer	Limited contact medical devices

	Others
Industrial / Professional	
	TULAC (textiles, upholstery, leather, apparel and carpets)

Industrial / Professional	Waste heat management, e-Energy production
Consumer	Limited contact medical devices
Professional	In Vitro Diagnostics sector (Healthcare)*
Industrial	Energy

	Medical devices
Industrial	Aerospace

	Construction products
Industrial/ Professional	Cross-sector application
Industrial / Professional	Food contact materials & packaging Construction products Medical devices Metal plating & manufacturing of metal products TULAC F-gases Electronics & energy Transportation
Consumer	Limited contact medical devices
	Electronics & energy

	Transport
Industrial / Professional	Cross-sector application
Industrial / Professional	Cross-sector application
Industrial / Professional	Machinery, electric drive technology, electronics
Industrial / Professional	Cross-sector application

Industrial	
Industrial / Professional	Machinery, electric drive technology
Industrial / Professional	Cross-sector application
Industrial / Professional	Cross-sector application

Professional	Medical devices
Industrial	
Industrial / Professional	Cross-sector application
Industrial / Professional	Electronics
Industrial	Machinery, electric drive technology
Industrial	
Industrial	

Industrial / Professional	Cross-sector application
Professional / Consumer	Medical devices
Industrial / Professional	Machinery, electric drive technology
Industrial	Chemical /Semicon
Industrial	Life Science, medical
Industrial	Life Science, Lab equipment
Industrial	Life Science

Consumer Industrial (automotive)/ Semicon	
Consumer	?
Industrial	Electronics & Energy, Transportation, Buildings and others
Industrial / Professional	Personal Protective Equipment (normally covered by TULAC, but please note that not all PPEs are textile applications)

Industrial	Medical Devices
Industrial	Chemical Industry and Oil, Gas & Mining

Industrial	Electronics & Energy
Industrial	Yes, but we believe the use was misunderstood, as it is fundamentally different from the use of fluoropolymer PPAs further down the value chain.
Industrial	Construction

Industrial	Energy
Industrial	Water Filtration

Industrial	Aerospace & Defence
Industrial / Professional	Widespread application of 3-D printing technologies wherever precision and complexity of shape is required. This can include everything from shoe soles to medical devices (overall <100kg PFAS per equipment manufacturer per year)
Industrial / Professional	Food Contact Coatings and Construction Products
Industrial	Construction Products
Industrial	Energy and Grid Infrastructure: (Transmission and distribution of electrical energy).

Industrial / Professional	Construction Products
Industrial / Professional/Consumer	Cross-sector application
Industrial	Aerospace
Professional	Medical devices
Industrial	Electronics & Energy
Industrial	Construction, Automotive
Consumer	Medical devices

Industrial	Aerospace Chemical Food & Beverage Mining & Minerals Petrochemical Pharmaceutical Power Generation Pulp & Paper Refrigeration Water & Wastewater
Industrial	Energy
Industrial	Automotive
Industrial	Automotive

Industrial	Construction
Industrial	Automotive
Industrial	Electronics & Energy
Industrial	F-Gases
Industrial	F-Gases
Industrial	Energy
Industrial	Electronics & Energy
Industrial	Automotive



Have you submitted any information on this use during the Call for evidence / First Consultation? (Volumes, Emissions, Alternatives, Other)	Do you plan to submit any information on this use during the Second Consultation? (Volumes, Emissions, Alternatives, Other)
No	Volumes, Alternatives
Alternatives	Alternatives
No	Alternatives
No	Alternatives
Alternatives	Alternatives

No	Alternatives, Other
No	Alternatives, Other
No	Alternatives, Other
No	Alternatives, Other
Yes	Alternatives, Other

Yes	Alternatives, Other
No	Alternatives, Other
No	Emissions, Alternatives, Other
Emissions, Alternatives, Others	Emissions, Alternatives, Others
Emissions, Alternatives, Others	Emissions, Alternatives, Others
Emissions, Alternatives, Others	Emissions, Alternatives, Others
Emissions, Alternatives, Others	Emissions, Alternatives, Others
Emissions, Alternatives, Others	Emissions, Alternatives, Others
No	No
No	No

No	No
No	No
No	No

No	No
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No	No
No	No
No	No
No	No

No	No
No	No
No	Other
No	Other
No	Other
No	Other
No	Other

Other	Other
No	Other
No	Other
No	Other
No	Other

No	Other
Other	Other
No	Other
No	Other
No	Other
Other	Other
Volumes, Alternatives, Other	Other

No	Other
No	Other
No	Other
No	Volumes, Alternatives
Volumes, Alternatives	Volumes, Alternatives
Volumes, Alternatives	Volumes, Alternatives
Volumes, Alternatives	Volumes, Alternatives

No	Volumes, Alternatives
No	Volumes, Alternatives
Volumes, Alternatives	Volumes, Emissions, Alternatives
Volumes, Alternatives	Volumes, Emissions, Alternatives

Volumes, Alternatives	Volumes, Emissions, Alternatives
Volumes, Alternatives	Volumes, Emissions, Alternatives

Volumes, Alternatives	Volumes, Emissions, Alternatives
Volumes, Alternatives	Volumes, Emissions, Alternatives

Volumes, Alternatives	Volumes, Emissions, Alternatives
Volumes, Alternatives	Volumes, Emissions, Alternatives

Volumes, Alternatives	Volumes, Emissions, Alternatives
No	Volumes, Emissions, Alternatives, Other
No	Volumes, Emissions, Alternatives, Other
No	Volumes, Emissions, Alternatives, Other
No	Volumes, Emissions, Alternatives, Other

No	Volumes, Emissions, Alternatives, Other
No	Volumes, Emissions, Alternatives, Other
No	Volumes, Emissions, Alternatives, Other
Volumes, Alternatives, Other	Volumes, Emissions, Alternatives, Others
Volumes, Alternatives, Other	Volumes, Emissions, Alternatives, Others

No	Volumes, Socio-economic impact

[illegible]