



FEDTEX

Individual and Unit Tactical Gear, Uniforms and Personal Protective Equipment

May 19-20, 2026 Raleigh, North Carolina

Hosted By
US Senator Thom Tillis
US Senator Ted Budd
North Carolina Military Business Center



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PFAS Research & Development, Industry Initiatives and Government Standards

- Moderator: **Erin Ananian-Gentile**, Regional Program Manager (New Bern), NC Military Business Center
- Kayla Messier Jones, Innovation Advisor, Research Triangle Institute (RTI International)
- Natalie Pomerantz, Research Chemical Engineer, US Army Natick Soldier Research, Development, and Engineering Center



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Navigating PFAS Challenges

Kayla Messier Jones

Innovation Advisor

RTI International



Why we continue to discuss PFAS: Three forces are converging to create a decisive window for the defense textiles industry.

723+ DoD installations requiring PFAS remediation | \$9.3B estimated cleanup cost

Oct 2026 AFFF deadline DoD-wide phase-out of PFAS-containing firefighting foam

DoD Mandate

- **AFFF phase-out** deadline: October 1, 2026 across all DoD installations
- FY26 NDAA includes first-ever PFAS accountability provisions for defense
- Army actively soliciting non-PFAS textiles for soldier clothing and equipment

Regulatory and Legal Pressure

- EPA designated PFOA and PFOS as CERCLA hazardous substances (2024)
- **14+ U.S. states** enacting PFAS bans on textiles and consumer products
- EU REACH restriction proposal covering all PFAS uses under review
- PFAS lawsuits and ongoing litigation

Defense
Textile
Industry

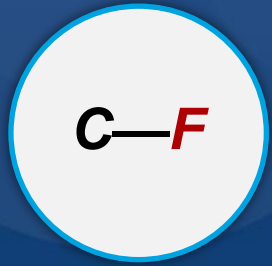
Market Opportunity

- PFAS-free textile replacement market accelerating toward 2035
- Early movers in defense textiles gaining competitive positioning
- SBIR/STTR funding actively targeting PFAS-free alternatives for military use

RTI International is an independent research institute dedicated to improving the human condition, backed by diverse expertise, high-quality collaboration, and expansive capabilities.



Unique chemical properties of PFAS provide exceptional performance across a range of products at low concentrations, making them difficult to replace.



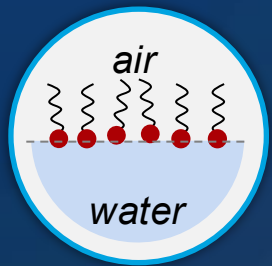
Strong Carbon – Fluorine Bonds

- Heat Resistant
- Chemically Inert



Low Surface Energy

- Hydrophobic/Oleophobic
- Nonstick
- Increased Penetration
- Lubrication/Reduced Friction
- Antistatic



Surfactant Properties

- Wetting
- Leveling Properties

Applications of PFAS



Paints, Coatings & Adhesives



Water-based Inks



Ski Wax



Oil & Gas



Paper and Packaging



Textiles



Firefighting Foams



Cement



Lubricants



Cosmetics

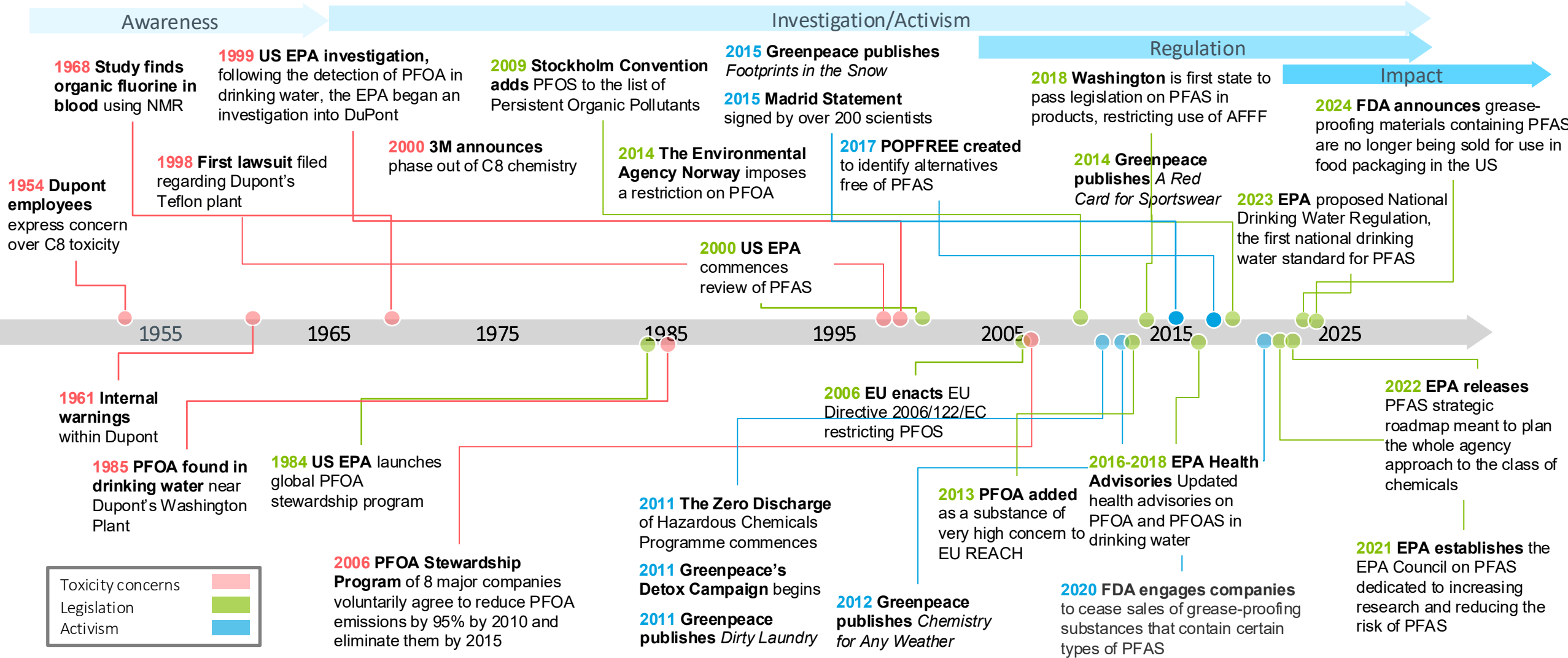


Plastics & Rubber



Electronics

The timeline for PFAS awareness, regulation, and impact took decades.



However, in recent years, timelines are contracting and regulations on PFAS are rapidly emerging at the state and federal level in the United States.

2023 ECHA submitted proposal to restrict over 10,000 PFAS substances; Currently ongoing process

2023 EPA proposed National Drinking Water Regulation, the first national drinking water standard for PFAS

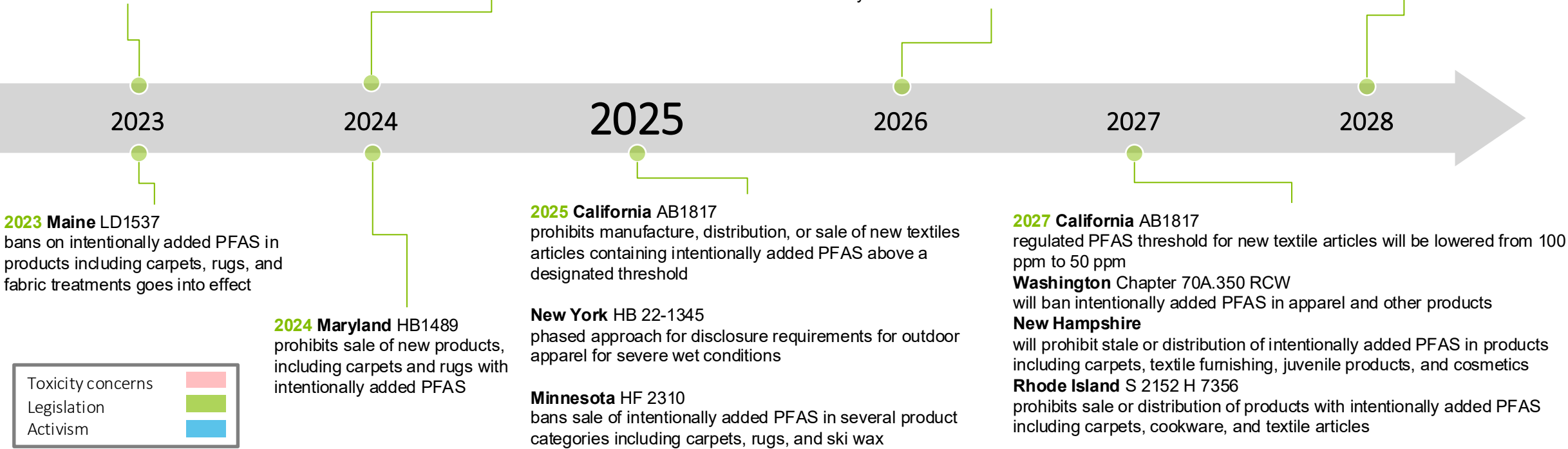
2024 US EPA designated PFOA and PFOS as hazardous substances under CERCLA. Established drinking water standard for 6 PFAS

2024 FDA announces grease-proofing materials containing PFAS are no longer being sold for use in food packaging in the US

2026 US EPA Toxic Substances Control Act Reporting Rule; manufacturers and importers of PFAS must report information on PFAS production and use

2026 Connecticut Act No. 24-59 prohibits sale and distribution of products, including cookware, cosmetics, and textile furnishings containing intentionally added PFAS

2028 California, Colorado, New York, Connecticut exemptions for outdoor apparel for severe wet conditions expire, full ban on PFAS in effect



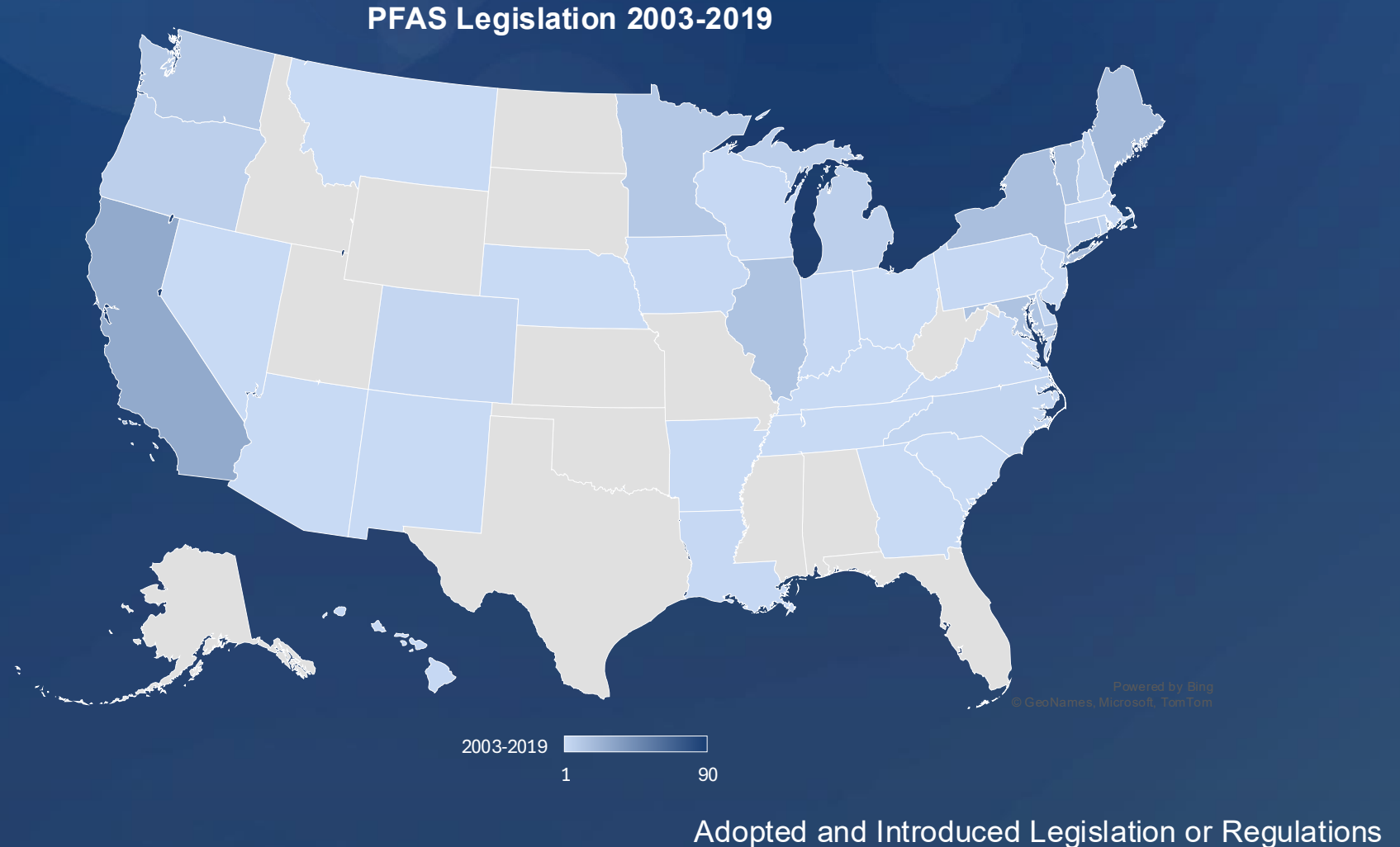
State level regulations are expanding PFAS restrictions with few exceptions, primarily targeting consumer products like food and beverage, toys, furniture, and apparel.

72%

of US states had PFAS regulations as of 2019

201

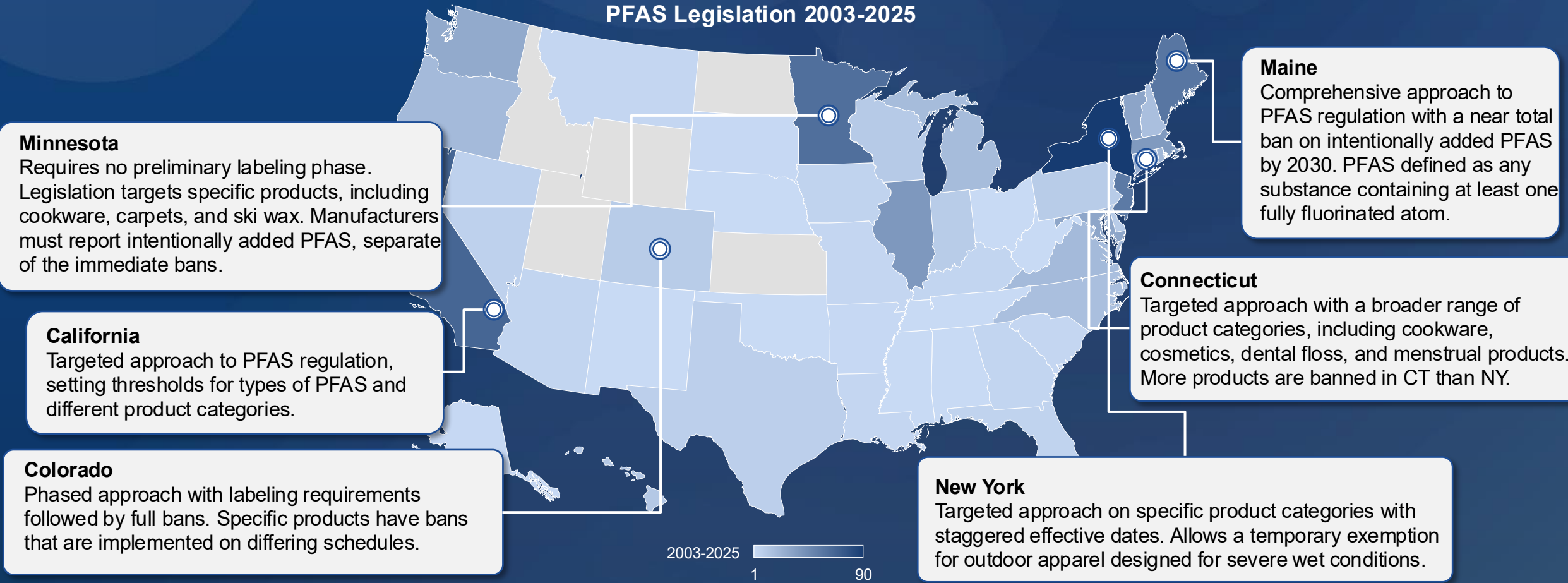
separate pieces of state level legislation or regulations were introduced or adopted by 2019



Over the past five years, PFAS legislation has grown exponentially and is widespread but inconsistent across the US, creating challenges for companies to navigate compliance.

544 New pieces of state level legislation were introduced or adopted between 2020–2025

2.7x Pieces of legislation implemented since 2020 compared to 2003–2019



PFAS definitions across state, federal, and international levels vary widely in scope, creating a fragmented regulatory landscape that makes compliance increasingly difficult.

DEFINITION / FRAMEWORK

APPROX. SCOPE OF PFAS COVERED

OECD (2021)

Organisation for Economic Co-operation and Development

Any fluorinated substance with at least one fully fluorinated $-CF_3$ or $-CF_2-$ group



~6 million +

Maine & Minnesota State Statutes

Maine LD 1503 · Minn. Stat. § 116.943 (Amara's Law)

Any fluorinated substance with at least 1 fully fluorinated carbon; intentionally added only

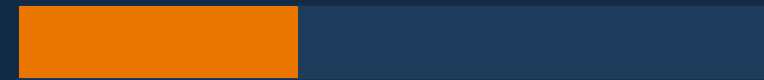


Tens of thousands

U.S. EPA — TSCA § 8(a)(7) (2023)

Federal reporting & recordkeeping rule

Substances with $R-(CF_2)-CF(R')R''$, $R-CF_2OCF_2-R'$, or $CF_3C(CF_3)R'R''$ substructures



~14,000 +

Buck et al. (2011) / Pre-2021 EPA

Foundational technical definition

Aliphatic substances containing the perfluoroalkyl moiety $-C_nF_{2n+1}-$



~5,000–7,000

U.S. EPA — Drinking Water MCL (2024)

National Primary Drinking Water Regulation

Six specific named compounds: PFOA, PFOS, PFHxS, PFNA, HFPO-DA (GenX), PFBS



6 compounds

The definition of “PFAS-Free” varies by supplier due to the ubiquitous use of PFAS as well as the complexity and lack of transparency characteristic of relevant supply chains.



“* PFAS are not intentional ingredients in FlexCoat™ NG.

To the best of our knowledge and based on available information, this coating does not contain PFAS. However, it cannot be guaranteed that it may not contain trace amounts of PFAS that occur unintentionally.”



“Our PFAS-Free* designation is an important distinction: **we do not intentionally add PFAS material to our designated products, but we cannot completely eliminate the possibility of trace presence due to environmental factors.** Unlike potentially misleading industry claims of absolute PFAS absence, our approach prioritizes transparency and scientific accuracy.”



Definitions

Note: all Definitions take Disclaimers into account and apply to the “Chemicals and/or Compounds of Interest” and/or “Per and poly-fluoroalkyl Substances (PFAS)” sections only

Terms	Definitions
Contains*	Present based on composition information disclosed by 3M suppliers, analytical testing, or both.
Not known to contain*	1. Analytical measurement for presence is not currently available; 2. If measurement is possible, a) The material has not been identified or disclosed to 3M and b) The material has not been specifically quantified or detected; OR c) Based on information from raw material suppliers, possible presence as an impurity or by-product at or below regulatory thresholds (e.g., 0.1 or 0.01 %)
Intentionally added**	Desired in the final product to provide a specific characteristic, appearance, or quality and/or to perform a specific function.
Not intentionally added**	By-product(s), impurity(ies) and/or unintended artifact(s) resulting from the formulation and/or manufacture of a material.
By-product***	A chemical substance produced without a separate commercial intent during the manufacture, processing, use, or disposal of another chemical substance or mixture.
Impurity***	A chemical substance which is unintentionally present with another chemical substance (e.g., residuals, catalysts, process solvents).

*Terms apply to the Chemicals and/or Compounds of Interest Section only (if section is present)

**Terms apply to the PFAS Section only (if section is present)

***Terms apply to both the Chemicals and/or Compounds of Interest and PFAS Sections (if section(s) are present)

In addition to patchwork regulations, other barriers make managing chemicals of concern difficult.



Lack of **quantitative sustainability and toxicological data** on hazardous chemicals and their alternatives leading to regrettable substitutions



Lack of **regulatory drivers** for increased transparency



Lack of **economic and market-based incentives** for producers to track and manage hazardous chemicals in their products and supply chains



Lack of **transparency** in supply chains

Many of today's sustainability challenges stem from prior breakthrough innovations.

Unintended Consequences

Breakthrough innovations often solve immediate problems but can create unforeseen long-term issues.

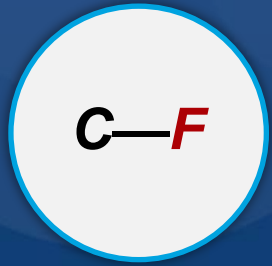
Scale and Adoption Speed

When innovations rapidly become ubiquitous, their negative impacts can quickly escalate before we fully understand or can mitigate them.

Technological Lock-in

Once a breakthrough innovation becomes deeply integrated into economic and social systems, it can be extremely difficult to replace, even when more sustainable alternatives emerge.

Unique chemical properties of PFAS provide exceptional performance across a range of products at low concentrations, making them difficult to replace.



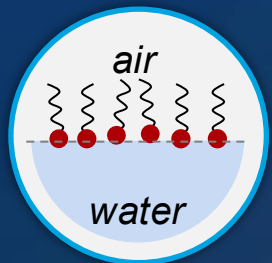
Strong Carbon – Fluorine Bonds

- Heat Resistant
- Chemically Inert



Low Surface Energy

- Hydrophobic/Oleophobic
- Nonstick
- Increased Penetration
- Lubrication/Reduced Friction
- Antistatic



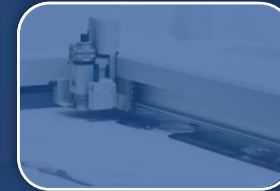
Surfactant Properties

- Wetting
- Leveling Properties

Applications of PFAS



Paints, Coatings & Adhesives



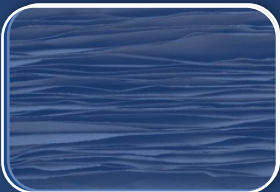
Water-based Inks



Ski Wax



Oil & Gas



Paper and Packaging



Textiles



Firefighting Foams



Cement



Lubricants



Cosmetics

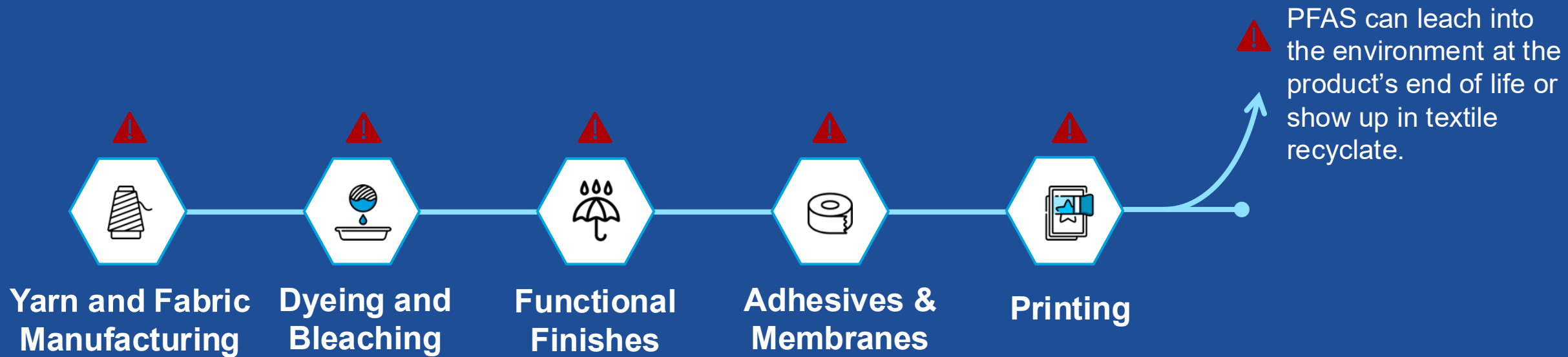


Plastics & Rubber



Electronics





 = Likely hotspot for PFAS

PFAS are used across the textile value chain due to their range of unique properties.

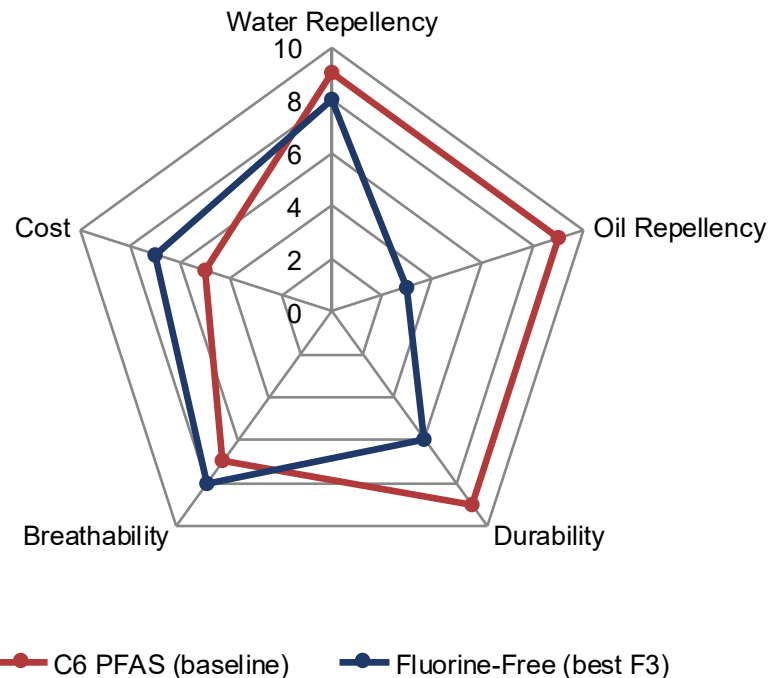
The R&D Landscape: Where Are We on PFAS Alternatives for Textile Applications?

	PFAS (baseline)	Silicone-based	Hydrocarbon / paraffin wax	Dendrimer-based	Bio-based polymers	Plasma-deposited
Water repellency	Benchmark	108–111° CA	Very good when new and clean	Comparable with a C6-based DWR on polyester	Very good when new	90–120° CA
Oil / grease repellency (AATCC 118)	Standard; achieves oil rating ≥5	Poor (47–52° hexadecane CA)	Very poor Repels water & aqueous dirt	Limited Partial improvement vs. silicone	Poor to none	Limited Depends on precursor chemistry
Wash Durability	Excellent	Good Typically needs reactivation	Moderate Needs reactivation	Moderate 5–10 washes in standard formulations	Very Good	Excellent
Breathability	High	High	High	High	High	High
Cost vs. PFAS	1×	1.2–1.8×	~1.2–1.5×	~1.3–1.7×	2–5×	4–8×
TRL	●●●●●●●●	●●●●●●●●	●●●●●●●●	●●●●●●●●	●●●●●●●●	●●●●●●●●

The Innovation Gap: Oleophobicity is the bottleneck, followed by wash durability

C6 PFAS vs. Best-in-Class Fluorine-Free (F3)

Relative performance, 0–10 scale (10 = best).
 F3 = consensus best non-fluorinated finish per axis.



Property	Comparison to C6 PFAS	Details
Water Repellency	Closing in	Silicone and hydrocarbon achieve Grade 4–5 spray ratings comparable to PFAS
Oil Repellency	Critical Gap	Best non-fluorinated coatings reach AATCC 118 Grade 2; PFAS achieves Grade 6+
Hydrostatic Pressure	Gap Remains	Alternatives reach 5,000–8,000 mm vs. PFAS 10,000+
Durability (Laundering)	Gap narrowing	Cross-linked silicone holds 50+ cycles; PFAS benchmark is 75–100+ cycles
Breathability	Comparable	Non-fluorinated finishes generally preserve or exceed MVTR performance

Research to Watch



BIOMIMETIC NANOSTRUCTURE Lotus-Effect Coatings

Silica nanoparticles infiltrated into fabric, then functionalized with long-alkyl-chain silanes; micro/nano roughness traps air to repel water without fluorine.

65

wash cycles

Dignes et al., Adv. Eng. Mater. 2025 • Wyss Institute / Harvard ("Nixe" platform)



HYBRID SOL-GEL SILICONE One-Step Water-Borne Finish

Octylsilane-modified amino-functional PDMS applied via standard pad-dry-cure; drop-in for existing mill equipment.

1-step

water-borne process

Hadhri, Colleoni, Trovato et al., Polymers 2025 • DOI: 10.3390/polym17111578



BIO-BASED POLYSACCHARIDE Starch–Chitosan–ZnO System

OSA-modified starch with chitosan and ZnO yields hydrophobic finishes (132° WCA on cotton) with hand-feel preserved and full life-cycle benefits at end of use.

8

days

Verbič et al., Carbohydrate Polymers 2025 • Also: Tagliaro et al., Carb. Polym. 2024



MOLECULAR-LEVEL GRAFTING Plant Fatty Acids on Cellulose


H&B Materials (CEISAM/Nantes) grafts fatty acids from agricultural waste directly onto cellulose fibers; repellency becomes part of the fiber, not a coating.

0

fresh water

H&B Materials • Techtexil Innovation Award 2026 ("New Chemicals & Dyes")

Effective chemical management starts with formalized policies, rigorous screening processes, and centralized data systems integrated into the innovation workflow.

Maturity Stage 

	FOUNDATIONAL	OPERATIONAL	INTEGRATED	STRATEGIC LEADER
Governance & Policy	Ad-hoc, region-specific compliance; No formal strategy	Public internal policy; high-level sustainable ambitions; limited commitments	Public policy aligned to voluntary industry standards; exec KPIs on safer chemistry	Portfolio targets tied to policy; budget for chemical footprint reduction
Restricted Substances Management	Regulation-only RSL; updated sporadically; MRSL not adopted	Company-wide RSL + adoption of MRSL; annual review	Dynamic RSL/MRSL including emerging hazards; tiered suppliers; third-party verification	Predictive 'Future RSL' via horizon scanning; Removes CoCs pre-regulation
Screening and Assessment in R&D	EHS end-stage check	Rapid hazard screen at concept gate	Formal alternatives assessment run at each Stage-Gate	NAMs, exposure & LCA in digital twins; Auto NO-GO if hazard score fails
Data & Digital Tools	Spreadsheets/SDS folders	Chemical inventory software. Manual SDS upload	Cloud platform links inventory & hazard dashboards	AI decision engine suggesting analogues; real-time supplier data feed
Partnerships & Certifications	None/retailer- or customer-mandated	Single external program in pilot SKUs	Multiple certifications; active in industry groups	Co-found open consortia. Invests in safer chemistry IP; External audits published
Transparency & Supplier Engagement	Certificates on request; limited buyer visibility	Supplier handbook and self declaration	Digital disclosure portal; Plain-language hazard info; public wastewater conformance	Public chemical footprint & progress towards targets; supplier KPIs published



Key Takeaways

Know where PFAS lives in your supply chain

Know exactly where PFAS enters your materials and products by mapping it and prioritizing non-critical uses in the short-term

Choose alternatives based on evidence

Alternatives exist - evaluate them based on updated and realistic specifications; avoid over-engineering products

Engage the ecosystem

Complex system challenges require collaborative solutions beyond individual company capacity. Pursue SBIR/STTR programs, pre-competitive research consortia, academic-industry partnerships, public-private partnerships, and supply chain collaboration

Build resiliency into your innovation workflow

Don't allow future regulatory changes or chemical scrutiny to take you by surprise

Thanks!

Connect with me on LinkedIn and reach out with any questions.



Kayla Messier Jones, MBA

Innovation Advisor

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U.S. ARMY



Perfluoroalkyl Substance (PFAS) Strategy

Supporting Soldiers in all Operational Environments and Improve Their Survivability, Protection, Mobility, and Sustainability

Dr. Natalie Pomerantz
Futures Engineering,
Product Manager Soldier Clothing & Individual
Equipment (PdM SCIE)

Every Ounce Matters,
Every Bullet Counts

May 20, 2026

Unclassified



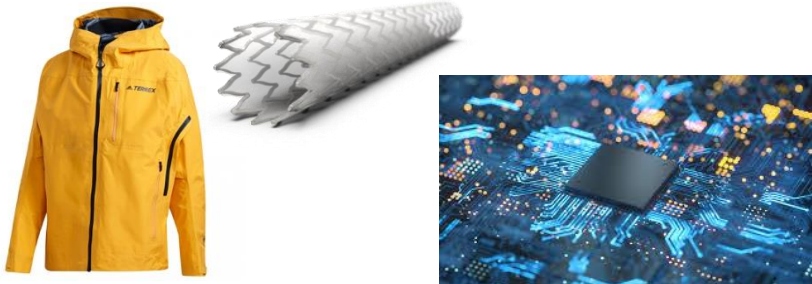
MILITARY TEXTILE APPLICATIONS

BARRIER MEMBRANES

- Provide a barrier against wind, rain, and snow/ice hence providing protection in extreme environments to prevent hypothermia
- Chemical/Biological (CB) Protective barriers
 - Used in MPHS, NFPA Class 1-3 suits

FLUOROPOLYMERS

- Most are safe, inert, stable
- Used inside the body, as landfill liners & for sterile environments
- Used in many sectors outside of textiles (medical, automotive, semiconductors, etc)



FABRIC REPELLANT FINISHES

- Provide water, oil and chemical warfare agent repellency and soil (stain) resistance on clothing & equipment (i.e. footwear, shelters, ballistic protection, etc.)
- Reduced friction on parachute components

SHORT C-F CHAINS

- Leech into groundwater & cause health problems
- **Supply chain is at highest risk**





Requirement: Resistance to Petroleum, Oils and Lubricants (POL), AATCC 118

Oil rating/solvent/surface tension

4 – tetradecane (26.4 dynes/cm)

5 – dodecane (24.7 dynes/cm)

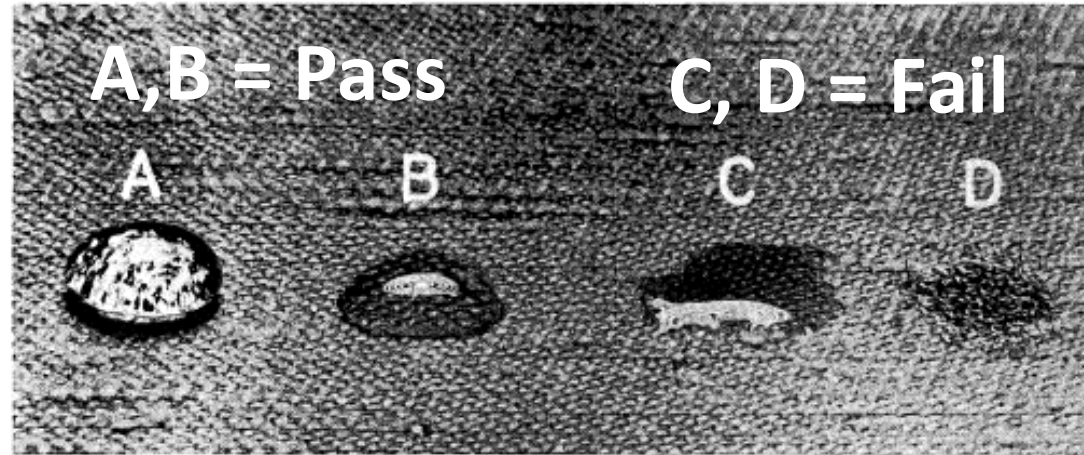
6 – decane (23.5 dynes/cm)

7 – octane (21.4 dynes/cm)

8 – heptane (14.8 dynes/cm)

JP-8 (~26 dynes/cm)

Kerosene (~25 dynes/cm)



Only PFAS-based finishes pass the oil rating

- Typically (exception is in footwear), SCIE requirements are a '4', roughly equivalent to commonly used fuels
- Developmental non-PFAS finishes AT BEST reach a '1' or a '2', commercially available finishes are commonly '0', designed for water repellency and stain release only



Demonstrating POL resistance without AATCC 118

Retaining FR properties for fuel handlers:

- Evaluation post-fuel contamination and post-contamination/laundry: Pyroman, hydrostatic resistance, protection against flash fire, electrostatic decay,
- Fuel penetration

Load carriage and durability:

- Evaluating properties post-fuel contamination
- Hydrostatic resistance, resistance to leakage, spray rating, break strength, tear strength
- Resistance to mildew

Environmental protection:

- Evaluating properties post-fuel contamination
- Hydrostatic resistance, spray rating, insulation, dynamic adsorption, water permeability
- Resistance to mildew

Dress clothing:

- Stain/soil release

Canopy cloth:

- Evaluating friction coefficients and spray rating (do not need POL resistance)



Path forward

- Request for Information in Aug 2024: Industry provided information on which items and specification revisions to prioritize from their production and textile finish developmental standpoint

Identified two fabric specifications:

- MIL-DTL-32439B Cloth, Duck, Textured Nylon and MIL-DTL-43128 Cloth, plain weave, Nylon
- Fabric specifications used widely across all services, include types and classes to delineate denier, water repellent treatment and FR: all include the oil rating
- Including additional, identical types and classes to what currently exists without the oil rating: enables end item users to choose a non-PFAS fabric without altering their specifications

RFI: Domestic Sources for Zero-Porosity, High-Performance Coated Parachute Cloth

- Published Apr 28, **Inactive May 27**
- <https://sam.gov/workspace/contract/opp/4300af0dcb5d4438bb98b9df158422ce/view>
- Product Service Code: 1670
- Base fabric must conform to PIA-C-44378, Type IV
- High-performance silicone formulation applied equally to both sides (non-PFAS)

Removing oil rating from low impact items (addition of stain release if needed) such as the Army Physical Fitness Uniform

FY26: Evaluations of Fuel Handlers Suit, FREE EWOL, FREE IWOL

FY27: ECWCS, Bivy Cover

FY28: Load Carriage, MOLLE related fabrics **Unclassified**



Points of Contact

Impacted Items PFAS Integrated Product Team (IPT)

POC: Natalie Pomerantz
natalie.l.pomerantz.civ@army.mil

Environmental Programs

ASTM F15.81 Per-and Polyfluoroalkyl Substances
POC: Peggy Auerbach
margaret.a.auerbach.civ@army.mil

Natick PFAS S&T IPT

Protect Working Group (CBR MOU):
Task 8 – Fluorine Free Approaches to Dermal
Liquid Protection – Scoping Study
POC: Molly Richards
molly.n.richard2.civ@army.mil

DOD PFAS Site/Task Group

<https://www.acq.osd.mil/eie/eer/ecc/pfas/index.html>



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