## TN-0155

# Evaluation of Extraction Options for EPA Method 1633

**Adam Robinson[1], Thushara Johnson[1], Adnan Khan[1], Heather Lord, PhD[1],Richard Jack, PhD[2], Sam Lodge[2], and Bryan Tackett, PhD[2]**
[1]Bureau Veritas, 6740 Campobello Road, Mississauga, ON, L5N 2L8 Canada
[2]Phenomenex, Inc., 411 Madrid Ave., Torrance, CA 90501 USA

## Introduction

PFAS compounds are present in all environmental matrices, including water, soil, air, and living organisms. Due to the persistent nature of these compounds, as well as their ability to be easily transported in the environment, there is a significant push to regulate them. The EPA has developed a PFAS Strategic Roadmap to outline the steps needed "to further the science and research, to restrict these dangerous chemicals from getting into the environment, and to immediately move to remediate the problem in communities across the country." One of these steps was to develop and promulgate a standardized method of testing for PFAS in non-Drinking Water matrices. The EPA, in collaboration with the Department of Defense (DOD), has published Method 1633 to test for 40 PFAS compounds in wastewater, surface water, groundwater, soil, biosolids, sediment, landfill leachate, and fish tissue.

This method involves a two-step sample prep approach using a weak anion exchange (WAX) SPE cartridge and graphitized carbon black (GCB) clean-up in a powder format, known as dispersive Solid Phase Extraction (dSPE). For water samples, GCB is added after WAX extraction, but for soil samples the GCB is added before the WAX SPE step. The purpose of the additional GCB clean-up step is to eliminate matrix that can cause interference and reduce bias. GCB has been shown to remove organic acids (such as humic and cholic acids), which can suppress ionization and lead to low bias on the recoveries (especially for PFOS). However, limitations of using GCB are well known in that this media can bind to longer chain PFAS compounds and lead to lower recoveries. This is stated in the EPA Method 1633, "…It is important to minimize the time the sample extract is in contact with the carbon." Besides these practical limitations, adding GCB in a dSPE step is very labor intensive and therefore not practical due to the extra time needed to add, mix, and centrifuge for each sample, especially in high throughput laboratories. This step can also lead to higher RSD values. To address these practical limitations, EPA Method 1633 Section 12.2.3 states, "The use of two stacked SPE cartridges, the first containing the WAX sorbent and the second containing the activated carbon, or other cartridge configurations may be employed in place of the use of the loose carbon described above."

Strata™ PFAS cartridges were developed as a single cartridge stacked with Strata-X-AW and Strata GCB sorbents that function as a traditional SPE cartridge with a built-in polishing step to meet the method guidelines. We have previously demonstrated the utility of the Strata PFAS stacked SPE format for PFAS analysis following DOD QSM 5.2/Table B15 for a variety of water matrices (TN-0145). We have shown that using a single, stacked WAX/GCB is cheaper, easier, and ultimately yields better recoveries for PFAS analytes from various water samples. This technical note presents a study to validate method performance for the broader compound list in EPA 1633 and demonstrate the same utility for both water and soil extracts.

## Sample Preparation

As a guidance method, EPA Method 1633 makes provisions to demonstrate equivalency as described in section 9.1.2a "… laboratory is permitted certain options to improve separations or lower the costs of measurements. These options include alternative extraction, concentration, and clean-up procedures, and changes in sample volumes, columns, and detectors." In addition, Section 7.1.7 indicates that "once the method is multi-laboratory validated, laboratories will have the flexibility to use carbon cartridges as long as all method QC criteria are met." In order to demonstrate equivalency, the Initial Precision and Recovery (IPR) as described in EPA Method 1633 section 9.2.1 was used for the comparison studies for water and soil matrices. For the water extract comparisons, 500 mL of reagent water per sample was used for 4 samples. For the soil comparison study, 5 g of Ottawa sand was used per sample for 4 samples, and all were spiked and extracted. Our extraction panel was expanded by adding three (3) additional analytes to reflect the California water board panel for PFAS compounds in wastewater discharges. Extracted Internal Standards (EIS) were added to all samples: 100 µL of Wellington MPFAC-HIF-ES 10x diluted + 13C2-PFHxDA at 25 ng/mL and 13C2D4-10:2-FTS at 100 ng/mL. The spike recoveries were compared with an injection internal standard fortified after extraction and results shown are in percent recovery. For details of the extraction procedure please refer to EPA Method 1633.

## LC Conditions

| | |
|---|---|
| **Column:** | Fully Porous Sub-2 µm C18 |
| **Dimensions:** | 50 x 2.1 mm |
| **Guard Column:** | SecurityGuard™ ULTRA for EVO-C18 (AJ0-9296) |
| **Delay Column Dimensions:** | 30 x 4.6 mm |
| **Mobile Phase:** | A: 2 mM Ammonium Acetate in (95:5, v/v) Water / Acetonitrile<br>B: Acetonitrile |
| **Gradient:** | |

| Time (min) | %B | Flow Rate (mL/min) |
|---|---|---|
| 0 | 2 | 0.35 |
| 0.2 | 2 | 0.35 |
| 4 | 30 | 0.4 |
| 7 | 55 | 0.4 |
| 9 | 75 | 0.4 |
| 10 | 95 | 0.4 |
| 10.4 | 2 | 0.4 |
| 11.8 | 2 | 0.4 |
| 12 | 2 | 0.35 |

| | |
|---|---|
| **Injection Volume:** | 2 µL |
| **Temperature:** | 40 °C |
| **LC System:** | Agilent® 1290 Infinity |
| **Detection:** | MRM |
| **Detector:** | Agilent 6495 |

## MS Conditions

| | |
|---|---|
| **Polarity:** | Negative |
| **Capillary Voltage:** | 2000 |
| **Nebulizer Pressure (psi):** | 25 |
| **Gas Temperature:** | 120 °C |
| **Gas Flow (L/min):** | 11 |
| **Sheath Gas Heater Temperature:** | 300 °C |
| **Sheath Gas Flow:** | 11 |
| **Cell Accelerator Voltage:** | 4 |
| **Collision Energy (CE):** | Compound Dependent |

## Equivalency Studies from Water Samples

For water samples, the precision of the extractions was determined by comparing the %RSD of spiked native PFAS analytes between Waters® Oasis® WAX + dSPE with GCB, Strata™-X-AW + dSPE with GCB, and Strata PFAS WAX/GCB cartridges shown in **Figure 1**. Water samples were extracted using two different procedures based on the SPE cartridges. Samples were either extracted with WAX followed by GCB powder as described in EPA 1633 for the Oasis WAX and the Strata-X-AW cartridges. For the dual stacked Strata PFAS, the GCB cleanup step was not used. **Table 1** shows the PFAS panel, spike concentrations, % recoveries, and %RSD for the different SPE cartridges.

**Figure 2** and **3** show the extraction precision of the PFAS analytes from the 4 water samples as %RSD for native and extracted internal standards (EIS). These results are compared with those obtained from the single lab, Draft Method (see labels "Table 5"). Overall, the precision was lower in our studies when compared to the published method. Though there were minor variations between the phases, the precision difference between the phases was not statistically significant within the sample size. Perfluorooctadecanoic Acid (PFODA) is not included in EPA Method 1633 but was added to this study as one of the standards tested per the CA water board recommendations.[2] This analyte had the poorest precision but still well below 15 %.

**Figure 1.** SPE Cartridges Used for the Comparison Study. Note the Order of the WAX/GCB vs. GCB/WAX for the Water and Soil Matrices, Respectively.

Waters Oasis WAX

150mg WAX

30 µm Particles
80 Å Pore Size
pKas 3.70 and 8.95
(Piperazine)

Strata-X-AW

150mg WAX
Part No.: 8B-S038-SCH

30 µm Particles
80 Å Pore Size
pKa 6.09 and 9.27
(Ethylenediamine)

Strata PFAS
WAX/GCB

200mg WAX / 50mg GCB
Part No.: CS0-9207
For water extraction

WAX
  50 µm Particles
  80 Å Pore Size
GCB
  120-400 mesh
  85 m$^2$/g surface area

Strata PFAS
GCB/WAX

50mg GCB / 200mg WAX
Part No.: CS0-9214
For soil/tissue extraction

GCB
  120-400 mesh
  85 m$^2$/g surface area
WAX
  50 µm particles
  80 Å pore size

**Table 1.** Comparison of PFAS Percent Spike Recoveries in Water Extracts and %RSD Using Different SPE Phases.

| | | Strata-X-AW | | Strata PFAS WAX/GCB | | Oasis WAX | |
|---|---|---|---|---|---|---|---|
| **Analyte** | **Spike (ng/L)** | **% Rec.** | **%RSD** | **% Rec.** | **%RSD** | **% Rec.** | **%RSD** |
| PFBA | 230.40 | 99 | 2.2 | 103 | 1 | 90 | 2 |
| PFPeA | 115.20 | 103 | 1.3 | 103 | 2 | 90 | 2 |
| PFHxA | 57.60 | 102 | 2.2 | 105 | 3 | 89 | 3 |
| PFHpA | 57.60 | 59 | 2.5 | 101 | 4 | 90 | 2 |
| PFOA | 57.60 | 58 | 1.3 | 102 | 4 | 91 | 3 |
| PFNA | 57.60 | 100 | 3.2 | 102 | 3 | 90 | 3 |
| PFDA | 57.60 | 99 | 3.4 | 103 | 1 | 89 | 3 |
| PFUnA | 57.60 | 105 | 1.5 | 104 | 2 | 90 | 2 |
| PFDoA | 57.60 | 102 | 2.9 | 103 | 4 | 91 | 3 |
| PFTrDA | 57.60 | 104 | 4.5 | 110 | 4 | 100 | 1 |
| PFTeDA | 57.60 | 101 | 1.5 | 101 | 3 | 93 | 3 |
| PFHxDA | 57.60 | 98 | 1.5 | 103 | 2 | 96 | 6 |
| PFoDA | 57.60 | 116 | 4.6 | 76.2 | 14 | 87 | 13 |
| PFBS | 51.10 | 101 | 1.3 | 102 | 1 | 89 | 3 |
| PFPeS | 54.20 | 101 | 2.4 | 102 | 2 | 89 | 1 |
| PFHxS | 52.60 | 101 | 2.6 | 101 | 2 | 89 | 1 |
| PFHpS | 54.90 | 104 | 1.3 | 111 | 1 | 90 | 2 |
| PFOS | 53.50 | 104 | 1.5 | 105 | 3 | 90 | 2 |
| PFNS | 55.40 | 108 | 2.5 | 106 | 2 | 91 | 2 |
| PFDS | 55.60 | 105 | 0.77 | 107 | 2 | 89 | 3 |
| PFDoS | 55.90 | 98.3 | 2 | 90.5 | 5 | 81 | 5 |
| 4:2-FTS | 216.00 | 102 | 0.32 | 102 | 2 | 90 | 4 |
| 6:2-FTS | 218.90 | 98.9 | 2.5 | 97.1 | 2 | 88 | 2 |
| 8:2-FTS | 221.20 | 102 | 2.4 | 103 | 4 | 89 | 6 |
| 10:2-FTS | 222.60 | 97.9 | 4.3 | 105 | 3 | 83 | 5 |
| PFOSA | 57.60 | 102 | 1.6 | 105 | 2 | 91 | 2 |
| MeFOSA | 57.60 | 101 | 3.4 | 97.5 | 3 | 92 | 2 |
| EtFOSA | 57.60 | 101 | 4 | 102 | 4 | 92 | 4 |
| MeFOSAA | 57.60 | 106 | 2.9 | 102 | 1 | 91 | 4 |
| EtFOSAA | 57.60 | 101 | 2.8 | 104 | 4 | 90 | 1 |
| MeFOSE | 576.00 | 101 | 1.5 | 107 | 2 | 89 | 1 |
| EtFOSE | 576.00 | 103 | 0.4 | 102 | 1 | 92 | 1 |
| HFPO-DA | 230.40 | 107 | 0.79 | 108 | 2 | 87 | 1 |
| ADONA | 217.70 | 105 | 0.94 | 110 | 3 | 87 | 2 |
| PFMPA | 115.20 | 29 | 7 | 106 | 2 | 70 | 7 |
| PFMBA | 115.20 | 109 | 4.5 | 105 | 2 | 88 | 2 |
| NFDHA | 1152.00 | 103 | 2.3 | 125 | 10 | 82 | 5 |
| 9Cl-PF3ONS | 215.40 | 104 | 5.5 | 105 | 4 | 84 | 2 |
| 11Cl-PF3OUdS | 217.70 | 105 | 5.3 | 104 | 3 | 82 | 3 |
| PFEESA | 102.50 | 101 | 1.2 | 106 | 3 | 87 | 3 |
| 3:3-FTCA | 288.00 | 80 | 14 | 101 | 2 | 66 | 6 |
| 5:3-FTCA | 1440.00 | 101 | 1.5 | 101 | 3 | 90 | 4 |
| 7:3-FTCA | 1440.00 | 101 | 0.9 | 100 | 4 | 91 | 4 |

**Figure 2.** %RSD of Spiked, Native PFAS Compounds from Water Samples. Precision Represents the Average of n=4 Extracts. The Green Dots are the %RSD from EPA Method 1633 "Table 5."

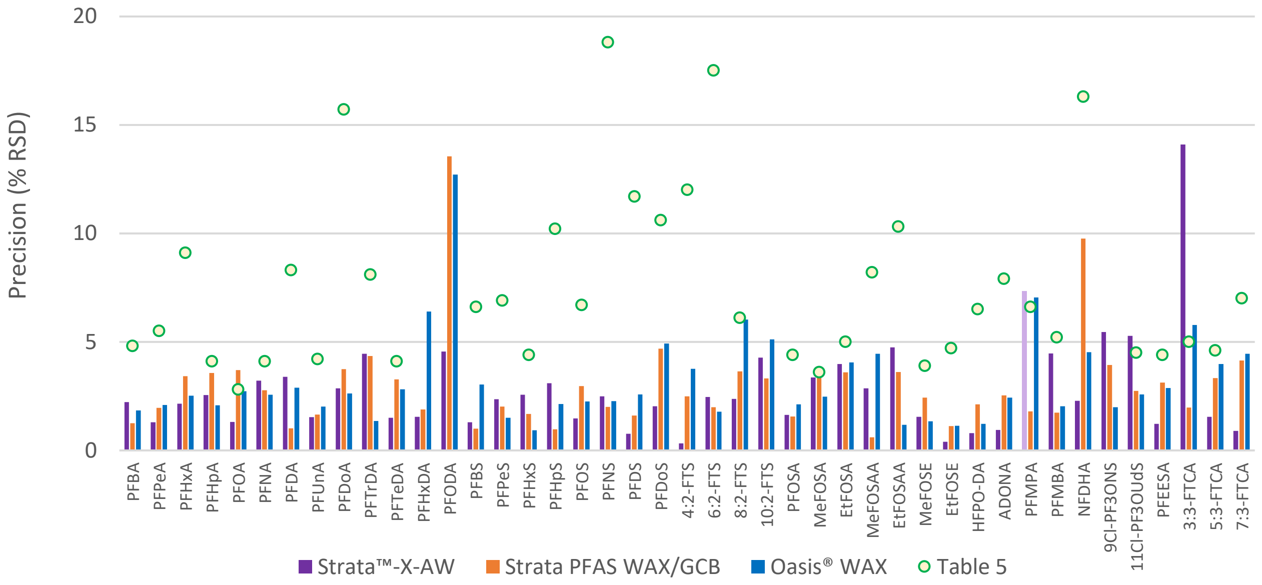
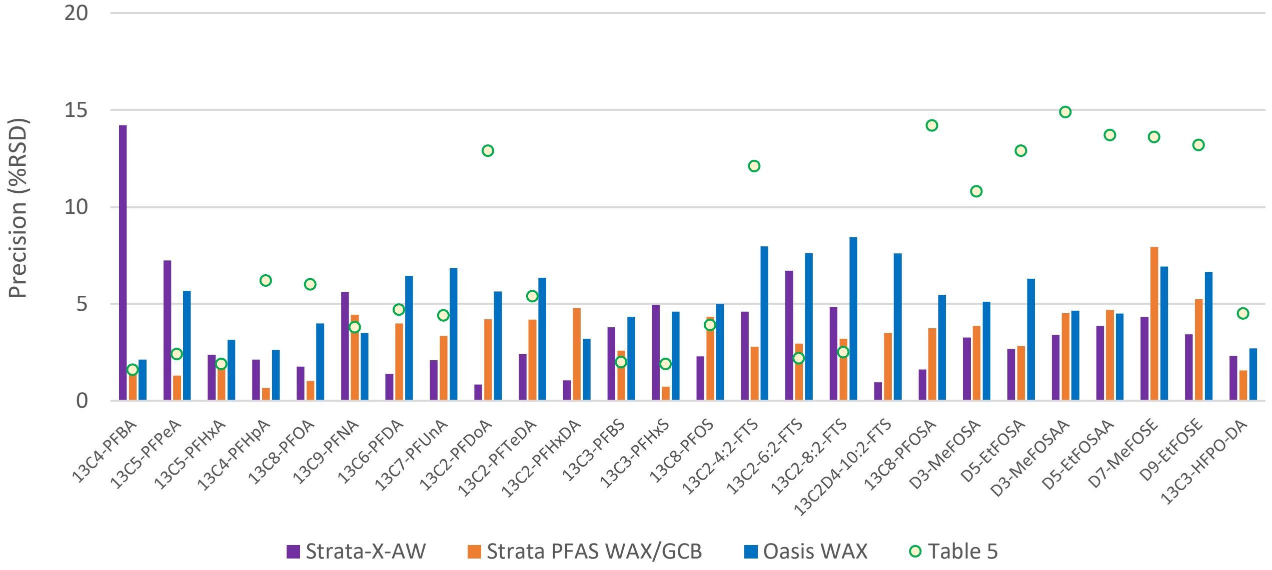


**Figure 3.** %RSD of Spiked, EIS from Water Samples. Precision Represents the Average of n=4 Extracts. The Green Dots are the %RSD from EPA Method 1633 "Table 5."



## Equivalency Studies from Soil Extracts

Per EPA Method 1633, soil extraction requires using an initial 0.3 % Methanolic Ammonium Hydroxide (see section 11.3.4 - 11.3.7) extraction, GCB clean-up by dSPE, followed by SPE using a WAX cartridge. Thus, the dSPE clean-up and WAX SPE are in a reverse order compared to the water samples. To simplify clean-up and SPE into a single step, we used a stacked cartridge that had GCB on top of the WAX SPE (the reverse order) compared to the format used for the water samples. Table 2 shows the PFAS panel, spike concentrations, % recoveries, and %RSD comparison between Strata PFAS GCB/WAX and Oasis WAX + GCB dSPE. The precision for the soil extraction are shown as %RSD for both native and extracted internal standards in **Figures 4** and **5**, respectively. These results are compared with those obtained from the single lab, Draft Method. The %RSD for the native standards had excellent precision below 10 % for all PFAS standards except for PFODA. Both procedures produced equivalent results for the cartridge comparison tests.

**Table 2.** Comparison of PFAS Percent Spike Recoveries in Water Extracts and %RSD Using Different SPE Phases.

| | | Strata™ PFAS GCB/WAX | | Oasis® WAX + GCB dSPE | |
|---|---|---|---|---|---|
| **Analyte** | **Spike (ng/g)** | **% Rec.** | **%RSD** | **% Rec.** | **%RSD** |
| PFBA | 23.0 | 102 | 1.2 | 105 | 1.4 |
| PFPeA | 11.5 | 102 | 0.9 | 105 | 1.9 |
| PFHxA | 5.8 | 101 | 2.0 | 105 | 1.6 |
| PFHpA | 5.8 | 102 | 1.4 | 104 | 1.6 |
| PFOA | 5.8 | 100 | 2.8 | 104 | 2.4 |
| PFNA | 5.8 | 100 | 1.2 | 104 | 3.3 |
| PFDA | 5.8 | 97.3 | 1.6 | 102 | 2.7 |
| PFUnA | 5.8 | 100 | 3.6 | 107 | 3.1 |
| PFDoA | 5.8 | 102 | 1.3 | 108 | 3.3 |
| PFTrDA | 5.8 | 103 | 1.8 | 104 | 3.9 |
| PFTeDA | 5.8 | 98.4 | 0.7 | 105 | 2.3 |
| PFHxDA | 5.8 | 95.3 | 4.8 | 106 | 5.2 |
| PFoDA | 5.8 | 73.8 | 21 | 138 | 23 |
| PFBS | 5.1 | 101 | 0.68 | 105 | 1.4 |
| PFPeS | 5.4 | 101 | 2.9 | 99.6 | 2.4 |
| PFHxS | 5.3 | 100.6 | 2.7 | 101 | 2.4 |
| PFHpS | 5.5 | 100 | 4.6 | 104 | 1.5 |
| PFOS | 5.3 | 99.7 | 4.4 | 104 | 2.4 |
| PFNS | 5.5 | 101 | 5.1 | 107 | 2.8 |
| PFDS | 5.6 | 98.5 | 4.7 | 102 | 2.8 |
| PFDoS | 5.6 | 91.0 | 5.9 | 106 | 6.0 |
| 4:2-FTS | 21.6 | 103 | 3.3 | 101 | 3.2 |
| 6:2-FTS | 21.9 | 99.8 | 2.3 | 107 | 5.0 |
| 8:2-FTS | 22.1 | 96.6 | 3.3 | 105 | 2.6 |
| 10:2-FTS | 22.3 | 101 | 3.6 | 105 | 4.3 |
| PFOSA | 5.8 | 99.4 | 1.4 | 112.6 | 5.6 |
| MeFOSA | 5.8 | 103 | 3.4 | 115 | 8.0 |
| EtFOSA | 5.8 | 105 | 7.4 | 116 | 8.2 |
| MeFOSAA | 5.8 | 101 | 3.7 | 104 | 5.4 |
| EtFOSAA | 5.8 | 104 | 3.2 | 107 | 3.2 |
| MeFOSE | 57.6 | 101 | 1.4 | 109 | 4.9 |
| EtFOSE | 57.6 | 99.5 | 1.5 | 104 | 6.4 |
| HFPO-DA | 23.0 | 106 | 1.3 | 102 | 1.5 |
| ADONA | 21.8 | 106 | 1.7 | 103 | 1.0 |
| PFMPA | 11.5 | 99.3 | 2.3 | 100 | 1.6 |
| PFMBA | 11.5 | 101 | 0.94 | 103 | 2.4 |
| NFDHA | 115.2 | 105 | 2.4 | 98.0 | 2.9 |
| 9Cl-PF3ONS | 21.5 | 107 | 4.2 | 108 | 2.9 |
| 11Cl-PF3OUdS | 21.8 | 103 | 2.9 | 108 | 3.9 |
| PFEESA | 10.3 | 101 | 2.2 | 102 | 1.1 |
| 3:3-FTCA | 28.8 | 82.3 | 5.8 | 91.3 | 4.7 |
| 5:3-FTCA | 144 | 98.4 | 1.8 | 101 | 0.93 |
| 7:3-FTCA | 144 | 96.5 | 1.7 | 102 | 0.61 |

**Figure 4.** %RSD of Spiked, Native PFAS Compounds from Soil Extracts. Precision Represents the Average of n=4 Extracts. The Green Dots are the %RSD from EPA Method 1633 "Table 5."

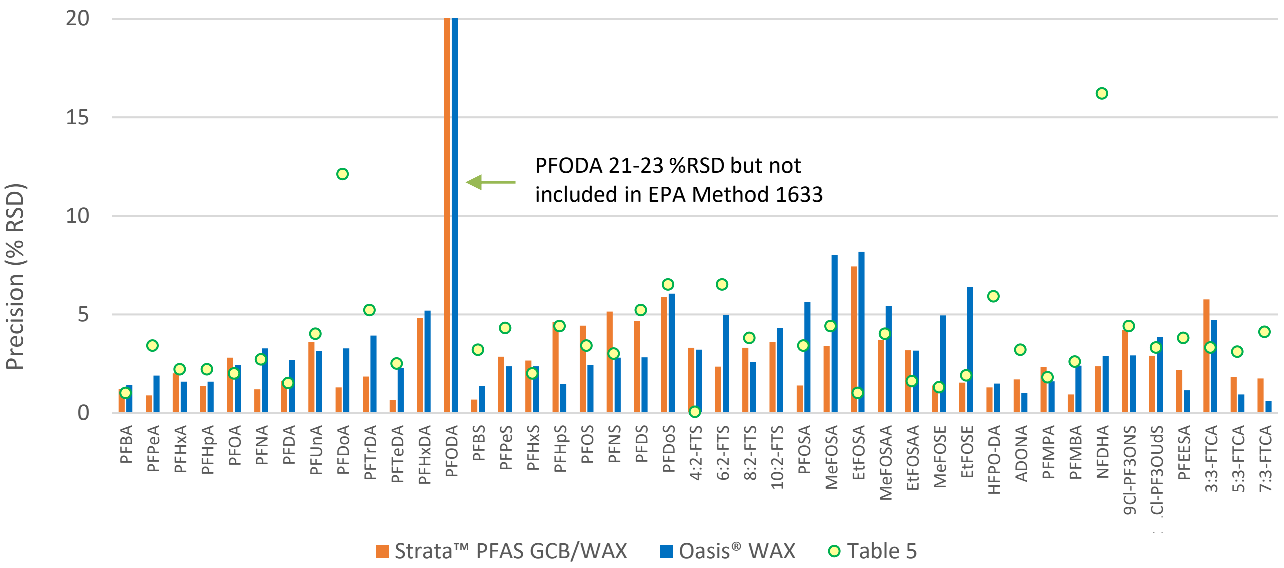
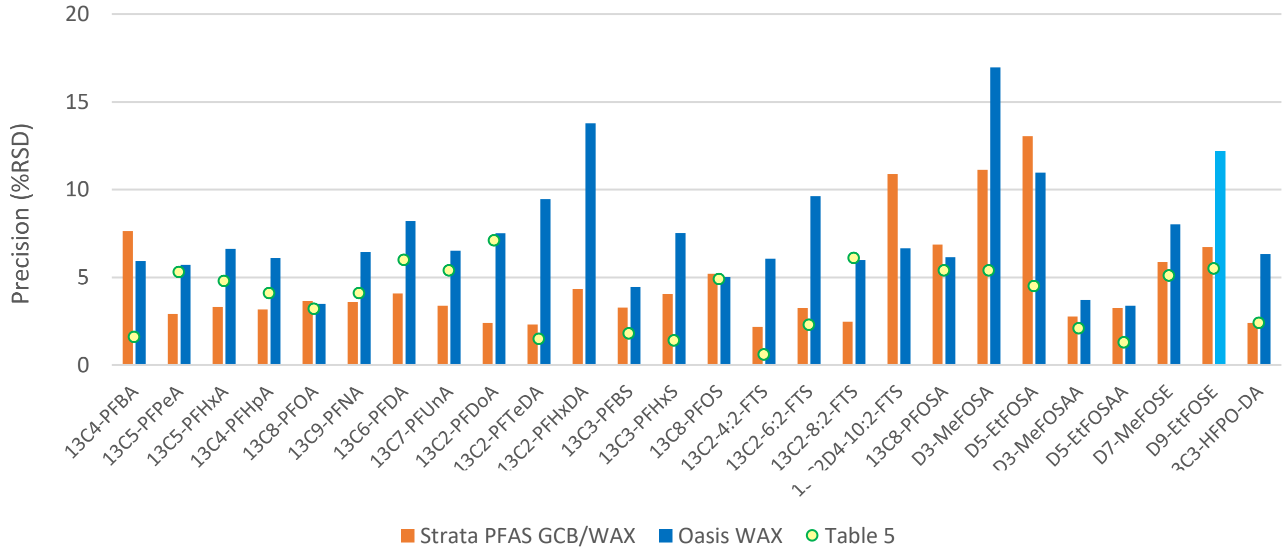


**Figure 5.** %RSD of Spiked, EIS from Soil Extracts. Precision Represents the Average of n=4 Extracts. The Green Dots are the %RSD from EPA Method 1633 "Table 5."



## Conclusions

Our results demonstrate equivalence of Strata™ PFAS stacked SPE format (compared to WAX + GCB dSPE) for an EPA 1633 PFAS panel from water samples and soil extracts. Importantly, Strata PFAS dual layer cartridges (with elimination of dSPE) provides equivalent performance to WAX cartridges specified in EPA Method 1633 for all 40 EPA 1633 parameters plus PFHxDA, PFODA, and 10:2FTS for both soil and water, as per IDOC requirements (Section 9.1.2) and DOD QSM 5.4 Table B-24. For the soil extract, only PFODA (which is not included in EPA 1633 PFAS panel) failed the IDC for both procedures. In our laboratory, the elimination of adding GCB in a dSPE step reduces labor per analytical batch (20 samples) by approximately 30 minutes for manual cartridge SPE clean-up. Elimination of the filtration step would provide a further 30 min labor reduction. Incorporation of the dual layer cartridges into the workflow enables automation of the full clean-up procedure, with the potential for a significant reduction in labor and improvements in data reproducibility.

## References

1. Office of Science and Technology. (2024, January). Method 1633: Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS. (EPA 821-R-24-001). Environmental Protection Agency. Office of Water.

2. WATER CODE SECTIONS 13267 AND 13383 ORDER FOR THE DETERMINATION OF THE PRESENCE OF PER- AND POLYFLUOROALKYL SUBSTANCES AT PUBLICLY OWNED TREATMENT WORKSORDER WQ 2020-0015-DWQ. CA Water Board www.waterboards.ca.gov

## SecurityGuard™ ULTRA Cartridges Ordering Information

| | | | Column ID (mm) | | |
|---|---|---|---|---|---|
| **Material** | **Description** | **pH Stability** | **2.1** | **3.0** | **4.6** |
| | | | /3pk | /3pk | /3pk |
| EVO C18 | (ODS, Octadecyl) | 1.0 – 12.0 | AJ0-9298 | AJ0-9297 | AJ0-9296 |
| C18 | (ODS, Octadecyl) | 1.5 – 8.5* | AJ0-8782 | AJ0-8775 | AJ0-8768 |
| C8 | (MOS, Octyl) | 1.5 – 8.5* | AJ0-8284 | AJ0-8777 | AJ0-8770 |
| PFP | (Pentafluorophenyl) | 1.5 – 8.5* | AJ0-8287 | AJ0-8780 | AJ0-8773 |
| F5 | (Pentafluorophenyl) | 1.5 – 8.5* | AJ0-9322 | AJ0-9321 | AJ0-9320 |
| Biphenyl | (Biphenyl) | 1.5 – 8.5* | AJ0-9209 | AJ0-9208 | AJ0-9207 |
| Phenyl | (Phenylhexyl) | 1.5 – 8.5* | AJ0-8788 | AJ0-8781 | AJ0-8774 |
| HILIC | (HILIC) | 2.0 – 7.5 | AJ0-8786 | AJ0-8779 | AJ0-8772 |
| Polar C18 | (Polar Functional C18) | 1.5 – 8.5* | AJ0-9532 | AJ0-9531 | AJ0-9530 |

*pH stable 1.5 – 8.5 under gradient conditions. pH stable 1.5–10 under isocratic conditions.
AJ0-9000 is the universal holder designed for use with 2.1mm, 3.0mm and 4.6mm ID cartridges.

## Strata™-X-AW Ordering Information

| **Strata** | | | |
|---|---|---|---|
| **Format** | **Sorbent Mass** | **Part Number** | **Unit** |
| **Tube** | | | |
|  | 100 mg | 8B-S038-EBJ | 3 mL (50/box) |
| | 100 mg | 8B-S038-ECH | 6 mL (30/box) |
| | 150 mg | 8B-S038-SCH | 6 mL (30/box) |
| | 200 mg | 8B-S038-FBJ | 3 mL (50/box) |
| | 200 mg | 8B-S038-FCH | 6 mL (30/box) |
| | 500 mg | 8B-S038-HBJ | 3 mL (50/box) |
| | 500 mg | 8B-S038-HCH | 6 mL (30/box) |
| **Giga™ Tube** | | | |
|  | 500 mg | 8B-S038-HDG | 12 mL (20/box) |
| | 1 g | 8B-S038-JDG | 12 mL (20/box) |
| | 1 g | 8B-S038-JEG | 20 mL (20/box) |
| | 5 g | 8B-S038-LFF | 60 mL (16/box) |

## Strata PFAS Ordering Information

| **Strata** | | |
|---|---|---|
| **Sorbent Mass** | **Part Number** | **Unit** |
| | | |
| 200 mg / 50 mg (WAX/GCB) | CS0-9207 | 6 mL (30/box) |
| 250 mg / 50 mg (WAX/GCB) | CS0-9215 | 6 mL (200/box) |
| 250 mg / 100 mg (GCB/WAX) | CS0-9217 | 6 mL (30/box) |
| 500 mg / 50 mg (WAX/GCB) | CS0-9208 | 6 mL (200/box) |
| 50 mg / 200 mg (GCB/WAX) | CS0-9214 | 6 mL (30/box) |

## PFAS CRM Native Standards. All analytes at the same concentration in acid form for easy calculation and dilution.

| **Product** | **Part** | **Volume** | **Concentration** |
|---|---|---|---|
| EPA 533 mix | AL0-101838 | 1 mL | 2 µg/mL in Methanol |
| EPA 537.1 mix | AL0-101839 | 1mL | 2 µg/mL in Methanol |
| EPA 533 + 537.1 mix | AL0-101840 | 1 mL | 2 µg/mL in Methanol |

Customized CRMs available. Contact Phenomenex for details.

## Other Recommended Products for Your PFAS Methods

| **Description** | **Part No.** |
|---|---|
| Luna™ Omega Column 3 µm PS C18 50 x 3 mm | 00B-4758-Y0 |
| Kinetex™ EVO Column 5 µm C18 100 x 2.1 mm | 00D-4633-AN |
| Strata SDB-L 500 mg/6mL tubes, 30/pk | 8B-S014-HCH |
| Verex™ Vial, 9 mm Screw, PP, 1.7 mL, 1000/pk | AR0-39P0-13 |
| Verex Vial, 9 mm Screw, PP, 300 µL, 1000/pk | AR0-39P2-13 |
| Verex Vial, 9 mm Screw, PP, 700 µL, 1000/pk | AR0-39P1-13 |
| SecurityCAP™ mobile phase filter for PFAS testing, 6-month capacity, ¼ in-28 thread | AC2-0961-P |
| SecurityCAP mobile phase starter kit for PFAS testing, 3-port GL45 caps and 6-month safety filter | AC2-4345-P |
| SecurityCAP mobile phase starter kit for PFAS testing, 2-port GL45 caps and 6-month safety filter | AC2-4245-P |

Columns and vials available in multiple sizes. Contact Phenomenex for details.

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anfrage@phenomenex.com

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t: +32 (0)2 503 4015 (French)
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beinfo@phenomenex.com

**Canada**
t: +1 (800) 543-3681
info@phenomenex.com

**China**
t: +86 400-606-8099
cninfo@phenomenex.com

**Czech Republic**
t: +420 272 017 077
cz-info@phenomenex.com

**Denmark**
t: +45 4824 8048
nordicinfo@phenomenex.com

**Finland**
t: +358 (0)9 4789 0063
nordicinfo@phenomenex.com

**France**
t: +33 (0)1 30 09 21 10
franceinfo@phenomenex.com

**Germany**
t: +49 (0)6021-58830-0
anfrage@phenomenex.com

**Hong Kong**
t: +852 6012 8162
hkinfo@phenomenex.com

**India**
t: +91 (0)40-3012 2400
indiainfo@phenomenex.com

**Indonesia**
t: +62 21 3952 5747
indoinfo@phenomenex.com

**Ireland**
t: +353 (0)1 247 5405
eireinfo@phenomenex.com

**Italy**
t: +39 051 6327511
italiainfo@phenomenex.com

**Japan**
t: +81 (0) 120-149-262
jpinfo@phenomenex.com

**Luxembourg**
t: +31 (0)30-2418700
nlinfo@phenomenex.com

**Mexico**
t: 01-800-844-5226
tecnicomx@phenomenex.com

**The Netherlands**
t: +31 (0)30-2418700
nlinfo@phenomenex.com

**New Zealand**
t: +64 (0)9-4780951
nzinfo@phenomenex.com

**Norway**
t: +47 810 02 005
nordicinfo@phenomenex.com

**Poland**
t: +48 22 51 02 180
pl-info@phenomenex.com

**Portugal**
t: +351 221 450 488
ptinfo@phenomenex.com

**Singapore**
t: 800-852-3944 (toll free)
t: 6559 4052 (office main line)
sginfo@phenomenex.com

**Slovakia**
t: +420 272 017 077
sk-info@phenomenex.com

**Spain**
t: +34 91-413-8613
espinfo@phenomenex.com

**Sweden**
t: +46 (0)8 611 6950
nordicinfo@phenomenex.com

**Switzerland**
t: +41 (0)61 692 20 20
swissinfo@phenomenex.com

**Taiwan**
t: +886 (0) 0801-49-1246
twinfo@phenomenex.com

**Thailand**
t: +66 (0) 2 566 0287
thaiinfo@phenomenex.com

**United Kingdom**
t: +44 (0)1625-501367
ukinfo@phenomenex.com

**USA**
t: +1 (310) 212-0555
info@phenomenex.com

**All other countries/regions**
**Corporate Office USA**
t: +1 (310) 212-0555
www.phenomenex.com/chat

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