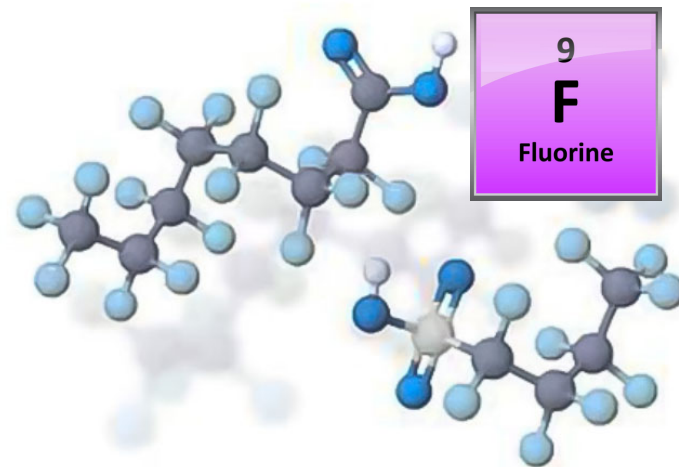


# ***PFAS - Current Regulatory Environment for Aerospace and Defense Products***

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# Overview

- The Aerospace and Defense (A&D) industry is extremely dependent on PFAS in many critical applications
- Increasing emerging regulatory developments are of concern to the Aerospace and Defense (A&D) industry
  - Deeper dives into EU REACH Proposed PFAS Restriction & US State of Maine's PFAS law & regulation
- In preparation for numerous regulatory business risks – the A&D industry is identifying and assessing dependencies on PFAS
  - Increased knowledge in support of advocacy and other risk management

# Aerospace and Defense Known PFAS Dependencies

General	Aerospace & Defense-Specific
<ul style="list-style-type: none"> <li>• Fire Fighting Foam (FFF)</li> <li>• Processing Aid (e.g., to make Teflon)</li> <li>• Surface protection (textiles)</li> <li>• Electronics (heat transfer)</li> <li>• Machinery functional fluids &amp; additives</li> <li>• Plastics and Rubber production</li> <li>• Formulated coatings, paints &amp; varnishes</li> </ul>	<ul style="list-style-type: none"> <li>• Phosphate ester-based brake &amp; hydraulic fluids</li> <li>• Flotation fluids in gyroscopes</li> <li>• Wire and cable insulation</li> <li>• Engine lubrication and elastomeric Seals</li> <li>• Thermal control / Radiator systems</li> <li>• Coatings (various)</li> <li>• Plating (various)</li> <li>• Electronics (various applications)</li> <li>• Metal processing</li> <li>• Mold release agent</li> <li>• Foam blowing</li> <li>• Flame retardant (e.g., in polycarbonate plastics)</li> <li>• Fire Fighting Foams (FFF)</li> </ul>

## Common Uses of Polymeric PFAS

- Fluoropolymers (such as PTFE and FKM) are used extensively in A&D mechanical components including:
  - Semiconductors
  - Wiring
  - Connectors
  - Tubing
  - Piping
  - Seals
  - Gaskets
  - Cables
  - Vents

- **No general reporting requirement for reporting PFAS, esp in hardware**
- **Many AD uses include qualified materials – composition changes can be challenging**

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Approved for Public Release

## Lots of Regulatory Activity

- EU – EU REACH proposed restriction on (many) PFAS, EU POPs restrictions (bans) on specific PFAS groups (e.g., PFOS)
- US – PFAS Recordkeeping and Reporting Rule (imminent), EPCRA Toxic Release Inventory reporting, US states reporting & restrictions
- Canada – proposal to restrict PFAS as a class
- Other regions – global regulations to implement recent Stockholm Convention listings of certain PFAS (PFHxS, PFOA, PFOS).

PFAS Regulations Growing

# Deeper Dive: EU PFAS Proposed Restriction

- Proposal issued on March 22, 2023
- Proposes to restrict (ban) a wide range of PFAS
  - Based on definition and not discrete list of PFAS
  - Covers over 10,000 PFAS species, both polymeric (e.g., “Teflon”) and non-polymeric (e.g., hydrofluorocarbons)
  - Most comprehensive proposal to restrict PFAS to-date
- Two Restriction Options (RO)
  - RO1 – full restriction (ban) – 18 months (not feasible)
  - RO2 – restriction with derogation options – **5 yrs** (implement existing alternatives); or **12 yrs** (identify, develop, (certify), implement), or **time-unlimited** (needed to support other efforts – e.g., HFC transitions under Kigali, for test standards needed for compliance, pharma uses)

# RO2 Details

(PFAS):

1. Shall not be manufactured, used or placed on the market as substances on their own;
2. Shall not be placed on the market in:
  - a. another substance, as a constituent;
  - b. a mixture,
  - c. an article

in a concentration of or above:

- i. **25 ppb for any PFAS** as measured with targeted PFAS analysis (polymeric PFASs excluded from quantification)
- ii. **250 ppb for the sum of PFASs** measured as sum of targeted PFAS analysis, optionally with prior degradation of precursors (polymeric PFASs excluded from quantification)
- iii. **50 ppm for PFASs (polymeric PFASs included).** If total fluorine exceeds 50 mg F/kg the manufacturer, importer or downstream user shall upon request provide to the enforcement authorities a proof for the fluorine measured as content of either PFASs or non-PFASs.

## Derogations Under RO2

- Many proposed and potential derogations (exemptions)
  - Some have applicability to A&D – including for “transport”, but not sufficient
  - Many impacts on A&D supply chain – e.g., electronics, metal finishing, hardware production equipment
- Issue – lack of understanding of PFAS dependence
  - Vigorous, yet incomplete efforts to identify and assess importance of PFAS in the A&D industry
  - Impacts on supply chain (incl. obsolescence)? Customers?

# Main comments Submitted by the A&D Industry

- Difficult to identify PFAS in the supply chain and in supplied hardware
- A&D products are critical to society/ security, environmental initiatives
  - PFAS are critical to those functions & aspirations
  - And (again), A&D - not just planes! e.g., ground and sea-based military systems
- Qualification/ certification for replacements will be challenging and lengthy
  - Alternatives are not available for many critical uses
  - Proposed 12 year derogation for “transport” would be insufficient – could be decades
- PFAS risk management should be based on (potential) risks
- Exclude fluoropolymers and fluoroelastomers from the scope of the restriction (including the PFAS required to make them)
  - Pose limited risks and provide great benefit; risks can be managed thru other mean



# PFAS Comments, Continued

- Exclude use of PFAS on their own, in formulations and in articles that are necessary for the maintenance, repair and overhaul (MRO) of existing A&D products
- Include a time-unlimited derogation for specific PFAS used in on-board fire suppression systems (e.g., hydrofluorocarbons)
- Restrictions should consider impacts on the supply chain due to material/ part obsolescence risks
- Consider separate “sector” derogations for A&D (or at least “D”)
  - Periodic review period to determine state of alternatives development

# US States Regulations

- Many states have enacted/ proposed regulations that are challenging for A&D (and other industries)
- Industry fears a wide variety of differing US state requirements
- Maine & Minnesota – reporting of PFAS in products (including hardware), no market for non-reporters
- West Virginia – reporting use of PFAS identified in wastewater sampling results.

Differing requirements across US states will be challenging for many US industries

# Deeper Dive: Maine PFAS in Product (Proposed) Regulation



- “Products Containing Perfluoroalkyl and Polyfluoroalkyl Substances”
  - Products/ components sold, offered for sale, or distributed for sale in the State of Maine which contain intentionally added perfluoroalkyl and polyfluoroalkyl substances (PFAS)
  - PFAS = “organic chemicals containing at least one fully fluorinated carbon atom” (!!!)
  - Reporting of “intentionally added” products – current deadline Jan. 1, 2025
    - Generally, “no data, no market”
  - Jan 1, 2030 – “a person may not sell, offer for sale, or distribute for sale in the State of Maine any product that contains intentionally added PFAS”
  - Concerns for many industries with operations, sales and suppliers in ME!

Minnesota’s Law is Similar – Reporting and General Ban

# Summary

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# Conclusions

- The Global A&D industry relies heavily on PFAS (particularly fluoropolymers) for many currently-irreplaceable uses
  - Industry is still challenged to identify all uses
  - Knock-on obsolescence for PFAS is a huge concern, even beyond regulatory restrictions
  - It will take decades to fully replace PFAS, if possible at all
- PFAS regulatory and customer restrictions and reporting requirements will continue to increase
  - Along with increased risk of related obsolescence risks for many industries

# Thank you!

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# Backup Slides

## – What Are PFAS?

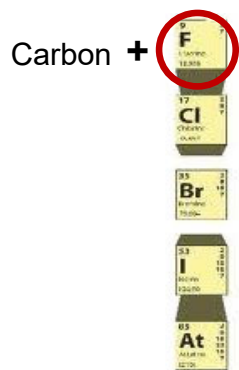
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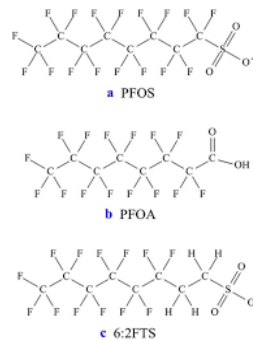
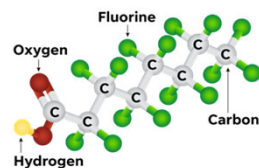


# PFAS Chemistry

- Synthetic organofluorine (alkyl) chemical compounds
- Contain fluorine atoms bonded to a carbon chain
  - Carbon-fluorine bond is one of the strongest ever created by man
  - Not seen in nature – **VERY STABLE!**
  - Length of chain can result in different physicochemical properties that influence the substance behavior in the environment and in organisms, and its bioaccumulation and (eco) toxicity



Group 17



Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs)	
<p><b>Non-Polymers</b></p> <p><b>Perfluoroalkyl Substances</b> <span style="float: right; background-color: yellow; border: 1px solid black; padding: 2px;">Table 2</span></p> <p><i>Compounds for which all hydrogens on all carbons (except for carbons associated with functional groups) have been replaced by fluorines</i></p> <ul style="list-style-type: none"> <li>▪ (Aliphatic) perfluorocarbons (PFCs)</li> <li>▪ Perfluoroalkyl acids</li> <li>▪ Perfluoroalkane sulfonyl fluorides</li> <li>▪ Perfluoroalkane sulfonamides</li> <li>▪ Perfluoroalkyl iodides</li> <li>▪ Perfluoroalkyl aldehydes</li> </ul>	<p><b>Polymers</b> <span style="float: right; background-color: yellow; border: 1px solid black; padding: 2px;">Table 4</span></p> <p><b>Fluoropolymers</b></p> <p><i>Carbon-only polymer backbone with fluorines directly attached</i></p> <p><b>Perfluoropolyethers</b></p> <p><i>Carbon and oxygen polymer backbone with fluorines directly attached to carbon</i></p> <p><b>Side-chain Fluorinated Polymers</b></p> <p><i>Variable composition non-fluorinated polymer backbone with fluorinated side chains</i></p> <ul style="list-style-type: none"> <li>▪ Fluorinated acrylate and methacrylate polymers</li> <li>▪ Fluorinated urethane polymers</li> <li>▪ Fluorinated oxetane polymers</li> </ul>
<p><b>Polyfluoroalkyl Substances</b> <span style="float: right; background-color: yellow; border: 1px solid black; padding: 2px;">Table 3</span></p> <p><i>Compounds for which all hydrogens on at least one (but not all) carbon have been replaced by fluorines</i></p> <ul style="list-style-type: none"> <li>▪ Perfluoroalkane sulfonamido derivatives</li> <li>▪ Fluorotelomer-based compounds</li> <li>▪ Semifluorinated <i>n</i>-alkanes and alkenes</li> </ul>	

For More Info: [OECD Fact Cards of Major Groups of Per- and Polyfluoroalkyl Substances \(PFASs\)](#)