

## NIST Technical Note NIST TN 2248

# Per- and Polyfluoroalkyl Substances in New Firefighter Turnout Gear Textiles

Andrew C. Maizel Andre Thompson Meghanne Tighe Samuel Escobar Veras Alix E. Rodowa Ryan Falkenstein-Smith Bruce Benner Kathleen Hoffman Michelle Donnelly Oliva Hernandez Nadine Wetzler Trung Ngu Jessica Reiner Benjamin Place John Kucklick Catherine Rimmer Rick D. Davis

This publication is available free of charge from: https://doi.org/10.6028/NIST.TN.2248



## NIST Technical Note NIST TN 2248

# Per- and Polyfluoroalkyl Substances in New Firefighter Turnout Gear Textiles

Rick D. Davis
Michelle Donnelly
Samuel Escobar Veras
Ryan Falkenstein-Smith
Oliva Hernandez\*
Kathleen Hoffman
Andrew C. Maizel
Trung Ngu\*
Andre Thompson
Meghanne Tighe
Nadine Wetzler\*
Fire Research Division
Engineering Laboratory

Bruce Benner
John Kucklick
Benjamin Place
Jessica Reiner
Catherine Rimmer
Alix E. Rodowa
Chemical Sciences Division
Material Measurement Laboratory

\*Former NIST employees; all work for this publication was conducted while at NIST.

This publication is available free of charge from: https://doi.org/10.6028/NIST.TN.2248

May 2023



U.S. Department of Commerce *Gina M. Raimondo, Secretary* 

This work was carried out by the National Institute of Standards and Technology (NIST), an agency of the US government, and, by statue, is not subject to copyright in USA. Certain commercial entities, equipment, or materials may be identified in this document in order to describe an experimental procedure or concept adequately. Such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the entities, materials, or equipment are necessarily the best available for the purpose. The policy of NIST is to use metric units of measurement in all its publications, and to provide statements of uncertainty for all original measurements. In this document, however, data from organizations outside NIST are shown, which may include measurements in non-metric units or measurements without uncertainty statements.

#### **NIST Technical Series Policies**

Copyright, Fair Use, and Licensing Statements
NIST Technical Series Publication Identifier Syntax

#### **Publication History**

Approved by the NIST Editorial Review Board on 2023-02-22

#### **How to Cite this NIST Technical Series Publication**

Maizel AC, Thompson A, Tighe M, Escobar Veras S, Rodowa AE, Falkenstein-Smith R, Benner B, Hoffman K, Donnelly M, Hernandez O, Wetzler N, Ngu T, Reiner J, Place B, Kucklick J, Rimmer C, Davis RD (2023) Per- and Polyfluoroalkyl Substances in New Firefighter Turnout Gear Textiles. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Technical Note (TN) NIST TN 2248. https://doi.org/10.6028/NIST.TN.2248

#### **NIST Author ORCID iDs**

Andrew C. Maizel: 0000-0002-2981-5241 Andre Thompson: 0000-0001-5717-6902 Meghanne Tighe: 0000-0002-8930-892X Samuel Escobar Veras: 0000-0002-0700-3250 Alix E. Rodowa: 0000-0002-3990-2111 Ryan Falkenstein-Smith: 000-0001-7039-5835

Kathleen Hoffman: 0000-0003-4320-0742 Michelle Donnelly: 0000-0003-1800-5515 Jessica Reiner: 0000-0002-1419-6062 Benjamin Place: 0000-0003-0953-5215 John Kucklick: 0000-0003-0327-0519 Catherine Rimmer: 0000-0001-6734-6629 Rick D. Davis: 0000-0003-2264-0490

Bruce Benner: 0000-0002-7589-5625

#### **Contact Information**

rick.davis@nist.gov

#### **Abstract**

Turnout gear is increasingly recognized as a potential source of per- and polyfluoroalkyl substance (PFAS) exposure to firefighters. To determine the identity, concentration, and prevalence of PFAS potentially present in new firefighter turnout gear, fifty-three nonvolatile, semivolatile, and volatile PFAS were quantified in twenty textiles used in the construction of firefighter turnout gear. Between one and 17 PFAS were observed and quantified in each textile, with higher numbers of detections, and higher concentrations of PFAS present in moisture barrier and outer shell textiles compared with thermal liner textiles. 6:2 fluorotelomer methacrylate, 6:2 fluorotelomer alcohol, and 6:2 fluorotelomer sulfonic acid are all fluorotelomerization-derived PFAS with six perfluorinated carbons and they were quantified at the highest concentrations of any PFAS, up to 1,520  $\mu$ g/kg  $\pm$  130  $\mu$ g/kg (mean  $\pm$  standard deviation of triplicate measurements of single textile),  $613 \mu g/kg \pm 15 \mu g/kg$  and  $393 \mu g/kg \pm 98$ µg/kg, respectively. These three PFAS were not detected in outer shells that had not received fluoropolymer treatments, which could indicate their presence is related to the application of side-chain fluorinated polymers. Also widely observed were two compounds with four perfluorinated carbons: perfluorobutane sulfonic acid and perfluorobutane sulfonamide. Perfluorocarboxylic acids, especially those with fewer than six perfluorinated carbons, were nearly universally identified in turnout gear textiles but at concentrations below 40 µg/kg. In contrast, PFAS with eight or more perfluorinated carbons, such as perfluorooctane sulfonic acid, were present at summed concentrations below 2 µg/kg in all textiles. Summed PFAS concentrations varied widely among each textile type which suggests that the amount of PFAS present in new turnout gear may depend on the specific textiles used in gear manufacturing.

## Keywords

Durable water repellent; firefighter; moisture barrier; outer shell; per- and polyfluoroalkyl substances; PFAS; turnout gear; thermal liner.

## **Table of Contents**

1. Introduction	12
2. Materials and Methods	13
2.1. Materials	13
2.2. Firefighter Turnout Gear Textiles	14
2.3. PFAS Analytical Standards	14
2.4. Chemical Analysis of PFAS in Firefighter Turnout Gear 1	extiles18
3. Results	18
4. Discussion	21
5. Summary	24
6. Future Work	24
7. References	45
Appendix A. Experimental Details	48
A.1. Firefighter Turnout Gear	48
A.2. PFAS Standards	51
A.3. Extraction and Analysis of PFAS in Firefighter Turnout G	ear Textiles59
A.3.1. Extraction of Nonvolatile PFAS	59
A.3.2. Extraction of Semivolatile and Volatile PFAS	59
A.3.3. HPLC-MS/MS Analysis of Nonvolatile and Semivolatile	PFAS60
A.3.4. GC-MS Analysis of Volatile PFAS	68
A.4. Quality Control Materials	70
A.4.1. Nonvolatile PFAS	70
A.4.2. Semivolatile PFAS	70
A.4.3. Volatile PFAS	71
A.4.4. Method Reproducibility Material (OS-FRM)	71
A.5. Data Processing and Sequence Quality Control Parameter	ers71
A.5.1. Nonvolatile and Semivolatile PFAS	71
A.5.2. Volatile PFAS	73
A.5.3. Reporting Limits	73
A.6. Quality Control Results	74
A.6.1. Textile Extraction Blanks and Background Correction .	74
A.6.2. Reporting Limits	74
A.6.3. NIST Reference Materials 8446 and 8447	75
A.6.4. Method Reproducibility Material (OS-FRM)	76
A.7. Appendix References	78
A.8. Abbreviations	79

## **List of Tables**

<b>Table 1.</b> Class names and abbreviations as well as individual compound names, abbreviations, analytical method used for quantification (i.e., nonvolatile, semivolatile, or volatile) as well as Chemical Abstract Service Registry Numbers (CAS RN) of all PFAS analyzed in this publication.
<b>Table 2.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-A. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 3.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-B. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 4.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-C. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 5.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-D. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 6.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-E. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 7.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-F. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile
<b>Table 8.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-A. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile
<b>Table 9.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-ASC. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 10.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-B. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 11.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-C. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 12.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-D. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 13.</b> PFAS concentrations and reporting limits (RL; $\mu$ g PFAS/kg textile) in outer shell textile OS-E. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
Table 14. PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-F. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 15.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-FSC. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for
<b>Table 16.</b> PFAS concentrations and reporting limits (RL; $\mu$ g PFAS/kg textile) in outer shell textile OS-G. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
39

<b>Table 17.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-A. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile40
<b>Table 18.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-B. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile41
<b>Table 19.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-C. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile42
<b>Table 20.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-D. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 21.</b> PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-E. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.
<b>Table 22.</b> Area densities (mean ± standard deviation of triplicate measurements; kg/m²) and images of firefighter turnout gear textiles evaluated in this technical note
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
<b>Table 24.</b> 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
expanded maximum combined percent relative uncertainty where provided
combined percent relative uncertainty where provided
relative uncertainty where provided
Table 29. Reference mass fractions for NIST Reference Material 8446 including mean value         and expanded uncertainty with 95 % confidence
expanded uncertainty with 95 % confidence
<b>Table 32.</b> PFAS-specific MRM parameters for nonvolatile PFAS analysis: Precursor and product ion m/z (M1 and M2, respectively), depolarization energy (DP), collision energy (CE), collision cell exit potential (CXP), entrance potential (EP), and LC retention time (RT). Qualifier ions are indicated with "-q." Injection standard ions are indicated with "INJ." Internal standard ions (IS) were analyzed with the same electronic settings as the corresponding target PFAS62 <b>Table 33.</b> MRM parameters for semivolatile PFAS: Precursor and product ion m/z (M1 and M2), depolarization energy (DP), collision energy (CE), collision cell exit potential (CXP), entrance potential (EP), and LC retention time (RT). Qualifier ions are indicated with "-q." Injection

standard ions are indicated with "INJ." Internal standard ions were analyzed with the same electronic settings as the corresponding target PFAS.	64
Table 34. Optimized source and gas parameters for nonvolatile and semivolatile PFAS analys	sis.
Table 35. Optimized primary (quantifier) and secondary (qualifier) ions (m/z), retention times,           and internal standards for each target analyte	
<b>Table 36</b> . Average and standard deviation of PFAS concentrations (ug/kg) in twelve replicates of OS-FRM. PFAS concentrations that were below the reporting limit were not included in	
average and standard deviation calculations	.77

## **List of Figures**

<b>Fig. 1.</b> Average PFAS concentrations determined from triplicate analysis of firefighter turnout
gear textiles. Average concentration is indicated by shade (legend at right). Measurements that
could not be reported due to QC standards not being met are indicated with white. µg PFAS/kg
textile is equivalent to ppb mass ratio. Measured PFAS concentrations in firefighter turnout gear
textiles are also presented in Tables 2 - 21
Fig. 2. Summed PFAS concentrations in firefighter turnout gear textiles according to textile type
(MB = moisture barrier, OS = outer shell, SC = non-DWR treated outer shell, TL = thermal liner).
Error bars indicate the combined standard uncertainty of the summed PFAS concentrations. Bar
color indicates PFAS class
Fig. 3. Summed PFAS concentrations in individual turnout gear textiles determined here as well
as similar measurements from three recent reports [1-3]. Measurements from each report are
ordering from left to right in increasing summed concentrations. The textile type (MB for
moisture barrier, OS for outer shell, TL for thermal liner, and Unspecified when the specific
layers analyzed are not known) is indicated by the marker shade23
<b>Fig. 4.</b> Extracted ion chromatogram from injection of 5 $\mu$ L (5 x 10 <sup>-9</sup> m <sup>3</sup> ) of approximately 50
ng/mL (5 x 10 <sup>4</sup> μg/m <sup>3</sup> ) of each perfluorocarboxylic acid (PFCA) in a calibration standard65
<b>Fig. 5.</b> Extracted ion chromatogram from injection of 5 μL (5 x 10 <sup>-9</sup> m <sup>3</sup> ) of approximately 50
ng/mL (5 x $10^4$ µg/m <sup>3</sup> ) of each perfluoroalkane sulfonic acid (PFSA) in a calibration standard.
Peaks derived from branched isomers of PFHxS and PFOS precede the linear isomer peaks .65
<b>Fig. 6.</b> Extracted ion chromatogram from injection of 5 $\mu$ L (5 x 10 <sup>-9</sup> m <sup>3</sup> ) of approximately 50
ng/mL (5 x $10^4$ µg/m <sup>3</sup> ) of each perfluoroalkane sulfonamide (FASA) in a calibration standard65
<b>Fig. 7.</b> Extracted ion chromatogram from injection of 5 μL (5 x 10 <sup>-9</sup> m <sup>3</sup> ) of approximately 50
ng/mL (5 x $10^4$ µg/m <sup>3</sup> ) of each per- and polyfluoroalkane sulfonamido acetic acid (FASAAs) in a
calibration standard. Peaks derived from branched isomers of MeFOSAA and EtFOSAA
precede the linear isomer peaks
Fig. 8. Extracted ion chromatogram from injection of 5 µL (5 x 10 <sup>-9</sup> m³) of approximately 50
ng/mL (5 x 10 <sup>4</sup> μg/m <sup>3</sup> ) of each n:2 fluorotelomer sulfonate PFAS in a calibration standard66
<b>Fig. 9.</b> Extracted ion chromatogram from injection of 5 µL (5 x 10 <sup>-9</sup> m <sup>3</sup> ) of approximately 50
ng/mL (5 x 10 <sup>4</sup> μg/m³) of each PPEA in a calibration standard
Fig. 10. Extracted ion chromatograms from injection of 5 µL (5 x 10 <sup>-9</sup> m <sup>3</sup> ) of approximately 10
ng/mL (10 <sup>4</sup> μg/m³) each of MeFBSA, MeFOSA, and EtFOSA in a calibration standard67
Fig. 11. Extracted ion chromatograms from injection of 5 µL (5 x 10 <sup>-9</sup> m <sup>3</sup> ) of approximately 10
ng/mL (10 <sup>4</sup> μg/m³) each of MeFOSE and EtFOSE in a calibration standard
Fig. 12. Extracted ion chromatograms from injection of 5 μL (5 x 10 <sup>-9</sup> m <sup>3</sup> ) of approximately 2
ng/mL(2 x 10 <sup>3</sup> μg/m <sup>3</sup> ) of each injection standard PFAS
Fig. 13. Extracted ion chromatograms from injection of 3 µL (3 x 10 <sup>-9</sup> m³) of a calibration
standard containing approximately 200 ng/mL (2 x 10 <sup>5</sup> µg/m <sup>3</sup> ) of each of five fluorotelomer
alcohols
Fig. 14. Extracted ion chromatograms from injection of 3 µL (3 x 10 <sup>-9</sup> m³) of a calibration
standard containing approximately 200 ng/mL (2 x 10 <sup>5</sup> µg/m <sup>3</sup> ) each of two fluorotelomer
acetates and two fluorotelomer acrylates
Fig. 15. Extracted ion chromatograms from injection of 3 µL (3 x 10 <sup>-9</sup> m <sup>3</sup> ) of a calibration
standard containing approximately 1,000 ng/mL (10 <sup>6</sup> µg/m <sup>3</sup> ) each of 6:2 and 8:2 fluorotelomer
methacrylate as well as approximately 500 ng/mL (5 x 10 <sup>5</sup> μg/m³) of 10:2 fluorotelomer
methacrylate
Fig. 16. Histograms of reporting limits for individual measurements of (a) all nonvolatile PFAS
(binwidth = 1 $\mu$ g/kg), (b) all semivolatile PFAS (binwidth = 1 $\mu$ g/kg), and (c) all volatile PFAS
(binwidth = $100 \mu g/kg$ )

Fig. 17. Recoveries of reference PFAS in NIST reference materials 8446 and 8447 ac	ross four
nonvolatile PFAS analytical batches. 100 % recovery is indicated with a solid line while	
and 130 % recoveries are indicated with dashed lines	75
Fig. 18. OS-FRM recovery across four nonvolatile/LC batches, one semivolatile batch	, and two
GC batches. 100 % recovery is indicated with a solid line while 70 % and 130 % recov	eries are
indicated with dashed lines	78

#### **Preface**

To determine whether firefighters may be exposed to per- and polyfluoroalkyl substances (PFAS) present in their turnout gear, 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," directed the National Institute of Standards and Technology (NIST) to "complete a study of the contents and composition of new and unused personal protective equipment worn by firefighters." And further, that this study shall examine "the identity, prevalence, and concentration of per- and polyfluoroalkyl substances (commonly known as "PFAS") in the personal protective equipment worn by firefighters...." In response to this directive, the Fire Research Division (FRD) in the NIST Engineering Laboratory began an investigation of PFAS concentrations in new textiles used in the construction of firefighter turnout gear. This investigation commenced with obtaining moisture barrier, outer shell, and thermal liner textiles from a commercial vendor of firefighting equipment. Additionally, two outer shell textiles that had not been treated with a fluoropolymer water repellent were obtained from the Division of Field Studies and Engineering – Field Research Branch of the National Institute of Occupational Safety & Health. The FRD established an analytical laboratory in which procedures for the extraction of PFAS from firefighter turnout gear textiles were developed and performed while analytical methods for PFAS quantitation in extracts of turnout gear textiles were developed through a collaboration with the NIST Chemical Sciences Division (CSD). A team of researchers in the FRD and CSD met routinely to refine experimental approaches, set quality control standards, and discuss results.

This publication contains the first findings of the NIST study on PFAS in firefighter personal protective equipment, detailing the targeted analysis of 53 nonvolatile, semivolatile, and volatile PFAS in textiles used to manufacture firefighter turnout gear. Upcoming reports will quantify PFAS concentrations in assembled gear, including gloves and hoods, as well as address additional requirements of the Guaranteeing Equipment Safety for Firefighters Act of 2020 that instruct NIST to determine the extent to which PFAS are released from turnout gear through the degradation of that gear during its typical use.

NIST TN 2248 May 2023

### **Acknowledgments**

We thank United States Senator Jeanne Shaheen and her staff for their support of PFAS-fire fighter gear research at NIST. Additionally, we thank Crystal Forester from the National Personal Protective Technology Laboratory (NPPTL) for providing scoured firefighter turnout gear textiles.

#### **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; Oliva Hernandez: Investigation; Kathleen Hoffman: Investigation; John Kucklick: Validation; Andrew Maizel: Conceptualization, Formal Analysis, Investigation, Methodology, Supervision, Validation, Writing; Trung Ngu: Investigation; Benjamin Place: Resources, Validation, Writing – review & editing; 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; Meghanne Tighe: Investigation, Supervision; Nadine Wetzler: Investigation.

#### 1. Introduction

Per- and polyfluoroalkyl substances (PFAS) comprise a diverse class of anthropogenic materials that include dozens of compounds previously documented in firefighter turnout gear and other high-performance outerwear [1-3]. To impart water resistance to textiles, PFAS are typically added as fluorinated polymers either in porous membranes, such as expanded polytetrafluoroethylene (ePTFE) fluoropolymers, or applied treatments featuring side-chain fluorinated polymers which consist of nonfluorinated polymer backbones and polyfluorinated side chains [4]. PFAS used in the production of side-chain fluorinated polymers are manufactured through one of two processes, electrochemical fluorination (ECF) or fluorotelomerization (FT), and certain molecular structures are considered characteristic of PFAS manufactured by each process [4, 5]. For example, PFAS containing perfluorinated chains connected directly to sulfonamide or sulfonate functional groups are associated with ECF-manufacturing while PFAS with alkyl chains that are perfluorinated except for two non-fluorinated carbons which connect the perfluorinated chain to terminal functional groups are associated with FT-manufacturing [4].

Turnout gear protects firefighters from "thermal, physical, environmental, and bloodborne pathogen hazards encountered during structural firefighting operations [6]." In the United States, performance specifications for turnout gear are specified in the National Fire Protection Association (NFPA) Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting (NFPA 1971) [6] as well as NFPA Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting (NFPA 1851) [7]. Turnout gear typically includes pants and a jacket, each with three layers: an outer shell on the outside of the garment, a moisture barrier beneath the outer shell, and a thermal liner closest to the firefighter's body [6]. NFPA 1971 § 8.62 ("Light Degradation Resistance Test") requires that moisture barriers maintain hydrostatic resistance following exposure to simulated sunlight and humidity [6], while NFPA 1971 §7.1.18 specifies a maximum water absorption for outer shell textiles [6]. To meet these specifications, moisture barrier and outer shell textiles may include ePTFE membranes or durable water repellent (DWR) treatments featuring side-chain fluorinate polymers [2].

Examinations of PFAS in firefighter turnout gear and dust from firefighter gear storage facilities have identified fluorinated polymers as well as numerous PFAS classes including perfluorocarboxylic acids (PFCAs), perfluoroalkane sulfonic acids (PFSAs), and n:2 fluorotelomer alcohols (n:2 FTOHs) [1-3, 8]. While PFAS concentrations in fluorinated polymer treated textiles have been shown to increase with weathering, PFAS have also been identified in new turnout gear, which may indicate they are residual materials from fluorinated polymer manufacturing [1, 9]. These residual materials may be PFAS monomers that were not completely incorporated into fluorinated polymers or "processing aids" used in fluorinated polymer production [4]. Historically, long-chain (i.e., containing eight or more perfluorinated carbons) PFCAs were used as processing aids, but these have at least partially been replaced by per- and polyfluoroalkyl ether acids (PPEA) such as 4,8-dioxa-3H-perfluorononanoate (ADONA) or hexafluoropropylene oxide dimer acid (HFPO-DA) [4, 10]. A recent examination of fluoropolymers manufactured in China observed both long-chain PFCAs as well as perfluoropolyethers in the finished products [11].

Employment as a firefighter has been found to correlate with higher serum PFAS concentrations, especially for those directly engaged in firefighting activities [12, 13], and numerous potential PFAS exposure pathways for firefighters have been documented, including fire scenes, aqueous film-forming foams [14], food grown at fire stations [15], and firefighter turnout gear [1-3]. The health effects of PFAS exposure are a subject of extensive ongoing research. For example, cancer incidence data are only available for a subset of known PFAS (e.g., perfluorooctanoic acid [PFOA] and perfluorooctane sulfonic acid [PFOS]) [16, 17]. PFOA has been categorized as a class 2B human carcinogen [18], and the US Environmental Protection Agency (EPA) has classified PFOA and PFOS as likely human carcinogens and HFPO-DA as a suggestive human carcinogen [19-24]. Recent EPA toxicological assessments for HFPO-DA, perfluorobutane sulfonic acid (PFBS), PFOA, and PFOS have cited concern over suppression of vaccine response (PFOA and PFOS), liver lesions (HFPO-DA), and decreased serum thyroid hormone serum concentrations (PFBS) as the critical health effects used to determine chronic reference dose [25-28]. Toxicity studies of oral PFHxS exposure to animals also have reported health effects on the liver, thyroid, and development [29]. Additionally, studies of oral PFNA exposure in rodents have reported adverse effects on the liver, development, and reproductive and immune systems [29].

This publication describes research performed in response to the Fiscal Year 2021 National Defense Authorization Act (H.R. 6395) [30], which directs the National Institute of Standards and Technology (NIST) to "examine...the identity, prevalence, and concentration of per- and polyfluoroalkyl substances...in the personal protective equipment worn by firefighters...." To quantify a broad cross section of PFAS, two extraction protocols and three analytical methods were developed and applied to determine the concentrations of 53 PFAS in 20 turnout gear textiles. The concentrations reported here will provide insight into the type and prevalence of PFAS that firefighters could be exposed to from wearing new turnout gear and will provide a baseline for future examinations of PFAS concentrations in weathered turnout gear.

#### 2. Materials and Methods

#### 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 was obtained from Supelco (Bellefonte, PA), while methanol (Optima LC-MS grade) for all other purposes was obtained from Thermo Fisher Scientific. 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  $\mu$ L) were obtained from Agilent Technologies (Santa Clara, CA). Polyethylene 2 mL vial caps for nonvolatile and semivolatile analysis were obtained from Phenomenex (Torrence, CA) while 2 mL vial caps with PTFE/silicone septa for volatile analysis were obtained from

<sup>&</sup>lt;sup>1</sup> Certain commercial equipment, instruments, or materials are identified in this paper to foster understanding. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

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 x  $10^{-5}$  m³) of 0.1 mol/L ( $10^2$  mol/m³) ammonium hydroxide in methanol and dried prior to 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  $\mu$ m, nylon) were obtained from Thermo Fisher and rinsed with 1 mL ( $10^{-6}$  m³) methanol prior to use.

#### 2.2. Firefighter Turnout Gear Textiles

A variety of turnout gear textiles was purchased in 2020 from a distributor and repairer of firefighter gear, who received the textiles from the original manufacturers. The textiles selected were representative of those commonly used in the construction of firefighter's jacket and pants (e.g., common fabric types, fabric constructions and manufacturers). When textiles differed only by color (same fabric type and construction, and manufacturer) only one color was included in the study. Other factors, such as cost/on sale and availability, were not considered. All textiles were purchased prior to assembly in firefighter turnout gear and were established to comply with the requirements of NFPA 1971 [6]. The textiles in this study were 1.39 m<sup>2</sup> (1.52 m x 0.914 m) each of six moisture barrier (MB-A, MB-B, MB-C, MB-D, MB-E, MB-F), five thermal liner (TL-A, TL-B, TL-C, TL-D, TL-E), and seven outer shell textiles (OS-A, OS-B, OS-C, OS-D, OS-E, OS-F, OS-G).

Two "scoured" outer shell textiles (OS-ASC, OS-FSC) were obtained from the Division of Field Studies and Engineering – Field Research Branch of the National Institute of Occupational Safety & Health. The "scoured" textiles were similar to two other outer shell textiles included in this study (i.e., OS-A and OS-F, respectively), except that no fluorinated polymer treatment had been applied and they were different colors. Due to the lack of DWR treatment, the two scoured outer shell textiles were not established to be NFPA 1971 compliant. Average area densities and pictures of all turnout gear textiles are shown in Appendix A.1 (Table 22).

Moisture barrier textiles were all comprised of an ePTFE membrane with an aramid fiber substrate while outer shell textiles were all comprised of aromatic polyamide (aramid) fiber blends that were woven with either plain, twill, or ripstop weave patterns. Thermal liner textiles consisted of aramid fiber or aramid-blend cloth, with one or two layers of attached aramid fiber batting. Prior to PFAS extractions all textiles were stored in separate sealed plastic containers in the dark at room temperature.

#### 2.3. PFAS Analytical Standards

The selection of PFAS for inclusion in this study was based on previous reports in the scientific literature, the professional experience of NIST researchers related to PFAS and firefighter gear, as well as conversations with subject matter experts outside NIST. Analytical standards were obtained for 53 PFAS including 11 PFCAs, eight PFSAs, six perfluoroalkane sulfonamides (FASA), three per- and polyfluoroalkane sulfonamido acetic acids (FASAA), two perfluoroalkane sulfonamido ethanols (FASE), eight PPEAs, six n:2 FTOHs, three n:2 fluorotelomer methacrylates (n:2 FTMAC), two n:2 fluorotelomer acetates (n:2 FTOAc), and four n:2 fluorotelomer sulfonates

NIST TN 2248 May 2023

(n:2 FTS). Information for all PFAS and their associated reference standards are provided in Table 1 and Appendix A.2 (Tables 23-28).

**Table 1.** Class names and abbreviations as well as individual compound names, abbreviations, analytical method used for quantification (i.e., nonvolatile, semivolatile, or volatile) as well as Chemical Abstract Service Registry Numbers (CAS RN) of all PFAS analyzed in this publication.

Class	Name	CAS RN
	Perfluorobutanoic acid (PFBA) - nonvolatile	375-22-4
•	Perfluoropentanoic acid (PFPeA) - nonvolatile	2706-90-3
	Perfluorohexanoic acid (PFHxA) - nonvolatile	307-24-4
	Perfluoroheptanoic acid (PFHpA) - nonvolatile	375-85-9
Perfluorocarboxylic	Perfluorooctanoic acid (PFOA) - nonvolatile	335-67-1
acids (PFCA)	Perfluorononanoic acid (PFNA) - nonvolatile	375-95-1
	Perfluorodecanoic acid (PFDA) - nonvolatile	335-76-2
	Perfluoroundecanoic acid (PFUnDA) - nonvolatile	2058-94-8
	Perfluorododecanoic acid (PFDoDA) - nonvolatile	307-55-1
	Perfluorotridecanoic acid (PFTrDA) - nonvolatile	72629-94-8
	Perfluorotetradacanoic acid (PFTeDA) - nonvolatile	0376-06-07
	Perfluoropropane sulfonic acid (PFPrS) - nonvolatile	423-41-6
	Perfluorobutane sulfonic acid (PFBS) - nonvolatile	375-73-5
D 01 11	Perfluoropentane sulfonic acid (PFPeS) - nonvolatile	2706-91-4
Perfluoroalkane	Perfluorohexane sulfonic acid (PFHxS) - nonvolatile	108427-53-8
sulfonic acids	Perfluoroheptane sulfonic acid (PFHpS) - nonvolatile	375-92-8
(PFSA)	Perfluorooctane sulfonic acid (PFOS) - nonvolatile	45298-90-6
	Perfluorononane sulfonic acid (PFNS) - nonvolatile	68259-12-1
	Perfluorodecane sulfonic acid (PFDS) - nonvolatile	335-77-3
	Perfluorobutane sulfonamide (FBSA) - nonvolatile	30334-69-1
	Perfluorohexane sulfonamide (FHxSA) - nonvolatile	41997-13-1
Perfluoroalkane	Perfluorooctane sulfonamide (FOSA) - nonvolatile	754-91-6
sulfonamides	N-Methyl perfluorobutane sulfonamide (MeFBSA) - semivolatile	68298-12-4
(FASAs	N-Methyl perfluorooctane sulfonamide (MeFOSA) – semivolatile	31506-32-8
	N-Ethyl perfluorooctane sulfonamide (EtFOSA) - semivolatile	4151-50-2
	Perfluorooctane sulfonamido acetic acid (FOSAA) - nonvolatile	2806-24-8
Perfluoroalkane sulfonamido acetic	N-Methyl perfluorooctane sulfonamido acetic acid (MeFOSAA) – nonvolatile	2355-31-9
acids (FASAA)	N-Ethyl perfluorooctane sulfonamido acetic acid (EtFOSAA) - nonvolatile	2991-50-6
Perfluoroalkane	<i>N</i> -Methyl perfluorooctane sulfonamido ethanol (MeFOSE) - semivolatile	24448-09-07
sulonamido ethanols (FASE)	<i>N</i> -Ethyl perfluorooctane sulfonamido ethanol (EtFOSE) - semivolatile	1691-99-2
	Perfluoro-3-methoxypropanoic acid (PF4OPeA) - nonvolatile	377-73-1
	Perfluoro-2-ethoxyethane sulfonic acid (PFEESA) - nonvolatile	113507-82-7
Per- and polyfluoroalkyl ether acids (PPEA)	Perfluoro-4-methoxybutanoic acid (PF5OHxA) - nonvolatile	863090-89-5
	Perfluoro-3,6-dioxaheptanoic acid (3-6-OPFHpA) - nonvolatile	151772-58-6
	Hexafluoropropylene oxide dimer acid (HFPO-DA) - nonvolatile	13252-13-6
	4,8-Dioxa-3H-perfluorononanoate (ADONA) - nonvolatile	958445-44-8
	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS) - nonvolatile	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS) - nonvolatile	763051-92-9

Table 1. (Continued)

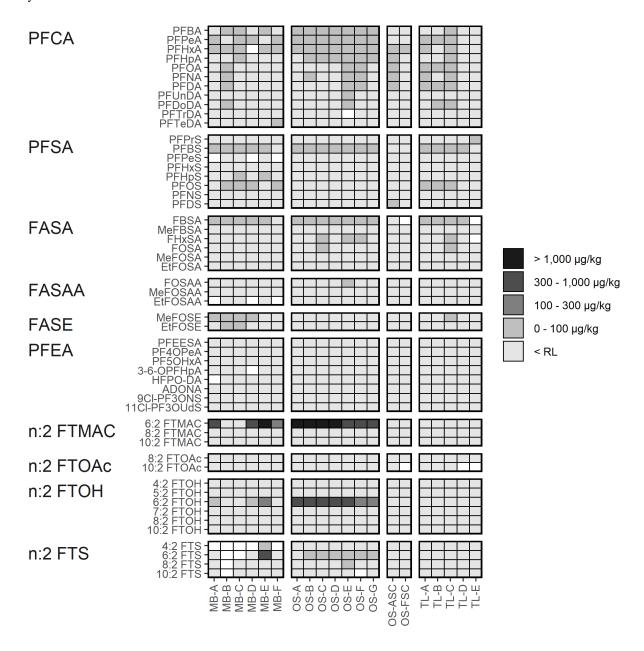
Class	Name	CAS RN
n:2 Fluorotelomer	6:2 Fluorotelomer methacrylate (6:2 FTMAC) - volatile	2144-53-8
methacrylates (n:2	8:2 Fluorotelomer methacrylate (8:2 FTMAC) - volatile	1996-88-9
FTMAC)	10:2 Fluorotelomer methacrylate (10:2 FTMAC) - volatile	2144-54-9
n:2 Fluorotelomer acetates	8:2 Fluorotelomer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

#### 2.4. Chemical Analysis of PFAS in Firefighter Turnout Gear Textiles

Three analytical procedures, referred to in this report as "nonvolatile," "semivolatile," and "volatile", were developed for the quantification of a chemically diverse set of 53 PFAS in firefighter turnout gear textiles. An extraction procedure for nonvolatile PFAS in firefighter turnout gear was derived from the method of Robel et al. [31]. Briefly, isotopically labeled PFAS internal standard solutions were added to turnout gear textile sections (approximately 0.1 g) before PFAS were extracted from the sections by three rounds of sonication in methanol. After each sonication round, extraction solvents were poured off and passed through ENVI-Carb SPE material to remove dyes. Following all three extraction rounds, the extraction solvents were combined and evaporated to dryness under nitrogen before being reconstituted in methanol. Subsequently, this method was adapted for the extraction of semivolatile and nonvolatile PFAS by replacing methanol with ethyl acetate as the extraction solvent and concentrating the extracts to 2 mL (2 x 10<sup>-6</sup> m<sup>3</sup>) instead of evaporating them to dryness to limit the loss of volatile PFAS. Nonvolatile and semivolatile PFAS were quantified with separate HPLC-MS/MS methods, while volatile PFAS were quantified with gas chromatography-mass spectrometry (GC-MS). Further details of the chemical analysis methods, including information regarding blank correction and the calculation of reporting limits (RL), can be found in Appendix A.

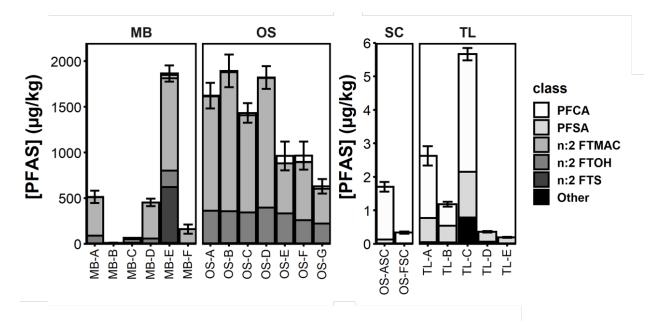
#### 3. Results

Across all 20 examined turnout gear textiles, 26 individual PFAS were quantified above the analyte- and sample-specific RLs, with between one and 17 PFAS quantified in each textile (Fig. 1, Tables 2-21). Perfluorocarboxylic acids, especially those with short perfluorinated chains (i.e., containing fewer than six perfluorinated carbons) were frequently quantified, with perfluorobutanoic acid (PFBA), perfluoropentanoic acid (PFPeA), and perfluorohexanoic acid (PFHxA) observed in 11, 14, and 16 textiles, respectively. Longer chain PFCAs, PFOA, perfluorononanoic acid (PFNA), and perfluorodecanoic acid (PFDA) were each detected in seven textiles while perfluoroheptanoic acid (PFHpA) was detected in nine and textiles. Also widely detected were PFBS and perfluorobutane sulfonamide (FBSA; both were detected in 16 textiles) as well as 6:2 fluorotelomer alcohol (6:2 FTOH; 10 textiles), 6:2 fluorotelomer methacrylate (6:2 FTMAC; 11 textiles), and 6:2 fluorotelomer sulfonic acid (6:2 FTS; seven textiles).



**Fig. 1.** Average PFAS concentrations determined from triplicate analysis of firefighter turnout gear textiles. Average concentration is indicated by shade (legend at right). Measurements that could not be reported due to QC standards not being met are indicated with white. μg PFAS/kg textile is equivalent to ppb mass ratio. Measured PFAS concentrations in firefighter turnout gear textiles are also presented in Tables 2 - 21.

In each moisture barrier textile, up to 11 individual PFAS were quantified above RLs (Fig. 1, Tables 2 – 7) and the highest individual concentrations were observed for FT-derived PFAS with six perfluorinated carbons: 6:2 FTMAC (up to 1,010 µg/kg  $\pm$  86 µg/kg; mean  $\pm$  standard deviation of triplicate measurements; MB-E; Table 6), 6:2 FTOH (up to 178.9 µg/kg  $\pm$  8.3 µg/kg; MB-E; Table 6), and 6:2 FTS (up to 613 µg/kg  $\pm$  15 µg/kg; MB-E; Table 6). Summed PFAS concentrations varied widely across moisture barrier textiles from 11.1 µg/kg  $\pm$  1.8 µg/kg (sum  $\pm$  combined standard uncertainty; MB-B; Fig. 2; Table 3) to 1,865 µg/kg  $\pm$  88 µg/kg (MB-E; Table 6). The wide range in summed PFAS concentrations derived from the variation in 6:2 FTMAC, 6:2 FTOH, and 6:2 FTS concentrations as summed PFAS concentrations were at least 161 µg/kg  $\pm$  51 µg/kg in moisture barrier textiles when at least one of these were detected, compared with at most 64.1 µg/kg  $\pm$  2.2 µg/kg when none were.



**Fig. 2.** Summed PFAS concentrations in firefighter turnout gear textiles according to textile type (MB = moisture barrier, OS = outer shell, SC = non-DWR treated outer shell, TL = thermal liner). Error bars indicate the combined standard uncertainty of the summed PFAS concentrations. Bar color indicates PFAS class.

Among DWR treated outer shell textiles, up to 17 individual PFAS were quantified above reporting limits and PFBS, 6:2 FTOH, and 6:2 FTMAC were universally detected while short-chain PFCAs were nearly universally detected (Fig. 1, Tables 8, 10-14, 16). Summed PFAS concentrations were more consistent than those observed for moisture barrier textiles, varying from 629 µg/kg  $\pm$  79 µg/kg (OS-G; Fig. 2; Table 16) to 1,890 µg/kg  $\pm$  180 µg/kg (OS-B; Table 10). 6:2 FTMAC (382 µg/kg  $\pm$  43 µg/kg to 1,520 µg/kg  $\pm$  130 µg/kg) and 6:2 FTOH (220 µg/kg  $\pm$  67 µg/kg to 393 µg/kg  $\pm$  98 µg/kg) were recorded in the highest concentrations of any PFAS and together made up at least 91 % of the summed PFAS mass in all treated outer shell textiles. Higher summed PFCA concentrations were observed in treated outer shell textiles than any other textile type, up to 81.4 µg/kg  $\pm$  1.4 µg/kg (OS-E; Table 13). However, PFCAs accounted for less than 9 % of the total summed PFAS mass in all treated outer shell textiles.

PFHxA was quantified in both scoured outer shell textiles while four other PFCAs (i.e., PFHpA, PFOA, PFNA, and PFDA) as well as PFDS were also quantified above the reporting limit in OSASC (Fig. 1, Tables 9, 15). No semivolatile, volatile, or FT-derived PFAS was quantified above the reporting limit in either scoured outer shell textile. Summed PFAS concentrations in the scoured outer shell textiles were between 0.335  $\mu$ g/kg  $\pm$  0.032  $\mu$ g/kg (OS-FSC; Fig. 2; Table 14) to 1.70  $\mu$ g/kg  $\pm$  0.15  $\mu$ g/kg (OS-ASC; Table 9), far below the summed concentrations recorded in treated outer shell textiles. The highest individual PFAS reported in scoured outer shell textiles was PFHxA in OS-ASC (0.59  $\mu$ g/kg  $\pm$  0.122  $\mu$ g/kg; Table 9).

Between one and 14 PFAS were quantified above the reporting limits in thermal liner textiles, though only a single semivolatile PFAS (i.e., *N*-methyl perfluorooctane sulonamido ethanol in TL-C; Table 19) and no volatile or FT-derived PFAS were quantified above reporting limits in any thermal liner textile. Most widely detected were FBSA and PFBS, which were each quantified in four of five thermal liner textiles, while PFPeA, PFOA, PFDA, and PFOS were each quantified in three of five. Summed PFAS concentrations in thermal liner textiles were much lower than those determined in moisture barrier or treated outer shell textiles and ranged from 0.190  $\mu$ g/kg  $\pm$  0.014  $\mu$ g/kg (TL-E; Fig. 2; Table 21) to 5.66  $\mu$ g/kg  $\pm$  0.19  $\mu$ g/kg (TL-C; Table 19). The highest individual PFAS concentration recorded in thermal liner textiles was PFBS in TL-C at 1.23  $\mu$ g/kg  $\pm$  0.08  $\mu$ g/kg (Table 19).

#### 4. Discussion

6:2 FTMAC and 6:2 FTOH are intermediates in the production of side-chain fluorinated acrylate polymers [4, 32] and have both been previously identified in turnout gear textiles [2, 3]. 6:2 FTMAC and 6:2 FTOH were either both detected, or both not detected, in 19 out of 20 textiles examined here. The presence of these FT-derived PFAS in moisture barrier textiles may indicate that these textiles were treated with side-chain fluorinated polymers in addition to their containing an ePTFE membrane. A related compound, 6:2 FTS is reported here at concentrations (i.e., 613  $\mu g/kg \pm 15 \mu g/kg$ ; MB-E; Table 6) up to over an order of magnitude higher than concentrations seen in other studies of turnout gear (i.e., up to 39.3 µg/kg) [1, 2]. 6:2 FTS has also been identified in high performance outdoor clothing, but at much lower concentrations than other fluorotelomer compounds such as 6:2 FTMAC or 6:2 FTOH [9]. While 6:2 FTS is an established environmental transformation product of other fluorotelomer-derived PFAS [4], the textiles analyzed in this publication were purchased prior to their assembly into turnout gear and stored in the dark at room temperature for approximately one year prior to extraction. Therefore, the detection of 6:2 FTS could indicate the compound is derived from textile manufacturing rather than transformation in the environment. Fluorotelomerization-derived PFAS with more or less than six perfluorinated carbons were not widely detected, with only 4:2 FTS and 8:2 FTS each being quantified in a single textile.

PFBS and FBSA are both ECF-derived PFAS with four perfluorinated carbons. They were both present above the reporting limit in the same 16 textiles and were observed in the highest concentrations (i.e.,  $8.6~\mu g/kg$  to  $34~\mu g/kg$ ) in MB-C and MB-E, which may indicate that they are derived from the same applied treatments. Short-chain PFSAs are used in water and stain repellent treatments, for example PFBS replaced PFOS as the active ingredient in a leading durable water repellent treatment since 2003 [32], and FASAs are raw materials for a range of fluorochemical

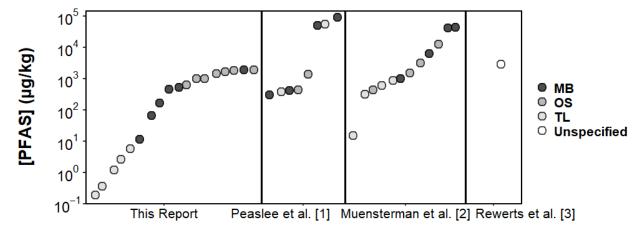
products including surface protection products [4]. Additionally, the four perfluorinated carbon compounds PFBS and N-methyl perfluorobutane sulonamidoethanol (MeFBSE) gave the highest observed PFAS concentrations in two recent investigations of PFAS in firefighter turnout gear [1, 2]. That both FT- and ECF-derived PFAS were widely quantified in the textiles studied here suggests that removing PFAS entirely from turnout gear would require multiple changes to firefighter turnout gear manufacturing.

While no individual PFCA was present above 40  $\mu$ g/kg in any textile, PFCAs were widely detected with at least one quantified above the reporting limit in 18 out of 20 textiles. This agrees with two previous studies of PFCA concentrations in 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  $\mu$ g/kg [1, 2]. The near ubiquity of low concentrations of PFCAs may reflect their use as fluoropolymer processing aids [4], indicate contaminated manufacturing facilities [11], or arise from cross-contamination during shipment and storage. That PFCAs were determined here to be present in untreated outer shell textiles at much lower concentrations than in treated outer shell textiles ( $\Sigma$ PFCAs = 0.335  $\mu$ g/kg  $\pm$  0.032  $\mu$ g/kg to 1.58  $\mu$ g/kg  $\pm$  0.14  $\mu$ g/kg in untreated outer shells vs. 5.32  $\mu$ g/kg  $\pm$  0.47  $\mu$ g/kg to 81.4  $\mu$ g/kg in treated outer shells) could indicate that the application of DWR treatments contributed PFCAs to treated outer shell textiles. PPEAs, replacement polymer processing aids for PFCAs, were not present above reporting limits in any textile (Fig. 1) which agrees with another recent examination of PFAS in firefighter gear that found none of four PPEAs to be present above detection limits in any examined turnout gear layer [2].

The large variation in summed PFAS concentrations among moisture barrier and treated outer shell textiles suggests that the amount of PFAS in new turnout gear varies according to the textiles used in manufacturing that gear (Fig. 2). For example, an article of turnout gear that contained the same mass of each textile layer would have almost six times as much summed mass of the PFAS reported here if it were constructed of MB-E, OS-B, and TL-C compared with a similar garment constructed of MB-B, OS-G, and TL-E. As all moisture barrier, DWR-treated outer shell, and thermal liner textiles examined here met NPFA standards for use in turnout gear, this finding suggests that the amount of PFAS present in new turnout gear might, in some cases, be lowered through the choice of commercially available textiles. However, while the summed PFAS concentrations in some moisture barrier and outer shell textiles approached 2,000 µg/kg, all thermal liner textiles had summed PFAS concentrations under 6 µg/kg. The low summed PFAS concentrations likely reflect the lack of fluorinated polymer treatments in thermal liner textiles that are not subject to moisture repellency standards. That thermal liners are the closest layer to firefighter skin in finished turnout gear 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 thermal liners as in other turnout gear textiles [1], and the results presented here may be specific to the PFAS and textiles examined in this study.

PFAS concentrations and types in turnout gear vary between this and other recent reports (Fig. 3) [1-3]. However, the use of dissimilar analytical methods and the examination of turnout gear manufactured in earlier decades likely contributed to some of the apparent differences in PFAS concentrations. Peaslee et al. [1] quantified nonvolatile PFAS in turnout gear layers produced between 2008 and 2017 with 2 x 10<sup>3</sup> mol NaOH/m<sup>3</sup> water as an extraction solvent and reported

PFBS concentrations up to  $90,400~\mu g/kg$  (Fig. 3). However, the use of this basic extraction solution resulted in PFBS measurements in fire station dust that were over 100 times higher than equivalent measurements made with methanol [1]. Therefore the reported PFBS concentrations may be affected by the transformation of other nonpolymer PFAS into PFBS or the base-mediated hydrolysis of fluorinated polymers [33]. PFAS concentrations determined using methanol as an extraction solution may provide better insight into the nonpolymer PFAS concentrations currently present in turnout gear textiles while basic extraction solutions may better probe the amount of nonpolymer PFAS that could be released during textile lifetimes. Muensterman et al. [2] reported summed nonvolatile and volatile PFAS concentrations up to  $43,000~\mu g/kg$  in firefighter pants layers produced in 2008 or 2019. However, the highest concentrations reported (i.e., MeFBSE at approximately  $40,000~\mu g/kg$  in two moisture barriers) were determined without the use of a known concentration MeFBSE reference standard.



**Fig. 3.** Summed PFAS concentrations in individual turnout gear textiles determined here as well as similar measurements from three recent reports [1-3]. Measurements from each report are ordering from left to right in increasing summed concentrations. The textile type (MB for moisture barrier, OS for outer shell, TL for thermal liner, and Unspecified when the specific layers analyzed are not known) is indicated by the marker shade.

Finally, Rewerts et al. [3] measured volatile PFAS in a used turnout gear jacket and quantified n:2 FTOHs with 6, 8, 10, and 12 perfluorinated carbons at individual concentrations up to 1,800 µg/kg (8:2 FTOH). These findings do not align with the results reported here which found PFAS with eight or more perfluorinated carbons were all present at summed concentrations under 2 µg/kg in all textiles. As the textiles examined in this study were commercially available in 2020, the low observed concentrations of long-chain PFAS was likely a result of the US EPA 2010/15 PFOA Stewardship Program, through which eight major producers of fluoropolymers and telomer manufacturers agreed to eliminate PFOA and its likely precursors (i.e., PFAS containing more than six perfluorinated carbons) from products and emissions by 2015. The jacket examined in Rewets et al. [3] was already used by 2018 and may have included textiles manufactured prior to the long chain phaseout. Muensterman et al. [2] also reported the presence of n:2 FTOHs with more than six perfluorinated carbons in turnout gear layers manufactured in 2008, but not in layers manufactured in 2019.

#### 5. Summary

This study utilized a targeted analytical approach to quantify 53 nonvolatile, semivolatile, and volatile PFAS across 20 moisture barrier, outer shell, and thermal liner textiles. Two extraction protocols were developed to maximize the recovery of targeted PFAS while minimizing the potential degradation of other polymer and nonpolymer PFAS. Nonvolatile and semivolatile PFAS were quantified with separate HPLC-MS/MS methods, while volatile PFAS were quantified with GC-MS.

Of the 53 PFAS examined, 27 were quantified below reporting limits in all analyzed textiles, while the remaining 26 were each quantified in between one and 16 textiles. 6:2 FTMAC, 6:2 FTOH, and 6:2 FTS were present in the highest observed concentrations, though they were only present above reporting limits in moisture barrier and DWR-treated outer shell textiles. Summed PFAS concentrations were much higher in moisture barriers and DWR-treated outer shell textiles than in untreated outer shell and thermal liner textiles. Additionally, PFAS concentrations varied within textile types, with largest differences observed among moisture barrier textiles.

This study adds to a growing literature examining firefighter turnout gear that found PFAS concentrations varied both between and within individual types of turnout gear textiles. 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. Additional research on PFAS in used turnout gear, PFAS transport between gear layers or into firefighters, and the occupational hazards faced by firefighters are all critical to understanding the potential PFAS exposure firefighters face.

#### 6. Future Work

Future work will examine the effect of typical use on the types and concentrations of PFAS in firefighter gear textiles as higher PFAS concentrations have been observed in used fire fighter gear compared with new firefighter gear [1], and exposure to heat, ultraviolet irradiation, and laundering have been found to alter PFAS concentrations in DWR treated textiles [34]. Additionally, efforts currently underway will use high-resolution mass spectrometry to identify a broader swath of PFAS than the 53 compounds quantified here, including screening for previously identified compounds as well as searching for novel PFAS. Other potential sources of PFAS exposure to firefighters will also be evaluated, including other firefighter personal protective equipment such as wildland fire gear, hoods, and gloves, as well as dust collected from fire stations. Finally, future work will evaluate the type and amount of PFAS that are released from firefighter gear textiles upon exposure to simulated sweat.

**Table 2.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-A. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.

PFCA (NV)         FASE (SV)           PFBA <rl< td="">         0.580         MeFOSE         <rl< td="">         0.258           PFPeA         0.649 ± 0.022         0.023         EFFOSE         0.575 ± 0.031         0.023           PFHAA         3.56 ± 0.08         0.155         FFFDA         <rl< td="">         0.019           PFHDA         <rl< td="">         0.510         PPEA (NV)         PFEOA         <rl< td="">         0.019           PFNA         <rl< td="">         0.023         PFOPEA (NV)          <rl< td="">         0.019           PFDA         <rl< td="">         0.023         PFSOHXA         <rl< td="">         0.021           PFDA         <rl< td="">         0.023         PFSOHXA         <rl< td="">         0.021           PFUNDA         <rl< td="">         0.023         PFSOHXA         <rl< td="">         0.021           PFUNDA         <rl< td="">         0.023         HFPO-DA         <rl< td="">         0.021           PFTDA         <rl< td="">         0.023         HFPO-DA         <rl< td="">         0.021           PFTBA         <rl< td="">         0.023         ADONA         <rl< td="">         0.022           PFSA (NV)          RL         0.021         n:2 FTMAC (V)            PFHSS         <t< th=""><th>PFAS</th><th>Concentration (μg/kg)</th><th>RL (μg/kg)</th><th>PFAS</th><th>Concentration (µg/kg)</th><th>RL (μg/kg)</th></t<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFAS	Concentration (μg/kg)	RL (μg/kg)	PFAS	Concentration (µg/kg)	RL (μg/kg)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFCA (NV)			FASE (SV)		
PFHxA         3.56 ± 0.08         0.155           PFHpA <rl< th="">         0.510         PPEA (NV)           PFOA         <rl< th="">         0.110         PFEESA         <rl< th="">         0.019           PFNA         <rl< th="">         0.023         PF4OPeA         <rl< th="">         0.021           PFDA         <rl< th="">         0.023         PF5OHxA         <rl< th="">         0.021           PFDDA         <rl< th="">         0.031         3-6-OPFHpA         <rl< th="">         0.021           PFDDA         <rl< th="">         0.023         HFPO-DA         <rl< th="">         0.021           PFTDA         <rl< th="">         0.023         ADONA         <rl< th="">         0.021           PFTDA         <rl< th="">         0.023         ADONA         <rl< th="">         0.022           PFSA (NV)           PFP3ONS         <rl< th="">         0.022           PFSA (NV)          R                                      <t< td=""><td>PFBA</td><td><rl< td=""><td>0.580</td><th>MeFOSE</th><td><rl< td=""><td>0.258</td></rl<></td></rl<></td></t<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFBA	<rl< td=""><td>0.580</td><th>MeFOSE</th><td><rl< td=""><td>0.258</td></rl<></td></rl<>	0.580	MeFOSE	<rl< td=""><td>0.258</td></rl<>	0.258
PFHpA <rl< th="">         0.510         PPEA (NV)           PFOA         <rl< td="">         0.110         PFEESA         <rl< td="">         0.019           PFNA         <rl< td="">         0.023         PF4OPeA         <rl< td="">         0.021           PFDA         <rl< td="">         0.023         PF5OHxA         <rl< td="">         0.021           PFUnDA         <rl< td="">         0.023         HFPO-DA         <rl< td="">         0.021           PFTDA         <rl< td="">         0.023         ADONA         <rl< td="">         0.021           PFTDA         <rl< td="">         0.131         9Cl-PF3ONS         <rl< td="">         0.022           PFSA (NV)          11Cl-PF3OUdS         <rl< td="">         0.022           PFPSA (NV)          8RL         0.021         n:2 FTMAC (V)         PFP5OURS         <rl< td="">         0.022           PFPSA (NV)          8RL         0.021         n:2 FTMAC (V)         PFP5OURS          83.2           PFPPS No value<sup>b</sup>         8.2 FTMAC         420 ± 68         83.2         83.2         PFP6S         No value<sup>b</sup>         82.2 FTMAC         <rl< td="">         42.6         42.6         PFP6S         RL         0.021         n:2 FTMAC         <rl< td="">         44.8         RPFP6PS</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFPeA	$0.649 \pm 0.022$	0.023	EtFOSE	$0.575 \pm 0.031$	0.023
PFOA <pre></pre>	PFHxA	$3.56\pm0.08$	0.155	_		
PFNA         ≪RL         0.023         PF4OPeA         ≪RL         0.021           PFDA         ≪RL         0.023         PF5OHxA         ≪RL         0.021           PFUnDA         ≪RL         0.031         3-6-OPFHpA         ≪RL         0.021           PFDODA         ≪RL         0.023         HFPO-DA         ≪RL         0.062           PFTDA         ≪RL         0.023         ADONA         ≪RL         0.021           PFTDA         ≪RL         0.023         ADONA         ≪RL         0.021           PFTDA         ≪RL         0.021         PFF3ONS         ≪RL         0.022           PFSA (NV)	PFHpA	<rl< td=""><td>0.510</td><th>PPEA (NV)</th><td></td><td></td></rl<>	0.510	PPEA (NV)		
PFDA <rl< th="">         0.023         PF50HxA         <rl< th="">         0.021           PFUnDA         <rl< th="">         0.031         3-6-OPFHpA         <rl< th="">         0.021           PFDoDA         <rl< th="">         0.023         HFPO-DA         <rl*< th="">         0.062           PFTDA         <rl< th="">         0.023         ADONA         <rl< th="">         0.021           PFTeDA         <rl< th="">         0.0131         9C-PF30NS         <rl< th="">         0.022           PFSA (NV)          0.131         9C-PF30NS         <rl< th="">         0.022           PFSA (NV)                       0.022          PFSO (V)  <t< td=""><td>PFOA</td><td><rl< td=""><td>0.110</td><th>PFEESA</th><td><rl< td=""><td>0.019</td></rl<></td></rl<></td></t<></rl<></rl<></rl<></rl<></rl<></rl*<></rl<></rl<></rl<></rl<></rl<>	PFOA	<rl< td=""><td>0.110</td><th>PFEESA</th><td><rl< td=""><td>0.019</td></rl<></td></rl<>	0.110	PFEESA	<rl< td=""><td>0.019</td></rl<>	0.019
PFUNDA <rl< th="">         0.031         3-6-OPFHpA         <rl< th="">         0.021           PFDODA         <rl< th="">         0.023         HFPO-DA         <rl*< th="">         0.062           PFTrDA         <rl< th="">         0.023         ADONA         <rl< th="">         0.021           PFTeDA         <rl< th="">         0.131         9CI-PF3ONS         <rl< th="">         0.022           PFSA (NV)          PFPS         <rl< th="">         0.021         n:2 FTMAC (V)         PFPSONS         <rl< th="">         0.022           PFPS         <rl< th="">         0.021         n:2 FTMAC (V)         PFPSONS         <rl< th="">         0.022         No value         6:2 FTMAC         420 ± 68         83.2         RS.2         PFPSONS         <rl< th="">         0.021         No value         RS.2 FTMAC         <rl< th="">         42.6         RRL         <th< td=""><td>PFNA</td><td><rl< td=""><td>0.023</td><th>PF4OPeA</th><td><rl< td=""><td>0.021</td></rl<></td></rl<></td></th<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl*<></rl<></rl<></rl<>	PFNA	<rl< td=""><td>0.023</td><th>PF4OPeA</th><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.023	PF4OPeA	<rl< td=""><td>0.021</td></rl<>	0.021
PFDoDA         ≪RL         0.023         HFPO-DA         ≪RL°         0.062           PFTrDA         ≪RL         0.023         ADONA         ≪RL         0.021           PFTeDA         ≪RL         0.131         9CI-PF3ONS         ≪RL         0.022           PFSA (NV)           PFPrS         ≪RL         0.021         n:2 FTMAC (V)         PPPS           PFPS         ≪RL         0.021         n:2 FTMAC (V)         PPPS           PFPS         No value <sup>b</sup> 8:2 FTMAC         420 ± 68         83.2           PFPS         No value <sup>b</sup> 8:2 FTMAC         420 ± 68         83.2           PFHS         No value <sup>b</sup> 8:2 FTMAC         420 ± 68         83.2           PFHS         ≪RL         0.021         10:2 FTMAC         ≪RL         42.6           PFHS         ≪RL         0.021         n:2 FTOAc (V)         PPPS         ————————————————————————————————————	PFDA	<rl< td=""><td>0.023</td><th>PF5OHxA</th><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.023	PF5OHxA	<rl< td=""><td>0.021</td></rl<>	0.021
PFTrDA         ≪RL         0.023         ADONA         ≪RL         0.021           PFTeDA         ≪RL         0.131         9Cl-PF3ONS         ≪RL         0.022           PFSA (NV)           PFPrS         ≪RL         0.021         m:2 FTMAC (V)         PFBS         0.065 ± 0.008         0.046         6:2 FTMAC         420 ± 68         83.2           PFPS         No value <sup>b</sup> 8:2 FTMAC         ≪RL         42.6           PFHS         ≪RL         0.021         10:2 FTMAC         ≪RL         42.6           PFHS         ≪RL         0.021         n:2 FTOAc (V)         WEDTOAC         ————————————————————————————————————	PFUnDA	<rl< td=""><td>0.031</td><th>3-6-OPFHpA</th><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.031	3-6-OPFHpA	<rl< td=""><td>0.021</td></rl<>	0.021
PFTeDA         ≪RL         0.131         9CI-PF3ONS         ≪RL         0.022           PFSA (NV)           PFPS         ≪RL         0.021         m:2 FTMAC (V)         PFBS         0.065 ± 0.008         0.046         6:2 FTMAC         420 ± 68         83.2           PFPS         No value <sup>b</sup> 8:2 FTMAC         ≪RL         42.6           PFHxS         ≪RL         0.021         10:2 FTMAC         ≪RL         42.6           PFHpS         ≪RL         0.022         PFOS         ≪RL         44.8           PFDS         ≪RL         0.021         n:2 FTOAc (V)         PFDS         ≪RL         44.6           PFDS         ≪RL         0.022         8:2 FTOAc         ≪RL         44.6           PFDS         ≪RL         0.022         8:2 FTOAc         ≪RL         46.8           PFDS         ≪RL         0.022         8:2 FTOAc         ≪RL         8.96           FASA (NV, SV)          n:2 FTOH(V)         ***         ***         ***         ***         ***         ***         ***         ***         ***         ***         ***         ***         ***         ***         ***         ***         ***         ***	PFDoDA	<rl< td=""><td>0.023</td><th>HFPO-DA</th><td><rl<sup>a</rl<sup></td><td>0.062</td></rl<>	0.023	HFPO-DA	<rl<sup>a</rl<sup>	0.062
I1Cl-PF3OUdS         ≪RL         0.022           PFFS         ≪RL         0.021         n:2 FTMAC (V)           PFBS         0.065 ± 0.008         0.046         6:2 FTMAC         420 ± 68         83.2           PFPeS         No value <sup>b</sup> 8:2 FTMAC         ≪RL         42.6           PFHxS         ≪RL         0.021         10:2 FTMAC         ≪RL         44.8           PFHpS         ≪RL         0.022         *** <td>PFTrDA</td> <td><rl< td=""><td>0.023</td><th>ADONA</th><td><rl< td=""><td>0.021</td></rl<></td></rl<></td>	PFTrDA	<rl< td=""><td>0.023</td><th>ADONA</th><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.023	ADONA	<rl< td=""><td>0.021</td></rl<>	0.021
PFSA (NV)           PFPRS <rl< td="">         0.021         n:2 FTMAC (V)           PFBS         0.065 ± 0.008         0.046         6:2 FTMAC         420 ± 68         83.2           PFPeS         No valueb         8:2 FTMAC         <rl< td="">         42.6           PFHxS         <rl< td="">         0.021         10:2 FTMAC         <rl< td="">         44.8           PFHpS         <rl< td="">         0.022         n:2 FTOAc (V)         PFNS         <rl< td="">         44.6           PFDS         <rl< td="">         0.021         n:2 FTOAc         <rl< td="">         44.6           PFDS         <rl< td="">         1.15         10:2 FTOAc         <rl< td="">         8.96           FASA (NV, SV)           n:2 FTOH (V)           FBSA (NV)         <rl< td="">         0.047         4:2 FTOH         <rl< td="">         46.8           MeFBSA (SV)         <rl< td="">         0.047         4:2 FTOH         <rl< td="">         89.5           FHXSA (NV)         <rl< td="">         0.047         6:2 FTOH         88.2 ± 4.6         45.0           FOSA (NV)         <rl< td="">         0.047         7:2 FTOH         <rl< td="">         44.8           MeFOSA (SV)         <rl< td="">         0.600</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFTeDA	<rl< td=""><td>0.131</td><th>9Cl-PF3ONS</th><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.131	9Cl-PF3ONS	<rl< td=""><td>0.022</td></rl<>	0.022
PFPrS <rl< th="">         0.021         n:2 FTMAC (V)           PFBS         0.065 ± 0.008         0.046         6:2 FTMAC         420 ± 68         83.2           PFPeS         No value<sup>b</sup>         8:2 FTMAC         <rl< td="">         42.6           PFHxS         <rl< td="">         0.021         10:2 FTMAC         <rl< td="">         44.8           PFHpS         <rl< td="">         0.022         ***<!--</td--><td></td><td></td><td></td><th>11Cl-PF3OUdS</th><td><rl< td=""><td>0.022</td></rl<></td></rl<></rl<></rl<></rl<></rl<>				11Cl-PF3OUdS	<rl< td=""><td>0.022</td></rl<>	0.022
PFBS         0.065 ± 0.008         0.046         6:2 FTMAC         420 ± 68         83.2           PFPeS         No valueb         8:2 FTMAC         ≪RL         42.6           PFHxS         ≪RL         0.021         10:2 FTMAC         ≪RL         44.8           PFHpS         ≪RL         0.022         *** <t< th=""><th>PFSA (NV)</th><th></th><th></th><th>-</th><th></th><th></th></t<>	PFSA (NV)			-		
PFPeS         No valueb         8:2 FTMAC <rl< th="">         42.6           PFHxS         <rl< td="">         0.021         10:2 FTMAC         <rl< td="">         44.8           PFHpS         <rl< td="">         0.022             44.8            44.8           44.8           42.6           44.8          44.8            44.8             44.8</rl<></rl<></rl<></rl<>	PFPrS	<rl< td=""><td>0.021</td><th>n:2 FTMAC (V)</th><td></td><td></td></rl<>	0.021	n:2 FTMAC (V)		
PFHxS <rl< th="">         0.021         10:2 FTMAC         <rl< th="">         44.8           PFHpS         <rl< th="">         0.022         10:2 FTMAC         <rl< th="">         44.8           PFOS         <rl< th="">         0.021         n:2 FTOAc (V)             PFNS         <rl< th="">         0.022         8:2 FTOAc         <rl< th="">         44.6           PFDS         <rl< th="">         1.15         10:2 FTOAc         <rl< th="">         8.96           FASA (NV, SV)         n:2 FTOH (V)   &lt;</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFBS	$0.065 \pm 0.008$	0.046	6:2 FTMAC	$420\pm68$	83.2
PFHpS <rl< th="">         0.022           PFOS         <rl< th="">         0.021         n:2 FTOAc (V)           PFNS         <rl< th="">         0.022         8:2 FTOAc         <rl< th="">         44.6           PFDS         <rl< th="">         1.15         10:2 FTOAc         <rl< th="">         8.96           FASA (NV, SV)         n:2 FTOH (V)</rl<></rl<></rl<></rl<></rl<></rl<>	PFPeS	No value <sup>b</sup>		8:2 FTMAC	<rl< td=""><td>42.6</td></rl<>	42.6
PFOS <rl< th="">         0.021         m:2 FTOAc (V)           PFNS         <rl< td="">         0.022         8:2 FTOAc         <rl< td="">         44.6           PFDS         <rl< td="">         1.15         10:2 FTOAc         <rl< td="">         8.96           FASA (NV, SV)           n:2 FTOH (V)           FBSA (NV)         <rl< td="">         0.047         4:2 FTOH         <rl< td="">         46.8           MeFBSA (SV)         <rl< td="">         0.490         5:2 FTOH         <rl< td="">         89.5           FHxSA (NV)         <rl< td="">         0.047         6:2 FTOH         88.2 ± 4.6         45.0           FOSA (NV)         <rl< td="">         0.047         7:2 FTOH         <rl< td="">         44.8           MeFOSA (SV)         <rl< td="">         0.600         8:2 FTOH         <rl< td="">         87.8           EtFOSA (SV)         0.76 ± 0.11         0.278         10:2 FTOH         <rl< td="">         45.0           FASAA (NV)           FOSAA         <rl< td="">         0.023         4:2 FTS         <rl< td="">         0.044           MeFOSAA         <rl< td="">         0.047         6:2 FTS         <rl< td="">         5.06           EtFOSAA         <rl< td="">         2.45         8:2 FTS         <rl< td=""></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFHxS	<rl< td=""><td>0.021</td><th>10:2 FTMAC</th><td><rl< td=""><td>44.8</td></rl<></td></rl<>	0.021	10:2 FTMAC	<rl< td=""><td>44.8</td></rl<>	44.8
PFNS <rl< th="">         0.022         8:2 FTOAc         <rl< th="">         44.6           PFDS         <rl< th="">         1.15         10:2 FTOAc         <rl< th="">         8.96           FASA (NV, SV)         n:2 FTOH (V)</rl<></rl<></rl<></rl<>	PFHpS	<rl< td=""><td>0.022</td><th>-</th><td></td><td></td></rl<>	0.022	-		
PFDS <rl< th="">         1.15         10:2 FTOAc         <rl< th="">         8.96           FASA (NV, SV)         n:2 FTOH (V)           FBSA (NV)         <rl< th="">         0.047         4:2 FTOH         <rl< th="">         46.8           MeFBSA (SV)         <rl< th="">         0.490         5:2 FTOH         <rl< th="">         89.5           FHxSA (NV)         <rl< th="">         0.047         6:2 FTOH         88.2 ± 4.6         45.0           FOSA (NV)         <rl< th="">         0.047         7:2 FTOH         <rl< th="">         44.8           MeFOSA (SV)         <rl< th="">         0.600         8:2 FTOH         <rl< th="">         87.8           EtFOSA (SV)         0.76 ± 0.11         0.278         10:2 FTOH         <rl< th="">         45.0           FOSAA         <rl< th="">         0.023         4:2 FTS         <rl< th="">         0.044           MeFOSAA         <rl< th="">         0.047         6:2 FTS         <rl< th="">         5.06           EtFOSAA         <rl< th="">         2.45         8:2 FTS         <rl< th="">         0.106</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFOS	<rl< td=""><td>0.021</td><th>n:2 FTOAc (V)</th><td></td><td></td></rl<>	0.021	n:2 FTOAc (V)		
FASA (NV, SV)           FBSA (NV)         < RL         0.047         4:2 FTOH         < RL         46.8           MeFBSA (SV)         < RL         0.490         5:2 FTOH         < RL         89.5           FHxSA (NV)         < RL         0.047         6:2 FTOH         88.2 ± 4.6         45.0           FOSA (NV)         < RL         0.047         7:2 FTOH         < RL         44.8           MeFOSA (SV)         < RL         0.600         8:2 FTOH         < RL         87.8           EtFOSA (SV)         0.76 ± 0.11         0.278         10:2 FTOH         < RL         45.0           FASAA (NV)         n:2 FTS (NV)           FOSAA         < RL         0.023         4:2 FTS         < RL <sup>a</sup> 0.044           MeFOSAA         < RL         0.047         6:2 FTS         < RL         5.06           EtFOSAA         < RL         2.45         8:2 FTS         < RL         0.106	PFNS	<rl< td=""><td>0.022</td><th>8:2 FTOAc</th><td><rl< td=""><td>44.6</td></rl<></td></rl<>	0.022	8:2 FTOAc	<rl< td=""><td>44.6</td></rl<>	44.6
FBSA (NV) <rl< th="">         0.047         4:2 FTOH         <rl< th="">         46.8           MeFBSA (SV)         <rl< th="">         0.490         5:2 FTOH         <rl< th="">         89.5           FHxSA (NV)         <rl< th="">         0.047         6:2 FTOH         88.2 ± 4.6         45.0           FOSA (NV)         <rl< th="">         0.047         7:2 FTOH         <rl< th="">         97.8           MeFOSA (SV)         <rl< th="">         0.600         8:2 FTOH         <rl< th="">         87.8           EtFOSA (SV)         0.76 ± 0.11         0.278         10:2 FTOH         <rl< th="">         45.0           FASAA (NV)         n:2 FTS (NV)           <rl< th="">         45.0           FOSAA         <rl< th="">         0.023         4:2 FTS         <rl< th="">         0.044           MeFOSAA         <rl< th="">         0.047         6:2 FTS         <rl< th="">         5.06           EtFOSAA         <rl< th="">         2.45         8:2 FTS         <rl< th="">         0.106</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFDS	<rl< td=""><td>1.15</td><th>10:2 FTOAc</th><td><rl< td=""><td>8.96</td></rl<></td></rl<>	1.15	10:2 FTOAc	<rl< td=""><td>8.96</td></rl<>	8.96
FBSA (NV) <rl< th="">         0.047         4:2 FTOH         <rl< th="">         46.8           MeFBSA (SV)         <rl< th="">         0.490         5:2 FTOH         <rl< th="">         89.5           FHxSA (NV)         <rl< th="">         0.047         6:2 FTOH         88.2 ± 4.6         45.0           FOSA (NV)         <rl< th="">         0.047         7:2 FTOH         <rl< th="">         97.8           MeFOSA (SV)         <rl< th="">         0.600         8:2 FTOH         <rl< th="">         87.8           EtFOSA (SV)         0.76 ± 0.11         0.278         10:2 FTOH         <rl< th="">         45.0           FASAA (NV)         n:2 FTS (NV)           <rl< th="">         45.0           FOSAA         <rl< th="">         0.023         4:2 FTS         <rl< th="">         0.044           MeFOSAA         <rl< th="">         0.047         6:2 FTS         <rl< th="">         5.06           EtFOSAA         <rl< th="">         2.45         8:2 FTS         <rl< th="">         0.106</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	FASA (NV, SV)			n;2 FTOH (V)		
FHxSA (NV) $<$ RL         0.047         6:2 FTOH $88.2 \pm 4.6$ 45.0           FOSA (NV) $<$ RL         0.047         7:2 FTOH $<$ RL         44.8           MeFOSA (SV) $<$ RL         0.600         8:2 FTOH $<$ RL         87.8           EtFOSA (SV)         0.76 $\pm$ 0.11         0.278         10:2 FTOH $<$ RL         45.0           FASAA (NV)         n:2 FTS (NV)           FOSAA $<$ RL         0.023         4:2 FTS $<$ RL         0.044           MeFOSAA $<$ RL         0.047         6:2 FTS $<$ RL         5.06           EtFOSAA $<$ RL         2.45         8:2 FTS $<$ RL         0.106		<rl< td=""><td>0.047</td><th>1.</th><td><rl< td=""><td>46.8</td></rl<></td></rl<>	0.047	1.	<rl< td=""><td>46.8</td></rl<>	46.8
FHxSA (NV) $<$ RL         0.047         6:2 FTOH $88.2 \pm 4.6$ $45.0$ FOSA (NV) $<$ RL         0.047         7:2 FTOH $<$ RL $44.8$ MeFOSA (SV) $<$ RL         0.600         8:2 FTOH $<$ RL $87.8$ EtFOSA (SV)         0.76 $\pm$ 0.11         0.278         10:2 FTOH $<$ RL $45.0$ FASAA (NV)         n:2 FTS (NV)           FOSAA $<$ RL         0.023         4:2 FTS $<$ RL $<$ RL $<$ 0.044           MeFOSAA $<$ RL         0.047         6:2 FTS $<$ RL $<$ 8.0           EtFOSAA $<$ RL         2.45         8:2 FTS $<$ RL         0.106	MeFBSA (SV)	<rl< td=""><td>0.490</td><th>5:2 FTOH</th><td><rl< td=""><td>89.5</td></rl<></td></rl<>	0.490	5:2 FTOH	<rl< td=""><td>89.5</td></rl<>	89.5
FOSA (NV) <rl< th="">         0.047         7:2 FTOH         <rl< th="">         44.8           MeFOSA (SV)         <rl< th="">         0.600         8:2 FTOH         <rl< th="">         87.8           EtFOSA (SV)         0.76 ± 0.11         0.278         10:2 FTOH         <rl< th="">         45.0           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.023         4:2 FTS         <rl*< th="">         0.044           MeFOSAA         <rl*< th="">         0.047         6:2 FTS         <rl< th="">         5.06           EtFOSAA         <rl< th="">         2.45         8:2 FTS         <rl< th="">         0.106</rl<></rl<></rl<></rl*<></rl*<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< th=""><th>0.047</th><th></th><th><math>88.2 \pm 4.6</math></th><th></th></rl<>	0.047		$88.2 \pm 4.6$	
EtFOSA (SV) $0.76 \pm 0.11$ $0.278$ $10:2$ FTOH $<$ RL $45.0$ FASAA (NV) $n:2$ FTS (NV)         FOSAA $<$ RL $0.023$ $4:2$ FTS $<$ RL $0.044$ MeFOSAA $<$ RL $0.047$ $6:2$ FTS $<$ RL $5.06$ EtFOSAA $<$ RL $2.45$ $8:2$ FTS $<$ RL $0.106$		<rl< td=""><td>0.047</td><th>7:2 FTOH</th><td><rl< td=""><td></td></rl<></td></rl<>	0.047	7:2 FTOH	<rl< td=""><td></td></rl<>	
FASAA (NV)           FOSAA <rl< th="">         0.023         4:2 FTS         <rl<sup>a         0.044           MeFOSAA         <rl<sup>a         0.047         6:2 FTS         <rl< th="">         5.06           EtFOSAA         <rl< th="">         2.45         8:2 FTS         <rl< th="">         0.106</rl<></rl<></rl<></rl<sup></rl<sup></rl<>	MeFOSA (SV)	<rl< th=""><th>0.600</th><th>8:2 FTOH</th><th><rl< th=""><th>87.8</th></rl<></th></rl<>	0.600	8:2 FTOH	<rl< th=""><th>87.8</th></rl<>	87.8
FOSAA <rl< th="">         0.023         4:2 FTS         <rla< th="">         0.044           MeFOSAA         <rla< th="">         0.047         6:2 FTS         <rl< th="">         5.06           EtFOSAA         <rl< th="">         2.45         8:2 FTS         <rl< th="">         0.106</rl<></rl<></rl<></rla<></rla<></rl<>	EtFOSA (SV)	$0.76 \pm 0.11$	0.278	10:2 FTOH	<rl< td=""><td>45.0</td></rl<>	45.0
FOSAA <rl< th="">         0.023         4:2 FTS         <rla< th="">         0.044           MeFOSAA         <rla< th="">         0.047         6:2 FTS         <rl< th="">         5.06           EtFOSAA         <rl< th="">         2.45         8:2 FTS         <rl< th="">         0.106</rl<></rl<></rl<></rla<></rla<></rl<>	FASAA (NV)			n:2 FTS (NV)		
MeFOSAA <rla< th="">         0.047         6:2 FTS         <rl< th="">         5.06           EtFOSAA         <rl< th="">         2.45         8:2 FTS         <rl< th="">         0.106</rl<></rl<></rl<></rla<>		<rl< td=""><td>0.023</td><th></th><td><rl<sup>a</rl<sup></td><td>0.044</td></rl<>	0.023		<rl<sup>a</rl<sup>	0.044
<b>EtFOSAA</b> <rl 2.45="" <b="">8:2 FTS <rl 0.106<="" td=""><td></td><td></td><td></td><th></th><td></td><td></td></rl></rl>						
				10:2 FTS	<rl< td=""><td>0.105</td></rl<>	0.105

<sup>&</sup>lt;sup>a</sup> Internal standard recovery did not meet QC standards, but all other QC standards met. Therefore, data do not meet QC standards and are not included in figures or this technical note beyond this table where they are included only for informational purposes.

<sup>&</sup>lt;sup>b</sup> QC standards not met. Data not reported.

**Table 3.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-B. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.

FASE (SV)           PFBA $1.34 \pm 0.11$ $0.278$ McPOSE $1.09 \pm 0.09$ $0.256$ PFPBA $< \text{RL}$ $0.086$ EtFOSE $0.237 \pm 0.023$ $0.237$ PFHAA $0.188 \pm 0.013$ $0.161$ PFEMA $0.188 \pm 0.013$ $0.161$ PFIDA $< \text{RL}$ $0.090$ PPEA (NV)         PFOA $< \text{RL}$ $0.019$ PFOA $0.279 \pm 0.054$ $0.114$ PFEESA $< \text{RL}$ $0.019$ PFNA $0.033 \pm 0.004$ $0.024$ PFAOPCA $< \text{RL}$ $0.022$ PFDA $0.319 \pm 0.041$ $0.024$ PFSOBNA $< \text{RL}$ $0.054$ PFUnDA $< \text{RL}$ $0.032$ $3$ -OPFHpA $< \text{RL}$ $0.054$ PFDuDA $< \text{RL}$ $0.024$ $< \text{HFO-DA}$ $< \text{RL}$ $0.022$ PFDTDA $< \text{RL}$ $0.024$ $< \text{ADONA}$ $< \text{RL}$ $0.022$ PFTDA $< \text{RL}$ $0.022$ $< \text{RL}$ $0.022$ $< \text{RL}$ $0.022$	PFAS	Concentration (μg/kg)	RL (μg/kg)	PFAS	Concentration (µg/kg)	RL (μg/kg)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFCA (NV)			FASE (SV)		
PFHxA $0.188 \pm 0.013$ $0.161$ PFHpA $\langle RL\rangle$ $0.090$ $PPEA (NV)$ PFOA $0.279 \pm 0.054$ $0.114$ PFEESA $\langle RL\rangle$ $0.019$ PFNA $0.030 \pm 0.004$ $0.024$ PF4OPeA $\langle RL\rangle$ $0.054$ PFDA $\langle RL\rangle$ $0.031$ $\langle RL\rangle$ $0.054$ PFDDA $\langle RL\rangle$ $0.032$ $3$ -6-OPFHpA $\langle RL\rangle$ $0.054$ PFDoDA $\langle RL\rangle$ $0.024$ HFPO-DA $\langle RL\rangle$ $0.022$ PFEDA $\langle RL\rangle$ $0.024$ ADONA $\langle RL\rangle$ $0.022$ PFTDA $\langle RL\rangle$ $0.024$ ADONA $\langle RL\rangle$ $0.022$ PFESA (NV) $\langle RL\rangle$ $0.023$ $\langle RL\rangle$ $0.023$ $\langle RL\rangle$ $0.023$ PFPSSA (NV) $\langle RL\rangle$ $0.025$ $\langle RL\rangle$	PFBA	$1.34 \pm 0.11$	0.278	MeFOSE	$1.09 \pm 0.09$	0.256
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFPeA	<rl< th=""><th>0.086</th><th>EtFOSE</th><th><math>0.237 \pm 0.023</math></th><th>0.237</th></rl<>	0.086	EtFOSE	$0.237 \pm 0.023$	0.237
PFOA $0.279 \pm 0.054$ $0.114$ PFEESA $<$ RL $0.019$ PFNA $0.030 \pm 0.004$ $0.024$ PF40PeA $<$ RL $0.022$ PFDA $0.319 \pm 0.041$ $0.024$ PF50HxA $<$ RL $0.054$ PFUnDA $<$ RL $0.032$ $<$ 3-G-OPFHpA $<$ RL $0.022$ PFDoDA $<$ 0.11 ± 0.014 $<$ 0.024 $<$ 4-DNA $<$ 8-RL $<$ 0.064           PFTDA $<$ RL $<$ 0.024 $<$ 4-DONA $<$ 8-RL $<$ 0.022           PFTeDA $<$ RL $<$ 0.024 $<$ 4-DONA $<$ 8-RL $<$ 0.022           PFTeDA $<$ 8-RL $<$ 0.024 $<$ 4-DONA $<$ 8-RL $<$ 0.022           PFTBA $<$ 8-RL $<$ 0.024 $<$ 4-DONA $<$ 8-RL $<$ 0.022           PFSA (NV) $<$ 8-RL $<$ 0.022 $<$ 8-RL $<$ 8-RL $<$ 9-C2-PF3ONS $<$ 8-RL $<$ 9-C2-PF3ONS $<$ 8-RL $<$ 0.023           PFPSS (NV) $<$ 8-RL $<$ 0.022 $<$ 8-2-FTMAC (V) $<$ 8-RL $<$ 7-64 $<$ 8-RL	PFHxA	$0.188 \pm 0.013$	0.161	_		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFHpA	<rl< td=""><td>0.090</td><th>PPEA (NV)</th><td></td><td></td></rl<>	0.090	PPEA (NV)		
PFDA         0.319 ± 0.041         0.024         PF5OHxA         ≪RL         0.054           PFUnDA         ≪RL         0.032         3-6-OPFHpA         ≪RL         0.022           PFDoDA         0.11 ± 0.014         0.024         HFPO-DA         ≪RL         0.064           PFTDA         ≪RL         0.024         ADONA         ≪RL         0.022           PFTEDA         ≪RL         0.035         9Cl-PF3ONS         ≪RL         0.022           PFSA (NV)           PFSA (NV)           PFSA (NV)           PFBS         ≪RL         0.022         n:2 FTMAC (V)           PFPS         ≪RL         0.023         8:2 FTMAC         ≪RL         39.1           PFPS         ≪RL         0.023         8:2 FTMAC         ≪RL         41.2           PFHSS         ≪RL         0.023         8:2 FTMAC         ≪RL         41.2           PFHSS         ≪RL         0.023         8:2 FTMAC         ≪RL         41.2           PFMS         ≪RL         0.023         8:2 FTMAC	PFOA	$0.279 \pm 0.054$	0.114	PFEESA	<rl< th=""><th>0.019</th></rl<>	0.019
PFUnDA         ≪RL         0.032         3-6-OPFHpA         ≪RL         0.022           PFDoDA         0.11 ± 0.014         0.024         HFPO-DA         ≪RL         0.064           PFTrDA         ≪RL         0.024         ADONA         ≪RL         0.022           PFTeDA         ≪RL         0.135         9Cl-PF3ONS         ≪RL         0.022           PFTS	PFNA	$0.030 \pm 0.004$	0.024	PF4OPeA	<rl< td=""><td>0.022</td></rl<>	0.022
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFDA	$0.319 \pm 0.041$	0.024	PF5OHxA	<rl< td=""><td>0.054</td></rl<>	0.054
PFTrDA         ≪RL         0.024         ADONA         ≪RL         0.022           PFTeDA         ≪RL         0.135         9Cl-PF3ONS         ≪RL         0.022           PFSA (NV)           PFPS         ≪RL         0.022         m:2 FTMAC (V)           PFBS         6.7 ± 1.7         0.025         6:2 FTMAC         ≪RL         76.4           PFPS         ≪RL         0.023         8:2 FTMAC         ≪RL         39.1           PFHxS         ≪RL         0.023         8:2 FTMAC         ≪RL         41.2           PFHpS         ≪RL         0.023         8:2 FTMAC         ≪RL         41.2           PFOS         0.026 ± 0.004         0.022         n:2 FTMAC (V)         PFDS            PFNS         ≪RL         0.023         8:2 FTOAc (V) </td <th>PFUnDA</th> <td><rl< td=""><td>0.032</td><th>3-6-ОРГНРА</th><td><rl< td=""><td>0.022</td></rl<></td></rl<></td>	PFUnDA	<rl< td=""><td>0.032</td><th>3-6-ОРГНРА</th><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.032	3-6-ОРГНРА	<rl< td=""><td>0.022</td></rl<>	0.022
PFTeDA         ≪RL         0.135         9Cl-PF3ONS         ≪RL         0.022           PFSA (NV)           PFPS         ≪RL         0.022         m:2 FTMAC (V)           PFBS         6.7 ± 1.7         0.025         6:2 FTMAC         ≪RL         76.4           PFPS         ≪RL         0.023         8:2 FTMAC         ≪RL         39.1           PFHXS         ≪RL         0.022         10:2 FTMAC         ≪RL         41.2           PFHPS         ≪RL         0.023         ***	PFDoDA	$0.11 \pm 0.014$	0.024	HFPO-DA	<rl< td=""><td>0.064</td></rl<>	0.064
TICI-PF30UdS         ≪RL         0.023           PFFS (NV)	PFTrDA	<rl< th=""><th>0.024</th><th>ADONA</th><th><rl< th=""><th>0.022</th></rl<></th></rl<>	0.024	ADONA	<rl< th=""><th>0.022</th></rl<>	0.022
PFSA (NV)           PFPrS $<$ RL $0.022$ $m:2$ FTMAC (V)           PFBS $6.7 \pm 1.7$ $0.025$ $6:2$ FTMAC $<$ RL $76.4$ PFPeS $<$ RL $0.023$ $8:2$ FTMAC $<$ RL $39.1$ PFHxS $<$ RL $0.022$ $10:2$ FTMAC $<$ RL $41.2$ PFOS $0.026 \pm 0.004$ $0.022$ $m:2$ FTOAc (V)           PFDS $<$ RL $0.023$ $8:2$ FTOAc $<$ RL $40.9$ PFDS $<$ RL $0.023$ $8:2$ FTOAc $<$ RL $40.9$ PFDS $<$ RL $0.023$ $8:2$ FTOAc $<$ RL $40.9$ PFDS $<$ RL $0.023$ $8:2$ FTOAc $<$ RL $40.9$ PFDS $<$ RL $0.023$ $8:2$ FTOH(V) $<$ RL $40.9$ PFDS $<$ RL $0.031$ $4:2$ FTOH $<$ RL $42.9$ MeFBSA (SV) $<$ RL $0.031$ $6:2$ FTOH $<$ RL $41.3$ FOSA (NV) $<$ RL	PFTeDA	<rl< td=""><td>0.135</td><th>9Cl-PF3ONS</th><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.135	9Cl-PF3ONS	<rl< td=""><td>0.022</td></rl<>	0.022
PFPrS $<$ RL $0.022$ $n:2 FTMAC (V)$ PFBS $6.7 \pm 1.7$ $0.025$ $6:2 FTMAC$ $<$ RL $76.4$ PFPeS $<$ RL $0.023$ $8:2 FTMAC$ $<$ RL $39.1$ PFHxS $<$ RL $0.022$ $<$ RL $<$ RL $<$ 41.2           PFOS $0.026 \pm 0.004$ $0.022$ $<$ RL $<$ RL $<$ RL           PFDS $<$ RL $<$ RL $<$ 0.023 $<$ RL $<$ RL $<$ 40.9           PFDS $<$ RL $<$ 0.023 $<$ RL $<$ RL $<$ RL $<$ 40.9           PFDS $<$ RL $<$ 0.023 $<$ 8:2 FTOAc $<$ RL $<$ 40.9           PFDS $<$ RL $<$ 0.059 $<$ 10:2 FTOAC $<$ RL $<$ 8.23           FASA (NV, SV)           FBSA (NV) $<$ RL $<$ 2.26 $<$ 5:2 FTOH (V) $<$ 8L $<$ 8.23           FHxSA (NV) $<$ RL $<$ 2.26 $<$ 5:2 FTOH $<$ RL $<$ 82.2           FHxSA (NV) $<$ RL $<$ 0.031 $<$ 6:2 FTOH $<$ RL				11Cl-PF3OUdS	<rl< td=""><td>0.023</td></rl<>	0.023
PFBS $6.7 \pm 1.7$ $0.025$ $6:2$ FTMAC $<$ RL $76.4$ PFPeS $<$ RL $0.023$ $8:2$ FTMAC $<$ RL $39.1$ PFHxS $<$ RL $0.022$ $<$ 10:2 FTMAC $<$ RL $<$ 41.2           PFHpS $<$ RL $0.023$ $<$ 2 $<$ 2 $<$ 41.2           PFNS $<$ RL $0.023$ $<$ 3:2 FTOAc $<$ $<$ 7.2 $<$ 7.2 $<$ 7.2 $<$ 7.2 $<$ 8.23           FDS $<$ RL $0.023$ $<$ 8:2 FTOAc $<$ $<$ 8.2 $<$ 8.23           FASA $(NV, SV)$ $<$ 8.2 $<$ 8.23 $<$ 8.23           FBSA $(NV, SV)$ $<$ 8.2 $<$ 8.2 FTOH $<$ 8.2 $<$ 8.2           FHxSA $(NV, SV)$ $<$ 8.2 $<$ 8.2 FTOH $<$ 8.3 $<$ 8.2 FTOH $<$ 8.3 $<$ 8.2 F	PFSA (NV)					
PFPeS <rl< th="">         0.023         8:2 FTMAC         <rl< th="">         39.1           PFHxS         <rl< th="">         0.022         10:2 FTMAC         <rl< th="">         41.2           PFMS         <rl< th="">         0.023         10:2 FTMAC         <rl< th="">         41.2           PFOS         0.026 ± 0.004         0.022         m:2 FTOAc (V)            PFNS         <rl< th="">         0.023         8:2 FTOAc         <rl< th="">         40.9           PFDS         <rl< th="">         0.023         8:2 FTOAc         <rl< th="">         40.9           PFDS         <rl< th="">         0.059         10:2 FTOAc         <rl< th="">         40.9           PFDS         <rl< th="">         0.059         10:2 FTOAc         <rl< th="">         40.9           PFDS         <rl< th="">         0.059         10:2 FTOAc         <rl< th="">         8.23    ***PFDS**  **CHA***  **CHA***  **CHA***  **CHA***  **CHA***  **CHA***  **CHA**  **PFDS**  **A***  **CHA**  **CH</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFPrS	<rl< th=""><th>0.022</th><th>n:2 FTMAC (V)</th><th></th><th></th></rl<>	0.022	n:2 FTMAC (V)		
PFHxS $\langle RL \rangle$ 0.022         10:2 FTMAC $\langle RL \rangle$ 41.2           PFHpS $\langle RL \rangle$ 0.023         10:2 FTMAC $\langle RL \rangle$ 41.2           PFOS         0.026 ± 0.004         0.022         n:2 FTOAc (V) $\langle RL \rangle$ 40.9           PFDS $\langle RL \rangle$ 0.023         8:2 FTOAc $\langle RL \rangle$ 40.9           PFDS $\langle RL \rangle$ 0.059         10:2 FTOAc $\langle RL \rangle$ 8.23           FASA (NV, SV)         n:2 FTOH (V) $\langle RL \rangle$ 8.23           FBSA (NV)         0.809 ± 0.036         0.031         4:2 FTOH $\langle RL \rangle$ 42.9           MeFBSA (SV) $\langle RL \rangle$ 0.031         6:2 FTOH $\langle RL \rangle$ 82.2           FHXSA (NV) $\langle RL \rangle$ 0.042         7:2 FTOH $\langle RL \rangle$ 41.3           FOSA (SV) $\langle RL \rangle$ 0.451         8:2 FTOH $\langle RL \rangle$ 41.3           FASAA (NV) $\langle RL \rangle$ 0.552         10:2 FTOH $\langle RL \rangle$ 41.3           FASAA (NV) $\langle RL \rangle$ 0.048         4:2 FTS $\langle RL \rangle$ 0.0457           MeFOSAA $\langle R$	PFBS	$6.7 \pm 1.7$	0.025	6:2 FTMAC	<rl< td=""><td>76.4</td></rl<>	76.4
PFHpS $<$ RL $0.023$ PFOS $0.026 \pm 0.004$ $0.022$ $n:2$ FTOAc (V)           PFNS $<$ RL $0.023$ $8:2$ FTOAc $<$ RL $40.9$ PFDS $<$ RL $0.059$ $10:2$ FTOAc $<$ RL $8.23$ FASA (NV, SV) $<$ RL $0.059$ $10:2$ FTOH (V)           FBSA (NV) $<$ RL $2.26$ $5:2$ FTOH $<$ RL $42.9$ MeFBSA (SV) $<$ RL $2.26$ $5:2$ FTOH $<$ RL $82.2$ FHxSA (NV) $<$ RL $0.031$ $6:2$ FTOH $<$ RL $41.3$ FOSA (NV) $<$ RL $0.042$ $7:2$ FTOH $<$ RL $41.1$ MeFOSA (SV) $<$ RL $0.451$ $8:2$ FTOH $<$ RL $41.3$ FASAA (NV) $<$ RL $0.451$ $8:2$ FTOH $<$ RL $41.3$ FOSAA $<$ RL $0.048$ $4:2$ FTS $<$ RL $41.3$ FOSAA $<$ RL $0.048$ $4:2$ FTS $<$ RL $0.0457$	PFPeS	<rl< td=""><td>0.023</td><th>8:2 FTMAC</th><td><rl< td=""><td>39.1</td></rl<></td></rl<>	0.023	8:2 FTMAC	<rl< td=""><td>39.1</td></rl<>	39.1
PFOS $0.026 \pm 0.004$ $0.022$ $m:2 FTOAc (V)$ PFNS $<$ RL $0.023$ $8:2 FTOAc$ $<$ RL $40.9$ PFDS $<$ RL $0.059$ $10:2 FTOAc$ $<$ RL $8.23$ FASA (NV, SV)           n:2 FTOH (V)           FBSA (NV) $<$ RL $2.26$ $5:2 FTOH$ $<$ RL $42.9$ MeFBSA (SV) $<$ RL $2.26$ $5:2 FTOH$ $<$ RL $41.3$ FOSA (NV) $<$ RL $0.031$ $6:2 FTOH$ $<$ RL $41.3$ FOSA (SV) $<$ RL $0.042$ $7:2 FTOH$ $<$ RL $41.1$ MeFOSA (SV) $<$ RL $0.451$ $8:2 FTOH$ $<$ RL $41.3$ FASAA (NV)           FOSAA $<$ RL $0.048$ $4:2 FTS$ $<$ RL $41.3$ FASAA (NV)           REFOSAA $<$ RL $0.048$ $<$ RL $<$	PFHxS	<rl< td=""><td>0.022</td><th>10:2 FTMAC</th><td><rl< td=""><td>41.2</td></rl<></td></rl<>	0.022	10:2 FTMAC	<rl< td=""><td>41.2</td></rl<>	41.2
PFNS <rl< th="">         0.023         8:2 FTOAc         <rl< th="">         40.9           PFDS         <rl< th="">         0.059         10:2 FTOAc         <rl< th="">         40.9           FASA (NV, SV)         n:2 FTOH (V)         RL         8.23           FBSA (NV)         0.809 ± 0.036         0.031         4:2 FTOH         <rl< th="">         42.9           MeFBSA (SV)         <rl< th="">         2.26         5:2 FTOH         <rl< th="">         82.2           FHXSA (NV)         <rl< th="">         0.031         6:2 FTOH         <rl< th="">         41.3           FOSA (NV)         <rl< th="">         0.042         7:2 FTOH         <rl< th="">         41.1           MeFOSA (SV)         <rl< th="">         0.451         8:2 FTOH         <rl< th="">         80.7           EtFOSA (SV)         <rl< th="">         0.552         10:2 FTOH         <rl< th="">         41.3           FOSAA         <rl< th="">         0.048         4:2 FTS         <rl<sup>a         0.0457           MeFOSAA         <rl< th="">         0.024         6:2 FTS         <rl<sup>a         0.0457           MeFOSAA         <rl< th="">         0.049         8:2 FTS         <rl<sup>a         0.0457           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rl<sup>a         0.110</rl<sup></rl<></rl<sup></rl<></rl<sup></rl<></rl<sup></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFHpS	<rl< td=""><td>0.023</td><th></th><td></td><td></td></rl<>	0.023			
PFDS <rl< th="">         0.059         10:2 FTOAc         <rl< th="">         8.23           FASA (NV, SV)         n:2 FTOH (V)         n:2 FTOH (V)           FBSA (NV)         0.809 ± 0.036         0.031         4:2 FTOH         <rl< th="">         42.9           MeFBSA (SV)         <rl< th="">         2.26         5:2 FTOH         <rl< th="">         82.2           FHxSA (NV)         <rl< th="">         0.031         6:2 FTOH         <rl< th="">         41.3           FOSA (NV)         <rl< th="">         0.042         7:2 FTOH         <rl< th="">         41.1           MeFOSA (SV)         <rl< th="">         0.451         8:2 FTOH         <rl< th="">         80.7           EtFOSA (SV)         <rl< th="">         0.552         10:2 FTOH         <rl< th="">         41.3           FOSAA         <rl< th="">         0.048         4:2 FTS         <rl<sup>a         0.0457           MeFOSAA         <rl< th="">         0.024         6:2 FTS         <rl<sup>a         0.0457           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rl<sup>a         0.110</rl<sup></rl<></rl<sup></rl<></rl<sup></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFOS	$0.026 \pm 0.004$	0.022	n:2 FTOAc (V)		
FASA (NV, SV)           FBSA (NV) $0.809 \pm 0.036$ $0.031$ $4:2$ FTOH $<$ RL $42.9$ MeFBSA (SV) $<$ RL $2.26$ $5:2$ FTOH $<$ RL $82.2$ FHxSA (NV) $<$ RL $0.031$ $6:2$ FTOH $<$ RL $41.3$ FOSA (NV) $<$ RL $0.042$ $7:2$ FTOH $<$ RL $41.1$ MeFOSA (SV) $<$ RL $0.451$ $8:2$ FTOH $<$ RL $80.7$ EtFOSA (SV) $<$ RL $0.552$ $10:2$ FTOH $<$ RL $41.3$ FASAA (NV) $<$ RL $0.0457$ $<$ RL $41.3$ FOSAA $<$ RL $0.048$ $<$ 2.2 FTS $<$ 2.2 RL $^a$ $0.0457$ MeFOSAA $<$ RL $0.048$ $<$ 4.2 FTS $<$ 4.2 RL $^a$ $<$ 5.24           EtFOSAA $<$ RL $0.049$ $<$ 8.2 FTS $<$ 2.2 RL $^a$ $<$ 3.110	PFNS	<rl< td=""><td>0.023</td><th>8:2 FTOAc</th><td><rl< td=""><td>40.9</td></rl<></td></rl<>	0.023	8:2 FTOAc	<rl< td=""><td>40.9</td></rl<>	40.9
FBSA (NV) $0.809 \pm 0.036$ $0.031$ 4:2 FTOH $<$ RL         42.9           MeFBSA (SV) $<$ RL         2.26         5:2 FTOH $<$ RL         82.2           FHxSA (NV) $<$ RL         0.031         6:2 FTOH $<$ RL         41.3           FOSA (NV) $<$ RL         0.042         7:2 FTOH $<$ RL         41.1           MeFOSA (SV) $<$ RL         0.451         8:2 FTOH $<$ RL         80.7           EtFOSA (SV) $<$ RL         0.552         10:2 FTOH $<$ RL         41.3           FOSAA $<$ RL         0.048         4:2 FTS $<$ RL         0.0457           MeFOSAA $<$ RL         0.024         6:2 FTS $<$ RL         5.24           EtFOSAA $<$ RL         0.049         8:2 FTS $<$ RL         0.110	PFDS	<rl< td=""><td>0.059</td><th>10:2 FTOAc</th><td><rl< td=""><td>8.23</td></rl<></td></rl<>	0.059	10:2 FTOAc	<rl< td=""><td>8.23</td></rl<>	8.23
FBSA (NV) $0.809 \pm 0.036$ $0.031$ 4:2 FTOH $<$ RL         42.9           MeFBSA (SV) $<$ RL         2.26         5:2 FTOH $<$ RL         82.2           FHxSA (NV) $<$ RL         0.031         6:2 FTOH $<$ RL         41.3           FOSA (NV) $<$ RL         0.042         7:2 FTOH $<$ RL         41.1           MeFOSA (SV) $<$ RL         0.451         8:2 FTOH $<$ RL         80.7           EtFOSA (SV) $<$ RL         0.552         10:2 FTOH $<$ RL         41.3           FOSAA $<$ RL         0.048         4:2 FTS $<$ RL         0.0457           MeFOSAA $<$ RL         0.024         6:2 FTS $<$ RL         5.24           EtFOSAA $<$ RL         0.049         8:2 FTS $<$ RL         0.110	FASA (NV, SV)			n;2 FTOH (V)		
MeFBSA (SV) <rl< th="">         2.26         5:2 FTOH         <rl< th="">         82.2           FHxSA (NV)         <rl< th="">         0.031         6:2 FTOH         <rl< th="">         41.3           FOSA (NV)         <rl< th="">         0.042         7:2 FTOH         <rl< th="">         41.1           MeFOSA (SV)         <rl< th="">         0.451         8:2 FTOH         <rl< th="">         80.7           EtFOSA (SV)         <rl< th="">         0.552         10:2 FTOH         <rl< th="">         41.3           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.048         4:2 FTS         <rl<sup>a         0.0457           MeFOSAA         <rl< th="">         0.024         6:2 FTS         <rl<sup>a         5.24           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rl<sup>a         0.110</rl<sup></rl<></rl<sup></rl<></rl<sup></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		$0.809 \pm 0.036$	0.031	1 /	<rl< th=""><th>42.9</th></rl<>	42.9
FHxSA (NV) <rl< th="">         0.031         6:2 FTOH         <rl< th="">         41.3           FOSA (NV)         <rl< th="">         0.042         7:2 FTOH         <rl< th="">         41.1           MeFOSA (SV)         <rl< th="">         0.451         8:2 FTOH         <rl< th="">         80.7           EtFOSA (SV)         <rl< th="">         0.552         10:2 FTOH         <rl< th="">         41.3           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.048         4:2 FTS         <rl<sup>a         0.0457           MeFOSAA         <rl< th="">         0.024         6:2 FTS         <rl<sup>a         5.24           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rl<sup>a         0.110</rl<sup></rl<></rl<sup></rl<></rl<sup></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< td=""><td>2.26</td><th></th><td><rl< td=""><td>82.2</td></rl<></td></rl<>	2.26		<rl< td=""><td>82.2</td></rl<>	82.2
FOSA (NV) <rl< th="">         0.042         7:2 FTOH         <rl< th="">         41.1           MeFOSA (SV)         <rl< th="">         0.451         8:2 FTOH         <rl< th="">         80.7           EtFOSA (SV)         <rl< th="">         0.552         10:2 FTOH         <rl< th="">         41.3           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.048         4:2 FTS         <rl<sup>a         0.0457           MeFOSAA         <rl< th="">         0.024         6:2 FTS         <rl<sup>a         5.24           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rl<sup>a         0.110</rl<sup></rl<></rl<sup></rl<></rl<sup></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< th=""><th>0.031</th><th></th><th><rl< th=""><th>41.3</th></rl<></th></rl<>	0.031		<rl< th=""><th>41.3</th></rl<>	41.3
MeFOSA (SV) <rl< th="">         0.451         8:2 FTOH         <rl< th="">         80.7           EtFOSA (SV)         <rl< th="">         0.552         10:2 FTOH         <rl< th="">         41.3           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.048         4:2 FTS         <rl<sup>a         0.0457           MeFOSAA         <rl< th="">         0.024         6:2 FTS         <rl<sup>a         5.24           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rl<sup>a         0.110</rl<sup></rl<></rl<sup></rl<></rl<sup></rl<></rl<></rl<></rl<></rl<>		<rl< th=""><th>0.042</th><th>7:2 FTOH</th><th><rl< th=""><th>41.1</th></rl<></th></rl<>	0.042	7:2 FTOH	<rl< th=""><th>41.1</th></rl<>	41.1
FASAA (NV)           FOSAA <rl< th="">         0.048         4:2 FTS         <rla< th="">         0.0457           MeFOSAA         <rl< th="">         0.024         6:2 FTS         <rla< th="">         5.24           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rla< th="">         0.110</rla<></rl<></rla<></rl<></rla<></rl<>		<rl< th=""><th>0.451</th><th>8:2 FTOH</th><th><rl< th=""><th>80.7</th></rl<></th></rl<>	0.451	8:2 FTOH	<rl< th=""><th>80.7</th></rl<>	80.7
FOSAA <rl< th="">         0.048         4:2 FTS         <rla< th="">         0.0457           MeFOSAA         <rl< th="">         0.024         6:2 FTS         <rla< th="">         5.24           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rla< th="">         0.110</rla<></rl<></rla<></rl<></rla<></rl<>	EtFOSA (SV)	<rl< td=""><td>0.552</td><th>10:2 FTOH</th><td><rl< td=""><td>41.3</td></rl<></td></rl<>	0.552	10:2 FTOH	<rl< td=""><td>41.3</td></rl<>	41.3
FOSAA <rl< th="">         0.048         4:2 FTS         <rla< th="">         0.0457           MeFOSAA         <rl< th="">         0.024         6:2 FTS         <rla< th="">         5.24           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rla< th="">         0.110</rla<></rl<></rla<></rl<></rla<></rl<>	FASAA (NV)			n:2 FTS (NV)		
MeFOSAA <rl< th="">         0.024         6:2 FTS         <rla< th="">         5.24           EtFOSAA         <rl< th="">         0.049         8:2 FTS         <rla< th="">         0.110</rla<></rl<></rla<></rl<>		<rl< td=""><td>0.048</td><th></th><td><rl<sup>a</rl<sup></td><td>0.0457</td></rl<>	0.048		<rl<sup>a</rl<sup>	0.0457
EtFOSAA <rl< th="">         0.049         8:2 FTS         <rla< th="">         0.110</rla<></rl<>		<rl< th=""><th>0.024</th><th></th><th><rl<sup>a</rl<sup></th><th></th></rl<>	0.024		<rl<sup>a</rl<sup>	
					<rl<sup>a</rl<sup>	0.110
				10:2 FTS		

<sup>&</sup>lt;sup>a</sup> Internal standard recovery did not meet QC standards, but all other QC standards met. Therefore, data do not meet QC standards and are not included in figures or this technical note beyond this table where they are included only for informational purposes.

**Table 4.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-C. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	$14.7 \pm 0.28$	0.242	MeFOSE	$0.86 \pm 0.18$	0.336
PFPeA	$0.157 \pm 0.026$	0.075	EtFOSE	$0.61 \pm 0.25$	0.312
PFHxA	$2.40 \pm 0.23$	0.159			
PFHpA	$0.104 \pm 0.010$	0.078	PPEA (NV)		
PFOA	<rl< td=""><td>0.113</td><td>PFEESA</td><td><rl< td=""><td>0.019</td></rl<></td></rl<>	0.113	PFEESA	<rl< td=""><td>0.019</td></rl<>	0.019
PFNA	<rl< td=""><td>0.024</td><td>PF4OPeA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.024	PF4OPeA	<rl< td=""><td>0.021</td></rl<>	0.021
PFDA	<rl< td=""><td>0.024</td><td>PF5OHxA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.024	PF5OHxA	<rl< td=""><td>0.021</td></rl<>	0.021
PFUnDA	<rl< td=""><td>0.031</td><td>3-6-OPFHpA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.031	3-6-OPFHpA	<rl< td=""><td>0.021</td></rl<>	0.021
PFDoDA	<rl< td=""><td>0.024</td><td>HFPO-DA</td><td><rl< td=""><td>0.064</td></rl<></td></rl<>	0.024	HFPO-DA	<rl< td=""><td>0.064</td></rl<>	0.064
PFTrDA	<rl< td=""><td>0.024</td><td>ADONA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.024	ADONA	<rl< td=""><td>0.021</td></rl<>	0.021
PFTeDA	<rl< td=""><td>0.134</td><td>9Cl-PF3ONS</td><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.134	9Cl-PF3ONS	<rl< td=""><td>0.022</td></rl<>	0.022
		_	11Cl-PF3OUdS	<rl< td=""><td>0.022</td></rl<>	0.022
PFSA (NV)		_			
PFPrS	<rl< td=""><td>0.021</td><td>n:2 FTMAC (V)</td><td></td><td></td></rl<>	0.021	n:2 FTMAC (V)		
PFBS	$32.1 \pm 2.0$	0.022	6:2 FTMAC	<rl< td=""><td>91.1</td></rl<>	91.1
PFPeS	<rl< td=""><td>0.022</td><td>8:2 FTMAC</td><td><rl< td=""><td>46.7</td></rl<></td></rl<>	0.022	8:2 FTMAC	<rl< td=""><td>46.7</td></rl<>	46.7
PFHxS	<rl< td=""><td>0.022</td><td>10:2 FTMAC</td><td><rl< td=""><td>49.1</td></rl<></td></rl<>	0.022	10:2 FTMAC	<rl< td=""><td>49.1</td></rl<>	49.1
PFHpS	$0.053 \pm 0.004$	0.023			
PFOS	$0.116 \pm 0.022$	0.061	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.023</td><td>8:2 FTOAc</td><td><rl< td=""><td>48.9</td></rl<></td></rl<>	0.023	8:2 FTOAc	<rl< td=""><td>48.9</td></rl<>	48.9
PFDS	<rl< td=""><td>0.051</td><td>10:2 FTOAc</td><td><rl< td=""><td>9.82</td></rl<></td></rl<>	0.051	10:2 FTOAc	<rl< td=""><td>9.82</td></rl<>	9.82
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	$13.1 \pm 0.7$	0.024	4:2 FTOH	<rl< td=""><td>51.2</td></rl<>	51.2
MeFBSA (SV)	<rl< td=""><td>2.96</td><td>5:2 FTOH</td><td><rl< td=""><td>98.0</td></rl<></td></rl<>	2.96	5:2 FTOH	<rl< td=""><td>98.0</td></rl<>	98.0
FHxSA (NV)	<rl< td=""><td>0.027</td><td>6:2 FTOH</td><td><rl< td=""><td>49.3</td></rl<></td></rl<>	0.027	6:2 FTOH	<rl< td=""><td>49.3</td></rl<>	49.3
FOSA (NV)	<rl< td=""><td>0.037</td><td>7:2 FTOH</td><td><rl< td=""><td>49.0</td></rl<></td></rl<>	0.037	7:2 FTOH	<rl< td=""><td>49.0</td></rl<>	49.0
MeFOSA (SV)	<rl< td=""><td>0.593</td><td>8:2 FTOH</td><td><rl< td=""><td>96.3</td></rl<></td></rl<>	0.593	8:2 FTOH	<rl< td=""><td>96.3</td></rl<>	96.3
EtFOSA (SV)	<rl< td=""><td>0.726</td><td>10:2 FTOH</td><td><rl< td=""><td>49.3</td></rl<></td></rl<>	0.726	10:2 FTOH	<rl< td=""><td>49.3</td></rl<>	49.3
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.047</td><td>4:2 FTS</td><td><rl<sup>a</rl<sup></td><td>0.045</td></rl<>	0.047	4:2 FTS	<rl<sup>a</rl<sup>	0.045
MeFOSAA	<rl< td=""><td>0.024</td><td>6:2 FTS</td><td><rl<sup>a</rl<sup></td><td>5.17</td></rl<>	0.024	6:2 FTS	<rl<sup>a</rl<sup>	5.17
EtFOSAA	<rl< td=""><td>0.048</td><td>8:2 FTS</td><td><rl< td=""><td>0.108</td></rl<></td></rl<>	0.048	8:2 FTS	<rl< td=""><td>0.108</td></rl<>	0.108
LIFOSAA	T.L.		10:2 FTS	<rl< td=""><td>0.107</td></rl<>	0.107

<sup>&</sup>lt;sup>a</sup> Internal standard recovery did not meet QC standards, but all other QC standards met. Therefore, data do not meet QC standards and are not included in figures or this technical note beyond this table where they are included only for informational purposes.

**Table 5.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-D. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	<rl< td=""><td>0.601</td><td>MeFOSE</td><td><math>0.46 \pm 0.33</math></td><td>0.248</td></rl<>	0.601	MeFOSE	$0.46 \pm 0.33$	0.248
PFPeA	$0.364 \pm 0.034$	0.024	EtFOSE	<rl< td=""><td>0.230</td></rl<>	0.230
PFHxA	1.31 ± 0.12 a	0.161	_		
PFHpA	<rl< td=""><td>0.528</td><td>PPEA (NV)</td><td></td><td></td></rl<>	0.528	PPEA (NV)		
PFOA	<rl< td=""><td>0.114</td><td>PFEESA</td><td><rl< td=""><td>0.019</td></rl<></td></rl<>	0.114	PFEESA	<rl< td=""><td>0.019</td></rl<>	0.019
PFNA	<rl< td=""><td>0.024</td><td>PF4OPeA</td><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.024	PF4OPeA	<rl< td=""><td>0.022</td></rl<>	0.022
PFDA	<rl< td=""><td>0.024</td><td>PF5OHxA</td><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.024	PF5OHxA	<rl< td=""><td>0.022</td></rl<>	0.022
PFUnDA	<rl< td=""><td>0.032</td><td>3-6-ОРГНРА</td><td><rl i<="" td=""><td>0.022</td></rl></td></rl<>	0.032	3-6-ОРГНРА	<rl i<="" td=""><td>0.022</td></rl>	0.022
PFDoDA	<rl< td=""><td>0.024</td><td>HFPO-DA</td><td><rl< td=""><td>0.064</td></rl<></td></rl<>	0.024	HFPO-DA	<rl< td=""><td>0.064</td></rl<>	0.064
PFTrDA	<rl< td=""><td>0.024</td><td>ADONA</td><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.024	ADONA	<rl< td=""><td>0.022</td></rl<>	0.022
PFTeDA	<rl< td=""><td>0.136</td><td>9Cl-PF3ONS</td><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.136	9Cl-PF3ONS	<rl< td=""><td>0.022</td></rl<>	0.022
			11Cl-PF3OUdS	<rl< td=""><td>0.023</td></rl<>	0.023
PFSA (NV)					
PFPrS	<rl< td=""><td>0.022</td><td>n:2 FTMAC (V)</td><td></td><td></td></rl<>	0.022	n:2 FTMAC (V)		
PFBS	$0.104 \pm 0.003$	0.048	6:2 FTMAC	$395 \pm 39$	73.9
PFPeS	No value		8:2 FTMAC	<rl< td=""><td>37.9</td></rl<>	37.9
PFHxS	<rl< td=""><td>0.022</td><td>10:2 FTMAC</td><td><rl< td=""><td>39.9</td></rl<></td></rl<>	0.022	10:2 FTMAC	<rl< td=""><td>39.9</td></rl<>	39.9
PFHpS	<rl< td=""><td>0.023</td><td></td><td></td><td></td></rl<>	0.023			
PFOS	$0.086 \pm 0.082^{b}$	0.022	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.023</td><td>8:2 FTOAc</td><td><rl< td=""><td>39.6</td></rl<></td></rl<>	0.023	8:2 FTOAc	<rl< td=""><td>39.6</td></rl<>	39.6
PFDS	<rl< td=""><td>1.19</td><td>10:2 FTOAc</td><td><rl< td=""><td>7.97</td></rl<></td></rl<>	1.19	10:2 FTOAc	<rl< td=""><td>7.97</td></rl<>	7.97
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	$0.324 \pm 0.045$	0.024	4:2 FTOH	<rl< td=""><td>41.6</td></rl<>	41.6
MeFBSA (SV)	<rl< td=""><td>2.19</td><td>5:2 FTOH</td><td><rl< td=""><td>79.5</td></rl<></td></rl<>	2.19	5:2 FTOH	<rl< td=""><td>79.5</td></rl<>	79.5
FHxSA (NV)	<rl< td=""><td>0.049</td><td>6:2 FTOH</td><td>56 ± 16</td><td>40.0</td></rl<>	0.049	6:2 FTOH	56 ± 16	40.0
FOSA (NV)	<rl< td=""><td>0.049</td><td>7:2 FTOH</td><td><rl< td=""><td>39.8</td></rl<></td></rl<>	0.049	7:2 FTOH	<rl< td=""><td>39.8</td></rl<>	39.8
MeFOSA (SV)	<rl< td=""><td>0.437</td><td>8:2 FTOH</td><td><rl< td=""><td>78.1</td></rl<></td></rl<>	0.437	8:2 FTOH	<rl< td=""><td>78.1</td></rl<>	78.1
EtFOSA (SV)	<rl< td=""><td>0.535</td><td>10:2 FTOH</td><td><rl< td=""><td>40.0</td></rl<></td></rl<>	0.535	10:2 FTOH	<rl< td=""><td>40.0</td></rl<>	40.0
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.048</td><td>4:2 FTS</td><td><rl a<="" td=""><td>0.046</td></rl></td></rl<>	0.048	4:2 FTS	<rl a<="" td=""><td>0.046</td></rl>	0.046
MeFOSAA	<rl< td=""><td>0.048</td><td>6:2 FTS</td><td><rl< td=""><td>5.24</td></rl<></td></rl<>	0.048	6:2 FTS	<rl< td=""><td>5.24</td></rl<>	5.24
EtFOSAA	<rl <sup="">a</rl>	0.024	8:2 FTS	<rl< td=""><td>0.110</td></rl<>	0.110
Lif Oblin	\KL	U.U <del>1</del> 3	10:2 FTS	<rl< td=""><td>0.110</td></rl<>	0.110

<sup>&</sup>lt;sup>a</sup> Internal standard recovery did not meet QC standards, but all other QC standards met. Therefore, data do not meet QC standards and are not included in figures or this technical note beyond this table where they are included only for informational purposes.

**Table 6.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-E. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	$16.1 \pm 4.4$	0.626	MeFOSE	<rl< td=""><td>0.230</td></rl<>	0.230
PFPeA	<rl< td=""><td>0.025</td><th>EtFOSE</th><td><rl< td=""><td>0.214</td></rl<></td></rl<>	0.025	EtFOSE	<rl< td=""><td>0.214</td></rl<>	0.214
PFHxA	$1.90 \pm 0.11$	1.18			
PFHpA	<rl< td=""><td>0.550</td><th>PPEA (NV)</th><td></td><td></td></rl<>	0.550	PPEA (NV)		
PFOA	<rl< td=""><td>0.119</td><th>PFEESA</th><td><rl< td=""><td>0.020</td></rl<></td></rl<>	0.119	PFEESA	<rl< td=""><td>0.020</td></rl<>	0.020
PFNA	<rl< td=""><td>0.025</td><th>PF4OPeA</th><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.025	PF4OPeA	<rl< td=""><td>0.022</td></rl<>	0.022
PFDA	<rl< td=""><td>0.025</td><th>PF5OHxA</th><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.025	PF5OHxA	<rl< td=""><td>0.022</td></rl<>	0.022
PFUnDA	<rl< td=""><td>0.033</td><th>3-6-ОРГНРА</th><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.033	3-6-ОРГНРА	<rl< td=""><td>0.022</td></rl<>	0.022
PFDoDA	<rl< td=""><td>0.025</td><th>HFPO-DA</th><td><rl< td=""><td>0.067</td></rl<></td></rl<>	0.025	HFPO-DA	<rl< td=""><td>0.067</td></rl<>	0.067
PFTrDA	<rl< th=""><th>0.025</th><th>ADONA</th><th><rl< th=""><th>0.022</th></rl<></th></rl<>	0.025	ADONA	<rl< th=""><th>0.022</th></rl<>	0.022
PFTeDA	<rl< td=""><td>0.141</td><th>9Cl-PF3ONS</th><td><rl< td=""><td>0.023</td></rl<></td></rl<>	0.141	9Cl-PF3ONS	<rl< td=""><td>0.023</td></rl<>	0.023
			11Cl-PF3OUdS	<rl< td=""><td>0.024</td></rl<>	0.024
PFSA (NV)					
PFPrS	<rl< td=""><td>0.022</td><th>n:2 FTMAC (V)</th><td></td><td></td></rl<>	0.022	n:2 FTMAC (V)		
PFBS	$34 \pm 10$	0.050	6:2 FTMAC	$1011 \pm 86$	66.8
PFPeS	<rl< td=""><td>0.024</td><th>8:2 FTMAC</th><td><rl< td=""><td>34.2</td></rl<></td></rl<>	0.024	8:2 FTMAC	<rl< td=""><td>34.2</td></rl<>	34.2
PFHxS	<rl< td=""><td>0.023</td><th>10:2 FTMAC</th><td><rl< td=""><td>36.0</td></rl<></td></rl<>	0.023	10:2 FTMAC	<rl< td=""><td>36.0</td></rl<>	36.0
PFHpS	$0.086 \pm 0.021$	0.024			
PFOS	<rl< td=""><td>0.106</td><th>n:2 FTOAc (V)</th><td></td><td></td></rl<>	0.106	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.024</td><th>8:2 FTOAc</th><td><rl< td=""><td>36.8</td></rl<></td></rl<>	0.024	8:2 FTOAc	<rl< td=""><td>36.8</td></rl<>	36.8
PFDS	<rl< td=""><td>0.228</td><th>10:2 FTOAc</th><td><rl< td=""><td>7.20</td></rl<></td></rl<>	0.228	10:2 FTOAc	<rl< td=""><td>7.20</td></rl<>	7.20
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	$8.6 \pm 2.5$	0.025	4:2 FTOH	<rl< th=""><th>37.5</th></rl<>	37.5
MeFBSA (SV)	<rl< td=""><td>2.03</td><th>5:2 FTOH</th><td><rl< td=""><td>71.8</td></rl<></td></rl<>	2.03	5:2 FTOH	<rl< td=""><td>71.8</td></rl<>	71.8
FHxSA (NV)	<rl< th=""><th>0.051</th><th>6:2 FTOH</th><th><math>178.9 \pm 8.3</math></th><th>36.1</th></rl<>	0.051	6:2 FTOH	$178.9 \pm 8.3$	36.1
FOSA (NV)	<rl< th=""><th>0.051</th><th>7:2 FTOH</th><th><rl< th=""><th>35.9</th></rl<></th></rl<>	0.051	7:2 FTOH	<rl< th=""><th>35.9</th></rl<>	35.9
MeFOSA (SV)	<rl< th=""><th>0.406</th><th>8:2 FTOH</th><th><rl< th=""><th>70.5</th></rl<></th></rl<>	0.406	8:2 FTOH	<rl< th=""><th>70.5</th></rl<>	70.5
EtFOSA (SV)	<rl< td=""><td>0.497</td><th>10:2 FTOH</th><td><rl< td=""><td>36.1</td></rl<></td></rl<>	0.497	10:2 FTOH	<rl< td=""><td>36.1</td></rl<>	36.1
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.050</td><th>4:2 FTS</th><td><math>0.85 \pm 0.27</math></td><td>0.048</td></rl<>	0.050	4:2 FTS	$0.85 \pm 0.27$	0.048
MeFOSAA	<rl< th=""><th>0.025</th><th>6:2 FTS</th><th>613 ± 15</th><th>1.18</th></rl<>	0.025	6:2 FTS	613 ± 15	1.18
EtFOSAA	<rl< th=""><th>0.051</th><th>8:2 FTS</th><th><rl< th=""><th>0.114</th></rl<></th></rl<>	0.051	8:2 FTS	<rl< th=""><th>0.114</th></rl<>	0.114
			10:2 FTS	<rl< th=""><th>0.113</th></rl<>	0.113
					-

**Table 7.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in moisture barrier textile MB-F. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	<rl< td=""><td>0.595</td><td>MeFOSE</td><td><rl< td=""><td>0.281</td></rl<></td></rl<>	0.595	MeFOSE	<rl< td=""><td>0.281</td></rl<>	0.281
PFPeA	$0.0853 \pm 0.007$	0.024	EtFOSE	<rl< td=""><td>0.261</td></rl<>	0.261
PFHxA	$0.880 \pm 0.057$	0.159			
PFHpA	<rl< td=""><td>0.523</td><td>PPEA (NV)</td><td></td><td></td></rl<>	0.523	PPEA (NV)		
PFOA	<rl< td=""><td>0.113</td><td>PFEESA</td><td><rl< td=""><td>0.019</td></rl<></td></rl<>	0.113	PFEESA	<rl< td=""><td>0.019</td></rl<>	0.019
PFNA	<rl< td=""><td>0.024</td><td>PF4OPeA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.024	PF4OPeA	<rl< td=""><td>0.021</td></rl<>	0.021
PFDA	<rl< td=""><td>0.024</td><td>PF5OHxA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.024	PF5OHxA	<rl< td=""><td>0.021</td></rl<>	0.021
PFUnDA	<rl< td=""><td>0.031</td><td>3-6-OPFHpA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.031	3-6-OPFHpA	<rl< td=""><td>0.021</td></rl<>	0.021
PFDoDA	<rl< td=""><td>0.024</td><td>HFPO-DA</td><td><rl< td=""><td>0.064</td></rl<></td></rl<>	0.024	HFPO-DA	<rl< td=""><td>0.064</td></rl<>	0.064
PFTrDA	<rl< td=""><td>0.024</td><td>ADONA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.024	ADONA	<rl< td=""><td>0.021</td></rl<>	0.021
PFTeDA	$0.27 \pm 0.14$	0.134	9Cl-PF3ONS	<rl< td=""><td>0.022</td></rl<>	0.022
		_	11Cl-PF3OUdS	<rl< td=""><td>0.022</td></rl<>	0.022
PFSA (NV)		_			
PFPrS	<rl< td=""><td>0.021</td><td>n:2 FTMAC (V)</td><td></td><td></td></rl<>	0.021	n:2 FTMAC (V)		
PFBS	<rl< td=""><td>0.048</td><td>6:2 FTMAC</td><td><math>160 \pm 51</math></td><td>83.8</td></rl<>	0.048	6:2 FTMAC	$160 \pm 51$	83.8
PFPeS	No value <sup>b</sup>		8:2 FTMAC	<rl< td=""><td>42.9</td></rl<>	42.9
PFHxS	<rl< td=""><td>0.022</td><td>10:2 FTMAC</td><td><rl< td=""><td>45.2</td></rl<></td></rl<>	0.022	10:2 FTMAC	<rl< td=""><td>45.2</td></rl<>	45.2
PFHpS	<rl< td=""><td>0.023</td><td></td><td></td><td></td></rl<>	0.023			
PFOS	$0.16 \pm 0.16^{a}$	0.022	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.023</td><td>8:2 FTOAc</td><td><rl< td=""><td>44.9</td></rl<></td></rl<>	0.023	8:2 FTOAc	<rl< td=""><td>44.9</td></rl<>	44.9
PFDS	<rl< td=""><td>1.18</td><td>10:2 FTOAc</td><td><rl< td=""><td>9.03</td></rl<></td></rl<>	1.18	10:2 FTOAc	<rl< td=""><td>9.03</td></rl<>	9.03
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	<rl< td=""><td>0.024</td><td>4:2 FTOH</td><td><rl< td=""><td>47.1</td></rl<></td></rl<>	0.024	4:2 FTOH	<rl< td=""><td>47.1</td></rl<>	47.1
MeFBSA (SV)	<rl< td=""><td>2.48</td><td>5:2 FTOH</td><td><rl< td=""><td>90.1</td></rl<></td></rl<>	2.48	5:2 FTOH	<rl< td=""><td>90.1</td></rl<>	90.1
FHxSA (NV)	<rl< td=""><td>0.048</td><td>6:2 FTOH</td><td><rl< td=""><td>45.3</td></rl<></td></rl<>	0.048	6:2 FTOH	<rl< td=""><td>45.3</td></rl<>	45.3
FOSA (NV)	<rl< td=""><td>0.048</td><td>7:2 FTOH</td><td><rl< td=""><td>45.1</td></rl<></td></rl<>	0.048	7:2 FTOH	<rl< td=""><td>45.1</td></rl<>	45.1
MeFOSA (SV)	<rl< td=""><td>0.496</td><td>8:2 FTOH</td><td><rl< td=""><td>88.5</td></rl<></td></rl<>	0.496	8:2 FTOH	<rl< td=""><td>88.5</td></rl<>	88.5
EtFOSA (SV)	<rl< td=""><td>0.607</td><td>10:2 FTOH</td><td><rl< td=""><td>45.3</td></rl<></td></rl<>	0.607	10:2 FTOH	<rl< td=""><td>45.3</td></rl<>	45.3
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.047</td><td>4:2 FTS</td><td><rl<sup>a</rl<sup></td><td>0.045</td></rl<>	0.047	4:2 FTS	<rl<sup>a</rl<sup>	0.045
MeFOSAA	<rl< td=""><td>0.024</td><td>6:2 FTS</td><td><rl< td=""><td>5.19</td></rl<></td></rl<>	0.024	6:2 FTS	<rl< td=""><td>5.19</td></rl<>	5.19
EtFOSAA	<rl<sup>a</rl<sup>	0.024	8:2 FTS	<rl< td=""><td>0.109</td></rl<>	0.109
EHUSAA	-1112	0.0 10	10:2 FTS	<rl< td=""><td>0.107</td></rl<>	0.107

<sup>&</sup>lt;sup>a</sup> Internal standard recovery did not meet QC standards, but all other QC standards met. Therefore, data do not meet QC standards and are not included in figures or this technical note beyond this table where they are included only for informational purposes.

<sup>&</sup>lt;sup>b</sup> QC standards not met. Data not reported.

**Table 8.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-A. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.

FASE (SV)           PFBA         2.10 ± 0.04         0.129         McPOSE         ≪RL         0.535           PFPeA         1.61 ± 0.04         0.126         EtFOSE         ≪RL         0.472           PFHXA         3.54 ± 0.28         0.275         FFHDA         ≪RL         0.491         PPEA (NV)         PPEA (NV)           PFOA         ≪RL         0.237         PFEESA         ≪RL         0.017           PFDA         ≪RL         0.112         PF4OPeA         ≪RL         0.040           PFDA         ≪RL         0.112         PF5OHAA         ≪RL         0.040           PFDA         ≪RL         0.112         PF5OHAA         ≪RL         0.019           PFDA         ≪RL         0.012         PF5OHAA         ≪RL         0.019           PFDA         ≪RL         0.012         3-6-OPFHpA         ≪RL         0.019           PFDODA         ≪RL         0.077         ADONA         ≪RL         0.019           PFTDA         ≪RL         0.042         9C-PF3ONS         ≪RL         0.020           PFTSA (NV)          n:2 FTMAC (V)         PFPFS <rl< td="">         0.020           PFPPS         ≪RL</rl<>	PFAS	Concentration (μg/kg)	RL (μg/kg)	PFAS	Concentration (µg/kg)	RL (μg/kg)
PFPeA         1.61 ± 0.04         0.126         EtFOSE         ≪RL         0.472           PFHxA         3.54 ± 0.28         0.275         PFHpA         ≪RL         0.491         PPEA (NV)           PFOA         ≪RL         0.491         PPEA (NV)         PFESA         ≪RL         0.017           PFNA         ≪RL         0.112         PFEOPEA         ≪RL         0.040           PFDA         ≪RL         0.112         PFSOHXA         ≪RL         0.040           PFUDA         ≪RL         0.112         PFSOHXA         ≪RL         0.019           PFUDA         ≪RL         0.112         PFSOHXA         ≪RL         0.019           PFDODA         ≪RL         0.012         3-6-OPFHpA         ≪RL         0.019           PFTDA         ≪RL         0.065         HFPO-DA <rl< th="">         0.0112           PFTDA         ≪RL         0.040         HFPO-DA         <rl< th="">         0.020           PFTSA (NV)         PFTSONS         <rl< th="">         0.020           PFSA (NV)          n:2 FTMAC (V)         PFPSONS         <rl< th="">         0.020           PFHSS         <rl< th="">         0.041         8:2 FTMAC         <rl< th="">         193</rl<></rl<></rl<></rl<></rl<></rl<>	PFCA (NV)			FASE (SV)		
PFHxA         3.54 ± 0.28         0.275           PFHpA         ⟨RL         0.491         PPEA (NV)           PFOA         ⟨RL         0.237         PFEESA         ⟨RL         0.017           PFNA         ⟨RL         0.112         PF4OPeA         ⟨RL         0.049           PFDA         ⟨RL         0.112         PF5OBXA         ⟨RL         0.019           PFDDA         ⟨RL         0.112         3-6-OPFHpA         ⟨RL         0.019           PFDoDA         ⟨RL         0.065         HFPO-DA         ⟨RL         0.012           PFTDA         ⟨RL         0.077         ADONA         ⟨RL         0.020           PFTDA         ⟨RL         0.142         9C-IPF3ONS         ⟨RL         0.020           PFSA (NV)         PFBSA (NV)         ⟨RL         0.103         m:2 FTMAC (V)         PFB5ONS         ⟨RL         0.020           PFPRS         ⟨RL         0.0103         m:2 FTMAC (V)         PFB5D         PFP6S         ⟨RL         0.040         8:2 FTMAC         ⟨RL         193           PFPRS         ⟨RL         0.041         PICE FTMAC         ⟨RL         260         PFPFSA (NV)         ⟨RL         0.041         PICE FTMAC	PFBA	$2.10 \pm 0.04$	0.129	MeFOSE	<rl< td=""><td>0.535</td></rl<>	0.535
PFHpA <rl< th="">         0.491         PPEA (NV)           PFOA         <rl< td="">         0.237         PFEESA         <rl< td="">         0.017           PFNA         <rl< td="">         0.112         PF4OPeA         <rl< td="">         0.049           PFDA         <rl< td="">         0.112         PF5OHxA         <rl< td="">         0.019           PFUNDA         <rl< td="">         0.112         3-6-OPFHpA         <rl< td="">         0.019           PFDODA         <rl< td="">         0.065         HFPO-DA         <rl< td="">         0.012           PFTDA         <rl< td="">         0.077         ADONA         <rl< td="">         0.020           PFTCPA         <rl< td="">         0.142         9CL-PF3ONS         <rl< td="">         0.020           PFTSA (NV)           <rl< td="">         0.020          <rl< td="">         0.020           PFSA (NV)</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFPeA	$1.61\pm0.04$	0.126	EtFOSE	<rl< td=""><td>0.472</td></rl<>	0.472
PFOA         ≪RL         0.237         PFEESA         ≪RL         0.017           PFNA         ≪RL         0.112         PF4OPeA         ≪RL         0.040           PFDA         ≪RL         0.112         PF5OHxA         ≪RL         0.019           PFUnDA         ≪RL         0.012         3-6-OPFHpA         ≪RL         0.019           PFDoDA         ≪RL         0.020         HFPO-DA         ≪RL         0.112           PFTDA         ≪RL         0.077         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.042         9Cl-PF3ONS         ≪RL         0.020           PFTSA (NV)         PFTS         ≪RL         0.103         m:2 FTMAC (V)         PF0S	PFHxA	$3.54 \pm 0.28$	0.275			
PFNA         ≪RL         0.112         PF4OPeA         ≪RL         0.040           PFDA         ≪RL         0.112         PF5OHxA         ≪RL         0.019           PFUnDA         ≪RL         0.112         3-6-OPFHpA         ≪RL         0.019           PFDoDA         ≪RL         0.0112         HFPO-DA         ≪RL         0.112           PFTrDA         ≪RL         0.077         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.077         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.0142         9C-PF3ONS         ≪RL         0.020           PFTBA         ≪RL         0.0103         m:2 FTMAC (V)         PF           PFPSA (NV)         PFPS         ≪RL         0.018         6:2 FTMAC         1250 ± 140         483           PFPES         ≪RL         0.040         8:2 FTMAC         № CRL         193           PFHxS         ≪RL         0.039         10:2 FTMAC         ≪RL         260           PFMS         ≪RL         0.041         m:2 FTOAc (V)         PF           PFNS         ≪RL         0.041         m:2 FTOAc (V)         PR           PFSA (NV, SV)	PFHpA	<rl< td=""><td>0.491</td><th>PPEA (NV)</th><td></td><td></td></rl<>	0.491	PPEA (NV)		
PFDA         ≪RL         0.112         PF5OHxA         ≪RL         0.019           PFUnDA         ≪RL         0.112         3-6-OPFHpA         ≪RL         0.019           PFDoDA         ≪RL         0.065         HFPO-DA         ≪RL         0.112           PFTDA         ≪RL         0.077         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.0142         9Cl-PF3ONS         ≪RL         0.020           PFSA (NV)           PFSA (NV)           PFSA (NV)           PFPSS         ≪RL         0.103         n:2 FTMAC (V)           PFBS         0.128 ± 0.012         0.018         6:2 FTMAC         1250 ± 140         483           PFPS         ≪RL         0.040         8:2 FTMAC         ≪RL         193           PFHSS         ≪RL         0.040         8:2 FTMAC         ≪RL         260           PFHSS         ≪RL         0.041         PROSE	PFOA	<rl< td=""><td>0.237</td><th>PFEESA</th><td><rl< td=""><td>0.017</td></rl<></td></rl<>	0.237	PFEESA	<rl< td=""><td>0.017</td></rl<>	0.017
PFUnDA         ≪RL         0.112         3-6-OPFHpA         ≪RL         0.019           PFDoDA         ≪RL         0.065         HFPO-DA         ≪RL         0.112           PFTrDA         ≪RL         0.077         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.142         9Cl-PF3ONS         ≪RL         0.020           PFSA (NV)         PFPS         ≪RL         0.103         m:2 FTMAC (V)         PFPSONS         ≪RL         0.020           PFPS         ≪RL         0.0103         m:2 FTMAC (V)         PFPSONS         ≪RL         0.039         10:2 FTMAC         1250 ± 140         483         PFPSONS         ≪RL         0.040         8:2 FTMAC         1250 ± 140         483         PFPSONS         ≪RL         0.040         8:2 FTMAC         ≪RL         193         PFPSONS         ≪RL         0.041         PFPSONS         ≪RL         0.041         PRSONS          REL         0.041         PRSONS	PFNA	<rl< td=""><td>0.112</td><th>PF4OPeA</th><td><rl< td=""><td>0.040</td></rl<></td></rl<>	0.112	PF4OPeA	<rl< td=""><td>0.040</td></rl<>	0.040
PFDoDA         ≪RL         0.065         HFPO-DA         ≪RL         0.112           PFTrDA         ≪RL         0.077         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.142         9Cl-PF3ONS         ≪RL         0.020           PFEDA         ≪RL         0.142         9Cl-PF3ONS         ≪RL         0.020           PFSA (NV)           PFPS         ≪RL         0.103         n:2 FTMAC (V)           PFBS         0.128 ± 0.012         0.018         6:2 FTMAC         1250 ± 140         483           PFPS         ≪RL         0.040         8:2 FTMAC         ≪RL         193           PFHSS         ≪RL         0.040         8:2 FTMAC         ≪RL         193           PFNS         ≪RL         0.041         m:2 FTOAc (V)         PFNS <th>PFDA</th> <td><rl< td=""><td>0.112</td><th>PF5OHxA</th><td><rl< td=""><td>0.019</td></rl<></td></rl<></td>	PFDA	<rl< td=""><td>0.112</td><th>PF5OHxA</th><td><rl< td=""><td>0.019</td></rl<></td></rl<>	0.112	PF5OHxA	<rl< td=""><td>0.019</td></rl<>	0.019
PFTrDA         ≪RL         0.077         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.142         9Cl-PF3ONS         ≪RL         0.020           PFSA (NV)           PFPS         ≪RL         0.103         m:2 FTMAC (V)           PFBS         0.128 ± 0.012         0.018         6:2 FTMAC         1250 ± 140         483           PFPS         ≪RL         0.040         8:2 FTMAC         ≪RL         193           PFHS         ≪RL         0.040         8:2 FTMAC         ≪RL         260           PFHS         ≪RL         0.041         9         10:2 FTMAC         ≪RL         260           PFNS         ≪RL         0.041         9         10:2 FTMAC                    483 <t< td=""><th>PFUnDA</th><td><rl< td=""><td>0.112</td><th>3-6-ОРГНРА</th><td><rl< td=""><td>0.019</td></rl<></td></rl<></td></t<>	PFUnDA	<rl< td=""><td>0.112</td><th>3-6-ОРГНРА</th><td><rl< td=""><td>0.019</td></rl<></td></rl<>	0.112	3-6-ОРГНРА	<rl< td=""><td>0.019</td></rl<>	0.019
PFTeDA         ≪RL         0.142         9Cl-PF3ONS         ≪RL         0.020           PFSA (NV)           PFPS         ≪RL         0.103         m:2 FTMAC (V)           PFBS         0.128 ± 0.012         0.018         6:2 FTMAC         1250 ± 140         483           PFPS         ≪RL         0.040         8:2 FTMAC         ≪RL         193           PFHxS         ≪RL         0.039         10:2 FTMAC         ≪RL         260           PFHpS         ≪RL         0.041         70:2 FTOAc (V)	PFDoDA	<rl< td=""><td>0.065</td><th>HFPO-DA</th><td><rl< td=""><td>0.112</td></rl<></td></rl<>	0.065	HFPO-DA	<rl< td=""><td>0.112</td></rl<>	0.112
TICL-PF3OUdS         < RL	PFTrDA	<rl< th=""><th>0.077</th><th>ADONA</th><th><rl< th=""><th>0.020</th></rl<></th></rl<>	0.077	ADONA	<rl< th=""><th>0.020</th></rl<>	0.020
PFSA (NV)           PFPRS <rl< th="">         0.103         n:2 FTMAC (V)           PFBS         0.128 ± 0.012         0.018         6:2 FTMAC         1250 ± 140         483           PFPES         <rl< th="">         0.040         8:2 FTMAC         <rl< th="">         193           PFHXS         <rl< th="">         0.039         10:2 FTMAC         <rl< th="">         260           PFHPS         <rl< th="">         0.041         m:2 FTOAc (V)            PFNS         <rl< th="">         0.049         n:2 FTOAc (V)            PFDS         <rl< th="">         0.041         8:2 FTOAc         <rl< th="">         202           PFDS         <rl< th="">         0.041         10:2 FTOAc         <rl< th="">         104           FASA (NV, SV)         n:2 FTOH(V)           FBSA (NV)         <rl< th="">         0.041         0.020         <rl< th="">         409           MeFBSA (SV)         <rl< th="">         0.020         6:2 FTOH         <rl< th="">         409           MeFBSA (NV)         <rl< th="">         0.043         7:2 FTOH         <rl< th="">         408           MeFOSA (SV)         <rl< th="">         1.24         8:2 FTOH         <rl< th="">         408           MeFOSAA         <rl< th="">         1.30&lt;</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFTeDA	<rl< td=""><td>0.142</td><th>9Cl-PF3ONS</th><td><rl< td=""><td>0.020</td></rl<></td></rl<>	0.142	9Cl-PF3ONS	<rl< td=""><td>0.020</td></rl<>	0.020
PFPrS <rl< th="">         0.103         n:2 FTMAC (V)           PFBS         0.128 ± 0.012         0.018         6:2 FTMAC         1250 ± 140         483           PFPeS         <rl< td="">         0.040         8:2 FTMAC         <rl< td="">         193           PFHxS         <rl< td="">         0.039         10:2 FTMAC         <rl< td="">         260           PFHpS         <rl< td="">         0.041         ***</rl<></rl<></rl<></rl<></rl<></rl<>				11Cl-PF3OUdS	<rl< td=""><td>0.020</td></rl<>	0.020
PFBS         0.128 ± 0.012         0.018         6:2 FTMAC         1250 ± 140         483           PFPeS <rl< td="">         0.040         8:2 FTMAC         <rl< td="">         193           PFHxS         <rl< td="">         0.039         10:2 FTMAC         <rl< td="">         260           PFHpS         <rl< td="">         0.041         ***</rl<></rl<></rl<></rl<></rl<>	PFSA (NV)					
PFPeS <rl< th="">         0.040         8:2 FTMAC         <rl< th="">         193           PFHxS         <rl< th="">         0.039         10:2 FTMAC         <rl< th="">         193           PFMS         <rl< th="">         0.041         10:2 FTMAC         <rl< th="">         260           PFNS         <rl< th="">         0.041         8:2 FTOAc (V)             PFNS         <rl< th="">         0.041         8:2 FTOAc         <rl< th="">         202           PFDS         <rl< th="">         0.041         10:2 FTOAc         <rl< th="">         104           FASA (NV, SV)           Interpretation of the color of th</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFPrS	<rl< td=""><td>0.103</td><th>n:2 FTMAC (V)</th><td></td><td></td></rl<>	0.103	n:2 FTMAC (V)		
PFHxS <rl< th="">         0.039         10:2 FTMAC         <rl< th="">         260           PFHpS         <rl< th="">         0.041          10:2 FTMAC         <rl< th="">         260           PFNS         <rl< th="">         0.049         n:2 FTOAc (V)</rl<></rl<></rl<></rl<></rl<>	PFBS	$0.128 \pm 0.012$	0.018	6:2 FTMAC	$1250 \pm 140$	483
PFHpS <rl< th="">         0.041           PFOS         <rl< th="">         0.049         n:2 FTOAc (V)           PFNS         <rl< th="">         0.041         8:2 FTOAc         <rl< th="">         202           PFDS         <rl< th="">         0.041         10:2 FTOAc         <rl< th="">         104           FASA (NV, SV)           FBSA (NV)         0.217 ± 0.011         0.020         4:2 FTOH         <rl< th="">         409           MeFBSA (SV)         <rl< th="">         5.14         5:2 FTOH         <rl< th="">         203           FHxSA (NV)         <rl< th="">         0.020         6:2 FTOH         362 ± 37         204           FOSA (NV)         <rl< th="">         0.043         7:2 FTOH         <rl< th="">         408           MeFOSA (SV)         <rl< th="">         1.24         8:2 FTOH         <rl< th="">         199           EtFOSA (SV)         <rl< th="">         1.30         10:2 FTOH         <rl< th="">         410           FOSAA         <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         0.227           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFPeS	<rl< td=""><td>0.040</td><th>8:2 FTMAC</th><td><rl< td=""><td>193</td></rl<></td></rl<>	0.040	8:2 FTMAC	<rl< td=""><td>193</td></rl<>	193
PFOS <rl< th="">         0.049         n:2 FTOAc (V)           PFNS         <rl< td="">         0.041         8:2 FTOAc         <rl< td="">         202           PFDS         <rl< td="">         0.041         10:2 FTOAc         <rl< td="">         104           FASA (NV, SV)           n:2 FTOH (V)           FBSA (NV)         <rl< td="">         5.14         5:2 FTOH         <rl< td="">         409           MeFBSA (SV)         <rl< td="">         5.14         5:2 FTOH         <rl< td="">         203           FHxSA (NV)         <rl< td="">         0.020         6:2 FTOH         362 ± 37         204           FOSA (NV)         <rl< td="">         0.043         7:2 FTOH         <rl< td="">         408           MeFOSA (SV)         <rl< td="">         1.24         8:2 FTOH         <rl< td="">         199           EtFOSA (SV)         <rl< td="">         1.30         10:2 FTOH         <rl< td="">         410           FASAA (NV)           FOSAA         <rl< td="">         0.043         4:2 FTS         <rl< td="">         0.105           MeFOSAA         <rl< td="">         0.112         6:2 FTS         <rl< td="">         0.227           EtFOSAA         <rl< td="">         0.136         8:2 FTS         <rl< td="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFHxS	<rl< td=""><td>0.039</td><th>10:2 FTMAC</th><td><rl< td=""><td>260</td></rl<></td></rl<>	0.039	10:2 FTMAC	<rl< td=""><td>260</td></rl<>	260
PFNS <rl< th="">         0.041         8:2 FTOAc         <rl< th="">         202           PFDS         <rl< th="">         0.041         10:2 FTOAc         <rl< th="">         202           FDSA (NV, SV)         Image: FTOH (V)         Image: FTOH (V)</rl<></rl<></rl<></rl<>	PFHpS	<rl< td=""><td>0.041</td><th></th><td></td><td></td></rl<>	0.041			
PFDS <rl< th="">         0.041         10:2 FTOAc         <rl< th="">         104           FASA (NV, SV)         n:2 FTOH (V)           FBSA (NV)         0.217 ± 0.011         0.020         4:2 FTOH         <rl< th="">         409           MeFBSA (SV)         <rl< th="">         5.14         5:2 FTOH         <rl< th="">         203           FHxSA (NV)         <rl< th="">         0.020         6:2 FTOH         362 ± 37         204           FOSA (NV)         <rl< th="">         0.043         7:2 FTOH         <rl< th="">         408           MeFOSA (SV)         <rl< th="">         1.24         8:2 FTOH         <rl< th="">         199           EtFOSA (SV)         <rl< th="">         1.30         10:2 FTOH         <rl< th="">         410           FOSAA         <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         0.227           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFOS	<rl< td=""><td>0.049</td><th>n:2 FTOAc (V)</th><td></td><td></td></rl<>	0.049	n:2 FTOAc (V)		
FASA (NV, SV)           FBSA (NV) $0.217 \pm 0.011$ $0.020$ $4:2$ FTOH $<$ RL $409$ MeFBSA (SV) $<$ RL $5.14$ $5:2$ FTOH $<$ RL $203$ FHxSA (NV) $<$ RL $0.020$ $6:2$ FTOH $<$ RL $408$ FOSA (NV) $<$ RL $0.043$ $7:2$ FTOH $<$ RL $408$ MeFOSA (SV) $<$ RL $1.24$ $8:2$ FTOH $<$ RL $199$ EtFOSA (SV) $<$ RL $1.30$ $10:2$ FTOH $<$ RL $410$ FOSAA $<$ RL $0.043$ $4:2$ FTS $<$ RL $0.105$ MeFOSAA $<$ RL $0.112$ $6:2$ FTS $<$ RL $1.25$ EtFOSAA $<$ RL $0.136$ $8:2$ FTS $<$ RL $0.227$	PFNS	<rl< td=""><td>0.041</td><th>8:2 FTOAc</th><td><rl< td=""><td>202</td></rl<></td></rl<>	0.041	8:2 FTOAc	<rl< td=""><td>202</td></rl<>	202
FBSA (NV)         0.217 ± 0.011         0.020         4:2 FTOH <rl< th="">         409           MeFBSA (SV)         <rl< th="">         5.14         5:2 FTOH         <rl< th="">         203           FHxSA (NV)         <rl< th="">         0.020         6:2 FTOH         362 ± 37         204           FOSA (NV)         <rl< th="">         0.043         7:2 FTOH         <rl< th="">         408           MeFOSA (SV)         <rl< th="">         1.24         8:2 FTOH         <rl< th="">         199           EtFOSA (SV)         <rl< th="">         1.30         10:2 FTOH         <rl< th="">         410           FOSAA         <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         1.25           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFDS	<rl< td=""><td>0.041</td><th>10:2 FTOAc</th><td><rl< td=""><td>104</td></rl<></td></rl<>	0.041	10:2 FTOAc	<rl< td=""><td>104</td></rl<>	104
FBSA (NV)         0.217 ± 0.011         0.020         4:2 FTOH <rl< th="">         409           MeFBSA (SV)         <rl< th="">         5.14         5:2 FTOH         <rl< th="">         203           FHxSA (NV)         <rl< th="">         0.020         6:2 FTOH         362 ± 37         204           FOSA (NV)         <rl< th="">         0.043         7:2 FTOH         <rl< th="">         408           MeFOSA (SV)         <rl< th="">         1.24         8:2 FTOH         <rl< th="">         199           EtFOSA (SV)         <rl< th="">         1.30         10:2 FTOH         <rl< th="">         410           FOSAA         <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         1.25           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	FASA (NV. SV)			n:2 FTOH (V)		
MeFBSA (SV) <rl< th="">         5.14         5:2 FTOH         <rl< th="">         203           FHxSA (NV)         <rl< th="">         0.020         6:2 FTOH         362 ± 37         204           FOSA (NV)         <rl< th="">         0.043         7:2 FTOH         <rl< th="">         408           MeFOSA (SV)         <rl< th="">         1.24         8:2 FTOH         <rl< th="">         199           EtFOSA (SV)         <rl< th="">         1.30         10:2 FTOH         <rl< th="">         410           FOSAA         <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         1.25           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		$0.217 \pm 0.011$	0.020	1.	<rl< th=""><th>409</th></rl<>	409
FHxSA (NV) <rl< th="">         0.020         6:2 FTOH         362 ± 37         204           FOSA (NV)         <rl< th="">         0.043         7:2 FTOH         <rl< th="">         408           MeFOSA (SV)         <rl< th="">         1.24         8:2 FTOH         <rl< th="">         199           EtFOSA (SV)         <rl< th="">         1.30         10:2 FTOH         <rl< th="">         410           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         1.25           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< th=""><th>5.14</th><th>-</th><th></th><th></th></rl<>	5.14	-		
FOSA (NV) <rl< th="">         0.043         7:2 FTOH         <rl< th="">         408           MeFOSA (SV)         <rl< th="">         1.24         8:2 FTOH         <rl< th="">         199           EtFOSA (SV)         <rl< th="">         1.30         10:2 FTOH         <rl< th="">         410           FASAA (NV)         n:2 FTS (NV)          <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         1.25           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< th=""><th>0.020</th><th></th><th></th><th></th></rl<>	0.020			
MeFOSA (SV) <rl< th="">         1.24         8:2 FTOH         <rl< th="">         199           EtFOSA (SV)         <rl< th="">         1.30         10:2 FTOH         <rl< th="">         410           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         1.25           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< th=""><th>0.043</th><th></th><th></th><th></th></rl<>	0.043			
EtFOSA (SV) <rl< th="">         1.30         10:2 FTOH         <rl< th="">         410           FASAA (NV)         n:2 FTS (NV)</rl<></rl<>		<rl< th=""><th>1.24</th><th></th><th></th><th></th></rl<>	1.24			
FOSAA <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         1.25           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<>		<rl< td=""><td>1.30</td><th>10:2 FTOH</th><td></td><td></td></rl<>	1.30	10:2 FTOH		
FOSAA <rl< th="">         0.043         4:2 FTS         <rl< th="">         0.105           MeFOSAA         <rl< th="">         0.112         6:2 FTS         <rl< th="">         1.25           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<></rl<></rl<>	FASAA (NV)			n:2 FTS (NV)		
MeFOSAA <rl< th="">         0.112         6:2 FTS         <rl< th="">         1.25           EtFOSAA         <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<></rl<></rl<>		<rl< th=""><th>0.043</th><th></th><th><rl< th=""><th>0.105</th></rl<></th></rl<>	0.043		<rl< th=""><th>0.105</th></rl<>	0.105
EtFOSAA <rl< th="">         0.136         8:2 FTS         <rl< th="">         0.227</rl<></rl<>						
				10:2 FTS	<rl< th=""><th>0.228</th></rl<>	0.228

**Table 9.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-ASC. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	<rl< td=""><td>0.216</td><th>MeFOSE</th><td><rl< td=""><td>0.479</td></rl<></td></rl<>	0.216	MeFOSE	<rl< td=""><td>0.479</td></rl<>	0.479
PFPeA	<rl< td=""><td>0.067</td><th>EtFOSE</th><td><rl< td=""><td>0.423</td></rl<></td></rl<>	0.067	EtFOSE	<rl< td=""><td>0.423</td></rl<>	0.423
PFHxA	$0.58 \pm 0.12$	0.380			
PFHpA	$0.176 \pm 0.014$	0.070	PPEA (NV)		
PFOA	$0.484 \pm 0.039$	0.363	PFEESA	<rl< td=""><td>0.025</td></rl<>	0.025
PFNA	$0.136 \pm 0.047$	0.096	PF4OPeA	<rl< td=""><td>0.030</td></rl<>	0.030
PFDA	$0.206 \pm 0.011$	0.204	PF5OHxA	<rl< td=""><td>0.042</td></rl<>	0.042
PFUnDA	<rl< td=""><td>0.135</td><th>3-6-OPFHpA</th><td><rl< td=""><td>0.024</td></rl<></td></rl<>	0.135	3-6-OPFHpA	<rl< td=""><td>0.024</td></rl<>	0.024
PFDoDA	<rl< td=""><td>0.110</td><th>HFPO-DA</th><td><rl< td=""><td>0.249</td></rl<></td></rl<>	0.110	HFPO-DA	<rl< td=""><td>0.249</td></rl<>	0.249
PFTrDA	<rl< td=""><td>0.072</td><th>ADONA</th><td><rl< td=""><td>0.024</td></rl<></td></rl<>	0.072	ADONA	<rl< td=""><td>0.024</td></rl<>	0.024
PFTeDA	<rl< td=""><td>0.143</td><th>9Cl-PF3ONS</th><td><rl< td=""><td>0.048</td></rl<></td></rl<>	0.143	9Cl-PF3ONS	<rl< td=""><td>0.048</td></rl<>	0.048
			11Cl-PF3OUdS	<rl< td=""><td>0.023</td></rl<>	0.023
PFSA (NV)					
PFPrS	<rl< td=""><td>0.033</td><th>n:2 FTMAC (V)</th><td></td><td></td></rl<>	0.033	n:2 FTMAC (V)		
PFBS	<rl< td=""><td>0.019</td><th>6:2 FTMAC</th><td><rl< td=""><td>326</td></rl<></td></rl<>	0.019	6:2 FTMAC	<rl< td=""><td>326</td></rl<>	326
PFPeS	<rl< td=""><td>0.025</td><th>8:2 FTMAC</th><td><rl< td=""><td>173</td></rl<></td></rl<>	0.025	8:2 FTMAC	<rl< td=""><td>173</td></rl<>	173
PFHxS	<rl< td=""><td>0.048</td><th>10:2 FTMAC</th><td><rl< td=""><td>176</td></rl<></td></rl<>	0.048	10:2 FTMAC	<rl< td=""><td>176</td></rl<>	176
PFHpS	<rl< td=""><td>0.024</td><th></th><td></td><td></td></rl<>	0.024			
PFOS	<rl< td=""><td>0.055</td><th>n:2 FTOAc (V)</th><td></td><td></td></rl<>	0.055	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.033</td><th>8:2 FTOAc</th><td><rl< td=""><td>74.8</td></rl<></td></rl<>	0.033	8:2 FTOAc	<rl< td=""><td>74.8</td></rl<>	74.8
PFDS	$0.124 \pm 0.046$	0.046	10:2 FTOAc	<rl< td=""><td>93.3</td></rl<>	93.3
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	<rl< td=""><td>0.024</td><th>4:2 FTOH</th><td><rl< td=""><td>72.4</td></rl<></td></rl<>	0.024	4:2 FTOH	<rl< td=""><td>72.4</td></rl<>	72.4
MeFBSA (SV)	<rl< td=""><td>4.60</td><th>5:2 FTOH</th><td><rl< td=""><td>182</td></rl<></td></rl<>	4.60	5:2 FTOH	<rl< td=""><td>182</td></rl<>	182
FHxSA (NV)	<rl< td=""><td>0.024</td><th>6:2 FTOH</th><td><rl< td=""><td>183</td></rl<></td></rl<>	0.024	6:2 FTOH	<rl< td=""><td>183</td></rl<>	183
FOSA (NV)	<rl< td=""><td>0.033</td><th>7:2 FTOH</th><td><rl< td=""><td>73.3</td></rl<></td></rl<>	0.033	7:2 FTOH	<rl< td=""><td>73.3</td></rl<>	73.3
MeFOSA (SV)	<rl< td=""><td>1.11</td><th>8:2 FTOH</th><td><rl< td=""><td>71.0</td></rl<></td></rl<>	1.11	8:2 FTOH	<rl< td=""><td>71.0</td></rl<>	71.0
EtFOSA (SV)	<rl< td=""><td>1.16</td><th>10:2 FTOH</th><td><rl< td=""><td>73.6</td></rl<></td></rl<>	1.16	10:2 FTOH	<rl< td=""><td>73.6</td></rl<>	73.6
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.059</td><th>4:2 FTS</th><td><rl< td=""><td>0.101</td></rl<></td></rl<>	0.059	4:2 FTS	<rl< td=""><td>0.101</td></rl<>	0.101
MeFOSAA	<rl< td=""><td>0.046</td><th>6:2 FTS</th><td><rl< td=""><td>0.155</td></rl<></td></rl<>	0.046	6:2 FTS	<rl< td=""><td>0.155</td></rl<>	0.155
EtFOSAA					
LITUSAA	<rl< td=""><td>0.119</td><th>8:2 FTS</th><td><rl< td=""><td>0.209</td></rl<></td></rl<>	0.119	8:2 FTS	<rl< td=""><td>0.209</td></rl<>	0.209

**Table 10.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-B. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	$2.69 \pm 0.080$	0.119	MeFOSE	<rl< td=""><td>0.507</td></rl<>	0.507
PFPeA	$2.42 \pm 0.060$	0.116	EtFOSE	<rl< td=""><td>0.448</td></rl<>	0.448
PFHxA	$6.10 \pm 0.18$	0.253			
PFHpA	$1.73 \pm 0.17$	0.451	PPEA (NV)		
PFOA	<rl< td=""><td>0.218</td><td>PFEESA</td><td><rl< td=""><td>0.016</td></rl<></td></rl<>	0.218	PFEESA	<rl< td=""><td>0.016</td></rl<>	0.016
PFNA	$0.152 \pm 0.030$	0.103	PF4OPeA	<rl< td=""><td>0.037</td></rl<>	0.037
PFDA	<rl< td=""><td>0.103</td><td>PF5OHxA</td><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.103	PF5OHxA	<rl< td=""><td>0.018</td></rl<>	0.018
PFUnDA	<rl< td=""><td>0.103</td><td>3-6-OPFHpA</td><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.103	3-6-OPFHpA	<rl< td=""><td>0.018</td></rl<>	0.018
PFDoDA	<rl< td=""><td>0.060</td><td>HFPO-DA</td><td><rl< td=""><td>0.103</td></rl<></td></rl<>	0.060	HFPO-DA	<rl< td=""><td>0.103</td></rl<>	0.103
PFTrDA	<rl< td=""><td>0.070</td><td>ADONA</td><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.070	ADONA	<rl< td=""><td>0.018</td></rl<>	0.018
PFTeDA	<rl< td=""><td>0.131</td><td>9Cl-PF3ONS</td><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.131	9Cl-PF3ONS	<rl< td=""><td>0.018</td></rl<>	0.018
			11Cl-PF3OUdS	<rl< td=""><td>0.018</td></rl<>	0.018
PFSA (NV)					
PFPrS	<rl< td=""><td>0.095</td><td>n:2 FTMAC (V)</td><td></td><td></td></rl<>	0.095	n:2 FTMAC (V)		
PFBS	$0.182 \pm 0.010$	0.017	6:2 FTMAC	$1520 \pm 130$	456
PFPeS	<rl< td=""><td>0.037</td><td>8:2 FTMAC</td><td><rl< td=""><td>183</td></rl<></td></rl<>	0.037	8:2 FTMAC	<rl< td=""><td>183</td></rl<>	183
PFHxS	<rl< td=""><td>0.036</td><td>10:2 FTMAC</td><td><rl< td=""><td>246</td></rl<></td></rl<>	0.036	10:2 FTMAC	<rl< td=""><td>246</td></rl<>	246
PFHpS	<rl< td=""><td>0.037</td><td></td><td></td><td></td></rl<>	0.037			
PFOS	<rl< td=""><td>0.045</td><td>n:2 FTOAc (V)</td><td></td><td></td></rl<>	0.045	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.038</td><td>8:2 FTOAc</td><td><rl< td=""><td>191.1</td></rl<></td></rl<>	0.038	8:2 FTOAc	<rl< td=""><td>191.1</td></rl<>	191.1
PFDS	<rl< td=""><td>0.038</td><td>10:2 FTOAc</td><td><rl< td=""><td>98.2</td></rl<></td></rl<>	0.038	10:2 FTOAc	<rl< td=""><td>98.2</td></rl<>	98.2
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	$0.091 \pm 0.010$	0.019	4:2 FTOH	<rl< td=""><td>387</td></rl<>	387
MeFBSA (SV)	<rl< td=""><td>4.87</td><td>5:2 FTOH</td><td><rl< td=""><td>192</td></rl<></td></rl<>	4.87	5:2 FTOH	<rl< td=""><td>192</td></rl<>	192
FHxSA (NV)	<rl< td=""><td>0.019</td><td>6:2 FTOH</td><td><math>350 \pm 120</math></td><td>193</td></rl<>	0.019	6:2 FTOH	$350 \pm 120$	193
FOSA (NV)	<rl< td=""><td>0.039</td><td>7:2 FTOH</td><td><rl< td=""><td>386</td></rl<></td></rl<>	0.039	7:2 FTOH	<rl< td=""><td>386</td></rl<>	386
MeFOSA (SV)	<rl< td=""><td>1.18</td><td>8:2 FTOH</td><td><rl< td=""><td>189</td></rl<></td></rl<>	1.18	8:2 FTOH	<rl< td=""><td>189</td></rl<>	189
EtFOSA (SV)	<rl< td=""><td>1.23</td><td>10:2 FTOH</td><td><rl< td=""><td>388</td></rl<></td></rl<>	1.23	10:2 FTOH	<rl< td=""><td>388</td></rl<>	388
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.039</td><td>4:2 FTS</td><td><rl< td=""><td>0.097</td></rl<></td></rl<>	0.039	4:2 FTS	<rl< td=""><td>0.097</td></rl<>	0.097
MeFOSAA	<rl< td=""><td>0.103</td><td>6:2 FTS</td><td><math>5.88 \pm 0.14</math></td><td>1.15</td></rl<>	0.103	6:2 FTS	$5.88 \pm 0.14$	1.15
EtFOSAA	<rl< td=""><td>0.125</td><td>8:2 FTS</td><td><rl< td=""><td>0.209</td></rl<></td></rl<>	0.125	8:2 FTS	<rl< td=""><td>0.209</td></rl<>	0.209
			10:2 FTS	<rl< td=""><td>0.21</td></rl<>	0.21

**Table 11.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-C. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	$5.11 \pm 0.11$	0.130	MeFOSE	<rl< td=""><td>0.406</td></rl<>	0.406
PFPeA	$5.19 \pm 0.06$	0.061	EtFOSE	<rl< td=""><td>0.359</td></rl<>	0.359
PFHxA	$10.4 \pm 0.4$	0.277			
PFHpA	$3.37 \pm 0.10$	0.064	PPEA (NV)		
PFOA	<rl< td=""><td>0.330</td><td>PFEESA</td><td><rl< td=""><td>0.017</td></rl<></td></rl<>	0.330	PFEESA	<rl< td=""><td>0.017</td></rl<>	0.017
PFNA	<rl< td=""><td>0.087</td><td>PF4OPeA</td><td><rl< td=""><td>0.027</td></rl<></td></rl<>	0.087	PF4OPeA	<rl< td=""><td>0.027</td></rl<>	0.027
PFDA	<rl< td=""><td>0.113</td><td>PF5OHxA</td><td><rl< td=""><td>0.019</td></rl<></td></rl<>	0.113	PF5OHxA	<rl< td=""><td>0.019</td></rl<>	0.019
PFUnDA	<rl< td=""><td>0.113</td><td>3-6-OPFHpA</td><td><rl< td=""><td>0.019</td></rl<></td></rl<>	0.113	3-6-OPFHpA	<rl< td=""><td>0.019</td></rl<>	0.019
PFDoDA	<rl< td=""><td>0.065</td><td>HFPO-DA</td><td><rl< td=""><td>0.113</td></rl<></td></rl<>	0.065	HFPO-DA	<rl< td=""><td>0.113</td></rl<>	0.113
PFTrDA	<rl< td=""><td>0.066</td><td>ADONA</td><td><rl< td=""><td>0.020</td></rl<></td></rl<>	0.066	ADONA	<rl< td=""><td>0.020</td></rl<>	0.020
PFTeDA	<rl< td=""><td>0.130</td><td>9Cl-PF3ONS</td><td><rl< td=""><td>0.020</td></rl<></td></rl<>	0.130	9Cl-PF3ONS	<rl< td=""><td>0.020</td></rl<>	0.020
			11Cl-PF3OUdS	<rl< td=""><td>0.020</td></rl<>	0.020
PFSA (NV)					
PFPrS	<rl< td=""><td>0.030</td><td>n:2 FTMAC (V)</td><td></td><td></td></rl<>	0.030	n:2 FTMAC (V)		
PFBS	$0.322 \pm 0.043$	0.018	6:2 FTMAC	$1066 \pm 68$	365
PFPeS	<rl< td=""><td>0.023</td><td>8:2 FTMAC</td><td><rl< td=""><td>146</td></rl<></td></rl<>	0.023	8:2 FTMAC	<rl< td=""><td>146</td></rl<>	146
PFHxS	<rl< td=""><td>0.039</td><td>10:2 FTMAC</td><td><rl< td=""><td>197</td></rl<></td></rl<>	0.039	10:2 FTMAC	<rl< td=""><td>197</td></rl<>	197
PFHpS	<rl< td=""><td>0.022</td><td>-</td><td></td><td></td></rl<>	0.022	-		
PFOS	<rl< td=""><td>0.049</td><td>n:2 FTOAc (V)</td><td></td><td></td></rl<>	0.049	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.030</td><td>8:2 FTOAc</td><td><rl< td=""><td>152.9</td></rl<></td></rl<>	0.030	8:2 FTOAc	<rl< td=""><td>152.9</td></rl<>	152.9
PFDS	<rl< td=""><td>0.041</td><td>10:2 FTOAc</td><td><rl< td=""><td>78.6</td></rl<></td></rl<>	0.041	10:2 FTOAc	<rl< td=""><td>78.6</td></rl<>	78.6
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	$0.315 \pm 0.021$	0.021	4:2 FTOH	<rl< td=""><td>309</td></rl<>	309
MeFBSA (SV)	<rl< td=""><td>3.90</td><td>5:2 FTOH</td><td><rl< td=""><td>154</td></rl<></td></rl<>	3.90	5:2 FTOH	<rl< td=""><td>154</td></rl<>	154
FHxSA (NV)	$0.023 \pm 0.001$	0.021	6:2 FTOH	$335 \pm 83$	154
FOSA (NV)	$0.032 \pm 0.001$	0.030	7:2 FTOH	<rl< td=""><td>309</td></rl<>	309
MeFOSA (SV)	<rl< td=""><td>0.941</td><td>8:2 FTOH</td><td><rl< td=""><td>151</td></rl<></td></rl<>	0.941	8:2 FTOH	<rl< td=""><td>151</td></rl<>	151
EtFOSA (SV)	<rl< td=""><td>0.986</td><td>10:2 FTOH</td><td><rl< td=""><td>310</td></rl<></td></rl<>	0.986	10:2 FTOH	<rl< td=""><td>310</td></rl<>	310
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.043</td><td>4:2 FTS</td><td><rl< td=""><td>0.092</td></rl<></td></rl<>	0.043	4:2 FTS	<rl< td=""><td>0.092</td></rl<>	0.092
MeFOSAA	<rl< td=""><td>0.042</td><td>6:2 FTS</td><td><math>7.26 \pm 0.62</math></td><td>0.141</td></rl<>	0.042	6:2 FTS	$7.26 \pm 0.62$	0.141
EtFOSAA	<rl< td=""><td>0.108</td><td>8:2 FTS</td><td><rl< td=""><td>0.190</td></rl<></td></rl<>	0.108	8:2 FTS	<rl< td=""><td>0.190</td></rl<>	0.190
			10:2 FTS	<rl< td=""><td>0.215</td></rl<>	0.215

**Table 12.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-D. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.

PFCA (NV)         FASE (SV)           PFBA         1.21 ± 0.36         0.118         McFOSE         ≪RL         0.543           PFPeA         1.05 ± 0.03         0.076         EcFOSE         ≪RL         0.480           PFHAA         2.63 ± 0.3         0.432         FEFOSA         ≪RL         0.016           PFOA         ≪RL         0.215         PFEESA         ≪RL         0.016           PFDA         ≪RL         0.102         PF4OPeA         ≪RL         0.034           PFDA         ≪RL         0.102         PF5OINA         ≪RL         0.017           PFDA         ≪RL         0.102         3-6-OPFHPA         ≪RL         0.017           PFDA         ≪RL         0.059         HFPO-DA         ≪RL         0.018           PFTDA         ≪RL         0.070         ADONA         ≪RL         0.018           PFTDA         ≪RL         0.0129         PCI-PF3ONS         ≪RL         0.018           PFFSA (NV)         ****         ****         ****         ****         ****         ****         ****         ****         ****         ****         ****         ****         ****         ****         ***         ***         ***	PFAS	Concentration (μg/kg)	RL (μg/kg)	PFAS	Concentration (µg/kg)	RL (μg/kg)
PFPeA         1.05 ± 0.03         0.076         EtFOSE         ≪RL         0.480           PFHxA         2.63 ± 0.3         0.432         PPEA (NV)           PFHpA         0.425 ± 0.044         0.080         PPEA (NV)           PFOA         ≪RL         0.215         PFEESA         ≪RL         0.016           PFNA         ≪RL         0.102         PF4OPeA         ≪RL         0.034           PFDA         ≪RL         0.102         PF5OHxA         ≪RL         0.031           PFDA         ≪RL         0.102         PF5OHxA         ≪RL         0.017           PFDDA         ≪RL         0.059         HFPO-DA         ≪RL         0.017           PFDDA         ≪RL         0.059         HFPO-DA         ≪RL         0.284           PFTPDA         ≪RL         0.059         HFPO-DA         ≪RL         0.018           PFTDA         ≪RL         0.059         HFPO-DA         ≪RL         0.018           PFTPA           0.018	PFCA (NV)			FASE (SV)		
PFHxA         2.63 ± 0.3         0.432           PFHpA         0.425 ± 0.044         0.080         PPEA (NV)           PFOA         ≪RL         0.215         PFESSA         ≪RL         0.016           PFNA         ≪RL         0.102         PFSOHXA         ≪RL         0.034           PFDADA         ≪RL         0.102         PFSOHXA         ≪RL         0.017           PFDoDA         ≪RL         0.029         HFPO-DA         ≪RL         0.017           PFTDA         ≪RL         0.070         ADONA         ≪RL         0.018           PFTrDA         ≪RL         0.070         ADONA         ≪RL         0.018           PFTeDA         ≪RL         0.018         %RL         0.018           PFTrDA	PFBA	$1.21 \pm 0.36$	0.118	MeFOSE	<rl< td=""><td>0.543</td></rl<>	0.543
PFHpA         0.425 ± 0.044         0.080         PPEA (NV)           PFOA         ≪RL         0.215         PFEESA         ≪RL         0.016           PFNA         ≪RL         0.102         PF4OPeA         ≪RL         0.034           PFDA         ≪RL         0.102         PF5OHXA         ≪RL         0.017           PFDA         ≪RL         0.0102         3-6-OPFHpA         ≪RL         0.017           PFDODA         ≪RL         0.059         HFPO-DA         ≪RL         0.018           PFTrDA         ≪RL         0.070         ADONA         ≪RL         0.018           PFTCPA         ≪RL         0.018         PC-PF3ONS         ≪RL         0.018           PFTCPA         ≪RL         0.037         n:2 FTMAC (V)         W         PC-PF3ONS         ≪RL         0.018           PFSA (NV)         W         N:2 FTMAC (V)         W         PFP5SA (NV)         W         N:2 FTMAC (V)         PFP6SS         ≪RL         0.037         N:2 FTMAC (V)         RL         491         PFP6SA (NC)         ≪RL         0.028         PFTMAC (V)         RL         265         PFP1PS         ≪RL         0.035         PTMAC (V)         RL         265         PFP3PS	PFPeA	$1.05\pm0.03$	0.076	EtFOSE	<rl< td=""><td>0.480</td></rl<>	0.480
PFOA <pre></pre>	PFHxA	$2.63\pm0.3$	0.432	_		
PFNA         ≪RL         0.102         PF4OPeA         ≪RL         0.034           PFDA         ≪RL         0.102         PF5OHxA         ≪RL         0.017           PFUNDA         ≪RL         0.102         3-6-OPFHpA         ≪RL         0.017           PFDODA         ≪RL         0.059         HFPO-DA         ≪RL         0.018           PFTDA         ≪RL         0.019         PG-PF3ONS         ≪RL         0.018           PFTeDA         ≪RL         0.029         PCI-PF3ONS         ≪RL         0.018           PFTeDA         ≪RL         0.029         PCI-PF3ONS         ≪RL         0.018           PFTCDA         ≪RL         0.029         PCI-PF3ONS         ≪RL         0.018           PFTCDA                  0.018 <t< td=""><th>PFHpA</th><td><math>0.425 \pm 0.044</math></td><td>0.080</td><th>PPEA (NV)</th><td></td><td></td></t<>	PFHpA	$0.425 \pm 0.044$	0.080	PPEA (NV)		
PFDA         ≪RL         0.102         PF50HxA         ≪RL         0.017           PFUnDA         ≪RL         0.102         3-6-OPFHpA         ≪RL         0.017           PFDoDA         ≪RL         0.059         HFPO-DA         ≪RL         0.284           PFTDA         ≪RL         0.070         ADONA         ≪RL         0.018           PFTEDA         ≪RL         0.029         PCI-PF3ONS         ≪RL         0.018           PFSA (NV)         W         C         C         O.018           PFPSA (NV)         W         N:2 FTMAC (V)         PFPS         ✓RL         0.018           PFPSS         ≪RL         0.037         n:2 FTMAC (V)         ✓         ✓           PFBS         0.115 ± 0.03         0.017         6:2 FTMAC         419 ± 76         491         PFPS         491         PPS         491         PPS         491         PPS         491         PPS         491         PPS <th>PFOA</th> <td><rl< td=""><td>0.215</td><th>PFEESA</th><td><rl< td=""><td>0.016</td></rl<></td></rl<></td>	PFOA	<rl< td=""><td>0.215</td><th>PFEESA</th><td><rl< td=""><td>0.016</td></rl<></td></rl<>	0.215	PFEESA	<rl< td=""><td>0.016</td></rl<>	0.016
PFUNDA         ≪RL         0.102         3-6-OPFHpA         ≪RL         0.017           PFDoDA         ≪RL         0.059         HFPO-DA         ≪RL         0.284           PFTrDA         ≪RL         0.070         ADONA         ≪RL         0.018           PFTeDA         ≪RL         0.129         9Cl-PF3ONS         ≪RL         0.018           PFTeDA           √RL         0.018           PFTeDA           √RL         0.018           PFTeDA           √RL         0.018           PFTeS           √RL         0.018           PFPSA (NV)               PFPS <rl< th="">         0.037          6:2 FTMAC (V)           491           PFPS         <rl< th="">         0.028         8:2 FTMAC         <rl< th="">         265           491             491                   491               <th< td=""><th>PFNA</th><td><rl< td=""><td>0.102</td><th>PF4OPeA</th><td><rl< td=""><td>0.034</td></rl<></td></rl<></td></th<></rl<></rl<></rl<>	PFNA	<rl< td=""><td>0.102</td><th>PF4OPeA</th><td><rl< td=""><td>0.034</td></rl<></td></rl<>	0.102	PF4OPeA	<rl< td=""><td>0.034</td></rl<>	0.034
PFDoDA         ≪RL         0.059         HFPO-DA         ≪RL         0.284           PFTrDA         ≪RL         0.070         ADONA         ≪RL         0.018           PFTeDA         ≪RL         0.129         9CI-PF3ONS         ≪RL         0.018           PFSA (NV)           PFPSA (NV)           PFPPS         ≪RL         0.037         n:2 FTMAC (V)           PFPSS         ≪RL         0.028         8:2 FTMAC         1419 ± 76         491           PFPSS         ≪RL         0.028         8:2 FTMAC         ≪RL         196           PFHxS         ≪RL         0.035         10:2 FTMAC         ≪RL         265           PFMS         ≪RL         0.028         10:2 FTMAC         ≪RL         265           PFNS         ≪RL         0.035         10:2 FTMAC         ≪RL         265           PFNS         ≪RL         0.038         2 FTOAc (V)         W         C         C         C         P         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C	PFDA	<rl< td=""><td>0.102</td><th>PF5OHxA</th><td><rl< td=""><td>0.017</td></rl<></td></rl<>	0.102	PF5OHxA	<rl< td=""><td>0.017</td></rl<>	0.017
PFTrDA         ≪RL         0.070         ADONA         ≪RL         0.018           PFTeDA         ≪RL         0.129         9Cl-PF3ONS         ≪RL         0.018           PFSA (NV)           PFPRS         ≪RL         0.037         n:2 FTMAC (V)           PFBS         0.115 ± 0.03         0.017         6:2 FTMAC         1419 ± 76         491           PFPSA (NV)         ≪RL         0.028         8:2 FTMAC         ≪RL         196           PFHXS         ≪RL         0.035         10:2 FTMAC         ≪RL         265           PFHpS         ≪RL         0.035         10:2 FTMAC         ≪RL         265           PFMS         ≪RL         0.035         10:2 FTMAC         ≪RL         265           PFDS         ≪RL         0.035         10:2 FTMAC </td <th>PFUnDA</th> <td><rl< td=""><td>0.102</td><th>3-6-OPFHpA</th><td><rl< td=""><td>0.017</td></rl<></td></rl<></td>	PFUnDA	<rl< td=""><td>0.102</td><th>3-6-OPFHpA</th><td><rl< td=""><td>0.017</td></rl<></td></rl<>	0.102	3-6-OPFHpA	<rl< td=""><td>0.017</td></rl<>	0.017
PFTeDA         ≪RL         0.129         9Cl-PF3ONS         ≪RL         0.018           PFSA (NV)           FPFS         ≪RL         0.037         n:2 FTMAC (V)           PFBS         0.115 ± 0.03         0.017         6:2 FTMAC         1419 ± 76         491           PFPS         ≪RL         0.028         8:2 FTMAC         ≪RL         196           PFHXS         ≪RL         0.035         10:2 FTMAC         ≪RL         265           PFHDS         ≪RL         0.028         ***         <	PFDoDA	<rl< td=""><td>0.059</td><th>HFPO-DA</th><td><rl< td=""><td>0.284</td></rl<></td></rl<>	0.059	HFPO-DA	<rl< td=""><td>0.284</td></rl<>	0.284
TICI-PF3OUdS         ≪RL         0.018           PFSA (NV)           PFPRS         ≪RL         0.037         n:2 FTMAC (V)           PFBS         0.115 ± 0.03         0.017         6:2 FTMAC         1419 ± 76         491           PFPeS         ≪RL         0.028         8:2 FTMAC         ≪RL         196           PFHxS         ≪RL         0.035         10:2 FTMAC         ≪RL         265           PFDS         ≪RL         0.028         N.2 FTOAc (V)         W.2 FT	PFTrDA	<rl< td=""><td>0.070</td><th>ADONA</th><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.070	ADONA	<rl< td=""><td>0.018</td></rl<>	0.018
PFSA (NV)           PFPrS <pre></pre>	PFTeDA	<rl< td=""><td>0.129</td><th>9Cl-PF3ONS</th><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.129	9Cl-PF3ONS	<rl< td=""><td>0.018</td></rl<>	0.018
PFPrS         ≪RL         0.037         n:2 FTMAC (V)           PFBS         0.115 ± 0.03         0.017         6:2 FTMAC         1419 ± 76         491           PFPeS         ≪RL         0.028         8:2 FTMAC         ≪RL         196           PFHxS         ≪RL         0.035         10:2 FTMAC         ≪RL         265           PFHpS         ≪RL         0.028         ————————————————————————————————————				11Cl-PF3OUdS	<rl< td=""><td>0.018</td></rl<>	0.018
PFBS         0.115 ± 0.03         0.017         6:2 FTMAC         1419 ± 76         491           PFPeS <rl< th="">         0.028         8:2 FTMAC         <rl< th="">         196           PFHxS         <rl< th="">         0.035         10:2 FTMAC         <rl< th="">         265           PFHpS         <rl< th="">         0.028        </rl<></rl<></rl<></rl<></rl<>	PFSA (NV)					
PFPeS <rl< th="">         0.028         8:2 FTMAC         <rl< th="">         196           PFHxS         <rl< th="">         0.035         10:2 FTMAC         <rl< th="">         265           PFHpS         <rl< th="">         0.028  <th>PFPrS</th><td><rl< td=""><td>0.037</td><th>n:2 FTMAC (V)</th><td></td><td></td></rl<></td></rl<></rl<></rl<></rl<></rl<>	PFPrS	<rl< td=""><td>0.037</td><th>n:2 FTMAC (V)</th><td></td><td></td></rl<>	0.037	n:2 FTMAC (V)		
PFHxS <rl< th="">         0.035         10:2 FTMAC         <rl< th="">         265           PFHpS         <rl< th="">         0.028</rl<></rl<></rl<>	PFBS	$0.115 \pm 0.03$	0.017	6:2 FTMAC	$1419 \pm 76$	491
PFHpS <rl< th="">         0.028           PFOS         <rl< th="">         0.044         m:2 FTOAc (V)           PFNS         <rl< th="">         0.037         8:2 FTOAc         <rl< th="">         205.6           PFDS         <rl< th="">         0.037         10:2 FTOAc         <rl< th="">         105.7           FASA (NV, SV)         n:2 FTOH (V)         n:2 FTOH (V)</rl<></rl<></rl<></rl<></rl<></rl<>	PFPeS	<rl< td=""><td>0.028</td><th>8:2 FTMAC</th><td><rl< td=""><td>196</td></rl<></td></rl<>	0.028	8:2 FTMAC	<rl< td=""><td>196</td></rl<>	196
PFOS <rl< th="">         0.044         n:2 FTOAc (V)           PFNS         <rl< td="">         0.037         8:2 FTOAc         <rl< td="">         205.6           PFDS         <rl< td="">         0.037         10:2 FTOAc         <rl< td="">         105.7           FASA (NV, SV)           n:2 FTOH (V)           FBSA (NV)         <rl< td="">         5.22         5:2 FTOH         <rl< td="">         207           FHxSA (NV)         <rl< td="">         0.019         6:2 FTOH         393 ± 98         207           FOSA (NV)         <rl< td="">         0.037         7:2 FTOH         <rl< td="">         415           MeFOSA (SV)         <rl< td="">         1.26         8:2 FTOH         <rl< td="">         203           EtFOSA (SV)         <rl< td="">         1.32         10:2 FTOH         <rl< td="">         417           FASAA (NV)           FOSAA         <rl< td="">         0.039         4:2 FTS         <rl< td="">         0.115           MeFOSAA         <rl< td="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< td="">         0.124         8:2 FTS         <rl< td="">         0.207</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFHxS	<rl< td=""><td>0.035</td><th>10:2 FTMAC</th><td><rl< td=""><td>265</td></rl<></td></rl<>	0.035	10:2 FTMAC	<rl< td=""><td>265</td></rl<>	265
PFNS <rl< th="">         0.037         8:2 FTOAc         <rl< th="">         205.6           PFDS         <rl< th="">         0.037         10:2 FTOAc         <rl< th="">         205.6           FASA (NV, SV)           FBSA (NV)         0.047 ± 0.008         0.019         4:2 FTOH         <rl< th="">         416           MeFBSA (SV)         <rl< th="">         5.22         5:2 FTOH         <rl< th="">         207           FHXSA (NV)         <rl< th="">         0.019         6:2 FTOH         393 ± 98         207           FOSA (NV)         <rl< th="">         0.037         7:2 FTOH         <rl< th="">         415           MeFOSA (SV)         <rl< th="">         1.26         8:2 FTOH         <rl< th="">         203           EtFOSA (SV)         <rl< th="">         1.32         10:2 FTOH         <rl< th="">         417           FASAA (NV)           FOSAA         <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFHpS	<rl< td=""><td>0.028</td><th></th><td></td><td></td></rl<>	0.028			
PFDS <rl< th="">         0.037         10:2 FTOAc         <rl< th="">         105.7           FASA (NV, SV)         n:2 FTOH (V)         7         Number of the content of the co</rl<></rl<>	PFOS	<rl< td=""><td>0.044</td><th>n:2 FTOAc (V)</th><td></td><td></td></rl<>	0.044	n:2 FTOAc (V)		
FASA (NV, SV)           FBSA (NV) $0.047 \pm 0.008$ $0.019$ $4:2$ FTOH $<$ RL $416$ MeFBSA (SV) $<$ RL $5.22$ $5:2$ FTOH $<$ RL $207$ FHxSA (NV) $<$ RL $0.019$ $6:2$ FTOH $393 \pm 98$ $207$ FOSA (NV) $<$ RL $0.037$ $7:2$ FTOH $<$ RL $415$ MeFOSA (SV) $<$ RL $1.26$ $8:2$ FTOH $<$ RL $203$ EtFOSA (SV) $<$ RL $1.32$ $10:2$ FTOH $<$ RL $417$ FOSAA $<$ RL $0.039$ $4:2$ FTS $<$ RL $0.115$ MeFOSAA $<$ RL $0.052$ $6:2$ FTS $3.24 \pm 0.072$ $0.176$ EtFOSAA $<$ RL $0.124$ $8:2$ FTS $<$ RL $0.207$	PFNS	<rl< td=""><td>0.037</td><th>8:2 FTOAc</th><td><rl< td=""><td>205.6</td></rl<></td></rl<>	0.037	8:2 FTOAc	<rl< td=""><td>205.6</td></rl<>	205.6
FBSA (NV)         0.047 ± 0.008         0.019         4:2 FTOH <rl< th="">         416           MeFBSA (SV)         <rl< th="">         5.22         5:2 FTOH         <rl< th="">         207           FHxSA (NV)         <rl< th="">         0.019         6:2 FTOH         393 ± 98         207           FOSA (NV)         <rl< th="">         0.037         7:2 FTOH         <rl< th="">         415           MeFOSA (SV)         <rl< th="">         1.26         8:2 FTOH         <rl< th="">         203           EtFOSA (SV)         <rl< th="">         1.32         10:2 FTOH         <rl< th="">         417           FASAA (NV)         n:2 FTS (NV)          <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFDS	<rl< td=""><td>0.037</td><th>10:2 FTOAc</th><td><rl< td=""><td>105.7</td></rl<></td></rl<>	0.037	10:2 FTOAc	<rl< td=""><td>105.7</td></rl<>	105.7
FBSA (NV)         0.047 ± 0.008         0.019         4:2 FTOH <rl< th="">         416           MeFBSA (SV)         <rl< th="">         5.22         5:2 FTOH         <rl< th="">         207           FHxSA (NV)         <rl< th="">         0.019         6:2 FTOH         393 ± 98         207           FOSA (NV)         <rl< th="">         0.037         7:2 FTOH         <rl< th="">         415           MeFOSA (SV)         <rl< th="">         1.26         8:2 FTOH         <rl< th="">         203           EtFOSA (SV)         <rl< th="">         1.32         10:2 FTOH         <rl< th="">         417           FASAA (NV)         n:2 FTS (NV)          <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	FASA (NV. SV)			n:2 FTOH (V)		
MeFBSA (SV) <rl< th="">         5.22         5:2 FTOH         <rl< th="">         207           FHxSA (NV)         <rl< th="">         0.019         6:2 FTOH         393 ± 98         207           FOSA (NV)         <rl< th="">         0.037         7:2 FTOH         <rl< th="">         415           MeFOSA (SV)         <rl< th="">         1.26         8:2 FTOH         <rl< th="">         203           EtFOSA (SV)         <rl< th="">         1.32         10:2 FTOH         <rl< th="">         417           FOSAA         <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		$0.047 \pm 0.008$	0.019	1 /	<ri.< td=""><td>416</td></ri.<>	416
FHxSA (NV) <rl< th="">         0.019         6:2 FTOH         393 ± 98         207           FOSA (NV)         <rl< th="">         0.037         7:2 FTOH         <rl< th="">         415           MeFOSA (SV)         <rl< th="">         1.26         8:2 FTOH         <rl< th="">         203           EtFOSA (SV)         <rl< th="">         1.32         10:2 FTOH         <rl< th="">         417           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< td=""><td>5.22</td><th></th><td></td><td></td></rl<>	5.22			
FOSA (NV) <rl< th="">         0.037         7:2 FTOH         <rl< th="">         415           MeFOSA (SV)         <rl< th="">         1.26         8:2 FTOH         <rl< th="">         203           EtFOSA (SV)         <rl< th="">         1.32         10:2 FTOH         <rl< th="">         417           FASAA (NV)         n:2 FTS (NV)          <rl< th="">         0.115           FOSAA         <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< td=""><td>0.019</td><th></th><td></td><td></td></rl<>	0.019			
MeFOSA (SV) <rl< th="">         1.26         8:2 FTOH         <rl< th="">         203           EtFOSA (SV)         <rl< th="">         1.32         10:2 FTOH         <rl< th="">         417           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	· · · · · · · · · · · · · · · · · · ·	<rl< td=""><td>0.037</td><th></th><td></td><td></td></rl<>	0.037			
EtFOSA (SV) <rl< th="">         1.32         10:2 FTOH         <rl< th="">         417           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< th=""><th>1.26</th><th></th><th></th><th></th></rl<>	1.26			
FOSAA <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<>		<rl< td=""><td>1.32</td><th>10:2 FTOH</th><td></td><td></td></rl<>	1.32	10:2 FTOH		
FOSAA <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.115           MeFOSAA         <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<></rl<></rl<>	FASAA (NV)			n:2 FTS (NV)		
MeFOSAA <rl< th="">         0.052         6:2 FTS         3.24 ± 0.072         0.176           EtFOSAA         <rl< th="">         0.124         8:2 FTS         <rl< th="">         0.207</rl<></rl<></rl<>		<rl< td=""><td>0.039</td><th></th><td><rl< td=""><td>0.115</td></rl<></td></rl<>	0.039		<rl< td=""><td>0.115</td></rl<>	0.115
<b>EtFOSAA</b> <rl 0.124="" <b="">8:2 FTS <rl 0.207<="" td=""><th></th><td></td><td></td><th></th><td></td><td></td></rl></rl>						

**Table 13.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-E. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	$16.1 \pm 0.3$	0.119	MeFOSE	<rl< td=""><td>0.533</td></rl<>	0.533
PFPeA	$20.0\pm1.1$	0.069	EtFOSE	<rl< td=""><td>0.471</td></rl<>	0.471
PFHxA	$37.5 \pm 0.7$	0.252	-		
PFHpA	$6.38 \pm 0.32$	0.072	PPEA (NV)		
PFOA	$0.473 \pm 0.055$	0.217	PFEESA	<rl< td=""><td>0.016</td></rl<>	0.016
PFNA	$0.286 \pm 0.029$	0.103	PF4OPeA	<rl< td=""><td>0.031</td></rl<>	0.031
PFDA	$0.421 \pm 0.044$	0.103	PF5OHxA	<rl< td=""><td>0.018</td></rl<>	0.018
PFUnDA	$0.125 \pm 0.013$	0.103	3-6-ОРГНРА	<rl< td=""><td>0.018</td></rl<>	0.018
PFDoDA	$0.143 \pm 0.005$	0.114	HFPO-DA	<rl< td=""><td>0.103</td></rl<>	0.103
PFTrDA	<rl<sup>a</rl<sup>	0.070	ADONA	<rl< td=""><td>0.018</td></rl<>	0.018
PFTeDA	<rl< td=""><td>0.130</td><td>9Cl-PF3ONS</td><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.130	9Cl-PF3ONS	<rl< td=""><td>0.018</td></rl<>	0.018
			11Cl-PF3OUdS	<rl< td=""><td>0.018</td></rl<>	0.018
PFSA (NV)					
PFPrS	<rl< td=""><td>0.034</td><td>n:2 FTMAC (V)</td><td></td><td></td></rl<>	0.034	n:2 FTMAC (V)		
PFBS	$0.152 \pm 0.023$	0.017	6:2 FTMAC	$550 \pm 130$	362
PFPeS	<rl< td=""><td>0.026</td><td>8:2 FTMAC</td><td><rl< td=""><td>193</td></rl<></td></rl<>	0.026	8:2 FTMAC	<rl< td=""><td>193</td></rl<>	193
PFHxS	<rl< td=""><td>0.036</td><td>10:2 FTMAC</td><td><rl< td=""><td>195</td></rl<></td></rl<>	0.036	10:2 FTMAC	<rl< td=""><td>195</td></rl<>	195
PFHpS	<rl< td=""><td>0.025</td><td></td><td></td><td></td></rl<>	0.025			
PFOS	<rl< td=""><td>0.045</td><td>n:2 FTOAc (V)</td><td></td><td></td></rl<>	0.045	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.034</td><td>8:2 FTOAc</td><td><rl< td=""><td>83.1</td></rl<></td></rl<>	0.034	8:2 FTOAc	<rl< td=""><td>83.1</td></rl<>	83.1
PFDS	<rl< td=""><td>0.038</td><td>10:2 FTOAc</td><td><rl< td=""><td>103.7</td></rl<></td></rl<>	0.038	10:2 FTOAc	<rl< td=""><td>103.7</td></rl<>	103.7
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	$0.394 \pm 0.024$	0.025	4:2 FTOH	<rl< td=""><td>80.5</td></rl<>	80.5
MeFBSA (SV)	<rl< td=""><td>5.12</td><td>5:2 FTOH</td><td><rl< td=""><td>203</td></rl<></td></rl<>	5.12	5:2 FTOH	<rl< td=""><td>203</td></rl<>	203
FHxSA (NV)	$0.031 \pm 0.003$	0.025	6:2 FTOH	$332 \pm 87$	204
FOSA (NV)	<rl< td=""><td>0.034</td><td>7:2 FTOH</td><td><rl< td=""><td>81.5</td></rl<></td></rl<>	0.034	7:2 FTOH	<rl< td=""><td>81.5</td></rl<>	81.5
MeFOSA (SV)	<rl< td=""><td>1.24</td><td>8:2 FTOH</td><td><rl< td=""><td>78.9</td></rl<></td></rl<>	1.24	8:2 FTOH	<rl< td=""><td>78.9</td></rl<>	78.9
EtFOSA (SV)	<rl< td=""><td>1.30</td><td>10:2 FTOH</td><td><rl< td=""><td>81.8</td></rl<></td></rl<>	1.30	10:2 FTOH	<rl< td=""><td>81.8</td></rl<>	81.8
FASAA (NV)			n:2 FTS (NV)		
FOSAA	$0.410 \pm 0.064$	0.039	4:2 FTS	<rl< td=""><td>0.105</td></rl<>	0.105
MeFOSAA	<rl< td=""><td>0.047</td><td>6:2 FTS</td><td><math>0.64 \pm 0.1</math></td><td>0.160</td></rl<>	0.047	6:2 FTS	$0.64 \pm 0.1$	0.160
EtFOSAA	<rl< td=""><td>0.123</td><td>8:2 FTS</td><td><math>0.268 \pm 0.036</math></td><td>0.208</td></rl<>	0.123	8:2 FTS	$0.268 \pm 0.036$	0.208
			10:2 FTS	<rl< td=""><td>0.245</td></rl<>	0.245

<sup>&</sup>lt;sup>a</sup> Internal standard recovery did not meet QC standards, but all other QC standards met. Therefore, data do not meet QC standards and are not included in figures or this technical note beyond this table where they are included only for informational purposes.

**Table 14.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-F. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.

PFCA (NV)         FASE (SV)           PFBA         11.3 ± 0.4         0.119         McFOSE         ≪RL         0.483           PFPeA         12.6 ± 0.1         0.116         EtFOSE         ≪RL         0.427           PFHAA         39.3 ± 1.8         0.254         FFESA         ≪RL         0.016           PFDA         4.94 ± 0.23         0.453         PPEA (NV)         FFESA         ≪RL         0.016           PFOA         0.362 ± 0.083         0.218         PFEESA         ≪RL         0.016           PFDA         0.318 ± 0.016         0.104         PF4OPCA         ≪RL         0.037           PFDA         0.318 ± 0.016         0.104         PF5OHAA         ≪RL         0.018           PFDA         3.18 ± 0.016         0.104         PF5OHAA         ≪RL         0.018           PFDA         ≪RL         0.004         HFPO-DA         ≪RL         0.018           PFDA         ≪RL         0.071         ADONA         ≪RL         0.018           PFTDA         ≪RL         0.071         6.2 FTMAC (V)             0.018             0.018           <	PFAS	Concentration (μg/kg)	RL (μg/kg)	PFAS	Concentration (µg/kg)	RL (μg/kg)
PFPeA         12.6 ± 0.1         0.116         EtFOSE         ≪RL         0.427           PFHxA         39.3 ± 1.8         0.254         PFPA         ✓ <t< th=""><th>PFCA (NV)</th><th></th><th></th><th>FASE (SV)</th><th></th><th></th></t<>	PFCA (NV)			FASE (SV)		
PFHXA         39.3 ± 1.8         0.254           PFHpA         4.94 ± 0.23         0.453         PPEA (NV)           PFOA         0.362 ± 0.083         0.218         PFEESA         ≪RL         0.016           PFNA         0.185 ± 0.035         0.104         PF4OPeA         ≪RL         0.037           PFDA         0.318 ± 0.016         0.104         PF5OPHA         ≪RL         0.018           PFUNDA         ≪RL         0.104         PF5OPHA         ≪RL         0.018           PFDoDA         ≪RL         0.060         HFPO-DA         ≪RL         0.018           PFTDA         ≪RL         0.071         ADONA         ≪RL         0.018           PFTDA         ≪RL         0.017         ADONA         ≪RL         0.018           PFTDA	PFBA	$11.3 \pm 0.4$	0.119	MeFOSE	<rl< th=""><th>0.483</th></rl<>	0.483
PFHpA $4.94 \pm 0.23$ $0.453$ PPEA (NV)           PFOA $0.362 \pm 0.083$ $0.218$ PFESA $RL$ $0.016$ PFNA $0.185 \pm 0.035$ $0.104$ PF4OPeA $RL$ $0.037$ PFDA $0.318 \pm 0.016$ 0.104         PF5OHXA $RL$ $0.018$ PFUDDA $RL$ $0.104$ 3-6-OPFHpA $RL$ $0.018$ PFDoDA $RL$ $0.060$ HFPO-DA $RL$ $0.014$ PFTDA $RL$ $0.071$ ADONA $RL$ $0.018$ PFTCDA $RL$ $0.011$ ADONA $RL$ $0.018$ PFTCDA $RL$ $0.011$ ADONA $RL$ $0.018$ PFTCDA $RL$ $0.071$ ADONA $RL$ $0.018$ PFTSA (NV) $RL$ $0.031$ $RL$ $0.018$ PFSSA (NV) $RL$ $0.095$ $n:2FTMAC(V)$ $RL$ $0.018$ PFPRS $RL$ $0.037$ $R.2FTMAC(V)$ $RL$ <th>PFPeA</th> <th><math>12.6 \pm 0.1</math></th> <th>0.116</th> <th>EtFOSE</th> <th><rl< th=""><th>0.427</th></rl<></th>	PFPeA	$12.6 \pm 0.1$	0.116	EtFOSE	<rl< th=""><th>0.427</th></rl<>	0.427
PFOA         0.362 ± 0.083         0.218         PFEESA         ≪RL         0.016           PFNA         0.185 ± 0.035         0.104         PF4OPeA         ≪RL         0.037           PFDA         0.318 ± 0.016         0.104         PF5OHXA         ≪RL         0.018           PFUNDA         ≪RL         0.104         3-6-OPFHpA         ≪RL         0.018           PFDoDA         ≪RL         0.000         HFPO-DA         ≪RL         0.018           PFTDA         ≪RL         0.060         HFPO-DA         ≪RL         0.018           PFTeDA         ≪RL         0.071         ADONA         ≪RL         0.018           PFTeDA         ≪RL         0.031         9CL-PF3ONS         ≪RL         0.018           PFTeDA           PCL-PF3ONS         ≪RL         0.018           PFSA (NV)          ************************************	PFHxA	$39.3 \pm 1.8$	0.254	_		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFHpA	$4.94 \pm 0.23$	0.453	PPEA (NV)		
PFDA         0.318 ± 0.016         0.104         PF5OHxA         ≪RL         0.018           PFUnDA         ≪RL         0.104         3-6-OPFHpA         ≪RL         0.018           PFDoDA         ≪RL         0.060         HFPO-DA         ≪RL         0.104           PFTDA         ≪RL         0.071         ADONA         ≪RL         0.018           PFTCDA         ≪RL         0.0131         9CL-PF3ONS         ≪RL         0.018           PFSA (NV)         ****	PFOA	$0.362 \pm 0.083$	0.218	PFEESA	<rl< th=""><th>0.016</th></rl<>	0.016
PFUNDA         ≪RL         0.104         3-6-OPFHpA         ≪RL         0.018           PFDoDA         ≪RL         0.060         HFPO-DA         ≪RL         0.104           PFTrDA         ≪RL         0.071         ADONA         ≪RL         0.018           PFTeDA         ≪RL         0.131         9CI-PF3ONS         ≪RL         0.018           PFTeDA           √RL         0.018           PFTeDA           √RL         0.018           PFTCDA           √RL         0.018           PFTCDA           √RL         0.018           PFTCDA           √RL         0.018           PFSA (NV)            ✓           PFSA (NV)             ✓            PFPS <rl< th="">         0.037         8:2 FTMAC (V)</rl<>	PFNA	$0.185 \pm 0.035$	0.104	PF4OPeA	<rl< th=""><th>0.037</th></rl<>	0.037
PFDoDA         ≪RL         0.060         HFPO-DA         ≪RL         0.104           PFTrDA         ≪RL         0.071         ADONA         ≪RL         0.018           PFTeDA         ≪RL         0.131         9CI-PF3ONS         ≪RL         0.018           PFSA (NV)           PFSA (NV)           PFPSA (NV)           PFPS	PFDA	$0.318 \pm 0.016$	0.104	PF5OHxA	<rl< td=""><td>0.018</td></rl<>	0.018
PFTrDA <rl< th="">         0.071         ADONA         <rl< th="">         0.018           PFTeDA         <rl< th="">         0.131         9Cl-PF3ONS         <rl< th="">         0.018           PFSA (NV)           PFPRS         <rl< th="">         0.095         n:2 FTMAC (V)           PFBS         1.263 ± 0.020         0.017         6:2 FTMAC         640 ± 150         328           PFPeS         <rl< td="">         0.037         8:2 FTMAC         <rl< td="">         174           PFHS         <rl< td="">         0.036         10:2 FTMAC         <rl< td="">         177           PFHS         <rl< td="">         0.036         10:2 FTMAC         <rl< td="">         177           PFHS         <rl< td="">         0.037         RETMAC         <rl< td="">         177           PFNS         <rl< td="">         0.037         RETMAC         <rl< td="">         177           PFNS         <rl< td="">         0.037         RETMAC         <rl< td="">         177           PFNS         <rl< td="">         0.038         8:2 FTOAc         <rl< td="">         75.2           PFDS         <rl< td="">         0.038         10:2 FTOAc         <rl< td="">         72.8           MeFBSA (NV)         <rl< td="">         4.64         5:2 FTOH         <rl< td="">         72.8</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFUnDA	<rl< td=""><td>0.104</td><th>3-6-ОРГНРА</th><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.104	3-6-ОРГНРА	<rl< td=""><td>0.018</td></rl<>	0.018
PFTedA $\langle RL \rangle$ 0.131         9Cl-PF3ONS $\langle RL \rangle$ 0.018           PFSA (NV)           PFPS $\langle RL \rangle$ 0.095         n:2 FTMAC (V)           PFBS         1.263 ± 0.020         0.017         6:2 FTMAC         640 ± 150         328           PFPS $\langle RL \rangle$ 0.037         8:2 FTMAC $\langle RL \rangle$ 174           PFHS $\langle RL \rangle$ 0.036         10:2 FTMAC $\langle RL \rangle$ 177           PFHS $\langle RL \rangle$ 0.036         10:2 FTMAC $\langle RL \rangle$ 177           PFHS $\langle RL \rangle$ 0.036         10:2 FTMAC $\langle RL \rangle$ 177           PFHS $\langle RL \rangle$ 0.037         0.037         0.037         0.037         0.037         0.037         0.037         0.038         0.038         0.02 FTOAC (V)         0.045         0.038         0.02 FTOAC (V)         0.045         0.038         0.02 FTOAC (V)         0.045         0.045         0.045         0.046         0.046         0.046         0.046         0.046         0.046         0.046         0.046         0.046         0.046         0.046         0.046         0.046         0.046 <td< td=""><th>PFDoDA</th><td><rl< td=""><td>0.060</td><th>HFPO-DA</th><td><rl< td=""><td>0.104</td></rl<></td></rl<></td></td<>	PFDoDA	<rl< td=""><td>0.060</td><th>HFPO-DA</th><td><rl< td=""><td>0.104</td></rl<></td></rl<>	0.060	HFPO-DA	<rl< td=""><td>0.104</td></rl<>	0.104
TICI-PF30UdS         ≪RL         0.018           PFSA (NV)           PFPRS         ≪RL         0.095         n:2 FTMAC (V)           PFBS         1.263 ± 0.020         0.017         6:2 FTMAC         640 ± 150         328           PFPeS         ≪RL         0.037         8:2 FTMAC         ≪RL         174           PFHxS         ≪RL         0.036         10:2 FTMAC         ≪RL         177           PFHpS         ≪RL         0.037	PFTrDA	<rl< th=""><th>0.071</th><th>ADONA</th><th><rl< th=""><th>0.018</th></rl<></th></rl<>	0.071	ADONA	<rl< th=""><th>0.018</th></rl<>	0.018
PFSA (NV)           PFPrS         < RL	PFTeDA	<rl< th=""><th>0.131</th><th>9Cl-PF3ONS</th><th><rl< th=""><th>0.018</th></rl<></th></rl<>	0.131	9Cl-PF3ONS	<rl< th=""><th>0.018</th></rl<>	0.018
PFPrS         ≪RL         0.095         n:2 FTMAC (V)           PFBS         1.263 ± 0.020         0.017         6:2 FTMAC         640 ± 150         328           PFPeS         ≪RL         0.037         8:2 FTMAC         ≪RL         174           PFHxS         ≪RL         0.036         10:2 FTMAC         ≪RL         177           PFOS         ≪RL         0.045         n:2 FTOAc (V)         FPNS         ≪RL         75.2           PFDS         ≪RL         0.038         8:2 FTOAc         ≪RL         75.2           PFDS         ≪RL         0.038         8:2 FTOAC         ≪RL         93.8           FASA (NV, SV)           FBSA (NV)         0.355 ± 0.005         0.019         4:2 FTOH (V)         CRL         72.8           MeFBSA (SV)         ≪RL         4.64         5:2 FTOH         ≪RL         183           FHxSA (NV)         0.036 ± 0.003         0.019         6:2 FTOH         ≪RL         73.7           MeFOSA (SV)         ≪RL         1.12         8:2 FTOH         ≪RL         74.0           FASAA (NV)           FOSAA         ≪RL         0.039         4:2 FTS <rl< td="">         0.097</rl<>				11Cl-PF3OUdS	<rl< th=""><th>0.018</th></rl<>	0.018
PFBS         1.263 ± 0.020         0.017         6:2 FTMAC         640 ± 150         328           PFPeS <rl< th="">         0.037         8:2 FTMAC         <rl< th="">         174           PFHxS         <rl< th="">         0.036         10:2 FTMAC         <rl< th="">         177           PFHpS         <rl< th="">         0.037  &lt;</rl<></rl<></rl<></rl<></rl<>	PFSA (NV)			-		
PFPeS <rl< th="">         0.037         8:2 FTMAC         <rl< th="">         174           PFHxS         <rl< th="">         0.036         10:2 FTMAC         <rl< th="">         177           PFHpS         <rl< th="">         0.037         0.037         0.037         0.038         0.045         0.038         0.038         0.038         0.038         0.038         0.038         0.038         0.038         0.038         0.038         0.038         0.038         0.038         0.038         0.039         0.038         0.039         0.038         0.039         0.038         0.039</rl<></rl<></rl<></rl<></rl<>	PFPrS	<rl< td=""><td>0.095</td><th>n:2 FTMAC (V)</th><td></td><td></td></rl<>	0.095	n:2 FTMAC (V)		
PFHxS <rl< th="">         0.036         10:2 FTMAC         <rl< th="">         177           PFNS         <rl< th="">         0.037        </rl<></rl<></rl<>	PFBS	$1.263 \pm 0.020$	0.017	6:2 FTMAC	$640 \pm 150$	328
PFHpS <rl< th="">         0.037           PFOS         <rl< th="">         0.045         m:2 FTOAc (V)           PFNS         <rl< th="">         0.038         8:2 FTOAc         <rl< th="">         75.2           PFDS         <rl< th="">         0.038         10:2 FTOAc         <rl< th="">         93.8           FASA (NV, SV)         m:2 FTOH (V)              FBSA (NV)         0.355 ± 0.005         0.019         4:2 FTOH         <rl< th="">         72.8           MeFBSA (SV)         <rl< th="">         4.64         5:2 FTOH         <rl< th="">         183           FHxSA (NV)         0.036 ± 0.003         0.019         6:2 FTOH         257 ± 43         184           FOSA (NV)         <rl< th="">         0.039         7:2 FTOH         <rl< th="">         73.7           MeFOSA (SV)         <rl< th="">         1.12         8:2 FTOH         <rl< th="">         71.4           EtFOSA         <rl< th="">         0.039         7:2 FTOH         <rl< th="">         74.0           FASAA (NV)         n:2 FTS (NV)           RL         74.0           FASAA (NV)         RL         0.039         4:2 FTS         <rl< th="">         0.097           MeFOSAA         <rl< th="">         0.104         6:2 FTS</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFPeS	<rl< td=""><td>0.037</td><th>8:2 FTMAC</th><td><rl< td=""><td>174</td></rl<></td></rl<>	0.037	8:2 FTMAC	<rl< td=""><td>174</td></rl<>	174
PFOS <rl< th="">         0.045         m:2 FTOAc (V)           PFNS         <rl< td="">         0.038         8:2 FTOAc         <rl< td="">         75.2           PFDS         <rl< td="">         0.038         10:2 FTOAc         <rl< td="">         93.8           FASA (NV, SV)           n:2 FTOH (V)           FBSA (NV)         0.355 ± 0.005         0.019         4:2 FTOH         <rl< td="">         72.8           MeFBSA (SV)         <rl< td="">         4.64         5:2 FTOH         <rl< td="">         183           FHxSA (NV)         0.036 ± 0.003         0.019         6:2 FTOH         257 ± 43         184           FOSA (NV)         <rl< td="">         0.039         7:2 FTOH         <rl< td="">         73.7           MeFOSA (SV)         <rl< td="">         1.12         8:2 FTOH         <rl< td="">         74.0           FASAA (NV)           n:2 FTS (NV)           FOSAA         <rl< td="">         0.039         4:2 FTS         <rl< td="">         0.097           MeFOSAA         <rl< td="">         0.104         6:2 FTS         1.69 ± 0.22         1.15           EtFOSAA         <rl< td="">         0.126         8:2 FTS         <rl< td="">         0.210</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFHxS	<rl< td=""><td>0.036</td><th>10:2 FTMAC</th><td><rl< td=""><td>177</td></rl<></td></rl<>	0.036	10:2 FTMAC	<rl< td=""><td>177</td></rl<>	177
PFNS <rl< th="">         0.038         8:2 FTOAc         <rl< th="">         75.2           PFDS         <rl< th="">         0.038         10:2 FTOAc         <rl< th="">         93.8           FASA (NV, SV)           FBSA (NV)         0.355 ± 0.005         0.019         4:2 FTOH         <rl< th="">         72.8           MeFBSA (SV)         <rl< th="">         4.64         5:2 FTOH         <rl< th="">         183           FHXSA (NV)         0.036 ± 0.003         0.019         6:2 FTOH         257 ± 43         184           FOSA (NV)         <rl< th="">         0.039         7:2 FTOH         <rl< th="">         73.7           MeFOSA (SV)         <rl< th="">         1.12         8:2 FTOH         <rl< th="">         74.0           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.097           MeFOSAA         <rl< th="">         0.104         6:2 FTS         1.69 ± 0.22         1.15           EtFOSAA         <rl< th="">         0.126         8:2 FTS         <rl< th="">         0.210</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFHpS	<rl< td=""><td>0.037</td><th>-</th><td></td><td></td></rl<>	0.037	-		
PFDS         ≪RL         0.038         10:2 FTOAc         ≪RL         93.8           FASA (NV, SV)           RBSA (NV)         0.355 ± 0.005         0.019         4:2 FTOH         ≪RL         72.8           MeFBSA (SV)         ≪RL         4.64         5:2 FTOH         ≪RL         183           FHxSA (NV)         0.036 ± 0.003         0.019         6:2 FTOH         257 ± 43         184           FOSA (NV)         ≪RL         0.039         7:2 FTOH         ≪RL         73.7           MeFOSA (SV)         ≪RL         1.12         8:2 FTOH         ≪RL         71.4           EtFOSA (SV)         ≪RL         1.17         10:2 FTOH         ≪RL         74.0           FOSAA         ≪RL         0.039         4:2 FTS         ≪RL         0.097           MeFOSAA         ≪RL         0.104         6:2 FTS         1.69 ± 0.22         1.15           EtFOSAA         ≪RL         0.126         8:2 FTS         ≪RL         0.210	PFOS	<rl< td=""><td>0.045</td><th>n:2 FTOAc (V)</th><td></td><td></td></rl<>	0.045	n:2 FTOAc (V)		
FASA (NV, SV)           FBSA (NV) $0.355 \pm 0.005$ $0.019$ $4:2$ FTOH $<$ RL $72.8$ MeFBSA (SV) $<$ RL $4.64$ $5:2$ FTOH $<$ RL $183$ FHxSA (NV) $0.036 \pm 0.003$ $0.019$ $6:2$ FTOH $257 \pm 43$ $184$ FOSA (NV) $<$ RL $0.039$ $7:2$ FTOH $<$ RL $73.7$ MeFOSA (SV) $<$ RL $1.12$ $8:2$ FTOH $<$ RL $71.4$ EtFOSA (SV) $<$ RL $1.17$ $10:2$ FTOH $<$ RL $74.0$ FOSAA $<$ RL $0.039$ $4:2$ FTS $<$ RL $0.097$ MeFOSAA $<$ RL $0.104$ $6:2$ FTS $1.69 \pm 0.22$ $1.15$ EtFOSAA $<$ RL $0.126$ $8:2$ FTS $<$ RL $0.210$	PFNS	<rl< td=""><td>0.038</td><th>8:2 FTOAc</th><td><rl< td=""><td>75.2</td></rl<></td></rl<>	0.038	8:2 FTOAc	<rl< td=""><td>75.2</td></rl<>	75.2
FBSA (NV) $0.355 \pm 0.005$ $0.019$ $4:2$ FTOH $<$ RL $72.8$ MeFBSA (SV) $<$ RL $4.64$ $5:2$ FTOH $<$ RL $183$ FHxSA (NV) $0.036 \pm 0.003$ $0.019$ $6:2$ FTOH $257 \pm 43$ $184$ FOSA (NV) $<$ RL $0.039$ $7:2$ FTOH $<$ RL $73.7$ MeFOSA (SV) $<$ RL $1.12$ $8:2$ FTOH $<$ RL $71.4$ EtFOSAA $<$ RL $0.039$ $4:2$ FTS $<$ RL $74.0$ FOSAA $<$ RL $0.039$ $4:2$ FTS $<$ RL $0.097$ MeFOSAA $<$ RL $0.104$ $6:2$ FTS $1.69 \pm 0.22$ $1.15$ EtFOSAA $<$ RL $0.126$ $8:2$ FTS $<$ RL $0.210$	PFDS	<rl< td=""><td>0.038</td><th>10:2 FTOAc</th><td><rl< td=""><td>93.8</td></rl<></td></rl<>	0.038	10:2 FTOAc	<rl< td=""><td>93.8</td></rl<>	93.8
FBSA (NV) $0.355 \pm 0.005$ $0.019$ $4:2$ FTOH $<$ RL $72.8$ MeFBSA (SV) $<$ RL $4.64$ $5:2$ FTOH $<$ RL $183$ FHxSA (NV) $0.036 \pm 0.003$ $0.019$ $6:2$ FTOH $257 \pm 43$ $184$ FOSA (NV) $<$ RL $0.039$ $7:2$ FTOH $<$ RL $73.7$ MeFOSA (SV) $<$ RL $1.12$ $8:2$ FTOH $<$ RL $71.4$ EtFOSAA $<$ RL $0.039$ $4:2$ FTS $<$ RL $74.0$ FOSAA $<$ RL $0.039$ $4:2$ FTS $<$ RL $0.097$ MeFOSAA $<$ RL $0.104$ $6:2$ FTS $1.69 \pm 0.22$ $1.15$ EtFOSAA $<$ RL $0.126$ $8:2$ FTS $<$ RL $0.210$	FASA (NV. SV)			n:2 FTOH (V)		
MeFBSA (SV) $\langle RL$ 4.64         5:2 FTOH $\langle RL$ 183           FHxSA (NV) $0.036 \pm 0.003$ 0.019         6:2 FTOH $257 \pm 43$ 184           FOSA (NV) $\langle RL$ 0.039         7:2 FTOH $\langle RL$ 73.7           MeFOSA (SV) $\langle RL$ 1.12         8:2 FTOH $\langle RL$ 71.4           EtFOSA (SV) $\langle RL$ 1.17         10:2 FTOH $\langle RL$ 74.0           FASAA (NV)         n:2 FTS (NV)           FOSAA $\langle RL$ 0.039         4:2 FTS $\langle RL$ 0.097           MeFOSAA $\langle RL$ 0.104         6:2 FTS         1.69 ± 0.22         1.15           EtFOSAA $\langle RL$ 0.126         8:2 FTS $\langle RL$ 0.210		$0.355 \pm 0.005$	0.019	1 /	<rl< th=""><th>72.8</th></rl<>	72.8
FHxSA (NV) $0.036 \pm 0.003$ $0.019$ $6:2$ FTOH $257 \pm 43$ $184$ FOSA (NV) $<$ RL $0.039$ $7:2$ FTOH $<$ RL $73.7$ MeFOSA (SV) $<$ RL $1.12$ $8:2$ FTOH $<$ RL $71.4$ EtFOSA (SV) $<$ RL $1.17$ $10:2$ FTOH $<$ RL $74.0$ FASAA (NV)           FOSAA $<$ RL $0.039$ $4:2$ FTS $<$ RL $0.097$ MeFOSAA $<$ RL $0.104$ $6:2$ FTS $1.69 \pm 0.22$ $1.15$ EtFOSAA $<$ RL $0.126$ $8:2$ FTS $<$ RL $0.210$		<rl< th=""><th>4.64</th><th></th><th></th><th></th></rl<>	4.64			
FOSA (NV) <rl< th="">         0.039         7:2 FTOH         <rl< th="">         73.7           MeFOSA (SV)         <rl< th="">         1.12         8:2 FTOH         <rl< th="">         71.4           EtFOSA (SV)         <rl< th="">         1.17         10:2 FTOH         <rl< th="">         74.0           FASAA (NV)         n:2 FTS (NV)          <rl< th="">         0.097           FOSAA         <rl< th="">         0.104         6:2 FTS         1.69 ± 0.22         1.15           MeFOSAA         <rl< th="">         0.126         8:2 FTS         <rl< th="">         0.210</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		$0.036 \pm 0.003$	0.019	6:2 FTOH		
MeFOSA (SV) $\langle RL \rangle$ 1.12         8:2 FTOH $\langle RL \rangle$ 71.4           EtFOSA (SV) $\langle RL \rangle$ 1.17         10:2 FTOH $\langle RL \rangle$ 74.0           FASAA (NV)         n:2 FTS (NV)           FOSAA $\langle RL \rangle$ 0.039         4:2 FTS $\langle RL \rangle$ 0.097           MeFOSAA $\langle RL \rangle$ 0.104         6:2 FTS         1.69 ± 0.22         1.15           EtFOSAA $\langle RL \rangle$ 0.126         8:2 FTS $\langle RL \rangle$ 0.210	· · · · · · · · · · · · · · · · · · ·	<rl< th=""><th>0.039</th><th>7:2 FTOH</th><th></th><th></th></rl<>	0.039	7:2 FTOH		
FASAA (NV)           FOSAA <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.097           MeFOSAA         <rl< th="">         0.104         6:2 FTS         1.69 ± 0.22         1.15           EtFOSAA         <rl< th="">         0.126         8:2 FTS         <rl< th="">         0.210</rl<></rl<></rl<></rl<></rl<>		<rl< th=""><th>1.12</th><th>8:2 FTOH</th><th></th><th></th></rl<>	1.12	8:2 FTOH		
FOSAA <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.097           MeFOSAA         <rl< th="">         0.104         6:2 FTS         1.69 ± 0.22         1.15           EtFOSAA         <rl< th="">         0.126         8:2 FTS         <rl< th="">         0.210</rl<></rl<></rl<></rl<></rl<>	EtFOSA (SV)	<rl< td=""><td>1.17</td><th>10:2 FTOH</th><td><rl< td=""><td>74.0</td></rl<></td></rl<>	1.17	10:2 FTOH	<rl< td=""><td>74.0</td></rl<>	74.0
FOSAA <rl< th="">         0.039         4:2 FTS         <rl< th="">         0.097           MeFOSAA         <rl< th="">         0.104         6:2 FTS         1.69 ± 0.22         1.15           EtFOSAA         <rl< th="">         0.126         8:2 FTS         <rl< th="">         0.210</rl<></rl<></rl<></rl<></rl<>	FASAA (NV)			n:2 FTS (NV)		
MeFOSAA         ≪RL         0.104         6:2 FTS         1.69 ± 0.22         1.15           EtFOSAA         ≪RL         0.126         8:2 FTS         ≪RL         0.210		<rl< th=""><th>0.039</th><th></th><th><rl< th=""><th>0.097</th></rl<></th></rl<>	0.039		<rl< th=""><th>0.097</th></rl<>	0.097
<b>EtFOSAA</b> <rl 0.126="" <b="">8:2 FTS <rl 0.210<="" th=""><th></th><th></th><th></th><th></th><th><math>1.69 \pm 0.22</math></th><th></th></rl></rl>					$1.69 \pm 0.22$	
				10:2 FTS		

<sup>&</sup>lt;sup>a</sup> QC standards not met. Data not reported.

**Table 15.** PFAS concentrations and reporting limits (RL;  $\mu$ g PFAS/kg textile) in outer shell textile OSFSC. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	<rl< td=""><td>0.228</td><td>MeFOSE</td><td><rl< td=""><td>0.496</td></rl<></td></rl<>	0.228	MeFOSE	<rl< td=""><td>0.496</td></rl<>	0.496
PFPeA	<rl< td=""><td>0.062</td><td>EtFOSE</td><td><rl< td=""><td>0.439</td></rl<></td></rl<>	0.062	EtFOSE	<rl< td=""><td>0.439</td></rl<>	0.439
PFHxA	$0.335 \pm 0.032$	0.196			
PFHpA	<rl< td=""><td>0.149</td><td>PPEA (NV)</td><td></td><td></td></rl<>	0.149	PPEA (NV)		
PFOA	<rl< td=""><td>0.446</td><td>PFEESA</td><td><rl< td=""><td>0.034</td></rl<></td></rl<>	0.446	PFEESA	<rl< td=""><td>0.034</td></rl<>	0.034
PFNA	<rl< td=""><td>0.144</td><td>PF4OPeA</td><td><rl< td=""><td>0.024</td></rl<></td></rl<>	0.144	PF4OPeA	<rl< td=""><td>0.024</td></rl<>	0.024
PFDA	<rl< td=""><td>0.231</td><td>PF5OHxA</td><td><rl< td=""><td>0.053</td></rl<></td></rl<>	0.231	PF5OHxA	<rl< td=""><td>0.053</td></rl<>	0.053
PFUnDA	<rl< td=""><td>0.204</td><td>3-6-OPFHpA</td><td><rl< td=""><td>0.034</td></rl<></td></rl<>	0.204	3-6-OPFHpA	<rl< td=""><td>0.034</td></rl<>	0.034
PFDoDA	<rl< td=""><td>0.117</td><td>HFPO-DA</td><td><rl< td=""><td>0.242</td></rl<></td></rl<>	0.117	HFPO-DA	<rl< td=""><td>0.242</td></rl<>	0.242
PFTrDA	<rl< td=""><td>0.055</td><td>ADONA</td><td><rl< td=""><td>0.027</td></rl<></td></rl<>	0.055	ADONA	<rl< td=""><td>0.027</td></rl<>	0.027
PFTeDA	<rl< td=""><td>0.119</td><td>9Cl-PF3ONS</td><td><rl< td=""><td>0.056</td></rl<></td></rl<>	0.119	9Cl-PF3ONS	<rl< td=""><td>0.056</td></rl<>	0.056
			11Cl-PF3OUdS	<rl< td=""><td>0.035</td></rl<>	0.035
PFSA (NV)					
PFPrS	<rl< td=""><td>0.042</td><td>n:2 FTMAC (V)</td><td></td><td></td></rl<>	0.042	n:2 FTMAC (V)		
PFBS	<rl< td=""><td>0.039</td><td>6:2 FTMAC</td><td><rl< td=""><td>338</td></rl<></td></rl<>	0.039	6:2 FTMAC	<rl< td=""><td>338</td></rl<>	338
PFPeS	<rl< td=""><td>0.025</td><td>8:2 FTMAC</td><td><rl< td=""><td>346</td></rl<></td></rl<>	0.025	8:2 FTMAC	<rl< td=""><td>346</td></rl<>	346
PFHxS	<rl< td=""><td>0.051</td><td>10:2 FTMAC</td><td><rl< td=""><td>182</td></rl<></td></rl<>	0.051	10:2 FTMAC	<rl< td=""><td>182</td></rl<>	182
PFHpS	<rl< td=""><td>0.031</td><td></td><td></td><td></td></rl<>	0.031			
PFOS	<rl< td=""><td>0.050</td><td>n:2 FTOAc (V)</td><td></td><td></td></rl<>	0.050	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.035</td><td>8:2 FTOAc</td><td><rl< td=""><td>77.5</td></rl<></td></rl<>	0.035	8:2 FTOAc	<rl< td=""><td>77.5</td></rl<>	77.5
PFDS	<rl< td=""><td>0.049</td><td>10:2 FTOAc</td><td><rl<sup>a</rl<sup></td><td>96.7</td></rl<>	0.049	10:2 FTOAc	<rl<sup>a</rl<sup>	96.7
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	No value <sup>a</sup>		4:2 FTOH	<rl< td=""><td>75.1</td></rl<>	75.1
MeFBSA (SV)	<rl< td=""><td>4.77</td><td>5:2 FTOH</td><td><rl< td=""><td>192</td></rl<></td></rl<>	4.77	5:2 FTOH	<rl< td=""><td>192</td></rl<>	192
FHxSA (NV)	<rl< td=""><td>0.031</td><td>6:2 FTOH</td><td><rl< td=""><td>396</td></rl<></td></rl<>	0.031	6:2 FTOH	<rl< td=""><td>396</td></rl<>	396
FOSA (NV)	<rl< td=""><td>0.076</td><td>7:2 FTOH</td><td><rl< td=""><td>76.0</td></rl<></td></rl<>	0.076	7:2 FTOH	<rl< td=""><td>76.0</td></rl<>	76.0
MeFOSA (SV)	<rl< td=""><td>1.15</td><td>8:2 FTOH</td><td><rl< td=""><td>73.6</td></rl<></td></rl<>	1.15	8:2 FTOH	<rl< td=""><td>73.6</td></rl<>	73.6
EtFOSA (SV)	<rl< td=""><td>1.21</td><td>10:2 FTOH</td><td><rl< td=""><td>76.3</td></rl<></td></rl<>	1.21	10:2 FTOH	<rl< td=""><td>76.3</td></rl<>	76.3
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.079</td><td>4:2 FTS</td><td><rl< td=""><td>0.104</td></rl<></td></rl<>	0.079	4:2 FTS	<rl< td=""><td>0.104</td></rl<>	0.104
MeFOSAA	<rl< td=""><td>0.047</td><td>6:2 FTS</td><td><rl< td=""><td>0.184</td></rl<></td></rl<>	0.047	6:2 FTS	<rl< td=""><td>0.184</td></rl<>	0.184
EtFOSAA	<rl< td=""><td>0.141</td><td>8:2 FTS</td><td><rl< td=""><td>0.214</td></rl<></td></rl<>	0.141	8:2 FTS	<rl< td=""><td>0.214</td></rl<>	0.214
LITUDAA	·ILL	V.1 (1	10:2 FTS	<rl< td=""><td>0.214</td></rl<>	0.214

<sup>&</sup>lt;sup>a</sup> QC standards not met. Data not reported.

<sup>&</sup>lt;sup>b</sup> Internal standard recovery did not meet QC standards, but all other QC standards met. Therefore, data do not meet QC standards and are not included in figures or this technical note beyond this table where they are included only for informational purposes.

**Table 16.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in outer shell textile OS-G. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	$4.27\pm0.02$	0.121	MeFOSE	<rl< td=""><td>0.724</td></rl<>	0.724
PFPeA	$4.33 \pm 0.11$	0.118	EtFOSE	<rl< td=""><td>0.672</td></rl<>	0.672
PFHxA	$12.6 \pm 0.5$	0.258			
PFHpA	$4.08 \pm 0.10$	0.460	PPEA (NV)		
PFOA	<rl< td=""><td>0.222</td><td>PFEESA</td><td><rl< td=""><td>0.016</td></rl<></td></rl<>	0.222	PFEESA	<rl< td=""><td>0.016</td></rl<>	0.016
PFNA	<rl< td=""><td>0.105</td><td>PF4OPeA</td><td><rl< td=""><td>0.038</td></rl<></td></rl<>	0.105	PF4OPeA	<rl< td=""><td>0.038</td></rl<>	0.038
PFDA	<rl< td=""><td>0.105</td><td>PF5OHxA</td><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.105	PF5OHxA	<rl< td=""><td>0.018</td></rl<>	0.018
PFUnDA	<rl< td=""><td>0.105</td><td>3-6-ОРГНРА</td><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.105	3-6-ОРГНРА	<rl< td=""><td>0.018</td></rl<>	0.018
PFDoDA	<rl< td=""><td>0.061</td><td>HFPO-DA</td><td><rl< td=""><td>0.105</td></rl<></td></rl<>	0.061	HFPO-DA	<rl< td=""><td>0.105</td></rl<>	0.105
PFTrDA	<rl< td=""><td>0.072</td><td>ADONA</td><td><rl< td=""><td>0.019</td></rl<></td></rl<>	0.072	ADONA	<rl< td=""><td>0.019</td></rl<>	0.019
PFTeDA	<rl< td=""><td>0.133</td><td>9Cl-PF3ONS</td><td><rl< td=""><td>0.018</td></rl<></td></rl<>	0.133	9Cl-PF3ONS	<rl< td=""><td>0.018</td></rl<>	0.018
			11Cl-PF3OUdS	<rl< td=""><td>0.019</td></rl<>	0.019
PFSA (NV)					
PFPrS	<rl< td=""><td>0.096</td><td>n:2 FTMAC (V)</td><td></td><td></td></rl<>	0.096	n:2 FTMAC (V)		
PFBS	$0.046 \pm 0.008$	0.017	6:2 FTMAC	$382 \pm 43$	216
PFPeS	<rl< td=""><td>0.038</td><td>8:2 FTMAC</td><td><rl< td=""><td>110</td></rl<></td></rl<>	0.038	8:2 FTMAC	<rl< td=""><td>110</td></rl<>	110
PFHxS	<rl< td=""><td>0.036</td><td>10:2 FTMAC</td><td><rl< td=""><td>116</td></rl<></td></rl<>	0.036	10:2 FTMAC	<rl< td=""><td>116</td></rl<>	116
PFHpS	<rl< td=""><td>0.038</td><td></td><td></td><td></td></rl<>	0.038			
PFOS	<rl< td=""><td>0.046</td><td>n:2 FTOAc (V)</td><td></td><td></td></rl<>	0.046	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.038</td><td>8:2 FTOAc</td><td><rl< td=""><td>116</td></rl<></td></rl<>	0.038	8:2 FTOAc	<rl< td=""><td>116</td></rl<>	116
PFDS	<rl< td=""><td>0.039</td><td>10:2 FTOAc</td><td><rl< td=""><td>23.2</td></rl<></td></rl<>	0.039	10:2 FTOAc	<rl< td=""><td>23.2</td></rl<>	23.2
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	$0.034 \pm 0.004$	0.019	4:2 FTOH	<rl< td=""><td>121</td></rl<>	121
MeFBSA (SV)	<rl< td=""><td>6.38</td><td>5:2 FTOH</td><td><rl< td=""><td>232</td></rl<></td></rl<>	6.38	5:2 FTOH	<rl< td=""><td>232</td></rl<>	232
FHxSA (NV)	<rl< td=""><td>0.019</td><td>6:2 FTOH</td><td><math>220 \pm 67</math></td><td>117</td></rl<>	0.019	6:2 FTOH	$220 \pm 67$	117
FOSA (NV)	<rl< td=""><td>0.040</td><td>7:2 FTOH</td><td><rl< td=""><td>116</td></rl<></td></rl<>	0.040	7:2 FTOH	<rl< td=""><td>116</td></rl<>	116
MeFOSA (SV)	<rl< td=""><td>1.28</td><td>8:2 FTOH</td><td><rl< td=""><td>228</td></rl<></td></rl<>	1.28	8:2 FTOH	<rl< td=""><td>228</td></rl<>	228
EtFOSA (SV)	<rl< td=""><td>1.56</td><td>10:2 FTOH</td><td><rl< td=""><td>117</td></rl<></td></rl<>	1.56	10:2 FTOH	<rl< td=""><td>117</td></rl<>	117
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.040</td><td>4:2 FTS</td><td><rl< td=""><td>0.099</td></rl<></td></rl<>	0.040	4:2 FTS	<rl< td=""><td>0.099</td></rl<>	0.099
MeFOSAA	<rl< td=""><td>0.105</td><td>6:2 FTS</td><td><math>2.42 \pm 0.17</math></td><td>1.17</td></rl<>	0.105	6:2 FTS	$2.42 \pm 0.17$	1.17
EtFOSAA	<rl< td=""><td>0.128</td><td>8:2 FTS</td><td><rl< td=""><td>0.213</td></rl<></td></rl<>	0.128	8:2 FTS	<rl< td=""><td>0.213</td></rl<>	0.213
			10:2 FTS	<rl< td=""><td>0.214</td></rl<>	0.214

**Table 17.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-A. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	<rl< td=""><td>0.642</td><th>MeFOSE</th><td><rl< td=""><td>0.256</td></rl<></td></rl<>	0.642	MeFOSE	<rl< td=""><td>0.256</td></rl<>	0.256
PFPeA	$0.152 \pm 0.046$	0.026	EtFOSE	<rl< td=""><td>0.238</td></rl<>	0.238
PFHxA	$0.636\pm0.091$	0.172	_		
PFHpA	<rl< td=""><td>0.565</td><th>PPEA (NV)</th><td></td><td></td></rl<>	0.565	PPEA (NV)		
PFOA	$0.95 \pm 0.22$	0.122	PFEESA	<rl< td=""><td>0.021</td></rl<>	0.021
PFNA	$0.045 \pm 0.019$	0.026	PF4OPeA	<rl< td=""><td>0.023</td></rl<>	0.023
PFDA	$0.072 \pm 0.029$	0.026	PF5OHxA	<rl< td=""><td>0.023</td></rl<>	0.023
PFUnDA	<rl< td=""><td>0.034</td><th>3-6-ОРГНрА</th><td><rl< td=""><td>0.023</td></rl<></td></rl<>	0.034	3-6-ОРГНрА	<rl< td=""><td>0.023</td></rl<>	0.023
PFDoDA	<rl< td=""><td>0.026</td><th>HFPO-DA</th><td><rl< td=""><td>0.069</td></rl<></td></rl<>	0.026	HFPO-DA	<rl< td=""><td>0.069</td></rl<>	0.069
PFTrDA	<rl< td=""><td>0.026</td><th>ADONA</th><td><rl< td=""><td>0.023</td></rl<></td></rl<>	0.026	ADONA	<rl< td=""><td>0.023</td></rl<>	0.023
PFTeDA	<rl< td=""><td>0.145</td><th>9Cl-PF3ONS</th><td><rl< td=""><td>0.024</td></rl<></td></rl<>	0.145	9Cl-PF3ONS	<rl< td=""><td>0.024</td></rl<>	0.024
			11Cl-PF3OUdS	<rl< td=""><td>0.024</td></rl<>	0.024
PFSA (NV)					
PFPrS	<rl< td=""><td>0.023</td><th>n:2 FTMAC (V)</th><td></td><td></td></rl<>	0.023	n:2 FTMAC (V)		
PFBS	$0.66 \pm 0.16$	0.051	6:2 FTMAC	<rl< td=""><td>76.6</td></rl<>	76.6
PFPeS	<rl< td=""><td>0.024</td><th>8:2 FTMAC</th><td><rl< td=""><td>39.2</td></rl<></td></rl<>	0.024	8:2 FTMAC	<rl< td=""><td>39.2</td></rl<>	39.2
PFHxS	<rl< td=""><td>0.023</td><th>10:2 FTMAC</th><td><rl< td=""><td>41.3</td></rl<></td></rl<>	0.023	10:2 FTMAC	<rl< td=""><td>41.3</td></rl<>	41.3
PFHpS	<rl< td=""><td>0.024</td><th></th><td></td><td></td></rl<>	0.024			
PFOS	$0.061 \pm 0.023$	0.024	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.025</td><th>8:2 FTOAc</th><td><rl< td=""><td>41.1</td></rl<></td></rl<>	0.025	8:2 FTOAc	<rl< td=""><td>41.1</td></rl<>	41.1
PFDS	<rl< td=""><td>1.27</td><th>10:2 FTOAc</th><td><rl< td=""><td>8.25</td></rl<></td></rl<>	1.27	10:2 FTOAc	<rl< td=""><td>8.25</td></rl<>	8.25
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	$0.050 \pm 0.016$	0.026	4:2 FTOH	<rl< td=""><td>43.1</td></rl<>	43.1
MeFBSA (SV)	<rl< td=""><td>2.26</td><th>5:2 FTOH</th><td><rl< td=""><td>82.4</td></rl<></td></rl<>	2.26	5:2 FTOH	<rl< td=""><td>82.4</td></rl<>	82.4
FHxSA (NV)	<rl< td=""><td>0.052</td><th>6:2 FTOH</th><td><rl< td=""><td>41.4</td></rl<></td></rl<>	0.052	6:2 FTOH	<rl< td=""><td>41.4</td></rl<>	41.4
FOSA (NV)	<rl< td=""><td>0.052</td><th>7:2 FTOH</th><td><rl< td=""><td>41.2</td></rl<></td></rl<>	0.052	7:2 FTOH	<rl< td=""><td>41.2</td></rl<>	41.2
MeFOSA (SV)	<rl< td=""><td>0.452</td><th>8:2 FTOH</th><td><rl< td=""><td>80.9</td></rl<></td></rl<>	0.452	8:2 FTOH	<rl< td=""><td>80.9</td></rl<>	80.9
EtFOSA (SV)	<rl< td=""><td>0.553</td><th>10:2 FTOH</th><td><rl< td=""><td>41.4</td></rl<></td></rl<>	0.553	10:2 FTOH	<rl< td=""><td>41.4</td></rl<>	41.4
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.051</td><th>4:2 FTS</th><td><rl< td=""><td>0.049</td></rl<></td></rl<>	0.051	4:2 FTS	<rl< td=""><td>0.049</td></rl<>	0.049
MeFOSAA	<rl< td=""><td>0.026</td><th>6:2 FTS</th><td><rl< td=""><td>5.61</td></rl<></td></rl<>	0.026	6:2 FTS	<rl< td=""><td>5.61</td></rl<>	5.61
EtFOSAA	<rl< td=""><td>0.052</td><th>8:2 FTS</th><td><rl< td=""><td>0.118</td></rl<></td></rl<>	0.052	8:2 FTS	<rl< td=""><td>0.118</td></rl<>	0.118
			10:2 FTS	<rl< td=""><td>0.116</td></rl<>	0.116

**Table 18.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-B. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.

PFCA (NV)         FASE (SV)         ARL         0.322           PFPeA         0.082 ± 0.006         0.022         EtFOSE <rl< td="">         0.322           PFPHAA         ≪RL         0.089         PFESA         <rl< td="">         0.299           PFHDA         ≪RL         0.089         PPEA (NV)         PFESA         <rl< td="">         0.018           PFNA         ≪RL         0.121         PF4OPeA         <rl< td="">         0.020         PFDA         <rl< td="">         0.020         PFSDHXA         <rl< td="">         0.020         PFDA         <rl< td="">         0.020         PFSDHXA         <rl< td="">         0.020         PFDDA         <rl< td="">         0.020         PFSDHXA         <rl< td="">         0.020         PFDDA         <rl< td="">         0.020         PFSDHXA         <rl< td="">         0.020         PFSDHXA         <rl< td="">         0.020         PFSDHXA         <rl< td="">         0.020         PFTDA         <rl< td="">         0.020         PFTDA         <rl< td="">         0.020         PRTDA         <rl< td="">         0.020         RRL         0.020         PSTBANA</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFAS	Concentration (µg/kg)	RL (μg/kg)	PFAS	Concentration (μg/kg)	RL (μg/kg)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFCA (NV)			FASE (SV)		
PFHXA <rl< th="">         0.483           PPHpA         <rl< th="">         0.089         PPEA (NV)           PFOA         0.276 ± 0.037         0.106         PFESA         <rl< th="">         0.018           PFNA         <rl< th="">         0.121         PF4OPeA         <rl< th="">         0.020           PFDA         0.202 ± 0.012         0.022         PF5OHXA         <rl< th="">         0.020           PFUnDA         <rl< th="">         0.029         3-6-OPFHpA         <rl< th="">         0.020           PFTDA         <rl< th="">         0.022         HFPO-DA         <rl< th="">         0.020           PFTDA         <rl< th="">         0.022         HFPO-DA         <rl< th="">         0.020           PFTDA         <rl< th="">         0.022         ADONA         <rl< th="">         0.020           PFTDA         <rl< th="">         0.022         PF30NS         <rl< th="">         0.021           PFTSA (NV)                                       <th< th=""><th>PFBA</th><th><rl< th=""><th>0.274</th><th>MeFOSE</th><th><rl< th=""><th>0.322</th></rl<></th></rl<></th></th<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFBA	<rl< th=""><th>0.274</th><th>MeFOSE</th><th><rl< th=""><th>0.322</th></rl<></th></rl<>	0.274	MeFOSE	<rl< th=""><th>0.322</th></rl<>	0.322
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFPeA	$0.082\pm0.006$	0.022	EtFOSE	<rl< th=""><th>0.299</th></rl<>	0.299
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFHxA	<rl< th=""><th>0.483</th><th></th><th></th><th></th></rl<>	0.483			
PFNA <pre></pre>	PFHpA	<rl< th=""><th>0.089</th><th>PPEA (NV)</th><th></th><th></th></rl<>	0.089	PPEA (NV)		
PFDA         0.202 ± 0.012         0.022         PF50HxA         ≪RL         0.020           PFUnDA         ≪RL         0.029         3-6-OPFHpA         ≪RL         0.020           PFDoDA         0.085 ± 0.007         0.022         HFPO-DA         ≪RL         0.060           PFTDA         ≪RL         0.022         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.022         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.026         PCI-PF3ONS         ≪RL         0.021           PFSA (NV)         ****         ***         **** <th>PFOA</th> <th><math display="block">0.276 \pm 0.037</math></th> <th>0.106</th> <th>PFEESA</th> <th><rl< th=""><th>0.018</th></rl<></th>	PFOA	$0.276 \pm 0.037$	0.106	PFEESA	<rl< th=""><th>0.018</th></rl<>	0.018
PFUnDA <rl< th="">         0.029         3-6-OPFHpA         <rl< th="">         0.020           PFDoDA         0.085 ± 0.007         0.022         HFPO-DA         <rl< th="">         0.060           PFTrDA         <rl< th="">         0.022         ADONA         <rl< th="">         0.020           PFTeDA         <rl< th="">         0.126         9C-PF3ONS         <rl< th="">         0.021           PFTDA         <rl< th="">         0.020         PF3ONS         <rl< th="">         0.021           PFSA (NV)          RL         0.020         RL         0.021           PFBS         <rl< th="">         0.020         m:2 FTMAC (V)         PF9S            PFHS         <rl< th="">         0.021         8:2 FTMAC   <th>PFNA</th><th><rl< th=""><th>0.121</th><th>PF4OPeA</th><th><rl< th=""><th>0.020</th></rl<></th></rl<></th></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFNA	<rl< th=""><th>0.121</th><th>PF4OPeA</th><th><rl< th=""><th>0.020</th></rl<></th></rl<>	0.121	PF4OPeA	<rl< th=""><th>0.020</th></rl<>	0.020
PFDoDA         0.085 ± 0.007         0.022         HFPO-DA         ≪RL         0.060           PFTrDA         ≪RL         0.022         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.126         9Cl-PF3ONS         ≪RL         0.021           PFSA (NV)           PFPSA (NV)           REL         0.020         n:2 FTMAC (V)           PFPSS         ≪RL         0.021         8:2 FTMAC         ≪RL         95.9           PFPSS         ≪RL         0.021         8:2 FTMAC         ≪RL         49.1           PFMS         ≪RL         0.021         8:2 FTMAC         ≪RL         49.1           PFPSS         ≪RL         0.021         8:2 FTMAC         ≪RL         49.1           PFPSS         ≪RL         0.021         8:2 FTOAc (V)         PFPS           PFPSS         ≪RL         0.021         8:2 FTOAc (V)         PFPS           PFPSS         ≪RL         0.039 ± 0.002         0.021         8:2 FTOAc (V)         PFPS           PFPSS <rl< th="">         0.039 ± 0.002         0.021         8:2 FTOAc (V)         PFPS</rl<>	PFDA	$0.202 \pm 0.012$	0.022	PF5OHxA	<rl< th=""><th>0.020</th></rl<>	0.020
PFTrDA         ≪RL         0.022         ADONA         ≪RL         0.020           PFTeDA         ≪RL         0.126         9Cl-PF3ONS         ≪RL         0.021           PFEDA         CRL         0.126         9Cl-PF3ONS         ≪RL         0.021           PFSA (NV)           PFBS         ≪RL         0.020         m:2 FTMAC (V)         PFBS           PFPES         ≪RL         0.021         8:2 FTMAC         ≪RL         49.1           PFHS         ≪RL         0.020         10:2 FTMAC         ≪RL         51.7           PFHS         ≪RL         0.020         10:2 FTMAC         ≪RL         51.7           PFHS         ≪RL         0.020         10:2 FTMAC         ≪RL         51.7           PFNS         ≪RL         0.021         m:2 FTOAc (V)         PTOAC (V)         P	PFUnDA	<rl< th=""><th>0.029</th><th>3-6-OPFHpA</th><th><rl< th=""><th>0.020</th></rl<></th></rl<>	0.029	3-6-OPFHpA	<rl< th=""><th>0.020</th></rl<>	0.020
PFTeDA         ≪RL         0.126         9Cl-PF3ONS         ≪RL         0.021           PFSA (NV)         11Cl-PF3OUdS         ≪RL         0.021           PFPS         ≪RL         0.020         m:2 FTMAC (V)           PFBS         0.455 ± 0.061         0.025         6:2 FTMAC         ≪RL         95.9           PFPES         ≪RL         0.021         8:2 FTMAC         ≪RL         49.1           PFHXS         ≪RL         0.020         10:2 FTMAC         ≪RL         51.7           PFHS         ≪RL         0.021         n:2 FTOAc (V)         PFOS         0.039 ± 0.002         0.021         n:2 FTOAc (V)         PFOS         √RL         51.4         10:3         √RL         51.4         10:3         √RL         51.4         10:3         √RL         51.4         √RL         53.9         √RL         53.9         √RL         53.9         √REFSA (NV, SV)         √RL         52 FTOH (V)         √RL         53.9         √REFSA (NV)         ≪RL         51.9         √RL         51.9         √RL         51.9         √RL         51.9         √RL         51.6         √REFOSA (NV)         ✓RL         0.041         √RL         51.6         √RL         51.8         √RL         51.8<	PFDoDA	$0.085 \pm 0.007$	0.022	HFPO-DA	<rl< th=""><th>0.060</th></rl<>	0.060
PFSA (NV)	PFTrDA	<rl< th=""><th>0.022</th><th>ADONA</th><th><rl< th=""><th>0.020</th></rl<></th></rl<>	0.022	ADONA	<rl< th=""><th>0.020</th></rl<>	0.020
PFSA (NV)           PFPRS         ≪RL         0.020         n:2 FTMAC (V)           PFBS         0.455 ± 0.061         0.025         6:2 FTMAC         ≪RL         95.9           PFPeS         ≪RL         0.021         8:2 FTMAC         ≪RL         49.1           PFHxS         ≪RL         0.020         10:2 FTMAC         ≪RL         51.7           PFHpS         ≪RL         0.021         n:2 FTOAc (V)         ***           PFNS         ≪RL         0.021         n:2 FTOAc         ≪RL         51.4           PFDS         ≪RL         0.021         8:2 FTOAc         ≪RL         10.3           **FASA (NV, SV)         ***         n:2 FTOH(V)         ***         ***           **FBSA (NV)         ≪RL         2.84         5:2 FTOH         ≪RL         53.9           **MeFBSA (SV)         ≪RL         0.030         6:2 FTOH         ≪RL         51.9           **FOSA (NV)         ≪RL         0.030         6:2 FTOH         ≪RL         51.6           **MeFOSA (SV)         ≪RL         0.568         8:2 FTOH         ≪RL         51.8           **FASAA (NV)         **RL         0.695         10:2 FTOH         **RL         51.8 </th <th>PFTeDA</th> <th><rl< th=""><th>0.126</th><th>9Cl-PF3ONS</th><th><rl< th=""><th>0.021</th></rl<></th></rl<></th>	PFTeDA	<rl< th=""><th>0.126</th><th>9Cl-PF3ONS</th><th><rl< th=""><th>0.021</th></rl<></th></rl<>	0.126	9Cl-PF3ONS	<rl< th=""><th>0.021</th></rl<>	0.021
PFPrS <rl< th="">         0.020         n:2 FTMAC (V)           PFBS         0.455 ± 0.061         0.025         6:2 FTMAC         <rl< td="">         95.9           PFPeS         <rl< td="">         0.021         8:2 FTMAC         <rl< td="">         49.1           PFHxS         <rl< td="">         0.020         10:2 FTMAC         <rl< td="">         51.7           PFHpS         <rl< td="">         0.021         n:2 FTOAc (V)         PFNS         <rl< td="">         51.4           PFDS         <rl< td="">         0.021         8:2 FTOAc         <rl< td="">         51.4           PFDS         <rl< td="">         0.021         8:2 FTOAc         <rl< td="">         51.4           PFDS         <rl< td="">         0.058         10:2 FTOAc         <rl< td="">         10:3           FASA (NV, SV)         n:2 FTOH (V)         THX         THX&lt;</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>				11Cl-PF3OUdS	<rl< th=""><th>0.021</th></rl<>	0.021
PFBS         0.455 ± 0.061         0.025         6:2 FTMAC         ≪RL         95.9           PFPeS         ≪RL         0.021         8:2 FTMAC         ≪RL         49.1           PFHxS         ≪RL         0.020         10:2 FTMAC         ≪RL         51.7           PFHpS         ≪RL         0.021         m:2 FTOAc (V)         White of the control	PFSA (NV)					
PFPeS <rl< th="">         0.021         8:2 FTMAC         <rl< th="">         49.1           PFHxS         <rl< td="">         0.020         10:2 FTMAC         <rl< td="">         51.7           PFHpS         <rl< td="">         0.021        </rl<></rl<></rl<></rl<></rl<>	PFPrS	<rl< th=""><th>0.020</th><th>n:2 FTMAC (V)</th><th></th><th></th></rl<>	0.020	n:2 FTMAC (V)		
PFHxS <rl< th="">         0.020         10:2 FTMAC         <rl< th="">         51.7           PFHpS         <rl< th="">         0.021         m:2 FTOAc (V)            PFOS         0.039 ± 0.002         0.021         m:2 FTOAc (V)            PFNS         <rl< th="">         0.021         8:2 FTOAc         <rl< th="">         51.4           PFDS         <rl< th="">         0.058         10:2 FTOAc         <rl< th="">         51.4           PFDS         <rl< th="">         0.058         10:2 FTOAc         <rl< th="">         51.4           PFDS         <rl< th="">         0.058         10:2 FTOAc         <rl< th="">         10.3           FASA (NV, SV)          n:2 FTOH (V)             FBSA (NV)         <rl< th="">         2.84         5:2 FTOH         <rl< th="">         53.9           MeFBSA (SV)         <rl< th="">         0.030         6:2 FTOH         <rl< th="">         51.9           FOSA (NV)         <rl< th="">         0.041         7:2 FTOH         <rl< th="">         51.6           MeFOSA (SV)         <rl< th="">         0.568         8:2 FTOH         <rl< th="">         51.8           FASAA (NV)          RL         0.042             FOSAA          <rl< <="" th=""><th>PFBS</th><th><math>0.455 \pm 0.061</math></th><th>0.025</th><th>6:2 FTMAC</th><th><rl< th=""><th>95.9</th></rl<></th></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFBS	$0.455 \pm 0.061$	0.025	6:2 FTMAC	<rl< th=""><th>95.9</th></rl<>	95.9
PFHpS <rl< th="">         0.021           PFOS         0.039 ± 0.002         0.021         m:2 FTOAc (V)           PFNS         <rl< th="">         0.021         8:2 FTOAc         <rl< th="">         51.4           PFDS         <rl< th="">         0.058         10:2 FTOAc         <rl< th="">         10.3           FASA (NV, SV)           RBSA (NV)         0.043 ± 0.006         0.022         4:2 FTOH         <rl< th="">         53.9           MeFBSA (SV)         <rl< th="">         2.84         5:2 FTOH         <rl< th="">         103           FHxSA (NV)         <rl< th="">         0.030         6:2 FTOH         <rl< th="">         51.9           FOSA (NV)         <rl< th="">         0.041         7:2 FTOH         <rl< th="">         51.6           MeFOSA (SV)         <rl< th="">         0.568         8:2 FTOH         <rl< th="">         101           EtFOSA (SV)         <rl< th="">         0.695         10:2 FTOH         <rl< th="">         51.8           FASAA (NV)         n:2 FTS (NV)</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFPeS	<rl< th=""><th>0.021</th><th>8:2 FTMAC</th><th><rl< th=""><th>49.1</th></rl<></th></rl<>	0.021	8:2 FTMAC	<rl< th=""><th>49.1</th></rl<>	49.1
PFOS $0.039 \pm 0.002$ $0.021$ $m:2$ FTOAc (V)           PFNS $<$ RL $0.021$ $8:2$ FTOAc $<$ RL $51.4$ PFDS $<$ RL $0.058$ $10:2$ FTOAc $<$ RL $10.3$ FASA (NV, SV)           n:2 FTOH (V)           FBSA (NV) $<$ RL $<$ RL $<$ RL $<$ S3.9           MeFBSA (SV) $<$ RL $<$ RL $<$ RL $<$ RL $<$ S1.9           FOSA (NV) $<$ RL $<$ RL $<$ RL $<$ S1.9           FOSA (NV) $<$ RL $<$ RL $<$ RL $<$ S1.9           FOSA (SV) $<$ RL $<$ RL $<$ RL $<$ S1.9           FOSA (SV) $<$ RL $<$ RL $<$ RL $<$ S1.6           FASAA (NV) $<$ RL $<$ RL $<$ RL $<$ S1.6           FOSAA $<$ RL $<$ RL $<$ RL $<$ S1.8           FOSAA $<$ RL $<$ RL $<$ RL $<$ RL           MeFOSAA $<$ RL $<$ RL $<$ RL $<$ RL           MeFOSAA	PFHxS	<rl< th=""><th>0.020</th><th>10:2 FTMAC</th><th><rl< th=""><th>51.7</th></rl<></th></rl<>	0.020	10:2 FTMAC	<rl< th=""><th>51.7</th></rl<>	51.7
PFNS <rl< th="">         0.021         8:2 FTOAc         <rl< th="">         51.4           PFDS         <rl< th="">         0.058         10:2 FTOAc         <rl< th="">         10.3           FASA (NV, SV)         n:2 FTOH (V)         n:2 FTOH (V)         respectively         RL         53.9           MeFBSA (SV)         <rl< th="">         2.84         5:2 FTOH         <rl< th="">         103           FHxSA (NV)         <rl< th="">         0.030         6:2 FTOH         <rl< th="">         51.9           FOSA (NV)         <rl< th="">         0.041         7:2 FTOH         <rl< th="">         51.6           MeFOSA (SV)         <rl< th="">         0.568         8:2 FTOH         <rl< th="">         101           EtFOSA (SV)         <rl< th="">         0.695         10:2 FTOH         <rl< th="">         51.8           FASAA (NV)         n:2 FTS (NV)</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFHpS	<rl< th=""><th>0.021</th><th></th><th></th><th></th></rl<>	0.021			
PFDS <rl< th="">         0.058         10:2 FTOAc         <rl< th="">         10.3           FASA (NV, SV)         n:2 FTOH (V)           FBSA (NV)         0.043 ± 0.006         0.022         4:2 FTOH         <rl< th="">         53.9           MeFBSA (SV)         <rl< th="">         2.84         5:2 FTOH         <rl< th="">         103           FHxSA (NV)         <rl< th="">         0.030         6:2 FTOH         <rl< th="">         51.9           FOSA (NV)         <rl< th="">         0.041         7:2 FTOH         <rl< th="">         51.6           MeFOSA (SV)         <rl< th="">         0.568         8:2 FTOH         <rl< th="">         101           EtFOSA (SV)         <rl< th="">         0.695         10:2 FTOH         <rl< th="">         51.8           FOSAA         <rl< th="">         0.044         4:2 FTS         <rl< th="">         0.042           MeFOSAA         <rl< th="">         0.022         6:2 FTS         <rl< th="">         0.197           EtFOSAA         <rl< th="">         0.045         8:2 FTS         <rl< th="">         0.102</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFOS	$0.039 \pm 0.002$	0.021	n:2 FTOAc (V)		
FASA (NV, SV)           FBSA (NV)         0.043 ± 0.006         0.022         4:2 FTOH <rl< th="">         53.9           MeFBSA (SV)         <rl< td="">         2.84         5:2 FTOH         <rl< td="">         103           FHxSA (NV)         <rl< td="">         0.030         6:2 FTOH         <rl< td="">         51.9           FOSA (NV)         <rl< td="">         0.041         7:2 FTOH         <rl< td="">         51.6           MeFOSA (SV)         <rl< td="">         0.568         8:2 FTOH         <rl< td="">         101           EtFOSA (SV)         <rl< td="">         0.695         10:2 FTOH         <rl< td="">         51.8           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< td="">         0.044         4:2 FTS         <rl< td="">         0.042           MeFOSAA         <rl< td="">         0.022         6:2 FTS         <rl< td="">         0.197           EtFOSAA         <rl< td="">         0.045         8:2 FTS         <rl< td="">         0.102</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFNS	<rl< th=""><th>0.021</th><th>8:2 FTOAc</th><th><rl< th=""><th>51.4</th></rl<></th></rl<>	0.021	8:2 FTOAc	<rl< th=""><th>51.4</th></rl<>	51.4
FBSA (NV)         0.043 ± 0.006         0.022         4:2 FTOH         ≪RL         53.9           MeFBSA (SV)         ≪RL         2.84         5:2 FTOH         ≪RL         103           FHxSA (NV)         ≪RL         0.030         6:2 FTOH         ≪RL         51.9           FOSA (NV)         ≪RL         0.041         7:2 FTOH         ≪RL         51.6           MeFOSA (SV)         ≪RL         0.568         8:2 FTOH         ≪RL         101           EtFOSA (SV)         ≪RL         0.695         10:2 FTOH         ≪RL         51.8           FASAA (NV)         n:2 FTS (NV)         ≪RL         0.042           MeFOSAA         ≪RL         0.044         4:2 FTS         ≪RL         0.042           MeFOSAA         ≪RL         0.022         6:2 FTS         ≪RL         0.197           EtFOSAA         ≪RL         0.045         8:2 FTS         ≪RL         0.102	PFDS	<rl< th=""><th>0.058</th><th>10:2 FTOAc</th><th><rl< th=""><th>10.3</th></rl<></th></rl<>	0.058	10:2 FTOAc	<rl< th=""><th>10.3</th></rl<>	10.3
FBSA (NV)         0.043 ± 0.006         0.022         4:2 FTOH         ≪RL         53.9           MeFBSA (SV)         ≪RL         2.84         5:2 FTOH         ≪RL         103           FHxSA (NV)         ≪RL         0.030         6:2 FTOH         ≪RL         51.9           FOSA (NV)         ≪RL         0.041         7:2 FTOH         ≪RL         51.6           MeFOSA (SV)         ≪RL         0.568         8:2 FTOH         ≪RL         101           EtFOSA (SV)         ≪RL         0.695         10:2 FTOH         ≪RL         51.8           FASAA (NV)         n:2 FTS (NV)         ≪RL         0.042           MeFOSAA         ≪RL         0.044         4:2 FTS         ≪RL         0.042           MeFOSAA         ≪RL         0.022         6:2 FTS         ≪RL         0.197           EtFOSAA         ≪RL         0.045         8:2 FTS         ≪RL         0.102	EACA (NIZ CIZ)			w.2 FTOH (I/)		
MeFBSA (SV) <rl< th="">         2.84         5:2 FTOH         <rl< th="">         103           FHxSA (NV)         <rl< th="">         0.030         6:2 FTOH         <rl< th="">         51.9           FOSA (NV)         <rl< th="">         0.041         7:2 FTOH         <rl< th="">         51.6           MeFOSA (SV)         <rl< th="">         0.568         8:2 FTOH         <rl< th="">         101           EtFOSA (SV)         <rl< th="">         0.695         10:2 FTOH         <rl< th="">         51.8           FASAA (NV)         n:2 FTS (NV)</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		0.043 + 0.006	0.022	1 /	∠D1	<i>52.</i> 0
FHxSA (NV) <rl< th="">         0.030         6:2 FTOH         <rl< th="">         51.9           FOSA (NV)         <rl< th="">         0.041         7:2 FTOH         <rl< th="">         51.6           MeFOSA (SV)         <rl< th="">         0.568         8:2 FTOH         <rl< th="">         101           EtFOSA (SV)         <rl< th="">         0.695         10:2 FTOH         <rl< th="">         51.8           FASAA (NV)         n:2 FTS (NV)</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>						
FOSA (NV) <rl< th="">         0.041         7:2 FTOH         <rl< th="">         51.6           MeFOSA (SV)         <rl< th="">         0.568         8:2 FTOH         <rl< th="">         101           EtFOSA (SV)         <rl< th="">         0.695         10:2 FTOH         <rl< th="">         51.8           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.044         4:2 FTS         <rl< th="">         0.042           MeFOSAA         <rl< th="">         0.022         6:2 FTS         <rl< th="">         0.197           EtFOSAA         <rl< th="">         0.045         8:2 FTS         <rl< th="">         0.102</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>						
MeFOSA (SV) <rl< th="">         0.568         8:2 FTOH         <rl< th="">         101           EtFOSA (SV)         <rl< th="">         0.695         10:2 FTOH         <rl< th="">         51.8           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.044         4:2 FTS         <rl< th="">         0.042           MeFOSAA         <rl< th="">         0.022         6:2 FTS         <rl< th="">         0.197           EtFOSAA         <rl< th="">         0.045         8:2 FTS         <rl< th="">         0.102</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>						
EtFOSA (SV) <rl< th="">         0.695         10:2 FTOH         <rl< th="">         51.8           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.044         4:2 FTS         <rl< th="">         0.042           MeFOSAA         <rl< th="">         0.022         6:2 FTS         <rl< th="">         0.197           EtFOSAA         <rl< th="">         0.045         8:2 FTS         <rl< th="">         0.102</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>						
FASAA (NV)           FOSAA <rl< th="">         0.044         4:2 FTS         <rl< th="">         0.042           MeFOSAA         <rl< th="">         0.022         6:2 FTS         <rl< th="">         0.197           EtFOSAA         <rl< th="">         0.045         8:2 FTS         <rl< th="">         0.102</rl<></rl<></rl<></rl<></rl<></rl<>						
FOSAA <rl< th="">         0.044         4:2 FTS         <rl< th="">         0.042           MeFOSAA         <rl< th="">         0.022         6:2 FTS         <rl< th="">         0.197           EtFOSAA         <rl< th="">         0.045         8:2 FTS         <rl< th="">         0.102</rl<></rl<></rl<></rl<></rl<></rl<>	EIFOSA (SV)	·KL	0.073	10:2 F 1OH	·KL	31.8
FOSAA <rl< th="">         0.044         4:2 FTS         <rl< th="">         0.042           MeFOSAA         <rl< th="">         0.022         6:2 FTS         <rl< th="">         0.197           EtFOSAA         <rl< th="">         0.045         8:2 FTS         <rl< th="">         0.102</rl<></rl<></rl<></rl<></rl<></rl<>	FASAA (NV)			n:2 FTS (NV)		
MeFOSAA <rl< th="">         0.022         6:2 FTS         <rl< th="">         0.197           EtFOSAA         <rl< th="">         0.045         8:2 FTS         <rl< th="">         0.102</rl<></rl<></rl<></rl<>		<rl< th=""><th>0.044</th><th></th><th><rl< th=""><th>0.042</th></rl<></th></rl<>	0.044		<rl< th=""><th>0.042</th></rl<>	0.042
EtFOSAA <rl< th="">         0.045         8:2 FTS         <rl< th="">         0.102</rl<></rl<>		<rl< th=""><th>0.022</th><th></th><th><rl< th=""><th>0.197</th></rl<></th></rl<>	0.022		<rl< th=""><th>0.197</th></rl<>	0.197
		<rl< th=""><th>0.045</th><th></th><th><rl< th=""><th>0.102</th></rl<></th></rl<>	0.045		<rl< th=""><th>0.102</th></rl<>	0.102
					<rl< th=""><th>0.100</th></rl<>	0.100

**Table 19.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-C. Analytical method indicated with NV for nonvolatile, SV for semivolatile, or V for volatile.

PFCA (NV)         FASE (SV)           PFBA         0.658 ± 0.076         0.190         McFOSE         0.537 ± 0.065         0.250           PFPeA         0.222 ± 0.040         0.059         EtFOSE         ≪RL         0.232           PFHAA         0.511 ± 0.061         0.335         HFFOA         0.855 ± 0.071         0.320         PFESA         ≪RL         0.022           PFOA         0.855 ± 0.071         0.320         PFEESA         ≪RL         0.026           PFDA         0.631 ± 0.060         0.180         PF4OPcA         ≪RL         0.026           PFDA         0.631 ± 0.060         0.180         PF5OHXA         ≪RL         0.027           PFUnDA         ≪RL         0.119         3-6-OPFHpA         ≪RL         0.021           PFDA         ≪RL         0.064         ADONA         ≪RL         0.021           PFTDA         ≪RL         0.0126         PCPF30NS         ≪RL         0.021           PFTSA (NV)         V         PFFSA (NV)         W         PFPFS <rl< td="">         0.022         8:2 FTMAC (V)         W         PFPRS         <rl< td="">         0.022         8:2 FTMAC (V)         <rl< td="">         38.0         ARL         9.0         ARL         <t< th=""><th>PFAS</th><th>Concentration (μg/kg)</th><th>RL (μg/kg)</th><th>PFAS</th><th>Concentration (µg/kg)</th><th>RL (μg/kg)</th></t<></rl<></rl<></rl<>	PFAS	Concentration (μg/kg)	RL (μg/kg)	PFAS	Concentration (µg/kg)	RL (μg/kg)
PFPeA         0.222 ± 0.040         0.059         EHFOSE         ≪RL         0.232           PFHxA         0.511 ± 0.061         0.335         PFHpA         0.238 ± 0.026         0.062         PPEA (NV)           PFOA         0.855 ± 0.071         0.320         PFESA         ≪RL         0.022           PFNA         0.192 ± 0.051         0.084         PF4OPeA         ≪RL         0.026           PFDA         0.631 ± 0.060         0.180         PF5OHxA         ≪RL         0.026           PFDA         0.631 ± 0.060         0.180         PF5OHxA         ≪RL         0.027           PFDDA         ≪RL         0.119         3-6-OPFHpA         ≪RL         0.021           PFDDA         ≪RL         0.044         ADONA         ≪RL         0.021           PFTDA         ≪RL         0.054         ADONA         ≪RL         0.021           PFTSA (NV)         PFFSA (NV)         ***         *	PFCA (NV)			FASE (SV)		
PFHXA         0.511 ± 0.061         0.335           PFHpA         0.238 ± 0.026         0.062         PPEA (NV)           PFOA         0.855 ± 0.071         0.320         PFESA         ≪RL         0.022           PFNA         0.192 ± 0.051         0.084         PF4OPeA         ≪RL         0.026           PFDA         0.631 ± 0.060         0.180         PF5OHXA         ≪RL         0.037           PFUnDA         ≪RL         0.119         3-6-OPFHpA         ≪RL         0.021           PFTDA         ≪RL         0.064         ADONA         ≪RL         0.021           PFTDA         ≪RL         0.064         ADONA         ≪RL         0.021           PFTA (NV)         PFTSA (NV)         C         MEPGSONS         ≪RL         0.021           PFPSA (NV)         PFPSS (NV)          MEPGSONS         ≪RL         0.021           PFPSS (NV)         PFPSS (NV)          MEPGSONS <rl< th="">         0.021           PFPRS (NV)         RRL         0.022         MEFTMAC (V)          RL         40.0           PFPRS (NV)         RRL         0.021         MEFTMAC (V)          RL         40.0           <th< td=""><th>PFBA</th><td><math>0.658 \pm 0.076</math></td><td>0.190</td><th>MeFOSE</th><td><math>0.537 \pm 0.065</math></td><td>0.250</td></th<></rl<>	PFBA	$0.658 \pm 0.076$	0.190	MeFOSE	$0.537 \pm 0.065$	0.250
PFHpA         0.238 ± 0.026         0.062         PPEA (NV)           PFOA         0.855 ± 0.071         0.320         PFEESA         ≪RL         0.022           PFNA         0.192 ± 0.051         0.084         PF40PcA         ≪RL         0.026           PFDA         0.631 ± 0.060         0.180         PF50HxA         ≪RL         0.027           PFUnDA         ≪RL         0.119         3-6-OPFHpA         ≪RL         0.021           PFTDA         ≪RL         0.064         ADONA         ≪RL         0.021           PFTeDA         ≪RL         0.064         ADONA         ≪RL         0.021           PFTSA (NV)         ————————————————————————————————————	PFPeA	$0.222 \pm 0.040$	0.059	EtFOSE	<rl< td=""><td>0.232</td></rl<>	0.232
PFOA $0.855 \pm 0.071$ $0.320$ PFEESA $<$ RL $0.022$ PFNA $0.192 \pm 0.051$ $0.084$ PF4OPeA $<$ RL $0.026$ PFDA $0.631 \pm 0.060$ $0.180$ PF5OHAA $<$ RL $0.037$ PFUnDA $<$ RL $0.119$ $<$ >A-GOPFHpA $<$ >RL $0.021$ PFDoDA $<$ 0.015 $<$ 0.009         HFPO-DA $<$ RL $<$ 0.219           PFTDA $<$ RL $<$ 0.064         ADONA $<$ RL $<$ 0.021           PFTeDA $<$ RL $<$ 0.064         ADONA $<$ RL $<$ 0.021           PFTeDA $<$ RL $<$ 0.024 $<$ 0.021         PF530NS $<$ RL $<$ 0.021           PFSA (NV) $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$	PFHxA	$0.511 \pm 0.061$	0.335			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	PFHpA	$0.238 \pm 0.026$	0.062	PPEA (NV)		
PFDA         0.631 ± 0.060         0.180         PF50HxA         ≪RL         0.037           PFUnDA         ≪RL         0.119         3-6-OPFHpA         ≪RL         0.021           PFDoDA         0.203 ± 0.015         0.097         HFPO-DA         ≪RL         0.219           PFTDA         ≪RL         0.064         ADONA         ≪RL         0.021           PFTDA         ≪RL         0.126         9CL-PF3ONS         ≪RL         0.042           PFSA (NV)         T         T         11CL-PF3OUdS         ≪RL         0.021           PFSSA (NV)         T         ***C         ***C         ***C         ***C         ***O         ***C         ***PTMAC (V)         ***C         <	PFOA	$0.855 \pm 0.071$	0.320	PFEESA	<rl< td=""><td>0.022</td></rl<>	0.022
PFUNDA         ≪RL         0.119         3-6-OPFHpA         ≪RL         0.021           PFDoDA         0.203 ± 0.015         0.097         HFPO-DA         ≪RL         0.219           PFTrDA         ≪RL         0.064         ADONA         ≪RL         0.021           PFTeDA         ≪RL         0.126         9Cl-PF3ONS         ≪RL         0.042           PFTeDA                0.021           PFTeDA                 0.021           PFTS           0.029   <	PFNA	$0.192 \pm 0.051$	0.084	PF4OPeA	<rl< td=""><td>0.026</td></rl<>	0.026
PFDoDA         0.203 ± 0.015         0.097         HFPO-DA         ≪RL         0.219           PFTrDA         ≪RL         0.064         ADONA         ≪RL         0.021           PFTeDA         ≪RL         0.126         9CI-PF3ONS         ≪RL         0.042           PFTeDA         ≪RL         0.126         9CI-PF3ONS         ≪RL         0.042           PFSA (NV)         PFPS         ≪RL         0.029         n:2 FTMAC (V)         PFPS           PFPS         ≪RL         0.029         n:2 FTMAC (V)         PFPS           PFPS         ≪RL         0.022         8:2 FTMAC         ≪RL         74.2           PFPS         ≪RL         0.022         8:2 FTMAC         ≪RL         38.0           PFHxS         ≪RL         0.042         10:2 FTMAC         ≪RL         40.0           PFMS         ≪RL         0.021         n:2 FTOAc (V)         PFPS	PFDA	$0.631 \pm 0.060$	0.180	PF5OHxA	<rl< td=""><td>0.037</td></rl<>	0.037
PFTrDA         ≪RL         0.064         ADONA         ≪RL         0.021           PFTeDA         ≪RL         0.126         9Cl-PF3ONS         ≪RL         0.042           PFSA (NV)           PFPS	PFUnDA	<rl< td=""><td>0.119</td><th>3-6-ОРГНРА</th><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.119	3-6-ОРГНРА	<rl< td=""><td>0.021</td></rl<>	0.021
PFTeDA         ≪RL         0.126         9Cl-PF3ONS         ≪RL         0.042           PFSA (NV)           PFPRS         ≪RL         0.029         m:2 FTMAC (V)         PFPS           PFBS         1.226 ± 0.081         0.017         6:2 FTMAC         ≪RL         74.2           PFPS         ≪RL         0.022         8:2 FTMAC         ≪RL         38.0           PFHXS         ≪RL         0.042         10:2 FTMAC         ≪RL         40.0           PFHDS         ≪RL         0.021         N:2 FTOAc         ≪RL         40.0           PFDS         ≪RL         0.029         8:2 FTOAc         ≪RL         39.8           PFDS         ≪RL         0.029         8:2 FTOAc         ≪RL         39.8           PFDS         ≪RL         0.029         8:2 FTOAc         ≪RL         39.8           PFDS         ≪RL         0.041         10:2 FTOAc         ≪RL         39.8           PFDS         ≪RL         0.029         8:2 FTOAc         ≪RL         4.1.7           FBSA (NV)         0.154 ± 0.004         0.021         4:2 FTOH         ≪RL         41.7           MeFBSA (SV)         ≪RL         2.20         5:2	PFDoDA	$0.203 \pm 0.015$	0.097	HFPO-DA	<rl< td=""><td>0.219</td></rl<>	0.219
PFSA (NV)   PFPrS	PFTrDA	<rl< td=""><td>0.064</td><th>ADONA</th><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.064	ADONA	<rl< td=""><td>0.021</td></rl<>	0.021
PFSA (NV)           PFPrS         ≪RL         0.029         n:2 FTMAC (V)           PFBS         1.226 ± 0.081         0.017         6:2 FTMAC         ≪RL         74.2           PFPeS         ≪RL         0.022         8:2 FTMAC         ≪RL         38.0           PFHxS         ≪RL         0.042         10:2 FTMAC         ≪RL         40.0           PFHpS         ≪RL         0.021         n:2 FTOAc (V)         PFNS         ≪RL         39.8           PFDS         ≪RL         0.029         8:2 FTOAc         ≪RL         39.8           PFDS         ≪RL         0.041         10:2 FTOAc         ≪RL         8.00           FASA (NV, SV)	PFTeDA	<rl< td=""><td>0.126</td><th>9Cl-PF3ONS</th><td><rl< td=""><td>0.042</td></rl<></td></rl<>	0.126	9Cl-PF3ONS	<rl< td=""><td>0.042</td></rl<>	0.042
PFPrS         ≪RL         0.029         n:2 FTMAC (V)           PFBS         1.226 ± 0.081         0.017         6:2 FTMAC         ≪RL         74.2           PFPeS         ≪RL         0.022         8:2 FTMAC         ≪RL         38.0           PFHxS         ≪RL         0.042         10:2 FTMAC         ≪RL         40.0           PFHpS         ≪RL         0.021				11Cl-PF3OUdS	<rl< td=""><td>0.021</td></rl<>	0.021
PFBS         1.226 ± 0.081         0.017         6:2 FTMAC         ≪RL         74.2           PFPeS         ≪RL         0.022         8:2 FTMAC         ≪RL         38.0           PFHxS         ≪RL         0.042         10:2 FTMAC         ≪RL         40.0           PFHpS         ≪RL         0.021 <th>PFSA (NV)</th> <th></th> <th></th> <th></th> <th></th> <th></th>	PFSA (NV)					
PFPeS <rl< th="">         0.022         8:2 FTMAC         <rl< th="">         38.0           PFHxS         <rl< th="">         0.042         10:2 FTMAC         <rl< th="">         40.0           PFHpS         <rl< th="">         0.021  &lt;</rl<></rl<></rl<></rl<></rl<>	PFPrS	<rl< td=""><td>0.029</td><th>n:2 FTMAC (V)</th><td></td><td></td></rl<>	0.029	n:2 FTMAC (V)		
PFHxS <rl< th="">         0.042         10:2 FTMAC         <rl< th="">         40.0           PFHpS         <rl< th="">         0.021           40.0           PFOS         0.142 ± 0.013         0.048         n:2 FTOAc (V)             PFNS         <rl< th="">         0.029         8:2 FTOAc         <rl< th="">         39.8           PFDS         <rl< th="">         0.041         10:2 FTOAc         <rl< th="">         8.00           FASA (NV, SV)         n:2 FTOH (V)                   8.00           FASA (NV, SV)         n:2 FTOH (V)</rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFBS	$1.226 \pm 0.081$	0.017	6:2 FTMAC	<rl< td=""><td>74.2</td></rl<>	74.2
PFHpS <rl< th="">         0.021           PFOS         0.142 ± 0.013         0.048         n:2 FTOAc (V)           PFNS         <rl< th="">         0.029         8:2 FTOAc         <rl< th="">         39.8           PFDS         <rl< th="">         0.041         10:2 FTOAc         <rl< th="">         8.00           FASA (NV, SV)           BFBSA (NV)         0.154 ± 0.004         0.021         4:2 FTOH         <rl< th="">         41.7           MeFBSA (SV)         <rl< th="">         2.20         5:2 FTOH         <rl< th="">         79.8           FHxSA (NV)         0.040 ± 0.004         0.021         6:2 FTOH         <rl< th="">         40.1           FOSA (NV)         0.055 ± 0.002         0.029         7:2 FTOH         <rl< th="">         39.9           MeFOSA (SV)         <rl< th="">         0.440         8:2 FTOH         <rl< th="">         78.4           EtFOSA (SV)         <rl< th="">         0.539         10:2 FTOH         <rl< th="">         40.1           FASAA (NV)         n:2 FTS (NV)</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFPeS	<rl< td=""><td>0.022</td><th>8:2 FTMAC</th><td><rl< td=""><td>38.0</td></rl<></td></rl<>	0.022	8:2 FTMAC	<rl< td=""><td>38.0</td></rl<>	38.0
PFOS $0.142 \pm 0.013$ $0.048$ $n:2$ FTOAc (V)           PFNS $<$ RL $0.029$ $8:2$ FTOAc $<$ RL $39.8$ PFDS $<$ RL $0.041$ $10:2$ FTOAc $<$ RL $8.00$ FASA (NV, SV)           n:2 FTOH (V)           FBSA (NV) $0.154 \pm 0.004$ $0.021$ $4:2$ FTOH $<$ RL $41.7$ MeFBSA (SV) $<$ RL $2.20$ $5:2$ FTOH $<$ RL $79.8$ FHxSA (NV) $0.040 \pm 0.004$ $0.021$ $6:2$ FTOH $<$ RL $40.1$ FOSA (NV) $0.055 \pm 0.002$ $0.029$ $7:2$ FTOH $<$ RL $39.9$ MeFOSA (SV) $<$ RL $0.440$ $8:2$ FTOH $<$ RL $40.1$ FASAA (NV)           n:2 FTS (NV)           PRINCE (NV)           PRINCE (NV)           REFOSAA $<$ RL $0.052$ $<$ RL	PFHxS	<rl< td=""><td>0.042</td><th>10:2 FTMAC</th><td><rl< td=""><td>40.0</td></rl<></td></rl<>	0.042	10:2 FTMAC	<rl< td=""><td>40.0</td></rl<>	40.0
PFNS <rl< th="">         0.029         8:2 FTOAc         <rl< th="">         39.8           PFDS         <rl< th="">         0.041         10:2 FTOAc         <rl< th="">         39.8           FASA (NV, SV)         n:2 FTOH (V)         RL         8.00           FBSA (NV)         0.154 ± 0.004         0.021         4:2 FTOH         <rl< th="">         41.7           MeFBSA (SV)         <rl< th="">         2.20         5:2 FTOH         <rl< th="">         79.8           FHXSA (NV)         0.040 ± 0.004         0.021         6:2 FTOH         <rl< th="">         40.1           FOSA (NV)         0.055 ± 0.002         0.029         7:2 FTOH         <rl< th="">         39.9           MeFOSA (SV)         <rl< th="">         0.440         8:2 FTOH         <rl< th="">         78.4           EtFOSA (SV)         <rl< th="">         0.0539         10:2 FTOH         <rl< th="">         40.1           FOSAA         <rl< th="">         0.052         4:2 FTS         <rl< th="">         0.089           MeFOSAA         <rl< th="">         0.040         6:2 FTS         <rl< th="">         0.137           EtFOSAA         <rl< th="">         0.105         8:2 FTS         <rl< th="">         0.184</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFHpS	<rl< td=""><td>0.021</td><th></th><td></td><td></td></rl<>	0.021			
PFDS <rl< th="">         0.041         10:2 FTOAc         <rl< th="">         8.00           FASA (NV, SV)         n:2 FTOH (V)           FBSA (NV)         0.154 ± 0.004         0.021         4:2 FTOH         <rl< th="">         41.7           MeFBSA (SV)         <rl< th="">         2.20         5:2 FTOH         <rl< th="">         79.8           FHxSA (NV)         0.040 ± 0.004         0.021         6:2 FTOH         <rl< th="">         40.1           FOSA (NV)         0.055 ± 0.002         0.029         7:2 FTOH         <rl< th="">         39.9           MeFOSA (SV)         <rl< th="">         0.440         8:2 FTOH         <rl< th="">         78.4           EtFOSA (SV)         <rl< th="">         0.539         10:2 FTOH         <rl< th="">         40.1           FOSAA         <rl< th="">         0.052         4:2 FTS         <rl< th="">         0.089           MeFOSAA         <rl< th="">         0.040         6:2 FTS         <rl< th="">         0.137           EtFOSAA         <rl< th="">         0.105         8:2 FTS         <rl< th="">         0.184</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>	PFOS	$0.142 \pm 0.013$	0.048	n:2 FTOAc (V)		
FASA (NV, SV)           FBSA (NV) $0.154 \pm 0.004$ $0.021$ $4:2$ FTOH $<$ RL $41.7$ MeFBSA (SV) $<$ RL $2.20$ $5:2$ FTOH $<$ RL $79.8$ FHxSA (NV) $0.040 \pm 0.004$ $0.021$ $6:2$ FTOH $<$ RL $40.1$ FOSA (NV) $0.055 \pm 0.002$ $0.029$ $7:2$ FTOH $<$ RL $39.9$ MeFOSA (SV) $<$ RL $0.440$ $8:2$ FTOH $<$ RL $78.4$ EtFOSA (SV) $<$ RL $0.539$ $10:2$ FTOH $<$ RL $40.1$ FOSAA $<$ RL $0.052$ $4:2$ FTS $<$ RL $0.089$ MeFOSAA $<$ RL $0.040$ $6:2$ FTS $<$ RL $0.137$ EtFOSAA $<$ RL $0.105$ $8:2$ FTS $<$ RL $0.184$	PFNS	<rl< td=""><td>0.029</td><th>8:2 FTOAc</th><td><rl< td=""><td>39.8</td></rl<></td></rl<>	0.029	8:2 FTOAc	<rl< td=""><td>39.8</td></rl<>	39.8
FBSA (NV) $0.154 \pm 0.004$ $0.021$ 4:2 FTOH $<$ RL $41.7$ MeFBSA (SV) $<$ RL $2.20$ 5:2 FTOH $<$ RL $79.8$ FHxSA (NV) $0.040 \pm 0.004$ $0.021$ $6:2$ FTOH $<$ RL $40.1$ FOSA (NV) $0.055 \pm 0.002$ $0.029$ $7:2$ FTOH $<$ RL $39.9$ MeFOSA (SV) $<$ RL $0.440$ $8:2$ FTOH $<$ RL $78.4$ EtFOSA (SV) $<$ RL $0.539$ $10:2$ FTOH $<$ RL $40.1$ FASAA (NV)           FOSAA $<$ RL $0.052$ $4:2$ FTS $<$ RL $0.089$ MeFOSAA $<$ RL $0.040$ $6:2$ FTS $<$ RL $0.137$ EtFOSAA $<$ RL $0.105$ $8:2$ FTS $<$ RL $0.184$	PFDS	<rl< td=""><td>0.041</td><th>10:2 FTOAc</th><td><rl< td=""><td>8.00</td></rl<></td></rl<>	0.041	10:2 FTOAc	<rl< td=""><td>8.00</td></rl<>	8.00
FBSA (NV) $0.154 \pm 0.004$ $0.021$ 4:2 FTOH $<$ RL $41.7$ MeFBSA (SV) $<$ RL $2.20$ 5:2 FTOH $<$ RL $79.8$ FHxSA (NV) $0.040 \pm 0.004$ $0.021$ $6:2$ FTOH $<$ RL $40.1$ FOSA (NV) $0.055 \pm 0.002$ $0.029$ $7:2$ FTOH $<$ RL $39.9$ MeFOSA (SV) $<$ RL $0.440$ $8:2$ FTOH $<$ RL $78.4$ EtFOSA (SV) $<$ RL $0.539$ $10:2$ FTOH $<$ RL $40.1$ FASAA (NV)           FOSAA $<$ RL $0.052$ $4:2$ FTS $<$ RL $0.089$ MeFOSAA $<$ RL $0.040$ $6:2$ FTS $<$ RL $0.137$ EtFOSAA $<$ RL $0.105$ $8:2$ FTS $<$ RL $0.184$	FASA (NV. SV)			n:2 FTOH (V)		
MeFBSA (SV) $\langle RL$ 2.20         5:2 FTOH $\langle RL$ 79.8           FHxSA (NV) $0.040 \pm 0.004$ $0.021$ 6:2 FTOH $\langle RL$ 40.1           FOSA (NV) $0.055 \pm 0.002$ $0.029$ 7:2 FTOH $\langle RL$ 39.9           MeFOSA (SV) $\langle RL$ $0.440$ 8:2 FTOH $\langle RL$ 78.4           EtFOSA (SV) $\langle RL$ $0.539$ 10:2 FTOH $\langle RL$ 40.1           FOSAA $\langle RL$ $0.052$ 4:2 FTS $\langle RL$ 0.089           MeFOSAA $\langle RL$ $0.040$ 6:2 FTS $\langle RL$ 0.137           EtFOSAA $\langle RL$ $0.105$ 8:2 FTS $\langle RL$ 0.184		$0.154 \pm 0.004$	0.021	1.	<rl< td=""><td>41.7</td></rl<>	41.7
FHxSA (NV) $0.040 \pm 0.004$ $0.021$ 6:2 FTOH $<$ RL $40.1$ FOSA (NV) $0.055 \pm 0.002$ $0.029$ 7:2 FTOH $<$ RL $39.9$ MeFOSA (SV) $<$ RL $0.440$ 8:2 FTOH $<$ RL $78.4$ EtFOSA (SV) $<$ RL $0.539$ $10:2$ FTOH $<$ RL $40.1$ FASAA (NV)         n:2 FTS (NV)           FOSAA $<$ RL $0.052$ $4:2$ FTS $<$ RL $0.089$ MeFOSAA $<$ RL $0.040$ $6:2$ FTS $<$ RL $0.137$ EtFOSAA $<$ RL $0.105$ $8:2$ FTS $<$ RL $0.184$		<rl< td=""><td>2.20</td><th></th><td><rl< td=""><td>-</td></rl<></td></rl<>	2.20		<rl< td=""><td>-</td></rl<>	-
FOSA (NV)         0.055 ± 0.002         0.029         7:2 FTOH <rl< th="">         39.9           MeFOSA (SV)         <rl< th="">         0.440         8:2 FTOH         <rl< th="">         78.4           EtFOSA (SV)         <rl< th="">         0.539         10:2 FTOH         <rl< th="">         40.1           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.052         4:2 FTS         <rl< th="">         0.089           MeFOSAA         <rl< th="">         0.040         6:2 FTS         <rl< th="">         0.137           EtFOSAA         <rl< th="">         0.105         8:2 FTS         <rl< th="">         0.184</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		$0.040 \pm 0.004$	0.021	-	<rl< td=""><td></td></rl<>	
MeFOSA (SV) <rl< th="">         0.440         8:2 FTOH         <rl< th="">         78.4           EtFOSA (SV)         <rl< td="">         0.539         10:2 FTOH         <rl< td="">         40.1           FASAA (NV)         FOSAA         <rl< td="">         0.052         4:2 FTS         <rl< td="">         0.089           MeFOSAA         <rl< td="">         0.040         6:2 FTS         <rl< td="">         0.137           EtFOSAA         <rl< td="">         0.105         8:2 FTS         <rl< td="">         0.184</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		$0.055 \pm 0.002$	0.029		<rl< td=""><td></td></rl<>	
EtFOSA (SV) <rl< th="">         0.539         10:2 FTOH         <rl< th="">         40.1           FASAA (NV)         n:2 FTS (NV)           FOSAA         <rl< th="">         0.052         4:2 FTS         <rl< th="">         0.089           MeFOSAA         <rl< th="">         0.040         6:2 FTS         <rl< th="">         0.137           EtFOSAA         <rl< th="">         0.105         8:2 FTS         <rl< th="">         0.184</rl<></rl<></rl<></rl<></rl<></rl<></rl<></rl<>		<rl< th=""><th>0.440</th><th></th><th><rl< th=""><th></th></rl<></th></rl<>	0.440		<rl< th=""><th></th></rl<>	
FOSAA <rl< th="">         0.052         4:2 FTS         <rl< th="">         0.089           MeFOSAA         <rl< th="">         0.040         6:2 FTS         <rl< th="">         0.137           EtFOSAA         <rl< th="">         0.105         8:2 FTS         <rl< th="">         0.184</rl<></rl<></rl<></rl<></rl<></rl<>		<rl< td=""><td>0.539</td><th>10:2 FTOH</th><td><rl< td=""><td></td></rl<></td></rl<>	0.539	10:2 FTOH	<rl< td=""><td></td></rl<>	
FOSAA <rl< th="">         0.052         4:2 FTS         <rl< th="">         0.089           MeFOSAA         <rl< th="">         0.040         6:2 FTS         <rl< th="">         0.137           EtFOSAA         <rl< th="">         0.105         8:2 FTS         <rl< th="">         0.184</rl<></rl<></rl<></rl<></rl<></rl<>	FASAA (NV)			n:2 FTS (NV)		
MeFOSAA <rl< th="">         0.040         6:2 FTS         <rl< th="">         0.137           EtFOSAA         <rl< th="">         0.105         8:2 FTS         <rl< th="">         0.184</rl<></rl<></rl<></rl<>		<rl< td=""><td>0.052</td><th></th><td><rl< td=""><td>0.089</td></rl<></td></rl<>	0.052		<rl< td=""><td>0.089</td></rl<>	0.089
EtFOSAA <rl< th="">         0.105         8:2 FTS         <rl< th="">         0.184</rl<></rl<>		<rl< td=""><td>0.040</td><th></th><td><rl< td=""><td></td></rl<></td></rl<>	0.040		<rl< td=""><td></td></rl<>	
					<rl< th=""><th></th></rl<>	

**Table 20.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-D. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	<rl< td=""><td>0.190</td><td>MeFOSE</td><td><rl< td=""><td>1.00</td></rl<></td></rl<>	0.190	MeFOSE	<rl< td=""><td>1.00</td></rl<>	1.00
PFPeA	<rl< td=""><td>0.059</td><td>EtFOSE</td><td><rl< td=""><td>0.987</td></rl<></td></rl<>	0.059	EtFOSE	<rl< td=""><td>0.987</td></rl<>	0.987
PFHxA	<rl< td=""><td>0.335</td><td></td><td></td><td></td></rl<>	0.335			
PFHpA	<rl< td=""><td>0.062</td><td>PPEA (NV)</td><td></td><td></td></rl<>	0.062	PPEA (NV)		
PFOA	<rl< td=""><td>0.320</td><td>PFEESA</td><td><rl< td=""><td>0.022</td></rl<></td></rl<>	0.320	PFEESA	<rl< td=""><td>0.022</td></rl<>	0.022
PFNA	<rl< td=""><td>0.084</td><td>PF4OPeA</td><td><rl< td=""><td>0.026</td></rl<></td></rl<>	0.084	PF4OPeA	<rl< td=""><td>0.026</td></rl<>	0.026
PFDA	<rl< td=""><td>0.180</td><td>PF5OHxA</td><td><rl< td=""><td>0.037</td></rl<></td></rl<>	0.180	PF5OHxA	<rl< td=""><td>0.037</td></rl<>	0.037
PFUnDA	<rl< td=""><td>0.119</td><td>3-6-OPFHpA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.119	3-6-OPFHpA	<rl< td=""><td>0.021</td></rl<>	0.021
PFDoDA	<rl< td=""><td>0.097</td><td>HFPO-DA</td><td><rl< td=""><td>0.220</td></rl<></td></rl<>	0.097	HFPO-DA	<rl< td=""><td>0.220</td></rl<>	0.220
PFTrDA	<rl< td=""><td>0.064</td><td>ADONA</td><td><rl< td=""><td>0.021</td></rl<></td></rl<>	0.064	ADONA	<rl< td=""><td>0.021</td></rl<>	0.021
PFTeDA	<rl< td=""><td>0.126</td><td>9Cl-PF3ONS</td><td><rl< td=""><td>0.042</td></rl<></td></rl<>	0.126	9Cl-PF3ONS	<rl< td=""><td>0.042</td></rl<>	0.042
			11Cl-PF3OUdS	<rl< td=""><td>0.021</td></rl<>	0.021
PFSA (NV)					
PFPrS	<rl< td=""><td>0.029</td><td>n:2 FTMAC (V)</td><td></td><td></td></rl<>	0.029	n:2 FTMAC (V)		
PFBS	$0.298 \pm 0.022$	0.017	6:2 FTMAC	<rl< td=""><td>70.7</td></rl<>	70.7
PFPeS	<rl< td=""><td>0.022</td><td>8:2 FTMAC</td><td><rl< td=""><td>72.3</td></rl<></td></rl<>	0.022	8:2 FTMAC	<rl< td=""><td>72.3</td></rl<>	72.3
PFHxS	<rl< td=""><td>0.042</td><td>10:2 FTMAC</td><td><rl< td=""><td>38.1</td></rl<></td></rl<>	0.042	10:2 FTMAC	<rl< td=""><td>38.1</td></rl<>	38.1
PFHpS	<rl< td=""><td>0.021</td><td></td><td></td><td></td></rl<>	0.021			
PFOS	<rl< td=""><td>0.048</td><td>n:2 FTOAc (V)</td><td></td><td></td></rl<>	0.048	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.029</td><td>8:2 FTOAc</td><td><rl< td=""><td>16.2</td></rl<></td></rl<>	0.029	8:2 FTOAc	<rl< td=""><td>16.2</td></rl<>	16.2
PFDS	<rl< td=""><td>0.041</td><td>10:2 FTOAc</td><td>No value<sup>a</sup></td><td>-</td></rl<>	0.041	10:2 FTOAc	No value <sup>a</sup>	-
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	$0.0607 \pm 0.0003$	0.021	4:2 FTOH	<rl< td=""><td>81.0</td></rl<>	81.0
MeFBSA (SV)	<rl< td=""><td>1.00</td><td>5:2 FTOH</td><td><rl< td=""><td>158</td></rl<></td></rl<>	1.00	5:2 FTOH	<rl< td=""><td>158</td></rl<>	158
FHxSA (NV)	<rl< td=""><td>0.021</td><td>6:2 FTOH</td><td><rl< td=""><td>82.9</td></rl<></td></rl<>	0.021	6:2 FTOH	<rl< td=""><td>82.9</td></rl<>	82.9
FOSA (NV)	<rl< td=""><td>0.029</td><td>7:2 FTOH</td><td><rl< td=""><td>89.8</td></rl<></td></rl<>	0.029	7:2 FTOH	<rl< td=""><td>89.8</td></rl<>	89.8
MeFOSA (SV)	<rl< td=""><td>0.419</td><td>8:2 FTOH</td><td><rl< td=""><td>84.6</td></rl<></td></rl<>	0.419	8:2 FTOH	<rl< td=""><td>84.6</td></rl<>	84.6
EtFOSA (SV)	<rl< td=""><td>0.420</td><td>10:2 FTOH</td><td><rl< td=""><td>82.3</td></rl<></td></rl<>	0.420	10:2 FTOH	<rl< td=""><td>82.3</td></rl<>	82.3
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.052</td><td>4:2 FTS</td><td><rl< td=""><td>0.090</td></rl<></td></rl<>	0.052	4:2 FTS	<rl< td=""><td>0.090</td></rl<>	0.090
MeFOSAA	<rl< td=""><td>0.040</td><td>6:2 FTS</td><td><rl< td=""><td>0.137</td></rl<></td></rl<>	0.040	6:2 FTS	<rl< td=""><td>0.137</td></rl<>	0.137
EtFOSAA	<rl< td=""><td>0.105</td><td>8:2 FTS</td><td><rl< td=""><td>0.184</td></rl<></td></rl<>	0.105	8:2 FTS	<rl< td=""><td>0.184</td></rl<>	0.184
			10:2 FTS	<rl< td=""><td>0.208</td></rl<>	0.208

<sup>&</sup>lt;sup>a</sup> QC standards not met. Data not reported.

**Table 21.** PFAS concentrations and reporting limits (RL; μg PFAS/kg textile) in thermal liner textile TL-E. Analytical method indicated with NV 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)			FASE (SV)		
PFBA	<rl< td=""><td>0.800</td><th>MeFOSE</th><td><rl< td=""><td>0.826</td></rl<></td></rl<>	0.800	MeFOSE	<rl< td=""><td>0.826</td></rl<>	0.826
PFPeA	<rl< td=""><td>0.025</td><th>EtFOSE</th><td><rl< td=""><td>0.814</td></rl<></td></rl<>	0.025	EtFOSE	<rl< td=""><td>0.814</td></rl<>	0.814
PFHxA	<rl< td=""><td>0.128</td><th></th><td></td><td></td></rl<>	0.128			
PFHpA	<rl< td=""><td>0.088</td><th>PPEA (NV)</th><td></td><td></td></rl<>	0.088	PPEA (NV)		
PFOA	<rl< td=""><td>0.135</td><th>PFEESA</th><td><rl< td=""><td>0.020</td></rl<></td></rl<>	0.135	PFEESA	<rl< td=""><td>0.020</td></rl<>	0.020
PFNA	<rl< td=""><td>0.026</td><th>PF4OPeA</th><td><rl< td=""><td>0.023</td></rl<></td></rl<>	0.026	PF4OPeA	<rl< td=""><td>0.023</td></rl<>	0.023
PFDA	<rl< td=""><td>0.076</td><th>PF5OHxA</th><td><rl< td=""><td>0.023</td></rl<></td></rl<>	0.076	PF5OHxA	<rl< td=""><td>0.023</td></rl<>	0.023
PFUnDA	<rl< td=""><td>0.039</td><th>3-6-ОРГНрА</th><td><rl< td=""><td>0.023</td></rl<></td></rl<>	0.039	3-6-ОРГНрА	<rl< td=""><td>0.023</td></rl<>	0.023
PFDoDA	<rl< td=""><td>0.025</td><th>HFPO-DA</th><td><rl< td=""><td>0.040</td></rl<></td></rl<>	0.025	HFPO-DA	<rl< td=""><td>0.040</td></rl<>	0.040
PFTrDA	<rl< td=""><td>0.073</td><th>ADONA</th><td><rl< td=""><td>0.023</td></rl<></td></rl<>	0.073	ADONA	<rl< td=""><td>0.023</td></rl<>	0.023
PFTeDA	<rl< td=""><td>0.047</td><th>9Cl-PF3ONS</th><td><rl< td=""><td>0.024</td></rl<></td></rl<>	0.047	9Cl-PF3ONS	<rl< td=""><td>0.024</td></rl<>	0.024
			11Cl-PF3OUdS	<rl< td=""><td>0.024</td></rl<>	0.024
PFSA (NV)					
PFPrS	$0.190 \pm 0.014$	0.026	n:2 FTMAC (V)		
PFBS	<rl< td=""><td>0.022</td><th>6:2 FTMAC</th><td><rl< td=""><td>65.1</td></rl<></td></rl<>	0.022	6:2 FTMAC	<rl< td=""><td>65.1</td></rl<>	65.1
PFPeS	<rl< td=""><td>0.024</td><th>8:2 FTMAC</th><td><rl< td=""><td>66.7</td></rl<></td></rl<>	0.024	8:2 FTMAC	<rl< td=""><td>66.7</td></rl<>	66.7
PFHxS	<rl< td=""><td>0.057</td><th>10:2 FTMAC</th><td><rl< td=""><td>35.1</td></rl<></td></rl<>	0.057	10:2 FTMAC	<rl< td=""><td>35.1</td></rl<>	35.1
PFHpS	<rl< td=""><td>0.024</td><th></th><td></td><td></td></rl<>	0.024			
PFOS	<rl< td=""><td>0.048</td><th>n:2 FTOAc (V)</th><td></td><td></td></rl<>	0.048	n:2 FTOAc (V)		
PFNS	<rl< td=""><td>0.024</td><th>8:2 FTOAc</th><td><rl< td=""><td>14.9</td></rl<></td></rl<>	0.024	8:2 FTOAc	<rl< td=""><td>14.9</td></rl<>	14.9
PFDS	<rl< td=""><td>0.058</td><th>10:2 FTOAc</th><td>No value<sup>a</sup></td><td></td></rl<>	0.058	10:2 FTOAc	No value <sup>a</sup>	
FASA (NV, SV)			n:2 FTOH (V)		
FBSA (NV)	No value <sup>a</sup>		4:2 FTOH	<rl< td=""><td>74.6</td></rl<>	74.6
MeFBSA (SV)	<rl< td=""><td>0.825</td><th>5:2 FTOH</th><td><rl< td=""><td>145</td></rl<></td></rl<>	0.825	5:2 FTOH	<rl< td=""><td>145</td></rl<>	145
FHxSA (NV)	No value <sup>a</sup>		6:2 FTOH	<rl< td=""><td>76.4</td></rl<>	76.4
FOSA (NV)	<rl< td=""><td>0.041</td><th>7:2 FTOH</th><td><rl< td=""><td>82.7</td></rl<></td></rl<>	0.041	7:2 FTOH	<rl< td=""><td>82.7</td></rl<>	82.7
MeFOSA (SV)	<rl< th=""><th>0.345</th><th>8:2 FTOH</th><th><rl< th=""><th>77.9</th></rl<></th></rl<>	0.345	8:2 FTOH	<rl< th=""><th>77.9</th></rl<>	77.9
EtFOSA (SV)	<rl< td=""><td>0.346</td><th>10:2 FTOH</th><td><rl< td=""><td>75.9</td></rl<></td></rl<>	0.346	10:2 FTOH	<rl< td=""><td>75.9</td></rl<>	75.9
FASAA (NV)			n:2 FTS (NV)		
FOSAA	<rl< td=""><td>0.050</td><th>4:2 FTS</th><td><rl< td=""><td>0.068</td></rl<></td></rl<>	0.050	4:2 FTS	<rl< td=""><td>0.068</td></rl<>	0.068
MeFOSAA	<rl< td=""><td>0.025</td><th>6:2 FTS</th><td><rl< td=""><td>0.195</td></rl<></td></rl<>	0.025	6:2 FTS	<rl< td=""><td>0.195</td></rl<>	0.195
EtFOSAA	<rl< td=""><td>0.051</td><th>8:2 FTS</th><td><rl< td=""><td>0.116</td></rl<></td></rl<>	0.051	8:2 FTS	<rl< td=""><td>0.116</td></rl<>	0.116
			10:2 FTS	<rl< td=""><td>0.114</td></rl<>	0.114

<sup>&</sup>lt;sup>a</sup> QC standards not met. Data not reported.

#### 7. References

- [1] Peaslee GF, Wilkinson JT, McGuinness SR, Tighe M, Caterisano N, Lee S, Gonzales A, Roddy M, Mills S, Mitchell K (2020) Another pathway for firefighter exposure to per- and polyfluoroalkyl substances: Firefighter textiles. *Environmental Science & Technology Letters* 7(8):594-599. https://doi.org/10.1021/acs.estlett.0c00410
- [2] Muensterman DJ, Titaley IA, Peaslee GF, Minc LD, Cahuas L, Rodowa AE, Horiuchi Y, Yamane S, Fouquet TNJ, Kissel JC, Carignan CC, Field JA (2022) Disposition of fluorine on new firefighter turnout gear. *Environmental Science & Technology* 56(2):974-983. https://doi.org/10.1021/acs.est.1c06322
- [3] Rewerts JN, Morre JT, Massey Simonich SL, Field JA (2018) In-vial extraction large volume gas chromatography mass spectrometry for analysis of volatile PFASs on papers and textiles. *Environmental Science & Technology* 52(18):10609-10616. <a href="https://doi.org/10.1021/acs.est.8b04304">https://doi.org/10.1021/acs.est.8b04304</a>
- [4] Buck RC, Franklin J, Berger U, Conder JM, Cousins IT, de Voogt P, Jensen AA, Kannan K, Mabury SA, van Leeuwen SP (2011) Perfluoroalkyl and polyfluoroalkyl substances in the environment: Terminology, classification, and origins. *Integrated Environmental Assessment and Management* 7(4):513-541. https://doi.org/10.1002/jeam.258
- [5] Charbonnet JA, Rodowa AE, Joseph NT, Guelfo JL, Field JA, Jones GD, Higgins CP, Helbling DE, Houtz EF (2021) Environmental source tracking of per- and polyfluoroalkyl substances within a forensic context: Current and future techniques. *Environmental Science & Technology* 55(11):7237-7245. https://doi.org/10.1021/acs.est.0c08506
- [6] National Fire Protection Association (2017) 1971 Standard on Protective Ensembles for Structural Fire Fighting and Prosimity Fire Fighting, 2018 Edition (National Fire Protection Association).
- [7] National Fire Protection Association (2020) 1851 Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting And Proximity Fire Fighting (National Fire Protection Association).
- [8] Young AS, Sparer-Fine EH, Pickard HM, Sunderland EM, Peaslee GF, Allen JG (2021) Per- and polyfluoroalkyl substances (PFAS) and total fluorine in fire station dust. *Journal of Exposure Science & Environmental Epidemiology* 31(5):930-942. <a href="https://doi.org/10.1038/s41370-021-00288-7">https://doi.org/10.1038/s41370-021-00288-7</a>
- [9] van der Veen I, Hanning AC, Stare A, Leonards PEG, de Boer J, Weiss JM (2020) The effect of weathering on per- and polyfluoroalkyl substances (PFASs) from durable water repellent (DWR) clothing. *Chemosphere* 249:126100. https://doi.org/10.1016/j.chemosphere.2020.126100
- [10] Wang Z, Cousins IT, Scheringer M, Hungerbuhler K (2013) Fluorinated alternatives to long-chain perfluoroalkyl carboxylic acids (PFCAs), perfluoroalkane sulfonic acids (PFSAs) and their potential precursors. *Environment International* 60:242-248. <a href="https://doi.org/10.1016/j.envint.2013.08.021">https://doi.org/10.1016/j.envint.2013.08.021</a>
- [11] Meng L, Song B, Lu Y, Lv K, Gao W, Wang Y, Jiang G (2021) The occurrence of per- and polyfluoroalkyl substances (PFASs) in fluoropolymer raw materials and products made in China. *Journal of Environmental Sciences* 107:77-86. <a href="https://doi.org/10.1016/j.jes.2021.01.027">https://doi.org/10.1016/j.jes.2021.01.027</a>
- [12] Trowbridge J, Gerona RR, Lin T, Rudel RA, Bessonneau V, Buren H, Morello-Frosch R (2020) Exposure to perfluoroalkyl substances in a cohort of women firefighters and office workers in San Francisco. *Environmental Science & Technology* 54(6):3363-3374. https://doi.org/10.1021/acs.est.9b05490
- [13] Graber JM, Black TM, Shah NN, Caban-Martinez AJ, Lu SE, Brancard T, Yu CH, Turyk ME, Black K, Steinberg MB, Fan Z, Burgess JL (2021) Prevalence and predictors of per- and polyfluoroalkyl substances (PFAS) serum levels among members of a suburban US volunteer fire

- department. *International Journal of Environmental Research and Public Health* 18(7):3730. https://doi.org/10.3390/ijerph18073730
- [14] Laitinen JA, Koponen J, Koikkalainen J, Kiviranta H (2014) Firefighters' exposure to perfluoroalkyl acids and 2-butoxyethanol present in firefighting foams. *Toxicology Letters* 231(2):227-232. https://doi.org/10.1016/j.toxlet.2014.09.007
- [15] Mesfin Tefera Y, Gaskin S, Mitchell K, Springer D, Mills S, Pisaniello D (2022) Food grown on fire stations as a potential pathway for firefighters' exposure to per- and poly-fluoroalkyl substances (PFAS). *Environment International* 168:107455. https://doi.org/10.1016/j.envint.2022.107455
- [16] Chang ET, Adami HO, Boffetta P, Cole P, Starr TB, Mandel JS (2014) A critical review of perfluorooctanoate and perfluorooctanesulfonate exposure and cancer risk in humans. *Critical Reviews in Toxicology* 44(S1):1-81. <a href="https://doi.org/10.3109/10408444.2014.905767">https://doi.org/10.3109/10408444.2014.905767</a>
- [17] Eriksen KT, Sorensen M, McLaughlin JK, Lipworth L, Tjonneland A, Overvad K, Raaschou-Nielsen O (2009) Perfluorooctanoate and perfluorooctanesulfonate plasma levels and risk of cancer in the general Danish population. *Journal of the National Cancer Institute* 101(8):605-609. <a href="https://doi.org/10.1093/jnci/djp041">https://doi.org/10.1093/jnci/djp041</a>
- [18] International Agency for Research on Cancer (2017) Some chemicals used as solvents and in polymer manufacture. (World Health Organization, Lyon, France), Vol. 110.
- [19] U.S. Environmental Protection Agency (2023) PUBLIC COMMENT DRAFT Toxicity Assessment and Proposed Maximum Contaminant Level Goal for Perfluorooctane Sulfonic Acid (PFOS) in Drinking Water, U.S. Environmental Protection Agency (Office of Water (4304T), Office of Science and Technology, Health and Ecological Criteria Division).
- [20] U.S. Environmental Protection Agency (2023) PUBLIC COMMENT DRAFT Toxicity Assessment and Proposed Maximum Contaminant Level Goal for Perfluorooctanoic Acid (PFOA) in Drinking Water, U.S. Environmental Protection Agency, (Office of Water (4304T), Office of Science and Technology, Health and Ecological Criteria Division).
- [21] U.S. Environmental Protection Agency (2023) PUBLIC REVIEW DRAFT Maximum

  Contaminant Level Goal (MCLG) Summary Document for a Mixture of Four Per- and

  Polyfluoroalkyl Substances (PFAS): HFPO-DA and its Ammonium Salt (also known as GenX

  Chemicals), PFBS, PFNA, and PFHxS, U.S. Environmental Protection Agency (Office of Water

  (4304T) Office of Science and Technology, Health and Ecological Criteria Division).
- [22] U.S. Environmental Protection Agency (2005) *Guidelines for Carcinogen Risk Assessment*, U.S. Environmental Protection Agency (Risk Assessment Forum).
- [23] U.S. Environmental Protection Agency (2016) *Health Effects Support Document for Perfluorooctane Sulfonate (PFOS)*, U.S. Environmental Protection Agency (Office of Water, Health and Ecological Criteria Division).
- [24] U.S. Environmental Protection Agency (2021) Human Health Toxicity Values for Hexafluoropropylene Oxide (HFPO) Dimer Acid and Its Ammonium Salt (CASRN 13252-13-6 and CASRN 62037-80-3), U.S. Environmental Protection Agency (Office of Water, Health and Ecological Criteria Division).
- [25] US Environmental Protection Agency (2022) *INTERIM Drinking Water Health Advisory: Perfluorooctane Sulfonic Acid (PFOS) CASRN 1763-23-1*, U.S. Environmental Protection Agency (Health and Ecological Criteria Division, Office of Science and Technology, Office of Water).
- [26] U.S. Environmental Protection Agency (2022) *INTERIM Drinking Water Health Advisory: Perfluorooctanoic Acid (PFOA) CASRN 335-67-1*, U.S. Environmental Protection Agency (Health and Ecological Criteria Division, Office of Science and Technology, Office of Water).
- [27] U.S. Environmental Protection Agency (2022) *Drinking Water Health Advisory:*Hexafluoropropylene Oxide (HFPO) Dimer Acid (CASRN 13252-13-6) and HFPO Dimer Acid Ammonium Salt (CASRN 62037-80-3), Also Known as "GenX Chemicals", U.S. Environmental

- Protection Agency (Health and Ecological Criteria Division, Office of Science and Technology, Office of Water).
- [28] U.S. Environmental Protection Agency (2022) *Drinking Water Health Advisory:*Perfluorobutance Sulfonic Acid (CASRN 375-73-5) and Related Compound Potassium

  Perfluorobutane Sulfonate (CASRN 29420-49-3) (U.S. Environmental Protection Agency), U.S.

  Environmental Protection Agency (Health and Ecological Criteria Division, Office of Science and Technology, Office of Water).
- [29] U.S. Department of Health and Human Services (2021) *Toxicological Profile for Perfluoroalkyls*, U.S. Department of Health and Human Services (Agency for Toxic Substances and Disease Registry).
- [30] William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Public Law 166-283, § 338 (2021)
- [31] Robel AE, Marshall K, Dickinson M, Lunderberg D, Butt C, Peaslee G, Stapleton HM, Field JA (2017) Closing the mass balance on fluorine on papers and textiles. *Environmental Science & Technology* 51(16):9022-9032. https://doi.org/10.1021/acs.est.7b02080
- [32] Renner R (2006) The long and the short of perfluorinated replacements. *Environmental Science & Technology* 40(1):12-13. https://doi.org/10.1021/es062612a
- [33] Washington JW, Jenkins TM (2015) Abiotic hydrolysis of fluorotelomer-based polymers as a source of perfluorocarboxylates at the global scale. *Environmental Science & Technology* 49(24):14129-14135. https://doi.org/10.1021/acs.est.5b03686
- [34] van der Veen I, Schellenberger S, Hanning AC, Stare A, de Boer J, Weiss JM, Leonards PEG (2022) Fate of per- and polyfluoroalkyl substances from durable water-repellent clothing during use. *Environmental Science & Technology* 56(9):5886-5897. <a href="https://doi.org/10.1021/acs.est.1c07876">https://doi.org/10.1021/acs.est.1c07876</a>

# Appendix A. Experimental Details

# A.1. Firefighter Turnout Gear

The area densities and images of cuttings for all examined firefighter turnout gear textile are shown in Table 22.

**Table 22.** Area densities (mean ± standard deviation of triplicate measurements; kg/m²) and images of firefighter turnout gear textiles evaluated in this technical note.

Textile	Area Density (kg/m²)	Image
MB-A	$0.1672 \pm 0.0026$	
MB-B	$0.1533 \pm 0.0015$	
МВ-С	$0.2540 \pm 0.0011$	
MB-D	$0.2049 \pm 0.0037$	
МВ-Е	$0.1675 \pm 0.0012$	
MB-F	$0.2128 \pm 0.0031$	
OS-A	$0.2244 \pm 0.0070$	

Table 22. (Continued)

Textile	Area Density (kg/m²)	Image
OS-ASC	$0.2093 \pm 0.0027$	
OS-B	$0.2635 \pm 0.0055$	
OS-C	$0.2333 \pm 0.0093$	
OS-D	$0.2619 \pm 0.0085$	
OS-E	$0.2461 \pm 0.0114$	
OS-F	$0.2574 \pm 0.0016$	
OS-FSC	$0.2178 \pm 0.0073$	

Table 22. (Continued)

Textile	Area Density (kg/m²)	Image
OS-G	$0.2779 \pm 0.0046$	
TL-A	$0.3428 \pm 0.0087$	
TL-B	$0.3813 \pm 0.0147$	
TL-C	$0.37.7 \pm 0.0019$	
TL-D	$0.3533 \pm 0.0043$	
TL-E	$0.3412 \pm 0.0106$	

#### A.2. PFAS Standards

Analytical standards (Table 23) and isotopically labeled standards (Table 24) for nonvolatile PFAS as well as semivolatile PFAS (Tables 25 and 26) were obtained from Wellington Laboratories (Guelph, Ontario, Canada). Analytical standards and isotopically labeled standards for volatile PFAS (Tables 27 and 28) 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 (Tables 29 and 30).

**Table 23.** 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 (2991-50-6, N-EtFOSAA), Potassium perfluorobutanesulfonate (2991-50-6, N-EtFOSAA), Potassium perfluorobutanesulfonate (630402-22-1; PFPeS), Potassium perfluorohexanesulfonate (3871-99-6; PFHxS), Sodium perfluorooctanesulfonate (2795-39-3; PFOS), Sodium perfluorononanesulfonate (2795-39-3; PFOS), Sodium perfluorooctanesulfonate (2795-39-3; PFOS), Sodium 1H,1H,2H,2H,-perfluoro-1-octanesulfonate (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 (27619-94-9; 6:2 FTS), Sodium 1H,2H,2H,-perfluoro-1-octanesulfonate (27619-94-9; 6:2 FTS), Sodium 1H,1H,2H,2H,-perfluoro-1-octanesulfonate (27619-94-9; 6:2 FTS), Sodium 1H,1H,2H,2H,-perfluoro-1-octanesulfonate (27619-94-9; 6:2 FTS), Sodium 1H,2H,2H,-perfluoro-1-octanesulfonate (27619-94-9; 6:2 FTS), Sodium 1H,1H,2H,2H,-perfluoro-1-octanesulfonate (27619-94-9; 6:2 FTS), Sodium 1H,1H,2H,2H,-perfluoro-1-octanesulfonate (27619-94-9; 6:2 FTS), Sodium 1-chloroeicosafluoro-3-oxaundecanel-1-sulfonate (83329-89-9; 11Cl-	1.00 ± 0.05 μg/mL in methanol/isopropanol (6%)/water (< 1%)
PFAC-MXG	PF3OUdS)  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)	$2.0 \pm 0.1 \mu g/mL$ in methanol/water (<1%)
L-PFPrS	Sodium perfluoropropanesulfonate (359868-82-9; PFPrS)	$50.0 \pm 2.5 \mu g/mL$ 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)	$50.0 \pm 2.5 \mu g/mL$ in methanol

**Table 24.** 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-	$1.00 \pm 0.05~\mu g/mL$ in
	[13C5]pentanoic acid, Perfluoro-n-[1,2,3,4,6-	methanol/isopropanol
	13C5]hexanoic acid, Perfluoro-n-[1,2,3,4-13C4]heptanoic	(2%)/water (<1%)
	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	
M3HFPO-DA	Tetrafluoro(heptafluoropropoxy)[13C3]propanoic acid	$50.0 \pm 2.5 \mu g/mL$ in methanol
MPFAC-C-IS	Perfluoro-n-[2,3,4-13C3]butanoic acid (PFBA-INJ),	$50.0 \pm 2.5 \ \mu g/mL$ in
	Perfluoro-n-[1,2,3,4-13C4]octanoic acid (PFOA -INJ),	methanol/water (<1%)
	Perfluoro-n-[1,2-13C2]decanoic acid (PFDA -INJ),	
	Sodium perfluoro-1-[1,2,3,4-13C4]-octanesulfonate	
	(PFOS -INJ)	

**Table 25.** 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; <b>MeFBSA</b> )	$50 \pm 2.5~\mu\text{g/mL}$	
N-MeFOSA-M	Heptadecafluoro-N-methyloctancesulfonamide (31506-32-8; <b>MeFOSA</b> )	$50 \pm 2.5~\mu g/mL$	
N-EtFOSA-M	Heptadecafluoro-N-ethyloctancesulfonamide (4151-50-2; <b>EtFOSA</b> )	$50 \pm 2.5 \mu \text{g/mL}$	
N-MeFOSE-M	2-(N-methylperfluoro-1-octanesulfonamido)-ethanol (24448-09-7; <b>MeFOSE</b> )	$50 \pm 2.5 \ \mu g/mL$	
N-EtFOSE-M	2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol (1691-99-2; <b>EtFOSE</b> )	$50 \pm 2.5 \mu \text{g/mL}$	

**Table 26.** 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	$50 \pm 2.5 \mu \text{g/mL}$	
d-N-EtFOSA	N-ethyl-d5-perfluoro-1-octanesulfonamide	$50 \pm 2.5 \ \mu g/mL$	
d7-N-MeFOSE-M	2-(N-methyl-d3-perfluoro-1-octanesulfonamido)ethan-d4-ol	$50 \pm 2.5~\mu g/mL$	
d9-N-EtFOSE-M	2-(N-ethyl-d5-perfluoro-1-octanesulfonamido)ethan-d4-ol	$50 \pm 2.5~\mu g/mL$	

**Table 27.** 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
FBET (Wellington Laboratories)	2-Perflourobutyl ethanol (2043-47-2; <b>4:2 FTOH</b> )	$50 \pm 2.5 \mu g/mL$ in methanol
5:2sFTOH (Wellington Laboratories)	1-Perfluoropentyl ethanol (914637-05-1; <b>5:2 FTOH</b> )	$50 \pm 2.5 \mu g/mL$ in methanol
FHET (Wellington Laboratories)	2-Perfluorohexyl ethanol (647-42-7; <b>6:2 FTOH</b> )	$50 \pm 2.5 \mu g/mL$ in methanol
7:2sFTOH (Wellington Laboratories)	1-Perfluoroheptyl ethanol (24015-83-6; <b>7:2 FTOH</b> )	$50 \pm 2.5 \mu g/mL$ in methanol
FOET (Wellington Laboratories)	2-Perfluorooctyl ethanol (678-39-7; <b>8:2 FTOH</b> )	50 ± 2.5 μg/mL in methanol
FDET (Wellington Laboratories)	2-Perfluorodecyl ethanol (865-86-1; 10:2 FTOH)	50 ± 2.5 μg/mL in methanol
8:2 FTOAc (Wellington Laboratories)	1H, 1H, 2H, 2H-Perfluorodecyl acetate (37858-04-1; <b>8:2 FTOAc</b> )	$48.5 \pm 2.4 \mu g/mL$ in isooctane
10:2FTOAc (Wellington Laboratories)	1H, 1H, 2H, 2H-Perfluorododecyl acetate (37858-05-2; <b>10:2 FTOAc</b> )	$50 \pm 2.5 \mu g/mL$ in isooctane
2324-3-46 (Synquest Laboratories)	1H, 1H, 2H, 2H-Perfluorooctyl methacrylate (2144-53-8; <b>6:2 FTMAC</b> )	Neat (97 % Purity)
2324-3-42 (Synquest Laboratories)	1H, 1H, 2H, 2H-Perfluorodecyl methacrylate (1996-88-9; <b>8:2 FTMAC</b> )	Neat (97 % Purity)
2324-3-Y5 (Synquest Laboratories)	1H, 1H, 2H, 2H-Perfluorododecyl methacrylate (2144-54-9; <b>10:2 FTMAC</b> )	Neat (97 % Purity)

**Table 28.** 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-[1,1,2,2-2H4]-ethanol	$48.5 \pm 2.4 \mu \text{g/mL}$ in
		methanol
MFHET	2-Perfluorohexyl- $[1,1-{}^{2}H_{2}]$ - $[1,2-{}^{13}C_{2}]$ -ethanol	$50 \pm 2.5 \ \mu g/mL$ in
		methanol
MFOET	2-Perfluorooctyl-[1,1- <sup>2</sup> H <sub>2</sub> ]-[1,2- <sup>13</sup> C <sub>2</sub> ]-ethanol	$50 \pm 2.5 \ \mu g/mL$ in
		methanol
MFDET	2-Perfluorodecyl-[1,1- <sup>2</sup> H <sub>2</sub> ]-[1,2- <sup>13</sup> C <sub>2</sub> ]-ethanol	$50 \pm 2.5 \mu\text{g/mL}$ in
		methanol

**Table 29.** Reference mass fractions for NIST Reference Material 8446 including mean value and expanded uncertainty with 95 % confidence.

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

**Table 30.** Reference mass fractions NIST Reference Material 8447 including mean value and expanded uncertainty with 95 % confidence.

PFAS	<b>Mass Fraction</b>		
	(mg/kg)		
PFBS	$42.3 \pm 2.3$		
PFHxS	55.2 ± 1.7		
PFOS	$56.6 \pm 2.5$		

### A.3. Extraction and Analysis of PFAS in Firefighter Turnout Gear Textiles

#### A.3.1. Extraction of Nonvolatile PFAS

An extraction procedure for nonvolatile PFAS in turnout gear textiles was developed by adapting the method of Robel et al. [1]. Target and internal standard working solutions were prepared by gravimetric dilution of commercially obtained PFAS standards in methanol. Nonvolatile PFAS extraction batches consisted of forty-eight individual samples, including three batch blanks (solvent blanks for the analysis of OS-ASC and OS-FSC or textile blanks containing OS-FSC for the remaining textiles), one in-house reference textile (OS-FRM), and eleven sets of quadruplicate cuttings of experimental textiles. For each textile blank and experimental textile, sections of approximately 0.1 g (10<sup>-4</sup> kg; approximately 0.01 m x 0.01 m; mass known) were cut with methanol-rinsed scissors and placed into pre-weighed 15 mL centrifuge tubes. When thermal liner textiles were sectioned, they were cut so that all layers were present in roughly equal areas. One sample of each quadruplicate experimental textile was selected for matrix spiking with approximately 0.1 mL (10<sup>-7</sup> m<sup>3</sup>: mass known) of a target working solution which contributed approximately 10 µg PFAS/kg textile of all nonvolatile target PFAS. Following the addition of matrix spikes to selected experimental textiles, all samples were capped and allowed to equilibrate at room temperature for 15 h - 20 h. Subsequently, approximately 0.1 mL ( $10^{-7}$  m<sup>3</sup>; mass known) of an internal standard working solution was added to all samples, which contributed approximately 10 µg PFAS/kg textile of isotopically labeled nonvolatile internal standard PFAS. All samples were then capped and allowed to equilibrate at room temperature for at least 1 h.

After equilibration with the internal standard working solution, 5 mL (5 x 10<sup>-6</sup> m<sup>3</sup>) of methanol was added to all samples, which were then vortexed and sonicated at 25 °C for 30 min. Samples were then centrifuged for 5 min at 2325 relative centrifugal field and the supernatants were decanted directly into the barrels of ENVI-Carb SPE cartridges (500 mg, 6 mL) that had previously been rinsed with 20 mL (2 x 10<sup>-5</sup> m<sup>3</sup>) of 0.1 mol/L (10<sup>2</sup> mol/m<sup>3</sup>) ammonium hydroxide in methanol. The decanted supernatants were then pushed through the SPE cartridges into 20 mL scintillation vials with positive pressure. Two additional rounds of methanol addition, sonication, centrifugation, and ENVI-Carb treatment were performed, and the extracts from each round of the same textile sample were passed through the same SPE cartridge and combined in a single 20 mL scintillation vial. Finally, each SPE cartridge was rinsed with 5 mL (5 x 10<sup>-6</sup> m<sup>3</sup>) of 0.1 mol/L (10<sup>2</sup> mol/m<sup>3</sup>) ammonium hydroxide in methanol that was collected and combined with the previously collected extracts that had passed through the same cartridge. The combined extracts were stored at -20 °C for 15 h – 20 h and then evaporated to dryness at 40 °C under nitrogen. The dried extracts were reconstituted in 0.5 mL (5 x  $10^{-7}$  m<sup>3</sup>) of methanol that contained approximately 2 x  $10^3$  µg/m<sup>3</sup> of nonvolatile injection standards (i.e., PFBA-INJ, PFOA-INJ, PFDA-INJ, PFOS-INJ) and passed through 0.22 µm methanol-rinsed syringe filters. The filtered extracts were collected in amber glass HPLC vials and stored at -20 °C in the dark until HPLC-MS/MS analysis.

#### A.3.2. Extraction of Semivolatile and Volatile PFAS

Semivolatile and volatile PFAS were extracted simultaneously with a method derived from the nonvolatile PFAS extraction method, except for the differences described below. Target and internal standards solutions were prepared in ethyl acetate rather than methanol. Samples selected

for matrix spiking were spiked with approximately 0.2~mL ( $2 \times 10^{-7}~\text{m}^3$ ; mass known) of a diluted target working solution which added approximately  $10^4~\mu g$  PFAS/kg textile for n:2 FTMACs,  $2 \times 10^3~\mu g$  PFAS/kg textiles for other volatile target PFAS, and  $4 \times 10~\mu g$  PFAS/kg textile for semivolatile PFAS. Approximately 0.2~mL ( $2 \times 10^{-7}~\text{m}^3$ ; mass known) of an internal standard working solution was added to all samples, which added approximately  $2 \times 10^3~\mu g$  PFAS/kg textile for all volatile PFAS internal standards and  $4 \times 10~\mu g$  PFAS/kg textile for all semivolatile PFAS internal standards. Ethyl acetate was used as an extraction solvent rather than methanol and extracts were concentrated to approximately 2~mL ( $2 \times 10^{-6}~\text{m}^3$ ; mass known) at 35 °C on a nitrogen evaporator.

Extracts for volatile PFAS analysis were analyzed by GC-MS without further processing, while extracts for semivolatile PFAS analysis were diluted 1:4 (masses known) with an ethyl acetate solution containing approximately  $2.5 \times 10^3 \, \mu g$  injection standard PFAS/m³ before analysis by HPLC-MS/MS.

## A.3.3. HPLC-MS/MS Analysis of Nonvolatile and Semivolatile PFAS

Thirty-seven nonvolatile and five semivolatile PFAS in firefighter textile extracts were quantified with separate HPLC-MS/MS methods that both used negative mode electrospray ionization. Method development for HPLC-MS/MS methods included the optimization of a liquid chromatography method, the optimization of MS source and gas parameters, and the optimization of multiple reaction monitoring (MRM) parameters.

The separation of nonvolatile and semivolatile PFAS was performed with an Agilent 1260 LC instrument. Potential PFAS contamination of this instrument was mitigated by replacing fluoropolymer tubing with equivalent polyetheretherketone (PEEK) tubing wherever possible as well as the use of PEEK in-line solvent filters. An Agilent Eclipse Plus C18 (4.6 mm x 50 mm, 5 um) column was installed between the pump and autosampler to prevent PFAS present in the mobile phase solutions from eluting simultaneously with PFAS present in the injected samples. During analysis sample vials were kept at 10 °C. For both methods, 5 µL (5 x 10<sup>-9</sup> m<sup>3</sup>) sample volumes were injected onto one (nonvolatile analysis) or two (semivolatile analysis) Agilent DIOL guard columns (4.6 mm x 12.5 mm, 6 µm), connected to an Agilent Poroshell 120 EC-C18 guard column (4.6 mm x 5 mm, 2.7 µm) and an Agilent Poroshell 120 EC-C18 analytical column (4.6 mm x 100 mm, 2.7 µm). The guard and analytical columns were kept at 40 °C. A binary gradient elution was used (Table 31) with mobile phase A consisting of 9.5 mmol/L (9.5 mol/m<sup>3</sup>) ammonium acetate, 0.5 mmol/L (0.5 mol/m<sup>3</sup>) ammonium hydroxide in water and mobile phase B consisting of 9.5 mmol/L (9.5 mol/m<sup>3</sup>) ammonium acetate, 0.5 mmol/L (0.5 mol/m<sup>3</sup>) ammonium hydroxide in methanol. Flow from the analytical column was directed to waste from 0 min to 4.25 min and to the ion source from 4.25 min to 18 min. The optimized MS/MS method parameters for nonvolatile and semivolatile PFAS analysis are described in Tables 32 - 34.

**Table 31.** HPLC mobile phase gradient used for the analysis of nonvolatile and semivolatile PFAS.

Time (min)	Flow Rate (mL/min)	B (%)
0	0.6	10
0.5	0.6	50
18	0.6	99
23	0.6	99
23.5	0.6	10
31.5	0.6	10

**Table 32.** PFAS-specific MRM parameters for nonvolatile PFAS analysis: Precursor and product ion m/z (M1 and M2, respectively), depolarization energy (DP), collision energy (CE), collision cell exit potential (CXP), entrance potential (EP), and LC retention time (RT). Qualifier ions are indicated with "-q." Injection standard ions are indicated with "INJ." Internal standard ions (IS) were analyzed with the same electronic settings as the corresponding target PFAS.

PFAS	M <sub>1</sub> /M <sub>2</sub>	DP	CE	CXP	EP	RT (min)	IS	IS M <sub>1</sub> /M <sub>2</sub>
PFBA	213/169	-25	-12	-15	-10	4.66	<sup>13</sup> C <sub>4</sub> -PFBA	217/172
PFPeA	263/219	-15	-12	-21	-10	5.81	<sup>13</sup> C <sub>5</sub> -PFPeA	268/223
PFHxA	313/269	-5	-14	-35	-10	7.22	<sup>13</sup> C <sub>4</sub> -PFHxA	318/273
PFHxA-q	313/119	-25	-26	-11	-10	7.22	<sup>13</sup> C <sub>4</sub> -PFHxA	318/273
PFHpA	363/319	-30	-14	-35	-10	8.80	<sup>13</sup> C <sub>4</sub> -PFHpA	367/322
PFHpA-q	363/169	-40	-22	-15	-10	8.80	<sup>13</sup> C <sub>4</sub> -PFHpA	367/322
PFOA	413/369	-5	-12	-41	-10	10.39	<sup>13</sup> C <sub>8</sub> -PFOA	421/376
PFOA-q	413/169	-50	-26	-19	-10	10.39	<sup>13</sup> C <sub>8</sub> -PFOA	421/376
PFNA	463/419	-35	-14	-33	-10	11.85	<sup>13</sup> C <sub>9</sub> -PFNA	472/427
PFNA-q	463/219	-35	-26	-23	-10	11.85	<sup>13</sup> C <sub>9</sub> -PFNA	472/427
PFDA	513/469	-5	-14	-21	-10	13.14	<sup>13</sup> C <sub>6</sub> -PFDA	519/474
PFDA-q	513/219	-65	-26	-23	-10	13.14	<sup>13</sup> C <sub>6</sub> -PFDA	519/474
PFUnDA	563/519	-65	-18	-55	-10	14.28	<sup>13</sup> C <sub>7</sub> -PFUnDA	570/525
PFUnDA-q	563/269	-55	-28	-29	-10	14.28	<sup>13</sup> C <sub>7</sub> -PFUnDA	570/525
PFDoDA	613/569	-75	-20	-29	-10	15.24	<sup>13</sup> C <sub>2</sub> -PFDoDA	615/570
PFDoDA-q	613/269	-5	-30	-29	-10	15.24	<sup>13</sup> C <sub>2</sub> -PFDoDA	615/570
PFTrDA	663/619	-70	-20	-29	-10	16.09	<sup>13</sup> C <sub>2</sub> -PFDoDA	615/570
PFTrDA-q	663/269	-55	-32	-27	-10	16.09	<sup>13</sup> C <sub>2</sub> -PFDoDA	615/570
PFTeDA	713/669	-50	-20	-33	-10	16.82	<sup>13</sup> C <sub>2</sub> -PFTeDA	715/670
PFTeDA-q	713/369	-95	-32	-37	-10	16.82	<sup>13</sup> C <sub>2</sub> -PFTeDA	715/670
PFPrS	248.9/80	-105	-44	-15	-10	4.97	<sup>13</sup> C <sub>4</sub> -PFBS	302/99
PFPrS-q	248.9/99	-50	-42	-15	-10	4.97	<sup>13</sup> C <sub>4</sub> -PFBS	302/99
PFBS	299/80	-105	-50	-9	-10	6.01	<sup>13</sup> C <sub>4</sub> -PFBS	302/99
PFBS-q	299/99	-75	-46	-15	-10	4.97	<sup>13</sup> C <sub>4</sub> -PFBS	302/99
PFPeS	349/80	-100	-62	-15	-10	7.39	<sup>13</sup> C <sub>3</sub> -PFHxS	402/99
PFPeS-q	349/99	-115	-54	-11	-10	7.39	<sup>13</sup> C <sub>3</sub> -PFHxS	402/99
PFHxS	399/80	-65	-60	-13	-10	8.80	<sup>13</sup> C <sub>3</sub> -PFHxS	402/99
PFHxS-q	399/99	-110	-52	-7	-10	8.80	<sup>13</sup> C <sub>3</sub> -PFHxS	402/99
PFHpS	449/80	-85	-72	-15	-10	10.45	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
PFHpS-q	449/99	-140	-60	-13	-10	10.45	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
PFOS	499/80	-155	-74	-7	-10	11.70	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
PFOS-q	499/99	-140	-56	-9	-10	11.70	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
PFNS	549/80	-110	-82	-7	-10	13.11	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
PFNS-q	549/99	-50	-70	-9	-10	13.11	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
PFDS	599/80	-215	-80	-17	-10	14.23	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
PFDS-q	599/99	-180	-70	-5	-10	14.23	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
FBSA	298/78	-60	-32	-7	-10	6.86	<sup>13</sup> C <sub>8</sub> -FOSA	509/78
FHxSA	398/78	-60	-42	-13	-10	10.53	<sup>13</sup> C <sub>8</sub> -FOSA	509/78

Table 32. (Continued).

PFAS	M <sub>1</sub> /M <sub>2</sub>	DP	CE	CXP	EP	RT (min)	IS	IS M <sub>1</sub> /M <sub>2</sub>
FHxSA-q	398/169	-110	-40	-19	-10	10.53	<sup>13</sup> C <sub>8</sub> -FOSA	509/78
FOSA	498/78	-90	-64	-9	-10	13.56	<sup>13</sup> C <sub>8</sub> -FOSA	509/78
FOSA-q	498/169	-110	-44	-13	-10	13.56	<sup>13</sup> C <sub>8</sub> -FOSA	509/78
MeFBSA	312/219	-35	-24	-21	-10	9.90	<sup>2</sup> H <sub>3</sub> -MeFOSA	515/169
MeFOSA	512/169	-105	-40	-17	-10	15.60	<sup>2</sup> H <sub>3</sub> -MeFOSA	515/169
MeFOSA-q	512/219	-105	-38	-33	-10	15.60	<sup>2</sup> H <sub>3</sub> -MeFOSA	515/169
EtFOSA	526/169	-105	-40	-17	-10	16.27	<sup>2</sup> H <sub>3</sub> -EtFOSA	531/169
EtFOSA-q	526/219	-105	-38	-33	-10	16.27	<sup>2</sup> H <sub>3</sub> -EtFOSA	531/169
FOSAA	559/498	-115	-38	-55	-10	12.97	<sup>2</sup> H <sub>3</sub> -MeFOSAA	573/419
FOSAA-q	559/419	-130	-36	-51	-10	12.97	<sup>2</sup> H <sub>3</sub> -MeFOSAA	573/419
N-MeFOSAA	570/419	-70	-26	-41	-10	13.60	<sup>2</sup> H <sub>3</sub> -MeFOSAA	573/419
N-MeFOSAA-q	570/512	-95	-28	-23	-10	13.60	<sup>2</sup> H <sub>3</sub> -MeFOSAA	573/419
N-EtFOSAA	584/419	-105	-26	-21	-10	14.15	<sup>2</sup> H <sub>5</sub> -EtFOSAA	589/419
N-EtFOSAA-q	584/526	-95	-30	-55	-10	14.15	<sup>2</sup> H <sub>5</sub> -EtFOSAA	589/419
4:2 FTS	327/307	-65	-26	-15	-10	7.09	<sup>13</sup> C <sub>2</sub> -4:2 FTS	329/81
4:2 FTS-q	327/81	-85	-36	-11	-10	7.09	<sup>13</sup> C <sub>2</sub> -4:2 FTS	329/81
6:2 FTS	427/407	-130	-32	-43	-10	10.31	<sup>13</sup> C <sub>2</sub> -6:2 FTS	429/409 or 429/81
6:2 FTS-q	427/81	-110	-56	-9	-10	10.31	<sup>13</sup> C <sub>2</sub> -6:2 FTS	429/409 or 429/81
8:2 FTS	527/507	-130	-34	-51	-10	13.15	<sup>13</sup> C <sub>2</sub> -8:2 FTS	529/509
8:2 FTS-q	527/81	-115	-70	-11	-10	13.15	<sup>13</sup> C <sub>2</sub> -8:2 FTS	529/509
10:2 FTS	627/607	-130	-42	-55	-10	15.29	<sup>13</sup> C <sub>2</sub> -8:2 FTS	529/509
10:2 FTS-q	627/81	-185	-70	-5	-10	15.29	<sup>13</sup> C <sub>2</sub> -8:2 FTS	529/509
HFPO-DA	329/285	-15	-10	-31	-10	7.66	<sup>13</sup> C <sub>3</sub> -HFPO-DA	332/287
HFPO-DA-q	329/169	-25	-16	-13	-10	7.66	<sup>13</sup> C <sub>3</sub> -HFPO-DA	332/287
ADONA	377/251	-50	-18	-33	-10	9.00	<sup>13</sup> C <sub>4</sub> -PFHpA	367/322
ADONA-q	377/85	-50	-36	-33	-10	9.00	<sup>13</sup> C <sub>4</sub> -PFHpA	367/322
9Cl-PF3ONS	531/351	-125	-34	-35	-10	12.58	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
9Cl-PF3ONS-q	533/353	-125	-34	-35	-10	12.58	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
11Cl-PF3OUdS	631/451	-125	-42	-47	-10	14.75	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
11Cl-PF3OUdS-q	633/453	-125	-42	-47	-10	14.75	<sup>13</sup> C <sub>3</sub> -PFOS	507/99
PF4OPeA	229/85	-35	-20	-7	-10	5.06	<sup>13</sup> C <sub>4</sub> -PFBA	217/172
PF5OHxA	279/85	-25	-22	-17	-10	6.19	<sup>13</sup> C <sub>5</sub> -PFPeA	268/223
3,6-OPFHpA	295/201	-5	-12	-21	-10	6.95	<sup>13</sup> C <sub>4</sub> -PFHxA	318/273
PFEESA	315/135	-30	-36	-17	-10	6.55	<sup>13</sup> C <sub>4</sub> -PFBS	302/99
PFBA-INJ	213/169	-25	-12	-15	-10	5.1	N/A	N/A
PFOA -INJ	413/369	-5	-12	-41	-10	11.1	N/A	N/A
PFDA -INJ	513/469	-5	-14	-21	-10	13.9	N/A	N/A
I I DA -INJ	313/10)	-			10	10.,	1 1/1 1	1 1 1

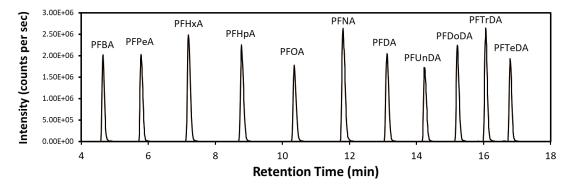
**Table 33.** MRM parameters for semivolatile PFAS: Precursor and product ion m/z (M1 and M2), depolarization energy (DP), collision energy (CE), collision cell exit potential (CXP), entrance potential (EP), and LC retention time (RT). Qualifier ions are indicated with "-q." Injection standard ions are indicated with "INJ." Internal standard ions were analyzed with the same electronic settings as the corresponding target PFAS.

PFAS	$M_1/M_2$	DP	CE	CXP	EP	RT (min)	IS	IS M <sub>1</sub> /M <sub>2</sub>
MeFBSA	312/219	-35	-24	-21	-10	9.7	d <sub>3</sub> -MeFOSA	515/169
MeFOSA	512/169	-105	-40	-17	-10	16.1	d <sub>3</sub> -MeFOSA	515/169
MeFOSA-q	512/219	-105	-38	-33	-10	16.1	d <sub>3</sub> -MeFOSA	515/169
EtFOSA	526/169	-105	-40	-17	-10	16.9	d <sub>3</sub> -EtFOSA	531/169
EtFOSA-q	526/219	-105	-38	-33	-10	16.9	d <sub>3</sub> -EtFOSA	531/169
MeFOSE	616/59	-70	-42	-11	-10	16.5	d <sub>3</sub> -MeFOSE	623/59
EtFOSE	630/59	-70	-52	-11	-10	17.2	d <sub>3</sub> -EtFOSE	639/59
PFBA-INJ	213/169	-25	-12	-15	-10	5.1	N/A	N/A
PFOA -INJ	413/369	-5	-12	-41	-10	11.1	N/A	N/A
PFDA -INJ	513/469	-5	-14	-21	-10	13.9	N/A	N/A
PFOS -INJ	499/80	-155	-74	-7	-10	12.6	N/A	N/A

Table 34. Optimized source and gas parameters for nonvolatile and semivolatile PFAS analysis.

Parameter	Value
Collision Gas (CAD)	9
Curtain Gas supply (CUR)	20 psi
Gas 1 (nebulizer gas; GS1)	50 psi
Gas 2 (heater gas; GS2)	50 psi
IonSpray Voltage (IS)	-4500 V
Temperature (TEM)	450 °C

Extracted ion chromatograms of nonvolatile PFAS are shown in Figs. 4 - 9. Extracted ion chromatograms of semivolatile PFAS are shown in Figs. 10 and 11. Extracted ion chromatograms of injection standard PFAS for both nonvolatile and semivolatile PFAS analysis are shown in Fig. 12.



**Fig. 4.** Extracted ion chromatogram from injection of 5 μL (5 x 10<sup>-9</sup> m³) of approximately 50 ng/mL (5 x 10<sup>4</sup> μg/m³) of each perfluorocarboxylic acid (PFCA) in a calibration standard.

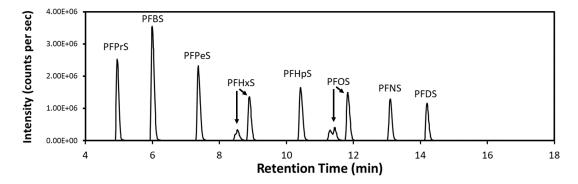
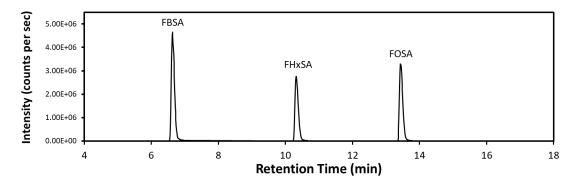
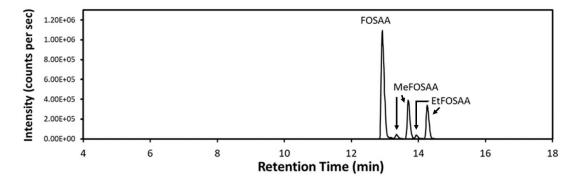


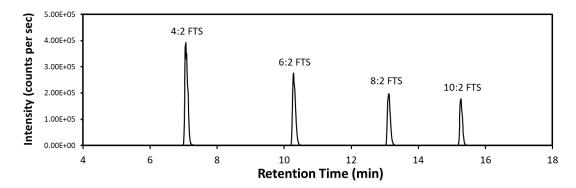
Fig. 5. Extracted ion chromatogram from injection of 5  $\mu$ L (5 x 10<sup>-9</sup> m³) of approximately 50 ng/mL (5 x 10<sup>4</sup>  $\mu$ g/m³) of each perfluoroalkane sulfonic acid (PFSA) in a calibration standard. Peaks derived from branched isomers of PFHxS and PFOS precede the linear isomer peaks



**Fig. 6.** Extracted ion chromatogram from injection of 5  $\mu$ L (5 x 10<sup>-9</sup> m³) of approximately 50 ng/mL (5 x 10<sup>4</sup>  $\mu$ g/m³) of each perfluoroalkane sulfonamide (FASA) in a calibration standard.



**Fig. 7.** Extracted ion chromatogram from injection of 5 μL (5 x 10<sup>-9</sup> m³) of approximately 50 ng/mL (5 x 10<sup>4</sup> μg/m³) of each per- and polyfluoroalkane sulfonamido acetic acid (FASAAs) in a calibration standard. Peaks derived from branched isomers of MeFOSAA and EtFOSAA precede the linear isomer peaks



**Fig. 8.** Extracted ion chromatogram from injection of 5  $\mu$ L (5 x 10<sup>-9</sup> m<sup>3</sup>) of approximately 50 ng/mL (5 x 10<sup>4</sup>  $\mu$ g/m<sup>3</sup>) of each n:2 fluorotelomer sulfonate PFAS in a calibration standard.

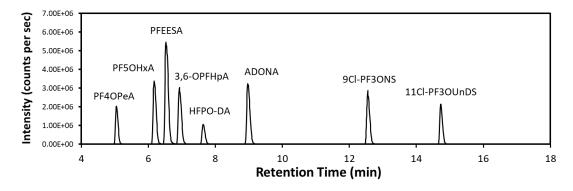
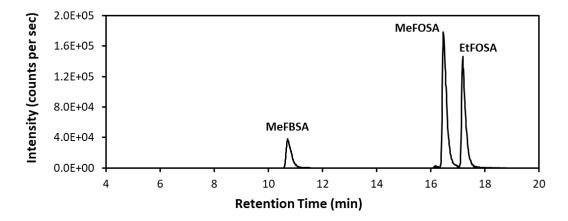


Fig. 9. Extracted ion chromatogram from injection of 5  $\mu$ L (5 x 10<sup>-9</sup> m³) of approximately 50 ng/mL (5 x 10<sup>4</sup>  $\mu$ g/m³) of each PPEA in a calibration standard.



**Fig. 10.** Extracted ion chromatograms from injection of 5 μL (5 x 10<sup>-9</sup> m³) of approximately 10 ng/mL (10<sup>4</sup> μg/m³) each of MeFBSA, MeFOSA, and EtFOSA in a calibration standard.

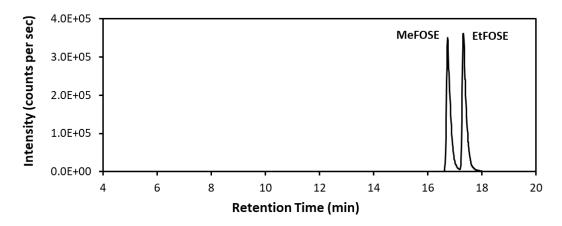
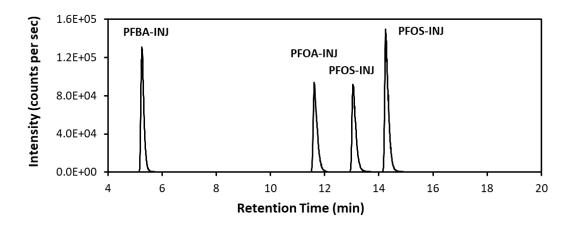


Fig. 11. Extracted ion chromatograms from injection of 5  $\mu$ L (5 x 10<sup>-9</sup> m<sup>3</sup>) of approximately 10 ng/mL (10<sup>4</sup>  $\mu$ g/m<sup>3</sup>) each of MeFOSE and EtFOSE in a calibration standard.



**Fig. 12.** Extracted ion chromatograms from injection of 5  $\mu$ L (5 x 10<sup>-9</sup> m³) of approximately 2 ng/mL(2 x 10<sup>3</sup>  $\mu$ g/m³) of each injection standard PFAS.

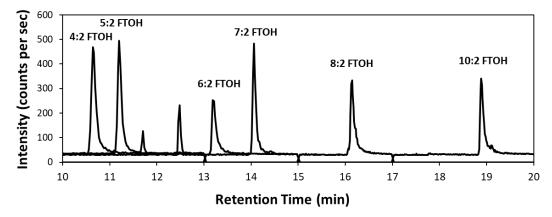
# A.3.4. GC-MS Analysis of Volatile PFAS

Eleven volatile PFAS in firefighter textile extracts were quantified with GC-MS with electron impact ionization. GC-MS method development included the identification of primary and secondary ions for each target and isotopically labeled internal standard volatile PFAS and the optimization of a gas chromatography method.

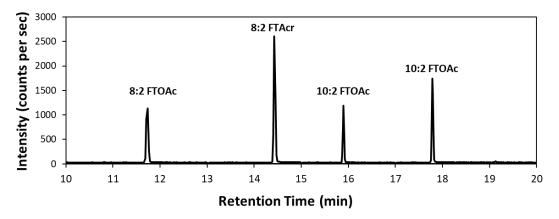
Separation and detection were performed on an Agilent 6890 gas chromatograph with an Agilent 5973A mass spectrometer. 3  $\mu$ L (3 x 10<sup>-9</sup> m³) sample aliquots were injected with a Gerstel MPS2 autosampler into a split/splitless port at 280 °C and onto a 1 m × 0.53 mm polar deactivated/uncoated retention gap connected directly with a press-tight connector to a 30 m × 0.25 mm Stabilwax-DB column (Restek, Bellefonte, PA, 0.25  $\mu$ m phase thickness) operated at a constant helium carrier flow of 2 mL/min (average linear velocity = 51 cm/s). The column temperature program began with an initial temperature of 45 °C for a 1.6 min hold followed by a 2 °C/min increase to 64 °C, then a 5 °C/min to 110 °C and a final ramp 20 °C/min to 210 °C with a 15 min hold at this final temperature. The interface temperature was set at 220 °C. Retention times for target and internal standard volatile PFAS, as well as primary and secondary ions for each target PFAS, are shown in Table 35. Extracted ion chromatograms of volatile PFAS are shown in Figs. 13-15.

**Table 35.** Optimized primary (quantifier) and secondary (qualifier) ions (m/z), retention times, and internal standards for each target analyte

Analyte	Primary/Secondary Ions	Retention Time (min)	Internal Standard
4:2 FTOH	244/196	11.3	<sup>2</sup> H <sub>4</sub> -4:2 FTOH
5:2 FTOH	219/255	12.1	<sup>2</sup> H <sub>4</sub> -4:2 FTOH
<b>6:2 FTOH</b>	344/363	13.9	<sup>2</sup> H <sub>2</sub> - <sup>13</sup> C <sub>2</sub> -6:2 FTOH
7:2 FTOH	319/399	14.7	<sup>2</sup> H <sub>2</sub> - <sup>13</sup> C <sub>2</sub> -6:2 FTOH
8:2 FTOH	405/444	16.6	<sup>2</sup> H <sub>2</sub> - <sup>13</sup> C <sub>2</sub> -8:2 FTOH
10:2 FTOH	505/544	19.2	<sup>2</sup> H <sub>2</sub> - <sup>13</sup> C <sub>2</sub> -10:2 FTOH
8:2 FTOAc	506/486	12.2	<sup>2</sup> H <sub>4</sub> -4:2 FTOH
10:2 FTOAc	606/527	16.2	<sup>2</sup> H <sub>2</sub> - <sup>13</sup> C <sub>2</sub> -8:2 FTOH
6:2 FTMAC	432/433	12.9	<sup>2</sup> H <sub>4</sub> -4:2 FTOH
8:2 FTMAC	532/533	16.3	<sup>2</sup> H <sub>2</sub> - <sup>13</sup> C <sub>2</sub> -8:2 FTOH
<b>10:2 FTMAC</b>	632/633	19.5	<sup>2</sup> H <sub>2</sub> - <sup>13</sup> C <sub>2</sub> -10:2 FTOH
<b>M4:2 FTOH</b>	248/-	11.1	N/A
M6:2 FTOH	344/-	13.8	N/A
M8:2 FTOH	448/-	16.5	N/A
M10:2 FTOH	509/-	18.9	N/A



**Fig. 13.** Extracted ion chromatograms from injection of 3 μL (3 x 10<sup>-9</sup> m<sup>3</sup>) of a calibration standard containing approximately 200 ng/mL (2 x 10<sup>5</sup> μg/m<sup>3</sup>) of each of five fluorotelomer alcohols.



**Fig. 14.** Extracted ion chromatograms from injection of 3 μL (3 x 10<sup>-9</sup> m<sup>3</sup>) of a calibration standard containing approximately 200 ng/mL (2 x 10<sup>5</sup> μg/m<sup>3</sup>) each of two fluorotelomer acetates and two fluorotelomer acrylates.

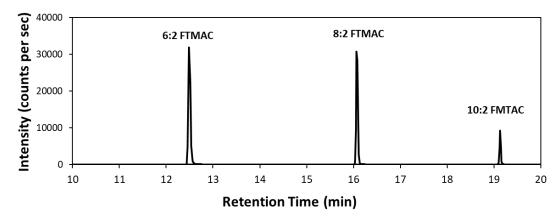


Fig. 15. Extracted ion chromatograms from injection of 3  $\mu$ L (3 x 10<sup>-9</sup> m³) of a calibration standard containing approximately 1,000 ng/mL (10<sup>6</sup>  $\mu$ g/m³) each of 6:2 and 8:2 fluorotelomer methacrylate as well as approximately 500 ng/mL (5 x 10<sup>5</sup>  $\mu$ g/m³) of 10:2 fluorotelomer methacrylate.

# A.4. Quality Control Materials

For the analysis of nonvolatile, semivolatile, and volatile PFAS quality control solutions including calibration standards, continuing calibration verification solutions, and continuing calibration blank solutions were made by the dilution of commercially available analytical standards. For nonvolatile PFAS, NIST RMs 8446 and 8447 were used as calibration verification solutions. To demonstrate extraction reproducibility, four hundred sections of an outer shell textile were prepared so that one could be extracted with each experimental batch.

#### A.4.1. Nonvolatile PFAS

For the quantification of nonvolatile PFAS in turnout gear textiles commercially obtained target standard (Table 23), internal standard (Table 24), and injection standard (i.e., PFBA-INJ, PFOA-INJ, PFDA-INJ, PFOS-INJ; Table 24) solutions were gravimetrically diluted in methanol using methanol-rinsed glassware to create working solutions. Each nonvolatile PFAS analytical sequence included thirteen calibration standards, prepared in methanol, with target PFAS present at approximately 0.005 ng/mL to 50 ng/mL (5  $\mu$ g/m³ to 5 x 10<sup>4</sup>  $\mu$ g/m³; equivalent to approximately 2.5 x 10<sup>-2</sup>  $\mu$ g PFAS/kg textile to 2.5 x 10<sup>2</sup>  $\mu$ g PFAS/kg textile) and internal standard and injection standard PFAS present at approximately 2,000 ng/mL (2 x 10<sup>3</sup>  $\mu$ g/m³; equivalent to approximately 10  $\mu$ g PFAS/kg textile).

All thirteen PFAS calibration solutions were analyzed at the start and end of each nonvolatile PFAS analytical sequence. Continuing calibration verifications (CCVs; target PFAS concentrations approximately 5 ng/mL; 5 x  $10^3$  µg/m³; internal and injection standard PFAS at approximately 2 ng/mL; 2 x  $10^3$  µg/m³) and continuing calibration blanks (CCBs; target PFAS concentrations 0 ng/mL; internal and injection standard PFAS at approximately 2 ng/mL; 2 x  $10^3$  µg/m³) were analyzed after every ten textile extract samples.

NIST RMs 8446 (Table 29) and 8447 (Table 30) were gravimetrically diluted with methanol in methanol-rinsed volumetric glassware and mixed with internal and injection standards (target PFAS concentrations approximately 1.25 ng/mL;  $1.25 \times 10^3 \, \mu g/m^3$ ; internal and injection standard PFAS present at approximately 2 ng/mL;  $2 \times 10^3 \, \mu g/m^3$ ). The diluted RM solutions were analyzed immediately following the first analysis of calibration standards.

#### A.4.2. Semivolatile PFAS

For the quantitation of semivolatile PFAS in turnout gear textiles commercially obtained target standard (Table 25), internal standard (Table 26), and injection standard (i.e., PFBA-INJ, PFOA-INJ, PFOA-INJ, PFOS-INJ; Table 24) solutions were gravimetrically diluted in ethyl acetate using methanol-rinsed volumetric glassware to create working solutions. Eleven semivolatile PFAS calibration standards were prepared in ethyl acetate, with target PFAS present at approximately 0.005 ng/mL to 10 ng/mL (5 μg/m³ to 10⁴ μg/m³; equivalent to approximately 0.1 μg PFAS/kg textile to 200 μg PFAS/kg textile) and internal standard and injection standard PFAS present at approximately 2 ng/mL (2 x 10³ μg/m³; equivalent to approximately 40 μg PFAS/kg textile).

All eleven calibration solutions were analyzed at the start and end of each semivolatile PFAS analytical sequence. CCVs (target PFAS concentrations approximately 2.5 ng/mL; 2.5 x 10<sup>3</sup> µg/m<sup>3</sup>

with internal and injection standard PFAS at approximately 2 ng/mL;  $2 \times 10^3 \,\mu g/m^3$ ) and CCBs (nonvolatile target PFAS concentrations 0 ng/mL with internal and injection standard PFAS at approximately 2 ng/mL;  $2 \times 10^3 \,\mu g/m^3$ ) were prepared and analyzed after every ten samples.

#### A.4.3. Volatile PFAS

For the quantification of volatile PFAS in turnout gear textiles commercially obtained target PFAS (Table 27) and internal standard PFAS (Table 28) solutions were gravimetrically diluted in ethyl acetate using methanol-rinsed glassware to create working solutions. Each GC-MS volatile PFAS analytical sequence included eight calibration standards, prepared in ethyl acetate, with target PFAS present at a range of approximately 5 ng/mL to 1,000 ng/mL (5 x  $10^3$  µg/m³ to  $10^6$  µg/m³) of 6:2 FTOH, 6:2 FTMAC, 8:2 FTMAC, and 10:2 FTMAC as well as approximately 0.5 ng/mL to 200 ng/mL (5 x  $10^2$  µg/m³ to 2 x  $10^5$  µg/m³) of the remaining volatile target PFAS ( $10^5$  µg/m³ was equivalent to approximately  $10^3$  µg/kg textile). Internal standard PFAS were present at approximately  $10^5$  µg/m³ in all calibration standards.

All eight calibration solutions were analyzed at the start and end of each GC-MS analytical sequence. CCVs (target PFAS concentrations approximately 50 ng/mL;  $5 \times 10^4 \mu\text{g/m}^3$  with internal and injection standard PFAS at approximately 100 ng/mL;  $10^5 \mu\text{g/m}^3$ ) and CCBs (target PFAS concentrations 0 ng/mL with internal and injection standard PFAS at approximately 100 ng/mL;  $10^5 \mu\text{g/m}^3$ ) were analyzed after every ten textile extract samples.

## A.4.4. Method Reproducibility Material (OS-FRM)

Four hundred sections of an outer shell textile (OS-F) were cut, weighed, and stored in polypropylene 15 mL capacity centrifuge tubes as OS-FRM (average  $\pm$  standard deviation of masses: 0.0997 g  $\pm$  0.006 g). Twelve sections were randomly selected with the Microsoft Excel function =rand()) sections were analyzed for nonvolatile PFAS and a separate twelve randomly selected sections were analyzed for semivolatile and volatile PFAS. Subsequent extraction batches included one randomly selected OS-FRM section and the reported PFAS concentrations were determined with each extraction batch to demonstrate extraction reproducibility.

# A.5. Data Processing and Sequence Quality Control Parameters

#### A.5.1. Nonvolatile and Semivolatile PFAS

For nonvolatile and semivolatile PFAS analysis, peak integration was performed in SCIEX Analyst 1.6.3 with a smoothing width of 7 points. PFAS identification in samples was confirmed by retention time matching with calibration solutions. For nonvolatile and semivolatile PFAS analysis, calibration slopes and intercepts were determined with  $1/x^2$ -weighted linear regressions of the ratio of target:internal standard peak areas against the ratio of target:internal standard nominal concentrations. Weighted linear regressions were used to allow a single linear regression to be applied to a wider calibration range than would be possible with unweighted linear regressions. Direct comparisons of weighted and unweighted linear regressions determined that reported textile concentrations varied by less than 10 % between the two methods. Calibration standards were only included in the calibration regression if their calculated value was within 70 %

- 130 % of their nominal value for both the initial and final calibrations. Calibration regressions were only considered acceptable if at least five consecutive calibration standards recovered within 70 % - 130 % of their nominal value for both the initial and final calibrations.

Target PFAS mass in analyzed solutions (i.e., QC solutions and textile extracts) were determined by Eq. (1), where "PFAS mass" is the mass of a target PFAS present in a prepared QC solution or textile extract, "IS mass" is the mass of associated internal standard in the same solution or extract, "Calibration Slope" is the calibration slope determined from the linear regression of calibration standard solutions, "Peak Area-PFAS" is the observed peak area from the target PFAS chromatogram, "Peak Area-IS" is the observed peak area from the associated internal standard chromatogram, and "Calibration Intercept" is the calibration intercept determined from the linear regression of the calibration standard solutions:

$$PFAS \; mass \; (ng) = \frac{IS \; mass \; (ng)}{Calibration \; Slope} \times \left\{ \left( \frac{Peak \; Area-PFAS}{Peak \; Area-IS} \right) - \; Calibration \; Intercept \right\}$$
 (1)

For nonvolatile PFAS analysis gravimetric dilutions of RMs 8446 and 8447 were analyzed after the initial calibration curves and data was only reported from analytical sequences in which recovery of 70 % to 130 % of the reference values was obtained for all PFAS with reported reference mass fractions. For both nonvolatile and semivolatile PFAS analysis, data was only reported from textile extracts that were bracketed with CCVs with recovery of 70 % to 130 %, except values that were reported as below the reporting limit ("<RL") when CCV recovery was over 130 %.

Internal standard and injection standard recoveries in textile extracts were determined by comparison of the observed internal response factor (i.e., peak area/nominal concentration) with the average response factor recorded in the calibration standards. Data was not reported when the associated internal standard recoveries were outside of 50 % to 150 % for more than one of three triplicate unspiked textile extracts. Data was not reported when the associated injection standard recoveries were outside of 70 % to 130 % for more than one of three triplicate unspiked textile extracts.

Matrix spike recoveries were determined to be the fraction of additional PFAS mass recovered in the spiked extracts compared with the average concentration recorded in the triplicate non-spiked extracts. Data was not reported when the associated matrix spike recovery was outside of 70 % to 130 %, with two exceptions. First, data was reported when matrix spike recovery was outside of 70 % to 130 % if the added concentration (µg PFAS/kg textile) from the matrix spike was less than the average concentration recorded in the triplicate unspiked extracts of the same sample. Second, data was also reported when associated with matrix spikes that had recovery over 130 % if the reported PFAS concentration was "< RL."

Consistent PFAS concentrations were recorded in solvent only and OS-FSC textile blank extracts within analytical batches and therefore nonvolatile and semivolatile PFAS concentrations in sample textile extracts were blank corrected by the average concentration recorded in the solvent only or OS-FSC textile blanks. PFAS concentrations in textiles were then calculated by Eq. (2), where "PFAS in Textile" is the PFAS concentration in a sample textile, "PFAS mass" is the PFAS

mass in the textile extract determined from Eq. (1), "Extract Vol." is the extract volume which was the nominal solution volume for nonvolatile PFAS analysis and the measured solution volume for semivolatile PFAS analysis, "Ave. Blank" is the average concentration recorded in the OS-FSC textile blank extracts for all textiles except for scoured outer shells where it is the average concentration recorded in solvent only extraction blanks, and "Sample Mass" is the mass of extracted textile:

$$PFAS in Textile(ng/g) = \left[ \frac{PFAS mass(ng)}{Extract Vol.(mL)} - Ave. Blank(\frac{ng}{mL}) \right] \times \frac{Extract Vol.(mL)}{Sample Mass(g)}$$
(2)

Extract volumes for nonvolatile PFAS analysis were presumed to be 0.5 mL (5 x 10<sup>-7</sup> m<sup>3</sup>) while extract masses for semivolatile PFAS analysis were determined gravimetrically.

#### A.5.2. Volatile PFAS

Peak integration for volatile PFAS analysis was performed with Agilent MassHunter. PFAS identification in samples was confirmed by retention time matching with calibration solutions. PFAS calibration slopes and intercepts were determined with 1/x-weighted linear regressions of the ratio of target:internal standard peak areas against the ratio of target:internal standard nominal concentrations. Calibration standard regressions met the same standards as applied for nonvolatile and semivolatile PFAS analysis. PFAS mass in injected solutions were determined by Eq. (1).

Secondary ion ratios were determined as the ratio of peak areas of the primary and secondary ions for each PFAS and are reported by comparison of the ratios determined in each extract with the average ratios determined in the four highest concentration calibration points. Data was only reported when associated with secondary ion ratios between 70 % - 130 % of the average ratio in the four highest calibration standards. Data was only reported when associated with internal standard and matrix spike recoveries that met the same standards as applied for nonvolatile and semivolatile PFAS analysis.

Volatile PFAS concentrations in solvent only and OS-FSC textile blank extracts were either consistent (6:2 FTMAC) or indistinguishable from zero (all other analytes), and therefore PFAS concentrations in sample textile extracts were blank corrected by the average concentration recorded in the OS-FSC textile blanks, except for scoured outer shell textiles which had extract concentrations blank corrected by the average concentration of solvent only extraction blanks. PFAS concentrations in textiles were then calculated by Eq. (2).

# A.5.3. Reporting Limits

Target PFAS reporting limits in textile extracts ( $\mu g/m^3$ ) were determined for each analyte in each extraction batch as the average concentration in triplicate solvent only or OS-FSC textile blank extracts plus the higher of either (a) three times the standard deviation among the associated blanks or (b) the nominal concentration of the lowest calibrant for which recovery of 70 % - 130% was obtained. Reporting limits were calculated for each textile extract ( $\mu g/kg$ ) by multiplying the analyte- and batch-specific reporting limit ( $\mu g/m^3$ ) by the extract concentration factor ( $m^3$ )

extract/kg extracted textile). Determined average reporting limits associated with all triplicate measurements are provided with those measurements (Tables 2-21). For reporting consistency, PFAS concentrations in firefighter turnout gear textiles were only reported when at least two of the triplicate extracts had concentrations above the reporting limit.

### A.6. Quality Control Results

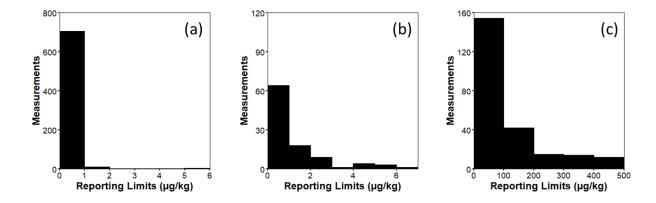
Reporting limits and blank derived background correction concentrations were determined for each PFAS within each extraction batch. Additionally, all nonvolatile PFAS calibrations were confirmed with independent calibration verification solutions (i.e., NIST RMs 8446 & 8447) and all nonvolatile, semivolatile, and volatile extraction batches included the analysis of an in-house reference textile (i.e., OS-FRM).

### A.6.1. Textile Extraction Blanks and Background Correction

OS-FSC was a "scoured" outer shell textiles that had not received DWR treatment. Prior to the extraction of other sample textiles, extracts of OS-FSC were prepared and compared against solvent-only extraction blanks to evaluate their potential use as textile extraction blank materials. This initial analysis of OS-FSC with solvent only extraction blanks found that all PFAS were present below reporting limits and this textile which was subsequently used as an extraction blank material for the determination of blank correction amounts and reporting limits in the remaining moisture barrier, outer shell, and thermal liner sample textiles. A subsequent analysis of OS-FSC, again with solvent only extraction blanks, did find measurable PFHxA concentrations (0.335  $\mu$ g/kg  $\pm$  0.032  $\mu$ g/kg; Table 15), while no other nonvolatile, semivolatile, or volatile PFAS was observed above the reporting limits. This may indicate that the PFHxA concentrations reported here in the examined moisture barrier, outer shell, and thermal liner textiles, which were determined by comparison with OS-FSC-containing textile extraction blanks, underestimate the true PFHxA concentrations in those textiles. However, the PFHxA concentration reported in OS-FSC is similar to the reporting limits in the remaining textiles (0.128  $\mu$ g/kg - 1.18  $\mu$ g/kg) and far below the mean PFHxA concentrations measured in the remaining textiles (6.5  $\mu$ g/kg).

## A.6.2. Reporting Limits

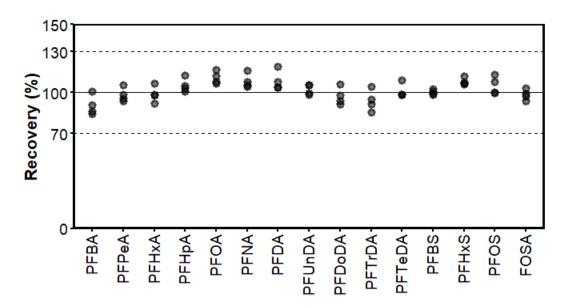
Reporting limits determined for each measurement are shown in Tables 2-21. Histograms of the reporting limits for measurements made with each of the three analytical methods are shown in Fig. 18. Virtually all the reporting limits for nonvolatile (729 out of 733) and semivolatile (82 out of 100) PFAS measurements were  $< 2 \mu g/kg$ . Reporting limits for volatile PFAS were much higher, 237 reported volatile GC measurements were associated with reporting limits over  $7 \mu g/kg$  and 83 measurements were associated with reporting limits over  $100 \mu g/kg$ .



**Fig. 16.** Histograms of reporting limits for individual measurements of (a) all nonvolatile PFAS (binwidth =  $1 \mu g/kg$ ), (b) all semivolatile PFAS (binwidth =  $1 \mu g/kg$ ), and (c) all volatile PFAS (binwidth =  $100 \mu g/kg$ ).

#### A.6.3. NIST Reference Materials 8446 and 8447

Nonvolatile PFAS concentrations in extracts of firefighter turnout gear textiles were determined across four analytical sequences. Gravimetric dilutions of NIST RMs 8446 Perfluorinated Carboxylic Acids and Perfluoroctane Sulfonamide in Methanol as well as 8447 Perfluorinated Sulfonic Acids in Methanol were prepared and analyzed with each sequence and measured concentrations were between 84.3 % - 119 % of the reference values for all analytes (Fig. 16) 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. 17.** Recoveries of reference PFAS in NIST reference materials 8446 and 8447 across four nonvolatile PFAS analytical batches. 100 % recovery is indicated with a solid line while 70 % and 130 % recoveries are indicated with dashed lines.

# A.6.4. Method Reproducibility Material (OS-FRM)

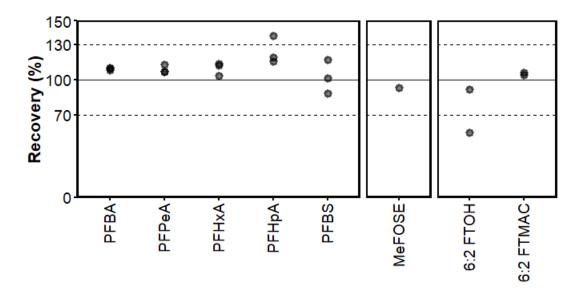
As described above, 400 cuttings of OS-FRM were prepared and 12 cuttings were extracted and analyzed for nonvolatile PFAS while a separate 12 cuttings were extracted and analyzed for semivolatile and volatile PFAS. Ten volatile PFAS, one semivolatile PFAS, and two volatile PFAS were quantified above the reporting limits in at least 10 of 12 replicate OS-FRM extracts and the averages and standard deviations of measured concentrations are shown in Table 36. While seven of the 13 PFAS quantified in OS-FRM were PFCAs with between three and eight perfluorinated carbons, they only accounted for 7.2 % of the summed PFAS mass while 6:2 FTOH and 6:2 FTMAC, both volatile fluorotelomer-based PFAS with six perfluorinated carbons accounted for 92.6 % of the summed PFAS mass.

Differences in reporting limits among nonvolatile PFAS (typically on the order of 0.1  $\mu g/kg$ ), semivolatile PFAS (typically on the order of 1  $\mu g/kg$ ), and volatile PFAS (typically on the order of 100  $\mu g/kg$ ) may contribute to the identification of more nonvolatile PFAS despite volatile PFAS being present at higher concentrations.

**Table 36**. Average and standard deviation of PFAS concentrations (ug/kg) in twelve replicates of OS-FRM. PFAS concentrations that were below the reporting limit were not included in average and standard deviation calculations.

PFAS	(µg/kg)
Nonvolatile PFAS	
PFBA	$11.69 \pm 0.48$
PFPeA	$12.81 \pm 0.73$
PFHxA	$38.1 \pm 3.2$
PFHpA	$5.37 \pm 0.43$
PFOA	$0.369 \pm 0.075$
PFNA	$0.214 \pm 0.048$
PFDA	$0.316 \pm 0.051$
PFBS	$1.38 \pm 0.29$
FBSA	$0.333 \pm 0.018$
FHxSA	$0.0345 \pm 0.005$
Semivolatile PFAS	
MeFOSE	$0.53 \pm 0.12$
Volatile PFAS	
6:2 FTOH	$273 \pm 39$
6:2 FTMAC	$613 \pm 107$

After the initial analysis of twelve replicates of OS-FRM, each subsequent extraction batch included a single cutting of OS-FRM to determine extraction consistency. For these subsequent extraction batches, the recovery of all analytes where concentrations over  $0.5 \,\mu g/kg$  were reported in the initial analysis are shown in Fig. 17. Except for a single analysis each of PFHpA (137 %) and 6:2 FTOH (55.1 %) all reported measurements of these higher concentration PFAS were between 88.1 - 119 %, which suggests that extraction procedures were performed consistently among extraction batches.



**Fig. 18**. OS-FRM recovery across four nonvolatile/LC batches, one semivolatile batch, and two GC batches. 100 % recovery is indicated with a solid line while 70 % and 130 % recoveries are indicated with dashed lines.

# A.7. Appendix References

[1] Robel AE, Marshall K, Dickinson M, Lunderberg D, Butt C, Peaslee G, Stapleton HM, Field JA (2017) Closing the mass balance on fluorine on papers and textiles. Environmental Science & Technology 51(16):9022-9032. <a href="https://doi.org/10.1021/acs.est.7b02080">https://doi.org/10.1021/acs.est.7b02080</a>

A.8. Abbreviations

6:2 FTMAC

6:2 fluorotelomer methacrylate

**6:2 FTOH** 

6:2 fluorotelomer alcohol

6:2 FTS

6:2 fluorotelomer sulfonate

**ADONA** 

4,8-dioxa-3H-perfluorononanoate

**CAS RN** 

Chemical Abstract Service Registry Number

CCB

Continuing calibration blank

CCV

Continuing calibration verification

CE

Collision energy

**CSD** 

Chemical Sciences Division

**CXP** 

Collision cell exit potential

DP

Depolarization energy

**DWR** 

Durable water repellent

**ECF** 

Electrochemical fluorination

EP

Entrance potential

**ePTFE** 

Expanded polytetrafluoroethylene

FASA

Perfluoroalkane sulfonamide

**FASAA** 

Per- and polyfluoroalkane sulfonamido acetic acid

**FASE** 

Perfluoroalkane sulfonamido ethanol

**FBSA** 

Perfluorobutane sulfonamide

**FRD** 

Fire Research Division

FΤ

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

**MeFBSE** 

N-Methyl perfluorobutane sulfonamidoethanol

**MRM** 

Multiple reaction monitoring

MS

Mass spectrometry

MS/MS

Tandem mass spectrometry

m/z

mass-to-charge ratio

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

**MeFASE** 

N-Methylperfluoroalkyl sulfonamidoethanol

NFPΔ

National Fire Protection Association

NIST TN 2248 May 2023

**NIST** 

National Institute of Standards and Technology

os

Outer shell

**PEEK** 

Polyetheretherketone

**PFAS** 

Per- and polyfluoroalkyl substances

PFBA

Perfluorobutanoic acid

**PFBS** 

Perfluorobutane sulfonic acid

PFCA

Perfluorocarboxylic acid

**PFDA** 

Perfluorodecanoic acid

**PFHpA** 

Perfluoroheptanoic acid

**PFHxA** 

Perfluorohexanoic acid

**PFPeA** 

Perfluoropentanoic acid

**PFNA** 

Perfluorononanoic acid

**PFOA** 

Perfluorooctanoic acid

**PFOS** 

Perfluorooctane sulfonic acid

PFSA

Perfluoroalkane sulfonic acid

**PPEA** 

Per- and polyfluoroalkyl ether acid

PTFE

Polytetrafluoroethylene

QC

Quality control

RL

Reporting limit

RM

Reference material

RT

Retention time

SC

"Scoured" outer shell

SPE

Solid phase extraction

TL

Thermal liner