IXM MANUFACTURING PROCESSES
POLYMERS STACK EMISSIONS TEST REPORT
TEST DATES: 25-26 SEPTEMBER 2019

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1. INTRODUCTION

1.1 FACILITY AND BACKGROUND INFORMATION

The Chemours Fayetteville Works (Chemours) is located in Bladen County, North Carolina, approximately 10 miles south of the city of Fayetteville. The Chemours operating areas on the site include the Fluoromonomers, IXM and Polymers Processing Aid (PPA) manufacturing areas, Wastewater Treatment, and Powerhouse.

Chemours contracted Weston Solutions, Inc. (Weston) to perform HFPO Dimer Acid Fluoride, captured as HFPO Dimer Acid emission testing on the Polymers Stack. Testing was performed on 25-26 September 2019 and generally followed the "Emission Test Protocol" reviewed and approved by the North Carolina Department of Environmental Quality (NCDEQ). This report provides the results from the emission test program.

1.2 TEST OBJECTIVES

The specific objectives for this test program were as follows:

- Measure the emissions concentrations and mass emissions rates of HFPO Dimer Acid Fluoride from the Polymers stack which is located in the IXM processes.
- Monitor and record process data in conjunction with the test program.
- Provide representative emissions data.

1.3 TEST PROGRAM OVERVIEW

During the emissions test program, the concentrations and mass emissions rates of HFPO Dimer Acid Fluoride were measured on the Polymers stack.

Table 1-1 provides a summary of the test location and the parameters that were measured along with the sampling/analytical procedures that were followed.

Section 2 provides a summary of test results. A description of the processes is provided in Section 3. Section 4 provides a description of the test locations. The sampling and analytical procedures are provided in Section 5. Detailed test results and discussion are provided in Section 6.

Appendix C includes the summary reports for the laboratory analytical results. The full laboratory data packages are provided in electronic format.

Table 1-1
Sampling Plan for Polymers Stack

Sampling Point & Location	**Polymers Stack**				
Number of Tests:	3				
Parameters To Be Tested:	HFPO Dimer Acid Fluoride (HFPO-DAF)	Volumetric Flow Rate and Gas Velocity	Carbon Dioxide	Oxygen	Water Content
Sampling or Monitoring Method	EPA M-0010	EPA M1 and M2 in conjunction with M-0010 tests	EPA M3/3A		EPA M4 in conjunction with M-0010 tests
Sample Extraction/ Analysis Method(s):	LC/MS/MS	NA[6]	NA		NA
Sample Size	> 1m^3	NA	NA	NA	NA
Total Number of Samples Collected[1]	3	3	3	3	3
Reagent Blanks (Solvents, Resins)[1]	1 set	0	0	0	0
Field Blank Trains[1]	1 per source	0	0	0	0
Proof Blanks[1]	1 per train	0	0	0	0
Trip Blanks[1,2]	1 set	0	0	0	
Lab Blanks	1 per fraction[3]	0	0	0	0
Laboratory or Batch Control Spike Samples (LCS)	1 per fraction[3]	0	0	0	0
Laboratory or Batch Control Spike Sample Duplicate (LCSD)	1 per fraction[3]	0	0	0	0
Media Blanks	1 set[4]	0	0	0	0
Isotope Dilution Internal Standard Spikes	Each sample	0	0	0	0
Total No. of Samples	7[5]	3	3	3	3

Key:

[1] Sample collected in field.

[2] Trip blanks include one XAD-2 resin module and one methanol sample per sample shipment.

[3] Lab blank and LCS/LCSD includes one set per analytical fraction (front half, back half and condensate).

[4] One set of media blank archived at laboratory at media preparation.

[5] Actual number of samples collected in field.

[6] Not applicable.

2. SUMMARY OF TEST RESULTS

A total of three test runs were performed on the Polymers Stack. Table 2-1 provides a summary of the HFPO Dimer Acid emission test results. Detailed test results summaries are provided in Section 6.

It is important to note that emphasis is being placed on the characterization of the emissions based on the stack test results. Research conducted in developing the protocol for stack testing HFPO Dimer Acid Fluoride, HFPO Dimer Acid Ammonium Salt and HFPO Dimer Acid realized that the resulting testing, including collection of the air samples and extraction of the various fraction of the sampling train, would result in all three compounds being expressed as simply the HFPO Dimer Acid. However, it should be understood that the total HFPO Dimer Acid results provided on Table 2-1 and in this report include a percentage of each of the three compounds.

Table 2-1
Summary of HFPO Dimer Acid Test Results

Source	Run No.	Emission Rates	
		lb/hr	g/sec
Polymers Stack	1	1.49E-04	1.87E-05
	2	1.50E-04	1.88E-05
	3	2.25E-04	2.84E-05
	Average	1.74E-04	2.20E-05

3. PROCESS DESCRIPTIONS

The IXM area is included in the scope of this test program.

3.1 POLYMERS

The Polymers area consists of a polymerization process, finishing and recycle. There are two types of polymer produced, using products made in the Fluoromonomers and IXM Precursors areas: SR polymer and CR polymer. Both SR and CR polymerization processes take place in a solvent. The reaction is initiated and sustained by continuous addition of Dimer Peroxide initiator. There is a Recycle Still that takes solution and removes any impurities, allowing the solution to be used again. The finishing area takes the polymer produced during polymerization and transforms it into pellets.

3.2 PROCESS OPERATIONS AND PARAMETERS

Source	Operation/Product	Batch or Continuous
Polymers Stack	CR Polymer	Continuous – Polymerization Batch – Recycle Still Batch – Line Four extrusion

During the test program, operations parameters were monitored by Chemours and are included in Appendix A.

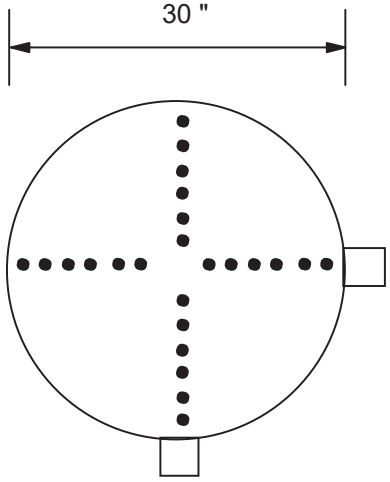
4. DESCRIPTION OF TEST LOCATIONS

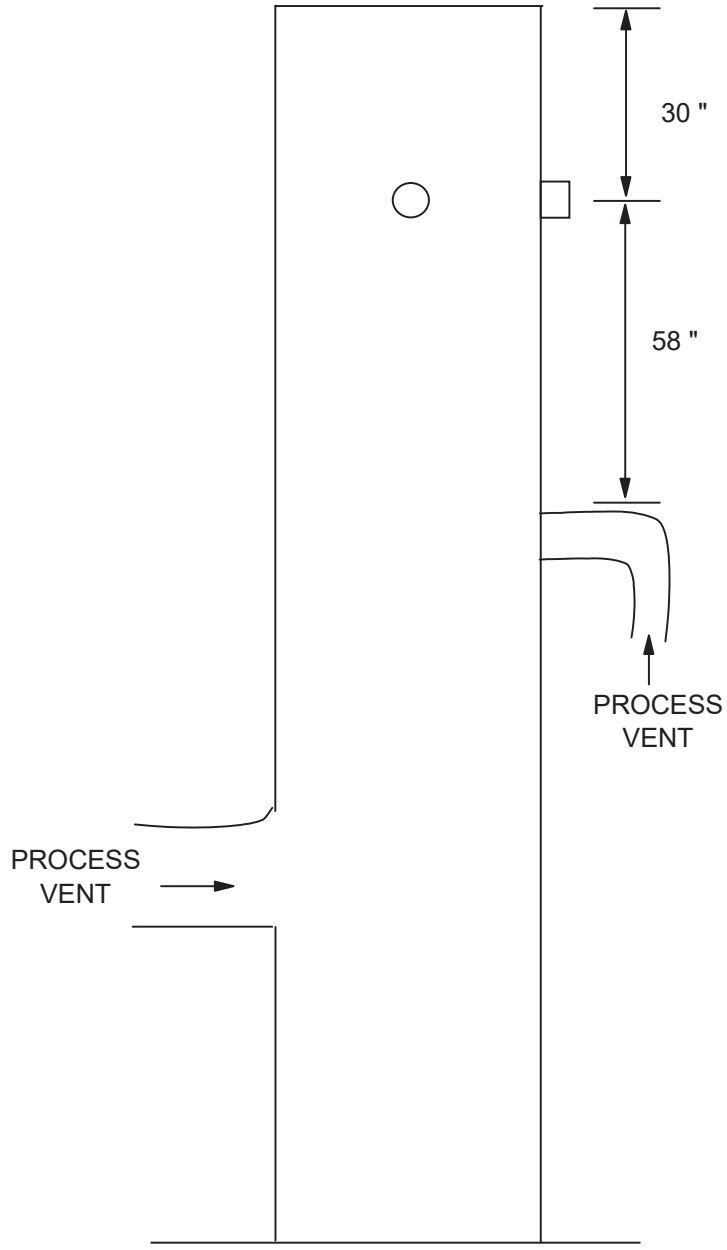
4.1 POLYMERS STACK

The Polymers stack is a 30-inch ID fiberglass stack located near the roof edge. Vent lines enter the stack at various points and a significant straight run of vertical stack without flow disturbances is not available. Two sample ports are installed in the stack 30 inches down from the stack exit and 58 inches up from the last vent line entry point. Per EPA Method 1, 24 traverse points, 12 per port, were used for sampling.

See Figure 4-1 for a schematic of the test port and traverse point locations.

Note: All measurements at the test location were confirmed prior to sampling.





TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE NEAR WALL (INCHES)
1	1
2	2
3	3 1/2
4	5 1/4
5	7 1/2
6	10 5/8
7	19 3/8
8	22 1/2
9	24 3/4
10	26 1/2
11	28
12	29

DRAWING NOT TO SCALE

FIGURE 4-1
POLYMERS STACK TEST PORT
AND TRAVERSE POINT LOCATIONS

5. SAMPLING AND ANALYTICAL METHODS

5.1 STACK GAS SAMPLING PROCEDURES

The purpose of this section is to describe the stack gas emissions sampling trains and to provide details of the stack sampling and analytical procedures utilized during the emissions test program.

5.1.1 Pre-Test Determinations

Preliminary test data were obtained at the test location. Stack geometry measurements were measured and recorded, and traverse point distances verified. A preliminary velocity traverse was performed utilizing a calibrated S-type pitot tube and an inclined manometer to determine velocity profiles. Flue gas temperatures were observed with a calibrated direct readout panel meter equipped with a chromel-alumel thermocouple. Preliminary water vapor content was estimated by wet bulb/dry bulb temperature measurements.

A check for the presence or absence of cyclonic flow was previously conducted at the test location. The cyclonic flow checks were negative (< 20°) verifying that the source was acceptable for testing.

Preliminary test data was used for nozzle sizing and sampling rate determinations for isokinetic sampling procedures.

Calibration of probe nozzles, pitot tubes, metering systems, and temperature measurement devices was performed as specified in Section 5 of EPA Method 5 test procedures.

5.2 STACK PARAMETERS

5.2.1 EPA Method 0010

The sampling train utilized to perform the HFPO Dimer Acid sampling was an EPA Method 0010 train (see Figure 5-1). The Method 0010 consisted of a borosilicate nozzle that attached directly to a heated borosilicate probe. In order to minimize possible thermal degradation of the HFPO Dimer Acid, the probe and particulate filter were heated above stack temperature to minimize water vapor condensation before the filter. The probe was connected directly to a heated borosilicate filter holder containing a solvent extracted glass fiber filter.

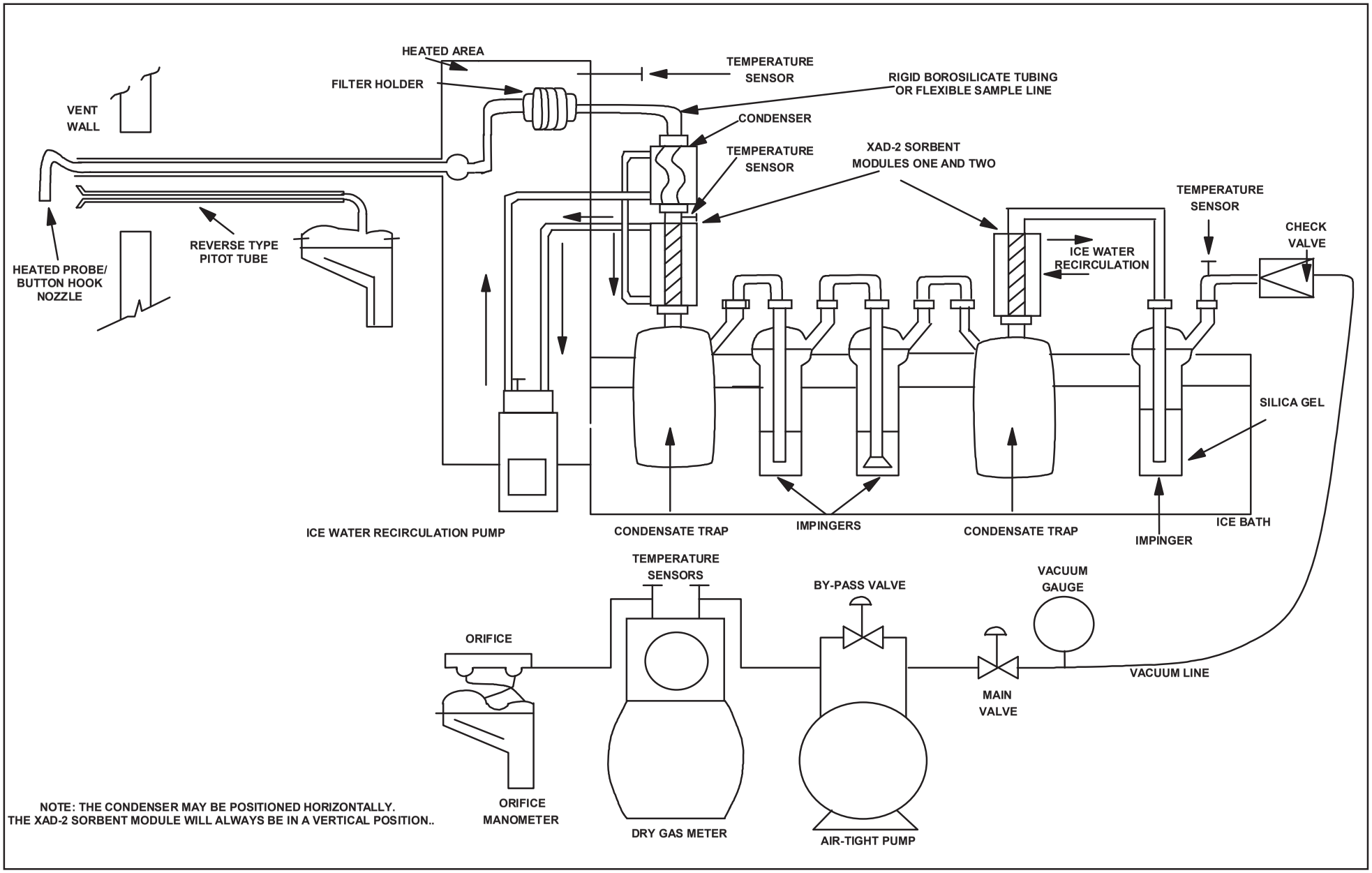


FIGURE 5-1
EPA METHOD 0010 SAMPLING TRAIN

A section of borosilicate glass or flexible polyethylene tubing connected the filter holder exit to a Grahm (spiral) type ice water-cooled condenser, an ice water-jacketed sorbent module containing approximately 40 grams of XAD-2 resin. The XAD-2 resin tube was equipped with an inlet temperature sensor. The XAD-2 resin trap was followed by a condensate knockout impinger and a series of two impingers that contained 100 mL of high purity distilled water. The train also included a second XAD-2 resin trap behind the impinger section to evaluate possible sampling train breakthrough. Each XAD-2 resin trap was connected to a 1-liter condensate knockout trap. The final impinger contained 300 grams of dry pre-weighed silica gel. All impingers and the condensate traps were maintained in an ice bath. Ice water was continuously circulated in the condenser and the XAD-2 module to maintain method-required temperature. A control console with a leakless vacuum pump, a calibrated orifice, and dual inclined manometers was connected to the final impinger via an umbilical cord to complete the sample train.

HFPO Dimer Acid Fluoride (CAS No. 2062-98-8) that is present in the stack gas is expected to be captured in the sampling train along with HFPO Dimer Acid (CAS No. 13252-13-6). HFPO Dimer Acid Fluoride undergoes hydrolysis instantaneously in water in the sampling train and during the sample recovery step and will be converted to HFPO Dimer Acid such that the amount of HFPO Dimer Acid emissions represents a combination of both HFPO Dimer Acid Fluoride and HFPO Dimer Acid.

During sampling, gas stream velocities were measured by attaching a calibrated S-type pitot tube into the gas stream adjacent to the sampling nozzle. The velocity pressure differential was observed immediately after positioning the nozzle at each traverse point, and the sampling rate adjusted to maintain isokineticity at 100% ± 10. Flue gas temperature was monitored at each point with a calibrated panel meter and thermocouple. Isokinetic test data was recorded at each traverse point during all test periods, as appropriate. Leak checks were performed on the sampling apparatus according to reference method instructions, prior to and following each run, component change (if required), or during midpoint port changes.

5.2.2 EPA Method 0010 Sample Recovery

At the conclusion of each test, the sampling train was dismantled, the openings sealed, and the components transported to the field laboratory trailer for recovery.

A consistent procedure was employed for sample recovery:

1. The two XAD-2 covered (to minimize light degradation) sorbent modules (1 and 2) were sealed and labeled.

2. The glass fiber filter(s) were removed from the holder with tweezers and placed in a polyethylene container along with any loose particulate and filter fragments.

3. The particulate adhering to the internal surfaces of the nozzle, probe and front half of the filter holder were rinsed with a solution of methanol and ammonium hydroxide into a polyethylene container while brushing a minimum of three times until no visible particulate remained. Particulate adhering to the brush was rinsed with methanol/ ammonium hydroxide into the same container. The container was sealed.

4. The volume of liquid collected in the first condensate trap was measured, the value recorded, and the contents poured into a polyethylene container.

5. All train components between the filter exit and the first condensate trap were rinsed with methanol/ammonium hydroxide. The solvent rinse was placed in a separate polyethylene container and sealed.

6. The volume of liquid in the impingers one, two, and second condensate trap were measured, the values recorded, and sample was placed in the same container as Step 4 above, then sealed.

7. The two impingers, condensate trap, and connectors were rinsed with methanol/ ammonium hydroxide. The solvent sample was placed in a separate polyethylene container and sealed.

8. The silica gel in the final impinger was weighed and the weight gain value recorded.

9. Site (reagent) blank samples of the methanol/ammonium hydroxide, XAD resin, filter and distilled water were retained for analysis.

Each container was labeled to clearly identify its contents. The height of the fluid level was marked on the container of each liquid sample to provide a reference point for a leakage check during transport. All samples were maintained cool.

During each test campaign, an M-0010 blank train was setup near the test location, leak checked and recovered along with the respective sample train. Following sample recovery, all samples were transported to Eurofins TestAmerica (TestAmerica) for sample extraction and analysis.

See Figure 5-2 for a schematic of the M-0010 sample recovery process.

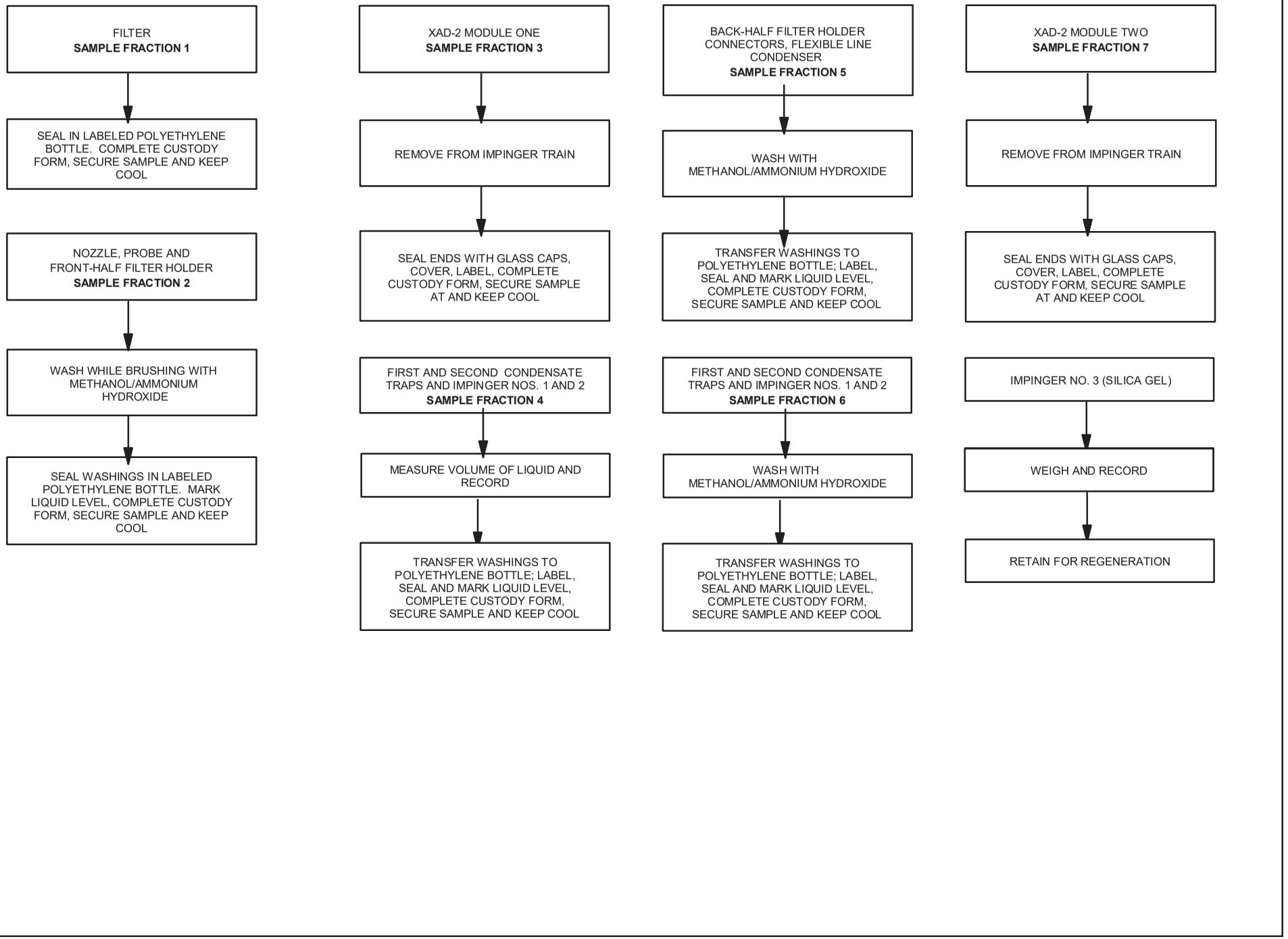


FIGURE 5-2
HFPO DIMER ACID SAMPLE RECOVERY PROCEDURES FOR METHOD 0010

IASDATA\CHEMOURS\15418.002.017\FIGURE 5-2 EPA 0010

5.2.3 EPA Method 0010 – Sample Analysis

Method 0010 sampling trains resulted in four separate analytical fractions for HFPO Dimer Acid analysis according to SW-846 Method 3542:

- Front-Half Composite—comprised of the particulate filter, and the probe, nozzle, and front-half of the filter holder solvent rinses,
- Back-Half Composite—comprised of the first XAD-2 resin material and the back-half of the filter holder with connecting glassware solvent rinses,
- Condensate Composite—comprised of the aqueous condensates and the contents of impingers one and two with solvent rinses,
- Breakthrough XAD-2 Resin Tube—comprised of the resin tube behind the series of impingers.

The second XAD-2 resin material was analyzed separately to evaluate any possible sampling train HFPO-DA breakthrough.

The front-half and back-half composites and the second XAD-2 resin material were placed in polypropylene wide-mouth bottles and tumbled with methanol containing 5% NH_4OH for 18 hours. Portions of the extracts were processed analytically for the HFPO dimer acid by liquid chromatography and duel mass spectroscopy (HPLC/MS/MS). The Condensate composite was concentrated onto a solid phase extraction (SPE) cartridge followed by desorption from the cartridge using methanol. Portions of those extracts were also processed analytically by HPLC/MS/MS.

Samples were spiked with isotope dilution internal standard (IDA) at the commencement of their preparation to provide accurate assessments of the analytical recoveries. Final data was corrected for IDA standard recoveries.

TestAmerica developed detailed procedures for the sample extraction and analysis for HFPO Dimer Acid. These procedures were incorporated into the test protocol.

5.3 EPA METHOD 3/3A (GAS STREAM COMPOSITION)

Stack gas stream composition (carbon dioxide and oxygen concentrations) was determined utilizing EPA Method 3/3A and also in combination with Method 0010 procedures discussed in the previous sections.

The fixed gases (carbon dioxide and oxygen) sampling train was utilized in accordance with the EPA Reference Method 3 specifications. The fixed gases were collected utilizing a diaphragm pump with a flow rotometer and Tedlar® sample bag.

The gas stream composition samples were collected from the exhaust of the control console calibrated orifice at a constant rate of ~0.5 liters per minute. This provided an integrated, conditioned (dry) sample. The gas passing through the control console orifice was conditioned by the impinger train. The sample was integrated with respect to time and location in the stack.

Analysis of the Tedlar® bag samples were performed using EPA Reference Method 3A analytical procedures. The conditioned Tedlar® bag samples were analyzed by calibrated analyzers such as a paramagnetic O2 analyzer and a non-dispersive infrared (NDIR) CO_2 analyzer. The O_2 and CO_2 analyzers were configured and calibrated in accordance with the gas analyzer requirements outlined in EPA Reference Method 3A. The dry molecular weight of the gas stream was calculated using the measured oxygen and carbon dioxide concentrations. The balance of the gas stream was assumed to be nitrogen. The dry molecular weight of the gas stream was used to calculate the stack gas volumetric flow rate.

6. DETAILED TEST RESULTS AND DISCUSSION

Each test was a minimum of 96 minutes in duration. A total of three test runs were performed on the Polymers Stack.

Table 6-1 provides detailed test data and test results for the Polymers Stack.

The Method 3/3A sampling indicated that the O_2 and CO_2 concentrations were at ambient air levels (20.9% O_2, 0% CO_2), therefore, 20.9% O_2 and 0% CO_2 values were used in all calculations.

TABLE 6-1
CHEMOURS - FAYETTEVILLE, NC
SUMMARY OF HFPO DIMER ACID TEST DATA AND TEST RESULTS
POLYMERS STACK

Test Data			
Run number	1	2	3
Location	Polymers Stack	Polymers Stack	Polymers Stack
Date	09/25/19	09/26/19	09/26/19
Time period	1300-1648	0833-1023	1100-1245
SAMPLING DATA:			
Sampling duration, min.	96.0	96.0	96.0
Nozzle diameter, in.	0.215	0.235	0.235
Cross sectional nozzle area, sq.ft.	0.000252	0.000301	0.000301
Barometric pressure, in. Hg	29.72	29.81	29.81
Avg. orifice press. diff., in H_2O	0.75	1.34	1.45
Avg. dry gas meter temp., deg F	92.3	76.6	80.8
Avg. abs. dry gas meter temp., deg. R	552	537	541
Total liquid collected by train, ml	18.2	30.4	33.3
Std. vol. of H_2O vapor coll., cu.ft.	0.9	1.4	1.57
Dry gas meter calibration factor	1.0069	1.0069	1.0069
Sample vol. at meter cond., dcf	45.585	57.848	60.409
Sample vol. at std. cond., dscf [(1)]	43.654	57.271	59.353
Percent of isokinetic sampling	97.8	95.1	95.4
GAS STREAM COMPOSITION DATA:			
CO_2, % by volume, dry basis	0.0	0.0	0.0
O_2, % by volume, dry basis	20.9	20.9	20.9
N_2, % by volume, dry basis	79.1	79.1	79.1
Molecular wt. of dry gas, lb/lb mole	28.84	28.84	28.84
H_20 vapor in gas stream, prop. by vol.	0.019	0.024	0.026
Mole fraction of dry gas	0.981	0.976	0.974
Molecular wt. of wet gas, lb/lb mole	28.63	28.57	28.56
GAS STREAM VELOCITY AND VOLUMETRIC FLOW DATA:			
Static pressure, in. H_2O	-0.05	-0.16	-0.20
Absolute pressure, in. Hg	29.72	29.80	29.80
Avg. temperature, deg. F	82	78	79
Avg. absolute temperature, deg.R	542	538	539
Pitot tube coefficient	0.84	0.84	0.84
Total number of traverse points	24	24	24
Avg. gas stream velocity, ft./sec.	32.4	36.4	37.7
Stack/duct cross sectional area, sq.ft.	4.91	4.91	4.91
Avg. gas stream volumetric flow, wacf/min.	9549	10729	11114
Avg. gas stream volumetric flow, dscf/min.	9055	10226	10565

[(1)] Standard conditions = 68 deg. F. (20 deg. C.) and 29.92 in Hg (760 mm Hg)

TABLE 6-1 (cont.)
CHEMOURS - FAYETTEVILLE, NC
SUMMARY OF HFPO DIMER ACID TEST DATA AND TEST RESULTS
POLYMERS STACK

TEST DATA			
Run number	1	2	3
Location	Polymers Stack	Polymers Stack	Polymers Stack
Date	09/25/19	09/26/19	09/26/19
Time period	1300-1648	0833-1023	1100-1245
LABORATORY REPORT DATA, ug.			
HFPO Dimer Acid	5.42	6.33	9.57
EMISSION RESULTS, ug/dscm.			
HFPO Dimer Acid	4.38	3.90	5.69
EMISSION RESULTS, lb/dscf.			
HFPO Dimer Acid	2.74E-10	2.44E-10	3.55E-10
EMISSION RESULTS, lb/hr.			
HFPO Dimer Acid	1.49E-04	1.50E-04	2.25E-04
EMISSION RESULTS, g/sec.			
HFPO Dimer Acid	1.87E-05	1.88E-05	2.84E-05

APPENDIX A
PROCESS OPERATIONS DATA

Polymers Stack

Date	9/25/2019											
Time	1400				1500				1600			
Stack Testing					RUN 1: 1500-1648							
Recycle Still												
Polymerization	CR 1050											
Line 4 Extrusion												
Line 3 Extrusion												

Date	9/26/2019																							
Time	800				900				1000				1100				1200				1300			
Stack Testing			RUN 2 : 0833-1023										RUN 3 - 1100-1245											
Recycle Still																								
Polymerization	CR 1050																							
Line 4 Extrusion																								
Line 3 Extrusion																								

APPENDIX B
RAW AND REDUCED TEST DATA

Sample and Velocity Traverse Point Data Sheet - Method 1

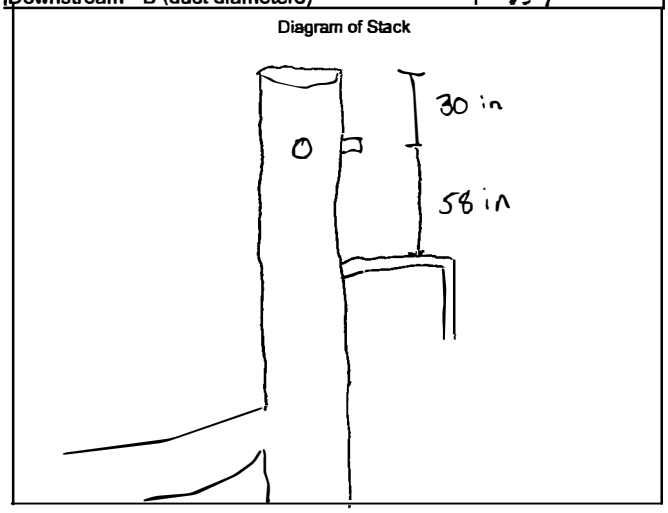
Client: Chemours
Operator: SR
Loaction/Plant: Fayetteville
Date: 3/21/18
Source: Polymers
W.O. Number:

Duct Type	☐ Circular	☐ Rectangular Duct	Indicate appropriate type	
Traverse Type	☐ Particulate Traverse	☐ Velocity Traverse	☐ CEM Traverse	

Distance from far wall to outside of port (in.) = C	48
Port Depth (in.) = D	18
Depth of Duct, diameter (in.) = C-D	30
Area of Duct (ft^2)	4.91
Total Traverse Points	24
Total Traverse Points per Port	12
Port Diameter (in.) —(Flange-Threaded-Hole)	
Monorail Length	
Rectangular Ducts Only	
Width of Duct, rectangular duct only (in.)	
Total Ports (rectangular duct only)	
Equivalent Diameter = (2*L*W)/(L+W)	

Flow Disturbances	
Upstream - A (ft)	2.5
Downstream - B (ft)	4.83
Upstream - A (duct diameters)	1.0
Downstream - B (duct diameters)	1.9

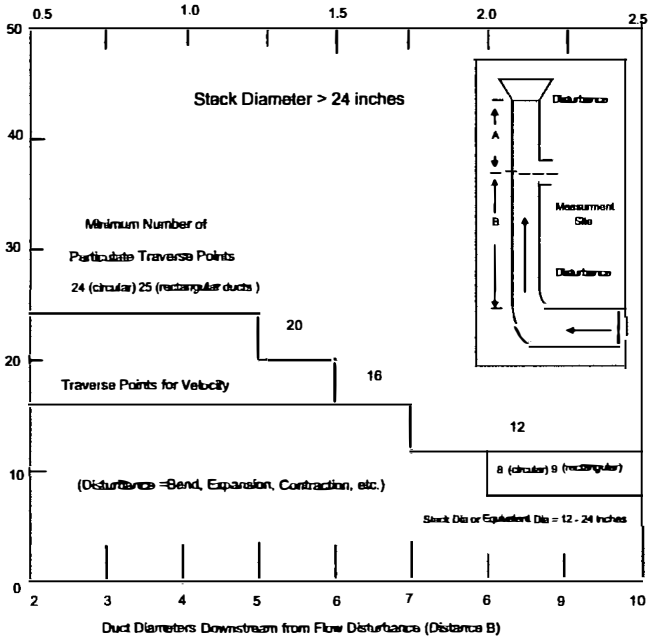
Diagram of Stack



Traverse Point Locations

Traverse Point	% of Duct	Distance from Inside Duct Wall (in)	Distance from Outside of Port (in)
1	2.1	1	19
2	6.7	2	20
3	11.8	3 1/2	21 1/2
4	17.7	5 1/4	23 1/4
5	25	7 1/2	25 1/2
6	35.6	10 5/8	28 5/8
7	64.4	19 3/8	37 3/8
8	75	22 1/2	40 1/2
9	82.3	24 3/4	42 3/4
10	88.2	26 1/2	44
11	93.3	28	46
12	97.9	29	47
CEM 3 Point(Long Measurment Line) Stratificaton Point Locations			
1	0.167		
2	0.50		
3	0.833		

Note: If stack dia < 12 inch use EPA Method 1A
(Sample port upstream of pitot port)
Note: If stack dia >24" then adjust traverse point to 1 inch from wall
If stack dia <24" then adjust traverse point to 0.5 inch from wall



Traverse Point Location Percent of Stack -Circular

Traverse Point	Number of Traverse Points: 1	2	3	4	5	6	7	8	9	10	11	12
1		14.6		6.7		4.4		3.2		2.6		2.1
2		85.4		25		14.6		10.5		8.2		6.7
3				75		29.6		19.4		14.6		11.8
4				93.3		70.4		32.3		22.6		17.7
5						85.4		67.7		34.2		25
6						95.6		80.6		65.8		35.6
7								89.5		77.4		64.4
8								96.8		85.4		75
9										91.8		82.3
10										97.4		88.2
11												93.3
12												97.9

Traverse Point Location Percent of Stack -Rectangular

Traverse Point	Number of Traverse Points: 1	2	3	4	5	6	7	8	9	10	11	12
1		25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2		75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3			83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4				87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5					90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6						91.7	78.6	68.8	61.1	55.0	50.0	45.8
7							92.9	81.3	72.2	65.0	59.1	54.2
8								93.8	83.3	75.0	68.2	62.5
9									94.4	85.0	77.3	70.8
10										95.0	86.4	79.2
11											95.5	87.5
12												95.8

CHEMOURS - FAYETTEVILLE, NC
INPUTS FOR HFPO DIMER ACID CALCULATIONS
POLYMERS STACK

Test Data			
Run number	1	2	3
Location	Polymers Stack	Polymers Stack	Polymers Stack
Date	09/25/19	09/26/19	09/26/19
Time period	1300-1648	0833-1023	1100-1245
Operator	MW	MW	MW
Inputs For Calcs.			
Sq. rt. delta P	0.56541	0.63797	0.66024
Delta H	0.7463	1.3400	1.4541
Stack temp. (deg.F)	82.2	78.0	78.7
Meter temp. (deg.F)	92.3	76.6	80.8
Sample volume (act.)	45.585	57.848	60.409
Barometric press. (in.Hg)	29.72	29.81	29.81
Volume H_2O imp. (ml)	6.0	10.0	20.0
Weight change sil. gel (g)	12.2	20.4	13.3
% CO_2	0.0	0.0	0.0
% O_2	20.9	20.9	20.9
% N_2	79.1	79.1	79.1
Area of stack (sq.ft.)	4.910	4.910	4.910
Sample time (min.)	96	96	96
Static pressure (in.H_2O)	-0.05	-0.16	-0.20
Nozzle dia. (in.)	0.215	0.235	0.235
Meter box cal.	1.0069	1.0069	1.0069
Cp of pitot tube	0.84	0.84	0.84
Traverse points	24	24	24

POLYMERS

ISOKINETIC FIELD DATA SHEET

EPA Method 0010 - HFPO Dimer Acid

Page (of

		Stack Conditions	Assumed	Actual
Client	Chemours			
W.O.#	15418.002.017			
Project ID	Chemours	% Moisture	≈2.5	
Mode/Source ID	Polymer	Impinger Vol (ml)		
Samp. Loc. ID	STK	Silica gel (g)		
Run No.ID	1	CO2, % by Vol	0.0	
Test Method ID	M0010	O2, % by Vol	20.6	
Date ID	9SEP2019	Temperature (°F)	≈85	
Source/Location	Polymer Stack	Meter Temp (°F)	≈90	
Sample Date	9/25/19 ✓	Static Press (in H_2O)	~~-0.35~~ -0.05 ✓	
Baro. Press (in Hg)	29.72 ✓			
Operator	MW WINKLER ✓	Ambient Temp (°F)	≈90	

Meter Box ID	12		
Meter Box Y	1.0069 ✓		
Meter Box Del H	1.8812		
Probe ID / Length	P697	6'	Sample Train (ft^3)
Probe Material	Boro		Leak Check @ (in Hg)
Pitot / Thermocouple ID	697		Pitot leak check good
Pitot Coefficient	0.84 ✓		Pitot Inspection good
Nozzle ID	S213		Method 3 System good
Nozzle Measurements	0.215	0.215	0.215
Avg Nozzle Dia (in)	0.215 ✓		**Temp Check**
Area of Stack (ft^2)	4.91 ✓		Meter Box Temp
Sample Time	96 ✓		Reference Temp
Total Traverse Pts	24 ✓		Pass/Fail (+/- 2°)
			Temp Change Response ?

K Factor 2.33

	Initial	Mid-Point	Final
	0.001	0.001	0.001
	✓	✓	✓
	yes / no	yes / no	yes / no
	yes / no	yes / no	yes / no
	yes / no	yes / no	yes / no
	yes / no	yes / no	yes / no
Temp Check	Pre-Test Set		Post-Test Set
Meter Box Temp	90		75
Reference Temp	90		76
Pass/Fail (+/- 2°)	Pass / Fail		Pass / Fail
Temp Change Response ?	yes / no		yes / no

TRAVERSE POINT NO.	SAMPLE TIME (min)	CLOCK TIME (plant time)	VELOCITY PRESSURE Delta P (in H2O)	ORIFICE PRESSURE Delta H (in H2O)	DRY GAS METER READING (ft^3)	STACK TEMP (°F)	DGM OUTLET TEMP (°F)	PROBE TEMP (°F)	FILTER BOX TEMP (F)	IMPINGER EXIT TEMP (oF)	SAMPLE TRAIN VAC (in Hg)	XAD EXIT TEMP (F)		COMMENTS
	0	1300 ✓			400.000									
A 1	4		0.50	1.16	402.22	82	83	100	100	64	2	53		
2	8		0.25	0.58	403.88	81	85	100	102	64	1	49		
3	12		0.28	0.65	405.62	80	87	100	102	64	1	49		
4	16		0.28	0.65	407.44	82	88	100	102	64	1	49		22.010 ✓
5	20		0.29	0.67	409.20	82	90	101	101	63	1	49		
6	24		0.30	0.69	411.10	82	90	101	101	63	1	53		
7	28		0.30	0.69	413.00	82	90	101	101	63	1	55		
8	32		0.32	0.74	414.90	82	93	102	102	63	1	55		
9	36		0.28	0.65	417.00	82	93	102	102	63	1	55		
10	40		0.28	0.65	418.65	82	93	101	101	63	1	55		
11	44		0.26	0.60	420.30	82	94	101	101	63	1	55		
12	48	1348	0.24	0.55	422.010	84	95	101	101	64	1	56		
		1600			422.100									
1	4		0.25	0.81	424.010	83	95	99	99	67	1	64		
B 2	8		0.36	0.83	426.00	83	95	100	100	66	1	60		23.575
3	12		0.35	0.81	427.95	83	96	100	100	65	1	60		
4	16		0.35	0.81	430.00	82	93	100	100	64	1	61		
5	20		0.35	0.81	431.191	82	93	100	100	62	1	63		
6	24		0.41	0.95	434.00	82	94	100	99	62	1	63		
7	28		0.41	0.95	436.30	82	94	100	99	62	1	63		
8	32		0.35	0.81	438.20	82	94	100	99	62	2	63		
9	36		0.38	0.88	440.34	82	94	100	99	62	2	63		
10	40		0.35	0.81	442.61	82	95	100	98	63	2	61		
11	44		0.25	0.58	444.55	82	95	100	98	63	2	61		
12	48	1648 ✓	0.25	0.58 ✓	445.615	82	95	100	98	63	2	61		
			Avg Delta P	Avg Delta H ✓	Total Volume	Avg Ts ✓	Avg Tm ✓	Min/Max	Min/Max	Max	Max Vac	Min/Max		
			~~0.31932~~	0.74625	45.525	82 ✓	92 ✓	99/102	98/102	67	2	49/64		
			Avg Sqrt Delta P	Avg Sqrt Del H ✓	Comments:									
			~~0.56122~~	0.86006	45.585 ✓									

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EPA Method 0010 from EPA SW-846

97.9 % Is 1.92 % Ms

~~.3225~~ ✓ .5654 ✓

9060 dscm

POLYMERS

ISOKINETIC FIELD DATA SHEET

EPA Method 0010 - HFPO Dimer Acid

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		Stack Conditions	Assumed	Actual
Client	Chemours			
W.O.#	15418.002.017			
Project ID	Chemours	% Moisture	=2	
Mode/Source ID	Polymer	Impinger Vol (ml)		
Samp. Loc. ID	STK	Silica gel (g)		
Run No.ID	2	CO2, % by Vol	0.0	
Test Method ID	M0010	O2, % by Vol	20.8	
Date ID	9SEP2019	Temperature (°F)	=75	
Source/Location	Polymer Stack	Meter Temp (°F)	~~75~~ 75	
Sample Date	9/26/19 ✓	Static Press (in H_2O)	-0.16 ✓	
Baro. Press (in Hg)	29.81 ✓			
Operator	MJ WONKELEN ✓	Ambient Temp (°F)	=75	

Meter Box ID	12		
Meter Box Y	1.0069 ✓		
Meter Box Del H	1.8812		
Probe ID / Length	P697	6'	Sample Train (ft³)
Probe Material	Boro		Leak Check @ (in Hg)
Pitot / Thermocouple ID	697		Pitot leak check good
Pitot Coefficient	0.84		Pitot Inspection good
Nozzle ID	G235		Method 3 System good
Nozzle Measurements	0.235 / 0.235 / 0.235		Temp Check
Avg Nozzle Dia (in)	0.235 ✓		Meter Box Temp
Area of Stack (ft²)	441 ✓		Reference Temp
Sample Time	96 ✓		Pass/Fail (+/- 2°)
Total Traverse Pts	24 ✓		Temp Change Response ?

K Factor 3,29

	Initial	Mid-Point	Final
Sample Train (ft³)	0.001	0.001	0.001
Leak Check @ (in Hg)	0.15	2 7	0.8
Pitot leak check good	yes / no	yes / no	yes / no
Pitot Inspection good	yes / no	yes / no	yes / no
Method 3 System good	yes / no	yes / no	yes / no
Temp Check	Pre-Test Set		Post-Test Set
Meter Box Temp	78		78
Reference Temp	77		79
Pass/Fail (+/- 2°)	Pass / Fail		Pass / Fail
Temp Change Response ?	yes / no		yes / no

TRAVERSE POINT NO.	SAMPLE TIME (min)	CLOCK TIME (plant time)	VELOCITY PRESSURE Delta P (in H2O)	ORIFICE PRESSURE Delta H (in H2O)	DRY GAS METER READING (ft³)	STACK TEMP (°F)	DGM OUTLET TEMP (oF)	PROBE TEMP (oF)	FILTER BOX TEMP (F)	IMPINGER EXIT TEMP (oF)	SAMPLE TRAIN VAC (in Hg)	XAD EXIT TEMP (F)		COMMENTS
	0	0833 ✓			445.942									
A 1	4		0.35	1.15	448.12	81	77	100	100	66	4	55		
2	8		0.35	1.15	450.30	81	77	100	100	66	4	55		✓
3	12		0.38	1.25	452.80	81	77	100	100	69	4	55		
4	16		0.41	1.35	455.10	80	79	100	100	64	4	54		28.698
5	20		0.41	1.35	457.44	80	79	100	100	64	4	54		
6	24		0.42	1.38	460.33	82	75	100	99	63	5	52		
7	28		0.45	1.48	462.44	80	76	101	99	62	5	51		
8	32		0.44	1.44	465.00	80	75	101	99	60	5	50		
9	36		0.44	1.44	467.77	80	75	102	99	55	5	49		
10	40		0.45	1.48	470.11	80	75	102	99	62	5	52		
11	44		0.38	1.25	472.44	78	75	102	99	62	5	52		
12	48	0921	0.35	1.15	474.640	78	75	102	99	62	4	52		
		0933			474.810									✓
B 1	4		0.36	1.18	476.98	76	76	101	102	67	4	59		
2	8		0.40	1.31	479.30	76	76	101	102	65	5	55		29,150
3	12		0.42	1.38	481.72	76	76	101	102	65	5	55		
4	16		0.42	1.38	484.22	76	76	101	102	64	5	55		
5	20		0.42	1.38	486.67	76	77	102	101	60	5	52		
6	24		0.43	1.41	489.13	76	77	102	101	60	5	52		
7	28		0.45	1.48	491.77	76	77	102	101	60	5	52		
8	32		0.45	1.48	494.40	76	77	102	101	60	5	52		
9	36		0.45	1.48	496.800	76	77	100	100	61	5	53		
10	40		0.45	1.48	499.32	76	78	100	100	62	5	54		
11	44		0.38	1.28	501.70	76	78	100	100	62	5	54		
12	48	1023 ✓	0.33	1.08	503.960	76	78	100	100	63	5	54		
			Avg Delta P ✓	Avg Delta H ✓	Total Volume ✓	Avg Ts ✓	Avg Tm ✓	Min/Max	Min/Max	Max	Max Vac	Min/Max		
			0.40792	1.34000	57.848	78 ✓	76.6	100/102	99/102	67	5	49/59		
			Avg Sqrt Delta P ✓	Avg Sqrt Del H ✓	Comments:									
			0.63797	1.15628	✓									

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EPA Method 0010 from EPA SW-846

2.4% M 95.7 Tdd

10230 dscfm

amd

ISOKINETIC FIELD DATA SHEET

EPA Method 0010 - HFPO Dimer Acid

		Stack Conditions	Assumed	Actual
Client	Chemours	% Moisture	≈3	
W.O.#	15418.002.017	Impinger Vol (ml)		
Project ID	Chemours	Silica gel (g)		
Mode/Source ID	Polymer	CO2, % by Vol	0.0	
Samp. Loc. ID	STK	O2, % by Vol	20.8	
Run No.ID	3	Temperature (°F)	≈80	
Test Method ID	M0010	Meter Temp (°F)	≈90	
Date ID	9SEP2019	Static Press (in H_2O)	−0.20 ✓	
Source/Location	Polymer Stack			
Sample Date	9/26/19 ✓			
Baro. Press (in Hg)	29.81 ✓			
Operator	MJ WINKELER ✓	Ambient Temp (°F)	≈80	

Meter Box ID	13		
Meter Box Y	1.0069 ✓		
Meter Box Del H	1.8812		
Probe ID / Length	P697	6'	Sample Train (ft³)
Probe Material	Boro		Leak Check @ (in Hg)
Pitot / Thermocouple ID	P697		Pitot leak check good
Pitot Coefficient	0.84 ✓		Pitot Inspection good
Nozzle ID	G235		Method 3 System good
Nozzle Measurements	0.235	0.235 / 0.235	Temp Check
Avg Nozzle Dia (in)	0.235 ✓		Meter Box Temp
Area of Stack (ft²)	4.91 ✓		Reference Temp
Sample Time	96 ✓		Pass/Fail (+/- 2°)
Total Traverse Pts	24 ✓		Temp Change Response ?

K Factor 3.31

	Initial	Mid-Point	Final
Sample Train (ft³)	0.001	0.001	0.001
Leak Check @ (in Hg)	@15	@6	@7
Pitot leak check good	yes / no	yes / no	yes / no
Pitot Inspection good	yes / no	yes / no	yes / no
Method 3 System good	yes / no	yes / no	yes / no
Temp Check	Pre-Test Set		Post-Test Set
Meter Box Temp	78		88
Reference Temp	79		89
Pass/Fail (+/- 2°)	Pass / Fail		Pass / Fail
Temp Change Response ?	yes / no		yes / no

TRAVERSE POINT NO.	SAMPLE TIME (min)	CLOCK TIME (plant time)	VELOCITY PRESSURE Delta P (in H2O)	ORIFICE PRESSURE Delta H (in H2O)	DRY GAS METER READING (ft³)	STACK TEMP (°F)	DGM OUTLET TEMP (oF)	PROBE TEMP (oF)	FILTER BOX TEMP (F)	IMPINGER EXIT TEMP (oF)	SAMPLE TRAIN VAC (in Hg)	XAD EXIT TEMP (F)		COMMENTS
	0	1100 ✓			504.115									
A 1	4		0.38	1.25	506.40	77	77	100	100	66	3	55		
2	8		0.42	1.39	509.00	78	78	100	102	66	3	46		
3	12		0.45	1.48	511.60	78	78	101	101	66	3	46		
4	16		0.48	1.58	514.30	78	78	101	101	66	3	46		29.895
5	20		0.48	1.58	517.40	78	78	101	101	66	3	46		
6	24		0.48	1.58	519.65	78	80	101	101	65	3	48		
7	28		0.48	1.58	522.33	78	80	100	100	64	3	48		
8	32		0.50	1.65	525.00	79	80	100	100	63	3	48		
9	36		0.50	1.65	528.10	78	79	100	100	63	3	48		
10	40		0.50	1.65	530.10	78	79	100	101	63	3	48		
11	44		0.35	1.15	532.10	78	79	100	100	63	2	47		
12	48	1148 / 1157	0.21	0.69	534.010 / 534.200	80	80	102	102	64	2	49		
B 1	4		0.40	1.32	536.800	80	82	100	100	66	2	53		
2	8		0.42	1.39	538.97	80	82	100	100	65	2	53		30.514
3	12		0.46	1.52	541.60	79	82	100	100	65	2	53		
4	16		0.46	1.52	544.30	79	82	100	100	65	2	48		
5	20		0.50	1.65	546.94	79	82	100	100	65	3	48		
6	24		0.48	1.58	549.64	79	82	100	100	65	4	49		
7	28		0.52	1.72	552.35	79	84	101	101	65	5	49		
8	32		0.52	1.72	555.20	79	84	100	100	65	5	49		
9	36		0.52	1.72	558.310	79	84	100	100	65	6	50		
10	40		0.50	1.65	560.60	79	84	100	100	65	6	50		
11	44		0.35	1.15	562.70	79	84	100	100	65	6	50		
12	48	1245 ✓	0.22	0.728	564.714	79	84	100	100	65	6	50		
			Avg Delta P ✓	Avg Delta H ✓	Total Volume ✓	Avg Ts ✓	Avg Tm ✓	Min/Max	Min/Max	Max	Max Vac	Min/Max		
			0.44083	1.45408	60.409 ✓	78.1	80.9	100/102	100/102	66	6	49/55		
			Avg Sqrt Delta P ✓	Avg Sqrt Del H ✓	Comments:									
			0.66024	1.19908										

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EPA Method 0010 from EPA SW-846

POLYMERS

SAMPLE RECOVERY FIELD DATA

Client: Chemours | W.O. #:
Location/Plant: ~~Fayetteville~~ | Source & Location: Polymers

Run No. 1 | Sample Date 9/25/19 | Recovery Date 9/25/19
Sample I.D. Polymer Stack | Analyst JTO | Filter Number NA

	Impinger 1	2	3	4	5	6	7	Imp.Total	8 Silica Gel	Total
Contents										
Final	6	120	120	0					312.7	
Initial	0	100	100	0					300	
Gain	6	20	20	0				6 ✓	12.7 ✓	18.7

Impinger Color: all clear | Labeled? ✓
Silica Gel Condition: blue 95% | Sealed? ✓

Run No. 2 | Sample Date 9/26/19 | Recovery Date 9/26/19
Sample I.D. Polymer Stack | Analyst JTO | Filter Number NA

	Impinger 1	2	3	4	5	6	7	Imp.Total	8 Silica Gel	Total
Contents										
Final	10	120	120	0					320.4	
Initial	0	100	100	0					300	
Gain	10	20	20	0				10 ✓	20.4 ✓	30.4

Impinger Color: all clear | Labeled? ✓
Silica Gel Condition: blue 95% | Sealed? ✓

Run No. 3 | Sample Date 9/26/19 | Recovery Date 9/26/19
Sample I.D. | Analyst JTO | Filter Number NA

	Impinger 1	2	3	4	5	6	7	Imp.Total	8 Silica Gel	Total
Contents										
Final	15	105	100	0					313.3	
Initial	0	100	100	0					300	
Gain	15	5	0	0		✓		20 ✓	13.3	

Impinger Color: all clear | Labeled? ✓
Silica Gel Condition: blue 90% | Sealed? ✓

Check COC for Sample IDs of Media Blanks

WESTON SOLUTIONS

Balance Checks

Date	Reference	Actual	
9/25/19	500.0	499.8	KS
9/26/19	500.0	499.6	JTO

POLYMERS
BLANK TRAIN

SAMPLE RECOVERY FIELD DATA

Client: Chemours W.O. #:
Location/Plant: Fayetteville Source & Location: Polymers

Run No. 2 Blank Train Sample Date 9/26/19 Recovery Date 9/26/19
Sample I.D. Analyst JMS Filter Number NA

	Impinger									
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents									Silica Gel	
Final	0	100	100	0					330	
Initial	0	100	100	0					330	
Gain	0	0	0	0					0	0

Impinger Color all clear Labeled? ✓
Silica Gel Condition blue 100% Sealed? ✓

Run No. ___ Sample Date ___ Recovery Date ___
Sample I.D. ___ Analyst ___ Filter Number ___

	Impinger									
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents									Silica Gel	
Final										
Initial										
Gain										

Impinger Color ___ Labeled? ___
Silica Gel Condition ___ Sealed? ___

Run No. ___ Sample Date ___ Recovery Date ___
Sample I.D. ___ Analyst ___ Filter Number ___

	Impinger									
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents									Silica Gel	
Final										
Initial										
Gain										

Impinger Color ___ Labeled? ___
Silica Gel Condition ___ Sealed? ___

Check COC for Sample IDs of Media Blanks

Source Gas Analysis Data Sheet - Modified Method 3/3A

Client Chemours
Location/Plant Fayetteville, NC
Source Polymers
W.O. Number 15418.002.017.0001

Analyst SK/KS
Date 9/25/19 - 9/26/19
Analyzer Make & Model Servomex 1400

Calibration 1530

Analysis Number	Span	Calibration Gas Value O_2 (%)	Calibration Gas Value CO_2 (%)	Analyzer Response O_2 (%)	Analyzer Response CO_2 (%)
1	Zero	0.0	0.0	0.0	0.0
2	Mid	12.1	9.0	12.0	9.1
3	High	21.3	17.1	21.3	17.1
	Average				

Run Number	Analysis Time	Analyzer Response O_2 (%)	Analyzer Response CO_2 (%)
1	1705-1711	20.8	00.0
2	1100-1106	20.8	00.0
3	1308-1314	20.8	00.0
	Average		

Run Number	Analysis Time	Analyzer Response O_2 (%)	Analyzer Response CO_2 (%)
1			
2			
3			
	Average		

Span	Cylinder ID
Mid	CC157024
High	ALM047628

**Report all values to the nearest 0.1 percent

APPENDIX C
LABORATORY ANALYTICAL REPORT

eurofins | Environment Testing TestAmerica

ANALYTICAL REPORT

Job Number: 140-16785-1

Job Description: Polymer Stack - M0010

Contract Number: LBIO-67048

For:
Chemours Company FC, LLC The
c/o AECOM
Sabre Building, Suite 300
4051 Ogletown Road
Newark, DE 19713

Attention: Michael Aucoin

Approved for release.
Courtney M Adkins
Project Manager I
10/9/2019 8:27 AM

Courtney M Adkins, Project Manager I
5815 Middlebrook Pike, Knoxville, TN, 37921
(865)291-3000
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10/09/2019

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Definitions/Glossary

Client: Chemours Company FC, LLC The
Project/Site: Polymer Stack - M0010

Job ID: 140-16785-1

Qualifiers

LCMS

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Method Summary

Client: Chemours Company FC, LLC The
Project/Site: Polymer Stack - M0010

Job ID: 140-16785-1

Method	Method Description	Protocol	Laboratory
8321A	HFPO-DA	SW846	TAL DEN
8321A	PFOA and PFOS	SW846	TAL DEN
None	Leaching Procedure	TAL SOP	TAL DEN
None	Leaching Procedure for Condensate	TAL SOP	TAL DEN
None	Leaching Procedure for XAD	TAL SOP	TAL DEN

Protocol References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.
TAL SOP = TestAmerica Laboratories, Standard Operating Procedure

Laboratory References:

TAL DEN = Eurofins TestAmerica, Denver, 4955 Yarrow Street, Arvada, CO 80002, TEL (303)736-0100

Sample Summary

Client: Chemours Company FC, LLC The
Project/Site: Polymer Stack - M0010

Job ID: 140-16785-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
140-16785-1	D-2301,2302 R1 M0010 FH	Air	09/25/19 00:00	09/27/19 10:35	
140-16785-2	D-2303,2304,2306 R1 M0010 BH	Air	09/25/19 00:00	09/27/19 10:35	
140-16785-3	D-2305 R1 M0010 IMP 1,2&3 CONDENSATE	Air	09/25/19 00:00	09/27/19 10:35	
140-16785-4	D-2307 R1 M0010 BREAKTHROUGH XAD-2 RESIN TUBE	Air	09/25/19 00:00	09/27/19 10:35	
140-16785-5	D-2308,2309 R2 M0010 FH	Air	09/26/19 00:00	09/27/19 10:35	
140-16785-6	D-2310,2311,2313 R2 M0010 BH	Air	09/26/19 00:00	09/27/19 10:35	
140-16785-7	D-2312 R2 M0010 IMP 1,2&3 CONDENSATE	Air	09/26/19 00:00	09/27/19 10:35	
140-16785-8	D-2314 R2 M0010 BREAKTHROUGH XAD-2 RESIN TUBE	Air	09/26/19 00:00	09/27/19 10:35	
140-16785-9	D-2315,2316 R3 M0010 FH	Air	09/26/19 00:00	09/27/19 10:35	
140-16785-10	D-2317,2318,2320 R3 M0010 BH	Air	09/26/19 00:00	09/27/19 10:35	
140-16785-11	D-2319 R3 M0010 IMP 1,2&3 CONDENSATE	Air	09/26/19 00:00	09/27/19 10:35	
140-16785-12	D-2321 R3 M0010 BREAKTHROUGH XAD-2 RESIN TUBE	Air	09/26/19 00:00	09/27/19 10:35	

Job Narrative
140-16785-1

Sample Receipt

The samples were received on September 27, 2019 at 10:35 AM in good condition and properly preserved. The temperature of the cooler at receipt was 0.6º C.

Quality Control and Data Interpretation

Unless otherwise noted, all holding times, and QC criteria were met and the test results shown in this report meet all applicable NELAC requirements.

Method 0010/Method 3542 Sampling Train Preparation

Train fractions were extracted and prepared for analysis in TestAmerica's Knoxville laboratory. Extracts and condensate samples were forwarded to the Denver laboratory for HFPO-DA analysis. All results are reported in "Total ug" per sample.

LCMS

No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Organic Prep

No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Comments

Reporting Limits (RLs) and Method Detection Limits (MDLs) for the HFPO-DA used in this report were derived in Denver for reporting soils and water samples. Method 0010 sampling train matrix specific RLs and MDLs have not been established for HFPO-DA. The soil and water limits are expected to be reasonable approximations of the actual matrix specific limits, under these conditions.

Breakthrough from the Modified Method 0010 Sampling Train for PFAS compounds will be measured by the percentage (%) concentration of a specific PFAS target analyte determined to be present in the Breakthrough XAD-2 resin module of a test run. If the concentration of a specific PFAS compound is ≤30% of the sum of the concentrations determined for the other three (3) fractions of the sampling train, then sampling breakthrough is determined not to have occurred. Also, no breakthrough will be determined to have occurred if < 250 µg of a target analyte is collected on all fractions of a sampling train. Breakthrough the sampling train implies that sample loss through the train has occurred and results in a negative bias to the sample results.

LCMS

Analysis Batch: 464589

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
DLCK 280-464589/13	Lab Control Sample	Total/NA	Air	8321A	

Prep Batch: 472296

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-16785-2	D-2303,2304,2306 R1 M0010 BH	Total/NA	Air	None	
140-16785-4	D-2307 R1 M0010 BREAKTHROUGH XAD-2 RE	Total/NA	Air	None	
140-16785-6	D-2310,2311,2313 R2 M0010 BH	Total/NA	Air	None	
140-16785-8	D-2314 R2 M0010 BREAKTHROUGH XAD-2 RE	Total/NA	Air	None	
140-16785-10	D-2317,2318,2320 R3 M0010 BH	Total/NA	Air	None	
140-16785-12	D-2321 R3 M0010 BREAKTHROUGH XAD-2 RE	Total/NA	Air	None	
MB 280-472296/1-A	Method Blank	Total/NA	Air	None	
LCS 280-472296/2-A	Lab Control Sample	Total/NA	Air	None	

Prep Batch: 472321

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-16785-1	D-2301,2302 R1 M0010 FH	Total/NA	Air	None	
140-16785-5	D-2308,2309 R2 M0010 FH	Total/NA	Air	None	
140-16785-9	D-2315,2316 R3 M0010 FH	Total/NA	Air	None	
MB 280-472321/13-A	Method Blank	Total/NA	Air	None	
MB 280-472321/1-A	Method Blank	Total/NA	Air	None	
LCS 280-472321/2-A	Lab Control Sample	Total/NA	Air	None	

Prep Batch: 472332

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-16785-3	D-2305 R1 M0010 IMP 1,2&3 CONDENSATE	Total/NA	Air	None	
140-16785-7	D-2312 R2 M0010 IMP 1,2&3 CONDENSATE	Total/NA	Air	None	
140-16785-11	D-2319 R3 M0010 IMP 1,2&3 CONDENSATE	Total/NA	Air	None	
MB 280-472332/13-A	Method Blank	Total/NA	Air	None	
MB 280-472332/1-A	Method Blank	Total/NA	Air	None	
LCS 280-472332/2-A	Lab Control Sample	Total/NA	Air	None	

Analysis Batch: 472874

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-16785-2	D-2303,2304,2306 R1 M0010 BH	Total/NA	Air	8321A	472296
140-16785-4	D-2307 R1 M0010 BREAKTHROUGH XAD-2 RE	Total/NA	Air	8321A	472296
140-16785-6	D-2310,2311,2313 R2 M0010 BH	Total/NA	Air	8321A	472296
140-16785-8	D-2314 R2 M0010 BREAKTHROUGH XAD-2 RE	Total/NA	Air	8321A	472296
140-16785-10	D-2317,2318,2320 R3 M0010 BH	Total/NA	Air	8321A	472296
140-16785-12	D-2321 R3 M0010 BREAKTHROUGH XAD-2 RE	Total/NA	Air	8321A	472296
MB 280-472296/1-A	Method Blank	Total/NA	Air	8321A	472296
LCS 280-472296/2-A	Lab Control Sample	Total/NA	Air	8321A	472296

Analysis Batch: 472875

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-16785-1	D-2301,2302 R1 M0010 FH	Total/NA	Air	8321A	472321
140-16785-5	D-2308,2309 R2 M0010 FH	Total/NA	Air	8321A	472321
140-16785-9	D-2315,2316 R3 M0010 FH	Total/NA	Air	8321A	472321
MB 280-472321/13-A	Method Blank	Total/NA	Air	8321A	472321
MB 280-472321/1-A	Method Blank	Total/NA	Air	8321A	472321
LCS 280-472321/2-A	Lab Control Sample	Total/NA	Air	8321A	472321

QC Association Summary

Client: Chemours Company FC, LLC The
Project/Site: Polymer Stack - M0010

Job ID: 140-16785-1

LCMS

Analysis Batch: 472876

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-16785-3	D-2305 R1 M0010 IMP 1,2&3 CONDENSATE	Total/NA	Air	8321A	472332
140-16785-7	D-2312 R2 M0010 IMP 1,2&3 CONDENSATE	Total/NA	Air	8321A	472332
140-16785-11	D-2319 R3 M0010 IMP 1,2&3 CONDENSATE	Total/NA	Air	8321A	472332
MB 280-472332/13-A	Method Blank	Total/NA	Air	8321A	472332
MB 280-472332/1-A	Method Blank	Total/NA	Air	8321A	472332
LCS 280-472332/2-A	Lab Control Sample	Total/NA	Air	8321A	472332

Client Sample ID: D-2301,2302 R1 M0010 FH

Lab Sample ID: 140-16785-1

Date Collected: 09/25/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - PFOA and PFOS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	1.66		0.125	0.0135	ug/Sample		09/30/19 09:50	10/03/19 14:56	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C3 HFPO-DA	*104*		*50 - 200*	*09/30/19 09:50*	*10/03/19 14:56*	*1*

Client Sample ID: D-2303,2304,2306 R1 M0010 BH

Lab Sample ID: 140-16785-2

Date Collected: 09/25/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - PFOA and PFOS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	3.58		0.225	0.0450	ug/Sample		09/29/19 11:20	10/03/19 13:27	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C3 HFPO-DA	*73*		*50 - 200*	*09/29/19 11:20*	*10/03/19 13:27*	*1*

Client Sample ID: D-2305 R1 M0010 IMP 1,2&3 CONDENSATE

Lab Sample ID: 140-16785-3

Date Collected: 09/25/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - HFPO-DA

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	0.176	J	0.201	0.0102	ug/Sample		09/30/19 10:21	10/03/19 16:01	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C3 HFPO-DA	*102*		*50 - 200*	*09/30/19 10:21*	*10/03/19 16:01*	*1*

Client Sample ID: D-2307 R1 M0010 BREAKTHROUGH XAD-2 RESIN TUBE

Lab Sample ID: 140-16785-4

Date Collected: 09/25/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - PFOA and PFOS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	ND		0.200	0.0400	ug/Sample		09/29/19 11:20	10/03/19 13:31	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C3 HFPO-DA	*80*		*50 - 200*	*09/29/19 11:20*	*10/03/19 13:31*	*1*

Client Sample ID: D-2308,2309 R2 M0010 FH

Lab Sample ID: 140-16785-5

Date Collected: 09/26/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - PFOA and PFOS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	1.85		0.125	0.0135	ug/Sample		09/30/19 09:50	10/03/19 14:59	1

Client Sample ID: D-2308,2309 R2 M0010 FH

Lab Sample ID: 140-16785-5

Date Collected: 09/26/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
13C3 HFPO-DA	104		50 - 200	09/30/19 09:50	10/03/19 14:59	1

Client Sample ID: D-2310,2311,2313 R2 M0010 BH

Lab Sample ID: 140-16785-6

Date Collected: 09/26/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - PFOA and PFOS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	4.20		0.250	0.0500	ug/Sample		09/29/19 11:20	10/03/19 13:37	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
13C3 HFPO-DA	73		50 - 200	09/29/19 11:20	10/03/19 13:37	1

Client Sample ID: D-2312 R2 M0010 IMP 1,2&3 CONDENSATE

Lab Sample ID: 140-16785-7

Date Collected: 09/26/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - HFPO-DA

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	0.281		0.208	0.0106	ug/Sample		09/30/19 10:21	10/03/19 16:04	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
13C3 HFPO-DA	101		50 - 200	09/30/19 10:21	10/03/19 16:04	1

Client Sample ID: D-2314 R2 M0010 BREAKTHROUGH XAD-2 RESIN TUBE

Lab Sample ID: 140-16785-8

Date Collected: 09/26/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - PFOA and PFOS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	ND		0.200	0.0400	ug/Sample		09/29/19 11:20	10/03/19 13:40	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
13C3 HFPO-DA	77		50 - 200	09/29/19 11:20	10/03/19 13:40	1

Client Sample ID: D-2315,2316 R3 M0010 FH

Lab Sample ID: 140-16785-9

Date Collected: 09/26/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - PFOA and PFOS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	2.15		0.100	0.0108	ug/Sample		09/30/19 09:50	10/03/19 15:02	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
13C3 HFPO-DA	104		50 - 200	09/30/19 09:50	10/03/19 15:02	1

Client Sample ID: D-2317,2318,2320 R3 M0010 BH

Lab Sample ID: 140-16785-10

Date Collected: 09/26/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - PFOA and PFOS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	5.93		0.250	0.0500	ug/Sample		09/29/19 11:20	10/03/19 13:44	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C3 HFPO-DA	*55*		*50 - 200*	*09/29/19 11:20*	*10/03/19 13:44*	*1*

Client Sample ID: D-2319 R3 M0010 IMP 1,2&3 CONDENSATE

Lab Sample ID: 140-16785-11

Date Collected: 09/26/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - HFPO-DA

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	1.44		0.220	0.0112	ug/Sample		09/30/19 10:21	10/03/19 16:07	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C3 HFPO-DA	*111*		*50 - 200*	*09/30/19 10:21*	*10/03/19 16:07*	*1*

Client Sample ID: D-2321 R3 M0010 BREAKTHROUGH XAD-2 RESIN TUBE

Lab Sample ID: 140-16785-12

Date Collected: 09/26/19 00:00
Matrix: Air
Date Received: 09/27/19 10:35
Sample Container: Air Train

Method: 8321A - PFOA and PFOS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HFPO-DA	0.0484	J	0.200	0.0400	ug/Sample		09/29/19 11:20	10/03/19 13:47	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C3 HFPO-DA	*80*		*50 - 200*	*09/29/19 11:20*	*10/03/19 13:47*	*1*

Default Detection Limits

Client: Chemours Company FC, LLC The
Project/Site: Polymer Stack - M0010

Job ID: 140-16785-1

Method: 8321A - HFPO-DA

Prep: None

Analyte	RL	MDL	Units
HFPO-DA	0.00250	0.00128	ug/Sample

Method: 8321A - PFOA and PFOS

Prep: None

Analyte	RL	MDL	Units
HFPO-DA	0.0250	0.00270	ug/Sample
HFPO-DA	0.100	0.0200	ug/Sample

APPENDIX D
SAMPLE CALCULATIONS

SAMPLE CALCULATIONS FOR
HFPO DIMER ACID (METHOD 0010)

Client: Chemours | **Plant: Fayetteville, NC**
Test Number: Run 3 | **Test Date: 09/26/19**
Test Location: Polymers Stack | **Test Period: 1100-1245**

1. HFPO Dimer Acid concentration, lbs/dscf.

$$Conc1 = \frac{W \times 2.2046 \times 10^{-9}}{Vm(std)}$$

$$Conc1 = \frac{9.6 \times 2.2046 \times 10\text{-}9}{59.353}$$

Conc1 = 3.55E-10

Where:

W = Weight of HFPO Dimer Acid collected in sample in ug.

Conc1 = Polymers Stack HFPO Dimer Acid concentration, lbs/dscf.

2.2046×10^{-9} = Conversion factor from ug to lbs.

2. HFPO Dimer Acid concentration, ug/dscm.

Conc2 = W / (Vm(std) x 0.02832)

Conc2 = 9.6 / (59.353 x 0.02832)

Conc2 = 5.69

Where:

Conc2 = Polymers Stack HFPO Dimer Acid concentration, ug/dscm.

0.02832 = Conversion factor from cubic feet to cubic meters.

3. HFPO Dimer Acid mass emission rate, lbs/hr.

$MR1_{(Outlet)}$ = Conc1 x Qs(std) x 60 min/hr

$MR1_{(Outlet)}$ = 3.55E-10 x 10565 x 60

$MR1_{(Outlet)}$ = 2.25E-04

Where:

$MR1_{(Outlet)}$ = Polymers Stack HFPO Dimer Acid mass emission rate, lbs/hr.

4. HFPO Dimer Acid mass emission rate, g/sec.

$MR2_{(Outlet)}$ = PMR1 x 453.59 / 3600

$MR2_{(Outlet)}$ = 2.25E-04 x 453.59 /3600

$MR2_{(Outlet)}$ = 2.84E-05

Where:

$MR2_{(Outlet)}$ = Polymers Stack HFPO Dimer Acid mass emission rate, g/sec.

453.6 = Conversion factor from pounds to grams.

3600 = Conversion factor from hours to seconds.

EXAMPLE CALCULATIONS FOR
VOLUMETRIC FLOW AND MOISTURE AND ISOKINETICS

Client: Chemours	Facility: Fayetteville, NC
Test Number: Run 3	Test Date: 09/26/19
Test Location: Polymers Stack	Test Period: 1100-1245

1. Volume of dry gas sampled at standard conditions (68 deg F, 29.92 in. Hg), dscf.

$$Vm(std) = \frac{17.64 \times Y \times Vm \times \left(Pb + \frac{delta\ H}{13.6} \right)}{(Tm + 460)}$$

$$Vm(std) = \frac{17.64 \times 1.0069 \times 60.409 \times \left(29.81 + \frac{1.454}{13.6} \right)}{80.83 + 460} = 59.353$$

Where:

Vm(std) =	Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.
Vm =	Volume of gas sample measured by the dry gas meter at meter conditions, dcf.
Pb =	Barometric Pressure, in Hg.
delt H =	Average pressure drop across the orifice meter, in H_2O
Tm =	Average dry gas meter temperature , deg F.
Y =	Dry gas meter calibration factor.
17.64 =	Factor that includes ratio of standard temperature (528 deg R) to standard pressure (29.92 in. Hg), deg R/in. Hg.
13.6 =	Specific gravity of mercury.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

$$Vw(std) = (0.04707 \times Vwc) + (0.04715 \times Wwsg)$$

$$Vw(std) = (0.04707 \times 20.0) + (0.04715 \times 13.3) = 1.57$$

Where:

Vw(std) =	Volume of water vapor in the gas sample corrected to standard conditions, scf.
Vwc =	Volume of liquid condensed in impingers, ml.
Wwsg =	Weight of water vapor collected in silica gel, g.
0.04707 =	Factor which includes the density of water (0.002201 lb/ml), the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(deg R); absolute temperature at standard conditions (528 deg R), absolute pressure at standard conditions (29.92 in. Hg), ft^3/ml.
0.04715 =	Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(deg R); absolute temperature at standard conditions (528 deg R), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content

$$bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

$$bws = \frac{1.57}{1.57 + 59.353} = 0.026$$

Where:

bws = Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

$$Md = 1 - bws$$

$$Md = 1 - 0.026 = 0.974$$

Where:

Md = Mole fraction of dry gas, dimensionless.

5. Dry molecular weight of gas stream, lb/lb-mole.

$$MWd = (0.440 \times \%\ CO_2) + (0.320 \times \%\ O_2) + (0.280 \times (\%\ N_2 + \%\ CO))$$

$$MWd = (0.440 \times 0.0) + (0.320 \times 20.9) + (0.280 \times (79.1 + 0.00))$$

$$MWd = 28.84$$

Where:

MWd = Dry molecular weight , lb/lb-mole.
% CO2 = Percent carbon dioxide by volume, dry basis.
$\%\ O_2$ = Percent oxygen by volume, dry basis.
$\%\ N_2$ = Percent nitrogen by volume, dry basis.
% CO = Percent carbon monoxide by volume, dry basis.
0.440 = Molecular weight of carbon dioxide, divided by 100.
0.320 = Molecular weight of oxygen, divided by 100.
0.280 = Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

$$MWs = (MWd \times Md) + (18 \times (1 - Md))$$

$$MWs = (28.84 \times 0.974) +(18 (1 - 0.974)) = 28.56$$

Where:

MWs = Molecular weight of wet gas, lb/lb-mole.
18 = Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$Vs = 85.49 \times Cp \times ((\text{delt } p)^{1/2})avg \times \left(\frac{Ts\ (avg)}{Ps \times MWs} \right)^{1/2}$$

$$Vs = 85.49 \times 0.84 \times 0.66024 \times \left(\frac{539}{29.80 \times 28.56} \right)^{\wedge}1/2 = 37.7$$

Where:

Vs = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec x $\frac{(lb/lb\text{-}mole)(in.\ Hg)^{1/2}}{(deg\ R)(in\ H_2O)}$

Cp = Pitot tube coefficient, dimensionless.

Ts = Absolute gas stream temperature, deg R = Ts, deg F + 460.

Ps = Absolute gas stack pressure, in. Hg. = Pb + $\frac{P(static)}{13.6}$

delt p = Velocity head of stack, in. H_2O.

8. Average gas stream volumetric flow rate at actual conditions, wacf/min.

$$Qs(act) = 60 \times Vs \times As$$

$$Qs(act) = 60 \times 37.7 \times 4.91 = 11114$$

Where:

Qs(act) = Volumetric flow rate of wet stack gas at actual conditions, wacf/min.

As = Cross-sectional area of stack, ft^2.

60 = Conversion factor from seconds to minutes.

9. Average gas stream dry volumetric flow rate at standard conditions, dscf/min.

$$Qs(std) = 17.64 \times Md \times \frac{Ps}{Ts} \times Qs(act)$$

$$Qs(std) = 17.64 \times 0.974 \times \frac{29.80}{538.7} \times 11114$$

$$Qs(std) = 10565$$

Where:

Qs(std) = Volumetric flow rate of dry stack gas at standard conditions, dscf/min.

10. Isokinetic variation calculated from intermediate values, percent.

$$I = \frac{17.327 \times Ts \times Vm(std)}{Vs \times O \times Ps \times Md \times (Dn)^2}$$

$$I = \frac{17.327 \times 539 \times 59.353}{37.7 \times 96 \times 29.80 \times 0.974 \times (0.235)^{\wedge}2} = 95.4$$

Where:

I =	Percent of isokinetic sampling.
O =	Total sampling time, minutes.
Dn =	Diameter of nozzle, inches.
17.327 =	Factor which includes standard temperature (528 deg R), standard pressure (29.92 in. Hg), the formula for calculating area of circle $D^{2/4}$, conversion of square feet to square inches (144), conversion of seconds to minutes (60), and conversion to percent (100), $\frac{(\text{in. Hg})(\text{in}^2)(\text{min})}{(\text{deg R})(\text{ft}^2)(\text{sec})}$

APPENDIX E
EQUIPMENT CALIBRATION RECORDS

Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 1
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E03NI79E15A00E4	Reference Number:	160-401424145-1
Cylinder Number:	CC157024	Cylinder Volume:	150.5 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12019	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Feb 26, 2019

Expiration Date: Feb 26, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	9.000 %	9.018 %	G1	+/- 0.6% NIST Traceable	02/26/2019
OXYGEN	12.00 %	12.06 %	G1	+/- 0.3% NIST Traceable	02/26/2019
NITROGEN	Balance			-	

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	061507	K014984	13.94 % CARBON DIOXIDE/NITROGEN	0.57%	Jan 30, 2024
NTRM	16060507	CC401541	23.204 % OXYGEN/NITROGEN	0.2%	Dec 24, 2021

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
HORIBA VA5011 T5V6VU9P NDIR CO2	NDIR	Feb 12, 2019
SIEMENS OXYMAT 61 S01062 O2	PARAMAGNETIC	Feb 18, 2019

Triad Data Available Upon Request

Signature on file

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
600 Union Landing Road
Cinnaminson, NJ 08077-0000
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E03NI62E15A0224	Reference Number:	82-401288925-1
Cylinder Number:	ALM047628	Cylinder Volume:	157.2 CF
Laboratory:	124 - Riverton (SAP) - NJ	Cylinder Pressure:	2015 PSIG
PGVP Number:	B52018	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Sep 04, 2018

Expiration Date: Sep 04, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	17.00 %	17.05 %	G1	+/- 0.7% NIST Traceable	09/04/2018
OXYGEN	21.00 %	21.25 %	G1	+/- 0.5% NIST Traceable	09/04/2018
NITROGEN	Balance			-	

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060804	CC415400	24.04 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	May 16, 2019
NTRM	09061420	CC273671	22.53 % OXYGEN/NITROGEN	+/- 0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA 510-CO2-19GYCXEG	NDIR	Aug 09, 2018
Horiba MPA 510-O2-7TWMJ041	Paramagnetic	Aug 09, 2018

Triad Data Available Upon Request

Signature on file
Approved for Release

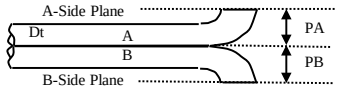
Type S Pitot Tube Inspection Data Form

Pitot Tube Identification Number: **P-697**

Inspection Date 1/5/18 Individual Conducting Inspection PM

If all Criteria PASS
Cp is equal to 0.84

PASS/FAIL



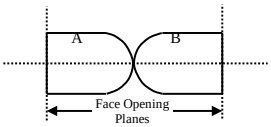
Distance to A Plane (PA) - inches 0.46 PASS

Distance to B Plane (PB) - inches 0.46 PASS

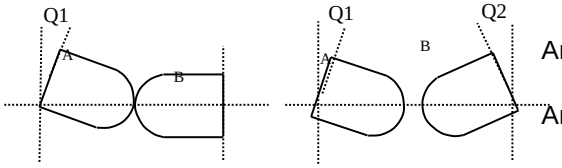
Pitot OD (D_t) - inches 0.375

$1.05\ D_t < P < 1.5\ D_t$

PA must Equal PB



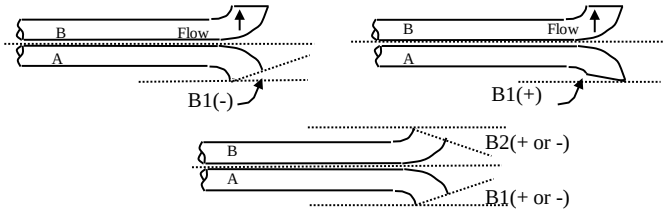
Are Open Faces Aligned Perpendicular to the Tube Axis (●) YES ( ) NO PASS



Angle of Q1 from vertical A Tube- degrees (absolute) 0 PASS

Angle of Q2 from vertical B Tube- degrees (absolute) 0 PASS

Q1 and Q2 must be ≤ 10°



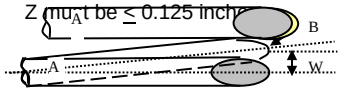
Angle of B1 from vertical A Tube- degrees (absolute) 0 PASS

Angle of B1 from vertical B Tube- degrees (absolute) 0 PASS

B1 or B2 must be ≤ 5°

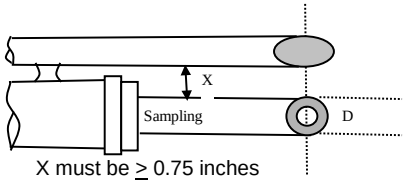
Horizontal offset between A and B Tubes (Z) - inches 0.007 PASS

Z must be ≤ 0.125 inches



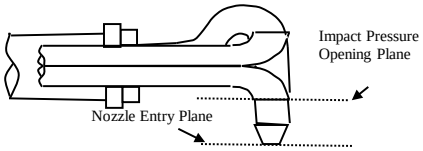
Vertical offset between A and B Tubes (W) - inches 0.018 PASS

W must be ≤ 0.03125 inches

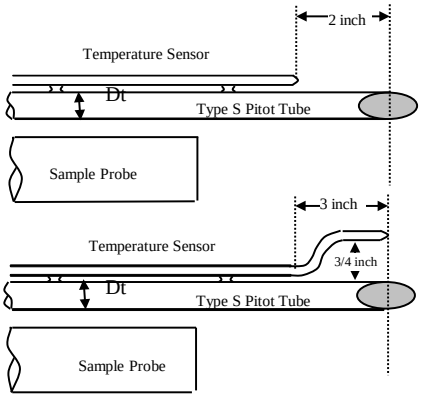


Distance between Sample Nozzle and Pitot (X) - inches 0.8 PASS

X must be ≥ 0.75 inches



Impact Pressure Opening Plane is above the Nozzle Entry Plane (●) YES ( ) NO ( ) NA



Thermocouple meets the Distance Criteria in the adjacent figure (●) YES ( ) NO ( ) NA

Thermocouple meets the Distance Criteria in the adjacent figure ( ) YES ( ) NO (●) NA

Long Cal and Temperature Cal Datasheet for Standard Dry Gas Meter Console

Calibrator MDW | **Meter Box Number** 12 | **Ambient Temp** 72

Date 10-Sep-18 | **Wet Test Meter Number** P-2952 | **Temp Reference Source** Thermocouple Simulator (Accuracy +/- 1°F)

Dry Gas Meter Number 14244707

Baro Press, in Hg (Pb)	29.96

Setting	Gas Volume		Temperatures			Calibration Results	
Orifice Manometer	Wet Test Meter	Dry gas Meter	Wet Test Meter	Dry Gas Meter			
in H_20 (ΔH)	ft^3 (Vw)	ft^3 (Vd)	°F (Tw)	Outlet, °F (Td_o)	Time, min (O)	Y	ΔH
0.5	5.0	885.853	73.0	75.00	12.60	1.0097	1.7823
		890.822		76.00			
		4.969		75.50			
1.0	5.0	892.810	73.0	76.00	9.1	1.0071	1.8559
		897.795		77.00			
		4.985		76.50			
1.5	10.0	898.799	73.0	77.00	15.20	1.0036	1.9381
		908.810		78.00			
		10.011		77.50			
2.0	10.0	915.870	73.0	78.00	13.1	1.0094	1.9158
		925.830		79.00			
		9.960		78.50			
3.0	10.0	926.870	73.0	79.00	10.70	1.0048	1.9137
		936.870		80.00			
		10.000		79.50			
						1.0069	**1.8812**

Vw - Gas Volume passing through the wet test meter
Vd - Gas Volume passing through the dry gas meter
Tw - Temp of gas in the wet test meter
Tdi - Temp of the inlet gas of the dry gas meter
Tdo - Temp of the outlet gas of the dry gas meter
Td - Average temp of the gas in the dry gas meter

0 - Time of calibration run
Pb - Barometric Pressure
ΔH - Pressure differential across orifice
Y - Ratio of accuracy of wet test meter to dry gas meter

$$Y = \frac{Vw * Pb * (td + 460)}{Vd * \left[Pb + \frac{(\Delta H)}{13.6}\right] * (tw + 460)}$$

$$\Delta H = \left[\frac{0.0317 * \Delta H}{Pb * (td + 460)}\right] * \left[\frac{(tw + 460) * O}{Vw}\right]^2$$

Reference Temperature	Temperature Reading from Individual Thermocouple Input [1]						Average Temperature Reading	Temp Difference [2] (%)
Select Temperature ○ °C ◉ °F	Channel Number							
	1	2	3	4	5	6		
32	32	32	32	32	32	32	32.0	0.0%
212	212	212	212	212	212	212	212.0	0.0%
932	932	932	932	932	932	932	932.0	0.0%
1832	1834	1834	1834	1834	1834	1834	1834.0	-0.1%

1 - Channel Temps must agree with +/- 5°F or 3°C

2 - Acceptable Temperature Difference less than 1.5 %

$$\text{Temp Diff} = \left[\frac{(\text{Reference Temp}(°F) + 460) - (\text{Test Temp}(°F) + 460)}{\text{Reference Temp}(°F) + 460}\right]$$

Y Factor Calibration Check Calculation

MODIFIED METHOD 0010 TEST TRAIN
POLYMERS STACK
METER BOX NO. 12
9/25/2019 + 9/26/2019

	Run 1	Run 2	Run 3
MWd = Dry molecular weight source gas, lb/lb-mole.			
0.32 = Molecular weight of oxygen, divided by 100.			
0.44 = Molecular weight of carbon dioxide, divided by 100.			
0.28 = Molecular weight of nitrogen or carbon monoxide, divided by 100.			
% CO_2 = Percent carbon dioxide by volume, dry basis.	0.0	0.0	0.0
% O_2 = Percent oxygen by volume, dry basis.	20.9	20.9	20.9

$$MWd = (0.32 * O_2) + (0.44 * CO_2) + (0.28 * (100 - (CO_2 + O_2)))$$

$$MWd = (0.32 * 20.9) + (0.44 * 0) + (0.28 * (100 - (0 + 20.9)))$$

$$MWd = (6.69) + (0.00) + (22.15)$$

MWd =	28.84	28.84	28.84

Tma = Source Temperature, absolute(^{o}R)			
Tm = Average dry gas meter temperature , deg F.	92.3	76.6	80.8

$$Tma = Ts + 460$$

$$Tma = 92.25 + 460$$

Tma =	552.25	536.58	540.83

Ps = Absolute meter pressure, inches Hg.			
13.60 = Specific gravity of mercury.			
delta H = Avg pressure drop across the orifice meter during sampling, in H2O	0.75	1.34	1.45
Pb = Barometric Pressure, in Hg.	29.72	29.81	29.81

$$Pm = Pb + (delta\ H / 13.6)$$

$$Pm = 29.72 + (0.74625 / 13.6)$$

Pm =	29.77	29.91	29.92

Yqa = dry gas meter calibration check value, dimensionless.			
0.03 = (29.92/528)(0.75)2 (in. Hg/°/R) cfm2.			
29.00 = dry molecular weight of air, lb/lb-mole.			
Vm = Volume of gas sample measured by the dry gas meter at meter conditions, dcf.	45.585	57.848	60.409
Y = Dry gas meter calibration factor (based on full calibration)	1.0069	1.0069	1.0069
Delta H@ = Dry Gas meter orifice calibration coefficient, in. H2O.	1.8812	1.8812	1.8812
avg SQRT Delta H = Avg SQRT press. drop across the orifice meter during sampling , in. H_2O	0.8601	1.1563	1.1991
O = Total sampling time, minutes.	96	96	96

$$Yqa = (O / Vm) * SQRT (0.0319 * Tma * 29) / (Delta\ H@ * Pm * MWd) * avg\ SQRT\ Delta\ H$$

$$Yqa = (96.00 / 45.59) * SQRT (0.0319 * 552.25 * 29) / (1.88 * 29.77 * 28.84) * 0.86$$

$$Yqa = 2.106 * SQRT 510.886 / 1,614.912 * 0.86$$

Yqa =	1.0187	1.0614	1.0580

Diff = Absolute difference between Yqa and Y	1.17	5.41	5.07

$$Diff = ((Y - Yqa) / Y) * 100$$

$$Diff = ((1.0069 - 1.019) / 1.0069) * 100$$

Average Diff = 3.88

Allowable = 5.0

APPENDIX F
LIST OF PROJECT PARTICIPANTS

The following WESTON employees participated in this project.

Paul Meeter	Senior Project Manager
Jeff O'Neill	Senior Project Manager
Matt Winkeler	Team Member
Steve Rathfon	Team Member
Kyle Schweitzer	Team Member