NIST Technical Note
NIST TN 2313

Per- and Polyfluoroalkyl Substances in Textiles Present in Firefighter Gloves, Hoods, and Wildland Gear

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Abstract

Firefighter turnout gear has been found to contain per- and polyfluoroalkyl substances (PFAS) and is a potential source of PFAS exposure to firefighters. However, previous evaluations of firefighter exposure to PFAS through personal protective gear has exclusively examined jackets and pants. In contrast, turnout gear contains other protective articles that contact firefighter skin, including hoods and gloves. Additionally, wildland firefighters typically wear gear that includes a shirt and pants, each made of a single layer, to allow easier movement relative to the heavy jacket and pants worn by structural firefighters. To determine the identity, concentration, and prevalence of PFAS potentially present in unused textiles present in firefighting hoods, gloves, and wildland gear, fifty-five nonvolatile, semivolatile, and volatile PFAS were quantified in thirty-two textiles taken from gloves and hoods used by structural firefighters as well as wildland firefighter shirts and pants. Between zero and nine individual PFAS were observed above their respective reporting limits in each textile, with the highest numbers of detections and highest concentrations of PFAS present in wildland gear textiles, compared to glove textiles, which had the second highest, and hood textiles which had the lowest. 6:2 fluorotelomer methacrylate (6:2 FTMAC) and 6:2 fluorotelomer alcohol (6:2 FTOH) are both fluorotelomerization-derived PFAS with six perfluorinated carbons, which were quantified at the highest concentrations of any PFAS reported here, up to 2980 µg/kg ± 820 µg/kg (mean ± standard deviation of triplicate measurements of single textile) and 1250 µg/kg ± 330 µg/kg, respectively. These two PFAS, however, were only detected in wildland firefighting gear textiles. Also observed in the wildland gear textiles were perfluorocarboxylic acids (PFCAs) with seven or fewer perfluorinated carbons at individual concentrations below 20 µg/kg. Four PFAS were observed in most of the glove layers: perfluorobutanoic acid, perfluorobutane sulfonic acid, perfluorobutane sulfonamide, and *N*-methyl perfluorobutane sulfonamide, with *N*-methyl perfluorobutane sulfonamide observed at the highest concentration, up to 117.2 µg/kg ± 7.0 µg/kg. Five different PFAS were observed across all the hoods, but concentrations were less than 1 µg/kg. PFAS concentrations varied widely among each textile type, suggesting that the amount of PFAS present in unused firefighter gear may depend on the textiles used in gear manufacturing.

Keywords

Gloves; hoods; moisture barrier; outer shell; per- and polyfluoroalkyl substances; PFAS; thermal liner; turnout gear; wildland gear textiles; Firefighter.

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Preface

This National Institute of Standards and Technology Technical Note (NIST TN 2313) is the third publication provided in response to Section 338 of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, titled the "Guaranteeing Equipment Safety for Firefighters Act of 2020." This act directed NIST to: "complete a study of the contents and composition of unused personal protective equipment worn by firefighters." The first two reports, NIST TN 2248 "Per- and Polyfluoroalkyl Substances in New Firefighter Turnout Gear Textiles" and NIST TN 2260 "Per- and Polyfluoroalkyl Substances in Firefighter Turnout Gear Textiles exposed to Abrasion, Elevated Temperature, Laundering, or Weathering", described the type, amount, and prevalence of PFAS measured from as-received and laboratory stressed structural firefighter jacket and pants fabrics.

This publication is the first report of measured PFAS concentrations in unused structural firefighter glove layers, unused structural firefighter hoods, and unused wildland firefighting gear. Similar to the first two reports, the current report is a targeted analysis of 55 nonvolatile, semivolatile, and volatile PFAS analytes detected using liquid chromatography/tandem mass spectrometry and gas chromatography/mass spectrometry. An upcoming report examines PFAS in these same firefighter components after laboratory stressing.

This NIST TN was produced through the combined efforts of researchers in the Fire Research Division of the NIST Engineering Laboratory and the Chemical Sciences Division of the NIST Material Measurement Laboratory.

Acknowledgments

We thank United States Senator Jeanne Shaheen and her staff for supporting PFAS-firefighter gear research at NIST.

Author Contributions

Bruce Benner: Methodology; Investigation; **Rick Davis:** Conceptualization, Funding acquisition; Project administration; Resources; Supervision; **Michelle Donnelly:** Resources; **Samuel Escobar Veras:** Investigation; **Ryan Falkenstein-Smith:** Methodology, Investigation; **John Kucklick:** Validation; **Andrew Maizel:** Conceptualization, Formal Analysis, Investigation, Methodology, Supervision, Validation, Writing; **Jessica Reiner:** Methodology, Validation, Writing – review & editing; **Catherine Rimmer:** Resources; **Alix Rodowa:** Methodology, Investigation, Validation, Writing – review & editing; **Andre Thompson:** Conceptualization, Investigation, Methodology, Resources, Supervision, Writing; **Meghanne Tighe:** Investigation, Supervision; **Audrey Tombaugh:** Investigation.

Executive Summary

This National Institute of Standards and Technology Technical Note (NIST TN 2313) characterizes the per- and polyfluoroalkyl substances (PFAS) present in unused structural firefighter gloves and hoods and unused wildland firefighter shirts and pants. Fifty-five individual PFAS, solvent-extracted from 15 layers in four unused firefighter gloves, eight textiles from unused firefighter hoods, and nine unused wildland firefighting gear textiles, were analyzed using gas or liquid chromatography-mass spectrometry analysis. The gear type is the only difference between this report and our two prior reports (NIST TN 2248 and TN 2260).

Across all unused structural firefighter glove layers, structural firefighter hood textiles, and wildland firefighter textiles, 19 PFAS were quantified above the reporting limits, with two PFAS (i.e., 6:2 fluorotelomer methacrylate; 6:2 FTMAC, and 6:2 fluorotelomer alcohol; 6:2 FTOH) present above 200 µg/kg in at least one textile. Among the textiles examined here, summed PFAS concentrations were highest in unused firefighter wildland gear textiles and lowest in unused structural hood textiles. Summed PFAS concentrations in an unused wildland textile totaled as high as 4240 µg/kg ± 890 µg/kg. Among unused firefighter glove layers, moisture barrier layers had the highest summed PFAS concentrations, totaling 118.9 µg/kg ± 7.1 µg/kg. The highest summed PFAS in an individual unused firefighter hood textile was 0.6 µg/kg ± 0.1 µg/kg.

This is the first publication to report PFAS in unused structural firefighter glove layers, structural firefighter hood textiles, and wildland firefighter textiles. Unused firefighter wildland gear textiles contain similar PFAS concentrations to structural firefighter turnout gear. Additional research examining PFAS after stressing firefighter hoods, glove layers, and wildland gear textiles, after long-term stressing of structural and firefighter gear, and after exposure to fire scenes are still needed for a fuller understanding of firefighter’s risk of PFAS exposure.

1. Introduction

Per- and polyfluoroalkyl substances (PFAS) are a class of anthropogenic compounds commonly used in a wide variety of commercial products [1], including as durable water repellent (DWR) treatments that impart chemical and water resistance to textiles used in firefighter turnout gear [2]. There is growing concern about PFAS negatively affecting human health and the environment [3]. There have also been studies of health effects found in animals following oral exposure to PFAS, including perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) [4]. Oral exposure of 2150 mg/kg ammonium perfluorooctanoate (i.e., the ammonium salt of PFOA) in male and female albino rats resulted in the deaths of all rats in one day [4], while treatment of Rhesus monkeys with 30 mg/kg/day ammonium perfluorooctanoate resulted in the death of one male and two females between seven and 12 weeks (group size 10/sex) [4]. The United States Environmental Protection Agency recently released a draft on the toxicity assessment and maximum contaminant level goals for PFOA and PFOS as likely human carcinogens [5].

Firefighters have been found to have higher serum PFAS concentrations than the general public [6]-[14]. Firefighters may be occupationally exposed to PFAS during their work activities, including the use of aqueous film-forming foams (AFFF) [6],[11],[15]-[17] firefighter gear that has been treated with fluorinated polymers [2],[18]-[19] or the accumulation of PFAS during firefighting activities or dust from firefighter stations [20]. While a link between the use of firefighter gear and elevated serum PFAS concentrations has not been established, many of the PFAS identified in firefighter gear textiles, such as 6:2 fluorotelomer alcohol (6:2 FTOH), 6:2 fluorotelomer methacrylate (6:2 FTMAC), and *N*-methyl perfluorobutanesulfonamido ethanol (MeFBSE) [18]-[19],[21]-[22], have not been quantified in firefighter serum.

To protect against exposure to heat and to prevent from becoming water-soaked, structural firefighters typically wear “turnout gear,” which includes a coat and pants and also equipment that protects extremities, including a hood, helmet, and gloves [23], which must meet the National Fire Protection Association (NFPA) 1971 standard: Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting [24]. Like turnout gear pants and jackets, gloves are also composed of an outer shell, thermal layer, and moisture barrier, though some gloves also contain an inner liner. Multiple reports have identified PFAS in other articles of firefighter gear [15],[18],[21]-[22] and gloves and hoods may come into direct contact with the sensitive skin of firefighters’ hands and face. Additionally, while previous studies have examined PFAS in turnout gear worn by structural firefighters, wildland firefighters typically wear different gear, including a shirt and pair of pants, each made of a single layer.

This publication describes research performed in response to the Fiscal Year 2021 National Defense Authorization Act (H.R. 6395) [25], which directed the National Institute of Standards and Technology (NIST) to examine the identity, prevalence, and concentration of PFAS in the personal protective equipment worn by firefighters. NIST has already published reports examining PFAS in new firefighter turnout gear textiles [21] and firefighter turnout gear textiles exposed to abrasion, elevated temperature, laundering, and weathering [22]. This report will provide additional insight into the type and prevalence of PFAS that firefighters could be exposed to from wearing unused firefighting gloves, hoods, and wildland gear. This report will also provide a baseline for future examinations of changes in PFAS concentrations in firefighter gloves, hoods, and wildland gear due to stresses related to firefighting activities.

2. Materials and Methods

Experimental chemicals and consumables were identical to those used in NIST TN 2248 [21] and NIST TN 2260 [22] and are detailed below (Section 3.1). Four firefighter glove textiles (Section 3.2), eight firefighter hood textiles (Section 3.3), and nine wildland firefighter textiles (Section 3.4) were obtained from several manufacturers of firefighter gear in 2021-2023. PFAS analytical standards (Sections 3.5 and A.1) and analytical techniques (Sections 3.6 and A.2) were also identical to those used in NIST TN 2248 [21].

2.1. Materials

Ammonium acetate (Optima LC-MS grade), ammonium hydroxide (Optima grade), ethyl acetate (Optima HPLC and GC grade), and water (Optima LC-MS grade) were obtained from Thermo Fisher Scientific (Waltham, MA). Methanol (OmniSolv LC-MS grade) for high-performance liquid chromatography-tandem mass spectrometry (HPLC-MS/MS) mobile phase solutions were obtained from Supelco (Bellefonte, PA). In contrast, methanol (Optima LC-MS grade) was obtained from Thermo Fisher Scientific for all other purposes. Nitrogen gas (Ultra High Purity grade) and helium gas (Ultra High Purity grade) were obtained from Roberts Oxygen (Rockville, MD).

High-performance liquid chromatography (HPLC) vials (2 mL capacity, amber glass) and glass vial inserts (250 µL) were obtained from Agilent Technologies (Santa Clara, CA). Polyethylene 2 mL vial caps for nonvolatile and semivolatile analysis were obtained from Phenomenex (Torrence, CA). In contrast, 2 mL vial caps with polytetrafluoroethylene (PTFE)/silicone septa for volatile analysis were obtained from Agilent Technologies. HPLC vials, inserts, and caps were used as received from their vendors. Supelco Analytical (Bellefone, PA) Supelclean ENVI-Carb solid phase extraction (SPE) tubes (6 mL x 500 mg) were rinsed with 20 mL (2×10^{-5} m^3) of 0.1 mol/L (10^2 mol/m^3) ammonium hydroxide in methanol and dried before use. Glass 20 mL capacity scintillation vials, glass Pasteur pipettes, and polypropylene 15 mL centrifuge tubes (Cole-Parmer Instrument Company, Vernon Hills, IL) were used as received. Syringes (1 mL capacity) and syringe filters (0.22 µm, nylon) were obtained from Thermo Fisher Scientific and rinsed with 1 mL methanol before use.

2.2. Firefighter Gloves

Structural firefighting gloves are required to meet NFPA 1971 [24] requirements. They are a multilayer construction consisting of an outer leather protective layer and a moisture barrier and thermal liner inner layers. Some gloves have a separate inner liner, while others have a liner incorporated with the thermal layer. **Figure 1** shows a glove cut open to reveal the layers.

For this investigation, four different models of structural firefighter gloves were tested. All were commonly used brands commercially available in 2023. The four glove models were designated GL-A, GL-B, GL-C, and GL-D. Because each glove comprised multiple layers, PFAS concentrations were determined for individual layers after fabric swatches were cut from the assembled gloves. GL-A included a leather outer shell (GL-A-OS), expanded polytetrafluoroethylene (ePTFE) moisture barrier (GL-A-MB), and Nomex/Kevlar thermal liner/inner liner (GL-A-IL). Glove A was the only glove tested that only had three layers. GL-B included an outer shell of 100 % para-aramid knit fleece on the top of the glove's hand (GL-B-OS), while the outer layer on the glove's palm was leather (not tested). GL-B also included a moisture barrier of a proprietary material labeled 100 % waterproof (GL-B-MB). At the same time, the layer against the skin was a Nomex/Kevlar thermal liner on the top of the glove's hand (GL-B-TL) and a modacrylic inner liner facing the glove's palm (GL-B-IL). GL-C had a 100 % Kevlar outer shell on top of the glove's hand (GL-C-OS) and a leather outer shell on its palm (not tested). GL-C included an ePTFE moisture barrier (GL-C-MB), while the thermal liner (GL-C-TL) and inner liner (GL-C-IL) were Kevlar/Nomex fleece blends. GL-D had a leather outer shell (GL-D-OS), ePTFE moisture barrier (GL-D-MB), Kevlar/Nomex blend thermal liner (GL-D-TL), and 100 % modacrylic inner liner (GL-D-IL). **Table 1** lists values of area density and photos of each glove layer in all four gloves.

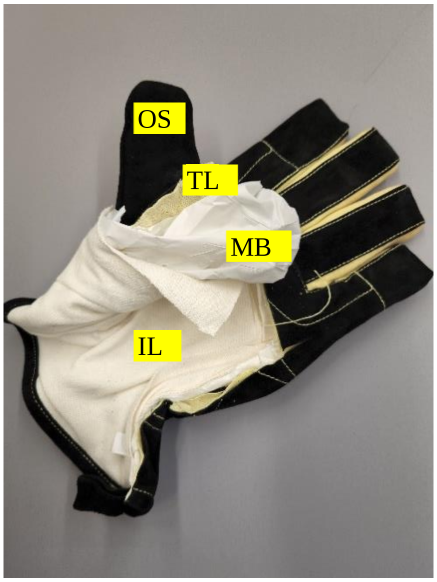


Fig. 1. Firefighter gloves are cut open to reveal individual firefighter glove layers (OS = outer shell, TL = thermal liner, MB = moisture barrier, IL = inner liner).

2.3. Firefighter Hoods

Structural firefighters wear protective hoods made of heat-resistant knitted materials. They provide thermal protection and flame resistance to the head and neck. The hoods are worn underneath the helmet, and if a self-contained breathing apparatus (SCBA) is worn, the hood is placed over the straps of the SCBA. The hoods have an opening in the front for a firefighter's face, or SCBA if worn, and have an extended bib area at the bottom of the hood that continues towards the shoulders so the hood can be tucked into the firefighter's coat. Hoods must meet the requirements of NFPA 1971 [24]. Only basic, knitted hoods designed for thermal protection were evaluated in this study. This study did not examine protective barrier hoods with extra particulate blocking features.

Eight models of hoods produced by three manufacturers were obtained from three vendors of firefighting gear in 2023. Hood samples were designated as HD-A through HD-H. The eight hoods comprised different types or combinations of materials and were obtained in various colors, while all were rib knit. HD-A was black and a mixture of carbon/aramid blend. HD-B was white and 100 % Nomex material. HD-C was black and a mixture of oxidized polyacrylonitrile and tri-blend carbon. HD-D was white and a mixture of Nomex and cellulose fibers made from wood. HD-E was tan and a mixture of polybenzimidazole (PBI) synthetic fiber and regenerated cellulose. HD-F was tan and a mixture of PBI synthetic fiber and cellulose fibers made from wood. HD-G was yellow and a mixture of polyimide derived from aromatic dianhydrides and aromatic diisocyanates, as well as cellulose fibers made from wood and heat-resistant, synthetic, lightweight fiber. HD-H has the same material composition as HD-G but was produced by a different manufacturer. **Table 1** lists values of area density and photos of each of the eight hoods.

2.4. Wildland Firefighter Gear Textiles

Wildland firefighters wear different gear than those who typically fight structural fires. Unlike the turnout gear of structural firefighters, which is composed of three layers, including an outer shell, a moisture barrier, and a thermal liner, wildland garments typically only contain one layer of fabric, similar to the outer shell fabric of the structural turnout gear. Wildland gear fabric must meet the requirements for work in the wildland firefighting environment, as detailed in NFPA 1977 [26].

For this investigation, nine commercially available wildland firefighter gear articles were manufactured by three common wildland firefighter gear manufacturers and then obtained by NIST from three different gear distributors in the form of fully assembled brush shirts, brush pants, or overcoats. Wildland firefighter gear samples were designated WL-A through WL-I and were all plain weave unless stated otherwise. WL-A was a coat made of meta-aramid, para-aramid, and anti-static to protect against electric arc. WL-B was a coat constructed of materials similar to WL-A but produced by a different manufacturer. WL-C was a coat labeled "non-fluorinated" and made of a cotton and nylon blend. WL-D was pants made of the same material as WL-A and obtained from the same manufacturer as WL-A. WL-E were pants made of heat-resistant, synthetic, lightweight fiber and Nomex. WL-F were pants labeled as "non-fluorinated" and made of the same material as WL-D but obtained from a different manufacturer. WL-G were pants labeled as "non-fluorinated" and made of the same material as WL-C, obtained from the same manufacturer as WL-C. WL-H was a shirt labeled "hypoallergenic due to the exclusion of chemical finishes and coatings." It was made of modacrylic, semi-synthetic lyocell fiber, and para-aramid fiber. WL-I was a shirt labeled as "not chemically treated" and made of the same material as WL-H but was obtained from a different manufacturer. **Table 1** shows the area density and photos of each wildland textile.

This NIST PFAS firefighter research is an anonymous study, meaning the researchers do not know the identity of the fabric manufacturer, and the fabric composition tables are not added until the report is complete. As obtained, the assembled wildland gear garments contained detailing such as stitching, buttons, reinforced areas, and reflective patches. For this evaluation, all the stitching or details were not included in the samples of wildland gear taken for PFAS analysis.

Table 1. Area densities (mean ± standard deviation of triplicate measurements; kg/m^2) and images of structural firefighter gloves and hoods, as well as wildland firefighter gear textiles, were evaluated in this NIST TN.

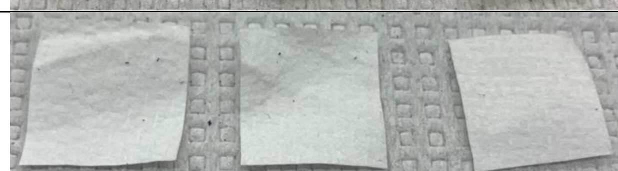
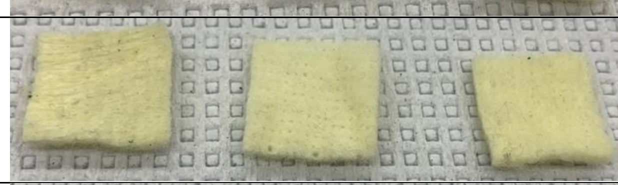
Textile	Area Density (kg/m^2)	Image
GL-A-IL	0.258 ± 0.007	
GL-A-MB	0.093 ± 0.005	
GL-A-OS	1.137 ± 0.014	
GL-B-IL	0.167 ± 0.007	
GL-B-TL	0.158 ± 0.004	
GL-B-MB	0.078 ± 0.001	

Table 1. (Continued)

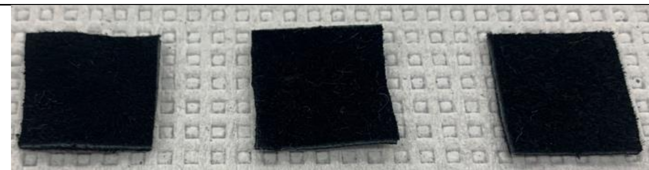
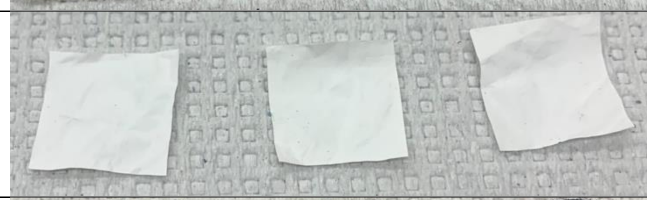
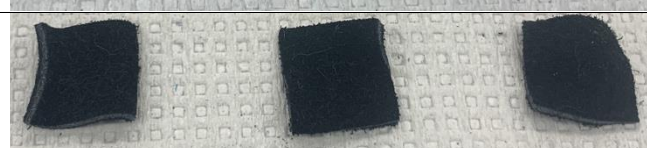
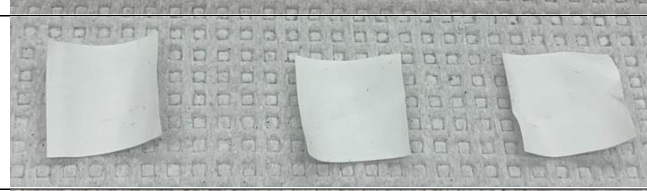
Textile	**Area Density (kg/m²)**	**Image**
GL-B-OS	1.147 ± 0.0+-	
GL-C-IL	0.197 ± 0.032	
GL-C-TL	0.204 ± 0.004	
GL-C-MB	0.093 ± 0.004	
GL-C-OS	0.981 ± 0.065	
GL-D-IL	0.356 ± 0.003	
GL-D-MB	0.106 ± 0.001	
GL-D-OS	0.243 ± 0.002	

Table 1. (Continued)

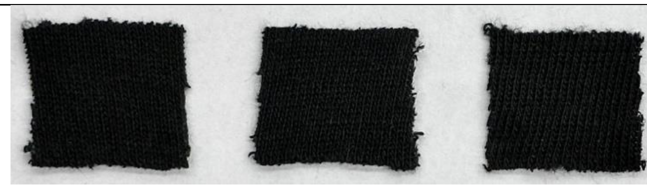
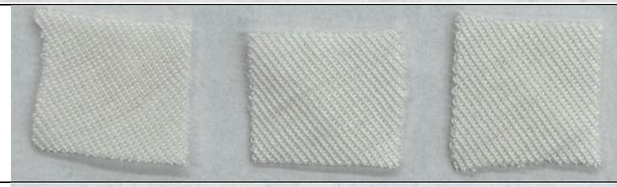
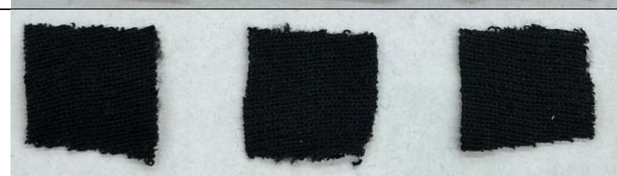
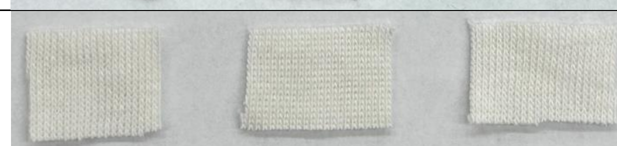
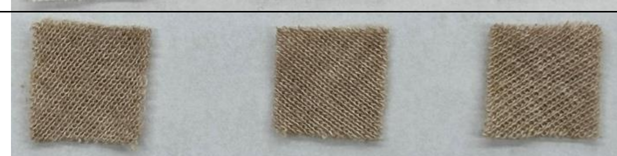
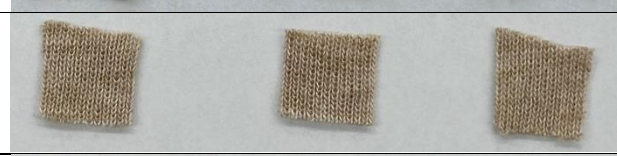
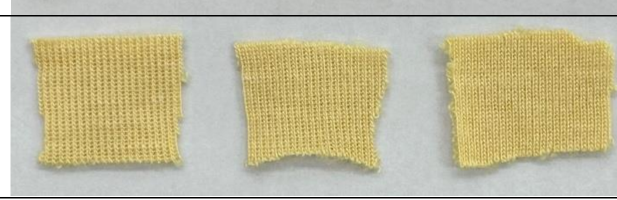
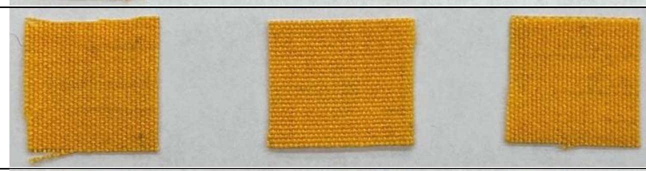
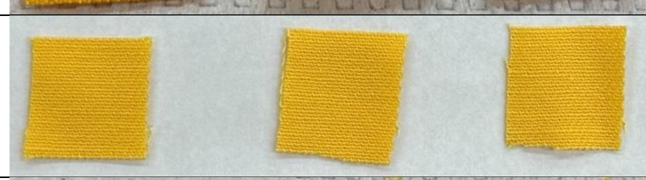
Textile	Area Density (kg/m^2)	Image
HD-A	0.229 ± 0.009	
HD-B	0.231 ± 0.008	
HD-C	0.209 ± 0.006	
HD-D	0.262 ± 0.006	
HD-E	0.195 ± 0.005	
HD-F	0.210 ± 0.008	
HD-G	0.302 ± 0.012	
HD-H	0.270 ± 0.028	

Table 1. (Continued)

Textile	Area Density (kg/m^2)	Image
WL-A	0.228 ± 0.014	
WL-B	0.247 ± 0.008	
WL-C	0.263 ± 0.013	
WL-D	0.225 ± 0.008	
WL-E	0.234 ± 0.006	
WL-F	0.215 ± 0.009	
WL-G	0.266 ± 0.009	
WL-H	0.179 ± 0.003	
WL-I	0.188 ± 0.005	

2.5. PFAS Analytical Standards

This study uses the same 55 PFAS analyte list described in our previous reports [21]-[22]. The selection of PFAS for inclusion in this study was based on earlier reports in the scientific literature, the professional experience of NIST researchers related to PFAS and firefighter gear, and conversations with subject matter experts outside NIST. Analytical standards were obtained for eleven perfluoroalkyl carboxylic acids (PFCA), eight perfluoroalkane sulfonic acids (PFSA), six perfluoroalkane sulfonamides (FASA), three per- and polyfluoroalkane sulfonamido acetic acids (FASAA), two perfluoroalkane sulfonamido ethanols (FASE), eight per- and polyfluoroalkyl ether acids (PPEA), two n:2 fluorotelomer acrylates (n:2 FTAcr), three n:2 fluorotelomer methacrylates (n:2 FTMAC), two n:2 fluorotelomer acetates (n:2 FTOAc), six n:2 fluorotelomer alcohols (n:2 FTOH), and four n:2 fluorotelomer sulfonates (n:2 FTS). Information for all PFAS and their associated reference standards are provided in **Table 2** and Appendix A.1 (**Table 35** – **Table 42**).

2.6. Chemical Analysis of PFAS in Firefighter Gear

Three analytical procedures, referred to in this report as "nonvolatile," "semivolatile," and "volatile," were previously developed for the quantification of a chemically diverse set of PFAS in firefighter turnout gear textiles. The analytical methods used to quantify individual PFAS are shown in **Table 2**. Detailed descriptions of these methods were previously described in NIST TN 2248 [21] and NIST TN 2260 [22]. Briefly, in the nonvolatile method, PFAS were extracted from stressed firefighter gear textiles by sonication in methanol at 25 °C with subsequent centrifugation, filtration through graphitized carbon (ENVI-Carb SPE tubes; 500 mg x 6 mL), and evaporation to dryness under nitrogen at 40 °C. Dried nonvolatile extracts were reconstituted in methanol and analyzed by LC-MS/MS. PFAS analyzed by the semivolatile and volatile analytical methods were extracted simultaneously by sonication in ethyl acetate at 25 °C and subsequent centrifugation, filtration through graphitized carbon (ENVI-Carb SPE tubes, 500 mg x 6 mL), and evaporation to 2 mL under nitrogen at 35 °C. Extracts were then analyzed by LC-MS/MS or GC-MS for semivolatile or volatile PFAS, respectively. PFAS concentrations below reporting limits or did not meet quality control standards were given a value and variance of zero for summed PFAS calculations. Reporting limits were PFAS and sample-specific. Most determined reporting limits were below 0.125 µg/kg for nonvolatile PFAS measurements (784 out of 1107) and below 0.625 µg/kg for semivolatile (102 out of 160) PFAS measurements. Reporting limits for volatile PFAS were 7.7 µg/kg or higher. More details on how reporting limits were calculated and specific reporting limits for each measurement are available in Appendix A.3.1 and **Table 3** – **Table 34**.

Table 2. Class names and abbreviations as well as individual compound names, abbreviations, analytical methods used for quantification (i.e., NV for nonvolatile, SV for semivolatile, and V for volatile) as well as Chemical Abstract Service Registry Numbers (CAS RN) of all PFAS analyzed in this technical note.

Class	Name	Analytical Method	CAS RN
Perfluorocarboxylic acids (PFCA)	Perfluorobutanoic acid (PFBA)	NV	375-22-4
	Perfluoropentanoic acid (PFPeA)	NV	2706-90-3
	Perfluorohexanoic acid (PFHxA)	NV	307-24-4
	Perfluoroheptanoic acid (PFHpA)	NV	375-85-9
	Perfluorooctanoic acid (PFOA)	NV	335-67-1
	Perfluorononanoic acid (PFNA)	NV	375-95-1
	Perfluorodecanoic acid (PFDA)	NV	335-76-2
	Perfluoroundecanoic acid (PFUnDA)	NV	2058-94-8
	Perfluorododecanoic acid (PFDoDA)	NV	307-55-1
	Perfluorotridecanoic acid (PFTrDA)	NV	72629-94-8
	Perfluorotetradacanoic acid (PFTeDA)	NV	0376-06-07
Perfluoroalkane sulfonic acids (PFSA)	Perfluoropropane sulfonic acid (PFPrS)	NV	423-41-6
	Perfluorobutane sulfonic acid (PFBS)	NV	375-73-5
	Perfluoropentane sulfonic acid (PFPeS)	NV	2706-91-4
	Perfluorohexane sulfonic acid (PFHxS)	NV	108427-53-8
	Perfluoroheptane sulfonic acid (PFHpS)	NV	375-92-8
	Perfluorooctane sulfonic acid (PFOS)	NV	45298-90-6
	Perfluorononane sulfonic acid (PFNS)	NV	68259-12-1
	Perfluorodecane sulfonic acid (PFDS)	NV	335-77-3
Perfluoroalkane sulfonamides (FASA)	Perfluorobutane sulfonamide (FBSA)	NV	30334-69-1
	Perfluorohexane sulfonamide (FHxSA)	NV	41997-13-1
	Perfluorooctane sulfonamide (FOSA)	NV	754-91-6
	N-Methyl perfluorobutane sulfonamide (MeFBSA)	SV	68298-12-4
	N-Methyl perfluorooctane sulfonamide (MeFOSA)	SV	31506-32-8
	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	SV	4151-50-2
Perfluoroalkane sulfonamido acetic acids (FASAA)	Perfluorooctane sulfonamido acetic acid (FOSAA)	NV	2806-24-8
	N-Methyl perfluorooctane sulfonamido acetic acid (MeFOSAA)	NV	2355-31-9
	N-Ethyl perfluorooctane sulfonamido acetic acid (EtFOSAA)	NV	2991-50-6
Perfluoroalkane sulonamido ethanols (FASE)	*N*-Methyl perfluorooctane sulfonamido ethanol (MeFOSE)	SV	24448-09-07
	N-Ethyl perfluorooctane sulfonamido ethanol (EtFOSE)	SV	1691-99-2
Per- and polyfluoroalkyl ether acids (PPEA)	Perfluoro-3-methoxypropanoic acid (PF4OPeA)	NV	377-73-1
	Perfluoro-2-ethoxyethane sulfonic acid (PFEESA)	NV	113507-82-7
	Perfluoro-4-methoxybutanoic acid (PF5OHxA)	NV	863090-89-5
	Perfluoro-3,6-dioxaheptanoic acid (3-6-OPFHpA)	NV	151772-58-6
	Hexafluoropropylene oxide dimer acid (HFPO-DA)	NV	13252-13-6
	4,8-Dioxa-3H-perfluorononanoate (ADONA)	NV	958445-44-8
	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	NV	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	NV	763051-92-9

Table 2. (Continued)

Class	Name	Analytical Method	CAS RN
n:2 Fluorotelomer acrylates (n:2 FTAcr)	8:2 Fluorotelomer acrylate (8:2 FTAcr)	V	27905-45-9
	10:2 Fluorotelmer acrylate (10:2 FTAcr)	V	17741-60-5
n:2 Fluorotelomer methacrylates (n:2 FTMAC)	6:2 Fluorotelomer methacrylate (6:2 FTMAC)	V	2144-53-8
	8:2 Fluorotelomer methacrylate (8:2 FTMAC)	V	1996-88-9
	10:2 Fluorotelomer methacrylate (10:2 FTMAC)	V	2144-54-9
n:2 Fluorotelomer acetates (n:2 FTOAc)	8:2 Fluorotelomer acetate (8:2 FTOAc)	V	37858-05-02
	10:2 Fluorotelomer acetate (10:2 FTOAc)	V	37858-05-02
n:2 Fluorotelomer alcohols (n:2 FTOH)	4:2 Fluorotelomer alcohol (4:2 FTOH)	V	2043-47-2
	5:2 sFluorotelomer alcohol (5:2 FTOH)	V	914637-05-1
	6:2 Fluorotelomer alcohol (6:2 FTOH)	V	647-42-7
	7:2 sFluorotelomer alcohol (7:2 FTOH)	V	24015-83-6
	8:2 Fluorotelomer alcohol (8:2 FTOH)	V	678-39-7
	10:2 Fluorotelomer alcohol (10:2 FTOH)	V	87017-97-8
n:2 Fluorotelomer sulfonic acids (n:2 FTS)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	NV	757124-72-4
	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NV	27619-97-2
	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NV	39108-34-4
	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	NV	120226-60-0

3. Results and Discussion

3.1. Area Density of Gloves, Hoods, and Wildland Textiles

Table 1 lists area densities for all firefighter glove layers, hood textiles, and wildland firefighter gear textiles examined here. The area densities were measured in triplicate as mass per unit area using approximately 2 cm x 2 cm cut squares of textiles. Gloves layer textile area densities varied from 0.078 kg/m^2 ± 0.001 kg/m^2 (GL-B-MB) to 1.15 kg/m^2 ± 0.03 kg/m^2 (GL-B-OS), hood area densities varied from 0.195 kg/m^2 ± 0.005 kg/m^2 (HD-E) to 0.30 kg/m^2 ± 0.01 kg/m^2 (HD-G), while wildland firefighter gear textiles had area densities from 0.179 kg/m^2 ± 0.003 kg/m^2 (WL-H) to 0.266 kg/m^2 ± 0.009 kg/m^2 (WL-C).

3.2. PFAS Occurrence and Concentrations in Firefighter Gloves Textiles

Across 15 layers from four glove models, 12 individual PFAS were quantified above the analyte- and sample-specific reporting limits, with between zero and seven PFAS quantified in each textile (**Fig. 2** and **Table 3** – **Table 17**). FASA was frequently quantified, with perfluorobutane sulfonamide (FBSA), *N*-methyl perfluorobutane sulfonamide (MeFBSA), and perfluorooctane sulfonamide (FOSA) being observed above reporting limits in 12, 7, and 2 textiles, respectively. Also widely detected, perfluorobutanoic acid (PFBA) was observed in 8 textiles, and perfluorobutane sulfonic acid (PFBS) was observed in 10 textiles.

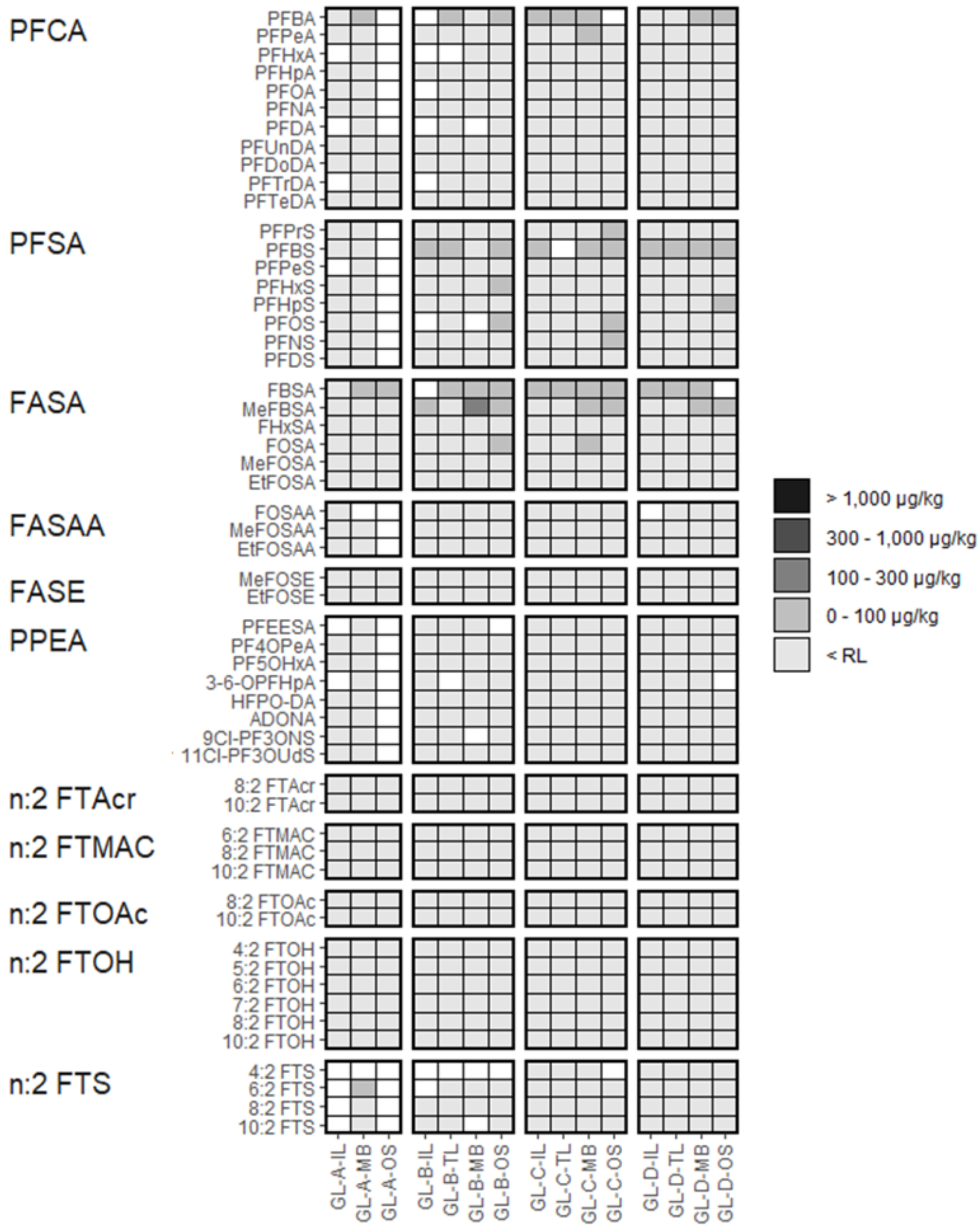


Fig. 2. Average PFAS concentrations (µg PFAS/kg textile or ppb mass ratio) determined from triplicate analysis of individual firefighter glove layers (GL = glove, IL = inner liner, TL = thermal liner, MB = moisture barrier, OS = outer shell). Measurements that could not be reported due to unmet QC standards are in white.

The highest individual PFAS concentrations observed in any glove layer were the FASAs in the moisture barrier layers with MeFBSA present up to 117.2 µg/kg ± 7.0 µg/kg (mean ± standard deviation of triplicate measurements; GL-B-MB; **Table 7**), FBSA up to 51.2 µg/kg ± 6.7 µg/kg (GL-C-MB; **Table 11**), and FBSA up to 68 µg/kg ± 13 µg/kg (GL-D-MB; **Table 15**). Summed PFAS concentrations varied widely across glove layers from no PFAS detected in GL-A1-IL (**Fig. 3** and **Table 3**) to 118.9 µg/kg ± 7.1 µg/kg in GL-B-MB (**Fig. 3** and **Table 7**). The highest summed PFAS concentrations across all glove layers were also observed in the moisture barrier layers, with summed concentrations up to 118.9 µg/kg ± 7.1 µg/kg (GL-B-MD; **Fig. 3 and Table 7**). The wide range in summed PFAS concentrations across moisture barrier textiles derived from the variation in concentration of FASAs (**Fig. 3,** other category), with FBSA and MeFBSA concentrations contributing up to 100 % of PFAS observed in moisture barrier textiles.

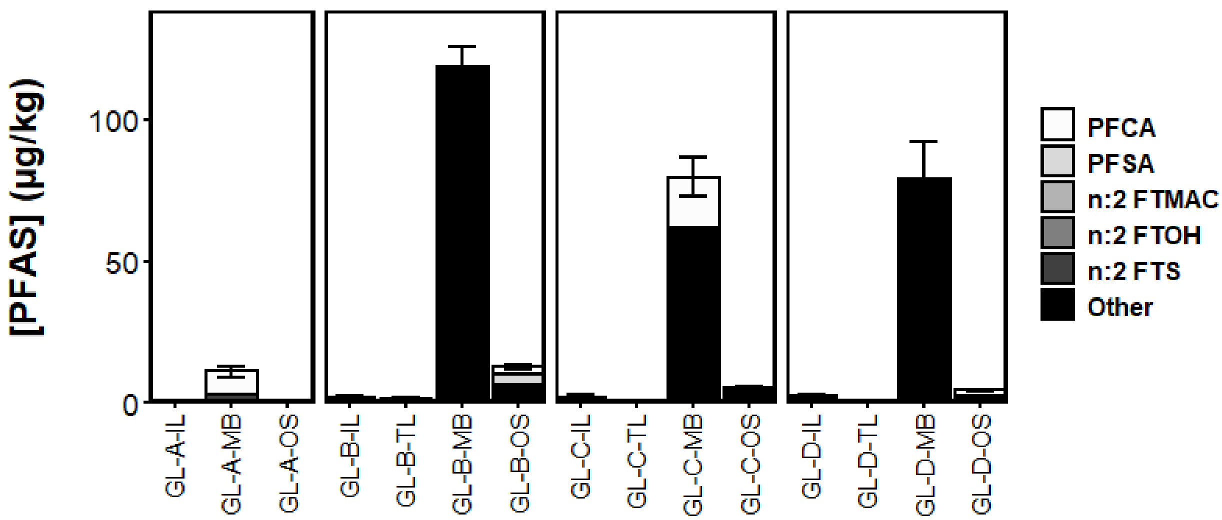


Fig. 3. Summed PFAS concentrations in individual firefighter glove layers (GL = glove, IL = inner liner, TL = thermal liner, MB = moisture barrier, OS = outer shell). Error bars indicate the combined standard uncertainty of the summed PFAS concentrations. The bar color indicates the PFAS class.

3.3. PFAS Occurrence and Concentrations in Firefighter Hoods Textiles

Across all eight firefighter hoods, only five individual PFAS were quantified above the analyte- and sample-specific reporting limits, with between zero and three individual PFAS quantified in each hood textile (**Fig. 4** and **Table 18** -**Table 25**). PFOS was detected in three hoods at concentrations up to 0.15 µg/kg ± 0.07 µg/kg (HD-B; **Table 19)**, while FOSA, PFBS, PFOA, and perfluorotetradacanoic acid (PFTeDA) were each detected above reporting limits in one or two hood textiles. Summed PFAS concentrations were below 0.6 µg/kg in all hoods. PFSAs were most widely quantified; PFBS and PFOS were observed in one and three textiles, respectively. PFCAs were widely quantified, with PFOA and PFTeDA observed in one and two textiles, respectively. FOSA was also observed in one textile.

The highest individual concentrations observed for any hood were PFCAs, including PFOA (up to 0.3 µg/kg ± 0.1 µg/kg; HD-B; **Table 19**), PFTeDA (up to 0.10 µg/kg ± 0.05 µg/kg; HD-C; **Table 20**), and PFTeDA (up to 0.08 µg/kg ± 0.01 µg/kg; HD-H; **Table 25**). The other highest individual concentrations were PFSAs, including PFBS (up to 0.13 µg/kg ± 0.07 µg/kg; HD-A; **Table 18**) and PFOS (up to 0.15 µg/kg ± 0.07 µg/kg; HD-B; **Table 19)**. Summed PFAS concentrations varied across hoods from no PFAS detected in hoods HD-D, HD-E, HD-F, and HD-G (**Fig. 5** and **Table 21** to **Table 24**), to 0.6 µg/kg ± 0.1 µg/kg in HD-B (**Fig. 5** and **Table 19**). Compared to the glove layers, the PFAS concentrations were low in the hoods, and no volatile PFAS was detected above reporting limits. The range in summed PFAS concentrations derived from the variation in the PFCA or PFSA classes, with 100 % of the PFAS detected above reporting limits occurring from these two PFAS classes, except HD-B, in which FOSA was also detected.

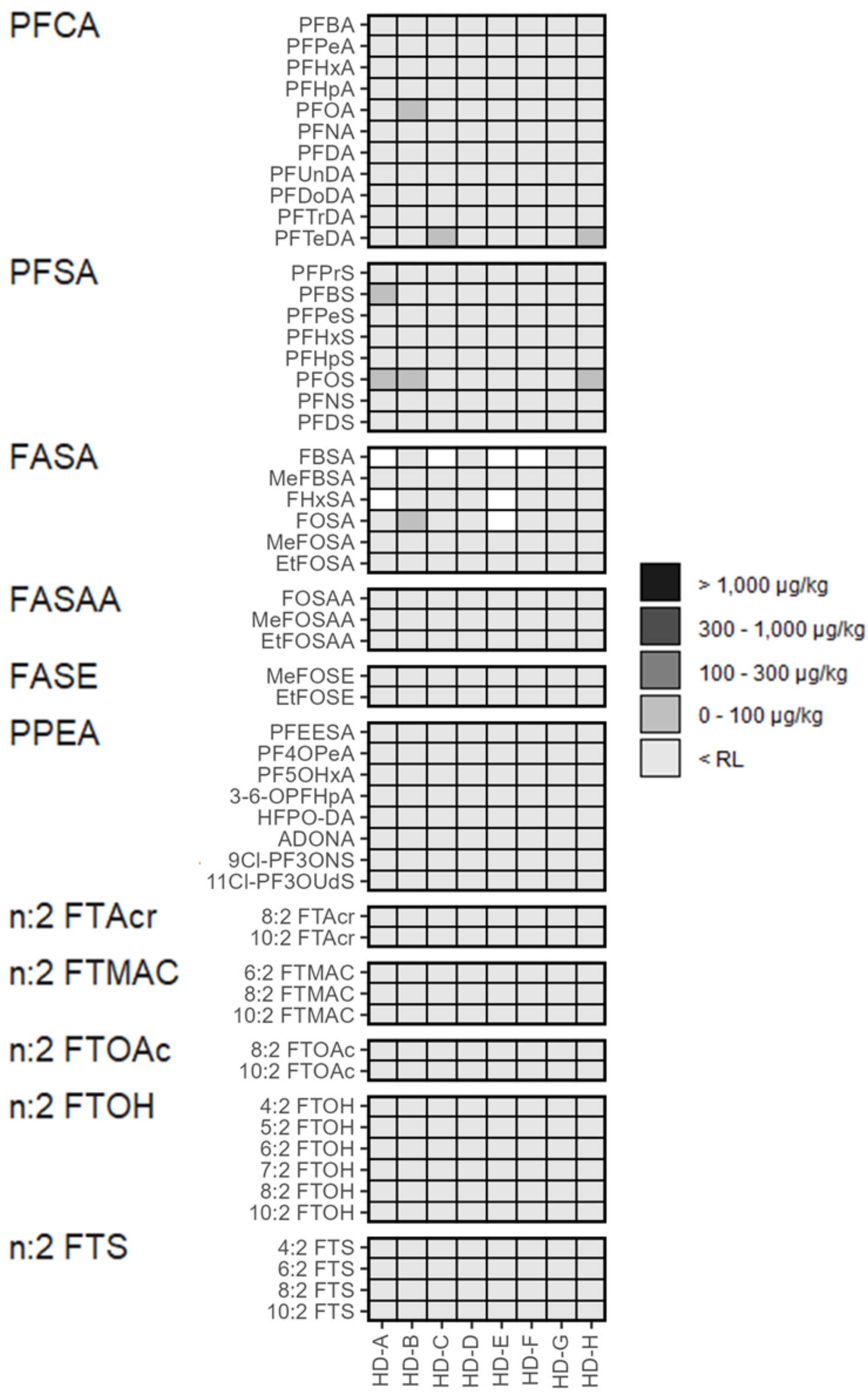


Fig. 4. Average PFAS concentrations (µg PFAS/kg textile or ppb mass ratio) determined from triplicate analysis of individual firefighter hood textiles. The average concentration is indicated by shade (legend at right). Measurements that could not be reported due to unmet QC standards are in white.

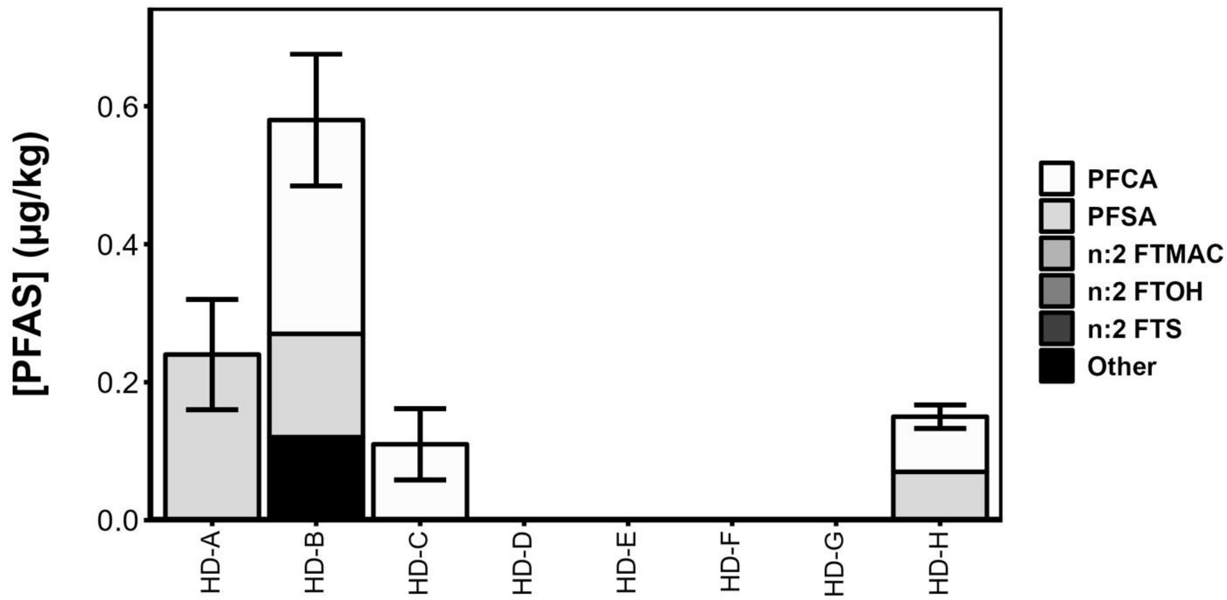


Fig. 5. Summed PFAS concentrations in individual firefighter hoods (HD = hood). Error bars indicate the combined standard uncertainty of the summed PFAS concentrations. The bar color indicates the PFAS class.

3.4. PFAS Occurrence and Concentrations in Wildland Gear Textiles

Across all nine wildland gear textiles, 11 individual PFAS were quantified above the analyte and sample-specific reporting limits, between zero and nine PFAS, quantified in each (**Fig. 6** and **Table 26** – **Table 33**). PFCAs, especially those with short perfluorinated chains (i.e., containing seven or fewer perfluorinated carbons) were frequently quantified, with PFBA, perfluoropentanoic acid (PFPeA), perfluorohexanoic acid (PFHxA), and perfluoroheptanoic acid (PFHpA) observed in 3, 6, 6, and 4 textiles, respectively. Also detected were 6:2 FTMAC and 6:2 FTOH; both were detected in 5 textiles, as well as 6:2 fluorotelomer sulfonic acid (6:2 FTS; 2 textiles), PFBS; 1 textile, perfluoropentane sulfonic acid (PFPeS; 1 textile), PFOS; 1 textile, and perfluorononane sulfonic acid (PFNS; 1 textile).

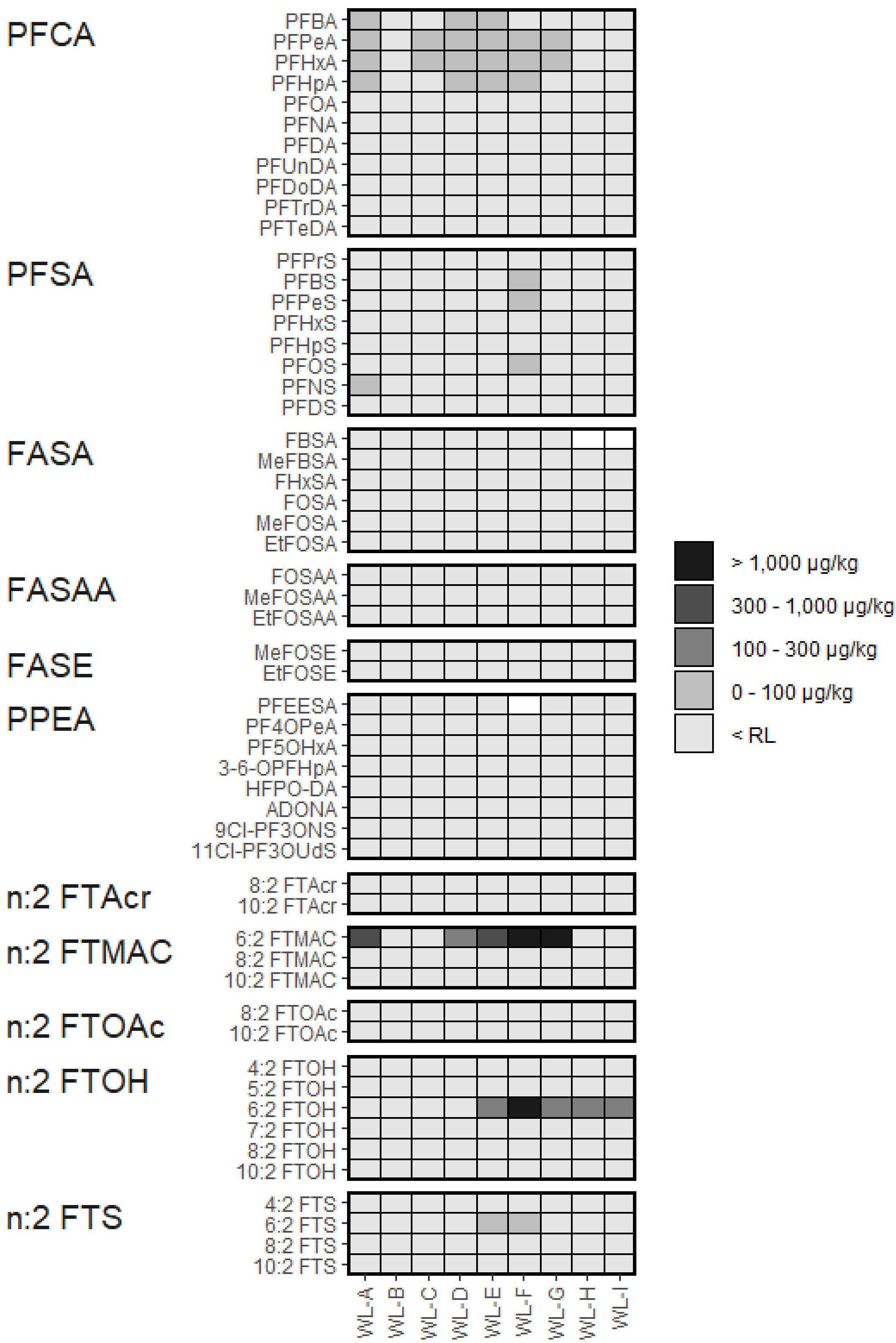


Fig. 6. Average PFAS concentrations (µg PFAS/kg textile or ppb mass ratio) determined from triplicate analysis of individual wildland firefighter gear textiles. The average concentration is indicated by shade (legend at right). Measurements that could not be reported due to unmet QC standards are in white.

The highest individual concentrations observed for any of the wildland gear textiles were in the fluorotelomerization (FT)-derived PFAS in WL-F, with 6:2 FTMAC concentration up to 2980 µg/kg ± 820 µg/kg (**Table 31**) and 6:2 FTOH concentration up to 1250 µg/kg ± 330 µg/kg (**Table 31**). Summed PFAS concentrations varied across wildland textiles from no PFAS detected in WL-B (**Fig. 7** and **Table 27**) to 4240 µg/kg ± 890 µg/kg in WL-F (**Fig. 7** and **Table 31**). Compared to the glove layers and hood textiles, summed PFAS concentrations were much higher in the wildland firefighter gear textiles. The range in summed PFAS concentrations derived from the variation in the FT-derived classes, with 6:2 FTMAC and 6:2 FTOH concentrations contributing over 95 % of the total summed PFAS in seven of the nine wildland firefighter gear textiles.

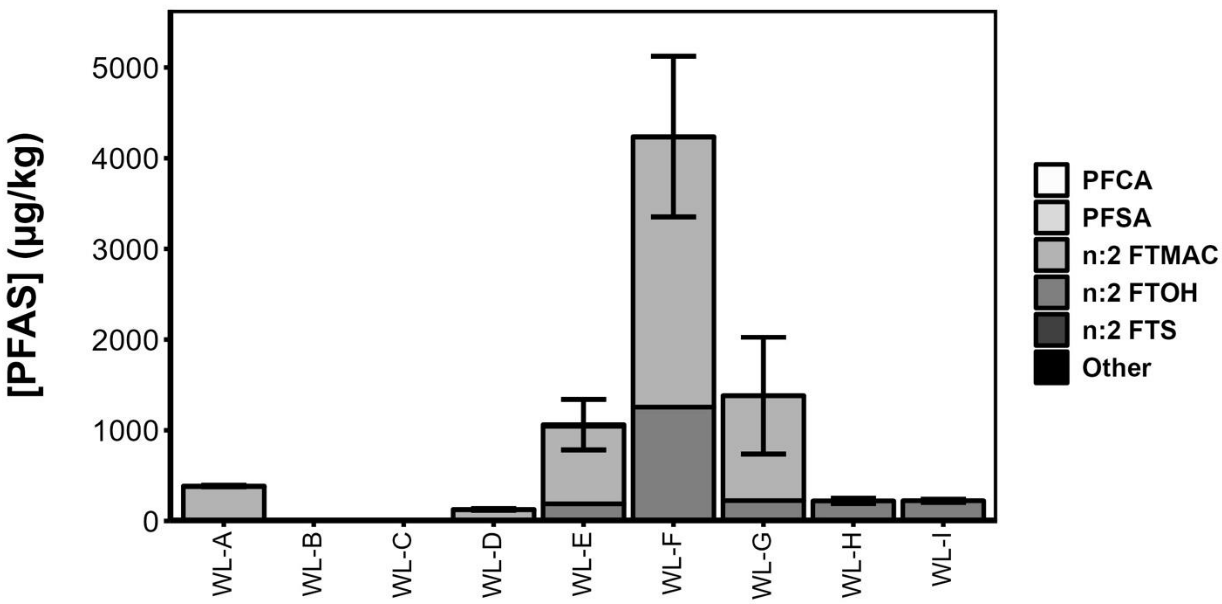


Fig. 7. Summed PFAS concentrations in individual wildland textiles (WL = wildland). Error bars indicate the combined standard uncertainty of the summed PFAS concentrations. The bar color indicates the PFAS class.

3.5. Summed PFAS Occurrence and Concentration Comparisons

In this report, PFAS concentrations in gloves, hoods, and wildland textiles are similar to PFAS concentrations previously reported in turnout gear jackets and pants textiles in a recent NIST report (**Fig. 8**) [21]. The highest summed PFAS concentrations Maizel et al. [21] reported in firefighter turnout gear outer shell and moisture barrier textiles were 1890 µg/kg ± 180 µg/kg and 1865 µg/kg ± 88 µg/kg, respectively. These measurements are lower than the summed PFAS concentrations reported here in wildland firefighter gear, with summed PFAS concentrations up to 4240 µg/kg ± 890 µg/kg, while the summed PFAS concentrations reported here in textiles present in gloves and hoods are much lower, with concentrations up to 118.9 µg/kg ± 7.1 µg/kg and 0.6 µg/kg ± 0.1 µg/kg, respectively. The highest concentration of individual PFAS in firefighter turnout gear textiles reported by Maizel et al. [21] was 6:2 FTMAC, present at concentrations up to 1520 µg/kg ± 130 µg/kg in an outer shell textile. While 6:2 FTMAC was not observed above reporting limits in firefighter gloves or hoods examined here, 6:2 FTMAC was observed in wildland firefighter gear at concentrations up to 2980 µg/kg ± 820 µg/kg. Similarly, the second highest concentration of individual PFAS in turnout gear Maizel et al. [21] reported was 6:2 FTOH, present in the outer shells up to 393 µg/kg ± 98 µg/kg. These measurements are lower than the 6:2 FTOH concentrations reported here in wildland firefighter gear, where 6:2 FTOH was present at concentrations up to 1250 µg/kg ± 330 µg/kg.

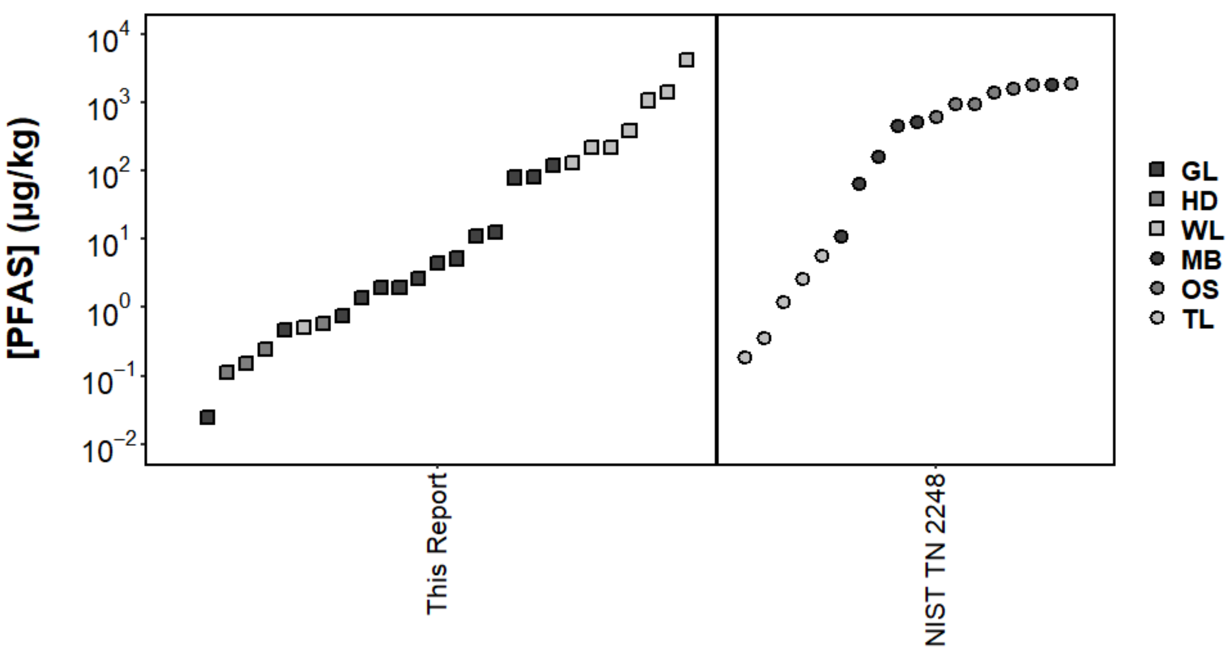


Fig. 8. Summed PFAS concentrations in individual firefighter gloves, hoods, and wildland textiles and from a previous report on structural firefighter jackets and pants [21]. Each report's measurements are ordered from left to right in increasing summed concentrations. The marker shade indicates the textile type (GL = glove, HD = hood, WL = wildland, MB = moisture barrier, OS = outer shell, TL = thermal liner).

6:2 FTMAC and 6:2 FTOH are intermediates in the production of side-chain fluorinated acrylate polymers [27]-[28] and have been previously identified in turnout gear textiles [18]-[19], [21][22]. 6:2 FTOH is also found in fast food packaging and stain- and water-resistant textiles

[29]. Anand et al. [30] performed a toxicological assessment of 6:2 FTMAC and found that, overall, 6:2 FTMAC is considered to have low toxicity potential. Rice et al. [29] compared the toxicological databases for 6:2 FTOH and PFHxA. They found that 6:2 FTOH is significantly more toxic than PFHxA, and 6:2 FTOH may be significantly underestimated as a human health risk. 6:2 FTMAC or 6:2 FTOH were detected above reporting limits in seven of the nine wildland firefighter textiles, but none in the hoods or gloves. These FT-derived PFAS in wildland textiles may indicate that these textiles were treated with side-chain fluorinated polymers. Fluorotelomerization-derived PFAS with more or less than six perfluorinated carbons were not detected in any other textile tested in this report, with only 6:2 FTS quantified in WL-E, WL-F, and GL-A-MB at concentrations up to 6.02 µg/kg ± 0.19 µg/kg.

PFBS, FBSA, and MeFBSA are all electrochemical fluorination-derived PFAS [27],[31] with four perfluorinated carbons. Rericha et al. [32] studied zebrafish to compare the toxicity of PFBS, PFPeA, FBSA, and 4:2 FTS (all containing four perfluorinated carbons). They concluded that FBSA was the most developmentally toxic and bioaccumulative, as well as inducing transcriptional changes that preceded morphological effects. In this report, PFBS, FBSA, and MeFBSA were each present above the reporting limits in 10, 12, and 7 glove layers, respectively, and were observed in the highest concentrations in the moisture barrier layers of gloves (i.e., 51.2 µg/kg ± 6.7 µg/kg, 68 µg/kg ±13 µg/kg and 117.2 µg/kg ± 7.0 µg/kg in GL-B-MB, GL-C-MB, and GL-D-MB), which may indicate that these glove layers are treated with similar durable water repellents treatments. Short-chain PFSAs are also used in water and stain-repellent treatments; for example, PFBS replaced PFOS as the active ingredient in a leading durable water-repellent fabric treatment in 2003 [28], but there are current efforts to discontinue the use of PFAS in manufacturing across products [33]. FASAs are raw materials for various fluorochemical products, including surface protection products [27]. PFBS and MeFBSE gave the highest observed PFAS concentrations in two recent investigations of PFAS in firefighter turnout gear [2],[18].

While no individual PFCA was identified in this NIST TN above 10 µg/kg in any textile, PFCAs were widely detected, with at least one quantified above the reporting limit in 17 textiles tested in this study. This agrees with two previous studies of PFCA concentrations in firefighter turnout gear that reported the near-universal quantification of short-chain PFCAs and occasional detection of PFCAs with up to 13 perfluorinated carbons, though all at individual concentrations below 40 µg/kg [2],[18],[21]. The omnipresence of low concentrations of PFCAs may reflect their use as fluoropolymer processing aids [27]. PFBA was the most widely observed PFCA and was present in 11 of the 17 textiles where PFCAs were identified. Weatherly et al. [34] analyzed serum chemistries, histology, immune phenotyping, and gene expression to evaluate the systemic toxicity of sub-chronic dermal PFBA, and results showed sustained dermal exposure to PFBA induces liver toxicity and alterations of PPAR target genes. PPEAs, replacement polymer processing aids for PFCAs, were not present above reporting limits in any textile (**Figs. 2, 4, and 6**), which agrees with another recent examination of PFAS in firefighter gear that measured none of the four PPEAs above reporting limits in any examined turnout gear layer [18],[21].

The significant variation in summed PFAS concentrations among gloves, hoods, and wildland textiles suggests that the amount of PFAS in unused gear varies according to the textiles used in manufacturing that gear (**Figs. 3, 5, and 7**). For example, a glove that contained the same mass of each textile layer would have almost ten times as much summed mass of the PFAS reported here if it were constructed of GL-B-MB, GL-B-OS, GL-D-TL, and GL-D-IL compared with a similar glove constructed of GL-A-MB, GL-A-OS, GL-B-TL, and GL-A-IL. As all gloves, hoods, and wildland textiles examined here met NPFA standards, this finding suggests that the amount of PFAS present in unused gear might, in some cases, be lowered through the choice of commercially available textiles. While the summed PFAS concentrations in some moisture barriers in gloves approached 200 µg/kg, all thermal and inner liners textiles in the gloves had summed PFAS concentrations under 5 µg/kg. The low summed PFAS concentrations likely reflect the lack of fluorinated polymer treatments in thermal and inner liners in gloves that are not subject to moisture-repellency standards. The fact that thermal and inner liners are the closest layers to firefighter skin in finished structural firefighter gloves could imply lower dermal PFAS exposure to firefighters than would be assumed by summing the PFAS present in all layers. However, other studies have found similar PFAS concentrations in structural firefighter turnout gear thermal liners as in other turnout gear textiles [2], and the results presented here may be specific to the PFAS and textiles examined in this study.

4. Summary

This study utilized a targeted analytical approach to quantify 55 nonvolatile, semivolatile, and volatile PFAS across 15 individual layers from four unused firefighter glove models, eight unused firefighter hoods, and nine unused articles of wildland firefighting gear. Two extraction protocols were applied to maximize the recovery of targeted PFAS while minimizing the potential degradation of other polymer and non-polymer PFAS. Nonvolatile and semivolatile PFAS were quantified with separate HPLC-MS/MS methods, while volatile PFAS were quantified with GC-MS.

Of the 55 PFAS examined, 36 were quantified below reporting limits in all analyzed textiles, while the remaining 19 were each quantified in between 1 and 25 textiles. 6:2 FTMAC and 6:2 FTOH were present in the highest observed PFAS concentrations, though they were only present above reporting limits in 7 of the wildland gear textiles and none of the hood textiles or glove layers. Summed PFAS concentrations were highest in wildland gear textiles, followed by the moisture barrier layers in the gloves, and lowest in the hoods. Additionally, PFAS concentrations were higher in the moisture barrier layers of the gloves than in any of the other glove layers (outer shell, thermal liner, or inner liner).

This study adds to a growing body of literature examining PFAS concentrations in structural firefighting turnout gear, including textiles in gloves, hoods, and wildland gear. While this and other studies examined different textiles and utilized dissimilar analytical methods, each provided unique insight into the occurrence of PFAS in turnout gear. However, since this study used the same analytical methods outlined in NIST TN 2248 [21] and NIST TN 2260 [22], direct comparisons of PFAS concentrations can be concluded. Additional research on PFAS in used turnout gear, PFAS transport between gear layers or into firefighters, and the occupational hazards firefighters face are critical to understanding the potential PFAS exposure firefighters face.

5. Future Work

Future work will examine the effect of typical use on the types and concentrations of PFAS in stressed textiles present in structural firefighter gloves, hoods, and wildland gear, as higher PFAS concentrations have been observed in stressed textiles present in firefighter gear compared with unused firefighter gear textiles [22]. Stressing of the gear will include elevated temperatures, abrasion, and accelerated weathering. Additionally, future efforts will use high-resolution mass spectrometry to identify a broader swath of PFAS than the 55 compounds quantified here, including screening for previously identified compounds and searching for novel non-targeted PFAS. Other potential sources of PFAS exposure to firefighters will also be evaluated, including multiple stressing of unused firefighter gear and dust or soot collected from fire stations. Finally, to better relate the measurements made here with the actual PFAS exposure to firefighters, the capacity of simulated sweat to extract PFAS from firefighter turnout gear will be evaluated.

Table 3. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-A-IL. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.220
PFPeA	<RL	0.042
PFHxA	No Value	
PFHpA	<RL	0.064
PFOA	<RL	0.109
PFNA	<RL	0.042
PFDA	No Value	
PFUnDA	<RL	0.063
PFDoDA	<RL	0.078
PFTrDA	No Value	
PFTeDA	<RL	0.137
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	<RL	0.035
PFPeS	No Value	
PFHxS	<RL	0.038
PFHpS	<RL	0.040
PFOS	<RL	0.080
PFNS	<RL	0.040
PFDS	<RL	0.105
FASA (NV, SV)		
FBSA (NV)	<RL	0.020
MeFBSA (SV)	<RL	0.638
FHxSA (NV)	<RL	0.020
FOSA (NV)	<RL	0.026
MeFOSA (SV)	<RL	0.607
EtFOSA (SV)	<RL	0.456
FASAA (NV)		
FOSAA	<RL	0.226
MeFOSAA	<RL	0.220
EtFOSAA	<RL	0.220
FASE (SV)		
MeFOSE	<RL	0.259
EtFOSE	<RL	0.579

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	No Value	
PF4OPeA	<RL	0.043
PF5OHxA	<RL	0.036
3-6-OPFHpA	No Value	
HFPO-DA	<RL	0.109
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.039
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	58.0
10:2 FTAcr	<RL	56.0
n:2 FTMAC (V)		
6:2 FTMAC	<RL	198
8:2 FTMAC	<RL	203
10:2 FTMAC	<RL	107
n:2 FTOAc (V)		
8:2 FTOAc	<RL	56.5
10:2 FTOAc	<RL	58.2
n:2 FTOH (V)		
4:2 FTOH	<RL	119
5:2 FTOH	<RL	113
6:2 FTOH	<RL	56.6
7:2 FTOH	<RL	56.0
8:2 FTOH	<RL	111
10:2 FTOH	<RL	113
n:2 FTS (NV)		
4:2 FTS	No Value	
6:2 FTS	No Value	
8:2 FTS	No Value	
10:2 FTS	No Value	

Table 4. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-A-MB. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	8.32 ± 0.67	0.206
PFPeA	<RL	0.039
PFHxA	<RL	0.352
PFHpA	<RL	0.060
PFOA	<RL	0.102
PFNA	<RL	0.039
PFDA	<RL	0.102
PFUnDA	<RL	0.059
PFDoDA	<RL	0.073
PFTrDA	<RL	0.079
PFTeDA	<RL	0.128
PFSA (NV)		
PFPrS	<RL	0.018
PFBS	<RL	0.033
PFPeS	<RL	0.024
PFHxS	<RL	0.036
PFHpS	<RL	0.037
PFOS	<RL	0.075
PFNS	<RL	0.038
PFDS	<RL	0.099
FASA (NV, SV)		
FBSA (NV)	0.111 ± 0.025	0.019
MeFBSA (SV)	<RL	0.843
FHxSA (NV)	<RL	0.019
FOSA (NV)	<RL	0.025
MeFOSA (SV)	<RL	0.803
EtFOSA (SV)	<RL	0.603
FASAA (NV)		
FOSAA		
MeFOSAA	<RL	0.206
EtFOSAA	<RL	0.206
FASE (SV)		
MeFOSE	<RL	0.342
EtFOSE	<RL	0.766

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.021
PF4OPeA	<RL	0.040
PF5OHxA	<RL	0.034
3-6-OPFHpA	<RL	0.043
HFPO-DA	<RL	0.102
ADONA	<RL	0.018
9Cl-PF3ONS	<RL	0.037
11Cl-PF3OUdS	<RL	0.018
n:2 FTAcr (V)		
8:2 FTAcr	<RL	76.5
10:2 FTAcr	<RL	73.9
n:2 FTMAC (V)		
6:2 FTMAC	<RL	262
8:2 FTMAC	<RL	268
10:2 FTMAC	<RL	141
n:2 FTOAc (V)		
8:2 FTOAc	<RL	74.5
10:2 FTOAc	<RL	76.9
n:2 FTOH (V)		
4:2 FTOH	<RL	157
5:2 FTOH	<RL	149
6:2 FTOH	<RL	74.7
7:2 FTOH	<RL	73.8
8:2 FTOH	<RL	147
10:2 FTOH	<RL	149
n:2 FTS (NV)		
4:2 FTS		
6:2 FTS	2.7 ± 1.7	0.196
8:2 FTS	<RL	0.392
10:2 FTS	<RL	0.204

Table 5. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-A-OS. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	No Value	
PFPeA	No Value	
PFHxA	No Value	
PFHpA	No Value	
PFOA	No Value	
PFNA	No Value	
PFDA	No Value	
PFUnDA	<RL	0.066
PFDoDA	<RL	0.081
PFTrDA	<RL	0.088
PFTeDA	<RL	0.142
PFSA (NV)		
PFPrS	No Value	
PFBS	No Value	
PFPeS	No Value	
PFHxS	No Value	
PFHpS	No Value	
PFOS	No Value	
PFNS	No Value	
PFDS	No Value	
FASA (NV, SV)		
FBSA (NV)	0.0242 ± 0.0025	0.021
MeFBSA (SV)	<RL	0.445
FHxSA (NV)	<RL	0.021
FOSA (NV)	<RL	0.027
MeFOSA (SV)	<RL	0.424
EtFOSA (SV)	<RL	0.318
FASAA (NV)		
FOSAA	No Value	
MeFOSAA	No Value	
EtFOSAA	No Value	
FASE (SV)		
MeFOSE	<RL	0.181
EtFOSE	<RL	0.404

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	No Value	
PF4OPeA	No Value	
PF5OHxA	No Value	
3-6-OPFHpA	No Value	
HFPO-DA	No Value	
ADONA	No Value	
9Cl-PF3ONS	No Value	
11Cl-PF3OUdS	No Value	
n:2 FTAcr (V)		
8:2 FTAcr	<RL	40.3
10:2 FTAcr	<RL	38.9
n:2 FTMAC (V)		
6:2 FTMAC	<RL	138
8:2 FTMAC	<RL	141
10:2 FTMAC	<RL	74.4
n:2 FTOAc (V)		
8:2 FTOAc	<RL	39.3
10:2 FTOAc	<RL	40.5
n:2 FTOH (V)		
4:2 FTOH	<RL	82.6
5:2 FTOH	<RL	78.6
6:2 FTOH	<RL	39.3
7:2 FTOH	<RL	38.9
8:2 FTOH	<RL	77.4
10:2 FTOH	<RL	78.6
n:2 FTS (NV)		
4:2 FTS	No Value	
6:2 FTS	No Value	
8:2 FTS	No Value	
10:2 FTS	No Value	

Table 6. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-B-IL. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	No Value	
PFPeA	<RL	0.042
PFHxA	No Value	
PFHpA	<RL	0.065
PFOA	No Value	
PFNA	<RL	0.042
PFDA	No Value	
PFUnDA	<RL	0.064
PFDoDA	<RL	0.079
PFTrDA	No Value	
PFTeDA	<RL	0.137
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	0.0421 ± 0.0055	0.035
PFPeS	<RL	0.025
PFHxS	<RL	0.039
PFHpS	<RL	0.040
PFOS	No Value	NA
PFNS	<RL	0.041
PFDS	<RL	0.106
FASA (NV, SV)		
FBSA (NV)	No Value	
MeFBSA (SV)	1.94 ± 0.17	0.631
FHxSA (NV)	<RL	0.021
FOSA (NV)	<RL	0.026
MeFOSA (SV)	<RL	0.601
EtFOSA (SV)	<RL	0.451
FASAA (NV)		
FOSAA	<RL	0.227
MeFOSAA	<RL	0.221
EtFOSAA	<RL	0.221
FASE (SV)		
MeFOSE	<RL	0.256
EtFOSE	<RL	0.573

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.023
PF4OPeA	<RL	0.043
PF5OHxA	<RL	0.036
3-6-OPFHpA	<RL	0.046
HFPO-DA	<RL	0.110
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.039
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	57.1
10:2 FTAcr	<RL	55.1
n:2 FTMAC (V)		
6:2 FTMAC	<RL	195
8:2 FTMAC	<RL	200
10:2 FTMAC	<RL	105
n:2 FTOAc (V)		
8:2 FTOAc	<RL	55.6
10:2 FTOAc	<RL	57.3
n:2 FTOH (V)		
4:2 FTOH	<RL	117
5:2 FTOH	<RL	111
6:2 FTOH	<RL	55.7
7:2 FTOH	<RL	55.1
8:2 FTOH	<RL	110
10:2 FTOH	<RL	111
n:2 FTS (NV)		
4:2 FTS	No Value	
6:2 FTS	No Value	
8:2 FTS	<RL	0.421
10:2 FTS	<RL	0.219

Table 7. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-B-MB. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.224
PFPeA	<RL	0.043
PFHxA	<RL	0.382
PFHpA	<RL	0.065
PFOA	<RL	0.111
PFNA	<RL	0.043
PFDA	No Value	
PFUnDA	<RL	0.064
PFDoDA	<RL	0.080
PFTrDA	<RL	0.086
PFTeDA	<RL	0.139
PFSA (NV)		
PFPrS	<RL	0.020
PFBS	<RL	0.036
PFPeS	<RL	0.026
PFHxS	<RL	0.039
PFHpS	<RL	0.041
PFOS	No Value	
PFNS	<RL	0.041
PFDS	<RL	0.107
FASA (NV, SV)		
FBSA (NV)	1.7 ± 1.2	0.021
MeFBSA (SV)	117.2 ± 7.0	0.870
FHxSA (NV)	<RL	0.021
FOSA (NV)	<RL	0.027
MeFOSA (SV)	<RL	0.828
EtFOSA (SV)	<RL	0.622
FASAA (NV)		
FOSAA	<RL	0.230
MeFOSAA	<RL	0.224
EtFOSAA	<RL	0.224
FASE (SV)		
MeFOSE	<RL	0.353
EtFOSE	<RL	0.790

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.023
PF4OPeA	<RL	0.043
PF5OHxA	<RL	0.036
3-6-OPFHpA	<RL	0.046
HFPO-DA	<RL	0.111
ADONA	<RL	0.020
9Cl-PF3ONS	No Value	
11Cl-PF3OUdS	<RL	0.020
n:2 FTAcr (V)		
8:2 FTAcr	<RL	78.8
10:2 FTAcr	<RL	76.1
n:2 FTMAC (V)		
6:2 FTMAC	<RL	270
8:2 FTMAC	<RL	276
10:2 FTMAC	<RL	145
n:2 FTOAc (V)		
8:2 FTOAc	<RL	76.8
10:2 FTOAc	<RL	79.2
n:2 FTOH (V)		
4:2 FTOH	<RL	161
5:2 FTOH	<RL	154
6:2 FTOH	<RL	76.9
7:2 FTOH	<RL	76.0
8:2 FTOH	<RL	151
10:2 FTOH	<RL	154
n:2 FTS (NV)		
4:2 FTS	No Value	
6:2 FTS	<RL	0.213
8:2 FTS	<RL	0.425
10:2 FTS	No Value	

Table 8. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-B-TL. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	0.28 ± 0.01	0.222
PFPeA	<RL	0.042
PFHxA	No Value	
PFHpA	<RL	0.065
PFOA	<RL	0.110
PFNA	<RL	0.042
PFDA	<RL	0.110
PFUnDA	<RL	0.064
PFDoDA	<RL	0.079
PFTrDA	<RL	0.085
PFTeDA	<RL	0.138
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	0.91 ± 0.63	0.035
PFPeS	<RL	0.025
PFHxS	<RL	0.039
PFHpS	<RL	0.040
PFOS	<RL	0.081
PFNS	<RL	0.041
PFDS	<RL	0.106
FASA (NV, SV)		
FBSA (NV)	0.168 ± 0.075	0.021
MeFBSA (SV)	<RL	0.675
FHxSA (NV)	<RL	0.021
FOSA (NV)	<RL	0.026
MeFOSA (SV)	<RL	0.643
EtFOSA (SV)	<RL	0.482
FASAA (NV)		
FOSAA	<RL	0.228
MeFOSAA	<RL	0.222
EtFOSAA	<RL	0.222
FASE (SV)		
MeFOSE	<RL	0.274
EtFOSE	<RL	0.613

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.023
PF4OPeA	<RL	0.043
PF5OHxA	<RL	0.036
3-6-OPFHpA	No Value	
HFPO-DA	<RL	0.110
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.039
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	61.3
10:2 FTAcr	<RL	59.1
n:2 FTMAC (V)		
6:2 FTMAC	<RL	210
8:2 FTMAC	<RL	214
10:2 FTMAC	<RL	113
n:2 FTOAc (V)		
8:2 FTOAc	<RL	59.7
10:2 FTOAc	<RL	61.5
n:2 FTOH (V)		
4:2 FTOH	<RL	125
5:2 FTOH	<RL	119
6:2 FTOH	<RL	59.8
7:2 FTOH	<RL	59.1
8:2 FTOH	<RL	118
10:2 FTOH	<RL	119
n:2 FTS (NV)		
4:2 FTS	No Value	
6:2 FTS	<RL	0.211
8:2 FTS	<RL	0.422
10:2 FTS	<RL	0.220

Table 9. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-B-OS. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	2.63 ± 0.48	0.217
PFPeA	<RL	0.041
PFHxA	<RL	0.371
PFHpA	<RL	0.063
PFOA	<RL	0.108
PFNA	<RL	0.041
PFDA	<RL	0.108
PFUnDA	<RL	0.063
PFDoDA	<RL	0.077
PFTrDA	<RL	0.084
PFTeDA	<RL	0.135
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	3.16 ± 0.28	0.035
PFPeS	<RL	0.025
PFHxS	0.0428 ± 0.0072	0.038
PFHpS	<RL	0.039
PFOS	0.3206 ± 0.0039	0.079
PFNS	<RL	0.040
PFDS	<RL	0.104
FASA (NV, SV)		
FBSA (NV)	1.63 ± 0.18	0.020
MeFBSA (SV)	4.62 ± 0.11	0.755
FHxSA (NV)	<RL	0.020
FOSA (NV)	0.166 ± 0.028	0.026
MeFOSA (SV)	<RL	0.719
EtFOSA (SV)	<RL	0.540
FASAA (NV)		
FOSAA	<RL	0.223
MeFOSAA	<RL	0.217
EtFOSAA	<RL	0.217
FASE (SV)		
MeFOSE	<RL	0.307
EtFOSE	<RL	0.686

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	No Value	
PF4OPeA	<RL	0.042
PF5OHxA	<RL	0.035
3-6-OPFHpA	<RL	0.045
HFPO-DA	<RL	0.108
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.039
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	68.3
10:2 FTAcr	<RL	65.9
n:2 FTMAC (V)		
6:2 FTMAC	<RL	234
8:2 FTMAC	<RL	239
10:2 FTMAC	<RL	126
n:2 FTOAc (V)		
8:2 FTOAc	<RL	66.5
10:2 FTOAc	<RL	68.6
n:2 FTOH (V)		
4:2 FTOH	<RL	140
5:2 FTOH	<RL	133
6:2 FTOH	<RL	66.6
7:2 FTOH	<RL	65.9
8:2 FTOH	<RL	131
10:2 FTOH	<RL	133
n:2 FTS (NV)		
4:2 FTS	No Value	
6:2 FTS	<RL	0.206
8:2 FTS	<RL	0.413
10:2 FTS	<RL	0.215

Table 10. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-C-IL. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile..

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	0.58 ± 0.35	0.228
PFPeA	<RL	0.043
PFHxA	<RL	0.390
PFHpA	<RL	0.067
PFOA	<RL	0.113
PFNA	<RL	0.043
PFDA	<RL	0.113
PFUnDA	<RL	0.066
PFDoDA	<RL	0.081
PFTrDA	<RL	0.088
PFTeDA	<RL	0.142
PFSA (NV)		
PFPrS	<RL	0.020
PFBS	0.84 ± 0.71	0.036
PFPeS	<RL	0.026
PFHxS	<RL	0.040
PFHpS	<RL	0.041
PFOS	<RL	0.083
PFNS	<RL	0.042
PFDS	<RL	0.109
FASA (NV, SV)		
FBSA (NV)	0.52 ± 0.12	0.021
MeFBSA (SV)	<RL	0.584
FHxSA (NV)	<RL	0.021
FOSA (NV)	<RL	0.027
MeFOSA (SV)	<RL	0.556
EtFOSA (SV)	<RL	0.417
FASAA (NV)		
FOSAA	<RL	0.234
MeFOSAA	<RL	0.228
EtFOSAA	<RL	0.228
FASE (SV)		
MeFOSE	<RL	0.237
EtFOSE	<RL	0.530

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.023
PF4OPeA	<RL	0.044
PF5OHxA	<RL	0.037
3-6-OPFHpA	<RL	0.047
HFPO-DA	<RL	0.113
ADONA	<RL	0.020
9Cl-PF3ONS	<RL	0.041
11Cl-PF3OUdS	<RL	0.020
n:2 FTAcr (V)		
8:2 FTAcr	<RL	52.9
10:2 FTAcr	<RL	51.1
n:2 FTMAC (V)		
6:2 FTMAC	<RL	181
8:2 FTMAC	<RL	185
10:2 FTMAC	<RL	97.6
n:2 FTOAc (V)		
8:2 FTOAc	<RL	51.5
10:2 FTOAc	<RL	53.1
n:2 FTOH (V)		
4:2 FTOH	<RL	108
5:2 FTOH	<RL	103
6:2 FTOH	<RL	51.6
7:2 FTOH	<RL	51.0
8:2 FTOH	<RL	102
10:2 FTOH	<RL	103
n:2 FTS (NV)		
4:2 FTS	<RL	0.214
6:2 FTS	<RL	0.217
8:2 FTS	<RL	0.434
10:2 FTS	<RL	0.226

Table 11. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-C-MB. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	17.6 ± 1.6	0.218
PFPeA	0.107 ± 0.038	0.042
PFHxA	<RL	0.373
PFHpA	<RL	0.064
PFOA	<RL	0.108
PFNA	<RL	0.042
PFDA	<RL	0.108
PFUnDA	<RL	0.063
PFDoDA	<RL	0.078
PFTrDA	<RL	0.084
PFTeDA	<RL	0.136
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	1.48 ± 0.83	0.035
PFPeS	<RL	0.025
PFHxS	<RL	0.038
PFHpS	<RL	0.040
PFOS	<RL	0.079
PFNS	<RL	0.040
PFDS	<RL	0.104
FASA (NV, SV)		
FBSA (NV)	51.2 ± 6.7	0.020
MeFBSA (SV)	9.26 ± 0.41	0.761
FHxSA (NV)	<RL	0.020
FOSA (NV)	0.0375 ± 0.0062	0.026
MeFOSA (SV)	<RL	0.725
EtFOSA (SV)	<RL	0.544
FASAA (NV)		
FOSAA	<RL	0.224
MeFOSAA	<RL	0.218
EtFOSAA	<RL	0.218
FASE (SV)		
MeFOSE	<RL	0.309
EtFOSE	<RL	0.692

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.022
PF4OPeA	<RL	0.042
PF5OHxA	<RL	0.035
3-6-OPFHpA	<RL	0.045
HFPO-DA	<RL	0.108
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.039
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	69.1
10:2 FTAcr	<RL	66.7
n:2 FTMAC (V)		
6:2 FTMAC	<RL	237
8:2 FTMAC	<RL	242
10:2 FTMAC	<RL	128
n:2 FTOAc (V)		
8:2 FTOAc	<RL	67.3
10:2 FTOAc	<RL	69.4
n:2 FTOH (V)		
4:2 FTOH	<RL	142
5:2 FTOH	<RL	135
6:2 FTOH	<RL	67.5
7:2 FTOH	<RL	66.7
8:2 FTOH	<RL	133
10:2 FTOH	<RL	135
n:2 FTS (NV)		
4:2 FTS	<RL	0.204
6:2 FTS	<RL	0.208
8:2 FTS	<RL	0.415
10:2 FTS	<RL	0.216

Table 12. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-C-TL. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	0.37 ± 0.20	0.217
PFPeA	<RL	0.041
PFHxA	<RL	0.371
PFHpA	<RL	0.063
PFOA	<RL	0.108
PFNA	<RL	0.041
PFDA	<RL	0.108
PFUnDA	<RL	0.063
PFDoDA	<RL	0.077
PFTrDA	<RL	0.084
PFTeDA	<RL	0.135
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	No Value	
PFPeS	<RL	0.025
PFHxS	<RL	0.038
PFHpS	<RL	0.039
PFOS	<RL	0.079
PFNS	<RL	0.040
PFDS	<RL	0.104
FASA (NV, SV)		
FBSA (NV)	0.387 ± 0.099	0.020
MeFBSA (SV)	<RL	0.640
FHxSA (NV)	<RL	0.020
FOSA (NV)	<RL	0.026
MeFOSA (SV)	<RL	0.610
EtFOSA (SV)	<RL	0.458
FASAA (NV)		
FOSAA	<RL	0.223
MeFOSAA	<RL	0.217
EtFOSAA	<RL	0.217
FASE (SV)		
MeFOSE	<RL	0.260
EtFOSE	<RL	0.581

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.022
PF4OPeA	<RL	0.042
PF5OHxA	<RL	0.035
3-6-OPFHpA	<RL	0.045
HFPO-DA	<RL	0.108
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.039
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	58.1
10:2 FTAcr	<RL	56.1
n:2 FTMAC (V)		
6:2 FTMAC	<RL	199
8:2 FTMAC	<RL	203
10:2 FTMAC	<RL	107
n:2 FTOAc (V)		
8:2 FTOAc	<RL	56.6
10:2 FTOAc	<RL	58.3
n:2 FTOH (V)		
4:2 FTOH	<RL	119
5:2 FTOH	<RL	113
6:2 FTOH	<RL	56.7
7:2 FTOH	<RL	56.1
8:2 FTOH	<RL	112
10:2 FTOH	<RL	113
n:2 FTS (NV)		
4:2 FTS	<RL	0.204
6:2 FTS	<RL	0.207
8:2 FTS	<RL	0.413
10:2 FTS	<RL	0.215

Table 13. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-C-OS. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	No Value	
PFPeA	<RL	0.021
PFHxA	<RL	0.191
PFHpA	<RL	0.033
PFOA	<RL	0.055
PFNA	<RL	0.021
PFDA	<RL	0.055
PFUnDA	<RL	0.032
PFDoDA	<RL	0.040
PFTrDA	<RL	0.043
PFTeDA	<RL	0.069
PFSA (NV)		
PFPrS	0.0312 ± 0.0013	0.010
PFBS	0.400 ± 0.066	0.018
PFPeS	<RL	0.013
PFHxS	<RL	0.019
PFHpS	<RL	0.020
PFOS	0.181 ± 0.012	0.041
PFNS	0.119 ± 0.025	0.020
PFDS	<RL	0.053
FASA (NV, SV)		
FBSA (NV)	2.99 ± 0.31	0.010
MeFBSA (SV)	1.44 ± 0.15	0.460
FHxSA (NV)	<RL	0.010
FOSA (NV)	<RL	0.013
MeFOSA (SV)	<RL	0.439
EtFOSA (SV)	<RL	0.329
FASAA (NV)		
FOSAA	<RL	0.115
MeFOSAA	<RL	0.112
EtFOSAA	<RL	0.112
FASE (SV)		
MeFOSE	<RL	0.187
EtFOSE	<RL	0.418

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.011
PF4OPeA	<RL	0.022
PF5OHxA	<RL	0.018
3-6-OPFHpA	<RL	0.023
HFPO-DA	<RL	0.055
ADONA	<RL	0.010
9Cl-PF3ONS	<RL	0.020
11Cl-PF3OUdS	<RL	0.010
n:2 FTAcr (V)		
8:2 FTAcr	<RL	41.9
10:2 FTAcr	<RL	40.4
n:2 FTMAC (V)		
6:2 FTMAC	<RL	143
8:2 FTMAC	<RL	147
10:2 FTMAC	<RL	77.3
n:2 FTOAc (V)		
8:2 FTOAc	<RL	40.8
10:2 FTOAc	<RL	42.1
n:2 FTOH (V)		
4:2 FTOH	<RL	85.8
5:2 FTOH	<RL	81.6
6:2 FTOH	<RL	40.9
7:2 FTOH	<RL	40.4
8:2 FTOH	<RL	80.5
10:2 FTOH	<RL	81.7
n:2 FTS (NV)		
4:2 FTS	No Value	
6:2 FTS	<RL	0.106
8:2 FTS	<RL	0.213
10:2 FTS	<RL	0.111

Table 14. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-D-IL. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.214
PFPeA	<RL	0.106
PFHxA	<RL	0.423
PFHpA	<RL	0.106
PFOA	<RL	0.106
PFNA	<RL	0.106
PFDA	<RL	0.214
PFUnDA	<RL	0.041
PFDoDA	<RL	0.106
PFTrDA	<RL	0.094
PFTeDA	<RL	0.163
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	0.0973 ± 0.0066	0.036
PFPeS	<RL	0.038
PFHxS	<RL	0.097
PFHpS	<RL	0.101
PFOS	<RL	0.098
PFNS	<RL	0.102
PFDS	<RL	0.039
FASA (NV, SV)		
FBSA (NV)	2.51 ± 0.22	0.041
MeFBSA (SV)	<RL	0.860
FHxSA (NV)	<RL	0.041
FOSA (NV)	<RL	0.106
MeFOSA (SV)	<RL	0.916
EtFOSA (SV)	<RL	0.908
FASAA (NV)		
FOSAA	No Value	
MeFOSAA	<RL	0.214
EtFOSAA	<RL	0.214
FASE (SV)		
MeFOSE	<RL	0.899
EtFOSE	<RL	0.899

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.026
PF5OHxA	<RL	0.038
3-6-OPFHpA	<RL	0.038
HFPO-DA	<RL	0.214
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.019
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	34.8
10:2 FTAcr	<RL	33.3
n:2 FTMAC (V)		
6:2 FTMAC	<RL	116
8:2 FTMAC	<RL	119
10:2 FTMAC	<RL	62.7
n:2 FTOAc (V)		
8:2 FTOAc	<RL	33.8
10:2 FTOAc	<RL	34.7
n:2 FTOH (V)		
4:2 FTOH	<RL	175
5:2 FTOH	<RL	356
6:2 FTOH	<RL	176
7:2 FTOH	<RL	70.6
8:2 FTOH	<RL	177
10:2 FTOH	<RL	70.4
n:2 FTS (NV)		
4:2 FTS	<RL	0.099
6:2 FTS	<RL	2.228
8:2 FTS	<RL	0.205
10:2 FTS	<RL	0.212

Table 15. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-D-MB. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	0.88 ± 0.74	0.220
PFPeA	<RL	0.109
PFHxA	<RL	0.435
PFHpA	<RL	0.109
PFOA	<RL	0.109
PFNA	<RL	0.109
PFDA	<RL	0.220
PFUnDA	<RL	0.042
PFDoDA	<RL	0.109
PFTrDA	<RL	0.096
PFTeDA	<RL	0.168
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	0.53 ± 0.27	0.037
PFPeS	<RL	0.039
PFHxS	<RL	0.100
PFHpS	<RL	0.104
PFOS	<RL	0.101
PFNS	<RL	0.105
PFDS	<RL	0.040
FASA (NV, SV)		
FBSA (NV)	68 ± 13	0.042
MeFBSA (SV)	10.17 ± 0.22	0.728
FHxSA (NV)	<RL	0.042
FOSA (NV)	<RL	0.109
MeFOSA (SV)	<RL	0.776
EtFOSA (SV)	<RL	0.769
FASAA (NV)		
FOSAA	<RL	0.112
MeFOSAA	<RL	0.220
EtFOSAA	<RL	0.220
FASE (SV)		
MeFOSE	<RL	0.761
EtFOSE	<RL	0.762

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.027
PF5OHxA	<RL	0.039
3-6-OPFHpA	<RL	0.039
HFPO-DA	<RL	0.220
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.019
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	29.4
10:2 FTAcr	<RL	28.2
n:2 FTMAC (V)		
6:2 FTMAC	<RL	98.5
8:2 FTMAC	<RL	101
10:2 FTMAC	<RL	53.1
n:2 FTOAc (V)		
8:2 FTOAc	<RL	28.6
10:2 FTOAc	<RL	29.4
n:2 FTOH (V)		
4:2 FTOH	<RL	149
5:2 FTOH	<RL	302
6:2 FTOH	<RL	149
7:2 FTOH	<RL	59.8
8:2 FTOH	<RL	150
10:2 FTOH	<RL	59.7
n:2 FTS (NV)		
4:2 FTS	<RL	0.102
6:2 FTS	<RL	2.29
8:2 FTS	<RL	0.211
10:2 FTS	<RL	0.218

Table 16. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-D-TL. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.217
PFPeA	<RL	0.107
PFHxA	<RL	0.428
PFHpA	<RL	0.107
PFOA	<RL	0.107
PFNA	<RL	0.107
PFDA	<RL	0.217
PFUnDA	<RL	0.041
PFDoDA	<RL	0.107
PFTrDA	<RL	0.095
PFTeDA	<RL	0.165
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	0.160 ± 0.035	0.037
PFPeS	<RL	0.039
PFHxS	<RL	0.098
PFHpS	<RL	0.102
PFOS	<RL	0.100
PFNS	<RL	0.103
PFDS	<RL	0.040
FASA (NV, SV)		
FBSA (NV)	0.314 ± 0.020	0.041
MeFBSA (SV)	<RL	0.887
FHxSA (NV)	<RL	0.041
FOSA (NV)	<RL	0.107
MeFOSA (SV)	<RL	0.945
EtFOSA (SV)	<RL	0.937
FASAA (NV)		
FOSAA	<RL	0.110
MeFOSAA	<RL	0.217
EtFOSAA	<RL	0.217
FASE (SV)		
MeFOSE	<RL	0.927
EtFOSE	<RL	0.928

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.026
PF5OHxA	<RL	0.039
3-6-OPFHpA	<RL	0.039
HFPO-DA	<RL	0.217
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.019
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	35.9
10:2 FTAcr	<RL	34.4
n:2 FTMAC (V)		
6:2 FTMAC	<RL	120
8:2 FTMAC	<RL	123
10:2 FTMAC	<RL	64.8
n:2 FTOAc (V)		
8:2 FTOAc	<RL	34.9
10:2 FTOAc	<RL	35.9
n:2 FTOH (V)		
4:2 FTOH	<RL	181
5:2 FTOH	<RL	368
6:2 FTOH	<RL	182
7:2 FTOH	<RL	72.9
8:2 FTOH	<RL	183
10:2 FTOH	<RL	72.8
n:2 FTS (NV)		
4:2 FTS	<RL	0.101
6:2 FTS	<RL	2.257
8:2 FTS	<RL	0.208
10:2 FTS	<RL	0.215

Table 17. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter glove textile GL-D-OS. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	2.24 ± 0.25	0.222
PFPeA	<RL	0.110
PFHxA	<RL	0.439
PFHpA	<RL	0.110
PFOA	<RL	0.110
PFNA	<RL	0.110
PFDA	<RL	0.222
PFUnDA	<RL	0.042
PFDoDA	<RL	0.110
PFTrDA	<RL	0.097
PFTeDA	<RL	0.170
PFSA (NV)		
PFPrS	<RL	0.019
PFBS	0.297 ± 0.025	0.038
PFPeS	<RL	0.040
PFHxS	<RL	0.101
PFHpS	0.123 ± 0.015	0.105
PFOS	<RL	0.102
PFNS	<RL	0.106
PFDS	<RL	0.041
FASA (NV, SV)		
FBSA (NV)	No Value	
MeFBSA (SV)	1.73 ± 0.17	0.979
FHxSA (NV)	<RL	0.042
FOSA (NV)	<RL	0.110
MeFOSA (SV)	<RL	1.04
EtFOSA (SV)	<RL	1.03
FASAA (NV)		
FOSAA	<RL	0.113
MeFOSAA	<RL	0.222
EtFOSAA	<RL	0.222
FASE (SV)		
MeFOSE	<RL	1.02
EtFOSE	<RL	1.02

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.027
PF5OHxA	<RL	0.040
3-6-OPFHpA	No Value	
HFPO-DA	<RL	0.222
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.019
11Cl-PF3OUdS	<RL	0.019
n:2 FTAcr (V)		
8:2 FTAcr	<RL	40.0
10:2 FTAcr	<RL	38.3
n:2 FTMAC (V)		
6:2 FTMAC	<RL	134
8:2 FTMAC	<RL	137
10:2 FTMAC	<RL	72.1
n:2 FTOAc (V)		
8:2 FTOAc	<RL	38.9
10:2 FTOAc	<RL	39.9
n:2 FTOH (V)		
4:2 FTOH	<RL	202
5:2 FTOH	<RL	410
6:2 FTOH	<RL	203
7:2 FTOH	<RL	81.2
8:2 FTOH	<RL	203
10:2 FTOH	<RL	81.0
n:2 FTS (NV)		
4:2 FTS	<RL	0.103
6:2 FTS	<RL	2.314
8:2 FTS	<RL	0.213
10:2 FTS	<RL	0.220

Table 18. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter hood textile HD-A. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.215
PFPeA	<RL	0.107
PFHxA	<RL	0.201
PFHpA	<RL	0.107
PFOA	<RL	0.107
PFNA	<RL	0.107
PFDA	<RL	0.215
PFUnDA	<RL	0.107
PFDoDA	<RL	0.107
PFTrDA	<RL	0.107
PFTeDA	<RL	0.041
PFSA (NV)		
PFPrS	<RL	0.044
PFBS	0.130 ± 0.067	0.018
PFPeS	<RL	0.039
PFHxS	<RL	0.037
PFHpS	<RL	0.039
PFOS	0.110 ± 0.043	0.038
PFNS	<RL	0.039
PFDS	<RL	0.040
FASA (NV, SV)		
FBSA (NV)	No Value	
MeFBSA (SV)	<RL	0.145
FHxSA (NV)	No Value	
FOSA (NV)	<RL	0.041
MeFOSA (SV)	<RL	0.070
EtFOSA (SV)	<RL	0.226
FASAA (NV)		
FOSAA	<RL	0.107
MeFOSAA	<RL	0.215
EtFOSAA	<RL	0.215
FASE (SV)		
MeFOSE	<RL	0.374
EtFOSE	<RL	0.069

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.019
PF5OHxA	<RL	0.038
3-6-OPFHpA	<RL	0.038
HFPO-DA	<RL	0.215
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.039
11Cl-PF3OUdS	<RL	0.040
n:2 FTAcr (V)		
8:2 FTAcr	<RL	13.9
10:2 FTAcr	<RL	13.5
n:2 FTMAC (V)		
6:2 FTMAC	<RL	47.7
8:2 FTMAC	<RL	48.8
10:2 FTMAC	<RL	25.7
n:2 FTOAc (V)		
8:2 FTOAc	<RL	27.7
10:2 FTOAc	<RL	28.5
n:2 FTOH (V)		
4:2 FTOH	<RL	72.5
5:2 FTOH	<RL	69.0
6:2 FTOH	<RL	69.5
7:2 FTOH	<RL	68.7
8:2 FTOH	<RL	68.0
10:2 FTOH	<RL	69.0
n:2 FTS (NV)		
4:2 FTS	<RL	0.201
6:2 FTS	<RL	0.405
8:2 FTS	<RL	0.409
10:2 FTS	<RL	0.207

Table 19. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter hood textile HD-B. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.218
PFPeA	<RL	0.108
PFHxA	<RL	0.204
PFHpA	<RL	0.108
PFOA	0.31 ± 0.06	0.108
PFNA	<RL	0.108
PFDA	<RL	0.218
PFUnDA	<RL	0.108
PFDoDA	<RL	0.108
PFTrDA	<RL	0.108
PFTeDA	<RL	0.042
PFSA (NV)		
PFPrS	<RL	0.045
PFBS	<RL	0.018
PFPeS	<RL	0.039
PFHxS	<RL	0.038
PFHpS	<RL	0.040
PFOS	0.150 ± 0.074	0.039
PFNS	<RL	0.040
PFDS	<RL	0.040
FASA (NV, SV)		
FBSA (NV)	<RL	0.042
MeFBSA (SV)	<RL	0.169
FHxSA (NV)	<RL	0.108
FOSA (NV)	0.120 ± 0.008	0.042
MeFOSA (SV)	<RL	0.081
EtFOSA (SV)	<RL	0.262
FASAA (NV)		
FOSAA	<RL	0.108
MeFOSAA	<RL	0.218
EtFOSAA	<RL	0.218
FASE (SV)		
MeFOSE	<RL	0.388
EtFOSE	<RL	0.080

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.019
PF5OHxA	<RL	0.039
3-6-OPFHpA	<RL	0.039
HFPO-DA	<RL	0.218
ADONA	<RL	0.020
9Cl-PF3ONS	<RL	0.040
11Cl-PF3OUdS	<RL	0.040
n:2 FTAcr (V)		
8:2 FTAcr	<RL	16.4
10:2 FTAcr	<RL	15.8
n:2 FTMAC (V)		
6:2 FTMAC	<RL	38.2
8:2 FTMAC	<RL	39.1
10:2 FTMAC	<RL	30.3
n:2 FTOAc (V)		
8:2 FTOAc	<RL	22.2
10:2 FTOAc	<RL	33.6
n:2 FTOH (V)		
4:2 FTOH	<RL	85.2
5:2 FTOH	<RL	81.1
6:2 FTOH	<RL	81.7
7:2 FTOH	<RL	80.8
8:2 FTOH	<RL	79.9
10:2 FTOH	<RL	81.1
n:2 FTS (NV)		
4:2 FTS	<RL	0.204
6:2 FTS	<RL	0.411
8:2 FTS	<RL	0.415
10:2 FTS	<RL	0.210

Table 20. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter hood textile HD-C. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.223
PFPeA	<RL	0.110
PFHxA	<RL	0.208
PFHpA	<RL	0.110
PFOA	<RL	0.110
PFNA	<RL	0.110
PFDA	<RL	0.223
PFUnDA	<RL	0.110
PFDoDA	<RL	0.110
PFTrDA	<RL	0.110
PFTeDA	0.110 ± 0.052	0.042
PFSA (NV)		
PFPrS	<RL	0.046
PFBS	<RL	0.018
PFPeS	<RL	0.040
PFHxS	<RL	0.039
PFHpS	<RL	0.040
PFOS	<RL	0.039
PFNS	<RL	0.041
PFDS	<RL	0.041
FASA (NV, SV)		
FBSA (NV)	No Value	
MeFBSA (SV)	<RL	0.431
FHxSA (NV)	<RL	0.110
FOSA (NV)	<RL	0.042
MeFOSA (SV)	<RL	0.142
EtFOSA (SV)	<RL	0.430
FASAA (NV)		
FOSAA	<RL	0.110
MeFOSAA	<RL	0.223
EtFOSAA	<RL	0.223
FASE (SV)		
MeFOSE	<RL	0.278
EtFOSE	<RL	0.200

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.019
PF5OHxA	<RL	0.040
3-6-OPFHpA	<RL	0.040
HFPO-DA	<RL	0.223
ADONA	<RL	0.020
9Cl-PF3ONS	<RL	0.041
11Cl-PF3OUdS	<RL	0.041
n:2 FTAcr (V)		
8:2 FTAcr	<RL	26.0
10:2 FTAcr	<RL	12.5
n:2 FTMAC (V)		
6:2 FTMAC	<RL	27.6
8:2 FTMAC	<RL	28.3
10:2 FTMAC	<RL	23.6
n:2 FTOAc (V)		
8:2 FTOAc	<RL	16.0
10:2 FTOAc	<RL	13.1
n:2 FTOH (V)		
4:2 FTOH	<RL	25.6
5:2 FTOH	<RL	65.1
6:2 FTOH	<RL	41.5
7:2 FTOH	<RL	25.9
8:2 FTOH	<RL	25.8
10:2 FTOH	<RL	64.4
n:2 FTS (NV)		
4:2 FTS	<RL	0.209
6:2 FTS	<RL	0.420
8:2 FTS	<RL	0.423
10:2 FTS	<RL	0.215

Table 21. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter hood textile HD-D. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.222
PFPeA	<RL	0.110
PFHxA	<RL	0.208
PFHpA	<RL	0.110
PFOA	<RL	0.110
PFNA	<RL	0.110
PFDA	<RL	0.222
PFUnDA	<RL	0.110
PFDoDA	<RL	0.110
PFTrDA	<RL	0.110
PFTeDA	<RL	0.042
PFSA (NV)		
PFPrS	<RL	0.046
PFBS	<RL	0.018
PFPeS	<RL	0.040
PFHxS	<RL	0.039
PFHpS	<RL	0.040
PFOS	<RL	0.039
PFNS	<RL	0.041
PFDS	<RL	0.041
FASA (NV, SV)		
FBSA (NV)	<RL	0.042
MeFBSA (SV)	<RL	0.569
FHxSA (NV)	<RL	0.110
FOSA (NV)	<RL	0.042
MeFOSA (SV)	<RL	0.188
EtFOSA (SV)	<RL	0.568
FASAA (NV)		
FOSAA	<RL	0.110
MeFOSAA	<RL	0.222
EtFOSAA	<RL	0.222
FASE (SV)		
MeFOSE	<RL	0.367
EtFOSE	<RL	0.264

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.019
PF5OHxA	<RL	0.040
3-6-OPFHpA	<RL	0.040
HFPO-DA	<RL	0.222
ADONA	<RL	0.020
9Cl-PF3ONS	<RL	0.041
11Cl-PF3OUdS	<RL	0.041
n:2 FTAcr (V)		
8:2 FTAcr	<RL	34.4
10:2 FTAcr	<RL	16.6
n:2 FTMAC (V)		
6:2 FTMAC	<RL	36.5
8:2 FTMAC	<RL	37.3
10:2 FTMAC	<RL	31.3
n:2 FTOAc (V)		
8:2 FTOAc	<RL	21.2
10:2 FTOAc	<RL	17.3
n:2 FTOH (V)		
4:2 FTOH	<RL	34.0
5:2 FTOH	<RL	86.4
6:2 FTOH	<RL	55.0
7:2 FTOH	<RL	34.4
8:2 FTOH	<RL	34.2
10:2 FTOH	<RL	85.4
n:2 FTS (NV)		
4:2 FTS	<RL	0.208
6:2 FTS	<RL	0.418
8:2 FTS	<RL	0.422
10:2 FTS	<RL	0.214

Table 22. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter hood textile HD-E. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.223
PFPeA	<RL	0.110
PFHxA	<RL	0.209
PFHpA	<RL	0.110
PFOA	<RL	0.110
PFNA	<RL	0.110
PFDA	<RL	0.223
PFUnDA	<RL	0.110
PFDoDA	<RL	0.110
PFTrDA	<RL	0.110
PFTeDA	<RL	0.042
PFSA (NV)		
PFPrS	<RL	0.046
PFBS	<RL	0.018
PFPeS	<RL	0.040
PFHxS	<RL	0.039
PFHpS	<RL	0.040
PFOS	<RL	0.039
PFNS	<RL	0.041
PFDS	<RL	0.041
FASA (NV, SV)		
FBSA (NV)	No Value	
MeFBSA (SV)	<RL	0.777
FHxSA (NV)	No Value	
FOSA (NV)	No Value	
MeFOSA (SV)	<RL	0.257
EtFOSA (SV)	<RL	0.775
FASAA (NV)		
FOSAA	<RL	0.110
MeFOSAA	<RL	0.223
EtFOSAA	<RL	0.223
FASE (SV)		
MeFOSE	<RL	0.501
EtFOSE	<RL	0.361

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.019
PF5OHxA	<RL	0.040
3-6-OPFHpA	<RL	0.040
HFPO-DA	<RL	0.223
ADONA	<RL	0.020
9Cl-PF3ONS	<RL	0.041
11Cl-PF3OUdS	<RL	0.041
n:2 FTAcr (V)		
8:2 FTAcr	<RL	33.9
10:2 FTAcr	<RL	16.4
n:2 FTMAC (V)		
6:2 FTMAC	<RL	49.9
8:2 FTMAC	<RL	51.0
10:2 FTMAC	<RL	30.8
n:2 FTOAc (V)		
8:2 FTOAc	<RL	28.9
10:2 FTOAc	<RL	17.1
n:2 FTOH (V)		
4:2 FTOH	<RL	33.4
5:2 FTOH	<RL	85.0
6:2 FTOH	<RL	54.1
7:2 FTOH	<RL	33.8
8:2 FTOH	<RL	33.7
10:2 FTOH	<RL	84.1
n:2 FTS (NV)		
4:2 FTS	<RL	0.209
6:2 FTS	<RL	0.420
8:2 FTS	<RL	0.424
10:2 FTS	<RL	0.215

Table 23. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter hood textile HD-F. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.263
PFPeA	<RL	0.130
PFHxA	<RL	0.246
PFHpA	<RL	0.130
PFOA	<RL	0.130
PFNA	<RL	0.130
PFDA	<RL	0.263
PFUnDA	<RL	0.130
PFDoDA	<RL	0.130
PFTrDA	<RL	0.130
PFTeDA	<RL	0.050
PFSA (NV)		
PFPrS	<RL	0.054
PFBS	<RL	0.022
PFPeS	<RL	0.047
PFHxS	<RL	0.046
PFHpS	<RL	0.048
PFOS	<RL	0.047
PFNS	<RL	0.048
PFDS	<RL	0.048
FASA (NV, SV)		
FBSA (NV)	No Value	
MeFBSA (SV)	<RL	0.917
FHxSA (NV)	<RL	0.130
FOSA (NV)	<RL	0.050
MeFOSA (SV)	<RL	0.303
EtFOSA (SV)	<RL	0.915
FASAA (NV)		
FOSAA	<RL	0.130
MeFOSAA	<RL	0.263
EtFOSAA	<RL	0.263
FASE (SV)		
MeFOSE	<RL	0.592
EtFOSE	<RL	0.426

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.020
PF4OPeA	<RL	0.023
PF5OHxA	<RL	0.047
3-6-OPFHpA	<RL	0.047
HFPO-DA	<RL	0.263
ADONA	<RL	0.024
9Cl-PF3ONS	<RL	0.048
11Cl-PF3OUdS	<RL	0.049
n:2 FTAcr (V)		
8:2 FTAcr	<RL	39.5
10:2 FTAcr	<RL	19.1
n:2 FTMAC (V)		
6:2 FTMAC	<RL	58.0
8:2 FTMAC	<RL	59.4
10:2 FTMAC	<RL	35.9
n:2 FTOAc (V)		
8:2 FTOAc	<RL	33.7
10:2 FTOAc	<RL	19.9
n:2 FTOH (V)		
4:2 FTOH	<RL	176
5:2 FTOH	<RL	167
6:2 FTOH	<RL	63.0
7:2 FTOH	<RL	39.4
8:2 FTOH	<RL	39.2
10:2 FTOH	<RL	97.9
n:2 FTS (NV)		
4:2 FTS	<RL	0.247
6:2 FTS	<RL	0.496
8:2 FTS	<RL	0.500
10:2 FTS	<RL	0.254

Table 24. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter hood textile HD-G. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.207
PFPeA	<RL	0.103
PFHxA	<RL	0.194
PFHpA	<RL	0.103
PFOA	<RL	0.103
PFNA	<RL	0.103
PFDA	<RL	0.207
PFUnDA	<RL	0.103
PFDoDA	<RL	0.103
PFTrDA	<RL	0.103
PFTeDA	<RL	0.039
PFSA (NV)		
PFPrS	<RL	0.042
PFBS	<RL	0.017
PFPeS	<RL	0.037
PFHxS	<RL	0.036
PFHpS	<RL	0.038
PFOS	<RL	0.037
PFNS	<RL	0.038
PFDS	<RL	0.038
FASA (NV, SV)		
FBSA (NV)	<RL	0.039
MeFBSA (SV)	<RL	0.156
FHxSA (NV)	<RL	0.103
FOSA (NV)	<RL	0.039
MeFOSA (SV)	<RL	0.325
EtFOSA (SV)	<RL	0.580
FASAA (NV)		
FOSAA	<RL	0.103
MeFOSAA	<RL	0.207
EtFOSAA	<RL	0.207
FASE (SV)		
MeFOSE	<RL	0.459
EtFOSE	<RL	0.457

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.016
PF4OPeA	<RL	0.018
PF5OHxA	<RL	0.037
3-6-OPFHpA	<RL	0.037
HFPO-DA	<RL	0.207
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.038
11Cl-PF3OUdS	<RL	0.038
n:2 FTAcr (V)		
8:2 FTAcr	<RL	18.0
10:2 FTAcr	<RL	17.3
n:2 FTMAC (V)		
6:2 FTMAC	<RL	62.1
8:2 FTMAC	<RL	62.9
10:2 FTMAC	<RL	33.2
n:2 FTOAc (V)		
8:2 FTOAc	<RL	35.5
10:2 FTOAc	<RL	23.9
n:2 FTOH (V)		
4:2 FTOH	<RL	47.0
5:2 FTOH	<RL	89.4
6:2 FTOH	<RL	75.8
7:2 FTOH	<RL	47.4
8:2 FTOH	<RL	47.2
10:2 FTOH	<RL	117.7
n:2 FTS (NV)		
4:2 FTS	<RL	0.194
6:2 FTS	<RL	0.390
8:2 FTS	<RL	0.394
10:2 FTS	<RL	0.200

Table 25. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in firefighter hood textile HD-H. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.226
PFPeA	<RL	0.112
PFHxA	<RL	0.212
PFHpA	<RL	0.112
PFOA	<RL	0.112
PFNA	<RL	0.112
PFDA	<RL	0.226
PFUnDA	<RL	0.112
PFDoDA	<RL	0.112
PFTrDA	<RL	0.112
PFTeDA	0.080 ± 0.014	0.043
PFSA (NV)		
PFPrS	<RL	0.046
PFBS	<RL	0.019
PFPeS	<RL	0.041
PFHxS	<RL	0.039
PFHpS	<RL	0.041
PFOS	0.070 ± 0.010	0.040
PFNS	<RL	0.041
PFDS	<RL	0.042
FASA (NV, SV)		
FBSA (NV)	<RL	0.043
MeFBSA (SV)	<RL	0.136
FHxSA (NV)	<RL	0.112
FOSA (NV)	<RL	0.043
MeFOSA (SV)	<RL	0.502
EtFOSA (SV)	<RL	0.506
FASAA (NV)		
FOSAA	<RL	0.112
MeFOSAA	<RL	0.226
EtFOSAA	<RL	0.226
FASE (SV)		
MeFOSE	<RL	0.400
EtFOSE	<RL	0.750

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.018
PF4OPeA	<RL	0.020
PF5OHxA	<RL	0.041
3-6-OPFHpA	<RL	0.041
HFPO-DA	<RL	0.226
ADONA	<RL	0.020
9Cl-PF3ONS	<RL	0.041
11Cl-PF3OUdS	<RL	0.042
n:2 FTAcr (V)		
8:2 FTAcr	<RL	21.1
10:2 FTAcr	<RL	20.4
n:2 FTMAC (V)		
6:2 FTMAC	<RL	549
8:2 FTMAC	<RL	73.9
10:2 FTMAC	<RL	39.0
n:2 FTOAc (V)		
8:2 FTOAc	<RL	41.7
10:2 FTOAc	<RL	43.0
n:2 FTOH (V)		
4:2 FTOH	<RL	131
5:2 FTOH	<RL	105
6:2 FTOH	<RL	162
7:2 FTOH	<RL	105
8:2 FTOH	<RL	162
10:2 FTOH	<RL	163
n:2 FTS (NV)		
4:2 FTS	<RL	0.212
6:2 FTS	<RL	0.426
8:2 FTS	<RL	0.430
10:2 FTS	<RL	0.218

Table 26. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in wildand textile WL-A. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	1.758 ± 0.071	0.170
PFPeA	1.97 ± 0.07	0.105
PFHxA	3.52 ± 0.15	0.344
PFHpA	0.1376 ± 0.0079	0.105
PFOA	<RL	0.212
PFNA	<RL	0.212
PFDA	<RL	0.212
PFUnDA	<RL	0.105
PFDoDA	<RL	0.106
PFTrDA	<RL	0.109
PFTeDA	<RL	0.152
PFSA (NV)		
PFPrS	<RL	0.038
PFBS	<RL	0.093
PFPeS	<RL	0.038
PFHxS	<RL	0.096
PFHpS	<RL	0.039
PFOS	<RL	0.098
PFNS	0.0709 ± 0.0085	0.039
PFDS	<RL	0.101
FASA (NV, SV)		
FBSA (NV)	<RL	0.105
MeFBSA (SV)	<RL	0.123
FHxSA (NV)	<RL	0.105
FOSA (NV)	<RL	0.105
MeFOSA (SV)	<RL	0.455
EtFOSA (SV)	<RL	0.458
FASAA (NV)		
FOSAA	<RL	0.432
MeFOSAA	<RL	0.212
EtFOSAA	<RL	0.212
FASE (SV)		
MeFOSE	<RL	0.362
EtFOSE	<RL	0.680

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.016
PF4OPeA	<RL	0.038
PF5OHxA	<RL	0.038
3-6-OPFHpA	<RL	0.038
HFPO-DA	<RL	0.212
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.098
11Cl-PF3OUdS	<RL	0.038
n:2 FTAcr (V)		
8:2 FTAcr	<RL	15.2
10:2 FTAcr	<RL	14.7
n:2 FTMAC (V)		
6:2 FTMAC	378.0 ± 7.6	105
8:2 FTMAC	<RL	53.2
10:2 FTMAC	<RL	28.0
n:2 FTOAc (V)		
8:2 FTOAc	<RL	30.0
10:2 FTOAc	<RL	30.9
n:2 FTOH (V)		
4:2 FTOH	<RL	112
5:2 FTOH	<RL	75.6
6:2 FTOH	<RL	153
7:2 FTOH	<RL	75.3
8:2 FTOH	<RL	150
10:2 FTOH	<RL	152
n:2 FTS (NV)		
4:2 FTS	<RL	0.098
6:2 FTS	<RL	0.400
8:2 FTS	<RL	0.403
10:2 FTS	<RL	0.210

Table 27. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in wildand textile WL-B. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.169
PFPeA	<RL	0.105
PFHxA	<RL	0.342
PFHpA	<RL	0.105
PFOA	<RL	0.211
PFNA	<RL	0.211
PFDA	<RL	0.211
PFUnDA	<RL	0.105
PFDoDA	<RL	0.106
PFTrDA	<RL	0.108
PFTeDA	<RL	0.151
PFSA (NV)		
PFPrS	<RL	0.038
PFBS	<RL	0.093
PFPeS	<RL	0.038
PFHxS	<RL	0.096
PFHpS	<RL	0.038
PFOS	<RL	0.097
PFNS	<RL	0.039
PFDS	<RL	0.101
FASA (NV, SV)		
FBSA (NV)	<RL	0.105
MeFBSA (SV)	<RL	0.145
FHxSA (NV)	<RL	0.105
FOSA (NV)	<RL	0.105
MeFOSA (SV)	<RL	0.536
EtFOSA (SV)	<RL	0.540
FASAA (NV)		
FOSAA	<RL	0.430
MeFOSAA	<RL	0.211
EtFOSAA	<RL	0.211
FASE (SV)		
MeFOSE	<RL	0.427
EtFOSE	<RL	0.801

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.016
PF4OPeA	<RL	0.038
PF5OHxA	<RL	0.038
3-6-OPFHpA	<RL	0.038
HFPO-DA	<RL	0.211
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.098
11Cl-PF3OUdS	<RL	0.038
n:2 FTAcr (V)		
8:2 FTAcr	<RL	11.1
10:2 FTAcr	<RL	10.7
n:2 FTMAC (V)		
6:2 FTMAC	<RL	76.6
8:2 FTMAC	<RL	38.7
10:2 FTMAC	<RL	20.4
n:2 FTOAc (V)		
8:2 FTOAc	<RL	21.8
10:2 FTOAc	<RL	22.5
n:2 FTOH (V)		
4:2 FTOH	<RL	138
5:2 FTOH	<RL	55.0
6:2 FTOH	<RL	112
7:2 FTOH	<RL	54.8
8:2 FTOH	<RL	109
10:2 FTOH	<RL	111
n:2 FTS (NV)		
4:2 FTS	<RL	0.098
6:2 FTS	<RL	0.398
8:2 FTS	<RL	0.402
10:2 FTS	<RL	0.210

Table 28. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in wildand textile WL-C. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.171
PFPeA	0.1089 ± 0.0043	0.106
PFHxA	0.391 ± 0.022	0.346
PFHpA	<RL	0.106
PFOA	<RL	0.214
PFNA	<RL	0.214
PFDA	<RL	0.214
PFUnDA	<RL	0.106
PFDoDA	<RL	0.107
PFTrDA	<RL	0.110
PFTeDA	<RL	0.153
PFSA (NV)		
PFPrS	<RL	0.038
PFBS	<RL	0.094
PFPeS	<RL	0.038
PFHxS	<RL	0.097
PFHpS	<RL	0.039
PFOS	<RL	0.098
PFNS	<RL	0.039
PFDS	<RL	0.102
FASA (NV, SV)		
FBSA (NV)	<RL	0.106
MeFBSA (SV)	<RL	0.183
FHxSA (NV)	<RL	0.106
FOSA (NV)	<RL	0.106
MeFOSA (SV)	<RL	0.677
EtFOSA (SV)	<RL	0.681
FASAA (NV)		
FOSAA	<RL	0.435
MeFOSAA	<RL	0.214
EtFOSAA	<RL	0.214
FASE (SV)		
MeFOSE	<RL	0.539
EtFOSE	<RL	1.01

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.038
PF5OHxA	<RL	0.038
3-6-OPFHpA	<RL	0.038
HFPO-DA	<RL	0.214
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.099
11Cl-PF3OUdS	<RL	0.038
n:2 FTAcr (V)		
8:2 FTAcr	<RL	11.0
10:2 FTAcr	<RL	10.7
n:2 FTMAC (V)		
6:2 FTMAC	<RL	76.6
8:2 FTMAC	<RL	38.7
10:2 FTMAC	<RL	20.4
n:2 FTOAc (V)		
8:2 FTOAc	<RL	21.8
10:2 FTOAc	<RL	22.5
n:2 FTOH (V)		
4:2 FTOH	<RL	174
5:2 FTOH	<RL	55.0
6:2 FTOH	<RL	111
7:2 FTOH	<RL	54.7
8:2 FTOH	<RL	109
10:2 FTOH	<RL	111
n:2 FTS (NV)		
4:2 FTS	<RL	0.099
6:2 FTS	<RL	0.403
8:2 FTS	<RL	0.407
10:2 FTS	<RL	0.212

Table 29. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in wildand textile WL-D. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	1.048 ± 0.028	0.171
PFPeA	0.765 ± 0.072	0.105
PFHxA	2.55 ± 0.25	0.345
PFHpA	0.6475 ± 0.0093	0.105
PFOA	<RL	0.213
PFNA	<RL	0.213
PFDA	<RL	0.213
PFUnDA	<RL	0.105
PFDoDA	<RL	0.106
PFTrDA	<RL	0.109
PFTeDA	<RL	0.152
PFSA (NV)		
PFPrS	<RL	0.038
PFBS	<RL	0.094
PFPeS	<RL	0.038
PFHxS	<RL	0.096
PFHpS	<RL	0.039
PFOS	<RL	0.098
PFNS	<RL	0.039
PFDS	<RL	0.102
FASA (NV, SV)		
FBSA (NV)	<RL	0.105
MeFBSA (SV)	<RL	0.114
FHxSA (NV)	<RL	0.105
FOSA (NV)	<RL	0.105
MeFOSA (SV)	<RL	0.422
EtFOSA (SV)	<RL	0.424
FASAA (NV)		
FOSAA	<RL	0.433
MeFOSAA	<RL	0.213
EtFOSAA	<RL	0.213
FASE (SV)		
MeFOSE	<RL	0.336
EtFOSE	<RL	0.630

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.016
PF4OPeA	<RL	0.038
PF5OHxA	<RL	0.038
3-6-OPFHpA	<RL	0.038
HFPO-DA	<RL	0.213
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.098
11Cl-PF3OUdS	<RL	0.038
n:2 FTAcr (V)		
8:2 FTAcr	<RL	7.99
10:2 FTAcr	<RL	7.71
n:2 FTMAC (V)		
6:2 FTMAC	123 ± 10	55.4
8:2 FTMAC	<RL	28.0
10:2 FTMAC	<RL	14.7
n:2 FTOAc (V)		
8:2 FTOAc	<RL	15.8
10:2 FTOAc	<RL	16.3
n:2 FTOH (V)		
4:2 FTOH	<RL	108
5:2 FTOH	<RL	39.8
6:2 FTOH	<RL	80.6
7:2 FTOH	<RL	39.6
8:2 FTOH	<RL	78.8
10:2 FTOH	<RL	80.1
n:2 FTS (NV)		
4:2 FTS	<RL	0.099
6:2 FTS	<RL	0.401
8:2 FTS	<RL	0.404
10:2 FTS	<RL	0.211

Table 30. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in wildand textile WL-E. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	4.36 ± 0.10	0.173
PFPeA	3.602 ± 0.052	0.107
PFHxA	8.74 ± 0.21	0.350
PFHpA	2.48 ± 0.03	0.107
PFOA	<RL	0.216
PFNA	<RL	0.216
PFDA	<RL	0.216
PFUnDA	<RL	0.107
PFDoDA	<RL	0.108
PFTrDA	<RL	0.111
PFTeDA	<RL	0.155
PFSA (NV)		
PFPrS	<RL	0.039
PFBS	<RL	0.095
PFPeS	<RL	0.039
PFHxS	<RL	0.098
PFHpS	<RL	0.039
PFOS	<RL	0.099
PFNS	<RL	0.040
PFDS	<RL	0.103
FASA (NV, SV)		
FBSA (NV)	<RL	0.107
MeFBSA (SV)	<RL	0.172
FHxSA (NV)	<RL	0.107
FOSA (NV)	<RL	0.107
MeFOSA (SV)	<RL	0.638
EtFOSA (SV)	<RL	0.642
FASAA (NV)		
FOSAA	<RL	0.440
MeFOSAA	<RL	0.216
EtFOSAA	<RL	0.216
FASE (SV)		
MeFOSE	<RL	0.508
EtFOSE	<RL	0.953

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.039
PF5OHxA	<RL	0.039
3-6-OPFHpA	<RL	0.039
HFPO-DA	<RL	0.216
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.100
11Cl-PF3OUdS	<RL	0.039
n:2 FTAcr (V)		
8:2 FTAcr	<RL	10.6
10:2 FTAcr	<RL	10.2
n:2 FTMAC (V)		
6:2 FTMAC	860 ± 280	600
8:2 FTMAC	<RL	37.0
10:2 FTMAC	<RL	19.5
n:2 FTOAc (V)		
8:2 FTOAc	<RL	20.8
10:2 FTOAc	<RL	21.5
n:2 FTOH (V)		
4:2 FTOH	<RL	164
5:2 FTOH	<RL	52.5
6:2 FTOH	182 ± 26	106
7:2 FTOH	<RL	52.3
8:2 FTOH	<RL	104
10:2 FTOH	<RL	106
n:2 FTS (NV)		
4:2 FTS	<RL	0.100
6:2 FTS	6.02 ± 0.19	0.407
8:2 FTS	<RL	0.411
10:2 FTS	<RL	0.214

Table 31. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in wildand textile WL-F. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.174
PFPeA	0.39 ± 0.03	0.107
PFHxA	4.98 ± 0.40	0.351
PFHpA	0.421 ± 0.038	0.107
PFOA	<RL	0.217
PFNA	<RL	0.217
PFDA	<RL	0.217
PFUnDA	<RL	0.107
PFDoDA	<RL	0.109
PFTrDA	<RL	0.111
PFTeDA	<RL	0.155
PFSA (NV)		
PFPrS	<RL	0.039
PFBS	0.545 ± 0.060	0.095
PFPeS	0.0561 ± 0.0082	0.039
PFHxS	<RL	0.098
PFHpS	<RL	0.039
PFOS	0.124 ± 0.019	0.100
PFNS	<RL	0.040
PFDS	<RL	0.104
FASA (NV, SV)		
FBSA (NV)	<RL	0.107
MeFBSA (SV)	<RL	0.207
FHxSA (NV)	<RL	0.107
FOSA (NV)	<RL	0.107
MeFOSA (SV)	<RL	0.765
EtFOSA (SV)	<RL	0.770
FASAA (NV)		
FOSAA	<RL	0.441
MeFOSAA	<RL	0.217
EtFOSAA	<RL	0.217
FASE (SV)		
MeFOSE	<RL	0.609
EtFOSE	<RL	1.142

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	No Value	
PF4OPeA	<RL	0.039
PF5OHxA	<RL	0.039
3-6-OPFHpA	<RL	0.039
HFPO-DA	<RL	0.217
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.100
11Cl-PF3OUdS	<RL	0.039
n:2 FTAcr (V)		
8:2 FTAcr	<RL	14.7
10:2 FTAcr	<RL	14.1
n:2 FTMAC (V)		
6:2 FTMAC	2980 ± 820	664
8:2 FTMAC	<RL	51.3
10:2 FTMAC	<RL	27.0
n:2 FTOAc (V)		
8:2 FTOAc	<RL	28.9
10:2 FTOAc	<RL	29.8
n:2 FTOH (V)		
4:2 FTOH	<RL	195
5:2 FTOH	<RL	72.9
6:2 FTOH	1250 ± 330	148
7:2 FTOH	<RL	72.6
8:2 FTOH	<RL	145
10:2 FTOH	<RL	147
n:2 FTS (NV)		
4:2 FTS	<RL	0.101
6:2 FTS	0.951 ± 0.057	0.408
8:2 FTS	<RL	0.412
10:2 FTS	<RL	0.215

Table 32. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in wildand textile WL-G. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)	PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)			***PPEA (NV)***		
PFBA	<RL	0.178	**PFEESA**	<RL	0.017
PFPeA	0.160 ± 0.023	0.110	**PF4OPeA**	<RL	0.040
PFHxA	1.47 ± 0.38	0.359	**PF5OHxA**	<RL	0.040
PFHpA	<RL	0.110	**3-6-OPFHpA**	<RL	0.040
PFOA	<RL	0.222	**HFPO-DA**	<RL	0.222
PFNA	<RL	0.222	**ADONA**	<RL	0.019
PFDA	<RL	0.222	**9Cl-PF3ONS**	<RL	0.102
PFUnDA	<RL	0.110	**11Cl-PF3OUdS**	<RL	0.040
PFDoDA	<RL	0.111			
PFTrDA	<RL	0.114	***n:2 FTAcr (V)***		
PFTeDA	<RL	0.159	**8:2 FTAcr**	<RL	14.4
			10:2 FTAcr	<RL	13.9
PFSA (NV)					
PFPrS	<RL	0.040	***n:2 FTMAC (V)***		
PFBS	<RL	0.097	**6:2 FTMAC**	1160 ± 640	534
PFPeS	<RL	0.040	**8:2 FTMAC**	<RL	50.5
PFHxS	<RL	0.100	**10:2 FTMAC**	<RL	26.6
PFHpS	<RL	0.040			
PFOS	<RL	0.102	***n:2 FTOAc (V)***		
PFNS	<RL	0.041	**8:2 FTOAc**	<RL	28.5
PFDS	<RL	0.106	**10:2 FTOAc**	<RL	29.3
FASA (NV, SV)			***n:2 FTOH (V)***		
FBSA (NV)	<RL	0.110	**4:2 FTOH**	<RL	104
MeFBSA (SV)	<RL	0.110	**5:2 FTOH**	<RL	71.8
FHxSA (NV)	<RL	0.110	**6:2 FTOH**	224 ± 54	146
FOSA (NV)	<RL	0.110	**7:2 FTOH**	<RL	71.5
MeFOSA (SV)	<RL	0.407	**8:2 FTOH**	<RL	142
EtFOSA (SV)	<RL	0.410	**10:2 FTOH**	<RL	144
FASAA (NV)			***n:2 FTS (NV)***		
FOSAA	<RL	0.451	**4:2 FTS**	<RL	0.103
MeFOSAA	<RL	0.222	**6:2 FTS**	<RL	0.417
EtFOSAA	<RL	0.222	**8:2 FTS**	<RL	0.421
			10:2 FTS	<RL	0.220
FASE (SV)					
MeFOSE	<RL	0.324			
EtFOSE	<RL	0.608			

Table 33. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in wildand textile WL-H. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.176
PFPeA	<RL	0.109
PFHxA	<RL	0.356
PFHpA	<RL	0.109
PFOA	<RL	0.220
PFNA	<RL	0.220
PFDA	<RL	0.220
PFUnDA	<RL	0.109
PFDoDA	<RL	0.110
PFTrDA	<RL	0.113
PFTeDA	<RL	0.157
PFSA (NV)		
PFPrS	<RL	0.039
PFBS	<RL	0.097
PFPeS	<RL	0.039
PFHxS	<RL	0.100
PFHpS	<RL	0.040
PFOS	<RL	0.101
PFNS	<RL	0.040
PFDS	<RL	0.105
FASA (NV, SV)		
FBSA (NV)	No Value	
MeFBSA (SV)	<RL	0.135
FHxSA (NV)	<RL	0.109
FOSA (NV)	<RL	0.109
MeFOSA (SV)	<RL	0.499
EtFOSA (SV)	<RL	0.502
FASAA (NV)		
FOSAA	<RL	0.447
MeFOSAA	<RL	0.220
EtFOSAA	<RL	0.220
FASE (SV)		
MeFOSE	<RL	0.397
EtFOSE	<RL	0.744

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.039
PF5OHxA	<RL	0.039
3-6-OPFHpA	<RL	0.039
HFPO-DA	<RL	0.220
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.102
11Cl-PF3OUdS	<RL	0.039
n:2 FTAcr (V)		
8:2 FTAcr	<RL	14.5
10:2 FTAcr	<RL	14.0
n:2 FTMAC (V)		
6:2 FTMAC	<RL	633
8:2 FTMAC	<RL	50.7
10:2 FTMAC	<RL	26.7
n:2 FTOAc (V)		
8:2 FTOAc	<RL	28.5
10:2 FTOAc	<RL	29.4
n:2 FTOH (V)		
4:2 FTOH	<RL	128
5:2 FTOH	<RL	72.0
6:2 FTOH	220 ± 30	146
7:2 FTOH	<RL	71.7
8:2 FTOH	<RL	143
10:2 FTOH	<RL	145
n:2 FTS (NV)		
4:2 FTS	<RL	0.102
6:2 FTS	<RL	0.414
8:2 FTS	<RL	0.418
10:2 FTS	<RL	0.218

Table 34. PFAS concentrations and reporting limits (RL; µg PFAS/kg textile) in wildand textile WL-I. NV indicates the analytical method for nonvolatile, SV for semivolatile, or V for volatile.

PFAS	Concentration (µg/kg)	RL (µg/kg)
PFCA (NV)		
PFBA	<RL	0.174
PFPeA	<RL	0.108
PFHxA	<RL	0.352
PFHpA	<RL	0.108
PFOA	<RL	0.217
PFNA	<RL	0.217
PFDA	<RL	0.217
PFUnDA	<RL	0.108
PFDoDA	<RL	0.109
PFTrDA	<RL	0.112
PFTeDA	<RL	0.156
PFSA (NV)		
PFPrS	<RL	0.039
PFBS	<RL	0.096
PFPeS	<RL	0.039
PFHxS	<RL	0.098
PFHpS	<RL	0.039
PFOS	<RL	0.100
PFNS	<RL	0.040
PFDS	<RL	0.104
FASA (NV, SV)		
FBSA (NV)	No Value	
MeFBSA (SV)	<RL	0.171
FHxSA (NV)	<RL	0.108
FOSA (NV)	<RL	0.108
MeFOSA (SV)	<RL	0.632
EtFOSA (SV)	<RL	0.636
FASAA (NV)		
FOSAA	<RL	0.443
MeFOSAA	<RL	0.217
EtFOSAA	<RL	0.217
FASE (SV)		
MeFOSE	<RL	0.503
EtFOSE	<RL	0.944

PFAS	Concentration (µg/kg)	RL (µg/kg)
PPEA (NV)		
PFEESA	<RL	0.017
PF4OPeA	<RL	0.039
PF5OHxA	<RL	0.039
3-6-OPFHpA	<RL	0.039
HFPO-DA	<RL	0.217
ADONA	<RL	0.019
9Cl-PF3ONS	<RL	0.101
11Cl-PF3OUdS	<RL	0.039
n:2 FTAcr (V)		
8:2 FTAcr	<RL	16.8
10:2 FTAcr	<RL	16.2
n:2 FTMAC (V)		
6:2 FTMAC	<RL	562
8:2 FTMAC	<RL	58.8
10:2 FTMAC	<RL	31.0
n:2 FTOAc (V)		
8:2 FTOAc	<RL	33.1
10:2 FTOAc	<RL	34.2
n:2 FTOH (V)		
4:2 FTOH	<RL	163
5:2 FTOH	<RL	83.5
6:2 FTOH	223 ± 17	166
7:2 FTOH	<RL	83.2
8:2 FTOH	<RL	166
10:2 FTOH	<RL	167
n:2 FTS (NV)		
4:2 FTS	<RL	0.101
6:2 FTS	<RL	0.410
8:2 FTS	<RL	0.414
10:2 FTS	<RL	0.216

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Appendix A. Experimental Details

A.1. PFAS Analytical Standards and NIST Reference Materials

Analytical standards (**Table 35**) and isotopically labeled standards (**Table 36**) for nonvolatile PFAS as well as semivolatile PFAS (**Table 37** and **Table 38**) were obtained from Wellington Laboratories (Guelph, Ontario, Canada). Analytical standards and isotopically labeled standards for volatile PFAS (**Table 39** and **Table 40**) were obtained from Wellington Laboratories and Synquest Laboratories (Alachua, FL).

NIST Reference Materials (RMs) 8446 Perfluorinated Carboxylic Acids and Perfluorooctane Sulfonamide in Methanol (8446) and 8447 Perfluorinated Sulfonic Acids in Methanol (8447) were obtained for use as quality control samples (**Table 41** and **Table 42**).

Table 35. Nonvolatile PFAS analytical standards obtained from Wellington Laboratories, with full analyte names, CAS RN, and abbreviations (bold), and analyte concentrations with expanded maximum combined percent relative uncertainty. PFHxS, PFOS, MeFOSAA, and EtFOSAA in PFAC30PAR were present as a mixture of structural isomers.

Standard	Contents	Concentration
PFAC30PAR	Perfluoro-n-butanoic acid (375-22-4; **PFBA**), Perfluoro-n-pentanoic acid (2706-90-3; **PFPeA**), Perfluoro-n-hexanoic acid (307-24-4; **PFHxA**), Perfluoro-n-heptanoic acid (375-85-9; **PFHpA**), Perfluoro-n-octanoic acid (335-67-1; PFOA), Perfluoro-n-nonanoic acid (375-95-1; **PFNA**), Perfluoro-n-decanoic acid (335-76-2; **PFDA**), Perfluoro-n-undecanoic acid (2058-94-8; **PFUnDA**), Perfluoro-n-dodecanoic acid (307-55-1; **PFDoDA**), Perfluoro-n-tridecanoic acid (72629-94-8; **PFTrDA**), Perfluoro-n-tetradecanoic acid (0376-06-07; **PFTeDA**), Perfluoro-1-butanesulfonamide (30334-69-1; **FBSA**), Perfluoro-1-hexanesulfonamide (41997-13-1; **FHxSA**), Perfluoro-1-octanesulfonamide (754-91-6; **FOSA**), Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (13252-13-6; HFPO-DA), N-methylperfluoro-1-octanesulfonamidoacetic acid (2355-31-9; **N-MeFOSAA**), N-ethylperfluoro-1-octanesulfonamidoacetic acid (2991-50-6, N-EtFOSAA), Potassium perfluorobutanesulfonate (29420-49-3; **PFBS**), Sodium perfluoropentanesulfonate (630402-22-1; **PFPeS**), Potassium perfluorohexanesulfonate (3871-99-6; **PFHxS**), Sodium perfluoroheptanesulfonate (21934-50-9; **PFHpS**), Potassium perfluorooctanesulfonate (2795-39-3; **PFOS**), Sodium perfluorononanesulfonate (98789-57-2; **PFNS**), Sodium perfluorodecanesulfonate (2806-15-7; **PFDS**), Sodium 1H,1H,2H,2H,-perfluoro-1-hexanesulfonate (27619-93-8; **4:2 FTS**), Sodium 1H,1H,2H,2H,-perfluoro-1-octanesulfonate (27619-94-9; **6:2 FTS**), Sodium 1H,1H,2H,2H,-perfluoro-1-decanesulfonate (27619-96-1; **8:2 FTS),** Sodium dodecafluoro-3H-4,8-dioxanonatoate; **NaDONA**), Potassium 9-chlorohexadecafluoro-3-oxanonane-1-sulfonate (73606-19-6; **9Cl-PF3ONS**), Potassium 11-chloroeicosafluoro-3-oxaundecane-1-sulfonate (83329-89-9; **11Cl-PF3OUdS**)	(1.00 ± 0.05) µg/mL in methanol/isopropanol (6%)/water (< 1%)
PFAC-MXG	Perfluoro-4-oxapentenoic acid (377-73-1; **PF4OPeA**), Perfluoro-5-oxahexanoic acid (863090-89-5; **PF5OHxA**), Perfluoro-3,6-dioxaheptanoic acid (151772-58-6; **3,6-OPFHpA**), Potassium perfluoro(2-ethoxyethane)sulfonic acid (**PFEESA**)	(2.0 ± 0.1) µg/mL in methanol/water (<1%)
L-PFPrS	Sodium perfluoropropanesulfonate (359868-82-9; **PFPrS**)	(50.0 ± 2.5) µg/mL in methanol
FOSAA	Perfluorooctane sulfonamidoacetic acid (2806-24-6; **FOSAA**)	(50.0 ± 2.5) µg/mL in methanol/water (<1%)
10:2FTS	Sodium 1H,1H,2H,2H,-perfluoro-1-dodecanesulfonate (**10:2 FTS**)	(50.0 ± 2.5) µg/mL in methanol

Table 36. Nonvolatile isotopically labeled PFAS internal and injection standards obtained from Wellington Laboratories, with full analyte names, and analyte concentrations with expanded maximum combined percent relative uncertainty where provided.

Standard	Contents	Concentration
MPFAC-24ES	Perfluoro-n-[13C4]-butanoic acid, Perfluoro-n-[13C5]-pentanoic acid, Perfluoro-n-[1,2,3,4,6-13C5]-hexanoic acid, Perfluoro-n-[1,2,3,4-13C4]-heptanoic acid, Perfluoro-n-[13C8]-octanoic acid, Perfluoro-n-[13C9]-nonanoic acid, Perfluoro-n-[1,2,3,4,5,6-13C5]decanoic acid, Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid, Perfluoro-n-[1,2-13C2]dodecanoic acid, Perfluoro-n-[1,2-13C2]tetradecanoic acid, Sodium perfluoro-1-[2,3,4-13C3]-butanesulfonate, Sodium perfluoro-1-[1,2,3-13C3]-hexanesulfonate, Sodium perfluoro-1-[13C8]-octanesulfonate, Perfluoro-1-[13C8]octanesulfonamide, N-methyl-d3-perlfuoro-1-octanesulfonamid acetic acid, N-ethyl-d5-perfluoro-1-octanesulfonamido acetic acid, Sodium 1H, 1H, 2H, 2H-perfluoro-1-[1,2-13C2]-hexane sulfonate, Sodium 1H, 1H, 2H, 2H-perfluoro-1-[1,2-13C2]-octane sulfonate, Sodium 1H, 1H, 2H, 2H-perlfuoro-1-[1,2-13C2]-decane sulfonate	(1.00 ± 0.05) µg/mL in methanol/isopropanol (2%)/water (<1%)
M3HFPO-DA	Tetrafluoro(heptafluoropropoxy)[$^{13}C_3$]-propanoic acid	(50.0 ± 2.5) µg/mL in methanol
MPFAC-C-IS	Perfluoro-n-[2,3,4-13C3]-butanoic acid (**PFBA-INJ**), Perfluoro-n-[1,2,3,4-13C4]-octanoic acid (**PFOA -INJ**), Perfluoro-n-[1,2-13C2]decanoic acid (**PFDA -INJ)**, Sodium perfluoro-1-[1,2,3,4-13C4]-octanesulfonate (**PFOS -INJ**)	(50.0 ± 2.5) µg/mL in methanol/water (<1%)

Table 37. Semivolatile PFAS analytical standards purchased from Wellington Laboratories including full analyte names, CAS RN, abbreviations (bold), and analyte concentrations with expanded maximum combined percent relative uncertainty where provided.

Standard	Contents	Concentration
N-MeFBSA-M	Nonafluoro-N-methylbutancesulfonamide (6829-12-4; **MeFBSA**)	(50 ± 2.5) µg/mL
N-MeFOSA-M	Heptadecafluoro-N-methyloctancesulfonamide (31506-32-8; **MeFOSA**)	(50 ± 2.5) µg/mL
N-EtFOSA-M	Heptadecafluoro-N-ethyloctancesulfonamide (4151-50-2; **EtFOSA**)	(50 ± 2.5) µg/mL
N-MeFOSE-M	2-(N-methylperfluoro-1-octanesulfonamido)-ethanol (24448-09-7; **MeFOSE**)	(50 ± 2.5) µg/mL
N-EtFOSE-M	2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol (1691-99-2; **EtFOSE**)	(50 ± 2.5) µg/mL

Table 38. Semivolatile isotopically labeled PFAS internal standards obtained from Wellington Laboratories, with full analyte names, and analyte concentrations with expanded maximum combined percent relative uncertainty where provided.

Standard	Contents	Concentration
d-N-MeFOSA-M	N-methy-d3-perflouro-1-octanesulfonamide	(50 ± 2.5) µg/mL
d-N-EtFOSA	N-ethyl-d5-perfluoro-1-octanesulfonamide	(50 ± 2.5) µg/mL
d7-N-MeFOSE-M	2-(N-methyl-d3-perfluoro-1-octanesulfonamido)ethan-d4-ol	(50 ± 2.5) µg/mL
d9-N-EtFOSE-M	2-(N-ethyl-d5-perfluoro-1-octanesulfonamido)ethan-d4-ol	(50 ± 2.5) µg/mL

Table 39. Volatile target PFAS analytical standards, supplier, full analyte names, CAS RN, abbreviations (bold), and analyte concentrations with expanded maximum combined percent relative uncertainty where provided.

Standard	Contents	Concentration
8:2FTAcr (Wellington Laboratories)	1H, 1H, 2H, 2H-Perfluorodecyl acrylate (27905-45-9; **8:2 FTAcr**)	(50.0 ± 2.5) µg / mL in isooctane
10:2 FTAcr (Wellington Laboratories)	1H, 1H, 2H, 2H-Pefluorododecyl acrylate (17741-60-5; **10:2 FTAcr**)	(47.9 ± 2.4) µg / mL in isooctane
FBET (Wellington Laboratories)	2-Perflourobutyl ethanol (2043-47-2; **4:2 FTOH**)	(50.0 ± 2.5) µg/mL in methanol
5:2sFTOH (Wellington Laboratories)	1-Perfluoropentyl ethanol (914637-05-1; **5:2 FTOH**)	(50.0 ± 2.5) µg/mL in methanol
FHET (Wellington Laboratories)	2-Perfluorohexyl ethanol (647-42-7; **6:2 FTOH**)	(50.0 ± 2.5) µg/mL in methanol
7:2sFTOH (Wellington Laboratories)	1-Perfluoroheptyl ethanol (24015-83-6; **7:2 FTOH**)	(50.0 ± 2.5) µg/mL in methanol
FOET (Wellington Laboratories)	2-Perfluorooctyl ethanol (678-39-7; **8:2 FTOH**)	(50.0 ± 2.5) µg/mL in methanol
FDET (Wellington Laboratories)	2-Perfluorodecyl ethanol (865-86-1; **10:2 FTOH**)	(50.0 ± 2.5) µg/mL in methanol
8:2 FTOAc (Wellington Laboratories)	1H, 1H, 2H, 2H-Perfluorodecyl acetate (37858-04-1; **8:2 FTOAc**)	(48.5 ± 2.4) µg/mL in isooctane
10:2FTOAc (Wellington Laboratories)	1H, 1H, 2H, 2H-Perfluorododecyl acetate (37858-05-2; **10:2 FTOAc**)	(50.0 ± 2.5) µg/mL in isooctane
8:2 FTAcr (Wellington Laboratories)	1H, 1H, 2H, 2H-Perfluorodecyl acrylate (27905-45-9; **8:2 FTAcr**)	(50.0 ± 2.5) µg/mL in isooctane
10:2 FTAcr (Wellington Laboratories	1H, 1H, 2H, 2H-Perfluorododecyl acrylate (17741-60-5; **10:2 FTAcr**)	(47.9 ± 2.4) µg/mL in isooctane
2324-3-46 (Synquest Laboratories)	1H, 1H, 2H, 2H-Perfluorooctyl methacrylate (2144-53-8; **6:2 FTMAC**)	Neat (97 % Purity)
2324-3-42 (Synquest Laboratories)	1H, 1H, 2H, 2H-Perfluorodecyl methacrylate (1996-88-9; **8:2 FTMAC**)	Neat (97 % Purity)
2324-3-Y5 (Synquest Laboratories)	1H, 1H, 2H, 2H-Perfluorododecyl methacrylate (2144-54-9; **10:2 FTMAC**)	Neat (97 % Purity)

Table 40. Volatile internal standard PFAS purchased from Wellington Laboratories, including full analyte names, and analyte concentrations with expanded maximum combined percent relative uncertainty where provided.

Standard	Contents	Concentration
MFBET	2-Perfluorobutyl-[1,1,2,2-$^{2}H_4$]-ethanol	(48.5 ± 2.4) µg/mL in methanol
MFHET	2-Perfluorohexyl-[1,1-$^{2}H_2$]-[1,2-$^{13}C_2$]-ethanol	(50 ± 2.5) µg/mL in methanol
MFOET	2-Perfluorooctyl-[1,1-$^{2}H_2$]-[1,2-$^{13}C_2$]-ethanol	(50 ± 2.5) µg/mL in methanol
MFDET	2-Perfluorodecyl-[1,1-$^{2}H_2$]-[1,2-$^{13}C_2$]-ethanol	(50 ± 2.5) µg/mL in methanol

Table 41. Reference mass fractions for NIST Reference Material 8446 including mean value and expanded uncertainty with 95 % confidence.

PFAS	Mass Fraction (mg/kg)
PFHxA	59.1 ± 1.4
PFHpA	76.0 ± 7.2
PFOA	54.8 ± 2.2
PFNA	63.0 ± 1.4
PFDA	58.1 ± 4.0
PFUdA	62.8 ± 6.5
PFDoDA	59.5 ± 7.0
PFTrDA	62.9 ± 2.8
PFTeDA	58.0 ± 3.8
PFBA	43 ± 11
PFPeA	60.9 ± 0.9
FOSA	66.9 ± 1.7

Table 42. Reference mass fractions NIST Reference Material 8447 including mean value and expanded uncertainty with 95 % confidence.

PFAS	Mass Fraction (mg/kg)
PFBS	42.3 ± 2.3
PFHxS	55.2 ± 1.7
PFOS	56.6 ± 2.5

A.2. PFAS Analysis

PFAS analytical methods and quality control processes and limits were performed in an identical manner as reported in a previous NIST TN 2248 [21].

A.3. Quality Control Results

Each analytical sequence resulted in a range of quality control (QC) results. Reporting limits determined for each measurement (Section A.5.1), NIST RM 8446 and 8447 recoveries (Section A.5.2), as well as OS-FRM recovery (Section A.5.3) are detailed below.

A.3.1. Reporting Limits

Reporting limits determined for each PFAS measurement in structural firefighter gloves, hoods, and wildland firefighter gear textiles are listed above in **Table 3** – **Table 34**. Histograms of the reporting limits for measurements made with each of the three analytical methods are shown in **Fig. 9**. Most determined reporting limits were below 0.125 µg/kg for nonvolatile PFAS measurements (784 out of 1107) and below 0.625 µg/kg for semivolatile (102 out of 160) PFAS measurements. Reporting limits for volatile PFAS were much higher; out of 410 reported volatile GC measurements, no reporting limit was under 7.7 µg/kg, and 132 were over 100 µg/kg.

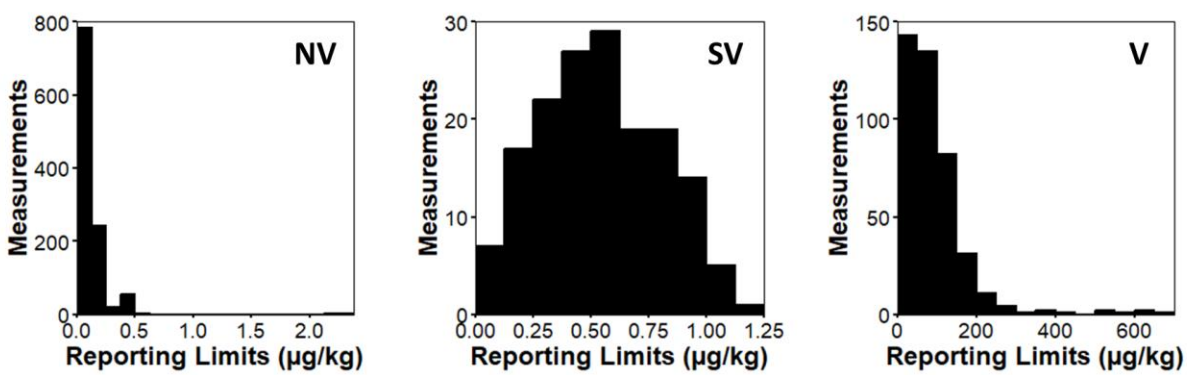

Fig. 9. Histograms of reporting limits for individual measurements of nonvolatile (NV; bin width = 0.125 µg/kg), semivolatile (SV; bin width = 0.125 µg/kg), and volatile PFAS (V; bin width = 50 µg/kg).

A.3.2. NIST Reference Materials 8446 and 8447

Nonvolatile PFAS concentrations in firefighter turnout gear textile extracts were determined across four analytical sequences. Gravimetric dilutions of NIST RMs 8446 Perfluorinated Carboxylic Acids and Perfluorooctane Sulfonamide in Methanol as well as 8447 Perfluorinated Sulfonic Acids in Methanol were prepared and analyzed with each sequence and measured concentrations were between 80.4 % - 119% of the reference values for all analytes (**Fig. 10).**

The recovery of all NIST RM 8446 and 8447 analytes suggests that calibration regressions determined with each nonvolatile analytical sequence were consistent and accurate.

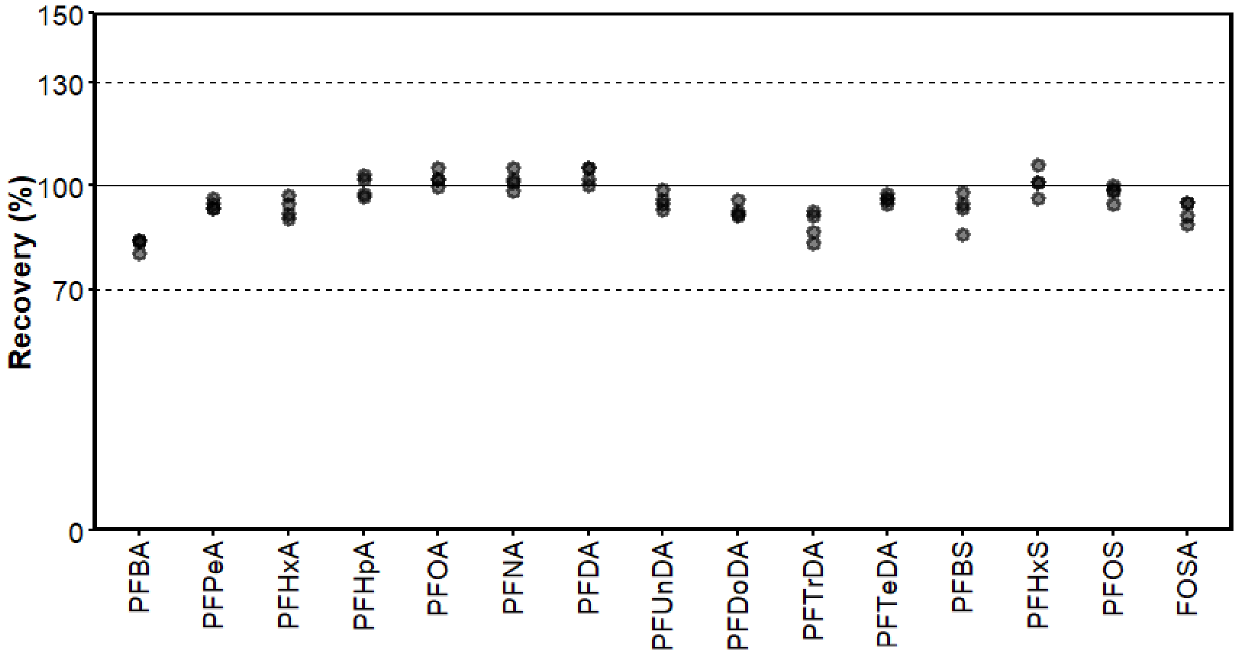

Fig. 10. Recovery of reference PFAS in NIST reference materials 8446 and 8447 across four analytical nonvolatile PFAS analytical sequences. 100 % recovery is indicated with a solid line while 70 % and 130 % recoveries are indicated with dashed lines.

A.3.3. Method Reproducibility Material OS-FRM

As described in NIST TN 2248 [21] and NIST TN 2260 [22], 400 firefighter gear outer shell textile OS-F samples were cut, weighed, and stored in 15 mL polypropylene centrifuge tubes as OS-FRM. Twelve were randomly selected and analyzed for nonvolatile, semivolatile, and volatile PFAS to determine baseline values. Each extraction batch of 11 firefighter gear samples was extracted with an additional single cutting of OS-FRM to demonstrate extraction consistency and calibration accuracy. Recoveries are shown in **Fig. 11**. Some recoveries are not shown because the measured concentration was below the sample and analyte specific reporting limit.

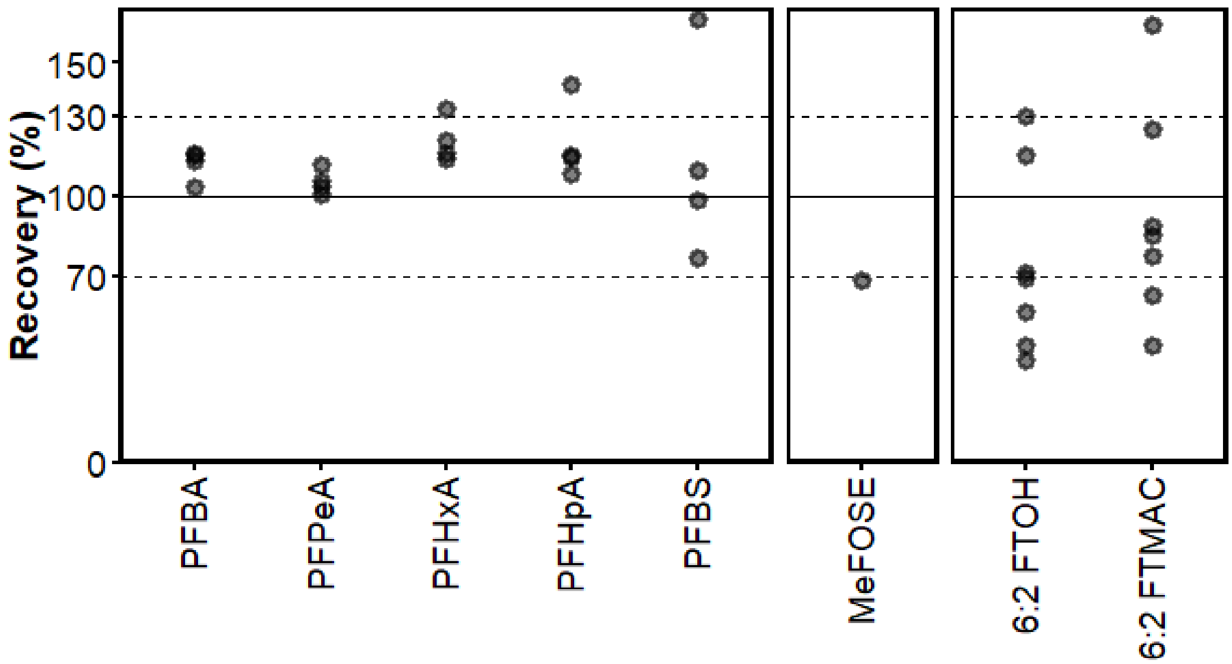

Fig. 11. Recovery PFAS with previously measured concentration over 0.5 µg/kg in OS-FRM across four analytical nonvolatile extraction batches, five semivolatile extraction batches, and six volatile extraction batches. Some recoveries are not shown because the measured concentration was below the sample and analyte specific reporting limit.

Appendix B. List of Symbols, Abbreviations, and Acronyms

10:2 FTAcr
10:2 fluorotelomer acrylate

4:2 FTS
4:2 fluorotelomer sulfonate

6:2 FTMAC
6:2 fluorotelomer methacrylate

6:2 FTOH
6:2 fluorotelomer alcohol

6:2 FTS
6:2 fluorotelomer sulfonate

8:2 FTAcr
8:2 fluorotelomer acrylate

ADONA
4,8-Dioxa-3H-perfluorononanoate

AFFF
Aqueous film-forming foams

CAS RN
Chemical Abstract Service Registry Number

9Cl-PF3ONS
9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid

11Cl-PF3OUdS
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid

DWR
Durable water repellent

ePTFE
Expanded polytetrafluoroethylene

EtFOSA
N-Ethyl perfluorooctane sulfonamide

EtFOSAA
N-Ethyl perfluorooctane sulfonamido acetic acid

EtFOSE
N-Ethyl perfluorooctane sulfonamido ethanol

FASA
Perfluoroalkane sulfonamide

FASAA
Per- and polyfluoroalkane sulfonamido acetic acid

FASE
Perfluoroalkane sulfonamido ethanol

FBSA
Perfluorobutane sulfonamide

FHxSA
Perfluorohexane sulfonamide

FOSA
Perfluorooctane sulfonamide

FOSAA
Perfluorooctane sulfonamido acetic acid

FT
Fluorotelomerization

GC-MS
Gas chromatography-mass spectrometry

HFPO-DA
Hexafluoropropylene oxide dimer acid

HPLC
High-performance liquid chromatography

INJ
Injection standard

IS
Internal standard

LC
Liquid chromatography

MB
Moisture barrier

MeFBSA
N-Methyl perfluorobutane sulfonamide

MeFBSE
N-Methyl perfluorobutane sulfonamidoethanol

MeFOSA
N-Methyl perfluorooctane sulfonamide

MeFOSAA

N-Methyl perfluorooctane sulfonamido acetic acid

MeFOSE
N-Methyl perfluorooctane sulfonamido ethanol

MS
Mass spectrometry

MS/MS
Tandem mass spectrometry

n:2 FTAcr
n:2 fluorotelomer acrylate

n:2 FTOAc
n:2 fluorotelomer acetate

n:2 FTOH
n:2 fluorotelomer alcohol

n:2 FTMAC
n:2 fluorotelomer methacrylate

n:2 FTS
n:2 fluorotelomer sulfonate

NFPA
National Fire Protection Association

NIST
National Institute of Standards and Technology

NIST TN
National Institute of Standards and Technology Technical Note

3-6-OPFHpA
Perfluoro-3,6-dioxaheptanoic acid

OS
Outer shell

PBI
Polybenzimidazole

PF4OPeA
Perfluoro-3-methoxypropanoic acid

PF5OHxA
Perfluoro-4-methoxybutanoic acid

PFAS
Per- and polyfluoroalkyl substances

PFBA
Perfluorobutanoic acid

PFBS
Perfluorobutane sulfonic acid

PFCA
Perfluorocarboxylic acid

PFDA
Perfluorodecanoic acid

PFDoDA
Perfluorododecanoic acid

PFDS
Perfluorodecane sulfonic acid

PFEESA
Perfluoro-2-ethoxyethane sulfonic acid

PFHpA
Perfluoroheptanoic acid

PFHpS
Perfluoroheptane sulfonic acid

PFHxA
Perfluorohexanoic acid

PFHxS
Perfluoro hexane sulfonic acid

PFNA
Perfluorononanoic acid

PFNS
Perfluorononane sulfonic acid

PFOA
Perfluorooctanoic acid

PFOS
Perfluorooctane sulfonic acid

PFPeA
Perfluoropentanoic acid

PFPeS
Perfluoropentane sulfonic acid

PFPrS
Perfluoropropane sulfonic acid

PFSA
Perfluoroalkane sulfonic acid

PFTeDA
Perfluorotetradacanoic acid

PFTrDA
Perfluorotridecanoic acid

PFUnDA
Perfluoroundecanoic acid

PPEA
Per- and polyfluoroalkyl ether acid

PTFE
Polytetrafluoroethylene

QC
Quality control

RL
Reporting limit

RM
Reference material

SCBA
Self-contained breathing apparatus

SPE
Solid phase extraction

TL
Thermal liner