Appendix K

HFPO-DA Data Evaluation

HFPO-DA Evaluation

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Abbreviations

ATG	Alliance Technical Group
CHA	Clean Harbors Aragonite
DRE	destruction and removal efficiency
dscm	dry standard cubic meter
HFPO-DA	Hexafluoropropylene oxide dimer acid
Focus	Focus Environmental, Inc.
ng	nanogram
OTM-45	Other Test Method 45
TMT-15	trimercapto-s-triazine trisodium salt, 15% solution
U.S. EPA	United States Environmental Protection Agency

1 Summary

1.1 Overview

The Other Test Method 45 (OTM-45) test results for the Aragonite project display hexafluoropropylene oxide dimer acid (HFPO-DA) stack gas concentrations of 161, 2645, and 134 ng/dscm corrected to 7% oxygen (O_2) for Runs 1A, 2A, and 3A, respectively. The HFPO-DA DRE values exceed 99.99 percent for Run 1A and Run 1C and exceed 99.95 percent for Run 2A. The OTM-45 sampling train components are believed to have been contaminated at the concentrations listed by an unidentified source resulting in destruction and removal efficiency (DRE) performance values that are biased low. There are several lines of evidence to support this conclusion:

- Two previous test programs in June of 2021 and February of 2022 at the Clean Harbors Aragonite incinerator produced HFPO-DA stack gas concentrations of <0.23 ng/dry standard cubic meter (dscm) @7% O_2 and <7.21 ng/dscm, respectively. The DRE values exceeding 99.9999 percent (2021 test) and greater than 99.999 percent (2022 test) were produced under similar process operating and HFPO-DA spiking conditions.

- HFPO-DA is thermally unstable and decarboxylates at 194°F (Lara Phelps, PFAS Incineration: EPA Activities and Research, ECOS-EPA Bimonthly PFAS Meeting, December 16, 2019)

- Chemical kinetic models indicate that HFPO-DA is much less thermally stable than PFOA and that other shorter chain PFCAs decompose at roughly the same temperature as PFOA (Jens Blotevogel, Robert J. Giraud, Anthony K Rappe, "Incinerability of PFOA and HFPO-DA: Mechanisms, Kinetics, and Thermal Stability Ranking," Chemical Engineering Journal, December 29, 2022 (https://doi.org/10.1016/j.cej.2022.141235).

- The other eight spiked PFAS compounds (with one exception for PFBA on Run 1A) had stack gas concentrations of <5 ng/dscm 7% O_2 as shown in Table 8-1

- HFPO-DA was not detected in any emission control system process residual stream (spray dryer solids, baghouse dust, or brine).

Appendix K presents a detailed discussion of the steps that were taken to investigate the magnitude of the HFPO-DA emissions. Several approaches were taken to attempt to identify potential sources of HFPO-DA contamination:

- Analysis of OTM-45 sample data and QA data

- Analysis of rinses from graduated glass cylinders used in OTM-45 sample preparation

- OTM-45 sample extracts confirmation analysis by a second laboratory

- Post test analysis of samples of the wet scrubber packing materials

- Post test analysis of wipe samples collected on scrubber internal walls

- Post test analysis of new baghouse bag materials

- Post test analysis of OTM-45 sampling train O-rings and filter holders.

Discussions of the results of each of these analyses are presented below.

1.2 Analysis of OTM-45 Sample Data and QA Data

The OTM-45 sampling train and proof blank train analytical data are summarized in Table K-1. The relative amounts of HFPO-DA in each sample fraction for each test run are summarized in Table K-2. The data are presented in a graphical format in Figure K-1. Note that the HFPO-DA mass distribution pattern within the trains shown in Figure K-1 is highly unusual because the largest mass fraction captured for two of the three runs is in the condensate and impinger solvent rinse samples. The back-half fractions, which contain the XAD-2 resin, typically display the largest mass fraction, yet the amount captured in these trains displays the smallest mass for two of the three runs. If the HFPO-DA in these trains been sampled through the OTM-45 sampling train, it would have to come through the probe and particulate filter first, followed by the coil condenser and XAD-2 resin tube, and then to the condensate fraction. A usual HFPO-DA distribution would have the highest mass collected in the Back-half fraction. For the condensate fractions to display the highest mass loading under these conditions, suggest that another means of entry to the sampling train fractions may have taken place. An evaluation of the various blank samples is also undertaken.

The definition of a sampling train proof blank (STPB) from OTM-45 Section 3.32 is as follows:

> "Sampling Train Proof Blank. The complete field assembly and recovery of a clean OTM-45 sampling train without actual sampling, including bringing the train to sampling location, heating, and leak checks. The STFB is conducted using clean glassware that has not been previously used for emissions sampling as part of the current field test. The purpose of the STPB is to determine if method analytes or other interferences are introduced into the sample from the clean, unused sample train glassware, train assembly, preparation, and recovery, including the field environment."

The STPB has a significant concentration of HFPO-DA in the front-half. Though this concentration is significant, it is much lower than the values measured in the front-half for the Run 1A, Run 1B, and Run 1C samples. The analytical result for the back-half was slightly above detection level. The analytical result for the condensate and impinger solvent rinse, and the breakthrough XAD resin are both below detection levels.

The OTM-45 blank sample results for HFPO-DA are presented in Table K-3 and include a glassware rinse proof blank, media blanks, media checks, and method blanks. The results of these analyses are all below detection limits.

It is inferred from the comparison of the analyses of the OTM-45 samples and associated QA data that the sampling train may be a contributor to the elevated level of HFPO-DA in the three sampling runs for the front-half sample. However, the highest concentrations of HFPO-DA in two of the three runs are in the condensate and impinger solvent rinse samples and the HFPO-DA concentration is non-detect in the STPB condensate and impinger solvent rinse sample. Therefore, it was concluded that the sampling train glassware, and the sampling media are not the primary sources of HFPO-DA found in the OTM-45 samples.

1.3 Analytical Laboratory Investigation

1.3.1 OTM-45 Sample Preparation

The Eurofins Knoxville OTM-45 sample preparation is performed using mostly disposable labware, except for Class A graduated glass cylinders. Eurofins conducted an internal investigation as part of another client's project to determine if normal cleaning practices are sufficient for cleaning graduated cylinders after they have been used to prepare samples (from non- Clean Harbors sources) that may have high concentrations of HFPO-DA. The test procedures were as follows:

- Sample #1: After cylinders were used for preparation of samples with high HFPO-DA concentrations (from

sources other than Clean Harbors), the graduated cylinders were cleaned using Eurofins normal procedures. Fifteen of these graduated cylinders were rinsed with methanol and the rinses were combined and placed on the hot block. The cylinders that were tested included two 1000 mL graduates, eight 250 mL graduates, and five 100 mL graduates. Two pairs of tweezers were also rinsed. Each rinse was approximately 3-5 mLs of methanol.

- Sample 2: Rinse the same fifteen graduated cylinders after normal cleaning and rinsing with methanol and combine the rinsates for hot-block concentration.
- Sample 3: Same process as for sample 2 (post-rinse/rinse check)
- Sample 4: Same process as for sample 3 (post-post/rinse check)
- Sample 5: Approximately 5 mL of solvent taken from three squirt bottles (15-20 mL total) is analyzed as a control. This solvent is not handled in a graduated cylinder.

The HFPO-DA analytical results are as follows:

- Sample #1: 1.9 ng/sample
- Sample #2: 0.2 ng/sample
- Sample #3: ND
- Sample #4: ND
- Sample #5: ND

The first rinse of glassware (Sample 1) had a detectable concentration of HFPO-DA, but the HFPO-DA concentration in the second rinse was near the detection level. Eurofins recommends multiple rinsings of glassware that had been used to prepare samples with potentially high concentrations of HFPO-DA.

The results of these analyses show that HFPO-DA concentration in graduated cylinders following "normal" cleaning procedures may still exhibit detectable levels of HFPO-DA contamination, but the levels are far below those found in the OTM-45 train samples. The procedures described above also demonstrate that HFPO-DA concentrations in graduated cylinders are reduced to non-detect levels if additional rinses are conducted. It should be noted that these analyses were not conducted on the specific graduated cylinders used during the preparation of the Clean Harbors OTM-45 samples.

1.3.2 OTM-45 Sample Extracts Confirmation Analysis

The OTM-45 samples were originally extracted and analyzed by the Eurofins Knoxville laboratory using EPA Method 537. A test was conducted to investigate if contamination of sample extracts could have occurred in the Eurofins Knoxville analytical instrumentation. Run 2A OTM-45 sample extracts were sent to the Eurofins West Sacramento laboratory for confirmatory analyses by EPA Method 537. A summary of the analytical results from the Eurofins Knoxville and West Sacramento laboratories are presented in Table K-4. The Eurofins analytical report is presented in Appendix J-5. The results are generally similar, with the results from the West Sacramento laboratory ranging from 3 to 22 percent higher than the values from the Knoxville laboratory. The relative percentage differences between the two sets of analyses were less than 25% for all four samples. Since the West Sacramento laboratory results are lower than those from the Knoxville laboratory for all four sample fractions, this seems to indicate that the Knoxville analytical equipment is not contributing to HFPO-DA contamination.

1.4 Evaluation of Treatment Chemicals

Three treatment chemicals (powdered activated carbon, sodium carbonate solution, and trimercapto-s-triazine trisodium salt, also known as TMT-15) and process water enter the emission control system downstream of the afterburner. Since any PFAS in these streams would not be destroyed in the afterburner, they could be a source of potential exhaust emissions. However, Table K-5 summarizes HFPO-DA concentrations in all treatment chemical and process water streams. All HFPO-DA concentrations were non-detect.

1.5 Evaluation of Residual

Residual streams that are generated in the emissions control system include spray dryer solids, baghouse dust, and brine. If high concentrations of HFPO-DA were in the process gas, it is likely that some of it would partition to one or more of these steams. Table K-5 summarizes HFPO-DA concentrations in all process residual streams and shows that all results were non-detect. This implies that there was not a significant concentration of HFPO-DA in the process gas within the emission control system.

1.6 Scrubber and Baghouse Investigation

The investigation included collecting wipe samples of the interior of the wet scrubber inlet elbow ducting, wet scrubber stage 1 exit ducting, and wet scrubber stage 2 exit ducting. Samples of used wet scrubber packing and one new baghouse bag were also collected for analysis. These samples were collected in February 2025 and are described as "post-test" samples. Post test samples of OTM-45 sampling train components were also collected and analyzed as described in Section 1.5. Table K-6 includes a list of post-test samples that were analyzed, along with the sample tracking numbers, descriptive notes, and the weights of each sample.

1.6.1 Post Test Analysis of Wipe Samples from the Scrubber Internal Wall

Wipe samples were collected from the internal walls of the wet scrubber duct by Clean Harbors Aragonite (CHA) personnel on February 14, 2025. Wipe samples of ducts were collected from three locations:

- Wet scrubber entrance wet elbow
- Wet scrubber stage 1 exit
- Wet scrubber stage 2 exit.

Samples were collected by wiping a one square foot area with a clean rag that had been soaked in methanol.

The samples were shipped to the Eurofins Knoxville laboratory and were received on February 16, 2025. At the Eurofins laboratory, the rags were cut into pieces, placed in a plastic bottle with a 5% ammonium hydroxide/methanol solution, and extracted on a shaker table for 18 hours. Samples were then analyzed using EPA Method 537. A summary of the results of these analyses are presented in Table K-7. Detailed analytical data for the scrubber wipe samples are presented in Table K-8. The Eurofins analytical report is presented in Appendix J-6. All HFPO-DA analytical results for all scrubber wipe samples are non-detect.

Since these samples were collected approximately two months after the PFAS test program was completed (November 14, 2024), the results do not necessarily represent conditions that may have existed at the time of the test. However, they do seem to indicate that there is not a systemic source of HFPO-DA contamination inside of the emission control system upstream of the scrubber.

1.6.2 Post Test Analysis of Wet Scrubber Packing

Samples of used wet scrubber packing material were collected by CHA personnel on February 14, 2025. Samples were shipped to Eurofins Knoxville and were received on February 16, 2025. The scrubber packing has a residue coating that requires modification to the standard sample preparation procedure. The scrubber packing sample was first cut into small pieces and extracted using the procedures described in Section 1.6.1. After extraction, the sample/solvent mixture could not pass through filter paper or glass wool because it was too thick. Therefore, an aliquot was centrifuged and a 2 mL sample of liquid was collected for analysis, spiked, and then brought up to 10 mL final volume with methanol. The sample was then analyzed using EPA Method 537.

Detailed results of the wet scrubber packing analysis are presented in Table K-8. All HFPO-DA analytical results are non-detect. The same caveats described in the last paragraph of Section 1.6.1 also apply to the wet scrubber packing sample.

1.6.3 Post test Analysis of Baghouse Bags

A new (unused) baghouse bag was collected by Clean Harbors personnel on February 14, 2025. The sample was shipped to Eurofins Knoxville and received on February 16, 2025. A section (200.8 grams) was cut from the bag, cut into small pieces, placed in a plastic bottle with a 5% ammonium hydroxide/methanol solution, and extracted on a shaker table for 18 hours. Samples were then analyzed using EPA Method 537. The detailed results from this analysis are presented in Table K-9. HFPO-DA was found at a concentration of 9.53 ng/sample.

A mass balance calculation was performed to estimate the extrapolated amount of HFPO-DA from the baghouse bags and evaluate whether they could have been responsible for the amount collected during an OTM-45 sampling run. This analysis is presented in Table K-10. The HFPO-DA mass on the baghouse bag sample was scaled up to estimate the total mass of HFPO-DA that could have been on a new set of bags. It was assumed the HFPO-DA was removed at a steady rate during the time that the bags had been in service (233 days) at the time the PFAS test program was conducted. Using the stack gas flow rate and the OTM-45 sample volume, the estimated mass of HFPO-DA from the bags that could have been collected by an OTM-45 sampling train was estimated to be 0.001 ng/sample. The actual mass of HFPO-DA reported on the OTM-45 sampling train ranged from 404 to 8,291 ng/sample. Therefore, it was concluded that HFPO-DA on baghouse bags was not the source of contamination of the OTM-45 samples.

1.7 Investigation of Sampling Train Components

1.7.1 Overview

Samples of OTM-45 sampling train O-rings and quartz glass filter frits were cleaned and supplied by ATG to be analyzed by Eurofins. Additionally, samples of new O-rings were procured by Focus that were analyzed “as received” without precleaning. A summary of the analytical results for these samples is presented in Table K-11. As shown in Table K-6, different numbers of O-rings and consequently different masses of O-rings were analyzed in each sample. To normalize and compare analytical results between the ATG supplied O-rings and the new O-rings procured by Focus, analytical results for each sample were divided by the total mass of O-rings in each sample, and the results expressed in units of ng/g. These normalized results are presented in Table K-12.

1.7.2 Post test Analysis of ATG OTM-45 Sampling Train O-rings and Filter Holders

The stack sampling train glassware and components for the Clean Harbors PFAS test were prepared at the ATG Pittsburgh office and shipped to the ATG Salt Lake City office. On February 10, 2025 Focus staff held a conference call with the ATG technician that had prepared the sampling train glassware and components. The purpose of the call was to discuss the preparation procedures and to request samples of O-rings and quartz filter frits of the type used in the OTM-45 trains. The ATG technician was not certain if the O-rings that were sent to the ATG Salt Lake City office were

new or used. He believed that both red (silicon rubber) and blue (Viton) O-rings had been sent to the Salt Lake City office. On May 14, 2025 Focus staff also spoke with ATG sampling crew leader who assembled the OTM-45 sampling trains. He also did not remember where the O-rings came from, whether they were new or used, or if they were silicon or Viton.

On February 13, 2024, the ATG technician in the Pittsburgh office collected samples of O-rings and one quartz filter frit for PFAS analysis by Eurofins. The O-rings were collected from a common bin at the Pittsburgh office and the rings could have been either new or used.

Prior to shipment to Eurofins, the O-rings were cleaned by ATG using one of the following two methods:

- Soapy water/tap water rinse/DI water rinse. This is the normal ATG cleaning procedure
- Soapy water/tap water rinse/DI water rinse /MeOH 5% NAOH. This method was not used during sampling equipment preparation, it was intended to simulate the field sampling train recovery procedure.

The quartz filter frit was cleaned using soap water/tap water rinse/DI water rinse. Neither set of O-rings nor the quartz filter frit were baked per the procedure in ATG's OTM-45 Standard Operating Procedure, Section 8.1.4.

Two small red silicon rubber O-rings, two large red silicon rubber O-rings, two small blue Viton O-rings, two large blue Viton O-rings were supplied that had been cleaned by each method. One quartz filter frit was also supplied which had been clean using the normal ATG cleaning procedures. The samples were shipped to the Eurofins Knoxville laboratory for analysis. The samples were prepared for analysis by Eurofins by combining the O-rings into two samples (silicon rubber and Viton) as shown in Table K-6 and cutting them into small pieces. Samples were then placed in a plastic bottle with a 5% ammonium hydroxide/methanol solution and extracted on a shaker table for 18 hours. Samples were then analyzed using EPA Method 537. The results of these analyses are presented in Table K-13 and they show that HFPO-DA was non-detect for all of the samples.

It should be noted the O-rings and quartz filter frit that were analyzed were not actually used in the OTM-45 trains during tests at the CHA site. The results of the analyses represent the potential for PFAS sample contamination by sampling train components. However, the results cannot be conclusively extrapolated to the CHA field test results. It should also be noted that the number of large O-rings and small O-rings that were analyzed (four of each) is different from the number of actual O-rings included in an OTM-45 sample train (two large and thirteen small).

There were several other PFAS compounds detected in the red silicon O-rings and quartz filter frit samples. The compounds that were detected on these components were generally the same compounds that were detected in the stack gas samples and sampling train proof blank (mostly PFCAs). Therefore, it appears that residual PFAS compounds on the sampling train components could have possibly biased the stack gas sample results high for some PFAS compounds.

1.7.3 Post-test Analysis of Focus OTM-45 Sampling Train O-rings and Filter Holders

Since ATG could not confirm if the O-rings they supplied were new or used, Focus purchased new O-rings of the same types and sizes as those supplied by ATG. In addition, Focus procured O-rings constructed of TFE coated Viton. These were provided by Environmental Supply Company, the same company that provided the O-rings to ATG. The purchased O-rings had the following part numbers:

- Small red silicon rubber O-rings Part number GP-107-S
- Large red silicon rubber O-rings Part number GP-108-S
- Small blue Viton O-rings Part number GP-107-V

- Large blue Viton O-rings Part number GP-108-V
- Small blue TFE Coated Viton O-rings Part number GP-107-T
- Large blue TFE Coated Viton O-rings Part number GP-108-T

The new O-rings were not washed but were analyzed “as received”. The O-rings were grouped into three samples as shown in Table K-6. They were then prepared for analysis and analyzed using the same procedures that were used for the O-rings supplied by ATG. The results of these analyses are presented in Table K-14 and show that HFPO-DA was non-detect for all samples.

1.7.4 Comparison of O-Ring Results

Five analytes were detected in the set of new red silicon O-rings supplied by Focus versus ten analytes detected on the red silicon O-rings supplied by ATG. The normalized PFAS mass of each analyte on the new red silicon O-rings was also much lower than the normalized PFAS mass of each analyte on the red silicon O-rings supplied by ATG as shown in Table K-14. This implies that some PFAS compounds detected on the ATG supplied O-rings likely came from external sources.

For the Viton and TFE coated Viton O-rings, PFBA and PFHxS were detected on both the new O-rings procured by Focus and the O-rings supplied by ATG. As shown in Table K-12, the normalized mass of detected analytes was approximately the same for the ATG supplied and Focus supplied O-rings.

1.8 Conclusions

No definitive source of the HFPO-DA contamination in the OTM-45 sampling train has been identified. However, some investigation techniques that were used relied on samples collected approximately three months after the field PFAS test was conducted. These samples may not be representative of conditions at the time of the field test. Therefore, the HFPO-DA contamination in the OTM-45 sample train is being attributed to unidentified sources.

Tables

Table K-1. HFPO-DA OTM-45 Data Summary

Sample Train Fraction	Run 1A (ng/sample)	Run 2A (ng/sample)	Run 3A (ng/sample)	Sampling Train Proof Blank (ng/sample)
Front Half	160	694	221	29
Back Half	68.3	1400	25.9	2.52
Condensate & Impinger Solvent Rinse	277	6180	155	<0.469
Breakthrough XAD	<2.40	16.6	<2.40	<2.40
Total Train (including Breakthrough XAD	<508	8291	<404	<34

Table K-2. HFPO-DA Relative Mass Distribution

Media	Run 1A (%)	Run 2A (%)	Run 3A (%)
Front Half	31.5	8.4	54.7
Back Half	13.5	16.9	6.4
Condensate & Impinger Solvent Rinse	54.6	74.5	38.3
BT XAD	0.5	0.2	0.6
Total	100.00	100.00	100.00

Table K-3. HFPO-DA Blank Samples

Glassware Proof Blank (ng/sample)	Filter Media Blank (ng/sample)	XAD-2 Media Blank (ng/sample)	MeOH/5% NH4OH (ng/sample)	DI Water Media Blank (ng/sample)
<0.60	<4.70	<2.40	<0.60	0.842
Method Blank MB 140-93798/1-B (ng/sample)	**Method Blank MB 140-93945/1-B (ng/sample)**	**Method Blank MB 140-93949/1-B (ng/sample)**		
<0.94	<4.62	<2.40		

Table K-4. OTM-45 Run 2A Extract Confirmation Analysis

Sample Train Fraction	Eurofins Knoxville (ng/sample)	Eurofins Sacramento (ng/sample)	Relative Percent Difference (%)
Front Half	694	778	-11.41
Back Half	1400	1440	-2.82
Condensate & Impinger Solvent Rinse	6180	7740	-22.41
BT XAD	16.6	19.1	-14.01
Total Train (including BT XAD)	8291	9977	-18.46

Table K-5. HFPO-DA Analytical Data for Chemicals, Utilities, and Residual Streams

Treatment Chemicals	Units	Run 1A	Run 2A	Run 3A
Powdered Activated Carbon	µg/kg	<0.20	<0.20	<0.20
TMT	ng/l	<3.90	<3.90	<3.90
Na_2CO_3	ng/l	<3.90	<9.75	<9.75
Utilities				
Process Water	ng/l	<0.368	<0.365	<0.366
Emission Control System Residuals				
Spray Dryer Solids				
>2 mm	µg/kg	<0.196	<0.172	<0.161
250 u - 2 mm	µg/kg	<0.185	<0.182	<0.161
<250 u	µg/kg	<0.169	<0.179	<0.154
Baghouse Dust	µg/kg	<0.20	<0.20	<0.20
Brine	ng/l	<0.365	<0.356	<0.369

Table K-6. Process Equipment, O-Ring, and Filter Frit Sample Information

Item No.	Sample No.	Sample Name	Notes[(a)]	Weight (g)
1	X-1000	QA Wet Elbow Wipe		62.16
2	X-1001	QA Stage 1 Exit Wipe		41.95
3	X-1002	QA Stage 2 Exit Wipe		54.2
4	X-1006	QA Packing - Used		164.77
5	X-1009	QA Baghouse Bag Material		200.8
6	X-1015, X-1016	QA Red O-Rings (ATG)	4 large and 4 small (silicon rubber)	5.71
7	X-1017, X-1018	QA Blue O-Rings (ATG)	4 large and 4 small (Viton)	7.73
8	X-1019	QA Quartz Filter Frit (ATG)	Includes rubber gasket	133.95
9	X-1025, X-1026	QA Red O-Ring (Focus)	10 large and 10 small (silicon rubber)	14.36
10	X-1027, C-1028	QA Blue O-Ring (Focus)	10 large and 10 small (Viton)	19.61
11	X-1029, X-1030	QA Blue O-Ring (Focus)	10 large and 10 small (TFE/Viton)	19.16

Note:

(a) There are two large O-rings and thirteen small O-rings in an OTM-45 sample train.

Table K-7. HFPO-DA Analytical Results for Process Equipment Samples

PFAS Category	CAS No.	Acronym	Scrubber Wipe Samples: Wet Elbow X-1000 (ng/sample)	Scrubber Wipe Samples: Stage 1 Exit X-1001 (ng/sample)	Scrubber Wipe Samples: Stage 2 Exit X-1002 (ng/sample)	Scrubber Packing: Packing - Used X-1006 (ng/sample)	Baghouse Filter: Bag Material X-1009 (ng/sample)
PFCAs	375-22-4	PFBA	< 2.580	< 2.600	< 2.580	< 65.000	21.500
	2706-90-3	PFPeA	< 0.357	< 0.360	< 0.358	< 9.000	14.800
	307-24-4	PFHxA	< 0.417	< 0.420	< 0.417	< 10.500	30.500
	375-85-9	PFHpA	< 1.230	< 1.240	< 1.230	< 31.000	8.190
	335-67-1	PFOA	< 1.290	< 1.300	< 1.290	< 32.500	85.400
	375-95-1	PFNA	< 0.169	< 0.170	< 0.169	< 4.250	3.430
	335-76-2	PFDA	< 0.496	< 0.500	< 0.497	< 12.500	3.430
	2058-94-8	PFUnA	< 0.337	< 0.340	< 0.338	< 8.500	2.260
	307-55-1	PFDoA	< 0.198	< 0.200	< 0.199	< 5.000	2.160
	72629-94-8	PFTriA	< 0.278	< 0.280	< 0.278	< 7.000	1.360
	376-06-7	PFTeA	< 0.337	< 0.340	< 0.338	< 8.500	1.620
	67905-19-5	PFHxDA	< 0.575	< 0.580	< 0.576	< 14.500	1.440
	16517-11-6	PFODA	< 0.437	< 0.440	< 0.437	< 11.000	< 0.220
PFSAs	375-73-5	PFBS	< 1.770	< 1.780	< 1.770	< 44.500	< 0.890
	2706-91-4	PFPeS	< 0.238	< 0.240	< 0.238	< 6.000	< 0.120
	355-46-4	PFHxS	< 0.218	< 0.220	< 0.219	< 5.500	< 0.110
	375-92-8	PFHpS	NR[a]	NR[a]	123.000	< 5.500	< 0.110
	1763-23-1	PFOS	< 0.893	< 0.900	< 0.894	< 22.500	0.736
	68259-12-1	PFNS	< 0.238	< 0.240	< 0.238	< 6.000	< 0.120
	335-77-3	PFDS	< 0.218	< 0.220	< 0.219	< 5.500	0.567
	79780-39-5	PFDoS	< 0.188	< 0.190	< 0.189	< 4.750	< 0.095
FOSAs	754-91-6	FOSA	< 0.175	< 0.176	< 0.175	< 4.400	< 0.088
	31506-32-8	NMeFOSA	< 0.298	< 0.300	< 0.298	< 7.500	0.326
	4151-50-2	NEtFOSA	< 0.317	< 0.320	< 0.318	< 8.000	< 0.160
FOSAAs	2355-31-9	NMeFOSAA	0.757	< 0.240	< 0.238	< 6.000	< 0.120
	2991-50-6	NEtFOSAA	< 0.278	< 0.280	< 0.278	< 7.000	0.455
FOSEs	24448-09-7	N-MeFOSE	< 9.720	< 9.800	< 9.740	< 245.000	< 4.900
	1691-99-2	N-EtFOSE	< 0.238	< 0.240	< 0.238	< 6.000	0.552
FTSs	757124-72-4	4:2 FTS	< 0.181	< 0.182	< 0.181	< 4.550	< 0.091
	27619-97-2	6:2 FTS	< 7.940	< 8.000	< 7.950	< 200.000	< 4.000
	39108-34-4	8:2 FTS	< 0.278	0.456	0.401	< 7.000	0.199
	120226-60-0	10:2 FTS	< 0.635	< 0.640	< 0.636	< 16.000	< 0.320
Fluorinated Replacement Chemicals	13252-13-6	HFPO-DA	< 9.330	< 9.400	< 9.340	< 235.000	9.520
	919005-14-4	DONA	< 0.278	< 0.280	< 0.278	< 7.000	< 0.140
	756426-58-1	9Cl-PF3ONS	< 0.194	< 0.196	< 0.195	< 4.900	< 0.098
	763051-92-9	11Cl-PF3OUdS	< 0.397	< 0.400	< 0.397	< 10.000	< 0.200
Additional Targets	377-73-1	PFECA F	< 0.298	< 0.300	< 0.298	< 7.500	0.248
	863090-89-5	PFECA A	< 0.397	< 0.400	< 0.397	< 10.000	0.470
	151772-58-6	PFECA B	< 0.298	< 0.300	< 0.298	< 7.500	0.227
	113507-82-7	PES	< 0.278	< 0.280	< 0.278	< 7.000	< 0.140
	356-02-5	3:3 FTCA	< 0.575	< 0.580	< 0.576	< 14.500	< 0.290
	914637-49-3	5:3 FTCA	< 0.952	< 0.960	< 0.954	< 24.000	1.230
	812-70-4	7:3 FTCA	< 0.694	< 0.700	< 0.696	< 17.500	< 0.350
	70887-84-2	8:2 FTUCA	< 0.437	< 0.440	< 0.437	< 11.000	< 0.220
	53826-13-4	10:2 FTCA	< 0.833	< 0.840	< 0.835	< 21.000	< 0.420
	27854-31-5	8:2 FTCA	< 0.694	< 0.700	< 0.696	< 17.500	< 0.350
	53826-12-3	6:2FTCA	< 0.853	< 0.860	< 0.854	< 21.500	< 0.430
	133201-07-7	PFECHS	< 0.437	< 0.440	< 0.437	< 11.000	< 0.220
	70887-88-6	6:2 FTUCA	< 0.278	< 0.280	< 0.278	< 7.000	< 0.140

Note
(a) NR - Result unusable
Yellow Shading - Spiking Chem. Runs 1A, 2A, 3A
Blue Shading - Not EPA Method 1633 Analyte
Pink Shading - Compound Detected

Table K-8. HFPO-DA Analytical Results for Scrubber Wipe & Packing Samples

PFAS Category	CAS No.	Acronym	X-1000 QA Wet Elbow Wipe					X-1001 QA Stage 1 Exit Wipe					X-1002 QA Stage 2 Exit Wipe					X-1006 QA Packing - Used				
			Measured (ng/sample)	ND	MDL (ng/sample)	Lab Flag	DV Flag	Measured (ng/sample)	ND	MDL (ng/sample)	Lab Flag	DV Flag	Measured (ng/sample)	ND	MDL (ng/sample)	Lab Flag	DV Flag	Measured (ng/sample)	ND	MDL (ng/sample)	Lab Flag	DV Flag
PFCAs	375-22-4	PFBA	< 2.580	ND	2.58			< 2.600	ND	2.60			< 2.580	ND	2.58			< 65.000	ND	65.0		
	2706-90-3	PFPeA	< 0.357	ND	0.357			< 0.360	ND	0.360			< 0.358	ND	0.358			< 9.000	ND	9.00		
	307-24-4	PFHxA	< 0.417	ND	0.417			< 0.420	ND	0.420			< 0.417	ND	0.417			< 10.5	ND	10.5		
	375-85-9	PFHpA	< 1.230	ND	1.23			< 1.240	ND	1.24			< 1.230	ND	1.23			< 31.000	ND	31.0		
	335-67-1	PFOA	< 1.290	ND	1.29			< 1.300	ND	1.30			< 1.290	ND	1.29			< 32.5	ND	32.5		
	375-95-1	PFNA	< 0.169	ND	0.169			< 0.170	ND	0.170			< 0.169	ND	0.169			< 4.250	ND	4.25		
	335-76-2	PFDA	< 0.496	ND	0.496			< 0.500	ND	0.500			< 0.497	ND	0.497			< 12.5	ND	12.5		
	2058-94-8	PFUnA	< 0.337	ND	0.337			< 0.340	ND	0.340			< 0.338	ND	0.338			< 8.500	ND	8.50		
	307-55-1	PFDoA	< 0.198	ND	0.198			< 0.200	ND	0.200			< 0.199	ND	0.199			< 5	ND	5.00		
	72629-94-8	PFTriA	< 0.278	ND	0.278			< 0.280	ND	0.280			< 0.278	ND	0.278			< 7.000	ND	7.00		
	376-06-7	PFTeA	< 0.337	ND	0.337			< 0.340	ND	0.340			< 0.338	ND	0.338			< 8.5	ND	8.50		
	67905-19-5	PFHxDA	< 0.575	ND	0.575			< 0.580	ND	0.580			< 0.576	ND	0.576			< 14.500	ND	14.5		
	16517-11-6	PFODA	< 0.437	ND	0.437			< 0.440	ND	0.440			< 0.437	ND	0.437			< 11	ND	11.0		
PFSAs	375-73-5	PFBS	< 1.770	ND	1.77			< 1.780	ND	1.78			< 1.770	ND	1.77			< 44.500	ND	44.5		
	2706-91-4	PFPeS	< 0.238	ND	0.238			< 0.240	ND	0.240			< 0.238	ND	0.238			< 6	ND	6.00		
	355-46-4	PFHxS	< 0.218	ND	0.218			< 0.220	ND	0.220			< 0.219	ND	0.219			< 5.500	ND	5.50		
	375-92-8	PFHpS	NR[c]		0.218	R		NR[c]		0.220	R		123.000		0.219	I CI		< 5.5	ND	5.50		
	1763-23-1	PFOS	< 0.893	ND	0.893	R		< 0.900	ND	0.900	R		< 0.894	ND	0.894			< 22.500	ND	22.5		
	68259-12-1	PFNS	< 0.238	ND	0.238	R		< 0.240	ND	0.240	R		< 0.238	ND	0.238			< 6	ND	6.00		
	335-77-3	PFDS	< 0.218	ND	0.218	R		< 0.220	ND	0.220	R		< 0.219	ND	0.219			< 5.500	ND	5.50		
	79780-39-5	PFDoS	< 0.188	ND	0.188	R		< 0.190	ND	0.190	R		< 0.189	ND	0.189			< 4.75	ND	4.75		
FOSAs	754-91-6	FOSA	< 0.175	ND	0.175			< 0.176	ND	0.176			< 0.175	ND	0.175			< 4.400	ND	4.40		
	31506-32-8	NMeFOSA	< 0.298	ND	0.298	R		< 0.300	ND	0.300	R		< 0.298	ND	0.298	R		< 7.5	ND	7.50		
	4151-50-2	NEtFOSA	< 0.317	ND	0.317	R		< 0.320	ND	0.320	R		< 0.318	ND	0.318	R		< 8.000	ND	8.00		
FOSAAs	2355-31-9	NMeFOSAA	0.757		0.238	J		< 0.240	ND	0.240			< 0.238	ND	0.238			< 6	ND	6.00		
	2991-50-6	NEtFOSAA	< 0.278	ND	0.278			< 0.280	ND	0.280			< 0.278	ND	0.278			< 7.000	ND	7.00		
FOSEs	24448-09-7	N-MeFOSE	< 9.720	ND	9.72	R		< 9.800	ND	9.80	R		< 9.740	ND	9.74	R		< 245	ND	245	R	
	1691-99-2	N-EtFOSE	< 0.238	ND	0.238	R		< 0.240	ND	0.240	R		< 0.238	ND	0.238	R		< 6.000	ND	6.00	R	
FTSs	757124-72-4	4:2 FTS	< 0.181	ND	0.181			< 0.182	ND	0.182			< 0.181	ND	0.181			< 4.55	ND	4.55		
	27619-97-2	6:2 FTS	< 7.940	ND	7.94			< 8.000	ND	8.00			< 7.950	ND	7.95			< 200.000	ND	200		
	39108-34-4	8:2 FTS	< 0.278	ND	0.278			0.456		0.280	J		0.401		0.278	J		< 7	ND	7.00		
	120226-60-0	10:2 FTS	< 0.635	ND	0.635			< 0.640	ND	0.640			< 0.636	ND	0.636			< 16.000	ND	16.0		
Fluorinated Replacement Chemicals	13252-13-6	HFPO-DA	< 9.330	ND	9.33			< 9.400	ND	9.40			< 9.340	ND	9.34			< 235	ND	235		
	919005-14-4	DONA	< 0.278	ND	0.278	R		< 0.280	ND	0.280	R		< 0.278	ND	0.278			< 7.000	ND	7.00		
	756426-58-1	9Cl-PF3ONS	< 0.194	ND	0.194	R		< 0.196	ND	0.196	R		< 0.195	ND	0.195			< 4.9	ND	4.90		
	763051-92-9	11Cl-PF3OUdS	< 0.397	ND	0.397	R		< 0.400	ND	0.400	R		< 0.397	ND	0.397			< 10.000	ND	10.0		
Additional Targets	377-73-1	PFECA F	< 0.298	ND	0.298			< 0.300	ND	0.300			< 0.298	ND	0.298			< 7.5	ND	7.50		
	863090-89-5	PFECA A	< 0.397	ND	0.397			< 0.400	ND	0.400			< 0.397	ND	0.397			< 10.000	ND	10.0		
	151772-58-6	PFECA B	< 0.298	ND	0.298			< 0.300	ND	0.300			< 0.298	ND	0.298			< 7.5	ND	7.50		
	113507-82-7	PES	< 0.278	ND	0.278			< 0.280	ND	0.280			< 0.278	ND	0.278			< 7.000	ND	7.00		
	356-02-5	3:3 FTCA	< 0.575	ND	0.575			< 0.580	ND	0.580			< 0.576	ND	0.576			< 14.5	ND	14.5		
	914637-49-3	5:3 FTCA	< 0.952	ND	0.952			< 0.960	ND	0.960			< 0.954	ND	0.954			< 24.000	ND	24.0		
	812-70-4	7:3 FTCA	< 0.694	ND	0.694			< 0.700	ND	0.700			< 0.696	ND	0.696			< 17.5	ND	17.5		
	70887-84-2	8:2 FTUCA	< 0.437	ND	0.437			< 0.440	ND	0.440			< 0.437	ND	0.437			< 11.000	ND	11.0		
	53826-13-4	10:2 FTCA	< 0.833	ND	0.833			< 0.840	ND	0.840			< 0.835	ND	0.835			< 21	ND	21.0		
	27854-31-5	8:2 FTCA	< 0.694	ND	0.694			< 0.700	ND	0.700			< 0.696	ND	0.696			< 17.500	ND	17.5		
	53826-12-3	6:2FTCA	< 0.853	ND	0.853			< 0.860	ND	0.860			< 0.854	ND	0.854			< 21.5	ND	21.5		
	133201-07-7	PFECHS	< 0.437	ND	0.437			< 0.440	ND	0.440			< 0.437	ND	0.437			< 11.000	ND	11.0		
	70887-88-6	6:2 FTUCA	< 0.278	ND	0.278			< 0.280	ND	0.280			< 0.278	ND	0.278			< 7	ND	7.00		
	Subtotal: Non-detect		49.747					50.094					49.77					1264.85				
	Subtotal: Detected		0.757					0.456					123.401					0				
	Grand Total		50.504					50.55					173.171					1264.85				

Yellow Shading - Spiking Chem. Runs 1A, 2A, 3A
Blue Shading - Not EPA Method 1633 Analyte
Pink Shading - Compound Detected

Table K-9. HFPO-DA Analytical Results for Baghouse Bag Sample

PFAS Category	CAS No.	Acronym	X-1009 QA BAGHOUSE BAG MATERIAL			
			Measured (ng/sample)	MDL (ng/sample)	Lab Flag	DV Flag
PFCAs	375-22-4	PFBA	21.500	1.30		
	2706-90-3	PFPeA	14.800	0.180		
	307-24-4	PFHxA	30.500	0.210		
	375-85-9	PFHpA	8.190	0.620	B	
	335-67-1	PFOA	85.400	0.650		
	375-95-1	PFNA	3.430	0.0850		
	335-76-2	PFDA	3.430	0.250		
	2058-94-8	PFUnA	2.260	0.170		
	307-55-1	PFDoA	2.160	0.100		
	72629-94-8	PFTriA	1.360	0.140		
	376-06-7	PFTeA	1.620	0.170		
	67905-19-5	PFHxDA	1.440	0.290	R	
	16517-11-6	PFODA	< 0.220	0.220	R	
PFSAs	375-73-5	PFBS	< 0.890	0.890		
	2706-91-4	PFPeS	< 0.120	0.120		
	355-46-4	PFHxS	< 0.110	0.110		
	375-92-8	PFHpS	< 0.110	0.110		
	1763-23-1	PFOS	0.736	0.450	J	
	68259-12-1	PFNS	< 0.120	0.120		
	335-77-3	PFDS	0.567	0.110	J	
	79780-39-5	PFDoS	< 0.095	0.0950		
FOSAs	754-91-6	FOSA	< 0.088	0.0880		
	31506-32-8	NMeFOSA	0.326	0.150	J	
	4151-50-2	NEtFOSA	< 0.160	0.160		
FOSAAs	2355-31-9	NMeFOSAA	< 0.120	0.120		
	2991-50-6	NEtFOSAA	0.455	0.140	J	
FOSEs	24448-09-7	N-MeFOSE	< 4.900	4.90		
	1691-99-2	N-EtFOSE	0.552	0.120	J	
FTSs	757124-72-4	4:2 FTS	< 0.091	0.0910		
	27619-97-2	6:2 FTS	< 4.000	4.00		
	39108-34-4	8:2 FTS	0.199	0.140	J	
	120226-60-0	10:2 FTS	< 0.320	0.320		
Fluorinated Replacement Chemicals	13252-13-6	HFPO-DA	9.520	4.70		
	919005-14-4	DONA	< 0.140	0.140		
	756426-58-1	9Cl-PF3ONS	< 0.098	0.0980		
	763051-92-9	11Cl-PF3OUdS	< 0.200	0.200		
Additional Targets	377-73-1	PFECA F	0.248	0.150	J	
	863090-89-5	PFECA A	0.470	0.200	J	
	151772-58-6	PFECA B	0.227	0.150	J	
	113507-82-7	PES	< 0.140	0.140		
	356-02-5	3:3 FTCA	< 0.290	0.290		
	914637-49-3	5:3 FTCA	1.230	0.480	I	
	812-70-4	7:3 FTCA	< 0.350	0.350		
	70887-84-2	8:2 FTUCA	< 0.220	0.220		
	53826-13-4	10:2 FTCA	< 0.420	0.420		
	27854-31-5	8:2 FTCA	< 0.350	0.350		
	53826-12-3	6:2FTCA	< 0.430	0.430		
	133201-07-7	PFECHS	< 0.220	0.220		
	70887-88-6	6:2 FTUCA	< 0.140	0.140		

Yellow Shading - Spiking Chem. Runs 1A, 2A, 3A
Blue Shading - Not EPA Method 1633 Analyte
Pink Shading - Compound Detected

Table K-10. Potential Contribution to Stack Gas HFPO-DA from Baghouse Bags

Calculate Potential Mass of HFPO-DA on Baghouse Bags			
Baghouse Information (03/21/25 E-mail from Cody Parks)			
Number of Bags	1920		
Bag Length (inches)	169.5		
Bag Length (ft)	14.125		
Bag Diameter (inches)	6		
Bag Diameter (ft)	0.5		
Bag Surface Area -Sides (ft^2/bag)	22.19		
Bag Surface Area -Bottom (ft^2/bag)	0.20		
Bag Surface Area (ft^2/bag)	22.38		
Total Bag Surface Area (ft^2)	42,977		
Fabric Unit Weight (oz/yd^3)	19		
Fabric Total Weight (lb)	5,671		
Baghouse Bag HFPO-DA (ng/sample)	9.52		
Baghouse Bag Sample Size (g)	200.8		
Baghouse Bag Sample Size (lb)	0.442		
Estimated Total Baghouse Bags HFPO-DA (ng)	122,055		
Assume HFPO-DA is Removed Evenly over Bag Time in Service			
Bags In-service Date	03/26/25		
Test Date	11/14/25		
Bags In-service Duration (days)	233		
Bags In-service Duration (hours)	5,592		
Parameter	**Run 1A**	**Run 2A**	**Run 3A**
Stack Gas Flow Rate (scfm)	34095	32,101	33040
Total Gas Flow (scf)	11,439,554,400	10,770,527,520	11,085,580,800
OTM-45 Sample Volume (scf/sample)	134.585	131.673	133.04
Potential HFPO-DA Collected on OTM-45 Train (ng/sample)	0.001	0.001	0.001
	Run 1A	**Run 2A**	**Run 3A**
OTM-45 Analytical Results	**(ng/sample)**	**(ng/sample)**	**(ng/sample)**
OTM-45 FH	160	694	221
OTM-45 BH	68.3	1,400	25.9
OTM-45 CONDENSATE, IMPINGER SOLVENT RINSE	277	6,180	155
OTM-45 BT XAD	2.4	16.6	2.4
Total	507.7	8,291	404.3
Potential HFPO-DA from Baghouse Bags as a percent of OTM-45 Analytical Results	0.00028	0.00002	0.00036

Table K-11. Summary of HFPO-DA Analytical Results for OTM-45 Sampling Train Components

PFAS Category	CAS No.	Acronym	ATG O-Ring Samples: Red O-Ring Silicon X-1015, X-1016 (ng/sample)	ATG O-Ring Samples: Blue O-Ring Viton X-1017, X-1018 (ng/sample)	ATG Quartz Filter Frit: Quartz Filter Frit X-1019 (ng/sample)	Focus O-Ring Samples: Red O-Ring Silicon X-1025, X-1026 (ng/sample)	Focus O-Ring Samples: Blue O-Ring Viton X-1027, X-1028 (ng/sample)	Focus O-Ring Samples: Blue O-Ring TFE-Viton X-1029, X-1030 (ng/sample)
PFCAs	375-22-4	PFBA	30.700	10.000	4.270	1.440	19.600	27.500
	2706-90-3	PFPeA	21.300	< 0.360	5.390	0.231	< 0.360	< 0.180
	307-24-4	PFHxA	17.000	< 0.420	2.850	< 0.206	< 0.420	< 0.210
	375-85-9	PFHpA	5.520	< 1.240	1.530	< 0.609	< 1.240	< 0.620
	335-67-1	PFOA	7.710	< 1.300	6.120	< 0.639	< 1.300	< 0.650
	375-95-1	PFNA	0.197	< 0.170	3.810	0.122	< 0.170	< 0.085
	335-76-2	PFDA	< 0.250	< 0.500	1.510	< 0.246	< 0.500	< 0.250
	2058-94-8	PFUnA	< 0.170	< 0.340	1.540	< 0.167	< 0.340	< 0.170
	307-55-1	PFDoA	< 0.100	< 0.200	0.956	< 0.098	< 0.200	< 0.100
	72629-94-8	PFTriA	< 0.140	< 0.280	1.210	< 0.138	< 0.280	< 0.140
	376-06-7	PFTeA	< 0.170	< 0.340	1.070	< 0.167	< 0.340	< 0.170
	67905-19-5	PFHxDA	< 0.290	< 0.580	0.708	< 0.285	< 0.580	< 0.290
	16517-11-6	PFODA	< 0.220	< 0.440	0.335	< 0.216	< 0.440	< 0.220
PFSAs	375-73-5	PFBS	< 0.890	< 1.780	< 0.890	1.460	< 1.780	< 0.890
	2706-91-4	PFPeS	< 0.120	< 0.240	< 0.120	< 0.118	< 0.240	< 0.120
	355-46-4	PFHxS	< 0.110	1.790	< 0.110	< 0.108	3.390	3.750
	375-92-8	PFHpS	< 0.110	< 0.220	< 0.110	< 0.108	< 0.220	< 0.110
	1763-23-1	PFOS	0.707	< 0.900	3.560	< 0.442	< 0.900	< 0.450
	68259-12-1	PFNS	< 0.120	< 0.240	< 0.120	< 0.118	< 0.240	< 0.120
	335-77-3	PFDS	< 0.110	< 0.220	< 0.110	< 0.108	< 0.220	< 0.110
	79780-39-5	PFDoS	< 0.095	< 0.190	< 0.095	< 0.093	< 0.190	< 0.095
FOSAs	754-91-6	FOSA	< 0.088	< 0.176	0.133	< 0.087	< 0.176	< 0.088
	31506-32-8	NMeFOSA	< 0.150	< 0.300	< 0.150	< 0.147	< 0.300	< 0.150
	4151-50-2	NEtFOSA	< 0.160	< 0.320	21.500	< 0.157	< 0.320	< 0.160
FOSAAs	2355-31-9	NMeFOSAA	< 0.120	< 0.240	< 0.120	< 0.118	< 0.240	< 0.120
	2991-50-6	NEtFOSAA	2.830	< 0.280	< 0.140	< 0.138	< 0.280	< 0.140
FOSEs	24448-09-7	N-MeFOSE	< 4.900	< 9.800	20.500	< 4.820	< 9.800	< 4.900
	1691-99-2	N-EtFOSE	< 0.120	< 0.240	---	< 0.118	< 0.240	< 0.120
FTSs	757124-72-4	4:2 FTS	< 0.091	< 0.182	< 0.091	< 0.089	< 0.182	< 0.091
	27619-97-2	6:2 FTS	< 4.000	< 8.000	< 4.000	< 3.930	< 8.000	< 4.000
	39108-34-4	8:2 FTS	< 0.140	< 0.280	< 0.140	0.249	< 0.280	< 0.140
	120226-60-0	10:2 FTS	< 0.320	< 0.640	< 0.320	< 0.314	< 0.640	< 0.320
Fluorinated Replacement Chemicals	13252-13-6	HFPO-DA	< 4.700	< 9.400	< 4.700	< 4.620	< 9.400	< 4.700
	919005-14-4	DONA	0.254	4.510	< 0.140	< 0.138	< 0.280	10.700
	756426-58-1	9Cl-PF3ONS	< 0.098	< 0.196	< 0.098	< 0.096	< 0.196	< 0.098
	763051-92-9	11Cl-PF3OUdS	< 0.200	< 0.400	< 0.200	< 0.197	< 0.400	< 0.200
Additional Targets	377-73-1	PFECA F	< 0.150	< 0.300	< 0.150	< 0.147	< 0.300	< 0.150
	863090-89-5	PFECA A	< 0.200	< 0.400	< 0.200	< 0.197	< 0.400	< 0.200
	151772-58-6	PFECA B	< 0.150	< 0.300	< 0.150	< 0.147	< 0.300	< 0.150
	113507-82-7	PES	< 0.140	< 0.280	< 0.140	< 0.138	< 0.280	< 0.140
	356-02-5	3:3 FTCA	< 0.290	< 0.580	< 0.290	< 0.285	< 0.580	< 0.290
	914637-49-3	5:3 FTCA	< 0.480	< 0.960	< 0.480	< 0.472	< 0.960	< 0.480
	812-70-4	7:3 FTCA	< 0.350	< 0.700	< 0.350	< 0.344	18.100	44.700
	70887-84-2	8:2 FTUCA	< 0.220	< 0.440	< 0.220	< 0.216	< 0.440	< 0.220
	53826-13-4	10:2 FTCA	< 0.420	< 0.840	< 0.420	< 0.413	< 0.840	< 0.420
	27854-31-5	8:2 FTCA	< 0.350	< 0.700	< 0.350	< 0.344	< 0.700	< 0.350
	53826-12-3	6:2FTCA	< 0.430	< 0.860	< 0.430	< 0.423	< 0.860	< 0.430
	133201-07-7	PFECHS	< 0.220	< 0.440	< 0.220	< 0.216	< 0.440	< 0.220
	70887-88-6	6:2 FTUCA	0.232	< 0.280	< 0.140	< 0.138	< 0.280	< 0.140

Yellow Shading - Spiking Chem. Runs 1A, 2A, 3A
Blue Shading - Not EPA Method 1633 Analyte
Pink Shading - Compound Detected

Table K-12. Normalized OTM-45 Sampling Train Components - HFPO-DA Analytical Results

PFAS Category	CAS No.	Acronym	ATG Quartz Filter Frit Quartz Filter Frit X-1019 (ng/g	ATG O-Ring Samples Red O-Ring Silicon X-1015, X-1016 (ng/g)	Focus O-Ring Samples Red O-Ring Silicon X-1025, X-1026 (ng/g)	ATG O-Ring Samples Blue O-Ring Viton X-1017, X-1018 (ng/g)	Focus O-Ring Samples Blue O-Ring Viton X-1027, X-1028 (ng/g)	Focus O-Ring Samples Blue O-Ring TFE-Viton X-1029, X-1030 (ng/g)
PFCAs	375-22-4	PFBA	0.032	5.377	0.100	1.294	0.999	1.435
	2706-90-3	PFPeA	0.040	3.730	0.016	< 0.047	< 0.018	< 0.009
	307-24-4	PFHxA	0.021	2.977	< 0.014	< 0.054	< 0.021	< 0.011
	375-85-9	PFHpA	0.011	0.967	< 0.042	< 0.160	< 0.063	< 0.032
	335-67-1	PFOA	0.046	1.350	< 0.044	< 0.168	< 0.066	< 0.034
	375-95-1	PFNA	0.028	0.035	0.008	< 0.022	< 0.009	< 0.004
	335-76-2	PFDA	0.011	< 0.044	< 0.017	< 0.065	< 0.025	< 0.013
	2058-94-8	PFUnA	0.011	< 0.030	< 0.012	< 0.044	< 0.017	< 0.009
	307-55-1	PFDoA	0.007	< 0.018	< 0.007	< 0.026	< 0.010	< 0.005
	72629-94-8	PFTriA	0.009	< 0.025	< 0.010	< 0.036	< 0.014	< 0.007
	376-06-7	PFTeA	0.008	< 0.030	< 0.012	< 0.044	< 0.017	< 0.009
	67905-19-5	PFHxDA	0.005	< 0.051	< 0.020	< 0.075	< 0.030	< 0.015
	16517-11-6	PFODA	0.003	< 0.039	< 0.015	< 0.057	< 0.022	< 0.011
PFSAs	375-73-5	PFBS	< 0.007	< 0.156	0.102	< 0.230	< 0.091	< 0.046
	2706-91-4	PFPeS	< 0.001	< 0.021	< 0.008	< 0.031	< 0.012	< 0.006
	355-46-4	PFHxS	< 0.001	< 0.019	< 0.008	0.232	0.173	0.196
	375-92-8	PFHpS	< 0.001	< 0.019	< 0.008	< 0.028	< 0.011	< 0.006
	1763-23-1	PFOS	0.027	0.124	< 0.031	< 0.116	< 0.046	< 0.023
	68259-12-1	PFNS	< 0.001	< 0.021	< 0.008	< 0.031	< 0.012	< 0.006
	335-77-3	PFDS	< 0.001	< 0.019	< 0.008	< 0.028	< 0.011	< 0.006
	79780-39-5	PFDoS	< 0.001	< 0.017	< 0.007	< 0.025	< 0.010	< 0.005
FOSAs	754-91-6	FOSA	0.001	< 0.015	< 0.006	< 0.023	< 0.009	< 0.005
	31506-32-8	NMeFOSA	< 0.001	< 0.026	< 0.010	< 0.039	< 0.015	< 0.008
	4151-50-2	NEtFOSA	0.161	< 0.028	< 0.011	< 0.041	< 0.016	< 0.008
FOSAAs	2355-31-9	NMeFOSAA	< 0.001	< 0.021	< 0.008	< 0.031	< 0.012	< 0.006
	2991-50-6	NEtFOSAA	< 0.001	0.496	< 0.010	< 0.036	< 0.014	< 0.007
FOSEs	24448-09-7	N-MeFOSE	0.153	< 0.858	< 0.336	< 1.268	< 0.500	< 0.256
	1691-99-2	N-EtFOSE	---	< 0.021	< 0.008	< 0.031	< 0.012	< 0.006
FTSs	757124-72-4	4:2 FTS	< 0.001	< 0.016	< 0.006	< 0.024	< 0.009	< 0.005
	27619-97-2	6:2 FTS	< 0.030	< 0.701	< 0.274	< 1.035	< 0.408	< 0.209
	39108-34-4	8:2 FTS	< 0.001	< 0.025	0.017	< 0.036	< 0.014	< 0.007
	120226-60-0	10:2 FTS	< 0.002	< 0.056	< 0.022	< 0.083	< 0.033	< 0.017
Fluorinated Replacement Chemicals	13252-13-6	HFPO-DA	< 0.035	< 0.823	< 0.322	< 1.216	< 0.479	< 0.245
	919005-14-4	DONA	< 0.001	0.044	< 0.010	0.583	< 0.014	0.558
	756426-58-1	9Cl-PF3ONS	< 0.001	< 0.017	< 0.007	< 0.025	< 0.010	< 0.005
	763051-92-9	11Cl-PF3OUdS	< 0.001	< 0.035	< 0.014	< 0.052	< 0.020	< 0.010
Additional Targets	377-73-1	PFECA F	< 0.001	< 0.026	< 0.010	< 0.039	< 0.015	< 0.008
	863090-89-5	PFECA A	< 0.001	< 0.035	< 0.014	< 0.052	< 0.020	< 0.010
	151772-58-6	PFECA B	< 0.001	< 0.026	< 0.010	< 0.039	< 0.015	< 0.008
	113507-82-7	PES	< 0.001	< 0.025	< 0.010	< 0.036	< 0.014	< 0.007
	356-02-5	3:3 FTCA	< 0.002	< 0.051	< 0.020	< 0.075	< 0.030	< 0.015
	914637-49-3	5:3 FTCA	< 0.004	< 0.084	< 0.033	< 0.124	< 0.049	< 0.025
	812-70-4	7:3 FTCA	< 0.003	< 0.061	< 0.024	< 0.091	0.923	2.333
	70887-84-2	8:2 FTUCA	< 0.002	< 0.039	< 0.015	< 0.057	< 0.022	< 0.011
	53826-13-4	10:2 FTCA	< 0.003	< 0.074	< 0.029	< 0.109	< 0.043	< 0.022
	27854-31-5	8:2 FTCA	< 0.003	< 0.061	< 0.024	< 0.091	< 0.036	< 0.018
	53826-12-3	6:2FTCA	< 0.003	< 0.075	< 0.029	< 0.111	< 0.044	< 0.022
	133201-07-7	PFECHS	< 0.002	< 0.039	< 0.015	< 0.057	< 0.022	< 0.011
	70887-88-6	6:2 FTUCA	< 0.001	0.041	< 0.010	< 0.036	< 0.014	< 0.007

Yellow Shading - Spiking Chem. Runs 1A, 2A, 3A
Blue Shading - Not EPA Method 1633 Analyte
Pink Shading - Compound Detected

Table K-13. Detailed HFPO-DA Analytical Results for ATG O-Ring and Filter Frit Samples

PFAS Category	CAS No.	Acronym	X-1015, 1016 QA Red O-Ring (ATG)				X-1017, 1018 QA Blue O-Ring (ATG)				X-1019 QA Quartz Filter Frit (ATG)			
			Measured (ng/sample)	MDL (ng/sample)	Lab Flag	DV Flag	Measured (ng/sample)	MDL (ng/sample)	Lab Flag	DV Flag	Measured (ng/sample)	MDL (ng/sample)	Lab Flag	DV Flag
PFCAs	375-22-4	PFBA	30.700	1.30			10.000	2.60			4.270	1.30		
	2706-90-3	PFPeA	21.300	0.180			< 0.360	0.360			5.390	0.180		
	307-24-4	PFHxA	17.000	0.210	Cl B		< 0.420	0.420			2.850	0.210	B	
	375-85-9	PFHpA	5.520	0.620	B		< 1.240	1.24			1.530	0.620	B	
	335-67-1	PFOA	7.710	0.650			< 1.300	1.30			6.120	0.650		
	375-95-1	PFNA	0.197	0.0850	J I		< 0.170	0.170			3.810	0.0850	I	
	335-76-2	PFDA	< 0.250	0.250			< 0.500	0.500			1.510	0.250		
	2058-94-8	PFUnA	< 0.170	0.170			< 0.340	0.340			1.540	0.170		
	307-55-1	PFDoA	< 0.100	0.100			< 0.200	0.200			0.956	0.100	J	
	72629-94-8	PFTriA	< 0.140	0.140			< 0.280	0.280			1.210	0.140		
	376-06-7	PFTeA	< 0.170	0.170			< 0.340	0.340			1.070	0.170		
	67905-19-5	PFHxDA	< 0.290	0.290			< 0.580	0.580	R		0.708	0.290	J	
	16517-11-6	PFODA	< 0.220	0.220			< 0.440	0.440	R		0.335	0.220	J	
PFSAs	375-73-5	PFBS	< 0.890	0.890			< 1.780	1.78			< 0.890	0.890		
	2706-91-4	PFPeS	< 0.120	0.120			< 0.240	0.240			< 0.120	0.120		
	355-46-4	PFHxS	< 0.110	0.110			1.790	0.220	J I		< 0.110	0.110		
	375-92-8	PFHpS	< 0.110	0.110			< 0.220	0.220			< 0.110	0.110		
	1763-23-1	PFOS	0.707	0.450	J I		< 0.900	0.900			3.560	0.450	I Cl	
	68259-12-1	PFNS	< 0.120	0.120			< 0.240	0.240			< 0.120	0.120		
	335-77-3	PFDS	< 0.110	0.110			< 0.220	0.220			< 0.110	0.110		
	79780-39-5	PFDoS	< 0.095	0.0950			< 0.190	0.190			< 0.095	0.0950		
FOSAs	754-91-6	FOSA	< 0.088	0.0880			< 0.176	0.176			0.133	0.0880	J	
	31506-32-8	NMeFOSA	< 0.150	0.150			< 0.300	0.300			< 0.150	0.150		
	4151-50-2	NEtFOSA	< 0.160	0.160			< 0.320	0.320			21.500	0.160	R	
FOSAAs	2355-31-9	NMeFOSAA	< 0.120	0.120			< 0.240	0.240			< 0.120	0.120		
	2991-50-6	NEtFOSAA	2.830	0.140			< 0.280	0.280			< 0.140	0.140		
FOSEs	24448-09-7	N-MeFOSE	< 4.900	4.90			< 9.800	9.80	R		20.500	4.90	Cl	
	1691-99-2	N-EtFOSE	< 0.120	0.120			< 0.240	0.240	R		NR[a]	0.120	R	
FTSs	757124-72-4	4:2 FTS	< 0.091	0.0910			< 0.182	0.182			< 0.091	0.0910		
	27619-97-2	6:2 FTS	< 4.000	4.00			< 8.000	8.00			< 4.000	4.00		
	39108-34-4	8:2 FTS	< 0.140	0.140			< 0.280	0.280			< 0.140	0.140		
	120226-60-0	10:2 FTS	< 0.320	0.320			< 0.640	0.640			< 0.320	0.320		
Fluorinated Replacement Chemicals	13252-13-6	HFPO-DA	< 4.700	4.70			< 9.400	9.40			< 4.700	4.70		
	919005-14-4	DONA	0.254	0.140	J		4.510	0.280			< 0.140	0.140		
	756426-58-1	9Cl-PF3ONS	< 0.098	0.0980			< 0.196	0.196			< 0.098	0.0980		
	763051-92-9	11Cl-PF3OUdS	< 0.200	0.200			< 0.400	0.400			< 0.200	0.200		
Additional Targets	377-73-1	PFECA F	< 0.150	0.150			< 0.300	0.300			< 0.150	0.150		
	863090-89-5	PFECA A	< 0.200	0.200			< 0.400	0.400			< 0.200	0.200		
	151772-58-6	PFECA B	< 0.150	0.150			< 0.300	0.300			< 0.150	0.150		
	113507-82-7	PES	< 0.140	0.140			< 0.280	0.280			< 0.140	0.140		
	356-02-5	3:3 FTCA	< 0.290	0.290			< 0.580	0.580			< 0.290	0.290		
	914637-49-3	5:3 FTCA	< 0.480	0.480			< 0.960	0.960			< 0.480	0.480		
	812-70-4	7:3 FTCA	< 0.350	0.350			< 0.700	0.700			< 0.350	0.350		
	70887-84-2	8:2 FTUCA	< 0.220	0.220			< 0.440	0.440			< 0.220	0.220		
	53826-13-4	10:2 FTCA	< 0.420	0.420			< 0.840	0.840			< 0.420	0.420		
	27854-31-5	8:2 FTCA	< 0.350	0.350			< 0.700	0.700			< 0.350	0.350		
	53826-12-3	6:2FTCA	< 0.430	0.430			< 0.860	0.860			< 0.430	0.430		
	133201-07-7	PFECHS	< 0.220	0.220			< 0.440	0.440			< 0.220	0.220		
	70887-88-6	6:2 FTUCA	0.232	0.140	J		< 0.280	0.280			< 0.140	0.140		

Yellow Shading - Spiking Chem. Runs 1A, 2A, 3A
Blue Shading - Not EPA Method 1633 Analyte
Pink Shading - Compound Detected

Table K-14. Detailed HFPO-DA Analytical Results for Focus O-Ring Samples

PFAS Category	CAS No.	Acronym	X-1025, 1026 QA Red O-Ring Silicon (Focus)				X-1027, 1028 QA Blue O-Ring Viton (Focus)				X-1029, 1030 QA Blue O-Ring TFE/Viton (Focus)			
			Measured (ng/sample)	MDL (ng/sample)	Lab Flag	DV Flag	Measured (ng/sample)	MDL (ng/sample)	Lab Flag	DV Flag	Measured (ng/sample)	MDL (ng/sample)	Lab Flag	DV Flag
PFCAs	375-22-4	PFBA	1.440	1.28	J		19.600	2.60			27.500	1.30		
	2706-90-3	PFPeA	0.231	0.177	J		< 0.360	0.360			< 0.180	0.180		
	307-24-4	PFHxA	< 0.206	0.206			< 0.420	0.420			< 0.210	0.210		
	375-85-9	PFHpA	< 0.609	0.609			< 1.240	1.24			< 0.620	0.620		
	335-67-1	PFOA	< 0.639	0.639			< 1.300	1.30			< 0.650	0.650		
	375-95-1	PFNA	0.122	0.0835	J		< 0.170	0.170			< 0.085	0.0850		
	335-76-2	PFDA	< 0.246	0.246			< 0.500	0.500			< 0.250	0.250		
	2058-94-8	PFUnA	< 0.167	0.167			< 0.340	0.340			< 0.170	0.170		
	307-55-1	PFDoA	< 0.098	0.0983			< 0.200	0.200			< 0.100	0.100		
	72629-94-8	PFTriA	< 0.138	0.138			< 0.280	0.280			< 0.140	0.140		
	376-06-7	PFTeA	< 0.167	0.167			< 0.340	0.340			< 0.170	0.170		
	67905-19-5	PFHxDA	< 0.285	0.285			< 0.580	0.580	R		< 0.290	0.290	R	
	16517-11-6	PFODA	< 0.216	0.216			< 0.440	0.440	R		< 0.220	0.220	R	
PFSAs	375-73-5	PFBS	1.460	0.875			< 1.780	1.78			< 0.890	0.890		
	2706-91-4	PFPeS	< 0.118	0.118			< 0.240	0.240			< 0.120	0.120		
	355-46-4	PFHxS	< 0.108	0.108			3.390	0.220	I		3.750	0.110	I	
	375-92-8	PFHpS	< 0.108	0.108			< 0.220	0.220			< 0.110	0.110		
	1763-23-1	PFOS	< 0.442	0.442			< 0.900	0.900			< 0.450	0.450		
	68259-12-1	PFNS	< 0.118	0.118			< 0.240	0.240			< 0.120	0.120		
	335-77-3	PFDS	< 0.108	0.108			< 0.220	0.220			< 0.110	0.110		
	79780-39-5	PFDoS	< 0.093	0.0934			< 0.190	0.190			< 0.095	0.0950		
FOSAs	754-91-6	FOSA	< 0.087	0.0865			< 0.176	0.176			< 0.088	0.0880		
	31506-32-8	NMeFOSA	< 0.147	0.147			< 0.300	0.300			< 0.150	0.150		
	4151-50-2	NEtFOSA	< 0.157	0.157			< 0.320	0.320			< 0.160	0.160		
FOSAAs	2355-31-9	NMeFOSAA	< 0.118	0.118			< 0.240	0.240			< 0.120	0.120		
	2991-50-6	NEtFOSAA	< 0.138	0.138			< 0.280	0.280			< 0.140	0.140		
FOSEs	24448-09-7	N-MeFOSE	< 4.820	4.82			< 9.800	9.80	R		< 4.900	4.90	R	
	1691-99-2	N-EtFOSE	< 0.118	0.118			< 0.240	0.240	R		< 0.120	0.120	R	
FTSs	757124-72-4	4:2 FTS	< 0.089	0.0894			< 0.182	0.182			< 0.091	0.0910		
	27619-97-2	6:2 FTS	< 3.930	3.93			< 8.000	8.00			< 4.000	4.00		
	39108-34-4	8:2 FTS	0.249	0.138	J		< 0.280	0.280			< 0.140	0.140		
	120226-60-0	10:2 FTS	< 0.314	0.314			< 0.640	0.640			< 0.320	0.320		
Fluorinated Replacement Chemicals	13252-13-6	HFPO-DA	< 4.620	4.62			< 9.400	9.40			< 4.700	4.70		
	919005-14-4	DONA	< 0.138	0.138			< 0.280	0.280			10.700	0.140		
	756426-58-1	9Cl-PF3ONS	< 0.096	0.0963			< 0.196	0.196			< 0.098	0.0980		
	763051-92-9	11Cl-PF3OUdS	< 0.197	0.197			< 0.400	0.400			< 0.200	0.200		
Additional Targets	377-73-1	PFECA F	< 0.147	0.147			< 0.300	0.300			< 0.150	0.150		
	863090-89-5	PFECA A	< 0.197	0.197			< 0.400	0.400			< 0.200	0.200		
	151772-58-6	PFECA B	< 0.147	0.147			< 0.300	0.300			< 0.150	0.150		
	113507-82-7	PES	< 0.138	0.138			< 0.280	0.280			< 0.140	0.140		
	356-02-5	3:3 FTCA	< 0.285	0.285			< 0.580	0.580			< 0.290	0.290		
	914637-49-3	5:3 FTCA	< 0.472	0.472			< 0.960	0.960			< 0.480	0.480		
	812-70-4	7:3 FTCA	< 0.344	0.344			18.100	0.700	I Cl		44.700	0.350	I Cl	
	70887-84-2	8:2 FTUCA	< 0.216	0.216			< 0.440	0.440			< 0.220	0.220		
	53826-13-4	10:2 FTCA	< 0.413	0.413			< 0.840	0.840			< 0.420	0.420		
	27854-31-5	8:2 FTCA	< 0.344	0.344			< 0.700	0.700			< 0.350	0.350		
	53826-12-3	6:2FTCA	< 0.423	0.423			< 0.860	0.860			< 0.430	0.430		
	133201-07-7	PFECHS	< 0.216	0.216			< 0.440	0.440			< 0.220	0.220		
	70887-88-6	6:2 FTUCA	< 0.138	0.138			< 0.280	0.280			< 0.140	0.140		

Yellow Shading - Spiking Chem. Runs 1A, 2A, 3A
Blue Shading - Not EPA Method 1633 Analyte
Pink Shading - Compound Detected