Number	Proposed exemption number by Dossier	Application	Use	Reasons of using PFAS substances
1-1	Not Applicable	Electric Equipment	Printed circuit boards and electric components	Printed circuit boards and electric equipments are used in the variety conditions, and also required proper functional operation. To keep high reliability, components are required moisture proof, waterproof, rust proof, corrosion resistance, UV protection and maintaining the performance. In addition, such functions as low dielectric constant, low dielectric loss tangent, low refractive index, and oil repellency are essential. Only PFAS substances can provide the required several functions together as one substance. As an example, PTFE, with its lowest dielectric constant, exhibits excellent high-frequency performance. Its properties, such as heat resistance and low water absorption, make it suitable for high-reliability applications like infrastructure equipment and automotive radar. By combining PTFE-based substrate materials with glass cloth and inorganic fillers, it becomes possible to meet all performance requirements for high-frequency circuit substrates, achieving a dielectric constant of 3.0 or less and a dielectric loss tangent of 0.001 or less. On the other hand, non-PFAS materials have a dielectric constant of 3.0 or higher and a dielectric loss tangent of 0.002 or higher. This results in reduced antenna efficiency, increased loss, shortened radio wave distance, and an inadequate S/N ratio.
1-2	Not Applicable	Electric Equipment	Mechanical parts (O-rings, valves, bearings, insulating coatings, parts that come into contact with samples)	Electric and electronic equipment, as well as energy devices, are required to operate properly in various environments. These components need to fulfill the following functions: chemical resistance, sealability, water repellency, oil repellency, waterproofness, heat resistance, weather resistance, rust proof, abrasion resistance, corrosion resistance, mold release, non-adhesiveness, cleanliness, dielectric constant, dielectric loss tangent, low refractive index, electrical insulation. Only PFAS substances can provide the required functions of the above requirements in one substance. As an example, PTFE's low coefficient of friction, self-lubricating properties, chemical compatibility and temperature stability make it an important material for bearing components in RACHP products (Refrigeration, Air Conditioning and Heat Pumps). PTFE bearings contribute to energy efficiency, smooth running and longevity, thereby improving the overall performance and reliability of RACHP systems. This is because there is no substance with the same level of coefficient of friction as the target component.

1-3	Not Applicable	Electric Equipment	Parts (optical components, detectors, and optical fibres)	These parts require functions such as high chemical resistance, corrosion resistance, water repellency and non-adhesive function, low refractive index. In addition, optical properties (detection efficiency, resolution and lifetime) and environmental resistance including under radiation are essential. Only PFAS substances can provide the required several functions together as one substance. As an example, the world's increasing data transmission and information communication, coupled with the growing data storage memory capacity, have led to the establishment of the USB 4 version 2.0 standard, enabling a transmission speed of 80 Gbps, which continues to rise alongside communication demands. While electric cables are limited to high-speed transmission over short distances, the use of optical cables with long-distance and high-speed capabilities is on the rise. However, current standard glass optical cables are susceptible to damage from bending or pressure, posing functional and safety risks due to broken glass fragments.On the other hand, plastic optical fibers and cables, devoid of the risk of breakage, offer a safe option for wiring in confined spaces. But, non-PFAS plastic optical fibers and cables still restrict their ability to transmit over long distances.
1-4	5-s	Electric Equipment	Lubricants and grease	Recently the parts getting smaller and smaller, it is difficult to take mechanical measures to prevent the lubricants from spreading. If the lubricant coated on the sliding portion of the precision parts is spread, the durability and performance of the products will be significantly reduced. In order to prevent from the above failure, PFAS related substances are added in the lubricants and grease, because PFAS related substances have function such as high dispersible, and high oil repellency. It is same purpose and function as “epilames used in watches” which SEAC Draft opinion proposed to exempted from the PFHxA restriction under REACH. The amount of PFAS use in this application is also very low. It is also a material with lubricity, thermal stability, and no negative effects on components, and no alternative material has been found.
1-5	Not Applicable	Electric Equipment	Display materials	PFAS are being used for controlling molecular orientation in liquid crystal displays; surfactant, smoothing, and leveling reagent of LCDs and OLEDs and banking materials for OLEDs and microLED displays. The function of PFAS in this application is to contributes unevenly distributed on the surface to promote molecular orientation and are also capable of controlling film thickness precisely. Their applications are diverse, including polarizing film’s surface layer / retardation layer, touchscreen panels’ protective layer / functional layer, protective layer outside liquid crystal cells, color resist / black resist that form color filters, and TFT substrate’s insulation layers. PFAS function is also used for the antifouling function addition of the display surface layer. Due to the extremely low intermolecular attraction and surface free-energy of C-F bonding, it is rich in water and oil repellency. It is also a material with thermal and chemical stability, and no alternative material has been found.

2-1	Not Applicable	Semiconductors	Photoresist	The Photoresist is being used for producing semiconductor devices with a photolithography process. The detailed application on Photoresist is "Positive Tone Photoresist", "Negative Tone Photoresist" and "Negative Tone Color Imaging-resist". PFAS in the photoresist are used as the following uses; The PAG (Photo Acid Generator) to use at the photolithography process, surfactant to control surface tensions and surface property, polymer to control surface distribution, initiator of polymerization and specific pigment.
2-2	5-ee	Semiconductors	Process materials	In the manufacturing of polishing pads, water repellent agents such as PFAS are essential to form an orderly porous structure of the polishing layer, which is essential for polishing performance. Specifically, when coagulating and uniformly foaming the urethane resin of the polishing layer by the wet coating method, it is important to prevent or delay the penetration of water from the backside of the polishing pad base material (nonwoven fabric), and for this purpose, it is necessary to apply a PFAS water repellent agent on the backside of the base material. PTFE films that have high heat resistance, releasability, and high strength is used for thermally compressing high-performance memory chips. Strength at high temperature and releasability are very important and cannot be replaced by other materials. In addition, PTFE films that have heat resistance and releasability is also used for sealing semiconductor chips with resin. Heat resistance exceeding 150°C and releasability are required and cannot be replaced by other materials.
3-1	Not Applicable	Medical devices	Filters for artificial nose	A single-use medical device "filter for artificial nose" which is connected to a respiratory circuit, etc. and used to prevent drying of the respiratory tract or the intrusion of foreign matter must have water resistance, breathability, and particle collection functions. Therefore, PTFE porous membranes that satisfies the required values in all functions is used as a filter.
3-2	5-s	Medical devices	Mechanical parts (tubes, lubricants, Coating)	The cable used in the presence of insulating oil are required both insulating and oilproof properties. Silicon tube is an alternative candidate, however, further evaluation is necessary. Only PFAS substances can provide the required several functions together as one substance. PFAS is also used as lubricant to prevent seizing due to friction between parts when assembling electrodes. The properties such as low boiling point (volatilises in ca. 10 sec), sliding properties and inertness (does not react with metals) are required.

3-3	5k	Medical devices	Process material (cleaning)	Cleaning solutions are used for cleaning in manufacturing processes. This application is similar to the suggested exemption 5k. It requires properties of low boiling point, inertness and flame resistance. There is no residues in the product itself. As an example, PFAS removes insulating oil from the surface of the X-ray tube container after the container is filled with oil. As X-ray tube assemblies are used in hospitals, there should be no residual oil on the surface, so a cleaning solution that evaporates quickly and has high solubility is required. Alcohol-based products such as ethanol are alternative candidates which satisfy the cleaning property and low boiling point. However, they are flammable and cannot be used in environments that handle high voltage and high temperatures in the manufacturing process. Therefore, there are currently no alternative candidates.
4-1	Not Applicable	Printing	Parts (smoothing material, antistatic agent, surfactant, coating aid)	In this application, PFAS-related substances are being used as the function of surfactant, anti-static reagent, and colour dye formation materials and to make the surface smooth and flat. As an example, printing application like photosensitive plate, plotter film, ink-jet recording head, and inkjet inks, toner are used. In this application, PFAS-related substances are being used for surfactant, coating aid and nucleating agent. Low dielectric constant, low refractive index, waterproof, oil repellency, electrical resistance, heat resistance, mold release and physical-chemical properties of fluoro-chemicals are essential function for these usages. Multifunction printers (MFPs) and Singlefunction printers (SFPs) are also applicable. These printers create text and images by the following steps; Charging -> Exposure -> Development -> Transfer -> Fusing. In this process, the materials relate on charging must be made of excellent wear and stain resistant in order to reliably maintain stable toner image formation. PFAS materials are being used in almost all processes. Especially, in the fusing process where powder toner is melted, fixed, and colored on paper by heat and pressure, PFA and PTFE are being required for the fusing member, which requires multiple functions such as heat resistance, mold releasability, low friction, and abrasion resistance. These are essential for MFPs and SPDs and currently there are no alternatives. Low-friction seals are also required for the toner supply section, and PFAS material (PTFE) are used, but there are no alternatives.

5-1	5-s	Industrial Products	Mechanical parts (lubricants, Sealing, filters)	For industrial applications, there are many cases where products are being used at industries including advanced research institutes all over the world, and/or being operated with extremely high reliability even under harsh conditions such as high temperature, high humidity, and high pressure. In particular, industrial equipment that is essential for our society, such as power generation and substation facilities, power transmission facilities, and other social and transportation infrastructure, has a defined service life from a safety perspective. Hence, “long-life” products have been often required. In addtion, industrial products application like industrial X-ray film, glass safe film, microfilm, measurement film (e.g. pressure, heat, light), high performance filtration and separation (e.g. gas separation membrane), materials which control the direction and phase of radio waves and light, data storage media, magnetic tapes and waterproof air-permeable membrane are used. In these application, PFAS-related substances are being used for surfactant, coating aid, leveling reagent, surface lubricant, and functional materials. Low dielectric constant, low refractive index, waterproof, oil repellency, low friction, lower coefficient of dynamic friction, surface smoothness, abrasion resistant, chemically resistant and temperature resistant, are essential function for these usages. As an example, PFAS materials (PTFE, PFA, FFKM, or PFAS-coated materials) are used as sealing materials in pipeline flanges, ball valves, and valves to prevent leaks from the joint surfaces of containers where liquids and gases are sealed. This usage encompasses hydraulic equipment, compressors, pumps, and boilers, as well as measuring equipment for monitoring chemical production plants. Additionally, PTFE is utilized as an inliner in pipelines for corrosive media, such as inorganic or organic acids. PFAS-related substances play an important role in all aspects, from O-rings and other mechanical parts to lubricants and housings in perspective with Insulation, flame resistance, durability, etc.
5-2	Not Applicable	Industrial Products	Water treatment membranes	Water treatment membranes require functions such as preventing foulants (membrane clogging materials) adhesion, preventing oil adhesion to the membranes, reducing abrasion, corrosion resistance, and resistance to high temperature water, water repellency, and chemical resistance. Only PFAS substances can provide the required several functions together as one substance.

6-1	6-e	Energy (Fuel cells)	PEM electroylser/Stack	In fuel cells, PFAS is widely used in the fuel cells stack. PFAS materials are essential to fuel cells in terms of proton conductivity in ion exchange membranes and ion exchange resin solutions, durability, and retention of gas sealing properties, as well as gas sealing, durability, resistance to oxidative degradation, and low leach out, which are necessary to seal reaction gases and cooling water. However, even though the current draft lists fuel cell with a derogation of additional 5 years, PEM water electrolyser is missing as a usage. PEM electrolyser technology is crucial to produce green Hydrogen in order to decarbonize many industrial applications like steel, glass and others industry sectors. The PFAS substances used for PEM electrolyser are exclusively fluoropolymers. More specifically, perfluorosulfonic acid (PFSA) polymers are typically used for the membrane as well as the binder in the electrodes. The materials are selected for their excellent thermal and chemical stability which is required due to harsh environments in PEM electrolyser application. Moreover, PFSA polymers encompass a high oxidative stability which is necessary to withstand high electric potential on the anode of a PEM electrolyser which occur in the regular operation. Notably, these fluoropolymers are not mobile, not water soluble, non-toxic and non-bioaccumulative. Annex E, page 416, of the restriction proposal mentions that there is “No information received” for the PEM electrolyser application. However, the evidence cited on page 415 and following as referring to “Sealing materials; gaskets” would in reality refer to membranes and ionomers for both PEM fuel cells as well as PEM electrolyser application. More specifically, on page 416 of Annex E membranes as a core component of a PEM electrolyser are described: “Another stakeholder: While conduction properties and performance of these materials can be reasonably good, mechanical stability and durability are extremely poor, as oxidation by oxygen radicals, occurs. All nonfluorinated membrane concepts are still highly immature against minimum lifetime requirements of >25 000 hours. Although there would be an economic advantage to finding performant fluorine-free materials, there is no alternative today to replace PFASs (PFSA, PTFE) in the hydrogen industry (both electrolyser and fuel cell).” Accordingly, the evidence provided in the 1st and 2nd call for evidence might be revisited in view of PEM electrolyser and therefore derogations should be introduced to allow for the development of non-PFAS alternatives.

6-2	5-r	Energy (Transmission and Distribution)	GIS(Gas Insulated Switchgear),GCB(Gas Circuit Breaker)	In a typical high-voltage gas-insulated circuit breaker (GCB), insulating gas (SF6) is sprayed onto the arc that is created when electricity is cut off. When spraying, the gas is efficiently rectified and several atmospheres of gas are sprayed onto the arc. A rectifying nozzle that can withstand this pressure is required and PTFE material is currently used. PTFE decomposes and sublimates when exposed to arc light, but the pressure and insulating capacity of the gas produced as it sublimates is also used to insulate the arc. When PTFE decomposes, it is also less likely to produce conductive carbides. Other resins produce large amounts of carbon (C) as they decompose, which can significantly reduce the insulating performance of equipment. SF6 decomposes during arc generation, and when the decomposed components recombine, they produce fluorinated decomposition products in addition to SF6. Some of the generated fluorides are corrosive components. PTFE is resistant to these corrosive components. In addition, if hydrogen (H) is included as an alternative material constituent, the SF6 decomposition components and hydrogen may combine to produce large amounts of hydrogen fluoride (HF), which is highly toxic. These factors make it difficult to replace PTFE due to its mechanical, thermal, corrosion and electrical properties.

7-1	5-s	Analytical equipment	Mechanical parts (reflector/integrating sphere, lubricant/GC, ICPMS, tube, switching valve, seal, insulation coating, packing)	PFAS material choices for specific properties such as reflectivity, resistance to vacuum, chemicals, heat, low temperature, ozone and X-ray, as well as mechanical considerations for different components in analytical equipment. As some examples： ・Integrating sphere reflector: BaSO4 is an alternative material with low reflectivity, but PFAS is the only option for higher reflectivity. ・Working fluids for pump (ICP-MS): PFPE-based oil is currently used which is less reactive with acids, as acids in exhaust gases can oxidise the synthetic oil and increase viscosity, leading to rotary pump failure. We use 1 liter and is exchanged every 2 years. Dry pump is available, however, it cost 3 times more. ・Wetted parts of liquid nitrogen pump for thermal analysis: The material is used under -196 °C. (PTFE) Besides PTFE, PEEK and polyimide exist as cold-resistant resins, but they are less flexible than PTFE and cannot be used for this purpose. Metals cannot be alternative since metals have high thermal conductivity, so there is a significant risk of low-temperature burns upon unintended contact and frosting due to high thermal conductivity. For the flow paths for the ozone gas we need ozone resistant material (PTFE). For the joints sealable materials are required. ・Shielded lid on Xenon lamp source chamber (PTFE): We need heat resistance at 200°C min, also as insulation because it is placed close to the lamp electrode. It should be ozone resistant because ozone is enclosed. ・The furnace of the thermal analyser: O-ring is used as sealing sealing components and is exposed to temperatures of around 220 °C. O-ring with silicon rubber (4C) cannot be used, as the upper limit of the normal service temperature is generally around 200 °C. ・Grease is used for vacuum seal O-ring. The grease with a low saturation vapour pressure to prevent outgassing in high vacuum section of about 0.0001 Pa. If outgassing occurs, it will negatively affect the analysis result. ・The plastic housing of the port valve: Port valve rotors need to be chemical resistant, sealable and low-friction. ・The flow paths：They need to be resistant to chemicals and have stain-proof surfaces to prevent contamination that would affect accurate analysis results. PEEK is a potential alternative, but its large inner diameter and increased cost pose challenges. Glass tubing is also considered, but finding suitable fittings is problematic due to dimensional tolerances. Also, chemical-resistant and transparent materials like PTFE, ETFE, and FEP are necessary for tubes to allow users to monitor liquid flow and air bubble presence during experiments. ・The cushioning component: It requires heat resistance, strength, and shock absorption up to speeds of 20 m/sec and temperatures ranging from -40°C to 150°C; silicon rubber is inadequate for substitution. ・Coaxial cables: PTFE serves as an insulator is handling minute fA level currents. ・Fluoroelastomer O-rings with X-ray resistance as well as characteristics of PFAS are used in X-ray equipment. No alternative to such a multi-resistant material has been found yet.

7-2	Not Applicable	Analytical equipment	Release liquid for diffraction grating manufacturing	PFAS is commonly used as a release agent between polymers and their molds, with PTFE being the most widely used release agent in the formation of polyurethane foam and polycarbonate components. The desirable properties of PFAS include the ability to form a thin and uniform film that does not damage the delicate structures of quick-drying or diffraction gratings. It also requires stability during the deposition of metal films on release films without reacting or damaging the metal. While some silicon-based alternatives are available for manufacturing, they are not suitable as substitutes for all applications. In terms of replication from a master, alternatives to PFAS tend to result in poor quality and fail to meet the required standards.
7-3	Not Applicable	Analytical equipment	Extraction solvent	Oil is often poorly biodegradable and must be disposed of properly. Otherwise, it will cause the negative impact to the environment. NDIR analysis (infrared spectroscopy) is used for this analysis of oil content. Oil is extracted from the sample with an extraction solvent that does not have a C-H bond, and the bond of C-H, which is an oil component, is analyzed by NDIR. PFAS substance is required as a solvent with no C-H bond, low volatility and high oil-dissolving power.
7-4	5-t	Analytical equipment	Reference material for the analysis	Reference material is essential for the reliable comparable, traceable accurate analysis, such as NMIJ CRM 4056-a, and NMIJ CRM 4220-a.
8-1	5-u,6-o	Automotive	Parts (filters/electrical components, lamps, timing belts, sliding agents)	Differential pressure inside and outside housing due to altitude and temperature differences while driving can damage sealed parts, allowing water and dust into electrical equipment and lamp housings. This compromises functionality and might lead to vehicle issues. To prevent this, water-resistant internal pressure adjustment filters like PFAS or PTFE are used in ventilation holes. Filters without such properties lose effectiveness due to oil and dust adherence. In lamps, similar measures are taken to prevent cloudy and dirty surfaces from rainwater and dust intrusion, ensuring proper light emission. No materials other than PFAS or PTFE meet these requirements for both applications. PFAS materials (such as PTFE or PFAS-coated materials) are utilized to enhance the durability and reduce noise in timing belts for vehicles, motorcycles, and machine tools. Additionally, they serve as sliding materials in automotive anti-vibration rubber to achieve noise reduction. PVDF with not only chemical and weathering resistances but also transparency is used to protective films. However, no alternatives with equivalent capabilities currently exist for these applications.
8-2	Not Applicable	Automotive	Cables	A major future market might be seen in the e-mobility where higher temperature resistances will be required as well for making quick charging possible. Some of them us ealso the polyimides with a fluoropolymer adhesive.

9-1	6-o	Transport	Refrigerants for transportation (containers, ship air conditioning)	PFAS substances, particularly in the form of refrigerants, are integral to container refrigeration machinery (Reefers) used for global trade via ships. These vessels must maintain cargo temperatures between -30 and +30 degrees Celsius while navigating through extreme outside temperatures of -30 to +50 degrees Celsius. PFAS refrigerants offer advantages like high energy efficiency, ample cooling capacity, and compact design, contributing to safety, economic viability, environmental considerations, and energy efficiency. Given the challenge of ensuring safety on marine vessels and the need to prevent refrigerant leakage in ship systems, PFAS refrigerants are chosen due to their non-combustible, non-toxic, and low-pressure properties. Currently, PFAS stands as the sole refrigerant meeting these stringent safety requirements.
9-2	Not Applicable	Transport	Aircraft wires	All aircraft wires for modern commecial aircraft use one layer of PI film in combination with a fluoropolymer like PFA , FEP or PTFE. However, no alternatives are seen without jeopardizing the quality of the wires and therefore reduce the ife time of aircraft and /or jeopardize the safety of air traffic in general. Without wires, no aircraft industry and even no more aircraft in Europe.
9-3	Not Applicable	Transport	Magnet wire for traction motors	Due to the required properties for train, tram and/or underground motors, like temperature resistance, high dielectric breakdown, partial discharge resistance, adhesion, long durability of more than 30 years, generally different types of polyimide films in combination with a fluoropolymer adhesive is wrapped around the magnet wire use in the modern traction motors. Even when it might be easier to find an alternative solution than for aircraft wire, it will take more than ten years to develop a solution which does not lower the quality of the traction motors.
10-1	Not Applicable	Agricultural Machinery	Mechanical parts (seals, hoses, bushes)	Agricultural machinery relies on PTFE for its mechanical components. PTFE (CAS No. 9002-84-0) is chosen for its heat resistance, wear resistance, low friction, and oil resistance properties. Presently, no viable substitutes or alternative technologies can replicate these attributes. Similarly, Tetrafluoroethylene Hexafluoropropylene Vinylidenefluoride copolymer (CAS No. 25190-89-0) is incorporated to meet fuel permeation regulations, and like PTFE, no alternatives have emerged.
11-1	Not Applicable	Construction product	Bearings	PFAS (PTFE) are used as low-friction materials in bearings for Construction product, such as seismic isolator and water gate operator. Bearings (such as oil bearings) that use materials other than PFAS textile are inferior in durability and cannot be used underwater.

12-1	5-e,5-ee	Textile	Industrial filters (semiconductors, lean rooms, hospitals, pharmaceuticals, biological laboratories, industrial waste facilities)	Air filters are pivotal for upkeeping cleanliness in environments and equipment, necessitating high collection efficiency (HEPA or higher) to avert product contamination and loss of function. Conserving efficiency over time is imperative. PTFE membrane-based HEPA and ULPA filters possess distinctive properties that fulfill these requisites. Presently, no other material offers this broad property profile. As a example, HEPA and ULPA filters ensure air purity in sophisticated environments like semiconductor production, demanding properties such as chemical resistance, mechanical stability, and hydro-/oleophobicity to maintain cleanliness, protect workers, and optimize production quality. Low air flow resistance also promotes energy efficiency, reducing costs and emissions. Filters should be made from low-pressure-drop materials to enhance energy efficiency, minimize expenses, and lower CO2 emissions, while also exhibiting low outgassing to prevent clean room product contamination. These standards are met exclusively by PTFE porous membranes. The another example, PTFE or PFAS-coated glass fiber are used in waste incineration and industrial filters, demanding heat and chemical resistance for high-temperature filtration and toxic gas treatment.
12-2	Not Applicable	Textile	Commercial filters (vacuum cleaner filters, electric toothbrushes, shavers)	Exhaust from household and industrial vacuum cleaners can negatively impact allergy sufferers, and high-performance filters are used to minimize the release of allergens and viruses. A filtration level known as HEPA, capable of capturing influenza and coronaviruses, is essential. PTFE porous membrane filters and non-woven glass filters can achieve this, but glass filters risk damage and fiber scattering, making them unsuitable. In vacuum cleaners, plastic fiber non-woven cloths offer low collection efficiency. However, for effectively countering allergens and viruses, filters utilizing PTFE porous membranes are highly efficient. Rechargeable electric toothbrushes and shavers release gas due to battery reactions, necessitating gas release holes. To prevent water and debris ingress while maintaining gas release, waterproof air-permeable membranes are used. These membranes must resist water and detergents, demanding materials with low surface tension. Currently, PFAS material coating is employed to confer detergent resistance to waterproof air-permeable membranes, with no known alternatives.
12-3	5-b,-5-cc	Textile	Personal masks (medical, military, etc.)	Masks used in an environment where small particles of gas or viruses that may affect the human body may exist is required to have a collection performance of HEPA or higher. In addition, masks with high collection performance generally have low breathability, but they cannot be used unless they are breathable enough for people to breathe, so high breathability materials are required for mask materials. Only PTFE porous membranes and glass non-woven cloths have the HEPA performance, but the air permeability of PTFE porous membrane is more than double comparing with glass non-woven cloth. In addition, the glass non-woven cloth is not suitable because it may break when folded and sucks in glass fiber pieces. Therefore, there is no material other than PTFE porous membrane that can be used for this application.

13-1	6-a,6-g	Food contact materials & packaging	Packaging, Filters	These parts require functions such as preventing the foods and beverage adhesion, reducing abrasion, preventing oil adhesion to the foods, and resistance to boiled water, hot water, and chemical resistance.
14-1	Not Applicable	Paper	Lubricants	Conveyor belts woven by the filaments containing the PFAS are used for drying process of paper-making factory. PFAS effects as lubricant that prevents stains (sticky sizing agents derived from used paper contained in the raw material pulp) from adhering to the conveyor belt and easily cleaning it. Especially the drying process requires high temperature conditions, PFAS acts as an excellent and essential lubricant by its heat resistance.
15-1	Not Applicable	Musical Instruments	String	PFAS(PVDF) musical instruments strings has several properties that cannot be substituted. PVDF is wear-resistant and exhibits excellent strength against rubbing between threads and obstacles during actual use. This reduces the frequency of string breakage and contributes to reduce its waste. In addition, PVDF has a high specific gravity of 1.78, so it delivers a characteristic firm and sparkling sound quality. Plus, it has low water absorbency to keep sound quality for less tuning frequency and low ultraviolet ray absorption to keep line strength and elongation.
16-1	Not Applicable	Fishing	Fishing lines	PFAS(PVDF) fishing line has several properties that cannot be substituted. Since PVDF is wear-resistant and exhibits excellent strength against rubbing between threads and obstacles during actual use. Moreover, PVDF has low water absorbency and low ultraviolet rays absorption to keep line strength longer. This reduces the frequency of fishing line breakage and the likelihood of fishing line being discarded into the water, fishing grounds, or other natural areas.
17-1	Not Applicable	Chemical containe	Sealings	Regarding the lids of bottles for various chemicals such as acids and alkalis, chemical resistance is required for the material of the surface of the inner side of the lid that contact with the chemicals. The material must be able to maintain its sealing performance without deterioration even after being exposed to chemicals for many years. If there is deterioration due to chemicals, the liquid may leak out from there and touches human hand and the hand will be burned. In addition, if there is deterioration due to chemicals, it may become a gas and flow out to the outside increasing the concentration in the air and igniting due to static electricity and may cause a fire. Therefore, the material of the sealing material is very important, and the PFAS material which has a stable C-F bond with very strong bond energy is suitable.

18-1	Not Applicable	Polymer production aids	catalysts	Trifluoromethanesulfonic acid (CAS No. 1493-13-6) is being used as catalyst for modification of polymer other than polymeric PFASs, and the modified polymer has excellent processability. Trifluoromethanesulfonic acid is chemically and thermally very stable, and it does not show oxidizing power. And also triflate anions are also chemically stable, and show almost no reducing or nucleophilic properties. There is no alternative substance that can satisfy the same chemical requirements for this application.