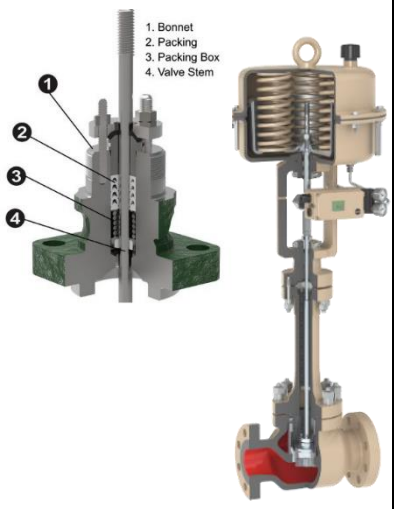
Factsheet "PFAS in PAMCo”

Process Automation – Monitoring - Control

		
Fig. 1: True Air Radar Level measurement	Fig. 2: Guided Wave Radar Level Measurement	Fig. 3: Pressure sensors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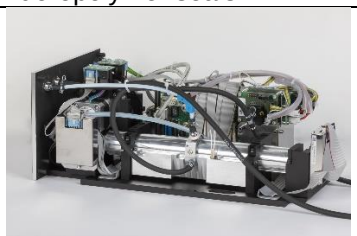
		
Fig. 34: Fidas24 in EL3000 housing - high temperature resistant sealing required, solenoid valves and PCBs included	Fig. 35: Limas21 module - different piping versions offered, pressure sensor included	Fig. 36: pressure sensor

Industry Overview and Products:

Process **A**utomation, **M**onitoring, **Co**ntrol (PAMCo) consists of measurement, monitoring and control systems and associated instrumentation.

Function:
Process Automation, Monitoring, Control and Drives equipment enables delivery of essential resources such as

- clean water, waste water
- other infrastructure (power and energy management, it and telecommunication, transport)
- safe food and beverage
- high quality pharmaceuticals, including vaccines and medical devices
- high quality biological pharmaceuticals
- reliable energy,
- metals and metal alloys,
- pulp and paper,
- building materials,
- mobile equipments (vehicles, mobile machines as for Construction, Agriculture, Forestry and Material Handling
- mobile devices (phone, tablet computers)
- transportation,
- recycling materials,

and essential goods such as

- electronic components,
- chemicals,
- oil & gas,
- fertilizer,
- technical gases (Oxygen, Green Hydrogen …),
- clean exhaust and combustion gases (marine sector)
- defense equipment.

Scope:
The PAMCo product range consists of a wide variety of devices that measure parameters and control processes.

Scope of PAMCo Equipment in particular:

- **Sensors**
  Pressure, Flow, Level, Temperature, Force, Vibration, Inductive, Photoelectric, Capacitive, Magnetic, Valve, Cylinder sensors, Ultrasonic, Density, Viscosity, Gas and liquid process Analysis, Corrosion, Erosion & Heat Trace Monitoring, Flame & Gas Detection, Gas analyzers, Energy Monitoring, Dust, Light
- **Actors**
  Electrical Drives, pneumatic actuators, hydraulic actuators, pumps, self-operated regulators, valves
- **Encoder**
  Transformation of mechanical information into electrical information
- **Monitoring and Control**
  Basic Process control system (BPCS), Distributed Control Systems (DCS),
  Safety Control system (SCS), Plant Asset Management System (PAMS),
  Continuous emission monitoring systems (CEMS)
- **Process Infrastructure**
  Interfaces, piping, accessory as solenoid, pneumatic booster, filter-regulator and connecting systems, Electrical Power Distribution

The PAMCo units operate as a single unit and failure could be catastrophic. Any failure could create an unstable and unsafe situation that could result in serious harm to people and/or the environment. PAMCo equipment has unlimited configuration flexibility to meet the wide range of processing requirements of the many industries served.

Market Information:

Process **A**utomation, **M**onitoring, **Co**ntrol (PAMCo) is a €194B global industry and a €56B European Industry. It consists of measurement, monitoring and control systems and associated instrumentation.[i]

- PAMCo market:
  - Turnover: 194 Billion € worldwide / 56 Billion € Europe [i)]
  - Employees: approx. 500.000 employees
  - PFAS related: approx. 75%

Requirements Profile

- (Lifetime: 15+ years
- Internal development times: 2-5 years
- PAMCo certification times: 2-4 years
- Supplier certification times: 2-4 years
- Customer certification times: 2-4 years
- Required availability time of spare parts: 10-25 years after product termination
- Temperature resistance: -196 °C up to +260 °C
- Dielectric strength: $\varepsilon_r < 3$
- Flame retardancy: UL 94 V0/V1

- Standards, certification/approvals, market/customer requirements:
  - EU / UKCA / Ordinary Location
  - Ex-approval (with multiple country transcriptions - Europe / America / Asia / Africa / Oceania)
  - Safety Approvals
  - Ship approvals
  - Food contact materials (Europe / USA / China)
  - Hygienic approvals (Europe / USA)
  - Radio approvals (Worldwide)

- The operating profile, to which PAMCo equipment is exposed, is defined by the industries using the technology, such as chemical processing plants, nuclear power plants, semiconductor manufacturing, mining, wastewater management, alternative fuels, oil and gas, rail and other mass transportation, and construction. These applications often involve exposure to multiple extreme environmental conditions simultaneously.

- PAMCo environmental conditions:
  - Hazardous environments are prevalent and include fire, explosion, and toxic chemical threats. These environments often require equipment certifications, namely ATEX Directive 2014/34 in Europe.
  - Broad chemical exposure is common due to the massive number of chemicals processed every day. These chemicals span the entire pH range and are processed at different temperatures and pressures. Example harsh chemicals include sulfuric acid, hydrofluoric acid and chlorine.
  - Low temperatures near -60°C. Beyond this for cryogenic processing, PAMCo equipment can be exposed to temperatures down to -200°C.
  - High temperatures near +200°C.
  - High pressures near 150 bar to accelerate and influence reaction rates and to increase volume-time efficiencies. Pressures up to 1000 bar exist in some chemical processes.

- Key success factors of PFAS in PAMCo products:
  - Broad chemical resistance to virtually all chemicals
  - Low temperature performance down to -200°C
  - High temperature performance up to +260°C
  - Corrosion resistance

- Intrinsic flame resistance with a high heat of combustion and limiting O2 Index
- Good electrical properties, excellent dielectric properties, high permeability for microwaves
- Low friction / Non-adhesive resistance
- Purity / inert

Identified PFAS Uses

In Finished Products / In Processes / In Machinery and Equipment of the Production Processes

1. Non-Contact Radar Level Measurement sensors using microwaves

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • PFA • PVDF • FFKM/FKM	• Microwave antenna and waveguide • Parts in contact with substances to be measured • Electroniocs Enclosures • O-Ring sealings

Reason for PFAS Use/ Requirements Profile:

- Very low dielectric constant
- Temperature resistance at high and low temperature
- Huge range of chemical resistance
- Very good water resistance, very low water absorption
- Longterm radiation resistance
- Approved flame / burn characteristics
- High UV radiation resistance
- Material strength even at very high and low temperatures
- Explosion proof standards EN60079 for Zone 0/Zone1 separation
- Less friction, low abrasion and low adhesion

2. Contact Radar Level Measurement sensors using microwaves

PFAS substance/substance group:	PFAS-containing material/component:
• PTFE • PFA • FFKM • FEPM	• **Parts in contact with substances to be measured** • **O-Ring sealings**

Reason for PFAS Use/ Requirements Profile:

- Very low dielectric constant
- Temperature resistance at high and low temperature
- Huge range of chemical resistance
- Very good water resistance, very low water absorption
- Longterm radiation resistance
- Approved flame / burn characteristics
- High UV radiation resistance
- Material strength even at very high and low temperatures
- Less friction, low abrasion and low adhesion

3. Pressure measurement sensors

PFAS substance/substance group:	PFAS-containing material/component:
• PTFE • FKM	• Seals • Pressure compensation membranes • Cables

Reason for PFAS Use/ Requirements Profile:

- Huge range of chemical resistance
- Temperature resistance at high and low temperature
- Constant dielectric properties

4. Diaphragm Seal

By using diaphragm seals, pressure measuring instruments can be adapted to even the most difficult of conditions within process industries. A diaphragm made of the appropriate material separates the medium from the measuring instrument.

Diaphragm seal

PFAS substance/substance group:	PFAS-containing material/component:
• PFA, PTFE	• Lining of the diaphragm seal

Reason for PFAS Use/ Requirements Profile:

- Diaphragm seals ensure reliable measurement results, e.g. when critical media are involved (acids, media with high temperatures, etc.)
- The pressure is transmitted in the diaphragm seal system and thus the medium is separated from the measuring device

Industries:

- Hygienic applications (food, pharmaceuticals, ...)
- Application according to substances (suitable for viscous substances such as oil, diesel, ...)

Effect of PFAS restriction:

- Certain substances (acids, etc.) /conditions (heat, etc.) attack the material of the measuring device
- Diaphragm seal systems that are not protected by PTFE can be a source of danger due to destruction by aggressive media
- For hydrofluoric acid, for example, no other material currently known
- Adhesions of viscous media can disturb the measurement and thus the entire process

5. Various devices

Pressure sensor

PFAS substance/substance group:	**PFAS-containing material/component:**
• FKM, FVMQ	• Sealings

Reason for PFAS Use/ Requirements Profile:

- Seals are essential for the functioning of the products, as they provide the barrier to the environment
- FKM and FVMQ are universally applicable for many different substances (Oils, lubricants, fuels, ...)
- FVMQ has unique low temperature properties

Industries:

- Hydrogen applications
- Renewable energies (wind turbines)
- Hydraulics (construction machinery, etc.)

Effect with PFAS restriction:

- No safe processes (Risk of confusion / high effort if there is a seal for each medium)
- Possible consequences: Leakage (release of oils or fuels into the environment), damage or failure of entire systems
- Extremely long development/modification time (searching for new materials, testing, approval)

6. Photoelectric sensors

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE	• Seals • Membranes

Reason for PFAS Use/ Requirements Profile:

- chemical resistance (e.g. alcoholic and alkaline cleaning agants, oils and lubricants)

7. Flow Measurement devices

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • PFA • FEP • ETFE • PVDF • FKM • FFKM	• Liners • Seals • Insulations • Pressure compensating membranes • Signal processing units • Cables

Reason for PFAS Use/ Requirements Profile:

- Temperature resistance at high and low temperature
- Huge range of chemical resistance
- Approved flame / burn characteristics
- Less friction, low abrasion and low adhesion
- Purity / inert
- Mechanical strength

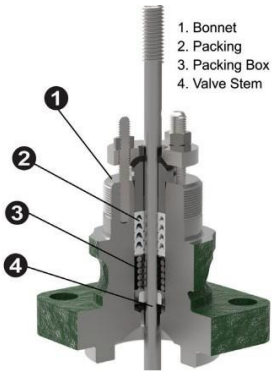
8. Temperature measurement (Sensors, transmitters and accessories)

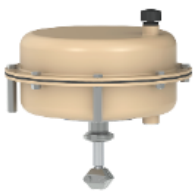
PFAS substance/substance group: • FEP, FP, FT, PFA, PTFE, PVDF, FPM, FKM, FPMX, ETFE	**PFAS-containing material/component:** • Protection fittings, gaskets, o-rings, cables, pipes, heat shrink sleeving
Reason for PFAS Use/ Requirements Profile: • Combination of properties with respect to high/low temperature, aggressive media/chemicals, abrasion, diffusion, friction, swelling, tensile strength, repelling surface, electrical isolation	

9. Process analytics
(Sensors, measuring systems, transmitters, accessories and assemblies)

Process analytics (pH, chlorine, conductivity, disinfection, oxygen..) is absolute necessary for long-term monitoring and limit monitoring of processes with stable process conditions: • Chemical industry • Pulp & paper industry • Power plants (e.g. flue gas washers, boiler feed water) • Incineration plants Food & Beverage • - CIP/SIP applications	Water & wastewater treatment: • Drinking water • Cooling water • Well water • Wastewater treatment plant Biotech and pharma industries • Bioreactors/fermenters: process control in enzyme production • Bioreactors/fermenters: control of culture growth
PFAS substance/substance group: • PTFE, PVDF, FFKM, FKM, FPM, FEP	**PFAS-containing material/component:** • Plastic parts, gaskets, o-rings, cables for e.g. electrode isolation, process connections, diaphragms, flow-through assemblies
Reason for PFAS Use/ Requirements Profile: • Combination of properties with respect to high/low temperature, aggressive media/chemicals, abrasion, diffusion, friction, swelling, tensile strength, repelling surface	

10. Valves





PFAS substance/substance group:	PFAS-containing material/component:
• PTFE • PCTFE • ETFE • PVQM • FKM, FFKM	• Seal packing • Seats • Diaphragm,
Reason for PFAS Use/ Requirements Profile: • Huge range of chemical resistance • Temperature resistance at high and low temperature • Long term stability • Purity / inert • Mechanical strength (Compressive modulus)	

11. Lined Control valve

PFAS substance/substance group:	PFAS-containing material/component:
• PTFE, PFA	• Valve lining (and others as Fig 1)
Reason for PFAS Use/ Requirements Profile: Pharmaceutical control valve, Cleaning and inertness • Agressive process media (e.g. Chlor)	

12. Self operated pressure regulator and component

PFAS substance/substance group:	PFAS-containing material/component:
• PTFE, FKM, FFKM, PVQM	• Sealings (packing. O-Rings) lubricants, diaphragm, bushing
Reason for PFAS Use/ Requirements Profile: • Chemical resistance, little friction temperature resistance, long life, good sealing, low emissions	

13. Mixing or Flow dividing valve with Electric actuator for District energy

PFAS substance/substance group:	PFAS-containing material/component:
• PTFE/ PTFE compound	• Sealing, O-ring, bushing, gearbox
Reason for PFAS Use/ Requirements Profile: • chemical resistance, little friction temperature resistance, long life, good sealing, low emissions	

14. Self operated regulator with electric setpoint actuator for District energy

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE/ PTFE compound	• Sealing, O-ring, bushing, gearbox

Reason for PFAS Use/ Requirements Profile:
- Chemical resistance, little friction temperature resistance, long life, good sealing, low emissions

15. Control valves for aseptic (pharma) and hygienic (food) applications

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE	• Diaphragm, bushing,/packing

Reason for PFAS Use/ Requirements Profile:
- Inert to process media , hygienic requirements, cleaning

16. Membrane valve for aseptic and hygienic application

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE	• Diaphragm, bushing,/packing

Reason for PFAS Use/ Requirements Profile: Agressive process media (e.g. Chlor)
- Hygienic requirements, cleaning, Inert to process media

17. Electric Accessories Positioner, solenoid valve, limit switch

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE, FKM, FFKM, PVQM	• Sealings (O-Rings) lubricants, diaphragm, bushing

Reason for PFAS Use/ Requirements Profile: Agressive process media (Chlor)
- Chemical resistance, little friction, temperature resistance, long life, good sealing, low emissions

18. Pneumatic accessories: Air volume booster, Reversing amplifier, Filter regulator



PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE, FKM, FFKM, PVQM	• Sealings (O-Rings) lubricants, diaphragm, bushing

Reason for PFAS Use/ Requirements Profile: Agressive process media (Chlor)
- Chemical resistance, little friction, temperature resistance, long life, good sealing, low emissions

19. Continuous emission monitoring systems (CEMS)

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • FKM • FFKM • PVDF • PFA	• Gas-conducting hoses • Seals, tubes, fittings, hoses • Insulations • Membranes

Reason for PFAS Use/ Requirements Profile:
- High temperature resistance
- Huge range of chemical resistance
- Dielectric prperty at elevated temperature

20. Gas analysis systems

PFAS substance/substance group:	**PFAS-containing material/component:**
• FKM • FFKM • FPM • PFA • PTFE • PVDF • Fluorocarbon gas: R134a	• Seals, gaskets, fittings • Filter elements, tubings, hoses • Membranes • Insulating shells • Valves

Reason for PFAS Use/ Requirements Profile:

- Temperature resistance at high and low temperature
- Huge range of chemical resistance
- Approved flame / burn characteristics
- Purity / inert
- Mechanical strength
- Dialectric property at elevated temperature
- Non-reactive inertness
- Diffusion resistance

21. Gas sample probe / Heated & unheated probes

Gas sample probe

- The gas composition must remain unchanged.
- Product is attached to the extraction flange on the process stack.
- Materials must resist a wide range of environmental conditions from polar frost to maritime salt air or extremely high process temperatures.

PFAS substance/substance group:	**PFAS-containing material/component:**
• Fluoropolymers: PTFE, PVDF, FKM (Viton®), FFKM	• Tubing, seals, O-rings, valves, filter housings, mounting flanges, cables & wires, electronic components, and metal coating of housings

Reason for PFAS Use/ Requirements Profile:

- Thermal performance at high temperatures
- Pressure resistance
- Corrosion resistance
- Non-reactive inertness
- Mechanical strength & flexibility
- Diffusion resistance
- Dielectric properties

22. Gas coolers / Peltier & compressor coolers

Gas cooler

- Condensate, usually water or acids, is removed by cooling the sample gas.
- There are compressors and Peltier coolers, or a combination of both**.**
- The sample gas coolers can adapt to the specific process conditions.

PFAS substance/substance group:	**PFAS-containing material/component:**
• Fluoropolymers: PTFE, PVDF, FKM (Viton®), FFKM • Fluorocarbon gas: R134a	• Seals, O-rings, insulation lubricants, heat exchangers, refrigerant, connectors, tubing, valves, cables & wires, electronic components, and metal coating of housings

Reason for PFAS Use/ Requirements Profile:

- Non-flammable refrigerant
- Thermal performance at high temperatures & low tempratures
- Pressure resistance
- Corrosion resistance
- Non-reactive inertness
- Mechanical strength & flexibility
- Diffusion resistance
- Dielectric properties

23. Sample gas pumps / Membranes, bellows & peristaltic pumps

Sample gas pump

- Sample gas pumps increase or decrease the pressure of the gas sample flow to ensure the gas flow through the gas analyzer.
- Depending on the gas composition and conditions there are various designs: Full PTFE bellows pump, full PTFE diaphragm pump, electrically heated diaphragm pump, corrosion-resistant diaphragm pump.

PFAS substance/substance group:	**PFAS-containing material/component:**
• Fluoropolymers: PTFE, PVDF, FKM (Viton®), FFKM	• Seals, O-rings, insulation lubricants, heat exchangers, refrigerant, connectors, tubing, valves, cables & wires, electronic components, and metal coating of housings

Reason for PFAS Use/ Requirements Profile:

- Thermal performance at high temperatures
- Pressure resistance
- Corrosion resistance
- Non-reactive inertness
- Mechanical strength & flexibility
- Diffusion resistance
- Dielectric properties

24. Filters / Heated & unheated

Filters retain particles, dust and aerosols throughout the gas sampling and gas flow before the gas analysis.

PFAS substance/substance group:	**PFAS-containing material/component:**
• Fluoropolymers: PTFE, PVDF, FEP, FKM (Viton®), FFKM	• Seals, O-rings, filter elements, connectors, filter element holders, filter heads, cables & wires, motor & electronic components, metal coating of housings and lubricants.

Reason for PFAS Use/ Requirements Profile:

- Thermal performance at high temperatures
- Pressure resistance
- Corrosion resistance
- Non-reactive inertness
- Mechanical strength & flexibility
- Diffusion resistance
- Dielectric properties

25. Analyzer / Oxygen & multigas analyzers

- The analyzer is the main component of the test gas measurement technology. A' test gas' is a clean and dry gas mixture.
- The conditioned gas must meet the requirements of the complex' analyzer for a reliable measurement.
- It is possible to measure: O_2 (oxygen), CO (carbon monoxide), CO_2 (carbon dioxide), CH_4 (methane), NO (nitrogen monoxide), NO_2 (nitrogen dioxide), H_2 (hydrogen).

PFAS substance/substance group:	**PFAS-containing material/component:**
• Fluoropolymers: PTFE, PVDF, FKM (Viton®), FFKM	• Tubing, electronic valves, flow meters, connectors, cables & wires, electronic components, metal coating of housings

Reason for PFAS Use/ Requirements Profile:

- Thermal performance
- Corrosion resistance
- Non-reactive inertness
- Mechanical strength & flexibility
- Diffusion resistance
- Dielectric properties

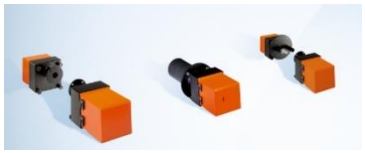
26. Liquid Analyzers

- Liquid analyzer are regulation-compliant online measurement of different parameter residues in drinking water and wastewater.
- The liquid analyzer monitors and controls:
  - Inlets of wastewater treatment plants
  - Outlets of wastewater treatment plants for documentation purposes
  - Aeration basins
  - Water treatment
  - Cleaning capacity of municipal and industrial wastewater plants
- It is possible to measure hardness, iron, TOC, COD, ammonium, aluminum, chromate, sodium, silica, orthophosphate,
  nitrite, total phosphate

PFAS substance/substance group:	**PFAS-containing material/component:**
• Fluoropolymers: PTFE, PVDF, FKM (Viton®), FFKM	• Tubing, electronic valves, flow meters, connectors, cables & wires, electronic components, metal coating of housings

Reason for PFAS Use/ Requirements Profile:
- Thermal performance
- Corrosion resistance
- Non-reactive inertness
- Mechanical strength & flexibility
- Diffusion resistance
- Dielectric properties
- Hygienic design

27. Dust measuring devices



PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • FKM • FFKM • PVDF • PFA	• Seals • O-rings • Parts carrying sample gases (e.g. probes, hoses)

Reason for PFAS Use/ Requirements Profile:
- Chemical and temperature resistance
- Resistance to aggressive components in the sample gas

28. Encoders

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE	• Seals • Lubricants • Gears • Circuit boards

Reason for PFAS Use/ Requirements Profile:
- Chemical resistance
- High temperature resistance

29. Sensors in harsh environments, like process with high temperatures

- Paint Draying
- Welding Process
- Lacquers process
- Wastewater Management
- Mobile Equipment (vehicles)
- Battery Draying

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • PFA • FKM • PFBS and its salts	• Housing • Seals (o-ring and other forms) • Cable

Reason for PFAS Use/ Requirements Profile:

- Temperature resistance at high and low temperature
- Good compression set in seals at high and low temperature
- Huge range of chemical resistance
- Mechanical, chemical resistance for cleaning process
- Less friction, low abrasion and low adhesion
- Very low µr (dielectric constant)
- Flame retardant and anti-dripping

30. Mobile Worker Equipment in Process Automation

Specifically: Mobile Communication Equipment for data, voice and video, intended for use in environments as defined in 2014/34/EU (ATEX)

- Affected Industries: Hydrogen, Food and Beverage Pharmaceutical, Chemical, Oil and Gas, Mining. Fire Fighting Operations.
- Affected Safety: Field Workers, Public Safety
- Use Case examples: Safety relevant communication, maintenance digital support, field service, manufacturing operations, incident management, public safety relevant communication

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • PFA • FKM • PVDF • PFBS and its salts	• Batteries • Sealings • Cables • Housing materials • Membranes covering speakers and microphones • Membrane for pressure compensation • Displays

Reason for PFAS Use/ Requirements Profile:

- Huge range of chemical resistance (at high and low temperature) since devices might be exposed to aggressive substances during usage
- Safety relevant properties as required by EU 2014/34/EU and harmonized standards
- Flame retardant and anti dripping properties of (certified) plastics
- Rechargeable Batteries: Batteries must be intrinsically safe to meet the requirements defined in the harmonized standards. Non-PFAS rechargeable batteries are not known yet.
- Displays (TFT/LCD): Non-PFAS based displays are not known yet.

31. Human Machine Interfaces in Process Automation
(intended for use in environments as defined in 2014/34/EU (ATEX))

- Affected Industries: Hydrogen, Food and Beverage, Life Science, Bio-Pharmaceutical, Pharmaceutical, Chemical, Oil and Gas, Mining.
- Affected Safety: Field Workers, Public Safety
- Use Case examples: Interaction with local control plant system, safety relevant communication, maintenance, field service, manufacturing operations, incident management, public safety relevant communication

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • PFA • FKM • PVDF • PFBS and ist salts	• Display - LCD • Keyboard, Mouse • Sealings • Cables • Housing materials • Membrane for pressure compensation and humidity control

Reason for PFAS Use/ Requirements Profile:

- Huge range of chemical resistance (at high and low temperature) since devices might be exposed to aggressive substances during usage
- Biological inactivity and inertia
- Safety relevant properties as required by EU 2014/34/EU and harmonized standards
- Flame retardant and anti dripping properties of (certified) plastics
- Displays (TFT/LCD): Non-PFAS based displays are not known yet.
- BIOS CMOS Batteries: Batteries must be intrinsically safe to meet the requirements defined in the harmonized standards. Non-PFAS BIOS CMOS batteries are not known yet
- Mechanical, chemical biological resistance for cleaning process

32. Field Junction Boxes and Control Cabinets in Process Automation
(intended for use in environments as defined in 2014/34/EU (ATEX))

- Affected Industries: Hydrogen, Food and Beverage, Life Science, Bio-Pharmaceutical, Pharmaceutical, Chemical, Oil and Gas, Mining.
- Affected Safety: Field Workers, Public Safety and Explosion Protection
  Use Case examples: Mounting of electrical equipment in explosion hazardous areas, Power supply control, Plant safety

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • PFA • FKM • PVDF • PFBS and ist salts	• Sealings • Cables • Housing materials • Membrane for pressure compensation and humidity control

Reason for PFAS Use/ Requirements Profile:

- Huge range of chemical resistance (at high (+70°C) and low temperature (-40°C)) since devices might be exposed to aggressive substances during usage
- Safety relevant properties as required by EU 2014/34/EU and harmonised standards
- Flame retardant and anti-dripping properties of (certified) plastics
- Displays (TFT/LCD): Non-PFAS based displays are not known yet.
- Mechanical, chemical resistance for cleaning process

33. Purge Enclosure in Process Automation (intended for use in environments as defined in 2014/34/EU (ATEX)

- Affected Industries: Hydrogen, Pharmaceutical, Chemical, Oil and Gas, Mining.
- Affected Safety: Field Workers, Public Safety and Explosion Protection
- Use Case examples: Power Applications, Variable Frequency Drives, Gas analyzers, HMIs, plant control, Electrical safety appliances, Motors, Environmental protection

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • PFA • FKM • PVDF • PFBS and ist salts	• Sealings • Cables • Housing Materials • Membrane for pressure compensation and humidity control

Reason for PFAS Use/ Requirements Profile: Agressive process media (Chlor)

- Huge range of chemical resistance (at high (+70°C) and low temperature (-40°C)) since devices might be exposed to aggressive substances during usage
- Safety relevant properties as required by EU 2014/34/EU and harmonized standards
- Flame retardant and anti-dripping properties of (certified) plastics
- Displays (TFT/LCD): Non-PFAS based displays are not known yet.
- Mechanical, chemical resistance for cleaning processMechanical, chemical resistance for cleaning process

34. Inductive sensors for welding applications

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE	• Coating of housing

Reason for PFAS Use/ Requirements Profile:

- chemical resistance
- high temperature resistance
- non-stick properties

35. Capacitive sensors for applications within explosive atmospheres

PFAS substance/substance group:	**PFAS-containing material/component:**
• Fluorpolymers	• seals

Reason for PFAS Use/ Requirements Profile:

- chemical resistance
- high temperature resistance
- reliability

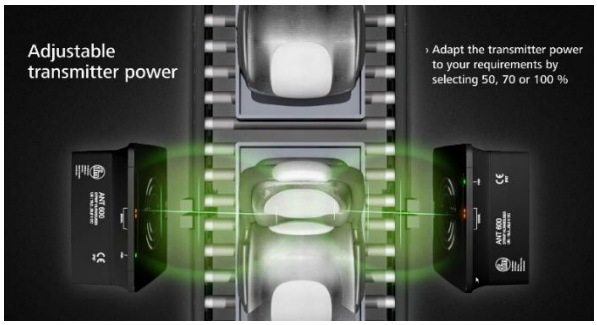
36. 2D- / 3D-Vision sensors / Cameras

example of Application (milking robot)

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE • FKM	• Housing • Seals (O-Ring and other forms) • Pressure equalization element

Reason for PFAS Use/ Requirements Profile:
- Chemical resistance
- High temperature resistance
- Hygienic aspects

37. RFID devices



example of Application (factory)

PFAS substance/substance group:	**PFAS-containing material/component:**
• PTFE	• Pressure equalization element

Reason for PFAS Use/ Requirements Profile:
- Dirt and water repellent housing ventilation

⇆ Substitution

Non-fluoropolymer alternative materials do not exist today for specific PAMCo applications due to the harsh operating conditions in which the materials are required to operate. While finding suitable alternatives is extremely challenging, evaluating them is straightforward because the material limits of basic properties are often exceeded. In many cases, one just needs to look up materials property data in standard references to determine suitability. In our search for alternatives, other fluoropolymers often show up as the best secondary and tertiary choices. For example, PCTFE is a good back-up material for PTFE and vice versa.

Other polymers can demonstrate superior performance in one single property. For example, Polyetheretherkeytone (PEEK) has slightly higher temperature performance than fluoropolymers. However, fluoropolymers are the best choice when both high temperature and chemical resistance are needed simultaneously.

Multiple classes of materials were considered as potential alternatives for fluoropolymers with none emerging as a direct replacement. These materials were identified and evaluated using a combination of available data, publications and thorough discussions with material experts and experts consulted from the broader materials industry.

Metals

Corrosion resistant metals such as stainless steel (SS), titanium, Hastelloy, nickel, copper, and brass were explored as alternatives to fluoropolymer liners and considered unacceptable because of significant incompatibility with some chemicals and lack of purity in certain applications. PTFE is commonly used to coat metals such as 316L SS to protect the surface from corrosion in harsh chemicals. A study by Waseem Akram compared corrosion rates for 316L and PTFE-coated 316L SS in two acidic mediums, hydrochloric acid (HCl) and nitric acid (HNO_3). Results are provided in Table below and show a significant corrosion performance increase (less Mils Per Year) by adding the protective layer of PTFE.[ii, iii]

Acids	Corrosion Rate: Mils Per Year (MPY)	
	Bare 316L SS	**316L w/PTFE Coating**
HCl	29.6	0.7
HNO_3	684.8	4.9

Table: Increase of Corrosion Performance by adding PTFE as a protective layer, study by Waseem Akram

Non-PFAS Polymers

Engineering plastics such as PEEK and polyphenylene sulphide (PPS) were considered as alternatives for liners, tubing, waveguides and seals but were deemed unsuitable due to their inability to meet all the criteria required for PAMCo equipment. PEEK and PPS can fulfil the high temperature performance requirements. However, their chemical resistance is inferior to fluoropolymers, especially for chemicals such as hydrogen sulfide (sour gas) and strong acids. Also, PEEK's compressive modulus is too high making it unfit for seats in valves and regulators and its moisture uptake prevents its use in certain waveguide applications. Another polymer considered was acetal, which has excellent lubrication properties. However, its chemical resistance and temperature limitations prevent it from being a suitable candidate. Another alternative is polyimides such as Vespel™. They generally have a much higher in compressive strength and therefore do not make good low-pressure seals. They are also incompatible with some media such as water and steam.

Non-PFFAS Elastomers

Traditional elastomers such as Ethylene Propylene Diene Monomer (EPDM), Hydrogenated Nitrile Butadiene (H-NBR), and Silicone have been considered as alternatives for seals, but were deemed unsuitable due to their inferior chemical resistance, temperature limitations, and mechanical properties. Most elastomers cannot operate above 150°C. Silicone has higher temperature resistance but is inferior in mechanical performance and is also not recommended in high friction and high wear applications. The use of materials that are not suitable for the operating conditions is not recommended and would, at a minimum, require an unrealistic number of maintenance cycles. In addition, worker and environmental safety could be compromised due to increased probability of failure and possible release of hazardous materials.

All potential alternatives, metals, non-PFAS polymers, and non-PFAS elastomers, are high performance materials that are likely to be persistent similar to fluoropolymers, resulting in the substitution of a persistent material for an inferior performing one, leading to increased maintenance cycles and generation of higher amounts of environmental waste.

Safe Use: Prevention and Reduction of Emissions and Exposure

Precise PAMCo fluoropolymer emissions are more difficult to assess because they take place at the end of a 15+ year life. Both the benefits and impacts must be considered. On the positive side, fluoropolymer valve packing prevents emissions to the environment due to increased seal efficiency over competing materials. On the negative side, negligible and non-toxic emissions may be released over the entire life cycle of the fluoropolymer product. Despite the relatively small emissions in the PAMCo sector, there are further mitigating factors that tend to reduce the concern about emissions even more. The useful lives of PAMCo equipment and components are very long, often greater than 15 years. This is in contrast to single use and/or limited lifetime consumer products that reach their end-of-life stage more quickly. Moreover, due to the closed-loop and sealed structure of PAMCo equipment, the risk of environmental or human exposure is very limited during the use phase. Even equipment operators are unlikely to come in contact with the fluoropolymers in the system, as the fluoropolymers are utilized in discrete, solid plastic parts that are embedded or lined inside the components of the final end-products.

Concerns related to PFAS emissions during the manufacturing of fluoropolymers are expected to be addressed and should be manageable in a reasonable and defined timeframe, per feedback received in a recent inquiry. Implementation of various abatement technologies/emission control methods to reduce the environmental footprint are necessary and we intend to continue maintaining a responsible supply chain.

Another option for estimating PAMCo emissions is to leverage the similarities to the Petroleum and Mining use sector and assign values that are on the same order of magnitude.

Socio-economic Impact

Consequences of the Proposed Restriction

Failure to grant a long-term derogation for PAMCo as a use sector in the PFAS restriction dossier and the implementation of a blanket PFAS ban on the sector will have significant socio-economic implications on the European economy. Industrial automation alone represents around 3-5% of major infrastructure capital. In addition to this impact, it should be noted that the number of essential products and services coming from these installations is orders of magnitude higher. If the REACH PFAS restriction proposal is adopted in its current form, PAMCo equipment will be eliminated for all use sectors except for the 14 defined in the restriction proposal, resulting in devastating cuts and a direct reduction of the European economy based on the elimination of most of the chemical processing industry alone.

Furthermore, the potential elimination of PAMCo and fluoropolymers, could cause the EU to fall behind other countries in terms of technological competitiveness, particularly in chemical processing. Possible consequences include a reduction in manufacturing operations, leading to increased imports of everything from food to pharmaceuticals. The materials used in PAMCo equipment are also used in the production of water and carbon sequestration equipment. all of which are critical to long-term sustainability success. Moreover, materials constraints will continue to limit the scope of technology-related activities, including those that are critical to Europe's future, namely alternative energy, transport and battery manufacturing. Materials are critical enablers of these technologies, and only a derogation for fluoropolymers will allow Europe to maintain a level playing field and increase the likelihood of a successful outcome.

Number of Companies Affected by a PFAS Ban

All companies who manufacture PAMCo equipment will be affected by the restriction. We estimate this number to be around 2,000 for Europe. Additionally, 100,000+ global customers will be affected given the large installed base and not viable replacement options.

Required Transition Period and/or Derogations

Fluoropolymers are clearly distinct from other chemicals in this very broad group of PFAS. There is strong evidence that these materials do not give rise to situations of concern for human health or the environment, while recognising that industry continues to make significant progress in reducing the use of PFAS

polymerisation aids and in implementing appropriate abatement techniques to adequately control the emissions of potentially harmful fluorinated by-products.

Fluoropolymers provide many beneficial properties simultaneously (combined in single products), allowing the continued development of applications that are critical to society, not only in terms of technological progress, but especially in terms of public safety and the development of green energy alternatives.

In conclusion, we recommend the inclusion of PAMCo as a new use sector in the restriction dossier and the exclusion of fluoropolymers from the scope of the restriction. Alternatively, we request a derogation of at least 12 years (plus transition period) for fluoropolymers for use in PAMCo equipment as part of the upcoming REACH PFAS restriction. In addition, a review option is needed to extend the derogation if no suitable alternatives are found. This position is in line with the industry's efforts to maintain environmental sustainability and human health and to reduce the use and the emissions of hazardous substances wherever possible.

We therefore request a two-fold derogation, as follows:

1. Incorporation of PAMCo equipment as a missing use,
2. Spare parts and refurbished products must in principle be exempted from the restriction. The repair-as-produced principle must be applied to the placing on the market of spare parts, wear parts and used parts. Especially in process industry 30 years use time is typical and therefore spare parts in approved/certified equipment must be available.
3. Fluoropolymers should be considered as “Polymers of Low Concern” (PLC) and therefore
   - ➔ be excluded from the restriction scope
     or
   - ➔ should have a 12-year derogation (plus transition period) for use in PAMCo equipment with review option for extension if no suitable substitutes are found

Our sector offers:

PAMCo equipment can be disassembled and separated at the end-of-life for processing or re-use in a circularity methodology. The fate of fluoropolymers at the end-of-life in this business sector is controllable and can be any one or more of the following:

Recovery and Recycling

Fluoropolymers can be chemically returned back to their building blocks for reconstruction without damage to their properties. Melt-processable fluoropolymers, which excludes PTFE, can be recycled through traditional mechanical methodologies. The challenge for non-melt processable fluoropolymers like PTFE is identifying ways to return materials to a facility that can perform chemical recycling. This is a difficult problem, but not insurmountable.

Incineration

There are available studies that strongly suggest that PTFE, the most stable fluoropolymer, undergoes complete thermal decomposition at a temperature of about 800°C and is safe for incineration at municipal incineration facilities5. Therefore, it is assumed that most other fluoropolymers also thermally decompose within similar parameters and are also safe for incineration at most typical municipality incineration facilities.

Landfills

Fluoropolymers are inherently safe, non-mobile, non-bio accumulative and non-toxic.
Waste is chemically inert and therefore, fluoropolymers disposed in landfills do not pose any substantive threat to human health and the environment.

Contact

Felix Seibl • Managing Director Measurement and Process Automation Section • Automation Department
Phone: +4969 6302 451 • Mobile: +49162 2664 931 • E-Mail: Felix.Seibl@zvei.org

Kirsten Metz • Senior Manager Environmental and Chemicals Policy • Sustainability & Environment Division •
Tel.: +4969 6302 212 • Mobile: +49162 2664 952 • E-Mail: Kirsten.Metz@zvei.org

ZVEI e. V. • Electro and Digital Industry Association • Lyoner Straße 9 • 60528 Frankfurt am Main • Germany
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