EGLE

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environment, Great Lakes, and Energy, Air Quality Division upon request.

Source Name: Weyerhaeuser NR Company   County: Crawford

Source Address: 4111 West Four Mile Road   City: Grayling

AQD Source ID (SRN): B7302   ROP No.: B7302-2016c   ROP Section No.: ______

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From NA To NA

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Air Emissions Test Report evaluating compliance with EUPRESSLINE/FGDRYERS.
This form shall certify that the testing was conducted in accordance with the 10/30/21
test plan and that the facility operating conditions were in compliance with permit
conditions or at the maximum routine operating conditions for the facility

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Rina Bethany	Panels Mfg Director	503-569-2560
Name of Responsible Official (print or type)	Title	Phone Number

Rina Bethany
Signature of Responsible Official

1/26/2021
Date

* Photocopy this form as needed.

EQP 5736 (Rev 04/30/2019)

January 28, 2021

Karen Kajiya-Mills kajiya-millsk@michigan.gov
Michigan Department of Environment, Great Lakes, and Energy
Air Quality Division – Technical Programs Unit
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Sharon LeBlanc leblancs@michigan.gov
Michigan Department of Environment, Great Lakes, and Energy
Air Quality Division – Gaylord District Office
2100 West M-32
Gaylord, Michigan 49735

Apex Project No. 11020-000068.00

Subject: **Air Emissions Test Report**
Biofilter and RTO Emissions Test and Relative Accuracy Test Audit
Weyerhaeuser
SRN B7302
4111 West Four Mile Road
Grayling, Michigan
Renewable Operating Permit MI-ROP-B7302-2016c

Dear Ms. Kajiya-Mills and Ms. LeBlanc:

On behalf of Weyerhaeuser, Apex Companies, LLC submits this report for compliance air emissions testing at the Weyerhaeuser facility in Grayling, Michigan. The compliance testing was conducted on December 9 and 10, 2020.

If you have any questions, please contact us.

Sincerely,

David Kawasaki, QSTI
Staff Consultant
Apex Companies, LLC
david.kawasaki@apexcos.com
Telephone 248.590.5134

Derek R. Wong, Ph.D., P.E.
National Account Manager
Apex Companies, LLC
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cc: Kathi Moss, Weyerhaeuser
Manoj Patel, USEPA Region V

APEX COMPANIES, LLC

Air Emissions Test and Relative Accuracy Test Audit of Biofilter and Regenerative Thermal Oxidizer Weyerhaeuser Grayling, Michigan

Prepared for:
Weyerhaeuser
4111 West Four Mile Road
Grayling, Michigan 49378

State Registration No. B7302

Apex Project No. 11020-000068.00
January 28, 2021

Apex Companies, LLC
46555 Humboldt Drive, Suite 103
Novi, Michigan 48377

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Executive Summary

Weyerhaeuser retained Apex Companies, LLC to perform air emissions testing at the EUPRESSLINE Biofilter and FGDRYERS regenerative thermal oxidizer (RTO) emission sources at the Weyerhaeuser facility in Grayling, Michigan.

The purpose of this testing was to (1) evaluate the formaldehyde removal efficiency of the press biofilter, and (2) perform a relative accuracy test audit (RATA) on certain continuous emissions monitoring systems (CEMS) as required by 40 CFR Part 60, Appendix F, "Quality Assurance Procedures," and incorporated in Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) MI-ROP-B7302-2016c, effective March 8, 2016. The following CEMS were evaluated:

- EUPRESSLINE Biofilter volatile organic compound (VOC) monitor
- FGDRYERS RTO carbon monoxide (CO) monitor
- FGDRYERS RTO VOC monitor

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1 through 4, 10, 25A, 205, 320 and Performance Specifications (PS) PS-4, PS-6, and PS-8.

Detailed results are presented in Tables 1 through 4 after the Tables Tab of this report. The following tables summarize the results of the testing conducted on December 9 and 10, 2020.

EUPRESSLINE Biofilter Formaldehyde Removal Efficiency Results

Parameter	Unit	Average Result	Permit Limit
Formaldehyde (inlet)	lb/hr	4.4	--
Formaldehyde (outlet)	lb/hr	0.05	1.0
Formaldehyde Removal Efficiency	%	98.9%	≥90

lb/hr: pound per hour

Relative Accuracy Test Audit Results

Parameter	Average RM Result	Average CEMS Result	Difference between CEMS and RM	Relative Accuracy (%)	Performance Specification
EUPRESSLINE Biofilter					
VOCs (lb/hr, as carbon)	9.7	9.9	-0.2	3.1%	≤10% AS
FGDRYERS RTO					
VOCs (lb/hr, as carbon)	3.1	3.7	-0.6	5.3%	≤10% AS
CO (lb/hr)	43.6	52.5	-8.9	7.3%	≤10% AS

CEMS: continuous emission monitoring system
lb/hr: pound per hour
RM: Reference Method
AS: Applicable Standard

1.0 Introduction

1.1 Summary of Test Program

Weyerhaeuser retained Apex Companies, LLC to perform air emissions testing at the EUPRESSLINE Biofilter and FGDRYERS regenerative thermal oxidizer (RTO) emission sources at the Weyerhaeuser facility in Grayling, Michigan.

The purpose of this testing was to (1) evaluate the formaldehyde removal efficiency of the press biofilter, and (2) perform a relative accuracy test audit (RATA) on certain continuous emissions monitoring systems (CEMS) as required by 40 CFR Part 60, Appendix F, "Quality Assurance Procedures," and incorporated in Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) MI-ROP-B7302-2016c, effective March 8, 2016. The following CEMS were evaluated:

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- FGDRYERS RTO carbon monoxide (CO) monitor
- FGDRYERS RTO VOC monitor

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1 through 4, 10, 25A, 205, 320, and Performance Specifications (PS) PS-4, PS-6, and PS-8.

Table 1-1 lists the emission sources tested, parameters, and test dates.

Table 1-1
Sources Tested, Parameters, and Test Dates

Source	Test Parameter	Test Date
EUPRESSLINE Biofilter	Volatile organic compounds (VOCs)† Formaldehyde	December 9, 2020
FGDRYERS RTO	VOCs Carbon monoxide (CO)	December 10, 2020

† In this report, the term VOC and THC are used interchangeably because the applicable ROP and test methods reference VOC, whereas the federal requirements of 40 CFR 60, Subpart DDDD, "National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products," reference total hydrocarbons (THC).

1.2 Key Personnel

The key personnel involved in this test program are listed in Table 1-2. Mr. David Kawasaki, Staff Consultant with Apex, led the emission testing program. Ms. Kathi Moss, Environmental Manager with Weyerhaeuser, provided process coordination and recorded operating parameters. Ms. Sharon LeBlanc and Mr. Robert Dickman, with EGLE, witnessed the testing and verified production parameters were recorded.

Table 1-2
Key Contact Information

Client	Apex
Kathi Moss Environmental Manager **Weyerhaeuser** 4111 West Four Mile Road Grayling, Michigan 49378 Phone: 989.348.3475 kathi.moss@weyerhaeuser.com	David Kawasaki, QSTI Staff Consultant **Apex Companies, LLC** 46555 Humboldt Drive, Suite 103 Novi, Michigan 48377 Phone: 248.590.5134 david.kawasaki@apexcos.com
EGLE	
Karen Kajiya-Mills Technical Programs Unit Supervisor **Environment, Great Lakes, and Energy** **Air Quality Division** **Technical Programs Unit** Constitution Hall, 2nd Floor, South 525 West Allegan Street Lansing, Michigan 48933 Phone: 517.256.0880 kajiya-millsk@michigan.gov	Sharon LeBlanc Environmental Quality Analyst **Environment, Great Lakes, and Energy** **Air Quality Division** **Gaylord District Office** 2100 West M-32 Gaylord, Michigan 49735 Phone: 989.217.0055 leblancs@michigan.gov
Robert Dickman Environmental Quality Analyst **Environment, Great Lakes, and Energy** **Air Quality Division** **Cadillac District Office** 120 West Chapin Street Cadillac, Michigan 49601 Phone: 231.878-4697 dickmanr@michigan.gov	

2.0 Source and Sampling Locations

2.1 Process Description

Weyerhaeuser manufactures oriented-strand board (OSB) at its facility in Grayling, Michigan. Wood logs are sorted by species and stored in the wood yard. The wood composition of boards manufactured during this testing event was 60% aspen, 15% pine, 20% soft maple, and 5% hard maple. Logs are transferred to heated vats to clean and thaw (in winter months) the wood. The wood logs are conveyed from the vats to a debarking machine that removes the outer layers of the logs. A ring-strander cuts the logs into thin wood chips (strands). The strands are conveyed to a storage bin where they are fed into four wood-fired dyers. The dryers remove moisture from the strands to a product-specific content. The strands exit the dryers and are sorted according to size using shaker screens.

The fine strands are collected and used as fuel in the dryers and RTOs. The larger strands are conveyed to a blending area where wax and resins are added for adhesion purposes. The strands are then layered, at different angles for strength, onto an 8-foot-wide conveyor belt. The layered strands are cut into 8-foot-by-24-foot sections and formed into mats. The mats are stacked, and the press is used to heat and compact the strands to form OSB. Depending on the thickness of the product (i.e., 7/16 or 23/32 inch) up to 16 mats can be compacted in less than 4 minutes. The OSB is cut, labeled, and prepared for shipment.

2.2 Control Equipment Description

As part of the manufacturing process, emissions are generated by wood debarking and stranding, conveyance, drying, binding and pressing, milling, and painting (sides of wood). Weyerhaeuser operates pollution control equipment to control the discharge of pollutants to the atmosphere. The biofilter, wet electrostatic precipitator (WESP), and RTOs control emissions from the drying and pressing operations.

The VOC CERMS installed on the EUPRESSLINE Biofilter and the VOC and CO CERMS on the FGDRYERS RTO exhaust stacks are used to evaluate continuous compliance with permit limits.

2.2.1 EUPRESSLINE Biofilter

The biofilter controls VOC and HAP emissions from the press portion of emission unit EUPRESSLINE. The press heats and compacts alternating layers of fine and coarse wood strands and binders into the OSB. Emissions from the press are captured within the total building enclosure and directed to a humidifier followed by a two-chamber biofilter. The biofilter contains Douglas fir mulch that provides a microbial environment for pollutant removal. Treated emissions from the two biofilter chambers discharge to a single stack (SVBIOFILTER).

Operating parameters were measured and recorded by Weyerhaeuser personnel during testing. Tables 2-1 and 2-2 summarize the operating conditions during testing of the EUPRESSLINE Biofilter. Additional operating parameter data are included in Appendix F.

Table 2-1
Summary of Biofilter Production Data

RATA Test Run	Press Feed Line Speed (ft/min)	Board Thickness (inch)
1	127.00	7/16
2	126.99	7/16
3	127.01	7/16
4	127.02	7/16
5	127.00	7/16
6	127.00	7/16
7	126.98	7/16
8	97.47	23/32
9	95.99	23/32
10	95.98	23/32
Average	**117.84**	-

Table 2-2
Summary of Biofilter Operating Data

Test Run	Biofilter Temperature (°F)
1	84.20
2	84.51
3	84.36
Average	**84.36**

2.2.2 FGDRYERS RTOs

North and south RTOs are used to control VOC and HAP emissions from four wood-fired strand dryers and a Coen® burner. Emissions from each dryer and the Coen® burner exhaust to a combined single duct leading to a Lundberg E-Tube WESP. The WESP is designed to remove particulate matter from the flue gas prior to incineration by two RTOs.

At the RTOs, valves alternate the flow direction through each of the RTO chambers. Each chamber contains heat exchange media that alternately heat the emissions entering one combustion chamber and absorbs heat from the emissions exiting the other combustion chamber. Supplemental heat is supplied in the combustion chambers with a gas burner. An induced draft fan transports the emissions through the RTOs, which discharges to the atmosphere via the RTO stack (SVRTOSTACK).

Operating parameters were measured and recorded by Weyerhaeuser personnel during testing. Table 2-3 summarizes the operating conditions during testing of the FGDRYERS RTO. Additional operating parameter data are included in Appendix F.

Table 2-3
Summary of RTO
Production Data

Test Run	Wood Processed (lb/hr)
1	110,578
2	117,912
3	99,405
4	85,726
5	91,509
6	90,314
7	113,501
8	113,919
9	111,944
10	113,815
Average	**104,862**

2.3 Flue Gas Sampling Locations

2.3.1 EUPRESSLINE Biofilter Inlet Sampling Location

Two sampling ports oriented at 90° to one another are located in a straight section of an 84-inch-internal-diameter duct. The sampling ports are located:

- Approximately 12.2 feet (1.7 duct diameters) from the nearest downstream disturbance.
- Approximately 49.1 feet (7.0 duct diameters) from the nearest upstream disturbance.

The sampling ports are accessible via grating above the control room housing the biofilter CEMS and CERMS equipment. A photograph of the EUPRESSLINE Biofilter inlet and outlet sampling locations is presented in Figure 2-1. Figure 1 in the Appendix depicts the EUPRESSLINE Biofilter inlet sampling ports and traverse point locations.

2.3.2 EUPRESSLINE Biofilter Outlet Sampling Location

Two sampling ports oriented at 90° to one another are located in a straight section of an 84-inch-internal-diameter duct. The sampling ports are located:

- Approximately 60 feet (8.6 duct diameters) from the nearest downstream disturbance.
- Approximately 70 feet (10 duct diameters) from the nearest upstream disturbance.

The sampling ports are accessible via grating above the control room housing the biofilter CEMS and CERMS equipment. A photograph of the EUPRESSLINE Biofilter inlet and outlet sampling locations is presented in Figure 2-1. Figure 2 in the Appendix depicts the EUPRESSLINE Biofilter outlet sampling ports and traverse point locations.

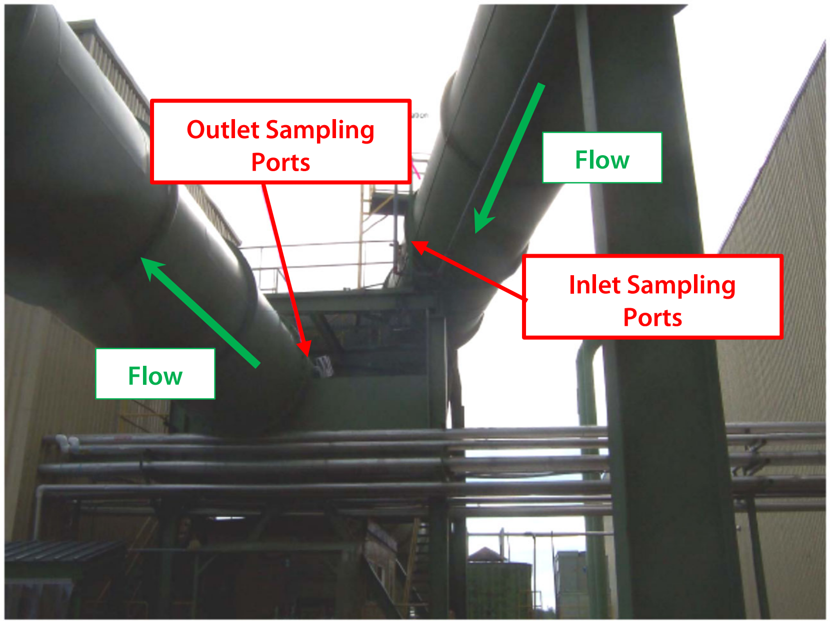


Figure 2-1. EUPRESSLINE Biofilter Inlet and Outlet Sampling Locations

2.3.3 FGDRYERS RTO Outlet Sampling Location

Four sampling ports oriented at 90° to one another are located in a straight section of a 105-inch-internal-diameter duct. The sampling ports are located:

- Approximately 40 feet (4.6 duct diameters) from the nearest downstream disturbance.
- Approximately 30 feet (3.4 duct diameters) from the nearest upstream disturbance.

The sampling ports are accessible via elevator to the top floor of the FGDRYER building and stairs to a catwalk. A photograph of the FGDRYERS RTO outlet sampling location is presented in Figure 2-2. Figure 3 in the Appendix depicts the FGDRYERS RTO outlet sampling ports and traverse point locations.

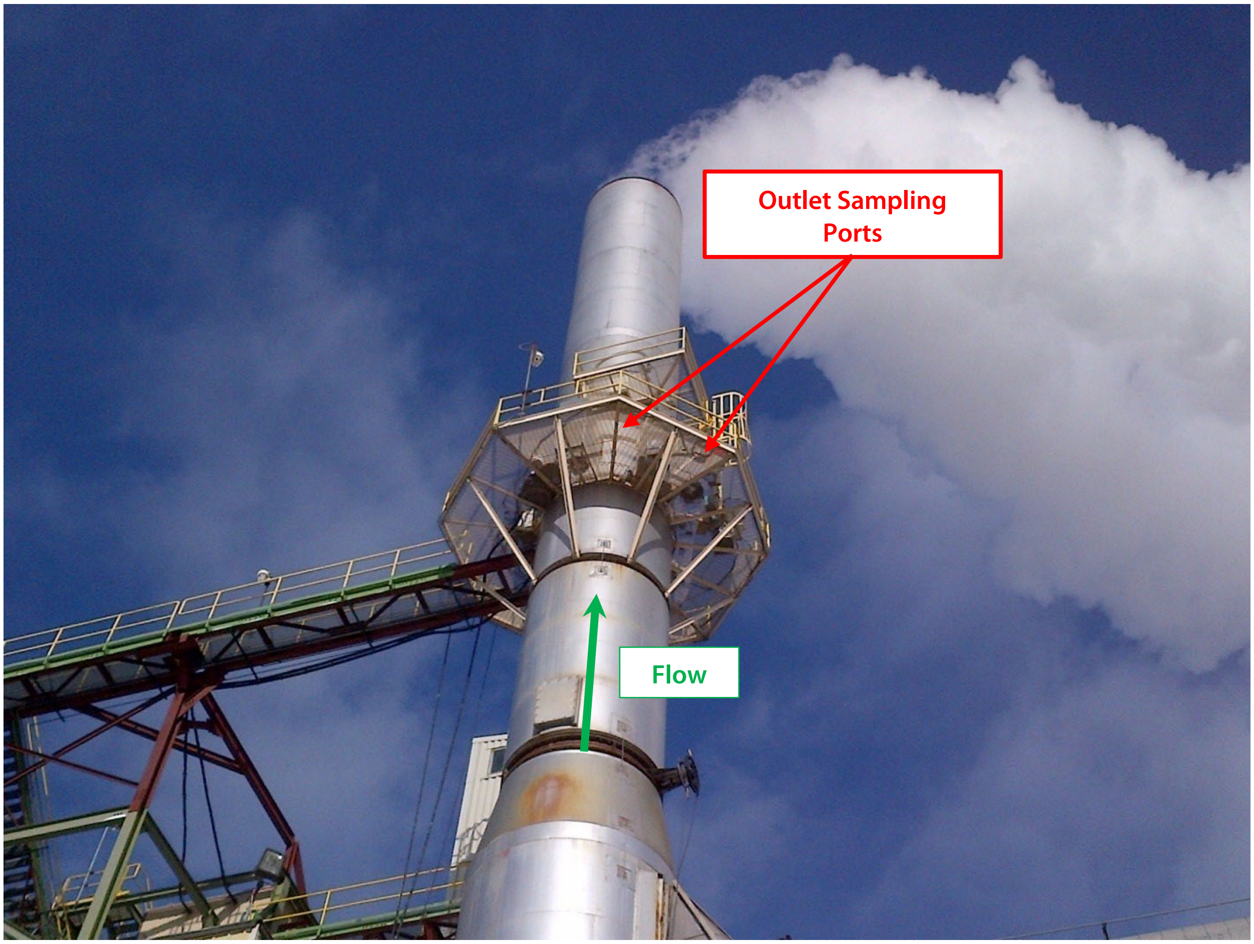


Figure 2-2. FGDRYERS RTO Outlet Sampling Location

2.4 Process Sampling Locations

Process sampling was not required during this test program. A process sample is a sample that is analyzed for operational parameters, such as calorific value of a fuel (e.g., natural gas, coal), organic compound content (e.g., paint coatings), or composition (e.g., polymers).

2.5 Continuous Emission Rate Monitoring Systems

Description and identification of the instrumentation operated by Weyerhaeuser to monitor source emission rates are presented in Sections 2.5.1 and 2.5.2.

2.5.1 EUPRESSLINE Biofilter Outlet

The VOC monitor is a California Analytical Instruments, Inc., Model 600 HFID, Serial Number B05011. The system extracts sample gas through a heated sample probe and heated filter connected to the monitor by a heated sample line. The VOC analyzer measures total hydrocarbons using a flame ionization detector (FID). The VOC monitor operates on a single range/span of 0 to 100 parts per million (ppm).

The flowrate monitor is a Teledyne UltraFlow Model 150, Serial Number 1501355. The air flowrate is measured by ultrasonic methods. The flow monitoring system uses 20% oxygen and 0% carbon dioxide for the flowrate calculations.

2.5.2 FGDRYERS RTO Outlet

The VOC monitor is a California Analytical Instruments, Inc., Model 600 HFID, Serial Number B05010. The system extracts sample gas through a heated sample probe and heated filter connected to the monitor by a heated sample line. The VOC analyzer measures total hydrocarbons using an FID. The VOC monitor operates on a dual range span: 0 to 100 ppm and 0 to 1,000 ppm.

The CO monitor is a California Analytical Instruments, Inc., Model 601, Serial Number B06014-M. The system extracts sample gas through a heated sample probe and heated filter connected to the gas conditioning system by a heated sample line. Moisture is removed from the sample before the sample is analyzed. The CO analyzer measures carbon monoxide concentration by non-dispersive infrared analysis. The analyzer has a span of 0 to 500 ppm.

The flowrate monitor is a Teledyne UltraFlow Model 150, Serial Number 1501354. The air flowrate is measured by ultrasonic methods. The flowrate monitoring system uses 20% oxygen and 1% carbon dioxide for the flowrate calculations.

3.0 **Summary and Discussion of Results**

3.1 Objectives and Test Matrix

The purpose of this testing was to (1) evaluate the formaldehyde removal efficiency of the press biofilter, and (2) perform a RATA on certain CEMS as required by 40 CFR Part 60, Appendix F, "Quality Assurance Procedures," and incorporated in EGLE ROP MI-ROP-B7302-2016c, effective March 8, 2016.

Table 3-1 summarizes the sampling and analytical matrix.

Table 3-1
Sampling and Analytical Matrix

Sampling Location	Sample/Type of Pollutant	Sample Method	Date (2020)	Run	Start Time	End Time	Analytical Laboratory
EUPRESSLINE Biofilter	Formaldehyde and moisture content	USEPA 1-3, 320	Dec. 9	1	0747	0847	Not applicable
				2	0901	1001	
				3	1024	1124	
	Flowrate, molecular weight, moisture content, VOC RATA	USEPA 1-3, 25A, 205, 320, PS-6, PS-8	Dec. 9	1	0720	0741	
				2	0746	0807	
				3	0807	0828	
				4	0828	0849	
				5	0901	0922	
				6†	0922	0949	
				7	0949	1010	
				8	1024	1045	
				9	1045	1106	
				10	1106	1127	
FGDRYERS RTO	Flowrate, molecular weight, moisture content, CO RATA, VOC RATA	USEPA 1-4, 10, 25A, 205, PS-4, PS-6, PS-8	Dec. 10	1	0641	0702	Not applicable
				2	0702	0723	
				3	0937	0958	
				4	1045	1106	
				5	1106	1127	
				6	1127	1148	
				7	1209	1230	
				8	1230	1251	
				9	1251	1312	
				10	1312	1333	

†: Data not recorded from 9:36 to 9:42 during the CEMS unit auto calibration

3.2 Field Test Changes and Issues

Communication between Weyerhaeuser, Apex, and EGLE allowed the testing to be completed as proposed in the October 30, 2020, Intent-to-Test Plan, with the following exceptions:

- Test Run 6 for the EUPRESSLINE Biofilter VOC RATA was paused between 9:36 and 9:42 while the CEMS unit underwent an automatic calibration.

- Fourier Transform Infrared (FTIR) minute data was not recorded from 8:03 to 8:20 during Test Run 1, for formaldehyde at the inlet of the EUPRESSLINE Biofilter, due to a recording error in the FTIR software. Production was normal during this time period, and the missing data is not expected to impact results.

3.3 Summary of Results

The results of testing are presented in Tables 3-2 and 3-3. Detailed results are presented in the Appendix Tables 1 through 4 after the Tables Tab of this report. Graphs are presented after the Graphs Tab of this report. Sample calculations are presented in Appendix B.

Table 3-2
EUPRESSLINE Biofilter Formaldehyde Removal Efficiency Results

Parameter	Unit	Average Result	Permit Limit
Formaldehyde (inlet)	lb/hr	4.4	--
Formaldehyde (outlet)	lb/hr	0.05	1.0
Formaldehyde Removal Efficiency	%	98.9%	≥90

lb/hr: pound per hour

Table 3-3
Relative Accuracy Test Audit Results

Parameter	Average RM Result	Average CEMS Result	Difference between CEMS and RM	Relative Accuracy (%)	Performance Specification
EUPRESSLINE Biofilter					
VOCs (lb/hr, as carbon)	9.7	9.9	-0.2	3.1%	≤10% AS
FGDRYERS RTO					
VOCs (lb/hr, as carbon)	3.1	3.7	-0.6	5.3%	≤10% AS
CO (lb/hr)	43.6	52.5	-8.9	7.3%	≤10% AS

CEMS: continuous emission monitoring system
lb/hr: pound per hour
RM: Reference Method
AS: Applicable Standard

4.0 Sampling and Analytical Procedures

Apex measured emissions in accordance with USEPA sampling methods. Table 4-1 presents the emissions test parameters and sampling methods.

Table 4-1
Emission Testing Methods

Parameter	EUPRESSLINE Biofilter Inlet	EUPRESSLINE Biofilter Outlet	FGDRYERS RTO Outlet	USEPA Reference	
				Method	Title
Sampling ports and traverse points	•	•	•	1	Sample and Velocity Traverses for Stationary Sources
Velocity and flowrate	•	•	•	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular weight	•	•	•	3	Gas Analysis for the Determination of Dry Molecular Weight
Moisture content			•	4	Determination of Moisture Content in Stack Gases
CO			•	10	Determination of Carbon Monoxide Emissions from Stationary Sources (Instrument Analyzer Procedure)
VOC		•	•	25A	Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer
Gas dilution		•	•	205	Verification of Gas Dilution Systems for Field Instrument Calibrations
Formaldehyde and moisture content	•	•		320	Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy
CO RATA			•	PS-4	Specifications and Test Procedures for Carbon Monoxide Continuous Emission Monitoring Systems in Stationary Sources
Flowrate RATA		•	•	PS-6	Specifications and Test Procedures for Continuous Emission Rate Monitoring Systems in Stationary Sources
VOC RATA		•	•	PS-8	Specifications and Test Procedures for Volatile Organic Compound Continuous Emission Monitoring Systems in Stationary Sources

4.1 Emission Test Methods

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

USEPA Method 1, "Sample and Velocity Traverses for Stationary Sources," was used to evaluate the sampling locations and the number of traverse points for sampling and the measurement of velocity profiles. Figures 1 through 3 in the Appendix depict the source locations and traverse points.

USEPA Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to measure flue gas velocity and calculate volumetric flowrates. S-type Pitot tubes and thermocouple assemblies, calibrated in accordance with Method 2, Section 10.0, were used during testing. Because the dimensions of the Pitot tubes met the requirements outlined in Method 2, Section 10.1, and are within the specified limits, the baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned. The digital manometer and thermometer are calibrated using calibration standards that are traceable to National Institute of Standards and Technology (NIST). Pitot tube inspection sheets are included in Appendix A.

Cyclonic Flow Check. Apex evaluated whether cyclonic flow was present at the sampling locations. Cyclonic flow is defined as a flow condition with an average null angle greater than 20°. The direction of flow can be determined by aligning the Pitot tube to obtain zero (null) velocity head reading—the direction would be parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack walls when a null angle is obtained, the direction of flow is measured. If the absolute average of the flow direction angles is greater than 20°, the flue gas is considered to be cyclonic at that sampling location and an alternative location should be selected.

The average of the measured traverse point flue gas velocity null angles were less than 20° at the sampling locations. The measurements indicate the absence of cyclonic flow.

Field data sheets are included in Appendix C. Computer-generated field data sheets are included in Appendix D.

4.1.2 Molecular Weight (USEPA Method 3)

USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight," was used to determine the molecular weight of the flue gas. Flue gas was extracted from the stack through a probe and directed into a Fyrite® gas analyzer. The concentrations of carbon dioxide (CO_2) and oxygen (O_2) were measured by chemical absorption to within ±0.5%. The average CO_2 and O_2 results of the grab samples were used to calculate molecular weight.

4.1.3 Moisture Content (USEPA Method 4)

USEPA Method 4, "Determination of Moisture Content in Stack Gases" was used to determine the moisture content of the flue gas. Refer to Figure 4-1 for a drawing of the USEPA Method 4 sampling train.

Apex's modular USEPA Method 4 stack sampling system consists of:

- A stainless steel probe.
- Tygon® umbilical line connecting the probe to the impingers.
- A set of four impingers with the configuration shown in Table 4-2.
- A sampling line.
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice.

Table 4-2
USEPA Method 4 Impinger Configuration

Impinger Order (Upstream to Downstream)	Impinger Type	Impinger Contents	Contents
1	Modified	Water	~100 grams
2	Greenburg Smith	Water	~100 grams
3	Modified	Empty	0 grams
4	Modified	Silica desiccant	~300 grams

Prior to initiating a test run, the sampling train was leak-checked by capping the probe tip and applying a vacuum of approximately 5 inches of mercury to the sampling train. The dry-gas meter was monitored for approximately 1 minute to verify the sample train leak rate was less than 0.02 cfm. The sample probe was then inserted into the sampling port in preparation of sampling. Flue gas was extracted at a constant rate from the stack, with moisture removed from the sample stream by the chilled impingers.

At the conclusion of the test run, a post-test leak check was conducted and the impinger train was carefully disassembled. The weight of liquid or silica gel in each impinger was measured with a scale capable of measuring to the nearest 0.5 gram. The weight of water collected within the impingers and volume of flue gas sampled were used to calculate the percent moisture content. One moisture content sample was collected for every three or four RATA test runs.

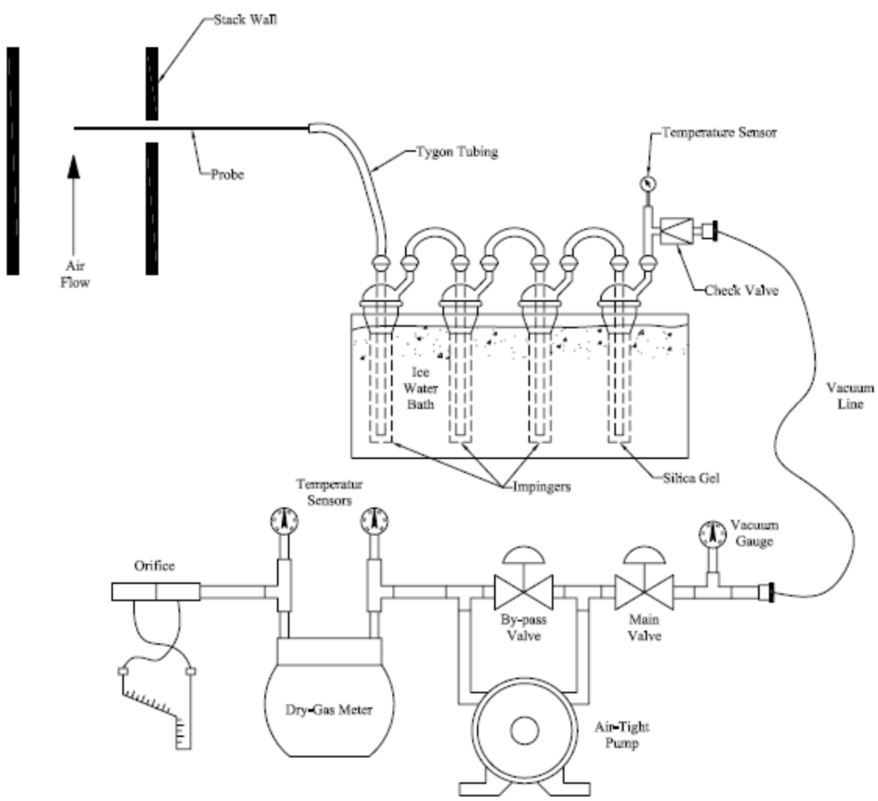


Figure 4-1. USEPA Method 4 Sampling Train

4.1.4 Carbon Monoxide (USEPA Method 10)

USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)," was used to measure carbon monoxide (CO) concentrations in the flue gas. Flue gas was continuously sampled in the stack and conveyed to an analyzer for concentration measurements. Flue gas was extracted from the stack through:

- A stainless-steel probe.
- Heated Teflon sample line to prevent condensation.
- A chilled Teflon impinger train (equipped with a peristaltic pump) to remove moisture from the sampled gas stream prior to entering the analyzer.
- CO analyzer.

Figure 4-2 depicts the USEPA Method 10 sampling train. Data was recorded at 1-second intervals on a computer equipped with data acquisition software. Recorded concentrations were averaged over the duration of each test run.

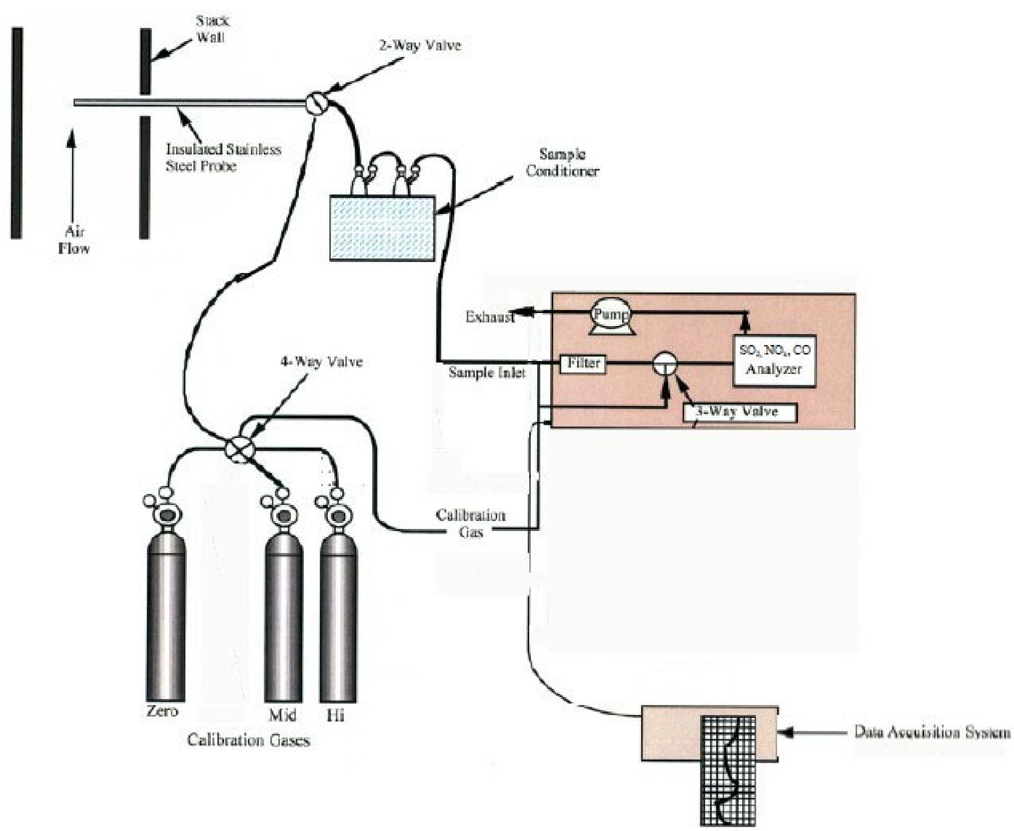


Figure 4-2. USEPA Method 10 Sampling Train

Prior to the second RATA run on the FGDRYERS RTO outlet, a 3-point stratification test was conducted at 17, 50, and 83% of the stack diameter to determine the minimum number of traverse points to be sampled. The average concentration at each traverse point differed from the mean by less than 5.0 percent, so one traverse point was used for the remainder of the RATA.

The pollutant concentrations were measured using an analyzer calibrated with zero-, mid-, and high-USEPA-Traceability-Protocol-certified calibration gases. The mid-level gas was 40 to 60% of the high-level (also referred to as span) gas.

Calibration Error Check. A calibration error check was performed by introducing zero-, mid-, and high-level calibration gases directly into the analyzer. The calibration error check was performed to verify the analyzer response was within ±2% of the certified calibration gas introduced.

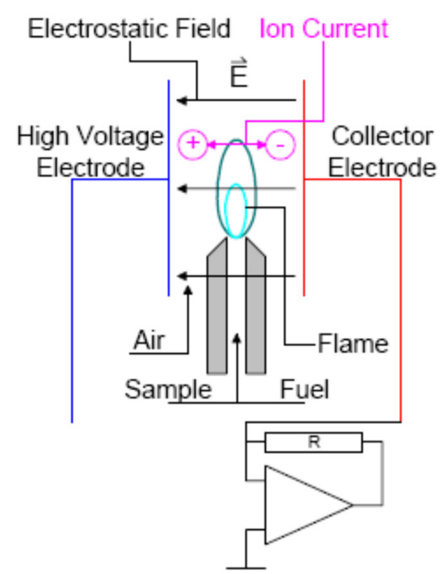
System Bias Test. Prior to each test run, a system bias test was performed where known concentrations of calibration gases were introduced at the probe tip to measure if an analyzer's response was within ±5% of the introduced calibration gas concentrations. At the conclusion of each test run, an additional system-bias check was performed to evaluate the analyzer drift from pre- and post-test system-bias checks. The system-bias check evaluates the analyzer drift against the ±3% quality assurance/quality control (QA/QC) requirement.

The analyzer drift data was used to correct the measured flue gas concentrations. Recorded concentrations were averaged over the duration of each test run.

4.1.5 Total Hydrocarbons (USEPA Method 25A)

USEPA Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," was used to measure volatile organic compound concentrations in the flue gas. Samples were collected through a stainless steel probe and heated sample line into an analyzer.

A flame ionization detector (FID) determines the average hydrocarbon concentration in part per million by volume (ppmv) of VOC as the calibration gas (i.e., propane). The FID is fueled by 100% hydrogen, which generates a flame with a negligible number of ions. Flue gas is introduced into the FID and enters the flame chamber. The combustion of flue gas generates electrically charged ions. The analyzer applies a polarizing voltage between two electrodes around the flame, producing an electrostatic field. Negatively charged ions, anions, migrate to a collector electrode, while positively charged ions, cations, migrate to a high-voltage electrode. The current between the electrodes is directly proportional to the hydrocarbon concentration in the sample. The flame chamber is depicted at right.



Using the voltage analog signal, measured by the FID, the concentration of VOCs was recorded by a data acquisition system (DAS). The average concentration of VOCs is reported as the calibration gas (i.e., propane) in equivalent units.

Before testing, the analyzer was calibrated by introducing a zero-calibration range gas (<1% of span value) and high-calibration range gas (80-90% span value) to the tip of the sampling probe. Next, a low-calibration range gas (25-35% of span value) and mid-calibration range gas (45-55% of span value) were introduced. The analyzers are considered to be calibrated when the analyzer response is ±5% of the calibration gas value.

Prior to testing at the EUPRESSLINE Biofilter, a 3-point stratification test was conducted at 17, 50, and 83% of the stack diameter to determine the minimum number of traverse points to be sampled. The average concentration at each traverse point differed from the mean by less than 0.5 ppmv, so one traverse point was used for the remainder of the RATA.

At the conclusion of a test run, a calibration drift test was performed by introducing the zero- and mid-calibration gas to the tip of the sampling probe. The test run data was considered valid if the calibration drift test demonstrated the analyzers are responding within 3% of the calibration span from pre-test to post-test calibrations.

Figure 4-3 depicts the USEPA Method 25A sampling train.

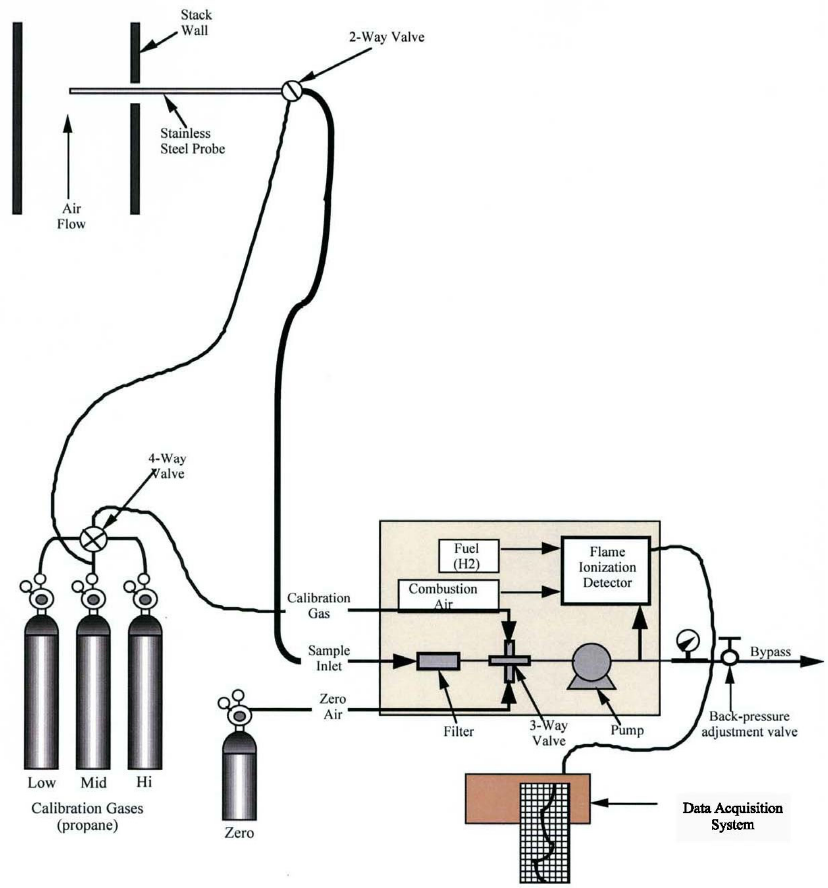


Figure 4-3. USEPA Method 25A Sampling Train

4.1.6 Gas Dilution (USEPA Method 205)

USEPA Method 205, "Verification of Gas Dilution Systems for Field Instrument Calibrations," was used to introduce known values of calibration gases into the analyzers. The gas dilution system consists of calibrated orifices or mass flow controllers and dilutes a high-level calibration gas to within ±2% of predicted values. The gas divider is capable of diluting gases at set increments and was evaluated for accuracy in the field in accordance with USEPA Method 205.

Prior to testing, the gas divider dilutions were measured to evaluate that they were within ±2% of predicted values. Two sets of three dilutions of the high-level calibration gas were performed. In addition, a certified mid-level calibration gas was introduced into an analyzer; this calibration gas concentration was within ± 10% of a gas divider dilution concentration.

4.1.7 Formaldehyde and Moisture Content (USEPA Method 320)

USEPA Method 320, "Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy," was used to measure formaldehyde and moisture content in the flue gas. Gaseous samples were withdrawn from the stack and transferred to an MKS Instruments MultiGas 2030 FTIR spectrometer.

The sample gas was directed through a heated probe, heated filter and heated transfer line connected to the FTIR. The probe, filter, transfer line, and FTIR were maintained at 191°C (375°F) during testing. The analyte concentrations were measured based on their infrared absorbance compared to reference spectra. The FTIR analyzer scanned the sample gas approximately once per second. A data point was generated every half-minute as the co-addition of 32 scans.

FTIR quality assurance procedures followed USEPA Method 320. A calibration transfer standard (CTS) was analyzed before and after testing. Acetaldehyde matrix spiking was performed prior to testing. Section 3.29 of USEPA Method 320 allows the use of a surrogate analyte for the purposes of analyte spiking. Acetaldehyde was chosen as a surrogate to formaldehyde for the following reason:

- Acetaldehyde's physical and chemical properties are similar to those of formaldehyde. Formaldehyde is the C1 aldehyde (CH2O); acetaldehyde is the C2 aldehyde (CH3CHO).

The analyte spikes were set to a target dilution ratio of 1:10 or less. Valid tests require spike recoveries to be within the Method 320 allowance of 100±30%.

Figure 4-4 depicts the USEPA Method 320 sampling train.

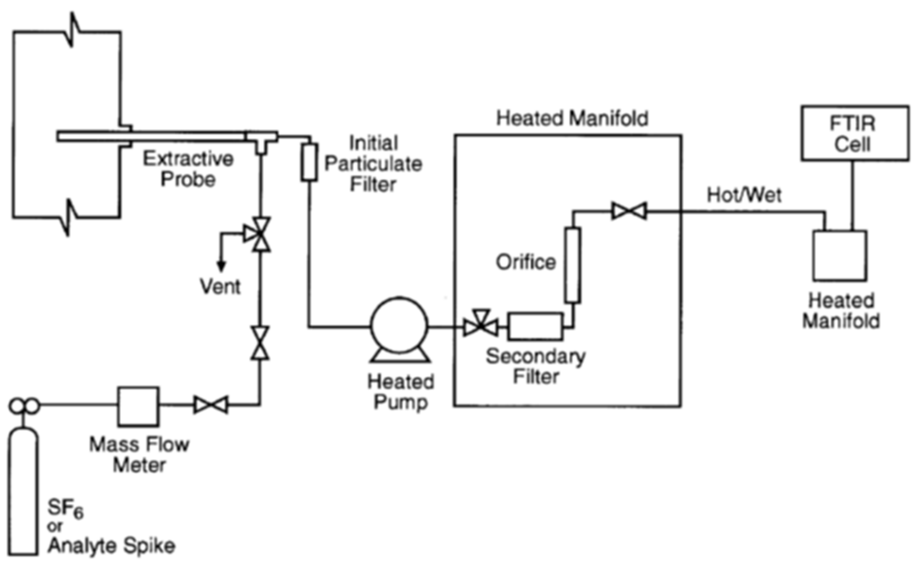


Figure 4-4. USEPA Method 320 Sampling Train

4.2 Process Data

Weyerhaeuser recorded process data during testing. EGLE personnel verified the requested operating and process data were recorded. Process data are included in Appendix F.

5.0 Quality Assurance and Quality Control

5.1 QA/QC Procedures

Equipment used in this emissions test program passed Quality Assurance (QA) and Quality Control (QC) procedures. Refer to Appendix A for equipment calibrations. Before testing, the sampling equipment was cleaned, inspected, and calibrated according to procedures outlined in the applicable USEPA sampling method and USEPA's "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III, Stationary Source-Specific Methods."

5.2 QA/QC Audits

Onsite QA/QC procedures (i.e., Pitot tube inspections, nozzle size verifications, leak check, calculation of isokinetic sampling rates, calibrations) were performed in accordance with the respective USEPA sampling methods. Equipment inspection and calibration measurements are presented in Appendix A.

Offsite QA audits include dry-gas meter and thermocouple calibrations.

5.2.1 Sampling Train QA/QC

The sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. Table 5-1 summarizes the QA/QC audits conducted on each sampling train.

Table 5-1
USEPA Method 4 Sampling Train QA/QC

Parameter	Runs 1-2	Run 3	Runs 4-6	Runs 7-10	Method Requirement	Comment
FGDRYERS RTO						
Sampling train post-test leak check	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 4 in Hg	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 4 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1	1		

5.2.2 Instrument Analyzer QA/QC

The instrument analyzer sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. The analyzers passed the applicable calibration criteria. Table 5-2 summarizes the gas cylinders used during this test program. Analyzer calibration, bias, and drift data are included in Appendix A.

Table 5-2
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Nitrogen	Airgas	AAL-17660	99.9995%	09/21/2028
Carbon monoxide	Airgas	CC27329	1,005 ppm	12/26/2025
Air	Airgas	ALM-011814	--	11/01/2026
Propane	Airgas	ALM-036155	110.0 ppm	03/02/2028
Propane	Airgas	ALM-014745	1,113 ppm	03/02/2028
Ethylene	Airgas	ALM 033173	96.74	05/14/2021
Acetaldehyde, methanol, sulfur hexafluoride	Airgas	CC716034	100.8 ppm 100.3 ppm 10.42 ppm	12/10/2020

5.2.3 Dry-Gas Meter QA/QC

Table 5-3 summarizes the dry-gas meter calibration checks in comparison to the acceptable USEPA tolerance. Complete dry-gas meter calibrations are included in Appendix A.

Table 5-3
Dry-Gas Meter Calibration QA/QC

Dry-Gas Meter	Pre-test DGM Calibration Factor	Post-test DGM Calibration Factor	Difference Between Pre- and Post-test Calibrations	Acceptable Tolerance	Comment
2	0.996 (10/19/2020)	0.998 (1/19/2021)	0.002	±0.05	Valid

5.2.4 Thermocouple QA/QC

Temperature measurements using thermocouples and digital pyrometers were compared to a reference temperature prior to testing to evaluate accuracy of the equipment. The thermocouples and pyrometers measured temperature within ±1.5% of the reference temperatures and were within USEPA acceptance criteria. Thermocouple calibration sheets are included in Appendix A.

5.3 Data Reduction and Validation

The emissions testing Project Manager and/or the QA/QC Officer validated computer spreadsheets. The computer spreadsheets were used to ensure that field calculations were accurate. Random inspection of the field data sheets were conducted to verify data have been recorded appropriately. At the completion of a test, the raw field data were entered into computer spreadsheets to provide applicable onsite emissions calculations. The computer data were checked against the raw field sheets for accuracy during review of the report.

5.4 QA/QC Problems

Equipment audits and QA/QC procedures demonstrate sample collection accuracy and compliance for the test runs.

6.0 Limitations

The information and opinions rendered in this report are exclusively for use by Weyerhaeuser. Apex Companies, LLC will not distribute or publish this report without consent of Weyerhaeuser except as required by law or court order. The information and opinions are given in response to a limited assignment and should be implemented only in light of that assignment. Apex Companies, LLC accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages

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Tables

Table 1

EUPRESSLINE Biofilter Formaldehyde Destruction Efficiency Results

Weyerhaeuser

Grayling, Michigan

Apex Companies Project No. 11020-000068.00

Sampling Date: December 9, 2020

Parameter		Units	Run 1	Run 2	Run 3	Average
Start Time			7:47-8:47	9:01-10:01	10:24-11:24	
Duration		min	60	60	60	60
Inlet	Gas Stream Volumetric Flowrate	scfm	98,328	94,403	91,692	94,807
	Formaldehyde Concentration	ppmv	8.99†	9.94	11.03	10.49
	Formaldehyde Concentration	**mg/dscm**	**11.2**	**12.4**	**13.8**	**12.5**
	Formaldehyde Mass Emission Rate	**lb/hr**	**4.1**	**4.4**	**4.7**	**4.4**
Outlet	Gas Stream Volumetric Flowrate	scfm	95,420	95,348	97,988	96,252
	Formaldehyde Concentration	ppmv	0.11	0.11	0.11	0.11
	Formaldehyde Concentration	**mg/dscm**	**0.14**	**0.14**	**0.14**	**0.14**
	Formaldehyde Mass Emission Rate	**lb/hr**	**0.05**	**0.05**	**0.05**	**0.05**
Formaldehyde Destruction Efficiency		**%**	**98.8**	**98.9**	**98.9**	**98.9**

Molecular weight of formaldehyde 30.03 g/mole

Standard conditions 68°F and 29.92 in Hg. 24.04 is the volume of 1 mole at Standard conditions

† Data missing from 8:03 to 8:20

scfm standard cubic feet per minute

ppmv part per million by volume

APEX

Table 2

EUPRESSLINE Biofilter VOC Relative Accuracy Test Audit Results

Weyerhaeuser

Grayling, Michigan

Apex Companies Project No. 11020-000068.00

Sampling Date: December 9, 2020

Run	Time	Reference Method VOC				CERM VOC	Difference
		SCFM	ppmv, as propane	ppmv, as carbon	lb/hr, as carbon	lb/hr, as carbon	lb/hr, as carbon
1	07:20-07:41	95,332	17.8	53.4	9.5	10.28	-0.8
2	07:46-08:07	93,776	13.7	41.0	7.2	8.09	-0.9
3	08:07-08:28	95,065	13.6	40.7	7.2	8.14	-0.9
4	08:28-08:49	97,419	18.3	55.0	10.0	10.29	-0.3
5	09:01-09:22	97,186	24.9	74.8	13.6	13.40	0.2
6	09:22-09:36,09:42-09:49	96,284	23.4	70.1	12.6	12.27	0.3
7	09:49-10:10	92,575	19.6	58.7	10.2	9.78	0.4
8	10:24-10:45	98,499	12.1	36.2	6.7	7.06	-0.4
9	10:45-11:06	99,774	15.0	44.9	8.4	8.35	0.0
10	11:06-11:27	95,692	16.2	48.6	8.7	9.37	-0.7
Mean		96,517	17.9	53.6	9.7	9.9	-0.2
Standard Deviation							0.5
Confidence Coefficient							0.38

Applicable Standard (Permit Limit)	19.5 lb/hr, as carbon
Average RM value (permit limit used if <50% of standard)	19.5 lb/hr, as carbon
Relative Accuracy	**3.1 %**

PS-6 Relative Accuracy Performance Specification — **The RA of the CERMS must be no greater than 10 percent**

Test run omitted from RATA calculations

Table 3

FGDRYERS RTO VOC Relative Accuracy Test Audit Results

Weyerhaeuser

Grayling, Michigan

Apex Companies Project No. 11020-000068.00

Sampling Date: December 10, 2020

Run	Time	Reference Method VOC SCFM	ppmv, as propane	ppmv, as carbon	lb/hr, as carbon	CERM VOC lb/hr, as carbon	Difference lb/hr, as carbon
1	6:41-7:02	109,889	4.35	13.05	2.68	2.87	-0.19
2	7:02-7:23	108,823	5.35	16.05	3.27	3.05	0.22
3	9:37-9:58	113,045	4.11	12.34	2.61	3.29	-0.68
4	10:45-11:06	117,352	5.20	15.61	3.42	4.20	-0.78
5	11:06-11:27	115,460	5.22	15.66	3.38	4.10	-0.72
6	11:27-11:48	114,869	5.20	15.60	3.35	4.29	-0.94
7	12:09-12:30	117,632	5.71	17.13	3.77	5.25	-1.48
8	12:30-12:51	117,544	4.79	14.37	3.16	4.38	-1.22
9	12:51-13:12	119,120	4.28	12.83	2.86	3.88	-1.02
10	13:12-13:33	117,987	4.28	12.85	2.83	3.33	-0.50
Mean		114,899	4.8	14.3	3.1	3.7	-0.6
Standard Deviation							0.44
Confidence Coefficient							0.34

Applicable Standard (Permit Limit) 18.6 lb/hr, as carbon

Average RM value (permit limit used if <50% of standard) 18.6 lb/hr, as carbon

Relative Accuracy 5.3 %

PS-6 Relative Accuracy Performance Specification **The RA of the CERMS must be no greater than 10 percent**

Test run omitted from RATA calculations

Table 4

FGDRYERS RTO CO Relative Accuracy Test Audit Results

Weyerhaeuser

Grayling, Michigan

Apex Companies Project No. 11020-000068.00

Sampling Date: December 10, 2020

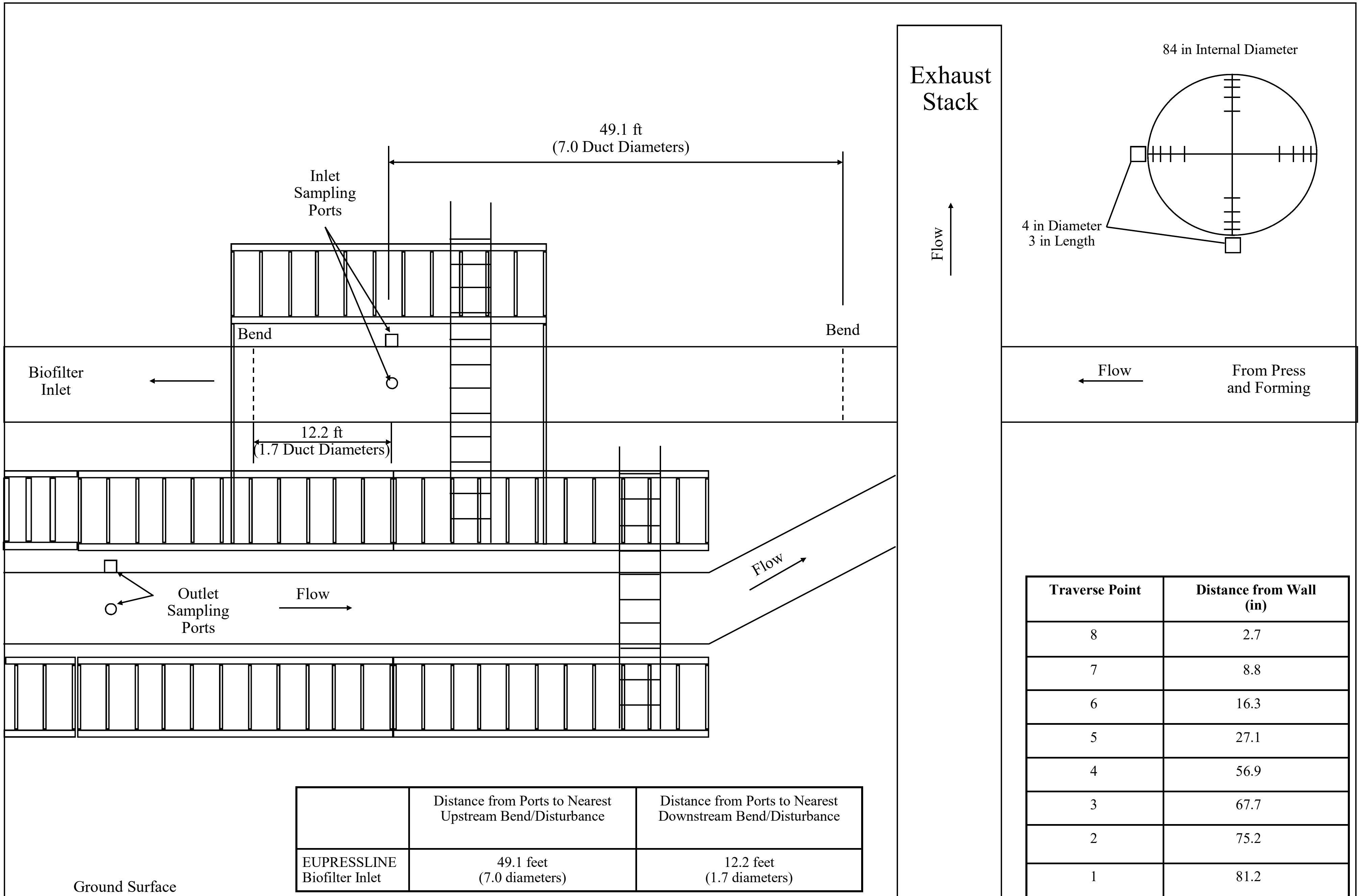
Run	Time	Reference Method CO				CERM CO	Difference
		DSCFM	ppmvd, measured	ppmvd, corrected	lb/hr	lb/hr	lb/hr
1	6:41-7:02	78,521	126.5	126.6	43.41	53.06	-9.65
2	7:02-7:23	77,759	136.4	136.7	46.38	50.93	-4.55
3	9:37-9:58	79,739	99.9	100.4	34.93	44.95	-10.02
4	10:45-11:06	79,563	127.4	130.7	45.37	53.76	-8.39
5	11:06-11:27	78,280	120.2	123.4	42.17	49.17	-7.00
6	11:27-11:48	77,880	117.1	120.3	40.91	48.51	-7.60
7	12:09-12:30	77,000	120.6	120.2	40.41	52.37	-11.96
8	12:30-12:51	76,942	130.8	130.3	43.77	55.51	-11.74
9	12:51-13:12	77,973	144.4	143.6	48.89	60.71	-11.82
10	13:12-13:33	77,232	163.8	162.8	54.87	64.30	-9.43
Mean		78,102	127.0	127.9	43.6	52.5	-8.9
Standard Deviation							2.3
Confidence Coefficient							1.80

Applicable Standard (Permit Limit)	147.3 lb/hr
Average RM value (permit limit used if <50% of standard)	147.3 lb/hr
Relative Accuracy	7.3 %

PS-6 Relative Accuracy Performance Specification — **The RA of the CERMS must be no greater than 10 percent**

Test run omitted from RATA calculations

Figures



	Distance from Ports to Nearest Upstream Bend/Disturbance	Distance from Ports to Nearest Downstream Bend/Disturbance
EUPRESSLINE Biofilter Inlet	49.1 feet (7.0 diameters)	12.2 feet (1.7 diameters)

Traverse Point	Distance from Wall (in)
8	2.7
7	8.8
6	16.3
5	27.1
4	56.9
3	67.7
2	75.2
1	81.2

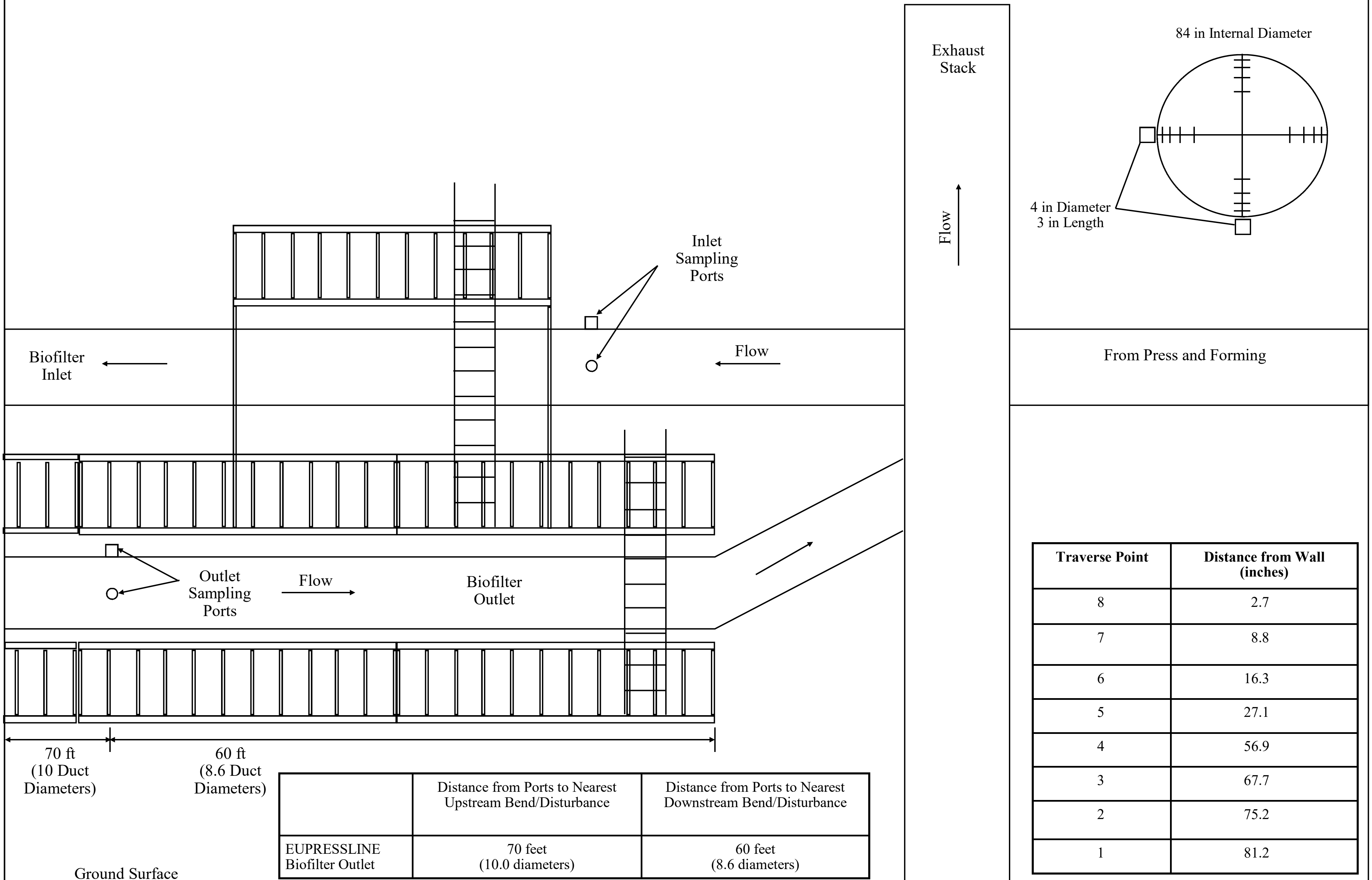
Figure 1
EUPRESSLINE Biofilter Inlet Sampling Ports and Traverse Point Locations

APEX

Weyerhaeuser
4111 West Four Mile Road
Grayling, Michigan

Project No. 11020-000068.00

Last Revision
January 15, 2021



	Distance from Ports to Nearest Upstream Bend/Disturbance	Distance from Ports to Nearest Downstream Bend/Disturbance
EUPRESSLINE Biofilter Outlet	70 feet (10.0 diameters)	60 feet (8.6 diameters)

Traverse Point	Distance from Wall (inches)
8	2.7
7	8.8
6	16.3
5	27.1
4	56.9
3	67.7
2	75.2
1	81.2

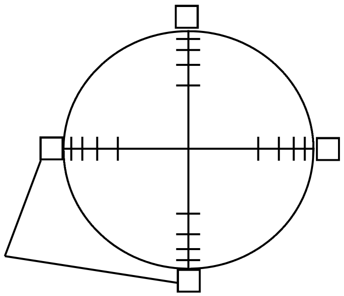
Figure 2
EUPRESSLINE Biofilter Outlet Sampling Ports and Traverse Point Locations

APEX

Weyerhaeuser
4111 West Four Mile Road
Grayling, Michigan

Project No. 11020-000068.00

Last Revision
January 15, 2021



Traverse Point	Distance from Wall (in)
8	3.4
7	11.0
6	20.4
5	33.9
4	71.1
3	84.6
2	94.0
1	101.6

	Distance from Ports to Nearest Upstream Bend/Disturbance	Distance from Ports to Nearest Downstream Bend/Disturbance
FGDRYERS-RTO OUTLET	30 feet (3.4 diameters)	40 feet (4.6 diameters)

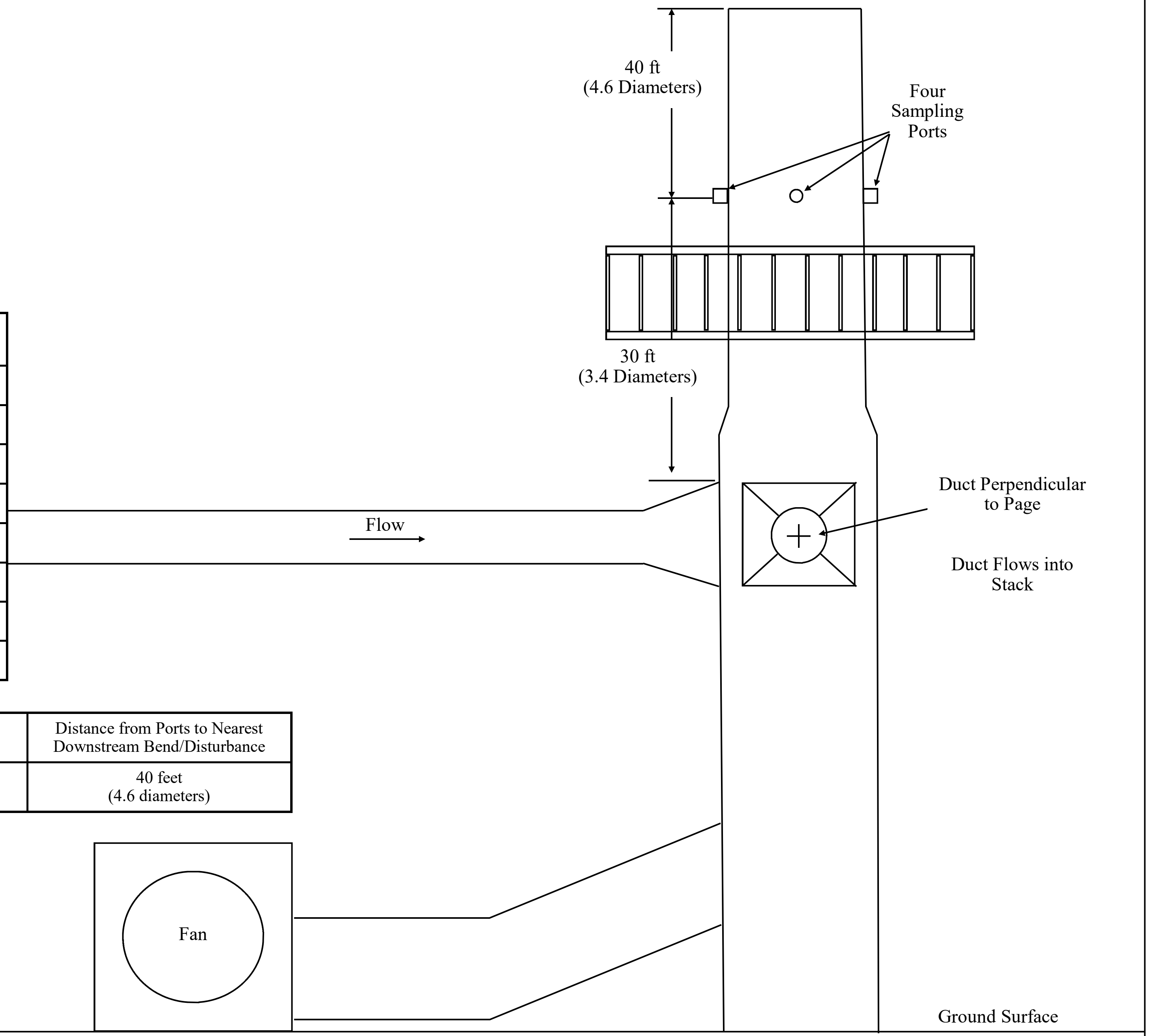


Figure 3
FGDRYERS RTO Outlet Sampling Ports and Traverse Point Locations

APEX

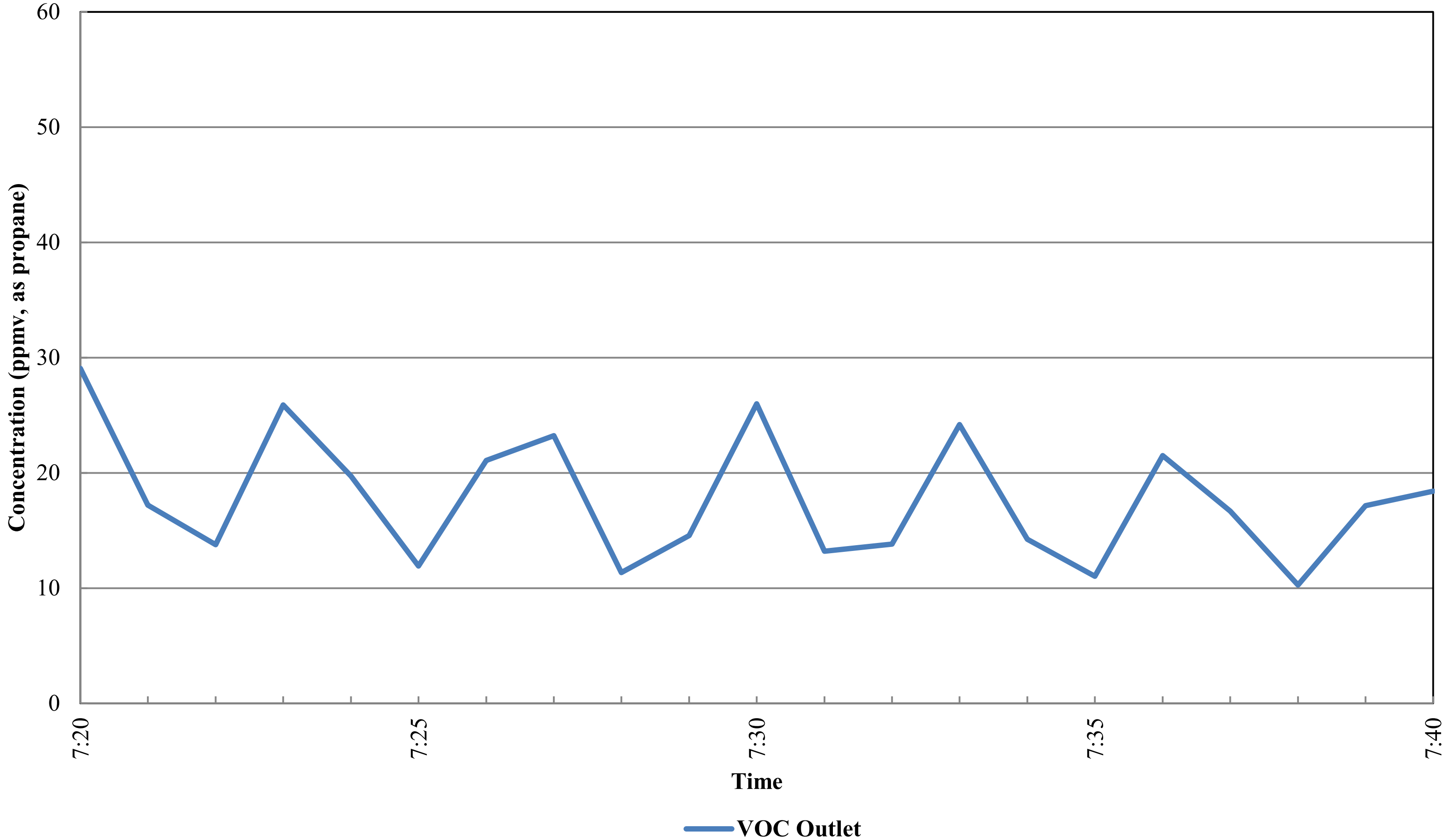
Weyerhaeuser
4111 West Four Mile Road
Grayling, Michigan

Project No. 11020-000068.00

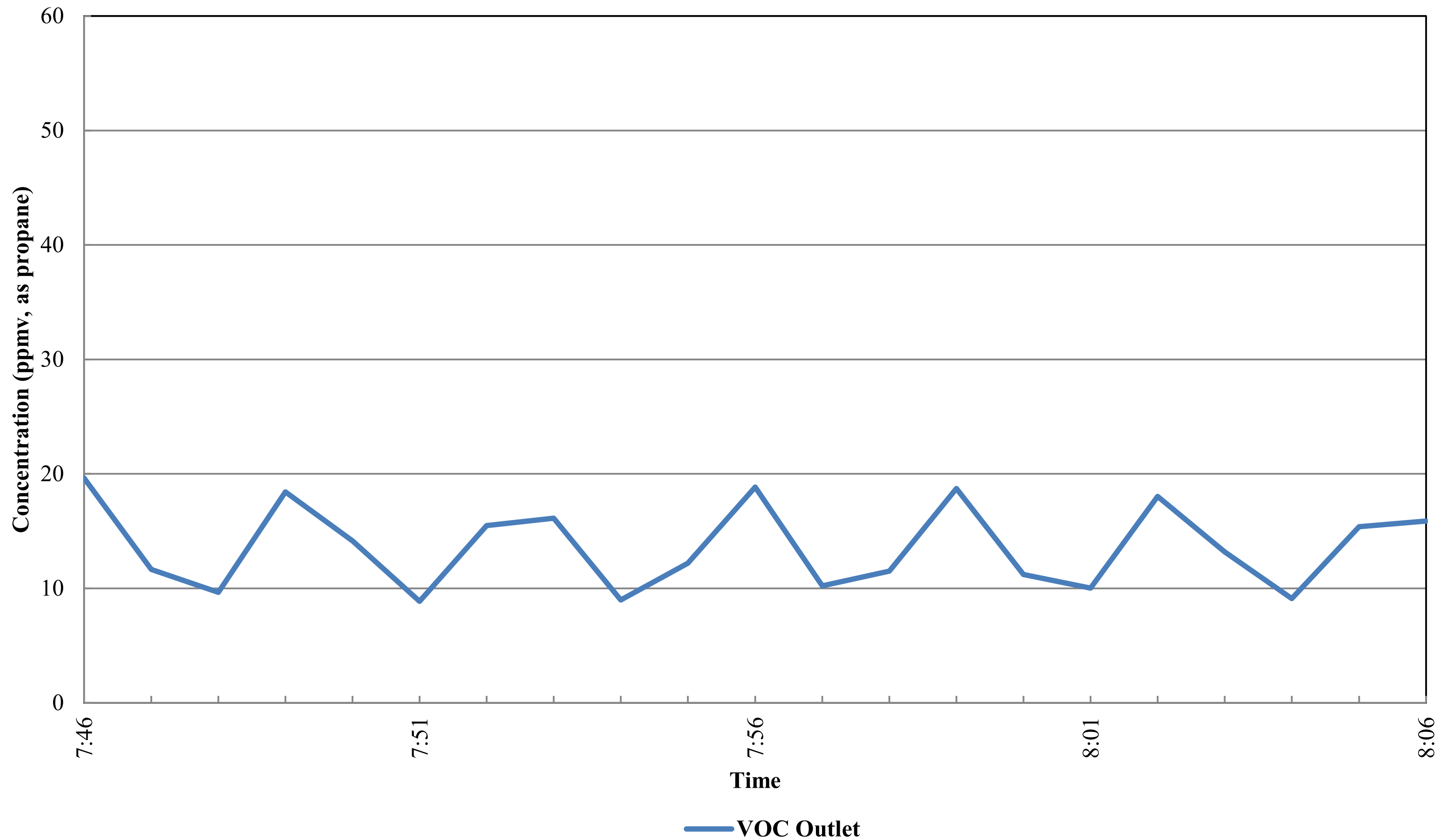
Last Revision
January 15, 2021

Graphs

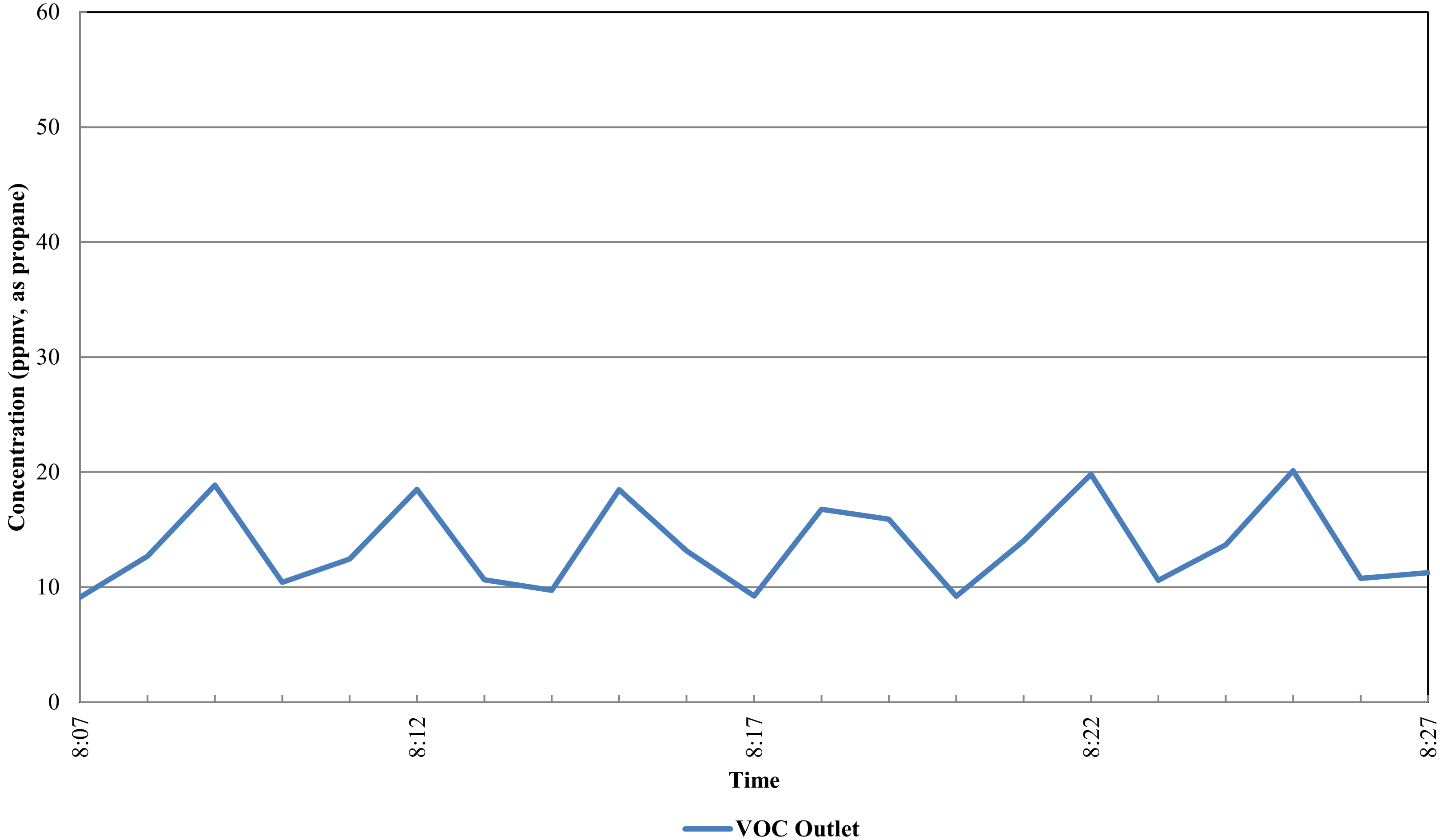
EUPRESSLINE Biofilter VOC Concentrations — Run 1
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020



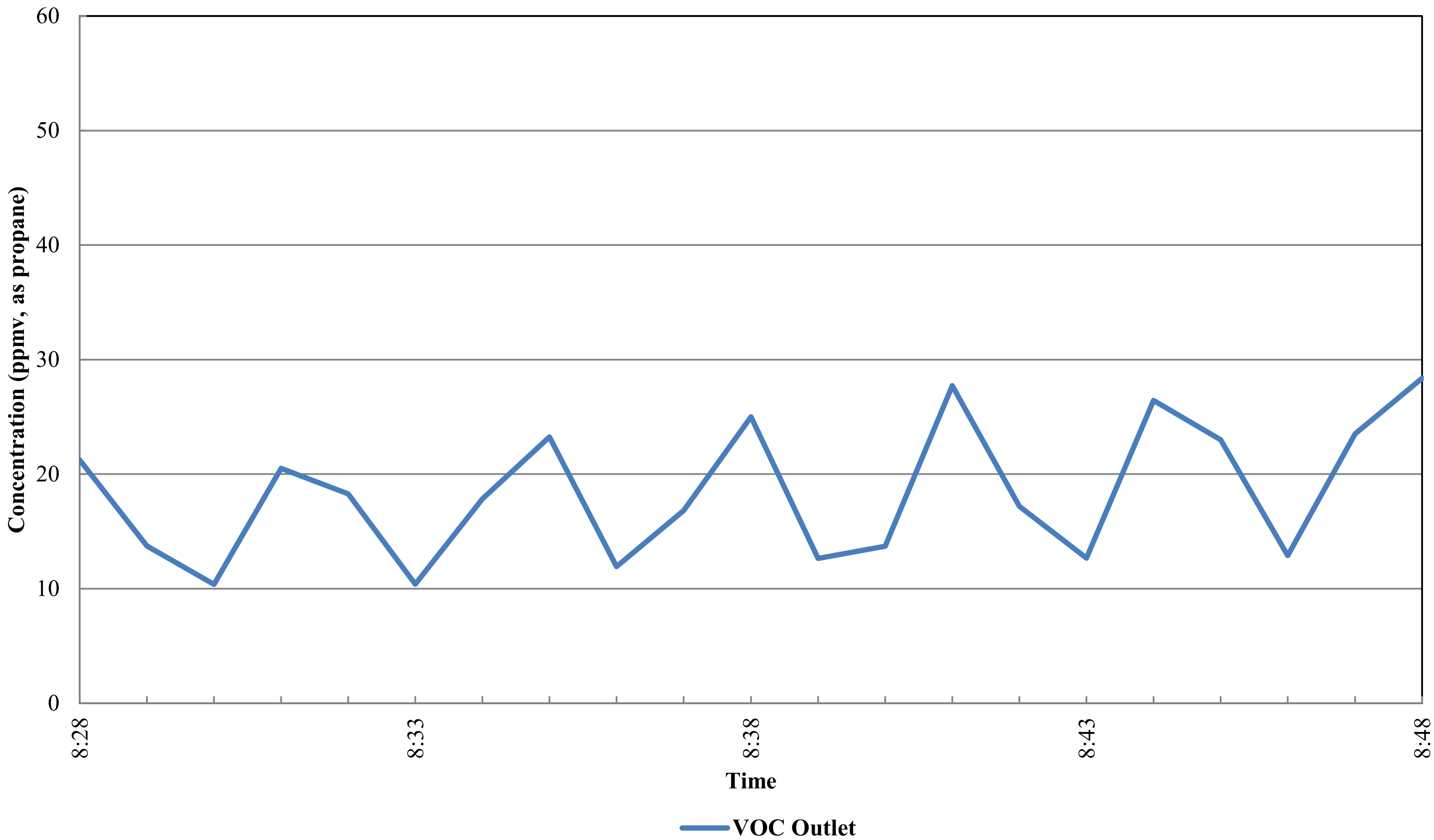
EUPRESSLINE Biofilter VOC Concentrations — Run 2
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020



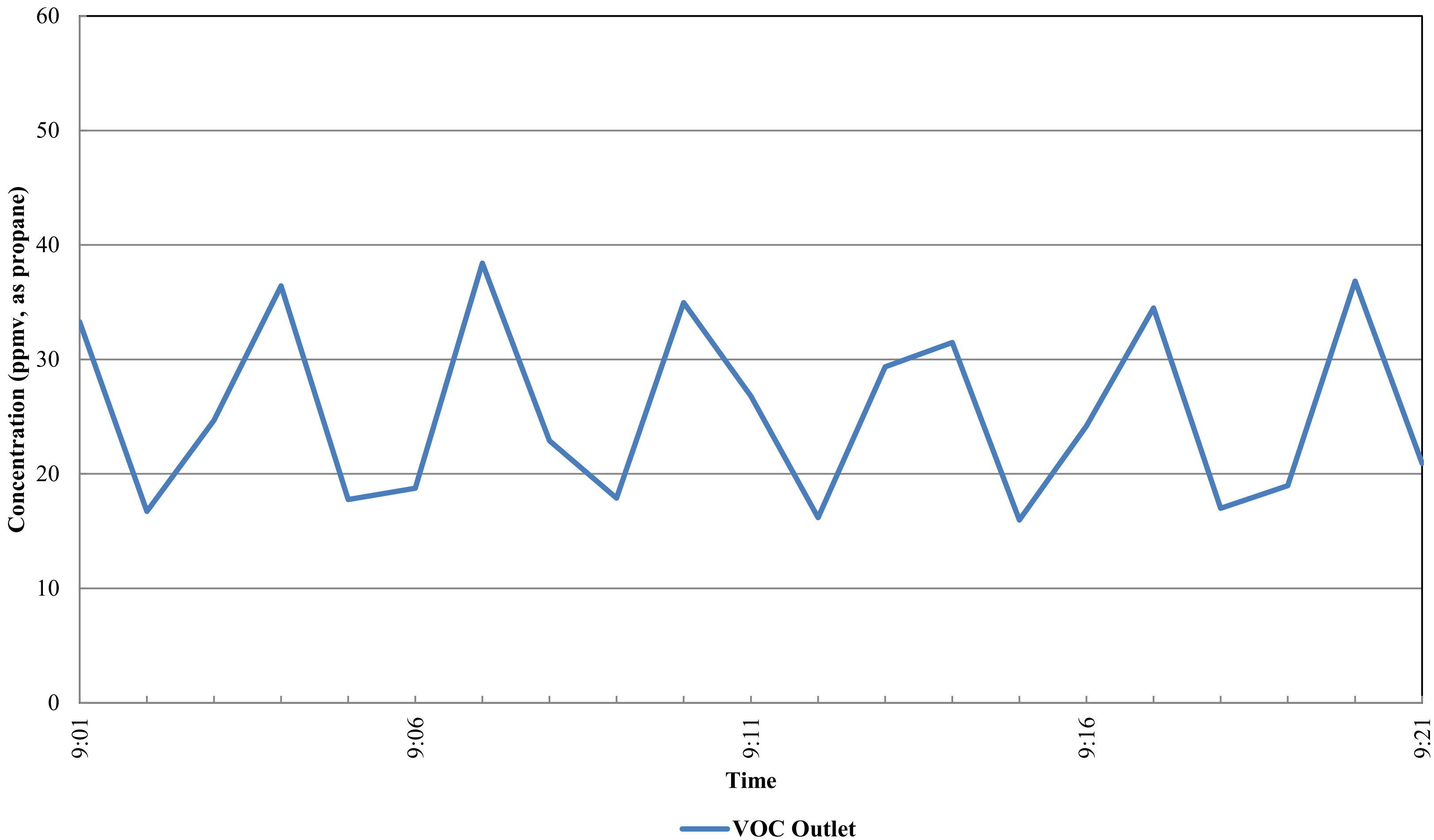
EUPRESSLINE Biofilter VOC Concentrations — Run 3
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020

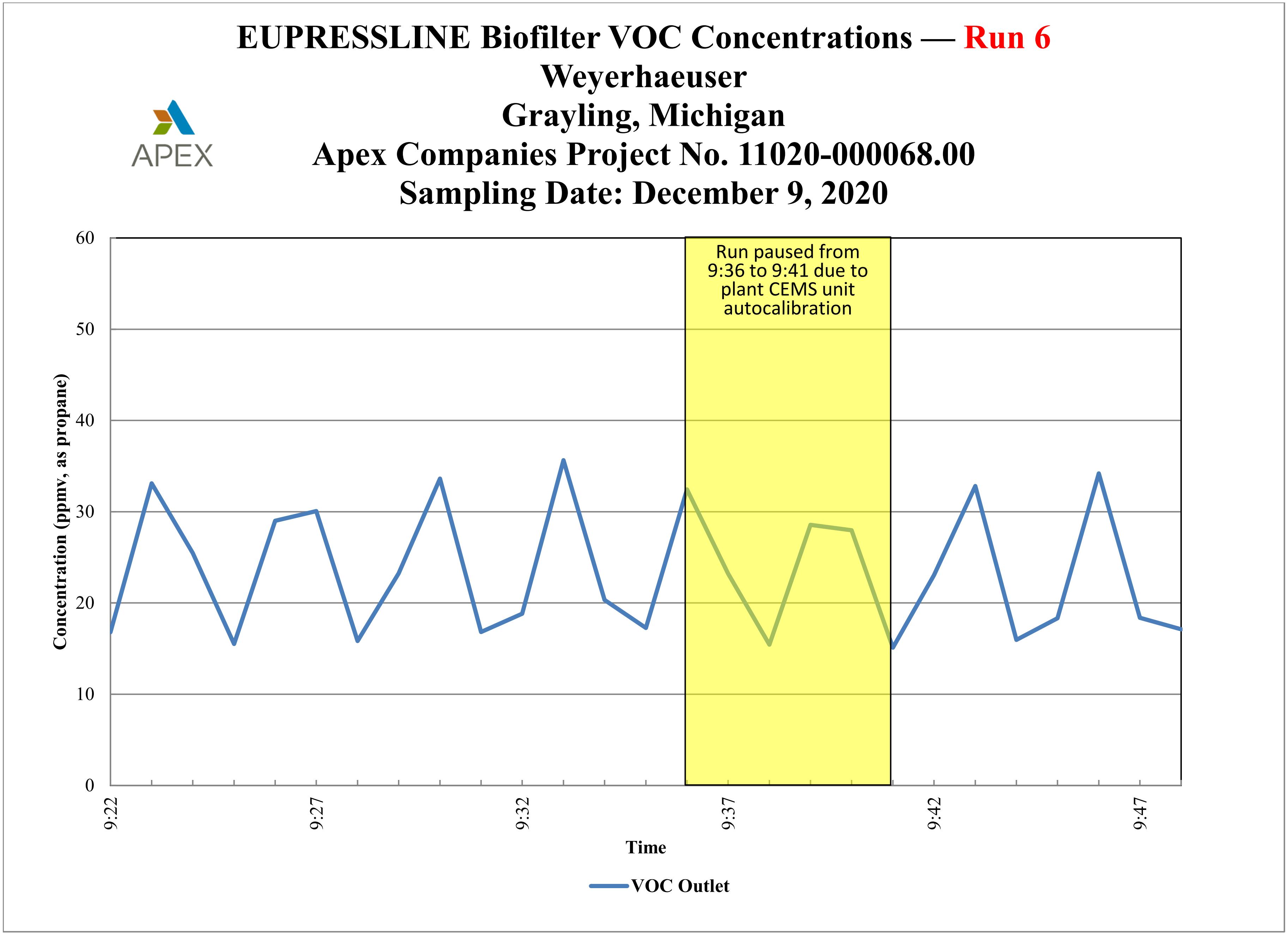


EUPRESSLINE Biofilter VOC Concentrations — Run 4
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020



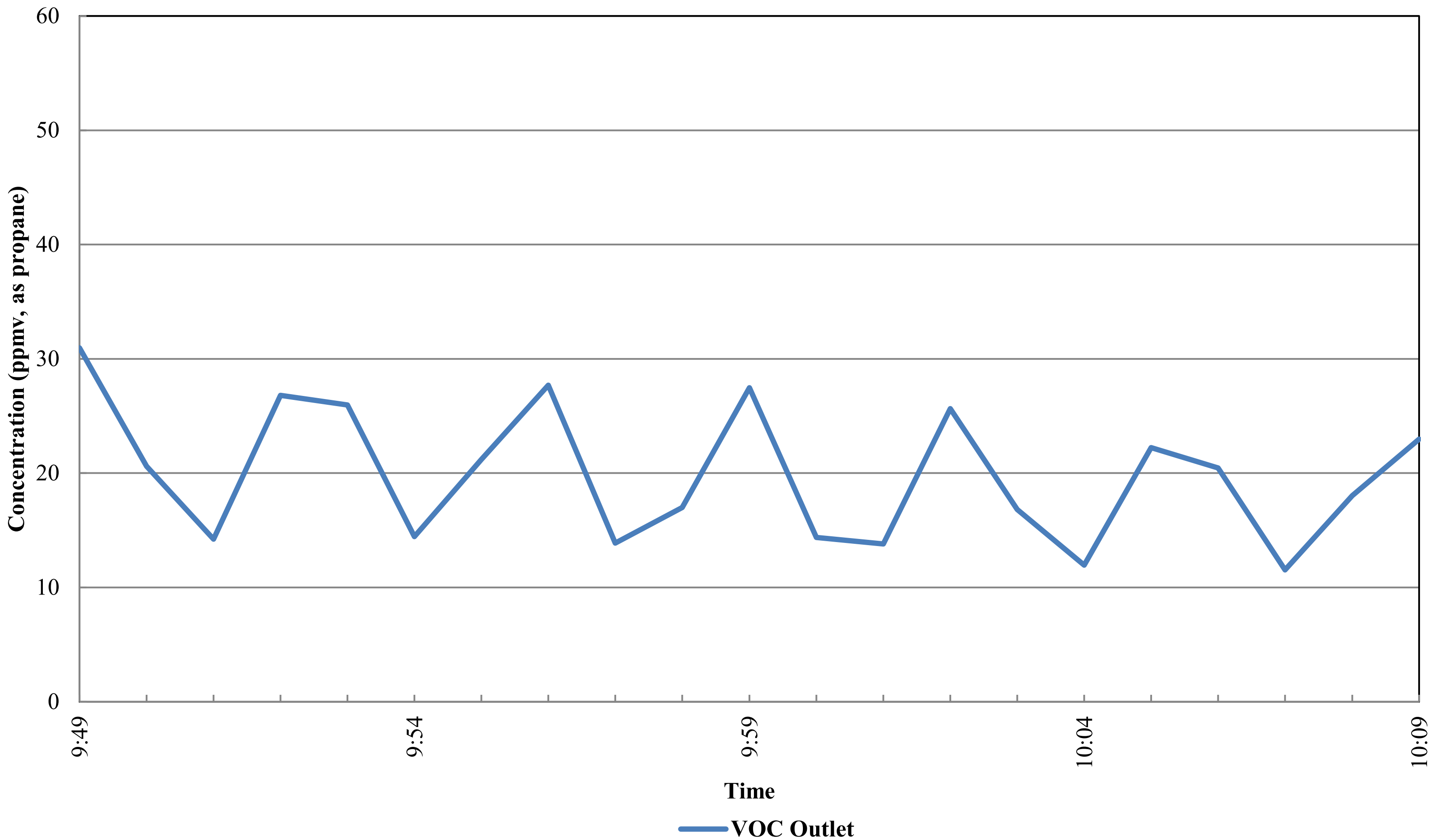
EUPRESSLINE Biofilter VOC Concentrations — Run 5
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020



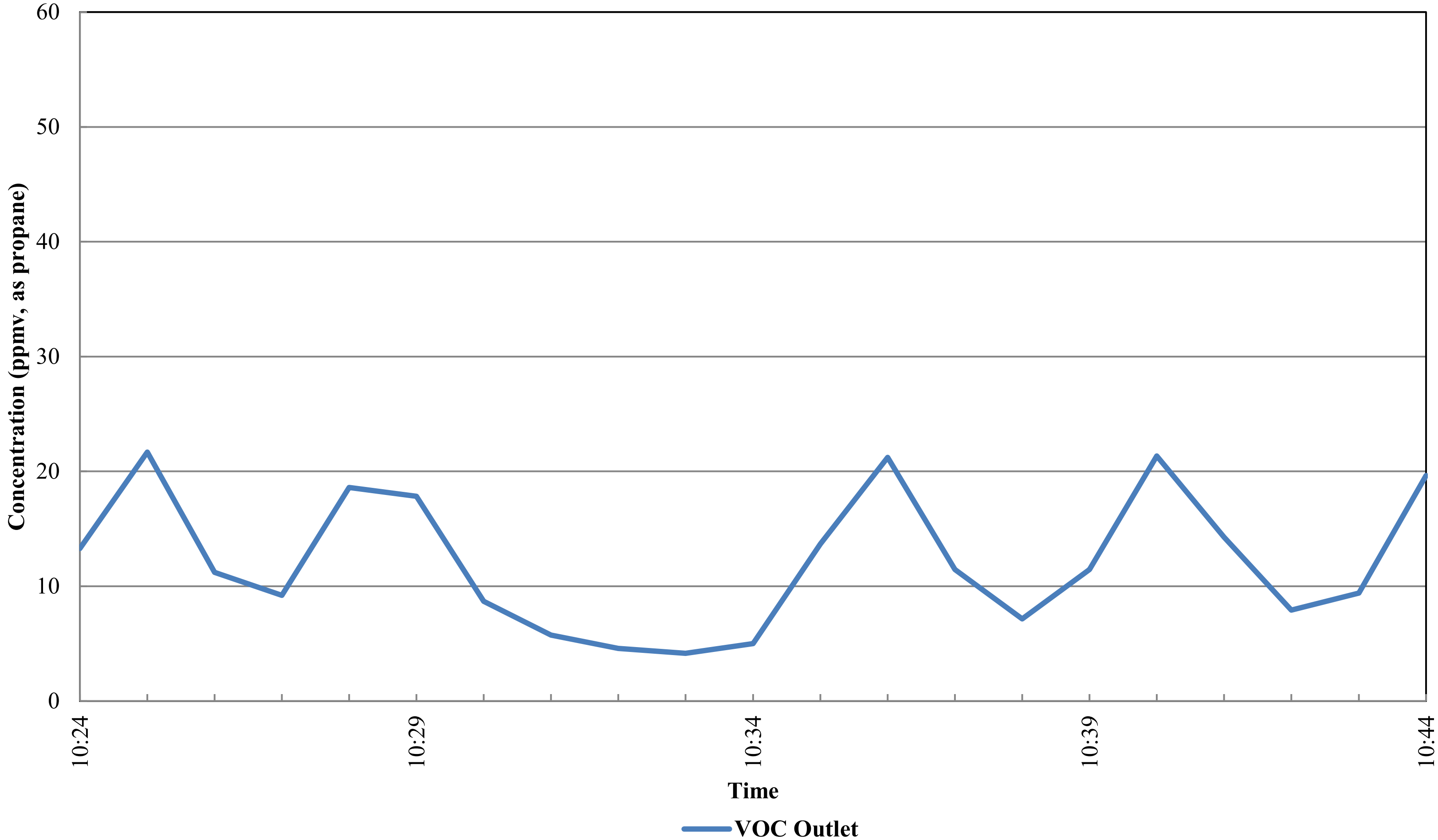


EUPRESSLINE Biofilter VOC Concentrations — Run 6
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020
APEX
Run paused from 9:36 to 9:41 due to plant CEMS unit autocalibration
Concentration (ppmv, as propane)
0
10
20
30
40
50
60
9:22
9:27
9:32
9:37
9:42
9:47
Time
VOC Outlet

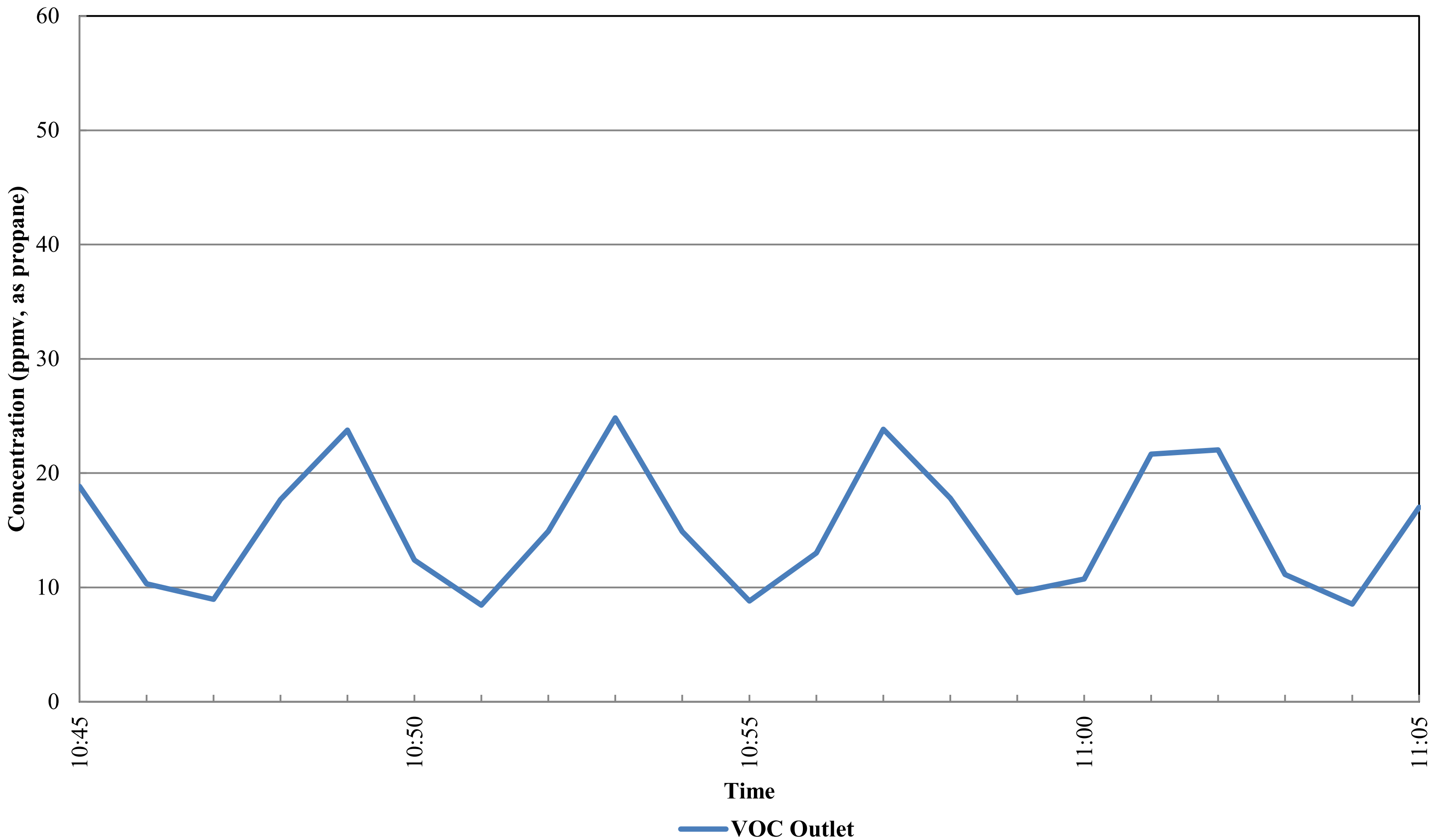
EUPRESSLINE Biofilter VOC Concentrations — Run 7
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020



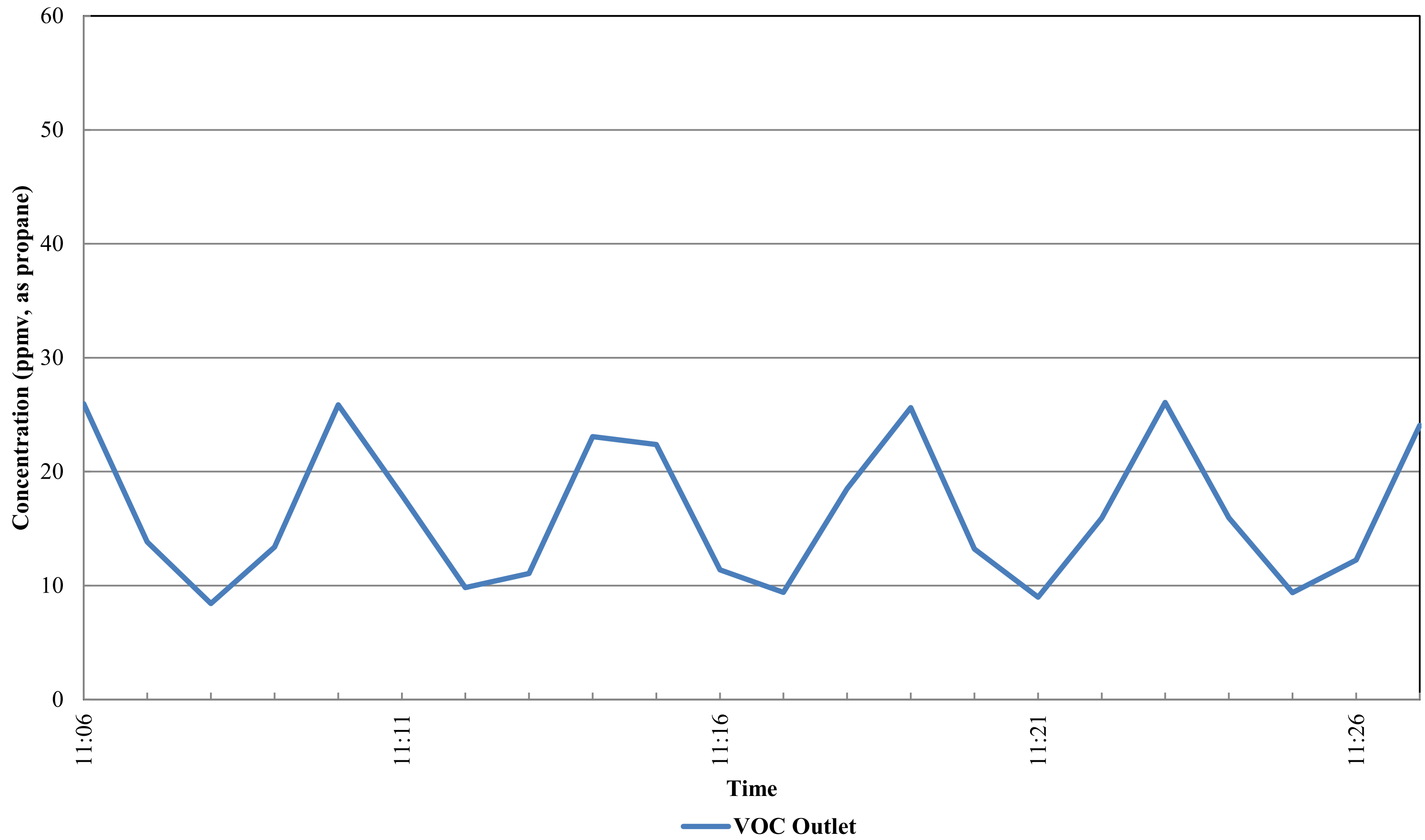
EUPRESSLINE Biofilter VOC Concentrations — Run 8
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020



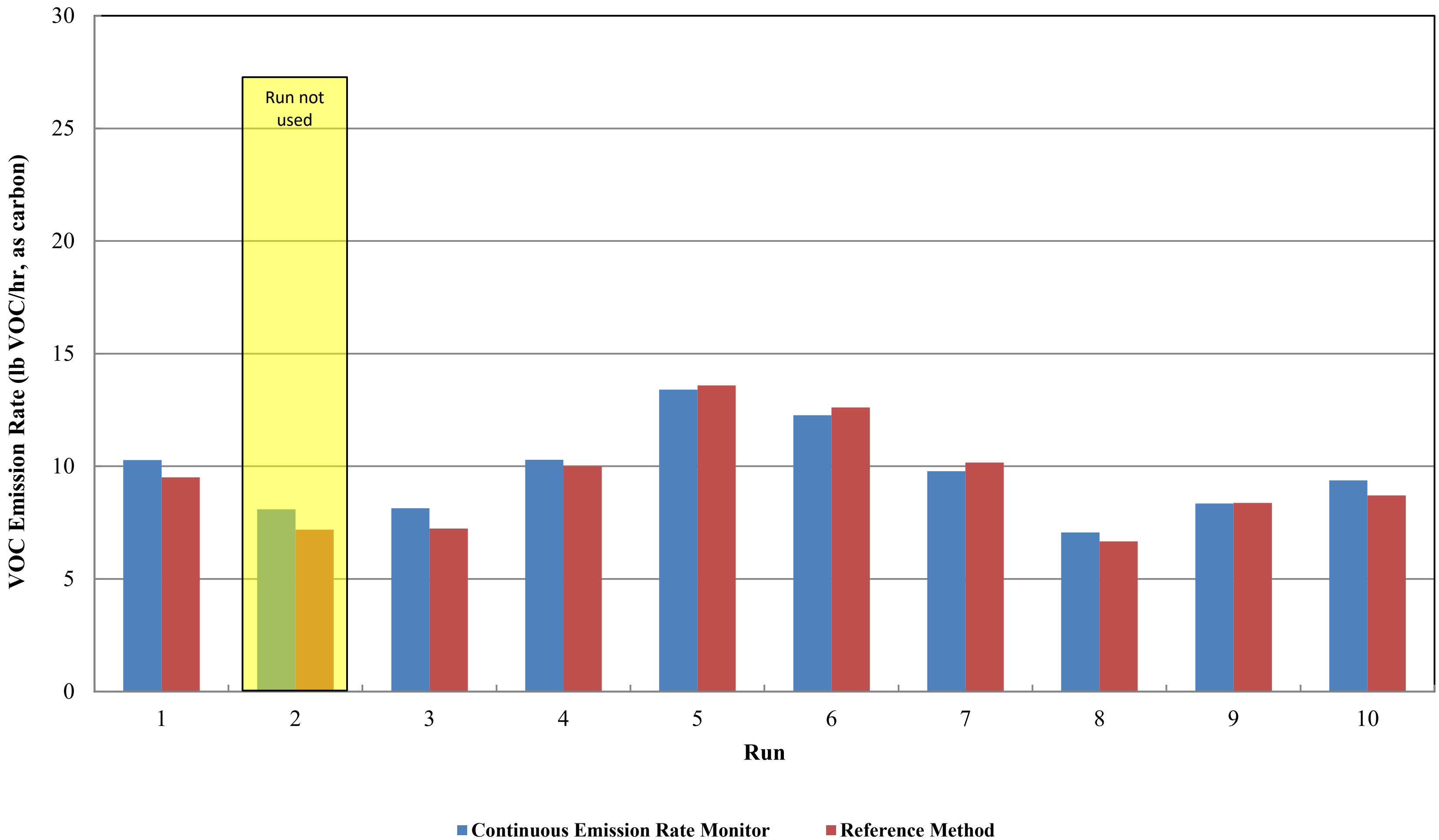
EUPRESSLINE Biofilter VOC Concentrations — Run 9
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020



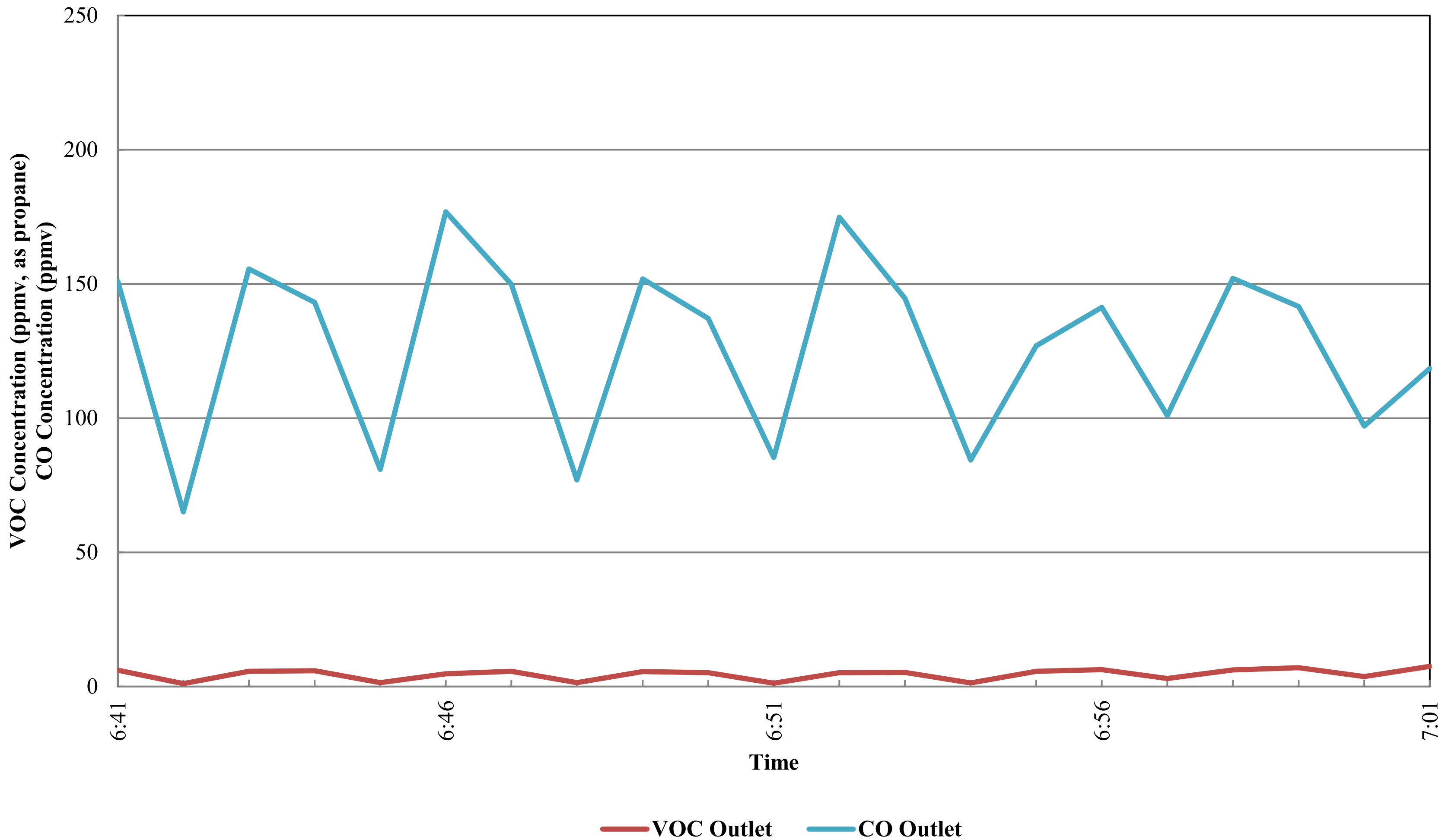
EUPRESSLINE Biofilter VOC Concentrations — Run 10
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 9, 2020



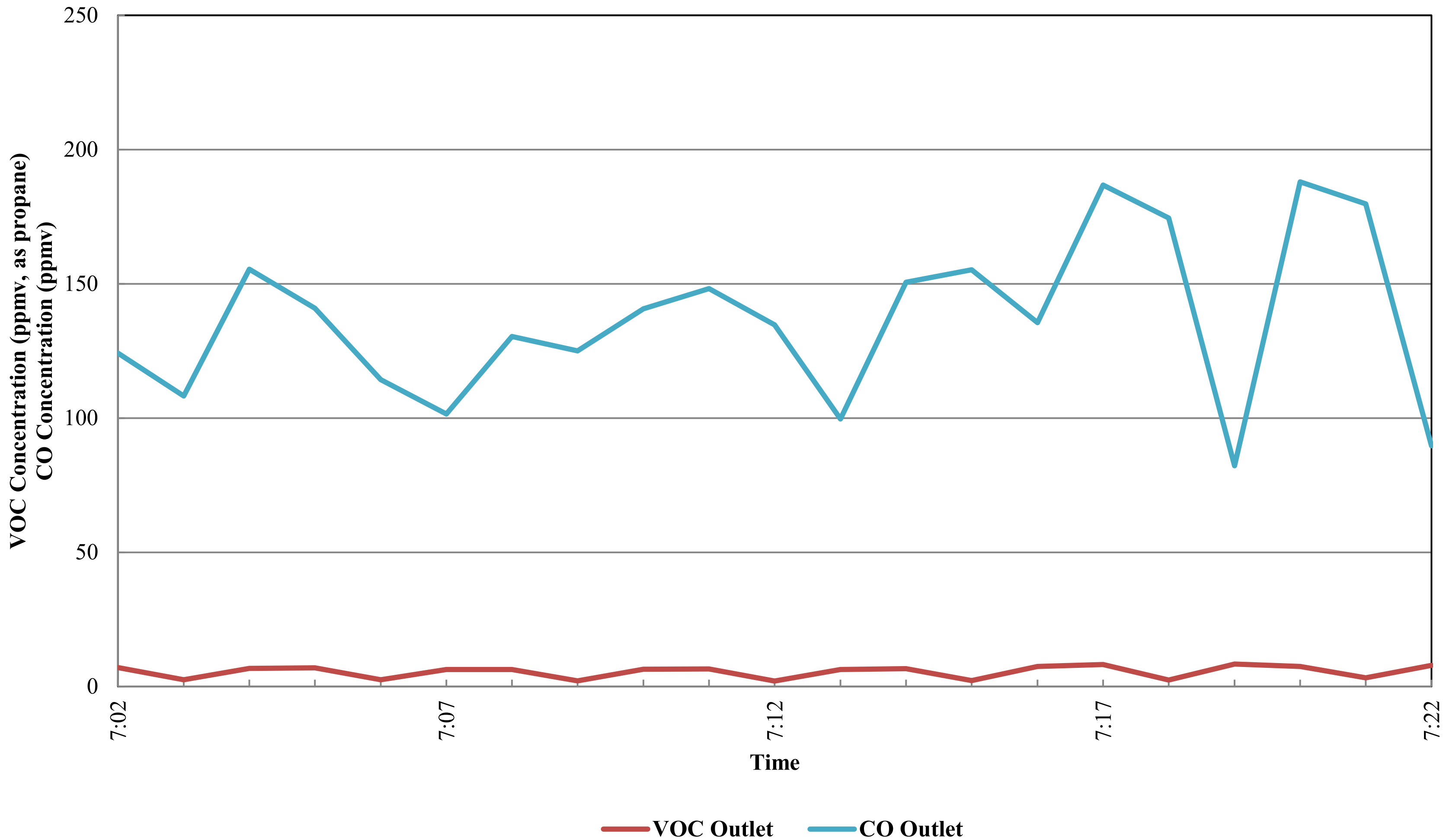
EUPRESSLINE Biofilter VOC RM to CERMS Comparison
Weyerhaeuser
Grayling, Michigan
Project No. 11020-000068.00
Sampling Date: December 9, 2020

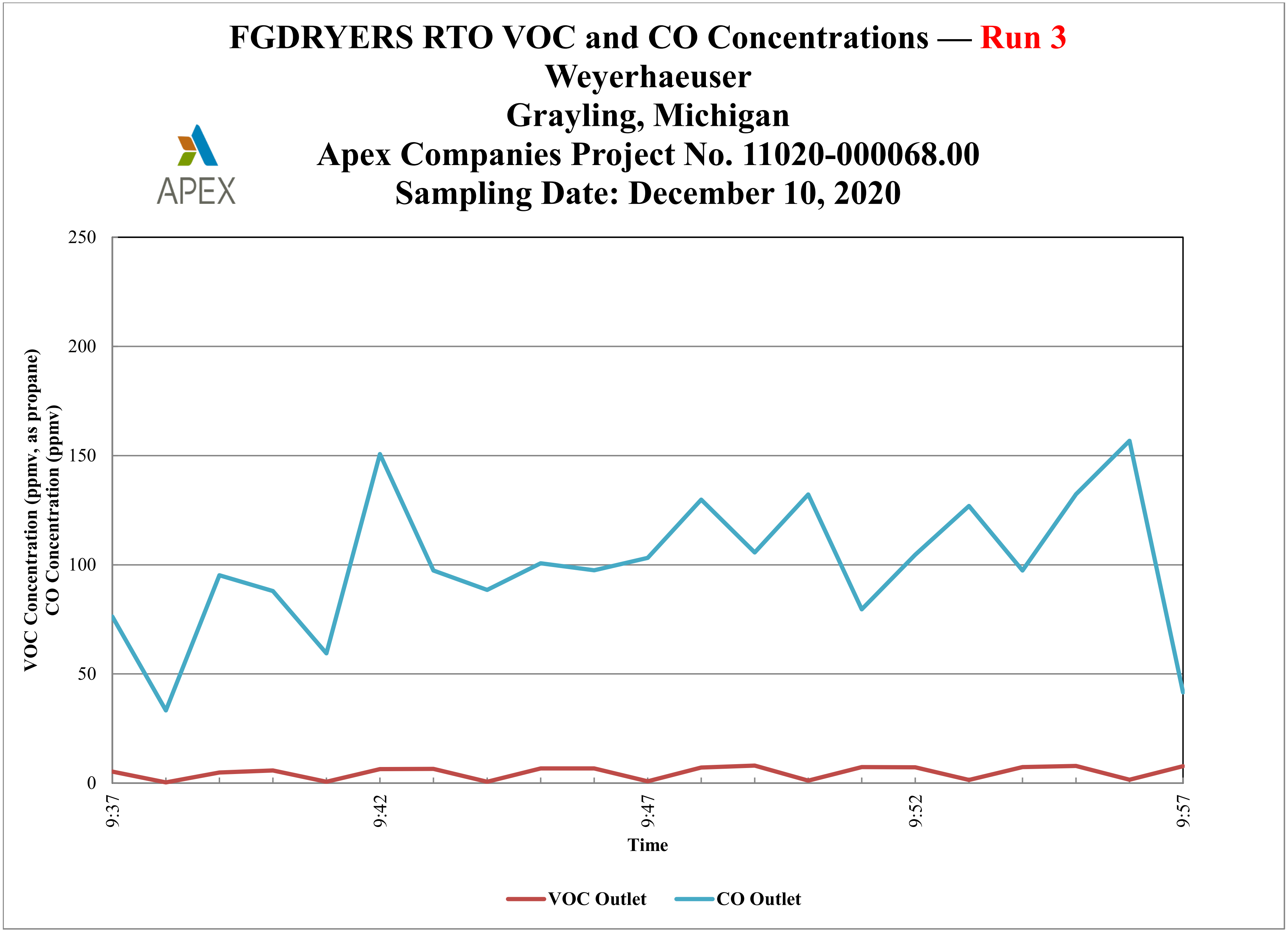


FGDRYERS RTO VOC and CO Concentrations — Run 1
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020



FGDRYERS RTO VOC and CO Concentrations — Run 2
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020

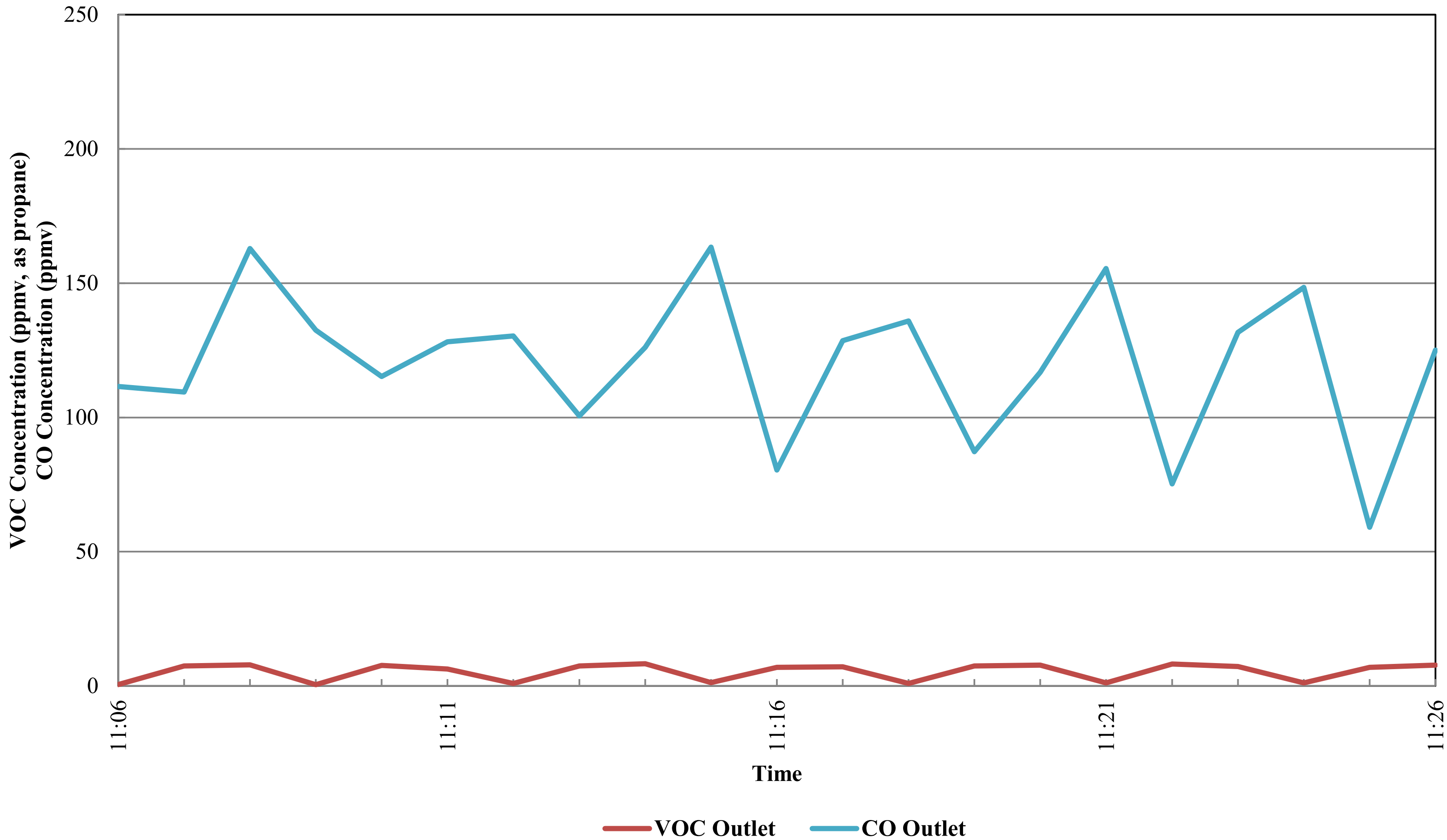




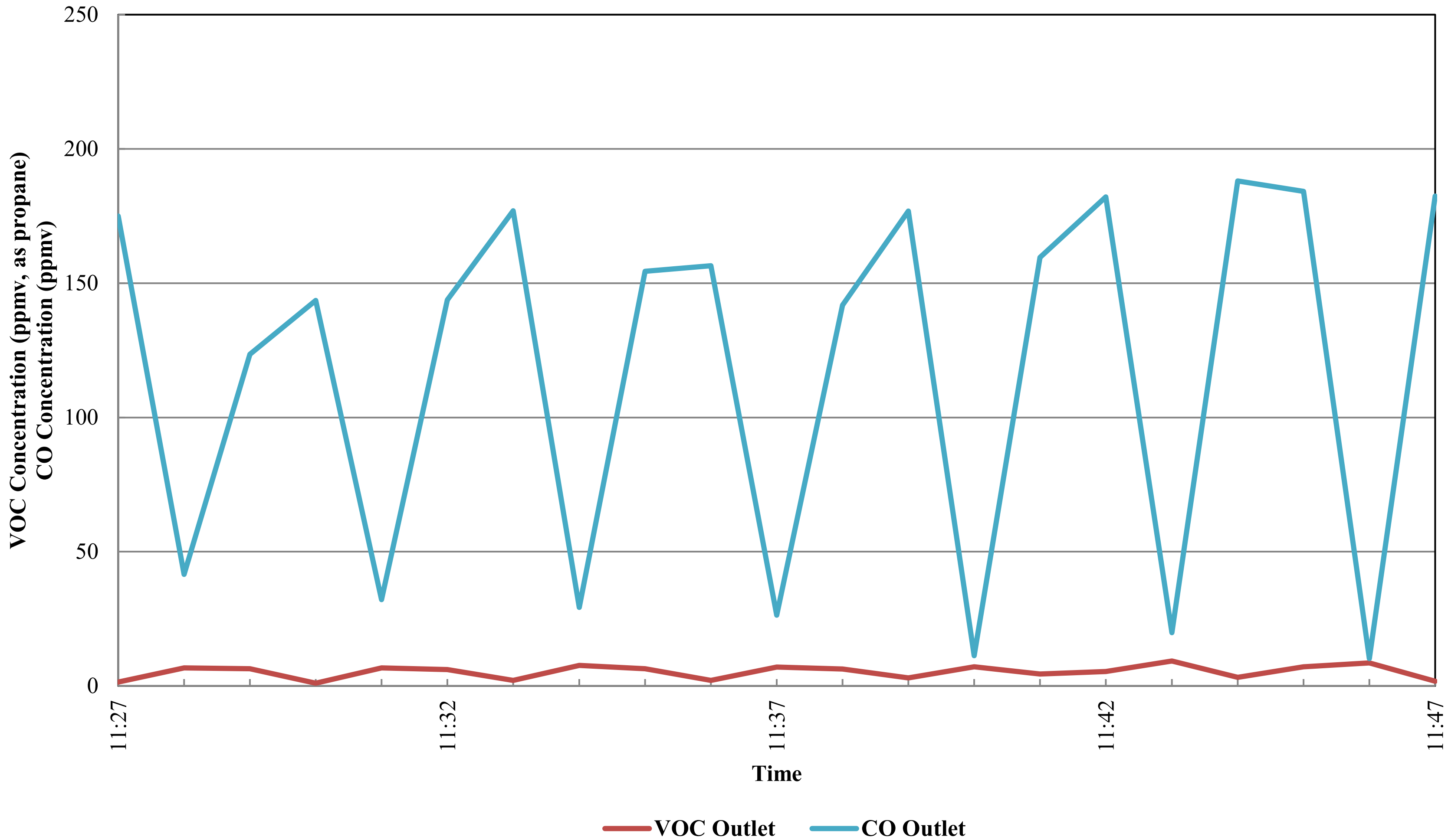
FGDRYERS RTO VOC and CO Concentrations — Run 3
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020
APEX
VOC Concentration (ppmv, as propane)
CO Concentration (ppmv)
250
200
150
100
50
0
9:37
9:42
9:47
9:52
9:57
Time
VOC Outlet
CO Outlet

FGDRYERS RTO VOC and CO Concentrations — Run 4
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020

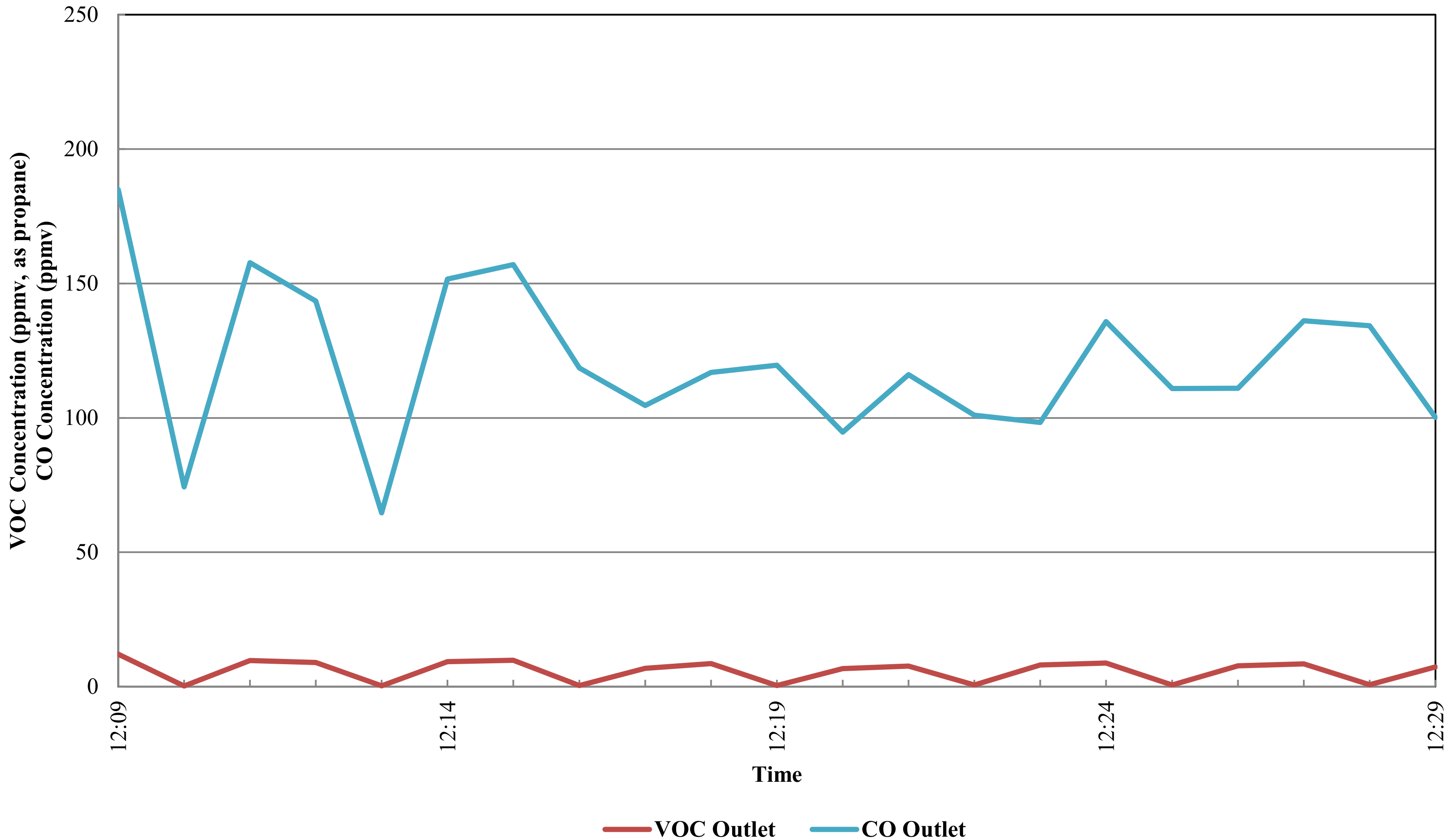
FGDRYERS RTO VOC and CO Concentrations — Run 5
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020

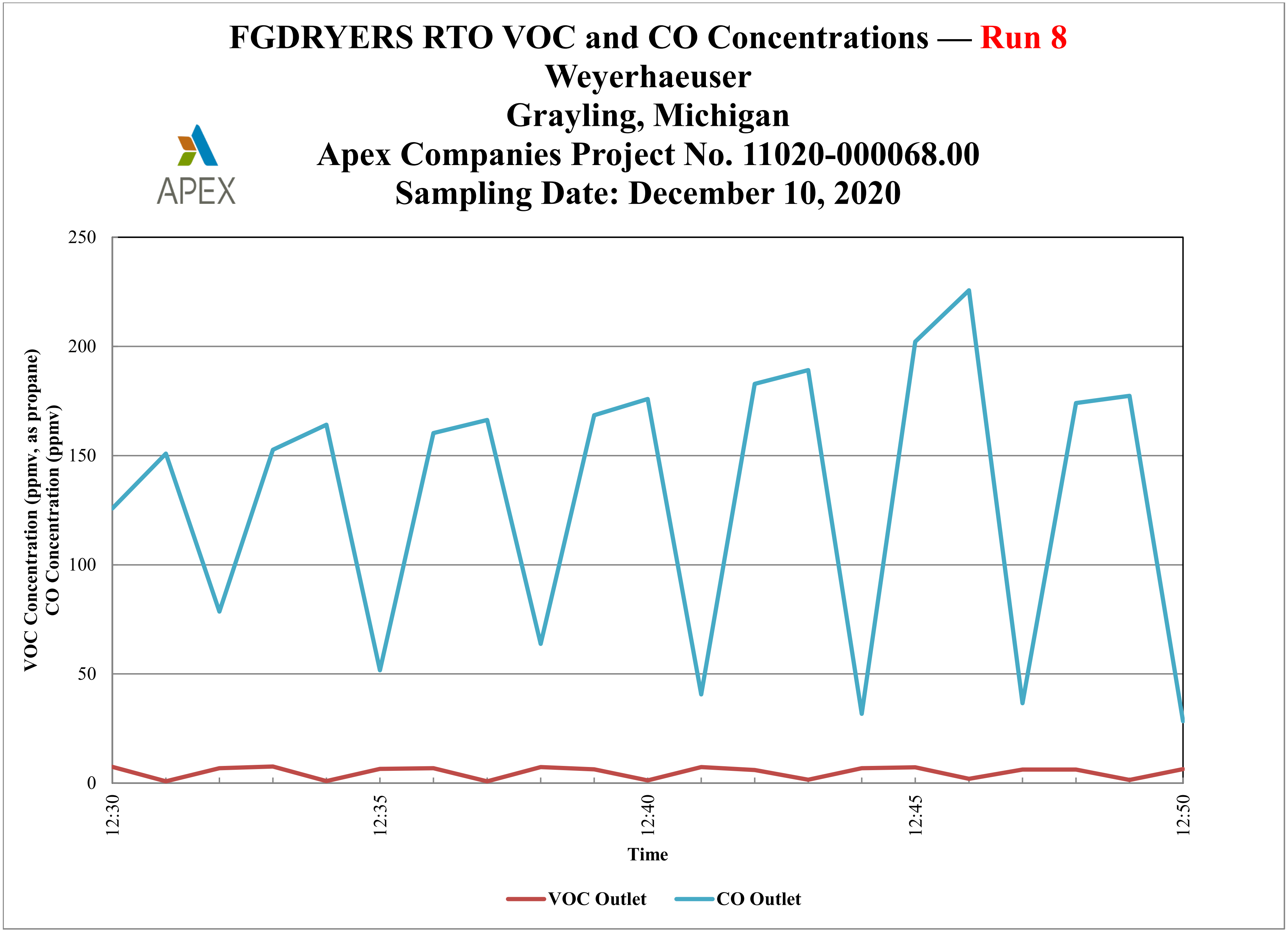


FGDRYERS RTO VOC and CO Concentrations — Run 6
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020



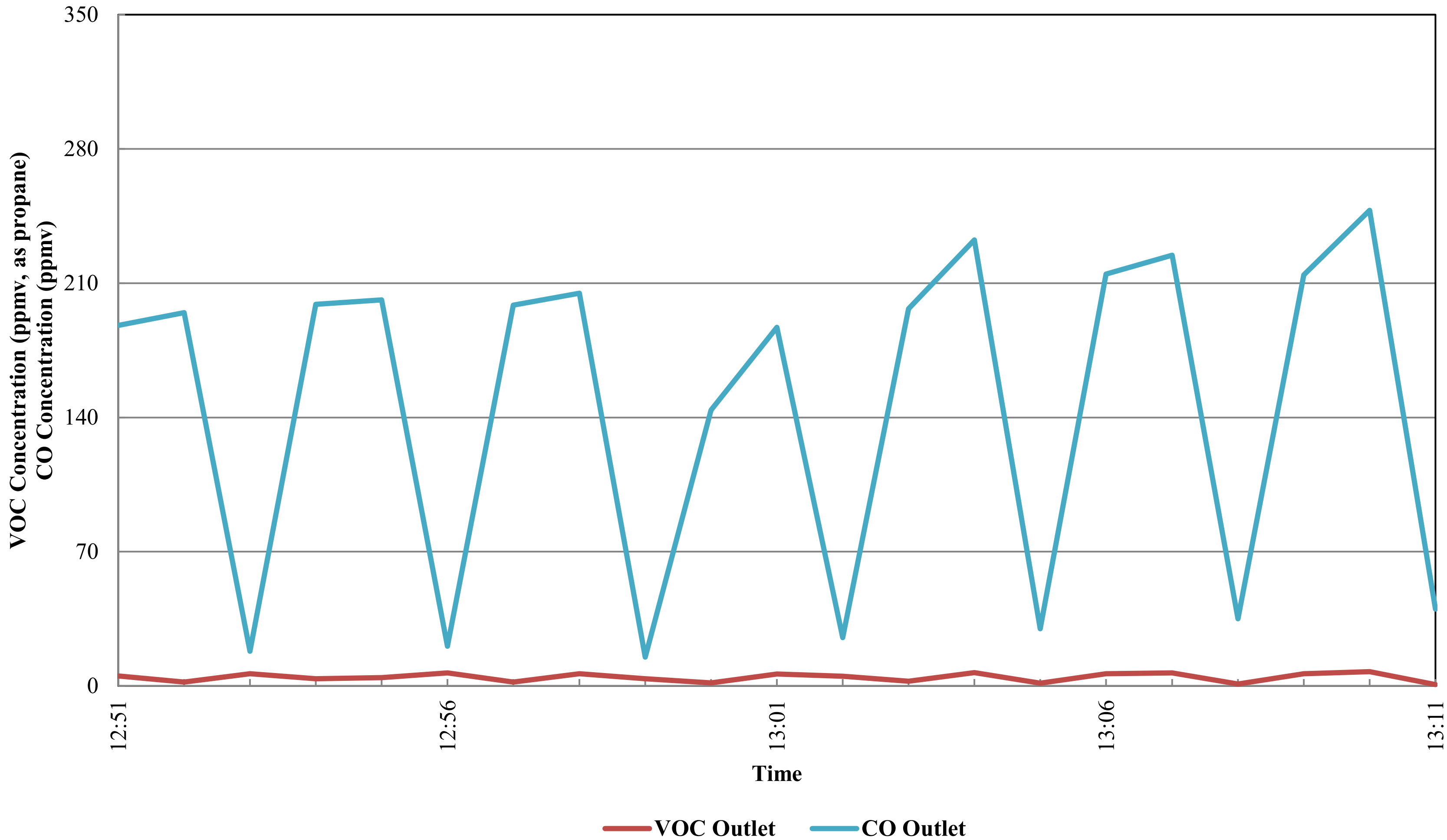
FGDRYERS RTO VOC and CO Concentrations — Run 7
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020



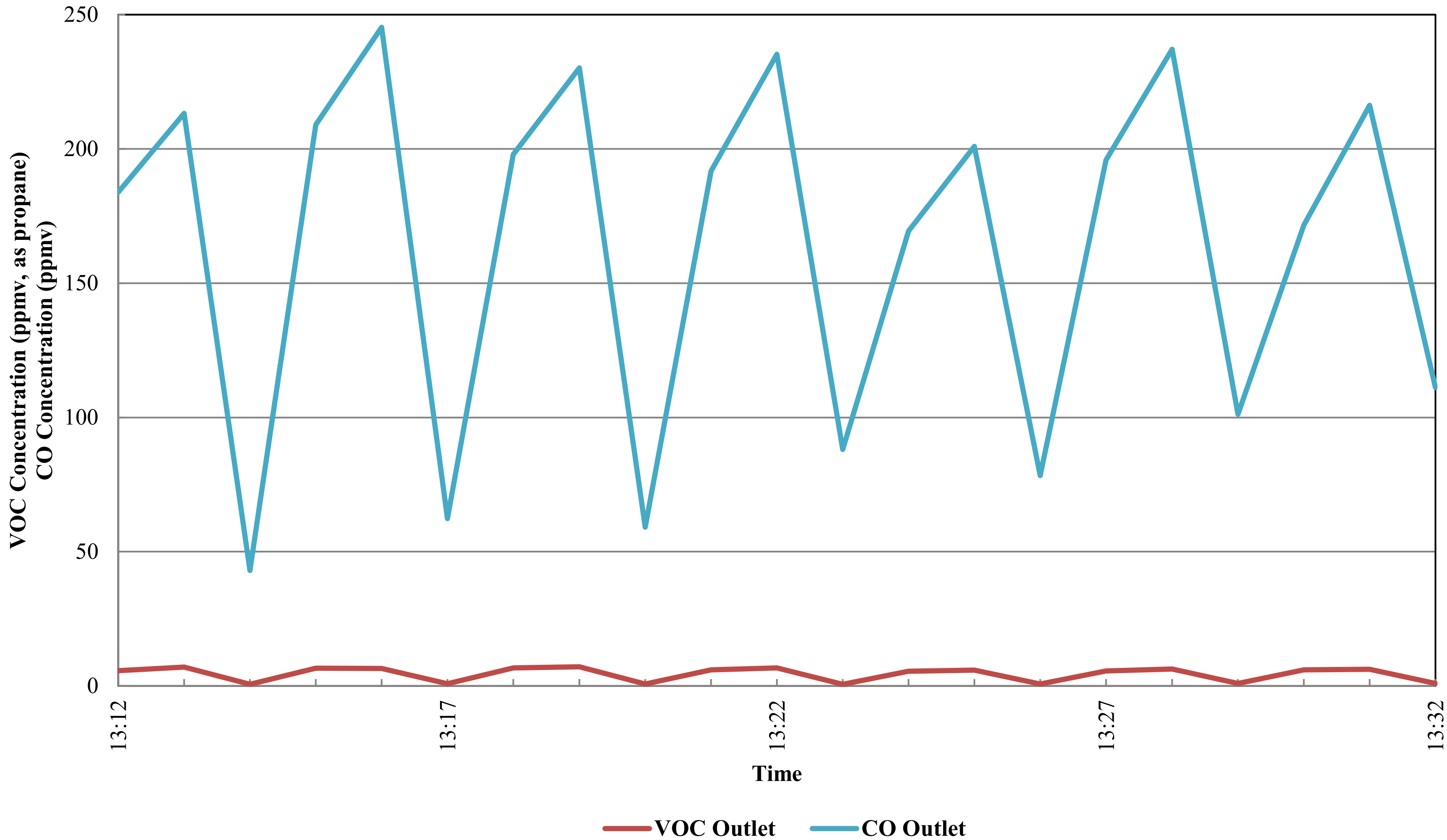


FGDRYERS RTO VOC and CO Concentrations — Run 8
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020
APEX
VOC Concentration (ppmv, as propane)
CO Concentration (ppmv)
250
200
150
100
50
0
12:30
12:35
12:40
12:45
12:50
Time
VOC Outlet
CO Outlet

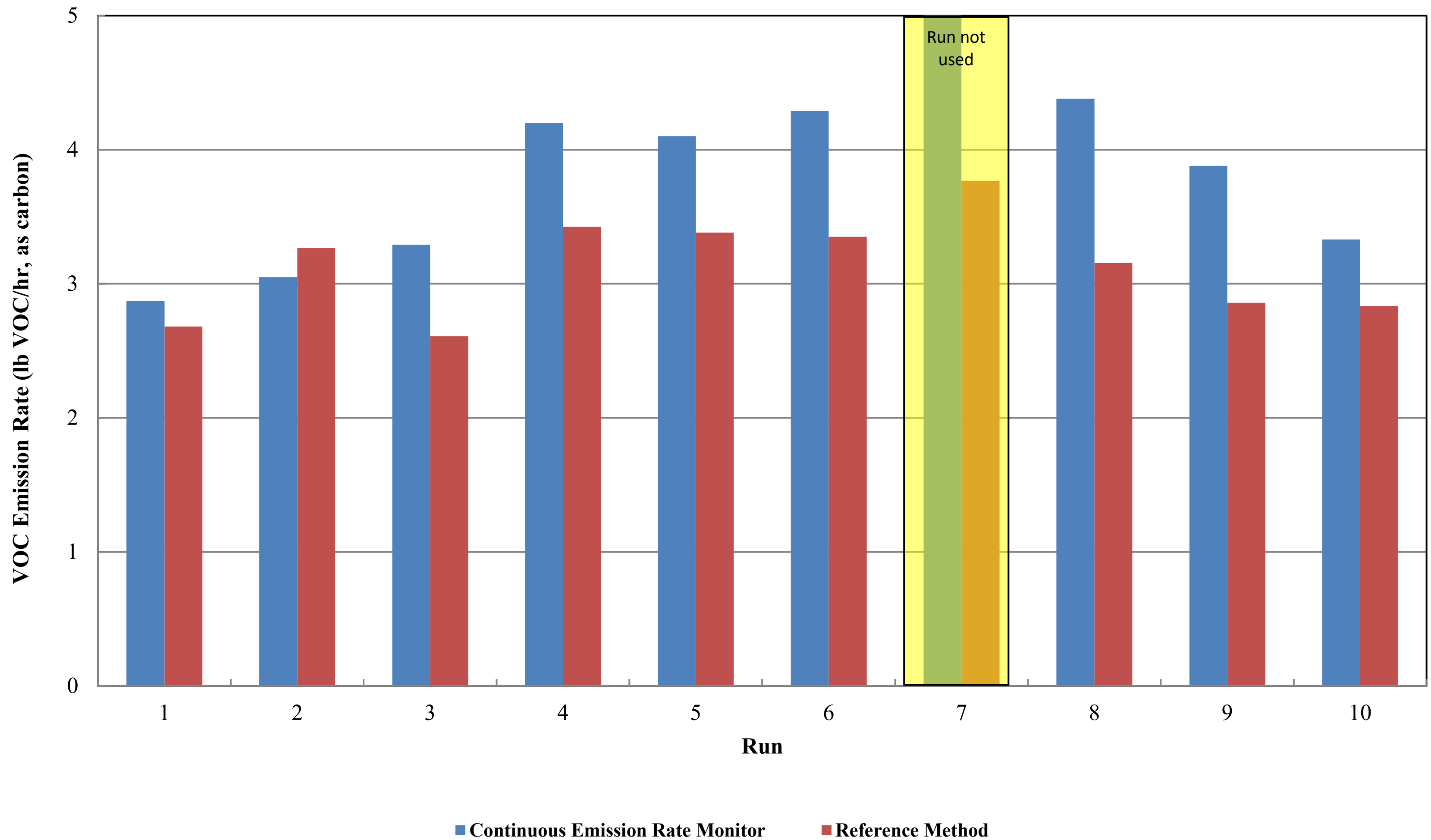
FGDRYERS RTO VOC and CO Concentrations — Run 9
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020



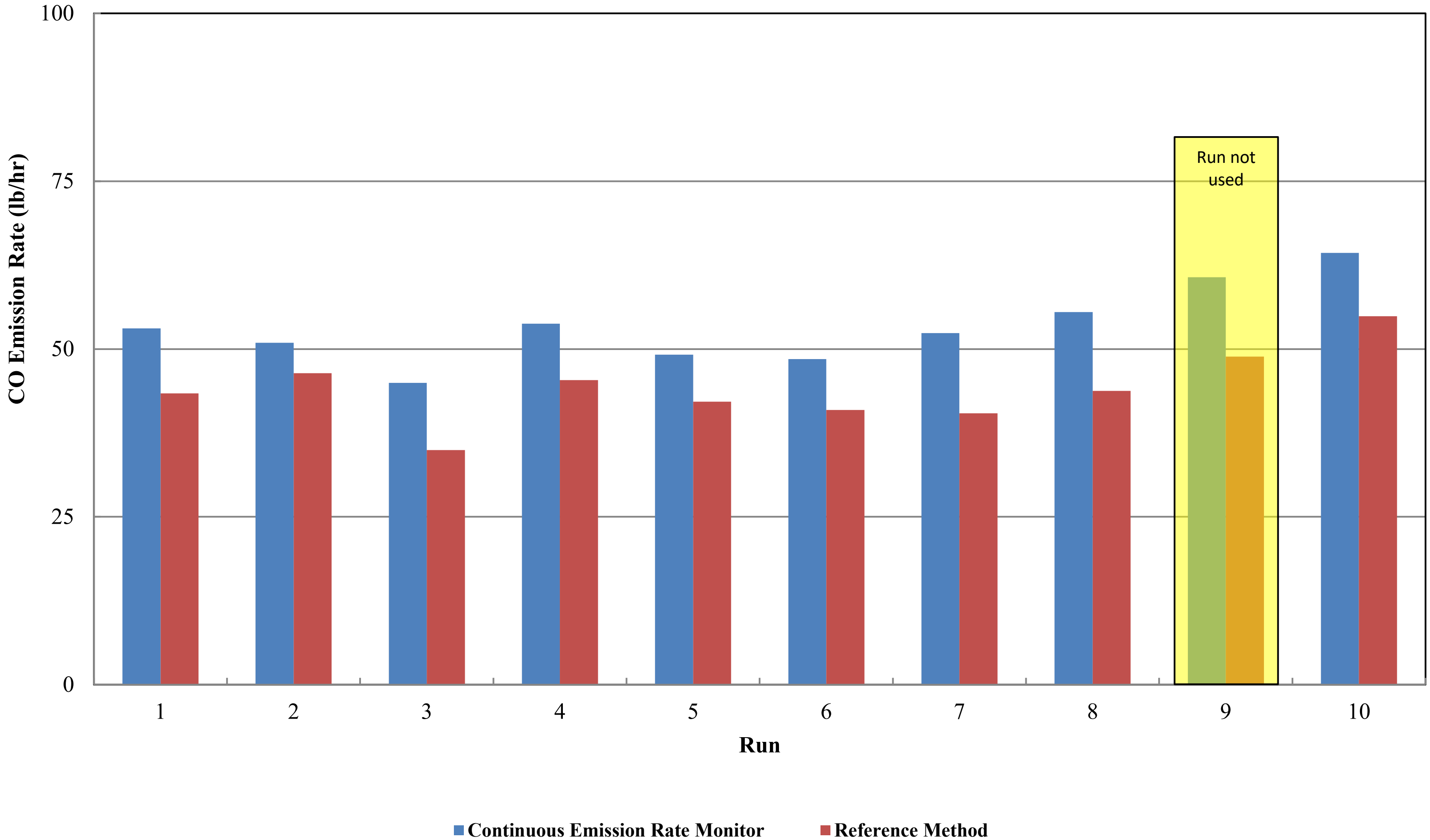
FGDRYERS RTO VOC and CO Concentrations — Run 10
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020



FGDRYERS RTO VOC RM to CERMS Comparison
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11018-000068.00
Sampling Date: December 10, 2020



FGDRYERS RTO CO RM to CERMS Comparison
Weyerhaeuser
Grayling, Michigan
Apex Companies Project No. 11020-000068.00
Sampling Date: December 10, 2020



Appendix A
Calibration and Inspection Sheets

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

ENVIRONMENTAL SUPPLY COMPANY

Quality - Service - Reliability

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record data and information in the **GREEN** cells, YELLOW cells are calculated.

DATE:	10/19/2020	**METER SERIAL #:**	2	**BAROMETRIC PRESSURE (in Hg):**	**INITIAL** 30.1	**FINAL** 30.1	**AVG (P_{bar})** 30.1
METER PART #:		**CRITICAL ORIFICE SET SERIAL #:**	JR				

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS FINAL	NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y % Diff to Average Y	Y % Diff with other orifices	$\Delta H_@$
55	1	0.453	13	812.150	817.545	5.395	45	67	69	61	62	64.75	9.00	1.1	5.4768	5.4625	0.997			1.71
	2	0.453	13	817.545	823.000	5.455	45	69	69	62	64	66	9.00	1.1	5.5245	5.4625	0.989			1.70
	3	0.453	13	823.000	828.51400	5.514	45	69	71	64	65	67.25	9.00	1.1	5.5710	5.4625	0.981			1.70
																AVG =	0.989	-0.69	-0.61	
63	1	0.5788	10	778.521	784.154	5.633	45	55	57	58	58	57	7.50	1.8	5.8141	5.8163	1.000			1.74
	2	0.5788	10	784.154	789.775	5.621	45	57	60	58	58	58.25	7.50	1.8	5.7877	5.8163	1.005			1.73
	3	0.5788	10	789.775	795.411	5.636	45	60	62	58	59	59.75	7.50	1.8	5.7864	5.8163	1.005			1.73
																AVG =	1.003	0.77	1.48	
73	1	0.8049	14	796.046	801.264	5.218	45	61	64	59	59	60.75	5.00	3.7	5.3716	5.3922	1.004			1.84
	2	0.8049	14	801.264	806.534	5.270	45	64	66	59	60	62.25	5.00	3.7	5.4096	5.3922	0.997			1.84
	3	0.8049	14	806.534	811.883	5.349	45	66	67	60	61	63.5	5.00	3.7	5.4775	5.3922	0.984			1.83
																AVG =	0.995	-0.08	0.62	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.996

AVERAGE $\Delta H_@$ = 1.76

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)
T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$\Delta H_@ = \left(\frac{0.75\,\theta}{V_{cr}(std)}\right)^2 \Delta H \left(\frac{V_m(std)}{V_m}\right)$$

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions
T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

BUREAU VERITAS

Meter Box Thermocouple Calibration Sheet

Meter Box #:	**2**	**Tech:**	**DK**	**Date:**	**10/19/2020**
Reference:	**PIE TC Source**				

	Reference Thermometer		Thermocouple		Difference
Source:	°F	°R	°F	°R	
Meter In:					
Ice bath	34	494	33	493	-0.20%
Boiling Water	212	672	211	671	-0.15%
Hot Oil	360	820	360	820	0.00%
Meter Out:					
Low	34	494	35	495	0.20%
Med	212	672	213	673	0.15%
High	360	820	362	822	0.24%
Stack:					
Low	34	494	27	487	-1.42%
Med	212	672	207	667	-0.74%
High	360	820	354	814	-0.73%
Probe:					
Low	34	494	34	494	0.00%
Med	212	672	207	667	-0.74%
High	360	820	354	814	-0.73%
Oven:					
Low	34	494	32	492	-0.40%
Med	212	672	206	666	-0.89%
High	360	820	353	813	-0.85%
Exit:					
Low	34	494	28	488	-1.21%
Med	212	672	205	665	-1.04%
High	360	820	352	812	-0.98%
Auxiliary:					
Low	34	494	29	489	-1.01%
Med	212	672	206	666	-0.89%
High	360	820	353	813	-0.85%

Note: Tolerance is ≤1.5%

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

ENVIRONMENTAL SUPPLY COMPANY

Quality - Service - Reliability

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record data and information in the **GREEN** cells, YELLOW cells are calculated.

DATE:	1/19/2021	METER SERIAL #:	2	BAROMETRIC PRESSURE (in Hg):	INITIAL: 29.8	FINAL: 29.8
METER PART #:		CRITICAL ORIFICE SET SERIAL #:	JR		AVG (P_{bar}): 29.8	

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS FINAL	NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y % Diff to Average Y	Y % Diff with other orifices	$\Delta H_@$
55	1	0.453	13	297.852	303.015	5.163	44	44	48	44	48	46	9.00	1.1	5.3816	5.4135	1.006			1.78
	2	0.453	13	303.015	308.252	5.237	44	48	50	48	50	49	9.00	1.1	5.4265	5.4135	0.998			1.77
	3	0.453	13	308.252	313.485	5.233	44	50	52	50	52	51	9.00	1.1	5.4011	5.4135	1.002			1.77
																AVG =	1.002	0.44	0.98	
63	1	0.5788	10	313.485	319.021	5.536	44	52	53	52	53	52.5	7.50	1.8	5.7070	5.7640	1.010			1.77
	2	0.5788	10	319.021	324.685	5.664	44	53	54	53	54	53.5	7.50	1.8	5.8275	5.7640	0.989			1.76
	3	0.5788	10	324.685	330.311	5.626	44	54	54	54	54	54	7.50	1.8	5.7828	5.7640	0.997			1.76
																AVG =	0.999	0.10	0.65	
73	1	0.8049	14	330.311	335.445	5.134	44	54	55	54	55	54.5	5.00	3.7	5.2966	5.3438	1.009			1.88
	2	0.8049	14	335.445	340.685	5.240	44	55	55	55	55	55	5.00	3.7	5.4007	5.3438	0.989			1.88
	3	0.8049	14	340.685	345.985	5.30	44	55	55	55	55	55	5.00	3.7	5.4625	5.3438	0.978			1.88
																AVG =	0.992	-0.54	-0.64	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.998

AVERAGE $\Delta H_@$ = 1.81

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)
T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$\Delta H_@ = \left(\frac{0.75\ \theta}{V_{cr}(std)}\right)^2 \Delta H \left(\frac{V_m(std)}{V_m}\right)$$

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions
T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)
K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

Environics®

ISO 9001 QUALITY MANAGEMENT · ANAB ACCREDITED MANAGEMENT SYSTEMS CERTIFICATION BODY

SERVICE REPORT

ATTN: David Kawasaki, Apex Companies, LLC

DATE OF SERVICE: 11/18/2020
SERIAL NUMBER: 6367

SERVICE TYPE: **RECALIBRATION**
NEXT CALIBRATION DUE: **11/19/2021**

CONDITIONS AS OBSERVED AND WORK PERFORMED:

- Unit powers up properly.
- Unit cleaned and Purged, data verified.
- All valves checked, ok.
- Checked for any software updates
- Voltages checked – 5v, -15v, +15v, 24v.
- Battery voltages checked.
- Unit leak tested.
- Tested all MFC's with each port.
- Zeros on each MFC checked.
- Spans checked on all MFCs.
- Incoming verification run on all MFCs.
- Verified all MFCs @ 5 standard points, passed within 1%
- All MFCs recalibrated
- All cables and screw/nuts tightened, ok.

Service Technician
11/18/2020

Environics®

SERIES 4040

System S/N 6367

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

MFC # 1 Size: 10000 SCCM

MFC Serial Number: 0103486002

This flow controller was calibrated using a NIST-traceable Flow Standard. This calibration was performed with Nitrogen at a standard reference temperature and pressure of 32°F and 29.92 in. Hg. The Flow Calibration Data is not performance data. This data is used by the system operating mode to improve the flow accuracy. The Flow Verification Data is performance data.

Flow Calibration Data

	Set Flow	True Flow
5%	500	484.498
10%	1000	988.178
20%	2000	1997.523
30%	3000	3002.708
40%	4000	4013.548
50%	5000	5024.901
60%	6000	6039.875
70%	7000	7077.845
80%	8000	8108.056
90%	9000	9166.224
100%	10000	10239.148

All values in SCCM

Flow Verification Data

	Set Flow	True Flow
99%	9900	9921.544
85%	8500	8518.306
55%	5500	5517.054
25%	2500	2500.638
10%	1000	997.013

All values in SCCM

Verified by: Terrie Lundmark

Date: 11-18-20

SERIES 4040

System S/N 6367

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

MFC # 2

Size: 10000 SCCM

MFC Serial Number: 0103486003

This flow controller was calibrated using a NIST-traceable Flow Standard. This calibration was performed with Nitrogen at a standard reference temperature and pressure of 32°F and 29.92 in. Hg. The Flow Calibration Data is not performance data. This data is used by the system operating mode to improve the flow accuracy. The Flow Verification Data is performance data.

Flow Calibration Data

	Set Flow	True Flow
5%	500	490.696
10%	1000	993.586
20%	2000	2004.661
30%	3000	3009.857
40%	4000	4018.185
50%	5000	5024.634
60%	6000	6040.024
70%	7000	7063.046
80%	8000	8085.829
90%	9000	9131.144
100%	10000	10177.882

All values in SCCM

Flow Verification Data

	Set Flow	True Flow
99%	9900	9926.599
85%	8500	8517.552
55%	5500	5514.260
25%	2500	2499.539
10%	1000	998.610

All values in SCCM

Verified by: Terri Lundmark

Date: 11-18-20

Environics®

SERIES 4040

System S/N 6367

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

MFC # 3 Size: 1000 SCCM

MFC Serial Number: 0101125002

This flow controller was calibrated using a NIST-traceable Flow Standard. This calibration was performed with Nitrogen at a standard reference temperature and pressure of 32°F and 29.92 in. Hg. The Flow Calibration Data is not performance data. This data is used by the system operating mode to improve the flow accuracy. The Flow Verification Data is performance data.

Flow Calibration Data

	Set Flow	True Flow
5%	50	47.818
10%	100	98.271
20%	200	199.839
30%	300	300.951
40%	400	402.462
50%	500	503.511
60%	600	604.776
70%	700	707.674
80%	800	811.628
90%	900	915.019
100%	1000	1019.838

Flow Verification Data

	Set Flow	True Flow
99%	990	989.008
85%	850	848.171
55%	550	549.887
25%	250	249.408
10%	100	99.851

All values in SCCM

Verified by: Terri Lundmark

Date: 11-18-20

Environics®

SERIES 4040

System S/N 6367

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

MFC # 4 Size: 100 SCCM

MFC Serial Number: 0101127002

This flow controller was calibrated using a NIST-traceable Flow Standard. This calibration was performed with Nitrogen at a standard reference temperature and pressure of 32°F and 29.92 in. Hg. The Flow Calibration Data is not performance data. This data is used by the system operating mode to improve the flow accuracy. The Flow Verification Data is performance data.

Flow Calibration Data

	Set Flow	True Flow
5%	5	5.175
10%	10	10.624
20%	20	21.477
30%	30	32.248
40%	40	42.941
50%	50	53.560
60%	60	64.108
70%	70	74.538
80%	80	85.086
90%	90	95.717
100%	100	106.402

All values in SCCM

Flow Verification Data

	Set Flow	True Flow
99%	99	98.672
85%	85	84.767
55%	55	54.811
25%	25	24.893
10%	10	9.967

All values in SCCM

Verified by: Lorri Lundmark Date: 11-18-20

Z540.1

Certificate of Calibration

FLUKE®

Everett Service Center

Certificate Number:	EVL670261		
Data Type:	Found-Left	**Calibration Date:**	17-Nov-2020
Result Summary:	In Tolerance	**Calibration Due:**	17-Nov-2021
Manufacturer:	Fluke	**Certificate Date:**	17-Nov-2020
Model:	51 II	**Temperature:**	22.8 °C
Serial Number:	97440191	**Humidity:**	33.1 %
Description:	Thermometer		
Procedure:	Fluke 51-II:(1 YEAR) ZCAL VER /5520	**Revision:**	1.2
Customer:	APEX COMPANIES		
City:	NOVI	**Country:**	US
State:	MI		
Purchase Order:	CCS KAWASAKI	**RMA:**	32077905

This calibration is traceable to the International System of Units (SI), through National Metrology Institutes (NIST, PTB, NRC, NPL, etc.), ratiometric techniques, or natural physical constants. This certificate applies only to the item identified and shall not be reproduced other than in full, without the specific written approval by Fluke Corporation. Calibration certificates without signature are not valid. The calibration has been completed in accordance with Fluke Electronics Corporation Quality System Document 111.0 Revision 124 and/or Fluke 17025 Quality Manual QSD 111.41 Revision 007.

The Data Type found in this certificate must be interpreted as:

- As - Found Calibration data collected before the unit is adjusted and / or repaired.
- As - Left Calibration data collected after the unit has been adjusted and / or repaired.
- Found-Left Calibration data collected without any adjustment and / or repair performed.

This calibration conforms to the requirements of ANSI/NCSL Z540-1-1994 (R2002).

In the attached measurement results, deviation may be expressed with units, Measured Value (MV) - Nominal Value (NV) or as a proportion of the nominal value ((MV-NV)/NV), expressed without units with a scalar multiplier such as % (0.01), or as a ratio of the units (mA/A, µV/V, etc.) Descriptions such as µA/A, µV/V, and others, where used to annotate results or column headings are the preferred replacements for what was historically labeled as "ppm" or parts-per-million and described the results in that column, unless otherwise noted by units symbols.

Where applicable, the expanded uncertainty of measurement at the time of test is given in the following pages. They are calculated in accordance with the method described in the ISO Guide to the Expression of Uncertainty in Measurement (GUM). The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k, such that the confidence level approximates 95%.

Where applicable, the Test Uncertainty Ratio (TUR) is provided in the following pages. Unless otherwise stated, the TUR for a given measurement result is 4:1 or greater.

Results are reviewed to establish where any measurement results exceeded the manufacturer's specifications.

Measurement results greater than limits of error are indicated by '!'.

ROBERT LEVER
Issued By

Standards Used

Asset	Description	Cal-Date	Cal-Due
12177	Fluke 5520A Calibrator	17-Jul-2020	17-Apr-2021

Calibration Data

Parameter	Nominal Value	Measurement Result	Limits of Error Lower Limit	Limits of Error Upper Limit	Test Uncertainty Ratio (TUR)
FUNCTIONAL TESTS:					
Display Test		Pass			
Keypad Test		Pass			
Thermocouple - Type K					
DEGREES CELSIUS VERIFICATION					
0.0 °C	0.00	-0.1	-0.3	0.3	1.88
20.0 °C	20.00	19.9	19.7	20.3	1.94
-190.0 °C	-190.00	-190.2	-190.7	-189.3	2.06
990.0 °C	990.00	989.8	989.2	990.8	3.06
DEGREES FAHRENHEIT VERIFICATION					
32.0 °F	32.00	31.7	31.4	32.6	1.93
73.4 °F	73.40	73.1	72.8	74.0	2.00
-310.0 °F	-310.00	-310.5	-311.2	-308.8	1.95
2192 °F	2192.0	2192	2190	2194	2.27

APEX

APEX COMPANIES, LLC
PITOT TUBE INSPECTION

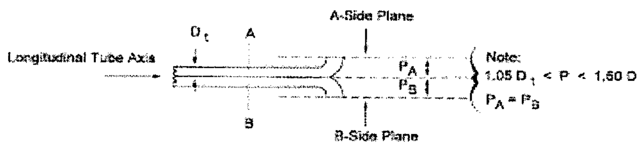
PITOT TUBE NO. 32

DATE 10/9/20

Pitot Tube not on Probe

Operator: TM

$3/16 \leq D_t \leq 3/8$
0.48 cm 0.95 cm
$P_A = P_B$



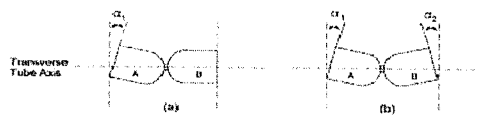
$1.05\ D_t \leq P_{A,B} \leq 1.5\ D_t$

YES NO

YES NO

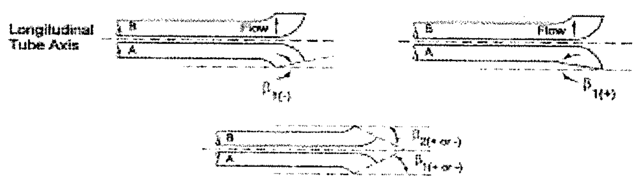
YES NO

α_1 and $\alpha_2 < 10°$



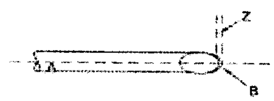
α YES NO

β_1 and $\beta_2 < 5°$



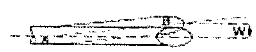
β YES NO

z < 0.32 cm (1/8 in)



z YES NO

w < 0.08 cm (1/32 in)



w YES NO

Pitot on Probe
Component Spacing OK

Pitot Tube Correction Factor: 0.84

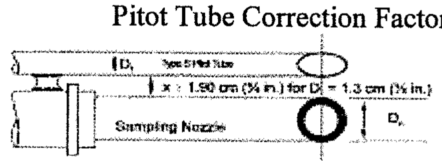


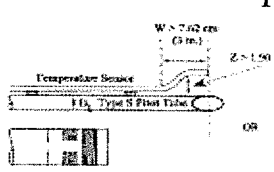
Fig. A

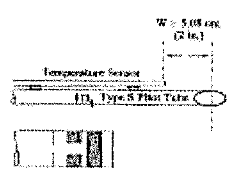
Fig.

A. $x \geq 1.9$ cm

A. YES NO

B-1. $z \geq 1.9$ cm
$w \geq 7.62$ cm





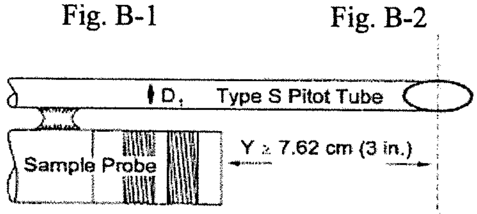
B-1. YES NO

or

Fig. B-1 Fig. B-2

B-2. $z \geq 5.08$ cm

C. $Y \geq 7.62$ cm



B-2. YES NO

C. YES NO

Fig. C

APEX COMPANIES, LLC
PITOT TUBE INSPECTION

APEX

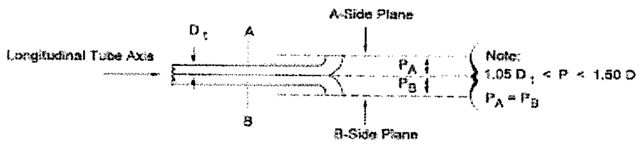
PITOT TUBE NO. 59

DATE 12/8/20

Pitot Tube not on Probe

Operator: WZ

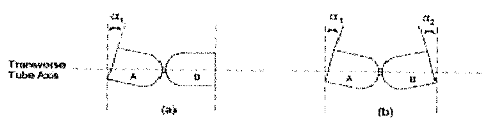
$3/16 \le Dt \le 3/8$
0.48 cm 0.95 cm
$P_A = P_B$ YES NO



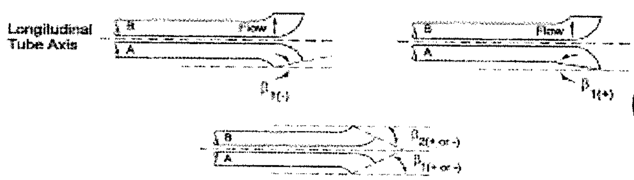
YES NO

$1.05\ Dt \le P_{A,B} \le 1.5\ Dt$ YES NO

α_1 and $\alpha_2 < 10°$

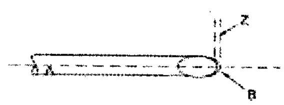


α YES NO

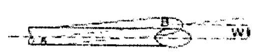


β_1 and $\beta_2 < 5°$ β YES NO

z < 0.32 cm (1/8 in) z YES NO



w < 0.08 cm (1/32 in) w YES NO



Pitot on Probe
Component Spacing OK

Pitot Tube Correction Factor: 0.84

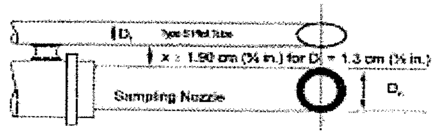
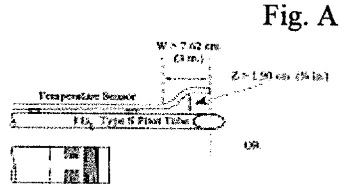


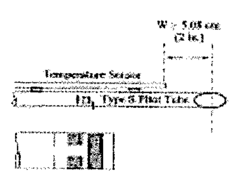
Fig. A

Fig.

A. $x \ge 1.9$ cm A. YES NO

B-1. $z \ge 1.9$ cm
$w \ge 7.62$ cm B-1. YES NO





or

Fig. B-1 Fig. B-2

B-2. $z \ge 5.08$ cm B-2. YES NO

C. $Y \ge 7.62$ cm C. YES NO

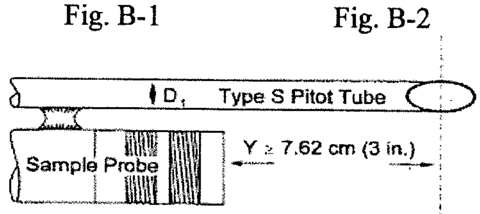


Fig. C

AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION

Customer ID: 022824 | S/N: M10640
Customer: APEX | City: NOVI | State: MI
As-Received Model #: ADM-880C | Converted to Model #: | Order #: R201943
PO #: | Customer Eqpt ID#: | Calibration Due Date:

This instrument has been calibrated using Calibration Standards which are traceable to NIST (National Institute of Standards and Technology). Test accuracy ratio is 4:1 for pressures and temperature. Quality Assurance Program and calibration procedures meet the requirements for ANSI/NCSL Z540-1, ISO 17025, MIL-STD 45662A and manufacturer's specifications. Calibration accuracy is certified when meters are used with properly functioning accessories only. All Uncertainties are expressed in expanded terms (twice the calculated uncertainty). This report shall not be reproduced, except in full, without the written approval of Shortridge Instruments, Inc. Results relate only to the item calibrated. For limitations on use, see Shortridge Instruments, Inc. Instruction Manual for the use of AirData Multimeters. Procedure used: Procedure for Differential Pressure, Absolute Pressure and Temperature Recalibration of AirData Multimeters SIP-CP02 Revision: 30 Dated: 04/04/16

Calibration Technician(s): M. Diddens M. Ramirez | Calibration Date: 07/21/2020
Calibration Approved by: J. Faulkner | Title: Cal Mgr | Date: 07/24/2020

AS-Received By M.D.	Final Test By MR	Test By
Date 07-16-2020 Rh 48 %	Date 07/21/2020 Rh 50 %	Date Rh %
Ambient Temperature 76 °F	Ambient Temperature 77 °F	Ambient Temperature N/A °F
Barometric Pressure 28.36 in Hg	Barometric Pressure 28.32 in Hg	Barometric Pressure in Hg
All within spec YES NO NA	All within spec YES NO	All within spec YES NO

ABSOLUTE PRESSURE TEST (in Hg)

TEST METER TOLERANCE = ± 2.0 % ± .1 in Hg AS-RECEIVED TEST WITHIN SPEC YES NO N/A See Notes

Pressure Standard: Heise #02-R S/N: 41741/42451 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #04-R S/N: 41743/42453 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #06-R S/N: 41742/42452-1 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #08-R S/N: 42186/43328 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #10-R S/N: 42203/43352 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #12A-R S/N: 45605/48491 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #14-R S/N: 43412/45043-2 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #16-R S/N: 43413/45044 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #18-R S/N: 44581/46845 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #20-R S/N: 44582/46847 As-Rcvd Test 2 Test 3

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
14.0	14.16	14.1	-.42	14.04	14.0	-.28			
28.4	28.36	28.4	.14	28.32	28.3	-.07		N/A	
40.0	40.14	40.2	.15	40.02	40.0	-.05			

DIFFERENTIAL PRESSURE TEST (in wc)

TEST METER TOLERANCE = ± 2.0 % ± 0.001 in wc AS-RECEIVED TEST WITHIN SPEC YES NO N/A See Notes

Pressure Standard: Heise #01-L S/N: 41739/42449 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #01-R S/N: 41739/42446 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #02-L S/N: 41741/42454 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #03A-L S/N: 45570/48461 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #03A-R S/N: 45570/48460 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #04-L S/N: 41743/42456 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #05-L S/N: 41740/42450 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #05-R S/N: 41740/42447 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #06-L S/N: 41742/42455 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #07-L S/N: 42185/42186 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #07-R S/N: 42185/43326 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #08-L S/N: 42186/43329 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #09-L S/N: 42202/43351 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #09-R S/N: 42202/43350 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #10-L S/N: 42203/43353 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #11-L S/N: 43165/44551-1 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #11-R S/N: 43165/44730 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #12A-L S/N: 45605/48490 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #13-L S/N: 43415/45041 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #13-R S/N: 43415/45039 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #14-L S/N: 43412/45045 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #15-L S/N: 43416/45042 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #15-R S/N: 43416/45040 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #16-L S/N: 43413/45046 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #17-L S/N: 44579/46842 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #17-R S/N: 44579/46841 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #18-L S/N: 44581/46846 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #19-L S/N: 44580/46844 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #19-R S/N: 44580/46843 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #20-L S/N: 44582/46848 As-Rcvd Test 2 Test 3

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
.0500	.0525	.0524	-.19	.0501	.0500	-.20			
.1250	.1254	.1253	-.08	.1264	.1262	-.16			
.2250	.2256	.2253	-.13	.2259	.2258	-.04			
1.000	1.026	1.027	.10	1.037	1.035	-.19			
2.000	2.027	2.028	.05	2.058	2.055	-.15		N/A	
3.600	3.611	3.607	-.11	3.642	3.632	-.27			
4.400	4.413	4.423	.23	4.419	4.424	.11			
27.00	27.07	27.24	.63	27.05	27.17	.44			
50.00	50.01	50.14	.26	50.12	50.11	-.02			
Overange	NA	✓	NA	NA	✓	NA	NA		NA

Shortridge Instruments, Inc.
7855 East Redfield Road Scottsdale, Arizona 85260
(480) 991-6744 • Fax (480) 443-1267 • www.shortridge.com

AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION

S/N: M10640

Order #: R201943

LOW VELOCITY CONFIRMATION (FPM)

TEST METER TOLERANCE = ± 3.0% ± 7 FPM   AS-RECEIVED TEST WITHIN SPEC YES NO N/A See Notes

Vel Eqv Trans Std: S/N: M02009 As-Rcvd Test 2 Test 3
Vel Eqv Trans Std: S/N: M02903 As-Rcvd Test 2 Test 3
Vel Eqv Trans Std: S/N: M10839 As-Rcvd Test 2 Test 3
Vel Eqv Trans Std: S/N: M10840 As-Rcvd Test 2 Test 3
Vel Eqv Trans Std: S/N: M10897 As-Rcvd Test 2 Test 3
Vel Eqv Trans Std: S/N: M10901 As-Rcvd Test 2 Test 3
Vel Eqv Trans Std: S/N: M13492 As-Rcvd Test 2 Test 3
Vel Eqv Trans Std: S/N: M19325 As-Rcvd Test 2 Test 3

Approx Set Point	Standard	Test Meter	Diff	Standard	Test Meter	Diff	Standard	Test Meter	Diff
100	101.7	100	-1.7	104	105	1		N/A	
500	530.2	529	-1.2	503	503	0			

ADM-880C, ADM-870/870C and ADM-860/860C models are read in AirFoil Mode. ADM-850/850L models are read in Pitot Tube Mode.

TEMPERATURE TEST - AIRDATA MULTIMETER (° F)

TEST METER TOLERANCE = ± 0.2° F   AS-RECEIVED TEST WITHIN SPEC YES NO N/A See Notes

RTD Simulator: S/N 249 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 250 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 253 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 254 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 256 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 257 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 292 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 293 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 294 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 313 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 314 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 315 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 316 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 317 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 318 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F

RTD Simulator Temperature Equivalent Set Point	Test Meter	Difference	Test Meter	Difference	Test Meter	Difference
35.60	35.6	0	35.7	.1	N/A	
95.00	95.0	0	95.0	0		
154.40	154.4	0	154.4	0		

NOTES:

The enclosed ADM Calibration Standards for Pressure and Temperature form(s) is/are an integral part of this calibration and must remain with this Certificate of Calibration. Note: There may be more than one such form included that pertains to this calibration.

Shortridge Instruments, Inc.
7855 East Redfield Road Scottsdale, Arizona 85260
(480) 991-6744 • Fax (480) 443-1267 • www.shortridge.com

Shortridge Instruments, Inc. AirData Multimeter Calibration Equipment

Order Number: R201943 Serial Number: M10640 Test Type: Initial As-Received Final

ABSOLUTE PRESSURE STANDARDS

ADM #02-R	S/N: 41741/42451	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 04/27/20	Due Date: 04/2021
ADM #04-R	S/N: 41743/42453	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/07/19	Due Date: 11/2020
ADM #06-R	S/N: 41742/42452-1	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/21/19	Due Date: 08/2020
ADM #08-R	S/N: 42186/43328	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/13/20	Due Date: 03/2021
ADM #10-R	S/N: 42203/43352	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 01/13/20	Due Date: 01/2021
ADM #12A-R	S/N: 45605/48491	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 07/16/19	Due Date: 07/2020
ADM #14-R	S/N: 43412/45043-2	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 10/07/19	Due Date: 09/2020
ADM #16-R	S/N: 43413/45044	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 02/27/20	Due Date: 02/2021
ADM #18-R	S/N: 44581/46845	Heise Model: PPM-2	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 05/20/20	Due Date: 05/2021
ADM #20-R	S/N: 44582/46847	Heise Model: PPM-2	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 06/20/19	Due Date: 06/2020

#02-R, 04-R, 06-R, 08-R, 10-R, 12A-R, 14-R, 16-R	Rated Accuracy: 0.05% fs (0.0305 in Hg)	Range: 0-30 psia	Resolution: 0.01	Uncertainty: < 0.0358
#18-R, 20-R	Rated Accuracy: 0.05% fs (0.0305 in Hg)	Range: 0-60 in Hg	Resolution: 0.001	Uncertainty: < 0.0358

DIFFERENTIAL PRESSURE STANDARDS

ADM #01-L	S/N: 41739/42449	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 05/05/20	Due Date: 04/2021
ADM #01-R	S/N: 41739/42446	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 05/05/20	Due Date: 04/2021
ADM #02-L	S/N: 41741/42454	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 05/04/20	Due Date: 04/2021
ADM #03A-L	S/N: 45570/48461	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/11/19	Due Date: 11/2020
ADM #03A-R	S/N: 45570/48460	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/11/19	Due Date: 11/2020
ADM #04-L	S/N: 41743/42456	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/08/19	Due Date: 11/2020
ADM #05-L	S/N: 41740/42450	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/26/19	Due Date: 08/2020
ADM #05-R	S/N: 41740/42447	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/28/19	Due Date: 08/2020
ADM #06-L	S/N: 41742/42455	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/26/19	Due Date: 08/2020
ADM #07-L	S/N: 42185/42186	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/13/20	Due Date: 03/2021
ADM #07-R	S/N: 42185/43326	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/11/20	Due Date: 03/2021
ADM #08-L	S/N: 42186/43329	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/13/20	Due Date: 03/2021
ADM #09-L	S/N: 42202/43351	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 01/30/20	Due Date: 01/2021
ADM #09-R	S/N: 42202/43350	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 01/30/20	Due Date: 01/2021
ADM #10-L	S/N: 42203/43353	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 01/30/20	Due Date: 01/2021
ADM #11-L	S/N: 43165/44551-1	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 07/15/19	Due Date: 07/2020
ADM #11-R	S/N: 43165/44730	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 07/15/19	Due Date: 07/2020
ADM #12A-L	S/N: 45605/48490	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 07/16/19	Due Date: 07/2020
ADM #13-L	S/N: 43415/45041	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/19/19	Due Date: 09/2020
ADM #13-R	S/N: 43415/45039	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/19/19	Due Date: 09/2020
ADM #14-L	S/N: 43412/45045	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/19/19	Due Date: 09/2020
ADM #15-L	S/N: 43416/45042	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/03/20	Due Date: 02/2021
ADM #15-R	S/N: 43416/45040	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/03/20	Due Date: 02/2021
ADM #16-L	S/N: 43413/45046	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/03/20	Due Date: 02/2021
ADM #17-L	S/N: 44579/46842	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 05/27/20	Due Date: 05/2021
ADM #17-R	S/N: 44579/46841	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 05/27/20	Due Date: 05/2021
ADM #18-L	S/N: 44581/46846	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 05/27/20	Due Date: 05/2021
ADM #19-L	S/N: 44580/46844	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 07/15/19	Due Date: 06/2020
ADM #19-R	S/N: 44580/46843	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 07/15/19	Due Date: 06/2020
ADM #20-L	S/N: 44582/46848	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 06/18/19	Due Date: 06/2020

#01-L, 03A-L, 05-L, 07-L, 09-L, 11-L, 13-L, 15-L, 17-L, 19-L	Rated Accuracy: > 0.07% fs (0.000175 in wc)	Range: 0.0-0.25 in wc	Res.: 0.00001	Uncertainty: < 0.00035
#01-R, 03A-R, 05-R, 07-R, 09-R, 11-R, 13-R, 15-R, 17-R, 19-R	Rated Accuracy: > 0.06% fs (0.003 in wc)	Range: 0.0-5.0 in wc	Res.: 0.0001	Uncertainty: < 0.00348
#02-L, 04-L, 06-L, 08-L, 10-L, 12A-L, 14-L, 16-L, 18-L, 20-L	Rated Accuracy: > 0.06% fs (0.03 in wc)	Range: 0.0-50.0 in wc	Res.: 0.001	Uncertainty: < 0.0346

Shortridge Instruments, Inc.
7855 East Redfield Road Scottsdale, Arizona 85260
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Customer Order Number, Meter Serial Number, and Test Type are referenced on page 1

LOW VELOCITY EQUIVALENT CONFIRMATION STANDARDS

Vel Eqv Transfer Standard S/N: M02009	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/10/19	Due Date: 12/2020
Vel Eqv Transfer Standard S/N: M02903	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/10/19	Due Date: 12/2020
Vel Eqv Transfer Standard S/N: M10839	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/10/19	Due Date: 12/2020
Vel Eqv Transfer Standard S/N: M10840	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/10/19	Due Date: 12/2020
Vel Eqv Transfer Standard S/N: M10897	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 01/17/20	Due Date: 01/2021
Vel Eqv Transfer Standard S/N: M10901	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, inc.	Calibration Date: 12/10/19	Due Date: 12/2020
Vel Eqv Transfer Standard S/N: M13492	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, inc.	Calibration Date: 08/08/19	Due Date: 08/2020
Vel Eqv Transfer Standard S/N: M19325	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 06/25/20	Due Date: 06/2021

Rated Accuracy: Velocity ± 1.5 % ± 3.5 fpm   Range: 100-5000 fpm   Resolution: 0.1   Uncertainty: <5.00 fpm at 100 fpm; <7.50 fpm at 500 fpm

TEMPERATURE STANDARDS

RTD Simulator S/N: 249	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/02/20	Due Date: 03/2024
RTD Simulator S/N: 250	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/02/20	Due Date: 03/2024
RTD Simulator S/N: 253	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/02/20	Due Date: 03/2024
RTD Simulator S/N: 254	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/04/20	Due Date: 04/2024
RTD Simulator S/N: 256	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/04/20	Due Date: 04/2024
RTD Simulator S/N: 257	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/04/20	Due Date: 04/2024
RTD Simulator S/N: 292	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 01/03/20	Due Date: 01/2024
RTD Simulator S/N: 293	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 01/03/20	Due Date: 01/2024
RTD Simulator S/N: 294	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 01/03/20	Due Date: 01/2024
RTD Simulator S/N: 313	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/16/18	Due Date: 03/2022
RTD Simulator S/N: 314	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/16/18	Due Date: 03/2022
RTD Simulator S/N: 315	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/16/18	Due Date: 03/2022
RTD Simulator S/N: 316	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/16/18	Due Date: 04/2022
RTD Simulator S/N: 317	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/16/18	Due Date: 04/2022
RTD Simulator S/N: 318	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/16/18	Due Date: 04/2022

Rated Accuracy: 0.025% of setting   Range: 100.00 Ω to 11111.10 Ω   Resolution: 0.01 Ω   Uncertainty: ≤ 32 ppm

Thermometer #1 S/N 8A089/Thermistor S/N A410660	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 08/27/19	Due Date: 08/2021
Thermometer #2 S/N 8B104/Thermistor S/N 871507	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 11/07/18	Due Date: 10/2020
Thermometer #5 S/N B11780/Thermistor S/N B10505	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 03/07/19	Due Date: 03/2021
Thermometer #6 S/N B11782/Thermistor S/N B10509	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 02/24/20	Due Date: 02/2022
Thermometer #7 S/N B49938/Thermistor S/N B482202	Model 1504/5610	Mfgd and Calibrated by Fluke		Calibration Date: 09/26/19	Due Date: 09/2021

Rated Accuracy(combined): 0.0324° F   Range: 32° F to 176° F   Resolution: 0.001° F   Combined Uncertainty with Baths: ≤ 0.040° F

Temp Transfer Standard S/N M00136	Model ADM-870	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 10/02/19	Due Date: 10/2020
Temp Transfer Standard S/N M96100	Model ADM-870	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 03/09/20	Due Date: 03/2021

Rated Accuracy: 0.03° F   Range: 33° F to 158° F   Resolution: 0.01° F   Uncertainty: < 0.023° F

Total combined Uncertainty for MultiTemp and TemProbe testing : ≤ 0.046° F

This form must remain with the Certificate of Calibration corresponding to the Customer Order Number and Meter Serial Number referenced on page 1.

Shortridge Instruments, Inc.
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Airgas

CERTIFICATE OF BATCH ANALYSIS

Grade of Product: CEM-CAL ZERO

Customer:	STOCK		
Part Number:	AI CZ15A	Reference Number:	32-401343874-1
Cylinder Analyzed:	ALM-011814	Cylinder Volume:	146.0 CF
Laboratory:	112 - Troy-32 (SAP) - MI	Cylinder Pressure:	2000 PSIG
Analysis Date:	Nov 01, 2018	Valve Outlet:	590
Lot Number:	32-401343874-1		

Expiration Date: Nov 01, 2026

ANALYTICAL RESULTS

Component		Requested Purity		Certified Concentration
AIR				
Carbon Dioxide	<	1.0 PPM	<LDL	0.04 PPM
NOx	<	0.1 PPM	<LDL	0.012 PPM
Sulfur Dioxide	<	0.1 PPM	<LDL	0.046 PPM
THC	<	0.1 PPM	<LDL	0.028 PPM
Percent Oxygen		20-21 %		20.88 %
Carbon Monoxide	<	0.5 PPM	<LDL	0.033 PPM

Permanent Notes: Airgas certifies that the contents of this cylinder meet the requirements of 40 CFR 72.2

Cylinders in Batch:

ALM-011814, ALM044699, ALM058412, CC114806, CC12177, CC12178, CC210547, CC231220, CC286456, CC310397, CC43947., CC452220, CC469691, CC6783, EB0001513, SG9162511BAL, XC034324B

Impurities verified against analytical standards traceable to NIST by weight and/or analysis.

Signature on file

Approved for Release

Stratification Test

Duct Diameter (inches)	84
Stratification Check Analyte	VOC

*stratification not required for ducts less than 4 inches in diameter
Sample for minimum of twice the response time

Initial Three-Point Stratification

Point	Distance From Stack Wall (inches)	Average Concentration (ppmv)	Average Concentration from Mean (ppmv)	Average Concentration from Mean (%)
3	14.0	7.2	0.4	6.4
2	42.0	6.5	0.3	3.9
1	70.0	6.6	0.2	2.5
	Mean	6.8		

Required Number of Sampling Points (least restrictive)	1	3

Sample Point Criteria
If concentration at each traverse point differs from the mean concentration for all traverse points by no more than ±5.0% of the mean concentration OR ±0.5 ppmv, then unstratified; 1 sample point

If concentration at each traverse point differs from the mean concentration for all traverse points by no more than ±10.0% of the mean concentration OR ±1.0 ppmv, then minimally stratified; 3 sample points

If concentration at each traverse point differs from the mean concentration for all traverse points by greater than ±10.0% of the mean concentration OR ±1.0 ppmv, then stratified; Method 1 sample points

VOC Calibration Gas Selection

Span Value (ppmv) 100.0 VOC

	Lower Limit	Calibration Gas	Upper Limit	Acceptable?
High-Level Concentration Gas (80-90% of span value, ppmv)	80.0	85.0	90.0	Yes
Mid-Level Concentratoin Gas (45-55% of span value, ppmv)	45.0	50.0	55.0	Yes
Low-Level Concentration Gas (25-35% of span value, ppmv)	25.0	30.0	35.0	Yes
Zero-Level Concentration Gas (0% of span value, ppmv)	0.0	0.0	0.1	Yes

APEX

VOC Calibration and Drift Data

Source:	Biofilter Outlet	Operator:	TMZ
Analyzer:	Black Jum 3-300A	Date:	12/9/2020

Calibration Error Data

Response Time: 20 Span: 100

Gas Range	Cylinder Value (ppmv)	Calibration Response (ppmv)	Absolute Difference (ppmv)	Calibration Error (% of calibration)	Pass/Fail
Zero gas	0.0	0.0	0.0	0.0	Pass
Low-range gas	30.0	30.4	0.4	1.3	Pass
Mid-range gas	50.0	50.9	0.9	1.8	Pass
High-range gas	85.0	85.1	0.1	0.1	Pass

Calibration Drift Data

Run 1

Gas Range	Initial Response (ppmv)	Final Response (ppmv)	Final Response Error (% of calibration)	Drift (% of span)	Pass/Fail
Zero gas	0.0	-0.3	-0.3	0.3	Pass
Low-range gas	30.4	29.9	0.3	0.5	Pass

Run 2-4

Gas Range	Initial Response (ppmv)	Final Response (ppmv)	Final Response Error (% of calibration)	Drift (% of span)	Pass/Fail
Zero gas	-0.3	-0.3	-0.3	0.0	Pass
Low-range gas	29.9	30.9	3.0	1.0	Pass

Run 5-7

Gas Range	Initial Response (ppmv)	Final Response (ppmv)	Final Response Error (% of calibration)	Drift (% of span)	Pass/Fail
Zero gas	-0.3	-0.2	-0.2	0.1	Pass
Low-range gas	30.9	30.4	1.3	0.5	Pass

Run 8-10

Gas Range	Initial Response (ppmv)	Final Response (ppmv)	Final Response Error (% of calibration)	Drift (% of span)	Pass/Fail
Zero gas	-0.2	0.2	0.2	0.4	Pass
Low-range gas	30.4	30.6	2.0	0.2	Pass

Final response(s) must be ±5% of cylinder value **and** drift must be less than ±3% of span. If both criteria are met, test is considered valid without comment

USEPA Method 205 Gas Dilution Field Calibration

High-Level Supply Gas 1113 ppmv

Expected Concentration (ppmv)	Acceptable Range[1] (ppmv)		Actual Concentration 1 (ppmv)	Actual Concentration 2 (ppmv)	Actual Concentration 3 (ppmv)	Acceptable Yes/No
	Low	High				
110.0	107.8	112.2	109.3	108.9	109.4	Yes
300.0	294.0	306.0	296.2	297.5	295.3	Yes

Mid-Level Supply Gas 110 ppmv

Expected Concentration (ppmv)	Acceptable Range[1] (ppmv)		Actual Concentration 1 (ppmv)	Actual Concentration 2 (ppmv)	Actual Concentration 3 (ppmv)	Acceptable Yes/No
	Low	High				
110.0	107.8	112.2	109.7	109.8	109.5	Yes

1: acceptable range is ±2% of the expected concentration

Stratification Test

Duct Diameter (inches)	105
Stratification Check Analyte	CO

*stratification not required for ducts less than 4 inches in diameter
Sample for minimum of twice the response time

Initial Three-Point Stratification

Point	Distance From Stack Wall (inches)	Average Concentration (ppmv)	Average Concentration from Mean (ppmv)	Average Concentration from Mean (%)
3	17.5	131.8	5.3	4.2
2	52.5	122.2	4.3	3.4
1	87.5	125.5	1.0	0.8
	Mean	126.5		

Required Number of Sampling Points (least restrictive)	Method 1	1

Sample Point Criteria
If concentration at each traverse point differs from the mean concentration for all traverse points by no more than ±5.0% of the mean concentration OR ±0.5 ppmv, then unstratified; 1 sample point

If concentration at each traverse point differs from the mean concentration for all traverse points by no more than ±10.0% of the mean concentration OR ±1.0 ppmv, then minimally stratified; 3 sample points

If concentration at each traverse point differs from the mean concentration for all traverse points by greater than ±10.0% of the mean concentration OR ±1.0 ppmv, then stratified; Method 1 sample points

CO Calibration Gas Selection

Span Value (%) 800.0 CO

	Lower Limit	Calibration Gas	Upper Limit	Acceptable?
High-Level Concentration Gas (span value, ppmv)	N/A	800.0	N/A	Yes
Mid-Level Concentratoin Gas (40-60% of span value, ppmv)	320.0	400.0	480.0	Yes
Zero-Level Concentration Gas (<20% of span value, ppmv)	0.0	0.0	160.0	Yes

VOC Calibration Gas Selection

Span Value (ppmv) 100.0 VOC

	Lower Limit	Calibration Gas	Upper Limit	Acceptable?
High-Level Concentration Gas (80-90% of span value, ppmv)	80.0	85.0	90.0	Yes
Mid-Level Concentratoin Gas (45-55% of span value, ppmv)	45.0	50.0	55.0	Yes
Low-Level Concentration Gas (25-35% of span value, ppmv)	25.0	30.0	35.0	Yes
Zero-Level Concentration Gas (0% of span value, ppmv)	0.0	0.0	0.1	Yes

CO Calibration, Bias, and Drift Data

Source	RTO Outlet		Calibration Span	800
Operator	TMZ		Response Time (s)	50
Date	December 10, 2020		Serial No.	48C
Analyzer	Therrmo High Level			

	Manufacturer's Certified Cylinder Value (%)	Analyzer Calibration Response (%)	Absolute Difference (%)	Calibration Error (% of Calibration Span)	Pass/Fail*
	A	B	A-B	(A-B)/CS * 100	
Low-level (or zero) calibration gas	0.0	0.2	-0.2	0.0	Pass
Mid-level calibration gas	400.0	398.2	1.8	0.2	Pass
High-level calibration gas	800.0	800.8	-0.8	-0.1	Pass

*Calibration error must be ±2%

Run 1-2

Initial Values						Final Values				
Calibration Gas Level	Certified Calibration Gas Value (ppmv)	Direct Response (ppmv)	System Response (ppmv)	System Bias (% of calibration span)	Bias: Pass/ Fail	System Response (ppmv)	System Bias (% of calibration span)	Bias: Pass/Fail	Drift (% of calibration span)	Drift: Pass/Fail
Low level gas	0.0	0.2	-0.3	-0.1	Pass	1.3	0.1	Pass	0.2	Pass
Upscale (mid) level gas	400.0	398.2	398.3	0.0	Pass	398.5	0.0	Pass	0.0	Pass

1: System Bias must be ≤ 5% of span
2: Drift must be ≤ 3% of span or |Biasf - Biasi|≤0.5%

Run 3

Initial Values						Final Values				
Calibration Gas Level	Certified Calibration Gas Value (ppmv)	Direct Response (ppmv)	System Response (ppmv)	System Bias (% of calibration span)	Bias: Pass/ Fail	System Response (ppmv)	System Bias (% of calibration span)	Bias: Pass/Fail	Drift (% of calibration span)	Drift: Pass/Fail
Low level gas	0.0	0.2	1.3	0.1	Pass	0.1	0.0	Pass	0.2	Pass
Upscale (mid) level gas	400.0	398.2	398.5	0.0	Pass	393.4	-0.6	Pass	0.6	Pass

1: System Bias must be ≤ 5% of span
2: Drift must be ≤ 3% of span or |Biasf - Biasi|≤0.5%

Run 4-6

Initial Values						Final Values				
Calibration Gas Level	Certified Calibration Gas Value (ppmv)	Direct Response (ppmv)	System Response (ppmv)	System Bias (% of calibration span)	Bias: Pass/ Fail	System Response (ppmv)	System Bias (% of calibration span)	Bias: Pass/Fail	Drift (% of calibration span)	Drift: Pass/Fail
Low level gas	0.0	0.2	0.1	0.0	Pass	-6.6	-0.9	Pass	0.8	Pass
Upscale (mid) level gas	400.0	398.2	393.4	-0.6	Pass	400.2	0.3	Pass	0.9	Pass

Run 7-10

Initial Values						Final Values				
Calibration Gas Level	Certified Calibration Gas Value (ppmv)	Direct Response (ppmv)	System Response (ppmv)	System Bias (% of calibration span)	Bias: Pass/ Fail	System Response (ppmv)	System Bias (% of calibration span)	Bias: Pass/Fail	Drift (% of calibration span)	Drift: Pass/Fail
Low level gas	0.0	0.2	-6.6	-0.9	Pass	-3.7	-0.5	Pass	0.4	Pass
Upscale (mid) level gas	400.0	398.2	400.2	0.3	Pass	410.3	1.5	Pass	1.3	Pass

1: System Bias must be ≤ 5% of span
2: Drift must be ≤ 3% of span or |Biasf - Biasi|≤0.5%

APEX

VOC Calibration and Drift Data

Source: Biofilter Outlet   Operator: TMZ
Analyzer: Black Jum 3-300A   Date: 12/10/2020

Calibration Error Data

Response Time: 20   Span: 100

Gas Range	Cylinder Value (ppmv)	Calibration Response (ppmv)	Absolute Difference (ppmv)	Calibration Error (% of calibration)	Pass/Fail
Zero gas	0.0	-0.3	0.3	0.3	Pass
Low-range gas	30.0	29.5	0.5	1.7	Pass
Mid-range gas	50.0	50.2	0.2	0.4	Pass
High-range gas	85.0	85.7	0.7	0.8	Pass

Calibration Drift Data

Run 1-2

Gas Range	Initial Response (ppmv)	Final Response (ppmv)	Final Response Error (% of calibration)	Drift (% of span)	Pass/Fail
Zero gas	-0.3	0.9	0.9	1.2	Pass
Low-range gas	29.5	29.6	1.3	0.1	Pass

Run 3

Gas Range	Initial Response (ppmv)	Final Response (ppmv)	Final Response Error (% of calibration)	Drift (% of span)	Pass/Fail
Zero gas	0.9	0.7	0.7	0.2	Pass
Low-range gas	29.6	30.8	2.7	1.2	Pass

Runs 4-6

Gas Range	Initial Response (ppmv)	Final Response (ppmv)	Final Response Error (% of calibration)	Drift (% of span)	Pass/Fail
Zero gas	0.7	-0.7	-0.7	1.4	Pass
Low-range gas	30.8	29.7	1.0	1.1	Pass

Run 7-10

Gas Range	Initial Response (ppmv)	Final Response (ppmv)	Final Response Error (% of calibration)	Drift (% of span)	Pass/Fail
Zero gas	-0.7	0.9	0.9	1.6	Pass
Low-range gas	29.7	31.2	4.0	1.5	Pass

Final response(s) must be ±5% of cylinder value **and** drift must be less than ±3% of span. If both criteria are met, test is considered valid without comment

Airgas
an Air Liquide company

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

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED HYDROCARBON

Part Number:	X04NI99C15A00X1	Reference Number:	160-401674875-1
Cylinder Number:	CC716034	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
Analysis Date:	Dec 10, 2019	Valve Outlet:	350SS
Lot Number:	160-401674875-1	Expiration Date:	Dec 10, 2020

Traceability Statement: Hydrocarbon Process standards are NIST traceable either directly by weight or by comparison to Airgas laboratory standards that are directly NIST traceable by weight.

CERTIFIED CONCENTRATIONS

Component	Requested Concentration	Reported Mole %	Accuracy
SULFUR HEXAFLUORIDE	10.00 PPM	10.42 PPM	+/- 5%
ACETALDEHYDE	100.0 PPM	100.8 PPM	+/- 2%
METHANOL	100.0 PPM	100.3 PPM	+/- 2%
NITROGEN	Balance	Balance	

Approved for Release

Airgas
an Air Liquide company

Airgas Great Lakes region
Airgas USA, LLC
1290 Combermere Dr.
Troy, MI 48083
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Customer:	BUREAU VERITAS NORTH AMERICA		
Part Number:	E02NI99E15A0101	Reference Number:	32-401081502-1
Cylinder Number:	CC27329.	Cylinder Volume:	144.4 CF
Laboratory:	112 - Troy-32 (SAP) - MI	Cylinder Pressure:	2015 PSIG
PGVP Number:	B62017	Valve Outlet:	350
Gas Code:	CO,BALN	Certification Date:	Dec 26, 2017

Expiration Date: Dec 26, 2025

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 MONOXIDE	1000 PPM	1005 PPM	G1	+/- 1% NIST Traceable	12/26/2017
NITROGEN	Balance			-	

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	05-1620	KAL004479	970.00 PPM CARBON MONOXIDE/NITROGEN	+/-0.36%	May 14, 2021

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
E/N 54 Nicolet 6700 CO	FTIR	Dec 01, 2017

Triad Data Available Upon Request

Signature on file
Approved for Release

Airgas Great Lakes region
Airgas USA, LLC
1290 Combermere Dr.
Troy, MI 48083
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Customer:	BUREAU VERITAS NORTH AMERICA		
Part Number:	X02NI99C15A1268	Reference Number:	32-401202132-1
Cylinder Number:	ALM033173	Cylinder Volume:	144.4 CF
Laboratory:	112 - Troy-32 (SAP) - MI	Cylinder Pressure:	2015 PSIG
Analysis Date:	May 14, 2018	Valve Outlet:	350
Lot Number:	32-401202132-1		

Expiration Date: May 14, 2021

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	96.74 PPM	+/- 2%
NITROGEN	Balance		

Signature on file

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS

Grade of Product: CEM-CAL ZERO

Part Number:	NI CZ15A	Reference Number:	32-401913205-1
Cylinder Number:	AAL-17660	Cylinder Volume:	142.0 CF
Laboratory:	112 - Troy-32 (SAP) - MI	Cylinder Pressure:	2000 PSIG
Analysis Date:	Sep 21, 2020	Valve Outlet:	580
Lot Number:	32-401913205-1		

Expiration Date: Sep 21, 2028

ANALYTICAL RESULTS

Component	Requested Purity	Certified Concentration
NITROGEN	99.9995 %	99.9995 %
CARBON DIOXIDE	< 1.0 PPM	0.090 PPM
NOx	< 0.1 PPM	<LDL 0.016 PPM
SO2	< 0.1 PPM	<LDL 0.091 PPM
THC	< 0.1 PPM	<LDL 0.024 PPM
CARBON MONOXIDE	< 0.5 PPM	<LDL 0.044 PPM

Permanent Notes: Airgas certifies that the contents of this cylinder meet the requirements of 40 CFR 72.2

Impurities verified against analytical standards traceable to NIST by weight and/or analysis.

Signature on file

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Customer:	APEX CO LLC		
Part Number:	E02AI99E15A1223	Reference Number:	32-401744856-1
Cylinder Number:	ALM-036155	Cylinder Volume:	146.2 CF
Laboratory:	112 - Troy-32 (SAP) - MI	Cylinder Pressure:	2015 PSIG
PGVP Number:	B62020	Valve Outlet:	590
Gas Code:	PPN,BALA	Certification Date:	Mar 02, 2020

Expiration Date: Mar 02, 2028

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 mole/mole 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
PROPANE	110.0 PPM	110.0 PPM	G1	+/- 0.9% NIST Traceable	03/02/2020
AIR	Balance			-	

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	010104	K025820	99.8 PPM PROPANE/AIR	+/-0.6%	May 03, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
E/N 54 Nicolet 6700 C3	FTIR	Feb 07, 2020

Triad Data Available Upon Request

Signature on file

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Customer:	APEX CO LLC		
Part Number:	E02AI99E15A00W3	Reference Number:	32-401744857-1
Cylinder Number:	ALM-014745	Cylinder Volume:	146.3 CF
Laboratory:	112 - Troy-32 (SAP) - MI	Cylinder Pressure:	2015 PSIG
PGVP Number:	B62020	Valve Outlet:	590
Gas Code:	PPN,BALA	Certification Date:	Mar 02, 2020

Expiration Date: Mar 02, 2028

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 mole/mole 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
PROPANE	1100 PPM	1113 PPM	G1	+/- 0.7% NIST Traceable	03/02/2020
AIR	Balance			-	

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	020105	SGP-1D006966	1186 PPM PROPANE/AIR	+/-0.6%	Nov 08, 2022

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
E/N 54 Nicolet 6700 C3	FTIR	Feb 07, 2020

Triad Data Available Upon Request

Signature on file

Approved for Release

Appendix B
Sample Calculations

Sample Calculations

Note: Values obtained through sample calculations may deviate from that presented within the report based upon rounding differences.

B.1 Stack Gas Volumetric Flowrate

Moisture Content

$V_{wc} = K_1 \cdot V_1$ for measurement of the volume of water

$V_{wc} = K_2 \cdot W_1$ for measurement of the mass of water

$V_{wsg} = K_2 \cdot W_2$

Where:

V_{wc}	=	volume of water vapor condensed in impingers at standard conditions (ft^3)
V_1	=	volume of water collected within impingers (ml)
W_1	=	mass of water collected in impingers (g)
K_1	=	0.04706 ft^3/ml water
V_{wsg}	=	volume of water vapor collected in silica gel at standard conditions (ft^3)
W_2	=	mass of water collected by silica gel (g)
K_2	=	0.04715 ft^3/g water

For example, if 276.9 grams of water were condensed in the impingers and 6.9 grams of water were collected by the silica gel, the volume of water collected in each section of the sampling train, in ft^3, would be calculated as follows:

$$V_{wc} = \left(0.04715 \frac{ft^3}{g}\right)(276.9\ g) = 13.0558\ ft^3$$

$$V_{wsg} = \left(0.04715 \frac{ft^3}{g}\right)(6.9\ g) = 0.3253\ ft^3$$

The total volume of water collected = $V_{wc} + V_{wsg}$

= $13.06\ ft^3 + 0.32\ ft^3 = 13.38 ft^3$

Gas Volume Standardization

$$V_{std} = V_m Y_m \left(\frac{T_{std}}{P_{std}}\right)\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m}\right)$$

Where:

V_{std}	=	volume of gas sampled at standard conditions (ft^3, standard)
V_m	=	volume of gas measured by dry gas meter (ft^3)
Y_m	=	dry-gas meter correction factor (dimensionless)
T_{std}	=	standard temperature ($528^oR = 460 + 68^oF$)
P_{std}	=	standard pressure (29.92 in Hg)
P_b	=	barometric pressure (in Hg)
ΔH	=	average orifice differential pressure (in H_2O)
T_m	=	average meter temperature (^oR)

For example, using the following values, the volume of gas sampled, corrected to standard conditions, is calculated:

V_m	=	volume of gas measured by dry-gas meter	=	25.527 ft^3
Y_m	=	dry-gas meter correction factor (dimensionless)	=	0.996
T_{std}	=	standard temperature ($528^oR = 460 + 68^oF$)	=	528 ^oR
P_{std}	=	standard pressure (in Hg)	=	29.92 in Hg
P_b	=	barometric pressure (in Hg)	=	28.5 in Hg
ΔH	=	average orifice differential pressure (in H_2O)	=	1.76 in H_2O
T_m	=	average meter temperature (^oR)	=	506.6^oR

$$V_{std} = (25.527\ \mathrm{ft}^3)(0.996)\left(\frac{528°\mathrm{R}}{29.92\ \mathrm{in\ Hg}}\right)\left(\frac{28.5\ \mathrm{in\ Hg} + \frac{1.76\ \mathrm{in\ H_2O}}{13.6\frac{\mathrm{in\ H_2O}}{\mathrm{in\ Hg}}}}{506.6°\mathrm{R}}\right) = 25.357\ \mathrm{ft}^3, \mathrm{std}$$

Moisture Fraction

$$B_{ws} = \frac{V_{wc} + V_{wsg}}{V_{wc} + V_{wsg} + V_{std}}$$

Where:

B_{ws} = exhaust gas moisture content

For example, using previously calculated values above, the exhaust gas moisture content is computed as follows:

$$B_{ws} = \frac{13.38\ \text{ft}^3}{13.38\ \text{ft}^3 + 25.357\ \text{ft}^3} = 0.3454 = 34.54\%$$

Absolute Stack Gas Temperature, T_s (^oR)

$$T_s = 460 + t_s$$

Where:

t_s = measured stack gas temperature (^oF)

For example, if the average stack temperature was 223^oF, then the average absolute stack gas temperature is

$T_s = 460 + 223 = 683^oR$

Absolute Stack Gas Pressure, P_s (in Hg)

$$P_s = P_{bar} + \left(\frac{P_{stat}}{13.6}\right)$$

Where:

P_{bar} = barometric pressure at test site (in Hg)
P_{stat} = stack static pressure (in H_2O)
13.6 = specific gravity of mercury (in H_2O/in Hg)

For example, if the barometric and stack static pressures were 28.5 in Hg, and -0.6222 in H_2O, respectively, the absolute stack pressure would be calculated as:

$$P_s = 28.5 + \left(\frac{-0.6222}{13.6}\right) = 28.45\ \text{inHg}$$

Stack Gas Molecular Weight, Dry Basis (lb/lb-mole)

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$

For example, if the average O_2 content of the exhaust gas stream was 14%, the CO_2 content of the gas stream was 6%, and the CO content was assumed to be negligible, the N_2 content is assumed to be the balance of the gas content (i.e. 100 – 14 – 6 = 80%). The dry stack gas molecular weight would be computed as follows:

$$M_d = 0.44(6\%) + 0.32(14\%) + 0.28(80\%) = 29.52 \frac{\text{lb}}{\text{lb}-\text{mole}}$$

Stack Gas Molecular Weight, Wet Basis (lb/lb-mole)

$$M_s = M_d\left(1 - \frac{B_{ws}}{100}\right) + 18\frac{\text{lb}}{\text{lb - mole}}\left(\frac{B_{ws}}{100}\right)$$

If the measured stack gas moisture content was 34.54%, then the wet stack gas molecular weight would be:

$$M_s = 29.52\frac{\text{lb}}{\text{lb} - \text{mole}}\left(1 - \frac{34.54}{100}\right) + 18\frac{\text{lb}}{\text{lb} - \text{mole}}\left(\frac{34.54}{100}\right) = 25.54\frac{\text{lb}}{\text{lb} - \text{mole}}$$

Stack Gas Velocity, V_s (ft/min)

$$V_s = \left(60\frac{\text{sec}}{\text{min}}\right) K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_s}{P_s M_s}}$$

Where:

K_p = Pitot tube constant equal to 85.49 $\frac{\text{ft}}{\text{sec}}\sqrt{\frac{(\text{lb/lb}-\cdot\text{mole})(\text{in Hg})}{(^{\circ}\text{R})(\text{in } H_2O)}}$

C_p = Pitot tube coefficient, dimensionless

$\left(\sqrt{\Delta P}\right)_{avg}$ = average square root of the velocity head of stack gas [(in H_2O)$^{0.5}$]

M_s = molecular weight of the stack gas, wet basis (lb/lb-mole)

For example, if the average of the square root of the velocity heads of the stack gas was 0.6367 (in H_2O)$^{0.5}$, and using values already calculated, the average stack gas velocity would be calculated as follows:

$$V_s = \left(60\,\frac{\text{sec}}{\text{min}}\right)\left(85.49\,\frac{\text{ft}}{\text{sec}}\sqrt{\frac{\left(\frac{\text{lb}}{\text{lb}-\text{mole}}\right)(\text{inHg})}{(°\text{R})(\text{in H}_2\text{O})}}\right)(0.84)$$

$$\times\, 0.6367\ (\text{in H}_2\text{O})^{0.5}\sqrt{\frac{683°\text{R}}{(28.45\ \text{inHg})\left(25.54\,\frac{\text{lb}}{\text{lb}-\text{mole}}\right)}} = 2{,}660\,\frac{\text{ft}}{\text{min}}$$

Average Stack Gas Volumetric Flowrate, Q_s (cfm)

$$Q_s = V_s \cdot A$$

Where:

V_s = stack gas velocity (ft/min)

A = cross-sectional area of stack (ft^2)

For example, if the exhaust stack has a diameter of 105 inches, then the cross-sectional area of the stack would be:

$$\frac{\pi}{4}\left(\frac{105\ \text{in}}{12\,\frac{\text{in}}{\text{ft}}}\right)^2 = 60.132\text{ft}^2$$

If the stack gas velocity was measured to be 2,660 ft/min, the stack gas volumetric flowrate is:

$$Q_s = \left(2{,}660\,\frac{\text{ft}}{\text{min}}\right)(60.132\ \text{ft}^2) = 159{,}942\,\frac{\text{ft}^3}{\text{min}}$$

Standard Stack Gas Volumetric Flowrate, Q_{std} (scfm)

$$Q_{std} = Q_s \left(\frac{528\ ^oR}{T_s} \right) \left(\frac{P_s}{29.92\ \text{in Hg}} \right)$$

Where:

T_s = absolute stack gas temperature (^oR)
P_s = absolute stack gas pressure (in Hg)

For example, to standardize the values calculated above, the standard stack gas volumetric flowrate would be calculated as follows:

$$Q_{std} = 159{,}942 \frac{ft^3}{min} \left(\frac{528°R}{683°R} \right) \left(\frac{28.45\ inHg}{29.92\ inHg} \right) = 117{,}544 \frac{ft^3}{min}, standard$$

Dry Standard Stack Gas Volumetric Flowrate, $Q_{std,dry}$ (dscfm)

$$Q_{std,dry} = Q_{std} (1 - B_{ws})$$

The dry standard stack gas volumetric flowrate would be calculated as follows:

$$Q_{std,dry} = \left(117{,}544 \frac{ft^3}{min}, standard \right) (1 - 0.3454) = 76{,}942 \frac{ft^3}{min}, standard, dry$$

B.2 Pollutant Concentration and Emission Rate

Concentration as mg/m³

$$C = C_{Gas}\left(\frac{MW}{24.04}\right)$$

Where:

C	=	concentration, mg/m^3
C_{Gas}	=	effluent gas concentration adjusted for bias, ppmv
MW	=	molecular weight as gram-mole
24.04	=	ideal gas molar volume at standard temperature (68°F) and pressure (29.92 in. Hg), L/mole

For example, if the corrected carbon monoxide concentration was 130.3 ppmv, the molecular weight of carbon monoxide is 28.01 grams per mole. The concentration in mg/m^3 is calculated as follows:

$$C = \frac{130.3}{1{,}000{,}000}\left(\frac{28.01\text{gram}}{\text{mole}}\right)\left(\frac{1\text{mole}}{24.04\text{ L}}\right)\left(\frac{1{,}000\text{L}}{\text{m}^3}\right)\left(\frac{1{,}000\text{ mg}}{1\text{ gram}}\right) = 151.84\,\frac{\text{mg}}{\text{m}^3}$$

Mass Emission Rate

$$(\text{lb/hr}) = CQ\left[\frac{\left(60\,\frac{\text{min}}{\text{hr}}\right)}{\left(453{,}590\,\frac{\text{mg}}{\text{lb}}\right)\left(35.31\,\frac{\text{ft}^3}{\text{m}^3}\right)}\right]$$

Where:

Q	=	flowrate (scfm)

For example, if the dry standardized flowrate was 76,942 dscfm, then the carbon monoxide mass emission rate is calculated as follows:

$$\left(\frac{\text{lb}}{\text{hr}}\right) = \left(151.84\,\frac{\text{mg}}{\text{m}^3}\right)\left(76{,}942\,\frac{\text{dry standard ft}^3}{\text{min}}\right)\left[\frac{\left(60\,\frac{\text{min}}{\text{hr}}\right)}{\left(453{,}590\,\frac{\text{mg}}{\text{lb}}\right)\left(35.31\,\frac{\text{ft}^3}{\text{m}^3}\right)}\right] = 43.77\,\frac{\text{lb}}{\text{hr}}$$

B.3 Relative Accuracy

Calculation of Standard Deviation of Data Set

$$S_d = \sqrt{\frac{\sum_{i=1}^{n} d_i^{\,2} - \left[\frac{\left(\sum_{i=1}^{n} d_i\right)^2}{n}\right]}{n-1}}$$

Where:

S_d = standard deviation of a sample set
di = difference between a reference method value and the corresponding continuous emission monitoring system value (RM_i-CEM_i), for a given data point
n = number of test runs

For example, the standard deviation of the differences between a reference method values and the corresponding continuous emission monitoring values for the 9 selected test runs was 1.6 lb/hr.

Calculation of Confidence Coefficient

$$cc = t_{0.025}\frac{S_d}{\sqrt{n}}$$

Where:

S_d = 2.35 lb/hr (for 9 test runs)
$t_{0.025}$ = t value = 2.306 (for 9 test runs)
n = 9 test runs

For example, the CO confidence coefficient for the test runs is:

$$cc = 2.306 \times \frac{2.35\ \text{lb/hr}}{\sqrt{9}} = 1.80\ \text{lb/hr}$$

Calculation of Relative Accuracy

$$RA = \frac{|d_{avg}| + |cc|}{RM_{avg}} \times 100$$

Where:

RA = Relative Accuracy

d_{avg} = The actual value of the mean difference between the reference method values and the corresponding CEM system values

RM_{avg} = Arithmetic mean of the reference method values (permit limit used if <50% of standard)

For example,

d_{avg} = -8.9 lb/hr

cc = 1.80 lb/hr

RM_{avg} = 147.3 lb/hr (permit limit is used)

Consequently:

$$RA = \frac{|-8.9| + |1.80|}{147.3} \text{ x } 100 = 7.3\%$$

B.4 Formaldehyde Reduction

$$\mathrm{PR} = \mathrm{CE}\left(\frac{\mathrm{ER_{in}} - \mathrm{ER_{out}}}{\mathrm{ER_{in}}}\right) \cdot 100$$

Where:	PR	=	Percent reduction (%)
	CE	=	capture efficiency (%)
	$\mathrm{ER_{in}}$	=	Emission rate of formaldehyde in the inlet vent stream of the control device (lb/hr)
	$\mathrm{ER_{out}}$	=	Emission rate of formaldehyde in the outlet vent stream of the control device (lb/hr)

Weyerhaueser informed Apex Companies that the capture efficiency was 100% based on its evaluation. Using an inlet mass emission rate of 4.4 lb/hr and an outlet mass emission rate of 0.05 lb/hr, the formaldehyde reduction is:

$$PR = (100\%)\left(\frac{4.4\frac{lb}{hr} - 0.05\frac{lb}{hr}}{4.4\frac{lb}{hr}}\right) * 100 = 98.9\%$$

Appendix C
Field Data Sheets

Run

Inlet 1

APEX

Date 12/4/20
Time 7:53

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility: Weyerhaeuser
Operators: TMZ
Sampling Location: Biofilter Inlet
Pitot Tube: S9
Stack Diameter, in: 84
Area, ft^2:
Pitot Tube Factor, C_p: 0.84
Stack Dimension, in: NA
Port Length, in: 3
Cyclonic Flow Check: ✓
Gas Temperature, °F WB: NA
Abs. Bar. Press., in Hg: 28.9
Gas Temperature, °F DB: 108
P_{bar}, Bar. Press., in Hg:
% CO_2: 0
% CO: 0
P_{stat}, Static Press., in H_2O: 1.504
% O_2: 21
% N_2: 79
% Moisture, v/v:
Pre-Test Pitot Leak Rate: Electronic in H_2O for 1 min a ____ in H_2O
Molecular Weight, M_d:
Post-Test Pitot Leak Rate: ____ in H_2O for 1 min a ____ in H_2O
Molecular Weight, M_s:

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(\text{in } H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.5694	107		0		
	7	0.6170	107		0		
	6	0.7743	107		0		
	5	0.7585	108		0		
	4	0.7032	108		0		
	3	0.6971	108		0		
	2	0.6956	108		0		
	1	0.4451	108		0		
S	8	0.5729	106		0		
	7	0.4882	107		5		
	6	0.5075	107		0		
	5	0.7041	108		0		
	4	0.8768	108		0		
	3	0.7358	108		0		
	2	0.7350	108		0		
	1	0.4967	108		5		
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	- in Hg
V_s	**#DIV/0!** ft/min
Q_s	**#DIV/0!** cfm
Q_{std}	**#DIV/0!** scfm
Q	**#DIV/0!** dscfm

Run

Inlet 2

APEX

Date 12/9/20
Time 4:04

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility Weyerhaeuser **Operators** TM

Sampling Location Biofilter Inlet **Pitot Tube** S9

Stack Diameter, in 84 **Area, ft^2** ______ **Pitot Tube Factor, C_p** 0.84

Stack Dimension, in NA **Port Length, in** 3 **Cyclonic Flow Check** ✓

Gas Temperature, ˚F WB NA **Abs. Bar. Press., in Hg** 28.4

Gas Temperature, ˚F DB ______ **P_{bar}, Bar. Press., in Hg** ______

% CO_2 0 **% CO** 0 **P_{stat}, Static Press., in H_2O** 1.345

% O_2 21 **% N_2** 79 **% Moisture, v/v** ______

Pre-Test Pitot Leak Rate Electronic in H_2O for 1 min a ______ in H_2O **Molecular Weight, M_d** ______

Post-Test Pitot Leak Rate ______ in H_2O for 1 min a ______ in H_2O **Molecular Weight, M_s** ______

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.4456	106				
	7	0.5599	106				
	6	0.6985	106				
	5	0.6835	106				
	4	0.7085	107				
	3	0.7105	107				
	2	0.7270	107				
	1	0.4585	108				
5	8	0.4418	107				
	7	0.4488	107				
	6	0.5807	107				
	5	0.6486	107				
	4	0.7589	107				
	3	0.~~8204~~7402	107				
	2	0.~~8004~~5738	107				
	1	0.5760	107				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

Inlet 3

APEX

Date 12/9/20
Time 10:34

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	Biofilter Inlet			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	✓
Gas Temperature, °F WB	NA			**Abs. Bar. Press., in Hg**	28.4
Gas Temperature, °F DB				**P_{bar}, Bar. Press., in Hg**	
% CO_2	0	**% CO**	0	**P_{stat}, Static Press., in H_2O**	1.300
% O_2	21	**% N_2**	79	**% Moisture, v/v**	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min a	in H_2O	**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min a	in H_2O	**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.4839	108				
	7	0.3345	108				
	6	0.5405	108				
	5	0.6046	108				
	4	0.6302	108				
	3	0.6437	108				
	2	0.5039	108				
	1	0.4252	108				
S	8	0.5534	108				
	7	0.5684	108				
	6	0.6887	108				
	5	0.7967	108				
	4	0.5908	108				
	3	0.6391	108				
	2	0.5515	108				
	1	0.5082	108				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

1 Out

APEX

Date 12/9/20
Time 7:30

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility Weyerhaeuser **Operators** TMZ
Sampling Location Biofilter Outlet **Pitot Tube** 59
Stack Diameter, in 84 **Area, ft²** **Pitot Tube Factor, C_p** 0.84
Stack Dimension, in NA **Port Length, in** 3 **Cyclonic Flow Check** ✓
Gas Temperature, °F WB NA **Abs. Bar. Press., in Hg** 28.4
Gas Temperature, °F DB 83 **P_{bar}, Bar. Press., in Hg**
% CO_2 0 **% CO** 0 **P_{stat}, Static Press., in H_2O** 0.5113
% O_2 21 **% N_2** 79 **% Moisture, v/v**
Pre-Test Pitot Leak Rate Electronic in H_2O for 1 min at ____ in H_2O **Molecular Weight, M_d**
Post-Test Pitot Leak Rate ____ in H_2O for 1 min at ____ in H_2O **Molecular Weight, M_s**

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(\text{in } H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.5328	83		0		
	7	0.5604	83		0		
	6	0.5717	83		0		
	5	0.6610	83		0		
	4	0.7692	83		0		
	3	0.7109	84		0		
	2	0.5887	83		0		
	1	0.3438	83		0		
S	8	0.4266	83		0		
	7	0.4130	83		0		
	6	0.5654	83		0		
	5	0.7316	83		0		
	4	0.7305	83		0		
	3	0.6952	83		0		
	2	0.6221	83		0		
	1	0.4058	83		0		
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

2 Outlet

APEX

Date	12/9/20
Time	7:48

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	[illegible]
Sampling Location	Biofilter Outlet			**Pitot Tube**	S9
Stack Diameter, in	84	**Area, ft²**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	✓
Gas Temperature, ˚F WB	NA			**Abs. Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	82			**P_{bar}, Bar. Press., in Hg**	
% CO_2	0	**% CO**	0	**P_{stat}, Static Press., in H_2O**	0.6006
% O_2	21	**% N_2**	79	**% Moisture, v/v**	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min a ____ in H_2O		**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min a ____ in H_2O		**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.4967	81				
	7	0.7150	81				
	6	0.7693	81				
	5	0.7193	81				
	4	0.5587	81				
	3	0.4818	82				
	2	0.3476	82				
	1	0.4031	82				
S	8	0.5731	82				
	7	0.5946	82				
	6	0.6279	82				
	5	0.6329	82				
	4	0.6782	82				
	3	0.5538	82				
	2	0.4446	82				
	1	0.4360	82				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

3 Outlet

APEX

Date 12/9/20
Time 8:14

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser	**Operators**	TAE
Sampling Location	Biofilter Outlet	**Pitot Tube**	59
Stack Diameter, in	84	**Pitot Tube Factor, C_p**	0.84
Area, ft^2		**Cyclonic Flow Check**	✓
Stack Dimension, in	NA	**Abs. Bar. Press., in Hg**	28.4
Port Length, in	3	**P_{bar}, Bar. Press., in Hg**	
Gas Temperature, °F WB	NA	**P_{stat}, Static Press., in H_2O**	0.6846
Gas Temperature, °F DB	83	**% Moisture, v/v**	
% CO_2	0	**Molecular Weight, M_d**	
% CO	0	**Molecular Weight, M_s**	
% O_2	21		
% N_2	79		
Pre-Test Pitot Leak Rate	Electronic in H_2O for 1 min at ___ in H_2O		
Post-Test Pitot Leak Rate	in H_2O for 1 min at ___ in H_2O		

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.4069	83				
	7	0.8103	83				
	6	0.8861	83				
	5	0.9788	83				
	4	0.7243	83				
	3	0.6240	83				
	2	0.3619	83				
	1	0.3460	83				
S	8	0.3689	83				
	7	0.5381	83				
	6	0.6614	83				
	5	0.6714	83				
	4	0.6835	83				
	3	0.5932	84				
	2	0.4178	84				
	1	0.3357	84				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

4 Outlet

APEX

Date	12/4/20
Time	8:30

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	[illegible]
Sampling Location	Biofilter Outlet			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	✓
Gas Temperature, °F WB	NA			**Abs. Bar. Press., in Hg**	28.4
Gas Temperature, °F DB	85			**P_{bar}, Bar. Press., in Hg**	
% CO_2	0	**% CO**	0	**P_{stat}, Static Press., in H_2O**	0.5830
% O_2	21	**% N_2**	79	**% Moisture, v/v**	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min at	in H_2O	**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min at	in H_2O	**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(\text{in } H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.7038	85				
	7	0.7051	85				
	6	0.7126	87				
	5	0.7643	84				
	4	0.6590	85				
	3	0.5736	85				
	2	0.5503	85				
	1	0.5691	85				
S	8	0.5071	85				
	7	0.4687	85				
	6	0.5230	85				
	5	0.6936	85				
	4	0.6990	85				
	3	0.6981	85				
	2	0.6321	85				
	1	0.4276	86				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	- in Hg
V_s	**#DIV/0!** ft/min
Q_s	**#DIV/0!** cfm
Q_{std}	**#DIV/0!** scfm
Q	**#DIV/0!** dscfm

Run

S Out

APEX

Date 12/9/20
Time 9:06

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			Operators	TMC
Sampling Location	Biofilter outlet			Pitot Tube	S9
Stack Diameter, in	84	Area, ft^2		Pitot Tube Factor, C_p	0.84
Stack Dimension, in	NA	Port Length, in	3	Cyclonic Flow Check	✓
Gas Temperature, °F WB	NA			Abs. Bar. Press., in Hg	28.4
Gas Temperature, °F DB	84			P_{bar}, Bar. Press., in Hg	0
% CO_2	0	% CO	0	P_{stat}, Static Press., in H_2O	0.5383
% O_2	21	% N_2	79	% Moisture, v/v	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min a	in H_2O	Molecular Weight, M_d	
Post-Test Pitot Leak Rate		in H_2O for 1 min a	in H_2O	Molecular Weight, M_s	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.5921	83				
	7	0.5157	83				
	6	0.5953	83				
	5	0.7297	83				
	4	0.7563	83				
	3	0.7304	83				
	2	0.6517	83				
	1	0.9207	83				
S	8	0.4207	81				
	7	0.5919	83				
	6	0.7576	83				
	5	0.7478	82				
	4	0.7234	83				
	3	0.5774	83				
	2	0.5304	83				
	1	0.3296	83				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

6 Out

APEX

Date 12/14/20

Time 9:29

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	Biofilter Outlet			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	✓
Gas Temperature, °F WB	NA			**Abs. Bar. Press., in Hg**	28.4
Gas Temperature, °F DB				**P_{bar}, Bar. Press., in Hg**	
% CO_2 0		**% CO**	0	**P_{stat}, Static Press., in H_2O**	0.6272
% O_2 21		**% N_2**	79	**% Moisture, v/v**	4
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min a	in H_2O	**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min a	in H_2O	**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.3525	87				
	7	0.6053	87				
	6	0.7384	87				
	5	0.9157	87				
	4	0.6605	87				
	3	0.4984	87				
	2	0.3981	87				
	1	0.3598	87				
S	8	0.6198	87				
	7	0.6966	87				
	6	0.7014	87				
	5	0.7016	87				
	4	0.6876	87				
	3	0.6903	87				
	2	0.4847	87				
	1	0.5078	87				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

7 Out

APEX

Date 12/9/20

Time 9:49

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	MC
Sampling Location	Biofilter Outlet			**Pitot Tube**	S9
Stack Diameter, in	84	**Area, ft^2**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	✓
Gas Temperature, °F WB	NA			**Abs. Bar. Press., in Hg**	28.4
Gas Temperature, °F DB				**P_{bar}, Bar. Press., in Hg**	
% CO_2	0	**% CO**	0	**P_{stat}, Static Press., in H_2O**	0.5616
% O_2	21	**% N_2**	79	**% Moisture, v/v**	4
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min at	in H_2O	**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min at	in H_2O	**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.~~[illegible]~~ 1747	81				
	7	0.6923	81				
	6	0.7269	81				
	5	0.7095	81				
	4	0.7528	81				
	3	0.6458	81				
	2	0.6841	81				
	1	0.5965	81				
S	8	0.3865	81				
	7	0.3418	81				
	6	0.2290	81				
	5	0.5507	81				
	4	0.6487	81				
	3	0.6466	81				
	2	0.5659	81				
	1	0.5277	81				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

8 Out

APEX

Date 12/9/20
Time 10:30

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TK
Sampling Location	Biofilter Outlet			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	✓
Gas Temperature, °F WB	NA			**Abs. Bar. Press., in Hg**	28.4
Gas Temperature, °F DB				**P_{bar}, Bar. Press., in Hg**	
% CO_2	0	**% CO**	0	**P_{stat}, Static Press., in H_2O**	0.5571
% O_2	21	**% N_2**	79	**% Moisture, v/v**	4
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min at	in H_2O	**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min at	in H_2O	**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.3788	81				
	7	0.3843	81				
	6	0.5846	81				
	5	0.7115	81				
	4	0.7525	81				
	3	0.7405	81				
	2	0.5849	81				
	1	0.3600	81				
S	8	0.8085	81				
	7	0.7258	81				
	6	0.7067	81				
	5	0.7166	81				
	4	0.7141	81				
	3	0.6551	81				
	2	0.5723	81				
	1	0.5336	81				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

9 Out

APEX

Date 12/9/20
Time 10:50

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	MZ
Sampling Location	Biofilter Outlet			**Pitot Tube**	S9
Stack Diameter, in	84	**Area, ft^2**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	✓
Gas Temperature, °F WB	NA			**Abs. Bar. Press., in Hg**	28.4
Gas Temperature, °F DB				**P_{bar}, Bar. Press., in Hg**	
% CO_2	0	**% CO**	0	**P_{stat}, Static Press., in H_2O**	0.5925
% O_2	21	**% N_2**	79	**% Moisture, v/v**	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min a	in H_2O	**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min a	in H_2O	**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(\text{in } H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.5276	87				
	7	0.5144	87				
	6	0.7191	87				
	5	0.6683	87				
	4	0.7627	87				
	3	0.8514	87				
	2	0.7886	87				
	1	0.7412	87				
S	8	0.4704	85				
	7	0.6247	85				
	6	0.7004	85				
	5	0.6852	86				
	4	0.6341	87				
	3	0.6014	87				
	2	0.4646	87				
	1	0.4723	87				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

10 Out

APEX

Date 12/9/20
Time 11:17

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	Biofilter Outlet			**Pitot Tube**	S9
Stack Diameter, in	84	**Area, ft^2**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	✓
Gas Temperature, °F WB	NA			**Abs. Bar. Press., in Hg**	
Gas Temperature, °F DB	83			**P_{bar}, Bar. Press., in Hg**	28.4
% CO_2	0	**% CO**	0	**P_{stat}, Static Press., in H_2O**	0.0587
% O_2	21	**% N_2**	79	**% Moisture, v/v**	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min at	in H_2O	**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min at	in H_2O	**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
T	8	0.5691	83				
	7	0.5982	83				
	6	0.6048	83				
	5	0.6476	83				
	4	0.6744	83				
	3	0.7154	83				
	2	0.6845	83				
	1	0.6519	83				
S	8	0.2982	83				
	7	0.6370	83				
	6	0.7124	83				
	5	0.6839	83				
	4	0.5859	83				
	3	0.4848	83				
	2	0.3777	83				
	1	0.4534	83				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	- in Hg
V_s	**#DIV/0!** ft/min
Q_s	**#DIV/0!** cfm
Q_{std}	**#DIV/0!** scfm
Q	**#DIV/0!** dscfm

Run

1

APEX

Date 12/10/20
Time 0655

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			Operators	TZ
Sampling Location	RTO Outlet			Pitot Tube	32
Stack Diameter, in	105	Area, ft^2		Pitot Tube Factor, C_p	0.84
Stack Dimension, in	NA	Port Length, in	6.5	Cyclonic Flow Check	✓
Gas Temperature, °F WB	NA			Abs. Bar. Press., in Hg	28.5
Gas Temperature, °F DB				P_{bar}, Bar. Press., in Hg	
% CO_2	6	% CO	0	P_{stat}, Static Press., in H_2O	-0.5814
% O_2	14	% N_2	80	% Moisture, v/v	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min at ___ in H_2O		Molecular Weight, M_d	
Post-Test Pitot Leak Rate		in H_2O for 1 min at ___ in H_2O		Molecular Weight, M_s	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos\theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.3907	236		0		
	3	0.3982	236		0		
	2	0.4301	236		0		
	1	0.2630	234		0		
B	4	0.4557	237		0		
	3	0.4146	237		0		
	2	0.3713	235		0		
	1	0.3154	235		0		
C	4	0.3866	236		0		
	3	0.4010	236		0		
	2	0.3083	236		0		
	1	0.1857	236		0		
D	4	0.3806	236		0		
	3	0.4491	235		0		
	2	0.4508	235		0		
	1	0.3907	238		0		
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

2

APEX

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date 12/10/20
Time 0707

Facility: Weyerhaeuser
Sampling Location: RTO Outlet
Stack Diameter, in: 105
Area, ft^2:
Stack Dimension, in: NA
Port Length, in: 6.5
Gas Temperature, °F WB: NA
Gas Temperature, °F DB:
% CO_2: 6
% CO: 0
% O_2: 14
% N_2: 80
Pre-Test Pitot Leak Rate: Electronic ___ in H_2O for 1 min a ___ in H_2O
Post-Test Pitot Leak Rate: ___ in H_2O for 1 min a ___ in H_2O

Operators: TMZ
Pitot Tube: 82
Pitot Tube Factor, C_p: 0.84
Cyclonic Flow Check: ✓
Abs. Bar. Press., in Hg: 28.5
P_{bar}, Bar. Press., in Hg:
P_{stat}, Static Press., in H_2O: -0.6593
% Moisture, v/v:
Molecular Weight, M_d:
Molecular Weight, M_s:

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.3958	241				
	3	0.4193	240				
	2	0.4509	239				
	1	0.3606	236				
B	4	0.3433	240				
	3	0.3044	240				
	2	0.3128	241				
	1	0.2132	240				
C	4	0.4556	239				
	3	0.4178	239				
	2	0.4842	239				
	1	0.3385	237				
D	4	0.3850	240				
	3	0.3199	242				
	2	0.4282	241				
	1	0.2090	241				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	- in Hg
V_s	#DIV/0! ft/min
Q_s	#DIV/0! cfm
Q_{std}	#DIV/0! scfm
Q	#DIV/0! dscfm

Run

3

APEX

Date 12/10/20
Time 0946

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	MZ
Sampling Location	RTO Outlet			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	✓
Gas Temperature, °F WB	NA			**Abs. Bar. Press., in Hg**	28.5
Gas Temperature, °F DB				**P_{bar}, Bar. Press., in Hg**	
% CO_2	6	**% CO**	0	**P_{stat}, Static Press., in H_2O**	-0.5968
% O_2	14	**% N_2**	80	**% Moisture, v/v**	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min a	in H_2O	**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min a	in H_2O	**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(\text{in } H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.3404	238				
	3	0.4212	237				
	2	0.3046	237				
	1	0.2386	237				
B	4	0.4541	239				
	3	0.4492	239				
	2	0.4948	240				
	1	0.3567	239				
C	4	0.3531	238				
	3	0.4279	238				
	2	0.4826	237				
	1	0.2560	232				
D	4	0.4853	236				
	3	0.4640	237				
	2	0.4259	238				
	1	0.3756	236				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

~~3~~ 4

APEX

Date 12/10/20
Time 1055

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			Operators	TR
Sampling Location	RTO Outlet			Pitot Tube	32
Stack Diameter, in	105	Area, ft^2		Pitot Tube Factor, C_p	0.84
Stack Dimension, in	NA	Port Length, in	6.5	Cyclonic Flow Check	✓
Gas Temperature, °F WB	NA			Abs. Bar. Press., in Hg	28.5
Gas Temperature, °F DB				P_{bar}, Bar. Press., in Hg	
% CO_2	0	% CO	0	P_{stat}, Static Press., in H_2O	-0.6305
% O_2	19	% N_2	80	% Moisture, v/v	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min at ___ in H_2O		Molecular Weight, M_d	
Post-Test Pitot Leak Rate		in H_2O for 1 min at ___ in H_2O		Molecular Weight, M_s	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.5141	217				
	3	0.5840	218				
	2	0.5306	217				
	1	0.2673	217				
B	4	0.4535	217				
	3	0.3696	217				
	2	0.3505	217				
	1	0.1767	214				
C	4	0.4886	218				
	3	0.4241	218				
	2	0.4369	217				
	1	0.3481	217				
D	4	0.4374	219				
	3	0.4208	219				
	2	0.4119	217				
	1	0.3706	217				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	#DIV/0!	ft/min
Q_s	#DIV/0!	cfm
Q_{std}	#DIV/0!	scfm
Q	#DIV/0!	dscfm

Run

5

APEX

Date 12/10/20
Time 1111

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			Operators	TMZ
Sampling Location	RTO Outlet			Pitot Tube	028932
Stack Diameter, in	105	Area, ft^2		Pitot Tube Factor, C_p	0.84
Stack Dimension, in	NA	Port Length, in	6.5	Cyclonic Flow Check	✓
Gas Temperature, °F WB	NA			Abs. Bar. Press., in Hg	28.5
Gas Temperature, °F DB				P_{bar}, Bar. Press., in Hg	
% CO_2	6	% CO	0	P_{stat}, Static Press., in H_2O	-0.6217
% O_2	14	% N_2	80	% Moisture, v/v	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min a ___ in H_2O		Molecular Weight, M_d	
Post-Test Pitot Leak Rate		in H_2O for 1 min a ___ in H_2O		Molecular Weight, M_s	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(\text{in } H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.5056	222				
	3	0.5157	222				
	2	0.5092	222				
	1	0.2787	222				
B	4	0.4432	225				
	3	0.3796	225				
	2	0.3651	225				
	1	0.2101	225				
C	4	0.4947	221				
	3	0.4136	221				
	2	0.4259	221				
	1	0.3317	221				
D	4	0.4269	224				
	3	0.4418	224				
	2	0.4066	224				
	1	0.2597	223				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	- in Hg
V_s	#DIV/0! ft/min
Q_s	#DIV/0! cfm
Q_{std}	#DIV/0! scfm
Q	#DIV/0! dscfm

Run

6

APEX

Date 12/10/20
Time 1147

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			Operators	TMZ
Sampling Location	RTO Outlet			Pitot Tube	32
Stack Diameter, in	105	Area, ft^2		Pitot Tube Factor, C_p	0.84
Stack Dimension, in	NA	Port Length, in	6.5	Cyclonic Flow Check	✓
Gas Temperature, °F WB	NA			Abs. Bar. Press., in Hg	28.5
Gas Temperature, °F DB				P_{bar}, Bar. Press., in Hg	
% CO_2	6	% CO		P_{stat}, Static Press., in H_2O	-0.6122
% O_2	14	% N_2		% Moisture, v/v	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min a	______in H_2O	Molecular Weight, M_d	
Post-Test Pitot Leak Rate		in H_2O for 1 min a	______in H_2O	Molecular Weight, M_s	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle (cos $\theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.4392	220				
	3	0.3876	220				
	2	0.3423	220				
	1	0.3778	220				
B	4	0.4532	220				
	3	0.4919	220				
	2	0.4349	220				
	1	0.3169	220				
C	4	0.4063	221				
	3	0.4011	221				
	2	0.3350	221				
	1	0.2240	221				
D	4	0.4748	222				
	3	0.5274	222				
	2	0.4243	222				
	1	0.2676	222				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

7

APEX

Date 12/10/20
Time 1219

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility: Weyerhaeuser
Operators: TMC
Sampling Location: RTO Outlet
Pitot Tube: 32
Stack Diameter, in: 105
Area, ft^2:
Pitot Tube Factor, C_p: 0.84
Stack Dimension, in: NA
Port Length, in: 6.5
Cyclonic Flow Check: ✓
Gas Temperature, °F WB: NA
Abs. Bar. Press., in Hg: 28.5
Gas Temperature, °F DB:
P_{bar}, Bar. Press., in Hg:
% CO_2: 6
% CO: 0
P_{stat}, Static Press., in H_2O: -0.6147
% O_2: 14
% N_2: 80
% Moisture, v/v:
Pre-Test Pitot Leak Rate: Electronic in H_2O for 1 min a ____ in H_2O
Molecular Weight, M_d:
Post-Test Pitot Leak Rate: in H_2O for 1 min a ____ in H_2O
Molecular Weight, M_s:

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.4727	221				
	3	0.4656	221				
	2	0.4392	221				
	1	0.3619	219				
B	4	0.4006	220				
	3	0.3927	220				
	2	0.3312	220				
	1	0.2582	220				
C	4	0.5208	217				
	3	0.4950	217				
	2	0.5114	217				
	1	0.2772	217				
D	4	0.4765	216				
	3	0.4064	216				
	2	0.3655	218				
	1	0.3319	218				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

8

APEX

Date 12/10/20
Time 1232

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	RTO Outlet			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft²**		**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	✓
Gas Temperature, °F WB	NA			**Abs. Bar. Press., in Hg**	28.5
Gas Temperature, °F DB				**P_{bar}, Bar. Press., in Hg**	
% CO_2	6	**% CO**	0	**P_{stat}, Static Press., in H_2O**	-0.6222
% O_2	14	**% N_2**	80	**% Moisture, v/v**	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min at ___ in H_2O		**Molecular Weight, M_d**	
Post-Test Pitot Leak Rate		in H_2O for 1 min at ___ in H_2O		**Molecular Weight, M_s**	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.4819	227				
	3	0.4517	224				
	2	0.4418	223				
	1	0.3522	222				
B	4	0.4109	226				
	3	0.3966	226				
	2	0.3401	225				
	1	0.2587	225				
C	4	0.5517	222				
	3	0.5066	222				
	2	0.5019	222				
	1	0.2857	222				
D	4	0.4665	221				
	3	0.4092	221				
	2	0.3675	224				
	1	0.3286	223				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	- in Hg
V_s	#DIV/0! ft/min
Q_s	#DIV/0! cfm
Q_{std}	#DIV/0! scfm
Q	#DIV/0! dscfm

Run

9

APEX

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date 12/10/20
Time 1259

Facility	Weyerhaeuser			Operators	WZ
Sampling Location	RTO Outlet			Pitot Tube	32
Stack Diameter, in	105	Area, ft^2		Pitot Tube Factor, C_p	0.84
Stack Dimension, in	N/A	Port Length, in	6.5	Cyclonic Flow Check	✓
Gas Temperature, °F WB	N/A			Abs. Bar. Press., in Hg	28.5
Gas Temperature, °F DB				P_{bar}, Bar. Press., in Hg	
% CO_2	6	% CO	0	P_{stat}, Static Press., in H_2O	-0.6055
% O_2	14	% N_2	80	% Moisture, v/v	
Pre-Test Pitot Leak Rate	Electronic	in H_2O for 1 min at	in H_2O	Molecular Weight, M_d	
Post-Test Pitot Leak Rate		in H_2O for 1 min at	in H_2O	Molecular Weight, M_s	

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.4214	220				
	3	0.4733	220				
	2	0.3636	220				
	1	0.2571	220				
B	4	0.4663	222				
	3	0.5025	222				
	2	0.5493	222				
	1	0.3264	222				
C	4	0.4575	221				
	3	0.4566	221				
	2	0.3464	221				
	1	0.2606	221				
D	4	0.4084	222				
	3	0.5223	222				
	2	0.5595	222				
	1	0.3547	222				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	- in Hg
V_s	**#DIV/0!** ft/min
Q_s	**#DIV/0!** cfm
Q_{std}	**#DIV/0!** scfm
Q	**#DIV/0!** dscfm

Run

10

APEX

Date 12/10/20
Time 1321

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility Weyerhaeuser **Operators** DMK
Sampling Location RTO Outlet **Pitot Tube** 32
Stack Diameter, in 105 **Area, ft^2** **Pitot Tube Factor, C_p** 0.84
Stack Dimension, in N/A **Port Length, in** 6.5 **Cyclonic Flow Check** ✓
Gas Temperature, °F WB N/A **Abs. Bar. Press., in Hg** 28.5
Gas Temperature, °F DB **P_{bar}, Bar. Press., in Hg**
% CO_2 6 **% CO** 0 **P_{stat}, Static Press., in H_2O** -0.6122
% O_2 14 **% N_2** 80 **% Moisture, v/v**
Pre-Test Pitot Leak Rate Electronic in H_2O for 1 min a ____ in H_2O **Molecular Weight, M_d**
Post-Test Pitot Leak Rate ____ in H_2O for 1 min a ____ in H_2O **Molecular Weight, M_s**

Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature °F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos\theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
A	4	0.4275	224				
	3	0.4819	224				
	2	0.3787	224				
	1	0.2717	224				
B	4	0.4881	225				
	3	0.5119	225				
	2	0.5247	225				
	1	0.3515	225				
C	4	0.4147	225				
	3	0.4229	225				
	2	0.3667	225				
	1	0.2788	225				
D	4	0.4119	226				
	3	0.5134	226				
	2	0.5219	225				
	1	0.2626	225				
Average		#DIV/0!	#DIV/0!	#DIV/0!			

Comments

P_s	-	in Hg
V_s	**#DIV/0!**	ft/min
Q_s	**#DIV/0!**	cfm
Q_{std}	**#DIV/0!**	scfm
Q	**#DIV/0!**	dscfm

Run

~~13~~ 1-2

Date: 12/10/20

Time: 0705

Field Data Sheet
Moisture Content (Reference)

Source ID: RTO Outlet
Company: Weyerhaeuser
Test Location: Grayling
Meter Yd:
Meter H@:
Pre-test Leak Rate: 0.000 CFM @ 5 in Hg
Post-test Leak Rate: 0.000 CFM @ 5 in Hg

Project #: 11020-000068.00
City/State: Grayling MI
Personnel: ~~MZ~~ DMK
Meter ID: 2
Barometric: 28.5

Traverse Point	Sample Time	Vacuum (in Hg)	Delta H (in H_2O)	Meter Volume (ft^3)	Meter Temperature Inlet (F)	Meter Temperature Outlet (F)	Impinger Temp. (F)
8	0	1	1.8	96.905	32	32	48
7	5	1		101.02	34	34	48
6	10	1		104.76	35	35	48
5	15	1		108.39	35	35	49
4	20	1		112.02	38	38	54
3	25	1		115.81	40	40	57
2	30	1		119.54	42	42	59
1	35	—		123.064	—	—	—
Averages:							

Analytical Data					
	Impinger Gain (g or ml)				Silica Gel Weight (g)
Final	V_f	876.8	760.6	661.0	W_f 933.8
Initial	V_i	703.2	734.2	648.4	W_i 921.8
Difference					

$V_{wc(std)} = 0.04707\ ft^3/ml\ of\ H_2O\ (V_f - V_i)$ $V_{wsg(std)} = 0.04715\ ft^3/g\ of\ H_2O\ (W_f - W_i)$

$$V_{m(std)} = 17.64\ Y \frac{V_m P_m}{(T_m + 460)}$$

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Run

~~[illegible]~~ ~~[illegible]~~ 3

APEX

Date: 12/10/20

Time: 0945

Field Data Sheet
Moisture Content (Reference)

Source ID: RTO

Company: Weyerhaeuser

Test Location: RTO Outlet

Meter Yd:

Meter H@:

Project #: 11020-000068.00

City/State: Grayling MI

Personnel: ~~[illegible]~~ DMK

Meter ID: 2

Barometric: 28.45

Pre-test Leak Rate: 0.000 CFM @ 5 in Hg

Post-test Leak Rate: 0.000 CFM @ 4 in Hg

Traverse Point	Sample Time	Vacuum (in Hg)	Delta H (in H_2O)	Meter Volume (ft^3)	Meter Temperature Inlet (F)	Meter Temperature Outlet (F)	Impinger Temp. (F)
8	0	1	1.8	123.180	33	33	43
7	5	1		126.99	35	35	48
6	10	1		130.74	36	36	50
5	15	1		134.52	37	37	52
4	20	1		138.25	39	39	55
3	25	1		142.07	40	40	55
2	30	1		145.86	42	42	55
1	35	—		149.214	—	—	—
Averages:							

Analytical Data					
	Impinger Gain (g or ml)				Silica Gel Weight (g)
Final	V_f	896.5	796.0	681.5	W_f 950.3
Initial	V_i	735.6	760.6	661.0	W_i 933.8
Difference					

$V_{wc(std)} = 0.04707$ ft^3/ml of H_2O $(V_f - V_i)$

$V_{wsg(std)} = 0.04715$ ft^3/g of H_2O $(W_f - W_i)$

$$V_{m(std)} = 17.64\ Y \frac{V_m P_m}{(T_m + 460)}$$

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Run

4-6

APEX

Date: 12/10/20

Time: 1101

Field Data Sheet
Moisture Content (Reference)

Source ID: RTO
Company: Weyerhaeuser
Test Location: RTO Outlet
Meter Yd:
Meter H@:
Pre-test Leak Rate: 0.000 CFM @ 7 in Hg
Post-test Leak Rate: 0.000 CFM @ 5 in Hg

Project #: 11020-000068.00
City/State: Grayling, MI
Personnel: ~~TAE~~ DMK
Meter ID: 2
Barometric: 28.5

Traverse Point	Sample Time	Vacuum (in Hg)	Delta H (in H_2O)	Meter Volume (ft^3)	Meter Temperature Inlet (F)	Meter Temperature Outlet (F)	Impinger Temp. (F)
8	0	1	1.8	149.272	47	47	43
7	5	1		153.00	48	48	45
6	10	1		156.77	49	49	47
5	15	1		160.55	51	51	48
4	20	1		164.21	51	51	48
3	25	1		168.09	52	52	50
2	30	1		171.91	52	52	50
1	35	—		176.055	—	—	—
Averages:							

Analytical Data					
	Impinger Gain (g or ml)				Silica Gel Weight (g)
Final	V_f	936.8	743.4	657.0	W_f 983.6
Initial	V_i	709.3	724.5	652.3	W_i 968.5
Difference					

$V_{wc(std)} = 0.04707\ ft^3/ml\ of\ H_2O\ (V_f - V_i)$ $V_{wsg(std)} = 0.04715\ ft^3/g\ of\ H_2O\ (W_f - W_i)$

$$V_{m(std)} = 17.64\ Y \frac{V_m P_m}{(T_m + 460)}$$

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Run

6-10

APEX

Date: 12/10/20

Time: 1230

Field Data Sheet
Moisture Content (Reference)

Source ID: RTO

Company: Weyerhaeuser

Test Location: RTO outlet

Meter Yd:

Meter H@:

Pre-test Leak Rate: 0.000 CFM @ 6 in Hg

Post-test Leak Rate: 0.000 CFM @ 4 in Hg

Project #: 1.020 000069.00

City/State: Grayling, MI

Personnel: DMK

Meter ID: 2

Barometric: 28.5

Traverse Point	Sample Time	Vacuum (in Hg)	Delta H (in H_2O)	Meter Volume (ft^3)	Meter Temperature Inlet (F)	Meter Temperature Outlet (F)	Impinger Temp. (F)
8	0	1	1.3	176.119	46	46	45
7	5	1		179.91	46	46	46
6	10	1		183.81	46	46	46
5	15	1		187.55	47	47	46
4	20	1		191.22	47	47	47
3	25	1		194.95	47	47	47
2	30	1		198.65	47	47	47
1	35	—	—	201.646	—	—	—
Averages:							

Analytical Data					
	Impinger Gain (g or ml)				Silica Gel Weight (g)
Final	V_f	927.1	763.8	659.6	W_f 1058.2
Initial	V_i	673.2	743.4	657.0	W_i 1051.3
Difference					

$V_{wc(std)} = 0.04707$ ft^3/ml of H_2O $(V_f - V_i)$ $V_{wsg(std)} = 0.04715$ ft^3/g of H_2O $(W_f - W_i)$

$$V_{m(std)} = 17.64\ Y \frac{V_m P_m}{(T_m + 460)}$$

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Appendix D
Computer-Generated Data Sheets

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 8, 2020

Time	VOC (ppmvd)
15:47:00	45.3
15:48:00	41.5
15:49:00	1.3
15:50:00	0.0
15:51:00	-0.1
15:52:00	0.8
15:53:00	-0.2
15:54:00	1.1
15:55:00	-1.6
15:56:00	-0.1
15:57:00	0.6
15:58:00	1.0
15:59:00	0.9
16:00:00	3.0
16:01:00	84.6
16:02:00	68.8
16:03:00	49.7
16:04:00	34.6
16:05:00	29.6
16:06:00	5.4

APEX

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 8, 2020

Time	VOC (ppmvd)
16:14:00	8.6
16:15:00	5.2
16:16:00	7.6
16:17:00	10.6
16:18:00	5.7
16:19:00	6.0
16:20:00	10.1
16:21:00	6.6
16:22:00	4.8
16:23:00	8.5
16:24:00	8.5
16:25:00	4.4
16:26:00	6.1
16:27:00	10.0
16:28:00	5.4
16:29:00	5.0
16:30:00	9.2
16:31:00	7.0
16:32:00	4.4
16:33:00	7.4
16:34:00	0.5

APEX

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 8, 2020

Time	VOC (ppmvd)
16:46:00	-1.5
16:47:00	-2.1
16:48:00	-0.2
16:49:00	2.3
16:50:00	66.2
16:51:00	244.3
16:52:00	225.0
16:53:00	297.9
16:54:00	284.9
16:55:00	381.9
16:56:00	446.5
16:57:00	446.4
16:58:00	275.1
16:59:00	233.2
17:00:00	244.9
17:01:00	118.1
17:02:00	146.0
17:03:00	101.9
17:04:00	109.3
17:05:00	169.7
17:06:00	240.6
17:07:00	296.2
17:08:00	131.0
17:09:00	108.9
17:10:00	207.2
17:11:00	297.5
17:12:00	135.8
17:13:00	109.4
17:14:00	207.5
17:15:00	295.3
17:16:00	49.0
17:17:00	4.3
17:18:00	44.5
17:19:00	107.8
17:20:00	109.7
17:21:00	57.1
17:22:00	109.8
17:23:00	49.6
17:24:00	109.5
17:25:00	12.8

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 9, 2020

Time	VOC (ppmvd)
6:56:00	19.4
6:57:00	14.7
6:58:00	0.8
6:59:00	-5.3
7:00:00	-3.5
7:01:00	0.0
7:02:00	14.9
7:03:00	16.0
7:04:00	47.0
7:05:00	80.9
7:06:00	85.1
7:07:00	85.4
7:08:00	69.7
7:09:00	50.9
7:10:00	34.7
7:11:00	30.4
7:12:00	3.6

APEX

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 9, 2020

Time	VOC (ppmvd)
7:20:00	29.1
7:21:00	17.2
7:22:00	13.8
7:23:00	25.9
7:24:00	19.7
7:25:00	11.9
7:26:00	21.1
7:27:00	23.2
7:28:00	11.4
7:29:00	14.6
7:30:00	26.0
7:31:00	13.2
7:32:00	13.8
7:33:00	24.2
7:34:00	14.3
7:35:00	11.0
7:36:00	21.5
7:37:00	16.7
7:38:00	10.3
7:39:00	17.1
7:40:00	18.4
7:41:00	4.1
7:42:00	-0.3
7:43:00	22.1
7:44:00	29.9
7:45:00	19.2
7:46:00	19.6
7:47:00	11.7
7:48:00	9.6
7:49:00	18.4
7:50:00	14.2
7:51:00	8.9
7:52:00	15.5
7:53:00	16.1
7:54:00	9.0
7:55:00	12.2
7:56:00	18.9
7:57:00	10.2
7:58:00	11.5
7:59:00	18.7
8:00:00	11.2
8:01:00	10.0
8:02:00	18.0
8:03:00	13.2
8:04:00	9.1
8:05:00	15.4

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 9, 2020

Time	(ppmvd)
8:06:00	15.9
8:07:00	9.1
8:08:00	12.7
8:09:00	18.9
8:10:00	10.4
8:11:00	12.4
8:12:00	18.5
8:13:00	10.6
8:14:00	9.7
8:15:00	18.5
8:16:00	13.2
8:17:00	9.2
8:18:00	16.8
8:19:00	15.9
8:20:00	9.2
8:21:00	14.0
8:22:00	19.8
8:23:00	10.6
8:24:00	13.7
8:25:00	20.1
8:26:00	10.8
8:27:00	11.3
8:28:00	21.3
8:29:00	13.7
8:30:00	10.4
8:31:00	20.5
8:32:00	18.3
8:33:00	10.4
8:34:00	17.8
8:35:00	23.2
8:36:00	11.9
8:37:00	16.8
8:38:00	25.0
8:39:00	12.6
8:40:00	13.7
8:41:00	27.7
8:42:00	17.2
8:43:00	12.7
8:44:00	26.4
8:45:00	23.0
8:46:00	12.9
8:47:00	23.5
8:48:00	28.4
8:49:00	24.6
8:50:00	30.9
8:51:00	19.8
8:52:00	-0.3

APEX

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 9, 2020

Time	(ppmvd)
8:53:00	25.5
8:54:00	67.7
8:55:00	68.3
8:56:00	66.3
8:57:00	35.7
8:58:00	29.6
8:59:00	18.6
9:00:00	28.3
9:01:00	33.3
9:02:00	16.7
9:03:00	24.7
9:04:00	36.4
9:05:00	17.8
9:06:00	18.8
9:07:00	38.4
9:08:00	22.9
9:09:00	17.9
9:10:00	35.0
9:11:00	26.8
9:12:00	16.2
9:13:00	29.4
9:14:00	31.5
9:15:00	16.0
9:16:00	24.2
9:17:00	34.5
9:18:00	17.0
9:19:00	19.0
9:20:00	36.9
9:21:00	20.9
9:22:00	16.8
9:23:00	33.1
9:24:00	25.5
9:25:00	15.5
9:26:00	29.0
9:27:00	30.1
9:28:00	15.8
9:29:00	23.2
9:30:00	33.6
9:31:00	16.8
9:32:00	18.8
9:33:00	35.6
9:34:00	20.3
9:35:00	17.3
9:36:00	32.4
9:37:00	23.2
9:38:00	15.4
9:39:00	28.6

APEX

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 9, 2020

Time	(ppmvd)
9:40:00	28.0
9:41:00	15.1
9:42:00	23.1
9:43:00	32.8
9:44:00	16.0
9:45:00	18.3
9:46:00	34.2
9:47:00	18.4
9:48:00	17.1
9:49:00	31.0
9:50:00	20.6
9:51:00	14.2
9:52:00	26.8
9:53:00	26.0
9:54:00	14.4
9:55:00	21.2
9:56:00	27.7
9:57:00	13.9
9:58:00	17.0
9:59:00	27.5
10:00:00	14.4
10:01:00	13.8
10:02:00	25.7
10:03:00	16.8
10:04:00	11.9
10:05:00	22.2
10:06:00	20.4
10:07:00	11.5
10:08:00	18.0
10:09:00	23.0
10:10:00	23.7
10:11:00	30.4
10:12:00	24.5
10:13:00	-0.2
10:14:00	15.0
10:15:00	66.0
10:16:00	66.2
10:17:00	66.3
10:18:00	29.8
10:19:00	19.3
10:20:00	12.8
10:21:00	18.6
10:22:00	20.8
10:23:00	9.9
10:24:00	13.3
10:25:00	21.7
10:26:00	11.2

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 9, 2020

Time	(ppmvd)
10:27:00	9.2
10:28:00	18.6
10:29:00	17.8
10:30:00	8.7
10:31:00	5.7
10:32:00	4.6
10:33:00	4.2
10:34:00	5.0
10:35:00	13.7
10:36:00	21.2
10:37:00	11.5
10:38:00	7.2
10:39:00	11.5
10:40:00	21.4
10:41:00	14.3
10:42:00	7.9
10:43:00	9.4
10:44:00	19.6
10:45:00	18.9
10:46:00	10.3
10:47:00	9.0
10:48:00	17.7
10:49:00	23.8
10:50:00	12.4
10:51:00	8.5
10:52:00	14.9
10:53:00	24.8
10:54:00	14.9
10:55:00	8.8
10:56:00	13.0
10:57:00	23.8
10:58:00	17.8
10:59:00	9.5
11:00:00	10.8
11:01:00	21.7
11:02:00	22.0
11:03:00	11.1
11:04:00	8.5
11:05:00	17.0
11:06:00	26.0
11:07:00	13.8
11:08:00	8.4
11:09:00	13.4
11:10:00	25.9
11:11:00	17.9
11:12:00	9.8
11:13:00	11.1

Biofilter VOC Concentrations
Weyerhaeuser
Grayling, Michigan
December 9, 2020

Time	(ppmvd)
11:14:00	23.1
11:15:00	22.4
11:16:00	11.4
11:17:00	9.4
11:18:00	18.5
11:19:00	25.6
11:20:00	13.2
11:21:00	9.0
11:22:00	15.9
11:23:00	26.1
11:24:00	16.0
11:25:00	9.4
11:26:00	12.2
11:27:00	24.1
11:28:00	26.3
11:29:00	30.6
11:30:00	29.1
11:31:00	0.2

Run

1

Date Dec 9, 2020
Time 7:30

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**Biofilter Outlet**			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	80			**P_{stat}, Static Press., in H_2O**	0.5113
% CO_2 0		**% CO**	0	**% Moisture, v/v**	4.08
% O_2 21		**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.4

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle (cos $\theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.5328	83	0.7299	0		
	7	0.5604	83	0.7486	0		
	6	0.5717	83	0.7561	0		
	5	0.6610	83	0.8130	0		
	4	0.7692	83	0.8770	0		
	3	0.7109	84	0.8431	0		
	2	0.5887	83	0.7673	0		
	1	0.3438	83	0.5863	0		
	8	0.4266	83	0.6531	0		
	7	0.4130	83	0.6427	0		
	6	0.5654	83	0.7519	0		
	5	0.7316	83	0.8553	0		
	4	0.7305	83	0.8547	0		
	3	0.6952	83	0.8338	0		
	2	0.6221	83	0.7887	0		
	1	0.4058	83	0.6370	0		
Average		0.5830	83	0.7587	0		

Comments

P_s	**28.44**	in Hg
V_s	**2,681**	ft/min
Q_s	**103,163**	cfm
Q_{std}	**95,332**	scfm
Q	**91,442**	dscfm

Run

2

Date	Dec 9, 2020
Time	7:48

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility Weyerhaeuser

Operators TMZ

Sampling Location Biofilter Outlet

Pitot Tube 59

Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	82			**P_{stat}, Static Press., in H_2O**	0.6006
% CO_2	0	**% CO**	0	**% Moisture, v/v**	4.08
% O_2	21	**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.4

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.4967	81	0.7048			
	7	0.7150	81	0.8456			
	6	0.7693	81	0.8771			
	5	0.7193	81	0.8481			
	4	0.5587	81	0.7475			
	3	0.4818	82	0.6941			
	2	0.3476	82	0.5896			
	1	0.4031	82	0.6349			
	8	0.5731	82	0.7570			
	7	0.5496	82	0.7414			
	6	0.6279	82	0.7924			
	5	0.6329	82	0.7956			
	4	0.6782	82	0.8235			
	3	0.5558	82	0.7455			
	2	0.4446	82	0.6668			
	1	0.4360	82	0.6603			
Average		0.5619	82	0.7453			

Comments

P_s	**28.44**	in Hg
V_s	**2,630**	ft/min
Q_s	**101,198**	cfm
Q_{std}	**93,776**	scfm
Q	**89,950**	dscfm

Run

3

APEX

Date	Dec 9, 2020
Time	8:14

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	Biofilter Outlet			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	83			**P_{stat}, Static Press., in H_2O**	0.6846
% CO_2 0		**% CO**	0	**% Moisture, v/v**	4.08
% O_2 21		**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.4

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.4069	83	0.6379			
	7	0.8123	83	0.9013			
	6	0.8861	83	0.9413			
	5	0.9788	83	0.9893			
	4	0.7293	83	0.8540			
	3	0.6240	83	0.7899			
	2	0.3659	83	0.6049			
	1	0.3460	83	0.5882			
	8	0.3689	83	0.6074			
	7	0.5381	83	0.7336			
	6	0.6614	83	0.8133			
	5	0.6719	83	0.8197			
	4	0.6835	83	0.8267			
	3	0.5932	84	0.7702			
	2	0.4178	84	0.6464			
	1	0.3357	84	0.5794			
Average		0.5887	83	0.7565			

Comments

P_s	**28.45**	in Hg
V_s	**2,673**	ft/min
Q_s	**102,852**	cfm
Q_{std}	**95,065**	scfm
Q	**91,186**	dscfm

Run

4

APEX

Date	Dec 9, 2020
Time	8:30

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**Biofilter Outlet**			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	85			**P_{stat}, Static Press., in H_2O**	0.5830
% CO_2 0		**% CO**	0	**% Moisture, v/v**	4.08
% O_2 21		**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.4

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.7038	83	0.8389			
	7	0.7051	83	0.8397			
	6	0.7126	83	0.8442			
	5	0.7643	84	0.8742			
	4	0.6590	85	0.8118			
	3	0.5736	85	0.7574			
	2	0.5503	85	0.7418			
	1	0.5691	85	0.7544			
	8	0.3571	85	0.5976			
	7	0.4687	85	0.6846			
	6	0.5230	85	0.7232			
	5	0.6936	85	0.8328			
	4	0.6990	85	0.8361			
	3	0.6981	85	0.8355			
	2	0.6321	85	0.7950			
	1	0.4276	86	0.6539			
Average		0.6086	85	0.7763			

Comments

P_s	**28.44**	in Hg
V_s	**2,747**	ft/min
Q_s	**105,705**	cfm
Q_{std}	**97,419**	scfm
Q	**93,444**	dscfm

Run

5

APEX

Date	Dec 9, 2020
Time	9:06

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**Biofilter Outlet**			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	83			**P_{stat}, Static Press., in H_2O**	0.5383
% CO_2 0		**% CO**	0	**% Moisture, v/v**	4.09
% O_2 21		**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.4

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.5971	83	0.7727			
	7	0.5157	83	0.7181			
	6	0.5953	83	0.7716			
	5	0.7297	83	0.8542			
	4	0.7563	83	0.8697			
	3	0.7304	83	0.8546			
	2	0.6517	83	0.8073			
	1	0.4207	83	0.6486			
	8	0.4207	81	0.6486			
	7	0.5919	83	0.7694			
	6	0.7576	83	0.8704			
	5	0.7478	82	0.8648			
	4	0.7234	83	0.8505			
	3	0.5774	83	0.7599			
	2	0.5304	83	0.7283			
	1	0.3396	83	0.5828			
Average		0.6054	83	0.7732			

Comments

P_s	**28.44**	in Hg
V_s	**2,731**	ft/min
Q_s	**105,114**	cfm
Q_{std}	**97,186**	scfm
Q	**93,211**	dscfm

Run

6

Date Dec 9, 2020
Time 9:29

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**Biofilter Outlet**			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	87			**P_{stat}, Static Press., in H_2O**	0.6272
% CO_2	0	**% CO**	0	**% Moisture, v/v**	4.09
% O_2	21	**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.4

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.3525	87	0.5937			
	7	0.6053	87	0.7780			
	6	0.7384	87	0.8593			
	5	0.9132	87	0.9556			
	4	0.6603	87	0.8126			
	3	0.4989	87	0.7063			
	2	0.3981	87	0.6310			
	1	0.3598	87	0.5998			
	8	0.6198	87	0.7873			
	7	0.6966	87	0.8346			
	6	0.7014	87	0.8375			
	5	0.7016	87	0.8376			
	4	0.6876	87	0.8292			
	3	0.6903	87	0.8308			
	2	0.4847	87	0.6962			
	1	0.5078	87	0.7126			
Average		0.6010	87	0.7689			

Comments

P_s	**28.45**	in Hg
V_s	**2,726**	ft/min
Q_s	**104,917**	cfm
Q_{std}	**96,284**	scfm
Q	**92,346**	dscfm

Run

7

APEX

Date	Dec 9, 2020
Time	9:49

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**Biofilter Outlet**			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	81			**P_{stat}, Static Press., in H_2O**	0.5616
% CO_2 0		**% CO**	0	**% Moisture, v/v**	4.09
% O_2 21		**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.4

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle (cos $\theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.1747	81	0.4180			
	7	0.6923	81	0.8320			
	6	0.7269	81	0.8526			
	5	0.7095	81	0.8423			
	4	0.7528	81	0.8676			
	3	0.6458	81	0.8036			
	2	0.6891	81	0.8301			
	1	0.5965	81	0.7723			
	8	0.3865	81	0.6217			
	7	0.3418	81	0.5846			
	6	0.2290	81	0.4785			
	5	0.5507	81	0.7421			
	4	0.6487	81	0.8054			
	3	0.6966	81	0.8346			
	2	0.5659	81	0.7523			
	1	0.5277	81	0.7264			
Average		0.5584	81	0.7353			

Comments

P_s	**28.44**	in Hg
V_s	**2,593**	ft/min
Q_s	**99,786**	cfm
Q_{std}	**92,575**	scfm
Q	**88,789**	dscfm

Run

8

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date	Dec 9, 2020
Time	10:30

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**Biofilter Outlet**			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	81			**P_{stat}, Static Press., in H_2O**	0.5571
% CO_2	0	**% CO**	0	**% Moisture, v/v**	4.15
% O_2	21	**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.39

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.3788	81	0.6155			
	7	0.3843	81	0.6199			
	6	0.5846	81	0.7646			
	5	0.7113	81	0.8434			
	4	0.7525	81	0.8675			
	3	0.7405	81	0.8605			
	2	0.5849	81	0.7648			
	1	0.3600	81	0.6000			
	8	0.8085	81	0.8992			
	7	0.7258	81	0.8519			
	6	0.7067	81	0.8407			
	5	0.7166	81	0.8465			
	4	0.7141	81	0.8450			
	3	0.6551	81	0.8094			
	2	0.5723	81	0.7565			
	1	0.5336	81	0.7305			
Average		0.6206	81	0.7822			

Comments

P_s	**28.44**	in Hg
V_s	**2,759**	ft/min
Q_s	**106,173**	cfm
Q_{std}	**98,499**	scfm
Q	**94,412**	dscfm

Run

9

Date: Dec 9, 2020
Time: 10:50

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility Weyerhaeuser

Operators TMZ

Sampling Location Biofilter Outlet

Pitot Tube 59

Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	87			**P_{stat}, Static Press., in H_2O**	0.5925
% CO_2	0	**% CO**	0	**% Moisture, v/v**	4.15
% O_2	21	**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.39

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.5276	87	0.7264			
	7	0.5144	87	0.7172			
	6	0.7191	87	0.8480			
	5	0.6683	87	0.8175			
	4	0.7627	87	0.8733			
	3	0.8514	87	0.9227			
	2	0.7886	87	0.8880			
	1	0.7412	87	0.8609			
	8	0.4704	85	0.6859			
	7	0.6247	85	0.7904			
	6	0.7004	85	0.8369			
	5	0.6852	86	0.8278			
	4	0.6391	87	0.7994			
	3	0.6011	87	0.7753			
	2	0.4696	87	0.6853			
	1	0.4723	87	0.6872			
Average		0.6398	87	0.7964			

Comments

P_s	**28.44**	in Hg
V_s	**2,823**	ft/min
Q_s	**108,643**	cfm
Q_{std}	**99,774**	scfm
Q	**95,634**	dscfm

Run

10

Date Dec 9, 2020
Time 11:12

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	Biofilter Outlet			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	83			**P_{stat}, Static Press., in H_2O**	0.6587
% CO_2	0	**% CO**	0	**% Moisture, v/v**	4.15
% O_2	21	**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.39

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.5691	83	0.7544			
	7	0.5982	83	0.7734			
	6	0.6048	83	0.7777			
	5	0.6476	83	0.8047			
	4	0.6744	83	0.8212			
	3	0.7154	83	0.8458			
	2	0.6895	83	0.8304			
	1	0.6519	83	0.8074			
	8	0.2982	83	0.5461			
	7	0.6370	83	0.7981			
	6	0.7124	83	0.8440			
	5	0.6839	83	0.8270			
	4	0.5859	83	0.7654			
	3	0.4848	83	0.6963			
	2	0.3777	83	0.6146			
	1	0.4534	83	0.6733			
Average		0.5865	83	0.7612			

Comments

P_s	**28.45**	in Hg
V_s	**2,689**	ft/min
Q_s	**103,501**	cfm
Q_{std}	**95,692**	scfm
Q	**91,720**	dscfm

Run

1

Date: Dec 9, 2020
Time: 7:53

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**Biofilter Inlet**			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	108			**P_{stat}, Static Press., in H_2O**	1.5040
% CO_2	0	**% CO**	0	**% Moisture, v/v**	2.21
% O_2	21	**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.6

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.5694	107	0.755	0		
	7	0.6170	107	0.785	0		
	6	0.7743	107	0.880	0		
	5	0.7585	108	0.871	0		
	4	0.7032	108	0.839	0		
	3	0.6971	108	0.835	0		
	2	0.6956	108	0.834	0		
	1	0.4451	108	0.667	0		
	8	0.5724	106	0.757	0		
	7	0.4882	107	0.699	5		
	6	0.5075	107	0.712	0		
	5	0.7041	108	0.839	0		
	4	0.8768	108	0.936	0		
	3	0.7358	108	0.858	0		
	2	0.7350	108	0.857	0		
	1	0.4967	108	0.705	5		
Average		0.6485	108	0.802	1		

Comments

P_s	**28.51**	in Hg
V_s	**2,882**	ft/min
Q_s	**110,920**	cfm
Q_{std}	**98,328**	scfm
Q	**96,155**	dscfm

Run

2

APEX

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date	Dec 9, 2020
Time	9:04

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**Biofilter Inlet**			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	107			**P_{stat}, Static Press., in H_2O**	1.3450
% CO_2 0		**% CO**	0	**% Moisture, v/v**	2.33
% O_2 21		**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.59

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ $(\text{in } H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.4456	106	0.668			
	7	0.5599	106	0.748			
	6	0.6985	106	0.836			
	5	0.6835	106	0.827			
	4	0.7085	107	0.842			
	3	0.7105	107	0.843			
	2	0.7270	107	0.853			
	1	0.4585	108	0.677			
	8	0.4418	107	0.665			
	7	0.4488	107	0.670			
	6	0.5807	107	0.762			
	5	0.6486	107	0.805			
	4	0.7584	107	0.871			
	3	0.7602	107	0.872			
	2	0.5738	107	0.757			
	1	0.3760	107	0.613			
Average		0.5988	107	0.769			

Comments

P_s	**28.50**	in Hg
V_s	**2,765**	ft/min
Q_s	**106,395**	cfm
Q_{std}	**94,403**	scfm
Q	**92,203**	dscfm

Run

3

APEX

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date	Dec 9, 2020
Time	10:34

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**Biofilter Inlet**			**Pitot Tube**	59
Stack Diameter, in	84	**Area, ft^2**	38.485	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	3	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.4
Gas Temperature, ˚F DB	108			**P_{stat}, Static Press., in H_2O**	1.3060
% CO_2 0		**% CO**	0	**% Moisture, v/v**	1.97
% O_2 21		**% N_2**	79	**Molecular Weight, M_d**	28.84
				Molecular Weight, M_s	28.63

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle (cos $\theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
	8	0.4839	108	0.696			
	7	0.3395	108	0.583			
	6	0.5405	108	0.735			
	5	0.6048	108	0.778			
	4	0.6302	108	0.794			
	3	0.6437	108	0.802			
	2	0.5039	108	0.710			
	1	0.4252	108	0.652			
	8	0.5534	108	0.744			
	7	0.5684	108	0.754			
	6	0.6887	108	0.830			
	5	0.7667	108	0.876			
	4	0.5906	108	0.769			
	3	0.6391	108	0.799			
	2	0.5515	108	0.743			
	1	0.5082	108	0.713			
Average		0.5649	108	0.749			

Comments

P_s	**28.50**	in Hg
V_s	**2,691**	ft/min
Q_s	**103,567**	cfm
Q_{std}	**91,692**	scfm
Q	**89,886**	dscfm

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
6:04:00	-1.4	-13.8
6:05:00	-1.4	-13.8
6:06:00	-1.4	-13.8
6:07:00	-1.4	-2.9
6:08:00	-1.4	0.2
6:09:00	-1.4	75.5
6:10:00	-1.4	750.9
6:11:00	-1.4	800.8
6:12:00	-1.4	612.8
6:13:00	-1.4	398.2
6:14:00	-1.2	304.3
6:15:00	6.5	115.8
6:16:00	3.9	348.3
6:17:00	10.6	331.0
6:18:00	-0.3	370.5
6:19:00	-0.4	26.3
6:20:00	-0.6	25.1
6:21:00	-0.7	24.1
6:22:00	-0.8	7.5
6:23:00	-0.9	-0.3
6:24:00	-0.6	15.7
6:25:00	-0.5	297.4
6:26:00	-0.6	343.5
6:27:00	-0.7	352.5
6:28:00	-0.8	386.5
6:29:00	-0.9	398.3
6:30:00	-0.6	370.5
6:31:00	-0.3	50.4
6:32:00	4.0	0.5
6:33:00	83.2	12.5
6:34:00	85.7	0.1
6:35:00	63.8	4.7
6:36:00	50.2	3.6
6:37:00	46.0	-0.2
6:38:00	29.5	6.0
6:39:00	30.0	-0.3
6:40:00	8.7	91.6
6:41:00	6.1	150.9
6:42:00	1.1	65.1
6:43:00	5.7	155.6
6:44:00	5.8	143.2
6:45:00	1.4	80.9
6:46:00	4.8	176.9
6:47:00	5.7	149.9
6:48:00	1.4	77.0
6:49:00	5.6	151.9
6:50:00	5.1	137.2

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
6:51:00	1.2	85.4
6:52:00	5.2	174.9
6:53:00	5.3	144.7
6:54:00	1.4	84.3
6:55:00	5.7	127.0
6:56:00	6.3	141.3
6:57:00	3.0	101.0
6:58:00	6.2	152.1
6:59:00	7.0	141.5
7:00:00	3.7	97.1
7:01:00	7.5	118.4
7:02:00	7.1	124.2
7:03:00	2.5	108.2
7:04:00	6.7	155.4
7:05:00	6.9	140.9
7:06:00	2.5	114.3
7:07:00	6.4	101.5
7:08:00	6.3	130.3
7:09:00	2.1	125.1
7:10:00	6.4	140.6
7:11:00	6.5	148.3
7:12:00	2.0	134.7
7:13:00	6.3	99.6
7:14:00	6.6	150.5
7:15:00	2.2	155.3
7:16:00	7.5	135.6
7:17:00	8.2	186.8
7:18:00	2.5	174.5
7:19:00	8.4	82.2
7:20:00	7.5	188.0
7:21:00	3.2	179.8
7:22:00	7.8	89.6
7:23:00	7.2	168.0
7:24:00	3.3	137.4
7:25:00	6.5	42.9
7:26:00	7.6	144.4
7:27:00	4.3	125.3
7:28:00	7.5	69.9
7:29:00	6.6	157.8
7:30:00	5.1	133.8
7:31:00	7.6	20.6
7:32:00	4.1	55.4
7:33:00	6.4	44.6
7:34:00	8.1	28.9
7:35:00	2.0	89.5
7:36:00	1.7	2.3
7:37:00	1.7	1.3

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
7:38:00	2.4	1.5
7:39:00	1.2	243.2
7:40:00	1.0	398.5
7:41:00	1.1	391.0
7:42:00	1.0	81.0
7:43:00	0.9	1.4
7:44:00	0.7	1.2
7:45:00	19.2	7.6
7:46:00	29.6	2.8
7:47:00	23.3	1.3
7:48:00	3.8	34.4
7:49:00	3.9	17.8
7:50:00	1.8	46.8
7:51:00	3.5	46.3
7:52:00	3.0	16.5
7:53:00	1.5	48.8
7:54:00	3.5	42.5
7:55:00	2.9	9.7
7:56:00	1.3	38.4
7:57:00	3.9	38.6
7:58:00	2.3	13.7
7:59:00	2.7	47.1
8:00:00	9.5	35.5
8:01:00	1.3	8.7
8:02:00	5.6	12.4
8:03:00	4.6	10.5
8:04:00	2.1	5.5
8:05:00	2.2	10.5
8:06:00	2.8	10.0
8:07:00	0.9	4.5
8:08:00	1.8	7.9
8:09:00	2.4	6.6
8:10:00	1.4	3.5
8:11:00	2.0	6.6
8:12:00	2.3	6.3
8:13:00	0.9	2.4
8:14:00	1.7	5.3
8:15:00	1.7	3.9
8:16:00	0.3	0.7
8:17:00	1.4	4.3
8:18:00	1.6	3.9
8:19:00	0.1	1.5
8:20:00	1.6	5.4
8:21:00	1.8	5.7
8:22:00	0.4	2.6
8:23:00	2.0	4.3
8:24:00	2.3	2.5

APEX

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
8:25:00	0.1	0.1
8:26:00	2.4	1.8
8:27:00	2.8	1.2
8:28:00	0.6	0.0
8:29:00	2.7	2.2
8:30:00	2.5	2.0
8:31:00	0.2	-0.1
8:32:00	1.9	3.2
8:33:00	2.0	4.4
8:34:00	0.3	2.4
8:35:00	1.7	4.7
8:36:00	1.8	3.6
8:37:00	0.2	0.5
8:38:00	1.6	2.0
8:39:00	1.7	2.7
8:40:00	0.4	1.0
8:41:00	2.0	7.1
8:42:00	2.3	7.9
8:43:00	0.6	6.1
8:44:00	2.6	13.3
8:45:00	2.5	10.1
8:46:00	0.3	7.8
8:47:00	2.6	14.3
8:48:00	2.8	12.2
8:49:00	0.5	11.4
8:50:00	2.6	13.0
8:51:00	2.3	9.9
8:52:00	0.3	7.7
8:53:00	1.9	6.2
8:54:00	1.8	3.5
8:55:00	0.4	3.4
8:56:00	1.7	1.5
8:57:00	1.5	0.0
8:58:00	0.3	-0.2
8:59:00	1.6	-0.7
9:00:00	1.7	-0.9
9:01:00	0.5	-0.3
9:02:00	1.7	-0.8
9:03:00	1.7	0.4
9:04:00	0.5	0.7
9:05:00	1.8	-1.1
9:06:00	1.8	-1.4
9:07:00	0.6	-1.0
9:08:00	1.6	-3.1
9:09:00	1.7	-2.8
9:10:00	0.2	-2.3
9:11:00	1.4	-4.0

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
9:12:00	1.9	-4.0
9:13:00	0.1	-3.7
9:14:00	2.1	-5.0
9:15:00	2.1	-3.7
9:16:00	0.4	-2.2
9:17:00	2.5	0.3
9:18:00	2.1	1.6
9:19:00	1.0	3.1
9:20:00	2.6	3.8
9:21:00	0.5	9.1
9:22:00	2.7	14.4
9:23:00	1.6	10.2
9:24:00	1.9	9.9
9:25:00	7.5	26.6
9:26:00	1.4	3.8
9:27:00	2.4	44.3
9:28:00	5.4	96.1
9:29:00	1.6	9.7
9:30:00	4.8	118.2
9:31:00	7.9	76.4
9:32:00	0.4	84.4
9:33:00	25.2	-5.4
9:34:00	29.0	-7.2
9:35:00	7.5	-2.8
9:36:00	5.2	97.8
9:37:00	5.2	76.3
9:38:00	0.3	33.3
9:39:00	4.8	95.2
9:40:00	5.8	88.0
9:41:00	0.7	59.4
9:42:00	6.4	150.7
9:43:00	6.5	97.4
9:44:00	0.7	88.5
9:45:00	6.7	100.7
9:46:00	6.7	97.5
9:47:00	0.8	103.2
9:48:00	7.1	129.8
9:49:00	8.0	105.6
9:50:00	1.1	132.2
9:51:00	7.4	79.6
9:52:00	7.3	104.6
9:53:00	1.4	126.9
9:54:00	7.4	97.4
9:55:00	7.8	132.3
9:56:00	1.6	156.8
9:57:00	7.7	41.6
9:58:00	8.1	140.5

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
9:59:00	2.2	169.0
10:00:00	7.6	52.3
10:01:00	7.6	147.3
10:02:00	3.1	203.8
10:03:00	8.0	22.8
10:04:00	5.8	111.0
10:05:00	3.3	122.9
10:06:00	6.4	33.0
10:07:00	5.9	98.6
10:08:00	2.5	112.6
10:09:00	9.1	21.3
10:10:00	9.1	85.0
10:11:00	6.4	41.7
10:12:00	5.8	7.4
10:13:00	4.1	11.7
10:14:00	2.3	6.8
10:15:00	3.3	2.8
10:16:00	2.8	2.4
10:17:00	1.8	2.9
10:18:00	3.0	-1.3
10:19:00	3.1	3.0
10:20:00	2.3	2.9
10:21:00	3.3	-0.8
10:22:00	6.1	2.3
10:23:00	1.9	41.0
10:24:00	0.7	-5.7
10:25:00	5.2	-6.1
10:26:00	30.8	-5.8
10:27:00	20.2	-5.4
10:28:00	-0.3	-5.2
10:29:00	-0.4	-5.1
10:30:00	-0.5	0.1
10:31:00	-0.2	-0.3
10:32:00	2.7	188.3
10:33:00	-0.6	391.7
10:34:00	-0.6	393.4
10:35:00	0.7	303.9
10:36:00	7.1	30.4
10:37:00	1.3	168.2
10:38:00	7.1	143.0
10:39:00	6.0	27.3
10:40:00	0.7	133.7
10:41:00	6.7	131.1
10:42:00	5.3	36.9
10:43:00	1.8	167.9
10:44:00	7.8	153.2
10:45:00	0.7	34.7

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
10:46:00	6.0	137.3
10:47:00	7.7	145.8
10:48:00	0.1	43.3
10:49:00	6.7	179.8
10:50:00	8.6	167.4
10:51:00	0.2	48.9
10:52:00	6.7	136.6
10:53:00	8.4	159.4
10:54:00	0.1	61.6
10:55:00	7.7	208.0
10:56:00	8.7	165.0
10:57:00	0.3	85.5
10:58:00	8.7	153.9
10:59:00	8.5	158.3
11:00:00	0.6	103.6
11:01:00	7.7	161.4
11:02:00	7.6	165.2
11:03:00	0.5	114.6
11:04:00	8.2	124.8
11:05:00	6.7	120.8
11:06:00	0.5	111.5
11:07:00	7.4	109.4
11:08:00	7.9	162.9
11:09:00	0.5	132.5
11:10:00	7.6	115.2
11:11:00	6.3	128.2
11:12:00	0.9	130.4
11:13:00	7.4	100.5
11:14:00	8.3	126.1
11:15:00	1.2	163.4
11:16:00	6.9	80.4
11:17:00	7.1	128.5
11:18:00	1.0	136.0
11:19:00	7.4	87.2
11:20:00	7.7	116.8
11:21:00	1.2	155.4
11:22:00	8.1	75.2
11:23:00	7.2	131.7
11:24:00	1.2	148.4
11:25:00	6.9	59.1
11:26:00	7.8	125.1
11:27:00	1.4	175.0
11:28:00	6.8	41.5
11:29:00	6.4	123.5
11:30:00	1.0	143.6
11:31:00	6.8	32.1
11:32:00	6.1	143.8

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
11:33:00	2.0	176.9
11:34:00	7.6	29.2
11:35:00	6.4	154.4
11:36:00	2.1	156.5
11:37:00	7.0	26.4
11:38:00	6.3	141.8
11:39:00	3.0	176.8
11:40:00	7.1	11.2
11:41:00	4.5	159.6
11:42:00	5.3	182.2
11:43:00	9.3	19.9
11:44:00	3.2	188.1
11:45:00	7.2	184.2
11:46:00	8.6	10.2
11:47:00	1.8	182.4
11:48:00	8.8	179.6
11:49:00	7.9	10.2
11:50:00	2.1	169.2
11:51:00	9.7	191.6
11:52:00	9.1	12.2
11:53:00	2.2	200.8
11:54:00	9.7	158.1
11:55:00	0.2	89.6
11:56:00	0.3	-6.6
11:57:00	0.0	-6.8
11:58:00	-0.1	64.0
11:59:00	-0.5	371.5
12:00:00	-0.7	400.2
12:01:00	-0.6	391.7
12:02:00	-0.7	78.7
12:03:00	-0.7	-7.7
12:04:00	5.3	-7.2
12:05:00	29.7	-1.4
12:06:00	30.0	-7.9
12:07:00	3.3	-5.4
12:08:00	10.9	149.9
12:09:00	12.1	184.9
12:10:00	0.2	74.3
12:11:00	9.8	157.7
12:12:00	9.0	143.5
12:13:00	0.3	64.7
12:14:00	9.3	151.6
12:15:00	9.8	157.1
12:16:00	0.4	118.6
12:17:00	6.8	104.6
12:18:00	8.6	116.9
12:19:00	0.5	119.6

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
12:20:00	6.7	94.7
12:21:00	7.6	116.1
12:22:00	0.6	101.0
12:23:00	8.0	98.3
12:24:00	8.8	135.8
12:25:00	0.6	110.9
12:26:00	7.8	111.0
12:27:00	8.5	136.2
12:28:00	0.8	134.3
12:29:00	7.3	100.1
12:30:00	7.5	125.8
12:31:00	0.8	150.9
12:32:00	6.9	78.6
12:33:00	7.6	152.7
12:34:00	1.0	164.1
12:35:00	6.5	51.6
12:36:00	6.8	160.3
12:37:00	0.8	166.3
12:38:00	7.4	63.7
12:39:00	6.3	168.5
12:40:00	1.3	175.9
12:41:00	7.3	40.6
12:42:00	6.0	182.8
12:43:00	1.6	189.2
12:44:00	6.8	31.8
12:45:00	7.2	202.2
12:46:00	1.9	225.7
12:47:00	6.2	36.6
12:48:00	6.2	174.1
12:49:00	1.4	177.4
12:50:00	6.4	28.4
12:51:00	5.2	188.0
12:52:00	2.0	194.7
12:53:00	6.3	18.0
12:54:00	3.7	198.9
12:55:00	4.3	201.3
12:56:00	6.8	20.7
12:57:00	2.0	198.6
12:58:00	6.4	204.7
12:59:00	3.8	15.0
13:00:00	1.5	143.9
13:01:00	6.2	187.0
13:02:00	5.0	25.2
13:03:00	2.5	196.6
13:04:00	7.0	232.5
13:05:00	1.4	29.8
13:06:00	6.4	214.7

Dryer RTO VOC and CO Concentrations
Weyerhaeuser
Grayling, Michigan
December 10, 2020

Time	VOC	CO
13:07:00	6.8	224.6
13:08:00	1.0	35.0
13:09:00	6.3	214.3
13:10:00	7.5	248.0
13:11:00	0.7	40.1
13:12:00	5.7	183.9
13:13:00	7.0	213.2
13:14:00	0.7	43.0
13:15:00	6.6	209.0
13:16:00	6.5	245.3
13:17:00	0.8	62.3
13:18:00	6.7	197.9
13:19:00	7.1	230.2
13:20:00	0.7	59.1
13:21:00	6.0	191.8
13:22:00	6.8	235.2
13:23:00	0.6	88.0
13:24:00	5.4	169.4
13:25:00	5.9	200.9
13:26:00	0.7	78.3
13:27:00	5.5	195.9
13:28:00	6.3	237.1
13:29:00	1.0	101.2
13:30:00	6.0	171.6
13:31:00	6.2	216.2
13:32:00	1.0	111.1
13:33:00	5.7	174.9
13:34:00	3.3	170.4
13:35:00	0.9	0.0
13:36:00	6.6	-2.4
13:37:00	31.2	-1.7
13:38:00	31.6	-2.9
13:39:00	4.7	-2.8
13:40:00	-0.1	-3.7
13:41:00	0.7	-3.8
13:42:00	-2.4	205.7
13:43:00	-3.9	409.3
13:44:00	-4.0	410.3
13:45:00	-0.7	68.5

Run

1

APEX

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date	Dec 10, 2020
Time	6:55

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**RTO Exhaust**			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	236			**P_{stat}, Static Press., in H_2O**	-0.5814
% CO_2 6		**% CO**	0	**% Moisture, v/v**	28.5
% O_2 14		**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	26.23

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.3907	236	0.625	0		
	3	0.3982	236	0.631	0		
	2	0.4301	236	0.656	0		
	1	0.2630	234	0.513	0		
SW	4	0.4557	237	0.675	0		
	3	0.4146	237	0.644	0		
	2	0.3713	235	0.609	0		
	1	0.3154	235	0.562	0		
NW	4	0.3866	236	0.622	0		
	3	0.4010	236	0.633	0		
	2	0.3083	236	0.555	0		
	1	0.1857	236	0.431	0		
NE	4	0.3806	236	0.617	0		
	3	0.4491	235	0.670	0		
	2	0.4508	235	0.671	0		
	1	0.3907	238	0.625	0		
Average		0.3745	236	0.609	0		

Comments

P_s	**28.46**	in Hg
V_s	**2,532**	ft/min
Q_s	**152,272**	cfm
Q_{std}	**109,889**	scfm
Q	**78,521**	dscfm

Run

2

APEX

Date	Dec 10, 2020
Time	7:07

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**RTO Exhaust**			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	240			**P_{stat}, Static Press., in H_2O**	-0.6593
% CO_2 6		**% CO**	0	**% Moisture, v/v**	28.5
% O_2 14		**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	26.23

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle (cos $\theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.3958	241	0.629			
	3	0.4193	240	0.648			
	2	0.4509	239	0.671			
	1	0.3606	236	0.600			
SW	4	0.3433	240	0.586			
	3	0.3844	240	0.620			
	2	0.3128	241	0.559			
	1	0.2132	240	0.462			
NW	4	0.4556	239	0.675			
	3	0.4178	239	0.646			
	2	0.4842	239	0.696			
	1	0.3385	237	0.582			
NE	4	0.3850	240	0.620			
	3	0.3199	242	0.566			
	2	0.4282	241	0.654			
	1	0.2090	241	0.457			
Average		0.3699	240	0.605			

Comments

P_s	**28.45**	in Hg
V_s	**2,522**	ft/min
Q_s	**151,651**	cfm
Q_{std}	**108,823**	scfm
Q	**77,759**	dscfm

Run

3

APEX

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date	Dec 10, 2020
Time	9:46

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**RTO Exhaust**			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	237			**P_{stat}, Static Press., in H_2O**	-0.5968
% CO_2	6	**% CO**	0	**% Moisture, v/v**	29.5
% O_2	14	**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	26.13

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.3404	238	0.583			
	3	0.4212	237	0.649			
	2	0.3046	237	0.552			
	1	0.2386	237	0.488			
SW	4	0.4541	239	0.674			
	3	0.4492	239	0.670			
	2	0.4948	240	0.703			
	1	0.3567	239	0.597			
NW	4	0.3531	238	0.594			
	3	0.4279	238	0.654			
	2	0.4826	237	0.695			
	1	0.2560	232	0.506			
NE	4	0.4853	236	0.697			
	3	0.4640	237	0.681			
	2	0.4259	238	0.653			
	1	0.3756	236	0.613			
Average		0.3956	237	0.626			

Comments

P_s	**28.46**	in Hg
V_s	**2,611**	ft/min
Q_s	**156,989**	cfm
Q_{std}	**113,045**	scfm
Q	**79,739**	dscfm

Run

4

Date	Dec 10, 2020
Time	10:55

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**RTO Exhaust**			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	217			**P_{stat}, Static Press., in H_2O**	-0.6305
% CO_2 6		**% CO**	0	**% Moisture, v/v**	32.2
% O_2 14		**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	25.81

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ $(in\ H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.5141	217	0.717			
	3	0.5840	218	0.764			
	2	0.5306	217	0.728			
	1	0.2673	217	0.517			
SW	4	0.4535	217	0.673			
	3	0.3696	217	0.608			
	2	0.3505	217	0.592			
	1	0.1767	214	0.420			
NW	4	0.4836	218	0.695			
	3	0.4241	218	0.651			
	2	0.4369	217	0.661			
	1	0.3481	217	0.590			
NE	4	0.4374	219	0.661			
	3	0.4208	219	0.649			
	2	0.4119	217	0.642			
	1	0.3706	217	0.609			
Average		0.4112	217	0.636			

Comments

P_s	**28.45**	in Hg
V_s	**2,632**	ft/min
Q_s	**158,281**	cfm
Q_{std}	**117,352**	scfm
Q	**79,563**	dscfm

Run

5

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date	Dec 10, 2020
Time	11:11

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**RTO Exhaust**			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	223			**P_{stat}, Static Press., in H_2O**	-0.6217
% CO_2	6	**% CO**	0	**% Moisture, v/v**	32.2
% O_2	14	**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	25.81

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.5056	222	0.711			
	3	0.5157	222	0.718			
	2	0.5092	222	0.714			
	1	0.2787	222	0.528			
SW	4	0.4432	223	0.666			
	3	0.3796	225	0.616			
	2	0.3651	225	0.604			
	1	0.2101	225	0.458			
NW	4	0.4947	221	0.703			
	3	0.4136	221	0.643			
	2	0.4259	221	0.653			
	1	0.3317	221	0.576			
NE	4	0.4269	224	0.653			
	3	0.4418	224	0.665			
	2	0.4066	224	0.638			
	1	0.2597	223	0.510			
Average		0.4005	223	0.628			

Comments

P_s	**28.45**	in Hg
V_s	**2,611**	ft/min
Q_s	**157,005**	cfm
Q_{std}	**115,460**	scfm
Q	**78,280**	dscfm

Run

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APEX

Date	Dec 10, 2020
Time	11:47

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**RTO Exhaust**			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	221			**P_{stat}, Static Press., in H_2O**	-0.6122
% CO_2 6		**% CO**	0	**% Moisture, v/v**	32.2
% O_2 14		**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	25.81

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.4392	220	0.663			
	3	0.3876	220	0.623			
	2	0.3423	220	0.585			
	1	0.3778	220	0.615			
SW	4	0.4532	220	0.673			
	3	0.4919	220	0.701			
	2	0.4349	220	0.659			
	1	0.3169	220	0.563			
NW	4	0.4063	221	0.637			
	3	0.4011	221	0.633			
	2	0.3350	221	0.579			
	1	0.2240	221	0.473			
NE	4	0.4748	222	0.689			
	3	0.5274	222	0.726			
	2	0.4243	222	0.651			
	1	0.2676	222	0.517			
Average		0.3940	221	0.624			

Comments

P_s	**28.45**	in Hg
V_s	**2,590**	ft/min
Q_s	**155,726**	cfm
Q_{std}	**114,869**	scfm
Q	**77,880**	dscfm

Run

7

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date	Dec 10, 2020
Time	12:19

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**RTO Exhaust**			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	219			**P_{stat}, Static Press., in H_2O**	-0.6147
% CO_2 6		**% CO**	0	**% Moisture, v/v**	34.5
% O_2 14		**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	25.54

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.4727	221	0.688			
	3	0.4656	221	0.682			
	2	0.4392	221	0.663			
	1	0.3619	219	0.602			
SW	4	0.4006	220	0.633			
	3	0.3927	220	0.627			
	2	0.3312	220	0.575			
	1	0.2582	220	0.508			
NW	4	0.5308	217	0.729			
	3	0.4950	217	0.704			
	2	0.5114	217	0.715			
	1	0.2772	217	0.526			
NE	4	0.4765	216	0.690			
	3	0.4064	216	0.637			
	2	0.3655	218	0.605			
	1	0.3319	218	0.576			
Average		0.4073	219	0.635			

Comments

P_s	**28.45**	in Hg
V_s	**2,644**	ft/min
Q_s	**158,975**	cfm
Q_{std}	**117,632**	scfm
Q	**77,000**	dscfm

Run

8

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Date	Dec 10, 2020
Time	12:32

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**RTO Exhaust**			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	223			**P_{stat}, Static Press., in H_2O**	-0.6222
% CO_2	6	**% CO**	0	**% Moisture, v/v**	34.5
% O_2	14	**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	25.54

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.4819	224	0.694			
	3	0.4517	224	0.672			
	2	0.4418	223	0.665			
	1	0.3522	222	0.593			
SW	4	0.4109	226	0.641			
	3	0.3966	226	0.630			
	2	0.3401	225	0.583			
	1	0.2587	225	0.509			
NW	4	0.5517	222	0.743			
	3	0.5066	222	0.712			
	2	0.5019	222	0.708			
	1	0.2857	222	0.535			
NE	4	0.4665	221	0.683			
	3	0.4092	221	0.640			
	2	0.3675	224	0.606			
	1	0.3286	223	0.573			
Average		0.4095	223	0.6367			

Comments

P_s	**28.45**	in Hg
V_s	**2,660**	ft/min
Q_s	**159,942**	cfm
Q_{std}	**117,544**	scfm
Q	**76,942**	dscfm

Run

9

APEX

Date: Dec 10, 2020
Time: 12:59

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	RTO Exhaust			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	221			**P_{stat}, Static Press., in H_2O**	-0.6055
% CO_2 6		**% CO**	0	**% Moisture, v/v**	34.5
% O_2 14		**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	25.54

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.4214	220	0.649			
	3	0.4733	220	0.688			
	2	0.3636	220	0.603			
	1	0.2571	220	0.507			
SW	4	0.4663	222	0.683			
	3	0.5025	222	0.709			
	2	0.5493	222	0.741			
	1	0.3264	222	0.571			
NW	4	0.4575	221	0.676			
	3	0.4566	221	0.676			
	2	0.3464	221	0.589			
	1	0.2606	221	0.510			
NE	4	0.4084	222	0.639			
	3	0.5223	222	0.723			
	2	0.5595	222	0.748			
	1	0.3547	222	0.596			
Average		0.4204	221	0.644			

Comments

P_s	**28.46**	in Hg
V_s	**2,687**	ft/min
Q_s	**161,605**	cfm
Q_{std}	**119,120**	scfm
Q	**77,973**	dscfm

Run

10

Date	Dec 10, 2020
Time	13:21

USEPA Method 2
Gas Velocity Traverse and Volumetric Flowrate

Facility	Weyerhaeuser			**Operators**	TMZ
Sampling Location	**RTO Exhaust**			**Pitot Tube**	32
Stack Diameter, in	105	**Area, ft^2**	60.132	**Pitot Tube Factor, C_p**	0.84
Stack Dimension, in	NA	**Port Length, in**	6.5	**Cyclonic Flow Check**	Yes<20°
Gas Temperature, ˚F WB	NA			**P_{bar}, Bar. Press., in Hg**	28.5
Gas Temperature, ˚F DB	225			**P_{stat}, Static Press., in H_2O**	-0.6122
% CO_2 6		**% CO**	0	**% Moisture, v/v**	34.5
% O_2 14		**% N_2**	80	**Molecular Weight, M_d**	29.52
				Molecular Weight, M_s	25.54

Sample Port	Traverse Point	Velocity Head Difference (ΔP) (in H_2O)	Stack Temperature ˚F	$(\Delta P)^{0.5}$ (in $H_2O)^{0.5}$	Null Angle (zero ΔP angle)	Cosine Null Angle ($\cos \theta_{y(i)}$)	Velocity of Stack Gas V_{ai} (ft/sec)
SE	4	0.4275	224	0.654			
	3	0.4819	224	0.694			
	2	0.3787	224	0.615			
	1	0.2717	224	0.521			
SW	4	0.4881	225	0.699			
	3	0.5119	225	0.715			
	2	0.5247	225	0.724			
	1	0.3515	225	0.593			
NW	4	0.4147	225	0.644			
	3	0.4229	225	0.650			
	2	0.3667	225	0.606			
	1	0.2788	225	0.528			
NE	4	0.4119	226	0.642			
	3	0.5134	226	0.717			
	2	0.5219	225	0.722			
	1	0.2626	225	0.512			
Average		0.4143	225	0.640			

Comments

P_s	**28.45**	in Hg
V_s	**2,676**	ft/min
Q_s	**160,922**	cfm
Q_{std}	**117,987**	scfm
Q	**77,232**	dscfm

FGDRYERS RTO Outlet Moisture Content Results

Weyerhaeuser
Grayling, Michigan
Sampling Date: December 10, 2020
Apex Companies Project No. 11020-000068.00

Parameter	Runs 1-2	Run 3	Runs 4-6	Runs 7-10	Average
Date	Thursday, December 10, 2020				
Start Time	7:05	9:45	11:01	12:30	
Barometric Pressure (in Hg)	28.5	28.5	28.5	28.5	28.5
Average Orifice Differential Pressure (in H_2O)	1.76	1.76	1.76	1.76	1.76
Meter Correction Factor (γ)	0.996	0.996	0.996	0.996	0.996
Average Meter Temperature (°F)	36.6	37.4	50.0	46.6	42.6
Average Meter Pressure (in Hg)	28.63	28.63	28.63	28.63	28.63
Gas Volume Sampled (ft^3)	26.159	26.034	26.783	25.527	26.126
Gas Volume Sampled (standard ft^3)	26.508	26.336	26.426	25.357	26.157
Mass of Condensate Collected (g)	212.6	216.8	251.1	276.9	239.4
Silica Gel Mass Gain (g)	12.0	16.5	15.1	6.9	12.6
Moisture Volume (standard ft^3)	10.6	11.0	12.6	13.4	11.9
Moisture Content (%)	**28.5**	**29.5**	**32.2**	**34.5**	**31.2**

in H_2O	inch of water
°F	degree Fahrenheit
in Hg	inch of mercury
ft^3	cubic foot
g	gram
standard temperature, °F	68
standard pressure, in Hg	29.92

Appendix E
FTIR Data

USEPA Method 320 FTIR Report
Biofilter Formaldehyde Emissions
Weyerhaeuser
Grayling, Michigan

Apex Project No. 11020-000068.00

Test Date: December 9, 2020

Report Date: December 23, 2020

Apex Companies, LLC
46555 Humboldt Drive, Suite 103
Novi, Michigan 48377

APEX

Table of Contents

Tables

Appendix

1.0 Summary

Apex Companies, LLC (Apex) performed Fourier Transform Infrared (FTIR) testing at the Weyerhaeuser facility in Grayling, Michigan on December 9, 2020. Testing was conducted at the Press Biofilter inlet and outlet for formaldehyde and moisture content following United States Environmental Protection Agency (USEPA) Method 320 procedures. Three one-hour runs were conducted at each test location for the analytes. Sample data was not recorded from 8:03 to 8:20 during Run 1 at the Biofilter Inlet due to an error in the instrument. During this period of missed data, the process was operating as normal; therefore, results are expected to be similar throughout testing and the missing data should not affect the results. Results of the testing are summarized in Table 1. Minute data are provided in Appendix A.

Table 1
FTIR Results

Parameter		Run 1	Run 2	Run 3
Date		12/9/20	12/9/20	12/9/20
Run Time		0747-0847	0901-1001	1024-1124
Biofilter Inlet				
Formaldehyde	ppm, wet	8.99†	9.94	11.03
Water	%	2.21†	2.33	1.97
Biofilter Outlet				
Formaldehyde	ppm, wet	0.11	0.11	0.11
Water	%	4.08	4.09	4.15

† Data missing from 0803 to 0820

2.0 FTIR Instrumentation and Sampling System

Sample gas was extracted through a Millennium heated probe/filter assembly and heated line using a heated head pump. The pump was located downstream of the FTIR and pulled sample gas through the FTIR spectrometer. Sampling equipment was maintained at 375°F prior to entering the FTIR. The absorption cell was maintained at 191°C to prevent condensation in the cell and minimize analyte adhesion to the walls and mirrors of the FTIR cell.

The FTIR instruments used for this test were MKS Model 2030 (inlet FTIR serial 018160753, outlet FTIR serial 110421214). The instruments are equipped with a fixed 5.11-meter path length cell, potassium bromide beam splitter, zinc selenide windows, and a mercury cadmium telluride liquid nitrogen-cooled detector. The inside walls of the cell are polished stainless steel to minimize interaction of the sample with the cell walls, and the cell mirrors are of bare gold. All components are constructed of aluminum, stainless steel, or Teflon. The absorption cell volume is approximately 0.2 liters.

3.0 Spectral Data and Analysis

MG2000 (version 10.2, ©MKS Instruments, 2018) software was used to collect and analyze all the infrared field data. The reference spectra used for these analyses were developed by MKS and USEPA. For all data analysis, the apodization was Norton-Beer, the baseline correction was linear, and the spectral resolution of the system was one-half wavenumber (0.5 cm^{-1}) single sided. A spectral file was created every half-minute as the co-addition of 32 separate scans. All spectra were analyzed using temperature and pressure corrections.

All interferograms, single beams, absorbance spectra, and background single beams were stored and archived. Data was collected on a laptop computer and backed up to a USB flash drive. Upon return to the office, data was transferred to Apex's server for storage.

4.0 Quality Assurance

4.1 FTIR Instrument Condition

The FTIR operator assessed the condition of the FTIR prior to testing. The operator visually inspected the FTIR using the FT-IR Config Utilities Instrument Monitor tool and recorded the peak signal intensity, detector linearity, and peak width. The peak signal intensity is generally between 1000-2000 cm^{-1} and is recommended to be greater than 0.5. The detector linearity can be viewed in a region below the detector cut-off (200-500 cm^{-1}) and should be horizontally linear at 0.000±0.005. The peak analysis utility compared the instrument's current laser frequency and full-width at half-height (FWHH) peak to the instrument's reference values. The single beam spectra are provided in Appendix B.

Table 2
Quality Assurance – FTIR Condition

Specification	Inlet Result (SN x753)	Outlet Result (SN x214)	Criteria
Peak Signal Intensity	1.003	1.622	>0.5
Detector Linearity	-0.000	0.002	0.000±0.005

4.2 Calibration Transfer Standards

At the beginning and end of each test run, a calibration transfer standard (CTS) gas (ALM033173, 96.74 ppm ethylene, balance nitrogen) was introduced to the FTIR system to verify its effective absorption path length. Cylinder gas certifications are provided in Appendix D. Over the test period, CTS recoveries for the instrument must vary by less than 5% of the mean CTS measurement. All CTS measurements were acceptable. Refer to Table 3 for results of the CTS verifications. CTS data are provided in Appendix C.

Table 3
Quality Assurance – CTS Measurements

Measurement	Inlet Concentration (ppm)	Inlet Recovery	Outlet Concentration (ppm)	Outlet Recovery	Criteria
Initial Direct	96.91	100.2%	97.21	100.5%	95-105%
Pre-Test System	96.89	100.2%	96.27	99.5%	
Run 1/2 System	97.34	100.6%	98.32	101.6%	
Run 2/3 System	97.18	100.5%	98.09	101.4%	
Post-Test System	96.97	100.2%	98.04	101.3%	
Post-Test Direct	96.35	99.6%	97.20	100.5%	

4.3 Matrix Dynamic Spikes

Dynamic spikes were conducted following USEPA Method 320 specifications for quality assurance. Acetaldehyde and methanol matrix spiking was performed prior to testing. A spike gas cylinder was used for the matrix spiking (CC716034, 100.8ppm acetaldehyde, 100.3ppm methanol, 10.42ppm sulfur hexafluoride, balance nitrogen). Sulfur hexafluoride was used to determine the dilution ratio of the spike gas cylinder in the native stack gas. Cylinder gas certifications are provided in Appendix D. Spike recoveries must be 100±30%. All spike recoveries were acceptable. The pre-test spike for the outlet exceeded the recommended 10% dilution ratio. The excess dilution ratio does not affect the results. Refer to Tables 4 and 5 for results of the matrix dynamic spikes. Dynamic spike data are provided in Appendix C.

Table 4
Quality Assurance – Inlet Dynamic Spike Results

Measurement	Spike Pre	Spike 1/2	Spike 2/3	Spike Post	Criteria
Native Acetaldehyde Concentration (ppmw)	3.45	3.51	2.89	3.38	-
Spiked Acetaldehyde Concentration (ppmw)	10.97	10.16	10.03	10.14	-
Dilution Ratio	7.5%	7.1%	7.2%	7.1%	<10%
Acetaldehyde Recovery	101.0%	95.7%	99.3%	97.1%	70-130%

Table 5
Quality Assurance – Outlet Dynamic Spike Results

Measurement	Spike Pre	Spike 1/2	Spike 2/3	Spike Post	Criteria
Native Acetaldehyde Concentration (ppmw)	0.41	1.18	1.43	1.92	-
Spiked Acetaldehyde Concentration (ppmw)	8.28	10.00	7.72	8.59	-
Dilution Ratio	7.8%	8.7%	6.2%	6.7%	<10%
Acetaldehyde Recovery	98.8%	99.2%	99.7%	98.5%	70-130%

4.4 System Response Times

The high and zero system response times were measured using the CTS cylinder. Response time spectra were created approximately every 8 seconds as the co-addition of 8 separate scans. The high response time is the time required to reach at least 95% of the cylinder value. The zero response time is the time required to reach less than 5% of the cylinder value while sending a zero gas through the system. System response times are summarized in Table 6. System response data are provided in Appendix C.

Table 6
Quality Assurance – System Response Time

Measurement	Inlet Response Time (sec)	Response	Outlet Response Time (sec)	Response	Criteria
CTS High Response (Ethylene)	23	99.5%	23	99.5%	≥95%
CTS Zero Response (Nitrogen)	30	0.6%	31	0.2%	≤5%

4.5 Minimum Detectable Concentrations (MDCs)

USEPA Method 320 and the equivalent ASTM Standard D6348-12 specify several analytical uncertainty parameters that the analyst may use to characterize the FTIR system performance. The higher of (1) the average zero nitrogen results, equivalent to ASTM D6348-12 MDC1, or (2) the average three-sigma concentration uncertainty (three times the uncertainty provided by the MG2000 software, called the residual), equivalent to ASTM D6348-12 MDC2, was used to evaluate the detection limit. The minimum detectable concentrations are summarized in Table 7.

Table 7
Quality Assurance – Minimum Detectable Concentrations

Measurement	Unit	Inlet MDC1	Inlet MDC2	Outlet MDC1	Outlet MDC2
Formaldehyde	ppm, wet	0.1	0.3	0.1	0.1
Water	%	0.1	0.1	0.1	0.1
Ethylene	ppm, wet	0.1	0.3	0.1	0.2
Acetaldehyde	ppm, wet	0.2	0.5	0.1	0.2
Sulfur hexafluoride	ppm, wet	0.1	0.1	0.1	0.1

4.6 Manual Method Validation

The FTIR operator evaluated the analytical method during a post-test validation of multiple sample spectra. Spectra validations were chosen to encompass the range of concentrations measured for the target analytes during the sampling period. The values obtained through manual validation were compared to the values reported by the software. Reported results were within 20% of the manually validated results. Calibration curves for the analytical method are provided in Appendix E. Manual validations are provided in Appendix F.

5.0 **Limitations**

The information and opinions rendered in this report are exclusively for use by Weyerhaeuser. Apex Companies, LLC will not distribute or publish this report without consent of Weyerhaeuser except as required by law or court order. The information is given in response to a limited assignment and should be implemented only in light of that assignment. Apex Companies, LLC accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession but disclaims any responsibility for consequential damages.

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Appendix A
FTIR Minute Data

Biofilter Inlet Run 1

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000109.LAB	12/9/2020	7:47:12	4.90	1.92	0.40	3.45	0.02	191.95	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000110.LAB	12/9/2020	7:47:41	3.54	1.44	0.25	2.83	0.02	191.90	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000111.LAB	12/9/2020	7:48:11	4.17	1.37	0.28	3.08	0.00	191.95	0.93	0.09	0.01	0.05	0.15	0.00
BIOIN_000112.LAB	12/9/2020	7:48:42	8.49	1.63	0.35	3.50	0.01	191.96	0.93	0.11	0.01	0.07	0.17	0.00
BIOIN_000113.LAB	12/9/2020	7:49:12	11.09	1.91	0.34	4.01	0.01	192.01	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000114.LAB	12/9/2020	7:49:42	23.55	4.83	0.45	4.07	0.02	191.96	0.93	0.11	0.03	0.10	0.19	0.00
BIOIN_000115.LAB	12/9/2020	7:50:12	7.44	2.43	0.47	3.72	0.02	191.97	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000116.LAB	12/9/2020	7:50:42	3.52	1.61	0.31	2.84	0.01	192.03	0.93	0.10	0.01	0.06	0.17	0.00
BIOIN_000117.LAB	12/9/2020	7:51:12	3.16	1.35	0.28	2.82	0.01	191.97	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000118.LAB	12/9/2020	7:51:42	5.64	1.41	0.45	2.89	0.01	191.99	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000119.LAB	12/9/2020	7:52:12	9.63	1.75	0.44	4.36	0.02	192.00	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000120.LAB	12/9/2020	7:52:42	13.52	2.31	0.46	4.29	0.00	191.98	0.93	0.13	0.01	0.11	0.19	0.00
BIOIN_000121.LAB	12/9/2020	7:53:12	19.48	4.80	0.30	3.16	0.02	191.99	0.93	0.11	0.02	0.09	0.19	0.00
BIOIN_000122.LAB	12/9/2020	7:53:42	4.17	1.84	0.39	3.08	0.01	191.96	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000123.LAB	12/9/2020	7:54:12	3.01	1.41	0.28	2.76	0.03	191.99	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000124.LAB	12/9/2020	7:54:42	3.42	1.29	0.36	2.98	0.02	191.98	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000125.LAB	12/9/2020	7:55:12	6.86	1.53	0.31	3.59	0.01	191.93	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000126.LAB	12/9/2020	7:55:42	9.55	1.80	0.41	4.71	0.01	191.93	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000127.LAB	12/9/2020	7:56:12	22.43	4.97	0.35	5.00	0.03	191.93	0.93	0.11	0.03	0.11	0.19	0.00
BIOIN_000128.LAB	12/9/2020	7:56:42	6.38	2.35	0.44	3.47	0.02	191.97	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000129.LAB	12/9/2020	7:57:12	3.34	1.57	0.44	3.19	0.01	191.93	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000130.LAB	12/9/2020	7:57:42	4.56	1.42	0.35	2.36	0.02	191.95	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000131.LAB	12/9/2020	7:58:12	8.36	1.58	0.41	2.80	0.01	192.01	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000132.LAB	12/9/2020	7:58:42	12.96	2.01	0.60	4.19	0.03	192.01	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000133.LAB	12/9/2020	7:59:12	16.09	2.65	0.58	4.68	0.00	192.01	0.93	0.13	0.01	0.12	0.19	0.00
BIOIN_000134.LAB	12/9/2020	7:59:42	16.89	4.24	0.33	3.62	0.03	192.09	0.93	0.11	0.02	0.08	0.19	0.00
BIOIN_000135.LAB	12/9/2020	8:00:12	4.29	1.79	0.21	3.71	0.02	192.02	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000136.LAB	12/9/2020	8:00:42	3.35	1.42	0.40	3.54	0.01	192.01	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000137.LAB	12/9/2020	8:01:12	4.71	1.36	0.39	3.46	0.00	192.01	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000138.LAB	12/9/2020	8:01:42	8.91	1.68	0.35	4.32	0.00	192.07	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000139.LAB	12/9/2020	8:02:12	11.59	1.98	0.55	4.25	0.02	192.01	0.93	0.12	0.01	0.09	0.18	0.00
BIOIN_000140.LAB	12/9/2020	8:02:42	22.51	4.86	0.32	3.89	0.02	192.04	0.93	0.11	0.02	0.10	0.19	0.00
BIOIN_000141.LAB	12/9/2020	8:21:25	8.15	2.19	0.46	4.33	0.03	192.00	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000142.LAB	12/9/2020	8:21:54	9.87	1.92	0.42	4.68	0.02	191.95	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000143.LAB	12/9/2020	8:22:24	19.80	5.23	0.27	4.28	0.04	191.97	0.93	0.11	0.02	0.09	0.19	0.00
BIOIN_000144.LAB	12/9/2020	8:22:54	4.10	1.88	0.25	3.28	0.02	191.93	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000145.LAB	12/9/2020	8:23:24	3.42	1.46	0.24	2.93	0.02	192.00	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000146.LAB	12/9/2020	8:23:55	6.03	1.48	0.41	3.14	0.02	191.94	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000147.LAB	12/9/2020	8:24:24	12.01	1.89	0.34	3.53	0.01	191.93	0.93	0.11	0.01	0.07	0.18	0.00
BIOIN_000148.LAB	12/9/2020	8:24:54	14.73	2.24	0.56	4.71	0.00	191.97	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000149.LAB	12/9/2020	8:25:24	22.11	4.42	0.38	4.16	0.03	191.96	0.93	0.11	0.02	0.09	0.19	0.00
BIOIN_000150.LAB	12/9/2020	8:25:54	7.46	2.38	0.26	3.67	0.00	191.89	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000151.LAB	12/9/2020	8:26:26	3.58	1.58	0.26	3.26	0.01	191.97	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000152.LAB	12/9/2020	8:26:55	3.41	1.36	0.32	3.26	0.03	191.92	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000153.LAB	12/9/2020	8:27:25	6.94	1.51	0.32	3.54	0.02	191.95	0.93	0.10	0.01	0.06	0.17	0.00
BIOIN_000154.LAB	12/9/2020	8:27:55	12.00	1.94	0.46	4.42	0.00	191.96	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000155.LAB	12/9/2020	8:28:24	14.05	2.32	0.46	5.34	0.00	191.98	0.93	0.12	0.01	0.11	0.19	0.00
BIOIN_000156.LAB	12/9/2020	8:28:54	20.68	5.48	0.22	3.64	0.03	191.95	0.93	0.11	0.03	0.10	0.20	0.00
BIOIN_000157.LAB	12/9/2020	8:29:25	4.41	1.91	0.36	3.48	0.02	191.95	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000158.LAB	12/9/2020	8:29:54	3.02	1.45	0.28	2.48	0.01	191.92	0.93	0.09	0.01	0.06	0.17	0.00
BIOIN_000159.LAB	12/9/2020	8:30:25	3.84	1.34	0.29	2.97	0.01	191.94	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000160.LAB	12/9/2020	8:30:54	8.60	1.62	0.44	3.37	0.01	191.93	0.93	0.10	0.01	0.07	0.18	0.00
BIOIN_000161.LAB	12/9/2020	8:31:24	10.94	1.92	0.49	3.93	0.01	191.98	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000162.LAB	12/9/2020	8:31:54	21.59	4.79	0.34	4.22	0.01	191.96	0.93	0.11	0.03	0.10	0.20	0.00
BIOIN_000163.LAB	12/9/2020	8:32:24	6.63	2.41	0.53	3.43	0.01	192.00	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000164.LAB	12/9/2020	8:32:55	3.24	1.61	0.22	2.92	0.03	191.98	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000165.LAB	12/9/2020	8:33:25	2.78	1.34	0.34	2.95	0.01	191.96	0.93	0.10	0.01	0.05	0.16	0.00
BIOIN_000166.LAB	12/9/2020	8:33:55	5.46	1.40	0.16	3.28	0.01	191.94	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000167.LAB	12/9/2020	8:34:24	9.59	1.76	0.41	3.51	0.00	191.95	0.93	0.11	0.01	0.07	0.17	0.00
BIOIN_000168.LAB	12/9/2020	8:34:55	11.77	2.16	0.50	4.38	0.02	191.95	0.93	0.12	0.01	0.09	0.19	0.00
BIOIN_000169.LAB	12/9/2020	8:35:25	18.55	4.98	0.20	3.46	0.02	191.91	0.93	0.11	0.03	0.09	0.19	0.00
BIOIN_000170.LAB	12/9/2020	8:35:55	3.85	1.83	0.27	3.48	0.02	191.98	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000171.LAB	12/9/2020	8:36:24	3.41	1.41	0.32	3.04	0.02	191.93	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000172.LAB	12/9/2020	8:36:55	5.97	1.47	0.25	2.87	0.01	191.92	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000173.LAB	12/9/2020	8:37:25	11.75	1.88	0.47	3.36	0.01	191.93	0.93	0.11	0.01	0.08	0.17	0.00
BIOIN_000174.LAB	12/9/2020	8:37:55	13.67	2.16	0.45	4.13	0.00	191.93	0.93	0.12	0.01	0.08	0.18	0.00
BIOIN_000175.LAB	12/9/2020	8:38:25	20.90	4.39	0.25	3.76	0.01	191.93	0.93	0.11	0.02	0.09	0.20	0.00
BIOIN_000176.LAB	12/9/2020	8:38:55	6.30	2.16	0.28	3.23	0.03	191.96	0.93	0.11	0.01	0.07	0.18	0.00
BIOIN_000177.LAB	12/9/2020	8:39:25	3.29	1.52	0.20	2.59	0.01	191.93	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000178.LAB	12/9/2020	8:39:55	3.01	1.33	0.38	2.86	0.01	191.95	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000179.LAB	12/9/2020	8:40:25	6.01	1.43	0.28	2.93	0.01	191.95	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000180.LAB	12/9/2020	8:40:55	9.92	1.78	0.31	3.61	0.02	191.95	0.93	0.11	0.01	0.07	0.18	0.00
BIOIN_000181.LAB	12/9/2020	8:41:25	13.68	2.41	0.62	4.68	0.01	191.99	0.93	0.12	0.01	0.11	0.19	0.00
BIOIN_000182.LAB	12/9/2020	8:41:55	16.67	4.46	0.40	3.51	0.03	191.98	0.93	0.11	0.02	0.08	0.19	0.00
BIOIN_000183.LAB	12/9/2020	8:42:25	4.03	1.78	0.41	2.97	0.02	192.03	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000184.LAB	12/9/2020	8:42:55	2.97	1.40	0.31	3.06	0.02	192.05	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000185.LAB	12/9/2020	8:43:25	3.65	1.30	0.30	2.79	0.00	192.04	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000186.LAB	12/9/2020	8:43:55	7.98	1.57	0.36	3.58	0.02	192.06	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000187.LAB	12/9/2020	8:44:25	9.96	1.85	0.43	4.05	0.02	192.06	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000188.LAB	12/9/2020	8:44:55	20.44	4.77	0.39	4.59	0.02	192.12	0.93	0.11	0.02	0.10	0.21	0.00
BIOIN_000189.LAB	12/9/2020	8:45:25	5.79	2.23	0.46	2.89	0.01	192.14	0.93	0.10	0.01	0.08	0.18	0.00
BIOIN_000190.LAB	12/9/2020	8:45:55	3.03	1.53	0.40	3.30	0.01	192.10	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000191.LAB	12/9/2020	8:46:25	3.00	1.32	0.23	2.92	0.02	192.12	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000192.LAB	12/9/2020	8:46:55	5.98	1.44	0.35	3.03	0.02	192.10	0.93	0.09	0.01	0.07	0.17	0.00
Average			**8.99**	**2.21**	**0.36**	**3.55**	**0.01**	**191.98**	**0.93**	**0.10**	**0.01**	**0.08**	**0.17**	**0.00**

Biofilter Inlet Run 2

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000209.LAB	12/9/2020	9:01:26	13.11	3.83	0.64	3.43	0.01	192.13	0.93	0.12	0.02	0.14	0.20	0.00
BIOIN_000210.LAB	12/9/2020	9:01:56	3.62	1.74	0.26	3.09	0.02	192.10	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000211.LAB	12/9/2020	9:02:26	3.74	1.41	0.45	2.44	0.02	192.08	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000212.LAB	12/9/2020	9:02:56	6.38	1.48	0.28	2.75	0.01	192.13	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000213.LAB	12/9/2020	9:03:26	12.14	1.90	0.41	3.26	0.01	192.15	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000214.LAB	12/9/2020	9:03:56	13.80	2.18	0.46	4.02	0.01	192.09	0.93	0.11	0.01	0.09	0.19	0.00
BIOIN_000215.LAB	12/9/2020	9:04:26	21.01	4.70	0.23	3.47	0.02	192.10	0.93	0.11	0.02	0.10	0.20	0.00
BIOIN_000216.LAB	12/9/2020	9:04:56	5.27	2.02	0.54	2.96	0.03	192.12	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000217.LAB	12/9/2020	9:05:26	3.18	1.48	0.37	2.86	0.02	192.14	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000218.LAB	12/9/2020	9:05:56	3.13	1.30	0.32	2.94	0.01	192.13	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000219.LAB	12/9/2020	9:06:26	6.44	1.46	0.28	3.46	0.00	192.10	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000220.LAB	12/9/2020	9:06:56	10.03	1.79	0.47	3.75	0.00	192.18	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000221.LAB	12/9/2020	9:07:26	16.80	3.03	0.33	3.91	0.00	192.15	0.93	0.10	0.01	0.08	0.18	0.00

BIOIN_000222.LAB	12/9/2020	9:07:56	12.82	3.77	0.57	3.51	0.01	192.17	0.93	0.13	0.02	0.13	0.20	0.00
BIOIN_000223.LAB	12/9/2020	9:08:26	3.66	1.74	0.30	3.08	0.02	192.16	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000224.LAB	12/9/2020	9:08:56	2.92	1.40	0.25	3.52	0.00	192.15	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000225.LAB	12/9/2020	9:09:26	5.44	1.41	0.23	3.55	0.01	192.15	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000226.LAB	12/9/2020	9:09:56	10.98	1.85	0.48	3.34	0.01	192.17	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000227.LAB	12/9/2020	9:10:26	12.81	2.09	0.59	4.16	0.01	192.21	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000228.LAB	12/9/2020	9:10:56	22.78	5.48	0.28	3.62	0.03	192.19	0.93	0.11	0.03	0.11	0.20	0.00
BIOIN_000229.LAB	12/9/2020	9:11:26	4.83	2.10	0.45	3.33	0.03	192.21	0.93	0.10	0.01	0.09	0.17	0.00
BIOIN_000230.LAB	12/9/2020	9:11:56	2.94	1.51	0.23	2.34	0.02	192.18	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000231.LAB	12/9/2020	9:12:26	3.75	1.38	0.26	3.17	0.01	192.21	0.93	0.08	0.01	0.06	0.15	0.00
BIOIN_000232.LAB	12/9/2020	9:12:56	9.59	1.71	0.48	3.06	0.01	192.21	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000233.LAB	12/9/2020	9:13:26	14.16	2.11	0.57	4.45	0.01	192.19	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000234.LAB	12/9/2020	9:13:56	22.68	3.92	0.28	3.43	0.00	192.19	0.93	0.11	0.02	0.09	0.18	0.00
BIOIN_000235.LAB	12/9/2020	9:14:26	12.51	3.73	0.70	3.56	0.00	192.17	0.93	0.12	0.02	0.13	0.19	0.00
BIOIN_000236.LAB	12/9/2020	9:14:57	3.93	1.79	0.37	3.00	0.02	192.20	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000237.LAB	12/9/2020	9:15:26	4.16	1.47	0.35	2.41	0.01	192.19	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000238.LAB	12/9/2020	9:15:56	7.46	1.57	0.35	2.92	0.00	192.19	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000239.LAB	12/9/2020	9:16:26	13.54	2.01	0.48	3.33	0.01	192.20	0.93	0.11	0.01	0.08	0.17	0.00
BIOIN_000240.LAB	12/9/2020	9:16:56	14.93	2.25	0.57	4.07	0.00	192.22	0.93	0.11	0.01	0.10	0.18	0.00
BIOIN_000241.LAB	12/9/2020	9:17:27	22.11	4.95	0.38	3.47	0.02	192.21	0.93	0.11	0.03	0.10	0.20	0.00
BIOIN_000242.LAB	12/9/2020	9:17:56	5.33	1.99	0.31	2.96	0.01	192.17	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000243.LAB	12/9/2020	9:18:26	3.28	1.48	0.24	2.69	0.01	192.20	0.93	0.08	0.01	0.06	0.15	0.00
BIOIN_000244.LAB	12/9/2020	9:18:57	3.72	1.35	0.29	2.60	0.02	192.18	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000245.LAB	12/9/2020	9:19:26	8.33	1.59	0.26	3.03	0.01	192.18	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000246.LAB	12/9/2020	9:19:56	11.90	1.92	0.43	3.77	0.01	192.15	0.93	0.10	0.01	0.09	0.17	0.00
BIOIN_000247.LAB	12/9/2020	9:20:26	20.46	3.75	0.20	4.06	0.01	192.15	0.93	0.10	0.02	0.09	0.19	0.00
BIOIN_000248.LAB	12/9/2020	9:20:56	10.37	3.25	0.69	3.68	0.00	192.16	0.93	0.11	0.01	0.11	0.19	0.00
BIOIN_000249.LAB	12/9/2020	9:21:27	3.68	1.70	0.27	2.89	0.02	192.13	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000250.LAB	12/9/2020	9:21:57	3.16	1.39	0.32	2.58	0.01	192.17	0.93	0.08	0.01	0.06	0.15	0.00
BIOIN_000251.LAB	12/9/2020	9:22:27	5.18	1.40	0.37	2.62	0.03	192.18	0.93	0.09	0.01	0.07	0.15	0.00
BIOIN_000252.LAB	12/9/2020	9:22:56	10.23	1.75	0.29	2.55	0.01	192.13	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000253.LAB	12/9/2020	9:23:26	11.83	2.00	0.59	4.65	0.02	192.13	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000254.LAB	12/9/2020	9:23:57	21.54	5.23	0.32	3.58	0.03	192.12	0.93	0.11	0.03	0.11	0.20	0.00
BIOIN_000255.LAB	12/9/2020	9:24:27	4.63	2.01	0.36	3.60	0.03	192.14	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000256.LAB	12/9/2020	9:24:57	3.05	1.48	0.29	3.24	0.01	192.14	0.93	0.08	0.01	0.06	0.15	0.00
BIOIN_000257.LAB	12/9/2020	9:25:27	3.87	1.35	0.32	2.33	0.01	192.15	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000258.LAB	12/9/2020	9:25:57	8.29	1.61	0.37	3.18	0.02	192.15	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000259.LAB	12/9/2020	9:26:27	12.27	1.96	0.49	3.83	0.02	192.13	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000260.LAB	12/9/2020	9:26:57	21.91	4.18	0.30	3.25	0.02	192.09	0.93	0.10	0.02	0.08	0.19	0.00
BIOIN_000261.LAB	12/9/2020	9:27:27	8.87	2.87	0.54	3.58	0.01	192.15	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000262.LAB	12/9/2020	9:27:57	3.49	1.65	0.24	3.24	0.01	192.18	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000263.LAB	12/9/2020	9:28:27	3.83	1.42	0.32	3.20	0.02	192.11	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000264.LAB	12/9/2020	9:28:57	7.02	1.51	0.35	3.19	0.01	192.13	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000265.LAB	12/9/2020	9:29:27	12.35	1.94	0.41	4.05	0.01	192.16	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000266.LAB	12/9/2020	9:29:57	13.21	2.13	0.46	4.18	0.02	192.16	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000267.LAB	12/9/2020	9:30:27	21.21	5.03	0.18	3.57	0.01	192.13	0.93	0.11	0.02	0.10	0.20	0.00
BIOIN_000268.LAB	12/9/2020	9:30:57	4.71	1.93	0.28	3.58	0.01	192.15	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000269.LAB	12/9/2020	9:31:27	3.17	1.45	0.32	2.68	0.01	192.11	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000270.LAB	12/9/2020	9:31:57	3.84	1.34	0.28	3.01	0.01	192.15	0.93	0.09	0.01	0.05	0.15	0.00
BIOIN_000271.LAB	12/9/2020	9:32:27	8.48	1.62	0.41	3.17	0.00	192.15	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000272.LAB	12/9/2020	9:32:57	12.03	1.95	0.46	4.21	0.00	192.19	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000273.LAB	12/9/2020	9:33:27	21.54	4.29	0.31	4.13	0.03	192.18	0.93	0.10	0.02	0.09	0.19	0.00
BIOIN_000274.LAB	12/9/2020	9:33:57	9.55	3.04	0.64	3.42	0.00	192.17	0.93	0.11	0.01	0.10	0.18	0.00
BIOIN_000275.LAB	12/9/2020	9:34:27	3.45	1.68	0.33	3.01	0.01	192.14	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000276.LAB	12/9/2020	9:34:57	3.53	1.40	0.35	3.25	0.02	192.16	0.93	0.09	0.01	0.07	0.15	0.00
BIOIN_000277.LAB	12/9/2020	9:35:27	7.48	1.57	0.33	2.70	0.02	192.19	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000278.LAB	12/9/2020	9:35:57	13.14	2.01	0.49	3.44	0.00	192.17	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000279.LAB	12/9/2020	9:36:27	14.21	2.22	0.65	4.23	0.01	192.18	0.93	0.11	0.01	0.10	0.18	0.00
BIOIN_000280.LAB	12/9/2020	9:36:57	23.49	5.76	0.28	2.95	0.04	192.15	0.93	0.11	0.03	0.11	0.20	0.00
BIOIN_000281.LAB	12/9/2020	9:37:27	4.68	2.01	0.31	3.04	0.02	192.14	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000282.LAB	12/9/2020	9:37:57	3.25	1.49	0.29	2.74	0.01	192.15	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000283.LAB	12/9/2020	9:38:27	4.80	1.44	0.33	2.55	0.01	192.15	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000284.LAB	12/9/2020	9:38:57	10.19	1.76	0.37	3.98	0.02	192.10	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000285.LAB	12/9/2020	9:39:27	13.81	2.11	0.49	4.13	0.02	192.12	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000286.LAB	12/9/2020	9:39:57	24.09	4.70	0.40	3.93	0.02	192.09	0.93	0.11	0.02	0.09	0.20	0.00
BIOIN_000287.LAB	12/9/2020	9:40:28	8.08	2.71	0.46	3.45	0.00	192.15	0.93	0.11	0.01	0.09	0.17	0.00
BIOIN_000288.LAB	12/9/2020	9:40:57	3.75	1.66	0.34	3.20	0.02	192.09	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000289.LAB	12/9/2020	9:41:27	3.77	1.42	0.31	2.87	0.01	192.18	0.93	0.09	0.01	0.07	0.15	0.00
BIOIN_000290.LAB	12/9/2020	9:41:57	7.58	1.56	0.35	3.37	0.01	192.13	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000291.LAB	12/9/2020	9:42:27	12.52	1.97	0.44	3.50	0.02	192.13	0.93	0.11	0.01	0.08	0.17	0.00
BIOIN_000292.LAB	12/9/2020	9:42:58	13.64	2.20	0.43	4.41	0.00	192.13	0.93	0.11	0.01	0.10	0.19	0.00
BIOIN_000293.LAB	12/9/2020	9:43:27	21.71	5.46	0.21	3.72	0.02	192.07	0.93	0.11	0.03	0.10	0.20	0.00
BIOIN_000294.LAB	12/9/2020	9:43:57	4.41	1.95	0.34	3.13	0.02	192.15	0.93	0.09	0.01	0.08	0.16	0.00
BIOIN_000295.LAB	12/9/2020	9:44:28	3.09	1.47	0.28	3.02	0.02	192.08	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000296.LAB	12/9/2020	9:44:58	4.01	1.36	0.28	3.34	0.01	192.10	0.93	0.08	0.01	0.07	0.15	0.00
BIOIN_000297.LAB	12/9/2020	9:45:27	9.08	1.70	0.44	3.40	0.02	192.07	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000298.LAB	12/9/2020	9:45:57	12.31	2.00	0.54	4.20	0.02	192.10	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000299.LAB	12/9/2020	9:46:27	23.81	4.97	0.25	3.60	0.02	192.14	0.93	0.11	0.03	0.10	0.20	0.00
BIOIN_000300.LAB	12/9/2020	9:46:58	7.77	2.66	0.46	2.77	0.01	192.14	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000301.LAB	12/9/2020	9:47:28	3.41	1.66	0.45	2.68	0.01	192.14	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000302.LAB	12/9/2020	9:47:57	4.15	1.43	0.29	3.25	0.01	192.13	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000303.LAB	12/9/2020	9:48:28	8.72	1.67	0.35	2.90	0.01	192.12	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000304.LAB	12/9/2020	9:48:58	14.63	2.11	0.47	4.10	0.01	192.13	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000305.LAB	12/9/2020	9:49:28	16.04	2.47	0.59	4.98	0.01	192.14	0.93	0.11	0.01	0.11	0.18	0.00
BIOIN_000306.LAB	12/9/2020	9:49:58	21.19	5.25	0.23	3.19	0.02	192.12	0.93	0.10	0.03	0.09	0.19	0.00
BIOIN_000307.LAB	12/9/2020	9:50:28	4.62	1.90	0.34	3.36	0.03	192.13	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000308.LAB	12/9/2020	9:50:58	3.26	1.48	0.29	3.26	0.01	192.15	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000309.LAB	12/9/2020	9:51:28	4.75	1.41	0.27	3.30	0.02	192.16	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000310.LAB	12/9/2020	9:51:58	10.30	1.79	0.56	3.53	0.01	192.12	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000311.LAB	12/9/2020	9:52:28	13.47	2.10	0.52	4.28	0.01	192.11	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000312.LAB	12/9/2020	9:52:58	24.71	5.19	0.47	3.86	0.03	192.15	0.93	0.11	0.03	0.11	0.19	0.00
BIOIN_000313.LAB	12/9/2020	9:53:28	7.79	2.70	0.46	2.78	0.00	192.11	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000314.LAB	12/9/2020	9:53:58	3.54	1.69	0.46	2.61	0.02	192.15	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000315.LAB	12/9/2020	9:54:28	4.17	1.47	0.42	2.96	0.02	192.15	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000316.LAB	12/9/2020	9:54:58	9.71	1.76	0.43	3.00	0.00	192.16	0.93	0.10	0.01	0.08	0.16	0.00
BIOIN_000317.LAB	12/9/2020	9:55:28	15.32	2.21	0.48	4.31	0.00	192.17	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000318.LAB	12/9/2020	9:55:58	16.85	2.62	0.56	4.16	0.01	192.14	0.93	0.13	0.01	0.12	0.19	0.00
BIOIN_000319.LAB	12/9/2020	9:56:28	21.51	5.84	0.32	2.14	0.03	192.14	0.93	0.11	0.03	0.10	0.19	0.00
BIOIN_000320.LAB	12/9/2020	9:56:58	4.37	2.01	0.23	2.56	0.03	192.15	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000321.LAB	12/9/2020	9:57:28	3.29	1.50	0.45	2.80	0.02	192.10	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000322.LAB	12/9/2020	9:57:58	6.80	1.56	0.31	2.70	0.01	192.13	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000323.LAB	12/9/2020	9:58:28	14.50	2.09	0.42	3.79	0.00	192.13	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000324.LAB	12/9/2020	9:58:58	17.46	2.41	0.58	3.91	0.00	192.14	0.93	0.12	0.01	0.09	0.18	0.00
BIOIN_000325.LAB	12/9/2020	9:59:28	28.47	5.97	0.28	2.21	0.02	192.13	0.93	0.11	0.03	0.11	0.19	0.00
BIOIN_000326.LAB	12/9/2020	9:59:58	7.43	2.60	0.54	2.85	0.00	192.17	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000327.LAB	12/9/2020	10:00:28	3.64	1.69	0.33	2.33	0.01	192.11	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000328.LAB	12/9/2020	10:00:58	4.20	1.46	0.29	2.25	0.02	192.15	0.93	0.09	0.01	0.07	0.16	0.00

Average			**9.94**	**2.33**	**0.39**	**3.32**	**0.01**	**192.15**	**0.93**	**0.10**	**0.01**	**0.08**	**0.17**	**0.00**

Biofilter Inlet Run 3

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000359.LAB	12/9/2020	10:24:29	13.93	2.03	0.50	3.29	0.03	192.15	0.93	0.11	0.01	0.10	0.18	0.00
BIOIN_000360.LAB	12/9/2020	10:24:59	16.05	2.30	0.57	3.97	0.01	192.15	0.93	0.12	0.01	0.10	0.19	0.00
BIOIN_000361.LAB	12/9/2020	10:25:29	25.06	5.52	0.43	2.91	0.03	192.13	0.93	0.12	0.03	0.11	0.20	0.00
BIOIN_000362.LAB	12/9/2020	10:25:59	5.66	2.12	0.47	2.85	0.02	192.18	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000363.LAB	12/9/2020	10:26:29	3.29	1.59	0.26	2.70	0.01	192.12	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000364.LAB	12/9/2020	10:26:59	2.93	1.36	0.32	2.78	0.02	192.14	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000365.LAB	12/9/2020	10:27:30	5.20	1.36	0.39	3.24	0.02	192.16	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000366.LAB	12/9/2020	10:27:59	12.07	1.82	0.43	2.80	0.01	192.15	0.93	0.11	0.01	0.07	0.17	0.00
BIOIN_000367.LAB	12/9/2020	10:28:29	14.97	2.16	0.42	3.85	0.00	192.11	0.93	0.11	0.01	0.11	0.18	0.00
BIOIN_000368.LAB	12/9/2020	10:29:00	25.78	5.29	0.31	3.36	0.02	192.12	0.93	0.12	0.03	0.11	0.20	0.00
BIOIN_000369.LAB	12/9/2020	10:29:29	6.91	2.41	0.38	3.18	0.02	192.07	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000370.LAB	12/9/2020	10:30:00	3.42	1.58	0.47	2.72	0.03	192.11	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000371.LAB	12/9/2020	10:30:29	2.14	1.30	0.15	2.57	0.01	192.12	0.93	0.09	0.01	0.07	0.15	0.00
BIOIN_000372.LAB	12/9/2020	10:31:00	1.32	1.11	0.27	2.91	0.01	192.12	0.93	0.08	0.01	0.06	0.15	0.00
BIOIN_000373.LAB	12/9/2020	10:31:30	1.10	1.03	0.19	3.12	0.02	192.10	0.93	0.08	0.01	0.06	0.15	0.00
BIOIN_000374.LAB	12/9/2020	10:32:00	0.79	0.96	0.09	2.42	0.01	192.15	0.93	0.08	0.01	0.05	0.14	0.00
BIOIN_000375.LAB	12/9/2020	10:32:30	0.75	0.93	0.22	2.63	0.01	192.16	0.93	0.07	0.01	0.05	0.14	0.00
BIOIN_000376.LAB	12/9/2020	10:32:59	0.81	0.93	0.18	1.89	0.01	192.17	0.93	0.08	0.01	0.05	0.15	0.00
BIOIN_000377.LAB	12/9/2020	10:33:29	1.10	1.03	0.28	2.10	0.01	192.17	0.93	0.08	0.01	0.06	0.14	0.00
BIOIN_000378.LAB	12/9/2020	10:34:00	1.27	0.97	0.26	2.43	0.01	192.18	0.93	0.08	0.01	0.05	0.15	0.00
BIOIN_000379.LAB	12/9/2020	10:34:30	1.66	0.96	0.24	2.32	0.01	192.18	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000380.LAB	12/9/2020	10:35:00	4.04	1.16	0.46	2.60	0.02	192.12	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000381.LAB	12/9/2020	10:35:30	10.89	1.77	0.39	3.09	0.02	192.09	0.93	0.11	0.01	0.09	0.17	0.00
BIOIN_000382.LAB	12/9/2020	10:36:00	15.25	2.19	0.55	4.09	0.00	192.18	0.93	0.11	0.01	0.10	0.19	0.00
BIOIN_000383.LAB	12/9/2020	10:36:30	33.85	4.28	0.18	2.86	0.02	192.13	0.93	0.12	0.02	0.08	0.20	0.00
BIOIN_000384.LAB	12/9/2020	10:37:00	10.24	2.13	0.38	3.36	0.02	192.16	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000385.LAB	12/9/2020	10:37:30	5.83	1.66	0.36	2.91	0.03	192.20	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000386.LAB	12/9/2020	10:38:00	4.56	1.39	0.29	2.61	0.02	192.16	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000387.LAB	12/9/2020	10:38:30	3.47	1.23	0.35	2.62	0.01	192.17	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000388.LAB	12/9/2020	10:39:00	2.99	1.15	0.24	2.66	0.01	192.14	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000389.LAB	12/9/2020	10:39:30	7.47	1.42	0.35	3.03	0.01	192.13	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000390.LAB	12/9/2020	10:40:00	14.50	1.99	0.41	3.45	0.02	192.13	0.93	0.11	0.01	0.09	0.17	0.00
BIOIN_000391.LAB	12/9/2020	10:40:30	19.71	2.41	0.65	3.45	0.00	192.16	0.93	0.12	0.01	0.11	0.19	0.00
BIOIN_000392.LAB	12/9/2020	10:41:00	35.39	4.25	0.36	3.21	0.02	192.13	0.93	0.13	0.02	0.09	0.20	0.00
BIOIN_000393.LAB	12/9/2020	10:41:30	8.73	1.83	0.48	3.34	0.02	192.13	0.93	0.11	0.01	0.08	0.17	0.00
BIOIN_000394.LAB	12/9/2020	10:42:00	6.29	1.59	0.21	2.93	0.00	192.11	0.93	0.10	0.01	0.06	0.17	0.00
BIOIN_000395.LAB	12/9/2020	10:42:30	4.75	1.34	0.32	2.74	0.01	192.14	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000396.LAB	12/9/2020	10:43:00	3.81	1.20	0.15	3.16	0.01	192.14	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000397.LAB	12/9/2020	10:43:30	4.46	1.21	0.31	3.21	0.01	192.13	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000398.LAB	12/9/2020	10:44:00	11.47	1.69	0.46	2.90	0.01	192.14	0.93	0.11	0.01	0.08	0.17	0.00
BIOIN_000399.LAB	12/9/2020	10:44:30	17.80	2.15	0.60	3.50	0.01	192.14	0.93	0.12	0.01	0.11	0.19	0.00
BIOIN_000400.LAB	12/9/2020	10:45:00	40.30	3.99	0.22	3.16	0.00	192.18	0.93	0.13	0.02	0.09	0.20	0.00
BIOIN_000401.LAB	12/9/2020	10:45:31	15.98	2.41	0.50	2.41	0.01	192.12	0.93	0.12	0.01	0.09	0.18	0.00
BIOIN_000402.LAB	12/9/2020	10:46:00	8.00	1.71	0.37	2.85	0.01	192.17	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000403.LAB	12/9/2020	10:46:30	6.01	1.47	0.27	3.03	0.01	192.20	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000404.LAB	12/9/2020	10:47:01	4.39	1.26	0.41	2.76	0.02	192.21	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000405.LAB	12/9/2020	10:47:30	3.71	1.16	0.18	2.98	-0.01	192.18	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000406.LAB	12/9/2020	10:48:00	6.60	1.34	0.30	3.14	0.01	192.15	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000407.LAB	12/9/2020	10:48:30	13.12	1.88	0.49	3.55	0.02	192.20	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000408.LAB	12/9/2020	10:49:00	16.84	2.22	0.54	3.08	0.00	192.20	0.93	0.12	0.01	0.10	0.18	0.00
BIOIN_000409.LAB	12/9/2020	10:49:30	39.90	4.58	0.37	2.92	0.01	192.22	0.93	0.14	0.02	0.09	0.21	0.00
BIOIN_000410.LAB	12/9/2020	10:50:00	9.61	1.92	0.34	2.86	0.02	192.19	0.93	0.11	0.01	0.08	0.17	0.00
BIOIN_000411.LAB	12/9/2020	10:50:30	6.80	1.65	0.31	3.12	0.01	192.16	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000412.LAB	12/9/2020	10:51:00	4.62	1.34	0.32	2.69	0.01	192.21	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000413.LAB	12/9/2020	10:51:30	3.43	1.20	0.24	2.95	0.01	192.20	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000414.LAB	12/9/2020	10:52:00	3.96	1.16	0.28	2.38	0.01	192.19	0.93	0.08	0.01	0.06	0.15	0.00
BIOIN_000415.LAB	12/9/2020	10:52:31	9.75	1.63	0.44	3.43	0.01	192.19	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000416.LAB	12/9/2020	10:53:01	15.07	2.09	0.60	3.11	0.00	192.17	0.93	0.12	0.01	0.09	0.19	0.00
BIOIN_000417.LAB	12/9/2020	10:53:30	31.73	3.56	0.16	3.09	0.00	192.22	0.93	0.12	0.02	0.08	0.19	0.00
BIOIN_000418.LAB	12/9/2020	10:54:00	19.48	2.96	0.62	3.47	0.01	192.18	0.93	0.12	0.01	0.11	0.19	0.00
BIOIN_000419.LAB	12/9/2020	10:54:31	7.93	1.76	0.41	2.91	0.00	192.22	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000420.LAB	12/9/2020	10:55:00	5.49	1.50	0.36	2.92	0.02	192.20	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000421.LAB	12/9/2020	10:55:31	4.22	1.28	0.23	2.57	0.01	192.21	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000422.LAB	12/9/2020	10:56:01	4.02	1.19	0.17	2.93	0.01	192.15	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000423.LAB	12/9/2020	10:56:31	8.29	1.49	0.38	3.43	0.02	192.18	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000424.LAB	12/9/2020	10:57:01	15.02	2.11	0.52	3.74	0.00	192.17	0.93	0.12	0.01	0.09	0.19	0.00
BIOIN_000425.LAB	12/9/2020	10:57:31	18.18	2.41	0.49	4.20	0.00	192.17	0.93	0.12	0.01	0.11	0.19	0.00
BIOIN_000426.LAB	12/9/2020	10:58:01	38.49	4.81	0.44	2.92	0.01	192.18	0.93	0.13	0.02	0.09	0.20	0.00
BIOIN_000427.LAB	12/9/2020	10:58:31	9.54	2.01	0.50	3.03	0.02	192.20	0.93	0.11	0.01	0.08	0.17	0.00
BIOIN_000428.LAB	12/9/2020	10:59:01	6.56	1.67	0.31	2.88	0.00	192.19	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000429.LAB	12/9/2020	10:59:31	4.84	1.40	0.28	2.92	0.01	192.22	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000430.LAB	12/9/2020	11:00:01	4.50	1.27	0.25	2.55	0.01	192.19	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000431.LAB	12/9/2020	11:00:31	5.72	1.31	0.23	3.13	0.01	192.18	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000432.LAB	12/9/2020	11:01:01	13.21	1.94	0.45	3.20	0.02	192.22	0.93	0.12	0.01	0.09	0.18	0.00
BIOIN_000433.LAB	12/9/2020	11:01:31	18.56	2.42	0.52	3.66	0.00	192.17	0.93	0.12	0.01	0.11	0.19	0.00
BIOIN_000434.LAB	12/9/2020	11:02:01	31.02	3.55	0.22	3.29	-0.01	192.14	0.93	0.12	0.02	0.08	0.19	0.00
BIOIN_000435.LAB	12/9/2020	11:02:31	25.87	3.66	0.67	3.48	-0.01	192.15	0.93	0.13	0.02	0.12	0.20	0.00
BIOIN_000436.LAB	12/9/2020	11:03:01	8.19	1.80	0.37	3.78	0.02	192.13	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000437.LAB	12/9/2020	11:03:31	5.90	1.58	0.29	3.25	0.02	192.12	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000438.LAB	12/9/2020	11:04:01	4.30	1.33	0.24	2.90	0.01	192.13	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000439.LAB	12/9/2020	11:04:31	3.54	1.18	0.38	3.12	0.01	192.14	0.93	0.08	0.01	0.06	0.15	0.00
BIOIN_000440.LAB	12/9/2020	11:05:01	5.46	1.29	0.22	2.76	0.02	192.10	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000441.LAB	12/9/2020	11:05:31	11.64	1.88	0.48	3.79	0.01	192.17	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000442.LAB	12/9/2020	11:06:01	15.30	2.23	0.61	4.43	0.01	192.17	0.93	0.12	0.01	0.10	0.19	0.00
BIOIN_000443.LAB	12/9/2020	11:06:31	36.81	4.62	0.43	3.27	0.02	192.13	0.93	0.13	0.02	0.09	0.20	0.00
BIOIN_000444.LAB	12/9/2020	11:07:01	11.28	2.24	0.53	3.22	0.01	192.13	0.93	0.11	0.01	0.07	0.18	0.00
BIOIN_000445.LAB	12/9/2020	11:07:31	6.58	1.69	0.23	3.05	0.02	192.12	0.93	0.10	0.01	0.06	0.17	0.00
BIOIN_000446.LAB	12/9/2020	11:08:01	4.79	1.42	0.33	2.87	0.02	192.16	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000447.LAB	12/9/2020	11:08:31	3.49	1.22	0.19	2.52	0.00	192.17	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000448.LAB	12/9/2020	11:09:01	2.95	1.15	0.22	3.14	0.01	192.06	0.93	0.09	0.01	0.05	0.16	0.00
BIOIN_000449.LAB	12/9/2020	11:09:31	7.47	1.47	0.41	3.33	0.02	192.15	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000450.LAB	12/9/2020	11:10:01	13.00	2.00	0.37	3.87	0.01	192.12	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000451.LAB	12/9/2020	11:10:32	17.79	2.47	0.56	3.89	0.00	192.18	0.93	0.12	0.01	0.10	0.19	0.00
BIOIN_000452.LAB	12/9/2020	11:11:01	32.63	4.52	0.37	2.58	0.01	192.18	0.93	0.12	0.02	0.09	0.20	0.00
BIOIN_000453.LAB	12/9/2020	11:11:31	7.91	1.88	0.35	3.57	0.01	192.17	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000454.LAB	12/9/2020	11:12:01	5.50	1.59	0.34	3.00	0.01	192.22	0.93	0.10	0.01	0.06	0.17	0.00
BIOIN_000455.LAB	12/9/2020	11:12:31	4.39	1.34	0.25	3.29	0.02	192.23	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000456.LAB	12/9/2020	11:13:01	3.83	1.21	0.32	3.43	0.01	192.20	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000457.LAB	12/9/2020	11:13:31	4.51	1.22	0.22	3.41	0.01	192.23	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000458.LAB	12/9/2020	11:14:02	10.33	1.75	0.40	4.15	0.01	192.25	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000459.LAB	12/9/2020	11:14:32	14.84	2.19	0.42	4.17	0.00	192.26	0.93	0.11	0.01	0.10	0.19	0.00

BIOIN_000460.LAB	12/9/2020	11:15:02	32.95	4.18	0.27	3.58	0.03	192.19	0.93	0.12	0.02	0.09	0.20	0.00
BIOIN_000461.LAB	12/9/2020	11:15:31	12.59	2.41	0.52	3.59	0.00	192.19	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000462.LAB	12/9/2020	11:16:02	6.63	1.71	0.35	3.07	0.02	192.23	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000463.LAB	12/9/2020	11:16:32	5.12	1.45	0.36	2.98	0.01	192.17	0.93	0.10	0.01	0.06	0.16	0.00
BIOIN_000464.LAB	12/9/2020	11:17:02	4.04	1.28	0.24	3.22	0.00	192.17	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000465.LAB	12/9/2020	11:17:32	3.67	1.20	0.22	3.35	0.02	192.15	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000466.LAB	12/9/2020	11:18:01	7.05	1.41	0.35	3.59	0.02	192.18	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000467.LAB	12/9/2020	11:18:32	13.03	1.99	0.42	3.37	0.00	192.17	0.93	0.12	0.01	0.09	0.18	0.00
BIOIN_000468.LAB	12/9/2020	11:19:02	15.91	2.27	0.59	4.08	0.02	192.14	0.93	0.12	0.01	0.10	0.18	0.00
BIOIN_000469.LAB	12/9/2020	11:19:32	33.67	4.49	0.33	3.14	0.02	192.15	0.93	0.13	0.02	0.09	0.21	0.00
BIOIN_000470.LAB	12/9/2020	11:20:02	8.32	1.88	0.43	3.35	0.01	192.11	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000471.LAB	12/9/2020	11:20:32	6.05	1.63	0.32	3.24	0.02	192.16	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000472.LAB	12/9/2020	11:21:02	4.46	1.36	0.26	3.63	0.01	192.09	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000473.LAB	12/9/2020	11:21:32	3.71	1.22	0.27	2.93	0.01	192.10	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000474.LAB	12/9/2020	11:22:02	4.58	1.25	0.29	3.59	0.01	192.02	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000475.LAB	12/9/2020	11:22:32	10.65	1.82	0.46	3.79	0.00	192.02	0.93	0.11	0.01	0.09	0.17	0.00
BIOIN_000476.LAB	12/9/2020	11:23:02	15.00	2.25	0.50	4.14	0.00	192.07	0.93	0.12	0.01	0.10	0.19	0.00
BIOIN_000477.LAB	12/9/2020	11:23:32	30.10	3.76	0.27	3.74	0.00	192.09	0.93	0.13	0.02	0.08	0.20	0.00
Average			**11.03**	**1.97**	**0.36**	**3.16**	**0.01**	**192.16**	**0.93**	**0.10**	**0.01**	**0.08**	**0.17**	**0.00**

Biofilter Outlet Run 1

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0111.LAB	12/9/2020	7:47:12	0.08	4.05	0.21	1.34	0.01	191.75	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0112.LAB	12/9/2020	7:47:42	0.16	4.05	0.16	1.26	0.00	191.76	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0113.LAB	12/9/2020	7:48:12	0.10	4.06	0.23	1.20	0.00	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0114.LAB	12/9/2020	7:48:43	0.16	4.05	0.27	1.17	0.00	191.76	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0115.LAB	12/9/2020	7:49:14	0.05	4.05	0.20	1.37	0.01	191.78	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0116.LAB	12/9/2020	7:49:44	0.10	4.06	0.12	1.06	0.00	191.80	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0117.LAB	12/9/2020	7:50:15	0.06	4.07	0.20	1.11	0.01	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0118.LAB	12/9/2020	7:50:45	0.17	4.07	0.19	1.17	0.00	191.82	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0119.LAB	12/9/2020	7:51:16	0.08	4.06	0.21	1.03	0.00	191.81	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0120.LAB	12/9/2020	7:51:46	0.13	4.06	0.24	1.24	0.01	191.80	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0121.LAB	12/9/2020	7:52:17	0.10	4.07	0.26	1.21	0.00	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0122.LAB	12/9/2020	7:52:47	0.07	4.07	0.18	0.88	0.00	191.76	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0123.LAB	12/9/2020	7:53:18	0.08	4.07	0.15	1.19	0.01	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0124.LAB	12/9/2020	7:53:49	0.15	4.09	0.26	1.13	0.00	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0125.LAB	12/9/2020	7:54:19	0.08	4.07	0.18	0.93	0.01	191.74	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0126.LAB	12/9/2020	7:54:50	0.13	4.08	0.22	1.08	0.01	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0127.LAB	12/9/2020	7:55:21	0.15	4.08	0.20	1.01	0.01	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0128.LAB	12/9/2020	7:55:51	0.04	4.07	0.22	1.01	0.01	191.77	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0129.LAB	12/9/2020	7:56:21	0.08	4.06	0.25	0.83	0.01	191.74	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0130.LAB	12/9/2020	7:56:51	0.11	4.07	0.27	1.09	0.00	191.76	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0131.LAB	12/9/2020	7:57:22	0.16	4.07	0.36	1.19	0.00	191.72	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0132.LAB	12/9/2020	7:57:52	0.04	4.07	0.24	1.15	0.00	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0133.LAB	12/9/2020	7:58:22	0.14	4.07	0.23	1.10	0.00	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0134.LAB	12/9/2020	7:58:54	0.08	4.09	0.22	1.29	0.01	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0135.LAB	12/9/2020	7:59:23	0.09	4.07	0.19	1.22	0.00	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0136.LAB	12/9/2020	7:59:54	0.13	4.08	0.23	1.23	0.00	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0137.LAB	12/9/2020	8:00:24	0.08	4.07	0.11	1.40	0.01	191.80	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0138.LAB	12/9/2020	8:00:54	0.05	4.08	0.26	1.02	0.02	191.82	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0139.LAB	12/9/2020	8:01:24	0.08	4.08	0.27	1.22	0.01	191.82	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0140.LAB	12/9/2020	8:01:55	0.10	4.09	0.28	0.91	0.01	191.81	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0141.LAB	12/9/2020	8:02:26	0.18	4.07	0.19	1.15	0.01	191.82	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0142.LAB	12/9/2020	8:02:57	0.19	4.07	0.24	1.27	0.00	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0143.LAB	12/9/2020	8:03:28	0.15	4.08	0.27	1.43	0.00	191.81	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0144.LAB	12/9/2020	8:03:58	0.04	4.07	0.14	1.16	0.00	191.82	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0145.LAB	12/9/2020	8:04:29	0.03	4.07	0.26	1.29	0.00	191.81	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0146.LAB	12/9/2020	8:05:00	0.14	4.07	0.27	1.41	0.00	191.84	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0147.LAB	12/9/2020	8:05:30	0.08	4.07	0.29	1.21	0.01	191.82	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0148.LAB	12/9/2020	8:06:01	0.18	4.07	0.15	0.85	0.00	191.80	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0149.LAB	12/9/2020	8:06:32	0.12	4.07	0.23	1.19	0.00	191.77	0.91	0.03	0.02	0.08	0.06	0.00
BIOOUT_0150.LAB	12/9/2020	8:07:02	0.15	4.08	0.30	1.23	0.00	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0151.LAB	12/9/2020	8:07:33	0.13	4.06	0.24	0.98	0.00	191.76	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0152.LAB	12/9/2020	8:08:04	0.09	4.07	0.26	1.09	0.00	191.76	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0153.LAB	12/9/2020	8:08:34	0.07	4.08	0.25	1.14	0.01	191.74	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0154.LAB	12/9/2020	8:09:04	0.13	4.08	0.22	1.19	0.01	191.76	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0155.LAB	12/9/2020	8:09:34	0.15	4.08	0.24	1.18	0.01	191.73	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0156.LAB	12/9/2020	8:10:05	0.07	4.07	0.23	1.12	0.01	191.71	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0157.LAB	12/9/2020	8:10:36	0.11	4.07	0.24	1.09	0.01	191.71	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0158.LAB	12/9/2020	8:11:08	0.16	4.08	0.15	1.16	0.00	191.73	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0159.LAB	12/9/2020	8:11:38	0.12	4.08	0.22	1.20	0.01	191.73	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0160.LAB	12/9/2020	8:12:08	0.16	4.08	0.18	0.93	0.00	191.74	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0161.LAB	12/9/2020	8:12:39	0.19	4.09	0.26	1.32	0.00	191.73	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0162.LAB	12/9/2020	8:13:09	0.09	4.08	0.29	1.05	0.00	191.75	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0163.LAB	12/9/2020	8:13:39	0.14	4.10	0.20	1.25	0.01	191.74	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0164.LAB	12/9/2020	8:14:09	0.21	4.08	0.18	1.17	0.00	191.74	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0165.LAB	12/9/2020	8:14:39	0.17	4.08	0.23	1.29	0.01	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0166.LAB	12/9/2020	8:15:11	0.00	4.08	0.25	1.09	0.00	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0167.LAB	12/9/2020	8:15:40	0.23	4.09	0.28	1.34	0.01	191.77	0.91	0.03	0.02	0.07	0.05	0.00
BIOOUT_0168.LAB	12/9/2020	8:16:11	0.04	4.08	0.30	1.29	0.00	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0169.LAB	12/9/2020	8:16:41	0.14	4.09	0.21	1.14	0.00	191.81	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0170.LAB	12/9/2020	8:17:12	0.10	4.08	0.21	1.30	0.00	191.75	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0171.LAB	12/9/2020	8:17:42	0.11	4.08	0.26	1.40	0.01	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0172.LAB	12/9/2020	8:18:12	0.03	4.09	0.24	1.10	0.00	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0173.LAB	12/9/2020	8:18:42	0.03	4.08	0.23	0.94	0.00	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0174.LAB	12/9/2020	8:19:13	0.10	4.11	0.23	1.47	0.01	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0175.LAB	12/9/2020	8:19:43	0.16	4.09	0.20	1.28	0.01	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0176.LAB	12/9/2020	8:20:13	-0.01	4.08	0.26	1.31	0.01	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0177.LAB	12/9/2020	8:20:45	0.11	4.09	0.18	1.09	0.00	191.79	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0178.LAB	12/9/2020	8:21:16	0.05	4.09	0.28	1.31	0.01	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0179.LAB	12/9/2020	8:21:47	0.06	4.08	0.19	1.16	-0.01	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0180.LAB	12/9/2020	8:22:17	0.06	4.10	0.25	1.12	0.00	191.83	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0181.LAB	12/9/2020	8:22:47	0.16	4.07	0.24	1.26	0.01	191.80	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0182.LAB	12/9/2020	8:23:18	0.07	4.08	0.21	1.20	0.00	191.76	0.91	0.03	0.02	0.08	0.06	0.00
BIOOUT_0183.LAB	12/9/2020	8:23:49	0.10	4.09	0.23	0.99	0.01	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0184.LAB	12/9/2020	8:24:20	0.06	4.08	0.28	1.11	0.00	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0185.LAB	12/9/2020	8:24:50	0.12	4.08	0.27	1.29	0.00	191.72	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0186.LAB	12/9/2020	8:25:20	0.07	4.10	0.26	1.12	0.01	191.72	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0187.LAB	12/9/2020	8:25:51	0.07	4.09	0.25	1.30	0.01	191.73	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0188.LAB	12/9/2020	8:26:22	0.11	4.09	0.23	1.09	0.00	191.76	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0189.LAB	12/9/2020	8:26:52	0.06	4.08	0.23	1.11	0.01	191.72	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0190.LAB	12/9/2020	8:27:23	0.07	4.07	0.29	1.20	0.00	191.73	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0191.LAB	12/9/2020	8:27:55	0.08	4.09	0.22	1.08	0.01	191.72	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0192.LAB	12/9/2020	8:28:26	0.07	4.08	0.16	1.21	0.00	191.77	0.91	0.03	0.02	0.07	0.05	0.00
BIOOUT_0193.LAB	12/9/2020	8:28:57	0.12	4.08	0.31	1.38	0.01	191.75	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0194.LAB	12/9/2020	8:29:27	0.03	4.08	0.23	1.31	0.00	191.73	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0195.LAB	12/9/2020	8:29:57	0.20	4.07	0.26	0.91	0.00	191.72	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0196.LAB	12/9/2020	8:30:28	0.08	4.09	0.23	1.26	0.00	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0197.LAB	12/9/2020	8:30:58	0.20	4.10	0.33	0.97	0.00	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0198.LAB	12/9/2020	8:31:29	0.01	4.08	0.32	1.05	0.00	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0199.LAB	12/9/2020	8:32:00	0.11	4.09	0.28	1.35	0.01	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0200.LAB	12/9/2020	8:32:30	0.17	4.08	0.22	1.06	0.01	191.76	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0201.LAB	12/9/2020	8:33:00	0.14	4.08	0.27	1.41	0.00	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0202.LAB	12/9/2020	8:33:31	0.10	4.08	0.19	0.99	0.01	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0203.LAB	12/9/2020	8:34:01	0.19	4.08	0.27	1.28	0.00	191.75	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0204.LAB	12/9/2020	8:34:31	0.12	4.09	0.25	1.21	0.00	191.81	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0205.LAB	12/9/2020	8:35:01	0.10	4.08	0.19	1.00	0.01	191.80	0.91	0.03	0.02	0.08	0.06	0.00
BIOOUT_0206.LAB	12/9/2020	8:35:31	0.11	4.09	0.27	1.24	0.01	191.80	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0207.LAB	12/9/2020	8:36:02	0.10	4.09	0.23	1.40	0.01	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0208.LAB	12/9/2020	8:36:32	0.13	4.09	0.24	0.97	0.00	191.81	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0209.LAB	12/9/2020	8:37:01	0.08	4.08	0.32	0.98	0.01	191.82	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0210.LAB	12/9/2020	8:37:31	0.17	4.09	0.29	1.39	0.01	191.82	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0211.LAB	12/9/2020	8:38:01	0.05	4.08	0.30	1.15	0.00	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0212.LAB	12/9/2020	8:38:32	0.11	4.09	0.20	1.11	0.00	191.78	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0213.LAB	12/9/2020	8:39:02	0.15	4.08	0.24	1.18	0.01	191.78	0.91	0.04	0.02	0.07	0.06	0.00

BIOOUT_0214.LAB	12/9/2020	8:39:32	0.14	4.08	0.23	1.29	0.01	191.80	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0215.LAB	12/9/2020	8:40:03	0.16	4.09	0.18	0.98	0.00	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0216.LAB	12/9/2020	8:40:33	0.08	4.09	0.29	0.95	0.01	191.77	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0217.LAB	12/9/2020	8:41:03	0.08	4.08	0.26	1.26	0.00	191.79	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0218.LAB	12/9/2020	8:41:33	0.08	4.08	0.27	1.32	0.00	191.83	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0219.LAB	12/9/2020	8:42:04	0.13	4.09	0.23	1.08	0.01	191.89	0.91	0.03	0.02	0.08	0.06	0.00
BIOOUT_0220.LAB	12/9/2020	8:42:34	0.09	4.08	0.26	1.34	0.01	191.88	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0221.LAB	12/9/2020	8:43:04	0.11	4.09	0.20	1.11	0.01	191.90	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0222.LAB	12/9/2020	8:43:34	0.10	4.09	0.34	1.00	0.01	191.91	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0223.LAB	12/9/2020	8:44:04	0.06	4.08	0.27	0.84	0.00	191.92	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0224.LAB	12/9/2020	8:44:34	0.07	4.07	0.25	0.89	0.01	191.91	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0225.LAB	12/9/2020	8:45:05	0.10	4.09	0.18	1.05	0.00	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0226.LAB	12/9/2020	8:45:35	0.11	4.08	0.18	1.12	0.02	191.96	0.91	0.03	0.02	0.08	0.07	0.00
BIOOUT_0227.LAB	12/9/2020	8:46:05	0.08	4.10	0.26	1.27	0.01	191.93	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0228.LAB	12/9/2020	8:46:35	0.07	4.09	0.27	1.08	0.00	191.95	0.91	0.03	0.02	0.07	0.06	0.00
Average			**0.11**	**4.08**	**0.24**	**1.16**	**0.00**	**191.79**	**0.91**	**0.03**	**0.02**	**0.07**	**0.06**	**0.00**

Biofilter Outlet Run 2

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0257.LAB	12/9/2020	9:01:19	0.12	4.07	0.23	1.25	0.00	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0258.LAB	12/9/2020	9:01:50	0.05	4.07	0.20	1.07	0.01	192.02	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0259.LAB	12/9/2020	9:02:21	0.13	4.06	0.18	1.50	0.01	192.00	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0260.LAB	12/9/2020	9:02:52	0.13	4.05	0.31	1.10	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0261.LAB	12/9/2020	9:03:23	0.11	4.08	0.22	1.04	0.01	191.96	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0262.LAB	12/9/2020	9:03:53	0.09	4.07	0.24	1.08	0.01	191.95	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0263.LAB	12/9/2020	9:04:24	0.15	4.08	0.19	1.15	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0264.LAB	12/9/2020	9:04:54	0.13	4.08	0.24	1.08	0.01	192.00	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0265.LAB	12/9/2020	9:05:24	0.10	4.09	0.22	1.11	0.01	192.02	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0266.LAB	12/9/2020	9:05:55	0.18	4.08	0.18	1.23	0.01	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0267.LAB	12/9/2020	9:06:25	0.06	4.06	0.19	0.89	0.01	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0268.LAB	12/9/2020	9:06:55	0.05	4.07	0.18	0.93	0.01	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0269.LAB	12/9/2020	9:07:26	0.11	4.08	0.28	1.00	0.01	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0270.LAB	12/9/2020	9:07:56	0.16	4.08	0.24	1.04	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0271.LAB	12/9/2020	9:08:27	0.15	4.08	0.24	1.26	0.00	192.03	0.91	0.03	0.02	0.07	0.08	0.00
BIOOUT_0272.LAB	12/9/2020	9:08:57	0.08	4.08	0.19	1.10	0.01	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0273.LAB	12/9/2020	9:09:27	0.06	4.07	0.25	1.14	0.00	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0274.LAB	12/9/2020	9:09:57	0.21	4.09	0.17	1.08	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0275.LAB	12/9/2020	9:10:28	0.10	4.08	0.19	1.15	0.00	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0276.LAB	12/9/2020	9:10:59	0.09	4.07	0.19	1.11	0.00	192.03	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0277.LAB	12/9/2020	9:11:29	0.10	4.06	0.14	0.97	0.01	192.06	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0278.LAB	12/9/2020	9:12:00	0.06	4.07	0.16	0.91	0.00	192.08	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0279.LAB	12/9/2020	9:12:30	0.15	4.08	0.18	0.89	0.01	192.08	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0280.LAB	12/9/2020	9:13:00	0.14	4.08	0.14	1.24	0.00	192.08	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0281.LAB	12/9/2020	9:13:30	0.07	4.09	0.12	0.95	0.00	192.06	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0282.LAB	12/9/2020	9:14:00	0.06	4.09	0.17	1.29	0.00	192.07	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0283.LAB	12/9/2020	9:14:30	0.15	4.08	0.19	1.10	0.00	192.05	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0284.LAB	12/9/2020	9:15:00	0.18	4.09	0.17	1.05	0.00	192.04	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0285.LAB	12/9/2020	9:15:30	0.00	4.08	0.19	0.88	0.00	192.02	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0286.LAB	12/9/2020	9:16:01	0.15	4.09	0.28	1.09	0.00	192.02	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0287.LAB	12/9/2020	9:16:31	0.06	4.10	0.21	1.00	0.00	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0288.LAB	12/9/2020	9:17:01	0.18	4.09	0.17	1.08	0.01	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0289.LAB	12/9/2020	9:17:32	0.18	4.11	0.28	1.25	0.01	192.05	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0290.LAB	12/9/2020	9:18:02	0.18	4.09	0.23	0.97	0.01	192.01	0.91	0.04	0.02	0.07	0.07	0.00
BIOOUT_0291.LAB	12/9/2020	9:18:33	0.08	4.08	0.22	1.09	0.01	192.01	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0292.LAB	12/9/2020	9:19:03	0.12	4.09	0.21	1.30	0.01	192.02	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0293.LAB	12/9/2020	9:19:34	0.17	4.09	0.20	1.37	0.00	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0294.LAB	12/9/2020	9:20:04	0.22	4.09	0.30	0.95	0.00	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0295.LAB	12/9/2020	9:20:34	0.16	4.08	0.23	1.26	0.00	192.02	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0296.LAB	12/9/2020	9:21:04	0.13	4.08	0.23	1.35	0.00	191.98	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0297.LAB	12/9/2020	9:21:34	0.15	4.09	0.19	0.98	0.01	191.99	0.91	0.03	0.02	0.08	0.07	0.00
BIOOUT_0298.LAB	12/9/2020	9:22:03	0.07	4.09	0.25	1.19	0.01	191.99	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0299.LAB	12/9/2020	9:22:34	0.10	4.11	0.26	1.31	0.01	191.95	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0300.LAB	12/9/2020	9:23:03	0.05	4.11	0.14	1.27	0.01	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0301.LAB	12/9/2020	9:23:33	0.06	4.09	0.26	1.23	0.02	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0302.LAB	12/9/2020	9:24:03	0.21	4.10	0.21	1.30	0.01	191.93	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0303.LAB	12/9/2020	9:24:33	0.21	4.09	0.30	1.25	0.00	191.92	0.91	0.04	0.02	0.08	0.07	0.00
BIOOUT_0304.LAB	12/9/2020	9:25:03	0.13	4.10	0.18	1.07	0.01	191.93	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0305.LAB	12/9/2020	9:25:33	0.05	4.11	0.16	1.18	0.01	191.96	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0306.LAB	12/9/2020	9:26:03	0.14	4.10	0.19	1.26	0.00	191.93	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0307.LAB	12/9/2020	9:26:33	0.11	4.10	0.20	1.29	0.00	191.95	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0308.LAB	12/9/2020	9:27:03	0.16	4.08	0.18	1.25	0.01	191.94	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0309.LAB	12/9/2020	9:27:33	0.07	4.10	0.22	1.28	0.02	191.93	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0310.LAB	12/9/2020	9:28:03	0.13	4.09	0.20	1.45	0.01	191.98	0.91	0.03	0.02	0.08	0.07	0.00
BIOOUT_0311.LAB	12/9/2020	9:28:33	0.19	4.10	0.25	1.08	0.00	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0312.LAB	12/9/2020	9:29:03	0.15	4.09	0.22	1.26	0.01	192.00	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0313.LAB	12/9/2020	9:29:33	0.14	4.09	0.21	1.39	0.01	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0314.LAB	12/9/2020	9:30:03	0.06	4.10	0.20	1.24	0.00	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0315.LAB	12/9/2020	9:30:33	0.08	4.10	0.14	1.00	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0316.LAB	12/9/2020	9:31:03	0.13	4.11	0.20	1.60	0.01	191.97	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0317.LAB	12/9/2020	9:31:34	0.10	4.11	0.20	1.08	0.00	191.96	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0318.LAB	12/9/2020	9:32:04	0.10	4.11	0.28	1.41	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0319.LAB	12/9/2020	9:32:35	0.15	4.11	0.19	1.54	0.00	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0320.LAB	12/9/2020	9:33:07	0.19	4.11	0.32	1.25	0.01	191.96	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0321.LAB	12/9/2020	9:33:37	0.13	4.08	0.19	1.06	0.00	192.03	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0322.LAB	12/9/2020	9:34:07	0.16	4.11	0.29	1.27	0.01	192.04	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0323.LAB	12/9/2020	9:34:37	0.10	4.10	0.19	1.52	0.01	192.02	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0324.LAB	12/9/2020	9:35:06	0.05	4.11	0.33	1.51	0.01	192.02	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0325.LAB	12/9/2020	9:35:36	0.03	4.10	0.19	1.23	0.00	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0326.LAB	12/9/2020	9:36:06	0.15	4.11	0.20	1.49	0.00	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0327.LAB	12/9/2020	9:36:36	0.09	4.10	0.10	0.98	0.01	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0328.LAB	12/9/2020	9:37:06	0.10	4.09	0.23	1.44	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0329.LAB	12/9/2020	9:37:36	0.20	4.11	0.20	1.50	0.00	191.99	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0330.LAB	12/9/2020	9:38:07	0.14	4.10	0.22	1.20	0.00	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0331.LAB	12/9/2020	9:38:37	0.04	4.11	0.14	1.38	0.01	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0332.LAB	12/9/2020	9:39:07	0.16	4.09	0.21	1.01	0.00	191.96	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0333.LAB	12/9/2020	9:39:36	0.15	4.11	0.19	1.56	0.00	191.95	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0334.LAB	12/9/2020	9:40:06	0.07	4.09	0.15	1.04	0.00	191.94	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0335.LAB	12/9/2020	9:40:36	0.17	4.09	0.24	1.40	0.01	191.97	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0336.LAB	12/9/2020	9:41:06	0.03	4.09	0.25	1.31	0.01	191.92	0.91	0.04	0.02	0.07	0.07	0.00
BIOOUT_0337.LAB	12/9/2020	9:41:37	0.15	4.10	0.26	1.42	0.01	191.96	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0338.LAB	12/9/2020	9:42:06	0.08	4.10	0.29	1.48	0.01	191.95	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0339.LAB	12/9/2020	9:42:36	0.08	4.10	0.21	1.29	0.01	191.96	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0340.LAB	12/9/2020	9:43:07	0.12	4.09	0.25	1.21	0.00	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0341.LAB	12/9/2020	9:43:37	0.09	4.11	0.23	1.50	0.00	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0342.LAB	12/9/2020	9:44:06	0.13	4.09	0.33	1.47	0.00	191.93	0.91	0.03	0.02	0.07	0.07	0.00

BIOOUT_0343.LAB	12/9/2020	9:44:37	0.06	4.09	0.20	1.36	0.00	191.98	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0344.LAB	12/9/2020	9:45:07	0.05	4.10	0.23	1.53	0.00	191.95	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0345.LAB	12/9/2020	9:45:37	0.22	4.11	0.22	1.45	0.01	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0346.LAB	12/9/2020	9:46:07	0.23	4.11	0.30	1.56	0.01	191.97	0.91	0.03	0.02	0.08	0.06	0.00
BIOOUT_0347.LAB	12/9/2020	9:46:36	0.04	4.11	0.31	1.17	0.00	191.98	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0348.LAB	12/9/2020	9:47:06	0.09	4.09	0.16	1.41	0.00	191.96	0.91	0.04	0.02	0.08	0.07	0.00
BIOOUT_0349.LAB	12/9/2020	9:47:37	0.04	4.10	0.31	1.44	0.01	191.95	0.91	0.04	0.02	0.07	0.07	0.00
BIOOUT_0350.LAB	12/9/2020	9:48:08	0.02	4.11	0.27	1.17	0.02	191.98	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0351.LAB	12/9/2020	9:48:40	0.13	4.11	0.20	1.24	0.00	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0352.LAB	12/9/2020	9:49:11	0.16	4.10	0.18	1.40	0.01	192.00	0.91	0.03	0.02	0.06	0.06	0.00
BIOOUT_0353.LAB	12/9/2020	9:49:41	0.12	4.10	0.24	1.37	0.02	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0354.LAB	12/9/2020	9:50:11	0.07	4.11	0.18	1.45	0.00	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0355.LAB	12/9/2020	9:50:41	0.12	4.10	0.22	1.26	0.01	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0356.LAB	12/9/2020	9:51:11	0.09	4.10	0.21	1.56	0.01	191.96	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0357.LAB	12/9/2020	9:51:41	0.12	4.10	0.26	1.64	0.00	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0358.LAB	12/9/2020	9:52:10	0.05	4.10	0.23	1.31	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0359.LAB	12/9/2020	9:52:40	0.14	4.10	0.19	1.22	0.01	192.02	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0360.LAB	12/9/2020	9:53:10	0.18	4.09	0.30	1.14	0.01	191.95	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0361.LAB	12/9/2020	9:53:40	0.20	4.11	0.19	1.40	0.00	191.98	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0362.LAB	12/9/2020	9:54:10	0.19	4.11	0.24	1.30	0.01	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0363.LAB	12/9/2020	9:54:41	0.10	4.11	0.22	1.44	0.00	192.00	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0364.LAB	12/9/2020	9:55:11	0.06	4.10	0.21	1.20	0.00	191.98	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0365.LAB	12/9/2020	9:55:41	0.06	4.11	0.26	1.27	0.00	191.96	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0366.LAB	12/9/2020	9:56:11	0.05	4.11	0.22	1.65	0.01	192.00	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0367.LAB	12/9/2020	9:56:41	0.10	4.11	0.16	1.34	0.00	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0368.LAB	12/9/2020	9:57:11	0.07	4.11	0.18	1.30	0.01	192.00	0.91	0.04	0.02	0.07	0.07	0.00
BIOOUT_0369.LAB	12/9/2020	9:57:41	0.12	4.12	0.24	1.65	0.00	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0370.LAB	12/9/2020	9:58:11	0.03	4.11	0.18	1.41	0.00	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0371.LAB	12/9/2020	9:58:40	0.05	4.11	0.20	1.43	0.00	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0372.LAB	12/9/2020	9:59:10	0.05	4.11	0.28	1.44	0.01	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0373.LAB	12/9/2020	9:59:40	0.14	4.10	0.24	1.54	0.01	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0374.LAB	12/9/2020	10:00:11	0.03	4.12	0.22	1.32	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0375.LAB	12/9/2020	10:00:42	0.15	4.12	0.18	1.29	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
Average			**0.11**	**4.09**	**0.22**	**1.26**	**0.01**	**191.99**	**0.91**	**0.03**	**0.02**	**0.07**	**0.06**	**0.00**

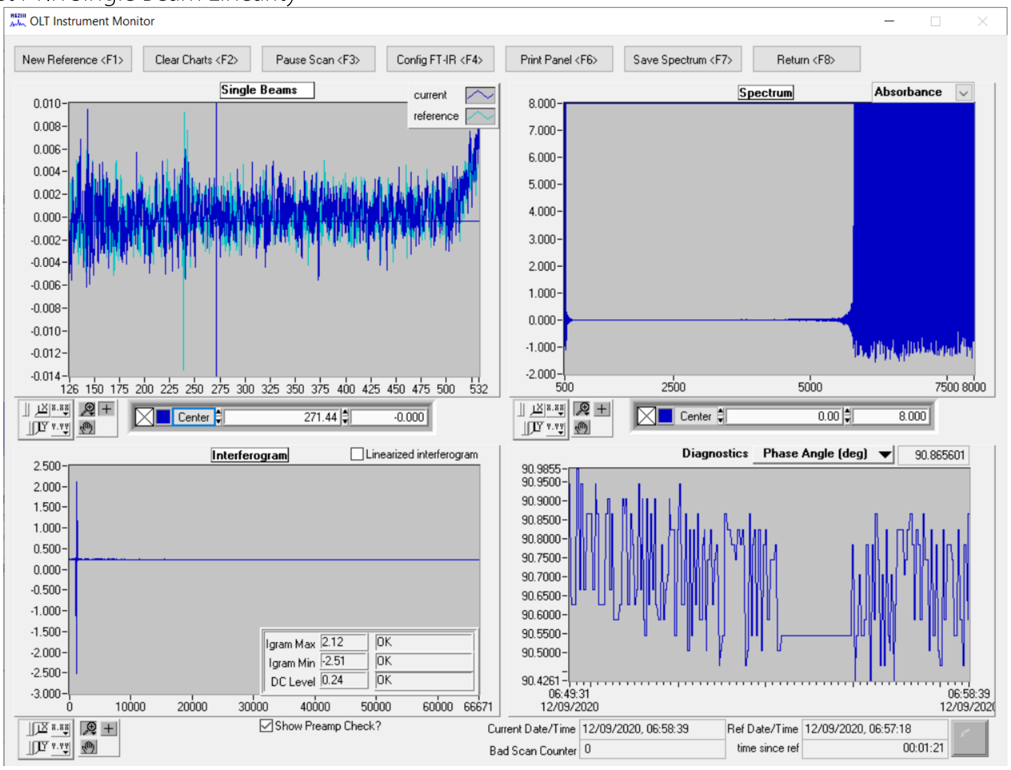
Biofilter Outlet Run 3

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0416.LAB	12/9/2020	10:24:04	0.17	4.11	0.30	1.63	0.01	192.00	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0417.LAB	12/9/2020	10:24:34	0.14	4.12	0.25	1.68	0.01	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0418.LAB	12/9/2020	10:25:04	0.12	4.12	0.21	1.44	0.00	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0419.LAB	12/9/2020	10:25:34	0.14	4.12	0.13	1.78	0.01	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0420.LAB	12/9/2020	10:26:04	0.06	4.13	0.28	1.52	0.01	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0421.LAB	12/9/2020	10:26:35	0.08	4.12	0.22	1.75	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0422.LAB	12/9/2020	10:27:05	0.17	4.11	0.20	1.64	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0423.LAB	12/9/2020	10:27:35	0.08	4.12	0.23	1.80	0.01	191.97	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0424.LAB	12/9/2020	10:28:05	0.13	4.13	0.18	1.66	0.00	191.96	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0425.LAB	12/9/2020	10:28:35	0.14	4.12	0.27	1.57	0.00	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0426.LAB	12/9/2020	10:29:06	0.10	4.13	0.23	1.78	0.00	191.97	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0427.LAB	12/9/2020	10:29:37	0.08	4.14	0.24	1.52	0.01	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0428.LAB	12/9/2020	10:30:07	0.09	4.13	0.16	1.74	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0429.LAB	12/9/2020	10:30:37	0.15	4.13	0.23	1.25	0.00	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0430.LAB	12/9/2020	10:31:07	0.10	4.13	0.23	1.56	0.01	191.99	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0431.LAB	12/9/2020	10:31:37	0.11	4.13	0.28	1.57	0.01	191.98	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0432.LAB	12/9/2020	10:32:08	0.10	4.14	0.24	1.45	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0433.LAB	12/9/2020	10:32:38	0.04	4.14	0.28	1.46	0.00	191.99	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0434.LAB	12/9/2020	10:33:08	0.13	4.13	0.21	1.79	0.01	191.98	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0435.LAB	12/9/2020	10:33:39	0.11	4.14	0.27	1.40	0.00	191.98	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0436.LAB	12/9/2020	10:34:09	-0.01	4.15	0.29	1.26	0.00	191.99	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0437.LAB	12/9/2020	10:34:40	0.11	4.15	0.34	1.70	0.01	192.02	0.91	0.04	0.02	0.07	0.05	0.00
BIOOUT_0438.LAB	12/9/2020	10:35:11	0.16	4.14	0.24	1.44	0.01	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0439.LAB	12/9/2020	10:35:41	0.10	4.14	0.16	1.60	0.01	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0440.LAB	12/9/2020	10:36:12	0.12	4.14	0.21	1.70	0.00	192.04	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0441.LAB	12/9/2020	10:36:42	0.20	4.15	0.23	1.79	0.01	192.03	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0442.LAB	12/9/2020	10:37:12	0.07	4.16	0.23	1.84	0.01	192.05	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0443.LAB	12/9/2020	10:37:44	0.06	4.14	0.18	1.41	0.00	192.07	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0444.LAB	12/9/2020	10:38:15	0.10	4.13	0.17	1.61	0.00	192.07	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0445.LAB	12/9/2020	10:38:45	0.05	4.14	0.26	1.98	0.00	192.06	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0446.LAB	12/9/2020	10:39:15	0.12	4.14	0.25	1.78	0.01	192.07	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0447.LAB	12/9/2020	10:39:46	0.04	4.13	0.25	1.76	0.01	192.06	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0448.LAB	12/9/2020	10:40:16	0.14	4.15	0.23	1.66	0.01	192.05	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0449.LAB	12/9/2020	10:40:47	0.07	4.15	0.25	1.73	0.01	192.04	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0450.LAB	12/9/2020	10:41:18	0.16	4.15	0.16	1.54	0.01	192.05	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0451.LAB	12/9/2020	10:41:48	0.15	4.15	0.16	1.80	0.00	192.04	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0452.LAB	12/9/2020	10:42:19	0.06	4.14	0.22	1.34	0.00	192.02	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0453.LAB	12/9/2020	10:42:49	0.07	4.15	0.24	1.68	0.00	192.02	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0454.LAB	12/9/2020	10:43:19	0.09	4.15	0.20	1.78	0.00	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0455.LAB	12/9/2020	10:43:50	0.16	4.15	0.23	1.53	0.01	192.00	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0456.LAB	12/9/2020	10:44:20	0.11	4.14	0.34	1.82	0.00	192.02	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0457.LAB	12/9/2020	10:44:50	0.04	4.15	0.28	1.78	0.00	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0458.LAB	12/9/2020	10:45:22	0.20	4.14	0.27	1.73	0.01	192.03	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0459.LAB	12/9/2020	10:45:52	0.13	4.16	0.27	1.93	0.01	192.02	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0460.LAB	12/9/2020	10:46:22	0.15	4.14	0.22	1.58	0.00	192.04	0.91	0.04	0.02	0.06	0.06	0.00
BIOOUT_0461.LAB	12/9/2020	10:46:52	0.06	4.15	0.22	1.71	0.01	192.06	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0462.LAB	12/9/2020	10:47:22	0.08	4.15	0.25	1.76	0.01	192.06	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0463.LAB	12/9/2020	10:47:53	0.05	4.15	0.22	1.51	0.01	192.07	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0464.LAB	12/9/2020	10:48:24	0.14	4.17	0.20	1.48	0.00	192.10	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0465.LAB	12/9/2020	10:48:55	0.08	4.15	0.22	1.34	0.00	192.11	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0466.LAB	12/9/2020	10:49:26	0.17	4.17	0.21	1.75	0.01	192.09	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0467.LAB	12/9/2020	10:49:56	0.09	4.16	0.20	1.93	0.00	192.10	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0468.LAB	12/9/2020	10:50:26	0.11	4.17	0.21	1.67	0.01	192.09	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0469.LAB	12/9/2020	10:50:57	0.20	4.15	0.23	1.70	0.01	192.12	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0470.LAB	12/9/2020	10:51:29	0.08	4.17	0.24	1.61	0.00	192.08	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0471.LAB	12/9/2020	10:52:00	0.10	4.16	0.29	2.02	0.01	192.09	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0472.LAB	12/9/2020	10:52:30	0.12	4.16	0.32	1.76	0.01	192.11	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0473.LAB	12/9/2020	10:53:01	0.12	4.15	0.28	1.46	0.01	192.13	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0474.LAB	12/9/2020	10:53:31	0.15	4.16	0.37	1.66	0.00	192.10	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0475.LAB	12/9/2020	10:54:01	0.16	4.16	0.27	1.66	0.01	192.08	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0476.LAB	12/9/2020	10:54:31	0.04	4.16	0.27	1.49	0.01	192.09	0.91	0.04	0.02	0.07	0.07	0.00
BIOOUT_0477.LAB	12/9/2020	10:55:02	0.06	4.15	0.20	1.88	0.00	192.12	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0478.LAB	12/9/2020	10:55:32	0.10	4.15	0.19	1.55	0.00	192.11	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0479.LAB	12/9/2020	10:56:03	0.05	4.16	0.23	1.87	0.00	192.10	0.91	0.03	0.02	0.08	0.06	0.00
BIOOUT_0480.LAB	12/9/2020	10:56:33	0.10	4.14	0.19	1.63	0.01	192.12	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0481.LAB	12/9/2020	10:57:04	0.15	4.15	0.20	1.97	0.01	192.10	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0482.LAB	12/9/2020	10:57:34	0.17	4.16	0.23	1.69	0.00	192.08	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0483.LAB	12/9/2020	10:58:05	0.07	4.16	0.24	1.68	0.01	192.08	0.91	0.03	0.02	0.08	0.06	0.00

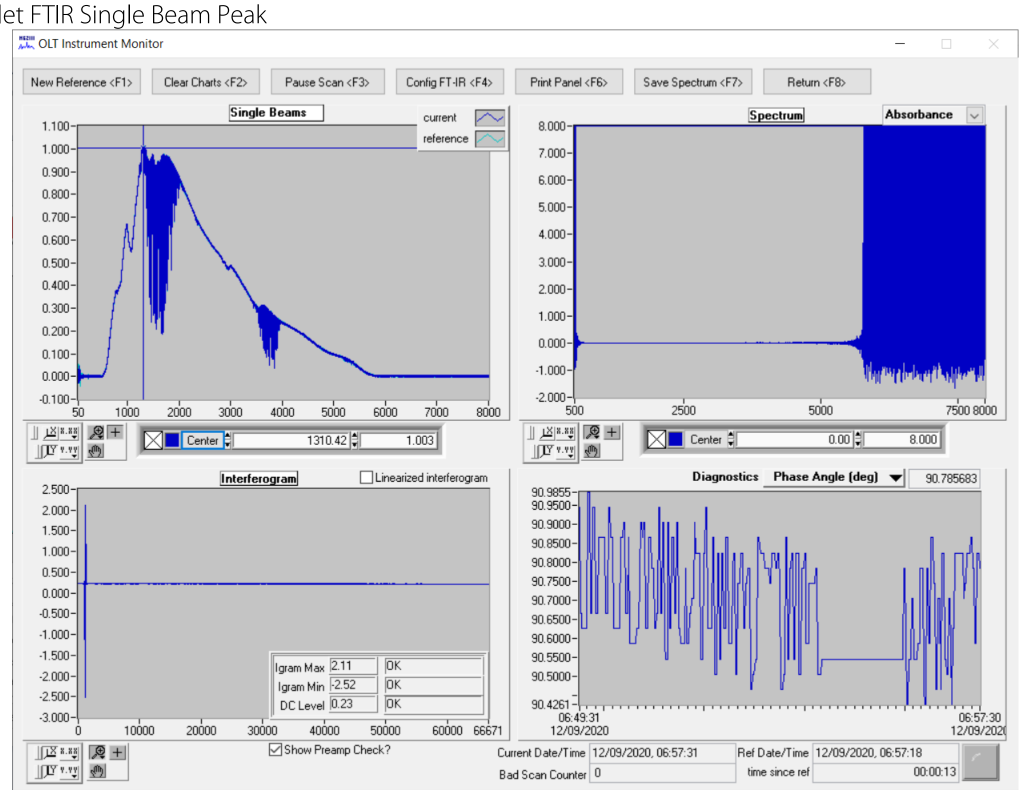
BIOOUT_0484.LAB	12/9/2020	10:58:35	0.15	4.16	0.30	1.71	0.01	192.08	0.91	0.04	0.02	0.07	0.07	0.00
BIOOUT_0485.LAB	12/9/2020	10:59:06	0.05	4.15	0.22	1.93	0.01	192.07	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0486.LAB	12/9/2020	10:59:37	0.15	4.17	0.26	1.62	0.00	192.07	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0487.LAB	12/9/2020	11:00:08	0.19	4.16	0.22	1.73	0.01	192.06	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0488.LAB	12/9/2020	11:00:39	0.15	4.15	0.16	1.51	0.00	192.05	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0489.LAB	12/9/2020	11:01:10	0.10	4.16	0.21	1.67	0.01	192.05	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0490.LAB	12/9/2020	11:01:41	0.02	4.17	0.28	1.78	0.01	192.06	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0491.LAB	12/9/2020	11:02:11	0.08	4.15	0.21	1.79	0.00	192.04	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0492.LAB	12/9/2020	11:02:42	0.10	4.14	0.33	1.55	0.00	192.04	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0493.LAB	12/9/2020	11:03:12	0.06	4.16	0.26	1.74	0.01	192.04	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0494.LAB	12/9/2020	11:03:42	0.10	4.16	0.23	1.72	0.01	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0495.LAB	12/9/2020	11:04:13	0.11	4.16	0.24	1.55	0.00	192.02	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0496.LAB	12/9/2020	11:04:43	0.11	4.17	0.25	1.75	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0497.LAB	12/9/2020	11:05:14	0.07	4.17	0.16	1.52	0.01	192.03	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0498.LAB	12/9/2020	11:05:45	0.12	4.16	0.27	1.88	0.00	192.02	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0499.LAB	12/9/2020	11:06:15	0.13	4.15	0.20	1.71	0.00	192.02	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0500.LAB	12/9/2020	11:06:45	0.18	4.14	0.23	1.73	0.00	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0501.LAB	12/9/2020	11:07:16	0.09	4.15	0.23	1.70	0.00	192.03	0.91	0.04	0.02	0.07	0.07	0.00
BIOOUT_0502.LAB	12/9/2020	11:07:46	0.13	4.15	0.29	2.11	0.01	192.03	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0503.LAB	12/9/2020	11:08:17	0.08	4.16	0.32	2.12	0.01	192.03	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0504.LAB	12/9/2020	11:08:48	0.00	4.16	0.24	1.61	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0505.LAB	12/9/2020	11:09:18	0.11	4.16	0.27	1.75	0.01	192.05	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0506.LAB	12/9/2020	11:09:48	0.09	4.16	0.22	2.01	0.00	192.06	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0507.LAB	12/9/2020	11:10:19	0.09	4.16	0.24	1.68	0.02	192.08	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0508.LAB	12/9/2020	11:10:49	0.12	4.15	0.22	1.87	0.01	192.09	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0509.LAB	12/9/2020	11:11:20	0.18	4.14	0.18	1.55	0.01	192.09	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0510.LAB	12/9/2020	11:11:50	0.17	4.14	0.26	1.96	0.01	192.08	0.91	0.04	0.02	0.07	0.07	0.00
BIOOUT_0511.LAB	12/9/2020	11:12:22	0.17	4.16	0.26	2.10	0.00	192.12	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0512.LAB	12/9/2020	11:12:53	0.10	4.17	0.20	1.92	0.00	192.15	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0513.LAB	12/9/2020	11:13:24	0.12	4.16	0.18	1.76	0.00	192.17	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0514.LAB	12/9/2020	11:13:55	0.08	4.16	0.25	1.98	0.01	192.14	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0515.LAB	12/9/2020	11:14:26	0.13	4.16	0.13	1.73	0.01	192.11	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0516.LAB	12/9/2020	11:14:56	0.08	4.16	0.24	1.94	0.01	192.10	0.91	0.03	0.02	0.08	0.06	0.00
BIOOUT_0517.LAB	12/9/2020	11:15:26	0.09	4.14	0.22	1.67	0.00	192.09	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0518.LAB	12/9/2020	11:15:57	0.10	4.15	0.29	1.97	0.00	192.09	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0519.LAB	12/9/2020	11:16:28	0.10	4.15	0.24	1.47	0.01	192.06	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0520.LAB	12/9/2020	11:16:58	0.04	4.16	0.24	1.63	0.01	192.07	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0521.LAB	12/9/2020	11:17:30	0.12	4.16	0.24	1.84	0.01	192.05	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0522.LAB	12/9/2020	11:18:00	0.11	4.16	0.17	1.92	0.00	192.02	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0523.LAB	12/9/2020	11:18:30	0.13	4.16	0.26	2.06	0.01	192.02	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0524.LAB	12/9/2020	11:19:00	0.04	4.14	0.28	1.93	0.01	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0525.LAB	12/9/2020	11:19:30	0.10	4.14	0.28	1.65	0.00	192.03	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0526.LAB	12/9/2020	11:20:01	0.09	4.15	0.10	1.83	0.01	192.00	0.91	0.04	0.02	0.07	0.07	0.00
BIOOUT_0527.LAB	12/9/2020	11:20:32	0.12	4.14	0.27	1.55	0.00	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0528.LAB	12/9/2020	11:21:02	0.02	4.15	0.26	1.82	0.02	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0529.LAB	12/9/2020	11:21:33	0.04	4.15	0.26	1.95	0.00	191.97	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0530.LAB	12/9/2020	11:22:04	0.14	4.16	0.25	2.15	0.01	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0531.LAB	12/9/2020	11:22:34	0.05	4.16	0.21	1.95	0.01	192.00	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0532.LAB	12/9/2020	11:23:04	0.14	4.15	0.22	1.91	0.01	192.00	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0533.LAB	12/9/2020	11:23:34	0.06	4.14	0.23	1.67	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
Average			**0.11**	**4.15**	**0.23**	**1.71**	**0.01**	**192.04**	**0.91**	**0.03**	**0.02**	**0.07**	**0.06**	**0.00**

Appendix B
FTIR Single Beam Spectra

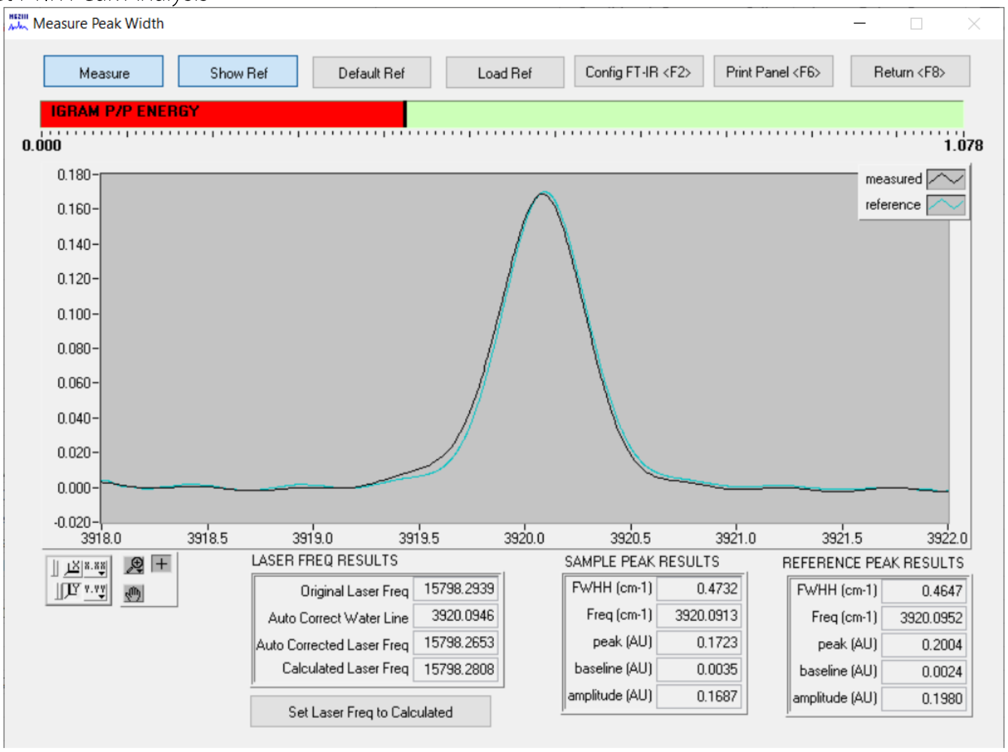
Biofilter Inlet FTIR Single Beam Linearity



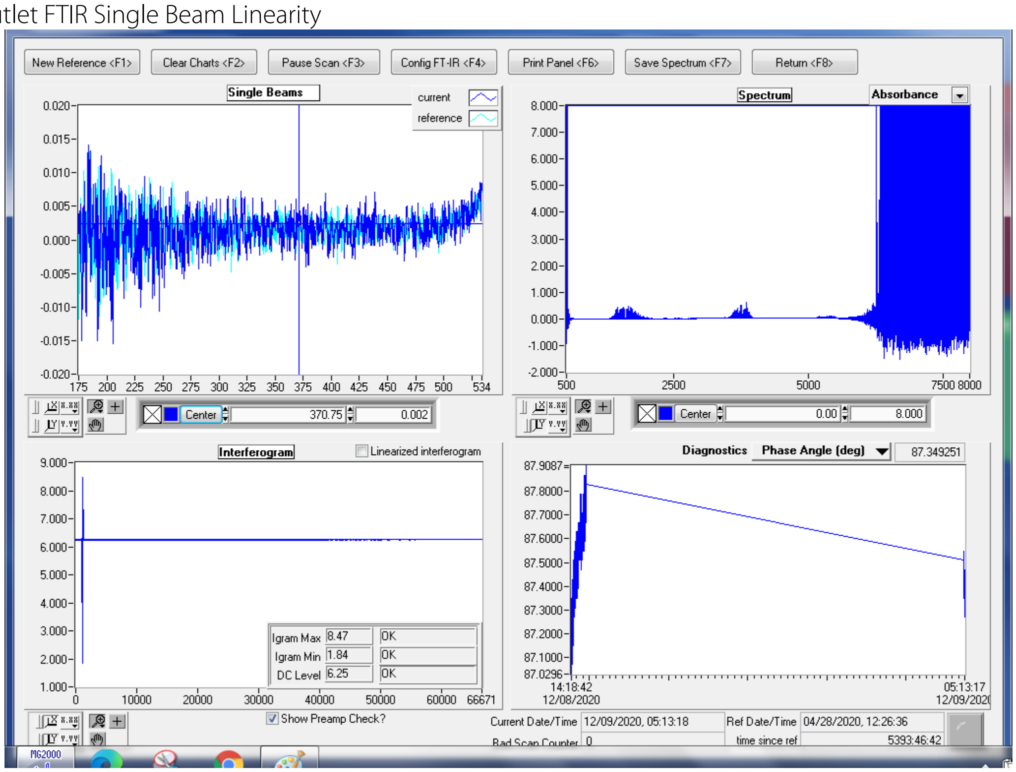
Biofilter Inlet FTIR Single Beam Peak



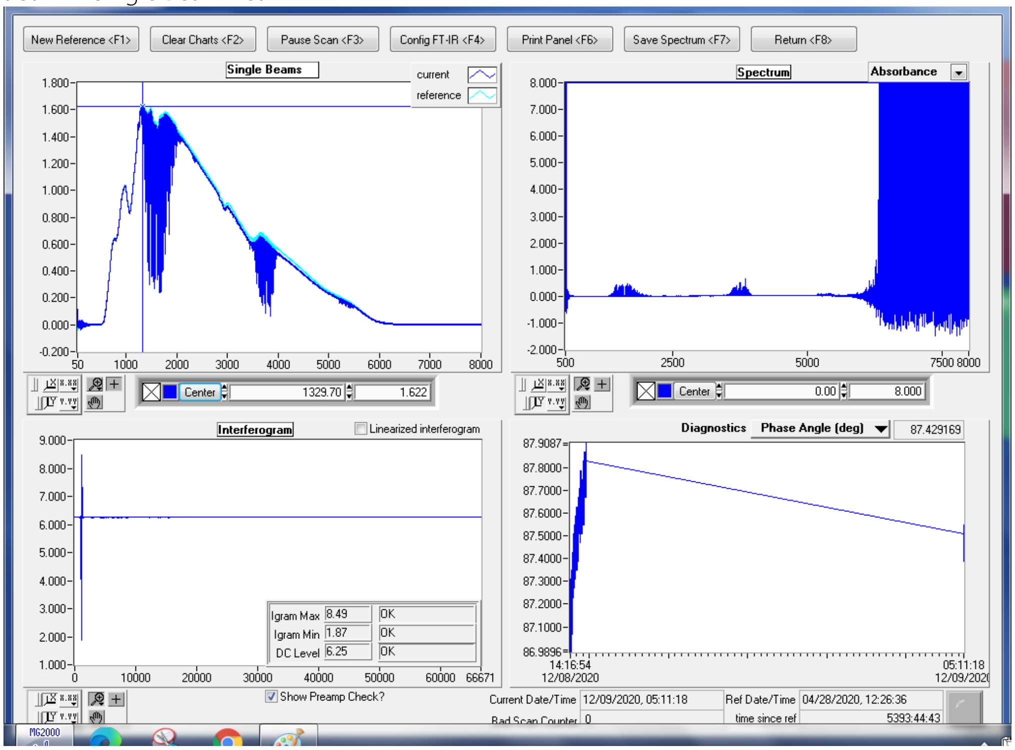
Biofilter Inlet FTIR Peak Analysis



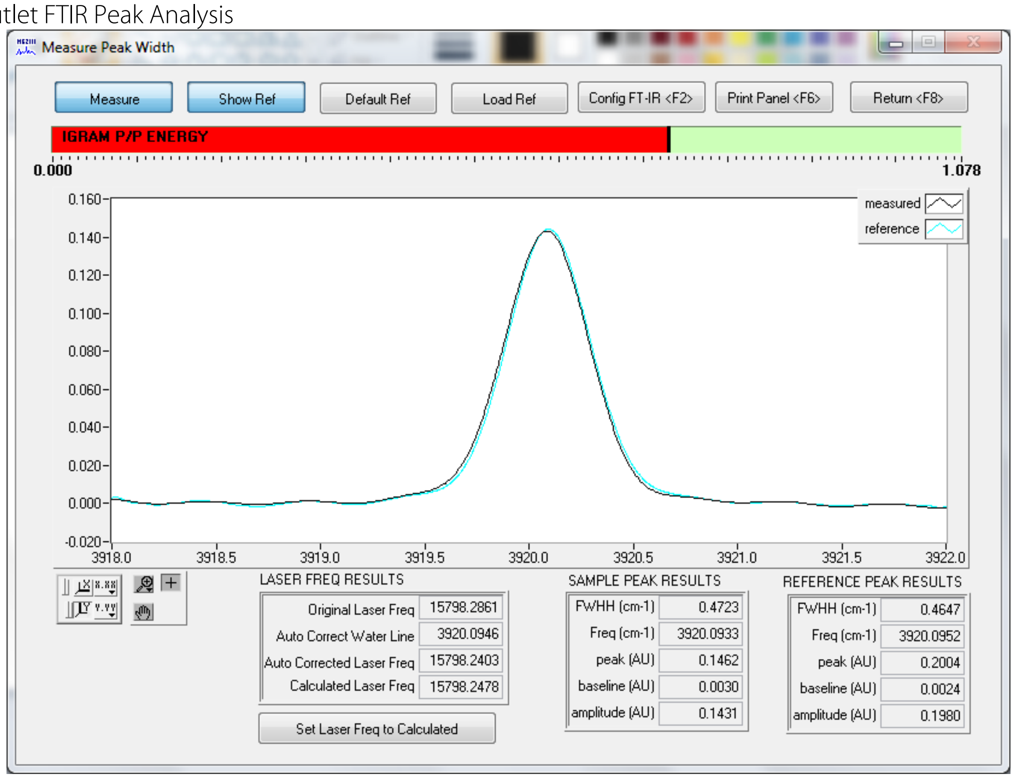
Biofilter Outlet FTIR Single Beam Linearity



Biofilter Outlet FTIR Single Beam Peak



Biofilter Outlet FTIR Peak Analysis



Appendix C
FTIR Quality Assurance Data

Biofilter Inlet Zero Direct (AAL-17660, nitrogen)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000001.LAB	12/9/2020	7:02:05	-0.06	0.00	0.07	0.15	0.00	192.19	0.95	0.03	0.00	0.04	0.05	0.00
BIOIN_000002.LAB	12/9/2020	7:02:36	0.16	0.01	0.17	0.03	0.01	192.19	0.95	0.03	0.00	0.04	0.05	0.00
BIOIN_000003.LAB	12/9/2020	7:03:06	-0.05	0.00	0.04	0.19	0.01	192.22	0.95	0.03	0.00	0.04	0.05	0.00
BIOIN_000004.LAB	12/9/2020	7:03:36	0.02	0.00	0.09	0.29	0.01	192.21	0.95	0.03	0.00	0.05	0.05	0.00
BIOIN_000005.LAB	12/9/2020	7:04:06	0.06	0.00	0.06	0.20	0.01	192.20	0.95	0.03	0.00	0.04	0.05	0.00
BIOIN_000006.LAB	12/9/2020	7:04:36	-0.10	0.00	0.11	0.16	0.02	192.20	0.95	0.03	0.00	0.04	0.04	0.00
BIOIN_000007.LAB	12/9/2020	7:05:06	0.14	0.00	-0.03	0.17	0.00	192.21	0.95	0.03	0.00	0.04	0.05	0.00
BIOIN_000008.LAB	12/9/2020	7:05:36	0.17	0.00	0.03	0.32	0.01	192.18	0.95	0.03	0.00	0.05	0.05	0.00
Average			**0.04**	**0.00**	**0.07**	**0.19**	**0.01**	**192.20**	**0.95**	**0.03**	**0.00**	**0.04**	**0.05**	**0.00**

Biofilter Inlet CTS Direct (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000010.LAB	12/9/2020	7:06:36	-0.06	0.01	96.77	0.38	0.00	192.20	0.95	0.03	0.00	0.09	0.05	0.00
BIOIN_000011.LAB	12/9/2020	7:07:06	0.21	0.01	96.91	0.44	-0.01	192.18	0.95	0.03	0.00	0.09	0.04	0.00
BIOIN_000012.LAB	12/9/2020	7:07:36	0.00	0.00	96.85	-0.07	0.01	192.16	0.95	0.03	0.00	0.10	0.05	0.00
BIOIN_000013.LAB	12/9/2020	7:08:06	-0.07	0.00	96.92	0.31	0.00	192.18	0.95	0.03	0.00	0.09	0.05	0.00
BIOIN_000014.LAB	12/9/2020	7:08:36	-0.03	0.01	97.10	0.40	0.02	192.15	0.95	0.03	0.00	0.09	0.04	0.00
Average			**0.01**	**0.01**	**96.91**	**0.29**	**0.00**	**192.17**	**0.95**	**0.03**	**0.00**	**0.09**	**0.05**	**0.00**

Biofilter Inlet Spike Direct (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000016.LAB	12/9/2020	7:09:36	-0.18	0.00	-0.98	102.32	10.21	192.10	0.95	0.04	0.00	0.18	0.06	0.00
BIOIN_000017.LAB	12/9/2020	7:10:06	-0.13	0.00	-1.22	102.18	10.20	192.08	0.95	0.04	0.00	0.18	0.06	0.01
BIOIN_000018.LAB	12/9/2020	7:10:36	-0.03	0.00	-1.22	101.98	10.19	192.07	0.95	0.04	0.01	0.19	0.06	0.01
BIOIN_000019.LAB	12/9/2020	7:11:06	-0.12	0.00	-1.10	102.22	10.19	192.08	0.95	0.04	0.01	0.18	0.06	0.01
BIOIN_000020.LAB	12/9/2020	7:11:36	-0.20	0.00	-1.16	102.09	10.25	192.09	0.95	0.04	0.01	0.20	0.06	0.01
Average			**-0.13**	**0.00**	**-1.14**	**102.16**	**10.21**	**192.08**	**0.95**	**0.04**	**0.01**	**0.19**	**0.06**	**0.01**

Biofilter Inlet CTS System and High Response Time (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000035.LAB	12/9/2020	7:16:11	8.15	1.59	0.37	3.12	0.01	191.96	0.93	0.11	0.01	0.10	0.18	0.00
BIOIN_000036.LAB	12/9/2020	7:16:18	7.21	1.61	3.18	10.00	0.98	191.90	0.93	0.10	0.01	0.10	0.18	0.00
BIOIN_000037.LAB	12/9/2020	7:16:26	0.48	0.53	85.47	4.94	0.61	191.87	0.93	0.07	0.01	0.11	0.13	0.00
BIOIN_000038.LAB	12/9/2020	7:16:33	-0.04	0.12	96.22	-0.49	0.03	191.96	0.93	0.06	0.01	0.11	0.10	0.00
BIOIN_000039.LAB	12/9/2020	7:16:41	0.10	0.08	96.82	-0.11	0.00	192.03	0.93	0.06	0.01	0.10	0.09	0.00
BIOIN_000040.LAB	12/9/2020	7:16:48	-0.29	0.06	97.26	0.25	0.02	191.94	0.93	0.06	0.01	0.12	0.10	0.00
BIOIN_000041.LAB	12/9/2020	7:16:56	0.16	0.05	96.98	-0.03	0.01	191.86	0.93	0.05	0.01	0.11	0.09	0.00
BIOIN_000042.LAB	12/9/2020	7:17:03	0.14	0.05	97.17	-0.16	0.01	191.98	0.93	0.06	0.01	0.12	0.09	0.00
Response/Average		**0:00:23**	**0.01**	**0.07**	**96.89**	**-0.11**	**0.02**	**191.95**	**0.93**	**0.06**	**0.01**	**0.11**	**0.10**	**0.00**

Biofilter Inlet Zero System and Zero Response Time (AAL-17660, nitrogen)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000043.LAB	12/9/2020	7:17:11	0.04	0.02	96.99	0.33	0.03	191.99	0.93	0.05	0.01	0.13	0.09	0.00
BIOIN_000044.LAB	12/9/2020	7:17:18	0.37	0.02	96.85	1.45	0.02	191.92	0.93	0.06	0.01	0.11	0.09	0.00
BIOIN_000045.LAB	12/9/2020	7:17:26	1.97	0.68	44.49	0.67	-0.03	191.89	0.93	0.08	0.01	0.12	0.14	0.00
BIOIN_000046.LAB	12/9/2020	7:17:34	0.71	0.02	1.68	-0.27	-0.01	191.95	0.93	0.06	0.01	0.08	0.09	0.00
BIOIN_000047.LAB	12/9/2020	7:17:41	0.09	0.02	0.59	-0.28	-0.02	191.95	0.93	0.06	0.01	0.08	0.09	0.00
BIOIN_000048.LAB	12/9/2020	7:17:49	0.23	0.02	0.40	0.49	0.00	191.87	0.92	0.06	0.01	0.08	0.09	0.00
BIOIN_000049.LAB	12/9/2020	7:17:57	0.34	0.02	0.28	0.82	0.01	191.94	0.93	0.06	0.01	0.08	0.09	0.00
BIOIN_000050.LAB	12/9/2020	7:18:04	0.50	0.02	0.39	0.96	-0.02	192.09	0.93	0.06	0.01	0.08	0.10	0.00
BIOIN_000051.LAB	12/9/2020	7:18:11	0.11	0.02	0.10	0.52	-0.01	191.98	0.93	0.05	0.01	0.09	0.09	0.00
Response/Average		**0:00:30**	**0.25**	**0.02**	**0.35**	**0.50**	**-0.01**	**191.97**	**0.93**	**0.06**	**0.01**	**0.08**	**0.09**	**0.00**

Biofilter Inlet Native

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000056.LAB	12/9/2020	7:20:41	22.53	5.48	0.24	3.48	0.04	191.91	0.93	0.12	0.03	0.10	0.20	0.00
BIOIN_000057.LAB	12/9/2020	7:21:11	4.90	2.05	0.33	3.17	0.02	191.92	0.93	0.09	0.01	0.08	0.17	0.00
BIOIN_000058.LAB	12/9/2020	7:21:41	3.32	1.50	0.40	3.16	0.02	191.91	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000059.LAB	12/9/2020	7:22:11	4.74	1.41	0.16	3.07	0.01	191.89	0.93	0.09	0.01	0.05	0.16	0.00
BIOIN_000060.LAB	12/9/2020	7:22:41	9.15	1.69	0.50	3.67	0.02	191.94	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000061.LAB	12/9/2020	7:23:11	13.01	2.06	0.52	4.17	0.01	191.92	0.93	0.11	0.01	0.09	0.18	0.00
Average			**9.61**	**2.36**	**0.36**	**3.45**	**0.02**	**191.91**	**0.93**	**0.10**	**0.01**	**0.08**	**0.17**	**0.00**

Biofilter Inlet Spiked (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000064.LAB	12/9/2020	7:24:41	3.43	1.52	0.42	10.73	0.79	191.93	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000065.LAB	12/9/2020	7:25:11	2.90	1.29	0.18	10.94	0.80	191.89	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000066.LAB	12/9/2020	7:25:41	4.88	1.30	0.17	10.26	0.79	191.90	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000067.LAB	12/9/2020	7:26:11	9.01	1.61	0.20	11.09	0.79	191.90	0.93	0.10	0.01	0.08	0.17	0.00
BIOIN_000068.LAB	12/9/2020	7:26:41	10.70	1.85	0.50	11.85	0.79	191.90	0.93	0.11	0.01	0.11	0.18	0.00
Average			**6.18**	**1.52**	**0.29**	**10.97**	**0.79**	**191.90**	**0.93**	**0.10**	**0.01**	**0.08**	**0.16**	**0.00**

Biofilter Inlet Native

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000182.LAB	12/9/2020	8:41:55	16.67	4.46	0.40	3.51	0.03	191.98	0.93	0.11	0.02	0.08	0.19	0.00
BIOIN_000183.LAB	12/9/2020	8:42:25	4.03	1.78	0.41	2.97	0.02	192.03	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000184.LAB	12/9/2020	8:42:55	2.97	1.40	0.31	3.06	0.02	192.05	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000185.LAB	12/9/2020	8:43:25	3.65	1.30	0.30	2.79	0.00	192.04	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000186.LAB	12/9/2020	8:43:55	7.98	1.57	0.36	3.58	0.02	192.06	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000187.LAB	12/9/2020	8:44:25	9.96	1.85	0.43	4.05	0.02	192.06	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000188.LAB	12/9/2020	8:44:55	20.44	4.77	0.39	4.59	0.02	192.12	0.93	0.11	0.02	0.10	0.21	0.00
Average			**9.39**	**2.45**	**0.37**	**3.51**	**0.02**	**192.05**	**0.93**	**0.10**	**0.01**	**0.07**	**0.18**	**0.00**

Biofilter Inlet Spiked (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000193.LAB	12/9/2020	8:47:26	9.37	1.75	0.52	6.51	0.41	192.17	0.93	0.11	0.01	0.08	0.18	0.00
BIOIN_000194.LAB	12/9/2020	8:47:55	13.64	2.52	0.53	11.71	0.77	192.14	0.93	0.12	0.01	0.13	0.19	0.00

BIOIN_000195.LAB	12/9/2020	8:48:25	13.63	3.88	0.22	11.11	0.79	192.16	0.93	0.11	0.02	0.09	0.18	0.00
BIOIN_000196.LAB	12/9/2020	8:48:55	3.46	1.65	0.19	10.17	0.80	192.11	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000197.LAB	12/9/2020	8:49:25	3.36	1.31	0.26	10.24	0.80	192.09	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000198.LAB	12/9/2020	8:49:55	6.38	1.41	0.15	10.18	0.81	192.09	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000199.LAB	12/9/2020	8:50:25	12.12	1.85	0.28	11.21	0.81	192.03	0.93	0.11	0.01	0.08	0.18	0.00
Average			**8.85**	**2.05**	**0.31**	**10.16**	**0.74**	**192.11**	**0.93**	**0.10**	**0.01**	**0.08**	**0.17**	**0.00**

Biofilter Inlet CTS System (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000202.LAB	12/9/2020	8:51:55	0.15	0.02	97.18	0.41	0.02	192.15	0.93	0.03	0.00	0.08	0.05	0.00
BIOIN_000203.LAB	12/9/2020	8:52:25	0.14	0.02	97.53	0.87	0.01	192.12	0.93	0.03	0.00	0.08	0.05	0.00
BIOIN_000204.LAB	12/9/2020	8:52:55	0.22	0.02	97.18	0.43	0.02	192.11	0.93	0.03	0.00	0.08	0.05	0.00
BIOIN_000205.LAB	12/9/2020	8:53:26	0.02	0.03	97.30	0.45	0.01	192.10	0.93	0.03	0.00	0.09	0.05	0.00
BIOIN_000206.LAB	12/9/2020	8:53:56	0.24	0.01	97.53	0.18	0.01	192.17	0.93	0.03	0.00	0.09	0.05	0.00
Average			**0.15**	**0.02**	**97.34**	**0.47**	**0.01**	**192.13**	**0.93**	**0.03**	**0.00**	**0.08**	**0.05**	**0.00**

Biofilter Inlet Native

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000331.LAB	12/9/2020	10:02:28	18.10	2.81	0.65	3.70	-0.01	192.19	0.93	0.12	0.01	0.13	0.19	0.00
BIOIN_000332.LAB	12/9/2020	10:02:58	19.76	5.24	0.19	2.73	0.02	192.14	0.93	0.11	0.02	0.10	0.18	0.00
BIOIN_000333.LAB	12/9/2020	10:03:28	4.32	1.94	0.34	2.35	0.02	192.13	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000334.LAB	12/9/2020	10:03:58	3.29	1.47	0.34	2.34	0.01	192.14	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000335.LAB	12/9/2020	10:04:28	5.21	1.47	0.44	3.03	0.00	192.13	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000336.LAB	12/9/2020	10:04:59	11.34	1.88	0.53	3.18	0.01	192.12	0.93	0.11	0.01	0.08	0.17	0.00
Average			**10.34**	**2.47**	**0.42**	**2.89**	**0.01**	**192.14**	**0.93**	**0.10**	**0.01**	**0.08**	**0.17**	**0.00**

Biofilter Inlet Spiked (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000338.LAB	12/9/2020	10:05:59	24.76	5.40	2.64	3.49	0.04	192.10	0.93	0.11	0.03	0.11	0.19	0.00
BIOIN_000339.LAB	12/9/2020	10:06:28	6.33	2.31	4.47	9.68	0.72	192.12	0.93	0.10	0.01	0.09	0.17	0.00
BIOIN_000340.LAB	12/9/2020	10:06:59	3.05	1.48	0.26	13.88	1.19	192.10	0.93	0.09	0.01	0.08	0.16	0.00
BIOIN_000341.LAB	12/9/2020	10:07:28	3.85	1.32	0.12	12.67	1.06	192.10	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000342.LAB	12/9/2020	10:07:59	8.62	1.58	0.44	9.99	0.76	192.07	0.93	0.10	0.01	0.08	0.16	0.00
BIOIN_000343.LAB	12/9/2020	10:08:29	13.10	1.95	0.29	10.47	0.76	192.10	0.93	0.12	0.01	0.09	0.18	0.00
Average			**9.95**	**2.34**	**1.37**	**10.03**	**0.75**	**192.10**	**0.93**	**0.10**	**0.01**	**0.09**	**0.17**	**0.00**

Biofilter Inlet CTS System (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000351.LAB	12/9/2020	10:12:29	0.14	0.01	97.22	0.67	0.01	192.12	0.93	0.03	0.00	0.09	0.05	0.00
BIOIN_000352.LAB	12/9/2020	10:12:59	0.22	0.01	97.16	0.40	0.02	192.08	0.93	0.03	0.00	0.09	0.06	0.00
BIOIN_000353.LAB	12/9/2020	10:13:29	0.30	0.01	97.25	0.00	0.02	192.11	0.93	0.03	0.00	0.09	0.05	0.00
BIOIN_000354.LAB	12/9/2020	10:13:59	0.15	0.02	96.83	0.86	0.01	192.07	0.93	0.03	0.00	0.10	0.05	0.00
BIOIN_000355.LAB	12/9/2020	10:14:29	0.17	0.02	97.46	0.26	0.01	192.11	0.93	0.03	0.00	0.09	0.05	0.00
Average			**0.20**	**0.01**	**97.18**	**0.44**	**0.01**	**192.10**	**0.93**	**0.03**	**0.00**	**0.09**	**0.05**	**0.00**

Biofilter Inlet Native

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000469.LAB	12/9/2020	11:19:32	33.67	4.49	0.33	3.14	0.02	192.15	0.93	0.13	0.02	0.09	0.21	0.00
BIOIN_000470.LAB	12/9/2020	11:20:02	8.32	1.88	0.43	3.35	0.01	192.11	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000471.LAB	12/9/2020	11:20:32	6.05	1.63	0.32	3.24	0.02	192.16	0.93	0.10	0.01	0.07	0.16	0.00
BIOIN_000472.LAB	12/9/2020	11:21:02	4.46	1.36	0.26	3.63	0.01	192.09	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000473.LAB	12/9/2020	11:21:32	3.71	1.22	0.27	2.93	0.01	192.10	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000474.LAB	12/9/2020	11:22:02	4.58	1.25	0.29	3.59	0.01	192.02	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000475.LAB	12/9/2020	11:22:32	10.65	1.82	0.46	3.79	0.00	192.02	0.93	0.11	0.01	0.09	0.17	0.00
Average			**10.20**	**1.95**	**0.34**	**3.38**	**0.01**	**192.09**	**0.93**	**0.10**	**0.01**	**0.07**	**0.17**	**0.00**

Biofilter Inlet Spiked (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000478.LAB	12/9/2020	11:24:02	18.85	3.17	2.45	3.72	0.00	192.13	0.93	0.12	0.01	0.10	0.19	0.00
BIOIN_000479.LAB	12/9/2020	11:24:32	6.72	1.71	5.02	7.12	0.37	192.14	0.93	0.10	0.01	0.07	0.17	0.00
BIOIN_000480.LAB	12/9/2020	11:25:02	4.81	1.40	0.28	11.32	0.92	192.10	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000481.LAB	12/9/2020	11:25:32	3.36	1.17	0.25	11.68	0.91	192.09	0.93	0.09	0.01	0.06	0.16	0.00
BIOIN_000482.LAB	12/9/2020	11:26:02	2.86	1.08	0.21	11.06	0.90	192.13	0.93	0.09	0.01	0.06	0.15	0.00
BIOIN_000483.LAB	12/9/2020	11:26:32	5.20	1.23	0.30	11.49	0.92	192.13	0.93	0.09	0.01	0.07	0.16	0.00
BIOIN_000484.LAB	12/9/2020	11:27:02	10.33	1.75	0.34	12.50	0.92	192.13	0.93	0.11	0.01	0.09	0.18	0.00
BIOIN_000485.LAB	12/9/2020	11:27:32	13.59	2.05	0.46	12.24	0.92	192.15	0.93	0.12	0.01	0.10	0.19	0.00
Average			**8.21**	**1.70**	**1.16**	**10.14**	**0.73**	**192.13**	**0.93**	**0.10**	**0.01**	**0.08**	**0.17**	**0.00**

Biofilter Inlet CTS System (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000491.LAB	12/9/2020	11:30:32	0.22	0.02	97.06	0.49	0.01	192.13	0.93	0.03	0.00	0.10	0.05	0.00
BIOIN_000492.LAB	12/9/2020	11:31:03	0.21	0.01	96.77	0.12	0.02	192.10	0.93	0.03	0.00	0.10	0.05	0.00
BIOIN_000493.LAB	12/9/2020	11:31:32	0.15	0.00	97.16	0.65	0.02	192.15	0.93	0.03	0.00	0.10	0.05	0.00
BIOIN_000494.LAB	12/9/2020	11:32:02	0.19	0.01	96.99	0.47	0.01	192.11	0.93	0.03	0.00	0.09	0.05	0.00
BIOIN_000495.LAB	12/9/2020	11:32:32	0.12	0.01	96.88	0.47	0.01	192.09	0.93	0.03	0.00	0.09	0.06	0.00
Average			**0.18**	**0.01**	**96.97**	**0.44**	**0.01**	**192.12**	**0.93**	**0.03**	**0.00**	**0.10**	**0.05**	**0.00**

Biofilter Inlet Zero System (AAL-17660, nitrogen)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000497.LAB	12/9/2020	11:33:32	0.20	0.02	1.22	0.74	0.00	192.12	0.93	0.03	0.00	0.05	0.05	0.00
BIOIN_000498.LAB	12/9/2020	11:34:03	0.28	0.01	0.25	0.41	0.00	192.09	0.93	0.03	0.00	0.05	0.05	0.00
BIOIN_000499.LAB	12/9/2020	11:34:32	0.20	0.01	0.30	0.27	0.00	192.08	0.93	0.03	0.00	0.04	0.05	0.00
BIOIN_000500.LAB	12/9/2020	11:35:02	0.06	0.01	0.18	0.37	0.00	192.06	0.93	0.03	0.00	0.05	0.05	0.00
BIOIN_000501.LAB	12/9/2020	11:35:33	0.15	0.01	0.28	0.30	0.01	192.02	0.93	0.03	0.00	0.05	0.05	0.00
BIOIN_000502.LAB	12/9/2020	11:36:02	0.10	0.01	0.08	0.46	0.00	192.06	0.93	0.03	0.00	0.04	0.05	0.00
Average			**0.16**	**0.01**	**0.39**	**0.42**	**0.00**	**192.07**	**0.93**	**0.03**	**0.00**	**0.05**	**0.05**	**0.00**

Biofilter Inlet CTS Direct (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)

BIOIN_000504.LAB	12/9/2020	11:48:03	0.00	0.00	96.62	0.23	0.01	192.25	0.96	0.03	0.01	0.10	0.05	0.00
BIOIN_000505.LAB	12/9/2020	11:48:33	-0.04	-0.01	96.22	0.19	0.00	192.26	0.96	0.03	0.00	0.10	0.05	0.00
BIOIN_000506.LAB	12/9/2020	11:49:03	0.12	-0.01	96.28	0.57	0.00	192.26	0.96	0.03	0.00	0.09	0.05	0.00
BIOIN_000507.LAB	12/9/2020	11:49:33	0.14	-0.01	96.21	0.18	-0.02	192.24	0.96	0.04	0.00	0.10	0.05	0.00
BIOIN_000508.LAB	12/9/2020	11:50:03	0.03	-0.01	96.43	0.14	0.01	192.25	0.96	0.03	0.00	0.10	0.05	0.00
Average			**0.05**	**-0.01**	**96.35**	**0.26**	**0.00**	**192.25**	**0.96**	**0.03**	**0.00**	**0.10**	**0.05**	**0.00**

Biofilter Inlet Zero Direct (AAL-17660, nitrogen)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOIN_000510.LAB	12/9/2020	11:51:03	-0.02	-0.01	0.27	0.62	0.01	192.21	0.96	0.03	0.00	0.05	0.05	0.00
BIOIN_000511.LAB	12/9/2020	11:51:33	0.02	-0.01	0.17	0.47	0.00	192.18	0.96	0.03	0.00	0.04	0.05	0.00
BIOIN_000512.LAB	12/9/2020	11:52:03	0.14	-0.01	0.15	1.03	0.01	192.23	0.96	0.03	0.00	0.05	0.05	0.00
BIOIN_000513.LAB	12/9/2020	11:52:33	0.10	-0.01	0.17	0.81	0.00	192.26	0.96	0.03	0.00	0.04	0.05	0.00
BIOIN_000514.LAB	12/9/2020	11:53:03	0.01	-0.01	0.10	0.03	0.00	192.26	0.96	0.03	0.00	0.05	0.06	0.00
Average			**0.05**	**-0.01**	**0.17**	**0.59**	**0.00**	**192.23**	**0.96**	**0.03**	**0.00**	**0.05**	**0.05**	**0.00**

Biofilter Outlet Zero Direct (AAL-17660, nitrogen)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0001.LAB	12/9/2020	6:22:16	0.02	0.00	0.02	-0.01	0.01	192.32	0.95	0.02	0.00	0.04	0.03	0.00
BIOOUT_0002.LAB	12/9/2020	6:22:47	0.08	0.00	0.07	-0.03	0.00	192.28	0.95	0.02	0.00	0.03	0.03	0.00
BIOOUT_0003.LAB	12/9/2020	6:23:18	-0.03	0.00	-0.01	-0.01	0.01	192.25	0.95	0.02	0.00	0.03	0.03	0.00
BIOOUT_0004.LAB	12/9/2020	6:23:49	-0.05	0.00	0.02	-0.06	0.00	192.21	0.95	0.02	0.00	0.03	0.03	0.00
BIOOUT_0005.LAB	12/9/2020	6:24:20	-0.06	0.00	0.04	0.32	0.00	192.25	0.95	0.02	0.00	0.03	0.03	0.00
BIOOUT_0006.LAB	12/9/2020	6:24:51	0.08	0.00	0.07	-0.14	0.00	192.20	0.95	0.02	0.00	0.03	0.03	0.00
BIOOUT_0007.LAB	12/9/2020	6:25:22	0.07	0.00	0.03	-0.15	-0.01	192.13	0.95	0.02	0.00	0.03	0.03	0.00
BIOOUT_0008.LAB	12/9/2020	6:25:53	0.08	0.00	-0.05	-0.23	0.00	192.14	0.95	0.02	0.00	0.03	0.03	0.00
Average			**0.02**	**0.00**	**0.02**	**-0.04**	**0.00**	**192.22**	**0.95**	**0.02**	**0.00**	**0.03**	**0.03**	**0.00**

Biofilter Outlet CTS Direct (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0010.LAB	12/9/2020	6:26:54	0.07	0.01	97.33	0.09	0.00	192.14	0.95	0.02	0.00	0.12	0.03	0.00
BIOOUT_0011.LAB	12/9/2020	6:27:25	0.08	0.01	97.26	-0.28	-0.01	192.09	0.95	0.02	0.00	0.13	0.03	0.00
BIOOUT_0012.LAB	12/9/2020	6:27:55	0.00	0.01	97.09	-0.15	0.00	192.10	0.95	0.02	0.00	0.13	0.03	0.00
BIOOUT_0013.LAB	12/9/2020	6:28:25	0.12	0.01	97.22	-0.18	0.00	192.10	0.95	0.02	0.00	0.12	0.03	0.00
BIOOUT_0014.LAB	12/9/2020	6:28:55	0.04	0.00	97.17	-0.22	0.00	192.09	0.95	0.02	0.00	0.11	0.03	0.00
Average			**0.06**	**0.01**	**97.21**	**-0.15**	**0.00**	**192.10**	**0.95**	**0.02**	**0.00**	**0.12**	**0.03**	**0.00**

Biofilter Outlet Spike Direct (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0016.LAB	12/9/2020	6:29:58	-0.02	0.00	-0.63	102.87	10.28	192.09	0.95	0.03	0.00	0.14	0.04	0.00
BIOOUT_0017.LAB	12/9/2020	6:30:29	-0.14	0.00	-0.62	102.88	10.32	192.08	0.95	0.03	0.00	0.15	0.05	0.00
BIOOUT_0018.LAB	12/9/2020	6:31:01	-0.24	0.00	-0.98	103.15	10.30	192.07	0.95	0.03	0.00	0.14	0.05	0.00
BIOOUT_0019.LAB	12/9/2020	6:31:31	-0.09	-0.01	-0.58	103.06	10.31	192.07	0.95	0.03	0.00	0.15	0.04	0.00
BIOOUT_0020.LAB	12/9/2020	6:32:01	-0.14	0.00	-0.61	103.00	10.29	192.04	0.95	0.03	0.00	0.15	0.04	0.00
Average			**-0.13**	**0.00**	**-0.68**	**102.99**	**10.30**	**192.07**	**0.95**	**0.03**	**0.00**	**0.15**	**0.04**	**0.00**

Biofilter Outlet CTS System and High Response Time (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0036.LAB	12/9/2020	6:36:00	0.07	4.01	0.12	0.60	-0.01	191.86	0.91	0.04	0.02	0.08	0.08	0.00
BIOOUT_0037.LAB	12/9/2020	6:36:08	0.43	3.74	3.00	7.09	0.66	191.92	0.92	0.04	0.02	0.09	0.08	0.00
BIOOUT_0038.LAB	12/9/2020	6:36:15	0.33	0.74	82.23	6.27	0.53	191.91	0.92	0.04	0.01	0.10	0.07	0.00
BIOOUT_0039.LAB	12/9/2020	6:36:23	0.00	0.18	96.24	0.21	0.02	191.86	0.92	0.04	0.00	0.12	0.06	0.00
BIOOUT_0040.LAB	12/9/2020	6:36:30	0.24	0.18	96.18	-0.30	0.02	191.90	0.92	0.04	0.01	0.12	0.06	0.00
BIOOUT_0041.LAB	12/9/2020	6:36:38	0.08	0.16	96.19	-0.20	0.01	191.90	0.91	0.03	0.01	0.12	0.06	0.00
BIOOUT_0042.LAB	12/9/2020	6:36:46	0.14	0.14	96.31	-0.19	0.02	191.89	0.91	0.04	0.01	0.14	0.06	0.00
BIOOUT_0043.LAB	12/9/2020	6:36:54	0.21	0.13	96.42	0.36	0.01	191.85	0.92	0.04	0.01	0.11	0.06	0.00
Response/Average		**0:00:23**	**0.13**	**0.16**	**96.27**	**-0.02**	**0.02**	**191.88**	**0.91**	**0.04**	**0.01**	**0.12**	**0.06**	**0.00**

Biofilter Outlet Zero System and Zero Response Time (AAL-17660, nitrogen)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0044.LAB	12/9/2020	6:37:01	0.29	0.11	96.13	0.52	0.00	191.86	0.92	0.04	0.01	0.11	0.06	0.00
BIOOUT_0045.LAB	12/9/2020	6:37:09	-0.03	0.12	95.97	-0.21	0.00	191.87	0.92	0.04	0.01	0.12	0.06	0.00
BIOOUT_0046.LAB	12/9/2020	6:37:17	0.22	1.62	50.04	0.08	-0.04	191.85	0.91	0.04	0.01	0.13	0.06	0.00
BIOOUT_0047.LAB	12/9/2020	6:37:24	0.07	0.90	4.17	0.07	-0.01	191.85	0.92	0.04	0.01	0.06	0.07	0.00
BIOOUT_0048.LAB	12/9/2020	6:37:32	-0.06	0.91	0.21	0.36	0.02	191.83	0.91	0.04	0.01	0.06	0.07	0.00
BIOOUT_0049.LAB	12/9/2020	6:37:40	-0.07	0.93	0.15	-0.12	0.01	191.77	0.91	0.04	0.01	0.06	0.07	0.00
BIOOUT_0050.LAB	12/9/2020	6:37:47	0.01	0.92	0.22	-0.06	0.00	191.85	0.91	0.04	0.01	0.06	0.06	0.00
BIOOUT_0051.LAB	12/9/2020	6:37:55	0.25	0.93	0.19	0.31	0.00	191.86	0.91	0.04	0.01	0.05	0.06	0.00
BIOOUT_0052.LAB	12/9/2020	6:38:03	-0.11	0.61	0.11	-0.05	0.02	191.85	0.91	0.04	0.01	0.06	0.07	0.00
Response/Average		**0:00:31**	**0.00**	**0.86**	**0.18**	**0.09**	**0.01**	**191.83**	**0.91**	**0.04**	**0.01**	**0.06**	**0.07**	**0.00**

Biofilter Outlet Native

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0059.LAB	12/9/2020	6:40:08	0.14	4.02	0.20	0.41	0.01	191.81	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0060.LAB	12/9/2020	6:40:38	0.14	4.03	0.19	0.72	0.00	191.83	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0061.LAB	12/9/2020	6:41:09	0.11	4.03	0.35	0.35	0.00	191.84	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0062.LAB	12/9/2020	6:41:39	0.16	4.03	0.29	0.37	0.01	191.82	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0063.LAB	12/9/2020	6:42:09	0.12	3.94	0.29	0.20	0.01	191.84	0.91	0.03	0.02	0.07	0.07	0.00
Average			**0.14**	**4.01**	**0.27**	**0.41**	**0.01**	**191.83**	**0.91**	**0.04**	**0.02**	**0.07**	**0.06**	**0.00**

Biofilter Outlet Spiked (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0066.LAB	12/9/2020	6:43:40	0.06	3.73	0.30	8.12	0.81	191.89	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0067.LAB	12/9/2020	6:44:10	0.06	3.73	0.13	8.47	0.80	191.84	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0068.LAB	12/9/2020	6:44:42	0.14	3.73	0.12	8.34	0.81	191.85	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0069.LAB	12/9/2020	6:45:13	0.09	3.73	0.16	8.18	0.81	191.84	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0070.LAB	12/9/2020	6:45:43	0.10	3.74	0.20	8.30	0.81	191.83	0.91	0.03	0.02	0.07	0.07	0.00
Average			**0.09**	**3.73**	**0.18**	**8.28**	**0.81**	**191.85**	**0.91**	**0.03**	**0.02**	**0.07**	**0.06**	**0.00**

Biofilter Outlet Native

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0228.LAB	12/9/2020	8:46:35	0.07	4.09	0.27	1.08	0.00	191.95	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0229.LAB	12/9/2020	8:47:07	0.06	4.10	0.28	1.24	0.01	191.97	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0230.LAB	12/9/2020	8:47:37	0.17	4.09	0.31	1.32	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0231.LAB	12/9/2020	8:48:07	0.13	4.09	0.17	1.14	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0232.LAB	12/9/2020	8:48:37	0.14	4.07	0.11	1.14	0.01	191.98	0.91	0.03	0.02	0.08	0.07	0.00
Average			**0.11**	**4.09**	**0.23**	**1.18**	**0.01**	**191.98**	**0.91**	**0.03**	**0.02**	**0.07**	**0.06**	**0.00**

Biofilter Outlet Spiked (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0251.LAB	12/9/2020	8:58:16	0.12	3.70	0.30	10.19	0.91	191.93	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0252.LAB	12/9/2020	8:58:46	0.16	3.72	0.32	9.97	0.91	191.98	0.91	0.03	0.02	0.07	0.07	0.00
BIOOUT_0253.LAB	12/9/2020	8:59:16	0.12	3.73	0.21	9.84	0.91	191.98	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0254.LAB	12/9/2020	8:59:47	0.16	3.74	0.22	10.03	0.91	191.96	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0255.LAB	12/9/2020	9:00:18	0.18	3.74	0.33	9.99	0.90	191.99	0.91	0.04	0.02	0.07	0.06	0.00

Average			**0.15**	**3.73**	**0.27**	**10.00**	**0.91**	**191.97**	**0.91**	**0.03**	**0.02**	**0.07**	**0.06**	**0.00**

Biofilter Outlet CTS System (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0245.LAB	12/9/2020	8:55:15	0.10	0.01	98.12	0.86	0.02	191.99	0.91	0.02	0.00	0.12	0.03	0.00
BIOOUT_0246.LAB	12/9/2020	8:55:45	0.10	0.00	98.27	0.76	0.01	191.97	0.91	0.02	0.00	0.12	0.03	0.00
BIOOUT_0247.LAB	12/9/2020	8:56:15	0.13	0.00	98.25	0.79	0.00	191.98	0.91	0.02	0.00	0.12	0.03	0.00
BIOOUT_0248.LAB	12/9/2020	8:56:45	0.16	0.00	98.27	0.97	0.01	191.94	0.91	0.02	0.00	0.12	0.03	0.00
BIOOUT_0249.LAB	12/9/2020	8:57:15	0.10	0.00	98.67	0.61	0.01	191.92	0.91	0.02	0.00	0.12	0.03	0.00
Average			**0.12**	**0.00**	**98.32**	**0.80**	**0.01**	**191.96**	**0.91**	**0.02**	**0.00**	**0.12**	**0.03**	**0.00**

Biofilter Outlet Native

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0370.LAB	12/9/2020	9:58:11	0.03	4.11	0.18	1.41	0.00	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0371.LAB	12/9/2020	9:58:40	0.05	4.11	0.20	1.43	0.00	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0372.LAB	12/9/2020	9:59:10	0.05	4.11	0.28	1.44	0.01	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0373.LAB	12/9/2020	9:59:40	0.14	4.10	0.24	1.54	0.01	192.01	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0374.LAB	12/9/2020	10:00:11	0.03	4.12	0.22	1.32	0.01	191.99	0.91	0.03	0.02	0.07	0.06	0.00
Average			**0.06**	**4.11**	**0.22**	**1.43**	**0.00**	**192.01**	**0.91**	**0.03**	**0.02**	**0.07**	**0.06**	**0.00**

Biofilter Outlet Spiked (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0408.LAB	12/9/2020	10:20:00	0.09	3.86	0.24	7.51	0.64	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0409.LAB	12/9/2020	10:20:30	0.02	3.88	0.20	7.74	0.64	191.95	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0410.LAB	12/9/2020	10:21:01	0.08	3.87	0.14	7.79	0.64	191.95	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0411.LAB	12/9/2020	10:21:31	0.10	3.89	0.21	7.73	0.64	191.97	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0412.LAB	12/9/2020	10:22:01	0.03	3.88	0.21	7.83	0.64	191.98	0.91	0.04	0.02	0.07	0.06	0.00
Average			**0.07**	**3.87**	**0.20**	**7.72**	**0.64**	**191.96**	**0.91**	**0.03**	**0.02**	**0.07**	**0.06**	**0.00**

Biofilter Outlet CTS System (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0401.LAB	12/9/2020	10:16:26	0.09	0.01	98.32	1.12	0.01	191.96	0.91	0.02	0.00	0.13	0.03	0.00
BIOOUT_0402.LAB	12/9/2020	10:16:57	0.17	0.01	98.18	1.60	0.00	191.97	0.91	0.02	0.00	0.12	0.03	0.00
BIOOUT_0403.LAB	12/9/2020	10:17:28	0.20	0.01	97.99	0.99	0.01	191.95	0.91	0.02	0.00	0.12	0.03	0.00
BIOOUT_0404.LAB	12/9/2020	10:17:58	0.11	0.00	98.09	1.36	0.01	191.97	0.91	0.02	0.00	0.13	0.03	0.00
BIOOUT_0405.LAB	12/9/2020	10:18:28	0.15	0.00	97.87	1.06	0.01	191.97	0.92	0.02	0.00	0.12	0.03	0.00
Average			**0.14**	**0.00**	**98.09**	**1.23**	**0.01**	**191.96**	**0.91**	**0.02**	**0.00**	**0.12**	**0.03**	**0.00**

Biofilter Outlet Native

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0531.LAB	12/9/2020	11:22:34	0.05	4.16	0.21	1.95	0.01	192.00	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0532.LAB	12/9/2020	11:23:04	0.14	4.15	0.22	1.91	0.01	192.00	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0533.LAB	12/9/2020	11:23:34	0.06	4.14	0.23	1.67	0.01	192.00	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0534.LAB	12/9/2020	11:24:05	0.13	4.15	0.21	1.97	0.00	192.03	0.91	0.03	0.02	0.07	0.06	0.00
BIOOUT_0535.LAB	12/9/2020	11:24:35	0.19	4.14	0.13	2.08	0.01	192.01	0.91	0.04	0.02	0.07	0.07	0.00
Average			**0.11**	**4.15**	**0.20**	**1.92**	**0.01**	**192.01**	**0.91**	**0.04**	**0.02**	**0.07**	**0.06**	**0.00**

Biofilter Outlet Spiked (CC716034, 100.8ppm acetaldehyde, 10.42ppm SF6)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0548.LAB	12/9/2020	11:41:20	0.25	3.84	0.24	8.80	0.69	191.98	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0549.LAB	12/9/2020	11:41:51	0.15	3.85	0.19	8.60	0.69	192.01	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0550.LAB	12/9/2020	11:42:22	0.08	3.85	0.21	8.57	0.70	192.02	0.91	0.04	0.02	0.06	0.06	0.00
BIOOUT_0551.LAB	12/9/2020	11:42:53	0.05	3.85	0.18	8.45	0.70	191.99	0.91	0.04	0.02	0.07	0.06	0.00
BIOOUT_0552.LAB	12/9/2020	11:43:24	0.12	3.85	0.12	8.53	0.70	192.00	0.91	0.04	0.02	0.07	0.06	0.00
Average			**0.13**	**3.85**	**0.19**	**8.59**	**0.70**	**192.00**	**0.91**	**0.04**	**0.02**	**0.07**	**0.06**	**0.00**

Biofilter Outlet CTS System (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0541.LAB	12/9/2020	11:37:47	0.14	0.00	97.86	1.54	0.01	191.98	0.91	0.02	0.00	0.12	0.03	0.00
BIOOUT_0542.LAB	12/9/2020	11:38:17	0.06	0.00	97.65	1.45	0.01	191.97	0.92	0.02	0.00	0.12	0.04	0.00
BIOOUT_0543.LAB	12/9/2020	11:38:48	0.10	0.00	98.23	1.68	0.01	191.96	0.91	0.02	0.00	0.13	0.03	0.00
BIOOUT_0544.LAB	12/9/2020	11:39:18	0.17	0.00	98.38	1.16	0.00	191.99	0.91	0.02	0.00	0.13	0.04	0.00
BIOOUT_0545.LAB	12/9/2020	11:39:48	0.17	0.00	98.07	1.40	0.01	192.00	0.91	0.02	0.00	0.12	0.03	0.00
Average			**0.13**	**0.00**	**98.04**	**1.45**	**0.01**	**191.98**	**0.91**	**0.02**	**0.00**	**0.12**	**0.04**	**0.00**

Biofilter Outlet Zero System (AAL-17660, nitrogen)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0554.LAB	12/9/2020	11:44:25	0.15	0.02	0.14	1.55	0.00	192.05	0.91	0.02	0.00	0.04	0.03	0.00
BIOOUT_0555.LAB	12/9/2020	11:44:55	0.17	0.00	0.24	1.75	0.00	192.05	0.91	0.02	0.00	0.05	0.03	0.00
BIOOUT_0556.LAB	12/9/2020	11:45:25	0.18	0.00	0.14	1.63	0.00	192.05	0.92	0.02	0.00	0.04	0.03	0.00
BIOOUT_0557.LAB	12/9/2020	11:45:55	0.10	0.00	0.12	1.44	0.00	192.08	0.92	0.02	0.00	0.04	0.04	0.00
BIOOUT_0558.LAB	12/9/2020	11:46:26	0.09	0.00	0.10	1.63	0.00	192.07	0.92	0.02	0.00	0.04	0.04	0.00
Average			**0.14**	**0.00**	**0.15**	**1.60**	**0.00**	**192.06**	**0.92**	**0.02**	**0.00**	**0.04**	**0.03**	**0.00**

Biofilter Outlet CTS Direct (ALM033173, 96.74ppm ethylene)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0562.LAB	12/9/2020	11:54:32	-0.02	-0.01	97.32	1.43	-0.01	192.83	0.95	0.02	0.00	0.13	0.03	0.00
BIOOUT_0563.LAB	12/9/2020	11:55:02	0.04	-0.01	97.20	1.46	-0.01	192.87	0.95	0.02	0.00	0.14	0.03	0.00
BIOOUT_0564.LAB	12/9/2020	11:55:32	0.12	-0.01	97.14	1.30	-0.01	192.84	0.95	0.02	0.00	0.13	0.03	0.00
BIOOUT_0565.LAB	12/9/2020	11:56:03	0.13	-0.01	97.23	1.36	-0.01	192.92	0.95	0.02	0.00	0.13	0.03	0.00
BIOOUT_0566.LAB	12/9/2020	11:56:32	0.01	-0.01	97.09	1.45	-0.01	192.92	0.95	0.02	0.00	0.13	0.03	0.00
Average			**0.06**	**-0.01**	**97.20**	**1.40**	**-0.01**	**192.88**	**0.95**	**0.02**	**0.00**	**0.13**	**0.03**	**0.00**

Biofilter Outlet Zero Direct (AAL-17660, nitrogen)

Spectrum	Date	Time	Formaldehyde (ppmw)	Water (%)	Ethylene (ppmw)	Acetaldehyde (ppmw)	SF6 (ppmw)	Temp (C)	Pressure (atm)	Formaldehyde resid (ppmw)	Water resid (%)	Ethylene resid (ppmw)	Acetaldehyde resid (ppmw)	SF6 resid (ppmw)
BIOOUT_0569.LAB	12/9/2020	11:58:03	0.11	-0.01	0.01	1.46	0.00	192.92	0.95	0.02	0.00	0.04	0.03	0.00
BIOOUT_0570.LAB	12/9/2020	11:58:33	-0.01	-0.01	0.06	1.91	0.00	192.93	0.95	0.02	0.00	0.04	0.03	0.00

BIOOUT_0571.LAB	12/9/2020	11:59:03	-0.03	-0.01	0.12	1.44	0.00	193.00	0.95	0.02	0.00	0.04	0.03	0.00
BIOOUT_0572.LAB	12/9/2020	11:59:33	0.07	-0.02	0.13	1.35	0.00	193.09	0.95	0.02	0.00	0.04	0.03	0.00
BIOOUT_0573.LAB	12/9/2020	12:00:03	0.02	-0.01	0.06	1.48	-0.01	193.83	0.95	0.02	0.00	0.04	0.03	0.00
Average			**0.03**	**-0.01**	**0.07**	**1.53**	**0.00**	**193.15**	**0.95**	**0.02**	**0.00**	**0.04**	**0.03**	**0.00**

Appendix D
Gas Cylinder Certificates of Analysis

Airgas
an Air Liquide company

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

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED HYDROCARBON

Part Number:	X04NI99C15A00X1	Reference Number:	160-401674875-1
Cylinder Number:	CC716034	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
Analysis Date:	Dec 10, 2019	Valve Outlet:	350SS
Lot Number:	160-401674875-1	Expiration Date:	Dec 10, 2020

Traceability Statement: Hydrocarbon Process standards are NIST traceable either directly by weight or by comparison to Airgas laboratory standards that are directly NIST traceable by weight.

CERTIFIED CONCENTRATIONS

Component	Requested Concentration	Reported Mole %	Accuracy
SULFUR HEXAFLUORIDE	10.00 PPM	10.42 PPM	+/- 5%
ACETALDEHYDE	100.0 PPM	100.8 PPM	+/- 2%
METHANOL	100.0 PPM	100.3 PPM	+/- 2%
NITROGEN	Balance	Balance	

Approved for Release

Airgas
an Air Liquide company

Airgas Great Lakes region
Airgas USA, LLC
1290 Combermere Dr.
Troy, MI 48083
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Customer:	BUREAU VERITAS NORTH AMERICA		
Part Number:	X02NI99C15A1268	Reference Number:	32-401202132-1
Cylinder Number:	ALM033173	Cylinder Volume:	144.4 CF
Laboratory:	112 - Troy-32 (SAP) - MI	Cylinder Pressure:	2015 PSIG
Analysis Date:	May 14, 2018	Valve Outlet:	350
Lot Number:	32-401202132-1		

Expiration Date: May 14, 2021

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	96.74 PPM	+/- 2%
NITROGEN	Balance		

Signature on file

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS

Grade of Product: CEM-CAL ZERO

Part Number:	NI CZ15A	Reference Number:	32-401913205-1
Cylinder Number:	AAL-17660	Cylinder Volume:	142.0 CF
Laboratory:	112 - Troy-32 (SAP) - MI	Cylinder Pressure:	2000 PSIG
Analysis Date:	Sep 21, 2020	Valve Outlet:	580
Lot Number:	32-401913205-1		

Expiration Date: Sep 21, 2028

ANALYTICAL RESULTS

Component		Requested Purity		Certified Concentration
NITROGEN		99.9995 %		99.9995 %
CARBON DIOXIDE	<	1.0 PPM		0.090 PPM
NOx	<	0.1 PPM	<LDL	0.016 PPM
SO2	<	0.1 PPM	<LDL	0.091 PPM
THC	<	0.1 PPM	<LDL	0.024 PPM
CARBON MONOXIDE	<	0.5 PPM	<LDL	0.044 PPM

Permanent Notes: Airgas certifies that the contents of this cylinder meet the requirements of 40 CFR 72.2

Impurities verified against analytical standards traceable to NIST by weight and/or analysis.

Signature on file

Approved for Release

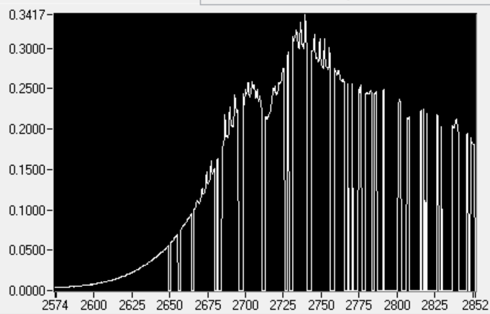
Appendix E
Analytical Method Calibration Curves

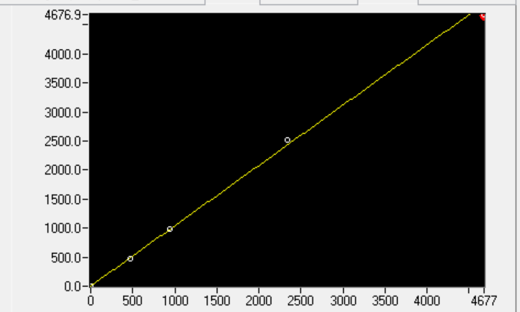
Gas Calibration Report

PRINT | CLOSE

Gas ID: Acetaldehyde (1000) 191C
LRF Path: C:\OLT\Methods 2019\Weyerhaeuser Biofilter Method\Acetaldehyde (1000) 191C_3.lrf

Lo Alarm: NaN
Hi Alarm: NaN
Span: Offset: 0.000000
Mutations: FALSE





Cal Spectra	Temp (C)	Pres (atm)	Conc (ppm-m)	Actual	Calc'd
Acetaldehyde (93.17ppm, 5.11m, 190	190.232	0.983	465.879	467.254	476.969
Acetaldehyde (186.35ppm, 5.11m, 19	190.130	0.983	934.364	937.327	993.716
Acetaldehyde (465.87ppm, 5.11m, 19	190.334	0.983	2334.606	2341.748	2509.735
Acetaldehyde (931.74ppm, 5.11m, 19	190.232	0.980	4676.877	4676.877	4676.877

Interpolation: Linear | Force Through Zero ☒
Min % Residuals ☒ | Excl. Zero ☐ | Quant w/ Highest ☒

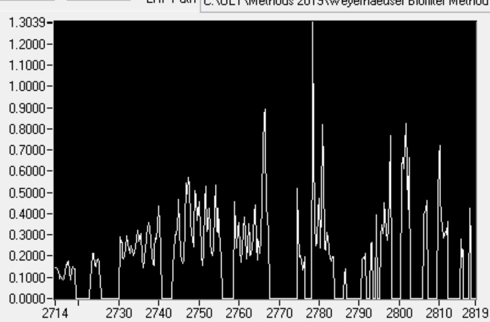
Spectral Regions
- Region 00 - 2574.30 to 2851.76 cm-1
- Region 01 - 813.10 to 2126.40 cm-1
- Region 02 - 2852.00 to 3640.51 cm-1

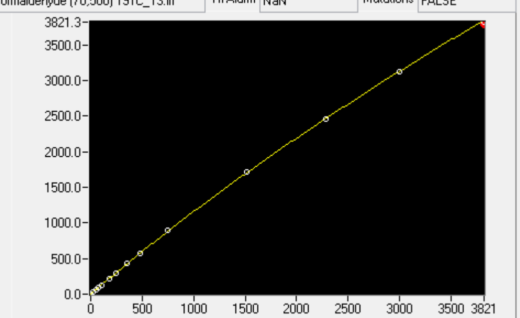
Gas Calibration Report

PRINT | CLOSE

Gas ID: Formaldehyde (70,500) 191C
LRF Path: C:\OLT\Methods 2019\Weyerhaeuser Biofilter Method\Formaldehyde (70,500) 191C_13.lrf

Lo Alarm: NaN
Hi Alarm: NaN
Span: Offset: 0.000000
Mutations: FALSE

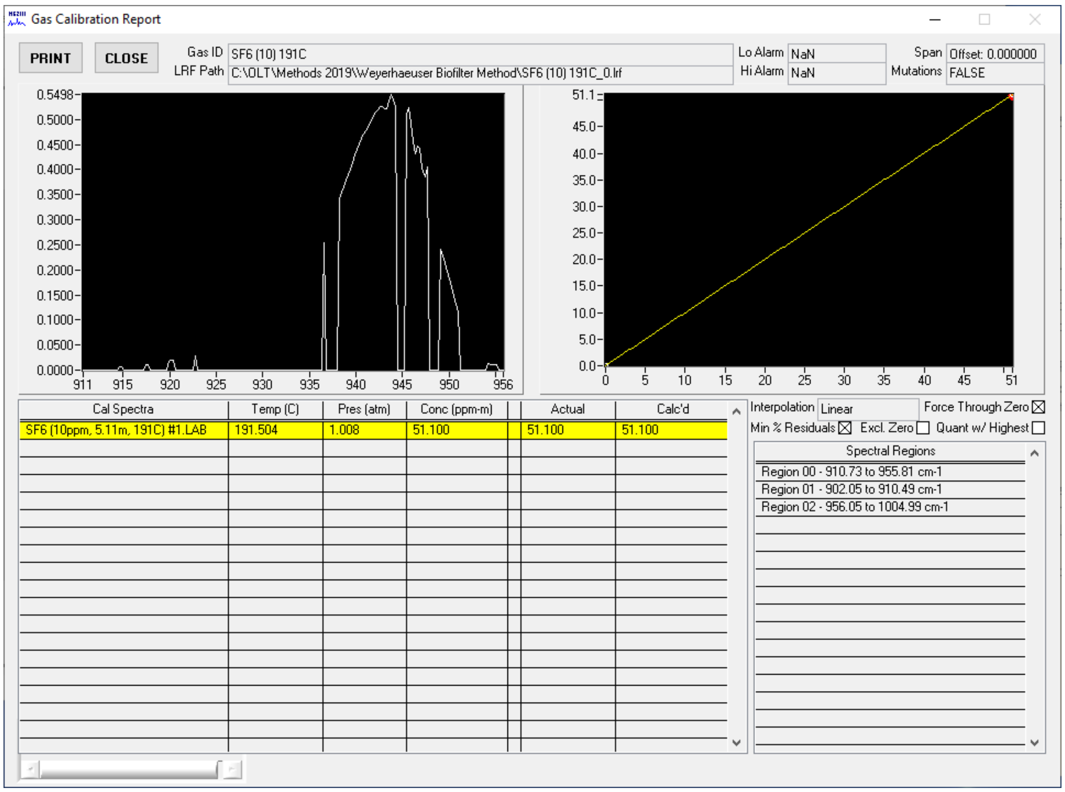




Cal Spectra	Temp (C)	Pres (atm)	Conc (ppm-m)	Actual	Calc'd
Formaldehyde (4.2ppm, 5.11m, 190C	190.166	1.040	21.462	21.439	26.946
Formaldehyde (10.5ppm, 5.11m, 190C	190.052	1.040	53.655	53.609	65.343
Formaldehyde (13.8ppm, 5.11m, 190C	190.268	1.041	70.518	70.454	87.007
Formaldehyde (14.7ppm, 5.11m, 190C	190.204	1.040	75.117	75.045	90.963
Formaldehyde (21.0ppm, 5.11m, 190C	190.141	1.041	107.310	107.263	128.907
Formaldehyde (34.5ppm, 5.11m, 190C	190.242	1.041	176.295	176.131	215.712
Formaldehyde (48.3ppm, 5.11m, 190C	190.281	1.041	246.813	246.564	301.308
Formaldehyde (69.0ppm, 5.11m, 190C	190.026	1.041	352.590	352.591	428.234
Formaldehyde (93.0ppm ext adj, 5.11m	190.030	1.041	475.230	475.230	571.906
Formaldehyde (146ppm ext adj, 5.11m,	190.030	1.041	746.060	746.060	891.925
Formaldehyde (296.0ppm ext, 5.11m, 1	190.030	1.041	1512.560	1512.560	1716.361
Formaldehyde (447.7ppm ext, 5.11m, 1	190.030	1.041	2287.747	2287.747	2465.984
Formaldehyde (587.2ppm ext, 5.11m, 1	190.030	1.041	3000.592	3000.592	3122.423
Formaldehyde (747.8ppm ext, 5.11m, 1	190.030	1.041	3821.258	3821.258	3821.258

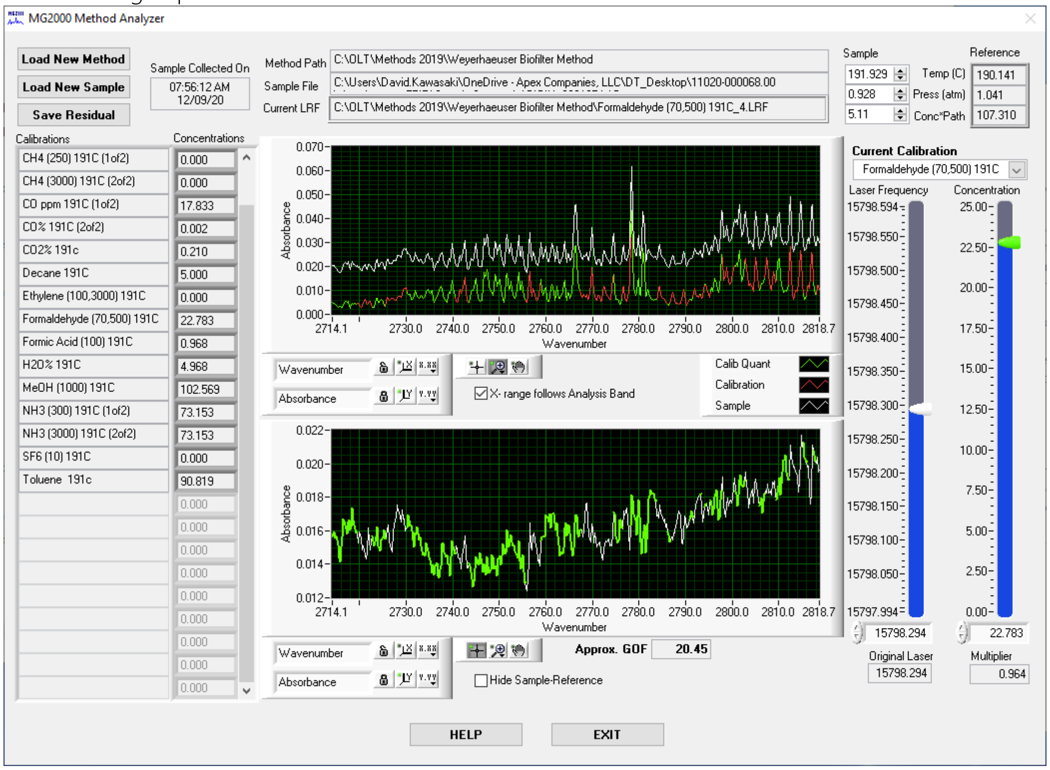
Interpolation: Quadratic | Force Through Zero ☒
Min % Residuals ☒ | Excl. Zero ☐ | Quant w/ Highest ☐

Spectral Regions
- Region 00 - 2714.12 to 2818.98 cm-1
- Region 01 - 885.18 to 1584.50 cm-1
- Region 02 - 1665.74 to 1817.37 cm-1
- Region 03 - 2446.06 to 2713.88 cm-1
- Region 04 - 2819.22 to 3256.51 cm-1
- Region 05 - 3341.84 to 3565.79 cm-1
- Region 06 - 4280.30 to 4499.91 cm-1

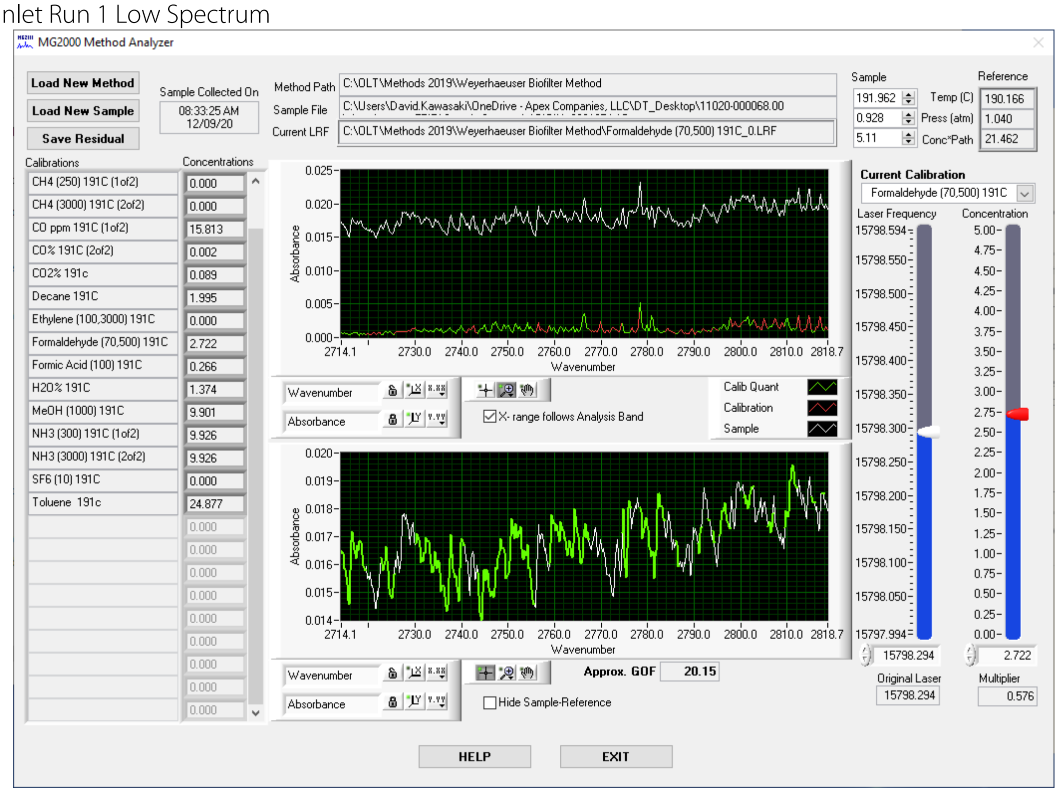

Gas Calibration Report
PRINT
CLOSE
Gas ID SF6 (10) 191C
LRF Path C:\OLT\Methods 2019\Weyerhaeuser Biofilter Method\SF6 (10) 191C_0.lrf
Lo Alarm NaN
Hi Alarm NaN
Span Offset: 0.000000
Mutations FALSE
Cal Spectra
Temp (C)
Pres (atm)
Conc (ppm-m)
Actual
Calc'd
SF6 (10ppm, 5.11m, 191C) #1.LAB
191.504
1.008
51.100
51.100
51.100
Interpolation Linear
Force Through Zero
Min % Residuals
Excl. Zero
Quant w/ Highest
Spectral Regions
Region 00 - 910.73 to 955.81 cm-1
Region 01 - 902.05 to 910.49 cm-1
Region 02 - 956.05 to 1004.99 cm-1

Appendix F
Spectra Manual Validation

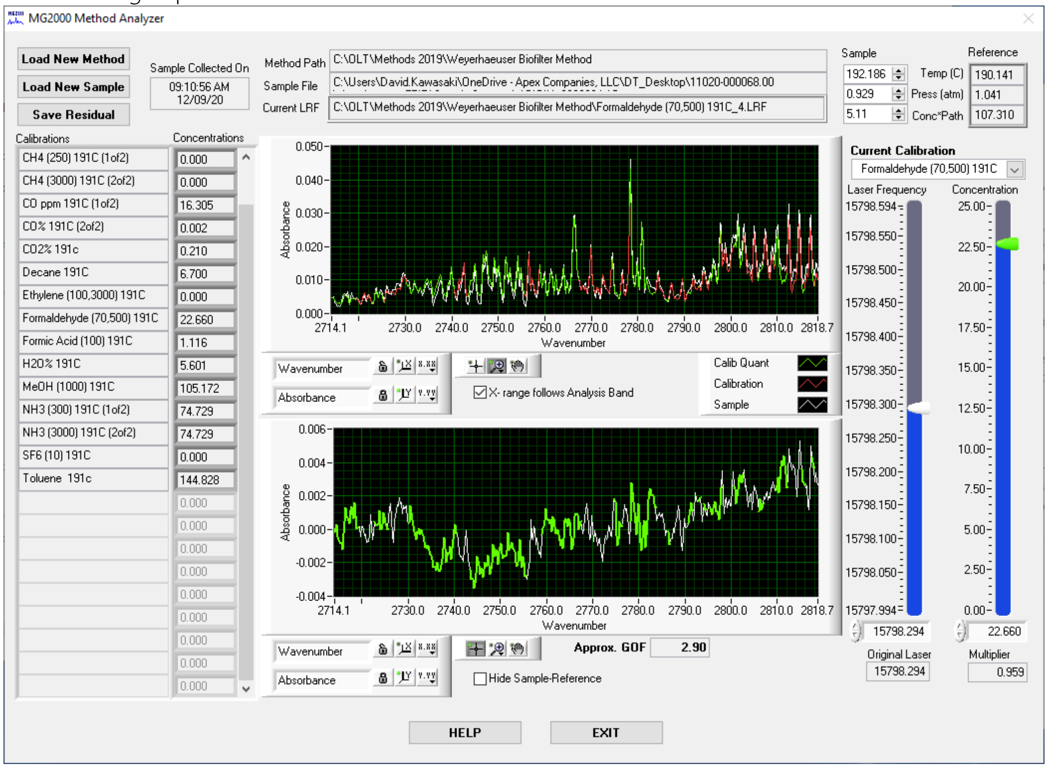
Biofilter Inlet Run 1 High Spectrum



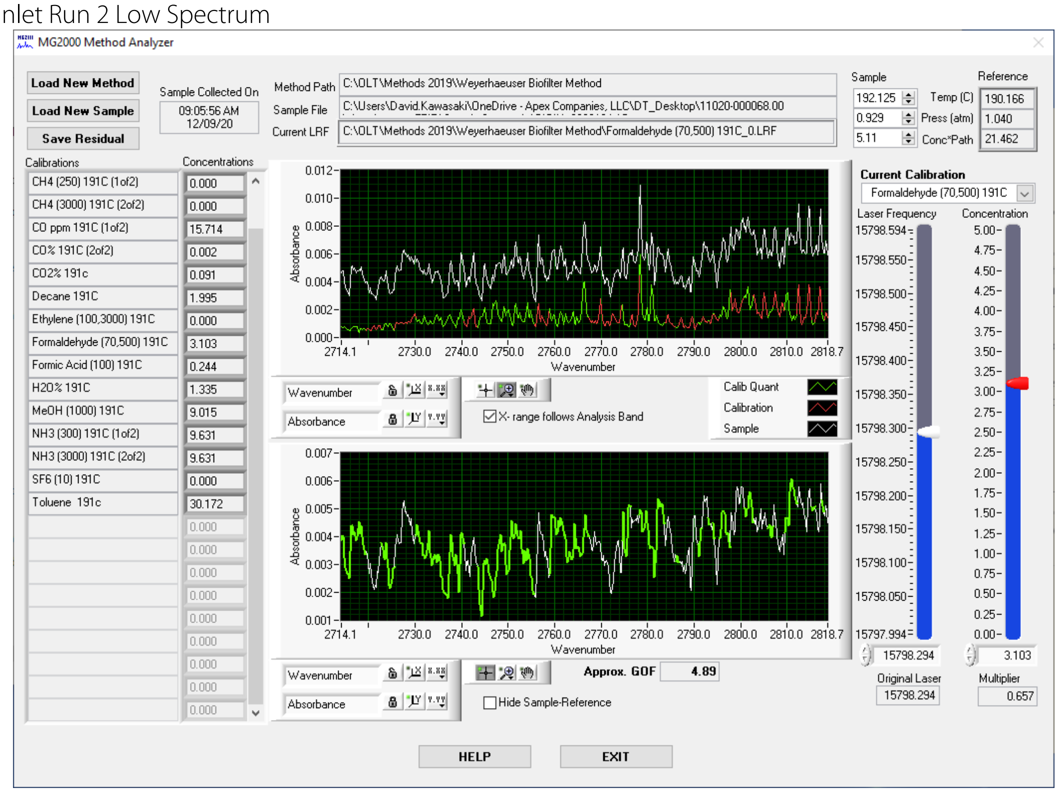
Biofilter Inlet Run 1 Low Spectrum



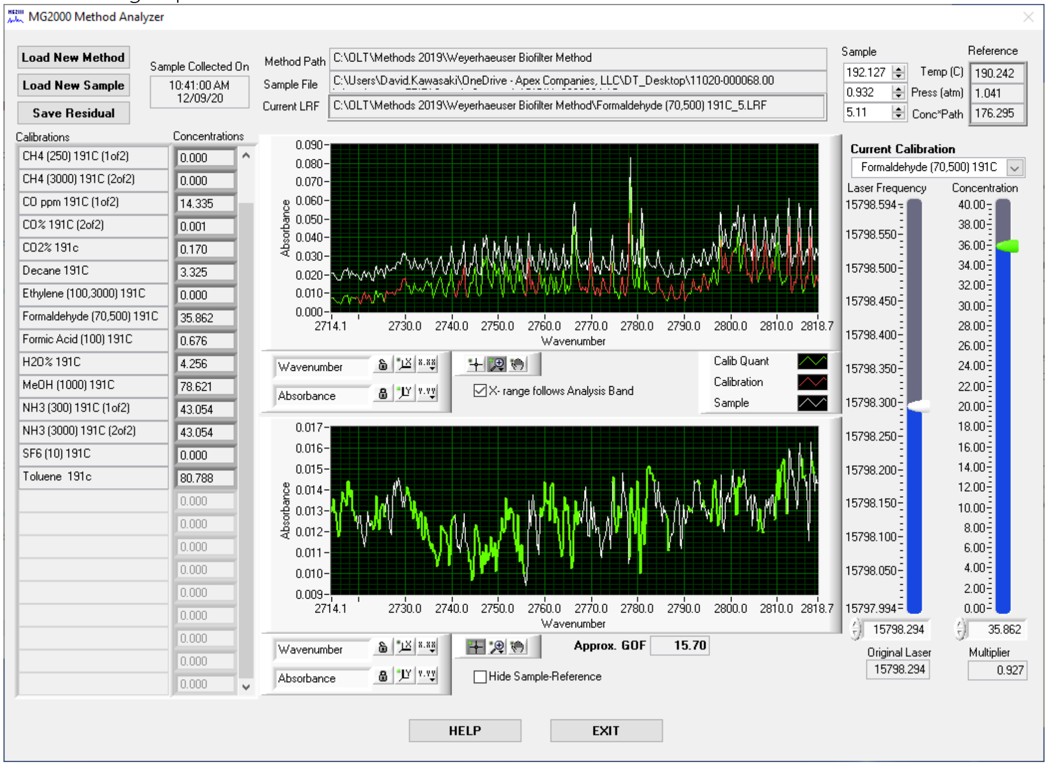
Biofilter Inlet Run 2 High Spectrum



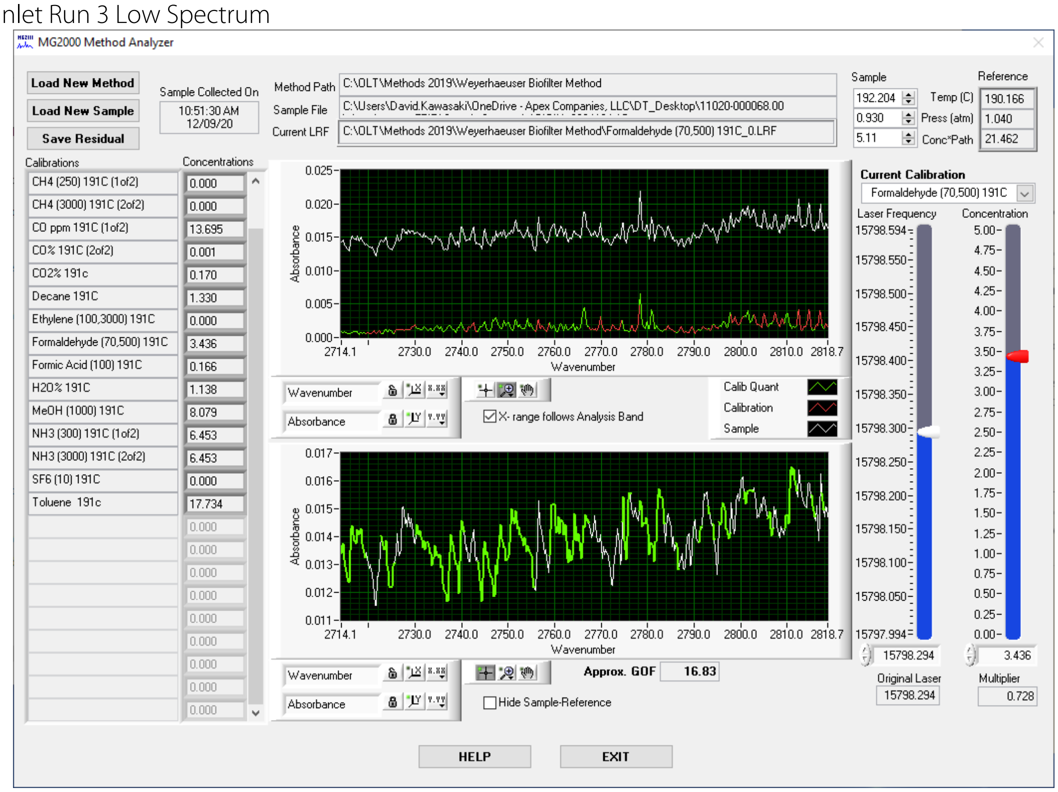
Biofilter Inlet Run 2 Low Spectrum



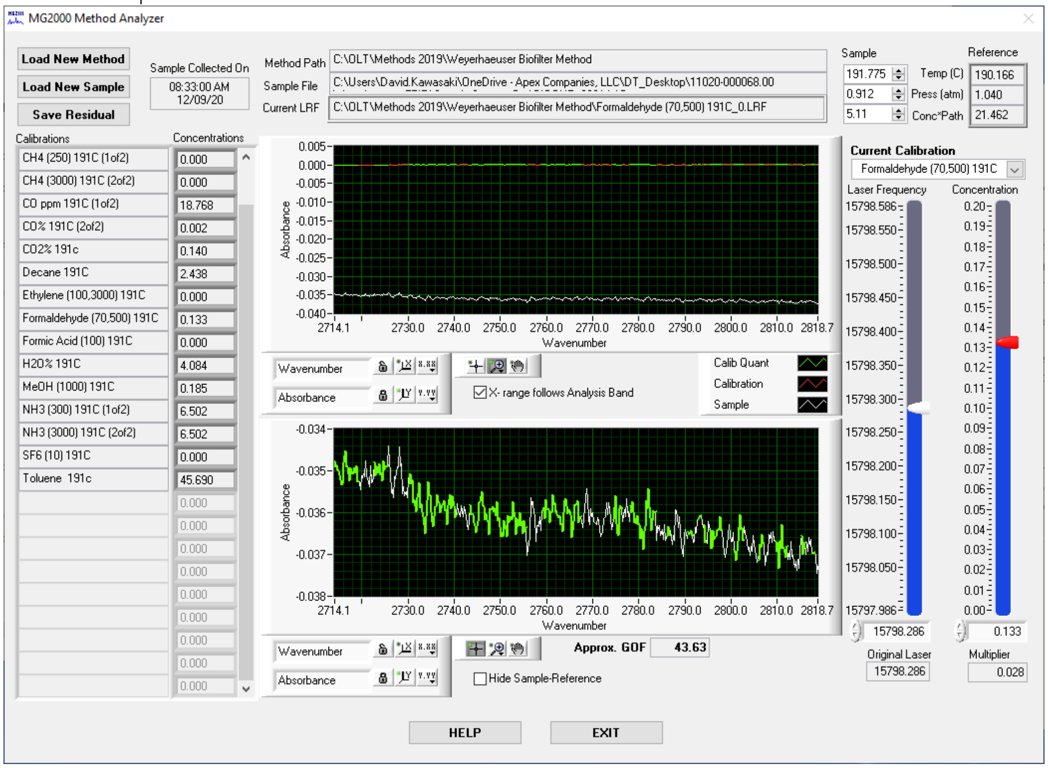
Biofilter Inlet Run 3 High Spectrum



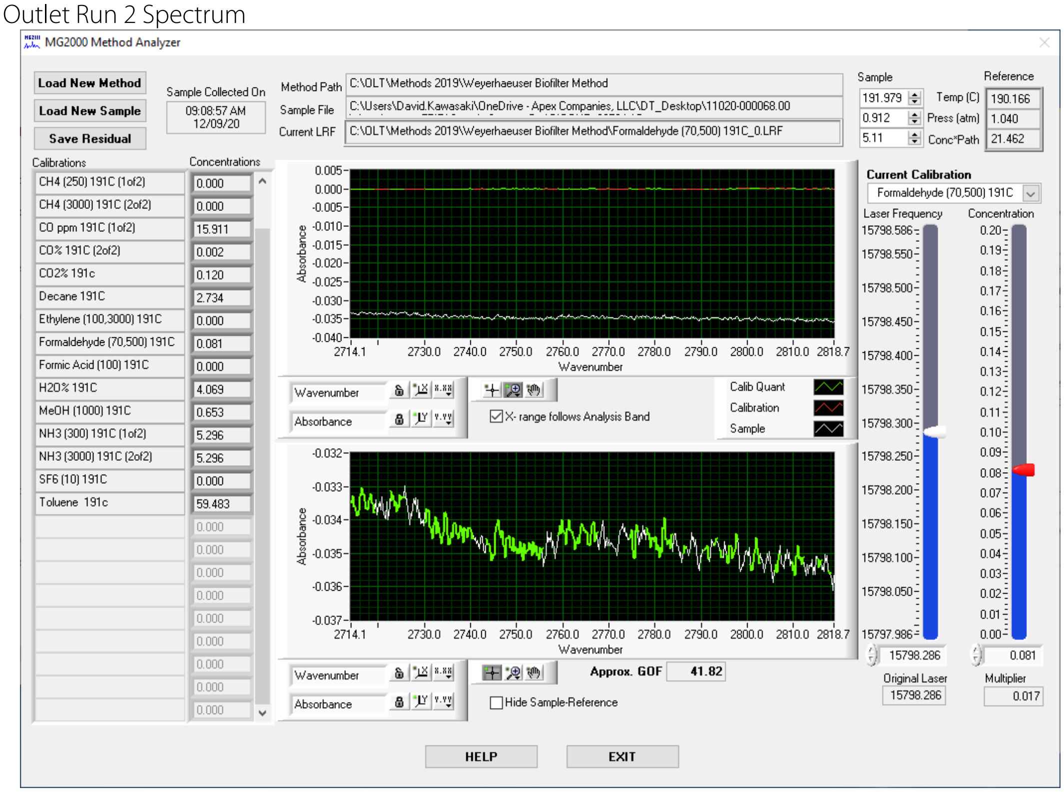
Biofilter Inlet Run 3 Low Spectrum



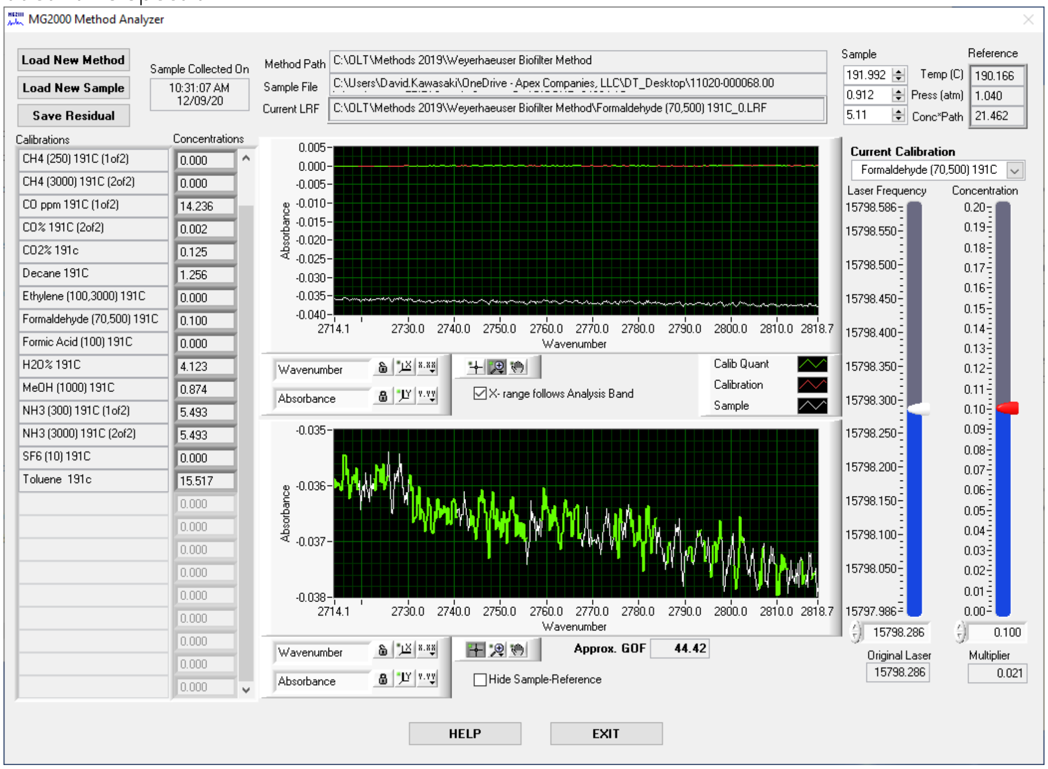
Biofilter Outlet Run 1 Spectrum



Biofilter Outlet Run 2 Spectrum



Biofilter Outlet Run 3 Spectrum



Appendix F
Facility Operating Data

<u>VOC CERMS Data Summary</u>
<u>Press Biofilter Stack</u>
12/9/2020
Weyerhaeuser Company
Grayling Michigan
Report prepared by: Kathi Moss and James Adams

Test No.	Average VOC ppm	Average VOC (lbs/hr carbon)	Average Air Flow (SCFM)	Average Press feed line speed (fpm)	Line speed aim rate for product	Product
1	17.40	10.28	100687	127.00	122.20	7/16"
2	13.60	8.09	100517	126.99	122.20	7/16"
3	13.62	8.14	100645	127.01	122.20	7/16"
4	18.20	10.29	100693	127.02	122.20	7/16"
5	23.74	13.40	100579	127.00	122.20	7/16"
6	20.60	12.27	103026	127.00	122.20	7/16"
7	16.64	9.78	100365	126.98	122.20	7/16"
8	11.76	7.06	100787	97.47	92.50	23/32"
9	13.95	8.35	100832	95.99	92.50	23/32"
10	15.77	9.37	100904	95.98	92.50	23/32"

Testing Notes:
The air flow monitor ran through an autocalibration during run 6. Data collected after 9:36 and before 9:42 are not included in the above totals.
Product change from 7/16" to 23/32" WFS occurred at 10:28.

PCWP MACT Testing - Mill Production Data
December 9, 2020
Weyerhaeuser Structurwood
Grayling, Michigan

Species Mix 12/09/2020 (CBI)
60% Aspen
15% Pine
20% Soft Maple
5% Hard Maple

Test runs 1 through 3 - Formaldehyde Efficiency (PCWP MACT and PPH)

Run #	Date/Time	Tons of Finished Product lb/hr	VOC ppm	VOC pph	*** Product	Press Air Flow	Bio Exhaust Temp	N Hum Dp	S Hum Dp
1	12/9/2020 7:47	127	15.01	8.77	7/16"	100,627	81	2.1	2.2
2	12/9/2020 9:01	85,959	21.12	11.41	7/16"	94,518	81	2.1	2.2
3	12/9/2020 10:24	92,113	13.77	8.07	23/32"	100,696	82	2.1	2.2

Biofitler Bed Temperatures

Run #1	Date and Start Time	Average Temp	* 3 Low Temp Average
1	12/9/2020 7:47 - 8:02	84.10	**84.15**
2	12/9/2020 8:02 - 8:17	84.17	
3	12/9/2020 8:17 - 8:32	84.23	
4	12/9/2020 8:32 - 8:47	84.29	
Run #2			
1	12/9/2020 9:01 - 9:16	84.41	
2	12/9/2020 9:16 - 9:31	84.48	
3	12/9/2020 9:31 - 9:46	84.54	
4	12/9/2020 9:46 - 10:01	84.60	** 3 High Temp Average
Run #3			
1	12/9/2020 10:24 - 10:39	84.55	
2	12/9/2020 10:39 - 10:54	84.42	**84.56**
3	12/9/2020 10:54 - 11:09	84.30	
4	12/9/2020 11:09 - 11:24	84.18	

**** Avg. Line Speed	Target Line Speed	
127.0	7/16" = 122.2	
127.0	7/16" = 122.2	
106.1	7/16" = 122.2	23/32" = 92.5

* Testing performed on 12/4/2007 achieved a lower minimum temperature o 77.7 dF during winter conditions due to lower outside ambient air temperatures. 8/13/2020 rule allows a 10% reduction to the measured minimum temperature, which changes the sites mimimum temperture to **69.93 dF.** This temperature will be used as the sites minimum operating temperature at the Biofilter system. (63.2262(m)(1)

** Testing performed on 8/4/2009 achieved a higher maximum temperature of 99.7 dF during summer conditions due higher outside ambient air temperatures. 8/13/2020 rule allows a 10% increase to the measured maximum temperature (not to exceed 8 dF), which changes the sites maximum temperture to **107.7 dF**. This temperature will to be used for the sites maximum operating temperature. (63.2262(m)(1)

Dryer Airflow, VOC, and CO CERMS Data Summary
Dryer RO Stack
10-Dec-20
Weyerhaeuser Company
Grayling Michigan
Report prepared by: Kathi Moss

Test No.	Average Air Flow (SCFM)	Average VOC ppm	Average VOC (lbs/hr carbon)	Average CO ppm	Average CO (PPH)	Average Dryer 1 Feed Rate (%)	Average Dryer 2 Feed Rate (%)	Average Dryer 3 Feed Rate (%)	Average Dryer 4 Feed Rate (%)	Wood Processed (PPH)
1	113354	4.52	2.87	134.23	53.06	80	80	78	0	110578
2	109415	4.87	3.05	134.42	50.93	86	86	72	0	117912
3	113004	5.12	3.29	115.01	44.95	92	92	91	91	99405
4	113585	6.60	4.20	138.20	53.76	96	69	96	93	85726
5	109024	6.60	4.10	130.72	49.17	96	94	96	8	91509
6	111184	6.82	4.29	127.08	48.51	96	94	96	0	90314
7	116894	7.97	5.25	130.81	52.37	91	91	91	90	113501
8	114951	6.72	4.38	140.82	55.51	90	90	90	90	113919
9	115399	5.98	3.88	152.52	60.71	90	90	90	90	111944
10	114948	5.18	3.33	164.42	64.30	90	90	90	90	113815
Average All Runs	**113176**	**6.04**	**3.86**	**136.82**	**53.33**	**91**	**88**	**89**	**55**	**104862**

Testing Notes:
Running 1/2" sheathing during all 10 test runs. Ran on 3 dryer systems through runs 1 & 2 due to conveyor issues in the woodroom causing low wood to the dryer systems. Shut down after run 3 to complete conveyor repair and fill wet bins. Ran on 3 dryers during runs 5 due to equipment issues on the formline required shutdown as bins were full. Shut down #4 dryer system just before run 6 so also audited on 3 dryer systems. Maintenance found loose bolts that had to be tightened or risk significant down time. Material throughput during 3-dryer operation is least 65% four system operation.