PFAS restriction proposal

Statement from SEW-EURODRIVE

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1. The Company

- One of the international market leaders in the field of electrical drive technology
- Global player with branches in 54 countries and a total of 17 production plants worldwide
- 21,000 employees worldwide, 800 of them in research and development
- Headquarters in Bruchsal, Germany
- 4.2 billion € turnover in 2022

2. Product(s)

Electrical drive technology is a key industry in mechanical and plant engineering. Particularly in the field of factory and process automation, electrical drive systems ensure energy-efficient drive solutions. By replacing old drive technology with modern drive systems, energy savings of 50% compared to the previous ones are often achieved today.

The core components of electrical drive systems are:

- **Electric motors** (DC and AC motors) for generating a rotary motion or linear motion from electrical energy
- **Frequency inverters** for controlling the speed, direction of rotation and power of the motor
- **Gear units and industrial gear units** for converting the mechanical power of the motor, i.e. increase of the torque by reducing the speed (or vice versa)

The electrical drive technology is supplemented by further hardware and software components for connecting to the energy and communication infrastructure, for monitoring machine and process parameters, and for energy recovery, storage, and supply (e.g. Motor starters, field distributors, controllers, I/O modules, input and output filters, display and operator panels, temperature sensors, vibration sensors, braking resistors, energy storage units, regenerative power supplies).

As a rule, an electrical drive system is a system solution. This consists of technically coordinated, partly customer-specific configured components that are selected and parameterized individually for the respective application.

Typical applications are:

- **Material handling**, e.g. crane system, conveyor belt, roller conveyor, transverse trolley, electrified monorail system, lift table, rotary table, automated storage system, autonomous mobile logistics assistant
- **Processing technology**, e.g. welding robot, wire bending machine, flying saw, agitator, mixer, shredder, screw press
- **Packaging technology**, e.g. filling system, sorting machine, pick-and-place robot, winder, cartoning machine, form-fill-seal machine, labeling machine

3. Market Information

There will hardly be a machine-manufactured or transported product, either now or in the future, with no electrical drive technology in its supply and value chain. The target industries of the electrical drive industry include, i.a., transportation and logistics, intralogistics, the automotive industry, the food and beverage industry, the pharmaceutical industry, cosmetics industry, mining, building materials industry, recycling industry, water treatment.

According to the EU Commission, electric motors account for around 50% of the world's electricity consumption [1]. Energy-efficient motors and drives thus play a central role in saving energy consumed globally and combating climate change. The electrical drive industry is essential for a sustainable economy.

According to evaluations by the ZVEI (German Association of the Electrical and Digital Industry), the global market for electric drives has reached a volume of 148.6 billion in 2021 €. According to forecasts by the ZVEI, growth is expected to be 16% in 2022 and a further 5% in 2023. [2]

[1] URL: https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labeling-rules-and-requirements/energy-label-and-ecodesign/energy-efficient-products/electric-motors-and-variable-speed-drives_en (visited on 21 Sept 2023)
[2] ZVEI e.V. (2022). *Statistischer Jahresbericht 2022. Elektrische Antriebe.* URL: https://www.zvei.org/presse-medien/publikationen/statistischer-jahresbericht-2022-des-fachbereichs-elektrische-antriebe (visited on 21 Sept 2023)

4. Requirements Profile

- Global market access
- Durability: At least 10,000 operating hours. Average of 15 years, sometimes up to 25 years or more possible
- Failsafe
- Short-term overload capacity (in some cases up to 300%)
- Low maintenance effort, partly maintenance-free
- Repair capability
- Required availability of spare parts: Usually up to 20 years after purchase, sometimes longer
- Precision
- Dynamization of processes, e.g. Adaptation to differences in utilization
- Energy efficiency, including according to the Eco-Design Directive 2009/125/EC
- Product safety, including in accordance with the Low Voltage Directive 2014/35/EU, Machinery Directive 2006/42/EC, EMC Directive 2014/30/EU
- Depending on the area of application:
  - Ambient temperatures up to +100°C.
  - Flame protection, e.g. according to UL94 V-0
  - Suitable for potentially explosive atmospheres, e.g. according to ATEX Directive 2014/34/EU
  - Suitable for corrosive industrial environments
  - Suitable for hygienic areas: food safety
  - Suitability for vacuum environment

Specific requirements for the components of the products are described in the following section 5 .

5. Identified PFAS Uses

General note: The requirements mentioned do not always apply simultaneously. For example, the temperature resistance can only be achieved at a significantly smaller interval than the specified interval if the mechanical or chemical stress is very high.

In the finished product

We develop and produce complex products. They consist of various purchased components and semi-finished products for further machining. In many cases, the components are already items with complex composition, e.g. electrical components, coated connecting elements, cables. Depending on the end product, we also process purchased mixtures during assembly (e.g. resins, adhesives, paints).

Due to the high loads that our products and their components have to withstand, the main focus of component selection is on technical suitability. On the other hand, the chemical composition of the purchased mixtures and products plays little or no role, especially in complex products, whereby legal regulations such as substance prohibitions and restrictions must of course be adhered to. Drive technology manufacturers usually specify the technical requirements for the required components, and the component manufacturer selects a suitable component with a suitable material composition based on this specification. The drive technology manufacturer uses tests that are usually described in terms of standards to check the technical suitability and to compare (possibly also by tests) alternatives available on the market with each other. If more than one component proves to be technically suitable, the component with the lowest price is usually selected, provided it is available in sufficient quantities and quality on the global market.

Since the safe use of components is generally possible without detailed knowledge of their chemical composition, it is even partially subject to the business secrets of the upstream producers in the supply chain. Furthermore, for the vast majority of PFAS, there is no declaration obligation towards downstream actors in the supply chain, as they are <u>not</u> classified as hazardous according to Regulation (EC) No. 1272/2008 (CLP Regulation). Against this background, we have only a limited knowledge of the presence of PFAS in our products and production processes, as it is based exclusively on technical specifications on our part and on voluntary information from the suppliers. For this reason, it can generally be assumed that the following list is incomplete – despite all efforts to find out where PFAS are located in the products of electrical drive technology.

1. Shaft sealing ring (dynamic seal)	**Example applications:**  *Figure 1* *© SEW-EURODRIVE GmbH & Co KG*
PFAS substance / substance group: FKM, PTFE	**PFAS-containing material/component:** Shaft sealing ring with elastomer part made of FKM, additionally with sealing lip made of PTFE compound depending on the application; additionally with PTFE-containing fleece depending on the application; depending on the application with PTFE protective disk

Reason for using PFAS / requirement profile:

Shaft sealing ring made of FKM

- Only used in demanding situations if the standard material NBR is not suitable for technical reasons (e.g. in potentially explosive atmospheres or in areas with high ambient temperatures), because FKM is more expensive
- The shaft sealing ring ensures tightness between the housing and the rotating shaft to prevent oil or other lubricants from leaking from the gear unit and at the same time the intrusion of particles that could damage the gear unit. The consequences of oil leakage would be the immediate wear of the gear unit until it fails and the possible contamination of the environment with oil.
- Service life of the shaft sealing ring: At least 10,000, sometimes up to 30,000 operating hours
- Suitable for ambient temperatures from -40°C to +115°C, also up to +200°C depending on application and oil
- Temperature resistance up to a temperature of the gear oil of +150°C.
- Fluid resistance to gear unit oils and bearing lubricants as well as, for example, to food, cleaning agents, disinfectants, salt water, waste water
- Resistance to mechanical influences, e.g. due to sand, dust, flour, building materials
- UV resistance
- Low friction coefficient: 0.2 µr or less
- Suitability for varying speeds up to 6,000 min-1 in highly dynamic applications with frequent changes of direction, load changes and high accelerations. NBR shaft sealing rings break at just about 1,800 revolutions per minute.
- For use in potentially explosive atmospheres, the products must meet the applicable Equipment Protection Level (EPL) after passing the climatic storage test according to IEC 60079-0, i.e. the degree of protection IP 5X according to IEC 60529 for equipment groups IIC and EPL Gb or the degree of protection IP6X for equipment groups IIIC and EPL Db.
- For design with sealing lip made of PTFE compound: Emergency running properties during dry running (relevant for linear movements)

PTFE protective disk

- Sits on the outside of the shaft sealing ring
- Protects the shaft sealing ring against extreme mechanical and chemical influences (e.g. by high-pressure cleaning)
- Suitability for applications in which even FKM shaft sealing rings have proven to be not resistant enough

Protective fleece made of composite material with PTFE

- Sits on the outside of the shaft sealing ring
- Suitable for applications with high contamination and moisture
- Service life: At least 10,000 operating hours
- Suitable for ambient temperatures from -25°C to +115°C.

Electrically conductive fleece made of composite material with PTFE

- Sits on the outside of the shaft sealing ring
- Prevents current continuity at the bearings. If current flows through the bearings, electrical erosion occurs and the bearing grease is subjected to extreme stress. The fleece protects the bearings from premature failure.
- Service life: At least 10,000 operating hours
- Suitable for ambient temperatures from -25°C to +115°C.

2. Gasket
(E.g. O-ring, flat gasket, sprayed gasket)

Example applications:

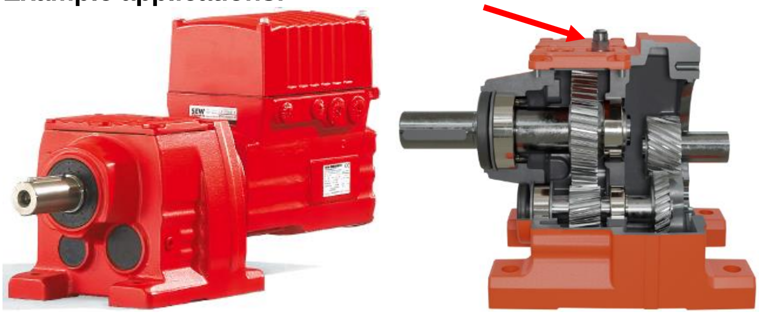

Figure 2
© SEW-EURODRIVE GmbH & Co KG

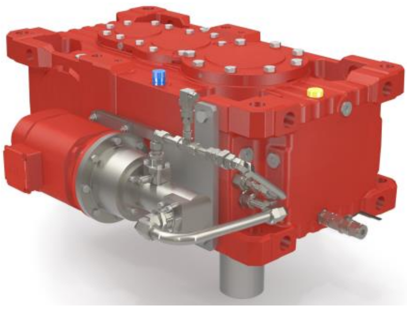

Figure 3

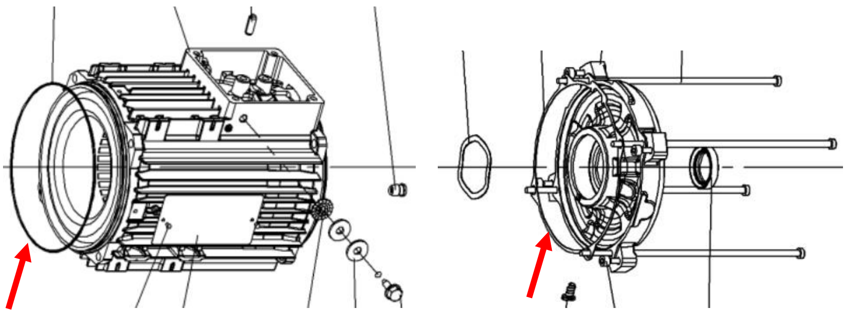

Figure 4 of an asynchronous motor with sealing rings
© SEW-EURODRIVE GmbH & Co KG

PFAS substance / substance group:
FKM, PTFE

PFAS-containing material/component:
E.g. Gasket on both sides of the motor, on brake mounting, on encoder mounting, on flange; O-rings of plug connectors, Cable glands, screw plugs (e.g. in an oil drain valve, motor flange, motor endshield), union nuts, hydraulic valves, check valves (e.g. in a motor pump); gasket of oil level indicators, flow indicators; PTFE-coated gaskets

Reason for using PFAS / Requirements profile:

- Used in demanding situations when alternative materials (e.g. EPDM, NBR) are not suitable for technical reasons, e.g. at ambient temperatures ≥ +80°C, surface temperatures up to +150°C, sometimes even up to +200°C. If possible, the cheaper alternative materials are used.
- Prevention of moisture and dust intrusion
- For gear units: Lubricant compatibility to prevent leakage of gear unit oil during operation and transport
- Suitability for potentially explosive atmospheres (e.g. according to ATEX Directive 2014/34/EU): Suitability for use in potentially explosive atmospheres of category 2 dust and gas, IP degree of protection IP66 after climatic storage according to EN IEC 60079-0

- Suitability for use in hygiene areas (e.g. in the pharmaceutical, cosmetics, food and beverage industry)
- Partly assembly-related necessity to reduce the friction of elastomer parts, e.g. with PTFE-coated sealing rings made of NBR. A molybdenum sulfide coating would be unsuitable because it would be rubbed off and does not remain on the part.
- Service life: At least 10,000 operating hours

<table>
<tr><td>3. Sliding element</td><td>Example applications:
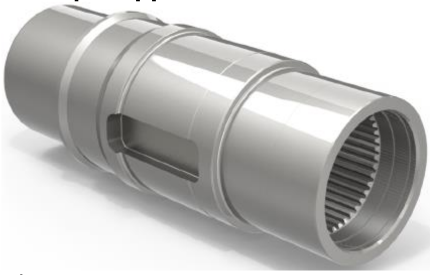
Figure 5
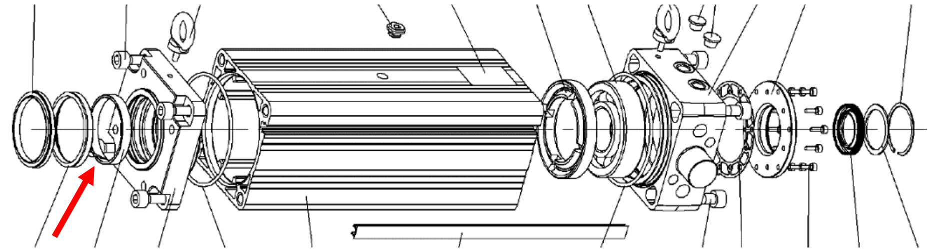
Figure 6
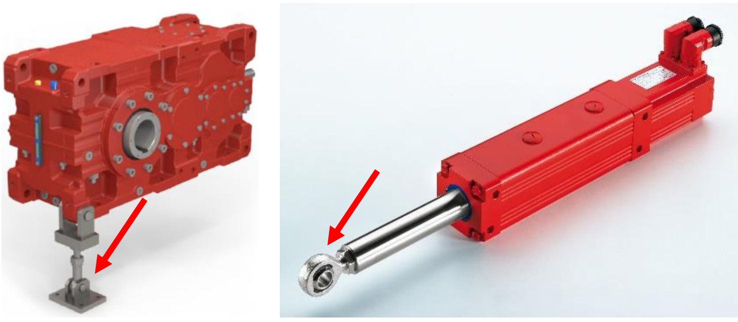
Figure 7

Figure 8 Automated guided vehicle with oscillating drive wheels
© SEW-EURODRIVE GmbH & Co KG</td></tr>
<tr><td>PFAS substance / substance group:
PTFE</td><td>PFAS-containing material/component:
E.g. plain bearing bushing made of a multi-layer composite material consisting of metal(s) and PTFE-containing coating, plain bearing bushing consisting of a</td></tr>
</table>

	composite material and a PTFE-containing sliding layer; thrust washer made of composite material with PTFE; guide ring made of composite material with PTFE; bearing shell made of composite material with PTFE

Reason for using PFAS / Requirements profile:

Plain bearing bushing:

- For hollow output shafts: Sleeve bushing prevents tribological contact corrosion and welding in the hollow shaft
- For automated guided vehicles: Drive wheels are oscillating mounted to compensate for uneven ground (e.g. with plain bearing bushings and thrust washers)
- Sliding properties (low friction coefficient)
- Dimensional stability
- Resistance to mechanical influences, e.g. wear resistance with uniform or single-sided loads depending on the application
- Service life: At least 10,000 operating hours
- Fixed fit (no migration out of the hollow shaft / bearing during operation)
- For hollow output shafts, additionally:
    - Low wall thickness required. For this reason, bushings made of bronze or plastic are not suitable.
    - Permitted static surface pressure at least 15 N/mm²
    - Temperature resistance from -50°C to +150°C.
    - Wear resistance even in dry running and oscillating movements
    - Maintenance-free
- In case of oscillating mounted drive wheels of automated guided vehicles, additionally:
    - Mechanical load capacity: The oscillating movement leads to significantly more wear locally than with a uniform 360° rotation. The permitted dynamic and static radial load rating of the sleeve bearing bushings must therefore be comparatively high, e.g. the dynamic load rating up to 280,000N and the static load rating up to 400,000N.
    - Maintenance-free

Guide ring

- Sliding properties (low friction coefficient) so that the piston can move freely
- Emergency running characteristics during dry running
- Temperature resistance > +100°C.
- Service life: At least 10,000 operating hours
- Dimensional stability for repeatability
- Lubricant compatibility

Bearing shell (in joint head)

- Sliding properties (low friction coefficient)
- Service life: At least 10,000 operating hours
- Maintenance-free
- High load capacity, even shock loads

4. Conductor insulation	**Example applications:**  *Figure 9*

<table>
<tr><td></td><td>
Figure 10
© SEW-EURODRIVE GmbH & Co KG</td></tr>
<tr><td>**PFAS substance / substance group:**
FEP, ETFE, PTFE</td><td>**PFAS-containing material/component:**
Insulation of the motor winding and conductors of components integrated in the motor housing (e.g. rotary encoder, brake, brake rectifier, brake control, forced cooling fan, sensors (e.g. temperature sensor) and other products that are exposed to high temperatures (e.g. braking resistor, energy storage unit)</td></tr>
<tr><td colspan="2">**Reason for using PFAS / Requirements profile:**
• Normative requirements for electric motors: ANSI/UL 758; NEMA HP 4, IEC 60034-1
• Temperature resistance at least up to +200°C, housing temperatures of up to +250°C occur with braking resistors, and also up to 350°C in the event of heat accumulation
• Suitability for nominal voltages up to AC 690 V.
• Electrical dielectric strength (high voltage test of electric motors at up to 2900 V AC and 50 or 60 Hz, of braking resistors at 4000 V AC and 50 Hz, both for a duration of 1 min)
• Flexibility and low friction coefficient: The conductor must withstand mechanical influences during assembly, e.g. due to edges, tight space conditions
• Chemical resistance and aging stability in aggressive ambient conditions</td></tr>
</table>

<table>
<tr><td>5. Grease</td><td>Example applications:
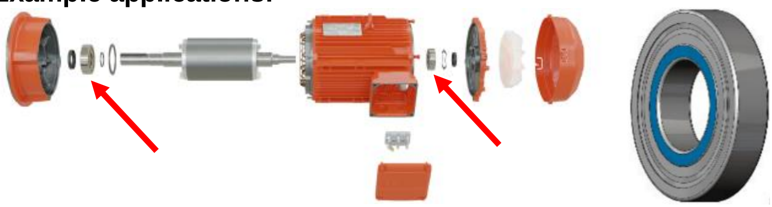
Figure 11
© SEW-EURODRIVE GmbH & Co KG</td></tr>
<tr><td>PFAS substance / substance group:
PFPE, PTFE</td><td>PFAS-containing material/component:
Grease</td></tr>
<tr><td colspan="2">Reason for using PFAS / Requirements profile:
• Suitability for particularly high ambient temperatures up to +100°C. PFAS-free grease is only suitable for ambient temperatures up to a maximum of +80°C.
• Compatibility with sealing material
• Temperature resistance up to at least +200°C.
• Low evaporation rate
• Service life lubrication: At least 10,000 operating hours
• Depending on the application: Approval for the food and pharmaceutical industry according to FDA 21 CFR § 178.3570
• Depending on the application: Suitable for use in vacuum environments</td></tr>
</table>

<table>
<tr><td>6. Heat shrink tubing</td><td>Example applications:
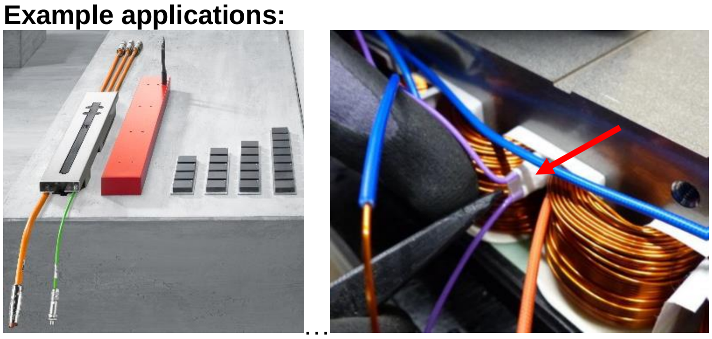
Figure 12</td></tr>
<tr><td>PFAS substance / substance group:
PVDF, PTFE</td><td>PFAS-containing material/component:
Heat shrink tubing in the temperature sensor made of PVDF or PTFE</td></tr>
<tr><td colspan="2">Reason for using PFAS / Requirements profile:
• Normative requirement: Thermal protection for rotating electrical machines according to EN 60034-11
• Temperature resistance up to at least +175°C (in shrunken state)
• Flexibility and low friction coefficient: The heat shrink tubing must withstand mechanical influences, especially during assembly, e.g. due to tight space</td></tr>
</table>

<table>
<tr><td>7. Flame-retardant plastic</td><td>Example applications:
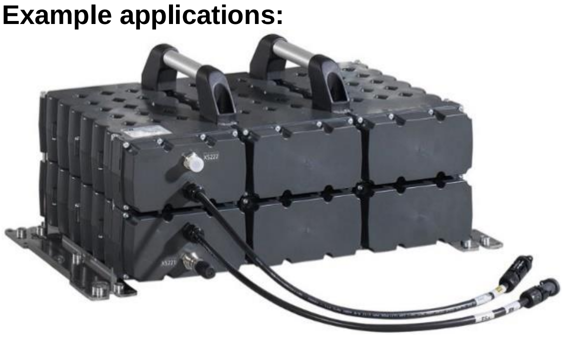
Figure 13</td></tr>
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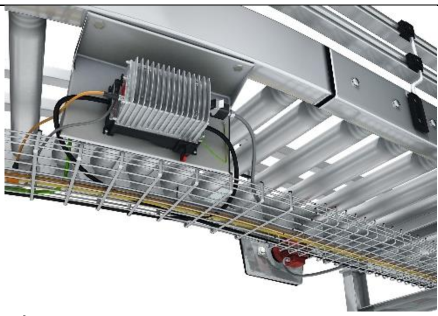
<table>
<tr><td></td><td>
Figure 14
© SEW-EURODRIVE GmbH & Co KG</td></tr>
<tr><td>PFAS substance / substance group:
E.g. PTFE</td><td>PFAS-containing material/component:
E.G. Flame-retardant device housing, e.g. made of polybutylene terephthalate (PBT) or polycarbonate (PC); electrical component (e.g. PCB relay) with component(s) made of flame-retardant plastic</td></tr>
<tr><td colspan="2">Reason for using PFAS / Requirements profile:
We have very little information about PFAS in flame-retardant plastics. The requirements listed below are to be understood as an example. PFAS-containing flame protection may already be required for lower requirements.
Flame protection and flame retarding to prevent or Deceleration of fires (UL fire class according to UL94: 5VA; Relative temperature index (RTI) according to UL standard 746B: ≥ 70°C; Hot-wire ignition (HWI) according to UL standard 746A: Performance Level Category (PLC) ≤ 3; High-Current Arc Ignition (HAI) according to UL standard 746A: Performance Level Category (PLC) ≤ 2)
Electrical dielectric strength (Comparative Tracking Index (CTI) according to UL standard 746A: Performance Level Category (PLC) ≤ 3)</td></tr>
</table>

<table>
<tr><td>8. Pressure compensation element</td><td>Example applications:

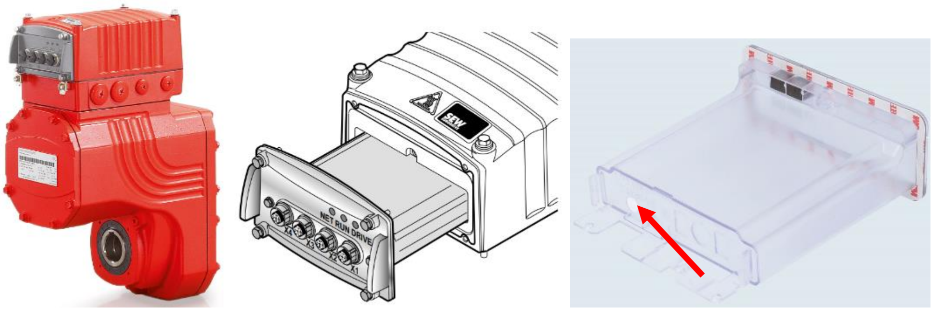



Figure 15</td></tr>
<tr><td>PFAS substance / substance group:
PTFE</td><td>PFAS-containing material/component:
PTFE layer on fleece</td></tr>
<tr><td colspan="2">Reason for using PFAS / Requirements profile:
Used to vent housings (pressure compensation) and to prevent the intrusion of damaged media (e.g. dirt) and liquids, which could restrict the function of the electronic components and lead to premature failure of the device
Used mainly in high humidity in the environment and in case of temperature fluctuations
Water tightness
Dust tightness
Air permeability, depending on the application, e.g. at a pressure of 70 mbar: >28 ml/min.</td></tr>
</table>

<table>
<tr><td>9. Cables, E-connectors, plug connectors, plugs, sockets, cable glands (including PCB plug connectors and terminals)</td><td>Example applications:

Figure 16

Figure 17</td></tr>
<tr><td>PFAS substance / substance group:
among other things PTFE, FEP, ETFE, PFPE</td><td>PFAS-containing material/component:
Possibly outer jacket, insulation, dielectric, grease, flame-retardant plastic</td></tr>
<tr><td colspan="2">Reason for using PFAS / Requirements profile:
As we do not have comprehensive information on the PFAS-containing materials/components, we refer to the consultation contributions of the manufacturers of these articles and their associations.</td></tr>
</table>

<table>
<tr><td>10. Electrical components for PCB assembly</td><td>Example applications:

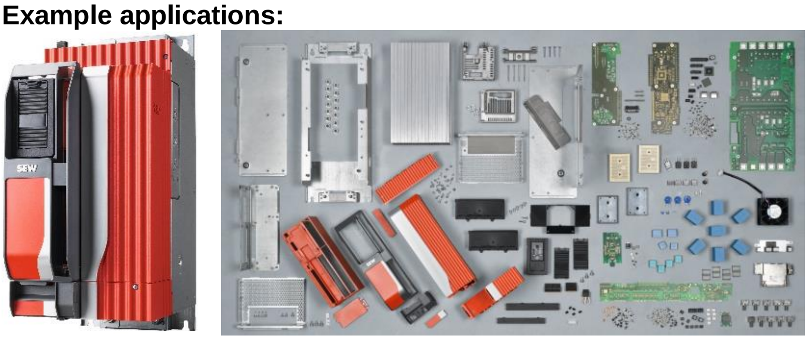



Figure 18
 …
Figure 19</td></tr>
<tr><td>PFAS substance / substance group:</td><td>PFAS-containing material/component:
Component(s) of electrical components such as electrolytic capacitors, microcontrollers and diodes, e.g. PTFE-containing anode in electrolytic capacitors</td></tr>
</table>

i.a. PTFE (We do not have any specific information on this.)	
Reason for using PFAS / Requirements profile: As we do not have comprehensive information on the PFAS-containing materials/components, we refer to the consultation contributions of the manufacturers of these articles and their associations.	

11. Lithium-ion battery	 *Figure 20*
PFAS substance / substance group: We do not have any specific information on this	**PFAS-containing material/component:** Possibly binder in the cathode, additive in the electrolyte
Reason for using PFAS / Requirements profile: As we do not have comprehensive information on the PFAS-containing materials/components, we refer to the consultation contributions of the manufacturers of these articles and their associations.	

In the process

We are only aware of applications of PFAS in our production process that remain in the product. These are listed in the previous section "In the finished product".
PFAS that are required to operate machines and production systems and that cannot usually be assigned to a specific product type are described in the next section "In machines and systems for production".
Of course, processes that depend on PFAS can take place in our upstream supply chain, such as semiconductor production or the use of PFAS-containing release agents in the manufacture of plastic parts. However, because we do not have any specific information, we as a company in the "Electrical Drive Technology" industry do not comment on this.

In machines and systems for production

We do not develop and produce machines and production systems ourselves. Suppliers are usually responsible for evaluating the technical suitability and selecting the components. Since knowledge of their chemical composition is generally not necessary for the safe use of the end products and components, suppliers also have little information about this.
Moreover, for the vast majority of PFAS, there is no declaration obligation towards downstream actors in the supply chain, as they are not classified as hazardous according to Regulation (EC) No. 1272/2008 (CLP Regulation). Against this background, we have very little knowledge of the presence of PFAS in machines and production systems, as it is mainly based on voluntary information from suppliers and their suppliers. The information available to us is therefore usually limited to operating materials for which a safety data sheet is available, as well as spare and wear parts that we can replace ourselves. For this reason, it can generally be assumed that the following list is incomplete – despite all efforts to find out where PFAS are located in machines and production systems.

<table>
<tr><td>1. Gasket
(E.g. O-ring)</td><td>Example applications:
O-ring in the valve of the paint pump in the painting system
O-ring in the valve in the ferrite core adhesive system</td></tr>
<tr><td>PFAS substance / substance group:
FFKM, FKM, PFA</td><td>PFAS-containing material/component:
Gasket</td></tr>
<tr><td colspan="2">Reason for using PFAS / Requirements profile:
In the ferrite core adhesive system, only the material FFKM has proven to be suitable. For tests with other materials (e.g. NBR, EPDM, FKM), the adhesive hardened anaerobically on the gasket, which prevented the valve from functioning after a short time.
Resistance to the medium processed in the system (e.g. adhesive, paint). The adhesive must not already cure in the machine, but first on the printed circuit board.
Replacement interval: At least 6 months. Since FFKM also hardens over time due to the heavy strain, the O-ring in the valve of the ferrite core adhesive system must be replaced every 6 months. Even shorter maintenance cycles would significantly reduce the cost-effectiveness of production in the EEA.</td></tr>
</table>

<table>
<tr><td>2. Oil and grease</td><td>Example applications:
Reflow furnace
Wave soldering system</td></tr>
<tr><td>PFAS substance / substance group:
PFPE, PTFE, additionally fluorinated greenhouse gas R-1234ze as spray</td><td>PFAS-containing material/component:
Base oil (PFPE), thickener (PTFE), as spray: Propellant gas</td></tr>
<tr><td colspan="2">Reason for using PFAS / Requirements profile:
Temperature resistance up to +280°C (no decomposition, no evaporation)
Maintenance every 2 months
The use of conventional lubricants would involve significantly higher maintenance costs, as these would decompose or evaporate at the high temperatures in the reflow furnace and the wave soldering system. The machine parts (e.g. chains, guides) would be encrusted and would have to be replaced annually instead of very rarely or not at all. This would not only conflict with the goal of resource efficiency, but also reduce the cost-effectiveness of production in the EEA.</td></tr>
</table>

<table>
<tr><td>3. Coating</td><td>Example applications:
Hoses in the ferrite core adhesive system</td></tr>
<tr><td>PFAS substance / substance group:
PTFE</td><td>PFAS-containing material/component:
Hose with PTFE coating on the inside</td></tr>
<tr><td colspan="2">Reason for using PFAS / Requirements profile:
Resistance to the medium processed in the system (adhesive). The adhesive must not already cure in the machine, but first on the printed circuit board.
Flexibility of the hoses must be maintained with the coating.
Anti-adhesive effect</td></tr>
</table>

<table>
<tr><td>4. Coolant</td><td>Example applications:
Coolant in the air dryer for generating compressed air</td></tr>
<tr><td>PFAS substance / substance group:
R134a, R1234yf</td><td>PFAS-containing material/component:
Gas</td></tr>
<tr><td colspan="2">Reason for using PFAS / Requirements profile:
As we do not have comprehensive information on PFAS-containing coolants, we refer to the consultation contributions of the manufacturers of these coolants and their associations.</td></tr>
</table>

6. Substitution

If technically possible and sufficient quantities in sufficient quality are available on the market, PFAS-free material is already used, e.g. Conductor insulation made of PVC or gaskets made of NBR or EPDM. This means that PFAS-containing materials are only used today if there is no other suitable solution or if other materials have proven unsuitable in tests or practice.

Since we do not have the necessary knowledge, skills and equipment to conduct material research in many areas, especially plastics, but these may be available in the upstream supply chain, we asked our suppliers for potentially suitable substitutes. Unfortunately, the search for equivalent alternatives has not yet been successful for the PFAS applications listed in section 5.
Our suppliers take the threat of a PFAS ban very seriously and would like to offer suitable alternatives. However, there are no alternatives that would satisfy the high technical requirements neither now nor in the foreseeable future. Though, there are development activities with the aim of improving PFAS-free materials that perform significantly worse than PFAS materials today. But the estimates regarding the possible achievable performance are significantly lower than what PFAS materials can already achieve today. The first samples that could be used to perform aptitude tests are only expected in about 4-5 years. No one can predict whether the samples will actually prove suitable. For example, it could also be shown that the technology itself is not suitable, that series production will not be economically possible, that larger quantities of hazardous chemicals and/or even more hazardous chemicals would have to be used for production than are necessary for today's production of PFAS materials (keyword "regrettable substitution"), or, in a good case, that the first sample is already quite promising, but has weaknesses that still need to be remedied before the suitability can be tested.

If a sample (e.g. a sealing ring) turns out to be a technically suitable alternative for all or only some(!) applications in which PFAS are used today, its suitability as a substitute in end products also depends on economic factors such as the quantity and quality available on the global market. The development of new technologies and materials is often an iterative process, the overall duration of which cannot be accurately predicted and the result of which may differ significantly from what was hoped for.

After successful development of a new technology, it usually takes another 5 to 10 years until new end products are introduced on the market in mechanical and plant engineering. This time is used for the development of new assemblies or changes to existing assemblies, the development, manufacture and procurement of tools and (new) production and process lines, the qualification of suppliers, technical aptitude tests of the components or materials at all stages of the manufacturing process, for conformity assessments and, if necessary third-party certifications (e.g. according to ATEX Directive 2014/34/EU), employee training and for selling out stocks. Since these steps have to be performed by every actor in the supply chain and can therefore only be performed sequentially in large parts, the entire conversion of electrical drive technology (in all variants, types and sizes) and the associated machines, tools and processes would take about 10-20 years. The costs for the changeover would be in the billions.

As is common for high-tech capital goods, products that are more and more efficient in terms of performance and energy are being developed over the years. A contrary trend is unthinkable for electrical drive technology also in the future, because this would stagnate or shrink the global economy. On the contrary, more and more areas are being automated and already automated areas are becoming more and more efficient, productive or flexible. This development, in turn, requires increasingly high-performance products and materials. Suitable PFAS-independent substitutes would therefore have to be at least equivalent or even better than current materials in order to be able to replace PFAS completely in the future. Poorer alternative materials could replace, at most, parts of today's PFAS applications, because the materials used today are often already used in the upper range of their performance and it must be assumed that due to ongoing technical progress, there will always be applications in which worse substitutes are unsuitable for technical reasons. It cannot be ruled out that these applications also include system-relevant processes such as sufficient supply of food and medicines to the people.

7. Safe use: Prevention and Reduction of Emissions and Exposure

During manufacture:
We do not manufacture any substances or mixtures. Products and end-use substances/mixtures, e.g. grease, sealant, paint, we purchase from their manufacturers or from distributors. Unfortunately, we do not have any information about possible emissions during their manufacture.
If special safety, health and environmental precautions are required for the use, suitable measures are taken and the potentially exposed employees are instructed and provided with suitable personal protective equipment. However, the emission and exposure protection measures taken are regularly checked as part of a continuous improvement process to determine whether they are suitable and sufficient and, if necessary, adjusted.
Lubricants are used in modern workplaces in a well-controlled environment with extraction with filter systems. Lubricant residues, washing water and contaminated cloths are collected separately and disposed of as special waste. The disposal and recycling of our production waste is carried out by professional companies in accordance with the applicable regulations.

During use:
PFAS emissions are not to be expected during use, or only in negligible quantities, because the PFAS-containing components are in the product. On the contrary, emissions of environmentally harmful substances during the use of gear units and gearmotors are to be expected if fluoropolymers are banned. Seals such as shaft sealing rings, flat gaskets and O-rings in gear units and gearmotors ensure that no gear oil leaks out and gets into the environment. As mentioned in section 5, the gaskets are made of polymeric PFAS (FKM, PTFE) in many applications due to the high technical requirements. The gaskets are designed to have a service life of at least 10,000 operating hours at speeds of up to 6,000 revolutions per minute. If the proposed PFAS restriction occurs and therefore the "alternative materials" such as NBR or ACM, which are significantly worse in comparison, have to be used, oil leaks would almost be preprogrammed under these conditions of use. However, there are environments in which oil leaks are unacceptable, e.g. outdoors, in potentially explosive areas, in hygiene areas such as pharmaceutical or food and beverage production, or in areas where oil leaks lead to production disruptions, e.g. in the automotive industry due to paint wetting disorders. Oil leaks may not be completely unacceptable in some areas, but they are still undesirable in most cases because they have to be eliminated for safety reasons. In order to prevent oil leaks, maintenance intervals would have to be shortened to a few months or weeks in some applications, in extreme cases, especially if the resistance to high temperatures and contact media is insufficient, even to a few days. Economical operation of many machines and systems would then no longer be possible. What the failures and downtimes of the machines and systems for carrying out maintenance would have not only for business consequences, but also for the political economy, would probably be in an order of magnitude that we can no longer understand.

During disposal/recycling:
At the end of their service life, our products are disposed of and recycled by professional companies in accordance with the applicable regulations. Waste electrical and electronic equipment is collected and professionally recycled in accordance with the regulations of the WEEE Directive 2012/19/EU, not least because it contains rare and expensive raw materials such as copper. As professional companies take care of the disposal and recycling of our products, we cannot provide precise information on the emissions that are generated.

Scientific studies show that no hazardous compounds are created during the disposal and combustion of fluoropolymers. Fluoropolymers are chemically, thermally and biologically stable and therefore are not expected to convert into dispersing non-polymer PFAS when disposed of at a landfill [1,2]. PTFE can be burned without causing problematic residues [3]. In addition, it is possible to recycle some fluoropolymers, as demonstrated by Dyneon GmbH's recycling process of fluoropolymers, which has been tried and tested on an industrial scale [4]. Researchers at the Fraunhofer Institute for Interfacial Engineering and Biotechnology have successfully reduced the molecular chains of harmful PFAS in contaminated water using plasma-based technology. By shortening the PFAS molecule chains to complete mineralization, contaminated water can be cleaned cost-effectively in the future [5].

[1] Korzeniowski, S.H., Buck, R.C., Newkold, R.M., El Kassmi, A., Laganis, E., Matsuoka, Y., Dinelli, B., Beauchet, S., Adamsky, F., Weilandt, K., Soni, V.K., Kapoor, D., Gunasekar, P., Malvasi, M., Brinati, G., Musio, S. (2023). *A critical review of the application of polymer of low concern regulatory criteria to fluoropolymers II: Fluoroplastics and fluoroelastomers.* Edited by Integrated Environmental Assessment and Management, Volume 19, Issue 2, Pages 326-354. URL: https://doi.org/10.1002/ieam.4646 (visited on 11 Sept 2023)

[2] Henry, B.J., Carlin, J.P., Hammerschmidt, J.A., Buck, R.C., Buxton, L.W., Fiedler, H., Seed, J., Hernandez, O. (2018). *A critical review of the application of polymer of low concern and regulatory criteria to fluoropolymers.* Edited by Integrated Environmental Assessment and Management, Volume 14, Issue 3, Pages 316-334. URL: https://doi.org/10.1002/ieam.4035 (visited on 11 Sept 2023)
[3] Aleksandrov, K., Gehrmann, H., Hauser, M., Mätzing, H., Pigeon, D., Stapf, D., Wexler, M. (2019). *Waste incineration of polytetrafluoroethylene (PTFE) to evaluate potential formation of per- and poly-fluorinated alkyl substances (PFAS) in flue gas.* Edited by Chemosphere, Volume 226, Pages 898-906.
URL: https://doi.org/10.1016/j.chemosphere.2019.03.191. (visited on 11 Sept 2023)
[4] Dyneon GmbH Advanced Materials Division (2016). *3M™ Dyneon™ Fluoropolymers. Up-cycling. Closing the loop.* URL: https://www.3m.co.uk/3M/en_GB/design-and-specialty-materials-uk/products/full-story/?storyid=bfc8cfed-72ac-4982-8f5e-79b7cbb4fc62 (visited on 11 Sept 2023)
[5] Fraunhofer IGB (2023). *Forschung Kompakt. Abwasserreinigung. Plasma gegen toxische PFAS-Chemikalien.* URL: https://www.fraunhofer.de/de/presse/presseinformationen/2023/mai-2023/plasma-gegen-toxische-pfas-chemikalien.html (visited on 11 Sept 2023)

8. Socio-Economic Consequences

As a manufacturer of electrical drive technology, we do not produce end products that can fulfill a specific purpose on their own, but rather components for end-user applications such as waste water treatment plants, port cranes, conveyor belts, high-bay warehouses, production machines, sorting machines, packaging machines or filling systems. Due to the wide range of end applications and industries in which our products are used, and because we have probably not yet found all PFAS applications in our products, production processes and resources, we can only qualitatively estimate the socio-economic effects of the proposed PFAS restriction. The possible negative socio-economic effects of the proposed restriction described below are in conflict with the EU's objectives in terms of sustainability, circular economy, product safety, security of supply and strengthening the competitiveness of the EU.

Productivity decreases and possible supply bottlenecks due to unreliable electrical drive systems / Regression in productivity, energy efficiency and resource efficiency
The sensitivity of global trade to failures in supply and value creation chains became clear, for example, when a container ship blocked the Suez Canal for days in March 2021 or when Chinese health authorities closed the port in the Chinese city of Shenzhen for several days in June 2021 due to a coronavirus outbreak. Standstill is expensive, whether in automotive production or in the port. For this reason, electrical drive technology products are designed and laid out technically in such a way that failures are avoided as far as possible. Seals and insulation materials play a crucial role in fail safety. The seals of many gearmotors (depending on the application) and the conductor insulation of our electric motors are made of fluoropolymers. A decisive reason for this is the resistance to high temperatures.

Electric motors without PFAS might be somehow possible according to the current state of technology – after all, it was possible without PFAS many decades ago – but at what price? Increasing energy efficiency requirements (e.g. due to the Eco-Design Directive 2009/125/EC), the ongoing trend towards miniaturization – not least to avoid wasting resources – and the advancing digitalization have led to that electrical drive systems have become ever smaller and more compact over the years and decades, and can now be optimally adapted to the respective application and its partly constantly varying load factors using speed controls. The more compact an electric motor is built at the same power, the higher temperatures are generated inside. In order to avoid high-temperature-resistant PFAS, electric motors should no longer become so hot. To do so, electric motors would have to be overdimensioned and/or additionally cooled – which would be waste of energy and resources from today's point of view and would not be possible at all, especially in many existing machines and systems due to limited space – or would have to be utilized significantly less. The latter could mean, for example, that a machine or system could no longer be continuously operated as it is now, but would have to be regularly paused, or that it would no longer be possible to transport as many goods or as many people as before at once. In addition, it is likely that downtime would be much more frequent, be it due to more frequent maintenance work or failures caused, for example, by excessive wear on shaft sealing rings.

As described at the beginning (see Section 2), a drive system nowadays usually consists of several interconnected or "intercommunicating" components. If a component is no longer available due to the PFAS ban in the future, or if it is only likely to have a smaller range of functions, the components that depend on this component would also be affected. This could mean, for example, that future drive systems could no longer generate highly dynamic and precise movements, or that important parameters could no longer be monitored ("condition monitoring"). The consequences would be significant productivity losses and more frequent unplanned outages because they could no longer be anticipated as before ("predictive maintenance").

The supply and value creation chains of all goods (including system-relevant goods!) would be much slower overall. The negative consequences of a much slower "rotating" trade could take on critical proportions in view of the steady population growth and demographic change. Particularly with regard to system-relevant supply and value creation chains, the safety and health of the European population could be threatened.

The question was at what price electrical drive technology would be possible without PFAS. We cannot give a precise answer. Perhaps the situation would be as if a container ship was constantly paralyzing an important trade route for several days or if one of the world's largest commercial ports was constantly closed for days.

Relocation of production sites to non-EEA countries
Because components and mixtures containing PFAS, as described above, are partly essential for the functioning of many machines and production systems, a large proportion of electrical drive technology products could no longer be produced in the European Economic Area.

A large proportion of our electronics production runs through the ferrite core adhesive system in a production plant based in Germany mentioned in section 5. O-rings made of FFKM and hoses with PTFE coating are installed in the machine because the adhesive would harden anaerobically to other materials. Since the O-rings made of FFKM are approximately 100 times more expensive than O-rings made of NBR, it would be preferable to do without the expensive FFKM for economic reasons. Even this material is not extremely durable: The O-rings made of FFKM must be replaced with new ones every 6 months. Because PFAS-containing spare and wearing parts may no longer be made available on the EEA market in the future due to the proposed PFAS restriction, operation of the ferrite core adhesive system in the EEA will no longer be possible. Although not 100% of electronics production is made by this machine, the question is of course whether the non-affected part will continue to be produced in the EEA or rather the entire production will be relocated outside the EEA. The same question is also raised for all other production lines in which at least one production step without PFAS is not technically or economically possible, e.g. the painting of gear units and gearmotors in a painting system whose paint pump requires a gasket made of a fluoropolymer material.
The relocation of production facilities to non-EEA countries would mean that the jobs of production and development employees in the EEA (Germany) would be eliminated and the dependence of the EEA on other economic regions would continue to increase.

In theory, many production sites could be transferred to non-EEA countries – but what about, for example, raw materials mining areas, goods handling centers or logistics centers? This is where high throughput and therefore fail-safe electrical materials handling technology are particularly important – often under adverse ambient conditions. If these cannot be operated in the EEA without PFAS for technical or economic reasons, there would be huge disruptions in supply and value creation chains, as described in the previous subsection.

Spare parts ban: Early end of life for used goods / Demise of second-hand markets
Because "placing on the market" according to the REACH Regulation refers to all deliveries in the EEA and imports into the EEA – and not just to the <u>first</u> one, the proposed ban on placing on the market would also affect any used goods containing PFAS, as well as spare parts and operating supplies (e.g. gaskets and lubricants). Due to the lack of PFAS-containing spare parts and operating supplies and the lack of PFAS-free alternatives, many used operating resources and devices (e.g. production machines) could no longer be repaired or maintained. This could lead to disproportionately high economic damage, particularly in the case of durable and expensive capital goods, and even insolvency of the natural or legal persons who own or operate them. This ban would also not be appropriate from an ecological point of view, because it would also affect products whose service life has not yet (by far) been exhausted and no or only negligible PFAS emissions can be expected during their use.
Due to the ban on placing on the market, used PFAS-containing goods in many cases could not only no longer be repaired and maintained, but should generally no longer be passed on within the EEA (second-hand marketing). As a result, used PFAS-containing goods would either have to be disposed of or exported for further use in economic regions outside the EEA after the ban on placing on the market takes effect. The latter would probably mean in many cases that the emission control measures for waste treatment would not meet EU standards.

End of life for new components even before the start of their use phase
Since all PFAS-containing substances, mixtures and articles are covered by the proposed ban on placing them on the EEA market, taking into account the REACH principle "Once an article – always an article", this would particularly hit products whose production or distribution involves more than one player in the EEA, This means particularly complex products with a high level of production depth, including those of electrical drive technology. For example, a PFAS-containing electric motor that the machine manufacturer purchased from an EEA-based manufacturer or distributor before the ban on placing on the market came into effect must neither become part of a new even more complex product (e.g. production machine, conveyor belt) nor must it be made available on the EEA market as a spare part for a machine or system that is already in operation. The electric motor manufacturer would also no longer be able to use PFAS-containing components (e.g. sealing rings, conductor insulation) for the production of new electric motors for the EEA market after the ban on placing on the market has come into effect, and would not even be allowed to make them available for the repair and maintenance of existing machines and systems on the EEA market, even if he had already been supplied with them before the ban on placing on the market took effect – and even if they had never been used. As a result, many components containing PFAS would have to be disposed of unused(!) or exported to non-EEA countries after the ban on placing on the market takes effect. In many cases, this would even mean disposing of PFAS-free components and ready-to-use chemicals that were actually intended for the production or assembly of a more complex PFAS-containing article, but could no longer be used for this purpose due to the ban on placing on the market on all PFAS-containing articles, unless they were also suitable for the production of other PFAS-free articles.

Possible availability bottlenecks for essential applications without alternatives
In view of the extensive restriction intention, there is a great deal of uncertainty in the economy regarding the future viability of business areas that depend on PFAS. Some companies (e.g. the company 3M [1]) are therefore holding back investments or planning to leave the relevant business areas – if they have not already done so. This development is welcome for dispensable and harmful PFAS applications. On the other hand, this development could mean that the need for indispensable and non-substitutable applications can soon no longer be met.

[1] URL: https://news.3m.com/2022-12-20-3M-to-Exit-PFAS-Manufacturing-by-the-End-of-2025 (visited on 25 Sept 2023)

Loss of competition of EEA products on the global market / Price increases in the EEA
The proposed PFAS restriction would mean replacing PFAS in electrical drive systems not only if there is an equivalent and suitable alternative, but also if there are only worse or no alternatives at all. As described above, this would significantly reduce the quality and safety of the products, and some "high-tech solutions" would no longer exist at all. At the same time, the enormous amount of effort required for modification, development, qualification and certification would have to be allocated to the price of the products. As low-quality products, especially in the case of high-tech capital goods, are not competitive on the global market – all the more if they are also more expensive than comparable but higher-quality products – a significant, if not complete, decline in exports of electrical drive systems produced in the EEA is to be expected.

Globally, the EEA sales market is significantly smaller than the rest of the world market combined. As a result, it would be unattractive for companies producing abroad to manufacture products specially adapted to the EEA market, unless the additional expenses for the adjustments could be compensated by higher sales prices. Whether companies in the EEA can afford these higher prices can be questioned. As the example of Great Britain shows, too high barriers to market access are not always without negative consequences for the economy. The UK government therefore intends to lower the barriers to market access again, including the widespread repeal of the mandatory UKCA marking.

9. Recommended changes to the draft restriction

Mandatory effective emission avoidance or reduction of emissions through preventive measures during manufacturing, downstream use and waste treatment
Not only through prohibitions, but also through stricter emission control measures, hazardous PFAS can be reduced in the environment. Since there are indispensable PFAS applications today and in the foreseeable future, it is not possible to dispense with any manufacturing and downstream application processes in which PFAS are produced or involved, as well as the treatment of waste. These processes could increasingly be relocated to non-EEA countries because, unlike the EEA, no total PFAS prohibitions are emerging there. However, this development could be contrary to the actual goal of the proposed PFAS restriction in the EEA, namely the minimization of further hazardous PFAS emissions, because emission protection requirements outside the EEA are often not as stringent as in the EEA. We therefore propose that emissions of hazardous PFAS during manufacturing, downstream use and waste treatment must be avoided or– if not possible – reduced as far as technically and practically feasible.

No more making available of hazardous PFAS and mixtures with hazardous PFAS constituents to the general public
As consumers usually do not (or cannot) take sufficient measures to avoid emissions, the supply of hazardous PFAS and mixtures to which hazardous PFAS have been intentionally added to the general public should be prohibited as a matter of principle. Exceptions to the restriction should only be granted if the use is indispensable and cannot be carried out exclusively in the context of industrial or commercial activities. For example, such a restriction could limit the handling of refrigerants containing PFAS to industrial and commercial users.

Restriction of the use of hazardous PFAS as polymerization aids
Wherever possible, hazardous PFAS should be avoided when producing fluoropolymers. This could not only reduce the risks of harmful emissions during production, but also any risks associated with non-reacted residual monomers in fluoropolymers. Exceptions to the restriction on the use of hazardous PFAS as a polymerization aid should be regularly reviewed against the background of new scientific findings and revoked if necessary.

Targeted limit values for avoidance and/or reduction of future emissions and exposures of hazardous PFAS but no regulation of existing ubiquitous environmental contaminants
The provisions of the REACH Regulation are based on the precautionary principle. Therefore, one of the main objectives of restrictions is to limit or reduce future inputs of hazardous substances into the environment. However, the identification and cleaning of areas contaminated in the past are not within the scope of the REACH Regulation. The limit values for PFAS in products (articles, mixtures and substances) should therefore be set at levels that limit only intended admixtures and impurities or residues caused by the manufacturing or production process, but not pre-existing ubiquitous environmental contaminants. This could prevent the need for analytical testing of raw materials and products for PFAS, which can contain PFAS neither according to their formulation nor due to manufacturing and production processes, but exclusively due to environmental contamination – which would hardly be possible in practice anyway.

Limitation of the scope of application of the restriction with the possibility of later adjustment on the basis of new scientific findings
In order to avert the socio-economic impacts described in section 8 as well as not stand in the way of fundamental sustainability goals, such as resources conservation or product life extension, or the transition to a circular economy, the restriction should **not** apply to the following:

- **Products (new or used) placed on the market for the first time**
- **Spare parts**
- **Substances and mixtures for the maintenance or repair of used products, unless there is a drop-in alternative**
- **Fluoropolymer and perfluoropolyether applications in products of electrical drive technology and mechanical and plant engineering and in their constituents, including operating supplies and auxiliary materials**

Since neither additional derogations from restrictions nor extensions of existing derogations can be requested after the date of entry into force, **the time limitation** of exclusions for applications, for which there are neither today nor in the foreseeable future equivalent as well as technically and economically feasible substitutes, would **not** be **justified**. Instead, the restriction could be amended subsequently against the background of new scientific findings.

Given the extensive and diverse substance group of PFAS and the numerous and diverse end applications, it is almost impossible to obtain a complete overview of all PFAS applications and whether and under what circumstances they would be dispensable. As a result, indispensable PFAS applications could be accidentally ignored and still banned by the proposed restriction – without any possibility of obtaining subsequent approval for them. For this reason, we propose instead, as is usual with REACH restrictions, a restriction based on the principle of a "blacklist".
A "blacklist" would not only contain applications that are to be (temporarily) permitted, but also, and especially, those that are to be banned. In contrast to the present restriction proposal, it would therefore be immediately recognizable which PFAS applications are dispensable and will be banned in the future, because suitable alternatives are already available for them today or in the near future (e.g. impregnating agents for textiles and leather, ski wax, cosmetic products). Certain, indispensable applications could also be taken into account as exceptions to the ban in this approach. In addition, in this case, there would also be the possibility to amend the restriction subsequently in the light of new scientific findings.

10. We offer

In view of the restriction intention and the scientific findings on the effects of different PFAS (groups) on human health and the environment, we question the need for PFAS. Our development departments work closely with suppliers to find alternatives. When developing new technologies and products, we are already switching to technically and economically suitable PFAS-independent technologies wherever possible.

For reasons of environmental protection and scarcity of resources, we are striving to reduce thermal recycling and expand material recycling. For example, wear parts such as sealing rings, which are replaced by our specialist personnel during repairs and maintenance work, could be collected separately and fed into a single-type recycling process. However, it is crucial for establishing such processes that the recyclates are competitive with conventional materials in terms of quality, price and short procurement channels.