CERAMIC FILTRATION UNITS
104, 112 AND 113
VERIFICATION OF EMISSION FACTORS
TEST REPORT

HOLLINGSWORTH & VOSE
FIBER COMPANY

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Report Date:
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CERTIFICATION OF REPORT INTEGRITY

Bison Engineering, Inc. certifies that this report represents the emissions tested at the Hollingsworth & Vose facility located in Corvallis, Oregon. Every effort was made to obtain accurate and representative data according to the emission testing requirements of the methods employed.

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1.0 INTRODUCTION

1.1 Introduction, Project Objective and Summary

Bison Engineering, Inc. (Bison) was retained by Hollingsworth & Vose (H&V) to perform emissions testing for emission factor verification on three newly installed ceramic filtration units (CFUs) at their glass fiber manufacturing facility located in Corvallis, Oregon. Bison conducted testing at Glass Plant 1, CFUs 112 (ultra rotary coarse) and 113 (glass melt), and CFU 104 (rotary coarse). Testing was performed according to the approved pretest protocol submitted to Oregon Department of Environmental Quality (ODEQ) on April 17, 2018. This is the third round of testing H&V has conducted in 2018 for emissions factor verification pursuant to State of Oregon Mutual Agreement Order #AQ/V-WR-15-132, Addendum No. 2, signed on April 19, 2017. Testing strictly followed EPA methodologies found in 40 CFR 60, Appendix A and the State of Oregon Department of Environmental Quality Source Sampling Manual Volume I, April 2015 Edition. The following pollutants were quantified: particulate matter (PM), oxides of nitrogen (NO_x), carbon monoxide (CO), non-methane volatile organic compounds (VOCs), total fluorides, hydrogen fluoride (HF), formaldehyde and metals. Oxygen (O_2) and carbon dioxide (CO_2) levels were also measured for molecular weight determination. Each test method was performed twice on CFUs 112 and 113, since the ultra rotary coarse and glass melt processes had not previously been tested. The table below describes the test methods used to determine pollutant emission rates.

Table 1: Test Matrix

Hollingsworth & Vose Emissions Factor Verification Testing			
Sources	**Method**	**Parameter**	**Comments**
CFU 112 (Ultra Rotary Coarse) CFU 113 (Glass Melt) CFU 104 (Rotary Coarse)	Method 1	Measurement Locations	Determined prior to testing
	Method 2	Volumetric Flow	Concurrent with each test run
	Method 3A	Molecular Weight, O_2 and CO_2 Determination	
	Method 4	Moisture	Incorporated with Method 5
	Method 5	Particulate Matter (with Oregon back-half)	Three 120-minute test runs per source
	Method 7E	NO_x	Three 120-minute test runs per source
	Method 10	CO	
	Method 13B	Total Fluorides	
	Method 25A	Non-Methane VOCs	
	Method 26A	Hydrogen Fluoride	
	Method 29	Specific Metals	Three 180-minute test runs per source
	Method 30B	Mercury (Hg)	
	Method 316	Formaldehyde	Three 120-minute test runs per source

1.2 Test Program Organization

The following personnel were on-site during the emissions test or were associated with the project.

1.2.1 Bison Engineering, Inc.

Onsite testing was led by David Blankenship, QI, Helena Source Team Lead. Other team members were Adam Bender, QI, Environmental Scientist; Conor Fox, QSTI, Environmental Scientist; Robert Rogge, Environmental Engineer; and Chris Whitten, Environmental Technician. Kelly Dorsi, PhD, Project Scientist, served as project manager, processed the test data and authored this report. Chris Hiltunen, P.E., President, performed a final quality assurance review of the data and test report. The primary contact for this report is:

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1.2.2 Hollingsworth & Vose

Ms. Anita Ragan is the primary contact for H&V. Ms. Ragan was present onsite for the duration of the testing. H&V staff members were responsible for monitoring process parameters during testing.

Anita Ragan, EHS Manager
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Corvallis, OR 97333
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1.2.3 Maul Foster & Alongi, Inc. (MFA)

Chad Darby is the primary contact for MFA. MFA representatives organized and provided process data to Bison.

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1.2.4 Oregon Department of Environmental Quality

Ms. Suzanne Blackburn is the primary ODEQ contact for this project. Ms. Blackburn was present onsite to observe testing.

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2.0 SOURCE DESCRIPTION

2.1 Facility Description

H&V owns and operates glass fiber manufacturing facilities located in Corvallis, Oregon. H&V manufactures specialty glass fiber for use in air and liquid filtration media and in batteries. A detailed facility and emission source description was included as part of the pretest protocol and will not be repeated here. H&V is currently in the process of converting emission controls on the glass melt furnace and all fiberizers from wet scrubbers to CFUs. The results presented in this report are intended to verify emission factors for rotary fine, rotary coarse and flame blown fiberizer production.

2.2 Emission Sources Descriptions

The following sections describe the source testing locations for this campaign.

2.2.1 CFU 112 – Glass Plant 1 (GP1)

Stack diameter: 30 inches
Distance A (Method 1): 102 inches (3.40 duct diameters)
Distance B (Method 1): 128 inches (4.27 duct diameters)
Port depth: 4 inches
Number of traverse points utilized: 24

This unit controls the ultra rotary coarse process. Testing was conducted on the vertical outlet stack using two orthogonal ports.

2.2.2 CFU 113 – GP1

Stack diameter: 20 inches
Distance A (Method 1): 96 inches (4.80 duct diameters)
Distance B (Method 1): 165 inches (8.25 duct diameters)
Port depth: 4 inches
Number of traverse points utilized: 8

CFU 113 is also located at GP1. The glass melt process was tested on this stack. Two orthogonal sampling ports are located on vertical ductwork which is accessed via a purpose-built testing platform.

2.2.3 CFU 104 – GP1

Stack diameter: 30 inches
Distance A (Method 1): 102 inches (3.40 duct diameters)
Distance B (Method 1): 128 inches (4.27 duct diameters)
Port depth: 4 inches
Number of traverse points utilized: 24

CFU 104 is located at GP1. The rotary coarse process was tested on this stack. Two orthogonal sampling ports are located on vertical ductwork accessed via stairs and a platform.

3.0 EMISSION TEST RESULTS

3.1 Summary of Results

The following tables summarize the run schedule and test results for all three sources. Additional materials, including raw data, example calculations and calibration records, can be found in the appendices to this report.

All isokinetic test methods were performed individually using separate trains. Gaseous test methods, 25A, 10 and 7E for VOCs, CO and NO_x, were always run concurrent to Methods 5 and 316. Formaldehyde results were added to results from Method 25A to calculate total VOCs. Methods 26A and 13B, both fluoride methods, were always run concurrently using opposing ports. Methods 29 and 30B for speciated metals and mercury were also run simultaneously. Table 2 presents the timeline that was followed for testing:

Table 2: Test Schedule

Hollingsworth & Vose Test Schedule September 11 – 28, 2018						
Source	**Date**	**Method**	**Run**	**Start Time**	**End Time**	**Run Duration**
CFU 112 Ultra Rotary Coarse	9/11/2018	M13B – Total Fluorides	1	10:35	12:40	2:05
	9/11/2018	M13B – Total Fluorides	2	13:05	15:13	2:08
	9/11/2018	M13B – Total Fluorides	3	15:40	17:46	2:06
	9/11/2018	M26A - HF	1	10:36	12:41	2:05
	9/11/2018	M26A - HF	2	13:06	15:14	2:08
	9/11/2018	M26A - HF	3	15:40	17:47	2:07
	9/12/2018	Gases/M5 - Particulate	1	10:52	12:59	2:07
	9/12/2018	Gases/M5 - Particulate	2	13:27	15:34	2:07
	9/12/2018	Gases/M5 - Particulate	3	16:00	18:07	2:07
	9/12/2018	M316 -Formaldehyde	1	10:53	13:00	2:07
	9/12/2018	M316 -Formaldehyde	2	13:28	15:35	2:07
	9/12/2018	M316 -Formaldehyde	3	16:01	18:08	2:07
	9/12/2018	M29 – Metals	1	8:45	11:52	3:07
	9/13/2018	M29 – Metals	2	12:16	15:23	3:07
	9/13/2018	M29 – Metals	3	15:44	18:48	3:04
	9/13/2018	M30B – Mercury	1	8:45	11:52	3:07
	9/13/2018	M30B – Mercury	2	12:16	15:23	3:07
	9/13/2018	M30B - Mercury	3	15:44	18:48	3:04
CFU 112 (2) Ultra Rotary Coarse	9/14/2018	M29 – Metals	1	9:35	13:02	3:27
	9/14/2018	M29 – Metals	2	13:20	16:25	3:05
	9/15/2018	M29 – Metals	3	10:15	13:21	3:06
	9/14/2018	M30B – Mercury	1	9:35	13:03	3:28
	9/14/2018	M30B – Mercury	2	13:20	16:25	3:05
	9/15/2018	M30B - Mercury	3	10:15	13:21	3:06
	9/15/2018	Gases/M5 - Particulate	1	13:50	15:56	2:06
	9/15/2018	Gases/M5 - Particulate	2	16:14	18:21	2:07
	9/15/2018	Gases/M5 - Particulate	3	18:41	20:46	2:05
	9/15/2018	M316 -Formaldehyde	1	13:49	15:55	2:06

CFU 112 (2) Ultra Rotary Coarse	9/15/2018	M316 -Formaldehyde	2	16:15	18:21	2:06
	9/15/2018	M316 -Formaldehyde	3	18:40	20:45	2:05
	9/16/2018	M13B – Total Fluorides	1	9:00	11:10	2:10
	9/16/2018	M13B – Total Fluorides	2	11:25	13:31	2:06
	9/16/2018	M13B – Total Fluorides	3	13:46	15:53	2:07
	9/16/2018	M26A - HF	1	9:00	11:10	2:10
	9/16/2018	M26A - HF	2	11:24	13:30	2:06
	9/16/2018	M26A - HF	3	13:45	15:51	2:06
CFU 113 Glass Melt	9/18/2018	Gases/M5 - Particulate	1	9:46	11:55	2:09
	9/18/2018	Gases/M5 - Particulate	2	12:15	14:22	2:07
	9/18/2018	Gases/M5 - Particulate	3	14:41	16:47	2:06
	9/18/2018	M316 -Formaldehyde	1	9:45	11:54	2:09
	9/18/2018	M316 -Formaldehyde	2	12:16	14:23	2:07
	9/18/2018	M316 -Formaldehyde	3	14:42	16:48	2:06
	9/19/2018	M13B – Total Fluorides	1	8:38	10:49	2:11
	9/19/2018	M13B – Total Fluorides	2	11:04	13:10	2:06
	9/19/2018	M13B – Total Fluorides	3	13:25	15:29	2:04
	9/19/2018	M26A - HF	1	8:39	10:50	2:11
	9/19/2018	M26A - HF	2	11:05	13:11	2:06
	9/19/2018	M26A - HF	3	13:26	15:30	2:04
	9/21/2018	M29 – Metals	1	9:45	12:51	3:06
	9/21/2018	M29 – Metals	2	13:10	16:16	3:06
	9/21/2018	M29 – Metals	3	16:34	19:39	3:05
	9/21/2018	M30B – Mercury	1	9:45	12:51	3:06
	9/21/2018	M30B – Mercury	2	13:10	16:16	3:06
	9/21/2018	M30B - Mercury	3	16:34	19:39	3:05
CFU 113 (2) Glass Melt	9/24/2018	M29 – Metals	1	9:25	12:30	3:05
	9/24/2018	M29 – Metals	2	12:50	15:55	3:05
	9/24/2018	M29 – Metals	3	16:16	19:21	3:05
	9/24/2018	M30B – Mercury	1	9:25	12:30	3:05
	9/24/2018	M30B – Mercury	2	12:50	15:55	3:05
	9/24/2018	M30B - Mercury	3	16:16	19:21	3:05
	9/25/2018	Gases/M5 - Particulate	1	9:14	11:21	2:07
	9/25/2018	Gases/M5 - Particulate	2	12:00	14:04	2:04
	9/25/2018	Gases/M5 - Particulate	3	14:30	16:36	2:06
	9/25/2018	M316 -Formaldehyde	1	9:15	11:22	2:07
	9/25/2018	M316 -Formaldehyde	2	12:01	14:05	2:04
	9/26/2018	M316 -Formaldehyde	3	14:31	16:37	2:06
	9/26/2018	M13B – Total Fluorides	1	9:00	11:05	2:05
	9/26/2018	M13B – Total Fluorides	2	11:23	13:28	2:05
	9/26/2018	M13B – Total Fluorides	3	13:43	15:48	2:05
	9/26/2018	M26A - HF	1	8:59	11:04	2:05
	9/26/2018	M26A - HF	2	11:22	13:27	2:05
	9/26/2018	M26A - HF	3	13:42	15:47	2:05
CFU 104 Rotary Coarse	9/27/2018	M29 – Metals	1	9:30	12:35	3:05
	9/27/2018	M29 – Metals	2	12:53	16:00	3:07
	9/27/2018	M29 – Metals	3	16:18	19:23	3:05
	9/27/2018	M30B – Mercury	1	9:30	12:35	3:05
	9/27/2018	M30B – Mercury	2	12:53	16:00	3:07
	9/27/2018	M30B - Mercury	3	16:18	19:23	3:05
	9/28/2018	Gases/M5 - Particulate	1	6:53	8:57	2:04
	9/28/2018	Gases/M5 - Particulate	2	9:15	11:19	2:04
	9/28/2018	Gases/M5 - Particulate	3	11:35	13:41	2:06

CFU 104 Rotary Coarse	9/28/2018	M316 -Formaldehyde	1	6:52	8:58	2:06
	9/28/2018	M316 -Formaldehyde	2	9:16	11:20	2:04
	9/28/2018	M316 -Formaldehyde	3	11:38	13:42	2:04
	9/28/2018	M13B – Total Fluorides	1	14:06	16:11	2:05
	9/28/2018	M13B – Total Fluorides	2	16:26	18:31	2:05
	9/28/2018	M13B – Total Fluorides	3	18:46	20:50	2:04
	9/28/2018	M26A - HF	1	14:05	16:10	2:05
	9/28/2018	M26A - HF	2	16:25	18:31	2:06
	9/28/2018	M26A - HF	3	18:45	20:49	2:04

Stack flows and conditions shown in the tables below (*) correspond to measurements from Method 5 sampling runs; these results are representative of the same values measured for the other methods. Point-by-point measurements of all stack characteristics can be found in the appendices of this report. Emission rates for NO_x, CO and VOCs were calculated using flows measured during coincident Method 5 sampling runs. Emission rates for mercury were calculated using flows measured during coincident Method 29 metals runs.

Table 3: CFU 112 (Ultra Rotary Coarse) Non-Metals Test Results

Hollingsworth & Vose Corvallis, OR CFU 112 – Ultra Rotary Coarse Results Summary September 11-12, 2018					
Parameters	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	9/12/18	9/12/18	9/12/18	-
Stack Temperature*	°F	196.5	192.0	206.0	198.2
Stack Moisture*	% v/v	1.87	2.10	2.03	2.00
Oxygen Content*	%	19.84	19.95	19.84	19.88
CO_2 Content*	%	0.47	0.46	0.46	0.46
Stack Flow Rate*	DSCFM	16,973.1	16,998.9	16,724.3	16,898.8
Sample Volume*	dscf	107.098	107.500	105.599	106.732
Filterable Particulate Matter (PM)	gr/dscf	1.44E-04	1.58E-04	9.50E-05	1.32E-04
	lbs/hr	2.10E-02	2.30E-02	1.36E-02	1.92E-02
	lb/lb glass	3.10E-05	3.34E-05	1.79E-05	2.74E-05
Condensable PM Inorganic	gr/dscf	9.36E-05	7.18E-05	1.24E-04	9.65E-05
	lbs/hr	1.36E-02	1.05E-02	1.78E-02	1.40E-02
	lb/lb glass	2.01E-05	1.52E-05	2.35E-05	1.96E-05
Condensable PM Organic	gr/dscf	7.92E-05	3.59E-05	5.11E-05	5.54E-05
	lbs/hr	1.15E-02	5.23E-03	7.33E-03	8.03E-03
	lb/lb glass	1.70E-05	7.60E-06	9.66E-06	1.14E-05
Total PM (Measured)†	gr/dscf	3.17E-04	2.66E-04	2.70E-04	2.84E-04
	lbs/hr	4.61E-02	3.87E-02	3.88E-02	4.12E-02
	lb/lb glass	6.81E-05	5.62E-05	5.11E-05	5.85E-05
Nitrogen Oxides (NO_x) Emissions	ppmvd	0.57	0.56	0.50	0.54
	lb/hr	6.93E-02	6.82E-02	5.99E-02	6.58E-02
	lb/lb glass	1.02E-04	9.92E-05	7.90E-05	9.35E-05
	lb/Mscf n.g.	1.71E-02	1.69E-02	1.45E-02	1.60E-02
Volatile Organic Compounds (VOCs) (Method 25A)	ppmvw	1.01	1.01	1.05	1.02
	lbs/hr	1.20E-01	1.20E-01	1.23E-01	1.21E-01
	lb/lb glass	1.77E-04	1.75E-04	1.62E-04	1.71E-04
	lb/Mscf n.g.	2.95E-02	2.98E-02	2.98E-02	2.97E-02

Hollingsworth & Vose Corvallis, OR CFU 112 – Ultra Rotary Coarse Results Summary September 11-12, 2018					
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	9/12/2018	9/12/2018	9/12/2018	-
Carbon Monoxide (CO)	ppmvd	24.09	23.86	24.58	24.18
	lb/hr	1.78	1.77	1.79	1.78
	lb/lb glass	2.64E-03	2.57E-03	2.36E-03	2.52E-03
	lb/Mscf n.g.	4.39E-01	4.38E-01	4.35E-01	4.37E-01
Formaldehyde (CH_2O)	lb/hr	1.32E-02	1.06E-02	1.42E-02	1.27E-02
	lb/lb glass	1.95E-05	1.54E-05	1.87E-05	1.79E-05
	lb/Mscf n.g.	3.25E-03	2.63E-03	3.44E-03	3.11E-03
Total VOCs (M25A + CH_2O)	lb/hr	1.33E-01	1.31E-01	1.37E-01	1.34E-01
	lb/lb glass	1.96E-04	1.90E-04	1.81E-04	1.89E-04
	lb/Mscf n.g.	3.27E-02	3.24E-02	3.32E-02	3.28E-02
Test Date – M13B/26A	-	9/11/2018	9/11/2018	9/11/2018	-
Hydrogen Fluorides (HF)	ppmvd	<1.61E-03	<1.46E-03	<1.49E-03	<1.52E-03
	lb/hr	<8.40E-05	<7.61E-05	<7.74E-05	<7.92E-05
	lb/lb glass	<1.26E-07	<1.10E-07	<1.09E-07	<1.15E-07
Total Fluorides	ppmvd	<1.86E-02	<1.82E-02	<1.87E-02	<1.85E-02
	lb/hr	<9.17E-04	<9.21E-04	<9.30E-04	<9.23E-04
	lb/lb glass	<1.38E-06	<1.34E-06	<1.30E-06	<1.34E-06

n.g. = natural gas
* Representative data from Method 5 particulate test
† Actual measured values are shown. The measured values are below the analytical detection limits specified in the Oregon Source Sampling Manual, revised April 2015. Results calculated based on the analytical detection limit for total particulate, 7 mg per sample train, can be found in Appendix B.
'<' represents results below the minimum detection limit (MDL) that have been calculated at the MDL.

Table 4: CFU 112 (Ultra Rotary Coarse) Metals Results

Hollingsworth & Vose
Corvallis, OR
CFU 112 – Ultra Rotary Coarse
Metals Results Summary
September 13, 2018
Average Results

Parameter	Species	µg/dscm	lb/hr	lb/lb glass
Metals (Method 29)	Antimony	<0.799	<5.18E-05	<7.69E-08
	Arsenic	<0.543	<3.51E-05	<5.17E-08
	Barium	0.136	8.76E-06	1.29E-08
	Beryllium	<0.016	<1.00E-06	<1.48E-09
	Cadmium	<0.013	<8.50E-07	<1.26E-09
	Chromium	0.108	6.92E-06	1.01E-08
	Cobalt	<0.039	<2.53E-06	<3.73E-09
	Copper	1.009	6.51E-05	9.59E-08
	Lead	<0.388	<2.51E-05	<3.70E-08
	Manganese	0.453	2.93E-05	4.30E-08
	Nickel	<0.233	<1.50E-05	<2.22E-08
	Phosphorus	<0.874	<5.64E-05	<8.27E-08
	Selenium	<1.163	<7.52E-05	<1.11E-07
	Zinc	1.716	1.11E-04	1.64E-07
Mercury (Method 30B)†	Mercury	1.93E-02	1.25E-06	1.85E-09

‘<’ denotes results calculated using the MDL for front half or back half results that were non-detect.

Table 5: CFU 112 (2) (Ultra Rotary Coarse) Non-Metals Test Results

Hollingsworth & Vose Corvallis, OR CFU 112 (2) – Ultra Rotary Coarse Results Summary September 15-16, 2018					
Parameters	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	9/15/2018	9/15/2018	9/15/2018	-
Stack Temperature*	°F	201.2	205.1	207.4	204.6
Stack Moisture*	% v/v	1.81	1.71	1.76	1.76
Oxygen Content*	%	19.99	20.14	20.11	20.08
CO_2 Content*	%	0.52	0.53	0.52	0.52
Stack Flow Rate*	DSCFM	17,557.4	17,568.1	17,396.4	17,507.3
Sample Volume*	dscf	110.685	110.807	109.169	110.220
Filterable Particulate Matter (PM)	gr/dscf	1.74E-04	1.32E-04	0.00E+00	1.02E-04
	lbs/hr	2.62E-02	1.99E-02	0.00E+00	1.54E-02
	lb/lb glass	3.82E-05	2.76E-05	0.00E+00	2.19E-05
Condensable PM Inorganic	gr/dscf	1.46E-04	9.75E-05	9.19E-05	1.12E-04
	lbs/hr	2.20E-02	1.47E-02	1.37E-02	1.68E-02
	lb/lb glass	3.21E-05	2.04E-05	1.93E-05	2.39E-05
Condensable PM Organic	gr/dscf	1.25E-04	9.05E-05	7.07E-05	9.55E-05
	lbs/hr	1.89E-02	1.36E-02	1.05E-02	1.43E-02
	lb/lb glass	2.75E-05	1.89E-05	1.49E-05	2.04E-05
Total PM (Measured)†	gr/dscf	4.46E-04	3.20E-04	1.63E-04	3.10E-04
	lbs/hr	6.71E-02	4.82E-02	2.42E-02	4.65E-02
	lb/lb glass	9.77E-05	6.69E-05	3.42E-05	6.63E-05
Nitrogen Oxides (NO_x) Emissions	ppmvd	0.92	0.94	0.97	0.94
	lb/hr	1.16E-01	1.18E-01	1.21E-01	1.18E-01
	lb/lb glass	1.68E-04	1.64E-04	1.71E-04	1.68E-04
	lb/Mscf n.g.	2.80E-02	2.81E-02	2.84E-02	2.82E-02
Volatile Organic Compounds (VOCs) (Method 25A)	ppmvw	0.98	1.01	0.99	0.99
	lbs/hr	1.20E-01	1.24E-01	1.20E-01	1.21E-01
	lb/lb glass	1.75E-04	1.72E-04	1.70E-04	1.72E-04
	lb/Mscf n.g.	2.90E-02	2.94E-02	2.83E-02	2.89E-02

Hollingsworth & Vose Corvallis, OR CFU 112 (2) – Ultra Rotary Coarse Results Summary September 15-16, 2018					
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
Test Date-M5/M316/Gases	-	9/15/2018	9/15/2018	9/15/2018	-
Carbon Monoxide (CO)	ppmvd	24.99	27.60	28.42	27.00
	lb/hr	1.91	2.12	2.16	2.06
	lb/lb glass	2.78E-03	2.94E-03	3.05E-03	2.92E-03
	lb/Mscf n.g.	4.62E-01	5.04E-01	5.08E-01	4.91E-01
Formaldehyde (CH_2O)	lb/hr	1.48E-02	<3.50E-04	<3.88E-04	<5.18E-03
	lb/lb glass	2.15E-05	<4.85E-07	<5.47E-07	<7.52E-06
	lb/Mscf n.g.	3.58E-03	<8.32E-05	<9.13E-05	<1.25E-03
Total VOCs (M25A + CH_2O)	lb/hr	1.35E-01	<1.24E-01	<1.21E-01	<1.27E-01
	lb/lb glass	1.96E-04	<1.72E-04	<1.70E-04	<1.80E-04
	lb/Mscf n.g.	3.26E-02	<2.95E-02	<2.84E-02	<3.02E-02
Test Date – M13B/26A	-	9/16/2018	9/16/2018	9/16/2018	-
Hydrogen Fluorides (HF)	ppmvd	<1.40E-03	<1.42E-03	<1.40E-03	<1.41E-03
	lb/hr	<8.04E-05	<7.83E-05	<7.65E-05	<7.84E-05
	lb/lb glass	<1.15E-07	<1.13E-07	<1.12E-07	<1.14E-07
Total Fluorides	ppmvd	<1.79E-02	<1.78E-02	<1.83E-02	<1.80E-02
	lb/hr	<9.30E-04	<9.35E-04	<8.95E-04	<9.20E-04
	lb/lb glass	<1.33E-06	<1.35E-06	<1.31E-06	<1.33E-06

n.g. = natural gas
* Representative data from Method 5 particulate test
† Actual measured values are shown. The measured values are below the analytical detection limits specified in the Oregon Source Sampling Manual, revised April 2015. Results calculated based on the analytical detection limit for total particulate, 7 mg per sample train, can be found in Appendix B.
'<' represents results below the minimum detection limit (MDL) that have been calculated at the MDL.

Table 6: CFU 112 (2) (Ultra Rotary Coarse) Metals Results

Hollingsworth & Vose Corvallis, OR CFU 112 (2) – Ultra Rotary Coarse Metals Results Summary September 14-15, 2018 Average Results				
Parameter	**Species**	**µg/dscm**	**lb/hr**	**lb/lb glass**
Metals (Method 29)	Antimony	<0.390	<2.50E-05	<3.60E-08
	Arsenic	<0.545	<3.50E-05	<5.04E-08
	Barium	0.106	6.80E-06	9.80E-09
	Beryllium	<0.016	<1.00E-06	<1.44E-09
	Cadmium	<0.027	<1.75E-06	<2.52E-09
	Chromium	0.036	2.34E-06	3.37E-09
	Cobalt	<0.041	<2.62E-06	<3.77E-09
	Copper	0.945	6.07E-05	8.73E-08
	Lead	<0.390	<2.50E-05	<3.60E-08
	Manganese	0.054	3.45E-06	4.96E-09
	Nickel	<0.234	<1.50E-05	<2.16E-08
	Phosphorus	<0.708	<4.55E-05	<6.55E-08
	Selenium	<1.169	<7.51E-05	<1.08E-07
	Zinc	1.919	1.23E-04	1.77E-07
Mercury (Method 30B)†	Mercury	1.96E-02	1.26E-06	1.81E-09

‘<’ denotes results calculated using the MDL for front half or back half results that were non-detect.

Table 7: CFU 113 (Glass Melt) Non-Metals Results

Hollingsworth & Vose Corvallis, OR CFU 113 – Glass Melt Results Summary September 18-19, 2018					
Parameters	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	9/18/2018	9/18/2018	9/18/2018	-
Stack Temperature*	°F	124.4	128.8	129.0	127.4
Stack Moisture*	% v/v	2.35	2.05	2.16	2.19
Oxygen Content*	%	19.99	19.76	20.05	19.93
CO_2 Content*	%	1.13	1.18	1.15	1.15
Stack Flow Rate*	DSCFM	5,564.8	5,510.3	5,417.4	5,497.5
Sample Volume*	dscf	79.527	78.519	77.139	78.395
Filterable Particulate Matter (PM)	gr/dscf	2.13E-04	2.16E-04	1.70E-04	2.00E-04
	lbs/hr	1.02E-02	1.02E-02	7.90E-03	9.43E-03
	lb/lb glass	2.80E-06	2.80E-06	2.13E-06	2.58E-06
Condensable PM Inorganic	gr/dscf	2.04E-04	1.38E-04	1.80E-04	1.74E-04
	lbs/hr	9.72E-03	6.50E-03	8.36E-03	8.19E-03
	lb/lb glass	2.67E-06	1.78E-06	2.26E-06	2.24E-06
Condensable PM Organic	gr/dscf	5.82E-05	4.91E-05	5.00E-05	5.24E-05
	lbs/hr	2.78E-03	2.32E-03	2.32E-03	2.47E-03
	lb/lb glass	7.63E-07	6.35E-07	6.27E-07	6.75E-07
Total PM (Measured)†	gr/dscf	4.75E-04	4.03E-04	4.00E-04	4.26E-04
	lbs/hr	2.27E-02	1.90E-02	1.86E-02	2.01E-02
	lb/lb glass	6.23E-06	5.21E-06	5.01E-06	5.49E-06
Nitrogen Oxides (NO_x) Emissions	ppmvd	1.36	1.48	1.49	1.44
	lb/hr	5.42E-02	5.84E-02	5.78E-02	5.68E-02
	lb/lb glass	1.49E-05	1.60E-05	1.56E-05	1.55E-05
	lb/Mscf n.g.	1.23E-02	1.32E-02	1.31E-02	1.29E-02
Volatile Organic Compounds (VOCs) (Method 25A)	ppmvw	2.33	2.38	2.56	2.42
	lbs/hr	9.10E-02	9.18E-02	9.72E-02	9.33E-02
	lb/lb glass	2.50E-05	2.51E-05	2.62E-05	2.55E-05
	lb/Mscf n.g.	2.06E-02	2.08E-02	2.20E-02	2.12E-02

Hollingsworth & Vose Corvallis, OR CFU 113 – Glass Melt Results Summary September 18-19, 2018					
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
Test Date – M5/M316/Gases	-	9/18/2018	9/18/2018	9/18/2018	-
Carbon Monoxide (CO)	ppmvd	6.99	7.71	7.83	7.51
	lb/hr	0.17	0.19	0.19	0.18
	lb/lb glass	4.67E-05	5.20E-05	5.13E-05	5.00E-05
	lb/Mscf n.g.	3.85E-02	4.31E-02	4.31E-02	4.16E-02
Formaldehyde (CH_2O)	lb/hr	4.86E-03	4.86E-03	5.10E-03	4.94E-03
	lb/lb glass	1.34E-06	1.33E-06	1.38E-06	1.35E-06
	lb/Mscf n.g.	1.10E-03	1.10E-03	1.16E-03	1.12E-03
Total VOCs (M25A + CH_2O)	lb/hr	9.59E-02	9.66E-02	1.02E-01	9.83E-02
	lb/lb glass	2.64E-05	2.65E-05	2.76E-05	2.68E-05
	lb/Mscf n.g.	2.17E-02	2.19E-02	2.32E-02	2.23E-02
Test Date – M13B/26A	-	9/19/2018	9/19/2019	9/19/2018	-
Hydrogen Fluorides (HF)	ppmvd	<1.98E-03	<1.97E-03	<1.98E-03	<1.98E-03
	lb/hr	<3.49E-05	<3.48E-05	<3.48E-05	<3.48E-05
	lb/lb glass	<9.52E-09	<9.47E-09	<9.39E-09	<9.46E-09
Total Fluorides	ppmvd	<1.66E-02	<1.70E-02	<1.72E-02	<1.69E-02
	lb/hr	<2.86E-04	<2.85E-04	<2.84E-04	<2.85E-04
	lb/lb glass	<7.79E-08	<7.74E-08	<7.69E-08	<7.74E-08

n.g. = natural gas
* Representative data from Method 5 particulate test
† Actual measured values are shown. The measured values are below the analytical detection limits specified in the Oregon Source Sampling Manual, revised April 2015. Results calculated based on the analytical detection limit for total particulate, 7 mg per sample train, can be found in Appendix C.
*Data from Method 5 (particulate) test
"<" represents results below the MDL that have been calculated at the MDL.

Table 8: CFU 113 (Glass Melt) Metals Results

Hollingsworth & Vose Corvallis, OR CFU 113 – Glass Melt Metals Results Summary September 21, 2018 Average Results				
Parameter	**Species**	**µg/dscm**	**lb/hr**	**lb/lb glass**
Metals (Method 29)	Antimony	<0.804	<1.68E-05	<4.56E-09
	Arsenic	<0.757	<1.58E-05	<4.29E-09
	Barium	0.093	1.94E-06	5.29E-10
	Beryllium	<0.022	<4.51E-07	<1.23E-10
	Cadmium	<0.277	<5.78E-06	<1.57E-09
	Chromium	0.097	2.03E-06	5.51E-10
	Cobalt	<0.054	<1.13E-06	<3.06E-10
	Copper	1.780	3.72E-05	1.01E-08
	Lead	<2.438	<5.08E-05	<1.38E-08
	Manganese	0.039	8.22E-07	2.24E-10
	Nickel	<0.324	<6.76E-06	<1.84E-09
	Phosphorus	<7.271	<1.52E-04	<4.13E-08
	Selenium	<1.621	<3.38E-05	<9.19E-09
	Zinc	2.952	6.12E-05	1.66E-08
Mercury** (Method 30B)	Mercury	33.901	7.00E-04	1.90E-07

'<' denotes results calculated using the MDL for front half or back half results that were non-detect.
**Mercury results shown here represent a two-run average because run 1 was voided. Please see section 3.4, Results Discussion, for further information.

Table 9: CFU 113 (2) (Glass Melt) Non-Metals Results

Hollingsworth & Vose Corvallis, OR CFU 113 (2) – Glass Melt Results Summary September 25-26, 2018					
Parameters	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	9/25/2018	9/25/2018	9/25/2018	-
Stack Temperature*	°F	135.6	138.8	143.3	139.2
Stack Moisture*	% v/v	2.16	1.81	1.63	1.87
Oxygen Content*	%	20.04	19.98	20.24	20.09
CO_2 Content*	%	1.00	0.96	0.94	0.97
Stack Flow Rate*	DSCFM	8,350.8	8,389.2	8,296.8	8,345.6
Sample Volume*	dscf	116.980	117.857	116.768	117.202
Filterable Particulate Matter (PM)	gr/dscf	1.32E-05	3.93E-05	8.59E-05	4.61E-05
	lbs/hr	9.44E-04	2.82E-03	6.11E-03	3.29E-03
	lb/lb glass	2.60E-07	7.78E-07	1.67E-06	9.02E-07
Condensable PM Inorganic	gr/dscf	2.64E-04	1.18E-04	1.92E-04	1.91E-04
	lbs/hr	1.89E-02	8.47E-03	1.36E-02	1.37E-02
	lb/lb glass	5.21E-06	2.34E-06	3.72E-06	3.75E-06
Condensable PM Organic	gr/dscf	9.89E-05	8.51E-05	6.61E-05	8.34E-05
	lbs/hr	7.08E-03	6.12E-03	4.70E-03	5.97E-03
	lb/lb glass	1.95E-06	1.69E-06	1.28E-06	1.64E-06
Total PM (Measured)†	gr/dscf	3.76E-04	2.42E-04	3.44E-04	3.21E-04
	lbs/hr	2.69E-02	1.74E-02	2.44E-02	2.29E-02
	lb/lb glass	7.42E-06	4.80E-06	6.66E-06	6.29E-06
Nitrogen Oxides (NO_x) Emissions	ppmvd	1.13	1.18	1.14	1.15
	lb/hr	6.76E-02	7.09E-02	6.78E-02	6.88E-02
	lb/lb glass	1.86E-05	1.96E-05	1.85E-05	1.89E-05
	lb/Mscf n.g.	1.53E-02	1.61E-02	1.54E-02	1.56E-02
Volatile Organic Compounds (VOCs) (Method 25A)	ppmvw	3.18	3.09	3.11	3.13
	lbs/hr	1.86E-01	1.81E-01	1.80E-01	1.80E-01
	lb/lb glass	5.13E-05	4.99E-05	4.90E-05	5.01E-05
	lb/Mscf n.g.	4.22E-02	4.10E-02	4.08E-02	4.13E-02

Hollingsworth & Vose Corvallis, OR CFU 113 (2) – Glass Melt Results Summary September 25-26, 2018					
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
Test Date – M5/M316/Gases	-	9/25/2018	9/25/2018	9/25/2018	-
Carbon Monoxide (CO)	ppmvd	8.98	8.63	8.60	8.74
	lb/hr	0.33	0.32	0.31	0.32
	lb/lb glass	9.10E-05	8.82E-05	8.46E-05	8.79E-05
	lb/Mscf n.g.	7.48E-02	7.25E-02	7.03E-02	7.25E-02
Formaldehyde (CH_2O)	lb/hr	5.25E-03	5.92E-03	5.93E-03	5.70E-03
	lb/lb glass	1.45E-06	1.63E-06	1.62E-06	1.57E-06
	lb/Mscf n.g.	1.19E-03	1.34E-03	1.34E-03	1.29E-03
Total VOCs (M25A + CH_2O)	lb/hr	1.91E-01	1.87E-01	1.86E-01	1.88E-01
	lb/lb glass	5.27E-05	5.15E-05	5.07E-05	5.16E-05
	lb/Mscf n.g.	4.34E-02	4.24E-02	4.21E-02	4.26E-02
Test Date – M13B/26A	-	9/26/2018	9/26/2018	9/26/2018	-
Hydrogen Fluorides (HF)	ppmvd	<1.64E-03	<1.49E-03	<1.42E-03	<1.52E-03
	lb/hr	<4.17E-05	<3.84E-05	<3.70E-05	<3.90E-05
	lb/lb glass	<1.14E-08	<1.05E-08	<1.00E-08	<1.07E-08
Total Fluorides	ppmvd	<1.19E-02	<1.19E-02	<1.20E-02	<1.19E-02
	lb/hr	<2.91E-04	<2.92E-04	<2.91E-04	<2.92E-04
	lb/lb glass	<8.00E-08	<8.01E-08	<7.89E-08	<7.97E-08

n.g. = natural gas
* Representative data from Method 5 particulate test
† Actual measured values are shown. The measured values are below the analytical detection limits specified in the Oregon Source Sampling Manual, revised April 2015. Results calculated based on the analytical detection limit for total particulate, 7 mg per sample train, can be found in Appendix C.
*Data from Method 5 (particulate) test
"<" represents results below the MDL that have been calculated at the MDL.

Table 10: CFU 113 (2) (Glass Melt) Metals Results

Hollingsworth & Vose Corvallis, OR CFU 113 (2) – Glass Melt Metals Results Summary September 24, 2018 Average Results				
Parameter	**Species**	**µg/dscm**	**lb/hr**	**lb/lb glass**
Metals (Method 29)	Antimony	<0.493	<1.46E-05	<3.95E-09
	Arsenic	<0.535	<1.59E-05	<4.30E-09
	Barium	0.243	7.18E-06	1.94E-09
	Beryllium	<0.015	<4.53E-07	<1.23E-10
	Cadmium	<0.190	<5.62E-06	<1.52E-09
	Chromium	0.089	2.64E-06	7.15E-10
	Cobalt	<0.073	<2.16E-06	<5.86E-10
	Copper	1.148	3.40E-05	9.21E-09
	Lead	<1.782	<5.28E-05	<1.43E-08
	Manganese	0.060	1.78E-06	4.81E-10
	Nickel	<0.229	<6.79E-06	<1.84E-09
	Phosphorus	<5.318	<1.57E-04	<4.27E-08
	Selenium	<1.147	<3.40E-05	<9.20E-09
	Zinc	2.979	8.82E-05	2.39E-08
Mercury (Method 30B)	Mercury	21.002	6.22E-04	1.69E-07

‘<’ denotes results calculated using the MDL for front half or back half results that were non-detect.

Table 11: CFU 104 (Rotary Coarse) Non-Metals Results

Hollingsworth & Vose Corvallis, OR CFU 104 – Rotary Coarse Results Summary September 28, 2018					
Parameters	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	9/28/2018	9/28/2018	9/28/2018	-
Stack Temperature*	°F	206.2	213.8	225.0	215.0
Stack Moisture*	% v/v	1.56	1.87	1.98	1.80
Oxygen Content*	%	19.88	19.74	19.83	19.82
CO_2 Content*	%	0.70	0.68	0.70	0.69
Stack Flow Rate*	DSCFM	17,553.2	17,540.8	17,225.9	17,440.0
Sample Volume*	dscf	110.418	111.151	109.684	110.418
Filterable Particulate Matter (PM)	gr/dscf	2.45E-04	4.23E-04	3.02E-04	3.23E-04
	lbs/hr	3.68E-02	6.37E-02	4.47E-02	4.84E-02
	lb/lb glass	9.84E-05	1.75E-04	1.21E-04	1.31E-04
Condensable PM Inorganic	gr/dscf	8.38E-05	1.53E-04	9.14E-05	1.09E-04
	lbs/hr	1.26E-02	2.30E-02	1.35E-02	1.64E-02
	lb/lb glass	3.37E-05	6.30E-05	3.66E-05	4.45E-05
Condensable PM Organic	gr/dscf	6.99E-06	1.04E-04	1.41E-05	4.17E-05
	lbs/hr	1.05E-03	1.57E-02	2.08E-03	6.26E-03
	lb/lb glass	2.81E-06	4.30E-05	5.63E-06	1.71E-05
Total PM (Measured)†	gr/dscf	3.35E-04	6.80E-04	4.08E-04	4.75E-04
	lbs/hr	5.05E-02	1.02E-01	6.02E-02	7.10E-02
	lb/lb glass	1.35E-04	2.81E-04	1.63E-04	1.93E-04
Nitrogen Oxides (NO_x) Emissions	ppmvd	3.19	3.20	2.82	3.07
	lb/hr	4.01E-01	4.02E-01	3.48E-01	3.84E-01
	lb/lb glass	1.07E-03	1.10E-03	9.43E-04	1.04E-03
	lb/Mscf n.g.	7.68E-02	7.63E-02	6.60E-02	7.30E-02
Volatile Organic Compounds (VOCs) (Method 25A)	ppmvw	0.52	0.47	0.45	0.48
	lbs/hr	6.36E-02	5.76E-02	5.42E-02	5.85E-02
	lb/lb glass	1.70E-04	1.58E-04	1.47E-04	1.58E-04
	lb/Mscf n.g.	1.22E-02	1.09E-02	1.03E-02	1.11E-02

Hollingsworth & Vose Corvallis, OR CFU 104 – Rotary Coarse Results Summary September 28, 2018					
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	9/28/2018	9/28/2018	9/28/2018	
Carbon Monoxide (CO)	ppmvd	145.28	145.50	149.67	146.82
	lb/hr	11.12	11.13	11.25	11.17
	lb/lb glass	2.97E-02	3.06E-02	3.05E-02	3.03E-02
	lb/Mscf n.g.	2.13	2.11	2.13	2.12
Formaldehyde (CH_2O)	lb/hr	1.38E-02	1.43E-02	1.56E-02	1.46E-02
	lb/lb glass	3.69E-05	3.93E-05	4.23E-05	3.95E-05
	lb/Mscf n.g.	2.64E-03	2.71E-03	2.96E-03	2.77E-03
Total VOCs ($M25A + CH_2O$)	lb/hr	7.74E-02	7.19E-02	6.98E-02	7.30E-02
	lb/lb glass	2.07E-04	1.97E-04	1.89E-04	1.98E-04
	lb/Mscf n.g.	1.48E-02	1.36E-02	1.32E-02	1.39E-02
Test Date – M13B/26A	-	9/28/2018	9/28/2018	9/28/2018	-
Hydrogen Fluorides (HF)	ppmvd	<1.52E-03	<1.39E-03	<1.44E-03	<1.45E-03
	lb/hr	<8.23E-05	<7.46E-05	<7.75E-05	<7.81E-05
	lb/lb glass	<2.24E-07	<2.05E-07	<2.08E-07	<2.12E-07
Total Fluorides	ppmvd	<1.84E-02	<1.82E-02	<1.84E-02	<1.83E-02
	lb/hr	<8.97E-04	<9.00E-04	<9.05E-04	<9.01E-04
	lb/lb glass	<2.44E-06	<2.48E-06	<2.43E-06	<2.45E-06

n.g. = natural gas
* Representative data from Method 5 particulate test
† Actual measured values are shown. The measured values are below the analytical detection limits specified in the Oregon Source Sampling Manual, revised April 2015. Results calculated based on the analytical detection limit for total particulate, 7 mg per sample train, can be found in Appendix D.
*Data from Method 5 (particulate) test
"<" represents results below the MDL that have been calculated at the MDL.

Table 12: CFU 104 (Rotary Coarse) Metals Results

Hollingsworth & Vose
Corvallis, OR
CFU 104 – Rotary Coarse
Metals Results Summary
September 27, 2018
Average Results

Parameter	Species	µg/dscm	lb/hr	lb/lb glass
Metals (Method 29)	Antimony	<0.383	<2.45E-05	<6.58E-08
	Arsenic	<0.537	<3.43E-05	<9.21E-08
	Barium	0.087	5.58E-06	1.50E-08
	Beryllium	<0.015	<9.80E-07	<2.63E-09
	Cadmium	<0.195	<1.24E-05	<3.34E-08
	Chromium	0.144	9.23E-06	2.48E-08
	Cobalt	<0.038	<2.45E-06	<6.58E-09
	Copper	0.689	4.40E-05	1.18E-07
	Lead	<1.694	<1.08E-04	<2.91E-07
	Manganese	0.081	5.15E-06	1.39E-08
	Nickel	<0.230	<1.47E-05	<3.95E-08
	Phosphorus	<4.732	<3.02E-04	<8.11E-07
	Selenium	<1.150	<7.35E-05	<1.97E-07
	Zinc	1.845	1.18E-04	3.18E-07
Mercury (Method 30B)	Mercury	4.97E-03	3.17E-07	8.53E-10

'<' denotes results calculated using the MDL for front half or back half results that were non-detect.

3.2 Plant Operations

All details of plant operations, including glass production rates and natural gas firing rates, were recorded by representatives of H&V during testing. Process data used for calculations shown throughout this report are based on values provided by MFA personnel who compiled and reduced the raw process data collected by H&V. These values are given in Appendix E. All three CFU units ran normally at the time of testing.

3.3 Field Notes

No adverse or unusual environmental conditions existed that are known to have influenced the outcome of these tests. All testing was performed as outlined in the test plan dated April 17, 2018 and associated approval letter.

3.4 Results Discussion

Specialty low-level mercury analysis was employed for this testing because previous CFU sampling in 2018 revealed mercury concentrations of about 1.5-2 nanograms (ng) for samples three-hours in duration. Similarly, spiked traps were requested at the lowest level possible, 5 ng mercury, based on near-detection limit anticipated concentrations.

The low-level analytical technique and 5 ng spikes were ultimately appropriate for all CFU units with the exception of CFU 113. Run 1 results, from the first round of mercury testing on CFU 113, were voided because the first trap flooded Ohio Lumex's low-level mercury analyzer. This was due to higher mercury levels compared to the other CFU units previously tested. The remaining five CFU 113 30B runs were analyzed using Ohio Lumex's regular-level analyzer. Results from these runs passed all quality assurance (QA) requirements (i.e. breakthrough and paired trap agreement) except for the field recovery test. The field recovery test came back high for both rounds of testing on CFU 113, indicating that spiked trap concentration (5 ng) was too low compared to actual measured mercury concentrations. Bison notes that higher spiked traps and shorter sampling time will be used to avoid this issue for future testing performed on CFU 113.

The failed field recovery tests were discussed with Ms. Blackburn of ODEQ shortly following the receipt of the mercury lab results. Since results for the five CFU 113 runs that were run on the regular-level analyzer are consistent, and all other QA requirements passed, she suggested that concentrations derived from the five runs be used as 2018 results. These will be compared to results from 2019 sampling that will be spiked at a higher level and/or have shorter run durations.

Other results worth highlighting include formaldehyde and PM results for the second round of testing on CFU 112 (September 15, 2018). Method 316 formaldehyde results came back as non-detect for runs 2 and 3 conducted that day. At Bison's request, Enthalpy lab confirmed these results by running a second aliquot of each sample. For the coincident Method 5 PM test, run 3, the probe rinse also came back with zero gain. Visual inspection of the glass dish used to evaporate this probe rinse confirmed that it looked perfectly clean. All process parameters recorded for CFU 112 during these runs were normal. Hence, it remains unclear why these runs produced outlier results. Bison suggests that CFU 112 (2), runs 2 and 3, be omitted when deriving formaldehyde emission factors for this unit, and that Method 5, run 3, be omitted when deriving PM emission factors for this unit.

4.0 EMISSION TEST METHODS AND PROCEDURES

4.1 Minimum Detection Limits

Results that are below the minimum detection limit (MDL) have been indicated in results tables and throughout this report using the ‘<’ symbol. Most MDLs were provided by the outside laboratories along with their reports. For Method 5, an analytical detection limit of 7 mg was used, as per ODEQ stipulations. Where results are below the MDL, emission factors have been calculated based on the MDL value of the associated method; actual emissions rates will be less than the value indicated. Where reagent blank values are below the MDL they are considered zero and no blank correction was performed. Where the allowable blank correction is larger than a sample result, the corrected result is shown as zero.

4.2 Testing Methods and Procedures

Bison testing personnel performed the following methods described in Title 40, Code of Federal Regulations (CFR), Part 60, Appendix A and the State of Oregon Department of Environmental Quality Source Sampling Manual Volume I, April 2015 Edition.

EPA Reference Method 1, *"Sample and Velocity Traverses for Stationary Sources."* The objective of Method 1 is to determine a suitable location for testing and to determine the velocity and/or sample points for the source. The distance upstream to atmosphere from the sampling ports (Distance A) is measured and the distance downstream to the nearest disturbance from the sample points (Distance B) is measured. Distances A and B are applied to Method 1, Figure 1-1 for particulate matter (PM) sampling points or Figure 1-2 for velocity measurement points. These figures give the minimum number of sample points according to the dimensions of the source. The number of points and the stack diameter are then applied to Method 1, Table 1-2 to determine equal area measurement points within the source. The results of Method 1 sampling location and sample or velocity point measurement locations are included in a report appendix.

EPA Reference Method 2, *"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube)." Concurrent with Method 5.* The objective of Method 2 is to measure stack gas velocity, collect temperature data, and calculate a volumetric flow. Method 2 velocity measurements were performed using a Type S pitot tube attached to a Method 5 particulate sampling probe. Differential pressures are measured using an inclined manometer, and temperatures are measured using a k-type thermal indicator. Bison has incorporated 0.84 as the Type S pitot tube coefficient (Cp). The average velocity, temperature, static pressure, and source area are used to calculate volumetric flow for the source. This isokinetic run data is recorded on electronic field data sheets. Copies of the field data sheets, results from the flow calculations, and calibration data are included in the report appendices.

EPA Reference Method 3A, "*Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)."* The objective of Method 3A is to determine the oxygen (O_2) and carbon dioxide (CO_2) concentrations in the stack gas stream. The principle is to extract a gas sample from a stationary source and route the sample through a conditioning system to a paramagnetic oxygen analyzer and an infrared carbon dioxide analyzer for the measurement of O_2 and CO_2 in percentages (%). The calibration adjustments of the O_2 and CO_2 analyzers are performed by sending EPA Protocol 1 gas directly to the analyzers. A system calibration is performed by sending calibration gas to the probe and through the system to the analyzers. The calibration error, system bias and system drift data, and measured concentrations are recorded on an automated data acquisition system (DAS).

Method 4*, "Determination of Moisture Content in the Stack Gases." Concurrent with Method 5.* Method 5 testing allows the option to obtain Method 4 moistures via the Method 5 sampling system sampled while maintaining an isokinetic sampling rate. The objective of Method 4 is to determine the moisture content of a gas stream. The principle of the method is to impinge a sample through chilled water and silica gel which captures any source gas moisture. The moisture is removed from the sample stream and the volume (or mass) of water extracted is determined. The sample volume and water volume (or mass) are used to calculate the moisture content of the stack gas. Method quality assurance is to perform a pre- and post-test dry gas meter (DGM) calibration. The DGM calibration data can be found in an appendix of this report. The impinger waters are volumetrically measured on-site and the silica gels are weighed on-site. The sampling data is recorded on field data sheets and then entered into spreadsheets for moisture determination calculations. Where a stack is shown to be saturated the moisture at saturation is used for all calculations.

Method 5,*"Determination of Particulate Emissions from Stationary Sources" (Methods 2 & 4 Inclusive).* The objective of Method 5 is to determine the filterable particulate matter (PM) from a source. Method 5 is an isokinetic sampling method (i.e., the velocity of sample stream entering the nozzle is approximately equal to the velocity of the approaching sample stream) for determination of PM. The exhaust gas stream is sampled along a cross-section of the stack and PM is captured within the nozzle, probe, filter-bell and on a 0.3 micron pore size glass fiber filter. The filter is maintained at a temperature of 248°F±25°F followed by impingers maintained at a temperature below 68°F. Bison used a Method 5 sampling train with a glass probe liner and nozzles to gather particulate samples. Method 5 incorporates Method 2 "velocity measurements" and Method 4 "moisture measurements." Following the State of Oregon Department of Environmental Quality Source Sampling Manual, the back-half impinger catch was also analyzed for inorganic and organic condensable particulate matter.

EPA Reference Method 7E, *"Determination of Nitrogen Oxides Emissions from Stationary Sources."* The objective of Method 7E testing is to determine the NOx concentration from the source. Method 7E entails extraction of a gas sample from a stationary source and routing the sample through a conditioning system to an analyzer for the measurement of NO_x (NO and NO_2) in ppmvd. Method 7E testing was performed on each source for the determination of NO_x. The calibration error, system bias and system drift data were within the tolerances of the method. The previously mentioned data and the testing data were recorded on a DAS. This data and test results can be found in the report appendices along with calibration records and gas certificates.

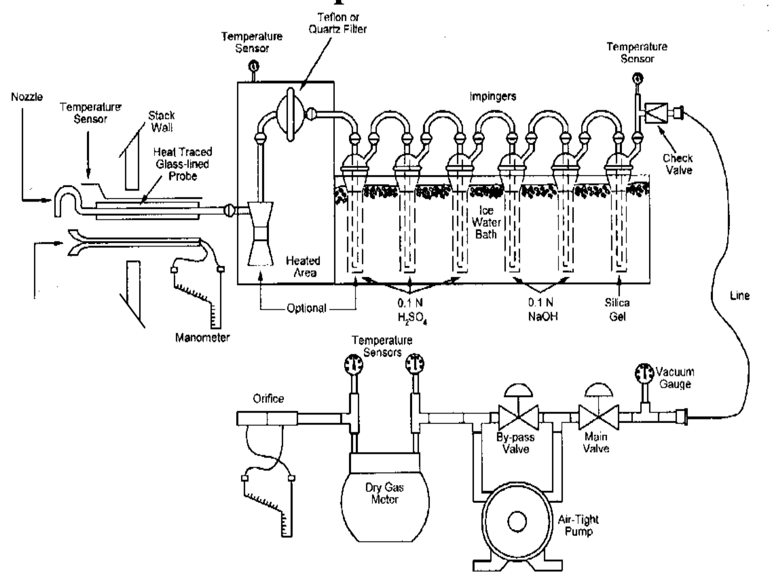
EPA Reference Method 10, "*Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure).*" The objective of Method 10 is to determine the CO concentrations from the source. Method 10 entails extraction of a gas sample from a stationary source and routing the sample through a conditioning system to an analyzer for the measurement of CO in ppmvd. The CO analyzer calibration adjustment is performed by sending EPA Protocol 1 gas directly to the analyzer. A system bias check is performed by sending calibration gas to the probe and through the system to the analyzer. The calibration error, system bias and system drift data, and measured concentrations are recorded on a DAS for permanent record.

EPA Reference Method 13B "*Determination of Total Fluoride Emissions from Stationary Sources.*" The objective of the method is to determine the fluoride (F^-) emissions from sources as specified in the regulations; it does not measure fluorocarbons, such as freons. Stack gas is withdrawn isokinetically from the source and collected in water and on a filter. The filter and water are combined and total F^- is then determined by the specific ion electrode method.

EPA Reference Method 25A, *"Determination of Total Gaseous Organic Concentration using a Flame Ionization Analyzer."* The objective of Method 25A is to determine the total gaseous organic concentrations (TGOC) from a source using a flame ionization detector (FID). Bison utilizes a gas chromatograph/flame ionization detector (GC/FID) for determination of the TGOC. Testing is performed by extracting a gas sample from the source through a heated sample line directly to the GC/FID for the measurement of methane and non-methane hydrocarbons which can be combined to produce a total hydrocarbon (THC) concentration value. The non-methane organic compound (NMOC) value is used to report volatile organic compound (VOC) concentrations since EPA's definition of a VOC does not include methane. The analyzer measurements are in parts per million by volume wet (ppmvw) and are reported as propane (C_3H_8). The gaseous measurement primarily consists of vaporous aromatic hydrocarbons: alkanes, aldenes and arenes.

EPA Reference Method 26A, "*Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Isokinetic Method.*" The objective of Method 26A is to isokinetically sample a source stream (i.e., the velocity of sample stream entering the nozzle is approximately equal to the velocity of the approaching sample stream) for determination of hydrogen chloride (HCl); hydrogen bromide (HBr); hydrogen fluoride (HF); chlorine (Cl_2), and bromine (Br_2) emissions. Method 26A is used on sources controlled by wet scrubbers, emitting acid PM (*e.g.,* hydrogen halides dissolved in water droplets). The sample system is that of Method 5 with Method 26 solutions of 0.1 normal sulfuric acid (H_2SO_4) and 0.1 normal sodium hydroxide (NaOH). The impinger solutions are recovered and sent to a laboratory for Cl and/or F analysis.

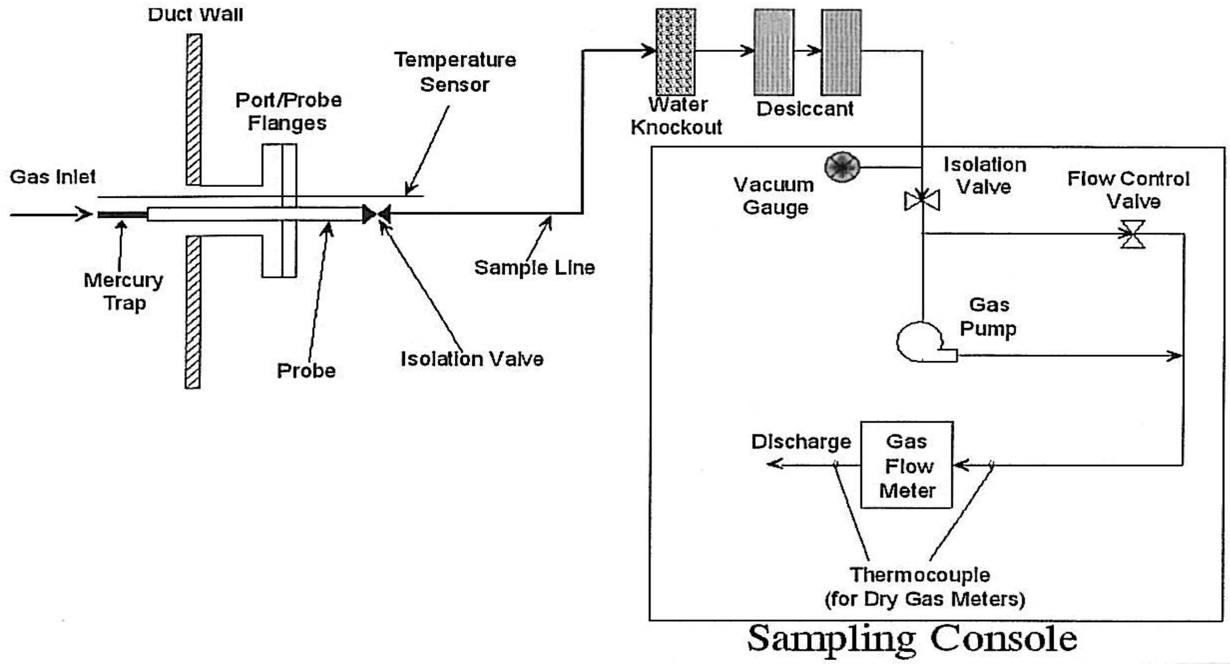
Figure 1: Typical Method 26A Sample Train Schematic



EPA Reference Method 29, *"Determination of Metals Emissions From Stationary Sources."* A stack sample is withdrawn isokinetically from the source, particulate emissions are collected in the probe and on a heated filter, and gaseous emissions are then collected in an aqueous acidic solution of hydrogen peroxide (analyzed for all metals including Hg) and an aqueous acidic solution of potassium permanganate (analyzed only for Hg). The recovered samples are digested, and appropriate fractions are analyzed for Hg by cold vapor atomic absorption spectroscopy (CVAAS) and for Sb, As, Ag, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, P, Se, Tl, and Zn by inductively coupled argon plasma emission spectroscopy (ICAP) or atomic absorption spectroscopy (AAS). Graphite furnace atomic absorption spectroscopy (GFAAS) is used for analysis of Sb, As, Cd, Co, Pb, Se, and Tl if these elements require greater analytical sensitivity than can be obtained by ICAP. If one so chooses, AAS may be used for analysis of all listed metals if the resulting in-stack method detection limits meet the goal of the testing program. Similarly, inductively coupled plasma-mass spectroscopy (ICP-MS) may be used for analysis of Sb, As, Ag, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Tl, and Zn.

EPA Reference Method 30B,*"Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Traps."* The objective of Method 30B is to determine elemental mercury (Hg^o) and oxidized mercury (Hg^{2+}) emissions from a source. The exhaust gas stream is sampled at a single point within the stack at a controlled sample rate. The sample is drawn through a carbon sorbent tube which is then analyzed by Ultra Violet Atomic Absorption (UV AA) or Ultra Violet Atomic Fluorescence (UV AF) cold vapor analysis. The analytical range is 0.1 µg/dscm to >50 µg/dscm.

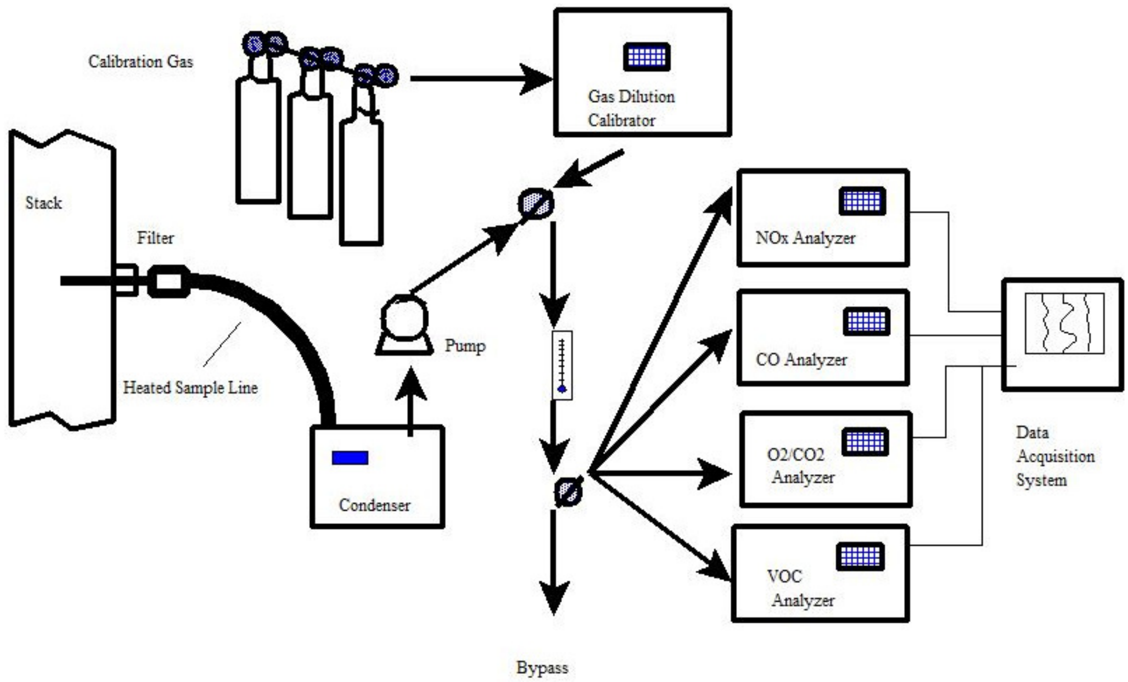
Figure 2: Method 30B Sampling Train



EPA Reference Method 316*, "Sampling and Analysis For Formaldehyde Emissions From Stationary Sources In The Mineral Wool And Wool Fiberglass Industries."* Gaseous and particulate pollutants are withdrawn isokinetically from an emission source and are collected in high purity water. Formaldehyde present in the emissions is highly soluble in high purity water. The high purity water containing formaldehyde is then analyzed using the modified pararosaniline method. Formaldehyde in the sample reacts with acidic pararosaniline, and the sodium sulfite, forming a purple chromophore. The intensity of the purple color, measured spectrophotometrically, provides an accurate and precise measure of the formaldehyde concentration in the sample.

EPA Reference Method 205, *"Verification of Gas Dilution Systems for Field Instrument Calibrations."* The objective of Method 205 is to produce a set of calibration gases that are used in instrumental analysis emission testing. This is achieved by diluting a concentrated gas to lower concentrations. The diluted gases are then to be used in calibrating analyzers, performing a system check and performing post-test bias checks. The dilution of the gases is performed by a dilution mass flow instrument. Method 205 stipulates the procedure and steps to evaluate the dilution instrument and confirm it is suitable for field use. Once the system has met the criteria cited, the dilution instrument is certified to be used in the field.

Figure 3: Instrumental Sampling Gas Flow for O_2, CO_2, NO_x, VOCS and CO



APPENDIX A: TEST PROTOCOL & CORRESPONDENCE

TEST PROTOCOL FOR YEAR 2018

EMISSION FACTOR
VERIFICATION TESTING

HOLLINGSWORTH & VOSE
GLASS FIBER MANUFACTURING PLANT

Submitted to: Oregon Department of Environmental Quality

Prepared for:

Hollingsworth & Vose
1115 SE Crystal Lake Drive
Corvallis, OR 97333

Prepared by:

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Version 2
Revised: April 17, 2018

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APPENDIX A: PROPOSED TESTING SCHEDULE

1.0 INTRODUCTION

Bison Engineering, Inc. (Bison) has been retained by Hollingsworth & Vose Fiber Company (H&V) to perform emission factor verification testing of their glass fiber manufacturing plant located in Corvallis, Oregon. This testing campaign is required by the Mutual Agreement and Final Order (MAO), Addendum No. 2, signed on April 19, 2017. Specifically, this testing campaign meets requirement 7E in the MAO. Testing will be performed according to the details listed in this protocol. This protocol covers all testing required by the MAO that will occur in 2018.

1.1 Contact Information

Company Information:		Hollingsworth & Vose Fiber Company
	Address:	1115 SE Crystal Lake Drive
		Corvallis, OR 97333
	Contact:	Anita Ragan
		anita.ragan@hovo.com
	Phone:	(541) 738-5382
Testing Consultant:		Bison Engineering, Inc.
	Address:	1400 11th Ave., Ste. 200
		Helena, MT 59601
	Contact:	Kelly Dorsi, PhD
		kdorsi@bison-eng.com
	Phone:	(406) 442-5768
State Authority:		Oregon Department of Environmental Quality (ODEQ)
	Address:	4026 Fairview Industrial Dr. SE
		Salem, OR 97302
	Contact:	Suzanne Blackburn,
		blackburn.suzanne@deq.state.or.us
	Phone:	(503) 378-5034
M29, M26A and M13B Outside Laboratory:		
		Chester LabNet
	Address:	12242 SW Garden Place
		Tigard, OR 97223-8246
	Contact:	Paul Duda
	Phone:	(503) 624-2183
	Website:	www.chesterlab.net

M30B Outside Laboratory:

	Ohio Lumex Co.
Address:	30350 Bruce Industrial Pkway
	Cleveland, OH 44139
Phone:	(440) 264-2500
Website:	www.ohiolumex.com

M316 Outside Laboratory:

	Enthalpy Analytical, Inc.
Address:	800-1 Capitola Dr.
	Durham, NC 27713-4385
Phone:	(919) 850-4392
Website:	www.enthalpy.com

1.2 Test Project Objective

The objectives of the 2018 testing campaigns are to conduct emission factor verification testing for multiple pollutants and production types at the H&V Corvallis, Oregon, facility. Throughout calendar year 2018, H&V will conduct source testing on four different product types and the furnace at the facility to measure outlet concentrations and mass flow rates of particulate and specific gases, including:

Particulate

- Filterable, condensable (Oregon back-half), and total particulate matter (PM)
- Speciated metals (filterable and condensable), excluding mercury, thallium, and silver
- Vapor phase mercury (Hg)

Gases

- Oxides of nitrogen (NOx)
- Non-methane volatile organic compounds (VOCs)
- Total fluorides (F^-)
- Hydrogen fluoride (HF)
- Formaldehyde (CH_2O)

Results for each pollutant will be reported in the following units:

- **PM** – grains per dry standard cubic feet (gr/dscf), pounds per hour (lb/hr) and pounds per ton glass processed (lb/ton glass processed)
- **Speciated metals** – micrograms per dry standard cubic meter (µg/dscm), milligrams per dry standard cubic meter (mg/dscm), lb/hr and lb/ton glass processed
- **Hg** – µg/dscf, lb/hr and lb/ton glass processed
- **NOx** – parts per million volume on dry basis (ppmvd), lb/hr and lb/ton glass processed, lb/1,000 scf of natural gas
- **CO**- ppmvd, lb/hour, lb/ton of glass processed, lb/1,000 scf of natural gas
- **VOC** – ppmvd, lb/hr, lb/ton glass processed, lb/1,000 scf of natural gas

- **F^-** – ppmvd, lb/hr and lb/ton glass processed
- **HF** – ppmvd, lb/hr and lb/ton glass processed
- **CH_2O** – ppmvd, lb/hr and lb/ton glass processed, lb/1,000 scf of natural gas

The following products and production units are each to be tested twice in 2018:

Rotary Coarse Fiber Production- Glass Plant 1 – Ceramic Filter Unit (CFU) 107

Ultra Rotary Coarse Fiber Production– Glass Plant 1 – CFU 112

Rotary Fine Fiber Production – Glass Plant 2 – CFU 117

Flame Blown Fiber Production – Glass Plant 2 – CFU 114

Furnace Stack – Glass Plant 1 – CFU 113

2.0 EMISSION SOURCE INFORMATION

2.1 Facility Description, Emission Sources

The first stage of manufacturing the glass fiber produced by H&V is achieved by melting solid raw materials in an electrically-heated melting furnace. The molten glass is then delivered via forehearths to stations that produce the fiber by either a rotary or flame blown fiberizer. Natural gas is combusted to maintain molten glass temperature as it passes through the forehearths. The fiberizers are classified as rotary fine, rotary coarse, rotary ultra coarse, or flame blown. The following is a description of the manufacturing processes specific to glass melting and fiberizing.

2.1.1 Glass Melt Furnaces

There are two electrically-heated glass melt furnaces (Line 1 and Line 2) that vent to a common control device and emission point. Inside the furnaces, fresh processed material of a specific recipe is added to the surface of the molten glass already present, thereby ensuring a continuous homogeneous mixture. All glass melting furnaces are electrically heated. Gaseous emissions resulting from the melting of the bulk materials in the two furnaces at GP1 are vented to the newly installed CFU 113.

2.1.2 Forehearths

Each glass melting furnace is serviced by a forehearth that receives molten glass at high temperatures and delivers it to the fiberizers. The forehearths, unlike the glass melting furnaces, are heated by natural gas combustion. Natural gas combustion emissions from each forehearth are captured by suspended rectangular hoods and conveyed through ductwork to vent with the furnace emissions.

The forehearths can also deliver molten glass to a glass patty former or to a station that produces glass cullet. Glass patties and cullet are glass that has hardened but can be liquefied later in a remelt unit upstream of a fiberizer when needed. No furnaces are located in the GP2 building, and there are no forehearths in that building. All fiberizers in GP2 are fed by remelt units that use cullet or glass patties.

2.1.3 Fiberizers (Rotary and Flame blown)

Rotary fiberizers receive molten glass from the forehearths (in Glass Plant 1 - GP1) or electric remelt units (in GP1 and Glass Plant 2 - GP2). The molten glass is fed to a rotary spinner disk which utilizes centrifugal forces to force the molten glass to flow outward through small holes in the rotary fiberizers. Flame attenuation results in glass fibers. The newly formed glass fibers are pneumatically conveyed to collection drums (in GP1 and GP2) or a former (in GP1) for capture and packaging.

H&V also utilizes four flame blown fiberizers. Flame blown fiberizers receive molten glass from electric remelt units in GP2. Molten glass flows by gravity through numerous small orifices to create threads that are then attenuated (stretched to the point of breaking) by high velocity hot air and flame. The newly formed glass fibers are pneumatically conveyed to drums for capture and packaging.

2.1.4 Emission Control

At the time of testing, the glass melting furnaces and fiberizers will be controlled by ceramic filter units (CFU). All furnaces and fiberizers are in the process of being converted to CFU controls. This testing campaign is intended to verify emission factors for the CFUs.

2.2 Client Responsibilities, Process Data

Hollingsworth & Vose will be responsible for:

- Assuring availability of the manufacturing processes during the scheduled test day as needed to facilitate the test program.
- Providing safe and secure access to the sampling ports whether through a permanent fixed landing or providing a man-lift for test team access. All Bison personnel are trained in the proper use of aerial lifts.
- Recording pertinent process details at 15-minute intervals during the test program.
- Reviewing production data from the day of testing and reducing the production data to production rates (tons/hr) during each test interval.
- Supplying CFU pressure drop (inches of water).
- Supplying natural gas usage rates (Mcf/hr), where applicable.
- Product type
- At least 90% of the design capacity for new or modified equipment.
- At least 90% of the maximum operating rate for existing equipment; or
- At 90 to 110% of the normal maximum operating rate for exiting equipment. The normal maximum operating rate is defined as the 90^{th} percentile of the average hourly operating rates during a 12-month period. Data supporting the normal maximum operating rate must be included with the source test report.
- Glass production rate (tons/hour)

Note: Only regular operating staff may adjust the production process and emission control parameters during the source performance tests and within two hours prior to the tests. Any operating adjustments made during the source performance tests, which are a result of consultation during the tests with source testing personnel, equipment vendors or consultants, may render the source performance test invalid.

3.0 SOURCE TEST PROGRAM DESCRIPTION

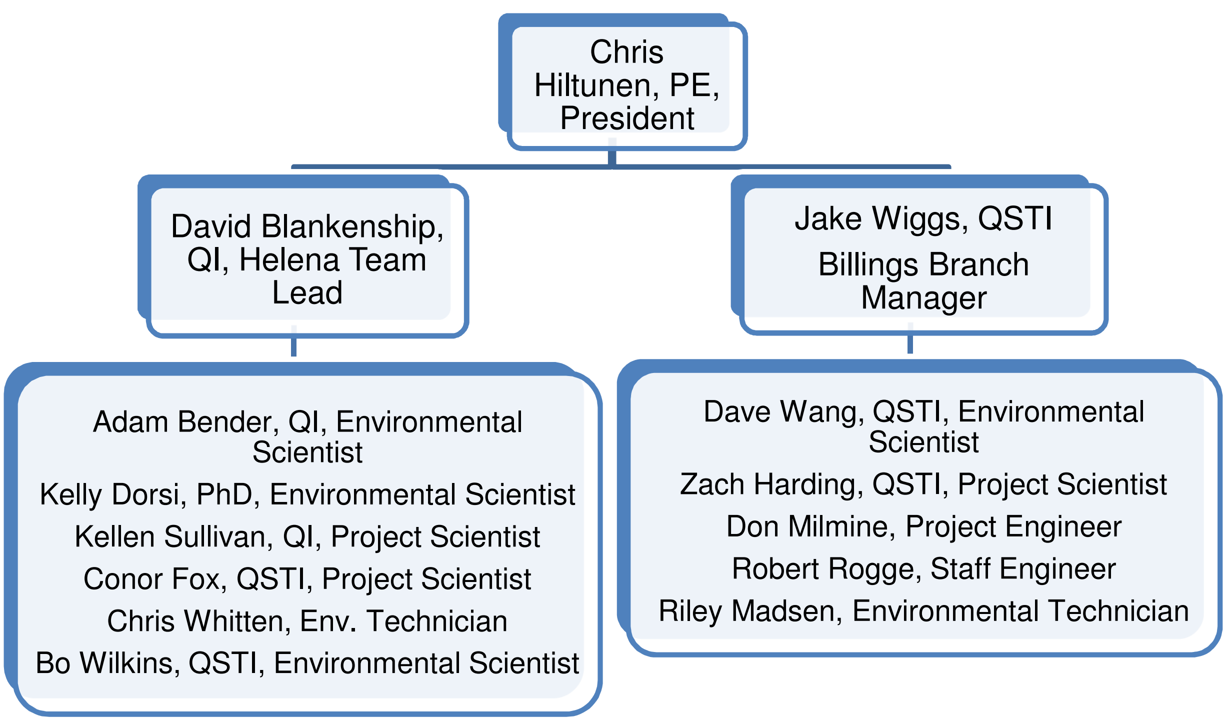
3.1 Testing Contractor

Bison Engineering Inc. is a full-service air quality consulting company that provides ambient air and meteorological monitoring, air quality permitting, air quality modeling, regulatory negotiations, process-to-emissions optimization and source testing services. Bison has performed hundreds of particulate performance tests on various industrial facilities over the past 30+ years and our field personnel are highly experienced stack testers. Bison has extensively invested in improving our quality systems and procedures and has recently completed our accreditation process through American Association for Laboratory Accreditation (A2LA).

3.2 Test Program Organization

The following chart shows the internal structure of Bison's stack testing teams. The 2018 testing will be led by Bison's Helena office with additional personnel support from Bison's Billings office. Tentatively, Kelly Dorsi, PhD, will serve as project manager. Dave Blankenship, QI, Helena Team Lead; Kellen Sullivan, QI; Zach Harding, QSTI; Conor Fox, QSTI, and Chris Whitten, Environmental Technician, will assist in performing the testing. Kelly Dorsi, PhD, will process the test data and prepare the final report. Personnel selected may be subject to change.

Bison Engineering Organizational Chart



3.3 Test Dates

See Appendix A for the 2018 proposed testing schedule. The 2018 test dates are preliminary and subject to change. ODEQ will be notified of any changes to the test dates that have been submitted with this protocol.

3.4 Report Date

Bison will submit a compliance test report to ODEQ no later than 60 days following the conclusion of each test campaign. Although the MAO states the report shall be provided within 45 days, due to the time required for lab analysis for the variety of tests being performed, Bison proposes that the 45-day time frame be extended to 60 days. *The request to extend the test report due date to 60 days after the conclusion of each test campaign has been approved by ODEQ.*

3.5 Safety Considerations and Working Conditions

Bison personnel will adhere to facility safety requirements. Bison personnel may be required to hoist the sampling equipment to the source being tested. Yellow caution tape may be placed to alert people to overhead work. When required, radio or hand signals will be used for safe lifting. Hazards associated with this facility include elevated working heights, ladders, electrical usage, overhead power lines, heated equipment and hot surfaces. These sources may require the use of powered man-lift equipment or scaffolding. Test equipment may need to be rope-hoisted, lifted or carried up staircases. Testers will have the following safety equipment at hand: hard hat; full-length pants, shirt, and/or coveralls; goggles (as required); full-height (over the ankle) work boots; hearing protection; work gloves; appropriate half- or full-face respirators.

4.0 SOURCE TESTING PROCEDURES

4.1 Sampling Site Location

Velocity/flow measurements will be performed at sample locations dictated by Method 1.

4.2 Test Plan

Testing at the five locations will be in accordance with the EPA methods specified in the following table:

Table 1: Test Matrix

<table>
<tr><th colspan="4">Hollingsworth & Vose
Corvallis, OR
Emissions Performance Testing
Test Matrix</th></tr>
<tr><th>Sources</th><th>Method</th><th>Parameter</th><th>Test Plan and Comments</th></tr>
<tr><td rowspan="13">Rotary Fine,

Flame Blown,

Rotary Coarse,

Ultra-Rotary Coarse,

Furnace Stack</td><td>Method 1</td><td>Measurement Locations</td><td>Determined prior to testing</td></tr>
<tr><td>Method 2</td><td>Volumetric Flow</td><td rowspan="2">Concurrent with each test run</td></tr>
<tr><td>Method 3A</td><td>Molecular Weight, O_2 and CO_2 Determination</td></tr>
<tr><td>Method 4 or ODEQ Method 4</td><td>Moisture</td><td>Incorporated with Method 5</td></tr>
<tr><td>Method 5</td><td>Filterable Particulate (with Oregon back-half)</td><td>Three 120-minute test runs per source</td></tr>
<tr><td>Method 7E</td><td>NO_x</td><td rowspan="5">Three 60-minute test runs (minimum) per source</td></tr>
<tr><td>Method 10</td><td>CO</td></tr>
<tr><td>Method 13B</td><td>Total Fluorides</td></tr>
<tr><td>Method 25A</td><td>Non-Methane VOCs</td></tr>
<tr><td>Method 26A</td><td>Hydrogen Fluoride</td></tr>
<tr><td>Method 29</td><td>Specific Metals</td><td rowspan="2">Three 180-minute test runs (minimum) per source</td></tr>
<tr><td>Method 30B</td><td>Mercury (Hg)</td></tr>
<tr><td>Method 316</td><td>Formaldehyde</td><td>Three 60-minute (minimum) test runs per source</td></tr>
</table>

4.3 Test Methods

The test will follow Environmental Protection Agency (EPA) methods described in Title 40, Code of Federal Regulations, Part 60, Appendix A (40 CFR 60, Appendix A) as follows:

EPA Reference Method 1, *"Sample and Velocity Traverses for Stationary Sources."* The objective of Method 1 is to determine a suitable location for testing and to determine the velocity measurement points for the source. The distance upstream to atmosphere from the sampling ports (Distance A) is measured and the distance downstream to the nearest disturbance from the sample points (Distance B) is measured. Distances A and B are applied to Method 1, Figure 1-2 for velocity measurement points. These figures give the minimum number of measurement points according to the dimensions of the source. The number of points and the stack diameter are then applied to Method 1, Table 1-2 to determine equal area measurement points within the source. The results of Method 1 location and velocity point measurement locations will be included in a report appendix.

EPA Reference Method 2, *"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube)."* The objective of Method 2 is to measure stack gas velocity, collect temperature data, and calculate a volumetric flow. Method 2 velocity measurements are performed using a Type S pitot tube. Differential pressures are measured using an inclined manometer, and temperatures are measured using a k-type thermal indicator. Bison has incorporated 0.84 as the Type S pitot tube coefficient (Cp). The average velocity, temperature, static pressure, and source area are used to calculate volumetric flow within the source. This field data is recorded on field data sheets. Copies of the field data, results from the flow calculations, and calibration data will be included in the appendices to the report. *The exhaust ducts must be checked for cyclonic flow prior to starting the test. Documentation of this must be provided in the test report*

EPA Reference Method 3A, "*Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)."* The objective of Method 3A is to determine the molecular weight of the source stream by determining oxygen (O_2) and carbon dioxide (CO_2) concentrations in the stack gas stream. The principle is to extract a gas sample from a stationary source and route the sample through a conditioning system to a paramagnetic oxygen analyzer and an infrared carbon dioxide analyzer for the measurement of O_2 and CO_2 in percentages (%). The O_2 and CO_2 analyzers calibration adjustments are performed by sending EPA Protocol 1 gas directly to the analyzers. A system calibration is performed by sending calibration gas to the probe and through the system to the analyzers. Bison's CO_2/O_2 analyzer is a Servomex Series 1400 (Serial Numbers 01415/B198 and 014208/901, respectively). The calibration error, system bias and system drift data, and measured concentrations are recorded on a data acquisition system (DAS). *Each Method 3A sampling system will be leak-checked before and after the testing program (before and after the last run). Results of the leak check will be documented in the test report*.

EPA Reference Method 4*, "Determination of Moisture Content in the Stack Gases."* The objective of Method 4 is to determine the moisture content of a gas stream. The principle of the method is to extract a sample from the source at a constant rate and impinge it through chilled water and silica gel. The moisture is removed from the sample stream and the volume (or mass) of water extracted is determined. The sample volume and water volume (or mass) are used to calculate the moisture content of the stack gas. The results of pre- and post-test dry gas meter (DGM) calibrations can be found in the DGM calibrations table. The DGM calibration data can be found in an appendix of this report. The impinger waters are volumetrically measured on-site and the silica gels are transported to Bison's lab and weighed. The test data is hand- recorded on field data sheets and then entered into spreadsheets for moisture determination calculations.

Method 5,*"Determination of Particulate Emissions from Stationary Sources" (Methods 2 & 4 and Oregon Method 5 Inclusive).* The objective of Method 5 is to determine the filterable particulate matter (PM) from a source. Method 5 is an isokinetic sampling method (i.e., the velocity of sample stream entering the nozzle is approximately equal to the velocity of the approaching sample stream) for determination of PM. The exhaust gas stream is sampled along a cross-section of the stack and PM is captured within the nozzle, probe, filter-bell and on the 0.3 micron pore size glass fiber filter. The filter is maintained at a temperature of 248°F±25°F followed by impingers maintained at a temperature below 68°F. Bison uses a Method 5 sampling train with a glass probe liner and nozzles to gather the particulate sample. Method 5 incorporates Method 2 "velocity measurements" and Method 4 "moisture measurements." Following the State of Oregon Department of Environmental Quality Source Sampling Manual the back-half impinger catch will also be analyzed for inorganic and organic condensable particulate matter.

EPA Reference Method 7E, "*Determination of Nitrogen Oxides Emissions from Stationary Sources."* The objective of Method 7E testing is to determine the NOx concentration from the source. Method 7E entails extraction of a gas sample from a stationary source and routing the sample through a conditioning system to an analyzer for the measurement of NOx (NO and NO_2) in ppmvd. The NO_2 analyzer calibration adjustment is performed by sending EPA Protocol 1 gas directly to the analyzer. A system bias check is performed by sending calibration gas to the probe and through the system to the analyzer. Bison uses a Thermo Environmental 42i (NO-NO_2-NO_x) analyzer. The calibration error, system bias and system drift data, and measured concentrations are recorded on a DAS for permanent record. Each Method 7E sampling system will be leak-checked before and after the testing program (before and after the last run). Results of the leak check will be documented within the test report. Measured emissions will be between 20 to 100 percent of the calibration span per Method 7E. *Each Method 7E sampling system will be leak-checked before and after the testing program (before and after the last run). Results of the leak check will be documented in the test report*.

EPA Reference Method 10, "*Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)."* The objective of Method 10 is to determine the CO concentrations from the source. Method 10 entails extraction of a gas sample from a stationary source and routing the sample through a conditioning system to an analyzer for the measurement of CO in ppmvd. The CO analyzer calibration adjustment is performed by sending EPA Protocol 1 gas directly to the analyzer. A system bias check is performed by sending calibration gas to the probe and through the system to the analyzer. The calibration error, system bias and system drift data, and measured concentrations are recorded on a DAS for permanent record. *Each Method 10 sampling system will be leak-checked before and after the testing program (before and after the last run). Results of the leak check will be documented in the test report*.

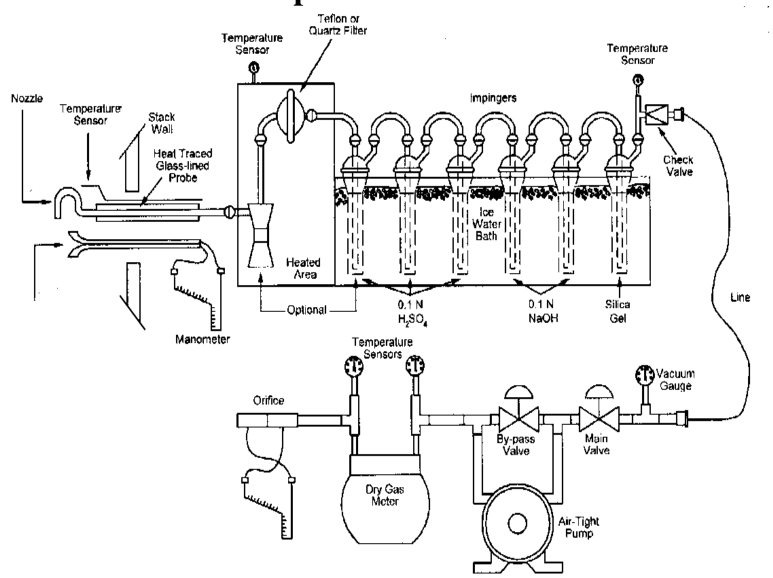
EPA Reference Method 13B "*Determination of Total Fluoride Emissions from Stationary Sources.*" The objective of the method is to determine the fluoride (F^-) emissions from sources as specified in the regulations; it does not measure fluorocarbons, such as freons. Stack gas is withdrawn isokinetically from the source and collected in water and on a filter. The filter and water are combined and total F^- is then determined by the specific ion electrode method. Isokinetic sampling rates will be maintained below 1.0 cfm. Bison will be using Whatman #1 filters during 2018 testing campaigns. Three filter blanks will be collected and submitted for analysis.

EPA Reference Method 25A, *"Determination of Total Gaseous Organic Concentration using a Flame Ionization Analyzer."* The objective of Method 25A is to determine the total gaseous organic concentrations (TGOC) from a source using a flame ionization detector (FID). Bison utilizes a gas chromatograph/flame ionization detector (GC/FID) for determination of the TGOC. Testing is performed by extracting a gas sample from the source through a heated sample line directly to the GC/FID for the measurement of methane and non-methane hydrocarbons which can be combined to produce a total hydrocarbon (THC) concentration value. The non-methane organic compound (NMOC) value is used to report volatile organic compound (VOC) concentrations since EPA's definition of a VOC does not include methane. The analyzer measurements are in parts per million by volume wet (ppmvw) and are reported as propane (C_3H_8). The gaseous measurement primarily consists of vaporous aromatic hydrocarbons: alkanes, aldenes and arenes. The VOC analyzer calibration adjustment is performed by sending EPA Protocol 1 gas through the sample line to the probe tip. A system drift check is performed by sending calibration gas to the probe and through the system to the analyzer. The calibration error, system bias and system drift data, and measured concentrations are recorded on a DAS for permanent record. *Each Method 25A sampling system must be leak-checked before and after the testing program (before the first run and after the last run). The methodology used to leak check the sample train must include the portion of sampling train within the analyzer. The results of the leak check must be reported in the test report. VOC emissions will include formaldehyde.*

Note: QA/QC procedures outlined in EPA Alt-106 will be utilized to make sure the GC column is properly removing methane and ethane from the sample. If ethane is not removed by the GC column use methane instead of ethane in the calibration gas.

EPA Reference Method 26A, "*Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Isokinetic Method.*" The objective of Method 26A is to isokinetically sample a source stream (i.e., the velocity of sample stream entering the nozzle is approximately equal to the velocity of the approaching sample stream) for determination of hydrogen chloride (HCl); hydrogen bromide (HBr); hydrogen fluoride (HF); chlorine (Cl_2), and bromine (Br_2) emissions. Method 26A is used on sources controlled by wet scrubbers, emitting acid PM (*e.g.,* hydrogen halides dissolved in water droplets). The sample system is that of Method 5 with Method 26 solutions of 0.1 normal sulfuric acid (H_2SO_4) and 0.1 normal sodium hydroxide (NaOH). The impinger solutions are recovered and sent to a laboratory for Cl and/or F analysis. *Probe and oven temperatures will be maintained at a temperature greater than 248°F.*

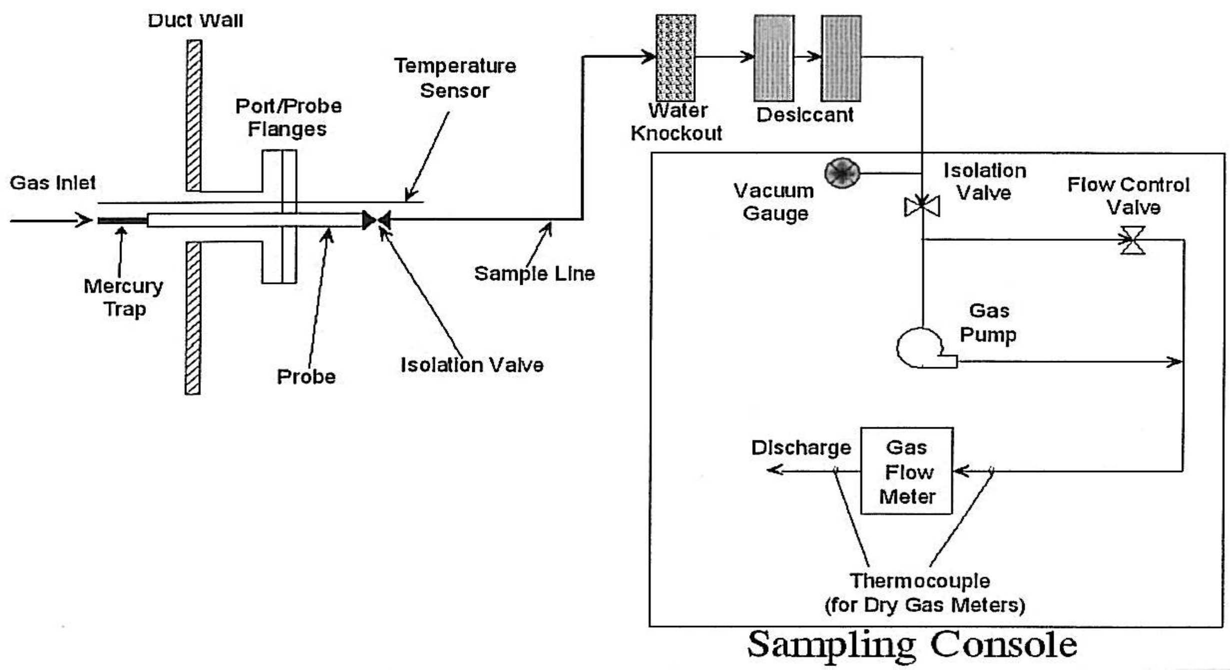
Figure 1: Typical Method 26A Sample Train Schematic



EPA Reference Method 29, *"Determination of Metals Emissions From Stationary Sources."* A stack sample is withdrawn isokinetically from the source, particulate emissions are collected in the probe and on a heated filter, and gaseous emissions are then collected in an aqueous acidic solution of hydrogen peroxide (analyzed for all metals including Hg) and an aqueous acidic solution of potassium permanganate (analyzed only for Hg). The recovered samples are digested, and appropriate fractions are analyzed for Hg by cold vapor atomic absorption spectroscopy (CVAAS) and for Sb, As, Ag, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, P, Se, Tl, and Zn by inductively coupled argon plasma emission spectroscopy (ICAP) or atomic absorption spectroscopy (AAS). Graphite furnace atomic absorption spectroscopy (GFAAS) is used for analysis of Sb, As, Cd, Co, Pb, Se, and Tl if these elements require greater analytical sensitivity than can be obtained by ICAP. If one so chooses, AAS may be used for analysis of all listed metals if the resulting in-stack method detection limits meet the goal of the testing program. Similarly, inductively coupled plasma-mass spectroscopy (ICP-MS) may be used for analysis of Sb, As, Ag, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Tl, and Zn.

EPA Reference Method 30B,*"Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Traps."* The objective of Method 30B is to determine elemental mercury (Hg^o) and oxidized mercury (Hg^{2+}) emissions from a source. The exhaust gas stream is sampled at a single point within the stack at a controlled sample rate. The sample is drawn through a carbon sorbent tube which is then analyzed by Ultra Violet Atomic Absorption (UV AA) or Ultra Violet Atomic Fluorescence (UV AF) cold vapor analysis. The analytical range is 0.1 µg/dscm to >50 µg/dscm. *Each Method 30B sampling system must be leak-checked before and after each test run. A leak is defined as greater than 4% of the sampling rate. Results of the leak check are to be documented within the test report*.

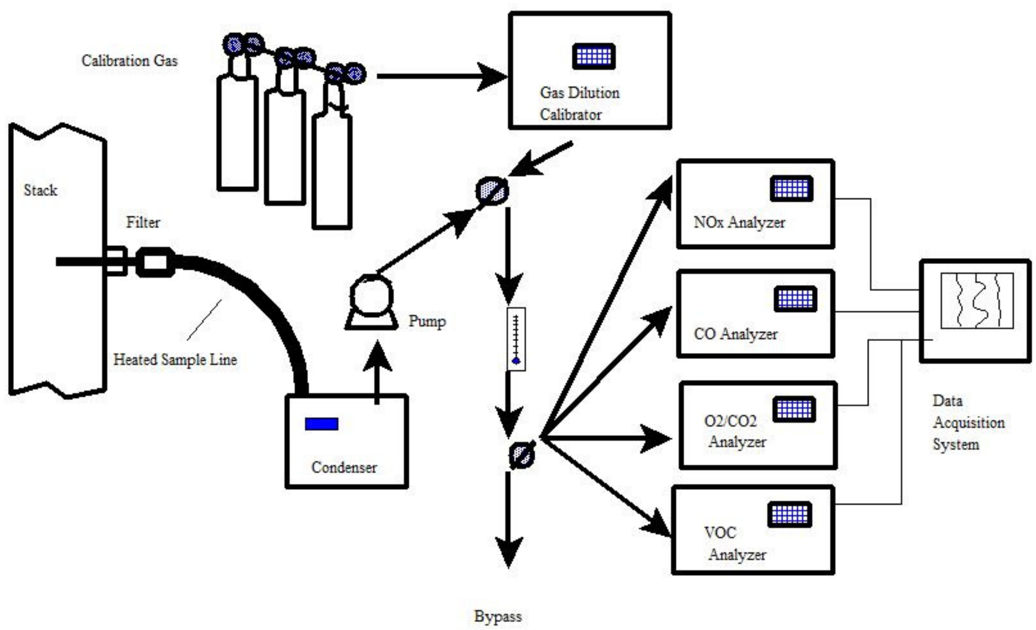
Figure 2: Method 30B Sampling Train



EPA Reference Method 316*, "Sampling and Analysis For Formaldehyde Emissions From Stationary Sources In The Mineral Wool And Wool Fiberglass Industries."* Gaseous and particulate pollutants are withdrawn isokinetically from an emission source and are collected in high purity water. Formaldehyde present in the emissions is highly soluble in high purity water. The high purity water containing formaldehyde is then analyzed using the modified pararosaniline method. Formaldehyde in the sample reacts with acidic pararosaniline, and the sodium sulfite, forming a purple chromophore. The intensity of the purple color, measured spectrophotometrically, provides an accurate and precise measure of the formaldehyde concentration in the sample. *Field duplicate samples, field spike samples and field blank samples will be performed as outlined in the test method.*

EPA Reference Method 205, *"Verification of Gas Dilution Systems for Field Instrument Calibrations."* The objective of Method 205 is to produce a set of calibration gases that are used in instrumental analysis emission testing. This is achieved by diluting a concentrated gas to lower concentrations. The diluted gases are then to be used in calibrating analyzers, performing a system check and performing post-test bias checks. The dilution of the gases is performed by a dilution mass flow instrument. Method 205 stipulates the procedure and steps to evaluate the dilution instrument and confirm it is suitable for field use. Once the system has met the criteria cited, the dilution instrument is certified to be used in the field.

Figure 3: Gaseous Sampling System Schematic



4.4 Analytical Methods

All Method 4 field water samples will be volumetrically measured on-site and analyzed as per sampling method. The silica gels are weighed on Bison's field scale. The test data is hand- recorded on field data sheets and then entered into spreadsheets for moisture determination calculations.

4.5 Minimum Detection Limitations

Should sampling result in non-detection with respect to the instrumentation or method parameters, emission data may be calculated at the minimum detection limit, pending state agency guidelines.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES

5.1 Documentation, Tracking and Certifications

Bison uses a unique project number for document control and tracking of all projects. All documentation pertaining to that project is filed according to project number.

The tracking number for this project is **HAV218610.**

Electronic project records are maintained on the server indefinitely. The test project manager and a quality manager will sign a certification page to document and authenticate that testing was performed according to the methods, applicable regulatory requirements and Bison's quality manual. This certification page will accompany the final report.

Should a situation arise that warrants a deviation from the approved protocol, it will be discussed with the client and/or regulatory agency. If necessary, approval to modify the test plan will be obtained from the regulatory agency. Any modification to the test plan or deviation from approved test methods will be documented in the final test report.

5.2 Sampling Protocol and Collection Procedures

All testing will be performed in accordance with the specified test methods and their prescribed quality control procedures.

The run number, date, location and source uniquely identify samples obtained in the field. Subdivisions of a sample are labeled and recorded as such (i.e., Sample 1 of 2). Samples are maintained in a manner to prevent deterioration, loss or damage. Samples remain in the control of the emissions testing team until/unless they are released to an outside laboratory for analysis. A chain of custody will be employed for tracking all samples. Sample preservation follows the applicable method recommendations.

Bison's test, laboratory, reporting, and quality assurance procedures will conform to the requirements specified in Bison's Quality Manual and ASTM D7036.

The individual test methods specify handling procedures for physical samples (liquids, traps, etc.). Bison will follow the procedures outlined in the appropriate methods as described in EPA 40 CFR Part 60, Appendix A and Appendix B.

Lab data is directly entered into computer spreadsheets; no written data is created unless upon request.

Method 5 particulate samples will be processed in-house by Bison at their Helena, Montana, laboratory. Bison will send other samples to the following outside laboratories for analysis: Method 29, M26A and M13B samples will be sent to Chester LabNet, Method 30B samples will be sent to Ohio Lumex, and Method 316 samples will be sent to Enthalpy Analytical, Inc. Contact information for the individual outside laboratories is given in Section 1.1 of this protocol.

5.3 Equipment and Instrument Calibration, Audits and Maintenance

Ongoing calibrations and audits of the testing equipment comprise a preventive maintenance program. Bison personnel calibrate equipment and instruments according to a set schedule and with standards traceable to the National Institute of Standards and Technology (NIST) and ASTM D7036. All equipment requiring calibrations for the methods described in this protocol also meet the appropriate criteria as specified in EPA 40 CFR Part 60 Appendix A. Equipment and instrument calibration results will be included in an appendix to the test report.

5.4 Instrument Calibration Gases

The calibration gases used in this project are all certified as EPA Protocol 1 gases and are purchased from AirGas. The calibration gas certifications will be included in the test report as an appendix.

5.5 Data Collection, Reduction and Validation

5.5.1 Data validation and editing procedures

Emissions test data is subject to multiple levels of validation. Bison has self-auditing spreadsheets that alert the field technician when data may be entered incorrectly by flagging calculation results that are outside of expected or reasonable values. Data is next audited during data processing and report generation. QA/QC checks associated with the testing (such as on-site analyzer calibrations and pre- or post-test equipment certifications) are rechecked during the review process.

A final draft of the test report is reviewed for technical content first by the project manager, and then by one of Bison's quality managers. All field data and spreadsheets will be supplied in an appendix to the report.

5.5.2 Type of personnel performing data validation

Personnel performing data validation and audits are trained in the applicable test methodology and authorized to review test data.

5.5.3 Sources of validation information used by data editors

The Bison staff member processing data uses the current emission test methods that are found on the EPA website.

5.5.4 Specific validation procedures for each source test method

The specific validation procedures are cited in each method. Please refer to the methods for details.

5.6 Internal Audits and Corrective Action

Stack flow measuring equipment is audited in accordance with the corresponding test methods.

When departures from policies or procedures in the Bison quality system or technical operations have been identified, Bison's quality manager meets with the Bison personnel involved to evaluate the significance of the non-conforming work and discuss appropriate corrective action. Corrective actions are given the highest priority and determined immediately after identifying non-conforming work. The format for implementing corrective action follows ASTM D7036.

5.7 Audit Request

Bison understands that ODEQ will require Stationary Source Audit Samples (SSAS) laboratory samples. Bison will obtain the following samples:

Fluoride in Impinger Solution for Method 13B

Hydrogen Fluoride in Impinger Solution for Method 26A

Metals in Impinger Solution for Method 29

The samples will come from:

Sigma-Aldrich Corporation
2931 Soldier Springs Rd
Laramie, WY 82070
Phone: (307) 742-5452

The samples will be submitted to the outside laboratory contractor and be processed at the same time as the stack samples. All audit results will be reported in the final stack test report alongside the emissions values.

APPENDIX A:
Proposed 2018 Testing Schedule

Table A-1: April Testing Schedule

Proposed Sampling Schedule Compliance Testing Rotary Fine (CFU-117) and Flame Blown (CFU-114) April 24, 2018 – May 2, 2018						
Day	**Date**	**Source**	**Sampling Method**	**Parameter**	**Number of Runs**	**Run Duration**
0	Monday 4/23/18	Travel Helena, MT to Corvallis, OR. Set up and prep equipment.				
1	Tuesday 4/24/18	CFU-117 (RF #1)	M5	PM	3	120 minutes
			7E	NO_x	3	120 minutes
			10	CO	3	120 minutes
			25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
2	Wednesday 4/25/18	CFU-117 (RF #1)	13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes
3	Thursday 4/26/18	CFU-117 (RF #1)	M29	Specific Metals	3	180 minutes
			M30B	Mercury	3	180 minutes
4	Friday 4/27/18	CFU-114 (FB #1)	M29	Specific Metals	3	180 minutes
			M30B	Mercury	3	180 minutes
5	Saturday 4/28/18	CFU-114 (FB #1)	M5	PM	3	120 minutes
			7E	NO_x	3	120 minutes
			10	CO	3	120 minutes
			25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
6	Sunday 4/29/18	CFU-114 (FB #1)	13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes

Table A-2: June Testing Schedule

Proposed Sampling Schedule Compliance Testing Rotary Fine (CFU-117), Flame Blown (CFU-114) and Rotary Coarse (CFU-107) June 5, 2018 – June 18, 2018						
Day	**Date**	**Source**	**Sampling Method**	**Parameter**	**Number of Runs**	**Run Duration**
0	Monday 6/4/18	Travel Helena, MT to Corvallis, OR. Set up and prep equipment.				
1	Tuesday 6/5/18	CFU-117 (RF #2)	M5	PM	3	120 minutes
			M25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
2	Wednesday 6/6/18	CFU-117 (RF #2)	7E	NO_x	3	60 minutes
			10	CO	3	60 minutes
			13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes
3	Thursday 6/7/18	CFU-117 (RF #2)	M29	Specific Metals	2	180 minutes
			M30B	Mercury	2	180 minutes
4	Friday 6/8/18	CFU-117 (RF #2)	M29	Specific Metals	1	180 minutes
			M30B	Mercury	1	180 minutes
5	Saturday 6/9/18	OFF				
6	Sunday 6/10/18	CFU-114 (FB #2)	M5	PM	3	120 minutes
			M25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
7	Monday 6/11/18	CFU-114 (FB #2)	7E	NO_x	3	60 minutes
			10	CO	3	60 minutes
			13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes
8	Tuesday 6/12/18	CFU-114 (FB #2)	M29	Specific Metals	2	180 minutes
			M30B	Mercury	2	180 minutes
9	Wednesday 6/13/18	CFU-114 (FB #2)	M29	Specific Metals	1	180 minutes
			M30B	Mercury	1	180 minutes
10	Thursday 6/14/18	OFF				
11	Friday 6/15/18	CFU-107 (RC #1)	M5	PM	3	120 minutes
			M25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
12	Saturday 6/16/18	CFU-107 (RC #1)	7E	NO_x	3	60 minutes
			10	CO	3	60 minutes
			13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes

13	Sunday 6/17/18	CFU-107 (RC #1)	M29	Specific Metals	2	180 minutes
			M30B	Mercury	2	180 minutes
14	Monday 6/18/18	CFU-107 (RC #1)	M29	Specific Metals	2	180 minutes
			M30B	Mercury	2	180 minutes

Table A-3: September Testing Schedule

Proposed Sampling Schedule Compliance Testing Rotary Coarse (CFU-107), Ultra Rotary Coarse (CFU-112) and Melter Stack (CFU-113) September 5, 2018 – September 18, 2018						
Day	**Date**	**Source**	**Sampling Method**	**Parameter**	**Number of Runs**	**Run Duration**
0	Tuesday 9/4/18	Travel Helena, MT to Corvallis, OR. Set up and prep equipment.				
1	Wednesday 9/5/18	CFU-107 (RC #2)	M5	PM	3	120 minutes
			M25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
2	Thursday 9/6/18	CFU-107 (RC #2)	7E	NO_x	3	60 minutes
			10	CO	3	60 minutes
			13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes
3	Friday 9/7/18	CFU-107 (RC #2)	M29	Specific Metals	2	180 minutes
			M30B	Mercury	2	180 minutes
4	Saturday 9/8/18	CFU-107 (RC #2)	M29	Specific Metals	1	180 minutes
			M30B	Mercury	1	180 minutes
5	Sunday 9/9/18	OFF				
6	Monday 9/10/18	CFU-112 (URC #1)	M5	PM	3	120 minutes
			M25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
7	Tuesday 9/11/18	CFU-112 (URC #1)	7E	NO_x	3	60 minutes
			10	CO	3	60 minutes
			13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes
8	Wednesday 9/12/18	CFU-112 (URC #1)	M29	Specific Metals	2	180 minutes
			M30B	Mercury	2	180 minutes
9	Thursday 9/13/18	CFU-112 (URC #1)	M29	Specific Metals	1	180 minutes
			M30B	Mercury	1	180 minutes
10	Friday 9/14/18	OFF				
11	Saturday 9/15/18	CFU-113 (MELT #1)	M5	PM	3	120 minutes
			M25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
12	Sunday 9/16/18	CFU-113 (MELT #1)	7E	NO_x	3	60 minutes
			10	CO	3	60 minutes

			13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes
13	Monday 9/17/18	CFU-113 (MELT #1)	M29	Specific Metals	2	180 minutes
			M30B	Mercury	2	180 minutes
14	Tuesday 9/18/18	CFU-113 (MELT #1)	M29	Specific Metals	1	180 minutes
			M30B	Mercury	1	180 minutes

Table A-4: October Testing Schedule

Proposed Sampling Schedule Compliance Testing Ultra Rotary Coarse (CFU-112) and Melter Stack (CFU-113) October 1, 2018 – October 10, 2018						
Day	**Date**	**Source**	**Sampling Method**	**Parameter**	**Number of Runs**	**Run Duration**
0	Monday 10/01/18	Travel Helena, MT to Corvallis, OR. Set up and prep equipment.				
1	Tuesday 10/02/18	CFU-112 (URC #2)	M5	PM	3	120 minutes
			M25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
2	Wednesday 10/03/18	CFU-112 (URC #2)	7E	NO_x	3	60 minutes
			13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes
3	Thursday 10/04/18	CFU-112 (URC #2)	M29	Specific Metals	2	180 minutes
			M30B	Mercury	2	180 minutes
4	Friday 10/05/18	CFU-112 (URC #2)	M29	Specific Metals	1	180 minutes
			M30B	Mercury	1	180 minutes
5	Saturday 10/06/18	OFF				
6	Sunday 10/07/18	CFU-113 (MELT #2)	M5	PM	3	120 minutes
			M25A	VOC	3	120 minutes
			M316	Formaldehyde	3	120 minutes
7	Monday 10/08/18	CFU-113 (MELT #2)	7E	NO_x	3	60 minutes
			13B	Total Fluoride	3	60 minutes
			26A	HF	3	60 minutes
8	Tuesday 10/09/18	CFU-113 (MELT #2)	M29	Specific Metals	2	180 minutes
			M30B	Mercury	2	180 minutes
9	Wednesday 10/10/18	CFU-113 (MELT #2)	M29	Specific Metals	1	180 minutes
			M30B	Mercury	1	180 minutes

This is the last page
of the protocol.

Oregon
Kate Brown, Governor

Department of Environmental Quality
Western Region Salem Office
4026 Fairview Industrial Dr. SE
Salem, OR 97302
(503) 378-8240
FAX (503) 373-7944
TTY 711

May 24, 2018

Anita Ragan
Hollingsworth & Vose Fiber Company
PO Box E
Corvallis, OR 97339

Chris Hiltunen
Bison Engineering, Inc.
1400 11th Ave., Suite 200
Helena, MT 59601

Re: Hollingsworth & Vose Fiber
Permit Number 02-2173-ST-01
June 2018 Source Test Plan - Rev. 2

Ms. Ragan and Mr. Hiltunen:

The source test plan received on March 23, 2018 for source testing at the Hollingsworth & Vose Fiber facility located in Corvallis, OR has been reviewed. DEQ understands emissions of the rotary coarse, rotary fine, flame blown, ultra rotary coarse and furnace exhausts will be tested for emissions of: filterable, condensable and total particulate matter (PM), carbon monoxide (CO), oxides of nitrogen (NOx), hydrogen fluoride (HF), total fluorides (F^-), mercury (Hg), specific metals, and volatile organic compounds (VOCs) including formaldehyde.

The testing will be done to determine compliance and to verify emission factors (EF). The source test plan for testing in June 2018 is approved with the following conditions:

GENERAL PROCESS CONDITIONS

1. Only regular operating staff may adjust the production process and emission control parameters during the source performance tests and within two (2) hours prior to the tests. Any operating adjustments made during the source performance tests, which are a result of consultation during the tests with source testing personnel, equipment vendors or consultants, may render the source performance test invalid.
2. For compliance tests, source testing must be performed as follows:
   - At least 90% of the design capacity for new or modified equipment.
   - At least 90% of the maximum operating rate for existing equipment; or
   - At 90 to 110% of the normal maximum operating rate for exiting equipment. The normal maximum operating rate is defined as the 90th percentile of the average hourly operating rates during a 12 month period. Data supporting the normal maximum operating rate must be included with the source test report.
3. All documentation of sampling equipment calibrations and analytical results should be maintained for a minimum of five years.

4. In general, the unanalyzed portions (aliquots) of the source test samples must be preserved up to the maximum holding times as specified by test method. Sample filters gravimetrically analyzed for particulate matter are to be archived for a minimum of 6 months. However, sample archiving specifications pertaining to laboratory glassware is left to the discretion of the analyzing laboratory and the testing contractor.

5. It is acceptable to postpone a scheduled test or suspend a test in progress if the discontinuation is due to equipment failure beyond the facility's control, construction delays beyond the facility's control, severe meteorological conditions, and situations that would jeopardize the safety of the testing contractors and/or operators. If the test is underway, the permittee should make every effort to complete the test run. All recoverable test information (process & sample data) must be available for DEQ review.

   It is unacceptable to postpone or suspend a test run in progress if it is discontinued because the source is not able to comply with an emission limit or verify an emission factor. The permittee must provide DEQ written documentation explaining the reasons for the postponement or stoppage, and any data collected prior to the stoppage.

6. During source testing the following process parameters must be monitored and recorded. All process parameters are to be reported for each individual test run and averaged for all test runs if appropriate.
   - Glass production rate, tons/hour
   - Product type
   - Natural gas usage where applicable, cf/hr
   - CFU pressure drop, inches of water
   - If a dry bulking agent is used in the CFU, the injection rate in lb/hr (if possible), and the bulking agent composition.

7. For source testing on a single CFU that spans several days, care should be taken to ensure that the process is running at a consistent rate over the several days of the test.
   - Glass product
   - Production rate, tons/hour
   - Bulking agent injection rate, lb/hr
   - CFU pressure drop, inches of water

EPA/ODEQ METHODS 1-4 CONDITIONS

8. The exhaust duct flow measurements must meet the EPA Methods 1 & 2 criteria. Documentation including clear diagrams must be provided in the source test report.

9. The exhaust ducts must be checked for cyclonic flow prior to starting the test. Documentation of this must be provided in the test report.

10. Each Method 3A sampling system must be leak-checked before and after the testing program (before the first run and after the last run). Results of the leak check are to be documented within the test report.

11. Moisture content of the exhaust stack gas must be determined by EPA Method 4 (incorporated into ODEQ Method 5 / EPA Method 13B / EPA Method 26A / EPA Method 29) for each test run. In addition, Section 12.1.7 of EPA Method 4 states "In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (alternate method) and one based upon the results of the impinger analysis (EPA Method 4). If this is the case, then ODEQ

Method 4 (wet bulb/dry bulb) shall be used as the alternative method. At minimum, two measurements of moisture content (Bws) using ODEQ Method 4 shall be made for each run and averaged for the run. The lower of the two values of Bws as determined by EPA Method 4 and ODEQ Method 4 shall be considered correct for each run.

EPA / ODEQ METHOD 5 CONDITIONS (Filterable, Condensable &Total PM)

12. During sampling, make sure other sampling probes are not interfering with isokinetic sampling.

13. The minimum sample volume is 31.8 dscf. DEQ recommends at least 60 dscf, so that the minimum weight of PM can be met.

14. For ODEQ Method 5, the method quantifiable limit (MQL) is 7 mg of PM, which should be taken into consideration when targeting a minimum sample volume and when calculating results. Since emission factors and compliance with permit limits are to be determined, it is very important that 7 mg or more are collected.

    If less than 7 mg is collected, compliance limit calculations shall be based not on the actual mass of PM collected but on the MQL of 7 mg as a "less than quantifiable limit" value. If that is the case, then the calculated grain loading concentrations reported will most likely be greater than the true concentrations.

    To avoid this situation, the sampling times should be long enough to collect a sample volume large enough to obtain at least 7 mg of PM per test run.

15. Filterable, condensable and total PM test results must be reported as follows for each test run and averaged for all three test runs. Complete example calculations must be provided for at least one test run.
    - gr/dscf
    - lb/hour
    - lb/ton of glass processed

    Note 1: If the values measured are below the detection limit of the method (7 mg) results should be reported as measured and as less than the detection limit.

EPA METHOD 7E CONDITIONS

16. The converter efficiency of the NOx analyzer must be documented within the test report.

17. Each Method 7E sampling system must be leak-checked before and after the testing program (before the first run and after the last run). Results of the leak check are to be documented within the test report.

18. Measured emissions should be between 20 to 100 percent of the calibration span.

19. NO_x emissions as NO_2 must be reported as indicated below for each individual test run and averaged for all three test runs. Hand calculations must be provided for at least one test run.
    - ppmvd
    - lb/hour
    - lb/ton of glass processed
    - lb/1000 scf of natural gas

EPA METHOD 10 CONDITIONS

20. Each Method 10 sampling system must be leak-checked before and after the testing program (before the first run and after the last run). Results of the leak check are to be documented within the test report.

21. Measured emissions should be between 20 to 100 percent of the calibration span.

22. CO emissions must be reported as indicated below for each individual test run and averaged for all three test runs. Hand calculations must be provided for at least one test run.
    - ppmvd
    - lb/hour
    - lb/ton of glass processed
    - lb/1000 scf of natural gas

EPA METHOD 13B CONDITIONS

23. An audit sample must be obtained from an EPA approved audit sample provider and be onsite during testing. The DEQ SSAS ID is R0032.

24. During sampling, make sure other sampling probes are not interfering with isokinetic sampling.

25. Before the test series, determine the average fluoride blank value of at least three filters (from the lot to be used for sampling) using the applicable procedures described in sections 8.3 and 8.4 of this method.

26. Select a nozzle size such that isokinetic sampling rates below 1.0 cfm can be maintained.

27. Total fluorides emissions must be reported as F as indicated below for each individual test run and averaged for all three test runs. Hand calculations must be provided for at least one test run.
    - ppmvd
    - lb/hour
    - lb/ton of glass processed

EPA METHOD 25A / EPA ALTERNATIVE METHOD 106 CONDITIONS

28. Each Method 25A sampling system must be leak-checked before and after the testing program (before the first run and after the last run). The methodology used to leak check the sample train must include the portion of sampling train within the analyzer. The results of the leak check must be reported in the test report.

29. Since EPA Method 25A does not measure formaldehyde and it will need to be measured using EPA Method 316. The formaldehyde emission rates must be included in the VOC emission rates.

30. The span of the analyzer used to perform EPA Method 25A should be equivalent to 1.5 to 2.5 times the expected concentration. Be prepared to utilize the analyzer’s lowest span value.

31. When using a low scale, the alternate drift limit of an absolute difference of less than 0.5 ppm may be used.

32. Results may not be drift corrected.

33. The calibration gases shall be the following percent of the instrument’s span.
    - zero < 0.1%
    - low-level = 25 - 35%
    - mid-level = 45 - 55%
    - high-level = 80 - 90%

34. QA/QC procedures outlined in EPA Alt-106 must be utilized to make sure the GC column is properly removing methane and ethane from the sample. If ethane is not removed by the GC column use methane instead of ethane in the calibration gas.

The procedures in Alternative Method 106 for methane must be followed for the FID / GC analyzer. https://www3.epa.gov/ttn/emc/approalt/ALT106.pdf

- A direct interface and heated sampling line from the sampling point to the GC injection valve must be used. All sampling components leading to the analyzer must be heated to greater than 220 F.
- Calibrate the instrument with a mixture of methane and propane. Linearity, calibration error, and calibration drift must be demonstrated.

35. VOC emissions must include formaldehyde and must be reported as indicated below for each individual test run and averaged for all three test runs on a propane basis. Results should include example calculations must be provided for at least one test run.
    - ppmvd
    - lb/hour
    - lb/ton of glass processed
    - lb/1000 scf of natural gas

EPA METHOD 26A CONDITIONS

36. An audit sample must be obtained from an EPA approved audit sample provider and be onsite during testing. The DEQ SSAS ID is R0032.
37. During sampling, make sure other sampling probes are not interfering with isokinetic sampling.
38. Probe and oven temperatures must be maintained at a temperature greater than 248F.
39. If condensation appears at or before the filter follow procedures outlined in Section 8.1.6 of the method.
40. HF emissions must be reported as indicated below for each individual test run and averaged for all three test runs. Hand calculations must be provided for at least one test run.
    - ppmvd
    - lb/hour
    - lb/ton of glass processed

EPA METHOD 29 CONDITIONS

41. An audit sample must be obtained from an EPA approved audit sample provider and be onsite during testing. The DEQ SSAS ID is R0032.
42. DEQ understands that you will not be performing sampling for Hexavalent Chromium. The total Chromium results will all be assumed to be Hexavalent Chromium.
43. All samples do not need to be analyzed for Silver and Thallium.
44. During metals testing, oxygen and carbon dioxide content of the stack gas shall be determined by EPA Method 3A.
45. At a minimum, 1.7 dscm (60 dscf) must be sampled each run.

    DEQ recommends at least 120 dscf be sampled to achieve the low detection levels that are desired.
46. During sampling, make sure other sampling probes are not interfering with isokinetic sampling.
47. Test results must be reported as follows for each test run and averaged for all three test runs. Test results shall not be blank corrected. Example calculations should be provided for at least one test run.
    - mg/dscm

- lb/hr
- lb/ton of glass processed

EPA METHOD 30B CONDITIONS

48. Follow Method 30A section 8.1 to select the sample traverse locations.

49. Each Method 30B sampling system must be leak-checked before and after the each test run. A leak is defined as greater than 4% of the sampling rate. Results of the leak check are to be documented within the test report.

50. Test results must be reported as follows for each test run and averaged for all three test runs. Example calculations should be provided for at least one test run.

    - µg/dscm
    - lb/hr
    - lb/ton of glass processed

EPA METHOD 205 CONDITIONS

51. If a gas dilution system is to be used to provide calibration gases for other source test methods, then the system shall be evaluated once during the source test in accordance with the requirements of EPA method 205 to make sure it meets specifications.

EPA METHOD 316 CONDITIONS

52. During sampling, make sure other sampling probes are not interfering with isokinetic sampling.

53. Follow sample storage and handling procedures outlined in sections 8.7.1 and 8.7.2.

54. Field Duplicate Samples, Field Spike Samples and Field Blank Samples are required as outlined in the test method.

55. Lab Blank Samples, Lab Duplicate Samples, and Lab Matrix Spike samples are required as outlined in the test method.

56. Formaldehyde emissions must be reported as indicated below for each individual test run and averaged for all three test runs. Results should include example calculations must be provided for at least one test run.
    - ppmvd
    - lb/hour
    - lb/ton of glass processed
    - lb/1000 scf of natural gas

GENERAL TESTING CONDITIONS

57. The request to extend the test report due date to 60 days after the conclusion of each test campaign is approved.

58. Please include a full lab data package for all samples analyzed by a lab. The detailed data can be sent by CD.

59. DEQ must be notified of any changes in the source test plan and/or the specified methods prior to testing. Significant changes not acknowledged by the DEQ could be basis for invalidating an entire test run and potentially the entire testing program. Documentation of any deviations must include an evaluation of the impact of the deviation on the test data.

60. Method-specific quality assurance/quality control (QA/QC) procedures must be performed to ensure that the data is valid for determining source compliance. This must be done whether or not DEQ representatives are on-site to observe the testing and whether or not a QA/QC requirement has been specifically acknowledged and approved by DEQ. Only method-specific requirements explicitly exempted by the EPA and/or DEQ need not be performed. Documentation of the procedures and results shall be presented in the source test report for review. Omission of this critical information will result in rejection of the data, requiring a retest.

61. A copy of a completed Source Test Audit Report (STAR) for all applicable Methods performed must accompany the submittal of the Source Test Report. A copy of the STAR forms is available electronically from the regional source test coordinator.

62. In an attempt to conserve natural resources and to minimize storage space requirements, the test report should be printed on both sides of each page within the document. The Department recognizes this may not be feasible for some supporting documentation (i.e. figures, maps, etc.).

The Department understands that the source test has been scheduled for June 5 - 18, 2018.

Please let me know if the schedule changes. I plan to observe these tests.
If you have any questions or concerns, please contact me at 503-378-5034.
My cell number is 503-508-1989.

Sincerely,

SBlackburn

Suzanne Blackburn
Environmental Engineer
Source Test Coordinator
DEQ Western Region-Salem

cc: Karen White-Fallon, DEQ

APPENDIX B: CFU 112 (ULTRA ROTARY COARSE) TEST DATA

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112**
DATE	**09/11/18**
METHOD	**13B**
POLLUTANT	**Fluorides**

EPA Method 1
Stack Parameters and Traverse Points

Client:	**Hollingsworth & Vose**
Location:	**Corvallis, OR**
Source:	**CFU 112**
Facility:	**Glass Plant 1**

Type of Testing: p (P for Particulate; V for Velocity/Nonparticulate)
Type of Duct: c (C for circular; R for rectangular)

Number of ports available: 2
Number of ports to be used: 2
Port diameter: 4 inches

Circular ID (Rectangular Depth): 30.00 inches
Port depth and/or wall thickness: 4.00 inches
Stack width (Rectangular only): inches

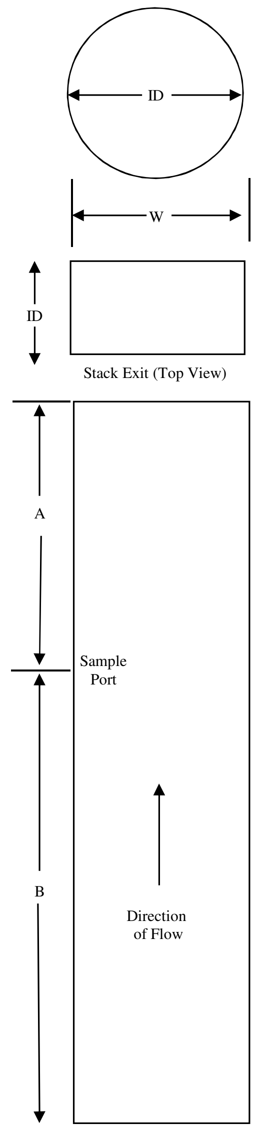
Equivalent Diameter
If rectangluar = $\frac{2*Depth*Width}{Depth + Width}$ = 30.00 inches (If circular = duct ID)
Stack/duct area = 4.909 sq.feet 706.9 sq.inches

Sample Port Location:	Downstrean from flow disturbance from process B	Upstream from flow disturbance toward exit A
Number of Inches:	128.00	102.00
Number of Diameters:	4.27	3.40

Minimum Number of Traverse Points: 24

Points	% of diameter	Distance from inside wall (in.)	Distance including port (in.)
1	2.1	0.63	4 5/8
2	6.7	2.01	6
3	11.8	3.54	7 1/2
4	17.7	5.31	9 1/4
5	25.0	7.50	11 1/2
6	35.6	10.68	14 5/8
7	64.4	19.32	23 3/8
8	75.0	22.50	26 1/2
9	82.3	24.69	28 3/4
10	88.2	26.46	30 1/2
11	93.3	27.99	32
12	97.9	29.37	33 3/8

Reference Diagram



Drawing NOT to scale and
NOT an acurate representation of stack.

Pre Traverse Flow Information

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112

Stack Temp: 192

Traverse Point	Velocity ΔP ("H_2O)	Null Angle
1	1.20	5.0
2	1.30	5.0
3	1.30	5.0
4	1.30	5.0
5	1.40	5.0
6	1.40	5.0
7	1.40	5.0
8	1.50	5.0
9	1.40	5.0
10	1.30	5.0
11	1.40	5.0
12	1.30	5.0
13	1.30	5.0
14	1.20	5.0
15	1.20	5.0
16	1.30	5.0
17	1.30	5.0
18	1.30	5.0
19	1.40	5.0
20	1.40	5.0
21	1.40	5.0
22	1.30	5.0
23	1.20	5.0
24	1.20	5.0
25		
26		
27		
28		
29		
30		

Average: 1.321 5

Flow is found to be:
Non-cyclonic x
Cyclonic

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:35**
Source:	**CFU 112**	**End Time:**	**12:40**
EPA Method:	**13B**	**Date:**	**9/11/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Overcast, 65 degrees

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.91 "Hg	O_2	19.60 %
Static Pressure	0.56 "H_2O	CO_2	0.70 %
Ave. ΔP	1.32 "H_2O	Rec. Nz.	0.2 inches
Stack Temperature	192 F		
Assumed moisture	0.5 %		
Assumed meter temp.	64 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.001	0.001
Leak check vacuum, "Hg	15	10

Nozzle check for roundness:

1	2	3
0.179	0.179	0.180 inches

Caliper ID# MN-2

Post Test Calculations:

Sample volume	72.340 dcf	Ave. ΔP	1.317 "H_2O
Wet mol. weight	28.68 M_s (actual)	Ave. √ΔP	1.1471 "H_2O
Actual H_2O	1.99 %	Ave. ΔH	1.213 "H_2O
Std. meter vol.	72.202 dscf	Ave. T_s	201.2 °F
Isokinetic Average	101.3 %	Ave. T_m	69.4 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	208	8.0
Silica gel, g	257.8	280.9	23.1
		Total water gain:	31.1

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	3.080	1.40	198	61	1.25	1.30	2	252	61
2	10.0	6.020	1.30	198	61	1.16	1.20	2	253	56
3	15.0	9.020	1.40	199	60	1.25	1.20	2	248	58
4	20.0	12.020	1.30	200	63	1.16	1.20	2	250	58
5	25.0	14.980	1.30	199	64	1.17	1.20	2	258	58
6	30.0	18.070	1.40	200	65	1.26	1.30	2	253	58
7	35.0	21.180	1.40	201	66	1.26	1.30	2	256	59
8	40.0	24.150	1.30	201	67	1.17	1.20	2	249	60
9	45.0	27.130	1.30	202	68	1.17	1.20	2	254	61
10	50.0	30.130	1.30	202	68	1.17	1.20	2	251	61
11	55.0	33.120	1.30	202	69	1.17	1.20	2	254	61
12	60.0	36.119	1.30	202	70	1.18	1.20	2	252	61
13	65.0	39.050	1.20	197	70	1.09	1.10	2	257	61
14	70.0	42.060	1.30	198	71	1.19	1.20	2	255	56
15	75.0	45.060	1.30	200	72	1.18	1.20	2	250	56
16	80.0	48.060	1.30	199	72	1.19	1.20	2	252	57
17	85.0	51.180	1.40	202	73	1.27	1.30	2	254	58
18	90.0	54.310	1.40	203	74	1.27	1.30	2	253	59
19	95.0	57.430	1.40	204	74	1.27	1.30	2	251	59
20	100.0	60.460	1.30	204	75	1.18	1.20	2	253	60
21	105.0	63.490	1.30	204	75	1.18	1.20	2	252	60
22	110.0	66.510	1.30	204	76	1.19	1.20	2	250	60
23	115.0	69.420	1.20	204	76	1.09	1.10	2	252	60
24	120.0	72.340	1.20	205	76	1.09	1.10	2	255	60

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**13:05**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:13**
EPA Method:	**13B**	Overcast, 65 degrees	**Date:**	**9/11/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size:	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.91 "Hg	O_2	19.6 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.32 "H_2O	Rec. Nz.	0.200 inches
Stack Temperature	192 F		
Assumed moisture	1.99 %		
Assumed meter temp.	69.4 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.001	0.000
Leak check vacuum, "Hg:	8	5

Nozzle check for roundness:

1	2	3	
0.179	0.179	0.180	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	74.586 dcf	Ave. ΔP	1.363 "H_2O
Wet mol. weight	28.69 M_s (actual)	Ave. √ΔP	1.1665 "H_2O
Actual H_2O	1.93 %	Ave. ΔH	1.271 "H_2O
Std. meter vol.	73.771 dscf	Ave. T_s	189 °F
Isokinetic Average	100.8 %	Ave. T_m	74.3 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	212	12.0
Silica gel, g	258.0	276.8	18.8
		Total water gain:	30.8

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.970	1.30	205	75	1.15	1.20	1	252	65
2	10.0	6.020	1.30	204	76	1.16	1.20	1	257	60
3	15.0	9.150	1.40	205	76	1.25	1.30	1	252	58
4	20.0	12.280	1.40	204	76	1.25	1.30	1	251	57
5	25.0	15.430	1.40	205	76	1.25	1.30	1	254	57
6	30.0	18.560	1.40	204	77	1.25	1.30	1	252	57
7	35.0	21.830	1.50	205	76	1.33	1.40	1	253	57
8	40.0	24.940	1.40	205	76	1.25	1.30	1	249	57
9	45.0	28.100	1.40	203	77	1.25	1.30	1	255	55
10	50.0	31.250	1.40	198	79	1.27	1.30	1	251	54
11	55.0	34.270	1.30	191	76	1.18	1.20	1	254	54
12	60.0	37.199	1.20	184	76	1.10	1.10	1	254	54
13	65.0	40.300	1.40	184	73	1.28	1.30	1	249	54
14	70.0	43.390	1.30	175	74	1.21	1.20	1	253	50
15	75.0	46.410	1.30	178	74	1.20	1.20	1	253	51
16	80.0	49.490	1.30	182	72	1.19	1.20	1	252	52
17	85.0	52.690	1.40	185	73	1.28	1.30	1	252	52
18	90.0	55.910	1.50	186	72	1.36	1.40	1	253	53
19	95.0	59.300	1.60	182	72	1.46	1.50	1	253	53
20	100.0	62.410	1.40	176	72	1.29	1.30	1	255	54
21	105.0	65.620	1.40	171	71	1.30	1.30	1	252	54
22	110.0	68.750	1.30	167	72	1.22	1.30	1	253	54
23	115.0	71.720	1.20	166	71	1.12	1.20	1	253	54
24	120.0	74.586	1.20	171	71	1.11	1.10	1	253	55

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**15:40**
Source:	**CFU 112**	**End Time:**	**17:46**
EPA Method:	**13B**	**Date:**	**9/11/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Overcast, 65 degrees

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size:	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.91 "Hg	O_2	19.6 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.32 "H_2O	Rec. Nz.	0.199 inches
Stack Temperature	192 F		
Assumed moisture	1.93 %		
Assumed meter temp.	74.3 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	9	5

Nozzle check for roundness:

1	2	3	
0.179	0.179	0.180	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	72.238 dcf	Ave. ΔP	1.346 "H_2O
Wet mol. weight	28.66 M_s (actual)	Ave. √ΔP	1.1597 "H_2O
Actual H_2O	2.17 %	Ave. ΔH	1.2 "H_2O
Std. meter vol.	71.880 dscf	Ave. T_s	200.8 °F
Isokinetic Average	99.8 %	Ave. T_m	71 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	212	12.0
Silica gel, g	258.2	280.1	21.9
		Total water gain:	33.9

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.940	1.30	192	69	1.16	1.20	2	256	60
2	10.0	5.940	1.30	190	69	1.17	1.20	2	254	56
3	15.0	8.940	1.30	197	70	1.16	1.20	2	253	58
4	20.0	11.960	1.40	199	70	1.24	1.20	2	253	58
5	25.0	15.030	1.40	200	70	1.24	1.20	2	254	59
6	30.0	18.090	1.40	201	71	1.24	1.20	2	253	59
7	35.0	21.120	1.40	201	71	1.24	1.20	2	254	61
8	40.0	24.120	1.30	203	71	1.15	1.20	2	253	61
9	45.0	27.190	1.40	204	71	1.24	1.20	2	253	61
10	50.0	30.230	1.40	205	72	1.24	1.20	2	254	61
11	55.0	33.210	1.30	205	72	1.15	1.20	2	252	61
12	60.0	36.187	1.30	203	72	1.15	1.20	2	252	61
13	65.0	39.110	1.30	202	71	1.15	1.20	2	252	62
14	70.0	42.010	1.20	203	72	1.06	1.10	2	253	57
15	75.0	44.890	1.20	203	72	1.06	1.10	2	255	58
16	80.0	47.900	1.40	203	71	1.24	1.20	2	256	59
17	85.0	51.040	1.50	203	72	1.33	1.30	2	251	60
18	90.0	54.140	1.40	202	72	1.24	1.20	2	253	61
19	95.0	57.260	1.40	200	72	1.25	1.30	2	255	61
20	100.0	60.310	1.40	200	71	1.24	1.20	2	252	61
21	105.0	63.290	1.30	200	71	1.15	1.20	2	254	62
22	110.0	66.280	1.30	200	71	1.15	1.20	2	253	62
23	115.0	69.230	1.30	201	71	1.15	1.20	2	254	62
24	120.0	72.238	1.40	201	71	1.24	1.20	2	253	63

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:35**
Source:	**CFU 112**	**End Time:**	**12:40**
Method:	**13B**	**Date:**	**9/11/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m ^oF	Traverse Point	Dp "H_2O	Stack T_s ^oF	$\sqrt{Dp}$
	0.000						
5	3.080	1.30	61	1	1.40	198	1.1832
10	6.020	1.20	61	2	1.30	198	1.1402
15	9.020	1.20	60	3	1.40	199	1.1832
20	12.020	1.20	63	4	1.30	200	1.1402
25	14.980	1.20	64	5	1.30	199	1.1402
30	18.070	1.30	65	6	1.40	200	1.1832
35	21.180	1.30	66	7	1.40	201	1.1832
40	24.150	1.20	67	8	1.30	201	1.1402
45	27.130	1.20	68	9	1.30	202	1.1402
50	30.130	1.20	68	10	1.30	202	1.1402
55	33.120	1.20	69	11	1.30	202	1.1402
60	36.119	1.20	70	12	1.30	202	1.1402
65	39.050	1.10	70	13	1.20	197	1.0954
70	42.060	1.20	71	14	1.30	198	1.1402
75	45.060	1.20	72	15	1.30	200	1.1402
80	48.060	1.20	72	16	1.30	199	1.1402
85	51.180	1.30	73	17	1.40	202	1.1832
90	54.310	1.30	74	18	1.40	203	1.1832
95	57.430	1.30	74	19	1.40	204	1.1832
100	60.460	1.20	75	20	1.30	204	1.1402
105	63.490	1.20	75	21	1.30	204	1.1402
110	66.510	1.20	76	22	1.30	204	1.1402
115	69.420	1.10	76	23	1.20	204	1.0954
120	72.340	1.10	76	24	1.20	205	1.0954

Client:	Hollingsworth & Vose		Run:	1
Source:	CFU 112		Date:	09/11/18

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	72.340	dcf	Rectangular		
Water Volume	31.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.91	"Hg	CO_2 Average	0.47	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.16	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.213	"H_2O	$\sqrt{Dp}$	1.1471	"H_2O
Temperature, T_m	69.4	^oF	Temperature, T_s	201.2	^oF
Temperature, T_m	529.4	^oA (^oR)	Temperature, T_s	661.2	^oA (R)
Pressure Meter, P_m	29.999	"Hg	Pressure Stack, P_s	29.951	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	72.202	dscf	Velocity, V_s	72.30	fps
	2.045	dscm	Volume (actual)	21,295.2	awcfm
Actual Volume, $V_{m(actual)}$	92.194	awcf		20,871.4	adcfm
Gas Stream Moisture			Volume (standard)	1,021,373.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.464	scf		1,001,048.3	dscf/hr
Moisture, B_{ws}	0.0199			16,684.1	dscf/min
Moisture EPA M4	1.99	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	481.962	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.66	lb/lb-mole			
Percent Isokinetic	101.2	%			

Laboratory Results

Fluoride	< 30.0	µg/sample			
Fluoride	< 3.00E-05	grams	MW F	19.0	g/mole
Emissions:					
Concentration, C_s	< 6.41E-06	gr/dscf			
	< 14.67	µg/dscm			
	< 1.86E-02	ppmvd			
Mass Emissions	< 9.17E-04	lb/hr			

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:05**
Source:	**CFU 112**	**End Time:**	**15:13**
Method:	**13B**	**Date:**	**09/11/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
5	2.970	1.20	75	1	1.30	205	1.1402
10	6.020	1.20	76	2	1.30	204	1.1402
15	9.150	1.30	76	3	1.40	205	1.1832
20	12.280	1.30	76	4	1.40	204	1.1832
25	15.430	1.30	76	5	1.40	205	1.1832
30	18.560	1.30	77	6	1.40	204	1.1832
35	21.830	1.40	76	7	1.50	205	1.2247
40	24.940	1.30	76	8	1.40	205	1.1832
45	28.100	1.30	77	9	1.40	203	1.1832
50	31.250	1.30	79	10	1.40	198	1.1832
55	34.270	1.20	76	11	1.30	191	1.1402
60	37.199	1.10	76	12	1.20	184	1.0954
65	40.300	1.30	73	13	1.40	184	1.1832
70	43.390	1.20	74	14	1.30	175	1.1402
75	46.410	1.20	74	15	1.30	178	1.1402
80	49.490	1.20	72	16	1.30	182	1.1402
85	52.690	1.30	73	17	1.40	185	1.1832
90	55.910	1.40	72	18	1.50	186	1.2247
95	59.300	1.50	72	19	1.60	182	1.2649
100	62.410	1.30	72	20	1.40	176	1.1832
105	65.620	1.30	71	21	1.40	171	1.1832
110	68.750	1.30	72	22	1.30	167	1.1402
115	71.720	1.20	71	23	1.20	166	1.0954
120	74.586	1.10	71	24	1.20	171	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 112**	**Date:**	**09/11/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	74.586	dcf	Rectangular		
Water Volume	30.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.91	"Hg	CO_2 Average	0.45	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.11	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.271	"H_2O	$\sqrt{Dp}$	1.1665	"H_2O
Temperature, T_m	74.3	^oF	Temperature, T_s	189.0	^oF
Temperature, T_m	534.3	^oA (^oR)	Temperature, T_s	649.0	^oA (R)
Pressure Meter, P_m	30.003	"Hg	Pressure Stack, P_s	29.951	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	73.771	dscf	Velocity, V_s	72.83	fps
	2.089	dscm	Volume (actual)	21,451.3	awcfm
Actual Volume, $V_{m(actual)}$	92.402	awcf		21,037.3	adcfm
Gas Stream Moisture			Volume (standard)	1,048,201.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.449	scf		1,027,971.3	dscf/hr
Moisture, B_{ws}	0.0193			17,132.9	dscf/min
Moisture EPA M4	1.93	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	473.069	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	100.7	%			

Laboratory Results

Fluoride	< 30.0	µg/sample			
Fluoride	< 3.00E-05	grams	MW F	19.0	g/mole

Emissions:

Concentration, C_s	< 6.27E-06	gr/dscf
	< 14.36	µg/dscm
	< 1.82E-02	ppmvd
Mass Emissions	< 9.21E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**15:40**
Source:	**CFU 112**	**End Time:**	**17:46**
Method:	**13B**	**Date:**	**09/11/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
5	2.940	1.20	69	1	1.30	192	1.1402
10	5.940	1.20	69	2	1.30	190	1.1402
15	8.940	1.20	70	3	1.30	197	1.1402
20	11.960	1.20	70	4	1.40	199	1.1832
25	15.030	1.20	70	5	1.40	200	1.1832
30	18.090	1.20	71	6	1.40	201	1.1832
35	21.120	1.20	71	7	1.40	201	1.1832
40	24.120	1.20	71	8	1.30	203	1.1402
45	27.190	1.20	71	9	1.40	204	1.1832
50	30.230	1.20	72	10	1.40	205	1.1832
55	33.210	1.20	72	11	1.30	205	1.1402
60	36.187	1.20	72	12	1.30	203	1.1402
65	39.110	1.20	71	13	1.30	202	1.1402
70	42.010	1.10	72	14	1.20	203	1.0954
75	44.890	1.10	72	15	1.20	203	1.0954
80	47.900	1.20	71	16	1.40	203	1.1832
85	51.040	1.30	72	17	1.50	203	1.2247
90	54.140	1.20	72	18	1.40	202	1.1832
95	57.260	1.30	72	19	1.40	200	1.1832
100	60.310	1.20	71	20	1.40	200	1.1832
105	63.290	1.20	71	21	1.30	200	1.1402
110	66.280	1.20	71	22	1.30	200	1.1402
115	69.230	1.20	71	23	1.30	201	1.1402
120	72.238	1.20	71	24	1.40	201	1.1832

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 112**	**Date:**	**09/11/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	72.238	dcf	Rectangular		
Water Volume	33.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.91	"Hg	CO_2 Average	0.48	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.16	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.200	"H_2O	$\sqrt{Dp}$	1.1597	"H_2O
Temperature, T_m	71.0	^oF	Temperature, T_s	200.8	^oF
Temperature, T_m	531.0	^oA (^oR)	Temperature, T_s	660.8	^oA (R)
Pressure Meter, P_m	29.998	"Hg	Pressure Stack, P_s	29.951	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	71.880	dscf	Velocity, V_s	73.09	fps
	2.035	dscm	Volume (actual)	21,527.9	awcfm
Actual Volume, $V_{m(actual)}$	91.896	awcf		21,060.7	adcfm
Gas Stream Moisture			Volume (standard)	1,033,158.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.595	scf		1,010,739.4	dscf/hr
Moisture, B_{ws}	0.0217			16,845.7	dscf/min
Moisture EPA M4	2.17	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	481.67	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.64	lb/lb-mole			
Percent Isokinetic	99.8	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	< 6.44E-06	gr/dscf
	< 14.74	µg/dscm
	< 1.87E-02	ppmvd
Mass Emissions	< 9.30E-04	lb/hr

"<" represents MDL value

EPA Method 13B
Laboratory Results
Total Fluoride

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 112**

Lab ID	Sample ID	Sample Date		Result	MDL	Units
18-S2201	CFU 112 Cont #1 Run 1	9/11/2018	<	MDL	30.0	µg/sample
18-S2202	CFU 112 Cont #1 Run 2	9/11/2018	<	MDL	30.0	µg/sample
18-S2203	CFU 112 Cont #1 Run 3	9/11/2018	<	MDL	30.0	µg/sample
18-S2210	H20 + Filter Blank	9/11/2018	<	MDL	30.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 13B
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112

Run			1	2	3	Average
Date			9/11/2018	9/11/2018	9/11/2018	
Run Start Time			10:35	13:05	15:40	
Run End Time			12:40	15:13	17:46	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.91	29.91	29.91	**29.91**
Nozzle Dia., in.			0.1793	0.1793	0.1793	**0.1793**
Isokinetic Average, %			101.2	100.7	99.8	**100.6**
Sample Volume, dscf			72.202	73.771	71.880	**72.618**
Sample Volume, dscm			2.045	2.089	2.035	**2.056**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.47	0.45	0.48	**0.47**
O_2 %vd			20.16	20.11	20.16	**20.14**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.99	1.93	2.17	**2.03**
Wet Molecular Weight, lb/lb-mole			28.66	28.67	28.64	**28.66**
Velocity, FPS			72.30	72.83	73.09	**72.74**
ADCFM			20,871.4	21,037.3	21,060.7	**20,989.8**
AWCFM			21,295.2	21,451.3	21,527.9	**21,424.8**
DSCFM			16,684.1	17,132.9	16,845.7	**16,887.6**
Stack Temperature, ^oF			201.2	189.0	200.8	**197.0**
Fluoride	Concentration, C_s	gr/dscf	< 6.41E-06	< 6.27E-06	< 6.44E-06	< **6.38E-06**
		µg/dscm	< 14.67	< 14.36	< 14.74	< **14.59**
		ppmvd	< 1.86E-02	< 1.82E-02	< 1.87E-02	< **1.85E-02**
	Mass	lb/hr	< 9.17E-04	< 9.21E-04	< 9.30E-04	< **9.23E-04**
		lb/lb glass	< 1.38E-06	< 1.34E-06	< 1.30E-06	< **1.34E-06**
Production Data	Glass Production	lbs/hr	665.0	689.2	713.4	**689.2**

"<" represents MDL value

EPA Methods 1-4, 13B
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:35**
Source:	**CFU 112**	**End Time:**	**12:40**
Method:	**13B**	**Date:**	**9/11/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.999 "Hg

where Pb: 29.91 "Hg
ΔH: 1.213 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.951 "Hg

where Pb: 29.91 "Hg
Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 72.202 dscf

where Vm: 72.340 dcf
Y: 0.9985
Pm: 29.999 "Hg
Tm: 529.4 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.464 scf

where H_2O: 31.10 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0199

where Vw(std): 1.464 scf
Vm(std): 72.202 dscf

6) % H_2O = Bws x 100 = 1.99 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 92.194 awcf

where Y: 0.9985
Vm: 72.3400 dcf
Bws: 0.0199
Ts: 661.2 °A
Tm: 529.4 °A
Pm: 29.999 "Hg
Ps: 29.951 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.88 lb/lb-mole

where CO_2: 0.47 %vd
O_2 20.16 %vd
N_2+CO= (100-(O_2+CO_2): 79.37 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.66 lb/lb-mole
where M_d: 28.88 lb/lb-mole
Bws: 0.0199

10) $\text{Stack Area(cir.)} = 3.1416$ (stack diameter/24)^2 = 4.909 sq. ft.
where Stack ID: 30 inches

$\text{Stack Area(rect.)} =$ stack width/12 x stack length/12 = NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(\text{Cp})(\text{Ave. Sqrt } \Delta\text{P})\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 72.30 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.1471
Ts: 661.2 °A
Ps: 29.951 "Hg
Ms: 28.66 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 21,295.2 AWCFM
where V_s: 72.30 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 20,871.4 ADCFM
where AWCFM: 21,295.2
Bws: 0.0199

14) $\text{Qsw} = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,021,373.6 wscf/hr
where V_s: 72.30 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 661.2 °A
Ps: 29.951 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,001,048.3 dscf/hr
where wscf/hr: 1,021,373.6
Bws: 0.0199

16) DSCFM= (dscf/hr)/60 mins/hr = 16,684.1 DSCFM
where dscf/hr: 1,001,048.3

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000175 sq. ft.
where Nozzle Size: 0.1793 inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 101.2 %

where Ts:	661.2	°A
Vm(Std):	72.202	dscf
Ps:	29.951	"Hg
Vs	72.30	ft/sec
Nozzle Area:	0.000175	sq. ft.
Sampling Time:	120	min.
Bws:	0.0199	

EPA Method 13B:

19) Fluoride laboratory results < 30.0 µg/sample

20) Fluoride = (µg/sample)/1,000,000 = < 3.00E-05 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 6.41E-06 gr/dscf

where Sample:	0.00003	grams
Vm(std)	72.202	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 14.67 µg/dscm

where Sample:	0.00003	grams
Vm(std)	2.045	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 481.962 Vol./Mole

where Ts:	661.2	°A
Ps:	29.951	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.86E-02 ppmvd

where MW:	19.0	g/mol
lb/hr:	0.00	
Vol./Mole:	481.962	
ADCFM:	20871.4	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 9.17E-04 lb/hr

where Cs:	6.41E-06	gr/dscf
Stack Flow:	1,001,048.3	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112**
DATE	**09/11/18**
METHOD	**26A**
POLLUTANT	**HF**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**10:36**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**		**End Time:**	**12:41**
EPA Method:	**26A**	Overcast 67 F Wind 1-3 Variable		**Date:**	**9/11/2018**
Box Operator:	**CMF**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	Box 12	Probe ID	3C	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size	0.2173 inches
ΔH@	1.846	Hot box ID	M5-hp	Nozzle area	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.91 "Hg	O_2	19.60 %
Static Pressure	0.56 "H_2O	CO_2	0.70 %
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.200 inches
Stack Temperature	192 F		
Assumed moisture	0.5 %		
Assumed meter temp.	64 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.002	0.001
Leak check vacuum, "Hg	10	9

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	107.170 dcf	Ave. ΔP	1.329 "H_2O
Wet mol. weight	28.68 M_s (actual)	Ave. √ΔP	1.1526 "H_2O
Actual H_2O	1.98 %	Ave. ΔH	2.671 "H_2O
Std. meter vol.	106.767 dscf	Ave. T_s	202.1 °F
Isokinetic Average	101.1 %	Ave. T_m	73.5 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	218	18.0
Silica gel, g	254.5	282.3	27.8
		Total water gain:	45.8

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.330	1.30	200	62	2.57	2.60	3	252	58
2	10.0	8.620	1.30	200	63	2.58	2.60	3	252	53
3	15.0	13.000	1.30	201	65	2.58	2.60	3	253	53
4	20.0	17.330	1.30	201	66	2.59	2.60	3	252	53
5	25.0	21.870	1.40	201	68	2.80	2.80	3	252	54
6	30.0	26.410	1.40	201	69	2.80	2.80	4	251	55
7	35.0	30.800	1.30	201	71	2.61	2.60	4	252	57
8	40.0	35.200	1.30	201	71	2.61	2.60	4	251	60
9	45.0	39.510	1.30	202	73	2.62	2.60	4	251	60
10	50.0	44.010	1.30	202	73	2.62	2.60	4	251	59
11	55.0	48.400	1.30	202	74	2.62	2.60	4	251	58
12	60.0	52.903	1.30	201	75	2.63	2.60	4	252	58
13	65.0	57.330	1.30	202	74	2.62	2.60	4	251	50
14	70.0	61.810	1.30	202	76	2.63	2.60	4	250	50
15	75.0	66.400	1.40	202	76	2.83	2.80	4	250	50
16	80.0	71.170	1.50	203	77	3.04	3.00	4	250	48
17	85.0	75.950	1.50	204	77	3.03	3.00	4	250	48
18	90.0	80.330	1.30	204	78	2.63	2.60	4	251	49
19	95.0	84.770	1.30	204	78	2.63	2.60	4	251	50
20	100.0	89.200	1.30	204	78	2.63	2.60	4	251	50
21	105.0	93.750	1.30	204	79	2.64	2.60	4	251	50
22	110.0	98.150	1.30	203	80	2.65	2.70	4	251	50
23	115.0	102.640	1.30	203	80	2.65	2.70	4	251	51
24	120.0	107.170	1.30	202	80	2.65	2.70	4	80	51

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**13:06**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:14**
EPA Method:	**26A**	Raining 63 F Wind 1-3 Variable	**Date:**	**9/11/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	Box 12	Probe ID	3C	Liner type:	Glass	
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173	inches
ΔH@	1.846	Hot box ID	M5-hp	Nozzle area:	0.000258	sq.ft.
		Pitot Cp	0.84	Probe heat:	250	F
				Filter heat:	250	F

Source Information:

Barometric Pressure	29.91 "Hg	O_2	19.6	%
Static Pressure	0.56 "H_2O	CO_2	0.7	%
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.199	inches
Stack Temperature	192 F			
Assumed moisture	1.98 %			
Assumed meter temp.	73.5 F			
Total number of points	24			
Time per point	5			
Total run time	120			

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	6

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	108.484 dcf	Ave. ΔP	1.308 "H_2O
Wet mol. weight	28.64 M_s (actual)	Ave. √ΔP	1.1436 "H_2O
Actual H_2O	2.38 %	Ave. ΔH	2.7 "H_2O
Std. meter vol.	107.343 dscf	Ave. T_s	188.8 °F
Isokinetic Average	101.8 %	Ave. T_m	77.2 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	228	28.0
Silica gel, g	260.1	287.8	27.7
		Total water gain:	55.7

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.370	1.30	206	79	2.57	2.60	4	253	60
2	10.0	8.850	1.30	206	79	2.57	2.60	4	252	60
3	15.0	13.320	1.30	206	79	2.57	2.60	4	252	50
4	20.0	17.790	1.30	206	79	2.57	2.60	4	252	51
5	25.0	22.370	1.40	206	79	2.77	2.80	4	251	51
6	30.0	26.800	1.30	204	80	2.58	2.70	4	251	51
7	35.0	31.500	1.40	205	79	2.77	2.80	4	251	52
8	40.0	35.990	1.30	204	79	2.58	2.60	4	248	52
9	45.0	40.420	1.30	203	79	2.58	2.60	4	252	52
10	50.0	45.080	1.40	196	79	2.81	2.90	4	252	52
11	55.0	49.620	1.30	189	79	2.64	2.70	4	251	52
12	60.0	54.165	1.30	184	79	2.66	2.70	4	252	52
13	65.0	58.680	1.30	176	76	2.68	2.70	4	252	54
14	70.0	63.200	1.30	177	76	2.67	2.70	4	252	54
15	75.0	67.720	1.30	179	76	2.66	2.70	4	252	51
16	80.0	72.240	1.30	184	75	2.64	2.70	4	252	53
17	85.0	76.810	1.30	186	75	2.63	2.70	4	251	53
18	90.0	81.340	1.40	186	75	2.83	2.90	4	251	53
19	95.0	85.910	1.30	181	75	2.65	2.70	4	252	53
20	100.0	90.420	1.30	175	75	2.68	2.70	4	251	54
21	105.0	94.990	1.30	169	75	2.70	2.80	4	251	54
22	110.0	99.630	1.30	166	75	2.71	2.80	4	251	54
23	115.0	104.060	1.20	166	75	2.51	2.60	4	252	55
24	120.0	108.484	1.20	170	75	2.49	2.60	4	251	55

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**3**
Location:	**Corvallis, OR**			**Start Time:**	**15:40**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**		**End Time:**	**17:47**
EPA Method:	**26A**	Raining 63 F Wind 1-3 Variable		**Date:**	**9/11/2018**
Box Operator:	**CMF**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	Box 12	Probe ID	3C	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	M5-hp	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.91 "Hg	O_2	19.6 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.199 inches
Stack Temperature	192 F		
Assumed moisture	2.38 %		
Assumed meter temp.	77.2 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.001
Leak check vacuum, "Hg:	9	6

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	106.576 dcf	Ave. ΔP	1.333 "H_2O
Wet mol. weight	28.64 M_s (actual)	Ave. √ΔP	1.1543 "H_2O
Actual H_2O	2.41 %	Ave. ΔH	2.663 "H_2O
Std. meter vol.	105.957 dscf	Ave. T_s	201.8 °F
Isokinetic Average	100.6 %	Ave. T_m	74.6 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	247.3	278	30.7
		Total water gain:	55.7

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.390	1.30	194	71	2.56	2.60	3	252	57
2	10.0	8.750	1.30	198	72	2.55	2.60	3	252	57
3	15.0	13.170	1.30	200	72	2.54	2.60	3	252	59
4	20.0	17.720	1.40	201	72	2.73	2.80	3	252	60
5	25.0	22.290	1.40	201	73	2.74	2.80	3	251	61
6	30.0	26.990	1.50	202	74	2.94	3.00	3	251	63
7	35.0	31.580	1.40	203	74	2.74	2.80	3	251	66
8	40.0	36.000	1.30	203	75	2.55	2.60	3	251	64
9	45.0	40.510	1.40	204	75	2.74	2.80	3	251	62
10	50.0	44.880	1.30	204	75	2.54	2.60	3	251	61
11	55.0	49.290	1.30	203	76	2.55	2.60	3	251	62
12	60.0	53.688	1.30	202	76	2.55	2.60	3	250	61
13	65.0	57.950	1.20	202	75	2.35	2.40	3	251	60
14	70.0	62.300	1.30	202	75	2.55	2.60	3	251	60
15	75.0	66.690	1.30	202	76	2.55	2.60	3	251	60
16	80.0	71.040	1.40	203	76	2.75	2.80	3	250	62
17	85.0	75.540	1.40	203	75	2.74	2.70	3	251	63
18	90.0	80.130	1.40	202	76	2.75	2.80	3	252	64
19	95.0	84.690	1.40	202	76	2.75	2.80	4	251	64
20	100.0	89.110	1.30	202	75	2.55	2.60	4	252	64
21	105.0	93.500	1.30	202	76	2.55	2.60	4	251	66
22	110.0	97.900	1.30	202	76	2.55	2.60	3	251	66
23	115.0	102.260	1.30	203	75	2.55	2.60	3	251	66
24	120.0	106.576	1.20	203	75	2.35	2.40	3	251	68

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:36**
Source:	**CFU 112**	**End Time:**	**12:41**
Method:	**26A**	**Date:**	**9/11/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
5	4.330	2.60	62	1	1.30	200	1.1402
10	8.620	2.60	63	2	1.30	200	1.1402
15	13.000	2.60	65	3	1.30	201	1.1402
20	17.330	2.60	66	4	1.30	201	1.1402
25	21.870	2.80	68	5	1.40	201	1.1832
30	26.410	2.80	69	6	1.40	201	1.1832
35	30.800	2.60	71	7	1.30	201	1.1402
40	35.200	2.60	71	8	1.30	201	1.1402
45	39.510	2.60	73	9	1.30	202	1.1402
50	44.010	2.60	73	10	1.30	202	1.1402
55	48.400	2.60	74	11	1.30	202	1.1402
60	52.903	2.60	75	12	1.30	201	1.1402
65	57.330	2.60	74	13	1.30	202	1.1402
70	61.810	2.60	76	14	1.30	202	1.1402
75	66.400	2.80	76	15	1.40	202	1.1832
80	71.170	3.00	77	16	1.50	203	1.2247
85	75.950	3.00	77	17	1.50	204	1.2247
90	80.330	2.60	78	18	1.30	204	1.1402
95	84.770	2.60	78	19	1.30	204	1.1402
100	89.200	2.60	78	20	1.30	204	1.1402
105	93.750	2.60	79	21	1.30	204	1.1402
110	98.150	2.70	80	22	1.30	203	1.1402
115	102.640	2.70	80	23	1.30	203	1.1402
120	107.170	2.70	80	24	1.30	202	1.1402

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Source:	**CFU 112**		**Date:**	**09/11/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	107.170	dcf	Rectangular		
Water Volume	45.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.91	"Hg	CO_2 Average	0.47	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.16	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.671	"H_2O	$\sqrt{Dp}$	1.1526	"H_2O
Temperature, T_m	73.5	^oF	Temperature, T_s	202.1	^oF
Temperature, T_m	533.5	^oA (^oR)	Temperature, T_s	662.1	^oA (R)
Pressure Meter, P_m	30.106	"Hg	Pressure Stack, P_s	29.951	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	106.767	dscf	Velocity, V_s	72.69	fps
	3.023	dscm	Volume (actual)	21,410.1	awcfm
Actual Volume, $V_{m(actual)}$	136.501	awcf		20,986.2	adcfm
Gas Stream Moisture			Volume (standard)	1,025,487.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.155	scf		1,005,182.7	dscf/hr
Moisture, B_{ws}	0.0198			16,753.0	dscf/min
Moisture EPA M4	1.98	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	482.618	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.66	lb/lb-mole			
Percent Isokinetic	101.1	%			

Laboratory Results

HF	< 4.05	µg/sample			
HF	< 4.05E-06	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	< 5.85E-07	gr/dscf
	< 1.34	µg/dscm
	< 1.61E-03	ppmvd
Mass Emissions HF	< 8.40E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:06**
Source:	**CFU 112**	**End Time:**	**15:14**
Method:	**26A**	**Date:**	**09/11/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**√Dp**
	0.000						
5	4.370	2.60	79	1	1.30	206	1.1402
10	8.850	2.60	79	2	1.30	206	1.1402
15	13.320	2.60	79	3	1.30	206	1.1402
20	17.790	2.60	79	4	1.30	206	1.1402
25	22.370	2.80	79	5	1.40	206	1.1832
30	26.800	2.70	80	6	1.30	204	1.1402
35	31.500	2.80	79	7	1.40	205	1.1832
40	35.990	2.60	79	8	1.30	204	1.1402
45	40.420	2.60	79	9	1.30	203	1.1402
50	45.080	2.90	79	10	1.40	196	1.1832
55	49.620	2.70	79	11	1.30	189	1.1402
60	54.165	2.70	79	12	1.30	184	1.1402
65	58.680	2.70	76	13	1.30	176	1.1402
70	63.200	2.70	76	14	1.30	177	1.1402
75	67.720	2.70	76	15	1.30	179	1.1402
80	72.240	2.70	75	16	1.30	184	1.1402
85	76.810	2.70	75	17	1.30	186	1.1402
90	81.340	2.90	75	18	1.40	186	1.1832
95	85.910	2.70	75	19	1.30	181	1.1402
100	90.420	2.70	75	20	1.30	175	1.1402
105	94.990	2.80	75	21	1.30	169	1.1402
110	99.630	2.80	75	22	1.30	166	1.1402
115	104.060	2.60	75	23	1.20	166	1.0954
120	108.484	2.60	75	24	1.20	170	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 112**	**Date:**	**09/11/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	108.484	dcf	Rectangular		
Water Volume	55.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.91	"Hg	CO_2 Average	0.45	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.11	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.700	"H_2O	√Dp	1.1436	"H_2O
Temperature, T_m	77.2	^oF	Temperature, T_s	188.8	^oF
Temperature, T_m	537.2	^oA (^oR)	Temperature, T_s	648.8	^oA (R)
Pressure Meter, P_m	30.109	"Hg	Pressure Stack, P_s	29.951	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	107.342	dscf	Velocity, V_s	71.45	fps
	3.040	dscm	Volume (actual)	21,044.9	awcfm
Actual Volume, $V_{m(actual)}$	135.031	awcf		20,544.0	adcfm
Gas Stream Moisture			Volume (standard)	1,028,657.0	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.621	scf		1,004,175.0	dscf/hr
Moisture, B_{ws}	0.0238			16,736.3	dscf/min
Moisture EPA M4	2.38	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	472.923	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.62	lb/lb-mole			
Percent Isokinetic	101.8	%			

Laboratory Results

HF	< 3.69	µg/sample		
HF	< 3.69E-06	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	< 5.30E-07	gr/dscf
	< 1.21	µg/dscm
	< 1.46E-03	ppmvd
Mass Emissions HF	< 7.61E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**15:40**
Source:	**CFU 112**	**End Time:**	**17:47**
Method:	**26A**	**Date:**	**09/11/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
5	4.390	2.60	71	1	1.30	194	1.1402
10	8.750	2.60	72	2	1.30	198	1.1402
15	13.170	2.60	72	3	1.30	200	1.1402
20	17.720	2.80	72	4	1.40	201	1.1832
25	22.290	2.80	73	5	1.40	201	1.1832
30	26.990	3.00	74	6	1.50	202	1.2247
35	31.580	2.80	74	7	1.40	203	1.1832
40	36.000	2.60	75	8	1.30	203	1.1402
45	40.510	2.80	75	9	1.40	204	1.1832
50	44.880	2.60	75	10	1.30	204	1.1402
55	49.290	2.60	76	11	1.30	203	1.1402
60	53.688	2.60	76	12	1.30	202	1.1402
65	57.950	2.40	75	13	1.20	202	1.0954
70	62.300	2.60	75	14	1.30	202	1.1402
75	66.690	2.60	76	15	1.30	202	1.1402
80	71.040	2.80	76	16	1.40	203	1.1832
85	75.540	2.70	75	17	1.40	203	1.1832
90	80.130	2.80	76	18	1.40	202	1.1832
95	84.690	2.80	76	19	1.40	202	1.1832
100	89.110	2.60	75	20	1.30	202	1.1402
105	93.500	2.60	76	21	1.30	202	1.1402
110	97.900	2.60	76	22	1.30	202	1.1402
115	102.260	2.60	75	23	1.30	203	1.1402
120	106.576	2.40	75	24	1.20	203	1.0954

Client:	Hollingsworth & Vose	Run:	3
Source:	CFU 112	Date:	09/11/18

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	106.576	dcf	Rectangular		
Water Volume	55.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.91	"Hg	CO_2 Average	0.48	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.16	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.663	"H_2O	√Dp	1.1543	"H_2O
Temperature, T_m	74.6	^oF	Temperature, T_s	201.8	^oF
Temperature, T_m	534.6	^oA (^oR)	Temperature, T_s	661.8	^oA (R)
Pressure Meter, P_m	30.106	"Hg	Pressure Stack, P_s	29.951	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	105.957	dscf	Velocity, V_s	72.83	fps
	3.000	dscm	Volume (actual)	21,451.3	awcfm
Actual Volume, $V_{m(actual)}$	136.001	awcf		20,934.3	adcfm
Gas Stream Moisture			Volume (standard)	1,027,928.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.621	scf		1,003,155.0	dscf/hr
Moisture, B_{ws}	0.0241			16,719.3	dscf/min
Moisture EPA M4	2.41	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	482.399	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.62	lb/lb-mole			
Percent Isokinetic	100.5	%			

Laboratory Results

HF	< 3.71	μg/sample			
HF	< 3.71E-06	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	< 5.40E-07	gr/dscf
	< 1.24	μg/dscm
	< 1.49E-03	ppmvd
Mass Emissions HF	< 7.74E-05	lb/hr

"<" represents MDL value

EPA Method 26A
Laboratory Results
HF

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 112**

Lab ID	Sample ID	Sample Date		Result	MDL	Sample Vol. (ml)	Units
18-S2212	CFU-112 Cont. 3 Run 1	9/11/2018	<	MDL	4.05	385.0	µg/sample
18-S2213	CFU-112 Cont. 3 Run 2	9/11/2018	<	MDL	3.69	350.0	µg/sample
18-S2214	CFU-112 Cont. 3 Run 3	9/11/2018	<	MDL	3.71	352.0	µg/sample
18-S2221	0.1N H2SO4 Blank	9/11/2018	<	MDL	4.45	423.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 26A
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112

Run			1	2	3	Average
Date			9/11/2018	9/11/2018	9/11/2018	
Run Start Time			10:36	13:06	15:40	
Run End Time			12:41	15:14	17:47	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.91	29.91	29.91	**29.91**
Nozzle Dia., in.			0.2173	0.2173	0.2173	**0.2173**
Isokinetic Average, %			101.1	101.8	100.5	**101.1**
Sample Volume, dscf			106.767	107.342	105.957	**106.689**
Sample Volume, dscm			3.023	3.040	3.000	**3.021**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.47	0.45	0.48	**0.47**
O_2 %vd			20.16	20.11	20.16	**20.14**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.98	2.38	2.41	**2.26**
Wet Molecular Weight, lb/lb-mole			28.66	28.62	28.62	**28.63**
Velocity, FPS			72.69	71.45	72.83	**72.32**
ADCFM			20,986.2	20,544.0	20,934.3	**20,821.5**
AWCFM			21,410.1	21,044.9	21,451.3	**21,302.1**
DSCFM			16,753.0	16,736.3	16,719.3	**16,736.2**
Stack Temperature, ^oF			202.1	188.8	201.8	**197.6**
HF	Concentration, C_s	gr/dscf	< 5.85E-07	< 5.30E-07	< 5.40E-07	< **5.52E-07**
		µg/dscm	< 1.34	< 1.21	< 1.24	< **1.26**
		ppmvd	< 1.61E-03	< 1.46E-03	< 1.49E-03	< **1.52E-03**
	Mass	lb/hr	< 8.40E-05	< 7.61E-05	< 7.74E-05	< **7.92E-05**
		lb/lb glass	< 1.26E-07	< 1.10E-07	< 1.09E-07	< **1.15E-07**
Production Data	Glass Production	lbs/hr	665.0	689.2	713.4	**689.2**

"<" represents MDL value

EPA Methods 1-4, 26A
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:36**
Source:	**CFU 112**	**End Time:**	**12:41**
Method:	**26A**	**Date:**	**9/11/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.106 "Hg

where Pb: 29.91 "Hg
ΔH: 2.671 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.951 "Hg

where Pb: 29.91 "Hg
Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 106.767 dscf

where Vm: 107.170 dcf
Y: 1.0008
Pm: 30.106 "Hg
Tm: 533.5 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.155 scf

where H_2O: 45.80 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0198

where Vw(std): 2.155 scf
Vm(std): 106.767 dscf

6) % H_2O = Bws x 100 = 1.98 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 136.501 awcf

where Y: 1.0008
Vm: 107.1699 dcf
Bws: 0.0198
Ts: 662.1 °A
Tm: 533.5 °A
Pm: 30.106 "Hg
Ps: 29.951 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.88 lb/lb-mole

where CO_2: 0.47 %vd
O_2 20.16 %vd
N_2+CO= (100-(O_2+CO_2): 79.37 %vd

9) $M_s = M_d(1 - Bws) + (18 \times Bws) =$ 28.66 lb/lb-mole
where M_d: 28.88 lb/lb-mole
Bws: 0.0198

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 4.909 sq. ft.
where Stack ID: 30 inches

Stack Area(rect.) = stack width/12 x stack length/12 = NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) Velocity, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 72.69 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.1526
Ts: 662.1 °A
Ps: 29.951 "Hg
Ms: 28.66 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 21,410.1 AWCFM
where V_s: 72.69 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 20,986.2 ADCFM
where AWCFM: 21,410.1
Bws: 0.0198

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right) =$ 1,025,487.3 wscf/hr
where V_s: 72.69 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 662.1 °A
Ps: 29.951 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,005,182.7 dscf/hr
where wscf/hr: 1,025,487.3
Bws: 0.0198

16) DSCFM= (dscf/hr)/60 mins/hr = 16,753.0 DSCFM
where dscf/hr: 1,005,182.7

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000258 sq. ft.
where Nozzle Size: 0.2173 inches

Client: Hollingsworth & Vose	Run: 1
Source: CFU 112	Date: 9/11/2018

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 101.1 %

where Ts:	662.1	°A
Vm(Std):	106.767	dscf
Ps:	29.951	"Hg
Vs	72.69	ft/sec
Nozzle Area:	0.000258	sq. ft.
Sampling Time:	120	min.
Bws:	0.0198	

EPA Method 26A:

19) HF laboratory results < 4.05 µg/sample

20) HF = (µg/sample)/1,000,000 = < 4.05E-06 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 5.85E-07 gr/dscf

where Sample:	0.00000	grams
Vm(std)	106.767	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 1.34 µg/dscm

where Sample:	0.00000	grams
Vm(std)	3.023	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 482.618 Vol./Mole

where Ts:	662.1	°A
Ps:	29.951	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.61E-03 ppmvd

where MW:	20.01	g/mol
lb/hr:	0.00	
Vol./Mole:	482.618	
ADCFM:	20986.2	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 8.40E-05 lb/hr

where Cs:	5.85E-07	gr/dscf
Stack Flow:	1,005,182.7	dscf/hr

Daily Gaseous Calibrations Log

Client: H;V

Source: CFV -112 - M13B/26A

Date: 09/11/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	0	✓

Method 205*			
Target	X	Direct	X
10	X	0	X
5	X	10	X
10	X	0	X
5	X	10	X
10	X	0	X
5	X	10	X

*Use of a calibrated instrument required

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X					0	X		
10	X					2.0	X		
20	X					4.0	X		

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X					0	X		
10	X					2.0	X		

- start @ 9:01

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run #1 5-min points

Test Times: R-1 ~~10:35~~ DSB - 10:35 - 12:40 R-2 13:05 - 15:14 R-3 15:40 - 17:47

Post leak check - pass

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 112**
Facility	**Glass Plant #1**	Date	**September 11, 2018**
Location	**Corvallis, OR**		

Run	1	2	3	
Date	9/11/2018	9/11/2018	9/11/2018	
Run Start Time	10:35	13:05	15:40	
Run End Time	12:40	15:14	17:47	
CO_2 %vd	0.47	0.45	0.48	0.47
O_2 %vd	20.16	20.11	20.16	20.14

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU 112**	Instrument Make:	**Servomex**
Facility:	**Glass Plant #1**	Date	**September 11, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.03	0.05	0.10	pass	0.04	0.05	pass	-0.05	pass				
	upscale	10.02	9.88	-0.70	pass	9.91	-0.55	pass	0.15	pass	20	19.90	20.16	10
Run 2	zero	0.03	0.04	0.05	pass	0.07	0.20	pass	0.15	pass				
	upscale	10.02	9.91	-0.55	pass	9.86	-0.80	pass	-0.25	pass	20	19.82	20.11	10
Run 3	zero	0.03	0.07	0.20	pass	0.06	0.15	pass	-0.05	pass				
	upscale	10.02	9.86	-0.80	pass	9.85	-0.85	pass	-0.05	pass	20	19.80	20.16	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0.03	10.02	20.1
Analyzer Cal. Error	0.15	0.10	0.50
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU 112**	Instrument Make:	**Servomex**
Facility:	**Glass Plant #1**	Date	**September 11, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

		Analyzer Cal. Response	*Initial Values* System Cal Response	Pre test System Cal. Bias % of span	pass/fail	*Final Values* System Cal Response	Post test System Cal. Bias % of span	pass/fail	System Drift % of span	pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.12	0.18	1.50	pass	0.23	2.75	pass	1.25	pass				
	upscale	1.92	1.94	0.50	pass	2.00	2.00	pass	1.50	pass	4	0.62	0.47	2
Run 2	zero	0.12	0.23	2.75	pass	0.19	1.75	pass	-1.00	pass				
	upscale	1.92	2.00	2.00	pass	1.94	0.50	pass	-1.50	pass	4	0.61	0.45	2
Run 3	zero	0.12	0.19	1.75	pass	0.21	2.25	pass	0.50	pass				
	upscale	1.92	1.94	0.50	pass	1.96	1.00	pass	0.50	pass	4	0.62	0.48	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0.12	1.92	4.06
Analyzer Cal. Error	3.00	-2.00	1.50
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 205 Dilution System Check

Company:	Hollingsworth & Vose	Source:	CFU 112	Instrument Make:	Environics
Facility:	Glass Plant #1	Date:	September 11, 2018	Instrument Model:	4040
Location:	Corvallis, OR			Instrument Serial #:	3880

		First	Second	Third	Average
High Level	10 % oxygen dilution system	10.04	10.02	10.04	10.04
Percent diff from avg recorded value		0.0%	-0.1%	0.1%	
Pass or Fail +/- 2%		PASS	PASS	PASS	
Percent diff from target of 10% O_2		0.4%	0.2%	0.4%	0.4%
Pass or Fail +/- 2% from target value					PASS
Mid Level	5 % oxygen dilution system	5.02	5.03	5.03	5.03
Percent diff from avg recorded value		-0.1%	0.0%	0.0%	
Pass or Fail +/- 2%		PASS	PASS	PASS	
Percent diff from target of 5% O_2		0.5%	0.6%	0.6%	0.6%
Pass or Fail +/- 2% from target value					PASS

							Tank value
Independent Mid Level Check	5% oxygen independent tank check	9.93	9.92	9.92	9.92		9.893
				Percent diff from avg		0.32%	
				Pass or Fail < 2%		PASS	

Summary - Method 205 - Verification of Gas Dilution Systems for Field Instrument Calibrations

A gas dilution system can provide known values of calibration gases through controlled dilution of high-level calibration gases with an appropriate dilution gas. The calibration gases with an appropriate dilution gas. The instrumental test methods in 40 CFR part 60 - e.g., Methods 3A, 6C, 7E, 10, 15, 16, 20, 25A and 25B require on-site, multi-point point calibration using gases of known concentrations. A gas dilution system that produces known low level calibration gases from high-level calibration gases, with a degree of confidence similar to that for Protocol 1 gases, may be used for compliance tests in lieu of multiple calibration gases when the gas dilution system is demonstrated to meet the requirements of this method.

The gas dilution system shall be evaluated on one analyzer once during each field test. A precalibrated analyzer is chosen, at the discretion of the source owner or operator, to demonstrate that the gas dilution system produces predictable gas concentrations spanning a range of concentrations. After meeting the requirements of this method, the remaining analyzers may be calibrated with the dilution system in accordance to the requirements of the applicable method for the duration of the field test.

The gas dilution system shall produce calibration gases whose measured values are within ±2 percent of the predicted values.

Instructions from Method 205

3.2.2 Calculate the predicted concentration for each of the dilutions based on the flow rates through the gas dilution system (or the dilution ratios) and the certified concentration of the high - level supply gas.

3.2.3 Introduce each of the dilutions from Section 3.2.1 into the analyzer or monitor one at a time and determine the instrument response for each of the dilutions.

3.2.4 Repeat the procedure in Section 3.2.3 two times, i.e., until three injections are made at dilution level. Calculate the average instrument response for each triplicate injection at each dilution level. No single injection shall differ by more than ±2 percent from the average instrument response for that dilution.

3.2.5 For each level of dilution, calculate the difference between the average concentration output recorded by the analyzer and the predicted concentration calculated in Section 3.2.2. The average concentration output from the analyzer shall be within ±2 percent of the predicted value.

3.2.6 Introduce the mid - level supply gas directly into the analyzer, bypassing the gas dilution system. Repeat the procedure twice more, for a total of three mid-level supply gas injections.

Calculate the average analyzer output concentration for the mid-level supply gas. The difference between the certified concentration of the mid-evel supply gas and the average instrument response shall be within ±2 percent.

3.3 If the gas dilution system meets the criteria listed in Section 3.2, the gas dilution system may be used throughout that field test.

Stratification Check

Facility Glass Plant #1

Location Corvallis, OR **Date** 9/11/2018

Source CFU 112 **Stack Dimensions** 30 inches

3 POINT METHOD

% of diameter		Pt location	O2%	Diff (+/- 5%)	Pass/Fail
16.7%	1	5.01	20.10	0.68%	PASS
50.0%	2	15.00	19.89	-0.37%	PASS
83.3%	3	24.99	19.90	-0.32%	PASS
		AVERAGE:	19.96		

*If 3 pt Method fails at < 10% level the gas stream is considered minimally stratified; perform sampling at three points

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:35**
Source:	**CFU 112**	**End Time:**	**12:40**
Method:	**3A**	**Date:**	**9/11/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \text{ x } 100 =$ 0.10 %v

where C_{Dir}:	10.02	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \text{ x } 100 =$ -0.70 %v

where C_{Dir}:	10.02	ppmv
C_S:	9.88	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.15 %v

where SB_{Final}:	-0.55	ppmv
SB_i:	-0.70	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 20.16 ppmv

where C_{Avg}:	19.90	ppmv
C_O:	0.05	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.90	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:35**
Source:	**CFU 112**	**End Time:**	**12:40**
Method:	**3A**	**Date:**	**9/11/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -2.00 %v

where C_{Dir}:	1.92	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.50 %v

where C_{Dir}:	1.92	ppmv
C_S:	1.94	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 1.50 %v

where SB_{Final}:	2.00	ppmv
SB_i:	0.50	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.47 ppmv

where C_{Avg}:	0.62	ppmv
C_O:	0.21	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.97	ppmv

Hollingsworth & Vose
Daily Calibrations with Method 205
9/11/2018

Date	Time	O2 [%]	CO2 [%]
9/11/2018	8:31:24	-0.08	0.15
9/11/2018	8:31:34	-0.08	0.15
9/11/2018	8:31:44	-0.08	0.15
9/11/2018	8:31:54	-0.08	0.15
9/11/2018	8:32:04	-0.08	0.15
9/11/2018	8:32:14	-0.05	0.15
9/11/2018	8:32:24	0.03	0.16
9/11/2018	8:32:34	0.03	0.15
9/11/2018	8:32:44	0.03	0.15
9/11/2018	8:32:54	0.03	0.16
9/11/2018	8:33:04	2.29	0.32
9/11/2018	8:33:14	19.96	20.24
9/11/2018	8:33:24	22.51	22.96
9/11/2018	8:33:34	22.01	23.02
9/11/2018	8:33:44	20.14	23.06
9/11/2018	8:33:54	20.08	19.7
9/11/2018	8:34:04	20.09	19.61
9/11/2018	8:34:14	20.09	19.63
9/11/2018	8:34:24	20.09	19.63
9/11/2018	8:34:34	20.09	19.63
9/11/2018	8:34:44	20.1	19.64
9/11/2018	8:34:54	20.1	19.64
9/11/2018	8:35:04	20.1	19.65
9/11/2018	8:35:14	20.1	19.65
9/11/2018	8:35:24	20.11	19.66
9/11/2018	8:35:34	20.11	19.66
9/11/2018	8:35:44	20.1	19.67
9/11/2018	8:35:54	20.07	19.67
9/11/2018	8:36:04	20.07	19.67
9/11/2018	8:36:14	19.52	19.65
9/11/2018	8:36:24	17.6	19.45
9/11/2018	8:36:34	18.39	19.39
9/11/2018	8:36:44	12.31	2.35
9/11/2018	8:36:54	10.07	0.27
9/11/2018	8:37:04	10.02	0.25
9/11/2018	8:37:14	10.02	0.24
9/11/2018	8:37:24	10.02	0.22
9/11/2018	8:37:34	10.02	0.21
9/11/2018	8:37:44	10.02	0.2

Hollingsworth & Vose
Daily Calibrations with Method 205
9/11/2018

Date	Time	O2 [%]	CO2 [%]
9/11/2018	8:37:54	9.42	0.19

Pre-Method 205 direct gas calibrated analyzer

	O2 [%]
Analyzer Zero	**0.03**
Analyzer Mid	**10.02**
Analyzer High	**20.10**

9/11/2018	8:38:04	8.81	0.24
9/11/2018	8:38:14	13.54	10.24
9/11/2018	8:38:24	11.9	10.57
9/11/2018	8:38:34	9.88	9.8
9/11/2018	8:38:44	10.09	9.86
9/11/2018	8:38:54	10.12	9.87
9/11/2018	8:39:04	10.07	9.87
9/11/2018	8:39:14	10.05	9.84
9/11/2018	8:39:24	10.05	9.86
9/11/2018	8:39:34	10.04	9.86
9/11/2018	8:39:44	10.05	9.86
9/11/2018	8:39:54	10.04	9.85
9/11/2018	8:40:04	10.05	9.86
9/11/2018	8:40:14	10.05	9.86
9/11/2018	8:40:24	9.98	9.79
9/11/2018	8:40:34	4.89	4.41
9/11/2018	8:40:44	4.96	5.13
9/11/2018	8:40:54	5.01	5.15
9/11/2018	8:41:04	5.02	5.15
9/11/2018	8:41:14	5.02	5.15
9/11/2018	8:41:24	5.03	5.15
9/11/2018	8:41:34	5.02	5.16
9/11/2018	8:41:44	8.62	9.01
9/11/2018	8:41:54	10.16	9.94
9/11/2018	8:42:04	10.07	9.88
9/11/2018	8:42:14	10.06	9.87
9/11/2018	8:42:24	9.94	9.7
9/11/2018	8:42:34	4.77	4.34
9/11/2018	8:42:44	4.97	5.14
9/11/2018	8:42:54	5.02	5.15

Hollingsworth & Vose
Daily Calibrations with Method 205
9/11/2018

Date	Time	O2 [%]	CO2 [%]
9/11/2018	8:43:04	5.03	5.16
9/11/2018	8:43:14	5.03	5.15
9/11/2018	8:43:24	5.03	5.16
9/11/2018	8:43:34	5.18	5.24
9/11/2018	8:43:44	10.29	10.62
9/11/2018	8:43:54	10.1	9.89
9/11/2018	8:44:04	10.06	9.86
9/11/2018	8:44:14	10.05	9.86
9/11/2018	8:44:24	10.04	9.86
9/11/2018	8:44:34	10.05	9.86
9/11/2018	8:44:44	10.05	9.86
9/11/2018	8:44:54	10.04	9.85
9/11/2018	8:45:04	10.04	9.86
9/11/2018	8:45:14	10.05	9.86
9/11/2018	8:45:24	10.05	9.86
9/11/2018	8:45:34	10.04	9.86
9/11/2018	8:45:44	9.44	8.96
9/11/2018	8:45:54	4.56	4.43
9/11/2018	8:46:04	4.99	5.14
9/11/2018	8:46:14	5.02	5.15
9/11/2018	8:46:24	5.03	5.16
9/11/2018	8:46:34	5.03	5.15
9/11/2018	8:46:44	5.03	5.15
9/11/2018	8:46:54	5.03	5.15
9/11/2018	8:47:04	5.03	5.16
9/11/2018	8:47:14	5.06	5.15
9/11/2018	8:47:24	2.44	2.07
9/11/2018	8:47:34	0.15	0.23
9/11/2018	8:47:44	0.08	0.21
9/11/2018	8:47:54	0.07	0.19
9/11/2018	8:48:04	0.07	0.19
9/11/2018	8:48:14	0.07	0.17
9/11/2018	8:48:24	0.06	0.17
9/11/2018	8:48:34	0.07	0.17
9/11/2018	8:48:44	0.06	0.16
9/11/2018	8:48:54	0.06	0.17
9/11/2018	8:49:04	0.06	0.16
9/11/2018	8:49:14	0.06	0.16
9/11/2018	8:49:24	0.06	0.16

Hollingsworth & Vose
Daily Calibrations with Method 205
9/11/2018

Date	Time	O2 [%]	CO2 [%]
9/11/2018	8:49:34	0.06	0.16
9/11/2018	8:49:44	0.06	0.15
9/11/2018	8:49:54	0.19	0.16
9/11/2018	8:50:04	8.37	0.18
9/11/2018	8:50:14	9.89	0.15
9/11/2018	8:50:24	9.95	0.15
9/11/2018	8:50:34	9.96	0.15
9/11/2018	8:50:44	10	0.14
9/11/2018	8:50:54	5.81	0.14
9/11/2018	8:51:04	0.29	0.14
9/11/2018	8:51:14	0.08	0.15
9/11/2018	8:51:24	0.07	0.14
9/11/2018	8:51:34	0.07	0.14
9/11/2018	8:51:44	0.06	0.14
9/11/2018	8:51:54	0.04	0.14
9/11/2018	8:52:04	3.2	0.14
9/11/2018	8:52:14	9.54	0.14
9/11/2018	8:52:24	9.9	0.13
9/11/2018	8:52:34	9.91	0.12
9/11/2018	8:52:44	9.92	0.13
9/11/2018	8:52:54	9.92	0.13
9/11/2018	8:53:04	9.92	0.13
9/11/2018	8:53:14	9.92	0.13
9/11/2018	8:53:24	9.63	0.13
9/11/2018	8:53:34	1.41	0.13
9/11/2018	8:53:44	0.06	0.13
9/11/2018	8:53:54	0.03	0.12
9/11/2018	8:54:04	0.02	0.13
9/11/2018	8:54:14	0.02	0.12
9/11/2018	8:54:24	0.02	0.12
9/11/2018	8:54:34	0.02	0.13
9/11/2018	8:54:44	0.02	0.12
9/11/2018	8:54:54	0.01	0.12
9/11/2018	8:55:04	0.89	0.13
9/11/2018	8:55:14	8.95	0.12
9/11/2018	8:55:24	9.88	0.12
9/11/2018	8:55:34	9.91	0.12
9/11/2018	8:55:44	9.91	0.12
9/11/2018	8:55:54	9.92	0.12

Hollingsworth & Vose
Daily Calibrations with Method 205
9/11/2018

Date	Time	O2 [%]	CO2 [%]
9/11/2018	8:56:04	9.92	0.13
9/11/2018	8:56:14	9.92	0.12
9/11/2018	8:56:24	9.92	0.12
9/11/2018	8:56:34	9.19	0.12
9/11/2018	8:56:44	8.99	0.12
9/11/2018	8:56:54	3.78	0.2
9/11/2018	8:57:04	0.95	0.85
9/11/2018	8:57:14	4.27	4.51
9/11/2018	8:57:24	3.9	4.08
9/11/2018	8:57:34	3.89	4.1
9/11/2018	8:57:44	4.37	4.41
9/11/2018	8:57:54	2.11	1.56
9/11/2018	8:58:04	0.37	0.33
9/11/2018	8:58:14	0.21	0.19
9/11/2018	8:58:24	0.04	0.13
9/11/2018	8:58:34	3.46	3.87
9/11/2018	8:58:44	4.04	4.22
9/11/2018	8:58:54	3.99	4.21
9/11/2018	8:59:04	4	4.22
9/11/2018	8:59:14	4	4.21
9/11/2018	8:59:24	4	4.12
9/11/2018	8:59:34	4.01	4.06
9/11/2018	8:59:44	4.01	4.06
9/11/2018	8:59:54	4.01	4.07
9/11/2018	9:00:04	3.97	4.03
9/11/2018	9:00:14	2.45	1.92
9/11/2018	9:00:24	2.04	1.93
9/11/2018	9:00:34	1.99	1.91
9/11/2018	9:00:44	2	1.91
9/11/2018	9:00:54	2	1.92
9/11/2018	9:01:04	2	1.92
9/11/2018	9:01:14	2	1.92
9/11/2018	9:01:24	2	1.92
9/11/2018	9:01:34	2.03	1.91

	CO2 [%]
Analyzer Zero	**0.12**
Analyzer Mid	**1.92**
Analyzer High	**4.06**

Hollingsworth & Vose
Daily Calibrations with Method 205
9/11/2018

Date	Time	O2 [%]	CO2 [%]
	O2 [%]	**O2 [%]**	
M-205	**10.04**	**0.06**	
	5.02	**9.93**	
	10.02	**0.07**	
	5.03	**9.92**	
	10.04	**0.02**	
	5.03	**9.92**	

SYSTEM

9/11/2018	9:01:44	17.42	0.43
9/11/2018	9:01:54	18.35	0.43
9/11/2018	9:02:04	14.21	0.85
9/11/2018	9:02:14	12.64	1
9/11/2018	9:02:24	12.2	1.04
9/11/2018	9:02:34	15.53	0.71
9/11/2018	9:02:44	16.72	0.79
9/11/2018	9:02:54	13.55	1.49
9/11/2018	9:03:04	11.05	1.71
9/11/2018	9:03:14	6.74	1.71
9/11/2018	9:03:24	5.46	1.69
9/11/2018	9:03:34	5.12	1.68
9/11/2018	9:03:44	5.01	1.68
9/11/2018	9:03:54	4.98	1.68
9/11/2018	9:04:04	4.97	1.68
9/11/2018	9:04:14	4.97	1.68
9/11/2018	9:04:24	4.97	1.68
9/11/2018	9:04:34	5.01	1.68
9/11/2018	9:04:44	5.09	1.68
9/11/2018	9:04:54	4.59	1.72
9/11/2018	9:05:04	4	1.76
9/11/2018	9:05:14	2.98	1.85
9/11/2018	9:05:24	2.45	1.92
9/11/2018	9:05:34	2.29	1.93
9/11/2018	9:05:44	2.24	1.94
9/11/2018	9:05:54	2.21	1.94
9/11/2018	9:06:04	2.2	1.94
9/11/2018	9:06:14	2.19	1.95

Hollingsworth & Vose
Daily Calibrations with Method 205
9/11/2018

Date	Time	O2 [%]	CO2 [%]
9/11/2018	9:06:24	2.18	1.93
9/11/2018	9:06:34	1.43	1.21
9/11/2018	9:06:44	0.62	0.52
9/11/2018	9:06:54	0.36	0.3
9/11/2018	9:07:04	0.28	0.22
9/11/2018	9:07:14	0.26	0.2
9/11/2018	9:07:24	0.25	0.18
9/11/2018	9:07:34	0.25	0.18
9/11/2018	9:07:44	0.25	0.18
9/11/2018	9:07:54	0.25	0.17
9/11/2018	9:08:04	0.25	0.18
9/11/2018	9:08:14	0.25	0.18
9/11/2018	9:08:24	0.25	0.18
9/11/2018	9:08:34	0.25	0.18
9/11/2018	9:08:44	0.25	0.18
9/11/2018	9:08:54	0.25	0.18
9/11/2018	9:09:04	0.25	0.18
9/11/2018	9:09:14	1.47	0.19
9/11/2018	9:09:24	2.08	0.21
9/11/2018	9:09:34	0.84	0.18
9/11/2018	9:09:44	0.42	0.18
9/11/2018	9:09:54	0.3	0.18
9/11/2018	9:10:04	0.26	0.18
9/11/2018	9:10:14	0.25	0.18
9/11/2018	9:10:24	0.21	0.18
9/11/2018	9:10:34	0.05	0.18
9/11/2018	9:10:44	0.05	0.18
9/11/2018	9:10:54	0.05	0.17
9/11/2018	9:11:04	0.05	0.18
9/11/2018	9:11:14	0.05	0.18
9/11/2018	9:11:24	0.05	0.18
9/11/2018	9:11:34	0.05	0.18
9/11/2018	9:11:44	0.05	0.18
9/11/2018	9:11:54	0.05	0.17
9/11/2018	9:12:04	0.06	0.17
9/11/2018	9:12:14	6.42	0.2
9/11/2018	9:12:24	14.04	0.6
9/11/2018	9:12:34	11.64	5.67
9/11/2018	9:12:44	10.41	8.29

Hollingsworth & Vose
Daily Calibrations with Method 205
9/11/2018

Date	Time	O2 [%]	CO2 [%]
9/11/2018	9:12:54	10.03	9.09
9/11/2018	9:13:04	9.93	9.32
9/11/2018	9:13:14	9.9	9.4
9/11/2018	9:13:24	9.88	9.42
9/11/2018	9:13:34	9.88	9.43
9/11/2018	9:13:44	9.88	9.44
9/11/2018	9:13:54	9.88	9.44
9/11/2018	9:14:04	9.89	9.45
9/11/2018	9:14:14	9.87	9.45
9/11/2018	9:14:24	12.07	7.43
9/11/2018	9:14:34	17.4	2.72

	O2 [%]	**CO2 [%]**
System Zero	**0.05**	**0.18**
System Mid	**9.88**	**1.94**

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]	
9/11/2018	10:35:56	20.06	0.61	**Stratification Check**
9/11/2018	10:36:56	20.07	0.60	
9/11/2018	10:37:56	20.41	0.41	
9/11/2018	10:38:56	20.06	0.60	
9/11/2018	10:39:56	19.91	0.61	**20.10**
9/11/2018	10:40:56	19.90	0.61	
9/11/2018	10:41:56	19.89	0.61	
9/11/2018	10:42:56	19.89	0.61	
9/11/2018	10:43:56	19.89	0.61	
9/11/2018	10:44:56	19.90	0.61	**19.89**
9/11/2018	10:45:56	19.90	0.61	
9/11/2018	10:46:56	19.90	0.62	
9/11/2018	10:47:56	19.90	0.62	
9/11/2018	10:48:56	19.90	0.62	
9/11/2018	10:49:56	19.90	0.62	**19.90**
9/11/2018	10:50:56	19.89	0.62	
9/11/2018	10:51:56	19.90	0.62	
9/11/2018	10:52:56	19.90	0.62	
9/11/2018	10:53:56	19.89	0.62	
9/11/2018	10:54:56	19.89	0.62	
9/11/2018	10:55:56	19.89	0.63	
9/11/2018	10:56:56	19.88	0.63	
9/11/2018	10:57:56	19.89	0.62	
9/11/2018	10:58:56	19.90	0.62	
9/11/2018	10:59:56	19.90	0.61	
9/11/2018	11:00:56	19.90	0.61	
9/11/2018	11:01:56	19.89	0.61	
9/11/2018	11:02:56	19.89	0.61	
9/11/2018	11:03:56	19.89	0.61	
9/11/2018	11:04:56	19.90	0.61	
9/11/2018	11:05:56	19.89	0.61	
9/11/2018	11:06:56	19.89	0.61	
9/11/2018	11:07:56	19.90	0.61	
9/11/2018	11:08:56	19.89	0.61	
9/11/2018	11:09:56	19.89	0.61	
9/11/2018	11:10:56	19.88	0.62	
9/11/2018	11:11:56	19.89	0.62	
9/11/2018	11:12:56	19.90	0.61	
9/11/2018	11:13:56	19.90	0.62	
9/11/2018	11:14:56	19.89	0.62	
9/11/2018	11:15:56	19.88	0.63	

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]
9/11/2018	11:16:56	19.89	0.63
9/11/2018	11:17:56	19.90	0.62
9/11/2018	11:18:56	19.90	0.62
9/11/2018	11:19:56	19.90	0.62
9/11/2018	11:20:56	19.89	0.62
9/11/2018	11:21:56	19.89	0.62
9/11/2018	11:22:56	19.89	0.62
9/11/2018	11:23:56	19.88	0.62
9/11/2018	11:24:56	19.88	0.62
9/11/2018	11:25:56	19.89	0.62
9/11/2018	11:26:56	19.90	0.61
9/11/2018	11:27:56	19.90	0.61
9/11/2018	11:28:56	19.89	0.61
9/11/2018	11:29:56	19.89	0.61
9/11/2018	11:30:56	19.89	0.61
9/11/2018	11:31:56	19.88	0.61
9/11/2018	11:32:56	19.89	0.61
9/11/2018	11:33:56	19.88	0.62
9/11/2018	11:34:56	19.88	0.62
9/11/2018	11:35:56	19.89	0.62
9/11/2018	11:36:56	19.89	0.61
9/11/2018	11:37:56	19.90	0.62
9/11/2018	11:38:56	19.89	0.62
9/11/2018	11:39:56	19.89	0.62
9/11/2018	11:40:56	19.89	0.62
9/11/2018	11:41:56	19.90	0.63
9/11/2018	11:42:56	19.89	0.63
9/11/2018	11:43:56	19.89	0.63
9/11/2018	11:44:56	19.88	0.63
9/11/2018	11:45:56	19.90	0.62
9/11/2018	11:46:56	19.90	0.62
9/11/2018	11:47:56	19.90	0.62
9/11/2018	11:48:56	19.89	0.62
9/11/2018	11:49:56	19.89	0.62
9/11/2018	11:50:56	19.90	0.62
9/11/2018	11:51:56	19.89	0.62
9/11/2018	11:52:56	19.90	0.61
9/11/2018	11:53:56	19.89	0.61
9/11/2018	11:54:56	19.89	0.61
9/11/2018	11:55:56	19.89	0.61
9/11/2018	11:56:56	19.88	0.61

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]
9/11/2018	11:57:56	19.90	0.61
9/11/2018	11:58:56	19.90	0.61
9/11/2018	11:59:56	19.90	0.61
9/11/2018	12:00:56	19.90	0.61
9/11/2018	12:01:56	19.90	0.61
9/11/2018	12:02:56	19.89	0.62
9/11/2018	12:03:56	19.89	0.62
9/11/2018	12:04:56	19.89	0.62
9/11/2018	12:05:56	19.89	0.62
9/11/2018	12:06:56	19.89	0.63
9/11/2018	12:07:56	19.89	0.63
9/11/2018	12:08:56	19.90	0.62
9/11/2018	12:09:56	19.89	0.62
9/11/2018	12:10:56	19.90	0.62
9/11/2018	12:11:56	19.89	0.63
9/11/2018	12:12:56	19.89	0.63
9/11/2018	12:13:56	19.89	0.63
9/11/2018	12:14:56	19.89	0.62
9/11/2018	12:15:56	19.89	0.62
9/11/2018	12:16:56	19.89	0.62
9/11/2018	12:17:56	19.89	0.61
9/11/2018	12:18:56	19.89	0.61
9/11/2018	12:19:56	19.89	0.61
9/11/2018	12:20:56	19.89	0.61
9/11/2018	12:21:56	19.89	0.61
9/11/2018	12:22:56	19.89	0.61
9/11/2018	12:23:56	19.89	0.60
9/11/2018	12:24:56	19.89	0.61
9/11/2018	12:25:56	19.88	0.61
9/11/2018	12:26:56	19.88	0.61
9/11/2018	12:27:56	19.88	0.62
9/11/2018	12:28:56	19.88	0.62
9/11/2018	12:29:56	19.89	0.62
9/11/2018	12:30:56	19.89	0.62
9/11/2018	12:31:56	19.88	0.63
9/11/2018	12:32:56	19.88	0.63
9/11/2018	12:33:56	19.88	0.63
9/11/2018	12:34:56	19.88	0.63
9/11/2018	12:35:56	19.88	0.63
9/11/2018	12:36:56	19.88	0.63
9/11/2018	12:37:56	19.88	0.63

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]
9/11/2018	12:38:56	19.88	0.62
9/11/2018	12:39:56	19.88	0.62
Final Average		**19.90**	**0.62**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/11/2018	12:41:36	19.63	12.20
9/11/2018	12:41:46	19.75	12.49
9/11/2018	12:41:56	15.80	11.43
9/11/2018	12:42:06	11.81	10.01
9/11/2018	12:42:16	10.52	9.63
9/11/2018	12:42:26	10.11	9.51
9/11/2018	12:42:36	9.98	9.48
9/11/2018	12:42:46	9.93	9.47
9/11/2018	12:42:56	9.92	9.46
9/11/2018	12:43:06	9.91	9.46
9/11/2018	12:43:16	9.91	9.47
9/11/2018	12:43:26	9.91	9.47
9/11/2018	12:43:36	9.91	9.47
9/11/2018	12:43:46	9.91	9.47
9/11/2018	12:43:56	9.91	9.47
9/11/2018	12:44:06	9.51	9.03
9/11/2018	12:44:16	4.82	4.44
9/11/2018	12:44:26	2.52	2.58
9/11/2018	12:44:36	2.17	2.23
9/11/2018	12:44:46	2.04	2.09
9/11/2018	12:44:56	2.00	2.04
9/11/2018	12:45:06	2.00	2.00
9/11/2018	12:45:16	1.99	2.00
9/11/2018	12:45:26	1.98	2.00
9/11/2018	12:45:36	1.97	1.98
9/11/2018	12:45:46	1.21	1.23
9/11/2018	12:45:56	0.43	0.57
9/11/2018	12:46:06	0.17	0.35
9/11/2018	12:46:16	0.09	0.27
9/11/2018	12:46:26	0.06	0.25
9/11/2018	12:46:36	0.05	0.23
9/11/2018	12:46:46	0.04	0.23
9/11/2018	12:46:56	0.04	0.22
9/11/2018	12:47:06	0.04	0.23
9/11/2018	12:47:16	0.04	0.22

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]
9/11/2018	12:47:26	0.04	0.22
9/11/2018	12:47:36	5.51	0.34
9/11/2018	12:47:46	14.61	0.53
9/11/2018	12:47:56	18.11	0.60
9/11/2018	12:48:06	19.25	0.62
9/11/2018	12:48:16	19.61	0.63
9/11/2018	12:48:26	19.74	0.63
9/11/2018	12:48:36	19.78	0.63
9/11/2018	12:48:46	19.80	0.62
9/11/2018	12:48:56	19.81	0.62
9/11/2018	12:49:06	19.82	0.62

	O2 [%]	CO2 [%]
System Zero	0.04	0.23
System Mid	9.91	2.00

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/11/2018	13:05:56	19.86	0.61
9/11/2018	13:06:56	19.86	0.61
9/11/2018	13:07:56	19.85	0.61
9/11/2018	13:08:56	19.85	0.61
9/11/2018	13:09:56	19.84	0.61
9/11/2018	13:10:56	19.84	0.61
9/11/2018	13:11:56	19.84	0.61
9/11/2018	13:12:56	19.84	0.61
9/11/2018	13:13:56	19.84	0.61
9/11/2018	13:14:56	19.85	0.61
9/11/2018	13:15:56	19.84	0.61
9/11/2018	13:16:56	19.84	0.61
9/11/2018	13:17:56	19.85	0.61
9/11/2018	13:18:56	19.85	0.61
9/11/2018	13:19:56	19.85	0.62
9/11/2018	13:20:56	19.84	0.62
9/11/2018	13:21:56	19.84	0.63
9/11/2018	13:22:56	19.83	0.63
9/11/2018	13:23:56	19.82	0.63
9/11/2018	13:24:56	19.82	0.62
9/11/2018	13:25:56	19.82	0.63
9/11/2018	13:26:56	19.83	0.62
9/11/2018	13:27:56	19.83	0.62
9/11/2018	13:28:56	19.83	0.62
9/11/2018	13:29:56	19.83	0.62
9/11/2018	13:30:56	19.83	0.62
9/11/2018	13:31:56	19.83	0.61
9/11/2018	13:32:56	19.83	0.61
9/11/2018	13:33:56	19.83	0.61
9/11/2018	13:34:56	19.83	0.60
9/11/2018	13:35:56	19.83	0.61
9/11/2018	13:36:56	19.83	0.61
9/11/2018	13:37:56	19.83	0.61
9/11/2018	13:38:56	19.82	0.61
9/11/2018	13:39:56	19.83	0.61
9/11/2018	13:40:56	19.83	0.61
9/11/2018	13:41:56	19.83	0.61
9/11/2018	13:42:56	19.83	0.61
9/11/2018	13:43:56	19.82	0.62
9/11/2018	13:44:56	19.82	0.62
9/11/2018	13:45:56	19.82	0.62

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/11/2018	13:46:56	19.83	0.62
9/11/2018	13:47:56	19.83	0.62
9/11/2018	13:48:56	19.83	0.61
9/11/2018	13:49:56	19.84	0.61
9/11/2018	13:50:56	19.83	0.62
9/11/2018	13:51:56	19.83	0.62
9/11/2018	13:52:56	19.82	0.62
9/11/2018	13:53:56	19.82	0.62
9/11/2018	13:54:56	19.82	0.61
9/11/2018	13:55:56	19.82	0.61
9/11/2018	13:56:56	19.82	0.61
9/11/2018	13:57:56	19.83	0.60
9/11/2018	13:58:56	19.82	0.60
9/11/2018	13:59:56	19.83	0.60
9/11/2018	14:00:56	19.82	0.60
9/11/2018	14:01:56	19.82	0.60
9/11/2018	14:02:56	19.83	0.60
9/11/2018	14:03:56	19.83	0.60
9/11/2018	14:04:56	19.83	0.60
9/11/2018	14:05:56	19.82	0.61
9/11/2018	14:06:56	19.81	0.61
9/11/2018	14:07:56	19.82	0.61
9/11/2018	14:08:56	19.83	0.61
9/11/2018	14:09:56	19.82	0.61
9/11/2018	14:10:56	19.82	0.62
9/11/2018	14:11:56	19.82	0.62
9/11/2018	14:12:56	19.82	0.62
9/11/2018	14:13:56	19.81	0.62
9/11/2018	14:14:56	19.81	0.62
9/11/2018	14:15:56	19.82	0.62
9/11/2018	14:16:56	19.82	0.62
9/11/2018	14:17:56	19.82	0.62
9/11/2018	14:18:56	19.81	0.62
9/11/2018	14:19:56	19.81	0.62
9/11/2018	14:20:56	19.81	0.61
9/11/2018	14:21:56	19.81	0.61
9/11/2018	14:22:56	19.81	0.61
9/11/2018	14:23:56	19.81	0.61
9/11/2018	14:24:56	19.81	0.61
9/11/2018	14:25:56	19.81	0.61
9/11/2018	14:26:56	19.81	0.61

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/11/2018	14:27:56	19.81	0.61
9/11/2018	14:28:56	19.81	0.61
9/11/2018	14:29:56	19.81	0.61
9/11/2018	14:30:56	19.81	0.61
9/11/2018	14:31:56	19.81	0.62
9/11/2018	14:32:56	19.82	0.61
9/11/2018	14:33:56	19.81	0.62
9/11/2018	14:34:56	19.82	0.62
9/11/2018	14:35:56	19.83	0.62
9/11/2018	14:36:56	19.82	0.62
9/11/2018	14:37:56	19.83	0.62
9/11/2018	14:38:56	19.84	0.61
9/11/2018	14:39:56	19.83	0.62
9/11/2018	14:40:56	19.82	0.62
9/11/2018	14:41:56	19.82	0.62
9/11/2018	14:42:56	19.82	0.62
9/11/2018	14:43:56	19.82	0.62
9/11/2018	14:44:56	19.82	0.62
9/11/2018	14:45:56	19.83	0.61
9/11/2018	14:46:56	19.83	0.60
9/11/2018	14:47:56	19.83	0.60
9/11/2018	14:48:56	19.82	0.60
9/11/2018	14:49:56	19.81	0.61
9/11/2018	14:50:56	19.82	0.60
9/11/2018	14:51:56	19.81	0.61
9/11/2018	14:52:56	19.81	0.61
9/11/2018	14:53:56	19.81	0.61
9/11/2018	14:54:56	19.81	0.61
9/11/2018	14:55:56	19.82	0.61
9/11/2018	14:56:56	19.82	0.61
9/11/2018	14:57:56	19.81	0.62
9/11/2018	14:58:56	19.82	0.62
9/11/2018	14:59:56	19.82	0.62
9/11/2018	15:00:56	19.81	0.62
9/11/2018	15:01:56	19.81	0.62
9/11/2018	15:02:56	19.81	0.62
9/11/2018	15:03:56	19.81	0.62
9/11/2018	15:04:56	19.81	0.63
9/11/2018	15:05:56	19.81	0.62
9/11/2018	15:06:56	19.81	0.62
9/11/2018	15:07:56	19.81	0.62

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/11/2018	15:08:56	19.81	0.62
9/11/2018	15:09:56	19.80	0.62
9/11/2018	15:10:56	19.82	0.61
9/11/2018	15:11:56	19.81	0.61
9/11/2018	15:12:56	19.81	0.61
9/11/2018	15:13:56	19.81	0.61
Final Average		**19.82**	**0.61**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/11/2018	15:15:06	19.80	0.61
9/11/2018	15:15:16	18.56	0.64
9/11/2018	15:15:26	10.44	0.54
9/11/2018	15:15:36	3.53	0.32
9/11/2018	15:15:46	1.15	0.23
9/11/2018	15:15:56	0.42	0.21
9/11/2018	15:16:06	0.19	0.20
9/11/2018	15:16:16	0.12	0.19
9/11/2018	15:16:26	0.09	0.20
9/11/2018	15:16:36	0.07	0.19
9/11/2018	15:16:46	0.07	0.19
9/11/2018	15:16:56	0.07	0.20
9/11/2018	15:17:06	0.06	0.19
9/11/2018	15:17:16	0.06	0.20
9/11/2018	15:17:26	0.06	0.20
9/11/2018	15:17:36	0.06	0.20
9/11/2018	15:17:46	0.06	0.19
9/11/2018	15:17:56	0.48	0.62
9/11/2018	15:18:06	1.46	1.40
9/11/2018	15:18:16	1.78	1.70
9/11/2018	15:18:26	1.88	1.81
9/11/2018	15:18:36	1.92	1.87
9/11/2018	15:18:46	1.93	1.90
9/11/2018	15:18:56	1.94	1.91
9/11/2018	15:19:06	1.94	1.92
9/11/2018	15:19:16	1.95	1.93
9/11/2018	15:19:26	1.95	1.93
9/11/2018	15:19:36	1.95	1.94
9/11/2018	15:19:46	1.95	1.94
9/11/2018	15:19:56	1.95	1.95
9/11/2018	15:20:06	1.96	1.94

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/11/2018	15:20:16	1.95	1.94
9/11/2018	15:20:26	1.97	1.97
9/11/2018	15:20:36	5.39	5.73
9/11/2018	15:20:46	8.50	8.39
9/11/2018	15:20:56	9.43	9.11
9/11/2018	15:21:06	9.72	9.32
9/11/2018	15:21:16	9.81	9.39
9/11/2018	15:21:26	9.84	9.42
9/11/2018	15:21:36	9.85	9.44
9/11/2018	15:21:46	9.86	9.44
9/11/2018	15:21:56	9.86	9.45
9/11/2018	15:22:06	9.87	9.46
9/11/2018	15:22:16	9.86	9.46
9/11/2018	15:22:26	9.86	9.46
9/11/2018	15:22:36	9.86	9.46
9/11/2018	15:22:46	9.85	9.47
9/11/2018	15:22:56	11.15	8.27
9/11/2018	15:23:06	16.17	3.72
9/11/2018	15:23:16	18.57	1.59
9/11/2018	15:23:26	19.37	1.01
9/11/2018	15:23:36	19.63	0.78

	O2 [%]	CO2 [%]
System Zero	0.07	0.19
System Mid	9.86	1.94

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/11/2018	15:40:56	19.80	0.62
9/11/2018	15:41:56	19.81	0.61
9/11/2018	15:42:56	19.81	0.62
9/11/2018	15:43:56	19.81	0.62
9/11/2018	15:44:56	19.81	0.62
9/11/2018	15:45:56	19.80	0.62
9/11/2018	15:46:56	19.81	0.62
9/11/2018	15:47:56	19.80	0.62
9/11/2018	15:48:56	19.80	0.63
9/11/2018	15:49:56	19.80	0.63
9/11/2018	15:50:56	19.80	0.63
9/11/2018	15:51:56	19.81	0.63
9/11/2018	15:52:56	19.80	0.63
9/11/2018	15:53:56	19.80	0.63
9/11/2018	15:54:56	19.80	0.63
9/11/2018	15:55:56	19.80	0.63
9/11/2018	15:56:56	19.80	0.62
9/11/2018	15:57:56	19.79	0.63
9/11/2018	15:58:56	19.80	0.62
9/11/2018	15:59:56	19.80	0.62
9/11/2018	16:00:56	19.80	0.62
9/11/2018	16:01:56	19.79	0.62
9/11/2018	16:02:56	19.79	0.62
9/11/2018	16:03:56	19.80	0.62
9/11/2018	16:04:56	19.80	0.62
9/11/2018	16:05:56	19.80	0.62
9/11/2018	16:06:56	19.80	0.62
9/11/2018	16:07:56	19.79	0.62
9/11/2018	16:08:56	19.79	0.62
9/11/2018	16:09:56	19.79	0.62
9/11/2018	16:10:56	19.80	0.63
9/11/2018	16:11:56	19.80	0.62
9/11/2018	16:12:56	19.79	0.63
9/11/2018	16:13:56	19.79	0.63
9/11/2018	16:14:56	19.79	0.63
9/11/2018	16:15:56	19.79	0.64
9/11/2018	16:16:56	19.80	0.63
9/11/2018	16:17:56	19.79	0.63
9/11/2018	16:18:56	19.79	0.63
9/11/2018	16:19:56	19.79	0.63
9/11/2018	16:20:56	19.79	0.63

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/11/2018	16:21:56	19.80	0.62
9/11/2018	16:22:56	19.79	0.62
9/11/2018	16:23:56	19.79	0.62
9/11/2018	16:24:56	19.79	0.62
9/11/2018	16:25:56	19.78	0.62
9/11/2018	16:26:56	19.79	0.62
9/11/2018	16:27:56	19.79	0.62
9/11/2018	16:28:56	19.79	0.62
9/11/2018	16:29:56	19.79	0.62
9/11/2018	16:30:56	19.79	0.62
9/11/2018	16:31:56	19.80	0.62
9/11/2018	16:32:56	19.79	0.62
9/11/2018	16:33:56	19.79	0.62
9/11/2018	16:34:56	19.79	0.63
9/11/2018	16:35:56	19.79	0.63
9/11/2018	16:36:56	19.79	0.63
9/11/2018	16:37:56	19.79	0.63
9/11/2018	16:38:56	19.79	0.64
9/11/2018	16:39:56	19.79	0.63
9/11/2018	16:40:56	19.79	0.63
9/11/2018	16:41:56	19.80	0.63
9/11/2018	16:42:56	19.80	0.63
9/11/2018	16:43:56	19.80	0.63
9/11/2018	16:44:56	19.80	0.63
9/11/2018	16:45:56	19.80	0.62
9/11/2018	16:46:56	19.80	0.62
9/11/2018	16:47:56	19.80	0.62
9/11/2018	16:48:56	19.80	0.62
9/11/2018	16:49:56	19.80	0.61
9/11/2018	16:50:56	19.80	0.61
9/11/2018	16:51:56	19.79	0.62
9/11/2018	16:52:56	19.79	0.62
9/11/2018	16:53:56	19.78	0.62
9/11/2018	16:54:56	19.78	0.62
9/11/2018	16:55:56	19.79	0.62
9/11/2018	16:56:56	19.79	0.62
9/11/2018	16:57:56	19.80	0.62
9/11/2018	16:58:56	19.80	0.62
9/11/2018	16:59:56	19.80	0.62
9/11/2018	17:00:56	19.79	0.63
9/11/2018	17:01:56	19.79	0.63

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/11/2018	17:02:56	19.80	0.63
9/11/2018	17:03:56	19.79	0.64
9/11/2018	17:04:56	19.80	0.63
9/11/2018	17:05:56	19.81	0.63
9/11/2018	17:06:56	19.80	0.63
9/11/2018	17:07:56	19.81	0.63
9/11/2018	17:08:56	19.80	0.63
9/11/2018	17:09:56	19.79	0.63
9/11/2018	17:10:56	19.79	0.63
9/11/2018	17:11:56	19.79	0.63
9/11/2018	17:12:56	19.80	0.62
9/11/2018	17:13:56	19.80	0.62
9/11/2018	17:14:56	19.81	0.61
9/11/2018	17:15:56	19.80	0.62
9/11/2018	17:16:56	19.79	0.62
9/11/2018	17:17:56	19.79	0.62
9/11/2018	17:18:56	19.80	0.62
9/11/2018	17:19:56	19.80	0.62
9/11/2018	17:20:56	19.80	0.62
9/11/2018	17:21:56	19.79	0.63
9/11/2018	17:22:56	19.80	0.62
9/11/2018	17:23:56	19.79	0.63
9/11/2018	17:24:56	19.79	0.63
9/11/2018	17:25:56	19.80	0.63
9/11/2018	17:26:56	19.79	0.64
9/11/2018	17:27:56	19.79	0.63
9/11/2018	17:28:56	19.80	0.63
9/11/2018	17:29:56	19.79	0.64
9/11/2018	17:30:56	19.79	0.64
9/11/2018	17:31:56	19.79	0.63
9/11/2018	17:32:56	19.79	0.63
9/11/2018	17:33:56	19.79	0.63
9/11/2018	17:34:56	19.79	0.63
9/11/2018	17:35:56	19.80	0.63
9/11/2018	17:36:56	19.79	0.63
9/11/2018	17:37:56	19.79	0.63
9/11/2018	17:38:56	19.79	0.62
9/11/2018	17:39:56	19.79	0.62
9/11/2018	17:40:56	19.79	0.62
9/11/2018	17:41:56	19.78	0.62
9/11/2018	17:42:56	19.79	0.62

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/11/2018	17:43:56	19.79	0.62
9/11/2018	17:44:56	19.79	0.62
9/11/2018	17:45:56	19.79	0.62
9/11/2018	17:46:56	19.79	0.62
Final Average		**19.80**	**0.62**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/11/2018	17:47:56	19.78	0.63
9/11/2018	17:48:06	19.80	0.63
9/11/2018	17:48:16	19.38	0.84
9/11/2018	17:48:26	10.70	1.00
9/11/2018	17:48:36	3.47	0.49
9/11/2018	17:48:46	1.13	0.30
9/11/2018	17:48:56	0.41	0.25
9/11/2018	17:49:06	0.19	0.23
9/11/2018	17:49:16	0.11	0.22
9/11/2018	17:49:26	0.08	0.22
9/11/2018	17:49:36	0.07	0.21
9/11/2018	17:49:46	0.06	0.21
9/11/2018	17:49:56	0.06	0.22
9/11/2018	17:50:06	0.05	0.21
9/11/2018	17:50:16	0.05	0.21
9/11/2018	17:50:26	0.05	0.22
9/11/2018	17:50:36	0.05	0.22
9/11/2018	17:50:46	0.05	0.22
9/11/2018	17:50:56	0.04	0.22
9/11/2018	17:51:06	0.04	0.22
9/11/2018	17:51:16	0.04	0.22
9/11/2018	17:51:26	0.04	0.22
9/11/2018	17:51:36	0.04	0.22
9/11/2018	17:51:46	0.04	0.22
9/11/2018	17:51:56	0.04	0.22
9/11/2018	17:52:06	0.04	0.23
9/11/2018	17:52:16	0.06	0.25
9/11/2018	17:52:26	0.94	1.06
9/11/2018	17:52:36	1.62	1.59
9/11/2018	17:52:46	1.82	1.78
9/11/2018	17:52:56	1.89	1.87
9/11/2018	17:53:06	1.91	1.91
9/11/2018	17:53:16	1.92	1.93

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/11/2018	17:53:26	1.93	1.95
9/11/2018	17:53:36	1.93	1.94
9/11/2018	17:53:46	1.93	1.95
9/11/2018	17:53:56	1.93	1.96
9/11/2018	17:54:06	1.94	1.96
9/11/2018	17:54:16	1.94	1.96
9/11/2018	17:54:26	1.94	1.97
9/11/2018	17:54:36	3.54	3.80
9/11/2018	17:54:46	7.75	7.83
9/11/2018	17:54:56	9.20	8.94
9/11/2018	17:55:06	9.64	9.28
9/11/2018	17:55:16	9.78	9.39
9/11/2018	17:55:26	9.83	9.43
9/11/2018	17:55:36	9.84	9.45
9/11/2018	17:55:46	9.85	9.46
9/11/2018	17:55:56	9.85	9.46
9/11/2018	17:56:06	9.85	9.46
9/11/2018	17:56:16	9.85	9.47
9/11/2018	17:56:26	9.86	9.47
9/11/2018	17:56:36	9.86	9.47
9/11/2018	17:56:46	9.84	9.47
9/11/2018	17:56:56	10.82	8.61
9/11/2018	17:57:06	16.18	3.87
9/11/2018	17:57:16	19.01	1.42
9/11/2018	17:57:26	19.97	0.71
9/11/2018	17:57:36	20.28	0.46
9/11/2018	17:57:46	20.38	0.36
9/11/2018	17:57:56	20.42	0.32
9/11/2018	17:58:06	20.44	0.30

	O2 [%]	CO2 [%]
System Zero	0.06	0.21
System Mid	9.85	1.96

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112**
DATE	**09/12/18**
METHOD	**5**
POLLUTANT	**Particulate Matter**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**10:52**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**		**End Time:**	**12:59**
EPA Method:	**5**	Scattered 54 F Wind Variable		**Date:**	**9/12/2018**
Box Operator:	**CMF**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3C	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size	0.2173 inches
ΔH@	1.846	Hot box ID	M5-HB	Nozzle area	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.82 "Hg	O_2	19.80 %
Static Pressure	0.56 "H_2O	CO_2	0.70 %
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.201 inches
Stack Temperature	196 F		
Assumed moisture	2 %		
Assumed meter temp.	68 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	12	8

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	107.935 dcf	Ave. ΔP	1.354 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.1634 "H_2O
Actual H_2O	1.87 %	Ave. ΔH	2.7 "H_2O
Std. meter vol.	107.098 dscf	Ave. T_s	196.5 °F
Isokinetic Average	100.2 %	Ave. T_m	74.1 °F

Moisture/Lab:

Filter	Q1371 #		
	Initial	Final	Gain
Impingers, g	200.0	218	18.0
Silica gel, g	240.6	265.9	25.3
		Total water gain:	43.3

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	5.0	4.280	1.30	203	68	2.53	2.50	2	250	64
2	10.0	8.550	1.30	203	68	2.53	2.50	2	250	53
3	15.0	12.840	1.30	205	69	2.52	2.70	2	251	57
4	20.0	17.320	1.40	205	69	2.72	2.70	2	251	57
5	25.0	21.806	1.40	205	70	2.72	2.70	2	252	61
6	30.0	26.350	1.40	205	71	2.73	2.70	2	252	62
7	35.0	30.820	1.40	206	72	2.73	2.70	2	252	63
8	40.0	35.500	1.50	206	73	2.93	2.90	2	251	63
9	45.0	40.040	1.40	205	74	2.74	2.70	2	252	63
10	50.0	44.480	1.30	205	75	2.55	2.60	2	250	64
11	55.0	48.880	1.30	205	76	2.56	2.60	2	251	64
12	60.0	53.335	1.30	204	76	2.56	2.60	2	252	64
13	65.0	57.780	1.30	200	75	2.57	2.60	2	252	64
14	70.0	62.370	1.40	202	75	2.76	2.80	2	252	61
15	75.0	66.920	1.40	202	75	2.76	2.80	2	252	65
16	80.0	71.560	1.40	202	76	2.77	2.80	2	251	67
17	85.0	76.150	1.40	190	77	2.82	2.80	2	251	58
18	90.0	80.760	1.40	185	76	2.84	2.80	2	249	51
19	95.0	85.420	1.40	181	77	2.86	2.90	2	251	48
20	100.0	90.100	1.40	177	77	2.88	2.90	2	251	48
21	105.0	94.610	1.30	175	77	2.68	2.70	2	251	46
22	110.0	99.120	1.30	178	78	2.67	2.70	2	253	46
23	115.0	103.650	1.30	181	78	2.66	2.70	2	250	46
24	120.0	107.935	1.20	185	77	2.44	2.40	2	252	46

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**13:27**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**		**End Time:**	**15:34**
EPA Method:	**5**	Raining 64 F Wind Variable		**Date:**	**9/12/2018**
Box Operator:	**CMF**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3C	Liner type:	Glass	
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173	inches
ΔH@	1.846	Hot box ID	M5-HB	Nozzle area:	0.000258	sq.ft.
		Pitot Cp	0.84	Probe heat:	250	F
				Filter heat:	250	F

Source Information:

Barometric Pressure	29.82	"Hg	O_2	19.8	%
Static Pressure	0.56	"H_2O	CO_2	0.7	%
Ave. ΔP	1.321	"H_2O	Rec. Nz.	0.199	inches
Stack Temperature	196	F			
Assumed moisture	1.87	%			
Assumed meter temp.	74.1	F			
Total number of points	24				
Time per point	5				
Total run time	120				

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	8

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	107.890	dcf	Ave. ΔP	1.354	"H_2O
Wet mol. weight	28.67	M_s (actual)	Ave. √ΔP	1.1633	"H_2O
Actual H_2O	2.1	%	Ave. ΔH	2.721	"H_2O
Std. meter vol.	107.500	dscf	Ave. T_s	192	°F
Isokinetic Average	100.4	%	Ave. T_m	71.9	°F

Moisture/Lab:

Filter	Q1372 #		
	Initial	Final	Gain
Impingers, g	200.0	224	24.0
Silica gel, g	263.7	288.7	25.0
		Total water gain:	49.0

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.490	1.40	194	71	2.78	2.80	3	252	62
2	10.0	8.870	1.30	196	72	2.58	2.60	3	252	62
3	15.0	13.420	1.40	197	71	2.77	2.80	3	251	50
4	20.0	17.940	1.40	198	70	2.76	2.80	3	251	51
5	25.0	22.470	1.40	197	70	2.76	2.80	3	251	52
6	30.0	26.880	1.30	196	71	2.57	2.60	3	252	53
7	35.0	31.440	1.40	191	71	2.79	2.80	3	249	53
8	40.0	35.800	1.30	179	72	2.65	2.60	3	252	53
9	45.0	40.350	1.30	175	72	2.66	2.70	3	251	54
10	50.0	44.640	1.20	172	72	2.47	2.50	3	250	55
11	55.0	48.920	1.20	177	72	2.45	2.50	3	251	58
12	60.0	53.333	1.30	182	72	2.64	2.60	3	251	58
13	65.0	58.330	1.50	182	72	3.04	3.00	3	253	58
14	70.0	62.750	1.30	192	72	2.60	2.60	3	253	53
15	75.0	67.260	1.40	195	72	2.78	2.80	3	251	54
16	80.0	71.810	1.40	196	72	2.78	2.80	3	250	55
17	85.0	76.350	1.40	196	72	2.78	2.80	3	252	56
18	90.0	80.900	1.40	197	72	2.77	2.80	3	250	57
19	95.0	85.430	1.40	197	72	2.77	2.80	3	250	57
20	100.0	89.960	1.40	198	73	2.77	2.80	3	251	57
21	105.0	94.500	1.40	199	73	2.77	2.80	3	251	59
22	110.0	99.070	1.40	200	73	2.77	2.80	3	251	60
23	115.0	103.470	1.30	201	73	2.56	2.60	3	251	60
24	120.0	107.890	1.30	201	73	2.56	2.60	3	250	59

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**16:00**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:07**
EPA Method:	**5**	Raining 64 F Wind Variable	**Date:**	**9/12/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3C	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	M5-HB	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.82 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.2 inches
Stack Temperature	196 F		
Assumed moisture	2.1 %		
Assumed meter temp.	71.9 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	8

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	106.326 dcf	Ave. ΔP	1.338 "H_2O
Wet mol. weight	28.68 M_s (actual)	Ave. √ΔP	1.1561 "H_2O
Actual H_2O	2.03 %	Ave. ΔH	2.629 "H_2O
Std. meter vol.	105.599 dscf	Ave. T_s	206 °F
Isokinetic Average	100.2 %	Ave. T_m	73.5 °F

Moisture/Lab:

Filter Q1373 #

	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	251.0	277.4	26.4
		Total water gain:	46.4

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.390	1.30	201	70	2.54	2.60	3	252	54
2	10.0	8.770	1.30	202	71	2.54	2.60	3	252	48
3	15.0	13.130	1.30	202	71	2.54	2.60	3	251	51
4	20.0	17.590	1.40	203	70	2.73	2.70	3	252	51
5	25.0	22.090	1.40	204	71	2.73	2.70	3	251	51
6	30.0	26.600	1.40	204	71	2.73	2.70	3	252	52
7	35.0	31.110	1.40	204	72	2.73	2.70	3	252	52
8	40.0	35.630	1.40	205	72	2.73	2.70	3	251	53
9	45.0	40.000	1.30	205	73	2.54	2.60	3	252	53
10	50.0	44.380	1.30	206	73	2.54	2.60	3	251	53
11	55.0	48.620	1.20	206	74	2.35	2.40	3	252	53
12	60.0	53.012	1.30	206	74	2.54	2.60	3	251	53
13	65.0	57.240	1.20	206	73	2.34	2.40	3	251	53
14	70.0	61.600	1.30	204	73	2.54	2.60	3	251	48
15	75.0	65.940	1.30	206	73	2.54	2.60	3	251	51
16	80.0	70.460	1.40	207	74	2.73	2.70	3	251	53
17	85.0	74.980	1.40	208	74	2.73	2.70	3	252	54
18	90.0	79.500	1.40	208	75	2.73	2.70	3	251	55
19	95.0	84.170	1.50	209	75	2.92	2.90	3	251	55
20	100.0	88.740	1.40	209	76	2.73	2.70	3	251	56
21	105.0	93.120	1.30	210	76	2.54	2.50	3	250	56
22	110.0	97.540	1.30	210	77	2.54	2.60	3	250	57
23	115.0	101.920	1.30	210	77	2.54	2.60	3	252	57
24	120.0	106.326	1.30	209	78	2.55	2.60	3	252	57

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:52**
Source:	**CFU 112**	**End Time:**	**12:59**
Method:	**ODEQ 5**	**Date:**	**9/12/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
5	4.280	2.50	68	1	1.30	203	1.1402
10	8.550	2.50	68	2	1.30	203	1.1402
15	12.840	2.70	69	3	1.30	205	1.1402
20	17.320	2.70	69	4	1.40	205	1.1832
25	21.806	2.70	70	5	1.40	205	1.1832
30	26.350	2.70	71	6	1.40	205	1.1832
35	30.820	2.70	72	7	1.40	206	1.1832
40	35.500	2.90	73	8	1.50	206	1.2247
45	40.040	2.70	74	9	1.40	205	1.1832
50	44.480	2.60	75	10	1.30	205	1.1402
55	48.880	2.60	76	11	1.30	205	1.1402
60	53.335	2.60	76	12	1.30	204	1.1402
65	57.780	2.60	75	13	1.30	200	1.1402
70	62.370	2.80	75	14	1.40	202	1.1832
75	66.920	2.80	75	15	1.40	202	1.1832
80	71.560	2.80	76	16	1.40	202	1.1832
85	76.150	2.80	77	17	1.40	190	1.1832
90	80.760	2.80	76	18	1.40	185	1.1832
95	85.420	2.90	77	19	1.40	181	1.1832
100	90.100	2.90	77	20	1.40	177	1.1832
105	94.610	2.70	77	21	1.30	175	1.1402
110	99.120	2.70	78	22	1.30	178	1.1402
115	103.650	2.70	78	23	1.30	181	1.1402
120	107.935	2.40	77	24	1.20	185	1.0954

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Source:	**CFU 112**		**Date:**	**09/12/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	107.935	dcf	Rectangular		
Water Volume	43.3	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.82	"Hg	CO_2 Average	0.47	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.84	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.700	"H_2O	√Dp	1.1634	"H_2O
Temperature, T_m	74.1	^oF	Temperature, T_s	196.5	^oF
Temperature, T_m	534.1	^oA (^oR)	Temperature, T_s	656.5	^oA (R)
Pressure Meter, P_m	30.019	"Hg	Pressure Stack, P_s	29.861	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	107.098	dscf	Velocity, V_s	73.16	fps
	3.033	dscm	Volume (actual)	21,548.5	awcfm
Actual Volume, $V_{m(actual)}$	136.023	awcf		21,145.5	adcfm
Gas Stream Moisture			Volume (standard)	1,037,794.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.038	scf		1,018,387.4	dscf/hr
Moisture, B_{ws}	0.0187			16,973.1	dscf/min
Moisture EPA M4	1.87	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.87	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	100.1	%			

Laboratory Results

EPA Method 5					
Filterable PM	1.00E-03	grams			
Emissions:					
Concentration, C_s	1.44E-04	gr/dscf			
	330	µg/dscm			
Mass Emissions	2.10E-02	lb/hr			
Back Half:					
Inorganic CPM	6.50E-04	grams	Organic CPM	5.50E-04	grams
Inorganic CPM, C_s	9.36E-05	gr/dscf	Organic CPM, C_s	7.92E-05	gr/dscf
	214	µg/dscm		181	µg/dscm
Mass Emissions	1.36E-02	lb/hr	Mass Emissions	1.15E-02	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:27**
Source:	**CFU 112**	**End Time:**	**15:34**
Method:	**ODEQ 5**	**Date:**	**09/12/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m ^oF	Traverse Point	Dp "H_2O	Stack T_s ^oF	$\sqrt{Dp}$
	0.000						
5	4.490	2.80	71	1	1.40	194	1.1832
10	8.870	2.60	72	2	1.30	196	1.1402
15	13.420	2.80	71	3	1.40	197	1.1832
20	17.940	2.80	70	4	1.40	198	1.1832
25	22.470	2.80	70	5	1.40	197	1.1832
30	26.880	2.60	71	6	1.30	196	1.1402
35	31.440	2.80	71	7	1.40	191	1.1832
40	35.800	2.60	72	8	1.30	179	1.1402
45	40.350	2.70	72	9	1.30	175	1.1402
50	44.640	2.50	72	10	1.20	172	1.0954
55	48.920	2.50	72	11	1.20	177	1.0954
60	53.333	2.60	72	12	1.30	182	1.1402
65	58.330	3.00	72	13	1.50	182	1.2247
70	62.750	2.60	72	14	1.30	192	1.1402
75	67.260	2.80	72	15	1.40	195	1.1832
80	71.810	2.80	72	16	1.40	196	1.1832
85	76.350	2.80	72	17	1.40	196	1.1832
90	80.900	2.80	72	18	1.40	197	1.1832
95	85.430	2.80	72	19	1.40	197	1.1832
100	89.960	2.80	73	20	1.40	198	1.1832
105	94.500	2.80	73	21	1.40	199	1.1832
110	99.070	2.80	73	22	1.40	200	1.1832
115	103.470	2.60	73	23	1.30	201	1.1402
120	107.890	2.60	73	24	1.30	201	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 112**	**Date:**	**09/12/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	107.890	dcf	Rectangular		
Water Volume	49.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.82	"Hg	CO_2 Average	0.46	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.95	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.721	"H_2O	√Dp	1.1633	"H_2O
Temperature, T_m	71.9	^oF	Temperature, T_s	192.0	^oF
Temperature, T_m	531.9	^oA (^oR)	Temperature, T_s	652.0	^oA (R)
Pressure Meter, P_m	30.020	"Hg	Pressure Stack, P_s	29.861	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	107.500	dscf	Velocity, V_s	72.94	fps
	3.044	dscm	Volume (actual)	21,483.7	awcfm
Actual Volume, $V_{m(actual)}$	135.916	awcf		21,032.5	adcfm
Gas Stream Moisture			Volume (standard)	1,041,814.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.306	scf		1,019,936.4	dscf/hr
Moisture, B_{ws}	0.0210			16,998.9	dscf/min
Moisture EPA M4	2.10	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.87	lb/lb-mole			
Wet, M_s	28.64	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

Front Half:					
Filterable PM	1.10E-03	grams			
Emissions:					
Concentration, C_s	1.58E-04	gr/dscf			
	361	µg/dscm			
Mass Emissions	2.30E-02	lb/hr			
Back Half:					
Inorganic CPM	5.00E-04	grams	Organic CPM	2.50E-04	grams
Inorganic CPM, C_s	7.18E-05	gr/dscf	Organic CPM, C_s	3.59E-05	gr/dscf
	164	µg/dscm		82	µg/dscm
Mass Emissions	1.05E-02	lb/hr	Mass Emissions	5.23E-03	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**16:00**
Source:	**CFU 112**	**End Time:**	**18:07**
Method:	**ODEQ 5**	**Date:**	**09/12/18**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
5	4.390	2.60	70	1	1.30	201	1.1402
10	8.770	2.60	71	2	1.30	202	1.1402
15	13.130	2.60	71	3	1.30	202	1.1402
20	17.590	2.70	70	4	1.40	203	1.1832
25	22.090	2.70	71	5	1.40	204	1.1832
30	26.600	2.70	71	6	1.40	204	1.1832
35	31.110	2.70	72	7	1.40	204	1.1832
40	35.630	2.70	72	8	1.40	205	1.1832
45	40.000	2.60	73	9	1.30	205	1.1402
50	44.380	2.60	73	10	1.30	206	1.1402
55	48.620	2.40	74	11	1.20	206	1.0954
60	53.012	2.60	74	12	1.30	206	1.1402
65	57.240	2.40	73	13	1.20	206	1.0954
70	61.600	2.60	73	14	1.30	204	1.1402
75	65.940	2.60	73	15	1.30	206	1.1402
80	70.460	2.70	74	16	1.40	207	1.1832
85	74.980	2.70	74	17	1.40	208	1.1832
90	79.500	2.70	75	18	1.40	208	1.1832
95	84.170	2.90	75	19	1.50	209	1.2247
100	88.740	2.70	76	20	1.40	209	1.1832
105	93.120	2.50	76	21	1.30	210	1.1402
110	97.540	2.60	77	22	1.30	210	1.1402
115	101.920	2.60	77	23	1.30	210	1.1402
120	106.326	2.60	78	24	1.30	209	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 112**	**Date:**	**09/12/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	106.326	dcf	Rectangular		
Water Volume	46.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.82	"Hg	CO_2 Average	0.46	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.84	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.629	"H_2O	√Dp	1.1561	"H_2O
Temperature, T_m	73.5	^oF	Temperature, T_s	206.0	^oF
Temperature, T_m	533.5	^oA (^oR)	Temperature, T_s	666.0	^oA (R)
Pressure Meter, P_m	30.013	"Hg	Pressure Stack, P_s	29.861	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	105.599	dscf	Velocity, V_s	73.25	fps
	2.990	dscm	Volume (actual)	21,575.1	awcfm
Actual Volume, $V_{m(actual)}$	136.282	awcf		21,137.1	adcfm
Gas Stream Moisture			Volume (standard)	1,024,249.2	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.184	scf		1,003,456.9	dscf/hr
Moisture, B_{ws}	0.0203			16,724.3	dscf/min
Moisture EPA M4	2.03	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.87	lb/lb-mole			
Wet, M_s	28.65	lb/lb-mole			
Percent Isokinetic	100.2	%			

Laboratory Results

Front Half:					
Filterable PM	0.00065	grams			
Emissions:					
Concentration, C_s	9.50E-05	gr/dscf			
	217	µg/dscm			
Mass Emissions	0.01	lb/hr			
Back Half:					
Inorganic CPM	8.50E-04	grams	Organic CPM	3.50E-04	grams
Inorganic CPM, C_s	1.24E-04	gr/dscf	Organic CPM, C_s	5.11E-05	gr/dscf
	284	µg/dscm		117.06	µg/dscm
Mass Emissions	0.018	lb/hr	Mass Emissions	7.33E-03	lb/hr

Oregon Method 5
Filterable and Condensable Particulate
Laboratory Gravimetric Data

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 112**

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction	Corrected Gain (grams)	
1	CPM Organics (Acetone BH)	130	43.96145	43.96200	0.00055	0.00E+00	**0.00055**	
	Probe Rinse (Acetone FH)	90	59.15790	59.15890	0.00100	0.00E+00	**0.00100**	
	Filter	Q1371	0.37035	0.36985	-0.00050		**0.00000**	
	CPM Inorganics (Water)	392	47.03715	47.03780	0.00065	0.00E+00	**0.00065**	
	CPM Organics (Hexane BH)	85	44.81200	44.81190	-0.00010	0.00E+00	**0.00000**	
	Impinger H_2O Gain, mls		200	218	18.0			
						Filterable PM (mg)	**1.00**	
						Total PM (mg)	**2.20**	**ND**
2	CPM Organics (Acetone BH)	140	44.97165	44.97190	0.00025	0.00E+00	**0.00025**	
	Probe Rinse (Acetone FH)	95	47.15310	47.15420	0.00110	0.00E+00	**0.00110**	
	Filter	Q1372	0.37635	0.37600	-0.00035		**0.00000**	
	CPM Inorganics (Water)	366	48.30270	48.30320	0.00050	0.00E+00	**0.00050**	
	CPM Organics (Hexane BH)	85	43.48910	43.48890	-0.00020	0.00E+00	**0.00000**	
	Impinger H_2O Gain, mls		200	224	24.0			
						Filterable PM (mg)	**1.10**	
						Total PM (mg)	**1.85**	**ND**
3	CPM Organics (Acetone BH)	130	44.42925	44.42960	0.00035	0.00E+00	**0.00035**	
	Probe Rinse (Acetone FH)	80	43.66685	43.66750	0.00065	0.00E+00	**0.00065**	
	Filter	Q1373	0.37470	0.37455	-0.00015		**0.00000**	
	CPM Inorganics (Water)	365	53.58795	53.58880	0.00085	0.00E+00	**0.00085**	
	CPM Organics (Hexane BH)	100	46.05505	46.05480	-0.00025	0.00E+00	**0.00000**	
	Impinger H_2O Gain, mls		200	220	20.0			
						Filterable PM (mg)	**0.65**	
						Total PM (mg)	**1.85**	**ND**
	Acetone Blank	160	45.69390	45.69390	0.00000	0.00E+00	g/g	
	Water Blank	200	49.47520	49.47520	0.00000	0.00E+00	g/g	
	Hexane Blank	100	43.10705	43.10700	0.00000	0.00E+00	g/g	

ND = Non-Detect. Values are below the method detection limit (7 mg).

Oregon Methods 1-5
Filterable and Condensable Particulate
Results Summary

Client: Hollingsworth & Vose
Source: CFU 112
Location: Corvallis, OR

Run			1	2	3	Average
Date			9/12/2018	9/12/2018	9/12/2018	
Run Start Time			10:52	13:27	16:00	
Run End Time			12:59	15:34	18:07	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.82	29.82	29.82	**29.82**
Nozzle Dia., in.			0.2173	0.2173	0.2173	**0.2173**
Isokinetic Average, %			100.1	100.3	100.2	**100.2**
Sample Volume, dscf			107.098	107.500	105.599	**106.732**
Sample Volume, dscm			3.033	3.044	2.990	**3.022**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.47	0.46	0.46	**0.46**
O_2 %vd			19.84	19.95	19.84	**19.88**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.87	2.10	2.03	**2.00**
Wet Molecular Weight, lb/lb-mole			28.67	28.64	28.65	**28.65**
Velocity, FPS			73.16	72.94	73.25	**73.12**
ADCFM			21,145.5	21,032.5	21,137.1	**21,105.0**
AWCFM			21,548.5	21,483.7	21,575.1	**21,535.8**
DSCFM			16,973.1	16,998.9	16,724.3	**16,898.8**
Stack Temperature, ^oF			196.5	192.0	206.0	**198.2**
Filterable Particulate	Concentration, C_s	gr/dscf	1.44E-04	1.58E-04	9.50E-05	**1.32E-04**
		µg/dscm	330	361	217	**303**
	Mass	lb/hr	2.10E-02	2.30E-02	1.36E-02	**1.92E-02**
		lb/lb glass	3.10E-05	3.34E-05	1.79E-05	**2.74E-05**
Inorganic CPM	Concentration, C_s	gr/dscf	9.36E-05	7.18E-05	1.24E-04	**9.65E-05**
		µg/dscm	214	164	284	**221**
	Mass	lb/hr	1.36E-02	1.05E-02	1.78E-02	**1.40E-02**
		lb/lb glass	2.01E-05	1.52E-05	2.35E-05	**1.96E-05**
Organic CPM	Concentration, C_s	gr/dscf	7.92E-05	3.59E-05	5.11E-05	**5.54E-05**
		µg/dscm	181	82	117	**127**
	Mass	lb/hr	1.15E-02	5.23E-03	7.33E-03	**8.03E-03**
		lb/lb glass	1.70E-05	7.60E-06	9.66E-06	**1.14E-05**
Measured Total PM	Concentration, C_s	gr/dscf	ND 3.17E-04	ND 2.66E-04	ND 2.70E-04	ND **2.84E-04**
		µg/dscm	ND 725.4	ND 607.8	ND 618.7	ND **650.6**
	Mass	lb/hr	ND 4.61E-02	ND 3.87E-02	ND 3.88E-02	ND **4.12E-02**
		lb/lb glass	ND 6.81E-05	ND 5.62E-05	ND 5.11E-05	ND **5.85E-05**
Total PM @ Method Detection Limit (7 mg)	Concentration, C_s	gr/dscf	< 1.01E-03	< 1.00E-03	< 1.02E-03	< **1.01E-03**
	Mass	lb/hr	< 1.47E-01	< 1.46E-01	< 1.47E-01	< **1.47E-01**
		lb/lb glass	< 2.17E-04	< 2.13E-04	< 1.93E-04	< **2.08E-04**
Production Data	Glass Production	lbs/hr	676.9	688.0	758.7	**707.9**

Oregon Methods 1-5
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:52**
Source:	**CFU 112**	**End Time:**	**12:59**
Method:	**ODEQ 5**	**Date:**	**9/12/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.019 "Hg
where Pb: 29.82 "Hg
ΔH: 2.700 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.861 "Hg
where Pb: 29.82 "Hg
Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 107.098 dscf
where Vm: 107.935 dcf
Y: 1.0008
Pm: 30.019 "Hg
Tm: 534.1 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.038 scf
where H_2O: 43.30 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0187

where Vw(std): 2.038 scf
Vm(std): 107.098 dscf

6) % H_2O = Bws x 100 = 1.87 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 136.023 awcf
where Y: 1.0008
Vm: 107.9349 dcf
Bws: 0.0187
Ts: 656.5 °A
Tm: 534.1 °A
Pm: 30.019 "Hg
Ps: 29.861 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.87 lb/lb-mole
where CO_2: 0.47 %vd
O_2 19.84 %vd
N_2+CO= (100-(O_2+CO_2): 79.69 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.67 lb/lb-mole
where M_d: 28.87 lb/lb-mole
Bws: 0.0187

10) $\text{Stack Area(cir.)} = 3.1416\ (\text{stack diameter}/24)^2 =$ 4.909 sq. ft.
where Stack ID: 30 inches

$\text{Stack Area(rect.)} = \text{stack width}/12 \text{ x stack length}/12 =$ NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 73.16 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.1634
Ts: 656.5 °A
Ps: 29.861 "Hg
Ms: 28.67 lb/lb-mole

12) $\text{AWCFM} = (V_s)(\text{stack area})(60 \text{ sec/min}) =$ 21,548.5 AWCFM
where V_s: 73.16 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 21,145.5 ADCFM
where AWCFM: 21,548.5
Bws: 0.0187

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,037,794.1 wscf/hr
where V_s: 73.16 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 656.5 °A
Ps: 29.861 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,018,387.4 dscf/hr
where wscf/hr: 1,037,794.1
Bws: 0.0187

16) DSCFM= (dscf/hr)/60 mins/hr = 16,973.1 DSCFM
where dscf/hr: 1,018,387.4

17) $\text{Nozzle Area} = 3.1416\ (\text{Nozzle Size}/24)^2 =$ 0.000258 sq. ft.
where Nozzle Size: 0.2173 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 112**	**Date:**	**9/12/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.1 %

where Ts:	656.5	°A
Vm(Std):	107.098	dscf
Ps:	29.861	"Hg
Vs	73.16	ft/sec
Nozzle Area:	0.000258	sq. ft.
Sampling Time:	120	min.
Bws:	0.0187	

ODEQ Method 5:

Front Half:

19) Filterable PM = filter gain + probe rinse gain = 1.00E-03 grams

where Filter Gain:	0.00000	grams
Probe Rinse:	0.00100	grams

20) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 1.44E-04 gr/dscf

where Sample:	0.00100	grams
Vm(std)	107.098	dscf

21) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 330 µg/dscm

where Sample:	0.00100	grams
Vm(std)	3.033	dscm

22) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 2.10E-02 lb/hr

where Cs:	1.44E-04	gr/dscf
Stack Flow:	1,018,387.4	dscf/hr

Back Half:

23) Inorganic CPM = water fraction = 6.50E-04 grams

Organic CPM = acetone BH + hexane BH = 5.50E-04 grams

Back-half concentrations and mass rates are calculated as front-half examples.

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112**
DATE	**09/12/18**
METHOD	**316**
POLLUTANT	**Formaldehyde**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:53**
Source:	**CFU 112**	**End Time:**	**13:00**
EPA Method:	**316**	**Date:**	**9/12/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Intermittent clouds, 60 degrees

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	30	Probe ID	3B	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.82 "Hg	O_2	19.80 %
Static Pressure	0.56 "H_2O	CO_2	0.70 %
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.201 inches
Stack Temperature	190 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	10	6

Nozzle check for roundness:

1	2	3
0.179	0.179	0.180 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	72.294 dcf	Ave. ΔP	1.333 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.1542 "H_2O
Actual H_2O	1.85 %	Ave. ΔH	1.192 "H_2O
Std. meter vol.	71.612 dscf	Ave. T_s	196.3 °F
Isokinetic Average	99.5 %	Ave. T_m	71.8 °F

Moisture/Lab:

	Initial	Final	Gain
Filter	NA #		
Impingers, g	200.0	217	17.0
Silica gel, g	239.9	251.6	11.7
		Total water gain:	28.7

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.870	1.30	206	67	1.13	1.10	1	253	59
2	10.0	5.960	1.40	206	69	1.23	1.20	1	253	52
3	15.0	8.970	1.40	206	67	1.22	1.20	1	256	51
4	20.0	11.940	1.40	206	68	1.22	1.20	1	254	53
5	25.0	14.970	1.40	206	68	1.22	1.20	1	253	52
6	30.0	18.000	1.40	205	68	1.23	1.20	1	252	52
7	35.0	21.060	1.40	204	69	1.23	1.20	1	253	52
8	40.0	24.110	1.40	204	70	1.23	1.20	1	254	52
9	45.0	27.120	1.30	202	71	1.15	1.20	1	257	52
10	50.0	30.130	1.30	202	72	1.15	1.20	1	254	52
11	55.0	33.010	1.20	199	73	1.07	1.10	1	253	53
12	60.0	35.899	1.20	200	73	1.07	1.10	1	253	53
13	65.0	38.910	1.30	204	73	1.15	1.20	1	253	59
14	70.0	41.840	1.30	204	73	1.15	1.20	1	253	52
15	75.0	44.900	1.40	204	73	1.24	1.20	1	253	52
16	80.0	47.910	1.40	202	73	1.24	1.20	1	252	52
17	85.0	51.080	1.40	190	74	1.27	1.30	1	252	48
18	90.0	54.240	1.40	185	74	1.28	1.30	1	253	42
19	95.0	57.340	1.40	181	74	1.29	1.30	1	253	43
20	100.0	60.370	1.30	176	75	1.21	1.20	1	255	44
21	105.0	63.400	1.30	175	75	1.21	1.20	1	254	45
22	110.0	66.440	1.30	178	75	1.20	1.20	1	254	45
23	115.0	69.370	1.20	181	75	1.10	1.10	1	254	45
24	120.0	72.294	1.20	185	75	1.10	1.10	1	252	46

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:28**
Source:	**CFU 112**	**End Time:**	**15:35**
EPA Method:	**316**	**Date:**	**9/12/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Intermittent clouds, 60 degrees

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	30	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size:	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.82 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.200 inches
Stack Temperature	190 F		
Assumed moisture	1.85 %		
Assumed meter temp.	71.8 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	9	6

Nozzle check for roundness:

1	2	3
0.179	0.179	0.180 inches

Caliper ID# MN-2

Post Test Calculations:

Sample volume	73.226 dcf	Ave. ΔP	1.375 "H_2O
Wet mol. weight	28.62 M_s (actual)	Ave. √ΔP	1.1719 "H_2O
Actual H_2O	2.53 %	Ave. ΔH	1.254 "H_2O
Std. meter vol.	72.764 dscf	Ave. T_s	192.3 °F
Isokinetic Average	99.8 %	Ave. T_m	70.2 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	226	26.0
Silica gel, g	240.0	254.2	14.2
		Total water gain:	40.2

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.980	1.30	195	70	1.16	1.20	1	253	59
2	10.0	6.070	1.40	197	71	1.25	1.30	1	253	50
3	15.0	9.090	1.40	198	70	1.25	1.20	1	255	48
4	20.0	12.130	1.40	198	70	1.25	1.20	1	250	49
5	25.0	15.230	1.40	197	70	1.25	1.30	1	252	50
6	30.0	18.360	1.40	195	70	1.25	1.30	1	251	49
7	35.0	21.440	1.40	188	70	1.27	1.30	1	250	49
8	40.0	24.420	1.30	179	70	1.19	1.20	1	252	50
9	45.0	27.430	1.30	174	70	1.20	1.20	1	255	51
10	50.0	30.440	1.30	174	70	1.20	1.20	1	254	51
11	55.0	33.390	1.20	177	71	1.11	1.10	1	256	51
12	60.0	36.234	1.20	182	71	1.10	1.10	1	254	52
13	65.0	39.310	1.40	192	70	1.26	1.30	1	253	49
14	70.0	42.280	1.30	194	71	1.17	1.20	1	253	49
15	75.0	45.350	1.40	196	70	1.25	1.30	1	253	50
16	80.0	48.440	1.40	197	70	1.25	1.30	1	250	51
17	85.0	51.680	1.60	197	70	1.43	1.40	1	255	51
18	90.0	54.950	1.60	197	70	1.43	1.40	1	254	51
19	95.0	57.990	1.40	197	70	1.25	1.30	1	254	52
20	100.0	61.040	1.40	197	70	1.25	1.30	1	253	52
21	105.0	64.100	1.40	198	70	1.25	1.30	1	252	54
22	110.0	67.120	1.30	198	70	1.16	1.20	1	254	55
23	115.0	70.150	1.40	199	70	1.24	1.20	1	252	55
24	120.0	73.226	1.40	198	71	1.25	1.30	1	254	54

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**16:01**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:08**
EPA Method:	**316**	Intermittent clouds, 60 degrees	**Date:**	**9/12/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	30	Probe ID	3B	Liner type:	Glass	
Y factor	0.9985	Nozzle ID	0.18	Nozzle size:	0.1793	inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000175	sq.ft.
		Pitot Cp	0.84	Probe heat:	250	F
				Filter heat:	250	F

Source Information:

Barometric Pressure	29.82	"Hg	O_2	19.8	%
Static Pressure	0.56	"H_2O	CO_2	0.7	%
Ave. ΔP	1.3	"H_2O	Rec. Nz.	0.201	inches
Stack Temperature	190	F			
Assumed moisture	2.53	%			
Assumed meter temp.	70.2	F			
Total number of points	24				
Time per point	5				
Total run time	120				

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	6

Nozzle check for roundness:

1	2	3	
0.179	0.179	0.180	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	72.490	dcf	Ave. ΔP	1.363	"H_2O
Wet mol. weight	28.64	M_s (actual)	Ave. √ΔP	1.1666	"H_2O
Actual H_2O	2.41	%	Ave. ΔH	1.208	"H_2O
Std. meter vol.	71.863	dscf	Ave. T_s	206	°F
Isokinetic Average	100.0	%	Ave. T_m	71.4	°F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	222	22.0
Silica gel, g	239.5	255.2	15.7
		Total water gain:	37.7

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.990	1.40	202	69	1.22	1.20	1	256	53
2	10.0	6.010	1.40	203	70	1.22	1.20	1	254	48
3	15.0	9.060	1.40	204	70	1.22	1.20	1	255	50
4	20.0	12.140	1.40	204	70	1.22	1.20	1	253	50
5	25.0	15.290	1.50	206	70	1.31	1.30	1	254	50
6	30.0	18.530	1.60	205	70	1.39	1.40	1	252	50
7	35.0	21.570	1.40	204	70	1.22	1.20	1	255	50
8	40.0	24.650	1.40	204	71	1.22	1.20	1	252	50
9	45.0	27.650	1.30	205	71	1.14	1.20	1	252	51
10	50.0	30.610	1.30	204	71	1.14	1.20	1	254	51
11	55.0	33.570	1.30	204	71	1.14	1.20	1	254	51
12	60.0	36.548	1.30	204	71	1.14	1.20	1	253	51
13	65.0	39.550	1.30	205	71	1.14	1.20	1	257	52
14	70.0	42.440	1.20	207	71	1.04	1.10	1	251	50
15	75.0	45.400	1.30	206	71	1.13	1.20	1	254	50
16	80.0	48.310	1.30	208	72	1.13	1.10	1	254	50
17	85.0	51.280	1.30	208	72	1.13	1.10	1	252	52
18	90.0	54.530	1.60	209	72	1.39	1.40	1	252	52
19	95.0	57.540	1.40	208	72	1.22	1.20	1	253	54
20	100.0	60.590	1.40	209	73	1.22	1.20	1	253	54
21	105.0	63.570	1.30	209	73	1.13	1.20	1	254	54
22	110.0	66.560	1.30	208	74	1.14	1.20	1	252	54
23	115.0	69.530	1.30	209	74	1.13	1.20	1	254	55
24	120.0	72.490	1.30	208	74	1.14	1.20	1	253	55

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:53**
Source:	**CFU 112**	**End Time:**	**13:00**
Method:	**316**	**Date:**	**9/12/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**√Dp**
	0.000						
5	2.870	1.10	67	1	1.30	206	1.1402
10	5.960	1.20	69	2	1.40	206	1.1832
15	8.970	1.20	67	3	1.40	206	1.1832
20	11.940	1.20	68	4	1.40	206	1.1832
25	14.970	1.20	68	5	1.40	206	1.1832
30	18.000	1.20	68	6	1.40	205	1.1832
35	21.060	1.20	69	7	1.40	204	1.1832
40	24.110	1.20	70	8	1.40	204	1.1832
45	27.120	1.20	71	9	1.30	202	1.1402
50	30.130	1.20	72	10	1.30	202	1.1402
55	33.010	1.10	73	11	1.20	199	1.0954
60	35.899	1.10	73	12	1.20	200	1.0954
65	38.910	1.20	73	13	1.30	204	1.1402
70	41.840	1.20	73	14	1.30	204	1.1402
75	44.900	1.20	73	15	1.40	204	1.1832
80	47.910	1.20	73	16	1.40	202	1.1832
85	51.080	1.30	74	17	1.40	190	1.1832
90	54.240	1.30	74	18	1.40	185	1.1832
95	57.340	1.30	74	19	1.40	181	1.1832
100	60.370	1.20	75	20	1.30	176	1.1402
105	63.400	1.20	75	21	1.30	175	1.1402
110	66.440	1.20	75	22	1.30	178	1.1402
115	69.370	1.10	75	23	1.20	181	1.0954
120	72.294	1.10	75	24	1.20	185	1.0954

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Source:	**CFU 112**		**Date:**	**09/12/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	72.294	dcf	Rectangular		
Water Volume	28.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.82	"Hg	CO_2 Average	0.47	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.84	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.192	"H_2O	$\sqrt{Dp}$	1.1542	"H_2O
Temperature, T_m	71.8	^oF	Temperature, T_s	196.3	^oF
Temperature, T_m	531.8	^oA (^oR)	Temperature, T_s	656.3	^oA (R)
Pressure Meter, P_m	29.908	"Hg	Pressure Stack, P_s	29.861	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	71.612	dscf	Velocity, V_s	72.57	fps
	2.028	dscm	Volume (actual)	21,374.8	awcfm
Actual Volume, $V_{m(actual)}$	90.907	awcf		20,979.4	adcfm
Gas Stream Moisture			Volume (standard)	1,029,738.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.351	scf		1,010,688.3	dscf/hr
Moisture, B_{ws}	0.0185			16,844.8	dscf/min
Moisture EPA M4	1.85	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	479.832	
Dry, M_d	28.87	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	99.4	%			

Laboratory Results

CH_2O	424.0	µg/sample			
CH_2O	4.24E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	9.14E-05	gr/dscf
	209.1	µg/dscm
	1.67E-01	ppmvd
Mass Emissions	1.32E-02	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:28**
Source:	**CFU 112**	**End Time:**	**15:35**
Method:	**316**	**Date:**	**09/12/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	$\sqrt{Dp}$
	0.000						
5	2.980	1.20	70	1	1.30	195	1.1402
10	6.070	1.30	71	2	1.40	197	1.1832
15	9.090	1.20	70	3	1.40	198	1.1832
20	12.130	1.20	70	4	1.40	198	1.1832
25	15.230	1.30	70	5	1.40	197	1.1832
30	18.360	1.30	70	6	1.40	195	1.1832
35	21.440	1.30	70	7	1.40	188	1.1832
40	24.420	1.20	70	8	1.30	179	1.1402
45	27.430	1.20	70	9	1.30	174	1.1402
50	30.440	1.20	70	10	1.30	174	1.1402
55	33.390	1.10	71	11	1.20	177	1.0954
60	36.234	1.10	71	12	1.20	182	1.0954
65	39.310	1.30	70	13	1.40	192	1.1832
70	42.280	1.20	71	14	1.30	194	1.1402
75	45.350	1.30	70	15	1.40	196	1.1832
80	48.440	1.30	70	16	1.40	197	1.1832
85	51.680	1.40	70	17	1.60	197	1.2649
90	54.950	1.40	70	18	1.60	197	1.2649
95	57.990	1.30	70	19	1.40	197	1.1832
100	61.040	1.30	70	20	1.40	197	1.1832
105	64.100	1.30	70	21	1.40	198	1.1832
110	67.120	1.20	70	22	1.30	198	1.1402
115	70.150	1.20	70	23	1.40	199	1.1832
120	73.226	1.30	71	24	1.40	198	1.1832

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Source:	**CFU 112**		**Date:**	**09/12/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	73.226	dcf	Rectangular		
Water Volume	40.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.82	"Hg	CO_2 Average	0.46	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.95	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.254	"H_2O	$\sqrt{Dp}$	1.1719	"H_2O
Temperature, T_m	70.2	^oF	Temperature, T_s	192.3	^oF
Temperature, T_m	530.2	^oA (^oR)	Temperature, T_s	652.3	^oA (R)
Pressure Meter, P_m	29.912	"Hg	Pressure Stack, P_s	29.861	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	72.764	dscf	Velocity, V_s	73.56	fps
	2.060	dscm	Volume (actual)	21,666.4	awcfm
Actual Volume, $V_{m(actual)}$	92.447	awcf		21,118.2	adcfm
Gas Stream Moisture			Volume (standard)	1,050,186.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.892	scf		1,023,617.1	dscf/hr
Moisture, B_{ws}	0.0253			17,060.3	dscf/min
Moisture EPA M4	2.53	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	476.907	
Dry, M_d	28.87	lb/lb-mole			
Wet, M_s	28.59	lb/lb-mole			
Percent Isokinetic	99.8	%			

Laboratory Results

CH_2O	341.0	µg/sample			
CH_2O	3.41E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	7.23E-05	gr/dscf
	165.5	µg/dscm
	1.33E-01	ppmvd
Mass Emissions	1.06E-02	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**16:01**
Source:	**CFU 112**	**End Time:**	**18:08**
Method:	**316**	**Date:**	**09/12/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH $"H_2O$	Meter T_m °F	Traverse Point	Dp $"H_2O$	Stack T_s °F	$\sqrt{Dp}$
	0.000						
5	2.990	1.20	69	1	1.40	202	1.1832
10	6.010	1.20	70	2	1.40	203	1.1832
15	9.060	1.20	70	3	1.40	204	1.1832
20	12.140	1.20	70	4	1.40	204	1.1832
25	15.290	1.30	70	5	1.50	206	1.2247
30	18.530	1.40	70	6	1.60	205	1.2649
35	21.570	1.20	70	7	1.40	204	1.1832
40	24.650	1.20	71	8	1.40	204	1.1832
45	27.650	1.20	71	9	1.30	205	1.1402
50	30.610	1.20	71	10	1.30	204	1.1402
55	33.570	1.20	71	11	1.30	204	1.1402
60	36.548	1.20	71	12	1.30	204	1.1402
65	39.550	1.20	71	13	1.30	205	1.1402
70	42.440	1.10	71	14	1.20	207	1.0954
75	45.400	1.20	71	15	1.30	206	1.1402
80	48.310	1.10	72	16	1.30	208	1.1402
85	51.280	1.10	72	17	1.30	208	1.1402
90	54.530	1.40	72	18	1.60	209	1.2649
95	57.540	1.20	72	19	1.40	208	1.1832
100	60.590	1.20	73	20	1.40	209	1.1832
105	63.570	1.20	73	21	1.30	209	1.1402
110	66.560	1.20	74	22	1.30	208	1.1402
115	69.530	1.20	74	23	1.30	209	1.1402
120	72.490	1.20	74	24	1.30	208	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 112**	**Date:**	**09/12/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	72.490	dcf	Rectangular		
Water Volume	37.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.82	"Hg	CO_2 Average	0.46	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.84	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.208	"H_2O	$\sqrt{Dp}$	1.1666	"H_2O
Temperature, T_m	71.4	^oF	Temperature, T_s	206.0	^oF
Temperature, T_m	531.4	^oA (^oR)	Temperature, T_s	666.0	^oA (R)
Pressure Meter, P_m	29.909	"Hg	Pressure Stack, P_s	29.861	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	71.863	dscf	Velocity, V_s	73.97	fps
	2.035	dscm	Volume (actual)	21,787.1	awcfm
Actual Volume, $V_{m(actual)}$	93.105	awcf		21,262.0	adcfm
Gas Stream Moisture			Volume (standard)	1,034,316.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.774	scf		1,009,389.9	dscf/hr
Moisture, B_{ws}	0.0241			16,823.2	dscf/min
Moisture EPA M4	2.41	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	486.924	
Dry, M_d	28.87	lb/lb-mole			
Wet, M_s	28.61	lb/lb-mole			

Percent Isokinetic	99.9	%

Laboratory Results

CH_2O	460.0	µg/sample			
CH_2O	4.60E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	9.88E-05	gr/dscf
	226.0	µg/dscm
	1.81E-01	ppmvd
Mass Emissions	1.42E-02	lb/hr

"<" represents MDL value

EPA Method 316
Laboratory Results
Formaldehyde

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR** **MDL** 0.0274 µg/mL
Source: **CFU 112**

Lab ID	Sample ID	Sample Date	<	Result	MDL	Sample Vol. (mL)	Units
4	Run 1	9/12/2018		424	11.9	435.0	µg/sample
8	Run 2	9/12/2018		341	12.1	440.0	µg/sample
9	Run 3	9/12/2018		460	11.5	418.0	µg/sample
20	H_20 Blank	9/12/2018	<	MDL	11.1	405.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 316
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112

Run			1	2	3	
Date			9/12/2018	9/12/2018	9/12/2018	
Run Start Time			10:53	13:28	16:01	
Run End Time			13:00	15:35	18:08	
Duration, min.			120	120	120	**Average**
Barometric Pressure, "Hg			29.82	29.82	29.82	**29.82**
Nozzle Dia., in.			0.1793	0.1793	0.1793	**0.1793**
Isokinetic Average, %			99.4	99.8	99.9	**99.7**
Sample Volume, dscf			71.612	72.764	71.863	**72.080**
Sample Volume, dscm			2.028	2.060	2.035	**2.041**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.47	0.46	0.46	**0.46**
O_2 %vd			19.84	19.95	19.84	**19.88**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.85	2.53	2.41	**2.26**
Wet Molecular Weight, lb/lb-mole			28.67	28.59	28.61	**28.62**
Velocity, FPS			72.57	73.56	73.97	**73.37**
ADCFM			20,979.4	21,118.2	21,262.0	**21,119.9**
AWCFM			21,374.8	21,666.4	21,787.1	**21,609.4**
DSCFM			16,844.8	17,060.3	16,823.2	**16,909.4**
Stack Temperature, ^oF			196.3	192.3	206.0	**198.2**
Formaldehyde	Concentration, C_s	gr/dscf	9.14E-05	7.23E-05	9.88E-05	**8.75E-05**
		µg/dscm	209.1	165.5	226.0	**200.2**
		ppmvd	1.67E-01	1.33E-01	1.81E-01	**1.60E-01**
	Mass	lb/hr	1.32E-02	1.06E-02	1.42E-02	**1.27E-02**
		lb/lb glass	1.95E-05	1.54E-05	1.88E-05	**1.79E-05**
Production Data	**Glass Production**	**lbs/hr**	676.9	688.0	758.7	**707.9**

"<" represents MDL value

EPA Methods 1-4, 316
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:53**
Source:	**CFU 112**	**End Time:**	**13:00**
Method:	**316**	**Date:**	**9/12/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.908 "Hg
   - where Pb: 29.82 "Hg
   - ΔH: 1.192 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.861 "Hg
   - where Pb: 29.82 "Hg
   - Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 71.612 dscf
   - where Vm: 72.294 dcf
   - Y: 0.9985
   - Pm: 29.908 "Hg
   - Tm: 531.8 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.351 scf
   - where H_2O: 28.70 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0185
   - where Vw(std): 1.351 scf
   - Vm(std): 71.612 dscf

6) $\% H_2O = Bws \times 100 =$ 1.85 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 90.907 awcf
   - where Y: 0.9985
   - Vm: 72.2939 dcf
   - Bws: 0.0185
   - Ts: 656.3 °A
   - Tm: 531.8 °A
   - Pm: 29.908 "Hg
   - Ps: 29.861 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.87 lb/lb-mole
   - where CO_2: 0.47 %vd
   - O_2 19.84 %vd
   - N_2+CO= (100-(O_2+CO_2): 79.69 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.67 lb/lb-mole
where M_d: 28.87 lb/lb-mole
Bws: 0.0185

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 4.909 sq. ft.
where Stack ID: 30 inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(\text{Cp})(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 72.57 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.1542
Ts: 656.3 °A
Ps: 29.861 "Hg
Ms: 28.67 lb/lb-mole

12) $\text{AWCFM} = (V_s)\text{(stack area)(60 sec/min)} =$ 21,374.8 AWCFM
where V_s: 72.57 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 20,979.4 ADCFM
where AWCFM: 21,374.8
Bws: 0.0185

14) $\text{Qsw} = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,029,738.5 wscf/hr
where V_s: 72.57 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 656.3 °A
Ps: 29.861 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,010,688.3 dscf/hr
where wscf/hr: 1,029,738.5
Bws: 0.0185

16) DSCFM= (dscf/hr)/60 mins/hr = 16,844.8 DSCFM
where dscf/hr: 1,010,688.3

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000175 sq. ft.
where Nozzle Size: 0.1793 inches

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right) =$ 99.4 %

where Ts:	656.3	°A
Vm(Std):	71.612	dscf
Ps:	29.861	"Hg
Vs	72.57	ft/sec
Nozzle Area:	0.000175	sq. ft.
Sampling Time:	120	min.
Bws:	0.0185	

EPA Method 316:

19) Formaldehyde laboratory results 424.0 µg/sample

20) Formaldehyde = (µg/sample)/1,000,000 = 4.24E-04 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 9.14E-05 gr/dscf

where Sample:	0.00042	grams
Vm(std)	71.612	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 209.1 µg/dscm

where Sample:	0.00042	grams
Vm(std)	2.028	dscm

23) Volume/Mole $= \left(\frac{359\frac{ft^3}{lb-mol}@STP\ (Ts)\ (29.92"Hg)}{492°A\ \ (Ps)}\right) =$ 479.832 Vol./Mole

where Ts:	656.3	°A
Ps:	29.861	"Hg

24) ppmvd $= \left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right) =$ 1.67E-01 ppmvd

where MW:	30.031	g/mol
lb/hr:	0.01	
Vol./Mole:	479.832	
ADCFM:	20979.4	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 1.32E-02 lb/hr

where Cs:	9.14E-05	gr/dscf
Stack Flow:	1,010,688.3	dscf/hr

Daily Gaseous Calibrations Log

Client: Hollingsworth & Vose

Source: CFV-112 - M5/M316

Date: 09/12/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	0	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

*Use of a calibrated instrument required

- completed on 9/11/18

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X	0	X	0	X	0	X	50.41	X
10	X	10	X	150	X	2	X		
20	X	20	X	300	X	4	X		

- recalibrate

DSB

NOx	CO
0	0
2.5	50
5.0	100

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X	0	X	0	X	0	X		
20		~~10~~	X	~~150~~	X	2	X		

2.5 ⟷ Recalibrate - 50

System VOC Calibrations			
		Initial target	Post Target
Zero	✓	0	0
Low	✓	6.25	—
Mid	✓	12.50	12.5
High	✓	21.25	—

Alt 106 → 50 CH_4

Stratification test during run #1

Test Times: R-1 10:52 - 13:00 R-2 13:27 - 15:35 R-3 16:00 - 18:08

post leak check - pass

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Holiingsworth & Vose**	Source	**CFU-112**
Facility	**Glass Plant #1**	Date	**September 12, 2018**
Location	**Corvallis OR**		

Run			1	2	3	
Date			9/12/2018	9/12/2018	9/12/2018	
Run Start Time			10:52	13:27	16:00	
Run End Time			13:00	15:35	18:08	
CO_2 %vd			0.47	0.46	0.46	0.46
O_2 %vd			19.84	19.95	19.84	19.88
WSCFM*			17,296.6	17,363.6	17,070.8	17,243.7
DSCFM*			16,973.1	16,998.9	16,724.3	16,898.8
Nitrogen Oxides	Concentration, C_s	ppmvd	0.57	0.56	0.50	0.54
	Mass	lb/hr	6.93E-02	6.82E-02	5.99E-02	6.58E-02
	Emission Factor	lb/lb glass	1.02E-04	9.92E-05	7.90E-05	9.35E-05
		lb/Mscf nat. gas	1.71E-02	1.69E-02	1.45E-02	1.60E-02
Carbon Monoxide	Concentration, C_s	ppmvd	24.09	23.86	24.58	24.18
	Mass	lb/hr	1.78	1.77	1.79	1.78
	Emission Factor	lb/lb glass	2.64E-03	2.57E-03	2.36E-03	2.52E-03
		lb/Mscf nat. gas	4.39E-01	4.38E-01	4.35E-01	4.37E-01
VOC	Concentration, C_s	ppmvw	1.01	1.01	1.05	1.02
	Mass	lb/hr	1.20E-01	1.20E-01	1.23E-01	1.21E-01
	Emission Factor	lb/lb glass	1.77E-04	1.75E-04	1.62E-04	1.71E-04
		lb/Mscf nat. gas	2.95E-02	2.98E-02	2.98E-02	2.97E-02
Formaldehyde**	Mass	lb/hr	1.32E-02	1.06E-02	1.42E-02	1.27E-02
	Emission Factor	lb/lb glass	1.95E-05	1.54E-05	1.87E-05	1.79E-05
		lb/Mscf nat. gas	3.25E-03	2.63E-03	3.44E-03	3.11E-03
Total VOCs†	Mass	lb/hr	1.33E-01	1.31E-01	1.37E-01	1.34E-01
	Emission Factor	lb/lb glass	1.96E-04	1.90E-04	1.81E-04	1.89E-04
		lb/Mscf nat. gas	3.27E-02	3.24E-02	3.32E-02	3.28E-02

Production Rates	Glass Production	lb/hr	676.9	688.0	758.7	707.9
	Natural Gas Use	scf/hr	4062.3	4037.3	4126.7	4075.4
		Mscf/hr	4.0623	4.0373	4.1267	4.0754

*Measured during concurrent Method 5 isokinetic runs
**From concurrent Method 316 isokinetic sampling
†Total VOCs = Method 25A VOCs + Formaldehyde

Bison Engineering, Inc.
Method 7E Nitrogen Oxides
Calibration Error, System Bias and System Drift
NOx molecular weight of 46

Company:	**Holiingsworth & Vose**	Source:	**CFU-112**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant #1**	Date:	**September 12, 2018**	Instrument Model:	**42i**
Location:	**Corvallis OR**			Instrument Serial #:	**729825194**

		Analyzer Cal. Response	*Initial Values* System Cal Response	*Initial Values* Pre test System Cal. Bias % of span	*Initial Values* Pre test System Cal. Bias pass/fail	*Final Values* System Cal Response	*Final Values* Post test System Cal. Bias % of span	*Final Values* Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
	zero	0.17	0.17	0.00	pass	0.20	0.60	pass	0.60	pass				
Run 1	upscale	2.57	2.23	-6.80	pass	2.64	1.40	pass	8.20	pass	5	0.70	0.57	2.5
	zero	0.17	0.20	0.60	pass	0.20	0.60	pass	0.00	pass				
Run 2	upscale	2.57	2.64	1.40	pass	2.23	-6.80	pass	-8.20	pass	5	0.70	0.56	2.5
	zero	0.17	0.20	0.60	pass	0.05	-2.40	pass	-3.00	pass				
Run 3	upscale	2.57	2.23	-6.80	pass	2.11	-9.20	pass	-2.40	pass	5	0.53	0.50	2.5
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2.5	5
Cal gas analyzer response	0.17	2.57	5.16
Analyzer Cal. Error %	3.40	1.40	3.20
Analyzer Cal. Error < 2%*	pass	pass	pass

NO2 CONVERTER TEST

NO2 Tank Value (ppm)	50.41
NO Check Value	51.93
NO2 to NO Conversion %	103.0%
NO2 Conversion > 90%	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 10 Carbon Monoxide
Calibration Error, System Bias and System Drift
CO molecular weight of 28

Company:	**Holiingsworth & Vose**	Source:	**CFU-112**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant #1**	Date:	**September 12, 2018**	Instrument Model:	**48i HL**
Location:	**Corvallis OR**			Instrument Serial #:	**734025183**

		Analyzer Cal. Response	Initial Values: System Cal Response	Initial Values: Pre test System Cal. Bias % of span	Initial Values: Pre test System Cal. Bias pass/fail	Final Values: System Cal Response	Final Values: Post test System Cal. Bias % of span	Final Values: Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.61	-0.55	0.06	pass	-3.08	-2.47	pass	-2.53	pass				
	upscale	49.33	48.92	-0.41	pass	50.43	1.10	pass	1.51	pass	100	22.99	24.09	50
Run 2	zero	-0.61	-3.08	-2.47	pass	-2.24	-1.63	pass	0.84	pass				
	upscale	49.33	50.43	1.10	pass	47.70	-1.63	pass	-2.73	pass	100	22.02	23.86	50
Run 3	zero	-0.61	-2.24	-1.63	pass	-3.41	-2.80	pass	-1.17	pass				
	upscale	49.33	47.70	-1.63	pass	49.24	-0.09	pass	1.54	pass	100	22.39	24.58	50
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	50	100
Cal gas analyzer response	-0.61	49.33	98.92
Analyzer Cal. Error	-0.61	-0.67	-1.08
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Holiingsworth & Vose**	Source	**CFU-112**	Instrument Make:	**Servomex**
Facility:	**Glass Plant #1**	Date	**September 12, 2018**	Instrument Model:	**1440**
Location:	**Corvallis OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.01	0.09	0.42	pass	0.00	-0.03	pass	-0.45	pass				
	upscale	9.94	10.05	0.53	pass	10.02	0.38	pass	-0.15	pass	20	19.87	19.84	10
Run 2	zero	0.01	0.00	-0.03	pass	-0.02	-0.13	pass	-0.10	pass				
	upscale	9.94	10.02	0.38	pass	9.91	-0.17	pass	-0.55	pass	20	19.89	19.95	10
Run 3	zero	0.01	-0.02	-0.13	pass	-0.05	-0.28	pass	-0.15	pass				
	upscale	9.94	9.91	-0.17	pass	9.87	-0.37	pass	-0.20	pass	20	19.66	19.84	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0.0066	9.9433333	20.04
Analyzer Cal. Error	0.03	-0.28	0.20
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Holiingsworth & Vose**	Source	**CFU-112**	Instrument Make:	**Servomex**
Facility:	**Glass Plant #1**	Date	**September 12, 2018**	Instrument Model:	**1440**
Location:	**Corvallis OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.18	0.23	1.25	pass	0.18	0.00	pass	-1.25	pass				
	upscale	1.95	1.93	-0.50	pass	1.95	0.00	pass	0.50	pass	4	0.61	0.47	2
Run 2	zero	0.18	0.18	0.00	pass	0.24	1.50	pass	1.50	pass				
	upscale	1.95	1.95	0.00	pass	1.97	0.50	pass	0.50	pass	4	0.61	0.46	2
Run 3	zero	0.18	0.24	1.50	pass	0.20	0.50	pass	-1.00	pass				
	upscale	1.95	1.97	0.50	pass	1.96	0.25	pass	-0.25	pass	4	0.62	0.46	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0.18	1.95	4.04
Analyzer Cal. Error	4.50	-1.25	1.00
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 25A Total Hydrocarbons or Volatile Organic Compounds (VOC)
Calibration Error and Drift Checks
VOC molecular weight of 44 as propane

Company: **Holiingsworth & Vose**	Source: **CFU-112**	Instrument Make:	**Thermo Environmental**
Facility: **Glass Plant #1**	Date: **September 12, 2018**	Instrument Model:	**55i**
Location: **Corvallis OR**		Instrument Serial #:	**1018142851**

		Calibration System Response	Post-Run System Response	Drift Determination % of span	Drift Determination pass/fail	Analyzer Span	Avg Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.13	0.07	-0.24	pass			
	upscale	12.47	12.37	-0.40	pass	25	1.01	12.5
Run 2	zero	0.13	0.46	1.32	pass			
	upscale	12.47	12.50	0.12	pass	25	1.01	12.5
Run 3	zero	0.13	0.46	1.32	pass			
	upscale	12.47	12.50	0.12	pass	25	1.05	12.5
				≤ 3%				

Instrument Response Time(s):	
Time 1	60
Time 2	60
Time 3	60
Average:	60

SYSTEM CAL. ERROR	Zero	Low	Mid	High
Calibration gas standards	0.00	6.25	12.50	21.25
Calibration gas system response	0.13	6.30	12.47	21.43
Calibration Predicted Response		6.40	12.66	
Calibration Error		1.48	1.53	
Calibration Error < 5% ?	pass	pass	pass	pass

EPA Method 7E,
Example Calculations

Client:	**Holiingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**10:52**
Source:	**CFU-112**	**End Time:**	**13:00**
Method:	**7E**	**Date:**	**9/12/2018**

EPA Method 7E:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ 1.40 %v

where C_{Dir}:	2.57	ppmv
C_V:	2.50	ppmv
CS:	5.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -6.80 %v

where C_{Dir}:	2.57	ppmv
C_S:	2.23	ppmv
CS:	5.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 8.20 %v

where SB_{Final}:	1.40	ppmv
SB_i:	-6.80	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.57 ppmv

where C_{Avg}:	0.70	ppmv
C_O:	0.19	ppmv
C_{MA}:	2.50	ppmv
C_M:	2.44	ppmv

NO_2 - NO Conversion Efficiency

5) $Eff_{NOx} = \left(\frac{C_{Dir}}{C_v}\right) \times 100 =$ 103.0 %v

where C_{Dir}:	51.93	ppmv
C_V:	50.41	ppmv

Emission Rates:

NO_x 1) lb/hr = (Stack Flow) (C) (46) ($1.558x10^{-7}$) = 6.93E-02 lb/hr

where Stack Flow:	16973.10	DSCFM
C:	0.57	ppm
Molecular Wt NO_x:	46	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

NO_x 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) x\ C =$ NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

EPA Method 10,
Example Calculations

Client:	**Holiingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**10:52**
Source:	**CFU-112**	**End Time:**	**13:00**
Method:	**10**	**Date:**	**9/12/2018**

EPA Method 10:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \text{ x } 100 =$ -0.67 %v

where C_{Dir}:	49.33	ppmv
C_V:	50.00	ppmv
CS:	100.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \text{ x } 100 =$ -0.41 %v

where C_{Dir}:	49.33	ppmv
C_S:	48.92	ppmv
CS:	100.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 1.51 %v

where SB_{Final}:	1.10	ppmv
SB_i:	-0.41	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 24.09 ppmv

where C_{Avg}:	22.99	ppmv
C_O:	-1.82	ppmv
C_{MA}:	50.00	ppmv
C_M:	49.68	ppmv

Emission Rates:

CO 1) lb/hr = (Stack Flow) (C) (28) ($1.558x10^{-7}$) = 1.78 lb/hr

where Stack Flow:	16973.10	DSCFM
C:	24.09	ppm
Molecular Wt. CO:	28	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

CO 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \text{ x C} =$ NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

EPA Method 3A,
Example Calculations

Client:	**Holiingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**10:52**
Source:	**CFU-112**	**End Time:**	**13:00**
Method:	**3A**	**Date:**	**9/12/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.28 %v

where C_{Dir}:	9.94	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.53 %v

where C_{Dir}:	9.94	ppmv
C_S:	10.05	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.15 %v

where SB_{Final}:	0.38	ppmv
SB_i:	0.53	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.84 ppmv

where C_{Avg}:	19.87	ppmv
C_O:	0.05	ppmv
C_{MA}:	10.00	ppmv
C_M:	10.04	ppmv

EPA Method 3A,
Example Calculations

Client:	**Holiingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**10:52**
Source:	**CFU-112**	**End Time:**	**13:00**
Method:	**3A**	**Date:**	**9/12/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \text{ x } 100 =$ -1.25 %v

where C_{Dir}:	1.95	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \text{ x } 100 =$ -0.50 %v

where C_{Dir}:	1.95	ppmv
C_S:	1.93	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.50 %v

where SB_{Final}:	0.00	ppmv
SB_i:	-0.50	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.47 ppmv

where C_{Avg}:	0.61	ppmv
C_O:	0.21	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.94	ppmv

EPA Method 25A,
Example Calculations

Client:	**Holiingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**10:52**
Source:	**CFU-112**	**End Time:**	**13:00**
Method:	**25A**	**Date:**	**9/12/2018**

EPA Method 25A:

Predicted Low and Mid Level Calibration Response (Mid)

1) $PR = \left(\frac{CR_H - CRZ}{SS}\right) x\ CS_M + CR_Z =$ 12.66 ppmv

where CR_H:	21.43	ppmv
CR_Z:	0.13	ppmv
SS:	21.25	ppmv
CS_M:	12.50	ppmv

Calibration Error Test

2) $CET = \left(\frac{SR - PR}{CGV}\right) x\ 100 =$ -1.53 %v

where PR:	12.66	ppmv
SR:	12.47	ppmv
CGV	12.50	ppmv

Drift Determination (Mid)

3) $D = \left(\frac{CSR - CSRC}{CSRS}\right) x\ 100 =$ 0.40 %v

where CSR:	12.47	ppmv
CSR_C:	12.37	ppmv
AS:	25.00	ppmv

Emission Rates:

VOC 1) lb/hr = (Stack Flow) (C) (44) (1.558×10^{-7}) = 1.20E-01 lb/hr

where Stack Flow:	17296.57	WSCFM
C:	1.01	ppm
Molecular Wt Propane:	44	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

VOC 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \times C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	6:32:57	-0.29	0.07	0.01	0.18	-0.84
9/12/2018	6:33:07	-0.27	0.06	0.01	0.17	-0.82
9/12/2018	6:33:17	-0.28	0.06	0.01	0.18	-0.75
9/12/2018	6:33:27	-0.29	0.07	0.00	0.18	-0.79
9/12/2018	6:33:37	-0.28	0.06	8.23	7.09	-0.78
9/12/2018	6:33:47	-0.27	0.07	19.09	18.67	-0.79
9/12/2018	6:33:57	-0.27	0.07	19.84	18.82	-0.82
9/12/2018	6:34:07	-0.26	0.07	19.88	18.84	-0.82
9/12/2018	6:34:17	-0.27	0.07	19.89	18.86	-0.81
9/12/2018	6:34:27	-0.26	0.06	19.90	18.87	-0.79
9/12/2018	6:34:37	-0.26	0.07	19.90	18.88	-0.82
9/12/2018	6:34:47	-0.26	0.07	19.91	18.88	-0.79
9/12/2018	6:34:57	-0.26	0.06	19.91	18.88	-0.78
9/12/2018	6:35:07	-0.28	0.07	19.91	18.89	-0.76
9/12/2018	6:35:17	-0.28	0.06	19.97	18.89	-0.79
9/12/2018	6:35:27	-0.27	0.07	20.03	19.43	-0.78
9/12/2018	6:35:37	-0.27	0.07	20.03	19.64	-0.81
9/12/2018	6:35:47	-0.28	0.07	20.03	19.65	-0.78
9/12/2018	6:35:57	-0.26	0.06	20.03	19.65	-0.87
9/12/2018	6:36:07	-0.27	0.06	20.03	19.66	-0.87
9/12/2018	6:36:17	-0.27	0.07	20.04	19.65	-0.79
9/12/2018	6:36:27	-0.28	0.06	20.04	19.66	-0.79
9/12/2018	6:36:37	-0.28	0.07	20.04	19.66	-0.78
9/12/2018	6:36:47	-0.28	0.07	20.04	19.66	-0.78
9/12/2018	6:36:57	-0.27	0.05	19.40	19.64	-0.79
9/12/2018	6:37:07	-0.26	0.06	16.37	15.06	-0.82
9/12/2018	6:37:17	-0.26	0.07	9.92	9.83	-0.79
9/12/2018	6:37:27	-0.27	0.06	9.99	9.96	-0.81
9/12/2018	6:37:37	-0.25	0.05	9.98	9.95	-0.79
9/12/2018	6:37:47	-0.26	0.06	9.97	9.93	-0.78
9/12/2018	6:37:57	-0.27	0.07	9.95	9.92	-0.78
9/12/2018	6:38:07	-0.27	0.05	9.96	9.92	-0.82
9/12/2018	6:38:17	-0.26	0.06	9.95	9.91	-0.82
9/12/2018	6:38:27	-0.26	0.07	9.94	9.90	-0.87
9/12/2018	6:38:37	-0.28	0.07	9.95	9.90	-0.76
9/12/2018	6:38:47	-0.26	0.07	9.94	9.90	-0.75
9/12/2018	6:38:57	-0.26	0.07	9.94	9.90	-0.72
9/12/2018	6:39:07	-0.26	0.06	9.93	9.89	-0.75
9/12/2018	6:39:17	-0.28	0.07	9.73	9.89	-0.79

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	6:39:27	-0.28	0.06	8.74	9.80	-0.75
9/12/2018	6:39:37	-0.28	0.06	8.74	9.80	-0.76
9/12/2018	6:39:47	-0.27	0.06	7.41	6.56	-0.75
9/12/2018	6:39:57	-0.26	0.06	0.52	0.37	-0.75
9/12/2018	6:40:07	-0.26	0.07	3.12	3.70	-0.82
9/12/2018	6:40:17	-0.28	0.06	3.95	4.27	-0.81
9/12/2018	6:40:27	-0.27	0.06	3.95	4.27	-0.72
9/12/2018	6:40:37	-0.28	0.07	3.95	4.28	-0.72
9/12/2018	6:40:47	-0.27	0.06	3.96	4.28	-0.76
9/12/2018	6:40:57	-0.27	0.06	3.97	4.28	-0.78
9/12/2018	6:41:07	-0.27	0.06	3.97	4.28	-0.75
9/12/2018	6:41:17	-0.27	0.06	3.97	4.15	-0.78
9/12/2018	6:41:27	-0.28	0.06	3.97	4.04	-0.79
9/12/2018	6:41:37	-0.26	0.07	3.97	4.04	-0.75
9/12/2018	6:41:47	-0.27	0.06	3.97	4.04	-0.76
9/12/2018	6:41:57	-0.28	0.06	3.97	4.03	-0.78
9/12/2018	6:42:07	-0.26	0.06	3.97	4.04	-0.78
9/12/2018	6:42:17	-0.26	0.07	3.97	4.04	-0.85
9/12/2018	6:42:27	-0.28	0.06	3.90	3.94	-0.78
9/12/2018	6:42:37	-0.27	0.06	2.34	2.17	-0.78
9/12/2018	6:42:47	-0.26	0.07	2.00	1.98	-0.84
9/12/2018	6:42:57	-0.26	0.07	1.97	1.96	-0.78
9/12/2018	6:43:07	-0.27	0.06	1.97	1.96	-0.79
9/12/2018	6:43:17	-0.27	0.06	1.96	1.95	-0.79
9/12/2018	6:43:27	-0.26	0.06	1.97	1.95	-0.75
9/12/2018	6:43:37	-0.26	0.06	1.97	1.95	-0.73
9/12/2018	6:43:47	-0.28	0.06	1.96	1.95	-0.78
9/12/2018	6:43:57	-0.27	0.07	1.96	1.95	-0.82
9/12/2018	6:44:07	-0.28	0.06	1.97	1.95	-0.78
9/12/2018	6:44:17	-0.28	0.06	1.97	1.94	-0.75
9/12/2018	6:44:27	-0.29	0.06	1.96	1.94	-0.84
9/12/2018	6:44:37	-0.26	0.05	1.85	1.93	-0.82
9/12/2018	6:44:47	-0.27	0.06	1.75	1.93	-0.81
9/12/2018	6:44:57	-0.27	0.06	1.75	1.93	-0.79
9/12/2018	6:45:07	-0.27	0.07	1.75	1.93	-0.78
9/12/2018	6:45:17	-0.27	0.07	1.75	1.94	-0.78
9/12/2018	6:45:27	-0.27	0.06	1.75	1.94	-0.82
9/12/2018	6:45:37	-0.26	0.06	1.75	1.94	-0.79
9/12/2018	6:45:47	-0.29	0.06	1.75	1.94	-0.82

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	6:45:57	-0.27	0.06	2.03	1.98	-0.82
9/12/2018	6:46:07	-0.27	0.05	1.85	1.40	-0.79
9/12/2018	6:46:17	-0.25	0.07	0.48	0.24	-0.72

Data omitted analyzer down for repairs

9/12/2018	7:32:27	107.93	0.00	-0.02	0.14	0.53
9/12/2018	7:32:37	184.60	0.01	-0.01	0.14	0.49
9/12/2018	7:32:47	184.28	0.03	-0.01	0.14	0.49
9/12/2018	7:32:57	184.28	0.13	-0.02	0.14	0.53
9/12/2018	7:33:07	184.01	0.14	-0.02	0.14	0.53
9/12/2018	7:33:17	67.56	0.13	-0.02	0.15	0.56
9/12/2018	7:33:27	17.53	0.14	-0.01	0.15	0.52
9/12/2018	7:33:37	17.50	0.13	-0.02	0.14	0.50
9/12/2018	7:33:47	17.50	0.15	-0.01	0.14	0.50
9/12/2018	7:33:57	17.94	0.14	-0.01	0.14	0.53
9/12/2018	7:34:07	19.00	0.14	-0.02	0.14	0.47
9/12/2018	7:34:17	19.11	0.13	-0.02	0.14	0.47
9/12/2018	7:34:27	19.20	0.14	-0.02	0.14	0.46
9/12/2018	7:34:37	19.17	0.14	-0.02	0.15	0.47
9/12/2018	7:34:47	19.23	0.14	-0.02	0.14	0.47
9/12/2018	7:34:57	19.17	0.14	-0.02	0.14	0.52
9/12/2018	7:35:07	12.14	0.13	-0.02	0.14	0.55
9/12/2018	7:35:17	9.01	0.13	-0.02	0.14	0.52
9/12/2018	7:35:27	8.98	0.12	-0.02	0.14	0.53
9/12/2018	7:35:37	8.89	0.12	-0.02	0.14	0.46
9/12/2018	7:35:47	8.87	0.13	-0.02	0.14	0.49
9/12/2018	7:35:57	8.86	0.14	-0.02	0.14	0.56
9/12/2018	7:36:07	9.26	0.14	-0.02	0.14	0.50
9/12/2018	7:36:17	9.86	0.13	-0.02	0.14	0.50
9/12/2018	7:36:27	9.86	0.15	-0.02	0.15	0.49
9/12/2018	7:36:37	9.87	0.27	-0.02	0.15	0.50
9/12/2018	7:36:47	9.86	0.26	-0.02	0.14	0.46
9/12/2018	7:36:57	9.86	0.27	-0.01	0.14	0.56
9/12/2018	7:37:07	9.86	0.28	-0.02	0.15	0.50
9/12/2018	7:37:17	9.86	0.26	-0.02	0.14	0.41
9/12/2018	7:37:27	9.86	0.27	-0.02	0.15	0.46
9/12/2018	7:37:37	9.83	0.28	-0.01	0.15	0.55
9/12/2018	7:37:47	9.86	0.15	-0.01	0.14	0.46

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	7:37:57	9.84	0.14	-0.01	0.15	0.49
9/12/2018	7:38:07	9.83	0.13	0.48	0.57	0.47
9/12/2018	7:38:17	9.83	0.14	0.02	0.17	0.46
9/12/2018	7:38:27	24.25	0.14	-0.01	0.15	0.43
9/12/2018	7:38:37	51.66	0.14	-0.01	0.15	0.46
9/12/2018	7:38:47	51.18	0.13	-0.01	0.16	0.50
9/12/2018	7:38:57	51.54	0.14	-0.01	0.15	0.44
9/12/2018	7:39:07	51.63	0.13	-0.02	0.15	0.43
9/12/2018	7:39:17	51.84	0.13	-0.01	0.15	0.46
9/12/2018	7:39:27	51.84	0.13	-0.02	0.14	0.47
9/12/2018	7:39:37	51.99	0.13	-0.02	0.15	0.49
9/12/2018	7:39:47	51.87	0.13	-0.01	0.15	0.49
9/12/2018	7:39:57	51.93	0.15	-0.01	0.15	0.53
NO2 Convertor Check		**51.93**				
9/12/2018	7:40:07	51.93	0.14	0.00	0.15	0.50
9/12/2018	7:40:17	51.68	0.13	0.00	0.16	0.47
9/12/2018	7:40:27	51.63	0.13	0.01	0.15	0.50
9/12/2018	7:40:37	51.63	0.15	0.01	0.16	0.49
9/12/2018	7:40:47	51.35	0.14	0.00	0.15	0.47
9/12/2018	7:40:57	21.71	0.12	0.01	0.15	0.43
9/12/2018	7:50:57	100.00	0.13	0.08	0.17	0.56
9/12/2018	7:51:07	100.00	0.12	0.07	0.17	0.50
9/12/2018	7:51:17	100.00	0.12	0.07	0.17	0.52
9/12/2018	7:51:27	100.00	0.13	0.06	0.17	0.46
9/12/2018	7:51:37	100.00	0.12	0.06	0.17	0.50
9/12/2018	7:51:47	100.00	0.12	0.06	0.18	0.47
9/12/2018	7:51:57	100.00	0.14	0.06	0.17	0.53
9/12/2018	7:52:07	100.00	0.14	0.06	0.17	0.56

	O2 [%]	CO2 [%]
Analyzer Zero	**0.01**	**0.18**
Analyzer Mid	**9.94**	**1.95**
Analyzer High	**20.04**	**4.04**

System

9/12/2018	7:52:17	100.00	0.13	2.23	0.17	0.50

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	7:52:27	100.00	0.13	12.60	0.21	0.41
9/12/2018	7:52:37	100.00	0.14	17.98	0.22	0.47
9/12/2018	7:52:47	70.49	0.14	14.55	0.22	0.49
9/12/2018	7:52:57	24.58	0.13	5.17	0.19	0.50
9/12/2018	7:53:07	21.20	0.12	2.24	0.76	0.47
9/12/2018	7:53:17	16.37	0.12	2.03	1.48	0.55
9/12/2018	7:53:27	22.98	0.13	2.00	1.73	0.47
9/12/2018	7:53:37	14.78	0.26	1.99	1.83	-0.84
9/12/2018	7:53:47	6.49	0.26	1.99	1.88	-0.85
9/12/2018	7:53:57	3.28	0.26	1.99	1.91	-0.81
9/12/2018	7:54:07	1.95	0.27	2.00	1.92	-0.87
9/12/2018	7:54:17	1.38	0.26	2.00	1.92	-0.93
9/12/2018	7:54:27	1.07	0.26	2.01	1.93	-0.85
9/12/2018	7:54:37	0.88	0.27	2.01	1.93	-0.81
9/12/2018	7:54:47	0.77	0.27	2.01	1.93	-0.79
9/12/2018	7:54:57	0.71	0.26	2.01	1.94	-0.82
9/12/2018	7:55:07	0.65	0.27	2.67	2.69	-0.81
9/12/2018	7:55:17	0.59	0.27	7.12	7.15	-0.76
9/12/2018	7:55:27	0.56	0.27	9.26	8.78	-0.79
9/12/2018	7:55:37	0.62	0.27	9.93	9.27	-0.87
9/12/2018	7:55:47	0.53	0.26	10.14	9.42	-0.79
9/12/2018	7:55:57	0.47	0.23	10.20	9.48	-0.82
9/12/2018	7:56:07	0.44	0.13	10.23	9.50	-0.79
9/12/2018	7:56:17	0.41	0.15	10.24	9.51	-0.84
9/12/2018	7:56:27	0.38	0.13	10.24	9.52	-0.82
9/12/2018	7:56:37	0.37	0.13	10.24	9.52	-0.81
9/12/2018	7:56:47	0.34	0.14	10.24	9.54	-0.84
9/12/2018	7:56:57	0.35	0.13	10.24	9.53	-0.79
9/12/2018	7:57:07	0.35	0.14	10.16	9.45	-0.60
9/12/2018	7:57:17	0.35	0.13	10.09	9.40	0.50
9/12/2018	7:57:27	0.32	0.14	10.06	9.38	0.47
9/12/2018	7:57:37	0.32	0.12	10.05	9.37	0.49
9/12/2018	7:57:47	0.31	0.15	10.05	9.38	0.49
9/12/2018	7:57:57	0.32	0.13	10.05	9.38	0.53
9/12/2018	7:58:07	0.32	0.14	10.05	9.38	0.46
9/12/2018	7:58:17	0.29	0.12	10.04	9.38	0.50
9/12/2018	7:58:27	0.29	0.25	10.24	9.22	0.46
9/12/2018	7:58:37	0.29	0.28	14.84	5.09	0.38
9/12/2018	7:58:47	0.28	0.27	18.61	1.80	0.49

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	7:58:57	0.32	0.27	19.95	0.83	0.47
9/12/2018	7:59:07	0.47	0.27	15.67	1.39	0.49
9/12/2018	7:59:17	0.59	0.27	5.72	0.81	0.46
9/12/2018	7:59:27	0.65	0.28	1.83	0.46	0.52
9/12/2018	7:59:37	1.03	0.21	0.71	0.40	-0.12
9/12/2018	7:59:47	11.82	0.14	0.36	0.35	-0.79
9/12/2018	7:59:57	10.19	0.13	0.23	0.29	-0.84
9/12/2018	8:00:07	4.68	0.14	0.19	0.26	-0.78
9/12/2018	8:00:17	2.50	0.15	0.18	0.24	-0.79
9/12/2018	8:00:27	1.71	0.14	0.16	0.24	-0.79
9/12/2018	8:00:37	1.41	0.13	0.11	0.24	-0.79
9/12/2018	8:00:47	1.16	0.17	0.08	0.23	-0.78
9/12/2018	8:00:57	0.65	0.28	0.07	0.22	-0.78
9/12/2018	8:01:07	0.38	0.27	0.11	0.23	-0.78
9/12/2018	8:01:17	0.29	0.27	0.13	0.23	-0.76
9/12/2018	8:01:27	0.50	0.27	0.18	0.23	-0.84
9/12/2018	8:01:37	0.62	0.26	0.22	0.22	-0.84
9/12/2018	8:01:47	0.68	0.27	0.25	0.22	-0.85
9/12/2018	8:01:57	0.68	0.27	0.27	0.22	-0.87
9/12/2018	8:02:07	0.62	0.05	0.27	0.22	-0.85
9/12/2018	8:02:17	0.59	0.00	0.28	0.22	-0.85
9/12/2018	8:02:27	0.56	-0.01	0.29	0.22	-0.85
9/12/2018	8:02:37	0.50	-0.01	0.30	0.21	-0.78
9/12/2018	8:02:47	0.47	-0.01	0.30	0.21	-0.84
9/12/2018	8:02:57	0.47	0.00	0.31	0.21	-0.79
9/12/2018	8:03:07	0.47	-0.01	0.30	0.22	-0.78
9/12/2018	8:03:17	0.47	0.00	0.30	0.22	-0.79
9/12/2018	8:03:27	0.47	0.00	0.30	0.21	-0.85
9/12/2018	8:03:37	0.47	0.00	0.30	0.21	-0.81
9/12/2018	8:03:47	0.47	-0.01	0.30	0.21	-0.79
9/12/2018	8:03:57	0.47	0.00	0.30	0.21	-0.84
9/12/2018	8:04:07	0.47	-0.01	0.30	0.21	-0.78
9/12/2018	8:04:17	0.47	-0.01	0.30	0.21	-0.82
9/12/2018	8:04:27	0.44	0.02	0.30	0.20	-0.79
9/12/2018	8:04:37	0.44	0.14	0.30	0.22	-0.84
9/12/2018	8:04:47	0.44	0.14	0.30	0.20	-0.89
9/12/2018	8:04:57	0.44	0.13	0.30	0.21	-0.89
9/12/2018	8:05:07	0.44	0.13	0.30	0.21	-0.79
9/12/2018	8:05:17	0.44	0.15	0.30	0.21	-0.85

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	8:05:27	0.44	0.13	0.30	0.21	-0.89
9/12/2018	8:05:37	0.44	0.12	0.30	0.21	-0.81
9/12/2018	8:05:47	0.44	0.12	0.30	0.21	-0.78
9/12/2018	8:05:57	0.44	0.13	0.30	0.21	-0.89
9/12/2018	8:06:07	0.44	0.14	0.30	0.20	-0.85
9/12/2018	8:06:17	0.44	0.14	0.30	0.21	-0.84
9/12/2018	8:06:27	0.44	0.12	0.30	0.20	-0.85
9/12/2018	8:06:37	0.44	0.13	0.30	0.20	-0.82
9/12/2018	8:06:47	0.44	0.12	0.30	0.20	-0.89
9/12/2018	8:06:57	0.44	1.94	0.30	0.20	3.78
9/12/2018	8:07:07	0.44	2.41	0.30	0.19	5.89
9/12/2018	8:07:17	0.44	2.41	0.30	0.19	6.71
9/12/2018	8:07:27	0.44	2.40	0.30	0.20	6.74
9/12/2018	8:07:37	0.44	2.40	0.30	0.20	6.75
9/12/2018	8:07:47	0.44	2.41	0.30	0.20	6.74
9/12/2018	8:07:57	0.44	2.41	0.30	0.19	6.74
9/12/2018	8:08:07	0.44	5.40	0.30	0.20	23.90
9/12/2018	8:08:17	0.44	12.36	0.30	0.21	49.65
9/12/2018	8:08:27	0.47	12.37	0.30	0.21	49.71
9/12/2018	8:08:37	0.47	12.37	0.30	0.20	49.72
9/12/2018	8:08:47	0.47	12.37	1.80	0.20	49.75
9/12/2018	8:08:57	0.47	12.37	10.40	0.22	49.71
9/12/2018	8:09:07	0.47	12.37	16.01	0.23	49.74
9/12/2018	8:09:17	0.41	12.37	18.53	0.24	50.12
9/12/2018	8:09:27	0.47	13.15	19.65	0.24	53.74
9/12/2018	8:09:37	0.50	13.16	19.86	0.25	53.70
9/12/2018	8:09:47	0.53	13.15	13.32	0.30	53.69
9/12/2018	8:09:57	0.53	13.15	8.00	0.31	53.77
9/12/2018	8:10:07	0.65	13.15	5.88	0.25	53.75
9/12/2018	8:10:17	1.65	13.16	4.98	0.23	53.80
9/12/2018	8:10:27	2.28	13.15	4.76	0.21	53.77
9/12/2018	8:10:37	2.47	12.52	4.10	0.22	49.60
9/12/2018	8:10:47	2.50	12.23	4.02	0.21	48.50
9/12/2018	8:10:57	2.41	12.23	6.93	0.21	48.44
9/12/2018	8:11:07	1.53	12.24	9.63	0.22	48.44
9/12/2018	8:11:17	0.91	12.24	8.77	0.22	48.47
9/12/2018	8:11:27	0.71	12.24	4.97	0.20	48.49
9/12/2018	8:11:37	0.56	12.25	2.85	0.20	48.53
9/12/2018	8:11:47	0.37	48.03	4.11	0.20	247.27

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	8:11:57	0.28	101.69	2.16	0.19	445.97
9/12/2018	8:12:07	0.28	101.70	0.99	0.20	445.91
9/12/2018	8:12:17	0.28	101.70	1.13	0.18	445.97
9/12/2018	8:12:27	0.25	101.69	3.11	0.18	445.88
9/12/2018	8:12:37	0.28	101.69	3.83	0.18	445.91
9/12/2018	8:12:47	0.38	101.70	4.16	0.18	445.92
9/12/2018	8:12:57	0.41	92.18	4.30	0.18	360.96
9/12/2018	8:13:07	0.41	6.56	4.35	0.17	21.13
9/12/2018	8:13:17	0.44	6.57	4.39	0.18	21.08
9/12/2018	8:13:27	0.44	6.57	4.40	0.18	21.07
9/12/2018	8:13:37	0.44	6.56	4.41	0.18	21.08
9/12/2018	8:13:47	0.44	6.57	4.41	0.19	21.07
9/12/2018	8:13:57	0.41	6.56	4.41	0.18	21.10
9/12/2018	8:14:07	0.41	6.56	4.41	0.18	21.05
9/12/2018	8:14:17	0.41	11.83	4.41	0.18	34.25
9/12/2018	8:14:27	0.41	13.15	4.41	0.17	35.68
9/12/2018	8:14:37	0.37	13.15	4.41	0.18	35.70
9/12/2018	8:14:47	0.38	13.15	4.41	0.17	35.70
9/12/2018	8:14:57	0.34	13.15	4.41	0.18	35.64
9/12/2018	8:15:07	0.35	13.16	4.41	0.18	35.68
9/12/2018	8:15:17	0.34	13.16	4.41	0.18	35.64
9/12/2018	8:15:27	0.34	17.60	4.41	0.19	15.98
9/12/2018	8:15:37	0.32	22.07	4.41	0.18	2.80
9/12/2018	8:15:47	0.32	22.06	4.41	0.18	2.88
9/12/2018	8:15:57	0.31	22.06	4.41	0.18	2.80
9/12/2018	8:16:07	0.32	22.06	4.41	0.18	2.74
9/12/2018	8:16:17	0.29	22.07	4.41	0.18	2.86
9/12/2018	8:16:27	0.29	22.06	4.41	0.18	2.86
9/12/2018	8:16:37	0.28	22.25	4.41	0.18	2.42
9/12/2018	8:16:47	0.29	23.02	4.41	0.18	1.49
9/12/2018	8:16:57	0.28	23.04	4.41	0.18	1.47
9/12/2018	8:17:07	0.29	23.03	4.41	0.18	1.46
9/12/2018	8:17:17	0.28	23.03	4.41	0.18	1.49
9/12/2018	8:17:27	0.28	23.02	4.41	0.17	1.50
9/12/2018	8:17:37	0.25	23.04	4.41	0.18	1.50
9/12/2018	8:17:47	0.25	23.03	4.35	0.18	1.53
9/12/2018	8:17:57	0.25	23.39	4.23	0.19	1.55
9/12/2018	8:18:07	0.25	23.42	4.19	0.18	1.46
9/12/2018	8:18:17	0.25	23.43	4.17	0.19	1.46

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	8:18:27	0.26	23.43	4.16	0.17	1.43
9/12/2018	8:18:37	0.25	23.43	4.16	0.18	1.50
9/12/2018	8:18:47	0.26	23.43	4.15	0.18	1.44
9/12/2018	8:18:57	0.25	23.43	4.16	0.18	1.50
9/12/2018	8:19:07	0.26	23.43	4.15	0.18	0.63
9/12/2018	8:19:17	0.25	23.43	4.15	0.18	0.21
9/12/2018	8:19:27	0.25	23.42	4.16	0.17	0.25
9/12/2018	8:19:37	0.25	23.43	4.15	0.18	0.25
9/12/2018	8:19:47	0.25	23.42	4.15	0.19	0.15
9/12/2018	8:19:57	0.25	23.43	4.15	0.19	0.16
9/12/2018	8:20:07	0.22	23.42	4.16	0.18	0.19
9/12/2018	8:20:17	0.22	23.05	4.15	0.19	0.21
9/12/2018	8:20:27	0.26	22.20	4.15	0.18	0.22
9/12/2018	8:20:37	0.25	22.20	4.15	0.18	0.21
9/12/2018	8:20:47	0.25	22.20	4.15	0.18	0.25
9/12/2018	8:20:57	0.22	22.20	4.15	0.18	0.21
9/12/2018	8:21:07	0.22	22.20	4.14	0.19	0.21
9/12/2018	8:21:17	0.23	22.20	3.56	0.18	0.19
9/12/2018	8:21:27	0.23	22.21	2.99	0.19	0.16
9/12/2018	8:21:37	0.22	22.06	2.78	0.20	0.27
9/12/2018	8:21:47	0.23	22.06	2.69	0.19	0.22
9/12/2018	8:21:57	0.22	22.07	2.64	0.20	0.27
9/12/2018	8:22:07	0.22	22.06	2.62	0.18	0.24
9/12/2018	8:22:17	0.22	22.06	2.61	0.18	0.28
9/12/2018	8:22:27	0.22	22.06	2.61	0.19	0.28
9/12/2018	8:22:37	0.23	22.06	2.61	0.19	0.24
9/12/2018	8:22:47	0.22	21.48	2.61	0.19	0.27
9/12/2018	8:22:57	0.22	21.43	2.61	0.18	0.22
9/12/2018	8:23:07	0.22	21.43	2.61	0.19	0.24
9/12/2018	8:23:17	0.23	21.43	2.60	0.18	0.21
9/12/2018	8:23:27	0.22	21.43	2.60	0.19	0.21
9/12/2018	8:23:37	0.22	21.44	2.61	0.19	0.22
9/12/2018	8:23:47	0.22	21.43	2.60	0.19	0.28
9/12/2018	8:23:57	0.22	19.09	2.61	0.19	0.21
9/12/2018	8:24:07	0.22	14.86	2.61	0.20	0.21
9/12/2018	8:24:17	0.23	14.85	2.60	0.20	0.24
9/12/2018	8:24:27	0.22	14.86	2.61	0.19	0.15
9/12/2018	8:24:37	0.23	14.85	2.61	0.21	0.10
9/12/2018	8:24:47	0.22	14.85	2.60	0.20	0.11

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	8:24:57	0.22	14.85	2.56	0.20	0.19
9/12/2018	8:25:07	0.22	14.80	2.35	0.21	0.22
9/12/2018	8:25:17	0.22	14.33	2.26	0.21	0.19
9/12/2018	8:25:27	0.23	14.33	2.22	0.20	0.18
9/12/2018	8:25:37	0.22	14.32	2.21	0.21	0.19
9/12/2018	8:25:47	0.22	14.33	2.20	0.20	0.19
9/12/2018	8:25:57	0.22	14.33	2.19	0.20	0.18
9/12/2018	8:26:07	0.22	14.32	2.19	0.19	0.21
9/12/2018	8:26:17	0.22	14.33	2.19	0.21	0.18
9/12/2018	8:26:27	0.23	14.11	2.19	0.19	0.21
9/12/2018	8:26:37	0.22	14.05	2.19	0.20	0.18
9/12/2018	8:26:47	0.22	14.05	2.20	0.20	0.16
9/12/2018	8:26:57	0.22	14.04	2.19	0.21	0.13
9/12/2018	8:27:07	0.22	14.05	2.19	0.19	0.22
9/12/2018	8:27:17	0.22	14.06	2.19	0.20	0.19
9/12/2018	8:27:27	0.23	14.05	2.19	0.20	0.18
9/12/2018	8:27:37	0.22	13.07	2.19	0.20	0.16
9/12/2018	8:27:47	0.23	12.09	2.19	0.20	0.19
9/12/2018	8:27:57	0.22	12.09	2.19	0.20	0.18
9/12/2018	8:28:07	0.23	12.09	2.19	0.19	0.24
9/12/2018	8:28:17	0.22	12.09	2.19	0.20	0.15
9/12/2018	8:28:27	0.23	12.10	2.19	0.20	0.21
9/12/2018	8:28:37	0.22	12.09	2.19	0.20	0.19
9/12/2018	8:28:47	0.20	12.07	2.19	0.20	0.21
9/12/2018	8:28:57	0.23	11.97	2.19	0.19	0.16
9/12/2018	8:29:07	0.20	11.96	2.19	0.21	0.11
9/12/2018	8:29:17	0.22	11.96	2.19	0.21	0.19
9/12/2018	8:29:27	0.22	11.96	2.19	0.19	0.24
9/12/2018	8:29:37	0.22	11.96	2.19	0.19	0.22
9/12/2018	8:29:47	0.22	11.95	1.99	0.20	0.18
9/12/2018	8:29:57	0.22	11.97	1.60	0.20	0.27
9/12/2018	8:30:07	0.31	11.85	1.36	0.20	0.28
9/12/2018	8:30:17	0.65	11.83	1.25	0.20	0.24
9/12/2018	8:30:27	0.71	11.83	1.19	0.20	0.19
9/12/2018	8:30:37	0.68	11.83	1.18	0.19	0.27
9/12/2018	8:30:47	0.62	11.84	1.17	0.20	0.25
9/12/2018	8:30:57	0.56	11.83	1.16	0.19	0.24
9/12/2018	8:31:07	0.53	11.83	1.16	0.20	0.19
9/12/2018	8:31:17	0.47	12.41	1.16	0.19	1.15

Holligsworth & Vose
Daily Calibrations
9/12/2018

Date	Time	NOx [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/12/2018	8:31:27	0.47	12.46	1.16	0.20	1.52
9/12/2018	8:31:37	0.44	12.46	1.16	0.20	1.56
9/12/2018	8:31:47	0.41	12.47	1.15	0.19	1.55
9/12/2018	8:31:57	0.40	12.47	1.16	0.20	1.50
9/12/2018	8:32:07	0.37	12.47	1.16	0.19	1.49
9/12/2018	8:32:17	0.37	12.47	1.16	0.20	1.50
9/12/2018	8:32:27	0.35	10.96	1.16	0.20	0.98
9/12/2018	8:32:37	0.34	6.94	1.16	0.19	0.22
9/12/2018	8:32:47	0.35	6.94	1.16	0.20	0.28
9/12/2018	8:32:57	0.34	6.94	1.16	0.19	0.27
9/12/2018	8:33:07	0.32	6.94	1.16	0.19	0.24
9/12/2018	8:33:17	0.31	6.95	1.16	0.21	0.24
9/12/2018	8:33:27	0.31	6.94	1.15	0.20	0.24
9/12/2018	8:33:37	0.31	6.93	1.16	0.18	0.24
9/12/2018	8:33:47	0.32	6.58	1.16	0.20	0.28
9/12/2018	8:33:57	0.28	6.58	1.15	0.18	0.25
9/12/2018	8:34:07	0.29	6.57	1.16	0.18	0.22
9/12/2018	8:34:17	0.28	6.58	1.16	0.19	0.24
9/12/2018	8:34:27	0.28	6.56	1.15	0.19	0.27
9/12/2018	8:34:37	0.28	6.57	1.16	0.18	0.28
9/12/2018	8:34:47	0.29	6.58	1.16	0.19	0.21
9/12/2018	8:34:57	0.28	6.39	1.15	0.19	0.31
9/12/2018	8:35:07	0.25	6.30	1.16	0.19	0.24
9/12/2018	8:35:17	0.28	6.31	1.15	0.19	0.28
9/12/2018	8:35:27	0.29	6.31	1.19	0.19	0.28
9/12/2018	8:35:37	0.25	6.29	2.62	0.18	0.27
9/12/2018	8:35:47	0.25	6.30	3.63	0.18	0.22
9/12/2018	8:35:57	0.25	6.31	4.05	0.18	0.30
9/12/2018	8:36:07	0.23	6.30	4.23	0.18	0.21

	VOC [PPM]	O2 [%]	CO2 [%]	ALT-106 CH4 [PPM]
System zero	**0.13**	**0.09**	**0.23**	**-0.85**
System low	**6.30**			
System mid	**12.47**	**10.05**	**1.93**	
System high	**21.43**			**49.73**

Holligsworth & Vose
Daily Calibrations
9/12/2018

Daily Calibrations-CO/NOx Recalibration

Date	Time	NOx [PPM]	CO [PPM]
9/12/2018	9:39:31	0.74	25.53
9/12/2018	9:39:41	0.74	25.41
9/12/2018	9:39:51	0.73	25.42
9/12/2018	9:40:01	0.71	25.34
9/12/2018	9:40:11	0.71	26.53
9/12/2018	9:40:21	0.71	28.35
9/12/2018	9:40:31	0.72	28.61
9/12/2018	9:40:41	0.70	23.08
9/12/2018	9:40:51	0.54	14.59
9/12/2018	9:41:01	0.34	7.17
9/12/2018	9:41:11	0.30	3.74
9/12/2018	9:41:21	0.32	2.95
9/12/2018	9:41:31	0.33	2.90
9/12/2018	9:41:41	0.39	2.67
9/12/2018	9:41:51	0.70	2.74
9/12/2018	9:42:01	0.82	3.52
9/12/2018	9:42:11	0.45	5.34
9/12/2018	9:42:21	0.37	6.01
9/12/2018	9:42:31	0.38	5.26
9/12/2018	9:42:41	0.39	4.61
9/12/2018	9:42:51	0.42	3.85
9/12/2018	9:43:01	0.47	3.15
9/12/2018	9:43:11	0.58	2.88
9/12/2018	9:43:21	0.71	2.76
9/12/2018	9:43:31	0.86	2.40
9/12/2018	9:43:41	1.01	2.89
9/12/2018	9:43:51	1.15	4.03
9/12/2018	9:44:01	1.30	5.70
9/12/2018	9:44:11	1.42	5.86
9/12/2018	9:44:21	1.54	5.01
9/12/2018	9:44:31	1.66	4.38
9/12/2018	9:44:41	1.78	3.51
9/12/2018	9:44:51	1.86	3.11
9/12/2018	9:45:01	1.96	3.05
9/12/2018	9:45:11	2.06	2.77
9/12/2018	9:45:21	2.17	2.58
9/12/2018	9:45:31	2.26	2.90
9/12/2018	9:45:41	2.34	4.10
9/12/2018	9:45:51	2.42	5.58
9/12/2018	9:46:01	2.50	5.77

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Daily Calibrations
9/12/2018

Daily Calibrations-CO/NOx Recalibration

Date	Time	NOx [PPM]	CO [PPM]
9/12/2018	9:46:11	2.88	5.61
9/12/2018	9:46:21	4.02	5.43
9/12/2018	9:46:31	4.94	5.19
9/12/2018	9:46:41	5.07	4.91
9/12/2018	9:46:51	5.25	4.89
9/12/2018	9:47:01	5.44	4.69
9/12/2018	9:47:11	5.60	4.71
9/12/2018	9:47:21	5.14	4.90
9/12/2018	9:47:31	5.20	6.29
9/12/2018	9:47:41	5.21	7.93
9/12/2018	9:47:51	5.13	7.82
9/12/2018	9:48:01	5.16	7.02
9/12/2018	9:48:11	5.19	6.31
9/12/2018	9:48:21	5.23	5.36
9/12/2018	9:48:31	5.25	4.98
9/12/2018	9:48:41	5.28	4.36
9/12/2018	9:48:51	3.54	2.48
9/12/2018	9:49:01	0.62	1.04
9/12/2018	9:49:11	0.22	0.63
9/12/2018	9:49:21	0.18	1.97
9/12/2018	9:49:31	0.17	2.61
9/12/2018	9:49:41	0.16	2.24
9/12/2018	9:49:51	0.17	1.41
9/12/2018	9:50:01	0.16	0.52
9/12/2018	9:50:11	0.17	0.23
9/12/2018	9:50:21	0.16	-0.31
9/12/2018	9:50:31	0.17	-0.68
9/12/2018	9:50:41	0.16	-0.66
9/12/2018	9:50:51	0.17	-0.49
9/12/2018	9:51:01	0.17	0.29
9/12/2018	9:51:11	0.17	1.83
9/12/2018	9:51:21	0.16	2.64
9/12/2018	9:51:31	0.17	2.27
9/12/2018	9:51:41	0.16	1.09
9/12/2018	9:51:51	0.17	0.34
9/12/2018	9:52:01	0.17	-0.20
9/12/2018	9:52:11	0.17	-0.39
9/12/2018	9:52:21	0.17	-0.57
9/12/2018	9:52:31	0.17	-0.71
9/12/2018	9:52:41	0.16	-0.54

Holligsworth & Vose
Daily Calibrations
9/12/2018

Daily Calibrations-CO/NOx Recalibration

Date	Time	NOx [PPM]	CO [PPM]
9/12/2018	9:52:51	0.17	0.68
9/12/2018	9:53:01	0.66	2.82
9/12/2018	9:53:11	1.65	4.21
9/12/2018	9:53:21	1.87	4.30
9/12/2018	9:53:31	1.61	3.67
9/12/2018	9:53:41	1.53	2.89
9/12/2018	9:53:51	1.54	2.50
9/12/2018	9:54:01	1.70	2.26
9/12/2018	9:54:11	1.99	1.89
9/12/2018	9:54:21	2.18	1.98
9/12/2018	9:54:31	2.03	2.01
9/12/2018	9:54:41	1.92	2.44
9/12/2018	9:54:51	1.97	4.09
9/12/2018	9:55:01	2.20	5.20
9/12/2018	9:55:11	2.57	5.40
9/12/2018	9:55:21	2.79	4.37
9/12/2018	9:55:31	2.87	3.66
9/12/2018	9:55:41	2.98	3.40
9/12/2018	9:55:51	3.04	2.97
9/12/2018	9:56:01	3.10	2.57
9/12/2018	9:56:11	3.14	2.35
9/12/2018	9:56:21	3.17	2.23
9/12/2018	9:56:31	3.21	3.10
9/12/2018	9:56:41	3.26	4.64
9/12/2018	9:56:51	3.25	5.40
9/12/2018	9:57:01	3.02	5.10
9/12/2018	9:57:11	2.82	4.00
9/12/2018	9:57:21	3.00	3.18
9/12/2018	9:57:31	3.01	2.63
9/12/2018	9:57:41	3.03	2.29
9/12/2018	9:57:51	3.03	2.13
9/12/2018	9:58:01	3.04	1.95
9/12/2018	9:58:11	3.07	1.84
9/12/2018	9:58:21	3.07	2.41
9/12/2018	9:58:31	3.07	3.73
9/12/2018	9:58:41	3.02	5.11
9/12/2018	9:58:51	2.91	5.19
9/12/2018	9:59:01	2.55	4.30
9/12/2018	9:59:11	2.55	3.61
9/12/2018	9:59:21	2.56	2.68

Holligsworth & Vose
Daily Calibrations
9/12/2018

Daily Calibrations-CO/NOx Recalibration

Date	Time	NOx [PPM]	CO [PPM]
9/12/2018	9:59:31	2.57	2.24
9/12/2018	9:59:41	2.55	1.92
9/12/2018	9:59:51	2.56	1.70
9/12/2018	10:00:01	2.57	1.85
9/12/2018	10:00:11	2.56	1.57
9/12/2018	10:00:21	2.58	2.58
9/12/2018	10:00:31	2.57	4.75
9/12/2018	10:00:41	2.55	7.93
9/12/2018	10:00:51	2.54	12.01
9/12/2018	10:01:01	2.53	16.21
9/12/2018	10:01:11	2.52	18.91
9/12/2018	10:01:21	2.08	20.25
9/12/2018	10:01:31	1.71	24.13
9/12/2018	10:01:41	16.82	42.76
9/12/2018	10:01:51	60.30	68.44
9/12/2018	10:02:01	91.78	89.07
9/12/2018	10:02:11	92.56	101.31
9/12/2018	10:02:21	92.44	106.56
9/12/2018	10:02:31	92.29	107.66
9/12/2018	10:02:41	92.25	107.26
9/12/2018	10:02:51	92.22	106.04
9/12/2018	10:03:01	92.20	105.31
9/12/2018	10:03:11	92.14	104.79
9/12/2018	10:03:21	92.14	104.50
9/12/2018	10:03:31	92.20	104.43
9/12/2018	10:03:41	92.20	104.18
9/12/2018	10:03:51	92.19	104.36
9/12/2018	10:04:01	92.18	105.20
9/12/2018	10:04:11	92.22	107.11
9/12/2018	10:04:21	92.28	101.98
9/12/2018	10:04:31	92.30	99.61
9/12/2018	10:04:41	92.23	98.91
9/12/2018	10:04:51	92.22	98.25
9/12/2018	10:05:01	92.27	97.57
9/12/2018	10:05:11	92.26	97.12
9/12/2018	10:05:21	92.25	96.86
9/12/2018	10:05:31	92.28	96.70
9/12/2018	10:05:41	92.27	96.96
9/12/2018	10:05:51	92.32	97.40
9/12/2018	10:06:01	92.32	99.20

Holligsworth & Vose
Daily Calibrations
9/12/2018

Daily Calibrations-CO/NOx Recalibration

Date	Time	NOx [PPM]	CO [PPM]
9/12/2018	10:06:11	92.31	100.17
9/12/2018	10:06:21	92.36	99.74
9/12/2018	10:06:31	92.37	99.02
9/12/2018	10:06:41	92.34	98.01
9/12/2018	10:06:51	92.31	97.46
9/12/2018	10:07:01	92.31	97.19
9/12/2018	10:07:11	92.35	96.93
9/12/2018	10:07:21	92.35	96.98
9/12/2018	10:07:31	92.33	97.01
9/12/2018	10:07:41	92.34	97.04
9/12/2018	10:07:51	92.30	98.04
9/12/2018	10:08:01	92.14	92.99
9/12/2018	10:08:11	75.79	79.44
9/12/2018	10:08:21	49.42	64.13
9/12/2018	10:08:31	46.46	54.67
9/12/2018	10:08:41	46.26	51.01
9/12/2018	10:08:51	46.15	49.56
9/12/2018	10:09:01	46.13	49.28
9/12/2018	10:09:11	46.11	49.16
9/12/2018	10:09:21	46.06	48.76
9/12/2018	10:09:31	46.04	49.07
9/12/2018	10:09:41	46.01	50.14
9/12/2018	10:09:51	46.03	51.73
9/12/2018	10:10:01	46.02	52.08
9/12/2018	10:10:11	46.00	51.33
9/12/2018	10:10:21	45.99	50.42
9/12/2018	10:10:31	45.98	49.63
9/12/2018	10:10:41	45.96	49.15
9/12/2018	10:10:51	45.93	48.76
9/12/2018	10:11:01	45.93	49.02
9/12/2018	10:11:11	45.96	48.79
9/12/2018	10:11:21	45.89	48.94
9/12/2018	10:11:31	45.90	49.72
9/12/2018	10:11:41	45.98	51.29
9/12/2018	10:11:51	45.92	51.92
9/12/2018	10:12:01	45.92	51.58
9/12/2018	10:12:11	45.89	50.56
9/12/2018	10:12:21	45.92	49.72
9/12/2018	10:12:31	45.85	49.34
9/12/2018	10:12:41	45.75	46.59

Holligsworth & Vose
Daily Calibrations
9/12/2018

Daily Calibrations-CO/NOx Recalibration

Date	Time	NOx [PPM]	CO [PPM]
9/12/2018	10:12:51	45.13	41.28
9/12/2018	10:13:01	28.30	34.31
9/12/2018	10:13:11	5.58	29.77
9/12/2018	10:13:21	10.55	27.33
9/12/2018	10:13:31	12.72	26.88
9/12/2018	10:13:41	6.59	26.21
9/12/2018	10:13:51	3.19	25.30
9/12/2018	10:14:01	1.76	24.55
9/12/2018	10:14:11	1.14	24.08
9/12/2018	10:14:21	0.90	23.07
9/12/2018	10:14:31	0.78	19.66
9/12/2018	10:14:41	0.60	14.28

	NOx [PPM]	CO [PPM]
Analyzer Zero	**0.17**	**-0.61**
Analyzer Mid	**2.57**	**49.33**
Analyzer High	**5.16**	**98.92**

System

9/12/2018	10:14:51	0.38	8.07
9/12/2018	10:15:01	0.26	3.70
9/12/2018	10:15:11	0.22	1.14
9/12/2018	10:15:21	0.20	0.50
9/12/2018	10:15:31	0.20	1.64
9/12/2018	10:15:41	0.18	2.39
9/12/2018	10:15:51	0.18	2.12
9/12/2018	10:16:01	0.18	1.42
9/12/2018	10:16:11	0.16	0.50
9/12/2018	10:16:21	0.16	0.01
9/12/2018	10:16:31	0.17	-0.27
9/12/2018	10:16:41	0.17	-0.57
9/12/2018	10:16:51	0.16	-0.53
9/12/2018	10:17:01	0.17	-0.54
9/12/2018	10:17:11	0.16	-0.51
9/12/2018	10:17:21	0.17	0.68
9/12/2018	10:17:31	0.16	2.01
9/12/2018	10:17:41	0.17	2.61
9/12/2018	10:17:51	0.27	4.40
9/12/2018	10:18:01	7.05	12.11

Holligsworth & Vose
Daily Calibrations
9/12/2018

Daily Calibrations-CO/NOx Recalibration

Date	Time	NOx [PPM]	CO [PPM]
9/12/2018	10:18:11	23.86	24.12
9/12/2018	10:18:21	36.91	35.08
9/12/2018	10:18:31	42.05	42.56
9/12/2018	10:18:41	44.18	45.90
9/12/2018	10:18:51	45.01	47.50
9/12/2018	10:19:01	45.39	48.09
9/12/2018	10:19:11	45.56	48.65
9/12/2018	10:19:21	45.65	50.22
9/12/2018	10:19:31	45.70	51.82
9/12/2018	10:19:41	45.67	51.77
9/12/2018	10:19:51	45.70	51.38
9/12/2018	10:20:01	45.76	50.22
9/12/2018	10:20:11	45.75	49.61
9/12/2018	10:20:21	45.74	49.20
9/12/2018	10:20:31	45.76	48.88
9/12/2018	10:20:41	45.78	48.68
9/12/2018	10:20:51	45.67	47.53
9/12/2018	10:21:01	39.04	43.35
9/12/2018	10:21:11	23.07	37.64
9/12/2018	10:21:21	12.12	30.24
9/12/2018	10:21:31	8.39	22.01
9/12/2018	10:21:41	5.10	13.94
9/12/2018	10:21:51	3.59	8.10
9/12/2018	10:22:01	2.93	4.73
9/12/2018	10:22:11	2.63	3.23
9/12/2018	10:22:21	2.47	2.42
9/12/2018	10:22:31	2.40	1.92
9/12/2018	10:22:41	2.37	2.17
9/12/2018	10:22:51	2.36	1.76
9/12/2018	10:23:01	2.34	1.95
9/12/2018	10:23:11	2.32	3.47
9/12/2018	10:23:21	2.30	4.64
9/12/2018	10:23:31	2.29	4.80
9/12/2018	10:23:41	2.28	4.04
9/12/2018	10:23:51	2.29	3.30
9/12/2018	10:24:01	2.27	2.52
9/12/2018	10:24:11	2.26	2.23
9/12/2018	10:24:21	2.26	1.97
9/12/2018	10:24:31	2.26	1.71
9/12/2018	10:24:41	2.25	1.54

Holligsworth & Vose
Daily Calibrations
9/12/2018

Daily Calibrations-CO/NOx Recalibration

Date	Time	NOx [PPM]	CO [PPM]
9/12/2018	10:24:51	2.23	1.78
9/12/2018	10:25:01	2.23	2.02
9/12/2018	10:25:11	2.23	3.49
9/12/2018	10:25:21	2.23	4.62
9/12/2018	10:25:31	2.23	4.49
9/12/2018	10:25:41	2.23	4.00
9/12/2018	10:25:51	2.23	3.12
System zero		**0.17**	**-0.55**
System mid		**2.23**	**48.92**

Hollingswoth & Vose
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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	10:52:22	0.72	22.77	1.00	19.89	0.62
9/12/2018	10:53:22	0.66	23.37	1.00	19.90	0.61
9/12/2018	10:54:22	0.67	21.88	0.99	19.90	0.60
9/12/2018	10:55:22	0.77	26.56	1.05	19.88	0.61
9/12/2018	10:56:22	0.78	25.06	1.10	19.89	0.60
9/12/2018	10:57:22	0.68	24.28	1.00	19.89	0.60
9/12/2018	10:58:22	0.65	21.81	1.00	19.90	0.60
9/12/2018	10:59:22	0.68	24.57	1.00	19.89	0.61
9/12/2018	11:00:22	0.70	23.36	1.00	19.88	0.61
9/12/2018	11:01:22	0.72	25.17	0.99	19.88	0.61
9/12/2018	11:02:22	0.74	23.88	1.01	19.88	0.61
9/12/2018	11:03:22	0.73	25.67	1.12	19.89	0.61
9/12/2018	11:04:22	0.74	23.64	1.12	19.88	0.61
9/12/2018	11:05:22	0.71	24.89	1.21	19.88	0.61
9/12/2018	11:06:22	0.69	22.87	1.20	19.89	0.61
9/12/2018	11:07:22	0.70	25.26	1.13	19.89	0.62
9/12/2018	11:08:22	0.72	23.32	1.13	19.89	0.62
9/12/2018	11:09:22	0.71	24.09	1.38	19.88	0.62
9/12/2018	11:10:22	0.72	24.34	0.96	19.88	0.62
9/12/2018	11:11:22	0.72	24.75	0.94	19.89	0.62
9/12/2018	11:12:22	0.70	24.77	1.04	19.88	0.62
9/12/2018	11:13:22	0.70	23.47	1.14	19.88	0.62
9/12/2018	11:14:22	0.70	24.41	1.25	19.88	0.61
9/12/2018	11:15:22	0.75	23.19	1.02	19.87	0.62
9/12/2018	11:16:22	0.74	25.28	1.09	19.87	0.61
9/12/2018	11:17:22	0.72	23.72	1.19	19.88	0.61
9/12/2018	11:18:22	0.71	25.09	1.22	19.88	0.61
9/12/2018	11:19:22	0.70	23.22	1.13	19.87	0.61
9/12/2018	11:20:22	0.69	24.99	1.13	19.87	0.60
9/12/2018	11:21:22	0.68	25.18	1.14	19.87	0.60
9/12/2018	11:22:22	0.72	25.73	1.05	19.87	0.61
9/12/2018	11:23:22	0.73	24.86	1.05	19.87	0.61
9/12/2018	11:24:22	0.77	23.91	1.08	19.87	0.61
9/12/2018	11:25:22	0.76	24.18	0.87	19.87	0.61
9/12/2018	11:26:22	0.71	22.90	1.00	19.87	0.61
9/12/2018	11:27:22	0.70	24.72	1.00	19.87	0.61
9/12/2018	11:28:22	0.71	22.62	1.00	19.88	0.61
9/12/2018	11:29:22	0.71	24.15	1.05	19.87	0.61
9/12/2018	11:30:22	0.70	23.42	1.12	19.87	0.62
9/12/2018	11:31:22	0.72	24.97	1.00	19.87	0.62
9/12/2018	11:32:22	0.72	24.22	1.22	19.87	0.62

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	11:33:22	0.73	23.83	1.00	19.87	0.62
9/12/2018	11:34:22	0.73	23.92	1.10	19.87	0.61
9/12/2018	11:35:22	0.70	22.76	1.32	19.87	0.62
9/12/2018	11:36:22	0.70	24.18	1.13	19.87	0.61
9/12/2018	11:37:22	0.69	22.08	1.00	19.87	0.61
9/12/2018	11:38:22	0.66	23.11	1.10	19.88	0.60
9/12/2018	11:39:22	0.69	21.85	1.05	19.87	0.61
9/12/2018	11:40:22	0.71	23.92	1.00	19.86	0.61
9/12/2018	11:41:22	0.74	23.60	1.00	19.87	0.60
9/12/2018	11:42:22	0.75	22.52	1.00	19.86	0.60
9/12/2018	11:43:22	0.74	24.78	1.00	19.86	0.61
9/12/2018	11:44:22	0.70	22.76	0.81	19.86	0.60
9/12/2018	11:45:22	0.73	23.86	0.99	19.86	0.60
9/12/2018	11:46:22	0.73	22.45	1.18	19.86	0.61
9/12/2018	11:47:22	0.71	22.52	0.99	19.87	0.60
9/12/2018	11:48:22	0.72	23.53	0.86	19.87	0.60
9/12/2018	11:49:22	0.76	21.39	0.75	19.86	0.60
9/12/2018	11:50:22	0.81	23.68	0.73	19.86	0.61
9/12/2018	11:51:22	0.79	22.03	0.79	19.86	0.61
9/12/2018	11:52:22	0.78	23.43	0.86	19.87	0.61
9/12/2018	11:53:22	0.76	22.20	0.86	19.87	0.62
9/12/2018	11:54:22	0.76	22.70	0.87	19.86	0.62
9/12/2018	11:55:22	0.75	23.81	0.86	19.86	0.62
9/12/2018	11:56:22	0.77	22.44	0.86	19.86	0.62
9/12/2018	11:57:22	0.75	23.54	0.82	19.87	0.61
9/12/2018	11:58:22	0.72	20.54	0.74	19.87	0.61
9/12/2018	11:59:22	0.71	21.97	0.86	19.87	0.60
9/12/2018	12:00:22	0.73	21.55	0.75	19.87	0.61
9/12/2018	12:01:22	0.74	22.13	0.82	19.86	0.60
9/12/2018	12:02:22	0.75	24.19	0.99	19.86	0.61
9/12/2018	12:03:22	0.75	22.13	1.13	19.87	0.60
9/12/2018	12:04:22	0.72	23.60	1.13	19.87	0.59
9/12/2018	12:05:22	0.73	22.02	1.13	19.87	0.59
9/12/2018	12:06:22	0.74	23.07	1.03	19.87	0.60
9/12/2018	12:07:22	0.69	22.61	0.93	19.87	0.59
9/12/2018	12:08:22	0.68	21.43	0.86	19.87	0.59
9/12/2018	12:09:22	0.67	23.34	0.93	19.88	0.59
9/12/2018	12:10:22	0.71	20.56	1.26	19.88	0.59
9/12/2018	12:11:22	0.70	20.93	1.26	19.88	0.59
9/12/2018	12:12:22	0.71	20.37	0.97	19.88	0.59
9/12/2018	12:13:22	0.73	21.37	0.94	19.87	0.60

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	12:14:22	0.75	22.36	1.00	19.87	0.60
9/12/2018	12:15:22	0.74	21.01	1.01	19.87	0.60
9/12/2018	12:16:22	0.69	23.83	1.00	19.87	0.61
9/12/2018	12:17:22	0.66	22.11	0.66	19.87	0.61
9/12/2018	12:18:22	0.69	23.22	0.95	19.87	0.61
9/12/2018	12:19:22	0.62	21.00	1.19	19.88	0.60
9/12/2018	12:20:22	0.67	21.15	1.24	19.86	0.61
9/12/2018	12:21:22	0.63	24.05	1.13	19.86	0.61
9/12/2018	12:22:22	0.64	22.23	1.01	19.87	0.61
9/12/2018	12:23:22	0.62	24.50	1.30	19.87	0.60
9/12/2018	12:24:22	0.64	22.53	1.17	19.87	0.60
9/12/2018	12:25:22	0.63	24.00	1.00	19.86	0.60
9/12/2018	12:26:22	0.65	22.91	1.03	19.86	0.59
9/12/2018	12:27:22	0.68	22.92	1.14	19.87	0.59
9/12/2018	12:28:22	0.67	23.08	1.02	19.86	0.59
9/12/2018	12:29:22	0.67	21.47	1.09	19.86	0.59
9/12/2018	12:30:22	0.65	22.42	1.08	19.87	0.59
9/12/2018	12:31:22	0.64	20.68	1.04	19.87	0.59
9/12/2018	12:32:22	0.65	22.46	1.12	19.87	0.59
9/12/2018	12:33:22	0.66	21.26	0.87	19.87	0.60
9/12/2018	12:34:22	0.66	22.29	0.87	19.87	0.60
9/12/2018	12:35:22	0.68	22.03	0.87	19.86	0.60
9/12/2018	12:36:22	0.66	21.00	0.93	19.86	0.60
9/12/2018	12:37:22	0.66	22.56	1.01	19.87	0.60
9/12/2018	12:38:22	0.65	22.14	1.01	19.86	0.61
9/12/2018	12:39:22	0.71	25.34	0.88	19.85	0.61
9/12/2018	12:40:22	0.70	22.93	1.07	19.86	0.61
9/12/2018	12:41:22	0.68	22.47	1.13	19.86	0.61
9/12/2018	12:42:22	0.64	22.09	1.01	19.86	0.61
9/12/2018	12:43:22	0.70	22.26	0.74	19.85	0.61
9/12/2018	12:44:22	0.63	21.85	0.87	19.86	0.60
9/12/2018	12:45:22	0.63	20.31	0.87	19.86	0.61
9/12/2018	12:46:22	0.65	22.55	0.96	19.86	0.60
9/12/2018	12:47:22	0.68	20.57	0.94	19.86	0.60
9/12/2018	12:48:22	0.66	22.78	0.87	19.86	0.60
9/12/2018	12:49:22	0.68	21.36	0.87	19.86	0.59
9/12/2018	12:50:22	0.66	22.81	1.00	19.86	0.59
9/12/2018	12:51:22	0.68	21.71	1.01	19.85	0.60
9/12/2018	12:52:22	0.70	22.56	1.01	19.86	0.59
9/12/2018	12:53:22	0.67	22.90	1.00	19.86	0.59
9/12/2018	12:54:22	0.68	22.38	1.01	19.86	0.60

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	12:55:22	0.67	22.95	1.01	19.87	0.59
9/12/2018	12:56:22	0.62	19.96	1.01	19.87	0.59
9/12/2018	12:57:22	0.67	22.65	1.01	19.86	0.60
9/12/2018	12:58:22	0.68	20.77	1.01	19.87	0.59
9/12/2018	12:59:22	0.65	20.93	0.93	19.87	0.60
Final Average		**0.70**	**22.99**	**1.01**	**19.87**	**0.61**

Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	13:01:12	0.74	18.50	0.79	4.65	0.30
9/12/2018	13:01:22	0.87	14.50	0.87	1.79	0.24
9/12/2018	13:01:32	0.82	9.48	0.87	0.76	0.22
9/12/2018	13:01:42	0.61	5.15	0.88	0.38	0.22
9/12/2018	13:01:52	0.57	3.69	0.87	0.24	0.20
9/12/2018	13:02:02	0.64	3.97	0.88	0.19	0.20
9/12/2018	13:02:12	0.61	4.07	0.87	0.17	0.20
9/12/2018	13:02:22	0.53	3.43	0.85	0.15	0.20
9/12/2018	13:02:32	0.50	2.55	0.74	0.15	0.21
9/12/2018	13:02:42	0.51	1.70	0.73	0.15	0.21
9/12/2018	13:02:52	0.57	1.39	0.74	0.15	0.21
9/12/2018	13:03:02	0.68	1.07	0.74	0.14	0.20
9/12/2018	13:03:12	0.81	0.95	0.74	0.14	0.21
9/12/2018	13:03:22	0.96	0.91	0.73	0.14	0.20
9/12/2018	13:03:32	1.13	0.81	0.74	0.14	0.21
9/12/2018	13:03:42	1.30	0.87	0.52	0.14	0.20
9/12/2018	13:03:52	1.44	0.91	0.48	0.14	0.21
9/12/2018	13:04:02	1.56	1.71	0.47	0.14	0.20
9/12/2018	13:04:12	1.66	3.30	0.47	0.14	0.19
9/12/2018	13:04:22	1.75	3.91	0.47	0.14	0.20
9/12/2018	13:04:32	1.81	3.09	0.47	0.14	0.19
9/12/2018	13:04:42	1.86	2.47	0.47	0.14	0.19
9/12/2018	13:04:52	1.93	1.75	0.33	0.15	0.20
9/12/2018	13:05:02	1.98	1.17	0.20	0.15	0.19
9/12/2018	13:05:12	2.03	1.09	0.20	0.16	0.20
9/12/2018	13:05:22	2.06	0.92	0.20	0.15	0.20
9/12/2018	13:05:32	2.10	0.65	0.20	0.16	0.20
9/12/2018	13:05:42	2.15	0.88	0.21	0.16	0.20
9/12/2018	13:05:52	2.18	0.89	0.21	0.16	0.19
9/12/2018	13:06:02	2.23	0.85	0.18	0.16	0.19
9/12/2018	13:06:12	2.27	1.83	0.07	0.16	0.20
9/12/2018	13:06:22	2.30	3.28	0.06	0.16	0.20

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	13:06:32	2.34	3.66	0.07	0.16	0.19
9/12/2018	13:06:42	2.37	3.35	0.07	0.16	0.19
9/12/2018	13:06:52	2.40	2.43	0.09	0.16	0.19
9/12/2018	13:07:02	2.43	1.68	0.07	0.16	0.20
9/12/2018	13:07:12	2.46	1.36	0.07	0.05	0.19
9/12/2018	13:07:22	2.47	0.98	0.31	0.02	0.20
9/12/2018	13:07:32	2.49	0.93	0.34	0.02	0.20
9/12/2018	13:07:42	2.52	0.86	0.34	0.02	0.19
9/12/2018	13:07:52	2.53	0.97	0.34	0.02	0.19
9/12/2018	13:08:02	2.55	0.62	0.34	0.01	0.20
9/12/2018	13:08:12	2.56	0.82	0.33	0.00	0.18
9/12/2018	13:08:22	2.57	1.31	0.33	0.00	0.19
9/12/2018	13:08:32	2.59	2.77	0.18	0.00	0.20
9/12/2018	13:08:42	2.60	3.77	0.06	0.00	0.19
9/12/2018	13:08:52	2.62	3.56	0.07	-0.01	0.17
9/12/2018	13:09:02	2.63	2.45	0.07	-0.01	0.19
9/12/2018	13:09:12	2.64	2.08	0.06	-0.01	0.18
9/12/2018	13:09:22	2.65	1.55	0.07	-0.02	0.19
9/12/2018	13:09:32	2.64	1.23	0.07	2.83	0.25
9/12/2018	13:09:42	2.64	1.56	0.07	11.81	0.44
9/12/2018	13:09:52	2.48	4.45	0.07	11.83	0.43
9/12/2018	13:10:02	1.95	8.70	0.07	5.26	0.30
9/12/2018	13:10:12	6.01	16.78	0.07	2.11	0.23
9/12/2018	13:10:22	20.45	26.63	0.08	0.84	0.20
9/12/2018	13:10:32	35.49	35.94	0.07	0.33	0.20
9/12/2018	13:10:42	42.07	43.52	0.07	0.13	0.18
9/12/2018	13:10:52	44.24	48.40	0.07	0.04	0.18
9/12/2018	13:11:02	45.08	49.77	0.34	0.01	0.19
9/12/2018	13:11:12	45.40	49.34	0.34	0.00	0.18
9/12/2018	13:11:22	45.51	48.57	0.34	-0.01	0.18
9/12/2018	13:11:32	45.55	48.35	0.34	-0.01	0.18
9/12/2018	13:11:42	45.61	47.90	0.34	-0.02	0.18
9/12/2018	13:11:52	45.62	47.70	0.35	-0.02	0.17
9/12/2018	13:12:02	45.61	47.61	0.33	-0.02	0.17
9/12/2018	13:12:12	45.61	47.71	0.15	-0.02	0.17
9/12/2018	13:12:22	45.61	47.57	0.06	-0.02	0.18
9/12/2018	13:12:32	45.63	47.39	0.07	-0.02	0.18
9/12/2018	13:12:42	45.63	47.57	0.06	-0.02	0.17
9/12/2018	13:12:52	45.61	48.58	0.05	-0.02	0.17
9/12/2018	13:13:02	45.62	50.21	0.07	-0.02	0.18
9/12/2018	13:13:12	45.62	50.90	0.06	-0.02	0.18

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	13:13:22	45.59	50.17	0.07	-0.02	0.18
9/12/2018	13:13:32	45.60	49.42	0.07	-0.02	0.18
9/12/2018	13:13:42	45.61	48.64	0.07	0.76	0.19
9/12/2018	13:13:52	45.64	48.06	0.06	6.87	0.34
9/12/2018	13:14:02	43.12	44.77	0.06	4.15	0.27
9/12/2018	13:14:12	32.08	36.74	0.07	1.78	0.30
9/12/2018	13:14:22	17.33	25.35	0.06	1.66	1.00
9/12/2018	13:14:32	8.31	14.48	0.10	1.82	1.51
9/12/2018	13:14:42	4.83	6.41	0.34	1.89	1.71
9/12/2018	13:14:52	3.20	2.04	0.35	1.91	1.84
9/12/2018	13:15:02	1.80	0.42	0.33	1.93	1.90
9/12/2018	13:15:12	1.04	0.80	0.34	1.94	1.93
9/12/2018	13:15:22	0.68	1.10	0.35	1.94	1.94
9/12/2018	13:15:32	0.52	0.71	0.33	1.94	1.95
9/12/2018	13:15:42	0.42	-0.27	0.33	1.94	1.96
9/12/2018	13:15:52	0.36	-1.09	0.54	1.94	1.96
9/12/2018	13:16:02	0.33	-1.37	0.60	2.18	2.21
9/12/2018	13:16:12	0.32	-1.70	0.60	5.87	6.01
9/12/2018	13:16:22	0.32	-1.86	0.59	8.35	8.04
9/12/2018	13:16:32	0.30	-1.94	0.60	9.33	8.82
9/12/2018	13:16:42	0.29	-1.91	0.60	9.74	9.15
9/12/2018	13:16:52	0.27	-1.97	0.59	9.90	9.28
9/12/2018	13:17:02	0.25	-2.66	0.33	9.98	9.33
9/12/2018	13:17:12	0.24	-2.79	0.06	10.00	9.36
9/12/2018	13:17:22	0.23	-1.29	0.07	10.01	9.38
9/12/2018	13:17:32	0.23	-0.12	0.07	10.02	9.38
9/12/2018	13:17:42	0.23	-0.78	0.08	10.02	9.39
9/12/2018	13:17:52	0.22	-1.32	0.07	10.03	9.40
9/12/2018	13:18:02	0.21	-1.82	0.07	10.03	9.40
9/12/2018	13:18:12	0.20	-2.69	0.09	10.02	9.40
9/12/2018	13:18:22	0.20	-3.10	0.20	10.02	9.40
9/12/2018	13:18:32	0.20	-3.08	0.21	10.34	9.11
9/12/2018	13:18:42	0.20	-3.05	0.22	14.42	5.46
9/12/2018	13:18:52	0.24	-0.46	0.20	15.58	3.34
9/12/2018	13:19:02	0.45	3.95	0.20	8.00	1.86
9/12/2018	13:19:12	0.60	6.92	0.19	4.24	1.14
9/12/2018	13:19:22	0.48	6.64	0.20	3.18	0.64
9/12/2018	13:19:32	0.36	5.55	0.08	2.76	0.43
9/12/2018	13:19:42	0.31	4.00	0.07	2.59	0.32
9/12/2018	13:19:52	0.27	2.24	0.07	2.54	0.28
9/12/2018	13:20:02	0.24	0.78	0.07	2.51	0.26

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	13:20:12	0.22	-0.16	0.07	2.51	0.24
9/12/2018	13:20:22	0.23	-0.89	0.07	2.50	0.23
9/12/2018	13:20:32	0.22	-1.16	0.07	2.49	0.23
9/12/2018	13:20:42	0.22	-1.67	2.96	2.50	0.23
9/12/2018	13:20:52	0.23	-1.75	4.89	2.50	0.23
9/12/2018	13:21:02	0.23	-1.52	4.89	2.50	0.23
9/12/2018	13:21:12	0.23	-1.46	4.89	2.49	0.22
9/12/2018	13:21:22	0.23	-1.46	4.89	2.49	0.22
9/12/2018	13:21:32	0.22	-1.40	4.89	2.50	0.21
9/12/2018	13:21:42	0.23	-0.10	4.88	2.50	0.22
9/12/2018	13:21:52	0.22	1.35	7.01	2.50	0.22
9/12/2018	13:22:02	0.22	1.25	11.97	2.50	0.22
9/12/2018	13:22:12	0.23	0.68	11.97	2.50	0.22
9/12/2018	13:22:22	0.23	-0.08	11.96	2.49	0.22
9/12/2018	13:22:32	0.22	-0.84	11.97	2.50	0.21
9/12/2018	13:22:42	0.23	-1.41	11.97	2.50	0.22
9/12/2018	13:22:52	0.21	-1.54	11.97	2.49	0.21
9/12/2018	13:23:02	0.20	-1.47	11.96	2.49	0.21
9/12/2018	13:23:12	0.20	-1.68	12.37	2.50	0.21
9/12/2018	13:23:22	0.20	-1.84	12.38	2.49	0.22
9/12/2018	13:23:32	0.20	-1.54	12.38	2.97	0.22
9/12/2018	13:23:42	0.20	-1.29	12.36	9.89	0.40
9/12/2018	13:23:52	0.23	1.26	12.37	15.61	0.53
9/12/2018	13:24:02	0.39	7.66	12.38	18.11	0.58
9/12/2018	13:24:12	0.59	14.57	12.37	19.14	0.59

	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
System Zero	**0.20**	**-3.08**	**0.07**	**0.00**	**0.18**
System Mid	**2.64**	**50.43**	**12.37**	**10.02**	**1.95**

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Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	13:27:22	0.68	20.61	1.54	19.92	0.61
9/12/2018	13:28:22	0.68	22.23	1.25	19.92	0.61
9/12/2018	13:29:22	0.72	21.15	1.13	19.92	0.61
9/12/2018	13:30:22	0.74	23.36	0.91	19.92	0.61
9/12/2018	13:31:22	0.74	22.73	0.96	19.91	0.61
9/12/2018	13:32:22	0.75	24.09	1.01	19.91	0.61
9/12/2018	13:33:22	0.72	22.46	1.01	19.93	0.60
9/12/2018	13:34:22	0.65	21.56	1.01	19.93	0.59
9/12/2018	13:35:22	0.69	21.96	1.13	19.93	0.59
9/12/2018	13:36:22	0.71	26.26	1.13	19.92	0.60
9/12/2018	13:37:22	0.74	25.24	1.05	19.93	0.60
9/12/2018	13:38:22	0.70	23.58	1.05	19.93	0.60
9/12/2018	13:39:22	0.68	21.35	1.11	19.94	0.60
9/12/2018	13:40:22	0.71	22.70	1.00	19.93	0.60
9/12/2018	13:41:22	0.73	21.34	1.23	19.93	0.60
9/12/2018	13:42:22	0.70	22.96	0.98	19.93	0.60
9/12/2018	13:43:22	0.71	21.54	0.93	19.94	0.61
9/12/2018	13:44:22	0.71	23.64	1.04	19.93	0.61
9/12/2018	13:45:22	0.68	22.16	1.14	19.93	0.62
9/12/2018	13:46:22	0.68	23.58	1.26	19.94	0.61
9/12/2018	13:47:22	0.67	23.37	1.26	19.94	0.61
9/12/2018	13:48:22	0.65	23.65	1.26	19.94	0.62
9/12/2018	13:49:22	0.66	24.73	1.26	19.94	0.62
9/12/2018	13:50:22	0.63	22.04	1.26	19.94	0.61
9/12/2018	13:51:22	0.64	23.02	1.26	19.95	0.61
9/12/2018	13:52:22	0.66	22.30	1.26	19.94	0.61
9/12/2018	13:53:22	0.68	22.90	1.16	19.95	0.61
9/12/2018	13:54:22	0.69	22.94	1.13	19.95	0.60
9/12/2018	13:55:22	0.70	22.15	1.13	19.94	0.60
9/12/2018	13:56:22	0.67	23.16	1.14	19.95	0.60
9/12/2018	13:57:22	0.69	21.83	1.26	19.94	0.60
9/12/2018	13:58:22	0.69	22.90	1.15	19.95	0.60
9/12/2018	13:59:22	0.70	22.97	1.04	19.95	0.60
9/12/2018	14:00:22	0.69	21.67	1.06	19.95	0.60
9/12/2018	14:01:22	0.63	22.18	1.10	19.96	0.59
9/12/2018	14:02:22	0.64	21.00	1.01	19.96	0.60
9/12/2018	14:03:22	0.64	22.79	1.26	19.96	0.60
9/12/2018	14:04:22	0.67	23.24	1.26	19.96	0.60
9/12/2018	14:05:22	0.68	22.51	1.18	19.95	0.61
9/12/2018	14:06:22	0.65	23.75	1.18	19.95	0.61
9/12/2018	14:07:22	0.67	23.15	1.24	19.95	0.61

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Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	14:08:22	0.68	21.80	1.13	19.95	0.62
9/12/2018	14:09:22	0.68	23.17	1.02	19.95	0.62
9/12/2018	14:10:22	0.65	22.56	1.01	19.95	0.62
9/12/2018	14:11:22	0.64	22.02	1.01	19.96	0.61
9/12/2018	14:12:22	0.65	22.63	1.00	19.95	0.62
9/12/2018	14:13:22	0.65	21.56	1.01	19.95	0.62
9/12/2018	14:14:22	0.64	22.21	1.00	19.96	0.61
9/12/2018	14:15:22	0.65	22.41	1.11	19.95	0.62
9/12/2018	14:16:22	0.62	21.36	1.05	19.95	0.61
9/12/2018	14:17:22	0.62	22.41	1.06	19.96	0.61
9/12/2018	14:18:22	0.63	22.04	1.10	19.96	0.61
9/12/2018	14:19:22	0.61	21.20	1.00	19.96	0.61
9/12/2018	14:20:22	0.67	22.87	1.12	19.95	0.60
9/12/2018	14:21:22	0.68	22.49	1.13	19.95	0.61
9/12/2018	14:22:22	0.65	21.93	1.06	19.95	0.61
9/12/2018	14:23:22	0.64	22.95	1.04	19.96	0.60
9/12/2018	14:24:22	0.65	21.17	1.13	19.96	0.60
9/12/2018	14:25:22	0.65	20.89	1.13	19.96	0.61
9/12/2018	14:26:22	0.69	22.65	1.02	19.95	0.61
9/12/2018	14:27:22	0.70	22.04	1.00	19.96	0.61
9/12/2018	14:28:22	0.66	21.99	1.00	19.96	0.61
9/12/2018	14:29:22	0.68	22.01	1.03	19.96	0.61
9/12/2018	14:30:22	0.69	20.73	1.13	19.96	0.62
9/12/2018	14:31:22	0.70	22.41	1.00	19.96	0.62
9/12/2018	14:32:22	0.68	23.64	1.00	19.96	0.63
9/12/2018	14:33:22	0.69	21.98	1.00	19.96	0.63
9/12/2018	14:34:22	0.68	22.44	1.00	19.96	0.62
9/12/2018	14:35:22	0.72	22.06	1.00	19.96	0.62
9/12/2018	14:36:22	0.79	20.68	1.00	19.96	0.62
9/12/2018	14:37:22	0.80	22.72	0.75	19.97	0.62
9/12/2018	14:38:22	0.80	22.45	0.82	19.96	0.62
9/12/2018	14:39:22	0.78	20.75	0.80	19.97	0.62
9/12/2018	14:40:22	0.79	21.84	0.73	19.96	0.62
9/12/2018	14:41:22	0.77	20.71	0.74	19.97	0.61
9/12/2018	14:42:22	0.75	19.41	0.86	19.98	0.61
9/12/2018	14:43:22	0.79	21.33	0.86	19.97	0.61
9/12/2018	14:44:22	0.80	21.66	0.69	19.96	0.61
9/12/2018	14:45:22	0.80	20.73	0.71	19.96	0.61
9/12/2018	14:46:22	0.80	21.77	0.86	19.97	0.61
9/12/2018	14:47:22	0.79	21.32	0.85	19.97	0.61
9/12/2018	14:48:22	0.78	20.32	0.86	19.97	0.61

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Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	14:49:22	0.80	21.09	0.87	19.97	0.61
9/12/2018	14:50:22	0.79	21.50	0.78	19.97	0.62
9/12/2018	14:51:22	0.79	20.02	0.77	19.97	0.62
9/12/2018	14:52:22	0.78	20.94	0.86	19.97	0.62
9/12/2018	14:53:22	0.78	21.32	0.86	19.97	0.62
9/12/2018	14:54:22	0.77	20.48	0.86	19.97	0.62
9/12/2018	14:55:22	0.77	20.93	0.86	19.97	0.62
9/12/2018	14:56:22	0.77	20.90	0.80	19.98	0.63
9/12/2018	14:57:22	0.77	19.87	0.69	19.98	0.62
9/12/2018	14:58:22	0.77	20.59	0.60	19.98	0.63
9/12/2018	14:59:22	0.76	21.64	0.73	19.98	0.62
9/12/2018	15:00:22	0.75	20.99	0.84	19.91	0.63
9/12/2018	15:01:22	0.76	22.12	0.94	19.80	0.62
9/12/2018	15:02:22	0.73	23.04	0.95	19.71	0.62
9/12/2018	15:03:22	0.69	20.93	0.86	19.69	0.62
9/12/2018	15:04:22	0.69	20.92	0.86	19.66	0.62
9/12/2018	15:05:22	0.69	22.22	0.99	19.76	0.62
9/12/2018	15:06:22	0.68	21.74	0.90	19.75	0.62
9/12/2018	15:07:22	0.65	20.97	0.94	19.75	0.61
9/12/2018	15:08:22	0.75	22.11	1.00	19.74	0.61
9/12/2018	15:09:22	0.76	20.68	1.00	19.75	0.61
9/12/2018	15:10:22	0.70	22.01	1.00	19.74	0.61
9/12/2018	15:11:22	0.70	22.90	0.89	19.74	0.61
9/12/2018	15:12:22	0.68	21.40	0.95	19.75	0.61
9/12/2018	15:13:22	0.66	22.25	1.11	19.75	0.61
9/12/2018	15:14:22	0.65	21.05	1.21	19.75	0.61
9/12/2018	15:15:22	0.68	21.12	1.00	19.75	0.61
9/12/2018	15:16:22	0.66	22.17	1.00	19.75	0.61
9/12/2018	15:17:22	0.65	20.58	0.90	19.75	0.62
9/12/2018	15:18:22	0.68	22.07	1.01	19.74	0.62
9/12/2018	15:19:22	0.67	22.34	1.04	19.74	0.62
9/12/2018	15:20:22	0.66	21.44	0.87	19.74	0.63
9/12/2018	15:21:22	0.69	22.74	0.87	19.74	0.63
9/12/2018	15:22:22	0.68	21.33	0.87	19.74	0.63
9/12/2018	15:23:22	0.68	22.03	0.87	19.74	0.63
9/12/2018	15:24:22	0.67	22.38	0.93	19.74	0.63
9/12/2018	15:25:22	0.66	20.93	0.98	19.74	0.62
9/12/2018	15:26:22	0.67	23.05	0.87	19.74	0.63
9/12/2018	15:27:22	0.66	20.53	1.00	19.75	0.62
9/12/2018	15:28:22	0.64	20.38	1.00	19.75	0.61
9/12/2018	15:29:22	0.68	20.65	1.08	19.74	0.62

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	15:30:22	0.65	21.85	1.13	19.74	0.62
9/12/2018	15:31:22	0.66	22.49	1.13	19.74	0.61
9/12/2018	15:32:22	0.68	22.87	1.13	19.74	0.61
9/12/2018	15:33:22	0.64	23.57	1.01	19.74	0.61
9/12/2018	15:34:22	0.65	20.89	1.01	19.74	0.61
9/12/2018	15:35:22	0.65	22.65	1.07	19.74	0.60
Final Average		**0.70**	**22.02**	**1.01**	**19.89**	**0.61**

Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	15:36:22	0.64	21.16	1.13	19.75	0.61
9/12/2018	15:36:32	0.63	20.84	1.13	19.39	0.60
9/12/2018	15:36:42	0.63	20.51	1.12	11.56	0.44
9/12/2018	15:36:52	0.62	17.47	1.13	5.10	0.30
9/12/2018	15:37:02	0.54	12.76	1.12	3.42	0.25
9/12/2018	15:37:12	0.39	8.22	1.13	2.81	0.23
9/12/2018	15:37:22	0.29	5.59	1.13	2.59	0.22
9/12/2018	15:37:32	0.24	3.22	1.12	2.52	0.21
9/12/2018	15:37:42	0.21	1.23	1.13	2.49	0.21
9/12/2018	15:37:52	0.20	0.07	1.12	2.48	0.21
9/12/2018	15:38:02	0.20	-0.78	1.13	2.48	0.20
9/12/2018	15:38:12	0.20	-1.23	1.91	2.48	0.21
9/12/2018	15:38:22	0.20	-1.33	2.68	2.48	0.21
9/12/2018	15:38:32	0.19	-1.64	2.67	2.48	0.21
9/12/2018	15:38:42	0.20	-1.43	2.67	2.47	0.21
9/12/2018	15:38:52	0.20	-1.67	2.66	2.48	0.21
9/12/2018	15:39:02	0.20	-0.47	2.66	2.48	0.22
9/12/2018	15:39:12	0.20	1.28	2.67	2.48	0.20
9/12/2018	15:39:22	0.20	1.43	4.53	2.47	0.21
9/12/2018	15:39:32	0.20	0.60	11.96	2.48	0.20
9/12/2018	15:39:42	0.20	-0.16	11.97	2.48	0.21
9/12/2018	15:39:52	0.20	-0.49	11.97	2.48	0.21
9/12/2018	15:40:02	0.20	-1.15	11.97	2.48	0.21
9/12/2018	15:40:12	0.20	-1.31	11.96	2.47	0.20
9/12/2018	15:40:22	0.20	-1.43	11.96	2.47	0.21
9/12/2018	15:40:32	0.20	-1.79	11.96	2.47	0.22
9/12/2018	15:40:42	0.20	-1.25	12.44	2.47	0.21
9/12/2018	15:40:52	0.20	0.46	12.50	2.48	0.21
9/12/2018	15:41:02	0.20	1.46	12.50	2.69	0.21
9/12/2018	15:41:12	0.20	1.27	12.49	8.89	0.37
9/12/2018	15:41:22	0.22	2.36	12.50	7.23	0.33

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	15:41:32	0.33	4.09	12.50	3.06	0.32
9/12/2018	15:41:42	0.35	4.24	12.50	2.27	1.08
9/12/2018	15:41:52	0.29	2.53	12.50	2.06	1.58
9/12/2018	15:42:02	0.39	0.54	12.49	1.97	1.78
9/12/2018	15:42:12	0.47	-0.98	12.50	1.94	1.88
9/12/2018	15:42:22	0.39	-1.61	12.50	1.93	1.93
9/12/2018	15:42:32	0.32	-1.18	12.49	1.93	1.95
9/12/2018	15:42:42	0.27	0.02	12.51	1.93	1.96
9/12/2018	15:42:52	0.25	0.65	12.51	1.92	1.97
9/12/2018	15:43:02	0.24	0.57	10.92	1.93	1.97
9/12/2018	15:43:12	0.23	-0.73	7.21	2.11	2.19
9/12/2018	15:43:22	0.22	-1.38	7.21	5.87	6.16
9/12/2018	15:43:32	0.23	-1.65	7.21	8.44	8.22
9/12/2018	15:43:42	0.23	-1.60	7.21	9.36	8.95
9/12/2018	15:43:52	0.23	-1.65	7.21	9.70	9.23
9/12/2018	15:44:02	0.21	-2.44	7.22	9.84	9.32
9/12/2018	15:44:12	0.20	-2.71	7.22	9.89	9.37
9/12/2018	15:44:22	0.20	-2.18	0.88	9.91	9.39
9/12/2018	15:44:32	0.20	-0.70	0.86	9.91	9.39
9/12/2018	15:44:42	0.20	-0.21	0.86	9.91	9.39
9/12/2018	15:44:52	0.20	-0.84	0.87	9.92	9.40
9/12/2018	15:45:02	0.20	-1.53	0.87	9.92	9.40
9/12/2018	15:45:12	0.20	-2.33	0.87	9.91	9.41
9/12/2018	15:45:22	0.20	-2.86	0.87	10.08	9.26
9/12/2018	15:45:32	0.20	-2.80	0.58	12.84	6.27
9/12/2018	15:45:42	0.23	-0.69	0.48	7.66	3.42
9/12/2018	15:45:52	0.97	6.24	0.47	2.90	1.40
9/12/2018	15:46:02	8.30	18.44	0.47	1.06	0.73
9/12/2018	15:46:12	26.88	32.02	0.47	0.39	0.45
9/12/2018	15:46:22	38.62	42.21	0.47	0.14	0.34
9/12/2018	15:46:32	42.86	47.19	0.47	0.04	0.29
9/12/2018	15:46:42	44.47	48.51	0.48	0.01	0.27
9/12/2018	15:46:52	45.05	48.79	0.47	-0.01	0.27
9/12/2018	15:47:02	45.31	48.40	0.47	-0.01	0.25
9/12/2018	15:47:12	45.46	47.70	0.47	-0.02	0.25
9/12/2018	15:47:22	45.51	47.69	0.47	-0.02	0.24
9/12/2018	15:47:32	45.55	47.78	0.47	-0.02	0.24
9/12/2018	15:47:42	45.56	47.43	0.47	-0.02	0.24
9/12/2018	15:47:52	45.59	47.89	0.45	-0.02	0.24
9/12/2018	15:48:02	45.62	49.64	0.35	-0.02	0.24
9/12/2018	15:48:12	45.59	50.80	0.34	0.00	0.25

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	15:48:22	44.29	46.20	0.35	0.03	0.27
9/12/2018	15:48:32	32.36	35.16	0.35	0.00	0.25
9/12/2018	15:48:42	15.64	22.08	0.34	-0.02	0.24
9/12/2018	15:48:52	7.34	11.31	0.35	-0.02	0.24
9/12/2018	15:49:02	4.26	5.27	0.35	-0.03	0.24
9/12/2018	15:49:12	3.08	2.58	0.34	-0.03	0.23
9/12/2018	15:49:22	2.62	1.56	0.34	-0.03	0.22
9/12/2018	15:49:32	2.42	0.86	0.34	-0.04	0.23
9/12/2018	15:49:42	2.32	0.89	0.35	-0.03	0.23
9/12/2018	15:49:52	2.27	1.66	0.34	-0.03	0.23
9/12/2018	15:50:02	2.26	3.53	0.34	-0.03	0.23
9/12/2018	15:50:12	2.24	3.98	0.34	-0.03	0.22
9/12/2018	15:50:22	2.23	3.17	0.41	-0.04	0.23
9/12/2018	15:50:32	2.23	2.24	0.47	-0.03	0.22
9/12/2018	15:50:42	2.23	1.78	0.47	-0.03	0.22
9/12/2018	15:50:52	2.23	1.40	0.47	-0.04	0.22
9/12/2018	15:51:02	2.23	0.99	0.48	2.89	0.29
9/12/2018	15:51:12	2.23	1.72	0.47	12.08	0.48
9/12/2018	15:51:22	2.08	4.98	0.47	16.72	0.58
9/12/2018	15:51:32	1.57	9.85	0.39	18.54	0.60

	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
System Zero	**0.20**	**-2.24**	**0.46**	**-0.02**	**0.24**
System Mid	**2.23**	**47.70**	**12.50**	**9.91**	**1.97**

Hollingswoth & Vose
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Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	16:00:22	0.70	22.37	1.01	19.69	0.62
9/12/2018	16:01:22	0.66	21.82	1.01	19.68	0.62
9/12/2018	16:02:22	0.66	23.06	1.00	19.69	0.62
9/12/2018	16:03:22	0.67	21.18	1.08	19.69	0.62
9/12/2018	16:04:22	0.69	22.86	1.13	19.68	0.63
9/12/2018	16:05:22	0.67	21.25	1.13	19.69	0.63
9/12/2018	16:06:22	0.66	22.90	1.13	19.69	0.63
9/12/2018	16:07:22	0.68	21.18	1.02	19.70	0.63
9/12/2018	16:08:22	0.65	22.98	1.01	19.69	0.63
9/12/2018	16:09:22	0.68	21.17	1.07	19.69	0.63
9/12/2018	16:10:22	0.30	23.60	1.10	19.68	0.63
9/12/2018	16:11:22	0.50	22.13	1.01	19.68	0.63
9/12/2018	16:12:22	0.50	22.98	1.01	19.69	0.63
9/12/2018	16:13:22	0.53	22.28	1.11	19.68	0.63
9/12/2018	16:14:22	0.55	25.29	1.13	19.67	0.63
9/12/2018	16:15:22	0.52	22.29	1.18	19.68	0.63
9/12/2018	16:16:22	0.50	22.74	1.24	19.69	0.62
9/12/2018	16:17:22	0.47	21.55	1.13	19.69	0.62
9/12/2018	16:18:22	0.49	22.40	1.02	19.69	0.61
9/12/2018	16:19:22	0.48	22.16	1.01	19.69	0.61
9/12/2018	16:20:22	0.59	23.34	1.07	19.69	0.61
9/12/2018	16:21:22	0.61	21.66	1.13	19.68	0.61
9/12/2018	16:22:22	0.56	22.72	1.12	19.68	0.62
9/12/2018	16:23:22	0.54	22.01	1.00	19.69	0.61
9/12/2018	16:24:22	0.51	21.98	1.01	19.68	0.62
9/12/2018	16:25:22	0.49	21.43	1.08	19.69	0.61
9/12/2018	16:26:22	0.56	22.32	1.08	19.68	0.62
9/12/2018	16:27:22	0.59	23.40	1.03	19.68	0.62
9/12/2018	16:28:22	0.53	21.64	1.13	19.69	0.62
9/12/2018	16:29:22	0.50	22.03	1.00	19.68	0.62
9/12/2018	16:30:22	0.50	21.29	1.01	19.68	0.63
9/12/2018	16:31:22	0.51	22.64	1.01	19.68	0.63
9/12/2018	16:32:22	0.49	21.62	1.01	19.68	0.63
9/12/2018	16:33:22	0.49	23.22	1.02	19.68	0.63
9/12/2018	16:34:22	0.53	22.60	1.14	19.68	0.63
9/12/2018	16:35:22	0.52	23.34	1.13	19.68	0.63
9/12/2018	16:36:22	0.49	21.47	1.13	19.68	0.62
9/12/2018	16:37:22	0.61	22.63	1.13	19.68	0.63
9/12/2018	16:38:22	0.57	21.01	1.16	19.69	0.62
9/12/2018	16:39:22	0.53	21.73	1.25	19.68	0.62
9/12/2018	16:40:22	0.53	21.52	1.01	19.68	0.62

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	16:41:22	0.56	22.67	1.00	19.67	0.62
9/12/2018	16:42:22	0.53	22.09	0.93	19.68	0.61
9/12/2018	16:43:22	0.48	21.43	0.98	19.68	0.61
9/12/2018	16:44:22	0.47	21.59	1.13	19.68	0.62
9/12/2018	16:45:22	0.50	21.54	1.13	19.67	0.61
9/12/2018	16:46:22	0.52	22.01	1.02	19.67	0.62
9/12/2018	16:47:22	0.52	23.09	0.81	19.66	0.62
9/12/2018	16:48:22	0.53	23.14	0.94	19.67	0.62
9/12/2018	16:49:22	0.51	22.25	1.10	19.66	0.62
9/12/2018	16:50:22	0.52	22.52	1.02	19.66	0.62
9/12/2018	16:51:22	0.53	21.29	1.13	19.66	0.63
9/12/2018	16:52:22	0.53	23.91	0.91	19.66	0.63
9/12/2018	16:53:22	0.52	22.19	0.96	19.66	0.64
9/12/2018	16:54:22	0.52	24.06	0.95	19.66	0.63
9/12/2018	16:55:22	0.51	21.79	0.87	19.65	0.64
9/12/2018	16:56:22	0.52	23.65	0.87	19.65	0.64
9/12/2018	16:57:22	0.50	22.04	1.00	19.66	0.63
9/12/2018	16:58:22	0.54	24.05	1.01	19.66	0.63
9/12/2018	16:59:22	0.54	22.35	1.01	19.65	0.63
9/12/2018	17:00:22	0.54	23.74	1.05	19.65	0.64
9/12/2018	17:01:22	0.52	22.78	1.10	19.65	0.63
9/12/2018	17:02:22	0.53	22.97	0.87	19.65	0.63
9/12/2018	17:03:22	0.51	23.20	0.87	19.65	0.63
9/12/2018	17:04:22	0.51	22.60	0.87	19.64	0.62
9/12/2018	17:05:22	0.53	23.89	0.94	19.64	0.63
9/12/2018	17:06:22	0.49	22.51	0.97	19.64	0.62
9/12/2018	17:07:22	0.54	24.60	0.89	19.64	0.62
9/12/2018	17:08:22	0.60	22.27	1.14	19.65	0.62
9/12/2018	17:09:22	0.52	23.38	1.14	19.65	0.62
9/12/2018	17:10:22	0.52	22.39	1.13	19.64	0.63
9/12/2018	17:11:22	0.53	24.02	1.08	19.64	0.62
9/12/2018	17:12:22	0.53	22.70	1.01	19.64	0.63
9/12/2018	17:13:22	0.51	23.17	1.00	19.64	0.63
9/12/2018	17:14:22	0.53	22.96	1.00	19.64	0.63
9/12/2018	17:15:22	0.50	22.13	1.10	19.64	0.63
9/12/2018	17:16:22	0.55	24.44	1.07	19.63	0.64
9/12/2018	17:17:22	0.56	23.75	0.97	19.64	0.64
9/12/2018	17:18:22	0.57	23.91	0.91	19.65	0.63
9/12/2018	17:19:22	0.52	20.94	1.14	19.66	0.63
9/12/2018	17:20:22	0.50	22.64	1.03	19.65	0.63
9/12/2018	17:21:22	0.50	21.15	1.02	19.65	0.62

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	17:22:22	0.50	22.80	1.07	19.65	0.63
9/12/2018	17:23:22	0.50	21.84	1.16	19.65	0.63
9/12/2018	17:24:22	0.58	23.67	1.26	19.64	0.63
9/12/2018	17:25:22	0.58	23.14	1.01	19.64	0.63
9/12/2018	17:26:22	0.53	21.48	1.01	19.65	0.62
9/12/2018	17:27:22	0.50	22.94	0.93	19.64	0.62
9/12/2018	17:28:22	0.52	21.28	0.93	19.64	0.62
9/12/2018	17:29:22	0.51	22.96	1.01	19.65	0.61
9/12/2018	17:30:22	0.49	21.20	1.01	19.65	0.61
9/12/2018	17:31:22	0.47	20.91	1.01	19.65	0.61
9/12/2018	17:32:22	0.48	21.82	1.01	19.65	0.62
9/12/2018	17:33:22	0.49	20.93	1.01	19.65	0.61
9/12/2018	17:34:22	0.47	22.88	1.04	19.65	0.62
9/12/2018	17:35:22	0.50	21.38	1.15	19.64	0.62
9/12/2018	17:36:22	0.50	22.50	1.27	19.64	0.62
9/12/2018	17:37:22	0.49	22.02	1.16	19.64	0.62
9/12/2018	17:38:22	0.52	21.28	1.06	19.64	0.63
9/12/2018	17:39:22	0.53	23.14	1.01	19.65	0.63
9/12/2018	17:40:22	0.50	21.27	0.98	19.64	0.63
9/12/2018	17:41:22	0.50	22.76	0.88	19.64	0.63
9/12/2018	17:42:22	0.50	22.02	1.01	19.64	0.63
9/12/2018	17:43:22	0.56	21.89	1.11	19.64	0.63
9/12/2018	17:44:22	0.53	23.30	1.14	19.64	0.63
9/12/2018	17:45:22	0.53	21.50	1.05	19.64	0.63
9/12/2018	17:46:22	0.49	22.06	0.88	19.64	0.62
9/12/2018	17:47:22	0.47	20.63	0.88	19.65	0.62
9/12/2018	17:48:22	0.49	21.39	0.87	19.64	0.62
9/12/2018	17:49:22	0.50	23.41	0.88	19.64	0.62
9/12/2018	17:50:22	0.52	22.49	1.00	19.63	0.62
9/12/2018	17:51:22	0.52	23.63	1.16	19.64	0.61
9/12/2018	17:52:22	0.50	21.47	1.26	19.64	0.61
9/12/2018	17:53:22	0.52	23.65	1.14	19.64	0.62
9/12/2018	17:54:22	0.48	20.55	1.24	19.65	0.61
9/12/2018	17:55:22	0.50	21.93	1.18	19.64	0.61
9/12/2018	17:56:22	0.51	21.89	1.08	19.64	0.62
9/12/2018	17:57:22	0.51	22.95	1.03	19.64	0.62
9/12/2018	17:58:22	0.51	21.66	1.13	19.64	0.62
9/12/2018	17:59:22	0.50	22.11	1.25	19.65	0.62
9/12/2018	18:00:22	0.56	23.19	1.16	19.64	0.63
9/12/2018	18:01:22	0.56	23.52	1.13	19.64	0.63
9/12/2018	18:02:22	0.53	21.10	1.13	19.65	0.63

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	18:03:22	0.52	21.20	1.13	19.65	0.63
9/12/2018	18:04:22	0.51	20.81	1.13	19.65	0.63
9/12/2018	18:05:22	0.53	22.59	1.13	19.64	0.63
9/12/2018	18:06:22	0.55	21.68	1.14	19.64	0.63
9/12/2018	18:07:22	0.56	23.72	1.13	19.64	0.63
9/12/2018	18:08:22	0.57	21.94	1.16	19.64	0.63
Final Average		**0.53**	**22.39**	**1.05**	**19.66**	**0.62**

Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	18:09:22	0.58	22.82	1.26	19.71	0.63
9/12/2018	18:09:32	0.58	24.32	1.26	15.58	0.54
9/12/2018	18:09:42	0.59	23.17	1.26	6.80	0.34
9/12/2018	18:09:52	0.62	18.20	1.27	3.92	0.26
9/12/2018	18:10:02	0.67	11.55	1.26	2.97	0.22
9/12/2018	18:10:12	0.63	5.33	1.26	2.63	0.23
9/12/2018	18:10:22	0.41	1.33	1.00	2.51	0.20
9/12/2018	18:10:32	0.25	-0.90	1.01	2.47	0.20
9/12/2018	18:10:42	0.16	-2.15	1.00	2.46	0.21
9/12/2018	18:10:52	0.10	-2.48	0.99	2.45	0.21
9/12/2018	18:11:02	0.10	-2.34	1.00	2.45	0.19
9/12/2018	18:11:12	0.10	-1.25	1.00	2.45	0.19
9/12/2018	18:11:22	0.10	0.24	1.01	2.45	0.19
9/12/2018	18:11:32	0.10	0.48	4.63	2.45	0.18
9/12/2018	18:11:42	0.10	-0.30	6.18	2.45	0.19
9/12/2018	18:11:52	0.10	-1.08	6.19	2.45	0.20
9/12/2018	18:12:02	0.10	-1.83	6.18	2.45	0.19
9/12/2018	18:12:12	0.09	-2.19	6.18	2.45	0.18
9/12/2018	18:12:22	0.08	-2.50	6.19	2.45	0.20
9/12/2018	18:12:32	0.07	-2.60	6.19	2.44	0.19
9/12/2018	18:12:42	0.07	-2.62	8.50	2.45	0.19
9/12/2018	18:12:52	0.08	-2.11	11.96	2.45	0.18
9/12/2018	18:13:02	0.07	-0.79	11.97	2.45	0.19
9/12/2018	18:13:12	0.08	0.53	11.97	2.45	0.19
9/12/2018	18:13:22	0.07	0.50	11.97	2.45	0.19
9/12/2018	18:13:32	0.07	-0.39	11.97	2.45	0.18
9/12/2018	18:13:42	0.07	-1.32	11.96	2.45	0.20
9/12/2018	18:13:52	0.08	-1.87	12.00	2.45	0.18
9/12/2018	18:14:02	0.07	-1.93	12.38	2.44	0.19
9/12/2018	18:14:12	0.06	-2.45	12.37	2.44	0.18
9/12/2018	18:14:22	0.04	-2.48	12.39	3.31	0.22

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	18:14:32	0.04	-2.13	12.38	8.65	0.36
9/12/2018	18:14:42	0.04	1.11	12.38	4.80	0.28
9/12/2018	18:14:52	1.09	10.41	12.38	1.79	0.23
9/12/2018	18:15:02	3.67	23.39	12.37	0.64	0.21
9/12/2018	18:15:12	12.13	34.76	12.48	0.22	0.20
9/12/2018	18:15:22	29.43	42.06	12.51	0.07	0.18
9/12/2018	18:15:32	40.90	45.19	12.51	0.01	0.19
9/12/2018	18:15:42	43.62	46.19	12.50	-0.02	0.18
9/12/2018	18:15:52	45.42	46.46	12.50	-0.02	0.19
9/12/2018	18:16:02	45.83	46.23	12.51	-0.03	0.18
9/12/2018	18:16:12	46.08	46.39	12.50	-0.03	0.19
9/12/2018	18:16:22	46.09	46.53	9.54	-0.03	0.19
9/12/2018	18:16:32	46.11	47.21	6.56	-0.03	0.18
9/12/2018	18:16:42	46.16	48.71	6.58	-0.04	0.19
9/12/2018	18:16:52	46.21	49.62	6.58	-0.03	0.20
9/12/2018	18:17:02	46.20	49.40	6.57	-0.03	0.19
9/12/2018	18:17:12	46.20	48.74	6.58	-0.03	0.20
9/12/2018	18:17:22	46.17	47.98	6.58	-0.03	0.19
9/12/2018	18:17:32	46.19	47.19	5.41	-0.04	0.19
9/12/2018	18:17:42	46.20	45.27	0.74	-0.02	0.19
9/12/2018	18:17:52	42.44	37.63	0.73	-0.03	0.20
9/12/2018	18:18:02	33.00	26.02	0.73	-0.04	0.18
9/12/2018	18:18:12	23.04	14.77	0.73	-0.04	0.20
9/12/2018	18:18:22	12.27	8.05	0.73	-0.04	0.20
9/12/2018	18:18:32	5.18	5.39	0.73	-0.04	0.18
9/12/2018	18:18:42	3.65	3.87	0.73	-0.04	0.19
9/12/2018	18:18:52	2.64	2.48	0.73	-0.04	0.19
9/12/2018	18:19:02	2.41	1.49	0.72	-0.04	0.18
9/12/2018	18:19:12	2.23	0.83	0.73	-0.04	0.19
9/12/2018	18:19:22	2.17	0.35	0.73	-0.04	0.20
9/12/2018	18:19:32	2.14	0.21	0.74	-0.05	0.19
9/12/2018	18:19:42	2.14	-0.10	0.72	-0.04	0.20
9/12/2018	18:19:52	2.14	0.10	0.74	-0.04	0.19
9/12/2018	18:20:02	2.13	1.13	0.57	-0.04	0.19
9/12/2018	18:20:12	2.11	2.58	0.47	-0.04	0.19
9/12/2018	18:20:22	2.11	2.72	0.47	-0.04	0.20
9/12/2018	18:20:32	2.11	2.12	0.47	-0.04	0.20
9/12/2018	18:20:42	2.11	1.32	0.47	-0.05	0.19
9/12/2018	18:20:52	2.11	0.50	0.47	-0.05	0.20
9/12/2018	18:21:02	2.11	0.17	0.47	-0.04	0.21
9/12/2018	18:21:12	2.11	0.13	0.39	-0.05	0.20

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/12/2018	18:21:22	2.11	0.01	0.20	-0.05	0.20
9/12/2018	18:21:32	2.10	-0.21	0.19	-0.05	0.20
9/12/2018	18:21:42	2.11	1.23	0.20	-0.04	0.20
9/12/2018	18:21:52	2.11	2.77	0.20	-0.05	0.20
9/12/2018	18:22:02	2.11	2.86	0.20	0.94	0.20
9/12/2018	18:22:12	2.10	1.94	0.20	7.88	0.23
9/12/2018	18:22:22	2.07	0.89	0.20	4.59	0.22
9/12/2018	18:22:32	1.88	-0.17	0.20	2.01	0.48
9/12/2018	18:22:42	1.40	-0.89	0.20	1.83	1.28
9/12/2018	18:22:52	1.15	-1.49	0.19	1.85	1.64
9/12/2018	18:23:02	1.21	-2.01	0.20	1.86	1.79
9/12/2018	18:23:12	1.09	-2.21	0.20	1.86	1.88
9/12/2018	18:23:22	0.69	-1.23	0.19	1.87	1.92
9/12/2018	18:23:32	0.39	-0.09	0.19	1.88	1.94
9/12/2018	18:23:42	0.27	-0.26	0.39	1.88	1.94
9/12/2018	18:23:52	0.18	-0.99	0.47	1.88	1.95
9/12/2018	18:24:02	0.16	-2.02	0.47	1.88	1.96
9/12/2018	18:24:12	0.12	-2.51	0.47	1.89	1.97
9/12/2018	18:24:22	0.10	-2.88	0.47	3.96	4.27
9/12/2018	18:24:32	0.10	-3.16	0.47	7.66	7.64
9/12/2018	18:24:42	0.10	-2.76	0.47	9.04	8.72
9/12/2018	18:24:52	0.09	-2.47	0.47	9.56	9.12
9/12/2018	18:25:02	0.08	-1.21	0.47	9.75	9.28
9/12/2018	18:25:12	0.08	-0.35	0.47	9.82	9.33
9/12/2018	18:25:22	0.07	-1.00	0.47	9.86	9.36
9/12/2018	18:25:32	0.06	-2.03	0.47	9.86	9.37
9/12/2018	18:25:42	0.05	-2.82	0.47	9.87	9.38
9/12/2018	18:25:52	0.05	-3.54	0.47	9.87	9.38
9/12/2018	18:26:02	0.04	-3.86	0.44	9.87	9.39

	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
System Zero	**0.05**	**-3.41**	**0.46**	**-0.05**	**0.20**
System Mid	**2.11**	**49.24**	**12.50**	**9.87**	**1.96**

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112**
DATE	**09/13/18**
METHOD	**29**
POLLUTANT	**Metals**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**8:45**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**	**End Time:**	**11:52**
EPA Method:	**29**	Overcast, 60 degrees	**Date:**	**9/13/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type	Glass	
Y factor	0.9985	Nozzle ID	0.216	Nozzle size	0.2153	inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000253	sq.ft.
		Pitot Cp	0.84	Probe heat	250	F
				Filter heat	250	F

Source Information:

Barometric Pressure	29.84	"Hg	O_2	19.80	%
Static Pressure	0.56	"H_2O	CO_2	0.70	%
Ave. ΔP	1.3	"H_2O	Rec. Nz.	0.201	inches
Stack Temperature	190	F			
Assumed moisture	2	%			
Assumed meter temp.	69	F			
Total number of points	24				
Time per point	7.5				
Total run time	180				

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.002
Leak check vacuum, "Hg	15	7

Nozzle check for roundness:

1	2	3	
0.215	0.215	0.216	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	158.624	dcf	Ave. ΔP	1.396	"H_2O
Wet mol. weight	28.7	M_s (actual)	Ave. √ΔP	1.1807	"H_2O
Actual H_2O	1.87	%	Ave. ΔH	2.596	"H_2O
Std. meter vol.	159.666	dscf	Ave. T_s	188.4	°F
Isokinetic Average	99.4	%	Ave. T_m	65.5	°F

Moisture/Lab:

Filter	Run 1 #		
	Initial	Final	Gain
Impingers, g	200.0	230	30.0
Silica gel, g	254.0	288.5	34.5
		Total water gain:	64.5

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	7.5	6.210	1.30	186	56	2.38	2.40	2	255	45
2	15.0	12.750	1.40	186	57	2.57	2.60	2	253	45
3	22.5	19.520	1.50	187	59	2.76	2.80	2.5	253	47
4	30.0	26.200	1.40	187	61	2.58	2.60	2.5	250	49
5	37.5	33.010	1.50	188	63	2.77	2.80	2.5	251	52
6	45.0	39.860	1.50	188	64	2.78	2.80	2.5	252	54
7	52.5	46.510	1.40	189	65	2.60	2.60	2	252	55
8	60.0	53.120	1.40	189	66	2.60	2.60	2	256	55
9	67.5	59.780	1.40	189	67	2.61	2.60	2	250	55
10	75.0	66.140	1.30	189	67	2.42	2.40	2	252	54
11	82.5	72.610	1.30	189	67	2.42	2.40	2	256	53
12	90.0	78.523	1.10	183	67	2.07	2.10	2	251	49
13	97.5	84.810	1.30	183	65	2.43	2.40	2	256	48
14	105.0	91.200	1.30	184	66	2.43	2.40	2	255	45
15	112.5	97.800	1.40	187	66	2.61	2.60	2.5	252	46
16	120.0	104.390	1.40	185	66	2.62	2.60	2.5	250	46
17	127.5	111.250	1.50	188	67	2.80	2.80	3	251	49
18	135.0	118.270	1.50	190	68	2.79	2.80	3	254	49
19	142.5	124.880	1.40	191	68	2.60	2.60	2.5	254	50
20	150.0	131.500	1.40	190	68	2.61	2.60	2.5	253	50
21	157.5	138.250	1.40	193	69	2.60	2.60	2.5	253	50
22	165.0	145.120	1.50	192	69	2.79	2.80	3	252	51
23	172.5	151.890	1.50	194	70	2.79	2.80	3	252	51
24	180.0	158.624	1.40	195	70	2.60	2.60	2.5	252	52

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**12:16**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:23**
EPA Method:	**29**	Overcast, 60 degrees	**Date:**	**9/13/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular	
Diameter	30.000 in
Rectangular	
Width	in
Length	in
Stack Area	4.909 sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.216	Nozzle size:	0.2153 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000253 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.84 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.201 inches
Stack Temperature	190 F		
Assumed moisture	1.87 %		
Assumed meter temp.	65.5 F		
Total number of points	24		
Time per point	7.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	6

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	161.903 dcf	Ave. ΔP	1.425 "H_2O
Wet mol. weight	28.69 M_s (actual)	Ave. √ΔP	1.1934 "H_2O
Actual H_2O	1.91 %	Ave. ΔH	2.65 "H_2O
Std. meter vol.	160.816 dscf	Ave. T_s	198.7 °F
Isokinetic Average	99.8 %	Ave. T_m	72.6 °F

Moisture/Lab:

Filter	Run2 #		
	Initial	Final	Gain
Impingers, g	200.0	230	30.0
Silica gel, g	248.5	285	36.5
		Total water gain:	66.5

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	7.5	6.580	1.40	197	68	2.59	2.60	2	255	52
2	15.0	13.250	1.40	197	69	2.59	2.60	2	251	52
3	22.5	20.110	1.50	196	68	2.77	2.80	2	256	52
4	30.0	27.010	1.50	196	69	2.78	2.80	2	249	53
5	37.5	33.910	1.50	197	69	2.77	2.80	2.5	254	53
6	45.0	40.810	1.50	197	70	2.78	2.80	2.5	252	53
7	52.5	47.460	1.40	197	71	2.60	2.60	2	253	55
8	60.0	54.140	1.40	196	71	2.60	2.60	2	253	54
9	67.5	61.100	1.50	196	72	2.79	2.80	2.5	255	55
10	75.0	67.980	1.50	198	72	2.79	2.80	2.5	251	55
11	82.5	74.690	1.40	199	73	2.60	2.60	2	253	56
12	90.0	81.398	1.40	199	73	2.60	2.60	2	254	56
13	97.5	88.300	1.50	199	73	2.79	2.80	2.5	250	59
14	105.0	94.980	1.40	200	73	2.60	2.60	2	255	56
15	112.5	101.720	1.40	198	74	2.61	2.60	2	250	56
16	120.0	108.390	1.40	199	74	2.61	2.60	2	251	58
17	127.5	115.110	1.40	199	74	2.61	2.60	2	253	58
18	135.0	122.080	1.50	200	75	2.79	2.80	2.5	249	58
19	142.5	129.000	1.50	201	75	2.79	2.80	2.5	249	59
20	150.0	135.760	1.40	201	76	2.61	2.60	2	253	60
21	157.5	142.510	1.40	201	76	2.61	2.60	2	254	62
22	165.0	148.960	1.30	201	76	2.42	2.40	2	254	65
23	172.5	155.420	1.30	202	76	2.42	2.40	2	249	60
24	180.0	161.903	1.30	203	76	2.41	2.40	2	253	58

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**15:44**
Source:	**CFU 112**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:48**
EPA Method:	**29**	Overcast, 60 degrees	**Date:**	**9/13/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.216	Nozzle size:	0.2153 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000253 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.84 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.2 inches
Stack Temperature	190 F		
Assumed moisture	1.91 %		
Assumed meter temp.	72.6 F		
Total number of points	24		
Time per point	7.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	7

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	160.092 dcf	Ave. ΔP	1.379 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.1738 "H_2O
Actual H_2O	1.84 %	Ave. ΔH	2.558 "H_2O
Std. meter vol.	157.853 dscf	Ave. T_s	201.8 °F
Isokinetic Average	99.8 %	Ave. T_m	76.4 °F

Moisture/Lab:

Filter	Run3 #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	240.3	278	37.7
		Total water gain:	62.7

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	7.5	6.670	1.40	202	74	2.59	2.60	2	252	58
2	15.0	13.350	1.40	202	74	2.59	2.60	2	254	48
3	22.5	20.010	1.40	200	74	2.60	2.60	2	251	50
4	30.0	26.740	1.40	201	75	2.60	2.60	2	252	52
5	37.5	33.410	1.40	200	75	2.61	2.60	2	254	52
6	45.0	40.410	1.50	200	76	2.80	2.80	2.5	252	53
7	52.5	47.120	1.40	201	77	2.61	2.60	2	254	54
8	60.0	53.840	1.40	202	77	2.61	2.60	2	253	55
9	67.5	60.300	1.30	200	77	2.43	2.40	2	253	55
10	75.0	66.490	1.20	203	77	2.23	2.20	2	251	56
11	82.5	72.740	1.20	204	78	2.23	2.20	2	253	57
12	90.0	79.023	1.20	204	77	2.23	2.20	2	252	58
13	97.5	85.720	1.40	202	76	2.60	2.60	2	254	59
14	105.0	92.690	1.50	200	77	2.80	2.80	2.5	253	56
15	112.5	99.670	1.50	202	77	2.79	2.80	2.5	250	56
16	120.0	106.400	1.40	202	77	2.61	2.60	2	255	60
17	127.5	113.450	1.50	201	77	2.80	2.80	2.5	253	61
18	135.0	120.150	1.40	202	77	2.61	2.60	2	253	62
19	142.5	126.880	1.40	202	77	2.61	2.60	2	252	62
20	150.0	133.640	1.40	202	77	2.61	2.60	2	252	64
21	157.5	140.100	1.30	203	77	2.42	2.40	2	254	65
22	165.0	146.850	1.40	202	77	2.61	2.60	2	253	57
23	172.5	153.600	1.40	202	77	2.61	2.60	2	254	54
24	180.0	160.092	1.30	203	77	2.42	2.40	2	252	53

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:45**
Source:	**CFU 112**	**End Time:**	**11:52**
Method:	**29**	**Date:**	**9/13/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m ^oF	Traverse Point	Dp "H_2O	Stack T_s ^oF	$\sqrt{Dp}$
	0.000						
7.5	6.210	2.40	56	1	1.30	186	1.1402
15.0	12.750	2.60	57	2	1.40	186	1.1832
22.5	19.520	2.80	59	3	1.50	187	1.2247
30.0	26.200	2.60	61	4	1.40	187	1.1832
37.5	33.010	2.80	63	5	1.50	188	1.2247
45.0	39.860	2.80	64	6	1.50	188	1.2247
52.5	46.510	2.60	65	7	1.40	189	1.1832
60.0	53.120	2.60	66	8	1.40	189	1.1832
67.5	59.780	2.60	67	9	1.40	189	1.1832
75.0	66.140	2.40	67	10	1.30	189	1.1402
82.5	72.610	2.40	67	11	1.30	189	1.1402
90.0	78.523	2.10	67	12	1.10	183	1.0488
97.5	84.810	2.40	65	13	1.30	183	1.1402
105.0	91.200	2.40	66	14	1.30	184	1.1402
112.5	97.800	2.60	66	15	1.40	187	1.1832
120.0	104.390	2.60	66	16	1.40	185	1.1832
127.5	111.250	2.80	67	17	1.50	188	1.2247
135.0	118.270	2.80	68	18	1.50	190	1.2247
142.5	124.880	2.60	68	19	1.40	191	1.1832
150.0	131.500	2.60	68	20	1.40	190	1.1832
157.5	138.250	2.60	69	21	1.40	193	1.1832
165.0	145.120	2.80	69	22	1.50	192	1.2247
172.5	151.890	2.80	70	23	1.50	194	1.2247
180.0	158.624	2.60	70	24	1.40	195	1.1832

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 112**	**Date:**	**09/13/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	30.000	in
Meter Volume, V_m	158.624	dcf	Rectangular		
Water Volume	64.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.84	"Hg	CO_2 Average	0.51	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.00	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.596	"H_2O	$\sqrt{Dp}$	1.1807	"H_2O
Temperature, T_m	65.5	^oF	Temperature, T_s	188.4	^oF
Temperature, T_m	525.5	^oA (^oR)	Temperature, T_s	648.4	^oA (^oR)
Pressure Meter, P_m	30.031	"Hg	Pressure Stack, P_s	29.881	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	159.666	dscf	Velocity, V_s	73.75	fps
	4.521	dscm	Volume (actual)	21,722.3	awcfm
Actual Volume, $V_{m(actual)}$	200.152	awcf		21,316.1	adcfm
Gas Stream Moisture			Volume (standard)	1,059,941.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.035	scf		1,040,120.9	dscf/hr
Moisture, B_{ws}	0.0187			17,335.3	dscf/min
Moisture EPA M4	1.87	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.68	lb/lb-mole			
Percent Isokinetic	99.3	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:16**
Source:	**CFU 112**	**End Time:**	**15:23**
Method:	**29**	**Date:**	**09/13/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter** ft^3	**ΔH** "H_2O	**Meter** T_m °F	**Traverse** Point	**Dp** "H_2O	**Stack** T_s °F	**√Dp**
	0.000						
7.5	6.580	2.60	68	1	1.40	197	1.1832
15.0	13.250	2.60	69	2	1.40	197	1.1832
22.5	20.110	2.80	68	3	1.50	196	1.2247
30.0	27.010	2.80	69	4	1.50	196	1.2247
37.5	33.910	2.80	69	5	1.50	197	1.2247
45.0	40.810	2.80	70	6	1.50	197	1.2247
52.5	47.460	2.60	71	7	1.40	197	1.1832
60.0	54.140	2.60	71	8	1.40	196	1.1832
67.5	61.100	2.80	72	9	1.50	196	1.2247
75.0	67.980	2.80	72	10	1.50	198	1.2247
82.5	74.690	2.60	73	11	1.40	199	1.1832
90.0	81.398	2.60	73	12	1.40	199	1.1832
97.5	88.300	2.80	73	13	1.50	199	1.2247
105.0	94.980	2.60	73	14	1.40	200	1.1832
112.5	101.720	2.60	74	15	1.40	198	1.1832
120.0	108.390	2.60	74	16	1.40	199	1.1832
127.5	115.110	2.60	74	17	1.40	199	1.1832
135.0	122.080	2.80	75	18	1.50	200	1.2247
142.5	129.000	2.80	75	19	1.50	201	1.2247
150.0	135.760	2.60	76	20	1.40	201	1.1832
157.5	142.510	2.60	76	21	1.40	201	1.1832
165.0	148.960	2.40	76	22	1.30	201	1.1402
172.5	155.420	2.40	76	23	1.30	202	1.1402
180.0	161.903	2.40	76	24	1.30	203	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 112**	**Date:**	**09/13/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	30.000	in
Meter Volume, V_m	161.903	dcf	Rectangular		
Water Volume	66.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.84	"Hg	CO_2 Average	0.46	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.05	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.650	"H_2O	$\sqrt{Dp}$	1.1934	"H_2O
Temperature, T_m	72.6	^oF	Temperature, T_s	198.7	^oF
Temperature, T_m	532.6	^oA (^oR)	Temperature, T_s	658.7	^oA (^oR)
Pressure Meter, P_m	30.035	"Hg	Pressure Stack, P_s	29.881	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	160.816	dscf	Velocity, V_s	75.15	fps
	4.554	dscm	Volume (actual)	22,134.7	awcfm
Actual Volume, $V_{m(actual)}$	204.879	awcf		21,711.9	adcfm
Gas Stream Moisture			Volume (standard)	1,063,173.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.129	scf		1,042,867.3	dscf/hr
Moisture, B_{ws}	0.0191			17,381.1	dscf/min
Moisture EPA M4	1.91	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	99.8	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**15:44**
Source:	**CFU 112**	**End Time:**	**18:48**
Method:	**29**	**Date:**	**09/13/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**√Dp**
	0.000						
7.5	6.670	2.60	74	1	1.40	202	1.1832
15.0	13.350	2.60	74	2	1.40	202	1.1832
22.5	20.010	2.60	74	3	1.40	200	1.1832
30.0	26.740	2.60	75	4	1.40	201	1.1832
37.5	33.410	2.60	75	5	1.40	200	1.1832
45.0	40.410	2.80	76	6	1.50	200	1.2247
52.5	47.120	2.60	77	7	1.40	201	1.1832
60.0	53.840	2.60	77	8	1.40	202	1.1832
67.5	60.300	2.40	77	9	1.30	200	1.1402
75.0	66.490	2.20	77	10	1.20	203	1.0954
82.5	72.740	2.20	78	11	1.20	204	1.0954
90.0	79.023	2.20	77	12	1.20	204	1.0954
97.5	85.720	2.60	76	13	1.40	202	1.1832
105.0	92.690	2.80	77	14	1.50	200	1.2247
112.5	99.670	2.80	77	15	1.50	202	1.2247
120.0	106.400	2.60	77	16	1.40	202	1.1832
127.5	113.450	2.80	77	17	1.50	201	1.2247
135.0	120.150	2.60	77	18	1.40	202	1.1832
142.5	126.880	2.60	77	19	1.40	202	1.1832
150.0	133.640	2.60	77	20	1.40	202	1.1832
157.5	140.100	2.40	77	21	1.30	203	1.1402
165.0	146.850	2.60	77	22	1.40	202	1.1832
172.5	153.600	2.60	77	23	1.40	202	1.1832
180.0	160.092	2.40	77	24	1.30	203	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 112**	**Date:**	**09/13/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	30.000	in
Meter Volume, V_m	160.092	dcf	Rectangular		
Water Volume	62.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.84	"Hg	CO_2 Average	0.46	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.14	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.558	"H_2O	√Dp	1.1738	"H_2O
Temperature, T_m	76.4	^oF	Temperature, T_s	201.8	^oF
Temperature, T_m	536.4	^oA (^oR)	Temperature, T_s	661.8	^oA (^oR)
Pressure Meter, P_m	30.028	"Hg	Pressure Stack, P_s	29.881	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	157.853	dscf	Velocity, V_s	74.07	fps
	4.470	dscm	Volume (actual)	21,816.6	awcfm
Actual Volume, $V_{m(actual)}$	201.907	awcf		21,415.2	adcfm
Gas Stream Moisture			Volume (standard)	1,042,986.2	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.951	scf		1,023,795.3	dscf/hr
Moisture, B_{ws}	0.0184			17,063.3	dscf/min
Moisture EPA M4	1.84	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.68	lb/lb-mole			
Percent Isokinetic	99.8	%			

Source:	CFU 112					Sample Date:	09/13/18
Run:		1					
Client ID:		Filter + Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL		5.150	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.590		0.614	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		0.403	<	MDL	0.100	0.040	µg/sample
Chromium		1.190		0.206	0.200	0.080	µg/sample
Cobalt	<	MDL	<	0.055	0.125	0.050	µg/sample
Copper		4.230		2.940	1.250	0.500	µg/sample
Lead	<	MDL	<	MDL	1.250	0.500	µg/sample
Manganese		1.400		0.574	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		12.700	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		8.920		2.280	0.750	0.300	µg/sample
Lab ID:		18-S2224		18-S2225			
Sample Vol:		250		100			mL

Source:	CFU 112					Sample Date:	09/13/18
Run:		2					
Client ID:		Filter + Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL		1.430	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.500		0.594	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		0.385	<	MDL	0.100	0.040	µg/sample
Chromium		1.090		0.252	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		2.390		2.320	1.250	0.500	µg/sample
Lead	<	MDL	<	MDL	1.250	0.500	µg/sample
Manganese		1.320		4.230	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		12.700	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		6.120		2.190	0.750	0.300	µg/sample
Lab ID:		18-S2226		18-S2227			
Sample Vol:		250		100			mL

Source: **CFU 112** **Sample Date: 09/13/18**

Run: **3**

Client ID:		**Filter + Front Half**		**Back Half**			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.750		0.762	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		0.357	<	MDL	0.100	0.040	µg/sample
Chromium		2.030		0.270	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		2.080		5.230	1.250	0.500	µg/sample
Lead	<	MDL	<	MDL	1.250	0.500	µg/sample
Manganese		1.440		3.090	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		15.300	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		7.360		3.080	0.750	0.300	µg/sample
Lab ID:		18-S2228		18-S2229			
Sample Vol:		250		100			mL

Source: **CFU 112**
Blank Values

Client ID:		Filter	MDL		BH Capture Soln.	MDL		FH/BH Rinse	MDL
Analyte	<	**µg/sample**	**Filter MDL µg/sample**		**5% HNO_3/ 10% H_2O_2 µg/sample**	< **5% HNO_3/ 10% H_2O_2 MDL µg/sample**	<	**0.1 N HNO_3 µg/sample**	< **0.1 N HNO_3 MDL µg/sample**
Antimony	<	MDL	1.250	<	MDL	0.500	<	MDL	1.250
Arsenic	<	MDL	1.750	<	MDL	0.700	<	MDL	1.750
Barium		2.820	0.125		0.423	0.050		0.454	0.125
Beryllium	<	MDL	0.050	<	MDL	0.020	<	MDL	0.050
Cadmium		0.365	0.100	<	MDL	0.040	<	MDL	0.100
Chromium		0.953	0.200		0.154	0.080	<	MDL	0.200
Cobalt	<	MDL	0.125	<	MDL	0.050	<	MDL	0.125
Copper	<	MDL	1.250		2.750	0.500		2.120	1.250
Lead	<	MDL	1.250	<	MDL	0.500	<	MDL	1.250
Manganese		1.030	0.075		0.980	0.030		0.206	0.075
Nickel	<	MDL	0.750	<	MDL	0.300	<	MDL	0.750
Phosphorus		13.400	5.000	<	MDL	2.000	<	MDL	5.000
Selenium	<	MDL	3.750	<	MDL	1.500	<	MDL	3.750
Zinc		1.240	0.750		0.724	0.300	<	MDL	0.750
Lab ID:		18-S2237			18-S2238			18-S2236	
Sample Vol, ml:		250			100			250	

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Species	**I Sample* FH Wash+Filter**	**II Blank* FH Wash, µg**	**III Blank* FH Filter, µg**	**IV Sample* BH Cap.Sol.**	**V Blank* BH Cap.Sol.**	**VI BH Blank* Corrected Cap.Sol.**	**VII BH Blank* Corrected Wash, µg**	**VIII Allowable BH Blank, µg**	**Species**
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	5.150	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.590	0.1816	2.820	0.614	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	0.403	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.190	< 0.0800	0.953	0.206	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.055	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	4.230	0.8480	< 1.250	2.940	0.0275	5.500	0.8480	6.348	**Copper**
Pb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.400	0.0824	1.030	0.574	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	12.700	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	8.920	< 0.3000	1.240	2.280	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2224**	**18-S2236**	**18-S2237**	**18-S2225**	**18-S2238**				
Content:	$0.1NHNO_3$	$0.1NHNO_3$	$0.1NHNO_3$	$5\%HNO_3$/	$5\%HNO_3$/	$5\%HNO_3$/	$0.1NHNO_3$		
	FH Filter & Probe Rinse			$10\%H_2O_2$	$10\%H_2O_2$	$10\%H_2O_2$			
	100ml 0.1N HNO_3 rinse			BH Imps 1&2					
		Same as BH		100ml .1N HNO_3 rinse			Same as FH		
		Blank Wash		200ml $5\%HNO_3/10\%H_2O_2$ reagent			Blank Wash		

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

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9/13/18

Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg		XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII		XV FH Net Sample, μg	Species
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.180	0.180	11.63		0.588	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.020	0.020	11.63		0.038	**Cadmium**
Cr	0.953	0.953		0.060	0.060	11.63		0.237	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.212	0.212	11.63		3.382	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	1.112	1.112		0.070	0.070	11.63		0.288	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		0.635	0.635	11.63		1.070	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.446	0.446	11.63		7.680	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

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9/13/18

Species	XVI Allowable BH Blank, μg	XVII Blank BH Total	XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of $1 \mu g$ or XIX	XXI BH Net Sample, μg	XXII FH Net Sample, μg	XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000	0.258	0.000	1.000	**5.150 <**	**1.250** <	**6.400**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.031	0.031	1.000	**0.000**	**0.588**	**0.588**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.038** <	**0.078**	**Cadmium**
Cr	0.308	0.308	0.010	0.010	1.000	**0.000**	**0.237**	**0.237**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.055 <**	**0.125** <	**0.180**	**Cobalt**
Cu	1.000	6.348	0.147	0.147	1.000	**1.940**	**3.382**	**5.322**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Lead**
Mn	1.000	2.042	0.029	0.029	1.000	**0.000**	**0.288**	**0.288**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**1.070** <	**3.070**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.114	0.114	1.000	**1.280**	**7.680**	**8.960**	**Zinc**

Allowable BH Blank Calculation:

if $1.00 \mu g$ >blank>0, use blank derived

if blank >$1.00 \mu g$, use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

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09/13/18

Species	**I** Sample* FH Wash+Filter	**II** Blank* FH Wash, µg	**III** Blank* FH Filter, µg	**IV** Sample* BH Cap.Sol.	**V** Blank* BH Cap.Sol.	**VI** BH Blank* Corrected Cap.Sol.	**VII** BH Blank* Corrected Wash, µg	**VIII** Allowable BH Blank, µg	**Species**
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	1.430	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.500	0.1816	2.820	0.594	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	0.385	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.090	< 0.0800	0.953	0.252	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	2.390	0.8480	< 1.250	2.320	0.0275	5.500	0.8480	6.348	**Copper**
Pb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.320	0.0824	1.030	4.230	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	12.700	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	6.120	< 0.3000	1.240	2.190	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2226**	**18-S2236**	**18-S2237**	**#REF!**	**18-S2238**				
Content:	0.1NHNO_3	0.1NHNO_3	0.1NHNO_3	5%HNO_3/ 10%H_2O_2	5%HNO_3/ 10%H_2O_2	5%HNO_3/ 10%H_2O_2	0.1NHNO_3		
	FH Filter & Probe Rinse			BH Imps 1&2					
	100ml 0.1N HNO_3 rinse	Same as BH Blank Wash		100ml .1N HNO_3 rinse			Same as FH Blank Wash		
				200ml 5%HNO_3/10%H_2O_2 reagent					

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

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9/13/18

Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg	XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII	XV FH Net Sample, μg	Species
Sb	0.000	0.000 <	0.063	0.000	11.63 <	1.250	**Antimony**
As	0.000	0.000 <	0.088	0.000	11.63 <	1.750	**Arsenic**
Ba	3.002	3.002	0.175	0.175	11.63	0.498	**Barium**
Be	0.000	0.000 <	0.003	0.000	11.63 <	0.050	**Beryllium**
Cd	0.365	0.365	0.019	0.019	11.63	0.020	**Cadmium**
Cr	0.953	0.953	0.055	0.055	11.63	0.137	**Chromium**
Co	0.000	0.000 <	0.006	0.000	11.63 <	0.125	**Cobalt**
Cu	0.848	0.848	0.120	0.120	11.63	1.542	**Copper**
Pb	0.000	0.000 <	0.063	0.000	11.63 <	1.250	**Lead**
Mn	1.112	1.112	0.066	0.066	11.63	0.208	**Manganese**
Ni	0.000	0.000 <	0.038	0.000	11.63 <	0.750	**Nickel**
P	11.630	13.400	0.635	0.635	11.63	1.070	**Phosphorus**
Se	0.000	0.000 <	0.188	0.000	11.63 <	3.750	**Selenium**
Zn	1.240	1.240	0.306	0.306	11.63	4.880	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

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Species	XVI Allowable BH Blank, μg	XVII Blank BH Total	XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of $1\mu g$ or XIX	XXI BH Net Sample, μg	XXII FH Net Sample, μg	XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000	0.072	0.000	1.000	**1.430 <**	**1.250** <	**2.680**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.030	0.030	1.000	**0.000**	**0.498**	**0.498**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.020** <	**0.060**	**Cadmium**
Cr	0.308	0.308	0.013	0.013	1.000	**0.000**	**0.137**	**0.137**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125** <	**0.175**	**Cobalt**
Cu	1.000	6.348	0.116	0.116	1.000	**1.320**	**1.542**	**2.862**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Lead**
Mn	1.000	2.042	0.212	0.212	1.000	**3.230**	**0.208**	**3.438**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**1.070** <	**3.070**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.110	0.110	1.000	**1.190**	**4.880**	**6.070**	**Zinc**

Allowable BH Blank Calculation:

if $1.00\mu g$ >blank>0, use blank derived

if blank >$1.00\mu g$, use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

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CFU 112

09/13/18

Species	I	II	III	IV	V	VI	VII	VIII	
	Sample*	**Blank***	**Blank***	**Sample***	**Blank***	**BH Blank***	**BH Blank***	**Allowable**	
	FH	**FH**	**FH**	**BH**	**BH**	**Corrected**	**Corrected**	**BH**	
Species	**Wash+Filter**	**Wash, µg**	**Filter, µg**	**Cap.Sol.**	**Cap.Sol.**	**Cap.Sol.**	**Wash, µg**	**Blank, µg**	**Species**
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.750	0.1816	2.820	0.762	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	0.357	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	2.030	< 0.0800	0.953	0.270	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	2.080	0.8480	< 1.250	5.230	0.0275	5.500	0.8480	6.348	**Copper**
Pb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.440	0.0824	1.030	3.090	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	15.300	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	7.360	< 0.3000	1.240	3.080	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2228**	**18-S2236**	**18-S2237**	**18-S2229**	**18-S2238**				
Content:	0.1NHNO_3	0.1NHNO_3	0.1NHNO_3	5%HNO_3/	5%HNO_3/	5%HNO_3/	0.1NHNO_3		
	FH Filter & Probe Rinse			10%H_2O_2	10%H_2O_2	10%H_2O_2			
	100ml 0.1N HNO_3 rinse			BH Imps 1&2					
		Same as BH		100ml .1N HNO_3 rinse			Same as FH		
		Blank Wash		200ml 5%HNO_3/10%H_2O_2 reagent			Blank Wash		

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

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Species	**X Allowable FH Blank, µg**	**XI FH Blank Corrected µg**		**XII 5% of FH Sample, µg**	**XIII Lessor of XI or XII**	**XIV Greater of A or XIII**		**XV FH Net Sample, µg**	Species
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.188	0.188	11.63		0.748	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.018	0.018	11.63		-0.008	**Cadmium**
Cr	0.953	0.953		0.102	0.102	11.63		1.077	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.104	0.104	11.63		1.232	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	1.112	1.112		0.072	0.072	11.63		0.328	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		0.765	0.765	11.63		3.670	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.368	0.368	11.63		6.120	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= µg A= 11.63 µg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

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CFU 112 **Method 29 Metals Blank Calculations** **Run: 3**

9/13/18

Species	XVI Allowable BH Blank, μg	XVII Blank BH Total	XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of $1\mu g$ or XIX	XXI BH Net Sample, μg	XXII FH Net Sample, μg	XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.038	0.038	1.000	**0.000**	**0.748**	**0.748**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.000** <	**0.040**	**Cadmium**
Cr	0.308	0.308	0.014	0.014	1.000	**0.000**	**1.077**	**1.077**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125** <	**0.175**	**Cobalt**
Cu	1.000	6.348	0.262	0.262	1.000	**4.230**	**1.232**	**5.462**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Lead**
Mn	1.000	2.042	0.155	0.155	1.000	**2.090**	**0.328**	**2.418**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**3.670** <	**5.670**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.154	0.154	1.000	**2.080**	**6.120**	**8.200**	**Zinc**

Allowable BH Blank Calculation:

if $1.00\mu g$ >blank>0, use blank derived

if blank >$1.00\mu g$, use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

EPA Method 29
Gas Stream Characteristics
Test Summary

Client: Hollingsworth & Vose
Source: CFU 112
Location: Corvallis, OR

Run			1	2	3	
Date			9/13/2018	9/13/2018	9/13/2018	
Run Start Time			8:45	12:16	15:44	
Run End Time			11:52	15:23	18:48	
Duration, min.			180	180	180	**Average**
Barometric Pressure, "Hg			29.84	29.84	29.84	**29.84**
Nozzle Dia., in.			0.2153	0.2153	0.2153	**0.2153**
Isokinetic Average, %			99.3	99.8	99.8	**99.6**
Sample Volume, dscf			159.666	160.816	157.853	**159.445**
Sample Volume, dscm			4.521	4.554	4.470	**4.515**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.51	0.46	0.46	**0.48**
O_2 %vd			20.00	20.05	20.14	**20.06**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.87	1.91	1.84	**1.87**
Wet Molecular Weight, lb/lb-mole			28.68	28.67	28.68	**28.68**
Velocity, FPS			73.75	75.15	74.07	**74.32**
ADCFM			21,316.1	21,711.9	21,415.2	**21,481.1**
AWCFM			21,722.3	22,134.7	21,816.6	**21,891.2**
DSCFM			17,335.3	17,381.1	17,063.3	**17,259.9**
Stack Temperature, ^oF			188.4	198.7	201.8	**196.3**
Production Data	Glass Production	lbs/hr	667.4	672.2	694.8	**678.1**

Hollingsworth & Vose **Test: M29**
CFU 112
Metals Results Summary

Run 1													
	Total				FH Net				BH Net				
Species	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	
Antimony	< 6.400	< 1.416	< 9.19E-05	< 1.38E-07	< 1.250	< 0.276	< 1.80E-05	< 2.69E-08	5.150	1.139	7.40E-05	1.11E-07	Sb
Arsenic	< 2.450	< 0.542	< 3.52E-05	< 5.27E-08	< 1.750	< 0.387	< 2.51E-05	< 3.77E-08	< 0.700	< 0.155	< 1.01E-05	< 1.51E-08	As
Barium	0.588	0.130	8.45E-06	1.27E-08	0.588	0.130	8.45E-06	1.27E-08	0.000	0.000	0.00E+00	0.00E+00	Ba
Beryllium	< 0.070	< 0.015	< 1.01E-06	< 1.51E-09	< 0.050	< 0.011	< 7.18E-07	< 1.08E-09	< 0.020	< 0.004	< 2.87E-07	< 4.30E-10	Be
Cadmium	< 0.078	< 0.017	< 1.12E-06	< 1.68E-09	0.038	0.008	5.46E-07	8.18E-10	< 0.040	< 0.009	< 5.74E-07	< 8.60E-10	Cd
Chromium	0.237	0.052	3.40E-06	5.10E-09	0.237	0.052	3.40E-06	5.10E-09	0.000	0.000	0.00E+00	0.00E+00	Cr
Cobalt	< 0.180	< 0.040	< 2.59E-06	< 3.87E-09	< 0.125	< 0.028	< 1.80E-06	< 2.69E-09	< 0.055	< 0.012	< 7.90E-07	< 1.18E-09	Co
Copper	5.322	1.177	7.64E-05	1.15E-07	3.382	0.748	4.86E-05	7.28E-08	1.940	0.429	2.79E-05	4.17E-08	Cu
Lead	< 1.750	< 0.387	< 2.51E-05	< 3.77E-08	< 1.250	< 0.276	< 1.80E-05	< 2.69E-08	< 0.500	< 0.111	< 7.18E-06	< 1.08E-08	Pb
Manganese	0.288	0.064	4.13E-06	6.19E-09	0.288	0.064	4.13E-06	6.19E-09	0.000	0.000	0.00E+00	0.00E+00	Mn
Nickel	< 1.050	< 0.232	< 1.51E-05	< 2.26E-08	< 0.750	< 0.166	< 1.08E-05	< 1.61E-08	< 0.300	< 0.066	< 4.31E-06	< 6.46E-09	Ni
Phosphorus	< 3.070	< 0.679	< 4.41E-05	< 6.61E-08	1.070	0.237	1.54E-05	2.30E-08	< 2.000	< 0.442	< 2.87E-05	< 4.30E-08	P
Selenium	< 5.250	< 1.161	< 7.54E-05	< 1.13E-07	< 3.750	< 0.829	< 5.39E-05	< 8.07E-08	< 1.500	< 0.332	< 2.15E-05	< 3.228E-08	Se
Zinc	8.960	1.982	1.29E-04	1.93E-07	7.680	1.699	1.10E-04	1.65E-07	1.280	0.283	1.84E-05	2.755E-08	Zn

Run 2													
	Total				FH Net				BH Net				
Species	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	
Antimony	< 2.680	< 0.588	< 3.83E-05	< 5.70E-08	< 1.250	< 0.274	< 1.79E-05	< 2.66E-08	1.430	0.314	2.04E-05	3.04E-08	Sb
Arsenic	< 2.450	< 0.538	< 3.50E-05	< 5.21E-08	< 1.750	< 0.384	< 2.50E-05	< 3.72E-08	< 0.700	< 0.154	< 1.00E-05	< 1.49E-08	As
Barium	0.498	0.109	7.13E-06	1.06E-08	0.498	0.109	7.13E-06	1.06E-08	0.000	0.000	0.00E+00	0.00E+00	Ba
Beryllium	< 0.070	< 0.015	< 1.00E-06	< 1.49E-09	< 0.050	< 0.011	< 7.15E-07	< 1.06E-09	< 0.020	< 0.004	< 2.86E-07	< 4.25E-10	Be
Cadmium	< 0.060	< 0.013	< 8.58E-07	< 1.28E-09	0.020	0.004	2.86E-07	4.25E-10	< 0.040	< 0.009	< 5.72E-07	< 8.51E-10	Cd
Chromium	0.137	0.030	1.96E-06	2.91E-09	0.137	0.030	1.96E-06	2.91E-09	0.000	0.000	0.00E+00	0.00E+00	Cr
Cobalt	< 0.175	< 0.038	< 2.50E-06	< 3.72E-09	< 0.125	< 0.027	< 1.79E-06	< 2.66E-09	< 0.050	< 0.011	< 7.15E-07	< 1.06E-09	Co
Copper	2.862	0.628	4.09E-05	6.09E-08	1.542	0.339	2.20E-05	3.28E-08	1.320	0.290	1.89E-05	2.81E-08	Cu
Lead	< 1.750	< 0.384	< 2.50E-05	< 3.72E-08	< 1.250	< 0.274	< 1.79E-05	< 2.66E-08	< 0.500	< 0.110	< 7.15E-06	< 1.06E-08	Pb
Manganese	3.438	0.755	4.91E-05	7.31E-08	0.208	0.046	2.97E-06	4.42E-09	3.230	0.709	4.62E-05	6.87E-08	Mn
Nickel	< 1.050	< 0.231	< 1.50E-05	< 2.23E-08	< 0.750	< 0.165	< 1.07E-05	< 1.60E-08	< 0.300	< 0.066	< 4.29E-06	< 6.38E-09	Ni
Phosphorus	< 3.070	< 0.674	< 4.39E-05	< 6.53E-08	1.070	0.235	1.53E-05	2.28E-08	< 2.000	< 0.439	< 2.86E-05	< 4.25E-08	P
Selenium	< 5.250	< 1.153	< 7.51E-05	< 1.12E-07	< 3.750	< 0.823	< 5.36E-05	< 7.98E-08	< 1.500	< 0.329	< 2.14E-05	< 3.19E-08	Se
Zinc	6.070	1.333	8.68E-05	1.29E-07	4.880	1.072	6.98E-05	1.04E-07	1.190	0.261	1.70E-05	2.53E-08	Zn

Hollingsworth & Vose **Test: M29**
CFU 112
Metals Results Summary

Run 3	Total				FH Net				BH Net				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 1.750	< 0.391	< 2.50E-05	< 3.60E-08	< 1.250	< 0.280	< 1.79E-05	< 2.57E-08	< 0.500	< 0.112	< 7.15E-06	< 1.03E-08	**Sb**
Arsenic	< 2.450	< 0.548	< 3.50E-05	< 5.04E-08	< 1.750	< 0.391	< 2.50E-05	< 3.60E-08	< 0.700	< 0.157	< 1.00E-05	< 1.44E-08	**As**
Barium	0.748	0.167	1.07E-05	1.54E-08	0.748	0.167	1.07E-05	1.54E-08	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.016	< 1.00E-06	< 1.44E-09	< 0.050	< 0.011	< 7.15E-07	< 1.03E-09	< 0.020	< 0.004	< 2.86E-07	< 4.12E-10	**Be**
Cadmium	< 0.040	< 0.009	< 5.72E-07	< 8.23E-10	0.000	0.000	0.00E+00	0.00E+00	< 0.040	< 0.009	< 5.72E-07	< 8.23E-10	**Cd**
Chromium	1.077	0.241	1.54E-05	2.22E-08	1.077	0.241	1.54E-05	2.22E-08	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.039	< 2.50E-06	< 3.60E-09	< 0.125	< 0.028	< 1.79E-06	< 2.57E-09	< 0.050	< 0.011	< 7.15E-07	< 1.03E-09	**Co**
Copper	5.462	1.222	7.81E-05	1.12E-07	1.232	0.276	1.76E-05	2.54E-08	4.230	0.946	6.05E-05	8.70E-08	**Cu**
Lead	< 1.750	< 0.391	< 2.50E-05	< 3.60E-08	< 1.250	< 0.280	< 1.79E-05	< 2.57E-08	< 0.500	< 0.112	< 7.15E-06	< 1.03E-08	**Pb**
Manganese	2.418	0.541	3.46E-05	4.98E-08	0.328	0.073	4.68E-06	6.74E-09	2.090	0.468	2.99E-05	4.30E-08	**Mn**
Nickel	< 1.050	< 0.235	< 1.50E-05	< 2.16E-08	< 0.750	< 0.168	< 1.07E-05	< 1.54E-08	< 0.300	< 0.067	< 4.29E-06	< 6.17E-09	**Ni**
Phosphorus	< 5.670	< 1.268	< 8.11E-05	< 1.17E-07	3.670	0.821	5.25E-05	7.55E-08	< 2.000	< 0.447	< 2.86E-05	< 4.12E-08	**P**
Selenium	< 5.250	< 1.174	< 7.51E-05	< 1.08E-07	< 3.750	< 0.839	< 5.36E-05	< 7.72E-08	< 1.500	< 0.336	< 2.14E-05	< 3.087E-08	**Se**
Zinc	8.200	1.834	1.17E-04	1.69E-07	6.120	1.369	8.75E-05	1.26E-07	2.080	0.465	2.97E-05	4.28E-08	**Zn**

Mean Runs 1-3	Total				FH Net				BH Net				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 3.610	< 0.799	< 5.18E-05	< 7.69E-08	< 1.250	< 0.277	< 1.79E-05	< 2.64E-08	< 2.360	< 0.522	< 3.39E-05	< 5.05E-08	**Sb**
Arsenic	< 2.450	< 0.543	< 3.51E-05	< 5.17E-08	< 1.750	< 0.388	< 2.51E-05	< 3.70E-08	< 0.700	< 0.155	< 1.00E-05	< 1.48E-08	**As**
Barium	0.612	0.136	8.76E-06	1.29E-08	0.612	0.136	8.76E-06	1.29E-08	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.016	< 1.00E-06	< 1.48E-09	< 0.050	< 0.011	< 7.16E-07	< 1.06E-09	< 0.020	< 0.004	< 2.86E-07	< 4.22E-10	**Be**
Cadmium	< 0.059	< 0.013	< 8.50E-07	< 1.26E-09	0.019	0.004	2.77E-07	4.15E-10	< 0.040	< 0.009	< 5.73E-07	< 8.45E-10	**Cd**
Chromium	0.484	0.108	6.92E-06	1.01E-08	0.484	0.108	6.92E-06	1.01E-08	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.177	< 0.039	< 2.53E-06	< 3.73E-09	< 0.125	< 0.028	< 1.79E-06	< 2.64E-09	< 0.052	< 0.011	< 7.40E-07	< 1.09E-09	**Co**
Copper	4.549	1.009	6.51E-05	9.59E-08	2.052	0.454	2.94E-05	4.36E-08	2.497	0.555	3.57E-05	5.23E-08	**Cu**
Lead	< 1.750	< 0.388	< 2.51E-05	< 3.70E-08	< 1.250	< 0.277	< 1.79E-05	< 2.64E-08	< 0.500	< 0.111	< 7.16E-06	< 1.06E-08	**Pb**
Manganese	2.048	0.453	2.93E-05	4.30E-08	0.274	0.061	3.93E-06	5.78E-09	1.773	0.392	2.54E-05	3.72E-08	**Mn**
Nickel	< 1.050	< 0.233	< 1.50E-05	< 2.22E-08	< 0.750	< 0.166	< 1.07E-05	< 1.58E-08	< 0.300	< 0.066	< 4.30E-06	< 6.34E-09	**Ni**
Phosphorus	< 3.937	< 0.874	< 5.64E-05	< 8.27E-08	1.937	0.431	2.77E-05	4.04E-08	< 2.000	< 0.443	< 2.86E-05	< 4.22E-08	**P**
Selenium	< 5.250	< 1.163	< 7.52E-05	< 1.11E-07	< 3.750	< 0.831	< 5.37E-05	< 7.92E-08	< 1.500	< 0.332	< 2.15E-05	< 3.168E-08	**Se**
Zinc	7.743	1.716	1.11E-04	1.64E-07	6.227	1.380	8.92E-05	1.32E-07	1.517	0.337	2.17E-05	3.189E-08	**Zn**
Total:	**< 33.788**	**< 7.488**	**< 4.84E-04**	**< 7.13E-07**	< 20.529	< 4.550	< 2.94E-04	< 4.33E-07	< 13.258	< 2.938	< 1.90E-04	< 2.80E-07	

‘<’ denotes results calculated using the minimum detection limit for front half or back half results that were non-detect.

EPA Methods 1-4, 29
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:45**
Source:	**CFU 112**	**End Time:**	**11:52**
Method:	**29**	**Date:**	**9/13/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.031 "Hg
   where Pb: 29.84 "Hg
   ΔH: 2.596 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.881 "Hg
   where Pb: 29.84 "Hg
   Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 159.666 dscf
   where Vm: 158.624 dcf
   Y: 0.9985
   Pm: 30.031 "Hg
   Tm: 525.5 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 3.035 scf
   where H_2O: 64.50 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0187
   where Vw(std): 3.035 scf
   Vm(std): 159.666 dscf

6) $\% H_2O = Bws \times 100 =$ 1.87 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 200.152 awcf
   where Y: 0.9985
   Vm: 158.6239 dcf
   Bws: 0.0187
   Ts: 648.4 °A
   Tm: 525.5 °A
   Pm: 30.031 "Hg
   Ps: 29.881 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.88 lb/lb-mole
   where CO_2: 0.51 %vd
   O_2 20.00 %vd
   $N_2+CO= (100-(O_2+CO_2)$: 79.49 %vd

9) $M_s = M_d(1 - Bws) + (18 \times Bws) =$ 28.68 lb/lb-mole

where M_d:	28.88	lb/lb-mole
Bws:	0.0187	

10) $\text{Stack Area(cir.)} = 3.1416\,(\text{stack diameter}/24)^2 =$ 4.909 sq. ft.

where Stack ID:	30	inches

$\text{Stack Area(rect.)} =$ stack width/12 x stack length/12 = NA sq. ft.

where Stack Width:	0.000	inches
Stack Length:	0.000	inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 73.75 fps

where Cp:	0.84	
Ave. Sqrt ΔP:	1.1807	
Ts:	648.4	°A
Ps:	29.881	"Hg
Ms:	28.68	lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 21,722.3 AWCFM

where V_s:	73.75	ft/sec
Stack Area:	4.909	sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 21,316.1 ADCFM

where AWCFM:	21,722.3	
Bws:	0.0187	

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ \text{"Hg}}\right) =$ 1,059,941.8 wscf/hr

where V_s:	73.75	ft/sec
Stack Area:	4.9090	sq. ft.
Ts:	648.4	°A
Ps:	29.881	"Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,040,120.9 dscf/hr

where wscf/hr:	1,059,941.8	
Bws:	0.0187	

16) DSCFM= (dscf/hr)/60 mins/hr = 17,335.3 DSCFM

where dscf/hr:	1,040,120.9	

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000253 sq. ft.

where Nozzle Size:	0.2153	inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 99.3 %

where Ts:	648.4	°A
Vm(Std):	159.666	dscf
Ps:	29.881	"Hg
Vs	73.75	ft/sec
Nozzle Area:	0.000253	sq. ft.
Sampling Time:	180	min.
Bws:	0.0187	

EPA Method 29:
Chromium

19) Cr Laboratory Results (blank corrected)

Front half (FH):	0.237	µg/sample
Back half (BH):	0.000	µg/sample
Total (FH + BH):	0.237	µg/sample

20) Cs = µg/Vm(std) = 0.052 µg/dscm

where Run 1 Total:	0.237	µg/sample
Vm(std):	4.521	dscm

21) Emission Rate = (Cs)($\frac{2.83168\ m^3}{ft^3}$)(stack flow)($\frac{2.2046E-9\ lb}{\mu g}$)= 3.40E-06 lb/hr

where Cs:	0.052	µg/dscm
Stack Flow:	1,040,120.9	dscf/hr

BISON
ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112**
DATE(S)	**09/13/18**
METHOD	**30B**
POLLUTANT	**Mercury**

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:45**
Source:	**CFU 112**	**End Time:**	**11:52**
EPA Method:	**30B**	**Start Date:**	**9/13/2018**
Box Operator:	**CMF**	**End Date:**	**9/13/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.84	"Hg
Test duration:	180	min

Equipment:

	Side A	Side B	
Probe ID:	HLN 30B		
Probe heat:	267 F		
Meterbox ID:	HLN Duel #2	HLN Duel #2	
Y factor:	1.0460	1.0380	
Desired sampling rate:	2	2	lpm
Trap ID#:	OL498459	OL462285	
Spiked @:	0	5	ng
Orifice # (if used):			

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	15
Train leak rate, lpm	0.002	0.003	0.000	0.012

Test Summary:

	Side A	Side B	
Sample Volume:	360.051	360.044	L
Ave. Meter Temp:	75.8	79.1	°F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	**Side A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0	0.000	0.000	186	186	55	55	6	5	266	268	2.000	2.000
5	9.710	9.730	186	186	55	56	7	5	268	268	1.942	1.946
10	19.930	19.910	187	187	57	58	7	5	268	267	2.044	2.036
15	30.090	30.090	187	187	59	61	7	5	266	268	2.032	2.036
20	40.340	40.310	187	187	61	63	7	5	266	268	2.050	2.044
25	50.660	50.620	188	188	64	67	7	5	266	268	2.064	2.062
30	60.600	60.590	188	188	65	68	7	5	266	268	1.988	1.994
35	70.590	70.610	188	188	67	70	7	5	267	268	1.998	2.004
40	80.610	80.590	188	188	69	73	7	5	266	268	2.004	1.996
45	90.540	90.530	189	189	70	74	7	5	266	268	1.986	1.988
50	100.500	100.530	189	189	72	76	7	5	266	268	1.992	2.000
55	110.480	110.490	189	189	73	77	7	5	266	268	1.996	1.992
60	120.270	120.280	189	189	75	79	7	5	266	267	1.958	1.958
65	130.020	130.010	189	189	76	80	7	5	266	268	1.950	1.946
70	139.890	139.910	189	189	77	80	7	5	266	268	1.974	1.980
75	149.750	149.780	187	187	78	82	7	5	266	268	1.972	1.974
80	159.290	159.300	184	184	79	83	9	5	267	268	1.908	1.904
85	169.620	169.580	182	182	80	83	7	5	267	268	2.066	2.056
90	180.049	180.049	181	181	80	84	7	5	267	268	2.086	2.094
95	190.440	190.490	182	182	80	83	7	6	266	268	2.078	2.088
100	200.460	200.440	187	187	80	83	7	6	266	268	2.004	1.990
105	210.250	210.230	188	188	80	84	7	5	266	268	1.958	1.958
110	220.270	220.220	188	188	81	84	7	6	267	267	2.004	1.998
115	230.480	230.480	188	188	81	85	7	6	266	267	2.042	2.052
120	240.730	240.730	189	189	82	85	7	6	266	268	2.050	2.050
125	250.780	250.770	190	190	83	86	7	6	267	268	2.010	2.008
130	260.490	260.510	190	190	83	86	7	6	267	267	1.942	1.948
135	270.200	270.210	191	191	83	87	7	6	266	268	1.942	1.940
140	279.900	279.890	191	191	83	87	7	6	266	268	1.940	1.936
145	289.660	289.680	192	192	83	87	7	6	266	268	1.952	1.958
150	299.670	299.690	193	193	84	88	7	6	266	268	2.002	2.002
155	309.680	309.700	193	193	84	88	8	6	266	268	2.002	2.002
160	319.890	319.910	194	194	85	88	8	6	266	268	2.042	2.042
165	330.170	330.170	194	194	85	89	8	6	266	268	2.056	2.052
170	340.430	340.400	195	195	85	89	8	6	266	268	2.052	2.046
175	350.440	350.420	195	195	86	90	7	6	266	268	2.002	2.004
180	360.051	360.044	195	195	86	90	7	6	266	268	1.922	1.925

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:16**
Source:	**CFU 112**	**End Time:**	**15:23**
EPA Method:	**30B**	**Start Date:**	**9/13/2018**
Box Operator:	**CMF**	**End Date:**	**9/13/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.84	"Hg
Test duration:	180	min

Equipment:

	Side A	Side B	
Probe ID:	HLN 30B		
Probe heat:	267		F
Meterbox ID:	HLN Duel #2	HLN Duel #2	
Y factor:	1.0460	1.0380	
Desired sampling rate:	2	2	lpm
Trap ID#:	OL498470	OLC047431	
Spiked @:	0	5	ng
Orifice # (if used):			

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	21	20	19
Train leak rate, lpm	0.001	0.002	0.000	0.002

Test Summary:

	Side A	Side B	
Sample Volume:	360.010	360.066	L
Ave. Meter Temp:	88	91.6	°F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	**Side A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0	0.000	0.000	196	196	83	86	9	6	266	268	2.000	2.000
5	10.190	10.180	196	196	83	86	9	6	266	268	2.038	2.036
10	20.350	20.330	197	197	83	85	9	6	266	268	2.032	2.030
15	30.300	30.310	196	196	83	86	8	6	266	268	1.990	1.996
20	40.250	40.150	196	196	83	86	8	6	266	268	1.990	1.968
25	50.390	50.440	196	196	83	86	8	6	266	268	2.028	2.058
30	60.590	60.580	197	197	83	86	8	6	266	268	2.040	2.028
35	70.770	70.800	197	197	85	88	9	7	266	268	2.036	2.044
40	80.970	80.840	197	197	86	89	9	7	266	268	2.040	2.008
45	91.020	91.020	197	197	86	89	9	7	266	268	2.010	2.036
50	100.630	100.620	196	196	86	89	8	6	266	268	1.922	1.920
55	110.220	110.240	196	196	87	91	8	6	266	268	1.918	1.924
60	120.010	120.020	196	196	87	91	8	6	266	268	1.958	1.956
65	129.430	129.440	197	197	87	91	8	6	266	268	1.884	1.884
70	139.120	139.110	199	199	87	91	8	6	266	268	1.938	1.934
75	148.990	148.990	199	199	88	92	8	6	267	268	1.974	1.976
80	159.250	159.250	199	199	89	92	9	7	267	268	2.052	2.052
85	169.550	169.590	200	200	89	93	9	7	266	268	2.060	2.068
90	179.920	179.937	200	200	89	93	9	7	266	268	2.074	2.069
95	190.070	190.090	199	199	89	92	9	7	266	268	2.030	2.031
100	200.240	200.230	198	198	89	92	9	7	266	268	2.034	2.028
105	210.430	210.430	199	199	89	93	9	7	266	268	2.038	2.040
110	220.630	220.620	199	199	89	93	9	7	266	268	2.040	2.038
115	230.730	230.750	199	199	89	93	9	7	266	268	2.020	2.026
120	240.920	240.940	199	199	90	93	9	7	266	268	2.038	2.038
125	251.010	251.010	200	200	90	93	9	7	266	268	2.018	2.014
130	261.160	261.140	201	201	90	94	9	7	266	268	2.030	2.026
135	271.090	271.090	201	201	91	94	9	7	266	268	1.986	1.990
140	281.060	281.060	201	201	91	95	9	7	266	268	1.994	1.994
145	290.970	290.960	201	201	91	95	9	7	266	268	1.982	1.980
150	300.920	300.930	201	201	91	95	9	7	266	268	1.990	1.994
155	310.830	310.840	201	201	91	96	9	7	266	268	1.982	1.982
160	320.740	320.740	201	201	92	96	9	7	266	268	1.982	1.980
165	330.790	330.780	201	201	92	96	9	7	266	268	2.010	2.008
170	340.780	340.790	201	201	92	96	9	7	266	268	1.998	2.002
175	350.470	350.460	203	203	92	96	9	7	266	268	1.938	1.934
180	360.010	360.066	203	203	92	96	9	7	266	268	1.908	1.921

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**15:44**
Source:	**CFU 112**	**End Time:**	**18:48**
EPA Method:	**30B**	**Start Date:**	**9/13/2018**
Box Operator:	**CMF**	**End Date:**	**9/13/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.84 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN 30B	
Probe heat:	267 F	
Meterbox ID:	HLN Duel #2	HLN Duel #2
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498430	OL462275
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	20	21	20	20
Train leak rate, lpm	0.000	0.000	0.001	0.002

Test Summary:

	Side A	Side B
Sample Volume:	360.682	360.689 L
Ave. Meter Temp:	78.7	80.9 °F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	**Side A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0	0.000	0.000	201	201	86	87	7	6	266	269	2.000	2.000
5	10.050	10.040	201	201	81	84	7	6	266	268	2.010	2.008
10	20.420	20.420	201	201	81	83	7	6	266	268	2.074	2.076
15	30.240	30.240	201	201	81	83	7	6	266	268	1.964	1.964
20	40.060	40.110	201	201	80	82	7	6	266	268	1.964	1.974
25	49.930	49.930	201	201	80	82	7	6	266	268	1.974	1.964
30	59.890	59.890	200	200	80	81	7	6	266	268	1.992	1.992
35	70.010	69.990	201	201	80	81	7	6	266	268	2.024	2.020
40	79.760	79.770	200	200	79	81	7	6	266	268	1.950	1.956
45	89.670	89.670	201	201	79	81	7	6	266	268	1.982	1.980
50	99.590	99.590	202	202	79	81	7	6	266	268	1.984	1.984
55	109.490	109.490	203	203	78	81	7	6	266	268	1.980	1.980
60	119.390	119.400	203	203	78	81	7	6	266	268	1.980	1.982
65	129.370	129.370	203	203	78	81	7	6	266	268	1.996	1.994
70	139.390	139.410	203	203	78	81	7	6	266	268	2.004	2.008
75	149.570	149.630	203	203	78	80	7	6	266	268	2.036	2.044
80	159.780	159.770	203	203	78	81	7	6	266	268	2.042	2.028
85	170.030	170.010	203	203	78	81	7	6	266	268	2.050	2.048
90	180.236	180.214	203	203	78	81	7	6	266	268	2.041	2.041
95	190.690	190.670	201	201	78	80	7	6	266	268	2.091	2.091
100	200.830	200.830	201	201	78	80	7	6	266	268	2.028	2.032
105	211.090	211.100	202	202	78	80	7	6	266	268	2.052	2.054
110	220.980	220.920	202	202	78	80	7	6	266	268	1.978	1.964
115	230.900	230.930	202	202	77	80	7	6	266	268	1.984	2.002
120	240.860	240.850	202	202	78	80	7	6	266	268	1.992	1.984
125	250.840	250.830	202	202	78	80	7	6	266	268	1.996	1.996
130	260.610	260.690	202	202	78	80	7	6	266	268	1.954	1.972
135	270.870	270.890	202	202	78	80	7	6	266	268	2.052	2.040
140	280.460	280.490	202	202	78	80	7	6	266	268	1.918	1.920
145	289.980	289.970	202	202	78	80	7	6	266	268	1.904	1.896
150	299.820	299.820	202	202	78	80	7	6	266	268	1.968	1.970
155	310.070	310.050	201	201	78	80	7	6	266	268	2.050	2.046
160	320.310	310.350	202	202	78	80	7	6	266	268	2.048	0.060
165	330.560	330.570	202	202	78	80	7	6	266	268	2.050	4.044
170	340.830	340.850	202	202	78	80	7	6	266	268	2.054	2.056
175	350.780	350.730	202	202	78	80	7	6	266	268	1.990	1.976
180	360.682	360.689	202	202	78	80	7	6	266	268	1.980	1.992

Method 30B
Mercury Concentration

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112
Test date: 9/13/2018

Meterbox Y:
Side A 1.0460
Side B 1.0380

Run	Sample	Sample Date	Trap ID	Spiked @ ng	Section 1 ng	Section 2 ng	Total Hg ng	Total Hg μg	DGM reading L	Sample volume (corrected for Y) L	Bp "Hg	Meter Temp. °F	Sample Vol. dscm	Hg Conc. μg/dscm	Ave. Pair Hg Conc. μg/dscm
1	A	9/13/2018	OL498459	0.0	8.1	0.8	8.9	8.90E-03	360.051	376.613	29.84	75.8	0.370	2.40E-02	2.26E-02
	B		OL462285	5.0	12.1	0.6	7.7	7.70E-03	360.044	373.726		79.1	0.365	2.11E-02	
2	A	9/13/2018	OL498470	0.0	6.9	0.5	7.4	7.40E-03	360.010	376.570	29.84	88.0	0.362	2.05E-02	2.06E-02
	B		OLC047431	5.0	11.8	0.6	7.4	7.40E-03	360.066	373.749		91.6	0.357	2.07E-02	
3	A	9/13/2018	OL498430	0.0	4.8	0.8	5.6	5.60E-03	360.682	377.273	29.84	78.7	0.369	1.52E-02	1.49E-02
	B		OL462275	5.0	9.9	0.4	5.3	5.30E-03	360.689	374.395		80.9	0.364	1.45E-02	

Average: 1.93E-02

Trap Concentrations Example Calculations:
Run 1, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 8.9 ng
   where Section 1: 8.1 ng
   Section 2: 0.8 ng
   Spike: 0.0 ng

2. Conversion to μg — Total Hg ng/1000 = 8.90E-03 μg
   where Total Hg ng: 8.9 ng

3. Corrected sample volume = DGM reading x Meterbox Y factor = 376.613 L
   where DGM reading: 360.051 L
   Y: 1.046

4. Standard Volume (DSCM) = Sample Vol. (L) x $\left(\frac{528\,°A}{Tm+460}\right)$x Bp/29.92 "Hg /1000 = 0.370 DSCM
   where Sample vol.: 376.613 L
   T_m: 75.8 °F
   B_p: 29.84 "Hg

5. Hg concentration μg/dscm = Total Hg μg / Volume DSCM = 0.024 μg/dscm
   where Total Hg: 8.90E-03 μg
   DSCM: 0.370

6. Average Pair Concentration = (Side A Conc.+ Side B Conc.)/2 = 0.023 μg/dscm
   where Side A: 0.024 μg/dscm
   Side B: 0.021 μg/dscm

Method 30B
Results QA/QC

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112
Test date: 9/13/2018
Test type: C [C for compliance; R for RATA]

Run	**Sample**	**Sample Date**	**Trap ID**	**Spiked @** ng	**Section 1** ng	**Section 2** ng	**Total Hg** ng	**Hg Conc.** µg/dscm	**Breakthr.** %	**Breakthr. Results** PASS/FAIL	C_{rec}. Spiked Compound µg/dscm	**Spiked Hg Recovery R Value** %	**RD Paired Traps** %	**Paired Trap Agree.** PASS/FAIL
1	A	9/13/2018	OL498459	0	8.1	0.8	8.9	2.40E-02	9.9	PASS	0.011	78.4	6.54	PASS
	B		OL462285	5	12.1	0.6	7.7	2.11E-02	5.0	PASS				
2	A	9/13/2018	OL498470	0	6.9	0.5	7.4	2.05E-02	7.2	PASS	0.014	102.1	0.70	PASS
	B		OLC047431	5	11.8	0.6	7.4	2.07E-02	5.1	PASS				
3	A	9/13/2018	OL498430	0	4.8	0.8	5.6	1.52E-02	16.7	PASS	0.013	95.3	2.17	PASS
	B		OL462275	5	9.9	0.4	5.3	1.45E-02	4.0	PASS				

1. Breakthrough Critera

Every sample must meet the following critera for breakthrough % from Section 1 to Section 2.

$$Breakthrough\,\% = \frac{Section\ 2\ ng}{Section\ 1\ ng} x100$$ Eq. 30B-2

Allowable Breakthrough %	Compliance Testing (µg/dscm)	RATA (µg/dscm)
10	> 1	> 1
20	≤1	≤1; >0.5
50	Hg conc. ≤30% of emission limit	≤0.5; >0.1

RM average: 0.019342252 µg/dscm

2. Field Recovery Test Field Recovery 3-run Average (%): 91.9 PASS

Determines the fraction of spiked Hg recovered (R). Perform for at least three runs per field test. Average of three runs must be between 85 and 115%

$$Crec = \frac{mass\ spiked\ (\mu g)}{Volume\ spiked\ (dscm)} - \frac{mass\ unspiked\ (\mu g)}{Volume\ unspiked\ (dscm)}$$ Eq. 30B-6

$$R = \frac{Crec\ (\frac{\mu g}{dscm})\ x\ vol.spiked\ (dscm)}{mass\ spiked\ (\mu g)} x100$$ Eq. 30B-7

3. Paired trap agreement

$$RD = \frac{|Conc.Trap\ A - Conc.Trap\ B|}{Conc.Trap\ A + Conc.Trap\ B} x100$$ Eq. 30B-5

If paired trains meet the relative deviation (RD) and other QA requirements, the average of the two Hg concs. may be used as an emissions test run value or as the reference method value for a RATA run.

Allowable Relative Dev. %	For Hg conc. (µg/dscm)
10	> 1
20	≤1
or ≤0.2 ug/dscm absolute difference in Hg concs.	≤1

M30B Table 9-1

Method 30B
Emission Calculations

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112
Test date: 9/13/2018

	Ave. Pair Hg Conc.	Hg Conc.	Stack Flow*	Glass Production	Stack Emissions	
Run	µg/dscm	lb/dscf	dscf/hr	lb/hr	lb/hr	lb/lb glass produced
1	2.26E-02	1.41E-12	1,040,120.9	667.4	1.47E-06	2.20E-09
2	2.06E-02	1.29E-12	1,042,867.3	672.2	1.34E-06	1.99E-09
3	1.49E-02	9.28E-13	1,023,795.3	694.8	9.50E-07	1.37E-09
Average Results:	1.93E-02	1.21E-12	1,035,594.5	678.1	1.25E-06	1.85E-09

*From direct stack measurements made during concurrent M29 runs

Daily Gaseous Calibrations Log

Client: H&V ✓

Source: CFU-112 - M29/30B (1)

Date: 09/13/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	0	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

*Use of a calibrated instrument required

see 9/11/18 Data

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X			0	X				
10	X			2	X				
20	✓			4	✓				

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0						0			
10						2			

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run #1

Test Times: R-1 08:45 - 11:52 R-2 12:16 - 15:23 R-3 15:44 - 18:48

Post - pass

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 112**
Facility	**Glass Plant 1**	Date	**September 13, 2018**
Location	**Corvallis, OR**		

Run	1	2	3	
Date	9/13/2018	9/13/2018	9/13/2018	
Run Start Time	8:45	12:16	15:44	
Run End Time	11:52	15:23	18:48	
CO_2 %vd	0.51	0.46	0.46	0.48
O_2 %vd	20.00	20.05	20.14	20.07

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU 112**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 13, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			Final Values								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.08	0.02	-0.30	pass	0.15	0.35	pass	0.65	pass				
	upscale	9.99	10.01	0.10	pass	9.88	-0.53	pass	-0.63	pass	20	19.80	20.00	10
Run 2	zero	0.08	0.15	0.35	pass	-0.11	-0.98	pass	-1.33	pass				
	upscale	9.99	9.88	-0.53	pass	9.74	-1.23	pass	-0.70	pass	20	19.65	20.05	10
Run 3	zero	0.08	-0.11	-0.98	pass	-0.12	-1.02	pass	-0.03	pass				
	upscale	9.99	9.74	-1.23	pass	9.69	-1.47	pass	-0.23	pass	20	19.69	20.14	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0.08	9.99	20.10
Analyzer Cal. Error	0.42	-0.07	0.48
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU 112**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 13, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
	zero	0.16	0.19	0.75	pass	0.28	2.92	pass	2.17	pass				
Run 1	upscale	1.87	1.91	0.92	pass	2.08	5.17	pass	4.25	pass	4	0.68	0.51	2
	zero	0.16	0.28	2.92	pass	0.27	2.75	pass	-0.17	pass				
Run 2	upscale	1.87	2.08	5.17	pass	2.06	4.67	pass	-0.50	pass	4	0.69	0.46	2
	zero	0.16	0.27	2.75	pass	0.28	3.08	pass	0.33	pass				
Run 3	upscale	1.87	2.06	4.67	pass	2.07	4.83	pass	0.17	pass	4	0.69	0.46	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0.16	1.87	3.91
Analyzer Cal. Error	4.00	-3.17	-2.33
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:45**
Source:	**CFU 112**	**End Time:**	**11:52**
Method:	**3A**	**Date:**	**9/13/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.07 %v

where C_{Dir}:	9.99	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.10 %v

where C_{Dir}:	9.99	ppmv
C_S:	10.01	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.63 %v

where SB_{Final}:	-0.53	ppmv
SB_i:	0.10	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 20.00 ppmv

where C_{Avg}:	19.80	ppmv
C_O:	0.09	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.94	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:45**
Source:	**CFU 112**	**End Time:**	**11:52**
Method:	**3A**	**Date:**	**9/13/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -3.17 %v

where C_{Dir}:	1.87	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.92 %v

where C_{Dir}:	1.87	ppmv
C_S:	1.91	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 4.25 %v

where SB_{Final}:	5.17	ppmv
SB_i:	0.92	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.51 ppmv

where C_{Avg}:	0.68	ppmv
C_O:	0.23	ppmv
C_{MA}:	2.00	ppmv
C_M:	2.00	ppmv

Hollingswoth & Vose
CFU #112
Daily Calibrations

Date	Time	O2 [%]	CO2 [%]
9/13/2018	7:26:03	18.67	0.23
9/13/2018	7:26:13	18.34	0.29
9/13/2018	7:26:23	2.63	0.20
9/13/2018	7:26:33	0.17	0.18
9/13/2018	7:26:43	0.11	0.18
9/13/2018	7:26:53	0.10	0.17
9/13/2018	7:27:03	0.09	0.18
9/13/2018	7:27:13	0.08	0.17
9/13/2018	7:27:23	0.09	0.16
9/13/2018	7:27:33	0.08	0.17
9/13/2018	7:27:43	0.08	0.17
9/13/2018	7:27:53	0.07	0.16
9/13/2018	7:28:03	0.07	0.16
9/13/2018	7:28:13	0.07	0.17
9/13/2018	7:28:23	0.07	0.16
9/13/2018	7:28:33	0.09	0.17
9/13/2018	7:28:43	0.09	0.15
9/13/2018	7:28:53	0.07	0.14
9/13/2018	7:29:03	0.06	0.16
9/13/2018	7:29:13	0.06	0.15
9/13/2018	7:29:23	0.06	0.15
9/13/2018	7:29:33	1.05	0.49
9/13/2018	7:29:43	10.60	13.77
9/13/2018	7:29:53	12.29	14.05
9/13/2018	7:30:03	13.45	13.53
9/13/2018	7:30:13	14.12	13.03
9/13/2018	7:30:23	14.40	12.64
9/13/2018	7:30:33	19.14	14.29
9/13/2018	7:30:43	20.32	18.26
9/13/2018	7:30:53	20.41	18.34
9/13/2018	7:31:03	20.09	19.12
9/13/2018	7:31:13	20.04	19.67
9/13/2018	7:31:23	20.29	19.70
9/13/2018	7:31:33	20.14	19.71
9/13/2018	7:31:43	20.10	19.71
9/13/2018	7:31:53	20.09	19.71
9/13/2018	7:32:03	20.10	19.72
9/13/2018	7:32:13	19.49	19.70
9/13/2018	7:32:23	18.14	16.74
9/13/2018	7:32:33	10.00	9.57
9/13/2018	7:32:43	9.97	9.92

Hollingswoth & Vose
CFU #112
Daily Calibrations

Date	Time	O2 [%]	CO2 [%]
9/13/2018	7:32:53	10.00	9.94
9/13/2018	7:33:03	9.99	9.94
9/13/2018	7:33:13	10.12	9.93
9/13/2018	7:33:23	6.02	5.40
9/13/2018	7:33:33	4.16	4.37
9/13/2018	7:33:43	4.04	4.22
9/13/2018	7:33:53	4.03	3.96
9/13/2018	7:34:03	4.02	3.92
9/13/2018	7:34:13	4.02	3.91
9/13/2018	7:34:23	4.01	3.91
9/13/2018	7:34:33	4.01	3.90
9/13/2018	7:34:43	4.01	3.89
9/13/2018	7:34:53	3.21	2.85
9/13/2018	7:35:03	1.93	1.80
9/13/2018	7:35:13	2.01	1.87
9/13/2018	7:35:23	2.02	1.88
9/13/2018	7:35:33	2.02	1.87
9/13/2018	7:35:43	2.02	1.87
9/13/2018	7:35:53	2.03	1.88

	O2 [%]	CO2 [%]
Analyzer Zero	**0.08**	**0.16**
Analyzer Mid	**9.99**	**1.87**
Analyzer High	**20.10**	**3.91**

System

9/13/2018	7:42:13	0.74	0.19
9/13/2018	7:42:23	0.64	0.19
9/13/2018	7:42:33	0.59	0.19
9/13/2018	7:42:43	0.56	0.19
9/13/2018	7:42:53	0.36	0.19
9/13/2018	7:43:03	0.04	0.18
9/13/2018	7:43:13	0.01	0.20
9/13/2018	7:43:23	0.01	0.19
9/13/2018	7:43:33	0.03	0.19
9/13/2018	7:43:43	0.03	0.19
9/13/2018	7:43:53	0.02	0.19
9/13/2018	7:44:03	0.03	0.19
9/13/2018	7:44:13	1.45	1.48
9/13/2018	7:44:23	5.45	5.44
9/13/2018	7:44:33	7.66	7.27
9/13/2018	7:44:43	8.68	8.10

Hollingswoth & Vose
CFU #112
Daily Calibrations

Date	Time	O2 [%]	CO2 [%]
9/13/2018	7:44:53	9.15	8.51
9/13/2018	7:45:03	9.38	8.70
9/13/2018	7:45:13	9.48	8.79
9/13/2018	7:45:23	9.53	8.84
9/13/2018	7:45:33	9.56	8.87
9/13/2018	7:45:43	9.57	8.88
9/13/2018	7:45:53	9.58	8.89
9/13/2018	7:46:03	9.57	8.90
9/13/2018	7:46:13	9.58	8.89
9/13/2018	7:46:23	10.17	8.32
9/13/2018	7:46:33	10.09	8.54
9/13/2018	7:46:43	9.83	8.74
9/13/2018	7:46:53	9.82	8.82
9/13/2018	7:47:03	9.96	8.87
9/13/2018	7:47:13	10.02	8.90
9/13/2018	7:47:23	10.00	8.92
9/13/2018	7:47:33	10.00	8.91
9/13/2018	7:47:43	9.68	8.56
9/13/2018	7:47:53	6.14	5.29
9/13/2018	7:48:03	3.72	3.38
9/13/2018	7:48:13	2.91	2.65
9/13/2018	7:48:23	2.53	2.27
9/13/2018	7:48:33	2.35	2.08
9/13/2018	7:48:43	2.27	1.98
9/13/2018	7:48:53	2.23	1.93
9/13/2018	7:49:03	2.21	1.92
9/13/2018	7:49:13	2.20	1.91
9/13/2018	7:49:23	2.20	1.90

	O2 [%]	CO2 [%]
System Zero	**0.02**	**0.19**
System Mid	**10.01**	**1.91**

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]
9/13/2018	8:45:15	19.87	0.66
9/13/2018	8:46:15	19.87	0.66
9/13/2018	8:47:15	19.87	0.66
9/13/2018	8:48:15	19.86	0.65
9/13/2018	8:49:15	19.86	0.66
9/13/2018	8:50:15	19.86	0.66
9/13/2018	8:51:15	19.85	0.66
9/13/2018	8:52:15	19.85	0.65
9/13/2018	8:53:15	19.85	0.66
9/13/2018	8:54:15	19.85	0.65
9/13/2018	8:55:15	19.85	0.66
9/13/2018	8:56:15	19.85	0.65
9/13/2018	8:57:15	19.85	0.66
9/13/2018	8:58:15	19.85	0.66
9/13/2018	8:59:15	19.85	0.66
9/13/2018	9:00:15	19.85	0.66
9/13/2018	9:01:15	19.84	0.66
9/13/2018	9:02:15	19.84	0.67
9/13/2018	9:03:15	19.84	0.67
9/13/2018	9:04:15	19.83	0.68
9/13/2018	9:05:15	19.84	0.67
9/13/2018	9:06:15	19.84	0.67
9/13/2018	9:07:15	19.84	0.67
9/13/2018	9:08:15	19.84	0.67
9/13/2018	9:09:15	19.83	0.67
9/13/2018	9:10:15	19.83	0.67
9/13/2018	9:11:15	19.83	0.67
9/13/2018	9:12:15	19.82	0.66
9/13/2018	9:13:15	19.84	0.66
9/13/2018	9:14:15	19.83	0.67
9/13/2018	9:15:15	19.83	0.66
9/13/2018	9:16:15	19.82	0.66
9/13/2018	9:17:15	19.82	0.66
9/13/2018	9:18:15	19.82	0.66
9/13/2018	9:19:15	19.82	0.66
9/13/2018	9:20:15	19.83	0.66
9/13/2018	9:21:15	19.83	0.66
9/13/2018	9:22:15	19.83	0.66
9/13/2018	9:23:15	19.83	0.66
9/13/2018	9:24:15	19.82	0.66
9/13/2018	9:25:15	19.83	0.66

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]
9/13/2018	9:26:15	19.82	0.67
9/13/2018	9:27:15	19.82	1.30
9/13/2018	9:28:15	19.83	0.73
9/13/2018	9:29:15	19.82	0.67
9/13/2018	9:30:15	19.82	0.67
9/13/2018	9:31:15	19.82	0.67
9/13/2018	9:32:15	19.82	0.67
9/13/2018	9:33:15	19.82	0.67
9/13/2018	9:34:15	19.82	0.68
9/13/2018	9:35:15	19.82	0.67
9/13/2018	9:36:15	19.81	0.68
9/13/2018	9:37:15	19.81	0.68
9/13/2018	9:38:15	19.82	0.68
9/13/2018	9:39:15	19.81	0.68
9/13/2018	9:40:15	19.81	0.67
9/13/2018	9:41:15	19.81	0.68
9/13/2018	9:42:15	19.81	0.68
9/13/2018	9:43:15	19.81	0.67
9/13/2018	9:44:15	19.80	0.68
9/13/2018	9:45:15	19.81	0.67
9/13/2018	9:46:15	19.81	0.66
9/13/2018	9:47:15	19.81	0.66
9/13/2018	9:48:15	19.81	0.67
9/13/2018	9:49:15	19.81	0.67
9/13/2018	9:50:15	19.81	0.67
9/13/2018	9:51:15	19.81	0.67
9/13/2018	9:52:15	19.81	0.66
9/13/2018	9:53:15	19.81	0.67
9/13/2018	9:54:15	19.80	0.67
9/13/2018	9:55:15	19.80	0.67
9/13/2018	9:56:15	19.81	0.67
9/13/2018	9:57:15	19.81	0.68
9/13/2018	9:58:15	19.81	0.67
9/13/2018	9:59:15	19.81	0.68
9/13/2018	10:00:15	19.81	0.67
9/13/2018	10:01:15	19.81	0.68
9/13/2018	10:02:15	19.81	0.68
9/13/2018	10:03:15	19.82	0.68
9/13/2018	10:04:15	19.81	0.68
9/13/2018	10:05:15	19.81	0.68
9/13/2018	10:06:15	19.81	0.67

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]
9/13/2018	10:07:15	19.81	0.67
9/13/2018	10:08:15	19.81	0.67
9/13/2018	10:09:15	19.81	0.68
9/13/2018	10:10:15	19.80	0.67
9/13/2018	10:11:15	19.81	0.67
9/13/2018	10:12:15	19.80	0.67
9/13/2018	10:13:15	19.80	0.67
9/13/2018	10:14:15	19.80	0.66
9/13/2018	10:15:15	19.79	0.67
9/13/2018	10:16:15	19.80	0.67
9/13/2018	10:17:15	19.79	0.67
9/13/2018	10:18:15	19.79	0.67
9/13/2018	10:19:15	19.79	0.67
9/13/2018	10:20:15	19.79	0.67
9/13/2018	10:21:15	19.79	0.67
9/13/2018	10:22:15	19.79	0.68
9/13/2018	10:23:15	19.79	0.67
9/13/2018	10:24:15	19.79	0.68
9/13/2018	10:25:15	19.79	0.68
9/13/2018	10:26:15	19.80	0.68
9/13/2018	10:27:15	19.79	0.68
9/13/2018	10:28:15	19.79	0.68
9/13/2018	10:29:15	19.80	0.68
9/13/2018	10:30:15	19.79	0.68
9/13/2018	10:31:15	19.79	0.69
9/13/2018	10:32:15	19.79	0.69
9/13/2018	10:33:15	19.79	0.69
9/13/2018	10:34:15	19.79	0.68
9/13/2018	10:35:15	19.79	0.69
9/13/2018	10:36:15	19.79	0.68
9/13/2018	10:37:15	19.80	0.68
9/13/2018	10:38:15	19.79	0.68
9/13/2018	10:39:15	19.79	0.68
9/13/2018	10:40:15	19.79	0.68
9/13/2018	10:41:15	19.80	0.68
9/13/2018	10:42:15	19.79	0.67
9/13/2018	10:43:15	19.79	0.67
9/13/2018	10:44:15	19.80	0.67
9/13/2018	10:45:15	19.79	0.67
9/13/2018	10:46:15	19.80	0.67
9/13/2018	10:47:15	19.80	0.67

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]
9/13/2018	10:48:15	19.79	0.68
9/13/2018	10:49:15	19.79	0.67
9/13/2018	10:50:15	19.79	0.68
9/13/2018	10:51:15	19.79	0.68
9/13/2018	10:52:15	19.79	0.68
9/13/2018	10:53:15	19.80	0.67
9/13/2018	10:54:15	19.79	0.68
9/13/2018	10:55:15	19.79	0.68
9/13/2018	10:56:15	19.79	0.69
9/13/2018	10:57:15	19.79	0.69
9/13/2018	10:58:15	19.78	0.69
9/13/2018	10:59:15	19.79	0.69
9/13/2018	11:00:15	19.78	0.82
9/13/2018	11:01:15	19.78	0.72
9/13/2018	11:02:15	19.78	0.69
9/13/2018	11:03:15	19.79	0.69
9/13/2018	11:04:15	19.79	0.68
9/13/2018	11:05:15	19.79	0.68
9/13/2018	11:06:15	19.79	0.68
9/13/2018	11:07:15	19.79	0.68
9/13/2018	11:08:15	19.78	0.68
9/13/2018	11:09:15	19.78	0.68
9/13/2018	11:10:15	19.78	0.68
9/13/2018	11:11:15	19.78	0.68
9/13/2018	11:12:15	19.78	0.68
9/13/2018	11:13:15	19.78	0.68
9/13/2018	11:14:15	19.78	0.68
9/13/2018	11:15:15	19.79	0.67
9/13/2018	11:16:15	19.79	0.67
9/13/2018	11:17:15	19.79	0.68
9/13/2018	11:18:15	19.79	0.68
9/13/2018	11:19:15	19.79	0.68
9/13/2018	11:20:15	19.78	0.68
9/13/2018	11:21:15	19.78	0.68
9/13/2018	11:22:15	19.79	0.69
9/13/2018	11:23:15	19.79	0.68
9/13/2018	11:24:15	19.79	0.68
9/13/2018	11:25:15	19.78	0.69
9/13/2018	11:26:15	19.78	0.69
9/13/2018	11:27:15	19.78	0.69
9/13/2018	11:28:15	19.79	0.69

Hollingswoth & Vose
CFU #112
Run #1

Date	**Time**	**O2 [%]**	**CO2 [%]**
9/13/2018	11:29:15	19.79	0.69
9/13/2018	11:30:15	19.79	0.78
9/13/2018	11:31:15	19.78	0.69
9/13/2018	11:32:15	19.78	0.69
9/13/2018	11:33:15	19.78	0.69
9/13/2018	11:34:15	19.78	0.69
9/13/2018	11:35:15	19.78	0.69
9/13/2018	11:36:15	19.77	0.69
9/13/2018	11:37:15	19.78	0.68
9/13/2018	11:38:15	19.79	0.68
9/13/2018	11:39:15	19.78	0.68
9/13/2018	11:40:15	19.79	0.67
9/13/2018	11:41:15	19.78	0.68
9/13/2018	11:42:15	19.78	0.68
9/13/2018	11:43:15	19.78	0.68
9/13/2018	11:44:15	19.79	0.67
9/13/2018	11:45:15	19.78	0.68
9/13/2018	11:46:15	19.77	0.68
9/13/2018	11:47:15	19.78	0.68
9/13/2018	11:48:15	19.78	0.68
9/13/2018	11:49:15	19.78	0.68
9/13/2018	11:50:15	19.78	0.68
9/13/2018	11:51:15	19.66	0.69
9/13/2018	11:52:15	19.79	0.71
Final Average		**19.80**	**0.68**

Bias Check

Date	**Time**	**O2 [%]**	**CO2 [%]**
9/13/2018	11:53:05	19.78	0.68
9/13/2018	11:53:15	19.78	0.68
9/13/2018	11:53:25	19.78	0.69
9/13/2018	11:53:35	19.78	0.69
9/13/2018	11:53:45	19.84	0.69
9/13/2018	11:53:55	14.32	0.63
9/13/2018	11:54:05	5.19	0.41
9/13/2018	11:54:15	1.77	0.33
9/13/2018	11:54:25	0.68	0.30
9/13/2018	11:54:35	0.33	0.29
9/13/2018	11:54:45	0.22	0.29
9/13/2018	11:54:55	0.18	0.29
9/13/2018	11:55:05	0.16	0.28

Hollingswoth & Vose
CFU #112
Run #1

Date	Time	O2 [%]	CO2 [%]
9/13/2018	11:55:15	0.15	0.28
9/13/2018	11:55:25	0.15	0.27
9/13/2018	11:55:35	0.15	0.28
9/13/2018	11:55:45	0.14	0.29
9/13/2018	11:55:55	0.23	0.38
9/13/2018	11:56:05	1.23	1.29
9/13/2018	11:56:15	1.79	1.75
9/13/2018	11:56:25	1.95	1.93
9/13/2018	11:56:35	2.00	2.01
9/13/2018	11:56:45	2.01	2.05
9/13/2018	11:56:55	2.02	2.05
9/13/2018	11:57:05	2.02	2.08
9/13/2018	11:57:15	2.02	2.08
9/13/2018	11:57:25	2.02	2.08
9/13/2018	11:57:35	2.05	2.07
9/13/2018	11:57:45	4.57	4.68
9/13/2018	11:57:55	8.13	8.29
9/13/2018	11:58:05	9.30	9.32
9/13/2018	11:58:15	9.68	9.66
9/13/2018	11:58:25	9.80	9.77
9/13/2018	11:58:35	9.85	9.81
9/13/2018	11:58:45	9.87	9.83
9/13/2018	11:58:55	9.87	9.84
9/13/2018	11:59:05	9.87	9.85
9/13/2018	11:59:15	9.87	9.86
9/13/2018	11:59:25	9.88	9.86
9/13/2018	11:59:35	9.88	9.86
9/13/2018	11:59:45	9.88	9.86
9/13/2018	11:59:55	9.88	9.87
9/13/2018	12:00:05	10.38	9.40
9/13/2018	12:00:15	15.09	4.93
9/13/2018	12:00:25	18.11	2.07
9/13/2018	12:00:35	19.19	1.20
9/13/2018	12:00:45	19.55	0.92
9/13/2018	12:00:55	19.67	0.80
9/13/2018	12:01:05	19.72	0.76

	O2 [%]	CO2 [%]
System Zero	**0.15**	**0.28**
System Mid	**9.88**	**2.08**

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/13/2018	12:16:15	19.78	0.73
9/13/2018	12:17:15	19.77	0.68
9/13/2018	12:18:15	19.77	0.69
9/13/2018	12:19:15	19.76	0.72
9/13/2018	12:20:15	19.76	0.69
9/13/2018	12:21:15	19.76	0.70
9/13/2018	12:22:15	19.76	0.70
9/13/2018	12:23:15	19.77	0.69
9/13/2018	12:24:15	19.76	0.70
9/13/2018	12:25:15	19.77	0.70
9/13/2018	12:26:15	19.76	0.70
9/13/2018	12:27:15	19.76	0.69
9/13/2018	12:28:15	19.77	0.69
9/13/2018	12:29:15	19.76	0.70
9/13/2018	12:30:15	19.76	0.69
9/13/2018	12:31:15	19.77	0.69
9/13/2018	12:32:15	19.77	0.69
9/13/2018	12:33:15	19.77	0.68
9/13/2018	12:34:15	19.76	0.68
9/13/2018	12:35:15	19.76	0.68
9/13/2018	12:36:15	19.77	0.68
9/13/2018	12:37:15	19.76	0.68
9/13/2018	12:38:15	19.76	0.68
9/13/2018	12:39:15	19.76	0.68
9/13/2018	12:40:15	19.76	0.68
9/13/2018	12:41:15	19.75	0.69
9/13/2018	12:42:15	19.75	0.69
9/13/2018	12:43:15	19.77	0.68
9/13/2018	12:44:15	19.76	0.68
9/13/2018	12:45:15	19.75	0.69
9/13/2018	12:46:15	19.76	0.69
9/13/2018	12:47:15	19.76	0.69
9/13/2018	12:48:15	19.76	0.69
9/13/2018	12:49:15	19.76	0.70
9/13/2018	12:50:15	19.76	0.69
9/13/2018	12:51:15	19.76	0.70
9/13/2018	12:52:15	19.75	0.70
9/13/2018	12:53:15	19.76	0.70
9/13/2018	12:54:15	19.76	0.70
9/13/2018	12:55:15	19.75	0.70
9/13/2018	12:56:15	19.76	0.69

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/13/2018	12:57:15	19.75	0.69
9/13/2018	12:58:15	19.75	0.69
9/13/2018	12:59:15	19.76	0.69
9/13/2018	13:00:15	19.76	0.69
9/13/2018	13:01:15	19.77	0.68
9/13/2018	13:02:15	19.77	0.68
9/13/2018	13:03:15	19.76	0.68
9/13/2018	13:04:15	19.76	0.68
9/13/2018	13:05:15	19.76	0.68
9/13/2018	13:06:15	19.77	0.68
9/13/2018	13:07:15	19.76	0.69
9/13/2018	13:08:15	19.77	0.68
9/13/2018	13:09:15	19.77	0.68
9/13/2018	13:10:15	19.77	0.68
9/13/2018	13:11:15	19.77	0.68
9/13/2018	13:12:15	19.76	0.68
9/13/2018	13:13:15	19.77	0.68
9/13/2018	13:14:15	19.76	0.69
9/13/2018	13:15:15	19.76	0.69
9/13/2018	13:16:15	19.76	0.69
9/13/2018	13:17:15	19.76	0.70
9/13/2018	13:18:15	19.76	0.70
9/13/2018	13:19:15	19.76	0.70
9/13/2018	13:20:15	19.75	0.70
9/13/2018	13:21:15	19.76	0.70
9/13/2018	13:22:15	19.76	0.70
9/13/2018	13:23:15	19.76	0.70
9/13/2018	13:24:15	19.76	0.69
9/13/2018	13:25:15	19.76	0.69
9/13/2018	13:26:15	19.76	0.69
9/13/2018	13:27:15	19.76	0.69
9/13/2018	13:28:15	19.76	0.69
9/13/2018	13:29:15	19.76	0.68
9/13/2018	13:30:15	19.75	0.69
9/13/2018	13:31:15	19.76	0.68
9/13/2018	13:32:15	19.75	0.69
9/13/2018	13:33:15	19.76	0.68
9/13/2018	13:34:15	19.76	0.68
9/13/2018	13:35:15	19.76	0.68
9/13/2018	13:36:15	19.76	0.68
9/13/2018	13:37:15	19.75	0.68

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/13/2018	13:38:15	19.75	0.69
9/13/2018	13:39:15	19.76	0.68
9/13/2018	13:40:15	19.75	0.69
9/13/2018	13:41:15	19.76	0.69
9/13/2018	13:42:15	19.76	0.69
9/13/2018	13:43:15	19.76	0.69
9/13/2018	13:44:15	19.56	0.69
9/13/2018	13:45:15	19.49	0.70
9/13/2018	13:46:15	19.49	0.70
9/13/2018	13:47:15	19.49	0.69
9/13/2018	13:48:15	19.49	0.69
9/13/2018	13:49:15	19.49	0.70
9/13/2018	13:50:15	19.49	0.70
9/13/2018	13:51:15	19.48	0.70
9/13/2018	13:52:15	19.49	0.69
9/13/2018	13:53:15	19.48	0.69
9/13/2018	13:54:15	19.49	0.69
9/13/2018	13:55:15	19.49	0.69
9/13/2018	13:56:15	19.49	0.69
9/13/2018	13:57:15	19.49	0.69
9/13/2018	13:58:15	19.48	0.69
9/13/2018	13:59:15	19.49	0.68
9/13/2018	14:00:15	19.48	0.68
9/13/2018	14:01:15	19.49	0.68
9/13/2018	14:02:15	19.48	0.69
9/13/2018	14:03:15	19.48	0.68
9/13/2018	14:04:15	19.49	0.68
9/13/2018	14:05:15	19.49	0.68
9/13/2018	14:06:15	19.49	0.68
9/13/2018	14:07:15	19.52	0.68
9/13/2018	14:08:15	19.58	0.69
9/13/2018	14:09:15	19.58	0.68
9/13/2018	14:10:15	19.58	0.69
9/13/2018	14:11:15	19.58	0.69
9/13/2018	14:12:15	19.58	0.69
9/13/2018	14:13:15	19.57	0.70
9/13/2018	14:14:15	19.57	0.70
9/13/2018	14:15:15	19.58	0.70
9/13/2018	14:16:15	19.58	0.70
9/13/2018	14:17:15	19.58	0.69
9/13/2018	14:18:15	19.58	0.69

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/13/2018	14:19:15	19.58	0.70
9/13/2018	14:20:15	19.57	0.70
9/13/2018	14:21:15	19.57	0.70
9/13/2018	14:22:15	19.58	0.69
9/13/2018	14:23:15	19.57	0.69
9/13/2018	14:24:15	19.57	0.69
9/13/2018	14:25:15	19.58	0.69
9/13/2018	14:26:15	19.57	0.69
9/13/2018	14:27:15	19.58	0.69
9/13/2018	14:28:15	19.58	0.68
9/13/2018	14:29:15	19.57	0.69
9/13/2018	14:30:15	19.58	0.68
9/13/2018	14:31:15	19.58	0.68
9/13/2018	14:32:15	19.58	0.68
9/13/2018	14:33:15	19.58	0.68
9/13/2018	14:34:15	19.58	0.69
9/13/2018	14:35:15	19.58	0.69
9/13/2018	14:36:15	19.58	0.69
9/13/2018	14:37:15	19.58	0.69
9/13/2018	14:38:15	19.58	0.69
9/13/2018	14:39:15	19.58	0.69
9/13/2018	14:40:15	19.58	0.69
9/13/2018	14:41:15	19.58	0.70
9/13/2018	14:42:15	19.58	0.70
9/13/2018	14:43:15	19.56	0.70
9/13/2018	14:44:15	19.57	0.70
9/13/2018	14:45:15	19.57	0.70
9/13/2018	14:46:15	19.57	0.70
9/13/2018	14:47:15	19.58	0.69
9/13/2018	14:48:15	19.57	0.70
9/13/2018	14:49:15	19.57	0.70
9/13/2018	14:50:15	19.58	0.71
9/13/2018	14:51:15	19.57	0.71
9/13/2018	14:52:15	19.57	0.71
9/13/2018	14:53:15	19.57	0.70
9/13/2018	14:54:15	19.57	0.70
9/13/2018	14:55:15	19.58	0.69
9/13/2018	14:56:15	19.57	0.69
9/13/2018	14:57:15	19.58	0.69
9/13/2018	14:58:15	19.57	0.69
9/13/2018	14:59:15	19.56	0.69

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/13/2018	15:00:15	19.57	0.69
9/13/2018	15:01:15	19.57	0.69
9/13/2018	15:02:15	19.58	0.69
9/13/2018	15:03:15	19.58	0.69
9/13/2018	15:04:15	19.57	0.69
9/13/2018	15:05:15	19.57	0.69
9/13/2018	15:06:15	19.57	0.70
9/13/2018	15:07:15	19.57	0.70
9/13/2018	15:08:15	19.57	0.70
9/13/2018	15:09:15	19.57	0.70
9/13/2018	15:10:15	19.57	0.70
9/13/2018	15:11:15	19.57	0.70
9/13/2018	15:12:15	19.57	0.70
9/13/2018	15:13:15	19.57	0.70
9/13/2018	15:14:15	19.57	0.70
9/13/2018	15:15:15	19.58	0.70
9/13/2018	15:16:15	19.57	0.70
9/13/2018	15:17:15	19.57	0.70
9/13/2018	15:18:15	19.58	0.69
9/13/2018	15:19:15	19.57	0.70
9/13/2018	15:20:15	19.57	0.69
9/13/2018	15:21:15	19.57	0.69
9/13/2018	15:22:15	19.57	0.70
9/13/2018	15:23:15	19.43	0.76
Final Average		**19.65**	**0.69**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/13/2018	15:24:05	18.69	1.15
9/13/2018	15:24:15	9.91	1.20
9/13/2018	15:24:25	3.23	0.61
9/13/2018	15:24:35	0.98	0.39
9/13/2018	15:24:45	0.26	0.32
9/13/2018	15:24:55	0.01	0.29
9/13/2018	15:25:05	-0.07	0.28
9/13/2018	15:25:15	-0.10	0.28
9/13/2018	15:25:25	-0.11	0.27
9/13/2018	15:25:35	-0.11	0.27
9/13/2018	15:25:45	-0.12	0.27
9/13/2018	15:25:55	-0.12	0.27
9/13/2018	15:26:05	0.57	0.96

Hollingswoth & Vose
CFU #112
Run #2

Date	Time	O2 [%]	CO2 [%]
9/13/2018	15:26:15	1.39	1.62
9/13/2018	15:26:25	1.65	1.87
9/13/2018	15:26:35	1.72	1.98
9/13/2018	15:26:45	1.75	2.03
9/13/2018	15:26:55	1.75	2.05
9/13/2018	15:27:05	1.75	2.06
9/13/2018	15:27:15	1.76	2.06
9/13/2018	15:27:25	1.75	2.06
9/13/2018	15:27:35	1.76	2.08
9/13/2018	15:27:45	1.76	2.09
9/13/2018	15:27:55	2.91	3.12
9/13/2018	15:28:05	7.05	7.54
9/13/2018	15:28:15	8.79	9.06
9/13/2018	15:28:25	9.35	9.56
9/13/2018	15:28:35	9.54	9.72
9/13/2018	15:28:45	9.60	9.80
9/13/2018	15:28:55	9.63	9.82
9/13/2018	15:29:05	9.63	9.84
9/13/2018	15:29:15	9.64	9.85
9/13/2018	15:29:25	9.64	9.85
9/13/2018	15:29:35	9.64	9.85
9/13/2018	15:29:45	9.65	9.86
9/13/2018	15:29:55	9.65	9.86
9/13/2018	15:30:05	9.65	9.86
9/13/2018	15:30:15	9.67	9.86
9/13/2018	15:30:25	9.70	9.86
9/13/2018	15:30:35	9.74	9.87
9/13/2018	15:30:45	9.74	9.88
9/13/2018	15:30:55	9.74	9.88
9/13/2018	15:31:05	9.73	9.88
9/13/2018	15:31:15	12.11	7.67
9/13/2018	15:31:25	16.79	3.34
9/13/2018	15:31:35	18.70	1.56
9/13/2018	15:31:45	19.37	1.06
9/13/2018	15:31:55	19.60	0.87
9/13/2018	15:32:05	19.67	0.79
9/13/2018	15:32:15	19.70	0.77

	O2 [%]	CO2 [%]
System Zero	**-0.11**	**0.27**
System Mid	**9.74**	**2.06**

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/13/2018	15:44:15	19.75	0.70
9/13/2018	15:45:15	19.74	0.71
9/13/2018	15:46:15	19.75	0.70
9/13/2018	15:47:15	19.75	0.70
9/13/2018	15:48:15	19.75	0.70
9/13/2018	15:49:15	19.75	0.69
9/13/2018	15:50:15	19.74	0.70
9/13/2018	15:51:15	19.74	0.69
9/13/2018	15:52:15	19.74	0.69
9/13/2018	15:53:15	19.74	0.69
9/13/2018	15:54:15	19.75	0.69
9/13/2018	15:55:15	19.74	0.69
9/13/2018	15:56:15	19.74	0.69
9/13/2018	15:57:15	19.74	0.70
9/13/2018	15:58:15	19.74	0.70
9/13/2018	15:59:15	19.75	0.69
9/13/2018	16:00:15	19.75	0.70
9/13/2018	16:01:15	19.75	0.70
9/13/2018	16:02:15	19.74	0.71
9/13/2018	16:03:15	19.74	0.71
9/13/2018	16:04:15	19.74	0.71
9/13/2018	16:05:15	19.74	0.71
9/13/2018	16:06:15	19.67	0.71
9/13/2018	16:07:15	19.66	0.71
9/13/2018	16:08:15	19.66	0.70
9/13/2018	16:09:15	19.67	0.71
9/13/2018	16:10:15	19.66	0.71
9/13/2018	16:11:15	19.67	0.70
9/13/2018	16:12:15	19.66	0.70
9/13/2018	16:13:15	19.66	0.70
9/13/2018	16:14:15	19.66	0.70
9/13/2018	16:15:15	19.66	0.70
9/13/2018	16:16:15	19.66	0.69
9/13/2018	16:17:15	19.66	0.69
9/13/2018	16:18:15	19.66	0.69
9/13/2018	16:19:15	19.67	0.69
9/13/2018	16:20:15	19.66	0.69
9/13/2018	16:21:15	19.66	0.70
9/13/2018	16:22:15	19.67	0.70
9/13/2018	16:23:15	19.67	0.69
9/13/2018	16:24:15	19.67	0.70

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/13/2018	16:25:15	19.67	0.70
9/13/2018	16:26:15	19.67	0.70
9/13/2018	16:27:15	19.67	0.70
9/13/2018	16:28:15	19.67	0.70
9/13/2018	16:29:15	19.67	0.70
9/13/2018	16:30:15	19.67	0.71
9/13/2018	16:31:15	19.68	0.71
9/13/2018	16:32:15	19.68	0.71
9/13/2018	16:33:15	19.67	0.71
9/13/2018	16:34:15	19.68	0.70
9/13/2018	16:35:15	19.67	0.70
9/13/2018	16:36:15	19.68	0.70
9/13/2018	16:37:15	19.68	0.70
9/13/2018	16:38:15	19.68	0.70
9/13/2018	16:39:15	19.67	0.70
9/13/2018	16:40:15	19.67	0.70
9/13/2018	16:41:15	19.68	0.70
9/13/2018	16:42:15	19.67	0.69
9/13/2018	16:43:15	19.68	0.69
9/13/2018	16:44:15	19.68	0.68
9/13/2018	16:45:15	19.68	0.69
9/13/2018	16:46:15	19.68	0.69
9/13/2018	16:47:15	19.68	0.69
9/13/2018	16:48:15	19.60	0.69
9/13/2018	16:49:15	19.68	0.69
9/13/2018	16:50:15	19.68	0.69
9/13/2018	16:51:15	19.68	0.69
9/13/2018	16:52:15	19.68	0.69
9/13/2018	16:53:15	19.68	0.70
9/13/2018	16:54:15	19.68	0.70
9/13/2018	16:55:15	19.68	0.70
9/13/2018	16:56:15	19.68	0.70
9/13/2018	16:57:15	19.68	0.71
9/13/2018	16:58:15	19.68	0.71
9/13/2018	16:59:15	19.68	0.71
9/13/2018	17:00:15	19.68	0.71
9/13/2018	17:01:15	19.68	0.71
9/13/2018	17:02:15	19.68	0.70
9/13/2018	17:03:15	19.68	0.70
9/13/2018	17:04:15	19.68	0.70
9/13/2018	17:05:15	19.68	0.70

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/13/2018	17:06:15	19.68	0.71
9/13/2018	17:07:15	19.68	0.70
9/13/2018	17:08:15	19.68	0.71
9/13/2018	17:09:15	19.68	0.70
9/13/2018	17:10:15	19.68	0.70
9/13/2018	17:11:15	19.68	0.69
9/13/2018	17:12:15	19.68	0.69
9/13/2018	17:13:15	19.68	0.69
9/13/2018	17:14:15	19.68	0.69
9/13/2018	17:15:15	19.71	0.68
9/13/2018	17:16:15	19.69	0.69
9/13/2018	17:17:15	19.69	0.69
9/13/2018	17:18:15	19.69	0.69
9/13/2018	17:19:15	19.69	0.69
9/13/2018	17:20:15	19.69	0.69
9/13/2018	17:21:15	19.69	0.69
9/13/2018	17:22:15	19.69	0.69
9/13/2018	17:23:15	19.69	0.69
9/13/2018	17:24:15	19.69	0.69
9/13/2018	17:25:15	19.69	0.70
9/13/2018	17:26:15	19.68	0.70
9/13/2018	17:27:15	19.68	0.70
9/13/2018	17:28:15	19.68	0.70
9/13/2018	17:29:15	19.68	0.70
9/13/2018	17:30:15	19.69	0.69
9/13/2018	17:31:15	19.68	0.70
9/13/2018	17:32:15	19.68	0.70
9/13/2018	17:33:15	19.68	0.70
9/13/2018	17:34:15	19.69	0.69
9/13/2018	17:35:15	19.69	0.69
9/13/2018	17:36:15	19.68	0.69
9/13/2018	17:37:15	19.68	0.69
9/13/2018	17:38:15	19.68	0.68
9/13/2018	17:39:15	19.68	0.69
9/13/2018	17:40:15	19.68	0.68
9/13/2018	17:41:15	19.68	0.68
9/13/2018	17:42:15	19.69	0.68
9/13/2018	17:43:15	19.69	0.68
9/13/2018	17:44:15	19.68	0.68
9/13/2018	17:45:15	19.68	0.69
9/13/2018	17:46:15	19.68	0.68

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/13/2018	17:47:15	19.68	0.68
9/13/2018	17:48:15	19.68	0.69
9/13/2018	17:49:15	19.68	0.69
9/13/2018	17:50:15	19.69	0.68
9/13/2018	17:51:15	19.69	0.69
9/13/2018	17:52:15	19.69	0.69
9/13/2018	17:53:15	19.69	0.69
9/13/2018	17:54:15	19.69	0.70
9/13/2018	17:55:15	19.69	0.69
9/13/2018	17:56:15	19.68	0.70
9/13/2018	17:57:15	19.68	0.70
9/13/2018	17:58:15	19.69	0.69
9/13/2018	17:59:15	19.68	0.70
9/13/2018	18:00:15	19.68	0.70
9/13/2018	18:01:15	19.68	0.69
9/13/2018	18:02:15	19.68	0.69
9/13/2018	18:03:15	19.69	0.69
9/13/2018	18:04:15	19.68	0.69
9/13/2018	18:05:15	19.68	0.68
9/13/2018	18:06:15	19.68	0.68
9/13/2018	18:07:15	19.68	0.68
9/13/2018	18:08:15	19.69	0.68
9/13/2018	18:09:15	19.68	0.68
9/13/2018	18:10:15	19.68	0.68
9/13/2018	18:11:15	19.68	0.68
9/13/2018	18:12:15	19.68	0.68
9/13/2018	18:13:15	19.68	0.68
9/13/2018	18:14:15	19.68	0.69
9/13/2018	18:15:15	19.68	0.69
9/13/2018	18:16:15	19.69	0.69
9/13/2018	18:17:15	19.68	0.69
9/13/2018	18:18:15	19.68	0.69
9/13/2018	18:19:15	19.68	0.69
9/13/2018	18:20:15	19.68	0.70
9/13/2018	18:21:15	19.69	0.69
9/13/2018	18:22:15	19.68	0.70
9/13/2018	18:23:15	19.69	0.69
9/13/2018	18:24:15	19.68	0.70
9/13/2018	18:25:15	19.68	0.69
9/13/2018	18:26:15	19.69	0.69
9/13/2018	18:27:15	19.68	0.70

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/13/2018	18:28:15	19.69	0.69
9/13/2018	18:29:15	19.69	0.69
9/13/2018	18:30:15	19.68	0.69
9/13/2018	18:31:15	19.69	0.68
9/13/2018	18:32:15	19.69	0.68
9/13/2018	18:33:15	19.69	0.68
9/13/2018	18:34:15	19.68	0.68
9/13/2018	18:35:15	19.68	0.69
9/13/2018	18:36:15	19.68	0.69
9/13/2018	18:37:15	19.68	0.68
9/13/2018	18:38:15	19.69	0.68
9/13/2018	18:39:15	19.69	0.68
9/13/2018	18:40:15	19.69	0.68
9/13/2018	18:41:15	19.69	0.68
9/13/2018	18:42:15	19.68	0.69
9/13/2018	18:43:15	19.69	0.68
9/13/2018	18:44:15	19.69	0.69
9/13/2018	18:45:15	19.69	0.69
9/13/2018	18:46:15	19.70	0.68
9/13/2018	18:47:15	19.69	0.69
9/13/2018	18:48:15	19.70	0.70
Final Average		**19.69**	**0.69**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/13/2018	18:51:15	19.70	0.69
9/13/2018	18:51:25	19.69	0.69
9/13/2018	18:51:35	19.69	0.69
9/13/2018	18:51:45	19.69	0.69
9/13/2018	18:51:55	19.73	0.68
9/13/2018	18:52:05	17.93	1.24
9/13/2018	18:52:15	8.04	1.04
9/13/2018	18:52:25	2.55	0.56
9/13/2018	18:52:35	0.76	0.38
9/13/2018	18:52:45	0.18	0.32
9/13/2018	18:52:55	-0.01	0.30
9/13/2018	18:53:05	-0.08	0.29
9/13/2018	18:53:15	-0.10	0.29
9/13/2018	18:53:25	-0.11	0.29
9/13/2018	18:53:35	-0.12	0.29
9/13/2018	18:53:45	-0.12	0.28

Hollingswoth & Vose
CFU #112
Run #3

Date	Time	O2 [%]	CO2 [%]
9/13/2018	18:53:55	-0.12	0.28
9/13/2018	18:54:05	0.26	0.69
9/13/2018	18:54:15	1.26	1.51
9/13/2018	18:54:25	1.61	1.84
9/13/2018	18:54:35	1.71	1.97
9/13/2018	18:54:45	1.75	2.04
9/13/2018	18:54:55	1.76	2.06
9/13/2018	18:55:05	1.77	2.07
9/13/2018	18:55:15	1.76	2.07
9/13/2018	18:55:25	1.76	2.08
9/13/2018	18:55:35	1.79	2.08
9/13/2018	18:55:45	4.26	4.62
9/13/2018	18:55:55	7.88	8.24
9/13/2018	18:56:05	9.08	9.30
9/13/2018	18:56:15	9.48	9.64
9/13/2018	18:56:25	9.61	9.77
9/13/2018	18:56:35	9.66	9.81
9/13/2018	18:56:45	9.68	9.84
9/13/2018	18:56:55	9.68	9.85
9/13/2018	18:57:05	9.69	9.85
9/13/2018	18:57:15	9.69	9.86
9/13/2018	18:57:25	9.69	9.86
9/13/2018	18:57:35	9.70	9.86
9/13/2018	18:57:45	9.70	9.87
9/13/2018	18:57:55	9.68	9.87
		O2 [%]	**CO2 [%]**
System Zero		**-0.12**	**0.28**
System Mid		**9.69**	**2.07**

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112 (2)**
DATE	**09/14/18**
METHOD	**M29**
POLLUTANT	**Metals**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**9:35**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**13:02**
EPA Method:	**M29**	Partly cloudy, 65 degrees	**Date:**	**9/14/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type	Glass	
Y factor	0.9985	Nozzle ID	0.216	Nozzle size	0.2153	inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000253	sq.ft.
		Pitot Cp	0.84	Probe heat	250	F
				Filter heat	250	F

Source Information:

Barometric Pressure	29.75 "Hg	O_2	19.80 %	
Static Pressure	0.56 "H_2O	CO_2	0.70 %	
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.201	inches
Stack Temperature	190 F			
Assumed moisture	2 %			
Assumed meter temp.	69 F			
Total number of points	24			
Time per point	7.5			
Total run time	180			

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	11	6

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	157.499 dcf	Ave. ΔP	1.388 "H_2O
Wet mol. weight	28.71 M_s (actual)	Ave. √ΔP	1.1776 "H_2O
Actual H_2O	1.76 %	Ave. ΔH	2.567 "H_2O
Std. meter vol.	158.803 dscf	Ave. T_s	191.1 °F
Isokinetic Average	99.4 %	Ave. T_m	63 °F

Moisture/Lab:

Filter	Run 1 #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	238.4	273.8	35.4
		Total water gain:	60.4

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	7.5	6.290	1.40	191	52	2.52	2.50	2	253	42
2	15.0	12.900	1.50	194	53	2.70	2.70	2.5	252	46
3	22.5	19.480	1.40	185	53	2.55	2.60	2.5	252	46
4	30.0	26.400	1.50	171	54	2.80	2.80	3	255	45
5	37.5	32.950	1.40	177	54	2.59	2.60	2.5	251	45
6	45.0	39.410	1.40	181	55	2.58	2.60	2.5	253	45
7	52.5	46.020	1.40	183	57	2.58	2.60	3	253	49
8	60.0	52.400	1.30	184	58	2.40	2.40	3	252	52
9	67.5	58.910	1.40	186	61	2.59	2.60	3	255	52
10	75.0	65.270	1.30	188	63	2.40	2.40	3	250	53
11	82.5	71.640	1.30	190	64	2.40	2.40	3	253	53
12	90.0	78.009	1.30	191	65	2.40	2.40	3	250	54
13	97.5	84.380	1.30	193	64	2.39	2.40	3	252	56
14	105.0	90.950	1.40	194	64	2.57	2.60	3	254	47
15	112.5	97.570	1.40	195	65	2.57	2.60	3	253	48
16	120.0	104.430	1.50	197	65	2.75	2.80	3	254	50
17	127.5	111.340	1.50	198	67	2.75	2.80	3	254	51
18	135.0	117.950	1.40	196	68	2.58	2.60	3	252	54
19	142.5	124.610	1.40	196	69	2.59	2.60	3	253	55
20	150.0	131.270	1.40	197	70	2.59	2.60	3	254	53
21	157.5	137.960	1.40	198	72	2.59	2.60	3	253	53
22	165.0	144.610	1.40	200	72	2.59	2.60	3	255	54
23	172.5	151.050	1.30	201	73	2.40	2.40	3	254	55
24	180.0	157.499	1.30	201	73	2.40	2.40	3	254	55

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:20**
Source:	**CFU 112 (2)**	**End Time:**	**16:25**
EPA Method:	**M29**	**Date:**	**9/14/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Partly cloudy, 65 degrees

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.216	Nozzle size:	0.2153 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000253 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.75 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.202 inches
Stack Temperature	190 F		
Assumed moisture	1.76 %		
Assumed meter temp.	63 F		
Total number of points	24		
Time per point	7.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	15	6

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	162.309 dcf	Ave. ΔP	1.396 "H_2O
Wet mol. weight	28.71 M_s (actual)	Ave. √ΔP	1.1811 "H_2O
Actual H_2O	1.7 %	Ave. ΔH	2.592 "H_2O
Std. meter vol.	159.338 dscf	Ave. T_s	204.7 °F
Isokinetic Average	100.4 %	Ave. T_m	77.2 °F

Moisture/Lab:

Filter	Run2 #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	246.6	280.3	33.7
		Total water gain:	58.7

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	7.5	6.430	1.30	201	71	2.40	2.40	2.5	255	59
2	15.0	13.090	1.40	200	72	2.60	2.60	3	254	48
3	22.5	20.040	1.50	203	72	2.77	2.80	3	253	48
4	30.0	26.920	1.50	203	72	2.77	2.80	3	254	48
5	37.5	34.030	1.50	204	73	2.77	2.80	3	255	48
6	45.0	40.850	1.40	204	73	2.59	2.60	3	252	50
7	52.5	47.590	1.40	204	75	2.60	2.60	3	251	50
8	60.0	54.320	1.40	205	76	2.60	2.60	3	247	50
9	67.5	61.120	1.40	206	77	2.60	2.60	3	252	52
10	75.0	68.040	1.40	207	78	2.60	2.60	3	254	53
11	82.5	74.550	1.30	208	79	2.41	2.40	3	251	53
12	90.0	81.027	1.30	208	79	2.41	2.40	3	253	54
13	97.5	87.840	1.40	207	79	2.60	2.60	3	254	62
14	105.0	94.750	1.40	208	79	2.60	2.60	3	253	53
15	112.5	101.600	1.40	207	80	2.61	2.60	3	253	54
16	120.0	108.630	1.50	206	80	2.80	2.80	3	253	54
17	127.5	115.730	1.50	206	80	2.80	2.80	3	253	55
18	135.0	122.250	1.30	205	80	2.43	2.40	2.5	253	55
19	142.5	128.790	1.30	204	80	2.43	2.40	2.5	253	56
20	150.0	135.540	1.40	205	80	2.62	2.60	3	253	56
21	157.5	142.300	1.40	205	80	2.62	2.60	3	253	57
22	165.0	149.060	1.40	204	79	2.62	2.60	3	253	59
23	172.5	155.800	1.40	203	79	2.62	2.60	3	253	59
24	180.0	162.309	1.30	200	79	2.44	2.40	3	251	58

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**3**
Location:	**Corvallis, OR**			**Start Time:**	**10:15**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**		**End Time:**	**13:21**
EPA Method:	**M29**	Partly cloudy, 65 degrees		**Date:**	**9/15/2018**
Box Operator:	**RR**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.216	Nozzle size:	0.2153 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000253 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.65 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.199 inches
Stack Temperature	190 F		
Assumed moisture	1.7 %		
Assumed meter temp.	77.2 F		
Total number of points	24		
Time per point	7.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	8

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	157.751 dcf	Ave. ΔP	1.358 "H_2O
Wet mol. weight	28.69 M_s (actual)	Ave. √ΔP	1.1653 "H_2O
Actual H_2O	1.96 %	Ave. ΔH	2.529 "H_2O
Std. meter vol.	157.726 dscf	Ave. T_s	186.8 °F
Isokinetic Average	99.7 %	Ave. T_m	65.6 °F

Moisture/Lab:

Filter	Run3 #		
	Initial	Final	Gain
Impingers, g	200.0	235	35.0
Silica gel, g	255.3	287.4	32.1
		Total water gain:	67.1

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	7.5	6.380	1.30	150	50	2.51	2.50	3.5	255	47
2	15.0	13.000	1.40	158	51	2.67	2.70	4	249	45
3	22.5	19.630	1.40	165	53	2.65	2.70	4	256	50
4	30.0	26.170	1.40	171	55	2.63	2.60	4	254	54
5	37.5	32.800	1.40	176	58	2.63	2.60	4	253	57
6	45.0	39.450	1.40	180	60	2.62	2.60	4	254	60
7	52.5	46.090	1.40	183	62	2.62	2.60	4	253	52
8	60.0	52.470	1.30	185	63	2.43	2.40	3.5	251	47
9	67.5	58.880	1.30	187	64	2.43	2.40	3.5	253	47
10	75.0	65.310	1.30	188	66	2.43	2.40	3.5	253	47
11	82.5	71.980	1.40	188	67	2.62	2.60	4	251	47
12	90.0	78.439	1.30	191	68	2.43	2.40	3.5	250	48
13	97.5	84.830	1.30	191	68	2.43	2.40	3.5	258	54
14	105.0	91.490	1.40	190	68	2.62	2.60	4	254	48
15	112.5	98.200	1.40	194	70	2.61	2.60	4	255	49
16	120.0	104.900	1.40	193	70	2.62	2.60	4	253	50
17	127.5	111.650	1.40	194	71	2.62	2.60	4	256	51
18	135.0	118.320	1.40	196	71	2.61	2.60	4	250	50
19	142.5	125.100	1.40	197	71	2.61	2.60	4	254	51
20	150.0	131.800	1.40	199	71	2.60	2.60	4	253	52
21	157.5	138.290	1.30	200	73	2.42	2.40	3.5	252	52
22	165.0	144.810	1.30	201	74	2.42	2.40	3.5	253	52
23	172.5	151.270	1.30	201	75	2.43	2.40	3.5	252	53
24	180.0	157.751	1.30	204	76	2.42	2.40	3.5	258	53

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:35**
Source:	**CFU 112 (2)**	**End Time:**	**13:02**
Method:	**29**	**Date:**	**9/14/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
7.5	6.290	2.50	52	1	1.40	191	1.1832
15.0	12.900	2.70	53	2	1.50	194	1.2247
22.5	19.480	2.60	53	3	1.40	185	1.1832
30.0	26.400	2.80	54	4	1.50	171	1.2247
37.5	32.950	2.60	54	5	1.40	177	1.1832
45.0	39.410	2.60	55	6	1.40	181	1.1832
52.5	46.020	2.60	57	7	1.40	183	1.1832
60.0	52.400	2.40	58	8	1.30	184	1.1402
67.5	58.910	2.60	61	9	1.40	186	1.1832
75.0	65.270	2.40	63	10	1.30	188	1.1402
82.5	71.640	2.40	64	11	1.30	190	1.1402
90.0	78.009	2.40	65	12	1.30	191	1.1402
97.5	84.380	2.40	64	13	1.30	193	1.1402
105.0	90.950	2.60	64	14	1.40	194	1.1832
112.5	97.570	2.60	65	15	1.40	195	1.1832
120.0	104.430	2.80	65	16	1.50	197	1.2247
127.5	111.340	2.80	67	17	1.50	198	1.2247
135.0	117.950	2.60	68	18	1.40	196	1.1832
142.5	124.610	2.60	69	19	1.40	196	1.1832
150.0	131.270	2.60	70	20	1.40	197	1.1832
157.5	137.960	2.60	72	21	1.40	198	1.1832
165.0	144.610	2.60	72	22	1.40	200	1.1832
172.5	151.050	2.40	73	23	1.30	201	1.1402
180.0	157.499	2.40	73	24	1.30	201	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 112 (2)**	**Date:**	**09/14/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	30.000	in
Meter Volume, V_m	157.499	dcf	Rectangular		
Water Volume	60.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.75	"Hg	CO_2 Average	0.51	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.91	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.567	"H_2O	$\sqrt{Dp}$	1.1776	"H_2O
Temperature, T_m	63.0	^oF	Temperature, T_s	191.1	^oF
Temperature, T_m	523.0	^oA (^oR)	Temperature, T_s	651.1	^oA (^oR)
Pressure Meter, P_m	29.939	"Hg	Pressure Stack, P_s	29.791	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	158.803	dscf	Velocity, V_s	73.81	fps
	4.497	dscm	Volume (actual)	21,740.0	awcfm
Actual Volume, $V_{m(actual)}$	200.279	awcf		21,357.4	adcfm
Gas Stream Moisture			Volume (standard)	1,053,223.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.842	scf		1,034,686.6	dscf/hr
Moisture, B_{ws}	0.0176			17,244.8	dscf/min
Moisture EPA M4	1.76	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	99.3	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:20**
Source:	**CFU 112 (2)**	**End Time:**	**16:25**
Method:	**29**	**Date:**	**09/14/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
7.5	6.430	2.40	71	1	1.30	201	1.1402
15.0	13.090	2.60	72	2	1.40	200	1.1832
22.5	20.040	2.80	72	3	1.50	203	1.2247
30.0	26.920	2.80	72	4	1.50	203	1.2247
37.5	34.030	2.80	73	5	1.50	204	1.2247
45.0	40.850	2.60	73	6	1.40	204	1.1832
52.5	47.590	2.60	75	7	1.40	204	1.1832
60.0	54.320	2.60	76	8	1.40	205	1.1832
67.5	61.120	2.60	77	9	1.40	206	1.1832
75.0	68.040	2.60	78	10	1.40	207	1.1832
82.5	74.550	2.40	79	11	1.30	208	1.1402
90.0	81.027	2.40	79	12	1.30	208	1.1402
97.5	87.840	2.60	79	13	1.40	207	1.1832
105.0	94.750	2.60	79	14	1.40	208	1.1832
112.5	101.600	2.60	80	15	1.40	207	1.1832
120.0	108.630	2.80	80	16	1.50	206	1.2247
127.5	115.730	2.80	80	17	1.50	206	1.2247
135.0	122.250	2.40	80	18	1.30	205	1.1402
142.5	128.790	2.40	80	19	1.30	204	1.1402
150.0	135.540	2.60	80	20	1.40	205	1.1832
157.5	142.300	2.60	80	21	1.40	205	1.1832
165.0	149.060	2.60	79	22	1.40	204	1.1832
172.5	155.800	2.60	79	23	1.40	203	1.1832
180.0	162.309	2.40	79	24	1.30	200	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 112 (2)**	**Date:**	**09/14/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	30.000	in
Meter Volume, V_m	162.309	dcf	Rectangular		
Water Volume	58.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.75	"Hg	CO_2 Average	0.52	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.15	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.592	"H_2O	$\sqrt{Dp}$	1.1811	"H_2O
Temperature, T_m	77.2	^oF	Temperature, T_s	204.7	^oF
Temperature, T_m	537.2	^oA (^oR)	Temperature, T_s	664.7	^oA (^oR)
Pressure Meter, P_m	29.941	"Hg	Pressure Stack, P_s	29.791	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	159.338	dscf	Velocity, V_s	74.78	fps
	4.512	dscm	Volume (actual)	22,025.7	awcfm
Actual Volume, $V_{m(actual)}$	205.025	awcf		21,651.3	adcfm
Gas Stream Moisture			Volume (standard)	1,045,232.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.762	scf		1,027,463.2	dscf/hr
Moisture, B_{ws}	0.0170			17,124.4	dscf/min
Moisture EPA M4	1.70	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.4	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**10:15**
Source:	**CFU 112 (2)**	**End Time:**	**13:21**
Method:	**29**	**Date:**	**09/15/18**

Sampling Data				Traverse Data			
Time min.	**Meter** ft^3	**ΔH** "H_2O	**Meter** T_m °F	**Traverse** Point	**Dp** "H_2O	**Stack** T_s °F	√Dp
	0.000						
7.5	6.380	2.50	50	1	1.30	150	1.1402
15.0	13.000	2.70	51	2	1.40	158	1.1832
22.5	19.630	2.70	53	3	1.40	165	1.1832
30.0	26.170	2.60	55	4	1.40	171	1.1832
37.5	32.800	2.60	58	5	1.40	176	1.1832
45.0	39.450	2.60	60	6	1.40	180	1.1832
52.5	46.090	2.60	62	7	1.40	183	1.1832
60.0	52.470	2.40	63	8	1.30	185	1.1402
67.5	58.880	2.40	64	9	1.30	187	1.1402
75.0	65.310	2.40	66	10	1.30	188	1.1402
82.5	71.980	2.60	67	11	1.40	188	1.1832
90.0	78.439	2.40	68	12	1.30	191	1.1402
97.5	84.830	2.40	68	13	1.30	191	1.1402
105.0	91.490	2.60	68	14	1.40	190	1.1832
112.5	98.200	2.60	70	15	1.40	194	1.1832
120.0	104.900	2.60	70	16	1.40	193	1.1832
127.5	111.650	2.60	71	17	1.40	194	1.1832
135.0	118.320	2.60	71	18	1.40	196	1.1832
142.5	125.100	2.60	71	19	1.40	197	1.1832
150.0	131.800	2.60	71	20	1.40	199	1.1832
157.5	138.290	2.40	73	21	1.30	200	1.1402
165.0	144.810	2.40	74	22	1.30	201	1.1402
172.5	151.270	2.40	75	23	1.30	201	1.1402
180.0	157.751	2.40	76	24	1.30	204	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 112 (2)**	**Date:**	**09/15/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	30.000	in
Meter Volume, V_m	157.751	dcf	Rectangular		
Water Volume	67.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.65	"Hg	CO_2 Average	0.51	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.08	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.529	"H_2O	√Dp	1.1653	"H_2O
Temperature, T_m	65.6	^oF	Temperature, T_s	186.8	^oF
Temperature, T_m	525.6	^oA (^oR)	Temperature, T_s	646.8	^oA (^oR)
Pressure Meter, P_m	29.836	"Hg	Pressure Stack, P_s	29.691	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	157.726	dscf	Velocity, V_s	72.94	fps
	4.466	dscm	Volume (actual)	21,483.7	awcfm
Actual Volume, $V_{m(actual)}$	198.677	awcf		21,062.6	adcfm
Gas Stream Moisture			Volume (standard)	1,044,211.4	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.158	scf		1,023,744.9	dscf/hr
Moisture, B_{ws}	0.0196			17,062.4	dscf/min
Moisture EPA M4	1.96	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	99.7	%			

Source:	CFU 112 (2)				Sample Date:	09/14/18	
Run:		1					
		Filter +					
Client ID:		Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.390		0.660	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		0.455	<	MDL	0.100	0.040	µg/sample
Chromium		1.130		0.266	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		2.240		3.720	1.250	0.500	µg/sample
Lead	<	MDL	<	MDL	1.250	0.500	µg/sample
Manganese		1.390		0.750	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		14.700	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		8.820		3.070	0.750	0.300	µg/sample
Lab ID:		18-S2230		18-S2231			
Sample Vol:		250		100			mL

Source:	CFU 112 (2)				Sample Date:	09/14/18	
Run:		2					
		Filter +					
Client ID:		Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.240		0.684	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		0.426	<	MDL	0.100	0.040	µg/sample
Chromium		1.080		0.236	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		2.010		3.840	1.250	0.500	µg/sample
Lead	<	MDL	<	MDL	1.250	0.500	µg/sample
Manganese		1.300		0.594	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		9.560	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		2.760		12.100	0.750	0.300	µg/sample
Lab ID:		18-S2232		18-S2233			
Sample Vol:		250		100			mL

Source:		**CFU 112 (2)**				**Sample Date:**	**09/15/18**
Run:		**3**					
Client ID:		**Filter + Front Half**		**Back Half**			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.800		0.784	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		0.462	<	MDL	0.100	0.040	µg/sample
Chromium		1.140		0.245	0.200	0.080	µg/sample
Cobalt	<	MDL		0.075	0.125	0.050	µg/sample
Copper		3.000		3.470	1.250	0.500	µg/sample
Lead	<	MDL	<	MDL	1.250	0.500	µg/sample
Manganese		1.370		0.462	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		12.100	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		4.000		1.880	0.750	0.300	µg/sample
Lab ID:		18-S2234		18-S2235			
Sample Vol:		250		100			mL

Source: **CFU 112 (2)**
Blank Values

Client ID:		Filter	MDL		BH Capture Soln.		MDL		FH/BH Rinse	MDL
Analyte	<	µg/sample	Filter MDL µg/sample		5% HNO_3/ 10% H_2O_2 µg/sample	<	5% HNO_3/ 10% H_2O_2 MDL µg/sample	<	0.1 N HNO_3 µg/sample	0.1 N HNO_3 MDL µg/sample
Antimony	<	MDL	1.250	<	MDL		0.500	<	MDL	1.250
Arsenic	<	MDL	1.750	<	MDL		0.700	<	MDL	1.750
Barium		2.820	0.125		0.423		0.050		0.454	0.125
Beryllium	<	MDL	0.050	<	MDL		0.020	<	MDL	0.050
Cadmium		0.365	0.100	<	MDL		0.040	<	MDL	0.100
Chromium		0.953	0.200		0.154		0.080	<	MDL	0.200
Cobalt	<	MDL	0.125	<	MDL		0.050	<	MDL	0.125
Copper	<	MDL	1.250		2.750		0.500		2.120	1.250
Lead	<	MDL	1.250	<	MDL		0.500	<	MDL	1.250
Manganese		1.030	0.075		0.980		0.030		0.206	0.075
Nickel	<	MDL	0.750	<	MDL		0.300	<	MDL	0.750
Phosphorus		13.400	5.000	<	MDL		2.000	<	MDL	5.000
Selenium	<	MDL	3.750	<	MDL		1.500	<	MDL	3.750
Zinc		1.240	0.750		0.724		0.300	<	MDL	0.750
Lab ID:		18-S2237			18-S2238				18-S2236	
Sample Vol, ml:		250			100				250	

CFU 112 (2)

09/14/18	I	II	III	IV	V	VI	VII	VIII	
	Sample*	Blank*	Blank*	Sample*	Blank*	BH Blank*	BH Blank*	Allowable	
	FH	FH	FH	BH	BH	Corrected	Corrected	BH	
Species	Wash+Filter	Wash, µg	Filter, µg	Cap.Sol.	Cap.Sol.	Cap.Sol.	Wash, µg	Blank, µg	Species
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.390	0.1816	2.820	0.660	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	0.455	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.130	< 0.0800	0.953	0.266	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	2.240	0.8480	< 1.250	3.720	0.0275	5.500	0.8480	6.348	**Copper**
Pb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.390	0.0824	1.030	0.750	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	14.700	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	8.820	< 0.3000	1.240	3.070	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2230**	**18-S2236**	**18-S2237**	**18-S2231**	**18-S2238**				
Content:	0.1NHNO_3	0.1NHNO_3	0.1NHNO_3	5%HNO_3/ 10%H_2O_2	5%HNO_3/ 10%H_2O_2	5%HNO_3/ 10%H_2O_2	0.1NHNO_3		

FH Filter & Probe Rinse

100ml 0.1N HNO_3 rinse

BH Imps 1&2

100ml .1N HNO_3 rinse

200ml 5%HNO_3/10%H_2O_2 reagent

Same as BH Blank Wash (II)

Same as FH Blank Wash (VII)

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

*** Blank Rules:**

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If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

9/14/18

Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg		XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII		XV FH Net Sample, μg	Species
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.170	0.170	11.63		0.388	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.023	0.023	11.63		0.090	**Cadmium**
Cr	0.953	0.953		0.057	0.057	11.63		0.177	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.112	0.112	11.63		1.392	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	1.112	1.112		0.070	0.070	11.63		0.278	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		0.735	0.735	11.63		3.070	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.441	0.441	11.63		7.580	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

*** Blank Rules:**
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9/14/18

Species	XVI Allowable BH Blank, μg	XVII Blank BH Total		XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of $1\mu g$ or XIX		XXI BH Net Sample, μg		XXII FH Net Sample, μg		XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Antimony**
As	0.000	0.000	<	0.035	0.000	1.000	<	**0.700**	**<**	**1.750**	<	**2.450**	**Arsenic**
Ba	1.000	1.028		0.033	0.033	1.000		**0.000**		**0.388**		**0.388**	**Barium**
Be	0.000	0.000	<	0.001	0.000	1.000	<	**0.020**	**<**	**0.050**	<	**0.070**	**Beryllium**
Cd	0.000	0.000	<	0.002	0.000	1.000	<	**0.040**		**0.090**	<	**0.130**	**Cadmium**
Cr	0.308	0.308		0.013	0.013	1.000		**0.000**		**0.177**		**0.177**	**Chromium**
Co	0.000	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000	6.348		0.186	0.186	1.000		**2.720**		**1.392**		**4.112**	**Copper**
Pb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Lead**
Mn	1.000	2.042		0.038	0.038	1.000		**0.000**		**0.278**		**0.278**	**Manganese**
Ni	0.000	0.000	<	0.015	0.000	1.000	<	**0.300**	**<**	**0.750**	<	**1.050**	**Nickel**
P	0.000	0.000	<	0.100	0.000	1.000	<	**2.000**		**3.070**	<	**5.070**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	1.000	1.448		0.154	0.154	1.000		**2.070**		**7.580**		**9.650**	**Zinc**

Allowable BH Blank Calculation:

if $1.00\mu g$ >blank>0, use blank derived

if blank >$1.00\mu g$, use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

*** Blank Rules:**

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If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

CFU 112 (2)

09/14/18	I	II	III	IV	V	VI	VII	VIII	
	Sample*	**Blank***	**Blank***	**Sample***	**Blank***	**BH Blank***	**BH Blank***	**Allowable**	
	FH	**FH**	**FH**	**BH**	**BH**	**Corrected**	**Corrected**	**BH**	
Species	**Wash+Filter**	**Wash, µg**	**Filter, µg**	**Cap.Sol.**	**Cap.Sol.**	**Cap.Sol.**	**Wash, µg**	**Blank, µg**	**Species**
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.240	0.1816	2.820	0.684	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	0.426	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.080	< 0.0800	0.953	0.236	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	2.010	0.8480	< 1.250	3.840	0.0275	5.500	0.8480	6.348	**Copper**
Pb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.300	0.0824	1.030	0.594	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	9.560	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	2.760	< 0.3000	1.240	12.100	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2232**	**18-S2236**	**18-S2237**	**#REF!**	**18-S2238**				
Content:	$0.1NHNO_3$	$0.1NHNO_3$	$0.1NHNO_3$	$5\%HNO_3/$	$5\%HNO_3/$	$5\%HNO_3/$	$0.1NHNO_3$		
	FH Filter & Probe Rinse			$10\%H_2O_2$	$10\%H_2O_2$	$10\%H_2O_2$			
	100ml 0.1N HNO_3 rinse			BH Imps 1&2					
		Same as BH		100ml .1N HNO_3 rinse			Same as FH		
		Blank Wash		200ml $5\%HNO_3/10\%H_2O_2$ reagent			Blank Wash		

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

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9/14/18

Species	**X Allowable FH Blank, μg**	**XI FH Blank Corrected μg**	**XII 5% of FH Sample, μg**	**XIII Lessor of XI or XII**	**XIV Greater of A or XIII**	**XV FH Net Sample, μg**	**Species**
Sb	0.000	0.000 <	0.063	0.000	11.63 <	1.250	**Antimony**
As	0.000	0.000 <	0.088	0.000	11.63 <	1.750	**Arsenic**
Ba	3.002	3.002	0.162	0.162	11.63	0.238	**Barium**
Be	0.000	0.000 <	0.003	0.000	11.63 <	0.050	**Beryllium**
Cd	0.365	0.365	0.021	0.021	11.63	0.061	**Cadmium**
Cr	0.953	0.953	0.054	0.054	11.63	0.127	**Chromium**
Co	0.000	0.000 <	0.006	0.000	11.63 <	0.125	**Cobalt**
Cu	0.848	0.848	0.101	0.101	11.63	1.162	**Copper**
Pb	0.000	0.000 <	0.063	0.000	11.63 <	1.250	**Lead**
Mn	1.112	1.112	0.065	0.065	11.63	0.188	**Manganese**
Ni	0.000	0.000 <	0.038	0.000	11.63 <	0.750	**Nickel**
P	11.630	13.400	0.478	0.478	11.63	-2.070	**Phosphorus**
Se	0.000	0.000 <	0.188	0.000	11.63 <	3.750	**Selenium**
Zn	1.240	1.240	0.138	0.138	11.63	1.520	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

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Species	XVI Allowable BH Blank, μg	XVII Blank BH Total	XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of $1\mu g$ or XIX	XXI BH Net Sample, μg	XXII FH Net Sample, μg	XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.034	0.034	1.000	**0.000**	**0.238**	**0.238**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.061** <	**0.101**	**Cadmium**
Cr	0.308	0.308	0.012	0.012	1.000	**0.000**	**0.127**	**0.127**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125** <	**0.175**	**Cobalt**
Cu	1.000	6.348	0.192	0.192	1.000	**2.840**	**1.162**	**4.002**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Lead**
Mn	1.000	2.042	0.030	0.030	1.000	**0.000**	**0.188**	**0.188**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**0.000** <	**2.000**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.605	0.605	1.000	**11.100**	**1.520**	**12.620**	**Zinc**

Allowable BH Blank Calculation:

if $1.00\mu g$ >blank>0, use blank derived

if blank >$1.00\mu g$, use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

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CFU 112 (2)

09/15/18

Species	**I Sample* FH Wash+Filter**	**II Blank* FH Wash, µg**	**III Blank* FH Filter, µg**	**IV Sample* BH Cap.Sol.**	**V Blank* BH Cap.Sol.**	**VI BH Blank* Corrected Cap.Sol.**	**VII BH Blank* Corrected Wash, µg**	**VIII Allowable BH Blank, µg**	**Species**
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.800	0.1816	2.820	0.784	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	0.462	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.140	< 0.0800	0.953	0.245	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	0.075	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	3.000	0.8480	< 1.250	3.470	0.0275	5.500	0.8480	6.348	**Copper**
Pb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.370	0.0824	1.030	0.462	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	12.100	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	4.000	< 0.3000	1.240	1.880	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2234**	**18-S2236**	**18-S2237**	**18-S2235**	**18-S2238**				
Content:	0.1NHNO_3	0.1NHNO_3	0.1NHNO_3	5%HNO_3/ 10%H_2O_2	5%HNO_3/ 10%H_2O_2	5%HNO_3/ 10%H_2O_2	0.1NHNO_3		
	FH Filter & Probe Rinse			BH Imps 1&2					
	100ml 0.1N HNO_3 rinse			100ml .1N HNO_3 rinse					
		Same as BH Blank Wash		200ml 5%HNO_3/10%H_2O_2 reagent			Same as FH Blank Wash		

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

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Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg		XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII		XV FH Net Sample, μg	Species
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.190	0.190	11.63		0.798	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.023	0.023	11.63		0.097	**Cadmium**
Cr	0.953	0.953		0.057	0.057	11.63		0.187	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.150	0.150	11.63		2.152	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	1.112	1.112		0.069	0.069	11.63		0.258	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		0.605	0.605	11.63		0.470	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.200	0.200	11.63		2.760	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

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9/15/18

Species	XVI Allowable BH Blank, µg	XVII Blank BH Total	XVIII 5% of BH sample, µg	XIX Lessor of XVII or XVIII	XX Greater of 1µg or XIX	XXI BH Net Sample, µg	XXII FH Net Sample, µg	XXIII FH+BH Total Net Sample, µg	Species
Sb	0.000	0.000	< 0.025	0.000	1.000	**< 0.500**	**< 1.250**	**< 1.750**	**Antimony**
As	0.000	0.000	< 0.035	0.000	1.000	**< 0.700**	**< 1.750**	**< 2.450**	**Arsenic**
Ba	1.000	1.028	0.039	0.039	1.000	**0.000**	**0.798**	**0.798**	**Barium**
Be	0.000	0.000	< 0.001	0.000	1.000	**< 0.020**	**< 0.050**	**< 0.070**	**Beryllium**
Cd	0.000	0.000	< 0.002	0.000	1.000	**< 0.040**	**0.097**	**< 0.137**	**Cadmium**
Cr	0.308	0.308	0.012	0.012	1.000	**0.000**	**0.187**	**0.187**	**Chromium**
Co	0.000	0.000	0.004	0.000	1.000	**0.075**	**< 0.125**	**< 0.200**	**Cobalt**
Cu	1.000	6.348	0.174	0.174	1.000	**2.470**	**2.152**	**4.622**	**Copper**
Pb	0.000	0.000	< 0.025	0.000	1.000	**< 0.500**	**< 1.250**	**< 1.750**	**Lead**
Mn	1.000	2.042	0.023	0.023	1.000	**0.000**	**0.258**	**0.258**	**Manganese**
Ni	0.000	0.000	< 0.015	0.000	1.000	**< 0.300**	**< 0.750**	**< 1.050**	**Nickel**
P	0.000	0.000	< 0.100	0.000	1.000	**< 2.000**	**0.470**	**< 2.470**	**Phosphorus**
Se	0.000	0.000	< 0.075	0.000	1.000	**< 1.500**	**< 3.750**	**< 5.250**	**Selenium**
Zn	1.000	1.448	0.094	0.094	1.000	**0.880**	**2.760**	**3.640**	**Zinc**

Allowable BH Blank Calculation:

if 1.00µg >blank>0, use blank derived

if blank >1.00µg , use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

*** Blank Rules:**

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EPA Method 29
Gas Stream Characteristics
Test Summary

Client: Hollingsworth & Vose
Source: CFU 112 (2)
Location: Corvallis, OR

Run			1	2	3	
Date			9/14/2018	9/14/2018	9/15/2018	
Run Start Time			9:35	13:20	10:15	
Run End Time			13:02	16:25	13:21	
Duration, min.			180	180	180	Average
Barometric Pressure, "Hg			29.75	29.75	29.65	**29.72**
Nozzle Dia., in.			0.2153	0.2153	0.2153	**0.2153**
Isokinetic Average, %			99.3	100.4	99.7	**99.8**
Sample Volume, dscf			158.803	159.338	157.726	**158.622**
Sample Volume, dscm			4.497	4.512	4.466	**4.492**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.51	0.52	0.51	**0.51**
O_2 %vd			19.91	20.15	20.08	**20.05**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.76	1.70	1.96	**1.81**
Wet Molecular Weight, lb/lb-mole			28.69	28.70	28.67	**28.69**
Velocity, FPS			73.81	74.78	72.94	**73.84**
ADCFM			21,357.4	21,651.3	21,062.6	**21,357.1**
AWCFM			21,740.0	22,025.7	21,483.7	**21,749.8**
DSCFM			17,244.8	17,124.4	17,062.4	**17,143.9**
Stack Temperature, ^oF			191.1	204.7	186.8	**194.2**
Production Data	Glass Production	lbs/hr	695.2	700.4	691.2	**695.6**

Hollingsworth & Vose **Test: M29**
CFU 112 (2)
Metals Results Summary

Run 1													
	Total				FH Net				BH Net				
Species	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	
Antimony	< 1.750	< 0.389	< 2.51E-05	< 3.62E-08	< 1.250	< 0.278	< 1.80E-05	< 2.58E-08	< 0.500	< 0.111	< 7.18E-06	< 1.03E-08	Sb
Arsenic	< 2.450	< 0.545	< 3.52E-05	< 5.06E-08	< 1.750	< 0.389	< 2.51E-05	< 3.62E-08	< 0.700	< 0.156	< 1.01E-05	< 1.45E-08	As
Barium	0.388	0.086	5.58E-06	8.03E-09	0.388	0.086	5.58E-06	8.03E-09	0.000	0.000	0.00E+00	0.00E+00	Ba
Beryllium	< 0.070	< 0.016	< 1.01E-06	< 1.45E-09	< 0.050	< 0.011	< 7.18E-07	< 1.03E-09	< 0.020	< 0.004	< 2.87E-07	< 4.13E-10	Be
Cadmium	< 0.130	< 0.029	< 1.87E-06	< 2.69E-09	0.090	0.020	1.29E-06	1.86E-09	< 0.040	< 0.009	< 5.75E-07	< 8.27E-10	Cd
Chromium	0.177	0.039	2.54E-06	3.66E-09	0.177	0.039	2.54E-06	3.66E-09	0.000	0.000	0.00E+00	0.00E+00	Cr
Cobalt	< 0.175	< 0.039	< 2.51E-06	< 3.62E-09	< 0.125	< 0.028	< 1.80E-06	< 2.58E-09	< 0.050	< 0.011	< 7.18E-07	< 1.03E-09	Co
Copper	4.112	0.914	5.91E-05	8.50E-08	1.392	0.310	2.00E-05	2.88E-08	2.720	0.605	3.91E-05	5.62E-08	Cu
Lead	< 1.750	< 0.389	< 2.51E-05	< 3.62E-08	< 1.250	< 0.278	< 1.80E-05	< 2.58E-08	< 0.500	< 0.111	< 7.18E-06	< 1.03E-08	Pb
Manganese	0.278	0.062	3.99E-06	5.74E-09	0.278	0.062	3.99E-06	5.74E-09	0.000	0.000	0.00E+00	0.00E+00	Mn
Nickel	< 1.050	< 0.233	< 1.51E-05	< 2.17E-08	< 0.750	< 0.167	< 1.08E-05	< 1.55E-08	< 0.300	< 0.067	< 4.31E-06	< 6.20E-09	Ni
Phosphorus	< 5.070	< 1.127	< 7.28E-05	< 1.05E-07	3.070	0.683	4.41E-05	6.34E-08	< 2.000	< 0.445	< 2.87E-05	< 4.13E-08	P
Selenium	< 5.250	< 1.167	< 7.54E-05	< 1.08E-07	< 3.750	< 0.834	< 5.39E-05	< 7.75E-08	< 1.500	< 0.334	< 2.15E-05	< 3.099E-08	Se
Zinc	9.650	2.146	1.39E-04	1.99E-07	7.580	1.686	1.09E-04	1.57E-07	2.070	0.460	2.97E-05	4.277E-08	Zn

Run 2													
	Total				FH Net				BH Net				
Species	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	
Antimony	< 1.750	< 0.388	< 2.49E-05	< 3.55E-08	< 1.250	< 0.277	< 1.78E-05	< 2.54E-08	< 0.500	< 0.111	< 7.11E-06	< 1.01E-08	Sb
Arsenic	< 2.450	< 0.543	< 3.48E-05	< 4.97E-08	< 1.750	< 0.388	< 2.49E-05	< 3.55E-08	< 0.700	< 0.155	< 9.95E-06	< 1.42E-08	As
Barium	0.238	0.053	3.39E-06	4.84E-09	0.238	0.053	3.39E-06	4.84E-09	0.000	0.000	0.00E+00	0.00E+00	Ba
Beryllium	< 0.070	< 0.016	< 9.95E-07	< 1.42E-09	< 0.050	< 0.011	< 7.11E-07	< 1.02E-09	< 0.020	< 0.004	< 2.84E-07	< 4.05E-10	Be
Cadmium	< 0.101	< 0.022	< 1.44E-06	< 2.05E-09	0.061	0.014	8.67E-07	1.24E-09	< 0.040	< 0.009	< 5.69E-07	< 8.12E-10	Cd
Chromium	0.127	0.028	1.81E-06	2.58E-09	0.127	0.028	1.81E-06	2.58E-09	0.000	0.000	0.00E+00	0.00E+00	Cr
Cobalt	< 0.175	< 0.039	< 2.49E-06	< 3.55E-09	< 0.125	< 0.028	< 1.78E-06	< 2.54E-09	< 0.050	< 0.011	< 7.11E-07	< 1.02E-09	Co
Copper	4.002	0.887	5.69E-05	8.12E-08	1.162	0.258	1.65E-05	2.36E-08	2.840	0.629	4.04E-05	5.76E-08	Cu
Lead	< 1.750	< 0.388	< 2.49E-05	< 3.55E-08	< 1.250	< 0.277	< 1.78E-05	< 2.54E-08	< 0.500	< 0.111	< 7.11E-06	< 1.01E-08	Pb
Manganese	0.188	0.042	2.67E-06	3.81E-09	0.188	0.042	2.67E-06	3.81E-09	0.000	0.000	0.00E+00	0.00E+00	Mn
Nickel	< 1.050	< 0.233	< 1.49E-05	< 2.13E-08	< 0.750	< 0.166	< 1.07E-05	< 1.52E-08	< 0.300	< 0.066	< 4.27E-06	< 6.09E-09	Ni
Phosphorus	< 2.000	< 0.443	< 2.84E-05	< 4.06E-08	0.000	0.000	0.00E+00	0.00E+00	< 2.000	< 0.443	< 2.84E-05	< 4.06E-08	P
Selenium	< 5.250	< 1.164	< 7.46E-05	< 1.07E-07	< 3.750	< 0.831	< 5.33E-05	< 7.61E-08	< 1.500	< 0.332	< 2.13E-05	< 3.04E-08	Se
Zinc	12.620	2.797	1.79E-04	2.56E-07	1.520	0.337	2.16E-05	3.09E-08	11.100	2.460	1.58E-04	2.25E-07	Zn

Hollingsworth & Vose **Test: M29**
CFU 112 (2)
Metals Results Summary

Run 3													
	Total				FH Net				BH Net				
Species	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	
Antimony	< 1.750	< 0.392	< 2.50E-05	< 3.62E-08	< 1.250	< 0.280	< 1.79E-05	< 2.59E-08	< 0.500	< 0.112	< 7.16E-06	< 1.04E-08	Sb
Arsenic	< 2.450	< 0.549	< 3.51E-05	< 5.07E-08	< 1.750	< 0.392	< 2.50E-05	< 3.62E-08	< 0.700	< 0.157	< 1.00E-05	< 1.45E-08	As
Barium	0.798	0.179	1.14E-05	1.65E-08	0.798	0.179	1.14E-05	1.65E-08	0.000	0.000	0.00E+00	0.00E+00	Ba
Beryllium	< 0.070	< 0.016	< 1.00E-06	< 1.45E-09	< 0.050	< 0.011	< 7.16E-07	< 1.04E-09	< 0.020	< 0.004	< 2.86E-07	< 4.14E-10	Be
Cadmium	< 0.137	< 0.031	< 1.96E-06	< 2.84E-09	0.097	0.022	1.39E-06	2.01E-09	< 0.040	< 0.009	< 5.72E-07	< 8.28E-10	Cd
Chromium	0.187	0.042	2.68E-06	3.87E-09	0.187	0.042	2.68E-06	3.87E-09	0.000	0.000	0.00E+00	0.00E+00	Cr
Cobalt	< 0.200	< 0.045	< 2.86E-06	< 4.14E-09	< 0.125	< 0.028	< 1.79E-06	< 2.59E-09	0.075	0.017	1.07E-06	1.55E-09	Co
Copper	4.622	1.035	6.61E-05	9.57E-08	2.152	0.482	3.08E-05	4.46E-08	2.470	0.553	3.53E-05	5.11E-08	Cu
Lead	< 1.750	< 0.392	< 2.50E-05	< 3.62E-08	< 1.250	< 0.280	< 1.79E-05	< 2.59E-08	< 0.500	< 0.112	< 7.16E-06	< 1.04E-08	Pb
Manganese	0.258	0.058	3.69E-06	5.33E-09	0.258	0.058	3.69E-06	5.33E-09	0.000	0.000	0.00E+00	0.00E+00	Mn
Nickel	< 1.050	< 0.235	< 1.50E-05	< 2.17E-08	< 0.750	< 0.168	< 1.07E-05	< 1.55E-08	< 0.300	< 0.067	< 4.29E-06	< 6.21E-09	Ni
Phosphorus	< 2.470	< 0.553	< 3.53E-05	< 5.11E-08	0.470	0.105	6.73E-06	9.73E-09	< 2.000	< 0.448	< 2.86E-05	< 4.14E-08	P
Selenium	< 5.250	< 1.176	< 7.51E-05	< 1.09E-07	< 3.750	< 0.840	< 5.37E-05	< 7.76E-08	< 1.500	< 0.336	< 2.15E-05	< 3.106E-08	Se
Zinc	3.640	0.815	5.21E-05	7.54E-08	2.760	0.618	3.95E-05	5.71E-08	0.880	0.197	1.26E-05	1.822E-08	Zn

Mean Runs 1-3													
	Total				FH Net				BH Net				
Species	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	
Antimony	< 1.750	< 0.390	< 2.50E-05	< 3.60E-08	< 1.250	< 0.278	< 1.79E-05	< 2.57E-08	< 0.500	< 0.111	< 7.15E-06	< 1.03E-08	Sb
Arsenic	< 2.450	< 0.545	< 3.50E-05	< 5.04E-08	< 1.750	< 0.390	< 2.50E-05	< 3.60E-08	< 0.700	< 0.156	< 1.00E-05	< 1.44E-08	As
Barium	0.475	0.106	6.80E-06	9.80E-09	0.475	0.106	6.80E-06	9.80E-09	0.000	0.000	0.00E+00	0.00E+00	Ba
Beryllium	< 0.070	< 0.016	< 1.00E-06	< 1.44E-09	< 0.050	< 0.011	< 7.15E-07	< 1.03E-09	< 0.020	< 0.004	< 2.86E-07	< 4.11E-10	Be
Cadmium	< 0.123	< 0.027	< 1.75E-06	< 2.52E-09	0.083	0.018	1.18E-06	1.70E-09	< 0.040	< 0.009	< 5.72E-07	< 8.22E-10	Cd
Chromium	0.164	0.036	2.34E-06	3.37E-09	0.164	0.036	2.34E-06	3.37E-09	0.000	0.000	0.00E+00	0.00E+00	Cr
Cobalt	< 0.183	< 0.041	< 2.62E-06	< 3.77E-09	< 0.125	< 0.028	< 1.79E-06	< 2.57E-09	< 0.058	< 0.013	< 8.34E-07	< 1.20E-09	Co
Copper	4.245	0.945	6.07E-05	8.73E-08	1.569	0.350	2.24E-05	3.23E-08	2.677	0.596	3.83E-05	5.50E-08	Cu
Lead	< 1.750	< 0.390	< 2.50E-05	< 3.60E-08	< 1.250	< 0.278	< 1.79E-05	< 2.57E-08	< 0.500	< 0.111	< 7.15E-06	< 1.03E-08	Pb
Manganese	0.241	0.054	3.45E-06	4.96E-09	0.241	0.054	3.45E-06	4.96E-09	0.000	0.000	0.00E+00	0.00E+00	Mn
Nickel	< 1.050	< 0.234	< 1.50E-05	< 2.16E-08	< 0.750	< 0.167	< 1.07E-05	< 1.54E-08	< 0.300	< 0.067	< 4.29E-06	< 6.17E-09	Ni
Phosphorus	< 3.180	< 0.708	< 4.55E-05	< 6.55E-08	1.180	0.263	1.69E-05	2.44E-08	< 2.000	< 0.445	< 2.86E-05	< 4.11E-08	P
Selenium	< 5.250	< 1.169	< 7.51E-05	< 1.08E-07	< 3.750	< 0.835	< 5.36E-05	< 7.71E-08	< 1.500	< 0.334	< 2.14E-05	< 3.083E-08	Se
Zinc	8.637	1.919	1.23E-04	1.77E-07	3.953	0.880	5.67E-05	8.15E-08	4.683	1.039	6.67E-05	9.543E-08	Zn
Total:	**< 29.568**	**< 6.580**	**< 4.23E-04**	**< 6.07E-07**	< 16.589	< 3.694	< 2.37E-04	< 3.41E-07	< 12.978	< 2.886	< 1.85E-04	< 2.66E-07	

'<' denotes results calculated using the minimum detection limit for front half or back half results that were non-detect.

EPA Methods 1-4, 29
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:35**
Source:	**CFU 112 (2)**	**End Time:**	**13:02**
Method:	**29**	**Date:**	**9/14/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.939 "Hg

where Pb: 29.75 "Hg

ΔH: 2.567 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.791 "Hg

where Pb: 29.75 "Hg

Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 158.803 dscf

where Vm: 157.499 dcf

Y: 0.9985

Pm: 29.939 "Hg

Tm: 523.0 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.842 scf

where H_2O: 60.40 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0176

where Vw(std): 2.842 scf

Vm(std): 158.803 dscf

6) $\% H_2O = Bws \times 100 =$ 1.76 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 200.279 awcf

where Y: 0.9985

Vm: 157.4989 dcf

Bws: 0.0176

Ts: 651.1 °A

Tm: 523.0 °A

Pm: 29.939 "Hg

Ps: 29.791 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.88 lb/lb-mole

where CO_2: 0.51 %vd

O_2 19.91 %vd

$N_2+CO= (100-(O_2+CO_2)$: 79.58 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.69 lb/lb-mole
where M_d: 28.88 lb/lb-mole
Bws: 0.0176

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 4.909 sq. ft.
where Stack ID: 30 inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(\text{Cp})(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 73.81 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.1776
Ts: 651.1 °A
Ps: 29.791 "Hg
Ms: 28.69 lb/lb-mole

12) $\text{AWCFM} = (V_s)\text{(stack area)(60 sec/min)} =$ 21,740.0 AWCFM
where V_s: 73.81 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 21,357.4 ADCFM
where AWCFM: 21,740.0
Bws: 0.0176

14) $\text{Qsw} = 3600(V_s)\text{(stack area)}\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,053,223.3 wscf/hr
where V_s: 73.81 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 651.1 °A
Ps: 29.791 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,034,686.6 dscf/hr
where wscf/hr: 1,053,223.3
Bws: 0.0176

16) DSCFM= (dscf/hr)/60 mins/hr = 17,244.8 DSCFM
where dscf/hr: 1,034,686.6

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000253 sq. ft.
where Nozzle Size: 0.2153 inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 99.3 %

where Ts:	651.1	°A
Vm(Std):	158.803	dscf
Ps:	29.791	"Hg
Vs	73.81	ft/sec
Nozzle Area:	0.000253	sq. ft.
Sampling Time:	180	min.
Bws:	0.0176	

EPA Method 29:
Chromium

19) Cr Laboratory Results (blank corrected)

Front half (FH):	0.177	µg/sample
Back half (BH):	0.000	µg/sample
Total (FH + BH):	0.177	µg/sample

20) Cs = µg/Vm(std) = 0.039 µg/dscm

where Run 1 Total:	0.177	µg/sample
Vm(std):	4.497	dscm

21) Emission Rate = (Cs)($\frac{2.83168\ m^3}{ft^3}$)(stack flow)($\frac{2.2046E-9\ lb}{\mu g}$)= 2.54E-06 lb/hr

where Cs:	0.039	µg/dscm
Stack Flow:	1,034,686.6	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis OR**
SOURCE	**CFU 112 (2)**
DATE(S)	**9/14-15/2018**
METHOD	**30B**
POLLUTANT	**Mercury**

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**9:35**
Source:	**CFU 112 (2)**	**End Time:**	**13:03**
EPA Method:	**30B**	**Start Date:**	**9/14/2018**
Box Operator:	**CMF**	**End Date:**	**9/14/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.75	"Hg
Test duration:	180	min

Equipment:

	Side A	Side B	
Probe ID:	HLN 30B		
Probe heat:	267 F		
Meterbox ID:	HLN Duel #2	HLN Duel #2	
Y factor:	1.0460	1.0380	
Desired sampling rate:	2	2	lpm
Trap ID#:	OLC055067	OL486007	
Spiked @:	0	5	ng
Orifice # (if used):			

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.002	0.001	0.002	0.001

Test Summary:

	Side A	Side B	
Sample Volume:	359.966	359.983	L
Ave. Meter Temp:	65.6	67.2	°F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
0	0.000	0.000	191	191	54	53	7	7	266	268	2.000	2.000
5	10.060	10.060	193	193	54	53	7	7	266	268	2.012	2.012
10	20.050	20.060	193	193	56	56	7	7	266	268	1.998	2.000
15	30.070	30.020	193	193	56	56	7	7	266	268	2.004	1.992
20	39.160	39.220	169	169	56	56	7	7	266	268	1.818	1.840
25	49.200	49.250	174	174	56	56	7	7	266	268	2.008	2.006
30	59.260	59.290	177	177	56	58	7	7	266	268	2.012	2.008
35	69.260	69.200	180	180	58	59	7	7	266	268	2.000	1.982
40	79.300	79.340	182	182	58	59	7	7	266	268	2.008	2.028
45	89.340	89.310	183	183	58	59	7	7	266	268	2.008	1.994
50	99.460	99.430	184	184	60	62	7	7	266	268	2.024	2.024
55	109.590	109.610	185	185	63	65	7	7	266	268	2.026	2.036
60	119.600	119.600	186	186	64	66	7	7	266	268	2.002	1.998
65	129.730	129.700	187	187	64	67	7	7	266	268	2.026	2.020
70	139.900	139.960	189	189	66	68	7	7	266	268	2.034	2.052
75	149.950	149.890	190	190	67	69	7	7	266	268	2.010	1.986
80	160.150	160.100	190	190	67	69	7	7	266	268	2.040	2.042
85	170.250	170.200	191	191	67	69	7	7	266	268	2.020	2.020
90	180.326	180.327	192	192	67	69	7	7	266	268	2.015	2.025
95	190.110	190.110	194	194	66	66	7	7	266	268	1.957	1.957
100	200.190	200.180	196	196	66	67	7	7	266	268	2.016	2.014
105	210.260	210.260	195	195	66	68	7	7	266	268	2.014	2.016
110	220.340	220.370	197	197	67	69	7	7	266	268	2.016	2.022
115	230.410	230.450	197	197	68	70	7	7	266	268	2.014	2.016
120	240.550	240.550	197	197	69	71	7	7	266	268	2.028	2.020
125	250.600	250.580	197	197	70	72	7	7	266	268	2.010	2.006
130	260.740	260.710	197	197	70	73	7	7	266	268	2.028	2.026
135	270.860	270.900	197	197	71	73	7	7	266	268	2.024	2.038
140	280.780	280.720	197	197	72	74	7	7	266	268	1.984	1.964
145	290.690	290.690	198	198	72	75	7	7	266	268	1.982	1.994
150	300.550	300.540	199	199	73	75	7	7	266	268	1.972	1.970
155	310.480	310.510	200	200	73	76	7	7	266	268	1.986	1.994
160	320.350	320.360	200	200	75	77	7	7	266	268	1.974	1.970
165	330.230	330.210	200	200	75	78	7	7	266	268	1.976	1.970
170	340.140	340.160	200	200	75	78	7	7	266	268	1.982	1.990
175	350.060	350.060	201	201	75	78	7	7	266	268	1.984	1.980
180	359.966	359.983	202	202	76	78	7	7	266	268	1.981	1.985

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis OR**	**Start Time:**	**13:20**
Source:	**CFU 112 (2)**	**End Time:**	**16:25**
EPA Method:	**30B**	**Start Date:**	**9/14/2018**
Box Operator:	**CMF**	**End Date:**	**9/14/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.75 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN 30B	
Probe heat:	267 F	
Meterbox ID:	HLN Duel #2	HLN Duel #2
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498465	OL486081
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.000	0.000	0.000	0.000

Test Summary:

	Side A	Side B
Sample Volume:	360.118	360.138 L
Ave. Meter Temp:	79.9	81.7 °F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	**Side A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0	0.000	0.000	201	201	75	77	8	6	266	268	2.000	2.000
5	9.940	9.910	201	201	75	76	9	6	266	268	1.988	1.982
10	19.980	19.990	201	201	75	76	9	6	266	268	2.008	2.016
15	29.820	29.840	201	201	75	76	9	6	266	268	1.968	1.970
20	39.840	39.860	203	203	75	77	9	6	266	268	2.004	2.004
25	50.040	50.010	203	203	75	77	9	6	266	268	2.040	2.030
30	60.260	60.260	203	203	76	78	9	6	266	268	2.044	2.050
35	70.540	70.540	204	204	77	79	9	6	266	268	2.056	2.056
40	80.760	80.750	205	205	78	80	9	6	266	268	2.044	2.042
45	90.900	90.900	205	205	78	80	9	6	266	268	2.028	2.030
50	101.010	101.040	205	205	79	81	9	6	266	268	2.022	2.028
55	111.200	111.180	205	205	79	81	9	6	266	268	2.038	2.028
60	121.140	121.110	206	206	79	81	9	6	266	268	1.988	1.986
65	131.080	131.110	207	207	81	82	9	6	266	268	1.988	2.000
70	141.050	141.060	208	208	81	82	9	6	266	268	1.994	1.990
75	150.950	150.980	208	208	82	83	9	6	266	268	1.980	1.984
80	160.840	160.880	208	208	82	84	9	6	266	268	1.978	1.980
85	170.930	170.920	208	208	83	85	9	6	266	268	2.018	2.008
90	180.940	180.975	208	208	83	84	9	6	266	268	2.002	2.011
95	191.080	191.060	208	208	83	84	9	6	266	268	2.028	2.017
100	201.050	201.050	208	208	83	84	9	6	266	268	1.994	1.998
105	211.000	211.000	207	207	82	84	9	6	266	268	1.990	1.990
110	220.980	220.980	206	206	82	84	9	6	266	268	1.996	1.996
115	230.960	230.940	206	206	82	84	9	6	266	268	1.996	1.992
120	240.960	240.960	206	206	82	84	9	6	266	268	2.000	2.004
125	250.910	250.900	206	206	81	84	9	6	266	268	1.990	1.988
130	260.920	260.880	205	205	81	84	9	6	266	268	2.002	1.996
135	270.910	270.920	205	205	81	83	9	6	266	268	1.998	2.008
140	280.890	280.880	205	205	81	83	9	6	266	268	1.996	1.992
145	290.900	290.890	205	205	81	83	9	6	266	268	2.002	2.002
150	300.870	300.860	205	205	81	83	9	6	266	268	1.994	1.994
155	310.870	310.860	204	204	81	83	9	6	266	268	2.000	2.000
160	320.860	320.850	204	204	81	83	9	6	266	268	1.998	1.998
165	330.860	330.870	201	201	81	83	9	6	266	268	2.000	2.004
170	340.850	340.840	200	200	82	84	9	6	266	268	1.998	1.994
175	350.720	350.730	198	198	82	84	9	6	266	268	1.974	1.978
180	360.118	360.138	200	200	82	84	9	6	266	268	1.880	1.882

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis OR**	**Start Time:**	**10:15**
Source:	**CFU 112 (2)**	**End Time:**	**13:21**
EPA Method:	**30B**	**Start Date:**	**9/15/2018**
Box Operator:	**CMF**	**End Date:**	**9/15/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.65 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN 30B	
Probe heat:	267 F	
Meterbox ID:	HLN Duel #2	HLN Duel #2
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498444	OL486025
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.001	0.002	0.001	0.000

Test Summary:

	Side A	Side B
Sample Volume:	360.225	360.216 L
Ave. Meter Temp:	71.5	74.9 °F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
0	0.000	0.000	150	150	52	53	6	6	266	268	2.000	2.000
5	9.980	9.950	154	154	53	55	6	6	266	268	1.996	1.990
10	19.790	19.760	161	161	54	56	6	6	266	268	1.962	1.962
15	29.670	29.670	165	165	56	59	6	6	266	268	1.976	1.982
20	39.630	39.660	170	170	58	61	7	6	266	268	1.992	1.998
25	49.880	49.860	174	174	58	61	7	6	266	268	2.050	2.040
30	59.990	59.990	176	176	61	65	7	6	266	268	2.022	2.026
35	70.110	70.080	178	178	63	66	7	6	266	268	2.024	2.018
40	80.270	80.300	181	181	64	68	7	6	266	268	2.032	2.044
45	90.450	90.450	183	183	66	70	7	6	266	268	2.036	2.030
50	100.660	100.620	185	185	67	70	7	6	266	268	2.042	2.034
55	110.840	110.820	186	186	68	72	7	6	266	268	2.036	2.040
60	121.070	121.070	187	187	69	73	7	7	266	268	2.046	2.050
65	131.290	131.330	188	188	70	74	7	7	266	268	2.044	2.052
70	141.440	141.440	188	188	71	75	7	7	266	268	2.030	2.022
75	151.540	151.500	189	189	71	75	7	7	266	268	2.020	2.012
80	161.530	161.560	189	189	73	77	7	7	266	268	1.998	2.012
85	171.400	171.410	192	192	74	78	7	7	266	268	1.974	1.970
90	181.324	181.407	192	192	74	78	7	7	266	268	1.985	1.999
95	191.290	191.320	190	190	74	78	7	7	266	268	1.993	1.983
100	201.210	201.250	191	191	75	78	7	7	266	268	1.984	1.986
105	211.120	211.080	192	192	75	78	7	7	266	268	1.982	1.966
110	221.040	221.090	192	192	76	79	7	7	266	268	1.984	2.002
115	230.990	230.980	194	194	77	80	7	7	266	268	1.990	1.978
120	240.900	240.950	195	195	78	81	7	7	266	268	1.982	1.994
125	250.840	250.840	197	197	78	81	7	7	266	268	1.988	1.978
130	260.910	260.910	197	197	78	81	7	7	266	268	2.014	2.014
135	270.700	270.730	197	197	80	83	7	7	266	268	1.958	1.964
140	280.650	280.690	199	199	80	83	7	7	266	268	1.990	1.992
145	290.590	290.580	200	200	80	83	7	7	266	268	1.988	1.978
150	300.500	300.510	200	200	80	83	7	7	266	268	1.982	1.986
155	310.470	310.490	201	201	81	85	7	7	266	268	1.994	1.996
160	320.440	320.420	201	201	81	85	7	7	266	268	1.994	1.986
165	330.390	330.360	202	202	82	86	7	7	266	268	1.990	1.988
170	340.310	340.320	204	204	82	86	7	7	266	268	1.984	1.992
175	350.220	350.250	205	205	83	87	7	7	266	268	1.982	1.986
180	360.225	360.216	205	205	83	87	7	7	266	268	2.001	1.993

Method 30B
Mercury Concentration

Client: Hollingsworth & Vose
Location: Corvallis OR
Source: CFU 112 (2)
Test date: 9/14-15/2018

Meterbox Y:
Side A 1.0460
Side B 1.0380

Run	Sample	Sample Date	Trap ID	Spiked @ ng	Section 1 ng	Section 2 ng	Total Hg ng	Total Hg µg	DGM reading L	Sample volume (corrected for Y) L	Bp "Hg	Meter Temp. °F	Sample Vol. dscm	Hg Conc. µg/dscm	Ave. Pair Hg Conc. µg/dscm
1	A	9/14/2018	OLC055067	0.0	7.6	0.9	8.5	8.50E-03	359.966	376.524	29.75	65.6	0.376	2.26E-02	2.12E-02
	B		OL486007	5.0	12.0	0.4	7.4	7.40E-03	359.983	373.662		67.2	0.372	1.99E-02	
2	A	9/14/2018	OL498465	0.0	6.5	0.2	6.7	6.70E-03	360.118	376.683	29.75	79.9	0.366	1.83E-02	1.80E-02
	B		OL486081	5.0	11.1	0.3	6.4	6.40E-03	360.138	373.823		81.7	0.362	1.77E-02	
3	A	9/15/2018	OL498444	0.0	6.9	0.1	7.0	7.00E-03	360.225	376.795	29.65	71.5	0.371	1.89E-02	1.97E-02
	B		OL486025	5.0	12.0	0.5	7.5	7.50E-03	360.216	373.904		74.9	0.366	2.05E-02	

Average: 1.96E-02

Trap Concentrations Example Calculations:
Run 1, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 8.5 ng
   where Section 1: 7.6 ng
   Section 2: 0.9 ng
   Spike: 0.0 ng

2. Conversion to µg — Total Hg ng/1000 = 8.50E-03 µg
   where Total Hg ng: 8.5 ng

3. Corrected sample volume — = DGM reading x Meterbox Y factor = 376.524 L
   where DGM reading: 359.966 L
   Y: 1.046

4. Standard Volume (DSCM) — = Sample Vol. (L) x $\left(\frac{528\,°A}{Tm+460}\right)$ x Bp/29.92 "Hg /1000 = 0.376 DSCM
   where Sample vol.: 376.524 L
   T_m: 65.6 °F
   B_p: 29.75 "Hg

5. Hg concentration µg/dscm — = Total Hg µg / Volume DSCM = 2.26E-02 µg/dscm
   where Total Hg: 8.50E-03 µg
   DSCM: 0.376

6. Average Pair Concentration — = (Side A Conc.+ Side B Conc.)/2 = 2.12E-02 µg/dscm
   where Side A: 0.023 µg/dscm
   Side B: 0.020 µg/dscm

Method 30B
Results QA/QC

Client: Hollingsworth & Vose
Location: Corvallis OR
Source: CFU 112 (2)
Test date: 9/14-15/2018
Test type: C [C for compliance; R for RATA]

Run	Sample	Sample Date	Trap ID	Spiked @ ng	Section 1 ng	Section 2 ng	Total Hg ng	Hg Conc. µg/dscm	Breakthr. %	Breakthr. Results PASS/FAIL	C_{rec}. Spiked Compound µg/dscm	Spiked Hg Recovery R Value %	RD Paired Traps %	Paired Trap Agree. PASS/FAIL
1	A	9/14/2018	OLC055067	0	7.6	0.9	8.5	2.26E-02	11.8	PASS	1.07E-02	79.8	6.39	PASS
	B		OL486007	5	12	0.4	7.4	1.99E-02	3.3	PASS				
2	A	9/14/2018	OL498465	0	6.5	0.2	6.7	1.83E-02	3.1	PASS	1.32E-02	95.5	1.74	PASS
	B		OL486081	5	11.1	0.3	6.4	1.77E-02	2.7	PASS				
3	A	9/15/2018	OL498444	0	6.9	0.1	7	1.89E-02	1.4	PASS	1.53E-02	112.0	4.15	PASS
	B		OL486025	5	12	0.5	7.5	2.05E-02	4.2	PASS				

1. Breakthrough Critera

Every sample must meet the following critera for breakthrough % from Section 1 to Section 2.

$$Breakthrough\,\% = \frac{Section\ 2\ ng}{Section\ 1\ ng} x100$$ Eq. 30B-2

Allowable Breakthrough %	Compliance Testing (µg/dscm)	RATA (µg/dscm)
10	> 1	> 1
20	≤1	≤1; >0.5
50	Hg conc. ≤30% of emission limit	≤0.5; >0.1

RM average: 1.96E-02 µg/dscm

2. Field Recovery Test Field Recovery 3-run Average (%): 95.7 PASS

Determines the fraction of spiked Hg recovered (R). Perform for at least three runs per field test. Average of three runs must be between 85 and 115%

$$Crec = \frac{mass\ spiked\ (\mu g)}{Volume\ spiked\ (dscm)} - \frac{mass\ unspiked\ (\mu g)}{Volume\ unspiked\ (dscm)}$$ Eq. 30B-6

$$R = \frac{Crec\ (\frac{\mu g}{dscm})\ x\ vol.spiked\ (dscm)}{mass\ spiked\ (\mu g)} x100$$ Eq. 30B-7

3. Paired trap agreement

$$RD = \frac{|Conc.Trap\ A - Conc.Trap\ B|}{Conc.Trap\ A + Conc.Trap\ B} x100$$ Eq. 30B-5

If paired trains meet the relative deviation (RD) and other QA requirements, the average of the two Hg concs. may be used as an emissions test run value or as the reference method value for a RATA run.

Allowable Relative Dev. %	For Hg conc. (µg/dscm)
10	> 1
20	≤1
or ≤0.2 ug/dscm absolute difference in Hg concs.	≤1

M30B Table 9-1

Method 30B
Emission Calculations

Client: Hollingsworth & Vose
Location: Corvallis OR
Source: CFU 112 (2)
Test date: 9/14-15/2018

Run	Ave. Pair Hg Conc.	Hg Conc.	Stack Flow*	Glass Production	Stack Emissions	
	µg/dscm	lb/dscf	dscf/hr	lb/hr	lb/hr	lb/lb glass produced
1	2.12E-02	1.33E-12	1,034,686.6	695.2	1.37E-06	1.97E-09
2	1.80E-02	1.12E-12	1,027,463.2	700.4	1.15E-06	1.65E-09
3	1.97E-02	1.23E-12	1,023,744.9	691.2	1.26E-06	1.82E-09
Average Results:	1.96E-02	1.23E-12	1,028,631.6	695.6	1.26E-06	1.81E-09

*From direct stack measurements made during concurrent M29 runs

Daily Gaseous Calibrations Log

Client: H&V

Source: CFU-112 - Day 2 on M29/30B

Date: 09/14/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	0	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

see 9/11 Data

*Use of a calibrated instrument required

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X					0	X		
10	X					2	X		
20	X					4	X		

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X					0	X		
10	X					2	X		

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run #1

Test Times: R-1 ~~08:15~~ - Process Plugged R-2 13:20 - 16:25 R-3 16:40 - Process Down Scrap run

09:45 - 13:03

~11:10 - 11:32 - Paused testing during port change

Post - pass

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-112 (2)**
Facility	**Glass Plant #1**	Date	**September 14, 2018**
Location	**Corvallis, OR**		

Run	1	2	
Date	9/14/2018	9/14/2018	
Run Start Time	9:45	13:20	
Run End Time	13:03	16:25	
CO_2 %vd	0.51	0.52	0.51
O_2 %vd	19.91	20.15	20.03

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-112 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant #1**	Date	**September 14, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			***Final Values***								
		Analyzer Cal. Response	**System Cal Response**	**Pre test System Cal. Bias % of span**	**Pre test System Cal. Bias pass/fail**	**System Cal Response**	**Post test System Cal. Bias % of span**	**Post test System Cal. Bias pass/fail**	**System Drift % of span**	**System Drift pass/fail**	**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
Run 1	zero	0.02	0.09	0.35	pass	0.04	0.10	pass	-0.25	pass				
Run 1	upscale	9.99	10.11	0.60	pass	9.82	-0.85	pass	-1.45	pass	20	19.78	19.91	10
Run 2	zero	0.02	0.04	0.10	pass	0.03	0.05	pass	-0.05	pass				
Run 2	upscale	9.99	9.82	-0.85	pass	9.80	-0.95	pass	-0.10	pass	20	19.73	20.15	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.02	9.99	20.07
Analyzer Cal. Error	0.10	-0.05	0.35
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-112 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant #1**	Date	**September 14, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	**System Cal Response**	**Pre test System Cal. Bias % of span**	**Pre test System Cal. Bias pass/fail**	**System Cal Response**	**Post test System Cal. Bias % of span**	**Post test System Cal. Bias pass/fail**	**System Drift % of span**	**System Drift pass/fail**	**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
Run 1	zero	0.00	0.05	1.17	pass	0.04	1.00	pass	-0.17	pass				
	upscale	1.87	1.83	-1.08	pass	1.84	-0.75	pass	0.33	pass	4	0.50	0.51	2
Run 2	zero	0.00	0.04	1.00	pass	0.05	1.25	pass	0.25	pass				
	upscale	1.87	1.84	-0.75	pass	1.84	-0.75	pass	0.00	pass	4	0.51	0.52	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.00	1.87	4.07
Analyzer Cal. Error	0.00	-3.25	1.75
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	**CFU-112 (2)**
Facility	**Glass Plant 1**	**September 15, 2018**
Location	**Corvallis, OR**	

Run	3
Date	9/15/2018
Run Start Time	10:15
Run End Time	13:21
CO_2 %vd	0.51
O_2 %vd	20.08

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-112 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 15, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference
Run 3	zero	-0.09	0.08	0.85	pass	0.08	0.85	pass	0.00	pass				
	upscale	9.86	10.00	0.70	pass	9.88	0.10	pass	-0.60	pass	20	19.88	20.08	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	-0.09	9.86	19.92
Analyzer Cal. Error	-0.45	-0.70	-0.40
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO_2
Calibration Error, System Bias and System Drift

Company: **Hollingsworth & Vose**	Source **CFU-112 (2)**	Instrument Make:	**Servomex**
Facility: **Glass Plant 1**	Date **September 15, 2018**	Instrument Model:	**1440**
Location: **Corvallis, OR**		Instrument Serial #:	**01440D1-5041**

		Initial Values				Final Values								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference
Run 3	zero	0.00	0.01	0.25	pass	0.02	0.50	pass	0.25	pass				
	upscale	1.83	1.82	-0.25	pass	1.83	0.00	pass	0.25	pass	4	0.48	0.51	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0	1.83	4.09
Analyzer Cal. Error	0.00	-4.25	2.25
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU-112 (2)**	**End Time:**	**13:03**
Method:	**3A**	**Date:**	**9/14/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \text{ x } 100 =$ -0.05 %v

where C_{Dir}: 9.99 ppmv
C_V: 10.00 ppmv
CS: 20.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \text{ x } 100 =$ 0.60 %v

where C_{Dir}: 9.99 ppmv
C_S: 10.11 ppmv
CS: 20.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 1.45 %v

where SB_{Final}: -0.85 ppmv
SB_i: 0.60 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.91 ppmv

where C_{Avg}: 19.78 ppmv
C_O: 0.07 ppmv
C_{MA}: 10.00 ppmv
C_M: 9.97 ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU-112 (2)**	**End Time:**	**13:03**
Method:	**3A**	**Date:**	**9/14/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -3.25 %v

where C_{Dir}:	1.87	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -1.08 %v

where C_{Dir}:	1.87	ppmv
C_S:	1.83	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.33 %v

where SB_{Final}:	-0.75	ppmv
SB_i:	-1.08	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O) \left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.51 ppmv

where C_{Avg}:	0.50	ppmv
C_O:	0.04	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.83	ppmv

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	7:40:28	-0.02	0.00
9/14/2018	7:40:38	-0.02	0.01
9/14/2018	7:40:48	-0.03	0.01
9/14/2018	7:40:58	-0.02	0.01
9/14/2018	7:41:08	-0.02	0.00
9/14/2018	7:41:18	-0.03	0.00
9/14/2018	7:41:28	-0.03	0.00
9/14/2018	7:41:38	-0.03	0.00
9/14/2018	7:41:48	0.01	-0.01
9/14/2018	7:41:58	0.02	0.00
9/14/2018	7:42:08	0.02	0.01
9/14/2018	7:42:18	0.02	0.00
9/14/2018	7:42:28	3.92	3.17
9/14/2018	7:42:38	13.41	15.66
9/14/2018	7:42:48	19.68	18.40
9/14/2018	7:42:58	20.30	19.08
9/14/2018	7:43:08	20.33	19.11
9/14/2018	7:43:18	20.11	19.43
9/14/2018	7:43:28	19.89	19.58
9/14/2018	7:43:38	19.80	19.57
9/14/2018	7:43:48	20.09	19.58
9/14/2018	7:43:58	20.10	19.58
9/14/2018	7:44:08	20.10	19.59
9/14/2018	7:44:18	20.10	19.60
9/14/2018	7:44:28	20.10	19.60
9/14/2018	7:44:38	20.10	19.60
9/14/2018	7:44:48	20.10	19.60
9/14/2018	7:44:58	20.07	19.60
9/14/2018	7:45:08	20.07	19.61
9/14/2018	7:45:18	20.07	19.60
9/14/2018	7:45:28	19.82	19.60
9/14/2018	7:45:38	18.82	18.13
9/14/2018	7:45:48	10.38	9.43
9/14/2018	7:45:58	9.99	9.82
9/14/2018	7:46:08	10.00	9.80
9/14/2018	7:46:18	9.99	9.79
9/14/2018	7:46:28	9.98	9.78
9/14/2018	7:46:38	9.98	9.77
9/14/2018	7:46:48	10.06	9.73
9/14/2018	7:46:58	5.29	4.73

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	7:47:08	4.04	4.14
9/14/2018	7:47:18	3.96	4.11
9/14/2018	7:47:28	3.95	4.10
9/14/2018	7:47:38	3.95	4.10
9/14/2018	7:47:48	3.96	4.09
9/14/2018	7:47:58	3.96	4.07
9/14/2018	7:48:08	3.99	4.08
9/14/2018	7:48:18	3.99	4.07
9/14/2018	7:48:28	3.20	3.01
9/14/2018	7:48:38	1.91	1.83
9/14/2018	7:48:48	1.99	1.88
9/14/2018	7:48:58	1.99	1.88
9/14/2018	7:49:08	1.99	1.87
9/14/2018	7:49:18	1.99	1.87
9/14/2018	7:49:28	1.99	1.87
9/14/2018	7:49:38	1.99	1.87
9/14/2018	7:49:48	1.99	1.87
9/14/2018	7:49:58	1.99	1.87
9/14/2018	7:50:08	1.99	1.86
9/14/2018	7:50:18	1.97	1.87
9/14/2018	7:50:28	2.89	1.55
		O2 [%]	**CO2 [%]**
Analyzer Zero		**0.02**	**0.00**
Analyzer Mid		**9.99**	**1.87**
Analyzer High		**20.07**	**4.07**

System

9/14/2018	7:50:38	18.41	0.21
9/14/2018	7:50:48	16.34	0.39
9/14/2018	7:50:58	12.42	0.88
9/14/2018	7:51:08	11.21	1.05
9/14/2018	7:51:18	10.80	1.10
9/14/2018	7:51:28	10.70	1.12
9/14/2018	7:51:38	10.65	1.12
9/14/2018	7:51:48	10.60	1.13
9/14/2018	7:51:58	11.81	1.00
9/14/2018	7:52:08	13.77	0.85
9/14/2018	7:52:18	7.01	1.51
9/14/2018	7:52:28	3.73	1.72
9/14/2018	7:52:38	2.68	1.79

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	7:52:48	2.34	1.82
9/14/2018	7:52:58	2.23	1.82
9/14/2018	7:53:08	2.19	1.82
9/14/2018	7:53:18	2.18	1.83
9/14/2018	7:53:28	2.17	1.83
9/14/2018	7:53:38	2.17	1.82
9/14/2018	7:53:48	2.17	1.83
9/14/2018	7:53:58	2.17	1.82
9/14/2018	7:54:08	2.17	1.82
9/14/2018	7:54:18	2.18	1.82
9/14/2018	7:54:28	4.68	4.56
9/14/2018	7:54:38	8.33	8.10
9/14/2018	7:54:48	9.53	9.10
9/14/2018	7:54:58	9.91	9.42
9/14/2018	7:55:08	10.04	9.53
9/14/2018	7:55:18	10.09	9.58
9/14/2018	7:55:28	10.10	9.59
9/14/2018	7:55:38	10.11	9.61
9/14/2018	7:55:48	10.11	9.61
9/14/2018	7:55:58	10.11	9.70
9/14/2018	7:56:08	10.11	9.70
9/14/2018	7:56:18	10.11	9.71
9/14/2018	7:56:28	10.11	9.71
9/14/2018	7:56:38	10.12	9.71
9/14/2018	7:56:48	9.61	9.11
9/14/2018	7:56:58	4.82	4.22
9/14/2018	7:57:08	1.74	1.41
9/14/2018	7:57:18	0.73	0.57
9/14/2018	7:57:28	0.40	0.26
9/14/2018	7:57:38	0.29	0.14
9/14/2018	7:57:48	0.26	0.10
9/14/2018	7:57:58	0.24	0.08
9/14/2018	7:58:08	0.23	0.07
9/14/2018	7:58:18	0.18	0.07
9/14/2018	7:58:28	0.18	0.06
9/14/2018	7:58:38	0.16	0.06
9/14/2018	7:58:48	0.10	0.06
9/14/2018	7:58:58	0.09	0.05
9/14/2018	7:59:08	0.09	0.05
9/14/2018	7:59:18	0.09	0.05

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	7:59:28	0.09	0.04
9/14/2018	7:59:38	0.09	0.04

	O2 [%]	CO2 [%]
System Zero	**0.09**	**0.05**
System Mid	**10.11**	**1.83**

Hollingswoth & Vose
CFU #112 (2)
Run #1
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	9:45:21	19.77	0.47
9/14/2018	9:46:21	19.77	0.47
9/14/2018	9:47:21	19.77	0.48
9/14/2018	9:48:21	19.77	0.47
9/14/2018	9:49:21	19.76	0.48
9/14/2018	9:50:21	19.76	0.48
9/14/2018	9:51:21	19.77	0.48
9/14/2018	9:52:21	19.76	0.48
9/14/2018	9:53:21	19.76	0.49
9/14/2018	9:54:21	19.76	0.49
9/14/2018	9:55:21	19.77	0.49
9/14/2018	9:56:21	19.76	0.49
9/14/2018	9:57:21	19.76	0.49
9/14/2018	9:58:21	19.75	0.50
9/14/2018	9:59:21	19.76	0.49
9/14/2018	10:00:21	19.76	0.49
9/14/2018	10:01:21	19.76	0.50
9/14/2018	10:02:21	19.76	0.49
9/14/2018	10:03:21	19.76	0.50
9/14/2018	10:04:21	19.75	0.50
9/14/2018	10:05:21	19.76	0.49
9/14/2018	10:06:21	19.75	0.49
9/14/2018	10:07:21	19.76	0.49
9/14/2018	10:08:21	19.76	0.49
9/14/2018	10:09:21	19.76	0.48
9/14/2018	10:10:21	19.76	0.48
9/14/2018	10:11:21	19.76	0.48
9/14/2018	10:12:21	19.76	0.48
9/14/2018	10:13:21	19.76	0.48
9/14/2018	10:14:21	19.75	0.49
9/14/2018	10:15:21	19.76	0.48
9/14/2018	10:16:21	19.76	0.48
9/14/2018	10:17:21	19.76	0.49
9/14/2018	10:18:21	19.75	0.49
9/14/2018	10:19:21	19.76	0.49
9/14/2018	10:20:21	19.75	0.49
9/14/2018	10:21:21	19.75	0.49
9/14/2018	10:22:21	19.76	0.50
9/14/2018	10:23:21	19.75	0.50
9/14/2018	10:24:21	19.75	0.50

Hollingswoth & Vose
CFU #112 (2)
Run #1
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	10:25:21	19.75	0.50
9/14/2018	10:26:21	19.74	0.50
9/14/2018	10:27:21	19.76	0.50
9/14/2018	10:28:21	19.75	0.50
9/14/2018	10:29:21	19.75	0.50
9/14/2018	10:30:21	19.75	0.49
9/14/2018	10:31:21	19.76	0.49
9/14/2018	10:32:21	19.76	0.49
9/14/2018	10:33:21	19.75	0.49
9/14/2018	10:34:21	19.76	0.49
9/14/2018	10:35:21	19.76	0.48
9/14/2018	10:36:21	19.75	0.48
9/14/2018	10:37:21	19.75	0.49
9/14/2018	10:38:21	19.75	0.48
9/14/2018	10:39:21	19.75	0.48
9/14/2018	10:40:21	19.75	0.48
9/14/2018	10:41:21	19.75	0.49
9/14/2018	10:42:21	19.75	0.49
9/14/2018	10:43:21	19.75	0.49
9/14/2018	10:44:21	19.75	0.49
9/14/2018	10:45:21	19.75	0.49
9/14/2018	10:46:21	19.76	0.49
9/14/2018	10:47:21	19.75	0.50
9/14/2018	10:48:21	19.76	0.50
9/14/2018	10:49:21	19.76	0.50
9/14/2018	10:50:21	19.76	0.50
9/14/2018	10:51:21	19.77	0.50
9/14/2018	10:52:21	19.78	0.50
9/14/2018	10:53:21	19.78	0.50
9/14/2018	10:54:21	19.77	0.50
9/14/2018	10:55:21	19.78	0.50
9/14/2018	10:56:21	19.78	0.50
9/14/2018	10:57:21	19.78	0.50
9/14/2018	10:58:21	19.79	0.49
9/14/2018	10:59:21	19.78	0.50
9/14/2018	11:00:21	19.78	0.49
9/14/2018	11:01:21	19.78	0.49
9/14/2018	11:02:21	19.78	0.49
9/14/2018	11:03:21	19.78	0.49
9/14/2018	11:04:21	19.78	0.49

Hollingswoth & Vose
CFU #112 (2)
Run #1
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	11:05:21	19.79	0.49
9/14/2018	11:06:21	19.79	0.49
9/14/2018	11:07:21	19.78	0.49
9/14/2018	11:08:21	19.78	0.49
9/14/2018	11:09:21	19.78	0.49
9/14/2018	11:10:21	19.78	0.50
9/14/2018	11:11:21	19.79	0.49
9/14/2018	11:12:21	19.78	0.50
9/14/2018	11:13:21	19.78	0.50
9/14/2018	11:14:21	19.79	0.50
9/14/2018	11:15:21	19.79	0.50
9/14/2018	11:16:21	19.79	0.50
9/14/2018	11:17:21	19.79	0.51
9/14/2018	11:18:21	19.79	0.51
9/14/2018	11:19:21	19.79	0.50
9/14/2018	11:20:21	19.79	0.51
9/14/2018	11:21:21	19.79	0.51
9/14/2018	11:22:21	19.79	0.51
9/14/2018	11:23:21	19.79	0.51
9/14/2018	11:24:21	19.79	0.50
9/14/2018	11:25:21	19.79	0.50
9/14/2018	11:26:21	19.79	0.50
9/14/2018	11:27:21	19.79	0.49
9/14/2018	11:28:21	19.80	0.49
9/14/2018	11:29:21	19.79	0.49
9/14/2018	11:30:21	19.79	0.49
9/14/2018	11:31:21	19.79	0.49
9/14/2018	11:32:21	19.79	0.49
9/14/2018	11:33:21	19.79	0.50
9/14/2018	11:34:21	19.79	0.50
9/14/2018	11:35:21	19.79	0.50
9/14/2018	11:36:21	19.79	0.50
9/14/2018	11:37:21	19.78	0.50
9/14/2018	11:38:21	19.79	0.50
9/14/2018	11:39:21	19.79	0.50
9/14/2018	11:40:21	19.79	0.50
9/14/2018	11:41:21	19.79	0.51
9/14/2018	11:42:21	19.79	0.51
9/14/2018	11:43:21	19.79	0.51
9/14/2018	11:44:21	19.79	0.50

Hollingswoth & Vose
CFU #112 (2)
Run #1
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	11:45:21	19.78	0.51
9/14/2018	11:46:21	19.79	0.51
9/14/2018	11:47:21	19.79	0.51
9/14/2018	11:48:21	19.79	0.51
9/14/2018	11:49:21	19.79	0.50
9/14/2018	11:50:21	19.79	0.50
9/14/2018	11:51:21	19.79	0.50
9/14/2018	11:52:21	19.79	0.50
9/14/2018	11:53:21	19.79	0.49
9/14/2018	11:54:21	19.80	0.49
9/14/2018	11:55:21	19.79	0.49
9/14/2018	11:56:21	19.79	0.50
9/14/2018	11:57:21	19.79	0.49
9/14/2018	11:58:21	19.80	0.49
9/14/2018	11:59:21	19.81	0.49
9/14/2018	12:00:21	19.80	0.49
9/14/2018	12:01:21	19.80	0.50
9/14/2018	12:02:21	19.80	0.50
9/14/2018	12:03:21	19.80	0.50
9/14/2018	12:04:21	19.80	0.50
9/14/2018	12:05:21	19.80	0.50
9/14/2018	12:06:21	19.80	0.50
9/14/2018	12:07:21	19.81	0.50
9/14/2018	12:08:21	19.81	0.50
9/14/2018	12:09:21	19.81	0.51
9/14/2018	12:10:21	19.81	0.51
9/14/2018	12:11:21	19.81	0.51
9/14/2018	12:12:21	19.81	0.51
9/14/2018	12:13:21	19.81	0.50
9/14/2018	12:14:21	19.81	0.50
9/14/2018	12:15:21	19.81	0.51
9/14/2018	12:16:21	19.81	0.50
9/14/2018	12:17:21	19.81	0.50
9/14/2018	12:18:21	19.81	0.50
9/14/2018	12:19:21	19.81	0.49
9/14/2018	12:20:21	19.80	0.49
9/14/2018	12:21:21	19.81	0.50
9/14/2018	12:22:21	19.80	0.50
9/14/2018	12:23:21	19.82	0.49
9/14/2018	12:24:21	19.81	0.49

Hollingswoth & Vose
CFU #112 (2)
Run #1
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	12:25:21	19.80	0.50
9/14/2018	12:26:21	19.80	0.49
9/14/2018	12:27:21	19.81	0.49
9/14/2018	12:28:21	19.80	0.50
9/14/2018	12:29:21	19.81	0.50
9/14/2018	12:30:21	19.80	0.50
9/14/2018	12:31:21	19.80	0.50
9/14/2018	12:32:21	19.80	0.51
9/14/2018	12:33:21	19.79	0.51
9/14/2018	12:34:21	19.80	0.51
9/14/2018	12:35:21	19.80	0.51
9/14/2018	12:36:21	19.79	0.51
9/14/2018	12:37:21	19.79	0.51
9/14/2018	12:38:21	19.78	0.51
9/14/2018	12:39:21	19.79	0.50
9/14/2018	12:40:21	19.79	0.51
9/14/2018	12:41:21	19.79	0.50
9/14/2018	12:42:21	19.79	0.50
9/14/2018	12:43:21	19.78	0.50
9/14/2018	12:44:21	19.78	0.50
9/14/2018	12:45:21	19.77	0.50
9/14/2018	12:46:21	19.77	0.50
9/14/2018	12:47:21	19.78	0.49
9/14/2018	12:48:21	19.78	0.49
9/14/2018	12:49:21	19.78	0.50
9/14/2018	12:50:21	19.78	0.49
9/14/2018	12:51:21	19.77	0.50
9/14/2018	12:52:21	19.77	0.50
9/14/2018	12:53:21	19.77	0.50
9/14/2018	12:54:21	19.77	0.50
9/14/2018	12:55:21	19.77	0.50
9/14/2018	12:56:21	19.77	0.51
9/14/2018	12:57:21	19.78	0.50
9/14/2018	12:58:21	19.78	0.51
9/14/2018	12:59:21	19.77	0.51
9/14/2018	13:00:21	19.77	0.51
9/14/2018	13:01:21	19.77	0.51
9/14/2018	13:02:21	19.77	0.51
9/14/2018	13:03:21	19.77	0.51
Final Average		**19.78**	**0.50**

Hollingswoth & Vose
CFU #112 (2)
Run #1
9/14/2018

Date	Time	O2 [%]	CO2 [%]
Bias Check			
9/14/2018	13:09:41	19.77	0.50
9/14/2018	13:09:51	19.77	0.50
9/14/2018	13:10:01	19.79	0.49
9/14/2018	13:10:11	19.01	0.51
9/14/2018	13:10:21	10.02	0.41
9/14/2018	13:10:31	3.32	0.17
9/14/2018	13:10:41	1.09	0.09
9/14/2018	13:10:51	0.39	0.05
9/14/2018	13:11:01	0.16	0.04
9/14/2018	13:11:11	0.09	0.04
9/14/2018	13:11:21	0.05	0.04
9/14/2018	13:11:31	0.05	0.04
9/14/2018	13:11:41	0.04	0.03
9/14/2018	13:11:51	0.03	0.04
9/14/2018	13:12:01	0.03	0.04
9/14/2018	13:12:11	0.04	0.04
9/14/2018	13:12:21	0.87	0.86
9/14/2018	13:12:31	1.61	1.41
9/14/2018	13:12:41	1.83	1.69
9/14/2018	13:12:51	1.89	1.78
9/14/2018	13:13:01	1.91	1.82
9/14/2018	13:13:11	1.92	1.82
9/14/2018	13:13:21	1.92	1.83
9/14/2018	13:13:31	1.92	1.83
9/14/2018	13:13:41	1.92	1.84
9/14/2018	13:13:51	1.92	1.84
9/14/2018	13:14:01	1.92	1.83
9/14/2018	13:14:11	2.30	2.09
9/14/2018	13:14:21	6.24	6.49
9/14/2018	13:14:31	8.66	8.65
9/14/2018	13:14:41	9.42	9.33
9/14/2018	13:14:51	9.67	9.57
9/14/2018	13:15:01	9.76	9.66
9/14/2018	13:15:11	9.79	9.69
9/14/2018	13:15:21	9.81	9.71
9/14/2018	13:15:31	9.81	9.72
9/14/2018	13:15:41	9.82	9.72
9/14/2018	13:15:51	9.82	9.73

Hollingswoth & Vose
CFU #112 (2)
Run #1
9/14/2018

Date	**Time**	**O2 [%]**	**CO2 [%]**
9/14/2018	13:16:01	9.82	9.73
9/14/2018	13:16:11	9.82	9.73
9/14/2018	13:16:21	9.82	9.74
9/14/2018	13:16:31	9.83	9.74
9/14/2018	13:16:41	9.81	9.75
9/14/2018	13:16:51	11.53	8.04
9/14/2018	13:17:01	16.41	3.42
9/14/2018	13:17:11	18.58	1.46
9/14/2018	13:17:21	19.33	0.89
		O2 [%]	**CO2 [%]**
System Zero		**0.04**	**0.04**
System Mid		**9.82**	**1.84**

Hollingswoth & Vose
CFU #112 (2)
Run #2
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	13:20:21	19.76	0.51
9/14/2018	13:21:21	19.75	0.52
9/14/2018	13:22:21	19.76	0.51
9/14/2018	13:23:21	19.76	0.51
9/14/2018	13:24:21	19.76	0.52
9/14/2018	13:25:21	19.77	0.51
9/14/2018	13:26:21	19.77	0.51
9/14/2018	13:27:21	19.76	0.51
9/14/2018	13:28:21	19.76	0.51
9/14/2018	13:29:21	19.76	0.51
9/14/2018	13:30:21	19.76	0.51
9/14/2018	13:31:21	19.76	0.51
9/14/2018	13:32:21	19.76	0.51
9/14/2018	13:33:21	19.76	0.50
9/14/2018	13:34:21	19.76	0.50
9/14/2018	13:35:21	19.77	0.50
9/14/2018	13:36:21	19.76	0.50
9/14/2018	13:37:21	19.76	0.50
9/14/2018	13:38:21	19.77	0.49
9/14/2018	13:39:21	19.76	0.49
9/14/2018	13:40:21	19.77	0.49
9/14/2018	13:41:21	19.76	0.50
9/14/2018	13:42:21	19.76	0.50
9/14/2018	13:43:21	19.75	0.50
9/14/2018	13:44:21	19.75	0.50
9/14/2018	13:45:21	19.75	0.50
9/14/2018	13:46:21	19.75	0.51
9/14/2018	13:47:21	19.76	0.51
9/14/2018	13:48:21	19.76	0.51
9/14/2018	13:49:21	19.76	0.51
9/14/2018	13:50:21	19.76	0.51
9/14/2018	13:51:21	19.76	0.51
9/14/2018	13:52:21	19.76	0.51
9/14/2018	13:53:21	19.76	0.51
9/14/2018	13:54:21	19.75	0.51
9/14/2018	13:55:21	19.76	0.51
9/14/2018	13:56:21	19.75	0.51
9/14/2018	13:57:21	19.75	0.51
9/14/2018	13:58:21	19.76	0.50
9/14/2018	13:59:21	19.75	0.50

Hollingswoth & Vose
CFU #112 (2)
Run #2
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	14:00:21	19.75	0.50
9/14/2018	14:01:21	19.75	0.50
9/14/2018	14:02:21	19.74	0.50
9/14/2018	14:03:21	19.76	0.50
9/14/2018	14:04:21	19.75	0.50
9/14/2018	14:05:21	19.75	0.50
9/14/2018	14:06:21	19.76	0.50
9/14/2018	14:07:21	19.75	0.50
9/14/2018	14:08:21	19.75	0.50
9/14/2018	14:09:21	19.75	0.50
9/14/2018	14:10:21	19.75	0.50
9/14/2018	14:11:21	19.75	0.50
9/14/2018	14:12:21	19.75	0.51
9/14/2018	14:13:21	19.75	0.51
9/14/2018	14:14:21	19.75	0.51
9/14/2018	14:15:21	19.75	0.51
9/14/2018	14:16:21	19.75	0.51
9/14/2018	14:17:21	19.75	0.51
9/14/2018	14:18:21	19.75	0.51
9/14/2018	14:19:21	19.75	0.51
9/14/2018	14:20:21	19.74	0.51
9/14/2018	14:21:21	19.75	0.51
9/14/2018	14:22:21	19.74	0.51
9/14/2018	14:23:21	19.74	0.51
9/14/2018	14:24:21	19.75	0.51
9/14/2018	14:25:21	19.75	0.50
9/14/2018	14:26:21	19.74	0.50
9/14/2018	14:27:21	19.74	0.50
9/14/2018	14:28:21	19.75	0.50
9/14/2018	14:29:21	19.74	0.50
9/14/2018	14:30:21	19.74	0.50
9/14/2018	14:31:21	19.74	0.50
9/14/2018	14:32:21	19.74	0.50
9/14/2018	14:33:21	19.74	0.50
9/14/2018	14:34:21	19.74	0.50
9/14/2018	14:35:21	19.74	0.50
9/14/2018	14:36:21	19.74	0.50
9/14/2018	14:37:21	19.74	0.51
9/14/2018	14:38:21	19.74	0.51
9/14/2018	14:39:21	19.74	0.52

Hollingswoth & Vose
CFU #112 (2)
Run #2
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	14:40:21	19.73	0.51
9/14/2018	14:41:21	19.74	0.51
9/14/2018	14:42:21	19.74	0.51
9/14/2018	14:43:21	19.74	0.51
9/14/2018	14:44:21	19.74	0.51
9/14/2018	14:45:21	19.73	0.52
9/14/2018	14:46:21	19.73	0.51
9/14/2018	14:47:21	19.73	0.51
9/14/2018	14:48:21	19.73	0.51
9/14/2018	14:49:21	19.73	0.50
9/14/2018	14:50:21	19.73	0.51
9/14/2018	14:51:21	19.73	0.50
9/14/2018	14:52:21	19.73	0.50
9/14/2018	14:53:21	19.73	0.50
9/14/2018	14:54:21	19.72	0.51
9/14/2018	14:55:21	19.72	0.50
9/14/2018	14:56:21	19.73	0.50
9/14/2018	14:57:21	19.73	0.50
9/14/2018	14:58:21	19.73	0.50
9/14/2018	14:59:21	19.73	0.50
9/14/2018	15:00:21	19.73	0.50
9/14/2018	15:01:21	19.73	0.51
9/14/2018	15:02:21	19.73	0.51
9/14/2018	15:03:21	19.72	0.51
9/14/2018	15:04:21	19.73	0.51
9/14/2018	15:05:21	19.73	0.51
9/14/2018	15:06:21	19.73	0.52
9/14/2018	15:07:21	19.72	0.51
9/14/2018	15:08:21	19.72	0.51
9/14/2018	15:09:21	19.72	0.51
9/14/2018	15:10:21	19.73	0.51
9/14/2018	15:11:21	19.73	0.51
9/14/2018	15:12:21	19.73	0.50
9/14/2018	15:13:21	19.73	0.51
9/14/2018	15:14:21	19.73	0.50
9/14/2018	15:15:21	19.73	0.50
9/14/2018	15:16:21	19.72	0.50
9/14/2018	15:17:21	19.72	0.50
9/14/2018	15:18:21	19.73	0.50
9/14/2018	15:19:21	19.74	0.49

Hollingswoth & Vose
CFU #112 (2)
Run #2
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	15:20:21	19.73	0.50
9/14/2018	15:21:21	19.72	0.50
9/14/2018	15:22:21	19.72	0.50
9/14/2018	15:23:21	19.72	0.51
9/14/2018	15:24:21	19.72	0.50
9/14/2018	15:25:21	19.72	0.50
9/14/2018	15:26:21	19.72	0.51
9/14/2018	15:27:21	19.72	0.51
9/14/2018	15:28:21	19.72	0.52
9/14/2018	15:29:21	19.72	0.52
9/14/2018	15:30:21	19.72	0.51
9/14/2018	15:31:21	19.72	0.52
9/14/2018	15:32:21	19.72	0.51
9/14/2018	15:33:21	19.72	0.52
9/14/2018	15:34:21	19.72	0.52
9/14/2018	15:35:21	19.72	0.51
9/14/2018	15:36:21	19.71	0.51
9/14/2018	15:37:21	19.72	0.51
9/14/2018	15:38:21	19.72	0.51
9/14/2018	15:39:21	19.71	0.51
9/14/2018	15:40:21	19.72	0.50
9/14/2018	15:41:21	19.72	0.50
9/14/2018	15:42:21	19.72	0.50
9/14/2018	15:43:21	19.71	0.50
9/14/2018	15:44:21	19.71	0.50
9/14/2018	15:45:21	19.72	0.50
9/14/2018	15:46:21	19.71	0.50
9/14/2018	15:47:21	19.71	0.51
9/14/2018	15:48:21	19.72	0.50
9/14/2018	15:49:21	19.72	0.50
9/14/2018	15:50:21	19.71	0.51
9/14/2018	15:51:21	19.71	0.52
9/14/2018	15:52:21	19.71	0.52
9/14/2018	15:53:21	19.72	0.52
9/14/2018	15:54:21	19.71	0.52
9/14/2018	15:55:21	19.72	0.52
9/14/2018	15:56:21	19.72	0.51
9/14/2018	15:57:21	19.71	0.52
9/14/2018	15:58:21	19.70	0.52
9/14/2018	15:59:21	19.69	0.52

Hollingswoth & Vose
CFU #112 (2)
Run #2
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	16:00:21	19.71	0.52
9/14/2018	16:01:21	19.70	0.52
9/14/2018	16:02:21	19.71	0.51
9/14/2018	16:03:21	19.72	0.50
9/14/2018	16:04:21	19.72	0.50
9/14/2018	16:05:21	19.71	0.50
9/14/2018	16:06:21	19.70	0.50
9/14/2018	16:07:21	19.71	0.50
9/14/2018	16:08:21	19.71	0.50
9/14/2018	16:09:21	19.70	0.51
9/14/2018	16:10:21	19.70	0.51
9/14/2018	16:11:21	19.71	0.51
9/14/2018	16:12:21	19.71	0.51
9/14/2018	16:13:21	19.71	0.51
9/14/2018	16:14:21	19.70	0.51
9/14/2018	16:15:21	19.72	0.51
9/14/2018	16:16:21	19.71	0.52
9/14/2018	16:17:21	19.70	0.52
9/14/2018	16:18:21	19.72	0.52
9/14/2018	16:19:21	19.71	0.52
9/14/2018	16:20:21	19.71	0.51
9/14/2018	16:21:21	19.71	0.52
9/14/2018	16:22:21	19.71	0.51
9/14/2018	16:23:21	19.72	0.51
9/14/2018	16:24:21	19.71	0.51
9/14/2018	16:25:21	19.72	0.51
Final Average		**19.73**	**0.51**

Bias Check

9/14/2018	16:26:21	19.72	0.51
9/14/2018	16:26:31	19.71	0.51
9/14/2018	16:26:41	19.73	0.51
9/14/2018	16:26:51	19.58	0.67
9/14/2018	16:27:01	12.41	1.19
9/14/2018	16:27:11	4.27	0.49
9/14/2018	16:27:21	1.41	0.20
9/14/2018	16:27:31	0.49	0.10
9/14/2018	16:27:41	0.20	0.07
9/14/2018	16:27:51	0.09	0.06
9/14/2018	16:28:01	0.05	0.05

Hollingswoth & Vose
CFU #112 (2)
Run #2
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	16:28:11	0.04	0.05
9/14/2018	16:28:21	0.03	0.05
9/14/2018	16:28:31	0.03	0.05
9/14/2018	16:28:41	0.02	0.04
9/14/2018	16:28:51	0.02	0.05
9/14/2018	16:29:01	0.02	0.05
9/14/2018	16:29:11	0.02	0.05
9/14/2018	16:29:21	0.01	0.05
9/14/2018	16:29:31	0.01	0.04
9/14/2018	16:29:41	0.01	0.03
9/14/2018	16:29:51	0.01	0.04
9/14/2018	16:30:01	0.00	0.03
9/14/2018	16:30:11	0.00	0.04
9/14/2018	16:30:21	0.00	0.04
9/14/2018	16:30:31	0.00	0.05
9/14/2018	16:30:41	0.00	0.04
9/14/2018	16:30:51	0.58	0.66
9/14/2018	16:31:01	1.48	1.38
9/14/2018	16:31:11	1.76	1.68
9/14/2018	16:31:21	1.85	1.77
9/14/2018	16:31:31	1.88	1.81
9/14/2018	16:31:41	1.89	1.82
9/14/2018	16:31:51	1.90	1.83
9/14/2018	16:32:01	1.90	1.82
9/14/2018	16:32:11	1.89	1.83
9/14/2018	16:32:21	1.90	1.83
9/14/2018	16:32:31	1.90	1.84
9/14/2018	16:32:41	1.90	1.84
9/14/2018	16:32:51	1.89	1.84
9/14/2018	16:33:01	1.92	1.84
9/14/2018	16:33:11	4.26	4.31
9/14/2018	16:33:21	7.94	8.07
9/14/2018	16:33:31	9.18	9.14
9/14/2018	16:33:41	9.57	9.50
9/14/2018	16:33:51	9.70	9.64
9/14/2018	16:34:01	9.75	9.68
9/14/2018	16:34:11	9.78	9.71
9/14/2018	16:34:21	9.79	9.70
9/14/2018	16:34:31	9.79	9.72
9/14/2018	16:34:41	9.79	9.73

Hollingswoth & Vose
CFU #112 (2)
Run #2
9/14/2018

Date	Time	O2 [%]	CO2 [%]
9/14/2018	16:34:51	9.79	9.74
9/14/2018	16:35:01	9.80	9.74
9/14/2018	16:35:11	9.80	9.74
9/14/2018	16:35:21	9.80	9.74
9/14/2018	16:35:31	9.78	9.75
9/14/2018	16:35:41	11.30	8.26
9/14/2018	16:35:51	16.22	3.58
9/14/2018	16:36:01	18.48	1.51
		O2 [%]	**CO2 [%]**
System Zero		**0.03**	**0.05**
System Mid		**9.80**	**1.84**

Daily Gaseous Calibrations Log

Client: H & V

Source: CFU-112 - M5/~~24~~ 316 DSB all gasses (2)

Date: 09/15/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	⊖	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

- see 9/11

*Use of a calibrated instrument required

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
⊖	X	⊖	X	⊖	X	0	X	50.41	X
10	X	2.5	X	50	X	2	X		
20	X	5.0	X	100	X	4	X		

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
⊖	X	⊖	X	⊖	X	⊖	X		
10	X	2.5	X	50	X	2	X		

DSB System @ 6:50

System VOC Calibrations		
	Initial target	Post Target
Zero	⊖	⊖
Low	6.25	—
Mid	12.50	12.50
High	21.25	—

begin @ 7:13

Alt-106 - 50 PPM CH_4

Stratification test during run #1 - see 9/11

w/ M-29 → Test Times: R-1 — R-2 — R-3 10:15 - 13:21

w/ M5-M316 → R-1 13:49 - 15:55 16:14 ~~18:40~~ DSB 18:21 18:40 - 20:45

336

post - pass

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/15/2018

Date	Time	O2 [%]	CO2 [%]
9/15/2018	6:22:49	-0.08	0.01
9/15/2018	6:22:59	-0.12	0.01
9/15/2018	6:23:09	-0.13	0.01
9/15/2018	6:23:19	-0.09	0.01
9/15/2018	6:23:29	-0.07	0.01
9/15/2018	6:23:39	-0.08	0.01
9/15/2018	6:23:49	-0.08	0.00
9/15/2018	6:23:59	-0.08	-0.01
9/15/2018	6:24:09	-0.09	0.00
9/15/2018	6:24:19	-0.09	0.01
9/15/2018	6:24:29	-0.09	0.00
9/15/2018	6:24:39	3.72	5.48
9/15/2018	6:24:49	10.49	14.57
9/15/2018	6:24:59	18.69	19.19
9/15/2018	6:25:09	19.52	19.59
9/15/2018	6:25:19	19.56	19.61
9/15/2018	6:25:29	19.56	19.62
9/15/2018	6:25:39	19.55	19.63
9/15/2018	6:25:49	19.75	19.63
9/15/2018	6:25:59	19.73	19.64
9/15/2018	6:26:09	19.80	19.64
9/15/2018	6:26:19	19.90	19.65
9/15/2018	6:26:29	19.93	19.66
9/15/2018	6:26:39	19.93	19.66
9/15/2018	6:26:49	19.41	19.63
9/15/2018	6:26:59	13.38	11.81
9/15/2018	6:27:09	9.86	9.81
9/15/2018	6:27:19	9.89	9.84
9/15/2018	6:27:29	9.87	9.82
9/15/2018	6:27:39	9.86	9.81
9/15/2018	6:27:49	9.86	9.80
9/15/2018	6:27:59	9.86	9.80
9/15/2018	6:28:09	8.81	8.09
9/15/2018	6:28:19	3.31	3.29
9/15/2018	6:28:29	3.82	4.10
9/15/2018	6:28:39	3.83	4.09
9/15/2018	6:28:49	3.83	4.08
9/15/2018	6:28:59	3.83	4.09
9/15/2018	6:29:09	3.86	4.08
9/15/2018	6:29:19	3.86	4.07

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/15/2018

Date	Time	O2 [%]	CO2 [%]
9/15/2018	6:29:29	2.94	2.87
9/15/2018	6:29:39	1.96	1.90
9/15/2018	6:29:49	1.85	1.84
9/15/2018	6:29:59	1.84	1.82
9/15/2018	6:30:09	1.85	1.82
9/15/2018	6:30:19	1.84	1.82
9/15/2018	6:30:29	1.77	1.82
9/15/2018	6:30:39	1.62	1.80
9/15/2018	6:30:49	1.62	1.80
9/15/2018	6:30:59	1.62	1.82
9/15/2018	6:31:09	1.63	1.82
9/15/2018	6:31:19	1.62	1.83
9/15/2018	6:31:29	1.63	1.83
9/15/2018	6:31:39	1.62	1.84
9/15/2018	6:31:49	1.62	1.84
9/15/2018	6:31:59	1.62	1.84
9/15/2018	6:32:09	1.63	1.84
9/15/2018	6:32:19	3.07	2.53
9/15/2018	6:32:29	1.27	0.59
9/15/2018	6:32:39	-0.04	0.04
9/15/2018	6:32:49	-0.09	0.02
9/15/2018	6:32:59	-0.10	0.02
9/15/2018	6:33:09	-0.10	0.01

		O2 [%]	CO2 [%]
Analyzer Zero		**-0.09**	**0.00**
Analyzer Mid		**9.86**	**1.83**
Analyzer High		**19.92**	**4.09**

Bias Check

9/15/2018	6:58:29	0.08	0.00
9/15/2018	6:58:39	0.08	0.01
9/15/2018	6:58:49	0.08	0.01
9/15/2018	6:58:59	0.09	0.00
9/15/2018	6:59:09	1.76	0.01
9/15/2018	6:59:19	9.97	0.03
9/15/2018	6:59:29	15.45	0.04
9/15/2018	6:59:39	17.05	0.05
9/15/2018	6:59:49	10.37	0.03
9/15/2018	6:59:59	4.95	0.16
9/15/2018	7:00:09	3.15	0.96

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/15/2018

Date	Time	O2 [%]	CO2 [%]
9/15/2018	7:00:19	2.50	1.42
9/15/2018	7:00:29	2.22	1.63
9/15/2018	7:00:39	2.09	1.73
9/15/2018	7:00:49	2.02	1.77
9/15/2018	7:00:59	2.00	1.80
9/15/2018	7:01:09	1.99	1.81
9/15/2018	7:01:19	1.99	1.81
9/15/2018	7:01:29	1.99	1.81
9/15/2018	7:01:39	1.98	1.82
9/15/2018	7:01:49	1.98	1.82
9/15/2018	7:01:59	1.98	1.81
9/15/2018	7:02:09	2.00	1.86
9/15/2018	7:02:19	4.59	5.07
9/15/2018	7:02:29	7.39	7.64
9/15/2018	7:02:39	8.67	8.69
9/15/2018	7:02:49	9.26	9.21
9/15/2018	7:02:59	9.53	9.44
9/15/2018	7:03:09	9.66	9.56
9/15/2018	7:03:19	9.81	9.63
9/15/2018	7:03:29	9.96	9.65
9/15/2018	7:03:39	9.99	9.67
9/15/2018	7:03:49	10.00	9.68
9/15/2018	7:03:59	10.00	9.69
9/15/2018	7:04:09	10.00	9.70
9/15/2018	7:04:19	10.00	9.70
9/15/2018	7:04:29	10.00	9.69

	O2 [%]	CO2 [%]
System Zero	**0.08**	**0.01**
System Mid	**10.00**	**1.82**

Hollingswoth & Vose
CFU #112 (2)
Run #3
9/15/2018

Date	Time	O2 [%]	CO2 [%]
9/15/2018	10:15:38	19.91	0.48
9/15/2018	10:16:38	19.91	0.47
9/15/2018	10:17:38	19.91	0.47
9/15/2018	10:18:38	19.90	0.47
9/15/2018	10:19:38	19.90	0.47
9/15/2018	10:20:38	19.89	0.47
9/15/2018	10:21:38	19.90	0.47
9/15/2018	10:22:38	19.91	0.46
9/15/2018	10:23:38	19.90	0.46
9/15/2018	10:24:38	19.91	0.46
9/15/2018	10:25:38	19.91	0.46
9/15/2018	10:26:38	19.90	0.47
9/15/2018	10:27:38	19.90	0.46
9/15/2018	10:28:38	19.90	0.47
9/15/2018	10:29:38	19.89	0.47
9/15/2018	10:30:38	19.90	0.47
9/15/2018	10:31:38	19.90	0.47
9/15/2018	10:32:38	19.90	0.47
9/15/2018	10:33:38	19.90	0.47
9/15/2018	10:34:38	19.90	0.48
9/15/2018	10:35:38	19.90	0.48
9/15/2018	10:36:38	19.90	0.48
9/15/2018	10:37:38	19.90	0.48
9/15/2018	10:38:38	19.90	0.48
9/15/2018	10:39:38	19.90	0.48
9/15/2018	10:40:38	19.91	0.48
9/15/2018	10:41:38	19.90	0.47
9/15/2018	10:42:38	19.90	0.48
9/15/2018	10:43:38	19.90	0.47
9/15/2018	10:44:38	19.89	0.48
9/15/2018	10:45:38	19.90	0.47
9/15/2018	10:46:38	19.90	0.46
9/15/2018	10:47:38	19.89	0.47
9/15/2018	10:48:38	19.89	0.47
9/15/2018	10:49:38	19.89	0.47
9/15/2018	10:50:38	19.89	0.47
9/15/2018	10:51:38	19.89	0.47
9/15/2018	10:52:38	19.89	0.47
9/15/2018	10:53:38	19.90	0.47
9/15/2018	10:54:38	19.89	0.47

Hollingswoth & Vose
CFU #112 (2)
Run #3
9/15/2018

Date	Time	O2 [%]	CO2 [%]
9/15/2018	10:55:38	19.89	0.48
9/15/2018	10:56:38	19.90	0.48
9/15/2018	10:57:38	19.89	0.48
9/15/2018	10:58:38	19.89	0.49
9/15/2018	10:59:38	19.89	0.49
9/15/2018	11:00:38	19.89	0.48
9/15/2018	11:01:38	19.90	0.48
9/15/2018	11:02:38	19.89	0.48
9/15/2018	11:03:38	19.90	0.48
9/15/2018	11:04:38	19.90	0.48
9/15/2018	11:05:38	19.89	0.48
9/15/2018	11:06:38	19.90	0.48
9/15/2018	11:07:38	19.89	0.48
9/15/2018	11:08:38	19.89	0.48
9/15/2018	11:09:38	19.89	0.48
9/15/2018	11:10:38	19.90	0.47
9/15/2018	11:11:38	19.90	0.47
9/15/2018	11:12:38	19.90	0.48
9/15/2018	11:13:38	19.90	0.47
9/15/2018	11:14:38	19.90	0.47
9/15/2018	11:15:38	19.90	0.47
9/15/2018	11:16:38	19.91	0.47
9/15/2018	11:17:38	19.90	0.48
9/15/2018	11:18:38	19.90	0.48
9/15/2018	11:19:38	19.90	0.48
9/15/2018	11:20:38	19.91	0.48
9/15/2018	11:21:38	19.90	0.49
9/15/2018	11:22:38	19.89	0.50
9/15/2018	11:23:38	19.89	0.49
9/15/2018	11:24:38	19.90	0.49
9/15/2018	11:25:38	19.90	0.48
9/15/2018	11:26:38	19.91	0.48
9/15/2018	11:27:38	19.91	0.48
9/15/2018	11:28:38	19.91	0.48
9/15/2018	11:29:38	19.90	0.49
9/15/2018	11:30:38	19.90	0.49
9/15/2018	11:31:38	19.90	0.48
9/15/2018	11:32:38	19.90	0.48
9/15/2018	11:33:38	19.90	0.47
9/15/2018	11:34:38	19.90	0.47

Hollingswoth & Vose
CFU #112 (2)
Run #3
9/15/2018

Date	Time	O2 [%]	CO2 [%]
9/15/2018	11:35:38	19.90	0.48
9/15/2018	11:36:38	19.90	0.48
9/15/2018	11:37:38	19.90	0.48
9/15/2018	11:38:38	19.90	0.48
9/15/2018	11:39:38	19.90	0.48
9/15/2018	11:40:38	19.90	0.49
9/15/2018	11:41:38	19.90	0.48
9/15/2018	11:42:38	19.89	0.49
9/15/2018	11:43:38	19.89	0.49
9/15/2018	11:44:38	19.90	0.49
9/15/2018	11:45:38	19.90	0.50
9/15/2018	11:46:38	19.90	0.50
9/15/2018	11:47:38	19.90	0.50
9/15/2018	11:48:38	19.90	0.50
9/15/2018	11:49:38	19.91	0.49
9/15/2018	11:50:38	19.90	0.49
9/15/2018	11:51:38	19.90	0.50
9/15/2018	11:52:38	19.90	0.49
9/15/2018	11:53:38	19.90	0.50
9/15/2018	11:54:38	19.90	0.49
9/15/2018	11:55:38	19.89	0.49
9/15/2018	11:56:38	19.89	0.49
9/15/2018	11:57:38	19.89	0.48
9/15/2018	11:58:38	19.91	0.48
9/15/2018	11:59:38	19.90	0.48
9/15/2018	12:00:38	19.89	0.48
9/15/2018	12:01:38	19.88	0.49
9/15/2018	12:02:38	19.89	0.49
9/15/2018	12:03:38	19.90	0.48
9/15/2018	12:04:38	19.89	0.49
9/15/2018	12:05:38	19.88	0.49
9/15/2018	12:06:38	19.89	0.49
9/15/2018	12:07:38	19.89	0.49
9/15/2018	12:08:38	19.89	0.50
9/15/2018	12:09:38	19.88	0.50
9/15/2018	12:10:38	19.88	0.51
9/15/2018	12:11:38	19.88	0.51
9/15/2018	12:12:38	19.88	0.50
9/15/2018	12:13:38	19.88	0.50
9/15/2018	12:14:38	19.88	0.50

Hollingswoth & Vose
CFU #112 (2)
Run #3
9/15/2018

Date	Time	O2 [%]	CO2 [%]
9/15/2018	12:15:38	19.87	0.50
9/15/2018	12:16:38	19.88	0.50
9/15/2018	12:17:38	19.89	0.49
9/15/2018	12:18:38	19.88	0.49
9/15/2018	12:19:38	19.88	0.49
9/15/2018	12:20:38	19.88	0.49
9/15/2018	12:21:38	19.88	0.48
9/15/2018	12:22:38	19.89	0.48
9/15/2018	12:23:38	19.88	0.49
9/15/2018	12:24:38	19.88	0.48
9/15/2018	12:25:38	19.88	0.48
9/15/2018	12:26:38	19.88	0.48
9/15/2018	12:27:38	19.88	0.48
9/15/2018	12:28:38	19.89	0.48
9/15/2018	12:29:38	19.88	0.49
9/15/2018	12:30:38	19.87	0.49
9/15/2018	12:31:38	19.86	0.50
9/15/2018	12:32:38	19.87	0.50
9/15/2018	12:33:38	19.88	0.50
9/15/2018	12:34:38	19.87	0.49
9/15/2018	12:35:38	19.87	0.50
9/15/2018	12:36:38	19.86	0.50
9/15/2018	12:37:38	19.87	0.50
9/15/2018	12:38:38	19.87	0.50
9/15/2018	12:39:38	19.87	0.49
9/15/2018	12:40:38	19.86	0.49
9/15/2018	12:41:38	19.86	0.49
9/15/2018	12:42:38	19.86	0.49
9/15/2018	12:43:38	19.85	0.49
9/15/2018	12:44:38	19.86	0.48
9/15/2018	12:45:38	19.86	0.48
9/15/2018	12:46:38	19.86	0.48
9/15/2018	12:47:38	19.86	0.48
9/15/2018	12:48:38	19.85	0.49
9/15/2018	12:49:38	19.85	0.48
9/15/2018	12:50:38	19.85	0.48
9/15/2018	12:51:38	19.85	0.49
9/15/2018	12:52:38	19.86	0.49
9/15/2018	12:53:38	19.85	0.49
9/15/2018	12:54:38	19.84	0.49

Hollingswoth & Vose
CFU #112 (2)
Run #3
9/15/2018

Date	Time	O2 [%]	CO2 [%]
9/15/2018	12:55:38	19.84	0.49
9/15/2018	12:56:38	19.85	0.49
9/15/2018	12:57:38	19.86	0.49
9/15/2018	12:58:38	19.86	0.50
9/15/2018	12:59:38	19.85	0.49
9/15/2018	13:00:38	19.85	0.50
9/15/2018	13:01:38	19.85	0.50
9/15/2018	13:02:38	19.85	0.50
9/15/2018	13:03:38	19.84	0.50
9/15/2018	13:04:38	19.85	0.49
9/15/2018	13:05:38	19.85	0.49
9/15/2018	13:06:38	19.86	0.48
9/15/2018	13:07:38	19.86	0.48
9/15/2018	13:08:38	19.84	0.48
9/15/2018	13:09:38	19.84	0.48
9/15/2018	13:10:38	19.84	0.47
9/15/2018	13:11:38	19.84	0.48
9/15/2018	13:12:38	19.84	0.48
9/15/2018	13:13:38	19.83	0.48
9/15/2018	13:14:38	19.83	0.48
9/15/2018	13:15:38	19.84	0.48
9/15/2018	13:16:38	19.84	0.48
9/15/2018	13:17:38	19.84	0.48
9/15/2018	13:18:38	19.84	0.48
9/15/2018	13:19:38	19.83	0.49
9/15/2018	13:20:38	19.83	0.49
9/15/2018	13:21:38	18.85	0.47
Final Average		**19.88**	**0.48**

Bias Check

9/15/2018	13:22:08	19.85	0.50
9/15/2018	13:22:18	19.77	0.49
9/15/2018	13:22:28	13.96	0.34
9/15/2018	13:22:38	6.60	0.16
9/15/2018	13:22:48	3.04	0.09
9/15/2018	13:22:58	1.43	0.05
9/15/2018	13:23:08	0.71	0.03
9/15/2018	13:23:18	0.38	0.03
9/15/2018	13:23:28	0.23	0.02
9/15/2018	13:23:38	0.16	0.02

Hollingswoth & Vose
CFU #112 (2)
Run #3
9/15/2018

Date	Time	O2 [%]	CO2 [%]
9/15/2018	13:23:48	0.13	0.02
9/15/2018	13:23:58	0.11	0.02
9/15/2018	13:24:08	0.10	0.02
9/15/2018	13:24:18	0.09	0.02
9/15/2018	13:24:28	0.09	0.01
9/15/2018	13:24:38	0.08	0.02
9/15/2018	13:24:48	0.09	0.01
9/15/2018	13:24:58	0.08	0.02
9/15/2018	13:25:08	0.36	0.19
9/15/2018	13:25:18	1.25	0.94
9/15/2018	13:25:28	1.34	1.06
9/15/2018	13:25:38	0.73	0.57
9/15/2018	13:25:48	0.38	0.29
9/15/2018	13:25:58	0.59	0.57
9/15/2018	13:26:08	1.43	1.38
9/15/2018	13:26:18	1.74	1.63
9/15/2018	13:26:28	1.89	1.74
9/15/2018	13:26:38	1.95	1.79
9/15/2018	13:26:48	1.98	1.82
9/15/2018	13:26:58	1.99	1.83
9/15/2018	13:27:08	1.99	1.83
9/15/2018	13:27:18	2.00	1.83
9/15/2018	13:27:28	2.00	1.83
9/15/2018	13:27:38	2.00	1.84
9/15/2018	13:27:48	4.48	4.77
9/15/2018	13:27:58	7.45	7.58
9/15/2018	13:28:08	8.77	8.69
9/15/2018	13:28:18	9.37	9.23
9/15/2018	13:28:28	9.65	9.47
9/15/2018	13:28:38	9.78	9.60
9/15/2018	13:28:48	9.84	9.66
9/15/2018	13:28:58	9.86	9.69
9/15/2018	13:29:08	9.88	9.70
9/15/2018	13:29:18	9.88	9.71
9/15/2018	13:29:28	9.88	9.71
9/15/2018	13:29:38	9.88	9.72
		O2 [%]	**CO2 [%]**
System Zero		**0.08**	**0.02**
System Mid		**9.88**	**1.83**

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis OR**
SOURCE	**CFU 112 (2)**
DATE	**09/15/18**
METHOD	**5**
POLLUTANT	**Particulate Matter**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**13:50**
Source:	**CFU 112 (2)**	**End Time:**	**15:56**
EPA Method:	**5**	**Date:**	**9/15/2018**
Box Operator:	**CMF**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Overcast 68 F Variable wind

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1307999	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size	0.2173 inches
ΔH@	1.846	Hot box ID	M5-HB	Nozzle area	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.65 "Hg	O_2	19.90 %
Static Pressure	0.56 "H_2O	CO_2	0.70 %
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.201 inches
Stack Temperature	204 F		
Assumed moisture	1.8 %		
Assumed meter temp.	69 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	15	8

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	111.192 dcf	Ave. ΔP	1.467 "H_2O
Wet mol. weight	28.71 M_s (actual)	Ave. √ΔP	1.2106 "H_2O
Actual H_2O	1.81 %	Ave. ΔH	2.883 "H_2O
Std. meter vol.	110.685 dscf	Ave. T_s	201.2 °F
Isokinetic Average	100.1 %	Ave. T_m	69.6 °F

Moisture/Lab:

Filter Q1374 #

	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	245.9	269.3	23.4
		Total water gain:	43.4

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.260	1.30	200	63	2.52	2.50	3	254	52
2	10.0	8.690	1.40	200	63	2.72	2.70	3	253	42
3	15.0	13.290	1.50	200	63	2.91	2.90	3	252	42
4	20.0	17.770	1.40	201	64	2.72	2.70	3	249	43
5	25.0	22.240	1.40	201	65	2.72	2.70	3	254	45
6	30.0	27.150	1.70	201	66	3.31	3.30	3	246	47
7	35.0	31.820	1.50	200	67	2.93	2.90	3	246	48
8	40.0	36.470	1.50	201	68	2.93	2.90	3	252	50
9	45.0	41.120	1.50	201	68	2.93	2.90	3	252	51
10	50.0	45.650	1.40	202	69	2.74	2.70	3	252	52
11	55.0	50.260	1.50	202	70	2.94	2.90	3	248	52
12	60.0	54.945	1.50	201	70	2.94	2.90	3	251	53
13	65.0	59.560	1.40	198	71	2.77	2.80	3	252	53
14	70.0	64.130	1.40	202	72	2.75	2.80	3	252	53
15	75.0	68.700	1.40	202	72	2.75	2.80	3	252	48
16	80.0	73.390	1.50	202	72	2.95	3.00	3	248	53
17	85.0	78.220	1.60	202	72	3.15	3.20	3	253	51
18	90.0	82.990	1.50	202	73	2.96	3.00	3	253	52
19	95.0	87.740	1.50	202	73	2.96	3.00	3	253	52
20	100.0	92.480	1.50	202	74	2.96	3.00	3	250	51
21	105.0	97.240	1.50	201	73	2.96	3.00	3	250	52
22	110.0	102.010	1.50	201	74	2.97	3.00	3	251	52
23	115.0	106.600	1.40	202	74	2.77	2.80	3	251	52
24	120.0	111.192	1.40	202	74	2.77	2.80	3	253	52

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis OR**	**Start Time:**	**16:14**
Source:	**CFU 112 (2)**	**End Time:**	**18:21**
EPA Method:	**5**	**Date:**	**9/15/2018**
Box Operator:	**CMF**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Overcast 68 F Variable wind

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1307999	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	M5-HB	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.65 "Hg	O_2	19.9 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.200 inches
Stack Temperature	204 F		
Assumed moisture	1.81 %		
Assumed meter temp.	69.6 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	6

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	112.178 dcf	Ave. ΔP	1.475 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.2141 "H_2O
Actual H_2O	1.71 %	Ave. ΔH	2.946 "H_2O
Std. meter vol.	110.807 dscf	Ave. T_s	205.1 °F
Isokinetic Average	100.1 %	Ave. T_m	73.8 °F

Moisture/Lab:

Filter Q1375 #

	Initial	Final	Gain
Impingers, g	200.0	215	15.0
Silica gel, g	257.7	283.6	25.9
		Total water gain:	40.9

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.390	1.30	205	73	2.55	2.60	2	253	57
2	10.0	8.890	1.40	205	73	2.75	2.80	2	253	48
3	15.0	13.540	1.40	205	73	2.75	2.80	2	251	50
4	20.0	18.290	1.50	205	73	2.94	3.00	2	251	51
5	25.0	23.110	1.60	204	73	3.15	3.20	2	251	52
6	30.0	27.820	1.50	205	74	2.95	3.00	2	251	52
7	35.0	32.540	1.50	203	74	2.96	3.00	2	252	53
8	40.0	37.260	1.50	202	74	2.96	3.00	2	253	54
9	45.0	41.980	1.50	203	74	2.96	3.00	2	252	54
10	50.0	46.700	1.50	204	74	2.95	3.00	2	252	54
11	55.0	51.430	1.50	204	74	2.95	3.00	2	251	54
12	60.0	56.139	1.50	206	74	2.95	3.00	2	252	55
13	65.0	60.520	1.30	205	74	2.56	2.60	2	252	61
14	70.0	65.090	1.40	206	74	2.75	2.80	2	251	54
15	75.0	69.850	1.50	206	74	2.95	3.00	2	251	54
16	80.0	74.560	1.50	206	74	2.95	3.00	2	251	54
17	85.0	79.250	1.50	206	73	2.94	2.90	2	251	54
18	90.0	83.880	1.50	206	74	2.95	3.00	2	251	54
19	95.0	88.600	1.50	206	74	2.95	3.00	2	250	57
20	100.0	93.340	1.50	206	74	2.95	3.00	2	250	58
21	105.0	98.020	1.50	206	74	2.95	3.00	2	251	58
22	110.0	102.740	1.50	206	74	2.95	3.00	2	251	59
23	115.0	107.450	1.50	206	74	2.95	3.00	2	251	59
24	120.0	112.178	1.50	206	74	2.95	3.00	2	251	59

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis OR**		**Start Time:**	**18:41**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**20:45**
EPA Method:	**5**	Overcast 68 F Variable wind	**Date:**	**9/15/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1307999	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	M5-HB	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.65 "Hg	O_2	19.9 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.2 inches
Stack Temperature	204 F		
Assumed moisture	1.71 %		
Assumed meter temp.	73.8 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	15	8

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	109.877 dcf	Ave. ΔP	1.454 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.205 "H_2O
Actual H_2O	1.76 %	Ave. ΔH	2.808 "H_2O
Std. meter vol.	109.169 dscf	Ave. T_s	207.4 °F
Isokinetic Average	99.6 %	Ave. T_m	70.5 °F

Moisture/Lab:

Filter	Q1376 #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	234.0	255.6	21.6
		Total water gain:	41.6

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.350	1.30	206	72	2.55	2.50	3	253	54
2	10.0	8.850	1.40	206	72	2.74	2.70	3	252	44
3	15.0	13.360	1.40	207	72	2.74	2.70	3	252	44
4	20.0	17.790	1.40	207	72	2.74	2.70	3	253	45
5	25.0	22.430	1.50	207	71	2.93	2.90	3	253	46
6	30.0	27.160	1.50	207	71	2.93	2.90	3	253	45
7	35.0	32.120	1.70	206	71	3.33	3.30	3	253	45
8	40.0	36.870	1.60	207	71	3.13	3.10	3	251	46
9	45.0	41.630	1.50	207	71	2.93	2.90	3	252	47
10	50.0	46.270	1.50	208	71	2.93	2.90	3	252	47
11	55.0	50.960	1.50	208	71	2.93	2.90	3	251	46
12	60.0	55.629	1.50	208	71	2.93	2.90	3	250	48
13	65.0	59.830	1.20	206	70	2.34	2.30	2	251	49
14	70.0	64.180	1.30	208	70	2.53	2.50	2	249	46
15	75.0	68.560	1.30	208	70	2.53	2.50	2	249	46
16	80.0	72.780	1.30	209	70	2.53	2.50	2	250	47
17	85.0	77.400	1.50	209	70	2.92	2.90	2	250	48
18	90.0	82.050	1.50	208	69	2.91	2.90	2	251	48
19	95.0	86.710	1.50	209	70	2.92	2.90	2	251	48
20	100.0	91.320	1.50	208	69	2.91	2.90	2	251	48
21	105.0	96.020	1.50	208	69	2.91	2.90	2	252	50
22	110.0	100.670	1.50	207	69	2.92	2.90	2	252	50
23	115.0	105.240	1.50	207	70	2.92	2.90	3	251	50
24	120.0	109.877	1.50	207	69	2.92	2.90	3	253	51

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**13:50**
Source:	**CFU 112 (2)**	**End Time:**	**15:56**
Method:	**ODEQ 5**	**Date:**	**9/15/2018**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
5	4.260	2.50	63	1	1.30	200	1.1402
10	8.690	2.70	63	2	1.40	200	1.1832
15	13.290	2.90	63	3	1.50	200	1.2247
20	17.770	2.70	64	4	1.40	201	1.1832
25	22.240	2.70	65	5	1.40	201	1.1832
30	27.150	3.30	66	6	1.70	201	1.3038
35	31.820	2.90	67	7	1.50	200	1.2247
40	36.470	2.90	68	8	1.50	201	1.2247
45	41.120	2.90	68	9	1.50	201	1.2247
50	45.650	2.70	69	10	1.40	202	1.1832
55	50.260	2.90	70	11	1.50	202	1.2247
60	54.945	2.90	70	12	1.50	201	1.2247
65	59.560	2.80	71	13	1.40	198	1.1832
70	64.130	2.80	72	14	1.40	202	1.1832
75	68.700	2.80	72	15	1.40	202	1.1832
80	73.390	3.00	72	16	1.50	202	1.2247
85	78.220	3.20	72	17	1.60	202	1.2649
90	82.990	3.00	73	18	1.50	202	1.2247
95	87.740	3.00	73	19	1.50	202	1.2247
100	92.480	3.00	74	20	1.50	202	1.2247
105	97.240	3.00	73	21	1.50	201	1.2247
110	102.010	3.00	74	22	1.50	201	1.2247
115	106.600	2.80	74	23	1.40	202	1.1832
120	111.192	2.80	74	24	1.40	202	1.1832

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 112 (2)**	**Date:**	**09/15/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	111.192	dcf	Rectangular		
Water Volume	43.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.65	"Hg	CO_2 Average	0.52	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.99	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.883	"H_2O	√Dp	1.2106	"H_2O
Temperature, T_m	69.6	^oF	Temperature, T_s	201.2	^oF
Temperature, T_m	529.6	^oA (^oR)	Temperature, T_s	661.2	^oA (R)
Pressure Meter, P_m	29.862	"Hg	Pressure Stack, P_s	29.691	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	110.685	dscf	Velocity, V_s	76.61	fps
	3.134	dscm	Volume (actual)	22,564.7	awcfm
Actual Volume, $V_{m(actual)}$	142.309	awcf		22,156.3	adcfm
Gas Stream Moisture			Volume (standard)	1,072,865.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.042	scf		1,053,446.7	dscf/hr
Moisture, B_{ws}	0.0181			17,557.4	dscf/min
Moisture EPA M4	1.81	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.68	lb/lb-mole			
Percent Isokinetic	100.0	%			

Laboratory Results

EPA Method 5					
Filterable PM	1.25E-03	grams			
Emissions:					
Concentration, C_s	1.74E-04	gr/dscf			
	399	µg/dscm			
Mass Emissions	2.62E-02	lb/hr			
Back Half:					
Inorganic CPM	1.05E-03	grams	Organic CPM	9.00E-04	grams
Inorganic CPM, C_s	1.46E-04	gr/dscf	Organic CPM, C_s	1.25E-04	gr/dscf
	335	µg/dscm		287	µg/dscm
Mass Emissions	2.20E-02	lb/hr	Mass Emissions	1.89E-02	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis OR**	**Start Time:**	**16:14**
Source:	**CFU 112 (2)**	**End Time:**	**18:21**
Method:	**ODEQ 5**	**Date:**	**09/15/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
5	4.390	2.60	73	1	1.30	205	1.1402
10	8.890	2.80	73	2	1.40	205	1.1832
15	13.540	2.80	73	3	1.40	205	1.1832
20	18.290	3.00	73	4	1.50	205	1.2247
25	23.110	3.20	73	5	1.60	204	1.2649
30	27.820	3.00	74	6	1.50	205	1.2247
35	32.540	3.00	74	7	1.50	203	1.2247
40	37.260	3.00	74	8	1.50	202	1.2247
45	41.980	3.00	74	9	1.50	203	1.2247
50	46.700	3.00	74	10	1.50	204	1.2247
55	51.430	3.00	74	11	1.50	204	1.2247
60	56.139	3.00	74	12	1.50	206	1.2247
65	60.520	2.60	74	13	1.30	205	1.1402
70	65.090	2.80	74	14	1.40	206	1.1832
75	69.850	3.00	74	15	1.50	206	1.2247
80	74.560	3.00	74	16	1.50	206	1.2247
85	79.250	2.90	73	17	1.50	206	1.2247
90	83.880	3.00	74	18	1.50	206	1.2247
95	88.600	3.00	74	19	1.50	206	1.2247
100	93.340	3.00	74	20	1.50	206	1.2247
105	98.020	3.00	74	21	1.50	206	1.2247
110	102.740	3.00	74	22	1.50	206	1.2247
115	107.450	3.00	74	23	1.50	206	1.2247
120	112.178	3.00	74	24	1.50	206	1.2247

Client:	Hollingsworth & Vose	Run:	2
Source:	CFU 112 (2)	Date:	09/15/18

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	112.178	dcf	Rectangular		
Water Volume	40.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.65	"Hg	CO_2 Average	0.53	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.14	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.946	"H_2O	√Dp	1.2141	"H_2O
Temperature, T_m	73.8	^oF	Temperature, T_s	205.1	^oF
Temperature, T_m	533.8	^oA (^oR)	Temperature, T_s	665.1	^oA (R)
Pressure Meter, P_m	29.867	"Hg	Pressure Stack, P_s	29.691	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	110.807	dscf	Velocity, V_s	77.03	fps
	3.138	dscm	Volume (actual)	22,688.4	awcfm
Actual Volume, $V_{m(actual)}$	143.160	awcf		22,300.4	adcfm
Gas Stream Moisture			Volume (standard)	1,072,421.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.925	scf		1,054,083.4	dscf/hr
Moisture, B_{ws}	0.0171			17,568.1	dscf/min
Moisture EPA M4	1.71	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.1	%			

Laboratory Results

Front Half:

Filterable PM	9.50E-04	grams
Emissions:		
Concentration, C_s	1.32E-04	gr/dscf
	303	µg/dscm
Mass Emissions	1.99E-02	lb/hr

Back Half:

Inorganic CPM	7.00E-04	grams	Organic CPM	6.50E-04	grams
Inorganic CPM, C_s	9.75E-05	gr/dscf	Organic CPM, C_s	9.05E-05	gr/dscf
	223	µg/dscm		207	µg/dscm
Mass Emissions	1.47E-02	lb/hr	Mass Emissions	1.36E-02	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis OR**	**Start Time:**	**18:41**
Source:	**CFU 112 (2)**	**End Time:**	**20:45**
Method:	**ODEQ 5**	**Date:**	**09/15/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
5	4.350	2.50	72	1	1.30	206	1.1402
10	8.850	2.70	72	2	1.40	206	1.1832
15	13.360	2.70	72	3	1.40	207	1.1832
20	17.790	2.70	72	4	1.40	207	1.1832
25	22.430	2.90	71	5	1.50	207	1.2247
30	27.160	2.90	71	6	1.50	207	1.2247
35	32.120	3.30	71	7	1.70	206	1.3038
40	36.870	3.10	71	8	1.60	207	1.2649
45	41.630	2.90	71	9	1.50	207	1.2247
50	46.270	2.90	71	10	1.50	208	1.2247
55	50.960	2.90	71	11	1.50	208	1.2247
60	55.629	2.90	71	12	1.50	208	1.2247
65	59.830	2.30	70	13	1.20	206	1.0954
70	64.180	2.50	70	14	1.30	208	1.1402
75	68.560	2.50	70	15	1.30	208	1.1402
80	72.780	2.50	70	16	1.30	209	1.1402
85	77.400	2.90	70	17	1.50	209	1.2247
90	82.050	2.90	69	18	1.50	208	1.2247
95	86.710	2.90	70	19	1.50	209	1.2247
100	91.320	2.90	69	20	1.50	208	1.2247
105	96.020	2.90	69	21	1.50	208	1.2247
110	100.670	2.90	69	22	1.50	207	1.2247
115	105.240	2.90	70	23	1.50	207	1.2247
120	109.877	2.90	69	24	1.50	207	1.2247

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Source:	**CFU 112 (2)**		**Date:**	**09/15/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	109.877	dcf	Rectangular		
Water Volume	41.6	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.65	"Hg	CO_2 Average	0.52	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.11	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.808	"H_2O	$\sqrt{Dp}$	1.2050	"H_2O
Temperature, T_m	70.5	^oF	Temperature, T_s	207.4	^oF
Temperature, T_m	530.5	^oA (^oR)	Temperature, T_s	667.4	^oA (R)
Pressure Meter, P_m	29.856	"Hg	Pressure Stack, P_s	29.691	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	109.169	dscf	Velocity, V_s	76.58	fps
	3.091	dscm	Volume (actual)	22,555.9	awcfm
Actual Volume, $V_{m(actual)}$	141.603	awcf		22,158.9	adcfm
Gas Stream Moisture			Volume (standard)	1,062,482.7	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.958	scf		1,043,783.0	dscf/hr
Moisture, B_{ws}	0.0176			17,396.4	dscf/min
Moisture EPA M4	1.76	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	99.6	%			

Laboratory Results

Front Half:					
Filterable PM	0.00E+00	grams			
Emissions:					
Concentration, C_s	0.00E+00	gr/dscf			
	0	µg/dscm			
Mass Emissions	0.00	lb/hr			
Back Half:					
Inorganic CPM	6.50E-04	grams	Organic CPM	5.00E-04	grams
Inorganic CPM, C_s	9.19E-05	gr/dscf	Organic CPM, C_s	7.07E-05	gr/dscf
	210	µg/dscm		161.76	µg/dscm
Mass Emissions	1.37E-02	lb/hr	Mass Emissions	1.05E-02	lb/hr

Oregon Method 5
Filterable and Condensable Particulate
Laboratory Gravimetric Data

Client: **Hollingsworth & Vose**
Location: **Corvallis OR**
Source: **CFU 112 (2)**

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction	Corrected Gain (grams)
1	CPM Organics (Acetone BH)	150	45.11620	45.11710	0.00090	0.00E+00	**0.00090**
	Probe Rinse (Acetone FH)	75	45.35335	45.35460	0.00125	0.00E+00	**0.00125**
	Filter	Q1374	0.37760	0.37755	-0.00005		**0.00000**
	CPM Inorganics (Water)	375	45.21275	45.21380	0.00105	0.00E+00	**0.00105**
	CPM Organics (Hexane BH)	90	42.75365	42.75350	-0.00015	0.00E+00	**0.00000**
	Impinger H_2O Gain, mls		200	220	20.0		
						Filterable PM (mg)	**1.25**
						Total PM (mg)	**3.20 ND**
2	CPM Organics (Acetone BH)	160	46.56375	46.56440	0.00065	0.00E+00	**0.00065**
	Probe Rinse (Acetone FH)	120	43.17845	43.17930	0.00085	0.00E+00	**0.00085**
	Filter	Q1375	0.38035	0.38045	0.00010		**0.00010**
	CPM Inorganics (Water)	385	46.37770	46.37840	0.00070	0.00E+00	**0.00070**
	CPM Organics (Hexane BH)	90	53.80060	53.80040	-0.00020	0.00E+00	**0.00000**
	Impinger H_2O Gain, mls		200	215	15.0		**15**
						Filterable PM (mg)	**0.95**
						Total PM (mg)	**2.30 ND**
3	CPM Organics (Acetone BH)	140	52.38950	52.39000	0.00050	0.00E+00	**0.00050**
	Probe Rinse (Acetone FH)	95	45.37960	45.37960	0.00000	0.00E+00	**0.00000**
	Filter	Q1376	0.37925	0.37910	-0.00015		**0.00000**
	CPM Inorganics (Water)	370	43.08105	43.08170	0.00065	0.00E+00	**0.00065**
	CPM Organics (Hexane BH)	95	47.37870	47.37860	-0.00010	0.00E+00	**0.00000**
	Impinger H_2O Gain, mls		200	220	20.0		
						Filterable PM (mg)	**0.00**
						Total PM (mg)	**1.15 ND**
	Acetone Blank	160	45.69390	45.69390	0.00000	0.00E+00	g/g
	Water Blank	200	49.47520	49.47520	0.00000	0.00E+00	g/g
	Hexane Blank	100	43.10705	43.10700	0.00000	0.00E+00	g/g

ND = Non-Detect. Values are below the method detection limit (7 mg).

Oregon Methods 1-5
Filterable and Condensable Particulate
Results Summary

Client: Hollingsworth & Vose
Source: CFU 112 (2)
Location: Corvallis OR

Run			1	2	3	
Date			9/15/2018	9/15/2018	9/15/2018	
Run Start Time			13:50	16:14	18:41	
Run End Time			15:56	18:21	20:45	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.65	29.65	29.65	**29.65**
Nozzle Dia., in.			0.2173	0.2173	0.2173	**0.2173**
Isokinetic Average, %			100.0	100.1	99.6	**99.9**
Sample Volume, dscf			110.685	110.807	109.169	**110.220**
Sample Volume, dscm			3.134	3.138	3.091	**3.121**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.52	0.53	0.52	**0.52**
O_2 %vd			19.99	20.14	20.11	**20.08**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.81	1.71	1.76	**1.76**
Wet Molecular Weight, lb/lb-mole			28.68	28.70	28.70	**28.69**
Velocity, FPS			76.61	77.03	76.58	**76.74**
ADCFM			22,156.3	22,300.4	22,158.9	**22,205.2**
AWCFM			22,564.7	22,688.4	22,555.9	**22,603.0**
DSCFM			17,557.4	17,568.1	17,396.4	**17,507.3**
Stack Temperature, ^oF			201.2	205.1	207.4	**204.6**
Filterable Particulate	Concentration, C_s	gr/dscf	1.74E-04	1.32E-04	0.00E+00	**1.02E-04**
		µg/dscm	399	303	0	**234**
	Mass	lb/hr	2.62E-02	1.99E-02	0.00E+00	**1.54E-02**
		lb/lb glass	3.82E-05	2.76E-05	0.00E+00	**2.19E-05**
Inorganic CPM	Concentration, C_s	gr/dscf	1.46E-04	9.75E-05	9.19E-05	**1.12E-04**
		µg/dscm	335	223	210	**256**
	Mass	lb/hr	2.20E-02	1.47E-02	1.37E-02	**1.68E-02**
		lb/lb glass	3.21E-05	2.04E-05	1.93E-05	**2.39E-05**
Organic CPM	Concentration, C_s	gr/dscf	1.25E-04	9.05E-05	7.07E-05	**9.55E-05**
		µg/dscm	287	207	162	**219**
	Mass	lb/hr	1.89E-02	1.36E-02	1.05E-02	**1.43E-02**
		lb/lb glass	2.75E-05	1.89E-05	1.49E-05	**2.04E-05**
Measured Total PM	Concentration, C_s	gr/dscf	ND 4.46E-04	ND 3.20E-04	ND 1.63E-04	ND **3.10E-04**
		µg/dscm	ND 1,021.1	ND 733.0	ND 372.0	ND **708.7**
	Mass	lb/hr	ND 6.71E-02	ND 4.82E-02	ND 2.42E-02	ND **4.65E-02**
		lb/lb glass	ND 9.77E-05	ND 6.69E-05	ND 3.42E-05	ND **6.63E-05**
Total PM @ Method Detection Limit (7 mg)	Concentration, C_s	gr/dscf	< 9.76E-04	< 9.75E-04	< 9.89E-04	< **9.80E-04**
	Mass	lb/hr	< 1.47E-01	< 1.47E-01	< 1.48E-01	< **1.47E-01**
		lb/lb glass	< 2.14E-04	< 2.04E-04	< 2.08E-04	< **2.08E-04**
Production Data	Glass Production	lbs/hr	687.3	721.0	708.7	**705.7**

Oregon Methods 1-5
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**13:50**
Source:	**CFU 112 (2)**	**End Time:**	**15:56**
Method:	**ODEQ 5**	**Date:**	**9/15/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.862 "Hg

where Pb: 29.65 "Hg

ΔH: 2.883 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.691 "Hg

where Pb: 29.65 "Hg

Static Press.: 0.56 "H_2O

3) $V_m(\text{std}) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 110.685 dscf

where Vm: 111.192 dcf

Y: 1.0008

Pm: 29.862 "Hg

Tm: 529.6 °A

4) $V_w(\text{std}) = (0.04706)(H_2O) =$ 2.042 scf

where H_2O: 43.40 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0181

where Vw(std): 2.042 scf

Vm(std): 110.685 dscf

6) % H_2O = Bws x 100 = 1.81 %v

7) $V_m(\text{actual}) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 142.309 awcf

where Y: 1.0008

Vm: 111.1919 dcf

Bws: 0.0181

Ts: 661.2 °A

Tm: 529.6 °A

Pm: 29.862 "Hg

Ps: 29.691 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.88 lb/lb-mole

where CO_2: 0.52 %vd

O_2 19.99 %vd

N_2+CO= (100-(O_2+CO_2): 79.49 %vd

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 112 (2)**	**Date:**	**9/15/2018**

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.68 lb/lb-mole

where M_d: 28.88 lb/lb-mole
Bws: 0.0181

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 4.909 sq. ft.

where Stack ID: 30 inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.

where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 76.61 fps

where Cp: 0.84
Ave. Sqrt ΔP: 1.2106
Ts: 661.2 °A
Ps: 29.691 "Hg
Ms: 28.68 lb/lb-mole

12) $\text{AWCFM} = (V_s)\text{(stack area)(60 sec/min)} =$ 22,564.7 AWCFM

where V_s: 76.61 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 22,156.3 ADCFM

where AWCFM: 22,564.7
Bws: 0.0181

14) $\text{Qsw} = 3600(V_s)\text{(stack area)}\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,072,865.6 wscf/hr

where V_s: 76.61 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 661.2 °A
Ps: 29.691 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,053,446.7 dscf/hr

where wscf/hr: 1,072,865.6
Bws: 0.0181

16) DSCFM= (dscf/hr)/60 mins/hr = 17,557.4 DSCFM

where dscf/hr: 1,053,446.7

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000258 sq. ft.

where Nozzle Size: 0.2173 inches

Client: **Hollingsworth & Vose** Run: **1**
Source: **CFU 112 (2)** Date: **9/15/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.0 %

where Ts:	661.2	°A
Vm(Std):	110.685	dscf
Ps:	29.691	"Hg
Vs	76.61	ft/sec
Nozzle Area:	0.000258	sq. ft.
Sampling Time:	120	min.
Bws:	0.0181	

ODEQ Method 5:

Front Half:

19) Filterable PM = filter gain + probe rinse gain = 0.00125 grams

where Filter Gain:	0.00000	grams
Probe Rinse:	0.00125	grams

20) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 1.74E-04 gr/dscf

where Sample:	0.00125	grams
Vm(std)	110.685	dscf

21) Cs = (Sample grams*1,000,000 μg/gram)/Vm(std) = 398.9 μg/dscm

where Sample:	0.00125	grams
Vm(std)	3.134	dscm

22) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 0.026 lb/hr

where Cs:	1.74E-04	gr/dscf
Stack Flow:	1,053,446.7	dscf/hr

Back Half:

23) Inorganic CPM = water fraction = 0.00105 grams
Organic CPM = acetone BH + hexane BH = 0.00090 grams

Back-half concentrations and mass rates are calculated as front-half examples.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112 (2)**
DATE	**09/15/18**
METHOD	**316**
POLLUTANT	**Formaldehyde**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**13:49**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:55**
EPA Method:	**316**	Partly cloudy, 68 degrees	**Date:**	**9/15/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.65 "Hg	O_2	19.80 %
Static Pressure	0.56 "H_2O	CO_2	0.70 %
Ave. ΔP	1.4 "H_2O	Rec. Nz.	0.196 inches
Stack Temperature	190 F		
Assumed moisture	2 %		
Assumed meter temp.	75 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	11	5

Nozzle check for roundness:

1	2	3
0.179	0.179	0.180 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	72.760 dcf	Ave. ΔP	1.371 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.1703 "H_2O
Actual H_2O	1.69 %	Ave. ΔH	1.204 "H_2O
Std. meter vol.	71.802 dscf	Ave. T_s	202.7 °F
Isokinetic Average	99.0 %	Ave. T_m	70.8 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	254.6	266.8	12.2
		Total water gain:	26.2

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	5.0	3.020	1.30	202	71	1.15	1.20	1	252	58
2	10.0	5.990	1.30	200	71	1.15	1.20	1	251	47
3	15.0	8.980	1.40	200	70	1.24	1.20	1	253	44
4	20.0	12.000	1.40	201	70	1.24	1.20	1	252	44
5	25.0	15.180	1.50	201	69	1.32	1.30	1	253	44
6	30.0	18.330	1.50	202	69	1.32	1.30	1	250	43
7	35.0	21.520	1.50	201	69	1.32	1.30	1	257	44
8	40.0	24.690	1.50	203	69	1.32	1.30	1	252	45
9	45.0	27.730	1.40	203	69	1.23	1.20	1	254	46
10	50.0	30.660	1.30	204	70	1.14	1.10	1	256	46
11	55.0	33.650	1.30	204	70	1.14	1.10	1	254	46
12	60.0	36.643	1.30	204	70	1.14	1.10	1	256	46
13	65.0	39.610	1.30	202	70	1.15	1.20	1	259	57
14	70.0	42.590	1.30	202	71	1.15	1.20	1	255	46
15	75.0	45.580	1.30	202	71	1.15	1.20	1	253	46
16	80.0	48.600	1.40	203	71	1.24	1.20	1	249	46
17	85.0	51.620	1.40	203	71	1.24	1.20	1	251	47
18	90.0	54.680	1.40	204	71	1.23	1.20	1	248	47
19	95.0	57.810	1.50	204	72	1.32	1.30	1	254	48
20	100.0	60.850	1.40	204	72	1.24	1.20	1	254	48
21	105.0	63.930	1.40	204	73	1.24	1.20	1	255	48
22	110.0	66.960	1.30	204	73	1.15	1.20	1	253	48
23	115.0	69.920	1.30	204	73	1.15	1.20	1	254	48
24	120.0	72.760	1.20	204	73	1.06	1.10	1	254	48

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**16:15**
Source:	**CFU 112 (2)**	**End Time:**	**18:21**
EPA Method:	**316**	**Date:**	**9/15/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Partly cloudy, 68 degrees

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size:	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.65 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.4 "H_2O	Rec. Nz.	0.196 inches
Stack Temperature	190 F		
Assumed moisture	1.69 %		
Assumed meter temp.	70.8 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	14	7

Nozzle check for roundness:

1	2	3
0.179	0.179	0.180 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	71.870 dcf	Ave. ΔP	1.321 "H_2O
Wet mol. weight	28.74 M_s (actual)	Ave. √ΔP	1.1487 "H_2O
Actual H_2O	1.44 %	Ave. ΔH	1.171 "H_2O
Std. meter vol.	70.544 dscf	Ave. T_s	207 °F
Isokinetic Average	99.2 %	Ave. T_m	73.6 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	206	6.0
Silica gel, g	241.8	257.7	15.9
		Total water gain:	21.9

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.950	1.30	207	73	1.15	1.20	1	254	57
2	10.0	5.950	1.40	207	73	1.24	1.20	1	251	55
3	15.0	8.990	1.40	207	73	1.24	1.20	1	251	55
4	20.0	12.060	1.40	206	73	1.24	1.20	1	253	56
5	25.0	15.150	1.40	206	73	1.24	1.20	1	255	56
6	30.0	18.250	1.40	206	73	1.24	1.20	1	254	56
7	35.0	21.330	1.40	206	74	1.24	1.20	1	254	56
8	40.0	24.350	1.30	205	74	1.16	1.20	1	253	57
9	45.0	27.360	1.30	206	74	1.16	1.20	1	251	57
10	50.0	30.330	1.30	206	74	1.16	1.20	1	252	57
11	55.0	33.150	1.20	207	74	1.07	1.10	1	253	58
12	60.0	36.072	1.20	206	74	1.07	1.10	1	253	58
13	65.0	38.890	1.20	207	73	1.06	1.10	1	259	59
14	70.0	41.800	1.20	205	74	1.07	1.10	1	256	57
15	75.0	44.780	1.30	206	74	1.16	1.20	1	253	57
16	80.0	47.700	1.30	207	74	1.15	1.20	1	254	58
17	85.0	50.750	1.40	207	73	1.24	1.20	1	254	58
18	90.0	53.810	1.40	208	73	1.24	1.20	1	254	58
19	95.0	56.940	1.40	209	74	1.24	1.20	1	252	59
20	100.0	59.990	1.40	209	74	1.24	1.20	1	251	59
21	105.0	63.040	1.40	209	74	1.24	1.20	1	252	59
22	110.0	66.000	1.30	209	74	1.15	1.10	1	251	59
23	115.0	68.910	1.20	209	74	1.06	1.10	1	254	59
24	120.0	71.870	1.20	209	74	1.06	1.10	1	250	60

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**18:40**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**20:45**
EPA Method:	**316**	Partly cloudy, 68 degrees	**Date:**	**9/15/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size:	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.65 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.4 "H_2O	Rec. Nz.	0.195 inches
Stack Temperature	190 F		
Assumed moisture	1.44 %		
Assumed meter temp.	73.6 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	13	5

Nozzle check for roundness:

1	2	3	
0.179	0.179	0.180	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	72.003 dcf	Ave. ΔP	1.333 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.1542 "H_2O
Actual H_2O	1.66 %	Ave. ΔH	1.159 "H_2O
Std. meter vol.	71.018 dscf	Ave. T_s	209 °F
Isokinetic Average	99.8 %	Ave. T_m	71 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	212	12.0
Silica gel, g	241.0	254.5	13.5
			25.5

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.920	1.20	208	73	1.07	1.10	1	254	60
2	10.0	5.880	1.30	207	73	1.16	1.20	1	254	50
3	15.0	8.840	1.30	206	73	1.16	1.20	1	254	45
4	20.0	11.860	1.40	208	73	1.24	1.20	1	253	44
5	25.0	14.920	1.40	208	73	1.24	1.20	1	255	44
6	30.0	17.990	1.40	208	72	1.24	1.20	1	254	45
7	35.0	21.080	1.40	208	72	1.24	1.20	1	255	45
8	40.0	24.170	1.40	209	72	1.24	1.20	1	254	46
9	45.0	27.120	1.30	210	72	1.15	1.10	1	251	46
10	50.0	30.090	1.30	210	71	1.15	1.10	1	252	47
11	55.0	33.040	1.30	211	71	1.15	1.10	1	250	47
12	60.0	35.902	1.20	210	71	1.06	1.10	1	254	48
13	65.0	38.750	1.20	207	71	1.06	1.10	1	259	54
14	70.0	41.620	1.20	207	71	1.06	1.10	1	254	46
15	75.0	44.610	1.30	208	70	1.15	1.10	1	252	45
16	80.0	47.530	1.30	208	70	1.15	1.10	1	253	45
17	85.0	50.550	1.40	210	70	1.23	1.20	1	254	47
18	90.0	53.670	1.40	210	70	1.23	1.20	1	252	47
19	95.0	56.780	1.40	211	70	1.23	1.20	1	253	47
20	100.0	59.860	1.40	211	70	1.23	1.20	1	253	47
21	105.0	62.830	1.30	210	70	1.15	1.11	1	252	47
22	110.0	65.850	1.40	210	69	1.23	1.20	1	253	49
23	115.0	68.880	1.40	210	69	1.23	1.20	1	252	49
24	120.0	72.003	1.40	210	69	1.23	1.20	1	256	49

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**13:49**
Source:	**CFU 112 (2)**	**End Time:**	**15:55**
Method:	**316**	**Date:**	**9/15/2018**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**√Dp**
	0.000						
5	3.020	1.20	71	1	1.30	202	1.1402
10	5.990	1.20	71	2	1.30	200	1.1402
15	8.980	1.20	70	3	1.40	200	1.1832
20	12.000	1.20	70	4	1.40	201	1.1832
25	15.180	1.30	69	5	1.50	201	1.2247
30	18.330	1.30	69	6	1.50	202	1.2247
35	21.520	1.30	69	7	1.50	201	1.2247
40	24.690	1.30	69	8	1.50	203	1.2247
45	27.730	1.20	69	9	1.40	203	1.1832
50	30.660	1.10	70	10	1.30	204	1.1402
55	33.650	1.10	70	11	1.30	204	1.1402
60	36.643	1.10	70	12	1.30	204	1.1402
65	39.610	1.20	70	13	1.30	202	1.1402
70	42.590	1.20	71	14	1.30	202	1.1402
75	45.580	1.20	71	15	1.30	202	1.1402
80	48.600	1.20	71	16	1.40	203	1.1832
85	51.620	1.20	71	17	1.40	203	1.1832
90	54.680	1.20	71	18	1.40	204	1.1832
95	57.810	1.30	72	19	1.50	204	1.2247
100	60.850	1.20	72	20	1.40	204	1.1832
105	63.930	1.20	73	21	1.40	204	1.1832
110	66.960	1.20	73	22	1.30	204	1.1402
115	69.920	1.20	73	23	1.30	204	1.1402
120	72.760	1.10	73	24	1.20	204	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 112 (2)**	**Date:**	**09/15/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	72.760	dcf	Rectangular		
Water Volume	26.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.65	"Hg	CO_2 Average	0.52	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.99	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.204	"H_2O	$\sqrt{Dp}$	1.1703	"H_2O
Temperature, T_m	70.8	^oF	Temperature, T_s	202.7	^oF
Temperature, T_m	530.8	^oA (^oR)	Temperature, T_s	662.7	^oA (R)
Pressure Meter, P_m	29.739	"Hg	Pressure Stack, P_s	29.691	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	71.802	dscf	Velocity, V_s	74.11	fps
	2.033	dscm	Volume (actual)	21,828.4	awcfm
Actual Volume, $V_{m(actual)}$	92.412	awcf		21,459.5	adcfm
Gas Stream Moisture			Volume (standard)	1,035,505.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.233	scf		1,018,005.8	dscf/hr
Moisture, B_{ws}	0.0169			16,966.8	dscf/min
Moisture EPA M4	1.69	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	487.285	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	99.0	%			

Laboratory Results

CH_2O	474.0	µg/sample			
CH_2O	4.74E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	1.02E-04	gr/dscf
	233.2	µg/dscm
	1.87E-01	ppmvd
Mass Emissions	1.48E-02	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**16:15**
Source:	**CFU 112 (2)**	**End Time:**	**18:21**
Method:	**316**	**Date:**	**09/15/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	$\sqrt{Dp}$
	0.000						
5	2.950	1.20	73	1	1.30	207	1.1402
10	5.950	1.20	73	2	1.40	207	1.1832
15	8.990	1.20	73	3	1.40	207	1.1832
20	12.060	1.20	73	4	1.40	206	1.1832
25	15.150	1.20	73	5	1.40	206	1.1832
30	18.250	1.20	73	6	1.40	206	1.1832
35	21.330	1.20	74	7	1.40	206	1.1832
40	24.350	1.20	74	8	1.30	205	1.1402
45	27.360	1.20	74	9	1.30	206	1.1402
50	30.330	1.20	74	10	1.30	206	1.1402
55	33.150	1.10	74	11	1.20	207	1.0954
60	36.072	1.10	74	12	1.20	206	1.0954
65	38.890	1.10	73	13	1.20	207	1.0954
70	41.800	1.10	74	14	1.20	205	1.0954
75	44.780	1.20	74	15	1.30	206	1.1402
80	47.700	1.20	74	16	1.30	207	1.1402
85	50.750	1.20	73	17	1.40	207	1.1832
90	53.810	1.20	73	18	1.40	208	1.1832
95	56.940	1.20	74	19	1.40	209	1.1832
100	59.990	1.20	74	20	1.40	209	1.1832
105	63.040	1.20	74	21	1.40	209	1.1832
110	66.000	1.10	74	22	1.30	209	1.1402
115	68.910	1.10	74	23	1.20	209	1.0954
120	71.870	1.10	74	24	1.20	209	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 112 (2)**	**Date:**	**09/15/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	71.870	dcf	Rectangular		
Water Volume	21.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.65	"Hg	CO_2 Average	0.53	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.14	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.171	"H_2O	$\sqrt{Dp}$	1.1487	"H_2O
Temperature, T_m	73.6	^oF	Temperature, T_s	207.0	^oF
Temperature, T_m	533.6	^oA (^oR)	Temperature, T_s	667.0	^oA (R)
Pressure Meter, P_m	29.736	"Hg	Pressure Stack, P_s	29.691	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	70.544	dscf	Velocity, V_s	72.94	fps
	1.998	dscm	Volume (actual)	21,483.7	awcfm
Actual Volume, $V_{m(actual)}$	91.151	awcf		21,174.3	adcfm
Gas Stream Moisture			Volume (standard)	1,012,587.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.031	scf		998,006.3	dscf/hr
Moisture, B_{ws}	0.0144			16,633.4	dscf/min
Moisture EPA M4	1.44	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	490.447	
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.73	lb/lb-mole			
Percent Isokinetic	99.2	%			

Laboratory Results

CH_2O	< 11.2	µg/sample			
CH_2O	< 1.12E-05	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	< 2.45E-06	gr/dscf
	< 5.6	µg/dscm
	< 4.50E-03	ppmvd
Mass Emissions	< 3.50E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**18:40**
Source:	**CFU 112 (2)**	**End Time:**	**20:45**
Method:	**316**	**Date:**	**09/15/18**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
5	2.920	1.10	73	1	1.20	208	1.0954
10	5.880	1.20	73	2	1.30	207	1.1402
15	8.840	1.20	73	3	1.30	206	1.1402
20	11.860	1.20	73	4	1.40	208	1.1832
25	14.920	1.20	73	5	1.40	208	1.1832
30	17.990	1.20	72	6	1.40	208	1.1832
35	21.080	1.20	72	7	1.40	208	1.1832
40	24.170	1.20	72	8	1.40	209	1.1832
45	27.120	1.10	72	9	1.30	210	1.1402
50	30.090	1.10	71	10	1.30	210	1.1402
55	33.040	1.10	71	11	1.30	211	1.1402
60	35.902	1.10	71	12	1.20	210	1.0954
65	38.750	1.10	71	13	1.20	207	1.0954
70	41.620	1.10	71	14	1.20	207	1.0954
75	44.610	1.10	70	15	1.30	208	1.1402
80	47.530	1.10	70	16	1.30	208	1.1402
85	50.550	1.20	70	17	1.40	210	1.1832
90	53.670	1.20	70	18	1.40	210	1.1832
95	56.780	1.20	70	19	1.40	211	1.1832
100	59.860	1.20	70	20	1.40	211	1.1832
105	62.830	1.11	70	21	1.30	210	1.1402
110	65.850	1.20	69	22	1.40	210	1.1832
115	68.880	1.20	69	23	1.40	210	1.1832
120	72.003	1.20	69	24	1.40	210	1.1832

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 112 (2)**	**Date:**	**09/15/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	72.003	dcf	Rectangular		
Water Volume	25.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.65	"Hg	CO_2 Average	0.52	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.11	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.159	"H_2O	$\sqrt{Dp}$	1.1542	"H_2O
Temperature, T_m	71.0	^oF	Temperature, T_s	209.0	^oF
Temperature, T_m	531.0	^oA (^oR)	Temperature, T_s	669.0	^oA (R)
Pressure Meter, P_m	29.735	"Hg	Pressure Stack, P_s	29.691	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	71.018	dscf	Velocity, V_s	73.43	fps
	2.011	dscm	Volume (actual)	21,628.1	awcfm
Actual Volume, $V_{m(actual)}$	92.245	awcf		21,269.1	adcfm
Gas Stream Moisture			Volume (standard)	1,016,342.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.200	scf		999,471.2	dscf/hr
Moisture, B_{ws}	0.0166			16,657.9	dscf/min
Moisture EPA M4	1.66	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	491.917	
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.71	lb/lb-mole			
Percent Isokinetic	99.7	%			

Laboratory Results

CH_2O	< 12.5	µg/sample			
CH_2O	< 1.25E-05	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	< 2.72E-06	gr/dscf
	< 6.2	µg/dscm
	< 4.98E-03	ppmvd
Mass Emissions	< 3.88E-04	lb/hr

"<" represents MDL value

EPA Method 316
Laboratory Results
Formaldehyde

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR** **MDL** 0.0275 µg/mL
Source: **CFU 112 (2)**

Lab ID	Sample ID	Sample Date	<	Result	MDL	Sample Vol. (mL)	Units
13	Run 1	9/15/2018		474	11.7	425.0	µg/sample
17	Run 2	9/15/2018	<	MDL	11.2	408.0	µg/sample
18	Run 3	9/15/2018	<	MDL	12.5	455.0	µg/sample
20	H_20 Blank	9/12/2018	<	MD	11.1	405.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 316
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112 (2)

Run			1	2	3	Average
Date			9/15/2018	9/15/2018	9/15/2018	
Run Start Time			13:49	16:15	18:40	
Run End Time			15:55	18:21	20:45	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.65	29.65	29.65	**29.65**
Nozzle Dia., in.			0.1793	0.1793	0.1793	**0.1793**
Isokinetic Average, %			99.0	99.2	99.7	**99.3**
Sample Volume, dscf			71.802	70.544	71.018	**71.121**
Sample Volume, dscm			2.033	1.998	2.011	**2.014**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.52	0.53	0.52	**0.52**
O_2 %vd			19.99	20.14	20.11	**20.08**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.69	1.44	1.66	**1.60**
Wet Molecular Weight, lb/lb-mole			28.70	28.73	28.71	**28.71**
Velocity, FPS			74.11	72.94	73.43	**73.49**
ADCFM			21,459.5	21,174.3	21,269.1	**21,301.0**
AWCFM			21,828.4	21,483.7	21,628.1	**21,646.7**
DSCFM			16,966.8	16,633.4	16,657.9	**16,752.7**
Stack Temperature, ^oF			202.7	207.0	209.0	**206.2**
Formaldehyde	Concentration, C_s	gr/dscf	1.02E-04	< 2.45E-06	< 2.72E-06	< **3.57E-05**
		µg/dscm	233.15	< 5.62	< 6.22	< **81.66**
		ppmvd	1.87E-01	< 4.50E-03	< 4.98E-03	< **6.54E-02**
	Mass	lb/hr	1.48E-02	< 3.50E-04	< 3.88E-04	< **5.18E-03**
		lb/lb glass	2.16E-05	< 4.85E-07	< 5.48E-07	< **7.53E-06**
Production Data	Glass Production	lbs/hr	687.3	721.0	708.7	**705.7**

"<" represents MDL value

EPA Methods 1-4, 316
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**13:49**
Source:	**CFU 112 (2)**	**End Time:**	**15:55**
Method:	**316**	**Date:**	**9/15/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.739 "Hg
   - where Pb: 29.65 "Hg
   - ΔH: 1.204 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.691 "Hg
   - where Pb: 29.65 "Hg
   - Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 71.802 dscf
   - where Vm: 72.760 dcf
   - Y: 0.9985
   - Pm: 29.739 "Hg
   - Tm: 530.8 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.233 scf
   - where H_2O: 26.20 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0169
   - where Vw(std): 1.233 scf
   - Vm(std): 71.802 dscf

6) % H_2O = Bws x 100 = 1.69 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 92.412 awcf
   - where Y: 0.9985
   - Vm: 72.7600 dcf
   - Bws: 0.0169
   - Ts: 662.7 °A
   - Tm: 530.8 °A
   - Pm: 29.739 "Hg
   - Ps: 29.691 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.88 lb/lb-mole
   - where CO_2: 0.52 %vd
   - O_2 19.99 %vd
   - N_2+CO= (100-(O_2+CO_2): 79.49 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.70 lb/lb-mole

where M_d: 28.88 lb/lb-mole
Bws: 0.0169

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 4.909 sq. ft.

where Stack ID: 30 inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.

where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(\text{Cp})(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 74.11 fps

where Cp: 0.84
Ave. Sqrt ΔP: 1.1703
Ts: 662.7 °A
Ps: 29.691 "Hg
Ms: 28.70 lb/lb-mole

12) $\text{AWCFM} = (V_s)\text{(stack area)(60 sec/min)} =$ 21,828.4 AWCFM

where V_s: 74.11 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 21,459.5 ADCFM

where AWCFM: 21,828.4
Bws: 0.0169

14) $\text{Qsw} = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,035,505.8 wscf/hr

where V_s: 74.11 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 662.7 °A
Ps: 29.691 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,018,005.8 dscf/hr

where wscf/hr: 1,035,505.8
Bws: 0.0169

16) DSCFM= (dscf/hr)/60 mins/hr = 16,966.8 DSCFM

where dscf/hr: 1,018,005.8

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000175 sq. ft.

where Nozzle Size: 0.1793 inches

Client: Hollingsworth & Vose	Run: 1
Source: CFU 112 (2)	Date: 9/15/2018

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 99.0 %

where Ts:	662.7	°A
Vm(Std):	71.802	dscf
Ps:	29.691	"Hg
Vs	74.11	ft/sec
Nozzle Area:	0.000175	sq. ft.
Sampling Time:	120	min.
Bws:	0.0169	

EPA Method 316:

19) Formaldehyde laboratory results 474.0 µg/sample

20) Formaldehyde = (µg/sample)/1,000,000 = 4.74E-04 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 1.02E-04 gr/dscf

where Sample:	0.00047	grams
Vm(std)	71.802	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 233.2 µg/dscm

where Sample:	0.00047	grams
Vm(std)	2.033	dscm

23) Volume/Mole = $\left(\frac{359\frac{ft^3}{lb-mol}@STP\ (Ts)\ (29.92"Hg)}{492°A\ (Ps)}\right)$ = 487.285 Vol./Mole

where Ts:	662.7	°A
Ps:	29.691	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 1.87E-01 ppmvd

where MW:	30.031	g/mol
lb/hr:	0.01	
Vol./Mole:	487.285	
ADCFM:	21459.5	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 1.48E-02 lb/hr

where Cs:	1.02E-04	gr/dscf
Stack Flow:	1,018,005.8	dscf/hr

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 112 (2)**
Facility	**Glass Plant 1**	Date	**September 15, 2018**
Location	**Corvallis, OR**		

Run			1	2	3	
Date			9/15/2018	9/15/2018	9/15/2018	
Run Start Time			13:49	16:14	18:40	
Run End Time			15:55	18:21	20:45	
CO_2 %vd			0.52	0.53	0.52	0.52
O_2 %vd			19.99	20.14	20.11	20.08
WSCFM*			17,881.1	17,873.7	17,708.0	17,821.0
DSCFM*			17,557.4	17,568.1	17,396.4	17,507.3
Nitrogen Oxides	Concentration, C_s	ppmvd	0.92	0.94	0.97	0.94
	Mass	lb/hr	1.16E-01	1.18E-01	1.21E-01	1.18E-01
	Emission Factor	lb/lb glass	1.68E-04	1.64E-04	1.71E-04	1.68E-04
		lb/Mscf nat. gas	2.80E-02	2.81E-02	2.84E-02	2.82E-02
Carbon Monoxide	Concentration, C_s	ppmvd	24.99	27.60	28.42	27.00
	Mass	lb/hr	1.91	2.12	2.16	2.06
	Emission Factor	lb/lb glass	2.78E-03	2.94E-03	3.05E-03	2.92E-03
		lb/Mscf nat. gas	4.62E-01	5.04E-01	5.08E-01	4.91E-01
VOC	Concentration, C_s	ppmvw	0.98	1.01	0.99	0.99
	Mass	lb/hr	1.20E-01	1.24E-01	1.20E-01	1.21E-01
	Emission Factor	lb/lb glass	1.75E-04	1.72E-04	1.70E-04	1.72E-04
		lb/Mscf nat. gas	2.90E-02	2.94E-02	2.83E-02	2.89E-02
Formaldehyde**	Mass	lb/hr	1.48E-02	3.50E-04	3.88E-04	5.18E-03
	Emission Factor	lb/lb glass	2.15E-05	4.85E-07	5.47E-07	7.52E-06
		lb/Mscf nat. gas	3.58E-03	8.32E-05	9.13E-05	1.25E-03
Total VOCs†	Mass	lb/hr	1.35E-01	1.24E-01	1.21E-01	1.27E-01
	Emission Factor	lb/lb glass	1.96E-04	1.72E-04	1.70E-04	1.80E-04
		lb/Mscf nat. gas	3.26E-02	2.95E-02	2.84E-02	3.02E-02

Production Rates	Glass Production	lb/hr	687.3	721.0	708.7	705.7
	Natural Gas Use	scf/hr	4137.8	4208.2	4251.3	4199.1
		Mscf/hr	4.1378	4.2082	4.2513	4.1991

*Measured during concurrent Method 5 isokinetic runs
**From concurrent Method 316 isokinetic sampling; Runs 2 and 3 results are <MDL calculated at the MDL.
†Total VOCs = Method 25A VOCs + Formaldehyde. Runs 2 and 3 include <MDL formaldehyde results.

Bison Engineering, Inc.

Method 7E Nitrogen Oxides

Calibration Error, System Bias and System Drift

NOx molecular weight of 46

Company:	**Hollingsworth & Vose**	Source:	**CFU 112 (2)**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 15, 2018**	Instrument Model:	**42i**
Location:	**Corvallis, OR**			Instrument Serial #:	**729825194**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.03	-0.03	0.00	pass	0.01	0.80	pass	0.80	pass				
	upscale	2.45	2.45	0.00	pass	2.47	0.40	pass	0.40	pass	5	0.90	0.92	2.5
Run 2	zero	-0.03	0.01	0.80	pass	-0.01	0.40	pass	-0.40	pass				
	upscale	2.45	2.47	0.40	pass	2.47	0.40	pass	0.00	pass	5	0.93	0.94	2.5
Run 3	zero	-0.03	-0.01	0.40	pass	-0.02	0.20	pass	-0.20	pass				
	upscale	2.45	2.47	0.40	pass	2.45	0.00	pass	-0.40	pass	5	0.95	0.97	2.5
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2.5	5
Cal gas analyzer response	-0.03	2.45	4.79
Analyzer Cal. Error %	-0.60	-1.00	-4.20
Analyzer Cal. Error < 2%*	pass	pass	pass

NO2 CONVERTER TEST

NO2 Tank Value (ppm)	50.41
NO Check Value	55.44
NO2 to NO Conversion %	110.0%
NO2 Conversion > 90%	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 10 Carbon Monoxide
Calibration Error, System Bias and System Drift
CO molecular weight of 28

Company:	**Hollingsworth & Vose**	Source:	**CFU 112 (2)**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 15, 2018**	Instrument Model:	**48i HL**
Location:	**Corvallis, OR**			Instrument Serial #:	**734025183**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.07	0.57	0.50	pass	-1.24	-1.31	pass	-1.81	pass				
	upscale	49.54	49.54	0.00	pass	49.77	0.23	pass	0.23	pass	100	24.65	24.99	50
Run 2	zero	0.07	-1.24	-1.31	pass	-3.03	-3.10	pass	-1.79	pass				
	upscale	49.54	49.77	0.23	pass	47.48	-2.06	pass	-2.29	pass	100	25.88	27.60	50
Run 3	zero	0.07	-3.03	-3.10	pass	-2.83	-2.90	pass	0.20	pass				
	upscale	49.54	47.48	-2.06	pass	47.08	-2.46	pass	-0.40	pass	100	25.61	28.42	50
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	50	100
Cal gas analyzer response	0.07	49.54	100.02
Analyzer Cal. Error	0.07	-0.46	0.02
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU 112 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 15, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.09	0.08	0.85	pass	0.09	0.90	pass	0.05	pass				
	upscale	9.86	10.00	0.70	pass	9.98	0.60	pass	-0.10	pass	20	19.89	19.99	10
Run 2	zero	-0.09	0.09	0.90	pass	0.07	0.80	pass	-0.10	pass				
	upscale	9.86	9.98	0.60	pass	9.87	0.05	pass	-0.55	pass	20	19.91	20.14	10
Run 3	zero	-0.09	0.07	0.80	pass	0.06	0.75	pass	-0.05	pass				
	upscale	9.86	9.87	0.05	pass	9.85	-0.05	pass	-0.10	pass	20	19.76	20.11	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	-0.09	9.86	19.92
Analyzer Cal. Error	-0.45	-0.70	-0.40
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU 112 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 15, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			Final Values								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.00	0.01	0.25	pass	0.00	0.00	pass	-0.25	pass				
	upscale	1.83	1.82	-0.25	pass	1.84	0.25	pass	0.50	pass	4	0.48	0.52	2
Run 2	zero	0.00	0.00	0.00	pass	0.05	1.25	pass	1.25	pass				
	upscale	1.83	1.84	0.25	pass	1.82	-0.25	pass	-0.50	pass	4	0.50	0.53	2
Run 3	zero	0.00	0.05	1.25	pass	0.02	0.50	pass	-0.75	pass				
	upscale	1.83	1.82	-0.25	pass	1.82	-0.25	pass	0.00	pass	4	0.50	0.52	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0	1.83	4.09
Analyzer Cal. Error	0.00	-4.25	2.25
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 25A Total Hydrocarbons or Volatile Organic Compounds (VOC)
Calibration Error and Drift Checks

VOC molecular weight of 44 as propane

Company:	**Hollingsworth & Vose**	Source:	**CFU 112 (2)**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 15, 2018**	Instrument Model:	**55i**
Location:	**Corvallis, OR**			Instrument Serial #:	**1018142851**

		Calibration System Response	Post-Run System Response	Drift Determination % of span	Drift Determination pass/fail	Analyzer Span	Avg Gas Conc	Instrument Cal. Reference Gas
	zero	0.07	0.34	1.08	pass			
Run 1	upscale	12.78	12.77	-0.04	pass	25	0.98	12.5
	zero	0.07	0.34	1.08	pass			
Run 2	upscale	12.78	12.50	-1.12	pass	25	1.01	12.5
	zero	0.07	0.20	0.52	pass			
Run 3	upscale	12.78	12.50	-1.12	pass	25	0.99	12.5
				≤ 3%				

Instrument Response Time(s):	
Time 1	60
Time 2	60
Time 3	60
Average:	60

SYSTEM CAL. ERROR	Zero	Low	Mid	High
Calibration gas standards	0.00	6.25	12.50	21.25
Calibration gas system response	0.07	6.58	12.78	22.34
Calibration Predicted Response		6.62	13.17	
Calibration Error		0.64	3.12	
Calibration Error < 5% ?	pass	pass	pass	pass

EPA Method 7E,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**13:49**
Source:	**CFU 112 (2)**	**End Time:**	**15:55**
Method:	**7E**	**Date:**	**9/15/2018**

EPA Method 7E:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \text{ x } 100 =$ -1.00 %v

where C_{Dir}:	2.45	ppmv
C_V:	2.50	ppmv
CS:	5.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \text{ x } 100 =$ 0.00 %v

where C_{Dir}:	2.45	ppmv
C_S:	2.45	ppmv
CS:	5.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.40 %v

where SB_{Final}:	0.40	ppmv
SB_i:	0.00	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O) \left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.92 ppmv

where C_{Avg}:	0.90	ppmv
C_O:	-0.01	ppmv
C_{MA}:	2.50	ppmv
C_M:	2.46	ppmv

NO_2 - NO Conversion Efficiency

5) $Eff_{NOx} = \left(\frac{C_{Dir}}{C_v}\right) \text{ x } 100 =$ 110.0 %v

where C_{Dir}:	55.44	ppmv
C_V:	50.41	ppmv

Emission Rates:

$\mathbf{NO_x}$ 1) lb/hr = (Stack Flow) (C) (46) ($1.558x10^{-7}$) = 0.12 lb/hr

where Stack Flow:	17557.40	DSCFM
C:	0.92	ppm
Molecular Wt NO_x:	46	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

$\mathbf{NO_x}$ 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) x\ C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

EPA Method 10,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**13:49**
Source:	**CFU 112 (2)**	**End Time:**	**15:55**
Method:	**10**	**Date:**	**9/15/2018**

EPA Method 10:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.46 %v

where C_{Dir}:	49.54	ppmv
C_V:	50.00	ppmv
CS:	100.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.00 %v

where C_{Dir}:	49.54	ppmv
C_S:	49.54	ppmv
CS:	100.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.23 %v

where SB_{Final}:	0.23	ppmv
SB_i:	0.00	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 24.99 ppmv

where C_{Avg}:	24.65	ppmv
C_O:	-0.34	ppmv
C_{MA}:	50.00	ppmv
C_M:	49.66	ppmv

Emission Rates:

CO 1) lb/hr = (Stack Flow) (C) (28) (1.558×10^{-7}) = 1.91 lb/hr

where Stack Flow:	17557.40	DSCFM
C:	24.99	ppm
Molecular Wt. CO:	28	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

CO 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \times C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**13:49**
Source:	**CFU 112 (2)**	**End Time:**	**15:55**
Method:	**3A**	**Date:**	**9/15/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \text{ x } 100 =$ -0.70 %v

where C_{Dir}:	9.86	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \text{ x } 100 =$ 0.70 %v

where C_{Dir}:	9.86	ppmv
C_S:	10.00	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.10 %v

where SB_{Final}:	0.60	ppmv
SB_i:	0.70	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.99 ppmv

where C_{Avg}:	19.89	ppmv
C_O:	0.09	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.99	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**13:49**
Source:	**CFU 112 (2)**	**End Time:**	**15:55**
Method:	**3A**	**Date:**	**9/15/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) x\ 100 =$ -4.25 %v

where C_{Dir}:	1.83	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) x\ 100 =$ -0.25 %v

where C_{Dir}:	1.83	ppmv
C_S:	1.82	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.50 %v

where SB_{Final}:	0.25	ppmv
SB_i:	-0.25	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.52 ppmv

where C_{Avg}:	0.48	ppmv
C_O:	0.01	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.83	ppmv

EPA Method 25A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**13:49**
Source:	**CFU 112 (2)**	**End Time:**	**15:55**
Method:	**25A**	**Date:**	**9/15/2018**

EPA Method 25A:

Predicted Low and Mid Level Calibration Response (Mid)

1) $PR = \left(\frac{CR_H - CRZ}{SS}\right) \times CS_M + CR_Z =$ 13.17 ppmv

where CR_H:	22.34	ppmv
CR_Z:	0.07	ppmv
SS:	21.25	ppmv
CS_M:	12.50	ppmv

Calibration Error Test

2) $CET = \left(\frac{SR - PR}{CGV}\right) \times 100 =$ -3.12 %v

where PR:	13.17	ppmv
SR:	12.78	ppmv
CGV	12.50	ppmv

Drift Determination (Mid)

3) $D = \left(\frac{CSR - CSRC}{CSRS}\right) \times 100 =$ 0.04 %v

where CSR:	12.78	ppmv
CSR_C:	12.77	ppmv
AS:	25.00	ppmv

Emission Rates:

VOC 1) lb/hr = (Stack Flow) (C) (44) ($1.558x10^{-7}$) = 1.20E-01 lb/hr

where Stack Flow:	17881.09	WSCFM
C:	0.98	ppm
Molecular Wt Propane:	44	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

VOC 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \text{x } C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

Hollingswoth & Vose
CFU #112
Initial Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	6:22:49	0.01	0.29	0.07	-0.08	0.01	0.15
9/15/2018	6:22:59	-0.01	0.01	0.08	-0.12	0.01	0.15
9/15/2018	6:23:09	-0.05	-0.87	0.07	-0.13	0.01	0.19
9/15/2018	6:23:19	-0.06	-1.62	0.07	-0.09	0.01	0.19
9/15/2018	6:23:29	-0.07	-2.11	0.06	-0.07	0.01	0.13
9/15/2018	6:23:39	-0.07	-2.51	0.07	-0.08	0.01	0.18
9/15/2018	6:23:49	-0.05	-1.86	0.07	-0.08	0.00	0.13
9/15/2018	6:23:59	-0.02	-0.37	0.07	-0.08	-0.01	0.19
9/15/2018	6:24:09	-0.01	1.10	0.07	-0.09	0.00	0.15
9/15/2018	6:24:19	-0.01	2.93	0.07	-0.09	0.01	0.15
9/15/2018	6:24:29	0.00	2.90	0.06	-0.09	0.00	0.16
9/15/2018	6:24:39	0.02	1.97	0.06	3.72	5.48	0.16
9/15/2018	6:24:49	0.00	1.17	0.07	10.49	14.57	0.11
9/15/2018	6:24:59	0.01	0.81	0.07	18.69	19.19	0.18
9/15/2018	6:25:09	0.01	1.12	0.06	19.52	19.59	0.16
9/15/2018	6:25:19	0.01	1.75	0.06	19.56	19.61	0.18
9/15/2018	6:25:29	0.01	1.36	0.07	19.56	19.62	0.22
9/15/2018	6:25:39	0.00	0.28	0.07	19.55	19.63	0.21
9/15/2018	6:25:49	-0.01	0.80	0.07	19.75	19.63	0.16
9/15/2018	6:25:59	-0.01	1.10	0.06	19.73	19.64	0.18
9/15/2018	6:26:09	-0.01	0.24	0.07	19.80	19.64	0.19
9/15/2018	6:26:19	-0.01	-0.67	0.05	19.90	19.65	0.18
9/15/2018	6:26:29	-0.02	-1.46	0.06	19.93	19.66	0.16
9/15/2018	6:26:39	-0.01	-2.08	0.06	19.93	19.66	0.21
9/15/2018	6:26:49	0.00	-2.29	0.07	19.41	19.63	0.25
9/15/2018	6:26:59	-0.04	-2.47	0.05	13.38	11.81	0.19
9/15/2018	6:27:09	-0.03	-1.85	0.05	9.86	9.81	0.18
9/15/2018	6:27:19	0.01	0.43	0.06	9.89	9.84	0.18
9/15/2018	6:27:29	0.00	2.05	0.06	9.87	9.82	0.16
9/15/2018	6:27:39	-0.04	1.39	0.05	9.86	9.81	0.19
9/15/2018	6:27:49	-0.04	0.43	0.07	9.86	9.80	0.19
9/15/2018	6:27:59	-0.02	-0.64	0.06	9.86	9.80	0.16
9/15/2018	6:28:09	-0.01	-1.27	0.05	8.81	8.09	0.24
9/15/2018	6:28:19	-0.04	-1.43	0.08	3.31	3.29	0.21
9/15/2018	6:28:29	-0.05	-1.10	0.06	3.82	4.10	0.18
9/15/2018	6:28:39	-0.06	-0.43	0.07	3.83	4.09	0.19
9/15/2018	6:28:49	-0.05	0.78	0.06	3.83	4.08	0.13
9/15/2018	6:28:59	-0.06	1.88	0.06	3.83	4.09	0.15
9/15/2018	6:29:09	-0.07	1.83	0.06	3.86	4.08	0.18
9/15/2018	6:29:19	-0.07	0.78	0.06	3.86	4.07	0.11
9/15/2018	6:29:29	-0.07	-0.07	0.06	2.94	2.87	0.16

Hollingswoth & Vose
CFU #112
Initial Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	6:29:39	-0.06	-0.45	0.06	1.96	1.90	0.18
9/15/2018	6:29:49	-0.03	-0.78	0.07	1.85	1.84	0.19
9/15/2018	6:29:59	0.01	-0.67	0.06	1.84	1.82	0.16
9/15/2018	6:30:09	0.01	-0.23	0.08	1.85	1.82	0.19
9/15/2018	6:30:19	0.00	0.91	0.06	1.84	1.82	0.13
9/15/2018	6:30:29	-0.02	2.23	0.06	1.77	1.82	0.16
9/15/2018	6:30:39	-0.05	1.97	0.06	1.62	1.80	0.10
9/15/2018	6:30:49	-0.07	0.97	0.07	1.62	1.80	0.16
9/15/2018	6:30:59	-0.09	0.20	0.06	1.62	1.82	0.13
9/15/2018	6:31:09	-0.07	-0.32	0.06	1.63	1.82	0.19
9/15/2018	6:31:19	-0.04	-0.45	0.06	1.62	1.83	0.15
9/15/2018	6:31:29	-0.03	-0.19	0.06	1.63	1.83	0.19
9/15/2018	6:31:39	-0.01	0.85	0.07	1.62	1.84	0.08
9/15/2018	6:31:49	0.00	2.35	0.05	1.62	1.84	0.13
9/15/2018	6:31:59	0.02	3.02	0.06	1.62	1.84	0.05
9/15/2018	6:32:09	0.00	2.47	0.06	1.63	1.84	0.11
9/15/2018	6:32:19	-0.03	1.52	0.05	3.07	2.53	0.11
9/15/2018	6:32:29	-0.04	4.12	0.06	1.27	0.59	0.01
9/15/2018	6:32:39	-0.05	23.10	0.07	-0.04	0.04	0.11
9/15/2018	6:32:49	-0.07	52.94	0.06	-0.09	0.02	0.19
9/15/2018	6:32:59	-0.07	78.85	0.06	-0.10	0.02	0.15
9/15/2018	6:33:09	-0.06	93.31	0.06	-0.10	0.01	0.19
9/15/2018	6:33:19	-0.06	99.46	0.07	-0.10	0.02	0.11
9/15/2018	6:33:29	-0.07	101.03	0.07	-0.11	0.01	0.22
9/15/2018	6:33:39	-0.08	100.46	0.07	-0.11	0.00	0.13
9/15/2018	6:33:49	-0.07	99.49	0.06	-0.11	0.00	0.13
9/15/2018	6:33:59	0.03	98.70	0.06	-0.11	-0.01	0.04
9/15/2018	6:34:09	8.22	97.88	0.06	-0.11	0.00	0.04
9/15/2018	6:34:19	10.32	97.59	0.06	-0.11	0.00	0.07
9/15/2018	6:34:29	10.31	97.75	0.07	-0.11	0.00	0.13
9/15/2018	6:34:39	10.32	99.09	0.06	-0.11	0.00	0.11
9/15/2018	6:34:49	10.32	100.46	0.06	-0.11	0.00	0.16
9/15/2018	6:34:59	10.34	100.50	0.07	-0.11	-0.01	0.10
9/15/2018	6:35:09	10.35	99.47	0.06	-0.08	-0.01	0.22
9/15/2018	6:35:19	10.32	97.22	0.06	-0.04	0.05	0.10
9/15/2018	6:35:29	10.31	87.11	0.05	-0.11	-0.01	0.13
9/15/2018	6:35:39	8.64	71.07	0.06	-0.12	-0.01	0.08
9/15/2018	6:35:49	37.97	57.90	0.05	-0.12	-0.01	0.21
9/15/2018	6:35:59	62.64	51.42	0.06	-0.12	-0.01	0.18
9/15/2018	6:36:09	53.03	51.14	0.05	-0.12	-0.01	0.19
9/15/2018	6:36:19	52.03	52.61	0.06	-0.09	-0.01	0.16

Hollingswoth & Vose
CFU #112
Initial Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	6:36:29	52.05	52.63	0.05	0.03	-0.01	0.21
9/15/2018	6:36:39	52.04	51.83	0.05	0.03	-0.02	0.13
9/15/2018	6:36:49	52.03	50.66	0.06	0.02	-0.02	0.22
9/15/2018	6:36:59	51.71	49.81	0.07	0.03	-0.02	0.15
9/15/2018	6:37:09	51.71	49.55	0.06	0.03	-0.02	0.13
9/15/2018	6:37:19	51.68	49.30	0.06	0.02	-0.02	0.19
9/15/2018	6:37:29	51.67	49.76	0.07	0.02	-0.02	0.13
9/15/2018	6:37:39	51.71	51.51	0.06	0.03	-0.02	0.19
9/15/2018	6:37:49	51.69	52.30	0.05	0.03	-0.02	0.19
9/15/2018	6:37:59	51.66	51.74	0.07	0.03	-0.02	0.21
9/15/2018	6:38:09	51.70	50.23	0.05	0.05	-0.03	0.16
9/15/2018	6:38:19	51.44	46.01	0.06	0.05	-0.02	0.25
9/15/2018	6:38:29	51.39	34.84	0.07	0.09	0.03	0.13
9/15/2018	6:38:39	51.41	22.57	0.06	0.59	0.60	0.21
9/15/2018	6:38:49	52.23	13.16	0.05	0.08	0.01	0.25
9/15/2018	6:38:59	31.10	8.61	0.07	0.03	-0.01	0.16
9/15/2018	6:39:09	9.41	8.00	0.06	0.02	-0.01	0.19
9/15/2018	6:39:19	7.78	7.58	0.07	0.02	-0.01	0.19
9/15/2018	6:39:29	6.24	7.03	0.06	0.02	-0.01	0.22
9/15/2018	6:39:39	5.82	6.18	0.05	0.02	-0.01	0.22
9/15/2018	6:39:49	5.78	5.52	0.06	0.02	-0.01	0.21
9/15/2018	6:39:59	5.77	4.81	0.07	0.02	-0.02	0.21
9/15/2018	6:40:09	5.78	4.77	0.07	0.02	-0.02	0.22
9/15/2018	6:40:19	5.78	5.07	0.07	0.02	-0.02	0.19
9/15/2018	6:40:29	5.76	6.32	0.06	0.02	-0.01	0.13
9/15/2018	6:40:39	5.51	7.64	0.07	0.02	-0.01	0.13
9/15/2018	6:40:49	5.46	7.65	0.07	0.02	-0.01	0.27
9/15/2018	6:40:59	5.48	7.17	0.07	0.02	-0.02	0.15
9/15/2018	6:41:09	5.48	6.05	0.07	0.02	-0.01	0.15
9/15/2018	6:41:19	5.47	5.39	0.09	0.02	0.00	0.25
9/15/2018	6:41:29	7.06	5.00	0.07	0.02	-0.01	0.22
9/15/2018	6:41:39	6.27	4.68	0.08	0.02	-0.02	0.21
9/15/2018	6:41:49	3.76	4.83	0.07	0.02	-0.02	0.24
9/15/2018	6:41:59	4.47	6.42	0.07	0.02	-0.01	0.21
9/15/2018	6:42:09	4.48	7.82	0.06	0.02	-0.01	0.22
9/15/2018	6:42:19	4.48	7.71	0.07	0.02	-0.01	0.19
9/15/2018	6:42:29	4.48	6.94	0.08	0.02	-0.02	0.22
9/15/2018	6:42:39	4.49	5.88	0.07	0.02	-0.01	0.16
9/15/2018	6:42:49	4.72	5.19	0.07	0.02	-0.02	0.22
9/15/2018	6:42:59	4.80	4.97	0.07	0.03	-0.02	0.18
9/15/2018	6:43:09	4.79	4.75	0.07	0.02	-0.02	0.16

Hollingswoth & Vose
CFU #112
Initial Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	6:43:19	4.79	5.07	0.07	0.02	-0.02	0.19
9/15/2018	6:43:29	4.79	6.77	0.07	0.02	-0.02	0.18
9/15/2018	6:43:39	4.78	7.62	0.06	0.02	-0.02	0.24
9/15/2018	6:43:49	4.78	6.47	0.07	0.02	-0.02	0.21
9/15/2018	6:43:59	3.76	4.85	0.06	0.02	-0.02	0.22
9/15/2018	6:44:09	2.57	3.62	0.07	0.02	-0.01	0.22
9/15/2018	6:44:19	2.47	2.92	0.06	0.02	-0.02	0.13
9/15/2018	6:44:29	2.45	2.61	0.06	0.02	-0.02	0.21
9/15/2018	6:44:39	2.45	2.52	0.07	0.02	-0.02	0.18
9/15/2018	6:44:49	2.46	3.82	0.07	0.02	-0.02	0.16
9/15/2018	6:44:59	2.47	5.24	0.07	0.02	-0.02	0.21
9/15/2018	6:45:09	2.43	5.37	0.07	0.04	-0.02	0.18
9/15/2018	6:45:19	2.45	4.50	0.07	0.04	-0.01	0.16
9/15/2018	6:45:29	2.45	3.30	0.08	0.05	-0.01	0.22
		NOx [PPM]	**CO [PPM]**		**O2 [%]**	**CO2 [%]**	
Analyzer Zero		**-0.03**	**0.07**		**-0.09**	**0.00**	
Analyzer Mid		**2.45**	**49.54**		**9.86**	**1.83**	
Analyzer High		**4.79**	**100.02**		**19.92**	**4.09**	
System							
9/15/2018	6:45:39	2.46	1.97	0.07	0.04	-0.01	0.24
9/15/2018	6:45:49	2.46	0.82	0.07	10.67	0.03	0.18
9/15/2018	6:45:59	2.18	0.60	0.07	20.72	0.04	0.19
9/15/2018	6:46:09	2.41	1.30	0.08	20.74	0.03	0.21
9/15/2018	6:46:19	1.29	2.57	0.07	20.95	0.05	0.21
9/15/2018	6:46:29	0.32	3.18	0.07	20.97	0.05	0.22
9/15/2018	6:46:39	0.24	2.65	0.07	20.97	0.06	0.19
9/15/2018	6:46:49	0.01	1.59	0.07	20.97	0.05	0.22
9/15/2018	6:46:59	-0.04	0.92	0.07	20.96	0.06	0.22
9/15/2018	6:47:09	-0.04	0.36	0.07	20.96	0.06	0.19
9/15/2018	6:47:19	-0.03	0.15	0.08	20.95	0.06	0.22
9/15/2018	6:47:29	-0.04	0.32	0.07	20.95	0.06	0.16
9/15/2018	6:47:39	-0.02	1.98	0.07	20.95	0.07	0.16
9/15/2018	6:47:49	-0.02	3.05	0.07	20.95	0.07	0.21
9/15/2018	6:47:59	-0.03	2.78	0.06	20.96	0.07	0.22
9/15/2018	6:48:09	-0.04	1.72	0.06	20.96	0.07	0.15
9/15/2018	6:48:19	-0.05	0.98	0.07	20.97	0.07	0.19
9/15/2018	6:48:29	-0.05	0.58	0.07	20.56	0.07	0.16
9/15/2018	6:48:39	-0.03	0.10	0.06	20.16	0.06	0.24
9/15/2018	6:48:49	-0.05	1.03	0.07	13.28	0.05	0.19
9/15/2018	6:48:59	-0.03	3.02	0.06	6.26	0.02	0.16

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	6:49:09	-0.03	4.32	0.07	2.94	0.02	0.25
9/15/2018	6:49:19	-0.04	3.73	0.07	1.45	0.01	0.21
9/15/2018	6:49:29	0.23	2.30	0.06	0.77	0.02	0.21
9/15/2018	6:49:39	0.25	1.54	0.07	0.47	0.01	0.21
9/15/2018	6:49:49	-0.03	0.77	0.07	0.32	0.01	0.25
9/15/2018	6:49:59	-0.03	0.43	0.07	0.26	0.00	0.24
9/15/2018	6:50:09	-0.03	0.52	0.07	0.23	0.01	0.21
9/15/2018	6:50:19	-0.04	1.88	0.08	0.21	0.01	0.25
9/15/2018	6:50:29	-0.04	3.32	0.07	0.21	0.00	0.19
9/15/2018	6:50:39	-0.05	3.47	0.06	0.21	0.01	0.18
9/15/2018	6:50:49	-0.04	2.38	0.06	0.20	0.00	0.19
9/15/2018	6:50:59	-0.02	1.57	0.06	0.21	0.01	0.15
9/15/2018	6:51:09	-0.04	1.00	0.07	0.20	0.00	0.21
9/15/2018	6:51:19	-0.02	0.40	0.07	0.20	0.00	0.24
9/15/2018	6:51:29	-0.04	0.08	0.07	0.20	0.01	0.19
9/15/2018	6:51:39	-0.02	1.09	0.07	1.87	0.01	0.21
9/15/2018	6:51:49	-0.03	2.65	0.07	8.33	0.03	0.18
9/15/2018	6:51:59	-0.04	3.50	0.07	5.58	0.03	0.24
9/15/2018	6:52:09	-0.05	2.97	0.07	2.71	0.02	0.21
9/15/2018	6:52:19	0.23	2.41	0.07	1.34	0.01	0.18
9/15/2018	6:52:29	0.27	2.36	0.06	0.72	0.01	0.21
9/15/2018	6:52:39	0.78	2.43	0.06	0.44	0.01	0.24
9/15/2018	6:52:49	1.09	2.51	0.07	0.31	0.01	0.19
9/15/2018	6:52:59	1.40	3.36	0.06	0.25	0.01	0.21
9/15/2018	6:53:09	1.44	4.92	0.07	0.21	0.00	0.21
9/15/2018	6:53:19	1.81	5.68	0.06	0.21	0.00	0.25
9/15/2018	6:53:29	1.83	4.80	0.07	0.20	0.00	0.25
9/15/2018	6:53:39	1.80	4.00	0.07	0.20	0.00	0.19
9/15/2018	6:53:49	2.14	3.35	0.07	0.20	0.00	0.25
9/15/2018	6:53:59	2.17	2.68	0.05	0.19	0.00	0.19
9/15/2018	6:54:09	2.14	2.58	0.06	0.19	-0.01	0.25
9/15/2018	6:54:19	2.15	3.54	0.06	0.19	0.01	0.13
9/15/2018	6:54:29	2.15	5.19	0.06	0.19	0.00	0.15
9/15/2018	6:54:39	2.15	5.72	0.07	0.19	0.00	0.15
9/15/2018	6:54:49	2.16	5.03	0.07	0.19	0.00	0.19
9/15/2018	6:54:59	2.41	4.35	0.07	0.19	0.00	0.24
9/15/2018	6:55:09	2.43	3.39	0.06	0.19	0.00	0.19
9/15/2018	6:55:19	2.45	2.98	0.06	0.19	-0.01	0.11
9/15/2018	6:55:29	2.44	2.80	0.08	0.12	0.00	0.19
9/15/2018	6:55:39	2.46	3.47	0.07	0.08	0.00	0.15
9/15/2018	6:55:49	2.44	5.26	0.06	0.09	0.00	0.08

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	6:55:59	2.45	6.14	0.07	0.24	0.01	0.13
9/15/2018	6:56:09	2.46	7.87	0.07	0.18	0.00	0.19
9/15/2018	6:56:19	5.36	15.02	0.07	0.13	0.00	0.19
9/15/2018	6:56:29	7.04	25.76	0.07	0.10	0.01	0.13
9/15/2018	6:56:39	22.49	35.89	0.06	0.09	0.00	0.21
9/15/2018	6:56:49	39.26	42.52	0.06	0.09	0.00	0.24
9/15/2018	6:56:59	46.58	46.26	0.06	0.09	0.00	0.22
9/15/2018	6:57:09	51.51	49.80	0.07	0.08	0.00	0.18
9/15/2018	6:57:19	53.29	51.55	0.07	0.09	0.00	0.16
9/15/2018	6:57:29	54.35	51.63	0.06	0.08	0.01	0.16
9/15/2018	6:57:39	54.86	51.00	0.06	0.08	0.01	0.18
9/15/2018	6:57:49	54.88	49.99	0.06	0.08	0.00	0.19
9/15/2018	6:57:59	55.14	49.34	0.07	0.08	0.00	0.21
9/15/2018	6:58:09	55.16	49.03	0.08	0.08	0.00	0.28
9/15/2018	6:58:19	55.16	49.22	0.06	0.08	0.00	0.19
9/15/2018	6:58:29	55.16	50.38	0.07	0.08	0.00	0.25
9/15/2018	6:58:39	55.16	52.06	0.06	0.08	0.01	0.22
9/15/2018	6:58:49	55.16	52.72	0.07	0.08	0.01	0.15
9/15/2018	6:58:59	55.15	51.61	0.07	0.09	0.00	0.16
9/15/2018	6:59:09	55.16	50.40	0.07	1.76	0.01	0.16
9/15/2018	6:59:19	55.16	48.45	0.07	9.97	0.03	0.18
9/15/2018	6:59:29	55.40	41.85	0.07	15.45	0.04	0.11
9/15/2018	6:59:39	45.26	30.86	0.07	17.05	0.05	0.11
9/15/2018	6:59:49	32.75	20.49	0.06	10.37	0.03	0.16
9/15/2018	6:59:59	22.00	14.40	0.07	4.95	0.16	0.19
9/15/2018	7:00:09	11.30	10.50	0.07	3.15	0.96	0.18
9/15/2018	7:00:19	7.04	7.26	0.06	2.50	1.42	0.16
9/15/2018	7:00:29	4.98	4.66	0.07	2.22	1.63	0.13
9/15/2018	7:00:39	3.47	2.52	0.06	2.09	1.73	0.18
9/15/2018	7:00:49	1.96	1.01	0.06	2.02	1.77	0.22
9/15/2018	7:00:59	1.29	0.21	0.07	2.00	1.80	0.18
9/15/2018	7:01:09	0.66	0.50	0.06	1.99	1.81	0.21
9/15/2018	7:01:19	0.30	2.22	0.06	1.99	1.81	0.15
9/15/2018	7:01:29	0.25	3.09	0.05	1.99	1.81	0.28
9/15/2018	7:01:39	0.24	2.11	0.06	1.98	1.82	0.21
9/15/2018	7:01:49	0.01	1.34	0.07	1.98	1.82	0.22
9/15/2018	7:01:59	-0.04	0.73	0.06	1.98	1.81	0.19
9/15/2018	7:02:09	-0.03	-0.13	0.05	2.00	1.86	0.19
9/15/2018	7:02:19	-0.02	-0.53	0.06	4.59	5.07	0.15
9/15/2018	7:02:29	-0.04	0.03	0.05	7.39	7.64	0.15
9/15/2018	7:02:39	-0.02	1.88	0.06	8.67	8.69	0.18

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	7:02:49	-0.02	3.24	0.05	9.26	9.21	0.24
9/15/2018	7:02:59	-0.02	2.49	0.06	9.53	9.44	0.19
9/15/2018	7:03:09	-0.02	1.11	0.05	9.66	9.56	0.13
9/15/2018	7:03:19	-0.02	-0.13	0.06	9.81	9.63	0.21
9/15/2018	7:03:29	-0.05	-0.83	0.05	9.96	9.65	0.22
9/15/2018	7:03:39	-0.03	-1.18	0.06	9.99	9.67	0.15
9/15/2018	7:03:49	-0.04	-1.04	0.07	10.00	9.68	0.19
9/15/2018	7:03:59	-0.05	0.35	0.05	10.00	9.69	0.15
9/15/2018	7:04:09	-0.03	1.68	0.05	10.00	9.70	0.16
9/15/2018	7:04:19	-0.03	1.70	0.06	10.00	9.70	0.08
9/15/2018	7:04:29	-0.05	0.92	0.06	10.00	9.69	0.13
9/15/2018	7:04:39	-0.06	0.05	0.06	10.35	9.35	0.18
9/15/2018	7:04:49	-0.04	-0.78	0.06	14.30	5.75	0.13
9/15/2018	7:04:59	-0.03	-1.10	0.06	17.62	2.82	0.15
9/15/2018	7:05:09	-0.04	-0.67	0.06	19.27	1.39	0.11
9/15/2018	7:05:19	-0.03	1.05	0.05	20.07	0.78	0.13
9/15/2018	7:05:29	-0.03	2.69	0.06	20.46	0.46	0.16
9/15/2018	7:05:39	-0.05	3.23	0.06	20.65	0.29	0.16
9/15/2018	7:05:49	-0.04	2.19	0.07	20.73	0.20	0.18
9/15/2018	7:05:59	-0.02	1.24	0.06	20.78	0.15	0.13
9/15/2018	7:06:09	-0.04	0.69	0.06	20.80	0.13	0.13
9/15/2018	7:06:19	-0.02	0.23	0.06	20.81	0.11	0.16
9/15/2018	7:06:29	-0.04	0.45	0.07	20.81	0.11	0.15
9/15/2018	7:06:39	-0.03	2.05	0.05	20.82	0.10	0.15
9/15/2018	7:06:49	-0.03	3.34	0.07	20.82	0.10	0.15
9/15/2018	7:06:59	-0.03	3.45	0.07	20.82	0.09	0.11
9/15/2018	7:07:09	-0.03	2.31	0.06	20.83	0.09	0.22
9/15/2018	7:07:19	-0.04	1.54	0.05	20.83	0.08	0.15
9/15/2018	7:07:29	-0.04	0.74	0.06	20.83	0.09	0.10
9/15/2018	7:07:39	-0.04	0.32	0.06	20.83	0.09	0.16
9/15/2018	7:07:49	-0.06	0.76	0.06	20.84	0.09	0.11
9/15/2018	7:07:59	-0.04	2.33	0.06	20.84	0.08	0.15
9/15/2018	7:08:09	-0.04	3.55	0.06	20.83	0.08	0.16
9/15/2018	7:08:19	-0.04	3.36	0.06	20.84	0.08	0.18
9/15/2018	7:08:29	-0.02	2.20	0.06	20.84	0.08	0.13
9/15/2018	7:08:39	-0.02	1.54	0.06	20.84	0.08	0.07
9/15/2018	7:08:49	-0.04	0.72	0.06	20.84	0.08	0.13
9/15/2018	7:08:59	-0.04	0.44	0.05	20.85	0.08	0.16
9/15/2018	7:09:09	-0.05	0.71	0.05	20.87	0.08	0.21
9/15/2018	7:09:19	-0.04	2.08	0.07	20.22	0.45	0.18
9/15/2018	7:09:29	-0.06	3.48	0.06	12.76	0.82	0.18

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	7:09:39	-0.03	3.02	0.07	6.15	0.45	0.13
9/15/2018	7:09:49	-0.04	2.26	0.06	2.99	0.29	0.18
9/15/2018	7:09:59	-0.04	1.40	0.07	1.55	0.23	0.22
9/15/2018	7:10:09	-0.04	0.78	0.06	0.88	0.16	0.21
9/15/2018	7:10:19	-0.04	0.42	0.06	0.58	0.11	0.19
9/15/2018	7:10:29	0.19	0.52	0.06	0.46	0.08	0.15
9/15/2018	7:10:39	0.25	1.90	0.07	0.40	0.05	0.19
9/15/2018	7:10:49	0.26	3.46	0.06	0.37	0.04	0.22
9/15/2018	7:10:59	0.24	3.63	0.07	0.36	0.04	0.22
9/15/2018	7:11:09	0.00	3.11	0.06	0.35	0.03	0.19
9/15/2018	7:11:19	-0.05	1.73	0.06	0.34	0.03	0.19
9/15/2018	7:11:29	-0.06	1.10	0.06	0.35	0.03	0.21
9/15/2018	7:11:39	-0.03	0.57	0.06	0.34	0.03	0.21
9/15/2018	7:11:49	-0.04	0.16	0.06	0.34	0.03	0.21
9/15/2018	7:11:59	-0.03	1.01	0.07	0.34	0.02	0.19
9/15/2018	7:12:09	-0.03	2.44	0.06	0.34	0.03	0.21
9/15/2018	7:12:19	-0.02	3.59	0.06	0.34	0.03	0.21
9/15/2018	7:12:29	-0.04	2.99	0.06	0.34	0.03	0.11
9/15/2018	7:12:39	-0.02	1.94	0.07	0.33	0.02	0.21
9/15/2018	7:12:49	-0.01	1.36	0.06	0.34	0.02	0.22
9/15/2018	7:12:59	-0.04	0.76	0.07	0.33	0.02	0.13
9/15/2018	7:13:09	-0.08	0.27	1.13	0.34	0.02	9.36
9/15/2018	7:13:19	-0.02	0.33	10.74	0.33	0.03	46.15
9/15/2018	7:13:29	-0.03	1.82	10.75	0.33	0.03	46.20
9/15/2018	7:13:39	-0.04	3.36	10.75	0.33	0.02	46.14
9/15/2018	7:13:49	-0.01	3.44	10.75	0.33	0.01	46.08
9/15/2018	7:13:59	-0.03	2.58	10.75	0.33	0.02	46.15
9/15/2018	7:14:09	-0.05	1.79	10.75	0.33	0.02	46.12
9/15/2018	7:14:19	-0.03	0.80	10.75	0.33	0.02	46.18
9/15/2018	7:14:29	-0.04	0.46	11.59	0.33	0.02	50.01
9/15/2018	7:14:39	-0.04	0.36	11.97	0.33	0.02	50.96
9/15/2018	7:14:49	-0.04	1.63	11.97	0.33	0.02	51.03
9/15/2018	7:14:59	-0.04	3.08	11.97	0.39	0.02	51.00
9/15/2018	7:15:09	-0.05	3.41	11.96	5.99	0.03	50.93
9/15/2018	7:15:19	-0.02	2.39	11.96	13.40	0.06	51.00
9/15/2018	7:15:29	-0.02	1.35	11.96	17.25	0.05	51.00
9/15/2018	7:15:39	-0.04	0.64	12.12	19.11	0.06	51.54
9/15/2018	7:15:49	-0.04	0.11	12.51	17.53	0.06	52.24
9/15/2018	7:15:59	-0.03	0.22	12.51	18.06	0.06	52.29
9/15/2018	7:16:09	-0.04	1.03	12.50	19.45	0.05	52.27
9/15/2018	7:16:19	-0.03	2.91	12.50	20.16	0.05	52.32

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	7:16:29	-0.04	3.69	12.50	20.50	0.06	52.29
9/15/2018	7:16:39	-0.03	2.70	12.51	20.66	0.05	52.24
9/15/2018	7:16:49	-0.05	1.67	12.50	20.75	0.06	52.19
9/15/2018	7:16:59	-0.04	0.99	5.87	20.81	0.06	23.81
9/15/2018	7:17:09	-0.03	0.54	5.13	19.56	0.05	23.81
9/15/2018	7:17:19	-0.04	0.15	5.14	11.61	0.12	23.80
9/15/2018	7:17:29	-0.06	0.56	5.15	7.52	0.19	23.83
9/15/2018	7:17:39	-0.02	1.72	5.14	5.92	0.10	23.87
9/15/2018	7:17:49	-0.04	3.39	5.14	5.15	0.05	23.80
9/15/2018	7:17:59	0.18	3.16	5.15	4.79	0.03	23.80
9/15/2018	7:18:09	0.75	2.39	2.99	4.62	0.02	11.19
9/15/2018	7:18:19	0.86	1.21	0.88	4.54	0.01	2.80
9/15/2018	7:18:29	0.84	0.67	0.85	4.51	0.01	2.80
9/15/2018	7:18:39	0.86	0.17	0.87	4.49	0.01	2.91
9/15/2018	7:18:49	0.85	0.16	0.87	4.49	0.01	2.77
9/15/2018	7:18:59	0.60	1.19	0.86	4.48	0.01	2.82
9/15/2018	7:19:09	0.56	2.76	0.86	4.48	0.01	2.74
9/15/2018	7:19:19	0.54	3.62	11.76	4.48	0.01	53.96
9/15/2018	7:19:29	0.30	2.69	55.39	4.48	0.01	173.41
9/15/2018	7:19:39	0.27	1.94	55.38	4.48	0.01	173.44
9/15/2018	7:19:49	0.27	1.07	55.38	4.48	0.01	173.43
9/15/2018	7:19:59	0.26	0.59	55.39	4.48	0.02	173.40
9/15/2018	7:20:09	0.25	0.13	55.39	4.48	0.01	173.44
9/15/2018	7:20:19	0.27	0.65	55.38	4.48	0.01	173.50
9/15/2018	7:20:29	0.25	2.26	55.38	4.48	0.02	173.44
9/15/2018	7:20:39	0.26	3.42	25.64	4.48	0.01	2.71
9/15/2018	7:20:49	0.01	3.03	22.34	4.48	0.01	2.79
9/15/2018	7:20:59	-0.02	1.87	22.34	4.48	0.01	2.74
9/15/2018	7:21:09	-0.03	1.13	22.34	4.48	0.01	2.72
9/15/2018	7:21:19	-0.03	0.63	22.35	4.48	0.01	2.75
9/15/2018	7:21:29	-0.04	0.26	22.34	4.48	0.01	2.80
9/15/2018	7:21:39	-0.05	0.43	22.35	4.48	0.01	2.83
9/15/2018	7:21:49	-0.02	1.71	22.19	4.48	0.01	1.85
9/15/2018	7:21:59	-0.02	3.23	22.07	4.48	0.01	1.47
9/15/2018	7:22:09	-0.04	3.35	22.08	4.48	0.01	1.44
9/15/2018	7:22:19	-0.04	2.37	22.08	4.48	0.01	1.50
9/15/2018	7:22:29	-0.04	1.60	22.08	4.48	0.01	1.46
9/15/2018	7:22:39	-0.03	0.96	22.07	4.48	0.02	1.40
9/15/2018	7:22:49	-0.03	0.39	22.08	4.48	0.01	1.44
9/15/2018	7:22:59	-0.05	0.64	22.07	4.48	0.01	0.95
9/15/2018	7:23:09	-0.04	1.50	22.06	4.48	0.01	0.19

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CFU #112
Initial Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	7:23:19	-0.04	3.40	22.08	4.48	0.01	0.25
9/15/2018	7:23:29	-0.07	3.53	22.07	3.89	0.01	0.24
9/15/2018	7:23:39	-0.04	2.68	22.07	3.21	0.02	0.18
9/15/2018	7:23:49	-0.06	1.70	22.07	2.92	0.02	0.16
9/15/2018	7:23:59	-0.01	0.97	22.08	2.78	0.02	0.10
9/15/2018	7:24:09	-0.01	0.60	22.07	2.72	0.01	0.21
9/15/2018	7:24:19	-0.02	0.15	22.06	2.69	0.02	0.08
9/15/2018	7:24:29	-0.06	1.03	22.07	2.67	0.02	0.22
9/15/2018	7:24:39	-0.04	2.39	22.06	2.67	0.02	0.15
9/15/2018	7:24:49	-0.03	3.38	22.07	2.66	0.02	0.18
9/15/2018	7:24:59	-0.04	2.99	22.07	2.66	0.01	0.21
9/15/2018	7:25:09	-0.01	1.94	22.07	2.66	0.01	0.19
9/15/2018	7:25:19	-0.03	1.19	22.07	2.65	0.01	0.21
9/15/2018	7:25:29	-0.04	0.85	15.56	2.65	0.02	0.19
9/15/2018	7:25:39	-0.01	0.40	12.77	2.66	0.01	0.15
9/15/2018	7:25:49	-0.03	0.67	12.77	2.65	0.02	0.21
9/15/2018	7:25:59	-0.02	1.75	12.78	2.66	0.01	0.22
9/15/2018	7:26:09	-0.02	3.37	12.78	2.65	0.01	0.22
9/15/2018	7:26:19	-0.03	3.43	12.77	2.51	0.02	0.19
9/15/2018	7:26:29	-0.04	2.48	12.77	2.03	0.01	0.18
9/15/2018	7:26:39	-0.04	1.65	12.92	1.68	0.01	0.18
9/15/2018	7:26:49	-0.03	0.81	13.16	1.51	0.02	0.13
9/15/2018	7:26:59	-0.04	0.55	13.15	1.43	0.03	0.22
9/15/2018	7:27:09	0.18	0.18	13.16	1.39	0.02	0.13
9/15/2018	7:27:19	0.24	0.96	13.16	1.36	0.02	0.16
9/15/2018	7:27:29	0.03	2.44	13.16	1.36	0.02	0.19
9/15/2018	7:27:39	-0.04	3.59	13.16	1.36	0.02	0.19
9/15/2018	7:27:49	-0.04	3.01	13.18	1.35	0.03	3.85
9/15/2018	7:27:59	-0.04	1.96	13.26	1.36	0.02	18.56
9/15/2018	7:28:09	-0.04	1.29	13.26	1.35	0.03	18.46
9/15/2018	7:28:19	-0.05	0.56	13.25	1.35	0.03	18.58
9/15/2018	7:28:29	-0.05	0.46	13.25	1.35	0.03	18.50
9/15/2018	7:28:39	-0.04	0.24	13.26	1.35	0.02	18.49
9/15/2018	7:28:49	-0.04	1.14	13.26	1.35	0.03	18.52
9/15/2018	7:28:59	-0.03	2.82	13.25	1.35	0.02	18.53
9/15/2018	7:29:09	-0.04	3.46	8.02	1.35	0.03	2.05
9/15/2018	7:29:19	-0.06	2.74	6.72	1.35	0.03	0.25
9/15/2018	7:29:29	-0.07	1.90	6.71	1.35	0.03	0.24
9/15/2018	7:29:39	-0.06	0.95	6.70	1.36	0.03	0.22
9/15/2018	7:29:49	-0.05	0.61	6.71	1.35	0.02	0.30
9/15/2018	7:29:59	-0.05	0.49	6.70	1.35	0.03	0.25

Hollingswoth & Vose
CFU #112
Initial Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/15/2018	7:30:09	-0.06	1.24	6.70	1.35	0.02	0.30
9/15/2018	7:30:19	-0.04	2.93	6.70	1.35	0.02	0.25
9/15/2018	7:30:29	-0.04	3.60	6.71	1.35	0.03	0.24
9/15/2018	7:30:39	-0.05	2.71	6.72	1.35	0.03	0.19
9/15/2018	7:30:49	-0.03	2.02	6.71	1.35	0.03	0.18
9/15/2018	7:30:59	-0.04	1.06	6.71	1.35	0.03	0.21
9/15/2018	7:31:09	-0.04	0.65	6.70	1.35	0.02	0.19
9/15/2018	7:31:19	-0.02	0.10	6.71	1.35	0.03	0.16
9/15/2018	7:31:29	-0.04	0.63	6.68	1.35	0.03	0.21
9/15/2018	7:31:39	-0.03	1.78	6.58	1.35	0.03	0.25
9/15/2018	7:31:49	-0.06	3.50	6.57	1.35	0.03	0.18
9/15/2018	7:31:59	-0.02	3.01	6.58	1.35	0.03	0.19
9/15/2018	7:32:09	-0.02	2.44	6.58	1.35	0.03	0.18
9/15/2018	7:32:19	-0.04	1.30	6.58	1.57	0.02	0.16
9/15/2018	7:32:29	-0.04	0.77	6.57	7.76	0.05	0.16
9/15/2018	7:32:39	-0.04	0.44	6.58	14.36	0.05	0.18
9/15/2018	7:32:49	-0.03	0.48	6.70	16.94	0.07	0.18
9/15/2018	7:32:59	-0.03	0.95	6.70	18.59	0.05	0.18
9/15/2018	7:33:09	-0.06	3.21	6.70	20.95	0.03	0.16
Analyzer NO2							
9/15/2018	7:33:19	7.85	4.17	6.70	21.03	0.02	0.22
9/15/2018	7:33:29	17.54	3.44	6.71	21.04	0.03	0.22
9/15/2018	7:33:39	33.57	2.08	6.70	21.05	0.02	0.19
9/15/2018	7:33:49	50.82	1.15	6.70	21.06	0.02	0.19
9/15/2018	7:33:59	54.77	0.61	6.32	21.06	0.02	0.15
9/15/2018	7:34:09	55.34	0.24	6.05	21.07	0.01	0.19
9/15/2018	7:34:19	55.43	0.14	6.05	21.07	0.02	0.27
9/15/2018	7:34:29	55.45	1.56	6.04	21.07	0.02	0.24
9/15/2018	7:34:39	55.44	3.13	6.05	21.07	0.02	0.19
9/15/2018	7:34:49	55.43	3.51	6.05	21.08	0.01	0.19
9/15/2018	7:34:59	55.46	2.44	6.04	21.08	0.02	0.21

	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	ALT-106 CH4 [PPM]
System zero	**-0.03**	**0.57**	**0.07**	**0.08**	**0.01**	**0.23**
System low			**6.58**			
System mid	**2.45**	**49.54**	**12.78**	**10.00**	**1.82**	
System high			**22.34**			**50.99**

NO2 convertor check **55.44**

Hollingswoth & Vose
CFU #112 (2)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	13:49:10	0.91	23.95	1.02	19.88	0.48
9/15/2018	13:50:10	0.90	25.86	1.13	19.88	0.49
9/15/2018	13:51:10	0.90	24.27	1.01	19.89	0.49
9/15/2018	13:52:10	0.90	26.28	1.00	19.88	0.49
9/15/2018	13:53:10	0.91	25.54	1.07	19.88	0.49
9/15/2018	13:54:10	0.91	24.31	1.10	19.89	0.49
9/15/2018	13:55:10	0.91	23.35	1.01	19.89	0.48
9/15/2018	13:56:10	0.90	22.82	1.00	19.89	0.48
9/15/2018	13:57:10	0.89	23.49	1.00	19.89	0.48
9/15/2018	13:58:10	0.91	23.51	0.92	19.88	0.48
9/15/2018	13:59:10	0.90	24.96	0.93	19.88	0.48
9/15/2018	14:00:10	0.90	23.84	0.97	19.87	0.48
9/15/2018	14:01:10	0.90	26.53	0.87	19.88	0.48
9/15/2018	14:02:10	0.91	23.38	0.87	19.88	0.47
9/15/2018	14:03:10	0.90	25.59	0.97	19.88	0.47
9/15/2018	14:04:10	0.91	25.00	1.07	19.89	0.47
9/15/2018	14:05:10	0.90	25.74	1.09	19.89	0.47
9/15/2018	14:06:10	0.91	24.89	0.99	19.89	0.47
9/15/2018	14:07:10	0.90	25.01	0.87	19.89	0.47
9/15/2018	14:08:10	0.90	23.33	0.87	19.89	0.47
9/15/2018	14:09:10	0.91	24.18	0.86	19.88	0.48
9/15/2018	14:10:10	0.90	25.92	0.81	19.88	0.48
9/15/2018	14:11:10	0.91	24.01	0.74	19.89	0.48
9/15/2018	14:12:10	0.91	23.93	0.74	19.89	0.48
9/15/2018	14:13:10	0.91	22.71	0.87	19.88	0.48
9/15/2018	14:14:10	0.90	24.07	0.87	19.89	0.48
9/15/2018	14:15:10	0.90	23.29	0.87	19.88	0.49
9/15/2018	14:16:10	0.90	24.55	0.93	19.89	0.48
9/15/2018	14:17:10	0.90	22.72	0.98	19.89	0.49
9/15/2018	14:18:10	0.91	24.84	0.87	19.88	0.49
9/15/2018	14:19:10	0.91	23.26	0.75	19.88	0.48
9/15/2018	14:20:10	0.91	24.50	0.84	19.89	0.48
9/15/2018	14:21:10	0.91	23.08	0.80	19.89	0.48
9/15/2018	14:22:10	0.90	25.10	0.82	19.89	0.48
9/15/2018	14:23:10	0.91	23.62	0.99	19.88	0.48
9/15/2018	14:24:10	0.91	24.99	0.87	19.88	0.47
9/15/2018	14:25:10	0.91	23.19	0.88	19.88	0.47
9/15/2018	14:26:10	0.92	23.67	0.96	19.89	0.46
9/15/2018	14:27:10	0.91	22.60	0.95	19.89	0.47
9/15/2018	14:28:10	0.91	23.29	0.87	19.89	0.47
9/15/2018	14:29:10	0.91	23.58	0.87	19.89	0.47

Hollingswoth & Vose
CFU #112 (2)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	14:30:10	0.90	23.60	1.01	19.88	0.48
9/15/2018	14:31:10	0.91	25.22	0.90	19.88	0.47
9/15/2018	14:32:10	0.90	23.60	0.94	19.89	0.47
9/15/2018	14:33:10	0.91	24.60	1.01	19.89	0.48
9/15/2018	14:34:10	0.91	23.41	1.01	19.88	0.48
9/15/2018	14:35:10	0.91	25.17	1.01	19.88	0.48
9/15/2018	14:36:10	0.90	24.03	1.01	19.89	0.48
9/15/2018	14:37:10	0.90	24.81	1.01	19.89	0.49
9/15/2018	14:38:10	0.90	24.16	1.07	19.89	0.48
9/15/2018	14:39:10	0.90	23.63	1.10	19.89	0.48
9/15/2018	14:40:10	0.89	24.65	1.00	19.89	0.48
9/15/2018	14:41:10	0.89	24.07	0.87	19.89	0.48
9/15/2018	14:42:10	0.90	25.29	1.09	19.89	0.48
9/15/2018	14:43:10	0.89	23.56	1.05	19.88	0.48
9/15/2018	14:44:10	0.89	24.39	0.95	19.89	0.48
9/15/2018	14:45:10	0.89	23.56	0.90	19.88	0.48
9/15/2018	14:46:10	0.90	23.70	1.01	19.89	0.47
9/15/2018	14:47:10	0.91	24.52	0.87	19.89	0.47
9/15/2018	14:48:10	0.90	25.55	0.97	19.88	0.47
9/15/2018	14:49:10	0.90	26.33	1.00	19.88	0.47
9/15/2018	14:50:10	0.89	23.63	1.00	19.88	0.47
9/15/2018	14:51:10	0.89	24.54	1.00	19.89	0.47
9/15/2018	14:52:10	0.90	23.20	1.00	19.90	0.47
9/15/2018	14:53:10	0.90	23.32	0.88	19.90	0.47
9/15/2018	14:54:10	0.90	24.04	0.87	19.89	0.47
9/15/2018	14:55:10	0.89	23.18	0.93	19.89	0.47
9/15/2018	14:56:10	0.89	24.83	1.00	19.90	0.47
9/15/2018	14:57:10	0.89	23.03	1.00	19.89	0.48
9/15/2018	14:58:10	0.91	25.20	0.87	19.89	0.48
9/15/2018	14:59:10	0.90	23.99	0.98	19.88	0.48
9/15/2018	15:00:10	1.00	25.12	1.08	19.89	0.49
9/15/2018	15:01:10	1.02	24.13	1.09	19.89	0.49
9/15/2018	15:02:10	0.90	24.84	1.01	19.88	0.49
9/15/2018	15:03:10	0.89	25.18	1.01	19.88	0.49
9/15/2018	15:04:10	0.90	24.32	1.01	19.88	0.49
9/15/2018	15:05:10	0.90	24.97	0.92	19.89	0.49
9/15/2018	15:06:10	0.91	22.38	0.94	19.89	0.48
9/15/2018	15:07:10	0.90	24.30	1.01	19.89	0.48
9/15/2018	15:08:10	0.90	24.06	1.00	19.88	0.48
9/15/2018	15:09:10	0.90	25.32	0.88	19.88	0.48
9/15/2018	15:10:10	0.90	24.30	1.00	19.89	0.48

Hollingswoth & Vose
CFU #112 (2)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	15:11:10	0.90	24.64	1.01	19.89	0.47
9/15/2018	15:12:10	0.89	25.12	1.00	19.89	0.47
9/15/2018	15:13:10	0.90	24.39	0.98	19.88	0.47
9/15/2018	15:14:10	0.90	26.25	0.88	19.88	0.48
9/15/2018	15:15:10	0.89	24.88	0.88	19.89	0.47
9/15/2018	15:16:10	0.90	25.22	0.97	19.89	0.47
9/15/2018	15:17:10	0.90	25.53	1.00	19.89	0.48
9/15/2018	15:18:10	0.90	25.41	1.01	19.88	0.48
9/15/2018	15:19:10	0.91	25.98	1.02	19.88	0.48
9/15/2018	15:20:10	0.91	23.95	1.13	19.89	0.48
9/15/2018	15:21:10	0.89	25.13	1.02	19.89	0.49
9/15/2018	15:22:10	0.90	23.91	0.92	19.90	0.48
9/15/2018	15:23:10	0.90	24.99	0.94	19.88	0.49
9/15/2018	15:24:10	0.89	25.20	1.08	19.89	0.49
9/15/2018	15:25:10	0.90	23.92	1.26	19.89	0.49
9/15/2018	15:26:10	0.90	25.05	1.13	19.89	0.49
9/15/2018	15:27:10	0.90	23.46	1.14	19.90	0.49
9/15/2018	15:28:10	0.89	25.31	0.98	19.89	0.49
9/15/2018	15:29:10	0.89	26.79	0.97	19.88	0.49
9/15/2018	15:30:10	1.00	26.97	1.11	19.89	0.49
9/15/2018	15:31:10	0.89	26.52	1.01	19.89	0.49
9/15/2018	15:32:10	0.88	24.28	1.13	19.89	0.48
9/15/2018	15:33:10	0.89	25.51	1.04	19.89	0.48
9/15/2018	15:34:10	0.88	24.57	0.94	19.89	0.48
9/15/2018	15:35:10	0.91	23.79	0.88	19.90	0.48
9/15/2018	15:36:10	0.90	24.96	0.89	19.90	0.47
9/15/2018	15:37:10	0.90	24.01	1.13	19.89	0.48
9/15/2018	15:38:10	0.89	26.86	0.91	19.88	0.49
9/15/2018	15:39:10	0.89	26.19	0.88	19.88	0.48
9/15/2018	15:40:10	0.89	25.43	1.04	19.89	0.48
9/15/2018	15:41:10	0.90	26.56	1.20	19.89	0.49
9/15/2018	15:42:10	0.89	25.73	1.01	19.89	0.49
9/15/2018	15:43:10	0.89	26.69	1.01	19.88	0.49
9/15/2018	15:44:10	0.90	26.41	1.00	19.89	0.49
9/15/2018	15:45:10	0.89	25.25	1.00	19.89	0.49
9/15/2018	15:46:10	0.88	26.55	1.05	19.89	0.50
9/15/2018	15:47:10	0.88	25.69	1.11	19.89	0.50
9/15/2018	15:48:10	0.89	25.87	1.00	19.88	0.50
9/15/2018	15:49:10	0.89	26.42	1.13	19.89	0.50
9/15/2018	15:50:10	0.88	24.57	1.05	19.89	0.50
9/15/2018	15:51:10	0.89	26.07	1.07	19.89	0.50

Hollingswoth & Vose
CFU #112 (2)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	15:52:10	0.87	25.59	1.10	19.89	0.49
9/15/2018	15:53:10	0.89	24.55	1.01	19.89	0.49
9/15/2018	15:54:10	0.89	26.69	1.01	19.89	0.49
9/15/2018	15:55:10	0.89	25.29	0.90	19.90	0.49
Final Average		**0.90**	**24.65**	**0.98**	**19.89**	**0.48**

Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	15:56:30	0.87	25.14	0.97	19.90	0.48
9/15/2018	15:56:40	0.90	24.79	1.00	14.50	0.35
9/15/2018	15:56:50	0.89	22.41	1.00	6.80	0.16
9/15/2018	15:57:00	0.90	17.80	1.00	3.09	0.08
9/15/2018	15:57:10	0.90	11.64	1.01	1.43	0.04
9/15/2018	15:57:20	0.62	6.27	1.00	0.70	0.02
9/15/2018	15:57:30	0.33	4.24	1.00	0.37	0.01
9/15/2018	15:57:40	0.01	3.62	1.06	0.22	0.01
9/15/2018	15:57:50	-0.01	2.01	1.13	0.16	0.01
9/15/2018	15:58:00	-0.01	1.06	1.13	0.13	0.01
9/15/2018	15:58:10	0.00	-0.10	1.13	0.11	0.00
9/15/2018	15:58:20	-0.01	-0.75	1.14	0.10	0.00
9/15/2018	15:58:30	0.01	-1.26	1.13	0.10	0.01
9/15/2018	15:58:40	0.01	-1.15	1.13	0.10	0.00
9/15/2018	15:58:50	0.01	-1.49	1.05	0.09	0.00
9/15/2018	15:59:00	0.00	-1.08	0.34	0.09	0.01
9/15/2018	15:59:10	-0.01	0.28	0.34	0.09	0.00
9/15/2018	15:59:20	-0.01	1.65	0.33	0.46	0.03
9/15/2018	15:59:30	0.00	1.92	0.34	0.78	0.04
9/15/2018	15:59:40	0.00	4.97	0.34	0.43	0.02
9/15/2018	15:59:50	-0.83	14.38	0.33	0.24	0.01
9/15/2018	16:00:00	16.25	26.20	0.34	0.16	0.01
9/15/2018	16:00:10	34.65	36.02	0.22	0.12	0.00
9/15/2018	16:00:20	42.67	41.70	0.19	0.10	0.00
9/15/2018	16:00:30	50.53	44.69	0.19	0.09	0.00
9/15/2018	16:00:40	52.73	47.46	0.21	0.08	0.00
9/15/2018	16:00:50	54.14	49.41	0.20	0.08	0.00
9/15/2018	16:01:00	54.59	50.19	0.21	0.08	0.00
9/15/2018	16:01:10	54.87	49.70	0.19	0.08	0.00
9/15/2018	16:01:20	54.91	48.97	0.60	0.08	0.00
9/15/2018	16:01:30	54.91	48.28	1.01	0.07	0.00
9/15/2018	16:01:40	54.91	47.27	1.00	0.12	0.01
9/15/2018	16:01:50	54.92	44.01	1.00	0.14	0.02

Hollingswoth & Vose
CFU #112 (2)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	16:02:00	49.03	35.42	1.01	0.10	0.01
9/15/2018	16:02:10	44.41	23.98	1.00	0.09	0.01
9/15/2018	16:02:20	30.47	15.56	1.00	0.07	0.00
9/15/2018	16:02:30	14.14	10.28	0.87	0.07	0.01
9/15/2018	16:02:40	9.28	6.82	0.34	0.07	0.00
9/15/2018	16:02:50	5.24	4.28	0.34	0.07	0.00
9/15/2018	16:03:00	4.04	2.80	0.35	0.07	0.00
9/15/2018	16:03:10	3.14	1.97	0.34	0.07	0.00
9/15/2018	16:03:20	2.80	1.44	0.34	0.06	0.00
9/15/2018	16:03:30	2.76	1.33	0.34	0.06	0.01
9/15/2018	16:03:40	2.76	1.15	0.35	0.07	0.00
9/15/2018	16:03:50	2.49	1.76	0.34	0.06	0.01
9/15/2018	16:04:00	2.48	3.21	0.34	0.06	0.01
9/15/2018	16:04:10	2.45	4.32	0.33	0.06	0.00
9/15/2018	16:04:20	2.48	3.85	0.35	0.10	0.01
9/15/2018	16:04:30	2.46	2.99	0.34	5.37	0.15
9/15/2018	16:04:40	2.47	3.46	0.33	10.30	0.26
9/15/2018	16:04:50	2.45	6.19	0.34	5.65	0.12
9/15/2018	16:05:00	2.48	7.71	0.25	2.62	4.13
9/15/2018	16:05:10	2.20	7.33	0.19	2.02	0.85
9/15/2018	16:05:20	1.53	4.57	0.21	7.98	1.37
9/15/2018	16:05:30	0.66	2.67	0.20	4.92	5.28
9/15/2018	16:05:40	0.87	2.76	0.21	7.74	7.85
9/15/2018	16:05:50	0.91	2.44	0.20	8.94	8.86
9/15/2018	16:06:00	0.62	1.36	0.19	9.46	9.32
9/15/2018	16:06:10	0.31	-0.11	0.32	9.68	9.51
9/15/2018	16:06:20	0.27	-0.80	0.59	9.79	9.62
9/15/2018	16:06:30	0.30	-1.28	0.59	9.98	9.84
9/15/2018	16:06:40	0.28	-1.70	0.59	9.99	9.82
9/15/2018	16:06:50	0.02	-2.04	0.59	9.98	9.81
9/15/2018	16:07:00	-0.02	-1.78	0.60	4.24	3.44
9/15/2018	16:07:10	-0.01	-0.68	0.60	2.78	2.02
9/15/2018	16:07:20	-0.02	0.69	0.60	2.02	1.62
9/15/2018	16:07:30	0.00	0.95	0.34	1.99	1.83
9/15/2018	16:07:40	-0.01	0.17	0.34	1.99	1.83
9/15/2018	16:07:50	-0.01	-0.54	0.35	1.99	1.83
9/15/2018	16:08:00	-0.01	-1.39	0.34	1.99	1.84
9/15/2018	16:08:10	-0.02	-1.79	0.34	1.99	1.83
9/15/2018	16:08:20	0.00	-1.83	0.34	1.99	1.84
9/15/2018	16:08:30	0.00	-2.18	0.34	2.17	1.82
9/15/2018	16:08:40	0.00	-1.03	0.24	6.41	1.51

Hollingswoth & Vose
CFU #112 (2)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	16:08:50	-0.01	1.45	0.18	4.50	0.97
9/15/2018	16:09:00	-0.01	4.34	0.20	2.82	0.73
9/15/2018	16:09:10	0.25	4.21	0.20	2.64	0.40
9/15/2018	16:09:20	0.28	2.83	0.20	2.59	0.20
9/15/2018	16:09:30	0.29	1.06	0.21	2.56	0.11
9/15/2018	16:09:40	0.28	-0.43	0.20	2.55	0.07
9/15/2018	16:09:50	0.28	-0.96	0.25	2.55	0.05
9/15/2018	16:10:00	0.28	-1.17	0.34	2.55	0.04
9/15/2018	16:10:10	0.01	-0.56	0.34	2.55	0.03
9/15/2018	16:10:20	-0.03	1.20	0.34	2.56	0.02
9/15/2018	16:10:30	-0.01	1.82	0.33	2.56	0.02
9/15/2018	16:10:40	-0.01	1.34	0.34	2.56	0.03
9/15/2018	16:10:50	-0.01	0.12	0.33	2.55	0.03
9/15/2018	16:11:00	-0.02	-0.41	1.59	2.56	0.03
9/15/2018	16:11:10	0.01	-1.00	12.78	2.56	0.02
9/15/2018	16:11:20	-0.02	-1.12	12.78	2.56	0.02
9/15/2018	16:11:30	-0.02	-1.29	12.77	2.56	0.03
9/15/2018	16:11:40	-0.03	-1.20	12.77	2.56	0.02
9/15/2018	16:11:50	0.00	-0.34	12.78	3.72	0.06
9/15/2018	16:12:00	-0.01	1.56	12.77	10.81	0.28
9/15/2018	16:12:10	-0.03	4.92	12.77	15.66	0.40
9/15/2018	16:12:20	0.24	9.31	12.77	17.94	0.45
9/15/2018	16:12:30	0.26	14.50	12.77	18.98	0.47
9/15/2018	16:12:40	0.54	18.70	12.77	19.46	0.49
9/15/2018	16:12:50	0.83	21.12	12.76	19.68	0.49
9/15/2018	16:13:00	0.90	22.03	12.78	19.78	0.50
9/15/2018	16:13:10	0.87	22.54	12.77	19.82	0.50
9/15/2018	16:13:20	0.87	23.02	12.77	19.85	0.50
		NOx [PPM]	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
System Zero		**0.01**	**-1.24**	**0.34**	**0.09**	**0.00**
System Mid		**2.47**	**49.77**	**12.77**	**9.98**	**1.84**

Hollingswoth & Vose
CFU #112 (2)
Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	16:14:10	0.88	24.10	3.63	19.88	0.49
9/15/2018	16:15:10	0.88	25.45	1.00	19.89	0.49
9/15/2018	16:16:10	0.88	24.85	1.00	19.89	0.49
9/15/2018	16:17:10	0.88	25.26	1.00	19.89	0.49
9/15/2018	16:18:10	0.88	26.72	1.00	19.90	0.49
9/15/2018	16:19:10	0.89	26.34	0.93	19.90	0.48
9/15/2018	16:20:10	1.03	27.43	0.95	19.90	0.48
9/15/2018	16:21:10	0.99	26.40	1.13	19.90	0.48
9/15/2018	16:22:10	0.89	24.85	1.00	19.90	0.48
9/15/2018	16:23:10	0.88	26.56	1.00	19.91	0.48
9/15/2018	16:24:10	0.88	26.46	1.01	19.91	0.48
9/15/2018	16:25:10	0.87	25.27	1.06	19.91	0.48
9/15/2018	16:26:10	0.88	26.31	1.11	19.90	0.48
9/15/2018	16:27:10	0.89	25.70	1.00	19.90	0.49
9/15/2018	16:28:10	0.88	27.89	1.01	19.89	0.49
9/15/2018	16:29:10	0.93	26.51	1.10	19.91	0.49
9/15/2018	16:30:10	0.89	24.53	1.13	19.91	0.49
9/15/2018	16:31:10	0.89	26.44	1.18	19.90	0.50
9/15/2018	16:32:10	0.89	25.99	1.23	19.90	0.50
9/15/2018	16:33:10	0.89	26.42	1.00	19.90	0.50
9/15/2018	16:34:10	0.90	27.32	1.11	19.89	0.51
9/15/2018	16:35:10	0.90	26.85	1.13	19.89	0.51
9/15/2018	16:36:10	0.90	25.78	1.01	19.90	0.50
9/15/2018	16:37:10	0.89	26.76	0.87	19.90	0.50
9/15/2018	16:38:10	0.90	26.15	0.88	19.90	0.50
9/15/2018	16:39:10	0.88	26.25	1.26	19.90	0.50
9/15/2018	16:40:10	0.88	27.21	1.05	19.90	0.50
9/15/2018	16:41:10	0.88	25.77	1.01	19.89	0.50
9/15/2018	16:42:10	0.89	26.90	1.06	19.89	0.50
9/15/2018	16:43:10	1.09	26.54	1.14	19.90	0.49
9/15/2018	16:44:10	0.90	25.03	1.14	19.90	0.49
9/15/2018	16:45:10	0.90	26.67	1.01	19.89	0.49
9/15/2018	16:46:10	1.08	26.31	0.91	19.89	0.49
9/15/2018	16:47:10	1.13	25.04	0.88	19.89	0.49
9/15/2018	16:48:10	0.89	25.86	0.88	19.90	0.49
9/15/2018	16:49:10	0.89	26.03	0.88	19.89	0.49
9/15/2018	16:50:10	1.14	26.17	1.01	19.89	0.50
9/15/2018	16:51:10	1.14	26.95	1.01	19.89	0.50
9/15/2018	16:52:10	0.95	26.56	1.01	19.89	0.50
9/15/2018	16:53:10	1.19	26.03	1.06	19.90	0.50
9/15/2018	16:54:10	1.09	26.93	1.13	19.90	0.50

Hollingswoth & Vose
CFU #112 (2)
Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	16:55:10	0.88	26.29	1.13	19.90	0.51
9/15/2018	16:56:10	0.88	26.44	1.13	19.90	0.51
9/15/2018	16:57:10	0.93	26.80	1.13	19.90	0.51
9/15/2018	16:58:10	0.89	24.53	1.06	19.91	0.50
9/15/2018	16:59:10	0.89	24.77	1.01	19.91	0.50
9/15/2018	17:00:10	0.88	26.61	1.03	19.90	0.51
9/15/2018	17:01:10	0.89	25.88	1.13	19.90	0.50
9/15/2018	17:02:10	1.03	27.09	1.01	19.89	0.51
9/15/2018	17:03:10	1.18	26.68	1.00	19.90	0.50
9/15/2018	17:04:10	1.07	25.63	1.00	19.90	0.50
9/15/2018	17:05:10	0.89	26.77	1.00	19.90	0.50
9/15/2018	17:06:10	0.93	25.94	0.99	19.90	0.50
9/15/2018	17:07:10	0.90	25.35	0.87	19.90	0.49
9/15/2018	17:08:10	0.90	26.59	1.08	19.91	0.49
9/15/2018	17:09:10	1.05	25.41	1.05	19.91	0.49
9/15/2018	17:10:10	0.89	25.20	0.94	19.90	0.49
9/15/2018	17:11:10	1.10	26.36	0.86	19.91	0.49
9/15/2018	17:12:10	0.89	25.78	0.87	19.91	0.49
9/15/2018	17:13:10	0.89	25.16	1.00	19.91	0.49
9/15/2018	17:14:10	0.98	26.17	1.01	19.91	0.49
9/15/2018	17:15:10	0.95	26.07	0.93	19.90	0.49
9/15/2018	17:16:10	1.00	25.67	0.86	19.91	0.50
9/15/2018	17:17:10	0.89	26.43	0.88	19.92	0.49
9/15/2018	17:18:10	0.89	25.13	1.01	19.93	0.49
9/15/2018	17:19:10	0.88	25.08	1.01	19.93	0.49
9/15/2018	17:20:10	0.88	25.09	1.01	19.92	0.49
9/15/2018	17:21:10	0.89	24.19	0.95	19.93	0.49
9/15/2018	17:22:10	0.88	25.44	0.87	19.92	0.50
9/15/2018	17:23:10	0.89	25.93	0.87	19.93	0.49
9/15/2018	17:24:10	0.88	25.02	1.00	19.92	0.50
9/15/2018	17:25:10	0.88	25.55	1.00	19.91	0.50
9/15/2018	17:26:10	0.88	26.28	1.00	19.91	0.50
9/15/2018	17:27:10	0.88	24.86	0.96	19.91	0.50
9/15/2018	17:28:10	0.88	25.71	0.89	19.91	0.50
9/15/2018	17:29:10	0.89	25.76	1.01	19.91	0.49
9/15/2018	17:30:10	0.88	25.05	0.89	19.90	0.49
9/15/2018	17:31:10	0.89	25.41	1.06	19.91	0.49
9/15/2018	17:32:10	0.89	26.02	1.07	19.92	0.48
9/15/2018	17:33:10	0.88	25.21	0.96	19.91	0.49
9/15/2018	17:34:10	0.89	25.07	0.88	19.91	0.49
9/15/2018	17:35:10	0.89	25.82	1.00	19.91	0.49

Hollingswoth & Vose
CFU #112 (2)
Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	17:36:10	0.89	24.89	1.01	19.91	0.49
9/15/2018	17:37:10	0.88	25.40	1.00	19.91	0.49
9/15/2018	17:38:10	0.88	26.31	1.01	19.91	0.49
9/15/2018	17:39:10	0.88	24.76	0.98	19.91	0.49
9/15/2018	17:40:10	0.89	25.60	0.87	19.91	0.50
9/15/2018	17:41:10	1.03	26.86	0.87	19.91	0.50
9/15/2018	17:42:10	0.88	25.42	0.97	19.92	0.50
9/15/2018	17:43:10	0.88	24.76	1.00	19.92	0.50
9/15/2018	17:44:10	0.88	25.45	0.95	19.91	0.50
9/15/2018	17:45:10	0.88	25.48	0.88	19.91	0.51
9/15/2018	17:46:10	0.87	26.53	1.00	19.91	0.50
9/15/2018	17:47:10	1.11	26.46	1.00	19.91	0.51
9/15/2018	17:48:10	1.18	25.76	1.00	19.91	0.50
9/15/2018	17:49:10	1.14	25.93	1.01	19.91	0.50
9/15/2018	17:50:10	0.87	25.86	1.00	19.91	0.50
9/15/2018	17:51:10	0.88	24.54	1.00	19.92	0.50
9/15/2018	17:52:10	0.88	25.16	1.00	19.92	0.50
9/15/2018	17:53:10	0.88	26.26	0.89	19.92	0.50
9/15/2018	17:54:10	0.87	25.25	0.94	19.92	0.49
9/15/2018	17:55:10	0.88	25.62	1.00	19.91	0.49
9/15/2018	17:56:10	0.88	26.94	1.02	19.91	0.49
9/15/2018	17:57:10	0.87	25.92	1.13	19.92	0.49
9/15/2018	17:58:10	0.87	25.27	1.01	19.92	0.49
9/15/2018	17:59:10	0.88	25.91	0.91	19.92	0.49
9/15/2018	18:00:10	0.97	24.76	0.94	19.92	0.49
9/15/2018	18:01:10	0.94	24.90	0.96	19.92	0.49
9/15/2018	18:02:10	0.87	25.72	0.86	19.92	0.49
9/15/2018	18:03:10	0.87	24.82	0.87	19.92	0.50
9/15/2018	18:04:10	0.88	25.87	0.87	19.92	0.50
9/15/2018	18:05:10	0.89	26.15	0.87	19.92	0.50
9/15/2018	18:06:10	0.87	25.50	0.87	19.92	0.51
9/15/2018	18:07:10	0.87	25.68	0.90	19.92	0.51
9/15/2018	18:08:10	0.92	26.81	1.00	19.91	0.51
9/15/2018	18:09:10	1.17	27.70	1.00	19.91	0.51
9/15/2018	18:10:10	1.18	27.10	1.10	19.92	0.51
9/15/2018	18:11:10	1.08	27.13	1.06	19.92	0.51
9/15/2018	18:12:10	0.87	24.56	1.01	19.93	0.51
9/15/2018	18:13:10	0.88	24.81	0.99	19.92	0.51
9/15/2018	18:14:10	0.89	25.76	0.87	19.92	0.51
9/15/2018	18:15:10	1.07	25.13	0.99	19.91	0.50
9/15/2018	18:16:10	1.14	25.91	0.91	19.91	0.50

Hollingswoth & Vose
CFU #112 (2)
Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	18:17:10	0.88	26.64	0.87	19.92	0.50
9/15/2018	18:18:10	0.88	24.96	0.86	19.91	0.49
9/15/2018	18:19:10	0.88	26.10	0.88	19.90	0.50
9/15/2018	18:20:10	0.91	27.14	1.13	19.90	0.50
9/15/2018	18:21:10	0.90	26.73	1.03	19.91	0.50
Final Average		**0.93**	**25.88**	**1.01**	**19.91**	**0.50**

Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	18:23:10	0.90	26.48	1.01	19.96	0.49
9/15/2018	18:23:20	0.89	26.15	1.01	18.17	0.43
9/15/2018	18:23:30	0.91	25.66	1.00	10.20	0.25
9/15/2018	18:23:40	0.90	23.19	1.00	5.81	0.12
9/15/2018	18:23:50	0.89	18.02	1.00	3.96	0.06
9/15/2018	18:24:00	0.89	10.91	1.00	3.16	0.04
9/15/2018	18:24:10	0.65	5.42	1.01	2.82	0.02
9/15/2018	18:24:20	0.34	1.92	1.00	2.68	0.02
9/15/2018	18:24:30	0.31	0.35	1.01	2.61	0.02
9/15/2018	18:24:40	0.28	-0.70	1.00	2.59	0.02
9/15/2018	18:24:50	0.06	-1.10	1.01	2.58	0.01
9/15/2018	18:25:00	0.02	-1.26	6.18	2.57	0.02
9/15/2018	18:25:10	0.00	-0.07	6.17	2.57	0.01
9/15/2018	18:25:20	-0.01	1.59	6.18	2.57	0.02
9/15/2018	18:25:30	0.00	1.93	6.18	2.58	0.01
9/15/2018	18:25:40	-0.01	0.94	6.17	2.57	0.01
9/15/2018	18:25:50	0.00	0.05	6.18	2.57	0.02
9/15/2018	18:26:00	0.00	-0.68	6.18	2.57	0.02
9/15/2018	18:26:10	-0.01	-0.74	10.60	2.57	0.02
9/15/2018	18:26:20	0.01	-1.44	12.50	2.57	0.02
9/15/2018	18:26:30	-0.02	-1.49	12.50	2.57	0.02
9/15/2018	18:26:40	-0.01	-1.10	12.50	2.71	0.02
9/15/2018	18:26:50	-0.01	0.94	12.51	8.44	0.21
9/15/2018	18:27:00	0.00	3.94	12.51	10.67	0.26
9/15/2018	18:27:10	-0.01	7.55	12.51	5.29	0.12
9/15/2018	18:27:20	0.25	8.40	12.61	2.64	0.25
9/15/2018	18:27:30	0.28	6.90	12.77	2.27	1.04
9/15/2018	18:27:40	0.28	3.47	12.77	2.12	1.48
9/15/2018	18:27:50	0.05	0.95	12.77	2.04	1.68
9/15/2018	18:28:00	0.24	-0.85	12.77	2.02	1.76
9/15/2018	18:28:10	0.29	-1.18	12.77	2.00	1.79
9/15/2018	18:28:20	0.31	-1.04	12.77	2.00	1.82

Hollingswoth & Vose
CFU #112 (2)
Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	18:28:30	0.27	0.54	11.98	2.00	1.82
9/15/2018	18:28:40	0.30	1.15	4.79	2.00	1.82
9/15/2018	18:28:50	0.05	0.50	4.79	2.00	1.83
9/15/2018	18:29:00	-0.02	-0.52	4.80	2.03	1.87
9/15/2018	18:29:10	-0.01	-1.02	4.79	4.92	5.28
9/15/2018	18:29:20	-0.03	-1.75	4.80	7.74	7.85
9/15/2018	18:29:30	-0.01	-1.78	4.79	8.94	8.86
9/15/2018	18:29:40	-0.02	-1.71	4.79	9.46	9.32
9/15/2018	18:29:50	0.00	-1.74	1.44	9.68	9.51
9/15/2018	18:30:00	0.00	-0.55	0.60	9.79	9.62
9/15/2018	18:30:10	-0.01	0.10	0.60	9.83	9.67
9/15/2018	18:30:20	0.00	-0.14	0.60	9.85	9.69
9/15/2018	18:30:30	0.00	-1.33	0.60	9.86	9.70
9/15/2018	18:30:40	0.00	-2.04	0.59	9.87	9.71
9/15/2018	18:30:50	0.00	-2.65	0.60	9.87	9.72
9/15/2018	18:31:00	-0.01	-2.78	0.48	9.87	9.72
9/15/2018	18:31:10	-0.01	-3.14	0.34	9.87	9.73
9/15/2018	18:31:20	-0.01	-3.16	0.35	9.87	9.73
9/15/2018	18:31:30	-0.01	-1.86	0.34	9.87	9.72
9/15/2018	18:31:40	0.01	-0.42	0.34	9.85	9.73
9/15/2018	18:31:50	-0.01	0.56	0.34	11.72	7.84
9/15/2018	18:32:00	0.00	0.67	0.33	15.93	4.01
9/15/2018	18:32:10	0.00	4.02	0.34	13.74	2.83
9/15/2018	18:32:20	0.24	8.40	0.34	6.67	1.47
9/15/2018	18:32:30	0.50	9.27	0.34	3.04	0.81
9/15/2018	18:32:40	0.59	7.15	0.35	1.38	0.43
9/15/2018	18:32:50	0.57	4.06	0.35	0.65	0.25
9/15/2018	18:33:00	0.83	2.17	0.33	0.33	0.15
9/15/2018	18:33:10	0.89	2.55	0.35	0.20	0.12
9/15/2018	18:33:20	1.14	3.50	0.34	0.13	0.08
9/15/2018	18:33:30	1.42	4.16	0.70	0.11	0.07
9/15/2018	18:33:40	1.78	3.11	0.73	0.09	0.07
9/15/2018	18:33:50	1.87	2.34	0.74	0.09	0.06
9/15/2018	18:34:00	2.10	1.78	0.74	0.08	0.05
9/15/2018	18:34:10	2.16	1.03	0.73	0.08	0.05
9/15/2018	18:34:20	2.16	1.00	0.73	0.08	0.05
9/15/2018	18:34:30	2.19	0.90	0.73	0.08	0.05
9/15/2018	18:34:40	2.41	1.06	0.50	0.07	0.05
9/15/2018	18:34:50	2.46	2.44	0.34	0.07	0.04
9/15/2018	18:35:00	2.46	3.88	0.34	0.07	0.05
9/15/2018	18:35:10	2.48	4.08	0.34	0.07	0.05

Hollingswoth & Vose
CFU #112 (2)
Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	18:35:20	2.47	3.14	0.34	0.07	0.04
9/15/2018	18:35:30	2.70	2.22	0.34	0.32	0.08
9/15/2018	18:35:40	2.75	2.44	0.35	0.62	0.20
9/15/2018	18:35:50	2.75	6.18	0.39	0.33	0.11
9/15/2018	18:36:00	10.55	16.03	0.49	0.19	0.07
9/15/2018	18:36:10	18.34	27.90	0.47	0.12	0.05
9/15/2018	18:36:20	30.52	37.37	0.48	0.09	0.05
9/15/2018	18:36:30	45.07	44.21	0.47	0.08	0.04
9/15/2018	18:36:40	50.19	48.23	0.47	0.07	0.04
9/15/2018	18:36:50	53.15	49.71	0.48	0.07	0.04
9/15/2018	18:37:00	53.95	49.15	0.48	0.07	0.03
9/15/2018	18:37:10	54.49	48.60	0.34	0.07	0.02
9/15/2018	18:37:20	54.61	47.87	0.34	0.07	0.03
9/15/2018	18:37:30	54.84	47.30	0.33	0.07	0.03
9/15/2018	18:37:40	54.89	47.26	0.35	0.25	0.03
9/15/2018	18:37:50	54.67	46.73	0.34	6.76	0.22
9/15/2018	18:38:00	54.61	45.07	0.34	13.77	0.38
9/15/2018	18:38:10	55.79	41.08	0.34	17.09	0.45
9/15/2018	18:38:20	42.06	37.22	0.34	18.57	0.48
9/15/2018	18:38:30	24.72	33.20	0.33	19.22	0.50
9/15/2018	18:38:40	15.43	29.55	0.35	19.51	0.50
9/15/2018	18:38:50	7.08	27.18	0.35	19.63	0.50
9/15/2018	18:39:00	4.23	25.93	0.34	19.70	0.50
9/15/2018	18:39:10	2.52	25.13	0.34	19.73	0.51
		NOx [PPM]	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
System Zero		**-0.01**	**-3.03**	**0.34**	**0.07**	**0.05**
System Mid		**2.47**	**47.48**	**12.50**	**9.87**	**1.82**

Hollingswoth & Vose
CFU #112 (2)
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	18:40:10	0.95	25.70	0.69	19.77	0.50
9/15/2018	18:41:10	0.89	26.56	0.64	19.77	0.50
9/15/2018	18:42:10	1.08	25.97	0.87	19.77	0.50
9/15/2018	18:43:10	1.05	27.12	1.00	19.77	0.49
9/15/2018	18:44:10	0.89	26.10	1.01	19.77	0.49
9/15/2018	18:45:10	0.90	25.45	0.94	19.78	0.49
9/15/2018	18:46:10	0.89	25.94	0.91	19.78	0.49
9/15/2018	18:47:10	0.90	24.51	1.01	19.78	0.49
9/15/2018	18:48:10	0.90	25.22	1.01	19.78	0.49
9/15/2018	18:49:10	0.90	25.54	1.01	19.78	0.49
9/15/2018	18:50:10	0.90	25.07	1.08	19.78	0.49
9/15/2018	18:51:10	0.90	26.32	1.03	19.78	0.49
9/15/2018	18:52:10	0.89	24.87	0.91	19.78	0.50
9/15/2018	18:53:10	0.89	26.69	1.01	19.77	0.50
9/15/2018	18:54:10	0.89	25.97	1.01	19.77	0.50
9/15/2018	18:55:10	0.87	27.67	0.91	19.78	0.50
9/15/2018	18:56:10	0.89	26.23	0.94	19.77	0.51
9/15/2018	18:57:10	0.90	25.35	0.96	19.77	0.51
9/15/2018	18:58:10	0.89	26.41	0.87	19.76	0.51
9/15/2018	18:59:10	0.90	24.55	0.88	19.77	0.50
9/15/2018	19:00:10	0.89	25.88	0.99	19.77	0.50
9/15/2018	19:01:10	0.89	24.94	0.92	19.77	0.50
9/15/2018	19:02:10	0.90	25.63	0.94	19.76	0.50
9/15/2018	19:03:10	0.89	25.48	1.00	19.77	0.49
9/15/2018	19:04:10	0.90	24.59	1.00	19.77	0.50
9/15/2018	19:05:10	0.90	26.59	0.86	19.77	0.49
9/15/2018	19:06:10	0.90	24.95	0.87	19.77	0.49
9/15/2018	19:07:10	0.91	27.39	0.95	19.76	0.49
9/15/2018	19:08:10	0.99	28.40	1.00	19.76	0.49
9/15/2018	19:09:10	1.20	27.23	1.03	19.76	0.49
9/15/2018	19:10:10	0.91	24.73	1.14	19.77	0.49
9/15/2018	19:11:10	0.90	23.43	0.89	19.77	0.49
9/15/2018	19:12:10	0.91	24.97	0.87	19.76	0.49
9/15/2018	19:13:10	0.90	24.45	0.80	19.77	0.49
9/15/2018	19:14:10	0.91	25.84	0.81	19.76	0.49
9/15/2018	19:15:10	0.95	25.33	1.00	19.76	0.50
9/15/2018	19:16:10	1.11	27.21	1.01	19.76	0.50
9/15/2018	19:17:10	0.91	24.88	0.89	19.76	0.50
9/15/2018	19:18:10	0.91	25.28	0.96	19.76	0.50
9/15/2018	19:19:10	0.89	24.47	1.00	19.76	0.51
9/15/2018	19:20:10	0.89	24.97	0.97	19.76	0.50

Hollingswoth & Vose
CFU #112 (2)
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	19:21:10	0.90	25.86	0.86	19.75	0.50
9/15/2018	19:22:10	0.91	24.62	1.00	19.75	0.50
9/15/2018	19:23:10	0.91	25.71	1.00	19.75	0.50
9/15/2018	19:24:10	0.90	24.54	0.93	19.75	0.50
9/15/2018	19:25:10	0.90	25.97	0.95	19.75	0.50
9/15/2018	19:26:10	0.90	24.08	1.12	19.75	0.50
9/15/2018	19:27:10	0.91	25.68	1.00	19.74	0.50
9/15/2018	19:28:10	0.90	25.08	1.12	19.74	0.50
9/15/2018	19:29:10	0.91	25.10	1.05	19.75	0.49
9/15/2018	19:30:10	0.91	25.54	1.00	19.75	0.49
9/15/2018	19:31:10	0.99	25.83	0.97	19.74	0.49
9/15/2018	19:32:10	1.07	26.40	0.87	19.74	0.49
9/15/2018	19:33:10	0.91	23.97	0.87	19.75	0.48
9/15/2018	19:34:10	0.91	25.73	0.98	19.75	0.49
9/15/2018	19:35:10	0.91	24.23	1.00	19.75	0.49
9/15/2018	19:36:10	0.91	26.07	0.94	19.74	0.49
9/15/2018	19:37:10	0.91	24.61	0.90	19.74	0.49
9/15/2018	19:38:10	0.91	26.05	1.13	19.75	0.49
9/15/2018	19:39:10	0.92	24.23	0.88	19.75	0.50
9/15/2018	19:40:10	0.91	26.31	0.96	19.74	0.50
9/15/2018	19:41:10	0.91	24.79	1.00	19.74	0.50
9/15/2018	19:42:10	0.92	25.95	1.00	19.73	0.51
9/15/2018	19:43:10	0.91	25.60	0.98	19.73	0.51
9/15/2018	19:44:10	1.20	26.20	0.86	19.74	0.50
9/15/2018	19:45:10	0.98	26.35	0.98	19.74	0.51
9/15/2018	19:46:10	0.91	24.85	1.34	19.73	0.50
9/15/2018	19:47:10	0.91	25.36	1.62	19.73	0.50
9/15/2018	19:48:10	0.92	24.89	1.71	19.73	0.50
9/15/2018	19:49:10	0.92	26.19	1.53	19.74	0.50
9/15/2018	19:50:10	0.90	25.00	1.38	19.73	0.50
9/15/2018	19:51:10	0.91	26.50	1.28	19.73	0.49
9/15/2018	19:52:10	0.92	25.00	1.26	19.72	0.49
9/15/2018	19:53:10	0.92	26.45	1.22	19.73	0.49
9/15/2018	19:54:10	0.92	24.89	1.13	19.73	0.49
9/15/2018	19:55:10	0.92	26.57	1.13	19.73	0.49
9/15/2018	19:56:10	0.91	24.89	1.13	19.73	0.49
9/15/2018	19:57:10	0.92	26.61	1.04	19.72	0.49
9/15/2018	19:58:10	0.92	25.01	1.07	19.72	0.49
9/15/2018	19:59:10	0.92	26.08	1.13	19.73	0.49
9/15/2018	20:00:10	0.92	24.58	1.11	19.72	0.49
9/15/2018	20:01:10	0.91	25.55	0.87	19.74	0.49

Hollingswoth & Vose
CFU #112 (2)
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	20:02:10	0.91	24.44	0.98	19.74	0.50
9/15/2018	20:03:10	0.92	25.84	1.00	19.75	0.50
9/15/2018	20:04:10	0.91	24.44	1.00	19.76	0.50
9/15/2018	20:05:10	0.90	25.93	0.98	19.76	0.50
9/15/2018	20:06:10	0.91	25.90	0.86	19.75	0.50
9/15/2018	20:07:10	0.91	25.54	1.12	19.75	0.50
9/15/2018	20:08:10	0.91	25.89	1.03	19.75	0.50
9/15/2018	20:09:10	0.91	25.02	0.93	19.75	0.50
9/15/2018	20:10:10	0.99	28.27	0.90	19.74	0.51
9/15/2018	20:11:10	1.16	27.00	1.02	19.76	0.50
9/15/2018	20:12:10	0.90	25.61	1.26	19.76	0.49
9/15/2018	20:13:10	0.91	25.30	1.14	19.76	0.49
9/15/2018	20:14:10	0.91	24.99	1.04	19.76	0.49
9/15/2018	20:15:10	0.90	27.35	1.06	19.76	0.49
9/15/2018	20:16:10	0.90	26.28	1.12	19.76	0.48
9/15/2018	20:17:10	0.90	25.88	1.12	19.76	0.48
9/15/2018	20:18:10	0.90	26.49	0.86	19.77	0.48
9/15/2018	20:19:10	1.00	26.01	1.07	19.76	0.49
9/15/2018	20:20:10	0.96	26.25	1.05	19.77	0.48
9/15/2018	20:21:10	0.90	25.32	1.04	19.77	0.49
9/15/2018	20:22:10	0.91	24.49	1.11	19.77	0.49
9/15/2018	20:23:10	0.90	26.12	1.00	19.77	0.49
9/15/2018	20:24:10	0.90	25.39	0.99	19.77	0.49
9/15/2018	20:25:10	0.90	25.61	1.09	19.77	0.49
9/15/2018	20:26:10	1.08	27.36	1.07	19.77	0.50
9/15/2018	20:27:10	1.14	25.69	0.96	19.77	0.50
9/15/2018	20:28:10	0.89	27.14	0.87	19.77	0.51
9/15/2018	20:29:10	0.94	26.70	1.00	19.78	0.50
9/15/2018	20:30:10	0.89	24.51	1.10	19.78	0.50
9/15/2018	20:31:10	0.89	24.86	1.04	19.78	0.49
9/15/2018	20:32:10	0.90	25.27	0.94	19.78	0.50
9/15/2018	20:33:10	0.88	25.05	0.91	19.78	0.50
9/15/2018	20:34:10	0.93	26.89	1.12	19.78	0.50
9/15/2018	20:35:10	1.18	25.42	1.00	19.78	0.50
9/15/2018	20:36:10	1.19	24.51	0.79	19.78	0.49
9/15/2018	20:37:10	1.19	25.63	0.58	19.78	0.49
9/15/2018	20:38:10	1.20	24.87	0.50	19.78	0.49
9/15/2018	20:39:10	1.19	25.43	0.61	19.78	0.49
9/15/2018	20:40:10	1.19	26.64	0.72	19.78	0.49
9/15/2018	20:41:10	1.18	25.29	0.84	19.78	0.49
9/15/2018	20:42:10	1.17	23.33	0.76	19.79	0.48

Hollingswoth & Vose
CFU #112 (2)
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	20:43:10	1.18	24.52	0.72	19.79	0.49
9/15/2018	20:44:10	1.18	25.35	0.73	19.79	0.49
9/15/2018	20:45:10	1.19	26.52	0.72	19.78	0.49
Final Average		**0.95**	**25.61**	**0.99**	**19.76**	**0.50**

Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	20:46:40	1.18	27.14	0.72	12.43	0.32
9/15/2018	20:46:50	1.19	25.10	0.72	6.00	0.15
9/15/2018	20:47:00	2.42	19.24	0.72	3.95	0.06
9/15/2018	20:47:10	4.14	12.74	0.73	3.15	0.03
9/15/2018	20:47:20	3.33	6.16	0.84	2.81	0.02
9/15/2018	20:47:30	1.77	3.13	0.85	2.66	0.01
9/15/2018	20:47:40	1.26	2.69	0.87	2.60	0.01
9/15/2018	20:47:50	0.67	2.37	0.86	2.57	0.01
9/15/2018	20:48:00	0.32	1.03	0.85	2.56	0.01
9/15/2018	20:48:10	0.27	0.22	0.85	2.56	0.01
9/15/2018	20:48:20	0.27	-0.71	0.87	2.55	0.01
9/15/2018	20:48:30	0.27	-1.01	5.06	2.56	0.00
9/15/2018	20:48:40	0.26	-1.64	7.85	2.56	0.01
9/15/2018	20:48:50	0.27	-1.72	7.86	2.56	0.01
9/15/2018	20:49:00	0.27	-0.86	7.86	2.56	0.01
9/15/2018	20:49:10	0.06	0.99	7.85	2.56	0.01
9/15/2018	20:49:20	-0.01	1.50	7.87	2.56	0.01
9/15/2018	20:49:30	-0.03	0.49	7.86	2.56	0.00
9/15/2018	20:49:40	-0.01	0.00	9.25	2.56	0.01
9/15/2018	20:49:50	-0.03	-1.00	12.50	2.56	0.01
9/15/2018	20:50:00	0.00	-1.37	12.50	2.56	0.01
9/15/2018	20:50:10	-0.01	-1.70	12.49	2.56	0.01
9/15/2018	20:50:20	-0.01	-1.66	12.49	3.09	0.03
9/15/2018	20:50:30	-0.02	-0.83	12.50	9.56	0.23
9/15/2018	20:50:40	-0.01	4.03	12.50	8.72	0.20
9/15/2018	20:50:50	0.00	8.29	12.49	4.10	0.10
9/15/2018	20:51:00	0.21	9.16	12.61	2.69	0.75
9/15/2018	20:51:10	0.50	6.47	12.63	2.31	1.35
9/15/2018	20:51:20	0.33	2.94	12.63	2.13	1.62
9/15/2018	20:51:30	0.27	0.09	12.63	2.04	1.74
9/15/2018	20:51:40	0.28	-0.97	12.63	2.01	1.78
9/15/2018	20:51:50	0.28	-1.69	12.62	2.00	1.80
9/15/2018	20:52:00	0.29	-1.72	12.63	1.99	1.81
9/15/2018	20:52:10	0.27	0.15	7.58	1.99	1.82

Hollingswoth & Vose
CFU #112 (2)
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	20:52:20	0.27	0.93	5.41	1.99	1.82
9/15/2018	20:52:30	0.05	0.31	5.41	1.99	1.83
9/15/2018	20:52:40	-0.01	-0.49	5.41	1.99	1.82
9/15/2018	20:52:50	-0.01	-1.52	5.41	2.29	2.21
9/15/2018	20:53:00	-0.01	-1.86	5.41	5.77	6.13
9/15/2018	20:53:10	-0.02	-2.49	5.40	8.08	8.12
9/15/2018	20:53:20	0.00	-2.29	3.38	9.07	8.98
9/15/2018	20:53:30	-0.01	-1.60	0.33	9.51	9.36
9/15/2018	20:53:40	-0.01	0.28	0.34	9.70	9.53
9/15/2018	20:53:50	-0.02	0.46	0.34	9.79	9.63
9/15/2018	20:54:00	0.00	-0.35	0.34	9.83	9.68
9/15/2018	20:54:10	-0.01	-1.74	0.33	9.84	9.69
9/15/2018	20:54:20	-0.03	-2.37	0.33	9.85	9.70
9/15/2018	20:54:30	-0.01	-2.86	0.32	9.86	9.70
9/15/2018	20:54:40	-0.02	-3.26	0.20	9.85	9.71
9/15/2018	20:54:50	-0.03	-3.26	0.20	10.00	9.57
9/15/2018	20:55:00	-0.01	-2.23	0.20	12.36	6.61
9/15/2018	20:55:10	-0.04	1.15	0.19	7.82	3.61
9/15/2018	20:55:20	0.21	4.07	0.19	3.65	1.66
9/15/2018	20:55:30	0.26	4.73	0.20	1.67	0.85
9/15/2018	20:55:40	0.49	3.76	0.20	0.78	0.44
9/15/2018	20:55:50	0.56	1.82	0.21	0.39	0.25
9/15/2018	20:56:00	0.81	1.09	0.19	0.22	0.15
9/15/2018	20:56:10	1.11	0.65	0.20	0.14	0.10
9/15/2018	20:56:20	1.40	0.41	0.19	0.10	0.07
9/15/2018	20:56:30	1.77	1.50	0.19	0.09	0.06
9/15/2018	20:56:40	2.10	3.51	0.19	0.08	0.05
9/15/2018	20:56:50	2.16	3.90	0.20	0.07	0.04
9/15/2018	20:57:00	2.16	2.90	0.26	0.07	0.04
9/15/2018	20:57:10	2.18	2.04	0.34	0.07	0.04
9/15/2018	20:57:20	2.40	1.39	0.33	0.07	0.04
9/15/2018	20:57:30	2.46	0.75	0.33	0.07	0.03
9/15/2018	20:57:40	2.47	0.70	0.33	0.07	0.04
9/15/2018	20:57:50	2.45	1.03	0.33	0.06	0.03
9/15/2018	20:58:00	2.45	2.38	0.33	0.06	0.03
9/15/2018	20:58:10	2.45	3.79	0.28	0.07	0.03
9/15/2018	20:58:20	2.44	3.64	0.06	0.17	0.03
9/15/2018	20:58:30	2.47	2.84	0.07	0.66	0.19
9/15/2018	20:58:40	2.70	5.00	0.05	0.38	0.12
9/15/2018	20:58:50	1.72	12.88	0.07	0.21	0.07
9/15/2018	20:59:00	15.21	24.65	0.05	0.13	0.04

Hollingswoth & Vose
CFU #112 (2)
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/15/2018	20:59:10	32.19	35.13	0.06	0.09	0.03
9/15/2018	20:59:20	41.31	41.47	0.06	0.08	0.02
9/15/2018	20:59:30	49.64	46.44	0.42	0.07	0.03
9/15/2018	20:59:40	52.54	49.34	0.46	0.07	0.02
9/15/2018	20:59:50	53.99	49.79	0.46	0.06	0.02
9/15/2018	21:00:00	54.55	48.89	0.46	0.06	0.02
9/15/2018	21:00:10	54.82	48.29	0.46	0.06	0.02
9/15/2018	21:00:20	54.92	47.67	0.46	0.06	0.01
9/15/2018	21:00:30	54.89	47.14	0.47	0.06	0.02
9/15/2018	21:00:40	54.91	47.07	0.47	0.06	0.02
9/15/2018	21:00:50	54.90	47.02	0.46	0.06	0.02
		NOx [PPM]	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
System Zero		**-0.02**	**-2.83**	**0.20**	**0.06**	**0.02**
System Mid		**2.45**	**47.08**	**12.50**	**9.85**	**1.82**

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112 (2)**
DATE	**09/16/18**
METHOD	**13B**
POLLUTANT	**Fluorides**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**9:00**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**11:10**
EPA Method:	**13B**	Partly cloudy with scattered rain, 60 degrees	**Date:**	**9/16/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.71 "Hg	O_2	19.80 %
Static Pressure	0.56 "H_2O	CO_2	0.70 %
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.201 inches
Stack Temperature	190 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	12	6

Nozzle check for roundness:

1	2	3
0.179	0.179	0.180 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	74.519 dcf	Ave. ΔP	1.442 "H_2O
Wet mol. weight	28.64 M_s (actual)	Ave. √ΔP	1.2001 "H_2O
Actual H_2O	2.38 %	Ave. ΔH	1.288 "H_2O
Std. meter vol.	74.929 dscf	Ave. T_s	184.1 °F
Isokinetic Average	99.8 %	Ave. T_m	62.1 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	255.2	274	18.8
		Total water gain:	38.8

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.950	1.40	187	57	1.23	1.20	2	258	45
2	10.0	5.860	1.30	189	58	1.14	1.10	2	257	45
3	15.0	8.900	1.40	189	58	1.23	1.20	2	253	46
4	20.0	11.870	1.40	189	58	1.23	1.20	2	253	49
5	25.0	14.850	1.40	189	60	1.24	1.20	2	251	50
6	30.0	17.930	1.40	189	60	1.24	1.20	2	252	50
7	35.0	21.070	1.50	190	61	1.33	1.30	2	252	52
8	40.0	24.260	1.50	190	61	1.33	1.30	2	255	54
9	45.0	27.360	1.40	190	62	1.24	1.20	2	255	54
10	50.0	30.390	1.40	191	62	1.24	1.20	2	255	55
11	55.0	33.400	1.40	192	63	1.24	1.20	2	251	55
12	60.0	36.478	1.40	192	64	1.24	1.20	2	253	56
13	65.0	39.480	1.30	186	62	1.16	1.20	2	256	57
14	70.0	42.440	1.40	182	64	1.26	1.30	2	257	52
15	75.0	45.550	1.40	178	64	1.27	1.30	2	260	50
16	80.0	48.930	1.60	179	64	1.45	1.50	2	252	51
17	85.0	52.200	1.60	178	64	1.45	1.50	2	254	52
18	90.0	55.550	1.70	177	64	1.54	1.50	2	254	54
19	95.0	58.800	1.50	176	64	1.36	1.40	2	253	56
20	100.0	62.040	1.50	175	64	1.36	1.40	2	254	56
21	105.0	65.230	1.50	175	64	1.36	1.40	2	253	55
22	110.0	68.360	1.40	176	64	1.27	1.30	2	258	55
23	115.0	71.440	1.40	179	64	1.27	1.30	2	255	56
24	120.0	74.519	1.40	180	64	1.26	1.30	2	253	56

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:25**
Source:	**CFU 112 (2)**	**End Time:**	**13:31**
EPA Method:	**13B**	**Date:**	**9/16/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Partly cloudy with scattered rain, 60 degrees

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size:	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.71 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.202 inches
Stack Temperature	190 F		
Assumed moisture	2.38 %		
Assumed meter temp.	62.1 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	13	7

Nozzle check for roundness:

1	2	3
0.179	0.179	0.180 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	75.577 dcf	Ave. ΔP	1.492 "H_2O
Wet mol. weight	28.69 M_s (actual)	Ave. √ΔP	1.221 "H_2O
Actual H_2O	1.96 %	Ave. ΔH	1.308 "H_2O
Std. meter vol.	75.532 dscf	Ave. T_s	193.3 °F
Isokinetic Average	99.2 %	Ave. T_m	65.3 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	215	15.0
Silica gel, g	263.3	280.4	17.1
		Total water gain:	32.1

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	5.0	3.160	1.50	187	63	1.33	1.30	2	254	57
2	10.0	6.370	1.60	190	64	1.41	1.40	2	256	51
3	15.0	9.500	1.50	191	64	1.32	1.30	2	253	50
4	20.0	12.550	1.40	191	64	1.24	1.20	2	252	51
5	25.0	15.670	1.50	192	64	1.32	1.30	2	257	51
6	30.0	18.810	1.50	192	64	1.32	1.30	2	253	51
7	35.0	21.970	1.50	192	64	1.32	1.30	2	254	50
8	40.0	25.130	1.50	191	65	1.33	1.30	2	252	51
9	45.0	28.260	1.40	191	65	1.24	1.30	2	251	51
10	50.0	31.370	1.40	190	65	1.24	1.30	2	254	53
11	55.0	34.450	1.40	190	65	1.24	1.30	2	251	54
12	60.0	37.489	1.40	189	65	1.24	1.30	2	253	54
13	65.0	40.490	1.40	193	65	1.23	1.20	2	254	59
14	70.0	43.610	1.50	194	66	1.32	1.30	2	253	54
15	75.0	46.860	1.60	195	66	1.41	1.40	2	253	54
16	80.0	50.110	1.60	196	66	1.41	1.40	2	254	53
17	85.0	53.390	1.60	196	66	1.41	1.40	2	252	54
18	90.0	56.480	1.50	196	66	1.32	1.30	2	252	54
19	95.0	59.630	1.50	195	66	1.32	1.30	2	253	52
20	100.0	62.820	1.50	197	67	1.32	1.30	2	253	53
21	105.0	66.010	1.50	198	67	1.32	1.30	2	255	53
22	110.0	69.220	1.50	197	67	1.32	1.30	2	253	46
23	115.0	72.420	1.50	198	67	1.32	1.30	2	252	47
24	120.0	75.577	1.50	198	67	1.32	1.30	2	255	47

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**13:46**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:53**
EPA Method:	**13B**	Partly cloudy with scattered rain, 60 degrees	**Date:**	**9/16/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.18	Nozzle size:	0.1793 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000175 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.71 "Hg	O_2	19.8 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.3 "H_2O	Rec. Nz.	0.201 inches
Stack Temperature	190 F		
Assumed moisture	1.96 %		
Assumed meter temp.	65.3 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.001
Leak check vacuum, "Hg:	10	12

Nozzle check for roundness:

1	2	3	
0.179	0.179	0.180	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	73.791 dcf	Ave. ΔP	1.417 "H_2O
Wet mol. weight	28.65 M_s (actual)	Ave. √ΔP	1.1899 "H_2O
Actual H_2O	2.28 %	Ave. ΔH	1.229 "H_2O
Std. meter vol.	73.148 dscf	Ave. T_s	202.2 °F
Isokinetic Average	99.5 %	Ave. T_m	69.5 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	239.5	255.7	16.2
		Total water gain:	36.2

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.970	1.30	201	68	1.15	1.20	2	254	52
2	10.0	5.940	1.30	200	68	1.15	1.20	2	253	52
3	15.0	9.040	1.50	200	68	1.32	1.30	2	253	53
4	20.0	12.090	1.40	200	68	1.24	1.20	2	251	53
5	25.0	15.150	1.40	200	68	1.24	1.20	2	252	53
6	30.0	18.280	1.50	201	68	1.32	1.30	2	254	54
7	35.0	21.440	1.50	201	68	1.32	1.30	2	251	54
8	40.0	24.640	1.50	201	69	1.32	1.30	2	251	55
9	45.0	27.810	1.50	201	69	1.32	1.30	2	252	57
10	50.0	30.860	1.40	202	69	1.23	1.20	2	254	56
11	55.0	33.900	1.40	202	69	1.23	1.20	2	253	57
12	60.0	36.942	1.40	203	70	1.24	1.20	2	252	57
13	65.0	40.000	1.40	203	70	1.24	1.20	2	255	57
14	70.0	42.990	1.40	204	70	1.23	1.20	2	252	53
15	75.0	46.000	1.40	204	70	1.23	1.20	2	256	54
16	80.0	49.190	1.50	204	70	1.32	1.30	2	253	54
17	85.0	52.260	1.40	203	70	1.24	1.20	2	250	54
18	90.0	55.430	1.50	203	71	1.33	1.30	2	257	55
19	95.0	58.460	1.40	203	71	1.24	1.20	2	256	56
20	100.0	61.530	1.40	203	71	1.24	1.20	2	250	56
21	105.0	64.630	1.40	203	71	1.24	1.20	2	253	57
22	110.0	67.720	1.40	204	71	1.24	1.20	2	254	57
23	115.0	70.720	1.30	203	71	1.15	1.20	2	254	56
24	120.0	73.791	1.40	204	71	1.24	1.20	2	254	56

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:00**
Source:	**CFU 112 (2)**	**End Time:**	**11:10**
Method:	**13B**	**Date:**	**9/16/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**√Dp**
	0.000						
5	2.950	1.20	57	1	1.40	187	1.1832
10	5.860	1.10	58	2	1.30	189	1.1402
15	8.900	1.20	58	3	1.40	189	1.1832
20	11.870	1.20	58	4	1.40	189	1.1832
25	14.850	1.20	60	5	1.40	189	1.1832
30	17.930	1.20	60	6	1.40	189	1.1832
35	21.070	1.30	61	7	1.50	190	1.2247
40	24.260	1.30	61	8	1.50	190	1.2247
45	27.360	1.20	62	9	1.40	190	1.1832
50	30.390	1.20	62	10	1.40	191	1.1832
55	33.400	1.20	63	11	1.40	192	1.1832
60	36.478	1.20	64	12	1.40	192	1.1832
65	39.480	1.20	62	13	1.30	186	1.1402
70	42.440	1.30	64	14	1.40	182	1.1832
75	45.550	1.30	64	15	1.40	178	1.1832
80	48.930	1.50	64	16	1.60	179	1.2649
85	52.200	1.50	64	17	1.60	178	1.2649
90	55.550	1.50	64	18	1.70	177	1.3038
95	58.800	1.40	64	19	1.50	176	1.2247
100	62.040	1.40	64	20	1.50	175	1.2247
105	65.230	1.40	64	21	1.50	175	1.2247
110	68.360	1.30	64	22	1.40	176	1.1832
115	71.440	1.30	64	23	1.40	179	1.1832
120	74.519	1.30	64	24	1.40	180	1.1832

Client:	Hollingsworth & Vose	Run:	1
Source:	CFU 112 (2)	Date:	09/16/18

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	74.519	dcf	Rectangular		
Water Volume	38.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.71	"Hg	CO_2 Average	0.48	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.03	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.288	"H_2O	√Dp	1.2001	"H_2O
Temperature, T_m	62.1	^oF	Temperature, T_s	184.1	^oF
Temperature, T_m	522.1	^oA (^oR)	Temperature, T_s	644.1	^oA (R)
Pressure Meter, P_m	29.805	"Hg	Pressure Stack, P_s	29.751	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	74.929	dscf	Velocity, V_s	74.96	fps
	2.122	dscm	Volume (actual)	22,078.7	awcfm
Actual Volume, $V_{m(actual)}$	94.203	awcf		21,553.2	adcfm
Gas Stream Moisture			Volume (standard)	1,079,805.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.826	scf		1,054,106.5	dscf/hr
Moisture, B_{ws}	0.0238			17,568.4	dscf/min
Moisture EPA M4	2.38	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	472.653	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.62	lb/lb-mole			
Percent Isokinetic	99.8	%			

Laboratory Results

Fluoride	< 30.0	µg/sample			
Fluoride	< 3.00E-05	grams	MW F	19.0	g/mole

Emissions:

Concentration, C_s	< 6.18E-06	gr/dscf
	< 14.14	µg/dscm
	< 1.79E-02	ppmvd
Mass Emissions	< 9.30E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:25**
Source:	**CFU 112 (2)**	**End Time:**	**13:31**
Method:	**13B**	**Date:**	**09/16/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m ^oF	Traverse Point	Dp "H_2O	Stack T_s ^oF	$\sqrt{Dp}$
	0.000						
5	3.160	1.30	63	1	1.50	187	1.2247
10	6.370	1.40	64	2	1.60	190	1.2649
15	9.500	1.30	64	3	1.50	191	1.2247
20	12.550	1.20	64	4	1.40	191	1.1832
25	15.670	1.30	64	5	1.50	192	1.2247
30	18.810	1.30	64	6	1.50	192	1.2247
35	21.970	1.30	64	7	1.50	192	1.2247
40	25.130	1.30	65	8	1.50	191	1.2247
45	28.260	1.30	65	9	1.40	191	1.1832
50	31.370	1.30	65	10	1.40	190	1.1832
55	34.450	1.30	65	11	1.40	190	1.1832
60	37.489	1.30	65	12	1.40	189	1.1832
65	40.490	1.20	65	13	1.40	193	1.1832
70	43.610	1.30	66	14	1.50	194	1.2247
75	46.860	1.40	66	15	1.60	195	1.2649
80	50.110	1.40	66	16	1.60	196	1.2649
85	53.390	1.40	66	17	1.60	196	1.2649
90	56.480	1.30	66	18	1.50	196	1.2247
95	59.630	1.30	66	19	1.50	195	1.2247
100	62.820	1.30	67	20	1.50	197	1.2247
105	66.010	1.30	67	21	1.50	198	1.2247
110	69.220	1.30	67	22	1.50	197	1.2247
115	72.420	1.30	67	23	1.50	198	1.2247
120	75.577	1.30	67	24	1.50	198	1.2247

Client:	**Hollingsworth & Vose**		**Run:**		**2**
Source:	**CFU 112 (2)**		**Date:**	**09/16/18**	

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	75.577	dcf	Rectangular		
Water Volume	32.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.71	"Hg	CO_2 Average	0.51	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.14	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.308	"H_2O	$\sqrt{Dp}$	1.2210	"H_2O
Temperature, T_m	65.3	^oF	Temperature, T_s	193.3	^oF
Temperature, T_m	525.3	^oA (^oR)	Temperature, T_s	653.3	^oA (R)
Pressure Meter, P_m	29.806	"Hg	Pressure Stack, P_s	29.751	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	75.532	dscf	Velocity, V_s	76.72	fps
	2.139	dscm	Volume (actual)	22,597.1	awcfm
Actual Volume, $V_{m(actual)}$	95.905	awcf		22,154.2	adcfm
Gas Stream Moisture			Volume (standard)	1,089,595.7	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.511	scf		1,068,239.6	dscf/hr
Moisture, B_{ws}	0.0196			17,804.0	dscf/min
Moisture EPA M4	1.96	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	479.404	
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.68	lb/lb-mole			
Percent Isokinetic	99.2	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	< 6.13E-06	gr/dscf
	< 14.03	µg/dscm
	< 1.78E-02	ppmvd
Mass Emissions	< 9.35E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**13:46**
Source:	**CFU 112 (2)**	**End Time:**	**15:53**
Method:	**13B**	**Date:**	**09/16/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
5	2.970	1.20	68	1	1.30	201	1.1402
10	5.940	1.20	68	2	1.30	200	1.1402
15	9.040	1.30	68	3	1.50	200	1.2247
20	12.090	1.20	68	4	1.40	200	1.1832
25	15.150	1.20	68	5	1.40	200	1.1832
30	18.280	1.30	68	6	1.50	201	1.2247
35	21.440	1.30	68	7	1.50	201	1.2247
40	24.640	1.30	69	8	1.50	201	1.2247
45	27.810	1.30	69	9	1.50	201	1.2247
50	30.860	1.20	69	10	1.40	202	1.1832
55	33.900	1.20	69	11	1.40	202	1.1832
60	36.942	1.20	70	12	1.40	203	1.1832
65	40.000	1.20	70	13	1.40	203	1.1832
70	42.990	1.20	70	14	1.40	204	1.1832
75	46.000	1.20	70	15	1.40	204	1.1832
80	49.190	1.30	70	16	1.50	204	1.2247
85	52.260	1.20	70	17	1.40	203	1.1832
90	55.430	1.30	71	18	1.50	203	1.2247
95	58.460	1.20	71	19	1.40	203	1.1832
100	61.530	1.20	71	20	1.40	203	1.1832
105	64.630	1.20	71	21	1.40	203	1.1832
110	67.720	1.20	71	22	1.40	204	1.1832
115	70.720	1.20	71	23	1.30	203	1.1402
120	73.791	1.20	71	24	1.40	204	1.1832
	`						0.0000

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 112 (2)**	**Date:**	**09/16/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	73.791	dcf	Rectangular		
Water Volume	36.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.1793	in.	Length		in
Nozzle Area	0.000175	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.71	"Hg	CO_2 Average	0.52	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.15	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.229	"H_2O	$\sqrt{Dp}$	1.1423	"H_2O
Temperature, T_m	69.5	^oF	Temperature, T_s	202.2	^oF
Temperature, T_m	529.5	^oA (^oR)	Temperature, T_s	662.2	^oA (R)
Pressure Meter, P_m	29.800	"Hg	Pressure Stack, P_s	29.751	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	73.148	dscf	Velocity, V_s	72.32	fps
	2.071	dscm	Volume (actual)	21,301.1	awcfm
Actual Volume, $V_{m(actual)}$	94.451	awcf		20,815.4	adcfm
Gas Stream Moisture			Volume (standard)	1,013,301.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.704	scf		990,198.2	dscf/hr
Moisture, B_{ws}	0.0228			16,503.3	dscf/min
Moisture EPA M4	2.28	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	485.935	
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.64	lb/lb-mole			
Percent Isokinetic	103.7	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole
Emissions:				
Concentration, C_s	< 6.33E-06	gr/dscf		
	< 14.49	µg/dscm		
	< 1.83E-02	ppmvd		
Mass Emissions	< 8.95E-04	lb/hr		

"<" represents MDL value

EPA Method 13B
Laboratory Results
Total Fluoride

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 112 (2)**

Lab ID	Sample ID	Sample Date		Result	MDL	Units
18-S2204	CFU 112 (2) Cont. #1 Run 1	9/16/2018	<	MDL	30.0	µg/sample
18-S2205	CFU 112 (2) Cont. #1 Run 2	9/16/2018	<	MDL	30.0	µg/sample
18-S2206	CFU 112 (2) Cont. #1 Run 3	9/16/2018	<	MDL	30.0	µg/sample
18-S2210	Cont. #2 H20 + Filter Blank	9/11/2018	<	MDL	30.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 13B
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112 (2)

Run			1	2	3	
Date			9/16/2018	9/16/2018	9/16/2018	
Run Start Time			9:00	11:25	13:46	
Run End Time			11:10	13:31	15:53	
Duration, min.			120	120	120	**Average**
Barometric Pressure, "Hg			29.71	29.71	29.71	**29.71**
Nozzle Dia., in.			0.1793	0.1793	0.1793	**0.1793**
Isokinetic Average, %			99.8	99.2	103.7	**100.9**
Sample Volume, dscf			74.929	75.532	73.148	**74.536**
Sample Volume, dscm			2.122	2.139	2.071	**2.111**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.48	0.51	0.52	**0.50**
O_2 %vd			20.03	20.14	20.15	**20.11**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			2.38	1.96	2.28	**2.21**
Wet Molecular Weight, lb/lb-mole			28.62	28.68	28.64	**28.65**
Velocity, FPS			74.96	76.72	72.32	**74.67**
ADCFM			21,553.2	22,154.2	20,815.4	**21,507.6**
AWCFM			22,078.7	22,597.1	21,301.1	**21,992.3**
DSCFM			17,568.4	17,804.0	16,503.3	**17,291.9**
Stack Temperature, ^oF			184.1	193.3	202.2	**193.2**
Fluoride	Concentration, C_s	gr/dscf	< 6.18E-06	< 6.13E-06	< 6.33E-06	< **6.21E-06**
		µg/dscm	< 14.14	< 14.03	< 14.49	< **14.22**
		ppmvd	< 1.79E-02	< 1.78E-02	< 1.83E-02	< **1.80E-02**
	Mass	lb/hr	< 9.30E-04	< 9.35E-04	< 8.95E-04	< **9.20E-04**
		lb/lb glass	< 1.33E-06	< 1.35E-06	< 1.31E-06	< **1.33E-06**
Production Data	Glass Production	lbs/hr	699.2	690.4	681.7	**690.4**

"<" represents MDL value

EPA Methods 1-4, 13B
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:00**
Source:	**CFU 112 (2)**	**End Time:**	**11:10**
Method:	**13B**	**Date:**	**9/16/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.805 "Hg
   - where Pb: 29.71 "Hg
   - ΔH: 1.288 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.751 "Hg
   - where Pb: 29.71 "Hg
   - Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 74.929 dscf
   - where Vm: 74.519 dcf
   - Y: 0.9985
   - Pm: 29.805 "Hg
   - Tm: 522.1 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.826 scf
   - where H_2O: 38.80 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0238
   - where Vw(std): 1.826 scf
   - Vm(std): 74.929 dscf

6) % H_2O = Bws x 100 = 2.38 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 94.203 awcf
   - where Y: 0.9985
   - Vm: 74.5190 dcf
   - Bws: 0.0238
   - Ts: 644.1 °A
   - Tm: 522.1 °A
   - Pm: 29.805 "Hg
   - Ps: 29.751 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.88 lb/lb-mole
   - where CO_2: 0.48 %vd
   - O_2 20.03 %vd
   - N_2+CO= (100-(O_2+CO_2): 79.49 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.62 lb/lb-mole
where M_d: 28.88 lb/lb-mole
Bws: 0.0238

10) $\text{Stack Area(cir.)} = 3.1416$ (stack diameter/24)^2 = 4.909 sq. ft.
where Stack ID: 30 inches

Stack Area(rect.) = stack width/12 x stack length/12 = NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) Velocity, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 74.96 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.2001
Ts: 644.1 °A
Ps: 29.751 "Hg
Ms: 28.62 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 22,078.7 AWCFM
where V_s: 74.96 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 21,553.2 ADCFM
where AWCFM: 22,078.7
Bws: 0.0238

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\text{ "Hg}}\right) =$ 1,079,805.9 wscf/hr
where V_s: 74.96 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 644.1 °A
Ps: 29.751 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,054,106.5 dscf/hr
where wscf/hr: 1,079,805.9
Bws: 0.0238

16) DSCFM= (dscf/hr)/60 mins/hr = 17,568.4 DSCFM
where dscf/hr: 1,054,106.5

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000175 sq. ft.
where Nozzle Size: 0.1793 inches

Client: Hollingsworth & Vose	Run: 1
Source: CFU 112 (2)	Date: 9/16/2018

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 99.8 %

where Ts:	644.1	°A
Vm(Std):	74.929	dscf
Ps:	29.751	"Hg
Vs	74.96	ft/sec
Nozzle Area:	0.000175	sq. ft.
Sampling Time:	120	min.
Bws:	0.0238	

EPA Method 13B:

19) Fluoride laboratory results < 30.0 µg/sample

20) Fluoride = (µg/sample)/1,000,000 = < 3.00E-05 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 6.18E-06 gr/dscf

where Sample:	0.00003	grams
Vm(std)	74.929	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 14.14 µg/dscm

where Sample:	0.00003	grams
Vm(std)	2.122	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 472.653 Vol./Mole

where Ts:	644.1	°A
Ps:	29.751	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.79E-02 ppmvd

where MW:	19.0	g/mol
lb/hr:	0.00	
Vol./Mole:	472.653	
ADCFM:	21553.2	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 9.30E-04 lb/hr

where Cs:	6.18E-06	gr/dscf
Stack Flow:	1,054,106.5	dscf/hr

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 112 (2)**
DATE	**09/16/18**
METHOD	**26A**
POLLUTANT	**HF**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**9:00**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**		**End Time:**	**11:10**
EPA Method:	**26A**	Raining 54 F Variable wind		**Date:**	**9/16/2018**
Box Operator:	**CMF**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1307999	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size	0.2173 inches
ΔH@	1.846	Hot box ID	M5-HB	Nozzle area	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.71 "Hg	O_2	19.90 %
Static Pressure	0.56 "H_2O	CO_2	0.70 %
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.201 inches
Stack Temperature	204 F		
Assumed moisture	1.8 %		
Assumed meter temp.	69 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	15	8

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	114.275 dcf	Ave. ΔP	1.567 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.2508 "H_2O
Actual H_2O	1.74 %	Ave. ΔH	3.133 "H_2O
Std. meter vol.	115.491 dscf	Ave. T_s	182.5 °F
Isokinetic Average	99.5 %	Ave. T_m	63 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	212	12.0
Silica gel, g	238.0	269.5	31.5
		Total water gain:	43.5

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.580	1.50	186	58	2.94	2.90	3	253	57
2	10.0	9.170	1.50	187	59	2.95	3.00	3	248	52
3	15.0	13.810	1.50	186	59	2.95	3.00	3	254	52
4	20.0	18.390	1.50	187	60	2.95	3.00	3	254	54
5	25.0	23.050	1.60	187	60	3.15	3.20	3	251	55
6	30.0	27.870	1.60	188	61	3.15	3.20	3	251	55
7	35.0	32.660	1.60	188	61	3.15	3.20	3	252	55
8	40.0	37.180	1.40	189	63	2.76	2.80	3	252	55
9	45.0	41.860	1.50	189	63	2.96	3.00	3	252	57
10	50.0	46.370	1.40	190	64	2.76	2.80	3	250	59
11	55.0	50.980	1.50	190	64	2.96	3.00	3	252	60
12	60.0	55.497	1.40	191	65	2.76	2.80	3	248	60
13	65.0	60.220	1.50	184	64	2.99	3.00	3	248	52
14	70.0	65.050	1.60	181	66	3.21	3.20	3	248	53
15	75.0	69.830	1.60	176	65	3.23	3.20	3	248	53
16	80.0	74.870	1.70	176	65	3.44	3.40	3	253	54
17	85.0	79.960	1.80	176	65	3.64	3.60	3	253	54
18	90.0	85.060	1.80	175	65	3.64	3.60	3	253	54
19	95.0	90.100	1.70	175	65	3.44	3.40	3	251	57
20	100.0	95.190	1.70	173	64	3.45	3.50	4	250	57
21	105.0	100.120	1.70	175	64	3.43	3.40	4	250	57
22	110.0	104.870	1.50	175	64	3.03	3.00	4	250	56
23	115.0	109.540	1.50	177	64	3.02	3.00	4	251	56
24	120.0	114.275	1.50	178	64	3.02	3.00	4	251	56

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**11:24**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**13:30**
EPA Method:	**26A**	Raining 54 F Variable wind	**Date:**	**9/16/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:			**Equipment:**						
Circular			Meterbox ID	12	Probe ID	1307999	Liner type:	Glass	
Diameter	30.000	in	Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173	inches
Rectangular			ΔH@	1.846	Hot box ID	M5-HB	Nozzle area:	0.000258	sq.ft.
Width		in			Pitot Cp	0.84	Probe heat:	250	F
Length		in					Filter heat:	250	F
Stack Area	4.909	sq.ft.							

Source Information:					
Barometric Pressure	29.71	"Hg	O_2	19.9	%
Static Pressure	0.56	"H_2O	CO_2	0.7	%
Ave. ΔP	1.321	"H_2O	Rec. Nz.	0.202	inches
Stack Temperature	204	F			
Assumed moisture	1.74	%			
Assumed meter temp.	63	F			
Total number of points	24				
Time per point	5				
Total run time	120				

Leak Checks:	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	11	8

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN-2	

Post Test Calculations:					
Sample volume	111.562	dcf	Ave. ΔP	1.475	"H_2O
Wet mol. weight	28.71	M_s (actual)	Ave. √ΔP	1.214	"H_2O
Actual H_2O	1.8	%	Ave. ΔH	2.95	"H_2O
Std. meter vol.	112.121	dscf	Ave. T_s	191.3	°F
Isokinetic Average	100.2	%	Ave. T_m	65.7	°F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	210	10.0
Silica gel, g	261.9	295.5	33.6
		Total water gain:	43.6

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.820	1.60	180	64	3.21	3.20	4	255	51
2	10.0	9.640	1.60	187	64	3.18	3.20	4	253	51
3	15.0	14.400	1.60	189	64	3.17	3.20	4	252	51
4	20.0	19.110	1.50	189	64	2.97	3.00	4	251	56
5	25.0	23.810	1.50	189	64	2.97	3.00	4	251	58
6	30.0	28.520	1.50	190	64	2.97	3.00	4	251	59
7	35.0	33.210	1.50	190	64	2.97	3.00	4	251	60
8	40.0	37.920	1.50	190	65	2.97	3.00	4	251	61
9	45.0	42.630	1.50	190	65	2.97	3.00	4	251	61
10	50.0	47.180	1.40	189	65	2.78	2.80	4	251	61
11	55.0	51.780	1.40	189	66	2.78	2.80	4	251	62
12	60.0	56.187	1.30	189	66	2.58	2.60	4	251	62
13	65.0	60.760	1.40	189	66	2.78	2.80	4	250	62
14	70.0	65.360	1.50	189	66	2.98	3.00	4	252	58
15	75.0	70.010	1.50	192	66	2.97	3.00	4	251	63
16	80.0	74.690	1.50	193	66	2.96	3.00	4	250	65
17	85.0	79.380	1.50	193	66	2.96	3.00	4	251	65
18	90.0	84.220	1.60	195	67	3.16	3.20	4	252	67
19	95.0	89.040	1.50	195	67	2.96	3.00	4	252	61
20	100.0	93.760	1.50	196	67	2.95	3.00	4	252	50
21	105.0	98.130	1.30	196	67	2.56	2.60	4	252	47
22	110.0	102.490	1.40	196	67	2.76	2.80	4	251	47
23	115.0	107.100	1.40	197	68	2.76	2.80	4	251	47
24	120.0	111.562	1.40	198	68	2.75	2.80	4	252	47

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**13:45**
Source:	**CFU 112 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:51**
EPA Method:	**26A**	Raining 54 F Variable wind	**Date:**	**9/16/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1307999	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	M5-HB	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.71 "Hg	O_2	19.9 %
Static Pressure	0.56 "H_2O	CO_2	0.7 %
Ave. ΔP	1.321 "H_2O	Rec. Nz.	0.201 inches
Stack Temperature	204 F		
Assumed moisture	1.8 %		
Assumed meter temp.	65.7 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	8

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	111.160 dcf	Ave. ΔP	1.463 "H_2O
Wet mol. weight	28.71 M_s (actual)	Ave. √ΔP	1.2088 "H_2O
Actual H_2O	1.87 %	Ave. ΔH	2.904 "H_2O
Std. meter vol.	110.674 dscf	Ave. T_s	200.7 °F
Isokinetic Average	100.1 %	Ave. T_m	70.6 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	243.8	274.7	30.9
		Total water gain:	44.9

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.420	1.40	200	67	2.74	2.70	4	255	49
2	10.0	8.840	1.30	198	68	2.56	2.60	4	254	49
3	15.0	13.500	1.50	198	69	2.95	3.00	4	251	51
4	20.0	18.170	1.50	198	68	2.95	3.00	4	253	54
5	25.0	22.820	1.50	199	69	2.95	3.00	4	251	56
6	30.0	27.490	1.50	199	69	2.95	3.00	4	250	56
7	35.0	32.180	1.50	199	69	2.95	3.00	4	251	57
8	40.0	36.960	1.60	201	70	3.14	3.10	4	252	58
9	45.0	41.850	1.60	201	70	3.14	3.10	4	251	59
10	50.0	46.610	1.60	201	70	3.14	3.10	4	251	60
11	55.0	51.300	1.50	202	71	2.95	3.00	4	252	60
12	60.0	55.919	1.40	202	71	2.75	2.80	4	248	60
13	65.0	60.440	1.40	201	71	2.76	2.80	4	251	57
14	70.0	65.010	1.40	202	71	2.75	2.80	4	253	58
15	75.0	69.660	1.50	203	71	2.94	2.90	4	251	59
16	80.0	74.240	1.40	202	71	2.75	2.80	4	251	59
17	85.0	78.930	1.50	201	72	2.96	3.00	4	250	60
18	90.0	83.470	1.40	201	72	2.76	2.80	4	251	60
19	95.0	88.250	1.50	201	72	2.96	3.00	4	252	61
20	100.0	93.020	1.60	201	72	3.15	3.20	4	251	61
21	105.0	97.610	1.40	201	72	2.76	2.80	4	251	62
22	110.0	102.160	1.40	202	73	2.76	2.80	4	251	61
23	115.0	106.600	1.30	202	73	2.56	2.60	4	252	61
24	120.0	111.160	1.40	202	73	2.76	2.80	4	251	61

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:00**
Source:	**CFU 112 (2)**	**End Time:**	**11:10**
Method:	**26A**	**Date:**	**9/16/2018**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
5	4.580	2.90	58	1	1.50	186	1.2247
10	9.170	3.00	59	2	1.50	187	1.2247
15	13.810	3.00	59	3	1.50	186	1.2247
20	18.390	3.00	60	4	1.50	187	1.2247
25	23.050	3.20	60	5	1.60	187	1.2649
30	27.870	3.20	61	6	1.60	188	1.2649
35	32.660	3.20	61	7	1.60	188	1.2649
40	37.180	2.80	63	8	1.40	189	1.1832
45	41.860	3.00	63	9	1.50	189	1.2247
50	46.370	2.80	64	10	1.40	190	1.1832
55	50.980	3.00	64	11	1.50	190	1.2247
60	55.497	2.80	65	12	1.40	191	1.1832
65	60.220	3.00	64	13	1.50	184	1.2247
70	65.050	3.20	66	14	1.60	181	1.2649
75	69.830	3.20	65	15	1.60	176	1.2649
80	74.870	3.40	65	16	1.70	176	1.3038
85	79.960	3.60	65	17	1.80	176	1.3416
90	85.060	3.60	65	18	1.80	175	1.3416
95	90.100	3.40	65	19	1.70	175	1.3038
100	95.190	3.50	64	20	1.70	173	1.3038
105	100.120	3.40	64	21	1.70	175	1.3038
110	104.870	3.00	64	22	1.50	175	1.2247
115	109.540	3.00	64	23	1.50	177	1.2247
120	114.275	3.00	64	24	1.50	178	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 112 (2)**	**Date:**	**09/16/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	114.275	dcf	Rectangular		
Water Volume	43.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.71	"Hg	CO_2 Average	0.48	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.03	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	3.133	"H_2O	$\sqrt{Dp}$	1.2508	"H_2O
Temperature, T_m	63.0	^oF	Temperature, T_s	182.5	^oF
Temperature, T_m	523.0	^oA (^oR)	Temperature, T_s	642.5	^oA (R)
Pressure Meter, P_m	29.940	"Hg	Pressure Stack, P_s	29.751	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	115.491	dscf	Velocity, V_s	77.93	fps
	3.270	dscm	Volume (actual)	22,953.5	awcfm
Actual Volume, $V_{m(actual)}$	143.894	awcf		22,554.1	adcfm
Gas Stream Moisture			Volume (standard)	1,125,384.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.047	scf		1,105,802.9	dscf/hr
Moisture, B_{ws}	0.0174			18,430.0	dscf/min
Moisture EPA M4	1.74	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	471.479	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	99.4	%			

Laboratory Results

HF	< 3.81	µg/sample		
HF	< 3.81E-06	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	< 5.09E-07	gr/dscf
	< 1.17	µg/dscm
	< 1.40E-03	ppmvd
Mass Emissions HF	< 8.04E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:24**
Source:	**CFU 112 (2)**	**End Time:**	**13:30**
Method:	**26A**	**Date:**	**09/16/18**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
5	4.820	3.20	64	1	1.60	180	1.2649
10	9.640	3.20	64	2	1.60	187	1.2649
15	14.400	3.20	64	3	1.60	189	1.2649
20	19.110	3.00	64	4	1.50	189	1.2247
25	23.810	3.00	64	5	1.50	189	1.2247
30	28.520	3.00	64	6	1.50	190	1.2247
35	33.210	3.00	64	7	1.50	190	1.2247
40	37.920	3.00	65	8	1.50	190	1.2247
45	42.630	3.00	65	9	1.50	190	1.2247
50	47.180	2.80	65	10	1.40	189	1.1832
55	51.780	2.80	66	11	1.40	189	1.1832
60	56.187	2.60	66	12	1.30	189	1.1402
65	60.760	2.80	66	13	1.40	189	1.1832
70	65.360	3.00	66	14	1.50	189	1.2247
75	70.010	3.00	66	15	1.50	192	1.2247
80	74.690	3.00	66	16	1.50	193	1.2247
85	79.380	3.00	66	17	1.50	193	1.2247
90	84.220	3.20	67	18	1.60	195	1.2649
95	89.040	3.00	67	19	1.50	195	1.2247
100	93.760	3.00	67	20	1.50	196	1.2247
105	98.130	2.60	67	21	1.30	196	1.1402
110	102.490	2.80	67	22	1.40	196	1.1832
115	107.100	2.80	68	23	1.40	197	1.1832
120	111.562	2.80	68	24	1.40	198	1.1832

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 112 (2)**	**Date:**	**09/16/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	111.562	dcf	Rectangular		
Water Volume	43.6	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.71	"Hg	CO_2 Average	0.51	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.14	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.950	"H_2O	$\sqrt{Dp}$	1.2140	"H_2O
Temperature, T_m	65.7	^oF	Temperature, T_s	191.3	^oF
Temperature, T_m	525.7	^oA (^oR)	Temperature, T_s	651.3	^oA (R)
Pressure Meter, P_m	29.927	"Hg	Pressure Stack, P_s	29.751	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	112.121	dscf	Velocity, V_s	76.15	fps
	3.175	dscm	Volume (actual)	22,429.2	awcfm
Actual Volume, $V_{m(actual)}$	141.696	awcf		22,025.5	adcfm
Gas Stream Moisture			Volume (standard)	1,084,821.4	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.052	scf		1,065,294.6	dscf/hr
Moisture, B_{ws}	0.0180			17,754.9	dscf/min
Moisture EPA M4	1.80	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	477.937	
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	100.2	%			

Laboratory Results

HF	< 3.74	µg/sample		
HF	< 3.74E-06	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	< 5.15E-07	gr/dscf
	< 1.18	µg/dscm
	< 1.42E-03	ppmvd
Mass Emissions HF	< 7.83E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**13:45**
Source:	**CFU 112 (2)**	**End Time:**	**15:51**
Method:	**26A**	**Date:**	**09/16/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**√Dp**
	0.000						
5	4.420	2.70	67	1	1.40	200	1.1832
10	8.840	2.60	68	2	1.30	198	1.1402
15	13.500	3.00	69	3	1.50	198	1.2247
20	18.170	3.00	68	4	1.50	198	1.2247
25	22.820	3.00	69	5	1.50	199	1.2247
30	27.490	3.00	69	6	1.50	199	1.2247
35	32.180	3.00	69	7	1.50	199	1.2247
40	36.960	3.10	70	8	1.60	201	1.2649
45	41.850	3.10	70	9	1.60	201	1.2649
50	46.610	3.10	70	10	1.60	201	1.2649
55	51.300	3.00	71	11	1.50	202	1.2247
60	55.919	2.80	71	12	1.40	202	1.1832
65	60.440	2.80	71	13	1.40	201	1.1832
70	65.010	2.80	71	14	1.40	202	1.1832
75	69.660	2.90	71	15	1.50	203	1.2247
80	74.240	2.80	71	16	1.40	202	1.1832
85	78.930	3.00	72	17	1.50	201	1.2247
90	83.470	2.80	72	18	1.40	201	1.1832
95	88.250	3.00	72	19	1.50	201	1.2247
100	93.020	3.20	72	20	1.60	201	1.2649
105	97.610	2.80	72	21	1.40	201	1.1832
110	102.160	2.80	73	22	1.40	202	1.1832
115	106.600	2.60	73	23	1.30	202	1.1402
120	111.160	2.80	73	24	1.40	202	1.1832

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 112 (2)**	**Date:**	**09/16/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	111.160	dcf	Rectangular		
Water Volume	44.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.71	"Hg	CO_2 Average	0.52	%vd
Static Pressure	0.56	"H_2O	O_2 Average	20.15	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.904	"H_2O	√Dp	1.2088	"H_2O
Temperature, T_m	70.6	^oF	Temperature, T_s	200.7	^oF
Temperature, T_m	530.6	^oA (^oR)	Temperature, T_s	660.7	^oA (R)
Pressure Meter, P_m	29.924	"Hg	Pressure Stack, P_s	29.751	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	110.674	dscf	Velocity, V_s	76.37	fps
	3.134	dscm	Volume (actual)	22,494.0	awcfm
Actual Volume, $V_{m(actual)}$	141.987	awcf		22,073.4	adcfm
Gas Stream Moisture			Volume (standard)	1,072,476.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.113	scf		1,052,421.5	dscf/hr
Moisture, B_{ws}	0.0187			17,540.4	dscf/min
Moisture EPA M4	1.87	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	484.835	
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	100.1	%			

Laboratory Results

HF	< 3.65	µg/sample		
HF	< 3.65E-06	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	< 5.09E-07	gr/dscf
	< 1.16	µg/dscm
	< 1.40E-03	ppmvd
Mass Emissions HF	< 7.65E-05	lb/hr

"<" represents MDL value

EPA Method 26A
Laboratory Results
HF

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 112 (2)**

Lab ID	Sample ID	Sample Date		Result	MDL	Sample Vol. (ml)	Units
18-S2215	Cont. 3 Run 1	9/16/2018	<	MDL	3.81	362.0	µg/sample
18-S2216	Cont. 3 Run 2	9/16/2018	<	MDL	3.74	355.0	µg/sample
18-S2217	Cont. 3 Run 3	9/16/2018	<	MDL	3.65	347.0	µg/sample
18-S2221	0.1N H2SO4 Blank	9/11/2018	<	MDL	4.45	423.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 26A
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 112 (2)

Run			1	2	3	Average
Date			9/16/2018	9/16/2018	9/16/2018	
Run Start Time			9:00	11:24	13:45	
Run End Time			11:10	13:30	15:51	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.71	29.71	29.71	**29.71**
Nozzle Dia., in.			0.2173	0.2173	0.2173	**0.2173**
Isokinetic Average, %			99.4	100.2	100.1	**99.9**
Sample Volume, dscf			115.491	112.121	110.674	**112.762**
Sample Volume, dscm			3.270	3.175	3.134	**3.193**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.48	0.51	0.52	**0.50**
O_2 %vd			20.03	20.14	20.15	**20.11**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.74	1.80	1.87	**1.80**
Wet Molecular Weight, lb/lb-mole			28.69	28.69	28.69	**28.69**
Velocity, FPS			77.93	76.15	76.37	**76.82**
ADCFM			22,554.1	22,025.5	22,073.4	**22,217.7**
AWCFM			22,953.5	22,429.2	22,494.0	**22,625.6**
DSCFM			18,430.0	17,754.9	17,540.4	**17,908.4**
Stack Temperature, °F			182.5	191.3	200.7	**191.5**
HF	Concentration, C_s	gr/dscf	< 5.09E-07	< 5.15E-07	< 5.09E-07	< **5.11E-07**
		µg/dscm	< 1.17	< 1.18	< 1.16	< **1.17**
		ppmvd	< 1.40E-03	< 1.42E-03	< 1.40E-03	< **1.41E-03**
	Mass	lb/hr	< 8.04E-05	< 7.83E-05	< 7.65E-05	< **7.84E-05**
		lb/lb glass	< 1.15E-07	< 1.13E-07	< 1.12E-07	< **1.14E-07**
Production Data	Glass Production	lbs/hr	699.2	690.4	681.7	**690.4**

"<" represents MDL value

EPA Methods 1-4, 26A
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:00**
Source:	**CFU 112 (2)**	**End Time:**	**11:10**
Method:	**26A**	**Date:**	**9/16/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.940 "Hg
   - where Pb: 29.71 "Hg
   - ΔH: 3.133 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.751 "Hg
   - where Pb: 29.71 "Hg
   - Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 115.491 dscf
   - where Vm: 114.275 dcf
   - Y: 1.0008
   - Pm: 29.940 "Hg
   - Tm: 523.0 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.047 scf
   - where H_2O: 43.50 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0174
   - where Vw(std): 2.047 scf
   - Vm(std): 115.491 dscf

6) % H_2O = Bws x 100 = 1.74 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 143.894 awcf
   - where Y: 1.0008
   - Vm: 114.2749 dcf
   - Bws: 0.0174
   - Ts: 642.5 °A
   - Tm: 523.0 °A
   - Pm: 29.940 "Hg
   - Ps: 29.751 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.88 lb/lb-mole
   - where CO_2: 0.48 %vd
   - O_2 20.03 %vd
   - N_2+CO= (100-(O_2+CO_2): 79.49 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.69 lb/lb-mole
where M_d: 28.88 lb/lb-mole
Bws: 0.0174

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 4.909 sq. ft.
where Stack ID: 30 inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 77.93 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.2508
Ts: 642.5 °A
Ps: 29.751 "Hg
Ms: 28.69 lb/lb-mole

12) $AWCFM = (V_s)\text{(stack area)(60 sec/min)} =$ 22,953.5 AWCFM
where V_s: 77.93 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 22,554.1 ADCFM
where AWCFM: 22,953.5
Bws: 0.0174

14) $Qsw = 3600(V_s)\text{(stack area)}\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,125,384.6 wscf/hr
where V_s: 77.93 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 642.5 °A
Ps: 29.751 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,105,802.9 dscf/hr
where wscf/hr: 1,125,384.6
Bws: 0.0174

16) DSCFM= (dscf/hr)/60 mins/hr = 18,430.0 DSCFM
where dscf/hr: 1,105,802.9

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000258 sq. ft.
where Nozzle Size: 0.2173 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 112 (2)**	**Date:**	**9/16/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 99.4 %

where Ts:	642.5	°A
Vm(Std):	115.491	dscf
Ps:	29.751	"Hg
Vs	77.93	ft/sec
Nozzle Area:	0.000258	sq. ft.
Sampling Time:	120	min.
Bws:	0.0174	

EPA Method 26A:

19) HF laboratory results < 3.81 µg/sample

20) HF = (µg/sample)/1,000,000 = < 3.81E-06 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 5.09E-07 gr/dscf

where Sample:	0.00000	grams
Vm(std)	115.491	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 1.17 µg/dscm

where Sample:	0.00000	grams
Vm(std)	3.270	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92''Hg)}{492\ (Ps)}\right)$ = 471.479 Vol./Mole

where Ts:	642.5	°A
Ps:	29.751	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.40E-03 ppmvd

where MW:	20.01	g/mol
lb/hr:	0.00	
Vol./Mole:	471.479	
ADCFM:	22554.1	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 8.04E-05 lb/hr

where Cs:	5.09E-07	gr/dscf
Stack Flow:	1,105,802.9	dscf/hr

Daily Gaseous Calibrations Log

Client: H & V

Source: CFU-112 w/ 13B, 26A, 3A (2)

Date: 09/16/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	Ø	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

See 9/11/18

*Use of a calibrated instrument required

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
Ø	X					Ø	X		
10	X					2	X		
20	X					4	X		

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
Ø						Ø	X		
10						2	X		

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run #1 - see 9/11

Test Times: R-1 09:00 - 11:10 R-2 11:24 - 13:30 R-3 13:45 - 15:53

post - pass

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-112 (2)**
Facility	**Glass Plant 1**	Date	**September 16, 2018**
Location	**Corvallis, OR**		

Run	1	2	3	
Date	9/16/2018	9/16/2018	9/16/2018	
Run Start Time	9:00	11:24	13:45	
Run End Time	11:10	13:30	15:53	
CO_2 %vd	0.48	0.51	0.52	0.50
O_2 %vd	20.03	20.14	20.15	20.11

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-112 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 16, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	pass/fail	System Cal Response	Post test System Cal. Bias % of span	pass/fail	System Drift % of span	pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.01	0.13	0.60	pass	0.01	0.00	pass	-0.60	pass				
	upscale	9.95	9.99	0.20	pass	9.85	-0.50	pass	-0.70	pass	20	19.80	20.03	10
Run 2	zero	0.01	0.01	0.00	pass	0.01	0.00	pass	0.00	pass				
	upscale	9.95	9.85	-0.50	pass	9.85	-0.50	pass	0.00	pass	20	19.83	20.14	10
Run 3	zero	0.01	0.01	0.00	pass	0.00	-0.05	pass	-0.05	pass				
	upscale	9.95	9.85	-0.50	pass	9.84	-0.55	pass	-0.05	pass	20	19.83	20.15	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0.01	9.95	20.04
Analyzer Cal. Error	0.05	-0.25	0.20
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO_2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-112 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 16, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.01	0.03	0.50	pass	0.03	0.50	pass	0.00	pass				
	upscale	1.86	1.83	-0.75	pass	1.83	-0.75	pass	0.00	pass	4	0.46	0.48	2
Run 2	zero	0.01	0.03	0.50	pass	0.03	0.50	pass	0.00	pass				
	upscale	1.86	1.83	-0.75	pass	1.83	-0.75	pass	0.00	pass	4	0.49	0.51	2
Run 3	zero	0.01	0.03	0.50	pass	0.03	0.50	pass	0.00	pass				
	upscale	1.86	1.83	-0.75	pass	1.82	-1.00	pass	-0.25	pass	4	0.50	0.52	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0.01	1.86	4.04
Analyzer Cal. Error	0.25	-3.50	1.00
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:00**
Source:	**CFU-112 (2)**	**End Time:**	**11:10**
Method:	**3A**	**Date:**	**9/16/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.25 %v

where C_{Dir}:	9.95	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.20 %v

where C_{Dir}:	9.95	ppmv
C_S:	9.99	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.70 %v

where SB_{Final}:	-0.50	ppmv
SB_i:	0.20	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 20.03 ppmv

where C_{Avg}:	19.80	ppmv
C_O:	0.07	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.92	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:00**
Source:	**CFU-112 (2)**	**End Time:**	**11:10**
Method:	**3A**	**Date:**	**9/16/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -3.50 %v

where C_{Dir}:	1.86	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.75 %v

where C_{Dir}:	1.86	ppmv
C_S:	1.83	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.00 %v

where SB_{Final}:	-0.75	ppmv
SB_i:	-0.75	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.48 ppmv

where C_{Avg}:	0.46	ppmv
C_O:	0.03	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.83	ppmv

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/16/2018

Date	Time	O2 [%]	CO2 [%]
9/16/2018	8:24:13	0.05	0.02
9/16/2018	8:24:23	0.02	0.02
9/16/2018	8:24:33	0.01	0.03
9/16/2018	8:24:43	0.00	0.02
9/16/2018	8:24:53	0.00	0.02
9/16/2018	8:25:03	0.00	0.02
9/16/2018	8:25:13	0.00	0.02
9/16/2018	8:25:23	0.00	0.01
9/16/2018	8:25:33	-0.01	0.01
9/16/2018	8:25:43	-0.01	0.01
9/16/2018	8:25:53	-0.01	0.01
9/16/2018	8:26:03	-0.01	0.01
9/16/2018	8:26:13	-0.02	0.01
9/16/2018	8:26:23	-0.02	0.02
9/16/2018	8:26:33	-0.02	0.01
9/16/2018	8:26:43	0.01	0.00
9/16/2018	8:26:53	0.01	0.01
9/16/2018	8:27:03	0.00	0.01
9/16/2018	8:27:13	8.71	7.59
9/16/2018	8:27:23	19.21	19.36
9/16/2018	8:27:33	19.97	19.55
9/16/2018	8:27:43	20.03	19.60
9/16/2018	8:27:53	20.04	19.63
9/16/2018	8:28:03	20.05	19.63
9/16/2018	8:28:13	20.06	19.65
9/16/2018	8:28:23	20.06	19.65
9/16/2018	8:28:33	19.31	19.17
9/16/2018	8:28:43	10.97	9.63
9/16/2018	8:28:53	9.94	9.80
9/16/2018	8:29:03	9.96	9.81
9/16/2018	8:29:13	9.96	9.80
9/16/2018	8:29:23	9.95	9.79
9/16/2018	8:29:33	9.94	9.78
9/16/2018	8:29:43	9.94	9.78
9/16/2018	8:29:53	9.55	8.96
9/16/2018	8:30:03	2.54	1.87
9/16/2018	8:30:13	2.00	1.90
9/16/2018	8:30:23	1.96	1.88
9/16/2018	8:30:33	1.95	1.88
9/16/2018	8:30:43	1.95	1.87
9/16/2018	8:30:53	1.95	1.86

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/16/2018

Date	Time	O2 [%]	CO2 [%]
9/16/2018	8:31:03	1.95	1.86
9/16/2018	8:31:13	1.94	1.87
9/16/2018	8:31:23	1.93	1.87
9/16/2018	8:31:33	0.77	0.52
9/16/2018	8:31:43	0.73	0.82
9/16/2018	8:31:53	3.80	4.20
9/16/2018	8:32:03	3.84	4.00
9/16/2018	8:32:13	3.86	4.01
9/16/2018	8:32:23	3.87	4.03
9/16/2018	8:32:33	3.88	4.03
9/16/2018	8:32:43	3.89	4.04
9/16/2018	8:32:53	3.89	4.04
9/16/2018	8:33:03	3.90	4.04
9/16/2018	8:33:13	3.88	3.99
		O2 [%]	**CO2 [%]**
Analyzer Zero		**0.01**	**0.01**
Analyzer Mid		**9.95**	**1.86**
Analyzer High		**20.04**	**4.04**

Bias Check

9/16/2018	8:33:23	14.04	0.40
9/16/2018	8:33:33	20.52	0.10
9/16/2018	8:33:43	19.68	0.09
9/16/2018	8:33:53	20.55	0.09
9/16/2018	8:34:03	20.92	0.09
9/16/2018	8:34:13	20.78	0.10
9/16/2018	8:34:23	20.77	0.09
9/16/2018	8:34:33	20.77	0.10
9/16/2018	8:34:43	20.76	0.09
9/16/2018	8:34:53	20.76	0.10
9/16/2018	8:35:03	20.76	0.10
9/16/2018	8:35:13	20.75	0.09
9/16/2018	8:35:23	20.76	0.09
9/16/2018	8:35:33	20.75	0.10
9/16/2018	8:35:43	20.75	0.10
9/16/2018	8:35:53	20.75	0.10
9/16/2018	8:36:03	20.78	0.10
9/16/2018	8:36:13	20.84	0.10
9/16/2018	8:36:23	20.67	0.10
9/16/2018	8:36:33	20.22	0.17
9/16/2018	8:36:43	11.58	0.16

Hollingswoth & Vose
CFU #112 (2)
Initial Daily Calibrations
9/16/2018

Date	Time	O2 [%]	CO2 [%]
9/16/2018	8:36:53	3.64	0.06
9/16/2018	8:37:03	1.24	0.04
9/16/2018	8:37:13	0.57	0.03
9/16/2018	8:37:23	0.38	0.03
9/16/2018	8:37:33	0.32	0.03
9/16/2018	8:37:43	0.30	0.03
9/16/2018	8:37:53	0.29	0.03
9/16/2018	8:38:03	0.19	0.03
9/16/2018	8:38:13	0.11	0.03
9/16/2018	8:38:23	0.13	0.03
9/16/2018	8:38:33	0.13	0.03
9/16/2018	8:38:43	0.13	0.03
9/16/2018	8:38:53	0.12	0.03
9/16/2018	8:39:03	0.59	0.56
9/16/2018	8:39:13	1.59	1.50
9/16/2018	8:39:23	1.91	1.72
9/16/2018	8:39:33	1.99	1.80
9/16/2018	8:39:43	2.02	1.82
9/16/2018	8:39:53	2.03	1.83
9/16/2018	8:40:03	2.03	1.83
9/16/2018	8:40:13	2.03	1.84
9/16/2018	8:40:23	2.03	1.84
9/16/2018	8:40:33	2.03	1.84
9/16/2018	8:40:43	2.21	1.86
9/16/2018	8:40:53	5.84	5.71
9/16/2018	8:41:03	8.77	8.53
9/16/2018	8:41:13	9.62	9.28
9/16/2018	8:41:23	9.87	9.52
9/16/2018	8:41:33	9.95	9.61
9/16/2018	8:41:43	9.97	9.64
9/16/2018	8:41:53	9.99	9.66
9/16/2018	8:42:03	9.99	9.67
9/16/2018	8:42:13	9.99	9.67
9/16/2018	8:42:23	9.99	9.67
9/16/2018	8:42:33	9.98	9.68
		O2 [%]	**CO2 [%]**
System Zero		**0.13**	**0.03**
System Mid		**9.99**	**1.83**

Hollingswoth & Vose
CFU 112 (2)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/16/2018	9:00:04	19.87	0.48
9/16/2018	9:01:04	19.87	0.48
9/16/2018	9:02:04	19.87	0.48
9/16/2018	9:03:04	19.87	0.48
9/16/2018	9:04:04	19.86	0.49
9/16/2018	9:05:04	19.86	0.49
9/16/2018	9:06:04	19.85	0.49
9/16/2018	9:07:04	19.85	0.48
9/16/2018	9:08:04	19.85	0.48
9/16/2018	9:09:04	19.84	0.49
9/16/2018	9:10:04	19.85	0.48
9/16/2018	9:11:04	19.83	0.48
9/16/2018	9:12:04	19.83	0.48
9/16/2018	9:13:04	19.84	0.48
9/16/2018	9:14:04	19.83	0.48
9/16/2018	9:15:04	19.83	0.47
9/16/2018	9:16:04	19.82	0.47
9/16/2018	9:17:04	19.83	0.47
9/16/2018	9:18:04	19.82	0.47
9/16/2018	9:19:04	19.81	0.47
9/16/2018	9:20:04	19.82	0.47
9/16/2018	9:21:04	19.82	0.46
9/16/2018	9:22:04	19.82	0.46
9/16/2018	9:23:04	19.82	0.46
9/16/2018	9:24:04	19.82	0.47
9/16/2018	9:25:04	19.82	0.47
9/16/2018	9:26:04	19.82	0.47
9/16/2018	9:27:04	19.82	0.47
9/16/2018	9:28:04	19.81	0.47
9/16/2018	9:29:04	19.81	0.47
9/16/2018	9:30:04	19.81	0.48
9/16/2018	9:31:04	19.81	0.48
9/16/2018	9:32:04	19.80	0.48
9/16/2018	9:33:04	19.80	0.48
9/16/2018	9:34:04	19.80	0.48
9/16/2018	9:35:04	19.80	0.48
9/16/2018	9:36:04	19.80	0.48
9/16/2018	9:37:04	19.80	0.48
9/16/2018	9:38:04	19.80	0.48
9/16/2018	9:39:04	19.80	0.48
9/16/2018	9:40:04	19.79	0.47

Hollingswoth & Vose
CFU 112 (2)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/16/2018	9:41:04	19.79	0.47
9/16/2018	9:42:04	19.79	0.47
9/16/2018	9:43:04	19.80	0.46
9/16/2018	9:44:04	19.80	0.46
9/16/2018	9:45:04	19.80	0.46
9/16/2018	9:46:04	19.79	0.46
9/16/2018	9:47:04	19.79	0.46
9/16/2018	9:48:04	19.80	0.46
9/16/2018	9:49:04	19.80	0.47
9/16/2018	9:50:04	19.79	0.47
9/16/2018	9:51:04	19.80	0.46
9/16/2018	9:52:04	19.80	0.47
9/16/2018	9:53:04	19.79	0.47
9/16/2018	9:54:04	19.79	0.47
9/16/2018	9:55:04	19.79	0.47
9/16/2018	9:56:04	19.79	0.47
9/16/2018	9:57:04	19.80	0.47
9/16/2018	9:58:04	19.80	0.47
9/16/2018	9:59:04	19.80	0.47
9/16/2018	10:00:04	19.80	0.47
9/16/2018	10:01:04	19.80	0.47
9/16/2018	10:02:04	19.80	0.47
9/16/2018	10:03:04	19.80	0.47
9/16/2018	10:04:04	19.80	0.47
9/16/2018	10:05:04	19.80	0.47
9/16/2018	10:06:04	19.81	0.46
9/16/2018	10:07:04	19.80	0.46
9/16/2018	10:08:04	19.80	0.46
9/16/2018	10:09:04	19.80	0.46
9/16/2018	10:10:04	19.80	0.45
9/16/2018	10:11:04	19.80	0.45
9/16/2018	10:12:04	19.80	0.45
9/16/2018	10:13:04	19.80	0.45
9/16/2018	10:14:04	19.80	0.45
9/16/2018	10:15:04	19.79	0.46
9/16/2018	10:16:04	19.80	0.45
9/16/2018	10:17:04	19.80	0.45
9/16/2018	10:18:04	19.80	0.45
9/16/2018	10:19:04	19.80	0.45
9/16/2018	10:20:04	19.79	0.46
9/16/2018	10:21:04	19.80	0.46

Hollingswoth & Vose
CFU 112 (2)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/16/2018	10:22:04	19.79	0.46
9/16/2018	10:23:04	19.80	0.46
9/16/2018	10:24:04	19.80	0.46
9/16/2018	10:25:04	19.80	0.46
9/16/2018	10:26:04	19.80	0.46
9/16/2018	10:27:04	19.79	0.46
9/16/2018	10:28:04	19.79	0.46
9/16/2018	10:29:04	19.80	0.46
9/16/2018	10:30:04	19.79	0.45
9/16/2018	10:31:04	19.79	0.45
9/16/2018	10:32:04	19.79	0.45
9/16/2018	10:33:04	19.79	0.45
9/16/2018	10:34:04	19.79	0.45
9/16/2018	10:35:04	19.79	0.44
9/16/2018	10:36:04	19.80	0.44
9/16/2018	10:37:04	19.79	0.44
9/16/2018	10:38:04	19.79	0.45
9/16/2018	10:39:04	19.79	0.45
9/16/2018	10:40:04	19.78	0.45
9/16/2018	10:41:04	19.79	0.45
9/16/2018	10:42:04	19.78	0.45
9/16/2018	10:43:04	19.78	0.45
9/16/2018	10:44:04	19.79	0.45
9/16/2018	10:45:04	19.79	0.45
9/16/2018	10:46:04	19.79	0.45
9/16/2018	10:47:04	19.79	0.46
9/16/2018	10:48:04	19.78	0.46
9/16/2018	10:49:04	19.78	0.47
9/16/2018	10:50:04	19.78	0.46
9/16/2018	10:51:04	19.78	0.46
9/16/2018	10:52:04	19.78	0.46
9/16/2018	10:53:04	19.78	0.46
9/16/2018	10:54:04	19.78	0.46
9/16/2018	10:55:04	19.78	0.46
9/16/2018	10:56:04	19.78	0.46
9/16/2018	10:57:04	19.78	0.46
9/16/2018	10:58:04	19.78	0.45
9/16/2018	10:59:04	19.78	0.45
9/16/2018	11:00:04	19.78	0.45
9/16/2018	11:01:04	19.78	0.45
9/16/2018	11:02:04	19.78	0.45

Hollingswoth & Vose
CFU 112 (2)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/16/2018	11:03:04	19.78	0.45
9/16/2018	11:04:04	19.78	0.45
9/16/2018	11:05:04	19.78	0.45
9/16/2018	11:06:04	19.78	0.45
9/16/2018	11:07:04	19.78	0.45
9/16/2018	11:08:04	19.91	0.45
9/16/2018	11:09:04	19.88	0.45
9/16/2018	11:10:04	19.88	0.45
Final Average		**19.80**	**0.46**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/16/2018	11:11:54	19.24	0.81
9/16/2018	11:12:04	15.11	1.18
9/16/2018	11:12:14	6.82	0.50
9/16/2018	11:12:24	2.28	0.20
9/16/2018	11:12:34	0.77	0.09
9/16/2018	11:12:44	0.29	0.05
9/16/2018	11:12:54	0.13	0.04
9/16/2018	11:13:04	0.06	0.03
9/16/2018	11:13:14	0.04	0.03
9/16/2018	11:13:24	0.03	0.03
9/16/2018	11:13:34	0.03	0.04
9/16/2018	11:13:44	0.02	0.03
9/16/2018	11:13:54	0.02	0.04
9/16/2018	11:14:04	0.01	0.04
9/16/2018	11:14:14	0.01	0.03
9/16/2018	11:14:24	0.01	0.03
9/16/2018	11:14:34	0.01	0.03
9/16/2018	11:14:44	0.01	0.04
9/16/2018	11:14:54	0.58	0.65
9/16/2018	11:15:04	1.48	1.39
9/16/2018	11:15:14	1.77	1.67
9/16/2018	11:15:24	1.86	1.78
9/16/2018	11:15:34	1.90	1.82
9/16/2018	11:15:44	1.90	1.83
9/16/2018	11:15:54	1.90	1.84
9/16/2018	11:16:04	1.91	1.83
9/16/2018	11:16:14	1.91	1.84
9/16/2018	11:16:24	1.93	1.83
9/16/2018	11:16:34	4.25	4.34

Hollingswoth & Vose
CFU 112 (2)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/16/2018	11:16:44	7.93	8.06
9/16/2018	11:16:54	9.20	9.13
9/16/2018	11:17:04	9.61	9.50
9/16/2018	11:17:14	9.75	9.64
9/16/2018	11:17:24	9.81	9.69
9/16/2018	11:17:34	9.83	9.70
9/16/2018	11:17:44	9.83	9.73
9/16/2018	11:17:54	9.84	9.73
9/16/2018	11:18:04	9.84	9.74
9/16/2018	11:18:14	9.85	9.75
9/16/2018	11:18:24	9.85	9.74
9/16/2018	11:18:34	9.85	9.76
9/16/2018	11:18:44	9.85	9.75
9/16/2018	11:18:54	9.85	9.76
9/16/2018	11:19:04	9.85	9.77
9/16/2018	11:19:14	10.41	9.20
9/16/2018	11:19:24	15.19	4.62
9/16/2018	11:19:34	18.19	1.84
9/16/2018	11:19:44	19.27	1.01
9/16/2018	11:19:54	19.64	0.70
9/16/2018	11:20:04	19.77	0.58
		O2 [%]	**CO2 [%]**
System Zero		**0.01**	**0.03**
System Span		**9.85**	**1.83**

Hollingswoth & Vose
CFU 112 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/16/2018	11:24:04	19.86	0.47
9/16/2018	11:25:04	19.86	0.46
9/16/2018	11:26:04	19.86	0.46
9/16/2018	11:27:04	19.86	0.46
9/16/2018	11:28:04	19.86	0.46
9/16/2018	11:29:04	19.87	0.46
9/16/2018	11:30:04	19.87	0.46
9/16/2018	11:31:04	19.87	0.46
9/16/2018	11:32:04	19.87	0.46
9/16/2018	11:33:04	19.87	0.46
9/16/2018	11:34:04	19.86	0.47
9/16/2018	11:35:04	19.84	0.48
9/16/2018	11:36:04	19.84	0.49
9/16/2018	11:37:04	19.84	0.48
9/16/2018	11:38:04	19.84	0.49
9/16/2018	11:39:04	19.84	0.49
9/16/2018	11:40:04	19.84	0.49
9/16/2018	11:41:04	19.84	0.49
9/16/2018	11:42:04	19.84	0.49
9/16/2018	11:43:04	19.84	0.49
9/16/2018	11:44:04	19.84	0.49
9/16/2018	11:45:04	19.84	0.49
9/16/2018	11:46:04	19.83	0.49
9/16/2018	11:47:04	19.84	0.48
9/16/2018	11:48:04	19.84	0.48
9/16/2018	11:49:04	19.84	0.48
9/16/2018	11:50:04	19.84	0.48
9/16/2018	11:51:04	19.84	0.48
9/16/2018	11:52:04	19.84	0.48
9/16/2018	11:53:04	19.84	0.47
9/16/2018	11:54:04	19.84	0.48
9/16/2018	11:55:04	19.84	0.48
9/16/2018	11:56:04	19.83	0.48
9/16/2018	11:57:04	19.84	0.48
9/16/2018	11:58:04	19.84	0.47
9/16/2018	11:59:04	19.84	0.48
9/16/2018	12:00:04	19.84	0.48
9/16/2018	12:01:04	19.84	0.49
9/16/2018	12:02:04	19.84	0.48
9/16/2018	12:03:04	19.84	0.49
9/16/2018	12:04:04	19.83	0.49

Hollingswoth & Vose
CFU 112 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/16/2018	12:05:04	19.84	0.49
9/16/2018	12:06:04	19.83	0.49
9/16/2018	12:07:04	19.83	0.50
9/16/2018	12:08:04	19.83	0.49
9/16/2018	12:09:04	19.84	0.49
9/16/2018	12:10:04	19.84	0.49
9/16/2018	12:11:04	19.84	0.49
9/16/2018	12:12:04	19.83	0.49
9/16/2018	12:13:04	19.84	0.48
9/16/2018	12:14:04	19.83	0.48
9/16/2018	12:15:04	19.83	0.48
9/16/2018	12:16:04	19.83	0.48
9/16/2018	12:17:04	19.83	0.48
9/16/2018	12:18:04	19.84	0.48
9/16/2018	12:19:04	19.83	0.48
9/16/2018	12:20:04	19.83	0.48
9/16/2018	12:21:04	19.84	0.48
9/16/2018	12:22:04	19.83	0.48
9/16/2018	12:23:04	19.83	0.48
9/16/2018	12:24:04	19.83	0.48
9/16/2018	12:25:04	19.83	0.48
9/16/2018	12:26:04	19.83	0.49
9/16/2018	12:27:04	19.82	0.50
9/16/2018	12:28:04	19.82	0.49
9/16/2018	12:29:04	19.83	0.49
9/16/2018	12:30:04	19.82	0.50
9/16/2018	12:31:04	19.82	0.50
9/16/2018	12:32:04	19.82	0.50
9/16/2018	12:33:04	19.82	0.50
9/16/2018	12:34:04	19.83	0.50
9/16/2018	12:35:04	19.83	0.49
9/16/2018	12:36:04	19.83	0.49
9/16/2018	12:37:04	19.83	0.49
9/16/2018	12:38:04	19.83	0.49
9/16/2018	12:39:04	19.82	0.49
9/16/2018	12:40:04	19.84	0.48
9/16/2018	12:41:04	19.84	0.48
9/16/2018	12:42:04	19.83	0.48
9/16/2018	12:43:04	19.84	0.48
9/16/2018	12:44:04	19.83	0.48
9/16/2018	12:45:04	19.83	0.48

Hollingswoth & Vose
CFU 112 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/16/2018	12:46:04	19.83	0.48
9/16/2018	12:47:04	19.83	0.48
9/16/2018	12:48:04	19.83	0.48
9/16/2018	12:49:04	19.83	0.49
9/16/2018	12:50:04	19.83	0.49
9/16/2018	12:51:04	19.83	0.49
9/16/2018	12:52:04	19.83	0.49
9/16/2018	12:53:04	19.83	0.49
9/16/2018	12:54:04	19.84	0.49
9/16/2018	12:55:04	19.83	0.50
9/16/2018	12:56:04	19.83	0.50
9/16/2018	12:57:04	19.83	0.49
9/16/2018	12:58:04	19.83	0.50
9/16/2018	12:59:04	19.83	0.50
9/16/2018	13:00:04	19.83	0.50
9/16/2018	13:01:04	19.83	0.50
9/16/2018	13:02:04	19.82	0.50
9/16/2018	13:03:04	19.82	0.50
9/16/2018	13:04:04	19.82	0.49
9/16/2018	13:05:04	19.83	0.49
9/16/2018	13:06:04	19.84	0.48
9/16/2018	13:07:04	19.83	0.48
9/16/2018	13:08:04	19.83	0.48
9/16/2018	13:09:04	19.83	0.48
9/16/2018	13:10:04	19.83	0.48
9/16/2018	13:11:04	19.83	0.48
9/16/2018	13:12:04	19.83	0.49
9/16/2018	13:13:04	19.82	0.49
9/16/2018	13:14:04	19.83	0.49
9/16/2018	13:15:04	19.83	0.49
9/16/2018	13:16:04	19.82	0.49
9/16/2018	13:17:04	19.82	0.50
9/16/2018	13:18:04	19.83	0.50
9/16/2018	13:19:04	19.83	0.50
9/16/2018	13:20:04	19.83	0.50
9/16/2018	13:21:04	19.83	0.50
9/16/2018	13:22:04	19.82	0.51
9/16/2018	13:23:04	19.82	0.50
9/16/2018	13:24:04	19.84	0.50
9/16/2018	13:25:04	19.83	0.50
9/16/2018	13:26:04	19.83	0.50

Hollingswoth & Vose
CFU 112 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/16/2018	13:27:04	19.83	0.49
9/16/2018	13:28:04	19.82	0.50
9/16/2018	13:29:04	19.83	0.49
9/16/2018	13:30:04	19.83	0.49
Final Average		**19.83**	**0.49**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/16/2018	13:32:24	19.84	0.49
9/16/2018	13:32:34	19.85	0.49
9/16/2018	13:32:44	17.42	1.33
9/16/2018	13:32:54	17.64	1.00
9/16/2018	13:33:04	19.03	0.67
9/16/2018	13:33:14	19.55	0.55
9/16/2018	13:33:24	19.73	0.51
9/16/2018	13:33:34	19.79	0.50
9/16/2018	13:33:44	19.87	0.49
9/16/2018	13:33:54	15.30	0.39
9/16/2018	13:34:04	5.72	0.18
9/16/2018	13:34:14	1.88	0.07
9/16/2018	13:34:24	0.64	0.05
9/16/2018	13:34:34	0.24	0.04
9/16/2018	13:34:44	0.10	0.03
9/16/2018	13:34:54	0.05	0.03
9/16/2018	13:35:04	0.03	0.03
9/16/2018	13:35:14	0.03	0.02
9/16/2018	13:35:24	0.02	0.03
9/16/2018	13:35:34	0.02	0.03
9/16/2018	13:35:44	0.01	0.03
9/16/2018	13:35:54	0.01	0.03
9/16/2018	13:36:04	0.01	0.03
9/16/2018	13:36:14	0.00	0.03
9/16/2018	13:36:24	0.00	0.03
9/16/2018	13:36:34	0.71	0.78
9/16/2018	13:36:44	1.53	1.45
9/16/2018	13:36:54	1.79	1.70
9/16/2018	13:37:04	1.86	1.78
9/16/2018	13:37:14	1.89	1.81
9/16/2018	13:37:24	1.90	1.82
9/16/2018	13:37:34	1.90	1.82
9/16/2018	13:37:44	1.91	1.83

Hollingswoth & Vose
CFU 112 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/16/2018	13:37:54	1.91	1.83
9/16/2018	13:38:04	1.96	1.83
9/16/2018	13:38:14	4.91	5.10
9/16/2018	13:38:24	8.21	8.30
9/16/2018	13:38:34	9.29	9.22
9/16/2018	13:38:44	9.64	9.54
9/16/2018	13:38:54	9.76	9.66
9/16/2018	13:39:04	9.81	9.71
9/16/2018	13:39:14	9.83	9.72
9/16/2018	13:39:24	9.84	9.75
9/16/2018	13:39:34	9.84	9.75
9/16/2018	13:39:44	9.84	9.76
9/16/2018	13:39:54	9.85	9.76
9/16/2018	13:40:04	9.85	9.76
9/16/2018	13:40:14	9.85	9.77
9/16/2018	13:40:24	9.85	9.77
9/16/2018	13:40:34	9.85	9.77
9/16/2018	13:40:44	9.85	9.77
9/16/2018	13:40:54	9.85	9.78
9/16/2018	13:41:04	9.85	9.78
9/16/2018	13:41:14	9.84	9.78
9/16/2018	13:41:24	12.65	7.02
9/16/2018	13:41:34	17.09	2.85
9/16/2018	13:41:44	18.85	1.32
9/16/2018	13:41:54	19.47	0.84
9/16/2018	13:42:04	19.68	0.65
9/16/2018	13:42:14	19.76	0.59
9/16/2018	13:42:24	19.79	0.56
9/16/2018	13:42:34	19.80	0.54
9/16/2018	13:42:44	19.80	0.54
		O2 [%]	**CO2 [%]**
System Zero		**0.01**	**0.03**
System Span		**9.85**	**1.83**

Hollingswoth & Vose
CFU 112 (2)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/16/2018	13:45:04	19.82	0.51
9/16/2018	13:46:04	19.83	0.51
9/16/2018	13:47:04	19.83	0.50
9/16/2018	13:48:04	19.83	0.50
9/16/2018	13:49:04	19.83	0.50
9/16/2018	13:50:04	19.83	0.50
9/16/2018	13:51:04	19.83	0.50
9/16/2018	13:52:04	19.83	0.50
9/16/2018	13:53:04	19.83	0.50
9/16/2018	13:54:04	19.83	0.49
9/16/2018	13:55:04	19.83	0.49
9/16/2018	13:56:04	19.83	0.49
9/16/2018	13:57:04	19.83	0.49
9/16/2018	13:58:04	19.83	0.49
9/16/2018	13:59:04	19.83	0.49
9/16/2018	14:00:04	19.84	0.49
9/16/2018	14:01:04	19.83	0.49
9/16/2018	14:02:04	19.84	0.49
9/16/2018	14:03:04	19.83	0.49
9/16/2018	14:04:04	19.83	0.49
9/16/2018	14:05:04	19.83	0.49
9/16/2018	14:06:04	19.83	0.49
9/16/2018	14:07:04	19.83	0.49
9/16/2018	14:08:04	19.83	0.50
9/16/2018	14:09:04	19.82	0.51
9/16/2018	14:10:04	19.82	0.51
9/16/2018	14:11:04	19.82	0.51
9/16/2018	14:12:04	19.83	0.51
9/16/2018	14:13:04	19.83	0.50
9/16/2018	14:14:04	19.83	0.50
9/16/2018	14:15:04	19.83	0.50
9/16/2018	14:16:04	19.83	0.50
9/16/2018	14:17:04	19.83	0.49
9/16/2018	14:18:04	19.83	0.49
9/16/2018	14:19:04	19.83	0.49
9/16/2018	14:20:04	19.83	0.49
9/16/2018	14:21:04	19.83	0.48
9/16/2018	14:22:04	19.83	0.48
9/16/2018	14:23:04	19.83	0.48
9/16/2018	14:24:04	19.83	0.48
9/16/2018	14:25:04	19.84	0.48

Hollingswoth & Vose
CFU 112 (2)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/16/2018	14:26:04	19.83	0.49
9/16/2018	14:27:04	19.83	0.49
9/16/2018	14:28:04	19.82	0.49
9/16/2018	14:29:04	19.82	0.49
9/16/2018	14:30:04	19.82	0.49
9/16/2018	14:31:04	19.82	0.50
9/16/2018	14:32:04	19.83	0.50
9/16/2018	14:33:04	19.82	0.50
9/16/2018	14:34:04	19.82	0.51
9/16/2018	14:35:04	19.83	0.50
9/16/2018	14:36:04	19.82	0.51
9/16/2018	14:37:04	19.84	0.50
9/16/2018	14:38:04	19.83	0.50
9/16/2018	14:39:04	19.83	0.51
9/16/2018	14:40:04	19.83	0.50
9/16/2018	14:41:04	19.83	0.51
9/16/2018	14:42:04	19.83	0.50
9/16/2018	14:43:04	19.83	0.50
9/16/2018	14:44:04	19.82	0.50
9/16/2018	14:45:04	19.83	0.49
9/16/2018	14:46:04	19.83	0.49
9/16/2018	14:47:04	19.83	0.49
9/16/2018	14:48:04	19.84	0.49
9/16/2018	14:49:04	19.83	0.49
9/16/2018	14:50:04	19.84	0.49
9/16/2018	14:51:04	19.84	0.49
9/16/2018	14:52:04	19.83	0.50
9/16/2018	14:53:04	19.84	0.49
9/16/2018	14:54:04	19.84	0.50
9/16/2018	14:55:04	19.84	0.50
9/16/2018	14:56:04	19.83	0.51
9/16/2018	14:57:04	19.83	0.51
9/16/2018	14:58:04	19.83	0.51
9/16/2018	14:59:04	19.83	0.51
9/16/2018	15:00:04	19.85	0.51
9/16/2018	15:01:04	19.84	0.51
9/16/2018	15:02:04	19.83	0.51
9/16/2018	15:03:04	19.83	0.51
9/16/2018	15:04:04	19.84	0.50
9/16/2018	15:05:04	19.84	0.50
9/16/2018	15:06:04	19.83	0.51

Hollingswoth & Vose
CFU 112 (2)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/16/2018	15:07:04	19.82	0.51
9/16/2018	15:08:04	19.84	0.50
9/16/2018	15:09:04	19.84	0.50
9/16/2018	15:10:04	19.83	0.49
9/16/2018	15:11:04	19.84	0.49
9/16/2018	15:12:04	19.84	0.49
9/16/2018	15:13:04	19.84	0.49
9/16/2018	15:14:04	19.84	0.49
9/16/2018	15:15:04	19.83	0.49
9/16/2018	15:16:04	19.84	0.49
9/16/2018	15:17:04	19.83	0.50
9/16/2018	15:18:04	19.83	0.50
9/16/2018	15:19:04	19.83	0.50
9/16/2018	15:20:04	19.83	0.50
9/16/2018	15:21:04	19.83	0.50
9/16/2018	15:22:04	19.83	0.51
9/16/2018	15:23:04	19.83	0.51
9/16/2018	15:24:04	19.83	0.51
9/16/2018	15:25:04	19.83	0.51
9/16/2018	15:26:04	19.82	0.51
9/16/2018	15:27:04	19.82	0.51
9/16/2018	15:28:04	19.83	0.51
9/16/2018	15:29:04	19.82	0.51
9/16/2018	15:30:04	19.82	0.51
9/16/2018	15:31:04	19.82	0.51
9/16/2018	15:32:04	19.82	0.51
9/16/2018	15:33:04	19.82	0.50
9/16/2018	15:34:04	19.82	0.50
9/16/2018	15:35:04	19.82	0.49
9/16/2018	15:36:04	19.83	0.49
9/16/2018	15:37:04	19.83	0.49
9/16/2018	15:38:04	19.83	0.49
9/16/2018	15:39:04	19.82	0.49
9/16/2018	15:40:04	19.82	0.50
9/16/2018	15:41:04	19.82	0.50
9/16/2018	15:42:04	19.82	0.50
9/16/2018	15:43:04	19.82	0.50
9/16/2018	15:44:04	19.82	0.50
9/16/2018	15:45:04	19.82	0.51
9/16/2018	15:46:04	19.83	0.50
9/16/2018	15:47:04	19.84	0.50

Hollingswoth & Vose
CFU 112 (2)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/16/2018	15:48:04	19.84	0.51
9/16/2018	15:49:04	19.83	0.51
9/16/2018	15:50:04	19.83	0.51
9/16/2018	15:51:04	19.84	0.51
9/16/2018	15:52:04	19.83	0.51
9/16/2018	15:53:04	19.56	0.60
Final Average		**19.83**	**0.50**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/16/2018	15:53:54	18.19	1.04
9/16/2018	15:54:04	8.38	0.85
9/16/2018	15:54:14	2.79	0.34
9/16/2018	15:54:24	0.94	0.15
9/16/2018	15:54:34	0.34	0.08
9/16/2018	15:54:44	0.14	0.06
9/16/2018	15:54:54	0.07	0.05
9/16/2018	15:55:04	0.04	0.04
9/16/2018	15:55:14	0.03	0.04
9/16/2018	15:55:24	0.02	0.05
9/16/2018	15:55:34	0.02	0.04
9/16/2018	15:55:44	0.01	0.04
9/16/2018	15:55:54	0.01	0.04
9/16/2018	15:56:04	0.01	0.04
9/16/2018	15:56:14	0.00	0.03
9/16/2018	15:56:24	0.00	0.04
9/16/2018	15:56:34	0.00	0.03
9/16/2018	15:56:44	0.00	0.04
9/16/2018	15:56:54	0.00	0.03
9/16/2018	15:57:04	0.00	0.04
9/16/2018	15:57:14	0.09	0.16
9/16/2018	15:57:24	1.09	1.12
9/16/2018	15:57:34	1.60	1.52
9/16/2018	15:57:44	1.14	1.08
9/16/2018	15:57:54	0.44	0.46
9/16/2018	15:58:04	0.14	0.19
9/16/2018	15:58:14	0.06	0.10
9/16/2018	15:58:24	0.85	0.99
9/16/2018	15:58:34	1.57	1.60
9/16/2018	15:58:44	1.79	1.75
9/16/2018	15:58:54	1.87	1.80

Hollingswoth & Vose
CFU 112 (2)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/16/2018	15:59:04	1.89	1.82
9/16/2018	15:59:14	1.90	1.83
9/16/2018	15:59:24	1.90	1.82
9/16/2018	15:59:34	1.90	1.82
9/16/2018	15:59:44	1.90	1.83
9/16/2018	15:59:54	1.90	1.83
9/16/2018	16:00:04	1.90	1.83
9/16/2018	16:00:14	1.90	1.84
9/16/2018	16:00:24	3.21	3.30
9/16/2018	16:00:34	7.33	7.61
9/16/2018	16:00:44	8.99	8.99
9/16/2018	16:00:54	9.54	9.46
9/16/2018	16:01:04	9.72	9.64
9/16/2018	16:01:14	9.80	9.71
9/16/2018	16:01:24	9.82	9.73
9/16/2018	16:01:34	9.83	9.74
9/16/2018	16:01:44	9.84	9.75
9/16/2018	16:01:54	9.84	9.75
9/16/2018	16:02:04	9.85	9.76
9/16/2018	16:02:14	9.85	9.77
9/16/2018	16:02:24	9.85	9.77
9/16/2018	16:02:34	9.84	9.77
9/16/2018	16:02:44	11.47	8.21
9/16/2018	16:02:54	16.67	3.37
9/16/2018	16:03:04	19.10	1.25
9/16/2018	16:03:14	19.97	0.57
9/16/2018	16:03:24	20.27	0.31
9/16/2018	16:03:34	20.37	0.20
		O2 [%]	**CO2 [%]**
System Zero		**0.00**	**0.03**
System Mid		**9.84**	**1.82**

APPENDIX C: CFU 113 (GLASS MELT) TEST DATA

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis OR**
SOURCE	**CFU 113**
DATE	**09/18/18**
METHOD	**M5**
POLLUTANT	**Particulate Matter**

EPA Method 1
Stack Parameters and Traverse Points

Client:	**Hollingsworth & Vose**
Location:	**Corvallis OR**
Source:	**CFU 113**
Facility:	**Glass Plant 1**

Type of Testing: P (P for Particulate; V for Velocity/Nonparticulate)
Type of Duct: C (C for circular; R for rectangular)

Number of ports available: 2
Number of ports to be used: 2
Port diameter: 4 inches

Circular ID (Rectangular Depth): 20.00 inches
Port depth and/or wall thickness: 4.00 inches
Stack width (Rectangular only): inches

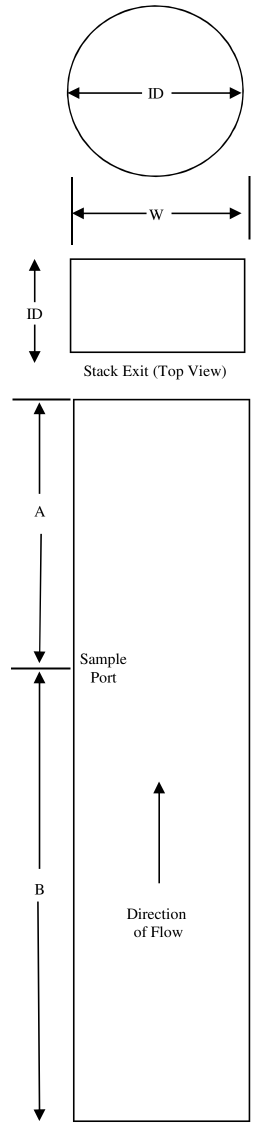
Equivalent Diameter
If rectangluar = $\frac{2*Depth*Width}{Depth + Width}$ = 20.00 inches (If circular = duct ID)
Stack/duct area = 2.182 sq.feet 314.2 sq.inches

Sample Port Location:	Downstrean from flow disturbance from process	Upstream from flow disturbance toward exit
	B	A
Number of Inches:	165.00	96.00
Number of Diameters:	8.25	4.80

Minimum Number of Traverse Points: 8

Points	% of diameter	Distance from inside wall (in.)	Distance including port (in.)
1	6.7	1.34	5 3/8
2	25.0	5.00	9
3	75.0	15.00	19
4	93.3	18.66	22 5/8

Reference Diagram



Drawing NOT to scale and
NOT an acurate representation of stack.

Pre Traverse Flow Information

Client: Hollingsworth & Vose
Location: Corvallis OR
Source: CFU 113

Stack Temp: 121

Traverse Point	Velocity ΔP ("H_2O)	Null Angle
1	0.65	0.0
2	0.74	2.0
3	0.79	0.0
4	0.78	5.0
5	0.60	0.0
6	0.67	0.0
7	0.78	5.0
8	0.79	0.0
9		
10		
11		
12		

Average: 0.725 1.5

Flow is found to be:
Non-cyclonic x
Cyclonic

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis OR**		**Start Time:**	**9:46**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**11:55**
EPA Method:	**M5**	Partly sunny, 60 degrees	**Date:**	**9/18/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size	0.2173 inches
$\Delta H@$	1.846	Hot box ID	HB-2	Nozzle area	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.89 "Hg	O_2	20.00 %
Static Pressure	-0.28 "H_2O	CO_2	0.60 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.226 inches
Stack Temperature	123 F		
Assumed moisture	1.7 %		
Assumed meter temp.	68 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.002
Leak check vacuum, "Hg	15	6

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	78.318 dcf	Ave. ΔP	0.664 "H_2O
Wet mol. weight	28.64 M_s (actual)	Ave. $\sqrt{\Delta P}$	0.8143 "H_2O
Actual H_2O	2.35 %	Ave. ΔH	1.438 "H_2O
Std. meter vol.	79.527 dscf	Ave. T_s	124.4 °F
Isokinetic Average	100.6 %	Ave. T_m	61.5 °F

Moisture/Lab:

	Initial	Final	Gain
Filter	Q1377 #		
Impingers, g	200.0	220	20.0
Silica gel, g	245.8	266.5	20.7
		Total water gain:	40.7

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	9.220	0.60	124	57	1.30	1.30	2	251	56
2	30.0	18.900	0.65	122	57	1.41	1.40	2	248	51
3	45.0	28.360	0.65	122	57	1.41	1.40	2	251	55
4	60.0	38.396	0.69	123	61	1.51	1.50	2	251	58
5	75.0	47.860	0.61	124	63	1.34	1.30	2	251	58
6	90.0	57.990	0.74	126	64	1.62	1.60	2	251	60
7	105.0	67.990	0.68	127	66	1.49	1.50	2	251	62
8	120.0	78.318	0.69	127	67	1.52	1.50	2	250	65

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis OR**		**Start Time:**	**12:15**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**14:22**
EPA Method:	**M5**	Partly sunny, 60 degrees	**Date:**	**9/18/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	HB-2	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.89 "Hg	O_2	20.0 %
Static Pressure	-0.28 "H_2O	CO_2	0.6 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.228 inches
Stack Temperature	123 F		
Assumed moisture	2.35 %		
Assumed meter temp.	61.5 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	5

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	78.627 dcf	Ave. ΔP	0.653 "H_2O
Wet mol. weight	28.68 M_s (actual)	Ave. √ΔP	0.8073 "H_2O
Actual H_2O	2.05 %	Ave. ΔH	1.45 "H_2O
Std. meter vol.	78.519 dscf	Ave. T_s	128.8 °F
Isokinetic Average	100.4 %	Ave. T_m	70.3 °F

Moisture/Lab:

Filter	Q1378 #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	234.9	249.9	15.0
		Total water gain:	35.0

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	10.010	0.69	127	68	1.50	1.50	1.5	253	66
2	30.0	20.320	0.71	127	69	1.55	1.60	1.5	254	58
3	45.0	30.320	0.66	128	70	1.44	1.50	1.5	251	51
4	60.0	40.372	0.69	128	70	1.51	1.50	1.5	250	51
5	75.0	50.370	0.66	129	71	1.44	1.50	1.5	250	59
6	90.0	60.000	0.64	131	71	1.39	1.40	1.5	251	49
7	105.0	69.330	0.60	131	71	1.31	1.30	1.5	251	50
8	120.0	78.627	0.57	129	72	1.25	1.30	1.5	250	52

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis OR**		**Start Time:**	**14:41**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**16:47**
EPA Method:	**M5**	Partly sunny, 60 degrees	**Date:**	**9/18/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	HB-2	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.89 "Hg	O_2	20.0 %
Static Pressure	-0.28 "H_2O	CO_2	0.6 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.226 inches
Stack Temperature	123 F		
Assumed moisture	2.05 %		
Assumed meter temp.	70.3 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	9	6

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	77.722 dcf	Ave. ΔP	0.633 "H_2O
Wet mol. weight	28.66 M_s (actual)	Ave. √ΔP	0.7946 "H_2O
Actual H_2O	2.16 %	Ave. ΔH	1.4 "H_2O
Std. meter vol.	77.139 dscf	Ave. T_s	129 °F
Isokinetic Average	100.3 %	Ave. T_m	73.5 °F

Moisture/Lab:

Filter	Q1379 #		
	Initial	Final	Gain
Impingers, g	200.0	218	18.0
Silica gel, g	259.6	277.7	18.1
		Total water gain:	36.1

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	10.430	0.71	129	72	1.56	1.60	2	256	63
2	30.0	20.670	0.70	130	73	1.54	1.60	2	252	54
3	45.0	30.050	0.60	129	73	1.32	1.30	2	250	54
4	60.0	39.481	0.58	128	74	1.28	1.30	2	252	56
5	75.0	49.220	0.65	129	74	1.43	1.40	2	253	65
6	90.0	59.310	0.66	129	74	1.46	1.50	2	249	60
7	105.0	68.610	0.60	129	74	1.32	1.30	2	251	60
8	120.0	77.722	0.56	129	74	1.24	1.20	2	254	62

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**9:46**
Source:	**CFU 113**	**End Time:**	**11:55**
Method:	**ODEQ 5**	**Date:**	**9/18/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
15	9.220	1.30	57	1	0.60	124	0.7746
30	18.900	1.40	57	2	0.65	122	0.8062
45	28.360	1.40	57	3	0.65	122	0.8062
60	38.396	1.50	61	4	0.69	123	0.8307
75	47.860	1.30	63	5	0.61	124	0.7810
90	57.990	1.60	64	6	0.74	126	0.8602
105	67.990	1.50	66	7	0.68	127	0.8246
120	78.318	1.50	67	8	0.69	127	0.8307

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113**	**Date:**	**09/18/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	78.318	dcf	Rectangular		
Water Volume	40.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.89	"Hg	CO_2 Average	1.13	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	19.99	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	1.438	"H_2O	√Dp	0.8143	"H_2O
Temperature, T_m	61.5	^oF	Temperature, T_s	124.4	^oF
Temperature, T_m	521.5	^oA (^oR)	Temperature, T_s	584.4	^oA (R)
Pressure Meter, P_m	29.996	"Hg	Pressure Stack, P_s	29.869	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	79.527	dscf	Velocity, V_s	48.26	fps
	2.252	dscm	Volume (actual)	6,318.2	awcfm
Actual Volume, $V_{m(actual)}$	90.331	awcf		6,169.7	adcfm
Gas Stream Moisture			Volume (standard)	341,922.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.915	scf		333,887.1	dscf/hr
Moisture, B_{ws}	0.0235			5,564.8	dscf/min
Moisture EPA M4	2.35	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.98	lb/lb-mole			
Wet, M_s	28.72	lb/lb-mole			
Percent Isokinetic	100.8	%			

Laboratory Results

EPA Method 5					
Filterable PM	0.00110	grams			
Emissions:					
Concentration, C_s	2.13E-04	gr/dscf			
	488	µg/dscm			
Mass Emissions	1.02E-02	lb/hr			
Back Half:					
Inorganic CPM	1.05E-03	grams	Organic CPM	3.00E-04	grams
Inorganic CPM, C_s	2.04E-04	gr/dscf	Organic CPM, C_s	5.82E-05	gr/dscf
	466	µg/dscm		133	µg/dscm
Mass Emissions	9.72E-03	lb/hr	Mass Emissions	2.78E-03	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis OR**	**Start Time:**	**12:15**
Source:	**CFU 113**	**End Time:**	**14:22**
Method:	**ODEQ 5**	**Date:**	**09/18/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH $"H_2O$	Meter T_m °F	Traverse Point	Dp $"H_2O$	Stack T_s °F	$\sqrt{Dp}$
	0.000						
15	10.010	1.50	68	1	0.69	127	0.8307
30	20.320	1.60	69	2	0.71	127	0.8426
45	30.320	1.50	70	3	0.66	128	0.8124
60	40.372	1.50	70	4	0.69	128	0.8307
75	50.370	1.50	71	5	0.66	129	0.8124
90	60.000	1.40	71	6	0.64	131	0.8000
105	69.330	1.30	71	7	0.60	131	0.7746
120	78.627	1.30	72	8	0.57	129	0.7550

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 113**	**Date:**	**09/18/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	78.627	dcf	Rectangular		
Water Volume	35.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.89	"Hg	CO_2 Average	1.18	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	19.76	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	1.450	"H_2O	$\sqrt{Dp}$	0.8073	"H_2O
Temperature, T_m	70.3	^oF	Temperature, T_s	128.8	^oF
Temperature, T_m	530.3	^oA (^oR)	Temperature, T_s	588.8	^oA (R)
Pressure Meter, P_m	29.997	"Hg	Pressure Stack, P_s	29.869	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	78.519	dscf	Velocity, V_s	48.00	fps
	2.223	dscm	Volume (actual)	6,284.2	awcfm
Actual Volume, $V_{m(actual)}$	89.581	awcf		6,155.4	adcfm
Gas Stream Moisture			Volume (standard)	337,538.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.647	scf		330,619.3	dscf/hr
Moisture, B_{ws}	0.0205			5,510.3	dscf/min
Moisture EPA M4	2.05	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.98	lb/lb-mole			
Wet, M_s	28.75	lb/lb-mole			
Percent Isokinetic	100.5	%			

Laboratory Results

Front Half:

Filterable PM	0.00110	grams
Emissions:		
Concentration, C_s	2.16E-04	gr/dscf
	495	µg/dscm
Mass Emissions	1.02E-02	lb/hr

Back Half:

Inorganic CPM	7.00E-04	grams	Organic CPM	2.50E-04	grams
Inorganic CPM, C_s	1.38E-04	gr/dscf	Organic CPM, C_s	4.91E-05	gr/dscf
	315	µg/dscm		112	µg/dscm
Mass Emissions	6.50E-03	lb/hr	Mass Emissions	2.32E-03	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis OR**	**Start Time:**	**14:41**
Source:	**CFU 113**	**End Time:**	**16:47**
Method:	**ODEQ 5**	**Date:**	**09/18/18**

Sampling Data				Traverse Data			
Time min.	**Meter** ft^3	**ΔH** "H_2O	**Meter** T_m °F	**Traverse** Point	**Dp** "H_2O	**Stack** T_s °F	**$\sqrt{Dp}$**
	0.000						
15	10.430	1.60	72	1	0.71	129	0.8426
30	20.670	1.60	73	2	0.70	130	0.8367
45	30.050	1.30	73	3	0.60	129	0.7746
60	39.481	1.30	74	4	0.58	128	0.7616
75	49.220	1.40	74	5	0.65	129	0.8062
90	59.310	1.50	74	6	0.66	129	0.8124
105	68.610	1.30	74	7	0.60	129	0.7746
120	77.722	1.20	74	8	0.56	129	0.7483

Client:	**Hollingsworth & Vose**		**Run:**	**3**	
Source:	**CFU 113**		**Date:**	**09/18/18**	

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	77.722	dcf	Rectangular		
Water Volume	36.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.89	"Hg	CO_2 Average	1.15	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.05	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	1.400	"H_2O	$\sqrt{Dp}$	0.7946	"H_2O
Temperature, T_m	73.5	^oF	Temperature, T_s	129.0	^oF
Temperature, T_m	533.5	^oA (^oR)	Temperature, T_s	589.0	^oA (R)
Pressure Meter, P_m	29.993	"Hg	Pressure Stack, P_s	29.869	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	77.139	dscf	Velocity, V_s	47.26	fps
	2.184	dscm	Volume (actual)	6,187.3	awcfm
Actual Volume, $V_{m(actual)}$	88.136	awcf		6,053.7	adcfm
Gas Stream Moisture			Volume (standard)	332,222.2	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.699	scf		325,046.2	dscf/hr
Moisture, B_{ws}	0.0216			5,417.4	dscf/min
Moisture EPA M4	2.16	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.99	lb/lb-mole			
Wet, M_s	28.75	lb/lb-mole			
Percent Isokinetic	100.4	%			

Laboratory Results

Front Half:					
Filterable PM	0.00085	grams			
Emissions:					
Concentration, C_s	1.70E-04	gr/dscf			
	389	µg/dscm			
Mass Emissions	7.90E-03	lb/hr			
Back Half:					
Inorganic CPM	9.00E-04	grams	Organic CPM	2.50E-04	grams
Inorganic CPM, C_s	1.80E-04	gr/dscf	Organic CPM, C_s	5.00E-05	gr/dscf
	412	µg/dscm		114.47	µg/dscm
Mass Emissions	8.36E-03	lb/hr	Mass Emissions	2.32E-03	lb/hr

Oregon Method 5
Filterable and Condensable Particulate
Laboratory Gravimetric Data

Client: **Hollingsworth & Vose**
Location: **Corvallis OR**
Source: **CFU 113**

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction	Corrected Gain (grams)
1	CPM Organics (Acetone BH)	150	44.15880	44.15910	0.00030	0.00E+00	**0.00030**
	Probe Rinse (Acetone FH)	100	44.54030	44.54140	0.00110	0.00E+00	**0.00110**
	Filter	Q1377	0.37075	0.37035	-0.00040		**0.00000**
	CPM Inorganics (Water)	445	45.93565	45.93670	0.00105	0.00E+00	**0.00105**
	CPM Organics (Hexane BH)	90	50.68200	50.68200	0.00000	0.00E+00	**0.00000**
	Impinger H_2O Gain, mls		200	220	20.0		
						Filterable PM (mg)	**1.10**
						Total PM (mg)	**2.45 ND**
2	CPM Organics (Acetone BH)	135	43.86175	43.86200	0.00025	0.00E+00	**0.00025**
	Probe Rinse (Acetone FH)	105	45.33115	45.33220	0.00105	0.00E+00	**0.00105**
	Filter	Q1378	0.37210	0.37215	0.00005		**0.00005**
	CPM Inorganics (Water)	395	43.17100	43.17170	0.00070	0.00E+00	**0.00070**
	CPM Organics (Hexane BH)	90	46.57455	46.57450	-0.00005	0.00E+00	**0.00000**
	Impinger H_2O Gain, mls		200	220	20.0		**20**
						Filterable PM (mg)	**1.10**
						Total PM (mg)	**2.05 ND**
3	CPM Organics (Acetone BH)	165	56.34005	56.34030	0.00025	0.00E+00	**0.00025**
	Probe Rinse (Acetone FH)	80	41.79605	41.79690	0.00085	0.00E+00	**0.00085**
	Filter	Q1379	0.37100	0.37080	-0.00020		**0.00000**
	CPM Inorganics (Water)	397	44.13940	44.14030	0.00090	0.00E+00	**0.00090**
	CPM Organics (Hexane BH)	85	44.41710	44.41690	-0.00020	0.00E+00	**0.00000**
	Impinger H_2O Gain, mls		200	218	18.0		
						Filterable PM (mg)	**0.85**
						Total PM (mg)	**2.00 ND**
	Acetone Blank	160	45.69390	45.69390	0.00000	0.00E+00	g/g
	Water Blank	200	49.47520	49.47520	0.00000	0.00E+00	g/g
	Hexane Blank	100	43.10705	43.10700	0.00000	0.00E+00	g/g

ND = Non-Detect. Values are below the method detection limit (7 mg).

Oregon Methods 1-5
Filterable and Condensable Particulate
Results Summary

Client: Hollingsworth & Vose
Source: CFU 113
Location: Corvallis OR

Run			1	2	3	Average
Date			9/18/2018	9/18/2018	9/18/2018	
Run Start Time			9:46	12:15	14:41	
Run End Time			11:55	14:22	16:47	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.89	29.89	29.89	**29.89**
Nozzle Dia., in.			0.2173	0.2173	0.2173	**0.2173**
Isokinetic Average, %			100.8	100.5	100.4	**100.6**
Sample Volume, dscf			79.527	78.519	77.139	**78.395**
Sample Volume, dscm			2.252	2.223	2.184	**2.220**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			1.13	1.18	1.15	**1.15**
O_2 %vd			19.99	19.76	20.05	**19.93**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			2.35	2.05	2.16	**2.19**
Wet Molecular Weight, lb/lb-mole			28.72	28.75	28.75	**28.74**
Velocity, FPS			48.26	48.00	47.26	**47.84**
ADCFM			6,169.7	6,155.4	6,053.7	**6,126.3**
AWCFM			6,318.2	6,284.2	6,187.3	**6,263.2**
DSCFM			5,564.8	5,510.3	5,417.4	**5,497.5**
Stack Temperature, °F			124.4	128.8	129.0	**127.4**
Filterable Particulate	Concentration, C_s	gr/dscf	2.13E-04	2.16E-04	1.70E-04	**2.00E-04**
		µg/dscm	488	495	389	**457**
	Mass	lb/hr	1.02E-02	1.02E-02	7.90E-03	**9.43E-03**
		lb/lb glass	2.80E-06	2.80E-06	2.13E-06	**2.58E-06**
Inorganic CPM	Concentration, C_s	gr/dscf	2.04E-04	1.38E-04	1.80E-04	**1.74E-04**
		µg/dscm	466	315	412	**398**
	Mass	lb/hr	9.72E-03	6.50E-03	8.36E-03	**8.19E-03**
		lb/lb glass	2.67E-06	1.78E-06	2.26E-06	**2.24E-06**
Organic CPM	Concentration, C_s	gr/dscf	5.82E-05	4.91E-05	5.00E-05	**5.24E-05**
		µg/dscm	133	112	114	**120**
	Mass	lb/hr	2.78E-03	2.32E-03	2.32E-03	**2.47E-03**
		lb/lb glass	7.63E-07	6.35E-07	6.27E-07	**6.75E-07**
Measured Total PM	Concentration, C_s	gr/dscf	ND 4.75E-04	ND 4.03E-04	ND 4.00E-04	ND **4.26E-04**
		µg/dscm	ND 1,087.9	ND 922.2	ND 915.8	ND **975.3**
	Mass	lb/hr	ND 2.27E-02	ND 1.90E-02	ND 1.86E-02	ND **2.01E-02**
		lb/lb glass	ND 6.23E-06	ND 5.21E-06	ND 5.01E-06	ND **5.49E-06**
Total PM @ Method Detection Limit (7 mg)	Concentration, C_s	gr/dscf	< 1.36E-03	< 1.38E-03	< 1.40E-03	< **1.38E-03**
	Mass	lb/hr	< 6.48E-02	< 6.50E-02	< 6.50E-02	< **6.49E-02**
		lb/lb glass	< 1.78E-05	< 1.78E-05	< 1.75E-05	< **1.77E-05**
Production Data	Glass Production	lbs/hr	3637.1	3651.3	3705.3	**3664.6**

Oregon Methods 1-5
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**9:46**
Source:	**CFU 113**	**End Time:**	**11:55**
Method:	**ODEQ 5**	**Date:**	**9/18/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.996 "Hg
where Pb: 29.89 "Hg
ΔH: 1.438 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.869 "Hg
where Pb: 29.89 "Hg
Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 79.527 dscf
where Vm: 78.318 dcf
Y: 1.0008
Pm: 29.996 "Hg
Tm: 521.5 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.915 scf
where H_2O: 40.70 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0235

where Vw(std): 1.915 scf
Vm(std): 79.527 dscf

6) % H_2O = Bws x 100 = 2.35 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 90.331 awcf
where Y: 1.0008
Vm: 78.3179 dcf
Bws: 0.0235
Ts: 584.4 °A
Tm: 521.5 °A
Pm: 29.996 "Hg
Ps: 29.869 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.98 lb/lb-mole
where CO_2: 1.13 %vd
O_2 19.99 %vd
N_2+CO= (100-(O_2+CO_2): 78.88 %vd

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113**	**Date:**	**9/18/2018**

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.72 lb/lb-mole

where M_d: 28.98 lb/lb-mole
Bws: 0.0235

10) $\text{Stack Area(cir.)} = 3.1416\ (\text{stack diameter}/24)^2 =$ 2.182 sq. ft.

where Stack ID: 20 inches

Stack Area(rect.) = stack width/12 x stack length/12 = NA sq. ft.

where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 48.26 fps

where Cp: 0.84
Ave. Sqrt ΔP: 0.8143
Ts: 584.4 °A
Ps: 29.869 "Hg
Ms: 28.72 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 6,318.2 AWCFM

where V_s: 48.26 ft/sec
Stack Area: 2.182 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 6,169.7 ADCFM

where AWCFM: 6,318.2
Bws: 0.0235

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ \text{"Hg}}\right) =$ 341,922.3 wscf/hr

where V_s: 48.26 ft/sec
Stack Area: 2.1820 sq. ft.
Ts: 584.4 °A
Ps: 29.869 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 333,887.1 dscf/hr

where wscf/hr: 341,922.3
Bws: 0.0235

16) DSCFM= (dscf/hr)/60 mins/hr = 5,564.8 DSCFM

where dscf/hr: 333,887.1

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000258 sq. ft.

where Nozzle Size: 0.2173 inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.8 %

where Ts:	584.4	°A
Vm(Std):	79.527	dscf
Ps:	29.869	"Hg
Vs	48.26	ft/sec
Nozzle Area:	0.000258	sq. ft.
Sampling Time:	120	min.
Bws:	0.0235	

ODEQ Method 5:

Front Half:

19) Filterable PM = filter gain + probe rinse gain = 0.00110 grams

where Filter Gain:	0.00000	grams
Probe Rinse:	0.00110	grams

20) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 2.13E-04 gr/dscf

where Sample:	0.00110	grams
Vm(std)	79.527	dscf

21) Cs = (Sample grams*1,000,000 μg/gram)/Vm(std) = 488 μg/dscm

where Sample:	0.00110	grams
Vm(std)	2.252	dscm

22) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 1.02E-02 lb/hr

where Cs:	2.13E-04	gr/dscf
Stack Flow:	333,887.1	dscf/hr

Back Half:

23) Inorganic CPM = water fraction = 0.00105 grams
Organic CPM = acetone BH + hexane BH = 0.00030 grams

Back-half concentrations and mass rates are calculated as front-half examples.

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113**
DATE	**09/18/18**
METHOD	**316**
POLLUTANT	**Formaldehyde**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU 113**	**End Time:**	**11:54**
EPA Method:	**316**	**Date:**	**9/18/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Partly sunny, 60 degrees

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.215	Nozzle size	0.2153 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000253 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.89 "Hg	O_2	19.90 %
Static Pressure	-0.28 "H_2O	CO_2	0.70 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.226 inches
Stack Temperature	118 F		
Assumed moisture	1.8 %		
Assumed meter temp.	69 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	13	10

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	79.152 dcf	Ave. ΔP	0.711 "H_2O
Wet mol. weight	28.62 M_s (actual)	Ave. √ΔP	0.8423 "H_2O
Actual H_2O	2.65 %	Ave. ΔH	1.463 "H_2O
Std. meter vol.	80.179 dscf	Ave. T_s	123 °F
Isokinetic Average	100.2 %	Ave. T_m	61.6 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	228	28.0
Silica gel, g	243.6	262	18.4
		Total water gain:	46.4

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	15.0	10.200	0.76	123	57	1.55	1.60	1.5	251	55
2	30.0	20.430	0.78	128	58	1.58	1.60	1.5	251	47
3	45.0	30.080	0.66	120	60	1.36	1.40	1.5	254	54
4	60.0	39.761	0.66	121	61	1.36	1.40	1.5	256	56
5	75.0	50.000	0.79	122	63	1.63	1.60	1.5	251	61
6	90.0	60.500	0.79	122	64	1.63	1.60	1.5	252	51
7	105.0	70.060	0.65	124	65	1.34	1.30	1.5	254	52
8	120.0	79.152	0.60	124	65	1.24	1.20	1.5	254	53

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**12:16**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**14:23**
EPA Method:	**316**	Partly sunny, 60 degrees	**Date:**	**9/18/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass	
Y factor	0.9985	Nozzle ID	0.215	Nozzle size:	0.2153	inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000253	sq.ft.
		Pitot Cp	0.84	Probe heat:	250	F
				Filter heat:	250	F

Source Information:

Barometric Pressure	29.89	"Hg	O_2	19.9	%
Static Pressure	-0.28	"H_2O	CO_2	0.7	%
Ave. ΔP	0.725	"H_2O	Rec. Nz.	0.228	inches
Stack Temperature	118	F			
Assumed moisture	2.65	%			
Assumed meter temp.	61.6	F			
Total number of points	8				
Time per point	15				
Total run time	120				

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	5

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	78.689	dcf	Ave. ΔP	0.679	"H_2O
Wet mol. weight	28.66	M_s (actual)	Ave. √ΔP	0.8226	"H_2O
Actual H_2O	2.3	%	Ave. ΔH	1.413	"H_2O
Std. meter vol.	78.496	dscf	Ave. T_s	126.6	°F
Isokinetic Average	100.4	%	Ave. T_m	69.6	°F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	224	24.0
Silica gel, g	234.8	250.1	15.3
		Total water gain:	39.3

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	8.750	0.55	124	67	1.12	1.10	1	254	63
2	30.0	18.600	0.65	125	69	1.33	1.40	1	256	55
3	45.0	27.570	0.58	126	69	1.19	1.20	1	253	45
4	60.0	37.947	0.76	126	70	1.56	1.60	1	252	45
5	75.0	47.690	0.68	127	70	1.39	1.40	1	252	58
6	90.0	57.950	0.72	129	70	1.47	1.50	1	254	47
7	105.0	68.110	0.74	129	71	1.51	1.50	1	249	49
8	120.0	78.689	0.75	127	71	1.54	1.60	1	256	51

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**14:42**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**16:48**
EPA Method:	**316**	Partly sunny, 60 degrees	**Date:**	**9/18/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.215	Nozzle size:	0.2153 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000253 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.89 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.226 inches
Stack Temperature	118 F		
Assumed moisture	2.3 %		
Assumed meter temp.	69.6 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	5

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	81.690 dcf	Ave. ΔP	0.728 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	0.8523 "H_2O
Actual H_2O	1.95 %	Ave. ΔH	1.513 "H_2O
Std. meter vol.	81.004 dscf	Ave. T_s	126.6 °F
Isokinetic Average	99.8 %	Ave. T_m	72.9 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	243.4	263.6	20.2
		Total water gain:	34.2

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	15.0	9.810	0.66	126	71	1.36	1.40	1.5	255	64
2	30.0	20.600	0.82	125	72	1.70	1.70	1.5	252	55
3	45.0	30.850	0.73	127	73	1.51	1.50	1.5	250	55
4	60.0	41.365	0.76	127	73	1.57	1.60	1.5	251	56
5	75.0	50.810	0.63	127	73	1.30	1.30	1.5	253	66
6	90.0	61.050	0.73	127	73	1.51	1.50	1.5	253	60
7	105.0	71.480	0.75	127	74	1.55	1.60	1.5	257	61
8	120.0	81.690	0.74	127	74	1.53	1.50	1.5	255	63

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU 113**	**End Time:**	**11:54**
Method:	**316**	**Date:**	**9/18/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m ^oF	Traverse Point	Dp "H_2O	Stack T_s ^oF	$\sqrt{Dp}$
	0.000						
15	10.200	1.60	57	1	0.76	123	0.8718
30	20.430	1.60	58	2	0.78	128	0.8832
45	30.080	1.40	60	3	0.66	120	0.8124
60	39.761	1.40	61	4	0.66	121	0.8124
75	50.000	1.60	63	5	0.79	122	0.8888
90	60.500	1.60	64	6	0.79	122	0.8888
105	70.060	1.30	65	7	0.65	124	0.8062
120	79.152	1.20	65	8	0.60	124	0.7746

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113**	**Date:**	**09/18/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	79.152	dcf	Rectangular		
Water Volume	46.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.89	"Hg	CO_2 Average	1.13	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	19.99	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.463	"H_2O	√Dp	0.8423	"H_2O
Temperature, T_m	61.6	^oF	Temperature, T_s	123.0	^oF
Temperature, T_m	521.6	^oA (^oR)	Temperature, T_s	583.0	^oA (R)
Pressure Meter, P_m	29.998	"Hg	Pressure Stack, P_s	29.869	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	80.179	dscf	Velocity, V_s	49.89	fps
	2.270	dscm	Volume (actual)	6,531.6	awcfm
Actual Volume, $V_{m(actual)}$	91.133	awcf		6,358.5	adcfm
Gas Stream Moisture			Volume (standard)	354,319.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.184	scf		344,930.1	dscf/hr
Moisture, B_{ws}	0.0265			5,748.8	dscf/min
Moisture EPA M4	2.65	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	426.127	
Dry, M_d	28.98	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

CH_2O	513.0	µg/sample			
CH_2O	5.13E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	9.87E-05	gr/dscf
	226.0	µg/dscm
	1.81E-01	ppmvd
Mass Emissions	4.86E-03	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:16**
Source:	**CFU 113**	**End Time:**	**14:23**
Method:	**316**	**Date:**	**09/18/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
15	8.750	1.10	67	1	0.55	124	0.7416
30	18.600	1.40	69	2	0.65	125	0.8062
45	27.570	1.20	69	3	0.58	126	0.7616
60	37.947	1.60	70	4	0.76	126	0.8718
75	47.690	1.40	70	5	0.68	127	0.8246
90	57.950	1.50	70	6	0.72	129	0.8485
105	68.110	1.50	71	7	0.74	129	0.8602
120	78.689	1.60	71	8	0.75	127	0.8660

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 113**	**Date:**	**09/18/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	78.689	dcf	Rectangular		
Water Volume	39.3	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.89	"Hg	CO_2 Average	1.18	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	19.76	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.413	"H_2O	$\sqrt{Dp}$	0.8226	"H_2O
Temperature, T_m	69.6	^oF	Temperature, T_s	126.6	^oF
Temperature, T_m	529.6	^oA (^oR)	Temperature, T_s	586.6	^oA (R)
Pressure Meter, P_m	29.994	"Hg	Pressure Stack, P_s	29.869	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	78.496	dscf	Velocity, V_s	48.84	fps
	2.223	dscm	Volume (actual)	6,394.1	awcfm
Actual Volume, $V_{m(actual)}$	89.449	awcf		6,247.0	adcfm
Gas Stream Moisture			Volume (standard)	344,733.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.849	scf		336,804.9	dscf/hr
Moisture, B_{ws}	0.0230			5,613.4	dscf/min
Moisture EPA M4	2.30	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	428.758	
Dry, M_d	28.98	lb/lb-mole			
Wet, M_s	28.73	lb/lb-mole			
Percent Isokinetic	100.6	%			

Laboratory Results

CH_2O	514.0	µg/sample			
CH_2O	5.14E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	1.01E-04	gr/dscf
	231.2	µg/dscm
	1.85E-01	ppmvd
Mass Emissions	4.86E-03	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**14:42**
Source:	**CFU 113**	**End Time:**	**16:48**
Method:	**316**	**Date:**	**09/18/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
15	9.810	1.40	71	1	0.66	126	0.8124
30	20.600	1.70	72	2	0.82	125	0.9055
45	30.850	1.50	73	3	0.73	127	0.8544
60	41.365	1.60	73	4	0.76	127	0.8718
75	50.810	1.30	73	5	0.63	127	0.7937
90	61.050	1.50	73	6	0.73	127	0.8544
105	71.480	1.60	74	7	0.75	127	0.8660
120	81.690	1.50	74	8	0.74	127	0.8602

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 113**	**Date:**	**09/18/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	81.690	dcf	Rectangular		
Water Volume	34.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.89	"Hg	CO_2 Average	1.15	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.05	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.513	"H_2O	$\sqrt{Dp}$	0.8523	"H_2O
Temperature, T_m	72.9	^oF	Temperature, T_s	126.6	^oF
Temperature, T_m	532.9	^oA (^oR)	Temperature, T_s	586.6	^oA (R)
Pressure Meter, P_m	30.001	"Hg	Pressure Stack, P_s	29.869	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	81.004	dscf	Velocity, V_s	50.56	fps
	2.294	dscm	Volume (actual)	6,619.3	awcfm
Actual Volume, $V_{m(actual)}$	91.977	awcf		6,490.2	adcfm
Gas Stream Moisture			Volume (standard)	356,874.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.609	scf		349,915.3	dscf/hr
Moisture, B_{ws}	0.0195			5,831.9	dscf/min
Moisture EPA M4	1.95	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	428.758	
Dry, M_d	28.99	lb/lb-mole			
Wet, M_s	28.78	lb/lb-mole			
Percent Isokinetic	99.9	%			

Laboratory Results

CH_2O	536.0	µg/sample			
CH_2O	5.36E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	1.02E-04	gr/dscf
	233.7	µg/dscm
	1.87E-01	ppmvd
Mass Emissions	5.10E-03	lb/hr

"<" represents MDL value

EPA Method 316
Laboratory Results
Formaldehyde

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR** **MDL** 0.0274 µg/mL
Source: **CFU 113**

Lab ID	Sample ID	Sample Date	<	Result	MDL	Sample Vol. (mL)	Units
4	Run 1	9/18/2018		513	13.3	485.0	µg/sample
8	Run 2	9/18/2018		514	12.9	470.0	µg/sample
9	Run 3	9/18/2018		536	13.8	505.0	µg/sample
20	H_20 Blank	9/12/2018	<	MDL	11.1	405.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 316
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113

Run			1	2	3	Average
Date			9/18/2018	9/18/2018	9/18/2018	
Run Start Time			9:45	12:16	14:42	
Run End Time			11:54	14:23	16:48	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.89	29.89	29.89	**29.89**
Nozzle Dia., in.			0.2153	0.2153	0.2153	**0.2153**
Isokinetic Average, %			100.3	100.6	99.9	**100.3**
Sample Volume, dscf			80.179	78.496	81.004	**79.893**
Sample Volume, dscm			2.270	2.223	2.294	**2.262**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			1.13	1.18	1.15	**1.15**
O_2 %vd			19.99	19.76	20.05	**19.93**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			2.65	2.30	1.95	**2.30**
Wet Molecular Weight, lb/lb-mole			28.69	28.73	28.78	**28.73**
Velocity, FPS			49.89	48.84	50.56	**49.76**
ADCFM			6,358.5	6,247.0	6,490.2	**6,365.2**
AWCFM			6,531.6	6,394.1	6,619.3	**6,515.0**
DSCFM			5,748.8	5,613.4	5,831.9	**5,731.4**
Stack Temperature, ^oF			123.0	126.6	126.6	**125.4**
Formaldehyde	Concentration, C_s	gr/dscf	9.87E-05	1.01E-04	1.02E-04	**1.01E-04**
		µg/dscm	226.0	231.2	233.7	**230.3**
		ppmvd	1.81E-01	1.85E-01	1.87E-01	**1.84E-01**
	Mass	lb/hr	4.86E-03	4.86E-03	5.10E-03	**4.94E-03**
		lb/lb glass	1.34E-06	1.33E-06	1.38E-06	**1.35E-06**
Production Data	Glass Production	lbs/hr	3637.1	3651.3	3705.3	**3664.6**

"<" represents MDL value

EPA Methods 1-4, 316
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU 113**	**End Time:**	**11:54**
Method:	**316**	**Date:**	**9/18/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.998 "Hg
where Pb: 29.89 "Hg
ΔH: 1.463 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.869 "Hg
where Pb: 29.89 "Hg
Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 80.179 dscf
where Vm: 79.152 dcf
Y: 0.9985
Pm: 29.998 "Hg
Tm: 521.6 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.184 scf
where H_2O: 46.40 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0265

where Vw(std): 2.184 scf
Vm(std): 80.179 dscf

6) % H_2O = Bws x 100 = 2.65 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 91.133 awcf
where Y: 0.9985
Vm: 79.1519 dcf
Bws: 0.0265
Ts: 583.0 °A
Tm: 521.6 °A
Pm: 29.998 "Hg
Ps: 29.869 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.98 lb/lb-mole
where CO_2: 1.13 %vd
O_2 19.99 %vd
N_2+CO= (100-(O_2+CO_2): 78.88 %vd

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113**	**Date:**	**9/18/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws) =$ 28.69 lb/lb-mole

where M_d: 28.98 lb/lb-mole

Bws: 0.0265

10) $\text{Stack Area(cir.)} = 3.1416\ (\text{stack diameter}/24)^2 =$ 2.182 sq. ft.

where Stack ID: 20 inches

$\text{Stack Area(rect.)} = \text{stack width}/12 \times \text{stack length}/12 =$ NA sq. ft.

where Stack Width: 0.000 inches

Stack Length: 0.000 inches

11) Velocity, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 49.89 fps

where Cp: 0.84

Ave. Sqrt ΔP: 0.8423

Ts: 583.0 °A

Ps: 29.869 "Hg

Ms: 28.69 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 6,531.6 AWCFM

where V_s: 49.89 ft/sec

Stack Area: 2.182 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 6,358.5 ADCFM

where AWCFM: 6,531.6

Bws: 0.0265

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ \text{"Hg}}\right) =$ 354,319.6 wscf/hr

where V_s: 49.89 ft/sec

Stack Area: 2.1820 sq. ft.

Ts: 583.0 °A

Ps: 29.869 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 344,930.1 dscf/hr

where wscf/hr: 354,319.6

Bws: 0.0265

16) DSCFM= (dscf/hr)/60 mins/hr = 5,748.8 DSCFM

where dscf/hr: 344,930.1

17) Nozzle Area = $3.1416\ (\text{Nozzle Size}/24)^2 =$ 0.000253 sq. ft.

where Nozzle Size: 0.2153 inches

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right) =$ 100.3 %

where Ts:	583.0	°A
Vm(Std):	80.179	dscf
Ps:	29.869	"Hg
Vs	49.89	ft/sec
Nozzle Area:	0.000253	sq. ft.
Sampling Time:	120	min.
Bws:	0.0265	

EPA Method 316:

19) Formaldehyde laboratory results 513 µg/sample

20) Formaldehyde = (µg/sample)/1,000,000 = 5.13E-04 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 9.87E-05 gr/dscf

where Sample:	0.00051	grams
Vm(std)	80.179	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 226.0 µg/dscm

where Sample:	0.00051	grams
Vm(std)	2.270	dscm

23) Volume/Mole $= \left(\frac{359\frac{ft^3}{lb-mol}@STP\ (Ts)\ (29.92"Hg)}{492°A\ \ (Ps)}\right) =$ 426.127 Vol./Mole

where Ts:	583.0	°A
Ps:	29.869	"Hg

24) ppmvd $= \left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right) =$ 1.81E-01 ppmvd

where MW:	30.031	g/mol
lb/hr:	0.00	
Vol./Mole:	426.127	
ADCFM:	6358.5	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 4.86E-03 lb/hr

where Cs:	9.87E-05	gr/dscf
Stack Flow:	344,930.1	dscf/hr

Daily Gaseous Calibrations Log

Client: H;V

Source: CFU-113 - Full gast ~~metals~~ 303 ms/316 (1)

Date: 09-18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	0	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

*Use of a calibrated instrument required

See 9-11

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	5	0	4	0	4	0	5	50.41	9
10	2	2.5	8	~~50~~ 25	6	2	4		
20	1	5	7	~~100~~ 50 DSB	5	4	3		

Start @ 7:20

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	12	0	14	0	11	0	12		
10	13	2.5	10	~~50~~ 25 DSB	11	2	12		

System VOC Calibrations		
	Initial target	Post Target
Zero	13 0	0
Low	16 6.25	—
Mid	15 12.50	12.50
High	14 21.25	—

— 50 ppm CH_4 alt 106 (12)

Stratification test during run #1

Test Times: R-1 9:45 – 11:54 R-2 12:15 – 14:23 R-3 14:41 – 16:49

Post leak ✓ Pass

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-113 (1)**
Facility	**Glass Plant 1**	Date	**September 18, 2018**
Location	**Corvallis, OR**		

Run			1	2	3	
Date			9/18/2018	9/18/2018	9/18/2018	
Run Start Time			9:45	12:15	14:41	
Run End Time			11:54	14:23	16:49	
Duration, min.			120	120	120	
CO_2 %vd			1.13	1.18	1.15	1.15
O_2 %vd			19.99	19.76	20.05	19.93
WSCFM*			5,698.7	5,625.6	5,537.0	5,620.5
DSCFM*			5,564.8	5,510.3	5,417.4	5,497.5
Nitrogen Oxides	Concentration, C_s	ppmvd	1.36	1.48	1.49	1.44
		[redacted]				
	Mass	lb/hr	5.42E-02	5.84E-02	5.78E-02	5.68E-02
	Emission Factor	lb/lb glass	1.49E-05	1.60E-05	1.56E-05	1.55E-05
		lb/Mscf nat. gas	1.23E-02	1.32E-02	1.31E-02	1.29E-02
Carbon Monoxide	Concentration, C_s	ppmvd	6.99	7.71	7.83	7.51
		[redacted]				
	Mass	lb/hr	0.17	0.19	0.19	0.18
	Emission Factor	lb/lb glass	4.67E-05	5.20E-05	5.13E-05	5.00E-05
		lb/Mscf nat. gas	3.85E-02	4.31E-02	4.31E-02	4.16E-02
VOC	Concentration, C_s	ppmvw	2.33	2.38	2.56	2.42
		[redacted]				
	Mass	lb/hr	9.10E-02	9.18E-02	9.72E-02	9.33E-02
	Emission Factor	lb/lb glass	2.50E-05	2.51E-05	2.62E-05	2.55E-05
		lb/Mscf nat. gas	2.06E-02	2.08E-02	2.20E-02	2.12E-02
Formaldehyde**	Mass	lb/hr	4.86E-03	4.86E-03	5.10E-03	4.94E-03
	Emission Factor	lb/lb glass	1.34E-06	1.33E-06	1.38E-06	1.35E-06
		lb/Mscf nat. gas	1.10E-03	1.10E-03	1.16E-03	1.12E-03
Total VOCs†	Mass	lb/hr	9.59E-02	9.66E-02	1.02E-01	9.83E-02
	Emission Factor	lb/lb glass	2.64E-05	2.65E-05	2.76E-05	2.68E-05
		lb/Mscf nat. gas	2.17E-02	2.19E-02	2.32E-02	2.23E-02

Production Rates	Glass Production	lb/hr	3637.1	3651.3	3705.3	3664.6
	Natural Gas Use	scf/hr	4411.8	4411.8	4411.8	4411.8
		Mscf/hr	4.4118	4.4118	4.4118	4.4118

*Measured during concurrent Method 5 isokinetic runs
**From concurrent Method 316 isokinetic sampling
†Total VOCs = Method 25A VOCs + Formaldehyde

Bison Engineering, Inc.

Method 7E Nitrogen Oxides

Calibration Error, System Bias and System Drift

NOx molecular weight of 46

Company:	**Hollingsworth & Vose**	Source:	**CFU-113 (1)**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 18, 2018**	Instrument Model:	**42i**
Location:	**Corvallis, OR**			Instrument Serial #:	**729825194**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.06	0.26	6.40	pass	-0.05	0.20	pass	-6.20	pass				
	upscale	2.42	2.42	0.00	pass	2.42	0.00	pass	0.00	pass	5	1.36	1.36	2.5
Run 2	zero	-0.06	-0.05	0.20	pass	-0.04	0.40	pass	0.20	pass				
	upscale	2.42	2.42	0.00	pass	2.44	0.40	pass	0.40	pass	5	1.42	1.48	2.5
Run 3	zero	-0.06	-0.04	0.40	pass	-0.05	0.20	pass	-0.20	pass				
	upscale	2.42	2.44	0.40	pass	2.43	0.20	pass	-0.20	pass	5	1.43	1.49	2.5
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2.5	5
Cal gas analyzer response	-0.06	2.42	5.34
Analyzer Cal. Error %	-1.20	-1.60	6.80
Analyzer Cal. Error < 2%*	pass	pass	pass

NO2 CONVERTER TEST	
NO2 Tank Value (ppm)	50.41
NO Check Value	52.71
NO2 to NO Conversion %	104.6%
NO2 Conversion > 90%	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 10 Carbon Monoxide
Calibration Error, System Bias and System Drift
CO molecular weight of 28

Company:	**Hollingsworth & Vose**	Source:	**CFU-113 (1)**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 18, 2018**	Instrument Model:	**48i HL**
Location:	**Corvallis, OR**			Instrument Serial #:	**734025183**

			Initial Values			***Final Values***								
		Analyzer Cal. Response	**System Cal Response**	**Pre test System Cal. Bias % of span**	**Pre test System Cal. Bias pass/fail**	**System Cal Response**	**Post test System Cal. Bias % of span**	**Post test System Cal. Bias pass/fail**	**System Drift % of span**	**System Drift pass/fail**	**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
Run 1	zero	-0.42	-0.35	0.14	pass	-1.68	-2.52	pass	-2.66	pass				
	upscale	24.92	24.69	-0.46	pass	25.05	0.26	pass	0.72	pass	50	6.22	6.99	25
Run 2	zero	-0.42	-1.68	-2.52	pass	-2.06	-3.28	pass	-0.76	pass				
	upscale	24.92	25.05	0.26	pass	24.72	-0.40	pass	-0.66	pass	50	6.38	7.71	25
Run 3	zero	-0.42	-2.06	-3.28	pass	-2.09	-3.34	pass	-0.06	pass				
	upscale	24.92	24.72	-0.40	pass	24.54	-0.76	pass	-0.36	pass	50	6.29	7.83	25
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	25	50
Cal gas analyzer response	-0.42	24.92	50.63
Analyzer Cal. Error	-0.84	-0.16	1.26
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.

Method 3A Oxygen

Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (1)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 18, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.03	0.06	0.15	pass	0.05	0.10	pass	-0.05	pass				
	upscale	9.93	9.98	0.25	pass	9.96	0.15	pass	-0.10	pass	20	19.88	19.99	10
Run 2	zero	0.03	0.05	0.10	pass	0.05	0.10	pass	0.00	pass				
	upscale	9.93	9.96	0.15	pass	9.92	-0.05	pass	-0.20	pass	20	19.59	19.76	10
Run 3	zero	0.03	0.05	0.10	pass	0.05	0.10	pass	0.00	pass				
	upscale	9.93	9.92	-0.05	pass	9.93	0.00	pass	0.05	pass	20	19.85	20.05	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0.03	9.93	20.09
Analyzer Cal. Error	0.15	-0.35	0.45
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (1)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 18, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.02	0.02	0.00	pass	0.01	-0.25	pass	-0.25	pass				
	upscale	1.86	1.84	-0.50	pass	1.83	-0.75	pass	-0.25	pass	4	1.04	1.13	2
Run 2	zero	0.02	0.01	-0.25	pass	0.02	0.00	pass	0.25	pass				
	upscale	1.86	1.83	-0.75	pass	1.81	-1.25	pass	-0.50	pass	4	1.08	1.18	2
Run 3	zero	0.02	0.02	0.00	pass	0.04	0.50	pass	0.50	pass				
	upscale	1.86	1.81	-1.25	pass	1.82	-1.00	pass	0.25	pass	4	1.06	1.15	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0.02	1.86	4.11
Analyzer Cal. Error	0.50	-3.50	2.75
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.

Method 25A Total Hydrocarbons or Volatile Organic Compounds (VOC)

Calibration Error and Drift Checks

VOC molecular weight of 44 as propane

Company:	**Hollingsworth & Vose**	Source:	**CFU-113 (1)**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 18, 2018**	Instrument Model:	**55i**
Location:	**Corvallis, OR**			Instrument Serial #:	**1018142851**

		Calibration System Response	Post-Run System Response	Drift Determination % of span	Drift Determination pass/fail	Analyzer Span	Avg Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.34	0.20	-0.56	pass			
	upscale	12.90	12.62	-1.12	pass	25	2.33	12.5
Run 2	zero	0.34	0.34	0.00	pass			
	upscale	12.90	12.50	-1.60	pass	25	2.38	12.5
Run 3	zero	0.34	0.19	-0.60	pass			
	upscale	12.90	12.63	-1.08	pass	25	2.56	12.5
				≤ 3%				

Instrument Response Time(s):	
Time 1	60
Time 2	60
Time 3	60
Average:	60

SYSTEM CAL. ERROR	Zero	Low	Mid	High
Calibration gas standards	0.00	6.25	12.50	21.25
Calibration gas system response	0.34	6.44	12.90	21.56
Calibration Predicted Response		6.58	12.82	
Calibration Error		2.26	0.62	
Calibration Error < 5% ?	pass	pass	pass	pass

Stratification Check

Facility	Glass Plant 1		
Location	Corvallis, OR	**Date**	9/18/2018
Source	CFU-113 (1)	**Stack Dimensions**	20 inches

3 POINT METHOD

% of diameter	Pt location		O2%	Diff (+/- 5%)	Pass/Fail
16.7%	1	3.34	19.87	-0.03%	PASS
50.0%	2	10.00	19.88	0.02%	PASS
83.3%	3	16.66	19.88	0.02%	PASS
		AVERAGE:	19.88		

*If 3 pt Method fails at < 10% level the gas stream is considered minimally stratified; perform sampling at three points

EPA Method 7E,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU-113 (1)**	**End Time:**	**11:54**
Method:	**7E**	**Date:**	**9/18/2018**

EPA Method 7E:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -1.60 %v

where C_{Dir}: 2.42 ppmv
C_V: 2.50 ppmv
CS: 5.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.00 %v

where C_{Dir}: 2.42 ppmv
C_S: 2.42 ppmv
CS: 5.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.00 %v

where SB_{Final}: 0.00 ppmv
SB_i: 0.00 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 1.36 ppmv

where C_{Avg}: 1.36 ppmv
C_O: 0.11 ppmv
C_{MA}: 2.50 ppmv
C_M: 2.42 ppmv

NO_2 - NO Conversion Efficiency

5) $Eff_{NOx} = \left(\frac{C_{Dir}}{C_v}\right) \times 100 =$ 104.6 %v

where C_{Dir}: 52.71 ppmv
C_V: 50.41 ppmv

Emission Rates:

NO_x 1) lb/hr = (Stack Flow) (C) (46) ($1.558x10^{-7}$) = 5.42E-02 lb/hr

where Stack Flow:	5564.80	DSCFM
C:	1.36	ppm
Molecular Wt NO_x:	46	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

NO_x 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \times C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

EPA Method 10,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU-113 (1)**	**End Time:**	**11:54**
Method:	**10**	**Date:**	**9/18/2018**

EPA Method 10:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.16 %v

where C_{Dir}: 24.92 ppmv
C_V: 25.00 ppmv
CS: 50.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.46 %v

where C_{Dir}: 24.92 ppmv
C_S: 24.69 ppmv
CS: 50.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.72 %v

where SB_{Final}: 0.26 ppmv
SB_i: -0.46 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O) \left(\frac{C_{MA}}{C_M - CO}\right) =$ 6.99 ppmv

where C_{Avg}: 6.22 ppmv
C_O: -1.02 ppmv
C_{MA}: 25.00 ppmv
C_M: 24.87 ppmv

Emission Rates:

CO 1) lb/hr = (Stack Flow) (C) (28) ($1.558x10^{-7}$) = 1.70E-01 lb/hr

where Stack Flow:	5564.80	DSCFM
C:	6.99	ppm
Molecular Wt. CO:	28	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

CO 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \times C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU-113 (1)**	**End Time:**	**11:54**
Method:	**3A**	**Date:**	**9/18/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.35 %v

where C_{Dir}:	9.93	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.25 %v

where C_{Dir}:	9.93	ppmv
C_S:	9.98	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.10 %v

where SB_{Final}:	0.15	ppmv
SB_i:	0.25	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.99 ppmv

where C_{Avg}:	19.88	ppmv
C_O:	0.06	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.97	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU-113 (1)**	**End Time:**	**11:54**
Method:	**3A**	**Date:**	**9/18/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -3.50 %v

where C_{Dir}:	1.86	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.50 %v

where C_{Dir}:	1.86	ppmv
C_S:	1.84	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.25 %v

where SB_{Final}:	-0.75	ppmv
SB_i:	-0.50	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 1.13 ppmv

where C_{Avg}:	1.04	ppmv
C_O:	0.02	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.84	ppmv

EPA Method 25A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU-113 (1)**	**End Time:**	**11:54**
Method:	**25A**	**Date:**	**9/18/2018**

EPA Method 25A:

Predicted Low and Mid Level Calibration Response (Mid)

1) $PR = \left(\frac{CR_H - CRZ}{SS}\right) \times CS_M + CR_Z =$ 12.82 ppmv

where CR_H:	21.56	ppmv
CR_Z:	0.34	ppmv
SS:	21.25	ppmv
CS_M:	12.50	ppmv

Calibration Error Test

2) $CET = \left(\frac{SR - PR}{CGV}\right) \times 100 =$ 0.62 %v

where PR:	12.82	ppmv
SR:	12.90	ppmv
CGV	12.50	ppmv

Drift Determination (Mid)

3) $D = \left(\frac{CSR - CSRC}{CSRS}\right) \times 100 =$ 1.12 %v

where CSR:	12.90	ppmv
CSR_C:	12.62	ppmv
AS:	25.00	ppmv

Emission Rates:

VOC 1) lb/hr = (Stack Flow) (C) (44) ($1.558x10^{-7}$) =			9.10E-02 lb/hr
where Stack Flow:	5698.71	WSCFM	
C:	2.33	ppm	
Molecular Wt Propane:	44	g/g-mole	
	1.558E-07	Conv. Factor	

O_2 Correction

VOC 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \text{ x } C$ =			NA ppmv
where $\%O_2$:	NA	%	
Measured O_2:	NA	%	
C:	NA	ppmv	

Hollingsworth & Vose
CFU-112
Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	6:54:31	-0.07	1.17	0.06	20.48	0.08	0.24
9/18/2018	6:54:41	-0.07	0.34	0.07	20.48	0.08	0.25
9/18/2018	6:54:51	-0.05	0.29	0.06	20.48	0.06	0.25
9/18/2018	6:55:01	-0.05	1.48	0.06	20.48	0.08	0.25
9/18/2018	6:55:11	-0.08	3.73	0.06	20.48	0.08	0.21
9/18/2018	6:55:21	-0.04	3.67	0.07	20.48	0.08	0.15
9/18/2018	6:55:31	-0.06	2.99	0.07	20.48	0.08	0.18
9/18/2018	6:55:41	-0.07	1.86	0.07	20.48	0.08	0.16
9/18/2018	6:55:51	-0.04	1.10	0.06	20.48	0.07	0.30
9/18/2018	6:56:01	-0.07	0.61	0.07	20.48	0.08	0.19
9/18/2018	6:56:11	-0.06	0.55	0.06	20.48	0.08	0.28
9/18/2018	6:56:21	-0.05	0.98	0.07	20.48	0.09	0.21
9/18/2018	6:56:31	-0.06	2.75	0.06	20.48	0.09	0.21
9/18/2018	6:56:41	-0.06	4.03	0.07	20.49	0.09	0.19
9/18/2018	6:56:51	-0.06	3.21	0.07	20.48	0.09	0.21
9/18/2018	6:57:01	-0.06	2.48	0.06	20.48	0.09	0.24
9/18/2018	6:57:11	-0.08	1.24	0.06	20.27	0.09	0.22
9/18/2018	6:57:21	-0.05	0.72	0.06	19.86	4.08	0.24
9/18/2018	6:57:31	-0.06	0.30	0.07	19.55	19.53	0.13
9/18/2018	6:57:41	-0.06	1.42	0.06	19.40	19.76	0.19
9/18/2018	6:57:51	-0.03	4.46	0.07	19.42	19.78	0.15
9/18/2018	6:58:01	-0.06	4.76	0.07	19.87	19.80	0.16
9/18/2018	6:58:11	-0.05	2.96	0.07	20.08	19.75	0.18
9/18/2018	6:58:21	-0.04	1.12	0.07	20.09	19.74	0.22
9/18/2018	6:58:31	-0.06	-0.60	0.07	20.09	19.75	0.18
9/18/2018	6:58:41	-0.06	-1.98	0.07	20.09	19.75	0.18
9/18/2018	6:58:51	-0.04	-1.96	0.06	20.09	19.76	0.18
9/18/2018	6:59:01	-0.05	-2.23	0.07	20.09	19.76	0.19
9/18/2018	6:59:11	-0.07	-0.67	0.06	19.94	19.77	0.22
9/18/2018	6:59:21	-0.06	1.20	0.07	18.00	17.18	0.25
9/18/2018	6:59:31	-0.04	1.16	0.07	10.07	9.65	0.28
9/18/2018	6:59:41	-0.03	1.38	0.05	9.94	9.88	0.25
9/18/2018	6:59:51	-0.05	0.93	0.07	9.94	9.87	0.22
9/18/2018	7:00:01	-0.06	0.02	0.07	9.93	9.86	0.24
9/18/2018	7:00:11	-0.05	-0.93	0.07	9.93	9.86	0.24
9/18/2018	7:00:21	-0.05	-1.71	0.07	9.92	9.84	0.15
9/18/2018	7:00:31	-0.05	-0.68	0.07	9.95	9.84	0.18
9/18/2018	7:00:41	-0.05	0.79	0.07	6.49	5.52	0.21
9/18/2018	7:00:51	-0.07	2.17	0.07	3.66	4.02	0.24
9/18/2018	7:01:01	-0.06	2.00	0.07	3.88	4.12	0.25
9/18/2018	7:01:11	-0.07	1.03	0.06	3.88	4.12	0.27
9/18/2018	7:01:21	-0.06	0.40	0.07	3.88	4.11	0.25

Hollingsworth & Vose
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Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:01:31	-0.06	-0.65	0.07	3.88	4.11	0.24
9/18/2018	7:01:41	-0.07	-1.00	0.06	3.88	4.11	0.25
9/18/2018	7:01:51	-0.04	-0.20	0.06	3.71	3.84	0.25
9/18/2018	7:02:01	-0.05	2.25	0.07	2.24	2.13	0.33
9/18/2018	7:02:11	0.06	2.73	0.06	1.91	1.88	0.27
9/18/2018	7:02:21	0.34	2.08	0.07	1.88	1.87	0.27
9/18/2018	7:02:31	0.42	1.18	0.07	1.88	1.86	0.24
9/18/2018	7:02:41	0.24	0.30	0.06	1.88	1.86	0.21
9/18/2018	7:02:51	0.21	-0.35	0.06	1.88	1.87	0.24
9/18/2018	7:03:01	0.24	-0.49	0.06	1.88	1.86	0.22
9/18/2018	7:03:11	0.11	-0.16	0.07	1.88	1.87	0.21
9/18/2018	7:03:21	-0.05	1.98	0.07	1.72	1.85	0.15
9/18/2018	7:03:31	-0.03	2.72	0.07	1.66	1.87	0.24
9/18/2018	7:03:41	-0.05	2.54	0.07	1.66	1.92	0.13
9/18/2018	7:03:51	-0.04	1.28	0.06	1.67	1.91	0.22
9/18/2018	7:04:01	-0.02	0.29	0.06	1.70	1.91	0.24
9/18/2018	7:04:11	-0.02	0.13	0.07	1.73	1.92	0.15
9/18/2018	7:04:21	-0.02	0.04	0.07	3.39	2.55	0.25
9/18/2018	7:04:31	0.04	0.81	0.07	1.14	0.51	0.24
9/18/2018	7:04:41	-0.42	12.71	0.07	-0.01	0.08	0.22
9/18/2018	7:04:51	10.06	28.72	0.06	-0.06	0.05	0.27
9/18/2018	7:05:01	37.96	41.56	0.07	-0.07	0.05	0.27
9/18/2018	7:05:11	54.57	48.47	0.07	-0.06	0.05	0.25
9/18/2018	7:05:21	55.71	50.38	0.06	-0.07	0.04	0.25
9/18/2018	7:05:31	57.09	50.69	0.07	-0.07	0.04	0.18
9/18/2018	7:05:41	56.94	50.32	0.07	-0.08	0.04	0.25
9/18/2018	7:05:51	56.86	50.51	0.07	-0.07	0.03	0.24
9/18/2018	7:06:01	56.78	50.85	0.06	-0.08	0.04	0.19
9/18/2018	7:06:11	56.70	52.06	0.06	-0.08	0.03	0.22
9/18/2018	7:06:21	56.71	52.39	0.06	-0.08	0.03	0.18
9/18/2018	7:06:31	56.70	52.00	0.07	-0.08	0.02	0.22
9/18/2018	7:06:41	56.70	51.26	0.06	-0.07	0.02	0.15
9/18/2018	7:06:51	56.71	51.04	0.06	0.04	0.03	0.19
9/18/2018	7:07:01	56.71	50.62	0.06	0.03	0.02	0.22
9/18/2018	7:07:11	56.70	50.50	0.07	0.03	0.02	0.25
9/18/2018	7:07:21	56.71	50.77	0.06	0.04	0.02	0.21
9/18/2018	7:07:31	56.70	52.04	0.07	0.03	0.02	0.18
9/18/2018	7:07:41	56.71	52.44	0.07	0.03	0.02	0.27
9/18/2018	7:07:51	56.71	52.25	0.07	0.03	0.02	0.27
9/18/2018	7:08:01	56.65	50.91	0.08	0.03	0.01	0.19
9/18/2018	7:08:11	56.56	49.76	0.07	0.04	0.02	0.28
9/18/2018	7:08:21	56.62	49.36	0.08	0.12	0.07	0.25

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:08:31	56.71	47.74	0.07	0.04	0.02	0.22
9/18/2018	7:08:41	57.30	40.67	0.06	0.02	0.01	0.25
9/18/2018	7:08:51	53.09	33.86	0.07	0.02	0.01	0.21
9/18/2018	7:09:01	39.79	29.33	0.07	0.03	0.01	0.22
9/18/2018	7:09:11	30.77	27.16	0.06	0.03	0.01	0.27
9/18/2018	7:09:21	29.25	26.24	0.07	0.02	0.01	0.22
9/18/2018	7:09:31	28.26	25.59	0.07	0.02	0.00	0.21
9/18/2018	7:09:41	28.17	25.29	0.07	0.03	0.01	0.27
9/18/2018	7:09:51	28.16	24.94	0.07	0.02	0.00	0.25
9/18/2018	7:10:01	28.12	24.76	0.08	0.03	0.00	0.25
9/18/2018	7:10:11	28.02	25.07	0.07	0.02	0.01	0.21
9/18/2018	7:10:21	28.03	26.12	0.07	0.02	0.01	0.13
9/18/2018	7:10:31	28.02	26.65	0.07	0.02	0.01	0.16
9/18/2018	7:10:41	28.02	26.40	0.07	0.02	0.00	0.22
9/18/2018	7:10:51	28.03	25.73	0.07	0.02	0.01	0.21
9/18/2018	7:11:01	28.03	24.89	0.08	0.57	0.61	0.21
9/18/2018	7:11:11	25.94	18.72	0.07	0.12	0.05	0.19
9/18/2018	7:11:21	21.40	11.68	0.07	0.03	0.00	0.19
9/18/2018	7:11:31	32.42	11.22	0.06	0.02	0.01	0.22
9/18/2018	7:11:41	16.21	7.17	0.06	0.02	0.01	0.21
9/18/2018	7:11:51	5.63	7.81	0.05	0.02	0.00	0.25
9/18/2018	7:12:01	5.51	8.37	0.06	0.02	0.00	0.19
9/18/2018	7:12:11	5.35	7.59	0.06	0.02	0.01	0.18
9/18/2018	7:12:21	5.34	6.48	0.07	0.02	0.00	0.19
9/18/2018	7:12:31	5.33	5.87	0.06	0.02	0.00	0.18
9/18/2018	7:12:41	5.34	5.26	0.07	0.02	0.00	0.21
9/18/2018	7:12:51	5.35	5.00	0.06	0.02	0.00	0.22
9/18/2018	7:13:01	5.32	5.03	0.07	0.02	-0.01	0.19
9/18/2018	7:13:11	5.34	6.91	0.06	0.01	-0.01	0.16
9/18/2018	7:13:21	5.34	8.23	0.06	0.02	-0.01	0.16
9/18/2018	7:13:31	5.33	7.82	0.07	0.01	-0.01	0.16
9/18/2018	7:13:41	5.34	5.99	0.07	0.01	-0.01	0.19
9/18/2018	7:13:51	4.85	4.55	0.07	0.02	-0.01	0.15
9/18/2018	7:14:01	3.67	3.32	0.07	0.02	-0.01	0.19
9/18/2018	7:14:11	2.87	2.73	0.07	0.01	-0.01	0.18
9/18/2018	7:14:21	2.71	2.29	0.06	0.02	-0.01	0.13
9/18/2018	7:14:31	2.71	3.25	0.06	0.02	-0.01	0.11
9/18/2018	7:14:41	2.71	4.82	0.07	0.01	-0.02	0.13
9/18/2018	7:14:51	2.61	5.89	0.07	0.02	-0.01	0.19
9/18/2018	7:15:01	2.43	5.35	0.07	0.01	-0.01	0.11
9/18/2018	7:15:11	2.43	4.25	0.07	0.02	-0.01	0.11
9/18/2018	7:15:21	2.43	3.41	0.07	0.02	-0.02	0.16

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:15:31	2.41	2.84	0.07	0.02	-0.01	0.11
9/18/2018	7:15:41	2.42	2.25	0.06	0.03	-0.02	0.13
9/18/2018	7:15:51	2.44	2.42	0.07	0.04	-0.02	0.19
9/18/2018	7:16:01	2.41	3.47	0.07	11.59	0.00	0.18
9/18/2018	7:16:11	2.43	4.45	0.07	20.53	-0.02	0.19
9/18/2018	7:16:21	2.56	4.29	0.07	20.88	-0.02	0.22
9/18/2018	7:16:31	12.06	2.69	0.07	20.89	-0.02	0.24
9/18/2018	7:16:41	35.44	1.78	0.06	20.89	-0.02	0.16
9/18/2018	7:16:51	50.72	0.78	0.07	20.88	-0.02	0.15
9/18/2018	7:17:01	50.69	0.15	0.07	20.88	-0.02	0.24
9/18/2018	7:17:11	52.41	-0.24	0.07	20.89	-0.02	0.19
9/18/2018	7:17:21	52.54	-0.18	0.07	20.89	-0.02	0.19
9/18/2018	7:17:31	52.75	1.46	0.06	20.89	-0.02	0.15
9/18/2018	7:17:41	52.72	2.86	0.07	20.90	-0.02	0.21
9/18/2018	7:17:51	52.75	2.91	0.07	20.90	-0.02	0.21
9/18/2018	7:18:01	52.74	1.60	0.07	20.90	-0.02	0.22
9/18/2018	7:18:11	52.73	1.26	0.06	20.90	-0.01	0.13
9/18/2018	7:18:21	52.73	0.03	0.07	20.92	-0.02	0.22
9/18/2018	7:18:31	52.70	0.10	0.05	19.67	-0.02	0.25
9/18/2018	7:18:41	52.70	-0.45	0.06	20.68	0.02	0.16
9/18/2018	7:18:51	51.66	1.15	0.07	20.82	0.03	0.21
9/18/2018	7:19:01	52.12	2.88	0.06	20.78	0.04	0.22
9/18/2018	7:19:11	41.05	3.44	0.07	20.76	0.04	0.18
9/18/2018	7:19:21	17.03	2.40	0.07	20.75	0.04	0.24
9/18/2018	7:19:31	2.19	1.40	0.07	20.75	0.05	0.24

	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]
Analyzer Zero	**-0.06**	**-0.42**	**0.03**	**0.02**
Analyzer Mid	**2.42**	**24.92**	**9.93**	**1.86**
Analyzer High	**5.34**	**50.63**	**20.09**	**4.11**

NO2 Converter Check **52.71**

Bias Check		NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:19:41	1.04	0.70	0.06	20.74	0.05	0.30
9/18/2018	7:19:51	0.39	0.40	0.07	20.74	0.05	0.24
9/18/2018	7:20:01	0.25	0.14	0.06	20.74	0.05	0.21
9/18/2018	7:20:11	0.22	0.42	0.06	20.74	0.05	0.24
9/18/2018	7:20:21	0.26	2.65	0.07	20.73	0.05	0.25
9/18/2018	7:20:31	0.24	3.45	0.06	20.73	0.05	0.30
9/18/2018	7:20:41	0.23	3.17	0.07	20.73	0.06	0.19
9/18/2018	7:20:51	0.24	2.17	0.07	20.73	0.05	2.57
9/18/2018	7:21:01	0.23	1.67	0.06	20.73	0.06	2.68

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:21:11	0.23	0.67	0.07	20.73	0.05	2.80
9/18/2018	7:21:21	0.13	0.64	0.07	20.77	0.13	2.80
9/18/2018	7:21:31	-0.05	0.14	0.07	16.04	1.54	2.85
9/18/2018	7:21:41	-0.06	0.84	0.07	6.91	0.78	2.85
9/18/2018	7:21:51	0.06	2.21	0.07	2.79	0.35	2.88
9/18/2018	7:22:01	0.24	3.26	0.28	1.19	0.15	2.89
9/18/2018	7:22:11	0.23	2.30	0.59	0.58	0.08	2.88
9/18/2018	7:22:21	0.23	2.00	0.59	0.33	0.05	2.82
9/18/2018	7:22:31	0.35	1.64	0.59	0.23	0.03	2.83
9/18/2018	7:22:41	0.75	1.82	0.59	0.19	0.01	2.89
9/18/2018	7:22:51	1.14	2.18	0.60	0.17	0.02	2.85
9/18/2018	7:23:01	1.25	2.21	0.59	0.16	0.02	2.77
9/18/2018	7:23:11	1.55	4.10	0.60	0.16	0.02	2.69
9/18/2018	7:23:21	1.92	5.32	0.60	0.16	0.02	1.64
9/18/2018	7:23:31	2.24	5.76	0.60	0.11	0.02	1.56
9/18/2018	7:23:41	2.43	4.58	0.59	0.06	0.02	1.56
9/18/2018	7:23:51	2.41	4.09	0.59	0.06	0.02	1.56
9/18/2018	7:24:01	2.42	2.94	0.59	0.06	0.02	1.58
9/18/2018	7:24:11	2.41	2.78	0.58	0.06	0.02	1.53
9/18/2018	7:24:21	2.42	2.26	0.59	0.06	0.02	1.53
9/18/2018	7:24:31	2.41	2.98	0.59	0.06	0.01	0.59
9/18/2018	7:24:41	2.43	4.14	0.59	0.06	0.02	0.22
9/18/2018	7:24:51	2.43	5.87	0.59	0.06	0.02	0.24
9/18/2018	7:25:01	2.43	5.26	0.58	0.13	0.01	0.28
9/18/2018	7:25:11	2.44	4.82	0.60	0.63	0.02	0.21
9/18/2018	7:25:21	1.22	2.67	0.60	0.34	0.02	0.25
9/18/2018	7:25:31	3.65	6.66	0.60	0.17	0.02	0.21
9/18/2018	7:25:41	9.14	12.25	0.43	0.11	0.01	0.25
9/18/2018	7:25:51	14.28	17.70	0.06	0.08	0.02	0.25
9/18/2018	7:26:01	20.51	21.48	0.07	0.06	0.01	0.25
9/18/2018	7:26:11	25.09	24.33	0.06	0.06	0.02	0.31
9/18/2018	7:26:21	26.34	25.79	0.06	0.06	0.01	0.28
9/18/2018	7:26:31	27.19	26.10	0.06	0.06	0.01	0.30
9/18/2018	7:26:41	27.40	25.65	0.07	0.05	0.02	0.27
9/18/2018	7:26:51	27.58	25.36	0.06	0.06	0.02	0.22
9/18/2018	7:27:01	27.58	25.01	0.47	0.05	0.02	0.25
9/18/2018	7:27:11	27.58	24.69	0.48	0.05	0.02	0.24
9/18/2018	7:27:21	27.64	24.60	0.47	0.05	0.01	0.30
9/18/2018	7:27:31	27.72	24.80	0.47	0.05	0.02	0.24
9/18/2018	7:27:41	27.73	25.74	0.47	0.05	0.02	0.27
9/18/2018	7:27:51	27.71	26.53	0.47	0.05	0.02	0.21
9/18/2018	7:28:01	27.67	26.26	0.47	0.10	0.01	0.28

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:28:11	27.64	25.75	0.47	6.38	0.03	0.27
9/18/2018	7:28:21	27.78	24.08	0.46	14.55	0.06	0.25
9/18/2018	7:28:31	25.15	19.29	0.46	18.24	0.07	0.28
9/18/2018	7:28:41	18.73	13.17	0.47	16.02	0.20	0.27
9/18/2018	7:28:51	13.04	7.86	0.47	8.15	1.04	0.27
9/18/2018	7:29:01	7.10	5.06	0.48	4.44	1.53	0.27
9/18/2018	7:29:11	5.79	7.91	0.47	2.96	1.72	0.16
9/18/2018	7:29:21	4.84	6.75	0.47	2.38	1.79	0.25
9/18/2018	7:29:31	3.86	4.35	0.47	2.14	1.81	0.28
9/18/2018	7:29:41	2.25	2.38	0.46	2.05	1.83	0.31
9/18/2018	7:29:51	1.02	1.28	0.47	2.01	1.84	0.22
9/18/2018	7:30:01	0.60	-0.05	0.47	2.00	1.84	0.27
9/18/2018	7:30:11	0.27	-0.07	0.47	1.99	1.84	0.22
9/18/2018	7:30:21	0.25	-0.94	0.47	1.99	1.84	0.25
9/18/2018	7:30:31	0.26	-0.05	0.47	1.98	1.84	0.47
9/18/2018	7:30:41	0.25	1.78	0.60	1.98	1.84	1.56
9/18/2018	7:30:51	0.26	2.85	0.59	1.98	1.84	1.55
9/18/2018	7:31:01	0.26	2.08	0.59	1.98	1.85	1.53
9/18/2018	7:31:11	0.26	1.42	0.59	2.30	1.94	1.52
9/18/2018	7:31:21	0.27	0.45	0.59	5.74	5.70	1.60
9/18/2018	7:31:31	0.22	0.08	0.59	8.28	8.15	1.50
9/18/2018	7:31:41	0.36	-0.22	0.59	9.28	9.09	1.61
9/18/2018	7:31:51	0.40	-0.08	0.50	9.68	9.48	0.34
9/18/2018	7:32:01	0.25	1.07	0.47	9.85	9.64	0.24
9/18/2018	7:32:11	0.26	1.98	0.47	9.91	9.70	0.24
9/18/2018	7:32:21	0.11	2.21	0.47	9.95	9.74	0.16
9/18/2018	7:32:31	-0.04	0.94	0.46	9.96	9.75	0.18
9/18/2018	7:32:41	-0.05	0.17	0.47	9.96	9.77	0.24
9/18/2018	7:32:51	-0.05	-0.78	0.47	9.97	9.77	0.25
9/18/2018	7:33:01	-0.04	-1.25	0.54	9.97	9.77	0.16
9/18/2018	7:33:11	-0.06	-1.66	0.60	9.98	9.79	0.24
9/18/2018	7:33:21	-0.03	-1.72	0.60	9.97	9.78	0.22
9/18/2018	7:33:31	-0.04	-0.61	0.60	9.98	9.79	0.21
9/18/2018	7:33:41	-0.06	1.22	0.60	9.98	9.79	0.27
9/18/2018	7:33:51	-0.04	1.83	0.59	9.98	9.79	0.19
9/18/2018	7:34:01	-0.05	0.99	0.60	9.98	9.79	0.24
9/18/2018	7:34:11	-0.04	0.21	0.55	10.18	9.60	0.21
9/18/2018	7:34:21	-0.04	-0.62	0.33	14.35	5.70	0.22
9/18/2018	7:34:31	-0.06	-1.21	0.34	18.03	2.38	0.24
9/18/2018	7:34:41	-0.04	-0.79	0.34	19.64	1.09	0.21
9/18/2018	7:34:51	-0.07	-0.30	0.34	18.85	1.17	0.24
9/18/2018	7:35:01	-0.05	1.01	0.33	11.05	1.36	0.27

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:35:11	-0.07	2.86	0.34	6.99	0.69	0.21
9/18/2018	7:35:21	-0.04	3.26	0.33	5.45	0.34	0.24
9/18/2018	7:35:31	0.30	2.57	0.45	4.84	0.19	0.31
9/18/2018	7:35:41	1.23	1.46	0.46	4.61	0.12	0.27
9/18/2018	7:35:51	1.66	0.95	0.47	4.51	0.08	0.27
9/18/2018	7:36:01	1.29	0.01	0.47	4.47	0.07	0.30
9/18/2018	7:36:11	1.04	-0.16	0.47	4.45	0.06	0.30
9/18/2018	7:36:21	0.71	-0.02	0.47	4.46	0.06	0.24
9/18/2018	7:36:31	0.52	0.50	0.46	4.45	0.06	0.28
9/18/2018	7:36:41	0.54	2.49	4.66	4.45	0.05	1.00
9/18/2018	7:36:51	0.53	3.30	7.47	4.45	0.04	1.52
9/18/2018	7:37:01	0.43	2.76	7.46	4.45	0.04	1.60
9/18/2018	7:37:11	0.23	1.77	7.47	4.45	0.04	1.55
9/18/2018	7:37:21	0.24	0.98	7.47	4.45	0.04	1.52
9/18/2018	7:37:31	0.23	0.37	7.46	4.44	0.03	1.53
9/18/2018	7:37:41	0.23	-0.18	7.47	4.44	0.03	1.50
9/18/2018	7:37:51	0.24	0.17	11.41	4.45	0.04	1.02
9/18/2018	7:38:01	0.24	0.78	20.62	4.45	0.03	0.18
9/18/2018	7:38:11	0.26	2.79	20.61	4.45	0.03	0.25
9/18/2018	7:38:21	0.14	3.20	20.61	4.45	0.03	0.24
9/18/2018	7:38:31	-0.04	2.43	20.61	4.44	0.02	0.27
9/18/2018	7:38:41	-0.04	1.57	20.62	4.45	0.04	0.28
9/18/2018	7:38:51	-0.04	0.61	20.61	4.45	0.02	0.25
9/18/2018	7:39:01	-0.04	0.07	20.61	4.45	0.02	0.16
9/18/2018	7:39:11	-0.04	-0.10	21.27	4.44	0.02	0.24
9/18/2018	7:39:21	-0.07	-0.17	21.26	4.44	0.02	0.16
9/18/2018	7:39:31	-0.03	1.23	21.28	4.45	0.02	0.18
9/18/2018	7:39:41	-0.04	2.82	21.28	4.44	0.01	0.24
9/18/2018	7:39:51	-0.04	2.99	21.27	4.44	0.02	0.30
9/18/2018	7:40:01	-0.04	2.15	21.28	4.40	0.03	0.22
9/18/2018	7:40:11	-0.05	1.30	21.27	3.53	0.01	0.19
9/18/2018	7:40:21	-0.04	0.84	21.48	2.97	0.01	0.27
9/18/2018	7:40:31	-0.07	0.10	21.56	2.76	0.01	0.21
9/18/2018	7:40:41	-0.05	0.24	21.55	2.69	0.01	0.25
9/18/2018	7:40:51	-0.04	0.22	21.56	2.65	0.01	0.25
9/18/2018	7:41:01	-0.06	2.08	21.56	2.63	0.01	0.21
9/18/2018	7:41:11	-0.03	3.15	21.56	2.63	0.01	0.24
9/18/2018	7:41:21	-0.06	2.89	21.55	2.62	0.01	0.24
9/18/2018	7:41:31	-0.04	1.86	21.34	2.63	0.01	0.25
9/18/2018	7:41:41	-0.05	1.16	21.02	2.62	0.01	0.30
9/18/2018	7:41:51	-0.05	0.53	21.01	2.62	0.01	0.27
9/18/2018	7:42:01	-0.05	0.06	21.01	2.62	0.01	0.31

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:42:11	-0.05	-0.03	21.02	2.62	0.01	0.27
9/18/2018	7:42:21	-0.05	0.53	21.01	2.62	0.01	0.25
9/18/2018	7:42:31	-0.06	2.14	21.01	2.62	0.00	0.18
9/18/2018	7:42:41	-0.06	3.12	20.25	2.62	0.01	0.25
9/18/2018	7:42:51	-0.04	2.67	13.39	2.61	0.01	0.21
9/18/2018	7:43:01	-0.04	1.80	13.38	2.62	0.01	0.22
9/18/2018	7:43:11	-0.03	0.93	13.40	2.62	0.01	0.19
9/18/2018	7:43:21	-0.06	0.15	13.39	2.62	0.01	0.22
9/18/2018	7:43:31	-0.05	0.12	13.39	2.62	0.01	0.27
9/18/2018	7:43:41	-0.04	-0.09	13.38	2.62	0.00	0.19
9/18/2018	7:43:51	-0.05	1.24	13.39	2.62	0.01	0.22
9/18/2018	7:44:01	-0.04	2.91	13.20	2.62	0.01	0.15
9/18/2018	7:44:11	-0.06	3.21	13.15	2.62	0.01	0.16
9/18/2018	7:44:21	-0.03	2.39	13.15	2.62	0.01	0.13
9/18/2018	7:44:31	-0.06	1.56	13.16	2.62	0.02	0.24
9/18/2018	7:44:41	-0.04	0.66	13.15	2.62	0.01	0.25
9/18/2018	7:44:51	-0.04	0.35	13.16	2.61	0.01	0.25
9/18/2018	7:45:01	-0.05	-0.05	13.16	2.62	0.01	0.21
9/18/2018	7:45:11	-0.04	-0.17	13.03	2.61	0.01	0.24
9/18/2018	7:45:21	-0.06	1.06	12.90	2.62	0.02	0.31
9/18/2018	7:45:31	-0.06	2.72	12.90	2.62	0.01	0.24
9/18/2018	7:45:41	-0.06	2.94	12.89	2.62	0.01	0.25
9/18/2018	7:45:51	-0.05	2.36	12.90	2.62	0.01	0.25
9/18/2018	7:46:01	-0.05	1.27	12.90	2.62	0.01	0.21
9/18/2018	7:46:11	-0.04	0.31	12.90	2.62	0.01	0.15
9/18/2018	7:46:21	-0.06	0.10	12.89	2.39	0.13	0.24
9/18/2018	7:46:31	-0.06	-0.37	12.89	1.84	0.15	0.25
9/18/2018	7:46:41	-0.06	0.09	12.90	1.53	0.06	0.24
9/18/2018	7:46:51	-0.05	1.25	12.89	1.40	0.03	0.24
9/18/2018	7:47:01	-0.04	3.11	12.89	1.36	0.02	0.22
9/18/2018	7:47:11	-0.06	2.46	12.89	1.33	0.01	0.24
9/18/2018	7:47:21	-0.04	1.91	12.89	1.32	0.01	0.25
9/18/2018	7:47:31	-0.03	1.35	12.89	1.32	0.01	0.19
9/18/2018	7:47:41	-0.05	0.37	12.90	1.32	0.01	0.24
9/18/2018	7:47:51	-0.04	0.30	12.90	1.32	0.01	0.24
9/18/2018	7:48:01	-0.05	-0.09	12.90	1.32	0.01	0.22
9/18/2018	7:48:11	-0.02	0.55	12.90	1.32	0.01	0.30
9/18/2018	7:48:21	-0.04	2.22	12.90	1.32	0.00	0.21
9/18/2018	7:48:31	-0.04	3.03	12.89	1.32	0.01	0.25
9/18/2018	7:48:41	-0.02	2.71	12.90	1.32	0.01	0.24
9/18/2018	7:48:51	-0.04	1.57	9.26	1.32	0.01	0.30
9/18/2018	7:49:01	-0.03	1.03	6.84	1.32	0.01	0.25

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Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:49:11	-0.03	0.16	6.84	1.32	0.01	0.21
9/18/2018	7:49:21	-0.03	-0.04	6.83	1.32	0.01	0.21
9/18/2018	7:49:31	-0.04	-0.22	6.83	1.32	0.01	0.24
9/18/2018	7:49:41	-0.05	0.55	6.83	1.32	0.01	0.19
9/18/2018	7:49:51	-0.05	2.15	6.82	1.32	0.01	0.24
9/18/2018	7:50:01	-0.05	2.94	6.76	1.32	0.01	0.28
9/18/2018	7:50:11	-0.05	2.47	6.57	1.32	0.01	0.22
9/18/2018	7:50:21	-0.04	1.52	6.57	1.31	0.02	0.27
9/18/2018	7:50:31	-0.04	0.87	6.57	1.32	0.01	0.30
9/18/2018	7:50:41	-0.05	0.15	6.57	1.32	0.02	0.21
9/18/2018	7:50:51	-0.05	0.15	6.57	1.32	0.01	0.34
9/18/2018	7:51:01	-0.04	-0.28	6.57	1.32	0.01	0.16
9/18/2018	7:51:11	-0.04	1.04	6.58	1.32	0.02	0.19
9/18/2018	7:51:21	-0.04	2.77	6.57	1.32	0.02	0.22
9/18/2018	7:51:31	-0.05	2.98	6.56	1.32	0.02	0.25
9/18/2018	7:51:41	-0.03	2.56	6.58	1.31	0.02	0.21
9/18/2018	7:51:51	-0.03	1.28	6.57	1.31	0.01	0.25
9/18/2018	7:52:01	-0.04	0.60	6.56	1.31	0.01	0.24
9/18/2018	7:52:11	-0.03	0.03	6.57	1.32	0.02	0.27
9/18/2018	7:52:21	-0.03	0.21	6.56	1.31	0.02	0.21
9/18/2018	7:52:31	-0.02	-0.16	6.57	1.31	0.01	0.22
9/18/2018	7:52:41	-0.04	0.98	6.57	1.31	0.02	0.18
9/18/2018	7:52:51	-0.03	2.87	6.57	1.31	0.03	0.21
9/18/2018	7:53:01	-0.04	2.75	6.57	1.31	0.01	0.19
9/18/2018	7:53:11	-0.02	2.18	6.59	1.31	0.02	0.22
9/18/2018	7:53:21	-0.03	1.17	6.58	1.31	0.02	0.18
9/18/2018	7:53:31	-0.04	0.64	6.58	1.47	0.02	0.16
9/18/2018	7:53:41	-0.01	-0.03	6.57	8.21	0.04	0.27
9/18/2018	7:53:51	-0.01	-0.09	6.58	15.40	0.06	0.27
9/18/2018	7:54:01	-0.01	-0.33	6.57	18.53	0.06	0.24
9/18/2018	7:54:11	-0.04	0.80	6.57	19.82	0.07	0.31
9/18/2018	7:54:21	-0.03	2.57	6.57	20.34	0.07	0.28
9/18/2018	7:54:31	-0.05	3.35	6.58	20.56	0.07	0.22
9/18/2018	7:54:41	-0.04	2.47	6.57	20.65	0.07	0.21
9/18/2018	7:54:51	-0.06	2.04	6.55	20.69	0.08	0.30
9/18/2018	7:55:01	-0.04	1.04	6.42	20.70	0.07	0.25
9/18/2018	7:55:11	-0.04	0.61	6.43	20.70	0.07	0.25
9/18/2018	7:55:21	-0.05	0.13	6.44	20.71	0.07	0.30
9/18/2018	7:55:31	-0.02	0.13	6.44	20.71	0.07	0.30
9/18/2018	7:55:41	-0.05	0.90	6.43	20.72	0.06	0.24
9/18/2018	7:55:51	-0.03	2.57	6.44	20.77	0.07	0.33
9/18/2018	7:56:01	-0.05	3.87	6.43	17.53	0.07	0.24

Hollingsworth & Vose
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Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	7:56:11	-0.04	3.52	1.87	8.08	0.04	2.59
9/18/2018	7:56:21	-0.03	2.41	0.73	3.32	0.03	2.86
9/18/2018	7:56:31	-0.03	1.16	0.74	1.50	0.02	2.86
9/18/2018	7:56:41	-0.04	0.51	0.73	0.78	0.02	2.86
9/18/2018	7:56:51	-0.04	0.21	0.72	0.50	0.02	2.83
9/18/2018	7:57:01	-0.04	-0.10	0.72	0.39	0.02	2.82
9/18/2018	7:57:11	-0.05	0.38	0.73	0.33	0.02	2.83
9/18/2018	7:57:21	-0.03	2.28	0.73	0.32	0.02	2.85
9/18/2018	7:57:31	-0.04	3.28	0.73	0.31	0.02	2.82
9/18/2018	7:57:41	-0.05	2.76	0.73	0.31	0.02	2.85
9/18/2018	7:57:51	-0.05	1.50	0.74	0.30	0.01	2.77
9/18/2018	7:58:01	-0.04	0.96	0.72	0.30	0.02	2.77
9/18/2018	7:58:11	-0.06	0.21	0.73	0.30	0.02	2.85
9/18/2018	7:58:21	-0.04	0.19	0.72	0.30	0.02	2.86
9/18/2018	7:58:31	-0.05	-0.41	1.24	0.30	0.02	4.80
9/18/2018	7:58:41	-0.03	0.51	3.32	0.30	0.01	9.32
9/18/2018	7:58:51	-0.04	2.19	3.33	0.30	0.01	9.36
9/18/2018	7:59:01	-0.05	3.17	3.33	0.30	0.01	9.33
9/18/2018	7:59:11	-0.03	2.29	3.32	0.30	0.02	9.27
9/18/2018	7:59:21	-0.04	1.57	3.33	0.30	0.02	9.29
9/18/2018	7:59:31	-0.03	0.45	3.32	0.30	0.02	9.33
9/18/2018	7:59:41	-0.04	0.42	3.31	0.30	0.01	9.39
9/18/2018	7:59:51	-0.04	-0.24	10.75	0.30	0.02	45.77
9/18/2018	8:00:01	-0.05	-0.19	11.58	0.30	0.02	49.78
9/18/2018	8:00:11	-0.06	0.35	11.58	0.29	0.02	49.80
9/18/2018	8:00:21	-0.03	2.24	11.58	0.30	0.02	49.87
9/18/2018	8:00:31	-0.05	3.14	11.59	0.30	0.02	49.81
9/18/2018	8:00:41	-0.02	2.76	11.58	0.30	0.01	49.83
9/18/2018	8:00:51	-0.04	1.50	11.58	0.30	0.02	49.78
9/18/2018	8:01:01	-0.04	1.07	11.97	1.28	0.01	51.31
9/18/2018	8:01:11	-0.05	0.05	12.24	10.00	0.04	52.30
9/18/2018	8:01:21	-0.04	0.03	12.24	16.23	0.06	52.29
9/18/2018	8:01:31	-0.06	-0.39	12.24	18.86	0.06	52.32
9/18/2018	8:01:41	-0.03	-0.16	12.24	19.95	0.06	52.30
9/18/2018	8:01:51	-0.04	0.76	12.25	20.40	0.06	52.33
9/18/2018	8:02:01	-0.04	2.67	12.25	20.57	0.06	52.30
9/18/2018	8:02:11	-0.05	2.96	12.28	20.65	0.07	52.77
9/18/2018	8:02:21	-0.06	2.58	12.36	20.69	0.06	53.83
9/18/2018	8:02:31	-0.06	1.47	12.37	20.70	0.06	53.78
9/18/2018	8:02:41	-0.07	0.63	12.37	20.71	0.07	53.81
9/18/2018	8:02:51	-0.04	0.39	12.37	20.71	0.06	53.78
9/18/2018	8:03:01	-0.06	-0.09	12.37	20.71	0.07	53.86

Hollingsworth & Vose
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Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/18/2018	8:03:11	-0.05	-0.10	12.37	20.71	0.06	53.80
9/18/2018	8:03:21	-0.05	1.22	12.37	20.71	0.06	48.85
9/18/2018	8:03:31	-0.05	2.86	1.13	20.71	0.06	4.25
9/18/2018	8:03:41	-0.03	3.31	1.12	20.71	0.06	4.27
9/18/2018	8:03:51	-0.04	2.22	1.13	20.72	0.06	4.27
9/18/2018	8:04:01	-0.05	1.72	1.13	20.72	0.06	4.27
9/18/2018	8:04:11	-0.06	0.73	1.12	20.72	0.06	4.22
9/18/2018	8:04:21	-0.04	0.35	1.13	20.72	0.06	4.22
9/18/2018	8:04:31	-0.07	0.01	1.12	20.71	0.06	4.22
9/18/2018	8:04:41	-0.05	-0.16	0.66	20.72	0.06	3.29
9/18/2018	8:04:51	-0.07	1.00	0.47	20.72	0.06	2.88
9/18/2018	8:05:01	-0.06	2.87	0.46	20.72	0.06	2.83
		NOx [PPM]	**CO [PPM]**		**O2 [%]**	**CO2 [%]**	
System Zero		**0.26**	**-0.35**		**0.06**	**0.02**	
System Mid		**2.42**	**24.69**		**9.98**	**1.84**	

		M-106
VOC System	**VOC [PPM]**	**CH4 [PPM]**
System Zero	**0.34**	**0.23**
System low	**6.44**	
System Mid	**12.90**	
System High	**21.56**	**52.47**

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	9:45:15	1.15	5.63	2.09	19.88	1.02
9/18/2018	9:46:15	1.16	7.17	2.19	19.88	1.02
9/18/2018	9:47:15	1.16	6.58	2.30	19.87	1.03
9/18/2018	9:48:15	1.15	6.16	2.41	19.87	1.02
9/18/2018	9:49:15	1.16	7.00	2.29	19.87	1.01
9/18/2018	9:50:15	1.15	5.83	2.28	19.86	1.03
9/18/2018	9:51:15	1.15	6.82	2.22	19.88	1.02
9/18/2018	9:52:15	1.15	6.44	2.19	19.89	1.00
9/18/2018	9:53:15	1.16	5.88	2.28	19.90	1.01
9/18/2018	9:54:15	1.15	7.26	2.29	19.88	1.03
9/18/2018	9:55:15	1.16	6.03	2.29	19.88	1.03
9/18/2018	9:56:15	1.16	7.26	2.29	19.89	1.02
9/18/2018	9:57:15	1.16	6.69	2.29	19.87	1.04
9/18/2018	9:58:15	1.16	6.35	2.29	19.87	1.04
9/18/2018	9:59:15	1.35	7.27	2.29	19.87	1.03
9/18/2018	10:00:15	1.18	5.88	2.29	19.88	1.02
9/18/2018	10:01:15	1.17	6.95	2.19	19.88	1.04
9/18/2018	10:02:15	1.16	7.07	2.16	19.87	1.05
9/18/2018	10:03:15	1.16	5.99	2.19	19.88	1.04
9/18/2018	10:04:15	1.24	7.41	2.28	19.88	1.04
9/18/2018	10:05:15	1.32	6.32	2.28	19.87	1.04
9/18/2018	10:06:15	1.43	7.00	2.29	19.88	1.05
9/18/2018	10:07:15	1.45	7.25	2.36	19.88	1.04
9/18/2018	10:08:15	1.32	5.99	2.30	19.89	1.03
9/18/2018	10:09:15	1.38	7.53	2.18	19.87	1.03
9/18/2018	10:10:15	1.45	6.34	2.29	19.88	1.03
9/18/2018	10:11:15	1.44	7.10	2.29	19.88	1.03
9/18/2018	10:12:15	1.44	7.31	2.29	19.86	1.03
9/18/2018	10:13:15	1.43	5.97	2.28	19.87	1.03
9/18/2018	10:14:15	1.44	7.35	2.29	19.86	1.04
9/18/2018	10:15:15	1.45	6.57	2.29	19.88	1.02
9/18/2018	10:16:15	1.45	6.53	2.28	19.88	1.03
9/18/2018	10:17:15	1.46	7.24	2.40	19.87	1.04
9/18/2018	10:18:15	1.45	6.11	2.50	19.87	1.04
9/18/2018	10:19:15	1.46	7.17	2.54	19.87	1.05
9/18/2018	10:20:15	1.44	6.59	2.51	19.88	1.04
9/18/2018	10:21:15	1.28	6.31	2.41	19.89	1.04
9/18/2018	10:22:15	1.39	7.24	2.41	19.88	1.05
9/18/2018	10:23:15	1.42	5.76	2.52	19.89	1.04
9/18/2018	10:24:15	1.17	6.92	2.54	19.90	1.03
9/18/2018	10:25:15	1.25	6.70	2.49	19.90	1.04
9/18/2018	10:26:15	1.41	5.94	2.43	19.89	1.04

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	10:27:15	1.45	7.29	2.54	19.88	1.04
9/18/2018	10:28:15	1.36	5.94	2.54	19.90	1.03
9/18/2018	10:29:15	1.16	6.47	2.54	19.89	1.03
9/18/2018	10:30:15	1.34	6.84	2.41	19.87	1.03
9/18/2018	10:31:15	1.47	5.59	2.33	19.87	1.03
9/18/2018	10:32:15	1.45	7.02	2.41	19.86	1.03
9/18/2018	10:33:15	1.46	6.11	2.29	19.86	1.03
9/18/2018	10:34:15	1.45	6.01	2.29	19.86	1.02
9/18/2018	10:35:15	1.45	6.69	2.37	19.87	1.02
9/18/2018	10:36:15	1.45	5.64	2.42	19.87	1.03
9/18/2018	10:37:15	1.45	6.47	2.41	19.86	1.03
9/18/2018	10:38:15	1.45	6.24	2.42	19.88	1.02
9/18/2018	10:39:15	1.38	5.48	2.29	19.88	1.02
9/18/2018	10:40:15	1.43	6.94	2.29	19.87	1.03
9/18/2018	10:41:15	1.45	5.42	2.29	19.87	1.03
9/18/2018	10:42:15	1.44	6.60	2.29	19.88	1.02
9/18/2018	10:43:15	1.45	6.23	2.29	19.87	1.04
9/18/2018	10:44:15	1.45	5.47	2.29	19.87	1.04
9/18/2018	10:45:15	1.45	6.77	2.28	19.87	1.04
9/18/2018	10:46:15	1.44	5.60	2.29	19.88	1.04
9/18/2018	10:47:15	1.45	6.20	2.29	19.89	1.03
9/18/2018	10:48:15	1.45	6.16	2.29	19.88	1.03
9/18/2018	10:49:15	1.41	5.16	2.29	19.89	1.03
9/18/2018	10:50:15	1.41	6.66	2.29	19.87	1.04
9/18/2018	10:51:15	1.45	5.33	2.29	19.87	1.04
9/18/2018	10:52:15	1.45	6.16	2.36	19.88	1.02
9/18/2018	10:53:15	1.45	5.87	2.31	19.89	1.02
9/18/2018	10:54:15	1.42	5.39	2.18	19.89	1.03
9/18/2018	10:55:15	1.43	6.52	2.28	19.89	1.02
9/18/2018	10:56:15	1.18	5.25	2.41	19.90	1.02
9/18/2018	10:57:15	1.15	6.21	2.31	19.89	1.02
9/18/2018	10:58:15	1.34	5.99	2.29	19.88	1.02
9/18/2018	10:59:15	1.27	5.34	2.29	19.89	1.03
9/18/2018	11:00:15	1.35	6.69	2.30	19.88	1.03
9/18/2018	11:01:15	1.46	5.30	2.42	19.87	1.04
9/18/2018	11:02:15	1.46	6.19	2.30	19.87	1.03
9/18/2018	11:03:15	1.46	6.17	2.29	19.88	1.03
9/18/2018	11:04:15	1.47	5.31	2.29	19.87	1.05
9/18/2018	11:05:15	1.46	6.60	2.28	19.87	1.04
9/18/2018	11:06:15	1.46	5.13	2.29	19.87	1.05
9/18/2018	11:07:15	1.46	6.28	2.29	19.87	1.05
9/18/2018	11:08:15	1.45	5.81	2.39	19.88	1.04

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	11:09:15	1.45	5.50	2.34	19.87	1.06
9/18/2018	11:10:15	1.45	6.58	2.33	19.87	1.06
9/18/2018	11:11:15	1.37	5.14	2.41	19.88	1.04
9/18/2018	11:12:15	1.35	6.29	2.41	19.87	1.05
9/18/2018	11:13:15	1.45	5.63	2.41	19.87	1.05
9/18/2018	11:14:15	1.45	5.53	2.41	19.87	1.05
9/18/2018	11:15:15	1.44	6.27	2.47	19.88	1.05
9/18/2018	11:16:15	1.44	4.89	2.54	19.87	1.05
9/18/2018	11:17:15	1.45	6.49	2.53	19.88	1.04
9/18/2018	11:18:15	1.17	5.51	2.41	19.88	1.04
9/18/2018	11:19:15	1.26	5.79	2.41	19.88	1.04
9/18/2018	11:20:15	1.16	6.21	2.49	19.89	1.03
9/18/2018	11:21:15	1.15	5.29	2.59	19.89	1.03
9/18/2018	11:22:15	1.15	6.60	2.62	19.87	1.04
9/18/2018	11:23:15	1.28	5.53	2.40	19.86	1.05
9/18/2018	11:24:15	1.45	5.75	2.28	19.87	1.05
9/18/2018	11:25:15	1.44	6.36	2.28	19.88	1.03
9/18/2018	11:26:15	1.44	5.11	2.28	19.87	1.04
9/18/2018	11:27:15	1.43	6.57	2.28	19.87	1.05
9/18/2018	11:28:15	1.45	6.00	2.28	19.87	1.03
9/18/2018	11:29:15	1.43	5.38	2.28	19.87	1.05
9/18/2018	11:30:15	1.44	6.80	2.17	19.86	1.06
9/18/2018	11:31:15	1.44	5.57	2.24	19.87	1.06
9/18/2018	11:32:15	1.40	6.03	2.34	19.90	1.04
9/18/2018	11:33:15	1.42	6.84	2.37	19.89	1.05
9/18/2018	11:34:15	1.25	5.45	2.28	19.91	1.04
9/18/2018	11:35:15	1.27	6.81	2.28	19.90	1.04
9/18/2018	11:36:15	1.25	6.16	2.28	19.91	1.03
9/18/2018	11:37:15	1.15	5.38	2.28	19.91	1.04
9/18/2018	11:38:15	1.22	6.52	2.28	19.89	1.05
9/18/2018	11:39:15	1.36	6.18	2.28	19.91	1.04
9/18/2018	11:40:15	1.37	5.36	2.28	19.88	1.06
9/18/2018	11:41:15	1.43	6.51	2.28	19.87	1.05
9/18/2018	11:42:15	1.43	6.44	2.28	19.88	1.04
9/18/2018	11:43:15	1.43	5.24	2.28	19.87	1.04
9/18/2018	11:44:15	1.43	6.64	2.24	19.88	1.04
9/18/2018	11:45:15	1.43	6.02	2.16	19.87	1.04
9/18/2018	11:46:15	1.43	5.67	2.28	19.87	1.05
9/18/2018	11:47:15	1.42	6.59	2.17	19.88	1.04
9/18/2018	11:48:15	1.44	5.80	2.23	19.89	1.04
9/18/2018	11:49:15	1.43	5.65	2.34	19.89	1.04
9/18/2018	11:50:15	1.44	6.71	2.36	19.88	1.04

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	11:51:15	1.44	6.01	2.15	19.88	1.05
9/18/2018	11:52:15	1.44	5.73	2.41	19.89	1.04
9/18/2018	11:53:15	1.44	6.65	2.31	19.88	1.05
9/18/2018	11:54:15	1.43	5.81	2.28	19.88	1.05
Final Average		**1.36**	**6.22**	**2.33**	**19.88**	**1.04**

	O2 [%]
Stratification Check	**19.87**
	19.88
	19.88

Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	11:55:55	1.43	4.90	2.28	19.87	1.06
9/18/2018	11:56:05	1.44	4.92	2.28	19.83	1.05
9/18/2018	11:56:15	1.42	5.76	2.28	19.90	1.05
9/18/2018	11:56:25	1.45	7.48	2.28	15.98	0.83
9/18/2018	11:56:35	1.43	7.59	2.28	7.33	0.39
9/18/2018	11:56:45	1.44	5.77	2.28	4.34	0.18
9/18/2018	11:56:55	1.26	3.34	2.27	3.29	0.09
9/18/2018	11:57:05	0.73	1.49	2.19	2.88	0.05
9/18/2018	11:57:15	0.55	0.05	2.15	2.73	0.04
9/18/2018	11:57:25	0.55	-0.86	2.15	2.66	0.03
9/18/2018	11:57:35	0.54	-1.14	2.15	2.63	0.02
9/18/2018	11:57:45	0.54	-0.43	2.16	2.62	0.02
9/18/2018	11:57:55	0.53	0.76	2.15	2.63	0.02
9/18/2018	11:58:05	0.33	2.08	2.16	2.62	0.02
9/18/2018	11:58:15	0.24	1.60	4.96	2.62	0.01
9/18/2018	11:58:25	0.25	0.78	9.17	2.62	0.02
9/18/2018	11:58:35	0.25	-0.27	9.16	2.63	0.03
9/18/2018	11:58:45	0.25	-0.60	9.16	2.62	0.02
9/18/2018	11:58:55	0.26	-1.02	9.16	2.62	0.02
9/18/2018	11:59:05	0.26	-1.17	9.16	2.62	0.02
9/18/2018	11:59:15	0.27	-0.79	9.17	2.62	0.02
9/18/2018	11:59:25	0.27	0.62	9.48	2.63	0.02
9/18/2018	11:59:35	0.24	1.76	12.26	2.62	0.02
9/18/2018	11:59:45	0.25	1.41	12.25	2.62	0.02
9/18/2018	11:59:55	0.26	0.78	12.25	2.62	0.02
9/18/2018	12:00:05	0.25	-0.07	12.25	2.62	0.02
9/18/2018	12:00:15	0.25	-0.74	12.24	2.62	0.02
9/18/2018	12:00:25	0.25	-1.00	12.25	2.62	0.02
9/18/2018	12:00:35	0.26	-1.22	12.24	2.62	0.02
9/18/2018	12:00:45	0.22	-1.03	12.55	2.97	0.03

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	12:00:55	0.04	0.72	12.62	9.27	0.47
9/18/2018	12:01:05	-0.06	2.12	12.62	8.07	0.71
9/18/2018	12:01:15	0.16	2.48	12.62	4.51	1.24
9/18/2018	12:01:25	0.44	1.79	12.62	2.97	1.59
9/18/2018	12:01:35	0.75	0.84	12.63	2.37	1.73
9/18/2018	12:01:45	1.07	-0.34	12.62	2.14	1.78
9/18/2018	12:01:55	1.13	-1.38	12.70	2.04	1.80
9/18/2018	12:02:05	0.95	-1.68	12.77	2.01	1.81
9/18/2018	12:02:15	0.87	-1.26	12.77	1.99	1.81
9/18/2018	12:02:25	0.86	0.29	12.77	1.99	1.81
9/18/2018	12:02:35	0.63	1.34	12.77	1.98	1.82
9/18/2018	12:02:45	0.53	0.64	12.77	1.98	1.82
9/18/2018	12:02:55	0.53	-0.29	12.77	1.98	1.82
9/18/2018	12:03:05	0.54	-0.99	11.11	1.98	1.83
9/18/2018	12:03:15	0.55	-1.64	4.52	1.98	1.82
9/18/2018	12:03:25	0.54	-1.96	4.52	1.98	1.83
9/18/2018	12:03:35	0.53	-1.87	4.52	1.98	1.82
9/18/2018	12:03:45	0.33	-0.79	4.52	2.00	1.82
9/18/2018	12:03:55	0.24	0.73	4.51	4.11	3.55
9/18/2018	12:04:05	0.23	1.23	4.52	7.61	7.38
9/18/2018	12:04:15	0.24	0.78	4.52	9.02	8.76
9/18/2018	12:04:25	0.24	-0.26	1.34	9.58	9.33
9/18/2018	12:04:35	0.24	-0.85	0.99	9.80	9.57
9/18/2018	12:04:45	0.22	-1.46	1.01	9.88	9.67
9/18/2018	12:04:55	0.03	-2.39	1.00	9.92	9.71
9/18/2018	12:05:05	-0.05	-2.59	1.00	9.94	9.73
9/18/2018	12:05:15	-0.06	-1.13	0.99	9.95	9.74
9/18/2018	12:05:25	-0.06	0.13	1.01	9.95	9.75
9/18/2018	12:05:35	-0.06	0.06	0.92	9.95	9.76
9/18/2018	12:05:45	-0.04	-0.81	0.87	9.95	9.75
9/18/2018	12:05:55	-0.05	-1.80	0.85	9.96	9.76
9/18/2018	12:06:05	-0.06	-2.42	0.87	9.96	9.77
9/18/2018	12:06:15	-0.04	-2.88	0.86	9.96	9.77
9/18/2018	12:06:25	-0.05	-2.78	0.86	9.96	9.77
9/18/2018	12:06:35	-0.04	-2.70	0.87	9.95	9.77
9/18/2018	12:06:45	-0.04	-0.96	0.74	11.63	8.23
9/18/2018	12:06:55	-0.04	0.44	0.47	15.88	4.51
9/18/2018	12:07:05	-0.03	1.14	0.47	11.05	2.96
9/18/2018	12:07:15	0.16	1.85	0.47	4.79	1.43
9/18/2018	12:07:25	0.68	1.66	0.47	2.08	0.73
9/18/2018	12:07:35	0.63	0.91	0.46	0.89	0.36
9/18/2018	12:07:45	0.53	0.27	0.47	0.41	0.19

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	12:07:55	0.54	0.75	0.47	0.21	0.11
9/18/2018	12:08:05	0.75	2.47	0.19	0.13	0.08
9/18/2018	12:08:15	1.07	3.83	0.19	0.09	0.05
9/18/2018	12:08:25	1.13	3.76	0.20	0.07	0.06
9/18/2018	12:08:35	1.35	3.05	0.19	0.06	0.05
9/18/2018	12:08:45	1.94	2.01	0.20	0.06	0.04
9/18/2018	12:08:55	2.12	1.72	0.19	0.06	0.04
9/18/2018	12:09:05	2.34	1.06	0.20	0.06	0.03
9/18/2018	12:09:15	2.41	0.95	0.85	0.05	0.04
9/18/2018	12:09:25	2.40	1.63	1.12	0.05	0.03
9/18/2018	12:09:35	2.41	3.06	1.13	0.05	0.03
9/18/2018	12:09:45	2.41	4.29	1.12	0.05	0.03
9/18/2018	12:09:55	2.41	3.99	1.12	0.05	0.03
9/18/2018	12:10:05	2.42	3.07	1.12	0.05	0.02
9/18/2018	12:10:15	2.41	2.00	1.13	0.05	0.02
9/18/2018	12:10:25	2.41	1.54	0.76	0.05	0.02
9/18/2018	12:10:35	2.41	1.18	0.20	0.05	0.02
9/18/2018	12:10:45	2.44	0.95	0.19	0.15	0.02
9/18/2018	12:10:55	2.43	2.40	0.20	1.00	0.23
9/18/2018	12:11:05	2.44	5.80	0.20	0.55	0.13
9/18/2018	12:11:15	3.58	6.83	0.18	0.25	0.06
9/18/2018	12:11:25	6.05	12.20	0.19	0.13	0.03
9/18/2018	12:11:35	12.45	17.45	0.20	0.08	0.03
9/18/2018	12:11:45	21.39	20.84	0.19	0.06	0.02
9/18/2018	12:11:55	25.21	22.56	0.19	0.06	0.02
9/18/2018	12:12:05	26.78	23.32	0.19	0.05	0.01
9/18/2018	12:12:15	27.39	24.05	0.19	0.05	0.02
9/18/2018	12:12:25	27.64	24.99	0.20	0.05	0.02
9/18/2018	12:12:35	27.72	25.59	0.19	0.05	0.01
9/18/2018	12:12:45	27.71	25.54	0.19	0.05	0.01
9/18/2018	12:12:55	27.71	25.00	0.62	0.05	0.01
9/18/2018	12:13:05	27.61	24.63	0.72	0.11	0.01
9/18/2018	12:13:15	27.67	24.24	0.73	6.27	0.39
9/18/2018	12:13:25	27.72	22.86	0.72	14.05	0.81
9/18/2018	12:13:35	24.30	19.03	0.73	17.49	0.96
9/18/2018	12:13:45	20.21	14.16	0.73	18.89	1.03
9/18/2018	12:13:55	14.30	10.29	0.73	19.45	1.05
9/18/2018	12:14:05	6.88	7.40	0.46	19.68	1.06
9/18/2018	12:14:15	3.57	5.39	0.18	19.77	1.08
9/18/2018	12:14:25	1.99	3.94	0.19	19.81	1.07
9/18/2018	12:14:35	1.30	3.20	0.19	19.82	1.08
9/18/2018	12:14:45	0.99	2.82	0.20	19.83	1.08

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	**Time**	**NOx [PPM]**	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
9/18/2018	12:14:55	0.91	2.55	0.19	19.83	1.08
		NOx [PPM]	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
System Zero		**-0.05**	**-1.68**	**0.20**	**0.05**	**0.01**
System Mid		**2.42**	**25.05**	**12.62**	**9.96**	**1.83**

Hollingsworth & Vose
CFU-113
Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	12:15:15	1.43	6.99	1.77	19.86	1.08
9/18/2018	12:16:15	1.44	6.49	2.19	19.87	1.08
9/18/2018	12:17:15	1.43	5.85	2.39	19.86	1.09
9/18/2018	12:18:15	1.43	6.92	2.54	19.86	1.10
9/18/2018	12:19:15	1.42	6.76	2.54	19.86	1.10
9/18/2018	12:20:15	1.44	5.93	2.54	19.88	1.08
9/18/2018	12:21:15	1.42	6.44	2.54	19.88	1.10
9/18/2018	12:22:15	1.41	6.95	2.47	19.86	1.10
9/18/2018	12:23:15	1.44	6.27	2.46	19.87	1.10
9/18/2018	12:24:15	1.43	6.18	2.54	19.88	1.10
9/18/2018	12:25:15	1.42	7.16	2.54	19.90	1.08
9/18/2018	12:26:15	1.43	6.59	2.54	19.90	1.08
9/18/2018	12:27:15	1.42	5.92	2.63	19.90	1.08
9/18/2018	12:28:15	1.42	6.95	2.60	19.90	1.08
9/18/2018	12:29:15	1.21	6.83	2.54	19.90	1.08
9/18/2018	12:30:15	1.42	5.85	2.54	19.88	1.08
9/18/2018	12:31:15	1.43	6.90	2.54	19.88	1.08
9/18/2018	12:32:15	1.42	7.05	2.65	19.87	1.08
9/18/2018	12:33:15	1.43	6.05	2.59	19.89	1.06
9/18/2018	12:34:15	1.42	6.55	2.44	19.87	1.09
9/18/2018	12:35:15	1.43	7.32	2.29	19.89	1.08
9/18/2018	12:36:15	1.42	6.52	2.28	19.89	1.08
9/18/2018	12:37:15	1.43	6.28	2.28	19.89	1.08
9/18/2018	12:38:15	1.40	7.46	2.28	19.91	1.08
9/18/2018	12:39:15	1.32	6.86	2.28	19.87	1.11
9/18/2018	12:40:15	1.43	6.14	2.32	19.85	1.11
9/18/2018	12:41:15	1.42	7.10	2.41	19.87	1.10
9/18/2018	12:42:15	1.42	7.16	2.41	19.87	1.11
9/18/2018	12:43:15	1.42	6.28	2.30	19.87	1.10
9/18/2018	12:44:15	1.44	6.48	2.37	19.88	1.10
9/18/2018	12:45:15	1.43	7.45	2.41	19.86	1.11
9/18/2018	12:46:15	1.42	6.81	2.39	19.85	1.12
9/18/2018	12:47:15	1.44	6.14	2.28	19.88	1.10
9/18/2018	12:48:15	1.43	7.09	2.15	19.87	1.11
9/18/2018	12:49:15	1.43	7.06	2.25	19.85	1.11
9/18/2018	12:50:15	1.44	6.18	2.28	19.86	1.11
9/18/2018	12:51:15	1.42	6.56	2.28	19.87	1.10
9/18/2018	12:52:15	1.42	7.08	2.28	19.86	1.11
9/18/2018	12:53:15	1.42	6.56	2.28	19.86	1.10
9/18/2018	12:54:15	1.41	6.14	2.40	19.85	1.10
9/18/2018	12:55:15	1.41	7.31	2.32	19.86	1.10
9/18/2018	12:56:15	1.41	6.81	2.35	19.86	1.09

Hollingsworth & Vose
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Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	12:57:15	1.42	6.24	2.41	19.87	1.09
9/18/2018	12:58:15	1.42	7.07	2.40	19.88	1.08
9/18/2018	12:59:15	1.43	7.25	2.28	19.86	1.09
9/18/2018	13:00:15	1.43	6.03	2.28	19.86	1.08
9/18/2018	13:01:15	1.42	6.79	2.28	19.86	1.08
9/18/2018	13:02:15	1.42	7.19	2.34	19.86	1.09
9/18/2018	13:03:15	1.43	6.46	2.38	19.85	1.10
9/18/2018	13:04:15	1.42	6.39	2.28	19.86	1.09
9/18/2018	13:05:15	1.43	7.12	2.28	19.86	1.11
9/18/2018	13:06:15	1.43	6.83	2.29	19.85	1.12
9/18/2018	13:07:15	1.44	6.01	2.28	19.86	1.11
9/18/2018	13:08:15	1.43	7.08	2.28	19.87	1.11
9/18/2018	13:09:15	1.43	6.91	2.29	19.86	1.11
9/18/2018	13:10:15	1.43	5.96	2.28	19.85	1.12
9/18/2018	13:11:15	1.43	6.74	2.40	19.86	1.11
9/18/2018	13:12:15	1.43	7.01	2.41	19.88	1.10
9/18/2018	13:13:15	1.43	5.93	2.41	19.87	1.10
9/18/2018	13:14:15	1.43	6.70	2.41	19.85	1.12
9/18/2018	13:15:15	1.43	6.94	2.41	19.85	1.11
9/18/2018	13:16:15	1.44	5.92	2.41	19.84	1.11
9/18/2018	13:17:15	1.44	6.64	2.31	19.84	1.11
9/18/2018	13:18:15	1.43	6.97	2.28	19.84	1.10
9/18/2018	13:19:15	1.44	5.85	2.29	19.85	1.10
9/18/2018	13:20:15	1.43	6.60	2.29	19.86	1.10
9/18/2018	13:21:15	1.43	7.10	2.29	19.84	1.11
9/18/2018	13:22:15	1.43	5.85	2.40	19.85	1.09
9/18/2018	13:23:15	1.43	6.65	2.22	19.84	1.10
9/18/2018	13:24:15	1.44	7.14	2.22	19.85	1.10
9/18/2018	13:25:15	1.45	6.01	2.32	19.85	1.10
9/18/2018	13:26:15	1.44	7.13	2.40	19.85	1.10
9/18/2018	13:27:15	1.44	7.00	2.28	19.84	1.11
9/18/2018	13:28:15	1.44	6.03	2.40	19.84	1.11
9/18/2018	13:29:15	1.44	7.24	2.41	19.84	1.11
9/18/2018	13:30:15	1.45	6.53	2.41	19.85	1.11
9/18/2018	13:31:15	1.44	6.10	2.39	19.85	1.12
9/18/2018	13:32:15	1.42	7.01	2.29	19.88	1.09
9/18/2018	13:33:15	1.34	5.64	2.41	19.87	1.09
9/18/2018	13:34:15	1.45	6.44	2.42	19.85	1.11
9/18/2018	13:35:15	1.46	6.71	2.35	19.85	1.10
9/18/2018	13:36:15	1.45	5.55	2.33	19.85	1.10
9/18/2018	13:37:15	1.45	6.95	2.42	19.83	1.11
9/18/2018	13:38:15	1.44	6.28	2.42	19.84	1.10

Hollingsworth & Vose
CFU-113
Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	13:39:15	1.45	5.81	2.41	19.84	1.10
9/18/2018	13:40:15	1.45	6.95	2.41	19.83	1.10
9/18/2018	13:41:15	1.45	5.79	2.41	19.84	1.10
9/18/2018	13:42:15	1.45	6.39	2.38	19.84	1.09
9/18/2018	13:43:15	1.47	6.52	2.29	19.84	1.09
9/18/2018	13:44:15	1.45	5.44	2.41	19.84	1.09
9/18/2018	13:45:15	1.45	6.87	2.42	19.86	1.07
9/18/2018	13:46:15	1.45	6.06	2.33	19.84	1.08
9/18/2018	13:47:15	1.45	5.91	2.33	19.86	1.07
9/18/2018	13:48:15	1.45	6.69	2.41	19.84	1.08
9/18/2018	13:49:15	1.45	5.37	2.41	19.84	1.09
9/18/2018	13:50:15	1.46	6.59	2.41	19.84	1.09
9/18/2018	13:51:15	1.45	6.07	2.31	19.86	1.07
9/18/2018	13:52:15	1.32	5.59	2.28	19.88	1.07
9/18/2018	13:53:15	1.34	6.88	2.28	19.85	1.09
9/18/2018	13:54:15	1.47	5.40	2.31	19.85	1.09
9/18/2018	13:55:15	1.45	6.59	2.54	19.85	1.09
9/18/2018	13:56:15	1.44	6.03	2.42	19.84	1.09
9/18/2018	13:57:15	1.45	5.86	2.41	19.84	1.09
9/18/2018	13:58:15	1.45	6.69	2.47	19.85	1.09
9/18/2018	13:59:15	1.45	5.40	2.52	19.87	1.08
9/18/2018	14:00:15	1.46	6.95	2.41	19.85	1.09
9/18/2018	14:01:15	1.46	5.46	2.41	19.83	1.09
9/18/2018	14:02:15	1.47	6.46	2.41	19.84	1.09
9/18/2018	14:03:15	1.46	6.39	2.42	19.83	1.09
9/18/2018	14:04:15	1.46	5.64	2.41	19.84	1.08
9/18/2018	14:05:15	1.46	6.86	2.41	19.85	1.08
9/18/2018	14:06:15	1.46	5.29	2.41	19.85	1.08
9/18/2018	14:07:15	1.46	6.95	2.41	19.83	1.07
9/18/2018	14:08:15	1.46	6.19	2.41	19.85	1.07
9/18/2018	14:09:15	1.45	6.40	2.41	19.86	1.06
9/18/2018	14:10:15	1.45	6.69	2.44	19.84	1.07
9/18/2018	14:11:15	1.38	5.85	2.54	19.85	1.06
9/18/2018	14:12:15	1.21	6.86	2.54	19.85	1.07
9/18/2018	14:13:15	1.46	5.19	2.54	19.82	1.09
9/18/2018	14:14:15	1.46	6.90	2.47	19.83	1.07
9/18/2018	14:15:15	1.45	5.19	2.42	19.83	1.06
9/18/2018	14:16:15	1.47	6.36	2.41	19.83	1.06
9/18/2018	14:17:15	1.47	5.33	2.42	19.84	1.06
9/18/2018	14:18:15	1.47	6.15	2.29	19.83	1.08
9/18/2018	14:19:15	1.45	6.17	2.39	19.82	1.09
9/18/2018	14:20:15	1.45	5.49	2.41	19.84	1.08

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	14:21:15	1.37	6.52	2.37	19.18	1.03
9/18/2018	14:22:15	1.62	3.03	2.30	3.70	0.13
9/18/2018	14:23:15	0.35	0.28	2.41	2.62	0.02
Final Average		**1.42**	**6.38**	**2.38**	**19.59**	**1.08**
Bias Check						
9/18/2018	14:23:35	0.27	1.39	2.41	2.61	0.02
9/18/2018	14:23:45	0.25	1.05	2.42	2.62	0.03
9/18/2018	14:23:55	0.28	0.13	2.41	2.62	0.03
9/18/2018	14:24:05	0.27	-0.79	2.41	2.62	0.02
9/18/2018	14:24:15	0.27	-0.96	5.11	2.62	0.02
9/18/2018	14:24:25	0.28	-1.28	9.16	2.62	0.02
9/18/2018	14:24:35	0.28	-1.61	9.17	2.62	0.02
9/18/2018	14:24:45	0.25	-1.70	9.17	2.62	0.01
9/18/2018	14:24:55	0.08	-1.32	9.16	2.62	0.01
9/18/2018	14:25:05	-0.02	0.06	9.17	2.62	0.01
9/18/2018	14:25:15	-0.03	1.31	9.17	2.62	0.01
9/18/2018	14:25:25	-0.04	0.98	9.45	2.62	0.02
9/18/2018	14:25:35	-0.02	-0.16	12.09	2.62	0.02
9/18/2018	14:25:45	-0.03	-0.81	12.09	2.62	0.00
9/18/2018	14:25:55	-0.02	-1.39	12.08	2.62	0.01
9/18/2018	14:26:05	-0.04	-1.62	12.09	2.61	0.01
9/18/2018	14:26:15	-0.04	-1.67	12.09	2.62	0.01
9/18/2018	14:26:25	-0.02	-1.72	12.09	2.62	0.01
9/18/2018	14:26:35	-0.03	-1.32	12.08	2.62	0.02
9/18/2018	14:26:45	-0.03	0.45	12.41	2.62	0.01
9/18/2018	14:26:55	-0.03	0.94	12.51	2.61	0.01
9/18/2018	14:27:05	-0.04	0.54	12.50	2.87	0.03
9/18/2018	14:27:15	-0.04	-0.02	12.50	8.13	0.41
9/18/2018	14:27:25	-0.05	-0.32	12.51	6.26	0.87
9/18/2018	14:27:35	0.15	-0.22	12.51	3.69	1.40
9/18/2018	14:27:45	0.43	-0.44	12.50	2.64	1.65
9/18/2018	14:27:55	0.55	-0.51	12.56	2.24	1.74
9/18/2018	14:28:05	0.54	-1.25	12.64	2.07	1.78
9/18/2018	14:28:15	0.55	-1.38	12.63	2.01	1.80
9/18/2018	14:28:25	0.55	-0.26	12.63	1.99	1.80
9/18/2018	14:28:35	0.56	1.05	12.63	1.98	1.80
9/18/2018	14:28:45	0.37	0.44	12.62	1.98	1.80
9/18/2018	14:28:55	0.26	-0.53	12.63	1.97	1.82
9/18/2018	14:29:05	0.26	-1.34	11.59	1.97	1.81
9/18/2018	14:29:15	0.27	-1.75	7.46	1.97	1.81
9/18/2018	14:29:25	0.24	-2.24	7.47	1.97	1.80

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	14:29:35	0.24	-2.24	7.47	1.96	1.81
9/18/2018	14:29:45	0.26	-2.21	7.46	2.11	1.80
9/18/2018	14:29:55	0.25	-1.56	7.46	5.07	4.61
9/18/2018	14:30:05	0.25	-0.05	7.47	8.07	7.83
9/18/2018	14:30:15	0.25	0.82	7.47	9.19	8.94
9/18/2018	14:30:25	0.25	0.45	1.65	9.63	9.40
9/18/2018	14:30:35	0.26	-0.47	0.99	9.81	9.58
9/18/2018	14:30:45	0.07	-1.90	1.01	9.88	9.66
9/18/2018	14:30:55	-0.03	-1.49	1.00	9.91	9.70
9/18/2018	14:31:05	-0.05	-2.09	1.00	9.92	9.72
9/18/2018	14:31:15	-0.04	-2.59	1.01	9.93	9.73
9/18/2018	14:31:25	-0.04	-3.13	1.01	9.93	9.73
9/18/2018	14:31:35	-0.04	-2.09	0.91	9.93	9.75
9/18/2018	14:31:45	-0.04	-0.47	0.87	9.94	9.73
9/18/2018	14:31:55	-0.02	-0.63	0.88	12.09	7.44
9/18/2018	14:32:05	-0.04	-1.12	0.87	8.03	4.03
9/18/2018	14:32:15	0.14	-0.67	0.87	3.48	1.76
9/18/2018	14:32:25	0.25	-0.70	0.86	1.47	0.83
9/18/2018	14:32:35	0.25	-0.40	0.87	0.63	0.39
9/18/2018	14:32:45	0.42	-0.15	0.75	0.29	0.20
9/18/2018	14:32:55	0.74	-0.45	0.47	0.16	0.11
9/18/2018	14:33:05	1.03	0.27	0.47	0.10	0.08
9/18/2018	14:33:15	1.32	2.29	0.48	0.07	0.06
9/18/2018	14:33:25	1.65	3.67	0.47	0.06	0.05
9/18/2018	14:33:35	1.83	3.24	0.47	0.06	0.04
9/18/2018	14:33:45	2.01	2.50	0.47	0.05	0.03
9/18/2018	14:33:55	2.31	1.88	0.47	0.05	0.03
9/18/2018	14:34:05	2.45	1.17	0.72	0.05	0.03
9/18/2018	14:34:15	2.44	0.72	0.73	0.05	0.02
9/18/2018	14:34:25	2.45	0.65	0.73	0.05	0.02
9/18/2018	14:34:35	2.44	0.78	0.74	0.05	0.03
9/18/2018	14:34:45	2.43	1.72	0.73	0.05	0.02
9/18/2018	14:34:55	2.44	3.42	0.73	0.05	0.02
9/18/2018	14:35:05	2.44	3.64	0.73	0.05	0.03
9/18/2018	14:35:15	2.45	3.05	0.46	0.04	0.02
9/18/2018	14:35:25	2.43	2.22	0.34	0.69	0.13
9/18/2018	14:35:35	2.41	2.43	0.35	0.75	0.19
9/18/2018	14:35:45	2.23	7.01	0.34	0.33	0.09
9/18/2018	14:35:55	5.85	8.61	0.35	0.16	0.05
9/18/2018	14:36:05	13.20	14.46	0.34	0.09	0.02
9/18/2018	14:36:15	18.67	19.28	0.34	0.06	0.03
9/18/2018	14:36:25	23.67	22.73	0.39	0.05	0.02

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Date	**Time**	**NOx [PPM]**	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
9/18/2018	14:36:35	26.36	24.51	0.47	0.05	0.01
9/18/2018	14:36:45	27.23	24.89	0.47	0.04	0.01
9/18/2018	14:36:55	27.67	24.58	0.48	0.04	0.02
9/18/2018	14:37:05	27.71	24.28	0.47	0.04	0.02
9/18/2018	14:37:15	27.73	24.05	0.47	0.04	0.02
9/18/2018	14:37:25	27.71	23.81	0.47	0.04	0.01
9/18/2018	14:37:35	27.72	23.74	0.46	0.04	0.01
9/18/2018	14:37:45	27.72	23.86	0.34	0.04	0.01
9/18/2018	14:37:55	27.72	24.62	0.34	0.05	0.01
9/18/2018	14:38:05	27.72	25.34	0.34	5.19	0.33
9/18/2018	14:38:15	27.72	24.19	0.34	13.51	0.78
9/18/2018	14:38:25	28.17	20.11	0.33	17.27	0.95
9/18/2018	14:38:35	22.94	14.63	0.34	18.78	1.02
9/18/2018	14:38:45	13.72	9.48	0.33	19.38	1.05
9/18/2018	14:38:55	7.92	6.00	0.11	19.62	1.06
9/18/2018	14:39:05	8.08	7.93	0.07	19.72	1.06
9/18/2018	14:39:15	4.09	6.03	0.06	19.77	1.06
9/18/2018	14:39:25	2.73	5.91	0.07	19.79	1.06
9/18/2018	14:39:35	2.15	6.95	0.06	19.81	1.07
9/18/2018	14:39:45	1.96	7.99	0.07	19.82	1.07
9/18/2018	14:39:55	1.80	7.54	0.07	19.82	1.07
9/18/2018	14:40:05	1.60	6.63	1.04	19.82	1.07
		NOx [PPM]	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
System Zero		**-0.04**	**-2.06**	**0.34**	**0.05**	**0.02**
System Mid		**2.44**	**24.71**	**12.50**	**9.92**	**1.81**

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	14:41:15	1.44	6.77	2.14	19.83	1.08
9/18/2018	14:42:15	1.44	6.34	2.32	19.82	1.09
9/18/2018	14:43:15	1.43	5.52	2.41	19.86	1.06
9/18/2018	14:44:15	1.44	6.87	2.39	19.87	1.06
9/18/2018	14:45:15	1.32	5.75	2.28	19.87	1.06
9/18/2018	14:46:15	1.37	6.14	2.41	19.85	1.07
9/18/2018	14:47:15	1.44	6.91	2.51	19.85	1.08
9/18/2018	14:48:15	1.44	6.09	2.55	19.86	1.07
9/18/2018	14:49:15	1.43	6.50	2.54	19.86	1.06
9/18/2018	14:50:15	1.44	6.71	2.54	19.85	1.07
9/18/2018	14:51:15	1.43	5.80	2.54	19.84	1.07
9/18/2018	14:52:15	1.44	6.20	2.54	19.84	1.06
9/18/2018	14:53:15	1.44	6.71	2.45	19.84	1.06
9/18/2018	14:54:15	1.44	5.70	2.41	19.83	1.06
9/18/2018	14:55:15	1.45	6.43	2.38	19.85	1.04
9/18/2018	14:56:15	1.43	6.55	2.29	19.85	1.03
9/18/2018	14:57:15	1.45	5.59	2.41	19.87	1.03
9/18/2018	14:58:15	1.44	6.53	2.42	19.88	1.03
9/18/2018	14:59:15	1.45	6.76	2.34	19.86	1.05
9/18/2018	15:00:15	1.45	5.34	2.33	19.86	1.05
9/18/2018	15:01:15	1.44	6.44	2.42	19.86	1.05
9/18/2018	15:02:15	1.45	6.41	2.41	19.85	1.06
9/18/2018	15:03:15	1.45	5.42	2.42	19.84	1.06
9/18/2018	15:04:15	1.45	6.38	2.41	19.86	1.05
9/18/2018	15:05:15	1.44	6.27	2.41	19.85	1.06
9/18/2018	15:06:15	1.43	5.57	2.37	19.84	1.07
9/18/2018	15:07:15	1.43	6.58	2.30	19.87	1.06
9/18/2018	15:08:15	1.44	6.57	2.41	19.84	1.06
9/18/2018	15:09:15	1.44	5.65	2.52	19.84	1.06
9/18/2018	15:10:15	1.44	6.49	2.46	19.86	1.05
9/18/2018	15:11:15	1.43	6.71	2.47	19.87	1.05
9/18/2018	15:12:15	1.42	5.61	2.54	19.86	1.05
9/18/2018	15:13:15	1.44	6.10	2.54	19.85	1.05
9/18/2018	15:14:15	1.43	6.54	2.41	19.85	1.05
9/18/2018	15:15:15	1.43	5.54	2.41	19.85	1.05
9/18/2018	15:16:15	1.42	6.00	2.41	19.87	1.03
9/18/2018	15:17:15	1.43	6.55	2.41	19.86	1.04
9/18/2018	15:18:15	1.43	5.56	2.41	19.85	1.04
9/18/2018	15:19:15	1.43	5.87	2.41	19.87	1.03
9/18/2018	15:20:15	1.43	6.61	2.41	19.87	1.04
9/18/2018	15:21:15	1.42	5.82	2.51	19.86	1.04
9/18/2018	15:22:15	1.42	5.91	2.54	19.85	1.05

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	15:23:15	1.41	6.66	2.55	19.87	1.03
9/18/2018	15:24:15	1.43	6.00	2.55	19.85	1.05
9/18/2018	15:25:15	1.43	5.91	2.67	19.85	1.04
9/18/2018	15:26:15	1.42	6.73	2.67	19.84	1.05
9/18/2018	15:27:15	1.43	5.95	2.67	19.87	1.03
9/18/2018	15:28:15	1.44	5.77	2.62	19.85	1.06
9/18/2018	15:29:15	1.42	6.45	2.54	19.85	1.04
9/18/2018	15:30:15	1.43	6.28	2.54	19.86	1.04
9/18/2018	15:31:15	1.42	5.73	2.42	19.87	1.03
9/18/2018	15:32:15	1.42	6.72	2.51	19.86	1.05
9/18/2018	15:33:15	1.42	6.57	2.62	19.85	1.05
9/18/2018	15:34:15	1.44	5.42	2.63	19.83	1.04
9/18/2018	15:35:15	1.43	6.26	2.54	19.85	1.03
9/18/2018	15:36:15	1.43	6.45	2.54	19.86	1.02
9/18/2018	15:37:15	1.44	5.59	2.43	19.88	1.01
9/18/2018	15:38:15	1.44	6.37	2.41	19.87	1.03
9/18/2018	15:39:15	1.43	7.10	2.48	19.85	1.04
9/18/2018	15:40:15	1.42	6.35	2.54	19.86	1.03
9/18/2018	15:41:15	1.42	6.87	2.55	19.86	1.04
9/18/2018	15:42:15	1.43	7.73	2.82	19.85	1.04
9/18/2018	15:43:15	1.41	6.68	2.70	19.83	1.04
9/18/2018	15:44:15	1.43	6.07	2.75	19.83	1.05
9/18/2018	15:45:15	1.43	6.94	2.76	19.85	1.03
9/18/2018	15:46:15	1.43	6.27	2.65	19.85	1.03
9/18/2018	15:47:15	1.43	5.37	2.55	19.85	1.04
9/18/2018	15:48:15	1.43	6.68	2.55	19.83	1.04
9/18/2018	15:49:15	1.43	6.12	2.45	19.84	1.03
9/18/2018	15:50:15	1.44	5.19	2.42	19.88	1.02
9/18/2018	15:51:15	1.44	6.25	2.42	19.87	1.04
9/18/2018	15:52:15	1.43	6.29	2.40	19.86	1.04
9/18/2018	15:53:15	1.43	5.30	2.28	19.86	1.04
9/18/2018	15:54:15	1.43	6.22	2.39	19.87	1.04
9/18/2018	15:55:15	1.42	6.48	2.41	19.86	1.06
9/18/2018	15:56:15	1.43	5.72	2.47	19.85	1.07
9/18/2018	15:57:15	1.43	6.01	2.57	19.86	1.05
9/18/2018	15:58:15	1.42	6.46	2.67	19.85	1.05
9/18/2018	15:59:15	1.42	5.94	2.67	19.85	1.06
9/18/2018	16:00:15	1.43	5.77	2.67	19.87	1.06
9/18/2018	16:01:15	1.44	6.71	2.67	19.87	1.06
9/18/2018	16:02:15	1.43	5.97	2.67	19.85	1.05
9/18/2018	16:03:15	1.44	5.59	2.68	19.86	1.05
9/18/2018	16:04:15	1.44	6.87	2.81	19.85	1.06

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	16:05:15	1.44	6.25	2.81	19.85	1.05
9/18/2018	16:06:15	1.43	5.66	2.71	19.85	1.05
9/18/2018	16:07:15	1.44	7.04	2.73	19.85	1.05
9/18/2018	16:08:15	1.44	6.52	2.84	19.88	1.05
9/18/2018	16:09:15	1.43	6.11	2.93	19.84	1.07
9/18/2018	16:10:15	1.43	6.75	2.82	19.84	1.06
9/18/2018	16:11:15	1.45	6.59	2.91	19.83	1.06
9/18/2018	16:12:15	1.45	5.51	2.86	19.84	1.05
9/18/2018	16:13:15	1.44	6.77	2.86	19.83	1.08
9/18/2018	16:14:15	1.43	6.45	2.92	19.86	1.06
9/18/2018	16:15:15	1.43	5.61	2.81	19.86	1.06
9/18/2018	16:16:15	1.43	6.66	2.56	19.85	1.08
9/18/2018	16:17:15	1.43	6.62	2.54	19.83	1.09
9/18/2018	16:18:15	1.43	5.87	2.61	19.85	1.06
9/18/2018	16:19:15	1.42	6.34	2.59	19.85	1.07
9/18/2018	16:20:15	1.43	6.99	2.43	19.86	1.06
9/18/2018	16:21:15	1.43	6.08	2.54	19.85	1.07
9/18/2018	16:22:15	1.44	6.12	2.54	19.86	1.07
9/18/2018	16:23:15	1.43	6.86	2.54	19.86	1.07
9/18/2018	16:24:15	1.43	6.32	2.49	19.86	1.07
9/18/2018	16:25:15	1.44	5.69	2.47	19.85	1.07
9/18/2018	16:26:15	1.44	6.98	2.67	19.84	1.08
9/18/2018	16:27:15	1.44	6.41	2.67	19.85	1.06
9/18/2018	16:28:15	1.43	6.01	2.57	19.87	1.05
9/18/2018	16:29:15	1.43	7.25	2.54	19.86	1.07
9/18/2018	16:30:15	1.43	6.97	2.59	19.87	1.06
9/18/2018	16:31:15	1.43	5.76	2.65	19.86	1.07
9/18/2018	16:32:15	1.43	6.99	2.54	19.86	1.07
9/18/2018	16:33:15	1.43	6.97	2.66	19.86	1.06
9/18/2018	16:34:15	1.43	6.00	2.66	19.83	1.08
9/18/2018	16:35:15	1.44	6.73	2.67	19.85	1.07
9/18/2018	16:36:15	1.45	7.00	2.67	19.86	1.06
9/18/2018	16:37:15	1.45	5.95	2.68	19.86	1.07
9/18/2018	16:38:15	1.44	6.32	2.67	19.85	1.07
9/18/2018	16:39:15	1.44	7.04	2.67	19.85	1.08
9/18/2018	16:40:15	1.44	6.41	2.67	19.84	1.10
9/18/2018	16:41:15	1.44	6.07	2.73	19.82	1.10
9/18/2018	16:42:15	1.44	7.05	2.79	19.83	1.08
9/18/2018	16:43:15	1.45	6.23	2.67	19.85	1.08
9/18/2018	16:44:15	1.44	5.72	2.67	19.86	1.06
9/18/2018	16:45:15	1.43	6.85	2.67	19.88	1.07
9/18/2018	16:46:15	1.43	6.62	2.60	19.86	1.08

Hollingsworth & Vose
CFU-113
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	16:47:15	1.44	5.72	2.59	19.87	1.08
9/18/2018	16:48:15	1.44	7.34	2.67	19.87	1.07
9/18/2018	16:49:15	1.43	6.61	2.67	19.85	1.08
Final Average		**1.43**	**6.29**	**2.56**	**19.85**	**1.06**

Bias Check

9/18/2018	16:50:35	1.44	5.81	2.67	18.80	1.02
9/18/2018	16:50:45	1.43	5.31	2.67	10.06	0.54
9/18/2018	16:50:55	2.03	5.74	2.67	4.78	0.25
9/18/2018	16:51:05	3.14	5.58	2.67	3.42	0.12
9/18/2018	16:51:15	3.08	5.72	2.66	2.92	0.06
9/18/2018	16:51:25	2.53	4.99	2.67	2.73	0.03
9/18/2018	16:51:35	1.82	2.80	2.67	2.66	0.02
9/18/2018	16:51:45	0.88	0.77	2.68	2.63	0.01
9/18/2018	16:51:55	0.34	-0.46	2.68	2.62	0.02
9/18/2018	16:52:05	0.06	-0.89	2.67	2.62	0.01
9/18/2018	16:52:15	-0.06	-1.44	2.67	2.62	0.02
9/18/2018	16:52:25	-0.04	-1.68	2.67	2.62	0.02
9/18/2018	16:52:35	-0.06	-0.96	2.66	2.62	0.02
9/18/2018	16:52:45	-0.06	0.75	3.79	2.62	0.01
9/18/2018	16:52:55	-0.04	1.81	4.27	2.62	0.01
9/18/2018	16:53:05	-0.06	1.16	4.26	2.62	0.01
9/18/2018	16:53:15	-0.04	0.07	4.27	2.62	0.01
9/18/2018	16:53:25	-0.06	-0.76	4.27	2.62	0.01
9/18/2018	16:53:35	-0.05	-1.21	4.26	2.62	0.01
9/18/2018	16:53:45	-0.07	-1.39	4.26	2.62	0.01
9/18/2018	16:53:55	-0.06	-1.39	7.29	2.62	0.02
9/18/2018	16:54:05	-0.04	-0.19	11.83	2.62	0.01
9/18/2018	16:54:15	-0.06	1.51	11.84	2.62	0.01
9/18/2018	16:54:25	-0.05	1.33	11.83	2.62	0.01
9/18/2018	16:54:35	-0.06	0.57	11.83	2.62	0.02
9/18/2018	16:54:45	-0.04	-0.27	11.84	2.62	0.01
9/18/2018	16:54:55	-0.07	-1.23	11.83	2.62	0.01
9/18/2018	16:55:05	-0.06	-1.45	11.89	2.62	0.01
9/18/2018	16:55:15	-0.05	-1.74	12.51	2.62	0.01
9/18/2018	16:55:25	-0.04	-1.87	12.50	2.62	0.01
9/18/2018	16:55:35	-0.04	-0.46	12.51	2.61	0.01
9/18/2018	16:55:45	-0.05	1.39	12.51	2.62	0.01
9/18/2018	16:55:55	-0.05	1.59	12.50	4.78	0.18
9/18/2018	16:56:05	-0.06	0.91	12.51	5.16	0.69
9/18/2018	16:56:15	0.12	0.19	12.51	3.31	1.32
9/18/2018	16:56:25	0.21	-0.28	12.60	2.50	1.62

Hollingsworth & Vose
CFU-113
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	16:56:35	0.25	-0.80	12.63	2.18	1.74
9/18/2018	16:56:45	0.21	-1.39	12.63	2.06	1.78
9/18/2018	16:56:55	0.24	-1.62	12.64	2.01	1.80
9/18/2018	16:57:05	0.21	-0.91	12.63	1.99	1.80
9/18/2018	16:57:15	0.22	0.78	12.63	1.98	1.80
9/18/2018	16:57:25	0.24	1.09	12.63	1.98	1.82
9/18/2018	16:57:35	0.21	0.01	11.70	1.98	1.82
9/18/2018	16:57:45	0.24	-1.09	10.74	1.98	1.81
9/18/2018	16:57:55	0.22	-1.44	10.75	1.98	1.82
9/18/2018	16:58:05	0.24	-2.22	10.75	1.98	1.82
9/18/2018	16:58:15	0.24	-2.32	10.75	1.98	1.82
9/18/2018	16:58:25	0.21	-2.46	10.74	1.98	1.82
9/18/2018	16:58:35	0.23	-1.00	10.75	1.98	1.82
9/18/2018	16:58:45	0.23	0.60	8.82	1.97	1.82
9/18/2018	16:58:55	0.25	1.08	1.14	1.98	1.82
9/18/2018	16:59:05	0.23	0.28	1.14	1.97	1.82
9/18/2018	16:59:15	0.25	-0.72	1.13	1.98	1.82
9/18/2018	16:59:25	0.25	-1.54	1.13	1.97	1.82
9/18/2018	16:59:35	0.24	-2.28	1.13	3.37	2.81
9/18/2018	16:59:45	0.26	-2.30	1.13	7.13	6.92
9/18/2018	16:59:55	0.24	-2.11	1.13	8.83	8.56
9/18/2018	17:00:05	0.25	-0.79	0.54	9.49	9.24
9/18/2018	17:00:15	0.25	1.06	0.47	9.75	9.52
9/18/2018	17:00:25	0.09	1.08	0.47	9.85	9.63
9/18/2018	17:00:35	-0.05	-0.17	0.48	9.90	9.69
9/18/2018	17:00:45	-0.05	-1.53	0.47	9.91	9.70
9/18/2018	17:00:55	-0.04	-2.21	0.46	9.92	9.72
9/18/2018	17:01:05	-0.05	-2.06	0.46	9.93	9.73
9/18/2018	17:01:15	-0.05	-2.28	0.54	9.93	9.73
9/18/2018	17:01:25	-0.06	-1.92	0.59	9.93	9.74
9/18/2018	17:01:35	-0.03	-1.82	0.59	9.94	9.74
9/18/2018	17:01:45	-0.07	-0.19	0.59	9.94	9.75
9/18/2018	17:01:55	-0.04	-0.20	0.59	9.94	9.75
9/18/2018	17:02:05	-0.04	-1.24	0.59	9.93	9.75
9/18/2018	17:02:15	-0.04	-2.06	0.60	11.32	8.43
9/18/2018	17:02:25	-0.04	-2.80	0.43	9.34	4.88
9/18/2018	17:02:35	-0.04	-2.68	0.07	4.17	2.19
9/18/2018	17:02:45	-0.04	-2.19	0.07	1.79	1.04
9/18/2018	17:02:55	-0.05	-1.51	0.06	0.76	0.50
9/18/2018	17:03:05	0.12	-0.12	0.07	0.34	0.27
9/18/2018	17:03:15	0.38	2.19	0.07	0.18	0.15
9/18/2018	17:03:25	0.70	2.90	0.06	0.12	0.11

Hollingsworth & Vose
CFU-113
Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/18/2018	17:03:35	1.20	2.44	0.06	0.08	0.09
9/18/2018	17:03:45	1.40	2.10	0.34	0.07	0.08
9/18/2018	17:03:55	1.63	1.65	0.34	0.06	0.07
9/18/2018	17:04:05	2.00	0.93	0.35	0.06	0.06
9/18/2018	17:04:15	2.31	0.65	0.34	0.06	0.06
9/18/2018	17:04:25	2.43	0.73	0.33	0.06	0.06
9/18/2018	17:04:35	2.43	1.86	0.34	0.05	0.06
9/18/2018	17:04:45	2.43	3.52	0.34	0.05	0.05
9/18/2018	17:04:55	2.44	3.87	0.34	0.05	0.05
9/18/2018	17:05:05	2.43	3.35	0.34	0.05	0.05
9/18/2018	17:05:15	2.42	2.48	0.34	0.05	0.05
9/18/2018	17:05:25	2.44	1.64	0.33	0.05	0.05
9/18/2018	17:05:35	2.42	1.04	0.34	0.05	0.04
9/18/2018	17:05:45	2.43	0.82	0.34	0.46	0.09
9/18/2018	17:05:55	2.42	1.09	0.34	0.76	0.21
9/18/2018	17:06:05	1.12	2.98	0.29	0.35	0.11
9/18/2018	17:06:15	4.61	8.70	0.20	0.17	0.07
9/18/2018	17:06:25	11.77	14.83	0.20	0.10	0.05
9/18/2018	17:06:35	17.13	19.60	0.20	0.07	0.04
9/18/2018	17:06:45	22.75	21.98	0.19	0.06	0.03
9/18/2018	17:06:55	25.76	22.97	0.20	0.06	0.04
9/18/2018	17:07:05	26.81	23.47	0.19	0.05	0.04
9/18/2018	17:07:15	27.36	23.51	0.21	0.05	0.03
9/18/2018	17:07:25	27.50	23.60	0.34	0.05	0.04
9/18/2018	17:07:35	27.58	24.48	0.34	0.05	0.03
9/18/2018	17:07:45	27.58	25.48	0.34	0.05	0.04
9/18/2018	17:07:55	27.57	25.52	0.34	0.06	0.03
9/18/2018	17:08:05	27.58	25.01	0.34	0.05	0.03
9/18/2018	17:08:15	27.57	24.49	0.34	0.04	0.04
9/18/2018	17:08:25	27.58	24.12	1.99	0.05	0.04
9/18/2018	17:08:35	27.57	23.78	-0.45	0.05	0.03
		NOx [PPM]	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
System Zero		**-0.05**	**-2.09**	**0.19**	**0.05**	**0.04**
System Mid		**2.43**	**24.54**	**12.63**	**9.93**	**1.82**

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113**
DATE	**09/19/18**
METHOD	**13B**
POLLUTANT	**Total Fluorides**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**8:38**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**10:49**
EPA Method:	**13B**	Clear sky, 50 degrees	**Date:**	**9/19/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.215	Nozzle size	0.2153 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000253 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.97 "Hg	O_2	19.90 %
Static Pressure	-0.28 "H_2O	CO_2	0.70 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.226 inches
Stack Temperature	120 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	14	9

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	79.094 dcf	Ave. ΔP	0.723 "H_2O
Wet mol. weight	28.66 M_s (actual)	Ave. √ΔP	0.8495 "H_2O
Actual H_2O	2.31 %	Ave. ΔH	1.475 "H_2O
Std. meter vol.	80.908 dscf	Ave. T_s	122.4 °F
Isokinetic Average	99.8 %	Ave. T_m	57.9 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	218	18.0
Silica gel, g	260.1	282.7	22.6
		Total water gain:	40.6

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	10.230	0.77	117	53	1.57	1.60	2	257	49
2	30.0	20.400	0.78	119	53	1.58	1.60	2	256	47
3	45.0	30.400	0.74	120	55	1.50	1.50	2	251	49
4	60.0	40.020	0.70	122	57	1.42	1.40	2	252	60
5	75.0	50.110	0.75	124	59	1.52	1.50	2	253	49
6	90.0	60.170	0.74	126	61	1.50	1.50	2	253	49
7	105.0	69.470	0.62	126	62	1.26	1.30	2	251	51
8	120.0	79.094	0.68	125	63	1.39	1.40	2	252	52

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:04**
Source:	**CFU 113**	**End Time:**	**13:10**
EPA Method:	**13B**	**Date:**	**9/19/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Clear sky, 50 degrees

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.215	Nozzle size:	0.2153 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000253 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.97 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.229 inches
Stack Temperature	120 F		
Assumed moisture	2.31 %		
Assumed meter temp.	57.9 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	6

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches

Caliper ID# MN-2

Post Test Calculations:

Sample volume	78.321 dcf	Ave. ΔP	0.688 "H_2O
Wet mol. weight	28.67 M_s (actual)	Ave. √ΔP	0.8279 "H_2O
Actual H_2O	2.19 %	Ave. ΔH	1.413 "H_2O
Std. meter vol.	78.783 dscf	Ave. T_s	128 °F
Isokinetic Average	100.1 %	Ave. T_m	66.6 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	253.6	271	17.4
Total water gain:			37.4

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	10.380	0.77	127	64	1.56	1.60	2	254	51
2	30.0	20.490	0.75	127	64	1.52	1.50	2	255	51
3	45.0	29.860	0.61	127	65	1.24	1.30	2	254	52
4	60.0	38.836	0.58	126	66	1.19	1.20	2	242	53
5	75.0	49.150	0.77	127	67	1.57	1.60	2	253	52
6	90.0	59.220	0.74	129	68	1.51	1.50	2	252	52
7	105.0	68.610	0.60	130	69	1.22	1.20	2	251	53
8	120.0	78.321	0.68	131	70	1.39	1.40	2	253	54

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**13:25**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:29**
EPA Method:	**13B**	Clear sky, 50 degrees	**Date:**	**9/19/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.215	Nozzle size:	0.2153 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000253 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.97 "Hg	O_2	19.9	%
Static Pressure	-0.28 "H_2O	CO_2	0.7	%
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.227	inches
Stack Temperature	120 F			
Assumed moisture	2.19 %			
Assumed meter temp.	66.6 F			
Total number of points	8			
Time per point	15			
Total run time	120			

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	13	5

Nozzle check for roundness:

1	2	3
0.215	0.215	0.216 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	78.514 dcf	Ave. ΔP	0.68	"H_2O
Wet mol. weight	28.66 M_s (actual)	Ave. √ΔP	0.8237	"H_2O
Actual H_2O	2.25 %	Ave. ΔH	1.4	"H_2O
Std. meter vol.	78.129 dscf	Ave. T_s	132.9	°F
Isokinetic Average	100.2 %	Ave. T_m	72.3	°F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	249.8	268	18.2
		Total water gain:	38.2

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	10.440	0.78	133	71	1.59	1.60	2	258	59
2	30.0	20.510	0.73	134	71	1.49	1.50	2	254	50
3	45.0	29.900	0.64	133	71	1.31	1.30	2	253	50
4	60.0	40.567	0.76	132	72	1.56	1.60	2	254	51
5	75.0	49.680	0.58	132	72	1.19	1.20	2	253	65
6	90.0	59.100	0.65	133	73	1.33	1.30	2	252	56
7	105.0	69.100	0.67	133	74	1.38	1.40	2	253	58
8	120.0	78.514	0.63	133	74	1.29	1.30	2	253	58

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:38**
Source:	**CFU 113**	**End Time:**	**10:49**
Method:	**13B**	**Date:**	**9/19/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
15	10.230	1.60	53	1	0.77	117	0.8775
30	20.400	1.60	53	2	0.78	119	0.8832
45	30.400	1.50	55	3	0.74	120	0.8602
60	40.020	1.40	57	4	0.70	122	0.8367
75	50.110	1.50	59	5	0.75	124	0.8660
90	60.170	1.50	61	6	0.74	126	0.8602
105	69.470	1.30	62	7	0.62	126	0.7874
120	79.094	1.40	63	8	0.68	125	0.8246

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Source:	**CFU 113**		**Date:**	**09/19/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	79.094	dcf	Rectangular		
Water Volume	40.6	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	1.19	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.07	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.475	"H_2O	$\sqrt{Dp}$	0.8495	"H_2O
Temperature, T_m	57.9	^oF	Temperature, T_s	122.4	^oF
Temperature, T_m	517.9	^oA (^oR)	Temperature, T_s	582.4	^oA (R)
Pressure Meter, P_m	30.078	"Hg	Pressure Stack, P_s	29.949	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	80.908	dscf	Velocity, V_s	50.18	fps
	2.291	dscm	Volume (actual)	6,569.6	awcfm
Actual Volume, $V_{m(actual)}$	91.303	awcf		6,417.8	adcfm
Gas Stream Moisture			Volume (standard)	357,701.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.911	scf		349,439.0	dscf/hr
Moisture, B_{ws}	0.0231			5,824.0	dscf/min
Moisture EPA M4	2.31	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	424.551	
Dry, M_d	28.99	lb/lb-mole			
Wet, M_s	28.74	lb/lb-mole			
Percent Isokinetic	99.9	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	< 5.72E-06	gr/dscf
	< 13.09	µg/dscm
	< 1.66E-02	ppmvd
Mass Emissions	< 2.86E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:04**
Source:	**CFU 113**	**End Time:**	**13:10**
Method:	**13B**	**Date:**	**09/19/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
15	10.380	1.60	64	1	0.77	127	0.8775
30	20.490	1.50	64	2	0.75	127	0.8660
45	29.860	1.30	65	3	0.61	127	0.7810
60	38.836	1.20	66	4	0.58	126	0.7616
75	49.150	1.60	67	5	0.77	127	0.8775
90	59.220	1.50	68	6	0.74	129	0.8602
105	68.610	1.20	69	7	0.60	130	0.7746
120	78.321	1.40	70	8	0.68	131	0.8246

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 113**	**Date:**	**09/19/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	78.321	dcf	Rectangular		
Water Volume	37.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	1.16	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.05	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.413	"H_2O	$\sqrt{Dp}$	0.8279	"H_2O
Temperature, T_m	66.6	^oF	Temperature, T_s	128.0	^oF
Temperature, T_m	526.6	^oA (^oR)	Temperature, T_s	588.0	^oA (R)
Pressure Meter, P_m	30.074	"Hg	Pressure Stack, P_s	29.949	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	78.783	dscf	Velocity, V_s	49.13	fps
	2.231	dscm	Volume (actual)	6,432.1	awcfm
Actual Volume, $V_{m(actual)}$	89.650	awcf		6,291.2	adcfm
Gas Stream Moisture			Volume (standard)	346,881.7	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.760	scf		339,285.0	dscf/hr
Moisture, B_{ws}	0.0219			5,654.8	dscf/min
Moisture EPA M4	2.19	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	428.633	
Dry, M_d	28.99	lb/lb-mole			
Wet, M_s	28.75	lb/lb-mole			
Percent Isokinetic	100.2	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	< 5.88E-06	gr/dscf
	< 13.45	µg/dscm
	< 1.70E-02	ppmvd
Mass Emissions	< 2.85E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**13:25**
Source:	**CFU 113**	**End Time:**	**15:29**
Method:	**13B**	**Date:**	**09/19/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
15	10.440	1.60	71	1	0.78	133	0.8832
30	20.510	1.50	71	2	0.73	134	0.8544
45	29.900	1.30	71	3	0.64	133	0.8000
60	40.567	1.60	72	4	0.76	132	0.8718
75	49.680	1.20	72	5	0.58	132	0.7616
90	59.100	1.30	73	6	0.65	133	0.8062
105	69.100	1.40	74	7	0.67	133	0.8185
120	78.514	1.30	74	8	0.63	133	0.7937

Client:	**Hollingsworth & Vose**		**Run:**	**3**	
Source:	**CFU 113**		**Date:**	**09/19/18**	

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	78.514	dcf	Rectangular		
Water Volume	38.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.2153	in.	Length		in
Nozzle Area	0.000253	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	1.19	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	19.99	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.400	"H_2O	$\sqrt{Dp}$	0.8237	"H_2O
Temperature, T_m	72.3	^oF	Temperature, T_s	132.9	^oF
Temperature, T_m	532.3	^oA (^oR)	Temperature, T_s	592.9	^oA (R)
Pressure Meter, P_m	30.073	"Hg	Pressure Stack, P_s	29.949	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	78.129	dscf	Velocity, V_s	49.09	fps
	2.212	dscm	Volume (actual)	6,426.9	awcfm
Actual Volume, $V_{m(actual)}$	89.701	awcf		6,282.3	adcfm
Gas Stream Moisture			Volume (standard)	343,734.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.798	scf		336,000.8	dscf/hr
Moisture, B_{ws}	0.0225			5,600.0	dscf/min
Moisture EPA M4	2.25	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	432.205	
Dry, M_d	28.99	lb/lb-mole			
Wet, M_s	28.74	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole
Emissions:				
Concentration, C_s	< 5.92E-06	gr/dscf		
	< 13.56	µg/dscm		
	< 1.72E-02	ppmvd		
Mass Emissions	< 2.84E-04	lb/hr		

"<" represents MDL value

EPA Method 13B
Laboratory Results
Total Fluoride

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 113**

Lab ID	Sample ID	Sample Date		Result	MDL	Units
18-S2207	CFU-113 Cont. 1 Run 1	9/19/2018	<	MDL	30.0	µg/sample
18-S2208	CFU-113 Cont. 1 Run 2	9/19/2018	<	MDL	30.0	µg/sample
18-S2209	CFU-113 Cont. 1 Run 3	9/19/2018	<	MDL	30.0	µg/sample
18-S2210	H20 + Filter Blank	9/11/2018	<	MDL	30.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 13B
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113

Run			1	2	3	Average
Date			9/19/2018	9/19/2018	9/19/2018	
Run Start Time			8:38	11:04	13:25	
Run End Time			10:49	13:10	15:29	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.97	29.97	29.97	**29.97**
Nozzle Dia., in.			0.2153	0.2153	0.2153	**0.2153**
Isokinetic Average, %			99.9	100.2	100.3	**100.1**
Sample Volume, dscf			80.908	78.783	78.129	**79.273**
Sample Volume, dscm			2.291	2.231	2.212	**2.245**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			1.19	1.16	1.19	**1.18**
O_2 %vd			20.07	20.05	19.99	**20.04**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			2.31	2.19	2.25	**2.25**
Wet Molecular Weight, lb/lb-mole			28.74	28.75	28.74	**28.74**
Velocity, FPS			50.18	49.13	49.09	**49.47**
ADCFM			6,417.8	6,291.2	6,282.3	**6,330.4**
AWCFM			6,569.6	6,432.1	6,426.9	**6,476.2**
DSCFM			5,824.0	5,654.8	5,600.0	**5,692.9**
Stack Temperature, °F			122.4	128.0	132.9	**127.8**
Fluoride	Concentration, C_s	gr/dscf	< 5.72E-06	< 5.88E-06	< 5.92E-06	< **5.84E-06**
		µg/dscm	< 13.09	< 13.45	< 13.56	< **13.37**
		ppmvd	< 1.66E-02	< 1.70E-02	< 1.72E-02	< **1.69E-02**
	Mass	lb/hr	< 2.86E-04	< 2.85E-04	< 2.84E-04	< **2.85E-04**
		lb/lb glass	< 7.79E-08	< 7.74E-08	< 7.69E-08	< **7.74E-08**
Production Data	Glass Production	lbs/hr	3,664.0	3,680.7	3,700.6	**3,681.8**

"<" represents MDL value

EPA Methods 1-4, 13B
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:38**
Source:	**CFU 113**	**End Time:**	**10:49**
Method:	**13B**	**Date:**	**9/19/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.078 "Hg
   where Pb: 29.97 "Hg
   ΔH: 1.475 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.949 "Hg
   where Pb: 29.97 "Hg
   Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 80.908 dscf
   where Vm: 79.094 dcf
   Y: 0.9985
   Pm: 30.078 "Hg
   Tm: 517.9 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.911 scf
   where H_2O: 40.60 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0231

   where Vw(std): 1.911 scf
   Vm(std): 80.908 dscf

6) % H_2O = Bws x 100 = 2.31 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 91.303 awcf
   where Y: 0.9985
   Vm: 79.0940 dcf
   Bws: 0.0231
   Ts: 582.4 °A
   Tm: 517.9 °A
   Pm: 30.078 "Hg
   Ps: 29.949 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.99 lb/lb-mole
   where CO_2: 1.19 %vd
   O_2 20.07 %vd
   N_2+CO= (100-(O_2+CO_2): 78.74 %vd

9) $M_s = M_d(1 - Bws) + (18 \times Bws) =$ 28.74 lb/lb-mole
where M_d: 28.99 lb/lb-mole
Bws: 0.0231

10) $\text{Stack Area(cir.)} = 3.1416\ (\text{stack diameter}/24)^2 =$ 2.182 sq. ft.
where Stack ID: 20 inches

$\text{Stack Area(rect.)} = \text{stack width}/12 \times \text{stack length}/12 =$ NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 50.18 fps
where Cp: 0.84
Ave. Sqrt ΔP: 0.8495
Ts: 582.4 °A
Ps: 29.949 "Hg
Ms: 28.74 lb/lb-mole

12) $\text{AWCFM} = (V_s)(\text{stack area})(60\ \text{sec/min}) =$ 6,569.6 AWCFM
where V_s: 50.18 ft/sec
Stack Area: 2.182 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 6,417.8 ADCFM
where AWCFM: 6,569.6
Bws: 0.0231

14) $\text{Qsw} = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ \text{"Hg}}\right) =$ 357,701.9 wscf/hr
where V_s: 50.18 ft/sec
Stack Area: 2.1820 sq. ft.
Ts: 582.4 °A
Ps: 29.949 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 349,439.0 dscf/hr
where wscf/hr: 357,701.9
Bws: 0.0231

16) DSCFM= (dscf/hr)/60 mins/hr = 5,824.0 DSCFM
where dscf/hr: 349,439.0

17) $\text{Nozzle Area} = 3.1416\ (\text{Nozzle Size}/24)^2 =$ 0.000253 sq. ft.
where Nozzle Size: 0.2153 inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 99.9 %

where Ts:	582.4	°A
Vm(Std):	80.908	dscf
Ps:	29.949	"Hg
Vs	50.18	ft/sec
Nozzle Area:	0.000253	sq. ft.
Sampling Time:	120	min.
Bws:	0.0231	

EPA Method 13B:

19) Fluoride laboratory results < 30.0 µg/sample

20) Fluoride = (µg/sample)/1,000,000 = < 3.00E-05 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 5.72E-06 gr/dscf

where Sample:	0.00003	grams
Vm(std)	80.908	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 13.09 µg/dscm

where Sample:	0.00003	grams
Vm(std)	2.291	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 424.551 Vol./Mole

where Ts:	582.4	°A
Ps:	29.949	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.66E-02 ppmvd

where MW:	19.0	g/mol
lb/hr:	0.00	
Vol./Mole:	424.551	
ADCFM:	6417.8	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 2.86E-04 lb/hr

where Cs:	5.72E-06	gr/dscf
Stack Flow:	349,439.0	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113**
DATE	**09/19/18**
METHOD	**26A**
POLLUTANT	**HF**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**8:39**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**10:50**
EPA Method:	**26A**	Scattered 49 f no Wind	**Date:**	**9/19/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size	0.2173 inches
$\Delta H@$	1.846	Hot box ID	HB-2	Nozzle area	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.97 "Hg	O_2	19.90 %
Static Pressure	-0.28 "H_2O	CO_2	0.70 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.226 inches
Stack Temperature	118 F		
Assumed moisture	1.8 %		
Assumed meter temp.	69 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	12	5

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	78.703 dcf	Ave. ΔP	0.685 "H_2O
Wet mol. weight	28.66 M_s (actual)	Ave. $\sqrt{\Delta P}$	0.8272 "H_2O
Actual H_2O	2.27 %	Ave. ΔH	1.488 "H_2O
Std. meter vol.	80.743 dscf	Ave. T_s	125 °F
Isokinetic Average	100.5 %	Ave. T_m	57.6 °F

Moisture/Lab:

	Initial	Final	Gain
Filter	NA #		
Impingers, g	200.0	217	17.0
Silica gel, g	244.9	267.8	22.9
		Total water gain:	39.9

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	9.170	0.62	121	52	1.33	1.30	2	246	43
2	30.0	19.570	0.78	122	53	1.68	1.70	2	251	43
3	45.0	29.400	0.67	123	55	1.45	1.50	2	252	54
4	60.0	38.962	0.65	125	57	1.40	1.40	2	250	58
5	75.0	48.900	0.67	126	59	1.45	1.50	2	250	58
6	90.0	58.720	0.69	127	60	1.49	1.50	2	251	43
7	105.0	68.615	0.69	128	62	1.50	1.50	2	251	43
8	120.0	78.703	0.71	128	63	1.54	1.50	2	251	45

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**11:05**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**13:11**
EPA Method:	**26A**	Scattered 49 f no Wind	**Date:**	**9/19/2019**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	HB-2	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.97 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.229 inches
Stack Temperature	118 F		
Assumed moisture	2.27 %		
Assumed meter temp.	57.6 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	6

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	80.499 dcf	Ave. ΔP	0.694 "H_2O
Wet mol. weight	28.68 M_s (actual)	Ave. √ΔP	0.8328 "H_2O
Actual H_2O	2.12 %	Ave. ΔH	1.5 "H_2O
Std. meter vol.	81.054 dscf	Ave. T_s	130.4 °F
Isokinetic Average	100.5 %	Ave. T_m	67.4 °F

Moisture/Lab:

	Initial	Final	Gain
Filter NA #			
Impingers, g	200.0	218	18.0
Silica gel, g	251.7	271	19.3
Total water gain:			37.3

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	10.070	0.68	129	64	1.47	1.50	2	250	54
2	30.0	20.360	0.73	129	65	1.58	1.60	2	251	54
3	45.0	30.540	0.69	129	66	1.49	1.50	2	251	55
4	60.0	40.665	0.70	129	67	1.52	1.50	2	252	56
5	75.0	50.450	0.64	129	68	1.39	1.40	2	252	58
6	90.0	60.510	0.69	131	69	1.50	1.50	2	252	58
7	105.0	70.580	0.71	132	69	1.54	1.50	2	252	58
8	120.0	80.499	0.71	135	71	1.54	1.50	2	252	61

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**13:26**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:30**
EPA Method:	**26A**	Scattered 49 f no Wind	**Date:**	**9/19/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	HB-2	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.97 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.226 inches
Stack Temperature	118 F		
Assumed moisture	2.12 %		
Assumed meter temp.	67.4 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	6

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	80.457 dcf	Ave. ΔP	0.686 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	0.8282 "H_2O
Actual H_2O	1.94 %	Ave. ΔH	1.475 "H_2O
Std. meter vol.	80.140 dscf	Ave. T_s	135.5 °F
Isokinetic Average	100.2 %	Ave. T_m	73.1 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	216	16.0
Silica gel, g	261.8	279.5	17.7
		Total water gain:	33.7

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	15.0	9.930	0.66	135	72	1.43	1.40	3	254	47
2	30.0	19.890	0.69	136	72	1.50	1.50	3	254	49
3	45.0	29.960	0.71	135	72	1.54	1.50	3	251	50
4	60.0	40.076	0.70	136	72	1.52	1.50	3	251	51
5	75.0	49.990	0.65	135	73	1.42	1.40	3	251	53
6	90.0	60.230	0.74	136	74	1.61	1.60	3	251	55
7	105.0	70.490	0.69	136	75	1.51	1.50	3	251	55
8	120.0	80.457	0.65	135	75	1.42	1.40	3	249	57

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:39**
Source:	**CFU 113**	**End Time:**	**10:50**
Method:	**26A**	**Date:**	**9/19/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
15	9.170	1.30	52	1	0.62	121	0.7874
30	19.570	1.70	53	2	0.78	122	0.8832
45	29.400	1.50	55	3	0.67	123	0.8185
60	38.962	1.40	57	4	0.65	125	0.8062
75	48.900	1.50	59	5	0.67	126	0.8185
90	58.720	1.50	60	6	0.69	127	0.8307
105	68.615	1.50	62	7	0.69	128	0.8307
120	78.703	1.50	63	8	0.71	128	0.8426

Client:	Hollingsworth & Vose		Run:	1
Source:	CFU 113		Date:	09/19/18

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	78.703	dcf	Rectangular		
Water Volume	39.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	1.19	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.07	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	1.488	"H_2O	√Dp	0.8272	"H_2O
Temperature, T_m	57.6	^oF	Temperature, T_s	125.0	^oF
Temperature, T_m	517.6	^oA (^oR)	Temperature, T_s	585.0	^oA (R)
Pressure Meter, P_m	30.079	"Hg	Pressure Stack, P_s	29.949	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	80.743	dscf	Velocity, V_s	48.97	fps
	2.286	dscm	Volume (actual)	6,411.2	awcfm
Actual Volume, $V_{m(actual)}$	91.486	awcf		6,265.7	adcfm
Gas Stream Moisture			Volume (standard)	347,525.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.878	scf		339,636.3	dscf/hr
Moisture, B_{ws}	0.0227			5,660.6	dscf/min
Moisture EPA M4	2.27	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	426.446	
Dry, M_d	28.99	lb/lb-mole			
Wet, M_s	28.74	lb/lb-mole			
Percent Isokinetic	100.6	%			

Laboratory Results

HF	< 3.76	µg/sample			
HF	< 3.76E-06	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	< 7.19E-07	gr/dscf
	< 1.64	µg/dscm
	< 1.98E-03	ppmvd
Mass Emissions HF	< 3.49E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:05**
Source:	**CFU 113**	**End Time:**	**13:11**
Method:	**26A**	**Date:**	**09/19/19**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	$\sqrt{Dp}$
	0.000						
15	10.070	1.50	64	1	0.68	129	0.8246
30	20.360	1.60	65	2	0.73	129	0.8544
45	30.540	1.50	66	3	0.69	129	0.8307
60	40.665	1.50	67	4	0.70	129	0.8367
75	50.450	1.40	68	5	0.64	129	0.8000
90	60.510	1.50	69	6	0.69	131	0.8307
105	70.580	1.50	69	7	0.71	132	0.8426
120	80.499	1.50	71	8	0.71	135	0.8426

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 113**	**Date:**	**09/19/19**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	80.499	dcf	Rectangular		
Water Volume	37.3	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	1.16	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.05	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	1.500	"H_2O	√Dp	0.8328	"H_2O
Temperature, T_m	67.4	^oF	Temperature, T_s	130.4	^oF
Temperature, T_m	527.4	^oA (^oR)	Temperature, T_s	590.4	^oA (R)
Pressure Meter, P_m	30.080	"Hg	Pressure Stack, P_s	29.949	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	81.054	dscf	Velocity, V_s	49.51	fps
	2.295	dscm	Volume (actual)	6,481.8	awcfm
Actual Volume, $V_{m(actual)}$	92.543	awcf		6,344.4	adcfm
Gas Stream Moisture			Volume (standard)	348,143.7	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.755	scf		340,763.1	dscf/hr
Moisture, B_{ws}	0.0212			5,679.4	dscf/min
Moisture EPA M4	2.12	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	430.383	
Dry, M_d	28.99	lb/lb-mole			
Wet, M_s	28.76	lb/lb-mole			
Percent Isokinetic	100.6	%			

Laboratory Results

HF	< 3.76	µg/sample			
HF	< 3.76E-06	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	< 7.16E-07	gr/dscf
	< 1.64	µg/dscm
	< 1.97E-03	ppmvd
Mass Emissions HF	< 3.48E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**13:26**
Source:	**CFU 113**	**End Time:**	**15:30**
Method:	**26A**	**Date:**	**09/19/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
15	9.930	1.40	72	1	0.66	135	0.8124
30	19.890	1.50	72	2	0.69	136	0.8307
45	29.960	1.50	72	3	0.71	135	0.8426
60	40.076	1.50	72	4	0.70	136	0.8367
75	49.990	1.40	73	5	0.65	135	0.8062
90	60.230	1.60	74	6	0.74	136	0.8602
105	70.490	1.50	75	7	0.69	136	0.8307
120	80.457	1.40	75	8	0.65	135	0.8062

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 113**	**Date:**	**09/19/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	80.457	dcf	Rectangular		
Water Volume	33.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	1.19	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	19.99	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	1.475	"H_2O	$\sqrt{Dp}$	0.8282	"H_2O
Temperature, T_m	73.1	^oF	Temperature, T_s	135.5	^oF
Temperature, T_m	533.1	^oA (^oR)	Temperature, T_s	595.5	^oA (R)
Pressure Meter, P_m	30.078	"Hg	Pressure Stack, P_s	29.949	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	80.140	dscf	Velocity, V_s	49.43	fps
	2.269	dscm	Volume (actual)	6,471.4	awcfm
Actual Volume, $V_{m(actual)}$	92.121	awcf		6,345.9	adcfm
Gas Stream Moisture			Volume (standard)	344,604.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.586	scf		337,919.0	dscf/hr
Moisture, B_{ws}	0.0194			5,632.0	dscf/min
Moisture EPA M4	1.94	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	434.101	
Dry, M_d	28.99	lb/lb-mole			
Wet, M_s	28.78	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

HF	< 3.74	µg/sample		
HF	< 3.74E-06	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	< 7.20E-07	gr/dscf
	< 1.65	µg/dscm
	< 1.98E-03	ppmvd
Mass Emissions HF	< 3.48E-05	lb/hr

"<" represents MDL value

EPA Method 26A
Laboratory Results
HF

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 113**

Lab ID	Sample ID	Sample Date		Result	MDL	Sample Vol. (ml)	Units
18-S2218	CFU-113 Cont. 3 Run 1	9/19/2018	<	MDL	3.76	357.0	µg/sample
18-S2219	CFU-113 Cont. 3 Run 2	9/19/2018	<	MDL	3.76	357.0	µg/sample
18-S2220	CFU-113 Cont. 3 Run 3	9/19/2018	<	MDL	3.74	355.0	µg/sample
18-S2221	0.1N H2SO4 Blank	9/11/2018	<	MDL	4.45	423.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 26A
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113

Run			1	2	3	Average
Date			9/19/2018	9/19/2019	9/19/2018	
Run Start Time			8:39	11:05	13:26	
Run End Time			10:50	13:11	15:30	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.97	29.97	29.97	**29.97**
Nozzle Dia., in.			0.2173	0.2173	0.2173	**0.2173**
Isokinetic Average, %			100.6	100.6	100.3	**100.5**
Sample Volume, dscf			80.743	81.054	80.140	**80.646**
Sample Volume, dscm			2.286	2.295	2.269	**2.283**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			1.19	1.16	1.19	**1.18**
O_2 %vd			20.07	20.05	19.99	**20.04**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			2.27	2.12	1.94	**2.11**
Wet Molecular Weight, lb/lb-mole			28.74	28.76	28.78	**28.76**
Velocity, FPS			48.97	49.51	49.43	**49.30**
ADCFM			6,265.7	6,344.4	6,345.9	**6,318.7**
AWCFM			6,411.2	6,481.8	6,471.4	**6,454.8**
DSCFM			5,660.6	5,679.4	5,632.0	**5,657.3**
Stack Temperature, ^{o}F			125.0	130.4	135.5	**130.3**
HF	Concentration, C_s	gr/dscf	< 7.19E-07	< 7.16E-07	< 7.20E-07	< **7.18E-07**
		µg/dscm	< 1.64	< 1.64	< 1.65	< **1.64**
		ppmvd	< 1.98E-03	< 1.97E-03	< 1.98E-03	< **1.98E-03**
	Mass	lb/hr	< 3.49E-05	< 3.48E-05	< 3.48E-05	< **3.48E-05**
		lb/lb glass	< 9.52E-09	< 9.47E-09	< 9.39E-09	< **9.46E-09**
Production Data	Glass Production	lbs/hr	3,664.0	3,680.7	3,700.6	**3,681.8**

"<" represents MDL value

EPA Methods 1-4, 26A
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:39**
Source:	**CFU 113**	**End Time:**	**10:50**
Method:	**26A**	**Date:**	**9/19/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.079 "Hg
where Pb: 29.97 "Hg
ΔH: 1.488 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.949 "Hg
where Pb: 29.97 "Hg
Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 80.743 dscf
where Vm: 78.703 dcf
Y: 1.0008
Pm: 30.079 "Hg
Tm: 517.6 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.878 scf
where H_2O: 39.90 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0227

where Vw(std): 1.878 scf
Vm(std): 80.743 dscf

6) % H_2O = Bws x 100 = 2.27 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 91.486 awcf
where Y: 1.0008
Vm: 78.7029 dcf
Bws: 0.0227
Ts: 585.0 °A
Tm: 517.6 °A
Pm: 30.079 "Hg
Ps: 29.949 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.99 lb/lb-mole
where CO_2: 1.19 %vd
O_2 20.07 %vd
N_2+CO= (100-(O_2+CO_2): 78.74 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.74 lb/lb-mole

where M_d:	28.99	lb/lb-mole
Bws:	0.0227	

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 2.182 sq. ft.

where Stack ID:	20	inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.

where Stack Width:	0.000	inches
Stack Length:	0.000	inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 48.97 fps

where Cp:	0.84	
Ave. Sqrt ΔP:	0.8272	
Ts:	585.0	°A
Ps:	29.949	"Hg
Ms:	28.74	lb/lb-mole

12) $AWCFM = (V_s)\text{(stack area)(60 sec/min)} =$ 6,411.2 AWCFM

where V_s:	48.97	ft/sec
Stack Area:	2.182	sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 6,265.7 ADCFM

where AWCFM:	6,411.2	
Bws:	0.0227	

14) $Qsw = 3600(V_s)\text{(stack area)}\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 347,525.1 wscf/hr

where V_s:	48.97	ft/sec
Stack Area:	2.1820	sq. ft.
Ts:	585.0	°A
Ps:	29.949	"Hg

15) Qsd = (wscf/hr)(1-Bws) = 339,636.3 dscf/hr

where wscf/hr:	347,525.1	
Bws:	0.0227	

16) DSCFM= (dscf/hr)/60 mins/hr = 5,660.6 DSCFM

where dscf/hr:	339,636.3	

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000258 sq. ft.

where Nozzle Size:	0.2173	inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.6 %

where Ts:	585.0	°A
Vm(Std):	80.743	dscf
Ps:	29.949	"Hg
Vs	48.97	ft/sec
Nozzle Area:	0.000258	sq. ft.
Sampling Time:	120	min.
Bws:	0.0227	

EPA Method 26A:

19) HF laboratory results < 3.76 µg/sample

20) HF = (µg/sample)/1,000,000 = < 3.76E-06 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 7.19E-07 gr/dscf

where Sample:	0.00000	grams
Vm(std)	80.743	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 1.64 µg/dscm

where Sample:	0.00000	grams
Vm(std)	2.286	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 426.446 Vol./Mole

where Ts:	585.0	°A
Ps:	29.949	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.98E-03 ppmvd

where MW:	20.01	g/mol
lb/hr:	0.00	
Vol./Mole:	426.446	
ADCFM:	6265.7	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 3.49E-05 lb/hr

where Cs:	7.19E-07	gr/dscf
Stack Flow:	339,636.3	dscf/hr

Daily Gaseous Calibrations Log

Client: H/V

Source: CFU-113 -repeat of 13B/26A/3A

Date: 09-19-18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
	0	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

*Use of a calibrated instrument required

- see 9-11

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	x					0	x		
10	x					2	x		
20	x					4	x		

8:10 -

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0						0			
10						2			

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run #1

Test Times: R-1 08:38 - 10:50 R-2 ~~11:~~ DSB 11:04 - 13:13 R-3 13:25 - 15:30

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-113 (1)**
Facility	**Glass Plant 1**	Date	**September 19, 2018**
Location	**Corvallis OR**		

Run	1	2	3	
Date	9/19/2018	9/19/2018	9/19/2018	
Run Start Time	8:38	11:04	13:25	
Run End Time	10:50	13:13	15:30	
CO_2 %vd	1.19	1.16	1.19	1.18
O_2 %vd	20.07	20.05	19.99	20.03

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (1)**
Facility:	**Glass Plant 1**	Date	**September 19, 2018**
Location:	**Corvallis OR**		

Instrument Make:	**Servomex**
Instrument Model:	**1440**
Instrument Serial #:	**01440D1-5041**

		Initial Values				Final Values									
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.01	0.07	0.30	pass	-0.02	-0.15	pass	-0.45	pass				
	upscale	9.95	9.83	-0.60	pass	9.84	-0.55	pass	0.05	pass	20	19.71	20.07	10
Run 2	zero	0.01	-0.02	-0.15	pass	-0.03	-0.20	pass	-0.05	pass				
	upscale	9.95	9.84	-0.55	pass	9.82	-0.65	pass	-0.10	pass	20	19.73	20.05	10
Run 3	zero	0.01	-0.03	-0.20	pass	-0.05	-0.30	pass	-0.10	pass				
	upscale	9.95	9.82	-0.65	pass	9.82	-0.65	pass	0.00	pass	20	19.67	19.99	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0.01	9.95	20.13
Analyzer Cal. Error	0.05	-0.25	0.65
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (1)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 19, 2018**	Instrument Model:	**1440**
Location:	**Corvallis OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.03	0.04	0.25	pass	0.03	0.00	pass	-0.25	pass				
	upscale	1.87	1.85	-0.50	pass	1.86	-0.25	pass	0.25	pass	4	1.12	1.19	2
Run 2	zero	0.03	0.03	0.00	pass	0.05	0.50	pass	0.50	pass				
	upscale	1.87	1.86	-0.25	pass	1.86	-0.25	pass	0.00	pass	4	1.10	1.16	2
Run 3	zero	0.03	0.05	0.50	pass	0.05	0.50	pass	0.00	pass				
	upscale	1.87	1.86	-0.25	pass	1.86	-0.25	pass	0.00	pass	4	1.13	1.19	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0.03	1.87	4.1
Analyzer Cal. Error	0.75	-3.25	2.50
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**8:38**
Source:	**CFU-113 (1)**	**End Time:**	**10:50**
Method:	**3A**	**Date:**	**9/19/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.25 %v

where C_{Dir}:	9.95	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.60 %v

where C_{Dir}:	9.95	ppmv
C_S:	9.83	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.05 %v

where SB_{Final}:	-0.55	ppmv
SB_i:	-0.60	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 20.07 ppmv

where C_{Avg}:	19.71	ppmv
C_O:	0.03	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.84	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**8:38**
Source:	**CFU-113 (1)**	**End Time:**	**10:50**
Method:	**3A**	**Date:**	**9/19/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -3.25 %v

where C_{Dir}:	1.87	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.50 %v

where C_{Dir}:	1.87	ppmv
C_S:	1.85	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.25 %v

where SB_{Final}:	-0.25	ppmv
SB_i:	-0.50	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 1.19 ppmv

where C_{Avg}:	1.12	ppmv
C_O:	0.04	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.86	ppmv

Hollingsworth & Vose
CFU-113
Daily Calibrations
9/19/2018

Date	Time	O2 [%]	CO2 [%]
9/19/2018	8:02:00	20.90	0.09
9/19/2018	8:02:10	20.90	0.10
9/19/2018	8:02:20	20.90	0.09
9/19/2018	8:02:30	20.74	0.09
9/19/2018	8:02:40	14.85	0.10
9/19/2018	8:02:50	3.92	0.06
9/19/2018	8:03:00	0.10	0.04
9/19/2018	8:03:10	0.02	0.03
9/19/2018	8:03:20	0.01	0.03
9/19/2018	8:03:30	0.01	0.02
9/19/2018	8:03:40	0.01	0.03
9/19/2018	8:03:50	0.01	0.03
9/19/2018	8:04:00	0.00	0.03
9/19/2018	8:04:10	0.04	0.02
9/19/2018	8:04:20	11.69	10.69
9/19/2018	8:04:30	19.59	19.57
9/19/2018	8:04:40	20.07	19.69
9/19/2018	8:04:50	20.10	19.71
9/19/2018	8:05:00	20.11	19.73
9/19/2018	8:05:10	20.12	19.73
9/19/2018	8:05:20	20.13	19.73
9/19/2018	8:05:30	20.13	19.74
9/19/2018	8:05:40	20.13	19.75
9/19/2018	8:05:50	20.13	19.75
9/19/2018	8:06:00	20.13	19.75
9/19/2018	8:06:10	20.13	19.76
9/19/2018	8:06:20	20.13	19.76
9/19/2018	8:06:30	20.14	19.77
9/19/2018	8:06:40	20.14	19.77
9/19/2018	8:06:50	19.57	19.70
9/19/2018	8:07:00	11.90	10.28
9/19/2018	8:07:10	9.96	9.85
9/19/2018	8:07:20	9.99	9.85
9/19/2018	8:07:30	9.98	9.84
9/19/2018	8:07:40	9.97	9.84
9/19/2018	8:07:50	9.96	9.83
9/19/2018	8:08:00	9.96	9.83
9/19/2018	8:08:10	9.96	9.82
9/19/2018	8:08:20	9.95	9.82
9/19/2018	8:08:30	9.95	9.81
9/19/2018	8:08:40	9.95	9.81

Hollingsworth & Vose
CFU-113
Daily Calibrations
9/19/2018

Date	Time	O2 [%]	CO2 [%]
9/19/2018	8:08:50	9.97	9.81
9/19/2018	8:09:00	6.67	5.60
9/19/2018	8:09:10	3.69	4.00
9/19/2018	8:09:20	3.93	4.12
9/19/2018	8:09:30	3.93	4.11
9/19/2018	8:09:40	3.93	4.11
9/19/2018	8:09:50	3.93	4.11
9/19/2018	8:10:00	3.93	4.10
9/19/2018	8:10:10	3.93	4.11
9/19/2018	8:10:20	3.93	4.10
9/19/2018	8:10:30	2.99	2.76
9/19/2018	8:10:40	2.01	1.92
9/19/2018	8:10:50	1.95	1.88
9/19/2018	8:11:00	1.94	1.87
9/19/2018	8:11:10	1.94	1.88
9/19/2018	8:11:20	1.94	1.87
9/19/2018	8:11:30	1.94	1.87
9/19/2018	8:11:40	1.94	1.88
9/19/2018	8:11:50	1.94	1.88
9/19/2018	8:12:00	1.93	1.87

	O2 [%]	CO2 [%]
Analyzer Zero	**0.01**	**0.03**
Analyzer Mid	**9.95**	**1.87**
Analyzer High	**20.13**	**4.10**

System

9/19/2018	8:12:10	11.21	1.12
9/19/2018	8:12:20	18.80	0.13
9/19/2018	8:12:30	12.41	0.78
9/19/2018	8:12:40	9.37	1.18
9/19/2018	8:12:50	8.36	1.26
9/19/2018	8:13:00	7.61	0.67
9/19/2018	8:13:10	2.93	0.24
9/19/2018	8:13:20	1.03	0.11
9/19/2018	8:13:30	0.46	0.07
9/19/2018	8:13:40	0.29	0.05
9/19/2018	8:13:50	0.24	0.04
9/19/2018	8:14:00	0.23	0.05
9/19/2018	8:14:10	0.22	0.04
9/19/2018	8:14:20	0.16	0.05

Hollingsworth & Vose
CFU-113
Daily Calibrations
9/19/2018

Date	Time	O2 [%]	CO2 [%]
9/19/2018	8:14:30	0.08	0.04
9/19/2018	8:14:40	0.08	0.04
9/19/2018	8:14:50	0.08	0.04
9/19/2018	8:15:00	0.08	0.04
9/19/2018	8:15:10	0.07	0.04
9/19/2018	8:15:20	0.07	0.05
9/19/2018	8:15:30	0.07	0.04
9/19/2018	8:15:40	0.07	0.04
9/19/2018	8:15:50	0.17	0.17
9/19/2018	8:16:00	1.19	1.26
9/19/2018	8:16:10	1.73	1.66
9/19/2018	8:16:20	1.88	1.77
9/19/2018	8:16:30	1.93	1.81
9/19/2018	8:16:40	1.95	1.83
9/19/2018	8:16:50	1.96	1.84
9/19/2018	8:17:00	1.97	1.85
9/19/2018	8:17:10	1.97	1.85
9/19/2018	8:17:20	1.97	1.85
9/19/2018	8:17:30	1.97	1.86
9/19/2018	8:17:40	1.97	1.85
9/19/2018	8:17:50	1.97	1.86
9/19/2018	8:18:00	2.37	2.36
9/19/2018	8:18:10	6.63	7.10
9/19/2018	8:18:20	8.87	8.91
9/19/2018	8:18:30	9.53	9.44
9/19/2018	8:18:40	9.73	9.61
9/19/2018	8:18:50	9.80	9.68
9/19/2018	8:19:00	9.82	9.70
9/19/2018	8:19:10	9.83	9.70
9/19/2018	8:19:20	9.83	9.71
9/19/2018	8:19:30	9.83	9.72
9/19/2018	8:19:40	9.83	9.72
9/19/2018	8:19:50	9.83	9.73
		O2 [%]	**CO2 [%]**
System Zero		**0.07**	**0.04**
System Mid		**9.83**	**1.85**

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/19/2018	8:38:10	19.59	1.10
9/19/2018	8:39:10	19.58	1.11
9/19/2018	8:40:10	19.59	1.10
9/19/2018	8:41:10	19.59	1.10
9/19/2018	8:42:10	19.59	1.10
9/19/2018	8:43:10	19.59	1.10
9/19/2018	8:44:10	19.59	1.10
9/19/2018	8:45:10	19.59	1.10
9/19/2018	8:46:10	19.59	1.10
9/19/2018	8:47:10	19.59	1.10
9/19/2018	8:48:10	19.59	1.10
9/19/2018	8:49:10	19.58	1.10
9/19/2018	8:50:10	19.59	1.10
9/19/2018	8:51:10	19.59	1.10
9/19/2018	8:52:10	19.58	1.11
9/19/2018	8:53:10	19.58	1.10
9/19/2018	8:54:10	19.58	1.10
9/19/2018	8:55:10	19.58	1.10
9/19/2018	8:56:10	19.58	1.10
9/19/2018	8:57:10	19.59	1.10
9/19/2018	8:58:10	19.58	1.10
9/19/2018	8:59:10	19.57	1.11
9/19/2018	9:00:10	19.56	1.10
9/19/2018	9:01:10	19.56	1.11
9/19/2018	9:02:10	19.56	1.11
9/19/2018	9:03:10	19.56	1.10
9/19/2018	9:04:10	19.56	1.09
9/19/2018	9:05:10	19.56	1.08
9/19/2018	9:06:10	19.55	1.08
9/19/2018	9:07:10	19.55	1.08
9/19/2018	9:08:10	19.54	1.09
9/19/2018	9:09:10	19.54	1.09
9/19/2018	9:10:10	19.54	1.10
9/19/2018	9:11:10	19.53	1.12
9/19/2018	9:12:10	19.53	1.12
9/19/2018	9:13:10	19.53	1.12
9/19/2018	9:14:10	19.53	1.13
9/19/2018	9:15:10	19.53	1.12
9/19/2018	9:16:10	19.53	1.12
9/19/2018	9:17:10	19.52	1.13
9/19/2018	9:18:10	19.52	1.13
9/19/2018	9:19:10	19.52	1.13

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/19/2018	9:20:10	19.52	1.14
9/19/2018	9:21:10	19.52	1.14
9/19/2018	9:22:10	19.51	1.14
9/19/2018	9:23:10	19.51	1.14
9/19/2018	9:24:10	19.50	1.14
9/19/2018	9:25:10	19.51	1.14
9/19/2018	9:26:10	19.51	1.14
9/19/2018	9:27:10	19.51	1.14
9/19/2018	9:28:10	19.51	1.13
9/19/2018	9:29:10	19.50	1.14
9/19/2018	9:30:10	19.50	1.14
9/19/2018	9:31:10	19.50	1.13
9/19/2018	9:32:10	19.50	1.14
9/19/2018	9:33:10	19.62	1.14
9/19/2018	9:34:10	19.83	1.14
9/19/2018	9:35:10	19.83	1.13
9/19/2018	9:36:10	19.82	1.13
9/19/2018	9:37:10	19.83	1.13
9/19/2018	9:38:10	19.82	1.14
9/19/2018	9:39:10	19.82	1.14
9/19/2018	9:40:10	19.82	1.13
9/19/2018	9:41:10	19.82	1.14
9/19/2018	9:42:10	19.81	1.14
9/19/2018	9:43:10	19.81	1.14
9/19/2018	9:44:10	19.81	1.15
9/19/2018	9:45:10	19.81	1.15
9/19/2018	9:46:10	19.82	1.15
9/19/2018	9:47:10	19.84	1.13
9/19/2018	9:48:10	19.84	1.13
9/19/2018	9:49:10	19.84	1.14
9/19/2018	9:50:10	19.83	1.14
9/19/2018	9:51:10	19.83	1.14
9/19/2018	9:52:10	19.83	1.12
9/19/2018	9:53:10	19.84	1.12
9/19/2018	9:54:10	19.83	1.13
9/19/2018	9:55:10	19.83	1.11
9/19/2018	9:56:10	19.84	1.11
9/19/2018	9:57:10	19.84	1.11
9/19/2018	9:58:10	19.84	1.11
9/19/2018	9:59:10	19.85	1.11
9/19/2018	10:00:10	19.85	1.12
9/19/2018	10:01:10	19.84	1.13

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/19/2018	10:02:10	19.83	1.13
9/19/2018	10:03:10	19.83	1.13
9/19/2018	10:04:10	19.83	1.13
9/19/2018	10:05:10	19.84	1.13
9/19/2018	10:06:10	19.84	1.13
9/19/2018	10:07:10	19.84	1.13
9/19/2018	10:08:10	19.84	1.13
9/19/2018	10:09:10	19.83	1.13
9/19/2018	10:10:10	19.83	1.13
9/19/2018	10:11:10	19.84	1.13
9/19/2018	10:12:10	19.84	1.13
9/19/2018	10:13:10	19.84	1.14
9/19/2018	10:14:10	19.84	1.13
9/19/2018	10:15:10	19.84	1.14
9/19/2018	10:16:10	19.83	1.14
9/19/2018	10:17:10	19.83	1.14
9/19/2018	10:18:10	19.84	1.14
9/19/2018	10:19:10	19.83	1.13
9/19/2018	10:20:10	19.83	1.14
9/19/2018	10:21:10	19.83	1.13
9/19/2018	10:22:10	19.83	1.12
9/19/2018	10:23:10	19.83	1.11
9/19/2018	10:24:10	19.82	1.11
9/19/2018	10:25:10	19.82	1.11
9/19/2018	10:26:10	19.84	1.09
9/19/2018	10:27:10	19.85	1.09
9/19/2018	10:28:10	19.84	1.09
9/19/2018	10:29:10	19.83	1.10
9/19/2018	10:30:10	19.83	1.11
9/19/2018	10:31:10	19.83	1.11
9/19/2018	10:32:10	19.83	1.10
9/19/2018	10:33:10	19.83	1.10
9/19/2018	10:34:10	19.84	1.10
9/19/2018	10:35:10	19.85	1.09
9/19/2018	10:36:10	19.84	1.09
9/19/2018	10:37:10	19.84	1.09
9/19/2018	10:38:10	19.83	1.10
9/19/2018	10:39:10	19.83	1.09
9/19/2018	10:40:10	19.83	1.10
9/19/2018	10:41:10	19.84	1.09
9/19/2018	10:42:10	19.84	1.09
9/19/2018	10:43:10	19.83	1.09

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/19/2018	10:44:10	19.83	1.10
9/19/2018	10:45:10	19.82	1.10
9/19/2018	10:46:10	19.82	1.11
9/19/2018	10:47:10	19.82	1.10
9/19/2018	10:48:10	19.83	1.10
9/19/2018	10:49:10	19.83	1.10
9/19/2018	10:50:10	19.83	1.10
Final Average		**19.71**	**1.12**

Bias Check

9/19/2018	10:53:10	19.84	1.10
9/19/2018	10:53:20	19.67	1.19
9/19/2018	10:53:30	12.30	1.21
9/19/2018	10:53:40	4.20	0.50
9/19/2018	10:53:50	1.36	0.20
9/19/2018	10:54:00	0.45	0.10
9/19/2018	10:54:10	0.16	0.06
9/19/2018	10:54:20	0.06	0.05
9/19/2018	10:54:30	0.02	0.04
9/19/2018	10:54:40	0.01	0.04
9/19/2018	10:54:50	0.00	0.04
9/19/2018	10:55:00	0.00	0.04
9/19/2018	10:55:10	-0.01	0.04
9/19/2018	10:55:20	-0.01	0.04
9/19/2018	10:55:30	-0.02	0.03
9/19/2018	10:55:40	-0.02	0.03
9/19/2018	10:55:50	-0.02	0.03
9/19/2018	10:56:00	-0.02	0.03
9/19/2018	10:56:10	-0.02	0.04
9/19/2018	10:56:20	0.29	0.38
9/19/2018	10:56:30	1.29	1.25
9/19/2018	10:56:40	1.69	1.62
9/19/2018	10:56:50	1.81	1.75
9/19/2018	10:57:00	1.86	1.80
9/19/2018	10:57:10	1.88	1.83
9/19/2018	10:57:20	1.88	1.83
9/19/2018	10:57:30	1.89	1.84
9/19/2018	10:57:40	1.89	1.84
9/19/2018	10:57:50	1.89	1.84
9/19/2018	10:58:00	1.90	1.85
9/19/2018	10:58:10	1.90	1.85
9/19/2018	10:58:20	1.90	1.85

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/19/2018	10:58:30	1.90	1.86
9/19/2018	10:58:40	1.90	1.86
9/19/2018	10:58:50	1.90	1.86
9/19/2018	10:59:00	1.90	1.86
9/19/2018	10:59:10	4.20	4.58
9/19/2018	10:59:20	7.99	8.22
9/19/2018	10:59:30	9.24	9.24
9/19/2018	10:59:40	9.64	9.57
9/19/2018	10:59:50	9.77	9.69
9/19/2018	11:00:00	9.81	9.73
9/19/2018	11:00:10	9.83	9.75
9/19/2018	11:00:20	9.84	9.76
9/19/2018	11:00:30	9.84	9.77
9/19/2018	11:00:40	9.84	9.77
		O2 [%]	**CO2 [%]**
System Zero		**-0.02**	**0.03**
System Mid		**9.84**	**1.86**

Hollingsworth & Vose
CFU-113 (1)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/19/2018	11:04:10	19.77	1.10
9/19/2018	11:05:10	19.76	1.11
9/19/2018	11:06:10	19.76	1.11
9/19/2018	11:07:10	19.77	1.10
9/19/2018	11:08:10	19.77	1.10
9/19/2018	11:09:10	19.77	1.10
9/19/2018	11:10:10	19.77	1.10
9/19/2018	11:11:10	19.78	1.09
9/19/2018	11:12:10	19.77	1.09
9/19/2018	11:13:10	19.77	1.09
9/19/2018	11:14:10	19.78	1.09
9/19/2018	11:15:10	19.78	1.08
9/19/2018	11:16:10	19.77	1.08
9/19/2018	11:17:10	19.77	1.08
9/19/2018	11:18:10	19.77	1.08
9/19/2018	11:19:10	19.76	1.07
9/19/2018	11:20:10	19.77	1.08
9/19/2018	11:21:10	19.77	1.08
9/19/2018	11:22:10	19.76	1.08
9/19/2018	11:23:10	19.76	1.08
9/19/2018	11:24:10	19.75	1.08
9/19/2018	11:25:10	19.78	1.07
9/19/2018	11:26:10	19.77	1.08
9/19/2018	11:27:10	19.76	1.09
9/19/2018	11:28:10	19.75	1.09
9/19/2018	11:29:10	19.76	1.09
9/19/2018	11:30:10	19.76	1.09
9/19/2018	11:31:10	19.75	1.10
9/19/2018	11:32:10	19.75	1.10
9/19/2018	11:33:10	19.76	1.09
9/19/2018	11:34:10	19.75	1.09
9/19/2018	11:35:10	19.75	1.09
9/19/2018	11:36:10	19.75	1.09
9/19/2018	11:37:10	19.74	1.10
9/19/2018	11:38:10	19.75	1.08
9/19/2018	11:39:10	19.74	1.09
9/19/2018	11:40:10	19.75	1.08
9/19/2018	11:41:10	19.75	1.08
9/19/2018	11:42:10	19.74	1.08
9/19/2018	11:43:10	19.76	1.07
9/19/2018	11:44:10	19.75	1.07
9/19/2018	11:45:10	19.76	1.07

Hollingsworth & Vose
CFU-113 (1)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/19/2018	11:46:10	19.76	1.06
9/19/2018	11:47:10	19.77	1.06
9/19/2018	11:48:10	19.77	1.06
9/19/2018	11:49:10	19.77	1.06
9/19/2018	11:50:10	19.76	1.07
9/19/2018	11:51:10	19.75	1.08
9/19/2018	11:52:10	19.73	1.09
9/19/2018	11:53:10	19.74	1.09
9/19/2018	11:54:10	19.75	1.09
9/19/2018	11:55:10	19.74	1.09
9/19/2018	11:56:10	19.73	1.10
9/19/2018	11:57:10	19.74	1.10
9/19/2018	11:58:10	19.73	1.10
9/19/2018	11:59:10	19.73	1.10
9/19/2018	12:00:10	19.74	1.10
9/19/2018	12:01:10	19.76	1.08
9/19/2018	12:02:10	19.75	1.09
9/19/2018	12:03:10	19.73	1.09
9/19/2018	12:04:10	19.74	1.08
9/19/2018	12:05:10	19.76	1.07
9/19/2018	12:06:10	19.75	1.08
9/19/2018	12:07:10	19.74	1.07
9/19/2018	12:08:10	19.75	1.07
9/19/2018	12:09:10	19.74	1.08
9/19/2018	12:10:10	19.74	1.08
9/19/2018	12:11:10	19.73	1.08
9/19/2018	12:12:10	19.73	1.09
9/19/2018	12:13:10	19.73	1.09
9/19/2018	12:14:10	19.73	1.09
9/19/2018	12:15:10	19.72	1.10
9/19/2018	12:16:10	19.72	1.11
9/19/2018	12:17:10	19.72	1.11
9/19/2018	12:18:10	19.73	1.10
9/19/2018	12:19:10	19.73	1.10
9/19/2018	12:20:10	19.73	1.11
9/19/2018	12:21:10	19.74	1.11
9/19/2018	12:22:10	19.74	1.11
9/19/2018	12:23:10	19.75	1.11
9/19/2018	12:24:10	19.74	1.12
9/19/2018	12:25:10	19.73	1.12
9/19/2018	12:26:10	19.72	1.12
9/19/2018	12:27:10	19.72	1.12

Hollingsworth & Vose
CFU-113 (1)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/19/2018	12:28:10	19.72	1.11
9/19/2018	12:29:10	19.72	1.12
9/19/2018	12:30:10	19.72	1.11
9/19/2018	12:31:10	19.70	1.12
9/19/2018	12:32:10	19.70	1.11
9/19/2018	12:33:10	19.70	1.10
9/19/2018	12:34:10	19.69	1.11
9/19/2018	12:35:10	19.69	1.11
9/19/2018	12:36:10	19.69	1.11
9/19/2018	12:37:10	19.69	1.11
9/19/2018	12:38:10	19.69	1.11
9/19/2018	12:39:10	19.70	1.10
9/19/2018	12:40:10	19.70	1.11
9/19/2018	12:41:10	19.69	1.12
9/19/2018	12:42:10	19.70	1.11
9/19/2018	12:43:10	19.70	1.11
9/19/2018	12:44:10	19.71	1.11
9/19/2018	12:45:10	19.70	1.12
9/19/2018	12:46:10	19.70	1.12
9/19/2018	12:47:10	19.69	1.13
9/19/2018	12:48:10	19.69	1.13
9/19/2018	12:49:10	19.70	1.12
9/19/2018	12:50:10	19.70	1.13
9/19/2018	12:51:10	19.69	1.13
9/19/2018	12:52:10	19.68	1.12
9/19/2018	12:53:10	19.68	1.12
9/19/2018	12:54:10	19.68	1.13
9/19/2018	12:55:10	19.68	1.13
9/19/2018	12:56:10	19.69	1.11
9/19/2018	12:57:10	19.68	1.11
9/19/2018	12:58:10	19.68	1.12
9/19/2018	12:59:10	19.68	1.11
9/19/2018	13:00:10	19.68	1.11
9/19/2018	13:01:10	19.67	1.12
9/19/2018	13:02:10	19.68	1.12
9/19/2018	13:03:10	19.68	1.11
9/19/2018	13:04:10	19.68	1.11
9/19/2018	13:05:10	19.68	1.11
9/19/2018	13:06:10	19.68	1.11
9/19/2018	13:07:10	19.68	1.11
9/19/2018	13:08:10	19.68	1.11
9/19/2018	13:09:10	19.68	1.11

Hollingsworth & Vose
CFU-113 (1)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/19/2018	13:10:10	19.67	1.12
9/19/2018	13:11:10	19.68	1.12
9/19/2018	13:12:10	19.68	1.12
9/19/2018	13:13:10	19.68	1.12
Final Average		**19.73**	**1.10**

Bias Check

9/19/2018	13:16:20	14.83	1.47
9/19/2018	13:16:30	5.36	0.67
9/19/2018	13:16:40	1.71	0.28
9/19/2018	13:16:50	0.56	0.13
9/19/2018	13:17:00	0.19	0.09
9/19/2018	13:17:10	0.06	0.07
9/19/2018	13:17:20	0.02	0.06
9/19/2018	13:17:30	0.00	0.06
9/19/2018	13:17:40	-0.01	0.06
9/19/2018	13:17:50	-0.01	0.06
9/19/2018	13:18:00	-0.01	0.05
9/19/2018	13:18:10	-0.02	0.05
9/19/2018	13:18:20	-0.02	0.05
9/19/2018	13:18:30	-0.02	0.05
9/19/2018	13:18:40	-0.02	0.05
9/19/2018	13:18:50	-0.03	0.05
9/19/2018	13:19:00	-0.03	0.05
9/19/2018	13:19:10	-0.03	0.05
9/19/2018	13:19:20	-0.02	0.04
9/19/2018	13:19:30	0.00	0.09
9/19/2018	13:19:40	0.88	0.97
9/19/2018	13:19:50	1.55	1.51
9/19/2018	13:20:00	1.76	1.72
9/19/2018	13:20:10	1.83	1.79
9/19/2018	13:20:20	1.86	1.82
9/19/2018	13:20:30	1.87	1.83
9/19/2018	13:20:40	1.88	1.84
9/19/2018	13:20:50	1.88	1.84
9/19/2018	13:21:00	1.88	1.85
9/19/2018	13:21:10	1.88	1.85
9/19/2018	13:21:20	1.89	1.86
9/19/2018	13:21:30	1.89	1.86
9/19/2018	13:21:40	1.89	1.85
9/19/2018	13:21:50	1.89	1.86
9/19/2018	13:22:00	1.89	1.85

Hollingsworth & Vose
CFU-113 (1)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/19/2018	13:22:10	1.89	1.86
9/19/2018	13:22:20	1.89	1.87
9/19/2018	13:22:30	1.89	1.85
9/19/2018	13:22:40	1.89	1.86
9/19/2018	13:22:50	1.89	1.86
9/19/2018	13:23:00	1.89	1.86
9/19/2018	13:23:10	3.29	3.54
9/19/2018	13:23:20	7.51	7.84
9/19/2018	13:23:30	9.08	9.11
9/19/2018	13:23:40	9.58	9.53
9/19/2018	13:23:50	9.74	9.67
9/19/2018	13:24:00	9.80	9.72
9/19/2018	13:24:10	9.82	9.74
9/19/2018	13:24:20	9.82	9.74
9/19/2018	13:24:30	9.82	9.76
		O2 [%]	**CO2 [%]**
System Zero		**-0.03**	**0.05**
System Mid		**9.82**	**1.86**

Hollingsworth & Vose
CFU-113 (1)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/19/2018	13:25:10	18.95	1.73
9/19/2018	13:26:10	19.65	1.16
9/19/2018	13:27:10	19.66	1.15
9/19/2018	13:28:10	19.67	1.14
9/19/2018	13:29:10	19.67	1.14
9/19/2018	13:30:10	19.67	1.15
9/19/2018	13:31:10	19.67	1.14
9/19/2018	13:32:10	19.67	1.15
9/19/2018	13:33:10	19.68	1.14
9/19/2018	13:34:10	19.68	1.14
9/19/2018	13:35:10	19.68	1.15
9/19/2018	13:36:10	19.68	1.15
9/19/2018	13:37:10	19.69	1.15
9/19/2018	13:38:10	19.68	1.15
9/19/2018	13:39:10	19.68	1.16
9/19/2018	13:40:10	19.65	1.17
9/19/2018	13:41:10	19.68	1.14
9/19/2018	13:42:10	19.69	1.14
9/19/2018	13:43:10	19.70	1.14
9/19/2018	13:44:10	19.69	1.14
9/19/2018	13:45:10	19.68	1.14
9/19/2018	13:46:10	19.68	1.14
9/19/2018	13:47:10	19.69	1.13
9/19/2018	13:48:10	19.67	1.14
9/19/2018	13:49:10	19.66	1.16
9/19/2018	13:50:10	19.68	1.13
9/19/2018	13:51:10	19.68	1.14
9/19/2018	13:52:10	19.68	1.14
9/19/2018	13:53:10	19.68	1.14
9/19/2018	13:54:10	19.68	1.14
9/19/2018	13:55:10	19.67	1.14
9/19/2018	13:56:10	19.67	1.14
9/19/2018	13:57:10	19.68	1.14
9/19/2018	13:58:10	19.68	1.14
9/19/2018	13:59:10	19.67	1.15
9/19/2018	14:00:10	19.67	1.14
9/19/2018	14:01:10	19.68	1.14
9/19/2018	14:02:10	19.69	1.13
9/19/2018	14:03:10	19.68	1.14

Hollingsworth & Vose
CFU-113 (1)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/19/2018	14:04:10	19.68	1.14
9/19/2018	14:05:10	19.68	1.13
9/19/2018	14:06:10	19.68	1.13
9/19/2018	14:07:10	19.67	1.13
9/19/2018	14:08:10	19.68	1.13
9/19/2018	14:09:10	19.68	1.13
9/19/2018	14:10:10	19.68	1.12
9/19/2018	14:11:10	19.68	1.11
9/19/2018	14:12:10	19.69	1.11
9/19/2018	14:13:10	19.70	1.10
9/19/2018	14:14:10	19.69	1.12
9/19/2018	14:15:10	19.68	1.13
9/19/2018	14:16:10	19.68	1.13
9/19/2018	14:17:10	19.68	1.13
9/19/2018	14:18:10	19.67	1.13
9/19/2018	14:19:10	19.66	1.14
9/19/2018	14:20:10	19.65	1.15
9/19/2018	14:21:10	19.65	1.15
9/19/2018	14:22:10	19.65	1.16
9/19/2018	14:23:10	19.65	1.16
9/19/2018	14:24:10	19.66	1.15
9/19/2018	14:25:10	19.66	1.16
9/19/2018	14:26:10	19.68	1.14
9/19/2018	14:27:10	19.67	1.15
9/19/2018	14:28:10	19.66	1.16
9/19/2018	14:29:10	19.65	1.16
9/19/2018	14:30:10	19.64	1.17
9/19/2018	14:31:10	19.66	1.15
9/19/2018	14:32:10	19.68	1.14
9/19/2018	14:33:10	19.67	1.14
9/19/2018	14:34:10	19.65	1.14
9/19/2018	14:35:10	19.65	1.14
9/19/2018	14:36:10	19.66	1.13
9/19/2018	14:37:10	19.67	1.12
9/19/2018	14:38:10	19.66	1.12
9/19/2018	14:39:10	19.67	1.11
9/19/2018	14:40:10	19.67	1.12
9/19/2018	14:41:10	19.64	1.14
9/19/2018	14:42:10	19.67	1.12

Hollingsworth & Vose
CFU-113 (1)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/19/2018	14:43:10	19.74	1.09
9/19/2018	14:44:10	19.75	1.08
9/19/2018	14:45:10	19.74	1.09
9/19/2018	14:46:10	19.74	1.09
9/19/2018	14:47:10	19.72	1.10
9/19/2018	14:48:10	19.67	1.13
9/19/2018	14:49:10	19.70	1.11
9/19/2018	14:50:10	19.68	1.12
9/19/2018	14:51:10	19.67	1.13
9/19/2018	14:52:10	19.67	1.11
9/19/2018	14:53:10	19.70	1.09
9/19/2018	14:54:10	19.70	1.10
9/19/2018	14:55:10	19.68	1.12
9/19/2018	14:56:10	19.67	1.12
9/19/2018	14:57:10	19.67	1.12
9/19/2018	14:58:10	19.69	1.12
9/19/2018	14:59:10	19.70	1.11
9/19/2018	15:00:10	19.66	1.13
9/19/2018	15:01:10	19.71	1.10
9/19/2018	15:02:10	19.75	1.09
9/19/2018	15:03:10	19.72	1.09
9/19/2018	15:04:10	19.73	1.10
9/19/2018	15:05:10	19.69	1.11
9/19/2018	15:06:10	19.69	1.11
9/19/2018	15:07:10	19.67	1.12
9/19/2018	15:08:10	19.68	1.12
9/19/2018	15:09:10	19.67	1.12
9/19/2018	15:10:10	19.67	1.13
9/19/2018	15:11:10	19.68	1.13
9/19/2018	15:12:10	19.66	1.13
9/19/2018	15:13:10	19.66	1.13
9/19/2018	15:14:10	19.65	1.12
9/19/2018	15:15:10	19.66	1.14
9/19/2018	15:16:10	19.66	1.14
9/19/2018	15:17:10	19.66	1.15
9/19/2018	15:18:10	19.65	1.15
9/19/2018	15:19:10	19.63	1.16
9/19/2018	15:20:10	19.65	1.15
9/19/2018	15:21:10	19.71	1.12

Hollingsworth & Vose
CFU-113 (1)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/19/2018	15:22:10	19.73	1.11
9/19/2018	15:23:10	19.73	1.09
9/19/2018	15:24:10	19.73	1.10
9/19/2018	15:25:10	19.73	1.10
9/19/2018	15:26:10	19.73	1.09
9/19/2018	15:27:10	19.72	1.11
9/19/2018	15:28:10	19.73	1.10
9/19/2018	15:29:10	19.72	1.09
9/19/2018	15:30:10	19.71	1.11
Final Average		**19.67**	**1.13**

Bias Check

9/19/2018	15:34:20	19.65	1.15
9/19/2018	15:34:30	19.66	1.14
9/19/2018	15:34:40	19.31	1.38
9/19/2018	15:34:50	11.26	1.48
9/19/2018	15:35:00	3.78	0.59
9/19/2018	15:35:10	1.22	0.25
9/19/2018	15:35:20	0.40	0.11
9/19/2018	15:35:30	0.13	0.07
9/19/2018	15:35:40	0.04	0.06
9/19/2018	15:35:50	0.01	0.05
9/19/2018	15:36:00	0.00	0.05
9/19/2018	15:36:10	-0.01	0.05
9/19/2018	15:36:20	-0.01	0.05
9/19/2018	15:36:30	-0.02	0.05
9/19/2018	15:36:40	-0.02	0.05
9/19/2018	15:36:50	-0.02	0.05
9/19/2018	15:37:00	-0.03	0.05
9/19/2018	15:37:10	-0.03	0.05
9/19/2018	15:37:20	-0.03	0.05
9/19/2018	15:37:30	-0.03	0.05
9/19/2018	15:37:40	-0.03	0.05
9/19/2018	15:37:50	-0.03	0.04
9/19/2018	15:38:00	-0.04	0.05
9/19/2018	15:38:10	-0.04	0.05
9/19/2018	15:38:20	-0.04	0.04
9/19/2018	15:38:30	-0.04	0.05
9/19/2018	15:38:40	-0.04	0.06

Hollingsworth & Vose
CFU-113 (1)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/19/2018	15:38:50	-0.04	0.04
9/19/2018	15:39:00	-0.04	0.05
9/19/2018	15:39:10	-0.04	0.05
9/19/2018	15:39:20	-0.05	0.05
9/19/2018	15:39:30	-0.04	0.05
9/19/2018	15:39:40	-0.04	0.05
9/19/2018	15:39:50	-0.05	0.04
9/19/2018	15:40:00	-0.05	0.05
9/19/2018	15:40:10	-0.05	0.05
9/19/2018	15:40:20	-0.05	0.05
9/19/2018	15:40:30	-0.04	0.05
9/19/2018	15:40:40	-0.05	0.05
9/19/2018	15:40:50	-0.05	0.05
9/19/2018	15:41:00	-0.05	0.05
9/19/2018	15:41:10	-0.05	0.04
9/19/2018	15:41:20	-0.05	0.05
9/19/2018	15:41:30	0.03	0.15
9/19/2018	15:41:40	0.99	1.09
9/19/2018	15:41:50	1.57	1.56
9/19/2018	15:42:00	1.75	1.74
9/19/2018	15:42:10	1.81	1.80
9/19/2018	15:42:20	1.84	1.82
9/19/2018	15:42:30	1.86	1.83
9/19/2018	15:42:40	1.86	1.85
9/19/2018	15:42:50	1.86	1.85
9/19/2018	15:43:00	1.87	1.85
9/19/2018	15:43:10	1.87	1.85
9/19/2018	15:43:20	1.87	1.85
9/19/2018	15:43:30	1.87	1.86
9/19/2018	15:43:40	1.88	1.86
9/19/2018	15:43:50	1.88	1.86
9/19/2018	15:44:00	1.88	1.87
9/19/2018	15:44:10	1.88	1.86
9/19/2018	15:44:20	1.88	1.87
9/19/2018	15:44:30	1.88	1.86
9/19/2018	15:44:40	4.70	5.14
9/19/2018	15:44:50	8.16	8.36
9/19/2018	15:45:00	9.26	9.26
9/19/2018	15:45:10	9.61	9.57

Hollingsworth & Vose
CFU-113 (1)
Run #3

Date	**Time**	**O2 [%]**	**CO2 [%]**
9/19/2018	15:45:20	9.72	9.68
9/19/2018	15:45:30	9.77	9.72
9/19/2018	15:45:40	9.79	9.74
9/19/2018	15:45:50	9.80	9.76
9/19/2018	15:46:00	9.80	9.76
9/19/2018	15:46:10	9.80	9.76
9/19/2018	15:46:20	9.80	9.77
9/19/2018	15:46:30	9.80	9.77
9/19/2018	15:46:40	9.81	9.77
9/19/2018	15:46:50	9.81	9.78
9/19/2018	15:47:00	9.81	9.78
9/19/2018	15:47:10	9.81	9.78
9/19/2018	15:47:20	9.81	9.78
9/19/2018	15:47:30	9.81	9.78
9/19/2018	15:47:40	9.81	9.78
9/19/2018	15:47:50	9.81	9.78
9/19/2018	15:48:00	9.81	9.78
9/19/2018	15:48:10	9.81	9.78
9/19/2018	15:48:20	9.82	9.78
9/19/2018	15:48:30	9.82	9.79
		O2 [%]	**CO2 [%]**
System Zero		**-0.05**	**0.05**
System Mid		**9.82**	**1.86**

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113**
DATE	**09/21/18**
METHOD	**29**
POLLUTANT	**Metals**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**9:25**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**12:51**
EPA Method:	**29**	Partly cloudy, 60+ degrees	**Date:**	**9/21/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.215	Nozzle size	0.2133 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000248 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.89 "Hg	O_2	19.90 %
Static Pressure	-0.28 "H_2O	CO_2	0.70 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.226 inches
Stack Temperature	120 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	8		
Time per point	22.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	15	7

Nozzle check for roundness:

1	2	3
0.213	0.213	0.214 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	115.631 dcf	Ave. ΔP	0.701 "H_2O
Wet mol. weight	28.66 M_s (actual)	Ave. √ΔP	0.8358 "H_2O
Actual H_2O	2.33 %	Ave. ΔH	1.375 "H_2O
Std. meter vol.	116.657 dscf	Ave. T_s	129.1 °F
Isokinetic Average	100.2 %	Ave. T_m	63.6 °F

Moisture/Lab:

Filter	N/A	#	
	Initial	Final	Gain
Impingers, g	200.0	238	38.0
Silica gel, g	250.1	271.1	21.0
		Total water gain:	59.0

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	22.5	15.330	0.81	118	57	1.60	1.60	1.5	252	47
2	45.0	30.250	0.78	125	58	1.52	1.50	1.5	252	47
3	67.5	44.500	0.64	128	61	1.25	1.30	1.5	255	52
4	90.0	57.297	0.55	129	62	1.07	1.10	1.5	252	53
5	112.5	71.930	0.73	132	64	1.42	1.40	1.5	250	57
6	135.0	87.210	0.77	133	67	1.51	1.50	1.5	254	53
7	157.5	101.910	0.71	133	69	1.40	1.40	1.5	252	54
8	180.0	115.631	0.62	135	71	1.22	1.20	1.5	22	56

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:10**
Source:	**CFU 113**	**End Time:**	**16:16**
EPA Method:	**29**	**Date:**	**9/21/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Partly cloudy, 60+ degrees

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.215	Nozzle size:	0.2133 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000248 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.89 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.228 inches
Stack Temperature	120 F		
Assumed moisture	2.33 %		
Assumed meter temp.	63.6 F		
Total number of points	8		
Time per point	22.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	14	7

Nozzle check for roundness:

1	2	3
0.213	0.213	0.214 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	112.943 dcf	Ave. ΔP	0.643 "H_2O
Wet mol. weight	28.65 M_s (actual)	Ave. √ΔP	0.8008 "H_2O
Actual H_2O	2.35 %	Ave. ΔH	1.275 "H_2O
Std. meter vol.	111.471 dscf	Ave. T_s	137.6 °F
Isokinetic Average	100.6 %	Ave. T_m	75.1 °F

Moisture/Lab:

	Initial	Final	Gain
Filter	N/A	#	
Impingers, g	200.0	238	38.0
Silica gel, g	271.0	290	19.0
		Total water gain:	57.0

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	22.5	14.780	0.69	136	72	1.35	1.40	1.5	256	66
2	45.0	29.390	0.71	135	73	1.39	1.40	1.5	255	59
3	67.5	43.680	0.64	135	74	1.26	1.30	1.5	255	60
4	90.0	57.300	0.61	138	74	1.19	1.20	1.5	256	64
5	112.5	72.220	0.70	138	76	1.38	1.40	1.5	255	66
6	135.0	86.430	0.66	139	77	1.30	1.30	1.5	252	50
7	157.5	100.150	0.60	140	78	1.18	1.20	1.5	254	52
8	180.0	112.943	0.53	140	77	1.04	1.00	1.5	253	55

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**16:34**
Source:	**CFU 113**	**Environmental Conditions/Test Notes:**	**End Time:**	**19:39**
EPA Method:	**29**	Partly cloudy, 60+ degrees	**Date:**	**9/21/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.215	Nozzle size:	0.2133 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000248 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.89 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	0.725 "H_2O	Rec. Nz.	0.225 inches
Stack Temperature	120 F		
Assumed moisture	2.35 %		
Assumed meter temp.	75.1 F		
Total number of points	8		
Time per point	22.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	13	5

Nozzle check for roundness:

1	2	3
0.213	0.213	0.214 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	117.169 dcf	Ave. ΔP	0.684 "H_2O
Wet mol. weight	28.67 M_s (actual)	Ave. √ΔP	0.8248 "H_2O
Actual H_2O	2.24 %	Ave. ΔH	1.363 "H_2O
Std. meter vol.	115.041 dscf	Ave. T_s	133.3 °F
Isokinetic Average	100.4 %	Ave. T_m	78 °F

Moisture/Lab:

Filter	N/A	#	
	Initial	Final	Gain
Impingers, g	200.0	234	34.0
Silica gel, g	271.0	293	22.0
		Total water gain:	56.0

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	22.5	15.780	0.80	139	77	1.57	1.60	1.5	254	52
2	45.0	31.100	0.77	137	78	1.52	1.50	1.5	249	53
3	67.5	45.560	0.64	135	79	1.27	1.30	1.5	255	55
4	90.0	58.621	0.54	133	79	1.08	1.10	1.5	253	57
5	112.5	74.050	0.77	132	78	1.53	1.50	1.5	251	59
6	135.0	89.550	0.75	132	78	1.49	1.50	1.5	254	58
7	157.5	103.810	0.64	130	78	1.28	1.30	1.5	253	59
8	180.0	117.169	0.56	128	77	1.12	1.10	1.5	251	62

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:25**
Source:	**CFU 113**	**End Time:**	**12:51**
Method:	**29**	**Date:**	**9/21/2018**

Sampling Data				**Traverse Data**			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m ^oF**	**Point**	**"H_2O**	**T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
22.5	15.330	1.60	57	1	0.81	118	0.9000
45.0	30.250	1.50	58	2	0.78	125	0.8832
67.5	44.500	1.30	61	3	0.64	128	0.8000
90.0	57.297	1.10	62	4	0.55	129	0.7416
112.5	71.930	1.40	64	5	0.73	132	0.8544
135.0	87.210	1.50	67	6	0.77	133	0.8775
157.5	101.910	1.40	69	7	0.71	133	0.8426
180.0	115.631	1.20	71	8	0.62	135	0.7874

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113**	**Date:**	**09/21/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	22.5	min	Diameter	20.000	in
Meter Volume, V_m	115.631	dcf	Rectangular		
Water Volume	59.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2133	in.	Length		in
Nozzle Area	0.000248	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.89	"Hg	CO_2 Average	1.09	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.13	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.375	"H_2O	√Dp	0.8358	"H_2O
Temperature, T_m	63.6	^oF	Temperature, T_s	129.1	^oF
Temperature, T_m	523.6	^oA (^oR)	Temperature, T_s	589.1	^oA (^oR)
Pressure Meter, P_m	29.991	"Hg	Pressure Stack, P_s	29.869	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	116.657	dscf	Velocity, V_s	49.74	fps
	3.303	dscm	Volume (actual)	6,512.0	awcfm
Actual Volume, $V_{m(actual)}$	133.543	awcf		6,360.3	adcfm
Gas Stream Moisture			Volume (standard)	349,596.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.777	scf		341,450.9	dscf/hr
Moisture, B_{ws}	0.0233			5,690.8	dscf/min
Moisture EPA M4	2.33	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.98	lb/lb-mole			
Wet, M_s	28.72	lb/lb-mole			
Percent Isokinetic	100.3	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:10**
Source:	**CFU 113**	**End Time:**	**16:16**
Method:	**29**	**Date:**	**09/21/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
22.5	14.780	1.40	72	1	0.69	136	0.8307
45.0	29.390	1.40	73	2	0.71	135	0.8426
67.5	43.680	1.30	74	3	0.64	135	0.8000
90.0	57.300	1.20	74	4	0.61	138	0.7810
112.5	72.220	1.40	76	5	0.70	138	0.8367
135.0	86.430	1.30	77	6	0.66	139	0.8124
157.5	100.150	1.20	78	7	0.60	140	0.7746
180.0	112.943	1.00	77	8	0.53	140	0.7280

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 113**	**Date:**	**09/21/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	22.5	min	Diameter	20.000	in
Meter Volume, V_m	112.943	dcf	Rectangular		
Water Volume	57.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2133	in.	Length		in
Nozzle Area	0.000248	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.89	"Hg	CO_2 Average	1.06	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.37	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.275	"H_2O	$\sqrt{Dp}$	0.8008	"H_2O
Temperature, T_m	75.1	^oF	Temperature, T_s	137.6	^oF
Temperature, T_m	535.1	^oA (^oR)	Temperature, T_s	597.6	^oA (^oR)
Pressure Meter, P_m	29.984	"Hg	Pressure Stack, P_s	29.869	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	111.471	dscf	Velocity, V_s	48.00	fps
	3.157	dscm	Volume (actual)	6,284.2	awcfm
Actual Volume, $V_{m(actual)}$	129.473	awcf		6,136.5	adcfm
Gas Stream Moisture			Volume (standard)	332,568.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.682	scf		324,752.9	dscf/hr
Moisture, B_{ws}	0.0235			5,412.5	dscf/min
Moisture EPA M4	2.35	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.98	lb/lb-mole			
Wet, M_s	28.72	lb/lb-mole			
Percent Isokinetic	100.7	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**16:34**
Source:	**CFU 113**	**End Time:**	**19:39**
Method:	**29**	**Date:**	**09/21/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**√Dp**
	0.000						
22.5	15.780	1.60	77	1	0.80	139	0.8944
45.0	31.100	1.50	78	2	0.77	137	0.8775
67.5	45.560	1.30	79	3	0.64	135	0.8000
90.0	58.621	1.10	79	4	0.54	133	0.7348
112.5	74.050	1.50	78	5	0.77	132	0.8775
135.0	89.550	1.50	78	6	0.75	132	0.8660
157.5	103.810	1.30	78	7	0.64	130	0.8000
180.0	117.169	1.10	77	8	0.56	128	0.7483

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 113**	**Date:**	**09/21/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	22.5	min	Diameter	20.000	in
Meter Volume, V_m	117.169	dcf	Rectangular		
Water Volume	56.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2133	in.	Length		in
Nozzle Area	0.000248	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.89	"Hg	CO_2 Average	1.07	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	19.72	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.363	"H_2O	√Dp	0.8248	"H_2O
Temperature, T_m	78.0	^{o}F	Temperature, T_s	133.3	^{o}F
Temperature, T_m	538.0	^{o}A (^{o}R)	Temperature, T_s	593.3	^{o}A (^{o}R)
Pressure Meter, P_m	29.990	"Hg	Pressure Stack, P_s	29.869	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	115.041	dscf	Velocity, V_s	49.27	fps
	3.258	dscm	Volume (actual)	6,450.4	awcfm
Actual Volume, $V_{m(actual)}$	132.510	awcf		6,305.9	adcfm
Gas Stream Moisture			Volume (standard)	343,841.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.635	scf		336,139.5	dscf/hr
Moisture, B_{ws}	0.0224			5,602.3	dscf/min
Moisture EPA M4	2.24	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.71	lb/lb-mole			
Percent Isokinetic	100.4	%			

Source: CFU 113 **Sample Date:** 09/21/18

Run: 1

Client ID:		Filter + Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.370		0.716	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		1.190	<	MDL	0.100	0.040	µg/sample
Chromium		1.240		0.294	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		3.700		4.150	1.250	0.500	µg/sample
Lead		7.360	<	MDL	1.250	0.500	µg/sample
Manganese		1.270		0.572	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		35.000	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		4.930		3.430	0.750	0.300	µg/sample
Lab ID:		18-S2351		18-S2352			
Sample Vol:		250		100			mL

Source: CFU 113 **Sample Date:** 09/21/18

Run: 2

Client ID:		Filter + Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.350		0.613	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		1.230	<	MDL	0.100	0.040	µg/sample
Chromium		1.260		0.322	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		3.000		3.760	1.250	0.500	µg/sample
Lead		7.670	<	MDL	1.250	0.500	µg/sample
Manganese		1.220		0.477	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		31.600	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		12.700		2.900	0.750	0.300	µg/sample
Lab ID:		18-S2353		18-S2354			
Sample Vol:		250		100			mL

Source:	CFU 113			Sample Date:	09/21/18	
Run:	3					
Client ID:	Filter + Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**

Analyte	<	Filter + Front Half Result	<	Back Half Result	FH MDL	BH MDL	Units
Antimony	<	MDL		3.080	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.190		0.640	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		1.250	<	MDL	0.100	0.040	µg/sample
Chromium		1.290		0.233	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		3.230		5.030	1.250	0.500	µg/sample
Lead		7.140	<	MDL	1.250	0.500	µg/sample
Manganese		1.230		0.435	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		33.000	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		8.600		2.670	0.750	0.300	µg/sample
Lab ID:		18-S2355		18-S2356			
Sample Vol:		250		100			mL

Source: **CFU 113**

Blank Values

Client ID:		Filter	MDL		BH Capture Soln.		MDL		FH/BH Rinse		MDL
Analyte	<	µg/sample	Filter MDL µg/sample		5% HNO_3/ 10% H_2O_2 µg/sample	<	5% HNO_3/ 10% H_2O_2 MDL µg/sample	<	0.1 N HNO_3 µg/sample	<	0.1 N HNO_3 MDL µg/sample
Antimony	<	MDL	1.250	<	MDL		0.500	<	MDL		1.250
Arsenic	<	MDL	1.750	<	MDL		0.700	<	MDL		1.750
Barium		2.820	0.125		0.423		0.050		0.454		0.125
Beryllium	<	MDL	0.050	<	MDL		0.020	<	MDL		0.050
Cadmium		0.365	0.100	<	MDL		0.040	<	MDL		0.100
Chromium		0.953	0.200		0.154		0.080	<	MDL		0.200
Cobalt	<	MDL	0.125	<	MDL		0.050	<	MDL		0.125
Copper	<	MDL	1.250		2.750		0.500		2.120		1.250
Lead	<	MDL	1.250	<	MDL		0.500	<	MDL		1.250
Manganese		1.030	0.075		0.980		0.030		0.206		0.075
Nickel	<	MDL	0.750	<	MDL		0.300	<	MDL		0.750
Phosphorus		13.400	5.000	<	MDL		2.000	<	MDL		5.000
Selenium	<	MDL	3.750	<	MDL		1.500	<	MDL		3.750
Zinc		1.240	0.750		0.724		0.300	<	MDL		0.750
Lab ID:		18-S2237			18-S2238				18-S2236		
Sample Vol, ml:		250			100				250		

Hollingsworth & Vose **Method 29 Metals Blank Calculations** **Run: 1**

CFU 113

09/21/18

Species	I Sample* FH Wash+Filter	II Blank* FH Wash, µg	III Blank* FH Filter, µg	IV Sample* BH Cap.Sol.	V Blank* BH Cap.Sol.	VI BH Blank* Corrected Cap.Sol.	VII BH Blank* Corrected Wash, µg	VIII Allowable BH Blank, µg	Species
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.370	0.1816	2.820	0.716	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	1.190	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.240	< 0.0800	0.953	0.294	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	3.700	0.8480	< 1.250	4.150	0.0275	5.500	0.8480	6.348	**Copper**
Pb	7.360	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.270	0.0824	1.030	0.572	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	35.000	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	4.930	< 0.3000	1.240	3.430	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2351**	**18-S2236**	**18-S2237**	**18-S2352**	**18-S2238**				
Content:	$0.1NHNO_3$	$0.1NHNO_3$	$0.1NHNO_3$	$5\%HNO_3/$ $10\%H_2O_2$	$5\%HNO_3/$ $10\%H_2O_2$	$5\%HNO_3/$ $10\%H_2O_2$	$0.1NHNO_3$		
	FH Filter & Probe Rinse			BH Imps 1&2					
	100ml 0.1N HNO_3 rinse	Same as BH Blank Wash		100ml .1N HNO_3 rinse			Same as FH Blank Wash		
				200ml $5\%HNO_3/10\%H_2O_2$ reagent					

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

Species	**X Allowable FH Blank, μg**	**XI FH Blank Corrected μg**		**XII 5% of FH Sample, μg**	**XIII Lessor of XI or XII**	**XIV Greater of A or XIII**		**XV FH Net Sample, μg**	**Species**
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.169	0.169	11.63		0.368	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.060	0.060	11.63		0.825	**Cadmium**
Cr	0.953	0.953		0.062	0.062	11.63		0.287	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.185	0.185	11.63		2.852	**Copper**
Pb	0.000	0.000		0.368	0.000	11.63		7.360	**Lead**
Mn	1.112	1.112		0.064	0.064	11.63		0.158	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		1.750	1.750	11.63		23.370	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.247	0.247	11.63		3.690	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

*** Blank Rules:**
"<" indicates value is below the minimum detection limit (MDL)
If Blank is a "<" value it is treated as zero.
If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

Species	XVI Allowable BH Blank, μg	XVII Blank BH Total		XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of $1\mu g$ or XIX		XXI BH Net Sample, μg		XXII FH Net Sample, μg		XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Antimony**
As	0.000	0.000	<	0.035	0.000	1.000	<	**0.700**	**<**	**1.750**	<	**2.450**	**Arsenic**
Ba	1.000	1.028		0.036	0.036	1.000		**0.000**		**0.368**		**0.368**	**Barium**
Be	0.000	0.000	<	0.001	0.000	1.000	<	**0.020**	**<**	**0.050**	<	**0.070**	**Beryllium**
Cd	0.000	0.000	<	0.002	0.000	1.000	<	**0.040**		**0.825**	<	**0.865**	**Cadmium**
Cr	0.308	0.308		0.015	0.015	1.000		**0.000**		**0.287**		**0.287**	**Chromium**
Co	0.000	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000	6.348		0.208	0.208	1.000		**3.150**		**2.852**		**6.002**	**Copper**
Pb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**		**7.360**	<	**7.860**	**Lead**
Mn	1.000	2.042		0.029	0.029	1.000		**0.000**		**0.158**		**0.158**	**Manganese**
Ni	0.000	0.000	<	0.015	0.000	1.000	<	**0.300**	**<**	**0.750**	<	**1.050**	**Nickel**
P	0.000	0.000	<	0.100	0.000	1.000	<	**2.000**		**23.370**	<	**25.370**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	1.000	1.448		0.172	0.172	1.000		**2.430**		**3.690**		**6.120**	**Zinc**

Allowable BH Blank Calculation:

if 1.00μg >blank>0, use blank derived

if blank >1.00μg , use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

CFU 113

09/21/18

Species	I Sample* FH Wash+Filter	II Blank* FH Wash, µg	III Blank* FH Filter, µg	IV Sample* BH Cap.Sol.	V Blank* BH Cap.Sol.	VI BH Blank* Corrected Cap.Sol.	VII BH Blank* Corrected Wash, µg	VIII Allowable BH Blank, µg	Species
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.350	0.1816	2.820	0.613	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	1.230	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.260	< 0.0800	0.953	0.322	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	3.000	0.8480	< 1.250	3.760	0.0275	5.500	0.8480	6.348	**Copper**
Pb	7.670	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.220	0.0824	1.030	0.477	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	31.600	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	12.700	< 0.3000	1.240	2.900	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2353**	**18-S2236**	**18-S2237**	**#REF!**	**18-S2238**				
Content:	$0.1NHNO_3$ FH Filter & Probe Rinse 100ml 0.1N HNO_3 rinse	$0.1NHNO_3$ Same as BH Blank Wash	$0.1NHNO_3$	$5\%HNO_3/$ $10\%H_2O_2$ BH Imps 1&2 100ml .1N HNO_3 rinse 200ml $5\%HNO_3/10\%H_2O_2$ reagent	$5\%HNO_3/$ $10\%H_2O_2$	$5\%HNO_3/$ $10\%H_2O_2$	$0.1NHNO_3$ Same as FH Blank Wash		

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg		XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII		XV FH Net Sample, μg	Species
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.168	0.168	11.63		0.348	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.062	0.062	11.63		0.865	**Cadmium**
Cr	0.953	0.953		0.063	0.063	11.63		0.307	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.150	0.150	11.63		2.152	**Copper**
Pb	0.000	0.000		0.384	0.000	11.63		7.670	**Lead**
Mn	1.112	1.112		0.061	0.061	11.63		0.108	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		1.580	1.580	11.63		19.970	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.635	0.635	11.63		11.460	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

*** Blank Rules:**
"<" indicates value is below the minimum detection limit (MDL)
If Blank is a "<" value it is treated as zero.
If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

9/21/18

Species	XVI Allowable BH Blank, µg	XVII Blank BH Total	XVIII 5% of BH sample, µg	XIX Lessor of XVII or XVIII	XX Greater of 1µg or XIX	XXI BH Net Sample, µg	XXII FH Net Sample, µg	XXIII FH+BH Total Net Sample, µg	Species
Sb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.031	0.031	1.000	**0.000**	**0.348**	**0.348**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.865** <	**0.905**	**Cadmium**
Cr	0.308	0.308	0.016	0.016	1.000	**0.014**	**0.307**	**0.321**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125** <	**0.175**	**Cobalt**
Cu	1.000	6.348	0.188	0.188	1.000	**2.760**	**2.152**	**4.912**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500**	**7.670** <	**8.170**	**Lead**
Mn	1.000	2.042	0.024	0.024	1.000	**0.000**	**0.108**	**0.108**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**19.970** <	**21.970**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.145	0.145	1.000	**1.900**	**11.460**	**13.360**	**Zinc**

Allowable BH Blank Calculation:

if 1.00µg >blank>0, use blank derived

if blank >1.00µg , use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

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If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

CFU 113

09/21/18

Species	I Sample* FH Wash+Filter	II Blank* FH Wash, µg	III Blank* FH Filter, µg	IV Sample* BH Cap.Sol.	V Blank* BH Cap.Sol.	VI BH Blank* Corrected Cap.Sol.	VII BH Blank* Corrected Wash, µg	VIII Allowable BH Blank, µg	Species
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	3.080	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.190	0.1816	2.820	0.640	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	1.250	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.290	< 0.0800	0.953	0.233	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	3.230	0.8480	< 1.250	5.030	0.0275	5.500	0.8480	6.348	**Copper**
Pb	7.140	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.230	0.0824	1.030	0.435	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	33.000	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	8.600	< 0.3000	1.240	2.670	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2355**	**18-S2236**	**18-S2237**	**18-S2356**	**18-S2238**				
Content:	0.1NHNO_3	0.1NHNO_3	0.1NHNO_3	5%HNO_3/ 10%H_2O_2	5%HNO_3/ 10%H_2O_2	5%HNO_3/ 10%H_2O_2	0.1NHNO_3		

FH Filter & Probe Rinse

100ml 0.1N HNO_3 rinse

Same as BH Blank Wash

BH Imps 1&2

100ml .1N HNO_3 rinse

200ml 5%HNO_3/10%H_2O_2 reagent

Same as FH Blank Wash

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

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Species	**X Allowable FH Blank, μg**	**XI FH Blank Corrected μg**		**XII 5% of FH Sample, μg**	**XIII Lessor of XI or XII**	**XIV Greater of A or XIII**		**XV FH Net Sample, μg**	**Species**
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.160	0.160	11.63		0.188	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.063	0.063	11.63		0.885	**Cadmium**
Cr	0.953	0.953		0.065	0.065	11.63		0.337	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.162	0.162	11.63		2.382	**Copper**
Pb	0.000	0.000		0.357	0.000	11.63		7.140	**Lead**
Mn	1.112	1.112		0.062	0.062	11.63		0.118	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		1.650	1.650	11.63		21.370	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.430	0.430	11.63		7.360	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

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9/21/18

Species	XVI Allowable BH Blank, μg	XVII Blank BH Total	XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of 1μg or XIX	XXI BH Net Sample, μg	XXII FH Net Sample, μg	XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000	0.154	0.000	1.000	**3.080 <**	**1.250** <	**4.330**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.032	0.032	1.000	**0.000**	**0.188**	**0.188**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.885** <	**0.925**	**Cadmium**
Cr	0.308	0.308	0.012	0.012	1.000	**0.000**	**0.337**	**0.337**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125** <	**0.175**	**Cobalt**
Cu	1.000	6.348	0.252	0.252	1.000	**4.030**	**2.382**	**6.412**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500**	**7.140** <	**7.640**	**Lead**
Mn	1.000	2.042	0.022	0.022	1.000	**0.000**	**0.118**	**0.118**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**21.370** <	**23.370**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.134	0.134	1.000	**1.670**	**7.360**	**9.030**	**Zinc**

Allowable BH Blank Calculation:

if 1.00μg >blank>0, use blank derived

if blank >1.00μg , use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

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EPA Method 29
Gas Stream Characteristics
Test Summary

Client: Hollingsworth & Vose
Source: CFU 113
Location: Corvallis, OR

Run			1	2	3	
Date			9/21/2018	9/21/2018	9/21/2018	
Run Start Time			9:25	13:10	16:34	
Run End Time			12:51	16:16	19:39	
Duration, min.			180	180	180	Average
Barometric Pressure, "Hg			29.89	29.89	29.89	**29.89**
Nozzle Dia., in.			0.2133	0.2133	0.2133	**0.2133**
Isokinetic Average, %			100.3	100.7	100.4	**100.5**
Sample Volume, dscf			116.657	111.471	115.041	**114.390**
Sample Volume, dscm			3.303	3.157	3.258	**3.239**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			1.09	1.06	1.07	**1.07**
O_2 %vd			20.13	20.37	19.72	**20.07**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			2.33	2.35	2.24	**2.31**
Wet Molecular Weight, lb/lb-mole			28.72	28.72	28.71	**28.72**
Velocity, FPS			49.74	48.00	49.27	**49.00**
ADCFM			6,360.3	6,136.5	6,305.9	**6,267.6**
AWCFM			6,512.0	6,284.2	6,450.4	**6,415.5**
DSCFM			5,690.8	5,412.5	5,602.3	**5,568.6**
Stack Temperature, ^oF			129.1	137.6	133.3	**133.3**
Production Data	Glass Production	lbs/hr	3663.7	3674.0	3692.6	**3676.8**

Hollingsworth & Vose **Test: M29**
CFU 113
Metals Results Summary

Run 1													
	Total				FH Net					BH Net			
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 1.750	< 0.530	< 1.13E-05	< 3.08E-09	< 1.250	< 0.378	< 8.07E-06	< 2.20E-09	< 0.500	< 0.151	< 3.23E-06	< 8.81E-10	**Sb**
Arsenic	< 2.450	< 0.742	< 1.58E-05	< 4.32E-09	< 1.750	< 0.530	< 1.13E-05	< 3.08E-09	< 0.700	< 0.212	< 4.52E-06	< 1.23E-09	**As**
Barium	0.368	0.112	2.38E-06	6.49E-10	0.368	0.112	2.38E-06	6.49E-10	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.021	< 4.52E-07	< 1.23E-10	< 0.050	< 0.015	< 3.23E-07	< 8.82E-11	< 0.020	< 0.006	< 1.29E-07	< 3.52E-11	**Be**
Cadmium	< 0.865	< 0.262	< 5.58E-06	< 1.52E-09	0.825	0.250	5.32E-06	1.45E-09	< 0.040	< 0.012	< 2.58E-07	< 7.04E-11	**Cd**
Chromium	0.287	0.087	1.85E-06	5.05E-10	0.287	0.087	1.85E-06	5.05E-10	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.053	< 1.13E-06	< 3.08E-10	< 0.125	< 0.038	< 8.07E-07	< 2.20E-10	< 0.050	< 0.015	< 3.23E-07	< 8.82E-11	**Co**
Copper	6.002	1.817	3.87E-05	1.06E-08	2.852	0.863	1.84E-05	5.02E-09	3.150	0.954	2.03E-05	5.55E-09	**Cu**
Lead	< 7.860	< 2.380	< 5.07E-05	< 1.38E-08	7.360	2.228	4.75E-05	1.30E-08	< 0.500	< 0.151	< 3.23E-06	< 8.81E-10	**Pb**
Manganese	0.158	0.048	1.02E-06	2.78E-10	0.158	0.048	1.02E-06	2.78E-10	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.318	< 6.78E-06	< 1.85E-09	< 0.750	< 0.227	< 4.84E-06	< 1.32E-09	< 0.300	< 0.091	< 1.94E-06	< 5.28E-10	**Ni**
Phosphorus	< 25.370	< 7.681	< 1.64E-04	< 4.47E-08	23.370	7.075	1.51E-04	4.12E-08	< 2.000	< 0.606	< 1.29E-05	< 3.52E-09	**P**
Selenium	< 5.250	< 1.589	< 3.39E-05	< 9.25E-09	< 3.750	< 1.135	< 2.42E-05	< 6.61E-09	< 1.500	< 0.454	< 9.68E-06	< 2.642E-09	**Se**
Zinc	6.120	1.853	3.95E-05	1.08E-08	3.690	1.117	2.38E-05	6.50E-09	2.430	0.736	1.57E-05	4.28E-09	**Zn**

Run 2													
	Total				FH Net				BH Net				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 1.750	< 0.554	< 1.12E-05	< 3.06E-09	< 1.250	< 0.396	< 8.03E-06	< 2.18E-09	< 0.500	< 0.158	< 3.21E-06	< 8.74E-10	**Sb**
Arsenic	< 2.450	< 0.776	< 1.57E-05	< 4.28E-09	< 1.750	< 0.554	< 1.12E-05	< 3.06E-09	< 0.700	< 0.222	< 4.50E-06	< 1.22E-09	**As**
Barium	0.348	0.110	2.24E-06	6.09E-10	0.348	0.110	2.24E-06	6.09E-10	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.022	< 4.50E-07	< 1.22E-10	< 0.050	< 0.016	< 3.21E-07	< 8.74E-11	< 0.020	< 0.006	< 1.28E-07	< 3.48E-11	**Be**
Cadmium	< 0.905	< 0.287	< 5.81E-06	< 1.58E-09	0.865	0.274	5.56E-06	1.51E-09	< 0.040	< 0.013	< 2.57E-07	< 7.00E-11	**Cd**
Chromium	0.321	0.102	2.06E-06	5.61E-10	0.307	0.097	1.97E-06	5.36E-10	0.014	0.004	9.00E-08	2.45E-11	**Cr**
Cobalt	< 0.175	< 0.055	< 1.12E-06	< 3.06E-10	< 0.125	< 0.040	< 8.03E-07	< 2.19E-10	< 0.050	< 0.016	< 3.21E-07	< 8.74E-11	**Co**
Copper	4.912	1.556	3.15E-05	8.59E-09	2.152	0.682	1.38E-05	3.76E-09	2.760	0.874	1.77E-05	4.82E-09	**Cu**
Lead	< 8.170	< 2.588	< 5.25E-05	< 1.43E-08	7.670	2.430	4.93E-05	1.34E-08	< 0.500	< 0.158	< 3.21E-06	< 8.74E-10	**Pb**
Manganese	0.108	0.034	6.91E-07	1.88E-10	0.108	0.034	6.91E-07	1.88E-10	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.333	< 6.74E-06	< 1.84E-09	< 0.750	< 0.238	< 4.82E-06	< 1.31E-09	< 0.300	< 0.095	< 1.93E-06	< 5.24E-10	**Ni**
Phosphorus	< 21.970	< 6.959	< 1.41E-04	< 3.84E-08	19.970	6.326	1.28E-04	3.49E-08	< 2.000	< 0.634	< 1.28E-05	< 3.50E-09	**P**
Selenium	< 5.250	< 1.663	< 3.37E-05	< 9.18E-09	< 3.750	< 1.188	< 2.41E-05	< 6.55E-09	< 1.500	< 0.475	< 9.63E-06	< 2.62E-09	**Se**
Zinc	13.360	4.232	8.58E-05	2.34E-08	11.460	3.630	7.36E-05	2.00E-08	1.900	0.602	1.22E-05	3.32E-09	**Zn**

Hollingsworth & Vose **Test: M29**
CFU 113
Metals Results Summary

Run 3													
	Total				FH Net				BH Net				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 4.330	< 1.329	< 2.79E-05	< 7.55E-09	< 1.250	< 0.384	< 8.05E-06	< 2.18E-09	3.080	0.945	1.98E-05	5.37E-09	**Sb**
Arsenic	< 2.450	< 0.752	< 1.58E-05	< 4.27E-09	< 1.750	< 0.537	< 1.13E-05	< 3.05E-09	< 0.700	< 0.215	< 4.51E-06	< 1.22E-09	**As**
Barium	0.188	0.058	1.21E-06	3.28E-10	0.188	0.058	1.21E-06	3.28E-10	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.021	< 4.51E-07	< 1.22E-10	< 0.050	< 0.015	< 3.22E-07	< 8.72E-11	< 0.020	< 0.006	< 1.29E-07	< 3.49E-11	**Be**
Cadmium	< 0.925	< 0.284	< 5.96E-06	< 1.61E-09	0.885	0.272	5.70E-06	1.54E-09	< 0.040	< 0.012	< 2.58E-07	< 6.99E-11	**Cd**
Chromium	0.337	0.103	2.17E-06	5.88E-10	0.337	0.103	2.17E-06	5.88E-10	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.054	< 1.13E-06	< 3.05E-10	< 0.125	< 0.038	< 8.05E-07	< 2.18E-10	< 0.050	< 0.015	< 3.22E-07	< 8.72E-11	**Co**
Copper	6.412	1.968	4.13E-05	1.12E-08	2.382	0.731	1.53E-05	4.15E-09	4.030	1.237	2.60E-05	7.03E-09	**Cu**
Lead	< 7.640	< 2.345	< 4.92E-05	< 1.33E-08	7.140	2.192	4.60E-05	1.25E-08	< 0.500	< 0.153	< 3.22E-06	< 8.72E-10	**Pb**
Manganese	0.118	0.036	7.57E-07	2.05E-10	0.118	0.036	7.57E-07	2.05E-10	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.322	< 6.76E-06	< 1.83E-09	< 0.750	< 0.230	< 4.83E-06	< 1.31E-09	< 0.300	< 0.092	< 1.93E-06	< 5.23E-10	**Ni**
Phosphorus	< 23.370	< 7.173	< 1.51E-04	< 4.08E-08	21.370	6.559	1.38E-04	3.73E-08	< 2.000	< 0.614	< 1.29E-05	< 3.49E-09	**P**
Selenium	< 5.250	< 1.611	< 3.38E-05	< 9.16E-09	< 3.750	< 1.151	< 2.42E-05	< 6.54E-09	< 1.500	< 0.460	< 9.66E-06	< 2.616E-09	**Se**
Zinc	9.030	2.772	5.82E-05	1.58E-08	7.360	2.259	4.74E-05	1.28E-08	1.670	0.513	1.08E-05	2.91E-09	**Zn**

Mean Runs 1-3													
	Total				FH Net				BH Net				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 2.610	< 0.804	< 1.68E-05	< 4.56E-09	< 1.250	< 0.386	< 8.05E-06	< 2.19E-09	< 1.360	< 0.418	< 8.76E-06	< 2.38E-09	**Sb**
Arsenic	< 2.450	< 0.757	< 1.58E-05	< 4.29E-09	< 1.750	< 0.540	< 1.13E-05	< 3.06E-09	< 0.700	< 0.216	< 4.51E-06	< 1.23E-09	**As**
Barium	0.302	0.093	1.94E-06	5.29E-10	0.302	0.093	1.94E-06	5.29E-10	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.022	< 4.51E-07	< 1.23E-10	< 0.050	< 0.015	< 3.22E-07	< 8.76E-11	< 0.020	< 0.006	< 1.29E-07	< 3.50E-11	**Be**
Cadmium	< 0.898	< 0.277	< 5.78E-06	< 1.57E-09	0.858	0.265	5.53E-06	1.50E-09	< 0.040	< 0.012	< 2.58E-07	< 7.01E-11	**Cd**
Chromium	0.315	0.097	2.03E-06	5.51E-10	0.310	0.096	2.00E-06	5.43E-10	0.005	0.001	3.00E-08	8.17E-12	**Cr**
Cobalt	< 0.175	< 0.054	< 1.13E-06	< 3.06E-10	< 0.125	< 0.039	< 8.05E-07	< 2.19E-10	< 0.050	< 0.015	< 3.22E-07	< 8.76E-11	**Co**
Copper	5.775	1.780	3.72E-05	1.01E-08	2.462	0.759	1.59E-05	4.31E-09	3.313	1.022	2.13E-05	5.80E-09	**Cu**
Lead	< 7.890	< 2.438	< 5.08E-05	< 1.38E-08	7.390	2.283	4.76E-05	1.29E-08	< 0.500	< 0.154	< 3.22E-06	< 8.76E-10	**Pb**
Manganese	0.128	0.039	8.22E-07	2.24E-10	0.128	0.039	8.22E-07	2.24E-10	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.324	< 6.76E-06	< 1.84E-09	< 0.750	< 0.232	< 4.83E-06	< 1.31E-09	< 0.300	< 0.093	< 1.93E-06	< 5.25E-10	**Ni**
Phosphorus	< 23.570	< 7.271	< 1.52E-04	< 4.13E-08	21.570	6.653	1.39E-04	3.78E-08	< 2.000	< 0.618	< 1.29E-05	< 3.50E-09	**P**
Selenium	< 5.250	< 1.621	< 3.38E-05	< 9.19E-09	< 3.750	< 1.158	< 2.41E-05	< 6.57E-09	< 1.500	< 0.463	< 9.66E-06	< 2.627E-09	**Se**
Zinc	9.503	2.952	6.12E-05	1.66E-08	7.503	2.335	4.83E-05	1.31E-08	2.000	0.617	1.29E-05	3.50E-09	**Zn**
Total:	**< 59.986**	**< 18.531**	**< 3.86E-04**	**< 1.05E-07**	< 48.198	< 14.894	< 3.10E-04	< 8.44E-08	< 11.788	< 3.636	< 7.59E-05	< 2.06E-08	

‘<’ denotes results calculated using the minimum detection limit for front half or back half results that were non-detect.

EPA Methods 1-4, 29
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:25**
Source:	**CFU 113**	**End Time:**	**12:51**
Method:	**29**	**Date:**	**9/21/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.991 "Hg
   where Pb: 29.89 "Hg
   ΔH: 1.375 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.869 "Hg
   where Pb: 29.89 "Hg
   Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 116.657 dscf
   where Vm: 115.631 dcf
   Y: 0.9985
   Pm: 29.991 "Hg
   Tm: 523.6 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.777 scf
   where H_2O: 59.00 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0233
   where Vw(std): 2.777 scf
   Vm(std): 116.657 dscf

6) % H_2O = Bws x 100 = 2.33 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 133.543 awcf
   where Y: 0.9985
   Vm: 115.6309 dcf
   Bws: 0.0233
   Ts: 589.1 °A
   Tm: 523.6 °A
   Pm: 29.991 "Hg
   Ps: 29.869 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.98 lb/lb-mole
   where CO_2: 1.09 %vd
   O_2 20.13 %vd
   N_2+CO= (100-(O_2+CO_2): 78.78 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.72 lb/lb-mole

where M_d:	28.98	lb/lb-mole
Bws:	0.0233	

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 2.182 sq. ft.

where Stack ID:	20	inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.

where Stack Width:	0.000	inches
Stack Length:	0.000	inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 49.74 fps

where Cp:	0.84	
Ave. Sqrt ΔP:	0.8358	
Ts:	589.1	°A
Ps:	29.869	"Hg
Ms:	28.72	lb/lb-mole

12) $AWCFM = (V_s)\text{(stack area)(60 sec/min)} =$ 6,512.0 AWCFM

where V_s:	49.74	ft/sec
Stack Area:	2.182	sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 6,360.3 ADCFM

where AWCFM:	6,512.0	
Bws:	0.0233	

14) $Qsw = 3600(V_s)\text{(stack area)}\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 349,596.5 wscf/hr

where V_s:	49.74	ft/sec
Stack Area:	2.1820	sq. ft.
Ts:	589.1	°A
Ps:	29.869	"Hg

15) Qsd = (wscf/hr)(1-Bws) = 341,450.9 dscf/hr

where wscf/hr:	349,596.5	
Bws:	0.0233	

16) DSCFM= (dscf/hr)/60 mins/hr = 5,690.8 DSCFM

where dscf/hr:	341,450.9	

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000248 sq. ft.

where Nozzle Size:	0.2133	inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.3 %

where Ts:	589.1	°A
Vm(Std):	116.657	dscf
Ps:	29.869	"Hg
Vs	49.74	ft/sec
Nozzle Area:	0.000248	sq. ft.
Sampling Time:	180	min.
Bws:	0.0233	

EPA Method 29:
Chromium

19) Cr Laboratory Results (blank corrected)

Front half (FH):	0.287	µg/sample
Back half (BH):	0.000	µg/sample
Total (FH + BH):	0.287	µg/sample

20) Cs = µg/Vm(std) = 0.087 µg/dscm

where Run 1 Total:	0.287	µg/sample
Vm(std):	3.303	dscm

21) Emission Rate = (Cs)($\frac{2.83168\ m^3}{ft^3}$)(stack flow)($\frac{2.2046E-9\ lb}{\mu g}$)= 1.85E-06 lb/hr

where Cs:	0.087	µg/dscm
Stack Flow:	341,450.9	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113 (1)**
DATE(S)	**09/21/18**
METHOD	**30B**
POLLUTANT	**Mercury**

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU 113 (1)**	**End Time:**	**12:51**
EPA Method:	**30B**	**Start Date:**	**9/21/2018**
Box Operator:	**CMF**	**End Date:**	**9/21/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.89 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN-30B	
Probe heat:	267 F	
Meterbox ID:	HLN-Duel 30B	HLN-Duel 30B
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498480	OL492744
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.001	0.002	0.002	0.002

Test Summary:

	Side A	Side B
Sample Volume:	360.310	360.324 L
Ave. Meter Temp:	75.1	77.6 °F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	**Side A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0	0.000	0.000	118	118	59	59	7	7	266	268	2.000	2.000
5	10.590	10.590	120	120	59	61	7	7	266	268	2.118	2.118
10	20.350	20.360	121	121	60	60	7	7	266	268	1.952	1.954
15	30.450	30.440	123	123	62	63	7	7	266	268	2.020	2.016
20	39.970	40.010	125	125	63	66	7	7	266	268	1.904	1.914
25	49.870	49.880	126	126	65	68	7	7	266	268	1.980	1.974
30	59.760	59.760	127	127	67	70	7	7	266	268	1.978	1.976
35	69.690	69.690	127	127	67	70	7	7	266	268	1.986	1.986
40	79.630	79.650	127	127	71	74	7	7	266	268	1.988	1.992
45	89.550	89.570	128	128	73	76	7	7	266	268	1.984	1.984
50	99.490	99.510	128	128	74	77	8	7	266	268	1.988	1.988
55	109.750	109.710	128	128	75	78	8	7	266	268	2.052	2.040
60	119.920	119.960	128	128	76	80	8	7	266	268	2.034	2.050
65	130.100	130.130	128	128	78	81	8	7	266	268	2.036	2.034
70	140.310	140.260	130	130	79	82	9	6	266	268	2.042	2.026
75	150.450	150.420	130	130	80	84	9	6	266	268	2.028	2.032
80	160.680	160.700	130	130	80	84	9	6	266	268	2.046	2.056
85	170.810	170.720	130	130	83	86	9	6	266	268	2.026	2.004
90	180.912	180.945	130	130	82	87	9	6	266	268	2.020	2.045
95	191.200	191.050	132	132	81	84	9	6	266	268	2.058	2.021
100	201.400	201.370	132	132	80	83	9	7	266	268	2.040	2.064
105	211.580	211.510	132	132	79	82	9	7	266	268	2.036	2.028
110	221.550	221.560	133	133	79	81	8	7	266	268	1.994	2.010
115	231.430	231.480	133	133	79	81	8	7	266	268	1.976	1.984
120	241.320	241.340	132	132	79	81	8	7	266	268	1.978	1.972
125	251.240	251.260	133	133	79	81	8	7	266	268	1.984	1.984
130	261.180	261.180	133	133	78	81	8	7	266	268	1.988	1.984
135	271.100	271.090	133	133	79	81	8	7	266	268	1.984	1.982
140	281.020	281.000	133	133	79	81	8	7	266	268	1.984	1.982
145	290.910	290.900	134	134	78	81	8	7	266	268	1.978	1.980
150	300.830	300.830	135	135	79	81	8	7	266	268	1.984	1.986
155	310.740	310.750	136	136	79	81	8	7	266	268	1.982	1.984
160	320.640	320.650	136	136	79	81	8	7	266	268	1.980	1.980
165	330.600	330.580	136	136	79	81	8	7	266	268	1.992	1.986
170	340.510	340.500	137	137	79	81	8	7	266	268	1.982	1.984
175	350.420	350.430	136	136	80	82	8	7	266	268	1.982	1.986
180	360.310	360.324	136	136	80	82	8	7	266	268	1.978	1.979

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**13:10**
Source:	**CFU 113 (1)**	**End Time:**	**16:16**
EPA Method:	**30B**	**Start Date:**	**9/21/2018**
Box Operator:	**CMF**	**End Date:**	**9/21/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.89 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN-30B	
Probe heat:	267 F	
Meterbox ID:	HLN-Duel 30B	HLN-Duel 30B
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498496	OL470836
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.002	0.002	0.001	0.001

Test Summary:

	Side A	Side B
Sample Volume:	360.218	360.254 L
Ave. Meter Temp:	82.6	84.6 °F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
0	0.000	0.000	135	135	79	80	9	7	266	268	2.000	2.000
5	10.550	10.500	135	135	79	80	8	7	266	268	2.110	2.100
10	21.160	21.060	135	135	78	80	7	7	266	268	2.122	2.112
15	31.240	31.360	135	135	78	80	7	7	266	268	2.016	2.060
20	41.400	41.430	135	135	79	81	7	7	266	268	2.032	2.014
25	51.460	51.440	135	135	80	82	7	7	266	268	2.012	2.002
30	61.380	61.350	135	135	80	82	7	7	266	268	1.984	1.982
35	71.290	71.330	135	135	80	82	7	7	266	268	1.982	1.996
40	81.310	81.280	135	135	81	83	7	7	266	268	2.004	1.990
45	91.290	91.280	135	135	81	83	7	7	266	268	1.996	2.000
50	101.330	101.310	135	135	81	83	7	7	266	268	2.008	2.006
55	111.330	111.310	135	135	81	83	7	7	266	268	2.000	2.000
60	121.360	121.350	137	137	81	84	7	7	266	268	2.006	2.008
65	131.380	131.360	137	137	82	84	7	7	266	268	2.004	2.002
70	141.390	141.380	137	137	82	84	7	7	266	268	2.002	2.004
75	151.400	151.390	137	137	83	85	7	7	266	268	2.002	2.002
80	161.350	161.320	137	137	83	85	7	7	266	268	1.990	1.986
85	171.290	171.300	137	137	83	86	8	7	266	268	1.988	1.996
90	181.022	181.003	139	139	84	86	8	7	266	268	1.946	1.941
95	190.840	190.830	139	139	84	86	8	7	266	268	1.964	1.965
100	200.630	200.610	139	139	84	86	8	7	266	268	1.958	1.956
105	210.420	210.400	139	139	84	86	8	7	266	268	1.958	1.958
110	220.250	220.240	139	139	84	86	8	7	266	268	1.966	1.968
115	230.150	230.140	139	139	84	86	8	7	266	268	1.980	1.980
120	239.900	239.900	139	139	84	86	8	7	266	268	1.950	1.952
125	249.660	249.690	140	140	84	86	8	7	266	268	1.952	1.958
130	259.490	259.490	140	140	85	87	8	7	266	268	1.966	1.960
135	269.290	269.310	140	140	85	87	8	7	266	268	1.960	1.964
140	279.090	279.100	140	140	85	87	8	7	266	268	1.960	1.958
145	289.020	289.030	140	140	85	87	8	7	266	268	1.986	1.986
150	299.120	299.130	140	140	85	87	8	7	266	268	2.020	2.020
155	309.310	309.320	140	140	85	87	8	7	266	268	2.038	2.038
160	319.460	319.440	140	140	85	87	8	7	266	268	2.030	2.024
165	329.680	329.680	140	140	85	87	8	7	266	268	2.044	2.048
170	339.850	339.860	140	140	85	87	8	7	266	268	2.034	2.036
175	349.990	349.990	140	140	85	87	8	7	266	268	2.028	2.026
180	360.218	360.254	139	139	85	87	8	9	266	268	2.046	2.053

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**16:34**
Source:	**CFU 113 (1)**	**End Time:**	**19:39**
EPA Method:	**30B**	**Start Date:**	**9/21/2018**
Box Operator:	**CMF**	**End Date:**	**9/21/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.89	"Hg
Test duration:	180	min

Equipment:

Probe ID:	HLN-30B		
Probe heat:	267	F	
	Side A	Side B	
Meterbox ID:	LN-Duel 30B	.N-Duel 30B	
Y factor:	1.0460	1.0380	
Desired sampling rate:	2	2	lpm
Trap ID#:	OL498473	OL492747	
Spiked @:	0	5	ng
Orifice # (if used):			

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.001	0.000	0.000	0.000

Test Summary:

	Side A	Side B	
Sample Volume:	361.051	361.071	L
Ave. Meter Temp:	83.6	85.5	°F

Time (min.)	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
	Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
0	0.000	0.000	139	139	84	85	9	7	266	268	2.000	2.000
5	10.520	10.500	138	138	84	85	9	7	266	268	2.104	2.100
10	20.410	20.440	138	138	83	85	9	7	266	268	1.978	1.988
15	30.620	30.620	138	138	83	85	9	7	266	268	2.042	2.036
20	40.720	40.720	137	137	83	85	9	7	266	268	2.020	2.020
25	50.950	50.960	137	137	83	85	9	7	266	268	2.046	2.048
30	60.990	60.960	137	137	84	86	9	7	266	268	2.008	2.000
35	70.920	70.950	136	136	84	86	9	7	266	268	1.986	1.998
40	80.890	80.870	136	136	84	86	9	7	266	268	1.994	1.984
45	90.750	90.770	136	136	84	87	9	7	266	268	1.972	1.980
50	100.690	100.720	136	136	85	87	9	7	266	268	1.988	1.990
55	110.600	110.620	134	134	85	87	9	7	266	268	1.982	1.980
60	120.550	120.570	134	134	85	87	9	7	266	268	1.990	1.990
65	130.500	130.500	134	134	85	87	9	7	266	268	1.990	1.986
70	140.430	140.450	135	135	85	87	9	7	266	268	1.986	1.990
75	150.370	150.380	135	135	85	87	9	7	266	268	1.988	1.986
80	160.300	160.300	135	135	85	87	9	7	266	268	1.986	1.984
85	170.250	170.250	135	135	85	87	9	7	266	268	1.990	1.990
90	180.211	180.175	135	135	84	87	9	7	266	268	1.992	1.985
95	190.220	190.210	132	132	84	86	9	7	266	268	2.002	2.007
100	200.180	200.190	132	132	83	86	9	7	266	268	1.992	1.996
105	210.200	210.200	132	132	83	86	9	7	266	268	2.004	2.002
110	220.120	220.100	132	132	83	85	9	7	266	268	1.984	1.980
115	230.040	230.020	132	132	83	85	9	7	266	268	1.984	1.984
120	239.980	239.960	133	133	83	85	9	7	266	268	1.988	1.988
125	249.940	249.920	133	133	83	85	9	7	266	268	1.992	1.992
130	259.860	259.840	133	133	83	85	9	7	266	268	1.984	1.984
135	269.900	269.850	133	133	83	85	9	7	266	268	2.008	2.002
140	279.750	279.740	130	130	83	85	9	7	266	268	1.970	1.978
145	289.740	289.840	130	130	83	85	9	7	266	268	1.998	2.020
150	299.940	299.940	128	128	83	85	9	7	266	268	2.040	2.020
155	310.130	310.130	128	128	82	84	9	7	266	268	2.038	2.038
160	320.290	320.210	128	128	82	84	9	7	266	268	2.032	2.016
165	330.420	330.350	128	128	82	84	9	7	266	268	2.026	2.028
170	340.740	340.740	128	128	82	84	9	7	266	268	2.064	2.078
175	350.850	350.740	128	128	84	84	9	7	266	268	2.022	2.000
180	361.051	361.071	128	128	84	84	9	7	266	268	2.040	2.066

Method 30B
Mercury Concentration

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113 (1)
Test date: 9/21/2018

Meterbox Y:
Side A 1.0460
Side B 1.0380

Run	Sample	Sample Date	Trap ID	Spiked @ ng	Section 1 ng	Section 2 ng	Total Hg ng	Total Hg µg	DGM reading L	Sample volume (corrected for Y) L	Bp "Hg	Meter Temp. °F	Sample Vol. dscm	Hg Conc. µg/dscm	Ave. Pair Hg Conc. µg/dscm
1	A	9/21/2018	OL498480	0.0	VOID	1.2	-	-	360.310	376.884	29.89	75.1	0.372	-	-
	B		OL492744	5.0	11,660	5.7	11660.7	11.661	360.324	374.016		77.6	0.367	31.776	
2	A	9/21/2018	OL498496	0.0	11,820	2.5	11822.5	11.823	360.218	376.788	29.89	82.6	0.366	32.277	32.395
	B		OL470836	5.0	11,780	0.4	11775.4	11.775	360.254	373.944		84.6	0.362	32.512	
3	A	9/21/2018	OL498473	0.0	13,040	2.0	13042.0	13.042	361.051	377.659	29.89	83.6	0.366	35.590	35.407
	B		OL492747	5.0	12,770	0.4	12765.4	12.765	361.071	374.792		85.5	0.362	35.224	

Average: 33.901

Trap Concentrations Example Calculations:
Run 2, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 11822.5 ng
where Section 1: 11820.0 ng
Section 2: 2.5 ng
Spike: 0.0 ng

2. Conversion to µg — Total Hg ng/1000 = 11.82 µg
where Total Hg ng: 11822.5 ng

3. Corrected sample volume = DGM reading x Meterbox Y factor = 376.788 L
where DGM reading: 360.218 L
Y: 1.046

4. Standard Volume (DSCM) $= \text{Sample Vol. (L)} \times \left(\frac{528\,°A}{Tm+460}\right) \times Bp/29.92\ "Hg\ /1000 =$ 0.366 DSCM
where Sample vol.: 376.788 L
T_m: 82.6 °F
B_p: 29.89 "Hg

5. Hg concentration µg/dscm = Total Hg µg / Volume DSCM = 32.277 µg/dscm
where Total Hg: 11.82 µg
DSCM: 0.366

6. Average Pair Concentration = (Side A Conc.+ Side B Conc.)/2 = 32.395 µg/dscm
where Side A: 32.277 µg/dscm
Side B: 32.512 µg/dscm

Run 1 was voided because Trap A flooded the low level mercury analyzer

Method 30B
Results QA/QC

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113 (1)
Test date: 9/21/2018
Test type: C [C for compliance; R for RATA]

Run	Sample	Sample Date	Trap ID	Spiked @ ng	Section 1 ng	Section 2 ng	Total Hg ng	Hg Conc. µg/dscm	Breakthr. %	Breakthr. Results PASS/FAIL	C_{rec}, Spiked Compound µg/dscm	Spiked Hg Recovery R Value %	RD Paired Traps %	Paired Trap Agree. PASS/FAIL
1	A	9/21/2018	OL498480	0	VOID	1.2	-	-	-	-	-	-	-	-
	B		OL492744	5	11660	5.7	11660.7	31.78	0.0	PASS				
2	A	9/21/2018	OL498496	0	11820	2.5	11822.5	32.28	0.0	PASS	0.249	1805	0.36	PASS
	B		OL470836	5	11780	0.4	11775.4	32.51	0.0	PASS				
3	A	9/21/2018	OL498473	0	13040	2	13042.0	35.59	0.0	PASS	0.352	2550	0.52	PASS
	B		OL492747	5	12770	0.4	12765.4	35.22	0.0	PASS				

1. Breakthrough Critera

Every sample must meet the following critera for breakthrough % from Section 1 to Section 2.

$$Breakthrough\,\% = \frac{Section\ 2\ ng}{Section\ 1\ ng} x100$$ Eq. 30B-2

Allowable Breakthrough %	Compliance Testing (µg/dscm)	RATA (µg/dscm)
10	> 1	> 1
20	≤1	≤1; >0.5
50	Hg conc. ≤30% of emission limit	≤0.5; >0.1

RM average: 33.901 µg/dscm

Run 1 was voided because Trap A flooded the low level mercury analyzer

2. Field Recovery Test Field Recovery 3-run Average (%): 2177 FAIL

Determines the fraction of spiked Hg recovered (R). Perform for at least three runs per field test. Average of three runs must be between 85 and 115%

$$Crec = \frac{mass\ spiked\ (\mu g)}{Volume\ spiked\ (dscm)} - \frac{mass\ unspiked\ (\mu g)}{Volume\ unspiked\ (dscm)}$$ Eq. 30B-6

$$R = \frac{Crec\ (\frac{\mu g}{dscm})\ x\ vol.spiked\ (dscm)}{mass\ spiked\ (\mu g)} x100$$ Eq. 30B-7

3. Paired trap agreement

$$RD = \frac{|Conc.Trap\ A - Conc.Trap\ B|}{Conc.Trap\ A + Conc.Trap\ B} x100$$ Eq. 30B-5

If paired trains meet the relative deviation (RD) and other QA requirements, the average of the two Hg concs. may be used as an emissions test run value or as the reference method value for a RATA run.

Allowable Relative Dev. %	For Hg conc. (µg/dscm)
10	> 1
20	≤1
or ≤0.2 ug/dscm absolute difference in Hg concs.	≤1

M30B Table 9-1

Method 30B
Emission Calculations

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113 (1)
Test date: 9/21/2018

Run	Ave. Pair Hg Conc. µg/dscm	Hg Conc. lb/dscf	Stack Flow* dscf/hr	Glass Production lb/hr	Stack Emissions lb/hr	Stack Emissions lb/lb glass produced
1	-	-	341,450.9	3663.7		
2	32.395	2.02E-09	324,752.9	3674.0	6.57E-04	1.79E-07
3	35.407	2.21E-09	336,139.5	3692.6	7.43E-04	2.01E-07
Average Results:	33.901	2.12E-09	334,114.4	3676.8	7.00E-04	1.90E-07

*From direct stack measurements made during concurrent M29 runs

Run 1 was voided because Trap A flooded the low level mercury analyzer

Daily Gaseous Calibrations Log

Client: H&V

Source: CFV-113 – M29/30B/3A

Date: 09/21/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	Ø	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

*Use of a calibrated instrument required

– see 9-11-18

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
Ø	X					Ø	X		
10	X					2	X		
20	X					4	X		

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
08:40 → Target	x	Target	x	Target	X	Target	X	Target	X
Ø	X					Ø	X		
10						2	X		

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run #1 —

Test Times: R-1 09:45 – 12:51 R-2 13:10 – 16:16 R-3 16:34 – 19:39

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-113 (1)**
Facility	**Glass Plant 1**	Date	**September 21, 2018**
Location	**Corvallis, OR**		

Run	1	2	3	
Date	9/21/2018	9/21/2018	9/21/2018	
Run Start Time	9:45	13:10	16:34	
Run End Time	12:51	16:16	19:39	
CO_2 %vd	1.09	1.06	1.07	1.07
O_2 %vd	20.13	20.37	19.72	20.07

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (1)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 21, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.00	0.14	0.70	pass	0.06	0.30	pass	-0.40	pass				
	upscale	9.89	9.92	0.15	pass	9.77	-0.60	pass	-0.75	pass	20	19.72	20.13	10
Run 2	zero	0.00	0.06	0.30	pass	0.08	0.40	pass	0.10	pass				
	upscale	9.89	9.77	-0.60	pass	9.84	-0.25	pass	0.35	pass	20	19.90	20.37	10
Run 3	zero	0.00	0.08	0.40	pass	0.08	0.40	pass	0.00	pass				
	upscale	9.89	9.84	-0.25	pass	10.08	0.95	pass	1.20	pass	20	19.56	19.72	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0	9.89	20.13
Analyzer Cal. Error	0.00	-0.55	0.65
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (1)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 21, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.01	0.02	0.75	pass	0.05	1.50	pass	0.75	pass				
	upscale	1.84	1.83	-0.25	pass	2.03	4.75	pass	5.00	pass	4	1.07	1.09	2
Run 2	zero	-0.01	0.05	1.50	pass	0.04	1.25	pass	-0.25	pass				
	upscale	1.84	2.03	4.75	pass	2.04	5.00	pass	0.25	pass	4	1.10	1.06	2
Run 3	zero	-0.01	0.04	1.25	pass	0.05	1.50	pass	0.25	pass				
	upscale	1.84	2.04	5.00	pass	2.04	5.00	pass	0.00	pass	4	1.11	1.07	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	-0.01	1.84	4.03
Analyzer Cal. Error	-0.25	-4.00	0.75
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU-113 (1)**	**End Time:**	**12:51**
Method:	**3A**	**Date:**	**9/21/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.55 %v

where C_{Dir}:	9.89	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.15 %v

where C_{Dir}:	9.89	ppmv
C_S:	9.92	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.75 %v

where SB_{Final}:	-0.60	ppmv
SB_i:	0.15	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 20.13 ppmv

where C_{Avg}:	19.72	ppmv
C_O:	0.10	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.85	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:45**
Source:	**CFU-113 (1)**	**End Time:**	**12:51**
Method:	**3A**	**Date:**	**9/21/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -4.00 %v

where C_{Dir}:	1.84	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.25 %v

where C_{Dir}:	1.84	ppmv
C_S:	1.83	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 5.00 %v

where SB_{Final}:	4.75	ppmv
SB_i:	-0.25	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 1.09 ppmv

where C_{Avg}:	1.07	ppmv
C_O:	0.04	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.93	ppmv

Hollingsworth & Vose
CFU-113 (1)
Daily Calibrations
9/21/2018

Date	Time	O2 [%]	CO2 [%]
9/21/2018	8:29:22	0.00	-0.01
9/21/2018	8:29:32	0.00	-0.01
9/21/2018	8:29:42	0.00	-0.01
9/21/2018	8:29:52	0.00	-0.01
9/21/2018	8:30:02	0.01	-0.02
9/21/2018	8:30:12	0.02	-0.01
9/21/2018	8:30:22	0.03	-0.01
9/21/2018	8:30:32	0.09	-0.01
9/21/2018	8:30:42	0.19	0.00
9/21/2018	8:30:52	0.32	-0.01
9/21/2018	8:31:02	0.48	-0.01
9/21/2018	8:31:12	0.63	0.00
9/21/2018	8:31:22	0.79	0.00
9/21/2018	8:31:32	0.90	-0.01
9/21/2018	8:31:42	1.72	0.03
9/21/2018	8:31:52	1.14	0.19
9/21/2018	8:32:02	17.26	16.29
9/21/2018	8:32:12	20.09	19.45
9/21/2018	8:32:22	20.28	19.50
9/21/2018	8:32:32	20.29	19.53
9/21/2018	8:32:42	20.30	19.53
9/21/2018	8:32:52	20.27	19.54
9/21/2018	8:33:02	20.22	19.55
9/21/2018	8:33:12	20.19	19.55
9/21/2018	8:33:22	20.10	19.56
9/21/2018	8:33:32	20.10	19.56
9/21/2018	8:33:42	19.37	19.54
9/21/2018	8:33:52	15.78	13.98
9/21/2018	8:34:02	9.73	9.51
9/21/2018	8:34:12	9.88	9.69
9/21/2018	8:34:22	9.89	9.70
9/21/2018	8:34:32	9.89	9.70
9/21/2018	8:34:42	9.89	9.70
9/21/2018	8:34:52	9.89	9.69
9/21/2018	8:35:02	9.89	9.69
9/21/2018	8:35:12	9.88	9.69
9/21/2018	8:35:22	7.00	5.88
9/21/2018	8:35:32	3.51	3.77
9/21/2018	8:35:42	3.85	4.02
9/21/2018	8:35:52	3.87	4.03
9/21/2018	8:36:02	3.86	4.03

Hollingsworth & Vose
CFU-113 (1)
Daily Calibrations
9/21/2018

Date	Time	O2 [%]	CO2 [%]
9/21/2018	8:36:12	3.87	4.03
9/21/2018	8:36:22	3.87	4.03
9/21/2018	8:36:32	3.87	4.03
9/21/2018	8:36:42	3.15	3.01
9/21/2018	8:36:52	2.07	1.94
9/21/2018	8:37:02	1.92	1.85
9/21/2018	8:37:12	1.90	1.84
9/21/2018	8:37:22	1.89	1.85
9/21/2018	8:37:32	1.89	1.84
9/21/2018	8:37:42	1.89	1.84
9/21/2018	8:37:52	1.89	1.83
9/21/2018	8:38:02	7.15	1.44
		O2 [%]	**CO2 [%]**
Analyzer Zero		**0.00**	**-0.01**
Analyzer Mid		**9.89**	**1.84**
Analyzer High		**20.13**	**4.03**
System			
9/21/2018	8:38:12	19.85	0.14
9/21/2018	8:38:22	20.52	0.12
9/21/2018	8:38:32	20.55	0.13
9/21/2018	8:38:42	20.53	0.13
9/21/2018	8:38:52	20.53	0.12
9/21/2018	8:39:02	20.52	0.12
9/21/2018	8:39:12	20.51	0.13
9/21/2018	8:39:22	20.50	0.13
9/21/2018	8:39:32	20.50	0.13
9/21/2018	8:39:42	20.49	0.14
9/21/2018	8:39:52	20.49	0.13
9/21/2018	8:40:02	20.48	0.14
9/21/2018	8:40:12	20.48	0.13
9/21/2018	8:40:22	20.19	0.13
9/21/2018	8:40:32	19.33	0.14
9/21/2018	8:40:42	18.65	0.11
9/21/2018	8:40:52	8.23	0.04
9/21/2018	8:41:02	2.52	0.02
9/21/2018	8:41:12	0.86	0.01
9/21/2018	8:41:22	0.37	0.01
9/21/2018	8:41:32	0.23	0.01
9/21/2018	8:41:42	0.19	0.01
9/21/2018	8:41:52	0.17	0.01

Hollingsworth & Vose
CFU-113 (1)
Daily Calibrations
9/21/2018

Date	Time	O2 [%]	CO2 [%]
9/21/2018	8:42:02	0.16	0.01
9/21/2018	8:42:12	0.16	0.01
9/21/2018	8:42:22	0.16	0.01
9/21/2018	8:42:32	0.15	0.02
9/21/2018	8:42:42	0.15	0.01
9/21/2018	8:42:52	0.15	0.01
9/21/2018	8:43:02	0.15	0.01
9/21/2018	8:43:12	0.15	0.01
9/21/2018	8:43:22	0.14	0.01
9/21/2018	8:43:32	0.14	0.02
9/21/2018	8:43:42	0.14	0.02
9/21/2018	8:43:52	0.14	0.02
9/21/2018	8:44:02	0.14	0.01
9/21/2018	8:44:12	0.14	0.01
9/21/2018	8:44:22	0.28	0.25
9/21/2018	8:44:32	1.30	1.33
9/21/2018	8:44:42	1.79	1.68
9/21/2018	8:44:52	1.92	1.77
9/21/2018	8:45:02	1.97	1.80
9/21/2018	8:45:12	1.98	1.82
9/21/2018	8:45:22	1.99	1.83
9/21/2018	8:45:32	1.99	1.83
9/21/2018	8:45:42	1.99	1.84
9/21/2018	8:45:52	1.99	1.84
9/21/2018	8:46:02	2.00	1.84
9/21/2018	8:46:12	3.98	4.52
9/21/2018	8:46:22	7.93	8.33
9/21/2018	8:46:32	9.20	9.26
9/21/2018	8:46:42	9.56	9.52
9/21/2018	8:46:52	9.65	9.62
9/21/2018	8:47:02	9.68	9.64
9/21/2018	8:47:12	9.69	9.66
9/21/2018	8:47:22	9.70	9.66
9/21/2018	8:47:32	9.70	9.67
9/21/2018	8:47:42	9.69	9.67
9/21/2018	8:47:52	9.69	9.66
9/21/2018	8:48:02	9.69	9.67
9/21/2018	8:48:12	9.69	9.68
9/21/2018	8:48:22	9.75	9.68
9/21/2018	8:48:32	9.95	9.68
9/21/2018	8:48:42	9.95	9.67

Hollingsworth & Vose
CFU-113 (1)
Daily Calibrations
9/21/2018

Date	Time	O2 [%]	CO2 [%]
9/21/2018	8:48:52	9.93	9.67
9/21/2018	8:49:02	9.93	9.70
9/21/2018	8:49:12	9.93	9.68
9/21/2018	8:49:22	9.93	9.67
9/21/2018	8:49:32	9.92	9.68
9/21/2018	8:49:42	9.92	9.67
9/21/2018	8:49:52	9.92	9.68
9/21/2018	8:50:02	9.92	9.68
9/21/2018	8:50:12	9.92	9.68
9/21/2018	8:50:22	9.92	9.69
9/21/2018	8:50:32	9.92	9.69
9/21/2018	8:50:42	9.92	9.68
9/21/2018	8:50:52	9.92	9.68
9/21/2018	8:51:02	9.92	9.68
9/21/2018	8:51:12	9.91	9.69
9/21/2018	8:51:22	9.92	9.69
		O2 [%]	**CO2 [%]**
System Zero		**0.14**	**0.02**
System Mid		**9.92**	**1.83**

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/21/2018	9:45:03	19.76	1.05
9/21/2018	9:46:03	19.77	1.05
9/21/2018	9:47:03	19.76	1.05
9/21/2018	9:48:03	19.76	1.06
9/21/2018	9:49:03	19.76	1.06
9/21/2018	9:50:03	19.76	1.07
9/21/2018	9:51:03	19.75	1.07
9/21/2018	9:52:03	19.75	1.07
9/21/2018	9:53:03	19.75	1.07
9/21/2018	9:54:03	19.74	1.07
9/21/2018	9:55:03	19.75	1.06
9/21/2018	9:56:03	19.75	1.06
9/21/2018	9:57:03	19.74	1.07
9/21/2018	9:58:03	19.75	1.05
9/21/2018	9:59:03	19.75	1.05
9/21/2018	10:00:03	19.75	1.05
9/21/2018	10:01:03	19.75	1.05
9/21/2018	10:02:03	19.75	1.05
9/21/2018	10:03:03	19.74	1.04
9/21/2018	10:04:03	19.74	1.05
9/21/2018	10:05:03	19.75	1.04
9/21/2018	10:06:03	19.75	1.04
9/21/2018	10:07:03	19.75	1.04
9/21/2018	10:08:03	19.75	1.04
9/21/2018	10:09:03	19.75	1.04
9/21/2018	10:10:03	19.75	1.05
9/21/2018	10:11:03	19.75	1.04
9/21/2018	10:12:03	19.75	1.05
9/21/2018	10:13:03	19.75	1.04
9/21/2018	10:14:03	19.75	1.06
9/21/2018	10:15:03	19.74	1.06
9/21/2018	10:16:03	19.74	1.05
9/21/2018	10:17:03	19.74	1.06
9/21/2018	10:18:03	19.74	1.05
9/21/2018	10:19:03	19.75	1.04
9/21/2018	10:20:03	19.74	1.04
9/21/2018	10:21:03	19.75	1.05
9/21/2018	10:22:03	19.74	1.06
9/21/2018	10:23:03	19.74	1.04
9/21/2018	10:24:03	19.74	1.04
9/21/2018	10:25:03	19.75	1.03
9/21/2018	10:26:03	19.76	1.03

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/21/2018	10:27:03	19.76	1.02
9/21/2018	10:28:03	19.75	1.02
9/21/2018	10:29:03	19.75	1.03
9/21/2018	10:30:03	19.75	1.02
9/21/2018	10:31:03	19.75	1.02
9/21/2018	10:32:03	19.75	1.02
9/21/2018	10:33:03	19.75	1.02
9/21/2018	10:34:03	19.74	1.02
9/21/2018	10:35:03	19.74	1.03
9/21/2018	10:36:03	19.74	1.03
9/21/2018	10:37:03	19.73	1.03
9/21/2018	10:38:03	19.73	1.03
9/21/2018	10:39:03	19.73	1.04
9/21/2018	10:40:03	19.74	1.03
9/21/2018	10:41:03	19.74	1.04
9/21/2018	10:42:03	19.74	1.04
9/21/2018	10:43:03	19.74	1.04
9/21/2018	10:44:03	19.74	1.04
9/21/2018	10:45:03	19.73	1.04
9/21/2018	10:46:03	19.73	1.04
9/21/2018	10:47:03	19.72	1.04
9/21/2018	10:48:03	19.73	1.05
9/21/2018	10:49:03	19.73	1.04
9/21/2018	10:50:03	19.73	1.04
9/21/2018	10:51:03	19.73	1.04
9/21/2018	10:52:03	19.73	1.04
9/21/2018	10:53:03	19.72	1.05
9/21/2018	10:54:03	19.72	1.03
9/21/2018	10:55:03	19.72	1.03
9/21/2018	10:56:03	19.72	1.03
9/21/2018	10:57:03	19.73	1.04
9/21/2018	10:58:03	19.73	1.04
9/21/2018	10:59:03	19.73	1.03
9/21/2018	11:00:03	19.73	1.04
9/21/2018	11:01:03	19.73	1.03
9/21/2018	11:02:03	19.73	1.03
9/21/2018	11:03:03	19.74	1.03
9/21/2018	11:04:03	19.73	1.04
9/21/2018	11:05:03	19.73	1.04
9/21/2018	11:06:03	19.73	1.04
9/21/2018	11:07:03	19.73	1.04
9/21/2018	11:08:03	19.73	1.05

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/21/2018	11:09:03	19.73	1.04
9/21/2018	11:10:03	19.73	1.04
9/21/2018	11:11:03	19.72	1.05
9/21/2018	11:12:03	19.72	1.06
9/21/2018	11:13:03	19.72	1.05
9/21/2018	11:14:03	19.72	1.05
9/21/2018	11:15:03	19.72	1.05
9/21/2018	11:16:03	19.72	1.05
9/21/2018	11:17:03	19.72	1.05
9/21/2018	11:18:03	19.72	1.05
9/21/2018	11:19:03	19.73	1.05
9/21/2018	11:20:03	19.72	1.06
9/21/2018	11:21:03	19.73	1.04
9/21/2018	11:22:03	19.74	1.03
9/21/2018	11:23:03	19.74	1.04
9/21/2018	11:24:03	19.73	1.04
9/21/2018	11:25:03	19.73	1.04
9/21/2018	11:26:03	19.74	1.05
9/21/2018	11:27:03	19.73	1.05
9/21/2018	11:28:03	19.72	1.06
9/21/2018	11:29:03	19.73	1.05
9/21/2018	11:30:03	19.73	1.05
9/21/2018	11:31:03	19.73	1.06
9/21/2018	11:32:03	19.72	1.07
9/21/2018	11:33:03	19.72	1.08
9/21/2018	11:34:03	19.72	1.08
9/21/2018	11:35:03	19.73	1.07
9/21/2018	11:36:03	19.71	1.08
9/21/2018	11:37:03	19.70	1.09
9/21/2018	11:38:03	19.70	1.09
9/21/2018	11:39:03	19.70	1.09
9/21/2018	11:40:03	19.69	1.09
9/21/2018	11:41:03	19.71	1.09
9/21/2018	11:42:03	19.71	1.08
9/21/2018	11:43:03	19.71	1.08
9/21/2018	11:44:03	19.71	1.08
9/21/2018	11:45:03	19.71	1.08
9/21/2018	11:46:03	19.70	1.07
9/21/2018	11:47:03	19.69	1.08
9/21/2018	11:48:03	19.69	1.08
9/21/2018	11:49:03	19.69	1.08
9/21/2018	11:50:03	19.70	1.07

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/21/2018	11:51:03	19.70	1.08
9/21/2018	11:52:03	19.71	1.08
9/21/2018	11:53:03	19.70	1.08
9/21/2018	11:54:03	19.70	1.08
9/21/2018	11:55:03	19.70	1.08
9/21/2018	11:56:03	19.69	1.10
9/21/2018	11:57:03	19.69	1.10
9/21/2018	11:58:03	19.69	1.10
9/21/2018	11:59:03	19.69	1.11
9/21/2018	12:00:03	19.70	1.10
9/21/2018	12:01:03	19.69	1.10
9/21/2018	12:02:03	19.69	1.10
9/21/2018	12:03:03	19.69	1.10
9/21/2018	12:04:03	19.69	1.11
9/21/2018	12:05:03	19.68	1.10
9/21/2018	12:06:03	19.69	1.11
9/21/2018	12:07:03	19.69	1.11
9/21/2018	12:08:03	19.69	1.10
9/21/2018	12:09:03	19.69	1.10
9/21/2018	12:10:03	19.70	1.10
9/21/2018	12:11:03	19.70	1.10
9/21/2018	12:12:03	19.70	1.10
9/21/2018	12:13:03	19.69	1.11
9/21/2018	12:14:03	19.69	1.11
9/21/2018	12:15:03	19.68	1.11
9/21/2018	12:16:03	19.68	1.12
9/21/2018	12:17:03	19.68	1.11
9/21/2018	12:18:03	19.68	1.11
9/21/2018	12:19:03	19.68	1.11
9/21/2018	12:20:03	19.68	1.11
9/21/2018	12:21:03	19.68	1.12
9/21/2018	12:22:03	19.69	1.10
9/21/2018	12:23:03	19.68	1.11
9/21/2018	12:24:03	19.69	1.12
9/21/2018	12:25:03	19.69	1.12
9/21/2018	12:26:03	19.69	1.12
9/21/2018	12:27:03	19.69	1.13
9/21/2018	12:28:03	19.69	1.12
9/21/2018	12:29:03	19.69	1.12
9/21/2018	12:30:03	19.69	1.11
9/21/2018	12:31:03	19.68	1.11
9/21/2018	12:32:03	19.69	1.10

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	Time	O2 [%]	CO2 [%]
9/21/2018	12:33:03	19.70	1.10
9/21/2018	12:34:03	19.69	1.10
9/21/2018	12:35:03	19.70	1.09
9/21/2018	12:36:03	19.69	1.09
9/21/2018	12:37:03	19.69	1.09
9/21/2018	12:38:03	19.68	1.09
9/21/2018	12:39:03	19.69	1.09
9/21/2018	12:40:03	19.69	1.08
9/21/2018	12:41:03	19.69	1.09
9/21/2018	12:42:03	19.69	1.09
9/21/2018	12:43:03	19.69	1.09
9/21/2018	12:44:03	19.69	1.10
9/21/2018	12:45:03	19.69	1.11
9/21/2018	12:46:03	19.68	1.11
9/21/2018	12:47:03	19.68	1.12
9/21/2018	12:48:03	19.67	1.12
9/21/2018	12:49:03	19.67	1.12
9/21/2018	12:50:03	19.68	1.11
9/21/2018	12:51:03	19.68	1.11
Final Average		**19.72**	**1.07**

Bias Check

9/21/2018	12:54:33	19.57	1.19
9/21/2018	12:54:43	19.03	1.61
9/21/2018	12:54:53	11.83	2.78
9/21/2018	12:55:03	4.22	1.07
9/21/2018	12:55:13	1.45	0.45
9/21/2018	12:55:23	0.55	0.20
9/21/2018	12:55:33	0.25	0.11
9/21/2018	12:55:43	0.16	0.09
9/21/2018	12:55:53	0.11	0.07
9/21/2018	12:56:03	0.09	0.06
9/21/2018	12:56:13	0.09	0.06
9/21/2018	12:56:23	0.08	0.06
9/21/2018	12:56:33	0.08	0.05
9/21/2018	12:56:43	0.08	0.05
9/21/2018	12:56:53	0.07	0.05
9/21/2018	12:57:03	0.07	0.05
9/21/2018	12:57:13	0.07	0.05
9/21/2018	12:57:23	0.07	0.05
9/21/2018	12:57:33	0.06	0.05
9/21/2018	12:57:43	0.06	0.05

Hollingsworth & Vose
CFU-113 (1)
Run #1

Date	**Time**	**O2 [%]**	**CO2 [%]**
9/21/2018	12:57:53	0.07	0.05
9/21/2018	12:58:03	0.06	0.05
9/21/2018	12:58:13	0.06	0.04
9/21/2018	12:58:23	0.05	0.05
9/21/2018	12:58:33	0.43	0.47
9/21/2018	12:58:43	0.46	0.55
9/21/2018	12:58:53	1.40	1.53
9/21/2018	12:59:03	1.71	1.83
9/21/2018	12:59:13	1.81	1.94
9/21/2018	12:59:23	1.85	1.99
9/21/2018	12:59:33	1.85	2.01
9/21/2018	12:59:43	1.86	2.02
9/21/2018	12:59:53	1.87	2.03
9/21/2018	13:00:03	1.86	2.03
9/21/2018	13:00:13	1.86	2.03
9/21/2018	13:00:23	2.41	2.65
9/21/2018	13:00:33	5.64	5.93
9/21/2018	13:00:43	7.07	7.11
9/21/2018	13:00:53	9.53	9.47
9/21/2018	13:01:03	9.68	9.62
9/21/2018	13:01:13	9.72	9.66
9/21/2018	13:01:23	9.74	9.68
9/21/2018	13:01:33	9.75	9.68
9/21/2018	13:01:43	9.75	9.70
9/21/2018	13:01:53	9.75	9.70
9/21/2018	13:02:03	9.75	9.69
9/21/2018	13:02:13	9.76	9.71
9/21/2018	13:02:23	9.76	9.72
9/21/2018	13:02:33	9.76	9.72
9/21/2018	13:02:43	9.76	9.72
9/21/2018	13:02:53	9.76	9.72
9/21/2018	13:03:03	9.78	9.72
9/21/2018	13:03:13	9.76	9.72

		O2 [%]	**CO2 [%]**
System Zero		**0.06**	**0.05**
System Mid		**9.77**	**2.03**

Hollingsworth & Vose
CFU-113
Run #2

Date	Time	O2 [%]	CO2 [%]
9/21/2018	13:10:03	19.98	1.10
9/21/2018	13:11:03	19.96	1.10
9/21/2018	13:12:03	19.91	1.10
9/21/2018	13:13:03	19.92	1.10
9/21/2018	13:14:03	19.91	1.11
9/21/2018	13:15:03	19.93	1.10
9/21/2018	13:16:03	19.93	1.10
9/21/2018	13:17:03	19.93	1.10
9/21/2018	13:18:03	19.93	1.10
9/21/2018	13:19:03	19.93	1.09
9/21/2018	13:20:03	19.93	1.10
9/21/2018	13:21:03	19.92	1.10
9/21/2018	13:22:03	19.93	1.10
9/21/2018	13:23:03	19.93	1.09
9/21/2018	13:24:03	19.93	1.09
9/21/2018	13:25:03	19.93	1.08
9/21/2018	13:26:03	19.93	1.08
9/21/2018	13:27:03	19.92	1.08
9/21/2018	13:28:03	19.93	1.08
9/21/2018	13:29:03	19.92	1.09
9/21/2018	13:30:03	19.92	1.09
9/21/2018	13:31:03	19.92	1.08
9/21/2018	13:32:03	19.92	1.09
9/21/2018	13:33:03	19.92	1.08
9/21/2018	13:34:03	19.93	1.08
9/21/2018	13:35:03	19.91	1.10
9/21/2018	13:36:03	19.92	1.09
9/21/2018	13:37:03	19.92	1.09
9/21/2018	13:38:03	19.93	1.09
9/21/2018	13:39:03	19.92	1.10
9/21/2018	13:40:03	19.92	1.10
9/21/2018	13:41:03	19.92	1.11
9/21/2018	13:42:03	19.92	1.10
9/21/2018	13:43:03	19.92	1.10
9/21/2018	13:44:03	19.92	1.10
9/21/2018	13:45:03	19.92	1.10
9/21/2018	13:46:03	19.92	1.10
9/21/2018	13:47:03	19.91	1.10
9/21/2018	13:48:03	19.91	1.10
9/21/2018	13:49:03	19.91	1.10
9/21/2018	13:50:03	19.91	1.10
9/21/2018	13:51:03	19.90	1.09

Hollingsworth & Vose
CFU-113
Run #2

Date	Time	O2 [%]	CO2 [%]
9/21/2018	13:52:03	19.91	1.09
9/21/2018	13:53:03	19.91	1.09
9/21/2018	13:54:03	19.91	1.09
9/21/2018	13:55:03	19.91	1.10
9/21/2018	13:56:03	19.91	1.10
9/21/2018	13:57:03	19.91	1.10
9/21/2018	13:58:03	19.91	1.10
9/21/2018	13:59:03	19.91	1.10
9/21/2018	14:00:03	19.91	1.10
9/21/2018	14:01:03	19.91	1.11
9/21/2018	14:02:03	19.91	1.11
9/21/2018	14:03:03	19.90	1.12
9/21/2018	14:04:03	19.90	1.12
9/21/2018	14:05:03	19.90	1.12
9/21/2018	14:06:03	19.90	1.12
9/21/2018	14:07:03	19.90	1.12
9/21/2018	14:08:03	19.91	1.12
9/21/2018	14:09:03	19.89	1.13
9/21/2018	14:10:03	19.90	1.12
9/21/2018	14:11:03	19.91	1.12
9/21/2018	14:12:03	19.92	1.12
9/21/2018	14:13:03	19.92	1.12
9/21/2018	14:14:03	19.91	1.12
9/21/2018	14:15:03	19.91	1.11
9/21/2018	14:16:03	19.90	1.12
9/21/2018	14:17:03	19.89	1.12
9/21/2018	14:18:03	19.91	1.12
9/21/2018	14:19:03	19.90	1.12
9/21/2018	14:20:03	19.89	1.13
9/21/2018	14:21:03	19.89	1.13
9/21/2018	14:22:03	19.89	1.13
9/21/2018	14:23:03	19.89	1.13
9/21/2018	14:24:03	19.89	1.13
9/21/2018	14:25:03	19.90	1.12
9/21/2018	14:26:03	19.90	1.12
9/21/2018	14:27:03	19.91	1.12
9/21/2018	14:28:03	19.91	1.11
9/21/2018	14:29:03	19.90	1.11
9/21/2018	14:30:03	19.90	1.12
9/21/2018	14:31:03	19.90	1.12
9/21/2018	14:32:03	19.90	1.13
9/21/2018	14:33:03	19.90	1.13

Hollingsworth & Vose
CFU-113
Run #2

Date	Time	O2 [%]	CO2 [%]
9/21/2018	14:34:03	19.90	1.12
9/21/2018	14:35:03	19.90	1.12
9/21/2018	14:36:03	19.90	1.11
9/21/2018	14:37:03	19.91	1.11
9/21/2018	14:38:03	19.91	1.10
9/21/2018	14:39:03	19.90	1.10
9/21/2018	14:40:03	19.90	1.10
9/21/2018	14:41:03	19.90	1.10
9/21/2018	14:42:03	19.90	1.09
9/21/2018	14:43:03	19.91	1.09
9/21/2018	14:44:03	19.90	1.10
9/21/2018	14:45:03	19.90	1.10
9/21/2018	14:46:03	19.90	1.10
9/21/2018	14:47:03	19.90	1.10
9/21/2018	14:48:03	19.89	1.11
9/21/2018	14:49:03	19.90	1.11
9/21/2018	14:50:03	19.90	1.10
9/21/2018	14:51:03	19.90	1.11
9/21/2018	14:52:03	19.90	1.11
9/21/2018	14:53:03	19.90	1.11
9/21/2018	14:54:03	19.90	1.11
9/21/2018	14:55:03	19.89	1.12
9/21/2018	14:56:03	19.89	1.12
9/21/2018	14:57:03	19.89	1.12
9/21/2018	14:58:03	19.89	1.11
9/21/2018	14:59:03	19.89	1.11
9/21/2018	15:00:03	19.90	1.10
9/21/2018	15:01:03	19.89	1.10
9/21/2018	15:02:03	19.89	1.11
9/21/2018	15:03:03	19.89	1.11
9/21/2018	15:04:03	19.89	1.11
9/21/2018	15:05:03	19.89	1.10
9/21/2018	15:06:03	19.89	1.11
9/21/2018	15:07:03	19.89	1.11
9/21/2018	15:08:03	19.89	1.11
9/21/2018	15:09:03	19.89	1.11
9/21/2018	15:10:03	19.89	1.11
9/21/2018	15:11:03	19.89	1.11
9/21/2018	15:12:03	19.89	1.12
9/21/2018	15:13:03	19.88	1.11
9/21/2018	15:14:03	19.88	1.12
9/21/2018	15:15:03	19.88	1.13

Hollingsworth & Vose
CFU-113
Run #2

Date	Time	O2 [%]	CO2 [%]
9/21/2018	15:16:03	19.89	1.14
9/21/2018	15:17:03	19.89	1.14
9/21/2018	15:18:03	19.88	1.14
9/21/2018	15:19:03	19.88	1.13
9/21/2018	15:20:03	19.89	1.12
9/21/2018	15:21:03	19.89	1.11
9/21/2018	15:22:03	19.89	1.12
9/21/2018	15:23:03	19.89	1.11
9/21/2018	15:24:03	19.89	1.12
9/21/2018	15:25:03	19.89	1.12
9/21/2018	15:26:03	19.89	1.10
9/21/2018	15:27:03	19.90	1.09
9/21/2018	15:28:03	19.90	1.08
9/21/2018	15:29:03	19.90	1.08
9/21/2018	15:30:03	19.90	1.07
9/21/2018	15:31:03	19.91	1.07
9/21/2018	15:32:03	19.91	1.05
9/21/2018	15:33:03	19.91	1.06
9/21/2018	15:34:03	19.91	1.07
9/21/2018	15:35:03	19.90	1.07
9/21/2018	15:36:03	19.91	1.06
9/21/2018	15:37:03	19.90	1.06
9/21/2018	15:38:03	19.90	1.07
9/21/2018	15:39:03	19.91	1.06
9/21/2018	15:40:03	19.90	1.07
9/21/2018	15:41:03	19.91	1.06
9/21/2018	15:42:03	19.91	1.06
9/21/2018	15:43:03	19.90	1.08
9/21/2018	15:44:03	19.90	1.09
9/21/2018	15:45:03	19.91	1.08
9/21/2018	15:46:03	19.90	1.08
9/21/2018	15:47:03	19.89	1.09
9/21/2018	15:48:03	19.89	1.09
9/21/2018	15:49:03	19.90	1.08
9/21/2018	15:50:03	19.89	1.08
9/21/2018	15:51:03	19.89	1.08
9/21/2018	15:52:03	19.90	1.08
9/21/2018	15:53:03	19.89	1.07
9/21/2018	15:54:03	19.89	1.08
9/21/2018	15:55:03	19.90	1.07
9/21/2018	15:56:03	19.90	1.08
9/21/2018	15:57:03	19.89	1.08

Hollingsworth & Vose
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Run #2

Date	Time	O2 [%]	CO2 [%]
9/21/2018	15:58:03	19.89	1.09
9/21/2018	15:59:03	19.90	1.08
9/21/2018	16:00:03	19.89	1.09
9/21/2018	16:01:03	19.89	1.09
9/21/2018	16:02:03	19.90	1.08
9/21/2018	16:03:03	19.89	1.10
9/21/2018	16:04:03	19.89	1.10
9/21/2018	16:05:03	19.90	1.08
9/21/2018	16:06:03	19.90	1.09
9/21/2018	16:07:03	19.89	1.10
9/21/2018	16:08:03	19.89	1.10
9/21/2018	16:09:03	19.89	1.10
9/21/2018	16:10:03	19.89	1.09
9/21/2018	16:11:03	19.89	1.09
9/21/2018	16:12:03	19.90	1.09
9/21/2018	16:13:03	19.90	1.08
9/21/2018	16:14:03	19.89	1.08
9/21/2018	16:15:03	19.89	1.08
9/21/2018	16:16:03	19.89	1.08
Final Average		**19.90**	**1.10**

Bias Check

9/21/2018	16:20:33	19.88	1.10
9/21/2018	16:20:43	19.88	1.10
9/21/2018	16:20:53	19.88	1.10
9/21/2018	16:21:03	19.88	1.10
9/21/2018	16:21:13	19.71	1.10
9/21/2018	16:21:23	18.70	1.57
9/21/2018	16:21:33	10.65	1.65
9/21/2018	16:21:43	3.87	0.68
9/21/2018	16:21:53	1.35	0.28
9/21/2018	16:22:03	0.53	0.12
9/21/2018	16:22:13	0.24	0.07
9/21/2018	16:22:23	0.15	0.05
9/21/2018	16:22:33	0.12	0.04
9/21/2018	16:22:43	0.09	0.05
9/21/2018	16:22:53	0.08	0.05
9/21/2018	16:23:03	0.08	0.04
9/21/2018	16:23:13	0.08	0.04
9/21/2018	16:23:23	0.08	0.04
9/21/2018	16:23:33	0.07	0.04
9/21/2018	16:23:43	0.16	0.13

Hollingsworth & Vose
CFU-113
Run #2

Date	Time	O2 [%]	CO2 [%]
9/21/2018	16:23:53	1.93	1.97
9/21/2018	16:24:03	1.20	1.32
9/21/2018	16:24:13	1.61	1.74
9/21/2018	16:24:23	1.76	1.89
9/21/2018	16:24:33	1.82	1.95
9/21/2018	16:24:43	1.85	1.98
9/21/2018	16:24:53	1.86	2.00
9/21/2018	16:25:03	1.86	2.00
9/21/2018	16:25:13	1.87	2.01
9/21/2018	16:25:23	1.87	2.02
9/21/2018	16:25:33	1.87	2.02
9/21/2018	16:25:43	1.88	2.03
9/21/2018	16:25:53	1.88	2.03
9/21/2018	16:26:03	1.88	2.03
9/21/2018	16:26:13	1.88	2.04
9/21/2018	16:26:23	1.88	2.04
9/21/2018	16:26:33	1.88	2.04
9/21/2018	16:26:43	1.88	2.04
9/21/2018	16:26:53	1.88	2.04
9/21/2018	16:27:03	1.88	2.05
9/21/2018	16:27:13	1.88	2.04
9/21/2018	16:27:23	1.88	2.05
9/21/2018	16:27:33	1.87	2.04
9/21/2018	16:27:43	1.88	2.05
9/21/2018	16:27:53	1.88	2.05
9/21/2018	16:28:03	1.88	2.05
9/21/2018	16:28:13	3.79	4.12
9/21/2018	16:28:23	8.40	8.53
9/21/2018	16:28:33	9.29	9.27
9/21/2018	16:28:43	9.60	9.53
9/21/2018	16:28:53	9.70	9.64
9/21/2018	16:29:03	9.74	9.68
9/21/2018	16:29:13	9.76	9.66
9/21/2018	16:29:23	9.82	9.68
9/21/2018	16:29:33	9.84	9.69
9/21/2018	16:29:43	9.83	9.71
9/21/2018	16:29:53	9.84	9.70
9/21/2018	16:30:03	9.86	9.70
		O2 [%]	**CO2 [%]**
System Zero		**0.08**	**0.04**
System Mid		**9.84**	**2.04**

Hollingsworth & Vose
CFU-113
Run #3

Date	Time	O2 [%]	CO2 [%]
9/21/2018	16:34:03	19.53	1.11
9/21/2018	16:35:03	19.52	1.11
9/21/2018	16:36:03	19.52	1.10
9/21/2018	16:37:03	19.52	1.11
9/21/2018	16:38:03	19.52	1.12
9/21/2018	16:39:03	19.53	1.11
9/21/2018	16:40:03	19.52	1.11
9/21/2018	16:41:03	19.52	1.10
9/21/2018	16:42:03	19.53	1.10
9/21/2018	16:43:03	19.53	1.10
9/21/2018	16:44:03	19.54	1.08
9/21/2018	16:45:03	19.54	1.09
9/21/2018	16:46:03	19.55	1.09
9/21/2018	16:47:03	19.54	1.10
9/21/2018	16:48:03	19.55	1.11
9/21/2018	16:49:03	19.54	1.10
9/21/2018	16:50:03	19.54	1.11
9/21/2018	16:51:03	19.55	1.10
9/21/2018	16:52:03	19.55	1.11
9/21/2018	16:53:03	19.55	1.10
9/21/2018	16:54:03	19.55	1.09
9/21/2018	16:55:03	19.54	1.11
9/21/2018	16:56:03	19.55	1.09
9/21/2018	16:57:03	19.56	1.09
9/21/2018	16:58:03	19.55	1.10
9/21/2018	16:59:03	19.54	1.10
9/21/2018	17:00:03	19.55	1.09
9/21/2018	17:01:03	19.56	1.09
9/21/2018	17:02:03	19.56	1.09
9/21/2018	17:03:03	19.55	1.09
9/21/2018	17:04:03	19.56	1.07
9/21/2018	17:05:03	19.56	1.08
9/21/2018	17:06:03	19.56	1.08
9/21/2018	17:07:03	19.56	1.09
9/21/2018	17:08:03	19.56	1.09
9/21/2018	17:09:03	19.56	1.09
9/21/2018	17:10:03	19.55	1.09
9/21/2018	17:11:03	19.56	1.09
9/21/2018	17:12:03	19.55	1.09
9/21/2018	17:13:03	19.55	1.10
9/21/2018	17:14:03	19.56	1.11
9/21/2018	17:15:03	19.55	1.11

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Run #3

Date	Time	O2 [%]	CO2 [%]
9/21/2018	17:16:03	19.56	1.11
9/21/2018	17:17:03	19.56	1.11
9/21/2018	17:18:03	19.54	1.12
9/21/2018	17:19:03	19.56	1.11
9/21/2018	17:20:03	19.56	1.11
9/21/2018	17:21:03	19.54	1.13
9/21/2018	17:22:03	19.54	1.13
9/21/2018	17:23:03	19.56	1.12
9/21/2018	17:24:03	19.55	1.11
9/21/2018	17:25:03	19.56	1.10
9/21/2018	17:26:03	19.56	1.11
9/21/2018	17:27:03	19.56	1.11
9/21/2018	17:28:03	19.56	1.11
9/21/2018	17:29:03	19.55	1.11
9/21/2018	17:30:03	19.56	1.10
9/21/2018	17:31:03	19.53	1.13
9/21/2018	17:32:03	19.54	1.12
9/21/2018	17:33:03	19.54	1.12
9/21/2018	17:34:03	19.55	1.11
9/21/2018	17:35:03	19.56	1.11
9/21/2018	17:36:03	19.54	1.11
9/21/2018	17:37:03	19.53	1.12
9/21/2018	17:38:03	19.54	1.12
9/21/2018	17:39:03	19.55	1.11
9/21/2018	17:40:03	19.55	1.11
9/21/2018	17:41:03	19.56	1.11
9/21/2018	17:42:03	19.55	1.11
9/21/2018	17:43:03	19.55	1.11
9/21/2018	17:44:03	19.55	1.12
9/21/2018	17:45:03	19.54	1.13
9/21/2018	17:46:03	19.53	1.14
9/21/2018	17:47:03	19.54	1.12
9/21/2018	17:48:03	19.53	1.12
9/21/2018	17:49:03	19.55	1.11
9/21/2018	17:50:03	19.55	1.11
9/21/2018	17:51:03	19.56	1.10
9/21/2018	17:52:03	19.56	1.10
9/21/2018	17:53:03	19.56	1.10
9/21/2018	17:54:03	19.56	1.10
9/21/2018	17:55:03	19.56	1.10
9/21/2018	17:56:03	19.56	1.10
9/21/2018	17:57:03	19.54	1.12

Hollingsworth & Vose
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Run #3

Date	Time	O2 [%]	CO2 [%]
9/21/2018	17:58:03	19.54	1.11
9/21/2018	17:59:03	19.56	1.10
9/21/2018	18:00:03	19.57	1.10
9/21/2018	18:01:03	19.56	1.11
9/21/2018	18:02:03	19.55	1.12
9/21/2018	18:03:03	19.57	1.10
9/21/2018	18:04:03	19.57	1.11
9/21/2018	18:05:03	19.59	1.10
9/21/2018	18:06:03	19.58	1.11
9/21/2018	18:07:03	19.57	1.11
9/21/2018	18:08:03	19.57	1.11
9/21/2018	18:09:03	19.57	1.11
9/21/2018	18:10:03	19.57	1.11
9/21/2018	18:11:03	19.57	1.11
9/21/2018	18:12:03	19.57	1.10
9/21/2018	18:13:03	19.57	1.11
9/21/2018	18:14:03	19.58	1.10
9/21/2018	18:15:03	19.57	1.10
9/21/2018	18:16:03	19.57	1.10
9/21/2018	18:17:03	19.58	1.08
9/21/2018	18:18:03	19.57	1.09
9/21/2018	18:19:03	19.56	1.09
9/21/2018	18:20:03	19.55	1.11
9/21/2018	18:21:03	19.56	1.10
9/21/2018	18:22:03	19.56	1.10
9/21/2018	18:23:03	19.57	1.09
9/21/2018	18:24:03	19.57	1.09
9/21/2018	18:25:03	19.58	1.09
9/21/2018	18:26:03	19.58	1.08
9/21/2018	18:27:03	19.58	1.09
9/21/2018	18:28:03	19.58	1.09
9/21/2018	18:29:03	19.57	1.11
9/21/2018	18:30:03	19.55	1.13
9/21/2018	18:31:03	19.55	1.13
9/21/2018	18:32:03	19.57	1.11
9/21/2018	18:33:03	19.59	1.10
9/21/2018	18:34:03	19.57	1.11
9/21/2018	18:35:03	19.57	1.11
9/21/2018	18:36:03	19.58	1.10
9/21/2018	18:37:03	19.58	1.10
9/21/2018	18:38:03	19.58	1.10
9/21/2018	18:39:03	19.58	1.10

Hollingsworth & Vose
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Run #3

Date	Time	O2 [%]	CO2 [%]
9/21/2018	18:40:03	19.57	1.10
9/21/2018	18:41:03	19.57	1.10
9/21/2018	18:42:03	19.57	1.10
9/21/2018	18:43:03	19.58	1.10
9/21/2018	18:44:03	19.57	1.10
9/21/2018	18:45:03	19.56	1.11
9/21/2018	18:46:03	19.56	1.12
9/21/2018	18:47:03	19.56	1.11
9/21/2018	18:48:03	19.56	1.11
9/21/2018	18:49:03	19.56	1.12
9/21/2018	18:50:03	19.57	1.11
9/21/2018	18:51:03	19.57	1.10
9/21/2018	18:52:03	19.57	1.11
9/21/2018	18:53:03	19.58	1.11
9/21/2018	18:54:03	19.59	1.10
9/21/2018	18:55:03	19.58	1.11
9/21/2018	18:56:03	19.58	1.11
9/21/2018	18:57:03	19.57	1.12
9/21/2018	18:58:03	19.56	1.13
9/21/2018	18:59:03	19.56	1.13
9/21/2018	19:00:03	19.59	1.11
9/21/2018	19:01:03	19.58	1.11
9/21/2018	19:02:03	19.56	1.12
9/21/2018	19:03:03	19.57	1.11
9/21/2018	19:04:03	19.56	1.11
9/21/2018	19:05:03	19.57	1.11
9/21/2018	19:06:03	19.58	1.09
9/21/2018	19:07:03	19.57	1.10
9/21/2018	19:08:03	19.57	1.10
9/21/2018	19:09:03	19.55	1.11
9/21/2018	19:10:03	19.57	1.10
9/21/2018	19:11:03	19.57	1.10
9/21/2018	19:12:03	19.54	1.12
9/21/2018	19:13:03	19.56	1.11
9/21/2018	19:14:03	19.56	1.10
9/21/2018	19:15:03	19.57	1.11
9/21/2018	19:16:03	19.58	1.10
9/21/2018	19:17:03	19.57	1.11
9/21/2018	19:18:03	19.55	1.13
9/21/2018	19:19:03	19.56	1.12
9/21/2018	19:20:03	19.57	1.12
9/21/2018	19:21:03	19.54	1.14

Hollingsworth & Vose
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Run #3

Date	Time	O2 [%]	CO2 [%]
9/21/2018	19:22:03	19.54	1.14
9/21/2018	19:23:03	19.56	1.12
9/21/2018	19:24:03	19.55	1.12
9/21/2018	19:25:03	19.53	1.14
9/21/2018	19:26:03	19.55	1.13
9/21/2018	19:27:03	19.55	1.12
9/21/2018	19:28:03	19.56	1.12
9/21/2018	19:29:03	19.56	1.12
9/21/2018	19:30:03	19.56	1.11
9/21/2018	19:31:03	19.55	1.11
9/21/2018	19:32:03	19.54	1.12
9/21/2018	19:33:03	19.54	1.12
9/21/2018	19:34:03	19.55	1.10
9/21/2018	19:35:03	19.56	1.10
9/21/2018	19:36:03	19.55	1.11
9/21/2018	19:37:03	19.56	1.10
9/21/2018	19:38:03	19.55	1.11
9/21/2018	19:39:03	19.53	1.12
Final Average		**19.56**	**1.11**

Bias Check

9/21/2018	19:44:33	19.56	1.12
9/21/2018	19:44:43	19.51	1.17
9/21/2018	19:44:53	18.37	1.44
9/21/2018	19:45:03	9.30	0.97
9/21/2018	19:45:13	3.26	0.41
9/21/2018	19:45:23	1.16	0.18
9/21/2018	19:45:33	0.46	0.10
9/21/2018	19:45:43	0.23	0.08
9/21/2018	19:45:53	0.15	0.06
9/21/2018	19:46:03	0.12	0.07
9/21/2018	19:46:13	0.11	0.06
9/21/2018	19:46:23	0.10	0.05
9/21/2018	19:46:33	0.09	0.06
9/21/2018	19:46:43	0.09	0.06
9/21/2018	19:46:53	0.09	0.05
9/21/2018	19:47:03	0.08	0.06
9/21/2018	19:47:13	0.08	0.05
9/21/2018	19:47:23	0.08	0.05
9/21/2018	19:47:33	0.08	0.05
9/21/2018	19:47:43	0.08	0.06
9/21/2018	19:47:53	0.07	0.05

Hollingsworth & Vose
CFU-113
Run #3

Date	Time	O2 [%]	CO2 [%]
9/21/2018	19:48:03	0.30	0.29
9/21/2018	19:48:13	1.96	1.85
9/21/2018	19:48:23	0.95	1.00
9/21/2018	19:48:33	1.50	1.66
9/21/2018	19:48:43	1.70	1.87
9/21/2018	19:48:53	1.78	1.95
9/21/2018	19:49:03	1.80	1.99
9/21/2018	19:49:13	1.82	2.01
9/21/2018	19:49:23	1.82	2.02
9/21/2018	19:49:33	1.83	2.02
9/21/2018	19:49:43	1.83	2.03
9/21/2018	19:49:53	1.83	2.03
9/21/2018	19:50:03	1.83	2.03
9/21/2018	19:50:13	1.85	2.04
9/21/2018	19:50:23	1.91	2.04
9/21/2018	19:50:33	1.93	2.04
9/21/2018	19:50:43	1.93	2.04
9/21/2018	19:50:53	1.93	2.05
9/21/2018	19:51:03	1.93	2.05
9/21/2018	19:51:13	2.52	2.68
9/21/2018	19:51:23	5.80	5.82
9/21/2018	19:51:33	9.30	9.03
9/21/2018	19:51:43	9.79	9.44
9/21/2018	19:51:53	9.96	9.59
9/21/2018	19:52:03	10.02	9.66
9/21/2018	19:52:13	10.05	9.69
9/21/2018	19:52:23	10.07	9.70
9/21/2018	19:52:33	10.07	9.71
9/21/2018	19:52:43	10.08	9.71
9/21/2018	19:52:53	10.07	9.71
9/21/2018	19:53:03	10.08	9.72
9/21/2018	19:53:13	10.08	9.72
9/21/2018	19:53:23	10.08	9.73
9/21/2018	19:53:33	10.08	9.73
		O2 [%]	**CO2 [%]**
System Zero		**0.08**	**0.05**
System Mid		**10.08**	**2.04**

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113 (2)**
DATE	**09/24/18**
METHOD	**M29**
POLLUTANT	**Metals**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**9:25**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**12:30**
EPA Method:	**M29**	Clear sky, 70 degrees	**Date:**	**9/24/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type	Glass	
Y factor	0.9985	Nozzle ID	0.213	Nozzle size	0.2133	inches
$\Delta H@$	1.799	Hot box ID	HB3	Nozzle area	0.000248	sq.ft.
		Pitot Cp	0.84	Probe heat	250	F
				Filter heat	250	F

Source Information:

Barometric Pressure	29.85	"Hg	O_2	19.90	%
Static Pressure	-0.28	"H_2O	CO_2	0.70	%
Ave. ΔP	1.35	"H_2O	Rec. Nz.	0.193	inches
Stack Temperature	120	F			
Assumed moisture	2	%			
Assumed meter temp.	69	F			
Total number of points	8				
Time per point	22.5				
Total run time	180				

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	12	6

Nozzle check for roundness:

1	2	3	
0.213	0.213	0.214	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	159.360	dcf	Ave. ΔP	1.375	"H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. $\sqrt{\Delta P}$	1.1699	"H_2O
Actual H_2O	2.00	%	Ave. ΔH	2.65	"H_2O
Std. meter vol.	161.620	dscf	Ave. T_s	132.8	°F
Isokinetic Average	99.2	%	Ave. T_m	61.8	°F

Moisture/Lab:

Filter	Run1 #		
	Initial	Final	Gain
Impingers, g	200.0	242	42.0
Silica gel, g	271.6	299.8	28.2
		Total water gain:	70.2

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	22.5	20.900	1.60	136	54	3.04	3.00	2.5	256	45
2	45.0	42.180	1.60	132	57	3.08	3.10	2.5	255	46
3	67.5	61.660	1.30	132	59	2.51	2.50	2.5	255	50
4	90.0	79.380	1.10	131	61	2.14	2.10	2.5	253	50
5	112.5	98.030	1.20	133	63	2.33	2.30	2.5	252	50
6	135.0	119.050	1.50	132	64	2.93	2.90	2.5	253	50
7	157.5	140.110	1.50	133	67	2.94	2.90	2.5	252	53
8	180.0	159.360	1.20	133	69	2.36	2.40	2.5	253	51

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:50**
Source:	**CFU 113 (2)**	**End Time:**	**15:55**
EPA Method:	**M29**	**Date:**	**9/24/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Clear sky, 70 degrees

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.213	Nozzle size:	0.2133 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000248 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.85 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	1.35 "H_2O	Rec. Nz.	0.195 inches
Stack Temperature	120 F		
Assumed moisture	2 %		
Assumed meter temp.	61.8 F		
Total number of points	8		
Time per point	22.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	10

Nozzle check for roundness:

1	2	3
0.213	0.213	0.214 inches

Caliper ID# MN-2

Post Test Calculations:

Sample volume	162.302 dcf	Ave. ΔP	1.338 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.1553 "H_2O
Actual H_2O	1.72 %	Ave. ΔH	2.675 "H_2O
Std. meter vol.	161.458 dscf	Ave. T_s	134.5 °F
Isokinetic Average	100.3 %	Ave. T_m	72 °F

Moisture/Lab:

Filter Run2 #

	Initial	Final	Gain
Impingers, g	200.0	234	34.0
Silica gel, g	263.5	289.7	26.2
Total water gain:			60.2

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	22.5	21.370	1.50	132	69	2.95	3.00	3	252	54
2	45.0	42.140	1.40	134	71	2.76	2.80	3	255	46
3	67.5	61.450	1.20	133	71	2.37	2.40	3	254	47
4	90.0	80.647	1.20	135	72	2.37	2.40	3	250	49
5	112.5	100.650	1.30	134	72	2.57	2.60	3	253	55
6	135.0	122.160	1.50	136	73	2.96	3.00	3	257	52
7	157.5	142.990	1.40	137	74	2.76	2.80	3	254	54
8	180.0	162.302	1.20	135	74	2.37	2.40	3	252	56

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**16:16**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**19:21**
EPA Method:	**M29**	Clear sky, 70 degrees	**Date:**	**9/24/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.213	Nozzle size:	0.2133 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000248 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.85 "Hg	O_2	19.9 %	
Static Pressure	-0.28 "H_2O	CO_2	0.7 %	
Ave. ΔP	1.35 "H_2O	Rec. Nz.	0.193 inches	
Stack Temperature	120 F			
Assumed moisture	1.72 %			
Assumed meter temp.	72 F			
Total number of points	8			
Time per point	22.5			
Total run time	180			

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	11	10

Nozzle check for roundness:

1	2	3
0.213	0.213	0.214 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	162.806 dcf	Ave. ΔP	1.35 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.1609 "H_2O
Actual H_2O	1.74 %	Ave. ΔH	2.7 "H_2O
Std. meter vol.	161.727 dscf	Ave. T_s	136.4 °F
Isokinetic Average	100.2 %	Ave. T_m	72.8 °F

Moisture/Lab:

Filter	Run3 #		
	Initial	Final	Gain
Impingers, g	200.0	234	34.0
Silica gel, g	266.5	293.5	27.0
		Total water gain:	61.0

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	22.5	20.730	1.40	135	72	2.77	2.80	3	258	64
2	45.0	42.250	1.50	137	72	2.96	3.00	3	260	55
3	67.5	62.220	1.30	137	73	2.57	2.60	3	246	56
4	90.0	81.477	1.20	137	73	2.37	2.40	3	250	57
5	112.5	100.680	1.20	137	73	2.37	2.40	3	250	63
6	135.0	120.660	1.30	136	73	2.57	2.60	3	242	58
7	157.5	141.350	1.40	135	73	2.78	2.80	3	256	58
8	180.0	162.806	1.50	137	73	2.97	3.00	3	253	57

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:25**
Source:	**CFU 113 (2)**	**End Time:**	**12:30**
Method:	**29**	**Date:**	**9/24/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter** ft^3	**ΔH** $''H_2O$	**Meter** T_m ^oF	**Traverse** Point	**Dp** $''H_2O$	**Stack** T_s ^oF	**$\sqrt{Dp}$**
	0.000						
22.5	20.900	3.00	54	1	1.60	136	1.2649
45.0	42.180	3.10	57	2	1.60	132	1.2649
67.5	61.660	2.50	59	3	1.30	132	1.1402
90.0	79.380	2.10	61	4	1.10	131	1.0488
112.5	98.030	2.30	63	5	1.20	133	1.0954
135.0	119.050	2.90	64	6	1.50	132	1.2247
157.5	140.110	2.90	67	7	1.50	133	1.2247
180.0	159.360	2.40	69	8	1.20	133	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113 (2)**	**Date:**	**09/24/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	22.5	min	Diameter	20.000	in
Meter Volume, V_m	159.360	dcf	Rectangular		
Water Volume	70.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.2133	in.	Length		in
Nozzle Area	0.000248	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.91	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.02	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.650	"H_2O	$\sqrt{Dp}$	1.1699	"H_2O
Temperature, T_m	61.8	^oF	Temperature, T_s	132.8	^oF
Temperature, T_m	521.8	^oA (^oR)	Temperature, T_s	592.8	^oA (^oR)
Pressure Meter, P_m	30.045	"Hg	Pressure Stack, P_s	29.829	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	161.620	dscf	Velocity, V_s	69.87	fps
	4.577	dscm	Volume (actual)	9,147.4	awcfm
Actual Volume, $V_{m(actual)}$	185.797	awcf		8,964.5	adcfm
Gas Stream Moisture			Volume (standard)	487,361.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.304	scf		477,613.9	dscf/hr
Moisture, B_{ws}	0.0200			7,960.2	dscf/min
Moisture EPA M4	2.00	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.95	lb/lb-mole			
Wet, M_s	28.73	lb/lb-mole			
Percent Isokinetic	99.3	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:50**
Source:	**CFU 113 (2)**	**End Time:**	**15:55**
Method:	**29**	**Date:**	**09/24/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
22.5	21.370	3.00	69	1	1.50	132	1.2247
45.0	42.140	2.80	71	2	1.40	134	1.1832
67.5	61.450	2.40	71	3	1.20	133	1.0954
90.0	80.647	2.40	72	4	1.20	135	1.0954
112.5	100.650	2.60	72	5	1.30	134	1.1402
135.0	122.160	3.00	73	6	1.50	136	1.2247
157.5	142.990	2.80	74	7	1.40	137	1.1832
180.0	162.302	2.40	74	8	1.20	135	1.0954

Client:	**Hollingsworth & Vose**		**Run:**	**2**	
Source:	**CFU 113 (2)**		**Date:**	**09/24/18**	

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	22.5	min	Diameter	20.000	in
Meter Volume, V_m	162.302	dcf	Rectangular		
Water Volume	60.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.2133	in.	Length		in
Nozzle Area	0.000248	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.93	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.27	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.675	"H_2O	$\sqrt{Dp}$	1.1553	"H_2O
Temperature, T_m	72.0	^oF	Temperature, T_s	134.5	^oF
Temperature, T_m	532.0	^oA (^oR)	Temperature, T_s	594.5	^oA (^oR)
Pressure Meter, P_m	30.047	"Hg	Pressure Stack, P_s	29.829	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	161.458	dscf	Velocity, V_s	69.05	fps
	4.572	dscm	Volume (actual)	9,040.0	awcfm
Actual Volume, $V_{m(actual)}$	185.613	awcf		8,884.5	adcfm
Gas Stream Moisture			Volume (standard)	480,264.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.833	scf		472,003.6	dscf/hr
Moisture, B_{ws}	0.0172			7,866.7	dscf/min
Moisture EPA M4	1.72	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.77	lb/lb-mole			
Percent Isokinetic	100.4	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**16:16**
Source:	**CFU 113 (2)**	**End Time:**	**19:21**
Method:	**29**	**Date:**	**09/24/18**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**√Dp**
	0.000						
22.5	20.730	2.80	72	1	1.40	135	1.1832
45.0	42.250	3.00	72	2	1.50	137	1.2247
67.5	62.220	2.60	73	3	1.30	137	1.1402
90.0	81.477	2.40	73	4	1.20	137	1.0954
112.5	100.680	2.40	73	5	1.20	137	1.0954
135.0	120.660	2.60	73	6	1.30	136	1.1402
157.5	141.350	2.80	73	7	1.40	135	1.1832
180.0	162.806	3.00	73	8	1.50	137	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 113 (2)**	**Date:**	**09/24/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	22.5	min	Diameter	20.000	in
Meter Volume, V_m	162.806	dcf	Rectangular		
Water Volume	61.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2133	in.	Length		in
Nozzle Area	0.000248	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.98	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.30	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.700	"H_2O	$\sqrt{Dp}$	1.1609	"H_2O
Temperature, T_m	72.8	^oF	Temperature, T_s	136.4	^oF
Temperature, T_m	532.8	^oA (^oR)	Temperature, T_s	596.4	^oA (^oR)
Pressure Meter, P_m	30.049	"Hg	Pressure Stack, P_s	29.829	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	161.727	dscf	Velocity, V_s	69.49	fps
	4.580	dscm	Volume (actual)	9,097.6	awcfm
Actual Volume, $V_{m(actual)}$	186.555	awcf		8,939.3	adcfm
Gas Stream Moisture			Volume (standard)	481,784.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.871	scf		473,401.5	dscf/hr
Moisture, B_{ws}	0.0174			7,890.0	dscf/min
Moisture EPA M4	1.74	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.97	lb/lb-mole			
Wet, M_s	28.78	lb/lb-mole			
Percent Isokinetic	100.3	%			

Source:	**CFU 113 (2)**					**Sample Date:**	**09/24/18**
Run:		**1**					
		Filter +					
Client ID:		**Front Half**		**Back Half**			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.330		0.691	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		1.240	<	MDL	0.100	0.040	µg/sample
Chromium		1.360		0.370	0.200	0.080	µg/sample
Cobalt		0.597	<	MDL	0.125	0.050	µg/sample
Copper		3.560		3.210	1.250	0.500	µg/sample
Lead		7.850	<	MDL	1.250	0.500	µg/sample
Manganese		1.410		0.434	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		34.100	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		10.600		2.070	0.750	0.300	µg/sample
Lab ID:		18-S2357		18-S2358			
Sample Vol:		250		100			mL

Source:	**CFU 113 (2)**					**Sample Date:**	**09/24/18**
Run:		**2**					
		Filter +					
Client ID:		**Front Half**		**Back Half**			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL		2.020	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.340		0.535	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		1.220	<	MDL	0.100	0.040	µg/sample
Chromium		1.320		0.219	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		2.770		3.780	1.250	0.500	µg/sample
Lead		7.580	<	MDL	1.250	0.500	µg/sample
Manganese		1.300		0.411	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		33.200	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		6.600		2.290	0.750	0.300	µg/sample
Lab ID:		18-S2359		18-S2360			
Sample Vol:		250		100			mL

Source:	CFU 113 (2)						Sample Date: 09/24/18
Run:		3					
Client ID:		Filter + Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		5.670		0.501	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		1.120	<	MDL	0.100	0.040	µg/sample
Chromium		1.340		0.229	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		3.780		4.200	1.250	0.500	µg/sample
Lead		7.530	<	MDL	1.250	0.500	µg/sample
Manganese		1.450		0.383	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		34.600	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		24.300		1.770	0.750	0.300	µg/sample
Lab ID:		18-S2361		18-S2362			
Sample Vol:		250		100			mL

Source: **CFU 113 (2)**
Blank Values

Client ID:		**Filter**	**MDL**		**BH Capture Soln.**	**MDL**		**FH/BH Rinse**	**MDL**
Analyte	**<**	**µg/sample**	**Filter MDL µg/sample**		**5% HNO_3/ 10% H_2O_2 µg/sample**	**<** **5% HNO_3/ 10% H_2O_2 MDL µg/sample**	**<**	**0.1 N HNO_3 µg/sample**	**<** **0.1 N HNO_3 MDL µg/sample**
Antimony	<	MDL	1.250	<	MDL	0.500	<	MDL	1.250
Arsenic	<	MDL	1.750	<	MDL	0.700	<	MDL	1.750
Barium		2.820	0.125		0.423	0.050		0.454	0.125
Beryllium	<	MDL	0.050	<	MDL	0.020	<	MDL	0.050
Cadmium		0.365	0.100	<	MDL	0.040	<	MDL	0.100
Chromium		0.953	0.200		0.154	0.080	<	MDL	0.200
Cobalt	<	MDL	0.125	<	MDL	0.050	<	MDL	0.125
Copper	<	MDL	1.250		2.750	0.500		2.120	1.250
Lead	<	MDL	1.250	<	MDL	0.500	<	MDL	1.250
Manganese		1.030	0.075		0.980	0.030		0.206	0.075
Nickel	<	MDL	0.750	<	MDL	0.300	<	MDL	0.750
Phosphorus		13.400	5.000	<	MDL	2.000	<	MDL	5.000
Selenium	<	MDL	3.750	<	MDL	1.500	<	MDL	3.750
Zinc		1.240	0.750		0.724	0.300	<	MDL	0.750
Lab ID:		18-S2237			18-S2238			18-S2236	
Sample Vol, ml:		250			100			250	

CFU 113 (2)

09/24/18

Species	**I Sample* FH Wash+Filter**	**II Blank* FH Wash, µg**	**III Blank* FH Filter, µg**	**IV Sample* BH Cap.Sol.**	**V Blank* BH Cap.Sol.**	**VI BH Blank* Corrected Cap.Sol.**	**VII BH Blank* Corrected Wash, µg**	**VIII Allowable BH Blank, µg**	**Species**
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.330	0.1816	2.820	0.691	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	1.240	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.360	< 0.0800	0.953	0.370	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	0.597	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	3.560	0.8480	< 1.250	3.210	0.0275	5.500	0.8480	6.348	**Copper**
Pb	7.850	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.410	0.0824	1.030	0.434	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	34.100	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	10.600	< 0.3000	1.240	2.070	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2357**	**18-S2236**	**18-S2237**	**18-S2358**	**18-S2238**				
Content:	$0.1NHNO_3$	$0.1NHNO_3$	$0.1NHNO_3$	$5\%HNO_3/$ $10\%H_2O_2$	$5\%HNO_3/$ $10\%H_2O_2$	$5\%HNO_3/$ $10\%H_2O_2$	$0.1NHNO_3$		
	FH Filter & Probe Rinse			BH Imps 1&2					
	100ml 0.1N HNO_3 rinse			100ml .1N HNO_3 rinse					
		Same as BH Blank Wash		200ml $5\%HNO_3/10\%H_2O_2$ reagent			Same as FH Blank Wash		

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

9/24/18

Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg		XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII		XV FH Net Sample, μg	Species
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.167	0.167	11.63		0.328	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.062	0.062	11.63		0.875	**Cadmium**
Cr	0.953	0.953		0.068	0.068	11.63		0.407	**Chromium**
Co	0.000	0.000		0.030	0.000	11.63		0.597	**Cobalt**
Cu	0.848	0.848		0.178	0.178	11.63		2.712	**Copper**
Pb	0.000	0.000		0.393	0.000	11.63		7.850	**Lead**
Mn	1.112	1.112		0.071	0.071	11.63		0.298	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		1.705	1.705	11.63		22.470	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.530	0.530	11.63		9.360	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

*** Blank Rules:**
"<" indicates value is below the minimum detection limit (MDL)
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If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

Species	XVI Allowable BH Blank, μg	XVII Blank BH Total	XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of $1\mu g$ or XIX	XXI BH Net Sample, μg	XXII FH Net Sample, μg	XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.035	0.035	1.000	**0.000**	**0.328**	**0.328**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.875** <	**0.915**	**Cadmium**
Cr	0.308	0.308	0.019	0.019	1.000	**0.062**	**0.407**	**0.469**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050**	**0.597** <	**0.647**	**Cobalt**
Cu	1.000	6.348	0.161	0.161	1.000	**2.210**	**2.712**	**4.922**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500**	**7.850** <	**8.350**	**Lead**
Mn	1.000	2.042	0.022	0.022	1.000	**0.000**	**0.298**	**0.298**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**22.470** <	**24.470**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.104	0.104	1.000	**1.070**	**9.360**	**10.430**	**Zinc**

Allowable BH Blank Calculation:

if 1.00μg >blank>0, use blank derived

if blank >1.00μg , use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

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Hollingsworth & Vose **Method 29 Metals Blank Calculations** **Run: 2**

CFU 113 (2)

09/24/18

Species	I	II	III	IV	V	VI	VII	VIII	
	Sample*	**Blank***	**Blank***	**Sample***	**Blank***	**BH Blank***	**BH Blank***	**Allowable**	
	FH	**FH**	**FH**	**BH**	**BH**	**Corrected**	**Corrected**	**BH**	
Species	**Wash+Filter**	**Wash, µg**	**Filter, µg**	**Cap.Sol.**	**Cap.Sol.**	**Cap.Sol.**	**Wash, µg**	**Blank, µg**	**Species**
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	2.020	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.340	0.1816	2.820	0.535	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	1.220	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.320	< 0.0800	0.953	0.219	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	2.770	0.8480	< 1.250	3.780	0.0275	5.500	0.8480	6.348	**Copper**
Pb	7.580	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.300	0.0824	1.030	0.411	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	33.200	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	6.600	< 0.3000	1.240	2.290	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2359**	**18-S2236**	**18-S2237**	**#REF!**	**18-S2238**				
Content:	0.1NHNO$_3$	0.1NHNO$_3$	0.1NHNO$_3$	5%HNO$_3$/	5%HNO$_3$/	5%HNO$_3$/	0.1NHNO$_3$		
	FH Filter & Probe Rinse			10%H$_2$O$_2$	10%H$_2$O$_2$	10%H$_2$O$_2$			
	100ml 0.1N HNO$_3$ rinse			BH Imps 1&2					
		Same as BH		100ml .1N HNO$_3$ rinse			Same as FH		
		Blank Wash		200ml 5%HNO$_3$/10%H$_2$O$_2$ reagent			Blank Wash		

Blanks are prorated to reflect 100ml for HNO$_3$ and 200ml for HNO$_3$/H$_2$O$_2$

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"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg	XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII	XV FH Net Sample, μg	Species
Sb	0.000	0.000	< 0.063	0.000	11.63	< 1.250	**Antimony**
As	0.000	0.000	< 0.088	0.000	11.63	< 1.750	**Arsenic**
Ba	3.002	3.002	0.167	0.167	11.63	0.338	**Barium**
Be	0.000	0.000	< 0.003	0.000	11.63	< 0.050	**Beryllium**
Cd	0.365	0.365	0.061	0.061	11.63	0.855	**Cadmium**
Cr	0.953	0.953	0.066	0.066	11.63	0.367	**Chromium**
Co	0.000	0.000	< 0.006	0.000	11.63	< 0.125	**Cobalt**
Cu	0.848	0.848	0.139	0.139	11.63	1.922	**Copper**
Pb	0.000	0.000	0.379	0.000	11.63	7.580	**Lead**
Mn	1.112	1.112	0.065	0.065	11.63	0.188	**Manganese**
Ni	0.000	0.000	< 0.038	0.000	11.63	< 0.750	**Nickel**
P	11.630	13.400	1.660	1.660	11.63	21.570	**Phosphorus**
Se	0.000	0.000	< 0.188	0.000	11.63	< 3.750	**Selenium**
Zn	1.240	1.240	0.330	0.330	11.63	5.360	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

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CFU 113 (2) **Method 29 Metals Blank Calculations** **Run: 2**

9/24/18

Species	XVI Allowable BH Blank, μg	XVII Blank BH Total	XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of $1\mu g$ or XIX	XXI BH Net Sample, μg	XXII FH Net Sample, μg	XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000	0.101	0.000	1.000	**2.020 <**	**1.250** <	**3.270**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.027	0.027	1.000	**0.000**	**0.338**	**0.338**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.855** <	**0.895**	**Cadmium**
Cr	0.308	0.308	0.011	0.011	1.000	**0.000**	**0.367**	**0.367**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125** <	**0.175**	**Cobalt**
Cu	1.000	6.348	0.189	0.189	1.000	**2.780**	**1.922**	**4.702**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500**	**7.580** <	**8.080**	**Lead**
Mn	1.000	2.042	0.021	0.021	1.000	**0.000**	**0.188**	**0.188**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**21.570** <	**23.570**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.115	0.115	1.000	**1.290**	**5.360**	**6.650**	**Zinc**

Allowable BH Blank Calculation:

if $1.00\mu g$ >blank>0, use blank derived

if blank >$1.00\mu g$, use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

*** Blank Rules:**

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CFU 113 (2)

09/24/18

Species	I Sample* FH Wash+Filter	II Blank* FH Wash, µg	III Blank* FH Filter, µg	IV Sample* BH Cap.Sol.	V Blank* BH Cap.Sol.	VI BH Blank* Corrected Cap.Sol.	VII BH Blank* Corrected Wash, µg	VIII Allowable BH Blank, µg	Species
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	5.670	0.1816	2.820	0.501	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	1.120	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.340	< 0.0800	0.953	0.229	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	3.780	0.8480	< 1.250	4.200	0.0275	5.500	0.8480	6.348	**Copper**
Pb	7.530	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.450	0.0824	1.030	0.383	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	34.600	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	24.300	< 0.3000	1.240	1.770	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2361**	**18-S2236**	**18-S2237**	**18-S2362**	**18-S2238**				
Content:	$0.1NHNO_3$	$0.1NHNO_3$	$0.1NHNO_3$	$5\%HNO_3/10\%H_2O_2$	$5\%HNO_3/10\%H_2O_2$	$5\%HNO_3/10\%H_2O_2$	$0.1NHNO_3$		

FH Filter & Probe Rinse
100ml 0.1N HNO_3 rinse

Same as BH Blank Wash

BH Imps 1&2
100ml .1N HNO_3 rinse
200ml $5\%HNO_3/10\%H_2O_2$ reagent

Same as FH Blank Wash

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

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Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg	XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII	XV FH Net Sample, μg	Species
Sb	0.000	0.000	< 0.063	0.000	11.63	< 1.250	**Antimony**
As	0.000	0.000	< 0.088	0.000	11.63	< 1.750	**Arsenic**
Ba	3.002	3.002	0.284	0.284	11.63	2.668	**Barium**
Be	0.000	0.000	< 0.003	0.000	11.63	< 0.050	**Beryllium**
Cd	0.365	0.365	0.056	0.056	11.63	0.755	**Cadmium**
Cr	0.953	0.953	0.067	0.067	11.63	0.387	**Chromium**
Co	0.000	0.000	< 0.006	0.000	11.63	< 0.125	**Cobalt**
Cu	0.848	0.848	0.189	0.189	11.63	2.932	**Copper**
Pb	0.000	0.000	0.377	0.000	11.63	7.530	**Lead**
Mn	1.112	1.112	0.073	0.073	11.63	0.338	**Manganese**
Ni	0.000	0.000	< 0.038	0.000	11.63	< 0.750	**Nickel**
P	11.630	13.400	1.730	1.730	11.63	22.970	**Phosphorus**
Se	0.000	0.000	< 0.188	0.000	11.63	< 3.750	**Selenium**
Zn	1.240	1.240	1.215	1.215	11.63	23.060	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

*** Blank Rules:**
"<" indicates value is below the minimum detection limit (MDL)
If Blank is a "<" value it is treated as zero.
If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

Species	**XVI Allowable BH Blank, μg**	**XVII Blank BH Total**	**XVIII 5% of BH sample, μg**	**XIX Lessor of XVII or XVIII**	**XX Greater of $1\mu g$ or XIX**	**XXI BH Net Sample, μg**	**XXII FH Net Sample, μg**	**XXIII FH+BH Total Net Sample, μg**	**Species**
Sb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.025	0.025	1.000	**0.000**	**2.668**	**2.668**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.755** <	**0.795**	**Cadmium**
Cr	0.308	0.308	0.011	0.011	1.000	**0.000**	**0.387**	**0.387**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125** <	**0.175**	**Cobalt**
Cu	1.000	6.348	0.210	0.210	1.000	**3.200**	**2.932**	**6.132**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500**	**7.530** <	**8.030**	**Lead**
Mn	1.000	2.042	0.019	0.019	1.000	**0.000**	**0.338**	**0.338**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**22.970** <	**24.970**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.089	0.089	1.000	**0.770**	**23.060**	**23.830**	**Zinc**

Allowable BH Blank Calculation:

if $1.00\mu g$ >blank>0, use blank derived

if blank >$1.00\mu g$, use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

EPA Method 29
Gas Stream Characteristics
Test Summary

Client: Hollingsworth & Vose
Source: CFU 113 (2)
Location: Corvallis, OR

Run			1	2	3	
Date			9/24/2018	9/24/2018	9/24/2018	
Run Start Time			9:25	12:50	16:16	
Run End Time			12:30	15:55	19:21	
Duration, min.			180	180	180	Average
Barometric Pressure, "Hg			29.85	29.85	29.85	**29.85**
Nozzle Dia., in.			0.2133	0.2133	0.2133	**0.2133**
Isokinetic Average, %			99.3	100.4	100.3	**100.0**
Sample Volume, dscf			161.620	161.458	161.727	**161.602**
Sample Volume, dscm			4.577	4.572	4.580	**4.576**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			0.91	0.93	0.98	**0.94**
O_2 %vd			20.02	20.27	20.30	**20.20**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			2.00	1.72	1.74	**1.82**
Wet Molecular Weight, lb/lb-mole			28.73	28.77	28.78	**28.76**
Velocity, FPS			69.87	69.05	69.49	**69.47**
ADCFM			8,964.5	8,884.5	8,939.3	**8,929.4**
AWCFM			9,147.4	9,040.0	9,097.6	**9,095.0**
DSCFM			7,960.2	7,866.7	7,890.0	**7,905.7**
Stack Temperature, ^oF			132.8	134.5	136.4	**134.6**
Production Data	Glass Production	lbs/hr	3673.2	3704.5	3694.5	**3690.7**

Hollingsworth & Vose **Test: M29**
CFU 113 (2)
Metals Results Summary

Run 1													
	Total				FH Net				BH Net				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 1.750	< 0.382	< 1.14E-05	< 3.10E-09	< 1.250	< 0.273	< 8.14E-06	< 2.22E-09	< 0.500	< 0.109	< 3.26E-06	< 8.87E-10	**Sb**
Arsenic	< 2.450	< 0.535	< 1.60E-05	< 4.34E-09	< 1.750	< 0.382	< 1.14E-05	< 3.10E-09	< 0.700	< 0.153	< 4.56E-06	< 1.24E-09	**As**
Barium	0.328	0.072	2.14E-06	5.82E-10	0.328	0.072	2.14E-06	5.82E-10	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.015	< 4.56E-07	< 1.24E-10	< 0.050	< 0.011	< 3.26E-07	< 8.88E-11	< 0.020	< 0.004	< 1.30E-07	< 3.54E-11	**Be**
Cadmium	< 0.915	< 0.200	< 5.96E-06	< 1.62E-09	0.875	0.191	5.70E-06	1.55E-09	< 0.040	< 0.009	< 2.61E-07	< 7.11E-11	**Cd**
Chromium	0.469	0.102	3.06E-06	8.32E-10	0.407	0.089	2.65E-06	7.22E-10	0.062	0.014	4.04E-07	1.10E-10	**Cr**
Cobalt	< 0.647	< 0.141	< 4.22E-06	< 1.15E-09	0.597	0.130	3.89E-06	1.06E-09	< 0.050	< 0.011	< 3.26E-07	< 8.88E-11	**Co**
Copper	4.922	1.075	3.21E-05	8.73E-09	2.712	0.593	1.77E-05	4.81E-09	2.210	0.483	1.44E-05	3.92E-09	**Cu**
Lead	< 8.350	< 1.824	< 5.44E-05	< 1.48E-08	7.850	1.715	5.11E-05	1.39E-08	< 0.500	< 0.109	< 3.26E-06	< 8.87E-10	**Pb**
Manganese	0.298	0.065	1.94E-06	5.28E-10	0.298	0.065	1.94E-06	5.28E-10	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.229	< 6.84E-06	< 1.86E-09	< 0.750	< 0.164	< 4.89E-06	< 1.33E-09	< 0.300	< 0.066	< 1.95E-06	< 5.32E-10	**Ni**
Phosphorus	< 24.470	< 5.346	< 1.59E-04	< 4.34E-08	22.470	4.909	1.46E-04	3.99E-08	< 2.000	< 0.437	< 1.30E-05	< 3.55E-09	**P**
Selenium	< 5.250	< 1.147	< 3.42E-05	< 9.31E-09	< 3.750	< 0.819	< 2.44E-05	< 6.65E-09	< 1.500	< 0.328	< 9.77E-06	< 2.66E-09	**Se**
Zinc	10.430	2.279	6.79E-05	1.85E-08	9.360	2.045	6.10E-05	1.66E-08	1.070	0.234	6.97E-06	1.898E-09	**Zn**

Run 2													
	Total				FH Net				BH Net				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 3.270	< 0.715	< 2.11E-05	< 5.69E-09	< 1.250	< 0.273	< 8.06E-06	< 2.17E-09	2.020	0.442	1.30E-05	3.51E-09	**Sb**
Arsenic	< 2.450	< 0.536	< 1.58E-05	< 4.26E-09	< 1.750	< 0.383	< 1.13E-05	< 3.04E-09	< 0.700	< 0.153	< 4.51E-06	< 1.22E-09	**As**
Barium	0.338	0.074	2.18E-06	5.89E-10	0.338	0.074	2.18E-06	5.89E-10	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.015	< 4.51E-07	< 1.22E-10	< 0.050	< 0.011	< 3.22E-07	< 8.69E-11	< 0.020	< 0.004	< 1.29E-07	< 3.48E-11	**Be**
Cadmium	< 0.895	< 0.196	< 5.77E-06	< 1.56E-09	0.855	0.187	5.51E-06	1.49E-09	< 0.040	< 0.009	< 2.58E-07	< 6.96E-11	**Cd**
Chromium	0.367	0.080	2.37E-06	6.38E-10	0.367	0.080	2.37E-06	6.38E-10	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.038	< 1.13E-06	< 3.04E-10	< 0.125	< 0.027	< 8.06E-07	< 2.18E-10	< 0.050	< 0.011	< 3.22E-07	< 8.69E-11	**Co**
Copper	4.702	1.028	3.03E-05	8.18E-09	1.922	0.420	1.24E-05	3.34E-09	2.780	0.608	1.79E-05	4.84E-09	**Cu**
Lead	< 8.080	< 1.767	< 5.21E-05	< 1.41E-08	7.580	1.658	4.89E-05	1.32E-08	< 0.500	< 0.109	< 3.22E-06	< 8.70E-10	**Pb**
Manganese	0.188	0.041	1.21E-06	3.26E-10	0.188	0.041	1.21E-06	3.26E-10	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.230	< 6.77E-06	< 1.83E-09	< 0.750	< 0.164	< 4.83E-06	< 1.30E-09	< 0.300	< 0.066	< 1.93E-06	< 5.22E-10	**Ni**
Phosphorus	< 23.570	< 5.155	< 1.52E-04	< 4.10E-08	21.570	4.718	1.39E-04	3.75E-08	< 2.000	< 0.437	< 1.29E-05	< 3.48E-09	**P**
Selenium	< 5.250	< 1.148	< 3.38E-05	< 9.13E-09	< 3.750	< 0.820	< 2.42E-05	< 6.52E-09	< 1.500	< 0.328	< 9.67E-06	< 2.61E-09	**Se**
Zinc	6.650	1.455	4.29E-05	1.16E-08	5.360	1.172	3.45E-05	9.33E-09	1.290	0.282	8.31E-06	2.24E-09	**Zn**

Hollingsworth & Vose **Test: M29**
CFU 113 (2)
Metals Results Summary

Run 3													
	Total				FH Net				BH Net				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 1.750	< 0.382	< 1.13E-05	< 3.06E-09	< 1.250	< 0.273	< 8.07E-06	< 2.18E-09	< 0.500	< 0.109	< 3.23E-06	< 8.73E-10	**Sb**
Arsenic	< 2.450	< 0.535	< 1.58E-05	< 4.28E-09	< 1.750	< 0.382	< 1.13E-05	< 3.06E-09	< 0.700	< 0.153	< 4.52E-06	< 1.22E-09	**As**
Barium	2.668	0.583	1.72E-05	4.66E-09	2.668	0.583	1.72E-05	4.66E-09	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.015	< 4.52E-07	< 1.22E-10	< 0.050	< 0.011	< 3.23E-07	< 8.74E-11	< 0.020	< 0.004	< 1.29E-07	< 3.49E-11	**Be**
Cadmium	< 0.795	< 0.174	< 5.13E-06	< 1.39E-09	0.755	0.165	4.87E-06	1.32E-09	< 0.040	< 0.009	< 2.58E-07	< 6.98E-11	**Cd**
Chromium	0.387	0.084	2.50E-06	6.76E-10	0.387	0.084	2.50E-06	6.76E-10	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.038	< 1.13E-06	< 3.06E-10	< 0.125	< 0.027	< 8.07E-07	< 2.18E-10	< 0.050	< 0.011	< 3.23E-07	< 8.74E-11	**Co**
Copper	6.132	1.339	3.96E-05	1.07E-08	2.932	0.640	1.89E-05	5.12E-09	3.200	0.699	2.06E-05	5.59E-09	**Cu**
Lead	< 8.030	< 1.753	< 5.18E-05	< 1.40E-08	7.530	1.644	4.86E-05	1.32E-08	< 0.500	< 0.109	< 3.23E-06	< 8.73E-10	**Pb**
Manganese	0.338	0.074	2.18E-06	5.90E-10	0.338	0.074	2.18E-06	5.90E-10	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.229	< 6.78E-06	< 1.83E-09	< 0.750	< 0.164	< 4.84E-06	< 1.31E-09	< 0.300	< 0.066	< 1.94E-06	< 5.24E-10	**Ni**
Phosphorus	< 24.970	< 5.452	< 1.61E-04	< 4.36E-08	22.970	5.015	1.48E-04	4.01E-08	< 2.000	< 0.437	< 1.29E-05	< 3.49E-09	**P**
Selenium	< 5.250	< 1.146	< 3.39E-05	< 9.17E-09	< 3.750	< 0.819	< 2.42E-05	< 6.55E-09	< 1.500	< 0.328	< 9.68E-06	< 2.62E-09	**Se**
Zinc	23.830	5.203	1.54E-04	4.16E-08	23.060	5.035	1.49E-04	4.03E-08	0.770	0.168	4.97E-06	1.345E-09	**Zn**

Mean Runs 1-3													
	Total				FH Net				BH Net				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 2.257	< 0.493	< 1.46E-05	< 3.95E-09	< 1.250	< 0.273	< 8.09E-06	< 2.19E-09	< 1.007	< 0.220	< 6.50E-06	< 1.76E-09	**Sb**
Arsenic	< 2.450	< 0.535	< 1.59E-05	< 4.30E-09	< 1.750	< 0.382	< 1.13E-05	< 3.07E-09	< 0.700	< 0.153	< 4.53E-06	< 1.23E-09	**As**
Barium	1.112	0.243	7.18E-06	1.94E-09	1.112	0.243	7.18E-06	1.94E-09	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.015	< 4.53E-07	< 1.23E-10	< 0.050	< 0.011	< 3.24E-07	< 8.77E-11	< 0.020	< 0.004	< 1.29E-07	< 3.50E-11	**Be**
Cadmium	< 0.868	< 0.190	< 5.62E-06	< 1.52E-09	0.828	0.181	5.36E-06	1.45E-09	< 0.040	< 0.009	< 2.59E-07	< 7.02E-11	**Cd**
Chromium	0.408	0.089	2.64E-06	7.15E-10	0.387	0.085	2.50E-06	6.79E-10	0.021	0.005	1.35E-07	3.67E-11	**Cr**
Cobalt	< 0.332	< 0.073	< 2.16E-06	< 5.86E-10	< 0.282	< 0.062	< 1.83E-06	< 4.98E-10	< 0.050	< 0.011	< 3.24E-07	< 8.77E-11	**Co**
Copper	5.252	1.148	3.40E-05	9.21E-09	2.522	0.551	1.63E-05	4.42E-09	2.730	0.597	1.77E-05	4.78E-09	**Cu**
Lead	< 8.153	< 1.782	< 5.28E-05	< 1.43E-08	7.653	1.672	4.95E-05	1.34E-08	< 0.500	< 0.109	< 3.24E-06	< 8.77E-10	**Pb**
Manganese	0.274	0.060	1.78E-06	4.81E-10	0.274	0.060	1.78E-06	4.81E-10	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.229	< 6.79E-06	< 1.84E-09	< 0.750	< 0.164	< 4.85E-06	< 1.32E-09	< 0.300	< 0.066	< 1.94E-06	< 5.26E-10	**Ni**
Phosphorus	< 24.337	< 5.318	< 1.57E-04	< 4.27E-08	22.337	4.881	1.45E-04	3.92E-08	< 2.000	< 0.437	< 1.29E-05	< 3.51E-09	**P**
Selenium	< 5.250	< 1.147	< 3.40E-05	< 9.20E-09	< 3.750	< 0.819	< 2.43E-05	< 6.57E-09	< 1.500	< 0.328	< 9.71E-06	< 2.63E-09	**Se**
Zinc	13.637	2.979	8.82E-05	2.39E-08	12.593	2.751	8.14E-05	2.21E-08	1.043	0.228	6.75E-06	1.829E-09	**Zn**
Total:	**< 65.450**	**< 14.301**	**< 4.23E-04**	**< 1.15E-07**	< 55.539	< 12.135	< 3.59E-04	< 9.74E-08	< 9.911	< 2.166	< 6.41E-05	< 1.74E-08	

'<' denotes results calculated using the minimum detection limit for front half or back half results that were non-detect.

EPA Methods 1-4, 29
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:25**
Source:	**CFU 113 (2)**	**End Time:**	**12:30**
Method:	**29**	**Date:**	**9/24/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.045 "Hg
   - where Pb: 29.85 "Hg
   - ΔH: 2.650 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.829 "Hg
   - where Pb: 29.85 "Hg
   - Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 161.620 dscf
   - where Vm: 159.360 dcf
   - Y: 0.9985
   - Pm: 30.045 "Hg
   - Tm: 521.8 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 3.304 scf
   - where H_2O: 70.20 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0200
   - where Vw(std): 3.304 scf
   - Vm(std): 161.620 dscf

6) % H_2O = Bws x 100 = 2.00 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 185.797 awcf
   - where Y: 0.9985
   - Vm: 159.3599 dcf
   - Bws: 0.0200
   - Ts: 592.8 °A
   - Tm: 521.8 °A
   - Pm: 30.045 "Hg
   - Ps: 29.829 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.95 lb/lb-mole
   - where CO_2: 0.91 %vd
   - O_2 20.02 %vd
   - N_2+CO= (100-(O_2+CO_2): 79.07 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.73 lb/lb-mole

where M_d: 28.95 lb/lb-mole
Bws: 0.0200

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 2.182 sq. ft.

where Stack ID: 20 inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.

where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 69.87 fps

where Cp: 0.84
Ave. Sqrt ΔP: 1.1699
Ts: 592.8 °A
Ps: 29.829 "Hg
Ms: 28.73 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 9,147.4 AWCFM

where V_s: 69.87 ft/sec
Stack Area: 2.182 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 8,964.5 ADCFM

where AWCFM: 9,147.4
Bws: 0.0200

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 487,361.1 wscf/hr

where V_s: 69.87 ft/sec
Stack Area: 2.1820 sq. ft.
Ts: 592.8 °A
Ps: 29.829 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 477,613.9 dscf/hr

where wscf/hr: 487,361.1
Bws: 0.0200

16) DSCFM= (dscf/hr)/60 mins/hr = 7,960.2 DSCFM

where dscf/hr: 477,613.9

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000248 sq. ft.

where Nozzle Size: 0.2133 inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 99.3 %

where Ts:	592.8	°A
Vm(Std):	161.620	dscf
Ps:	29.829	"Hg
Vs	69.87	ft/sec
Nozzle Area:	0.000248	sq. ft.
Sampling Time:	180	min.
Bws:	0.0200	

EPA Method 29:
Chromium

19) Cr Laboratory Results (blank corrected)

Front half (FH):	0.407	µg/sample
Back half (BH):	0.062	µg/sample
Total (FH + BH):	0.469	µg/sample

20) Cs = µg/Vm(std) = 0.102 µg/dscm

where Run 1 Total:	0.469	µg/sample
Vm(std):	4.577	dscm

21) Emission Rate = (Cs)($\frac{2.83168\ m^3}{ft^3}$)(stack flow)($\frac{2.2046E-9\ lb}{\mu g}$)= 3.06E-06 lb/hr

where Cs:	0.102	µg/dscm
Stack Flow:	477,613.9	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113 (2)**
DATE(S)	**09/24/18**
METHOD	**30B**
POLLUTANT	**Mercury**

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**9:25**
Source:	**CFU 113 (2)**		**End Time:**	**12:30**
EPA Method:	**30B**		**Start Date:**	**9/24/2018**
Box Operator:	**CMF**		**End Date:**	**9/24/2018**
Technician(s):	**CW**			

Pre-Test Information:

Barometric Pressure:	29.85 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN- 30B	
Probe heat:	267 F	
Meterbox ID:	HLN DUEL 30B	HLN DUEL 30B
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498434	OL470820
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.002	0.001	0.000	0.000

Test Summary:

	Side A	Side B
Sample Volume:	359.879	359.833 L
Ave. Meter Temp:	70.4	71.8 °F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	**Side A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0	0.000	0.000	134	134	55	56	6	6	266	268	2.000	2.000
5	9.740	9.730	134	134	56	57	6	6	266	268	1.948	1.946
10	19.550	19.520	134	134	58	59	6	6	266	268	1.962	1.958
15	29.450	29.470	133	133	59	61	6	6	266	268	1.980	1.990
20	39.330	39.300	133	133	59	62	6	6	266	268	1.976	1.966
25	49.420	49.440	132	132	62	64	6	6	266	268	2.018	2.028
30	59.620	59.640	132	132	64	65	6	6	266	268	2.040	2.040
35	69.830	69.880	131	131	65	66	6	6	266	268	2.042	2.048
40	80.020	80.070	132	132	66	68	6	6	266	268	2.038	2.038
45	90.250	90.240	132	132	66	68	7	7	266	268	2.046	2.034
50	100.490	100.460	131	131	68	70	7	7	266	268	2.048	2.044
55	110.790	110.710	131	131	68	70	7	7	266	268	2.060	2.050
60	120.750	120.750	131	131	69	70	7	7	266	268	1.992	2.008
65	130.740	130.720	131	131	69	70	7	7	266	268	1.998	1.994
70	140.730	140.710	131	131	71	72	7	7	266	268	1.998	1.998
75	150.700	150.690	132	132	71	72	7	7	266	268	1.994	1.996
80	160.710	160.720	132	132	71	72	7	7	266	268	2.002	2.006
85	170.710	170.690	133	133	72	74	7	7	266	268	2.000	1.994
90	180.757	180.721	133	133	72	74	7	7	266	268	2.009	2.006
95	190.780	190.780	133	133	73	74	7	7	266	268	2.005	2.012
100	200.810	200.790	133	133	73	74	7	7	266	268	2.006	2.002
105	210.830	210.760	133	133	73	74	7	7	266	268	2.004	1.994
110	220.850	220.870	133	133	74	75	7	7	266	268	2.004	2.022
115	230.880	230.800	133	133	74	75	7	7	266	268	2.006	1.986
120	240.930	240.900	133	133	74	75	7	7	266	268	2.010	2.020
125	250.950	250.950	133	133	74	75	7	7	266	268	2.004	2.010
130	260.990	260.980	133	133	75	77	7	7	266	268	2.008	2.006
135	271.050	271.090	133	133	75	77	7	7	266	268	2.012	2.022
140	281.050	281.030	133	133	76	78	7	7	266	268	2.000	1.988
145	290.930	290.940	133	133	77	78	7	7	266	268	1.976	1.982
150	300.730	300.760	133	133	77	79	7	7	266	268	1.960	1.964
155	310.670	310.670	133	133	78	79	7	7	266	268	1.988	1.982
160	320.620	320.640	133	133	78	79	7	7	266	268	1.990	1.994
165	330.420	330.430	133	133	78	79	7	7	266	268	1.960	1.958
170	340.450	340.430	134	134	78	79	7	7	266	268	2.006	2.000
175	350.120	350.110	134	134	79	80	7	7	266	268	1.934	1.936
180	359.879	359.833	134	134	79	80	7	7	266	268	1.952	1.945

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:50**
Source:	**CFU 113 (2)**	**End Time:**	**15:55**
EPA Method:	**30B**	**Start Date:**	**9/24/2018**
Box Operator:	**CMF**	**End Date:**	**9/24/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.85	"Hg
Test duration:	180	min

Equipment:

	Side A	Side B	
Probe ID:	HLN- 30B		
Probe heat:	267 F		
Meterbox ID:	HLN DUEL 30B	HLN DUEL 30B	
Y factor:	1.0460	1.0380	
Desired sampling rate:	2	2	lpm
Trap ID#:	OL498427	OL492713	
Spiked @:	0	5	ng
Orifice # (if used):			

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.001	0.002	0.001	0.000

Test Summary:

	Side A	Side B	
Sample Volume:	360.120	360.093	L
Ave. Meter Temp:	81	82.3	°F

	Meter Volume (L)		**Stack Temp. (°F)**		**Meter Temp. (°F)**		**Vacuum ("Hg)**		**Trap Temperature (°F)**		**Sampling Rate (Lpm)**	
Time (min.)	**Side A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0	0.000	0.000	135	135	77	78	7	6	266	268	2.000	2.000
5	10.290	10.240	134	134	77	78	7	6	266	268	2.058	2.048
10	20.260	20.250	134	134	77	78	7	6	266	268	1.994	2.002
15	30.240	30.210	134	134	77	78	7	6	266	268	1.996	1.992
20	40.210	40.220	134	134	78	79	7	6	266	268	1.994	2.002
25	50.230	50.200	135	135	78	79	7	6	266	268	2.004	1.996
30	60.240	60.230	134	134	79	80	7	6	266	268	2.002	2.006
35	70.250	70.230	134	134	79	80	7	6	266	268	2.002	2.000
40	80.320	80.310	133	133	79	81	7	6	266	268	2.014	2.016
45	90.380	90.360	133	133	80	81	7	6	266	268	2.012	2.010
50	100.440	100.400	133	133	80	82	7	6	266	268	2.012	2.008
55	110.500	110.500	134	134	81	82	7	6	266	268	2.012	2.020
60	120.580	120.560	134	134	81	82	7	6	266	268	2.016	2.012
65	130.590	130.590	135	135	81	83	7	6	266	268	2.002	2.006
70	140.680	140.690	135	135	81	83	7	6	266	268	2.018	2.020
75	150.720	150.700	135	135	81	83	7	6	266	268	2.008	2.002
80	160.840	160.760	135	135	82	86	7	6	266	268	2.024	2.012
85	170.910	170.930	135	135	82	84	7	6	266	268	2.014	2.034
90	181.004	180.992	135	135	82	84	7	6	266	268	2.019	2.012
95	191.000	191.000	134	134	81	83	7	6	266	268	1.999	2.002
100	201.210	201.160	135	135	81	83	7	6	266	268	2.042	2.032
105	211.170	211.120	135	135	82	83	7	6	266	268	1.992	1.992
110	221.130	221.050	135	135	82	83	7	6	266	268	1.992	1.986
115	231.230	231.260	135	135	82	83	7	6	266	268	2.020	2.042
120	241.260	241.240	135	135	82	83	7	6	266	268	2.006	1.996
125	251.290	251.260	135	135	82	83	7	6	266	268	2.006	2.004
130	261.270	261.310	135	135	82	84	7	6	266	268	1.996	2.010
135	271.250	271.220	137	137	83	84	7	6	266	268	1.996	1.982
140	281.220	281.250	137	137	83	84	7	6	266	268	1.994	2.006
145	290.800	290.910	137	137	83	84	7	6	266	268	1.916	1.932
150	300.700	300.690	136	136	83	84	7	6	266	268	1.980	1.956
155	310.540	310.530	135	135	83	84	7	6	266	268	1.968	1.968
160	320.450	320.440	135	135	83	84	7	6	266	268	1.982	1.982
165	330.290	330.280	135	135	83	84	7	6	266	268	1.968	1.968
170	340.250	340.260	135	135	83	84	7	6	266	268	1.992	1.996
175	350.050	350.030	135	135	83	84	7	6	266	268	1.960	1.954
180	360.120	360.093	135	135	83	84	7	6	266	268	2.014	2.013

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**16:16**
Source:	**CFU 113 (2)**		**End Time:**	**19:21**
EPA Method:	**30B**		**Start Date:**	**9/24/2018**
Box Operator:	**CMF**		**End Date:**	**9/24/2018**
Technician(s):	**CW**			

Pre-Test Information:

Barometric Pressure:	29.85 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN- 30B	
Probe heat:	267 F	
Meterbox ID:	HLN DUEL 30B	HLN DUEL 30B
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498451	OL470860
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.000	0.000	0.001	0.000

Test Summary:

	Side A	Side B
Sample Volume:	360.480	360.452 L
Ave. Meter Temp:	80.9	82.6 °F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	**Side A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0	0.000	0.000	136	136	80	81	8	7	266	268	2.000	2.000
5	10.160	10.190	136	136	80	81	8	7	266	268	2.032	2.038
10	20.000	20.010	136	136	79	80	8	7	266	268	1.968	1.964
15	29.950	29.990	136	136	79	80	8	7	266	268	1.990	1.996
20	39.820	39.850	136	136	79	80	8	7	266	268	1.974	1.972
25	49.930	49.900	136	136	80	82	8	7	266	268	2.022	2.010
30	60.110	60.130	137	137	80	82	8	7	266	268	2.036	2.046
35	70.240	70.240	137	137	80	82	8	7	266	268	2.026	2.022
40	80.340	80.320	137	137	81	82	8	7	266	268	2.020	2.016
45	90.360	90.400	137	137	81	82	8	7	266	268	2.004	2.016
50	100.320	100.250	137	137	81	82	8	7	266	268	1.992	1.970
55	110.470	110.510	136	136	81	83	8	7	266	268	2.030	2.052
60	120.620	120.620	136	136	81	82	8	7	266	268	2.030	2.022
65	130.690	130.750	136	136	81	82	8	7	266	268	2.014	2.026
70	140.620	140.640	136	136	82	84	8	7	266	268	1.986	1.978
75	150.660	150.690	136	136	82	83	8	7	266	268	2.008	2.010
80	160.700	160.690	136	136	82	83	8	7	266	268	2.008	2.000
85	170.760	170.790	136	136	82	83	8	7	266	268	2.012	2.020
90	180.812	180.832	136	136	82	84	8	7	266	268	2.010	2.008
95	190.970	190.970	136	136	82	84	8	7	266	268	2.032	2.028
100	201.010	201.150	136	136	82	84	8	7	266	268	2.008	2.036
105	211.040	211.040	136	136	82	84	8	7	266	268	2.006	1.978
110	221.060	221.040	136	136	82	84	8	7	266	268	2.004	2.000
115	230.940	230.950	136	136	81	83	8	7	266	268	1.976	1.982
120	240.810	240.790	135	135	81	83	8	7	266	268	1.974	1.968
125	250.690	250.600	136	136	81	83	8	7	266	268	1.976	1.962
130	260.590	260.590	136	136	81	83	8	7	266	268	1.980	1.998
135	270.460	270.460	136	136	81	83	8	7	266	268	1.974	1.974
140	280.490	280.490	136	136	81	83	8	7	266	268	2.006	2.006
145	290.260	290.240	136	136	81	83	8	7	266	268	1.954	1.950
150	300.120	300.110	136	136	81	83	8	7	266	268	1.972	1.974
155	310.050	310.050	136	136	81	83	8	7	266	268	1.986	1.988
160	319.930	319.920	136	136	81	83	8	7	266	268	1.976	1.974
165	330.050	330.090	136	136	81	83	8	7	266	268	2.024	2.034
170	340.170	340.170	136	136	81	83	8	7	266	268	2.024	2.016
175	350.310	350.360	136	136	81	83	8	7	266	268	2.028	2.038
180	360.480	360.452	136	136	81	83	8	7	266	268	2.034	2.018

Method 30B
Mercury Concentration

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113 (2)
Test date: 9/24/2018

Meterbox Y:
Side A 1.0460
Side B 1.0380

Run	Sample	Sample Date	Trap ID	Spiked @ ng	Section 1 ng	Section 2 ng	Total Hg ng	Total Hg µg	DGM reading L	Sample volume (corrected for Y) L	Bp "Hg	Meter Temp. °F	Sample Vol. dscm	Hg Conc. µg/dscm	Ave. Pair Hg Conc. µg/dscm
1	A	9/24/2018	OL498434	0.0	8,568	8.7	8576.7	8.577	359.879	376.433	29.85	70.4	0.374	22.941	22.468
	B		OL470820	5.0	8,138	4.6	8137.6	8.138	359.833	373.507		71.8	0.370	21.995	
2	A	9/24/2018	OL498427	0.0	6,937	1.4	6938.4	6.938	360.120	376.686	29.85	81.0	0.367	18.917	18.818
	B		OL492713	5.0	6,799	2.3	6796.3	6.796	360.093	373.777		82.3	0.363	18.719	
3	A	9/24/2018	OL498451	0.0	8,293	0.1	8293.1	8.293	360.480	377.062	29.85	80.9	0.367	22.584	21.720
	B		OL470860	5.0	7,578	2.3	7575.3	7.575	360.452	374.149		82.6	0.363	20.855	

Average: 21.002

Trap Concentrations Example Calculations:
Run 1, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 8576.7 ng
where Section 1: 8568.0 ng
Section 2: 8.7 ng
Spike: 0.0 ng

2. Conversion to µg — Total Hg ng/1000 = 8.58 µg
where Total Hg ng: 8576.7 ng

3. Corrected sample volume — = DGM reading x Meterbox Y factor = 376.433 L
where DGM reading: 359.879 L
Y: 1.046

4. Standard Volume (DSCM) — $= \text{Sample Vol. (L)} \times \left(\frac{528\,°A}{Tm+460}\right) \times \text{Bp}/29.92\ \text{"Hg}\ /1000 =$ 0.374 DSCM
where Sample vol.: 376.433 L
T_m: 70.4 °F
B_p: 29.85 "Hg

5. Hg concentration µg/dscm — = Total Hg µg / Volume DSCM = 22.941 µg/dscm
where Total Hg: 8.58E+00 µg
DSCM: 0.374

6. Average Pair Concentration — = (Side A Conc.+ Side B Conc.)/2 = 22.468 µg/dscm
where Side A: 22.941 µg/dscm
Side B: 21.995 µg/dscm

Method 30B
Results QA/QC

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113 (2)
Test date: 9/24/2018
Test type: C [C for compliance; R for RATA]

Run	**Sample**	**Sample Date**	**Trap ID**	**Spiked @** ng	**Section 1** ng	**Section 2** ng	**Total Hg** ng	**Hg Conc.** µg/dscm	**Breakthr.** %	**Breakthr. Results** PASS/FAIL	C_{rec}. Spiked Compound µg/dscm	**Spiked Hg Recovery R Value** %	**RD Paired Traps** %	**Paired Trap Agree.** PASS/FAIL
1	A	9/24/2018	OL498434	0	8,568	8.7	8576.7	22.941	0.1	PASS	0.933	6900.3	2.11	PASS
	B		OL470820	5	8,138	4.6	8137.6	21.995	0.1	PASS				
2	A	9/24/2018	OL498427	0	6,937	1.4	6938.4	18.917	0.0	PASS	0.185	1340.3	0.53	PASS
	B		OL492713	5	6,799	2.3	6796.3	18.719	0.0	PASS				
3	A	9/24/2018	OL498451	0	8,293	0.1	8293.1	22.584	0.0	PASS	1.715	12459.0	3.98	PASS
	B		OL470860	5	7,578	2.3	7575.3	20.855	0.0	PASS				

1. Breakthrough Critera

Every sample must meet the following critera for breakthrough % from Section 1 to Section 2.

$$Breakthrough\,\% = \frac{Section\ 2\ ng}{Section\ 1\ ng} x100$$ Eq. 30B-2

Allowable Breakthrough %	Compliance Testing (µg/dscm)	RATA (µg/dscm)
10	> 1	> 1
20	≤1	≤1; >0.5
50	Hg conc. ≤30% of emission limit	≤0.5; >0.1

RM average: 21.00210213 µg/dscm

2. Field Recovery Test Field Recovery 3-run Average (%): 6899.9 FAIL

Determines the fraction of spiked Hg recovered (R). Perform for at least three runs per field test. Average of three runs must be between 85 and 115%

$$Crec = \frac{mass\ spiked\ (\mu g)}{Volume\ spiked\ (dscm)} - \frac{mass\ unspiked\ (\mu g)}{Volume\ unspiked\ (dscm)}$$ Eq. 30B-6

$$R = \frac{Crec\ (\frac{\mu g}{dscm})\ x\ vol.spiked\ (dscm)}{mass\ spiked\ (\mu g)} x100$$ Eq. 30B-7

3. Paired trap agreement

$$RD = \frac{|Conc.Trap\ A - Conc.Trap\ B|}{Conc.Trap\ A + Conc.Trap\ B} x100$$ Eq. 30B-5

If paired trains meet the relative deviation (RD) and other QA requirements, the average of the two Hg concs. may be used as an emissions test run value or as the reference method value for a RATA run.

Allowable Relative Dev. %	For Hg conc. (µg/dscm)
10	> 1
20	≤1
or ≤0.2 ug/dscm absolute difference in Hg concs.	≤1

M30B Table 9-1

Method 30B
Emission Calculations

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113 (2)
Test date: 9/24/2018

Run	Ave. Pair Hg Conc. µg/dscm	Hg Conc. lb/dscf	Stack Flow* dscf/hr	Glass Production lb/hr	Stack Emissions lb/hr	Stack Emissions lb/lb glass produced
1	22.468	1.40E-09	477,613.9	3673.2	6.70E-04	1.82E-07
2	18.818	1.17E-09	472,003.6	3704.5	5.54E-04	1.50E-07
3	21.720	1.36E-09	473,401.5	3694.5	6.42E-04	1.74E-07
Average Results:	21.002	1.31E-09	474,339.7	3690.7	6.22E-04	1.69E-07

*From direct stack measurements made during concurrent M29 runs

Daily Gaseous Calibrations Log

Client: H&V

Source: CFU-113 - M2/4/30B/3A (2)

Date: 09/24/18

Test Technician: GWF

Leak check:

Vacuum "	Rate	Pass
—	Ø	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

*Use of a calibrated instrument required

see 9-4-18

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X					8	X		
10	X						X		
20	X					4	X		

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X					8	X		
10	X								

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run **#1**

Test Times: R-1 09:25 - 12:30 R-2 12:50 - 15:55 R-3 16:16 - 19:21

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-113 (2)**
Facility	**Glass Plant 1**	Date	**September 24, 2018**
Location	**Corvallis OR**		

Run	1	2	3	
Date	9/24/2018	9/24/2018	9/24/2018	
Run Start Time	9:25	12:50	16:16	
Run End Time	12:30	15:55	19:21	
CO_2 %vd	0.91	0.93	0.98	0.94
O_2 %vd	20.02	20.27	20.30	20.20

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 24, 2018**	Instrument Model:	**1440**
Location:	**Corvallis OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			Final Values								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.02	0.19	0.85	pass	0.14	0.60	pass	-0.25	pass				
	upscale	9.95	10.06	0.55	pass	9.86	-0.45	pass	-1.00	pass	20	19.77	20.02	10
Run 2	zero	0.02	0.14	0.60	pass	0.13	0.55	pass	-0.05	pass				
	upscale	9.95	9.86	-0.45	pass	9.83	-0.60	pass	-0.15	pass	20	19.82	20.27	10
Run 3	zero	0.02	0.13	0.55	pass	0.06	0.20	pass	-0.35	pass				
	upscale	9.95	9.83	-0.60	pass	9.78	-0.85	pass	-0.25	pass	20	19.81	20.30	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0.02	9.95	20.02
Analyzer Cal. Error	0.10	-0.25	0.10
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 24, 2018**	Instrument Model:	**1440**
Location:	**Corvallis OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			Final Values									
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.01	0.05	1.00	pass	0.09	2.00	pass	1.00	pass				
	upscale	1.84	2.04	5.00	pass	1.93	2.25	pass	-2.75	pass	4	0.94	0.91	2
Run 2	zero	0.01	0.09	2.00	pass	0.10	2.25	pass	0.25	pass				
	upscale	1.84	1.93	2.25	pass	1.88	1.00	pass	-1.25	pass	4	0.94	0.93	2
Run 3	zero	0.01	0.10	2.25	pass	0.09	2.00	pass	-0.25	pass				
	upscale	1.84	1.88	1.00	pass	1.88	1.00	pass	0.00	pass	4	0.97	0.98	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0.01	1.84	4.03
Analyzer Cal. Error	0.25	-4.00	0.75
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**9:25**
Source:	**CFU-113 (2)**	**End Time:**	**12:30**
Method:	**3A**	**Date:**	**9/24/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.25 %v

where C_{Dir}:	9.95	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.55 %v

where C_{Dir}:	9.95	ppmv
C_S:	10.06	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 1.00 %v

where SB_{Final}:	-0.45	ppmv
SB_i:	0.55	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 20.02 ppmv

where C_{Avg}:	19.77	ppmv
C_O:	0.17	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.96	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**9:25**
Source:	**CFU-113 (2)**	**End Time:**	**12:30**
Method:	**3A**	**Date:**	**9/24/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \text{ x } 100 =$ -4.00 %v

where C_{Dir}:	1.84	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \text{ x } 100 =$ 5.00 %v

where C_{Dir}:	1.84	ppmv
C_S:	2.04	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 2.75 %v

where SB_{Final}:	2.25	ppmv
SB_i:	5.00	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.91 ppmv

where C_{Avg}:	0.94	ppmv
C_O:	0.07	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.99	ppmv

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/24/2018

Date	Time	O2 [%]	CO2 [%]
9/24/2018	8:07:40	0.05	0.00
9/24/2018	8:07:50	0.04	0.00
9/24/2018	8:08:00	0.01	0.00
9/24/2018	8:08:10	0.01	0.00
9/24/2018	8:08:20	0.01	0.01
9/24/2018	8:08:30	0.02	0.02
9/24/2018	8:08:40	0.02	0.01
9/24/2018	8:08:50	0.01	0.01
9/24/2018	8:09:00	0.01	0.02
9/24/2018	8:09:10	0.01	0.02
9/24/2018	8:09:20	4.31	3.26
9/24/2018	8:09:30	18.77	19.19
9/24/2018	8:09:40	20.16	19.74
9/24/2018	8:09:50	20.27	19.78
9/24/2018	8:10:00	20.16	19.80
9/24/2018	8:10:10	20.12	19.82
9/24/2018	8:10:20	20.11	19.82
9/24/2018	8:10:30	20.10	19.83
9/24/2018	8:10:40	20.07	19.84
9/24/2018	8:10:50	20.06	19.84
9/24/2018	8:11:00	20.05	19.84
9/24/2018	8:11:10	20.05	19.85
9/24/2018	8:11:20	20.04	19.85
9/24/2018	8:11:30	20.03	19.85
9/24/2018	8:11:40	20.02	19.86
9/24/2018	8:11:50	20.02	19.86
9/24/2018	8:12:00	19.26	19.10
9/24/2018	8:12:10	10.59	9.23
9/24/2018	8:12:20	9.80	9.78
9/24/2018	8:12:30	9.88	9.84
9/24/2018	8:12:40	9.97	9.86
9/24/2018	8:12:50	9.97	9.85
9/24/2018	8:13:00	9.95	9.84
9/24/2018	8:13:10	9.95	9.84
9/24/2018	8:13:20	9.95	9.85
9/24/2018	8:13:30	9.95	9.84
9/24/2018	8:13:40	9.94	9.84
9/24/2018	8:13:50	9.94	9.84
9/24/2018	8:14:00	9.95	9.84
9/24/2018	8:14:10	9.97	9.84
9/24/2018	8:14:20	6.44	5.15

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/24/2018

Date	Time	O2 [%]	CO2 [%]
9/24/2018	8:14:30	3.59	3.95
9/24/2018	8:14:40	3.90	4.11
9/24/2018	8:14:50	3.92	4.11
9/24/2018	8:15:00	3.92	4.11
9/24/2018	8:15:10	3.92	4.11
9/24/2018	8:15:20	3.93	4.10
9/24/2018	8:15:30	3.92	4.09
9/24/2018	8:15:40	3.92	4.06
9/24/2018	8:15:50	3.92	4.05
9/24/2018	8:16:00	3.92	4.04
9/24/2018	8:16:10	3.92	4.04
9/24/2018	8:16:20	3.92	4.04
9/24/2018	8:16:30	3.92	4.04
9/24/2018	8:16:40	3.92	4.04
9/24/2018	8:16:50	3.91	4.02
9/24/2018	8:17:00	3.91	4.04
9/24/2018	8:17:10	3.91	4.02
9/24/2018	8:17:20	3.91	3.99
9/24/2018	8:17:30	3.91	3.99
9/24/2018	8:17:40	3.91	3.99
9/24/2018	8:17:50	3.91	3.99
9/24/2018	8:18:00	3.79	3.75
9/24/2018	8:18:10	2.30	1.82
9/24/2018	8:18:20	2.02	1.87
9/24/2018	8:18:30	1.96	1.84
9/24/2018	8:18:40	1.95	1.84
9/24/2018	8:18:50	1.94	1.84
9/24/2018	8:19:00	1.94	1.82
9/24/2018	8:19:10	1.94	1.82
9/24/2018	8:19:20	1.95	1.82
9/24/2018	8:19:30	0.79	0.58
9/24/2018	8:19:40	0.01	0.02
9/24/2018	8:19:50	-0.01	0.01
9/24/2018	8:20:00	-0.02	0.01
9/24/2018	8:20:10	-0.01	0.01
9/24/2018	8:20:20	-0.01	0.00
9/24/2018	8:20:30	-0.01	0.00
9/24/2018	8:20:40	-0.01	0.01
9/24/2018	8:20:50	0.01	0.00
9/24/2018	8:21:00	0.03	0.03
9/24/2018	8:21:10	0.01	0.00

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/24/2018

Date	Time	O2 [%]	CO2 [%]
9/24/2018	8:21:20	3.21	3.59
9/24/2018	8:21:30	3.86	3.89
9/24/2018	8:21:40	3.85	3.90
9/24/2018	8:21:50	3.85	3.92
9/24/2018	8:22:00	3.87	3.96
9/24/2018	8:22:10	3.88	3.99
9/24/2018	8:22:20	3.89	4.01
9/24/2018	8:22:30	3.90	4.00
9/24/2018	8:22:40	2.75	2.51
9/24/2018	8:22:50	2.05	1.89
9/24/2018	8:23:00	1.96	1.84
9/24/2018	8:23:10	1.94	1.84
9/24/2018	8:23:20	1.94	1.85
9/24/2018	8:23:30	1.94	1.85
9/24/2018	8:23:40	2.08	2.00
9/24/2018	8:23:50	2.14	2.03
9/24/2018	8:24:00	2.13	2.02
9/24/2018	8:24:10	2.13	2.01
9/24/2018	8:24:20	2.13	2.02
9/24/2018	8:24:30	2.13	2.01
9/24/2018	8:24:40	2.13	2.01

		O2 [%]	CO2 [%]
Analyzer Zero		**0.02**	**0.01**
Analyzer Mid		**9.95**	**1.84**
Analyzer High		**20.02**	**4.03**

System

9/24/2018	8:24:50	2.02	1.89
9/24/2018	8:25:00	11.27	0.19
9/24/2018	8:25:10	20.38	0.06
9/24/2018	8:25:20	20.60	0.06
9/24/2018	8:25:30	18.87	0.31
9/24/2018	8:25:40	8.62	0.23
9/24/2018	8:25:50	2.88	0.10
9/24/2018	8:26:00	1.08	0.07
9/24/2018	8:26:10	0.52	0.05
9/24/2018	8:26:20	0.34	0.05
9/24/2018	8:26:30	0.27	0.05
9/24/2018	8:26:40	0.25	0.05
9/24/2018	8:26:50	0.24	0.05
9/24/2018	8:27:00	0.23	0.05

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/24/2018

Date	Time	O2 [%]	CO2 [%]
9/24/2018	8:27:10	0.23	0.05
9/24/2018	8:27:20	0.23	0.04
9/24/2018	8:27:30	0.22	0.05
9/24/2018	8:27:40	0.22	0.05
9/24/2018	8:27:50	0.22	0.05
9/24/2018	8:28:00	0.23	0.05
9/24/2018	8:28:10	0.21	0.05
9/24/2018	8:28:20	0.19	0.05
9/24/2018	8:28:30	0.19	0.05
9/24/2018	8:28:40	0.18	0.06
9/24/2018	8:28:50	0.84	0.78
9/24/2018	8:29:00	4.59	4.86
9/24/2018	8:29:10	7.44	7.53
9/24/2018	8:29:20	9.05	8.91
9/24/2018	8:29:30	9.63	9.39
9/24/2018	8:29:40	9.81	9.54
9/24/2018	8:29:50	9.86	9.60
9/24/2018	8:30:00	9.95	9.64
9/24/2018	8:30:10	10.06	9.66
9/24/2018	8:30:20	10.08	9.67
9/24/2018	8:30:30	10.07	9.68
9/24/2018	8:30:40	10.07	9.68
9/24/2018	8:30:50	10.03	9.69
9/24/2018	8:31:00	9.98	9.69
9/24/2018	8:31:10	9.97	9.70
9/24/2018	8:31:20	9.98	9.70
9/24/2018	8:31:30	7.72	7.24
9/24/2018	8:31:40	5.01	4.88
9/24/2018	8:31:50	3.78	3.67
9/24/2018	8:32:00	2.66	2.51
9/24/2018	8:32:10	2.36	2.20
9/24/2018	8:32:20	2.27	2.09
9/24/2018	8:32:30	2.24	2.05
9/24/2018	8:32:40	2.22	2.04
9/24/2018	8:32:50	2.22	2.04
9/24/2018	8:33:00	2.22	2.04
9/24/2018	8:33:10	2.20	2.02
9/24/2018	8:33:20	2.16	1.96
9/24/2018	8:33:30	2.10	1.91
9/24/2018	8:33:40	2.08	1.90
9/24/2018	8:33:50	5.00	1.64

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/24/2018

Date	Time	O2 [%]	CO2 [%]
9/24/2018	8:34:00	14.28	0.78
		O2 [%]	**CO2 [%]**
System Zero		**0.19**	**0.05**
System Mid		**10.06**	**2.04**

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	O2 [%]	CO2 [%]
9/24/2018	9:25:08	19.76	0.96
9/24/2018	9:26:08	19.76	0.95
9/24/2018	9:27:08	19.75	0.95
9/24/2018	9:28:08	19.76	0.95
9/24/2018	9:29:08	19.76	0.96
9/24/2018	9:30:08	19.75	0.95
9/24/2018	9:31:08	19.75	0.95
9/24/2018	9:32:08	19.75	0.95
9/24/2018	9:33:08	19.75	0.95
9/24/2018	9:34:08	19.75	0.95
9/24/2018	9:35:08	19.75	0.95
9/24/2018	9:36:08	19.77	0.94
9/24/2018	9:37:08	19.77	0.94
9/24/2018	9:38:08	19.76	0.94
9/24/2018	9:39:08	19.76	0.94
9/24/2018	9:40:08	19.77	0.94
9/24/2018	9:41:08	19.77	0.94
9/24/2018	9:42:08	19.76	0.94
9/24/2018	9:43:08	19.76	0.95
9/24/2018	9:44:08	19.76	0.95
9/24/2018	9:45:08	19.76	0.94
9/24/2018	9:46:08	19.78	0.94
9/24/2018	9:47:08	19.78	0.93
9/24/2018	9:48:08	19.78	0.93
9/24/2018	9:49:08	19.80	0.92
9/24/2018	9:50:08	19.79	0.92
9/24/2018	9:51:08	19.79	0.92
9/24/2018	9:52:08	19.80	0.92
9/24/2018	9:53:08	19.79	0.92
9/24/2018	9:54:08	19.76	0.93
9/24/2018	9:55:08	19.77	0.92
9/24/2018	9:56:08	19.77	0.93
9/24/2018	9:57:08	19.76	0.94
9/24/2018	9:58:08	19.78	0.92
9/24/2018	9:59:08	19.77	0.93
9/24/2018	10:00:08	19.76	0.93
9/24/2018	10:01:08	19.76	0.94
9/24/2018	10:02:08	19.76	0.94
9/24/2018	10:03:08	19.77	0.93
9/24/2018	10:04:08	19.78	0.93
9/24/2018	10:05:08	19.77	0.94
9/24/2018	10:06:08	19.78	0.93

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	O2 [%]	CO2 [%]
9/24/2018	10:07:08	19.78	0.94
9/24/2018	10:08:08	19.78	0.95
9/24/2018	10:09:08	19.78	0.95
9/24/2018	10:10:08	19.78	0.95
9/24/2018	10:11:08	19.78	0.95
9/24/2018	10:12:08	19.78	0.95
9/24/2018	10:13:08	19.78	0.95
9/24/2018	10:14:08	19.79	0.95
9/24/2018	10:15:08	19.77	0.96
9/24/2018	10:16:08	19.78	0.95
9/24/2018	10:17:08	19.81	0.94
9/24/2018	10:18:08	19.78	0.95
9/24/2018	10:19:08	19.77	0.96
9/24/2018	10:20:08	19.77	0.95
9/24/2018	10:21:08	19.77	0.94
9/24/2018	10:22:08	19.78	0.94
9/24/2018	10:23:08	19.79	0.93
9/24/2018	10:24:08	19.77	0.95
9/24/2018	10:25:08	19.76	0.95
9/24/2018	10:26:08	19.77	0.93
9/24/2018	10:27:08	19.80	0.92
9/24/2018	10:28:08	19.79	0.93
9/24/2018	10:29:08	19.79	0.94
9/24/2018	10:30:08	19.78	0.94
9/24/2018	10:31:08	19.78	0.95
9/24/2018	10:32:08	19.78	0.95
9/24/2018	10:33:08	19.78	0.95
9/24/2018	10:34:08	19.78	0.95
9/24/2018	10:35:08	19.80	0.94
9/24/2018	10:36:08	19.78	0.95
9/24/2018	10:37:08	19.77	0.95
9/24/2018	10:38:08	19.77	0.95
9/24/2018	10:39:08	19.76	0.96
9/24/2018	10:40:08	19.78	0.94
9/24/2018	10:41:08	19.78	0.95
9/24/2018	10:42:08	19.76	0.96
9/24/2018	10:43:08	19.76	0.95
9/24/2018	10:44:08	19.77	0.95
9/24/2018	10:45:08	19.78	0.94
9/24/2018	10:46:08	19.77	0.95
9/24/2018	10:47:08	19.78	0.94
9/24/2018	10:48:08	19.77	0.94

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	O2 [%]	CO2 [%]
9/24/2018	10:49:08	19.77	0.94
9/24/2018	10:50:08	19.76	0.95
9/24/2018	10:51:08	19.78	0.94
9/24/2018	10:52:08	19.79	0.94
9/24/2018	10:53:08	19.78	0.94
9/24/2018	10:54:08	19.76	0.95
9/24/2018	10:55:08	19.75	0.96
9/24/2018	10:56:08	19.76	0.95
9/24/2018	10:57:08	19.77	0.95
9/24/2018	10:58:08	19.75	0.96
9/24/2018	10:59:08	19.76	0.95
9/24/2018	11:00:08	19.76	0.96
9/24/2018	11:01:08	19.75	0.97
9/24/2018	11:02:08	19.75	0.97
9/24/2018	11:03:08	19.75	0.97
9/24/2018	11:04:08	19.76	0.96
9/24/2018	11:05:08	19.76	0.96
9/24/2018	11:06:08	19.77	0.95
9/24/2018	11:07:08	19.78	0.94
9/24/2018	11:08:08	19.77	0.95
9/24/2018	11:09:08	19.78	0.94
9/24/2018	11:10:08	19.76	0.95
9/24/2018	11:11:08	19.75	0.95
9/24/2018	11:12:08	19.75	0.95
9/24/2018	11:13:08	19.77	0.93
9/24/2018	11:14:08	19.78	0.92
9/24/2018	11:15:08	19.80	0.91
9/24/2018	11:16:08	19.80	0.91
9/24/2018	11:17:08	19.78	0.92
9/24/2018	11:18:08	19.76	0.93
9/24/2018	11:19:08	19.76	0.93
9/24/2018	11:20:08	19.77	0.92
9/24/2018	11:21:08	19.77	0.92
9/24/2018	11:22:08	19.77	0.93
9/24/2018	11:23:08	19.77	0.93
9/24/2018	11:24:08	19.76	0.94
9/24/2018	11:25:08	19.74	0.95
9/24/2018	11:26:08	19.77	0.94
9/24/2018	11:27:08	19.78	0.93
9/24/2018	11:28:08	19.77	0.94
9/24/2018	11:29:08	19.77	0.94
9/24/2018	11:30:08	19.77	0.95

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	O2 [%]	CO2 [%]
9/24/2018	11:31:08	19.76	0.95
9/24/2018	11:32:08	19.75	0.96
9/24/2018	11:33:08	19.77	0.94
9/24/2018	11:34:08	19.76	0.94
9/24/2018	11:35:08	19.75	0.94
9/24/2018	11:36:08	19.76	0.93
9/24/2018	11:37:08	19.75	0.94
9/24/2018	11:38:08	19.77	0.93
9/24/2018	11:39:08	19.76	0.93
9/24/2018	11:40:08	19.76	0.93
9/24/2018	11:41:08	19.76	0.93
9/24/2018	11:42:08	19.74	0.94
9/24/2018	11:43:08	19.75	0.93
9/24/2018	11:44:08	19.77	0.92
9/24/2018	11:45:08	19.77	0.92
9/24/2018	11:46:08	19.75	0.93
9/24/2018	11:47:08	19.76	0.93
9/24/2018	11:48:08	19.75	0.94
9/24/2018	11:49:08	19.77	0.93
9/24/2018	11:50:08	19.77	0.93
9/24/2018	11:51:08	19.77	0.93
9/24/2018	11:52:08	19.77	0.93
9/24/2018	11:53:08	19.76	0.95
9/24/2018	11:54:08	19.75	0.96
9/24/2018	11:55:08	19.77	0.94
9/24/2018	11:56:08	19.77	0.94
9/24/2018	11:57:08	19.76	0.94
9/24/2018	11:58:08	19.77	0.94
9/24/2018	11:59:08	19.75	0.95
9/24/2018	12:00:08	19.77	0.95
9/24/2018	12:01:08	19.75	0.95
9/24/2018	12:02:08	19.77	0.95
9/24/2018	12:03:08	19.76	0.95
9/24/2018	12:04:08	19.79	0.94
9/24/2018	12:05:08	19.80	0.93
9/24/2018	12:06:08	19.76	0.95
9/24/2018	12:07:08	19.77	0.95
9/24/2018	12:08:08	19.77	0.94
9/24/2018	12:09:08	19.76	0.95
9/24/2018	12:10:08	19.78	0.93
9/24/2018	12:11:08	19.77	0.94
9/24/2018	12:12:08	19.78	0.94

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	O2 [%]	CO2 [%]
9/24/2018	12:13:08	19.78	0.94
9/24/2018	12:14:08	19.79	0.94
9/24/2018	12:15:08	19.77	0.95
9/24/2018	12:16:08	19.78	0.94
9/24/2018	12:17:08	19.78	0.95
9/24/2018	12:18:08	19.76	0.95
9/24/2018	12:19:08	19.76	0.96
9/24/2018	12:20:08	19.75	0.96
9/24/2018	12:21:08	19.75	0.97
9/24/2018	12:22:08	19.76	0.96
9/24/2018	12:23:08	19.77	0.96
9/24/2018	12:24:08	19.77	0.96
9/24/2018	12:25:08	19.77	0.95
9/24/2018	12:26:08	19.77	0.96
9/24/2018	12:27:08	19.78	0.95
9/24/2018	12:28:08	19.76	0.96
9/24/2018	12:29:08	19.77	0.95
9/24/2018	12:30:08	19.77	0.95
Final Average		**19.77**	**0.94**

Bias Check

9/24/2018	12:31:08	19.77	0.95
9/24/2018	12:31:18	19.91	0.94
9/24/2018	12:31:28	20.22	0.95
9/24/2018	12:31:38	19.69	0.94
9/24/2018	12:31:48	19.60	0.94
9/24/2018	12:31:58	19.72	0.95
9/24/2018	12:32:08	18.71	1.00
9/24/2018	12:32:18	9.38	0.68
9/24/2018	12:32:28	3.32	0.32
9/24/2018	12:32:38	1.23	0.18
9/24/2018	12:32:48	0.53	0.13
9/24/2018	12:32:58	0.28	0.11
9/24/2018	12:33:08	0.20	0.10
9/24/2018	12:33:18	0.17	0.10
9/24/2018	12:33:28	0.15	0.09
9/24/2018	12:33:38	0.15	0.09
9/24/2018	12:33:48	0.14	0.09
9/24/2018	12:33:58	0.14	0.09
9/24/2018	12:34:08	0.14	0.09
9/24/2018	12:34:18	0.13	0.09
9/24/2018	12:34:28	0.13	0.10

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	O2 [%]	CO2 [%]
9/24/2018	12:34:38	0.23	0.15
9/24/2018	12:34:48	4.13	3.96
9/24/2018	12:34:58	7.85	7.79
9/24/2018	12:35:08	9.16	9.05
9/24/2018	12:35:18	9.60	9.51
9/24/2018	12:35:28	9.76	9.67
9/24/2018	12:35:38	9.82	9.73
9/24/2018	12:35:48	9.84	9.76
9/24/2018	12:35:58	9.85	9.78
9/24/2018	12:36:08	9.86	9.78
9/24/2018	12:36:18	9.86	9.79
9/24/2018	12:36:28	9.86	9.80
9/24/2018	12:36:38	9.86	9.80
9/24/2018	12:36:48	9.86	9.81
9/24/2018	12:36:58	9.87	9.81
9/24/2018	12:37:08	9.88	9.82
9/24/2018	12:37:18	7.72	7.45
9/24/2018	12:37:28	3.33	3.24
9/24/2018	12:37:38	2.39	2.41
9/24/2018	12:37:48	2.15	2.11
9/24/2018	12:37:58	2.06	2.01
9/24/2018	12:38:08	2.04	1.97
9/24/2018	12:38:18	2.02	1.95
9/24/2018	12:38:28	2.02	1.94
9/24/2018	12:38:38	2.02	1.93
9/24/2018	12:38:48	2.02	1.94
9/24/2018	12:38:58	2.02	1.93
9/24/2018	12:39:08	2.02	1.92
9/24/2018	12:39:18	2.02	1.92
9/24/2018	12:39:28	2.01	1.92
9/24/2018	12:39:38	6.20	1.70
9/24/2018	12:39:48	14.43	1.26
9/24/2018	12:39:58	17.89	1.08
		O2 [%]	**CO2 [%]**
System Zero		**0.14**	**0.09**
System Span		**9.86**	**1.93**

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	O2 [%]	CO2 [%]
9/24/2018	12:50:08	19.86	0.95
9/24/2018	12:51:08	19.86	0.95
9/24/2018	12:52:08	19.87	0.95
9/24/2018	12:53:08	19.87	0.95
9/24/2018	12:54:08	19.87	0.94
9/24/2018	12:55:08	19.86	0.95
9/24/2018	12:56:08	19.87	0.94
9/24/2018	12:57:08	19.87	0.94
9/24/2018	12:58:08	19.85	0.94
9/24/2018	12:59:08	19.84	0.95
9/24/2018	13:00:08	19.86	0.94
9/24/2018	13:01:08	19.88	0.92
9/24/2018	13:02:08	19.89	0.92
9/24/2018	13:03:08	19.86	0.93
9/24/2018	13:04:08	19.84	0.95
9/24/2018	13:05:08	19.85	0.94
9/24/2018	13:06:08	19.84	0.94
9/24/2018	13:07:08	19.88	0.94
9/24/2018	13:08:08	19.88	0.93
9/24/2018	13:09:08	19.87	0.94
9/24/2018	13:10:08	19.87	0.94
9/24/2018	13:11:08	19.87	0.95
9/24/2018	13:12:08	19.86	0.95
9/24/2018	13:13:08	19.87	0.95
9/24/2018	13:14:08	19.89	0.93
9/24/2018	13:15:08	19.87	0.94
9/24/2018	13:16:08	19.87	0.94
9/24/2018	13:17:08	19.87	0.94
9/24/2018	13:18:08	19.85	0.95
9/24/2018	13:19:08	19.86	0.94
9/24/2018	13:20:08	19.86	0.94
9/24/2018	13:21:08	19.88	0.92
9/24/2018	13:22:08	19.87	0.92
9/24/2018	13:23:08	19.86	0.92
9/24/2018	13:24:08	19.86	0.93
9/24/2018	13:25:08	19.84	0.93
9/24/2018	13:26:08	19.86	0.92
9/24/2018	13:27:08	19.88	0.91
9/24/2018	13:28:08	19.87	0.92
9/24/2018	13:29:08	19.86	0.92
9/24/2018	13:30:08	19.85	0.94
9/24/2018	13:31:08	19.86	0.92

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	O2 [%]	CO2 [%]
9/24/2018	13:32:08	19.83	0.94
9/24/2018	13:33:08	19.85	0.92
9/24/2018	13:34:08	19.81	0.93
9/24/2018	13:35:08	19.81	0.93
9/24/2018	13:36:08	19.80	0.93
9/24/2018	13:37:08	19.80	0.94
9/24/2018	13:38:08	19.80	0.93
9/24/2018	13:39:08	19.80	0.93
9/24/2018	13:40:08	19.80	0.93
9/24/2018	13:41:08	19.79	0.93
9/24/2018	13:42:08	19.80	0.92
9/24/2018	13:43:08	19.80	0.93
9/24/2018	13:44:08	19.82	0.91
9/24/2018	13:45:08	19.80	0.92
9/24/2018	13:46:08	19.80	0.92
9/24/2018	13:47:08	19.80	0.91
9/24/2018	13:48:08	19.79	0.91
9/24/2018	13:49:08	19.79	0.92
9/24/2018	13:50:08	19.78	0.92
9/24/2018	13:51:08	19.78	0.92
9/24/2018	13:52:08	19.78	0.92
9/24/2018	13:53:08	19.79	0.92
9/24/2018	13:54:08	19.85	0.92
9/24/2018	13:55:08	19.85	0.92
9/24/2018	13:56:08	19.85	0.92
9/24/2018	13:57:08	19.85	0.92
9/24/2018	13:58:08	19.85	0.92
9/24/2018	13:59:08	19.85	0.92
9/24/2018	14:00:08	19.84	0.93
9/24/2018	14:01:08	19.85	0.93
9/24/2018	14:02:08	19.85	0.94
9/24/2018	14:03:08	19.84	0.94
9/24/2018	14:04:08	19.83	0.94
9/24/2018	14:05:08	19.84	0.93
9/24/2018	14:06:08	19.84	0.94
9/24/2018	14:07:08	19.84	0.93
9/24/2018	14:08:08	19.83	0.93
9/24/2018	14:09:08	19.83	0.94
9/24/2018	14:10:08	19.84	0.93
9/24/2018	14:11:08	19.85	0.92
9/24/2018	14:12:08	19.85	0.92
9/24/2018	14:13:08	19.84	0.92

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	O2 [%]	CO2 [%]
9/24/2018	14:14:08	19.82	0.93
9/24/2018	14:15:08	19.83	0.92
9/24/2018	14:16:08	19.82	0.92
9/24/2018	14:17:08	19.84	0.92
9/24/2018	14:18:08	19.84	0.92
9/24/2018	14:19:08	19.83	0.93
9/24/2018	14:20:08	19.84	0.92
9/24/2018	14:21:08	19.85	0.92
9/24/2018	14:22:08	19.83	0.93
9/24/2018	14:23:08	19.84	0.93
9/24/2018	14:24:08	19.83	0.94
9/24/2018	14:25:08	19.82	0.94
9/24/2018	14:26:08	19.82	0.95
9/24/2018	14:27:08	19.82	0.95
9/24/2018	14:28:08	19.83	0.95
9/24/2018	14:29:08	19.82	0.95
9/24/2018	14:30:08	19.82	0.95
9/24/2018	14:31:08	19.81	0.96
9/24/2018	14:32:08	19.82	0.95
9/24/2018	14:33:08	19.81	0.95
9/24/2018	14:34:08	19.82	0.94
9/24/2018	14:35:08	19.83	0.94
9/24/2018	14:36:08	19.82	0.94
9/24/2018	14:37:08	19.80	0.95
9/24/2018	14:38:08	19.81	0.94
9/24/2018	14:39:08	19.82	0.94
9/24/2018	14:40:08	19.83	0.93
9/24/2018	14:41:08	19.81	0.94
9/24/2018	14:42:08	19.84	0.92
9/24/2018	14:43:08	19.84	0.93
9/24/2018	14:44:08	19.82	0.94
9/24/2018	14:45:08	19.80	0.95
9/24/2018	14:46:08	19.81	0.95
9/24/2018	14:47:08	19.82	0.95
9/24/2018	14:48:08	19.81	0.96
9/24/2018	14:49:08	19.82	0.96
9/24/2018	14:50:08	19.82	0.96
9/24/2018	14:51:08	19.81	0.97
9/24/2018	14:52:08	19.80	0.97
9/24/2018	14:53:08	19.83	0.96
9/24/2018	14:54:08	19.82	0.97
9/24/2018	14:55:08	19.80	0.98

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	O2 [%]	CO2 [%]
9/24/2018	14:56:08	19.78	0.99
9/24/2018	14:57:08	19.81	0.97
9/24/2018	14:58:08	19.81	0.97
9/24/2018	14:59:08	19.82	0.97
9/24/2018	15:00:08	19.83	0.96
9/24/2018	15:01:08	19.79	0.98
9/24/2018	15:02:08	19.81	0.97
9/24/2018	15:03:08	19.80	0.97
9/24/2018	15:04:08	19.80	0.98
9/24/2018	15:05:08	19.80	0.98
9/24/2018	15:06:08	19.80	0.98
9/24/2018	15:07:08	19.80	0.98
9/24/2018	15:08:08	19.80	0.99
9/24/2018	15:09:08	19.80	0.99
9/24/2018	15:10:08	19.80	0.99
9/24/2018	15:11:08	19.80	0.98
9/24/2018	15:12:08	19.80	0.99
9/24/2018	15:13:08	19.79	1.00
9/24/2018	15:14:08	19.81	0.99
9/24/2018	15:15:08	19.83	0.98
9/24/2018	15:16:08	19.81	0.98
9/24/2018	15:17:08	19.80	0.98
9/24/2018	15:18:08	19.81	0.97
9/24/2018	15:19:08	19.81	0.97
9/24/2018	15:20:08	19.82	0.96
9/24/2018	15:21:08	19.81	0.97
9/24/2018	15:22:08	19.81	0.96
9/24/2018	15:23:08	19.81	0.96
9/24/2018	15:24:08	19.80	0.97
9/24/2018	15:25:08	19.81	0.96
9/24/2018	15:26:08	19.79	0.96
9/24/2018	15:27:08	19.78	0.96
9/24/2018	15:28:08	19.79	0.95
9/24/2018	15:29:08	19.79	0.95
9/24/2018	15:30:08	19.79	0.95
9/24/2018	15:31:08	19.78	0.95
9/24/2018	15:32:08	19.78	0.95
9/24/2018	15:33:08	19.75	0.96
9/24/2018	15:34:08	19.78	0.95
9/24/2018	15:35:08	19.79	0.94
9/24/2018	15:36:08	19.79	0.94
9/24/2018	15:37:08	19.77	0.95

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	O2 [%]	CO2 [%]
9/24/2018	15:38:08	19.76	0.96
9/24/2018	15:39:08	19.75	0.97
9/24/2018	15:40:08	19.78	0.96
9/24/2018	15:41:08	19.79	0.95
9/24/2018	15:42:08	19.80	0.95
9/24/2018	15:43:08	19.78	0.96
9/24/2018	15:44:08	19.77	0.97
9/24/2018	15:45:08	19.78	0.96
9/24/2018	15:46:08	19.77	0.96
9/24/2018	15:47:08	19.77	0.96
9/24/2018	15:48:08	19.78	0.96
9/24/2018	15:49:08	19.79	0.95
9/24/2018	15:50:08	19.78	0.95
9/24/2018	15:51:08	19.78	0.95
9/24/2018	15:52:08	19.80	0.94
9/24/2018	15:53:08	19.79	0.95
9/24/2018	15:54:08	19.79	0.95
9/24/2018	15:55:08	19.78	0.96
Final Average		**19.82**	**0.94**

Bias Check

9/24/2018	15:57:08	19.82	0.97
9/24/2018	15:57:18	16.98	1.00
9/24/2018	15:57:28	7.22	0.57
9/24/2018	15:57:38	2.53	0.29
9/24/2018	15:57:48	0.95	0.18
9/24/2018	15:57:58	0.43	0.13
9/24/2018	15:58:08	0.25	0.12
9/24/2018	15:58:18	0.18	0.13
9/24/2018	15:58:28	0.16	0.12
9/24/2018	15:58:38	0.14	0.12
9/24/2018	15:58:48	0.14	0.12
9/24/2018	15:58:58	0.14	0.12
9/24/2018	15:59:08	0.13	0.11
9/24/2018	15:59:18	0.12	0.10
9/24/2018	15:59:28	0.14	0.10
9/24/2018	15:59:38	0.13	0.11
9/24/2018	15:59:48	0.13	0.10
9/24/2018	15:59:58	0.13	0.10
9/24/2018	16:00:08	0.13	0.11
9/24/2018	16:00:18	0.56	0.59
9/24/2018	16:00:28	1.46	1.26

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	O2 [%]	CO2 [%]
9/24/2018	16:00:38	1.80	1.54
9/24/2018	16:00:48	1.92	1.74
9/24/2018	16:00:58	1.96	1.82
9/24/2018	16:01:08	1.97	1.84
9/24/2018	16:01:18	1.98	1.86
9/24/2018	16:01:28	1.99	1.87
9/24/2018	16:01:38	1.99	1.88
9/24/2018	16:01:48	1.99	1.88
9/24/2018	16:01:58	1.99	1.88
9/24/2018	16:02:08	3.23	3.39
9/24/2018	16:02:18	7.34	7.68
9/24/2018	16:02:28	8.98	9.04
9/24/2018	16:02:38	9.53	9.50
9/24/2018	16:02:48	9.72	9.66
9/24/2018	16:02:58	9.78	9.72
9/24/2018	16:03:08	9.81	9.75
9/24/2018	16:03:18	9.82	9.76
9/24/2018	16:03:28	9.82	9.77
9/24/2018	16:03:38	9.82	9.78
9/24/2018	16:03:48	9.83	9.78
9/24/2018	16:03:58	9.83	9.79
9/24/2018	16:04:08	9.83	9.79
9/24/2018	16:04:18	9.83	9.80
9/24/2018	16:04:28	9.82	9.80
9/24/2018	16:04:38	11.07	8.65
9/24/2018	16:04:48	15.96	4.27
9/24/2018	16:04:58	18.40	2.05
9/24/2018	16:05:08	19.28	1.37
9/24/2018	16:05:18	19.59	1.13
		O2 [%]	**CO2 [%]**
System Zero		**0.13**	**0.10**
System Span		**9.83**	**1.88**

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	O2 [%]	CO2 [%]
9/24/2018	16:16:08	19.82	0.94
9/24/2018	16:17:08	19.84	0.94
9/24/2018	16:18:08	19.83	0.95
9/24/2018	16:19:08	19.83	0.95
9/24/2018	16:20:08	19.85	0.95
9/24/2018	16:21:08	19.85	0.95
9/24/2018	16:22:08	19.84	0.96
9/24/2018	16:23:08	19.84	0.95
9/24/2018	16:24:08	19.84	0.96
9/24/2018	16:25:08	19.83	0.96
9/24/2018	16:26:08	19.83	0.97
9/24/2018	16:27:08	19.83	0.97
9/24/2018	16:28:08	19.84	0.97
9/24/2018	16:29:08	19.83	0.98
9/24/2018	16:30:08	19.85	0.97
9/24/2018	16:31:08	19.84	0.97
9/24/2018	16:32:08	19.84	0.98
9/24/2018	16:33:08	19.84	1.00
9/24/2018	16:34:08	19.83	1.01
9/24/2018	16:35:08	19.84	0.99
9/24/2018	16:36:08	19.84	0.99
9/24/2018	16:37:08	19.82	1.00
9/24/2018	16:38:08	19.84	0.98
9/24/2018	16:39:08	19.85	0.97
9/24/2018	16:40:08	19.85	0.96
9/24/2018	16:41:08	19.84	0.96
9/24/2018	16:42:08	19.85	0.96
9/24/2018	16:43:08	19.86	0.96
9/24/2018	16:44:08	19.86	0.96
9/24/2018	16:45:08	19.84	0.96
9/24/2018	16:46:08	19.85	0.96
9/24/2018	16:47:08	19.83	0.97
9/24/2018	16:48:08	19.84	0.97
9/24/2018	16:49:08	19.83	0.98
9/24/2018	16:50:08	19.82	0.98
9/24/2018	16:51:08	19.84	0.97
9/24/2018	16:52:08	19.86	0.97
9/24/2018	16:53:08	19.84	0.98
9/24/2018	16:54:08	19.85	0.98
9/24/2018	16:55:08	19.83	0.99
9/24/2018	16:56:08	19.84	0.99
9/24/2018	16:57:08	19.86	0.97

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	O2 [%]	CO2 [%]
9/24/2018	16:58:08	19.85	0.98
9/24/2018	16:59:08	19.83	0.99
9/24/2018	17:00:08	19.82	0.99
9/24/2018	17:01:08	19.85	0.97
9/24/2018	17:02:08	19.87	0.96
9/24/2018	17:03:08	19.84	0.97
9/24/2018	17:04:08	19.84	0.97
9/24/2018	17:05:08	19.84	0.96
9/24/2018	17:06:08	19.84	0.96
9/24/2018	17:07:08	19.83	0.96
9/24/2018	17:08:08	19.82	0.97
9/24/2018	17:09:08	19.83	0.95
9/24/2018	17:10:08	19.80	0.97
9/24/2018	17:11:08	19.81	0.97
9/24/2018	17:12:08	19.81	0.96
9/24/2018	17:13:08	19.81	0.97
9/24/2018	17:14:08	19.81	0.97
9/24/2018	17:15:08	19.81	0.97
9/24/2018	17:16:08	19.81	0.98
9/24/2018	17:17:08	19.80	0.99
9/24/2018	17:18:08	19.82	0.98
9/24/2018	17:19:08	19.81	0.98
9/24/2018	17:20:08	19.84	0.97
9/24/2018	17:21:08	19.81	0.98
9/24/2018	17:22:08	19.81	0.98
9/24/2018	17:23:08	19.81	0.99
9/24/2018	17:24:08	19.80	0.99
9/24/2018	17:25:08	19.80	1.00
9/24/2018	17:26:08	19.80	1.00
9/24/2018	17:27:08	19.81	0.98
9/24/2018	17:28:08	19.83	0.98
9/24/2018	17:29:08	19.81	0.98
9/24/2018	17:30:08	19.81	0.98
9/24/2018	17:31:08	19.79	0.99
9/24/2018	17:32:08	19.82	0.97
9/24/2018	17:33:08	19.80	0.97
9/24/2018	17:34:08	19.79	0.98
9/24/2018	17:35:08	19.82	0.97
9/24/2018	17:36:08	19.82	0.97
9/24/2018	17:37:08	19.80	0.98
9/24/2018	17:38:08	19.81	0.98
9/24/2018	17:39:08	19.81	0.98

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	O2 [%]	CO2 [%]
9/24/2018	17:40:08	19.84	0.96
9/24/2018	17:41:08	19.82	0.98
9/24/2018	17:42:08	19.82	0.98
9/24/2018	17:43:08	19.82	0.99
9/24/2018	17:44:08	19.83	0.98
9/24/2018	17:45:08	19.82	0.98
9/24/2018	17:46:08	19.82	0.99
9/24/2018	17:47:08	19.82	0.98
9/24/2018	17:48:08	19.81	0.99
9/24/2018	17:49:08	19.82	0.98
9/24/2018	17:50:08	19.81	0.99
9/24/2018	17:51:08	19.83	0.97
9/24/2018	17:52:08	19.80	0.98
9/24/2018	17:53:08	19.80	0.98
9/24/2018	17:54:08	19.81	0.97
9/24/2018	17:55:08	19.82	0.97
9/24/2018	17:56:08	19.81	0.97
9/24/2018	17:57:08	19.81	0.98
9/24/2018	17:58:08	19.80	0.98
9/24/2018	17:59:08	19.79	0.98
9/24/2018	18:00:08	19.79	0.98
9/24/2018	18:01:08	19.79	0.99
9/24/2018	18:02:08	19.78	0.99
9/24/2018	18:03:08	19.78	0.99
9/24/2018	18:04:08	19.79	0.99
9/24/2018	18:05:08	19.77	1.00
9/24/2018	18:06:08	19.79	0.99
9/24/2018	18:07:08	19.79	0.99
9/24/2018	18:08:08	19.79	1.00
9/24/2018	18:09:08	19.80	0.99
9/24/2018	18:10:08	19.79	1.00
9/24/2018	18:11:08	19.79	1.00
9/24/2018	18:12:08	19.79	1.00
9/24/2018	18:13:08	19.79	0.99
9/24/2018	18:14:08	19.79	1.00
9/24/2018	18:15:08	19.80	0.99
9/24/2018	18:16:08	19.79	1.00
9/24/2018	18:17:08	19.78	1.00
9/24/2018	18:18:08	19.78	0.99
9/24/2018	18:19:08	19.80	0.98
9/24/2018	18:20:08	19.79	0.97
9/24/2018	18:21:08	19.79	0.96

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	O2 [%]	CO2 [%]
9/24/2018	18:22:08	19.80	0.97
9/24/2018	18:23:08	19.79	0.97
9/24/2018	18:24:08	19.79	0.97
9/24/2018	18:25:08	19.81	0.95
9/24/2018	18:26:08	19.81	0.96
9/24/2018	18:27:08	19.79	0.96
9/24/2018	18:28:08	19.81	0.96
9/24/2018	18:29:08	19.80	0.96
9/24/2018	18:30:08	19.80	0.95
9/24/2018	18:31:08	19.80	0.96
9/24/2018	18:32:08	19.79	0.96
9/24/2018	18:33:08	19.81	0.95
9/24/2018	18:34:08	19.80	0.96
9/24/2018	18:35:08	19.80	0.96
9/24/2018	18:36:08	19.80	0.95
9/24/2018	18:37:08	19.79	0.96
9/24/2018	18:38:08	19.80	0.96
9/24/2018	18:39:08	19.79	0.96
9/24/2018	18:40:08	19.79	0.95
9/24/2018	18:41:08	19.80	0.95
9/24/2018	18:42:08	19.80	0.95
9/24/2018	18:43:08	19.80	0.94
9/24/2018	18:44:08	19.81	0.94
9/24/2018	18:45:08	19.80	0.94
9/24/2018	18:46:08	19.81	0.94
9/24/2018	18:47:08	19.81	0.93
9/24/2018	18:48:08	19.81	0.93
9/24/2018	18:49:08	19.80	0.94
9/24/2018	18:50:08	19.81	0.93
9/24/2018	18:51:08	19.80	0.94
9/24/2018	18:52:08	19.80	0.93
9/24/2018	18:53:08	19.81	0.93
9/24/2018	18:54:08	19.80	0.94
9/24/2018	18:55:08	19.81	0.93
9/24/2018	18:56:08	19.80	0.94
9/24/2018	18:57:08	19.81	0.93
9/24/2018	18:58:08	19.81	0.94
9/24/2018	18:59:08	19.81	0.94
9/24/2018	19:00:08	19.81	0.94
9/24/2018	19:01:08	19.81	0.94
9/24/2018	19:02:08	19.82	0.93
9/24/2018	19:03:08	19.81	0.94

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	O2 [%]	CO2 [%]
9/24/2018	19:04:08	19.80	0.94
9/24/2018	19:05:08	19.80	0.94
9/24/2018	19:06:08	19.80	0.94
9/24/2018	19:07:08	19.80	0.94
9/24/2018	19:08:08	19.79	0.94
9/24/2018	19:09:08	19.80	0.93
9/24/2018	19:10:08	19.79	0.94
9/24/2018	19:11:08	19.80	0.93
9/24/2018	19:12:08	19.80	0.92
9/24/2018	19:13:08	19.79	0.93
9/24/2018	19:14:08	19.79	0.93
9/24/2018	19:15:08	19.78	0.93
9/24/2018	19:16:08	19.80	0.92
9/24/2018	19:17:08	19.79	0.93
9/24/2018	19:18:08	19.80	0.92
9/24/2018	19:19:08	19.79	0.93
9/24/2018	19:20:08	19.79	0.93
9/24/2018	19:21:08	19.79	0.93
Final Average		**19.81**	**0.97**
Bias Check			
9/24/2018	19:22:38	19.75	1.00
9/24/2018	19:22:48	13.08	1.28
9/24/2018	19:22:58	4.70	0.58
9/24/2018	19:23:08	1.66	0.30
9/24/2018	19:23:18	0.67	0.18
9/24/2018	19:23:28	0.34	0.15
9/24/2018	19:23:38	0.23	0.12
9/24/2018	19:23:48	0.19	0.12
9/24/2018	19:23:58	0.17	0.13
9/24/2018	19:24:08	0.16	0.13
9/24/2018	19:24:18	0.12	0.10
9/24/2018	19:24:28	0.08	0.08
9/24/2018	19:24:38	0.07	0.09
9/24/2018	19:24:48	0.07	0.10
9/24/2018	19:24:58	0.06	0.09
9/24/2018	19:25:08	0.06	0.08
9/24/2018	19:25:18	0.06	0.09
9/24/2018	19:25:28	0.08	0.10
9/24/2018	19:25:38	1.04	1.06
9/24/2018	19:25:48	1.78	1.49
9/24/2018	19:25:58	1.23	0.99

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	O2 [%]	CO2 [%]
9/24/2018	19:26:08	0.50	0.44
9/24/2018	19:26:18	0.21	0.21
9/24/2018	19:26:28	0.11	0.13
9/24/2018	19:26:38	0.07	0.10
9/24/2018	19:26:48	0.89	0.99
9/24/2018	19:26:58	0.86	0.90
9/24/2018	19:27:08	1.50	1.54
9/24/2018	19:27:18	1.82	1.77
9/24/2018	19:27:28	1.90	1.83
9/24/2018	19:27:38	1.94	1.86
9/24/2018	19:27:48	1.94	1.86
9/24/2018	19:27:58	1.95	1.88
9/24/2018	19:28:08	1.95	1.87
9/24/2018	19:28:18	1.95	1.88
9/24/2018	19:28:28	1.95	1.88
9/24/2018	19:28:38	1.95	1.88
9/24/2018	19:28:48	2.88	3.03
9/24/2018	19:28:58	7.07	7.48
9/24/2018	19:29:08	8.88	8.97
9/24/2018	19:29:18	9.46	9.47
9/24/2018	19:29:28	9.66	9.64
9/24/2018	19:29:38	9.73	9.70
9/24/2018	19:29:48	9.76	9.72
9/24/2018	19:29:58	9.77	9.75
9/24/2018	19:30:08	9.77	9.75
9/24/2018	19:30:18	9.77	9.76
9/24/2018	19:30:28	9.78	9.76
9/24/2018	19:30:38	9.78	9.76
9/24/2018	19:30:48	9.77	9.77
9/24/2018	19:30:58	9.96	9.59
		O2 [%]	**CO2 [%]**
System Zero		**0.06**	**0.09**
System Span		**9.78**	**1.88**

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis OR**
SOURCE	**CFU 113 (2)**
DATE	**09/25/18**
METHOD	**5 ODEQ**
POLLUTANT	**Particulate Matter**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis OR**			**Start Time:**	**9:14**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**		**End Time:**	**11:21**
EPA Method:	**5 ODEQ**	Clear 70 F Wind Variable		**Date:**	**9/25/2018**
Box Operator:	**CMF**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.218	Nozzle size	0.2157 inches
$\Delta H@$	1.846	Hot box ID	HB2	Nozzle area	0.000254 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.99 "Hg	O_2	19.90 %
Static Pressure	-0.28 "H_2O	CO_2	0.50 %
Ave. ΔP	1.35 "H_2O	Rec. Nz.	0.195 inches
Stack Temperature	134 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	12	6

Nozzle check for roundness:

1	2	3	
0.215	0.215	0.217	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	114.756 dcf	Ave. ΔP	1.513 "H_2O
Wet mol. weight	28.64 M_s (actual)	Ave. $\sqrt{\Delta P}$	1.2291 "H_2O
Actual H_2O	2.16 %	Ave. ΔH	3.15 "H_2O
Std. meter vol.	116.980 dscf	Ave. T_s	135.6 °F
Isokinetic Average	100.2 %	Ave. T_m	63.4 °F

Moisture/Lab:

Filter Q1380 #

	Initial	Final	Gain
Impingers, g	200.0	230	30.0
Silica gel, g	254.3	279.2	24.9
		Total water gain:	54.9

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	15.0	14.470	1.60	135	58	3.29	3.30	3	252	41
2	30.0	29.090	1.60	139	58	3.27	3.30	3	249	45
3	45.0	43.420	1.50	138	61	3.09	3.10	3	251	47
4	60.0	57.682	1.50	137	63	3.11	3.10	3	251	48
5	75.0	72.640	1.60	133	65	3.35	3.40	3	252	53
6	90.0	87.520	1.60	133	65	3.35	3.40	3	252	49
7	105.0	101.450	1.40	134	68	2.94	2.90	3	251	51
8	120.0	114.756	1.30	136	69	2.73	2.70	3	252	51

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis OR**		**Start Time:**	**12:00**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**14:04**
EPA Method:	**5 ODEQ**	Clear 70 F Wind Variable	**Date:**	**9/25/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.218	Nozzle size:	0.2157 inches
ΔH@	1.846	Hot box ID	HB2	Nozzle area:	0.000254 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.99 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.5 %
Ave. ΔP	1.35 "H_2O	Rec. Nz.	0.196 inches
Stack Temperature	134 F		
Assumed moisture	2.16 %		
Assumed meter temp.	63.4 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	6

Nozzle check for roundness:

1	2	3
0.215	0.215	0.217 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	118.045 dcf	Ave. ΔP	1.525 "H_2O
Wet mol. weight	28.68 M_s (actual)	Ave. √ΔP	1.2342 "H_2O
Actual H_2O	1.81 %	Ave. ΔH	3.238 "H_2O
Std. meter vol.	117.857 dscf	Ave. T_s	138.8 °F
Isokinetic Average	100.5 %	Ave. T_m	74.5 °F

Moisture/Lab:

	Initial	Final	Gain
Filter Q1381 #			
Impingers, g	200.0	220	20.0
Silica gel, g	234.8	261	26.2
		Total water gain:	46.2

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	14.750	1.60	137	70	3.35	3.40	4	253	53
2	30.0	29.760	1.60	137	70	3.35	3.40	4	253	53
3	45.0	44.740	1.50	137	72	3.15	3.20	4	253	53
4	60.0	58.275	1.30	138	74	2.74	2.70	4	252	59
5	75.0	73.440	1.60	137	76	3.39	3.40	4	252	62
6	90.0	88.570	1.60	140	77	3.37	3.40	4	252	65
7	105.0	103.350	1.50	141	78	3.16	3.20	4	252	67
8	120.0	118.045	1.50	143	79	3.16	3.20	4	251	59

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis OR**		**Start Time:**	**14:30**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**16:36**
EPA Method:	**5 ODEQ**	Clear 70 F Wind Variable	**Date:**	**9/25/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.218	Nozzle size:	0.2157 inches
ΔH@	1.846	Hot box ID	HB2	Nozzle area:	0.000254 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.99 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.5 %
Ave. ΔP	1.35 "H_2O	Rec. Nz.	0.194 inches
Stack Temperature	134 F		
Assumed moisture	1.81 %		
Assumed meter temp.	74.5 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	8

Nozzle check for roundness:

1	2	3
0.215	0.215	0.217 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	118.082 dcf	Ave. ΔP	1.5 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. $\sqrt{\Delta P}$	1.2237 "H_2O
Actual H_2O	1.63 %	Ave. ΔH	3.2 "H_2O
Std. meter vol.	116.768 dscf	Ave. T_s	143.3 °F
Isokinetic Average	100.7 %	Ave. T_m	79.6 °F

Moisture/Lab:

Filter Q1382 #

	Initial	Final	Gain
Impingers, g	200.0	210	10.0
Silica gel, g	250.8	281.8	31.0
		Total water gain:	41.0

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	15.120	1.60	144	78	3.38	3.40	4	254	63
2	30.0	30.330	1.60	144	78	3.38	3.40	4	254	62
3	45.0	45.020	1.50	143	79	3.18	3.20	4	250	64
4	60.0	60.260	1.60	143	80	3.40	3.40	4	250	64
5	75.0	75.590	1.60	143	80	3.40	3.40	4	250	59
6	90.0	90.350	1.50	143	80	3.18	3.20	4	252	59
7	105.0	104.270	1.30	143	81	2.76	2.80	4	255	59
8	120.0	118.082	1.30	143	81	2.76	2.80	4	255	61

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**9:14**
Source:	**CFU 113 (2)**	**End Time:**	**11:21**
Method:	**ODEQ 5**	**Date:**	**9/25/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
15	14.470	3.30	58	1	1.60	135	1.2649
30	29.090	3.30	58	2	1.60	139	1.2649
45	43.420	3.10	61	3	1.50	138	1.2247
60	57.682	3.10	63	4	1.50	137	1.2247
75	72.640	3.40	65	5	1.60	133	1.2649
90	87.520	3.40	65	6	1.60	133	1.2649
105	101.450	2.90	68	7	1.40	134	1.1832
120	114.756	2.70	69	8	1.30	136	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113 (2)**	**Date:**	**09/25/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	114.756	dcf	Rectangular		
Water Volume	54.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.2157	in.	Length		in
Nozzle Area	0.000254	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.99	"Hg	CO_2 Average	1.00	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.04	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	3.150	"H_2O	$\sqrt{Dp}$	1.2291	"H_2O
Temperature, T_m	63.4	^oF	Temperature, T_s	135.6	^oF
Temperature, T_m	523.4	^oA (^oR)	Temperature, T_s	595.6	^oA (R)
Pressure Meter, P_m	30.222	"Hg	Pressure Stack, P_s	29.969	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	116.980	dscf	Velocity, V_s	73.42	fps
	3.312	dscm	Volume (actual)	9,612.1	awcfm
Actual Volume, $V_{m(actual)}$	134.703	awcf		9,404.5	adcfm
Gas Stream Moisture			Volume (standard)	512,108.0	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.584	scf		501,046.5	dscf/hr
Moisture, B_{ws}	0.0216			8,350.8	dscf/min
Moisture EPA M4	2.16	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.72	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

EPA Method 5

Filterable PM	0.00010	grams
Emissions:		
Concentration, C_s	1.32E-05	gr/dscf
	30	µg/dscm
Mass Emissions	9.44E-04	lb/hr

Back Half:

Inorganic CPM	2.00E-03	grams	Organic CPM	7.50E-04	grams
Inorganic CPM, C_s	2.64E-04	gr/dscf	Organic CPM, C_s	9.89E-05	gr/dscf
	604	µg/dscm		226	µg/dscm
Mass Emissions	1.89E-02	lb/hr	Mass Emissions	7.08E-03	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis OR**	**Start Time:**	**12:00**
Source:	**CFU 113 (2)**	**End Time:**	**14:04**
Method:	**ODEQ 5**	**Date:**	**09/25/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH $"H_2O$	Meter T_m ^oF	Traverse Point	Dp $"H_2O$	Stack T_s ^oF	$\sqrt{Dp}$
	0.000						
15	14.750	3.40	70	1	1.60	137	1.2649
30	29.760	3.40	70	2	1.60	137	1.2649
45	44.740	3.20	72	3	1.50	137	1.2247
60	58.275	2.70	74	4	1.30	138	1.1402
75	73.440	3.40	76	5	1.60	137	1.2649
90	88.570	3.40	77	6	1.60	140	1.2649
105	103.350	3.20	78	7	1.50	141	1.2247
120	118.045	3.20	79	8	1.50	143	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 113 (2)**	**Date:**	**09/25/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	118.045	dcf	Rectangular		
Water Volume	46.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.2157	in.	Length		in
Nozzle Area	0.000254	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.99	"Hg	CO_2 Average	0.96	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	19.98	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	3.238	"H_2O	√Dp	1.2342	"H_2O
Temperature, T_m	74.5	^oF	Temperature, T_s	138.8	^oF
Temperature, T_m	534.5	^oA (^oR)	Temperature, T_s	598.8	^oA (R)
Pressure Meter, P_m	30.228	"Hg	Pressure Stack, P_s	29.969	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	117.857	dscf	Velocity, V_s	73.89	fps
	3.337	dscm	Volume (actual)	9,673.7	awcfm
Actual Volume, $V_{m(actual)}$	135.956	awcf		9,498.6	adcfm
Gas Stream Moisture			Volume (standard)	512,632.0	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.174	scf		503,353.4	dscf/hr
Moisture, B_{ws}	0.0181			8,389.2	dscf/min
Moisture EPA M4	1.81	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.95	lb/lb-mole			
Wet, M_s	28.75	lb/lb-mole			
Percent Isokinetic	100.6	%			

Laboratory Results

Front Half:

Filterable PM	0.00030	grams
Emissions:		
Concentration, C_s	3.93E-05	gr/dscf
	90	µg/dscm
Mass Emissions	2.82E-03	lb/hr

Back Half:

Inorganic CPM	9.00E-04	grams	Organic CPM	6.50E-04	grams
Inorganic CPM, C_s	1.18E-04	gr/dscf	Organic CPM, C_s	8.51E-05	gr/dscf
	270	µg/dscm		195	µg/dscm
Mass Emissions	8.47E-03	lb/hr	Mass Emissions	6.12E-03	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis OR**	**Start Time:**	**14:30**
Source:	**CFU 113 (2)**	**End Time:**	**16:36**
Method:	**ODEQ 5**	**Date:**	**09/25/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
15	15.120	3.40	78	1	1.60	144	1.2649
30	30.330	3.40	78	2	1.60	144	1.2649
45	45.020	3.20	79	3	1.50	143	1.2247
60	60.260	3.40	80	4	1.60	143	1.2649
75	75.590	3.40	80	5	1.60	143	1.2649
90	90.350	3.20	80	6	1.50	143	1.2247
105	104.270	2.80	81	7	1.30	143	1.1402
120	118.082	2.80	81	8	1.30	143	1.1402

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Source:	**CFU 113 (2)**		**Date:**	**09/25/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	118.082	dcf	Rectangular		
Water Volume	41.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2157	in.	Length		in
Nozzle Area	0.000254	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.99	"Hg	CO_2 Average	0.94	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.24	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	3.200	"H_2O	√Dp	1.2237	"H_2O
Temperature, T_m	79.6	^oF	Temperature, T_s	143.3	^oF
Temperature, T_m	539.6	^oA (^oR)	Temperature, T_s	603.3	^oA (R)
Pressure Meter, P_m	30.225	"Hg	Pressure Stack, P_s	29.969	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	116.768	dscf	Velocity, V_s	73.49	fps
	3.306	dscm	Volume (actual)	9,621.3	awcfm
Actual Volume, $V_{m(actual)}$	135.464	awcf		9,464.5	adcfm
Gas Stream Moisture			Volume (standard)	506,053.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.929	scf		497,805.2	dscf/hr
Moisture, B_{ws}	0.0163			8,296.8	dscf/min
Moisture EPA M4	1.63	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.78	lb/lb-mole			
Percent Isokinetic	100.8	%			

Laboratory Results

Front Half:					
Filterable PM	0.00065	grams			
Emissions:					
Concentration, C_s	8.59E-05	gr/dscf			
	197	µg/dscm			
Mass Emissions	6.11E-03	lb/hr			
Back Half:					
Inorganic CPM	1.45E-03	grams	Organic CPM	5.00E-04	grams
Inorganic CPM, C_s	1.92E-04	gr/dscf	Organic CPM, C_s	6.61E-05	gr/dscf
	439	µg/dscm		151.24	µg/dscm
Mass Emissions	1.36E-02	lb/hr	Mass Emissions	4.70E-03	lb/hr

Oregon Method 5
Filterable and Condensable Particulate
Laboratory Gravimetric Data

Client: **Hollingsworth & Vose**
Location: **Corvallis OR**
Source: **CFU 113 (2)**

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction	Corrected Gain (grams)	
1	CPM Organics (Acetone BH)	135	52.62735	52.62810	0.00075	0.00E+00	**0.00075**	
	Probe Rinse (Acetone FH)	105	43.22330	43.22340	0.00010	0.00E+00	**0.00010**	
	Filter	Q1380	0.37735	0.37730	-0.00005		**0.00000**	
	CPM Inorganics (Water)	350	44.06640	44.06840	0.00200	0.00E+00	**0.00200**	
	CPM Organics (Hexane BH)	85	42.57070	42.57040	-0.00030	0.00E+00	**0.00000**	
	Impinger H_2O Gain, mls		200	230	30.0			
						Filterable PM (mg)	**0.10**	
						Total PM (mg)	**2.85**	**ND**
2	CPM Organics (Acetone BH)	165	44.90145	44.90210	0.00065	0.00E+00	**0.00065**	
	Probe Rinse (Acetone FH)	95	44.80250	44.80280	0.00030	0.00E+00	**0.00030**	
	Filter	Q1381	0.37965	0.37955	-0.00010		**0.00000**	
	CPM Inorganics (Water)	400	44.99930	45.00020	0.00090	0.00E+00	**0.00090**	
	CPM Organics (Hexane BH)	90	44.78315	44.78310	-0.00005	0.00E+00	**0.00000**	
	Impinger H_2O Gain, mls		200	220	20.0			
						Filterable PM (mg)	**0.30**	
						Total PM (mg)	**1.85**	**ND**
3	CPM Organics (Acetone BH)	145	50.47600	50.47650	0.00050	0.00E+00	**0.00050**	
	Probe Rinse (Acetone FH)	125	42.12735	42.12800	0.00065	0.00E+00	**0.00065**	
	Filter	Q1382	0.37880	0.37845	-0.00035		**0.00000**	
	CPM Inorganics (Water)	390	43.23725	43.23870	0.00145	0.00E+00	**0.00145**	
	CPM Organics (Hexane BH)	95	54.64150	54.64150	0.00000	0.00E+00	**0.00000**	
	Impinger H_2O Gain, mls		200	210	10.0			
						Filterable PM (mg)	**0.65**	
						Total PM (mg)	**2.60**	**ND**
	Acetone Blank	160	45.69390	45.69390	0.00000	0.00E+00	g/g	
	Water Blank	200	49.47520	49.47520	0.00000	0.00E+00	g/g	
	Hexane Blank	100	43.10705	43.10700	0.00000	0.00E+00	g/g	

ND = Non-Detect. Values are below the method detection limit (7 mg).

Oregon Methods 1-5
Filterable and Condensable Particulate
Results Summary

Client: Hollingsworth & Vose
Source: CFU 113 (2)
Location: Corvallis OR

Run			1	2	3	Average
Date			9/25/2018	9/25/2018	9/25/2018	
Run Start Time			9:14	12:00	14:30	
Run End Time			11:21	14:04	16:36	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.99	29.99	29.99	**29.99**
Nozzle Dia., in.			0.2157	0.2157	0.2157	**0.2157**
Isokinetic Average, %			100.3	100.6	100.8	**100.6**
Sample Volume, dscf			116.980	117.857	116.768	**117.202**
Sample Volume, dscm			3.312	3.337	3.306	**3.318**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			1.00	0.96	0.94	**0.97**
O_2 %vd			20.04	19.98	20.24	**20.09**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			2.16	1.81	1.63	**1.87**
Wet Molecular Weight, lb/lb-mole			28.72	28.75	28.78	**28.75**
Velocity, FPS			73.42	73.89	73.49	**73.60**
ADCFM			9,404.5	9,498.6	9,464.5	**9,455.9**
AWCFM			9,612.1	9,673.7	9,621.3	**9,635.7**
DSCFM			8,350.8	8,389.2	8,296.8	**8,345.6**
Stack Temperature, ^oF			135.6	138.8	143.3	**139.2**
Filterable Particulate	Concentration, C_s	gr/dscf	1.32E-05	3.93E-05	8.59E-05	**4.61E-05**
		µg/dscm	30	90	197	**106**
	Mass	lb/hr	9.44E-04	2.82E-03	6.11E-03	**3.29E-03**
		lb/lb glass	2.60E-07	7.78E-07	1.67E-06	**9.02E-07**
Inorganic CPM	Concentration, C_s	gr/dscf	2.64E-04	1.18E-04	1.92E-04	**1.91E-04**
		µg/dscm	604	270	439	**437**
	Mass	lb/hr	1.89E-02	8.47E-03	1.36E-02	**1.37E-02**
		lb/lb glass	5.21E-06	2.34E-06	3.72E-06	**3.75E-06**
Organic CPM	Concentration, C_s	gr/dscf	9.89E-05	8.51E-05	6.61E-05	**8.34E-05**
		µg/dscm	226	195	151	**191**
	Mass	lb/hr	7.08E-03	6.12E-03	4.70E-03	**5.97E-03**
		lb/lb glass	1.95E-06	1.69E-06	1.28E-06	**1.64E-06**
Measured Total PM	Concentration, C_s	gr/dscf	ND 3.76E-04	ND 2.42E-04	ND 3.44E-04	ND **3.21E-04**
		µg/dscm	ND 860.5	ND 554.4	ND 786.4	ND **733.8**
	Mass	lb/hr	ND 2.69E-02	ND 1.74E-02	ND 2.44E-02	ND **2.29E-02**
		lb/lb glass	ND 7.42E-06	ND 4.80E-06	ND 6.66E-06	ND **6.29E-06**
Total PM @ Method Detection Limit (7 mg)	Concentration, C_s	gr/dscf	< 9.23E-04	< 9.16E-04	< 9.25E-04	< **9.22E-04**
	Mass	lb/hr	< 6.61E-02	< 6.59E-02	< 6.58E-02	< **6.59E-02**
		lb/lb glass	< 1.82E-05	< 1.82E-05	< 1.79E-05	< **1.81E-05**
Production Data	Glass Production	lbs/hr	3627.1	3627.9	3666.0	**3640.3**

Oregon Methods 1-5
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**9:14**
Source:	**CFU 113 (2)**	**End Time:**	**11:21**
Method:	**ODEQ 5**	**Date:**	**9/25/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.222 "Hg
where Pb: 29.99 "Hg
ΔH: 3.150 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.969 "Hg
where Pb: 29.99 "Hg
Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 116.980 dscf
where Vm: 114.756 dcf
Y: 1.0008
Pm: 30.222 "Hg
Tm: 523.4 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.584 scf
where H_2O: 54.90 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0216

where Vw(std): 2.584 scf
Vm(std): 116.980 dscf

6) % H_2O = Bws x 100 = 2.16 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 134.703 awcf
where Y: 1.0008
Vm: 114.7559 dcf
Bws: 0.0216
Ts: 595.6 °A
Tm: 523.4 °A
Pm: 30.222 "Hg
Ps: 29.969 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.96 lb/lb-mole
where CO_2: 1.00 %vd
O_2 20.04 %vd
N_2+CO= (100-(O_2+CO_2): 78.96 %vd

9) $M_s = M_d(1 - Bws) + (18 \times Bws) =$ 28.72 lb/lb-mole
where M_d: 28.96 lb/lb-mole
Bws: 0.0216

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 2.182 sq. ft.
where Stack ID: 20 inches

Stack Area(rect.) = stack width/12 x stack length/12 = NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) Velocity, $V_s = 85.49(Cp)(Ave. Sqrt\ \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 73.42 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.2291
Ts: 595.6 °A
Ps: 29.969 "Hg
Ms: 28.72 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 9,612.1 AWCFM
where V_s: 73.42 ft/sec
Stack Area: 2.182 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 9,404.5 ADCFM
where AWCFM: 9,612.1
Bws: 0.0216

14) $Qsw = 3600(V_s)(stack\ area)\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right) =$ 512,108.0 wscf/hr
where V_s: 73.42 ft/sec
Stack Area: 2.1820 sq. ft.
Ts: 595.6 °A
Ps: 29.969 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 501,046.5 dscf/hr
where wscf/hr: 512,108.0
Bws: 0.0216

16) DSCFM= (dscf/hr)/60 mins/hr = 8,350.8 DSCFM
where dscf/hr: 501,046.5

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000254 sq. ft.
where Nozzle Size: 0.2157 inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.3 %

where Ts:	595.6	°A
Vm(Std):	116.980	dscf
Ps:	29.969	"Hg
Vs	73.42	ft/sec
Nozzle Area:	0.000254	sq. ft.
Sampling Time:	120	min.
Bws:	0.0216	

ODEQ Method 5:

Front Half:

19) Filterable PM = filter gain + probe rinse gain = 0.00010 grams

where Filter Gain:	0.00000	grams
Probe Rinse:	0.00010	grams

20) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 1.32E-05 gr/dscf

where Sample:	0.00010	grams
Vm(std)	116.980	dscf

21) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 30 µg/dscm

where Sample:	0.00010	grams
Vm(std)	3.312	dscm

22) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 9.44E-04 lb/hr

where Cs:	1.32E-05	gr/dscf
Stack Flow:	501,046.5	dscf/hr

Back Half:

23) Inorganic CPM = water fraction = 0.00200 grams
Organic CPM = acetone BH + hexane BH = 0.00075 grams

Back-half concentrations and mass rates are calculated as front-half examples.

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113 (2)**
DATE	**09/25/18**
METHOD	**316**
POLLUTANT	**Formaldehyde**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**9:15**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**11:22**
EPA Method:	**316**	Clear sky, 70+ degrees	**Date:**	**9/25/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type	Glass	
Y factor	0.9985	Nozzle ID	0.213	Nozzle size	0.2130	inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000247	sq.ft.
		Pitot Cp	0.84	Probe heat	250	F
				Filter heat	250	F

Source Information:

Barometric Pressure	29.99	"Hg	O_2	19.90	%
Static Pressure	-0.28	"H_2O	CO_2	0.70	%
Ave. ΔP	1.35	"H_2O	Rec. Nz.	0.194	inches
Stack Temperature	130	F			
Assumed moisture	2	%			
Assumed meter temp.	69	F			
Total number of points	8				
Time per point	15				
Total run time	120				

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	15	10

Nozzle check for roundness:

1	2	3	
0.213	0.213	0.213	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	109.908	dcf	Ave. ΔP	1.463	"H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. √ΔP	1.2086	"H_2O
Actual H_2O	2.06	%	Ave. ΔH	2.825	"H_2O
Std. meter vol.	111.713	dscf	Ave. T_s	137.1	°F
Isokinetic Average	100.2	%	Ave. T_m	63.3	°F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	228	28.0
Silica gel, g	258.3	280.2	21.9
		Total water gain:	49.9

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	12.810	1.30	138	59	2.47	2.50	2	253	45
2	30.0	26.160	1.40	140	59	2.65	2.70	2	252	42
3	45.0	39.530	1.40	139	61	2.67	2.70	2	250	44
4	60.0	53.487	1.50	138	62	2.87	2.90	2	253	45
5	75.0	67.870	1.60	135	64	3.09	3.10	2	253	54
6	90.0	82.310	1.60	134	66	3.10	3.10	2	254	48
7	105.0	95.850	1.40	136	67	2.71	2.70	2	251	50
8	120.0	109.908	1.50	137	68	2.91	2.90	2	254	51

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**12:01**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**14:05**
EPA Method:	**316**	Clear sky, 70+ degrees	**Date:**	**9/25/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.213	Nozzle size:	0.2130 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000247 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.99 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	1.35 "H_2O	Rec. Nz.	0.196 inches
Stack Temperature	130 F		
Assumed moisture	2.06 %		
Assumed meter temp.	63.3 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	11	9

Nozzle check for roundness:

1	2	3
0.213	0.213	0.213 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	111.402 dcf	Ave. ΔP	1.45 "H_2O
Wet mol. weight	28.71 M_s (actual)	Ave. √ΔP	1.204 "H_2O
Actual H_2O	1.81 %	Ave. ΔH	2.8 "H_2O
Std. meter vol.	110.851 dscf	Ave. T_s	140 °F
Isokinetic Average	99.8 %	Ave. T_m	74.5 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	242.8	266.1	23.3
		Total water gain:	43.3

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	15.0	13.580	1.40	138	70	2.71	2.70	2.5	252	63
2	30.0	27.710	1.50	138	72	2.92	2.90	2.5	250	62
3	45.0	41.880	1.50	139	73	2.92	2.90	2.5	250	65
4	60.0	55.577	1.40	140	75	2.73	2.70	2.5	253	56
5	75.0	69.300	1.40	138	75	2.74	2.70	2.5	258	59
6	90.0	83.050	1.40	141	76	2.73	2.70	2.5	254	56
7	105.0	97.230	1.50	142	77	2.93	2.90	2.5	255	58
8	120.0	111.402	1.50	144	78	2.92	2.90	2.5	252	58

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**14:31**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**16:37**
EPA Method:	**316**	Clear sky, 70+ degrees	**Date:**	**9/25/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass	
Y factor	0.9985	Nozzle ID	0.213	Nozzle size:	0.2130	inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000247	sq.ft.
		Pitot Cp	0.84	Probe heat:	250	F
				Filter heat:	250	F

Source Information:

Barometric Pressure	29.99	"Hg	O_2	19.9	%
Static Pressure	-0.28	"H_2O	CO_2	0.7	%
Ave. ΔP	1.35	"H_2O	Rec. Nz.	0.193	inches
Stack Temperature	130	F			
Assumed moisture	1.81	%			
Assumed meter temp.	74.5	F			
Total number of points	8				
Time per point	15				
Total run time	120				

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	8	8

Nozzle check for roundness:

1	2	3	
0.213	0.213	0.213	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	113.861	dcf	Ave. ΔP	1.488	"H_2O
Wet mol. weight	28.73	M_s (actual)	Ave. √ΔP	1.219	"H_2O
Actual H_2O	1.63	%	Ave. ΔH	2.888	"H_2O
Std. meter vol.	112.396	dscf	Ave. T_s	143.9	°F
Isokinetic Average	100.1	%	Ave. T_m	78.9	°F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	258.5	284.1	25.6
		Total water gain:	39.6

Traverse Point	**Time (min.)**	**Meter Volume (dcf)** 0.000	**Velocity ΔP ("H_2O)**	**Stack Temp. (°F)**	**Meter Temp. (°F)**	**Calc. ΔH**	**Run ΔH**	**Vacuum ("Hg)**	**Filter Box (°F)**	**Condenser Temp (≤68°F)**
1	15.0	13.320	1.30	145	78	2.54	2.50	2	253	62
2	30.0	26.980	1.40	143	78	2.75	2.70	2	253	53
3	45.0	41.230	1.50	144	78	2.94	2.90	2	253	55
4	60.0	55.494	1.50	144	79	2.94	2.90	2	253	57
5	75.0	69.840	1.50	144	79	2.94	2.90	2	248	64
6	90.0	84.600	1.60	144	79	3.14	3.10	2	250	56
7	105.0	99.340	1.60	144	80	3.14	3.10	2	260	57
8	120.0	113.861	1.50	143	80	2.95	3.00	2	249	58

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:15**
Source:	**CFU 113 (2)**	**End Time:**	**11:22**
Method:	**316**	**Date:**	**9/25/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
15	12.810	2.50	59	1	1.30	138	1.1402
30	26.160	2.70	59	2	1.40	140	1.1832
45	39.530	2.70	61	3	1.40	139	1.1832
60	53.487	2.90	62	4	1.50	138	1.2247
75	67.870	3.10	64	5	1.60	135	1.2649
90	82.310	3.10	66	6	1.60	134	1.2649
105	95.850	2.70	67	7	1.40	136	1.1832
120	109.908	2.90	68	8	1.50	137	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113 (2)**	**Date:**	**09/25/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	109.908	dcf	Rectangular		
Water Volume	49.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.99	"Hg	CO_2 Average	1.00	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.04	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.825	"H_2O	$\sqrt{Dp}$	1.2086	"H_2O
Temperature, T_m	63.3	^oF	Temperature, T_s	137.1	^oF
Temperature, T_m	523.3	^oA (^oR)	Temperature, T_s	597.1	^oA (R)
Pressure Meter, P_m	30.198	"Hg	Pressure Stack, P_s	29.969	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	111.713	dscf	Velocity, V_s	72.28	fps
	3.163	dscm	Volume (actual)	9,462.9	awcfm
Actual Volume, $V_{m(actual)}$	128.831	awcf		9,268.0	adcfm
Gas Stream Moisture			Volume (standard)	502,889.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.348	scf		492,530.4	dscf/hr
Moisture, B_{ws}	0.0206			8,208.8	dscf/min
Moisture EPA M4	2.06	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	434.976	
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.73	lb/lb-mole			
Percent Isokinetic	100.2	%			

Laboratory Results

CH_2O	540.0	μg/sample			
CH_2O	5.40E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	7.46E-05	gr/dscf
	170.7	μg/dscm
	1.37E-01	ppmvd
Mass Emissions	5.25E-03	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:01**
Source:	**CFU 113 (2)**	**End Time:**	**14:05**
Method:	**316**	**Date:**	**09/25/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
15	13.580	2.70	70	1	1.40	138	1.1832
30	27.710	2.90	72	2	1.50	138	1.2247
45	41.880	2.90	73	3	1.50	139	1.2247
60	55.577	2.70	75	4	1.40	140	1.1832
75	69.300	2.70	75	5	1.40	138	1.1832
90	83.050	2.70	76	6	1.40	141	1.1832
105	97.230	2.90	77	7	1.50	142	1.2247
120	111.402	2.90	78	8	1.50	144	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 113 (2)**	**Date:**	**09/25/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	111.402	dcf	Rectangular		
Water Volume	43.3	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.99	"Hg	CO_2 Average	0.96	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	19.98	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.800	"H_2O	√Dp	1.2040	"H_2O
Temperature, T_m	74.5	^oF	Temperature, T_s	140.0	^oF
Temperature, T_m	534.5	^oA (^oR)	Temperature, T_s	600.0	^oA (R)
Pressure Meter, P_m	30.196	"Hg	Pressure Stack, P_s	29.969	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	110.851	dscf	Velocity, V_s	72.15	fps
	3.139	dscm	Volume (actual)	9,445.9	awcfm
Actual Volume, $V_{m(actual)}$	128.131	awcf		9,274.9	adcfm
Gas Stream Moisture			Volume (standard)	499,559.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.038	scf		490,517.1	dscf/hr
Moisture, B_{ws}	0.0181			8,175.3	dscf/min
Moisture EPA M4	1.81	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	437.089	
Dry, M_d	28.95	lb/lb-mole			
Wet, M_s	28.75	lb/lb-mole			
Percent Isokinetic	99.9	%			

Laboratory Results

CH_2O	607.0	µg/sample			
CH_2O	6.07E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	8.45E-05	gr/dscf
	193.4	µg/dscm
	1.55E-01	ppmvd
Mass Emissions	5.92E-03	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**14:31**
Source:	**CFU 113 (2)**	**End Time:**	**16:37**
Method:	**316**	**Date:**	**09/25/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m ^oF	Traverse Point	Dp "H_2O	Stack T_s ^oF	$\sqrt{Dp}$
	0.000						
15	13.320	2.50	78	1	1.30	145	1.1402
30	26.980	2.70	78	2	1.40	143	1.1832
45	41.230	2.90	78	3	1.50	144	1.2247
60	55.494	2.90	79	4	1.50	144	1.2247
75	69.840	2.90	79	5	1.50	144	1.2247
90	84.600	3.10	79	6	1.60	144	1.2649
105	99.340	3.10	80	7	1.60	144	1.2649
120	113.861	3.00	80	8	1.50	143	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 113 (2)**	**Date:**	**09/25/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	113.861	dcf	Rectangular		
Water Volume	39.6	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.99	"Hg	CO_2 Average	0.94	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.24	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.888	"H_2O	√Dp	1.2190	"H_2O
Temperature, T_m	78.9	^oF	Temperature, T_s	143.9	^oF
Temperature, T_m	538.9	^oA (^oR)	Temperature, T_s	603.9	^oA (R)
Pressure Meter, P_m	30.202	"Hg	Pressure Stack, P_s	29.969	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	112.395	dscf	Velocity, V_s	73.25	fps
	3.183	dscm	Volume (actual)	9,589.9	awcfm
Actual Volume, $V_{m(actual)}$	130.521	awcf		9,433.6	adcfm
Gas Stream Moisture			Volume (standard)	503,900.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.864	scf		495,686.5	dscf/hr
Moisture, B_{ws}	0.0163			8,261.4	dscf/min
Moisture EPA M4	1.63	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	439.93	
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.78	lb/lb-mole			
Percent Isokinetic	100.2	%			

Laboratory Results

CH_2O	610.0	µg/sample			
CH_2O	6.10E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	8.37E-05	gr/dscf
	191.6	µg/dscm
	1.53E-01	ppmvd
Mass Emissions	5.93E-03	lb/hr

"<" represents MDL value

EPA Method 316
Laboratory Results
Formaldehyde

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR** **MDL** 0.0274 µg/mL
Source: **CFU 113 (2)**

Lab ID	Sample ID	Sample Date	<	Result	MDL	Sample Vol. (mL)	Units
4	Run 1	9/25/2018		540	12.6	460.0	µg/sample
8	Run 2	9/25/2018		607	13.0	475.0	µg/sample
9	Run 3	9/25/2018		610	12.3	450.0	µg/sample
20	H_20 Blank	9/12/2018	<	MDL	11.1	405.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 316
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113 (2)

Run			1	2	3	Average
Date			9/25/2018	9/25/2018	9/25/2018	
Run Start Time			9:15	12:01	14:31	
Run End Time			11:22	14:05	16:37	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.99	29.99	29.99	**29.99**
Nozzle Dia., in.			0.2130	0.2130	0.2130	**0.2130**
Isokinetic Average, %			100.2	99.9	100.2	**100.1**
Sample Volume, dscf			111.713	110.851	112.395	**111.653**
Sample Volume, dscm			3.163	3.139	3.183	**3.162**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			1.00	0.96	0.94	**0.97**
O_2 %vd			20.04	19.98	20.24	**20.09**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			2.06	1.81	1.63	**1.83**
Wet Molecular Weight, lb/lb-mole			28.73	28.75	28.78	**28.75**
Velocity, FPS			72.28	72.15	73.25	**72.56**
ADCFM			9,268.0	9,274.9	9,433.6	**9,325.5**
AWCFM			9,462.9	9,445.9	9,589.9	**9,499.6**
DSCFM			8,208.8	8,175.3	8,261.4	**8,215.2**
Stack Temperature, ^oF			137.1	140.0	143.9	**140.3**
Formaldehyde	Concentration, C_s	gr/dscf	7.46E-05	8.45E-05	8.37E-05	**8.09E-05**
		µg/dscm	170.7	193.4	191.6	**185.2**
		ppmvd	1.37E-01	1.55E-01	1.53E-01	**1.48E-01**
	Mass	lb/hr	5.25E-03	5.92E-03	5.93E-03	**5.70E-03**
		lb/lb glass	1.45E-06	1.63E-06	1.62E-06	**1.57E-06**
Production Data	Glass Production	lbs/hr	3627.1	3627.9	3666.0	**3640.3**

"<" represents MDL value

EPA Methods 1-4, 316
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:15**
Source:	**CFU 113 (2)**	**End Time:**	**11:22**
Method:	**316**	**Date:**	**9/25/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.198 "Hg
where Pb: 29.99 "Hg
ΔH: 2.825 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.969 "Hg
where Pb: 29.99 "Hg
Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 111.713 dscf
where Vm: 109.908 dcf
Y: 0.9985
Pm: 30.198 "Hg
Tm: 523.3 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.348 scf
where H_2O: 49.90 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0206

where Vw(std): 2.348 scf
Vm(std): 111.713 dscf

6) % H_2O = Bws x 100 = 2.06 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 128.831 awcf
where Y: 0.9985
Vm: 109.9080 dcf
Bws: 0.0206
Ts: 597.1 °A
Tm: 523.3 °A
Pm: 30.198 "Hg
Ps: 29.969 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.96 lb/lb-mole
where CO_2: 1.00 %vd
O_2 20.04 %vd
N_2+CO= (100-(O_2+CO_2): 78.96 %vd

9) $M_s = M_d(1 - Bws) + (18 \times Bws) =$ 28.73 lb/lb-mole
where M_d: 28.96 lb/lb-mole
Bws: 0.0206

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 2.182 sq. ft.
where Stack ID: 20 inches

Stack Area(rect.) = stack width/12 x stack length/12 = NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) Velocity, $V_s = 85.49(Cp)(Ave. Sqrt\ \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 72.28 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.2086
Ts: 597.1 °A
Ps: 29.969 "Hg
Ms: 28.73 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 9,462.9 AWCFM
where V_s: 72.28 ft/sec
Stack Area: 2.182 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 9,268.0 ADCFM
where AWCFM: 9,462.9
Bws: 0.0206

14) $Qsw = 3600(V_s)(stack\ area)\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right) =$ 502,889.9 wscf/hr
where V_s: 72.28 ft/sec
Stack Area: 2.1820 sq. ft.
Ts: 597.1 °A
Ps: 29.969 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 492,530.4 dscf/hr
where wscf/hr: 502,889.9
Bws: 0.0206

16) DSCFM= (dscf/hr)/60 mins/hr = 8,208.8 DSCFM
where dscf/hr: 492,530.4

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000247 sq. ft.
where Nozzle Size: 0.2130 inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.2 %

where Ts:	597.1	°A
Vm(Std):	111.713	dscf
Ps:	29.969	"Hg
Vs	72.28	ft/sec
Nozzle Area:	0.000247	sq. ft.
Sampling Time:	120	min.
Bws:	0.0206	

EPA Method 316:

19) Formaldehyde laboratory results 540.0 µg/sample

20) Formaldehyde = (µg/sample)/1,000,000 = 5.40E-04 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 7.46E-05 gr/dscf

where Sample:	0.00054	grams
Vm(std)	111.713	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 170.7 µg/dscm

where Sample:	0.00054	grams
Vm(std)	3.163	dscm

23) Volume/Mole = $\left(\frac{359\frac{ft^3}{lb-mol}@STP\ (Ts)\ (29.92"Hg)}{492°A\ (Ps)}\right)$ = 434.976 Vol./Mole

where Ts:	597.1	°A
Ps:	29.969	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 1.37E-01 ppmvd

where MW:	30.031	g/mol
lb/hr:	0.01	
Vol./Mole:	434.976	
ADCFM:	9268.0	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 5.25E-03 lb/hr

where Cs:	7.46E-05	gr/dscf
Stack Flow:	492,530.4	dscf/hr

Daily Gaseous Calibrations Log

Client: H&V

Source: CFU-1.13 m5/316/Full gasses

Date: 09/25/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	Ø	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

*Use of a calibrated instrument required

See 9-11-18

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
Ø	x	Ø	x	Ø	x	Ø	x	50.41	x
10	x	5	x	25	x	2	x		
20	x	10	x	50	x	4	x		

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
Ø	x	Ø *	x	Ø *	x	Ø '	x		
10 *	x	5 *	x	25 '	x	2 *	x		

System VOC Calibrations		
	Initial target	Post Target
Zero	Ø	Ø ✓
Low	6.25	—
Mid	12.5	12.5 ✓✓✓
High	~~22.5~~ 21.25 DSB	—

— A1t-106 50ppm CH_4

Stratification test during run #1 - See 9-18

Test Times: R-1 09:14 - 11:22 R-2 12:00 - 14:05 R-3 14:30 - 16:37

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-113 (2)**
Facility	**Glass Plant 1**	Date	**September 25, 2018**
Location	**Corvallis, OR**		

Run			1	2	3	
Date			9/25/2018	9/25/2018	9/25/2018	
Run Start Time			9:14	12:00	14:30	
Run End Time			11:22	14:05	16:37	
CO_2 %vd			1.00	0.96	0.94	0.97
O_2 %vd			20.04	19.98	20.24	20.09
WSCFM*			8,535.1	8,543.9	8,434.2	8,504.4
DSCFM*			8,350.8	8,389.2	8,296.8	8,345.6
Nitrogen Oxides	Concentration, C_s	ppmdv	1.13	1.18	1.14	1.15
	Mass	lb/hr	6.76E-02	7.09E-02	6.78E-02	6.88E-02
	Emission Factor	lb/lb glass	1.86E-05	1.96E-05	1.85E-05	1.89E-05
		lb/Mscf nat. gas	1.53E-02	1.61E-02	1.54E-02	1.56E-02
Carbon Monoxide	Concentration, C_s	ppmdv	8.98	8.63	8.60	8.74
	Mass	lb/hr	0.33	0.32	0.31	0.32
	Emission Factor	lb/lb glass	9.10E-05	8.82E-05	8.46E-05	8.79E-05
		lb/Mscf nat. gas	7.48E-02	7.25E-02	7.03E-02	7.25E-02
VOC	Concentration, C_s	ppmvw	3.18	3.09	3.11	3.13
	Mass	lb/hr	1.86E-01	1.81E-01	1.80E-01	1.80E-01
	Emission Factor	lb/lb glass	5.13E-05	4.99E-05	4.90E-05	5.01E-05
		lb/Mscf nat. gas	4.22E-02	4.10E-02	4.08E-02	4.13E-02
Formaldehyde**	Mass	lb/hr	5.25E-03	5.92E-03	5.93E-03	5.70E-03
	Emission Factor	lb/lb glass	1.45E-06	1.63E-06	1.62E-06	1.57E-06
		lb/Mscf nat. gas	1.19E-03	1.34E-03	1.34E-03	1.29E-03
Total VOCs†	Mass	lb/hr	1.91E-01	1.87E-01	1.86E-01	1.88E-01
	Emission Factor	lb/lb glass	5.27E-05	5.15E-05	5.07E-05	5.16E-05
		lb/Mscf nat. gas	4.34E-02	4.24E-02	4.21E-02	4.26E-02

Production Rates	Glass Production	lb/hr	3627.1	3627.9	3666.0	3640.3
	Natural Gas Use	scf/hr	4,411.8	4,411.8	4,411.8	4,411.8
		Mscf/hr	4.4118	4.4118	4.4118	4.4118

*Measured during concurrent Method 5 isokinetic runs
**From concurrent Method 316 isokinetic sampling
†Total VOCs = Method 25A VOCs + Formaldehyde

Bison Engineering, Inc.
Method 7E Nitrogen Oxides
Calibration Error, System Bias and System Drift

NOx molecular weight of 46

Company:	**Hollingsworth & Vose**	Source:	**CFU-113 (2)**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 25, 2018**	Instrument Model:	**42i**
Location:	**Corvallis, OR**			Instrument Serial #:	**729825194**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.01	0.00	0.10	pass	-0.02	-0.10	pass	-0.20	pass				
	upscale	4.83	5.09	2.60	pass	4.79	-0.40	pass	-3.00	pass	10	1.11	1.13	5
Run 2	zero	-0.01	-0.02	-0.10	pass	-0.01	0.00	pass	0.10	pass				
	upscale	4.83	4.79	-0.40	pass	5.09	2.60	pass	3.00	pass	10	1.15	1.18	5
Run 3	zero	-0.01	-0.01	0.00	pass	-0.01	0.00	pass	0.00	pass				
	upscale	4.83	5.09	2.60	pass	5.11	2.80	pass	0.20	pass	10	1.16	1.14	5
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	5	10
Cal gas analyzer response	-0.01	4.83	10.05
Analyzer Cal. Error %	-0.10	-1.70	0.50
Analyzer Cal. Error < 2%*	pass	pass	pass

NO2 CONVERTER TEST

NO2 Tank Value (ppm)	50.41
NO Check Value	50.47
NO2 to NO Conversion %	100.1%
NO2 Conversion > 90%	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 10 Carbon Monoxide

Calibration Error, System Bias and System Drift

CO molecular weight of 28

Company:	**Hollingsworth & Vose**	Source:	**CFU-113 (2)**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 25, 2018**	Instrument Model:	**48i HL**
Location:	**Corvallis, OR**			Instrument Serial #:	**734025183**

			Initial Values			***Final Values***								
		Analyzer Cal. Response	**System Cal Response**	**Pre test System Cal. Bias % of span**	**Pre test System Cal. Bias pass/fail**	**System Cal Response**	**Post test System Cal. Bias % of span**	**Post test System Cal. Bias pass/fail**	**System Drift % of span**	**System Drift pass/fail**	**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
Run 1	zero	0.33	0.25	-0.16	pass	-0.13	-0.92	pass	-0.76	pass				
	upscale	24.87	25.18	0.62	pass	24.75	-0.24	pass	-0.86	pass	50	9.01	8.98	25
Run 2	zero	0.33	-0.13	-0.92	pass	-0.23	-1.12	pass	-0.20	pass				
	upscale	24.87	24.75	-0.24	pass	24.93	0.12	pass	0.36	pass	50	8.46	8.63	25
Run 3	zero	0.33	-0.23	-1.12	pass	-1.56	-3.78	pass	-2.66	pass				
	upscale	24.87	24.93	0.12	pass	25.52	1.30	pass	1.18	pass	50	8.09	8.60	25
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	25	50
Cal gas analyzer response	0.33	24.87	49.74
Analyzer Cal. Error	0.66	-0.26	-0.52
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 25, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			Final Values								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.01	0.05	0.30	pass	0.03	0.20	pass	-0.10	pass				
	upscale	10.12	9.88	-1.20	pass	9.97	-0.75	pass	0.45	pass	20	19.85	20.04	10
Run 2	zero	-0.01	0.03	0.20	pass	0.04	0.25	pass	0.05	pass				
	upscale	10.12	9.97	-0.75	pass	9.78	-1.70	pass	-0.95	pass	20	19.70	19.98	10
Run 3	zero	-0.01	0.04	0.25	pass	0.04	0.25	pass	0.00	pass				
	upscale	10.12	9.78	-1.70	pass	9.79	-1.65	pass	0.05	pass	20	19.76	20.24	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	-0.01	10.12	19.95
Analyzer Cal. Error	-0.05	0.60	-0.25
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO_2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 25, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.03	0.03	0.00	pass	0.05	0.50	pass	0.50	pass				
	upscale	1.89	1.82	-1.75	pass	1.81	-2.00	pass	-0.25	pass	4	0.93	1.00	2
Run 2	zero	0.03	0.05	0.50	pass	0.05	0.50	pass	0.00	pass				
	upscale	1.89	1.81	-2.00	pass	1.86	-0.75	pass	1.25	pass	4	0.91	0.96	2
Run 3	zero	0.03	0.05	0.50	pass	0.04	0.25	pass	-0.25	pass				
	upscale	1.89	1.86	-0.75	pass	1.85	-1.00	pass	-0.25	pass	4	0.90	0.94	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0.03	1.89	4.14
Analyzer Cal. Error	0.75	-2.75	3.50
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 25A Total Hydrocarbons or Volatile Organic Compounds (VOC)
Calibration Error and Drift Checks
VOC molecular weight of 44 as propane

Company:	**Hollingsworth & Vose**	Source:	**CFU-113 (2)**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 25, 2018**	Instrument Model:	**55i**
Location:	**Corvallis, OR**			Instrument Serial #:	**1018142851**

		Calibration System Response	Post-Run System Response	Drift Determination % of span	Drift Determination pass/fail	Analyzer Span	Avg Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.33	0.07	-1.04	pass			
	upscale	12.50	12.36	-0.56	pass	25	3.18	12.5
Run 2	zero	0.33	0.07	-1.04	pass			
	upscale	12.50	12.31	-0.76	pass	25	3.09	12.5
Run 3	zero	0.33	0.07	-1.04	pass			
	upscale	12.50	12.51	0.04	pass	25	3.11	12.5
				≤ 3%				

Instrument Response Time(s):	
Time 1	60
Time 2	60
Time 3	60
Average:	60

SYSTEM CAL. ERROR	Zero	Low	Mid	High
Calibration gas standards	0.00	6.25	12.50	21.25
Calibration gas system response	0.33	6.30	12.50	21.27
Calibration Predicted Response		6.49	12.65	
Calibration Error		3.02	1.18	
Calibration Error < 5% ?	pass	pass	pass	pass

EPA Method 7E,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:14**
Source:	**CFU-113 (2)**	**End Time:**	**11:22**
Method:	**7E**	**Date:**	**9/25/2018**

EPA Method 7E:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -1.70 %v

where C_{Dir}:	4.83	ppmv
C_V:	5.00	ppmv
CS:	10.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 2.60 %v

where C_{Dir}:	4.83	ppmv
C_S:	5.09	ppmv
CS:	10.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 3.00 %v

where SB_{Final}:	-0.40	ppmv
SB_i:	2.60	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 1.13 ppmv

where C_{Avg}:	1.11	ppmv
C_O:	-0.01	ppmv
C_{MA}:	5.00	ppmv
C_M:	4.94	ppmv

NO_2 - NO Conversion Efficiency

5) $Eff_{NOx} = \left(\frac{C_{Dir}}{C_v}\right) \times 100 =$ 100.1 %v

where C_{Dir}:	50.47	ppmv
C_V:	50.41	ppmv

Emission Rates:

NO_x 1)	lb/hr = (Stack Flow) (C) (46) ($1.558x10^{-7}$) =			6.76E-02 lb/hr
	where Stack Flow:	8350.80	DSCFM	
	C:	1.13	ppm	
	Molecular Wt NO_x:	46	g/g-mole	
		1.558E-07	Conv. Factor	

O_2 Correction

NO_x 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \text{x } C =$ NA ppmv

where $\%O_2$:	NA	%	
Measured O_2:	NA	%	
C:	NA	ppmv	

EPA Method 10,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:14**
Source:	**CFU-113 (2)**	**End Time:**	**11:22**
Method:	**10**	**Date:**	**9/25/2018**

EPA Method 10:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.26 %v

where C_{Dir}:	24.87	ppmv
C_V:	25.00	ppmv
CS:	50.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.62 %v

where C_{Dir}:	24.87	ppmv
C_S:	25.18	ppmv
CS:	50.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.86 %v

where SB_{Final}:	-0.24	ppmv
SB_i:	0.62	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 8.98 ppmv

where C_{Avg}:	9.01	ppmv
C_O:	0.06	ppmv
C_{MA}:	25.00	ppmv
C_M:	24.97	ppmv

Emission Rates:

CO 1) lb/hr = (Stack Flow) (C) (28) (1.558×10^{-7}) = 0.33 lb/hr

where Stack Flow:	8350.80	DSCFM
C:	8.98	ppm
Molecular Wt. CO:	28	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

CO 2) $C_{@\%O2} = \left(\frac{20.9 - \%O2}{20.9 - \text{Measured O2}}\right) \times C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:14**
Source:	**CFU-113 (2)**	**End Time:**	**11:22**
Method:	**3A**	**Date:**	**9/25/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) x\ 100 =$ 0.60 %v

where C_{Dir}:	10.12	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) x\ 100 =$ -1.20 %v

where C_{Dir}:	10.12	ppmv
C_S:	9.88	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.45 %v

where SB_{Final}:	-0.75	ppmv
SB_i:	-1.20	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O) \left(\frac{C_{MA}}{C_M - CO}\right) =$ 20.04 ppmv

where C_{Avg}:	19.85	ppmv
C_O:	0.04	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.93	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:14**
Source:	**CFU-113 (2)**	**End Time:**	**11:22**
Method:	**3A**	**Date:**	**9/25/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -2.75 %v

where C_{Dir}:	1.89	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -1.75 %v

where C_{Dir}:	1.89	ppmv
C_S:	1.82	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.25 %v

where SB_{Final}:	-2.00	ppmv
SB_i:	-1.75	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 1.00 ppmv

where C_{Avg}:	0.93	ppmv
C_O:	0.04	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.82	ppmv

EPA Method 25A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:14**
Source:	**CFU-113 (2)**	**End Time:**	**11:22**
Method:	**25A**	**Date:**	**9/25/2018**

EPA Method 25A:

Predicted Low and Mid Level Calibration Response (Mid)

1) $PR = \left(\frac{CR_H - CRZ}{SS}\right) x\ CS_M + CR_Z =$ 12.65 ppmv

where CR_H:	21.27	ppmv
CR_Z:	0.33	ppmv
SS:	21.25	ppmv
CS_M:	12.50	ppmv

Calibration Error Test

2) $CET = \left(\frac{SR - PR}{CGV}\right) x\ 100 =$ -1.18 %v

where PR:	12.65	ppmv
SR:	12.50	ppmv
CGV	12.50	ppmv

Drift Determination (Mid)

3) $D = \left(\frac{CSR - CSRC}{CSRS}\right) x\ 100 =$ 0.56 %v

where CSR:	12.50	ppmv
CSR_C:	12.36	ppmv
AS:	25.00	ppmv

Emission Rates:

VOC 1) lb/hr = (Stack Flow) (C) (44) (1.558×10^{-7}) = 1.86E-01 lb/hr

where Stack Flow:	8535.13	WSCFM
C:	3.18	ppm
Molecular Wt Propane:	44	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

VOC 2) $C_{@\%O2} = \left(\frac{20.9 - \%O2}{20.9 - \text{Measured O2}}\right) \times C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/25/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	6:49:59	0.00	0.54	0.06	-0.04	0.05	0.18
9/25/2018	6:50:09	-0.01	0.24	0.07	0.00	0.04	0.24
9/25/2018	6:50:19	-0.01	0.21	0.06	0.00	0.00	0.22
9/25/2018	6:50:29	0.01	0.30	0.07	0.01	0.00	0.24
9/25/2018	6:50:39	0.01	1.09	0.06	0.00	0.00	0.24
9/25/2018	6:50:49	0.00	2.43	0.06	0.00	-0.01	0.25
9/25/2018	6:50:59	0.01	3.41	0.07	0.00	-0.02	0.28
9/25/2018	6:51:09	0.01	3.07	0.07	0.00	-0.01	0.22
9/25/2018	6:51:19	0.02	2.08	0.07	-0.01	-0.01	0.19
9/25/2018	6:51:29	0.01	1.30	0.07	9.85	10.10	0.24
9/25/2018	6:51:39	0.00	1.07	0.07	18.99	19.38	0.18
9/25/2018	6:51:49	-0.01	2.15	0.06	19.53	19.48	0.25
9/25/2018	6:51:59	-0.01	2.74	0.07	19.50	19.51	0.22
9/25/2018	6:52:09	-0.01	1.26	0.06	19.85	19.82	0.21
9/25/2018	6:52:19	-0.02	0.17	0.07	19.87	19.80	0.18
9/25/2018	6:52:29	0.02	0.08	0.07	19.94	19.74	0.24
9/25/2018	6:52:39	-0.03	0.85	0.07	19.95	19.76	0.27
9/25/2018	6:52:49	-0.02	1.02	0.07	19.95	19.77	0.21
9/25/2018	6:52:59	-0.01	0.24	0.07	19.95	19.77	0.27
9/25/2018	6:53:09	0.00	-0.46	0.06	19.95	19.77	0.27
9/25/2018	6:53:19	-0.01	-1.10	0.07	19.00	19.10	0.24
9/25/2018	6:53:29	-0.03	-1.33	0.07	10.67	9.55	0.24
9/25/2018	6:53:39	0.01	-0.87	0.07	10.13	9.89	0.18
9/25/2018	6:53:49	-0.01	-0.24	0.07	10.12	9.89	0.19
9/25/2018	6:53:59	0.00	-0.15	0.06	10.12	9.86	0.24
9/25/2018	6:54:09	-0.01	0.16	0.07	10.11	9.87	0.19
9/25/2018	6:54:19	-0.01	1.25	0.07	8.73	7.68	0.22
9/25/2018	6:54:29	0.01	1.51	0.07	3.70	3.41	0.30
9/25/2018	6:54:39	-0.01	1.30	0.07	4.22	4.15	0.22
9/25/2018	6:54:49	0.00	1.16	0.07	4.23	4.14	0.27
9/25/2018	6:54:59	-0.01	0.58	0.07	4.24	4.14	0.22
9/25/2018	6:55:09	0.00	-0.13	0.07	4.23	4.14	0.27
9/25/2018	6:55:19	0.00	-0.68	0.06	4.24	4.14	0.21
9/25/2018	6:55:29	0.03	-0.70	0.06	4.05	3.82	0.28
9/25/2018	6:55:39	0.02	-0.44	0.06	2.64	2.17	0.22
9/25/2018	6:55:49	0.02	0.69	0.06	2.34	1.92	0.28
9/25/2018	6:55:59	0.73	2.36	0.06	2.31	1.90	0.21
9/25/2018	6:56:09	1.80	2.36	0.05	2.31	1.90	0.24
9/25/2018	6:56:19	1.59	1.53	0.06	2.31	1.89	0.19
9/25/2018	6:56:29	0.83	0.94	0.07	2.31	1.89	0.21
9/25/2018	6:56:39	0.40	0.51	0.06	2.31	1.89	0.28

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/25/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	6:56:49	0.29	0.03	0.05	2.31	1.89	0.24
9/25/2018	6:56:59	0.30	-0.38	0.05	2.27	1.89	0.22
9/25/2018	6:57:09	0.29	-0.45	0.06	2.11	1.87	0.24
9/25/2018	6:57:19	0.29	-0.22	0.07	2.11	1.89	0.25
9/25/2018	6:57:29	0.30	0.45	0.05	2.12	1.94	0.28
9/25/2018	6:57:39	0.30	2.00	0.06	2.12	2.11	0.30
9/25/2018	6:57:49	0.28	2.99	0.06	2.11	2.15	0.27
9/25/2018	6:57:59	0.30	2.59	0.07	2.12	2.15	0.27
9/25/2018	6:58:09	0.30	1.84	0.06	2.14	2.15	0.30
9/25/2018	6:58:19	0.86	1.65	0.07	5.55	3.34	0.28
9/25/2018	6:58:29	1.79	8.86	0.06	2.35	0.42	0.24
9/25/2018	6:58:39	19.20	22.51	0.07	2.24	0.44	0.16
9/25/2018	6:58:49	44.12	25.99	0.06	2.20	0.49	0.22
9/25/2018	6:58:59	72.48	20.67	0.07	2.15	0.65	0.18
9/25/2018	6:59:09	107.85	12.94	0.06	2.12	0.68	0.21
9/25/2018	6:59:19	123.43	9.09	0.06	2.08	0.67	0.28
9/25/2018	6:59:29	125.56	8.32	0.05	2.05	0.68	0.16
9/25/2018	6:59:39	102.09	7.48	0.06	2.02	0.67	0.25
9/25/2018	6:59:49	60.98	6.02	0.07	2.00	0.68	0.33
9/25/2018	6:59:59	40.78	4.45	0.06	1.98	0.65	0.27
9/25/2018	7:00:09	32.88	3.32	0.07	1.95	0.67	0.25
9/25/2018	7:00:19	28.94	2.67	0.06	1.93	0.68	0.24
9/25/2018	7:00:29	28.15	2.29	0.07	1.91	0.69	0.25
9/25/2018	7:00:39	27.48	2.21	0.07	1.88	0.69	0.25
9/25/2018	7:00:49	26.90	2.19	0.05	1.87	0.71	0.15
9/25/2018	7:00:59	26.48	2.73	0.07	1.85	0.71	0.24
9/25/2018	7:01:09	26.22	4.31	0.06	1.83	0.72	0.18
9/25/2018	7:01:19	25.72	5.01	0.07	1.82	0.71	0.24
9/25/2018	7:01:29	25.08	4.39	0.06	1.80	0.73	0.21
9/25/2018	7:01:39	24.68	3.79	0.06	1.80	0.74	0.22
9/25/2018	7:01:49	24.56	2.95	0.06	1.79	0.73	0.18
9/25/2018	7:01:59	24.55	2.22	0.06	1.78	0.73	0.19
9/25/2018	7:02:09	24.59	1.68	0.07	1.79	0.73	0.10
9/25/2018	7:02:19	24.37	1.50	0.07	1.79	0.73	0.19
9/25/2018	7:02:29	24.26	1.35	0.07	1.79	0.74	0.21
9/25/2018	7:02:39	19.70	1.76	0.07	1.79	0.73	0.21
9/25/2018	7:02:49	12.56	3.08	0.06	1.80	0.75	0.15
9/25/2018	7:02:59	8.79	3.96	0.06	1.80	0.75	0.13
9/25/2018	7:03:09	6.30	3.65	0.07	2.10	0.80	0.21
9/25/2018	7:03:19	9.92	4.34	0.06	1.98	0.55	0.19
9/25/2018	7:03:29	17.81	17.22	0.08	0.48	0.09	0.22

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/25/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	7:03:39	48.73	44.64	0.06	0.44	0.09	0.18
9/25/2018	7:03:49	91.94	70.42	0.06	0.44	0.08	0.21
9/25/2018	7:03:59	108.24	86.67	0.06	0.43	0.08	0.21
9/25/2018	7:04:09	110.99	92.98	0.07	0.42	0.08	0.22
9/25/2018	7:04:19	112.70	94.56	0.06	0.43	0.07	0.21
9/25/2018	7:04:29	112.22	96.16	0.06	0.43	0.07	0.21
9/25/2018	7:04:39	111.98	97.90	0.07	0.43	0.07	0.22
9/25/2018	7:04:49	111.82	97.98	0.06	0.43	0.07	0.24
9/25/2018	7:04:59	111.70	96.96	0.07	0.43	0.08	0.27
9/25/2018	7:05:09	111.70	96.29	0.07	0.42	0.07	0.22
9/25/2018	7:05:19	111.69	95.53	0.06	0.43	0.07	0.24
9/25/2018	7:05:29	111.69	95.03	0.06	0.43	0.07	0.27
9/25/2018	7:05:39	111.70	94.69	0.07	0.42	0.07	0.27
9/25/2018	7:05:49	111.70	94.75	0.07	0.42	0.08	0.27
9/25/2018	7:05:59	111.87	98.15	0.06	0.42	0.06	0.25
9/25/2018	7:06:09	111.97	101.46	0.06	0.42	0.07	0.19
9/25/2018	7:06:19	111.97	102.86	0.07	0.42	0.07	0.21
9/25/2018	7:06:29	111.81	102.69	0.07	0.42	0.07	0.24
9/25/2018	7:06:39	111.68	99.88	0.06	0.42	0.06	0.27
9/25/2018	7:06:49	111.66	99.24	0.07	0.42	0.07	0.24
9/25/2018	7:06:59	111.68	99.88	0.06	0.43	0.07	0.27
9/25/2018	7:07:09	111.86	99.12	0.07	0.46	0.08	0.21
9/25/2018	7:07:19	111.96	94.11	0.06	0.42	0.06	0.25
9/25/2018	7:07:29	113.38	80.85	0.07	0.42	0.06	0.19
9/25/2018	7:07:39	98.85	66.15	0.07	0.42	0.06	0.22
9/25/2018	7:07:49	71.80	57.22	0.06	0.41	0.06	0.25
9/25/2018	7:07:59	59.17	54.33	0.07	0.41	0.06	0.19
9/25/2018	7:08:09	56.03	52.66	0.06	0.41	0.06	0.24
9/25/2018	7:08:19	54.62	51.67	0.07	0.41	0.05	0.19
9/25/2018	7:08:29	54.43	50.76	0.06	0.41	0.05	0.27
9/25/2018	7:08:39	54.29	50.06	0.07	0.41	0.05	0.30
9/25/2018	7:08:49	54.28	49.63	0.06	0.41	0.05	0.25
9/25/2018	7:08:59	54.29	49.53	0.06	0.41	0.06	0.25
9/25/2018	7:09:09	54.30	49.61	0.06	0.41	0.05	0.22
9/25/2018	7:09:19	32.15	44.03	0.07	0.41	0.05	0.25
9/25/2018	7:09:29	27.15	33.00	0.08	0.42	0.05	0.25
9/25/2018	7:09:39	27.07	26.43	0.07	0.42	0.05	0.30
9/25/2018	7:09:49	27.00	26.16	0.07	0.41	0.05	0.19
9/25/2018	7:09:59	27.01	25.71	0.07	0.41	0.05	0.21
9/25/2018	7:10:09	27.00	25.39	0.07	0.41	0.05	0.21
9/25/2018	7:10:19	27.01	25.06	0.06	0.41	0.04	0.21

Hollingsworth & Vose
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Daily Calibrations
9/25/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	7:10:29	27.01	24.78	0.07	0.41	0.05	0.28
9/25/2018	7:10:39	27.01	24.78	0.06	0.59	0.20	0.24
9/25/2018	7:10:49	27.01	23.26	0.06	1.21	0.86	0.19
9/25/2018	7:10:59	25.05	18.86	0.06	0.44	0.06	0.25
9/25/2018	7:11:09	22.59	13.39	0.07	0.41	0.05	0.33
9/25/2018	7:11:19	34.32	18.04	0.06	0.41	0.05	0.27
9/25/2018	7:11:29	17.49	13.26	0.06	0.41	0.04	0.28
9/25/2018	7:11:39	10.42	11.65	0.06	0.41	0.04	0.21
9/25/2018	7:11:49	10.41	10.85	0.06	0.41	0.04	0.21
9/25/2018	7:11:59	10.41	10.07	0.07	0.41	0.04	0.22
9/25/2018	7:12:09	10.41	9.94	0.06	0.41	0.03	0.25
9/25/2018	7:12:19	10.40	10.01	0.06	0.41	0.03	0.24
9/25/2018	7:12:29	10.87	9.72	0.06	0.41	0.04	0.24
9/25/2018	7:12:39	10.39	10.90	0.07	0.41	0.04	0.24
9/25/2018	7:12:49	9.94	12.48	0.06	0.41	0.03	0.27
9/25/2018	7:12:59	10.08	13.12	0.06	0.41	0.03	0.27
9/25/2018	7:13:09	10.12	12.44	0.07	0.41	0.04	0.25
9/25/2018	7:13:19	9.94	11.47	0.06	0.41	0.03	0.19
9/25/2018	7:13:29	9.83	10.77	0.06	0.41	0.03	0.25
9/25/2018	7:13:39	9.82	9.91	0.05	0.41	0.03	0.27
9/25/2018	7:13:49	10.00	8.47	0.07	0.40	0.03	0.24
9/25/2018	7:13:59	8.71	6.72	0.07	0.41	0.03	0.22
9/25/2018	7:14:09	6.34	5.41	0.07	0.41	0.03	0.16
9/25/2018	7:14:19	5.22	5.52	0.07	0.41	0.03	0.28
9/25/2018	7:14:29	4.93	7.04	0.06	0.40	0.03	0.18
9/25/2018	7:14:39	4.81	8.08	0.07	0.41	0.03	0.22
9/25/2018	7:14:49	4.80	7.93	0.06	0.40	0.04	0.24
9/25/2018	7:14:59	4.80	7.07	0.07	0.41	0.03	0.22
9/25/2018	7:15:09	4.81	6.38	0.06	0.41	0.03	0.28
9/25/2018	7:15:19	4.82	5.67	0.07	0.40	0.04	0.22
9/25/2018	7:15:29	4.84	5.21	0.07	0.40	0.04	0.27
9/25/2018	7:15:39	4.82	4.89	0.08	0.41	0.03	0.27
9/25/2018	7:15:49	4.83	4.97	0.07	0.40	0.05	0.21
9/25/2018	7:15:59	4.81	5.37	0.07	0.41	0.03	0.25
9/25/2018	7:16:09	4.83	6.83	0.07	0.40	0.03	0.25
9/25/2018	7:16:19	4.81	7.84	0.07	0.40	0.03	0.22
9/25/2018	7:16:29	4.83	7.76	0.06	0.41	0.04	0.22
9/25/2018	7:16:39	4.84	6.88	0.06	0.42	0.03	0.27
9/25/2018	7:16:49	4.83	5.87	0.07	0.43	0.03	0.19
9/25/2018	7:16:59	4.84	4.49	0.07	11.01	0.04	0.16
9/25/2018	7:17:09	4.81	3.24	0.07	20.49	0.03	0.19

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	7:17:19	12.92	1.89	0.07	20.80	0.03	0.21
9/25/2018	7:17:29	26.73	0.99	0.05	20.83	0.03	0.16
9/25/2018	7:17:39	38.58	1.02	0.06	20.84	0.04	0.19
9/25/2018	7:17:49	48.83	2.29	0.07	20.85	0.04	0.18
9/25/2018	7:17:59	53.04	3.43	0.07	20.86	0.04	0.16
9/25/2018	7:18:09	53.37	2.97	0.07	20.85	0.04	0.24
9/25/2018	7:18:19	53.68	2.27	0.06	20.85	0.04	0.19
9/25/2018	7:18:29	53.78	1.43	0.06	20.86	0.04	0.22
9/25/2018	7:18:39	53.78	0.89	0.06	20.86	0.03	0.15
9/25/2018	7:18:49	53.77	0.42	0.06	20.86	0.04	0.16
9/25/2018	7:18:59	53.78	0.13	0.06	20.86	0.03	0.19
9/25/2018	7:19:09	52.49	0.09	0.06	20.87	0.03	0.22
9/25/2018	7:19:19	51.95	0.14	0.07	20.87	0.03	0.21
9/25/2018	7:19:29	51.06	0.79	0.06	20.87	0.04	0.22
9/25/2018	7:19:39	50.46	2.52	0.06	20.87	0.04	0.21
9/25/2018	7:19:49	50.45	3.22	0.07	20.87	0.04	0.27
9/25/2018	7:19:59	50.44	2.79	0.06	20.87	0.04	0.22
9/25/2018	7:20:09	50.47	1.88	0.07	20.87	0.04	0.21
9/25/2018	7:20:19	50.47	1.25	0.06	20.87	0.04	0.22
9/25/2018	7:20:29	50.45	0.64	0.07	20.88	0.04	0.19
9/25/2018	7:20:39	50.45	0.48	0.05	20.88	0.04	0.27
9/25/2018	7:20:49	50.44	0.19	0.05	20.88	0.05	0.27
9/25/2018	7:20:59	50.47	0.10	0.06	20.88	0.05	0.28
9/25/2018	7:21:09	50.47	0.30	0.06	20.90	0.04	0.28
9/25/2018	7:21:19	50.47	1.85	0.06	19.38	0.04	0.27
9/25/2018	7:21:29	50.46	3.32	0.07	20.29	0.07	0.27
9/25/2018	7:21:39	49.93	3.26	0.07	20.23	0.09	0.27
9/25/2018	7:21:49	48.88	2.33	0.06	20.36	0.09	0.25
9/25/2018	7:21:59	35.51	1.49	0.07	20.65	0.10	0.27
9/25/2018	7:22:09	14.40	1.10	0.13	20.69	0.11	1.00
9/25/2018	7:22:19	4.43	0.57	0.20	20.67	0.11	1.55
9/25/2018	7:22:29	1.69	0.50	0.20	20.69	0.10	1.58
9/25/2018	7:22:39	0.42	0.27	0.20	20.66	0.11	1.58
9/25/2018	7:22:49	0.31	0.55	0.19	20.69	0.12	1.52

	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]
Analyzer Zero	**-0.01**	**0.33**	**-0.01**	**0.03**
Analyzer Mid	**4.83**	**24.87**	**10.12**	**1.89**
Analyzer High	**10.05**	**49.74**	**19.95**	**4.14**

NO2 Converter Check **50.47**

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
System							
9/25/2018	7:22:59	0.30	1.92	0.18	19.76	0.59	1.55
9/25/2018	7:23:09	0.29	3.50	0.19	10.43	0.88	1.56
9/25/2018	7:23:19	0.49	3.71	0.22	3.84	0.38	1.58
9/25/2018	7:23:29	0.78	3.70	0.33	1.66	0.18	1.50
9/25/2018	7:23:39	1.68	4.16	0.34	0.96	0.11	1.55
9/25/2018	7:23:49	2.87	4.54	0.34	0.73	0.09	1.61
9/25/2018	7:23:59	3.73	4.81	0.33	0.66	0.08	1.53
9/25/2018	7:24:09	4.32	4.97	0.34	0.63	0.09	1.61
9/25/2018	7:24:19	4.70	4.77	0.33	0.64	0.08	1.56
9/25/2018	7:24:29	4.81	4.86	0.33	0.62	0.08	1.44
9/25/2018	7:24:39	4.82	5.58	0.21	0.61	0.08	1.58
9/25/2018	7:24:49	4.80	6.99	0.20	0.61	0.08	1.63
9/25/2018	7:24:59	4.83	8.04	0.20	0.60	0.09	1.61
9/25/2018	7:25:09	4.82	7.79	0.20	0.61	0.08	1.60
9/25/2018	7:25:19	4.82	7.06	0.19	0.60	0.08	1.53
9/25/2018	7:25:29	4.83	6.22	0.20	0.61	0.08	1.61
9/25/2018	7:25:39	4.83	5.49	0.19	0.59	0.09	1.56
9/25/2018	7:25:49	4.81	5.15	0.36	0.68	0.08	1.53
9/25/2018	7:25:59	4.84	5.03	0.47	0.74	0.08	1.60
9/25/2018	7:26:09	4.82	4.83	0.47	0.62	0.09	1.53
9/25/2018	7:26:19	5.01	4.80	0.47	0.56	0.09	1.55
9/25/2018	7:26:29	5.11	5.71	0.47	0.56	0.08	1.55
9/25/2018	7:26:39	5.12	7.46	0.46	0.59	0.08	1.56
9/25/2018	7:26:49	5.11	8.26	0.47	0.59	0.07	1.56
9/25/2018	7:26:59	5.12	7.71	0.38	0.58	0.08	1.63
9/25/2018	7:27:09	5.11	6.75	0.19	0.58	0.09	1.53
9/25/2018	7:27:19	5.10	6.08	0.19	0.58	0.08	1.56
9/25/2018	7:27:29	5.12	5.66	0.19	0.58	0.08	1.56
9/25/2018	7:27:39	5.09	5.46	0.19	0.58	0.08	1.61
9/25/2018	7:27:49	5.10	5.22	0.20	0.58	0.07	1.64
9/25/2018	7:27:59	5.08	4.78	0.20	0.58	0.08	1.58
9/25/2018	7:28:09	5.06	4.43	0.19	0.58	0.08	1.50
9/25/2018	7:28:19	4.23	4.66	0.07	0.58	0.08	1.53
9/25/2018	7:28:29	2.93	4.72	0.07	0.58	0.08	1.61
9/25/2018	7:28:39	1.87	4.16	0.07	0.56	0.07	1.60
9/25/2018	7:28:49	0.75	2.84	0.06	0.58	0.08	1.55
9/25/2018	7:28:59	0.28	1.85	0.06	0.57	0.08	1.58
9/25/2018	7:29:09	0.11	0.97	0.07	0.58	0.08	1.55
9/25/2018	7:29:19	0.00	0.65	0.05	0.58	0.07	1.55
9/25/2018	7:29:29	0.01	0.37	0.06	0.58	0.07	1.67

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	7:29:39	0.00	0.25	0.07	0.47	0.08	1.61
9/25/2018	7:29:49	-0.02	0.18	0.06	-0.02	0.07	1.58
9/25/2018	7:29:59	0.00	0.94	0.06	-0.02	0.03	1.55
9/25/2018	7:30:09	-0.03	2.58	0.07	-0.02	0.04	1.56
9/25/2018	7:30:19	0.00	3.61	0.06	0.05	0.03	1.58
9/25/2018	7:30:29	-0.02	3.05	0.06	0.05	0.03	1.58
9/25/2018	7:30:39	-0.01	2.28	0.17	0.05	0.03	1.56
9/25/2018	7:30:49	-0.02	1.38	0.34	0.05	0.03	1.56
9/25/2018	7:30:59	-0.02	0.88	0.34	0.05	0.03	1.60
9/25/2018	7:31:09	0.01	0.29	0.33	0.05	0.03	1.58
9/25/2018	7:31:19	-0.01	0.32	0.33	0.05	0.03	1.53
9/25/2018	7:31:29	0.00	0.13	0.34	0.05	0.03	1.55
9/25/2018	7:31:39	-0.01	0.44	0.35	0.05	0.03	1.64
9/25/2018	7:31:49	-0.01	1.94	0.31	0.05	0.03	1.35
9/25/2018	7:31:59	0.01	3.19	0.05	0.04	0.04	0.24
9/25/2018	7:32:09	-0.01	3.20	0.06	0.05	0.03	0.22
9/25/2018	7:32:19	-0.01	2.67	0.06	0.04	0.03	0.27
9/25/2018	7:32:29	-0.01	2.60	0.06	0.05	0.03	0.31
9/25/2018	7:32:39	0.72	3.11	0.06	0.05	0.03	0.25
9/25/2018	7:32:49	2.12	3.99	0.07	0.05	0.03	0.19
9/25/2018	7:32:59	3.30	4.49	0.07	0.05	0.04	0.25
9/25/2018	7:33:09	4.15	4.65	0.28	0.04	0.03	0.21
9/25/2018	7:33:19	4.69	5.32	0.33	0.05	0.02	0.22
9/25/2018	7:33:29	4.82	6.65	0.34	0.05	0.02	0.25
9/25/2018	7:33:39	5.00	7.89	0.34	0.04	0.02	0.31
9/25/2018	7:33:49	5.08	7.98	0.34	0.05	0.02	0.21
9/25/2018	7:33:59	5.09	6.99	0.34	0.04	0.02	0.22
9/25/2018	7:34:09	5.09	6.21	0.34	0.05	0.02	0.27
9/25/2018	7:34:19	5.11	5.61	0.26	0.05	0.02	0.24
9/25/2018	7:34:29	5.09	5.37	0.20	0.05	0.02	0.19
9/25/2018	7:34:39	5.10	5.08	0.20	0.04	0.03	0.25
9/25/2018	7:34:49	5.10	5.06	0.20	0.04	0.02	0.22
9/25/2018	7:34:59	5.11	4.78	0.19	0.30	0.01	0.22
9/25/2018	7:35:09	5.11	7.23	0.20	0.25	0.02	0.22
9/25/2018	7:35:19	7.06	14.98	0.19	0.14	0.02	0.27
9/25/2018	7:35:29	9.78	26.04	0.22	0.09	0.01	0.16
9/25/2018	7:35:39	10.05	18.19	0.33	0.07	0.03	0.22
9/25/2018	7:35:49	18.10	21.59	0.33	0.05	0.03	0.24
9/25/2018	7:35:59	22.44	23.41	0.33	0.05	0.02	0.24
9/25/2018	7:36:09	24.32	24.08	0.34	0.05	0.02	0.25
9/25/2018	7:36:19	25.26	24.41	0.34	0.05	0.02	0.33

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	7:36:29	25.65	24.54	0.33	0.05	0.02	0.33
9/25/2018	7:36:39	25.85	24.62	0.35	0.05	0.02	0.24
9/25/2018	7:36:49	25.94	25.02	0.34	0.04	0.02	0.30
9/25/2018	7:36:59	25.98	25.97	0.34	0.05	0.02	0.30
9/25/2018	7:37:09	25.98	26.28	0.35	0.05	0.02	0.34
9/25/2018	7:37:19	25.99	26.00	0.34	0.05	0.02	0.30
9/25/2018	7:37:29	25.99	25.49	0.34	0.05	0.02	0.33
9/25/2018	7:37:39	25.98	25.19	0.34	0.05	0.01	0.24
9/25/2018	7:37:49	25.99	24.86	0.34	0.05	0.03	0.27
9/25/2018	7:37:59	25.99	24.58	0.41	4.08	0.03	0.25
9/25/2018	7:38:09	25.99	23.40	0.47	12.60	0.05	0.27
9/25/2018	7:38:19	23.84	19.63	0.47	16.29	0.06	0.28
9/25/2018	7:38:29	20.53	14.16	0.48	10.34	0.04	0.27
9/25/2018	7:38:39	15.25	9.61	0.48	4.53	0.03	0.31
9/25/2018	7:38:49	16.47	13.64	0.47	2.55	0.66	0.25
9/25/2018	7:38:59	8.97	9.47	0.46	2.18	1.29	0.24
9/25/2018	7:39:09	5.63	6.04	0.47	2.04	1.58	0.24
9/25/2018	7:39:19	3.50	3.83	0.47	1.97	1.71	0.27
9/25/2018	7:39:29	2.13	2.00	0.47	1.95	1.77	0.30
9/25/2018	7:39:39	1.13	0.79	0.47	1.93	1.78	0.37
9/25/2018	7:39:49	0.54	0.21	0.46	1.93	1.80	0.27
9/25/2018	7:39:59	0.30	-0.14	0.46	1.93	1.81	0.28
9/25/2018	7:40:09	0.29	-0.09	0.46	1.93	1.82	0.21
9/25/2018	7:40:19	0.12	0.97	0.47	1.93	1.81	0.28
9/25/2018	7:40:29	-0.01	2.35	0.46	1.94	1.81	0.24
9/25/2018	7:40:39	0.00	2.65	0.47	1.94	1.82	0.27
9/25/2018	7:40:49	-0.01	1.70	0.47	1.94	1.82	0.24
9/25/2018	7:40:59	0.01	1.14	0.46	1.99	1.88	0.24
9/25/2018	7:41:09	0.02	0.44	0.47	4.93	5.36	0.33
9/25/2018	7:41:19	-0.01	-0.02	0.47	7.69	7.90	0.25
9/25/2018	7:41:29	-0.01	-0.09	0.47	8.85	8.92	0.27
9/25/2018	7:41:39	-0.01	0.17	0.48	9.35	9.35	0.27
9/25/2018	7:41:49	0.00	-0.02	0.47	9.57	9.55	0.30
9/25/2018	7:41:59	0.01	0.03	0.47	9.66	9.65	0.33
9/25/2018	7:42:09	0.00	1.17	0.47	9.71	9.68	0.25
9/25/2018	7:42:19	-0.01	1.82	0.49	9.72	9.72	0.30
9/25/2018	7:42:29	0.00	1.54	0.47	9.73	9.72	0.27
9/25/2018	7:42:39	-0.01	0.67	0.47	9.74	9.73	0.27
9/25/2018	7:42:49	-0.01	-0.06	0.47	9.74	9.73	0.24
9/25/2018	7:42:59	-0.01	-0.62	0.47	9.75	9.74	0.22
9/25/2018	7:43:09	0.00	-1.05	0.47	9.84	9.86	0.30

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	7:43:19	-0.01	-1.30	0.46	9.87	9.81	0.22
9/25/2018	7:43:29	0.01	-1.40	0.47	9.88	9.82	0.33
9/25/2018	7:43:39	0.00	-1.24	0.47	9.88	9.82	0.31
9/25/2018	7:43:49	-0.01	-0.47	0.46	9.88	9.83	0.22
9/25/2018	7:43:59	0.00	1.09	0.46	9.87	9.83	0.21
9/25/2018	7:44:09	0.01	1.63	0.47	9.87	9.82	0.30
9/25/2018	7:44:19	0.00	1.19	0.47	9.93	9.77	0.31
9/25/2018	7:44:29	0.01	0.33	0.48	13.33	6.54	0.27
9/25/2018	7:44:39	0.00	-0.08	0.47	17.25	3.01	0.34
9/25/2018	7:44:49	-0.01	-0.19	0.48	19.12	1.37	0.25
9/25/2018	7:44:59	-0.01	0.40	0.48	18.99	1.20	0.28
9/25/2018	7:45:09	-0.01	0.70	0.48	11.08	1.18	0.27
9/25/2018	7:45:19	0.01	0.29	0.47	4.85	0.62	0.30
9/25/2018	7:45:29	0.00	0.44	0.47	2.17	0.41	0.34
9/25/2018	7:45:39	0.17	1.86	0.47	1.07	0.35	0.34
9/25/2018	7:45:49	0.29	3.30	0.49	0.60	0.30	0.34
9/25/2018	7:45:59	0.29	3.45	0.47	0.40	0.25	0.22
9/25/2018	7:46:09	0.31	2.47	0.47	0.32	0.18	0.31
9/25/2018	7:46:19	0.29	1.82	0.47	0.30	0.14	0.31
9/25/2018	7:46:29	0.28	1.07	0.67	0.30	0.11	1.05
9/25/2018	7:46:39	0.29	0.67	0.87	0.29	0.09	1.60
9/25/2018	7:46:49	0.11	0.43	0.86	0.30	0.08	1.58
9/25/2018	7:46:59	0.01	0.28	0.87	0.29	0.08	1.55
9/25/2018	7:47:09	0.00	0.13	0.87	0.29	0.07	1.61
9/25/2018	7:47:19	0.00	0.76	0.87	0.29	0.07	1.66
9/25/2018	7:47:29	0.00	2.14	0.87	0.29	0.07	1.63
9/25/2018	7:47:39	-0.01	3.09	1.96	0.29	0.07	8.69
9/25/2018	7:47:49	0.01	3.03	6.31	0.29	0.06	25.14
9/25/2018	7:47:59	0.02	2.33	6.30	0.29	0.06	25.20
9/25/2018	7:48:09	0.00	1.58	6.30	0.29	0.06	25.14
9/25/2018	7:48:19	0.01	0.94	6.31	0.30	0.07	25.11
9/25/2018	7:48:29	-0.01	0.62	6.29	0.29	0.06	25.09
9/25/2018	7:48:39	0.02	0.28	6.31	0.29	0.06	25.09
9/25/2018	7:48:49	0.02	0.13	6.31	0.29	0.06	25.12
9/25/2018	7:48:59	0.00	0.25	11.52	0.29	0.05	52.30
9/25/2018	7:49:09	0.00	1.31	12.10	0.30	0.05	52.33
9/25/2018	7:49:19	0.00	2.73	12.09	0.30	0.05	52.38
9/25/2018	7:49:29	0.01	3.23	12.09	0.29	0.05	52.32
9/25/2018	7:49:39	-0.01	2.48	12.09	0.29	0.05	52.32
9/25/2018	7:49:49	0.01	1.48	12.09	0.36	0.05	52.38
9/25/2018	7:49:59	0.03	0.90	12.10	6.34	0.07	52.38

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/25/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	7:50:09	-0.01	0.54	12.33	14.04	0.08	53.31
9/25/2018	7:50:19	0.01	0.31	12.50	17.68	0.09	53.84
9/25/2018	7:50:29	-0.01	0.25	12.50	19.29	0.09	53.75
9/25/2018	7:50:39	0.00	0.37	12.50	19.99	0.09	53.74
9/25/2018	7:50:49	-0.01	0.98	12.48	20.30	0.10	53.83
9/25/2018	7:50:59	0.02	2.76	12.50	20.44	0.09	53.78
9/25/2018	7:51:09	0.03	4.18	12.51	20.50	0.09	53.84
9/25/2018	7:51:19	0.00	3.93	10.88	20.53	0.09	44.40
9/25/2018	7:51:29	0.00	3.12	7.06	20.54	0.09	30.37
9/25/2018	7:51:39	0.00	2.08	7.06	20.54	0.09	30.36
9/25/2018	7:51:49	-0.02	1.50	7.08	20.56	0.10	30.36
9/25/2018	7:51:59	0.01	1.07	7.08	20.49	0.09	30.39
9/25/2018	7:52:09	0.00	1.00	7.06	14.66	0.26	30.42
9/25/2018	7:52:19	0.00	0.89	7.07	8.75	0.30	30.40
9/25/2018	7:52:29	0.01	0.65	7.06	6.29	0.16	30.34
9/25/2018	7:52:39	0.72	1.15	0.87	5.24	0.10	2.91
9/25/2018	7:52:49	1.99	2.46	0.87	4.79	0.07	2.83
9/25/2018	7:52:59	2.66	3.27	0.86	4.60	0.05	2.85
9/25/2018	7:53:09	2.96	2.82	0.87	4.52	0.05	2.85
9/25/2018	7:53:19	2.71	2.09	0.87	4.48	0.04	2.85
9/25/2018	7:53:29	2.10	1.28	0.86	4.47	0.05	2.89
9/25/2018	7:53:39	1.65	0.76	0.87	4.46	0.04	2.89
9/25/2018	7:53:49	1.29	0.45	15.99	4.47	0.03	30.13
9/25/2018	7:53:59	1.03	0.34	22.46	4.46	0.04	37.03
9/25/2018	7:54:09	0.73	0.36	22.47	4.46	0.04	36.98
9/25/2018	7:54:19	0.59	1.05	22.46	4.46	0.04	36.98
9/25/2018	7:54:29	0.41	2.43	22.48	4.46	0.05	36.98
9/25/2018	7:54:39	0.28	3.18	22.46	4.46	0.04	36.95
9/25/2018	7:54:49	0.30	2.90	22.46	4.46	0.04	37.00
9/25/2018	7:54:59	0.29	2.10	22.53	4.46	0.04	19.25
9/25/2018	7:55:09	0.31	1.32	22.63	4.46	0.04	1.56
9/25/2018	7:55:19	0.32	0.96	22.64	4.46	0.03	1.53
9/25/2018	7:55:29	0.16	0.30	22.63	4.46	0.03	1.52
9/25/2018	7:55:39	0.01	0.18	22.62	4.46	0.03	1.56
9/25/2018	7:55:49	0.01	0.49	22.63	4.46	0.03	1.61
9/25/2018	7:55:59	0.00	1.23	22.64	4.46	0.03	1.56
9/25/2018	7:56:09	0.02	2.94	22.63	4.46	0.03	1.29
9/25/2018	7:56:19	-0.01	3.53	22.62	4.46	0.03	0.25
9/25/2018	7:56:29	0.00	3.09	22.63	4.46	0.03	0.24
9/25/2018	7:56:39	0.03	2.20	22.63	4.46	0.03	0.19
9/25/2018	7:56:49	0.00	1.29	22.63	4.46	0.04	0.25

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/25/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	7:56:59	0.02	0.81	22.62	4.46	0.02	0.24
9/25/2018	7:57:09	-0.01	0.54	22.62	4.46	0.03	0.22
9/25/2018	7:57:19	0.00	0.05	22.63	4.45	0.02	0.19
9/25/2018	7:57:29	-0.01	-0.02	22.75	4.46	0.01	0.21
9/25/2018	7:57:39	0.01	0.60	22.76	4.45	0.03	0.27
9/25/2018	7:57:49	0.01	2.05	22.76	4.45	0.02	0.24
9/25/2018	7:57:59	0.03	3.26	22.76	4.45	0.03	0.25
9/25/2018	7:58:09	-0.02	3.19	22.76	4.45	0.03	0.25
9/25/2018	7:58:19	0.00	2.01	22.78	4.45	0.03	0.28
9/25/2018	7:58:29	0.02	1.42	22.76	4.45	0.03	0.25
9/25/2018	7:58:39	0.01	0.81	22.76	4.45	0.03	0.27
9/25/2018	7:58:49	0.00	0.41	22.76	4.45	0.02	0.27
9/25/2018	7:58:59	0.00	0.38	22.75	4.46	0.01	0.24
9/25/2018	7:59:09	0.02	0.31	22.75	4.45	0.03	0.21
9/25/2018	7:59:19	0.00	1.26	22.76	4.46	0.02	0.28
9/25/2018	7:59:29	-0.01	2.72	22.77	4.45	0.02	0.28
9/25/2018	7:59:39	0.01	3.33	21.81	4.45	0.03	0.25
9/25/2018	7:59:49	-0.02	2.62	21.40	4.46	0.03	0.30
9/25/2018	7:59:59	0.01	1.67	21.40	4.45	0.03	0.31
9/25/2018	8:00:09	0.00	1.04	21.39	4.45	0.03	0.30
9/25/2018	8:00:19	0.02	0.56	21.40	4.45	0.02	0.27
9/25/2018	8:00:29	-0.01	0.35	21.40	4.45	0.03	0.27
9/25/2018	8:00:39	0.00	0.20	21.40	4.45	0.02	0.24
9/25/2018	8:00:49	-0.01	0.38	21.39	4.45	0.03	0.27
9/25/2018	8:00:59	0.00	1.61	21.38	4.45	0.04	0.24
9/25/2018	8:01:09	-0.01	3.17	21.39	4.44	0.02	0.22
9/25/2018	8:01:19	0.00	3.46	21.39	4.46	0.03	0.22
9/25/2018	8:01:29	-0.01	2.65	21.38	4.45	0.02	0.27
9/25/2018	8:01:39	0.01	1.65	21.39	4.45	0.03	0.21
9/25/2018	8:01:49	0.00	1.08	21.39	4.45	0.03	0.22
9/25/2018	8:01:59	0.01	0.50	21.39	4.45	0.02	0.24
9/25/2018	8:02:09	0.01	0.24	21.39	4.45	0.02	0.25
9/25/2018	8:02:19	-0.01	0.22	21.39	4.45	0.02	0.24
9/25/2018	8:02:29	0.01	0.50	21.41	4.45	0.02	0.25
9/25/2018	8:02:39	-0.02	1.64	21.40	4.45	0.03	0.18
9/25/2018	8:02:49	-0.02	3.32	21.39	4.46	0.03	0.22
9/25/2018	8:02:59	-0.02	3.49	21.31	4.44	0.03	0.21
9/25/2018	8:03:09	0.00	2.63	21.28	4.45	0.03	0.25
9/25/2018	8:03:19	-0.03	1.69	21.26	4.45	0.03	0.24
9/25/2018	8:03:29	-0.01	0.99	21.27	4.44	0.03	0.13
9/25/2018	8:03:39	-0.01	0.52	21.27	4.39	0.03	0.21

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/25/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	8:03:49	0.00	0.39	21.27	3.52	0.03	0.24
9/25/2018	8:03:59	0.00	0.29	21.26	2.98	0.03	0.18
9/25/2018	8:04:09	-0.01	0.84	21.27	2.76	0.03	0.24
9/25/2018	8:04:19	-0.01	2.41	21.27	2.66	0.03	0.16
9/25/2018	8:04:29	-0.01	3.49	21.27	2.62	0.03	0.27
9/25/2018	8:04:39	0.00	2.94	21.26	2.60	0.03	0.19
9/25/2018	8:04:49	-0.01	2.21	21.27	2.60	0.03	0.16
9/25/2018	8:04:59	-0.01	1.19	21.27	2.60	0.03	0.19
9/25/2018	8:05:09	-0.01	0.86	21.27	2.59	0.03	0.19
9/25/2018	8:05:19	-0.01	0.31	20.68	2.60	0.03	0.21
9/25/2018	8:05:29	-0.01	0.20	15.38	2.59	0.03	0.24
9/25/2018	8:05:39	-0.01	0.30	15.38	2.59	0.03	0.30
9/25/2018	8:05:49	0.00	1.41	15.37	2.59	0.03	0.19
9/25/2018	8:05:59	-0.02	3.08	15.37	2.59	0.03	0.25
9/25/2018	8:06:09	-0.03	3.52	15.36	2.59	0.03	0.27
9/25/2018	8:06:19	-0.01	2.79	15.36	2.59	0.04	0.27
9/25/2018	8:06:29	-0.01	1.84	15.37	2.59	0.03	0.25
9/25/2018	8:06:39	-0.03	1.28	13.07	2.59	0.03	0.21
9/25/2018	8:06:49	-0.03	0.81	12.51	2.59	0.03	0.27
9/25/2018	8:06:59	-0.02	0.42	12.50	2.59	0.03	0.27
9/25/2018	8:07:09	-0.03	0.05	12.50	2.59	0.04	0.28
9/25/2018	8:07:19	-0.02	0.83	12.50	2.59	0.04	0.25
9/25/2018	8:07:29	-0.03	2.13	12.50	2.59	0.03	0.30
9/25/2018	8:07:39	-0.01	3.36	12.50	2.39	0.05	0.19
9/25/2018	8:07:49	-0.03	3.23	12.50	1.87	0.04	0.25
9/25/2018	8:07:59	-0.03	2.22	12.50	1.55	0.04	0.30
9/25/2018	8:08:09	0.17	1.60	12.50	1.41	0.04	0.21
9/25/2018	8:08:19	0.28	0.84	12.51	1.35	0.04	0.18
9/25/2018	8:08:29	0.28	0.48	12.49	1.32	0.03	0.31
9/25/2018	8:08:39	0.28	0.35	12.50	1.31	0.04	0.27
9/25/2018	8:08:49	0.11	0.41	12.50	1.31	0.04	0.22
9/25/2018	8:08:59	-0.01	1.37	12.95	1.31	0.03	7.33
9/25/2018	8:09:09	-0.01	2.94	14.73	1.30	0.04	23.80
9/25/2018	8:09:19	-0.02	3.60	14.73	1.30	0.04	23.78
9/25/2018	8:09:29	-0.01	2.91	14.73	1.30	0.04	23.86
9/25/2018	8:09:39	-0.01	2.03	14.73	1.30	0.04	23.77
9/25/2018	8:09:49	-0.02	1.25	14.74	1.30	0.04	23.84
9/25/2018	8:09:59	-0.02	0.70	14.72	1.30	0.04	23.83
9/25/2018	8:10:09	-0.01	0.44	14.73	1.30	0.04	23.77
9/25/2018	8:10:19	-0.01	0.25	7.15	1.30	0.05	2.59
9/25/2018	8:10:29	-0.03	0.78	6.29	1.30	0.04	0.22

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/25/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/25/2018	8:10:39	-0.01	2.20	6.30	1.30	0.05	0.24
9/25/2018	8:10:49	-0.01	3.49	6.31	1.30	0.04	0.28
9/25/2018	8:10:59	-0.02	3.16	6.30	1.30	0.04	0.21
9/25/2018	8:11:09	-0.01	2.27	6.30	1.30	0.05	0.16
9/25/2018	8:11:19	-0.02	1.56	6.30	1.30	0.05	0.19
9/25/2018	8:11:29	-0.02	0.69	6.29	1.30	0.04	0.25
9/25/2018	8:11:39	-0.03	0.38	6.30	1.29	0.04	0.21
9/25/2018	8:11:49	-0.01	0.50	6.30	1.30	0.04	0.21
9/25/2018	8:11:59	-0.02	0.44	6.29	1.30	0.04	0.30
9/25/2018	8:12:09	-0.01	1.52	6.29	1.30	0.04	0.22
9/25/2018	8:12:19	0.00	2.98	6.31	1.31	0.05	0.30
9/25/2018	8:12:29	-0.01	3.23	6.29	6.37	0.05	0.24
9/25/2018	8:12:39	-0.02	2.51	6.30	14.00	0.07	0.27
9/25/2018	8:12:49	-0.01	1.73	6.29	17.67	0.09	0.24
9/25/2018	8:12:59	-0.01	1.19	6.30	19.28	0.09	0.22
9/25/2018	8:13:09	-0.01	0.69	6.31	19.99	0.09	0.24
9/25/2018	8:13:19	0.01	0.46	6.30	20.30	0.09	0.21
9/25/2018	8:13:29	0.17	0.62	6.30	20.43	0.09	0.28
9/25/2018	8:13:39	0.12	1.46	6.29	20.49	0.09	0.24
9/25/2018	8:13:49	0.00	3.28	6.30	20.52	0.09	0.25
9/25/2018	8:13:59	0.01	3.71	3.60	20.53	0.09	1.50
9/25/2018	8:14:09	-0.01	3.06	3.59	20.54	0.09	1.50
9/25/2018	8:14:19	-0.01	2.38	3.60	20.55	0.09	1.46
9/25/2018	8:14:29	-0.01	1.47	3.60	20.54	0.09	1.52
		NOx [PPM]	**CO [PPM]**		**O2 [%]**	**CO2 [%]**	
System Zero		**0.00**	**0.25**		**0.05**	**0.03**	
System Mid		**5.09**	**25.18**		**9.88**	**1.82**	

		M-106
VOC System	**VOC [PPM]**	**CH4 [PPM]**
System Zero	**0.33**	**0.25**
System low	**6.30**	
System Mid	**12.50**	
System High	**21.27**	**52.36**

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	9:14:14	1.16	10.31	3.28	19.74	0.95
9/25/2018	9:15:14	1.17	10.02	3.20	19.74	0.95
9/25/2018	9:16:14	1.17	8.99	3.20	19.74	0.95
9/25/2018	9:17:14	1.18	10.58	3.32	19.74	0.95
9/25/2018	9:18:14	1.18	9.68	3.33	19.74	0.96
9/25/2018	9:19:14	1.18	9.72	3.33	19.74	0.95
9/25/2018	9:20:14	1.18	10.38	3.28	19.73	0.96
9/25/2018	9:21:14	1.18	8.92	3.21	19.73	0.96
9/25/2018	9:22:14	1.17	10.35	3.33	19.73	0.95
9/25/2018	9:23:14	1.18	10.09	3.33	19.73	0.95
9/25/2018	9:24:14	1.18	9.01	3.23	19.72	0.94
9/25/2018	9:25:14	1.19	10.29	3.26	19.71	0.94
9/25/2018	9:26:14	1.18	9.28	3.26	19.70	0.94
9/25/2018	9:27:14	1.18	9.71	3.07	19.69	0.95
9/25/2018	9:28:14	1.18	10.11	3.07	19.69	0.94
9/25/2018	9:29:14	1.18	8.76	3.07	19.69	0.94
9/25/2018	9:30:14	1.17	10.45	3.15	19.69	0.94
9/25/2018	9:31:14	1.18	8.94	3.14	19.88	0.94
9/25/2018	9:32:14	1.19	9.91	3.10	20.00	0.95
9/25/2018	9:33:14	1.18	9.69	3.20	19.82	0.95
9/25/2018	9:34:14	1.18	8.89	3.08	19.75	0.94
9/25/2018	9:35:14	1.18	10.67	3.17	19.74	0.94
9/25/2018	9:36:14	1.17	8.86	3.27	19.74	0.94
9/25/2018	9:37:14	1.19	9.82	3.29	19.74	0.94
9/25/2018	9:38:14	1.19	9.57	3.21	19.74	0.94
9/25/2018	9:39:14	1.19	8.71	3.33	19.74	0.94
9/25/2018	9:40:14	1.19	9.95	3.34	19.74	0.94
9/25/2018	9:41:14	1.19	8.36	3.33	19.74	0.93
9/25/2018	9:42:14	1.19	9.79	3.33	19.75	0.93
9/25/2018	9:43:14	1.14	8.92	3.33	19.74	0.93
9/25/2018	9:44:14	1.19	9.26	3.32	19.73	0.93
9/25/2018	9:45:14	1.18	9.82	3.07	19.73	0.93
9/25/2018	9:46:14	1.07	8.58	3.27	19.75	0.92
9/25/2018	9:47:14	0.89	9.95	3.32	19.76	0.91
9/25/2018	9:48:14	1.10	8.21	3.43	19.72	0.93
9/25/2018	9:49:14	1.20	9.85	3.60	19.73	0.92
9/25/2018	9:50:14	1.19	8.97	3.60	19.73	0.93
9/25/2018	9:51:14	1.17	9.03	3.22	19.75	0.91
9/25/2018	9:52:14	0.95	9.33	3.02	19.76	0.91
9/25/2018	9:53:14	1.05	8.48	3.21	19.76	0.92
9/25/2018	9:54:14	1.19	9.83	3.51	19.75	0.92
9/25/2018	9:55:14	1.19	8.28	3.58	19.74	0.92

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	9:56:14	1.14	10.19	3.33	19.76	0.91
9/25/2018	9:57:14	0.90	9.19	3.44	19.76	0.92
9/25/2018	9:58:14	0.95	9.29	3.38	19.75	0.92
9/25/2018	9:59:14	1.19	9.48	3.39	19.73	0.94
9/25/2018	10:00:14	1.19	8.48	3.42	19.84	0.94
9/25/2018	10:01:14	1.19	9.72	3.20	19.97	0.93
9/25/2018	10:02:14	1.00	8.14	3.07	19.97	0.94
9/25/2018	10:03:14	1.05	9.54	3.07	19.99	0.92
9/25/2018	10:04:14	0.89	8.70	3.00	19.98	0.92
9/25/2018	10:05:14	1.14	8.77	2.94	19.96	0.93
9/25/2018	10:06:14	1.14	9.35	2.93	19.98	0.92
9/25/2018	10:07:14	1.00	8.10	2.82	19.98	0.93
9/25/2018	10:08:14	1.00	9.61	2.93	19.97	0.93
9/25/2018	10:09:14	1.03	7.92	3.12	19.96	0.93
9/25/2018	10:10:14	1.19	9.69	3.08	19.96	0.92
9/25/2018	10:11:14	1.19	7.93	2.91	19.96	0.92
9/25/2018	10:12:14	1.04	9.64	2.82	20.00	0.90
9/25/2018	10:13:14	0.89	7.89	2.94	19.98	0.91
9/25/2018	10:14:14	1.15	9.44	2.85	19.95	0.92
9/25/2018	10:15:14	1.19	8.76	2.97	19.96	0.92
9/25/2018	10:16:14	1.20	8.76	3.03	19.95	0.92
9/25/2018	10:17:14	1.10	8.80	2.94	19.97	0.91
9/25/2018	10:18:14	0.90	8.49	2.95	19.97	0.91
9/25/2018	10:19:14	0.90	9.06	3.07	19.97	0.91
9/25/2018	10:20:14	0.91	8.28	3.26	19.98	0.91
9/25/2018	10:21:14	1.01	9.34	3.34	19.96	0.93
9/25/2018	10:22:14	1.11	8.29	3.29	19.96	0.93
9/25/2018	10:23:14	0.95	9.22	3.20	19.96	0.93
9/25/2018	10:24:14	0.96	8.28	3.20	19.95	0.94
9/25/2018	10:25:14	1.00	9.33	2.98	19.96	0.94
9/25/2018	10:26:14	1.11	8.21	2.86	19.95	0.95
9/25/2018	10:27:14	1.05	9.22	2.82	19.95	0.95
9/25/2018	10:28:14	0.91	8.23	2.87	19.96	0.94
9/25/2018	10:29:14	0.90	9.35	3.07	19.94	0.95
9/25/2018	10:30:14	1.11	8.56	3.32	19.95	0.94
9/25/2018	10:31:14	0.95	9.21	3.13	19.97	0.93
9/25/2018	10:32:14	0.90	8.39	3.14	19.95	0.93
9/25/2018	10:33:14	0.90	8.99	3.16	19.96	0.93
9/25/2018	10:34:14	0.91	8.35	3.06	19.95	0.93
9/25/2018	10:35:14	1.00	8.68	2.94	19.94	0.93
9/25/2018	10:36:14	1.20	8.58	2.94	19.94	0.94
9/25/2018	10:37:14	0.99	8.38	2.94	19.95	0.93

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	10:38:14	0.89	8.98	3.07	19.95	0.92
9/25/2018	10:39:14	1.06	7.95	3.14	19.93	0.93
9/25/2018	10:40:14	1.21	9.14	2.94	19.93	0.93
9/25/2018	10:41:14	0.91	7.72	2.81	19.94	0.94
9/25/2018	10:42:14	1.11	9.46	2.81	19.93	0.95
9/25/2018	10:43:14	1.16	7.87	2.89	19.94	0.94
9/25/2018	10:44:14	0.92	9.22	2.94	19.96	0.92
9/25/2018	10:45:14	0.92	8.04	2.99	19.94	0.94
9/25/2018	10:46:14	1.10	9.11	3.20	19.88	0.94
9/25/2018	10:47:14	0.91	8.55	3.32	19.87	0.94
9/25/2018	10:48:14	0.91	8.75	3.23	19.87	0.94
9/25/2018	10:49:14	1.15	9.34	3.34	19.86	0.94
9/25/2018	10:50:14	1.20	8.97	3.47	19.87	0.94
9/25/2018	10:51:14	1.21	9.65	3.44	19.85	0.95
9/25/2018	10:52:14	1.20	8.33	3.20	19.86	0.94
9/25/2018	10:53:14	1.20	9.57	3.20	19.86	0.94
9/25/2018	10:54:14	1.20	7.72	3.02	19.87	0.93
9/25/2018	10:55:14	1.19	9.72	3.05	19.85	0.93
9/25/2018	10:56:14	1.21	8.95	3.22	19.83	0.94
9/25/2018	10:57:14	1.19	9.31	3.32	19.82	0.93
9/25/2018	10:58:14	1.20	8.95	3.19	19.84	0.92
9/25/2018	10:59:14	1.19	8.02	3.09	19.83	0.93
9/25/2018	11:00:14	1.19	9.47	3.14	19.84	0.92
9/25/2018	11:01:14	1.19	8.29	3.19	19.86	0.91
9/25/2018	11:02:14	1.18	8.78	3.24	19.85	0.92
9/25/2018	11:03:14	1.18	9.19	3.47	19.85	0.91
9/25/2018	11:04:14	1.19	7.73	3.71	19.83	0.93
9/25/2018	11:05:14	1.19	9.47	3.55	19.83	0.92
9/25/2018	11:06:14	1.19	8.23	3.34	19.84	0.91
9/25/2018	11:07:14	1.19	8.61	3.20	19.84	0.92
9/25/2018	11:08:14	1.19	9.21	3.21	19.83	0.92
9/25/2018	11:09:14	1.19	7.62	3.33	19.84	0.93
9/25/2018	11:10:14	1.18	9.25	3.22	19.84	0.93
9/25/2018	11:11:14	1.19	8.66	3.12	19.84	0.92
9/25/2018	11:12:14	1.18	7.85	3.01	19.84	0.93
9/25/2018	11:13:14	1.17	9.18	2.96	19.84	0.93
9/25/2018	11:14:14	1.18	8.17	3.07	19.88	0.93
9/25/2018	11:15:14	1.19	8.16	3.19	19.86	0.91
9/25/2018	11:16:14	1.19	9.17	3.10	19.86	0.91
9/25/2018	11:17:14	1.19	8.04	3.20	19.86	0.91
9/25/2018	11:18:14	1.19	8.54	3.33	19.86	0.91
9/25/2018	11:19:14	1.18	8.93	3.32	19.88	0.90

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	11:20:14	1.18	7.91	3.20	19.87	0.90
9/25/2018	11:21:14	1.18	8.93	3.31	19.86	0.90
9/25/2018	11:22:14	1.18	8.94	3.24	19.85	0.90
Final Average		**1.11**	**9.01**	**3.18**	**19.85**	**0.93**
Bias Check						
9/25/2018	11:41:14	-0.01	2.52	11.97	3.21	0.07
9/25/2018	11:41:24	-0.02	1.39	11.97	3.21	0.07
9/25/2018	11:41:34	0.00	0.74	11.96	3.22	0.07
9/25/2018	11:41:44	-0.01	0.38	11.97	3.21	0.07
9/25/2018	11:41:54	0.00	-0.08	12.04	3.21	0.07
9/25/2018	11:42:04	-0.02	0.02	12.37	3.21	0.07
9/25/2018	11:42:14	-0.01	1.16	12.38	3.37	0.07
9/25/2018	11:42:24	0.00	2.76	12.37	8.87	0.40
9/25/2018	11:42:34	-0.03	3.70	12.37	6.78	0.31
9/25/2018	11:42:44	0.00	3.77	12.38	3.89	0.22
9/25/2018	11:42:54	0.27	3.04	12.37	2.85	0.65
9/25/2018	11:43:04	0.27	1.82	12.37	2.64	1.24
9/25/2018	11:43:14	0.29	1.00	12.38	2.57	1.59
9/25/2018	11:43:24	0.24	0.08	12.37	2.53	1.72
9/25/2018	11:43:34	-0.02	-0.39	12.37	2.52	1.77
9/25/2018	11:43:44	0.02	0.29	12.36	2.52	1.79
9/25/2018	11:43:54	0.22	2.04	12.36	2.52	1.80
9/25/2018	11:44:04	-0.02	2.89	12.36	2.51	1.81
9/25/2018	11:44:14	-0.03	2.36	12.37	2.51	1.81
9/25/2018	11:44:24	-0.02	1.22	5.69	2.51	1.81
9/25/2018	11:44:34	-0.03	0.18	1.25	3.66	3.18
9/25/2018	11:44:44	-0.01	-0.42	1.25	7.50	7.34
9/25/2018	11:44:54	-0.02	-0.46	1.25	9.07	8.75
9/25/2018	11:45:04	-0.02	-0.35	1.25	9.65	9.28
9/25/2018	11:45:14	0.00	0.30	1.25	9.88	9.45
9/25/2018	11:45:24	-0.03	1.74	1.26	9.96	9.51
9/25/2018	11:45:34	-0.01	1.97	0.93	10.00	9.54
9/25/2018	11:45:44	-0.01	1.08	0.19	10.00	9.56
9/25/2018	11:45:54	-0.01	0.24	0.19	10.00	9.56
9/25/2018	11:46:04	-0.01	-0.84	0.20	10.01	9.56
9/25/2018	11:46:14	-0.01	-1.42	0.19	10.01	9.57
9/25/2018	11:46:24	-0.02	-1.29	0.19	10.01	9.58
9/25/2018	11:46:34	-0.02	-1.65	0.19	10.02	9.58
9/25/2018	11:46:44	-0.02	-0.64	0.19	9.99	9.58
9/25/2018	11:46:54	-0.03	0.96	0.06	9.97	9.59
9/25/2018	11:47:04	-0.01	1.62	0.07	9.97	9.59

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	11:47:14	-0.02	0.63	0.05	9.97	9.60
9/25/2018	11:47:24	-0.02	-0.13	0.07	9.97	9.59
9/25/2018	11:47:34	-0.02	-0.88	0.06	9.98	9.59
9/25/2018	11:47:44	-0.01	-1.40	0.07	9.93	9.56
9/25/2018	11:47:54	-0.02	-1.53	0.05	6.99	6.08
9/25/2018	11:48:04	-0.01	-1.49	0.06	3.96	3.01
9/25/2018	11:48:14	-0.01	0.32	0.07	3.07	2.32
9/25/2018	11:48:24	-0.03	2.46	0.06	2.77	2.02
9/25/2018	11:48:34	-0.01	2.90	0.06	2.78	1.90
9/25/2018	11:48:44	-0.03	2.36	0.07	8.91	1.51
9/25/2018	11:48:54	-0.04	1.75	0.06	8.90	1.17
9/25/2018	11:49:04	-0.01	1.78	0.07	3.90	0.77
9/25/2018	11:49:14	0.28	2.12	0.13	1.89	0.39
9/25/2018	11:49:24	0.28	2.41	0.18	1.22	0.22
9/25/2018	11:49:34	0.63	2.64	0.20	0.99	0.15
9/25/2018	11:49:44	1.58	4.51	0.20	0.90	0.12
9/25/2018	11:49:54	2.80	6.97	0.18	0.87	0.12
9/25/2018	11:50:04	3.43	7.60	0.21	0.86	0.11
9/25/2018	11:50:14	4.20	7.12	0.19	0.85	0.11
9/25/2018	11:50:24	4.47	6.16	0.25	0.85	0.10
9/25/2018	11:50:34	4.46	5.29	0.72	0.85	0.10
9/25/2018	11:50:44	4.50	5.00	0.73	0.84	0.10
9/25/2018	11:50:54	4.51	4.43	0.73	0.84	0.10
9/25/2018	11:51:04	4.81	4.65	0.73	0.84	0.10
9/25/2018	11:51:14	4.79	5.84	0.73	0.84	0.10
9/25/2018	11:51:24	4.79	7.43	0.72	0.84	0.09
9/25/2018	11:51:34	4.79	7.81	0.72	0.84	0.10
9/25/2018	11:51:44	4.79	7.18	0.20	0.84	0.09
9/25/2018	11:51:54	4.77	6.21	0.07	0.83	0.10
9/25/2018	11:52:04	4.80	5.26	0.06	0.84	0.09
9/25/2018	11:52:14	4.77	5.05	0.06	0.87	0.09
9/25/2018	11:52:24	4.81	4.75	0.06	1.96	0.32
9/25/2018	11:52:34	5.04	5.17	0.05	1.37	0.34
9/25/2018	11:52:44	4.76	9.62	0.07	1.02	0.18
9/25/2018	11:52:54	5.18	15.93	0.13	0.79	0.11
9/25/2018	11:53:04	12.30	20.49	0.19	0.38	0.08
9/25/2018	11:53:14	19.14	22.80	0.19	0.17	0.06
9/25/2018	11:53:24	21.49	24.07	0.20	0.09	0.05
9/25/2018	11:53:34	23.99	24.07	0.20	0.06	0.06
9/25/2018	11:53:44	24.59	23.75	0.21	0.05	0.06
9/25/2018	11:53:54	25.13	24.17	0.20	0.04	0.05
9/25/2018	11:54:04	25.14	24.56	0.19	0.04	0.05

Hollingsworth & Vose
CFU-113 (2)
Test Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	11:54:14	25.12	26.61	0.18	0.04	0.06
9/25/2018	11:54:24	25.10	27.44	0.19	0.04	0.06
9/25/2018	11:54:34	25.10	26.91	0.19	0.03	0.05
9/25/2018	11:54:44	25.11	25.87	0.19	0.03	0.06
9/25/2018	11:54:54	25.15	25.17	0.19	0.04	0.06
9/25/2018	11:55:04	25.44	24.53	0.19	0.03	0.05
9/25/2018	11:55:14	25.44	24.30	0.07	0.03	0.04
9/25/2018	11:55:24	25.42	24.42	0.07	0.03	0.05
9/25/2018	11:55:34	25.43	25.54	0.06	0.03	0.05
9/25/2018	11:55:44	25.42	27.01	0.05	0.04	0.06
9/25/2018	11:55:54	25.44	27.37	0.07	1.60	0.14
9/25/2018	11:56:04	25.42	26.38	0.06	10.00	0.53
9/25/2018	11:56:14	24.98	23.09	0.05	15.40	0.74
9/25/2018	11:56:24	20.58	18.70	0.06	17.81	0.83
9/25/2018	11:56:34	16.63	13.88	0.07	18.87	0.88
9/25/2018	11:56:44	10.63	10.52	0.06	19.32	0.89
9/25/2018	11:56:54	4.65	9.01	0.06	19.53	0.89
9/25/2018	11:57:04	3.21	9.86	0.05	19.61	0.89
9/25/2018	11:57:14	1.80	10.76	0.07	19.66	0.90
9/25/2018	11:57:24	1.43	10.51	0.05	19.68	0.90
9/25/2018	11:57:34	1.18	9.53	0.06	19.69	0.90
9/25/2018	11:57:44	1.18	8.29	0.69	19.69	0.90
9/25/2018	11:57:54	1.17	7.84	2.15	19.69	0.91
9/25/2018	11:58:04	1.16	7.17	2.14	19.70	0.89

	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
System Zero	**-0.02**	**-0.13**	**0.07**	**0.03**	**0.05**
System Mid	**4.79**	**24.75**	**12.36**	**9.97**	**1.81**

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	12:00:14	1.17	8.92	3.45	19.71	0.91
9/25/2018	12:01:14	1.17	8.89	3.27	19.70	0.91
9/25/2018	12:02:14	1.18	7.70	3.19	19.71	0.91
9/25/2018	12:03:14	1.17	8.83	3.15	19.72	0.90
9/25/2018	12:04:14	1.16	8.76	3.08	19.71	0.90
9/25/2018	12:05:14	1.17	7.82	3.19	19.72	0.90
9/25/2018	12:06:14	1.17	8.60	3.43	19.72	0.90
9/25/2018	12:07:14	1.17	9.09	3.38	19.71	0.90
9/25/2018	12:08:14	1.12	7.99	3.15	19.73	0.88
9/25/2018	12:09:14	1.13	8.27	2.94	19.72	0.89
9/25/2018	12:10:14	1.17	9.16	2.94	19.71	0.90
9/25/2018	12:11:14	1.18	8.35	2.93	19.73	0.89
9/25/2018	12:12:14	1.02	8.14	2.93	19.74	0.89
9/25/2018	12:13:14	1.17	9.15	2.93	19.71	0.90
9/25/2018	12:14:14	1.17	8.39	2.94	19.72	0.90
9/25/2018	12:15:14	1.16	7.90	2.92	19.71	0.91
9/25/2018	12:16:14	1.17	9.26	2.81	19.83	0.90
9/25/2018	12:17:14	1.01	8.60	2.93	19.74	0.91
9/25/2018	12:18:14	1.16	7.88	2.85	19.73	0.92
9/25/2018	12:19:14	1.17	9.08	2.87	19.87	0.91
9/25/2018	12:20:14	1.17	8.91	2.93	19.75	0.92
9/25/2018	12:21:14	1.16	7.85	2.93	19.75	0.92
9/25/2018	12:22:14	1.18	9.30	2.80	19.75	0.92
9/25/2018	12:23:14	1.16	8.79	2.91	19.76	0.91
9/25/2018	12:24:14	1.17	7.98	3.01	19.76	0.91
9/25/2018	12:25:14	1.17	9.05	3.07	19.77	0.91
9/25/2018	12:26:14	1.17	9.02	3.08	19.75	0.91
9/25/2018	12:27:14	1.17	7.79	3.19	19.62	0.91
9/25/2018	12:28:14	1.17	8.94	3.46	19.78	0.90
9/25/2018	12:29:14	1.17	9.14	3.16	19.91	0.91
9/25/2018	12:30:14	1.16	8.14	3.13	19.92	0.90
9/25/2018	12:31:14	1.18	8.88	3.23	19.82	0.91
9/25/2018	12:32:14	1.17	9.04	3.30	19.88	0.89
9/25/2018	12:33:14	1.17	8.21	3.19	20.37	0.88
9/25/2018	12:34:14	1.17	8.26	3.07	19.83	0.89
9/25/2018	12:35:14	1.17	9.25	3.15	19.80	0.90
9/25/2018	12:36:14	1.18	8.60	3.19	19.80	0.91
9/25/2018	12:37:14	1.17	8.07	3.22	19.79	0.91
9/25/2018	12:38:14	1.16	9.36	3.32	19.80	0.91
9/25/2018	12:39:14	1.17	8.73	3.07	19.79	0.91
9/25/2018	12:40:14	1.18	7.98	3.07	19.81	0.90
9/25/2018	12:41:14	1.17	9.15	3.07	19.81	0.91

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	12:42:14	1.17	8.62	3.11	19.71	0.92
9/25/2018	12:43:14	1.17	8.07	3.21	19.66	0.92
9/25/2018	12:44:14	1.18	9.29	3.32	19.65	0.92
9/25/2018	12:45:14	1.18	9.06	3.32	19.64	0.92
9/25/2018	12:46:14	1.17	8.12	3.32	19.63	0.91
9/25/2018	12:47:14	1.17	8.68	3.32	19.68	0.92
9/25/2018	12:48:14	1.16	9.09	3.32	19.78	0.91
9/25/2018	12:49:14	1.17	8.46	3.33	19.70	0.92
9/25/2018	12:50:14	1.17	8.40	3.47	19.66	0.92
9/25/2018	12:51:14	1.17	9.37	3.47	19.69	0.91
9/25/2018	12:52:14	1.17	8.72	3.37	19.69	0.90
9/25/2018	12:53:14	1.17	8.02	3.27	19.68	0.90
9/25/2018	12:54:14	1.16	9.17	3.20	19.68	0.90
9/25/2018	12:55:14	1.16	8.71	3.19	19.70	0.90
9/25/2018	12:56:14	1.16	7.70	3.19	19.68	0.90
9/25/2018	12:57:14	1.17	9.06	3.00	19.68	0.88
9/25/2018	12:58:14	1.17	8.83	3.01	19.69	0.88
9/25/2018	12:59:14	1.16	7.90	2.99	19.67	0.89
9/25/2018	13:00:14	1.15	9.07	2.83	19.66	0.90
9/25/2018	13:01:14	1.17	8.83	3.07	19.68	0.89
9/25/2018	13:02:14	1.17	7.94	3.06	19.67	0.90
9/25/2018	13:03:14	1.17	8.77	3.06	19.65	0.91
9/25/2018	13:04:14	1.17	9.15	3.07	19.66	0.91
9/25/2018	13:05:14	1.19	7.91	3.10	19.65	0.91
9/25/2018	13:06:14	1.18	8.58	3.19	19.65	0.92
9/25/2018	13:07:14	1.18	8.98	3.06	19.67	0.91
9/25/2018	13:08:14	1.17	8.17	2.96	19.65	0.92
9/25/2018	13:09:14	1.17	8.07	3.01	19.66	0.91
9/25/2018	13:10:14	1.17	8.95	3.07	19.66	0.91
9/25/2018	13:11:14	1.18	8.38	3.07	19.65	0.92
9/25/2018	13:12:14	1.18	8.21	3.07	19.65	0.92
9/25/2018	13:13:14	1.17	9.42	3.07	19.63	0.93
9/25/2018	13:14:14	1.18	8.66	3.07	19.65	0.91
9/25/2018	13:15:14	1.17	7.87	3.00	19.68	0.90
9/25/2018	13:16:14	1.17	9.09	2.94	19.67	0.90
9/25/2018	13:17:14	1.17	8.90	2.94	19.65	0.90
9/25/2018	13:18:14	1.17	7.90	2.94	19.66	0.90
9/25/2018	13:19:14	1.18	8.84	2.94	19.64	0.90
9/25/2018	13:20:14	1.18	8.79	3.11	19.66	0.89
9/25/2018	13:21:14	1.18	8.13	3.09	19.66	0.89
9/25/2018	13:22:14	1.18	8.32	2.97	19.67	0.89
9/25/2018	13:23:14	1.18	8.79	3.07	19.66	0.90

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	13:24:14	1.18	7.94	2.94	19.64	0.91
9/25/2018	13:25:14	1.19	8.31	3.03	19.64	0.91
9/25/2018	13:26:14	1.17	8.86	2.99	19.66	0.90
9/25/2018	13:27:14	1.17	7.99	2.94	19.66	0.91
9/25/2018	13:28:14	1.18	7.96	2.94	19.65	0.92
9/25/2018	13:29:14	1.18	9.05	2.94	19.63	0.92
9/25/2018	13:30:14	1.18	8.05	2.94	19.66	0.91
9/25/2018	13:31:14	1.18	8.06	3.03	19.64	0.93
9/25/2018	13:32:14	1.18	8.93	3.07	19.65	0.92
9/25/2018	13:33:14	1.18	7.87	3.03	19.65	0.91
9/25/2018	13:34:14	1.19	7.79	2.94	19.65	0.91
9/25/2018	13:35:14	1.19	8.69	2.94	19.64	0.92
9/25/2018	13:36:14	1.19	7.78	2.94	19.65	0.91
9/25/2018	13:37:14	1.18	8.12	2.94	19.65	0.91
9/25/2018	13:38:14	1.18	8.61	2.94	19.66	0.91
9/25/2018	13:39:14	1.18	7.50	2.96	19.65	0.91
9/25/2018	13:40:14	1.18	8.76	3.07	19.64	0.92
9/25/2018	13:41:14	1.18	8.36	3.07	19.64	0.92
9/25/2018	13:42:14	1.18	7.63	3.07	19.66	0.90
9/25/2018	13:43:14	1.13	8.91	3.21	19.66	0.90
9/25/2018	13:44:14	1.08	7.32	3.25	19.67	0.90
9/25/2018	13:45:14	1.15	8.35	3.04	19.66	0.91
9/25/2018	13:46:14	1.14	8.49	2.81	19.66	0.91
9/25/2018	13:47:14	1.14	7.41	2.93	19.63	0.92
9/25/2018	13:48:14	1.20	8.95	3.03	19.65	0.91
9/25/2018	13:49:14	0.99	8.14	3.07	19.66	0.91
9/25/2018	13:50:14	0.90	7.98	3.10	19.66	0.91
9/25/2018	13:51:14	0.89	8.63	3.20	19.66	0.91
9/25/2018	13:52:14	0.99	7.30	3.20	19.65	0.92
9/25/2018	13:53:14	1.14	8.80	3.30	19.63	0.93
9/25/2018	13:54:14	1.14	7.97	3.25	19.64	0.93
9/25/2018	13:55:14	0.99	7.66	3.20	19.65	0.93
9/25/2018	13:56:14	1.09	8.62	3.20	19.65	0.92
9/25/2018	13:57:14	0.89	7.04	3.20	19.65	0.92
9/25/2018	13:58:14	1.09	8.82	3.08	19.62	0.93
9/25/2018	13:59:14	1.19	7.67	2.98	19.64	0.93
9/25/2018	14:00:14	0.90	8.45	2.94	19.66	0.92
9/25/2018	14:01:14	1.00	8.66	2.94	19.64	0.93
9/25/2018	14:02:14	1.20	7.68	2.95	19.64	0.93
9/25/2018	14:03:14	1.14	8.96	3.07	19.63	0.93
9/25/2018	14:04:14	1.19	7.91	2.96	19.62	0.94
9/25/2018	14:05:14	1.19	8.31	3.11	19.63	0.93

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
Final Average		**1.15**	**8.46**	**3.09**	**19.70**	**0.91**
Bias Check						
9/25/2018	14:12:54	0.03	-0.68	12.04	2.56	0.04
9/25/2018	14:13:04	-0.01	0.29	12.04	2.56	0.04
9/25/2018	14:13:14	-0.01	2.25	12.04	2.56	0.04
9/25/2018	14:13:24	-0.01	2.69	12.04	2.57	0.04
9/25/2018	14:13:34	-0.02	2.05	12.04	2.58	0.04
9/25/2018	14:13:44	-0.01	1.02	12.03	2.57	0.04
9/25/2018	14:13:54	-0.01	0.15	12.03	2.58	0.04
9/25/2018	14:14:04	-0.03	-0.19	12.13	2.58	0.04
9/25/2018	14:14:14	-0.02	-0.45	12.18	2.58	0.05
9/25/2018	14:14:24	-0.02	-0.63	12.18	2.57	0.04
9/25/2018	14:14:34	-0.03	-0.77	12.18	2.57	0.04
9/25/2018	14:14:44	-0.04	1.22	12.19	2.53	0.05
9/25/2018	14:14:54	-0.04	2.62	12.17	3.99	0.12
9/25/2018	14:15:04	-0.02	2.66	12.18	8.18	0.37
9/25/2018	14:15:14	-0.03	2.48	12.23	3.66	0.18
9/25/2018	14:15:24	0.27	2.15	12.31	1.72	0.35
9/25/2018	14:15:34	0.28	1.27	12.31	2.02	1.21
9/25/2018	14:15:44	0.26	0.27	12.31	1.30	0.85
9/25/2018	14:15:54	-0.01	-0.50	12.31	0.52	0.36
9/25/2018	14:16:04	-0.02	-0.82	12.31	0.23	0.16
9/25/2018	14:16:14	-0.01	-0.73	12.31	0.11	0.09
9/25/2018	14:16:24	-0.03	0.99	12.28	0.07	0.06
9/25/2018	14:16:34	-0.02	2.48	12.04	0.22	0.24
9/25/2018	14:16:44	-0.01	2.27	12.04	1.05	1.08
9/25/2018	14:16:54	0.00	1.36	12.04	1.25	1.29
9/25/2018	14:17:04	0.00	0.27	12.04	1.73	1.68
9/25/2018	14:17:14	-0.01	-0.39	12.05	1.88	1.79
9/25/2018	14:17:24	-0.01	-0.73	12.04	1.93	1.84
9/25/2018	14:17:34	-0.03	-1.31	12.04	1.94	1.85
9/25/2018	14:17:44	-0.02	-1.42	3.60	1.95	1.85
9/25/2018	14:17:54	-0.02	-0.40	1.66	1.94	1.86
9/25/2018	14:18:04	-0.02	1.55	1.66	1.95	1.86
9/25/2018	14:18:14	-0.02	1.92	1.66	1.99	1.90
9/25/2018	14:18:24	-0.01	1.32	1.66	5.33	5.85
9/25/2018	14:18:34	-0.02	0.58	1.66	8.27	8.49
9/25/2018	14:18:44	-0.02	-0.12	1.67	9.25	9.32
9/25/2018	14:18:54	-0.01	-0.27	1.12	9.59	9.62
9/25/2018	14:19:04	-0.02	-0.84	0.60	9.72	9.72
9/25/2018	14:19:14	-0.01	-1.57	0.60	9.76	9.77

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	14:19:24	-0.01	-1.75	0.60	9.78	9.79
9/25/2018	14:19:34	0.00	-0.17	0.60	9.78	9.80
9/25/2018	14:19:44	-0.01	1.22	0.60	9.78	9.80
9/25/2018	14:19:54	-0.02	0.92	0.60	9.83	9.78
9/25/2018	14:20:04	-0.02	-0.07	0.54	11.12	7.12
9/25/2018	14:20:14	0.00	-0.39	0.34	5.90	3.41
9/25/2018	14:20:24	-0.01	-0.08	0.34	2.23	1.31
9/25/2018	14:20:34	-0.02	1.08	0.34	0.81	0.58
9/25/2018	14:20:44	0.56	1.92	0.34	0.32	0.29
9/25/2018	14:20:54	1.19	2.91	0.34	0.15	0.17
9/25/2018	14:21:04	2.76	4.46	0.34	0.08	0.12
9/25/2018	14:21:14	3.96	6.36	0.35	0.06	0.11
9/25/2018	14:21:24	4.19	7.23	0.21	0.05	0.09
9/25/2018	14:21:34	4.82	6.53	0.20	0.05	0.09
9/25/2018	14:21:44	4.81	5.79	0.19	0.05	0.08
9/25/2018	14:21:54	4.82	5.15	0.20	0.04	0.08
9/25/2018	14:22:04	4.82	4.83	0.20	0.05	0.07
9/25/2018	14:22:14	5.08	4.23	0.20	0.04	0.08
9/25/2018	14:22:24	5.09	4.33	0.19	0.04	0.07
9/25/2018	14:22:34	5.09	4.57	0.12	0.04	0.07
9/25/2018	14:22:44	5.10	6.25	0.07	0.04	0.07
9/25/2018	14:22:54	5.09	7.20	0.07	0.04	0.07
9/25/2018	14:23:04	5.08	7.14	0.07	0.04	0.07
9/25/2018	14:23:14	5.38	6.18	0.07	0.11	0.15
9/25/2018	14:23:24	5.37	5.37	0.06	0.29	0.34
9/25/2018	14:23:34	5.38	6.86	0.07	0.15	0.17
9/25/2018	14:23:44	8.06	11.42	0.07	0.07	0.10
9/25/2018	14:23:54	9.82	16.55	0.07	0.05	0.08
9/25/2018	14:24:04	16.35	20.64	0.07	0.04	0.06
9/25/2018	14:24:14	23.02	24.03	0.07	0.04	0.06
9/25/2018	14:24:24	23.93	26.32	0.07	0.04	0.06
9/25/2018	14:24:34	25.13	26.70	0.07	0.04	0.06
9/25/2018	14:24:44	25.13	26.04	0.08	0.04	0.05
9/25/2018	14:24:54	25.42	25.18	0.06	0.04	0.06
9/25/2018	14:25:04	25.45	24.52	0.06	0.04	0.06
9/25/2018	14:25:14	25.43	24.17	0.07	0.04	0.06
9/25/2018	14:25:24	25.43	23.66	0.06	0.03	0.06
9/25/2018	14:25:34	25.44	23.60	0.07	0.04	0.05
9/25/2018	14:25:44	25.43	24.66	0.07	0.03	0.05
9/25/2018	14:25:54	25.44	26.52	0.07	0.04	0.05
9/25/2018	14:26:04	25.44	27.11	0.07	0.04	0.05
9/25/2018	14:26:14	25.44	26.47	0.07	0.04	0.05

Hollingsworth & Vose
CFU-113 (2)
Test Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	14:26:24	25.44	25.78	0.07	4.74	0.29
9/25/2018	14:26:34	25.45	24.01	0.07	13.75	0.66
9/25/2018	14:26:44	24.24	19.90	0.07	17.57	0.82
9/25/2018	14:26:54	23.93	15.34	0.07	18.95	0.86
9/25/2018	14:27:04	15.17	11.23	0.07	19.45	0.89
9/25/2018	14:27:14	6.01	8.79	0.07	19.62	0.89
9/25/2018	14:27:24	4.18	8.96	0.07	19.68	0.90
9/25/2018	14:27:34	1.85	10.01	0.07	19.72	0.90

	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
System Zero	**-0.01**	**-0.23**	**0.07**	**0.04**	**0.05**
System Mid	**5.09**	**24.93**	**12.31**	**9.78**	**1.86**

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	14:30:14	1.19	8.72	2.85	19.76	0.88
9/25/2018	14:31:14	0.88	7.31	3.20	19.76	0.89
9/25/2018	14:32:14	0.98	8.72	3.09	19.75	0.91
9/25/2018	14:33:14	1.19	8.67	3.41	19.75	0.91
9/25/2018	14:34:14	1.19	7.85	3.48	19.75	0.92
9/25/2018	14:35:14	1.18	8.71	3.30	19.76	0.91
9/25/2018	14:36:14	1.07	8.34	3.20	19.76	0.90
9/25/2018	14:37:14	1.18	7.60	3.33	19.74	0.92
9/25/2018	14:38:14	1.19	8.60	3.22	19.74	0.92
9/25/2018	14:39:14	1.18	8.69	3.36	19.73	0.93
9/25/2018	14:40:14	1.18	7.71	3.37	19.75	0.93
9/25/2018	14:41:14	1.18	8.77	3.24	19.75	0.93
9/25/2018	14:42:14	1.04	8.40	3.47	19.78	0.91
9/25/2018	14:43:14	1.04	7.43	3.23	19.76	0.93
9/25/2018	14:44:14	1.19	8.99	3.20	19.76	0.92
9/25/2018	14:45:14	1.18	8.24	3.20	19.76	0.92
9/25/2018	14:46:14	1.18	7.71	3.23	19.76	0.91
9/25/2018	14:47:14	1.18	8.69	3.32	19.75	0.91
9/25/2018	14:48:14	1.19	8.04	3.20	19.77	0.91
9/25/2018	14:49:14	1.13	7.69	3.10	19.76	0.91
9/25/2018	14:50:14	1.19	8.84	3.07	19.78	0.89
9/25/2018	14:51:14	1.18	8.37	3.12	19.77	0.90
9/25/2018	14:52:14	1.18	7.48	3.20	19.77	0.89
9/25/2018	14:53:14	1.18	8.77	3.20	19.77	0.89
9/25/2018	14:54:14	1.18	7.94	3.20	19.77	0.89
9/25/2018	14:55:14	1.17	7.46	3.00	19.76	0.90
9/25/2018	14:56:14	1.18	8.56	2.88	19.77	0.89
9/25/2018	14:57:14	1.18	8.12	2.90	19.77	0.90
9/25/2018	14:58:14	1.18	7.42	3.07	19.77	0.90
9/25/2018	14:59:14	1.18	8.70	3.07	19.74	0.91
9/25/2018	15:00:14	1.17	8.27	3.18	19.76	0.91
9/25/2018	15:01:14	1.18	7.62	3.20	19.75	0.92
9/25/2018	15:02:14	1.18	8.88	3.14	19.76	0.92
9/25/2018	15:03:14	1.18	8.73	3.04	19.76	0.93
9/25/2018	15:04:14	1.16	7.65	2.95	19.76	0.93
9/25/2018	15:05:14	1.18	9.02	3.32	19.75	0.94
9/25/2018	15:06:14	1.19	8.51	3.45	19.74	0.94
9/25/2018	15:07:14	1.18	7.73	3.48	19.75	0.93
9/25/2018	15:08:14	1.17	8.82	3.52	19.75	0.93
9/25/2018	15:09:14	1.17	8.08	3.56	19.76	0.92
9/25/2018	15:10:14	1.18	7.49	3.34	19.77	0.90
9/25/2018	15:11:14	1.18	8.75	3.47	19.77	0.89

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	15:12:14	1.18	8.27	3.48	19.75	0.89
9/25/2018	15:13:14	1.18	7.33	3.40	19.77	0.88
9/25/2018	15:14:14	1.18	8.58	3.37	19.75	0.89
9/25/2018	15:15:14	1.17	7.94	3.47	19.78	0.87
9/25/2018	15:16:14	1.18	7.25	3.48	19.75	0.88
9/25/2018	15:17:14	1.17	8.49	3.36	19.76	0.87
9/25/2018	15:18:14	1.17	8.14	3.43	19.77	0.86
9/25/2018	15:19:14	1.17	7.12	3.36	19.77	0.86
9/25/2018	15:20:14	1.17	8.35	3.25	19.77	0.86
9/25/2018	15:21:14	1.16	8.35	3.48	19.76	0.87
9/25/2018	15:22:14	1.17	7.24	3.21	19.74	0.88
9/25/2018	15:23:14	1.18	8.52	3.30	19.73	0.89
9/25/2018	15:24:14	1.19	8.23	3.40	19.74	0.89
9/25/2018	15:25:14	1.18	7.09	3.34	19.76	0.88
9/25/2018	15:26:14	1.18	8.50	3.09	19.77	0.88
9/25/2018	15:27:14	1.08	8.03	3.20	19.77	0.88
9/25/2018	15:28:14	1.18	7.16	3.09	19.76	0.90
9/25/2018	15:29:14	1.18	8.43	3.16	19.76	0.90
9/25/2018	15:30:14	1.17	8.16	3.19	19.75	0.90
9/25/2018	15:31:14	1.17	7.32	3.20	19.75	0.91
9/25/2018	15:32:14	1.18	8.65	3.20	19.76	0.90
9/25/2018	15:33:14	1.18	8.24	3.20	19.76	0.90
9/25/2018	15:34:14	1.12	7.34	3.19	19.75	0.90
9/25/2018	15:35:14	1.18	8.25	3.12	19.76	0.90
9/25/2018	15:36:14	1.18	8.53	3.02	19.76	0.89
9/25/2018	15:37:14	1.07	7.01	2.92	19.79	0.87
9/25/2018	15:38:14	1.13	8.30	2.81	19.77	0.88
9/25/2018	15:39:14	1.18	8.40	2.82	19.77	0.88
9/25/2018	15:40:14	1.19	7.12	2.71	19.77	0.88
9/25/2018	15:41:14	1.18	8.42	2.74	19.77	0.88
9/25/2018	15:42:14	1.18	8.25	2.82	19.77	0.88
9/25/2018	15:43:14	1.18	7.32	2.83	19.77	0.88
9/25/2018	15:44:14	1.18	8.60	3.07	19.77	0.89
9/25/2018	15:45:14	1.17	8.13	3.07	19.74	0.91
9/25/2018	15:46:14	1.17	7.47	2.99	19.77	0.89
9/25/2018	15:47:14	1.12	8.38	3.00	19.76	0.90
9/25/2018	15:48:14	1.18	8.27	3.01	19.76	0.89
9/25/2018	15:49:14	1.18	7.27	2.81	19.76	0.90
9/25/2018	15:50:14	1.17	8.32	2.93	19.77	0.89
9/25/2018	15:51:14	1.18	8.12	2.84	19.76	0.90
9/25/2018	15:52:14	1.18	7.20	2.88	19.75	0.91
9/25/2018	15:53:14	1.18	8.18	2.98	19.74	0.91

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	15:54:14	1.18	8.09	3.07	19.77	0.89
9/25/2018	15:55:14	1.17	7.37	3.07	19.77	0.90
9/25/2018	15:56:14	1.17	7.97	2.96	19.77	0.90
9/25/2018	15:57:14	1.18	8.27	3.03	19.77	0.89
9/25/2018	15:58:14	1.17	7.25	3.02	19.76	0.90
9/25/2018	15:59:14	1.17	7.94	2.94	19.77	0.90
9/25/2018	16:00:14	1.18	8.42	2.95	19.77	0.90
9/25/2018	16:01:14	1.18	7.66	3.08	19.74	0.92
9/25/2018	16:02:14	1.17	7.94	3.07	19.77	0.90
9/25/2018	16:03:14	1.17	8.23	3.00	19.78	0.89
9/25/2018	16:04:14	0.92	7.58	2.94	19.78	0.89
9/25/2018	16:05:14	1.17	7.76	2.95	19.75	0.90
9/25/2018	16:06:14	1.18	8.44	2.94	19.75	0.90
9/25/2018	16:07:14	1.17	7.42	3.19	19.76	0.90
9/25/2018	16:08:14	1.18	7.64	3.10	19.76	0.90
9/25/2018	16:09:14	1.18	8.72	3.00	19.75	0.90
9/25/2018	16:10:14	1.17	7.37	2.94	19.76	0.90
9/25/2018	16:11:14	1.17	8.14	2.94	19.76	0.90
9/25/2018	16:12:14	1.17	8.46	2.95	19.76	0.91
9/25/2018	16:13:14	1.18	7.52	3.17	19.75	0.93
9/25/2018	16:14:14	1.17	8.17	3.03	19.74	0.93
9/25/2018	16:15:14	1.18	8.62	3.00	19.75	0.94
9/25/2018	16:16:14	1.19	7.57	3.05	19.76	0.93
9/25/2018	16:17:14	1.20	7.80	2.94	19.75	0.93
9/25/2018	16:18:14	1.19	8.96	2.94	19.74	0.94
9/25/2018	16:19:14	1.18	8.11	3.04	19.76	0.93
9/25/2018	16:20:14	1.17	7.86	2.92	19.77	0.93
9/25/2018	16:21:14	1.17	8.84	2.85	19.75	0.93
9/25/2018	16:22:14	1.17	8.11	2.95	19.74	0.94
9/25/2018	16:23:14	1.17	7.89	3.07	19.76	0.93
9/25/2018	16:24:14	1.18	8.68	3.07	19.75	0.93
9/25/2018	16:25:14	1.17	8.16	2.98	19.74	0.93
9/25/2018	16:26:14	1.17	7.43	2.94	19.75	0.92
9/25/2018	16:27:14	1.17	8.59	2.91	19.75	0.92
9/25/2018	16:28:14	1.17	8.23	2.82	19.78	0.90
9/25/2018	16:29:14	1.08	7.61	2.94	19.77	0.91
9/25/2018	16:30:14	1.17	8.85	2.83	19.74	0.93
9/25/2018	16:31:14	1.18	8.48	2.97	19.73	0.93
9/25/2018	16:32:14	1.17	7.53	3.02	19.75	0.92
9/25/2018	16:33:14	1.18	8.81	2.93	19.77	0.92
9/25/2018	16:34:14	1.18	8.38	2.82	19.76	0.92
9/25/2018	16:35:14	1.17	7.61	2.94	19.75	0.92

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	16:36:14	1.17	8.88	3.14	19.76	0.92
9/25/2018	16:37:14	1.18	8.27	3.06	19.77	0.92
Final Average		**1.16**	**8.09**	**3.11**	**19.76**	**0.90**
Bias Check						
9/25/2018	16:45:14	0.00	-0.70	11.57	2.78	0.06
9/25/2018	16:45:24	0.00	0.20	11.59	2.78	0.05
9/25/2018	16:45:34	-0.01	1.59	11.58	2.78	0.06
9/25/2018	16:45:44	0.00	2.02	11.59	2.78	0.04
9/25/2018	16:45:54	0.00	1.59	11.58	2.85	0.06
9/25/2018	16:46:04	0.01	0.78	11.61	6.16	0.26
9/25/2018	16:46:14	0.00	0.34	11.83	3.42	0.15
9/25/2018	16:46:24	-0.04	0.13	11.84	1.33	0.12
9/25/2018	16:46:34	-0.02	-0.16	11.85	1.58	0.93
9/25/2018	16:46:44	0.00	-0.52	11.84	1.84	1.49
9/25/2018	16:46:54	0.01	-0.51	11.83	1.92	1.72
9/25/2018	16:47:04	0.00	0.60	11.83	1.93	1.80
9/25/2018	16:47:14	-0.02	1.62	11.84	1.94	1.84
9/25/2018	16:47:24	-0.01	1.53	12.38	1.95	1.85
9/25/2018	16:47:34	-0.03	0.55	12.50	1.95	1.85
9/25/2018	16:47:44	0.00	-0.52	12.51	1.95	1.85
9/25/2018	16:47:54	-0.01	-0.92	12.51	1.95	1.85
9/25/2018	16:48:04	-0.01	-1.35	12.52	1.95	1.86
9/25/2018	16:48:14	-0.01	-1.65	12.50	4.37	4.76
9/25/2018	16:48:24	-0.01	-1.71	12.50	7.92	8.18
9/25/2018	16:48:34	-0.01	-1.29	7.39	9.14	9.21
9/25/2018	16:48:44	-0.01	0.04	2.29	9.56	9.57
9/25/2018	16:48:54	-0.01	1.66	2.30	9.70	9.70
9/25/2018	16:49:04	0.00	1.48	2.29	9.75	9.75
9/25/2018	16:49:14	-0.01	0.11	2.30	9.78	9.78
9/25/2018	16:49:24	0.01	-0.86	2.30	9.79	9.78
9/25/2018	16:49:34	0.00	-1.44	2.29	9.79	9.79
9/25/2018	16:49:44	0.00	-1.12	1.95	9.79	9.79
9/25/2018	16:49:54	-0.01	-1.51	0.60	9.80	9.79
9/25/2018	16:50:04	-0.01	-1.51	0.60	9.79	9.79
9/25/2018	16:50:14	-0.01	-1.67	0.60	9.79	9.80
9/25/2018	16:50:24	-0.01	-1.54	0.60	9.82	9.80
9/25/2018	16:50:34	0.02	-1.05	0.61	9.82	9.81
9/25/2018	16:50:44	0.01	0.53	0.60	10.07	9.59
9/25/2018	16:50:54	0.02	0.56	0.61	12.63	6.03
9/25/2018	16:51:04	0.02	-0.28	0.25	6.83	2.96
9/25/2018	16:51:14	0.01	-0.04	0.21	2.57	1.17

Hollingsworth & Vose
CFU-113 (2)
Test Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/25/2018	16:51:24	0.30	0.72	0.21	0.94	0.53
9/25/2018	16:51:34	0.29	1.81	0.21	0.36	0.26
9/25/2018	16:51:44	1.48	2.50	0.19	0.17	0.16
9/25/2018	16:51:54	2.76	3.07	0.19	0.10	0.12
9/25/2018	16:52:04	3.68	3.41	0.20	0.07	0.10
9/25/2018	16:52:14	4.51	4.28	0.11	0.06	0.09
9/25/2018	16:52:24	4.51	6.30	0.06	0.05	0.07
9/25/2018	16:52:34	4.81	7.07	0.08	0.05	0.08
9/25/2018	16:52:44	4.82	6.28	0.07	0.05	0.06
9/25/2018	16:52:54	4.82	5.45	0.07	0.05	0.08
9/25/2018	16:53:04	4.83	4.79	0.07	0.05	0.07
9/25/2018	16:53:14	4.84	4.39	0.07	0.04	0.07
9/25/2018	16:53:24	4.83	3.99	0.07	0.05	0.06
9/25/2018	16:53:34	4.82	3.74	0.08	0.04	0.06
9/25/2018	16:53:44	5.10	4.03	0.08	0.04	0.06
9/25/2018	16:53:54	5.11	3.87	0.08	0.26	0.32
9/25/2018	16:54:04	5.12	6.71	0.07	0.17	0.19
9/25/2018	16:54:14	4.83	11.96	0.07	0.09	0.11
9/25/2018	16:54:24	11.32	17.26	0.07	0.06	0.07
9/25/2018	16:54:34	17.56	20.65	0.07	0.05	0.06
9/25/2018	16:54:44	20.66	22.39	0.06	0.04	0.06
9/25/2018	16:54:54	24.26	23.26	0.06	0.04	0.06
9/25/2018	16:55:04	24.58	23.61	0.07	0.04	0.05
9/25/2018	16:55:14	25.17	23.67	0.07	0.04	0.06
9/25/2018	16:55:24	25.18	23.49	0.08	0.04	0.04
9/25/2018	16:55:34	25.13	23.42	0.07	0.04	0.05
9/25/2018	16:55:44	25.16	23.74	0.08	0.04	0.05
9/25/2018	16:55:54	25.16	25.23	0.07	0.04	0.05
9/25/2018	16:56:04	25.16	26.40	0.08	0.03	0.04
9/25/2018	16:56:14	25.16	26.34	0.07	0.04	0.04
9/25/2018	16:56:24	25.16	25.49	0.07	0.04	0.04
9/25/2018	16:56:34	25.14	24.72	0.07	0.04	0.05

	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
System Zero	**-0.01**	**-1.56**	**0.07**	**0.04**	**0.04**
System Mid	**5.11**	**25.52**	**12.51**	**9.79**	**1.85**

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113 (2)**
DATE	**09/26/18**
METHOD	**13B**
POLLUTANT	**Total Fluoride**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**9:00**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**11:05**
EPA Method:	**13B**	Clear sky, 70+ degrees	**Date:**	**9/26/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.213	Nozzle size	0.2130 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000247 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.85 "Hg	O_2	19.90 %
Static Pressure	-0.28 "H_2O	CO_2	0.70 %
Ave. ΔP	1.35 "H_2O	Rec. Nz.	0.194 inches
Stack Temperature	130 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	9	8

Nozzle check for roundness:

1	2	3
0.213	0.213	0.213 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	111.536 dcf	Ave. ΔP	1.5 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.224 "H_2O
Actual H_2O	1.89 %	Ave. ΔH	2.888 "H_2O
Std. meter vol.	112.642 dscf	Ave. T_s	141.5 °F
Isokinetic Average	100.2 %	Ave. T_m	64.3 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	212	12.0
Silica gel, g	247.0	281	34.0
		Total water gain:	46.0

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	13.770	1.50	139	59	2.85	2.90	4	252	63
2	30.0	27.950	1.60	139	59	3.04	3.00	4	253	54
3	45.0	42.370	1.60	140	62	3.05	3.10	4	256	58
4	60.0	56.338	1.50	141	64	2.87	2.90	4	254	63
5	75.0	69.470	1.30	140	65	2.49	2.50	4	253	65
6	90.0	83.450	1.50	143	67	2.87	2.90	4	252	56
7	105.0	97.000	1.40	145	68	2.68	2.70	4	253	57
8	120.0	111.536	1.60	145	70	3.07	3.10	4	252	58

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:23**
Source:	**CFU 113 (2)**	**End Time:**	**13:28**
EPA Method:	**13B**	**Date:**	**9/26/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Clear sky, 70+ degrees

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.213	Nozzle size:	0.2130 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000247 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.85 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	1.35 "H_2O	Rec. Nz.	0.195 inches
Stack Temperature	130 F		
Assumed moisture	1.89 %		
Assumed meter temp.	64.3 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	10

Nozzle check for roundness:

1	2	3
0.213	0.213	0.213 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	114.430 dcf	Ave. ΔP	1.525 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.2344 "H_2O
Actual H_2O	1.73 %	Ave. ΔH	2.95 "H_2O
Std. meter vol.	113.061 dscf	Ave. T_s	146.4 °F
Isokinetic Average	100.0 %	Ave. T_m	76 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	210	10.0
Silica gel, g	241.1	273.5	32.4
		Total water gain:	42.4

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	13.630	1.40	145	72	2.70	2.70	4	253	60
2	30.0	28.170	1.60	145	73	3.09	3.10	4	254	56
3	45.0	42.880	1.60	145	75	3.11	3.10	4	254	57
4	60.0	57.134	1.50	146	76	2.91	2.90	4	253	58
5	75.0	71.100	1.40	146	78	2.73	2.70	4	255	55
6	90.0	85.150	1.50	148	78	2.91	2.90	4	254	60
7	105.0	99.780	1.60	148	78	3.11	3.10	4	259	62
8	120.0	114.430	1.60	148	78	3.11	3.10	4	254	63

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**13:43**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:48**
EPA Method:	**13B**	Clear sky, 70+ degrees	**Date:**	**9/26/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.213	Nozzle size:	0.2130 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000247 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.85 "Hg	O_2	19.9 %
Static Pressure	-0.28 "H_2O	CO_2	0.7 %
Ave. ΔP	1.35 "H_2O	Rec. Nz.	0.193 inches
Stack Temperature	130 F		
Assumed moisture	1.73 %		
Assumed meter temp.	76 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	8

Nozzle check for roundness:

1	2	3
0.213	0.213	0.213 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	114.245 dcf	Ave. ΔP	1.5 "H_2O
Wet mol. weight	28.74 M_s (actual)	Ave. √ΔP	1.2244 "H_2O
Actual H_2O	1.52 %	Ave. ΔH	2.9 "H_2O
Std. meter vol.	112.068 dscf	Ave. T_s	151.8 °F
Isokinetic Average	100.2 %	Ave. T_m	79.8 °F

Moisture/Lab:

	Initial	Final	Gain
Filter	NA #		
Impingers, g	200.0	210	10.0
Silica gel, g	236.8	263.5	26.7
		Total water gain:	36.7

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	14.210	1.50	149	77	2.91	2.90	4	259	64
2	30.0	28.870	1.60	151	77	3.09	3.10	4	256	59
3	45.0	43.540	1.60	151	79	3.11	3.10	4	252	59
4	60.0	57.822	1.50	152	80	2.91	2.90	4	254	60
5	75.0	72.300	1.50	153	80	2.91	2.90	4	260	60
6	90.0	86.690	1.50	153	80	2.91	2.90	4	255	58
7	105.0	100.380	1.40	152	82	2.73	2.70	4	254	59
8	120.0	114.245	1.40	153	83	2.73	2.70	4	251	60

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:00**
Source:	**CFU 113 (2)**	**End Time:**	**11:05**
Method:	**13B**	**Date:**	**9/26/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
15	13.770	2.90	59	1	1.50	139	1.2247
30	27.950	3.00	59	2	1.60	139	1.2649
45	42.370	3.10	62	3	1.60	140	1.2649
60	56.338	2.90	64	4	1.50	141	1.2247
75	69.470	2.50	65	5	1.30	140	1.1402
90	83.450	2.90	67	6	1.50	143	1.2247
105	97.000	2.70	68	7	1.40	145	1.1832
120	111.536	3.10	70	8	1.60	145	1.2649

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113 (2)**	**Date:**	**09/26/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	111.536	dcf	Rectangular		
Water Volume	46.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.96	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.11	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.888	"H_2O	√Dp	1.2240	"H_2O
Temperature, T_m	64.3	^oF	Temperature, T_s	141.5	^oF
Temperature, T_m	524.3	^oA (^oR)	Temperature, T_s	601.5	^oA (R)
Pressure Meter, P_m	30.062	"Hg	Pressure Stack, P_s	29.829	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	112.642	dscf	Velocity, V_s	73.61	fps
	3.190	dscm	Volume (actual)	9,637.0	awcfm
Actual Volume, $V_{m(actual)}$	131.245	awcf		9,454.9	adcfm
Gas Stream Moisture			Volume (standard)	506,022.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.165	scf		496,458.3	dscf/hr
Moisture, B_{ws}	0.0189			8,274.3	dscf/min
Moisture EPA M4	1.89	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	440.238	
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.75	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	< 4.11E-06	gr/dscf
	< 9.40	µg/dscm
	< 1.19E-02	ppmvd
Mass Emissions	< 2.91E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:23**
Source:	**CFU 113 (2)**	**End Time:**	**13:28**
Method:	**13B**	**Date:**	**09/26/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
15	13.630	2.70	72	1	1.40	145	1.1832
30	28.170	3.10	73	2	1.60	145	1.2649
45	42.880	3.10	75	3	1.60	145	1.2649
60	57.134	2.90	76	4	1.50	146	1.2247
75	71.100	2.70	78	5	1.40	146	1.1832
90	85.150	2.90	78	6	1.50	148	1.2247
105	99.780	3.10	78	7	1.60	148	1.2649
120	114.430	3.10	78	8	1.60	148	1.2649

Client:	**Hollingsworth & Vose**		**Run:**		**2**
Source:	**CFU 113 (2)**		**Date:**	**09/26/18**	

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	114.430	dcf	Rectangular		
Water Volume	42.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.98	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.21	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.950	"H_2O	$\sqrt{Dp}$	1.2344	"H_2O
Temperature, T_m	76.0	^oF	Temperature, T_s	146.4	^oF
Temperature, T_m	536.0	^oA (^oR)	Temperature, T_s	606.4	^oA (R)
Pressure Meter, P_m	30.067	"Hg	Pressure Stack, P_s	29.829	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	113.061	dscf	Velocity, V_s	74.50	fps
	3.202	dscm	Volume (actual)	9,753.5	awcfm
Actual Volume, $V_{m(actual)}$	132.591	awcf		9,584.8	adcfm
Gas Stream Moisture			Volume (standard)	508,001.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.995	scf		499,213.5	dscf/hr
Moisture, B_{ws}	0.0173			8,320.2	dscf/min
Moisture EPA M4	1.73	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	443.825	
Dry, M_d	28.97	lb/lb-mole			
Wet, M_s	28.78	lb/lb-mole			
Percent Isokinetic	100.1	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	< 4.09E-06	gr/dscf
	< 9.37	µg/dscm
	< 1.19E-02	ppmvd
Mass Emissions	< 2.92E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**13:43**
Source:	**CFU 113 (2)**	**End Time:**	**15:48**
Method:	**13B**	**Date:**	**09/26/18**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
15	14.210	2.90	77	1	1.50	149	1.2247
30	28.870	3.10	77	2	1.60	151	1.2649
45	43.540	3.10	79	3	1.60	151	1.2649
60	57.822	2.90	80	4	1.50	152	1.2247
75	72.300	2.90	80	5	1.50	153	1.2247
90	86.690	2.90	80	6	1.50	153	1.2247
105	100.380	2.70	82	7	1.40	152	1.1832
120	114.245	2.70	83	8	1.40	153	1.1832

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 113 (2)**	**Date:**	**09/26/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	114.245	dcf	Rectangular		
Water Volume	36.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.97	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.17	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.900	"H_2O	√Dp	1.2244	"H_2O
Temperature, T_m	79.8	^oF	Temperature, T_s	151.8	^oF
Temperature, T_m	539.8	^oA (^oR)	Temperature, T_s	611.8	^oA (R)
Pressure Meter, P_m	30.063	"Hg	Pressure Stack, P_s	29.829	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	112.068	dscf	Velocity, V_s	74.21	fps
	3.173	dscm	Volume (actual)	9,715.6	awcfm
Actual Volume, $V_{m(actual)}$	132.314	awcf		9,567.9	adcfm
Gas Stream Moisture			Volume (standard)	501,558.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.727	scf		493,934.4	dscf/hr
Moisture, B_{ws}	0.0152			8,232.2	dscf/min
Moisture EPA M4	1.52	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	447.777	
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.79	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

Fluoride	< 30.0	µg/sample			
Fluoride	< 3.00E-05	grams	MW F	19.0	g/mole
Emissions:					
Concentration, C_s	< 4.13E-06	gr/dscf			
	< 9.45	µg/dscm			
	< 1.20E-02	ppmvd			
Mass Emissions	< 2.91E-04	lb/hr			

"<" represents MDL value

EPA Method 13B
Laboratory Results
Total Fluoride

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 113 (2)**

Lab ID	Sample ID	Sample Date		Result	MDL	Units
18-S2337	Cont. 1 Run 1	9/26/2018	<	MDL	30.0	µg/sample
18-S2338	Cont. 1 Run 2	9/26/2018	<	MDL	30.0	µg/sample
18-S2339	Cont. 1 Run 3	9/26/2018	<	MDL	30.0	µg/sample
18-S2210	H20 + Filter Blank		<	MDL	30.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 13B
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113 (2)

Run			1	2	3	Average
Date			9/26/2018	9/26/2018	9/26/2018	
Run Start Time			9:00	11:23	13:43	
Run End Time			11:05	13:28	15:48	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.85	29.85	29.85	**29.85**
Nozzle Dia., in.			0.2130	0.2130	0.2130	**0.2130**
Isokinetic Average, %			100.3	100.1	100.3	**100.2**
Sample Volume, dscf			112.642	113.061	112.068	**112.590**
Sample Volume, dscm			3.190	3.202	3.173	**3.188**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			0.96	0.98	0.97	**0.97**
O_2 %vd			20.11	20.21	20.17	**20.16**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			1.89	1.73	1.52	**1.71**
Wet Molecular Weight, lb/lb-mole			28.75	28.78	28.79	**28.77**
Velocity, FPS			73.61	74.50	74.21	**74.11**
ADCFM			9,454.9	9,584.8	9,567.9	**9,535.9**
AWCFM			9,637.0	9,753.5	9,715.6	**9,702.0**
DSCFM			8,274.3	8,320.2	8,232.2	**8,275.6**
Stack Temperature, ^oF			141.5	146.4	151.8	**146.6**
Fluoride	Concentration, C_s	gr/dscf	< 4.11E-06	< 4.09E-06	< 4.13E-06	< **4.11E-06**
		µg/dscm	< 9.40	< 9.37	< 9.45	< **9.41**
		ppmvd	< 1.19E-02	< 1.19E-02	< 1.20E-02	< **1.19E-02**
	Mass	lb/hr	< 2.91E-04	< 2.92E-04	< 2.91E-04	< **2.92E-04**
		lb/lb glass	< 8.00E-08	< 8.01E-08	< 7.89E-08	< **7.97E-08**
Production Data	Glass Production	lbs/hr	3642.2	3645.4	3695.0	**3660.9**

"<" represents MDL value

EPA Methods 1-4, 13B
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:00**
Source:	**CFU 113 (2)**	**End Time:**	**11:05**
Method:	**13B**	**Date:**	**9/26/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.062 "Hg
- where Pb: 29.85 "Hg
- ΔH: 2.888 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.829 "Hg
- where Pb: 29.85 "Hg
- Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 112.642 dscf
- where Vm: 111.536 dcf
- Y: 0.9985
- Pm: 30.062 "Hg
- Tm: 524.3 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.165 scf
- where H_2O: 46.00 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0189
- where Vw(std): 2.165 scf
- Vm(std): 112.642 dscf

6) $\% H_2O = Bws \times 100 =$ 1.89 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 131.245 awcf
- where Y: 0.9985
- Vm: 111.5359 dcf
- Bws: 0.0189
- Ts: 601.5 °A
- Tm: 524.3 °A
- Pm: 30.062 "Hg
- Ps: 29.829 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.96 lb/lb-mole
- where CO_2: 0.96 %vd
- O_2 20.11 %vd
- N_2+CO= (100-(O_2+CO_2): 78.93 %vd

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113 (2)**	**Date:**	**9/26/2018**

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.75 lb/lb-mole

where M_d: 28.96 lb/lb-mole

Bws: 0.0189

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 2.182 sq. ft.

where Stack ID: 20 inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.

where Stack Width: 0.000 inches

Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 73.61 fps

where Cp: 0.84

Ave. Sqrt ΔP: 1.2240

Ts: 601.5 °A

Ps: 29.829 "Hg

Ms: 28.75 lb/lb-mole

12) $\text{AWCFM} = (V_s)\text{(stack area)(60 sec/min)} =$ 9,637.0 AWCFM

where V_s: 73.61 ft/sec

Stack Area: 2.182 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 9,454.9 ADCFM

where AWCFM: 9,637.0

Bws: 0.0189

14) $\text{Qsw} = 3600(V_s)\text{(stack area)}\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 506,022.1 wscf/hr

where V_s: 73.61 ft/sec

Stack Area: 2.1820 sq. ft.

Ts: 601.5 °A

Ps: 29.829 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 496,458.3 dscf/hr

where wscf/hr: 506,022.1

Bws: 0.0189

16) DSCFM= (dscf/hr)/60 mins/hr = 8,274.3 DSCFM

where dscf/hr: 496,458.3

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000247 sq. ft.

where Nozzle Size: 0.2130 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113 (2)**	**Date:**	**9/26/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.3 %

where Ts:	601.5	°A
Vm(Std):	112.642	dscf
Ps:	29.829	"Hg
Vs	73.61	ft/sec
Nozzle Area:	0.000247	sq. ft.
Sampling Time:	120	min.
Bws:	0.0189	

EPA Method 13B:

19) Fluoride laboratory results < 30.0 µg/sample

20) Fluoride = (µg/sample)/1,000,000 = < 3.00E-05 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 4.11E-06 gr/dscf

where Sample:	0.00003	grams
Vm(std)	112.642	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 9.40 µg/dscm

where Sample:	0.00003	grams
Vm(std)	3.190	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 440.238 Vol./Mole

where Ts:	601.5	°A
Ps:	29.829	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.19E-02 ppmvd

where MW:	19.0	g/mol
lb/hr:	0.00	
Vol./Mole:	440.238	
ADCFM:	9454.9	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 2.91E-04 lb/hr

where Cs:	4.11E-06	gr/dscf
Stack Flow:	496,458.3	dscf/hr

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 113 (2)**
DATE	**09/26/18**
METHOD	**26A**
POLLUTANT	**HF**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**8:59**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**11:04**
EPA Method:	**26A**	Clear 75F 2-3 mph East	**Date:**	**9/26/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.216	Nozzle size	0.2157 inches
ΔH@	1.846	Hot box ID	HLN1	Nozzle area	0.000254 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.85 "Hg	O_2	19.80 %
Static Pressure	-0.28 "H_2O	CO_2	0.60 %
Ave. ΔP	1.5 "H_2O	Rec. Nz.	0.19 inches
Stack Temperature	136 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	X
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	15	15

Nozzle check for roundness:

1	2	3
0.215	0.215	0.217 inches
	Caliper ID#	MN#2

Post Test Calculations:

Sample volume	112.559 dcf	Ave. ΔP	1.463 "H_2O
Wet mol. weight	28.67 M_s (actual)	Ave. √ΔP	1.2081 "H_2O
Actual H_2O	1.98 %	Ave. ΔH	3.15 "H_2O
Std. meter vol.	114.078 dscf	Ave. T_s	140.9 °F
Isokinetic Average	100.0 %	Ave. T_m	64 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	257.7	286.7	29.0
		Total water gain:	49.0

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	15.0	14.630	1.60	138	57	3.27	3.30	3	252	51
2	30.0	28.680	1.50	138	59	3.08	3.10	2	251	63
3	45.0	42.150	1.30	139	62	2.68	2.70	2	251	65
4	60.0	55.441	1.30	140	64	2.68	3.70	2	251	49
5	75.0	70.070	1.60	140	65	3.31	3.30	3	252	54
6	90.0	84.950	1.60	144	67	3.30	3.30	3	251	50
7	105.0	99.410	1.50	144	69	3.11	3.10	3	251	50
8	120.0	112.559	1.30	144	69	2.69	2.70	3	251	50

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**11:22**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**13:27**
EPA Method:	**26A**	Clear 75F 2-3 mph East	**Date:**	**9/26/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular	
Diameter	20.000 in
Rectangular	
Width	in
Length	in
Stack Area	2.182 sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.216	Nozzle size:	0.2157 inches
ΔH@	1.846	Hot box ID	HLN1	Nozzle area:	0.000254 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.85 "Hg	O_2	19.8 %
Static Pressure	-0.28 "H_2O	CO_2	0.6 %
Ave. ΔP	1.5 "H_2O	Rec. Nz.	0.191 inches
Stack Temperature	136 F		
Assumed moisture	1.98 %		
Assumed meter temp.	64 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	6	9

Nozzle check for roundness:

1	2	3
0.215	0.215	0.217 inches
	Caliper ID#	MN#2

Post Test Calculations:

Sample volume	116.860 dcf	Ave. ΔP	1.513 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.2291 "H_2O
Actual H_2O	1.75 %	Ave. ΔH	3.163 "H_2O
Std. meter vol.	115.703 dscf	Ave. T_s	144.8 °F
Isokinetic Average	99.8 %	Ave. T_m	76.4 °F

Moisture/Lab:

	Initial	Final	Gain
Filter	NA #		
Impingers, g	200.0	212	12.0
Silica gel, g	237.7	269.5	31.8
		Total water gain:	43.8

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	14.800	1.60	143	72	3.34	3.30	4	251	52
2	30.0	29.670	1.60	145	73	3.33	3.30	4	248	53
3	45.0	44.260	1.50	143	75	3.15	3.10	4	248	55
4	60.0	58.739	1.50	144	77	3.15	3.20	4	248	55
5	75.0	73.950	1.60	144	78	3.37	3.40	4	248	59
6	90.0	89.060	1.60	146	79	3.36	3.40	4	248	59
7	105.0	103.300	1.40	146	79	2.94	2.90	4	250	61
8	120.0	116.860	1.30	147	78	2.72	2.70	4	250	61

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**13:42**
Source:	**CFU 113 (2)**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:47**
EPA Method:	**26A**	Clear 75F 2-3 mph East	**Date:**	**9/26/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3B	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.216	Nozzle size:	0.2157 inches
ΔH@	1.846	Hot box ID	HLN1	Nozzle area:	0.000254 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.85 "Hg	O_2	19.8 %
Static Pressure	-0.28 "H_2O	CO_2	0.6 %
Ave. ΔP	1.5 "H_2O	Rec. Nz.	0.188 inches
Stack Temperature	136 F		
Assumed moisture	1.75 %		
Assumed meter temp.	76.4 F		
Total number of points	8		
Time per point	15		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	9	10

Nozzle check for roundness:

1	2	3
0.215	0.215	0.217 inches
	Caliper ID#	MN#2

Post Test Calculations:

Sample volume	119.535 dcf	Ave. ΔP	1.538 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.2389 "H_2O
Actual H_2O	1.56 %	Ave. ΔH	3.238 "H_2O
Std. meter vol.	117.669 dscf	Ave. T_s	150.4 °F
Isokinetic Average	101.0 %	Ave. T_m	79.6 °F

Moisture/Lab:

	Initial	Final	Gain
Filter	NA #		
Impingers, g	200.0	208	8.0
Silica gel, g	240.0	271.6	31.6
		Total water gain:	39.6

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	15.0	15.600	1.70	147	78	3.57	3.60	5	253	55
2	30.0	31.250	1.60	150	78	3.35	3.30	5	253	55
3	45.0	45.740	1.40	150	78	2.93	2.90	5	251	55
4	60.0	59.176	1.30	151	78	2.72	2.70	5	251	55
5	75.0	74.330	1.60	150	78	3.35	3.40	5	250	57
6	90.0	89.590	1.60	153	82	3.36	3.40	5	251	63
7	105.0	104.380	1.50	151	82	3.16	3.20	5	251	63
8	120.0	119.535	1.60	151	83	3.37	3.40	5	251	63

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:59**
Source:	**CFU 113 (2)**	**End Time:**	**11:04**
Method:	**26A**	**Date:**	**9/26/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m ^oF	Traverse Point	Dp "H_2O	Stack T_s ^oF	$\sqrt{Dp}$
	0.000						
15	14.630	3.30	57	1	1.60	138	1.2649
30	28.680	3.10	59	2	1.50	138	1.2247
45	42.150	2.70	62	3	1.30	139	1.1402
60	55.441	3.70	64	4	1.30	140	1.1402
75	70.070	3.30	65	5	1.60	140	1.2649
90	84.950	3.30	67	6	1.60	144	1.2649
105	99.410	3.10	69	7	1.50	144	1.2247
120	112.559	2.70	69	8	1.30	144	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113 (2)**	**Date:**	**09/26/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	112.559	dcf	Rectangular		
Water Volume	49.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2157	in.	Length		in
Nozzle Area	0.000254	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.96	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.1	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	3.150	"H_2O	$\sqrt{Dp}$	1.2081	"H_2O
Temperature, T_m	64.0	^oF	Temperature, T_s	140.9	^oF
Temperature, T_m	524.0	^oA (^oR)	Temperature, T_s	600.9	^oA (R)
Pressure Meter, P_m	30.082	"Hg	Pressure Stack, P_s	29.829	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	114.078	dscf	Velocity, V_s	72.63	fps
	3.230	dscm	Volume (actual)	9,508.7	awcfm
Actual Volume, $V_{m(actual)}$	132.908	awcf		9,320.4	adcfm
Gas Stream Moisture			Volume (standard)	499,783.7	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.306	scf		489,888.0	dscf/hr
Moisture, B_{ws}	0.0198			8,164.8	dscf/min
Moisture EPA M4	1.98	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	439.799	
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.74	lb/lb-mole			
Percent Isokinetic	100.1	%			

Laboratory Results

HF	< 4.40	µg/sample			
HF	< 4.40E-06	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	< 5.95E-07	gr/dscf
	< 1.36	µg/dscm
	< 1.64E-03	ppmvd
Mass Emissions HF	< 4.17E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:22**
Source:	**CFU 113 (2)**	**End Time:**	**13:27**
Method:	**26A**	**Date:**	**09/26/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	$\sqrt{Dp}$
	0.000						
15	14.800	3.30	72	1	1.60	143	1.2649
30	29.670	3.30	73	2	1.60	145	1.2649
45	44.260	3.10	75	3	1.50	143	1.2247
60	58.739	3.20	77	4	1.50	144	1.2247
75	73.950	3.40	78	5	1.60	144	1.2649
90	89.060	3.40	79	6	1.60	146	1.2649
105	103.300	2.90	79	7	1.40	146	1.1832
120	116.860	2.70	78	8	1.30	147	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 113 (2)**	**Date:**	**09/26/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	116.860	dcf	Rectangular		
Water Volume	43.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.2157	in.	Length		in
Nozzle Area	0.000254	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.98	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.21	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	3.163	"H_2O	√Dp	1.2291	"H_2O
Temperature, T_m	76.4	^oF	Temperature, T_s	144.8	^oF
Temperature, T_m	536.4	^oA (^oR)	Temperature, T_s	604.8	^oA (R)
Pressure Meter, P_m	30.083	"Hg	Pressure Stack, P_s	29.829	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	115.703	dscf	Velocity, V_s	74.08	fps
	3.276	dscm	Volume (actual)	9,698.6	awcfm
Actual Volume, $V_{m(actual)}$	135.359	awcf		9,528.9	adcfm
Gas Stream Moisture			Volume (standard)	506,474.4	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.061	scf		497,611.1	dscf/hr
Moisture, B_{ws}	0.0175			8,293.5	dscf/min
Moisture EPA M4	1.75	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	442.654	
Dry, M_d	28.97	lb/lb-mole			
Wet, M_s	28.78	lb/lb-mole			
Percent Isokinetic	99.9	%			

Laboratory Results

HF	< 4.05	μg/sample			
HF	< 4.05E-06	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	< 5.40E-07	gr/dscf
	< 1.24	μg/dscm
	< 1.49E-03	ppmvd
Mass Emissions HF	< 3.84E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**13:42**
Source:	**CFU 113 (2)**	**End Time:**	**15:47**
Method:	**26A**	**Date:**	**09/26/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**√Dp**
	0.000						
15	15.600	3.60	78	1	1.70	147	1.3038
30	31.250	3.30	78	2	1.60	150	1.2649
45	45.740	2.90	78	3	1.40	150	1.1832
60	59.176	2.70	78	4	1.30	151	1.1402
75	74.330	3.40	78	5	1.60	150	1.2649
90	89.590	3.40	82	6	1.60	153	1.2649
105	104.380	3.20	82	7	1.50	151	1.2247
120	119.535	3.40	83	8	1.60	151	1.2649

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 113 (2)**	**Date:**	**09/26/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	15	min	Diameter	20.000	in
Meter Volume, V_m	119.535	dcf	Rectangular		
Water Volume	39.6	ml (g)	Width		in
Nozzle Diameter, N_z	0.2157	in.	Length		in
Nozzle Area	0.000254	sq.ft.	Stack Area	2.182	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.97	%vd
Static Pressure	-0.28	"H_2O	O_2 Average	20.17	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	3.238	"H_2O	$\sqrt{Dp}$	1.2389	"H_2O
Temperature, T_m	79.6	^oF	Temperature, T_s	150.4	^oF
Temperature, T_m	539.6	^oA (^oR)	Temperature, T_s	610.4	^oA (R)
Pressure Meter, P_m	30.088	"Hg	Pressure Stack, P_s	29.829	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	117.669	dscf	Velocity, V_s	75.01	fps
	3.332	dscm	Volume (actual)	9,820.3	awcfm
Actual Volume, $V_{m(actual)}$	138.665	awcf		9,667.1	adcfm
Gas Stream Moisture			Volume (standard)	508,127.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.864	scf		500,201.0	dscf/hr
Moisture, B_{ws}	0.0156			8,336.7	dscf/min
Moisture EPA M4	1.56	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	446.752	
Dry, M_d	28.96	lb/lb-mole			
Wet, M_s	28.79	lb/lb-mole			
Percent Isokinetic	101.1	%			

Laboratory Results

HF	< 3.95	µg/sample		
HF	< 3.95E-06	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	< 5.18E-07	gr/dscf
	< 1.19	µg/dscm
	< 1.42E-03	ppmvd
Mass Emissions HF	< 3.70E-05	lb/hr

"<" represents MDL value

EPA Method 26A
Laboratory Results
HF

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 113 (2)**

Lab ID	Sample ID	Sample Date		Result	MDL	Sample Vol. (ml)	Units
18-S2344	Cont. 3 Run 1	9/26/2018	<	MDL	4.40	418.0	µg/sample
18-S2345	Cont. 3 Run 2	9/26/2018	<	MDL	4.05	385.0	µg/sample
18-S2346	Cont. 3 Run 3	9/26/2018	<	MDL	3.95	375.0	µg/sample
18-S2221	0.1N H2SO4 Blank	9/11/2018	<	MDL	4.45	423.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 26A
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 113 (2)

Run			1	2	3	Average
Date			9/26/2018	9/26/2018	9/26/2018	
Run Start Time			8:59	11:22	13:42	
Run End Time			11:04	13:27	15:47	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.85	29.85	29.85	**29.85**
Nozzle Dia., in.			0.2157	0.2157	0.2157	**0.2157**
Isokinetic Average, %			100.1	99.9	101.1	**100.4**
Sample Volume, dscf			114.078	115.703	117.669	**115.817**
Sample Volume, dscm			3.230	3.276	3.332	**3.279**
Stack Diameter, in.			20.00	20.00	20.00	**20.00**
Stack Area, sq.ft.			2.182	2.182	2.182	**2.182**
CO_2 %vd			0.96	0.98	0.97	**0.97**
O_2 %vd			20.11	20.21	20.17	**20.16**
Static Press., "H_2O			-0.28	-0.28	-0.28	**-0.28**
H_2O %v			1.98	1.75	1.56	**1.76**
Wet Molecular Weight, lb/lb-mole			28.74	28.78	28.79	**28.77**
Velocity, FPS			72.63	74.08	75.01	**73.91**
ADCFM			9,320.4	9,528.9	9,667.1	**9,505.5**
AWCFM			9,508.7	9,698.6	9,820.3	**9,675.9**
DSCFM			8,164.8	8,293.5	8,336.7	**8,265.0**
Stack Temperature, ^oF			140.9	144.8	150.4	**145.4**
HF	Concentration, C_s	gr/dscf	< 5.95E-07	< 5.40E-07	< 5.18E-07	< **5.51E-07**
		µg/dscm	< 1.36	< 1.24	< 1.19	< **1.26**
		ppmvd	< 1.64E-03	< 1.49E-03	< 1.42E-03	< **1.52E-03**
	Mass	lb/hr	< 4.17E-05	< 3.84E-05	< 3.70E-05	< **3.90E-05**
		lb/lb glass	< 1.14E-08	< 1.05E-08	< 1.00E-08	< **1.07E-08**
Production Data	Glass Production	lbs/hr	3,642.2	3,645.4	3,695.0	**3,660.9**

"<" represents MDL value

EPA Methods 1-4, 26A
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:59**
Source:	**CFU 113 (2)**	**End Time:**	**11:04**
Method:	**26A**	**Date:**	**9/26/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.082 "Hg
   - where Pb: 29.85 "Hg
   - ΔH: 3.150 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.829 "Hg
   - where Pb: 29.85 "Hg
   - Static Press.: -0.28 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 114.078 dscf
   - where Vm: 112.559 dcf
   - Y: 1.0008
   - Pm: 30.082 "Hg
   - Tm: 524.0 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.306 scf
   - where H_2O: 49.00 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0198
   - where Vw(std): 2.306 scf
   - Vm(std): 114.078 dscf

6) % H_2O = Bws x 100 = 1.98 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 132.908 awcf
   - where Y: 1.0008
   - Vm: 112.5589 dcf
   - Bws: 0.0198
   - Ts: 600.9 °A
   - Tm: 524.0 °A
   - Pm: 30.082 "Hg
   - Ps: 29.829 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.96 lb/lb-mole
   - where CO_2: 0.96 %vd
   - O_2 20.11 %vd
   - N_2+CO= (100-(O_2+CO_2): 78.93 %vd

Client: Hollingsworth & Vose	Run: 1
Source: CFU 113 (2)	Date: 9/26/2018

9) $M_s = M_d(1 - Bws) + (18 \times Bws) =$ 28.74 lb/lb-mole

where M_d: 28.96 lb/lb-mole

Bws: 0.0198

10) $\text{Stack Area(cir.)} = 3.1416\ (\text{stack diameter}/24)^2 =$ 2.182 sq. ft.

where Stack ID: 20 inches

$\text{Stack Area(rect.)} = \text{stack width}/12 \times \text{stack length}/12 =$ NA sq. ft.

where Stack Width: 0.000 inches

Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 72.63 fps

where Cp: 0.84

Ave. Sqrt ΔP: 1.2081

Ts: 600.9 °A

Ps: 29.829 "Hg

Ms: 28.74 lb/lb-mole

12) $AWCFM = (V_s)(\text{stack area})(60\ \text{sec/min}) =$ 9,508.7 AWCFM

where V_s: 72.63 ft/sec

Stack Area: 2.182 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 9,320.4 ADCFM

where AWCFM: 9,508.7

Bws: 0.0198

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ \text{"Hg}}\right) =$ 499,783.7 wscf/hr

where V_s: 72.63 ft/sec

Stack Area: 2.1820 sq. ft.

Ts: 600.9 °A

Ps: 29.829 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 489,888.0 dscf/hr

where wscf/hr: 499,783.7

Bws: 0.0198

16) DSCFM= (dscf/hr)/60 mins/hr = 8,164.8 DSCFM

where dscf/hr: 489,888.0

17) $\text{Nozzle Area} = 3.1416\ (\text{Nozzle Size}/24)^2 =$ 0.000254 sq. ft.

where Nozzle Size: 0.2157 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 113 (2)**	**Date:**	**9/26/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.1 %

where Ts:	600.9	°A
Vm(Std):	114.078	dscf
Ps:	29.829	"Hg
Vs	72.63	ft/sec
Nozzle Area:	0.000254	sq. ft.
Sampling Time:	120	min.
Bws:	0.0198	

EPA Method 26A:

19) HF laboratory results < 4.40 µg/sample

20) HF = (µg/sample)/1,000,000 = < 4.40E-06 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 5.95E-07 gr/dscf

where Sample:	0.00000	grams
Vm(std)	114.078	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 1.36 µg/dscm

where Sample:	0.00000	grams
Vm(std)	3.230	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 439.799 Vol./Mole

where Ts:	600.9	°A
Ps:	29.829	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.64E-03 ppmvd

where MW:	20.01	g/mol
lb/hr:	0.00	
Vol./Mole:	439.799	
ADCFM:	9320.4	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 4.17E-05 lb/hr

where Cs:	5.95E-07	gr/dscf
Stack Flow:	489,888.0	dscf/hr

Daily Gaseous Calibrations Log

Client: H&V

Source: CFU-113 M 13b/26A/3A

Date: 09/26/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	0	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

*Use of a calibrated instrument required

See 9-11

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X					0	X		
2	X					10	X		
4	X					20	X		

08:42 →

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0						0			
2						10			

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run #1

Test Times: R-1 08:59 - 11:05 R-2 11:22 - 13:28 R-3 13:42 - 15:48

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-113 (2)**
Facility	**Glass Plant 1**	Date	**September 26, 2018**
Location	**Corvallis OR**		

Run	1	2	3	
Date	9/26/2018	9/26/2018	9/26/2018	
Run Start Time	8:59	11:22	13:42	
Run End Time	11:05	13:28	15:48	
CO_2 %vd	0.96	0.98	0.97	0.97
O_2 %vd	20.11	20.21	20.17	20.16

Bison Engineering, Inc.

Method 3A Oxygen

Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 26, 2018**	Instrument Model:	**1440**
Location:	**Corvallis OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			***Final Values***								
		Analyzer Cal. Response	**System Cal Response**	**Pre test System Cal. Bias % of span**	**pass/fail**	**System Cal Response**	**Post test System Cal. Bias % of span**	**pass/fail**	**System Drift % of span**	**pass/fail**	**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
Run 1	zero	0.03	0.08	0.25	pass	0.05	0.10	pass	-0.15	pass				
	upscale	9.95	9.87	-0.40	pass	9.79	-0.80	pass	-0.40	pass	20	19.70	20.11	10
Run 2	zero	0.03	0.05	0.10	pass	0.06	0.15	pass	0.05	pass				
	upscale	9.95	9.79	-0.80	pass	9.84	-0.55	pass	0.25	pass	20	19.78	20.21	10
Run 3	zero	0.03	0.06	0.15	pass	0.06	0.15	pass	0.00	pass				
	upscale	9.95	9.84	-0.55	pass	9.84	-0.55	pass	0.00	pass	20	19.79	20.17	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.03	9.95	20.1
Analyzer Cal. Error	0.15	-0.25	0.50
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO_2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-113 (2)**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 26, 2018**	Instrument Model:	**1440**
Location:	**Corvallis OR**			Instrument Serial #:	**01440D1-5041**

		Initial Values				Final Values									
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.02	0.06	2.00	pass	0.03	1.25	pass	-0.75	pass				
	upscale	1.87	1.87	0.00	pass	1.86	-0.25	pass	-0.25	pass	4	0.92	0.96	2
Run 2	zero	-0.02	0.03	1.25	pass	0.05	1.75	pass	0.50	pass				
	upscale	1.87	1.86	-0.25	pass	1.87	0.00	pass	0.25	pass	4	0.93	0.98	2
Run 3	zero	-0.02	0.05	1.75	pass	0.04	1.50	pass	-0.25	pass				
	upscale	1.87	1.87	0.00	pass	1.87	0.00	pass	0.00	pass	4	0.93	0.97	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	-0.02	1.87	4.13
Analyzer Cal. Error	-0.50	-3.25	3.25
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**8:59**
Source:	**CFU-113 (2)**	**End Time:**	**11:05**
Method:	**3A**	**Date:**	**9/26/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.25 %v

where C_{Dir}:	9.95	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.40 %v

where C_{Dir}:	9.95	ppmv
C_S:	9.87	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.40 %v

where SB_{Final}:	-0.80	ppmv
SB_i:	-0.40	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 20.11 ppmv

where C_{Avg}:	19.70	ppmv
C_O:	0.07	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.83	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**8:59**
Source:	**CFU-113 (2)**	**End Time:**	**11:05**
Method:	**3A**	**Date:**	**9/26/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -3.25 %v

where C_{Dir}:	1.87	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.00 %v

where C_{Dir}:	1.87	ppmv
C_S:	1.87	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.25 %v

where SB_{Final}:	-0.25	ppmv
SB_i:	0.00	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.96 ppmv

where C_{Avg}:	0.92	ppmv
C_O:	0.05	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.87	ppmv

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/26/2018

Date	Time	O2 [%]	CO2 [%]
9/26/2018	8:34:04	-0.09	-0.08
9/26/2018	8:34:14	-0.10	-0.08
9/26/2018	8:34:24	-0.10	-0.08
9/26/2018	8:34:34	-0.05	-0.03
9/26/2018	8:34:44	0.02	-0.02
9/26/2018	8:34:54	0.03	-0.01
9/26/2018	8:35:04	0.03	-0.02
9/26/2018	8:35:14	0.02	-0.02
9/26/2018	8:35:24	1.00	0.19
9/26/2018	8:35:34	17.12	17.10
9/26/2018	8:35:44	19.93	19.53
9/26/2018	8:35:54	20.23	19.56
9/26/2018	8:36:04	20.14	19.30
9/26/2018	8:36:14	20.18	19.56
9/26/2018	8:36:24	20.14	19.62
9/26/2018	8:36:34	20.10	19.91
9/26/2018	8:36:44	20.10	19.92
9/26/2018	8:36:54	20.10	19.93
9/26/2018	8:37:04	20.10	19.93
9/26/2018	8:37:14	19.60	19.86
9/26/2018	8:37:24	11.67	10.22
9/26/2018	8:37:34	9.93	9.90
9/26/2018	8:37:44	9.97	9.92
9/26/2018	8:37:54	9.97	9.91
9/26/2018	8:38:04	9.96	9.92
9/26/2018	8:38:14	9.96	9.91
9/26/2018	8:38:24	9.96	9.91
9/26/2018	8:38:34	9.95	9.90
9/26/2018	8:38:44	9.95	9.90
9/26/2018	8:38:54	9.95	9.90
9/26/2018	8:39:04	9.96	9.91
9/26/2018	8:39:14	6.87	5.79
9/26/2018	8:39:24	3.70	4.01
9/26/2018	8:39:34	3.93	4.14
9/26/2018	8:39:44	3.94	4.14
9/26/2018	8:39:54	3.94	4.13
9/26/2018	8:40:04	3.94	4.13
9/26/2018	8:40:14	3.95	4.13
9/26/2018	8:40:24	2.36	2.03
9/26/2018	8:40:34	1.99	1.91
9/26/2018	8:40:44	1.94	1.88

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/26/2018

Date	Time	O2 [%]	CO2 [%]
9/26/2018	8:40:54	1.94	1.88
9/26/2018	8:41:04	1.94	1.87
9/26/2018	8:41:14	1.94	1.88
9/26/2018	8:41:24	1.94	1.87
9/26/2018	8:41:34	1.94	1.88
9/26/2018	8:41:44	1.93	1.87
9/26/2018	8:41:54	1.93	1.87
9/26/2018	8:42:04	1.93	1.87
9/26/2018	8:42:14	1.93	1.87
9/26/2018	8:42:24	1.92	1.87
		O2 [%]	**CO2 [%]**
Analyzer Low		**0.03**	**-0.02**
Analyzer Mid		**9.95**	**1.87**
Analyzer High		**20.10**	**4.13**

System

9/26/2018	8:42:34	16.36	0.48
9/26/2018	8:42:44	15.94	0.42
9/26/2018	8:42:54	9.96	1.13
9/26/2018	8:43:04	7.96	1.34
9/26/2018	8:43:14	7.42	1.39
9/26/2018	8:43:24	7.28	1.41
9/26/2018	8:43:34	7.24	1.43
9/26/2018	8:43:44	7.22	1.42
9/26/2018	8:43:54	10.73	1.06
9/26/2018	8:44:04	13.86	0.81
9/26/2018	8:44:14	6.39	1.60
9/26/2018	8:44:24	3.19	1.80
9/26/2018	8:44:34	2.34	1.85
9/26/2018	8:44:44	2.11	1.86
9/26/2018	8:44:54	2.05	1.87
9/26/2018	8:45:04	2.03	1.87
9/26/2018	8:45:14	2.02	1.87
9/26/2018	8:45:24	2.01	1.88
9/26/2018	8:45:34	2.01	1.87
9/26/2018	8:45:44	2.01	1.87
9/26/2018	8:45:54	2.01	1.88
9/26/2018	8:46:04	2.00	1.87
9/26/2018	8:46:14	2.00	1.87
9/26/2018	8:46:24	2.00	1.87
9/26/2018	8:46:34	2.00	1.87

Hollingsworth & Vose
CFU-113 (2)
Daily Calibrations
9/26/2018

Date	Time	O2 [%]	CO2 [%]
9/26/2018	8:46:44	2.81	2.51
9/26/2018	8:46:54	7.26	7.51
9/26/2018	8:47:04	9.19	9.25
9/26/2018	8:47:14	9.68	9.69
9/26/2018	8:47:24	9.81	9.81
9/26/2018	8:47:34	9.85	9.84
9/26/2018	8:47:44	9.86	9.87
9/26/2018	8:47:54	9.86	9.88
9/26/2018	8:48:04	9.86	9.88
9/26/2018	8:48:14	9.87	9.88
9/26/2018	8:48:24	9.86	9.89
9/26/2018	8:48:34	9.87	9.90
9/26/2018	8:48:44	9.87	9.90
9/26/2018	8:48:54	8.57	8.34
9/26/2018	8:49:04	3.23	2.85
9/26/2018	8:49:14	0.94	0.88
9/26/2018	8:49:24	0.32	0.34
9/26/2018	8:49:34	0.16	0.17
9/26/2018	8:49:44	0.11	0.10
9/26/2018	8:49:54	0.09	0.09
9/26/2018	8:50:04	0.09	0.07
9/26/2018	8:50:14	0.08	0.07
9/26/2018	8:50:24	0.09	0.06
9/26/2018	8:50:34	0.08	0.06

	O2 [%]	CO2 [%]
System Low	**0.08**	**0.06**
System Mid	**9.87**	**1.87**

Hollingsworth & Vose
CFU-113
Run #1

Date	Time	O2 [%]	CO2 [%]
9/26/2018	8:59:36	19.66	0.92
9/26/2018	9:00:36	19.66	0.93
9/26/2018	9:01:36	19.64	0.93
9/26/2018	9:02:36	19.65	0.92
9/26/2018	9:03:36	19.64	0.92
9/26/2018	9:04:36	19.64	0.92
9/26/2018	9:05:36	19.63	0.93
9/26/2018	9:06:36	19.63	0.92
9/26/2018	9:07:36	19.63	0.92
9/26/2018	9:08:36	19.63	0.92
9/26/2018	9:09:36	19.62	0.92
9/26/2018	9:10:36	19.61	0.93
9/26/2018	9:11:36	19.62	0.92
9/26/2018	9:12:36	19.62	0.92
9/26/2018	9:13:36	19.62	0.93
9/26/2018	9:14:36	19.61	0.93
9/26/2018	9:15:36	19.61	0.94
9/26/2018	9:16:36	19.61	0.95
9/26/2018	9:17:36	19.60	0.95
9/26/2018	9:18:36	19.60	0.94
9/26/2018	9:19:36	19.60	0.94
9/26/2018	9:20:36	19.60	0.95
9/26/2018	9:21:36	19.60	0.94
9/26/2018	9:22:36	19.60	0.95
9/26/2018	9:23:36	19.59	0.95
9/26/2018	9:24:36	19.59	0.95
9/26/2018	9:25:36	19.65	0.93
9/26/2018	9:26:36	19.74	0.94
9/26/2018	9:27:36	19.74	0.94
9/26/2018	9:28:36	19.74	0.93
9/26/2018	9:29:36	19.73	0.93
9/26/2018	9:30:36	19.74	0.93
9/26/2018	9:31:36	19.73	0.92
9/26/2018	9:32:36	19.74	0.92
9/26/2018	9:33:36	19.74	0.92
9/26/2018	9:34:36	19.74	0.92
9/26/2018	9:35:36	19.74	0.92
9/26/2018	9:36:36	19.74	0.92
9/26/2018	9:37:36	19.73	0.92

Hollingsworth & Vose
CFU-113
Run #1

Date	Time	O2 [%]	CO2 [%]
9/26/2018	9:38:36	19.73	0.92
9/26/2018	9:39:36	19.73	0.92
9/26/2018	9:40:36	19.73	0.93
9/26/2018	9:41:36	19.73	0.92
9/26/2018	9:42:36	19.73	0.93
9/26/2018	9:43:36	19.74	0.93
9/26/2018	9:44:36	19.73	0.94
9/26/2018	9:45:36	19.74	0.93
9/26/2018	9:46:36	19.73	0.93
9/26/2018	9:47:36	19.73	0.93
9/26/2018	9:48:36	19.74	0.93
9/26/2018	9:49:36	19.74	0.93
9/26/2018	9:50:36	19.74	0.92
9/26/2018	9:51:36	19.74	0.92
9/26/2018	9:52:36	19.74	0.93
9/26/2018	9:53:36	19.74	0.93
9/26/2018	9:54:36	19.74	0.92
9/26/2018	9:55:36	19.73	0.92
9/26/2018	9:56:36	19.73	0.92
9/26/2018	9:57:36	19.74	0.92
9/26/2018	9:58:36	19.73	0.92
9/26/2018	9:59:36	19.73	0.92
9/26/2018	10:00:36	19.73	0.92
9/26/2018	10:01:36	19.73	0.92
9/26/2018	10:02:36	19.73	0.93
9/26/2018	10:03:36	19.73	0.92
9/26/2018	10:04:36	19.72	0.92
9/26/2018	10:05:36	19.72	0.93
9/26/2018	10:06:36	19.73	0.93
9/26/2018	10:07:36	19.73	0.93
9/26/2018	10:08:36	19.74	0.93
9/26/2018	10:09:36	19.73	0.94
9/26/2018	10:10:36	19.73	0.94
9/26/2018	10:11:36	19.73	0.94
9/26/2018	10:12:36	19.73	0.93
9/26/2018	10:13:36	19.73	0.93
9/26/2018	10:14:36	19.73	0.93
9/26/2018	10:15:36	19.72	0.93
9/26/2018	10:16:36	19.71	0.93

Hollingsworth & Vose
CFU-113
Run #1

Date	Time	O2 [%]	CO2 [%]
9/26/2018	10:17:36	19.72	0.93
9/26/2018	10:18:36	19.72	0.92
9/26/2018	10:19:36	19.72	0.92
9/26/2018	10:20:36	19.72	0.91
9/26/2018	10:21:36	19.72	0.91
9/26/2018	10:22:36	19.72	0.91
9/26/2018	10:23:36	19.73	0.91
9/26/2018	10:24:36	19.74	0.90
9/26/2018	10:25:36	19.73	0.91
9/26/2018	10:26:36	19.72	0.91
9/26/2018	10:27:36	19.73	0.90
9/26/2018	10:28:36	19.73	0.90
9/26/2018	10:29:36	19.72	0.91
9/26/2018	10:30:36	19.74	0.91
9/26/2018	10:31:36	19.72	0.91
9/26/2018	10:32:36	19.73	0.91
9/26/2018	10:33:36	19.73	0.91
9/26/2018	10:34:36	19.72	0.92
9/26/2018	10:35:36	19.71	0.92
9/26/2018	10:36:36	19.70	0.92
9/26/2018	10:37:36	19.72	0.91
9/26/2018	10:38:36	19.72	0.91
9/26/2018	10:39:36	19.73	0.91
9/26/2018	10:40:36	19.73	0.91
9/26/2018	10:41:36	19.72	0.91
9/26/2018	10:42:36	19.72	0.91
9/26/2018	10:43:36	19.71	0.91
9/26/2018	10:44:36	19.70	0.91
9/26/2018	10:45:36	19.70	0.90
9/26/2018	10:46:36	19.71	0.90
9/26/2018	10:47:36	19.72	0.89
9/26/2018	10:48:36	19.70	0.90
9/26/2018	10:49:36	19.70	0.90
9/26/2018	10:50:36	19.70	0.90
9/26/2018	10:51:36	19.70	0.90
9/26/2018	10:52:36	19.71	0.90
9/26/2018	10:53:36	19.70	0.91
9/26/2018	10:54:36	19.72	0.90
9/26/2018	10:55:36	19.71	0.90

Hollingsworth & Vose
CFU-113
Run #1

Date	Time	O2 [%]	CO2 [%]
9/26/2018	10:56:36	19.71	0.91
9/26/2018	10:57:36	19.71	0.91
9/26/2018	10:58:36	19.72	0.91
9/26/2018	10:59:36	19.71	0.90
9/26/2018	11:00:36	19.70	0.91
9/26/2018	11:01:36	19.71	0.91
9/26/2018	11:02:36	19.71	0.91
9/26/2018	11:03:36	19.71	0.91
9/26/2018	11:04:36	19.69	0.91
9/26/2018	11:05:36	19.70	0.91
Final Average		**19.70**	**0.92**

Bias Check

9/26/2018	11:07:36	19.66	0.90
9/26/2018	11:07:46	12.07	0.57
9/26/2018	11:07:56	3.55	0.21
9/26/2018	11:08:06	1.00	0.08
9/26/2018	11:08:16	0.32	0.06
9/26/2018	11:08:26	0.13	0.04
9/26/2018	11:08:36	0.08	0.04
9/26/2018	11:08:46	0.06	0.03
9/26/2018	11:08:56	0.05	0.03
9/26/2018	11:09:06	0.05	0.04
9/26/2018	11:09:16	0.04	0.03
9/26/2018	11:09:26	0.04	0.04
9/26/2018	11:09:36	0.40	0.45
9/26/2018	11:09:46	1.47	1.40
9/26/2018	11:09:56	1.81	1.72
9/26/2018	11:10:06	1.89	1.81
9/26/2018	11:10:16	1.92	1.84
9/26/2018	11:10:26	1.92	1.85
9/26/2018	11:10:36	1.92	1.85
9/26/2018	11:10:46	1.92	1.86
9/26/2018	11:10:56	1.92	1.86
9/26/2018	11:11:06	1.92	1.86
9/26/2018	11:11:16	2.23	1.94
9/26/2018	11:11:26	6.25	6.41
9/26/2018	11:11:36	8.84	8.98
9/26/2018	11:11:46	9.52	9.62

Hollingsworth & Vose
CFU-113
Run #1

Date	Time	O2 [%]	CO2 [%]
9/26/2018	11:11:56	9.70	9.80
9/26/2018	11:12:06	9.75	9.86
9/26/2018	11:12:16	9.77	9.89
9/26/2018	11:12:26	9.78	9.90
9/26/2018	11:12:36	9.79	9.90
9/26/2018	11:12:46	9.80	9.91
9/26/2018	11:12:56	9.79	9.92
9/26/2018	11:13:06	9.79	9.92
9/26/2018	11:13:16	9.79	9.93
9/26/2018	11:13:26	9.79	9.93
9/26/2018	11:13:36	9.78	9.93
		O2 [%]	**CO2 [%]**
System Zero		**0.05**	**0.03**
System Span		**9.79**	**1.86**

Hollingsworth & Vose
CFU-113 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/26/2018	11:22:36	19.68	0.92
9/26/2018	11:23:36	19.69	0.92
9/26/2018	11:24:36	19.71	0.91
9/26/2018	11:25:36	19.70	0.92
9/26/2018	11:26:36	19.70	0.91
9/26/2018	11:27:36	19.69	0.92
9/26/2018	11:28:36	19.68	0.92
9/26/2018	11:29:36	19.68	0.92
9/26/2018	11:30:36	19.69	0.92
9/26/2018	11:31:36	19.68	0.92
9/26/2018	11:32:36	19.70	0.91
9/26/2018	11:33:36	19.68	0.92
9/26/2018	11:34:36	19.68	0.91
9/26/2018	11:35:36	19.69	0.91
9/26/2018	11:36:36	19.70	0.90
9/26/2018	11:37:36	19.69	0.90
9/26/2018	11:38:36	19.67	0.91
9/26/2018	11:39:36	19.68	0.91
9/26/2018	11:40:36	19.70	0.90
9/26/2018	11:41:36	19.68	0.90
9/26/2018	11:42:36	19.68	0.91
9/26/2018	11:43:36	19.71	0.90
9/26/2018	11:44:36	19.82	0.90
9/26/2018	11:45:36	19.80	0.91
9/26/2018	11:46:36	19.81	0.91
9/26/2018	11:47:36	19.82	0.92
9/26/2018	11:48:36	19.81	0.92
9/26/2018	11:49:36	19.81	0.92
9/26/2018	11:50:36	19.81	0.92
9/26/2018	11:51:36	19.80	0.92
9/26/2018	11:52:36	19.81	0.92
9/26/2018	11:53:36	19.80	0.93
9/26/2018	11:54:36	19.79	0.93
9/26/2018	11:55:36	19.80	0.92
9/26/2018	11:56:36	19.79	0.93
9/26/2018	11:57:36	19.81	0.92
9/26/2018	11:58:36	19.82	0.91
9/26/2018	11:59:36	19.79	0.92
9/26/2018	12:00:36	19.80	0.91
9/26/2018	12:01:36	19.80	0.91
9/26/2018	12:02:36	19.79	0.92
9/26/2018	12:03:36	19.80	0.91

Hollingsworth & Vose
CFU-113 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/26/2018	11:22:36	19.68	0.92
9/26/2018	12:04:36	19.80	0.92
9/26/2018	12:05:36	19.80	0.91
9/26/2018	12:06:36	19.80	0.92
9/26/2018	12:07:36	19.81	0.92
9/26/2018	12:08:36	19.82	0.92
9/26/2018	12:09:36	19.83	0.90
9/26/2018	12:10:36	19.83	0.91
9/26/2018	12:11:36	19.81	0.92
9/26/2018	12:12:36	19.83	0.91
9/26/2018	12:13:36	19.81	0.93
9/26/2018	12:14:36	19.80	0.94
9/26/2018	12:15:36	19.82	0.93
9/26/2018	12:16:36	19.83	0.92
9/26/2018	12:17:36	19.81	0.93
9/26/2018	12:18:36	19.81	0.94
9/26/2018	12:19:36	19.80	0.94
9/26/2018	12:20:36	19.80	0.94
9/26/2018	12:21:36	19.79	0.95
9/26/2018	12:22:36	19.80	0.93
9/26/2018	12:23:36	19.80	0.93
9/26/2018	12:24:36	19.80	0.94
9/26/2018	12:25:36	19.79	0.94
9/26/2018	12:26:36	19.79	0.93
9/26/2018	12:27:36	19.79	0.93
9/26/2018	12:28:36	19.80	0.93
9/26/2018	12:29:36	19.81	0.92
9/26/2018	12:30:36	19.79	0.93
9/26/2018	12:31:36	19.79	0.93
9/26/2018	12:32:36	19.80	0.93
9/26/2018	12:33:36	19.80	0.94
9/26/2018	12:34:36	19.80	0.94
9/26/2018	12:35:36	19.79	0.95
9/26/2018	12:36:36	19.80	0.94
9/26/2018	12:37:36	19.80	0.95
9/26/2018	12:38:36	19.79	0.95
9/26/2018	12:39:36	19.79	0.95
9/26/2018	12:40:36	19.82	0.93
9/26/2018	12:41:36	19.81	0.94
9/26/2018	12:42:36	19.81	0.94
9/26/2018	12:43:36	19.81	0.94
9/26/2018	12:44:36	19.81	0.94

Hollingsworth & Vose
CFU-113 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/26/2018	11:22:36	19.68	0.92
9/26/2018	12:45:36	19.82	0.94
9/26/2018	12:46:36	19.81	0.94
9/26/2018	12:47:36	19.83	0.92
9/26/2018	12:48:36	19.79	0.94
9/26/2018	12:49:36	19.80	0.94
9/26/2018	12:50:36	19.81	0.93
9/26/2018	12:51:36	19.81	0.93
9/26/2018	12:52:36	19.81	0.94
9/26/2018	12:53:36	19.80	0.94
9/26/2018	12:54:36	19.81	0.93
9/26/2018	12:55:36	19.82	0.93
9/26/2018	12:56:36	19.81	0.93
9/26/2018	12:57:36	19.81	0.93
9/26/2018	12:58:36	19.79	0.94
9/26/2018	12:59:36	19.80	0.95
9/26/2018	13:00:36	19.79	0.96
9/26/2018	13:01:36	19.80	0.95
9/26/2018	13:02:36	19.80	0.95
9/26/2018	13:03:36	19.80	0.95
9/26/2018	13:04:36	19.80	0.95
9/26/2018	13:05:36	19.79	0.95
9/26/2018	13:06:36	19.79	0.95
9/26/2018	13:07:36	19.81	0.94
9/26/2018	13:08:36	19.81	0.94
9/26/2018	13:09:36	19.82	0.92
9/26/2018	13:10:36	19.81	0.93
9/26/2018	13:11:36	19.81	0.94
9/26/2018	13:12:36	19.81	0.92
9/26/2018	13:13:36	19.80	0.93
9/26/2018	13:14:36	19.79	0.93
9/26/2018	13:15:36	19.81	0.92
9/26/2018	13:16:36	19.81	0.92
9/26/2018	13:17:36	19.82	0.91
9/26/2018	13:18:36	19.81	0.92
9/26/2018	13:19:36	19.79	0.93
9/26/2018	13:20:36	19.78	0.94
9/26/2018	13:21:36	19.80	0.93
9/26/2018	13:22:36	19.79	0.93
9/26/2018	13:23:36	19.79	0.93
9/26/2018	13:24:36	19.80	0.94
9/26/2018	13:25:36	19.80	0.94

Hollingsworth & Vose
CFU-113 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/26/2018	11:22:36	19.68	0.92
9/26/2018	13:26:36	19.82	0.93
9/26/2018	13:27:36	19.82	0.94
9/26/2018	13:28:36	19.81	0.94
Final Average		**19.78**	**0.93**

Bias Check

9/26/2018	13:30:16	19.84	0.93
9/26/2018	13:30:26	19.46	1.11
9/26/2018	13:30:36	10.40	1.04
9/26/2018	13:30:46	3.00	0.37
9/26/2018	13:30:56	0.87	0.16
9/26/2018	13:31:06	0.30	0.08
9/26/2018	13:31:16	0.14	0.07
9/26/2018	13:31:26	0.09	0.06
9/26/2018	13:31:36	0.07	0.05
9/26/2018	13:31:46	0.06	0.06
9/26/2018	13:31:56	0.06	0.05
9/26/2018	13:32:06	0.05	0.06
9/26/2018	13:32:16	0.08	0.09
9/26/2018	13:32:26	1.06	1.09
9/26/2018	13:32:36	1.72	1.63
9/26/2018	13:32:46	1.88	1.80
9/26/2018	13:32:56	1.92	1.85
9/26/2018	13:33:06	1.93	1.86
9/26/2018	13:33:16	1.94	1.87
9/26/2018	13:33:26	1.94	1.87
9/26/2018	13:33:36	1.94	1.87
9/26/2018	13:33:46	1.94	1.87
9/26/2018	13:33:56	2.55	2.21
9/26/2018	13:34:06	6.88	7.07
9/26/2018	13:34:16	9.05	9.10
9/26/2018	13:34:26	9.60	9.65
9/26/2018	13:34:36	9.76	9.80
9/26/2018	13:34:46	9.81	9.86
9/26/2018	13:34:56	9.82	9.88
9/26/2018	13:35:06	9.83	9.89
9/26/2018	13:35:16	9.83	9.90
9/26/2018	13:35:26	9.84	9.90
9/26/2018	13:35:36	9.84	9.91
9/26/2018	13:35:46	9.85	9.90
9/26/2018	13:35:56	9.85	9.91

Hollingsworth & Vose
CFU-113 (2)
Run #2

Date	Time	O2 [%]	CO2 [%]
9/26/2018	11:22:36	19.68	0.92
9/26/2018	13:36:06	9.84	9.91
9/26/2018	13:36:16	10.08	9.69
9/26/2018	13:36:26	14.80	5.26
9/26/2018	13:36:36	18.24	2.14
9/26/2018	13:36:46	19.32	1.31
9/26/2018	13:36:56	19.62	1.09
		O2 [%]	**CO2 [%]**
System Zero		**0.06**	**0.05**
System Span		**9.84**	**1.87**

Hollingsworth & Vose
CFU-113 (2)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/26/2018	13:42:36	19.80	0.93
9/26/2018	13:43:36	19.81	0.92
9/26/2018	13:44:36	19.80	0.92
9/26/2018	13:45:36	19.82	0.92
9/26/2018	13:46:36	19.82	0.92
9/26/2018	13:47:36	19.80	0.93
9/26/2018	13:48:36	19.80	0.93
9/26/2018	13:49:36	19.80	0.94
9/26/2018	13:50:36	19.79	0.94
9/26/2018	13:51:36	19.80	0.94
9/26/2018	13:52:36	19.81	0.94
9/26/2018	13:53:36	19.80	0.94
9/26/2018	13:54:36	19.80	0.94
9/26/2018	13:55:36	19.81	0.93
9/26/2018	13:56:36	19.80	0.94
9/26/2018	13:57:36	19.80	0.94
9/26/2018	13:58:36	19.81	0.94
9/26/2018	13:59:36	19.80	0.94
9/26/2018	14:00:36	19.81	0.93
9/26/2018	14:01:36	19.81	0.93
9/26/2018	14:02:36	19.80	0.93
9/26/2018	14:03:36	19.81	0.92
9/26/2018	14:04:36	19.81	0.92
9/26/2018	14:05:36	19.81	0.92
9/26/2018	14:06:36	19.80	0.92
9/26/2018	14:07:36	19.80	0.93
9/26/2018	14:08:36	19.82	0.91
9/26/2018	14:09:36	19.81	0.92
9/26/2018	14:10:36	19.81	0.93
9/26/2018	14:11:36	19.79	0.94
9/26/2018	14:12:36	19.80	0.93
9/26/2018	14:13:36	19.79	0.94
9/26/2018	14:14:36	19.79	0.94
9/26/2018	14:15:36	19.83	0.92
9/26/2018	14:16:36	19.80	0.94
9/26/2018	14:17:36	19.80	0.94
9/26/2018	14:18:36	19.80	0.94
9/26/2018	14:19:36	19.79	0.94
9/26/2018	14:20:36	19.79	0.94
9/26/2018	14:21:36	19.79	0.94
9/26/2018	14:22:36	19.79	0.94
9/26/2018	14:23:36	19.81	0.93

Hollingsworth & Vose
CFU-113 (2)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/26/2018	14:24:36	19.82	0.92
9/26/2018	14:25:36	19.81	0.93
9/26/2018	14:26:36	19.80	0.93
9/26/2018	14:27:36	19.80	0.92
9/26/2018	14:28:36	19.79	0.93
9/26/2018	14:29:36	19.80	0.92
9/26/2018	14:30:36	19.80	0.92
9/26/2018	14:31:36	19.81	0.91
9/26/2018	14:32:36	19.80	0.92
9/26/2018	14:33:36	19.79	0.92
9/26/2018	14:34:36	19.79	0.92
9/26/2018	14:35:36	19.80	0.91
9/26/2018	14:36:36	19.80	0.91
9/26/2018	14:37:36	19.80	0.91
9/26/2018	14:38:36	19.80	0.92
9/26/2018	14:39:36	19.82	0.91
9/26/2018	14:40:36	19.81	0.92
9/26/2018	14:41:36	19.80	0.93
9/26/2018	14:42:36	19.81	0.93
9/26/2018	14:43:36	19.80	0.93
9/26/2018	14:44:36	19.81	0.93
9/26/2018	14:45:36	19.80	0.93
9/26/2018	14:46:36	19.78	0.93
9/26/2018	14:47:36	19.79	0.93
9/26/2018	14:48:36	19.78	0.94
9/26/2018	14:49:36	19.78	0.93
9/26/2018	14:50:36	19.79	0.92
9/26/2018	14:51:36	19.80	0.92
9/26/2018	14:52:36	19.79	0.92
9/26/2018	14:53:36	19.79	0.92
9/26/2018	14:54:36	19.80	0.91
9/26/2018	14:55:36	19.81	0.90
9/26/2018	14:56:36	19.80	0.92
9/26/2018	14:57:36	19.80	0.91
9/26/2018	14:58:36	19.80	0.92
9/26/2018	14:59:36	19.80	0.92
9/26/2018	15:00:36	19.78	0.92
9/26/2018	15:01:36	19.79	0.92
9/26/2018	15:02:36	19.80	0.92
9/26/2018	15:03:36	19.80	0.92
9/26/2018	15:04:36	19.80	0.92
9/26/2018	15:05:36	19.81	0.92

Hollingsworth & Vose
CFU-113 (2)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/26/2018	15:06:36	19.80	0.93
9/26/2018	15:07:36	19.81	0.92
9/26/2018	15:08:36	19.80	0.93
9/26/2018	15:09:36	19.79	0.93
9/26/2018	15:10:36	19.78	0.94
9/26/2018	15:11:36	19.78	0.95
9/26/2018	15:12:36	19.80	0.93
9/26/2018	15:13:36	19.80	0.93
9/26/2018	15:14:36	19.79	0.94
9/26/2018	15:15:36	19.78	0.94
9/26/2018	15:16:36	19.78	0.94
9/26/2018	15:17:36	19.80	0.92
9/26/2018	15:18:36	19.79	0.93
9/26/2018	15:19:36	19.78	0.94
9/26/2018	15:20:36	19.78	0.94
9/26/2018	15:21:36	19.76	0.95
9/26/2018	15:22:36	19.77	0.94
9/26/2018	15:23:36	19.80	0.93
9/26/2018	15:24:36	19.77	0.94
9/26/2018	15:25:36	19.77	0.94
9/26/2018	15:26:36	19.76	0.95
9/26/2018	15:27:36	19.78	0.94
9/26/2018	15:28:36	19.79	0.93
9/26/2018	15:29:36	19.78	0.95
9/26/2018	15:30:36	19.77	0.95
9/26/2018	15:31:36	19.77	0.94
9/26/2018	15:32:36	19.76	0.94
9/26/2018	15:33:36	19.78	0.93
9/26/2018	15:34:36	19.77	0.93
9/26/2018	15:35:36	19.78	0.94
9/26/2018	15:36:36	19.78	0.93
9/26/2018	15:37:36	19.79	0.93
9/26/2018	15:38:36	19.78	0.93
9/26/2018	15:39:36	19.77	0.93
9/26/2018	15:40:36	19.77	0.93
9/26/2018	15:41:36	19.78	0.93
9/26/2018	15:42:36	19.79	0.93
9/26/2018	15:43:36	19.78	0.93
9/26/2018	15:44:36	19.76	0.95
9/26/2018	15:45:36	19.76	0.95
9/26/2018	15:46:36	19.77	0.94
9/26/2018	15:47:36	19.77	0.94

Hollingsworth & Vose
CFU-113 (2)
Run #3

Date	Time	O2 [%]	CO2 [%]
9/26/2018	15:48:36	19.79	0.94
Final Average		**19.79**	**0.93**
Bias Check			
9/26/2018	15:50:06	19.78	0.95
9/26/2018	15:50:16	19.26	1.17
9/26/2018	15:50:26	9.83	1.03
9/26/2018	15:50:36	2.83	0.36
9/26/2018	15:50:46	0.84	0.14
9/26/2018	15:50:56	0.29	0.08
9/26/2018	15:51:06	0.14	0.06
9/26/2018	15:51:16	0.09	0.06
9/26/2018	15:51:26	0.07	0.05
9/26/2018	15:51:36	0.06	0.05
9/26/2018	15:51:46	0.06	0.05
9/26/2018	15:51:56	0.06	0.04
9/26/2018	15:52:06	0.05	0.04
9/26/2018	15:52:16	0.05	0.05
9/26/2018	15:52:26	0.06	0.05
9/26/2018	15:52:36	0.96	1.00
9/26/2018	15:52:46	1.69	1.60
9/26/2018	15:52:56	1.87	1.78
9/26/2018	15:53:06	1.92	1.84
9/26/2018	15:53:16	1.93	1.86
9/26/2018	15:53:26	1.94	1.86
9/26/2018	15:53:36	1.94	1.86
9/26/2018	15:53:46	1.93	1.87
9/26/2018	15:53:56	1.93	1.87
9/26/2018	15:54:06	2.06	1.86
9/26/2018	15:54:16	5.44	5.41
9/26/2018	15:54:26	8.64	8.73
9/26/2018	15:54:36	9.49	9.53
9/26/2018	15:54:46	9.72	9.75
9/26/2018	15:54:56	9.79	9.83
9/26/2018	15:55:06	9.81	9.86
9/26/2018	15:55:16	9.82	9.87
9/26/2018	15:55:26	9.83	9.88
9/26/2018	15:55:36	9.83	9.88
9/26/2018	15:55:46	9.83	9.89
9/26/2018	15:55:56	9.83	9.90
9/26/2018	15:56:06	9.84	9.90
9/26/2018	15:56:16	9.84	9.90

Hollingsworth & Vose
CFU-113 (2)
Run #3

Date	**Time**	**O2 [%]**	**CO2 [%]**
9/26/2018	15:56:26	13.43	6.52
		O2 [%]	**CO2 [%]**
System Zero		**0.06**	**0.04**
System Span		**9.84**	**1.87**

APPENDIX D: CFU 104 (ROTARY COARSE) TEST DATA

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 104**
DATE	**09/27/18**
METHOD	**29**
POLLUTANT	**Metals**

EPA Method 1
Stack Parameters and Traverse Points

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 104**
Facility: **Glass Plant 1**

Type of Testing: p (P for Particulate; V for Velocity/Nonparticulate)
Type of Duct: c (C for circular; R for rectangular)

Number of ports available: 2
Number of ports to be used: 2
Port diameter: 4 inches

Circular ID (Rectangular Depth): 30.00 inches
Port depth and/or wall thickness: 4.00 inches
Stack width (Rectangular only): inches

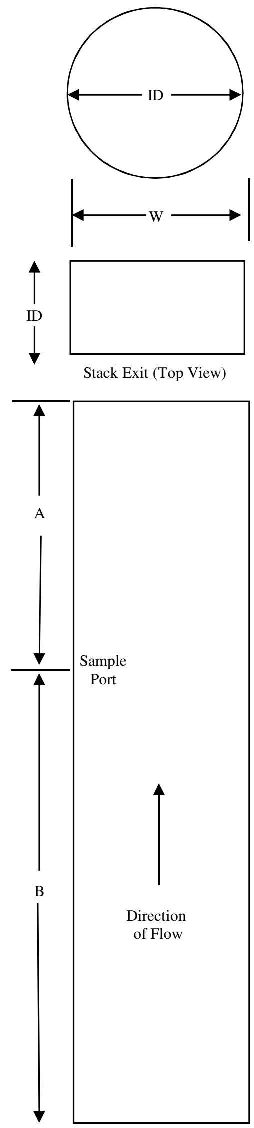
Equivalent Diameter
If rectangluar = $\frac{2*Depth*Width}{Depth + Width}$ = 30.00 inches (If circular = duct ID)
Stack/duct area = 4.909 sq.feet 706.9 sq.inches

Sample Port Location:	Downstrean from flow disturbance <u>from process</u> B	Upstream from flow disturbance <u>toward exit</u> A
Number of Inches:	128.00	102.00
Number of Diameters:	4.27	3.40

Minimum Number of Traverse Points: 24

Points	% of diameter	Distance from inside wall (in.)	Distance including port (in.)
1	2.1	0.63	4 5/8
2	6.7	2.01	6
3	11.8	3.54	7 1/2
4	17.7	5.31	9 1/4
5	25.0	7.50	11 1/2
6	35.6	10.68	14 5/8
7	64.4	19.32	23 3/8
8	75.0	22.50	26 1/2
9	82.3	24.69	28 3/4
10	88.2	26.46	30 1/2
11	93.3	27.99	32
12	97.9	29.37	33 3/8

Reference Diagram



Drawing NOT to scale and
NOT an acurate representation of stack.

Pre Traverse Flow Information

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 104

Stack Temp: 190 -0.75

Traverse Point	Velocity ΔP ("H_2O)	Null Angle
1	1.30	5.0
2	1.40	5.0
3	1.40	5.0
4	1.40	5.0
5	1.40	5.0
6	1.40	5.0
7	1.50	5.0
8	1.50	5.0
9	1.50	5.0
10	1.50	5.0
11	1.50	5.0
12	1.40	5.0
13	1.10	5.0
14	1.20	5.0
15	1.30	5.0
16	1.40	5.0
17	1.40	5.0
18	1.50	5.0
19	1.50	5.0
20	1.50	5.0
21	1.50	5.0
22	1.50	5.0
23	1.50	5.0
24	1.50	5.0
25		
26		
27		
28		
29		
30		

Average: 1.421 5

Flow is found to be:
Non-cyclonic x
Cyclonic

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**9:30**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**		**End Time:**	**12:35**
EPA Method:	**29**	Clear Sky, 75+ degrees		**Date:**	**9/27/2018**
Box Operator:	**RR**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.217	Nozzle size	0.2173 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.70 %
Static Pressure	-0.79 "H_2O	CO_2	0.90 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.197 inches
Stack Temperature	200 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	24		
Time per point	7.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	15	8

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN#2

Post Test Calculations:

Sample volume	160.601 dcf	Ave. ΔP	1.425 "H_2O
Wet mol. weight	28.71 M_s (actual)	Ave. √ΔP	1.1924 "H_2O
Actual H_2O	1.99 %	Ave. ΔH	2.646 "H_2O
Std. meter vol.	161.001 dscf	Ave. T_s	214.3 °F
Isokinetic Average	99.7 %	Ave. T_m	65.6 °F

Moisture/Lab:

Filter	Run 1 #		
	Initial	Final	Gain
Impingers, g	200.0	232	32.0
Silica gel, g	246.7	284.1	37.4
		Total water gain:	69.4

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	7.5	6.710	1.50	206	56	2.75	2.80	3	253	60
2	15.0	13.500	1.50	205	55	2.75	2.80	3	253	47
3	22.5	20.280	1.50	207	57	2.76	2.80	3	252	47
4	30.0	27.300	1.60	205	58	2.95	3.00	3	255	50
5	37.5	34.300	1.50	209	59	2.76	2.80	3	255	54
6	45.0	41.210	1.60	211	61	2.94	2.90	3	253	59
7	52.5	47.810	1.40	211	62	2.58	2.60	3	254	61
8	60.0	54.220	1.30	211	63	2.40	2.40	3	254	63
9	67.5	60.600	1.30	211	64	2.41	2.40	3	253	62
10	75.0	66.920	1.30	213	65	2.40	2.40	3	255	61
11	82.5	73.050	1.20	213	65	2.22	2.20	3	255	56
12	90.0	78.897	1.10	213	66	2.04	2.00	3	252	56
13	97.5	85.620	1.40	210	66	2.60	2.60	3	253	57
14	105.0	92.530	1.50	216	67	2.77	2.80	3	254	51
15	112.5	99.450	1.50	217	67	2.77	2.80	3	251	51
16	120.0	106.280	1.50	218	68	2.77	2.80	3	254	53
17	127.5	113.260	1.50	219	70	2.78	2.80	3	252	53
18	135.0	120.350	1.60	220	70	2.96	3.00	3	251	53
19	142.5	127.300	1.50	221	70	2.77	2.80	3	253	53
20	150.0	134.300	1.50	221	72	2.78	2.80	3	254	53
21	157.5	141.320	1.50	221	73	2.78	2.80	3	253	53
22	165.0	148.000	1.40	221	73	2.60	2.60	3	254	53
23	172.5	154.480	1.30	222	73	2.41	2.40	3	253	54
24	180.0	160.601	1.20	223	74	2.22	2.20	3	253	54

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**12:53**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**16:00**
EPA Method:	**29**	Clear Sky, 75+ degrees	**Date:**	**9/27/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass	
Y factor	0.9985	Nozzle ID	0.217	Nozzle size:	0.2173	inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000258	sq.ft.
		Pitot Cp	0.84	Probe heat:	250	F
				Filter heat:	250	F

Source Information:

Barometric Pressure	29.72	"Hg	O_2	19.7	%
Static Pressure	-0.79	"H_2O	CO_2	0.9	%
Ave. ΔP	1.42	"H_2O	Rec. Nz.	0.198	inches
Stack Temperature	200	F			
Assumed moisture	1.99	%			
Assumed meter temp.	65.6	F			
Total number of points	24				
Time per point	7.5				
Total run time	180				

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	13	10

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN#2	

Post Test Calculations:

Sample volume	167.086	dcf	Ave. ΔP	1.479	"H_2O
Wet mol. weight	28.72	M_s (actual)	Ave. √ΔP	1.2154	"H_2O
Actual H_2O	1.95	%	Ave. ΔH	2.758	"H_2O
Std. meter vol.	163.200	dscf	Ave. T_s	232.7	°F
Isokinetic Average	100.5	%	Ave. T_m	79.6	°F

Moisture/Lab:

Filter	Run2 #		
	Initial	Final	Gain
Impingers, g	200.0	238	38.0
Silica gel, g	274.8	305.7	30.9
		Total water gain:	68.9

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	7.5	7.030	1.50	224	74	2.78	2.80	3	251	56
2	15.0	13.910	1.50	226	74	2.77	2.80	3	251	53
3	22.5	20.930	1.50	226	75	2.77	2.80	3	257	54
4	30.0	28.100	1.60	227	75	2.96	3.00	3	250	54
5	37.5	35.080	1.50	228	75	2.77	2.80	3	254	54
6	45.0	42.330	1.60	229	77	2.96	3.00	3	255	55
7	52.5	49.350	1.50	230	77	2.77	2.80	3	254	57
8	60.0	56.340	1.50	230	78	2.77	2.80	3	251	57
9	67.5	63.140	1.40	231	78	2.59	2.60	3	255	58
10	75.0	69.900	1.40	233	79	2.58	2.60	3	253	59
11	82.5	76.670	1.40	234	80	2.58	2.60	3	253	60
12	90.0	83.248	1.30	233	80	2.40	2.40	3	252	60
13	97.5	90.310	1.50	234	80	2.77	2.80	3	253	64
14	105.0	97.340	1.50	235	81	2.77	2.80	3	255	60
15	112.5	104.620	1.60	235	81	2.95	3.00	3	253	60
16	120.0	111.890	1.60	236	81	2.95	3.00	3	252	62
17	127.5	119.150	1.60	237	82	2.95	3.00	3	254	64
18	135.0	126.350	1.60	237	82	2.95	3.00	3	253	65
19	142.5	133.590	1.60	237	83	2.96	3.00	3	254	65
20	150.0	140.620	1.50	238	83	2.77	2.80	3	253	64
21	157.5	147.430	1.40	237	83	2.59	2.60	3	253	56
22	165.0	154.260	1.40	236	84	2.60	2.60	3	254	56
23	172.5	160.800	1.30	236	84	2.41	2.40	3	253	56
24	180.0	167.086	1.20	235	84	2.23	2.20	3	255	56

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**16:18**
Source:	**CFU 104**	**End Time:**	**19:23**
EPA Method:	**29**	**Date:**	**9/27/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Clear Sky, 75+ degrees

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	1307999	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.799	Hot box ID	HB3	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.7 %
Static Pressure	-0.79 "H_2O	CO_2	0.9 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.195 inches
Stack Temperature	200 F		
Assumed moisture	1.95 %		
Assumed meter temp.	79.6 F		
Total number of points	24		
Time per point	7.5		
Total run time	180		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	15	10

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN#2	

Post Test Calculations:

Sample volume	164.975 dcf	Ave. ΔP	1.421 "H_2O
Wet mol. weight	28.76 M_s (actual)	Ave. √ΔP	1.1914 "H_2O
Actual H_2O	1.54 %	Ave. ΔH	2.642 "H_2O
Std. meter vol.	159.347 dscf	Ave. T_s	232.8 °F
Isokinetic Average	99.8 %	Ave. T_m	85.5 °F

Moisture/Lab:

Filter	Run3 #		
	Initial	Final	Gain
Impingers, g	200.0	228	28.0
Silica gel, g	271.4	296.3	24.9
		Total water gain:	52.9

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	7.5	6.730	1.40	234	84	2.60	2.60	3	255	61
2	15.0	13.620	1.40	234	85	2.61	2.60	3	254	56
3	22.5	20.600	1.50	236	85	2.79	2.80	3	253	56
4	30.0	27.710	1.50	235	85	2.79	2.80	3	253	58
5	37.5	34.740	1.50	235	85	2.79	2.80	3	254	58
6	45.0	41.810	1.50	236	86	2.79	2.80	3	253	60
7	52.5	48.650	1.40	236	86	2.61	2.60	3	253	60
8	60.0	55.220	1.30	235	87	2.43	2.40	3	253	61
9	67.5	61.850	1.30	235	87	2.43	2.40	3	253	62
10	75.0	68.370	1.30	236	87	2.42	2.40	3	253	63
11	82.5	75.230	1.40	235	87	2.61	2.60	3	253	63
12	90.0	82.101	1.40	234	87	2.62	2.60	3	252	65
13	97.5	89.230	1.50	231	86	2.81	2.80	3	253	66
14	105.0	96.300	1.50	232	86	2.81	2.80	3	254	56
15	112.5	103.390	1.50	231	86	2.81	2.80	3	253	52
16	120.0	110.470	1.50	231	86	2.81	2.80	3	252	52
17	127.5	117.800	1.60	231	86	3.00	3.00	3	254	52
18	135.0	124.900	1.50	231	85	2.81	2.80	3	252	51
19	142.5	131.710	1.40	231	85	2.62	2.60	3	255	51
20	150.0	138.500	1.40	230	85	2.62	2.60	3	253	50
21	157.5	145.310	1.40	230	84	2.62	2.60	3	253	50
22	165.0	151.890	1.30	230	84	2.43	2.40	3	253	51
23	172.5	158.430	1.30	230	84	2.43	2.40	3	253	51
24	180.0	164.975	1.30	228	83	2.43	2.40	3	253	52

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:30**
Source:	**CFU 104**	**End Time:**	**12:35**
Method:	**29**	**Date:**	**9/27/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
7.5	6.710	2.80	56	1	1.50	206	1.2247
15.0	13.500	2.80	55	2	1.50	205	1.2247
22.5	20.280	2.80	57	3	1.50	207	1.2247
30.0	27.300	3.00	58	4	1.60	205	1.2649
37.5	34.300	2.80	59	5	1.50	209	1.2247
45.0	41.210	2.90	61	6	1.60	211	1.2649
52.5	47.810	2.60	62	7	1.40	211	1.1832
60.0	54.220	2.40	63	8	1.30	211	1.1402
67.5	60.600	2.40	64	9	1.30	211	1.1402
75.0	66.920	2.40	65	10	1.30	213	1.1402
82.5	73.050	2.20	65	11	1.20	213	1.0954
90.0	78.897	2.00	66	12	1.10	213	1.0488
97.5	85.620	2.60	66	13	1.40	210	1.1832
105.0	92.530	2.80	67	14	1.50	216	1.2247
112.5	99.450	2.80	67	15	1.50	217	1.2247
120.0	106.280	2.80	68	16	1.50	218	1.2247
127.5	113.260	2.80	70	17	1.50	219	1.2247
135.0	120.350	3.00	70	18	1.60	220	1.2649
142.5	127.300	2.80	70	19	1.50	221	1.2247
150.0	134.300	2.80	72	20	1.50	221	1.2247
157.5	141.320	2.80	73	21	1.50	221	1.2247
165.0	148.000	2.60	73	22	1.40	221	1.1832
172.5	154.480	2.40	73	23	1.30	222	1.1402
180.0	160.601	2.20	74	24	1.20	223	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 104**	**Date:**	**09/27/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	30.000	in
Meter Volume, V_m	160.601	dcf	Rectangular		
Water Volume	69.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.71	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.92	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.646	"H_2O	√Dp	1.1924	"H_2O
Temperature, T_m	65.6	^oF	Temperature, T_s	214.3	^oF
Temperature, T_m	525.6	^oA (^oR)	Temperature, T_s	674.3	^oA (^oR)
Pressure Meter, P_m	29.915	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	161.001	dscf	Velocity, V_s	76.22	fps
	4.559	dscm	Volume (actual)	22,449.8	awcfm
Actual Volume, $V_{m(actual)}$	211.696	awcf		22,003.0	adcfm
Gas Stream Moisture			Volume (standard)	1,045,644.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.266	scf		1,024,836.3	dscf/hr
Moisture, B_{ws}	0.0199			17,080.6	dscf/min
Moisture EPA M4	1.99	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	99.7	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:53**
Source:	**CFU 104**	**End Time:**	**16:00**
Method:	**29**	**Date:**	**09/27/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m ^oF	Traverse Point	Dp "H_2O	Stack T_s ^oF	$\sqrt{Dp}$
	0.000						
7.5	7.030	2.80	74	1	1.50	224	1.2247
15.0	13.910	2.80	74	2	1.50	226	1.2247
22.5	20.930	2.80	75	3	1.50	226	1.2247
30.0	28.100	3.00	75	4	1.60	227	1.2649
37.5	35.080	2.80	75	5	1.50	228	1.2247
45.0	42.330	3.00	77	6	1.60	229	1.2649
52.5	49.350	2.80	77	7	1.50	230	1.2247
60.0	56.340	2.80	78	8	1.50	230	1.2247
67.5	63.140	2.60	78	9	1.40	231	1.1832
75.0	69.900	2.60	79	10	1.40	233	1.1832
82.5	76.670	2.60	80	11	1.40	234	1.1832
90.0	83.248	2.40	80	12	1.30	233	1.1402
97.5	90.310	2.80	80	13	1.50	234	1.2247
105.0	97.340	2.80	81	14	1.50	235	1.2247
112.5	104.620	3.00	81	15	1.60	235	1.2649
120.0	111.890	3.00	81	16	1.60	236	1.2649
127.5	119.150	3.00	82	17	1.60	237	1.2649
135.0	126.350	3.00	82	18	1.60	237	1.2649
142.5	133.590	3.00	83	19	1.60	237	1.2649
150.0	140.620	2.80	83	20	1.50	238	1.2247
157.5	147.430	2.60	83	21	1.40	237	1.1832
165.0	154.260	2.60	84	22	1.40	236	1.1832
172.5	160.800	2.40	84	23	1.30	236	1.1402
180.0	167.086	2.20	84	24	1.20	235	1.0954

Client:	Hollingsworth & Vose		Run:	2	
Source:	**CFU 104**		**Date:**	**09/27/18**	

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	30.000	in
Meter Volume, V_m	167.086	dcf	Rectangular		
Water Volume	68.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.72	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.93	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.758	"H_2O	$\sqrt{Dp}$	1.2154	"H_2O
Temperature, T_m	79.6	^oF	Temperature, T_s	232.7	^oF
Temperature, T_m	539.6	^oA (^oR)	Temperature, T_s	692.7	^oA (^oR)
Pressure Meter, P_m	29.923	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	163.200	dscf	Velocity, V_s	78.73	fps
	4.621	dscm	Volume (actual)	23,189.1	awcfm
Actual Volume, $V_{m(actual)}$	220.353	awcf		22,736.9	adcfm
Gas Stream Moisture			Volume (standard)	1,051,388.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.242	scf		1,030,886.7	dscf/hr
Moisture, B_{ws}	0.0195			17,181.4	dscf/min
Moisture EPA M4	1.95	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.5	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**16:18**
Source:	**CFU 104**	**End Time:**	**19:23**
Method:	**29**	**Date:**	**09/27/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
7.5	6.730	2.60	84	1	1.40	234	1.1832
15.0	13.620	2.60	85	2	1.40	234	1.1832
22.5	20.600	2.80	85	3	1.50	236	1.2247
30.0	27.710	2.80	85	4	1.50	235	1.2247
37.5	34.740	2.80	85	5	1.50	235	1.2247
45.0	41.810	2.80	86	6	1.50	236	1.2247
52.5	48.650	2.60	86	7	1.40	236	1.1832
60.0	55.220	2.40	87	8	1.30	235	1.1402
67.5	61.850	2.40	87	9	1.30	235	1.1402
75.0	68.370	2.40	87	10	1.30	236	1.1402
82.5	75.230	2.60	87	11	1.40	235	1.1832
90.0	82.101	2.60	87	12	1.40	234	1.1832
97.5	89.230	2.80	86	13	1.50	231	1.2247
105.0	96.300	2.80	86	14	1.50	232	1.2247
112.5	103.390	2.80	86	15	1.50	231	1.2247
120.0	110.470	2.80	86	16	1.50	231	1.2247
127.5	117.800	3.00	86	17	1.60	231	1.2649
135.0	124.900	2.80	85	18	1.50	231	1.2247
142.5	131.710	2.60	85	19	1.40	231	1.1832
150.0	138.500	2.60	85	20	1.40	230	1.1832
157.5	145.310	2.60	84	21	1.40	230	1.1832
165.0	151.890	2.40	84	22	1.30	230	1.1402
172.5	158.430	2.40	84	23	1.30	230	1.1402
180.0	164.975	2.40	83	24	1.30	228	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 104**	**Date:**	**09/27/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	30.000	in
Meter Volume, V_m	164.975	dcf	Rectangular		
Water Volume	52.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.72	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.82	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	2.642	"H_2O	$\sqrt{Dp}$	1.1914	"H_2O
Temperature, T_m	85.5	^oF	Temperature, T_s	232.8	^oF
Temperature, T_m	545.5	^oA (^oR)	Temperature, T_s	692.8	^oA (^oR)
Pressure Meter, P_m	29.914	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	159.347	dscf	Velocity, V_s	77.13	fps
	4.512	dscm	Volume (actual)	22,717.9	awcfm
Actual Volume, $V_{m(actual)}$	214.286	awcf		22,368.0	adcfm
Gas Stream Moisture			Volume (standard)	1,029,873.2	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.489	scf		1,014,013.2	dscf/hr
Moisture, B_{ws}	0.0154			16,900.2	dscf/min
Moisture EPA M4	1.54	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.74	lb/lb-mole			

Percent Isokinetic 99.7 %

Source:	CFU 104					Sample Date:	09/27/18
Run:		1					
Client ID:		Filter + Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.520		0.547	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		1.180	<	MDL	0.100	0.040	µg/sample
Chromium		1.830		0.198	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		3.480		2.180	1.250	0.500	µg/sample
Lead		7.560	<	MDL	1.250	0.500	µg/sample
Manganese		1.690		0.407	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		29.400	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		11.000		4.400	0.750	0.300	µg/sample
Lab ID:		18-S2363		18-S2364			
Sample Vol:		250		100			mL

Source:	CFU 104					Sample Date:	09/27/18
Run:		2					
Client ID:		Filter + Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.370		0.521	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		1.200	<	MDL	0.100	0.040	µg/sample
Chromium		1.390		0.656	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		2.130		2.810	1.250	0.500	µg/sample
Lead		7.400	<	MDL	1.250	0.500	µg/sample
Manganese		1.410		0.538	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		33.300	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		6.070		3.760	0.750	0.300	µg/sample
Lab ID:		18-S2365		18-S2366			
Sample Vol:		250		100			mL

Source:	CFU 104				Sample Date: 09/27/18		
Run:		3					
Client ID:		Filter + Front Half		Back Half			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	<	MDL	<	MDL	1.250	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.750	0.700	µg/sample
Barium		3.310		0.474	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium		1.260	<	MDL	0.100	0.040	µg/sample
Chromium		1.270		0.269	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		1.920		2.460	1.250	0.500	µg/sample
Lead		6.740	<	MDL	1.250	0.500	µg/sample
Manganese		1.340		0.445	0.075	0.030	µg/sample
Nickel	<	MDL	<	MDL	0.750	0.300	µg/sample
Phosphorus		31.000	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		5.430		1.350	0.750	0.300	µg/sample
Lab ID:		18-S2367		18-S2368			
Sample Vol:		250		100			mL

Source: **CFU 104**

Blank Values

Client ID:		Filter	MDL		BH Capture Soln.	MDL		FH/BH Rinse	MDL
Analyte	<	µg/sample	Filter MDL µg/sample	<	5% HNO_3/ 10% H_2O_2 µg/sample	5% HNO_3/ 10% H_2O_2 MDL µg/sample	<	0.1 N HNO_3 µg/sample	0.1 N HNO_3 MDL µg/sample
Antimony	<	MDL	1.250	<	MDL	0.500	<	MDL	1.250
Arsenic	<	MDL	1.750	<	MDL	0.700	<	MDL	1.750
Barium		2.820	0.125		0.423	0.050		0.454	0.125
Beryllium	<	MDL	0.050	<	MDL	0.020	<	MDL	0.050
Cadmium		0.365	0.100	<	MDL	0.040	<	MDL	0.100
Chromium		0.953	0.200		0.154	0.080	<	MDL	0.200
Cobalt	<	MDL	0.125	<	MDL	0.050	<	MDL	0.125
Copper	<	MDL	1.250		2.750	0.500		2.120	1.250
Lead	<	MDL	1.250	<	MDL	0.500	<	MDL	1.250
Manganese		1.030	0.075		0.980	0.030		0.206	0.075
Nickel	<	MDL	0.750	<	MDL	0.300	<	MDL	0.750
Phosphorus		13.400	5.000	<	MDL	2.000	<	MDL	5.000
Selenium	<	MDL	3.750	<	MDL	1.500	<	MDL	3.750
Zinc		1.240	0.750		0.724	0.300	<	MDL	0.750
Lab ID:		18-S2237			18-S2238			18-S2236	
Sample Vol, ml:		250			100			250	

Hollingsworth & Vose

CFU 104

09/27/18

Method 29 Metals Blank Calculations

Run: 1

	I	II	III	IV	V	VI	VII	VIII	
	Sample*	Blank*	Blank*	Sample*	Blank*	BH Blank*	BH Blank*	Allowable	
	FH	FH	FH	BH	BH	Corrected	Corrected	BH	
Species	Wash+Filter	Wash, µg	Filter, µg	Cap.Sol.	Cap.Sol.	Cap.Sol.	Wash, µg	Blank, µg	Species
Volume(ml)	100	100	N/A	100	µg/mL	200	100		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.520	0.1816	2.820	0.547	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	1.180	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.830	< 0.0800	0.953	0.198	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	3.480	0.8480	< 1.250	2.180	0.0275	5.500	0.8480	6.348	**Copper**
Pb	7.560	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.690	0.0824	1.030	0.407	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	29.400	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	11.000	< 0.3000	1.240	4.400	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2363**	**18-S2236**	**18-S2237**	**18-S2364**	**18-S2238**				
Content:	$0.1NHNO_3$	$0.1NHNO_3$	$0.1NHNO_3$	$5\%HNO_3/$	$5\%HNO_3/$	$5\%HNO_3/$	$0.1NHNO_3$		
	FH Filter & Probe Rinse			$10\%H_2O_2$	$10\%H_2O_2$	$10\%H_2O_2$			
	100ml 0.1N HNO_3 rinse			BH Imps 1&2					
		Same as BH		100ml .1N HNO_3 rinse			Same as FH		
		Blank Wash		200ml $5\%HNO_3/10\%H_2O_2$ reagent			Blank Wash		

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

9/27/18

Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg		XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII		XV FH Net Sample, μg	Species
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.176	0.176	11.63		0.518	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.059	0.059	11.63		0.815	**Cadmium**
Cr	0.953	0.953		0.092	0.092	11.63		0.877	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.174	0.174	11.63		2.632	**Copper**
Pb	0.000	0.000		0.378	0.000	11.63		7.560	**Lead**
Mn	1.112	1.112		0.085	0.085	11.63		0.578	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		1.470	1.470	11.63		17.770	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.550	0.550	11.63		9.760	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

*** Blank Rules:**
"<" indicates value is below the minimum detection limit (MDL)
If Blank is a "<" value it is treated as zero.
If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

9/27/18

Species	XVI Allowable BH Blank, μg	XVII Blank BH Total	XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of $1\mu g$ or XIX	XXI BH Net Sample, μg	XXII FH Net Sample, μg	XXIII FH+BH Total Net Sample, μg	Species
Sb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.027	0.027	1.000	**0.000**	**0.518**	**0.518**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.815** <	**0.855**	**Cadmium**
Cr	0.308	0.308	0.010	0.010	1.000	**0.000**	**0.877**	**0.877**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125** <	**0.175**	**Cobalt**
Cu	1.000	6.348	0.109	0.109	1.000	**1.180**	**2.632**	**3.812**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500**	**7.560** <	**8.060**	**Lead**
Mn	1.000	2.042	0.020	0.020	1.000	**0.000**	**0.578**	**0.578**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**17.770** <	**19.770**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.220	0.220	1.000	**3.400**	**9.760**	**13.160**	**Zinc**

Allowable BH Blank Calculation:

if 1.00μg >blank>0, use blank derived

if blank >1.00μg , use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

*** Blank Rules:**

"<" indicates value is below the minimum detection limit (MDL)

If Blank is a "<" value it is treated as zero.

If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

CFU 104

09/27/18

Species	I Sample* FH Wash+Filter	II Blank* FH Wash, µg	III Blank* FH Filter, µg	IV Sample* BH Cap.Sol.	V Blank* BH Cap.Sol.	VI BH Blank* Corrected Cap.Sol.	VII BH Blank* Corrected Wash, µg	VIII Allowable BH Blank, µg	Species
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.370	0.1816	2.820	0.521	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	1.200	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.390	< 0.0800	0.953	0.656	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	2.130	0.8480	< 1.250	2.810	0.0275	5.500	0.8480	6.348	**Copper**
Pb	7.400	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.410	0.0824	1.030	0.538	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	33.300	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	6.070	< 0.3000	1.240	3.760	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2365**	**18-S2236**	**18-S2237**	**#REF!**	**18-S2238**				
Content:	$0.1NHNO_3$	$0.1NHNO_3$	$0.1NHNO_3$	$5\%HNO_3/$ $10\%H_2O_2$	$5\%HNO_3/$ $10\%H_2O_2$	$5\%HNO_3/$ $10\%H_2O_2$	$0.1NHNO_3$		
	FH Filter & Probe Rinse			BH Imps 1&2					
	100ml 0.1N HNO_3 rinse	Same as BH Blank Wash		100ml .1N HNO_3 rinse			Same as FH Blank Wash		
				200ml $5\%HNO_3/10\%H_2O_2$ reagent					

Blanks are prorated to reflect 100ml for HNO_3 and 200ml for HNO_3/H_2O_2

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If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

9/27/18

Species	**X Allowable FH Blank, μg**	**XI FH Blank Corrected μg**		**XII 5% of FH Sample, μg**	**XIII Lessor of XI or XII**	**XIV Greater of A or XIII**		**XV FH Net Sample, μg**	**Species**
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.169	0.169	11.63		0.368	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.060	0.060	11.63		0.835	**Cadmium**
Cr	0.953	0.953		0.070	0.070	11.63		0.437	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.107	0.107	11.63		1.282	**Copper**
Pb	0.000	0.000		0.370	0.000	11.63		7.400	**Lead**
Mn	1.112	1.112		0.071	0.071	11.63		0.298	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		1.665	1.665	11.63		21.670	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.304	0.304	11.63		4.830	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

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9/27/18

Species	XVI Allowable BH Blank, µg	XVII Blank BH Total	XVIII 5% of BH sample, µg	XIX Lessor of XVII or XVIII	XX Greater of 1µg or XIX	XXI BH Net Sample, µg	XXII FH Net Sample, µg	XXIII FH+BH Total Net Sample, µg	Species
Sb	0.000	0.000	< 0.025	0.000	1.000	**< 0.500**	**< 1.250**	**< 1.750**	**Antimony**
As	0.000	0.000	< 0.035	0.000	1.000	**< 0.700**	**< 1.750**	**< 2.450**	**Arsenic**
Ba	1.000	1.028	0.026	0.026	1.000	**0.000**	**0.368**	**0.368**	**Barium**
Be	0.000	0.000	< 0.001	0.000	1.000	**< 0.020**	**< 0.050**	**< 0.070**	**Beryllium**
Cd	0.000	0.000	< 0.002	0.000	1.000	**< 0.040**	**0.835**	**< 0.875**	**Cadmium**
Cr	0.308	0.308	0.033	0.033	1.000	**0.348**	**0.437**	**0.785**	**Chromium**
Co	0.000	0.000	< 0.003	0.000	1.000	**< 0.050**	**< 0.125**	**< 0.175**	**Cobalt**
Cu	1.000	6.348	0.141	0.141	1.000	**1.810**	**1.282**	**3.092**	**Copper**
Pb	0.000	0.000	< 0.025	0.000	1.000	**< 0.500**	**7.400**	**< 7.900**	**Lead**
Mn	1.000	2.042	0.027	0.027	1.000	**0.000**	**0.298**	**0.298**	**Manganese**
Ni	0.000	0.000	< 0.015	0.000	1.000	**< 0.300**	**< 0.750**	**< 1.050**	**Nickel**
P	0.000	0.000	< 0.100	0.000	1.000	**< 2.000**	**21.670**	**< 23.670**	**Phosphorus**
Se	0.000	0.000	< 0.075	0.000	1.000	**< 1.500**	**< 3.750**	**< 5.250**	**Selenium**
Zn	1.000	1.448	0.188	0.188	1.000	**2.760**	**4.830**	**7.590**	**Zinc**

Allowable BH Blank Calculation:

if 1.00µg >blank>0, use blank derived

if blank >1.00µg , use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

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CFU 104

09/27/18

Species	I Sample* FH Wash+Filter	II Blank* FH Wash, µg	III Blank* FH Filter, µg	IV Sample* BH Cap.Sol.	V Blank* BH Cap.Sol.	VI BH Blank* Corrected Cap.Sol.	VII BH Blank* Corrected Wash, µg	VIII Allowable BH Blank, µg	Species
Volume(ml)	**100**	**100**	**N/A**	**100**	**µg/mL**	**200**	**100**		
Sb	< 1.250	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Antimony**
As	< 1.750	< 0.7000	< 1.750	< 0.700	< 0.0070	< 1.400	< 0.7000	0.000	**Arsenic**
Ba	3.310	0.1816	2.820	0.474	0.0042	0.846	0.1816	1.028	**Barium**
Be	< 0.050	< 0.0200	< 0.050	< 0.020	< 0.0002	< 0.040	< 0.0200	0.000	**Beryllium**
Cd	1.260	< 0.0400	0.365	< 0.040	< 0.0004	< 0.080	< 0.0400	0.000	**Cadmium**
Cr	1.270	< 0.0800	0.953	0.269	0.0015	0.308	< 0.0800	0.308	**Chromium**
Co	< 0.125	< 0.0500	< 0.125	< 0.050	< 0.0005	< 0.100	< 0.0500	0.000	**Cobalt**
Cu	1.920	0.8480	< 1.250	2.460	0.0275	5.500	0.8480	6.348	**Copper**
Pb	6.740	< 0.5000	< 1.250	< 0.500	< 0.0050	< 1.000	< 0.5000	0.000	**Lead**
Mn	1.340	0.0824	1.030	0.445	0.0098	1.960	0.0824	2.042	**Manganese**
Ni	< 0.750	< 0.3000	< 0.750	< 0.300	< 0.0030	< 0.600	< 0.3000	0.000	**Nickel**
P	31.000	< 2.0000	13.400	< 2.000	< 0.0200	< 4.000	< 2.0000	0.000	**Phosphorus**
Se	< 3.750	< 1.5000	< 3.750	< 1.500	< 0.0150	< 3.000	< 1.5000	0.000	**Selenium**
Zn	5.430	< 0.3000	1.240	1.350	0.0072	1.448	< 0.3000	1.448	**Zinc**
Lab:	**18-S2367**	**18-S2236**	**18-S2237**	**18-S2368**	**18-S2238**				
Content:	0.1NHNO$_3$	0.1NHNO$_3$	0.1NHNO$_3$	5%HNO$_3$/ 10%H$_2$O$_2$	5%HNO$_3$/ 10%H$_2$O$_2$	5%HNO$_3$/ 10%H$_2$O$_2$	0.1NHNO$_3$		
	FH Filter & Probe Rinse 100ml 0.1N HNO$_3$ rinse	Same as BH Blank Wash		BH Imps 1&2 100ml .1N HNO$_3$ rinse 200ml 5%HNO$_3$/10%H$_2$O$_2$ reagent			Same as FH Blank Wash		

Blanks are prorated to reflect 100ml for HNO$_3$ and 200ml for HNO$_3$/H$_2$O$_2$

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Species	X Allowable FH Blank, μg	XI FH Blank Corrected μg		XII 5% of FH Sample, μg	XIII Lessor of XI or XII	XIV Greater of A or XIII		XV FH Net Sample, μg	Species
Sb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	3.002	3.002		0.166	0.166	11.63		0.308	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.365	0.365		0.063	0.063	11.63		0.895	**Cadmium**
Cr	0.953	0.953		0.064	0.064	11.63		0.317	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.848	0.848		0.096	0.096	11.63		1.072	**Copper**
Pb	0.000	0.000		0.337	0.000	11.63		6.740	**Lead**
Mn	1.112	1.112		0.067	0.067	11.63		0.228	**Manganese**
Ni	0.000	0.000	<	0.038	0.000	11.63	<	0.750	**Nickel**
P	11.630	13.400		1.550	1.550	11.63		19.370	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.240	1.240		0.272	0.272	11.63		4.190	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
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Species	**XVI Allowable BH Blank, μg**	**XVII Blank BH Total**	**XVIII 5% of BH sample, μg**	**XIX Lessor of XVII or XVIII**	**XX Greater of $1\mu g$ or XIX**	**XXI BH Net Sample, μg**	**XXII FH Net Sample, μg**	**XXIII FH+BH Total Net Sample, μg**	**Species**
Sb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250** <	**1.750**	**Antimony**
As	0.000	0.000 <	0.035	0.000	1.000 <	**0.700 <**	**1.750** <	**2.450**	**Arsenic**
Ba	1.000	1.028	0.024	0.024	1.000	**0.000**	**0.308**	**0.308**	**Barium**
Be	0.000	0.000 <	0.001	0.000	1.000 <	**0.020 <**	**0.050** <	**0.070**	**Beryllium**
Cd	0.000	0.000 <	0.002	0.000	1.000 <	**0.040**	**0.895** <	**0.935**	**Cadmium**
Cr	0.308	0.308	0.013	0.013	1.000	**0.000**	**0.317**	**0.317**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125** <	**0.175**	**Cobalt**
Cu	1.000	6.348	0.123	0.123	1.000	**1.460**	**1.072**	**2.532**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500**	**6.740** <	**7.240**	**Lead**
Mn	1.000	2.042	0.022	0.022	1.000	**0.000**	**0.228**	**0.228**	**Manganese**
Ni	0.000	0.000 <	0.015	0.000	1.000 <	**0.300 <**	**0.750** <	**1.050**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000**	**19.370** <	**21.370**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750** <	**5.250**	**Selenium**
Zn	1.000	1.448	0.068	0.068	1.000	**0.350**	**4.190**	**4.540**	**Zinc**

Allowable BH Blank Calculation:

if $1.00\mu g$ >blank>0, use blank derived

if blank >$1.00\mu g$, use greater of 1.00 or 5% of sample ug or BH blank whichever is lessor

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EPA Method 29
Gas Stream Characteristics
Test Summary

Client: Hollingsworth & Vose
Source: CFU 104
Location: Corvallis, OR

Run			1	2	3	
Date			9/27/2018	9/27/2018	9/27/2018	
Run Start Time			9:30	12:53	16:18	
Run End Time			12:35	16:00	19:23	
Duration, min.			180	180	180	**Average**
Barometric Pressure, "Hg			29.72	29.72	29.72	**29.72**
Nozzle Dia., in.			0.2173	0.2173	0.2173	**0.2173**
Isokinetic Average, %			99.7	100.5	99.7	**100.0**
Sample Volume, dscf			161.001	163.200	159.347	**161.183**
Sample Volume, dscm			4.559	4.621	4.512	**4.564**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.71	0.72	0.72	**0.72**
O_2 %vd			19.92	19.93	19.82	**19.89**
Static Press., "H_2O			-0.79	-0.79	-0.79	**-0.79**
H_2O %v			1.99	1.95	1.54	**1.83**
Wet Molecular Weight, lb/lb-mole			28.69	28.70	28.74	**28.71**
Velocity, FPS			76.22	78.73	77.13	**77.36**
ADCFM			22,003.0	22,736.9	22,368.0	**22,369.3**
AWCFM			22,449.8	23,189.1	22,717.9	**22,785.6**
DSCFM			17,080.6	17,181.4	16,900.2	**17,054.1**
Stack Temperature, ^oF			214.3	232.7	232.8	**226.6**
Production Data	**Glass Production**	**lbs/hr**	367.4	374.6	375.4	**372.5**

Hollingsworth & Vose **Test: M29**
CFU 104
Metals Results Summary

Run 1													
	Total				**FH Net**				**BH Net**				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 1.750	< 0.384	< 2.46E-05	< 6.68E-08	< 1.250	< 0.274	< 1.75E-05	< 4.77E-08	< 0.500	< 0.110	< 7.02E-06	< 1.91E-08	**Sb**
Arsenic	< 2.450	< 0.537	< 3.44E-05	< 9.36E-08	< 1.750	< 0.384	< 2.46E-05	< 6.68E-08	< 0.700	< 0.154	< 9.82E-06	< 2.67E-08	**As**
Barium	0.518	0.114	7.28E-06	1.98E-08	0.518	0.114	7.28E-06	1.98E-08	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.015	< 9.82E-07	< 2.67E-09	< 0.050	< 0.011	< 7.02E-07	< 1.91E-09	< 0.020	< 0.004	< 2.81E-07	< 7.65E-10	**Be**
Cadmium	< 0.855	< 0.188	< 1.20E-05	< 3.27E-08	0.815	0.179	1.14E-05	3.11E-08	< 0.040	< 0.009	< 5.61E-07	< 1.53E-09	**Cd**
Chromium	0.877	0.192	1.23E-05	3.35E-08	0.877	0.192	1.23E-05	3.35E-08	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.038	< 2.46E-06	< 6.68E-09	< 0.125	< 0.027	< 1.75E-06	< 4.77E-09	< 0.050	< 0.011	< 7.02E-07	< 1.91E-09	**Co**
Copper	3.812	0.836	5.35E-05	1.46E-07	2.632	0.577	3.69E-05	1.01E-07	1.180	0.259	1.66E-05	4.51E-08	**Cu**
Lead	< 8.060	< 1.768	< 1.13E-04	< 3.08E-07	7.560	1.658	1.06E-04	2.89E-07	< 0.500	< 0.110	< 7.02E-06	< 1.91E-08	**Pb**
Manganese	0.578	0.127	8.11E-06	2.21E-08	0.578	0.127	8.11E-06	2.21E-08	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.230	< 1.47E-05	< 4.01E-08	< 0.750	< 0.165	< 1.05E-05	< 2.86E-08	< 0.300	< 0.066	< 4.21E-06	< 1.15E-08	**Ni**
Phosphorus	< 19.770	< 4.336	< 2.77E-04	< 7.55E-07	17.770	3.898	2.49E-04	6.79E-07	< 2.000	< 0.439	< 2.81E-05	< 7.64E-08	**P**
Selenium	< 5.250	< 1.152	< 7.37E-05	< 2.01E-07	< 3.750	< 0.823	< 5.26E-05	< 1.43E-07	< 1.500	< 0.329	< 2.11E-05	< 5.729E-08	**Se**
Zinc	13.160	2.887	1.85E-04	5.03E-07	9.760	2.141	1.37E-04	3.73E-07	3.400	0.746	4.77E-05	1.299E-07	**Zn**

Run 2													
	Total				**FH Net**				**BH Net**				
Species	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	**µg**	**µg/dscm**	**lb/hr**	**lb/lb glass**	
Antimony	< 1.750	< 0.379	< 2.44E-05	< 6.51E-08	< 1.250	< 0.271	< 1.74E-05	< 4.65E-08	< 0.500	< 0.108	< 6.96E-06	< 1.86E-08	**Sb**
Arsenic	< 2.450	< 0.530	< 3.41E-05	< 9.11E-08	< 1.750	< 0.379	< 2.44E-05	< 6.51E-08	< 0.700	< 0.151	< 9.75E-06	< 2.60E-08	**As**
Barium	0.368	0.080	5.13E-06	1.37E-08	0.368	0.080	5.13E-06	1.37E-08	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.015	< 9.75E-07	< 2.60E-09	< 0.050	< 0.011	< 6.96E-07	< 1.86E-09	< 0.020	< 0.004	< 2.79E-07	< 7.45E-10	**Be**
Cadmium	< 0.875	< 0.189	< 1.22E-05	< 3.25E-08	0.835	0.181	1.16E-05	3.10E-08	< 0.040	< 0.009	< 5.57E-07	< 1.49E-09	**Cd**
Chromium	0.785	0.170	1.09E-05	2.92E-08	0.437	0.095	6.09E-06	1.62E-08	0.348	0.075	4.85E-06	1.29E-08	**Cr**
Cobalt	< 0.175	< 0.038	< 2.44E-06	< 6.51E-09	< 0.125	< 0.027	< 1.74E-06	< 4.65E-09	< 0.050	< 0.011	< 6.96E-07	< 1.86E-09	**Co**
Copper	3.092	0.669	4.31E-05	1.15E-07	1.282	0.277	1.79E-05	4.77E-08	1.810	0.392	2.52E-05	6.73E-08	**Cu**
Lead	< 7.900	< 1.710	< 1.10E-04	< 2.94E-07	7.400	1.601	1.03E-04	2.75E-07	< 0.500	< 0.108	< 6.96E-06	< 1.86E-08	**Pb**
Manganese	0.298	0.064	4.15E-06	1.11E-08	0.298	0.064	4.15E-06	1.11E-08	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.050	< 0.227	< 1.46E-05	< 3.90E-08	< 0.750	< 0.162	< 1.04E-05	< 2.79E-08	< 0.300	< 0.065	< 4.18E-06	< 1.12E-08	**Ni**
Phosphorus	< 23.670	< 5.122	< 3.30E-04	< 8.80E-07	21.670	4.689	3.02E-04	8.06E-07	< 2.000	< 0.433	< 2.79E-05	< 7.44E-08	**P**
Selenium	< 5.250	< 1.136	< 7.31E-05	< 1.95E-07	< 3.750	< 0.812	< 5.22E-05	< 1.39E-07	< 1.500	< 0.325	< 2.09E-05	< 5.58E-08	**Se**
Zinc	7.590	1.643	1.06E-04	2.82E-07	4.830	1.045	6.73E-05	1.80E-07	2.760	0.597	3.84E-05	1.03E-07	**Zn**

Hollingsworth & Vose **Test: M29**
CFU 104
Metals Results Summary

Run 3													
	Total				FH Net				BH Net				
Species	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	
Antimony	< 1.750	< 0.388	< 2.46E-05	< 6.54E-08	< 1.250	< 0.277	< 1.75E-05	< 4.67E-08	< 0.500	< 0.111	< 7.02E-06	< 1.87E-08	Sb
Arsenic	< 2.450	< 0.543	< 3.44E-05	< 9.16E-08	< 1.750	< 0.388	< 2.46E-05	< 6.54E-08	< 0.700	< 0.155	< 9.82E-06	< 2.62E-08	As
Barium	0.308	0.068	4.33E-06	1.15E-08	0.308	0.068	4.33E-06	1.15E-08	0.000	0.000	0.00E+00	0.00E+00	Ba
Beryllium	< 0.070	< 0.016	< 9.82E-07	< 2.62E-09	< 0.050	< 0.011	< 7.01E-07	< 1.87E-09	< 0.020	< 0.004	< 2.81E-07	< 7.49E-10	Be
Cadmium	< 0.935	< 0.207	< 1.31E-05	< 3.49E-08	0.895	0.198	1.26E-05	3.34E-08	< 0.040	< 0.009	< 5.61E-07	< 1.49E-09	Cd
Chromium	0.317	0.070	4.45E-06	1.18E-08	0.317	0.070	4.45E-06	1.18E-08	0.000	0.000	0.00E+00	0.00E+00	Cr
Cobalt	< 0.175	< 0.039	< 2.46E-06	< 6.54E-09	< 0.125	< 0.028	< 1.75E-06	< 4.67E-09	< 0.050	< 0.011	< 7.01E-07	< 1.87E-09	Co
Copper	2.532	0.561	3.55E-05	9.46E-08	1.072	0.238	1.50E-05	4.01E-08	1.460	0.324	2.05E-05	5.46E-08	Cu
Lead	< 7.240	< 1.605	< 1.02E-04	< 2.71E-07	6.740	1.494	9.46E-05	2.52E-07	< 0.500	< 0.111	< 7.02E-06	< 1.87E-08	Pb
Manganese	0.228	0.050	3.19E-06	8.51E-09	0.228	0.050	3.19E-06	8.51E-09	0.000	0.000	0.00E+00	0.00E+00	Mn
Nickel	< 1.050	< 0.233	< 1.47E-05	< 3.92E-08	< 0.750	< 0.166	< 1.05E-05	< 2.80E-08	< 0.300	< 0.066	< 4.21E-06	< 1.12E-08	Ni
Phosphorus	< 21.370	< 4.736	< 3.00E-04	< 7.99E-07	19.370	4.293	2.72E-04	7.24E-07	< 2.000	< 0.443	< 2.81E-05	< 7.47E-08	P
Selenium	< 5.250	< 1.164	< 7.37E-05	< 1.96E-07	< 3.750	< 0.831	< 5.26E-05	< 1.40E-07	< 1.500	< 0.332	< 2.10E-05	< 5.606E-08	Se
Zinc	4.540	1.006	6.37E-05	1.70E-07	4.190	0.929	5.88E-05	1.57E-07	0.350	0.078	4.91E-06	1.308E-08	Zn

Mean Runs 1-3													
	Total				FH Net				BH Net				
Species	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	µg	µg/dscm	lb/hr	lb/lb glass	
Antimony	< 1.750	< 0.383	< 2.45E-05	< 6.58E-08	< 1.250	< 0.274	< 1.75E-05	< 4.70E-08	< 0.500	< 0.110	< 7.00E-06	< 1.88E-08	Sb
Arsenic	< 2.450	< 0.537	< 3.43E-05	< 9.21E-08	< 1.750	< 0.383	< 2.45E-05	< 6.58E-08	< 0.700	< 0.153	< 9.80E-06	< 2.63E-08	As
Barium	0.398	0.087	5.58E-06	1.50E-08	0.398	0.087	5.58E-06	1.50E-08	0.000	0.000	0.00E+00	0.00E+00	Ba
Beryllium	< 0.070	< 0.015	< 9.80E-07	< 2.63E-09	< 0.050	< 0.011	< 7.00E-07	< 1.88E-09	< 0.020	< 0.004	< 2.80E-07	< 7.53E-10	Be
Cadmium	< 0.888	< 0.195	< 1.24E-05	< 3.34E-08	0.848	0.186	1.19E-05	3.19E-08	< 0.040	< 0.009	< 5.60E-07	< 1.50E-09	Cd
Chromium	0.660	0.144	9.23E-06	2.48E-08	0.544	0.119	7.61E-06	2.05E-08	0.116	0.025	1.62E-06	4.31E-09	Cr
Cobalt	< 0.175	< 0.038	< 2.45E-06	< 6.58E-09	< 0.125	< 0.027	< 1.75E-06	< 4.70E-09	< 0.050	< 0.011	< 7.00E-07	< 1.88E-09	Co
Copper	3.145	0.689	4.40E-05	1.18E-07	1.662	0.364	2.33E-05	6.28E-08	1.483	0.325	2.08E-05	5.56E-08	Cu
Lead	< 7.733	< 1.694	< 1.08E-04	< 2.91E-07	7.233	1.584	1.01E-04	2.72E-07	< 0.500	< 0.110	< 7.00E-06	< 1.88E-08	Pb
Manganese	0.368	0.081	5.15E-06	1.39E-08	0.368	0.081	5.15E-06	1.39E-08	0.000	0.000	0.00E+00	0.00E+00	Mn
Nickel	< 1.050	< 0.230	< 1.47E-05	< 3.95E-08	< 0.750	< 0.164	< 1.05E-05	< 2.82E-08	< 0.300	< 0.066	< 4.20E-06	< 1.13E-08	Ni
Phosphorus	< 21.603	< 4.732	< 3.02E-04	< 8.11E-07	19.603	4.293	2.74E-04	7.36E-07	< 2.000	< 0.438	< 2.80E-05	< 7.52E-08	P
Selenium	< 5.250	< 1.150	< 7.35E-05	< 1.97E-07	< 3.750	< 0.822	< 5.25E-05	< 1.41E-07	< 1.500	< 0.329	< 2.10E-05	< 5.637E-08	Se
Zinc	8.430	1.845	1.18E-04	3.18E-07	6.260	1.372	8.77E-05	2.36E-07	2.170	0.474	3.04E-05	8.185E-08	Zn
Total:	**< 53.971**	**< 11.821**	**< 7.55E-04**	**< 2.03E-06**	< 44.592	< 9.768	< 6.24E-04	< 1.68E-06	< 9.379	< 2.053	< 1.31E-04	< 3.53E-07	

'<' denotes results calculated using the minimum detection limit for front half or back half results that were non-detect.

EPA Methods 1-4, 29
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:30**
Source:	**CFU 104**	**End Time:**	**12:35**
Method:	**29**	**Date:**	**9/27/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.915 "Hg
   - where Pb: 29.72 "Hg
   - ΔH: 2.646 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.662 "Hg
   - where Pb: 29.72 "Hg
   - Static Press.: -0.79 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 161.001 dscf
   - where Vm: 160.601 dcf
   - Y: 0.9985
   - Pm: 29.915 "Hg
   - Tm: 525.6 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 3.266 scf
   - where H_2O: 69.40 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0199
   - where Vw(std): 3.266 scf
   - Vm(std): 161.001 dscf

6) $\% H_2O = Bws \times 100 =$ 1.99 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 211.696 awcf
   - where Y: 0.9985
   - Vm: 160.6009 dcf
   - Bws: 0.0199
   - Ts: 674.3 °A
   - Tm: 525.6 °A
   - Pm: 29.915 "Hg
   - Ps: 29.662 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.91 lb/lb-mole
   - where CO_2: 0.71 %vd
   - O_2 19.92 %vd
   - $N_2+CO= (100-(O_2+CO_2)$: 79.37 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.69 lb/lb-mole

where M_d:	28.91	lb/lb-mole
Bws:	0.0199	

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 4.909 sq. ft.

where Stack ID:	30	inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.

where Stack Width:	0.000	inches
Stack Length:	0.000	inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 76.22 fps

where Cp:	0.84	
Ave. Sqrt ΔP:	1.1924	
Ts:	674.3	°A
Ps:	29.662	"Hg
Ms:	28.69	lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 22,449.8 AWCFM

where V_s:	76.22	ft/sec
Stack Area:	4.909	sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 22,003.0 ADCFM

where AWCFM:	22,449.8	
Bws:	0.0199	

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,045,644.6 wscf/hr

where V_s:	76.22	ft/sec
Stack Area:	4.9090	sq. ft.
Ts:	674.3	°A
Ps:	29.662	"Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,024,836.3 dscf/hr

where wscf/hr:	1,045,644.6	
Bws:	0.0199	

16) DSCFM= (dscf/hr)/60 mins/hr = 17,080.6 DSCFM

where dscf/hr:	1,024,836.3	

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000258 sq. ft.

where Nozzle Size:	0.2173	inches

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right) =$ 99.7 %

where Ts:	674.3	°A
Vm(Std):	161.001	dscf
Ps:	29.662	"Hg
Vs	76.22	ft/sec
Nozzle Area:	0.000258	sq. ft.
Sampling Time:	180	min.
Bws:	0.0199	

EPA Method 29:
Chromium

19) Cr Laboratory Results (blank corrected)

Front half (FH):	0.877	µg/sample
Back half (BH):	0.000	µg/sample
Total (FH + BH):	0.877	µg/sample

20) Cs = µg/Vm(std) = 0.192 µg/dscm

where Run 1 Total:	0.877	µg/sample
Vm(std):	4.559	dscm

21) Emission Rate $= (Cs)\left(\frac{2.83168\ m^3}{ft^3}\right)(\text{stack flow})\left(\frac{2.2046E-9\ lb}{\mu g}\right) =$ 1.23E-05 lb/hr

where Cs:	0.192	µg/dscm
Stack Flow:	1,024,836.3	dscf/hr

COMPANY	**Hollingsworth &Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 104**
DATE(S)	**09/27/18**
METHOD	**30B**
POLLUTANT	**Mercury**

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth &Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:30**
Source:	**CFU 104**	**End Time:**	**12:35**
EPA Method:	**30B**	**Start Date:**	**9/27/2018**
Box Operator:	**CMF**	**End Date:**	**9/27/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.72 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN 30B	
Probe heat:	267 F	
Meterbox ID:	HLN Duel 30B	HLN Duel 30B
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498454	OL486072
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.003	0.003	0.001	0.002

Test Summary:

	Side A	Side B
Sample Volume:	360.871	360.879 L
Ave. Meter Temp:	84.8	87.1 °F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	**Side A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0	0.000	0.000	205	205	66	67	9	8	266	268	2.000	2.000
5	10.150	10.200	205	205	66	67	9	8	266	268	2.030	2.040
10	20.230	20.200	206	206	68	70	9	8	266	268	2.016	2.000
15	30.260	30.170	207	207	69	71	9	8	266	268	2.006	1.994
20	40.300	40.350	208	208	71	73	9	8	266	268	2.008	2.036
25	50.340	50.370	207	207	73	75	9	8	266	268	2.008	2.004
30	60.400	60.470	207	207	75	77	9	8	266	268	2.012	2.020
35	70.570	70.530	211	211	75	77	9	8	266	268	2.034	2.012
40	80.660	80.680	211	211	77	80	9	8	266	268	2.018	2.030
45	90.750	90.710	211	211	78	81	9	9	266	268	2.018	2.006
50	100.890	100.950	211	211	79	82	9	9	266	268	2.028	2.048
55	110.760	110.800	211	211	81	84	9	9	266	268	1.974	1.970
60	120.450	120.540	211	211	81	84	9	9	266	268	1.938	1.948
65	130.290	130.310	211	211	83	86	9	9	266	268	1.968	1.954
70	140.210	140.180	212	212	84	87	9	9	266	268	1.984	1.974
75	150.160	150.180	212	212	87	86	9	9	266	268	1.990	2.000
80	159.830	159.890	212	212	87	89	9	9	266	268	1.934	1.942
85	169.800	169.800	212	212	87	89	9	9	266	268	1.994	1.982
90	179.809	179.837	212	212	88	90	9	9	266	268	2.002	2.007
95	189.950	189.920	216	216	89	91	9	9	266	268	2.028	2.017
100	200.250	200.230	216	216	89	91	9	9	266	268	2.060	2.062
105	210.260	210.300	216	216	90	92	9	9	266	268	2.002	2.014
110	220.030	220.030	216	216	90	92	9	9	266	268	1.954	1.946
115	230.070	230.060	219	219	90	91	9	9	266	268	2.008	2.006
120	240.080	240.090	219	219	91	94	9	9	266	268	2.002	2.006
125	250.130	250.190	219	219	91	94	9	9	266	268	2.010	2.020
130	260.190	260.190	220	220	92	95	9	9	266	268	2.012	2.000
135	270.270	270.250	221	221	93	95	10	9	266	268	2.016	2.012
140	280.390	280.360	221	221	92	95	10	9	266	268	2.024	2.022
145	290.500	290.450	211	211	92	95	10	9	266	268	2.022	2.018
150	300.520	300.520	211	211	93	96	10	9	266	268	2.004	2.014
155	310.560	310.660	211	211	94	97	10	9	266	268	2.008	2.028
160	320.610	320.630	211	211	94	97	10	9	266	268	2.010	1.994
165	330.710	330.660	211	211	94	97	10	9	266	268	2.020	2.006
170	340.760	340.770	211	211	96	99	10	9	266	268	2.010	2.022
175	350.800	350.850	211	211	96	99	10	9	266	268	2.008	2.016
180	360.871	360.879	211	211	96	99	10	9	266	268	2.014	2.006

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth &Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:53**
Source:	**CFU 104**	**End Time:**	**16:00**
EPA Method:	**30B**	**Start Date:**	**9/27/2018**
Box Operator:	**CMF**	**End Date:**	**9/27/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.72 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN 30B	
Probe heat:	267 F	
Meterbox ID:	HLN Duel 30B	HLN Duel 30B
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498441	OL486032
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.003	0.001	0.000	0.000

Test Summary:

	Side A	Side B
Sample Volume:	360.303	360.332 L
Ave. Meter Temp:	89.9	91.8 °F

Time (min.)	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
	Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
0	0.000	0.000	226	226	90	92	10	8	266	268	2.000	2.000
5	10.560	10.490	226	226	90	92	10	8	266	268	2.112	2.098
10	20.750	20.760	226	226	90	92	10	8	266	268	2.038	2.054
15	30.850	30.850	226	226	90	92	10	8	266	268	2.020	2.018
20	40.770	40.770	226	226	88	90	10	8	266	268	1.984	1.984
25	50.750	50.740	227	227	88	90	10	8	266	268	1.996	1.994
30	60.460	60.480	228	228	88	90	10	8	266	268	1.942	1.948
35	70.550	70.570	228	228	88	90	10	8	266	268	2.018	2.018
40	80.150	80.180	228	228	88	90	10	8	266	268	1.920	1.922
45	89.940	89.960	228	228	89	91	10	8	266	268	1.958	1.956
50	99.910	99.930	228	228	89	91	10	8	266	268	1.994	1.994
55	109.860	109.860	231	231	89	91	10	8	266	268	1.990	1.986
60	119.820	119.830	231	231	89	91	10	8	266	268	1.992	1.994
65	129.820	129.860	231	231	89	91	10	8	266	268	2.000	2.006
70	139.910	139.880	231	231	89	91	10	8	266	268	2.018	2.004
75	150.060	150.070	234	234	89	91	10	8	266	268	2.030	2.038
80	160.160	160.150	233	233	89	91	10	8	266	268	2.020	2.016
85	170.290	170.220	233	233	89	91	10	8	266	268	2.026	2.014
90	180.373	180.394	233	233	89	91	10	8	266	268	2.017	2.035
95	190.900	190.910	233	233	89	91	10	8	266	268	2.105	2.103
100	200.980	200.950	233	233	89	91	10	8	266	268	2.016	2.008
105	210.950	210.950	233	233	89	91	10	8	266	268	1.994	2.000
110	220.710	220.720	236	236	90	92	10	8	266	268	1.952	1.954
115	230.590	230.580	236	236	90	92	10	8	266	268	1.976	1.972
120	240.420	240.390	236	236	91	92	10	8	266	268	1.966	1.962
125	250.310	250.270	237	237	91	92	10	8	266	268	1.978	1.976
130	260.260	260.270	237	237	91	92	10	8	266	268	1.990	2.000
135	270.200	270.260	237	237	91	92	10	8	266	268	1.988	1.998
140	280.240	280.200	237	237	91	92	10	8	266	268	2.008	1.988
145	290.300	290.260	237	237	92	94	10	8	266	268	2.012	2.012
150	300.220	300.260	237	237	92	94	10	8	266	268	1.984	2.000
155	310.160	310.140	236	236	92	94	10	8	266	268	1.988	1.976
160	320.120	320.110	236	236	92	94	10	8	266	268	1.992	1.994
165	330.290	330.330	235	235	92	94	10	8	266	268	2.034	2.044
170	340.320	340.380	235	235	92	94	10	8	266	268	2.006	2.010
175	350.460	350.460	235	235	92	94	10	8	266	268	2.028	2.016
180	360.303	360.332	235	235	92	94	10	8	266	268	1.969	1.974

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth &Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**16:18**
Source:	**CFU 104**	**End Time:**	**19:23**
EPA Method:	**30B**	**Start Date:**	**9/27/2018**
Box Operator:	**CMF**	**End Date:**	**9/27/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.72	"Hg
Test duration:	180	min

Equipment:

	Side A	Side B
Probe ID:	HLN 30B	
Probe heat:	267 F	
Meterbox ID:	HLN Duel 30B	HLN Duel 30B
Y factor:	1.0460	1.0380
Desired sampling rate:	2	2 lpm
Trap ID#:	OL498467	OL492723
Spiked @:	0	5 ng
Orifice # (if used):		

Leak Checks:

	Pre-test Side A	Pre-test Side B	Post-test Side A	Post-test Side B
Leak check vacuum, "Hg	20	20	20	20
Train leak rate, lpm	0.000	0.000	0.000	0.000

Test Summary:

	Side A	Side B
Sample Volume:	360.405	360.457 L
Ave. Meter Temp:	91.3	91.9 °F

	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Time (min.)	Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
0	0.000	0.000	234	234	91	92	9	10	266	268	2.000	2.000
5	10.110	9.980	234	234	91	92	9	10	266	268	2.022	1.996
10	20.200	20.350	234	234	91	92	9	10	266	268	2.018	2.074
15	30.650	30.630	234	234	91	92	9	10	266	268	2.090	2.056
20	40.850	40.860	234	234	91	92	9	10	266	268	2.040	2.046
25	50.390	50.400	236	236	92	93	10	10	266	268	1.908	1.908
30	60.280	60.250	236	236	92	93	10	10	266	268	1.978	1.970
35	70.240	70.200	235	235	92	93	10	10	266	268	1.992	1.990
40	80.200	80.180	235	235	92	93	10	10	266	268	1.992	1.996
45	90.400	90.390	235	235	92	93	10	10	266	268	2.040	2.042
50	100.520	100.480	235	235	94	95	10	10	266	268	2.024	2.018
55	110.570	110.600	235	235	94	95	10	10	266	268	2.010	2.024
60	120.640	120.550	236	236	94	95	10	10	266	268	2.014	1.990
65	130.750	130.600	236	236	94	95	10	10	266	268	2.022	2.010
70	140.820	140.850	236	236	94	95	10	10	266	268	2.014	2.050
75	150.880	150.850	236	236	94	95	10	10	266	268	2.012	2.000
80	160.960	160.990	236	236	94	95	10	10	266	268	2.016	2.028
85	171.150	171.160	233	233	94	95	10	10	266	268	2.038	2.034
90	181.151	181.237	233	233	92	93	10	10	266	268	2.000	2.015
95	191.310	191.270	233	233	92	93	10	10	266	268	2.032	2.007
100	201.260	201.260	232	232	92	92	10	10	266	268	1.990	1.998
105	211.210	211.200	232	232	92	92	10	10	266	268	1.990	1.988
110	220.990	220.970	231	231	92	92	10	10	266	268	1.956	1.954
115	230.900	230.940	231	231	91	91	10	10	266	268	1.982	1.994
120	240.760	240.730	231	231	91	91	10	10	266	268	1.972	1.958
125	250.620	250.630	231	231	91	91	10	10	266	268	1.972	1.980
130	260.520	260.580	231	231	91	91	10	10	266	268	1.980	1.990
135	270.380	270.420	231	231	91	91	10	10	266	268	1.972	1.968
140	280.290	280.270	231	231	91	91	10	10	266	268	1.982	1.970
145	290.110	290.190	230	230	89	89	10	10	266	268	1.964	1.984
150	299.980	299.970	230	230	89	89	10	10	266	268	1.974	1.956
155	309.910	309.950	230	230	88	88	10	10	266	268	1.986	1.996
160	319.990	319.980	230	230	88	88	10	10	266	268	2.016	2.006
165	330.130	330.080	230	230	88	88	10	10	266	268	2.028	2.020
170	340.280	340.300	230	230	88	88	10	10	266	268	2.030	2.044
175	350.400	350.350	230	230	88	88	10	10	266	268	2.024	2.010
180	360.405	360.457	229	229	88	88	10	10	266	268	2.001	2.021

Method 30B
Mercury Concentration

Client: Hollingsworth &Vose
Location: Corvallis, OR
Source: CFU 104
Test date: 9/27/2018

Meterbox Y:
Side A 1.0460
Side B 1.0380

Run	Sample	Sample Date	Trap ID	Spiked @ ng	Section 1 ng	Section 2 ng	Total Hg ng	Total Hg µg	DGM reading L	Sample volume (corrected for Y) L	Bp "Hg	Meter Temp. °F	Sample Vol. dscm	Hg Conc. µg/dscm	Ave. Pair Hg Conc. µg/dscm
1	A	9/27/2018	OL498454	0.0	1.9	0.3	2.2	2.20E-03	360.871	377.471	29.72	84.8	0.363	6.05E-03	5.53E-03
	B		OL486072	5.0	6.7	0.1	1.8	1.80E-03	360.879	374.592		87.1	0.359	5.01E-03	
2	A	9/27/2018	OL498441	0.0	1.5	0.3	1.8	1.80E-03	360.303	376.877	29.72	89.9	0.359	5.01E-03	4.75E-03
	B		OL486032	5.0	6.5	0.1	1.6	1.60E-03	360.332	374.025		91.8	0.356	4.50E-03	
3	A	9/27/2018	OL498467	0.0	1.4	0.3	1.7	1.70E-03	360.405	376.984	29.72	91.3	0.359	4.74E-03	4.62E-03
	B		OL492723	5.0	6.2	0.4	1.6	1.60E-03	360.457	374.154		91.9	0.356	4.50E-03	

Average: 4.97E-03

Trap Concentrations Example Calculations:
Run 1, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 2.2 ng
   where Section 1: 1.9 ng
   Section 2: 0.3 ng
   Spike: 0.0 ng

2. Conversion to µg — Total Hg ng/1000 = 2.20E-03 µg
   where Total Hg ng: 2.2 ng

3. Corrected sample volume — = DGM reading x Meterbox Y factor = 377.471 L
   where DGM reading: 360.871 L
   Y: 1.046

4. Standard Volume (DSCM) — = Sample Vol. (L) x $\left(\frac{528\,°A}{Tm+460}\right)$x Bp/29.92 "Hg /1000 = 0.363 DSCM
   where Sample vol.: 377.471 L
   T_m: 84.8 °F
   B_p: 29.72 "Hg

5. Hg concentration µg/dscm — = Total Hg µg / Volume DSCM = 6.05E-03 µg/dscm
   where Total Hg: 2.20E-03 µg
   DSCM: 0.363

6. Average Pair Concentration — = (Side A Conc.+ Side B Conc.)/2 = 5.53E-03 µg/dscm
   where Side A: 0.006 µg/dscm
   Side B: 0.005 µg/dscm

Method 30B
Results QA/QC

Client: Hollingsworth &Vose
Location: Corvallis, OR
Source: CFU 104
Test date: 9/27/2018
Test type: C [C for compliance; R for RATA]

Run	Sample	Sample Date	Trap ID	Spiked @ ng	Section 1 ng	Section 2 ng	Total Hg ng	Hg Conc. µg/dscm	Breakthr. %	Breakthr. Results PASS/FAIL	C_{rec}. Spiked Compound µg/dscm	Spiked Hg Recovery R Value %	Field Recovery PASS/FAIL	RD Paired Traps %	Paired Trap Agree. PASS/FAIL
1	A	9/27/2018	OL498454	0	1.9	0.3	2.2	6.05E-03	15.8	PASS	1.29E-02	92.5	PASS	9.41	PASS
	B		OL486072	5	6.7	0.1	1.8	5.01E-03	1.5	PASS					
2	A	9/27/2018	OL498441	0	1.5	0.3	1.8	5.01E-03	20.0	See emissions limit	1.36E-02	96.4	PASS	5.33	PASS
	B		OL486032	5	6.5	0.1	1.6	4.50E-03	1.5	PASS					
3	A	9/27/2018	OL498467	0	1.4	0.3	1.7	4.74E-03	21.4	See emissions limit	1.38E-02	98.3	PASS	2.60	PASS
	B		OL492723	5	6.2	0.4	1.6	4.50E-03	6.5	PASS					

1. Breakthrough Critera

Every sample must meet the following critera for breakthrough % from Section 1 to Section 2.

$$Breakthrough\,\% = \frac{Section\ 2\ ng}{Section\ 1\ ng} x100$$ Eq. 30B-2

Allowable Breakthrough %	Compliance Testing (µg/dscm)	RATA (µg/dscm)
10	> 1	> 1
20	≤1	≤1; >0.5
50	Hg conc. ≤30% of emission limit	≤0.5; >0.1

RM average: 0.004969204 µg/dscm

2. Field Recovery Test Field Recovery 3-run Average (%): 95.7 PASS

Determines the fraction of spiked Hg recovered (R). Perform for at least three runs per field test. Average of three runs must be between 85 and 115%

$$Crec = \frac{mass\ spiked\ (\mu g)}{Volume\ spiked\ (dscm)} - \frac{mass\ unspiked\ (\mu g)}{Volume\ unspiked\ (dscm)}$$ Eq. 30B-6

$$R = \frac{Crec\ (\frac{\mu g}{dscm})\ x\ vol.spiked\ (dscm)}{mass\ spiked\ (\mu g)} x100$$ Eq. 30B-7

3. Paired trap agreement

$$RD = \frac{|Conc.Trap\ A - Conc.Trap\ B|}{Conc.Trap\ A + Conc.Trap\ B} x100$$ Eq. 30B-5

If paired trains meet the relative deviation (RD) and other QA requirements, the average of the two Hg concs. may be used as an emissions test run value or as the reference method value for a RATA run.

Allowable Relative Dev. %	For Hg conc. (µg/dscm)
10	> 1
20	≤1
or ≤0.2 ug/dscm absolute difference in Hg concs.	≤1

M30B Table 9-1

Method 30B
Emission Calculations

Client: Hollingsworth &Vose
Location: Corvallis, OR
Source: CFU 104
Test date: 9/27/2018

Run	**Ave. Pair Hg Conc.** µg/dscm	**Hg Conc.** lb/dscf	**Stack Flow*** dscf/hr	**Glass Production** lb/hr	**Stack Emissions** lb/hr	lb/lb glass produced
1	5.53E-03	3.45E-13	1,024,836.3	367.4	3.54E-07	9.64E-10
2	4.75E-03	2.97E-13	1,030,886.7	374.6	3.06E-07	8.17E-10
3	4.62E-03	2.88E-13	1,014,013.2	375.4	2.92E-07	7.79E-10
Average Results:	4.97E-03	3.10E-13	1,023,245.4	372.5	3.17E-07	8.53E-10

*From direct stack measurements made during concurrent M29 runs

Daily Gaseous Calibrations Log

Client: H ; V

Source: CFV - 104

Date: 09/27/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	-0	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

- see 9/11/18

*Use of a calibrated instrument required

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X					0	X		
10	X					2	X		
20	X					4	X		

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X					0	X		
10	X					2	X		

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run #1 — 5 minute points during R-1

Test Times: R-1 09:30 – 12:35 R-2 12:53 – 16:00 R-3 ~~16:15~~ DSB 16:18 – 19:23

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-104**
Facility	**Glass Plant 1**	Date	**September 27, 2018**
Location	**Corvallis, OR**		

Run	1	2	3	
Date	9/27/2018	9/27/2018	9/27/2018	
Run Start Time	9:30	12:53	16:18	
Run End Time	12:35	16:00	19:23	
CO_2 %vd	0.71	0.72	0.72	0.72
O_2 %vd	19.92	19.93	19.82	19.89

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-104**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 27, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.04	0.08	0.20	pass	0.00	-0.20	pass	-0.40	pass				
	upscale	9.93	9.94	0.05	pass	9.88	-0.25	pass	-0.30	pass	20	19.70	19.92	10
Run 2	zero	0.04	0.00	-0.20	pass	0.01	-0.15	pass	0.05	pass				
	upscale	9.93	9.88	-0.25	pass	9.97	0.20	pass	0.45	pass	20	19.78	19.93	10
Run 3	zero	0.04	0.01	-0.15	pass	0.00	-0.20	pass	-0.05	pass				
	upscale	9.93	9.97	0.20	pass	9.96	0.15	pass	-0.05	pass	20	19.75	19.82	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0.04	9.93	20.08
Analyzer Cal. Error	0.20	-0.35	0.40
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-104**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 27, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.01	0.02	0.75	pass	0.04	1.25	pass	0.50	pass				
	upscale	1.87	1.88	0.25	pass	1.88	0.25	pass	0.00	pass	4	0.69	0.71	2
Run 2	zero	-0.01	0.04	1.25	pass	0.04	1.25	pass	0.00	pass				
	upscale	1.87	1.88	0.25	pass	1.87	0.00	pass	-0.25	pass	4	0.70	0.72	2
Run 3	zero	-0.01	0.04	1.25	pass	0.05	1.50	pass	0.25	pass				
	upscale	1.87	1.87	0.00	pass	1.86	-0.25	pass	-0.25	pass	4	0.70	0.72	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	-0.01	1.87	4.11
Analyzer Cal. Error	-0.25	-3.25	2.75
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Stratification Check

Facility	Glass Plant 1		
Location	Corvallis, OR	**Date**	9/27/2018
Source	CFU-104	**Stack Dimensions**	30 inches

3 POINT METHOD

% of diameter	Pt location		O2%	Diff (+/- 5%)	Pass/Fail
16.7%	1	5.01	19.79	0.05%	PASS
50.0%	2	15.00	19.78	0.00%	PASS
83.3%	3	24.99	19.77	-0.05%	PASS
		AVERAGE:	19.78		

*If 3 pt Method fails at < 10% level the gas stream is considered minimally stratified; perform sampling at three points

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:30**
Source:	**CFU-104**	**End Time:**	**12:35**
Method:	**3A**	**Date:**	**9/27/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.35 %v

where C_{Dir}:	9.93	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.05 %v

where C_{Dir}:	9.93	ppmv
C_S:	9.94	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.30 %v

where SB_{Final}:	-0.25	ppmv
SB_i:	0.05	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.92 ppmv

where C_{Avg}:	19.70	ppmv
C_O:	0.04	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.91	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:30**
Source:	**CFU-104**	**End Time:**	**12:35**
Method:	**3A**	**Date:**	**9/27/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -3.25 %v

where C_{Dir}:	1.87	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.25 %v

where C_{Dir}:	1.87	ppmv
C_S:	1.88	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.00 %v

where SB_{Final}:	0.25	ppmv
SB_i:	0.25	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.71 ppmv

where C_{Avg}:	0.69	ppmv
C_O:	0.03	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.88	ppmv

Hollingsworth & Vose
CFU-104
Daily Calibrations
9/27/2018

Date	Time	O2 [%]	CO2 [%]
9/27/2018	8:39:13	0.07	-0.01
9/27/2018	8:39:23	0.07	-0.01
9/27/2018	8:39:33	0.06	-0.01
9/27/2018	8:39:43	0.06	-0.02
9/27/2018	8:39:53	0.05	-0.01
9/27/2018	8:40:03	0.05	-0.01
9/27/2018	8:40:13	0.05	-0.01
9/27/2018	8:40:23	0.04	-0.01
9/27/2018	8:40:33	0.04	-0.02
9/27/2018	8:40:43	0.04	-0.01
9/27/2018	8:40:53	11.48	10.78
9/27/2018	8:41:03	19.71	19.62
9/27/2018	8:41:13	20.24	19.72
9/27/2018	8:41:23	20.28	19.75
9/27/2018	8:41:33	20.29	19.84
9/27/2018	8:41:43	20.14	19.92
9/27/2018	8:41:53	20.08	19.92
9/27/2018	8:42:03	20.08	19.93
9/27/2018	8:42:13	20.08	19.93
9/27/2018	8:42:23	20.08	19.94
9/27/2018	8:42:33	20.07	19.92
9/27/2018	8:42:43	20.07	19.89
9/27/2018	8:42:53	18.03	16.85
9/27/2018	8:43:03	10.00	9.55
9/27/2018	8:43:13	9.94	9.88
9/27/2018	8:43:23	9.95	9.88
9/27/2018	8:43:33	9.94	9.87
9/27/2018	8:43:43	9.94	9.86
9/27/2018	8:43:53	9.94	9.86
9/27/2018	8:44:03	9.94	9.85
9/27/2018	8:44:13	9.94	9.86
9/27/2018	8:44:23	9.93	9.86
9/27/2018	8:44:33	9.93	9.85
9/27/2018	8:44:43	9.93	9.86
9/27/2018	8:44:53	9.92	9.85
9/27/2018	8:45:03	9.92	9.85
9/27/2018	8:45:13	9.92	9.85
9/27/2018	8:45:23	9.92	9.85
9/27/2018	8:45:33	7.45	6.26
9/27/2018	8:45:43	3.59	3.83
9/27/2018	8:45:53	3.91	4.10

Hollingsworth & Vose
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Daily Calibrations
9/27/2018

Date	Time	O2 [%]	CO2 [%]
9/27/2018	8:46:03	3.93	4.11
9/27/2018	8:46:13	3.93	4.11
9/27/2018	8:46:23	3.93	4.11
9/27/2018	8:46:33	3.93	4.11
9/27/2018	8:46:43	3.36	3.23
9/27/2018	8:46:53	2.16	1.99
9/27/2018	8:47:03	1.97	1.89
9/27/2018	8:47:13	1.95	1.88
9/27/2018	8:47:23	1.95	1.87
9/27/2018	8:47:33	1.95	1.87
9/27/2018	8:47:43	1.95	1.87
9/27/2018	8:47:53	1.95	1.88
9/27/2018	8:48:03	1.94	1.87
9/27/2018	8:48:13	1.94	1.87
9/27/2018	8:48:23	1.94	1.87
9/27/2018	8:48:33	1.94	1.87
9/27/2018	8:48:43	1.93	1.87
9/27/2018	8:48:53	1.93	1.86
9/27/2018	8:49:03	1.93	1.87
9/27/2018	8:49:13	1.93	1.87
9/27/2018	8:49:23	1.93	1.86
9/27/2018	8:49:33	1.93	1.87
9/27/2018	8:49:43	1.93	1.86
9/27/2018	8:49:53	1.93	1.87
9/27/2018	8:50:03	1.93	1.87
9/27/2018	8:50:13	1.91	1.86

		O2 [%]	CO2 [%]
Analyzer Zero		**0.04**	**-0.01**
Analyzer Mid		**9.93**	**1.87**
Analyzer Span		**20.08**	**4.11**

System

9/27/2018	8:50:23	10.83	0.96
9/27/2018	8:50:33	18.62	0.69
9/27/2018	8:50:43	11.22	1.41
9/27/2018	8:50:53	6.71	1.09
9/27/2018	8:51:03	6.93	0.43
9/27/2018	8:51:13	2.92	0.16
9/27/2018	8:51:23	1.03	0.06
9/27/2018	8:51:33	0.44	0.03
9/27/2018	8:51:43	0.26	0.03

Hollingsworth & Vose
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Daily Calibrations
9/27/2018

Date	Time	O2 [%]	CO2 [%]
9/27/2018	8:51:53	0.20	0.02
9/27/2018	8:52:03	0.17	0.02
9/27/2018	8:52:13	0.14	0.02
9/27/2018	8:52:23	0.10	0.02
9/27/2018	8:52:33	0.09	0.03
9/27/2018	8:52:43	0.09	0.02
9/27/2018	8:52:53	0.08	0.02
9/27/2018	8:53:03	0.08	0.01
9/27/2018	8:53:13	0.08	0.02
9/27/2018	8:53:23	0.23	0.20
9/27/2018	8:53:33	1.29	1.33
9/27/2018	8:53:43	1.80	1.72
9/27/2018	8:53:53	1.95	1.83
9/27/2018	8:54:03	1.99	1.86
9/27/2018	8:54:13	2.00	1.87
9/27/2018	8:54:23	2.01	1.88
9/27/2018	8:54:33	2.01	1.88
9/27/2018	8:54:43	2.01	1.88
9/27/2018	8:54:53	2.01	1.87
9/27/2018	8:55:03	2.00	1.88
9/27/2018	8:55:13	2.01	1.89
9/27/2018	8:55:23	2.00	1.89
9/27/2018	8:55:33	3.44	3.39
9/27/2018	8:55:43	7.61	7.84
9/27/2018	8:55:53	9.23	9.19
9/27/2018	8:56:03	9.72	9.63
9/27/2018	8:56:13	9.88	9.77
9/27/2018	8:56:23	9.92	9.82
9/27/2018	8:56:33	9.94	9.83
9/27/2018	8:56:43	9.94	9.85
9/27/2018	8:56:53	9.95	9.86
9/27/2018	8:57:03	9.93	9.86
9/27/2018	8:57:13	9.90	9.87
9/27/2018	8:57:23	9.89	9.88
9/27/2018	8:57:33	11.62	8.20
		O2 [%]	**CO2 [%]**
System Zero		**0.08**	**0.02**
System Mid		**9.94**	**1.88**

Hollingsworth & Vose
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Run #1

Date	Time	O2 [%]	CO2 [%]
9/27/2018	9:30:56	19.79	0.69
9/27/2018	9:31:56	19.80	0.69
9/27/2018	9:32:56	19.80	0.68
9/27/2018	9:33:56	19.79	0.68
9/27/2018	9:34:56	19.79	0.69
9/27/2018	9:35:56	19.79	0.69
9/27/2018	9:36:56	19.78	0.69
9/27/2018	9:37:56	19.78	0.69
9/27/2018	9:38:56	19.78	0.69
9/27/2018	9:39:56	19.78	0.68
9/27/2018	9:40:56	19.77	0.68
9/27/2018	9:41:56	19.77	0.68
9/27/2018	9:42:56	19.77	0.67
9/27/2018	9:43:56	19.77	0.68
9/27/2018	9:44:56	19.77	0.68
9/27/2018	9:45:56	19.76	0.68
9/27/2018	9:46:56	19.76	0.68
9/27/2018	9:47:56	19.77	0.68
9/27/2018	9:48:56	19.76	0.68
9/27/2018	9:49:56	19.76	0.68
9/27/2018	9:50:56	19.75	0.68
9/27/2018	9:51:56	19.75	0.69
9/27/2018	9:52:56	19.76	0.68
9/27/2018	9:53:56	19.76	0.69
9/27/2018	9:54:56	19.74	0.69
9/27/2018	9:55:56	19.75	0.69
9/27/2018	9:56:56	19.75	0.70
9/27/2018	9:57:56	19.74	0.70
9/27/2018	9:58:56	19.74	0.70
9/27/2018	9:59:56	19.74	0.70
9/27/2018	10:00:56	19.74	0.70
9/27/2018	10:01:56	19.75	0.69
9/27/2018	10:02:56	19.74	0.69
9/27/2018	10:03:56	19.73	0.69
9/27/2018	10:04:56	19.74	0.69
9/27/2018	10:05:56	19.74	0.69
9/27/2018	10:06:56	19.73	0.69
9/27/2018	10:07:56	19.74	0.68
9/27/2018	10:08:56	19.74	0.68
9/27/2018	10:09:56	19.73	0.68
9/27/2018	10:10:56	19.73	0.68
9/27/2018	10:11:56	19.73	0.68

Hollingsworth & Vose
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Run #1

Date	Time	O2 [%]	CO2 [%]
9/27/2018	10:12:56	19.72	0.68
9/27/2018	10:13:56	19.73	0.68
9/27/2018	10:14:56	19.73	0.68
9/27/2018	10:15:56	19.72	0.68
9/27/2018	10:16:56	19.72	0.68
9/27/2018	10:17:56	19.73	0.69
9/27/2018	10:18:56	19.73	0.68
9/27/2018	10:19:56	19.74	0.69
9/27/2018	10:20:56	19.73	0.68
9/27/2018	10:21:56	19.73	0.69
9/27/2018	10:22:56	19.73	0.69
9/27/2018	10:23:56	19.73	0.69
9/27/2018	10:24:56	19.72	0.69
9/27/2018	10:25:56	19.72	0.69
9/27/2018	10:26:56	19.72	0.69
9/27/2018	10:27:56	19.72	0.69
9/27/2018	10:28:56	19.72	0.69
9/27/2018	10:29:56	19.72	0.69
9/27/2018	10:30:56	19.72	0.69
9/27/2018	10:31:56	19.71	0.69
9/27/2018	10:32:56	19.71	0.69
9/27/2018	10:33:56	19.71	0.69
9/27/2018	10:34:56	19.71	0.68
9/27/2018	10:35:56	19.71	0.68
9/27/2018	10:36:56	19.71	0.68
9/27/2018	10:37:56	19.70	0.68
9/27/2018	10:38:56	19.71	0.68
9/27/2018	10:39:56	19.70	0.68
9/27/2018	10:40:56	19.70	0.69
9/27/2018	10:41:56	19.70	0.69
9/27/2018	10:42:56	19.69	0.69
9/27/2018	10:43:56	19.70	0.69
9/27/2018	10:44:56	19.70	0.69
9/27/2018	10:45:56	19.69	0.69
9/27/2018	10:46:56	19.69	0.69
9/27/2018	10:47:56	19.69	0.69
9/27/2018	10:48:56	19.69	0.70
9/27/2018	10:49:56	19.69	0.70
9/27/2018	10:50:56	19.69	0.70
9/27/2018	10:51:56	19.70	0.70
9/27/2018	10:52:56	19.69	0.70
9/27/2018	10:53:56	19.69	0.70

Hollingsworth & Vose
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Run #1

Date	Time	O2 [%]	CO2 [%]
9/27/2018	10:54:56	19.69	0.69
9/27/2018	10:55:56	19.69	0.69
9/27/2018	10:56:56	19.69	0.69
9/27/2018	10:57:56	19.69	0.69
9/27/2018	10:58:56	19.69	0.70
9/27/2018	10:59:56	19.68	0.69
9/27/2018	11:00:56	19.68	0.69
9/27/2018	11:01:56	19.67	0.69
9/27/2018	11:02:56	19.67	0.69
9/27/2018	11:03:56	19.68	0.69
9/27/2018	11:04:56	19.67	0.69
9/27/2018	11:05:56	19.68	0.69
9/27/2018	11:06:56	19.68	0.69
9/27/2018	11:07:56	19.68	0.69
9/27/2018	11:08:56	19.68	0.69
9/27/2018	11:09:56	19.67	0.69
9/27/2018	11:10:56	19.68	0.69
9/27/2018	11:11:56	19.68	0.69
9/27/2018	11:12:56	19.67	0.70
9/27/2018	11:13:56	19.68	0.70
9/27/2018	11:14:56	19.67	0.71
9/27/2018	11:15:56	19.67	0.70
9/27/2018	11:16:56	19.68	0.70
9/27/2018	11:17:56	19.68	0.70
9/27/2018	11:18:56	19.67	0.70
9/27/2018	11:19:56	19.67	0.70
9/27/2018	11:20:56	19.67	0.69
9/27/2018	11:21:56	19.67	0.69
9/27/2018	11:22:56	19.67	0.69
9/27/2018	11:23:56	19.67	0.69
9/27/2018	11:24:56	19.67	0.69
9/27/2018	11:25:56	19.67	0.69
9/27/2018	11:26:56	19.67	0.69
9/27/2018	11:27:56	19.66	0.69
9/27/2018	11:28:56	19.67	0.68
9/27/2018	11:29:56	19.66	0.69
9/27/2018	11:30:56	19.67	0.69
9/27/2018	11:31:56	19.66	0.68
9/27/2018	11:32:56	19.66	0.68
9/27/2018	11:33:56	19.67	0.68
9/27/2018	11:34:56	19.66	0.69
9/27/2018	11:35:56	19.66	0.69

Hollingsworth & Vose
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Run #1

Date	Time	O2 [%]	CO2 [%]
9/27/2018	11:36:56	19.66	0.69
9/27/2018	11:37:56	19.67	0.69
9/27/2018	11:38:56	19.67	0.69
9/27/2018	11:39:56	19.67	0.70
9/27/2018	11:40:56	19.67	0.69
9/27/2018	11:41:56	19.67	0.69
9/27/2018	11:42:56	19.68	0.69
9/27/2018	11:43:56	19.67	0.69
9/27/2018	11:44:56	19.67	0.69
9/27/2018	11:45:56	19.67	0.70
9/27/2018	11:46:56	19.67	0.70
9/27/2018	11:47:56	19.67	0.69
9/27/2018	11:48:56	19.66	0.69
9/27/2018	11:49:56	19.66	0.69
9/27/2018	11:50:56	19.66	0.69
9/27/2018	11:51:56	19.66	0.68
9/27/2018	11:52:56	19.66	0.68
9/27/2018	11:53:56	19.65	0.68
9/27/2018	11:54:56	19.66	0.68
9/27/2018	11:55:56	19.66	0.68
9/27/2018	11:56:56	19.66	0.67
9/27/2018	11:57:56	19.65	0.68
9/27/2018	11:58:56	19.66	0.68
9/27/2018	11:59:56	19.66	0.68
9/27/2018	12:00:56	19.65	0.69
9/27/2018	12:01:56	19.65	0.69
9/27/2018	12:02:56	19.65	0.69
9/27/2018	12:03:56	19.65	0.69
9/27/2018	12:04:56	19.64	0.70
9/27/2018	12:05:56	19.65	0.70
9/27/2018	12:06:56	19.65	0.70
9/27/2018	12:07:56	19.66	0.70
9/27/2018	12:08:56	19.66	0.70
9/27/2018	12:09:56	19.66	0.70
9/27/2018	12:10:56	19.66	0.69
9/27/2018	12:11:56	19.66	0.69
9/27/2018	12:12:56	19.66	0.69
9/27/2018	12:13:56	19.65	0.69
9/27/2018	12:14:56	19.66	0.69
9/27/2018	12:15:56	19.66	0.69
9/27/2018	12:16:56	19.66	0.68
9/27/2018	12:17:56	19.66	0.68

Hollingsworth & Vose
CFU-104
Run #1

Date	Time	O2 [%]	CO2 [%]
9/27/2018	12:18:56	19.66	0.68
9/27/2018	12:19:56	19.66	0.68
9/27/2018	12:20:56	19.65	0.68
9/27/2018	12:21:56	19.65	0.68
9/27/2018	12:22:56	19.65	0.68
9/27/2018	12:23:56	19.65	0.68
9/27/2018	12:24:56	19.65	0.68
9/27/2018	12:25:56	19.65	0.68
9/27/2018	12:26:56	19.65	0.69
9/27/2018	12:27:56	19.65	0.69
9/27/2018	12:28:56	19.66	0.69
9/27/2018	12:29:56	19.66	0.69
9/27/2018	12:30:56	19.65	0.69
9/27/2018	12:31:56	19.65	0.69
9/27/2018	12:32:56	19.66	0.69
9/27/2018	12:33:56	19.66	0.69
Final Average		**19.70**	**0.69**

		O2 [%]
Stratification Check		**19.79**
		19.78
		19.77

Bias Check

9/27/2018	12:35:26	19.71	0.69
9/27/2018	12:35:36	15.10	1.06
9/27/2018	12:35:46	6.14	0.54
9/27/2018	12:35:56	1.96	0.22
9/27/2018	12:36:06	0.61	0.10
9/27/2018	12:36:16	0.18	0.07
9/27/2018	12:36:26	0.04	0.05
9/27/2018	12:36:36	0.00	0.05
9/27/2018	12:36:46	-0.02	0.05
9/27/2018	12:36:56	-0.03	0.04
9/27/2018	12:37:06	0.01	0.04
9/27/2018	12:37:16	0.00	0.04
9/27/2018	12:37:26	0.00	0.04
9/27/2018	12:37:36	0.53	0.61
9/27/2018	12:37:46	1.45	1.37
9/27/2018	12:37:56	1.73	1.69
9/27/2018	12:38:06	1.82	1.80

Hollingsworth & Vose
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Run #1

Date	Time	O2 [%]	CO2 [%]
9/27/2018	12:38:16	1.85	1.84
9/27/2018	12:38:26	1.86	1.85
9/27/2018	12:38:36	1.86	1.85
9/27/2018	12:38:46	1.86	1.86
9/27/2018	12:38:56	1.86	1.86
9/27/2018	12:39:06	1.86	1.86
9/27/2018	12:39:16	1.86	1.86
9/27/2018	12:39:26	1.86	1.86
9/27/2018	12:39:36	2.02	1.91
9/27/2018	12:39:46	5.52	5.91
9/27/2018	12:39:56	8.33	8.66
9/27/2018	12:40:06	9.20	9.45
9/27/2018	12:40:16	9.48	9.72
9/27/2018	12:40:26	9.57	9.82
9/27/2018	12:40:36	9.60	9.85
9/27/2018	12:40:46	9.62	9.86
9/27/2018	12:40:56	9.62	9.88
9/27/2018	12:41:06	9.63	9.89
9/27/2018	12:41:16	9.63	9.90
9/27/2018	12:41:26	9.63	9.90
9/27/2018	12:41:36	9.67	9.90
9/27/2018	12:41:46	9.84	9.90
9/27/2018	12:41:56	9.88	9.91
9/27/2018	12:42:06	9.88	9.90
9/27/2018	12:42:16	9.87	9.91
		O2 [%]	**CO2 [%]**
System Zero		**0.00**	**0.04**
System Mid		**9.88**	**1.88**

Hollingsworth & Vose
CFU-104
Run #2

Date	Time	O2 [%]	CO2 [%]
9/27/2018	12:53:56	19.79	0.70
9/27/2018	12:54:56	19.79	0.70
9/27/2018	12:55:56	19.79	0.70
9/27/2018	12:56:56	19.79	0.70
9/27/2018	12:57:56	19.79	0.70
9/27/2018	12:58:56	19.79	0.70
9/27/2018	12:59:56	19.80	0.69
9/27/2018	13:00:56	19.79	0.70
9/27/2018	13:01:56	19.79	0.69
9/27/2018	13:02:56	19.79	0.69
9/27/2018	13:03:56	19.80	0.69
9/27/2018	13:04:56	19.79	0.69
9/27/2018	13:05:56	19.79	0.68
9/27/2018	13:06:56	19.80	0.68
9/27/2018	13:07:56	19.79	0.68
9/27/2018	13:08:56	19.79	0.68
9/27/2018	13:09:56	19.79	0.68
9/27/2018	13:10:56	19.79	0.68
9/27/2018	13:11:56	19.79	0.69
9/27/2018	13:12:56	19.80	0.69
9/27/2018	13:13:56	19.80	0.69
9/27/2018	13:14:56	19.79	0.69
9/27/2018	13:15:56	19.80	0.69
9/27/2018	13:16:56	19.80	0.69
9/27/2018	13:17:56	19.80	0.69
9/27/2018	13:18:56	19.80	0.70
9/27/2018	13:19:56	19.79	0.70
9/27/2018	13:20:56	19.80	0.70
9/27/2018	13:21:56	19.80	0.70
9/27/2018	13:22:56	19.80	0.69
9/27/2018	13:23:56	19.80	0.70
9/27/2018	13:24:56	19.80	0.70
9/27/2018	13:25:56	19.80	0.70
9/27/2018	13:26:56	19.80	0.69
9/27/2018	13:27:56	19.79	0.69
9/27/2018	13:28:56	19.80	0.69
9/27/2018	13:29:56	19.80	0.69
9/27/2018	13:30:56	19.80	0.69
9/27/2018	13:31:56	19.80	0.68
9/27/2018	13:32:56	19.80	0.69
9/27/2018	13:33:56	19.80	0.69
9/27/2018	13:34:56	19.80	0.69

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Date	Time	O2 [%]	CO2 [%]
9/27/2018	13:35:56	19.80	0.69
9/27/2018	13:36:56	19.80	0.69
9/27/2018	13:37:56	19.80	0.69
9/27/2018	13:38:56	19.80	0.69
9/27/2018	13:39:56	19.81	0.69
9/27/2018	13:40:56	19.80	0.69
9/27/2018	13:41:56	19.80	0.70
9/27/2018	13:42:56	19.80	0.70
9/27/2018	13:43:56	19.81	0.70
9/27/2018	13:44:56	19.80	0.70
9/27/2018	13:45:56	19.80	0.71
9/27/2018	13:46:56	19.79	0.71
9/27/2018	13:47:56	19.79	0.71
9/27/2018	13:48:56	19.80	0.70
9/27/2018	13:49:56	19.79	0.71
9/27/2018	13:50:56	19.79	0.70
9/27/2018	13:51:56	19.79	0.70
9/27/2018	13:52:56	19.79	0.70
9/27/2018	13:53:56	19.79	0.70
9/27/2018	13:54:56	19.79	0.70
9/27/2018	13:55:56	19.79	0.69
9/27/2018	13:56:56	19.79	0.69
9/27/2018	13:57:56	19.79	0.69
9/27/2018	13:58:56	19.79	0.69
9/27/2018	13:59:56	19.79	0.69
9/27/2018	14:00:56	19.79	0.69
9/27/2018	14:01:56	19.79	0.69
9/27/2018	14:02:56	19.79	0.70
9/27/2018	14:03:56	19.79	0.69
9/27/2018	14:04:56	19.80	0.69
9/27/2018	14:05:56	19.79	0.71
9/27/2018	14:06:56	19.78	0.70
9/27/2018	14:07:56	19.79	0.71
9/27/2018	14:08:56	19.79	0.71
9/27/2018	14:09:56	19.79	0.71
9/27/2018	14:10:56	19.79	0.71
9/27/2018	14:11:56	19.79	0.71
9/27/2018	14:12:56	19.79	0.71
9/27/2018	14:13:56	19.79	0.71
9/27/2018	14:14:56	19.79	0.71
9/27/2018	14:15:56	19.79	0.71
9/27/2018	14:16:56	19.78	0.70

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Date	Time	O2 [%]	CO2 [%]
9/27/2018	14:17:56	19.79	0.70
9/27/2018	14:18:56	19.79	0.70
9/27/2018	14:19:56	19.79	0.70
9/27/2018	14:20:56	19.78	0.70
9/27/2018	14:21:56	19.78	0.70
9/27/2018	14:22:56	19.78	0.70
9/27/2018	14:23:56	19.78	0.70
9/27/2018	14:24:56	19.79	0.69
9/27/2018	14:25:56	19.79	0.69
9/27/2018	14:26:56	19.78	0.70
9/27/2018	14:27:56	19.78	0.70
9/27/2018	14:28:56	19.78	0.70
9/27/2018	14:29:56	19.78	0.70
9/27/2018	14:30:56	19.78	0.70
9/27/2018	14:31:56	19.78	0.71
9/27/2018	14:32:56	19.78	0.71
9/27/2018	14:33:56	19.77	0.71
9/27/2018	14:34:56	19.78	0.71
9/27/2018	14:35:56	19.78	0.71
9/27/2018	14:36:56	19.78	0.71
9/27/2018	14:37:56	19.78	0.71
9/27/2018	14:38:56	19.78	0.71
9/27/2018	14:39:56	19.78	0.71
9/27/2018	14:40:56	19.77	0.71
9/27/2018	14:41:56	19.78	0.71
9/27/2018	14:42:56	19.78	0.71
9/27/2018	14:43:56	19.77	0.70
9/27/2018	14:44:56	19.78	0.70
9/27/2018	14:45:56	19.77	0.70
9/27/2018	14:46:56	19.78	0.70
9/27/2018	14:47:56	19.77	0.70
9/27/2018	14:48:56	19.78	0.70
9/27/2018	14:49:56	19.78	0.69
9/27/2018	14:50:56	19.78	0.70
9/27/2018	14:51:56	19.78	0.69
9/27/2018	14:52:56	19.78	0.70
9/27/2018	14:53:56	19.78	0.70
9/27/2018	14:54:56	19.78	0.70
9/27/2018	14:55:56	19.78	0.70
9/27/2018	14:56:56	19.78	0.71
9/27/2018	14:57:56	19.78	0.71
9/27/2018	14:58:56	19.77	0.71

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Date	Time	O2 [%]	CO2 [%]
9/27/2018	14:59:56	19.78	0.71
9/27/2018	15:00:56	19.78	0.71
9/27/2018	15:01:56	19.78	0.71
9/27/2018	15:02:56	19.78	0.71
9/27/2018	15:03:56	19.78	0.71
9/27/2018	15:04:56	19.78	0.71
9/27/2018	15:05:56	19.78	0.70
9/27/2018	15:06:56	19.79	0.70
9/27/2018	15:07:56	19.79	0.70
9/27/2018	15:08:56	19.78	0.70
9/27/2018	15:09:56	19.78	0.69
9/27/2018	15:10:56	19.78	0.69
9/27/2018	15:11:56	19.78	0.69
9/27/2018	15:12:56	19.77	0.70
9/27/2018	15:13:56	19.77	0.70
9/27/2018	15:14:56	19.77	0.70
9/27/2018	15:15:56	19.77	0.70
9/27/2018	15:16:56	19.77	0.70
9/27/2018	15:17:56	19.77	0.70
9/27/2018	15:18:56	19.77	0.70
9/27/2018	15:19:56	19.77	0.70
9/27/2018	15:20:56	19.77	0.70
9/27/2018	15:21:56	19.77	0.71
9/27/2018	15:22:56	19.77	0.72
9/27/2018	15:23:56	19.77	0.72
9/27/2018	15:24:56	19.77	0.71
9/27/2018	15:25:56	19.77	0.71
9/27/2018	15:26:56	19.77	0.71
9/27/2018	15:27:56	19.77	0.71
9/27/2018	15:28:56	19.77	0.71
9/27/2018	15:29:56	19.77	0.71
9/27/2018	15:30:56	19.77	0.71
9/27/2018	15:31:56	19.77	0.70
9/27/2018	15:32:56	19.77	0.70
9/27/2018	15:33:56	19.77	0.70
9/27/2018	15:34:56	19.77	0.70
9/27/2018	15:35:56	19.77	0.69
9/27/2018	15:36:56	19.77	0.69
9/27/2018	15:37:56	19.78	0.69
9/27/2018	15:38:56	19.77	0.69
9/27/2018	15:39:56	19.77	0.69
9/27/2018	15:40:56	19.78	0.69

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Run #2

Date	Time	O2 [%]	CO2 [%]
9/27/2018	15:41:56	19.77	0.69
9/27/2018	15:42:56	19.77	0.69
9/27/2018	15:43:56	19.77	0.69
9/27/2018	15:44:56	19.77	0.70
9/27/2018	15:45:56	19.77	0.70
9/27/2018	15:46:56	19.77	0.70
9/27/2018	15:47:56	19.78	0.70
9/27/2018	15:48:56	19.78	0.70
9/27/2018	15:49:56	19.77	0.70
9/27/2018	15:50:56	19.77	0.70
9/27/2018	15:51:56	19.77	0.70
9/27/2018	15:52:56	19.77	0.70
9/27/2018	15:53:56	19.77	0.70
9/27/2018	15:54:56	19.77	0.70
9/27/2018	15:55:56	19.77	0.69
9/27/2018	15:56:56	19.76	0.70
9/27/2018	15:57:56	19.76	0.69
9/27/2018	15:58:56	19.76	0.69
9/27/2018	15:59:56	19.76	0.69
Final Average		**19.78**	**0.70**

Bias Check

9/27/2018	16:01:26	19.82	0.71
9/27/2018	16:01:36	15.35	1.58
9/27/2018	16:01:46	5.61	0.74
9/27/2018	16:01:56	1.80	0.30
9/27/2018	16:02:06	0.61	0.13
9/27/2018	16:02:16	0.22	0.07
9/27/2018	16:02:26	0.10	0.06
9/27/2018	16:02:36	0.05	0.06
9/27/2018	16:02:46	0.04	0.06
9/27/2018	16:02:56	0.03	0.05
9/27/2018	16:03:06	0.02	0.05
9/27/2018	16:03:16	0.02	0.04
9/27/2018	16:03:26	0.02	0.05
9/27/2018	16:03:36	0.01	0.04
9/27/2018	16:03:46	0.01	0.04
9/27/2018	16:03:56	0.00	0.04
9/27/2018	16:04:06	0.00	0.04
9/27/2018	16:04:16	0.01	0.04
9/27/2018	16:04:26	0.01	0.05
9/27/2018	16:04:36	0.74	0.79

Hollingsworth & Vose
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Run #2

Date	Time	O2 [%]	CO2 [%]
9/27/2018	16:04:46	1.57	1.46
9/27/2018	16:04:56	1.82	1.72
9/27/2018	16:05:06	1.89	1.81
9/27/2018	16:05:16	1.92	1.84
9/27/2018	16:05:26	1.93	1.85
9/27/2018	16:05:36	1.92	1.86
9/27/2018	16:05:46	1.93	1.86
9/27/2018	16:05:56	1.93	1.86
9/27/2018	16:06:06	1.93	1.87
9/27/2018	16:06:16	1.93	1.87
9/27/2018	16:06:26	1.93	1.86
9/27/2018	16:06:36	3.13	3.01
9/27/2018	16:06:46	7.38	7.56
9/27/2018	16:06:56	9.13	9.08
9/27/2018	16:07:06	9.68	9.57
9/27/2018	16:07:16	9.86	9.75
9/27/2018	16:07:26	9.91	9.81
9/27/2018	16:07:36	9.94	9.84
9/27/2018	16:07:46	9.95	9.85
9/27/2018	16:07:56	9.96	9.86
9/27/2018	16:08:06	9.96	9.86
9/27/2018	16:08:16	9.97	9.86
9/27/2018	16:08:26	9.96	9.87
9/27/2018	16:08:36	9.97	9.88
9/27/2018	16:08:46	9.97	9.88
9/27/2018	16:08:56	9.97	9.88
9/27/2018	16:09:06	9.97	9.89
9/27/2018	16:09:16	9.97	9.89
9/27/2018	16:09:26	9.97	9.89
9/27/2018	16:09:36	9.98	9.90
9/27/2018	16:09:46	9.98	9.90
9/27/2018	16:09:56	9.96	9.89
		O2 [%]	**CO2 [%]**
System Zero		**0.01**	**0.04**
System Mid		**9.97**	**1.87**

Hollingsworth & Vose
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Run #3

Date	Time	O2 [%]	CO2 [%]
9/27/2018	16:18:56	19.76	0.71
9/27/2018	16:19:56	19.75	0.70
9/27/2018	16:20:56	19.76	0.70
9/27/2018	16:21:56	19.75	0.70
9/27/2018	16:22:56	19.76	0.70
9/27/2018	16:23:56	19.75	0.70
9/27/2018	16:24:56	19.75	0.69
9/27/2018	16:25:56	19.76	0.69
9/27/2018	16:26:56	19.76	0.69
9/27/2018	16:27:56	19.75	0.69
9/27/2018	16:28:56	19.76	0.69
9/27/2018	16:29:56	19.76	0.69
9/27/2018	16:30:56	19.76	0.69
9/27/2018	16:31:56	19.76	0.69
9/27/2018	16:32:56	19.76	0.69
9/27/2018	16:33:56	19.77	0.69
9/27/2018	16:34:56	19.76	0.69
9/27/2018	16:35:56	19.77	0.70
9/27/2018	16:36:56	19.76	0.70
9/27/2018	16:37:56	19.76	0.71
9/27/2018	16:38:56	19.76	0.70
9/27/2018	16:39:56	19.76	0.71
9/27/2018	16:40:56	19.76	0.71
9/27/2018	16:41:56	19.76	0.71
9/27/2018	16:42:56	19.77	0.70
9/27/2018	16:43:56	19.76	0.70
9/27/2018	16:44:56	19.76	0.70
9/27/2018	16:45:56	19.77	0.70
9/27/2018	16:46:56	19.77	0.70
9/27/2018	16:47:56	19.77	0.70
9/27/2018	16:48:56	19.76	0.69
9/27/2018	16:49:56	19.76	0.69
9/27/2018	16:50:56	19.77	0.69
9/27/2018	16:51:56	19.77	0.69
9/27/2018	16:52:56	19.77	0.69
9/27/2018	16:53:56	19.77	0.69
9/27/2018	16:54:56	19.76	0.69
9/27/2018	16:55:56	19.76	0.69
9/27/2018	16:56:56	19.76	0.70
9/27/2018	16:57:56	19.76	0.70
9/27/2018	16:58:56	19.77	0.70
9/27/2018	16:59:56	19.77	0.70

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Run #3

Date	Time	O2 [%]	CO2 [%]
9/27/2018	17:00:56	19.78	0.70
9/27/2018	17:01:56	19.79	0.70
9/27/2018	17:02:56	19.76	0.71
9/27/2018	17:03:56	19.72	0.73
9/27/2018	17:04:56	19.72	0.73
9/27/2018	17:05:56	19.74	0.72
9/27/2018	17:06:56	19.75	0.72
9/27/2018	17:07:56	19.76	0.71
9/27/2018	17:08:56	19.75	0.71
9/27/2018	17:09:56	19.75	0.71
9/27/2018	17:10:56	19.75	0.71
9/27/2018	17:11:56	19.75	0.71
9/27/2018	17:12:56	19.75	0.70
9/27/2018	17:13:56	19.75	0.70
9/27/2018	17:14:56	19.75	0.70
9/27/2018	17:15:56	19.75	0.70
9/27/2018	17:16:56	19.75	0.70
9/27/2018	17:17:56	19.76	0.69
9/27/2018	17:18:56	19.76	0.69
9/27/2018	17:19:56	19.76	0.69
9/27/2018	17:20:56	19.76	0.70
9/27/2018	17:21:56	19.76	0.70
9/27/2018	17:22:56	19.76	0.70
9/27/2018	17:23:56	19.76	0.70
9/27/2018	17:24:56	19.76	0.70
9/27/2018	17:25:56	19.76	0.71
9/27/2018	17:26:56	19.76	0.71
9/27/2018	17:27:56	19.76	0.71
9/27/2018	17:28:56	19.76	0.71
9/27/2018	17:29:56	19.76	0.71
9/27/2018	17:30:56	19.76	0.71
9/27/2018	17:31:56	19.76	0.71
9/27/2018	17:32:56	19.76	0.71
9/27/2018	17:33:56	19.76	0.71
9/27/2018	17:34:56	19.76	0.71
9/27/2018	17:35:56	19.76	0.70
9/27/2018	17:36:56	19.76	0.70
9/27/2018	17:37:56	19.76	0.70
9/27/2018	17:38:56	19.76	0.69
9/27/2018	17:39:56	19.76	0.69
9/27/2018	17:40:56	19.77	0.69
9/27/2018	17:41:56	19.77	0.69

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Run #3

Date	Time	O2 [%]	CO2 [%]
9/27/2018	17:42:56	19.76	0.70
9/27/2018	17:43:56	19.76	0.70
9/27/2018	17:44:56	19.76	0.69
9/27/2018	17:45:56	19.75	0.70
9/27/2018	17:46:56	19.76	0.70
9/27/2018	17:47:56	19.76	0.70
9/27/2018	17:48:56	19.76	0.70
9/27/2018	17:49:56	19.75	0.71
9/27/2018	17:50:56	19.76	0.71
9/27/2018	17:51:56	19.76	0.71
9/27/2018	17:52:56	19.76	0.71
9/27/2018	17:53:56	19.76	0.71
9/27/2018	17:54:56	19.76	0.71
9/27/2018	17:55:56	19.76	0.71
9/27/2018	17:56:56	19.76	0.71
9/27/2018	17:57:56	19.76	0.71
9/27/2018	17:58:56	19.76	0.71
9/27/2018	17:59:56	19.76	0.70
9/27/2018	18:00:56	19.76	0.71
9/27/2018	18:01:56	19.77	0.70
9/27/2018	18:02:56	19.77	0.70
9/27/2018	18:03:56	19.75	0.70
9/27/2018	18:04:56	19.76	0.69
9/27/2018	18:05:56	19.75	0.69
9/27/2018	18:06:56	19.76	0.69
9/27/2018	18:07:56	19.75	0.69
9/27/2018	18:08:56	19.75	0.69
9/27/2018	18:09:56	19.75	0.70
9/27/2018	18:10:56	19.75	0.70
9/27/2018	18:11:56	19.75	0.70
9/27/2018	18:12:56	19.75	0.70
9/27/2018	18:13:56	19.75	0.70
9/27/2018	18:14:56	19.75	0.70
9/27/2018	18:15:56	19.75	0.71
9/27/2018	18:16:56	19.75	0.71
9/27/2018	18:17:56	19.75	0.71
9/27/2018	18:18:56	19.75	0.71
9/27/2018	18:19:56	19.75	0.71
9/27/2018	18:20:56	19.75	0.71
9/27/2018	18:21:56	19.75	0.71
9/27/2018	18:22:56	19.76	0.70
9/27/2018	18:23:56	19.76	0.70

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Run #3

Date	Time	O2 [%]	CO2 [%]
9/27/2018	18:24:56	19.75	0.70
9/27/2018	18:25:56	19.75	0.70
9/27/2018	18:26:56	19.75	0.71
9/27/2018	18:27:56	19.75	0.70
9/27/2018	18:28:56	19.75	0.70
9/27/2018	18:29:56	19.75	0.69
9/27/2018	18:30:56	19.75	0.69
9/27/2018	18:31:56	19.76	0.69
9/27/2018	18:32:56	19.76	0.69
9/27/2018	18:33:56	19.76	0.69
9/27/2018	18:34:56	19.76	0.69
9/27/2018	18:35:56	19.76	0.69
9/27/2018	18:36:56	19.76	0.70
9/27/2018	18:37:56	19.76	0.70
9/27/2018	18:38:56	19.76	0.70
9/27/2018	18:39:56	19.76	0.70
9/27/2018	18:40:56	19.75	0.71
9/27/2018	18:41:56	19.76	0.71
9/27/2018	18:42:56	19.75	0.71
9/27/2018	18:43:56	19.76	0.71
9/27/2018	18:44:56	19.75	0.71
9/27/2018	18:45:56	19.76	0.71
9/27/2018	18:46:56	19.76	0.71
9/27/2018	18:47:56	19.75	0.70
9/27/2018	18:48:56	19.75	0.71
9/27/2018	18:49:56	19.75	0.70
9/27/2018	18:50:56	19.75	0.70
9/27/2018	18:51:56	19.75	0.70
9/27/2018	18:52:56	19.76	0.69
9/27/2018	18:53:56	19.75	0.69
9/27/2018	18:54:56	19.75	0.69
9/27/2018	18:55:56	19.75	0.69
9/27/2018	18:56:56	19.75	0.69
9/27/2018	18:57:56	19.75	0.69
9/27/2018	18:58:56	19.75	0.69
9/27/2018	18:59:56	19.75	0.69
9/27/2018	19:00:56	19.74	0.69
9/27/2018	19:01:56	19.74	0.69
9/27/2018	19:02:56	19.75	0.69
9/27/2018	19:03:56	19.75	0.69
9/27/2018	19:04:56	19.75	0.70
9/27/2018	19:05:56	19.74	0.70

Hollingsworth & Vose
CFU-104
Run #3

Date	Time	O2 [%]	CO2 [%]
9/27/2018	19:06:56	19.74	0.70
9/27/2018	19:07:56	19.74	0.71
9/27/2018	19:08:56	19.74	0.71
9/27/2018	19:09:56	19.74	0.70
9/27/2018	19:10:56	19.74	0.70
9/27/2018	19:11:56	19.74	0.70
9/27/2018	19:12:56	19.74	0.70
9/27/2018	19:13:56	19.74	0.70
9/27/2018	19:14:56	19.74	0.70
9/27/2018	19:15:56	19.74	0.70
9/27/2018	19:16:56	19.73	0.70
9/27/2018	19:17:56	19.73	0.69
9/27/2018	19:18:56	19.74	0.68
9/27/2018	19:19:56	19.74	0.68
9/27/2018	19:20:56	19.73	0.68
9/27/2018	19:21:56	19.73	0.68
9/27/2018	19:22:56	19.74	0.69
9/27/2018	19:23:56	19.74	0.68
Final Average		**19.75**	**0.70**

Bias Check

9/27/2018	19:24:56	19.77	0.68
9/27/2018	19:25:06	18.90	0.96
9/27/2018	19:25:16	9.51	0.84
9/27/2018	19:25:26	3.10	0.34
9/27/2018	19:25:36	1.02	0.14
9/27/2018	19:25:46	0.35	0.08
9/27/2018	19:25:56	0.14	0.06
9/27/2018	19:26:06	0.07	0.05
9/27/2018	19:26:16	0.04	0.05
9/27/2018	19:26:26	0.03	0.06
9/27/2018	19:26:36	0.02	0.05
9/27/2018	19:26:46	0.01	0.05
9/27/2018	19:26:56	0.01	0.05
9/27/2018	19:27:06	0.01	0.05
9/27/2018	19:27:16	0.01	0.05
9/27/2018	19:27:26	0.00	0.05
9/27/2018	19:27:36	0.00	0.05
9/27/2018	19:27:46	0.22	0.30
9/27/2018	19:27:56	1.28	1.24
9/27/2018	19:28:06	1.73	1.64
9/27/2018	19:28:16	1.86	1.79

Hollingsworth & Vose
CFU-104
Run #3

Date	Time	O2 [%]	CO2 [%]
9/27/2018	19:28:26	1.91	1.83
9/27/2018	19:28:36	1.92	1.85
9/27/2018	19:28:46	1.92	1.86
9/27/2018	19:28:56	1.93	1.85
9/27/2018	19:29:06	1.93	1.86
9/27/2018	19:29:16	1.92	1.86
9/27/2018	19:29:26	1.92	1.86
9/27/2018	19:29:36	2.48	2.27
9/27/2018	19:29:46	6.63	6.83
9/27/2018	19:29:56	8.88	8.84
9/27/2018	19:30:06	9.59	9.50
9/27/2018	19:30:16	9.83	9.72
9/27/2018	19:30:26	9.91	9.79
9/27/2018	19:30:36	9.94	9.83
9/27/2018	19:30:46	9.95	9.84
9/27/2018	19:30:56	9.96	9.85
9/27/2018	19:31:06	9.96	9.86
9/27/2018	19:31:16	9.96	9.86
9/27/2018	19:31:26	9.96	9.87
9/27/2018	19:31:36	9.97	9.88
		O2 [%]	**CO2 [%]**
System Zero		**0.00**	**0.05**
System Mid		**9.96**	**1.86**

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 104**
DATE	**09/28/18**
METHOD	**5 ODEQ**
POLLUTANT	**Particulate Matter**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**6:53**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**8:57**
EPA Method:	**5 ODEQ**	Clear 62 F 2-4 E	**Date:**	**9/28/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1370999	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size	0.2173 inches
ΔH@	1.846	Hot box ID	HB3	Nozzle area	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
		.		Filter heat	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.90 %
Static Pressure	-0.79 "H_2O	CO_2	0.70 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.197 inches
Stack Temperature	205 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	X
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	15	8

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN#2

Post Test Calculations:

Sample volume	108.513 dcf	Ave. ΔP	1.475 "H_2O
Wet mol. weight	28.74 M_s (actual)	Ave. √ΔP	1.2138 "H_2O
Actual H_2O	1.56 %	Ave. ΔH	2.804 "H_2O
Std. meter vol.	110.418 dscf	Ave. T_s	206.2 °F
Isokinetic Average	99.8 %	Ave. T_m	59.2 °F

Moisture/Lab:

Filter	Q1389 #		
	Initial	Final	Gain
Impingers, g	200.0	210	10.0
Silica gel, g	262.4	289.5	27.1
		Total water gain:	37.1

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.360	1.40	206	53	2.62	2.60	3	251	40
2	10.0	8.680	1.40	206	55	2.63	2.60	3	251	40
3	15.0	13.190	1.50	206	56	2.83	2.80	3	251	41
4	20.0	17.740	1.50	206	56	2.83	2.80	3	251	41
5	25.0	22.240	1.50	208	56	2.82	2.80	3	251	47
6	30.0	26.810	1.60	208	56	3.01	3.00	3	251	47
7	35.0	31.420	1.60	208	56	3.01	3.00	3	251	47
8	40.0	35.920	1.50	207	58	2.83	2.80	3	252	50
9	45.0	40.450	1.50	207	58	2.83	2.80	3	251	53
10	50.0	44.940	1.50	206	58	2.84	2.80	3	251	53
11	55.0	49.490	1.50	206	59	2.84	2.80	3	251	53
12	60.0	54.095	1.50	205	60	2.85	2.90	3	251	53
13	65.0	58.740	1.50	203	60	2.86	2.90	3	251	53
14	70.0	63.360	1.50	205	60	2.85	2.90	3	251	53
15	75.0	68.080	1.60	205	61	3.05	3.10	3	251	53
16	80.0	72.680	1.50	205	61	2.86	2.90	3	251	53
17	85.0	77.250	1.50	205	61	2.86	2.90	3	251	53
18	90.0	81.990	1.60	205	61	3.05	3.10	3	251	53
19	95.0	86.610	1.50	205	62	2.86	2.90	3	251	53
20	100.0	91.030	1.40	206	62	2.67	2.70	3	251	54
21	105.0	95.470	1.40	207	62	2.66	2.70	3	251	54
22	110.0	99.920	1.40	208	63	2.67	2.70	3	251	54
23	115.0	104.220	1.30	208	63	2.48	2.50	3	251	54
24	120.0	108.513	1.20	207	64	2.29	2.30	3	251	53

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**9:15**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**11:19**
EPA Method:	**5 ODEQ**	Clear 62 F 2-4 E	**Date:**	**9/28/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular	
Diameter	30.000 in
Rectangular	
Width	in
Length	in
Stack Area	4.909 sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1370999	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	HB3	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.9 %
Static Pressure	-0.79 "H_2O	CO_2	0.7 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.199 inches
Stack Temperature	205 F		
Assumed moisture	1.56 %		
Assumed meter temp.	59.2 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	X	X
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	6

Nozzle check for roundness:

1	2	3	
0.217	0.217	0.218	inches
	Caliper ID#	MN#2	

Post Test Calculations:

Sample volume	110.705 dcf	Ave. ΔP	1.496 "H_2O
Wet mol. weight	28.71 M_s (actual)	Ave. √ΔP	1.2228 "H_2O
Actual H_2O	1.87 %	Ave. ΔH	2.888 "H_2O
Std. meter vol.	111.152 dscf	Ave. T_s	213.8 °F
Isokinetic Average	100.6 %	Ave. T_m	66.3 °F

Moisture/Lab:

Filter	Q1390 #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	236.7	261.6	24.9
		Total water gain:	44.9

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.630	1.50	209	63	2.87	2.90	3	255	50
2	10.0	9.110	1.50	209	63	2.87	2.90	3	255	50
3	15.0	13.710	1.50	211	63	2.87	2.90	3	255	50
4	20.0	18.360	1.50	211	64	2.87	2.90	3	255	50
5	25.0	22.910	1.50	211	64	2.87	2.90	3	255	50
6	30.0	27.490	1.50	212	64	2.87	2.90	3	251	54
7	35.0	32.070	1.50	212	64	2.87	2.90	3	251	54
8	40.0	36.820	1.60	212	65	3.06	3.00	3	251	54
9	45.0	41.450	1.50	212	66	2.88	2.90	3	251	54
10	50.0	45.930	1.40	213	66	2.68	2.70	3	251	56
11	55.0	50.420	1.40	214	66	2.68	2.70	3	251	57
12	60.0	54.885	1.40	214	66	2.68	2.70	3	251	57
13	65.0	59.520	1.50	214	67	2.87	2.90	3	251	57
14	70.0	64.160	1.50	212	67	2.88	2.90	3	251	55
15	75.0	68.820	1.50	214	67	2.87	2.90	3	251	55
16	80.0	73.440	1.50	214	67	2.87	2.90	3	251	55
17	85.0	78.090	1.50	215	67	2.87	2.90	3	251	55
18	90.0	82.700	1.50	215	67	2.87	2.90	3	251	55
19	95.0	87.330	1.50	217	67	2.86	2.90	3	251	55
20	100.0	92.110	1.60	217	69	3.06	3.10	3	251	57
21	105.0	96.760	1.50	218	69	2.87	2.90	3	251	57
22	110.0	101.390	1.50	218	70	2.87	2.90	3	251	57
23	115.0	106.170	1.60	219	70	3.06	3.10	3	251	57
24	120.0	110.705	1.40	219	70	2.68	2.70	3	251	57

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**11:35**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**13:41**
EPA Method:	**5 ODEQ**	Clear 62 F 2-4 E	**Date:**	**9/28/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1370999	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	HB3	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.9 %
Static Pressure	-0.79 "H_2O	CO_2	0.7 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.198 inches
Stack Temperature	205 F		
Assumed moisture	1.87 %		
Assumed meter temp.	66.3 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	X	X
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	8	8

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN#2

Post Test Calculations:

Sample volume	110.936 dcf	Ave. ΔP	1.471 "H_2O
Wet mol. weight	28.69 M_s (actual)	Ave. √ΔP	1.2119 "H_2O
Actual H_2O	1.98 %	Ave. ΔH	2.838 "H_2O
Std. meter vol.	109.684 dscf	Ave. T_s	225 °F
Isokinetic Average	101.0 %	Ave. T_m	74.4 °F

Moisture/Lab:

Filter	Q1391 #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	244.3	266.3	22.0
		Total water gain:	47.0

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.730	1.50	217	70	2.86	2.90	3	252	55
2	10.0	9.530	1.60	218	70	3.05	3.10	3	252	55
3	15.0	14.190	1.50	218	71	2.86	2.90	3	252	55
4	20.0	18.860	1.50	219	72	2.87	2.90	3	252	59
5	25.0	23.650	1.60	220	72	3.05	3.10	3	253	60
6	30.0	28.360	1.50	220	72	2.86	2.90	3	253	60
7	35.0	33.120	1.50	220	72	2.86	2.90	3	253	49
8	40.0	37.840	1.60	220	72	3.05	3.10	3	253	49
9	45.0	42.640	1.60	223	72	3.04	3.10	3	252	47
10	50.0	47.200	1.40	224	72	2.66	2.70	3	252	47
11	55.0	51.620	1.40	224	72	2.66	2.70	3	252	47
12	60.0	56.050	1.30	225	75	2.48	2.50	3	252	47
13	65.0	60.700	1.50	224	75	2.86	2.90	3	250	52
14	70.0	65.320	1.50	228	75	2.84	2.90	3	250	52
15	75.0	69.890	1.40	229	76	2.66	2.70	3	250	52
16	80.0	74.520	1.50	229	77	2.85	2.90	3	250	52
17	85.0	79.180	1.50	229	77	2.85	2.90	3	250	52
18	90.0	83.750	1.50	230	77	2.85	2.90	3	250	52
19	95.0	88.450	1.50	230	77	2.85	2.90	3	250	52
20	100.0	93.250	1.60	231	78	3.04	3.00	3	251	51
21	105.0	97.890	1.50	231	78	2.85	2.90	3	252	51
22	110.0	102.620	1.40	231	78	2.66	2.70	3	252	51
23	115.0	106.800	1.20	230	78	2.28	2.30	3	252	51
24	120.0	110.936	1.20	230	78	2.28	2.30	3	252	52

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**6:53**
Source:	**CFU 104**	**End Time:**	**8:57**
Method:	**ODEQ 5**	**Date:**	**9/28/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
5	4.360	2.60	53	1	1.40	206	1.1832
10	8.680	2.60	55	2	1.40	206	1.1832
15	13.190	2.80	56	3	1.50	206	1.2247
20	17.740	2.80	56	4	1.50	206	1.2247
25	22.240	2.80	56	5	1.50	208	1.2247
30	26.810	3.00	56	6	1.60	208	1.2649
35	31.420	3.00	56	7	1.60	208	1.2649
40	35.920	2.80	58	8	1.50	207	1.2247
45	40.450	2.80	58	9	1.50	207	1.2247
50	44.940	2.80	58	10	1.50	206	1.2247
55	49.490	2.80	59	11	1.50	206	1.2247
60	54.095	2.90	60	12	1.50	205	1.2247
65	58.740	2.90	60	13	1.50	203	1.2247
70	63.360	2.90	60	14	1.50	205	1.2247
75	68.080	3.10	61	15	1.60	205	1.2649
80	72.680	2.90	61	16	1.50	205	1.2247
85	77.250	2.90	61	17	1.50	205	1.2247
90	81.990	3.10	61	18	1.60	205	1.2649
95	86.610	2.90	62	19	1.50	205	1.2247
100	91.030	2.70	62	20	1.40	206	1.1832
105	95.470	2.70	62	21	1.40	207	1.1832
110	99.920	2.70	63	22	1.40	208	1.1832
115	104.220	2.50	63	23	1.30	208	1.1402
120	108.513	2.30	64	24	1.20	207	1.0954

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Source:	**CFU 104**		**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	108.513	dcf	Rectangular		
Water Volume	37.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.70	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.88	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.804	"H_2O	$\sqrt{Dp}$	1.2138	"H_2O
Temperature, T_m	59.2	^oF	Temperature, T_s	206.2	^oF
Temperature, T_m	519.2	^oA (^oR)	Temperature, T_s	666.2	^oA (R)
Pressure Meter, P_m	29.926	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	110.418	dscf	Velocity, V_s	77.05	fps
	3.127	dscm	Volume (actual)	22,694.3	awcfm
Actual Volume, $V_{m(actual)}$	142.815	awcf		22,340.3	adcfm
Gas Stream Moisture			Volume (standard)	1,069,883.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.746	scf		1,053,192.9	dscf/hr
Moisture, B_{ws}	0.0156			17,553.2	dscf/min
Moisture EPA M4	1.56	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.74	lb/lb-mole			
Percent Isokinetic	99.8	%			

Laboratory Results

EPA Method 5					
Filterable PM	0.00175	grams			
Emissions:					
Concentration, C_s	2.45E-04	gr/dscf			
	560	µg/dscm			
Mass Emissions	3.68E-02	lb/hr			
Back Half:					
Inorganic CPM	6.00E-04	grams	Organic CPM	5.00E-05	grams
Inorganic CPM, C_s	8.38E-05	gr/dscf	Organic CPM, C_s	6.99E-06	gr/dscf
	192	µg/dscm		16	µg/dscm
Mass Emissions	1.26E-02	lb/hr	Mass Emissions	1.05E-03	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**9:15**
Source:	**CFU 104**	**End Time:**	**11:19**
Method:	**ODEQ 5**	**Date:**	**09/28/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
5	4.630	2.90	63	1	1.50	209	1.2247
10	9.110	2.90	63	2	1.50	209	1.2247
15	13.710	2.90	63	3	1.50	211	1.2247
20	18.360	2.90	64	4	1.50	211	1.2247
25	22.910	2.90	64	5	1.50	211	1.2247
30	27.490	2.90	64	6	1.50	212	1.2247
35	32.070	2.90	64	7	1.50	212	1.2247
40	36.820	3.00	65	8	1.60	212	1.2649
45	41.450	2.90	66	9	1.50	212	1.2247
50	45.930	2.70	66	10	1.40	213	1.1832
55	50.420	2.70	66	11	1.40	214	1.1832
60	54.885	2.70	66	12	1.40	214	1.1832
65	59.520	2.90	67	13	1.50	214	1.2247
70	64.160	2.90	67	14	1.50	212	1.2247
75	68.820	2.90	67	15	1.50	214	1.2247
80	73.440	2.90	67	16	1.50	214	1.2247
85	78.090	2.90	67	17	1.50	215	1.2247
90	82.700	2.90	67	18	1.50	215	1.2247
95	87.330	2.90	67	19	1.50	217	1.2247
100	92.110	3.10	69	20	1.60	217	1.2649
105	96.760	2.90	69	21	1.50	218	1.2247
110	101.390	2.90	70	22	1.50	218	1.2247
115	106.170	3.10	70	23	1.60	219	1.2649
120	110.705	2.70	70	24	1.40	219	1.1832

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	110.705	dcf	Rectangular		
Water Volume	44.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.68	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.74	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.888	"H_2O	$\sqrt{Dp}$	1.2228	"H_2O
Temperature, T_m	66.3	^oF	Temperature, T_s	213.8	^oF
Temperature, T_m	526.3	^oA (^oR)	Temperature, T_s	673.8	^oA (R)
Pressure Meter, P_m	29.932	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	111.151	dscf	Velocity, V_s	78.12	fps
	3.147	dscm	Volume (actual)	23,009.5	awcfm
Actual Volume, $V_{m(actual)}$	145.863	awcf		22,579.2	adcfm
Gas Stream Moisture			Volume (standard)	1,072,505.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.113	scf		1,052,449.6	dscf/hr
Moisture, B_{ws}	0.0187			17,540.8	dscf/min
Moisture EPA M4	1.87	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.5	%			

Laboratory Results

Front Half:					
Filterable PM	0.00305	grams			
Emissions:					
Concentration, C_s	4.23E-04	gr/dscf			
	969	µg/dscm			
Mass Emissions	6.37E-02	lb/hr			
Back Half:					
Inorganic CPM	1.10E-03	grams	Organic CPM	7.50E-04	grams
Inorganic CPM, C_s	1.53E-04	gr/dscf	Organic CPM, C_s	1.04E-04	gr/dscf
	350	µg/dscm		238	µg/dscm
Mass Emissions	2.30E-02	lb/hr	Mass Emissions	1.57E-02	lb/hr

Isokinetic Field Data
Field Data and Calculations
Particulate Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**11:35**
Source:	**CFU 104**	**End Time:**	**13:41**
Method:	**ODEQ 5**	**Date:**	**09/28/18**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
5	4.730	2.90	70	1	1.50	217	1.2247
10	9.530	3.10	70	2	1.60	218	1.2649
15	14.190	2.90	71	3	1.50	218	1.2247
20	18.860	2.90	72	4	1.50	219	1.2247
25	23.650	3.10	72	5	1.60	220	1.2649
30	28.360	2.90	72	6	1.50	220	1.2247
35	33.120	2.90	72	7	1.50	220	1.2247
40	37.840	3.10	72	8	1.60	220	1.2649
45	42.640	3.10	72	9	1.60	223	1.2649
50	47.200	2.70	72	10	1.40	224	1.1832
55	51.620	2.70	72	11	1.40	224	1.1832
60	56.050	2.50	75	12	1.30	225	1.1402
65	60.700	2.90	75	13	1.50	224	1.2247
70	65.320	2.90	75	14	1.50	228	1.2247
75	69.890	2.70	76	15	1.40	229	1.1832
80	74.520	2.90	77	16	1.50	229	1.2247
85	79.180	2.90	77	17	1.50	229	1.2247
90	83.750	2.90	77	18	1.50	230	1.2247
95	88.450	2.90	77	19	1.50	230	1.2247
100	93.250	3.00	78	20	1.60	231	1.2649
105	97.890	2.90	78	21	1.50	231	1.2247
110	102.620	2.70	78	22	1.40	231	1.1832
115	106.800	2.30	78	23	1.20	230	1.0954
120	110.936	2.30	78	24	1.20	230	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	110.936	dcf	Rectangular		
Water Volume	47.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.70	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.83	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.838	"H_2O	$\sqrt{Dp}$	1.2119	"H_2O
Temperature, T_m	74.4	^oF	Temperature, T_s	225.0	^oF
Temperature, T_m	534.4	^{o}A (^{o}R)	Temperature, T_s	685.0	^{o}A (R)
Pressure Meter, P_m	29.929	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	109.684	dscf	Velocity, V_s	78.08	fps
	3.106	dscm	Volume (actual)	22,997.7	awcfm
Actual Volume, $V_{m(actual)}$	146.494	awcf		22,542.3	adcfm
Gas Stream Moisture			Volume (standard)	1,054,429.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.212	scf		1,033,551.8	dscf/hr
Moisture, B_{ws}	0.0198			17,225.9	dscf/min
Moisture EPA M4	1.98	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	101.0	%			

Laboratory Results

Front Half:					
Filterable PM	0.00215	grams			
Emissions:					
Concentration, C_s	3.02E-04	gr/dscf			
	692	µg/dscm			
Mass Emissions	4.47E-02	lb/hr			
Back Half:					
Inorganic CPM	6.50E-04	grams	Organic CPM	1.00E-04	grams
Inorganic CPM, C_s	9.14E-05	gr/dscf	Organic CPM, C_s	1.41E-05	gr/dscf
	209	µg/dscm		32.20	µg/dscm
Mass Emissions	1.35E-02	lb/hr	Mass Emissions	2.08E-03	lb/hr

Oregon Method 5
Filterable and Condensable Particulate
Laboratory Gravimetric Data

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 104

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction	Corrected Gain (grams)	
1	CPM Organics (Acetone BH)	150	45.04685	45.04690	0.00005	0.00E+00	**0.00005**	
	Probe Rinse (Acetone FH)	95	44.09150	44.09200	0.00050	0.00E+00	**0.00050**	
	Filter	Q1389	0.37845	0.37970	0.00125		**0.00125**	
	CPM Inorganics (Water)	420	43.50740	43.50800	0.00060	0.00E+00	**0.00060**	
	CPM Organics (Hexane BH)	90	42.04090	42.04090	0.00000	0.00E+00	**0.00000**	
	Impinger H_2O Gain, mls		200	210	10.0			
						Filterable PM (mg)	**1.75**	
						Total PM (mg)	**2.40**	**ND**
2	CPM Organics (Acetone BH)	155	54.46775	54.46850	0.00075	0.00E+00	**0.00075**	
	Probe Rinse (Acetone FH)	100	51.21870	51.21950	0.00080	0.00E+00	**0.00080**	
	Filter	Q1390	0.37615	0.37840	0.00225		**0.00225**	
	CPM Inorganics (Water)	410	40.48310	40.48420	0.00110	0.00E+00	**0.00110**	
	CPM Organics (Hexane BH)	90	55.03580	55.03550	-0.00030	0.00E+00	**0.00000**	
	Impinger H_2O Gain, mls		200	220	20.0		**20**	
						Filterable PM (mg)	**3.05**	
						Total PM (mg)	**4.90**	**ND**
3	CPM Organics (Acetone BH)	145	43.05190	43.05200	0.00010	0.00E+00	**0.00010**	
	Probe Rinse (Acetone FH)	60	42.04800	42.04810	0.00010	0.00E+00	**0.00010**	
	Filter	Q1391	0.37870	0.38075	0.00205		**0.00205**	
	CPM Inorganics (Water)	400	45.64855	45.64920	0.00065	0.00E+00	**0.00065**	
	CPM Organics (Hexane BH)	85	47.19960	47.19950	-0.00010	0.00E+00	**0.00000**	
	Impinger H_2O Gain, mls		200	225	25.0			
						Filterable PM (mg)	**2.15**	
						Total PM (mg)	**2.90**	**ND**
	Acetone Blank	160	45.69390	45.69390	0.00000	0.00E+00	g/g	
	Water Blank	200	49.47520	49.47520	0.00000	0.00E+00	g/g	
	Hexane Blank	100	43.10705	43.10700	0.00000	0.00E+00	g/g	

ND = Non-Detect. Values are below the method detection limit (7 mg).

Oregon Methods 1-5
Filterable and Condensable Particulate
Results Summary

Client: Hollingsworth & Vose
Source: CFU 104
Location: Corvallis, OR

Run			1	2	3	Average
Date			9/28/2018	9/28/2018	9/28/2018	
Run Start Time			6:53	9:15	11:35	
Run End Time			8:57	11:19	13:41	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.72	29.72	29.72	**29.72**
Nozzle Dia., in.			0.2173	0.2173	0.2173	**0.2173**
Isokinetic Average, %			99.8	100.5	101.0	**100.4**
Sample Volume, dscf			110.418	111.151	109.684	**110.418**
Sample Volume, dscm			3.127	3.147	3.106	**3.127**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.70	0.68	0.70	**0.69**
O_2 %vd			19.88	19.74	19.83	**19.82**
Static Press., "H_2O			-0.79	-0.79	-0.79	**-0.79**
H_2O %v			1.56	1.87	1.98	**1.80**
Wet Molecular Weight, lb/lb-mole			28.74	28.70	28.69	**28.71**
Velocity, FPS			77.05	78.12	78.08	**77.75**
ADCFM			22,340.3	22,579.2	22,542.3	**22,487.3**
AWCFM			22,694.3	23,009.5	22,997.7	**22,900.5**
DSCFM			17,553.2	17,540.8	17,225.9	**17,440.0**
Stack Temperature, ^oF			206.2	213.8	225.0	**215.0**
Filterable Particulate	Concentration, C_s	gr/dscf	2.45E-04	4.23E-04	3.02E-04	**3.23E-04**
		µg/dscm	560	969	692	**740**
	Mass	lb/hr	3.68E-02	6.37E-02	4.47E-02	**4.84E-02**
		lb/lb glass	9.84E-05	1.75E-04	1.21E-04	**1.31E-04**
Inorganic CPM	Concentration, C_s	gr/dscf	8.38E-05	1.53E-04	9.14E-05	**1.09E-04**
		µg/dscm	192	350	209	**250**
	Mass	lb/hr	1.26E-02	2.30E-02	1.35E-02	**1.64E-02**
		lb/lb glass	3.37E-05	6.30E-05	3.66E-05	**4.45E-05**
Organic CPM	Concentration, C_s	gr/dscf	6.99E-06	1.04E-04	1.41E-05	**4.17E-05**
		µg/dscm	16	238	32	**96**
	Mass	lb/hr	1.05E-03	1.57E-02	2.08E-03	**6.26E-03**
		lb/lb glass	2.81E-06	4.30E-05	5.63E-06	**1.71E-05**
Measured Total PM	Concentration, C_s	gr/dscf	ND 3.35E-04	ND 6.80E-04	ND 4.08E-04	ND **4.75E-04**
		µg/dscm	ND 767.5	ND 1,557.0	ND 933.7	ND **1,086.1**
	Mass	lb/hr	ND 5.05E-02	ND 1.02E-01	ND 6.02E-02	ND **7.10E-02**
		lb/lb glass	ND 1.35E-04	ND 2.81E-04	ND 1.63E-04	ND **1.93E-04**
Total PM @ Method Detection Limit (7 mg)	Concentration, C_s	gr/dscf	< 9.78E-04	< 9.72E-04	< 9.85E-04	< **9.78E-04**
	Mass	lb/hr	< 1.47E-01	< 1.46E-01	< 1.45E-01	< **1.46E-01**
		lb/lb glass	< 3.94E-04	< 4.01E-04	< 3.94E-04	< **3.96E-04**
Production Data	Glass Production	lbs/hr	373.8	364.3	369.0	**369.0**

Oregon Methods 1-5
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**6:53**
Source:	**CFU 104**	**End Time:**	**8:57**
Method:	**ODEQ 5**	**Date:**	**9/28/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.926 "Hg
where Pb: 29.72 "Hg
ΔH: 2.804 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.662 "Hg
where Pb: 29.72 "Hg
Static Press.: -0.79 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 110.418 dscf
where Vm: 108.513 dcf
Y: 1.0008
Pm: 29.926 "Hg
Tm: 519.2 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.746 scf
where H_2O: 37.10 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0156

where Vw(std): 1.746 scf
Vm(std): 110.418 dscf

6) % H_2O = Bws x 100 = 1.56 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 142.815 awcf
where Y: 1.0008
Vm: 108.5129 dcf
Bws: 0.0156
Ts: 666.2 °A
Tm: 519.2 °A
Pm: 29.926 "Hg
Ps: 29.662 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.91 lb/lb-mole
where CO_2: 0.70 %vd
O_2 19.88 %vd
N_2+CO= (100-(O_2+CO_2): 79.42 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.74 lb/lb-mole

where M_d: 28.91 lb/lb-mole

Bws: 0.0156

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 4.909 sq. ft.

where Stack ID: 30 inches

Stack Area(rect.) = stack width/12 x stack length/12 = NA sq. ft.

where Stack Width: 0.000 inches

Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 77.05 fps

where Cp: 0.84

Ave. Sqrt ΔP: 1.2138

Ts: 666.2 °A

Ps: 29.662 "Hg

Ms: 28.74 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 22,694.3 AWCFM

where V_s: 77.05 ft/sec

Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 22,340.3 ADCFM

where AWCFM: 22,694.3

Bws: 0.0156

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,069,883.1 wscf/hr

where V_s: 77.05 ft/sec

Stack Area: 4.9090 sq. ft.

Ts: 666.2 °A

Ps: 29.662 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,053,192.9 dscf/hr

where wscf/hr: 1,069,883.1

Bws: 0.0156

16) DSCFM= (dscf/hr)/60 mins/hr = 17,553.2 DSCFM

where dscf/hr: 1,053,192.9

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000258 sq. ft.

where Nozzle Size: 0.2173 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 104**	**Date:**	**9/28/2018**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right) =$ 99.8 %

where Ts:	666.2	°A
Vm(Std):	110.418	dscf
Ps:	29.662	"Hg
Vs	77.05	ft/sec
Nozzle Area:	0.000258	sq. ft.
Sampling Time:	120	min.
Bws:	0.0156	

ODEQ Method 5:

Front Half:

19) Filterable PM = filter gain + probe rinse gain = 0.00175 grams

where Filter Gain:	0.00125	grams
Probe Rinse:	0.00050	grams

20) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 2.45E-04 gr/dscf

where Sample:	0.00175	grams
Vm(std)	110.418	dscf

21) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 560 µg/dscm

where Sample:	0.00175	grams
Vm(std)	3.127	dscm

22) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 3.68E-02 lb/hr

where Cs:	2.45E-04	gr/dscf
Stack Flow:	1,053,192.9	dscf/hr

Back Half:

23) Inorganic CPM = water fraction = 0.00060 grams
Organic CPM = acetone BH + hexane BH = 0.00005 grams

Back-half concentrations and mass rates are calculated as front-half examples.

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 104**
DATE	**09/28/18**
METHOD	**316**
POLLUTANT	**Formaldehyde**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**6:52**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**8:58**
EPA Method:	**316**	Clear Sky, 65 degrees	**Date:**	**9/28/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.182	Nozzle size	0.1820 inches
ΔH@	1.799	Hot box ID	HB2	Nozzle area	0.000181 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.70 %
Static Pressure	-0.79 "H_2O	CO_2	0.90 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.197 inches
Stack Temperature	200 F		
Assumed moisture	2 %		
Assumed meter temp.	69 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	10	10

Nozzle check for roundness:

1	2	3
0.182	0.182	0.182 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	74.326 dcf	Ave. ΔP	1.4 "H_2O
Wet mol. weight	28.74 M_s (actual)	Ave. √ΔP	1.1828 "H_2O
Actual H_2O	1.70 %	Ave. ΔH	1.3 "H_2O
Std. meter vol.	75.427 dscf	Ave. T_s	209.1 °F
Isokinetic Average	100.1 %	Ave. T_m	57.5 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	206	6.0
Silica gel, g	241.6	263.4	21.8
		Total water gain:	27.8

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	5.0	2.880	1.30	208	55	1.17	1.20	1.5	255	48
2	10.0	5.790	1.30	208	55	1.17	1.20	1.5	253	41
3	15.0	8.930	1.40	209	55	1.26	1.30	1.5	253	38
4	20.0	12.040	1.40	210	55	1.26	1.30	1.5	253	41
5	25.0	15.140	1.40	210	55	1.26	1.30	1.5	253	43
6	30.0	18.250	1.40	210	55	1.26	1.30	1.5	253	44
7	35.0	21.350	1.40	210	55	1.26	1.30	1.5	253	47
8	40.0	24.460	1.40	215	56	1.25	1.30	1.5	254	49
9	45.0	27.550	1.40	211	56	1.26	1.30	1.5	251	51
10	50.0	30.670	1.40	210	56	1.26	1.30	1.5	252	53
11	55.0	33.770	1.40	210	57	1.26	1.30	1.5	254	55
12	60.0	36.733	1.30	208	57	1.17	1.20	1.5	252	56
13	65.0	39.690	1.30	207	57	1.18	1.20	1.5	251	53
14	70.0	42.800	1.40	209	58	1.26	1.30	1.5	252	53
15	75.0	45.900	1.40	208	58	1.27	1.30	1.5	252	55
16	80.0	49.130	1.50	208	59	1.36	1.40	1.5	256	56
17	85.0	52.480	1.60	207	59	1.45	1.50	1.5	254	57
18	90.0	55.800	1.60	207	59	1.45	1.50	1.5	255	60
19	95.0	58.900	1.40	208	60	1.27	1.30	1.5	255	61
20	100.0	62.010	1.40	208	60	1.27	1.30	1.5	254	63
21	105.0	65.130	1.40	209	60	1.27	1.30	1.5	252	63
22	110.0	68.220	1.40	209	61	1.27	1.30	1.5	254	64
23	115.0	71.330	1.40	210	61	1.27	1.30	1.5	252	64
24	120.0	74.326	1.30	210	61	1.18	1.20	1.5	254	64

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**9:16**
Source:	**CFU 104**	**End Time:**	**11:20**
EPA Method:	**316**	**Date:**	**9/28/2018**
Box Operator:	**RR**		
Technician(s):	**CW**		

Environmental Conditions/Test Notes:
Clear Sky, 65 degrees

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.182	Nozzle size:	0.1820 inches
ΔH@	1.799	Hot box ID	HB2	Nozzle area:	0.000181 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.7 %
Static Pressure	-0.79 "H_2O	CO_2	0.9 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.199 inches
Stack Temperature	200 F		
Assumed moisture	1.7 %		
Assumed meter temp.	57.5 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	14	9

Nozzle check for roundness:

1	2	3
0.182	0.182	0.182 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	75.553 dcf	Ave. ΔP	1.425 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.1935 "H_2O
Actual H_2O	1.94 %	Ave. ΔH	1.325 "H_2O
Std. meter vol.	75.565 dscf	Ave. T_s	215.1 °F
Isokinetic Average	100.0 %	Ave. T_m	65.1 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	255.8	267.6	11.8
		Total water gain:	31.8

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	3.120	1.40	212	62	1.27	1.30	1	254	57
2	10.0	6.230	1.40	213	62	1.27	1.30	1	253	45
3	15.0	9.330	1.40	213	62	1.27	1.30	1	254	45
4	20.0	12.590	1.50	213	63	1.37	1.40	1	253	45
5	25.0	15.810	1.50	213	63	1.37	1.40	1	252	46
6	30.0	19.010	1.50	214	63	1.36	1.40	1	253	46
7	35.0	22.250	1.50	213	63	1.37	1.40	1	252	47
8	40.0	25.440	1.50	214	64	1.37	1.40	1	254	47
9	45.0	28.560	1.40	214	64	1.28	1.30	1	254	47
10	50.0	31.680	1.40	214	65	1.28	1.30	1	253	47
11	55.0	34.800	1.40	215	65	1.28	1.30	1	254	48
12	60.0	37.925	1.40	215	65	1.28	1.30	1	252	48
13	65.0	40.970	1.30	215	65	1.19	1.20	1	253	58
14	70.0	43.950	1.30	216	66	1.19	1.20	1	253	51
15	75.0	47.050	1.40	215	66	1.28	1.30	1	256	51
16	80.0	50.240	1.40	215	66	1.28	1.30	1	253	51
17	85.0	53.340	1.40	215	66	1.28	1.30	1	254	52
18	90.0	56.440	1.40	214	66	1.28	1.30	1	252	52
19	95.0	59.640	1.50	214	66	1.37	1.40	1	254	53
20	100.0	62.920	1.50	217	68	1.37	1.40	1	255	53
21	105.0	66.050	1.40	219	68	1.28	1.30	1	253	54
22	110.0	69.300	1.50	220	68	1.37	1.40	1	252	54
23	115.0	72.430	1.40	220	68	1.27	1.30	1	253	54
24	120.0	75.553	1.40	220	69	1.28	1.30	1	251	55

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**11:38**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**13:42**
EPA Method:	**316**	Clear Sky, 65 degrees	**Date:**	**9/28/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.182	Nozzle size:	0.1820 inches
ΔH@	1.799	Hot box ID	HB2	Nozzle area:	0.000181 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.7 %
Static Pressure	-0.79 "H_2O	CO_2	0.9 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.198 inches
Stack Temperature	200 F		
Assumed moisture	1.94 %		
Assumed meter temp.	65.1 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	10

Nozzle check for roundness:

1	2	3	
0.182	0.182	0.182	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	76.005 dcf	Ave. ΔP	1.408 "H_2O
Wet mol. weight	28.71 M_s (actual)	Ave. √ΔP	1.1864 "H_2O
Actual H_2O	2 %	Ave. ΔH	1.308 "H_2O
Std. meter vol.	74.706 dscf	Ave. T_s	227 °F
Isokinetic Average	100.4 %	Ave. T_m	74.3 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	222	22.0
Silica gel, g	283.2	293.6	10.4
		Total water gain:	32.4

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.980	1.20	220	70	1.09	1.10	1	255	63
2	10.0	6.130	1.40	221	70	1.27	1.30	1	249	62
3	15.0	9.290	1.40	221	70	1.27	1.30	1	253	61
4	20.0	12.430	1.40	221	70	1.27	1.30	1	253	61
5	25.0	15.580	1.40	222	72	1.27	1.30	1	253	62
6	30.0	18.730	1.40	223	73	1.28	1.30	1	253	55
7	35.0	22.010	1.50	223	73	1.37	1.40	1	254	53
8	40.0	25.200	1.40	224	73	1.27	1.30	1	254	51
9	45.0	28.290	1.40	225	73	1.27	1.30	1	254	52
10	50.0	31.470	1.40	226	73	1.27	1.30	1	252	52
11	55.0	34.610	1.40	226	74	1.27	1.30	1	253	52
12	60.0	37.754	1.40	227	74	1.27	1.30	1	254	53
13	65.0	40.810	1.30	226	75	1.18	1.20	1	254	59
14	70.0	44.000	1.40	228	75	1.27	1.30	1	252	51
15	75.0	47.180	1.40	230	75	1.27	1.30	1	256	53
16	80.0	50.450	1.50	231	76	1.36	1.40	1	253	52
17	85.0	53.700	1.50	230	76	1.36	1.40	1	253	53
18	90.0	56.970	1.50	231	76	1.36	1.40	1	254	55
19	95.0	60.230	1.50	232	76	1.36	1.40	1	254	54
20	100.0	63.410	1.40	232	77	1.27	1.30	1	253	56
21	105.0	66.570	1.40	232	77	1.27	1.30	1	252	55
22	110.0	69.710	1.40	232	78	1.27	1.30	1	252	56
23	115.0	72.850	1.40	232	78	1.27	1.30	1	254	55
24	120.0	76.005	1.40	232	78	1.27	1.30	1	254	55

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**6:52**
Source:	**CFU 104**	**End Time:**	**8:58**
Method:	**316**	**Date:**	**9/28/2018**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	$\sqrt{Dp}$
	0.000						
5	2.880	1.20	55	1	1.30	208	1.1402
10	5.790	1.20	55	2	1.30	208	1.1402
15	8.930	1.30	55	3	1.40	209	1.1832
20	12.040	1.30	55	4	1.40	210	1.1832
25	15.140	1.30	55	5	1.40	210	1.1832
30	18.250	1.30	55	6	1.40	210	1.1832
35	21.350	1.30	55	7	1.40	210	1.1832
40	24.460	1.30	56	8	1.40	215	1.1832
45	27.550	1.30	56	9	1.40	211	1.1832
50	30.670	1.30	56	10	1.40	210	1.1832
55	33.770	1.30	57	11	1.40	210	1.1832
60	36.733	1.20	57	12	1.30	208	1.1402
65	39.690	1.20	57	13	1.30	207	1.1402
70	42.800	1.30	58	14	1.40	209	1.1832
75	45.900	1.30	58	15	1.40	208	1.1832
80	49.130	1.40	59	16	1.50	208	1.2247
85	52.480	1.50	59	17	1.60	207	1.2649
90	55.800	1.50	59	18	1.60	207	1.2649
95	58.900	1.30	60	19	1.40	208	1.1832
100	62.010	1.30	60	20	1.40	208	1.1832
105	65.130	1.30	60	21	1.40	209	1.1832
110	68.220	1.30	61	22	1.40	209	1.1832
115	71.330	1.30	61	23	1.40	210	1.1832
120	74.326	1.20	61	24	1.30	210	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	74.326	dcf	Rectangular		
Water Volume	27.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.1820	in.	Length		in
Nozzle Area	0.000181	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.70	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.88	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.300	"H_2O	√Dp	1.1828	"H_2O
Temperature, T_m	57.5	^oF	Temperature, T_s	209.1	^oF
Temperature, T_m	517.5	^oA (^oR)	Temperature, T_s	669.1	^oA (R)
Pressure Meter, P_m	29.816	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	75.427	dscf	Velocity, V_s	75.28	fps
	2.136	dscm	Volume (actual)	22,173.0	awcfm
Actual Volume, $V_{m(actual)}$	98.122	awcf		21,796.1	adcfm
Gas Stream Moisture			Volume (standard)	1,040,775.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.308	scf		1,023,081.9	dscf/hr
Moisture, B_{ws}	0.0170			17,051.4	dscf/min
Moisture EPA M4	1.70	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	492.472	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.72	lb/lb-mole			
Percent Isokinetic	100.0	%			

Laboratory Results

CH_2O	460.0	µg/sample			
CH_2O	4.60E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	9.41E-05	gr/dscf
	215.4	µg/dscm
	1.72E-01	ppmvd
Mass Emissions	1.38E-02	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**9:16**
Source:	**CFU 104**	**End Time:**	**11:20**
Method:	**316**	**Date:**	**09/28/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	√Dp
	0.000						
5	3.120	1.30	62	1	1.40	212	1.1832
10	6.230	1.30	62	2	1.40	213	1.1832
15	9.330	1.30	62	3	1.40	213	1.1832
20	12.590	1.40	63	4	1.50	213	1.2247
25	15.810	1.40	63	5	1.50	213	1.2247
30	19.010	1.40	63	6	1.50	214	1.2247
35	22.250	1.40	63	7	1.50	213	1.2247
40	25.440	1.40	64	8	1.50	214	1.2247
45	28.560	1.30	64	9	1.40	214	1.1832
50	31.680	1.30	65	10	1.40	214	1.1832
55	34.800	1.30	65	11	1.40	215	1.1832
60	37.925	1.30	65	12	1.40	215	1.1832
65	40.970	1.20	65	13	1.30	215	1.1402
70	43.950	1.20	66	14	1.30	216	1.1402
75	47.050	1.30	66	15	1.40	215	1.1832
80	50.240	1.30	66	16	1.40	215	1.1832
85	53.340	1.30	66	17	1.40	215	1.1832
90	56.440	1.30	66	18	1.40	214	1.1832
95	59.640	1.40	66	19	1.50	214	1.2247
100	62.920	1.40	68	20	1.50	217	1.2247
105	66.050	1.30	68	21	1.40	219	1.1832
110	69.300	1.40	68	22	1.50	220	1.2247
115	72.430	1.30	68	23	1.40	220	1.1832
120	75.553	1.30	69	24	1.40	220	1.1832

Client:	**Hollingsworth & Vose**		**Run:**		**2**
Source:	**CFU 104**		**Date:**	**09/28/18**	

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	75.553	dcf	Rectangular		
Water Volume	31.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.1820	in.	Length		in
Nozzle Area	0.000181	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.68	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.74	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.325	"H_2O	$\sqrt{Dp}$	1.1935	"H_2O
Temperature, T_m	65.1	^oF	Temperature, T_s	215.1	^oF
Temperature, T_m	525.1	^oA (^oR)	Temperature, T_s	675.1	^oA (R)
Pressure Meter, P_m	29.817	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	75.565	dscf	Velocity, V_s	76.34	fps
	2.140	dscm	Volume (actual)	22,485.2	awcfm
Actual Volume, $V_{m(actual)}$	99.425	awcf		22,049.0	adcfm
Gas Stream Moisture			Volume (standard)	1,046,049.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.497	scf		1,025,756.4	dscf/hr
Moisture, B_{ws}	0.0194			17,095.9	dscf/min
Moisture EPA M4	1.94	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	496.888	
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	100.0	%			

Laboratory Results

CH_2O	477.0	µg/sample			
CH_2O	4.77E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	9.74E-05	gr/dscf
	222.9	µg/dscm
	1.79E-01	ppmvd
Mass Emissions	1.43E-02	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**11:38**
Source:	**CFU 104**	**End Time:**	**13:42**
Method:	**316**	**Date:**	**09/28/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	$\sqrt{Dp}$
	0.000						
5	2.980	1.10	70	1	1.20	220	1.0954
10	6.130	1.30	70	2	1.40	221	1.1832
15	9.290	1.30	70	3	1.40	221	1.1832
20	12.430	1.30	70	4	1.40	221	1.1832
25	15.580	1.30	72	5	1.40	222	1.1832
30	18.730	1.30	73	6	1.40	223	1.1832
35	22.010	1.40	73	7	1.50	223	1.2247
40	25.200	1.30	73	8	1.40	224	1.1832
45	28.290	1.30	73	9	1.40	225	1.1832
50	31.470	1.30	73	10	1.40	226	1.1832
55	34.610	1.30	74	11	1.40	226	1.1832
60	37.754	1.30	74	12	1.40	227	1.1832
65	40.810	1.20	75	13	1.30	226	1.1402
70	44.000	1.30	75	14	1.40	228	1.1832
75	47.180	1.30	75	15	1.40	230	1.1832
80	50.450	1.40	76	16	1.50	231	1.2247
85	53.700	1.40	76	17	1.50	230	1.2247
90	56.970	1.40	76	18	1.50	231	1.2247
95	60.230	1.40	76	19	1.50	232	1.2247
100	63.410	1.30	77	20	1.40	232	1.1832
105	66.570	1.30	77	21	1.40	232	1.1832
110	69.710	1.30	78	22	1.40	232	1.1832
115	72.850	1.30	78	23	1.40	232	1.1832
120	76.005	1.30	78	24	1.40	232	1.1832

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	76.005	dcf	Rectangular		
Water Volume	32.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.1820	in.	Length		in
Nozzle Area	0.000181	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.70	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.83	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.308	"H_2O	$\sqrt{Dp}$	1.1864	"H_2O
Temperature, T_m	74.3	^oF	Temperature, T_s	227.0	^oF
Temperature, T_m	534.3	^oA (^oR)	Temperature, T_s	687.0	^oA (R)
Pressure Meter, P_m	29.816	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	74.705	dscf	Velocity, V_s	76.55	fps
	2.115	dscm	Volume (actual)	22,547.0	awcfm
Actual Volume, $V_{m(actual)}$	100.088	awcf		22,096.1	adcfm
Gas Stream Moisture			Volume (standard)	1,030,758.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.525	scf		1,010,142.9	dscf/hr
Moisture, B_{ws}	0.0200			16,835.7	dscf/min
Moisture EPA M4	2.00	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	505.647	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

CH_2O	525.0	µg/sample			
CH_2O	5.25E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	1.08E-04	gr/dscf
	248.2	µg/dscm
	1.99E-01	ppmvd
Mass Emissions	1.56E-02	lb/hr

"<" represents MDL value

EPA Method 316
Laboratory Results
Formaldehyde

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR** **MDL** 0.0274 µg/mL
Source: **CFU 104**

Lab ID	Sample ID	Sample Date	<	Result	MDL	Sample Vol. (mL)	Units
4	Run 1	9/28/2018		460	12.19	445.0	µg/sample
8	Run 2	9/28/2018		477	12.47	455.0	µg/sample
9	Run 3	9/28/2018		525	12.74	465.0	µg/sample
20	H_20 Blank	9/12/2018	<	MDL	11.10	405.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 316
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 104

Run			1	2	3	Average
Date			9/28/2018	9/28/2018	9/28/2018	
Run Start Time			6:52	9:16	11:38	
Run End Time			8:58	11:20	13:42	
Duration, min.			120	120	120	
Barometric Pressure, "Hg			29.72	29.72	29.72	**29.72**
Nozzle Dia., in.			0.1820	0.1820	0.1820	**0.1820**
Isokinetic Average, %			100.0	100.0	100.3	**100.1**
Sample Volume, dscf			75.427	75.565	74.705	**75.232**
Sample Volume, dscm			2.136	2.140	2.115	**2.130**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.70	0.68	0.70	**0.69**
O_2 %vd			19.88	19.74	19.83	**19.82**
Static Press., "H_2O			-0.79	-0.79	-0.79	**-0.79**
H_2O %v			1.70	1.94	2.00	**1.88**
Wet Molecular Weight, lb/lb-mole			28.72	28.69	28.69	**28.70**
Velocity, FPS			75.28	76.34	76.55	**76.06**
ADCFM			21,796.1	22,049.0	22,096.1	**21,980.4**
AWCFM			22,173.0	22,485.2	22,547.0	**22,401.7**
DSCFM			17,051.4	17,095.9	16,835.7	**16,994.3**
Stack Temperature, ^{o}F			209.1	215.1	227.0	**217.1**
Formaldehyde	Concentration, C_s	gr/dscf	9.41E-05	9.74E-05	1.08E-04	**1.00E-04**
		µg/dscm	215.36	222.90	248.23	**228.83**
		ppmvd	1.72E-01	1.79E-01	1.99E-01	**1.83E-01**
	Mass	lb/hr	1.38E-02	1.43E-02	1.56E-02	**1.46E-02**
		lb/lb glass	3.68E-05	3.92E-05	4.24E-05	**3.95E-05**
Production Data	Glass Production	lbs/hr	373.8	364.3	369.0	**369.0**

"<" represents MDL value

EPA Methods 1-4, 316
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**6:52**
Source:	**CFU 104**	**End Time:**	**8:58**
Method:	**316**	**Date:**	**9/28/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.816 "Hg

where Pb: 29.72 "Hg

ΔH: 1.300 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.662 "Hg

where Pb: 29.72 "Hg

Static Press.: -0.79 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 75.427 dscf

where Vm: 74.326 dcf

Y: 0.9985

Pm: 29.816 "Hg

Tm: 517.5 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.308 scf

where H_2O: 27.80 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0170

where Vw(std): 1.308 scf

Vm(std): 75.427 dscf

6) % H_2O = Bws x 100 = 1.70 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 98.122 awcf

where Y: 0.9985

Vm: 74.3259 dcf

Bws: 0.0170

Ts: 669.1 °A

Tm: 517.5 °A

Pm: 29.816 "Hg

Ps: 29.662 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.91 lb/lb-mole

where CO_2: 0.70 %vd

O_2 19.88 %vd

N_2+CO= (100-(O_2+CO_2): 79.42 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.72 lb/lb-mole
where M_d: 28.91 lb/lb-mole
Bws: 0.0170

10) $\text{Stack Area(cir.)} = 3.1416 \text{ (stack diameter/24)}^2 =$ 4.909 sq. ft.
where Stack ID: 30 inches

$\text{Stack Area(rect.)} = \text{stack width/12 x stack length/12} =$ NA sq. ft.
where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) $\text{Velocity, } V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 75.28 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.1828
Ts: 669.1 °A
Ps: 29.662 "Hg
Ms: 28.72 lb/lb-mole

12) $\text{AWCFM} = (V_s)\text{(stack area)(60 sec/min)} =$ 22,173.0 AWCFM
where V_s: 75.28 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 21,796.1 ADCFM
where AWCFM: 22,173.0
Bws: 0.0170

14) $\text{Qsw} = 3600(V_s)\text{(stack area)}\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,040,775.1 wscf/hr
where V_s: 75.28 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 669.1 °A
Ps: 29.662 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,023,081.9 dscf/hr
where wscf/hr: 1,040,775.1
Bws: 0.0170

16) DSCFM= (dscf/hr)/60 mins/hr = 17,051.4 DSCFM
where dscf/hr: 1,023,081.9

17) $\text{Nozzle Area} = 3.1416 \text{ (Nozzle Size/24)}^2 =$ 0.000181 sq. ft.
where Nozzle Size: 0.1820 inches

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.0 %

where Ts:	669.1	°A
Vm(Std):	75.427	dscf
Ps:	29.662	"Hg
Vs	75.28	ft/sec
Nozzle Area:	0.000181	sq. ft.
Sampling Time:	120	min.
Bws:	0.0170	

EPA Method 316:

19) Formaldehyde laboratory results 460.0 µg/sample

20) Formaldehyde = (µg/sample)/1,000,000 = 4.60E-04 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 9.41E-05 gr/dscf

where Sample:	0.00046	grams
Vm(std)	75.427	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 215.4 µg/dscm

where Sample:	0.00046	grams
Vm(std)	2.136	dscm

23) Volume/Mole = $\left(\frac{359\frac{ft^3}{lb-mol}@STP\ (Ts)\ (29.92"Hg)}{492°A\ (Ps)}\right)$ = 492.472 Vol./Mole

where Ts:	669.1	°A
Ps:	29.662	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 1.72E-01 ppmvd

where MW:	30.031	g/mol
lb/hr:	0.01	
Vol./Mole:	492.472	
ADCFM:	21796.1	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 1.38E-02 lb/hr

where Cs:	9.41E-05	gr/dscf
Stack Flow:	1,023,081.9	dscf/hr

09/28 1 of 2

Daily Gaseous Calibrations Log

Client: H i V

Source: CFU-104 -M5/316/ Full gasses

Date: 09/28/18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass
—	0	✓

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

- see 9/11/18

*Use of a calibrated instrument required

Direct Analyzer Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X	0	X	0	X	0	X	50.41	X
10	X	5	X	200	X	2	X		
20	X	10	X	400	X	4	X		

System Calibrations									
O_2 %		NO_x		CO		CO_2		NO_2	
Target	x	Target	x	Target	X	Target	X	Target	X
0	X	0	X	0	X	0	X		
10	X	5	X	200	X	2	X		

System VOC Calibrations		
	Initial target	Post Target
Zero	✓ 0	0
Low	✓ 6.25	—
Mid	✓ 12.50	12.50
High	✓ 21.25	—

- Alt-106 @ 50 ppm CH_4

Stratification test during run #1

Test Times: R-1 06:52 - 08:58 R-2 09:17 - 11:20 R-3 11:37 - 13:42

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-104**
Facility	**Glass Plant 1**	Date	**September 28, 2018**
Location	**Corvallis, OR**		

Run			1	2	3	
Date			9/28/2018	9/28/2018	9/28/2018	
Run Start Time			6:52	9:19	11:37	
Run End Time			8:58	11:20	13:42	
Duration, min.			120	120	120	
CO_2 %vd			0.70	0.68	0.70	0.69
O_2 %vd			19.88	19.74	19.83	19.82
WSCFM*			17,831.4	17,875.1	17,573.8	17,760.1
DSCFM*			17,553.2	17,540.8	17,225.9	17,440.0
Nitrogen Oxides	Concentration, C_s	ppmvd	3.19	3.20	2.82	3.07
		[redacted]				
	Mass	lb/hr	4.01E-01	4.02E-01	3.48E-01	3.84E-01
	Emission Factor	lb/lb glass	1.07E-03	1.10E-03	9.43E-04	1.04E-03
		lb/Mscf nat. gas	7.68E-02	7.63E-02	6.60E-02	7.30E-02
Carbon Monoxide	Concentration, C_s	ppmvd	145.28	145.50	149.67	146.82
		[redacted]				
	Mass	lb/hr	11.12	11.13	11.25	11.17
	Emission Factor	lb/lb glass	2.97E-02	3.06E-02	3.05E-02	3.03E-02
		lb/Mscf nat. gas	2.13	2.11	2.13	2.12
VOC	Concentration, C_s	ppmvw	0.52	0.47	0.45	0.48
		[redacted]				
	Mass	lb/hr	6.36E-02	5.76E-02	5.42E-02	5.85E-02
	Emission Factor	lb/lb glass	1.70E-04	1.58E-04	1.47E-04	1.58E-04
		lb/Mscf nat. gas	1.22E-02	1.09E-02	1.03E-02	1.11E-02
Formaldehyde**	Mass	lb/hr	1.38E-02	1.43E-02	1.56E-02	1.46E-02
	Emission Factor	lb/lb glass	3.69E-05	3.93E-05	4.23E-05	3.95E-05
		lb/Mscf nat. gas	2.64E-03	2.71E-03	2.96E-03	2.77E-03
Total VOCs†	Mass	lb/hr	7.74E-02	7.19E-02	6.98E-02	7.30E-02
	Emission Factor	lb/lb glass	2.07E-04	1.97E-04	1.89E-04	1.98E-04
		lb/Mscf nat. gas	1.48E-02	1.36E-02	1.32E-02	1.39E-02

Production Rates	Glass Production	lb/hr	373.8	364.3	369.0	369.0
	Natural Gas Use	scf/hr	5223	5274.9	5277.7	5258.5
		Mscf/hr	5.2230	5.2749	5.2777	5.2585

*Measured during concurrent Method 5 isokinetic runs
**From concurrent Method 316 isokinetic sampling
†Total VOCs = Method 25A VOCs + Formaldehyde

Bison Engineering, Inc.
Method 7E Nitrogen Oxides
Calibration Error, System Bias and System Drift
NOx molecular weight of 46

Company:	**Hollingsworth & Vose**	Source:	**CFU-104**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 28, 2018**	Instrument Model:	**42i**
Location:	**Corvallis, OR**			Instrument Serial #:	**729825194**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	pass/fail	System Cal Response	Post test System Cal. Bias % of span	pass/fail	System Drift % of span	pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	-0.03	-0.01	0.20	pass	0.02	0.50	pass	0.30	pass				
	upscale	5.10	5.10	0.00	pass	4.95	-1.50	pass	-1.50	pass	10	3.21	3.19	5
Run 2	zero	-0.03	0.02	0.50	pass	0.21	2.40	pass	1.90	pass				
	upscale	5.10	4.95	-1.50	pass	5.39	2.90	pass	4.40	pass	10	3.35	3.20	5
Run 3	zero	-0.03	0.21	2.40	pass	0.27	3.00	pass	0.60	pass				
	upscale	5.10	5.39	2.90	pass	5.10	0.00	pass	-2.90	pass	10	3.06	2.82	5
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR

	Zero	Mid	High
Calibration gas standards	0	5	10
Cal gas analyzer response	-0.03	5.1	9.82
Analyzer Cal. Error %	-0.30	1.00	-1.80
Analyzer Cal. Error < 2%*	pass	pass	pass

NO2 CONVERTER TEST

NO2 Tank Value (ppm)	50.41
NO Check Value	48.45
NO2 to NO Conversion %	96.1%
NO2 Conversion > 90%	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 10 Carbon Monoxide
Calibration Error, System Bias and System Drift
CO molecular weight of 28

Company:	**Hollingsworth & Vose**	Source:	**CFU-104**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 28, 2018**	Instrument Model:	**48i HL**
Location:	**Corvallis, OR**			Instrument Serial #:	**734025183**

			Initial Values			***Final Values***								
		Analyzer Cal. Response	**System Cal Response**	**Pre test System Cal. Bias % of span**	**pass/fail**	**System Cal Response**	**Post test System Cal. Bias % of span**	**pass/fail**	**System Drift % of span**	**pass/fail**	**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
Run 1	zero	2.09	1.97	-0.03	pass	0.79	-0.33	pass	-0.30	pass				
	upscale	199.42	199.94	0.13	pass	198.68	-0.18	pass	-0.31	pass	400	145.16	145.28	200
Run 2	zero	2.09	0.79	-0.33	pass	-1.84	-0.98	pass	-0.66	pass				
	upscale	199.42	198.68	-0.18	pass	196.89	-0.63	pass	-0.45	pass	400	143.75	145.50	200
Run 3	zero	2.09	-1.84	-0.98	pass	-2.02	-1.03	pass	-0.05	pass				
	upscale	199.42	196.89	-0.63	pass	198.15	-0.32	pass	0.32	pass	400	147.33	149.67	200
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	200	400
Cal gas analyzer response	2.09	199.42	401.3
Analyzer Cal. Error	0.52	-0.15	0.33
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-104**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 28, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
	zero	0.00	0.04	0.20	pass	0.03	0.15	pass	-0.05	pass				
Run 1	upscale	9.92	9.97	0.25	pass	9.97	0.25	pass	0.00	pass	20	19.79	19.88	10
	zero	0.00	0.03	0.15	pass	0.03	0.15	pass	0.00	pass				
Run 2	upscale	9.92	9.97	0.25	pass	9.97	0.25	pass	0.00	pass	20	19.65	19.74	10
	zero	0.00	0.03	0.15	pass	0.04	0.20	pass	0.05	pass				
Run 3	upscale	9.92	9.97	0.25	pass	9.98	0.30	pass	0.05	pass	20	19.75	19.83	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0	9.92	20.01
Analyzer Cal. Error	0.00	-0.40	0.05
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-104**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 28, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*								
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.02	0.02	0.00	pass	0.04	0.50	pass	0.50	pass				
	upscale	1.90	1.88	-0.50	pass	1.86	-1.00	pass	-0.50	pass	4	0.67	0.70	2
Run 2	zero	0.02	0.04	0.50	pass	0.05	0.75	pass	0.25	pass				
	upscale	1.90	1.86	-1.00	pass	1.86	-1.00	pass	0.00	pass	4	0.66	0.68	2
Run 3	zero	0.02	0.05	0.75	pass	0.06	1.00	pass	0.25	pass				
	upscale	1.90	1.86	-1.00	pass	1.87	-0.75	pass	0.25	pass	4	0.69	0.70	2
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	2	4
Cal gas analyzer response	0.02	1.9	4.14
Analyzer Cal. Error	0.50	-2.50	3.50
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 25A Total Hydrocarbons or Volatile Organic Compounds (VOC)
Calibration Error and Drift Checks

VOC molecular weight of 44 as propane

Company:	**Hollingsworth & Vose**	Source:	**CFU-104**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**September 28, 2018**	Instrument Model:	**55i**
Location:	**Corvallis, OR**			Instrument Serial #:	**1018142851**

		Calibration System Response	Post-Run System Response	Drift Determination % of span	Drift Determination pass/fail	Analyzer Span	Avg Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.06	0.07	0.04	pass			
	upscale	12.77	12.37	-1.60	pass	25	0.52	12.5
Run 2	zero	0.06	0.19	0.52	pass			
	upscale	12.77	12.09	-2.72	pass	25	0.47	12.5
Run 3	zero	0.06	0.07	0.04	pass			
	upscale	12.77	12.50	-1.08	pass	25	0.45	12.5
				≤ 3%				

Instrument Response Time(s):	
Time 1	60
Time 2	60
Time 3	60
Average:	60

SYSTEM CAL. ERROR	Zero	Low	Mid	High
Calibration gas standards	0.00	6.25	12.50	21.25
Calibration gas system response	0.06	6.29	12.77	21.56
Calibration Predicted Response		6.38	12.71	
Calibration Error		1.50	0.50	
Calibration Error < 5% ?	pass	pass	pass	pass

EPA Method 7E,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**6:52**
Source:	**CFU-104**	**End Time:**	**8:58**
Method:	**7E**	**Date:**	**9/28/2018**

EPA Method 7E:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) x\ 100 =$ 1.00 %v

where C_{Dir}: 5.10 ppmv
C_V: 5.00 ppmv
CS: 10.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) x\ 100 =$ 0.00 %v

where C_{Dir}: 5.10 ppmv
C_S: 5.10 ppmv
CS: 10.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 1.50 %v

where SB_{Final}: -1.50 ppmv
SB_i: 0.00 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 3.19 ppmv

where C_{Avg}: 3.21 ppmv
C_O: 0.01 ppmv
C_{MA}: 5.00 ppmv
C_M: 5.03 ppmv

NO_2 - NO Conversion Efficiency

5) $Eff_{NOx} = \left(\frac{C_{Dir}}{C_v}\right) x\ 100 =$ 96.1 %v

where C_{Dir}: 48.45 ppmv
C_V: 50.41 ppmv

Emission Rates:

NO_x 1) lb/hr = (Stack Flow) (C) (46) ($1.558x10^{-7}$) =			0.40 lb/hr
where Stack Flow:	17553.20	DSCFM	
C:	3.19	ppm	
Molecular Wt NO_x:	46	g/g-mole	
	1.558E-07	Conv. Factor	

O_2 Correction

NO_x 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \text{ x C } =$ NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

EPA Method 10,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**6:52**
Source:	**CFU-104**	**End Time:**	**8:58**
Method:	**10**	**Date:**	**9/28/2018**

EPA Method 10:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.15 %v

where C_{Dir}:	199.42	ppmv
C_V:	200.00	ppmv
CS:	400.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.13 %v

where C_{Dir}:	199.42	ppmv
C_S:	199.94	ppmv
CS:	400.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.31 %v

where SB_{Final}:	-0.18	ppmv
SB_i:	0.13	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 145.28 ppmv

where C_{Avg}:	145.16	ppmv
C_O:	1.38	ppmv
C_{MA}:	200.00	ppmv
C_M:	199.31	ppmv

Emission Rates:

CO 1) lb/hr = (Stack Flow) (C) (28) (1.558×10^{-7}) = 11.12 lb/hr

where Stack Flow:	17553.20	DSCFM
C:	145.28	ppm
Molecular Wt. CO:	28	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

CO 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \times C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**6:52**
Source:	**CFU-104**	**End Time:**	**8:58**
Method:	**3A**	**Date:**	**9/28/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.40 %v

where C_{Dir}:	9.92	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.25 %v

where C_{Dir}:	9.92	ppmv
C_S:	9.97	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.00 %v

where SB_{Final}:	0.25	ppmv
SB_i:	0.25	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.88 ppmv

where C_{Avg}:	19.79	ppmv
C_O:	0.04	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.97	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**6:52**
Source:	**CFU-104**	**End Time:**	**8:58**
Method:	**3A**	**Date:**	**9/28/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -2.50 %v

where C_{Dir}:	1.90	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.50 %v

where C_{Dir}:	1.90	ppmv
C_S:	1.88	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.50 %v

where SB_{Final}:	-1.00	ppmv
SB_i:	-0.50	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.70 ppmv

where C_{Avg}:	0.67	ppmv
C_O:	0.03	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.87	ppmv

EPA Method 25A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**6:52**
Source:	**CFU-104**	**End Time:**	**8:58**
Method:	**25A**	**Date:**	**9/28/2018**

EPA Method 25A:

Predicted Low and Mid Level Calibration Response (Mid)

1) $PR = \left(\frac{CR_H - CRZ}{SS}\right) \times CS_M + CR_Z =$ 12.71 ppmv

where CR_H:	21.56 ppmv
CR_Z:	0.06 ppmv
SS:	21.25 ppmv
CS_M:	12.50 ppmv

Calibration Error Test

2) $CET = \left(\frac{SR - PR}{CGV}\right) \times 100 =$ 0.50 %v

where PR:	12.71 ppmv
SR:	12.77 ppmv
CGV	12.50 ppmv

Drift Determination (Mid)

3) $D = \left(\frac{CSR - CSRC}{CSRS}\right) \times 100 =$ 1.60 %v

where CSR:	12.77 ppmv
CSR_C:	12.37 ppmv
AS:	25.00 ppmv

Emission Rates:

VOC 1) lb/hr = (Stack Flow) (C) (44) ($1.558x10^{-7}$) = 0.06 lb/hr

where Stack Flow:	17831.39	WSCFM
C:	0.52	ppm
Molecular Wt Propane:	44	g/g-mole
	1.558E-07	Conv. Factor

O_2 Correction

VOC 2) $C_{@\%O2} = \left(\frac{20.9-\%O2}{20.9-\text{Measured O2}}\right) \times C$ = NA ppmv

where $\%O_2$:	NA	%
Measured O_2:	NA	%
C:	NA	ppmv

Hollingsworth & Vose
CFU-104
Initial Daily Calibrations
9/28/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/28/2018	5:42:04	-0.02	1.65	0.06	0.03	0.04	0.19
9/28/2018	5:42:14	-0.02	1.83	0.06	0.03	0.03	0.22
9/28/2018	5:42:24	0.00	3.78	0.06	0.02	0.03	0.21
9/28/2018	5:42:34	-0.02	5.32	0.06	0.02	0.03	0.24
9/28/2018	5:42:44	-0.01	4.57	0.06	0.01	0.03	0.21
9/28/2018	5:42:54	-0.03	3.61	0.05	0.01	0.03	0.21
9/28/2018	5:43:04	-0.01	2.76	0.06	0.01	0.02	0.25
9/28/2018	5:43:14	-0.03	2.14	0.07	0.01	0.03	0.24
9/28/2018	5:43:24	-0.04	1.65	0.06	0.00	0.02	0.15
9/28/2018	5:43:34	-0.02	2.49	0.06	0.00	0.02	0.21
9/28/2018	5:43:44	-0.01	3.83	0.06	-0.01	0.02	0.22
9/28/2018	5:43:54	-0.01	5.00	0.06	0.02	0.02	0.18
9/28/2018	5:44:04	-0.03	4.57	0.06	12.31	12.03	0.22
9/28/2018	5:44:14	-0.02	3.73	0.07	19.55	19.69	0.22
9/28/2018	5:44:24	0.17	4.53	0.06	19.97	19.78	0.21
9/28/2018	5:44:34	0.83	4.23	0.06	19.99	19.80	0.25
9/28/2018	5:44:44	1.30	2.41	0.07	20.00	19.81	0.21
9/28/2018	5:44:54	0.68	1.69	0.06	20.01	19.81	0.18
9/28/2018	5:45:04	0.18	2.71	0.07	20.01	19.82	0.19
9/28/2018	5:45:14	-0.03	2.84	0.06	20.01	19.83	0.19
9/28/2018	5:45:24	-0.01	1.74	0.06	20.01	19.82	0.19
9/28/2018	5:45:34	-0.02	1.01	0.06	19.58	19.63	0.16
9/28/2018	5:45:44	-0.02	0.38	0.07	11.26	9.78	0.24
9/28/2018	5:45:54	0.00	0.29	0.06	9.90	9.91	0.15
9/28/2018	5:46:04	-0.02	1.37	0.06	9.93	9.92	0.16
9/28/2018	5:46:14	-0.02	1.26	0.06	9.92	9.91	0.18
9/28/2018	5:46:24	-0.01	2.23	0.05	9.92	9.90	0.15
9/28/2018	5:46:34	-0.02	3.71	0.06	7.90	6.97	0.11
9/28/2018	5:46:44	-0.01	3.16	0.06	3.48	3.71	0.18
9/28/2018	5:46:54	-0.01	2.71	0.05	3.89	4.15	0.22
9/28/2018	5:47:04	0.00	2.31	0.05	3.90	4.15	0.21
9/28/2018	5:47:14	-0.03	1.16	0.06	3.90	4.15	0.15
9/28/2018	5:47:24	-0.02	0.85	0.06	3.90	4.15	0.19
9/28/2018	5:47:34	-0.02	0.99	0.06	3.90	4.14	0.13
9/28/2018	5:47:44	-0.01	2.01	0.07	3.90	4.14	0.18
9/28/2018	5:47:54	-0.01	3.73	0.06	3.90	4.14	0.15
9/28/2018	5:48:04	-0.03	4.24	0.07	3.86	4.08	0.15
9/28/2018	5:48:14	-0.02	2.99	0.06	2.35	2.15	0.15
9/28/2018	5:48:24	0.07	2.06	0.05	1.95	1.89	0.11
9/28/2018	5:48:34	0.35	1.69	0.06	1.91	1.88	0.19
9/28/2018	5:48:44	0.48	1.05	0.06	1.91	1.88	0.19

Hollingsworth & Vose
CFU-104
Initial Daily Calibrations
9/28/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/28/2018	5:48:54	0.27	0.79	0.06	1.91	1.88	0.16
9/28/2018	5:49:04	0.27	2.37	0.06	1.91	1.88	0.24
9/28/2018	5:49:14	0.28	3.85	0.06	1.90	1.87	0.18
9/28/2018	5:49:24	0.27	4.12	0.05	1.91	1.88	0.19
9/28/2018	5:49:34	0.28	3.01	0.07	1.91	1.88	0.18
9/28/2018	5:49:44	0.26	2.16	0.06	1.74	1.87	0.16
9/28/2018	5:49:54	0.18	1.32	0.06	1.70	1.86	0.19
9/28/2018	5:50:04	-0.03	1.16	0.06	1.69	1.89	0.16
9/28/2018	5:50:14	-0.01	1.02	0.06	1.70	1.96	0.08
9/28/2018	5:50:24	-0.01	2.40	0.06	1.85	1.82	0.13
9/28/2018	5:50:34	-0.03	4.57	0.07	0.30	0.16	0.13
9/28/2018	5:50:44	-0.01	7.11	0.07	1.46	0.94	0.18
9/28/2018	5:50:54	-0.01	36.69	0.07	0.16	0.08	0.18
9/28/2018	5:51:04	31.07	143.64	0.07	0.00	0.05	0.10
9/28/2018	5:51:14	131.32	258.19	0.06	-0.01	0.05	0.13
9/28/2018	5:51:24	226.11	335.31	0.06	-0.02	0.05	0.08
9/28/2018	5:51:34	329.99	363.24	0.06	-0.02	0.04	0.27
9/28/2018	5:51:44	409.30	371.60	0.05	-0.02	0.04	0.25
9/28/2018	5:51:54	414.39	376.31	0.06	-0.02	0.03	0.22
9/28/2018	5:52:04	418.25	378.96	0.07	-0.03	0.04	0.18
9/28/2018	5:52:14	418.47	378.69	0.07	-0.03	0.03	0.15
9/28/2018	5:52:24	418.39	376.87	0.06	-0.03	0.04	0.19
9/28/2018	5:52:34	418.10	375.35	0.06	-0.03	0.03	0.22
9/28/2018	5:52:44	418.15	380.33	0.07	-0.03	0.04	0.19
9/28/2018	5:52:54	418.95	400.07	0.06	-0.03	0.03	0.21
9/28/2018	5:53:04	419.27	401.88	0.06	-0.03	0.02	0.21
9/28/2018	5:53:14	418.88	405.56	0.07	-0.03	0.02	0.21
9/28/2018	5:53:24	418.37	402.31	0.07	-0.03	0.02	0.21
9/28/2018	5:53:34	418.09	402.23	0.07	-0.04	0.02	0.18
9/28/2018	5:53:44	417.88	399.36	0.06	-0.04	0.03	0.18
9/28/2018	5:53:54	417.90	397.25	0.06	-0.03	0.03	0.19
9/28/2018	5:54:04	418.17	394.90	0.06	0.35	0.47	0.19
9/28/2018	5:54:14	419.04	368.46	0.07	0.05	0.08	0.16
9/28/2018	5:54:24	383.19	302.30	0.06	-0.04	0.03	0.16
9/28/2018	5:54:34	263.23	245.24	0.06	-0.04	0.03	0.18
9/28/2018	5:54:44	185.76	214.00	0.07	-0.04	0.03	0.18
9/28/2018	5:54:54	197.59	204.24	0.06	-0.05	0.02	0.13
9/28/2018	5:55:04	202.83	201.14	0.07	-0.05	0.02	0.21
9/28/2018	5:55:14	202.45	199.80	0.07	-0.05	0.03	0.15
9/28/2018	5:55:24	201.94	199.05	0.06	-0.05	0.03	0.11
9/28/2018	5:55:34	201.67	198.36	0.07	-0.05	0.02	0.15

Hollingsworth & Vose
CFU-104
Initial Daily Calibrations
9/28/2018

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/28/2018	5:55:44	201.39	199.01	0.07	-0.05	0.02	0.19
9/28/2018	5:55:54	201.11	200.90	0.06	-0.04	0.03	0.16
9/28/2018	5:56:04	200.88	197.74	0.07	-0.03	0.03	0.13
9/28/2018	5:56:14	200.92	164.99	0.07	0.04	0.09	0.13
9/28/2018	5:56:24	201.05	130.68	0.07	0.37	0.07	0.08
9/28/2018	5:56:34	202.69	102.25	0.07	0.06	0.02	0.19
9/28/2018	5:56:44	180.23	67.87	0.06	-0.05	0.02	0.21
9/28/2018	5:56:54	95.39	37.07	0.05	-0.06	0.02	0.21
9/28/2018	5:57:04	33.13	19.15	0.06	-0.06	0.03	0.19
9/28/2018	5:57:14	25.40	15.47	0.07	-0.06	0.02	0.16
9/28/2018	5:57:24	19.11	16.47	0.06	-0.06	0.02	0.22
9/28/2018	5:57:34	18.82	15.98	0.06	-0.06	0.02	0.22
9/28/2018	5:57:44	18.46	14.74	0.07	-0.06	0.01	0.21
9/28/2018	5:57:54	17.95	13.78	0.07	-0.06	0.01	0.24
9/28/2018	5:58:04	17.46	12.74	0.07	-0.06	0.02	0.19
9/28/2018	5:58:14	17.16	12.37	0.07	-0.06	0.01	0.25
9/28/2018	5:58:24	16.85	12.09	0.07	-0.07	0.03	0.18
9/28/2018	5:58:34	16.47	13.14	0.06	-0.06	0.02	0.25
9/28/2018	5:58:44	15.96	14.94	0.06	-0.07	0.02	0.19
9/28/2018	5:58:54	15.67	15.36	0.07	-0.07	0.02	2.02
9/28/2018	5:59:04	15.48	14.71	0.06	-0.07	0.01	2.82
9/28/2018	5:59:14	15.38	13.27	0.06	-0.07	0.01	2.85
9/28/2018	5:59:24	15.08	12.83	0.07	-0.07	0.01	2.77
9/28/2018	5:59:34	14.80	12.18	0.07	-0.07	0.01	2.83
9/28/2018	5:59:44	14.59	12.16	0.07	-0.07	0.01	2.79
9/28/2018	5:59:54	14.53	12.98	0.07	-0.07	0.01	2.80
9/28/2018	6:00:04	14.20	14.75	0.07	-0.07	0.02	2.77
9/28/2018	6:00:14	13.99	15.65	0.07	-0.07	0.01	2.80
9/28/2018	6:00:24	13.90	14.58	0.06	-0.07	0.02	2.74
9/28/2018	6:00:34	12.99	13.52	0.06	-0.07	0.01	2.75
9/28/2018	6:00:44	11.88	12.77	0.07	-0.07	0.01	2.80
9/28/2018	6:00:54	11.64	12.21	0.06	-0.06	0.01	2.82
9/28/2018	6:01:04	11.52	11.62	0.08	-0.07	0.01	2.80
9/28/2018	6:01:14	11.30	12.49	0.08	-0.07	0.01	2.88
9/28/2018	6:01:24	10.67	14.37	0.20	-0.07	0.01	2.89
9/28/2018	6:01:34	10.42	15.46	0.19	-0.07	0.01	2.82
9/28/2018	6:01:44	10.40	15.15	0.20	-0.07	0.01	2.74
9/28/2018	6:01:54	10.22	13.68	0.20	-0.07	0.01	2.85
9/28/2018	6:02:04	10.04	13.05	0.20	-0.07	0.01	2.80
9/28/2018	6:02:14	9.81	12.06	0.20	-0.07	0.00	2.82
9/28/2018	6:02:24	9.82	11.83	0.20	-0.07	0.01	2.88

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/28/2018	6:02:34	9.82	12.20	0.42	-0.07	0.00	2.85
9/28/2018	6:02:44	9.82	13.75	0.47	-0.07	0.01	2.80
9/28/2018	6:02:54	9.96	15.20	0.48	-0.07	0.01	2.80
9/28/2018	6:03:04	10.12	15.05	0.47	-0.07	0.00	2.83
9/28/2018	6:03:14	10.10	13.75	0.47	-0.07	0.01	2.75
9/28/2018	6:03:24	9.92	11.48	0.46	-0.07	0.00	2.86
9/28/2018	6:03:34	9.34	9.26	0.46	-0.07	0.01	2.85
9/28/2018	6:03:44	8.40	7.13	0.46	-0.07	0.00	2.88
9/28/2018	6:03:54	6.56	7.17	0.46	-0.07	0.00	2.79
9/28/2018	6:04:04	5.10	8.77	0.46	-0.07	0.00	2.79
9/28/2018	6:04:14	5.10	9.77	0.47	-0.07	0.01	2.79
9/28/2018	6:04:24	5.11	9.77	0.48	-0.07	0.00	2.77
9/28/2018	6:04:34	5.09	8.78	0.47	-0.07	0.01	2.86
9/28/2018	6:04:44	5.09	7.75	0.47	-0.07	0.01	2.82
9/28/2018	6:04:54	5.10	6.96	0.45	-0.07	0.00	2.75
9/28/2018	6:05:04	5.10	6.52	0.34	-0.08	0.00	2.72
9/28/2018	6:05:14	5.10	6.93	0.34	-0.07	0.00	2.74
9/28/2018	6:05:24	5.10	8.45	0.34	11.65	0.01	2.79
9/28/2018	6:05:34	5.11	9.22	0.34	20.46	0.00	2.79
9/28/2018	6:05:44	9.44	7.33	0.34	20.79	0.00	2.75
9/28/2018	6:05:54	29.99	4.47	0.33	20.80	0.00	2.82
9/28/2018	6:06:04	41.55	2.65	0.34	20.80	-0.01	2.72
9/28/2018	6:06:14	45.33	2.06	0.34	20.80	0.00	2.75
9/28/2018	6:06:24	47.93	1.42	0.34	20.80	0.00	2.72
9/28/2018	6:06:34	48.26	1.54	0.34	20.80	0.00	2.69
9/28/2018	6:06:44	48.45	3.64	0.34	20.81	0.00	2.75
9/28/2018	6:06:54	48.45	4.79	0.34	20.81	-0.01	2.77
9/28/2018	6:07:04	48.44	4.69	0.34	20.81	0.00	2.80
9/28/2018	6:07:14	48.45	3.36	0.35	20.81	0.00	2.77
9/28/2018	6:07:24	48.44	2.85	0.25	20.82	-0.01	2.80
9/28/2018	6:07:34	48.46	1.61	0.20	20.81	-0.01	2.80
9/28/2018	6:07:44	48.44	1.44	0.20	20.82	0.00	2.82
9/28/2018	6:07:54	48.45	1.69	0.21	20.83	0.00	2.77
9/28/2018	6:08:04	48.45	2.87	0.20	20.50	-0.01	2.85
9/28/2018	6:08:14	48.44	4.64	0.20	18.42	0.00	2.77
9/28/2018	6:08:24	48.34	5.20	0.20	19.92	-0.01	2.72
9/28/2018	6:08:34	48.06	3.94	0.16	9.50	0.00	2.80
9/28/2018	6:08:44	47.29	2.99	0.07	16.52	0.05	2.82
9/28/2018	6:08:54	45.50	2.68	0.07	16.79	0.17	2.75
9/28/2018	6:09:04	38.78	2.02	0.06	9.39	0.10	2.79
9/28/2018	6:09:14	14.73	2.18	0.07	3.88	0.04	2.74

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/28/2018	6:09:24	2.27	4.62	0.07	1.56	0.02	2.77
9/28/2018	6:09:34	2.56	7.23	0.07	0.68	0.01	2.75
		NOx [PPM]	CO [PPM]		O2 [%]	CO2 [%]	
Analyzer Zero		**-0.03**	**2.09**		**0.00**	**0.02**	
Analyzer Mid		**5.10**	**199.42**		**9.92**	**1.90**	
Analyzer High		**9.82**	**401.30**		**20.01**	**4.14**	
NO2 Converter Check		**48.45**					
System							
9/28/2018	6:09:44	3.03	9.00	0.07	0.31	0.02	2.79
9/28/2018	6:09:54	3.91	8.43	0.34	0.16	0.01	2.83
9/28/2018	6:10:04	4.60	8.03	0.34	0.09	0.01	2.75
9/28/2018	6:10:14	4.79	7.15	0.34	0.06	0.02	2.72
9/28/2018	6:10:24	4.88	6.74	0.34	0.05	0.01	2.75
9/28/2018	6:10:34	5.08	6.69	0.34	0.05	0.01	2.74
9/28/2018	6:10:44	5.11	7.34	0.33	0.05	0.01	2.80
9/28/2018	6:10:54	5.10	9.21	0.33	0.05	0.01	2.77
9/28/2018	6:11:04	5.10	10.08	0.14	0.04	0.02	0.92
9/28/2018	6:11:14	5.11	9.49	0.06	0.04	0.02	0.21
9/28/2018	6:11:24	5.08	8.50	0.05	0.04	0.02	0.15
9/28/2018	6:11:34	5.11	7.93	0.06	0.04	0.02	0.21
9/28/2018	6:11:44	5.09	6.83	0.07	0.06	0.03	0.16
9/28/2018	6:11:54	5.11	6.75	0.07	5.72	0.04	0.16
9/28/2018	6:12:04	5.02	6.55	0.07	14.11	0.06	0.16
9/28/2018	6:12:14	4.83	6.93	0.07	17.98	0.07	0.24
9/28/2018	6:12:24	4.38	7.49	0.08	19.43	0.07	0.24
9/28/2018	6:12:34	2.79	6.88	0.07	12.98	0.06	0.24
9/28/2018	6:12:44	1.41	13.11	0.07	5.44	0.04	0.22
9/28/2018	6:12:54	0.75	46.45	0.06	2.21	0.03	0.22
9/28/2018	6:13:04	12.51	95.66	0.07	0.92	0.03	0.19
9/28/2018	6:13:14	54.77	140.23	0.07	0.69	0.03	0.18
9/28/2018	6:13:24	89.03	153.82	0.08	1.24	0.04	0.33
9/28/2018	6:13:34	108.59	128.24	0.20	1.59	0.03	1.52
9/28/2018	6:13:44	110.83	85.58	0.20	1.73	0.04	1.53
9/28/2018	6:13:54	65.45	46.82	0.21	1.79	0.04	1.53
9/28/2018	6:14:04	28.95	23.40	0.19	1.82	0.03	1.53
9/28/2018	6:14:14	15.68	11.17	0.21	1.82	0.03	1.46
9/28/2018	6:14:24	5.39	6.44	0.19	1.33	0.03	1.53
9/28/2018	6:14:34	3.11	13.72	0.20	0.61	0.03	1.46
9/28/2018	6:14:44	10.08	51.00	0.11	0.28	0.03	0.45

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9/28/2018	6:14:54	38.66	104.95	0.07	0.15	0.02	0.25
9/28/2018	6:15:04	71.32	152.82	0.07	0.09	0.02	0.15
9/28/2018	6:15:14	119.96	180.94	0.07	0.06	0.03	0.19
9/28/2018	6:15:24	157.56	192.67	0.07	0.06	0.03	0.13
9/28/2018	6:15:34	166.03	196.69	0.07	0.05	0.03	0.25
9/28/2018	6:15:44	172.74	197.51	0.06	0.05	0.03	0.22
9/28/2018	6:15:54	173.44	197.92	0.07	0.05	0.03	0.21
9/28/2018	6:16:04	173.92	197.57	0.07	0.05	0.03	0.22
9/28/2018	6:16:14	173.39	198.46	0.07	0.05	0.03	0.22
9/28/2018	6:16:24	173.07	200.96	0.07	0.05	0.03	0.18
9/28/2018	6:16:34	172.85	202.77	0.07	0.04	0.03	0.15
9/28/2018	6:16:44	172.76	201.82	0.07	0.05	0.03	0.21
9/28/2018	6:16:54	172.55	200.41	0.07	0.05	0.03	0.15
9/28/2018	6:17:04	172.46	199.60	0.07	0.05	0.03	0.22
9/28/2018	6:17:14	172.25	198.52	0.07	0.05	0.03	0.22
9/28/2018	6:17:24	172.26	198.11	0.07	0.05	0.03	0.19
9/28/2018	6:17:34	172.33	198.53	0.07	0.05	0.03	0.16
9/28/2018	6:17:44	172.45	200.18	0.07	0.05	0.03	0.18
9/28/2018	6:17:54	172.24	202.17	0.07	0.05	0.03	0.21
9/28/2018	6:18:04	172.17	202.58	0.07	0.05	0.04	0.16
9/28/2018	6:18:14	171.84	200.91	0.07	0.04	0.04	0.19
9/28/2018	6:18:24	171.64	199.84	0.07	0.05	0.04	0.16
9/28/2018	6:18:34	171.74	199.08	0.08	0.05	0.04	0.19
9/28/2018	6:18:44	171.93	197.99	0.08	0.92	0.04	0.25
9/28/2018	6:18:54	171.92	195.59	0.08	9.59	0.06	0.18
9/28/2018	6:19:04	167.81	176.35	0.07	15.93	0.08	0.16
9/28/2018	6:19:14	155.10	134.26	0.07	11.85	0.06	0.21
9/28/2018	6:19:24	132.06	89.67	0.07	5.30	0.07	0.21
9/28/2018	6:19:34	78.16	56.67	0.06	2.93	0.79	0.16
9/28/2018	6:19:44	37.25	42.76	0.07	2.33	1.43	0.13
9/28/2018	6:19:54	31.63	35.34	0.07	2.10	1.69	0.16
9/28/2018	6:20:04	25.10	26.31	0.06	2.01	1.79	0.19
9/28/2018	6:20:14	17.99	15.88	0.07	1.98	1.83	0.15
9/28/2018	6:20:24	11.77	8.72	0.08	1.97	1.86	0.10
9/28/2018	6:20:34	7.32	6.77	0.07	1.98	1.86	0.19
9/28/2018	6:20:44	3.84	6.41	0.07	1.97	1.87	0.19
9/28/2018	6:20:54	2.78	5.14	0.07	1.97	1.88	0.15
9/28/2018	6:21:04	2.07	3.88	0.07	1.98	1.88	0.11
9/28/2018	6:21:14	1.75	2.61	0.06	1.98	1.88	0.13
9/28/2018	6:21:24	1.39	1.50	0.07	1.98	1.88	0.16
9/28/2018	6:21:34	1.11	1.24	0.06	2.20	2.16	0.21

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/28/2018	6:21:44	0.91	0.96	0.05	5.81	6.29	0.08
9/28/2018	6:21:54	0.91	2.76	0.06	8.31	8.42	0.18
9/28/2018	6:22:04	0.88	4.53	0.07	9.30	9.26	0.22
9/28/2018	6:22:14	0.89	5.14	0.06	9.69	9.61	0.15
9/28/2018	6:22:24	0.78	3.51	0.06	9.86	9.74	0.15
9/28/2018	6:22:34	0.56	2.06	0.06	9.93	9.81	0.13
9/28/2018	6:22:44	0.57	1.17	0.06	9.95	9.83	0.18
9/28/2018	6:22:54	0.55	0.29	0.06	9.96	9.85	0.11
9/28/2018	6:23:04	0.58	0.26	0.06	9.97	9.86	0.15
9/28/2018	6:23:14	0.49	0.77	0.06	9.97	9.86	0.15
9/28/2018	6:23:24	0.29	3.04	0.05	9.97	9.86	0.15
9/28/2018	6:23:34	0.30	3.63	0.07	10.05	9.78	0.08
9/28/2018	6:23:44	0.28	2.96	0.07	13.76	6.21	0.16
9/28/2018	6:23:54	0.29	2.05	0.07	17.76	2.64	0.16
9/28/2018	6:24:04	0.28	1.42	0.08	14.91	2.27	0.15
9/28/2018	6:24:14	0.30	2.06	0.06	8.42	1.32	0.18
9/28/2018	6:24:24	0.47	3.33	0.07	5.99	0.65	0.21
9/28/2018	6:24:34	1.08	4.04	0.07	5.04	0.34	0.16
9/28/2018	6:24:44	1.86	5.80	0.07	4.67	0.20	0.13
9/28/2018	6:24:54	3.11	6.67	0.07	4.52	0.13	0.16
9/28/2018	6:25:04	3.78	5.19	0.07	4.47	0.10	0.19
9/28/2018	6:25:14	3.18	4.07	0.06	4.44	0.08	0.22
9/28/2018	6:25:24	2.58	2.90	0.06	4.43	0.08	0.19
9/28/2018	6:25:34	2.10	2.35	1.87	4.43	0.08	0.19
9/28/2018	6:25:44	1.74	2.25	18.24	4.43	0.06	0.18
9/28/2018	6:25:54	1.39	2.67	18.23	4.43	0.07	0.16
9/28/2018	6:26:04	1.09	4.73	18.24	4.43	0.07	0.16
9/28/2018	6:26:14	0.88	5.16	18.24	4.43	0.06	0.21
9/28/2018	6:26:24	0.89	4.57	18.23	4.43	0.06	0.18
9/28/2018	6:26:34	0.79	3.71	18.23	4.43	0.06	0.22
9/28/2018	6:26:44	0.56	2.69	18.23	4.43	0.06	0.18
9/28/2018	6:26:54	0.58	2.43	19.99	4.43	0.05	0.16
9/28/2018	6:27:04	0.58	1.68	20.75	4.43	0.05	0.19
9/28/2018	6:27:14	0.58	2.05	20.76	4.43	0.05	0.15
9/28/2018	6:27:24	0.58	3.71	20.76	4.43	0.05	0.24
9/28/2018	6:27:34	0.48	5.28	20.75	4.43	0.05	0.21
9/28/2018	6:27:44	0.26	4.93	20.74	4.43	0.05	0.16
9/28/2018	6:27:54	0.28	3.82	20.76	4.43	0.05	0.21
9/28/2018	6:28:04	0.27	2.89	20.74	4.43	0.05	0.24
9/28/2018	6:28:14	0.29	2.33	20.75	4.43	0.04	0.27
9/28/2018	6:28:24	0.29	1.76	20.74	4.43	0.05	0.19

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/28/2018	6:28:34	0.28	2.05	20.75	4.43	0.04	0.19
9/28/2018	6:28:44	0.29	3.74	20.74	4.43	0.04	0.22
9/28/2018	6:28:54	0.30	4.97	20.75	4.43	0.04	0.16
9/28/2018	6:29:04	0.26	4.92	20.74	4.43	0.05	0.16
9/28/2018	6:29:14	0.30	3.92	20.74	4.44	0.04	0.15
9/28/2018	6:29:24	0.29	2.86	20.75	4.46	0.04	0.21
9/28/2018	6:29:34	0.28	2.37	20.74	4.54	0.04	0.16
9/28/2018	6:29:44	0.28	1.60	20.75	4.56	0.05	0.19
9/28/2018	6:29:54	0.28	1.69	20.74	4.58	0.04	0.22
9/28/2018	6:30:04	0.27	3.17	20.75	4.58	0.03	0.24
9/28/2018	6:30:14	0.28	5.05	20.75	4.58	0.03	0.21
9/28/2018	6:30:24	0.29	4.95	20.73	4.59	0.04	0.25
9/28/2018	6:30:34	0.28	3.96	21.00	4.58	0.04	0.25
9/28/2018	6:30:44	0.29	3.28	21.02	4.58	0.04	0.25
9/28/2018	6:30:54	0.30	2.15	21.02	4.59	0.04	0.21
9/28/2018	6:31:04	0.29	1.97	21.02	4.58	0.04	0.13
9/28/2018	6:31:14	0.28	1.70	21.01	4.49	0.03	0.18
9/28/2018	6:31:24	0.27	2.93	21.02	3.55	0.03	0.24
9/28/2018	6:31:34	0.29	4.46	21.01	3.04	0.03	0.16
9/28/2018	6:31:44	0.28	4.88	21.35	2.84	0.04	0.18
9/28/2018	6:31:54	0.20	4.33	21.56	2.77	0.03	0.19
9/28/2018	6:32:04	-0.01	3.21	21.57	2.74	0.03	0.15
9/28/2018	6:32:14	0.00	2.34	21.56	2.73	0.03	0.21
9/28/2018	6:32:24	-0.01	1.90	21.56	2.72	0.03	0.18
9/28/2018	6:32:34	-0.01	1.39	21.56	2.72	0.03	0.21
9/28/2018	6:32:44	-0.02	2.61	21.56	2.72	0.03	0.25
9/28/2018	6:32:54	-0.02	4.44	19.48	2.72	0.03	0.15
9/28/2018	6:33:04	-0.01	5.32	14.59	2.72	0.03	0.18
9/28/2018	6:33:14	-0.02	4.52	14.58	2.72	0.03	0.13
9/28/2018	6:33:24	-0.02	3.48	14.57	2.72	0.02	0.16
9/28/2018	6:33:34	0.00	2.96	14.58	2.72	0.03	0.13
9/28/2018	6:33:44	-0.01	1.80	14.59	2.72	0.03	0.25
9/28/2018	6:33:54	0.02	1.54	14.59	2.72	0.03	0.19
9/28/2018	6:34:04	-0.01	1.79	14.59	2.71	0.03	0.10
9/28/2018	6:34:14	-0.02	3.51	12.76	2.72	0.03	0.22
9/28/2018	6:34:24	0.01	5.22	12.77	2.72	0.03	0.15
9/28/2018	6:34:34	-0.01	4.63	12.78	2.72	0.03	0.15
9/28/2018	6:34:44	-0.02	3.89	12.77	2.71	0.03	0.13
9/28/2018	6:34:54	0.00	3.20	12.78	2.15	0.03	0.08
9/28/2018	6:35:04	0.26	5.86	12.77	1.66	0.03	0.08
9/28/2018	6:35:14	0.97	9.61	12.78	1.45	0.02	0.15

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/28/2018	6:35:24	2.01	10.87	12.75	1.37	0.03	0.05
9/28/2018	6:35:34	4.83	9.74	12.76	1.33	0.03	0.10
9/28/2018	6:35:44	6.24	8.41	12.77	1.32	0.03	0.08
9/28/2018	6:35:54	4.11	6.38	12.77	1.31	0.03	0.16
9/28/2018	6:36:04	2.26	4.24	12.77	1.32	0.03	0.15
9/28/2018	6:36:14	1.64	3.40	12.77	1.31	0.03	0.19
9/28/2018	6:36:24	1.16	2.34	12.77	1.31	0.03	0.16
9/28/2018	6:36:34	1.08	1.66	10.34	1.32	0.04	0.15
9/28/2018	6:36:44	0.90	1.72	6.70	1.31	0.03	0.18
9/28/2018	6:36:54	0.81	2.91	6.70	1.31	0.03	0.19
9/28/2018	6:37:04	0.57	4.47	6.70	1.32	0.03	0.16
9/28/2018	6:37:14	0.56	5.00	6.69	1.31	0.02	0.16
9/28/2018	6:37:24	0.57	4.38	6.70	1.31	0.03	0.21
9/28/2018	6:37:34	0.57	3.19	6.70	1.32	0.03	0.16
9/28/2018	6:37:44	0.56	2.50	6.63	1.31	0.03	0.22
9/28/2018	6:37:54	0.55	1.85	6.30	1.31	0.03	0.18
9/28/2018	6:38:04	0.55	1.86	6.29	1.31	0.03	0.15
9/28/2018	6:38:14	0.49	2.98	6.30	1.31	0.03	0.15
9/28/2018	6:38:24	0.26	4.74	6.29	1.31	0.03	0.15
9/28/2018	6:38:34	0.26	4.69	6.29	4.56	0.04	0.18
9/28/2018	6:38:44	0.29	4.24	6.29	13.24	0.06	0.16
9/28/2018	6:38:54	0.28	2.92	6.30	16.48	0.07	0.15
9/28/2018	6:39:04	0.27	2.40	6.30	9.35	0.05	0.11
9/28/2018	6:39:14	0.28	1.73	6.29	3.88	0.04	0.15
9/28/2018	6:39:24	0.27	1.49	6.30	1.72	0.03	0.13
9/28/2018	6:39:34	0.19	2.71	6.29	1.10	0.03	0.15
9/28/2018	6:39:44	0.08	4.39	6.30	1.67	0.03	0.15
9/28/2018	6:39:54	0.27	4.99	6.30	1.30	0.03	0.13
9/28/2018	6:40:04	0.28	4.42	6.30	0.58	0.04	0.11
9/28/2018	6:40:14	0.18	3.04	3.79	0.26	0.03	0.11
9/28/2018	6:40:24	-0.03	2.35	1.54	0.14	0.04	0.11
9/28/2018	6:40:34	-0.02	1.91	1.53	0.11	0.04	0.13
9/28/2018	6:40:44	-0.02	1.60	1.53	0.14	0.04	0.10
9/28/2018	6:40:54	-0.01	2.20	1.52	0.19	0.04	0.16
9/28/2018	6:41:04	-0.02	4.09	1.54	0.23	0.03	0.15
9/28/2018	6:41:14	0.00	5.16	1.53	0.25	0.04	0.15
9/28/2018	6:41:24	-0.01	4.71	1.45	0.26	0.03	0.45
9/28/2018	6:41:34	-0.01	3.58	0.60	0.27	0.04	1.44
9/28/2018	6:41:44	-0.02	2.59	0.58	0.27	0.04	1.46
9/28/2018	6:41:54	-0.01	1.80	0.59	0.28	0.03	1.41
9/28/2018	6:42:04	0.00	1.67	0.60	0.28	0.03	1.38

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
9/28/2018	6:42:14	-0.02	1.70	0.60	0.28	0.04	1.40
9/28/2018	6:42:24	-0.01	3.09	0.59	0.28	0.03	1.40
9/28/2018	6:42:34	0.01	5.08	0.60	0.28	0.04	1.43
9/28/2018	6:42:44	-0.03	5.05	9.50	0.28	0.04	42.93
9/28/2018	6:42:54	-0.01	4.25	10.49	0.28	0.04	47.60
9/28/2018	6:43:04	0.00	3.20	10.49	0.28	0.04	47.59
9/28/2018	6:43:14	-0.01	2.36	10.49	0.28	0.04	47.57
9/28/2018	6:43:24	0.00	1.86	10.49	0.28	0.05	47.48
9/28/2018	6:43:34	0.01	1.47	10.49	0.28	0.05	47.48
9/28/2018	6:43:44	-0.01	2.26	10.49	0.29	0.04	47.56
9/28/2018	6:43:54	0.00	4.08	11.15	0.28	0.04	51.17
9/28/2018	6:44:04	0.01	5.33	11.58	0.28	0.04	51.66
9/28/2018	6:44:14	0.00	4.60	11.57	0.28	0.05	51.67
		NOx [PPM]	**CO [PPM]**		**O2 [%]**	**CO2 [%]**	
System Zero		**-0.01**	**1.97**		**0.04**	**0.02**	
System Mid		**5.10**	**199.94**		**9.97**	**1.88**	

		M-106
VOC System	**VOC [PPM]**	**CH4 [PPM]**
System Zero	**0.06**	
System low	**6.29**	
System Mid	**12.77**	
System High	**21.56**	**51.50**

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	6:52:42	2.76	145.15	0.59	19.80	0.68
9/28/2018	6:53:42	2.86	146.73	0.59	19.79	0.68
9/28/2018	6:54:42	3.01	147.22	0.59	19.81	0.67
9/28/2018	6:55:42	3.06	147.53	0.59	19.81	0.67
9/28/2018	6:56:42	3.00	140.66	0.60	19.80	0.67
9/28/2018	6:57:42	3.05	141.75	0.59	19.81	0.67
9/28/2018	6:58:42	3.05	142.78	0.59	19.81	0.67
9/28/2018	6:59:42	3.05	140.47	0.60	19.82	0.67
9/28/2018	7:00:42	3.05	138.91	0.59	19.81	0.67
9/28/2018	7:01:42	3.04	141.95	0.60	19.81	0.67
9/28/2018	7:02:42	3.04	144.36	0.60	19.81	0.67
9/28/2018	7:03:42	3.04	143.73	0.60	19.82	0.67
9/28/2018	7:04:42	3.05	145.28	0.59	19.82	0.67
9/28/2018	7:05:42	3.04	147.20	0.60	19.82	0.68
9/28/2018	7:06:42	3.05	146.59	0.59	19.81	0.68
9/28/2018	7:07:42	3.06	146.94	0.55	19.81	0.68
9/28/2018	7:08:42	3.06	147.08	0.49	19.81	0.69
9/28/2018	7:09:42	3.05	146.41	0.60	19.82	0.69
9/28/2018	7:10:42	3.05	146.42	0.59	19.82	0.69
9/28/2018	7:11:42	3.06	147.56	0.60	19.81	0.69
9/28/2018	7:12:42	3.05	148.11	0.59	19.81	0.69
9/28/2018	7:13:42	3.05	147.43	0.60	19.81	0.69
9/28/2018	7:14:42	3.05	147.05	0.60	19.82	0.68
9/28/2018	7:15:42	3.05	145.44	0.60	19.82	0.68
9/28/2018	7:16:42	3.04	143.82	0.60	19.82	0.68
9/28/2018	7:17:42	3.05	146.00	0.60	19.81	0.68
9/28/2018	7:18:42	3.05	146.84	0.60	19.82	0.68
9/28/2018	7:19:42	3.05	143.27	0.57	19.82	0.67
9/28/2018	7:20:42	3.05	139.16	0.47	19.82	0.67
9/28/2018	7:21:42	3.05	141.36	0.60	19.82	0.67
9/28/2018	7:22:42	3.04	141.99	0.60	19.82	0.67
9/28/2018	7:23:42	3.05	142.59	0.53	19.82	0.67
9/28/2018	7:24:42	3.04	144.28	0.52	19.82	0.67
9/28/2018	7:25:42	3.05	144.77	0.58	19.81	0.67
9/28/2018	7:26:42	3.27	146.79	0.47	19.81	0.67
9/28/2018	7:27:42	3.16	146.80	0.48	19.81	0.67
9/28/2018	7:28:42	3.05	145.20	0.56	19.81	0.67
9/28/2018	7:29:42	3.33	148.12	0.54	19.80	0.67
9/28/2018	7:30:42	3.38	148.64	0.50	19.80	0.68
9/28/2018	7:31:42	3.21	146.11	0.60	19.80	0.68
9/28/2018	7:32:42	3.20	146.74	0.60	19.80	0.68
9/28/2018	7:33:42	3.32	148.98	0.59	19.80	0.69

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	7:34:42	3.30	146.09	0.60	19.80	0.69
9/28/2018	7:35:42	3.05	145.27	0.60	19.80	0.68
9/28/2018	7:36:42	3.06	145.69	0.58	19.80	0.68
9/28/2018	7:37:42	3.04	141.29	0.47	19.81	0.68
9/28/2018	7:38:42	3.05	145.12	0.47	19.81	0.68
9/28/2018	7:39:42	3.15	144.68	0.47	19.80	0.68
9/28/2018	7:40:42	3.05	141.31	0.54	19.80	0.68
9/28/2018	7:41:42	3.05	144.23	0.60	19.81	0.68
9/28/2018	7:42:42	3.07	144.67	0.59	19.81	0.68
9/28/2018	7:43:42	3.10	142.53	0.47	19.80	0.67
9/28/2018	7:44:42	3.06	143.90	0.58	19.80	0.67
9/28/2018	7:45:42	3.21	143.39	0.51	19.81	0.66
9/28/2018	7:46:42	3.12	146.22	0.47	19.80	0.66
9/28/2018	7:47:42	3.38	149.27	0.47	19.80	0.67
9/28/2018	7:48:42	3.38	147.82	0.47	19.80	0.67
9/28/2018	7:49:42	3.38	148.61	0.47	19.79	0.67
9/28/2018	7:50:42	3.37	148.80	0.58	19.80	0.67
9/28/2018	7:51:42	3.36	147.55	0.60	19.80	0.67
9/28/2018	7:52:42	3.36	148.65	0.60	19.80	0.67
9/28/2018	7:53:42	3.37	145.64	0.60	19.80	0.67
9/28/2018	7:54:42	3.38	145.09	0.60	19.79	0.68
9/28/2018	7:55:42	3.32	145.60	0.60	19.80	0.67
9/28/2018	7:56:42	3.32	144.13	0.60	19.79	0.68
9/28/2018	7:57:42	3.21	143.93	0.54	19.80	0.68
9/28/2018	7:58:42	3.22	144.90	0.47	19.79	0.69
9/28/2018	7:59:42	3.38	144.07	0.47	19.79	0.68
9/28/2018	8:00:42	3.38	147.50	0.47	19.79	0.68
9/28/2018	8:01:42	3.38	146.88	0.47	19.79	0.68
9/28/2018	8:02:42	3.37	145.83	0.47	19.79	0.68
9/28/2018	8:03:42	3.38	145.59	0.47	19.79	0.68
9/28/2018	8:04:42	3.37	144.98	0.47	19.79	0.68
9/28/2018	8:05:42	3.38	147.94	0.47	19.79	0.67
9/28/2018	8:06:42	3.37	146.53	0.47	19.79	0.67
9/28/2018	8:07:42	3.39	144.82	0.48	19.79	0.67
9/28/2018	8:08:42	3.38	146.67	0.48	19.78	0.66
9/28/2018	8:09:42	3.39	143.71	0.47	19.78	0.66
9/28/2018	8:10:42	3.38	147.16	0.47	19.78	0.66
9/28/2018	8:11:42	3.38	147.17	0.47	19.79	0.66
9/28/2018	8:12:42	3.39	145.44	0.59	19.79	0.66
9/28/2018	8:13:42	3.39	146.40	0.51	19.79	0.66
9/28/2018	8:14:42	3.28	144.15	0.47	19.79	0.66
9/28/2018	8:15:42	3.23	143.25	0.47	19.79	0.66

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	8:16:42	3.39	146.76	0.47	19.78	0.66
9/28/2018	8:17:42	3.39	146.57	0.47	19.78	0.66
9/28/2018	8:18:42	3.39	145.76	0.47	19.78	0.66
9/28/2018	8:19:42	3.34	144.97	0.48	19.78	0.67
9/28/2018	8:20:42	3.39	144.77	0.52	19.78	0.67
9/28/2018	8:21:42	3.38	144.80	0.58	19.79	0.67
9/28/2018	8:22:42	3.38	144.22	0.47	19.78	0.68
9/28/2018	8:23:42	3.38	146.38	0.59	19.78	0.68
9/28/2018	8:24:42	3.39	144.87	0.60	19.78	0.68
9/28/2018	8:25:42	3.38	144.56	0.60	19.78	0.67
9/28/2018	8:26:42	3.39	144.89	0.56	19.79	0.67
9/28/2018	8:27:42	3.38	142.72	0.48	19.79	0.67
9/28/2018	8:28:42	3.38	144.73	0.48	19.78	0.67
9/28/2018	8:29:42	3.39	144.47	0.48	19.78	0.67
9/28/2018	8:30:42	3.39	144.92	0.55	19.78	0.66
9/28/2018	8:31:42	3.39	146.14	0.55	19.78	0.66
9/28/2018	8:32:42	3.40	144.27	0.48	19.77	0.66
9/28/2018	8:33:42	3.41	150.58	0.48	19.77	0.66
9/28/2018	8:34:42	3.40	150.36	0.47	19.77	0.66
9/28/2018	8:35:42	3.40	149.57	0.48	19.77	0.66
9/28/2018	8:36:42	3.40	150.65	0.48	19.77	0.67
9/28/2018	8:37:42	3.39	149.01	0.48	19.77	0.66
9/28/2018	8:38:42	3.40	149.02	0.47	19.77	0.66
9/28/2018	8:39:42	3.38	146.91	0.47	19.77	0.66
9/28/2018	8:40:42	3.28	144.41	0.36	19.78	0.66
9/28/2018	8:41:42	3.28	140.40	0.44	19.78	0.67
9/28/2018	8:42:42	3.07	139.81	0.42	19.77	0.67
9/28/2018	8:43:42	3.18	143.44	0.35	19.77	0.67
9/28/2018	8:44:42	3.08	140.04	0.34	19.78	0.67
9/28/2018	8:45:42	3.08	141.39	0.35	19.78	0.67
9/28/2018	8:46:42	3.07	140.88	0.45	19.77	0.68
9/28/2018	8:47:42	3.08	142.87	0.48	19.77	0.67
9/28/2018	8:48:42	3.07	142.50	0.48	19.78	0.67
9/28/2018	8:49:42	3.09	142.84	0.48	19.78	0.67
9/28/2018	8:50:42	3.13	143.01	0.47	19.77	0.67
9/28/2018	8:51:42	3.08	140.62	0.48	19.77	0.67
9/28/2018	8:52:42	3.07	143.59	0.47	19.77	0.67
9/28/2018	8:53:42	3.08	141.60	0.47	19.77	0.67
9/28/2018	8:54:42	3.08	143.51	0.47	19.77	0.67
9/28/2018	8:55:42	3.35	146.57	0.48	19.77	0.67
9/28/2018	8:56:42	3.40	147.52	0.48	19.77	0.66
9/28/2018	8:57:42	3.40	146.02	0.36	19.77	0.65

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Date	**Time**	**NOx [PPM]**	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
Final Average		**3.21**	**145.16**	**0.52**	**19.79**	**0.67**
Bias Check		**NOx [PPM]**	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
9/28/2018	9:01:22	0.02	0.73	26.84	2.62	0.02
9/28/2018	9:01:32	0.02	0.27	10.90	2.62	0.02
9/28/2018	9:01:42	0.02	0.41	10.89	2.62	0.02
9/28/2018	9:01:52	0.02	0.44	10.89	2.62	0.02
9/28/2018	9:02:02	0.03	1.93	10.90	2.61	0.02
9/28/2018	9:02:12	0.03	3.61	10.89	2.62	0.01
9/28/2018	9:02:22	0.01	3.56	10.90	2.62	0.02
9/28/2018	9:02:32	0.03	2.86	10.89	2.62	0.02
9/28/2018	9:02:42	0.02	1.87	12.37	2.62	0.02
9/28/2018	9:02:52	0.03	1.26	12.37	2.61	0.03
9/28/2018	9:03:02	0.04	0.93	12.37	2.61	0.02
9/28/2018	9:03:12	0.03	0.50	12.38	2.79	0.03
9/28/2018	9:03:22	0.03	1.09	12.37	7.24	0.22
9/28/2018	9:03:32	0.03	9.24	12.37	5.01	0.16
9/28/2018	9:03:42	0.07	20.87	12.37	2.87	0.16
9/28/2018	9:03:52	0.35	26.98	12.27	2.39	0.90
9/28/2018	9:04:02	0.61	23.40	12.25	2.19	1.46
9/28/2018	9:04:12	0.58	15.23	12.25	2.06	1.69
9/28/2018	9:04:22	0.32	7.94	12.25	2.01	1.78
9/28/2018	9:04:32	0.33	4.07	12.25	2.00	1.83
9/28/2018	9:04:42	0.32	1.60	12.25	1.99	1.84
9/28/2018	9:04:52	0.28	0.59	12.24	1.98	1.84
9/28/2018	9:05:02	0.02	-0.16	8.69	1.99	1.85
9/28/2018	9:05:12	0.03	-0.41	3.32	1.99	1.85
9/28/2018	9:05:22	0.02	0.00	3.34	1.99	1.87
9/28/2018	9:05:32	0.03	1.43	3.33	2.14	2.05
9/28/2018	9:05:42	0.02	2.65	3.32	5.58	6.02
9/28/2018	9:05:52	0.04	2.64	3.33	8.17	8.28
9/28/2018	9:06:02	0.04	1.87	3.34	9.22	9.18
9/28/2018	9:06:12	0.01	1.45	3.02	9.65	9.56
9/28/2018	9:06:22	0.03	0.29	0.08	9.84	9.73
9/28/2018	9:06:32	0.02	-0.28	0.07	9.91	9.80
9/28/2018	9:06:42	0.02	-1.01	0.07	9.94	9.83
9/28/2018	9:06:52	0.03	-1.46	0.06	9.96	9.85
9/28/2018	9:07:02	-0.01	-1.47	0.07	9.97	9.86
9/28/2018	9:07:12	0.01	-0.63	0.08	9.97	9.86
9/28/2018	9:07:22	0.02	1.20	0.07	9.97	9.87
9/28/2018	9:07:32	0.02	1.79	0.07	9.96	9.88
9/28/2018	9:07:42	0.01	1.41	0.08	10.86	8.98

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	9:07:52	0.04	2.77	0.07	10.34	5.60
9/28/2018	9:08:02	0.06	11.64	0.08	4.97	2.54
9/28/2018	9:08:12	0.37	18.43	0.07	2.12	1.14
9/28/2018	9:08:22	0.99	19.35	0.07	0.90	0.57
9/28/2018	9:08:32	1.58	15.00	0.07	0.40	0.32
9/28/2018	9:08:42	2.24	9.85	0.07	0.19	0.19
9/28/2018	9:08:52	2.88	7.20	0.07	0.10	0.12
9/28/2018	9:09:02	3.71	7.03	0.07	0.07	0.10
9/28/2018	9:09:12	4.02	8.36	0.07	0.05	0.07
9/28/2018	9:09:22	4.26	8.62	0.06	0.04	0.07
9/28/2018	9:09:32	4.53	7.76	0.07	0.04	0.07
9/28/2018	9:09:42	4.57	6.91	0.07	0.04	0.06
9/28/2018	9:09:52	4.54	6.13	0.29	0.03	0.07
9/28/2018	9:10:02	4.58	5.60	1.14	0.03	0.07
9/28/2018	9:10:12	4.83	5.48	1.14	0.03	0.06
9/28/2018	9:10:22	4.85	5.07	1.15	0.03	0.05
9/28/2018	9:10:32	4.87	5.23	1.13	0.04	0.05
9/28/2018	9:10:42	5.13	5.91	1.14	4.58	0.22
9/28/2018	9:10:52	5.13	14.68	1.13	5.16	0.23
9/28/2018	9:11:02	5.24	35.16	1.13	2.32	0.11
9/28/2018	9:11:12	6.39	71.49	0.17	0.99	0.07
9/28/2018	9:11:22	10.91	113.57	0.08	0.43	0.05
9/28/2018	9:11:32	50.62	150.08	0.07	0.20	0.04
9/28/2018	9:11:42	87.23	173.41	0.08	0.10	0.05
9/28/2018	9:11:52	118.34	185.27	0.08	0.06	0.05
9/28/2018	9:12:02	149.51	191.02	0.08	0.04	0.05
9/28/2018	9:12:12	158.67	193.26	0.08	0.03	0.04
9/28/2018	9:12:22	167.94	195.28	0.24	0.04	0.04
9/28/2018	9:12:32	169.44	198.22	0.34	0.03	0.04
9/28/2018	9:12:42	171.42	199.24	0.35	0.03	0.04
9/28/2018	9:12:52	171.45	199.11	0.35	0.03	0.04
9/28/2018	9:13:02	171.70	197.70	0.35	0.03	0.04

	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
System Zero	**0.02**	**0.79**	**0.07**	**0.03**	**0.04**
System Mid	**4.95**	**198.68**	**12.37**	**9.97**	**1.86**

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Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	9:19:42	3.38	142.94	0.48	19.74	0.66
9/28/2018	9:20:42	3.12	141.89	0.38	19.74	0.66
9/28/2018	9:21:42	3.34	143.24	0.42	19.74	0.65
9/28/2018	9:22:42	3.17	143.19	0.44	19.75	0.65
9/28/2018	9:23:42	3.24	142.44	0.36	19.76	0.65
9/28/2018	9:24:42	3.24	146.25	0.48	19.75	0.65
9/28/2018	9:25:42	3.38	145.46	0.59	19.75	0.66
9/28/2018	9:26:42	3.17	143.55	0.44	19.75	0.66
9/28/2018	9:27:42	3.07	143.10	0.40	19.75	0.66
9/28/2018	9:28:42	3.30	143.47	0.44	19.75	0.66
9/28/2018	9:29:42	3.23	144.92	0.35	19.75	0.66
9/28/2018	9:30:42	3.08	137.64	0.35	19.76	0.66
9/28/2018	9:31:42	3.08	136.54	0.45	19.75	0.66
9/28/2018	9:32:42	3.07	134.19	0.40	19.76	0.67
9/28/2018	9:33:42	3.09	136.47	0.40	19.76	0.67
9/28/2018	9:34:42	3.08	138.28	0.46	19.76	0.67
9/28/2018	9:35:42	3.08	139.08	0.35	19.75	0.67
9/28/2018	9:36:42	3.07	139.79	0.47	19.76	0.66
9/28/2018	9:37:42	3.13	142.43	0.39	19.75	0.67
9/28/2018	9:38:42	3.40	145.15	0.35	19.76	0.66
9/28/2018	9:39:42	3.25	142.33	0.35	19.75	0.67
9/28/2018	9:40:42	3.39	145.78	0.36	19.75	0.67
9/28/2018	9:41:42	3.22	141.24	0.48	19.75	0.66
9/28/2018	9:42:42	3.36	143.46	0.48	19.75	0.66
9/28/2018	9:43:42	3.30	142.71	0.48	19.75	0.66
9/28/2018	9:44:42	3.28	141.97	0.36	19.75	0.65
9/28/2018	9:45:42	3.08	141.86	0.24	19.75	0.65
9/28/2018	9:46:42	3.08	140.78	0.35	19.74	0.66
9/28/2018	9:47:42	3.13	142.40	0.35	19.75	0.66
9/28/2018	9:48:42	3.08	140.11	0.45	19.74	0.66
9/28/2018	9:49:42	3.31	143.98	0.40	19.74	0.66
9/28/2018	9:50:42	3.25	140.91	0.39	19.74	0.66
9/28/2018	9:51:42	3.08	142.15	0.46	19.75	0.66
9/28/2018	9:52:42	3.34	147.81	0.34	19.73	0.67
9/28/2018	9:53:42	3.39	151.57	0.46	19.73	0.67
9/28/2018	9:54:42	3.40	149.55	0.39	19.73	0.67
9/28/2018	9:55:42	3.40	150.44	0.35	19.73	0.68
9/28/2018	9:56:42	3.39	149.25	0.38	19.73	0.68
9/28/2018	9:57:42	3.41	148.73	0.47	19.74	0.68
9/28/2018	9:58:42	3.40	149.27	0.35	19.73	0.68
9/28/2018	9:59:42	3.40	145.76	0.45	19.74	0.67
9/28/2018	10:00:42	3.39	144.49	0.47	19.74	0.67

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	10:01:42	3.40	142.17	0.48	19.75	0.67
9/28/2018	10:02:42	3.34	143.03	0.47	19.74	0.67
9/28/2018	10:03:42	3.07	140.27	0.48	19.75	0.66
9/28/2018	10:04:42	3.29	144.29	0.60	19.74	0.66
9/28/2018	10:05:42	3.41	141.83	0.41	19.74	0.66
9/28/2018	10:06:42	3.24	142.08	0.41	19.74	0.66
9/28/2018	10:07:42	3.40	142.31	0.48	19.74	0.66
9/28/2018	10:08:42	3.40	144.42	0.48	19.74	0.65
9/28/2018	10:09:42	3.40	147.27	0.47	19.73	0.66
9/28/2018	10:10:42	3.40	149.47	0.47	19.73	0.66
9/28/2018	10:11:42	3.41	148.79	0.56	19.74	0.65
9/28/2018	10:12:42	3.41	146.20	0.54	19.74	0.66
9/28/2018	10:13:42	3.40	149.07	0.48	19.73	0.66
9/28/2018	10:14:42	3.41	148.38	0.47	19.73	0.67
9/28/2018	10:15:42	3.40	146.36	0.21	19.73	0.66
9/28/2018	10:16:42	3.40	142.49	0.20	19.73	0.67
9/28/2018	10:17:42	3.40	145.30	0.28	19.73	0.67
9/28/2018	10:18:42	3.41	142.33	0.39	19.73	0.67
9/28/2018	10:19:42	3.41	144.38	0.48	19.72	0.67
9/28/2018	10:20:42	3.40	142.66	0.48	19.73	0.67
9/28/2018	10:21:42	3.41	143.85	0.47	19.72	0.67
9/28/2018	10:22:42	3.45	141.95	0.47	19.72	0.67
9/28/2018	10:23:42	3.41	143.04	0.47	19.73	0.67
9/28/2018	10:24:42	3.41	141.61	0.47	19.73	0.67
9/28/2018	10:25:42	3.35	142.29	0.47	19.73	0.67
9/28/2018	10:26:42	3.36	144.06	0.47	19.73	0.67
9/28/2018	10:27:42	3.42	143.22	0.37	19.73	0.67
9/28/2018	10:28:42	3.41	144.21	0.42	19.73	0.66
9/28/2018	10:29:42	3.30	141.80	0.42	19.73	0.66
9/28/2018	10:30:42	3.19	141.96	0.37	19.72	0.66
9/28/2018	10:31:42	3.41	142.20	0.47	19.72	0.66
9/28/2018	10:32:42	3.40	145.04	0.47	19.72	0.66
9/28/2018	10:33:42	3.41	144.13	0.47	19.72	0.66
9/28/2018	10:34:42	3.42	147.03	0.47	19.72	0.66
9/28/2018	10:35:42	3.41	146.30	0.47	19.72	0.66
9/28/2018	10:36:42	3.40	148.24	0.47	19.72	0.66
9/28/2018	10:37:42	3.40	147.71	0.47	19.72	0.66
9/28/2018	10:38:42	3.40	147.29	0.48	19.72	0.67
9/28/2018	10:39:42	3.39	144.99	0.47	19.72	0.67
9/28/2018	10:40:42	3.40	143.60	0.53	19.72	0.67
9/28/2018	10:41:42	3.40	145.98	0.59	19.72	0.67
9/28/2018	10:42:42	3.40	138.89	0.59	19.72	0.68

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	10:43:42	3.40	140.13	0.47	19.72	0.67
9/28/2018	10:44:42	3.39	141.36	0.57	19.73	0.68
9/28/2018	10:45:42	3.40	139.24	0.60	19.73	0.67
9/28/2018	10:46:42	3.40	141.53	0.54	19.73	0.68
9/28/2018	10:47:42	3.39	143.03	0.49	19.74	0.68
9/28/2018	10:48:42	3.40	144.10	0.59	19.75	0.67
9/28/2018	10:49:42	3.40	144.67	0.60	19.75	0.67
9/28/2018	10:50:42	3.39	141.88	0.60	19.75	0.67
9/28/2018	10:51:42	3.40	144.01	0.60	19.75	0.67
9/28/2018	10:52:42	3.39	143.69	0.59	19.75	0.66
9/28/2018	10:53:42	3.40	144.38	0.58	19.75	0.66
9/28/2018	10:54:42	3.40	145.93	0.47	19.75	0.66
9/28/2018	10:55:42	3.39	146.25	0.57	19.74	0.66
9/28/2018	10:56:42	3.40	146.56	0.60	19.74	0.67
9/28/2018	10:57:42	3.40	145.93	0.59	19.75	0.66
9/28/2018	10:58:42	3.40	145.85	0.57	19.75	0.67
9/28/2018	10:59:42	3.39	147.43	0.47	19.75	0.67
9/28/2018	11:00:42	3.39	147.45	0.59	19.75	0.67
9/28/2018	11:01:42	3.38	145.80	0.59	19.75	0.67
9/28/2018	11:02:42	3.36	146.37	0.59	19.75	0.67
9/28/2018	11:03:42	3.38	142.96	0.55	19.75	0.67
9/28/2018	11:04:42	3.38	143.44	0.48	19.75	0.68
9/28/2018	11:05:42	3.37	145.49	0.59	19.75	0.68
9/28/2018	11:06:42	3.38	144.96	0.48	19.75	0.68
9/28/2018	11:07:42	3.38	145.56	0.46	19.75	0.68
9/28/2018	11:08:42	3.38	143.94	0.53	19.75	0.68
9/28/2018	11:09:42	3.37	141.71	0.56	19.76	0.68
9/28/2018	11:10:42	3.37	143.64	0.47	19.76	0.68
9/28/2018	11:11:42	3.36	144.59	0.59	19.76	0.68
9/28/2018	11:12:42	3.37	143.99	0.59	19.76	0.68
9/28/2018	11:13:42	3.37	144.78	0.52	19.76	0.68
9/28/2018	11:14:42	3.37	143.95	0.46	19.76	0.67
9/28/2018	11:15:42	3.37	144.26	0.47	19.75	0.67
9/28/2018	11:16:42	3.38	147.02	0.47	19.75	0.68
9/28/2018	11:17:42	3.38	145.73	0.47	19.76	0.67
9/28/2018	11:18:42	3.37	143.69	0.56	19.76	0.67
9/28/2018	11:19:42	3.52	146.00	0.53	19.74	0.67
9/28/2018	11:20:42	5.91	117.01	0.50	8.64	0.32
Final Average		**3.35**	**143.75**	**0.47**	**19.65**	**0.66**

Bias Check		NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	11:23:22	0.88	0.90	10.23	2.61	0.04

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	11:23:32	0.93	0.23	10.23	2.61	0.03
9/28/2018	11:23:42	0.91	-0.09	10.60	2.61	0.03
9/28/2018	11:23:52	0.57	0.33	12.09	2.61	0.04
9/28/2018	11:24:02	0.57	1.63	12.09	2.61	0.04
9/28/2018	11:24:12	0.59	3.34	12.08	2.61	0.03
9/28/2018	11:24:22	0.58	3.56	12.08	2.62	0.03
9/28/2018	11:24:32	0.58	2.52	12.09	6.74	0.21
9/28/2018	11:24:42	0.59	9.93	12.09	6.03	0.20
9/28/2018	11:24:52	0.59	21.66	12.08	3.25	0.15
9/28/2018	11:25:02	0.90	26.94	12.09	2.51	0.87
9/28/2018	11:25:12	0.89	23.20	12.09	2.22	1.45
9/28/2018	11:25:22	0.90	14.70	12.09	2.07	1.68
9/28/2018	11:25:32	0.90	8.63	12.10	2.02	1.79
9/28/2018	11:25:42	1.21	6.08	12.09	2.00	1.82
9/28/2018	11:25:52	0.91	4.57	12.09	1.99	1.84
9/28/2018	11:26:02	0.90	2.44	12.09	1.99	1.86
9/28/2018	11:26:12	0.59	1.05	6.22	1.99	1.86
9/28/2018	11:26:22	0.60	0.05	2.28	1.98	1.86
9/28/2018	11:26:32	0.58	-0.58	2.28	1.98	1.86
9/28/2018	11:26:42	0.30	-0.90	2.28	1.98	1.87
9/28/2018	11:26:52	0.31	-0.82	2.29	3.03	3.17
9/28/2018	11:27:02	0.29	0.32	2.29	6.85	7.17
9/28/2018	11:27:12	0.30	2.22	2.28	8.68	8.68
9/28/2018	11:27:22	0.29	2.62	1.61	9.43	9.35
9/28/2018	11:27:32	0.29	1.60	0.06	9.74	9.63
9/28/2018	11:27:42	0.29	0.50	0.07	9.88	9.75
9/28/2018	11:27:52	0.31	-0.59	0.07	9.93	9.80
9/28/2018	11:28:02	0.30	-1.63	0.07	9.96	9.84
9/28/2018	11:28:12	0.31	-1.92	0.06	9.97	9.84
9/28/2018	11:28:22	0.01	-1.96	0.07	9.97	9.85
9/28/2018	11:28:32	-0.01	-0.38	0.07	9.95	9.85
9/28/2018	11:28:42	-0.01	1.24	0.06	11.85	7.98
9/28/2018	11:28:52	0.01	7.83	0.07	10.52	4.75
9/28/2018	11:29:02	0.01	23.12	0.07	4.81	2.09
9/28/2018	11:29:12	0.89	34.07	0.07	2.03	1.00
9/28/2018	11:29:22	1.49	33.99	0.06	0.87	0.51
9/28/2018	11:29:32	3.04	25.36	0.06	0.39	0.29
9/28/2018	11:29:42	4.82	15.60	0.07	0.19	0.17
9/28/2018	11:29:52	5.11	9.87	0.35	0.11	0.13
9/28/2018	11:30:02	5.68	8.45	0.47	0.07	0.10
9/28/2018	11:30:12	5.70	8.71	0.47	0.05	0.09
9/28/2018	11:30:22	6.00	8.53	0.48	0.04	0.09

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	11:30:32	6.03	7.28	0.47	0.04	0.08
9/28/2018	11:30:42	6.02	6.26	0.47	0.04	0.07
9/28/2018	11:30:52	5.89	5.71	0.46	0.04	0.07
9/28/2018	11:31:02	5.59	4.86	0.31	0.04	0.07
9/28/2018	11:31:12	5.38	4.72	0.06	0.03	0.07
9/28/2018	11:31:22	5.64	4.75	0.06	0.03	0.06
9/28/2018	11:31:32	5.39	6.40	0.06	0.03	0.06
9/28/2018	11:31:42	5.38	7.75	0.07	0.04	0.07
9/28/2018	11:31:52	5.38	8.30	0.07	0.04	0.05
9/28/2018	11:32:02	5.67	7.35	0.07	0.04	0.06
9/28/2018	11:32:12	5.39	6.45	0.07	0.79	0.09
9/28/2018	11:32:22	5.38	7.09	0.07	6.49	0.30
9/28/2018	11:32:32	5.40	19.69	0.07	3.95	0.19
9/28/2018	11:32:42	5.36	48.77	0.07	1.68	0.11
9/28/2018	11:32:52	12.48	91.23	0.07	0.71	0.08
9/28/2018	11:33:02	17.86	133.71	0.08	0.32	0.06
9/28/2018	11:33:12	59.47	166.31	0.07	0.16	0.06
9/28/2018	11:33:22	100.21	184.44	0.06	0.09	0.06
9/28/2018	11:33:32	119.33	192.00	0.17	0.06	0.05
9/28/2018	11:33:42	140.95	194.19	0.20	0.04	0.06
9/28/2018	11:33:52	145.66	195.04	0.21	0.03	0.06
9/28/2018	11:34:02	150.66	194.65	0.19	0.03	0.05
9/28/2018	11:34:12	151.29	194.89	0.19	0.03	0.05
9/28/2018	11:34:22	151.89	194.69	0.20	0.03	0.05
9/28/2018	11:34:32	151.87	195.35	0.19	0.03	0.05
9/28/2018	11:34:42	151.89	197.94	0.13	3.57	0.19
9/28/2018	11:34:52	151.59	197.38	0.07	12.06	0.47

	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
System Zero	**0.21**	**-1.84**	**0.19**	**0.03**	**0.05**
System Mid	**5.39**	**196.89**	**12.09**	**9.97**	**1.86**

Hollingsworth & Vose
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Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	11:37:42	3.05	146.52	0.47	19.75	0.68
9/28/2018	11:38:42	3.05	144.99	0.48	19.75	0.68
9/28/2018	11:39:42	3.05	143.30	0.60	19.75	0.67
9/28/2018	11:40:42	3.04	145.17	0.49	19.76	0.67
9/28/2018	11:41:42	3.04	144.16	0.55	19.77	0.67
9/28/2018	11:42:42	3.05	143.99	0.60	19.77	0.67
9/28/2018	11:43:42	3.05	141.98	0.59	19.77	0.67
9/28/2018	11:44:42	3.04	142.44	0.60	19.76	0.67
9/28/2018	11:45:42	3.05	144.66	0.47	19.76	0.67
9/28/2018	11:46:42	3.05	147.04	0.47	19.76	0.68
9/28/2018	11:47:42	3.05	145.27	0.54	19.77	0.68
9/28/2018	11:48:42	3.05	144.55	0.55	19.76	0.68
9/28/2018	11:49:42	3.05	149.25	0.46	19.76	0.69
9/28/2018	11:50:42	3.05	151.52	0.47	19.75	0.69
9/28/2018	11:51:42	3.06	149.38	0.46	19.75	0.69
9/28/2018	11:52:42	3.06	144.20	0.47	19.76	0.70
9/28/2018	11:53:42	3.06	146.05	0.47	19.76	0.69
9/28/2018	11:54:42	3.06	146.12	0.47	19.76	0.69
9/28/2018	11:55:42	3.06	146.60	0.47	19.76	0.69
9/28/2018	11:56:42	3.07	147.53	0.47	19.77	0.68
9/28/2018	11:57:42	3.07	144.68	0.47	19.76	0.69
9/28/2018	11:58:42	3.06	141.10	0.54	19.76	0.69
9/28/2018	11:59:42	3.05	144.72	0.55	19.76	0.70
9/28/2018	12:00:42	3.05	143.63	0.45	19.76	0.69
9/28/2018	12:01:42	3.05	143.13	0.34	19.76	0.69
9/28/2018	12:02:42	3.05	144.70	0.46	19.76	0.68
9/28/2018	12:03:42	3.06	142.64	0.56	19.75	0.68
9/28/2018	12:04:42	3.05	141.50	0.59	19.75	0.68
9/28/2018	12:05:42	3.06	143.26	0.56	19.76	0.68
9/28/2018	12:06:42	3.07	145.16	0.47	19.75	0.68
9/28/2018	12:07:42	3.07	146.80	0.47	19.74	0.69
9/28/2018	12:08:42	3.06	147.95	0.58	19.74	0.69
9/28/2018	12:09:42	3.06	146.10	0.52	19.75	0.69
9/28/2018	12:10:42	3.06	145.49	0.47	19.75	0.69
9/28/2018	12:11:42	3.06	147.16	0.47	19.74	0.69
9/28/2018	12:12:42	3.06	148.33	0.47	19.75	0.69
9/28/2018	12:13:42	3.05	147.13	0.47	19.74	0.70
9/28/2018	12:14:42	3.05	145.92	0.56	19.75	0.70
9/28/2018	12:15:42	3.06	145.71	0.59	19.75	0.70
9/28/2018	12:16:42	3.06	146.85	0.56	19.75	0.70
9/28/2018	12:17:42	3.05	145.27	0.46	19.75	0.70
9/28/2018	12:18:42	3.06	146.15	0.47	19.75	0.70

Hollingsworth & Vose
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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	12:19:42	3.05	143.97	0.47	19.75	0.70
9/28/2018	12:20:42	3.05	141.16	0.46	19.75	0.70
9/28/2018	12:21:42	3.05	141.25	0.34	19.76	0.69
9/28/2018	12:22:42	3.05	141.70	0.26	19.75	0.70
9/28/2018	12:23:42	3.05	141.35	0.47	19.75	0.69
9/28/2018	12:24:42	3.05	142.91	0.47	19.76	0.69
9/28/2018	12:25:42	3.05	144.02	0.47	19.76	0.69
9/28/2018	12:26:42	3.05	144.12	0.47	19.76	0.68
9/28/2018	12:27:42	3.05	145.04	0.42	19.75	0.69
9/28/2018	12:28:42	3.05	148.17	0.31	19.76	0.69
9/28/2018	12:29:42	3.05	145.30	0.19	19.75	0.69
9/28/2018	12:30:42	3.04	146.36	0.45	19.75	0.69
9/28/2018	12:31:42	3.04	147.94	0.37	19.75	0.69
9/28/2018	12:32:42	3.05	145.22	0.34	19.76	0.69
9/28/2018	12:33:42	3.04	144.60	0.41	19.76	0.69
9/28/2018	12:34:42	3.04	149.45	0.58	19.76	0.69
9/28/2018	12:35:42	3.05	148.58	0.46	19.75	0.69
9/28/2018	12:36:42	3.05	149.30	0.35	19.75	0.70
9/28/2018	12:37:42	3.05	150.86	0.16	19.75	0.70
9/28/2018	12:38:42	3.05	150.35	0.24	19.75	0.70
9/28/2018	12:39:42	3.04	148.69	0.46	19.75	0.70
9/28/2018	12:40:42	3.05	147.29	0.47	19.75	0.71
9/28/2018	12:41:42	3.05	146.58	0.33	19.75	0.71
9/28/2018	12:42:42	3.04	146.68	0.44	19.75	0.70
9/28/2018	12:43:42	3.05	146.31	0.47	19.75	0.70
9/28/2018	12:44:42	3.04	144.66	0.47	19.75	0.70
9/28/2018	12:45:42	3.04	143.72	0.47	19.75	0.70
9/28/2018	12:46:42	3.04	147.01	0.46	19.75	0.70
9/28/2018	12:47:42	3.04	147.50	0.46	19.75	0.70
9/28/2018	12:48:42	3.05	144.87	0.37	19.75	0.70
9/28/2018	12:49:42	3.04	145.55	0.34	19.75	0.69
9/28/2018	12:50:42	3.05	146.43	0.37	19.75	0.69
9/28/2018	12:51:42	3.05	145.54	0.46	19.75	0.69
9/28/2018	12:52:42	3.04	146.70	0.34	19.76	0.69
9/28/2018	12:53:42	3.04	151.53	0.44	19.75	0.69
9/28/2018	12:54:42	3.05	150.93	0.47	19.75	0.69
9/28/2018	12:55:42	3.05	149.16	0.52	19.75	0.69
9/28/2018	12:56:42	3.05	147.93	0.58	19.75	0.69
9/28/2018	12:57:42	3.05	147.96	0.47	19.75	0.69
9/28/2018	12:58:42	3.05	147.93	0.47	19.75	0.69
9/28/2018	12:59:42	3.05	150.80	0.47	19.75	0.69
9/28/2018	13:00:42	3.05	148.98	0.47	19.75	0.70

Hollingsworth & Vose
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Date	**Time**	**NOx [PPM]**	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
9/28/2018	13:01:42	3.05	146.90	0.43	19.76	0.70
9/28/2018	13:02:42	3.06	149.56	0.35	19.75	0.70
9/28/2018	13:03:42	3.06	148.64	0.47	19.75	0.71
9/28/2018	13:04:42	3.05	148.57	0.47	19.75	0.71
9/28/2018	13:05:42	3.06	151.78	0.55	19.74	0.71
9/28/2018	13:06:42	3.05	152.09	0.54	19.75	0.71
9/28/2018	13:07:42	3.04	149.03	0.47	19.75	0.70
9/28/2018	13:08:42	3.05	148.91	0.47	19.75	0.70
9/28/2018	13:09:42	3.05	148.42	0.47	19.75	0.70
9/28/2018	13:10:42	3.06	147.96	0.57	19.74	0.70
9/28/2018	13:11:42	3.05	148.80	0.60	19.75	0.70
9/28/2018	13:12:42	3.05	149.27	0.55	19.75	0.70
9/28/2018	13:13:42	3.05	151.25	0.47	19.74	0.70
9/28/2018	13:14:42	3.06	154.26	0.47	19.74	0.70
9/28/2018	13:15:42	3.04	154.18	0.58	19.74	0.69
9/28/2018	13:16:42	3.05	150.45	0.51	19.75	0.69
9/28/2018	13:17:42	3.05	149.80	0.41	19.74	0.69
9/28/2018	13:18:42	3.05	152.83	0.34	19.74	0.69
9/28/2018	13:19:42	3.05	153.34	0.34	19.75	0.69
9/28/2018	13:20:42	3.04	147.48	0.34	19.75	0.68
9/28/2018	13:21:42	3.04	145.44	0.12	19.75	0.69
9/28/2018	13:22:42	3.04	147.12	0.23	19.75	0.69
9/28/2018	13:23:42	3.04	148.67	0.38	19.74	0.69
9/28/2018	13:24:42	3.04	149.27	0.39	19.75	0.69
9/28/2018	13:25:42	3.04	148.16	0.07	19.75	0.70
9/28/2018	13:26:42	3.04	145.85	0.19	19.75	0.70
9/28/2018	13:27:42	3.03	144.18	0.30	19.75	0.70
9/28/2018	13:28:42	3.04	146.35	0.34	19.75	0.70
9/28/2018	13:29:42	3.04	149.38	0.38	19.75	0.71
9/28/2018	13:30:42	3.04	148.90	0.47	19.75	0.71
9/28/2018	13:31:42	3.03	148.22	0.47	19.75	0.70
9/28/2018	13:32:42	3.05	147.58	0.35	19.74	0.70
9/28/2018	13:33:42	3.05	147.30	0.25	19.75	0.70
9/28/2018	13:34:42	3.05	146.34	0.32	19.75	0.70
9/28/2018	13:35:42	3.06	151.14	0.51	19.74	0.70
9/28/2018	13:36:42	3.32	159.60	0.60	19.73	0.70
9/28/2018	13:37:42	3.38	161.19	0.47	19.73	0.70
9/28/2018	13:38:42	3.38	159.30	0.47	19.74	0.70
9/28/2018	13:39:42	3.38	154.41	0.47	19.74	0.69
9/28/2018	13:40:42	3.18	150.76	0.47	19.75	0.69
9/28/2018	13:41:42	3.07	150.77	0.45	19.75	0.69
Final Average		**3.06**	**147.33**	**0.45**	**19.75**	**0.69**

Hollingsworth & Vose
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Run #3

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
Bias Check		**NOx [PPM]**	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
9/28/2018	13:43:02	3.06	149.35	0.34	11.25	0.41
9/28/2018	13:43:12	3.39	139.66	0.35	5.60	0.36
9/28/2018	13:43:22	3.06	116.09	0.34	3.77	0.19
9/28/2018	13:43:32	5.70	82.55	0.34	3.07	0.11
9/28/2018	13:43:42	8.70	49.96	0.43	2.80	0.07
9/28/2018	13:43:52	6.87	26.71	0.47	2.69	0.05
9/28/2018	13:44:02	4.83	12.91	0.48	2.64	0.05
9/28/2018	13:44:12	4.04	5.81	0.47	2.63	0.05
9/28/2018	13:44:22	2.78	2.44	0.48	2.62	0.06
9/28/2018	13:44:32	2.20	1.24	0.48	2.62	0.05
9/28/2018	13:44:42	1.88	2.15	0.47	2.62	0.05
9/28/2018	13:44:52	1.51	3.37	3.56	2.62	0.04
9/28/2018	13:45:02	1.19	3.54	10.75	2.62	0.04
9/28/2018	13:45:12	1.21	2.63	10.76	2.62	0.05
9/28/2018	13:45:22	0.89	1.48	10.75	2.61	0.04
9/28/2018	13:45:32	0.90	0.69	10.76	2.62	0.05
9/28/2018	13:45:42	0.89	0.29	10.75	2.62	0.04
9/28/2018	13:45:52	0.89	-0.29	10.75	2.62	0.05
9/28/2018	13:46:02	0.57	0.13	10.75	2.62	0.05
9/28/2018	13:46:12	0.59	1.64	11.97	2.62	0.04
9/28/2018	13:46:22	0.57	2.79	11.96	2.61	0.05
9/28/2018	13:46:32	0.57	2.56	11.97	2.62	0.05
9/28/2018	13:46:42	0.58	1.84	11.97	2.61	0.05
9/28/2018	13:46:52	0.59	0.96	11.97	2.61	0.04
9/28/2018	13:47:02	0.59	0.17	11.98	2.62	0.04
9/28/2018	13:47:12	0.31	-0.07	11.98	2.63	0.05
9/28/2018	13:47:22	0.28	-0.38	12.07	2.69	0.05
9/28/2018	13:47:32	0.28	0.47	12.09	2.71	0.05
9/28/2018	13:47:42	0.30	2.54	12.10	2.72	0.05
9/28/2018	13:47:52	0.29	3.30	12.09	6.10	0.20
9/28/2018	13:48:02	0.28	8.79	12.10	6.55	0.22
9/28/2018	13:48:12	0.29	19.68	12.10	3.49	0.14
9/28/2018	13:48:22	0.56	26.03	12.09	2.57	0.74
9/28/2018	13:48:32	0.58	23.34	12.27	2.26	1.40
9/28/2018	13:48:42	0.58	15.47	12.50	2.10	1.68
9/28/2018	13:48:52	0.92	8.47	12.51	2.03	1.79
9/28/2018	13:49:02	0.90	5.07	12.50	2.00	1.83
9/28/2018	13:49:12	0.57	3.96	12.50	2.00	1.87
9/28/2018	13:49:22	0.60	2.87	12.50	1.99	1.87
9/28/2018	13:49:32	0.56	1.60	12.51	1.99	1.87

Hollingsworth & Vose
CFU-104
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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
9/28/2018	13:49:42	0.31	0.22	11.42	1.99	1.88
9/28/2018	13:49:52	0.30	-0.58	1.54	4.57	4.91
9/28/2018	13:50:02	0.29	-0.87	1.54	7.76	7.92
9/28/2018	13:50:12	0.28	-0.80	1.54	9.05	9.00
9/28/2018	13:50:22	0.29	-0.05	1.54	9.59	9.47
9/28/2018	13:50:32	0.29	1.32	1.54	9.81	9.67
9/28/2018	13:50:42	0.27	1.89	1.54	9.91	9.76
9/28/2018	13:50:52	0.27	1.07	1.53	9.95	9.81
9/28/2018	13:51:02	0.28	-0.21	0.36	9.97	9.83
9/28/2018	13:51:12	0.29	-1.09	0.07	9.97	9.84
9/28/2018	13:51:22	0.28	-1.53	0.06	9.98	9.84
9/28/2018	13:51:32	0.28	-2.25	0.07	9.98	9.84
9/28/2018	13:51:42	0.25	-2.27	0.07	9.97	9.84
9/28/2018	13:51:52	-0.01	-1.38	0.06	10.37	9.46
9/28/2018	13:52:02	-0.01	1.80	0.07	10.07	6.31
9/28/2018	13:52:12	0.00	10.92	0.06	4.86	2.93
9/28/2018	13:52:22	0.01	21.23	0.07	2.07	1.30
9/28/2018	13:52:32	2.75	24.63	0.07	0.89	0.66
9/28/2018	13:52:42	4.86	20.67	0.06	0.40	0.36
9/28/2018	13:52:52	5.34	14.12	0.06	0.20	0.22
9/28/2018	13:53:02	5.65	8.83	0.06	0.11	0.15
9/28/2018	13:53:12	5.66	6.53	0.07	0.07	0.13
9/28/2018	13:53:22	5.41	7.33	0.07	0.06	0.11
9/28/2018	13:53:32	5.39	7.99	0.06	0.05	0.10
9/28/2018	13:53:42	5.39	7.60	0.07	0.05	0.09
9/28/2018	13:53:52	5.11	6.54	0.07	0.04	0.09
9/28/2018	13:54:02	5.09	5.48	0.06	0.04	0.08
9/28/2018	13:54:12	5.11	4.78	0.07	0.04	0.09
9/28/2018	13:54:22	5.11	4.56	0.07	0.04	0.08
9/28/2018	13:54:32	5.10	4.56	0.07	0.38	0.10
9/28/2018	13:54:42	5.38	6.09	0.06	4.57	0.26
9/28/2018	13:54:52	5.37	18.07	0.05	2.72	0.18
9/28/2018	13:55:02	5.38	47.36	0.07	1.17	0.11
9/28/2018	13:55:12	14.21	90.05	0.06	0.52	0.10
9/28/2018	13:55:22	22.25	132.43	0.06	0.24	0.08
9/28/2018	13:55:32	61.20	163.42	0.07	0.12	0.08
9/28/2018	13:55:42	103.03	180.45	0.07	0.08	0.07
9/28/2018	13:55:52	122.09	188.05	0.07	0.05	0.07
9/28/2018	13:56:02	142.71	191.70	0.07	0.05	0.07
9/28/2018	13:56:12	146.52	194.27	0.06	0.04	0.07
9/28/2018	13:56:22	150.98	197.21	0.07	0.04	0.06
9/28/2018	13:56:32	151.59	198.89	0.07	0.04	0.07

Hollingsworth & Vose
CFU-104
Run #3

Date	**Time**	**NOx [PPM]**	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
9/28/2018	13:56:42	151.87	198.36	0.06	0.04	0.06

	NOx [PPM]	**CO [PPM]**	**VOC [PPM]**	**O2 [%]**	**CO2 [%]**
System Zero	**0.27**	**-2.02**	**0.07**	**0.04**	**0.06**
System Mid	**5.10**	**198.15**	**12.50**	**9.98**	**1.87**

BISON
ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 104**
DATE	**09/28/18**
METHOD	**13B**
POLLUTANT	**Fluorides**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**14:06**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**16:11**
EPA Method:	**13B**	Clear Sky, 75 degrees	**Date:**	**9/28/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type	Glass
Y factor	0.9985	Nozzle ID	0.182	Nozzle size	0.1820 inches
ΔH@	1.799	Hot box ID	HB2	Nozzle area	0.000181 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.90 %
Static Pressure	-0.79 "H_2O	CO_2	0.70 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.198 inches
Stack Temperature	200 F		
Assumed moisture	1.94 %		
Assumed meter temp.	65.1 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	11	11

Nozzle check for roundness:

1	2	3
0.182	0.182	0.182 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	75.190 dcf	Ave. ΔP	1.371 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.1701 "H_2O
Actual H_2O	1.97 %	Ave. ΔH	1.267 "H_2O
Std. meter vol.	72.915 dscf	Ave. T_s	237.3 °F
Isokinetic Average	100.0 %	Ave. T_m	81.5 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	215	15.0
Silica gel, g	237.1	253.2	16.1
		Total water gain:	31.1

Traverse Point	Time (min.)	Meter Volume (dcf)	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
		0.000								
1	5.0	2.970	1.20	234	79	1.09	1.10	2	254	65
2	10.0	6.080	1.30	235	79	1.18	1.20	2	254	61
3	15.0	9.150	1.30	235	79	1.18	1.20	2	255	61
4	20.0	12.270	1.40	237	80	1.27	1.30	2	255	62
5	25.0	15.560	1.50	237	80	1.36	1.40	2	252	62
6	30.0	18.890	1.60	238	80	1.44	1.40	2	253	62
7	35.0	22.140	1.50	238	80	1.35	1.40	2	254	63
8	40.0	25.340	1.40	236	80	1.27	1.30	2	252	63
9	45.0	28.530	1.40	236	81	1.27	1.30	2	251	64
10	50.0	31.710	1.40	235	81	1.27	1.30	2	250	64
11	55.0	34.860	1.40	237	81	1.27	1.30	2	255	64
12	60.0	38.015	1.40	236	82	1.27	1.30	2	254	64
13	65.0	40.960	1.20	233	81	1.09	1.10	2	255	66
14	70.0	43.940	1.20	235	82	1.09	1.10	2	256	61
15	75.0	46.990	1.30	238	82	1.18	1.20	2	255	56
16	80.0	50.000	1.30	239	82	1.18	1.20	2	254	53
17	85.0	53.150	1.40	239	82	1.27	1.30	2	254	53
18	90.0	56.450	1.50	239	83	1.36	1.40	2	251	52
19	95.0	59.620	1.40	240	83	1.27	1.30	2	252	51
20	100.0	62.780	1.40	240	83	1.27	1.30	2	252	52
21	105.0	65.930	1.40	240	84	1.27	1.30	2	256	52
22	110.0	69.080	1.40	240	84	1.27	1.30	2	253	52
23	115.0	72.150	1.30	240	84	1.18	1.20	2	253	52
24	120.0	75.190	1.30	238	84	1.18	1.20	2	255	53

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**16:26**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:31**
EPA Method:	**13B**	Clear Sky, 75 degrees	**Date:**	**9/28/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.182	Nozzle size:	0.1820 inches
$\Delta H@$	1.799	Hot box ID	HB2	Nozzle area:	0.000181 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.9 %
Static Pressure	-0.79 "H_2O	CO_2	0.7 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.195 inches
Stack Temperature	200 F		
Assumed moisture	1.97 %		
Assumed meter temp.	81.5 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	14	8

Nozzle check for roundness:

1	2	3
0.182	0.182	0.182 inches
	Caliper ID#	MN-2

Post Test Calculations:

Sample volume	76.565 dcf	Ave. ΔP	1.404 "H_2O
Wet mol. weight	28.69 M_s (actual)	Ave. $\sqrt{\Delta P}$	1.1847 "H_2O
Actual H_2O	2.02 %	Ave. ΔH	1.304 "H_2O
Std. meter vol.	73.806 dscf	Ave. T_s	232.9 °F
Isokinetic Average	99.7 %	Ave. T_m	84.8 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	215	15.0
Silica gel, g	255.5	272.9	17.4
		Total water gain:	32.4

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	3.090	1.30	239	84	1.18	1.20	2	258	65
2	10.0	6.170	1.30	239	85	1.18	1.20	2	255	59
3	15.0	9.260	1.30	240	85	1.18	1.20	2	254	57
4	20.0	12.460	1.40	239	85	1.27	1.30	2	254	56
5	25.0	15.660	1.40	241	85	1.27	1.30	2	254	56
6	30.0	18.940	1.50	241	85	1.36	1.40	2	252	55
7	35.0	22.220	1.50	241	86	1.36	1.40	2	252	55
8	40.0	25.490	1.50	242	86	1.36	1.40	2	253	55
9	45.0	28.660	1.40	242	86	1.27	1.30	2	253	55
10	50.0	31.730	1.30	242	86	1.18	1.20	2	252	56
11	55.0	34.890	1.40	240	86	1.27	1.30	2	252	57
12	60.0	38.060	1.40	238	86	1.28	1.30	2	254	60
13	65.0	41.230	1.40	235	86	1.28	1.30	2	256	65
14	70.0	44.410	1.40	231	86	1.29	1.30	2	252	58
15	75.0	47.570	1.40	229	86	1.29	1.30	2	254	59
16	80.0	50.780	1.40	228	85	1.29	1.30	2	250	60
17	85.0	53.990	1.40	227	85	1.30	1.30	2	253	60
18	90.0	57.200	1.40	226	85	1.30	1.30	2	251	60
19	95.0	60.380	1.40	225	85	1.30	1.30	2	253	60
20	100.0	63.600	1.40	223	84	1.30	1.30	2	251	60
21	105.0	66.790	1.40	222	83	1.30	1.30	2	252	60
22	110.0	69.980	1.40	221	82	1.30	1.30	2	254	60
23	115.0	73.260	1.50	220	82	1.39	1.40	2	254	60
24	120.0	76.565	1.50	219	81	1.39	1.40	2	253	60

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**18:46**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**20:50**
EPA Method:	**13B**	Clear Sky, 75 degrees	**Date:**	**9/28/2018**
Box Operator:	**RR**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	3B	Liner type:	Glass
Y factor	0.9985	Nozzle ID	0.182	Nozzle size:	0.1820 inches
$\Delta H@$	1.799	Hot box ID	HB2	Nozzle area:	0.000181 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.722 "Hg	O_2	19.9 %
Static Pressure	-0.79 "H_2O	CO_2	0.7 %
Ave. ΔP	1.42 "H_2O	Rec. Nz.	0.194 inches
Stack Temperature	200 F		
Assumed moisture	2.02 %		
Assumed meter temp.	84.8 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	12	10

Nozzle check for roundness:

1	2	3	
0.182	0.182	0.182	inches
	Caliper ID#	MN-2	

Post Test Calculations:

Sample volume	74.403 dcf	Ave. ΔP	1.346 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. $\sqrt{\Delta P}$	1.1596 "H_2O
Actual H_2O	1.7 %	Ave. ΔH	1.246 "H_2O
Std. meter vol.	73.058 dscf	Ave. T_s	213.3 °F
Isokinetic Average	99.1 %	Ave. T_m	74.8 °F

Moisture/Lab:

	Initial	Final	Gain
Filter	NA #		
Impingers, g	200.0	210	10.0
Silica gel, g	254.4	271.2	16.8
		Total water gain:	26.8

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	2.950	1.20	219	79	1.11	1.10	2	255	64
2	10.0	6.000	1.30	218	79	1.20	1.20	2	250	57
3	15.0	9.040	1.30	217	78	1.20	1.20	2	255	56
4	20.0	12.220	1.40	215	77	1.30	1.30	2	254	56
5	25.0	15.360	1.40	215	77	1.30	1.30	2	251	57
6	30.0	18.660	1.50	214	76	1.39	1.40	2	252	57
7	35.0	21.790	1.40	213	76	1.30	1.30	2	255	57
8	40.0	25.000	1.40	212	76	1.30	1.30	2	252	57
9	45.0	28.210	1.40	212	75	1.30	1.30	2	252	57
10	50.0	31.360	1.40	212	75	1.30	1.30	2	254	57
11	55.0	34.510	1.40	212	75	1.30	1.30	2	251	57
12	60.0	37.542	1.30	213	74	1.20	1.20	2	254	57
13	65.0	40.470	1.20	212	74	1.11	1.10	2	257	60
14	70.0	43.390	1.20	212	74	1.11	1.10	2	251	56
15	75.0	46.480	1.30	212	74	1.20	1.20	2	252	57
16	80.0	49.590	1.30	212	74	1.20	1.20	2	254	57
17	85.0	52.710	1.40	211	73	1.30	1.30	2	252	58
18	90.0	55.850	1.40	213	73	1.29	1.30	2	255	58
19	95.0	58.990	1.40	213	73	1.29	1.30	2	252	59
20	100.0	62.140	1.40	213	73	1.29	1.30	2	257	59
21	105.0	65.300	1.40	212	73	1.29	1.30	2	252	60
22	110.0	68.340	1.30	212	73	1.20	1.20	2	251	60
23	115.0	71.360	1.30	212	73	1.20	1.20	2	252	60
24	120.0	74.403	1.30	212	72	1.20	1.20	2	253	60

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**14:06**
Source:	**CFU 104**	**End Time:**	**16:11**
Method:	**13B**	**Date:**	**9/28/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
5	2.970	1.10	79	1	1.20	234	1.0954
10	6.080	1.20	79	2	1.30	235	1.1402
15	9.150	1.20	79	3	1.30	235	1.1402
20	12.270	1.30	80	4	1.40	237	1.1832
25	15.560	1.40	80	5	1.50	237	1.2247
30	18.890	1.40	80	6	1.60	238	1.2649
35	22.140	1.40	80	7	1.50	238	1.2247
40	25.340	1.30	80	8	1.40	236	1.1832
45	28.530	1.30	81	9	1.40	236	1.1832
50	31.710	1.30	81	10	1.40	235	1.1832
55	34.860	1.30	81	11	1.40	237	1.1832
60	38.015	1.30	82	12	1.40	236	1.1832
65	40.960	1.10	81	13	1.20	233	1.0954
70	43.940	1.10	82	14	1.20	235	1.0954
75	46.990	1.20	82	15	1.30	238	1.1402
80	50.000	1.20	82	16	1.30	239	1.1402
85	53.150	1.30	82	17	1.40	239	1.1832
90	56.450	1.40	83	18	1.50	239	1.2247
95	59.620	1.30	83	19	1.40	240	1.1832
100	62.780	1.30	83	20	1.40	240	1.1832
105	65.930	1.30	84	21	1.40	240	1.1832
110	69.080	1.30	84	22	1.40	240	1.1832
115	72.150	1.20	84	23	1.30	240	1.1402
120	75.190	1.20	84	24	1.30	238	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	75.190	dcf	Rectangular		
Water Volume	31.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.1820	in.	Length		in
Nozzle Area	0.000181	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.71	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.87	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.267	"H_2O	$\sqrt{Dp}$	1.1701	"H_2O
Temperature, T_m	81.5	^oF	Temperature, T_s	237.3	^oF
Temperature, T_m	541.5	^oA (^oR)	Temperature, T_s	697.3	^oA (R)
Pressure Meter, P_m	29.813	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	72.914	dscf	Velocity, V_s	76.05	fps
	2.065	dscm	Volume (actual)	22,399.8	awcfm
Actual Volume, $V_{m(actual)}$	99.123	awcf		21,958.5	adcfm
Gas Stream Moisture			Volume (standard)	1,008,899.4	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.464	scf		989,024.1	dscf/hr
Moisture, B_{ws}	0.0197			16,483.7	dscf/min
Moisture EPA M4	1.97	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	513.228	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.0	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	< 6.35E-06	gr/dscf
	< 14.53	µg/dscm
	< 1.84E-02	ppmvd
Mass Emissions	< 8.97E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**16:26**
Source:	**CFU 104**	**End Time:**	**18:31**
Method:	**13B**	**Date:**	**09/28/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
5	3.090	1.20	84	1	1.30	239	1.1402
10	6.170	1.20	85	2	1.30	239	1.1402
15	9.260	1.20	85	3	1.30	240	1.1402
20	12.460	1.30	85	4	1.40	239	1.1832
25	15.660	1.30	85	5	1.40	241	1.1832
30	18.940	1.40	85	6	1.50	241	1.2247
35	22.220	1.40	86	7	1.50	241	1.2247
40	25.490	1.40	86	8	1.50	242	1.2247
45	28.660	1.30	86	9	1.40	242	1.1832
50	31.730	1.20	86	10	1.30	242	1.1402
55	34.890	1.30	86	11	1.40	240	1.1832
60	38.060	1.30	86	12	1.40	238	1.1832
65	41.230	1.30	86	13	1.40	235	1.1832
70	44.410	1.30	86	14	1.40	231	1.1832
75	47.570	1.30	86	15	1.40	229	1.1832
80	50.780	1.30	85	16	1.40	228	1.1832
85	53.990	1.30	85	17	1.40	227	1.1832
90	57.200	1.30	85	18	1.40	226	1.1832
95	60.380	1.30	85	19	1.40	225	1.1832
100	63.600	1.30	84	20	1.40	223	1.1832
105	66.790	1.30	83	21	1.40	222	1.1832
110	69.980	1.30	82	22	1.40	221	1.1832
115	73.260	1.40	82	23	1.50	220	1.2247
120	76.565	1.40	81	24	1.50	219	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	76.565	dcf	Rectangular		
Water Volume	32.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.1820	in.	Length		in
Nozzle Area	0.000181	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.72	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.83	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.304	"H_2O	$\sqrt{Dp}$	1.1847	"H_2O
Temperature, T_m	84.8	^oF	Temperature, T_s	232.9	^oF
Temperature, T_m	544.8	^oA (^oR)	Temperature, T_s	692.9	^oA (R)
Pressure Meter, P_m	29.816	"Hg	Pressure Stack, P_s	29.662	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	73.805	dscf	Velocity, V_s	76.77	fps
	2.090	dscm	Volume (actual)	22,611.8	awcfm
Actual Volume, $V_{m(actual)}$	99.752	awcf		22,155.0	adcfm
Gas Stream Moisture			Volume (standard)	1,024,918.4	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.525	scf		1,004,215.0	dscf/hr
Moisture, B_{ws}	0.0202			16,736.9	dscf/min
Moisture EPA M4	2.02	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	509.989	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	99.7	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	< 6.27E-06	gr/dscf
	< 14.35	µg/dscm
	< 1.82E-02	ppmvd
Mass Emissions	< 9.00E-04	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**18:46**
Source:	**CFU 104**	**End Time:**	**20:50**
Method:	**13B**	**Date:**	**09/28/18**

Sampling Data				Traverse Data			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
5	2.950	1.10	79	1	1.20	219	1.0954
10	6.000	1.20	79	2	1.30	218	1.1402
15	9.040	1.20	78	3	1.30	217	1.1402
20	12.220	1.30	77	4	1.40	215	1.1832
25	15.360	1.30	77	5	1.40	215	1.1832
30	18.660	1.40	76	6	1.50	214	1.2247
35	21.790	1.30	76	7	1.40	213	1.1832
40	25.000	1.30	76	8	1.40	212	1.1832
45	28.210	1.30	75	9	1.40	212	1.1832
50	31.360	1.30	75	10	1.40	212	1.1832
55	34.510	1.30	75	11	1.40	212	1.1832
60	37.542	1.20	74	12	1.30	213	1.1402
65	40.470	1.10	74	13	1.20	212	1.0954
70	43.390	1.10	74	14	1.20	212	1.0954
75	46.480	1.20	74	15	1.30	212	1.1402
80	49.590	1.20	74	16	1.30	212	1.1402
85	52.710	1.30	73	17	1.40	211	1.1832
90	55.850	1.30	73	18	1.40	213	1.1832
95	58.990	1.30	73	19	1.40	213	1.1832
100	62.140	1.30	73	20	1.40	213	1.1832
105	65.300	1.30	73	21	1.40	212	1.1832
110	68.340	1.20	73	22	1.30	212	1.1402
115	71.360	1.20	73	23	1.30	212	1.1402
120	74.403	1.20	72	24	1.30	212	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	74.403	dcf	Rectangular		
Water Volume	26.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.1820	in.	Length		in
Nozzle Area	0.000181	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.72	%vd
Static Pressure	-0.79	"H_2O	O_2 Average	19.82	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9985	Y			

Field Data Averages

Meter			Stack		
ΔH	1.246	"H_2O	√Dp	1.1596	"H_2O
Temperature, T_m	74.8	^oF	Temperature, T_s	213.3	^oF
Temperature, T_m	534.8	^oA (^oR)	Temperature, T_s	673.3	^oA (R)
Pressure Meter, P_m	29.814	"Hg	Pressure Stack, P_s	29.664	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	73.058	dscf	Velocity, V_s	74.03	fps
	2.069	dscm	Volume (actual)	21,804.8	awcfm
Actual Volume, $V_{m(actual)}$	95.630	awcf		21,434.1	adcfm
Gas Stream Moisture			Volume (standard)	1,017,177.4	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.261	scf		999,885.4	dscf/hr
Moisture, B_{ws}	0.0170			16,664.8	dscf/min
Moisture EPA M4	1.70	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	495.53	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.72	lb/lb-mole			

Percent Isokinetic	99.1	%

Laboratory Results

Fluoride	< 30.0	µg/sample			
Fluoride	< 3.00E-05	grams	MW F	19.0	g/mole

Emissions:

Concentration, C_s	< 6.34E-06	gr/dscf
	< 14.50	µg/dscm
	< 1.84E-02	ppmvd
Mass Emissions	< 9.05E-04	lb/hr

"<" represents MDL value

EPA Method 13B
Laboratory Results
Total Fluoride

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 104**

Lab ID	Sample ID	Sample Date		Result	MDL	Units
18-S2340	Cont. 1 Run 1	9/28/2018	<	MDL	30.0	µg/sample
18-S2341	Cont. 1 Run 2	9/28/2018	<	MDL	30.0	µg/sample
18-S2342	Cont. 1 Run 3	9/28/2018	<	MDL	30.0	µg/sample
18-S2210	H20 + Filter Blank	9/11/2018	<	MDL	30.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 13B
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 104

Run			1	2	3	
Date			9/28/2018	9/28/2018	9/28/2018	
Run Start Time			14:06	16:26	18:46	
Run End Time			16:11	18:31	20:50	
Duration, min.			120	120	120	**Average**
Barometric Pressure, "Hg			29.72	29.72	29.72	**29.72**
Nozzle Dia., in.			0.1820	0.1820	0.1820	**0.1820**
Isokinetic Average, %			100.0	99.7	99.1	**99.6**
Sample Volume, dscf			72.914	73.805	73.058	**73.259**
Sample Volume, dscm			2.065	2.090	2.069	**2.075**
Stack Diameter, in.			30.00	30.00	30.00	**30.00**
Stack Area, sq.ft.			4.909	4.909	4.909	**4.909**
CO_2 %vd			0.71	0.72	0.72	**0.72**
O_2 %vd			19.87	19.83	19.82	**19.84**
Static Press., "H_2O			-0.79	-0.79	-0.79	**-0.79**
H_2O %v			1.97	2.02	1.70	**1.90**
Wet Molecular Weight, lb/lb-mole			28.70	28.69	28.72	**28.70**
Velocity, FPS			76.05	76.77	74.03	**75.62**
ADCFM			21,958.5	22,155.0	21,434.1	**21,849.2**
AWCFM			22,399.8	22,611.8	21,804.8	**22,272.1**
DSCFM			16,483.7	16,736.9	16,664.8	**16,628.5**
Stack Temperature, ^oF			237.3	232.9	213.3	**227.8**
Fluoride	Concentration, C_s	gr/dscf	< 6.35E-06	< 6.27E-06	< 6.34E-06	< **6.32E-06**
		µg/dscm	< 14.53	< 14.35	< 14.50	< **14.46**
		ppmvd	< 1.84E-02	< 1.82E-02	< 1.84E-02	< **1.83E-02**
	Mass	lb/hr	< 8.97E-04	< 9.00E-04	< 9.05E-04	< **9.01E-04**
		lb/lb glass	< 2.44E-06	< 2.48E-06	< 2.43E-06	< **2.45E-06**
Production Data	**Glass Production**	**lbs/hr**	367.4	363.5	373.0	**368.0**

"<" represents MDL value

EPA Methods 1-4, 13B
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**14:06**
Source:	**CFU 104**	**End Time:**	**16:11**
Method:	**13B**	**Date:**	**9/28/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.813 "Hg

where Pb: 29.72 "Hg
ΔH: 1.267 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.662 "Hg

where Pb: 29.72 "Hg
Static Press.: -0.79 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 72.914 dscf

where Vm: 75.190 dcf
Y: 0.9985
Pm: 29.813 "Hg
Tm: 541.5 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 1.464 scf

where H_2O: 31.10 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0197

where Vw(std): 1.464 scf
Vm(std): 72.914 dscf

6) % H_2O = Bws x 100 = 1.97 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 99.123 awcf

where Y: 0.9985
Vm: 75.1899 dcf
Bws: 0.0197
Ts: 697.3 °A
Tm: 541.5 °A
Pm: 29.813 "Hg
Ps: 29.662 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.91 lb/lb-mole

where CO_2: 0.71 %vd
O_2 19.87 %vd
N_2+CO= (100-(O_2+CO_2): 79.42 %vd

9) $M_s = M_d(1 - Bws) + (18 \text{ x } Bws) =$ 28.70 lb/lb-mole

where M_d: 28.91 lb/lb-mole
Bws: 0.0197

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 4.909 sq. ft.

where Stack ID: 30 inches

Stack Area(rect.) = stack width/12 x stack length/12 = NA sq. ft.

where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) Velocity, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \text{ x } Ms)}}\right) =$ 76.05 fps

where Cp: 0.84
Ave. Sqrt ΔP: 1.1701
Ts: 697.3 °A
Ps: 29.662 "Hg
Ms: 28.70 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 22,399.8 AWCFM

where V_s: 76.05 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 21,958.5 ADCFM

where AWCFM: 22,399.8
Bws: 0.0197

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92 \text{ "Hg}}\right) =$ 1,008,899.4 wscf/hr

where V_s: 76.05 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 697.3 °A
Ps: 29.662 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 989,024.1 dscf/hr

where wscf/hr: 1,008,899.4
Bws: 0.0197

16) DSCFM= (dscf/hr)/60 mins/hr = 16,483.7 DSCFM

where dscf/hr: 989,024.1

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000181 sq. ft.

where Nozzle Size: 0.1820 inches

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 104 **Date: 9/28/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.0 %

where Ts:	697.3	°A
Vm(Std):	72.914	dscf
Ps:	29.662	"Hg
Vs	76.05	ft/sec
Nozzle Area:	0.000181	sq. ft.
Sampling Time:	120	min.
Bws:	0.0197	

EPA Method 13B:

19) Fluoride laboratory results < 30.0 µg/sample

20) Fluoride = (µg/sample)/1,000,000 = < 3.00E-05 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 6.35E-06 gr/dscf

where Sample:	0.00003	grams
Vm(std)	72.914	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 14.53 µg/dscm

where Sample:	0.00003	grams
Vm(std)	2.065	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 513.228 Vol./Mole

where Ts:	697.3	°A
Ps:	29.662	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.84E-02 ppmvd

where MW:	19.0	g/mol
lb/hr:	0.00	
Vol./Mole:	513.228	
ADCFM:	21958.5	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 8.97E-04 lb/hr

where Cs:	6.35E-06	gr/dscf
Stack Flow:	989,024.1	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**Glass Plant 1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 104**
DATE	**09/28/18**
METHOD	**26A**
POLLUTANT	**HF**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**14:05**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**16:10**
EPA Method:	**26A**	Clear 75 F 2-4 E	**Date:**	**9/28/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1349999	Liner type	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size	0.2173 inches
$\Delta H@$	1.846	Hot box ID	HB3	Nozzle area	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat	250 F
				Filter heat	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.90 %
Static Pressure	-0.78 "H_2O	CO_2	0.70 %
Ave. ΔP	1.4 "H_2O	Rec. Nz.	0.196 inches
Stack Temperature	230 F		
Assumed moisture	1.5 %		
Assumed meter temp.	86 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	15	10

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN#2

Post Test Calculations:

Sample volume	113.010 dcf	Ave. ΔP	1.508 "H_2O
Wet mol. weight	28.71 M_s (actual)	Ave. $\sqrt{\Delta P}$	1.2272 "H_2O
Actual H_2O	1.82 %	Ave. ΔH	2.917 "H_2O
Std. meter vol.	110.105 dscf	Ave. T_s	235.3 °F
Isokinetic Average	100.8 %	Ave. T_m	82.4 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	216	16.0
Silica gel, g	242.0	269.4	27.4
		Total water gain:	43.4

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.820	1.60	220	79	3.11	3.10	3	253	63
2	10.0	9.550	1.50	232	79	2.86	2.90	3	253	57
3	15.0	14.250	1.50	233	80	2.87	2.90	3	252	58
4	20.0	18.920	1.50	234	80	2.86	2.90	3	252	58
5	25.0	23.640	1.60	235	81	3.05	3.10	3	251	59
6	30.0	28.430	1.60	235	81	3.05	3.10	3	250	61
7	35.0	33.400	1.60	235	81	3.05	3.10	3	250	61
8	40.0	38.260	1.60	236	81	3.05	3.10	3	250	61
9	45.0	42.950	1.50	235	82	2.87	2.90	4	250	62
10	50.0	47.460	1.40	236	82	2.67	2.70	4	252	63
11	55.0	52.050	1.40	236	82	2.67	2.70	4	252	63
12	60.0	56.323	1.20	235	83	2.30	2.30	4	252	63
13	65.0	61.170	1.60	235	83	3.07	3.10	4	251	68
14	70.0	66.080	1.60	235	83	3.07	3.10	4	248	64
15	75.0	70.990	1.60	236	83	3.06	3.10	4	248	59
16	80.0	75.800	1.60	237	83	3.06	3.10	4	248	59
17	85.0	80.640	1.60	237	84	3.06	3.10	4	248	55
18	90.0	85.450	1.60	237	83	3.06	3.10	4	250	56
19	95.0	90.250	1.60	238	84	3.06	3.10	4	250	56
20	100.0	95.000	1.50	239	84	2.86	2.90	4	250	56
21	105.0	99.720	1.50	239	85	2.87	2.90	4	250	57
22	110.0	104.240	1.40	238	85	2.68	2.70	4	250	59
23	115.0	108.800	1.30	238	85	2.49	2.50	4	251	59
24	120.0	113.010	1.30	236	85	2.50	2.50	4	251	59

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**2**
Location:	**Corvallis, OR**		**Start Time:**	**16:25**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:31**
EPA Method:	**26A**	Clear 75 F 2-4 E	**Date:**	**9/28/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	30.000	in
Rectangular		
Width		in
Length		in
Stack Area	4.909	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1349999	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	HB3	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.9 %
Static Pressure	-0.78 "H_2O	CO_2	0.7 %
Ave. ΔP	1.4 "H_2O	Rec. Nz.	0.197 inches
Stack Temperature	230 F		
Assumed moisture	1.82 %		
Assumed meter temp.	82.4 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	11	8

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN#2

Post Test Calculations:

Sample volume	112.623 dcf	Ave. ΔP	1.471 "H_2O
Wet mol. weight	28.73 M_s (actual)	Ave. √ΔP	1.2116 "H_2O
Actual H_2O	1.68 %	Ave. ΔH	2.858 "H_2O
Std. meter vol.	109.050 dscf	Ave. T_s	231.5 °F
Isokinetic Average	100.7 %	Ave. T_m	85.7 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	280.0	305.6	25.6
		Total water gain:	39.6

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.750	1.50	236	85	2.87	2.90	4	252	65
2	10.0	9.480	1.50	237	85	2.86	2.90	4	256	58
3	15.0	14.210	1.50	237	85	2.86	3.10	4	254	56
4	20.0	19.070	1.60	238	85	3.05	3.10	4	254	56
5	25.0	24.020	1.60	238	85	3.05	3.10	4	251	55
6	30.0	28.820	1.60	238	85	3.05	3.10	4	251	55
7	35.0	33.690	1.60	239	85	3.04	3.10	4	251	55
8	40.0	38.720	1.70	241	87	3.24	3.30	4	251	55
9	45.0	43.460	1.50	240	87	2.86	2.90	4	251	55
10	50.0	48.360	1.60	240	87	3.05	3.10	4	251	58
11	55.0	52.980	1.40	240	87	2.67	2.70	4	250	59
12	60.0	57.426	1.30	236	87	2.49	2.50	4	251	60
13	65.0	62.000	1.40	236	87	2.69	2.70	4	252	60
14	70.0	66.730	1.50	236	86	2.87	2.90	4	252	60
15	75.0	71.450	1.50	228	86	2.91	2.90	4	252	60
16	80.0	76.160	1.50	226	86	2.91	2.90	4	252	62
17	85.0	80.880	1.50	225	86	2.92	2.90	4	252	62
18	90.0	85.620	1.50	224	86	2.92	2.90	4	252	62
19	95.0	90.320	1.50	223	86	2.93	2.90	4	252	62
20	100.0	94.920	1.40	222	86	2.74	2.70	4	252	62
21	105.0	99.570	1.40	221	85	2.73	2.70	4	252	49
22	110.0	104.000	1.30	220	85	2.54	2.50	4	252	49
23	115.0	108.320	1.20	218	85	2.35	2.40	4	252	49
24	120.0	112.623	1.20	217	83	2.35	2.40	4	252	49

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**18:45**
Source:	**CFU 104**	**Environmental Conditions/Test Notes:**	**End Time:**	**20:49**
EPA Method:	**26A**	Clear 75 F 2-4 E	**Date:**	**9/28/2018**
Box Operator:	**CMF**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular	
Diameter	30.000 in
Rectangular	
Width	in
Length	in
Stack Area	4.909 sq.ft.

Equipment:

Meterbox ID	12	Probe ID	1349999	Liner type:	Glass
Y factor	1.0008	Nozzle ID	0.217	Nozzle size:	0.2173 inches
ΔH@	1.846	Hot box ID	HB3	Nozzle area:	0.000258 sq.ft.
		Pitot Cp	0.84	Probe heat:	250 F
				Filter heat:	250 F

Source Information:

Barometric Pressure	29.72 "Hg	O_2	19.9 %
Static Pressure	-0.78 "H_2O	CO_2	0.7 %
Ave. ΔP	1.4 "H_2O	Rec. Nz.	0.197 inches
Stack Temperature	230 F		
Assumed moisture	1.68 %		
Assumed meter temp.	85.7 F		
Total number of points	24		
Time per point	5		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.000	0.000
Leak check vacuum, "Hg:	10	6

Nozzle check for roundness:

1	2	3
0.217	0.217	0.218 inches
	Caliper ID#	MN#2

Post Test Calculations:

Sample volume	110.450 dcf	Ave. ΔP	1.442 "H_2O
Wet mol. weight	28.74 M_s (actual)	Ave. √ΔP	1.1995 "H_2O
Actual H_2O	1.57 %	Ave. ΔH	2.8 "H_2O
Std. meter vol.	108.806 dscf	Ave. T_s	210.6 °F
Isokinetic Average	99.8 %	Ave. T_m	76.3 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	212	12.0
Silica gel, g	263.2	288	24.8
		Total water gain:	36.8

Traverse Point	Time (min.)	Meter Volume (dcf) 0.000	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	5.0	4.600	1.40	212	81	2.76	2.80	4	253	61
2	10.0	9.260	1.50	214	81	2.95	2.90	4	252	56
3	15.0	13.990	1.50	214	80	2.94	2.90	4	250	57
4	20.0	18.690	1.50	213	80	2.94	2.90	4	252	58
5	25.0	23.360	1.50	213	80	2.94	2.90	4	252	58
6	30.0	28.050	1.50	210	80	2.96	3.00	4	252	58
7	35.0	32.750	1.50	210	80	2.96	3.00	4	250	58
8	40.0	37.300	1.40	210	77	2.74	2.70	4	249	59
9	45.0	42.000	1.50	210	77	2.94	2.90	4	251	59
10	50.0	46.590	1.40	210	76	2.74	2.70	4	251	59
11	55.0	50.950	1.30	210	76	2.54	2.50	4	250	59
12	60.0	54.968	1.00	211	76	1.95	2.00	4	250	59
13	65.0	59.510	1.40	211	76	2.74	2.70	4	250	59
14	70.0	64.180	1.50	210	75	2.93	2.90	4	250	59
15	75.0	68.840	1.50	209	75	2.93	2.90	4	254	57
16	80.0	73.510	1.50	210	75	2.93	2.90	4	247	58
17	85.0	78.160	1.50	209	75	2.93	2.90	4	247	58
18	90.0	82.840	1.50	209	74	2.93	2.90	4	247	58
19	95.0	87.690	1.60	210	74	3.12	3.10	4	247	58
20	100.0	92.480	1.60	210	74	3.12	3.10	4	247	58
21	105.0	97.000	1.40	210	73	2.72	2.70	4	251	59
22	110.0	101.530	1.40	210	73	2.72	2.70	4	254	59
23	115.0	106.100	1.40	210	72	2.72	2.70	4	247	60
24	120.0	110.450	1.30	210	72	2.52	2.50	4	247	61

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**14:05**
Source:	**CFU 104**	**End Time:**	**16:10**
Method:	**26A**	**Date:**	**9/28/2018**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m °F**	**Traverse Point**	**Dp "H_2O**	**Stack T_s °F**	**$\sqrt{Dp}$**
	0.000						
5	4.820	3.10	79	1	1.60	220	1.2649
10	9.550	2.90	79	2	1.50	232	1.2247
15	14.250	2.90	80	3	1.50	233	1.2247
20	18.920	2.90	80	4	1.50	234	1.2247
25	23.640	3.10	81	5	1.60	235	1.2649
30	28.430	3.10	81	6	1.60	235	1.2649
35	33.400	3.10	81	7	1.60	235	1.2649
40	38.260	3.10	81	8	1.60	236	1.2649
45	42.950	2.90	82	9	1.50	235	1.2247
50	47.460	2.70	82	10	1.40	236	1.1832
55	52.050	2.70	82	11	1.40	236	1.1832
60	56.323	2.30	83	12	1.20	235	1.0954
65	61.170	3.10	83	13	1.60	235	1.2649
70	66.080	3.10	83	14	1.60	235	1.2649
75	70.990	3.10	83	15	1.60	236	1.2649
80	75.800	3.10	83	16	1.60	237	1.2649
85	80.640	3.10	84	17	1.60	237	1.2649
90	85.450	3.10	83	18	1.60	237	1.2649
95	90.250	3.10	84	19	1.60	238	1.2649
100	95.000	2.90	84	20	1.50	239	1.2247
105	99.720	2.90	85	21	1.50	239	1.2247
110	104.240	2.70	85	22	1.40	238	1.1832
115	108.800	2.50	85	23	1.30	238	1.1402
120	113.010	2.50	85	24	1.30	236	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	113.010	dcf	Rectangular		
Water Volume	43.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.71	%vd
Static Pressure	-0.78	"H_2O	O_2 Average	19.87	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.917	"H_2O	$\sqrt{Dp}$	1.2272	"H_2O
Temperature, T_m	82.4	^oF	Temperature, T_s	235.3	^oF
Temperature, T_m	542.4	^oA (^oR)	Temperature, T_s	695.3	^oA (R)
Pressure Meter, P_m	29.934	"Hg	Pressure Stack, P_s	29.663	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	110.105	dscf	Velocity, V_s	79.63	fps
	3.118	dscm	Volume (actual)	23,454.2	awcfm
Actual Volume, $V_{m(actual)}$	149.019	awcf		23,027.3	adcfm
Gas Stream Moisture			Volume (standard)	1,059,467.0	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.042	scf		1,040,184.7	dscf/hr
Moisture, B_{ws}	0.0182			17,336.4	dscf/min
Moisture EPA M4	1.82	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	511.739	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.71	lb/lb-mole			
Percent Isokinetic	100.8	%			

Laboratory Results

HF	< 3.95	µg/sample		
HF	< 3.95E-06	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	< 5.54E-07	gr/dscf
	< 1.27	µg/dscm
	< 1.52E-03	ppmvd
Mass Emissions HF	< 8.23E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**16:25**
Source:	**CFU 104**	**End Time:**	**18:31**
Method:	**26A**	**Date:**	**09/28/18**

Sampling Data				Traverse Data			
Time min.	Meter ft^3	ΔH "H_2O	Meter T_m °F	Traverse Point	Dp "H_2O	Stack T_s °F	$\sqrt{Dp}$
	0.000						
5	4.750	2.90	85	1	1.50	236	1.2247
10	9.480	2.90	85	2	1.50	237	1.2247
15	14.210	3.10	85	3	1.50	237	1.2247
20	19.070	3.10	85	4	1.60	238	1.2649
25	24.020	3.10	85	5	1.60	238	1.2649
30	28.820	3.10	85	6	1.60	238	1.2649
35	33.690	3.10	85	7	1.60	239	1.2649
40	38.720	3.30	87	8	1.70	241	1.3038
45	43.460	2.90	87	9	1.50	240	1.2247
50	48.360	3.10	87	10	1.60	240	1.2649
55	52.980	2.70	87	11	1.40	240	1.1832
60	57.426	2.50	87	12	1.30	236	1.1402
65	62.000	2.70	87	13	1.40	236	1.1832
70	66.730	2.90	86	14	1.50	236	1.2247
75	71.450	2.90	86	15	1.50	228	1.2247
80	76.160	2.90	86	16	1.50	226	1.2247
85	80.880	2.90	86	17	1.50	225	1.2247
90	85.620	2.90	86	18	1.50	224	1.2247
95	90.320	2.90	86	19	1.50	223	1.2247
100	94.920	2.70	86	20	1.40	222	1.1832
105	99.570	2.70	85	21	1.40	221	1.1832
110	104.000	2.50	85	22	1.30	220	1.1402
115	108.320	2.40	85	23	1.20	218	1.0954
120	112.623	2.40	83	24	1.20	217	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	112.623	dcf	Rectangular		
Water Volume	39.6	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.72	%vd
Static Pressure	-0.78	"H_2O	O_2 Average	19.83	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.858	"H_2O	√Dp	1.2116	"H_2O
Temperature, T_m	85.7	^oF	Temperature, T_s	231.5	^oF
Temperature, T_m	545.7	^oA (^oR)	Temperature, T_s	691.5	^oA (R)
Pressure Meter, P_m	29.930	"Hg	Pressure Stack, P_s	29.663	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	109.050	dscf	Velocity, V_s	78.37	fps
	3.088	dscm	Volume (actual)	23,083.1	awcfm
Actual Volume, $V_{m(actual)}$	146.576	awcf		22,695.3	adcfm
Gas Stream Moisture			Volume (standard)	1,048,432.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.864	scf		1,030,819.1	dscf/hr
Moisture, B_{ws}	0.0168			17,180.3	dscf/min
Moisture EPA M4	1.68	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	508.942	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.73	lb/lb-mole			
Percent Isokinetic	100.7	%			

Laboratory Results

HF	< 3.58	µg/sample			
HF	< 3.58E-06	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	< 5.07E-07	gr/dscf
	< 1.16	µg/dscm
	< 1.39E-03	ppmvd
Mass Emissions HF	< 7.46E-05	lb/hr

"<" represents MDL value

Isokinetic Field Data
Field Data and Calculations
Emissions and Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**18:45**
Source:	**CFU 104**	**End Time:**	**20:49**
Method:	**26A**	**Date:**	**09/28/18**

Sampling Data				**Traverse Data**			
Time min.	**Meter ft^3**	**ΔH "H_2O**	**Meter T_m ^oF**	**Traverse Point**	**Dp "H_2O**	**Stack T_s ^oF**	**$\sqrt{Dp}$**
	0.000						
5	4.600	2.80	81	1	1.40	212	1.1832
10	9.260	2.90	81	2	1.50	214	1.2247
15	13.990	2.90	80	3	1.50	214	1.2247
20	18.690	2.90	80	4	1.50	213	1.2247
25	23.360	2.90	80	5	1.50	213	1.2247
30	28.050	3.00	80	6	1.50	210	1.2247
35	32.750	3.00	80	7	1.50	210	1.2247
40	37.300	2.70	77	8	1.40	210	1.1832
45	42.000	2.90	77	9	1.50	210	1.2247
50	46.590	2.70	76	10	1.40	210	1.1832
55	50.950	2.50	76	11	1.30	210	1.1402
60	54.968	2.00	76	12	1.00	211	1.0000
65	59.510	2.70	76	13	1.40	211	1.1832
70	64.180	2.90	75	14	1.50	210	1.2247
75	68.840	2.90	75	15	1.50	209	1.2247
80	73.510	2.90	75	16	1.50	210	1.2247
85	78.160	2.90	75	17	1.50	209	1.2247
90	82.840	2.90	74	18	1.50	209	1.2247
95	87.690	3.10	74	19	1.60	210	1.2649
100	92.480	3.10	74	20	1.60	210	1.2649
105	97.000	2.70	73	21	1.40	210	1.1832
110	101.530	2.70	73	22	1.40	210	1.1832
115	106.100	2.70	72	23	1.40	210	1.1832
120	110.450	2.50	72	24	1.30	210	1.1402

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 104**	**Date:**	**09/28/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	30.000	in
Meter Volume, V_m	110.450	dcf	Rectangular		
Water Volume	36.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.2173	in.	Length		in
Nozzle Area	0.000258	sq.ft.	Stack Area	4.909	sq.ft.

Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.72	"Hg	CO_2 Average	0.72	%vd
Static Pressure	-0.78	"H_2O	O_2 Average	19.82	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0008	Y			

Field Data Averages

Meter			Stack		
ΔH	2.800	"H_2O	$\sqrt{Dp}$	1.1995	"H_2O
Temperature, T_m	76.3	^oF	Temperature, T_s	210.6	^oF
Temperature, T_m	536.3	^oA (^oR)	Temperature, T_s	670.6	^oA (R)
Pressure Meter, P_m	29.926	"Hg	Pressure Stack, P_s	29.663	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	108.806	dscf	Velocity, V_s	76.40	fps
	3.081	dscm	Volume (actual)	22,502.9	awcfm
Actual Volume, $V_{m(actual)}$	141.669	awcf		22,149.6	adcfm
Gas Stream Moisture			Volume (standard)	1,053,932.4	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.732	scf		1,037,385.7	dscf/hr
Moisture, B_{ws}	0.0157			17,289.8	dscf/min
Moisture EPA M4	1.57	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	493.559	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.74	lb/lb-mole			
Percent Isokinetic	99.8	%			

Laboratory Results

HF	< 3.69	µg/sample			
HF	< 3.69E-06	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	< 5.23E-07	gr/dscf
	< 1.20	µg/dscm
	< 1.44E-03	ppmvd
Mass Emissions HF	< 7.75E-05	lb/hr

"<" represents MDL value

EPA Method 26A
Laboratory Results
HF

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 104**

Lab ID	Sample ID	Sample Date		Result	MDL	Sample Vol. (ml)	Units
18-S2347	Cont. 3 Run 1	9/28/2018	<	MDL	3.95	375.0	µg/sample
18-S2348	Cont. 3 Run 2	9/28/2018	<	MDL	3.58	340.0	µg/sample
18-S2349	Cont. 3 Run 3	9/28/2018	<	MDL	3.69	350.0	µg/sample
18-S2221	0.1N H2SO4 Blank	9/11/2018	<	MDL	4.45	423.0	µg/sample

*If sample results are below MDL, MDL value is shown. A "<" sign designates less than MDL.
If blank values are below MDL, no blank corrections are performed.

EPA Method 26A
Results Summary

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 104

Run			1		2		3		Average
Date			9/28/2018		9/28/2018		9/28/2018		
Run Start Time			14:05		16:25		18:45		
Run End Time			16:10		18:31		20:49		
Duration, min.			120		120		120		
Barometric Pressure, "Hg			29.72		29.72		29.72		**29.72**
Nozzle Dia., in.			0.2173		0.2173		0.2173		**0.2173**
Isokinetic Average, %			100.8		100.7		99.8		**100.4**
Sample Volume, dscf			110.105		109.050		108.806		**109.320**
Sample Volume, dscm			3.118		3.088		3.081		**3.096**
Stack Diameter, in.			30.00		30.00		30.00		**30.00**
Stack Area, sq.ft.			4.909		4.909		4.909		**4.909**
CO_2 %vd			0.71		0.72		0.72		**0.72**
O_2 %vd			19.87		19.83		19.82		**19.84**
Static Press., "H_2O			-0.78		-0.78		-0.78		**-0.78**
H_2O %v			1.82		1.68		1.57		**1.69**
Wet Molecular Weight, lb/lb-mole			28.71		28.73		28.74		**28.73**
Velocity, FPS			79.63		78.37		76.40		**78.13**
ADCFM			23,027.3		22,695.3		22,149.6		**22,624.1**
AWCFM			23,454.2		23,083.1		22,502.9		**23,013.4**
DSCFM			17,336.4		17,180.3		17,289.8		**17,268.8**
Stack Temperature, ^oF			235.3		231.5		210.6		**225.8**
HF	Concentration, C_s	gr/dscf	<	5.54E-07	<	5.07E-07	<	5.23E-07	< **5.28E-07**
		µg/dscm	<	1.27	<	1.16	<	1.20	< **1.21**
		ppmvd	<	1.52E-03	<	1.39E-03	<	1.44E-03	< **1.45E-03**
	Mass	lb/hr	<	8.23E-05	<	7.46E-05	<	7.75E-05	< **7.81E-05**
		lb/lb glass	<	2.24E-07	<	2.05E-07	<	2.08E-07	< **2.12E-07**
Production Data	Glass Production	lbs/hr		367.4		363.5		373.0	**368.0**

"<" represents MDL value

EPA Methods 1-4, 26A
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**14:05**
Source:	**CFU 104**	**End Time:**	**16:10**
Method:	**26A**	**Date:**	**9/28/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.934 "Hg

where Pb: 29.72 "Hg

ΔH: 2.917 "H_2O

2) $Ps = Pb + (\text{Static Press.}/13.6) =$ 29.663 "Hg

where Pb: 29.72 "Hg

Static Press.: -0.78 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 110.105 dscf

where Vm: 113.010 dcf

Y: 1.0008

Pm: 29.934 "Hg

Tm: 542.4 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.042 scf

where H_2O: 43.40 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0182

where Vw(std): 2.042 scf

Vm(std): 110.105 dscf

6) % H_2O = Bws x 100 = 1.82 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 149.019 awcf

where Y: 1.0008

Vm: 113.0099 dcf

Bws: 0.0182

Ts: 695.3 °A

Tm: 542.4 °A

Pm: 29.934 "Hg

Ps: 29.663 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.91 lb/lb-mole

where CO_2: 0.71 %vd

O_2 19.87 %vd

N_2+CO= (100-(O_2+CO_2): 79.42 %vd

9) $M_s = M_d(1 - Bws) + (18 \times Bws) =$ 28.71 lb/lb-mole

where M_d: 28.91 lb/lb-mole
Bws: 0.0182

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 4.909 sq. ft.

where Stack ID: 30 inches

Stack Area(rect.) = stack width/12 x stack length/12 = NA sq. ft.

where Stack Width: 0.000 inches
Stack Length: 0.000 inches

11) Velocity, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 79.63 fps

where Cp: 0.84
Ave. Sqrt ΔP: 1.2272
Ts: 695.3 °A
Ps: 29.663 "Hg
Ms: 28.71 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 23,454.2 AWCFM

where V_s: 79.63 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 23,027.3 ADCFM

where AWCFM: 23,454.2
Bws: 0.0182

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\text{ "Hg}}\right) =$ 1,059,467.0 wscf/hr

where V_s: 79.63 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 695.3 °A
Ps: 29.663 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,040,184.7 dscf/hr

where wscf/hr: 1,059,467.0
Bws: 0.0182

16) DSCFM= (dscf/hr)/60 mins/hr = 17,336.4 DSCFM

where dscf/hr: 1,040,184.7

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000258 sq. ft.

where Nozzle Size: 0.2173 inches

Client: Hollingsworth & Vose	Run: 1
Source: CFU 104	Date: 9/28/2018

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.8 %

where Ts:	695.3	°A
Vm(Std):	110.105	dscf
Ps:	29.663	"Hg
Vs	79.63	ft/sec
Nozzle Area:	0.000258	sq. ft.
Sampling Time:	120	min.
Bws:	0.0182	

EPA Method 26A:

19) HF laboratory results < 3.95 µg/sample

20) HF = (µg/sample)/1,000,000 = < 3.95E-06 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 5.54E-07 gr/dscf

where Sample:	0.00000	grams
Vm(std)	110.105	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 1.27 µg/dscm

where Sample:	0.00000	grams
Vm(std)	3.118	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 511.739 Vol./Mole

where Ts:	695.3	°A
Ps:	29.663	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.52E-03 ppmvd

where MW:	20.01	g/mol
lb/hr:	0.00	
Vol./Mole:	511.739	
ADCFM:	23027.3	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 8.23E-05 lb/hr

where Cs:	5.54E-07	gr/dscf
Stack Flow:	1,040,184.7	dscf/hr

09/28 2 OF 2

Daily Gaseous Calibrations Log

Client:

Source: CFU-104 ... 13B/26A/3A

Date: 09-28-18

Test Technician: DSB

Leak check:

Vacuum "	Rate	Pass

Method 205*			
Target	X	Direct	X
10		0	
5		10	
10		0	
5		10	
10		0	
5		10	

*Use of a calibrated instrument required

see 9-11

Direct Analyzer Calibrations									
O2 %		NOx		CO		CO2		NO2	
Target	x	Target	x	Target	X	Target	X	Target	X

See Page 1

System Calibrations									
O2 %		NOx		CO		CO2		NO2	
Target	x	Target	x	Target	X	Target	X	Target	X
~~0~~						~~0~~	X		
10						2	X		

System VOC Calibrations		
	Initial target	Post Target
Zero		
Low		
Mid		
High		

Stratification test during run #1

Test Times: R-1 14:05-16:11 R-2 16:25-18:30 R-3 18:45-20:50

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-104**
Facility	**Glass Plant 1**	Date	**September 28, 2018**
Location	**Corvallis, OR**		

Run	1	2	3	
Date	9/28/2018	9/28/2018	9/28/2018	
Run Start Time	14:05	16:25	18:45	
Run End Time	16:11	18:30	20:50	
Duration, min.	120	120	120	
CO_2 %vd	0.71	0.72	0.72	0.72
O_2 %vd	19.87	19.83	19.82	19.84

Bison Engineering, Inc.
Method 3A Oxygen
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-104**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 28, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			*Final Values*									
		Analyzer Cal. Response	System Cal Response	Pre test System Cal. Bias % of span	Pre test System Cal. Bias pass/fail	System Cal Response	Post test System Cal. Bias % of span	Post test System Cal. Bias pass/fail	System Drift % of span	System Drift pass/fail	Analyzer Span	Raw Avg Gas Conc	Corrected Gas Conc	Instrument Cal. Reference Gas
Run 1	zero	0.00	0.04	0.20	pass	0.08	0.40	pass	0.20	pass				
	upscale	9.92	9.98	0.30	pass	10.00	0.40	pass	0.10	pass	20	19.79	19.87	10
Run 2	zero	0.00	0.08	0.40	pass	0.08	0.40	pass	0.00	pass				
	upscale	9.92	10.00	0.40	pass	10.01	0.45	pass	0.05	pass	20	19.76	19.83	10
Run 3	zero	0.00	0.08	0.40	pass	0.09	0.45	pass	0.05	pass				
	upscale	9.92	10.01	0.45	pass	10.01	0.45	pass	0.00	pass	20	19.76	19.82	10
				< 5%*			< 5%*		< 3%*					

ANALYZER CAL. ERROR	Zero	Mid	High
Calibration gas standards	0	10	20
Cal gas analyzer response	0	9.92	20.01
Analyzer Cal. Error	0.00	-0.40	0.05
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

Bison Engineering, Inc.
Method 3A CO2
Calibration Error, System Bias and System Drift

Company:	**Hollingsworth & Vose**	Source	**CFU-104**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**September 28, 2018**	Instrument Model:	**1440**
Location:	**Corvallis, OR**			Instrument Serial #:	**01440D1-5041**

			Initial Values			***Final Values***								
		Analyzer Cal. Response	**System Cal Response**	**Pre test System Cal. Bias % of span**	**Pre test System Cal. Bias pass/fail**	**System Cal Response**	**Post test System Cal. Bias % of span**	**Post test System Cal. Bias pass/fail**	**System Drift % of span**	**System Drift pass/fail**	**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
Run 1	zero	0.02	0.06	1.00	pass	0.05	0.75	pass	-0.25	pass				
	upscale	1.90	1.87	-0.75	pass	1.87	-0.75	pass	0.00	pass	4	0.70	0.71	2
Run 2	zero	0.02	0.05	0.75	pass	0.05	0.75	pass	0.00	pass				
	upscale	1.90	1.87	-0.75	pass	1.84	-1.50	pass	-0.75	pass	4	0.70	0.72	2
Run 3	zero	0.02	0.05	0.75	pass	0.07	1.25	pass	0.50	pass				
	upscale	1.90	1.84	-1.50	pass	1.87	-0.75	pass	0.75	pass	4	0.71	0.72	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.02	1.9	4.14
Analyzer Cal. Error	0.50	-2.50	3.50
Analyzer Cal. Error < 2%*	pass	pass	pass

***Or < 0.5 ppm absolute difference**

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**14:05**
Source:	**CFU-104**	**End Time:**	**16:11**
Method:	**3A**	**Date:**	**9/28/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.40 %v

where C_{Dir}:	9.92	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.30 %v

where C_{Dir}:	9.92	ppmv
C_S:	9.98	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.10 %v

where SB_{Final}:	0.40	ppmv
SB_i:	0.30	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.87 ppmv

where C_{Avg}:	19.79	ppmv
C_O:	0.06	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.99	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**14:05**
Source:	**CFU-104**	**End Time:**	**16:11**
Method:	**3A**	**Date:**	**9/28/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -2.50 %v

where C_{Dir}:	1.90	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.75 %v

where C_{Dir}:	1.90	ppmv
C_S:	1.87	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = \mid SB_{Final} - SB_i \mid =$ 0.00 %v

where SB_{Final}:	-0.75	ppmv
SB_i:	-0.75	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.71 ppmv

where C_{Avg}:	0.70	ppmv
C_O:	0.06	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.87	ppmv

Hollingswoth & Vose
CFU 104
Run #1

Date	Time	O2 [%]	CO2 [%]
9/28/2018	14:05:31	19.77	0.69
9/28/2018	14:06:31	19.78	0.69
9/28/2018	14:07:31	19.78	0.69
9/28/2018	14:08:31	19.78	0.69
9/28/2018	14:09:31	19.78	0.69
9/28/2018	14:10:31	19.78	0.69
9/28/2018	14:11:31	19.79	0.69
9/28/2018	14:12:31	19.78	0.70
9/28/2018	14:13:31	19.79	0.70
9/28/2018	14:14:31	19.78	0.70
9/28/2018	14:15:31	19.79	0.71
9/28/2018	14:16:31	19.78	0.71
9/28/2018	14:17:31	19.79	0.70
9/28/2018	14:18:31	19.79	0.70
9/28/2018	14:19:31	19.78	0.70
9/28/2018	14:20:31	19.79	0.70
9/28/2018	14:21:31	19.78	0.70
9/28/2018	14:22:31	19.79	0.70
9/28/2018	14:23:31	19.78	0.70
9/28/2018	14:24:31	19.78	0.70
9/28/2018	14:25:31	19.78	0.69
9/28/2018	14:26:31	19.79	0.69
9/28/2018	14:27:31	19.79	0.69
9/28/2018	14:28:31	19.79	0.69
9/28/2018	14:29:31	19.79	0.69
9/28/2018	14:30:31	19.80	0.68
9/28/2018	14:31:31	19.80	0.69
9/28/2018	14:32:31	19.80	0.69
9/28/2018	14:33:31	19.80	0.69
9/28/2018	14:34:31	19.80	0.69
9/28/2018	14:35:31	19.80	0.69
9/28/2018	14:36:31	19.79	0.69
9/28/2018	14:37:31	19.79	0.70
9/28/2018	14:38:31	19.80	0.70
9/28/2018	14:39:31	19.79	0.70
9/28/2018	14:40:31	19.79	0.70
9/28/2018	14:41:31	19.79	0.71
9/28/2018	14:42:31	19.79	0.71
9/28/2018	14:43:31	19.80	0.70
9/28/2018	14:44:31	19.79	0.70
9/28/2018	14:45:31	19.79	0.70

Hollingswoth & Vose
CFU 104
Run #1

Date	Time	O2 [%]	CO2 [%]
9/28/2018	14:46:31	19.80	0.70
9/28/2018	14:47:31	19.79	0.70
9/28/2018	14:48:31	19.79	0.70
9/28/2018	14:49:31	19.79	0.69
9/28/2018	14:50:31	19.79	0.69
9/28/2018	14:51:31	19.79	0.69
9/28/2018	14:52:31	19.79	0.69
9/28/2018	14:53:31	19.79	0.69
9/28/2018	14:54:31	19.79	0.68
9/28/2018	14:55:31	19.79	0.69
9/28/2018	14:56:31	19.79	0.69
9/28/2018	14:57:31	19.79	0.69
9/28/2018	14:58:31	19.79	0.69
9/28/2018	14:59:31	19.79	0.69
9/28/2018	15:00:31	19.79	0.69
9/28/2018	15:01:31	19.79	0.70
9/28/2018	15:02:31	19.79	0.70
9/28/2018	15:03:31	19.80	0.70
9/28/2018	15:04:31	19.81	0.70
9/28/2018	15:05:31	19.80	0.70
9/28/2018	15:06:31	19.79	0.70
9/28/2018	15:07:31	19.80	0.70
9/28/2018	15:08:31	19.80	0.70
9/28/2018	15:09:31	19.80	0.70
9/28/2018	15:10:31	19.80	0.70
9/28/2018	15:11:31	19.79	0.70
9/28/2018	15:12:31	19.80	0.69
9/28/2018	15:13:31	19.79	0.69
9/28/2018	15:14:31	19.79	0.69
9/28/2018	15:15:31	19.79	0.69
9/28/2018	15:16:31	19.79	0.69
9/28/2018	15:17:31	19.79	0.69
9/28/2018	15:18:31	19.79	0.69
9/28/2018	15:19:31	19.79	0.69
9/28/2018	15:20:31	19.79	0.69
9/28/2018	15:21:31	19.79	0.69
9/28/2018	15:22:31	19.78	0.69
9/28/2018	15:23:31	19.79	0.69
9/28/2018	15:24:31	19.79	0.70
9/28/2018	15:25:31	19.79	0.69
9/28/2018	15:26:31	19.79	0.70

Hollingswoth & Vose
CFU 104
Run #1

Date	Time	O2 [%]	CO2 [%]
9/28/2018	15:27:31	19.79	0.70
9/28/2018	15:28:31	19.79	0.71
9/28/2018	15:29:31	19.79	0.71
9/28/2018	15:30:31	19.79	0.70
9/28/2018	15:31:31	19.79	0.70
9/28/2018	15:32:31	19.79	0.70
9/28/2018	15:33:31	19.79	0.70
9/28/2018	15:34:31	19.79	0.70
9/28/2018	15:35:31	19.79	0.70
9/28/2018	15:36:31	19.79	0.70
9/28/2018	15:37:31	19.79	0.70
9/28/2018	15:38:31	19.79	0.69
9/28/2018	15:39:31	19.79	0.69
9/28/2018	15:40:31	19.79	0.69
9/28/2018	15:41:31	19.79	0.69
9/28/2018	15:42:31	19.79	0.69
9/28/2018	15:43:31	19.79	0.69
9/28/2018	15:44:31	19.79	0.69
9/28/2018	15:45:31	19.79	0.69
9/28/2018	15:46:31	19.80	0.69
9/28/2018	15:47:31	19.80	0.69
9/28/2018	15:48:31	19.80	0.69
9/28/2018	15:49:31	19.79	0.70
9/28/2018	15:50:31	19.79	0.70
9/28/2018	15:51:31	19.79	0.70
9/28/2018	15:52:31	19.79	0.70
9/28/2018	15:53:31	19.79	0.70
9/28/2018	15:54:31	19.79	0.70
9/28/2018	15:55:31	19.79	0.70
9/28/2018	15:56:31	19.79	0.70
9/28/2018	15:57:31	19.78	0.70
9/28/2018	15:58:31	19.79	0.70
9/28/2018	15:59:31	19.78	0.70
9/28/2018	16:00:31	19.78	0.70
9/28/2018	16:01:31	19.79	0.70
9/28/2018	16:02:31	19.78	0.69
9/28/2018	16:03:31	19.78	0.69
9/28/2018	16:04:31	19.77	0.69
9/28/2018	16:05:31	19.77	0.69
9/28/2018	16:06:31	19.77	0.69
9/28/2018	16:07:31	19.78	0.69

Hollingswoth & Vose
CFU 104
Run #1

Date	Time	O2 [%]	CO2 [%]
9/28/2018	16:08:31	19.77	0.69
9/28/2018	16:09:31	19.75	0.69
9/28/2018	16:10:31	19.77	0.69
Final Average		**19.79**	**0.70**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/28/2018	16:11:21	19.78	0.70
9/28/2018	16:11:31	19.80	0.70
9/28/2018	16:11:41	18.07	0.63
9/28/2018	16:11:51	7.49	0.29
9/28/2018	16:12:01	2.15	0.12
9/28/2018	16:12:11	0.67	0.06
9/28/2018	16:12:21	0.27	0.05
9/28/2018	16:12:31	0.16	0.05
9/28/2018	16:12:41	0.12	0.05
9/28/2018	16:12:51	0.10	0.06
9/28/2018	16:13:01	0.10	0.05
9/28/2018	16:13:11	0.09	0.05
9/28/2018	16:13:21	0.09	0.05
9/28/2018	16:13:31	0.08	0.05
9/28/2018	16:13:41	0.08	0.05
9/28/2018	16:13:51	0.08	0.05
9/28/2018	16:14:01	0.08	0.05
9/28/2018	16:14:11	0.08	0.05
9/28/2018	16:14:21	0.75	0.74
9/28/2018	16:14:31	1.61	1.50
9/28/2018	16:14:41	1.87	1.74
9/28/2018	16:14:51	1.95	1.81
9/28/2018	16:15:01	1.98	1.83
9/28/2018	16:15:11	1.99	1.85
9/28/2018	16:15:21	1.99	1.86
9/28/2018	16:15:31	1.99	1.86
9/28/2018	16:15:41	2.00	1.87
9/28/2018	16:15:51	2.00	1.87
9/28/2018	16:16:01	2.04	1.91
9/28/2018	16:16:11	5.88	6.28
9/28/2018	16:16:21	8.90	8.87
9/28/2018	16:16:31	9.69	9.52
9/28/2018	16:16:41	9.91	9.71
9/28/2018	16:16:51	9.98	9.77

Hollingswoth & Vose
CFU 104
Run #1

Date	Time	O2 [%]	CO2 [%]
9/28/2018	16:17:01	10.00	9.79
9/28/2018	16:17:11	10.00	9.80
9/28/2018	16:17:21	10.00	9.81
9/28/2018	16:17:31	10.01	9.82
9/28/2018	16:17:41	10.00	9.82
9/28/2018	16:17:51	11.83	7.99
9/28/2018	16:18:01	16.86	3.17
9/28/2018	16:18:11	18.86	1.41
9/28/2018	16:18:21	19.46	0.97
9/28/2018	16:18:31	19.65	0.82
9/28/2018	16:18:41	19.69	0.75
9/28/2018	16:18:51	19.72	0.75
9/28/2018	16:19:01	19.72	0.74
		O2 [%]	**CO2 [%]**
System Zero		**0.08**	**0.05**
System Span		**10.00**	**1.87**

Hollingswoth & Vose
CFU 104
Run #2

Date	Time	O2 [%]	CO2 [%]
9/28/2018	16:25:31	19.75	0.70
9/28/2018	16:26:31	19.75	0.71
9/28/2018	16:27:31	19.75	0.70
9/28/2018	16:28:31	19.76	0.70
9/28/2018	16:29:31	19.75	0.70
9/28/2018	16:30:31	19.75	0.69
9/28/2018	16:31:31	19.75	0.69
9/28/2018	16:32:31	19.75	0.69
9/28/2018	16:33:31	19.75	0.69
9/28/2018	16:34:31	19.74	0.69
9/28/2018	16:35:31	19.74	0.70
9/28/2018	16:36:31	19.75	0.70
9/28/2018	16:37:31	19.75	0.70
9/28/2018	16:38:31	19.74	0.70
9/28/2018	16:39:31	19.74	0.70
9/28/2018	16:40:31	19.74	0.70
9/28/2018	16:41:31	19.74	0.71
9/28/2018	16:42:31	19.74	0.70
9/28/2018	16:43:31	19.74	0.71
9/28/2018	16:44:31	19.75	0.70
9/28/2018	16:45:31	19.75	0.71
9/28/2018	16:46:31	19.75	0.70
9/28/2018	16:47:31	19.75	0.70
9/28/2018	16:48:31	19.75	0.70
9/28/2018	16:49:31	19.76	0.70
9/28/2018	16:50:31	19.75	0.70
9/28/2018	16:51:31	19.75	0.70
9/28/2018	16:52:31	19.75	0.69
9/28/2018	16:53:31	19.75	0.70
9/28/2018	16:54:31	19.75	0.69
9/28/2018	16:55:31	19.75	0.69
9/28/2018	16:56:31	19.75	0.69
9/28/2018	16:57:31	19.75	0.69
9/28/2018	16:58:31	19.75	0.69
9/28/2018	16:59:31	19.76	0.69
9/28/2018	17:00:31	19.76	0.69
9/28/2018	17:01:31	19.76	0.69
9/28/2018	17:02:31	19.76	0.69
9/28/2018	17:03:31	19.76	0.70
9/28/2018	17:04:31	19.75	0.70
9/28/2018	17:05:31	19.75	0.70

Hollingswoth & Vose
CFU 104
Run #2

Date	Time	O2 [%]	CO2 [%]
9/28/2018	17:06:31	19.76	0.70
9/28/2018	17:07:31	19.76	0.71
9/28/2018	17:08:31	19.76	0.71
9/28/2018	17:09:31	19.76	0.70
9/28/2018	17:10:31	19.77	0.70
9/28/2018	17:11:31	19.76	0.70
9/28/2018	17:12:31	19.76	0.70
9/28/2018	17:13:31	19.76	0.70
9/28/2018	17:14:31	19.76	0.70
9/28/2018	17:15:31	19.76	0.70
9/28/2018	17:16:31	19.76	0.70
9/28/2018	17:17:31	19.76	0.69
9/28/2018	17:18:31	19.75	0.70
9/28/2018	17:19:31	19.75	0.69
9/28/2018	17:20:31	19.75	0.69
9/28/2018	17:21:31	19.75	0.69
9/28/2018	17:22:31	19.76	0.69
9/28/2018	17:23:31	19.76	0.69
9/28/2018	17:24:31	19.75	0.69
9/28/2018	17:25:31	19.75	0.69
9/28/2018	17:26:31	19.75	0.69
9/28/2018	17:27:31	19.75	0.69
9/28/2018	17:28:31	19.76	0.69
9/28/2018	17:29:31	19.76	0.70
9/28/2018	17:30:31	19.76	0.70
9/28/2018	17:31:31	19.77	0.70
9/28/2018	17:32:31	19.76	0.71
9/28/2018	17:33:31	19.77	0.70
9/28/2018	17:34:31	19.76	0.70
9/28/2018	17:35:31	19.77	0.70
9/28/2018	17:36:31	19.76	0.70
9/28/2018	17:37:31	19.76	0.70
9/28/2018	17:38:31	19.76	0.70
9/28/2018	17:39:31	19.76	0.70
9/28/2018	17:40:31	19.76	0.70
9/28/2018	17:41:31	19.76	0.69
9/28/2018	17:42:31	19.77	0.69
9/28/2018	17:43:31	19.76	0.69
9/28/2018	17:44:31	19.76	0.69
9/28/2018	17:45:31	19.77	0.69
9/28/2018	17:46:31	19.77	0.69

Hollingswoth & Vose
CFU 104
Run #2

Date	Time	O2 [%]	CO2 [%]
9/28/2018	17:47:31	19.77	0.69
9/28/2018	17:48:31	19.76	0.69
9/28/2018	17:49:31	19.76	0.69
9/28/2018	17:50:31	19.76	0.69
9/28/2018	17:51:31	19.77	0.69
9/28/2018	17:52:31	19.77	0.69
9/28/2018	17:53:31	19.77	0.70
9/28/2018	17:54:31	19.76	0.70
9/28/2018	17:55:31	19.77	0.70
9/28/2018	17:56:31	19.76	0.71
9/28/2018	17:57:31	19.77	0.71
9/28/2018	17:58:31	19.77	0.71
9/28/2018	17:59:31	19.77	0.70
9/28/2018	18:00:31	19.77	0.71
9/28/2018	18:01:31	19.77	0.71
9/28/2018	18:02:31	19.77	0.70
9/28/2018	18:03:31	19.78	0.70
9/28/2018	18:04:31	19.78	0.70
9/28/2018	18:05:31	19.77	0.70
9/28/2018	18:06:31	19.77	0.70
9/28/2018	18:07:31	19.78	0.69
9/28/2018	18:08:31	19.77	0.69
9/28/2018	18:09:31	19.77	0.69
9/28/2018	18:10:31	19.77	0.69
9/28/2018	18:11:31	19.77	0.69
9/28/2018	18:12:31	19.78	0.69
9/28/2018	18:13:31	19.77	0.69
9/28/2018	18:14:31	19.77	0.70
9/28/2018	18:15:31	19.77	0.70
9/28/2018	18:16:31	19.77	0.70
9/28/2018	18:17:31	19.77	0.70
9/28/2018	18:18:31	19.77	0.70
9/28/2018	18:19:31	19.78	0.70
9/28/2018	18:20:31	19.77	0.70
9/28/2018	18:21:31	19.77	0.71
9/28/2018	18:22:31	19.78	0.71
9/28/2018	18:23:31	19.77	0.71
9/28/2018	18:24:31	19.77	0.71
9/28/2018	18:25:31	19.77	0.71
9/28/2018	18:26:31	19.76	0.71
9/28/2018	18:27:31	19.77	0.71

Hollingswoth & Vose
CFU 104
Run #2

Date	Time	O2 [%]	CO2 [%]
9/28/2018	18:28:31	19.77	0.70
9/28/2018	18:29:31	19.77	0.70
9/28/2018	18:30:31	19.78	0.70
Final Average		**19.76**	**0.70**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/28/2018	18:31:11	19.77	0.70
9/28/2018	18:31:21	19.82	0.70
9/28/2018	18:31:31	16.72	1.09
9/28/2018	18:31:41	6.11	0.58
9/28/2018	18:31:51	1.76	0.23
9/28/2018	18:32:01	0.56	0.11
9/28/2018	18:32:11	0.23	0.07
9/28/2018	18:32:21	0.15	0.06
9/28/2018	18:32:31	0.12	0.06
9/28/2018	18:32:41	0.10	0.06
9/28/2018	18:32:51	0.09	0.05
9/28/2018	18:33:01	0.09	0.05
9/28/2018	18:33:11	0.09	0.06
9/28/2018	18:33:21	0.08	0.05
9/28/2018	18:33:31	0.08	0.05
9/28/2018	18:33:41	0.08	0.05
9/28/2018	18:33:51	0.08	0.05
9/28/2018	18:34:01	0.08	0.05
9/28/2018	18:34:11	0.07	0.05
9/28/2018	18:34:21	0.08	0.06
9/28/2018	18:34:31	0.07	0.05
9/28/2018	18:34:41	0.07	0.05
9/28/2018	18:34:51	0.07	0.05
9/28/2018	18:35:01	0.07	0.05
9/28/2018	18:35:11	0.07	0.05
9/28/2018	18:35:21	0.48	0.49
9/28/2018	18:35:31	1.51	1.41
9/28/2018	18:35:41	1.84	1.72
9/28/2018	18:35:51	1.93	1.81
9/28/2018	18:36:01	1.96	1.84
9/28/2018	18:36:11	1.98	1.84
9/28/2018	18:36:21	1.99	1.85
9/28/2018	18:36:31	1.99	1.86
9/28/2018	18:36:41	1.99	1.86

Hollingswoth & Vose
CFU 104
Run #2

Date	Time	O2 [%]	CO2 [%]
9/28/2018	18:36:51	2.00	1.87
9/28/2018	18:37:01	2.00	1.87
9/28/2018	18:37:11	2.00	1.87
9/28/2018	18:37:21	2.31	2.24
9/28/2018	18:37:31	6.77	7.16
9/28/2018	18:37:41	9.13	9.07
9/28/2018	18:37:51	9.75	9.56
9/28/2018	18:38:01	9.93	9.72
9/28/2018	18:38:11	9.98	9.77
9/28/2018	18:38:21	9.99	9.78
9/28/2018	18:38:31	10.00	9.80
9/28/2018	18:38:41	10.00	9.80
9/28/2018	18:38:51	10.01	9.80
9/28/2018	18:39:01	10.01	9.80
9/28/2018	18:39:11	10.01	9.81
9/28/2018	18:39:21	9.99	9.81
9/28/2018	18:39:31	13.00	6.86
9/28/2018	18:39:41	17.50	2.56
9/28/2018	18:39:51	19.06	1.27
9/28/2018	18:40:01	19.52	0.93
9/28/2018	18:40:11	19.66	0.79
		O2 [%]	**CO2 [%]**
System Zero		**0.08**	**0.05**
System Span		**10.01**	**1.84**

Hollingswoth & Vose
CFU 104
Run #3

Date	Time	O2 [%]	CO2 [%]
9/28/2018	18:45:31	19.75	0.72
9/28/2018	18:46:31	19.75	0.72
9/28/2018	18:47:31	19.76	0.71
9/28/2018	18:48:31	19.76	0.71
9/28/2018	18:49:31	19.76	0.71
9/28/2018	18:50:31	19.76	0.71
9/28/2018	18:51:31	19.76	0.71
9/28/2018	18:52:31	19.76	0.71
9/28/2018	18:53:31	19.76	0.71
9/28/2018	18:54:31	19.76	0.71
9/28/2018	18:55:31	19.77	0.70
9/28/2018	18:56:31	19.76	0.70
9/28/2018	18:57:31	19.76	0.70
9/28/2018	18:58:31	19.76	0.70
9/28/2018	18:59:31	19.76	0.70
9/28/2018	19:00:31	19.76	0.70
9/28/2018	19:01:31	19.76	0.70
9/28/2018	19:02:31	19.76	0.70
9/28/2018	19:03:31	19.76	0.70
9/28/2018	19:04:31	19.76	0.70
9/28/2018	19:05:31	19.76	0.70
9/28/2018	19:06:31	19.76	0.71
9/28/2018	19:07:31	19.76	0.71
9/28/2018	19:08:31	19.76	0.71
9/28/2018	19:09:31	19.76	0.71
9/28/2018	19:10:31	19.76	0.71
9/28/2018	19:11:31	19.76	0.72
9/28/2018	19:12:31	19.76	0.72
9/28/2018	19:13:31	19.76	0.72
9/28/2018	19:14:31	19.76	0.71
9/28/2018	19:15:31	19.76	0.71
9/28/2018	19:16:31	19.76	0.72
9/28/2018	19:17:31	19.76	0.71
9/28/2018	19:18:31	19.76	0.71
9/28/2018	19:19:31	19.76	0.71
9/28/2018	19:20:31	19.76	0.71
9/28/2018	19:21:31	19.76	0.70
9/28/2018	19:22:31	19.77	0.70
9/28/2018	19:23:31	19.76	0.70
9/28/2018	19:24:31	19.76	0.70
9/28/2018	19:25:31	19.76	0.70

Hollingswoth & Vose
CFU 104
Run #3

Date	Time	O2 [%]	CO2 [%]
9/28/2018	19:26:31	19.75	0.71
9/28/2018	19:27:31	19.76	0.70
9/28/2018	19:28:31	19.76	0.70
9/28/2018	19:29:31	19.76	0.70
9/28/2018	19:30:31	19.76	0.70
9/28/2018	19:31:31	19.75	0.70
9/28/2018	19:32:31	19.75	0.71
9/28/2018	19:33:31	19.75	0.71
9/28/2018	19:34:31	19.75	0.72
9/28/2018	19:35:31	19.75	0.72
9/28/2018	19:36:31	19.76	0.71
9/28/2018	19:37:31	19.75	0.72
9/28/2018	19:38:31	19.75	0.72
9/28/2018	19:39:31	19.75	0.72
9/28/2018	19:40:31	19.75	0.72
9/28/2018	19:41:31	19.76	0.71
9/28/2018	19:42:31	19.75	0.71
9/28/2018	19:43:31	19.75	0.71
9/28/2018	19:44:31	19.75	0.71
9/28/2018	19:45:31	19.75	0.70
9/28/2018	19:46:31	19.75	0.70
9/28/2018	19:47:31	19.76	0.70
9/28/2018	19:48:31	19.76	0.70
9/28/2018	19:49:31	19.75	0.70
9/28/2018	19:50:31	19.75	0.70
9/28/2018	19:51:31	19.75	0.69
9/28/2018	19:52:31	19.75	0.70
9/28/2018	19:53:31	19.75	0.70
9/28/2018	19:54:31	19.75	0.70
9/28/2018	19:55:31	19.75	0.70
9/28/2018	19:56:31	19.76	0.70
9/28/2018	19:57:31	19.76	0.70
9/28/2018	19:58:31	19.76	0.70
9/28/2018	19:59:31	19.75	0.71
9/28/2018	20:00:31	19.75	0.71
9/28/2018	20:01:31	19.75	0.71
9/28/2018	20:02:31	19.75	0.71
9/28/2018	20:03:31	19.76	0.71
9/28/2018	20:04:31	19.76	0.71
9/28/2018	20:05:31	19.76	0.72
9/28/2018	20:06:31	19.75	0.71

Hollingswoth & Vose
CFU 104
Run #3

Date	Time	O2 [%]	CO2 [%]
9/28/2018	20:07:31	19.75	0.71
9/28/2018	20:08:31	19.75	0.71
9/28/2018	20:09:31	19.76	0.71
9/28/2018	20:10:31	19.76	0.71
9/28/2018	20:11:31	19.75	0.71
9/28/2018	20:12:31	19.75	0.70
9/28/2018	20:13:31	19.75	0.70
9/28/2018	20:14:31	19.76	0.70
9/28/2018	20:15:31	19.76	0.70
9/28/2018	20:16:31	19.76	0.70
9/28/2018	20:17:31	19.76	0.70
9/28/2018	20:18:31	19.76	0.70
9/28/2018	20:19:31	19.76	0.70
9/28/2018	20:20:31	19.75	0.70
9/28/2018	20:21:31	19.75	0.71
9/28/2018	20:22:31	19.75	0.71
9/28/2018	20:23:31	19.76	0.71
9/28/2018	20:24:31	19.76	0.71
9/28/2018	20:25:31	19.75	0.71
9/28/2018	20:26:31	19.75	0.71
9/28/2018	20:27:31	19.75	0.72
9/28/2018	20:28:31	19.75	0.72
9/28/2018	20:29:31	19.75	0.71
9/28/2018	20:30:31	19.75	0.71
9/28/2018	20:31:31	19.75	0.71
9/28/2018	20:32:31	19.75	0.72
9/28/2018	20:33:31	19.75	0.71
9/28/2018	20:34:31	19.75	0.71
9/28/2018	20:35:31	19.75	0.71
9/28/2018	20:36:31	19.75	0.70
9/28/2018	20:37:31	19.76	0.70
9/28/2018	20:38:31	19.77	0.70
9/28/2018	20:39:31	19.76	0.69
9/28/2018	20:40:31	19.76	0.69
9/28/2018	20:41:31	19.76	0.70
9/28/2018	20:42:31	19.76	0.70
9/28/2018	20:43:31	19.75	0.70
9/28/2018	20:44:31	19.76	0.70
9/28/2018	20:45:31	19.76	0.70
9/28/2018	20:46:31	19.75	0.71
9/28/2018	20:47:31	19.75	0.71

Hollingswoth & Vose
CFU 104
Run #3

Date	Time	O2 [%]	CO2 [%]
9/28/2018	20:48:31	19.75	0.71
9/28/2018	20:49:31	19.75	0.71
9/28/2018	20:50:31	19.75	0.73
Final Average		**19.76**	**0.71**

Bias Check

Date	Time	O2 [%]	CO2 [%]
9/28/2018	20:51:11	19.75	0.72
9/28/2018	20:51:21	19.75	0.77
9/28/2018	20:51:31	12.61	1.11
9/28/2018	20:51:41	3.80	0.42
9/28/2018	20:51:51	1.11	0.18
9/28/2018	20:52:01	0.39	0.11
9/28/2018	20:52:11	0.19	0.08
9/28/2018	20:52:21	0.13	0.08
9/28/2018	20:52:31	0.11	0.08
9/28/2018	20:52:41	0.10	0.07
9/28/2018	20:52:51	0.10	0.08
9/28/2018	20:53:01	0.09	0.07
9/28/2018	20:53:11	0.09	0.07
9/28/2018	20:53:21	0.09	0.07
9/28/2018	20:53:31	0.09	0.07
9/28/2018	20:53:41	0.08	0.07
9/28/2018	20:53:51	0.08	0.07
9/28/2018	20:54:01	0.09	0.08
9/28/2018	20:54:11	0.89	0.91
9/28/2018	20:54:21	1.69	1.59
9/28/2018	20:54:31	1.89	1.78
9/28/2018	20:54:41	1.96	1.84
9/28/2018	20:54:51	1.98	1.86
9/28/2018	20:55:01	1.99	1.87
9/28/2018	20:55:11	1.99	1.88
9/28/2018	20:55:21	2.00	1.87
9/28/2018	20:55:31	2.00	1.89
9/28/2018	20:55:41	2.11	2.01
9/28/2018	20:55:51	6.25	6.69
9/28/2018	20:56:01	9.00	8.98
9/28/2018	20:56:11	9.71	9.55
9/28/2018	20:56:21	9.92	9.72
9/28/2018	20:56:31	9.97	9.78
9/28/2018	20:56:41	9.99	9.80

Hollingswoth & Vose
CFU 104
Run #3

Date	Time	O2 [%]	CO2 [%]
9/28/2018	20:56:51	10.00	9.81
9/28/2018	20:57:01	10.02	9.82
9/28/2018	20:57:11	10.01	9.82
9/28/2018	20:57:21	10.00	9.82
		O2 [%]	**CO2 [%]**
System Zero		**0.09**	**0.07**
System Span		**10.01**	**1.87**

APPENDIX E: PROCESS DATA

Table 1
September 2018 Source Test Campaign - Production Data Summary - Method 5, 7E, 10, and 25A
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Product Type	Source Test ID	Source Test Time [1]	Total Hourly Fiber Pull Rate [2] (lb/hr)								
				CFU-112			CFU-104			CFU-113		
				L2R4	L2R9	Total	L1R7	L1R8	Total	Production Line 1	Production Line 2	Total
09/12/2018 CFU-112 Outlet	URC	Run 1	10:52 - 12:59	338.1	338.9	676.9	--	--	--	--	--	--
		Run 2	13:27 - 15:34	346.8	341.3	688.0	--	--	--	--	--	--
		Run 3	16:00 - 18:07	377.4	381.3	758.7	--	--	--	--	--	--
		Average		**354.1**	**353.8**	**707.9**	**--**	**--**	**--**	**--**	**--**	**--**
09/15/2018 CFU-112 Outlet	URC	Run 1	13:50 - 15:56	341.3	346.0	687.3	--	--	--	--	--	--
		Run 2	16:14 - 18:21	359.1	361.9	721.0	--	--	--	--	--	--
		Run 3	18:41 - 20:46	348.4	360.3	708.7	--	--	--	--	--	--
		Average		**349.6**	**356.1**	**705.6**	**--**	**--**	**--**	**--**	**--**	**--**
09/28/2018 CFU-104 Outlet	RC	Run 1	06:53 - 08:57	--	--	--	184.9	188.9	373.8	--	--	--
		Run 2	09:15 - 11:19	--	--	--	182.5	181.7	364.3	--	--	--
		Run 3	11:35 - 13:41	--	--	--	184.1	184.9	369.0	--	--	--
		Average		**--**	**--**	**--**	**183.9**	**185.2**	**369.0**	**--**	**--**	**--**
09/18/2018 CFU-113 Outlet	GM	Run 1	09:46 - 11:55	--	--	--	--	--	--	1,845.9	1,791.1	3,637.1
		Run 2	12:15 - 14:22	--	--	--	--	--	--	1,857.0	1,794.3	3,651.3
		Run 3	14:41 - 16:47	--	--	--	--	--	--	1,896.7	1,808.6	3,705.3
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**1,866.5**	**1,798.0**	**3,664.6**
09/25/2018 CFU-113 Outlet	GM	Run 1	09:14 - 11:21	--	--	--	--	--	--	1,808.2	1,818.9	3,627.1
		Run 2	12:00 - 14:04	--	--	--	--	--	--	1,827.3	1,800.7	3,627.9
		Run 3	14:30 - 16:36	--	--	--	--	--	--	1,835.2	1,830.8	3,666.0
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**1,823.6**	**1,816.8**	**3,640.4**

GM = Glass Melt
RC = Rotary Coarse
URC = Ultra Rotary Coarse

References:

(1) Information provided by Bison Engineering via correspondence.

(2) Fiber pull rates provided by Hollingsworth & Vose Fiber Company via correspondence. Value represents the average pull rate measured over the source test time per test run.

Table 2
September 2018 Source Test Campaign - Production Data Summary - Method 13B and 26A
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Product Type	Source Test ID	Source Test Time [1]	Total Hourly Fiber Pull Rate [2] (lb/hr)								
				CFU-112			CFU-104			CFU-113		
				L2R4	L2R9	Total	L1R7	L1R8	Total	Production Line 1	Production Line 2	Total
09/11/2018 CFU-112 Outlet	URC	Run 1	10:35 - 12:40	333.3	331.7	665.0	--	--	--	--	--	--
		Run 2	13:05 - 15:13	343.6	345.6	689.2	--	--	--	--	--	--
		Run 3	15:40 - 17:46	357.9	355.5	713.4	--	--	--	--	--	--
		Average		**345.0**	**344.3**	**689.2**	**--**	**--**	**--**	**--**	**--**	**--**
09/16/2018 CFU-112 Outlet	URC	Run 1	09:00 - 11:10	344.4	354.7	699.2	--	--	--	--	--	--
		Run 2	11:25 - 13:31	345.2	345.2	690.4	--	--	--	--	--	--
		Run 3	13:46 - 15:53	339.7	342.0	681.7	--	--	--	--	--	--
		Average		**343.1**	**347.3**	**690.4**	**--**	**--**	**--**	**--**	**--**	**--**
09/28/2018 CFU-104 Outlet	RC	Run 1	14:06 - 16:11	--	--	--	183.7	183.7	367.4	--	--	--
		Run 2	16:26 - 18:31	--	--	--	183.3	180.1	363.5	--	--	--
		Run 3	18:46 - 20:50	--	--	--	184.9	188.1	373.0	--	--	--
		Average		**--**	**--**	**--**	**184.0**	**184.0**	**368.0**	**--**	**--**	**--**
09/19/2018 CFU-113 Outlet	GM	Run 1	08:38 - 10:49	--	--	--	--	--	--	1,845.1	1,818.9	3,664.0
		Run 2	11:04 - 13:10	--	--	--	--	--	--	1,859.4	1,821.3	3,680.7
		Run 3	13:25 - 15:29	--	--	--	--	--	--	1,891.2	1,809.4	3,700.6
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**1,865.2**	**1,816.5**	**3,681.8**
09/26/2018 CFU-113 Outlet	GM	Run 1	09:00 - 11:05	--	--	--	--	--	--	1,818.5	1,823.7	3,642.2
		Run 2	11:23 - 13:28	--	--	--	--	--	--	1,858.2	1,787.2	3,645.4
		Run 3	13:43 - 15:48	--	--	--	--	--	--	1,896.7	1,798.3	3,695.0
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**1,857.8**	**1,803.1**	**3,660.9**

GM = Glass Melt
RC = Rotary Coarse
URC = Ultra Rotary Coarse

References:

(1) Information provided by Bison Engineering via correspondence.

(2) Fiber pull rates provided by Hollingsworth & Vose Fiber Company via correspondence. Value represents the average pull rate measured over the source test time per test run.

Table 3
September 2018 Source Test Campaign - Production Data Summary - Method 29 and 30B
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Product Type	Source Test ID	Source Test Time [1]	Total Hourly Fiber Pull Rate [2] (lb/hr)								
				CFU-112			CFU-104			CFU-113		
				L2R4	L2R9	Total	L1R7	L1R8	Total	Production Line 1	Production Line 2	Total
09/13/2018 CFU-112 Outlet	URC	Run 1	08:45 - 11:52	327.0	340.5	667.4	--	--	--	--	--	--
		Run 2	12:16 - 15:23	325.4	346.8	672.2	--	--	--	--	--	--
		Run 3	15:44 - 18:48	342.4	352.4	694.8	--	--	--	--	--	--
		Average		**331.6**	**346.5**	**678.1**	**--**	**--**	**--**	**--**	**--**	**--**
09/14-15/2018 CFU-112 Outlet	URC	Run 1	09:35 - 13:02	341.6	353.5	695.2	--	--	--	--	--	--
		Run 2	13:20 - 16:25	341.3	359.1	700.4	--	--	--	--	--	--
		Run 3	10:15 - 13:21	340.1	351.2	691.2	--	--	--	--	--	--
		Average		**341.0**	**354.6**	**695.6**	**--**	**--**	**--**	**--**	**--**	**--**
09/27/2018 CFU-104 Outlet	RC	Run 1	09:30 - 12:35	--	--	--	181.3	186.1	367.4	--	--	--
		Run 2	12:53 - 16:00	--	--	--	186.5	188.1	374.6	--	--	--
		Run 3	16:18 - 19:23	--	--	--	186.1	189.3	375.4	--	--	--
		Average		**--**	**--**	**--**	**184.6**	**187.8**	**372.5**	**--**	**--**	**--**
09/21/2018 CFU-113 Outlet	GM	Run 1	09:45 - 12:51	--	--	--	--	--	--	1,838.8	1,824.9	3,663.7
		Run 2	13:10 - 16:16	--	--	--	--	--	--	1,851.5	1,822.5	3,674.0
		Run 3	16:34 - 19:39	--	--	--	--	--	--	1,849.1	1,843.5	3,692.6
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**1,846.4**	**1,830.3**	**3,676.8**
09/24/2018 CFU-113 Outlet	GM	Run 1	09:25 - 12:30	--	--	--	--	--	--	1,829.2	1,843.9	3,673.2
		Run 2	12:50 - 15:55	--	--	--	--	--	--	1,876.1	1,828.4	3,704.5
		Run 3	16:16 - 19:21	--	--	--	--	--	--	1,844.6	1,849.9	3,694.5
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**1,850.0**	**1,840.7**	**3,690.7**

GM = Glass Melt
RC = Rotary Coarse
URC = Ultra Rotary Coarse

References:

(1) Information provided by Bison Engineering via correspondence.

(2) Fiber pull rates provided by Hollingsworth & Vose Fiber Company via correspondence. Value represents the average pull rate measured over the source test time per test run.

Table 4
September 2018 Source Test Campaign - Production Data Summary - Method 316
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Product Type	Source Test ID	Source Test Time (1)	Total Hourly Fiber Pull Rate (2) (lb/hr)								
				CFU-112			CFU-104			CFU-113		
				L2R4	L2R9	Total	L1R7	L1R8	Total	Production Line 1	Production Line 2	Total
09/12/2018 CFU-112 Outlet	URC	Run 1	10:53 - 13:00	338.1	338.9	676.9	--	--	--	--	--	--
		Run 2	13:28 - 15:35	346.8	341.3	688.0	--	--	--	--	--	--
		Run 3	16:01 - 18:08	377.4	381.3	758.7	--	--	--	--	--	--
		Average		**354.1**	**353.8**	**707.9**	**--**	**--**	**--**	**--**	**--**	**--**
09/15/2018 CFU-112 Outlet	URC	Run 1	13:49 - 15:55	341.3	346.0	687.3	--	--	--	--	--	--
		Run 2	16:15 - 18:21	359.1	361.9	721.0	--	--	--	--	--	--
		Run 3	18:40 - 20:45	348.4	360.3	708.7	--	--	--	--	--	--
		Average		**349.6**	**356.1**	**705.6**	**--**	**--**	**--**	**--**	**--**	**--**
09/28/2018 CFU-104 Outlet	RC	Run 1	06:52 - 08:58	--	--	--	184.9	188.9	373.8	--	--	--
		Run 2	09:16 - 11:20	--	--	--	182.5	181.7	364.3	--	--	--
		Run 3	11:38 - 13:42	--	--	--	184.1	184.9	369.0	--	--	--
		Average		**--**	**--**	**--**	**183.9**	**185.2**	**369.0**	**--**	**--**	**--**
09/18/2018 CFU-113 Outlet	GM	Run 1	09:45 - 11:54	--	--	--	--	--	--	1,845.9	1,791.1	3,637.1
		Run 2	12:16 - 14:23	--	--	--	--	--	--	1,857.0	1,794.3	3,651.3
		Run 3	14:42 - 16:48	--	--	--	--	--	--	1,896.7	1,808.6	3,705.3
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**1,866.5**	**1,798.0**	**3,664.6**
09/25/2018 CFU-113 Outlet	GM	Run 1	09:15 - 11:22	--	--	--	--	--	--	1,808.2	1,818.9	3,627.1
		Run 2	12:01 - 14:05	--	--	--	--	--	--	1,827.3	1,800.7	3,627.9
		Run 3	14:31 - 16:37	--	--	--	--	--	--	1,835.2	1,830.8	3,666.0
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**1,823.6**	**1,816.8**	**3,640.4**

GM = Glass Melt
RC = Rotary Coarse
URC = Ultra Rotary Coarse

References:

(1) Information provided by Bison Engineering via correspondence.

(2) Fiber pull rates provided by Hollingsworth & Vose Fiber Company via correspondence. Value represents the average pull rate measured over the source test time per test run.

Table 5
September 2018 Source Test Campaign - Natural Gas Usage - M7E, M10, M25A, and M316
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Product Type	Source Test ID	Source Test Time (1)	Total Hourly Natural Gas Usage (cf/hr)								
				CFU-112 (2)			CFU-104 (2)			CFU-113 (a)		
				L2R4	L2R9	Total	L1R7	L1R8	Total	Production Line 1	Production Line 2	Total
09/12/2018 CFU-112 Outlet	URC	Run 1	10:52 - 12:59	2,082.8	1,979.5	4,062.3	--	--	--	--	--	--
		Run 2	13:27 - 15:34	2,070.0	1,967.3	4,037.3	--	--	--	--	--	--
		Run 3	16:00 - 18:07	2,080.9	2,045.7	4,126.7	--	--	--	--	--	--
		Average		**2,077.9**	**1,997.5**	**4,075.4**	**--**	**--**	**--**	**--**	**--**	**--**
09/15/2018 CFU-112 Outlet	URC	Run 1	13:50 - 15:56	2,084.9	2,052.9	4,137.8	--	--	--	--	--	--
		Run 2	16:14 - 18:21	2,161.6	2,046.6	4,208.2	--	--	--	--	--	--
		Run 3	18:41 - 20:46	2,211.0	2,040.3	4,251.3	--	--	--	--	--	--
		Average		**2,152.5**	**2,046.6**	**4,199.1**	**--**	**--**	**--**	**--**	**--**	**--**
09/28/2018 CFU-104 Outlet	RC	Run 1	06:53 - 08:57	--	--	--	2,538.8	2,684.2	5,223.0	--	--	--
		Run 2	09:15 - 11:19	--	--	--	2,564.2	2,710.7	5,274.9	--	--	--
		Run 3	11:35 - 13:41	--	--	--	2,514.6	2,763.1	5,277.7	--	--	--
		Average		**--**	**--**	**--**	**2,539.2**	**2,719.3**	**5,258.5**	**--**	**--**	**--**
09/18/2018 CFU-113 Outlet	GM	Run 1	09:45 - 11:54	--	--	--	--	--	--	2,451.0	1,960.8	4,411.8
		Run 2	12:16 - 14:23	--	--	--	--	--	--	2,451.0	1,960.8	4,411.8
		Run 3	14:42 - 16:48	--	--	--	--	--	--	2,451.0	1,960.8	4,411.8
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**2,451.0**	**1,960.8**	**4,411.8**
09/25/2018 CFU-113 Outlet	GM	Run 1	09:15 - 11:22	--	--	--	--	--	--	2,451.0	1,960.8	4,411.8
		Run 2	12:01 - 14:05	--	--	--	--	--	--	2,451.0	1,960.8	4,411.8
		Run 3	14:31 - 16:37	--	--	--	--	--	--	2,451.0	1,960.8	4,411.8
		Average		**--**	**--**	**--**	**--**	**--**	**--**	**2,451.0**	**1,960.8**	**4,411.8**

GM = Glass Melt
RC = Rotary Coarse
URC = Ultra Rotary Coarse

Notes:

(a) Hourly natural gas usage rate (cf/hr) = (Line 1 or 2 forehearth firing rate [MMBtu/hr]) x (10^6 Btu/MMBtu) / (natural gas heat content [Btu/scf])

Line 1 forehearth firing rate (MMBtu/hr) =	2.50	(3)
Line 2 forehearth firing rate (MMBtu/hr) =	2.00	(3)
Natural gas heat content (Btu/scf) =	1,020	(4)

References:

(1) Information provided by Bison Engineering via correspondence.
(2) Natural gas usage provided by Hollingsworth & Vose Fiber Company via correspondence. Value represents the average natural gas usage measured over the source test time per test run.
(3) Information provided by Hollingsworth & Vose Fiber Company via correspondence.
(4) AP-42 Chapter 1.4 (July 1998), Table 1.4-2 "Emission Factors for Criteria Pollutants and Greenhouse Gases from Natural Gas Combustion."

Table 6
September 2018 Source Test Campaign - Pressure Differentials
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Method	Product Type	Source Test ID	Source Test Time (1)	Pressure Differential (2) (" w.c.)
09/12/2018 CFU-112 Outlet	M5, M7E, M10, M25A	URC	Run 1	10:52 - 12:59	4.016
			Run 2	13:27 - 15:34	3.972
			Run 3	16:00 - 18:07	4.110
			Average		**4.033**
09/15/2018 CFU-112 Outlet	M5, M7E, M10, M25A	URC	Run 1	13:50 - 15:56	3.526
			Run 2	16:14 - 18:21	4.021
			Run 3	18:41 - 20:46	3.579
			Average		**3.709**
09/11/2018 CFU-112 Outlet	M13B & M26A	URC	Run 1	10:35 - 12:40	3.843
			Run 2	13:05 - 15:13	3.590
			Run 3	15:40 - 17:46	3.708
			Average		**3.714**
09/16/2018 CFU-112 Outlet	M13B & M26A	URC	Run 1	09:00 - 11:10	3.876
			Run 2	11:25 - 13:31	3.099
			Run 3	13:46 - 15:53	3.193
			Average		**3.390**
09/13/2018 CFU-112 Outlet	M29 & M30B	URC	Run 1	08:45 - 11:52	3.767
			Run 2	12:16 - 15:23	3.796
			Run 3	15:44 - 18:48	3.874
			Average		**3.812**
09/14/2018 CFU-112 Outlet	M29 & M30B	URC	Run 1	09:35 - 13:02	3.382
			Run 2	13:20 - 16:25	3.545
			Run 3	10:15 - 13:21	2.995
			Average		**3.307**
09/12/2018 CFU-112 Outlet	M316	URC	Run 1	10:53 - 13:00	4.016
			Run 2	13:28 - 15:35	3.981
			Run 3	16:01 - 18:08	4.110
			Average		**4.035**
09/15/2018 CFU-112 Outlet	M316	URC	Run 1	13:49 - 15:55	3.526
			Run 2	16:15 - 18:21	4.021
			Run 3	18:40 - 20:45	3.579
			Average		**3.709**
09/28/2018 CFU-104 Outlet	M5, M7E, M10, M25A	RC	Run 1	06:53 - 08:57	5.207
			Run 2	09:15 - 11:19	5.185
			Run 3	11:35 - 13:41	5.207
			Average		**5.200**
09/28/2018 CFU-104 Outlet	M13B & M26A	RC	Run 1	14:06 - 16:11	5.339
			Run 2	16:26 - 18:31	5.202
			Run 3	18:46 - 20:50	5.042
			Average		**5.195**
09/27/2018 CFU-104 Outlet	M29 & M30B	RC	Run 1	09:30 - 12:35	5.176
			Run 2	12:53 - 16:00	5.416
			Run 3	16:18 - 19:23	5.602
			Average		**5.398**
09/28/2018 CFU-104 Outlet	M316	RC	Run 1	06:52 - 08:58	5.207
			Run 2	09:16 - 11:20	5.186
			Run 3	11:38 - 13:42	5.207
			Average		**5.200**

Table 6
September 2018 Source Test Campaign - Pressure Differentials
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Method	Product Type	Source Test ID	Source Test Time [(1)]	Pressure Differential [(2)] (" w.c.)
09/18/2018 CFU-113 Outlet	M5, M7E, M10, M25A	GM	Run 1	09:46 - 11:55	1.718
			Run 2	12:15 - 14:22	1.788
			Run 3	14:41 - 16:47	1.613
			Average		**1.707**
09/25/2018 CFU-113 Outlet	M5, M7E, M10, M25A	GM	Run 1	09:14 - 11:21	2.861
			Run 2	12:00 - 14:04	2.670
			Run 3	14:30 - 16:36	2.540
			Average		**2.691**
09/19/2018 CFU-113 Outlet	M13B & M26A	GM	Run 1	08:38 - 10:49	1.707
			Run 2	11:04 - 13:10	1.770
			Run 3	13:25 - 15:29	1.679
			Average		**1.719**
09/26/2018 CFU-113 Outlet	M13B & M26A	GM	Run 1	09:00 - 11:05	2.777
			Run 2	11:23 - 13:28	2.635
			Run 3	13:43 - 15:48	2.616
			Average		**2.676**
09/21/2018 CFU-113 Outlet	M29 & M30B	GM	Run 1	09:45 - 12:51	1.655
			Run 2	13:10 - 16:16	1.689
			Run 3	16:34 - 19:39	1.708
			Average		**1.684**
09/24/2018 CFU-113 Outlet	M29 & M30B	GM	Run 1	09:25 - 12:30	2.626
			Run 2	12:50 - 15:55	2.564
			Run 3	16:16 - 19:21	2.522
			Average		**2.570**
09/18/2018 CFU-113 Outlet	M316	GM	Run 1	09:45 - 11:54	1.718
			Run 2	12:16 - 14:23	1.788
			Run 3	14:42 - 16:48	1.613
			Average		**1.707**
09/25/2018 CFU-113 Outlet	M316	GM	Run 1	09:15 - 11:22	2.861
			Run 2	12:01 - 14:05	2.670
			Run 3	14:31 - 16:37	2.540
			Average		**2.691**

GM = Glass Melt
RC = Rotary Coarse
URC = Ultra Rotary Coarse

References:
(1) Information provided by Bison Engineering via correspondence.
(2) Information provided by Hollingsworth & Vose Fiber Company via correspondence. Value represents the average pressure differential measured over the source test time per test run.

APPENDIX F: LABORATORY REPORTS

Gravimetric Information

Client: Hollingsworth & Vose

Location: Corvallis, OR

Job number: HAV218775

Dates: 9/11-28/2018

Filters:

Sample Identification	Filter #	Date	Tare 1 (g)	Date	Tare 2 (g)	CHECK	Average	Filter #	Date	Final 1 (g)	Date	Final 2 (g)	CHECK	Average	Gain
HAV218775 CFU 112 M5 Run 1	Q1371	8/8/2018	0.3704	8/9/2018	0.3703	-0.0001	0.37035	Q1371	10/10/2018	0.3696	10/5/2018	0.3701	0.0005	0.36985	-0.00050
HAV218775 CFU 112 M5 Run 2	Q1372	8/8/2018	0.3765	8/9/2018	0.3762	-0.0003	0.37635	Q1372	10/4/2018	0.3761	10/5/2018	0.3759	-0.0002	0.37600	-0.00035
HAV218775 CFU 112 M5 Run 3	Q1373	8/8/2018	0.3747	8/9/2018	0.3747	0.0000	0.37470	Q1373	10/4/2018	0.3745	10/5/2018	0.3746	0.0001	0.37455	-0.00015
HAV218775 CFU 112 (2) M5 Run 1	Q1374	8/8/2018	0.3776	8/9/2018	0.3776	0.0000	0.37760	Q1374	10/4/2018	0.3776	10/5/2018	0.3775	-0.0001	0.37755	-0.00005
HAV218775 CFU 112 (2) M5 Run 2	Q1375	8/8/2018	0.3804	8/9/2018	0.3803	-0.0001	0.38035	Q1375	10/4/2018	0.3805	10/5/2018	0.3804	-0.0001	0.38045	0.00010
HAV218775 CFU 112 (2) M5 Run 3	Q1376	8/8/2018	0.3793	8/9/2018	0.3792	-0.0001	0.37925	Q1376	10/4/2018	0.3792	10/5/2018	0.3790	-0.0002	0.37910	-0.00015
HAV218775 CFU 113 M5 Run 1	Q1377	8/8/2018	0.3708	8/9/2018	0.3707	-0.0001	0.37075	Q1377	10/4/2018	0.3703	10/5/2018	0.3704	0.0001	0.37035	-0.00040
HAV218775 CFU 113 M5 Run 2	Q1378	8/8/2018	0.3721	8/9/2018	0.3721	0.0000	0.37210	Q1378	10/4/2018	0.3723	10/5/2018	0.3720	-0.0003	0.37215	0.00005
HAV218775 CFU 113 M5 Run 3	Q1379	8/8/2018	0.3709	8/9/2018	0.3711	0.0002	0.37100	Q1379	10/4/2018	0.3708	10/5/2018	0.3708	0.0000	0.37080	-0.00020
HAV218775 CFU 113 (2) M5 Run 1	Q1380	8/8/2018	0.3775	8/9/2018	0.3772	-0.0003	0.37735	Q1380	10/4/2018	0.3774	10/5/2018	0.3772	-0.0002	0.37730	-0.00005
HAV218775 CFU 113 (2) M5 Run 2	Q1381	8/8/2018	0.3797	8/9/2018	0.3796	-0.0001	0.37965	Q1381	10/4/2018	0.3795	10/5/2018	0.3796	0.0001	0.37955	-0.00010
HAV218775 CFU 113 (2) M5 Run 3	Q1382	8/8/2018	0.3787	8/9/2018	0.3789	0.0002	0.37880	Q1382	10/4/2018	0.3784	10/5/2018	0.3785	0.0001	0.37845	-0.00035
HAV218775 CFU 104 M5 Run 3	Q1389	8/15/2018	0.3786	8/21/2018	0.3783	-0.0003	0.37845	Q1389	10/4/2018	0.3799	10/5/2018	0.3795	-0.0004	0.37970	0.00125
HAV218775 CFU 104 M5 Run 4	Q1390	8/15/2018	0.3759	8/21/2018	0.3764	0.0005	0.37615	Q1390	10/4/2018	0.3786	10/5/2018	0.3782	-0.0004	0.37840	0.00225
HAV218775 CFU 104 M5 Run 5	Q1391	8/15/2018	0.3788	8/21/2018	0.3786	-0.0002	0.37870	Q1391	10/4/2018	0.3810	10/5/2018	0.3805	-0.0005	0.38075	0.00205

Liquid Fractions:

Wt (g)	Sample Identification	Dish #	Date	Tare 1 (g)	Date	Tare 2 (g)	CHECK	Average	Dish #	Date	Final 1 (g)	Date	Final 2 (g)	CHECK	Average	Gain
410	HAV218775 CFU112 Cont #4 Run 1	68	10/3/2018	47.0372	10/4/2018	47.0371	0.0001	47.03715	68	10/14/2018	47.0378	10/16/2018	47.0377	0.0001	47.03780	0.00065
390	HAV218775 CFU112 Cont #4 Run 2	69	10/3/2018	48.3027	10/4/2018	48.3027	0.0000	48.30270	69	10/14/2018	48.3032	10/16/2018	48.3032	0.0000	48.30320	0.00050
385	HAV218775 CFU112 Cont #4 Run 3	70	10/3/2018	53.5880	10/4/2018	53.5879	0.0001	53.58795	70	10/14/2018	53.5889	10/16/2018	53.5887	0.0002	53.58880	0.00085
395	HAV218775 CFU112 (2) Cont #4 Run 1	71	10/3/2018	45.2129	10/4/2018	45.2126	0.0003	45.21275	71	10/14/2018	45.2138	10/16/2018	45.2138	0.0000	45.21380	0.00105
400	HAV218775 CFU112 (2) Cont #4 Run 2	72	10/3/2018	46.3776	10/4/2018	46.3778	-0.0002	46.37770	72	10/14/2018	46.3783	10/16/2018	46.3784	-0.0001	46.37840	0.00070
390	HAV218775 CFU112 (2) Cont #4 Run 3	73	10/3/2018	43.0811	10/4/2018	43.0810	0.0001	43.08105	73	10/14/2018	43.0816	10/16/2018	43.0817	-0.0001	43.08170	0.00065
465	HAV218775 CFU113 Cont #4 Run 1	74	10/3/2018	45.9356	10/4/2018	45.9357	-0.0001	45.93565	74	10/16/2018	45.9367	10/17/2018	45.9366	0.0001	45.93670	0.00105
415	HAV218775 CFU113 Cont #4 Run 2	75	10/11/2018	43.1710	10/12/2018	43.1710	0.0000	43.17100	75	10/14/2018	43.1718	10/16/2018	43.1715	0.0003	43.17170	0.00070
415	HAV218775 CFU113 Cont #4 Run 3	76	10/11/2018	44.1395	10/12/2018	44.1393	0.0002	44.13940	76	10/14/2018	44.1403	10/16/2018	44.1403	0.0000	44.14030	0.00090
380	HAV218775 CFU113(2) Cont #4 Run 1	77	10/11/2018	44.0665	10/12/2018	44.0663	0.0002	44.06640	77	10/15/2018	44.0685	10/16/2018	44.0683	0.0002	44.06840	0.00200
420	HAV218775 CFU113(2) Cont #4 Run 2	78	10/11/2018	44.9995	10/12/2018	44.9991	0.0004	44.99930	78	10/16/2018	45.0002	10/16/2018	45.0001	0.0001	45.00020	0.00090
400	HAV218775 CFU113(2) Cont #4 Run 3	79	10/11/2018	43.2372	10/12/2018	43.2373	-0.0001	43.23725	79	10/15/2018	43.2386	10/16/2018	43.2387	-0.0001	43.23870	0.00145
430	HAV218775 CFU104 Cont #4 Run 1	80	10/11/2018	43.5074	10/12/2018	43.5074	0.0000	43.50740	80	10/16/2018	43.5082	10/17/2018	43.5078	0.0004	43.50800	0.00060
430	HAV218775 CFU104 Cont #4 Run 2	81	10/11/2018	40.4830	10/12/2018	40.4832	-0.0002	40.48310	81	10/16/2018	40.4843	10/17/2018	40.4840	0.0003	40.48420	0.00110
425	HAV218775 CFU104 Cont #4 Run 3	82	10/11/2018	45.6486	10/12/2018	45.6485	0.0001	45.64855	82	10/16/2018	45.6493	10/17/2018	45.6491	0.0002	45.64920	0.00065
200	HAV218775 DI H2O Blank	83	10/11/2018	49.4752	10/12/2018	49.4752	0.0000	49.47520	83	10/16/2018	49.4753	10/17/2018	49.4750	0.0003	49.47520	0.00000
90	HAV218775 CFU 112 Probe Rinse Run 1	84	10/11/2018	59.1578	10/12/2018	59.1580	-0.0002	59.15790	84	10/17/2018	59.1590	10/18/2018	59.1588	0.0002	59.15890	0.00100
95	HAV218775 CFU 112 Probe Rinse Run 2	85	10/11/2018	47.1531	10/12/2018	47.1531	0.0000	47.15310	85	10/17/2018	47.1540	10/18/2018	47.1543	-0.0003	47.15420	0.00110
80	HAV218775 CFU 112 Probe Rinse Run 3	86	10/11/2018	43.6667	10/12/2018	43.6670	-0.0003	43.66685	86	10/17/2018	43.6674	10/18/2018	43.6675	-0.0001	43.66750	0.00065
75	HAV218775 CFU 112(2) Probe Rinse Run 1	87	10/11/2018	45.3533	10/12/2018	45.3534	-0.0001	45.35335	87	10/17/2018	45.3544	10/18/2018	45.3548	-0.0004	45.35460	0.00125
120	HAV218775 CFU 112(2) Probe Rinse Run 2	88	10/11/2018	43.1784	10/12/2018	43.1785	-0.0001	43.17845	88	10/17/2018	43.1791	10/18/2018	43.1795	-0.0004	43.17930	0.00085
95	HAV218775 CFU 112(2) Probe Rinse Run 3	89	10/11/2018	45.3797	10/12/2018	45.3795	0.0002	45.37960	89	10/17/2018	45.3794	10/18/2018	45.3797	-0.0003	45.37960	0.00000
100	HAV218775 CFU 113 Probe Rinse Run 1	89A	10/12/2018	44.5403	10/13/2018	44.5403	0.0000	44.54030	89A	10/17/2018	44.5413	10/18/2018	44.5414	-0.0001	44.54140	0.00110
105	HAV218775 CFU 113 Probe Rinse Run 2	90A	10/11/2018	45.3312	10/12/2018	45.3311	0.0001	45.33115	90A	10/17/2018	45.3321	10/18/2018	45.3322	-0.0001	45.33220	0.00105
80	HAV218775 CFU 113 Probe Rinse Run 3	90	10/12/2018	41.7960	10/13/2018	41.7961	-0.0001	41.79605	90	10/17/2018	41.7969	10/18/2018	41.7968	0.0001	41.79690	0.00085
105	HAV218775 CFU 113(2) Probe Rinse Run 1	91	10/11/2018	43.2233	10/12/2018	43.2233	0.0000	43.22330	91	10/17/2018	43.2234	10/18/2018	43.2233	0.0001	43.22340	0.00010
95	HAV218775 CFU 113(2) Probe Rinse Run 2	92	10/11/2018	44.8026	10/12/2018	44.8024	0.0002	44.80250	92	10/17/2018	44.8027	10/18/2018	44.8029	-0.0002	44.80280	0.00030
125	HAV218775 CFU 113(2) Probe Rinse Run 3	93	10/11/2018	42.1274	10/12/2018	42.1273	0.0001	42.12735	93	10/17/2018	42.1278	10/18/2018	42.1281	-0.0003	42.12800	0.00065
95	HAV218775 CFU 104 Probe Rinse Run 1	94	10/11/2018	44.0915	10/12/2018	44.0915	0.0000	44.09150	94	10/17/2018	44.0918	10/18/2018	44.0921	-0.0003	44.09200	0.00050

Liquid Fractions:

Wt (g)	Sample Identification	Dish #	Date	Tare 1 (g)	Date	Tare 2 (g)	CHECK	Average	Dish #	Date	Final 1 (g)	Date	Final 2 (g)	CHECK	Average	Gain
100	HAV218775 CFU 104 Probe Rinse Run 2	95	10/11/2018	51.2187	10/12/2018	51.2187	0.0000	51.21870	95	10/17/2018	51.2194	10/18/2018	51.2195	-0.0001	51.21950	0.00080
60	HAV218775 CFU 104 Probe Rinse Run 3	96	10/11/2018	42.0479	10/12/2018	42.0481	-0.0002	42.04800	96	10/17/2018	42.0480	10/18/2018	42.0481	-0.0001	42.04810	0.00010
130	HAV218775 CFU 112 Cont #5 Run 1	97	10/11/2018	43.9614	10/12/2018	43.9615	-0.0001	43.96145	97	10/17/2018	43.9619	10/18/2018	43.9620	-0.0001	43.96200	0.00055
140	HAV218775 CFU 112 Cont #5 Run 2	98	10/11/2018	44.9717	10/12/2018	44.9716	0.0001	44.97165	98	10/17/2018	44.9719	10/18/2018	44.9719	0.0000	44.97190	0.00025
130	HAV218775 CFU 112 Cont #5 Run 3	99	10/11/2018	44.4292	10/12/2018	44.4293	-0.0001	44.42925	99	10/17/2018	44.4296	10/18/2018	44.4295	0.0001	44.42960	0.00035
150	HAV218775 CFU 112(2) Cont #5 Run 1	100	10/11/2018	45.1164	10/12/2018	45.1160	0.0004	45.11620	100	10/17/2018	45.1169	10/18/2018	45.1172	-0.0003	45.11710	0.00090
160	HAV218775 CFU 112(2) Cont #5 Run 2	1	10/11/2018	46.5637	10/12/2018	46.5638	-0.0001	46.56375	1	10/17/2018	46.5643	10/18/2018	46.5644	-0.0001	46.56440	0.00065
140	HAV218775 CFU 112(2) Cont #5 Run 3	2	10/11/2018	52.3895	10/12/2018	52.3895	0.0000	52.38950	2	10/18/2018	52.3901	10/19/2018	52.3899	0.0002	52.39000	0.00050
150	HAV218775 CFU 113 Cont #5 Run 1	3	10/11/2018	44.1587	10/12/2018	44.1589	-0.0002	44.15880	3	10/18/2018	44.1589	10/19/2018	44.1592	-0.0003	44.15910	0.00030
135	HAV218775 CFU 113 Cont #5 Run 2	4	10/11/2018	43.8616	10/12/2018	43.8619	-0.0003	43.86175	4	10/17/2018	43.8619	10/18/2018	43.8621	-0.0002	43.86200	0.00025
165	HAV218775 CFU 113 Cont #5 Run 3	5	10/11/2018	56.3400	10/12/2018	56.3401	-0.0001	56.34005	5	10/17/2018	56.3401	10/18/2018	56.3405	-0.0004	56.34030	0.00025
135	HAV218775 CFU 113(2) Cont #5 Run 1	6	10/10/2018	52.6273	10/11/2018	52.6274	-0.0001	52.62735	6	10/18/2018	52.6282	10/19/2018	52.6280	0.0002	52.62810	0.00075
165	HAV218775 CFU 113(2) Cont #5 Run 2	7	10/11/2018	44.9015	10/12/2018	44.9014	0.0001	44.90145	7	10/18/2018	44.9020	10/19/2018	44.9021	-0.0001	44.90210	0.00065
145	HAV218775 CFU 113(2) Cont #5 Run 3	8	10/11/2018	50.4758	10/12/2018	50.4762	-0.0004	50.47600	8	10/18/2018	50.4764	10/19/2018	50.4766	-0.0002	50.47650	0.00050
150	HAV218775 CFU 104 Cont #5 Run 1	9	10/11/2018	45.0468	10/12/2018	45.0469	-0.0001	45.04685	9	10/17/2018	45.0467	10/18/2018	45.0471	-0.0004	45.04690	0.00005
155	HAV218775 CFU 104 Cont #5 Run 2	10	10/11/2018	54.4676	10/12/2018	54.4679	-0.0003	54.46775	10	10/18/2018	54.4684	10/19/2018	54.4686	-0.0002	54.46850	0.00075
145	HAV218775 CFU 104 Cont #5 Run 3	11	10/11/2018	43.0519	10/12/2018	43.0519	0.0000	43.05190	11	10/18/2018	43.0520	10/19/2018	43.0520	0.0000	43.05200	0.00010
85	HAV218775 CFU 112 Cont #6 Organic Run 1	12	10/11/2018	44.8118	10/12/2018	44.8122	-0.0004	44.81200	12	10/17/2018	44.8118	10/18/2018	44.8119	-0.0001	44.81190	-0.00010
85	HAV218775 CFU 112 Cont #6 Organic Run 2	13	10/11/2018	43.4891	10/12/2018	43.4891	0.0000	43.48910	13	10/18/2018	43.4889	10/19/2018	43.4889	0.0000	43.48890	-0.00020
100	HAV218775 CFU 112 Cont #6 Organic Run 3	14	10/11/2018	46.0549	10/12/2018	46.0552	-0.0003	46.05505	14	10/18/2018	46.0546	10/19/2018	46.0549	-0.0003	46.05480	-0.00025
90	HAV218775 CFU 112(2) Cont #6 Organic Run 1	15	10/11/2018	42.7536	10/12/2018	42.7537	-0.0001	42.75365	15	10/18/2018	42.7535	10/19/2018	42.7535	0.0000	42.75350	-0.00015
90	HAV218775 CFU 112(2) Cont #6 Organic Run 2	16	10/11/2018	53.8005	10/12/2018	53.8007	-0.0002	53.80060	16	10/17/2018	53.8003	10/18/2018	53.8005	-0.0002	53.80040	-0.00020
95	HAV218775 CFU 112(2) Cont #6 Organic Run 3	17	10/11/2018	47.3787	10/12/2018	47.3787	0.0000	47.37870	17	10/17/2018	47.3785	10/18/2018	47.3787	-0.0002	47.37860	-0.00010
90	HAV218775 CFU 113 Cont #6 Organic Run 1	18	10/11/2018	50.6820	10/13/2018	50.6820	0.0000	50.68200	18	10/17/2018	50.6820	10/18/2018	50.6820	0.0000	50.68200	0.00000
90	HAV218775 CFU 113 Cont #6 Organic Run 2	19	10/11/2018	46.5744	10/13/2018	46.5747	-0.0003	46.57455	19	10/17/2018	46.5745	10/18/2018	46.5745	0.0000	46.57450	-0.00005
85	HAV218775 CFU 113 Cont #6 Organic Run 3	20	10/11/2018	44.4172	10/13/2018	44.4170	0.0002	44.41710	20	10/17/2018	44.4169	10/18/2018	44.4169	0.0000	44.41690	-0.00020
85	HAV218775 CFU 113(2) Cont #6 Organic Run 1	21	10/11/2018	42.5706	10/13/2018	42.5708	-0.0002	42.57070	21	10/17/2018	42.5704	10/18/2018	42.5704	0.0000	42.57040	-0.00030
90	HAV218775 CFU 113(2) Cont #6 Organic Run 2	22	10/11/2018	44.7832	10/13/2018	44.7831	0.0001	44.78315	22	10/18/2018	44.7831	10/19/2018	44.7830	0.0001	44.78310	-0.00005
95	HAV218775 CFU 113(2) Cont #6 Organic Run 3	23	10/11/2018	54.6415	10/13/2018	54.6415	0.0000	54.64150	23	10/17/2018	54.6414	10/18/2018	54.6415	-0.0001	54.64150	0.00000
90	HAV218775 CFU 104 Cont #6 Organic Run 1	24	10/11/2018	42.0409	10/13/2018	42.0409	0.0000	42.04090	24	10/17/2018	42.0408	10/18/2018	42.0410	-0.0002	42.04090	0.00000
90	HAV218775 CFU 104 Cont #6 Organic Run 2	25	10/11/2018	55.0356	10/13/2018	55.0360	-0.0004	55.03580	25	10/17/2018	55.0354	10/18/2018	55.0355	-0.0001	55.03550	-0.00030
85	HAV218775 CFU 104 Cont #6 Organic Run 3	26	10/11/2018	47.1995	10/13/2018	47.1997	-0.0002	47.19960	26	10/18/2018	47.1996	10/19/2018	47.1994	0.0002	47.19950	-0.00010
160	HAV218775 Acetone Blank	27	10/12/2018	45.6939	10/14/2018	45.6939	0.0000	45.69390	27	10/18/2018	45.6939	10/19/2018	45.6939	0.0000	45.69390	0.00000
100	HAV218775 Hexane Blank	28	10/12/2018	43.1070	10/14/2018	43.1071	-0.0001	43.10705	28	10/17/2018	43.1068	10/18/2018	43.1071	-0.0003	43.10700	-0.00005

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR
Source: CFU ~~#~~ 112 **Date(s):** 9/11/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
13B	1	Initial: 200 Rinse vol: 402	Final: 208 Gain: 8 ml	n/a	Initial: 257.8 #: 1	Final: 280.9 Gain: 23.1 g.
26A	1	Initial: 200 Rinse vol: 165	Final: 218 Gain: 18 ml		Initial: 254.5 #: 2	Final: 282.3 Gain: 27.8 g.
13B	2	Initial: 200 Rinse vol: 370	Final: 212 Gain: 12 ml		Initial: 258.0 #: 3	Final: 276.8 Gain: 18.8
26A	2	Initial: 200 Rinse vol: 120	Final: 228 Gain: 28 ml		Initial: 260.1 #: 4	Final: 287.8 Gain: 27.7
13B	3	Initial: 200 Rinse vol: 368	Final: 212 Gain: +12 ml.		Initial: 258.2 #: 5	Final: 280.1 Gain: 21.9
26A	3	Initial: 200 Rinse vol: 130	Final: 225 Gain: 25 ml		Initial: 247.3 #: 6	Final: 278.0 Gain: 30.7

Field Moisture Log:

Client: H+V
Source: CFU 112
Location: Corvallis, OR
Date(s): 9/12/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
5	1	**Initial:** 200 **Rinse vol:** 195	**Final:** 218 **Gain:** 18ml	Q1371	**Initial:** 240.6 **#:** 9	**Final:** 265.9 **Gain:** 25.3
316	1	**Initial:** 200 **Rinse vol:** 211	**Final:** 217 **Gain:** 17ml	n/a	**Initial:** 239.9 **#:** 10	**Final:** 251.6 **Gain:** 11.7
5	2	**Initial:** 200 **Rinse vol:** 170	**Final:** 224 **Gain:** 24ml	Q1372	**Initial:** 263.7 **#:** 11	**Final:** 288.7 **Gain:** 25.0
316	2	**Initial:** 200 **Rinse vol:** 205	**Final:** 226 **Gain:** 26ml	n/a	**Initial:** 240.0 **#:** 12	**Final:** 254.2 **Gain:** 14.2
5	3	**Initial:** 200 **Rinse vol:** 165ml	**Final:** 220 **Gain:** 20ml	Q1373	**Initial:** 251.0 **#:** 13	**Final:** 277.4 **Gain:** 26.4
316	3	**Initial:** 200 **Rinse vol:** 190	**Final:** 222 **Gain:** 22ml	n/a	**Initial:** 239.5 **#:** 14	**Final:** 255.2 **Gain:** 15.7

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR

Source: CFU 112 **Date(s):** 9/13/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
29	1	Initial: 200 Rinse vol: 100	Final: 230 Gain: 30 ml	n/a	Initial: 254.0 #: 15	Final: 288.5 Gain: 34.5
29	2	Initial: 200 Rinse vol: 100	Final: 230 Gain: 30 ml	n/a	Initial: 248.5 #: 16	Final: 285.0 Gain: 36.5
29	3	Initial: 200 Rinse vol: 100	Final: 225 Gain: 25 ml	n/a	Initial: 240.3 #: 17	Final: 278.0 Gain: 37.7
		Initial: Rinse vol:	Final: Gain:		Initial: #:	Final: Gain:
		Initial: Rinse vol:	Final: Gain:		Initial: #:	Final: Gain:
		Initial: Rinse vol:	Final: Gain:		Initial: #:	Final: Gain:

Field Moisture Log:

Client: H+V
Location: Corvallis, OR
Source: CFU 112 (2)
Date(s): 9/14/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
29	1	Initial: 200 Rinse vol: 100	Final: 225 Gain: 25ml	n/a	Initial: 238.4 #: 18	Final: 273.8 Gain: 35.4
29	2	Initial: 200 Rinse vol: 100	Final: 225 Gain: 25ml	n/a	Initial: 246.6 #: 19	Final: 280.3 Gain: 33.7
29	3	Initial: 200 Rinse vol: 100	Final: 235 Gain: 35ml	n/a	Initial: 255.3 #: 20	Final: 287.4 Gain: 32.1
		Initial: Rinse vol:	Final: Gain:		Initial: #:	Final: Gain:
		Initial: Rinse vol:	Final: Gain:		Initial: #:	Final: Gain:
		Initial: Rinse vol:	Final: Gain:		Initial: #:	Final: Gain:

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR
Source: CFU 112 (2) **Date(s):** 9/15/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
5	1	Initial: 200 Rinse vol: 175	Final: 220 Gain: 20 ml	Q1374	Initial: 245.9 #: 21	Final: 269.3 Gain: 23.4
316	1	Initial: 200 Rinse vol: 205	Final: 214 Gain: 14 ml	n/a	Initial: 254.6 #: 22	Final: 266.8 Gain: 12.2
5	2	Initial: 200 Rinse vol: 185	Final: 215 Gain: 15 ml	Q1375	Initial: 257.7 #: 23	Final: 283.6 Gain: 25.9
316	2	Initial: 200 Rinse vol: 195	Final: 206 Gain: 6 ml	n/a	Initial: 241.8 #: 24	Final: 257.7 Gain: 15.9
5	3	Initial: 200 Rinse vol: 175	Final: 220 Gain: 20 ml	Q1376	Initial: 234.0 #: 25	Final: 255.6 Gain: 21.6
316	3	Initial: 200 Rinse vol: 235	Final: 212 ml Gain: 12 ml	n/a	Initial: 241.0 #: 26	Final: 254.5 Gain: 13.5

Field Moisture Log:

Client: H+V **Location:** Corvallis, OR

Source: CFU 112 (2) **Date(s):** 9/16/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
13B	1	Initial: 200 Rinse vol: 420	Final: 220 Gain: 20 ml	n/a	Initial: 255.2 #: 27	Final: 274.0 Gain: 18.8
26A	1	Initial: 200 Rinse vol: 153	Final: 212 Gain: 12 ml		Initial: 238.0 #: 28	Final: 269.5 Gain: 31.5
13B	2	Initial: 200 Rinse vol: 380	Final: 215 Gain: 15 ml		Initial: 263.3 #: 29	Final: 280.4 Gain: 17.1
26A	2	Initial: 200 Rinse vol: 143	Final: 210 Gain: 10 ml		Initial: 261.9 #: 30	Final: 295.5 Gain: 33.6
13B	3	Initial: 200 Rinse vol: 410	Final: 220 Gain: 20 ml		Initial: 239.5 #: 31	Final: 255.7 Gain: 16.2
26A	3	Initial: 200 Rinse vol: 135	Final: 214 Gain: 14 ml		Initial: 243.8 #: 32	Final: 274.7 Gain: 30.9

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR

Source: CFU 113 **Date(s):** 9/18/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
5	1	Initial: 200 Rinse vol: 250	Final: 220 Gain: 20ml	Q1377	Initial: 245.8 #: 39	Final: 266.5 Gain: 20.7
316	1	Initial: 200 Rinse vol: 240	Final: 228 Gain: 28ml	n/a	Initial: 243.6 #: 40	Final: 262.0 Gain: 18.4
5	2	Initial: 200 Rinse vol: 200	Final: 220 Gain: 20ml	Q1378	Initial: 234.9 #: 41	Final: 249.9 Gain: 15.0
316	2	Initial: 200 Rinse vol: 230	Final: 224 Gain: 24ml	n/a	Initial: 234.8 #: 42	Final: 250.1 Gain: 15.3
5	3	Initial: 200 Rinse vol: 245	Final: 218 Gain: 18ml	Q1379	Initial: 259.6 #: 43	Final: 277.7 Gain: 18.1
316	3	Initial: 200 Rinse vol: 275	Final: 214 Gain: 14ml	n/a	Initial: 243.4 #: 44	Final: 263.6 Gain: 20.2

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR
Source: CFU113 **Date(s):** 9/19/18

Method	Run #	Impingers (g) Initial	Impingers (g) Final	Impingers (g) Rinse vol	Impingers (g) Gain	Filter #	Silica gel (g) Initial	Silica gel (g) Final	Silica gel (g) #	Silica gel (g) Gain
13B	1	200	218	275	18 ml	n/a	260.1	282.7	45	22.6
26A	1	200	217	145	17 ml		244.9	267.8	46	22.9
13B	2	200	220	310	20 ml		253.6	271.0	47	17.4
26A	2	200	218	142	18 ml		251.7	271.0	48	19.3
13B	3	200	220	280	20 ml		249.8	268.0	49	18.2
26A	3	200	216	140	16 ml		261.8	279.5	50	17.7

Field Moisture Log:

Client: HrV **Location:** Corvallis, OR

Source: CFU 113 **Date(s):** 9/21/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
29	1	Initial: 200 Rinse vol: 100	Final: 238 Gain: 38ml	n/a	Initial: 250.1 #: 51	Final: 271.1 Gain: 21.0
29	2	Initial: 200 Rinse vol: 100	Final: 238 Gain: 38ml	n/a	Initial: 271.0 #: 52	Final: 290.0 Gain: 19.0
29	3	Initial: 200 Rinse vol: 100	Final: 234 Gain: 34ml	n/a	Initial: 271.0 #: 53	Final: 293.0 Gain: 22.0
		Initial: Rinse vol:	Final: Gain:		Initial: #:	Final: Gain:
		Initial: Rinse vol:	Final: Gain:		Initial: #:	Final: Gain:
		Initial: Rinse vol:	Final: Gain:		Initial: #:	Final: Gain:

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR

Source: CFU 113(2) **Date(s):** 9/24/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
29	1	**Initial:** 200 **Rinse vol:** 100	**Final:** 242 **Gain:** 42ml	n/a	**Initial:** 271.6 **#:** 54	**Final:** 299.8 **Gain:** 28.2
29	2	**Initial:** 200 **Rinse vol:** 100	**Final:** 234 **Gain:** 34ml		**Initial:** 263.5 **#:** 55	**Final:** 289.7 **Gain:** 26.2
29	3	**Initial:** 200 **Rinse vol:** 100	**Final:** 234 **Gain:** 34ml		**Initial:** 266.5 **#:** 56	**Final:** 293.5 **Gain:** 27.0
		Initial: **Rinse vol:**	**Final:** **Gain:**		**Initial:** **#:**	**Final:** **Gain:**
		Initial: **Rinse vol:**	**Final:** **Gain:**		**Initial:** **#:**	**Final:** **Gain:**
		Initial: **Rinse vol:**	**Final:** **Gain:**		**Initial:** **#:**	**Final:** **Gain:**

Field Moisture Log:

Client: H2V
Location: Corvallis, OR
Source: CFU 113(2)
Date(s): 9/25/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
5	1	Initial: 200 Rinse vol: 160	Final: 230 Gain: 30ml	Q1380	Initial: 254.3 #: 57	Final: 279.2 Gain: 24.9
316	1	Initial: 200 Rinse vol: 225	Final: 228 Gain: 28ml	n/a	Initial: 258.3 #: 58	Final: 280.2 Gain: 21.9
5	2	Initial: 200 Rinse vol: 205	Final: 220 Gain: 20ml	Q1381	Initial: 234.8 #: 59	Final: 261.0 Gain: 26.2
316	2	Initial: 200 Rinse vol: 250	Final: 220 Gain: 20ml	n/a	Initial: 242.8 #: 60	Final: 266.1 Gain: 23.3
5	3	Initial: 200 Rinse vol: 195	Final: 210 Gain: 10ml	Q1382	Initial: 250.8 #: 61	Final: 281.8 Gain: 31.0
316	3	Initial: 200 Rinse vol: 231	Final: 214 Gain: 14ml	n/a	Initial: 258.5 #: 62	Final: 284.1 Gain: 25.6

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR

Source: CFU 113(2) **Date(s):** 9/26/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
13B	1	Initial: 200 Rinse vol: 230	Final: 212 Gain: 12ml	n/a	Initial: 247.0 #: 63	Final: 281.0 Gain: 34.0
26A	1	Initial: 200 Rinse vol: 200	Final: 220 Gain: 20ml		Initial: 257.7 #: 64	Final: 286.7 Gain: 29.0
13B	2	Initial: 200 Rinse vol: 240	Final: 210 Gain: 10ml		Initial: 241.1 #: 65	Final: 273.5 Gain: 32.4
26A	2	Initial: 200 Rinse vol: 175	Final: 212 Gain: 12ml		Initial: 237.7 #: 66	Final: 269.5 Gain: 31.8
13B	3	Initial: 200 Rinse vol: 240	Final: 210 Gain: 10ml		Initial: 236.8 #: 67	Final: 263.5 Gain: 26.7
26A	3	Initial: 200 Rinse vol: 170	Final: 208 Gain: 8ml		Initial: 240.0 #: 68	Final: 271.6 Gain: 31.6

Field Moisture Log:

Client: H+V **Location:** Corvallis, OR

Source: CF4104 **Date(s):** 9/27/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
29	1	Initial: 200	Final: 232	n/a	Initial: 246.7	Final: 284.1
		Rinse vol: 100	Gain: 32ml		#: 69	Gain: 37.4
29	2	Initial: 200	Final: 238	n/a	Initial: 274.8	Final: 305.7
		Rinse vol: 100	Gain: 38ml		#: 70	Gain: 30.9
29	3	Initial: 200	Final: 228	n/a	Initial: 271.4	Final: 296.3
		Rinse vol: 100	Gain: 28ml		#: 71	Gain: 24.9
		Initial:	Final:		Initial:	Final:
		Rinse vol:	Gain:		#:	Gain:
		Initial:	Final:		Initial:	Final:
		Rinse vol:	Gain:		#:	Gain:
		Initial:	Final:		Initial:	Final:
		Rinse vol:	Gain:		#:	Gain:

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR

Source: CFU 104 **Date(s):** 9/28/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
M-5	1	**Initial:** 200 **Rinse vol:** 220	**Final:** 210 **Gain:** 10 ml	Q1389	**Initial:** 262.4 **#:** 72	**Final:** 289.5 **Gain:** 27.1
316	1	**Initial:** 200 **Rinse vol:** 235	**Final:** 206 **Gain:** 6 ml	n/a	**Initial:** 241.6 **#:** 73	**Final:** 263.4 **Gain:** 21.8
M-5	2	**Initial:** 200 **Rinse vol:** 220	**Final:** 220 **Gain:** 20 ml	Q1390	**Initial:** 236.7 **#:** 74	**Final:** 261.6 **Gain:** 24.9
316	2	**Initial:** 200 **Rinse vol:** 230	**Final:** 220 **Gain:** 20 ml	n/a	**Initial:** 255.8 **#:** 75	**Final:** 267.6 **Gain:** 11.8
M-5	3	**Initial:** 200 **Rinse vol:** 205	**Final:** 225 **Gain:** 25 ml	Q1391	**Initial:** 244.3 **#:** 76	**Final:** 266.3 **Gain:** 22.0
316	3	**Initial:** 200 **Rinse vol:** 240	**Final:** 222 **Gain:** 22 ml	n/a	**Initial:** 283.2 **#:** 77	**Final:** 293.6 **Gain:** 10.4

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR
Source: CFU 104 **Date(s):** 9/28/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
13B	1	Initial: 200 Rinse vol: 380	Final: 215 Gain: 15ml	n/a	Initial: 237.1 #: 78	Final: 253.2 Gain: 16.1
26A	1	Initial: 200 Rinse vol: 165	Final: 216 Gain: 16ml		Initial: 242.0 #: 79	Final: 269.4 Gain: 27.4
13B	2	Initial: 200 Rinse vol: 345	Final: 215 Gain: 15ml		Initial: 255.5 #: 80	Final: 272.9 Gain: 17.4
26A	2	Initial: 200 Rinse vol: 130	Final: 214 Gain: 14ml		Initial: 280.0 #: 81	Final: 305.6 Gain: 25.6
13B	3	Initial: 200 Rinse vol: 310	Final: 210 Gain: 10ml		Initial: 254.4 #: 82	Final: 271.2 Gain: 16.8
26A	3	Initial: 200 Rinse vol: 140	Final: 212 Gain: 12ml		Initial: 263.2 #: 83	Final: 288.0 Gain: 24.8

BISON ENGINEERING

PROJECT: HAV218775

CLIENT # B020
REPORT # 18-419

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Case Narrative

Date: October 19, 2018

General Information

Client:	Bison Engineering
Client Number:	B020
Report Number:	18-419
Sample Description:	Impinger Trains
Sample Numbers:	18-S2201 – 18-S2240, 18-S2337 – 18-S2368, 18-S2372, 18-S2373

Analysis

Analytes:	F, HF, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, P, Se, Zn
Analytical Protocols:	EPA Method 13B, EPA Method 26A, EPA Method 29
Analytical Notes:	Method 29 back half sample 18-S2362 was initially mislabeled by the lab. The mistake was discovered after the rest of the back half samples were evaporated down so 18-S2362 was evaporated by itself. A second method blank, MB_BH2, was evaporated and digested with the lone straggler sample. The second method blank was analyzed for all metals. A second LCS set was not done for that sample. No other problems were encountered during the analyses. Results have not been blank corrected.
QA/QC Review:	All of the data have been reviewed by the analysts performing the analyses and the project manager. All of the quality control and sample-specific information in this package is complete and meets or exceeds the minimum requirements for acceptability.
Comments:	If you have any questions or concerns regarding this analysis, please feel free to contact the project manager.
Disclaimer:	This report shall not be reproduced, except in full, without the written approval of the laboratory. The results only represent that of the samples as received into the laboratory.

Paul Duda 10/19/18

Project Manager Date
Paul Duda

Lab ID: 18-S2201
Client ID: Cont #1 Run 1
Source: CFU-112
Run Number: 1
Sample Date: 9/11/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2202
Client ID: Cont #1 Run 2
Source: CFU-112
Run Number: 2
Sample Date: 9/11/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2203
Client ID: Cont #1 Run 3
Source: CFU-112
Run Number: 3
Sample Date: 9/11/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2204
Client ID: Cont #1 Run 1
Source: CFU-112 (2)
Run Number: 1
Sample Date: 9/16/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2205
Client ID: Cont #1 Run 2
Source: CFU-112 (2)
Run Number: 2
Sample Date: 9/16/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2206
Client ID: Cont #1 Run 3
Source: CFU-112 (2)
Run Number: 3
Sample Date: 9/16/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2207
Client ID: Cont #1 Run 1
Source: CFU-113
Run Number: 1
Sample Date: 9/19/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2208
Client ID: Cont #1 Run 2
Source: CFU-113
Run Number: 2
Sample Date: 9/19/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2209
Client ID: Cont #1 Run 3
Source: CFU-113
Run Number: 3
Sample Date: 9/19/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2210
Client ID: Cont #2 DI Blank
Sample Date: 9/11/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2211
Client ID: M13B Audit SSAS346

Analyte	Result	DL	Units
Fluoride, IC	3,120	30.0	µg/sample

Lab ID: 18-S2337
Client ID: Cont #1 Run 1
Source: CFU-113 (2)
Run Number: 1
Sample Date: 9/26/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2338
Client ID: Cont #1 Run 2
Source: CFU-113 (2)
Run Number: 2
Sample Date: 9/26/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2339
Client ID: Cont #1 Run 3
Source: CFU-113 (2)
Run Number: 3
Sample Date: 9/26/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2340
Client ID: Cont #1 Run 1
Source: CFU-104
Run Number: 1
Sample Date: 9/28/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2341
Client ID: Cont #1 Run 2
Source: CFU-104
Run Number: 2
Sample Date: 9/28/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2342
Client ID: Cont #1 Run 3
Source: CFU-104
Run Number: 3
Sample Date: 9/28/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S2343
Client ID: M13B Audit SSAS345
Sample Date: 9/28/18

Analyte	Result	DL	Units
Fluoride, IC	6,020	30.0	µg/sample

Lab ID: 18-S2212
Client ID: Cont #3 Run 1
Source: CFU-112
Run Number: 1
Sample Date: 9/11/18
Sample Volume: 385. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	4.05

Lab ID: 18-S2213
Client ID: Cont #3 Run 2
Source: CFU-112
Run Number: 2
Sample Date: 9/11/18
Sample Volume: 350. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.69

Lab ID: 18-S2214
Client ID: Cont #3 Run 3
Source: CFU-112
Run Number: 3
Sample Date: 9/11/18
Sample Volume: 352. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.71

Lab ID: 18-S2215
Client ID: Cont #3 Run 1
Source: CFU-112 (2)
Run Number: 1
Sample Date: 9/16/18
Sample Volume: 362. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.81

Lab ID: 18-S2216
Client ID: Cont #3 Run 2
Source: CFU-112 (2)
Run Number: 2
Sample Date: 9/16/18
Sample Volume: 355. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.74

Lab ID: 18-S2217
Client ID: Cont #3 Run 3
Source: CFU-112 (2)
Run Number: 3
Sample Date: 9/16/18
Sample Volume: 347. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.65

Lab ID: 18-S2218
Client ID: Cont #3 Run 1
Source: CFU-113
Run Number: 1
Sample Date: 9/19/18
Sample Volume: 357. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.76

Lab ID: 18-S2219
Client ID: Cont #3 Run 2
Source: CFU-113
Run Number: 2
Sample Date: 9/19/18
Sample Volume: 357. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.76

Lab ID: 18-S2220
Client ID: Cont #3 Run 3
Source: CFU-113
Run Number: 3
Sample Date: 9/19/18
Sample Volume: 355. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.74

Lab ID: 18-S2221
Client ID: 0.1N H2SO4 Blank
Sample Date: 9/11/18
Sample Volume: 423. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	4.45

Lab ID: 18-S2222
Client ID: HPLC DI Blank
Sample Date: 9/11/18
Sample Volume: 196. mL

	mg/L		µg/sample	
Analyte	Conc.	DL	Conc.	DL
HF	< DL	0.011	< DL	2.06

Lab ID: 18-S2223
Client ID: M26A Audit SSAS346

	mg/L	
Analyte	Conc.	DL
HF	20.0	0.011

Lab ID: 18-S2344
Client ID: Cont #3 Run 1
Source: CFU-113(2)
Run Number: 1
Sample Date: 9/26/18
Sample Volume: 418. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	4.40

Lab ID: 18-S2345
Client ID: Cont #3 Run 2
Source: CFU-113(2)
Run Number: 2
Sample Date: 9/26/18
Sample Volume: 385. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	4.05

Lab ID: 18-S2346
Client ID: Cont #3 Run 3
Source: CFU-113(2)
Run Number: 3
Sample Date: 9/26/18
Sample Volume: 375. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.95

Lab ID: 18-S2347
Client ID: Cont #3 Run 1
Source: CFU-104
Run Number: 1
Sample Date: 9/28/18
Sample Volume: 375. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.95

Lab ID: 18-S2348
Client ID: Cont #3 Run 2
Source: CFU-104
Run Number: 2
Sample Date: 9/28/18
Sample Volume: 340. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.58

Lab ID: 18-S2349
Client ID: Cont #3 Run 3
Source: CFU-104
Run Number: 3
Sample Date: 9/28/18
Sample Volume: 350. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.69

Lab ID: 18-S2350
Client ID: M26A Audit SSAS345

Analyte	mg/L Conc.	mg/L DL
HF	345.	0.011

Lab ID: 18-S2224
Client ID: Run 1 FH
Source: CFU-112
Run Number: 1
Sample Date: 9/13/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.59	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	0.403	0.100	µg/sample
Chromium, ICP	1.19	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	4.23	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.40	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	12.7	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	8.92	0.750	µg/sample

Lab ID: 18-S2225
Client ID: Run 1 BH
Source: CFU-112
Run Number: 1
Sample Date: 9/13/18

Analyte	Result	DL	Units
Antimony, ICP	5.15	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.614	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.206	0.080	µg/sample
Cobalt, ICP	0.055	0.050	µg/sample
Copper, ICP	2.94	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.574	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	2.28	0.300	µg/sample

Lab ID: 18-S2226
Client ID: Run 2 FH
Source: CFU-112
Run Number: 2
Sample Date: 9/13/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.50	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	0.385	0.100	µg/sample
Chromium, ICP	1.09	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	2.39	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.32	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	12.7	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	6.12	0.750	µg/sample

Lab ID: 18-S2227
Client ID: Run 2 BH
Source: CFU-112
Run Number: 2
Sample Date: 9/13/18

Analyte	Result	DL	Units
Antimony, ICP	1.43	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.594	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.252	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	2.32	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	4.23	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	2.19	0.300	µg/sample

Lab ID: 18-S2228
Client ID: Run 3 FH
Source: CFU-112
Run Number: 3
Sample Date: 9/13/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.75	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	0.357	0.100	µg/sample
Chromium, ICP	2.03	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	2.08	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.44	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	15.3	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	7.36	0.750	µg/sample

Lab ID: 18-S2229
Client ID: Run 3 BH
Source: CFU-112
Run Number: 3
Sample Date: 9/13/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.762	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.270	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	5.23	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	3.09	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	3.08	0.300	µg/sample

Lab ID: 18-S2230
Client ID: Run 1 FH
Source: CFU-112 (2)
Run Number: 1
Sample Date: 9/14/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.39	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	0.455	0.100	µg/sample
Chromium, ICP	1.13	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	2.24	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.39	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	14.7	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	8.82	0.750	µg/sample

Lab ID: 18-S2231
Client ID: Run 1 BH
Source: CFU-112 (2)
Run Number: 1
Sample Date: 9/14/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.660	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.266	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	3.72	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.750	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	3.07	0.300	µg/sample

Lab ID: 18-S2232
Client ID: Run 2 FH
Source: CFU-112 (2)
Run Number: 2
Sample Date: 9/14/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.24	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	0.426	0.100	µg/sample
Chromium, ICP	1.08	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	2.01	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.30	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	9.56	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	2.76	0.750	µg/sample

Lab ID: 18-S2233
Client ID: Run 2 BH
Source: CFU-112 (2)
Run Number: 2
Sample Date: 9/14/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.684	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.236	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	3.84	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.594	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	12.1	0.300	µg/sample

Lab ID: 18-S2234
Client ID: Run 3 FH
Source: CFU-112 (2)
Run Number: 3
Sample Date: 9/15/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.80	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	0.462	0.100	µg/sample
Chromium, ICP	1.14	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	3.00	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.37	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	12.1	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	4.00	0.750	µg/sample

Lab ID: 18-S2235
Client ID: Run 3 BH
Source: CFU-112 (2)
Run Number: 3
Sample Date: 9/15/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.784	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.245	0.080	µg/sample
Cobalt, ICP	0.075	0.050	µg/sample
Copper, ICP	3.47	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.462	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	1.88	0.300	µg/sample

Lab ID: 18-S2236
Client ID: 0.1N HNO3 Blank
Sample Date: 9/13/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	0.454	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	< DL	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	2.12	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	0.206	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	< DL	0.750	µg/sample

Lab ID: 18-S2237
Client ID: Filter Blank
Sample Date: 9/13/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	2.82	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	0.365	0.100	µg/sample
Chromium, ICP	0.953	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	< DL	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.03	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	13.4	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	1.24	0.750	µg/sample

Lab ID: 18-S2238
Client ID: H2O2/HNO3 Blank
Sample Date: 9/13/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.423	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.154	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	2.75	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.980	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	0.724	0.300	µg/sample

Lab ID: 18-S2239
Client ID: M29 Metals Filter Audit SSAS346

Analyte	Result	DL	Units
Antimony, ICP	49.8	1.25	µg/sample
Arsenic, ICP	26.0	1.75	µg/sample
Barium, ICP	40.1	0.125	µg/sample
Beryllium, ICP	46.0	0.050	µg/sample
Cadmium, ICP	25.9	0.100	µg/sample
Chromium, ICP	33.1	0.200	µg/sample
Cobalt, ICP	23.4	0.125	µg/sample
Copper, ICP	34.7	1.25	µg/sample
Lead, ICP	53.0	1.25	µg/sample
Manganese, ICP	42.5	0.075	µg/sample
Nickel, ICP	57.6	0.750	µg/sample
Phosphorus, ICP	10.8	5.00	µg/sample
Selenium, ICP	25.9	3.75	µg/sample
Zinc, ICP	40.1	0.750	µg/sample

Lab ID: 18-S2240
Client ID: M29 Metals Impinger Audit SSAS346

Analyte	Result	DL	Units
Antimony, ICP	0.597	0.00200	µg/mL
Arsenic, ICP	0.416	0.00280	µg/mL
Barium, ICP	2.30	0.00020	µg/mL
Beryllium, ICP	0.649	0.00008	µg/mL
Cadmium, ICP	0.311	0.00016	µg/mL
Chromium, ICP	1.21	0.00032	µg/mL
Cobalt, ICP	2.66	0.00020	µg/mL
Copper, ICP	0.922	0.00200	µg/mL
Lead, ICP	2.92	0.00200	µg/mL
Manganese, ICP	0.366	0.00012	µg/mL
Nickel, ICP	2.21	0.00120	µg/mL
Phosphorus, ICP	0.041	0.00800	µg/mL
Selenium, ICP	0.793	0.00600	µg/mL
Zinc, ICP	0.715	0.00120	µg/mL

Lab ID: 18-S2351
Client ID: Run 1 FH
Source: CFU-113
Run Number: 1
Sample Date: 9/21/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.37	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	1.19	0.100	µg/sample
Chromium, ICP	1.24	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	3.70	1.25	µg/sample
Lead, ICP	7.36	1.25	µg/sample
Manganese, ICP	1.27	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	35.0	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	4.93	0.750	µg/sample

Lab ID: 18-S2352
Client ID: Run 1 BH
Source: CFU-113
Run Number: 1
Sample Date: 9/21/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.716	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.294	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	4.15	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.572	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	3.43	0.300	µg/sample

Lab ID: 18-S2353
Client ID: Run 2 FH
Source: CFU-113
Run Number: 2
Sample Date: 9/21/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.35	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	1.23	0.100	µg/sample
Chromium, ICP	1.26	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	3.00	1.25	µg/sample
Lead, ICP	7.67	1.25	µg/sample
Manganese, ICP	1.22	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	31.6	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	12.7	0.750	µg/sample

Lab ID: 18-S2354
Client ID: Run 2 BH
Source: CFU-113
Run Number: 2
Sample Date: 9/21/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.613	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.322	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	3.76	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.477	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	2.90	0.300	µg/sample

Lab ID: 18-S2355
Client ID: Run 3 FH
Source: CFU-113
Run Number: 3
Sample Date: 9/21/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.19	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	1.25	0.100	µg/sample
Chromium, ICP	1.29	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	3.23	1.25	µg/sample
Lead, ICP	7.14	1.25	µg/sample
Manganese, ICP	1.23	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	33.0	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	8.60	0.750	µg/sample

Lab ID: 18-S2356
Client ID: Run 3 BH
Source: CFU-113
Run Number: 3
Sample Date: 9/21/18

Analyte	Result	DL	Units
Antimony, ICP	3.08	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.640	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.233	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	5.03	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.435	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	2.67	0.300	µg/sample

Lab ID: 18-S2357
Client ID: Run 1 FH
Source: CFU-113(2)
Run Number: 1
Sample Date: 9/24/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.33	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	1.24	0.100	µg/sample
Chromium, ICP	1.36	0.200	µg/sample
Cobalt, ICP	0.597	0.125	µg/sample
Copper, ICP	3.56	1.25	µg/sample
Lead, ICP	7.85	1.25	µg/sample
Manganese, ICP	1.41	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	34.1	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	10.6	0.750	µg/sample

Lab ID: 18-S2358
Client ID: Run 1 BH
Source: CFU-113(2)
Run Number: 1
Sample Date: 9/24/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.691	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.370	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	3.21	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.434	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	2.07	0.300	µg/sample

Lab ID: 18-S2359
Client ID: Run 2 FH
Source: CFU-113(2)
Run Number: 2
Sample Date: 9/24/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.34	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	1.22	0.100	µg/sample
Chromium, ICP	1.32	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	2.77	1.25	µg/sample
Lead, ICP	7.58	1.25	µg/sample
Manganese, ICP	1.30	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	33.2	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	6.60	0.750	µg/sample

Lab ID: 18-S2360
Client ID: Run 2 BH
Source: CFU-113(2)
Run Number: 2
Sample Date: 9/24/18

Analyte	Result	DL	Units
Antimony, ICP	2.02	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.535	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.219	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	3.78	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.411	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	2.29	0.300	µg/sample

Lab ID: 18-S2361
Client ID: Run 3 FH
Source: CFU-113(2)
Run Number: 3
Sample Date: 9/24/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	5.67	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	1.12	0.100	µg/sample
Chromium, ICP	1.34	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	3.78	1.25	µg/sample
Lead, ICP	7.53	1.25	µg/sample
Manganese, ICP	1.45	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	34.6	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	24.3	0.750	µg/sample

Lab ID: 18-S2362
Client ID: Run 3 BH
Source: CFU-113(2)
Run Number: 3
Sample Date: 9/24/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.501	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.229	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	4.20	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.383	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	1.77	0.300	µg/sample

Lab ID: 18-S2363
Client ID: Run 1 FH
Source: CFU-104
Run Number: 1
Sample Date: 9/27/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.52	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	1.18	0.100	µg/sample
Chromium, ICP	1.83	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	3.48	1.25	µg/sample
Lead, ICP	7.56	1.25	µg/sample
Manganese, ICP	1.69	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	29.4	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	11.0	0.750	µg/sample

Lab ID: 18-S2364
Client ID: Run 1 BH
Source: CFU-104
Run Number: 1
Sample Date: 9/27/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.547	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.198	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	2.18	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.407	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	4.40	0.300	µg/sample

Lab ID: 18-S2365
Client ID: Run 2 FH
Source: CFU-104
Run Number: 2
Sample Date: 9/27/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.37	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	1.20	0.100	µg/sample
Chromium, ICP	1.39	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	2.13	1.25	µg/sample
Lead, ICP	7.40	1.25	µg/sample
Manganese, ICP	1.41	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	33.3	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	6.07	0.750	µg/sample

Lab ID: 18-S2366
Client ID: Run 2 BH
Source: CFU-104
Run Number: 2
Sample Date: 9/27/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.521	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.656	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	2.81	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.538	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	3.76	0.300	µg/sample

Lab ID: 18-S2367
Client ID: Run 3 FH
Source: CFU-104
Run Number: 3
Sample Date: 9/27/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.31	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	1.26	0.100	µg/sample
Chromium, ICP	1.27	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.92	1.25	µg/sample
Lead, ICP	6.74	1.25	µg/sample
Manganese, ICP	1.34	0.075	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	31.0	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	5.43	0.750	µg/sample

Lab ID: 18-S2368
Client ID: Run 3 BH
Source: CFU-104
Run Number: 3
Sample Date: 9/27/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.474	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.269	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	2.46	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.445	0.030	µg/sample
Nickel, ICP	< DL	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	1.35	0.300	µg/sample

Lab ID: 18-S2372
Client ID: M29 Metals Filter Audit SSAS345

Analyte	Result	DL	Units
Antimony, ICP	82.2	1.25	µg/sample
Arsenic, ICP	223.	1.75	µg/sample
Barium, ICP	209.	0.125	µg/sample
Beryllium, ICP	78.4	0.050	µg/sample
Cadmium, ICP	64.6	0.100	µg/sample
Chromium, ICP	141.	0.200	µg/sample
Cobalt, ICP	206.	0.125	µg/sample
Copper, ICP	73.4	1.25	µg/sample
Lead, ICP	43.4	1.25	µg/sample
Manganese, ICP	99.9	0.075	µg/sample
Nickel, ICP	139.	0.750	µg/sample
Phosphorus, ICP	31.9	5.00	µg/sample
Selenium, ICP	157.	3.75	µg/sample
Zinc, ICP	122.	0.750	µg/sample

Lab ID: 18-S2373
Client ID: M29 Metals Impinger Audit SSAS345

Analyte	Result	DL	Units
Antimony, ICP	9.86	0.00200	µg/mL
Arsenic, ICP	9.98	0.00280	µg/mL
Barium, ICP	9.57	0.00020	µg/mL
Beryllium, ICP	9.44	0.00008	µg/mL
Cadmium, ICP	9.86	0.00016	µg/mL
Chromium, ICP	10.9	0.00032	µg/mL
Cobalt, ICP	9.92	0.00020	µg/mL
Copper, ICP	9.56	0.00200	µg/mL
Lead, ICP	9.36	0.00200	µg/mL
Manganese, ICP	9.68	0.00012	µg/mL
Nickel, ICP	9.73	0.00120	µg/mL
Phosphorus, ICP	0.439	0.00800	µg/mL
Selenium, ICP	9.69	0.00600	µg/mL
Zinc, ICP	9.76	0.00120	µg/mL

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: Ion Chromatography
Sample Description: Method 13B
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. mg/L	DL Conc. mg/L
F	ICB	< DL	0.030
F	Meth_Blk	< DL	0.030
F	CCB	< DL	0.030
F	CCB	< DL	0.030

ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

Calibration QC

Analyte	Sample ID	Standard Conc. mg/L	Measured Conc. mg/L	Percent Recovery
F	ICV	1.00	1.03	102.7
F	CCV	1.00	1.03	103.4
F	CCV	1.00	1.04	104.0

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery

Duplicate Data

Analyte	Sample ID	Sample Conc. mg/L	Duplicate Conc. mg/L	RPD
F	18-S2201	< 0.03	< 0.03	N/C #

RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100
N/C: RPD is not calculated when sample or duplicate is below detection limit
Duplicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or duplicate concentration is less than 5x the detection limit

Matrix Spike Analysis

Analyte	Sample ID	Sample Conc. mg/L	Spike Conc. mg/L	Spike Amount mg/L	Percent Recovery
F	LCS	< 0.03	1.06	1.00	106.
F	LCS	< 0.03	1.02	1.00	102.
F	18-S2202	< 0.03	1.03	1.00	103.

Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
F	LCS-DUP	1.06	1.02	4.22

RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100
Duplicate Limit: 20% RPD

LCS Limit: 80% - 120% Recovery

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: Ion Chromatography
Sample Description: Method 13B
Report Number: 18-419
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Blank Data

Analyte	Sample ID	Measured Conc. mg/L	DL Conc. mg/L
F	ICB	< DL	0.030
F	CCB	< DL	0.030
F	Meth_Blk	< DL	0.030
F	CCB	< DL	0.030
F	CCB	< DL	0.030

ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

Calibration QC

Analyte	Sample ID	Standard Conc. mg/L	Measured Conc. mg/L	Percent Recovery
F	ICV	1.00	1.06	106.4
F	CCV	1.00	1.04	103.8
F	CCV	1.00	1.04	104.3
F	CCV	1.00	1.05	105.1

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery

Duplicate Data

Analyte	Sample ID	Sample Conc. mg/L	Duplicate Conc. mg/L	RPD
F	18-S2337	< 0.03	< 0.03	N/C #

RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100
N/C: RPD is not calculated when sample or duplicate is below detection limit
Duplicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or duplicate concentration is less than 5x the detection limit

Matrix Spike Analysis

Analyte	Sample ID	Sample Conc. mg/L	Spike Conc. mg/L	Spike Amount mg/L	Percent Recovery
F	LCS	< 0.03	1.04	1.00	104.
F	LCS	< 0.03	1.03	1.00	103.
F	18-S2338	< 0.03	1.04	1.00	104.

Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

LCS Limit: 80% - 120% Recovery

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: Ion Chromatography
Sample Description: Method 13B
Report Number: 18-419
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Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. μg/L	Duplicate Conc. μg/L	RPD
F	LCS-DUP	1.04	1.03	1.54

RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100
Duplicate Limit: 20% RPD

LCS Limit: 80% - 120% Recovery

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: Ion Chromatography
Sample Description: Method 26A
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. mg/L	DL Conc. mg/L
F	ICB	< DL	0.010
F	CCB	< DL	0.010
F	CCB	< DL	0.010
F	CCB	< DL	0.010

ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

Calibration QC

Analyte	Sample ID	Standard Conc. mg/L	Measured Conc. mg/L	Percent Recovery
F	ICV	1.00	1.04	104.1
F	CCV	1.00	1.02	102.1
F	CCV	1.00	1.02	102.0
F	CCV	1.00	1.04	103.6

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery

Duplicate Data

All samples analyzed in duplicate. The reported concentrations are the average of the two measurements.

Matrix Spike Analysis

Analyte	Sample ID	Sample Conc. mg/L	Spike Conc. mg/L	Spike Amount mg/L	Percent Recovery
F	18-S2212	< 0.01	1.04	1.00	104.
F	18-S2215	< 0.01	1.07	1.00	107.
F	18-S2218	< 0.01	1.03	1.00	103.

Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

LCS Limit: 80% - 120% Recovery

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: Ion Chromatography
Sample Description: Method 26A
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. mg/L	DL Conc. mg/L
F	ICB	< DL	0.010
F	CCB	< DL	0.010
F	CCB	< DL	0.010

ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

Calibration QC

Analyte	Sample ID	Standard Conc. mg/L	Measured Conc. mg/L	Percent Recovery
F	ICV	1.00	1.05	104.8
F	CCV	1.00	1.04	104.5
F	CCV	1.00	1.05	104.6

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery

Duplicate Data

All samples analyzed in duplicate. The reported concentrations are the average of the two measurements.

Matrix Spike Analysis

Analyte	Sample ID	Sample Conc. mg/L	Spike Conc. mg/L	Spike Amount mg/L	Percent Recovery
F	18-S2344	< 0.01	1.01	1.00	101.
F	18-S2347	< 0.01	1.04	1.00	104.

Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

LCS Limit: 80% - 120% Recovery

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Front Half
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
As	ICB	< DL	7.00
As	Meth_Blk	< DL	7.00
As	CCB	< DL	7.00
As	CCB	< DL	7.00
Ba	ICB	< DL	0.500
Ba	Meth_Blk	< DL	0.500
Ba	CCB	< DL	0.500
Ba	Meth_Blk	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Be	ICB	< DL	0.200
Be	Meth_Blk	< DL	0.200
Be	CCB	< DL	0.200
Be	CCB	< DL	0.200
Cd	ICB	< DL	0.400
Cd	Meth_Blk	< DL	0.400
Cd	CCB	< DL	0.400
Cd	CCB	< DL	0.400
Co	ICB	< DL	0.500
Co	Meth_Blk	< DL	0.500
Co	CCB	< DL	0.500
Co	CCB	< DL	0.500
Cr	ICB	< DL	0.800
Cr	Meth_Blk	< DL	0.800
Cr	CCB	< DL	0.800
Cr	CCB	< DL	0.800
Cu	ICB	< DL	5.00
Cu	Meth_Blk	< DL	5.00
Cu	CCB	< DL	5.00
Cu	CCB	< DL	5.00
Mn	ICB	< DL	0.300
Mn	Meth_Blk	< DL	0.300
Mn	CCB	< DL	0.300
Mn	CCB	< DL	0.300
Ni	ICB	< DL	3.00
Ni	Meth_Blk	< DL	3.00
Ni	CCB	< DL	3.00
Ni	CCB	< DL	3.00
P	ICB	< DL	20.0
P	Meth_Blk	< DL	20.0
P	CCB	< DL	20.0
P	CCB	< DL	20.0
Pb	ICB	< DL	5.00
Pb	Meth_Blk	10.7	5.00
Pb	CCB	< DL	5.00
Pb	CCB	< DL	5.00
Sb	ICB	< DL	5.00
Sb	Meth_Blk	< DL	5.00
Sb	CCB	< DL	5.00
Sb	CCB	< DL	5.00
Se	ICB	< DL	15.0
Se	Meth_Blk	< DL	15.0
Se	CCB	< DL	15.0
Se	CCB	< DL	15.0
Zn	ICB	< DL	3.00
Zn	Meth_Blk	< DL	3.00
Zn	CCB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Front Half
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
Zn	CCB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
As	ICV	2500	2460	98.4
As	LL-CCV	35.0	32.6	93.2
As	CCV	2500	2390	95.8
As	CCV	2500	2420	96.7
Ba	ICV	2500	2700	107.9
Ba	LL-CCV	2.50	2.77	110.8
Ba	CCV	2500	2620	105.0
Ba	CCV	2500	2710	108.3
Ba	CCV	2500	2630	105.0
Ba	CCV	2500	2730	109.0
Ba	CCV	2500	2720	109.0
Be	ICV	2500	2460	98.6
Be	LL-CCV	1.00	1.02	101.5
Be	CCV	2500	2440	97.4
Be	CCV	2500	2410	96.4
Cd	ICV	2500	2430	97.2
Cd	LL-CCV	2.00	2.24	112.2
Cd	CCV	2500	2440	97.8
Cd	CCV	2500	2400	96.2
Co	ICV	2500	2430	97.1
Co	LL-CCV	2.50	2.22	88.8
Co	CCV	2500	2440	97.5
Co	CCV	2500	2390	95.6
Cr	ICV	2500	2400	96.0
Cr	LL-CCV	4.00	4.06	101.6
Cr	CCV	2500	2410	96.5
Cr	CCV	2500	2360	94.4
Cu	ICV	2500	2390	95.5
Cu	LL-CCV	25.0	26.8	107.2
Cu	CCV	2500	2440	97.8
Cu	CCV	2500	2400	96.2
Mn	ICV	2500	2490	99.7
Mn	LL-CCV	1.50	1.53	101.9
Mn	CCV	2500	2510	100.3
Mn	CCV	2500	2460	98.2
Ni	ICV	2500	2430	97.2
Ni	LL-CCV	15.0	15.8	105.6
Ni	CCV	2500	2440	97.5
Ni	CCV	2500	2390	95.4
P	ICV	2500	2400	96.1
P	LL-CCV	100.	98.0	98.0
P	CCV	2500	2340	93.6
P	CCV	2500	2360	94.2
Pb	ICV	2500	2430	97.3
Pb	LL-CCV	25.0	26.5	105.8
Pb	CCV	2500	2360	94.2

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV: Low Level CCV
LL-CCV Limits: 70% - 130% Recovery

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QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Front Half
Report Number: 18-419

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Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Pb	CCV	2500	2370	94.7
Sb	ICV	2500	2450	98.0
Sb	LL-CCV	25.0	23.5	94.0
Sb	CCV	2500	2410	96.5
Sb	CCV	2500	2430	97.0
Se	ICV	2500	2500	100.2
Se	LL-CCV	75.0	69.1	92.1
Se	CCV	2500	2430	97.2
Se	CCV	2500	2460	98.5
Zn	ICV	2500	2470	98.9
Zn	LL-CCV	15.0	16.4	109.4
Zn	CCV	2500	2480	99.2
Zn	CCV	2500	2440	97.6

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV: Low Level CCV
LL-CCV Limits: 70% - 130% Recovery

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
As	18-S2224	< 7	< 7	N/C #
As	18-S2230	< 7	< 7	N/C #
Ba	18-S2224	14.35	13.71	4.56
Ba	18-S2230	13.55	13.87	2.33
Ba	18-S2225	6.140	6.240	1.62
Ba	18-S2231	6.604	6.643	0.59
Be	18-S2224	< 0.2	< 0.2	N/C #
Be	18-S2230	< 0.2	< 0.2	N/C #
Cd	18-S2224	1.611	1.691	4.85 #
Cd	18-S2230	1.821	1.933	5.97 #
Co	18-S2224	< 0.5	< 0.5	N/C #
Co	18-S2230	< 0.5	< 0.5	N/C #
Cr	18-S2224	4.750	4.853	2.15
Cr	18-S2230	4.506	4.643	2.99
Cu	18-S2224	16.93	14.31	16.8 #
Cu	18-S2230	8.976	8.704	3.08 #
Mn	18-S2224	5.599	5.479	2.17
Mn	18-S2230	5.556	5.549	0.13
Ni	18-S2224	< 3	< 3	N/C #
Ni	18-S2230	< 3	< 3	N/C #
P	18-S2224	50.87	54.98	7.77 #
P	18-S2230	58.85	59.07	0.37 #
Pb	18-S2224	< 5	< 5	N/C #
Pb	18-S2230	< 5	< 5	N/C #
Sb	18-S2224	< 5	< 5	N/C #
Sb	18-S2230	< 5	< 5	N/C #
Se	18-S2224	< 15	< 15	N/C #
Se	18-S2230	< 15	< 15	N/C #
Zn	18-S2224	35.67	35.53	0.39

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
Replicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or replicate concentration is less than 5x the detection limit

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Front Half
Report Number: 18-419

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
Zn	18-S2230	35.27	35.46	0.54

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
Replicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or replicate concentration is less than 5x the detection limit

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
As	LCS	< 7	2493.	2500.	99.7
As	LCS	< 7	2526.	2500.	101.
As	18-S2226	< 7	2296.	2500.	91.8
As	18-S2232	< 7	2302.	2500.	92.1
Ba	LCS	< 0.5	2542.	2500.	102.
Ba	LCS	< 0.5	2595.	2500.	104.
Ba	18-S2226	14.01	2445.	2500.	97.2
Ba	18-S2232	12.96	2420.	2500.	96.3
Ba	LCS	< 0.5	2469.	2500.	98.8
Ba	LCS	< 0.5	2492.	2500.	99.7
Ba	18-S2227	5.938	2388.	2500.	95.3
Ba	18-S2233	6.836	2354.	2500.	93.9
Be	LCS	< 0.2	2484.	2500.	99.4
Be	LCS	< 0.2	2506.	2500.	100.
Be	18-S2226	< 0.2	2304.	2500.	92.2
Be	18-S2232	< 0.2	2291.	2500.	91.6
Cd	LCS	< 0.4	2524.	2500.	101.
Cd	LCS	< 0.4	2558.	2500.	102.
Cd	18-S2226	1.540	2357.	2500.	94.2
Cd	18-S2232	1.706	2349.	2500.	93.9
Co	LCS	< 0.5	2455.	2500.	98.2
Co	LCS	< 0.5	2493.	2500.	99.7
Co	18-S2226	< 0.5	2250.	2500.	90.0
Co	18-S2232	< 0.5	2239.	2500.	89.6
Cr	LCS	< 0.8	2399.	2500.	96.0
Cr	LCS	< 0.8	2439.	2500.	97.6
Cr	18-S2226	4.351	2271.	2500.	90.7
Cr	18-S2232	4.325	2261.	2500.	90.3
Cu	LCS	< 5	2456.	2500.	98.2
Cu	LCS	< 5	2496.	2500.	99.8
Cu	18-S2226	9.552	2455.	2500.	97.8
Cu	18-S2232	8.052	2446.	2500.	97.5
Mn	LCS	< 0.3	2490.	2500.	99.6
Mn	LCS	< 0.3	2530.	2500.	101.
Mn	18-S2226	5.281	2356.	2500.	94.0
Mn	18-S2232	5.181	2342.	2500.	93.5
Ni	LCS	< 3	2482.	2500.	99.3
Ni	LCS	< 3	2516.	2500.	101.
Ni	18-S2226	< 3	2256.	2500.	90.2
Ni	18-S2232	< 3	2248.	2500.	89.9
P	LCS	< 20	2470.	2500.	98.8
P	LCS	< 20	2490.	2500.	99.6
P	18-S2226	50.77	2307.	2500.	90.2
P	18-S2232	38.23	2311.	2500.	90.9

LCS Limit: 80% - 120% Recovery   Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Front Half
Report Number: 18-419

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Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Pb	LCS	10.69	2457.	2500.	97.9
Pb	LCS	10.69	2485.	2500.	99.0
Pb	18-S2226	< 5	2161.	2500.	86.4
Pb	18-S2232	< 5	2156.	2500.	86.2
Sb	LCS	< 5	2476.	2500.	99.0
Sb	LCS	< 5	2502.	2500.	100.
Sb	18-S2226	< 5	2273.	2500.	90.9
Sb	18-S2232	< 5	2279.	2500.	91.2
Se	LCS	< 15	2591.	2500.	104.
Se	LCS	< 15	2618.	2500.	105.
Se	18-S2226	< 15	2303.	2500.	92.1
Se	18-S2232	< 15	2312.	2500.	92.5
Zn	LCS	< 3	2599.	2500.	104.
Zn	LCS	< 3	2634.	2500.	105.
Zn	18-S2226	24.47	2397.	2500.	94.9
Zn	18-S2232	11.05	2383.	2500.	94.9

LCS Limit: 80% - 120% Recovery   Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
As	LCS-DUP	2490	2530	1.32
Ba	LCS-DUP	2540	2600	2.06
Ba	LCS-DUP	2470	2490	0.93
Be	LCS-DUP	2480	2510	0.88
Cd	LCS-DUP	2520	2560	1.34
Co	LCS-DUP	2460	2490	1.54
Cr	LCS-DUP	2400	2440	1.65
Cu	LCS-DUP	2460	2500	1.62
Mn	LCS-DUP	2490	2530	1.59
Ni	LCS-DUP	2480	2520	1.36
P	LCS-DUP	2470	2490	0.81
Pb	LCS-DUP	2460	2480	1.13
Sb	LCS-DUP	2480	2500	1.04
Se	LCS-DUP	2590	2620	1.04
Zn	LCS-DUP	2600	2630	1.34

Duplicate Limit: 20% RPD
RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Back Half
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
As	ICB	< DL	7.00
As	CCB	< DL	7.00
As	Meth_Blk	< DL	7.00
As	CCB	< DL	7.00
As	CCB	< DL	7.00
As	CCB	< DL	7.00
Ba	ICB	< DL	0.500
Ba	Meth_Blk	< DL	0.500
Ba	CCB	< DL	0.500
Ba	Meth_Blk	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Be	ICB	< DL	0.200
Be	CCB	< DL	0.200
Be	Meth_Blk	< DL	0.200
Be	CCB	< DL	0.200
Be	CCB	< DL	0.200
Be	CCB	< DL	0.200
Cd	ICB	< DL	0.400
Cd	CCB	< DL	0.400
Cd	Meth_Blk	< DL	0.400
Cd	CCB	< DL	0.400
Cd	CCB	< DL	0.400
Cd	CCB	< DL	0.400
Co	ICB	< DL	0.500
Co	CCB	< DL	0.500
Co	Meth_Blk	< DL	0.500
Co	CCB	< DL	0.500
Co	CCB	< DL	0.500
Co	CCB	< DL	0.500
Cr	ICB	< DL	0.800
Cr	CCB	< DL	0.800
Cr	Meth_Blk	< DL	0.800
Cr	CCB	< DL	0.800
Cr	CCB	< DL	0.800
Cr	CCB	< DL	0.800
Cu	ICB	< DL	5.00
Cu	CCB	< DL	5.00
Cu	Meth_Blk	< DL	5.00
Cu	CCB	< DL	5.00
Cu	CCB	< DL	5.00
Cu	CCB	< DL	5.00
Mn	ICB	< DL	0.300
Mn	CCB	< DL	0.300
Mn	Meth_Blk	< DL	0.300
Mn	CCB	< DL	0.300
Mn	CCB	< DL	0.300
Mn	CCB	< DL	0.300
Ni	ICB	< DL	3.00
Ni	CCB	< DL	3.00
Ni	Meth_Blk	< DL	3.00
Ni	CCB	< DL	3.00
Ni	CCB	< DL	3.00
Ni	CCB	< DL	3.00
P	ICB	< DL	20.0
P	CCB	< DL	20.0
P	Meth_Blk	< DL	20.0

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Back Half
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
P	CCB	< DL	20.0
P	CCB	< DL	20.0
P	CCB	< DL	20.0
Pb	ICB	< DL	5.00
Pb	CCB	< DL	5.00
Pb	Meth_Blk	< DL	5.00
Pb	CCB	< DL	5.00
Pb	CCB	< DL	5.00
Pb	CCB	< DL	5.00
Sb	ICB	< DL	5.00
Sb	CCB	< DL	5.00
Sb	Meth_Blk	< DL	5.00
Sb	CCB	< DL	5.00
Sb	CCB	< DL	5.00
Sb	CCB	< DL	5.00
Se	ICB	< DL	15.0
Se	CCB	< DL	15.0
Se	Meth_Blk	< DL	15.0
Se	CCB	< DL	15.0
Se	CCB	< DL	15.0
Se	CCB	< DL	15.0
Zn	ICB	< DL	3.00
Zn	CCB	< DL	3.00
Zn	Meth_Blk	< DL	3.00
Zn	CCB	< DL	3.00
Zn	CCB	< DL	3.00
Zn	CCB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
As	ICV	2500	2460	98.4
As	LL-CCV	35.0	33.3	95.3
As	CCV	2500	2400	95.8
As	CCV	2500	2420	96.8
As	CCV	2500	2420	96.9
As	CCV	2500	2450	97.8
Ba	ICV	2500	2700	107.9
Ba	LL-CCV	2.50	2.77	110.8
Ba	CCV	2500	2620	105.0
Ba	CCV	2500	2710	108.3
Ba	CCV	2500	2630	105.0
Ba	CCV	2500	2730	109.0
Ba	CCV	2500	2720	109.0
Be	ICV	2500	2460	98.6
Be	LL-CCV	1.00	1.03	103.4
Be	CCV	2500	2430	97.4
Be	CCV	2500	2410	96.4
Be	CCV	2500	2420	96.6
Be	CCV	2500	2450	98.2
Cd	ICV	2500	2430	97.2

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV: Low Level CCV
LL-CCV Limits: 70% - 130% Recovery

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Back Half
Report Number: 18-419

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Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Cd	LL-CCV	2.50	2.33	93.1
Cd	CCV	2500	2440	97.8
Cd	CCV	2500	2400	96.1
Cd	CCV	2500	2440	97.7
Cd	CCV	2500	2460	98.4
Co	ICV	2500	2430	97.1
Co	LL-CCV	2.50	2.36	94.2
Co	CCV	2500	2440	97.5
Co	CCV	2500	2390	95.6
Co	CCV	2500	2420	97.0
Co	CCV	2500	2450	98.1
Cr	ICV	2500	2400	95.9
Cr	LL-CCV	4.00	4.16	104.1
Cr	CCV	2500	2410	96.4
Cr	CCV	2500	2360	94.4
Cr	CCV	2500	2390	95.5
Cr	CCV	2500	2410	96.3
Cu	ICV	2500	2390	95.5
Cu	LL-CCV	25.0	26.8	107.2
Cu	CCV	2500	2440	97.8
Cu	CCV	2500	2400	96.2
Cu	CCV	2500	2420	96.8
Cu	CCV	2500	2420	96.6
Mn	ICV	2500	2490	99.6
Mn	LL-CCV	1.50	1.54	102.4
Mn	CCV	2500	2510	100.3
Mn	CCV	2500	2460	98.2
Mn	CCV	2500	2490	99.5
Mn	CCV	2500	2510	100.5
Ni	ICV	2500	2430	97.3
Ni	LL-CCV	15.0	15.7	104.7
Ni	CCV	2500	2440	97.6
Ni	CCV	2500	2390	95.4
Ni	CCV	2500	2430	97.1
Ni	CCV	2500	2460	98.2
P	ICV	2500	2450	98.0
P	LL-CCV	100.	94.0	94.0
P	CCV	2500	2380	95.3
P	CCV	2500	2410	96.3
P	CCV	2500	2420	97.0
P	CCV	2500	2430	97.4
Pb	ICV	2500	2440	97.6
Pb	LL-CCV	25.0	23.4	93.6
Pb	CCV	2500	2360	94.2
Pb	CCV	2500	2370	94.9
Pb	CCV	2500	2400	95.9
Pb	CCV	2500	2420	96.7
Sb	ICV	2500	2430	97.1
Sb	LL-CCV	25.0	22.9	91.6
Sb	CCV	2500	2390	95.6
Sb	CCV	2500	2410	96.2
Sb	CCV	2500	2420	96.8
Sb	CCV	2500	2420	96.9
Se	ICV	2500	2510	100.3
Se	LL-CCV	75.0	69.8	93.0
Se	CCV	2500	2430	97.3
Se	CCV	2500	2460	98.5

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV: Low Level CCV
LL-CCV Limits: 70% - 130% Recovery

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QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Back Half
Report Number: 18-419

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Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Se	CCV	2500	2480	99.3
Se	CCV	2500	2500	99.8
Zn	ICV	2500	2470	98.9
Zn	LL-CCV	15.0	16.4	109.4
Zn	CCV	2500	2480	99.2
Zn	CCV	2500	2440	97.6
Zn	CCV	2500	2480	99.3
Zn	CCV	2500	2500	100.1

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV: Low Level CCV
LL-CCV Limits: 70% - 130% Recovery

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD	
As	18-S2225	< 7	< 7	N/C	#
As	18-S2231	< 7	< 7	N/C	#
Ba	18-S2224	14.35	13.71	4.56	
Ba	18-S2230	13.55	13.87	2.33	
Ba	18-S2225	6.140	6.240	1.62	
Ba	18-S2231	6.604	6.643	0.59	
Be	18-S2225	< 0.2	< 0.2	N/C	#
Be	18-S2231	< 0.2	< 0.2	N/C	#
Cd	18-S2225	< 0.4	< 0.4	N/C	#
Cd	18-S2231	< 0.4	< 0.4	N/C	#
Co	18-S2225	0.547	0.531	2.97	#
Co	18-S2231	< 0.5	< 0.5	N/C	#
Cr	18-S2225	2.058	2.213	7.26	#
Cr	18-S2231	2.660	2.525	5.21	#
Cu	18-S2225	29.37	29.29	0.27	
Cu	18-S2231	37.23	37.57	0.91	
Mn	18-S2225	5.736	5.802	1.14	
Mn	18-S2231	7.496	7.578	1.09	
Ni	18-S2225	< 3	< 3	N/C	#
Ni	18-S2231	< 3	< 3	N/C	#
P	18-S2225	< 20	< 20	N/C	#
P	18-S2231	< 20	< 20	N/C	#
Pb	18-S2225	< 5	< 5	N/C	#
Pb	18-S2231	< 5	< 5	N/C	#
Sb	18-S2225	51.46	51.18	0.55	
Sb	18-S2231	< 5	< 5	N/C	#
Se	18-S2225	< 15	< 15	N/C	#
Se	18-S2231	< 15	< 15	N/C	#
Zn	18-S2225	22.83	23.22	1.69	
Zn	18-S2231	30.69	30.80	0.36	

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
Replicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or replicate concentration is less than 5x the detection limit

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Back Half
Report Number: 18-419

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Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
As	LCS	< 7	2308.	2500.	92.3
As	LCS	< 7	2310.	2500.	92.4
As	18-S2227	< 7	2138.	2500.	85.5
As	18-S2233	< 7	2135.	2500.	85.4
Ba	LCS	< 0.5	2542.	2500.	102.
Ba	LCS	< 0.5	2595.	2500.	104.
Ba	18-S2226	14.01	2445.	2500.	97.2
Ba	18-S2232	12.96	2420.	2500.	96.3
Ba	LCS	< 0.5	2469.	2500.	98.8
Ba	LCS	< 0.5	2492.	2500.	99.7
Ba	18-S2227	5.938	2388.	2500.	95.3
Ba	18-S2233	6.836	2354.	2500.	93.9
Be	LCS	< 0.2	2317.	2500.	92.7
Be	LCS	< 0.2	2344.	2500.	93.8
Be	18-S2227	< 0.2	2139.	2500.	85.6
Be	18-S2233	< 0.2	2151.	2500.	86.0
Cd	LCS	< 0.4	2303.	2500.	92.1
Cd	LCS	< 0.4	2346.	2500.	93.8
Cd	18-S2227	< 0.4	2117.	2500.	84.7
Cd	18-S2233	< 0.4	2129.	2500.	85.2
Co	LCS	< 0.5	2313.	2500.	92.5
Co	LCS	< 0.5	2357.	2500.	94.3
Co	18-S2227	< 0.5	2155.	2500.	86.2
Co	18-S2233	< 0.5	2168.	2500.	86.7
Cr	LCS	< 0.8	2319.	2500.	92.8
Cr	LCS	< 0.8	2351.	2500.	94.0
Cr	18-S2227	2.523	2187.	2500.	87.4
Cr	18-S2233	2.359	2193.	2500.	87.6
Cu	LCS	< 5	2323.	2500.	92.9
Cu	LCS	< 5	2369.	2500.	94.8
Cu	18-S2227	23.25	2211.	2500.	87.5
Cu	18-S2233	38.38	2222.	2500.	87.3
Mn	LCS	< 0.3	2404.	2500.	96.2
Mn	LCS	< 0.3	2448.	2500.	97.9
Mn	18-S2227	42.34	2298.	2500.	90.2
Mn	18-S2233	5.937	2274.	2500.	90.7
Ni	LCS	< 3	2308.	2500.	92.3
Ni	LCS	< 3	2348.	2500.	93.9
Ni	18-S2227	< 3	2132.	2500.	85.3
Ni	18-S2233	< 3	2139.	2500.	85.6
P	LCS	< 20	2260.	2500.	90.4
P	LCS	< 20	2278.	2500.	91.1
P	18-S2227	< 20	2082.	2500.	83.3
P	18-S2233	< 20	2103.	2500.	84.1
Pb	LCS	< 5	2270.	2500.	90.8
Pb	LCS	< 5	2281.	2500.	91.2
Pb	18-S2227	< 5	2087.	2500.	83.5
Pb	18-S2233	< 5	2101.	2500.	84.0
Sb	LCS	< 5	2205.	2500.	88.2
Sb	LCS	< 5	2301.	2500.	92.0
Sb	18-S2227	14.33	2148.	2500.	85.3
Sb	18-S2233	< 5	2149.	2500.	86.0
Se	LCS	< 15	2323.	2500.	92.9
Se	LCS	< 15	2342.	2500.	93.7
Se	18-S2227	< 15	2165.	2500.	86.6
Se	18-S2233	< 15	2163.	2500.	86.5
Zn	LCS	< 3	2335.	2500.	93.4
Zn	LCS	< 3	2379.	2500.	95.2

LCS Limit: 80% - 120% Recovery   Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Back Half
Report Number: 18-419

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Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Zn	18-S2227	21.94	2150.	2500.	85.1
Zn	18-S2233	121.3	2250.	2500.	85.1

LCS Limit: 80% - 120% Recovery   Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
As	LCS-DUP	2310	2310	0.09
Ba	LCS-DUP	2540	2600	2.06
Ba	LCS-DUP	2470	2490	0.93
Be	LCS-DUP	2320	2340	1.16
Cd	LCS-DUP	2300	2350	1.85
Co	LCS-DUP	2310	2360	1.88
Cr	LCS-DUP	2320	2350	1.37
Cu	LCS-DUP	2320	2370	1.96
Mn	LCS-DUP	2400	2450	1.81
Ni	LCS-DUP	2310	2350	1.72
P	LCS-DUP	2260	2280	0.79
Pb	LCS-DUP	2270	2280	0.48
Sb	LCS-DUP	2200	2300	4.26
Se	LCS-DUP	2320	2340	0.81
Zn	LCS-DUP	2340	2380	1.87

Duplicate Limit: 20% RPD
RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Front Half
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
As	ICB	< DL	7.00
As	MB_FH	< DL	7.00
As	CCB	< DL	7.00
As	CCB	< DL	7.00
As	CCB	< DL	7.00
Ba	ICB	< DL	0.500
Ba	MB_FH	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Be	ICB	< DL	0.200
Be	MB_FH	0.229	0.200
Be	CCB	< DL	0.200
Be	CCB	< DL	0.200
Be	CCB	< DL	0.200
Cd	ICB	< DL	0.400
Cd	MB_FH	< DL	0.400
Cd	CCB	< DL	0.400
Cd	CCB	< DL	0.400
Cd	CCB	< DL	0.400
Co	ICB	< DL	0.500
Co	MB_FH	< DL	0.500
Co	CCB	< DL	0.500
Co	CCB	< DL	0.500
Co	CCB	< DL	0.500
Cr	ICB	< DL	0.800
Cr	MB_FH	< DL	0.800
Cr	CCB	< DL	0.800
Cr	CCB	< DL	0.800
Cr	CCB	< DL	0.800
Cu	ICB	< DL	5.00
Cu	MB_FH	< DL	5.00
Cu	CCB	< DL	5.00
Cu	CCB	< DL	5.00
Cu	CCB	< DL	5.00
Mn	ICB	< DL	0.300
Mn	MB_FH	< DL	0.300
Mn	CCB	< DL	0.300
Mn	CCB	< DL	0.300
Mn	CCB	< DL	0.300
Ni	ICB	< DL	3.00
Ni	MB_FH	< DL	3.00
Ni	CCB	< DL	3.00
Ni	CCB	< DL	3.00
Ni	CCB	< DL	3.00
P	ICB	< DL	20.0
P	MB_FH	< DL	20.0
P	CCB	< DL	20.0
P	CCB	< DL	20.0
P	CCB	< DL	20.0
Pb	ICB	< DL	5.00
Pb	MB_FH	< DL	5.00
Pb	CCB	< DL	5.00
Pb	CCB	< DL	5.00
Pb	CCB	< DL	5.00
Sb	ICB	< DL	5.00
Sb	MB_FH	< DL	5.00
Sb	CCB	< DL	5.00
Sb	CCB	< DL	5.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Front Half
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
Sb	CCB	< DL	5.00
Se	ICB	< DL	15.0
Se	MB_FH	< DL	15.0
Se	CCB	< DL	15.0
Se	CCB	< DL	15.0
Se	CCB	< DL	15.0
Zn	ICB	< DL	3.00
Zn	MB_FH	< DL	3.00
Zn	CCB	< DL	3.00
Zn	CCB	< DL	3.00
Zn	CCB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
As	ICV	2500	2490	99.6
As	LL-CCV	35.0	34.6	99.0
As	CCV	2500	2460	98.2
As	CCV	2500	2440	97.7
As	CCV	2500	2480	99.4
Ba	ICV	2500	2530	101.3
Ba	LL-CCV	2.50	2.50	99.9
Ba	CCV	2500	2520	100.6
Ba	CCV	2500	2540	101.6
Ba	CCV	2500	2580	103.3
Be	ICV	2500	2530	101.3
Be	LL-CCV	1.00	0.98	97.6
Be	CCV	2500	2500	100.0
Be	CCV	2500	2480	99.4
Be	CCV	2500	2500	100.0
Cd	ICV	2500	2490	99.6
Cd	LL-CCV	1.50	1.75	116.9
Cd	CCV	2500	2490	99.5
Cd	CCV	2500	2450	98.1
Cd	CCV	2500	2450	98.0
Co	ICV	2500	2500	99.9
Co	LL-CCV	2.50	2.22	88.8
Co	CCV	2500	2490	99.4
Co	CCV	2500	2460	98.3
Co	CCV	2500	2460	98.5
Cr	ICV	2500	2480	99.1
Cr	LL-CCV	4.00	4.28	107.0
Cr	CCV	2500	2480	99.0
Cr	CCV	2500	2440	97.6
Cr	CCV	2500	2440	97.8
Cu	ICV	2500	2470	98.8
Cu	LL-CCV	25.0	27.7	110.7
Cu	CCV	2500	2460	98.5
Cu	CCV	2500	2450	98.0
Cu	CCV	2500	2450	98.1
Mn	ICV	2500	2560	102.6

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV: Low Level CCV
LL-CCV Limits: 70% - 130% Recovery

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Front Half
Report Number: 18-419
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Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Mn	LL-CCV	1.50	1.60	106.5
Mn	CCV	2500	2560	102.5
Mn	CCV	2500	2520	100.9
Mn	CCV	2500	2530	101.1
Ni	ICV	2500	2510	100.3
Ni	LL-CCV	15.0	16.3	108.8
Ni	CCV	2500	2500	100.1
Ni	CCV	2500	2470	98.9
Ni	CCV	2500	2470	98.8
P	ICV	2500	2510	100.4
P	LL-CCV	100.	102.	102.2
P	CCV	2500	2480	99.2
P	CCV	2500	2450	98.1
P	CCV	2500	2480	99.4
Pb	ICV	2500	2480	99.1
Pb	LL-CCV	25.0	27.2	108.8
Pb	CCV	2500	2440	97.8
Pb	CCV	2500	2430	97.4
Pb	CCV	2500	2470	98.7
Sb	ICV	2500	2480	99.0
Sb	LL-CCV	25.0	28.9	115.6
Sb	CCV	2500	2450	98.1
Sb	CCV	2500	2440	97.6
Sb	CCV	2500	2470	99.0
Se	ICV	2500	2530	101.3
Se	LL-CCV	75.0	77.0	102.6
Se	CCV	2500	2480	99.3
Se	CCV	2500	2480	99.2
Se	CCV	2500	2510	100.4
Zn	ICV	2500	2550	102.0
Zn	LL-CCV	15.0	17.2	114.9
Zn	CCV	2500	2560	102.4
Zn	CCV	2500	2530	101.2
Zn	CCV	2500	2520	100.9

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV: Low Level CCV
LL-CCV Limits: 70% - 130% Recovery

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
As	18-S2351	< 7	< 7	N/C #
As	18-S2357	< 7	< 7	N/C #
As	18-S2363	< 7	< 7	N/C #
Ba	18-S2351	13.48	13.25	1.72
Ba	18-S2357	13.31	13.30	0.08
Ba	18-S2363	14.08	14.35	1.90
Be	18-S2351	< 0.2	< 0.2	N/C #
Be	18-S2357	< 0.2	< 0.2	N/C #
Be	18-S2363	< 0.2	< 0.2	N/C #

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
Replicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or replicate concentration is less than 5x the detection limit

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Front Half
Report Number: 18-419
==

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
Cd	18-S2351	4.769	4.754	0.32
Cd	18-S2357	4.954	4.545	8.61
Cd	18-S2363	4.734	4.811	1.61
Co	18-S2351	< 0.5	< 0.5	N/C #
Co	18-S2357	2.388	1.919	21.8 #
Co	18-S2363	< 0.5	< 0.5	N/C #
Cr	18-S2351	4.963	4.840	2.51
Cr	18-S2357	5.444	5.332	2.08
Cr	18-S2363	7.335	7.400	0.88
Cu	18-S2351	14.78	14.27	3.51 #
Cu	18-S2357	14.22	14.10	0.85 #
Cu	18-S2363	13.92	13.87	0.36 #
Mn	18-S2351	5.079	4.972	2.13
Mn	18-S2357	5.634	5.667	0.58
Mn	18-S2363	6.770	6.715	0.82
Ni	18-S2351	< 3	< 3	N/C #
Ni	18-S2357	< 3	< 3	N/C #
Ni	18-S2363	< 3	< 3	N/C #
P	18-S2351	140.0	140.4	0.29
P	18-S2357	136.4	134.4	1.48
P	18-S2363	117.4	125.8	6.91
Pb	18-S2351	29.45	29.92	1.58
Pb	18-S2357	31.41	31.26	0.48
Pb	18-S2363	30.25	29.66	1.97
Sb	18-S2351	< 5	< 5	N/C #
Sb	18-S2357	< 5	< 5	N/C #
Sb	18-S2363	< 5	< 5	N/C #
Se	18-S2351	< 15	< 15	N/C #
Se	18-S2357	< 15	< 15	N/C #
Se	18-S2363	< 15	< 15	N/C #
Zn	18-S2351	19.73	19.62	0.56
Zn	18-S2357	42.32	41.74	1.38
Zn	18-S2363	44.19	43.87	0.73

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
Replicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or replicate concentration is less than 5x the detection limit

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
As	LCS	< 7	2591.	2500.	104.
As	LCS	< 7	2587.	2500.	103.
As	18-S2353	< 7	2329.	2500.	93.2
As	18-S2359	< 7	2365.	2500.	94.6
As	18-S2365	< 7	2360.	2500.	94.4
Ba	LCS	< 0.5	2452.	2500.	98.1
Ba	LCS	< 0.5	2441.	2500.	97.6
Ba	18-S2353	13.39	2289.	2500.	91.0
Ba	18-S2359	13.34	2313.	2500.	92.0
Ba	18-S2365	13.48	2323.	2500.	92.4
Be	LCS	0.229	2602.	2500.	104.
Be	LCS	0.229	2594.	2500.	104.

LCS Limit: 80% - 120% Recovery   Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Front Half
Report Number: 18-419
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Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Be	18-S2353	< 0.2	2375.	2500.	95.0
Be	18-S2359	< 0.2	2381.	2500.	95.2
Be	18-S2365	< 0.2	2402.	2500.	96.1
Cd	LCS	< 0.4	2600.	2500.	104.
Cd	LCS	< 0.4	2604.	2500.	104.
Cd	18-S2353	4.934	2306.	2500.	92.0
Cd	18-S2359	4.888	2326.	2500.	92.8
Cd	18-S2365	4.809	2328.	2500.	92.9
Co	LCS	< 0.5	2541.	2500.	102.
Co	LCS	< 0.5	2537.	2500.	101.
Co	18-S2353	< 0.5	2286.	2500.	91.4
Co	18-S2359	< 0.5	2310.	2500.	92.4
Co	18-S2365	< 0.5	2309.	2500.	92.4
Cr	LCS	< 0.8	2487.	2500.	99.5
Cr	LCS	< 0.8	2480.	2500.	99.2
Cr	18-S2353	5.032	2324.	2500.	92.8
Cr	18-S2359	5.284	2347.	2500.	93.7
Cr	18-S2365	5.566	2335.	2500.	93.2
Cu	LCS	< 5	2567.	2500.	103.
Cu	LCS	< 5	2554.	2500.	102.
Cu	18-S2353	12.02	2533.	2500.	101.
Cu	18-S2359	11.08	2554.	2500.	102.
Cu	18-S2365	8.536	2543.	2500.	101.
Mn	LCS	< 0.3	2588.	2500.	104.
Mn	LCS	< 0.3	2581.	2500.	103.
Mn	18-S2353	4.896	2398.	2500.	95.7
Mn	18-S2359	5.182	2425.	2500.	96.8
Mn	18-S2365	5.651	2411.	2500.	96.2
Ni	LCS	< 3	2573.	2500.	103.
Ni	LCS	< 3	2568.	2500.	103.
Ni	18-S2353	< 3	2300.	2500.	92.0
Ni	18-S2359	< 3	2318.	2500.	92.7
Ni	18-S2365	< 3	2319.	2500.	92.8
P	LCS	< 20	2638.	2500.	106.
P	LCS	< 20	2648.	2500.	106.
P	18-S2353	126.3	2523.	2500.	95.9
P	18-S2359	132.6	2548.	2500.	96.6
P	18-S2365	133.1	2515.	2500.	95.3
Pb	LCS	< 5	2579.	2500.	103.
Pb	LCS	< 5	2580.	2500.	103.
Pb	18-S2353	30.69	2232.	2500.	88.1
Pb	18-S2359	30.32	2259.	2500.	89.1
Pb	18-S2365	29.62	2254.	2500.	89.0
Sb	LCS	< 5	2564.	2500.	103.
Sb	LCS	< 5	2563.	2500.	103.
Sb	18-S2353	< 5	2309.	2500.	92.4
Sb	18-S2359	< 5	2335.	2500.	93.4
Sb	18-S2365	< 5	2339.	2500.	93.6
Se	LCS	< 15	2665.	2500.	107.
Se	LCS	< 15	2665.	2500.	107.
Se	18-S2353	< 15	2308.	2500.	92.3
Se	18-S2359	< 15	2345.	2500.	93.8
Se	18-S2365	< 15	2354.	2500.	94.2
Zn	LCS	< 3	2701.	2500.	108.
Zn	LCS	< 3	2703.	2500.	108.
Zn	18-S2353	50.69	2486.	2500.	97.4
Zn	18-S2359	26.40	2488.	2500.	98.5

LCS Limit: 80% - 120% Recovery   Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Front Half
Report Number: 18-419

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Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Zn	18-S2365	24.27	2483.	2500.	98.3

LCS Limit: 80% - 120% Recovery Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
As	LCS-DUP	2590	2590	0.15
Ba	LCS-DUP	2450	2440	0.45
Be	LCS-DUP	2600	2590	0.31
Cd	LCS-DUP	2600	2600	0.15
Co	LCS-DUP	2540	2540	0.16
Cr	LCS-DUP	2490	2480	0.28
Cu	LCS-DUP	2570	2550	0.51
Mn	LCS-DUP	2590	2580	0.27
Ni	LCS-DUP	2570	2570	0.19
P	LCS-DUP	2640	2650	0.38
Pb	LCS-DUP	2580	2580	0.04
Sb	LCS-DUP	2560	2560	0.04
Se	LCS-DUP	2660	2660	0.00
Zn	LCS-DUP	2700	2700	0.07

Duplicate Limit: 20% RPD
RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100

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QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Back Half
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
As	ICB	< DL	7.00
As	MB_BH	< DL	7.00
As	MB_BH2	< DL	7.00
As	CCB	< DL	7.00
As	CCB	< DL	7.00
As	CCB	< DL	7.00
Ba	ICB	< DL	0.500
Ba	MB_BH	< DL	0.500
Ba	MB_BH_2	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Ba	CCB	< DL	0.500
Ba	ICB	< DL	0.500
Ba	CCB	< DL	0.500
Be	ICB	< DL	0.200
Be	MB_BH	< DL	0.200
Be	MB_BH2	< DL	0.200
Be	CCB	< DL	0.200
Be	CCB	< DL	0.200
Be	CCB	< DL	0.200
Cd	ICB	< DL	0.400
Cd	MB_BH	< DL	0.400
Cd	MB_BH2	< DL	0.400
Cd	CCB	< DL	0.400
Cd	CCB	< DL	0.400
Cd	CCB	< DL	0.400
Co	ICB	< DL	0.500
Co	MB_BH	< DL	0.500
Co	MB_BH2	< DL	0.500
Co	CCB	< DL	0.500
Co	CCB	< DL	0.500
Co	CCB	< DL	0.500
Cr	ICB	< DL	0.800
Cr	MB_BH	< DL	0.800
Cr	MB_BH2	< DL	0.800
Cr	CCB	< DL	0.800
Cr	CCB	< DL	0.800
Cr	CCB	< DL	0.800
Cu	ICB	< DL	5.00
Cu	MB_BH	< DL	5.00
Cu	MB_BH2	< DL	5.00
Cu	CCB	< DL	5.00
Cu	CCB	< DL	5.00
Cu	CCB	< DL	5.00
Mn	ICB	< DL	0.300
Mn	MB_BH	< DL	0.300
Mn	MB_BH2	< DL	0.300
Mn	CCB	< DL	0.300
Mn	CCB	< DL	0.300
Mn	CCB	< DL	0.300
Ni	ICB	< DL	3.00
Ni	MB_BH	< DL	3.00
Ni	MB_BH2	< DL	3.00
Ni	CCB	< DL	3.00
Ni	CCB	< DL	3.00
Ni	CCB	< DL	3.00
P	ICB	< DL	20.0
P	MB_BH	< DL	20.0
P	MB_BH2	< DL	20.0

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Back Half
Report Number: 18-419

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Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
P	CCB	< DL	20.0
P	CCB	< DL	20.0
P	CCB	< DL	20.0
Pb	ICB	< DL	5.00
Pb	MB_BH	< DL	5.00
Pb	MB_BH2	< DL	5.00
Pb	CCB	< DL	5.00
Pb	CCB	< DL	5.00
Pb	CCB	< DL	5.00
Sb	ICB	< DL	5.00
Sb	MB_BH	< DL	5.00
Sb	MB_BH2	< DL	5.00
Sb	CCB	< DL	5.00
Sb	CCB	< DL	5.00
Sb	CCB	< DL	5.00
Se	ICB	< DL	15.0
Se	MB_BH	< DL	15.0
Se	MB_BH2	< DL	15.0
Se	CCB	< DL	15.0
Se	CCB	< DL	15.0
Se	CCB	< DL	15.0
Zn	ICB	< DL	3.00
Zn	MB_BH	< DL	3.00
Zn	MB_BH2	< DL	3.00
Zn	CCB	< DL	3.00
Zn	CCB	< DL	3.00
Zn	CCB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
As	ICV	2500	2460	98.5
As	LL-CCV	35.0	34.8	99.4
As	CCV	2500	2440	97.5
As	CCV	2500	2440	97.8
As	CCV	2500	2450	98.0
Ba	ICV	2500	2530	101.1
Ba	LL-CCV	2.50	2.54	101.7
Ba	CCV	2500	2590	103.7
Ba	CCV	2500	2600	103.8
Ba	CCV	2500	2530	101.2
Ba	ICV	2500	2450	98.0
Ba	LL-CCV	2.50	2.69	107.5
Ba	CCV	2500	2480	99.1
Be	ICV	2500	2460	98.6
Be	LL-CCV	1.00	0.99	99.2
Be	CCV	2500	2470	98.8
Be	CCV	2500	2460	98.4
Be	CCV	2500	2450	98.1
Cd	ICV	2500	2470	98.8
Cd	LL-CCV	2.00	1.95	97.4

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV: Low Level CCV
LL-CCV Limits: 70% - 130% Recovery

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Back Half
Report Number: 18-419

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Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Cd	CCV	2500	2470	98.8
Cd	CCV	2500	2460	98.2
Cd	CCV	2500	2450	98.0
Co	ICV	2500	2480	99.4
Co	LL-CCV	2.50	2.44	97.5
Co	CCV	2500	2480	99.3
Co	CCV	2500	2460	98.5
Co	CCV	2500	2460	98.4
Cr	ICV	2500	2450	98.0
Cr	LL-CCV	4.00	4.05	101.2
Cr	CCV	2500	2450	98.0
Cr	CCV	2500	2430	97.2
Cr	CCV	2500	2430	97.2
Cu	ICV	2500	2450	98.1
Cu	LL-CCV	25.0	28.9	115.6
Cu	CCV	2500	2450	98.0
Cu	CCV	2500	2450	98.0
Cu	CCV	2500	2460	98.3
Mn	ICV	2500	2540	101.8
Mn	LL-CCV	1.50	1.63	108.5
Mn	CCV	2500	2540	101.8
Mn	CCV	2500	2530	101.2
Mn	CCV	2500	2530	101.2
Ni	ICV	2500	2490	99.5
Ni	LL-CCV	15.0	14.7	98.2
Ni	CCV	2500	2490	99.6
Ni	CCV	2500	2470	98.9
Ni	CCV	2500	2470	98.7
P	ICV	2500	2470	98.8
P	LL-CCV	100.	97.8	97.8
P	CCV	2500	2440	97.7
P	CCV	2500	2450	97.9
P	CCV	2500	2450	98.0
Pb	ICV	2500	2450	98.0
Pb	LL-CCV	25.0	23.8	95.2
Pb	CCV	2500	2440	97.6
Pb	CCV	2500	2430	97.0
Pb	CCV	2500	2430	97.2
Sb	ICV	2500	2410	96.4
Sb	LL-CCV	25.0	24.7	98.7
Sb	CCV	2500	2400	96.0
Sb	CCV	2500	2410	96.3
Sb	CCV	2500	2410	96.4
Se	ICV	2500	2520	100.9
Se	LL-CCV	75.0	70.4	93.9
Se	CCV	2500	2500	100.1
Se	CCV	2500	2490	99.8
Se	CCV	2500	2510	100.5
Zn	ICV	2500	2540	101.4
Zn	LL-CCV	15.0	16.4	109.6
Zn	CCV	2500	2540	101.6
Zn	CCV	2500	2520	100.9
Zn	CCV	2500	2520	100.8

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV: Low Level CCV
LL-CCV Limits: 70% - 130% Recovery

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Back Half
Report Number: 18-419
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Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
As	18-S2352	< 7	< 7	N/C #
As	18-S2358	< 7	< 7	N/C #
As	18-S2364	< 7	< 7	N/C #
Ba	18-S2352	7.155	7.103	0.73
Ba	18-S2358	6.906	6.872	0.49
Ba	18-S2364	5.469	5.538	1.25
Be	18-S2352	< 0.2	< 0.2	N/C #
Be	18-S2358	< 0.2	< 0.2	N/C #
Be	18-S2364	< 0.2	< 0.2	N/C #
Cd	18-S2352	< 0.4	< 0.4	N/C #
Cd	18-S2358	< 0.4	< 0.4	N/C #
Cd	18-S2364	< 0.4	< 0.4	N/C #
Co	18-S2352	< 0.5	< 0.5	N/C #
Co	18-S2358	< 0.5	< 0.5	N/C #
Co	18-S2364	< 0.5	< 0.5	N/C #
Cr	18-S2352	2.941	3.007	2.22 #
Cr	18-S2358	3.700	3.621	2.16 #
Cr	18-S2364	1.975	1.866	5.68 #
Cu	18-S2352	41.52	38.98	6.31
Cu	18-S2358	32.08	31.39	2.17
Cu	18-S2364	21.76	20.61	5.43 #
Mn	18-S2352	5.725	5.713	0.21
Mn	18-S2358	4.343	4.372	0.67
Mn	18-S2364	4.066	4.059	0.17
Ni	18-S2352	< 3	< 3	N/C #
Ni	18-S2358	< 3	< 3	N/C #
Ni	18-S2364	< 3	< 3	N/C #
P	18-S2352	< 20	< 20	N/C #
P	18-S2358	< 20	< 20	N/C #
P	18-S2364	< 20	< 20	N/C #
Pb	18-S2352	< 5	< 5	N/C #
Pb	18-S2358	< 5	< 5	N/C #
Pb	18-S2364	< 5	< 5	N/C #
Sb	18-S2352	< 5	< 5	N/C #
Sb	18-S2358	< 5	< 5	N/C #
Sb	18-S2364	< 5	< 5	N/C #
Se	18-S2352	< 15	< 15	N/C #
Se	18-S2358	< 15	< 15	N/C #
Se	18-S2364	< 15	< 15	N/C #
Zn	18-S2352	34.29	34.01	0.82
Zn	18-S2358	20.71	21.03	1.53
Zn	18-S2364	43.97	43.80	0.39

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
Replicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or
replicate concentration is less than 5x the detection limit

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
As	LCS	< 7	2345.	2500.	93.8
As	LCS	< 7	2369.	2500.	94.8
As	18-S2354	< 7	2165.	2500.	86.6

LCS Limit: 80% - 120% Recovery Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike
concentration is less than 25% of the sample concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Back Half
Report Number: 18-419
==

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
As	18-S2360	< 7	2183.	2500.	87.3
As	18-S2366	< 7	2156.	2500.	86.2
Ba	LCS	< 0.5	2539.	2500.	102.
Ba	LCS	< 0.5	2479.	2500.	99.2
Ba	18-S2354	6.129	2314.	2500.	92.3
Ba	18-S2360	5.348	2293.	2500.	91.5
Ba	18-S2366	5.206	2287.	2500.	91.3
Be	LCS	< 0.2	2361.	2500.	94.4
Be	LCS	< 0.2	2375.	2500.	95.0
Be	18-S2354	< 0.2	2175.	2500.	87.0
Be	18-S2360	< 0.2	2190.	2500.	87.6
Be	18-S2366	< 0.2	2185.	2500.	87.4
Cd	LCS	< 0.4	2350.	2500.	94.0
Cd	LCS	< 0.4	2368.	2500.	94.7
Cd	18-S2354	< 0.4	2178.	2500.	87.1
Cd	18-S2360	< 0.4	2202.	2500.	88.1
Cd	18-S2366	< 0.4	2173.	2500.	86.9
Co	LCS	< 0.5	2386.	2500.	95.4
Co	LCS	< 0.5	2399.	2500.	96.0
Co	18-S2354	< 0.5	2236.	2500.	89.4
Co	18-S2360	< 0.5	2247.	2500.	89.9
Co	18-S2366	< 0.5	2217.	2500.	88.7
Cr	LCS	< 0.8	2411.	2500.	96.4
Cr	LCS	< 0.8	2421.	2500.	96.8
Cr	18-S2354	3.216	2268.	2500.	90.6
Cr	18-S2360	2.193	2279.	2500.	91.1
Cr	18-S2366	6.555	2253.	2500.	89.9
Cu	LCS	< 5	2422.	2500.	96.9
Cu	LCS	< 5	2418.	2500.	96.7
Cu	18-S2354	37.57	2297.	2500.	90.4
Cu	18-S2360	37.83	2324.	2500.	91.4
Cu	18-S2366	28.14	2271.	2500.	89.7
Mn	LCS	< 0.3	2490.	2500.	99.6
Mn	LCS	< 0.3	2499.	2500.	100.
Mn	18-S2354	4.774	2336.	2500.	93.2
Mn	18-S2360	4.113	2350.	2500.	93.8
Mn	18-S2366	5.377	2326.	2500.	92.8
Ni	LCS	< 3	2379.	2500.	95.2
Ni	LCS	< 3	2392.	2500.	95.7
Ni	18-S2354	< 3	2218.	2500.	88.7
Ni	18-S2360	< 3	2236.	2500.	89.4
Ni	18-S2366	< 3	2200.	2500.	88.0
P	LCS	< 20	2315.	2500.	92.6
P	LCS	< 20	2338.	2500.	93.5
P	18-S2354	< 20	2136.	2500.	85.4
P	18-S2360	< 20	2158.	2500.	86.3
P	18-S2366	< 20	2133.	2500.	85.3
Pb	LCS	< 5	2332.	2500.	93.3
Pb	LCS	< 5	2363.	2500.	94.5
Pb	18-S2354	< 5	2150.	2500.	86.0
Pb	18-S2360	< 5	2170.	2500.	86.8
Pb	18-S2366	< 5	2133.	2500.	85.3
Sb	LCS	< 5	2347.	2500.	93.9
Sb	LCS	< 5	2379.	2500.	95.2
Sb	18-S2354	< 5	2144.	2500.	85.8
Sb	18-S2360	20.18	2183.	2500.	86.5
Sb	18-S2366	< 5	2146.	2500.	85.8
Se	LCS	< 15	2389.	2500.	95.6

LCS Limit: 80% - 120% Recovery   Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA Method 29 Back Half
Report Number: 18-419

==

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. $\mu g/L$	Spike Conc. $\mu g/L$	Spike Amount $\mu g/L$	Percent Recovery
Se	LCS	< 15	2422.	2500.	96.9
Se	18-S2354	< 15	2208.	2500.	88.3
Se	18-S2360	< 15	2231.	2500.	89.2
Se	18-S2366	< 15	2182.	2500.	87.3
Zn	LCS	< 3	2397.	2500.	95.9
Zn	LCS	< 3	2409.	2500.	96.4
Zn	18-S2354	28.96	2230.	2500.	88.0
Zn	18-S2360	22.87	2257.	2500.	89.4
Zn	18-S2366	37.55	2233.	2500.	87.8

LCS Limit: 80% - 120% Recovery Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. $\mu g/L$	Duplicate Conc. $\mu g/L$	RPD
As	LCS-DUP	2340	2370	1.02
Ba	LCS-DUP	2540	2480	2.39
Be	LCS-DUP	2360	2380	0.59
Cd	LCS-DUP	2350	2370	0.76
Co	LCS-DUP	2390	2400	0.54
Cr	LCS-DUP	2410	2420	0.41
Cu	LCS-DUP	2420	2420	0.17
Mn	LCS-DUP	2490	2500	0.36
Ni	LCS-DUP	2380	2390	0.54
P	LCS-DUP	2320	2340	0.99
Pb	LCS-DUP	2330	2360	1.32
Sb	LCS-DUP	2350	2380	1.35
Se	LCS-DUP	2390	2420	1.37
Zn	LCS-DUP	2400	2410	0.50

Duplicate Limit: 20% RPD
RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100

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SOURCE SAMPLE RECEIPT CHECKLIST

Client	Bison Engineering	Date	9/21/18
# Runs	9 of M13B & M26A 6 of M29, plus blanks and audit	Report #	18-419

Custody Seals Inspected, If Present	hand delivered	
Chain-of-Custody Form Inspected	✓	
CoC present with samples?	✓	*
CoC indicate analytical methodology to be used? (eg M29 etc)	✓	!!
CoC indicate if compliance testing? (esp. M26)	audits	!!
M26 samples have Thiosulfate added in field?	N/A	!!
M29 indicate FH/BH separate or combined?	separate	!!
Has Form Been Signed?	✓	
Have Date and Time Custody Released Been Noted on Form?	✓	
All Sample Containers Inspected	✓	
Does Number of Samples Match Number on CoC Form?	✓	!!
Do All Sample ID Numbers Match Those on the CoC Form?	✓	!!
Did client mark sample volumes prior to shipment?	✓	*
If required by method, did client vent samples prior to shipment?	N/A	
Are the Sample Containers Intact?	✓	!!
Are signs of leakage present?	No	*
Chain-of-Custody Form Signed and Dated by CLN	✓	
Corrective Actions		
Client Contacted Due to Mismatching Sample ID Numbers		
Client Contacted Due to Broken Sample Container(s)		
Client Contacted Due to Leaking Sample Container(s)		
Client contacted for verification of methodology?		
Corrective Actions Documented?		
Corrective Actions Accomplished?		

*Items marked !! shall be addressed **prior to any analytical work being started**.*
*Items marked * shall be **noted in case narrative** upon reporting of results to client.*

Signed [signature]

Notes

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CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Company Name: Bison Engineering, Inc.	
Contact: Kelly Dorsi	Phone: (406) 442-5768
E-Mail Address: kDorsi@bison.eng	Fax:
Report Address: 1400 11th Ave	
City: Helena	State: MT / Zip: 59601
Billing Address: same as above	
City:	State: / Zip:
PO #:	Project: HAU218

Turn Around Time
- ☐ Standard
- ☐ Rush ________ Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume (~~m³~~) mL	~~Particle Size~~	M-13B	M-26A	Remarks
18-S2201	Imp. catch Run #1 cont #1	CEU-112	09/11	~~692.90~~ → 610.0		X		
S2202	Imp. Catch Run #2 cont #1			~~646.90~~ → 582.0		X		
S2203	Imp. catch Run #3 cont #1			580.0		X		
18-S2210	D.I. Blank H_2O cont. #2			500		X		
18-S2212	cont. #3 Run #1						X	
S2213	cont. #3 Run #2						X	
S2214	cont. #3 Run #3						X	
18-S2221	0.1 H_2SO_4 Blank			200			X	
S2222	HOLC DI Blank			200			X	
18-S2223	audit samples						X	SSAS344
18-S2211	audit samples					X		SSAS346

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time
Adam Bender	
David Blankenship 09/21/18 14:05	Lisa Ball 9/21/18 14:10

Notes:

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CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Company Name: Bison Engineering, Inc.		
Contact: Kelly Dorsi	Phone: 406-442-5768	
E-Mail Address: kdorsi@bison-eng.com	Fax:	
Report Address: 1400 11th Ave.		
City: Helena	State: MT	Zip: 59601
Billing Address: "		
City: "	State: "	Zip: "
PO #:	Project: HAV218775	

Turn Around Time
☒ Standard
☐ Rush ______
Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume ~~(m³)~~ ml	Particle Size	Analysis Requested	M-13B	M-26A								Remarks
18-S2204	M-13B cont. #1 Run1	CFU112(2)	09/16/18	640			X									
S2205	M-13B cont. #1 Run2	CFU 112(2)	✓	595			X									
S2206	M-13B cont. #1 Run3	CFU 112(2)	✓	630			X									
18-S2215	M-26A cont. #3 Run1	CFU112(2)	✓	365				X								
S2216	M-26A cont. #3 Run2	CFU 112(2)	✓	355				X								
S2217	M-26A cont. #3 Run3	CFU112(2)	✓	350				X								

Relinquished By: (Signature) Date/Time [signature]	Received By: (Signature) Date/Time	Notes:
Relinquished By: (Signature) Date/Time [signature] 09/21/18 14:05	Received By: (Signature) Date/Time [signature] 9/21/18 14:??	

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CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Company Name: Bison Engineering, Inc.			
Contact: Kelly Dorsi		Phone: 406-442-5768	
E-Mail Address: Kdorsi@bison-eng.com		Fax:	
Report Address: 1400 11th Ave			
City: Helena	State: MT	Zip: 59601	
Billing Address: "			
City: "	State: "	Zip: "	
PO #:	Project: HAV218775		

Turn Around Time
- ☒ Standard
- ☐ Rush ________ Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume ~~(m³)~~ ml	Particle Size	M-13B	M-26A									Remarks
18-52207	Run 1 cont. #1	CFU113	9/19/18	495		X										
52208	Run 2 cont. #1	↓	↓	530		X										
52209	Run 3 cont. #1	↓	↓	500		X										
18-52218	Run 1 cont. #3	↓	↓	~~360~~ 350			X									
52219	Run 2 cont. #3	↓	↓	360			X									
52220	Run 3 cont. #3	↓	↓	356			X									

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	Notes:
[signature] 9/21/18 10:30		
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	
[signature] 09/21/18 14:05	Lisa Ball 9/21/18 1410	

Company Name: Bison Engineering, Inc.	
Contact: Kelly Dorsi	Phone: 406 442-5768
E-Mail Address: kdorsi@bison-eng.com	Fax:
Report Address: 1400 11th Ave.	
City: Helena	State: MT · Zip: 59601
Billing Address: "	
City: "	State: " · Zip: "
PO #:	Project: HAV218775

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CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Turn Around Time
☒ Standard
☐ Rush ________ Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume (~~m³~~) ml	Particle Size	Analysis Requested: M-29	Remarks
18-S2224	Cont. #3 Run1 probe rinse	CFU112	9/13/18	100ml			
18-S2225	cont. #4 Run1	CFU112	"	330ml			
18-S2226	cont. #3 Run2 probe rinse	CFU112	"	100ml			
18-S2227	Cont. #4 Run2	CFU112	"	330ml			
18-S2228	Cont. #3 Run3 probe rinse	CFU112	"	100ml			
18-S2229	cont. #4 Run3	CFU112	"	325ml			
18-S2238	5% HNO3 10% H2O2 blank	n/a	9/13/18	200ml			
—	D.I. H2O blank	n/a	9/13/18	100ml			
18-S2236	0.1N HNO3 Blank	n/a	9/13/18	300ml			
18-S2237	Quartz filter blank	n/a	9/13/18	n/a			
18-S2224	cont. #1 Run1 filter		9/13/18	n/a			
18-S2226 / 18-S2228	cont. #1 Run2 filter / cont. #1 Run3 filter		9/13/18 / 9/13/18	n/a			

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	Notes:
[signature]		
Relinquished By: (Signature) Date/Time: [signature] 09/21/18 14:05	Received By: (Signature) Date/Time: [signature] 9/21/18 1410	

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Company Name	Bison Engineering, Inc.		
Contact	Kelly Dorsi	Phone	406-442-5768
E-Mail Address	kdorsi@bison-eng.com	Fax	
Report Address	1400 11th Ave.		
City: Helena	State: MT	Zip: 59601	
Billing Address	"		
City: "	State: "	Zip: "	
PO #		Project	

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CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Turn Around Time
☒ Standard
☐ Rush ____________ Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume ~~(m³)~~ ml	Particle Size	Analysis Requested	Remarks
18-S2230	Cont. #1 Run 1 Quartz filter	CFU 112(2)	9/14/18	n/a		M-29	
18-S2232	Cont. #1 Run 2 Quartz filter		9/14/18	n/a			
18-S2234	Cont. #1 Run 3 Quartz filter		9/15/18	n/a			
18-S2230	Cont. #3 Run 1 probe rinse		9/14/18	100			
18-S2231	Cont. #4 Run 1 Imp. catch		9/14/18	325			
18-S2232	Cont. #3 Run 2 probe rinse		9/14/18	100			
18-S2233	Cont. #4 Run 2 Imp. catch		9/14/18	325			
18-S2234	Cont. #3 Run 3 Probe rinse		9/15/18	100			
18-S2235	Cont. #4 Run 3 Imp. catch		9/15/18	335			
18-S2239	Filter audit sample	n/a					
18-S2240	Aqueous audit sample	n/a					

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	Notes:
[signature]		
[signature] 09/21/18 14:05	[signature] 9/21/18 14:10	

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SOURCE SAMPLE RECEIPT CHECKLIST

Client	Bison Engineering	Date	9/29/18
# Runs	6 of M13B & M26A 9 of M29, plus audit	Report #	18-419

Custody Seals Inspected, If Present	hand delivered	
Chain-of-Custody Form Inspected	✓	
CoC present with samples?	✓	*
CoC indicate analytical methodology to be used? (eg M29 etc)	✓	!!
CoC indicate if compliance testing? (esp. M26)	audit	!!
M26 samples have Thiosulfate added in field?	N/A	!!
M29 indicate FH/BH separate or combined?	separate	!!
Has Form Been Signed?	✓	
Have Date and Time Custody Released Been Noted on Form?	✓	
All Sample Containers Inspected	✓	
Does Number of Samples Match Number on CoC Form?	✓	!!
Do All Sample ID Numbers Match Those on the CoC Form?	✓	!!
Did client mark sample volumes prior to shipment?	✓	*
If required by method, did client vent samples prior to shipment?	N/A	
Are the Sample Containers Intact?	✓	!!
Are signs of leakage present?	No	*
Chain-of-Custody Form Signed and Dated by CLN	✓	
Corrective Actions		
Client Contacted Due to Mismatching Sample ID Numbers		
Client Contacted Due to Broken Sample Container(s)		
Client Contacted Due to Leaking Sample Container(s)		
Client contacted for verification of methodology?		
Corrective Actions Documented?		
Corrective Actions Accomplished?		

Items marked !! shall be addressed ***prior to any analytical work being started****.*
*Items marked * shall be* ***noted in case narrative*** *upon reporting of results to client.*

Signed [signature]

Notes

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Company Name Bison Engineering, Inc.	
Contact ~~Kdorsi~~ Kelly Dorsi	Phone 406-442-5768
E-Mail Address kdorsi@bison-eng.com	Fax
Report Address 1400 11th Ave	
City Helena	State MT / Zip 59601
Billing Address "	
City "	State " / Zip "
PO #	Project HAV218775

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CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Turn Around Time
☒ Standard
☒ Rush Notsure
Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume ~~(m³)~~ ml	Particle Size	Analysis Requested: M-13B	M-26A									Remarks
18-52337	M-13B Run1 Cont. #1	CFU113(2)	9/26/18	442 ml		X										
52338	M-13B Run2 Cont. #1	↓	↓	450 ml		X										
52339	M-13B Run3 Cont. #1	↓	↓	450 ml		X										
18-52344	M-26A Run1 Cont. #3	↓	↓	420 ml			X									
52345	M-26A Run2 Cont. #3	↓	↓	390 ml			X									
52346	M-26A Run3 Cont. #3	↓	↓	380 ml			X									
18-52350	sigma M-26A auditsamples						X									
18-52343	sigma M-13B auditsamples					X										

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	Notes:
[signature]	[signature] 9.29.18 1028	
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	

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Company Name Bison Engineering, Inc.
Contact Kelly Dorsi | **Phone** 406-442-5768
E-Mail Address Kdorsi@bison-eng.com | **Fax**
Report Address 1400 11th Ave
City Helena | **State** MT | **Zip** 59601
Billing Address ''
City '' | **State** '' | **Zip** ''
PO # | **Project** HAV218775

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CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Turn Around Time
☒ Standard
☒ Rush ________ Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume ~~(m³)~~ ml	Particle Size	Analysis Requested: M-13B	Analysis Requested: M-26A									Remarks
18-52340	M-13B Run1 cont.#1	CFU104	9/28/18	595		X										
52341	M-13B Run2 cont.#1	↓	↓	560		X										
52342	M-13B Run3 cont.#1	↓	↓	520		X										
18-52343	M-26A Run1 cont.#3	↓	↓	380			X									
52344	M-26A Run2 cont.#3	↓	↓	345			X									
52345	M-26A Run3 cont.#3	↓	↓	352			X									

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time
[signature]	[signature] 9.29.18 1025
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time

Notes:

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CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Company Name: Bison Engineering, Inc.			
Contact: Kelly Dorsi		Phone: 406-442-5768	
E-Mail Address: kdorsi@bison-eng.com		Fax:	
Report Address: 1400 11th Ave.			
City: Helena	State: MT	Zip: 59601	
Billing Address: "			
City: "	State: "	Zip: "	
PO #:	Project: HAV218775		

Turn Around Time
- ☒ Standard
- ☒ Rush ______ Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume (m³) ml	Particle Size	Analysis Requested: M-29	Remarks
18-52351	Run1 cont.#1	CFU113	9/21/18	n/a			
18-52353	Run2 cont.#1			n/a			
18-52355	Run3 cont.#1			n/a			
18-52351	Run1 cont.#3 probe rinse			100ml			
18-52353	Run2 cont.#3 probe rinse			100ml			
18-52355	Run3 cont.#3 probe rinse			100ml			
18-52352	Run1 cont.#4 Imp.catch+rinse			338ml			
18-52354	Run2 cont.#4 Imp.catch+rinse			338ml			
18-52356	Run3 cont.#4 Imp.catch+rinse			334ml			

Relinquished By: (Signature) Date/Time: [signature]	Received By: (Signature) Date/Time: [signature] 9.29.18 1028	Notes:
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	

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Company Name	Bison Engineering, Inc.
Contact	Kelly Dorsi
Phone	406-442-5768
E-Mail Address	kdorsi@bison-eng.com
Fax	
Report Address	1400 11th Ave.
City	Helena
State	MT
Zip	59601
Billing Address	"
City	"
State	"
Zip	"
PO #	
Project	HAV218775

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
(503) 624-2183
Fax (503) 624-2653
cln@chesterlab.net

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Turn Around Time
☒ Standard
☒ Rush ______ Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume (~~m³~~ ml)	Particle Size	Analysis Requested: M-29										Remarks
18-52357	Cont. #1 filter Run1	CFU 113(2)	9/24/18	n/a		X										
18-52359	Cont. #1 filter Run2	↓	↓	n/a		X										
18-52361	Cont. #1 filter Run3	↓	↓	n/a		X										
18-52357	Cont. #3 Proberinse Run1	↓	↓	100 ml		X										
18-52359	Cont. #3 Proberinse Run2	↓	↓	100 ml		X										
18-52361	Cont. #3 Proberinse Run3	↓	↓	100 ml		X										
18-52358	Cont. #4 Imp. catch Run1	↓	↓	342 ml		X										
18-52360	Cont. #4 Imp. catch Run2	↓	↓	334 ml		X										
18-52362	Cont. #4 Imp. catch Run3	↓	↓	334 ml		X										

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time
[signature]	[signature] 9.29.18 1028
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time

Notes:

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Company Name Bison Engineering, Inc.			
Contact Kelly Dorsi		Phone 406-442-5768	
E-Mail Address kdorsi@bison-eng.com		Fax	
Report Address 1400 11th Ave			
City Helena	State MT	Zip 59601	
Billing Address 1400 11th Ave.			
City Helena	State MT	Zip 59601	
PO #	Project HAV218775		

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
(503) 624-2183
Fax (503) 624-2653
cln@chesterlab.net

CHAIN-OF-CUSTODY RECORD

Turn Around Time
☒ Standard
☒ Rush ____________ Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume ~~(m³)~~ ml	Particle Size	Analysis Requested: M-29										Remarks
18-S2363	M-29 Run1 cont#1 Filter	CFU104	9/27/18	n/a		X										
18-S2365	M-29 Run2 Cont #1 Filter	↓	↓	n/a		X										
18-S2367	M-29 Run3 cont #1 Filter			n/a		X										
18-S2363	M-29 Run1 cont. #3 proberinse			100 ml		X										
18-S2365	M-29 Run2 cont. #3 proberinse			100 ml		X										
18-S2367	M-29 Run3 cont. #3 proberinse			100 ml		X										
18-S2364	M-29 Run1 cont #4 Imp.catch			332 ml		X										
18-S2366	M-29 Run2 cont. #4 Imp.catch			338 ml		X										
18-S2368	M-29 Run3 cont. #4 Imp.catch			328 ml		X										
18-S2372	Sigma filter auditsample					X										
18-S2373	Sigma aqueous audit sample					X										

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	Notes:
[signature]	[signature] 9.29.18 1025	
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	

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<u>RAW DATA</u>

Available upon request

Bison Engineering

1400 11th Avenue
Helena, MT 59601

CFU 112

Corvallis, OR

Client Project # HAV218775

Analytical Report
(0918-103)

EPA Method 316

Formaldehyde

Enthalpy Analytical, LLC

Phone: (919) 850 - 4392 / Fax: (919) 850 - 9012 / www.enthalpy.com

800-1 Capitola Drive Durham, NC 27713-4385

I certify that to the best of my knowledge all analytical data presented in this report:

- Have been checked for completeness
- Are accurate, error-free, and legible
- Have been conducted in accordance with approved protocol, and that all deviations and analytical problems are summarized in the appropriate narrative(s)

This analytical report was prepared in Portable Document Format (.PDF) and contains ??? pages.

Report Issued: xx/xx/xxxx

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Summary of Results

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Enthalpy Analytical

Company: Bison Engineering, Inc.

Job No.: 0918-103 - EPA Method 316

Client No.: HAV 218775

Summary Table

Compound	Sample ID / Catch Weight (µg)		
	Cont. #1 Run 1 CFU112	***Cont. #1 Run 2 CFU112***	***Cont. #1 Run 3 CFU112***
Formaldehyde	424	341	460
	Field Train Blank	***DI H2O Blank***	
Formaldehyde	11.8 ND	11.1 ND	
	Cont #1 Run 1 CFU112(2)	***Cont #1 Run 2 CFU112(2)***	***Cont #1 Run 3 CFU112(2)***
Formaldehyde	474	11.2 ND	12.5 ND
	M-316 Field Train Blank		
Formaldehyde	12.1 ND		

Results

Enthalpy Analytical

Company: Bison Engineering, Inc.

Job No.: 0918-103 - EPA Method 316

Client No.: HAV 218775

MDL 0.0274 (µg/mL) Lower Curve Limit 0.274 (µg/mL)

LOQ 0.274 (µg/mL) Upper Curve Limit 3.29 (µg/mL)

Compound Formaldehyde

Sample ID	Lab ID	Absorbance	Conc (µg/mL)	Dilution	Volume (mL)	Catch Weight (µg)	Qual
Cont. #1 Run 1 CFU112	4	0.4857	0.9751	1	435	424	
Cont. #1 Run 2 CFU112	8	0.3861	0.7751	1	440	341	
Cont. #1 Run 3 CFU112	9	0.5476	1.0994	1	418	460	
Field Train Blank	10	0.0000	0.0274	1	430	11.8	ND
DI H_2O Blank	20	0.0001	0.0274	1	405	11.1	ND
Cont #1 Run 1 CFU112(2)	13	0.5551	1.1143	1	425	474	
Cont #1 Run 2 CFU112(2)	17	0.0118	0.0274	1	408	11.2	ND
Cont #1 Run 3 CFU112(2)	18	0.0129	0.0274	1	455	12.5	ND
M-316 Field Train Blank	19	0.0022	0.0274	1	442	12.1	ND
Snowball II 2150 #MB1	10	0.0000	0.0274	1	1.00	0.0274	ND
Snowball II 2150 #MB2	3	0.0017	0.0274	1	1.00	0.0274	ND
Snowball II 2150 #MB3	12	0.0003	0.0274	1	1.00	0.0274	ND
LD / Cont. #1 Run 1 CFU112	5	0.4865	0.9766	1	435	425	
					% Difference	0.2%	
AD / Cont. #1 Run 1 CFU112	6	0.2429	0.4877	2	435	424	
					%Difference	0.0%	
MS / Cont. #1 Run 1 CFU112	7	0.9333	1.8737	1	2.50	4.68	
					spike amount (ug)	2.19	
					native amount (ug)	2.42	
					Spike recovery	103%	
LD / Cont #1 Run 1 CFU112(2)	14	0.5534	1.1110	1	425	472	
					% Difference	0.3%	
AD / Cont #1 Run 1 CFU112(2)	15	0.2792	0.5604	2	425	476	
					%Difference	0.6%	
MS / Cont #1 Run 1 CFU112(2)	16	0.9999	2.0074	1	2.50	5.02	
					spike amount (ug)	2.19	
					native amount (ug)	2.76	
					Spike recovery	103%	

Narrative Summary

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Enthalpy Analytical Narrative Summary

Company	Bison Engineering Inc.
Job #	0918-103 Line 1. EPA Method 316
Client #	HAV 218775

Custody

Matthew St. Lawrence received the samples on 9/18/18 at 4.4 °C [CFU112] and 1.4 °C [CFU112(2)] after being relinquished by Bison Engineering Inc. The samples were received in good condition.

Prior to, during, and after analysis, the samples were kept under lock with access only to authorized personnel by Enthalpy Analytical, LLC.

Analysis

The samples were analyzed for formaldehyde using the analytical procedures in EPA Method 316, Sampling and Analysis for Formaldehyde Emissions from Stationary Sources in the Mineral Wool and Wool Fiberglass Industries (40 CFR Part 63, Appendix A).

The sodium sulfite reagent was used within 24 hours of preparation. Formaldehyde standards were made by diluting a certified solution with DIUF-grade water. Samples and standards were analyzed following the procedures in Section 11.0. Any sample dilutions were performed on an aliquot of the original sample prior to the addition of pararosaniline reagent.

The Hewlett Packard Model 8453, Diode Array Spectrophotometer ("Snowball II" S/N US73000904) was operated at 570 nm.

Calibration

The calibration curve is located in the Raw Data section of this report.

QC Notes

The analyses of the field and laboratory blanks did not contain formaldehyde at concentrations greater than the MDL.

Matrix spikes were prepared using aliquots of samples ***Cont. #1 Run 1 CFU112*** and ***Cont. #1 Run 1 CFU112(2)***. The matrix spikes were analyzed in the same manner as the samples and both exhibited spike recovery values of 103%.

Laboratory duplicate (LD) and alternate dilution (AD) analyses were performed using samples ***Cont. #1 Run 1 CFU112*** and ***Cont. #1 Run 1 CFU112(2)***. The LD and AD analyses exhibited percent difference values of less than 1%.

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Enthalpy Analytical Narrative Summary
(continued)

QC Notes (continued)	All sample preparation and analytical holding times specified in the method were met.
Reporting Notes	These analyses met the requirements of the TNI Standard. Any deviations from the requirements of the reference method or TNI Standard have been stated above. The results presented in this report are representative of the samples as provided to the laboratory.

General Reporting Notes

The following are general reporting notes that are applicable to all Enthalpy Analytical, LLC data reports, unless specifically noted otherwise.

- Any analysis which refers to the method as ***"Type"*** represents a planned deviation from the reference method. For instance a Hydrogen Sulfide assay from a Tedlar bag would be labeled as "EPA Method 16-Type" because Tedlar bags are not mentioned as one of the collection options in EPA Method 16.

- The acronym ***MDL*** represents the Minimum Detection Limit. Below this value the laboratory cannot determine the presence of the analyte of interest reliably.

- The acronym ***LOQ*** represents the Limit of Quantification. Below this value the laboratory cannot quantitate the analyte of interest within the criteria of the method.

- The acronym ***ND*** following a value indicates a non-detect or analytical result below the MDL.

- The letter ***J*** in the Qualifier or Flag column in the results indicates that the value is between the MDL and the LOQ. The laboratory can positively identify the analyte of interest as present, but the value should be considered an estimate.

- The letter ***E*** in the Qualifier or Flag column indicates an analytical result exceeding 100% of the highest calibration point. The associated value should be considered as an estimate.

- Sample results are presented 'as measured' for single injection methodologies, or an average value if multiple injections are made. If all injections are below the MDL, the sample is considered non-detect and the ND value is presented. If one, but not all, are below the MDL, the MDL value is used for any injections that are below the MDL. For example, if the MDL is 0.500 and LOQ is 1.00, and the instrument measures 0.355, 0.620, and 0.442 - the result reported is the average of 0.500, 0.620, and 0.500 - - - i.e. 0.540 with a J flag.

- When a spike recovery (Bag Spike, Collocated Spike Train, or liquid matrix spike) is being calculated, the native (unspiked) sample result is used in the calculations, as long as the value is above the MDL. If a sample is ND, then 0 is used as the native amount (not the MDL value).

- The acronym ***DF*** represents Dilution Factor. This number represents dilution of the sample during the preparation and/or analysis process. The analytical result taken from a laboratory instrument is multiplied by the DF to determine the final undiluted sample results.

- The addition of ***MS*** to the Sample ID represents a Matrix Spike. An aliquot of an actual sample is spiked with a known amount of analyte so that a percent recovery value can be determined. The MS analysis indicates what effect the sample matrix may have on the target analyte, i.e. whether or not anything in the sample matrix interferes with the analysis of the analyte(s).

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General Reporting Notes
(continued)

- The addition of ***MSD*** to the Sample ID represents a Matrix Spike Duplicate. Prepared in the same manner as a MS, the use of duplicate matrix spikes allows further confirmation of laboratory quality by showing the consistency of results gained by performing the same steps multiple times.

- The addition of ***LD*** to the Sample ID represents a Laboratory Duplicate. The analyst prepares an additional aliquot of sample for testing and the results of the duplicate analysis are compared to the initial result. The result should have a difference value of within 10% of the initial result (if the results of the original analysis are greater than the LOQ).

- The addition of ***AD*** to the Sample ID represents an Alternate Dilution. The analyst prepares an additional aliquot at a different dilution factor (usually double the initial factor). This analysis helps confirm that no additional compound is present and coeluting or sharing absorbance with the analyte of interest, as they would have a different response/absorbance than the analyte of interest.

- The Sample ID ***LCS*** represents a Laboratory Control Sample. Clean matrix, similar to the client sample matrix, prepared and analyzed by the laboratory using the same reagents, spiking standards and procedures used for the client samples. The LCS is used to assess the control of the laboratory's analytical system. Whenever spikes are prepared for our client projects, two spikes are retained as LCSs. The LCSs are labeled with the associated project number and kept in-house at the appropriate temperature conditions. When the project samples are received for analysis, the LCSs are analyzed to confirm that the analyte could be recovered from the media, separate from the samples which were used on the project and which may have been affected by source matrix, sample collection, and/or sample transport.

- **Significant Figures**: Where the reported value is much greater than unity (1.00) in the units expressed, the number is rounded to a whole number of units, rather than to 3 significant figures. For example, a value of 10,456.45 ug catch is rounded to 10,456 ug. There are five significant digits displayed, but no confidence should be placed on more than two significant digits. In the case of small numbers, generally 3 significant figures are presented, but still only 2 should be used with confidence. Many neat materials are only certified to 3 digits, and as the mathematically correct final result is always 1 digit less than all its pre-cursors - 2 significant figures are what are most defensible.

- **Manual Integration**: The data systems used for processing will flag manually integrated peaks with an "M". There are several reasons a peak may be manually integrated. These reasons will be identified by the following two letter designations on sample chromatograms, if provided in the report. The peak was ***not integrated*** by the software **"NI"**, the peak was ***integrated incorrectly*** by the software **"II"** or the ***wrong peak*** was integrated by the software **"WP"**. These codes will accompany the analyst's manual integration stamp placed next to the compound name on the chromatogram.

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Sample Custody

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Chain of Custody Record

Page 1 of 1

Special Handling:

☒ Standard Turn Around Time (10 business days)
☐ Rush Turn Around Time -- Date Needed______
- All TATs Subject to Approval by Enthalpy Analytical, Inc.
- All Bag/Can Samples Disposed of 1 Month from Receipt.
- All Other Samples Disposed of 4 Months from Receipt.

Client Name: Bison Engineering, Inc.
Project Manager: Kelly Dorsi
Report To: Kelly Dorsi kdorsi@bison-eng.com
Special Instructions:

Project Number: HAV218775
Site Name: CFU 112
Location: Corvallis, OR

PO#:
Telephone#: (406) 442-5768
Email: kdorsi@bison-eng.com

For spiked or duplicate samples: please provide sample volumes for recovery calculations. For Particulates: please provide tare weights and/or condensed water volumes.

A=Air 1=H2SO4 2=NaOH W=Water O=Other
X=XAD C=Charcoal SG=Silica Gel

G=Grab C=Composite Q=Quality Control O=Other

Sample ID	Date	Time	Sample Volume	Type	Matrix	# of VOA Vials	# of Glass	# of Plastic	# of Bags	# of Canisters	# of Tubes	# Other	Analyses: M-316	Notes:
Cont. #1 Run1 CFU112	9/12/18	10:30	413 ml					1						
Cont. #1 Run2 CFU112	9/12/18	13:00	431 ml					1						
Cont. #1 Run3 CFU112	9/12/18	15:30	412 ml					1						
Field train blank	9/12/18	16:00	~400 ml					1						
D.I. H2O blank	9/12/18	16:00	~410 ml					1						

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Condition Upon Receipt:
Adam Bender [signature]		Matt A. Lawrence	9/18/18	8:37am	☐ Iced ☐ Ambient ☐ °C____
					☐ Iced ☐ Ambient ☐ °C____
					☐ Iced ☐ Ambient ☐ °C____

800-1 Capitola Drive • Durham, NC 27713 • (919) 850-4392 • FAX (919) 850-9012 • www.enthalpy.com

4.4°C Raytek 5   Good Condition
MST 9/18/18

ENTHALPY analytical, inc

Chain of Custody Record

Page 1 of 1

Special Handling:
- [X] Standard Turn Around Time (10 business days)
- [ ] Rush Turn Around Time -- Date Needed________
- All TATs Subject to Approval by Enthalpy Analytical, Inc.
- All Bag/Can Samples Disposed of 1 Month from Receipt.
- All Other Samples Disposed of 4 Months from Receipt.

Client Name: Bison Engineering, Inc.
Project Manager: Kelly Dorsi
Report To: Kelly Dorsi
Special Instructions:

Project Number: HAV218775
Site Name: CFU 112 (2)
Location: Corvallis, OR

PO#:
Telephone#: 406-442-5768
Email: kdorsi@bison-eng.com

For spiked or duplicate samples: please provide sample volumes for recovery calculations. For Particulates: please provide tare weights and/or condensed water volumes.

A=Air 1=H2SO4 2=NaOH W=Water O=Other
X=XAD C=Charcoal SG=Silica Gel
G=Grab C=Composite Q=Quality Control O=Other

Sample ID	Date	Time	Sample Volume	Type	Matrix	# of VOA Vials	# of Glass	# of Plastic	# of Bags	# of Canisters	# of Tubes	# Other	Analyses: M-316	Notes:
Cont. #1 Run 1 CFU 112 (2)	9/15/18	15:00	420ml					1						
Cont. #1 Run 2 CFU 112 (2)	9/15/18	18:30	400ml					1						
Cont. #1 Run 3 CFU 112 (2)	9/15/18	21:00	450ml					1						
M-316 Field train blank	9/15/18	15:30	~430ml					1						

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Condition Upon Receipt:
[signature]		Matt d. Lawrence	9/18/18	8:37am	☐ Iced ☐ Ambient ☐ °C____
					☐ Iced ☐ Ambient ☐ °C____
					☐ Iced ☐ Ambient ☐ °C____

800-1 Capitola Drive • Durham, NC 27713 • (919) 850-4392 • FAX (919) 850-9012 • www.enthalpy.com

1.4°C Raytek 5
Good condition
MST 9/18/18

Raw Data

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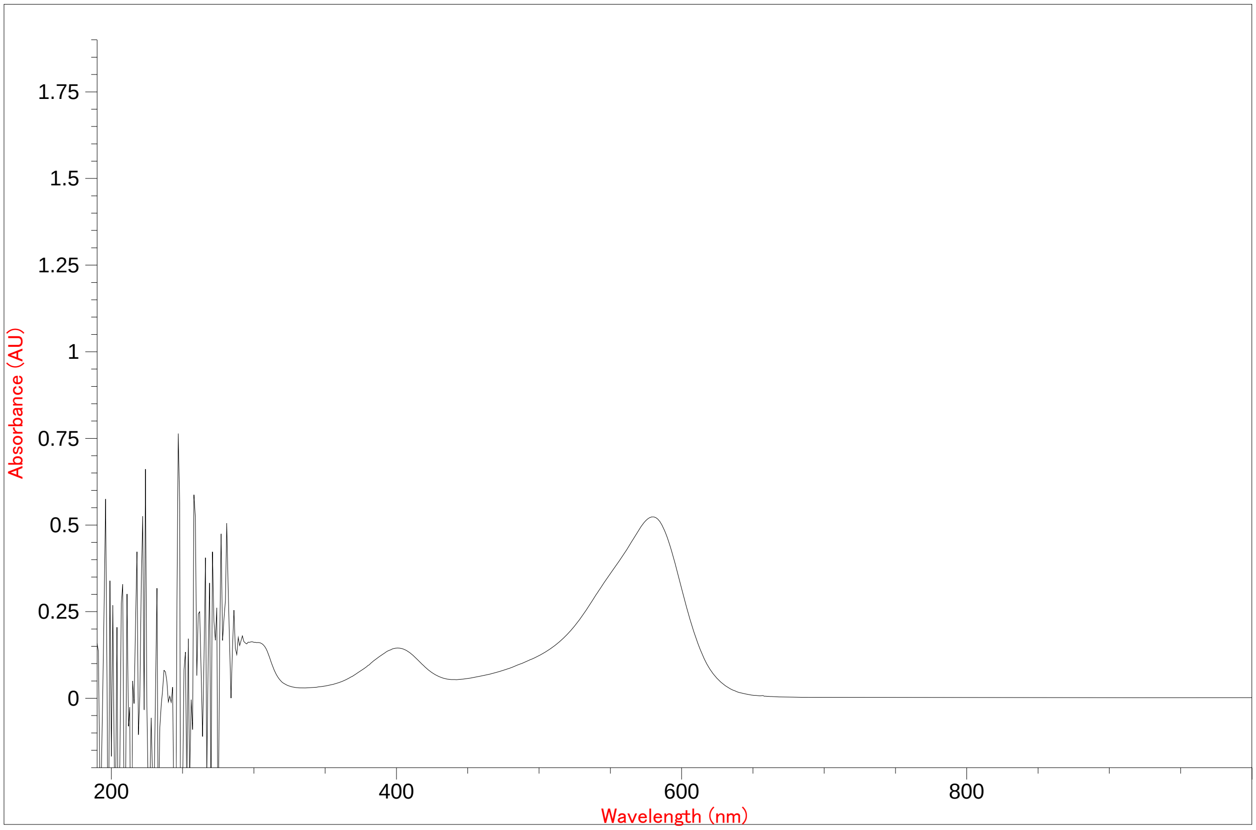
Sample 6

Sample Name	0918-103.1-R1.M316 (#4)
Operator	Scott Wilson
Date	9/20/18
Time	12:43:28
Path Length	1
Path Length Unit	cm

Sample Spectrum



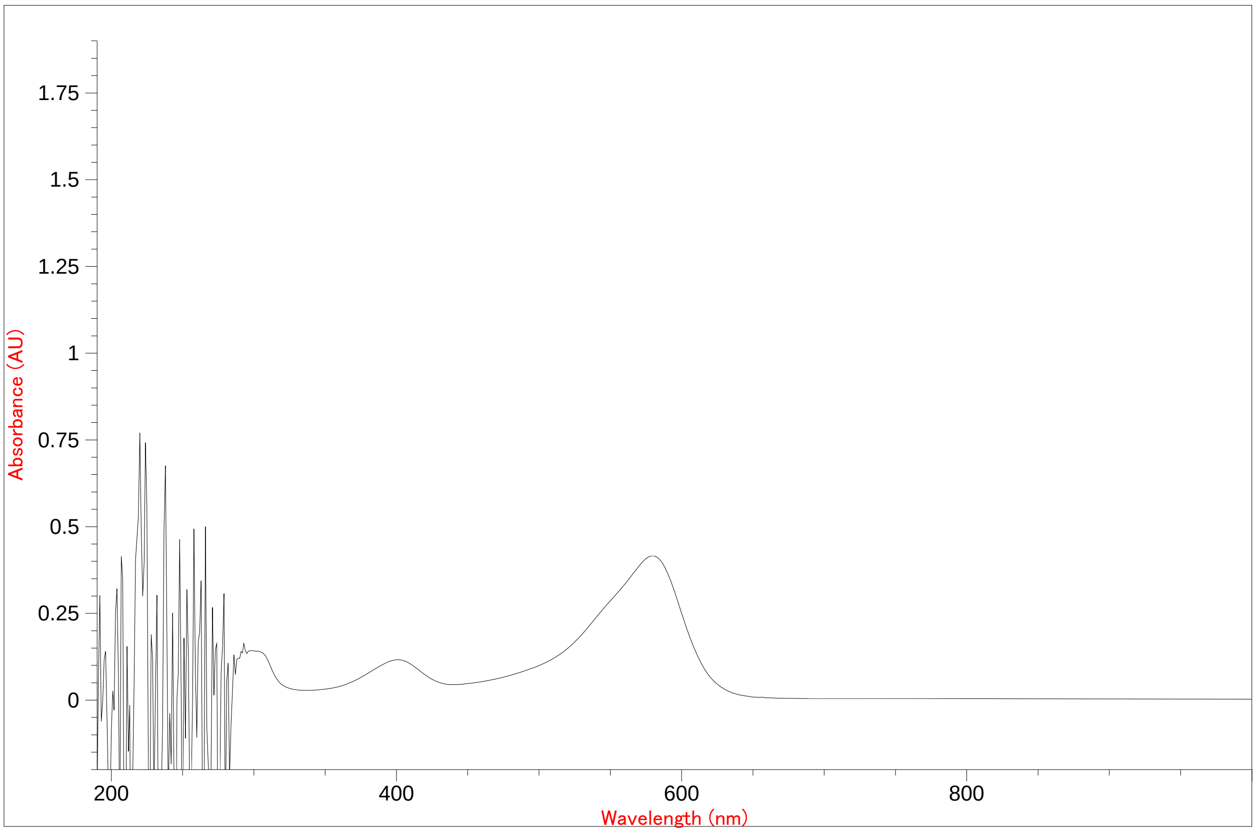
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.97508	ug/mL	0.02441

Sample 10

Sample Name	0918-103.1-R2.M316 (#8)
Operator	Scott Wilson
Date	9/20/18
Time	12:45:11
Path Length	1
Path Length Unit	cm

Sample Spectrum



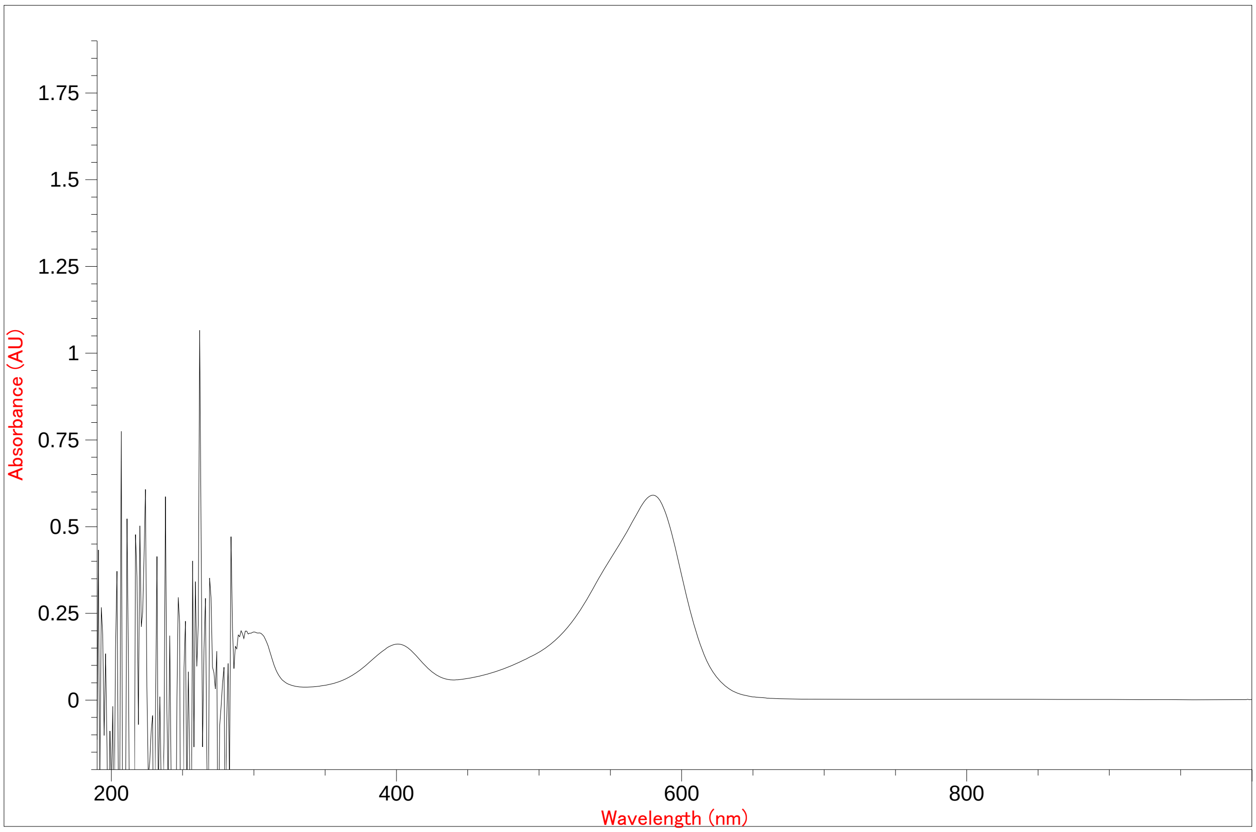
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.77509	ug/mL	0.02417

Sample 11

Sample Name	0918-103.1-R3.M316 (#9)
Operator	Scott Wilson
Date	9/20/18
Time	12:45:28
Path Length	1
Path Length Unit	cm

Sample Spectrum



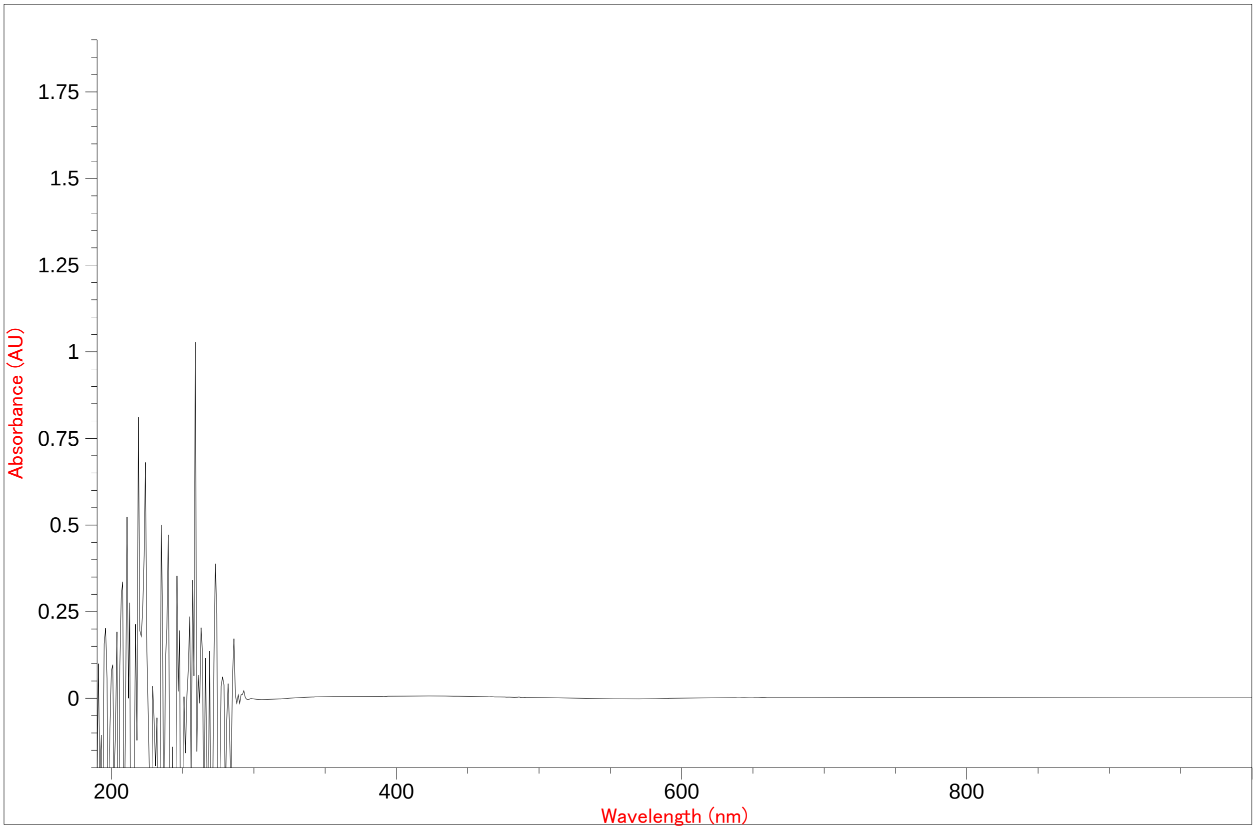
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.09938	ug/mL	0.02458

Sample 12

Sample Name	0918-103.1-FTB.M316 (#10)
Operator	Scott Wilson
Date	9/20/18
Time	12:46:24
Path Length	1
Path Length Unit	cm

Sample Spectrum



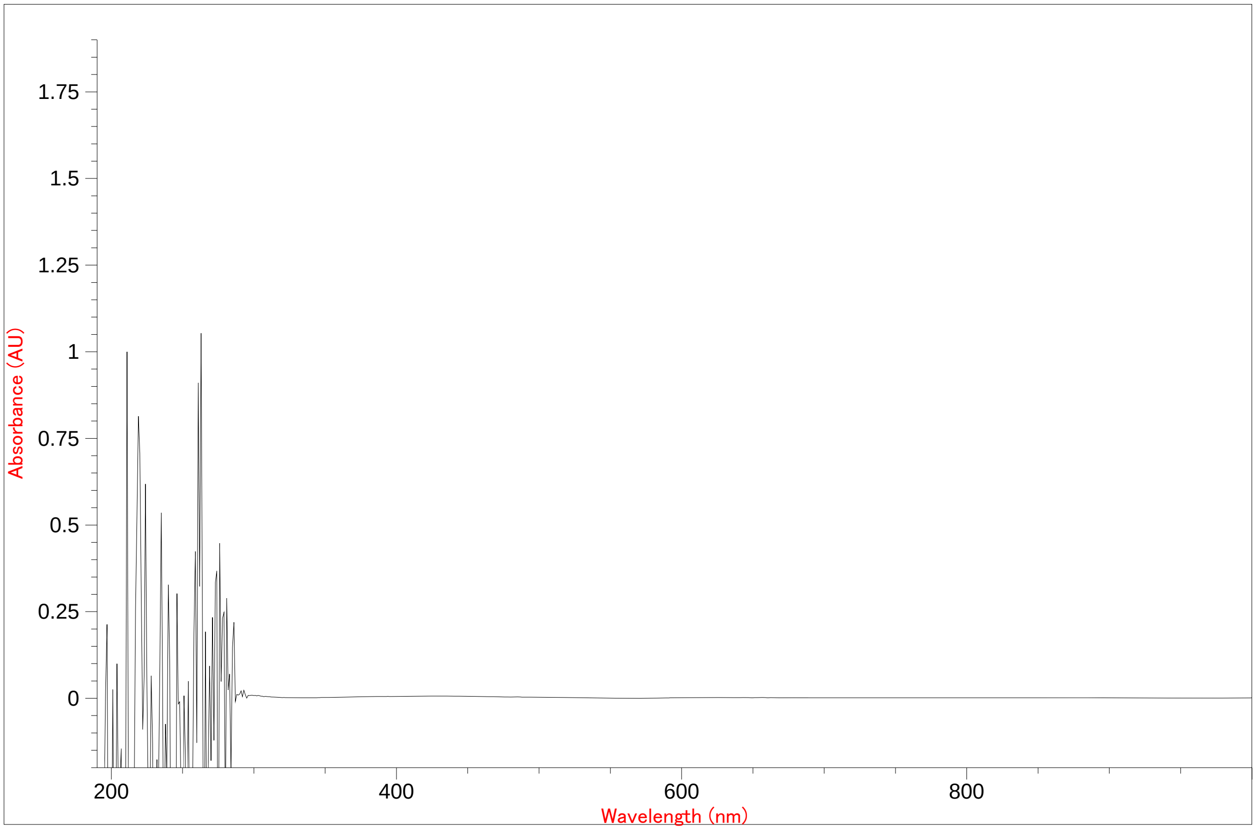
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00346	ug/mL	0.02376

Sample 22

Sample Name	0918-103.Blank.M316 (#20)
Operator	Scott Wilson
Date	9/20/18
Time	12:48:49
Path Length	1
Path Length Unit	cm

Sample Spectrum



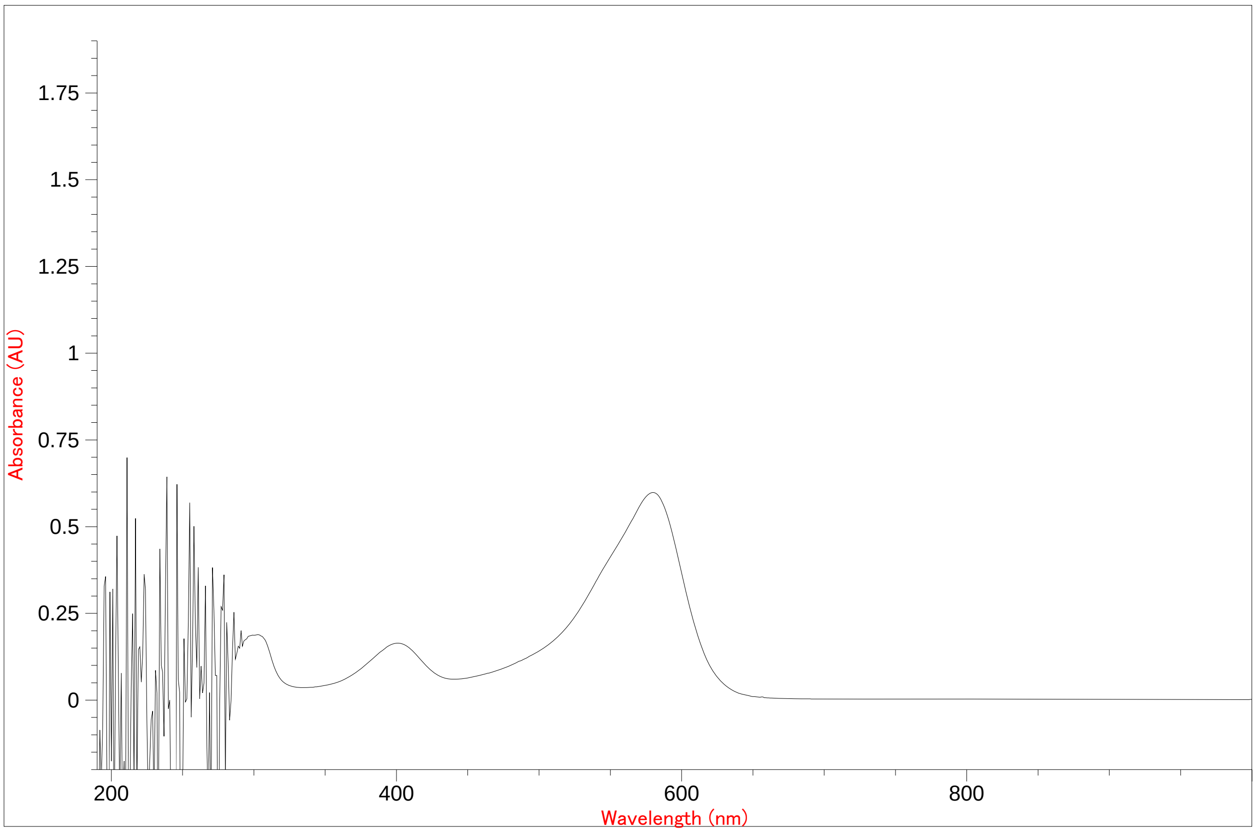
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00020	ug/mL	0.02376

Sample 15

Sample Name	0918-103.2-R1.M316 (#13)
Operator	Scott Wilson
Date	9/20/18
Time	12:47:13
Path Length	1
Path Length Unit	cm

Sample Spectrum



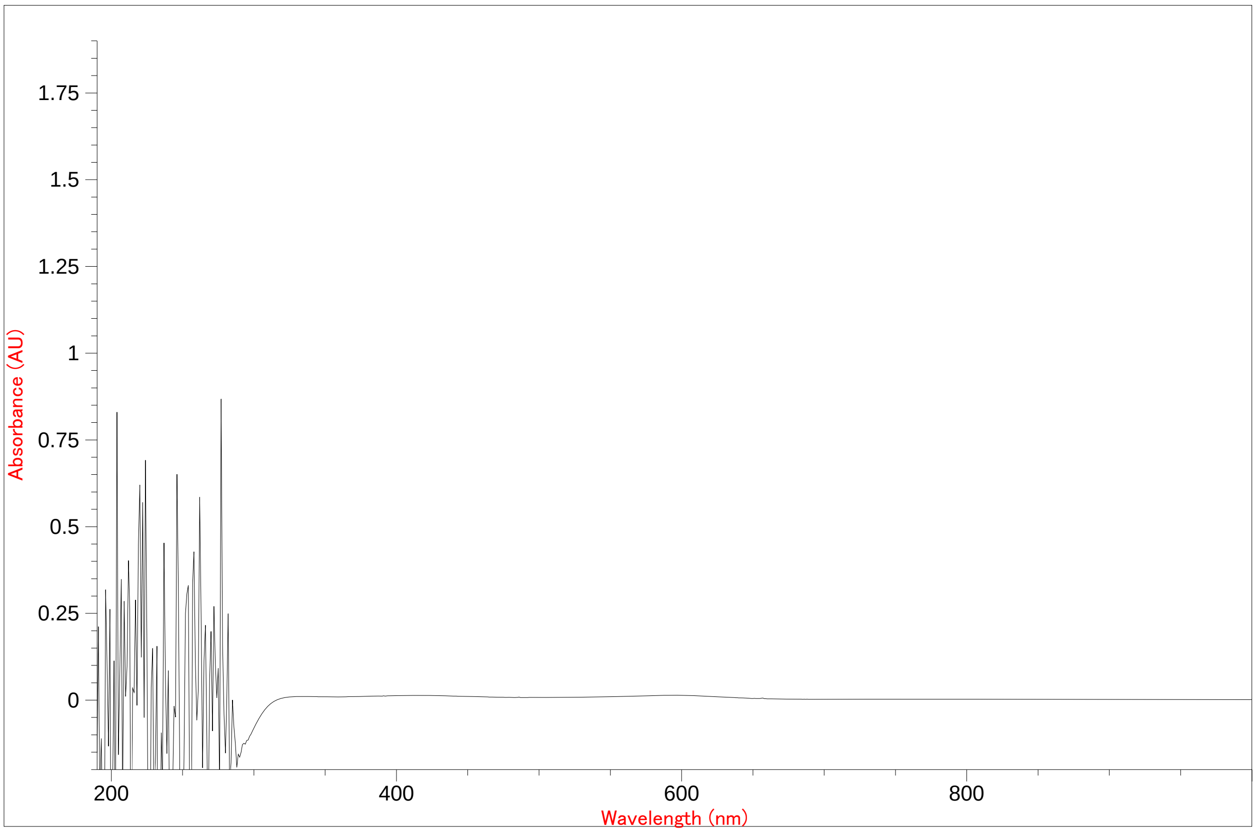
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.11433	ug/mL	0.02461

Sample 19

Sample Name	0918-103.2-R2.M316 (#17)
Operator	Scott Wilson
Date	9/20/18
Time	12:48:05
Path Length	1
Path Length Unit	cm

Sample Spectrum



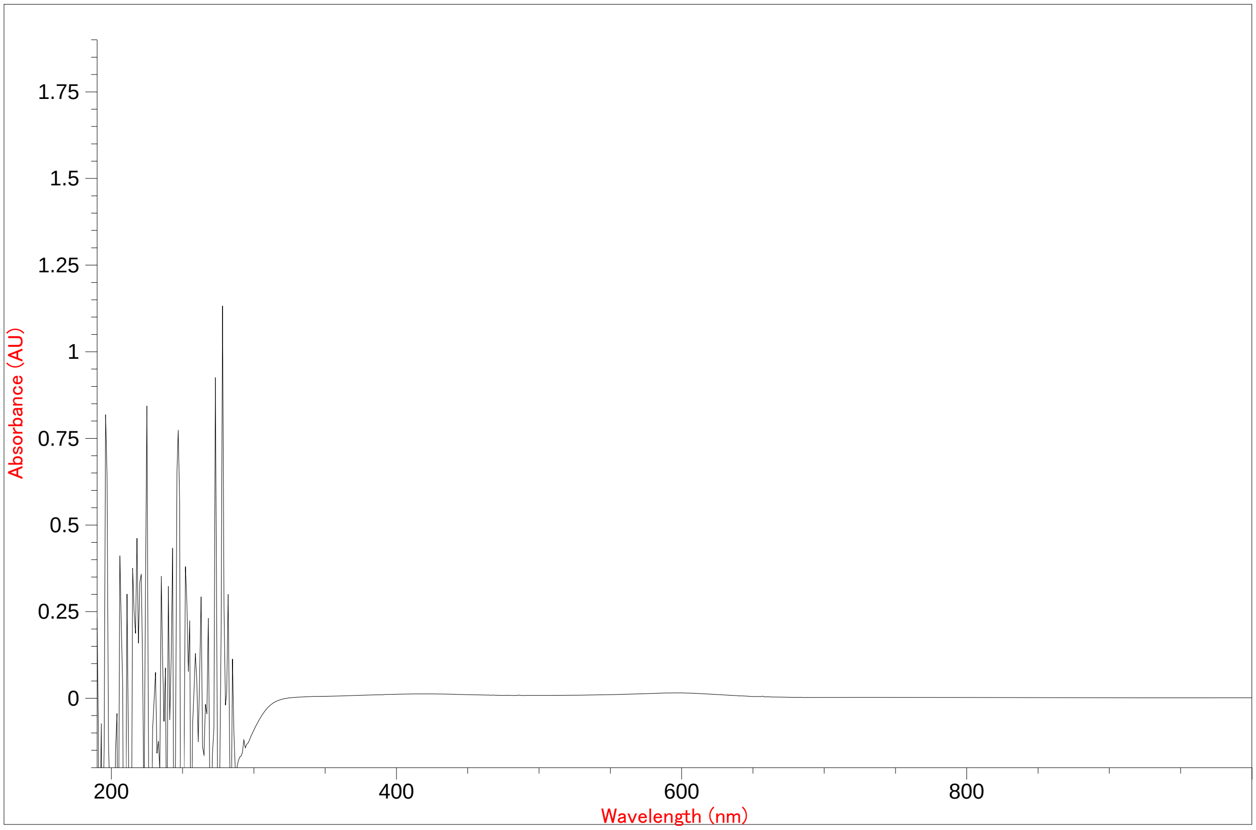
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.02379	ug/mL	0.02376

Sample 20

Sample Name	0918-103.2-R3.M316 (#18)
Operator	Scott Wilson
Date	9/20/18
Time	12:48:21
Path Length	1
Path Length Unit	cm

Sample Spectrum



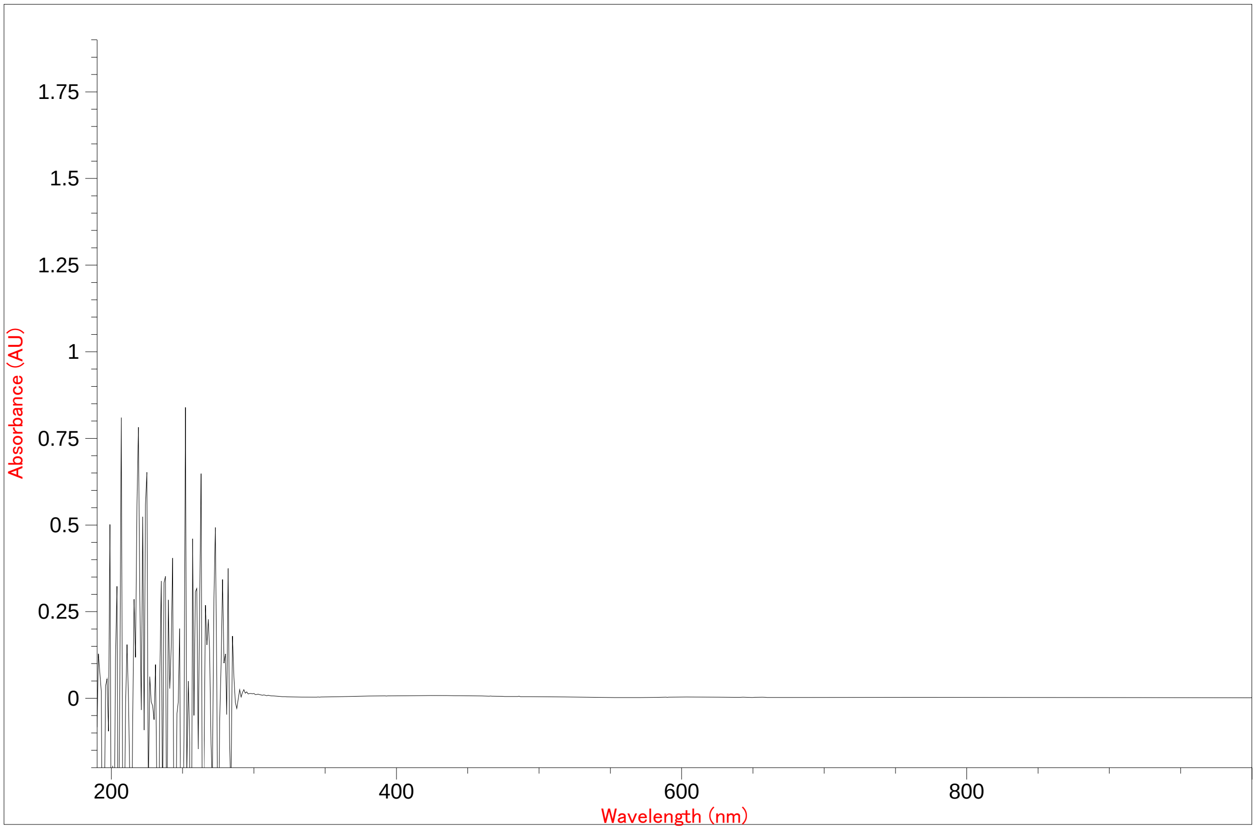
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.02596	ug/mL	0.02376

Sample 21

Sample Name	0918-103.2-FTB.M316 (#19)
Operator	Scott Wilson
Date	9/20/18
Time	12:48:35
Path Length	1
Path Length Unit	cm

Sample Spectrum



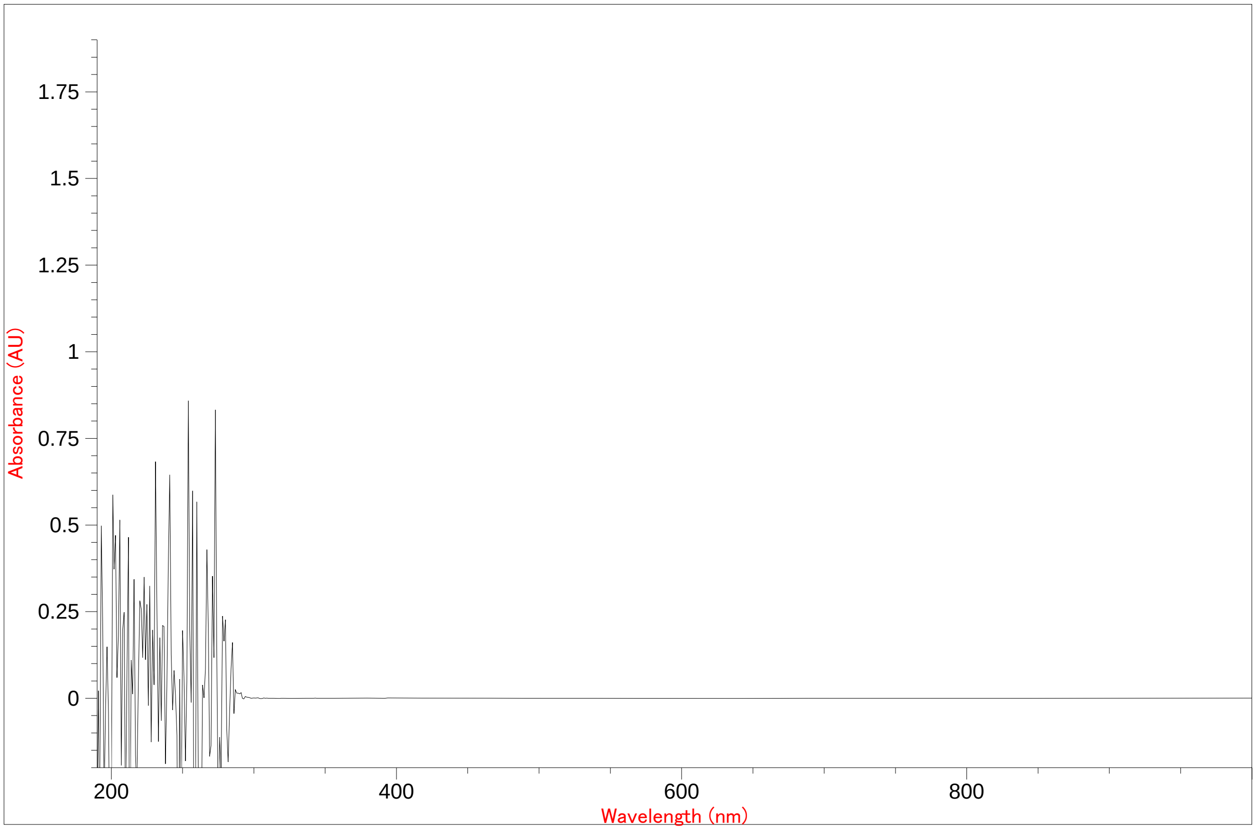
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00432	ug/mL	0.02376

Sample 3

Sample Name	Snowball II 2150 #MB1 (#10)
Operator	Scott Wilson
Date	9/20/18
Time	11:16:01
Path Length	1
Path Length Unit	cm

Sample Spectrum



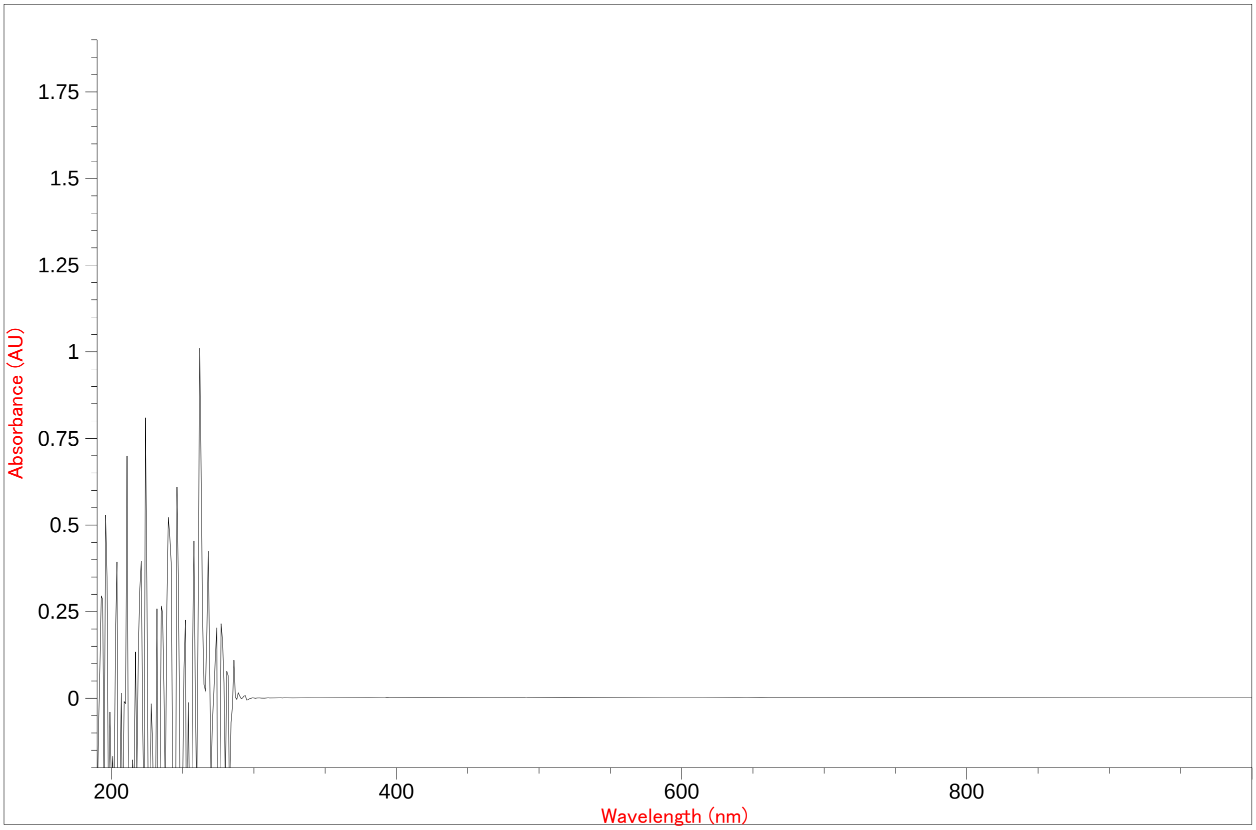
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00006	ug/mL	0.02376

Sample 5

Sample Name	Snowball II 2150 #MB2 (#3)
Operator	Scott Wilson
Date	9/20/18
Time	12:43:14
Path Length	1
Path Length Unit	cm

Sample Spectrum



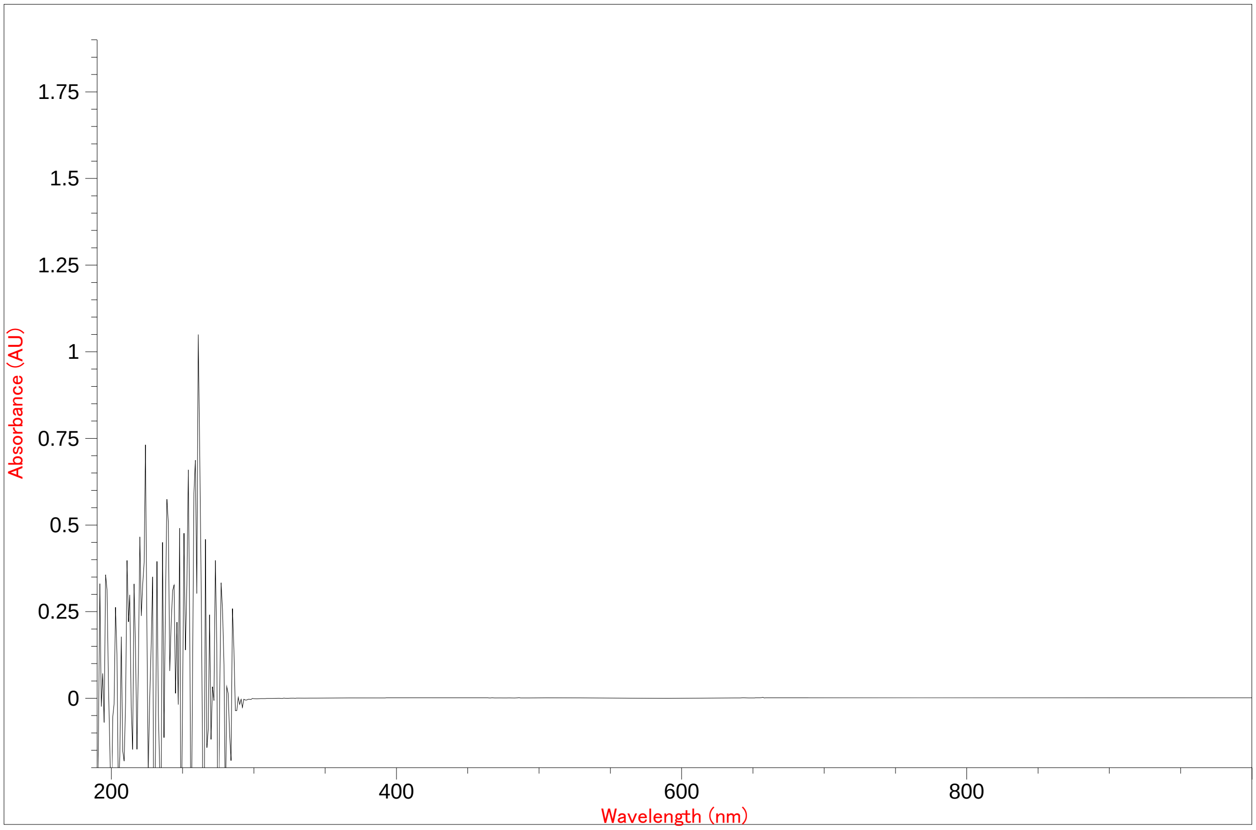
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00340	ug/mL	0.02376

Sample 14

Sample Name	Snowball II 2150 #MB3 (#12)
Operator	Scott Wilson
Date	9/20/18
Time	12:46:54
Path Length	1
Path Length Unit	cm

Sample Spectrum



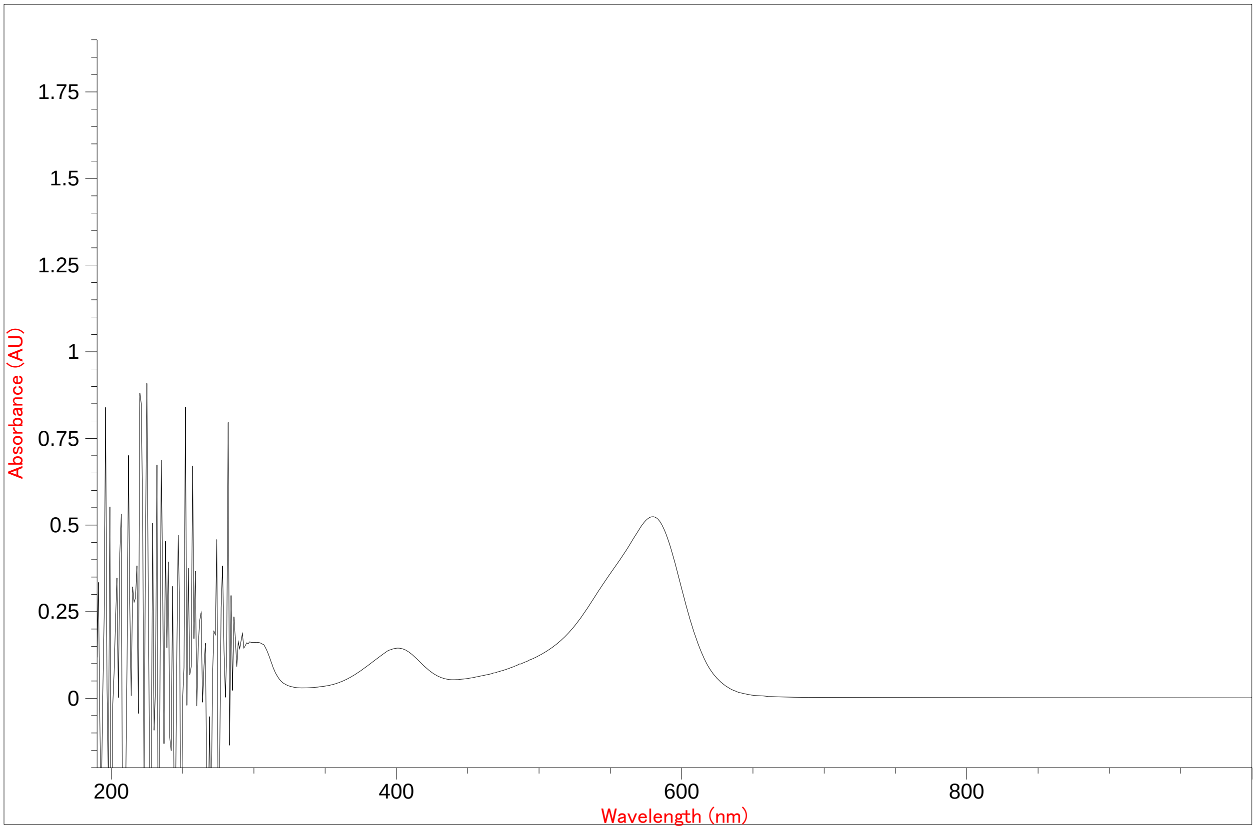
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00067	ug/mL	0.02376

Sample 7

Sample Name	0918-103.LD/1-R1.M316 (#5)
Operator	Scott Wilson
Date	9/20/18
Time	12:43:41
Path Length	1
Path Length Unit	cm

Sample Spectrum



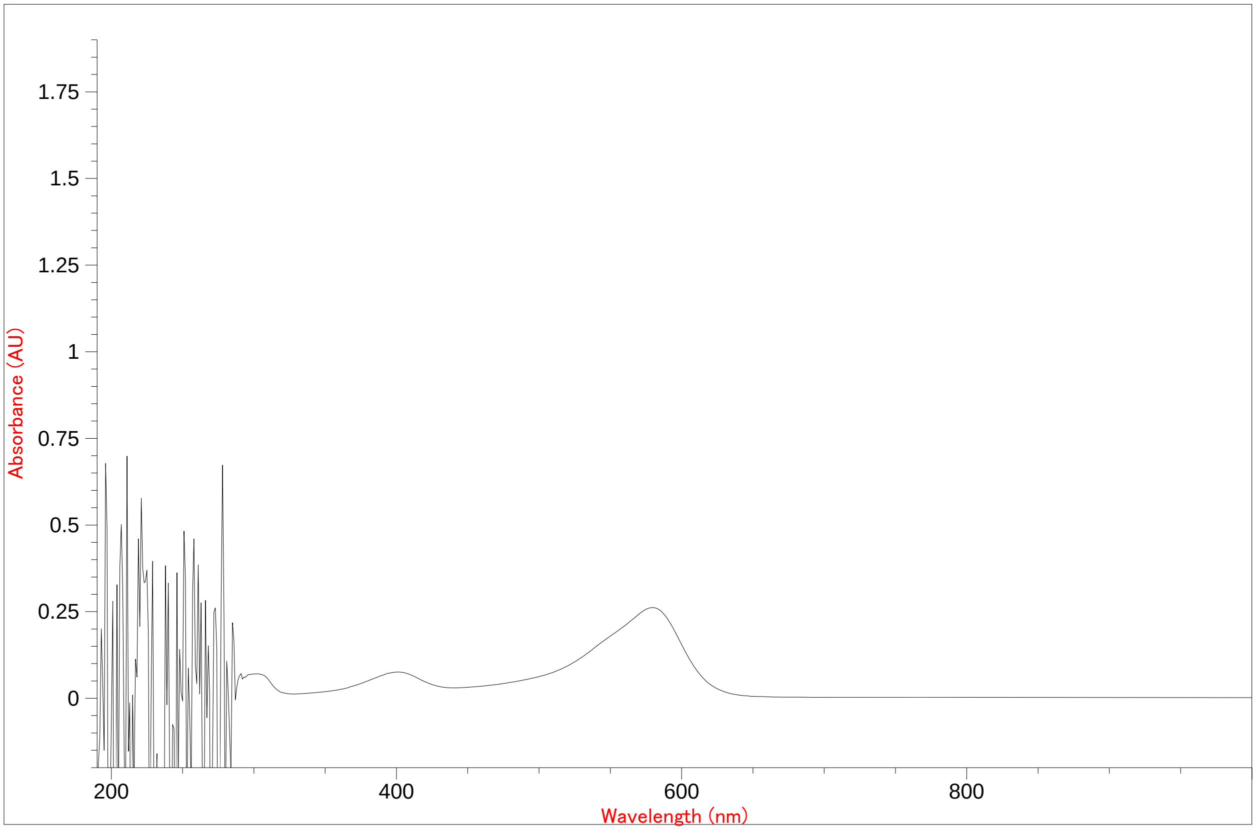
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.97659	ug/mL	0.02441

Sample 8

Sample Name	0918-103.AD/1-R1.M316 (#6)
Operator	Scott Wilson
Date	9/20/18
Time	12:44:36
Path Length	1
Path Length Unit	cm

Sample Spectrum



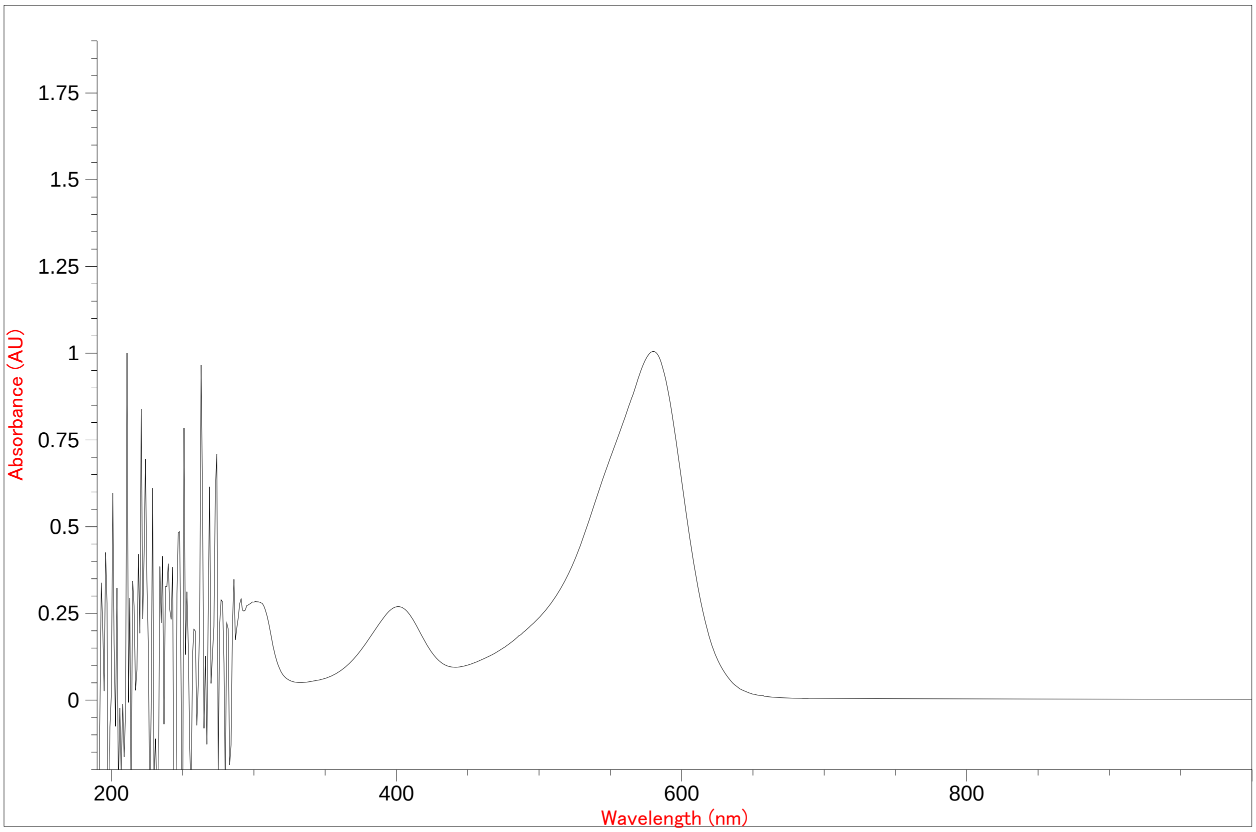
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.48765	ug/mL	0.02393

Sample 9

Sample Name	0918-103.MS/1-R1.M316 (#7)
Operator	Scott Wilson
Date	9/20/18
Time	12:44:58
Path Length	1
Path Length Unit	cm

Sample Spectrum



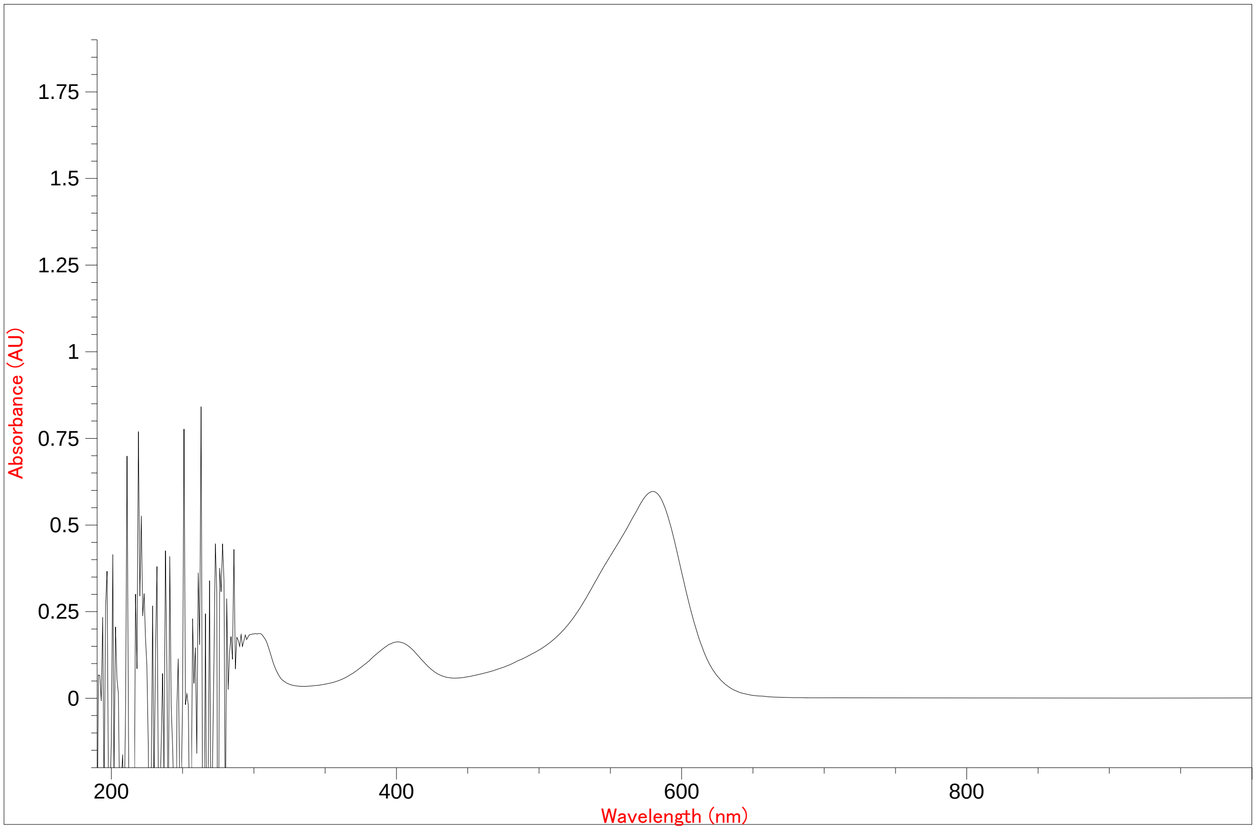
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.87369	ug/mL	0.02608

Sample 16

Sample Name	0918-103.LD/2-R1.M316 (#14)
Operator	Scott Wilson
Date	9/20/18
Time	12:47:26
Path Length	1
Path Length Unit	cm

Sample Spectrum



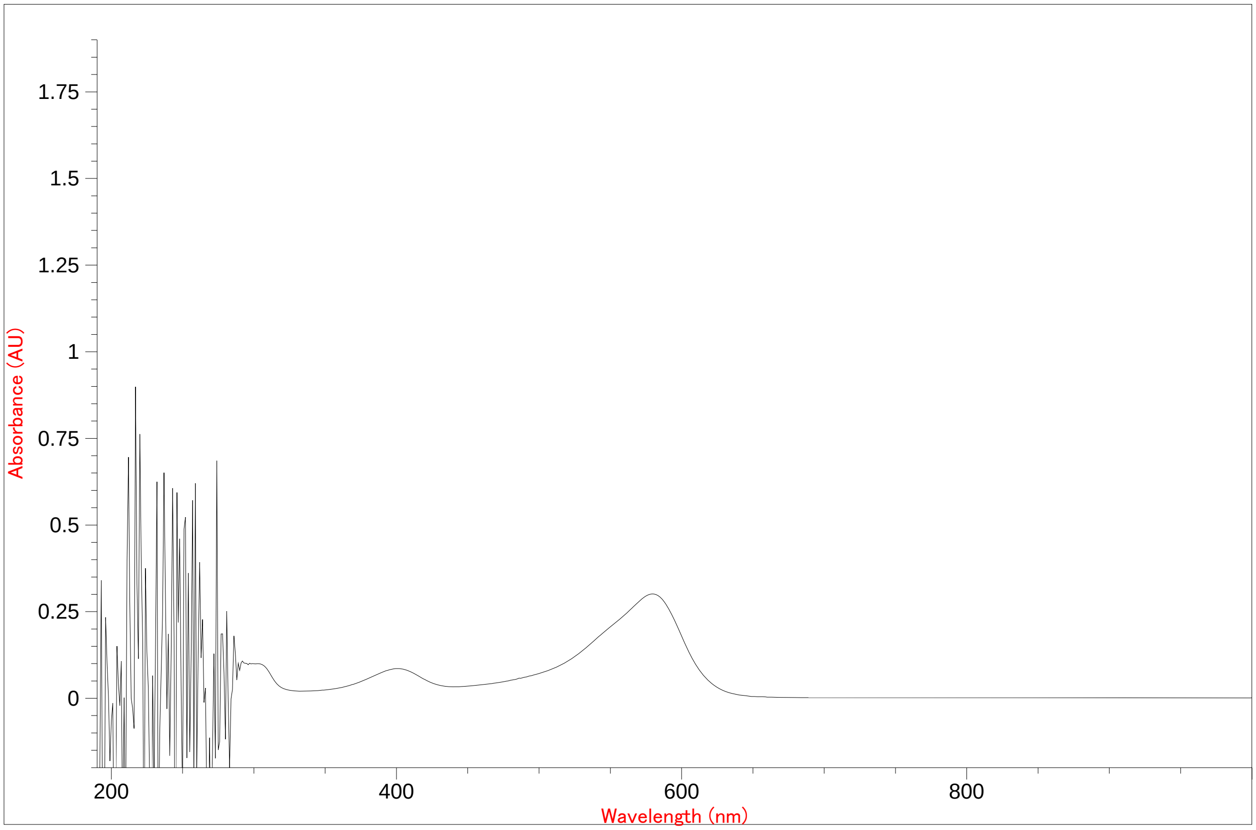
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.11096	ug/mL	0.02460

Sample 17

Sample Name	0918-103.AD/2-R1.M316 (#15)
Operator	Scott Wilson
Date	9/20/18
Time	12:47:39
Path Length	1
Path Length Unit	cm

Sample Spectrum



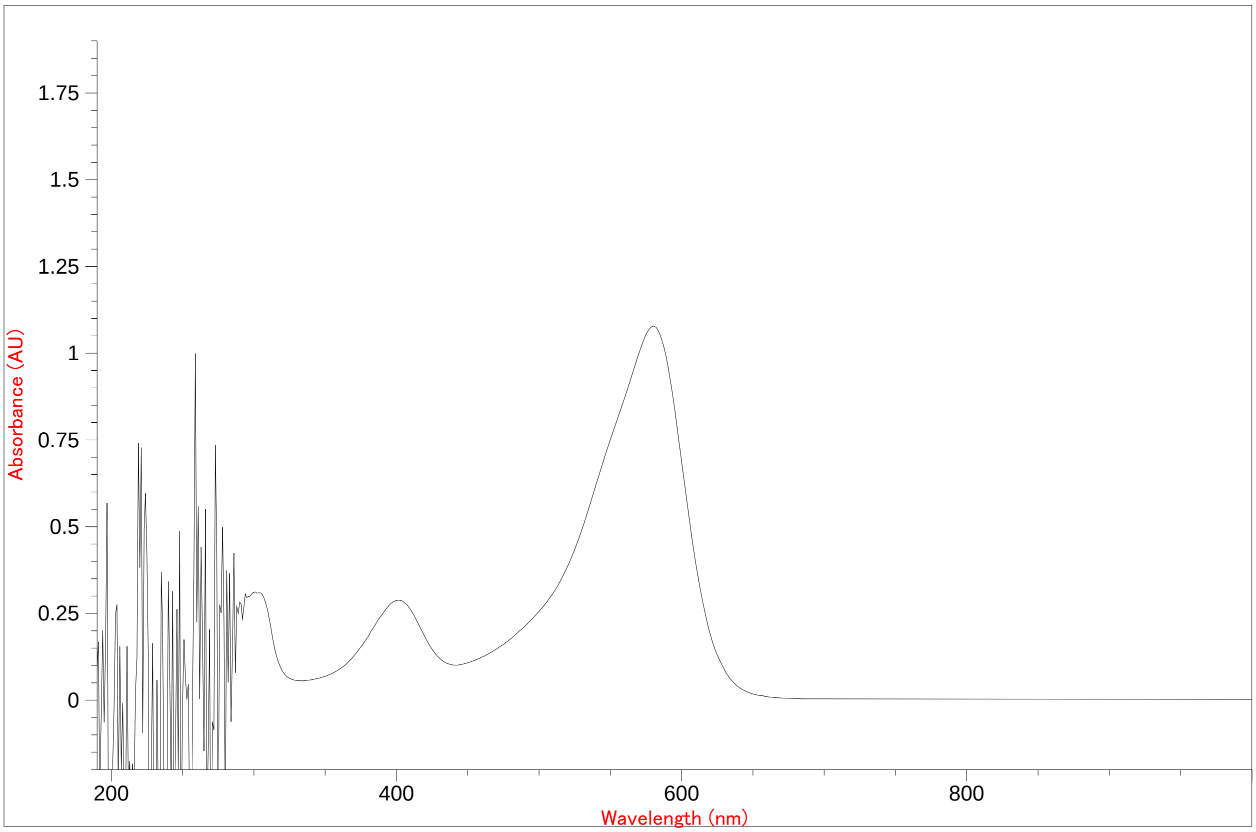
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.56042	ug/mL	0.02398

Sample 18

Sample Name	0918-103.MS/2-R1.M316 (#16)
Operator	Scott Wilson
Date	9/20/18
Time	12:47:50
Path Length	1
Path Length Unit	cm

Sample Spectrum



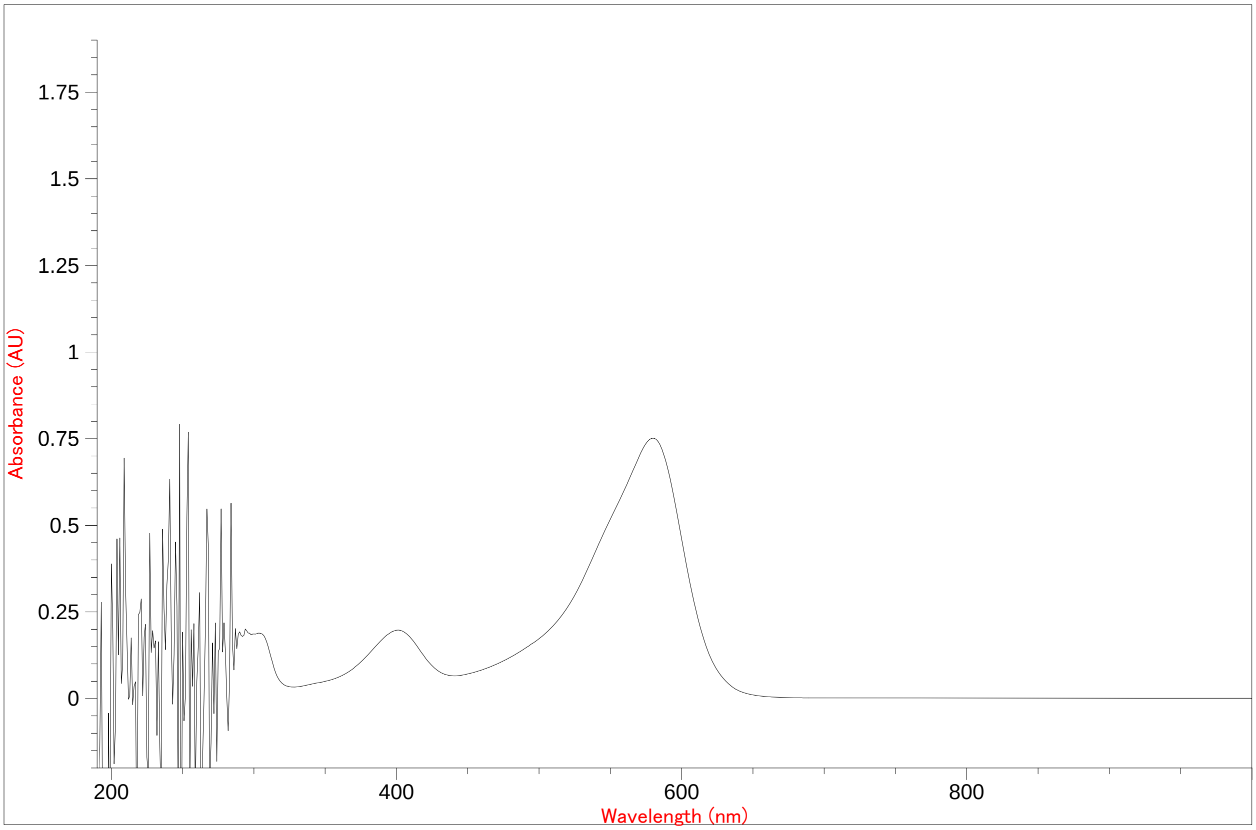
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	2.00744	ug/mL	0.02640

Sample 1

Sample Name	Snowball II 2150 #SS1 (#8)
Operator	Scott Wilson
Date	9/20/18
Time	11:15:36
Path Length	1
Path Length Unit	cm

Sample Spectrum



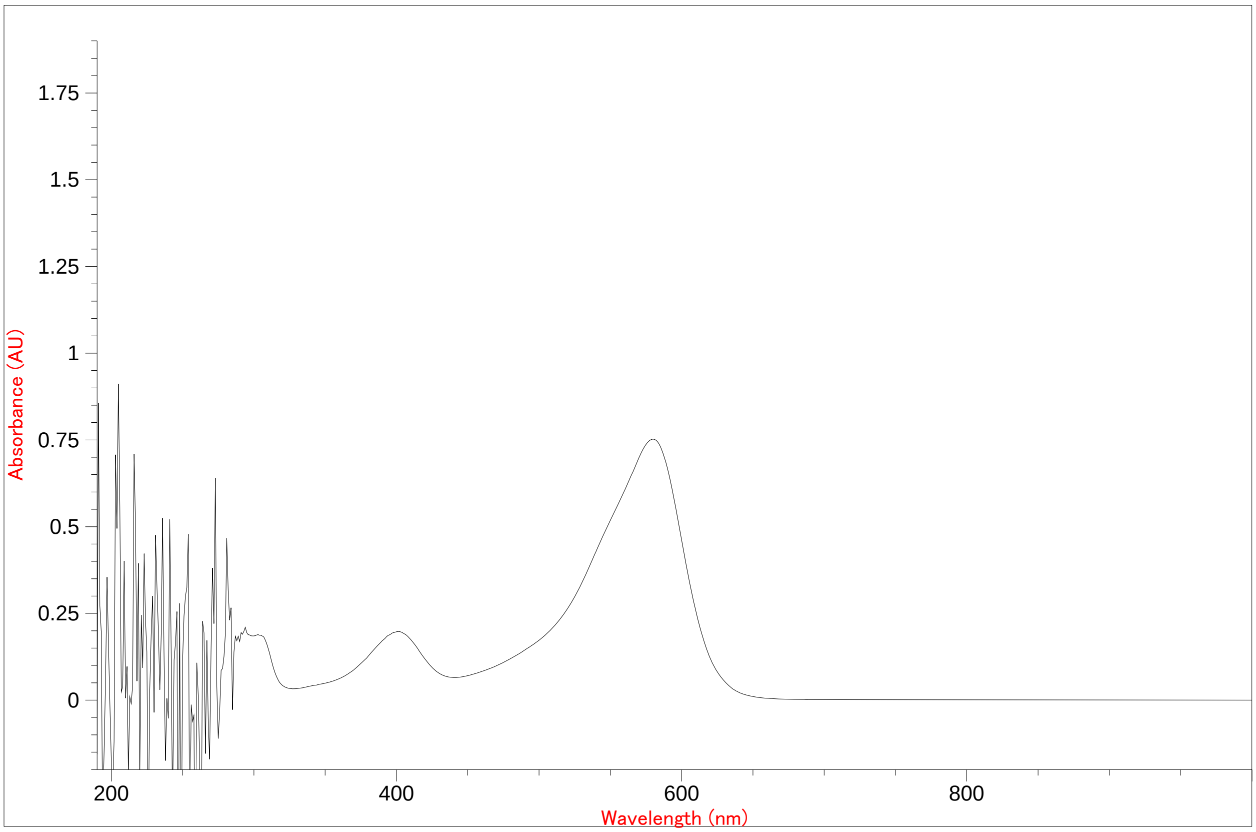
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.39955	ug/mL	0.02508

Sample 2

Sample Name	Snowball II 2150 #SS2 (#9)
Operator	Scott Wilson
Date	9/20/18
Time	11:15:49
Path Length	1
Path Length Unit	cm

Sample Spectrum



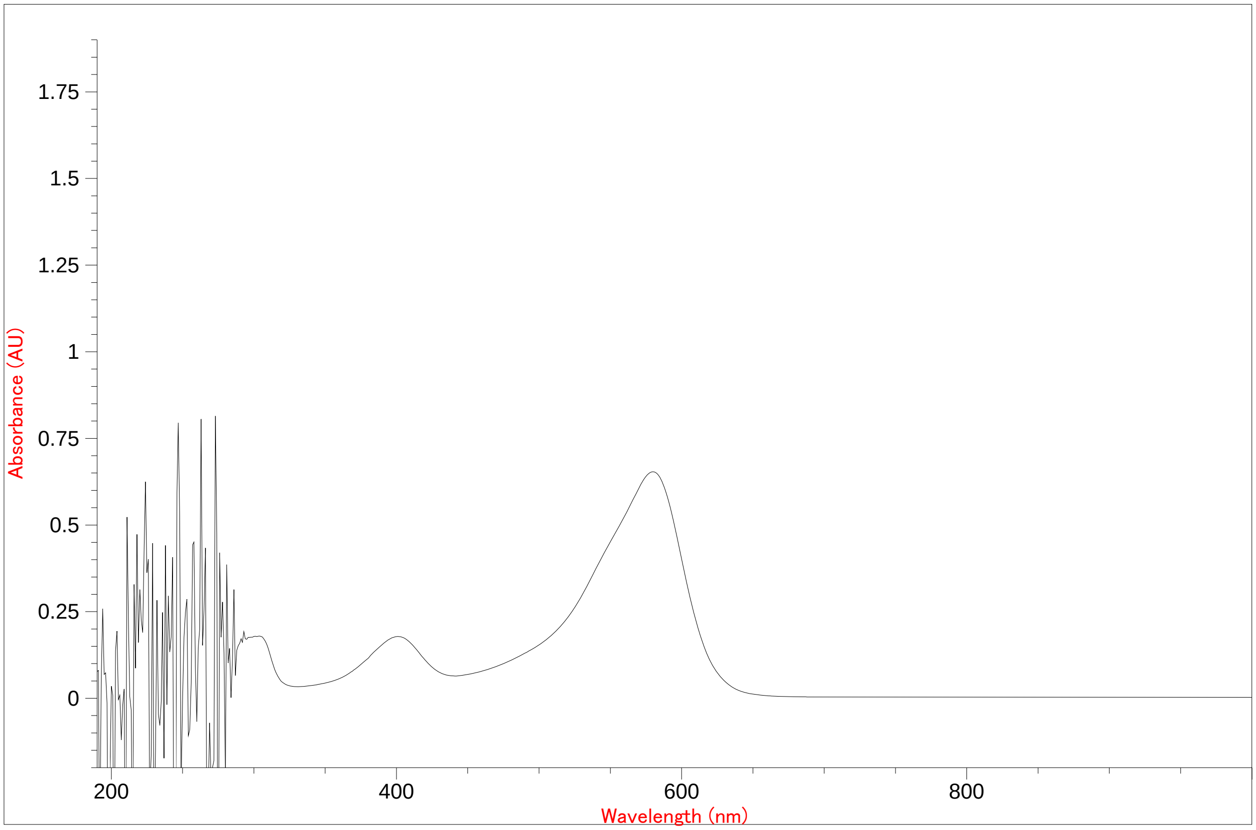
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.40084	ug/mL	0.02508

Sample 4

Sample Name	Snowball II 2150 #SSA (#2)
Operator	Scott Wilson
Date	9/20/18
Time	12:42:44
Path Length	1
Path Length Unit	cm

Sample Spectrum



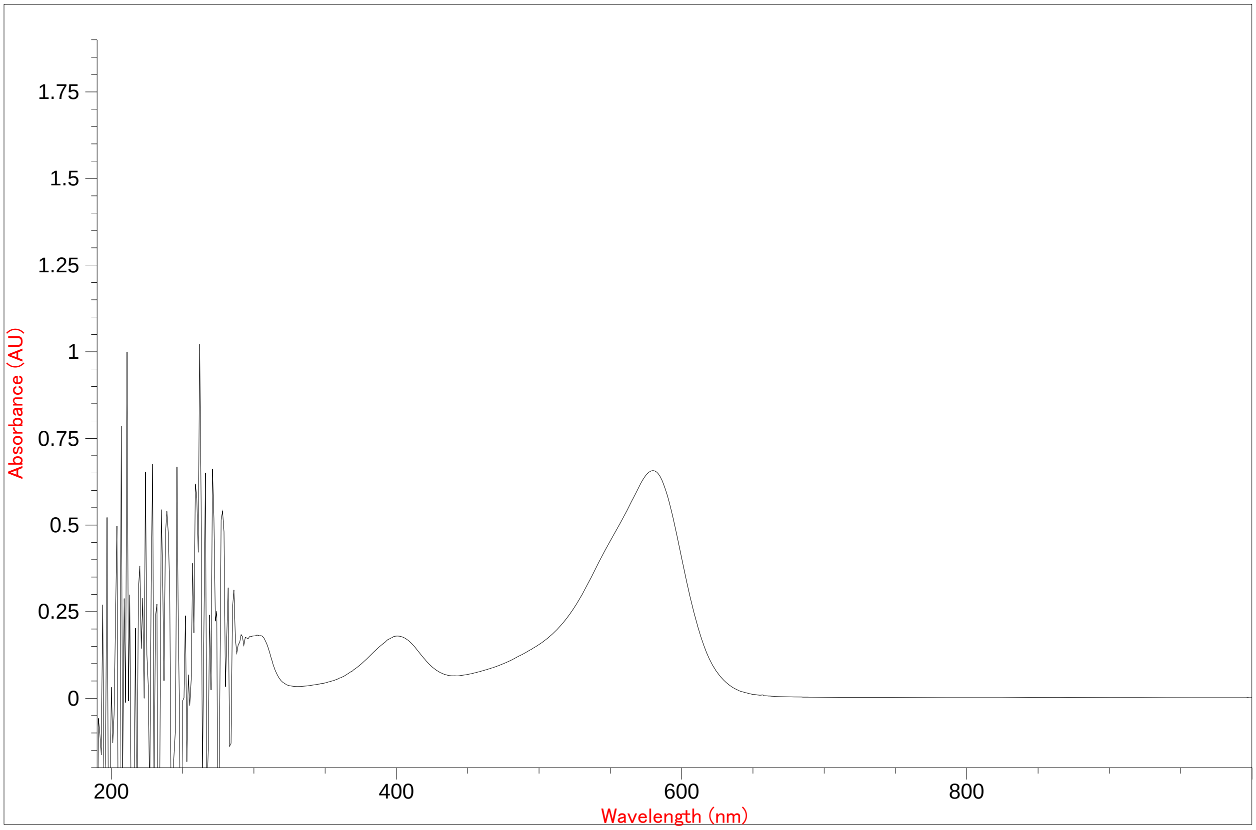
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.21772	ug/mL	0.02477

Sample 13

Sample Name	Snowball II 2150 #SSB (#11)
Operator	Scott Wilson
Date	9/20/18
Time	12:46:36
Path Length	1
Path Length Unit	cm

Sample Spectrum



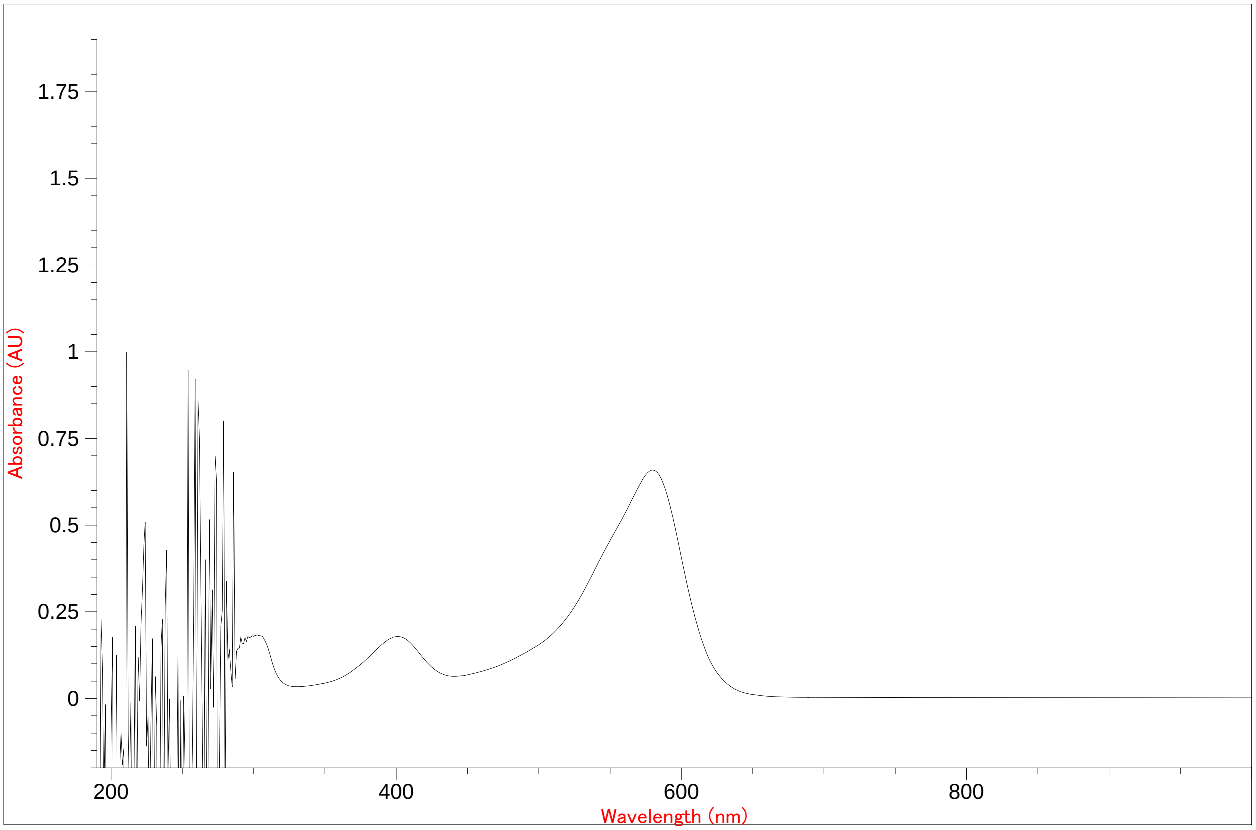
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.22467	ug/mL	0.02478

Sample 23

Sample Name	Snowball II 2150 #SSC (#21)
Operator	Scott Wilson
Date	9/20/18
Time	12:49:01
Path Length	1
Path Length Unit	cm

Sample Spectrum



Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.22696	ug/mL	0.02478

Results Summary

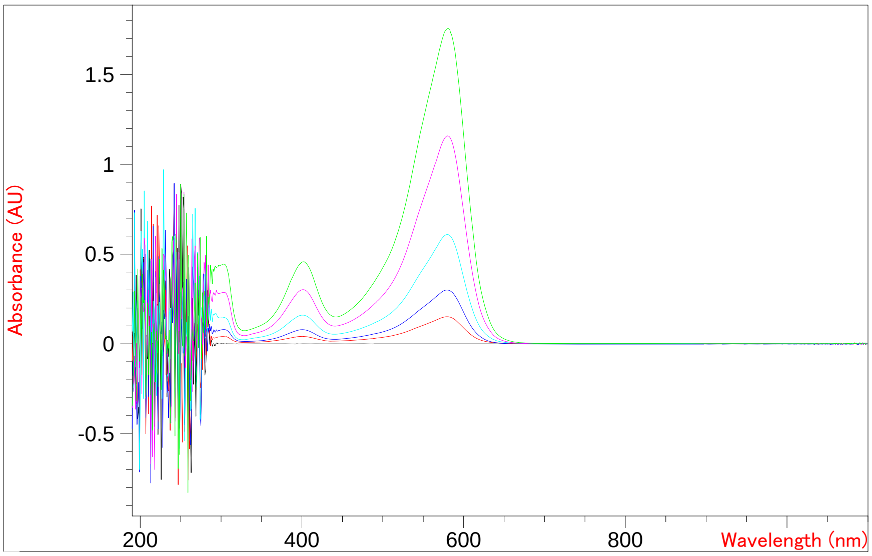
Sample Name	Data Value	Result Value	Unit	Std.Dev.
Snowball II 2150 #SS1 (#8)	0.69714	1.39955	ug/mL	0.02508
Snowball II 2150 #SS2 (#9)	0.69778	1.40084	ug/mL	0.02508
Snowball II 2150 #MB1 (#10)	0.00003	0.00006	ug/mL	0.02376
Snowball II 2150 #SSA (#2)	0.60657	1.21772	ug/mL	0.02477
Snowball II 2150 #MB2 (#3)	0.00169	0.00340	ug/mL	0.02376
0918-103.1-R1.M316 (#4)	0.48570	0.97508	ug/mL	0.02441
0918-103.LD/1-R1.M316 (#5)	0.48645	0.97659	ug/mL	0.02441
0918-103.AD/1-R1.M316 (#6)	0.24291	0.48765	ug/mL	0.02393
0918-103.MS/1-R1.M316 (#7)	0.93332	1.87369	ug/mL	0.02608
0918-103.1-R2.M316 (#8)	0.38608	0.77509	ug/mL	0.02417
0918-103.1-R3.M316 (#9)	0.54762	1.09938	ug/mL	0.02458
0918-103.1-FTB.M316 (#10)	-0.00173	-0.00346	ug/mL	0.02376
Snowball II 2150 #SSB (#11)	0.61003	1.22467	ug/mL	0.02478
Snowball II 2150 #MB3 (#12)	0.00034	0.00067	ug/mL	0.02376
0918-103.2-R1.M316 (#13)	0.55506	1.11433	ug/mL	0.02461
0918-103.LD/2-R1.M316 (#14)	0.55339	1.11096	ug/mL	0.02460
0918-103.AD/2-R1.M316 (#15)	0.27916	0.56042	ug/mL	0.02398
0918-103.MS/2-R1.M316 (#16)	0.99994	2.00744	ug/mL	0.02640
0918-103.2-R2.M316 (#17)	0.01185	0.02379	ug/mL	0.02376
0918-103.2-R3.M316 (#18)	0.01293	0.02596	ug/mL	0.02376
0918-103.2-FTB.M316 (#19)	0.00215	0.00432	ug/mL	0.02376
0918-103.Blank.M316 (#20)	0.00010	0.00020	ug/mL	0.02376
Snowball II 2150 #SSC (#21)	0.61117	1.22696	ug/mL	0.02478

*** End Results Report ***

*** Calibration Report ***

Number of Standards 6

Standard Spectra



#	Standard	Path Length	Unit	Date	Time
1	Snowball II 2150	1.000	cm	9/20/18	11:14:09
2	Snowball II 2150	1.000	cm	9/20/18	11:14:23
3	Snowball II 2150	1.000	cm	9/20/18	11:14:38
4	Snowball II 2150	1.000	cm	9/20/18	11:14:55
5	Snowball II 2150	1.000	cm	9/20/18	11:15:09
6	Snowball II 2150	1.000	cm	9/20/18	11:15:24

Data Analysis:

Spectral Processing:

Absorbance

Use Wavelength(s):

Single (nm): 570

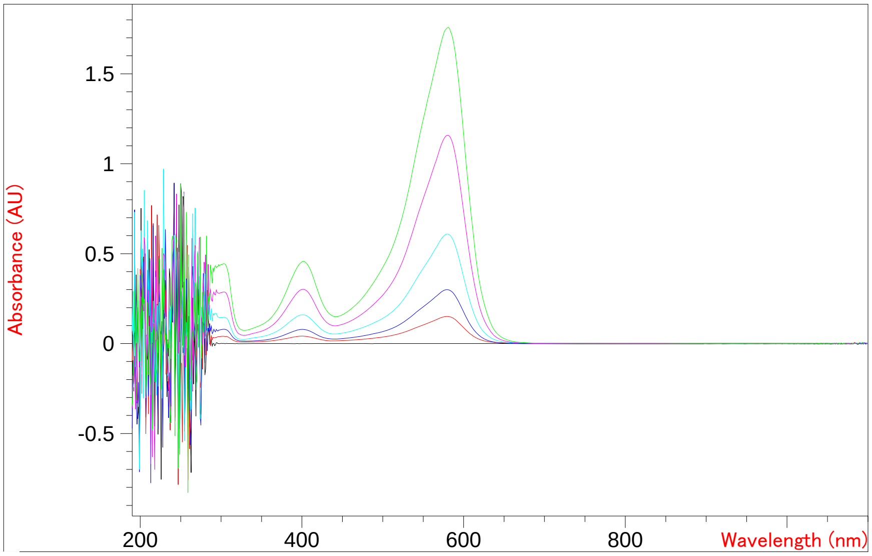
Evaluation: SCA

Calibrated at: Date 9/20/2018 Time 11:16:28 AM
Operator: Scott Wilson

Weighting Method: Least squares
Calibration Curve: C = k1 * A

Analyte Name	Unit
Formaldehyde	ug/mL

Processed Standard Spectra



Coefficients

k#	Value
1	2.00756

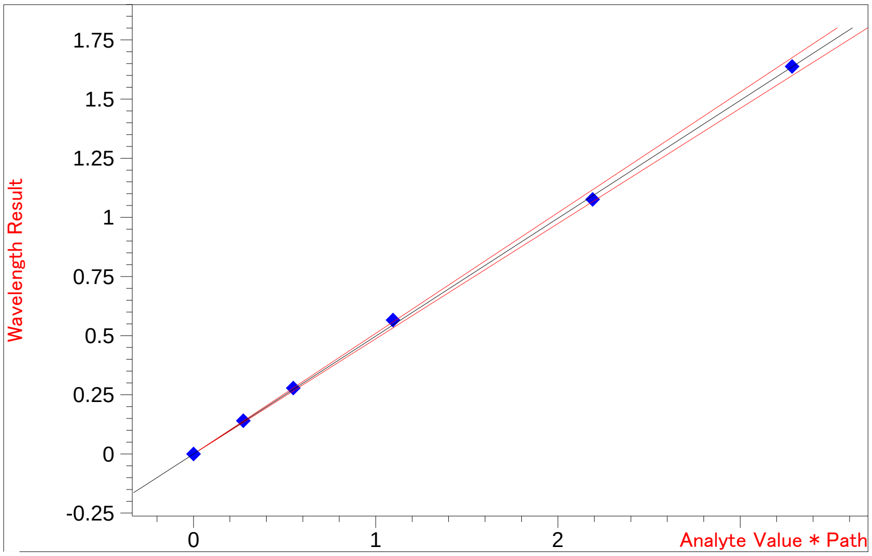
Used Wavelength Results (Absorbance (AU))

#	Value	#	Value	#	Value
1	-0.00009	3	0.27868	5	1.07562
2	0.14049	4	0.56575	6	1.63795

Calibration Table of Formaldehyde (ug/mL)

#	Standard Name	Value	Fitted Val.	Error (%)
1	Snowball II 2150	0.00000	-0.00019	-100.0
2	Snowball II 2150	0.27380	0.28204	-2.9
3	Snowball II 2150	0.54750	0.55947	-2.1
4	Snowball II 2150	1.09500	1.13577	-3.6
5	Snowball II 2150	2.19000	2.15937	1.4
6	Snowball II 2150	3.28500	3.28829	-0.1

Calibration Curve (Data Analysis)



SCA Summary

Analyte Name	Formaldehyde
Number of Standards	6
Calculation Method	LSQ
Calibration Curve	C = k1 * A
Coefficient k1	2.00760 ug/mL
Std.Dev. of k1	1.1516E-2 ug/mL
Std.Dev. of Calibration	2.3761E-2 ug/mL
Correl. Coeff. (R^2)	0.99984
Uncertainty	2.37 %

*** End Calibration Report ***

This Is The Last Page Of This Report.

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Bison Engineering

1400 11th Avenue
Helena, MT 59601

CFU 113 - Corvallis, OR
Project # HAV 218775

Analytical Report
(0918-136)

EPA Method 316

Formaldehyde

Enthalpy Analytical, LLC

Phone: (919) 850 - 4392 / Fax: (919) 850 - 9012 / www.enthalpy.com
800-1 Capitola Drive Durham, NC 27713-4385

I certify that to the best of my knowledge all analytical data presented in this report:

- Have been checked for completeness
- Are accurate, error-free, and legible
- Have been conducted in accordance with approved protocol, and that all deviations and analytical problems are summarized in the appropriate narrative(s)

This analytical report was prepared in Portable Document Format (.PDF) and contains ??? pages.

Report Issued: xx/xx/xxxx

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Summary of Results

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Enthalpy Analytical

Company: Bison Engineering, Inc.

Job No.: 0918-136 - EPA Method 316

Client No.: HAV 218775

Summary Table

Compound	Sample ID / Catch Weight (µg)			
	Cont. #1 Run 1	***Cont. #1 Run 2***	***Cont. #1 Run 3***	***Field Train Blank***
Formaldehyde	513	514	536	12.0 ND

Results

Enthalpy Analytical

Company: Bison Engineering, Inc.

Job No.: 0918-136 - EPA Method 316

Client No.: HAV 218775

MDL	0.0274	(µg/mL)		Lower Curve Limit	0.274	(µg/mL)
LOQ	0.274	(µg/mL)		Upper Curve Limit	3.29	(µg/mL)

Compound Formaldehyde

Sample ID	Lab ID	Absorbance	Conc (µg/mL)	Dilution	Volume (mL)	Catch Weight (µg)	Qual
Cont. #1 Run 1	4	0.4921	1.0583	1	485	513	
Cont. #1 Run 2	8	0.5087	1.0941	1	470	514	
Cont. #1 Run 3	9	0.4933	1.0609	1	505	536	
Field Train Blank	10	0.0000	0.0274	1	440	12.0	ND
Snowball II 2150 #MB1	10	0.0007	0.0274	1	1.00	0.0274	ND
Snowball II 2150 #MB5	3	0.0012	0.0274	1	1.00	0.0274	ND
LD/Cont. #1 Run 1	5	0.4924	1.0590	1	485	514	
					% Difference	0.1%	
AD/Cont. #1 Run 1	6	0.2510	0.5398	2	485	524	
					%Difference	2.0%	
MS/Cont. #1 Run 1	7	0.9006	1.9369	1	2.50	4.84	
					spike amount (ug)	2.19	
					native amount (ug)	2.62	
					Spike recovery	101%	
Snowball II 2161 #SS1	8	0.6326	1.3605	1	1.00	1.36	
					spike amount (ug)	1.31	
					Spike recovery	104%	
Snowball II 2161 #SS2	9	0.6348	1.3652	1	1.00	1.37	
					spike amount (ug)	1.31	
					Spike recovery	104%	

Narrative Summary

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Enthalpy Analytical Narrative Summary

Company	Bison Engineering Inc.
Job #	0918-136 EPA Method 316
Client #	HAV 218775

Custody	Matthew St. Lawrence of Enthalpy Analytical, LLC received the samples on 9/24/18 at 18.6 °C after being relinquished by Bison Engineering Inc. The samples were received in good condition. Prior to, during, and after analysis, the samples were kept under lock with access only to authorized personnel by Enthalpy Analytical, LLC.
Analysis	The samples were analyzed for formaldehyde using the analytical procedures in EPA Method 316, Sampling and Analysis for Formaldehyde Emissions from Stationary Sources in the Mineral Wool and Wool Fiberglass Industries (40 CFR Part 63, Appendix A). The Hewlett Packard Model 8453, Diode Array Spectrophotometer “Snowball II” (S/N US73000904) was operated at 570 nm for these analyses.
Calibration	The calibration curve is located in the Raw Data section of this report.
QC Notes	The analyses of the field and laboratory blanks did not show formaldehyde at concentrations greater than the detection limit. Laboratory Duplicate (LD) and Alternate Dilution analyses were performed using aliquots of sample ***Cont. #1 Run 1.*** The duplicate analyses did not differ from the original by more than 2.0%. A Matrix Spike was prepared using an aliquot of sample ***Cont. #1 Run 1***. The matrix spike was analyzed in the same manner as the samples and exhibited a spike recovery of 101%. The second source standards were analyzed as Laboratory Control Samples (LCS) and both had spike recovery values of 104%. The samples were analyzed within the 14-day holding time specified by the method.
Reporting Notes	These analyses met the requirements of the TNI Standard. Any deviations from the requirements of the reference method or TNI Standard have been stated above. The results presented in this report are representative of the samples as provided to the laboratory.

General Reporting Notes

The following are general reporting notes that are applicable to all Enthalpy Analytical, LLC data reports, unless specifically noted otherwise.

- Any analysis which refers to the method as ***"Type"*** represents a planned deviation from the reference method. For instance a Hydrogen Sulfide assay from a Tedlar bag would be labeled as "EPA Method 16-Type" because Tedlar bags are not mentioned as one of the collection options in EPA Method 16.

- The acronym ***MDL*** represents the Minimum Detection Limit. Below this value the laboratory cannot determine the presence of the analyte of interest reliably.

- The acronym ***LOQ*** represents the Limit of Quantification. Below this value the laboratory cannot quantitate the analyte of interest within the criteria of the method.

- The acronym ***ND*** following a value indicates a non-detect or analytical result below the MDL.

- The letter ***J*** in the Qualifier or Flag column in the results indicates that the value is between the MDL and the LOQ. The laboratory can positively identify the analyte of interest as present, but the value should be considered an estimate.

- The letter ***E*** in the Qualifier or Flag column indicates an analytical result exceeding 100% of the highest calibration point. The associated value should be considered as an estimate.

- Sample results are presented 'as measured' for single injection methodologies, or an average value if multiple injections are made. If all injections are below the MDL, the sample is considered non-detect and the ND value is presented. If one, but not all, are below the MDL, the MDL value is used for any injections that are below the MDL. For example, if the MDL is 0.500 and LOQ is 1.00, and the instrument measures 0.355, 0.620, and 0.442 - the result reported is the average of 0.500, 0.620, and 0.500 - - - i.e. 0.540 with a J flag.

- When a spike recovery (Bag Spike, Collocated Spike Train, or liquid matrix spike) is being calculated, the native (unspiked) sample result is used in the calculations, as long as the value is above the MDL. If a sample is ND, then 0 is used as the native amount (not the MDL value).

- The acronym ***DF*** represents Dilution Factor. This number represents dilution of the sample during the preparation and/or analysis process. The analytical result taken from a laboratory instrument is multiplied by the DF to determine the final undiluted sample results.

- The addition of ***MS*** to the Sample ID represents a Matrix Spike. An aliquot of an actual sample is spiked with a known amount of analyte so that a percent recovery value can be determined. The MS analysis indicates what effect the sample matrix may have on the target analyte, i.e. whether or not anything in the sample matrix interferes with the analysis of the analyte(s).

General Reporting Notes
(continued)

- The addition of ***MSD*** to the Sample ID represents a Matrix Spike Duplicate. Prepared in the same manner as a MS, the use of duplicate matrix spikes allows further confirmation of laboratory quality by showing the consistency of results gained by performing the same steps multiple times.

- The addition of ***LD*** to the Sample ID represents a Laboratory Duplicate. The analyst prepares an additional aliquot of sample for testing and the results of the duplicate analysis are compared to the initial result. The result should have a difference value of within 10% of the initial result (if the results of the original analysis are greater than the LOQ).

- The addition of ***AD*** to the Sample ID represents an Alternate Dilution. The analyst prepares an additional aliquot at a different dilution factor (usually double the initial factor). This analysis helps confirm that no additional compound is present and coeluting or sharing absorbance with the analyte of interest, as they would have a different response/absorbance than the analyte of interest.

- The Sample ID ***LCS*** represents a Laboratory Control Sample. Clean matrix, similar to the client sample matrix, prepared and analyzed by the laboratory using the same reagents, spiking standards and procedures used for the client samples. The LCS is used to assess the control of the laboratory's analytical system. Whenever spikes are prepared for our client projects, two spikes are retained as LCSs. The LCSs are labeled with the associated project number and kept in-house at the appropriate temperature conditions. When the project samples are received for analysis, the LCSs are analyzed to confirm that the analyte could be recovered from the media, separate from the samples which were used on the project and which may have been affected by source matrix, sample collection, and/or sample transport.

- **Significant Figures**: Where the reported value is much greater than unity (1.00) in the units expressed, the number is rounded to a whole number of units, rather than to 3 significant figures. For example, a value of 10,456.45 ug catch is rounded to 10,456 ug. There are five significant digits displayed, but no confidence should be placed on more than two significant digits. In the case of small numbers, generally 3 significant figures are presented, but still only 2 should be used with confidence. Many neat materials are only certified to 3 digits, and as the mathematically correct final result is always 1 digit less than all its pre-cursors - 2 significant figures are what are most defensible.

- **Manual Integration**: The data systems used for processing will flag manually integrated peaks with an "M". There are several reasons a peak may be manually integrated. These reasons will be identified by the following two letter designations on sample chromatograms, if provided in the report. The peak was ***not integrated*** by the software **"NI"**, the peak was ***integrated incorrectly*** by the software **"II"** or the ***wrong peak*** was integrated by the software **"WP"**. These codes will accompany the analyst's manual integration stamp placed next to the compound name on the chromatogram.

Sample Custody

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ENTHALPY analytical, inc

Chain of Custody Record

Page 1 of 1

Special Handling:
- [X] Standard Turn Around Time (10 business days)
- [ ] Rush Turn Around Time -- Date Needed______
- All TATs Subject to Approval by Enthalpy Analytical, Inc.
- All Bag/Can Samples Disposed of 1 Month from Receipt.
- All Other Samples Disposed of 4 Months from Receipt.

Client Name: Bison Engineering, Inc.
Project Manager: Kelly Dorsi
Report To: Kelly Dorsi
Special Instructions:

Project Number: HAY218775
Site Name: CFU 113
Location: Corvallis, OR

PO#:
Telephone#: 406-442-5768
Email: kdorsi@bison-eng.com

For spiked or duplicate samples: please provide sample volumes for recovery calculations. For Particulates: please provide tare weights and/or condensed water volumes.

A=Air 1=H2SO4 2=NaOH W=Water O=Other
X=XAD C=Charcoal SG=Silica Gel
G=Grab C=Composite Q=Quality Control O=Other

Sample ID	Date	Time	Sample Volume	Type	Matrix	# of VOA Vials	# of Glass	# of Plastic	# of Bags	# of Canisters	# of Tubes	# Other	Analyses: M-316								Notes:
Cont. #1 Run1	9/18/18	12:30	~470ml																		
cont. #1 Run2	9/18/18	15:00	~455ml																		
Cont. #1 Run3	9/18/18	18:00	~490ml																		
Fieldtrainblank	9/18/18	18:00	~440ml																		

Relinquished By	Date:	Received By	Date:	Time:	Sample Condition Upon Receipt:
[signature]	09/21/18	Matt A. Lawrence	9/24/18	8:26am	☐ Iced ☐ Ambient ☐ °C____
					☐ Iced ☐ Ambient ☐ °C____
					☐ Iced ☐ Ambient ☐ °C____

Good condition
18.6°C RaytekS
MSt 9/24/18

Raw Data

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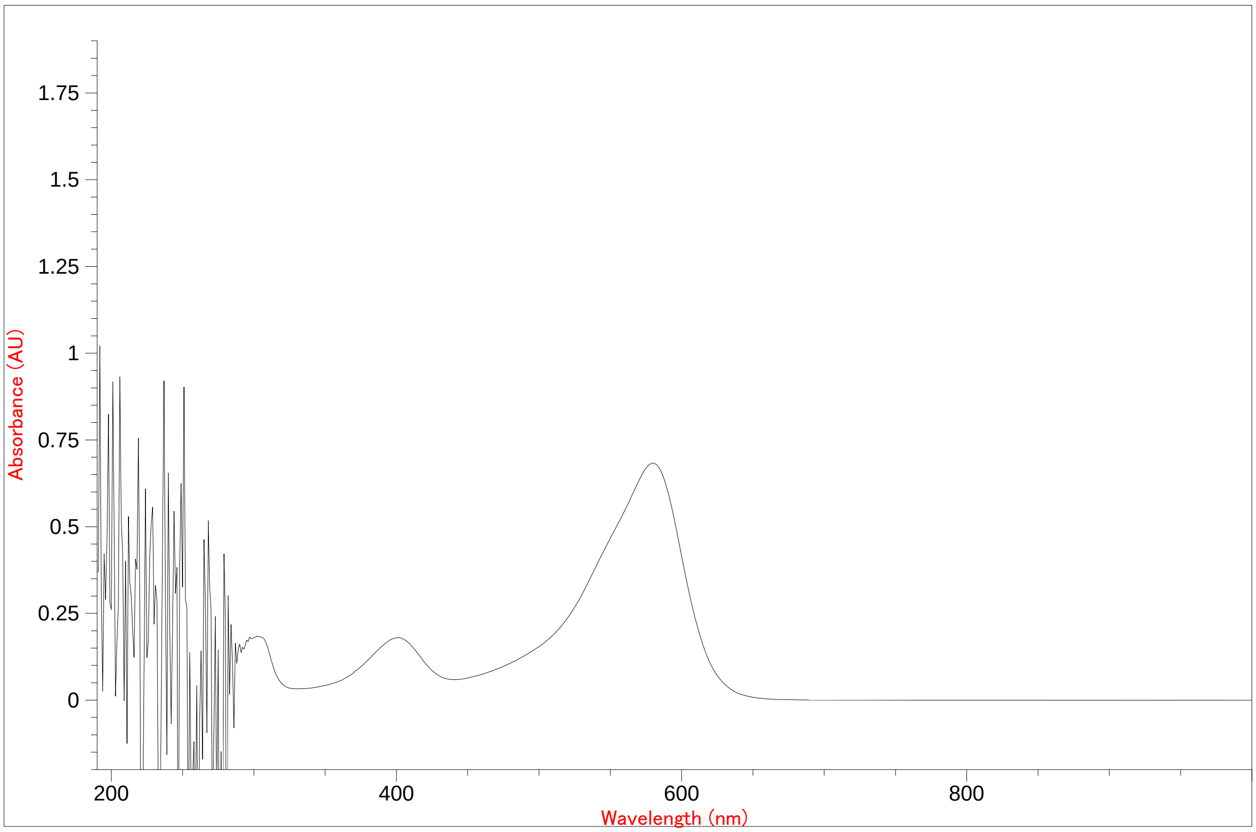
Sample 1

Sample Name	Snowball II 2161 #SS1 (#8)
Operator	Scott Wilson
Date	10/1/18
Time	10:45:22
Path Length	1
Path Length Unit	cm

Sample Spectrum



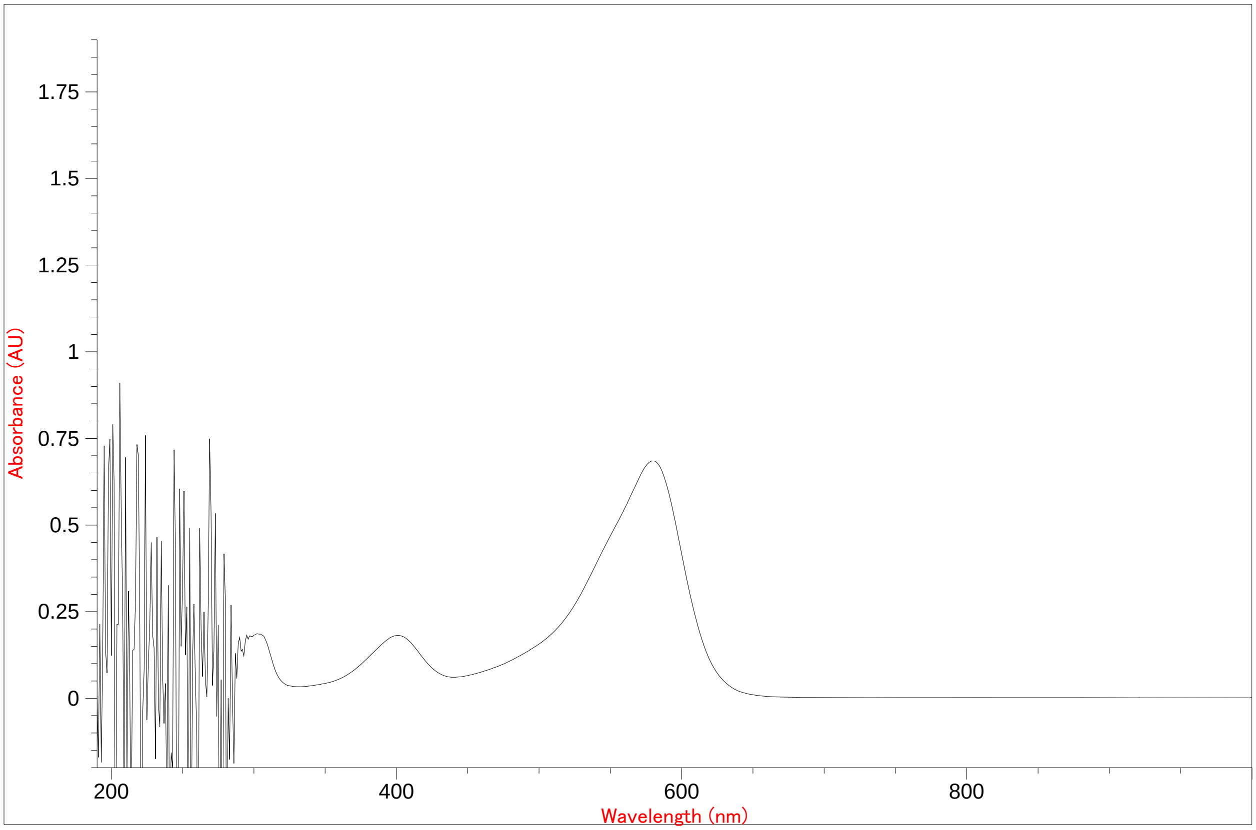
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.36053	ug/mL	0.00741

Sample 2

Sample Name	Snowball II 2161 #SS2 (#9)
Operator	Scott Wilson
Date	10/1/18
Time	10:45:38
Path Length	1
Path Length Unit	cm

Sample Spectrum



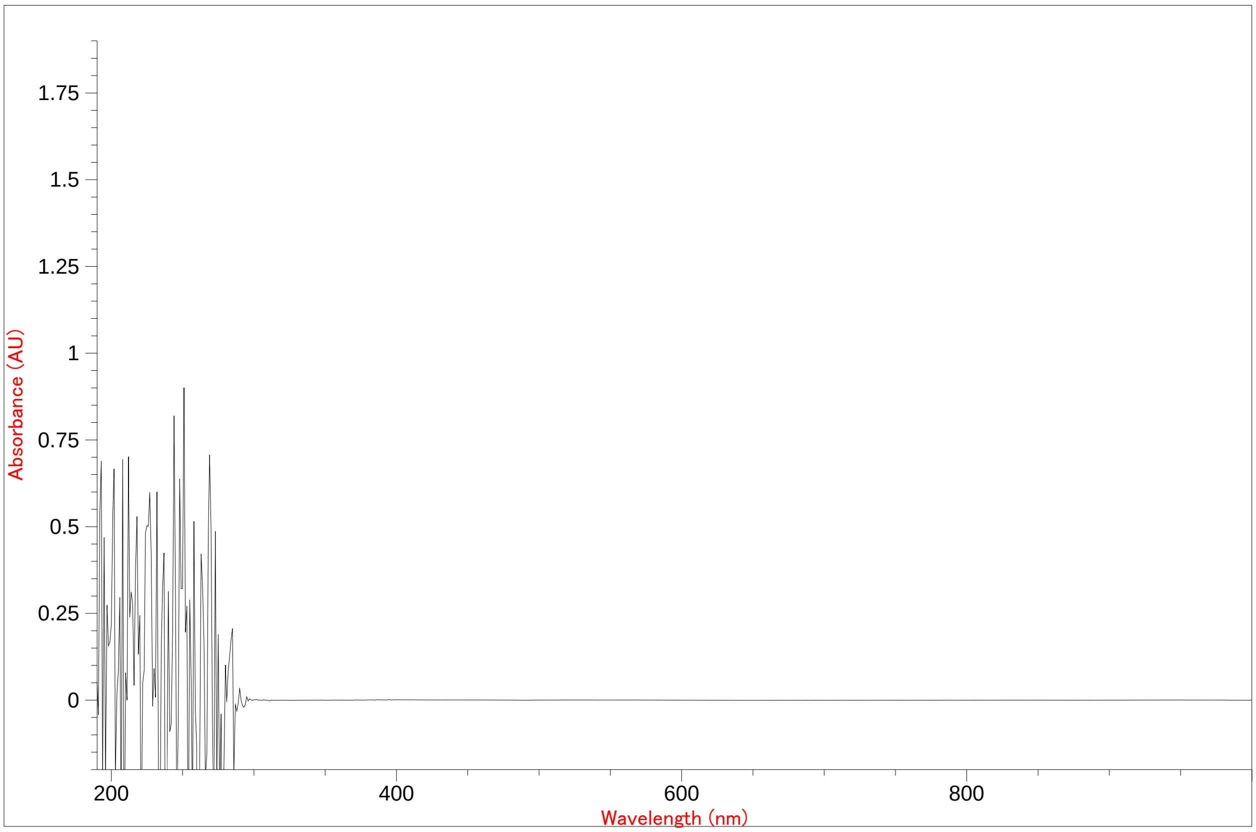
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.36519	ug/mL	0.00741

Sample 3

Sample Name	Snowball II 2161 #MB1 (#10)
Operator	Scott Wilson
Date	10/1/18
Time	10:45:53
Path Length	1
Path Length Unit	cm

Sample Spectrum



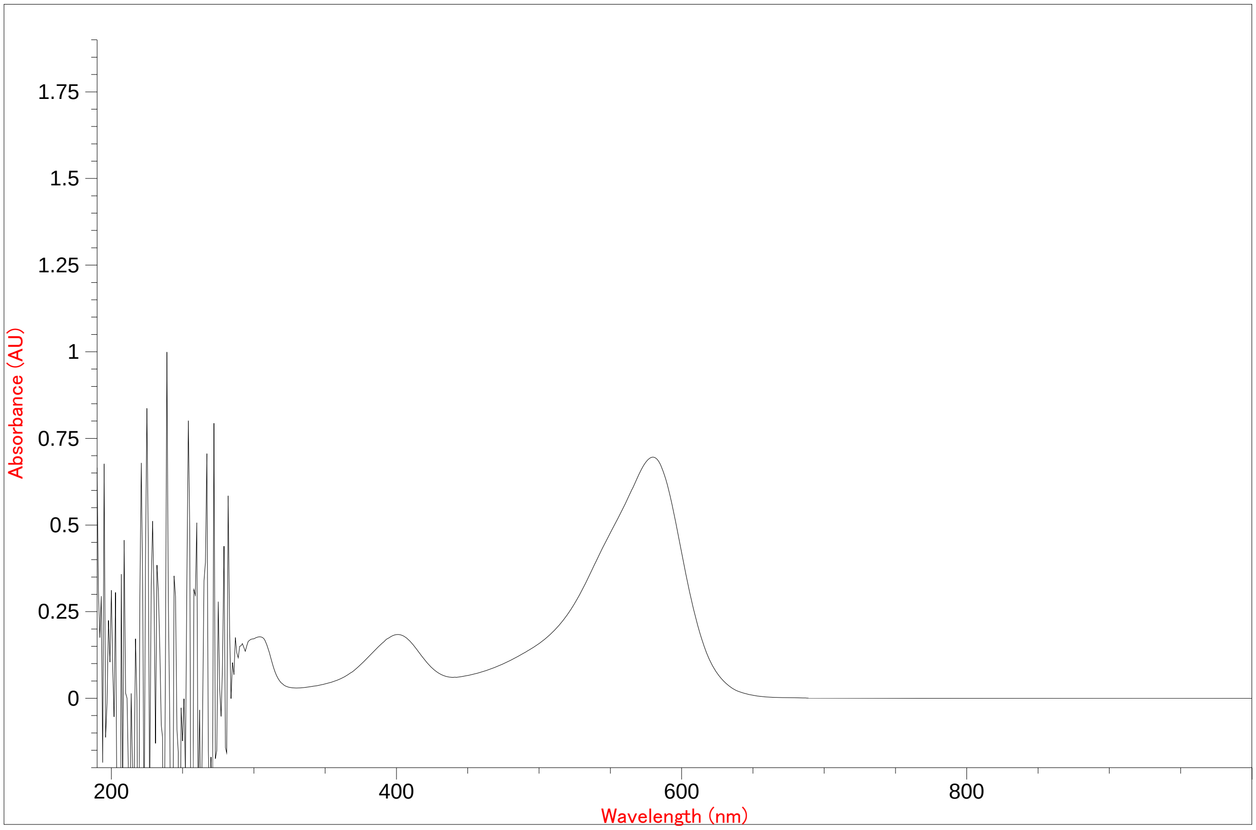
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00145	ug/mL	0.00704

Sample 4

Sample Name	Snowball II 2161 #SSF (#2)
Operator	Scott Wilson
Date	10/1/18
Time	14:28:47
Path Length	1
Path Length Unit	cm

Sample Spectrum



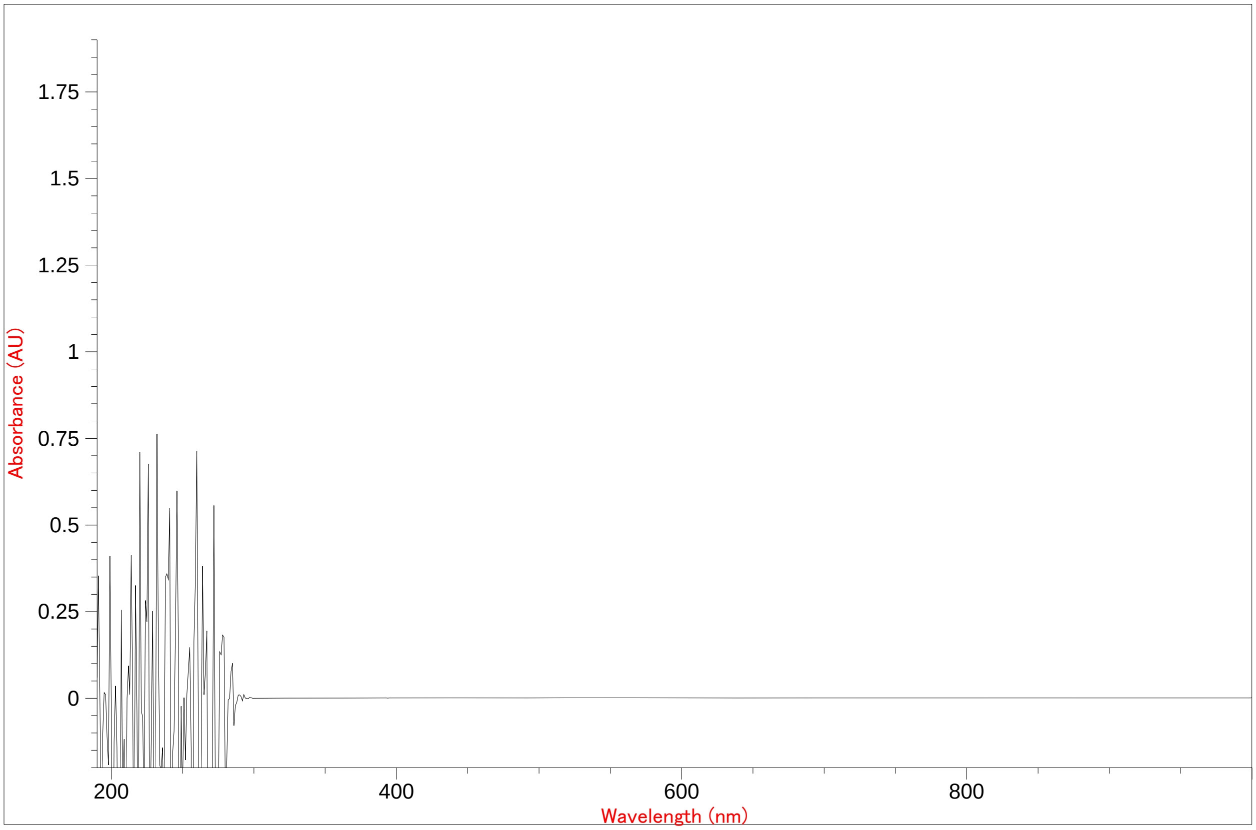
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.38816	ug/mL	0.00742

Sample 5

Sample Name	Snowball II 2161 #MB5 (#3)
Operator	Scott Wilson
Date	10/1/18
Time	14:29:00
Path Length	1
Path Length Unit	cm

Sample Spectrum



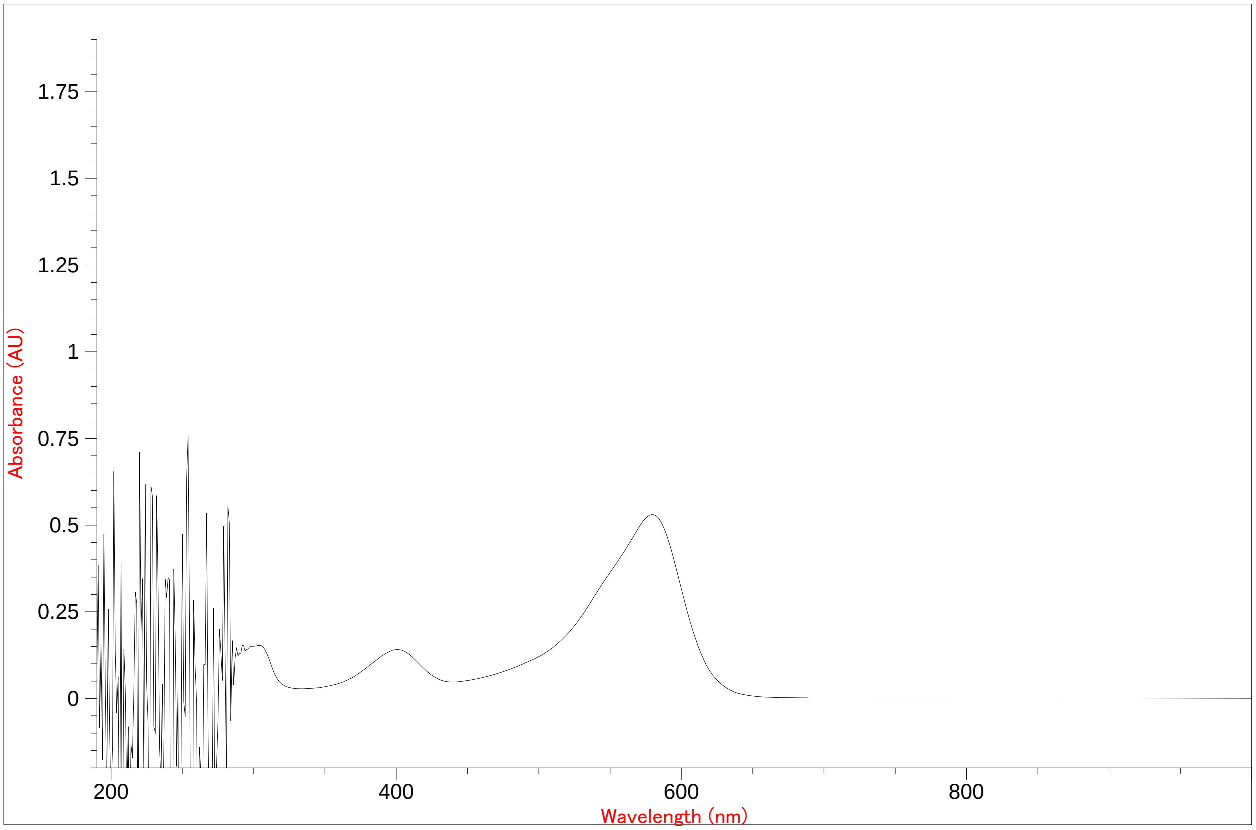
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00266	ug/mL	0.00704

Sample 6

Sample Name	0918-136.R1.M316 (#4)
Operator	Scott Wilson
Date	10/1/18
Time	14:29:19
Path Length	1
Path Length Unit	cm

Sample Spectrum



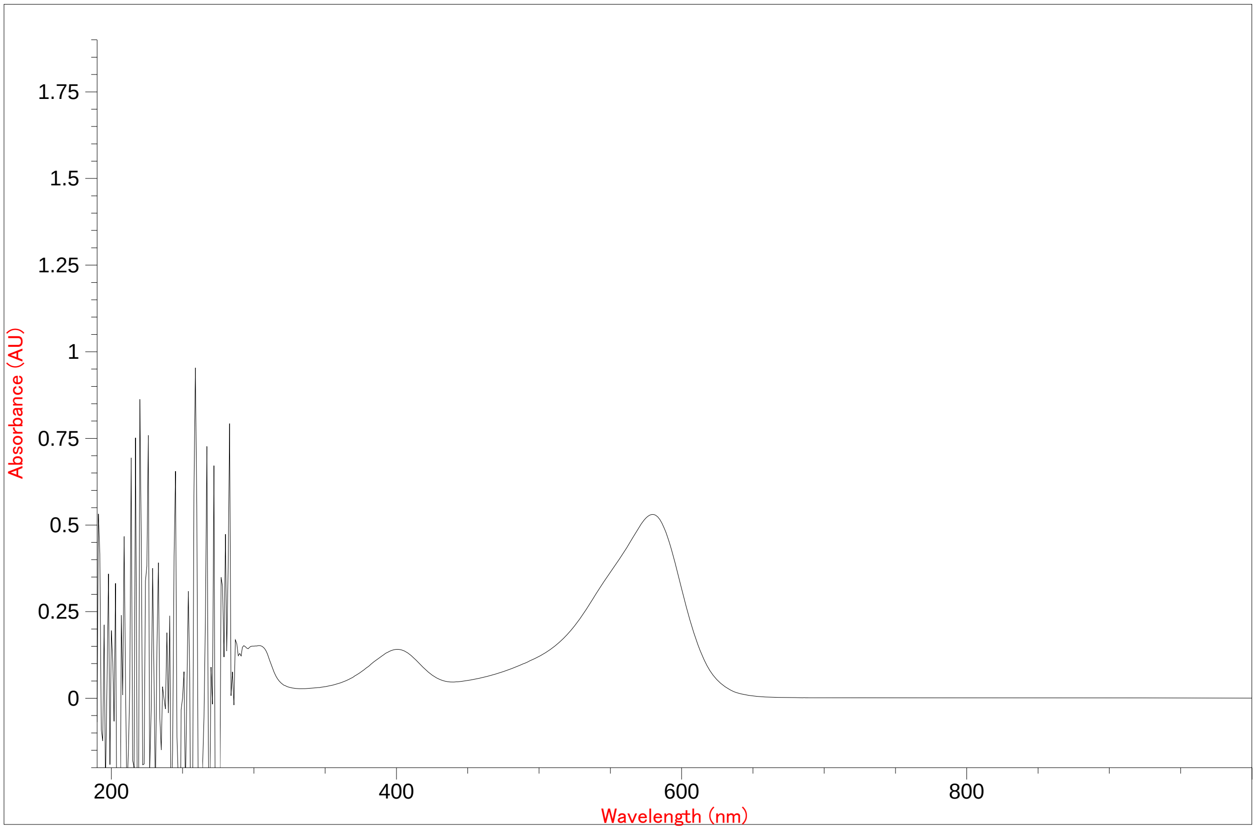
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.05829	ug/mL	0.00726

Sample 7

Sample Name	0918-136.LD/R1.M316 (#5)
Operator	Scott Wilson
Date	10/1/18
Time	14:29:28
Path Length	1
Path Length Unit	cm

Sample Spectrum



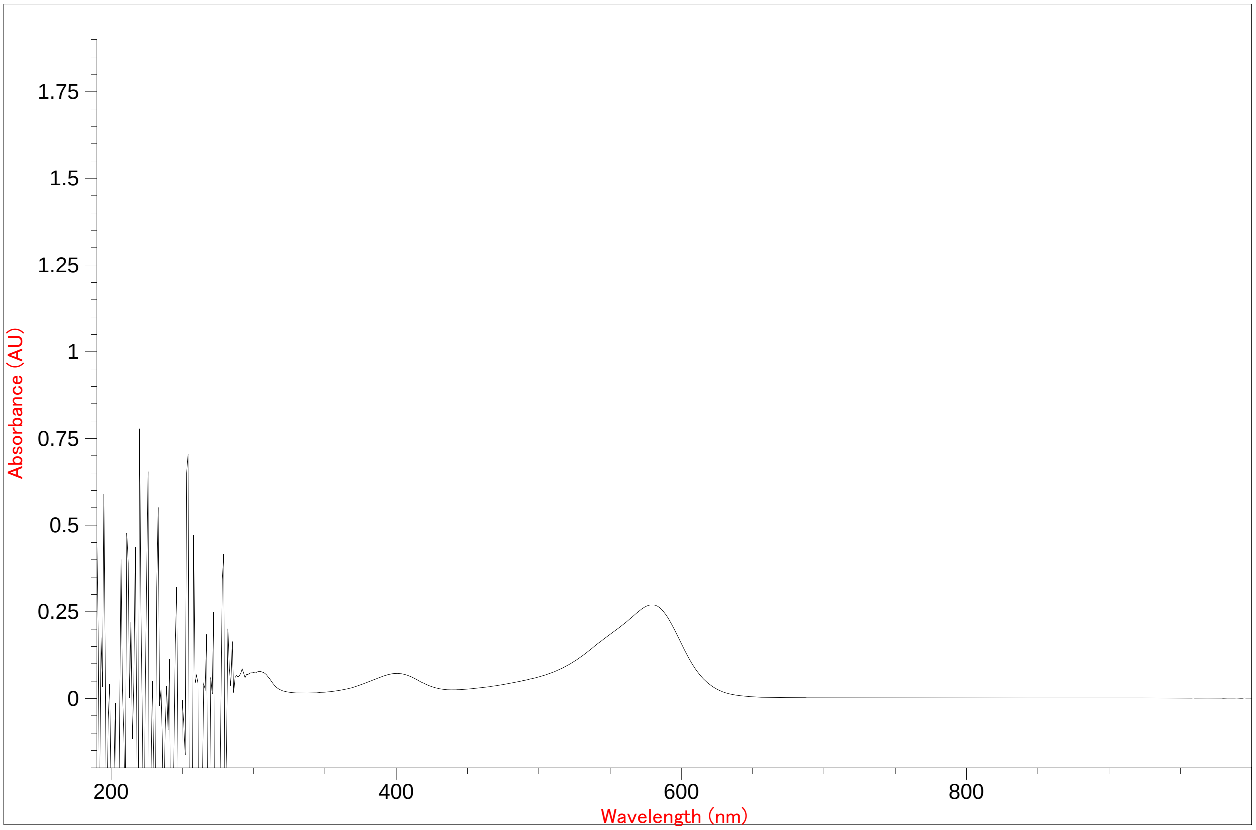
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.05900	ug/mL	0.00726

Sample 8

Sample Name	0918-136.AD/R1.M316 (#6)
Operator	Scott Wilson
Date	10/1/18
Time	14:29:37
Path Length	1
Path Length Unit	cm

Sample Spectrum



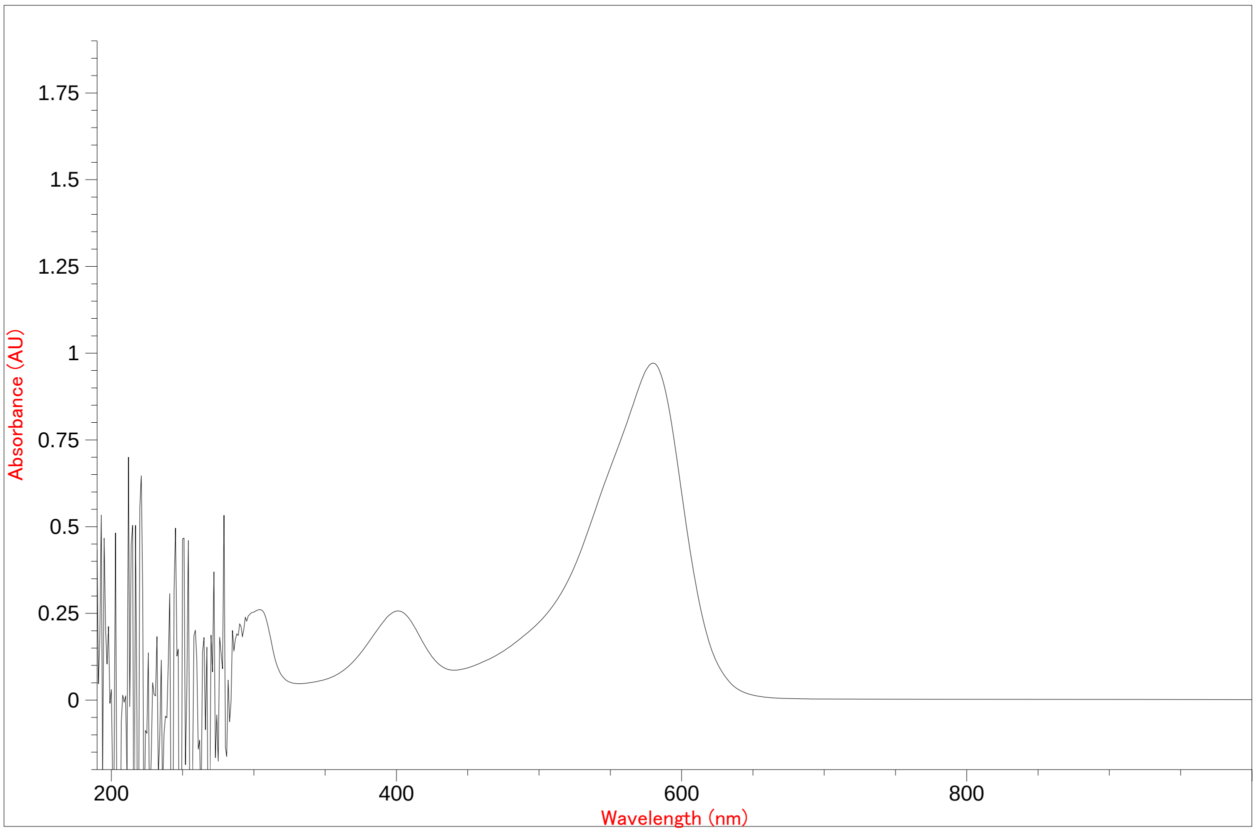
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.53976	ug/mL	0.00710

Sample 9

Sample Name	0918-136.MS/R1.M316 (#7)
Operator	Scott Wilson
Date	10/1/18
Time	14:29:49
Path Length	1
Path Length Unit	cm

Sample Spectrum



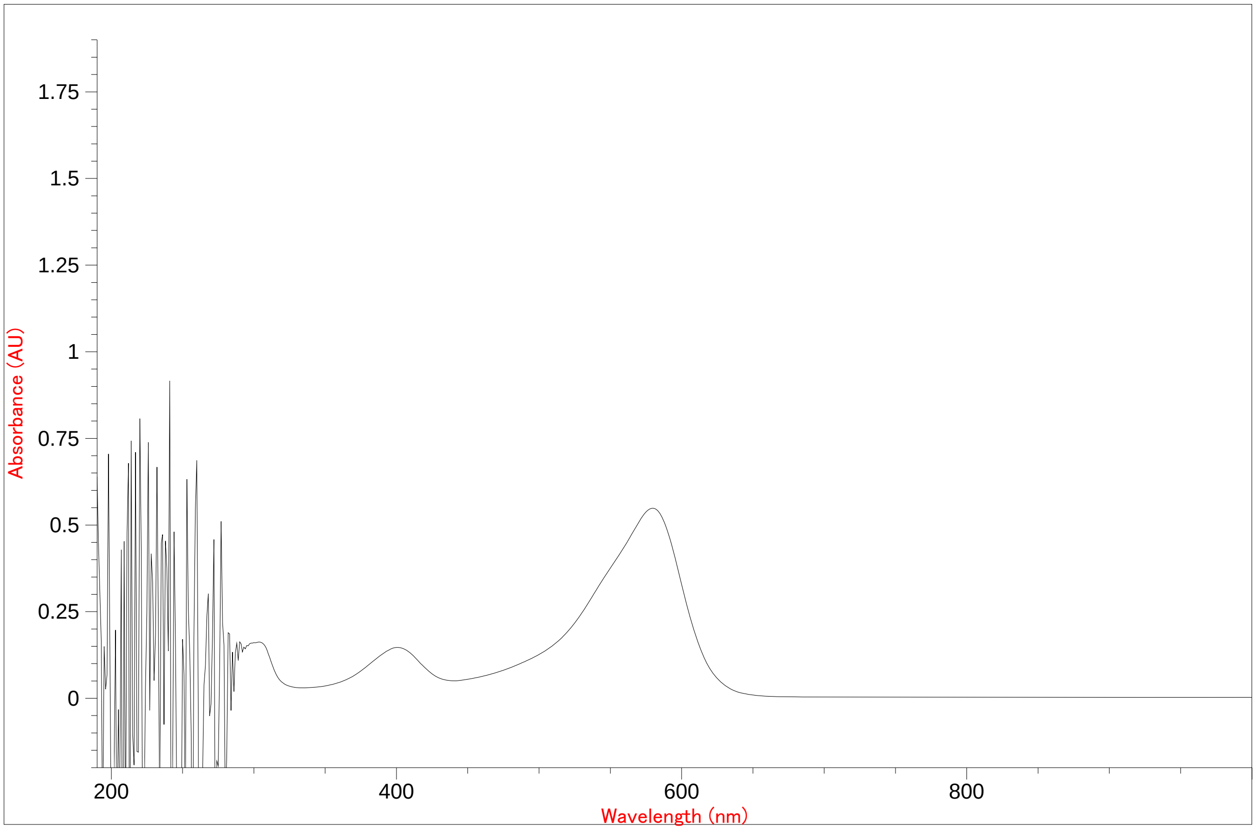
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.93689	ug/mL	0.00777

Sample 10

Sample Name	0918-136.R2.M316 (#8)
Operator	Scott Wilson
Date	10/1/18
Time	14:30:03
Path Length	1
Path Length Unit	cm

Sample Spectrum



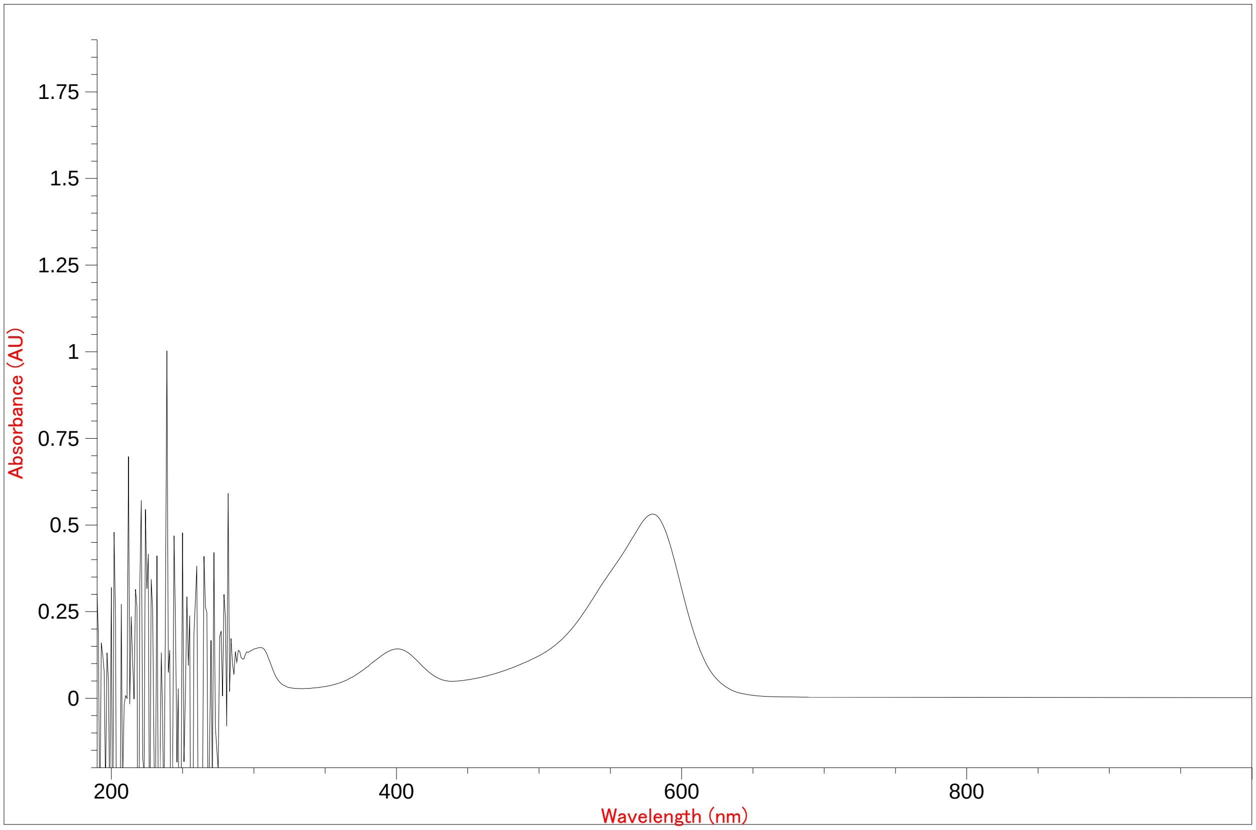
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.09409	ug/mL	0.00728

Sample 11

Sample Name	0918-136.R3.M316 (#9)
Operator	Scott Wilson
Date	10/1/18
Time	14:30:13
Path Length	1
Path Length Unit	cm

Sample Spectrum



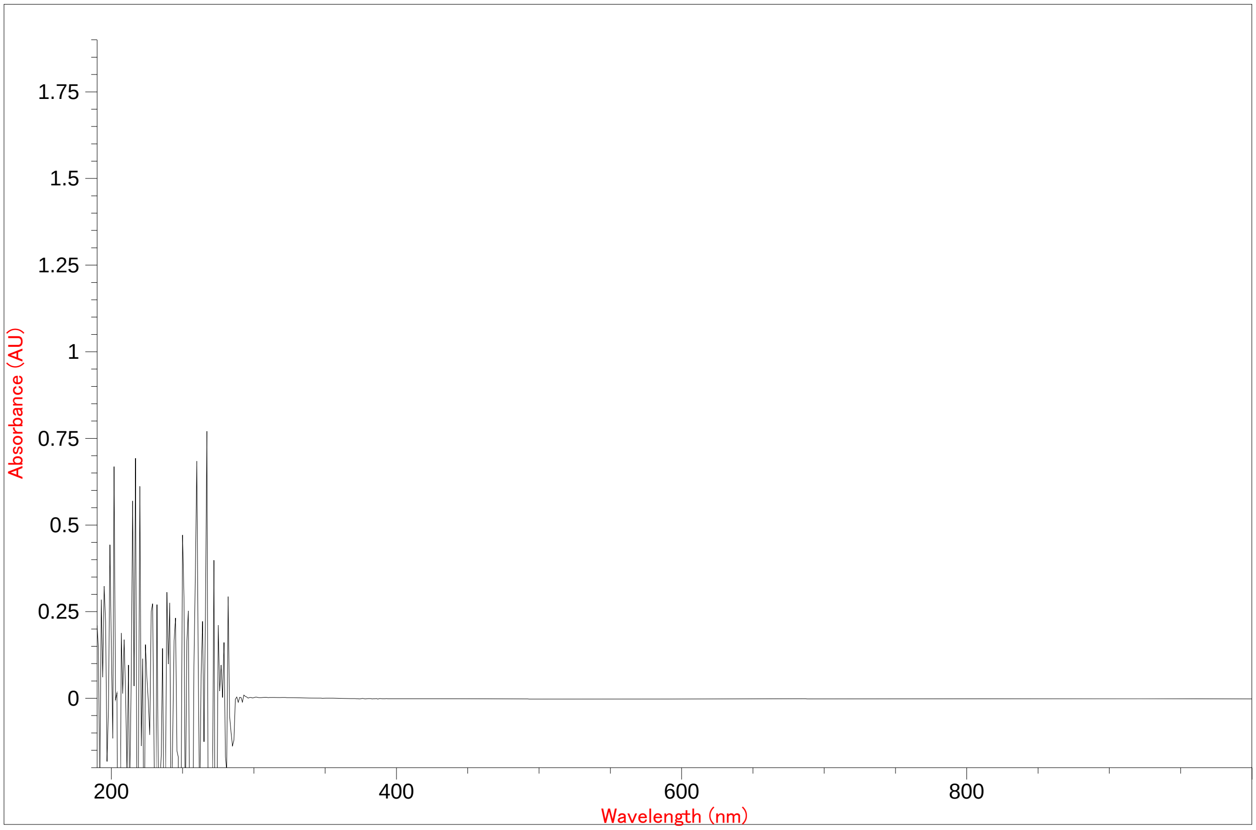
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.06092	ug/mL	0.00726

Sample 12

Sample Name	0918-136.FTB.M316 (#10)
Operator	Scott Wilson
Date	10/1/18
Time	14:30:24
Path Length	1
Path Length Unit	cm

Sample Spectrum



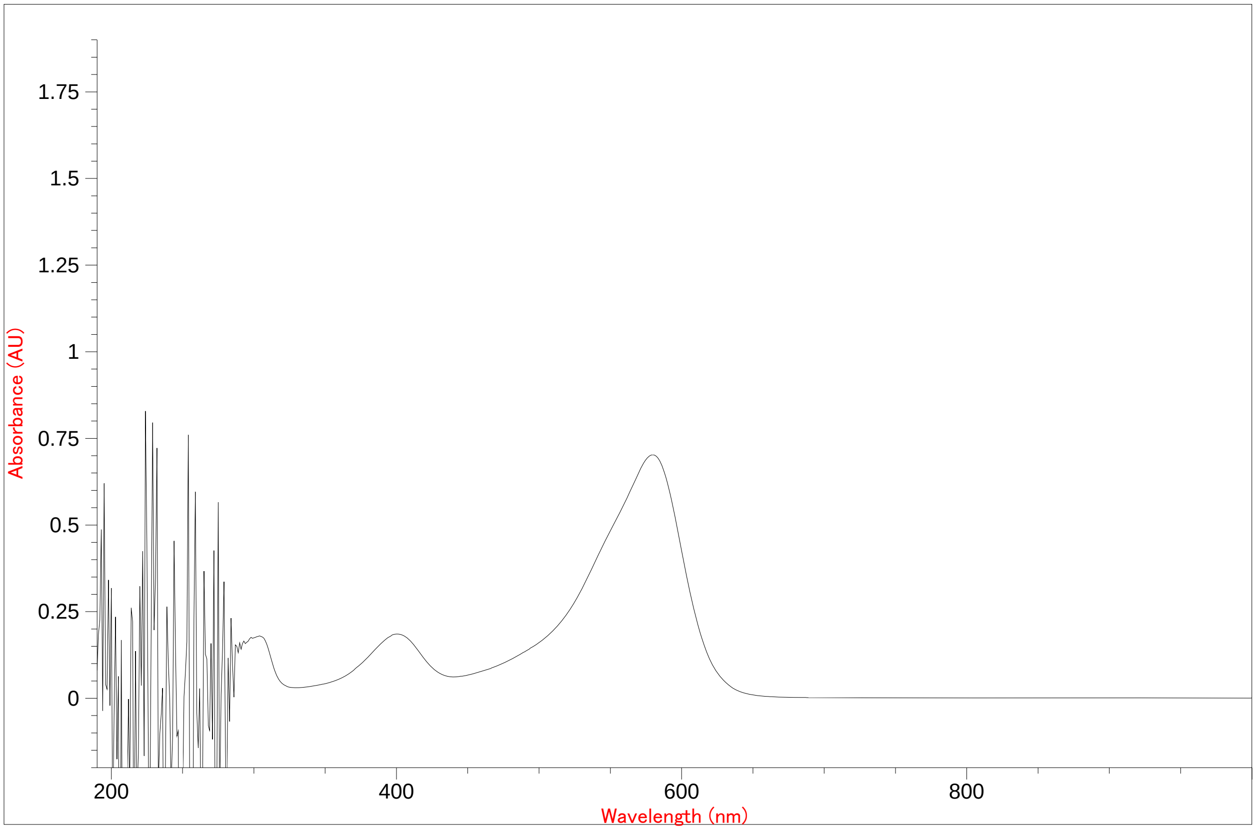
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00478	ug/mL	0.00704

Sample 13

Sample Name	Snowball II 2161 #SSG (#11)
Operator	Scott Wilson
Date	10/1/18
Time	14:30:34
Path Length	1
Path Length Unit	cm

Sample Spectrum



Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.40253	ug/mL	0.00743

Results Summary

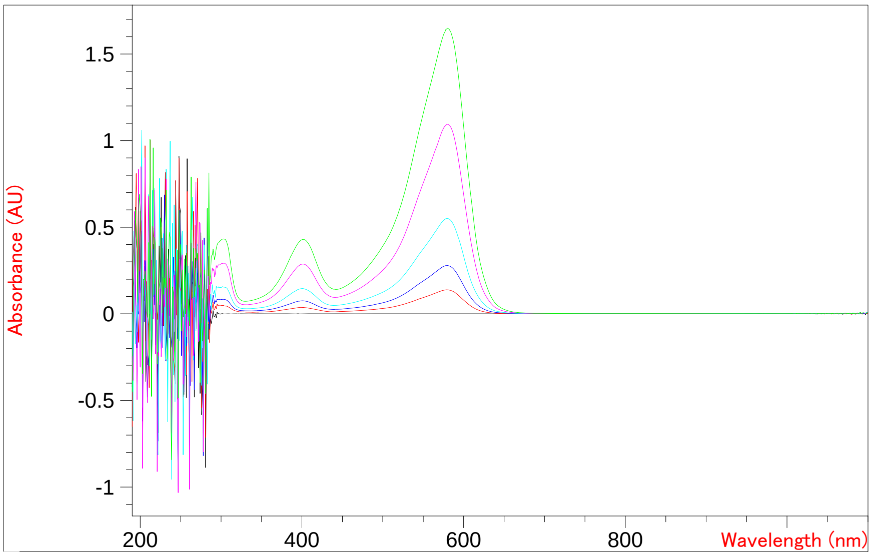
Sample Name	Data Value	Result Value	Unit	Std.Dev.
Snowball II 2161 #SS1 (#8)	0.63259	1.36053	ug/mL	0.00741
Snowball II 2161 #SS2 (#9)	0.63476	1.36519	ug/mL	0.00741
Snowball II 2161 #MB1 (#10)	0.00067	0.00145	ug/mL	0.00704
Snowball II 2161 #SSF (#2)	0.64543	1.38816	ug/mL	0.00742
Snowball II 2161 #MB5 (#3)	0.00124	0.00266	ug/mL	0.00704
0918-136.R1.M316 (#4)	0.49206	1.05829	ug/mL	0.00726
0918-136.LD/R1.M316 (#5)	0.49239	1.05900	ug/mL	0.00726
0918-136.AD/R1.M316 (#6)	0.25097	0.53976	ug/mL	0.00710
0918-136.MS/R1.M316 (#7)	0.90057	1.93689	ug/mL	0.00777
0918-136.R2.M316 (#8)	0.50871	1.09409	ug/mL	0.00728
0918-136.R3.M316 (#9)	0.49328	1.06092	ug/mL	0.00726
0918-136.FTB.M316 (#10)	-0.00222	-0.00478	ug/mL	0.00704
Snowball II 2161 #SSG (#11)	0.65211	1.40253	ug/mL	0.00743

*** End Results Report ***

*** Calibration Report ***

Number of Standards 6

Standard Spectra



#	Standard	Path Length	Unit	Date	Time
1	Snowball II 2161	1.000	cm	10/1/18	10:43:24
2	Snowball II 2161	1.000	cm	10/1/18	10:44:00
3	Snowball II 2161	1.000	cm	10/1/18	10:44:19
4	Snowball II 2161	1.000	cm	10/1/18	10:44:35
5	Snowball II 2161	1.000	cm	10/1/18	10:44:51
6	Snowball II 2161	1.000	cm	10/1/18	10:45:06

Data Analysis:

Spectral Processing:

Absorbance

Use Wavelength(s):

Single (nm): 570

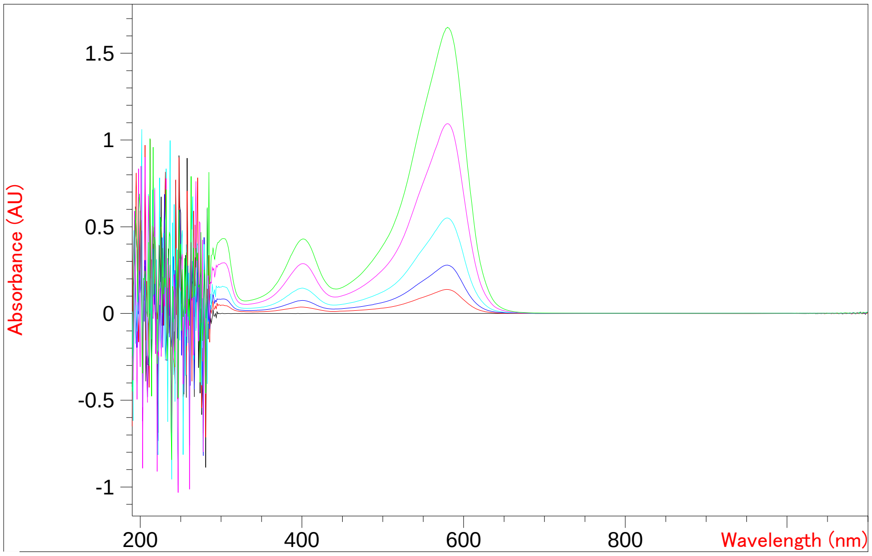
Evaluation: SCA

Calibrated at: Date 10/1/2018 Time 10:49:37 AM
Operator: Scott Wilson

Weighting Method: Least squares
Calibration Curve: C = k1 * A

Analyte Name	Unit
Formaldehyde	ug/mL

Processed Standard Spectra



Coefficients

k#	Value
1	2.15074

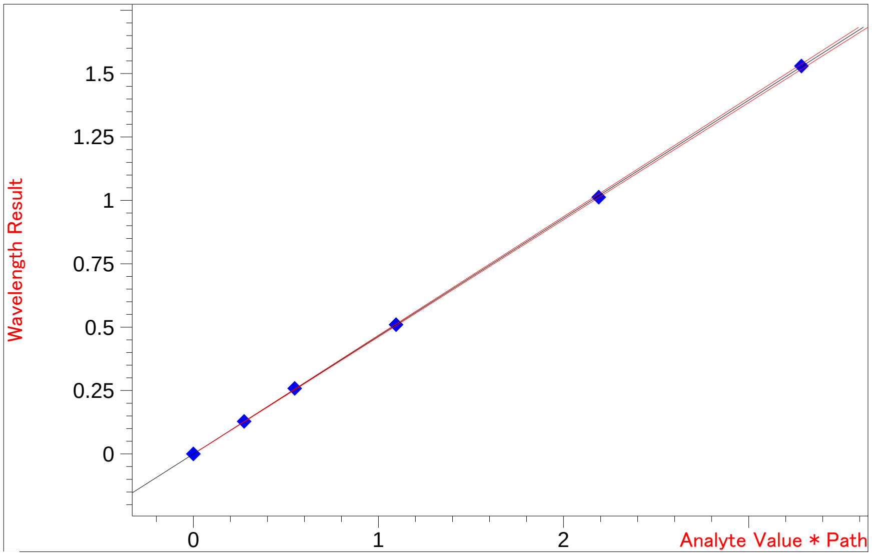
Used Wavelength Results (Absorbance (AU))

#	Value	#	Value	#	Value
1	0.00015	3	0.25841	5	1.01279
2	0.12854	4	0.50996	6	1.52997

Calibration Table of Formaldehyde (ug/mL)

#	Standard Name	Value	Fitted Val.	Error (%)
1	Snowball II 2161	0.00000	0.00031	-100.0
2	Snowball II 2161	0.27380	0.27645	-1.0
3	Snowball II 2161	0.54750	0.55577	-1.5
4	Snowball II 2161	1.09500	1.09678	-0.2
5	Snowball II 2161	2.19000	2.17825	0.5
6	Snowball II 2161	3.28500	3.29056	-0.2

Calibration Curve (Data Analysis)



SCA Summary

Analyte Name	Formaldehyde
Number of Standards	6
Calculation Method	LSQ
Calibration Curve	C = k1 * A
Coefficient k1	2.15070 ug/mL
Std.Dev. of k1	3.6536E-3 ug/mL
Std.Dev. of Calibration	7.0372E-3 ug/mL
Correl. Coeff. (R^2)	0.99999
Uncertainty	0.70 %

*** End Calibration Report ***

This Is The Last Page Of This Report.

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Bison Engineering

1400 11th Avenue
Helena, MT 59601

CFU 113 (2) and CFU 104

Corvallis, OR
Client Project # HAV218775

Analytical Report
(1018-022)

EPA Method 316

Formaldehyde

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Enthalpy Analytical, LLC

Phone: (919) 850 - 4392 / Fax: (919) 850 - 9012 / www.enthalpy.com
800-1 Capitola Drive Durham, NC 27713-4385

I certify that to the best of my knowledge all analytical data presented in this report:

- Have been checked for completeness
- Are accurate, error-free, and legible
- Have been conducted in accordance with approved protocol, and that all deviations and analytical problems are summarized in the appropriate narrative(s)

This analytical report was prepared in Portable Document Format (.PDF) and contains ??? pages.

Report Issued: xx/xx/xxxx

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Summary of Results

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Enthalpy Analytical

Company: Bison Engineering

Job No.: 1018-002 - EPA Method 316 Analysis

Project No.: CFU 113 & CFU 104: Corvallis, OR

Summary - Formaldehyde

Sample ID	Catch Weight (ug)
CFU 113 (2) Run 1	540
CFU 113 (2) Run 2	607
CFU 113 (2) Run 3	610
CFU 113 (2) FTB	14.2 ND
CFU 104 Run 1	460
CFU 104 Run 2	477
CFU 104 Run 3	525
CFU 104 FTB	11.0 ND

Results

Enthalpy Analytical

Company: Bison Engineering

Job No.: 1018-002 - EPA Method 316 Analysis

Project No.: CFU 113 & CFU 104: Corvallis, OR

MDL	0.0274	(µg/mL)		Lower Curve Limit	0.274	(µg/mL)
LOQ	0.274	(µg/mL)		Upper Curve Limit	3.29	(µg/mL)
Compound	Formaldehyde					

Sample ID	Lab ID	Absorbance	Analytical Concentration (µg/mL)	Dilution	Volume (mL)	Catch Weight (µg)	Qual
CFU 113 (2) Run 1	4	0.2730	0.5872	2	460	540	
CFU 113 (2) Run 2	8	0.2973	0.6394	2	475	607	
CFU 113 (2) Run 3	9	0.3153	0.6781	2	450	610	
CFU 113 (2) FTB	10	0.0001	0.0001	1	520	14.2	ND
CFU 104 Run 1	4	0.4693	1.0347	1	445	460	
CFU 104 Run 2	8	0.4759	1.0494	1	455	477	
CFU 104 Run 3	9	0.5124	1.1298	1	465	525	
CFU 104 FTB	10	0.0000	0.0274	1	400	11.0	ND
Snowball II 2161 #MB1	10	0.0007	0.0274	1	1.00	0.0274	ND
Snowball 2161 #MB6	3	0.0000	0.0274	1	1.00	0.0274	ND
Snowball II 2167 #MB1	10	0.0000	0.0274	1	1.00	0.0274	ND
Snowball II 2167 #MB2	3	0.0000	0.0274	1	1.00	0.0274	ND

LD / CFU 113 (2) Run 1	5	0.2730	0.5871	2	460	540	
					% Difference	0.0%	

AD / CFU 113 (2) Run 1	12	0.1893	0.4071	3	460	562	
					% Difference	3.9%	

MS / CFU 113 (2) Run 1	7	0.6184	1.3300	1	2.50	3.33	
					Spike Amount (µg)	2.19	
					Native Amount (µg)	1.46	
					Spike Recovery (%)	85.3%	

Enthalpy Analytical

Company: Bison Engineering

Job No.: 1018-002 - EPA Method 316 Analysis

Project No.: CFU 113 & CFU 104: Corvallis, OR

MDL	0.0274	(µg/mL)		Lower Curve Limit	0.274	(µg/mL)
LOQ	0.274	(µg/mL)		Upper Curve Limit	3.29	(µg/mL)
Compound	Formaldehyde					

Sample ID	Lab ID	Absorbance	Analytical Concentration (µg/mL)	Dilution	Volume (mL)	Catch Weight (µg)	Qual
LD / CFU 104 Run 1	5	0.4697	1.0356	1	445	461	
					% Difference	0.1%	
AD / CFU 104 Run 1	6	0.2356	0.5195	2	455	473	
					% Difference	2.6%	
MS / CFU 104 Run 1	7	0.8591	1.8943	1	2.50	4.74	
					Spike Amount (µg)	2.19	
					Native Amount (µg)	2.57	
					Spike Recovery (%)	99.1%	
Snowball II 2161 #SS1	8	0.6326	1.3605	1	1.00	1.36	
					Spike Amount (µg)	1.31	
					Spike Recovery (%)	104%	
Snowball II 2161 #SS2	9	0.6348	1.3652	1	1.00	1.37	
					Spike Amount (µg)	1.31	
					Spike Recovery (%)	104%	
Snowball II 2167 #SS1	8	0.6255	1.3792	1	1.00	1.38	
					Spike Amount (µg)	1.31	
					Spike Recovery (%)	105%	
Snowball II 2167 #SS2	9	0.6237	1.3752	1	1.00	1.38	
					Spike Amount (µg)	1.31	
					Spike Recovery (%)	105%	

Narrative Summary

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Enthalpy Analytical Narrative Summary

Company	Bison Engineering
Job #	1018-002 - EPA Method 316
Client #	HAV218775

Custody	Matthew St. Lawrence received the samples on 10/1/18 and 10/2/18 after being relinquished by Bison Engineering. The samples were received at 18.8 °C and 23.4 °C respectively and were in good condition. Prior to, during, and after analysis, the samples were kept under lock with access only to authorized personnel by Enthalpy Analytical, LLC.
Analysis	The samples were analyzed for formaldehyde using the analytical procedures in EPA Method 316, Sampling and Analysis for Formaldehyde Emissions from Stationary Sources in the Mineral Wool and Wool Fiberglass Industries (40 CFR Part 63, Appendix A). The Hewlett Packard Model 8453, Diode Array Spectrophotometer “Snowball II” (S/N US73000904) was operated at 570 nm.
Calibration	The calibration curve is included in the Raw Data section of this report.
QC Notes	The analyses of the client’s blanks and laboratory method blanks did not contain formaldehyde at concentrations greater than the detection limit. Laboratory Duplicate (LD) and Alternate Dilution (AD) analyses were prepared using aliquots of samples ***CFU 113 (2) Run 1*** and ***CFU 104 Run 1***. The highest percent difference value was 3.9%. Matrix Spikes were prepared using aliquots of samples ***CFU 113 (2) Run 1*** and ***CFU 104 Run 1***and yielded recovery values of 85.3% and 99.1% respectively. The second source standards also served as Laboratory Control Samples (LCS) and exhibited spike recovery values of 104% and 105%. The samples were analyzed within the two week holding time specified by the method.
Reporting Notes	These analyses met the requirements of the TNI Standard. Any deviations from the requirements of the reference method or TNI Standard have been previously noted in the report narrative. The results presented in this report are representative of the samples as provided to the laboratory.

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General Reporting Notes

The following are general reporting notes that are applicable to all Enthalpy Analytical, LLC data reports, unless specifically noted otherwise.

- Any analysis which refers to the method as ***"Type"*** represents a planned deviation from the reference method. For instance a Hydrogen Sulfide assay from a Tedlar bag would be labeled as "EPA Method 16-Type" because Tedlar bags are not mentioned as one of the collection options in EPA Method 16.

- The acronym ***MDL*** represents the Minimum Detection Limit. Below this value the laboratory cannot determine the presence of the analyte of interest reliably.

- The acronym ***LOQ*** represents the Limit of Quantification. Below this value the laboratory cannot quantitate the analyte of interest within the criteria of the method.

- The acronym ***ND*** following a value indicates a non-detect or analytical result below the MDL.

- The letter ***J*** in the Qualifier or Flag column in the results indicates that the value is between the MDL and the LOQ. The laboratory can positively identify the analyte of interest as present, but the value should be considered an estimate.

- The letter ***E*** in the Qualifier or Flag column indicates an analytical result exceeding 100% of the highest calibration point. The associated value should be considered as an estimate.

- Sample results are presented 'as measured' for single injection methodologies, or an average value if multiple injections are made. If all injections are below the MDL, the sample is considered non-detect and the ND value is presented. If one, but not all, are below the MDL, the MDL value is used for any injections that are below the MDL. For example, if the MDL is 0.500 and LOQ is 1.00, and the instrument measures 0.355, 0.620, and 0.442 - the result reported is the average of 0.500, 0.620, and 0.500 - - - i.e. 0.540 with a J flag.

- When a spike recovery (Bag Spike, Collocated Spike Train, or liquid matrix spike) is being calculated, the native (unspiked) sample result is used in the calculations, as long as the value is above the MDL. If a sample is ND, then 0 is used as the native amount (not the MDL value).

- The acronym ***DF*** represents Dilution Factor. This number represents dilution of the sample during the preparation and/or analysis process. The analytical result taken from a laboratory instrument is multiplied by the DF to determine the final undiluted sample results.

- The addition of ***MS*** to the Sample ID represents a Matrix Spike. An aliquot of an actual sample is spiked with a known amount of analyte so that a percent recovery value can be determined. The MS analysis indicates what effect the sample matrix may have on the target analyte, i.e. whether or not anything in the sample matrix interferes with the analysis of the analyte(s).

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General Reporting Notes
(continued)

- The addition of ***MSD*** to the Sample ID represents a Matrix Spike Duplicate. Prepared in the same manner as a MS, the use of duplicate matrix spikes allows further confirmation of laboratory quality by showing the consistency of results gained by performing the same steps multiple times.

- The addition of ***LD*** to the Sample ID represents a Laboratory Duplicate. The analyst prepares an additional aliquot of sample for testing and the results of the duplicate analysis are compared to the initial result. The result should have a difference value of within 10% of the initial result (if the results of the original analysis are greater than the LOQ).

- The addition of ***AD*** to the Sample ID represents an Alternate Dilution. The analyst prepares an additional aliquot at a different dilution factor (usually double the initial factor). This analysis helps confirm that no additional compound is present and coeluting or sharing absorbance with the analyte of interest, as they would have a different response/absorbance than the analyte of interest.

- The Sample ID ***LCS*** represents a Laboratory Control Sample. Clean matrix, similar to the client sample matrix, prepared and analyzed by the laboratory using the same reagents, spiking standards and procedures used for the client samples. The LCS is used to assess the control of the laboratory's analytical system. Whenever spikes are prepared for our client projects, two spikes are retained as LCSs. The LCSs are labeled with the associated project number and kept in-house at the appropriate temperature conditions. When the project samples are received for analysis, the LCSs are analyzed to confirm that the analyte could be recovered from the media, separate from the samples which were used on the project and which may have been affected by source matrix, sample collection, and/or sample transport.

- **Significant Figures**: Where the reported value is much greater than unity (1.00) in the units expressed, the number is rounded to a whole number of units, rather than to 3 significant figures. For example, a value of 10,456.45 ug catch is rounded to 10,456 ug. There are five significant digits displayed, but no confidence should be placed on more than two significant digits. In the case of small numbers, generally 3 significant figures are presented, but still only 2 should be used with confidence. Many neat materials are only certified to 3 digits, and as the mathematically correct final result is always 1 digit less than all its pre-cursors - 2 significant figures are what are most defensible.

- **Manual Integration**: The data systems used for processing will flag manually integrated peaks with an "M". There are several reasons a peak may be manually integrated. These reasons will be identified by the following two letter designations on sample chromatograms, if provided in the report. The peak was ***not integrated*** by the software **"NI"**, the peak was ***integrated incorrectly*** by the software **"II"** or the ***wrong peak*** was integrated by the software **"WP"**. These codes will accompany the analyst's manual integration stamp placed next to the compound name on the chromatogram.

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Sample Custody

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Chain of Custody Record

Page 1 of 1

Special Handling:

☒ Standard Turn Around Time (10 business days)
☒ Rush Turn Around Time -- Date Needed______

- All TATs Subject to Approval by Enthalpy Analytical, Inc.
- All Bag/Can Samples Disposed of 1 Month from Receipt.
- All Other Samples Disposed of 4 Months from Receipt.

Client Name: Bison Engineering, Inc.
Project Manager: Kelly Dorsi
Report To: Kelly Dorsi
Special Instructions:

Project Number: HAV218775
Site Name: CFU 113(2)
Location: Corvallis, OR

PO#:
Telephone#: 406-442-5768
Email: kdorsi@bison-eng.com

For spiked or duplicate samples: please provide sample volumes for recovery calculations. For Particulates: please provide tare weights and/or condensed water volumes.

A=Air 1=H2SO4 2=NaOH W=Water O=Other
X=XAD C=Charcoal SG=Silica Gel
G=Grab C=Composite Q=Quality Control O=Other

Sample ID	Date	Time	Sample Volume	Type	Matrix	# of VOA Vials	# of Glass	# of Plastic	# of Bags	# of Canisters	# of Tubes	# Other	Analyses: M-316	Notes:
M-316 cont.#1 Run1 CFU 113(2)	9/25/18		455ml					1						
M-316 cont.#1 Run2 CFU 113(2)			470ml					1						
M-316 cont.#1 Run3 CFU 113(2)			445ml					1						
M-316 Field train Blank			510ml					1						

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Condition Upon Receipt:
[signature]		Matt A. Lawrence	10/1/18	8:36am	☐ Iced ☐ Ambient ☐ °C 18.8
					☐ Iced ☐ Ambient ☐ °C ____
					☐ Iced ☐ Ambient ☐ °C ____

Good condition MST 10/1/18
18.8°C Raytek5

ENTHALPY analytical, inc

Chain of Custody Record

Page 1 of 1

Special Handling:
- [X] Standard Turn Around Time (10 business days)
- [X] Rush Turn Around Time -- Date Needed________
- All TATs Subject to Approval by Enthalpy Analytical, Inc.
- All Bag/Can Samples Disposed of 1 Month from Receipt.
- All Other Samples Disposed of 4 Months from Receipt.

Client Name: Bison Engineering, Inc.
Project Manager: Kelly Dorsi
Report To: Kelly Dorsi
Special Instructions:

Project Number: HAV218775
Site Name: CFU 104
Location: Corvallis, OR

PO#:
Telephone#: 406-442-5768
Email: kdorsi@bison-eng.com

For spiked or duplicate samples: please provide sample volumes for recovery calculations. For Particulates: please provide tare weights and/or condensed water volumes.

A=Air 1=H2SO4 2=NaOH W=Water O=Other
X=XAD C=Charcoal SG=Silica Gel
G=Grab C=Composite Q=Quality Control O=Other

Sample ID	Date	Time	Sample Volume	Type	Matrix	# of VOA Vials	# of Glass	# of Plastic	# of Bags	# of Canisters	# of Tubes	# Other	Analyses: 316								Notes:
M-316 Cont. #1 Run1	9/28/18	9:45	440ml					1													
M-316 Cont. #1 Run2	9/28/18	12:00	450ml					1													
M-316 cont. #1 Run3	9/28/18	14:45	460ml					1													
Fieldtrainblank	9/28/18	12:00	400ml					1													

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Condition Upon Receipt:
[signature]		Matt d. [signature]	10/2/18	8:45am	☐ Iced ☑ Ambient ☐ °C 23.4
					☐ Iced ☐ Ambient ☐ °C
					☐ Iced ☐ Ambient ☐ °C

Good Condition MSF 10/2/18
23.4°C Rayteks

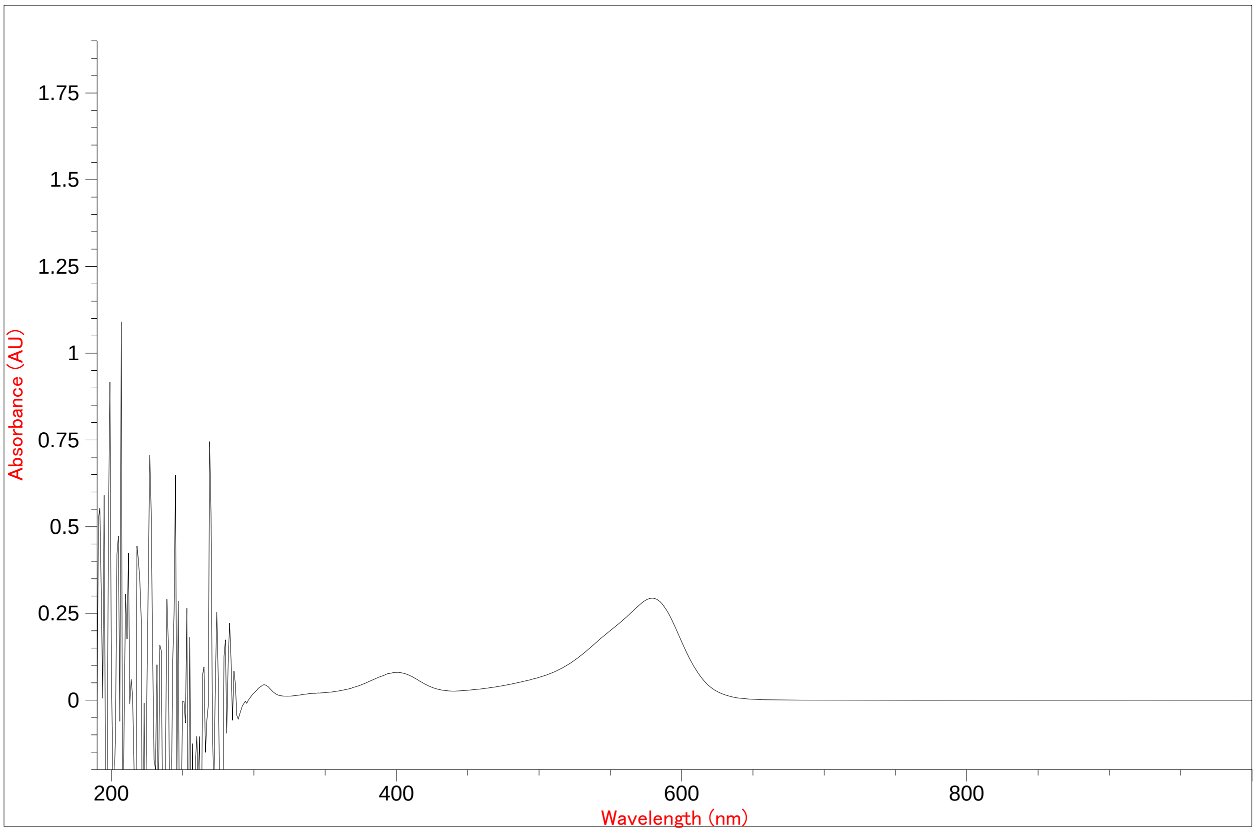
Raw Data

ENTHALPY
ANALYTICAL

Sample 6

Sample Name	1018-002.R1*2.M316 (#4)
Operator	Scott Wilson
Date	10/1/18
Time	15:48:07
Path Length	1
Path Length Unit	cm

Sample Spectrum



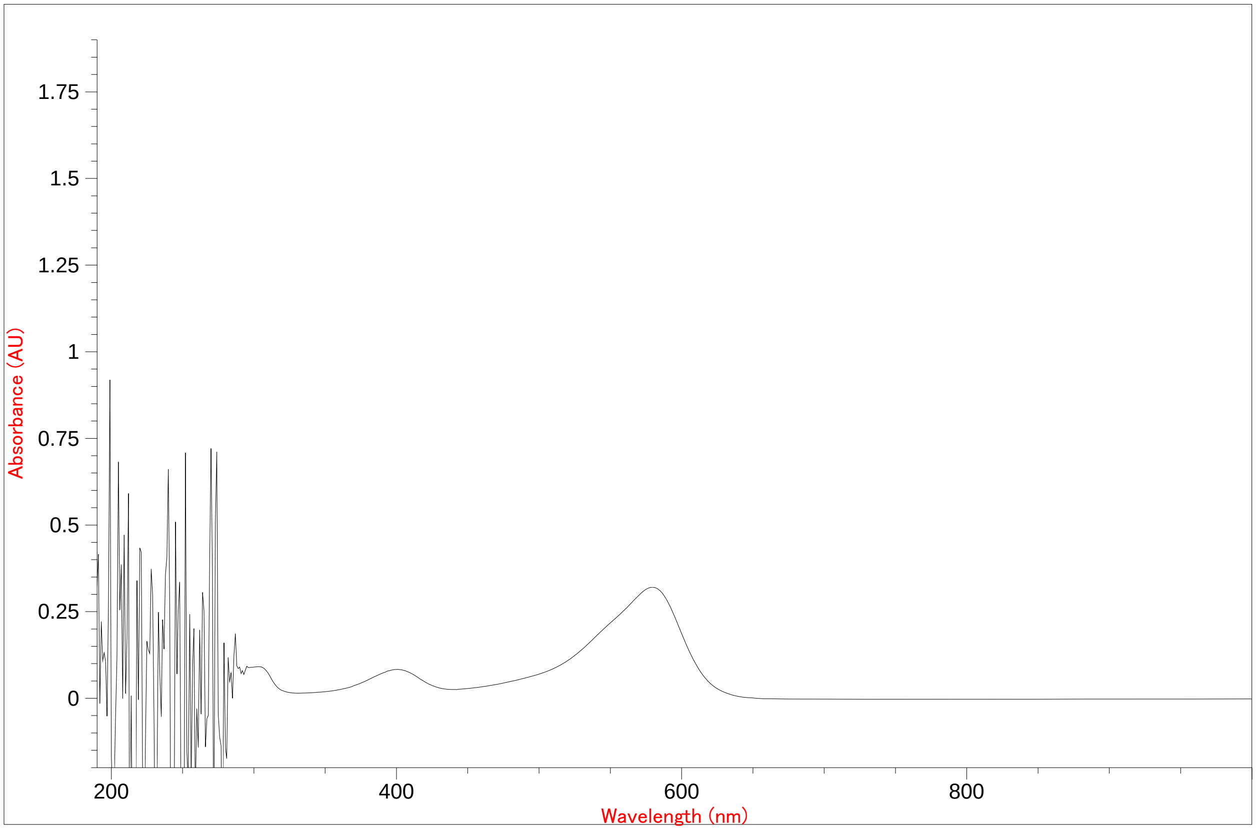
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.58716	ug/mL	0.00711

Sample 9

Sample Name	1018-002.R2*2.M316 (#8)
Operator	Scott Wilson
Date	10/1/18
Time	15:49:10
Path Length	1
Path Length Unit	cm

Sample Spectrum



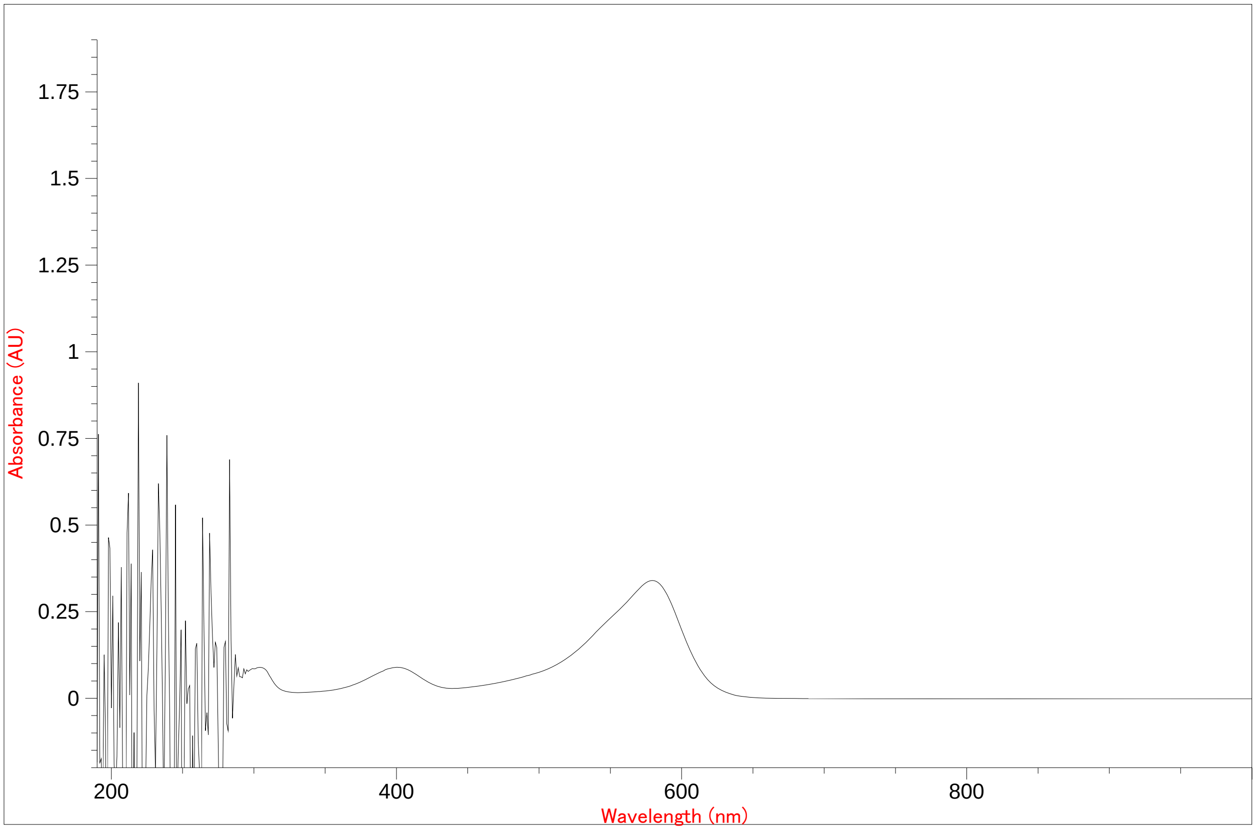
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.63943	ug/mL	0.00712

Sample 10

Sample Name	1018-002.R3*2.M316 (#9)
Operator	Scott Wilson
Date	10/1/18
Time	15:49:24
Path Length	1
Path Length Unit	cm

Sample Spectrum



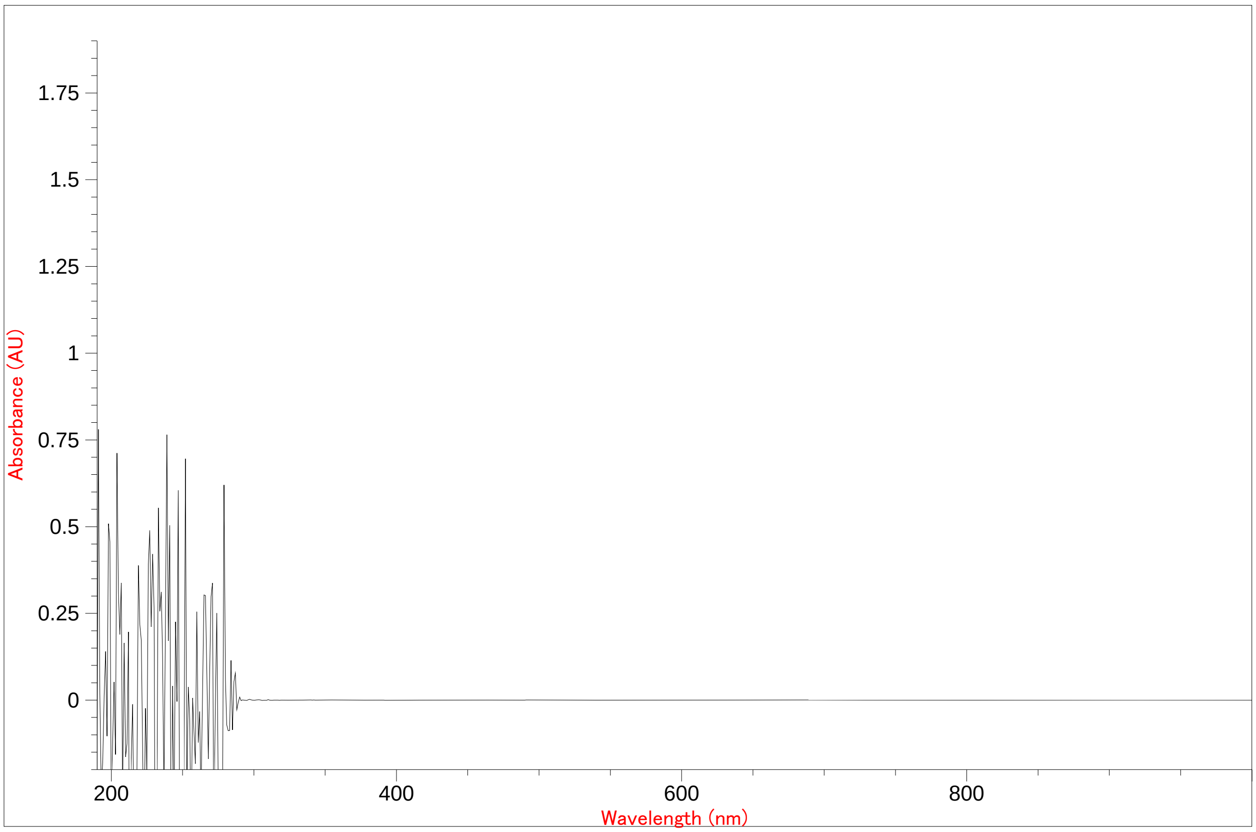
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.67814	ug/mL	0.00713

Sample 11

Sample Name	1018-002.FTB.M316 (#10)
Operator	Scott Wilson
Date	10/1/18
Time	15:49:41
Path Length	1
Path Length Unit	cm

Sample Spectrum



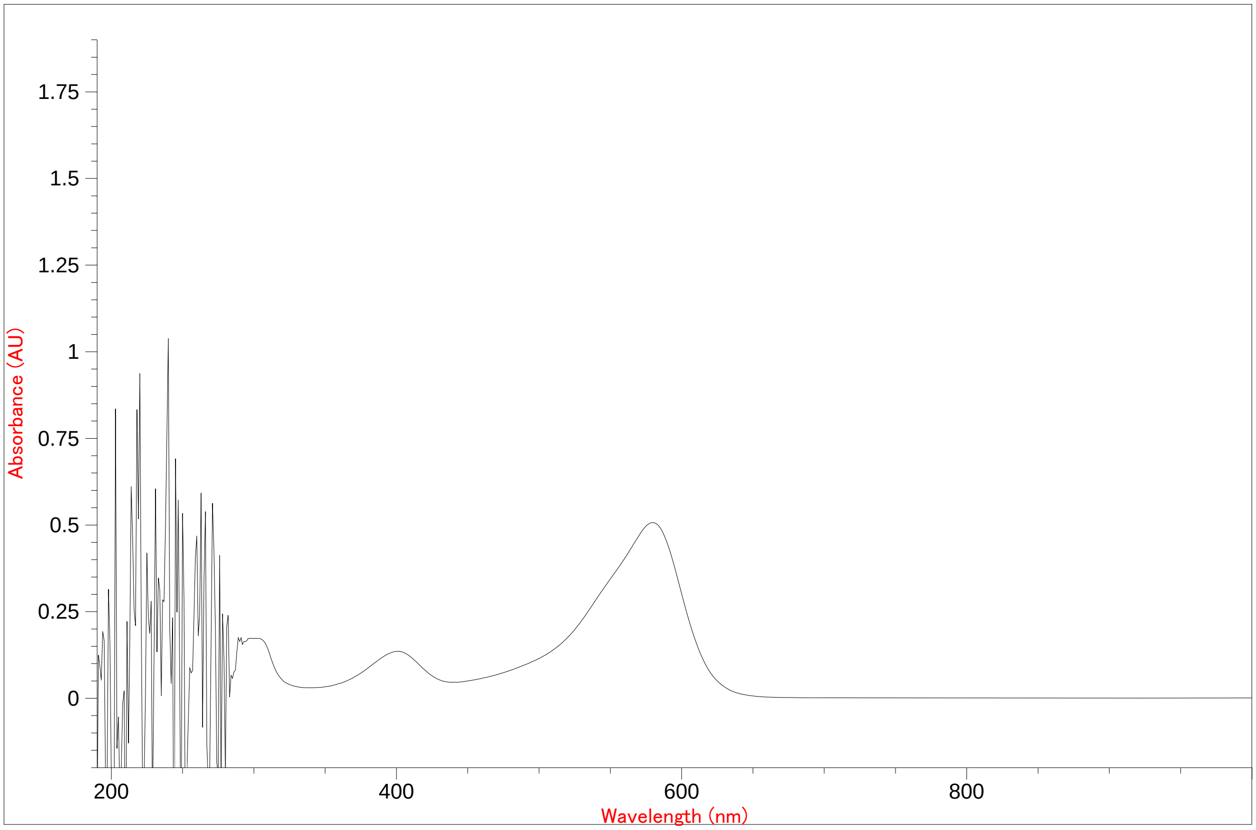
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00014	ug/mL	0.00704

Sample 6

Sample Name	1018-002.R1 104.M316 (#4)
Operator	Scott Wilson
Date	10/3/18
Time	9:55:33
Path Length	1
Path Length Unit	cm

Sample Spectrum



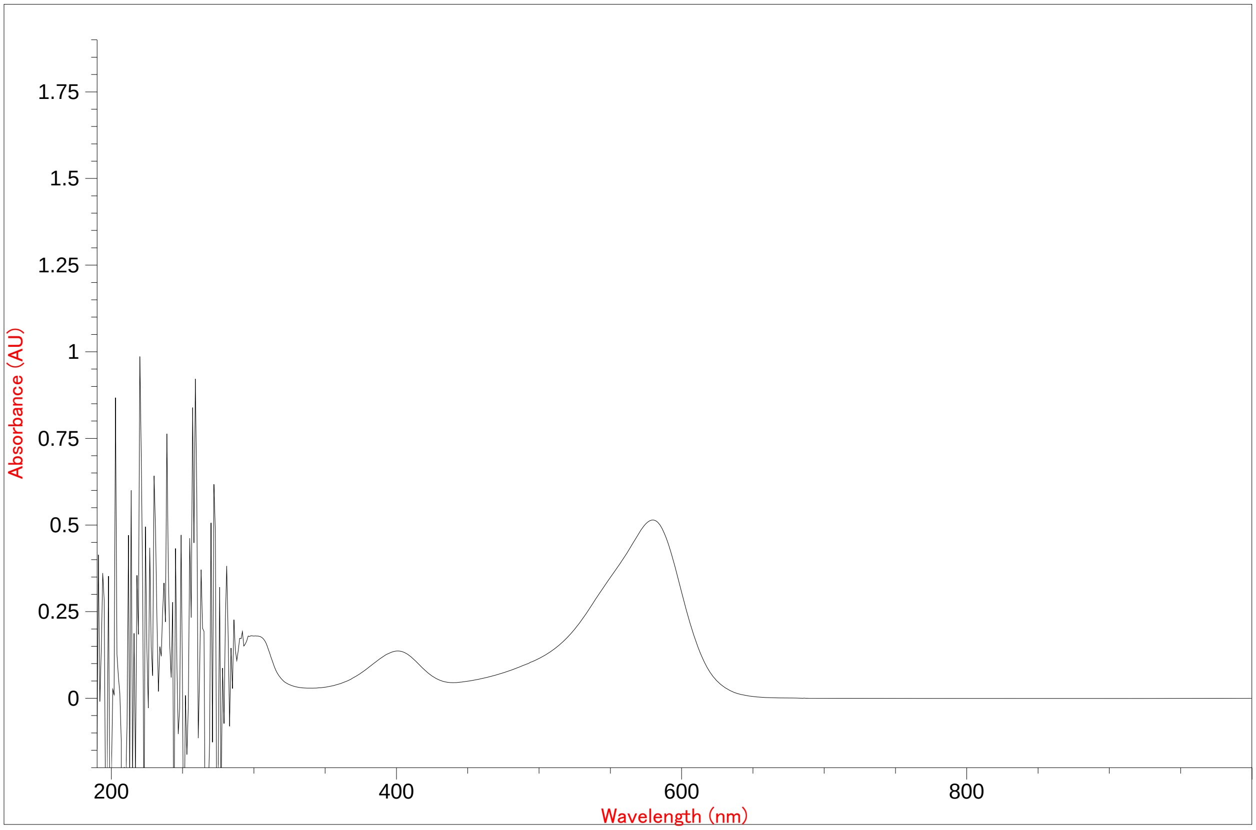
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.03474	ug/mL	0.01042

Sample 10

Sample Name	1018-002.R2 104.M316 (#8)
Operator	Scott Wilson
Date	10/3/18
Time	9:57:03
Path Length	1
Path Length Unit	cm

Sample Spectrum



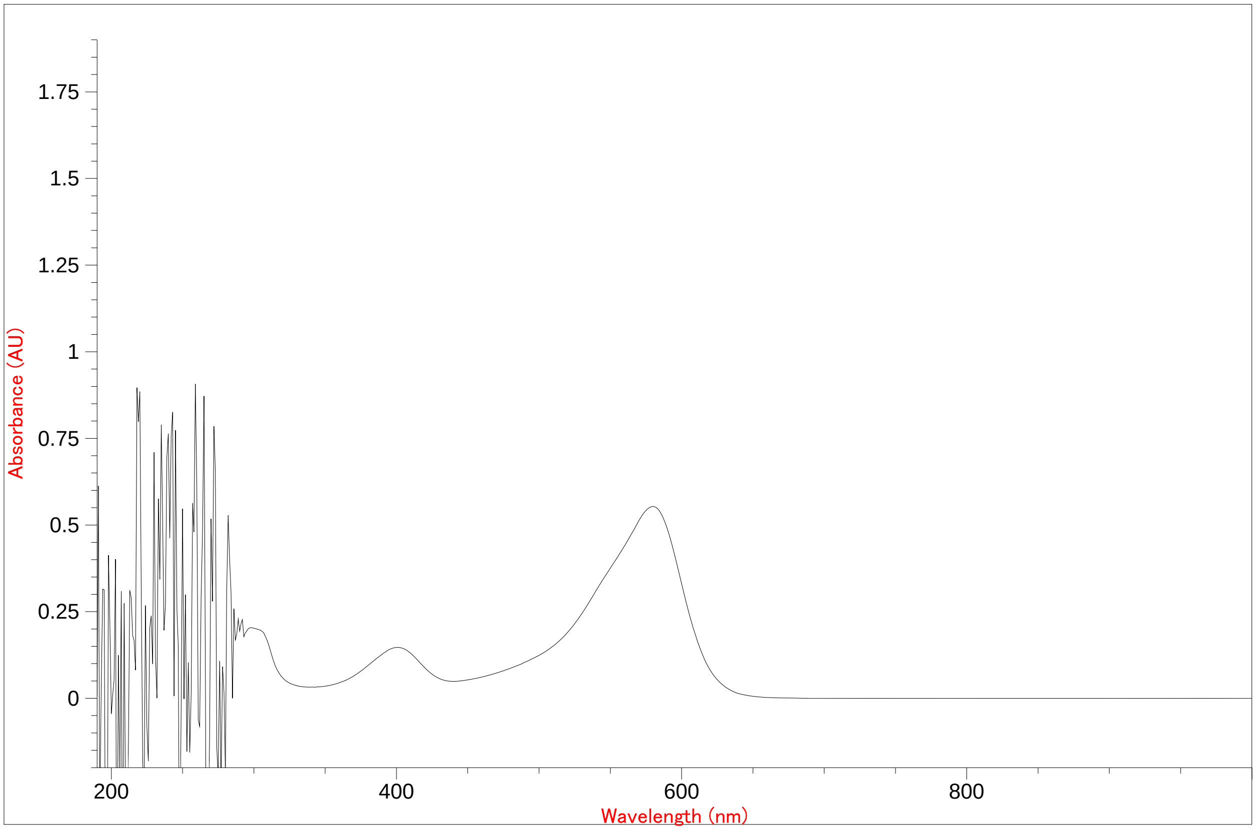
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.04938	ug/mL	0.01042

Sample 11

Sample Name	1018-002.R3 104.M316 (#9)
Operator	Scott Wilson
Date	10/3/18
Time	9:57:28
Path Length	1
Path Length Unit	cm

Sample Spectrum



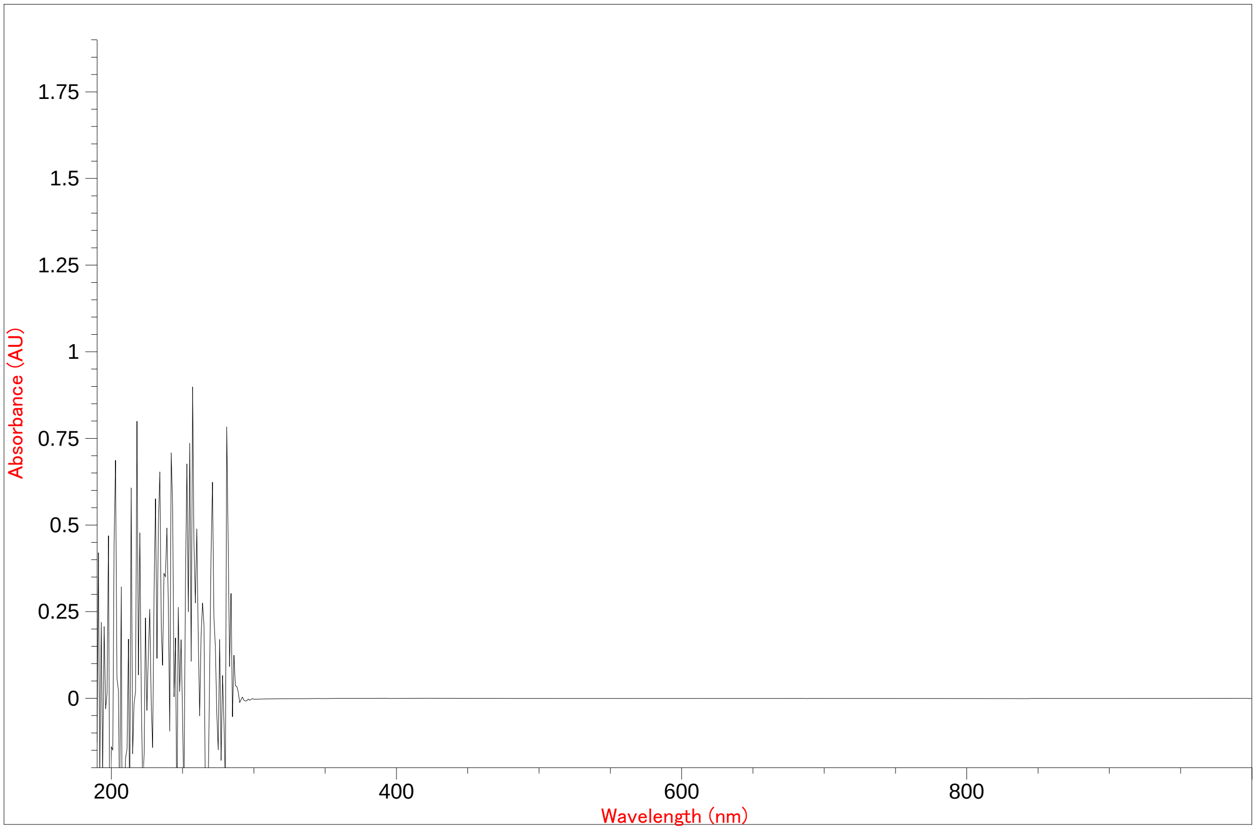
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.12978	ug/mL	0.01047

Sample 12

Sample Name	1018-002.FTB 104.M316 (#10)
Operator	Scott Wilson
Date	10/3/18
Time	9:57:55
Path Length	1
Path Length Unit	cm

Sample Spectrum



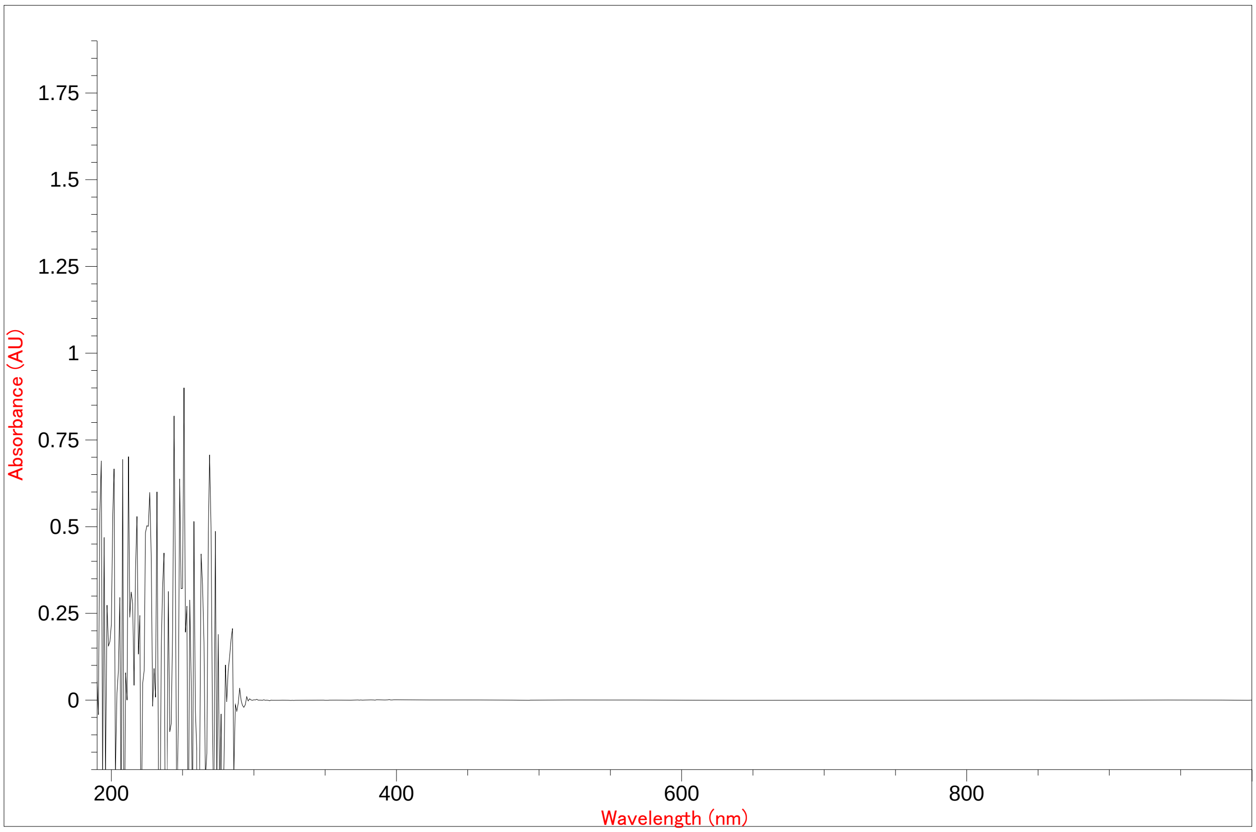
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00115	ug/mL	0.01011

Sample 3

Sample Name	Snowball II 2161 #MB1 (#10)
Operator	Scott Wilson
Date	10/1/18
Time	10:45:53
Path Length	1
Path Length Unit	cm

Sample Spectrum



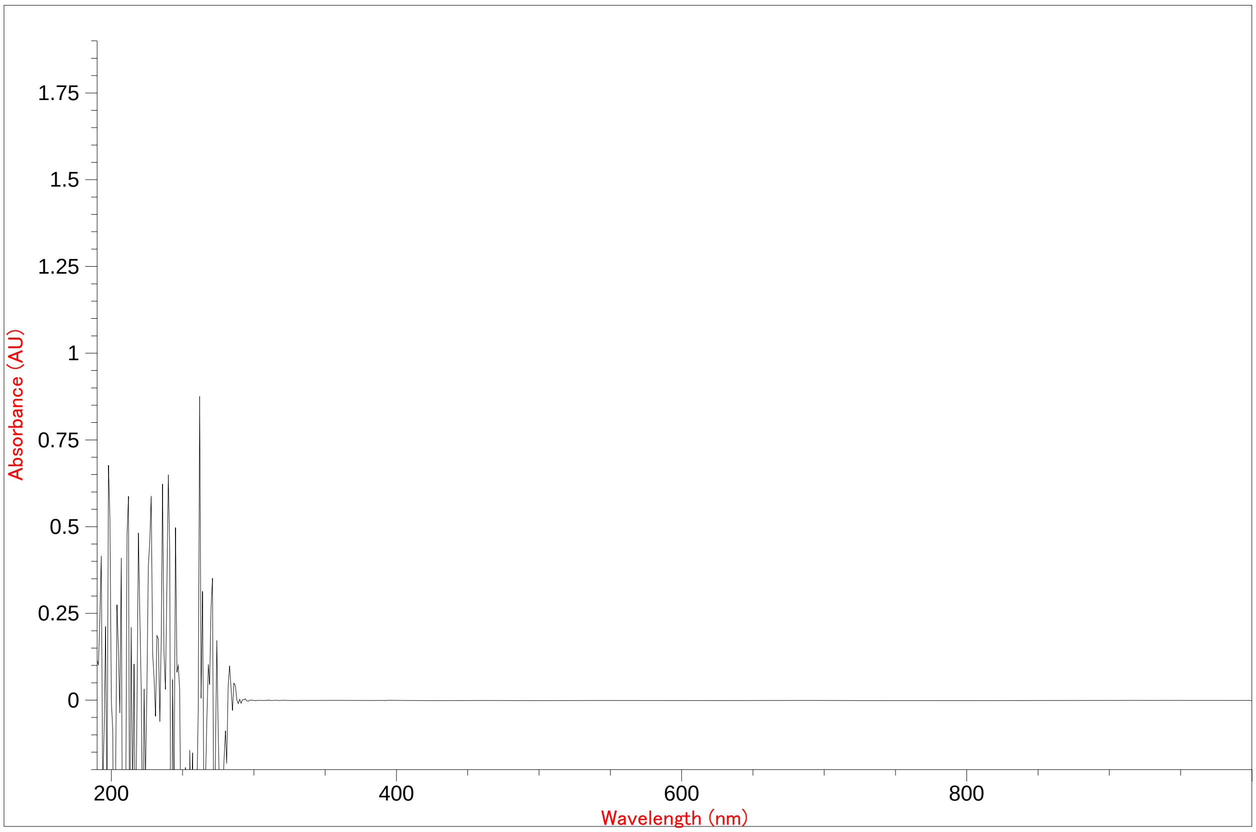
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00145	ug/mL	0.00704

Sample 5

Sample Name	Snowball II 2161 #MB6 (#3)
Operator	Scott Wilson
Date	10/1/18
Time	15:47:51
Path Length	1
Path Length Unit	cm

Sample Spectrum



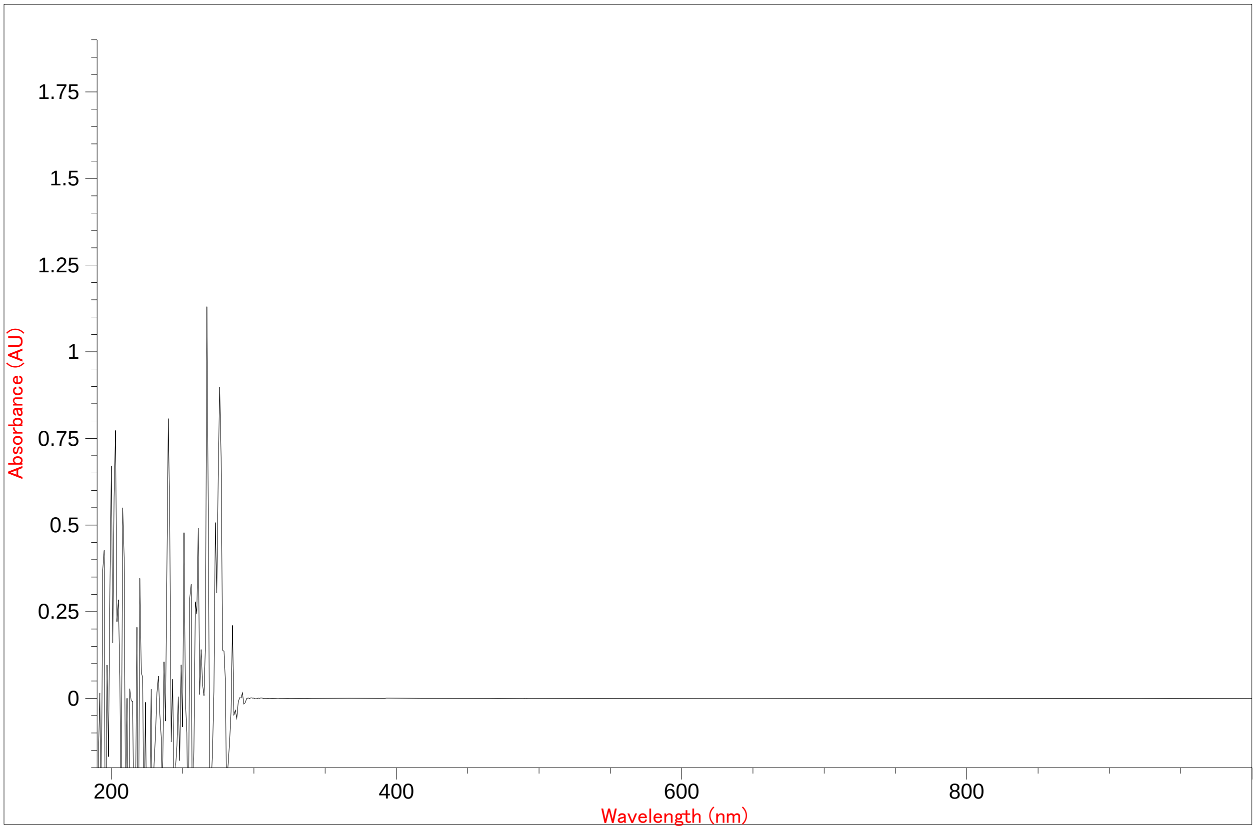
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00245	ug/mL	0.00704

Sample 3

Sample Name	Snowball II 2167 #MB1 (#10)
Operator	Scott Wilson
Date	10/3/18
Time	9:37:28
Path Length	1
Path Length Unit	cm

Sample Spectrum



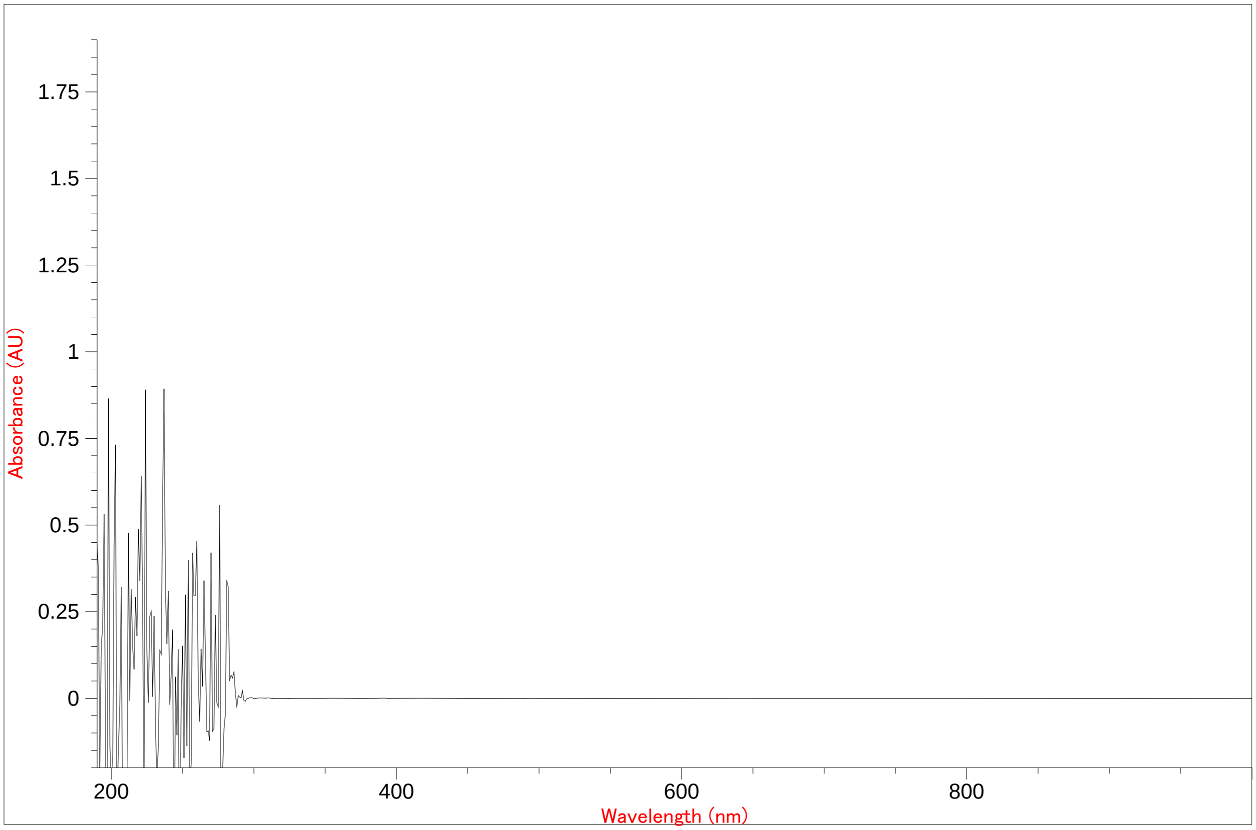
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00062	ug/mL	0.01011

Sample 5

Sample Name	Snowball II 2167 #MB2 (#3)
Operator	Scott Wilson
Date	10/3/18
Time	9:55:08
Path Length	1
Path Length Unit	cm

Sample Spectrum



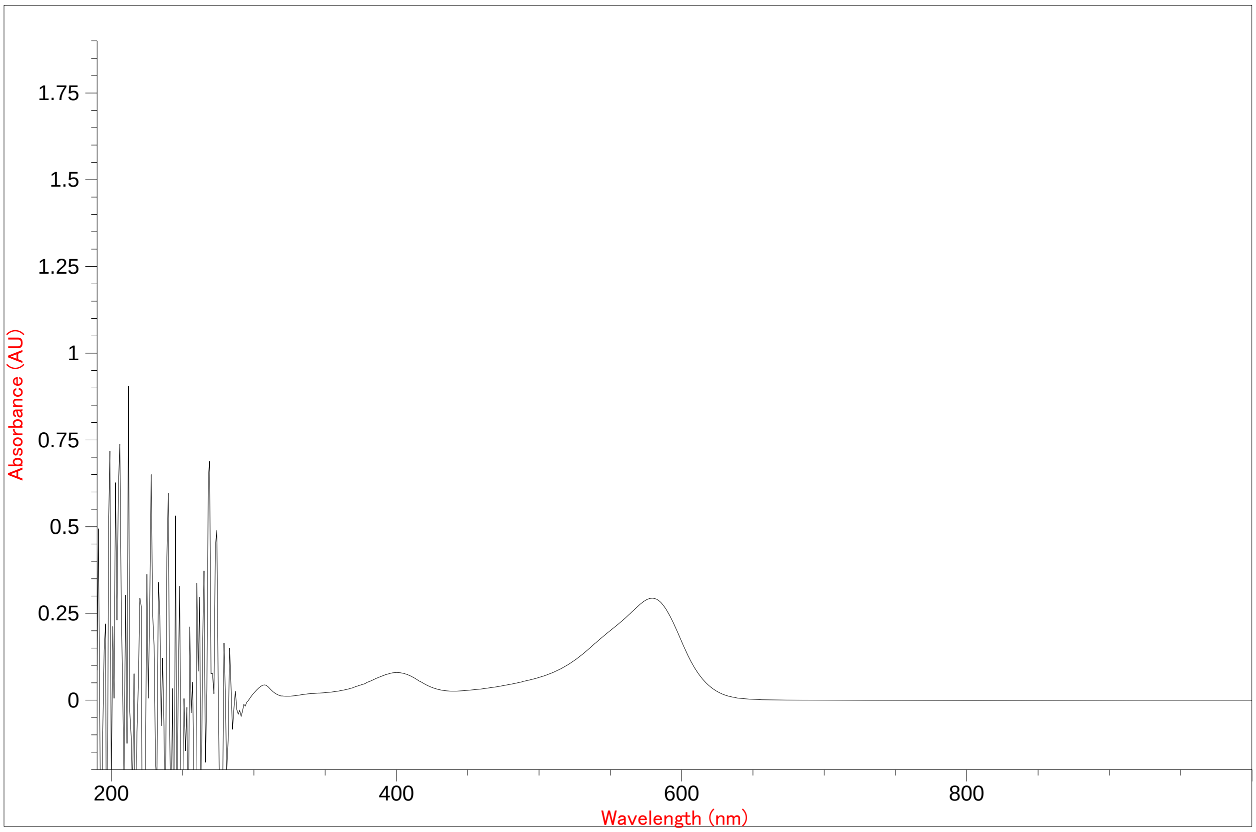
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00078	ug/mL	0.01011

Sample 7

Sample Name	1018-002.LD/R1*2.M316 (#5)
Operator	Scott Wilson
Date	10/1/18
Time	15:48:20
Path Length	1
Path Length Unit	cm

Sample Spectrum



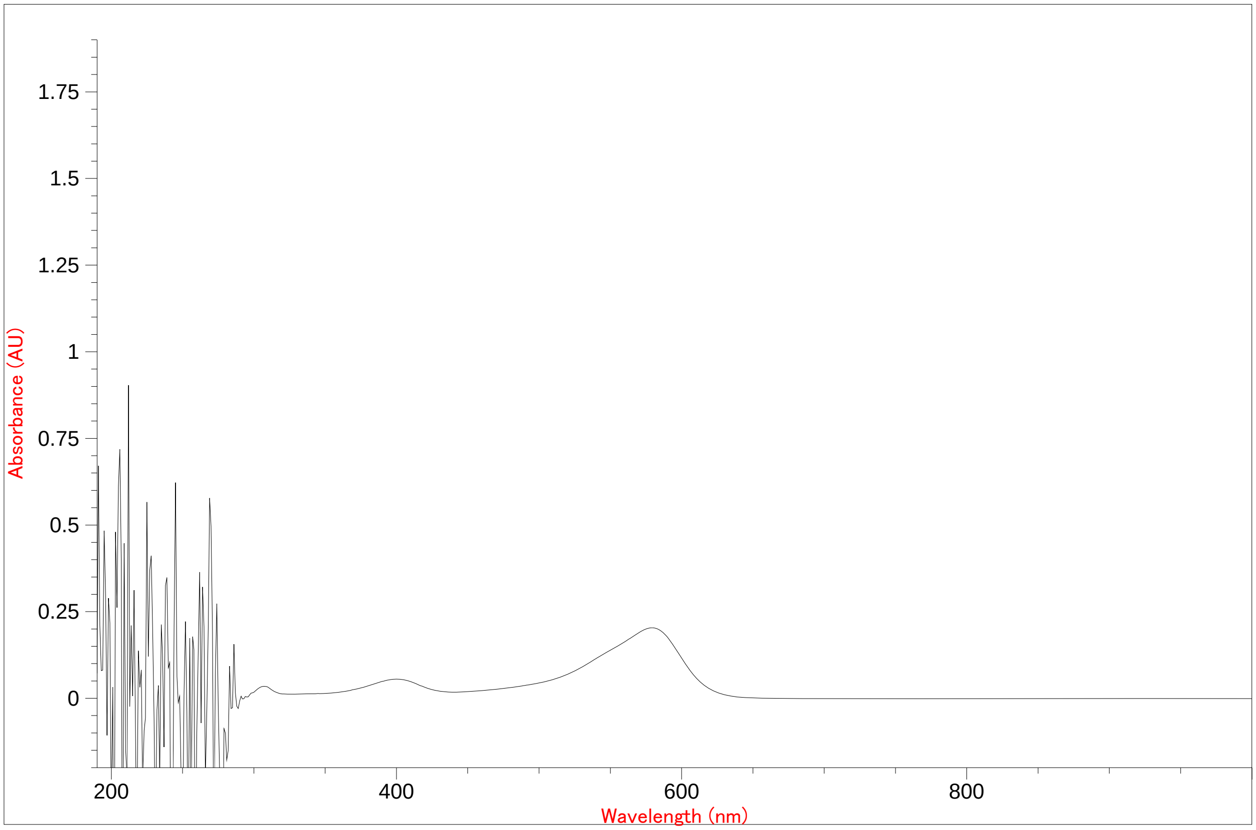
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.58707	ug/mL	0.00711

Sample 13

Sample Name	1018-002.AD/R1*3.M316 (#12)
Operator	Scott Wilson
Date	10/1/18
Time	15:55:27
Path Length	1
Path Length Unit	cm

Sample Spectrum



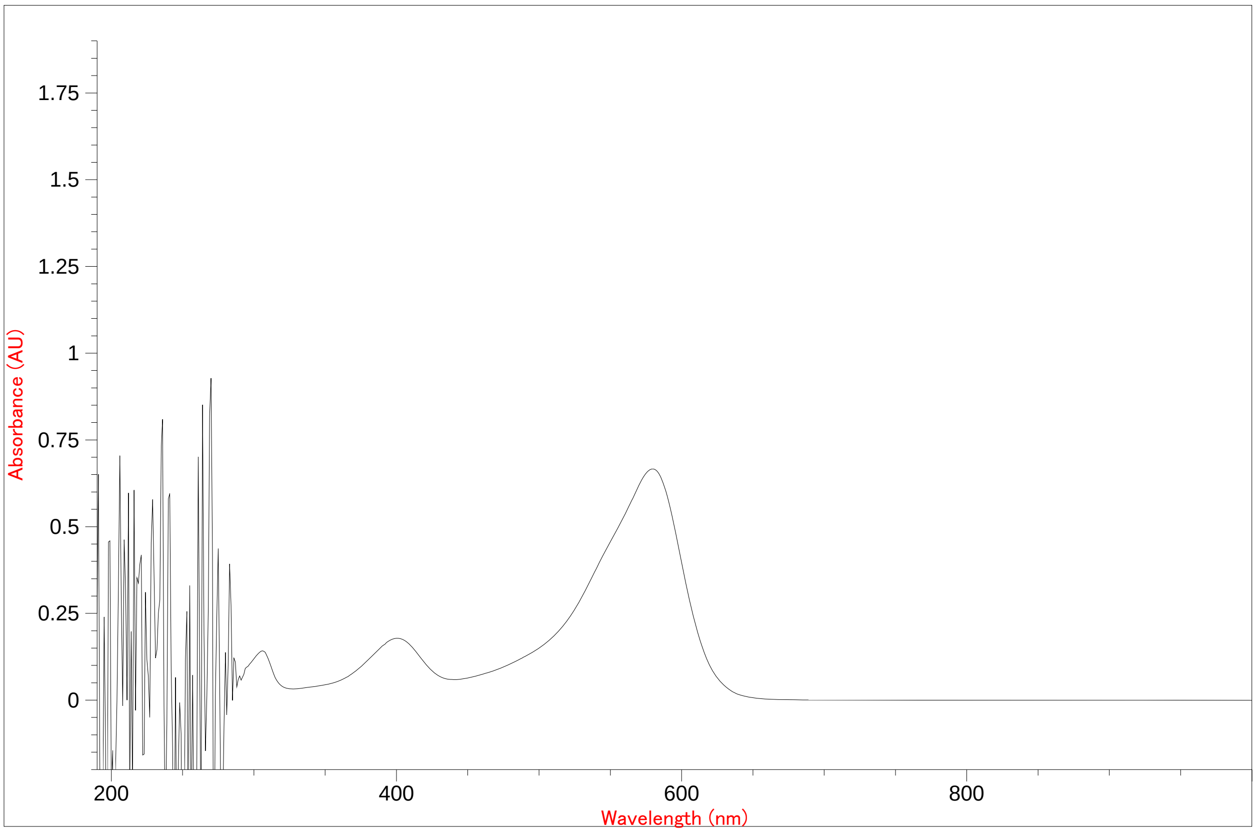
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.40709	ug/mL	0.00707

Sample 8

Sample Name	1018-002.MS/R1*2.M316 (#7)
Operator	Scott Wilson
Date	10/1/18
Time	15:48:53
Path Length	1
Path Length Unit	cm

Sample Spectrum



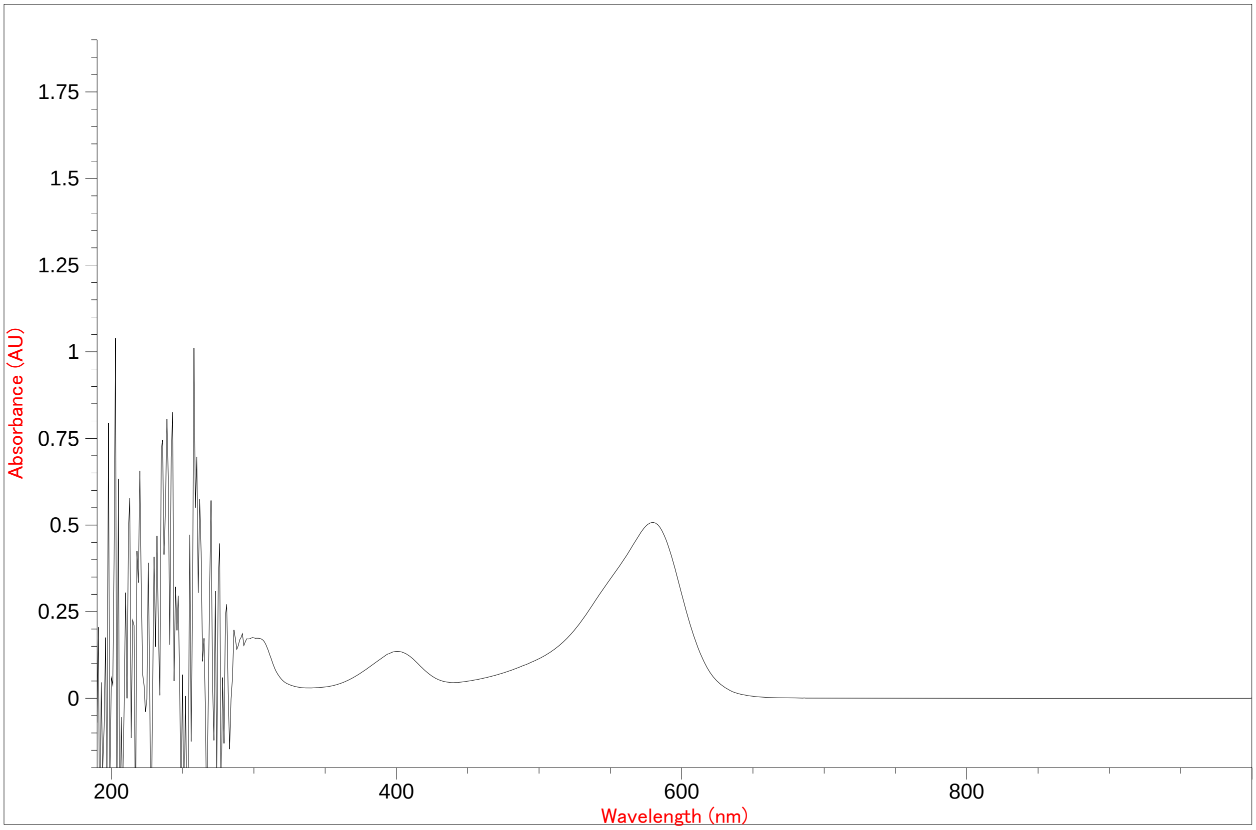
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.33004	ug/mL	0.00739

Sample 7

Sample Name	1018-002.LD/R1 104.M316 (#5)
Operator	Scott Wilson
Date	10/3/18
Time	9:55:54
Path Length	1
Path Length Unit	cm

Sample Spectrum



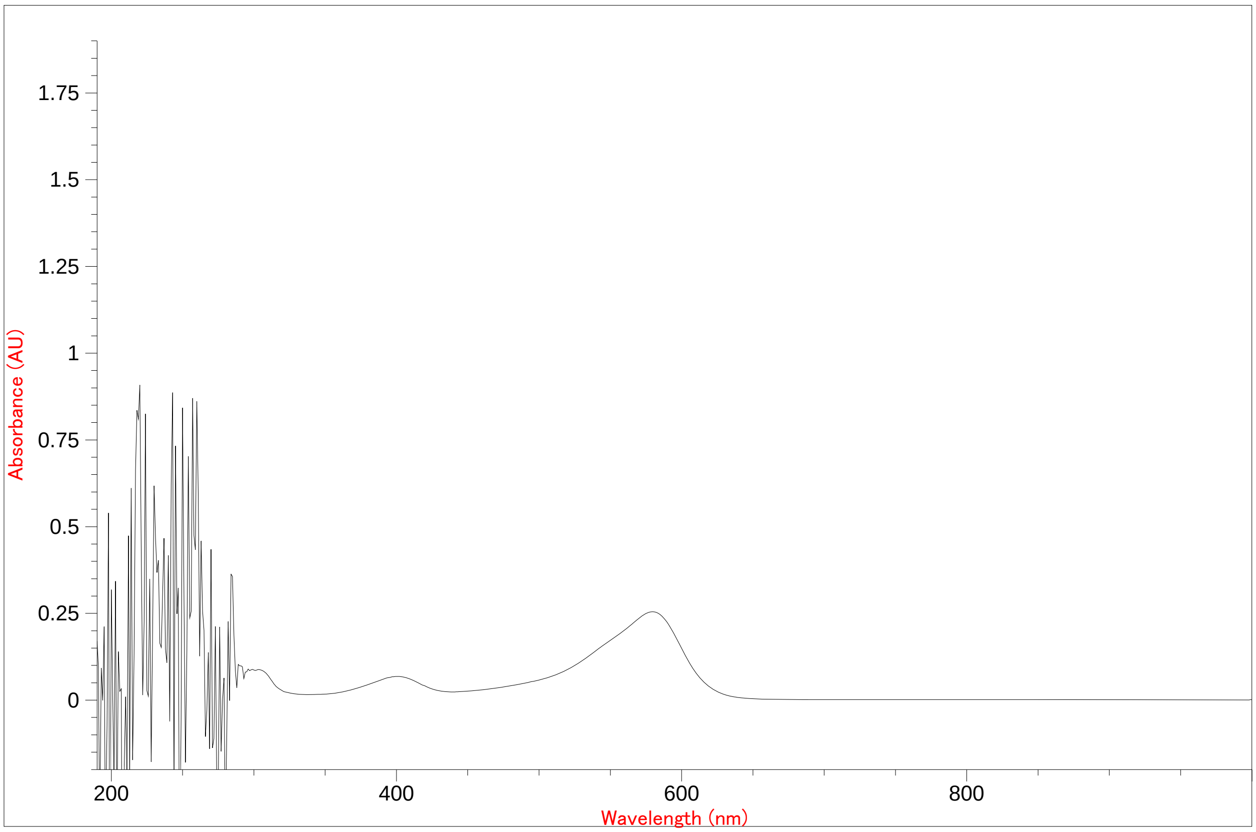
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.03564	ug/mL	0.01042

Sample 8

Sample Name	1018-002.AD/R1 104.M316 (#6)
Operator	Scott Wilson
Date	10/3/18
Time	9:56:11
Path Length	1
Path Length Unit	cm

Sample Spectrum



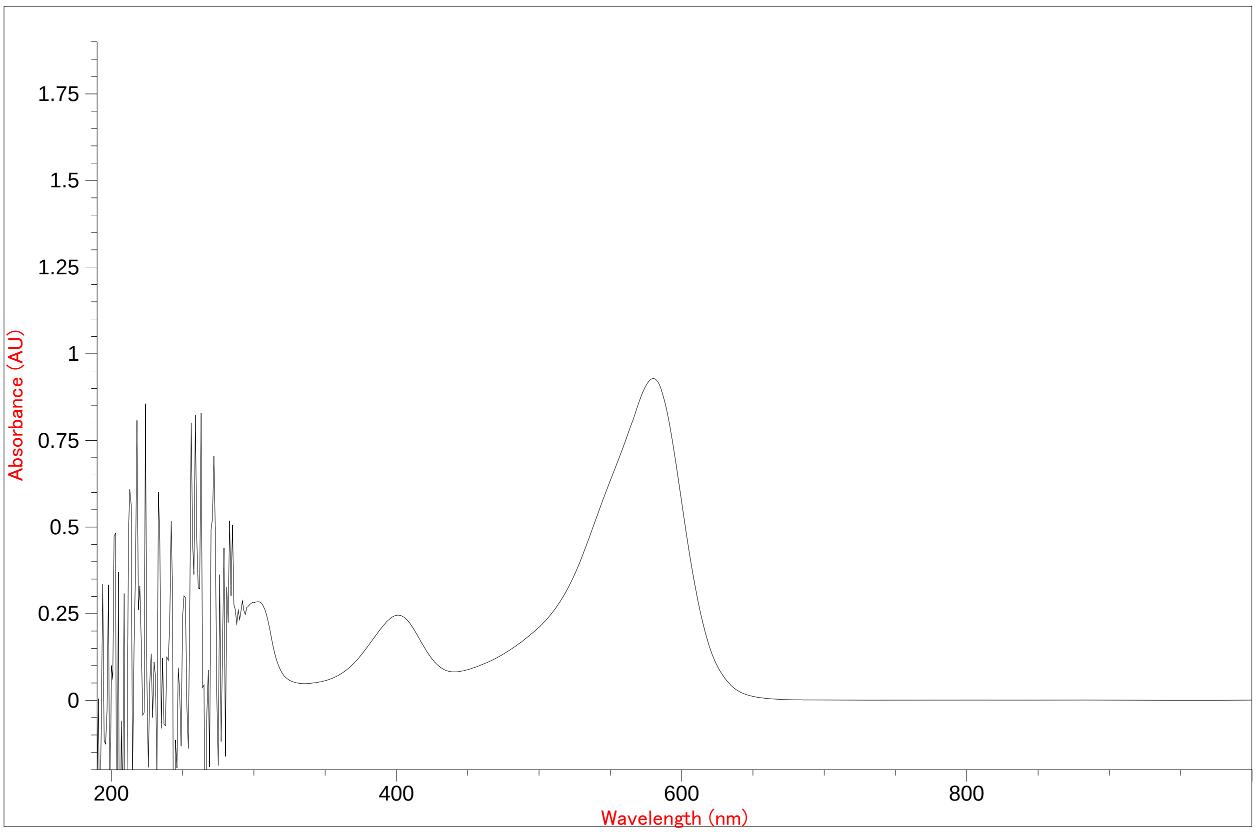
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.51952	ug/mL	0.01018

Sample 9

Sample Name	1018-002.MS/R1 104.M316 (#7)
Operator	Scott Wilson
Date	10/3/18
Time	9:56:30
Path Length	1
Path Length Unit	cm

Sample Spectrum



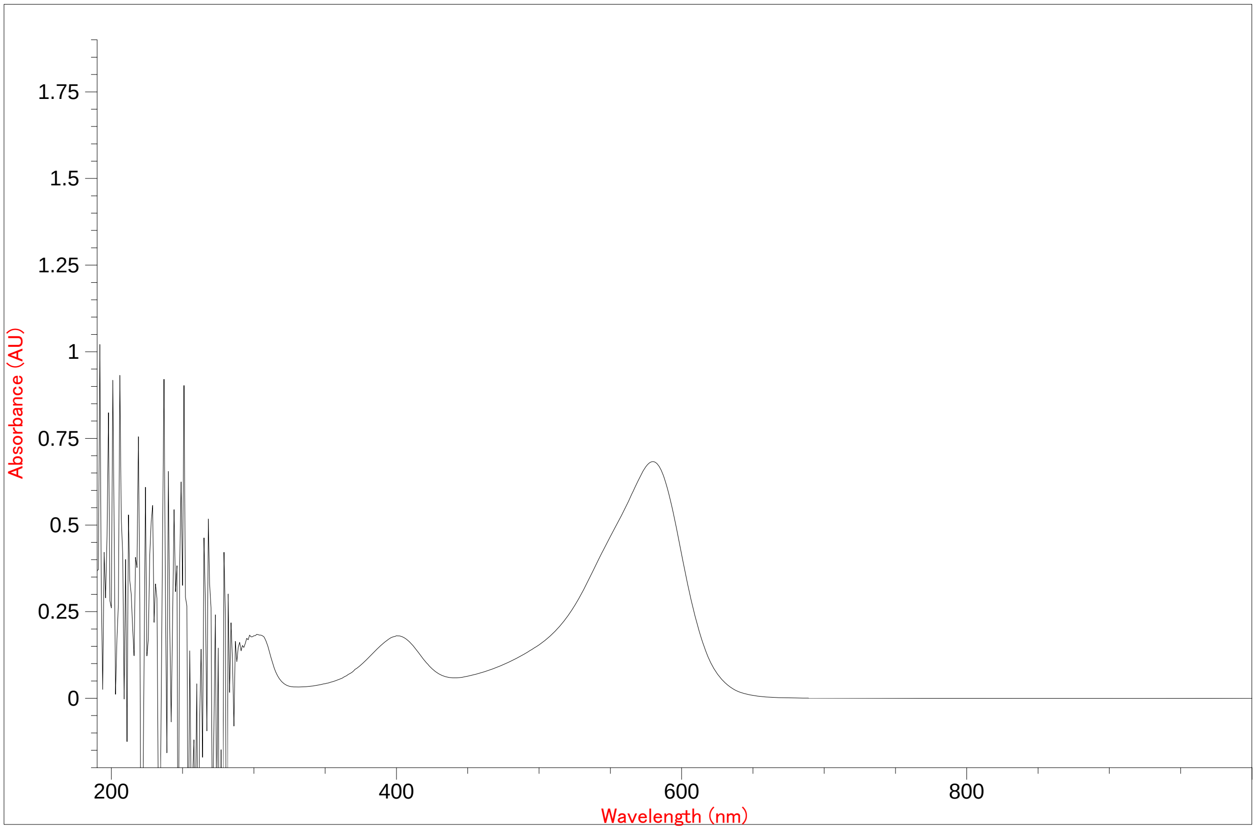
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.89433	ug/mL	0.01111

Sample 1

Sample Name	Snowball II 2161 #SS1 (#8)
Operator	Scott Wilson
Date	10/1/18
Time	10:45:22
Path Length	1
Path Length Unit	cm

Sample Spectrum



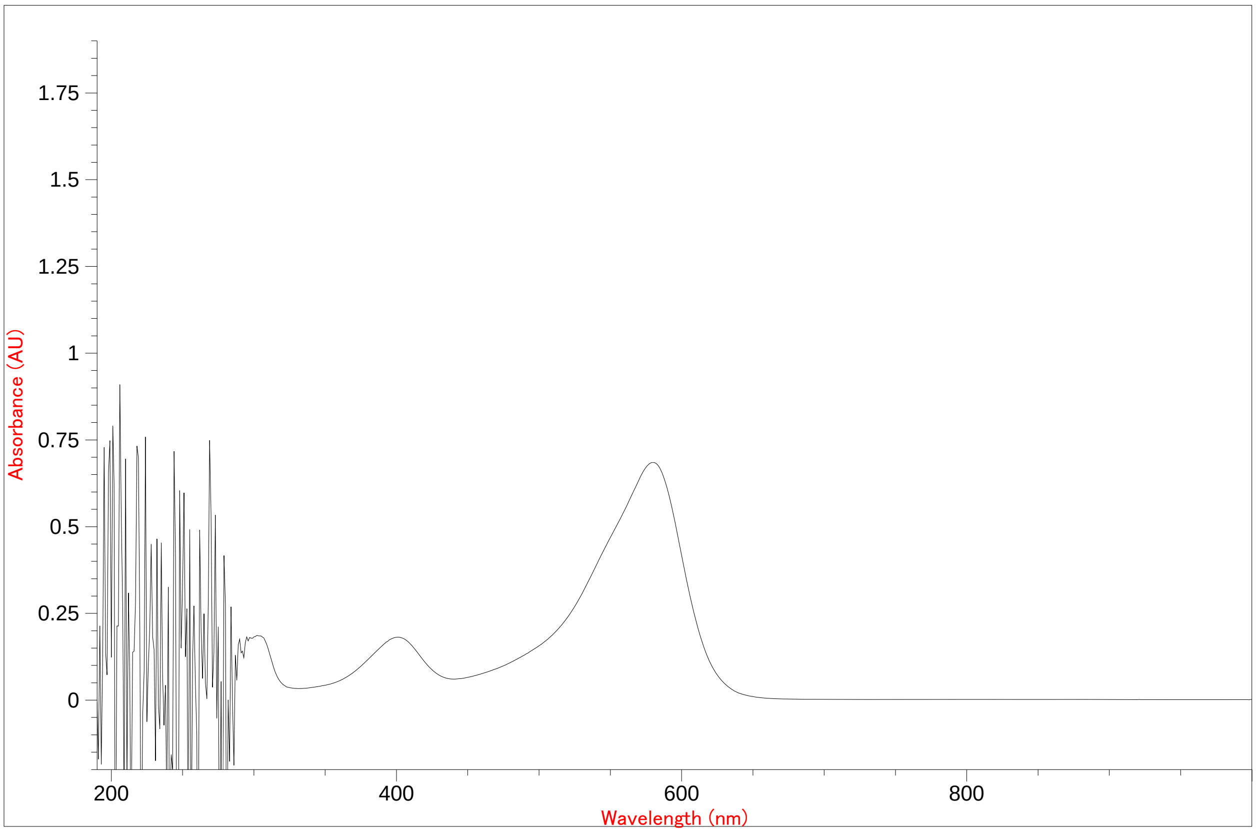
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.36053	ug/mL	0.00741

Sample 2

Sample Name	Snowball II 2161 #SS2 (#9)
Operator	Scott Wilson
Date	10/1/18
Time	10:45:38
Path Length	1
Path Length Unit	cm

Sample Spectrum



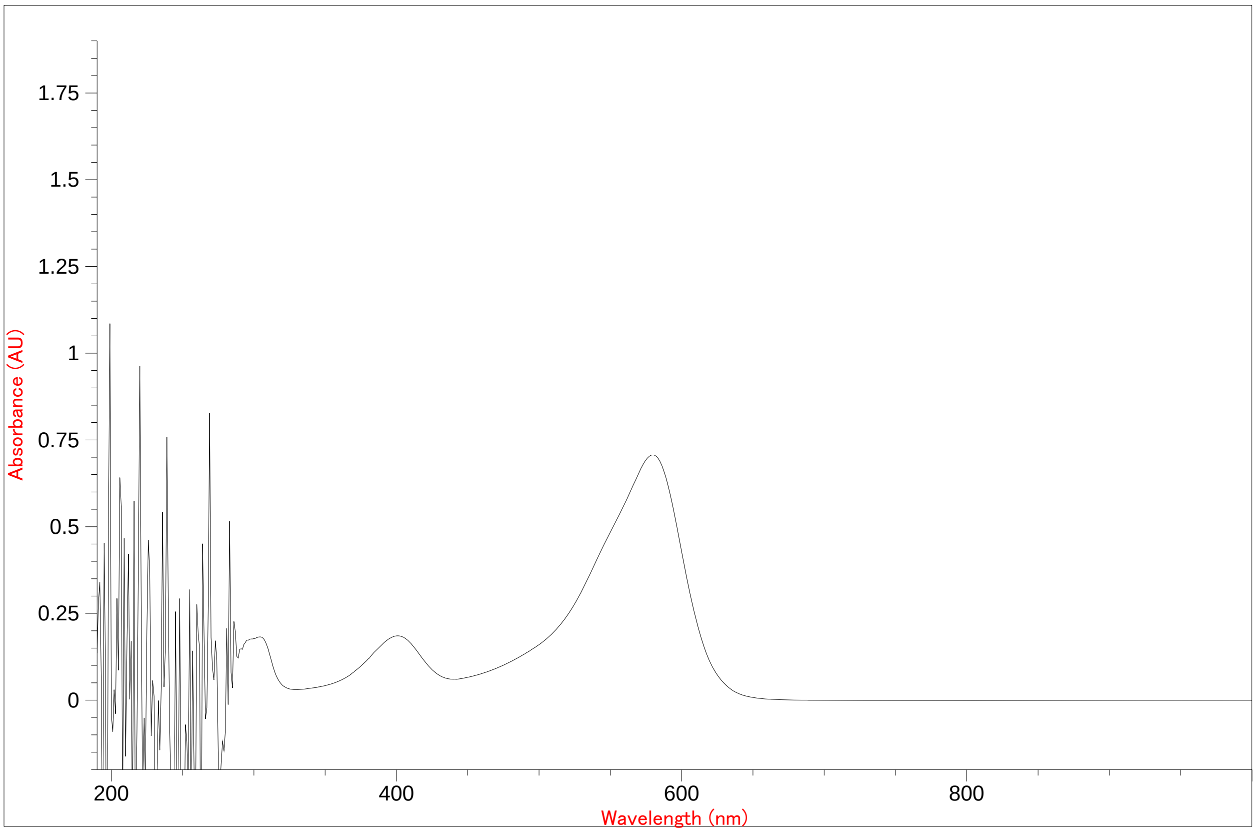
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.36519	ug/mL	0.00741

Sample 4

Sample Name	Snowball II 2161 #SSH (#2)
Operator	Scott Wilson
Date	10/1/18
Time	15:47:38
Path Length	1
Path Length Unit	cm

Sample Spectrum



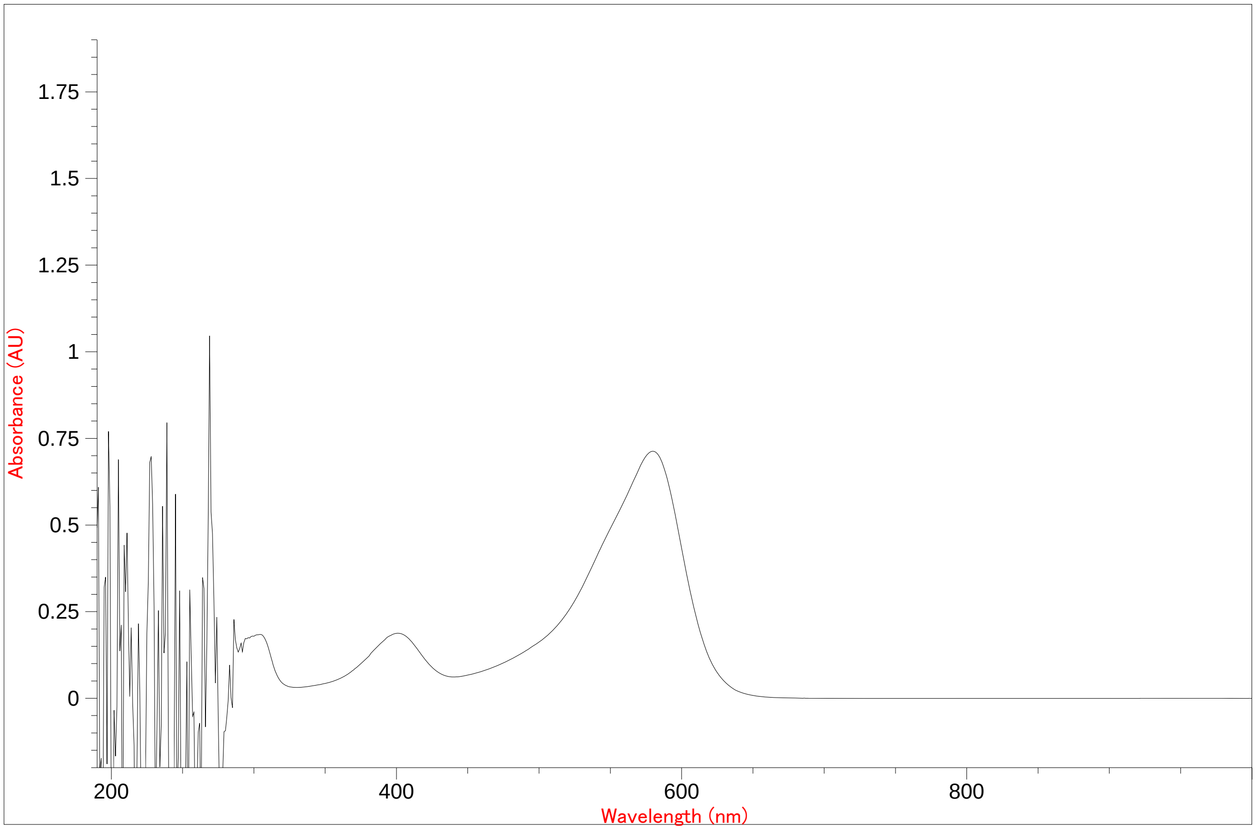
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.40910	ug/mL	0.00743

Sample 12

Sample Name	Snowball II 2161 #SSI (#11)
Operator	Scott Wilson
Date	10/1/18
Time	15:49:53
Path Length	1
Path Length Unit	cm

Sample Spectrum



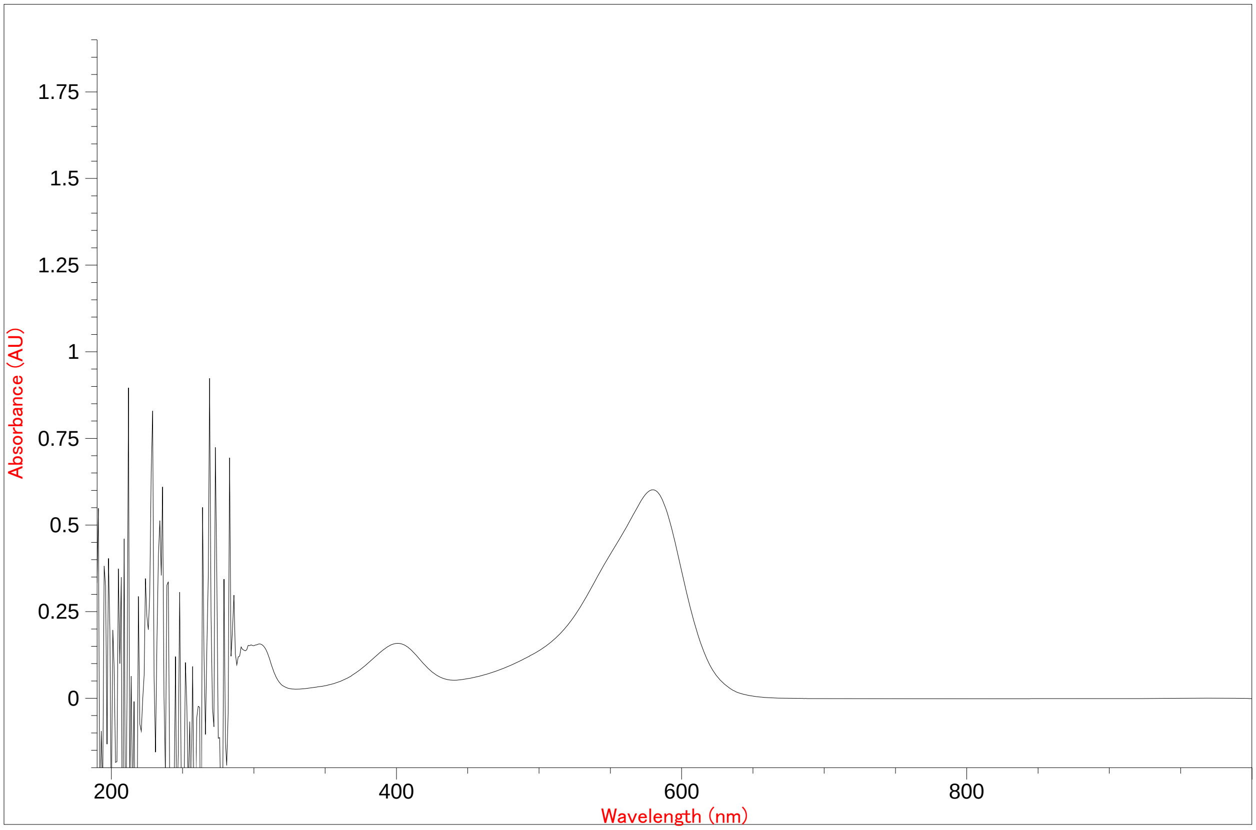
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.42250	ug/mL	0.00744

Sample 14

Sample Name	Snowball II 2161 #SSJ (#13)
Operator	Scott Wilson
Date	10/1/18
Time	15:58:16
Path Length	1
Path Length Unit	cm

Sample Spectrum



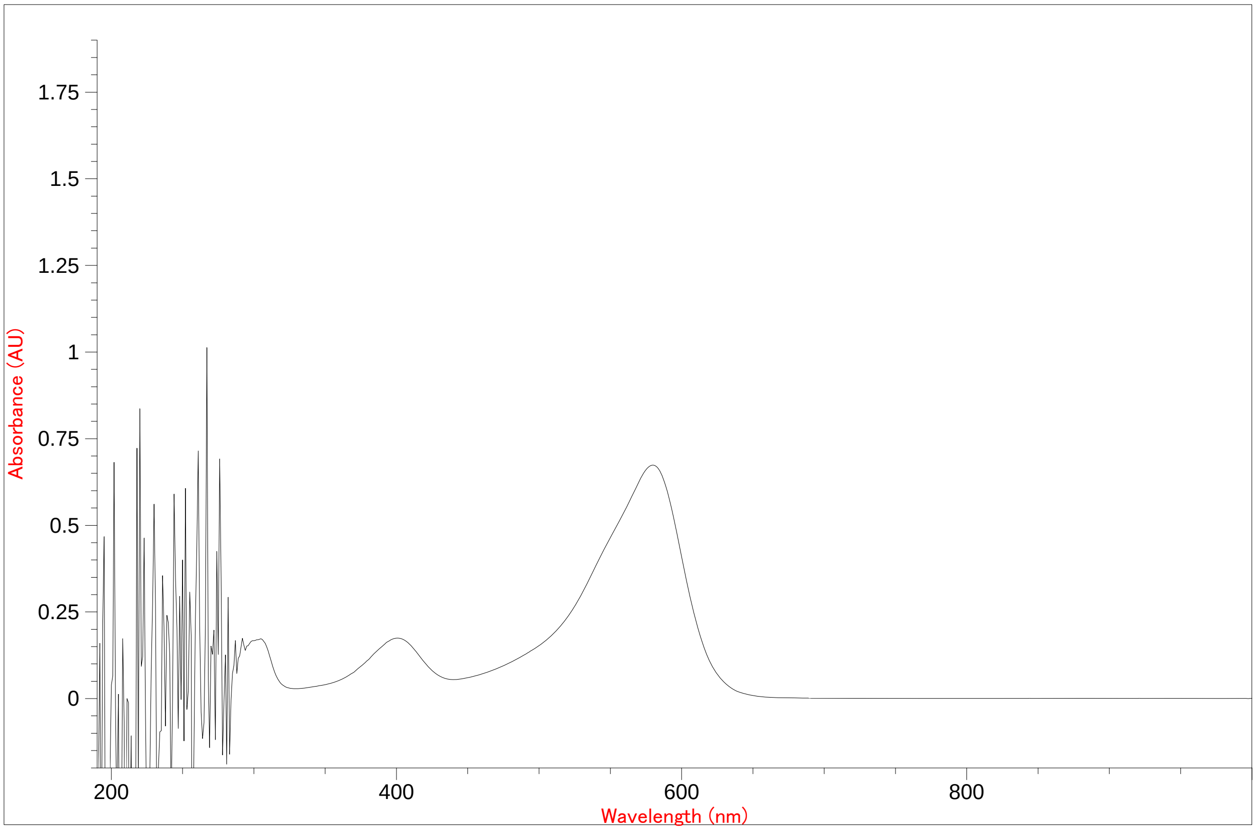
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.20216	ug/mL	0.00733

Sample 1

Sample Name	Snowball II 2167 #SS1 (#8)
Operator	Scott Wilson
Date	10/3/18
Time	9:37:00
Path Length	1
Path Length Unit	cm

Sample Spectrum



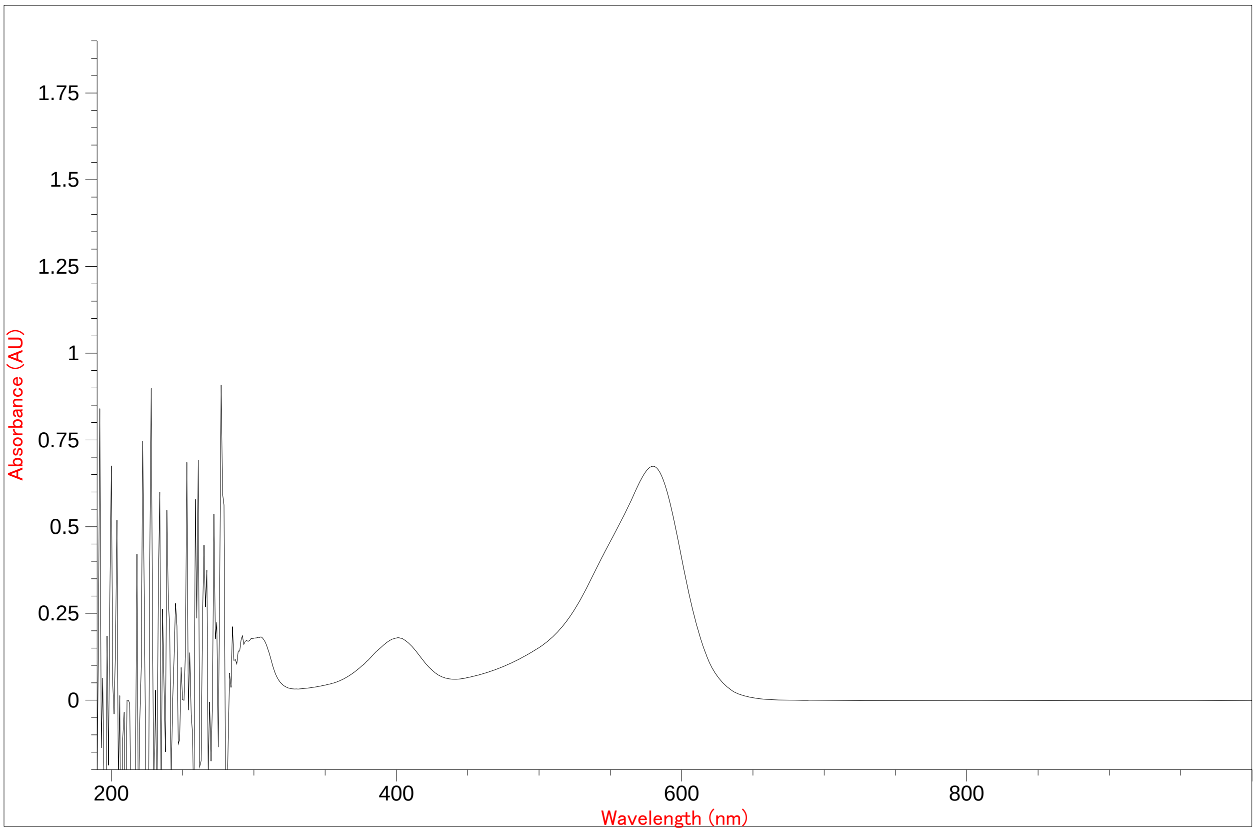
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37918	ug/mL	0.01065

Sample 2

Sample Name	Snowball II 2167 #SS2 (#9)
Operator	Scott Wilson
Date	10/3/18
Time	9:37:14
Path Length	1
Path Length Unit	cm

Sample Spectrum



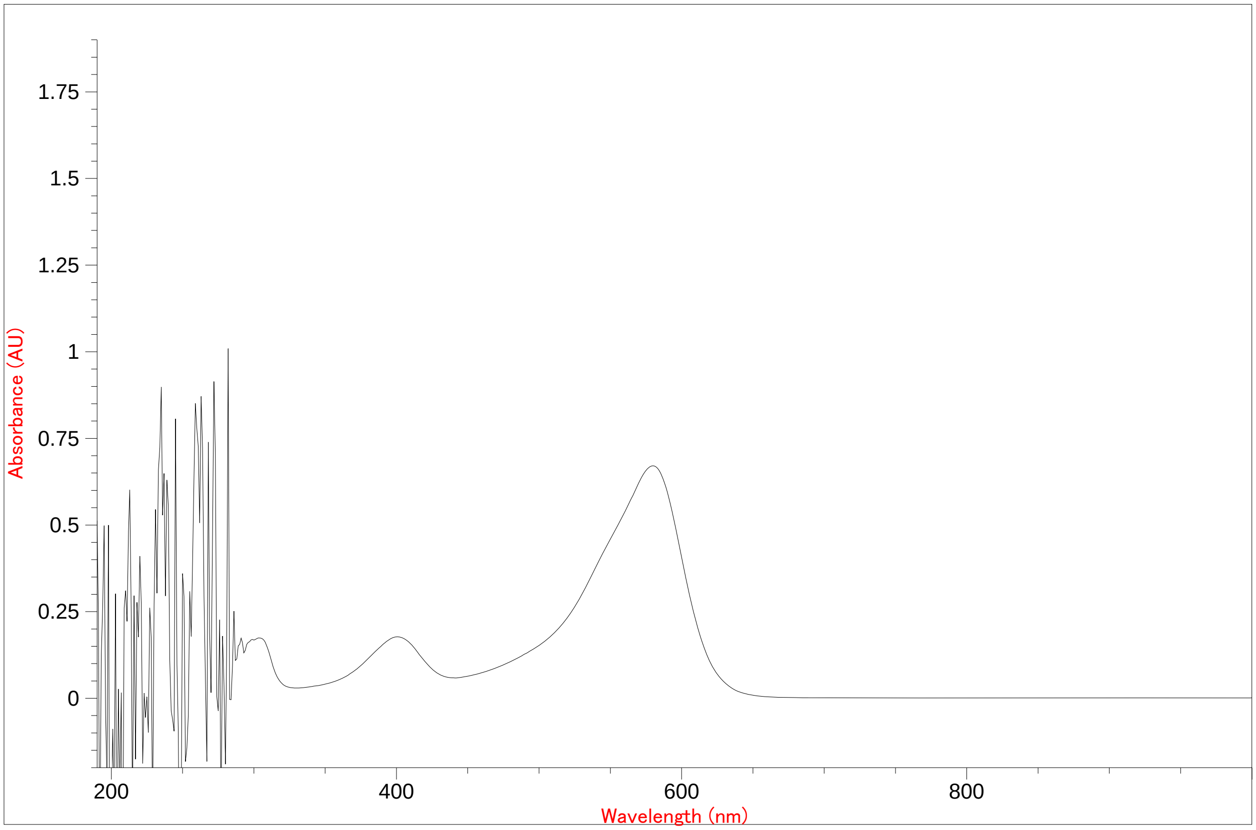
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37517	ug/mL	0.01065

Sample 4

Sample Name	Snowball II 2167 #SSA (#2)
Operator	Scott Wilson
Date	10/3/18
Time	9:54:54
Path Length	1
Path Length Unit	cm

Sample Spectrum



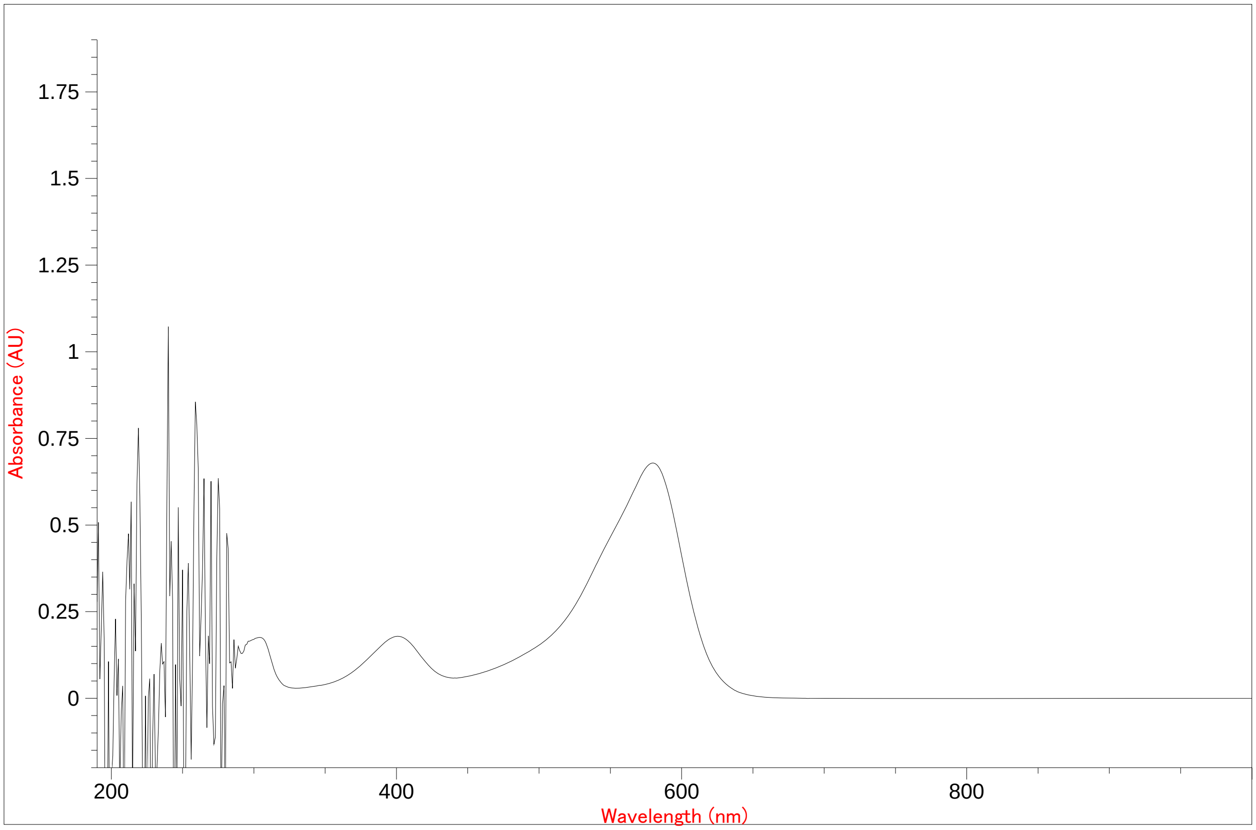
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37142	ug/mL	0.01065

Sample 13

Sample Name	Snowball II 2167 #SSB (#11)
Operator	Scott Wilson
Date	10/3/18
Time	9:58:12
Path Length	1
Path Length Unit	cm

Sample Spectrum



Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.38831	ug/mL	0.01066

Results Summary

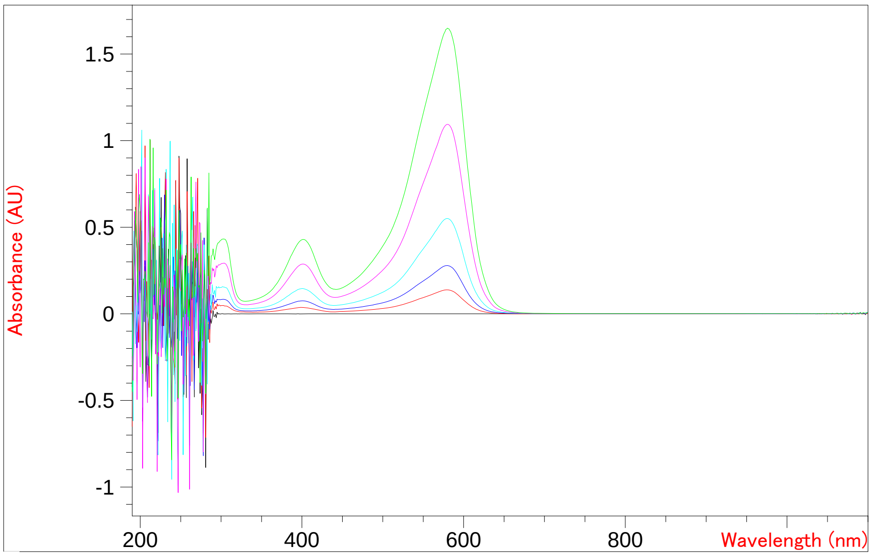
Sample Name	Data Value	Result Value	Unit	Std.Dev.
Snowball II 2161 #SS1 (#8)	0.63259	1.36053	ug/mL	0.00741
Snowball II 2161 #SS2 (#9)	0.63476	1.36519	ug/mL	0.00741
Snowball II 2161 #MB1 (#10)	0.00067	0.00145	ug/mL	0.00704
Snowball II 2161 #SSH (#2)	0.65517	1.40910	ug/mL	0.00743
Snowball II 2161 #MB6 (#3)	-0.00114	-0.00245	ug/mL	0.00704
1018-002.R1*2.M316 (#4)	0.27300	0.58716	ug/mL	0.00711
1018-002.LD/R1*2.M316 (#5)	0.27296	0.58707	ug/mL	0.00711
1018-002.MS/R1*2.M316 (#7)	0.61841	1.33004	ug/mL	0.00739
1018-002.R2*2.M316 (#8)	0.29731	0.63943	ug/mL	0.00712
1018-002.R3*2.M316 (#9)	0.31531	0.67814	ug/mL	0.00713
1018-002.FTB.M316 (#10)	0.00006	0.00014	ug/mL	0.00704
Snowball II 2161 #SSI (#11)	0.66140	1.42250	ug/mL	0.00744
1018-002.AD/R1*3.M316 (#12)	0.18928	0.40709	ug/mL	0.00707
Snowball II 2161 #SSJ (#13)	0.55895	1.20216	ug/mL	0.00733

*** End Results Report ***

*** Calibration Report ***

Number of Standards 6

Standard Spectra



#	Standard	Path Length	Unit	Date	Time
1	Snowball II 2161	1.000	cm	10/1/18	10:43:24
2	Snowball II 2161	1.000	cm	10/1/18	10:44:00
3	Snowball II 2161	1.000	cm	10/1/18	10:44:19
4	Snowball II 2161	1.000	cm	10/1/18	10:44:35
5	Snowball II 2161	1.000	cm	10/1/18	10:44:51
6	Snowball II 2161	1.000	cm	10/1/18	10:45:06

Data Analysis:

Spectral Processing:

Absorbance

Use Wavelength(s):

Single (nm): 570

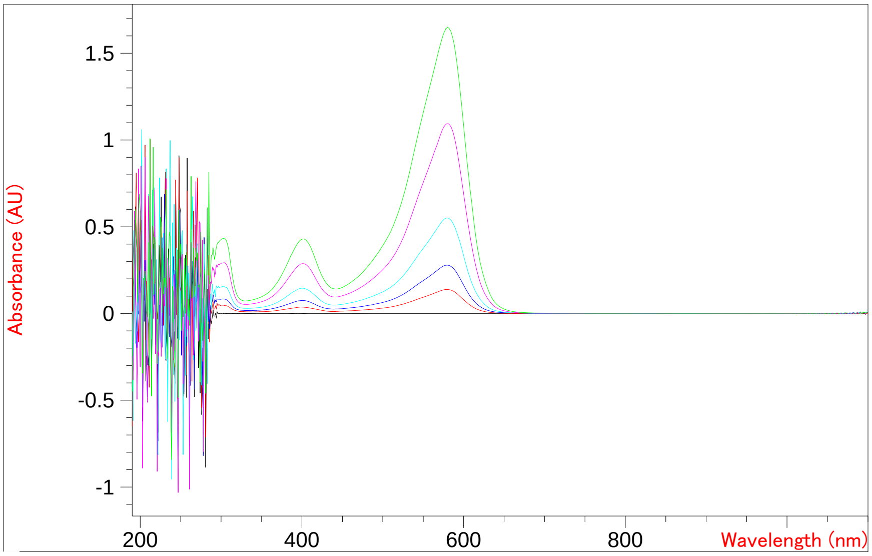
Evaluation: SCA

Calibrated at: Date 10/1/2018 Time 10:49:37 AM
Operator: Scott Wilson

Weighting Method: Least squares
Calibration Curve: C = k1 * A

Analyte Name	Unit
Formaldehyde	ug/mL

Processed Standard Spectra



Coefficients

k#	Value
1	2.15074

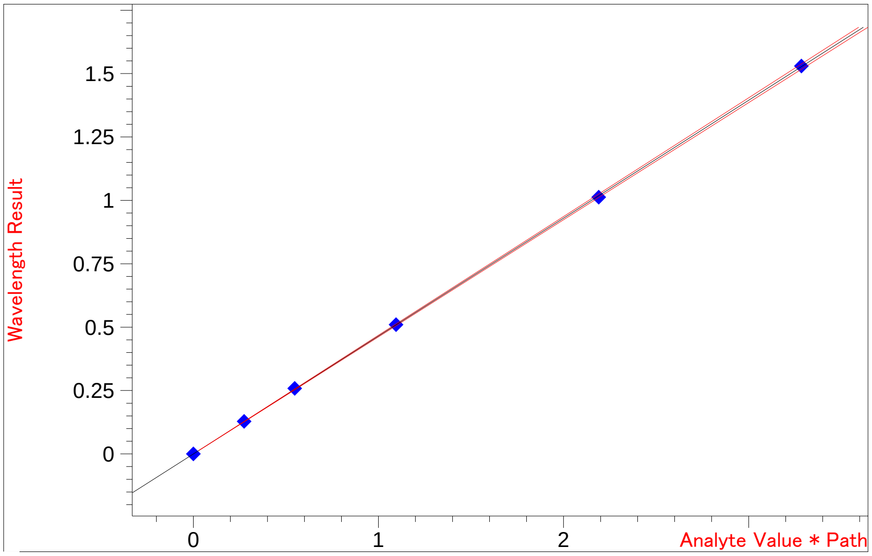
Used Wavelength Results (Absorbance (AU))

#	Value	#	Value	#	Value
1	0.00015	3	0.25841	5	1.01279
2	0.12854	4	0.50996	6	1.52997

Calibration Table of Formaldehyde (ug/mL)

#	Standard Name	Value	Fitted Val.	Error (%)
1	Snowball II 2161	0.00000	0.00031	-100.0
2	Snowball II 2161	0.27380	0.27645	-1.0
3	Snowball II 2161	0.54750	0.55577	-1.5
4	Snowball II 2161	1.09500	1.09678	-0.2
5	Snowball II 2161	2.19000	2.17825	0.5
6	Snowball II 2161	3.28500	3.29056	-0.2

Calibration Curve (Data Analysis)



SCA Summary

Analyte Name	Formaldehyde
Number of Standards	6
Calculation Method	LSQ
Calibration Curve	C = k1 * A
Coefficient k1	2.15070 ug/mL
Std.Dev. of k1	3.6536E-3 ug/mL
Std.Dev. of Calibration	7.0372E-3 ug/mL
Correl. Coeff. (R^2)	0.99999
Uncertainty	0.70 %

*** End Calibration Report ***

Results Summary

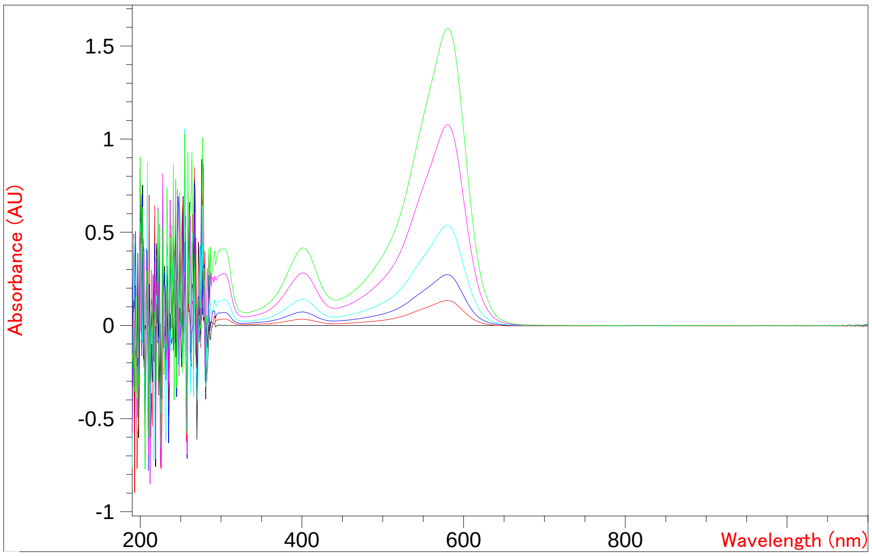
Sample Name	Data Value	Result Value	Unit	Std.Dev.
Snowball II 2167 #SS1 (#8)	0.62550	1.37918	ug/mL	0.01065
Snowball II 2167 #SS2 (#9)	0.62368	1.37517	ug/mL	0.01065
Snowball II 2167 #MB1 (#10)	-0.00028	-0.00062	ug/mL	0.01011
Snowball II 2167 #SSA (#2)	0.62198	1.37142	ug/mL	0.01065
Snowball II 2167 #MB2 (#3)	-0.00035	-0.00078	ug/mL	0.01011
1018-002.R1 104.M316 (#4)	0.46928	1.03474	ug/mL	0.01042
1018-002.LD/R1 104.M316 (#5)	0.46969	1.03564	ug/mL	0.01042
1018-002.AD/R1 104.M316 (#6)	0.23562	0.51952	ug/mL	0.01018
1018-002.MS/R1 104.M316 (#7)	0.85914	1.89433	ug/mL	0.01111
1018-002.R2 104.M316 (#8)	0.47593	1.04938	ug/mL	0.01042
1018-002.R3 104.M316 (#9)	0.51239	1.12978	ug/mL	0.01047
1018-002.FTB 104.M316 (#10)	-0.00052	-0.00115	ug/mL	0.01011
Snowball II 2167 #SSB (#11)	0.62964	1.38831	ug/mL	0.01066

*** End Results Report ***

*** Calibration Report ***

Number of Standards   6

Standard Spectra



#	Standard	Path Length	Unit	Date	Time
1	Snowball II 2167	1.000	cm	10/3/18	9:35:25
2	Snowball II 2167	1.000	cm	10/3/18	9:35:39
3	Snowball II 2167	1.000	cm	10/3/18	9:35:59
4	Snowball II 2167	1.000	cm	10/3/18	9:36:13
5	Snowball II 2167	1.000	cm	10/3/18	9:36:30
6	Snowball II 2167	1.000	cm	10/3/18	9:36:44

Data Analysis:

Spectral Processing:

Absorbance

Use Wavelength(s):

Single (nm):   570

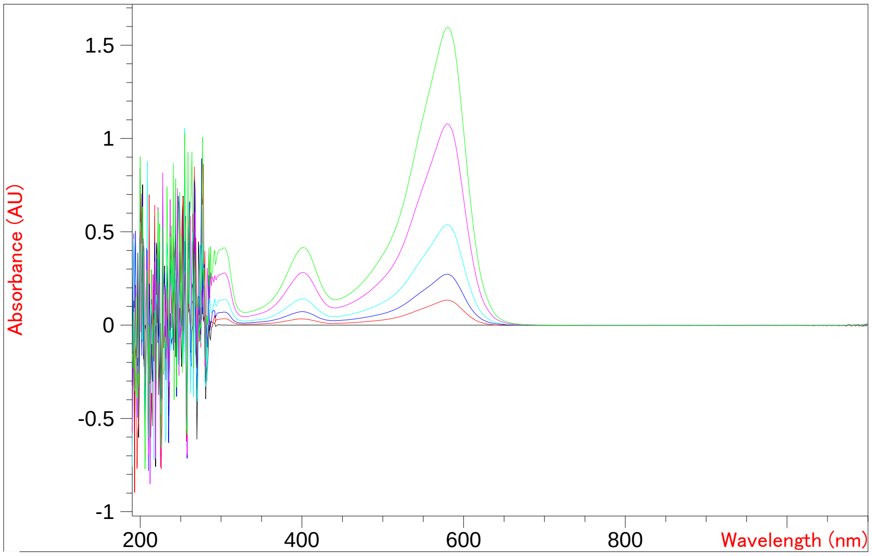
Evaluation: SCA

Calibrated at: Date 10/3/2018 Time 9:38:14 AM
Operator: Scott Wilson

Weighting Method: Least squares
Calibration Curve: C = k1 * A

Analyte Name	Unit
Formaldehyde	ug/mL

Processed Standard Spectra



Coefficients

k#	Value
1	2.20492

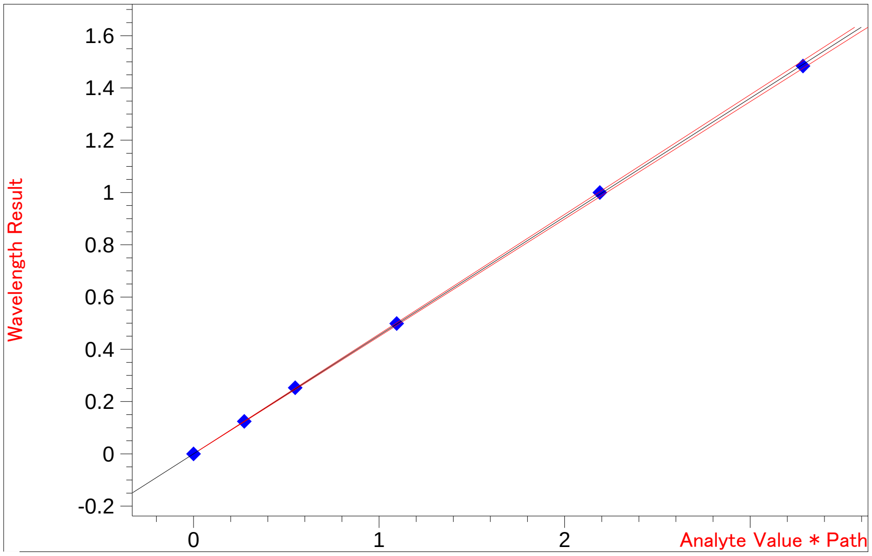
Used Wavelength Results (Absorbance (AU))

#	Value	#	Value	#	Value
1	-0.00016	3	0.25278	5	1.00001
2	0.12394	4	0.49852	6	1.48390

Calibration Table of Formaldehyde (ug/mL)

#	Standard Name	Value	Fitted Val.	Error (%)
1	Snowball II 2167	0.00000	-0.00036	-100.0
2	Snowball II 2167	0.27380	0.27328	0.2
3	Snowball II 2167	0.54750	0.55736	-1.8
4	Snowball II 2167	1.09500	1.09920	-0.4
5	Snowball II 2167	2.19000	2.20494	-0.7
6	Snowball II 2167	3.28500	3.27188	0.4

Calibration Curve (Data Analysis)



SCA Summary

Analyte Name	Formaldehyde
Number of Standards	6
Calculation Method	LSQ
Calibration Curve	C = k1 * A
Coefficient k1	2.20490 ug/mL
Std.Dev. of k1	5.3789E-3 ug/mL
Std.Dev. of Calibration	1.0106E-2 ug/mL
Correl. Coeff. (R^2)	0.99997
Uncertainty	1.01 %

*** End Calibration Report ***

This Is The Last Page Of This Report.

Sorbent Trap Analysis Report

Project Number:	2015501	Plant:	Bison Engineering	Date:	10/1/2018
		Contact:	Kelly Dorsi	Analyst(s):	Patrick Cook
		Phone:	406 442 57 68	Method:	EPA 7473
Turn-around:	Standard	Email:	kdorsi@bison-eng.com	Method Uncertainty:	± 10%

Trap ID	AGS Mass (ng)	Section 1 Mass (ng)	Section 2 Mass (ng)	Total Mass (ng)[1]	Section 3 Mass (ng)	Spike Level (ng)	Breakthrough (%)[2]	Spike Recovery (%)[3]	Source	Notes
OL498459		8.1	0.8	**8.9**			9.57%		Stack Run 1	
OL462285		12.1	0.6	**12.7**		5	5.28%		Stack Run 1	
OL498470		6.9	0.5	**7.4**			6.91%		Stack Run 2	
OLC047431		11.8	0.6	**12.4**		5	4.82%		Stack Run 2	
OL498430		4.8	0.8	**5.6**			16.28%		Stack Run 3	
OL462275		9.9	0.4	**10.3**		5	3.55%		Stack Run 3	
OLC055067		7.6	0.9	**8.5**			12.05%		Stack Run 1	
OL486007		12.0	0.4	**12.4**		5	2.95%		Stack Run 1	
OL498465		6.5	0.2	**6.7**			2.67%		Stack Run 2	
OL486081		11.1	0.3	**11.4**		5	2.43%		Stack Run 2	
OL498444		6.9	0.1	**7.0**			0.85%		Stack Run 3	
OL486025		12.0	0.5	**12.5**		5	4.02%		Stack Run 3	

MDL = 0.193 ng	LOQ = 2 ng

Laboratory NELAP Accreditation #E871092

[1] Total Mass = PF+AGS+S1+S2

[2] Breakthrough = S2 / (PF+AGS+S1)

[3] Spike Recovery = S3 / Spike Level

For PS-12B Only

R = Data invalidation qualifier. Refer to notes

OHIO LUMEX™

Bison Engineering

Date: October 1, 2018

Analyst: Patrick Cook	**Temperature (°C):** 680
File Name: 181001_PMC_BisonEngineering	**Flow Rate (L/min):** 1.00
Analyzer: 140	**MDL (ng):** 0.19
Cell type: Medium	**SD:** 2.1

	ID #	PF Mass (ng)	AGS Mass (ng)	Section 1 Mass (ng)	Section 2 Mass (ng)	Section 3 Mass (ng)	Section 4 Mass (ng)	Spike Level (ng)	Source:	Notes:
1	OL498459			8.1	0.8				Stack Run 1	
2	OL462285			12.1	0.6			5	Stack Run 1	
3	OL498470			6.9	0.5				Stack Run 2	
4	OLC047431			11.8	0.6			5	Stack Run 2	
5	OL498430			4.8	0.8				Stack Run 3	
6	OL462275			9.9	0.4			5	Stack Run 3	
7	OLC055067			7.6	0.9				Stack Run 1	
8	OL486007			12.0	0.4			5	Stack Run 1	
9	OL498465			6.5	0.2				Stack Run 2	
10	OL486081			11.1	0.3			5	Stack Run 2	
11	OL498444			6.9	0.1				Stack Run 3	
12	OL486025			12.0	0.5			5	Stack Run 3	
13										
14										
15										
16										
17										
18										
19										
20										

Additional Notes:

Daily Calibration*

Lot # Std.	Std. (ng)	Calculated (ng)
M2-MEB656771 B	2.0	see cal. report
M2-MEB656771 B	5.0	see cal. report
M2-MEB656771 B	10.0	see cal. report
M2-MEB658995 B	50.0	see cal. report
M2-MEB658995 B	100.0	see cal. report
M2-HG657392B	500.0	see cal. report
M2-HG657392B	1000.0	see cal. report

Independent Calibration Verification**

Lot # Std.	Std. (ng)	Calculated (ng)
M2-HG657626	100.0	97.7

Response Factor (Method 30B Only)***

Lot # Std.	Std. (ng)	(area count/mass)
M2-MEB656771 B	1.0	512
RF Pipette ID (if different from cal):		L3

Immediately report any QA/QC failures or anything suspicious to the QA/QC Manager

Continuing Calibration Verifications****

Lot # Std.	Std. (ng)	Calculated (ng)
M2-MEB658995 B	50.0	48.8
M2-MEB658995 B	50.0	48.4
M2-MEB658995 B	100.0	96.4

*Performed daily prior to analysis of sorbent traps, Refer to SOP for Instrument Calibration for acceptance criteria

**Performed immediately after calibration curve is verified, must come within 10% of expected value

***Response factor value must fall between the LOQ and MDL

****Performed between every 10 samples for method 30B and every analytical batch

*****Subject to change, for analyst convenience only

Active Hg Standard Bank*****

Concentration (µg/mL)	Lot #/Bottle ID	Exp. Date
0.1	M2-MEB656771 B	6/22/2019
1	M2-MEB658995 B	7/16/2019
10	M2-HG657392B	7/16/2019
100	M2-MEB662005 B	9/14/2019
1000	J2-HG02140	5/21/2019
0.1	M2-MEB656771 A	7/16/2019
1	M2-MEB658995 A	4/17/2019
10	M2-HG657392 A	8/17/2019
100	M2-MEB662005 A	6/11/2019
1 (Independent)	M2-HG657626	4/12/2019
10 (Independent)	M2-MEB659704	10/6/2018
100 (Independent)	K2-MEB631050	4/17/2019

Pipette Identification

AB

OHIO LUMEX

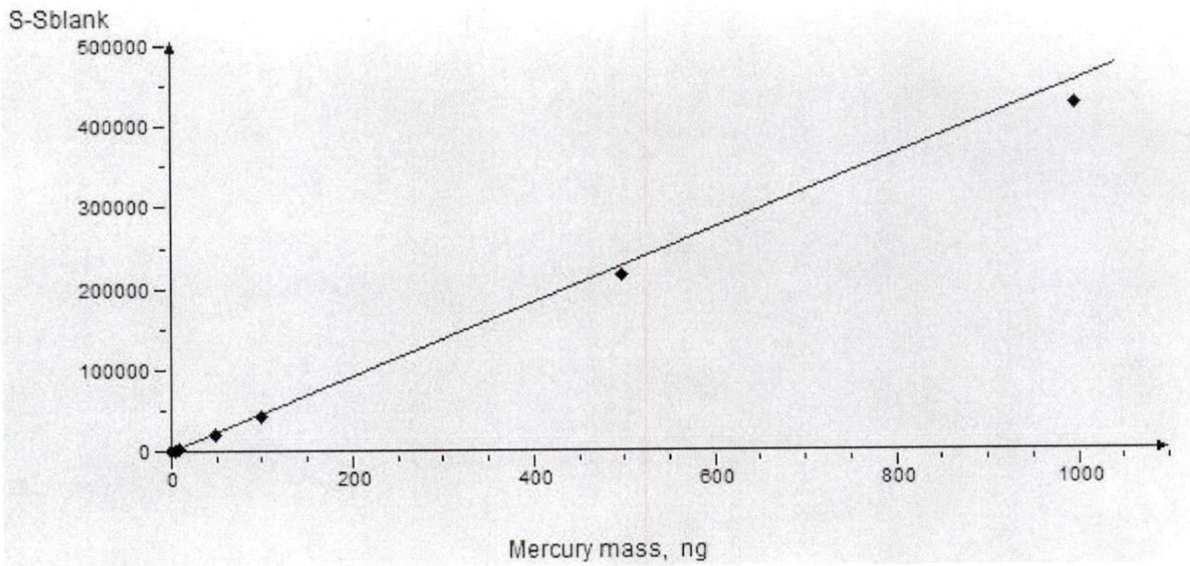
Analyst Signature: Patrick Cook

By signing this report I confirm that the above data are true to the best of my knowledge.

Date: Oct 1, 2018

REPORT

Report created	01.10.2018 12:55:27
Instrument RA915+	Serial number 140
Calibration created	01.10.2018 11:46:02
Calibration name	181001_PMC_2-1000



Results

N	Mercury mass, ng	S-Sblank	Ref.data, ng/g	Calculated, ng/g	d, %
1	1000.00	432000	1000.0	936.2	-6.4
2	500.00	218300	500.0	473.2	-5.4
3	100.00	44470	100.0	96.4	-3.6
4	50.00	22480	50.0	48.7	-2.6
5	10.00	4822	10.0	10.5	4.5
6	2.00	977	2.0	2.1	5.9
7	5.00	2480	5.0	5.4	7.5

Calibration	S - Sblank = a·m
Algorithm	WLSM
Correlation coefficient	0.999986
Residual standard deviation	20.899411

Trap ID

OL498459

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 9-13-18 Spike Time:______

Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU 112

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:

Run START: 9-13-18 (Date) 8:30 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 1

Run END: 9-13-18 (Date) 11:52 (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

9-13-18

Ave Duct Temp (F°): ~~200~~ 190

Estimated Ave Hg Concentration (μg/dscm):______

Ave Trap Temp (F°): ~~258~~ 266

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2,000

STARTUP **SHUTDOWN**

For CEMENT KILNS Only

Total Volume (L) 360.051 or (dscm):______

No. of RAW MILL OFF Events During Sampling:______

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):______

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-13-2018	8:15	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-13-18	11:58	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-01-18	11:53	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL462285

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) [signature]

Production Lot: S-28D2 Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 4/5/2018 Spike Time: 1039 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFW12

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:

Run START: 9-13-18 (Date) 8:30 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 1

Run END: 9-13-18 (Date) 11:52 (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 190

Estimated Ave Hg Concentration (µg/dscm):

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.044 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-13-18	8:15	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-13-18	11:57	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-01-18	11:57	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: April 2021

Trap ID

OL498470

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:________ Spike Time:________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU112

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:

Run START: 9-13-18 (Date) 12:06 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 2

Run END: 9-13-18 (Date) 15:30 (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 200

Estimated Ave Hg Concentration (µg/dscm): <5

Ave Trap Temp (F°): 266

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.010 or (dscm):________

For CEMENT KILNS Only

No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9/13/2018	12:10	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9/13/18	15:32	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-01-18	12:02	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OLC047431

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) ____

Production Lot: S-1F1F Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 6/5/2017 Spike Time: 1258 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU 112

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID: ____

Run START: 9-13-18 (Date) 12:06 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 2

Run END: 9-13-18 (Date) 15:30 (Time)

Sampling Train (circle one): A **B**

POST-Run Leak Check (circle one): PASS FAIL

Notes: ____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 200

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 208

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

For CEMENT KILNS Only

Total Volume (L) 360.06 or (dscm): ____

No. of RAW MILL OFF Events During Sampling: ____

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng): ____

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9/13/18	12:11	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9/13/18	15:33	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-01-18	12:18	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2020

Trap ID

OL498430

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At**:__________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)__________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:__________ Spike Time:__________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU112

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:__________

Run START: 9-13-18 (Date) 15:40 (Time)

Sampling Location: Stack
(stack, FGD inlet, etc.)

Run Number (optional): Run 3

Run END: 9-13-18 (Date) 18:54 (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:__________

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 200

Estimated Ave Hg Concentration (µg/dscm):__________

Ave Trap Temp (F°): 266

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360801 or (dscm):__________

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:__________

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):__________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by				**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by				
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-01-18	12:20	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL462275

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) [signature]

Production Lot: S-28D2 Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 4/5/2018 Spike Time: 1039 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU 112

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID:

Run START: 9-13-18 (Date) 15:40 (Time)

Sampling Location: Stack
(stack, FGD inlet, etc.)

Run Number (optional): Run 3

Run END: 9-13-18 (Date) 18:54 (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 200

Estimated Ave Hg Concentration (μg/dscm):

Ave Trap Temp (F°): 288

Circle Event if Occurred During Sampling: **STARTUP** **SHUTDOWN**

Ave Flow Rate (cc/min): 2000

For CEMENT KILNS Only

Total Volume (L) 360.880 or (dscm):

No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-13-18	15:37	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by				
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-01-18	12:24	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com
Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: April 2021

Trap ID

OLC055067

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)

Production Lot: U-A5F Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: Spike Time: Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPICFU112 Round 2

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID:

Run START: 9-14-18 (Date) 8:05 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 1

Run END: 9-14-18 (Date) 13:10 (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 192

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 266

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 359.966 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-14-18	7:45	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-14-18	13:12	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-01-18	12:28	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: July 2020

Trap ID

OL486007

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) [signature]

Production Lot: S-2A7B Carbon Lot: NC

☐ High Flow ☐ Coil Pre-filter ☐ 240 mm
☐ Static Pre-filter ☐ AGS ☐ 300 mm
☐ Fluffy Pre-filter ☒ 185 mm ☐ 450 mm

Spike Date: 6/4/2018 Spike Time: 1203 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU112 Round 2

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID:

Run START: 9-14-18 (Date) 8:05 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 1

Run END: 9-14-18 (Date) 13:10 (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 192

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 359.985 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-14-18	7:45	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-14-18	13:12	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9-24-18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-1-18	12:32	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com
Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: May 2021

Trap ID

OL498465

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**______

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)______

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:______ Spike Time:______ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAU GPI CFU112 Round 2

PRE-Run Leak Check (circle one): **PASS** **FAIL** (PASS circled)

Boiler ID:______

Run START: 9-14-18 (Date) 13:15 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 2

Run END: 9-14-18 (Date) 16:30 (Time)

Sampling Train (circle one): **A** **B** (A circled)

POST-Run Leak Check (circle one): **PASS** **FAIL** (PASS circled)

Notes:______

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 205

Estimated Ave Hg Concentration (µg/dscm): <5

Ave Trap Temp (F°): 266

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.118 or (dscm):______

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:______

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):______

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-14-18	13:12	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-14-18	16:32	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Pat Cook	10-1-18	12:36	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL486081

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)

Production Lot: S-2A7B Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 6/4/2018 Spike Time: 1203 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU #2 Round 2

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:

Run START: 9-14-18 (Date) 13:15 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 2

Run END: 9-14-18 (Date) 16:30 (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 205

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.138 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-14-18	13:12	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-14-18	16:32	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-1-18	12:39	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: May 2021

Trap ID

OL498444

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**__________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)__________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:__________ Spike Time:__________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAVGP / CFU112 Round 2

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID: __________

Run START: 9-15-18 (Date) 10:00 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 3

Run END: __________ (Date) __________ (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: __________

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):__________

Estimated Ave Hg Concentration (μg/dscm):__________

Ave Trap Temp (F°):__________

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

Ave Flow Rate (cc/min):__________

For CEMENT KILNS Only

Total Volume (L)________ or (dscm):________

No. of RAW MILL OFF Events During Sampling: __________

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):__________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-15-18	9:55	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by				
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-1-18	12:45	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Best Before: June 2021

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Trap ID

OL486025

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

Production Lot: S-2A7B Carbon Lot: NC

Spike Date: 6/4/2018 Spike Time: 1203

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) [signature]

☐High Flow ☐Coil Pre-filter ☐240 mm
☒Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU 112 Round 2

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:

Run START: 9-15-18 (Date) 10:00 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 3

Run END: (Date) (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):

Estimated Ave Hg Concentration (μg/dscm):

Ave Trap Temp (F°):

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

Ave Flow Rate (cc/min):

Total Volume (L) or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-15-18	9:55	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by				
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	9/24/18	1330	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-1-18	12:48	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: May 2021

OHIO LUMEX™

Analysis Sample Return Form

From:	
Contact Name:	Click here to enter text. Kelly Dorsi
Company/Plant:	Bison Engineering, Inc.
Date:	9/13/18
Email:	kdorsi@bison-eng.com
Phone Number:	406-442-5768

Ship to:
Name: Ohio Lumex Analytical Laboratory
Company: Ohio Lumex Co., Inc.
Address: 30350 Bruce Industrial Pkwy Solon, OH 44139 USA
Phone: 1 440 264 2500

Source Type: ☐ Coal Fired Power ☐ Cement Kiln ☐ Industrial Boiler ☒ Other: __________

Sample Quantity	Sample IDs	Sampling Method / Expected Capture Source Concentration / Notes
1	Click here to enter text. OL462285 spiked@5ng. Run 1 (B) CFU112	30B < 5ng.
1	OL498459 Run 1 (A) CFU112	
1	OLC047431 spiked @ 5ng. Run2 (B) CFU112	
1	OL498470 Run2 (A) CFU112	
1	OL462275 Spiked@5ng. Run3(B) CFU112	
1	OL498450 Run3(A) CFU112	

Analysis Turnaround Time:	Report Type:	Payment Method:
☐ Same Day Rush ☐ Next Day Rush ☐ Two Day Rush ☐ *Expedited Compliance (1-2 Business Days) ☐ Standard (3-5 Business Day)	☒ Standard ☐ Extended (additional cost)	☐ Purchase Order PO #: ________ Please provide a hard or electronic copy when available ☐ Credit Card If paying by credit card, please provide a phone number so that we may contact for the cc# Phone Number: ________

Contacts to receive report:	Packaging Instructions:
Kelly Dorsi	Please return traps packaged in their individual plastic tubes with caps on accompanied by their unique chain of custody. Place into a cardboard box or tube with enough packaging material that the traps cannot bounce or bend – similarly to how they were delivered.

Comments: use low Hg. analyzer!

*Long-term compliance contract required

OHIO LUMEX

ANALYSIS SAMPLE RETURN FORM

FROM:	
Contact Name:	Click here to enter text. Kelly Dorsi
Company/Plant:	Bison Engineering, Inc.
Date:	9/14/18 – 9/15/18
Email:	kdorsi@bison-eng.com
Phone Number:	406-442-5768

SHIP TO:
Name: Ohio Lumex Analytical Laboratory
Company: Ohio Lumex Co., Inc.
Address: 30350 Bruce Industrial Pkwy
Solon, OH 44139
Phone: (440) 264-2500

Source Type: ☐ Coal Fired Power ☐ Cement Kiln ☐ Industrial Boiler ☒ Other: ________

Sample Quantity:	Sample IDs	Sampling Method / Expected Capture Source Concentration / Notes:
1	OLC055067 Run1 (A) CFU 112 (2)	30B < 5ng.
1	OL486007 spiked@5ng Run1 (B) CFU 112 (2)	
1	OL498465 Run2 (A) CFU 112 (2)	
1	OL486081 spiked@5ng. Run2 (B) CFU 112 (2)	
1	OL498444 Run3 (A) CFU 112 (2)	
1	OL486025 spiked@5ng. Run3 (B) CFU 112 (2)	

Analysis Turnaround Time:	Report Type:	Payment Method:
☐ Same Day Rush ☐ Next Day Rush ☐ Two Day Rush ☐ *Expedited Compliance (1-2 Business Days) ☒ Standard (3-5 Business Day)	☒ Standard ☐ Extended (additional cost)	☐ Purchase Order PO #: ________ *Please provide a hard or electronic copy when available* ☐ Credit Card *If paying by credit card, please provide a phone number so that we may contact for the cc#* Phone Number: ________

Contacts to receive report:	Packaging Instructions:
Kelly Dorsi	**Packaging Instructions:** Please return traps packaged in their individual plastic tubes with caps on accompanied by their unique chain of custody. Place into a cardboard box or tube with enough packaging material that the traps cannot bounce or bend – similarly to how they were delivered.

Comments: use low Hg analyzer

*Long-term compliance contract required

18C.197

Sorbent Trap Analysis Report

Project Number:	2015634	Plant:	Bison Engineering	Date:	10/8/2018
		Contact:	Kelly Dorsi	Analyst(s):	Joe Simon & Alejandra Ng-Feng
		Phone:	406 442 57 68	Method:	EPA 7473
Turn-around:	Two Day Rush	Email:	kdorsi@bison-eng.com	Method Uncertainty:	± 10%

Trap ID	AGS Mass (ng)	Section 1 Mass (ng)	Section 2 Mass (ng)	Total Mass (ng)[1]	Section 3 Mass (ng)	Spike Level (ng)	Breakthrough (%)[2]	Spike Recovery (%)[3]	Source	Notes
OL498480		2158*	1.2	**1.2**			N/A		CFU113 Stack Run 1	*Out of range; flooded cell
OL492744		11660	5.7	**11670**		5	0.05%		CFU113 Stack Run 1	
OL498434		8568	8.7	**8577**			0.10%		CFU113 Stack Run 1	
OL470820		8138	4.6	**8143**		5	0.06%		CFU113 Stack Run 1	
OL498496		11820	2.5	**11820**			0.02%		CFU113 Stack Run 2	
OL470836		11780	0.4	**11780**		5	0.00%		CFU113 Stack Run 2	
OL498427		6937	1.4	**6938**			0.02%		CFU113 Stack Run 2	
OL492713		6799	2.3	**6801**		5	0.03%		CFU113 Stack Run 2	
OL498473		13040	2.0	**13040**			0.02%		CFU113 Stack Run 3	
OL492747		12770	0.4	**12770**		5	0.00%		CFU113 Stack Run 3	
OL498451		8293	0.1	**8293**			0.00%		CFU113 Stack Run 3	
OL470860		7578	2.3	**7580**		5	0.03%		CFU113 Stack Run 3	
OL498454		1.9	0.3	**2.2**			16.04%		CFU 104 Stack Run 1	
OL486072		6.7	0.1	**6.8**		5	1.83%		CFU 104 Stack Run 1	
OL498441		1.5	0.3	**1.8**			22.89%		CFU 104 Stack Run 2	
OL486032		6.5	0.1	**6.6**		5	1.22%		CFU 104 Stack Run 2	
OL498467		1.4	0.3	**1.7**			18.09%		CFU 104 Stack Run 3	
OL492723		6.2	0.4	**6.6**		5	6.13%		CFU 104 Stack Run 3	

See bench sheets for MDL and LOQ

Laboratory NELAP Accreditation #E871092

[1] Total Mass = PF+AGS+S1+S2

[2] Breakthrough = S2 / (PF+AGS+S1)

[3] Spike Recovery = S3 / Spike Level
For PS-12B Only

R = Data invalidation qualifier. Refer to notes

Bison Engineering

Date: October 8, 2018

Analyst: Alejandra Ng-Feng
File Name: 181008_ANF_BisonEngineering
Analyzer: 1475
Cell type: Short

Temperature (°C): 635
Flow Rate (L/min): 3.90
MDL (ng): 0.69
SD: 0.7

	ID #	PF Mass (ng)	AGS Mass (ng)	Section 1 Mass (ng)	Section 2 Mass (ng)	Section 3 Mass (ng)	Section 4 Mass (ng)	Spike Level (ng)	Source:	Notes:
1	OL492744			11660	5.7			5	CFU113 Stack Run 1	
2	OL498434			8568	8.7				CFU113 Stack Run 1	
3	OL470820			8138	4.6			5	CFU113 Stack Run 1	
4	OL498496			11820	2.5				CFU113 Stack Run 2	
5	OL470836			11780	0.4			5	CFU113 Stack Run 2	
6	OL498427			6937	1.4				CFU113 Stack Run 2	
7	OL492713			6799	2.3			5	CFU113 Stack Run 2	
8	OL498473			13040	2.0				CFU113 Stack Run 3	
9	OL492747			12770	0.4			5	CFU113 Stack Run 3	
10	OL498451			8293	0.1				CFU113 Stack Run 3	
11	OL470860			7578	2.3			5	CFU113 Stack Run 3	
12										
13										
14										
15										
16										
17										
18										
19										
20										

Additional Notes:

Daily Calibration*		
Lot # Std.	Std. (ng)	Calculated (ng)
M2-MEB658995 B	40.0	*see cal. report*
M2-MEB658995 B	100.0	*see cal. report*
M2-HG657392B	1000.0	*see cal. report*
M2-MEB662005 B	5000.0	*see cal. report*
M2-MEB662005 B	10000.0	*see cal. report*
J2-HG02140	40000.0	*see cal. report*
		see cal. report

Independent Calibration Verification**		
Lot # Std.	Std. (ng)	Calculated (ng)
K2-MEB631050	7000.0	7225

Response Factor (Method 30B Only)***		
Lot # Std.	Std. (ng)	(area count/mass)
M2-MEB658995 B	20.0	14.2
RF Pipette ID (if different from cal):		

Immediately report any QA/QC failures or anything suspicious to the QA/QC Manager

Continuing Calibration Verifications****		
Lot # Std.	Std. (ng)	Calculated (ng)
M2-MEB662005 B	5000.0	5107
M2-MEB662005 B	10000.0	9498
M2-MEB662005 B	5000.0	4663
M2-MEB662005 B	10000.0	9169

*Performed daily prior to analysis of sorbent traps, Refer to SOP for Instrument Calibration for acceptance criteria

**Performed immediately after calibration curve is verified, must come within 10% of expected value

***Response factor value must fall between the LOQ and MDL

****Performed between every 10 samples for method 30B and every analytical batch

*****Subject to change, for analyst convenience only

Active Hg Standard Bank*****		
Concentration (µg/mL)	Lot #/Bottle ID	Exp. Date
0.1	M2-MEB656771 B	6/22/2019
1	M2-MEB658995 B	7/16/2019
10	M2-HG657392B	7/16/2019
100	M2-MEB662005 B	9/14/2019
1000	J2-HG02140	5/21/2019
0.1	M2-MEB656771 A	7/16/2019
1	M2-MEB658995 A	4/17/2019
10	M2-HG657392 A	8/17/2019
100	M2-MEB662005 A	6/11/2019
1 (Independent)	M2-HG657626	4/12/2019
10 (Independent)	M2-MEB659704	10/6/2018
100 (Independent)	K2-MEB631050	4/17/2019

Pipette Identification
AB

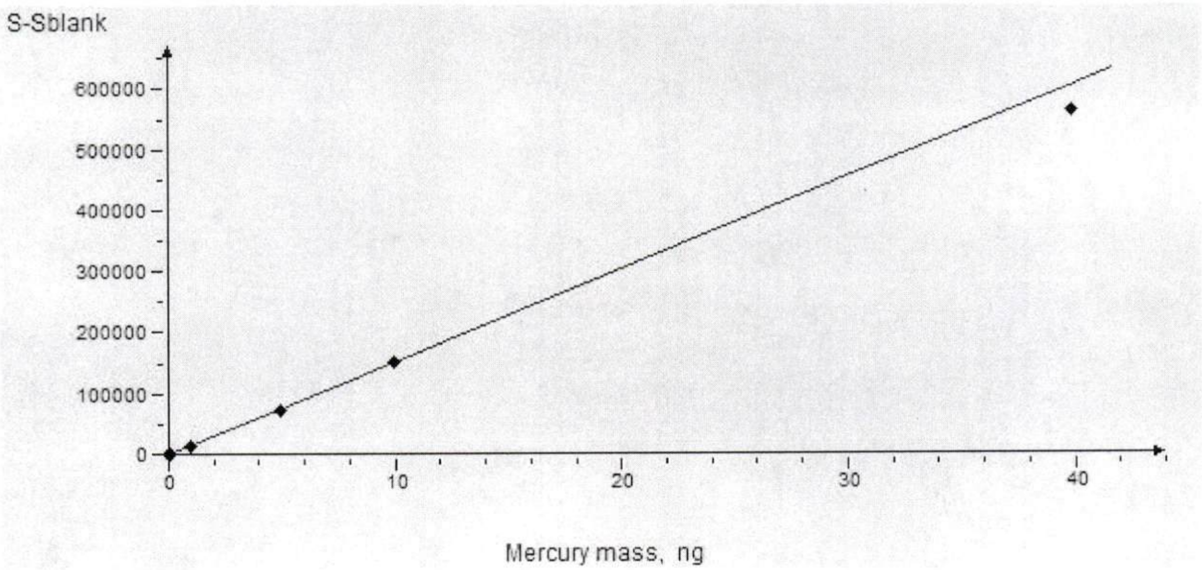
OHIO LUMEX

Analyst Signature: [signature]
By signing this report I confirm that the above data are true to the best of my knowledge.

Date: 10-08-18

REPORT

Report created	08.10.2018 11:08:13
Instrument RA915+	Serial number 1475
Calibration created	08.10.2018 11:08:07
Calibration name	181008_ANF_40-40000ng



Results

N	Mercury mass, ng	S-Sblank	Ref.data, ng/g	Calculated, ng/g	d, %
1	40.00	570200	40000.0	37219.8	-7.0
2	10.00	155900	10000.0	10177.7	1.8
3	5.00	73620	5000.0	4805.8	-3.9
4	1.00	15270	1000.0	996.9	-0.3
5	0.10	1613	100.0	105.3	5.3
6	0.04	638	40.0	41.6	4.1

Calibration	S - Sblank = a·m
Algorithm	WLSM
Correlation coefficient	0.999734
Residual standard deviation	883.121928

Bison Engineering	Date: October 8, 2018
Analyst: Joe Simon	Temperature (°C): 680
File Name: 181008_JWS_BisonEngineering	Flow Rate (L/min): 1.00
Analyzer: 140	MDL (ng): 0.19
Cell type: Medium	SD: 2.7

	ID #	PF Mass (ng)	AGS Mass (ng)	Section 1 Mass (ng)	Section 2 Mass (ng)	Section 3 Mass (ng)	Section 4 Mass (ng)	Spike Level (ng)	Source:	Notes:
1	OL498480			2158*	1.2				CFU113 Stack Run 1	*Out of range; flooded cell
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Additional Notes:	

Daily Calibration*		
Lot # Std.	Std. (ng)	Calculated (ng)
M2-MEB656771 B	2.0	*see cal. report*
M2-MEB656771 B	5.0	*see cal. report*
M2-MEB656771 B	10.0	*see cal. report*
M2-MEB658995 B	100.0	*see cal. report*
M2-HG657392B	500.0	*see cal. report*
M2-HG657392B	1000.0	*see cal. report*
		see cal. report

Independent Calibration Verification**		
Lot # Std.	Std. (ng)	Calculated (ng)
M2-HG657626	50.0	50.9

Response Factor (Method 30B Only)***		
Lot # Std.	Std. (ng)	(area count/mass)
M2-MEB656771 B	1.0	466
RF Pipette ID (if different from cal):		L3

Immediately report any QA/QC failures or anything suspicious to the QA/QC Manager

Continuing Calibration Verifications****		
Lot # Std.	Std. (ng)	Calculated (ng)
OLS003927	400.0	405.1

*Performed daily prior to analysis of sorbent traps, Refer to SOP for Instrument Calibration for acceptance criteria

**Performed immediately after calibration curve is verified, must come within 10% of expected value

***Response factor value must fall between the LOQ and MDL

****Performed between every 10 samples for method 30B and every analytical batch

*****Subject to change, for analyst convenience only

Active Hg Standard Bank*****		
Concentration (µg/mL)	Lot #/Bottle ID	Exp. Date
0.1	M2-MEB656771 B	6/22/2019
1	M2-MEB658995 B	7/16/2019
10	M2-HG657392B	7/16/2019
100	M2-MEB662005 B	9/14/2019
1000	J2-HG02140	5/21/2019
0.1	M2-MEB656771 A	7/16/2019
1	M2-MEB658995 A	4/17/2019
10	M2-HG657392 A	8/17/2019
100	M2-MEB662005 A	6/11/2019
1 (Independent)	M2-HG657626	4/12/2019
10 (Independent)	M2-MEB659704	10/6/2018
100 (Independent)	K2-MEB631050	4/17/2019

Pipette Identification
AB

OHIO LUMEX

Analyst Signature: Joseph Simon

By signing this report I confirm that the above data are true to the best of my knowledge.

Date: 10/8/18

1292

Bison Engineering		Date:	October 8, 2018
Analyst:	Joe Simon	Temperature (°C):	680
File Name:	181008_JWS_BisonEngineering2	Flow Rate (L/min):	1.00
Analyzer:	140	MDL (ng):	0.19
Cell type:	Medium	SD:	2.7

	ID #	PF Mass (ng)	AGS Mass (ng)	Section 1 Mass (ng)	Section 2 Mass (ng)	Section 3 Mass (ng)	Section 4 Mass (ng)	Spike Level (ng)	Source:	Notes:
1	OL498454			1.9	0.3				CFU 104 Stack Run 1	
2	OL486072			6.7	0.1			5	CFU 104 Stack Run 1	
3	OL498441			1.5	0.3				CFU 104 Stack Run 2	
4	OL486032			6.5	0.1			5	CFU 104 Stack Run 2	
5	OL498467			1.4	0.3				CFU 104 Stack Run 3	
6	OL492723			6.2	0.4			5	CFU 104 Stack Run 3	
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Additional Notes:

Daily Calibration*		
Lot # Std.	Std. (ng)	Calculated (ng)
M2-MEB656771 B	2.0	see cal. report
M2-MEB656771 B	5.0	see cal. report
M2-MEB656771 B	10.0	see cal. report
M2-MEB658995 B	100.0	see cal. report
M2-HG657392B	500.0	see cal. report
M2-HG657392B	1000.0	see cal. report
		see cal. report

Independent Calibration Verification**		
Lot # Std.	Std. (ng)	Calculated (ng)
M2-HG657626	50.0	50.9

Response Factor (Method 30B Only)***		
Lot # Std.	Std. (ng)	(area count/mass)
M2-MEB656771 B	1.0	466
RF Pipette ID (if different from cal):		L3

Immediately report any QA/QC failures or anything suspicious to the QA/QC Manager

Continuing Calibration Verifications****		
Lot # Std.	Std. (ng)	Calculated (ng)
OLS003927	400.0	405.1
M2-MEB658995 B	50.0	51.2
M2-MEB658995 B	50.0	49.9

*Performed daily prior to analysis of sorbent traps, Refer to SOP for Instrument Calibration for acceptance criteria

**Performed immediately after calibration curve is verified, must come within 10% of expected value

***Response factor value must fall between the LOQ and MDL

****Performed between every 10 samples for method 30B and every analytical batch

*****Subject to change, for analyst convenience only

Active Hg Standard Bank*****		
Concentration (µg/mL)	Lot #/Bottle ID	Exp. Date
0.1	M2-MEB656771 B	6/22/2019
1	M2-MEB658995 B	7/16/2019
10	M2-HG657392B	7/16/2019
100	M2-MEB662005 B	9/14/2019
1000	J2-HG02140	5/21/2019
0.1	M2-MEB656771 A	7/16/2019
1	M2-MEB658995 A	4/17/2019
10	M2-HG657392 A	8/17/2019
100	M2-MEB662005 A	6/11/2019
1 (Independent)	M2-HG657626	4/12/2019
10 (Independent)	M2-MEB659704	10/6/2018
100 (Independent)	K2-MEB631050	4/17/2019

Pipette Identification
AB

OHIO LUMEX

Analyst Signature: Joseph Simon

By signing this report I confirm that the above data are true to the best of my knowledge.

Date: 10/8/18

1293

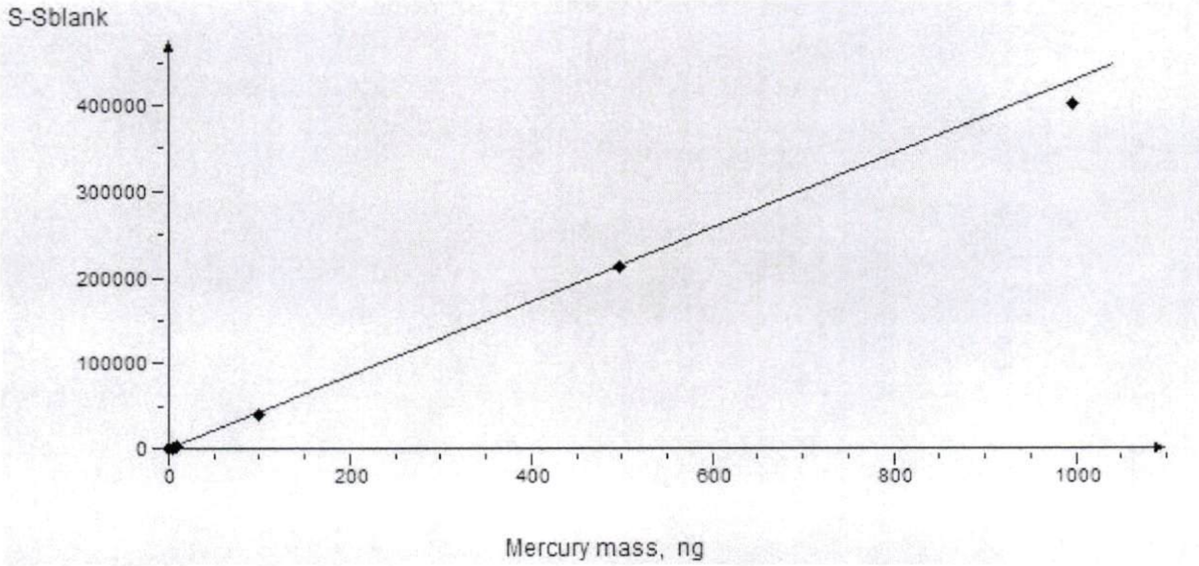
REPORT

Report created 08.10.2018 13:11:40

Instrument RA915+ Serial number 140

Calibration created 08.10.2018 13:11:00

Calibration name 181008_JWS_2-1000



Results

N	Mercury mass, ng	S-Sblank	Ref.data, ng/g	Calculated, ng/g	d, %
1	5.00	2346	5.0	5.4	8.1
2	2.00	932	2.0	2.1	7.3
3	1000.00	406700	1000.0	936.7	-6.3
4	500.00	214500	500.0	494.2	-1.2
5	100.00	41930	100.0	96.6	-3.4
6	10.00	4148	10.0	9.6	-4.5

Calibration S - Sblank = a·m

Algorithm WLSM

Correlation coefficient 0.999717

Residual standard deviation 20.126163

Trap ID

OL498480

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:________ Spike Time:________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU3	PRE-Run Leak Check (circle one):		PASS	FAIL
Boiler ID:	Run START:	9-21-18 (Date)	8:15 (Time)	
Sampling Location: Stack (stack, FGD inlet, etc.)				
Run Number (optional): Run 1	Run END:	9-21-18 (Date)	13:00 (Time)	
Sampling Train (circle one): A B	POST-Run Leak Check (circle one):		PASS	FAIL
Notes:				

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 130	Estimated Ave Hg Concentration (µg/dscm): <5
Ave Trap Temp (F°): 266	Circle Event if Occurred During Sampling:
Ave Flow Rate (cc/min): 2000	STARTUP SHUTDOWN
Total Volume (L) 360.310 or (dscm):____	For CEMENT KILNS Only No. of RAW MILL OFF Events During Sampling:____

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-21-18	8:10	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-21-18	13:05	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1135	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S[signature]	10/8/18	13:45	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL492744

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) Anna Batyreva

Production Lot: S-2C92 Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 8/20/2018 Spike Time: 1059 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GP1 CFW13

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID:

Run START: 9-21-18 (Date) 8:15 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 1

Run END: ~~8~~ 9-21-18 (Date) 13:00 (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 130

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.324 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-21-18	8:10	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-21-18	13:05	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1130	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10.05.18	1542	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: August 2021

Trap ID

OL498434

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**__________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)__________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:__________ Spike Time:__________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GP1 CFG13 Round 2

PRE-Run Leak Check (circle one): PASS FAIL (PASS circled)

Boiler ID:__________

Run START: 9-24-18 (Date) 9:20 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 1

Run END: 9-24-18 (Date) 12:35 (Time)

Sampling Train (circle one): A B (A circled)

POST-Run Leak Check (circle one): PASS FAIL (PASS circled)

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 133

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 266

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 359.879 or (dscm):__________

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:__________

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):__________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-24-18	9:16	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-24-18	12:37	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1130	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-08-18	1545	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL470820

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) Anna Batyreva

Production Lot: S-2C92 Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 8/20/2018 Spike Time: 1059 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU 113 Round 2

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:

Run START: 9/24/2018 (Date) 9:20 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 1

Run END: 9-24-18 (Date) 12:35 (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 133

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 359.883 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-24-18	9:16	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-24-18	12:37	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1130	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10.08.18	1548	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com
Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: August 2021

Trap ID

OL498496

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**__________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)__________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:__________ Spike Time:__________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAVGPICFU113

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID:

Run START: 9-21-18 (Date) 13:07 (Time)

Sampling Location: Stack
(stack, FGD inlet, etc.)

Run Number (optional): Run 2

Run END: 9-21-18 (Date) 16:22 (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 138

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 266

Circle Event if Occurred During Sampling: **STARTUP** **SHUTDOWN**

Ave Flow Rate (cc/min): 2000

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

Total Volume (L) 360.216 or (dscm):

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):__________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-21-18	13:06	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-21-18	16:24	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1135	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-05-18	1558	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL470836

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) Anna Batyreva

Production Lot: S-2C92 Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 8/20/2018 Spike Time: 1059 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAVCFUI13 GPI

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID:

Run START: 9-21-18 (Date) 13:07 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 2

Run END: 9-21-18 (Date) 16:22 (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 138

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.254 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-21-18	13:06	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-21-18	16:24	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1135	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-08-18	1605	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: August 2021

Trap ID

OL498427

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) m

QA/QC Signature (Spiker)________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:________ Spike Time:________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU113 Round 2 PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:________ Run START: 9-24-18 (Date) 12:40 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 2 Run END: 9-24-18 (Date) 15:59 (Time)

Sampling Train (circle one): A B POST-Run Leak Check (circle one): PASS FAIL

Notes:________

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 135 Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 266 Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000 **STARTUP** **SHUTDOWN**

For CEMENT KILNS Only

Total Volume (L) 360.120 or (dscm):________ No. of RAW MILL OFF Events During Sampling:________

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-24-18	12:38	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-24-18	16:00	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1130	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-05-18	1610	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL492713

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) Anna Batyreva

Production Lot: S-2C92 Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 8/20/2018 Spike Time: 1059 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAVGPI CFW13 Round 2 PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID: Run START: 9-24-18 (Date) 12:40 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 2 Run END: 9-24-18 (Date) 15:59 (Time)

Sampling Train (circle one): **A** **B** POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 135 Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 268 Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000 **STARTUP** **SHUTDOWN**

For CEMENT KILNS Only

Total Volume (L) 360.093 or (dscm): No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-24-18	12:38	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-24-18	16:00	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1130	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-08-18	1616	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: August 2021

Trap ID

OL498473

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) m

QA/QC Signature (Spiker)________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:________ Spike Time:________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GP1 CFU113

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID: ________

Run START: 9-21-18 (Date) 16:32 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 3

Run END: 9-21-18 (Date) ________ (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes: ________

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): ________

Estimated Ave Hg Concentration (μg/dscm): ________

Ave Trap Temp (F°): ________

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

Ave Flow Rate (cc/min): ________

For CEMENT KILNS Only

No. of RAW MILL OFF Events During Sampling: ________

Total Volume (L)________ or (dscm): ________

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng): ________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-21-18	16:32	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by				(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1130	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10.08.18	1626	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL492747

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) Anna Botyleva

Production Lot: S-2C92 Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 8/20/2018 Spike Time: 1059 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU113

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID:

Run START: 9-21-18 (Date) 16:32 (Time)

Sampling Location: Stack
(stack, FGD inlet, etc.)

Run Number (optional): Run 3

Run END: 9-21-18 (Date) (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):

Estimated Ave Hg Concentration (µg/dscm):

Ave Trap Temp (F°):

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

Ave Flow Rate (cc/min): 2000

For CEMENT KILNS Only

Total Volume (L) or (dscm):

No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-21-18	16:30	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by				(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1130	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10·08·18	1630	Seal intact as received Yes ☐ No ☐

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Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com
Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: August 2021

Trap ID

OL498451

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:________ Spike Time:________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU113 Round 2

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID: ________

Run START: 9-24-18 (Date) 16:10 (Time)

Sampling Location: Stack
(stack, FGD inlet, etc.)

Run Number (optional): Run 3

Run END: 9-24-18 (Date) 19:25 (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: ________

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 136

Estimated Ave Hg Concentration (µg/dscm): <5

Ave Trap Temp (F°): 266

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

For CEMENT KILNS Only

Total Volume (L) 360.480 or (dscm):________

No. of RAW MILL OFF Events During Sampling: ________

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-24-18	16:09	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-24-18	19:27	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1130	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10-05-18	1642	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com
Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL470860

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

Production Lot: S-2C92 Carbon Lot: NC

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) Anna Batyreva

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 8/20/2018 Spike Time: 1059 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU113 Round 2

PRE-Run Leak Check (circle one): **PASS** **FAIL** (PASS circled)

Boiler ID:

Run START: 9-24-18 (Date) 16:10 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run 3

Run END: 9-24-18 (Date) 19:25 (Time)

Sampling Train (circle one): **A** **B** (B circled)

POST-Run Leak Check (circle one): **PASS** **FAIL** (PASS circled)

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 136

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

For CEMENT KILNS Only

Total Volume (L): 360.45 or (dscm):

No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-24-18	16:09	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-24-18	19:27	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1130	Seal intact as received Yes ☐ No ☐
Trap analyzed by	KHym	10-08-18	1645	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: August 2021

Trap ID

OL498454

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker)

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: Spike Time: Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFUID4

PRE-Run Leak Check (circle one): **PASS** **FAIL** (PASS circled)

Boiler ID:

Run START: 9-27-18 (Date) 9:17 (Time)

Sampling Location: Stack (Stack, FGD inlet, etc.)

Run Number (optional): Run 1

Run END: 9-27-18 (Date) 12:39 (Time)

Sampling Train (circle one): **A** **B** (A circled)

POST-Run Leak Check (circle one): **PASS** **FAIL** (PASS circled)

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 212

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 266

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.871 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-27-18	9:15	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-27-18	12:43	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1135	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S[signature]	10/8/18	14:33	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL486072

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) [signature]

Production Lot: S-2A7B Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 6/4/2018 Spike Time: 1203 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU104

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Boiler ID:

Run START: 9-27-18 (Date) 9:17 (Time)

Sampling Location: Stack
(stack, FGD inlet, etc.)

Run Number (optional): Run 1

Run END: 9-27-18 (Date) 12:38 (Time)

Sampling Train (circle one): **A** **B**

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 212

Estimated Ave Hg Concentration (μg/dscm): <5

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.89 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-27-18	9:15	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-27-18	12:43	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/1/18	11:35	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S.	10/8/18	14:39	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: May 2021

Trap ID

OL498441

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) m B

QA/QC Signature (Spiker)________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Static Pre-filter ☐Fluffy Pre-filter ☐Coil Pre-filter ☐AGS ☒185 mm ☐240 mm ☐300 mm ☐450 mm

Spike Date:________ Spike Time:________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: GAV GPI CFU104

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:________

Run START: 9-27-18 (Date) 12:49 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): Run2

Run END: 9-27-18 (Date) 16:05 (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:________

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 232

Estimated Ave Hg Concentration (µg/dscm): <5

Ave Trap Temp (F°): 266

Circle Event if Occurred During Sampling: **STARTUP** **SHUTDOWN**

Ave Flow Rate (cc/min): 2000

For CEMENT KILNS Only

Total Volume (L) 360.303 or (dscm):________

No. of RAW MILL OFF Events During Sampling:________

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-27-18	12:47	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-27-18	16:08	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1135	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S.	10/8/18	14:43	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com
Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL486032

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) [signature]

Production Lot: S-2A7B Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 6/4/2018 Spike Time: 1203 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFU104

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:

Run START: 9-27-18 (Date) 12:49 (Time)

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): 2

Run END: 9-27-18 (Date) 16:05 (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 232

Estimated Ave Hg Concentration (µg/dscm): <5

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.332 or (dscm):

For CEMENT KILNS Only
No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-27-18	12:47	**If Applicable** Place Chain of Custody seal here
Trap removed and sealed by	[signature]	9-27-18	16:08	(See Security Seal Instruction Sheet)
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1135	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10/8/18	14:51	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: May 2021

Trap ID

OL498467

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☒ **Unspiked** ☐ **Spiked At:**__________

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) m [signature]

QA/QC Signature (Spiker)__________

Production Lot: U-BCE Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date:__________ Spike Time:__________ Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFWGH	PRE-Run Leak Check (circle one):		PASS	FAIL
Boiler ID:	Run START:	9-27-18 (Date)	16:15 (Time)	
Sampling Location: Stack (stack, FGD inlet, etc.)				
Run Number (optional): Run 3	Run END:	9-27-18 (Date)	19:25 (Time)	
Sampling Train (circle one): A B	POST-Run Leak Check (circle one):		PASS	FAIL
Notes:				

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 233	Estimated Ave Hg Concentration (μg/dscm): <5
Ave Trap Temp (F°): 266	Circle Event if Occurred During Sampling:
Ave Flow Rate (cc/min): 2000	**STARTUP** **SHUTDOWN**
Total Volume (L) 360.405 or (dscm):____	For CEMENT KILNS Only No. of RAW MILL OFF Events During Sampling:____

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):__________

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-27-18	16:10	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-27-18	19:29	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1135	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	10/8/18	14:58	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com
Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: June 2021

Trap ID

OL492723

OHIO LUMEX

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) Anna Batyreva

Production Lot: S-2C92 Carbon Lot: NC

☐High Flow ☐Coil Pre-filter ☐240 mm
☐Static Pre-filter ☐AGS ☐300 mm
☐Fluffy Pre-filter ☒185 mm ☐450 mm

Spike Date: 8/20/2018 Spike Time: 1059 Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: HAV GPI CFW04

PRE-Run Leak Check (circle one): PASS FAIL

Boiler ID:

Run START: 9-27-18 (Date) 16:15 (Time)

Sampling Location: (stack, FGD inlet, etc.)

Run Number (optional): Run 3

Run END: 9-27-18 (Date) 19:25 (Time)

Sampling Train (circle one): A B

POST-Run Leak Check (circle one): PASS FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 233

Estimated Ave Hg Concentration (μg/dscm):

Ave Trap Temp (F°): 268

Circle Event if Occurred During Sampling:

Ave Flow Rate (cc/min): 2000

STARTUP **SHUTDOWN**

Total Volume (L) 360.457 or (dscm):

For CEMENT KILNS Only

No. of RAW MILL OFF Events During Sampling:

REQUIRED IF RETURNING TO OHIO LUMEX FOR ANALYSIS

Estimated Hg Mass in Section 1 of Sorbent Trap (ng):

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	9-27-18	16:10	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	9-27-18	19:29	
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	10/4/18	1135	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S[signature]	10/8/18	15:02	Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: August 2021

OHIO LUMEX

ANALYSIS SAMPLE RETURN FORM

FROM:	
Contact Name:	Kelly Dorsi
Company/Plant:	Bison Engineering, Inc.
Date:	9/24/18
Email:	kdorsi@bison-eng.com
Phone Number:	406-442-5768

SHIP TO:
Name: Ohio Lumex Analytical Laboratory
Company: Ohio Lumex Co., Inc.
Address: 30350 Bruce Industrial Pkwy
Solon, OH 44139
Phone: (440) 264-2500

Source Type: ☐ Coal Fired Power ☐ Cement Kiln ☐ Industrial Boiler ☒ Other: ________

Sample Quantity:	Sample IDs	Sampling Method / Expected Capture Source Concentration / Notes:
1	OL498434 (A) CFU113(2) Run 1	30B < 5ng.
1	OL470820 (B) CFU 113(2) Run 1 spiked @ 5 ng.	↓
1	OL498427 (A) CFU 113 (2) Run 2	
1	OL492713 (B) CFU 113 (2) Run 2 spiked @ 5 ng.	
1	OL498451 (A) CFU113 (2) Run 3	
1	OL470860 (B) CFU 113 (2) Run 3 spiked @ 5 ng.	

Analysis Turnaround Time:	Report Type:	Payment Method:
☐ Same Day Rush ☐ Next Day Rush ☐ Two Day Rush ☐ *Expedited Compliance (1-2 Business Days) ☐ Standard (3-5 Business Day)	☒ Standard ☐ Extended (additional cost)	☐ Purchase Order PO #: ________ *Please provide a hard or electronic copy when available* ☐ Credit Card *If paying by credit card, please provide a phone number so that we may contact for the cc#* Phone Number: ________

Contacts to receive report:

Packaging Instructions: Please return traps packaged in their individual plastic tubes with caps on accompanied by their unique chain of custody. Place into a cardboard box or tube with enough packaging material that the traps cannot bounce or bend – similarly to how they were delivered.

Comments: ~~use low Hg analyzer~~

High level

10/8/2018

*Long-term compliance contract required

www.ohiolumex.com

Toll Free: 888-876-2611
Fax: (440)264-2501 1313

180,197

OHIO LUMEX

ANALYSIS SAMPLE RETURN FORM

FROM:	
Contact Name:	Click here to enter text. Kelly Dorsi
Company/Plant:	Bison Engineering, Inc.
Date:	9/21/18
Email:	Kdorsi@bison-eng.com
Phone Number:	(406) 442-5768

SHIP TO:
Name: Ohio Lumex Analytical Laboratory
Company: Ohio Lumex Co., Inc.
Address: 30350 Bruce Industrial Pkwy
Solon, OH 44139
Phone: (440) 264-2500

Source Type: ☐ Coal Fired Power ☐ Cement Kiln ☐ Industrial Boiler ☒ Other: ________________

Sample Quantity:	Sample IDs	Sampling Method / Expected Capture Source Concentration / Notes:
1	OL498480 (A) CFU113 Run1	30B <5ng.
1	OL492744 (B) CFU113 Run1 spiked@ 5ng.	
1	OL498496 (A) CFU113 Run2	
1	OL470836 (B) CFU113 Run2 spiked@5ng.	
1	OL498473(A) CFU113 Run3	
1	OL492747(B) CFU113 Run3 spiked@ 5ng.	

Analysis Turnaround Time:	Report Type:	Payment Method:
☐ Same Day Rush ☐ Next Day Rush ☐ Two Day Rush ☒ *Expedited Compliance (1-2 Business Days) ☒ Standard (3-5 Business Day)	☒ Standard ☐ Extended (additional cost)	☐ Purchase Order PO #: ________ *Please provide a hard or electronic copy when available* ☐ Credit Card *If paying by credit card, please provide a phone number so that we may contact for the cc#* Phone Number: ________________

Contacts to receive report: Kelly Dorsi

Packaging Instructions: Please return traps packaged in their individual plastic tubes with caps on accompanied by their unique chain of custody. Place into a cardboard box or tube with enough packaging material that the traps cannot bounce or bend – similarly to how they were delivered.

Comments: ~~use low Hg analyzer~~

High level any

*Long-term compliance contract required

10/8/2018

18C.197

OHIO LUMEX

ANALYSIS SAMPLE RETURN FORM

FROM:	
Contact Name:	Click here to enter text. Kelly Dorsi
Company/Plant:	Bison Engineering, Inc.
Date:	9/27/18
Email:	kdorsi@bison-eng.com
Phone Number:	406-442-5768

SHIP TO:
Name: Ohio Lumex Analytical Laboratory
Company: Ohio Lumex Co., Inc.
Address: 30350 Bruce Industrial Pkwy
Solon, OH 44139
Phone: (440) 264-2500

Source Type: ☐ Coal Fired Power ☐ Cement Kiln ☐ Industrial Boiler ☒ Other: ____________

Sample Quantity:	Sample IDs	Sampling Method / Expected Capture Source Concentration / Notes:
1	OL498454(A) CFU104 Run1	30B < 5ng.
1	OL486072(B) CFU104 Run1 spiked @ 5ng.	
1	OL498441(A) CFU104 Run2	
1	OL486032(B) CFU104 Run2 spiked @ 5ng.	
1	OL498467(A) CFU104 Run3	
1	OL492723(B) CFU104 Run3 spiked @ 5ng.	

Analysis Turnaround Time:	Report Type:	Payment Method:
☐ Same Day Rush ☐ Next Day Rush ☐ Two Day Rush ☐ *Expedited Compliance (1-2 Business Days) ☒ Standard (3-5 Business Day)	☒ Standard ☐ Extended (additional cost)	☐ Purchase Order PO #: ________ *Please provide a hard or electronic copy when available* ☐ Credit Card *If paying by credit card, please provide a phone number so that we may contact for the cc#* Phone Number: ______________

Contacts to receive report:	Packaging Instructions:
Kelly Dorsi	**Packaging Instructions:** Please return traps packaged in their individual plastic tubes with caps on accompanied by their unique chain of custody. Place into a cardboard box or tube with enough packaging material that the traps cannot bounce or bend – similarly to how they were delivered.

Comments: use low Hg analyzer

*Long-term compliance contract required

180.197

APPENDIX G: AUDIT SAMPLES

PROFICIENCY TESTING

Evaluation Report

Quick Turn **SSAS346**

Study Type	SSAS
Open Date	2018-09-10
Close Date	2018-10-03
Report Generated	2018-10-17
Laboratory	Chester Labnet Paul Duda 12242 SW Garden Place Tigard OR 97223 US
Account Number	50205534

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Provider of the proficiency test

Sigma-Aldrich RTC, Inc.
2931 Solider Springs Road
Laramie, WY 82070 USA
PTService@sial.com

Statistical analysis and reporting

QuoData GmbH Quality & Statistics!

Release of the report

Mark Pooler
(QA manager)

Sign:

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Facility Information

Facility Name:	Hollingsworth & Vose
Address:	1115 SE Crystal Lake Dr., Corvallis, OR 97333
Contact Name:	Anita Ragan
Phone Number:	541-738-5382
Email:	anita.ragan@hovo.com

Regulatory Agency Information

Agency Name:	
Address:	4026 Fairview Industrial Dr SE, Salem, OR 97302
Contact Name:	Suzanne Blackburn
TNI Regulator:	R0032
Phone Number:	503-378-5034
Email:	blackburn.suzanne@deq.state.or.us

Stack Tester Information

Company Name:	Bison Engineering Inc.
Address:	1400 11th Ave, Helena, MT 59601
Contact name:	Kelly Dorsi
TNI Tester ID:	T0276
TNI Project ID:	HAV218776
Phone Number:	406-442-5768
Email:	kdorsi@bison-eng.com

Laboratory Information

Laboratory Name:	Chester LabNet
Address:	12242 SW Garden Place, Tigard, OR 97223
TNI Lab ID:	L0058
Contact Name:	Paul Duda
Phone Number:	503-624-2183
Email:	pduda@chesterlab.net

1 Laboratory Performance Evaluation Summary

Summary Results for SSAS346
PEA1940-20ML FLUORIDE IN IMPINGER SOLUTION
SSAS346

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
EPA 13B (2000) **10402105**				
Analytes that are not part of any analyte group				
Fluoride[2] 1730	3.12 mg/dscm	3.01 mg/dscm	2.55 - 3.46 mg/dscm	**0.5** Acceptable
Analyst: Analysis Date: 2018-09-26		*Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.075, d:0*		

* Evaluation parameters used for the statistical analysis: explanation at the end of report; A questionable result is acceptable but to be checked.
[1] NELAC Compliant, covered by Sigma-Aldrich RTC's ANAB Proficiency Testing Provider accreditation, Cert. AP-1469
[2] ISO 17043 Accredited, covered by Sigma-Aldrich RTC's ANAB Proficiency Testing Provider accreditation, Cert AP-1469

Summary Results for SSAS346
PEA1941-20ML Hydrogen Halides/Halogens in Impinger Solution
SSAS346

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
EPA Method 26A (2000) **10403200**				
Analytes that are not part of any analyte group				
Hydrogen fluoride[2] 1775	20.0 mg/L	18.2 mg/L	16.4 - 20.0 mg/L	**2.0** Acceptable
Analyst: Analysis Date: 2018-09-24		*Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.05, d:0*		

* Evaluation parameters used for the statistical analysis: explanation at the end of report; A questionable result is acceptable but to be checked.
[1] NELAC Compliant, covered by Sigma-Aldrich RTC's ANAB Proficiency Testing Provider accreditation, Cert. AP-1469
[2] ISO 17043 Accredited, covered by Sigma-Aldrich RTC's ANAB Proficiency Testing Provider accreditation, Cert AP-1469

Summary Results for SSAS346
PEA1948-1EA Metals in Impinger Solution
SSAS346

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
EPA Method 29 (ICP) (2000) 10403608				
Analytes that are not part of any analyte group				
Antimony, Sb[2] 1005 Analyst: Analysis Date: 2018-10-02	0.597 ug/ml	0.643 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	0.482 - 0.804 ug/ml	**-0.6** Acceptable
Arsenic, As[2] 1010 Analyst: Analysis Date: 2018-10-02	0.416 ug/ml	0.455 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	0.341 - 0.569 ug/ml	**-0.7** Acceptable
Barium, Ba[2] 1015 Analyst: Analysis Date: 2018-10-02	2.30 ug/ml	2.23 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	1.67 - 2.78 ug/ml	**0.3** Acceptable
Beryllium, Be[2] 1020 Analyst: Analysis Date: 2018-10-02	0.649 ug/ml	0.726 ug/ml *Evaluation Criteria – 4** *Parameters*: break:1.0, highPercentage:0.25, lowPercentage:0.30*	0.508 - 0.944 ug/ml	**-1.1** Acceptable
Cadmium, Cd[2] 1030 Analyst: Analysis Date: 2018-10-02	0.311 ug/ml	0.349 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	0.279 - 0.419 ug/ml	**-1.1** Acceptable
Chromium, Cr (total)[2] 1040 Analyst: Analysis Date: 2018-10-02	1.21 ug/ml	1.17 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	0.934 - 1.40 ug/ml	**0.4** Acceptable
Cobalt, Co[2] 1050 Analyst: Analysis Date: 2018-10-02	2.66 ug/ml	2.78 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	2.08 - 3.47 ug/ml	**-0.3** Acceptable
Copper, Cu[2] 1055 Analyst: Analysis Date: 2018-10-02	0.922 ug/ml	0.983 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	0.737 - 1.23 ug/ml	**-0.5** Acceptable
Lead, Pb[2] 1075 Analyst: Analysis Date: 2018-10-02	2.92 ug/ml	3.20 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	2.40 - 4.00 ug/ml	**-0.7** Acceptable

* Evaluation parameters used for the statistical analysis: explanation at the end of report; A questionable result is acceptable but to be checked.

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[2] ISO 17043 Accredited, covered by Sigma-Aldrich RTC's ANAB Proficiency Testing Provider accreditation, Cert AP-1469

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
Manganese, Mn[2] 1090 Analyst: Analysis Date: 2018-10-02	0.366 ug/ml	0.383 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	0.287 - 0.479 ug/ml	**-0.4** Acceptable
Nickel, Ni[2] 1105 Analyst: Analysis Date: 2018-10-02	2.21 ug/ml	2.36 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	1.89 - 2.83 ug/ml	**-0.6** Acceptable
Selenium, Se[2] 1140 Analyst: Analysis Date: 2018-10-02	0.793 ug/ml	0.872 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	0.654 - 1.09 ug/ml	**-0.7** Acceptable
Zinc, Zn[2] 1190 Analyst: Analysis Date: 2018-10-02	0.715 ug/ml	0.742 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	0.556 - 0.928 ug/ml	**-0.3** Acceptable

* Evaluation parameters used for the statistical analysis: explanation at the end of report; A questionable result is acceptable but to be checked.

[1] NELAC Compliant, covered by Sigma-Aldrich RTC's ANAB Proficiency Testing Provider accreditation, Cert. AP-1469

[2] ISO 17043 Accredited, covered by Sigma-Aldrich RTC's ANAB Proficiency Testing Provider accreditation, Cert AP-1469

Summary Results for SSAS346
PEA1945-1EA Metals on Filter Paper
SSAS346

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
EPA Method 29 (ICP) (2000) 10403608				
Analytes that are not part of any analyte group				
Antimony, Sb[2] 1005 Analyst: Analysis Date: 2018-10-02	49.8 ug/filter	53.2 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	39.9 - 66.5 ug/filter	**-0.5** Acceptable
Arsenic, As[2] 1010 Analyst: Analysis Date: 2018-10-02	26.0 ug/filter	29.0 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	21.7 - 36.2 ug/filter	**-0.8** Acceptable
Barium, Ba[2] 1015 Analyst: Analysis Date: 2018-10-02	40.1 ug/filter	33.3 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	25.0 - 41.6 ug/filter	**1.6** Acceptable
Beryllium, Be[2] 1020 Analyst: Analysis Date: 2018-10-02	46.0 ug/filter	47.3 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	35.5 - 59.1 ug/filter	**-0.2** Acceptable
Cadmium, Cd[2] 1030 Analyst: Analysis Date: 2018-10-02	25.9 ug/filter	25.3 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	20.2 - 30.3 ug/filter	**0.3** Acceptable
Chromium, Cr (total)[2] 1040 Analyst: Analysis Date: 2018-10-02	33.1 ug/filter	30.1 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	24.1 - 36.2 ug/filter	**1.0** Acceptable
Cobalt, Co[2] 1050 Analyst: Analysis Date: 2018-10-02	23.4 ug/filter	23.3 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	17.5 - 29.1 ug/filter	**0.0** Acceptable
Copper, Cu[2] 1055 Analyst: Analysis Date: 2018-10-02	34.7 ug/filter	34.8 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	26.1 - 43.5 ug/filter	**0.0** Acceptable
Lead, Pb[2] 1075 Analyst: Analysis Date: 2018-10-02	53.0 ug/filter	55.7 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	44.5 - 66.8 ug/filter	**-0.5** Acceptable

* Evaluation parameters used for the statistical analysis: explanation at the end of report; A questionable result is acceptable but to be checked.

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Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
Manganese, Mn[2] 1090 Analyst: Analysis Date: 2018-10-02	42.5 ug/filter	42.7 ug/filter *Evaluation Criteria – 4** *Parameters*: break:20, highPercentage:0.20, lowPercentage:0.30*	34.2 - 51.2 ug/filter	**-0.1** Acceptable
Nickel, Ni[2] 1105 Analyst: Analysis Date: 2018-10-02	57.6 ug/filter	51.0 ug/filter *Evaluation Criteria – 4** *Parameters*: break:30, highPercentage:0.20, lowPercentage:0.30*	40.8 - 61.2 ug/filter	**1.9** Acceptable
Selenium, Se[2] 1140 Analyst: Analysis Date: 2018-10-02	25.9 ug/filter	26.4 ug/filter *Evaluation Criteria – 4** *Parameters*: break:40, highPercentage:0.25, lowPercentage:0.30*	18.5 - 34.3 ug/filter	**-0.2** Acceptable
Zinc, Zn[2] 1190 Analyst: Analysis Date: 2018-10-02	40.1 ug/filter	38.0 ug/filter *Evaluation Criteria – 4** *Parameters*: break:40, highPercentage:0.25, lowPercentage:0.30*	26.6 - 49.4 ug/filter	**0.6** Acceptable

* Evaluation parameters used for the statistical analysis: explanation at the end of report; A questionable result is acceptable but to be checked.

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2 Sample Information

PEA1940-20ML FLUORIDE IN IMPINGER SOLUTION SSAS346

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Fluoride 1730	mg/dscm	3.01 ± 0.0153	---	---

PEA1941-20ML Hydrogen Halides/Halogens in Impinger Solution SSAS346

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Hydrogen fluoride 1775	mg/L	18.2 ± 0.0928	---	---

PEA1948-1EA Metals in Impinger Solution SSAS346

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Antimony, Sb 1005	ug/ml	0.643 ± 0.00328	---	---
Arsenic, As 1010	ug/ml	0.455 ± 0.00232	---	---
Barium, Ba 1015	ug/ml	2.23 ± 0.0114	---	---
Beryllium, Be 1020	ug/ml	0.726 ± 0.00370	---	---
Cadmium, Cd 1030	ug/ml	0.349 ± 0.00178	---	---
Chromium, Cr (total) 1040	ug/ml	1.17 ± 0.00596	---	---
Cobalt, Co 1050	ug/ml	2.78 ± 0.0142	---	---
Copper, Cu 1055	ug/ml	0.983 ± 0.00501	---	---
Lead, Pb 1075	ug/ml	3.20 ± 0.0163	---	---
Manganese, Mn 1090	ug/ml	0.383 ± 0.00195	---	---
Nickel, Ni 1105	ug/ml	2.36 ± 0.0120	---	---
Selenium, Se 1140	ug/ml	0.872 ± 0.00445	---	---

* Study mean and Study Std. Dev. from the latest scheduled study within this scheme. If not available, this is indicated by "---".

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Zinc, Zn 1190	ug/ml	0.742 ± 0.00378	---	---

PEA1945-1EA Metals on Filter Paper SSAS346

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Antimony, Sb 1005	ug/filter	53.2 ± 0.271	---	---
Arsenic, As 1010	ug/filter	29.0 ± 0.148	---	---
Barium, Ba 1015	ug/filter	33.3 ± 0.170	---	---
Beryllium, Be 1020	ug/filter	47.3 ± 0.241	---	---
Cadmium, Cd 1030	ug/filter	25.3 ± 0.129	---	---
Chromium, Cr (total) 1040	ug/filter	30.1 ± 0.154	---	---
Cobalt, Co 1050	ug/filter	23.3 ± 0.119	---	---
Copper, Cu 1055	ug/filter	34.8 ± 0.177	---	---
Lead, Pb 1075	ug/filter	55.7 ± 0.284	---	---
Manganese, Mn 1090	ug/filter	42.7 ± 0.218	---	---
Nickel, Ni 1105	ug/filter	51.0 ± 0.260	---	---
Selenium, Se 1140	ug/filter	26.4 ± 0.135	---	---
Zinc, Zn 1190	ug/filter	38.0 ± 0.194	---	---

* Study mean and Study Std. Dev. from the latest scheduled study within this scheme. If not available, this is indicated by "---".

3 Statistical Analysis

3.1 Definitions and Interpretation

Reported Value

The laboratory result.

Assigned Value

Value attributed to a particular quantity and accepted, sometimes by convention, as having an uncertainty appropriate for a given purpose. See ISO/IEC 17043 for additional information. In general the assigned value is the value used to assess proficiency and may or may not be the made to value (gravimetric value).

Acceptance Window:

The range of values that constitute acceptable performance for this QT.

z-score

A z-score shows how a single data point compares to normal data. A z-score says not only whether a point was above or below average, but how unusual the measurement is. Generally, a method result with a z-score less than |2| is considered to be in control, a z-score between |2| and |3| is considered 'Questionable', but still within control and a z-score greater than |3| is considered not acceptable and the method is out of control. For WS studies, a z-score greater than |2| is unacceptable.

Calculated as z = (Reported Value - Assigned Value) / Proficiency Std. Dev.

Proficiency Std. Dev.

Standard deviation calculated based on **Evaluation Criteria**.

Study Mean

Statistical study mean calculated using a robust statistical model (Algorithm A). Robust statistical techniques to minimize the influence that extreme results can have on estimates of the mean and standard deviation. NOTE - These techniques assign less weight to extreme results, rather than eliminate them from a data set.

Study Std. Dev.

Standard deviation calculated from study data using robust statistics.

Gravimetric Value

The 'prepared to' value, determined by gravimetric means. The uncertainty associated to this value is the standard uncertainty and based on Sigma-Aldrich RTC's gravimetric tolerances.

3.2 Evaluation Criteria

1 - Regression Equation

Acceptance windows based on TNI adopted equation of proficiency value +/- 3 proficiency standard deviations and check limits of proficiency value +/- 2 proficiency standard deviations. Proficiency value and proficiency standard deviation are calculated from gravimetric variables a, b, c & d as proficiency value = a * gravimetric + b and proficiency standard deviation = c * gravimetric + d.

2 - Study Robust Mean and c, d regression

Acceptance windows based on TNI adopted equation of proficiency value +/- 3 proficiency standard deviations and check limits of proficiency value +/- 2 proficiency standard deviations. Proficiency value and proficiency standard deviation calculated from robust study mean and variables c & d as proficiency value = robust mean and proficiency standard deviation = c *proficiency value + d.

3 - Fixed Limits

Acceptance windows based on span of gravimetric percentage from gravimetric as gravimetric +/- gravimetric * percentage.

4 - Adjustable Fixed Limits

Acceptance windows based on a span of gravimetric percentage from gravimetric as gravimetric +/- gravimetric * lowPercentage where gravimetric < break and gravimetric +/- gravimetric * highPercentage where gravimetric >= break.

5 - Study Statistics

Acceptance windows based on a number of standard deviations span from the study mean as study mean +/- (deviations * standard deviation).

6 - Log Transform Statistics

Acceptance windows based on lognormal distributed data. Acceptance windows = mean(lognormal) +/- span * standard deviation(lognormal).

7 - Regression Equation 2SD

Acceptance windows based on EPA equation of proficiency value +/- 2 proficiency standard deviations. Proficiency value and proficiency standard deviation are calculated from gravimetric variables a, b, c & d as proficiency value = a * gravimetric + b and proficiency standard deviation = c * gravimetric + d. Generally reserved for drinking water studies.

4 Proficiency Test Item Preparation, Homogeneity and Stability Assessment

Sigma-Aldrich RTC uses proprietary and published methods for the manufacture, homogeneity and stability testing of proficiency test items. Sigma-Aldrich RTC's proficiency test materials meet the requirements of ISO Guide 34. For more information contact Sigma-Aldrich RTC. Additionally Sigma-Aldrich RTC complies with the TNI Volume 3 'General Requirements for Environmental Proficiency Test Providers', EL-V3-2009, 2009 for all TNI Fields of Proficiency Testing analytes.

5 Metrological Traceability

All preparations are made using balances calibrated annually traceable to NIST standards. Where appropriate analytical measurements are traceable through an unbroken chain to NIST standards, or a Certified Reference Material manufactured under ISO Guide 34 in conjunction with ISO/IEC 17025.

6 Additional Information

Go to merck-pt.com for additional information on summary statistics for specific methods, advice on the interpretation of the statistical analysis and additional comments/recommendations. Sigma-Aldrich RTC recommends that you contact your accreditation body for specific instruction.

7 References

[1] ISO 13528: Statistical methods for use in proficiency testing by interlaboratory comparison, August 2015

[2] ISO/IEC 17025:2017: General requirements for the competence of testing and calibration laboratories

[3] ISO/IEC 17043:2010: Conformity assessment - General requirements for proficiency testing, May 2010

[4] S. Uhlig und P. Henschel (1997): Limits of tolerance and z-scores in ring tests. Fresenius' J. Anal. Chem., Vol. 358, pp. 761-766.

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MilliporeSigma

PROFICIENCY TESTING

Evaluation Report

Quick Turn **SSAS345**

Study Type SSAS

Open Date 2018-09-10
Close Date 2018-10-19

Report Generated 2018-10-25

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Paul Duda
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Statistical analysis and reporting

QuoData GmbH Quality & Statistics!

Release of the report

Mark Pooler
(QA manager)

Sign:

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1 Laboratory Performance Evaluation Summary

Summary Results for SSAS345
PEA1940-20ML FLUORIDE IN IMPINGER SOLUTION
SSAS345

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
EPA 13B (2000) **10402105**				
Analytes that are not part of any analyte group				
Fluoride[2] 1730	6.02 mg/dscm	6.01 mg/dscm	5.11 - 6.91 mg/dscm	**0.0** Acceptable
Analyst: SH Analysis Date: 2018-10-09		*Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.075, d:0*		

* Evaluation parameters used for the statistical analysis: explanation at the end of report; A questionable result is acceptable but to be checked.
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Summary Results for SSAS345
PEA1941-20ML Hydrogen Halides/Halogens in Impinger Solution
SSAS345

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
EPA Method 26A (2000) 10403200				
Analytes that are not part of any analyte group				
Hydrogen fluoride[2] 1775 Analyst: SH Analysis Date: 2018-10-03	345 mg/L	335 mg/L *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.05, d:0*	302 - 368 mg/L	**0.6** Acceptable

* Evaluation parameters used for the statistical analysis: explanation at the end of report; A questionable result is acceptable but to be checked.

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Summary Results for SSAS345
PEA1948-1EA Metals in Impinger Solution
SSAS345

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
EPA Method 29 (ICP) (2000) 10403608				
Analytes that are not part of any analyte group				
Antimony, Sb[2] 1005 Analyst: Analysis Date: 2018-10-16	9.86 ug/ml	10.0 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	7.50 - 12.5 ug/ml	**-0.1** Acceptable
Arsenic, As[2] 1010 Analyst: Analysis Date: 2018-10-16	9.98 ug/ml	10.0 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	7.50 - 12.5 ug/ml	**0.0** Acceptable
Barium, Ba[2] 1015 Analyst: Analysis Date: 2018-10-18	9.57 ug/ml	10.0 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	7.50 - 12.5 ug/ml	**-0.3** Acceptable
Beryllium, Be[2] 1020 Analyst: Analysis Date: 2018-10-16	9.44 ug/ml	9.99 ug/ml *Evaluation Criteria – 4** *Parameters*: break:1.0, highPercentage:0.25, lowPercentage:0.30*	7.49 - 12.5 ug/ml	**-0.7** Acceptable
Cadmium, Cd[2] 1030 Analyst: Analysis Date: 2018-10-16	9.86 ug/ml	9.99 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	8.00 - 12.0 ug/ml	**-0.1** Acceptable
Chromium, Cr (total)[2] 1040 Analyst: Analysis Date: 2018-10-16	10.9 ug/ml	10.0 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	8.00 - 12.0 ug/ml	**0.9** Acceptable
Cobalt, Co[2] 1050 Analyst: Analysis Date: 2018-10-16	9.92 ug/ml	9.99 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	7.50 - 12.5 ug/ml	**-0.1** Acceptable
Copper, Cu[2] 1055 Analyst: Analysis Date: 2018-10-16	9.56 ug/ml	10.0 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	7.51 - 12.5 ug/ml	**-0.4** Acceptable
Lead, Pb[2] 1075 Analyst: Analysis Date: 2018-10-16	9.36 ug/ml	10.0 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	7.51 - 12.5 ug/ml	**-0.5** Acceptable

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Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
Manganese, Mn[2] 1090 Analyst: Analysis Date: 2018-10-16	9.68 ug/ml	10.0 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	7.50 - 12.5 ug/ml	**-0.3** Acceptable
Nickel, Ni[2] 1105 Analyst: Analysis Date: 2018-10-16	9.73 ug/ml	9.99 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	8.00 - 12.0 ug/ml	**-0.3** Acceptable
Selenium, Se[2] 1140 Analyst: Analysis Date: 2018-10-16	9.69 ug/ml	9.99 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	7.49 - 12.5 ug/ml	**-0.2** Acceptable
Zinc, Zn[2] 1190 Analyst: Analysis Date: 2018-10-16	9.76 ug/ml	10.0 ug/ml *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	7.50 - 12.5 ug/ml	**-0.2** Acceptable

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Summary Results for SSAS345
PEA1945-1EA Metals on Filter Paper
SSAS345

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
EPA Method 29 (ICP) (2000) 10403608				
Analytes that are not part of any analyte group				
Antimony, Sb[2] 1005 Analyst: Analysis Date: 2018-10-17	82.2 ug/filter	81.6 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	61.2 - 102 ug/filter	**0.1** Acceptable
Arsenic, As[2] 1010 Analyst: Analysis Date: 2018-10-17	223 ug/filter	222 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	166 - 278 ug/filter	**0.0** Acceptable
Barium, Ba[2] 1015 Analyst: Analysis Date: 2018-10-18	209 ug/filter	200 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	150 - 250 ug/filter	**0.4** Acceptable
Beryllium, Be[2] 1020 Analyst: Analysis Date: 2018-10-17	78.4 ug/filter	78.6 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	58.9 - 98.2 ug/filter	**0.0** Acceptable
Cadmium, Cd[2] 1030 Analyst: Analysis Date: 2018-10-17	64.6 ug/filter	67.1 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	53.7 - 80.5 ug/filter	**-0.4** Acceptable
Chromium, Cr (total)[2] 1040 Analyst: Analysis Date: 2018-10-17	141 ug/filter	140 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	112 - 168 ug/filter	**0.1** Acceptable
Cobalt, Co[2] 1050 Analyst: Analysis Date: 2018-10-17	206 ug/filter	208 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	156 - 260 ug/filter	**-0.1** Acceptable
Copper, Cu[2] 1055 Analyst: Analysis Date: 2018-10-17	73.4 ug/filter	70.2 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.125, d:0*	52.6 - 87.7 ug/filter	**0.4** Acceptable
Lead, Pb[2] 1075 Analyst: Analysis Date: 2018-10-17	43.4 ug/filter	41.7 ug/filter *Evaluation Criteria – 7** *Parameters*: a:1, b:0, c:0.10, d:0*	33.4 - 50.0 ug/filter	**0.4** Acceptable

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Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
Manganese, Mn[2] 1090 Analyst: Analysis Date: 2018-10-17	99.9 ug/filter	97.3 ug/filter *Evaluation Criteria – 4** *Parameters*: break:20, highPercentage:0.20, lowPercentage:0.30*	77.8 - 117 ug/filter	**0.4** Acceptable
Nickel, Ni[2] 1105 Analyst: Analysis Date: 2018-10-17	139 ug/filter	141 ug/filter *Evaluation Criteria – 4** *Parameters*: break:30, highPercentage:0.20, lowPercentage:0.30*	113 - 169 ug/filter	**-0.2** Acceptable
Selenium, Se[2] 1140 Analyst: Analysis Date: 2018-10-17	157 ug/filter	175 ug/filter *Evaluation Criteria – 4** *Parameters*: break:40, highPercentage:0.25, lowPercentage:0.30*	131 - 219 ug/filter	**-1.2** Acceptable
Zinc, Zn[2] 1190 Analyst: Analysis Date: 2018-10-17	122 ug/filter	117 ug/filter *Evaluation Criteria – 4** *Parameters*: break:40, highPercentage:0.25, lowPercentage:0.30*	87.8 - 146 ug/filter	**0.5** Acceptable

* Evaluation parameters used for the statistical analysis: explanation at the end of report; A questionable result is acceptable but to be checked.

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2 Sample Information

PEA1940-20ML FLUORIDE IN IMPINGER SOLUTION
SSAS345

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Fluoride 1730	mg/dscm	6.01 ± 0.0306	---	---

PEA1941-20ML Hydrogen Halides/Halogens in Impinger Solution
SSAS345

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Hydrogen fluoride 1775	mg/L	335 ± 1.56	---	---

PEA1948-1EA Metals in Impinger Solution
SSAS345

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Antimony, Sb 1005	ug/ml	10.0 ± 0.0510	---	---
Arsenic, As 1010	ug/ml	10.0 ± 0.0510	---	---
Barium, Ba 1015	ug/ml	10.0 ± 0.0510	---	---
Beryllium, Be 1020	ug/ml	9.99 ± 0.0510	---	---
Cadmium, Cd 1030	ug/ml	9.99 ± 0.0510	---	---
Chromium, Cr (total) 1040	ug/ml	10.0 ± 0.0510	---	---
Cobalt, Co 1050	ug/ml	9.99 ± 0.0510	---	---
Copper, Cu 1055	ug/ml	10.0 ± 0.0510	---	---
Lead, Pb 1075	ug/ml	10.0 ± 0.0511	---	---
Manganese, Mn 1090	ug/ml	10.0 ± 0.0510	---	---
Nickel, Ni 1105	ug/ml	9.99 ± 0.0510	---	---
Selenium, Se 1140	ug/ml	9.99 ± 0.0509	---	---

* Study mean and Study Std. Dev. from the latest scheduled study within this scheme. If not available, this is indicated by "---".

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Zinc, Zn 1190	ug/ml	10.0 ± 0.0510	---	---

PEA1945-1EA Metals on Filter Paper SSAS345

Analyte	Unit	Gravimetric Value	Study Mean*	Study Std. Dev.*
Antimony, Sb 1005	ug/filter	81.6	---	---
Arsenic, As 1010	ug/filter	222	---	---
Barium, Ba 1015	ug/filter	200	---	---
Beryllium, Be 1020	ug/filter	78.6	---	---
Cadmium, Cd 1030	ug/filter	67.1	---	---
Chromium, Cr (total) 1040	ug/filter	140	---	---
Cobalt, Co 1050	ug/filter	208	---	---
Copper, Cu 1055	ug/filter	70.2	---	---
Lead, Pb 1075	ug/filter	41.7	---	---
Manganese, Mn 1090	ug/filter	97.3	---	---
Nickel, Ni 1105	ug/filter	141	---	---
Selenium, Se 1140	ug/filter	175	---	---
Zinc, Zn 1190	ug/filter	117	---	---

* Study mean and Study Std. Dev. from the latest scheduled study within this scheme. If not available, this is indicated by "---".

3 Statistical Analysis

3.1 Definitions and Interpretation

Reported Value

The laboratory result.

Assigned Value

Value attributed to a particular quantity and accepted, sometimes by convention, as having an uncertainty appropriate for a given purpose. See ISO/IEC 17043 for additional information. In general the assigned value is the value used to assess proficiency and may or may not be the made to value (gravimetric value).

Acceptance Window:

The range of values that constitute acceptable performance for this QT.

z-score

A z-score shows how a single data point compares to normal data. A z-score says not only whether a point was above or below average, but how unusual the measurement is. Generally, a method result with a z-score less than |2| is considered to be in control, a z-score between |2| and |3| is considered 'Questionable', but still within control and a z-score greater than |3| is considered not acceptable and the method is out of control. For WS studies, a z-score greater than |2| is unacceptable.

Calculated as z = (Reported Value - Assigned Value) / Proficiency Std. Dev.

Proficiency Std. Dev.

Standard deviation calculated based on **Evaluation Criteria**.

Study Mean

Statistical study mean calculated using a robust statistical model (Algorithm A). Robust statistical techniques to minimize the influence that extreme results can have on estimates of the mean and standard deviation. NOTE - These techniques assign less weight to extreme results, rather than eliminate them from a data set.

Study Std. Dev.

Standard deviation calculated from study data using robust statistics.

Gravimetric Value

The 'prepared to' value, determined by gravimetric means. The uncertainty associated to this value is the standard uncertainty and based on Sigma-Aldrich RTC's gravimetric tolerances.

3.2 Evaluation Criteria

1 - Regression Equation

Acceptance windows based on TNI adopted equation of proficiency value +/- 3 proficiency standard deviations and check limits of proficiency value +/- 2 proficiency standard deviations. Proficiency value and proficiency standard deviation are calculated from gravimetric variables a, b, c & d as proficiency value = a * gravimetric + b and proficiency standard deviation = c * gravimetric + d.

2 - Study Robust Mean and c, d regression

Acceptance windows based on TNI adopted equation of proficiency value +/- 3 proficiency standard deviations and check limits of proficiency value +/- 2 proficiency standard deviations. Proficiency value and proficiency standard deviation calculated from robust study mean and variables c & d as proficiency value = robust mean and proficiency standard deviation = c *proficiency value + d.

3 - Fixed Limits

Acceptance windows based on span of gravimetric percentage from gravimetric as gravimetric +/- gravimetric * percentage.

4 - Adjustable Fixed Limits

Acceptance windows based on a span of gravimetric percentage from gravimetric as gravimetric +/- gravimetric * lowPercentage where gravimetric < break and gravimetric +/- gravimetric * highPercentage where gravimetric >= break.

5 - Study Statistics

Acceptance windows based on a number of standard deviations span from the study mean as study mean +/- (deviations * standard deviation).

6 - Log Transform Statistics

Acceptance windows based on lognormal distributed data. Acceptance windows = mean(lognormal) +/- span * standard deviation(lognormal).

7 - Regression Equation 2SD

Acceptance windows based on EPA equation of proficiency value +/- 2 proficiency standard deviations. Proficiency value and proficiency standard deviation are calculated from gravimetric variables a, b, c & d as proficiency value = a * gravimetric + b and proficiency standard deviation = c * gravimetric + d. Generally reserved for drinking water studies.

4 Proficiency Test Item Preparation, Homogeneity and Stability Assessment

Sigma-Aldrich RTC uses proprietary and published methods for the manufacture, homogeneity and stability testing of proficiency test items. Sigma-Aldrich RTC's proficiency test materials meet the requirements of ISO Guide 34. For more information contact Sigma-Aldrich RTC. Additionally Sigma-Aldrich RTC complies with the TNI Volume 3 'General Requirements for Environmental Proficiency Test Providers', EL-V3-2009, 2009 for all TNI Fields of Proficiency Testing analytes.

5 Metrological Traceability

All preparations are made using balances calibrated annually traceable to NIST standards. Where appropriate analytical measurements are traceable through an unbroken chain to NIST standards, or a Certified Reference Material manufactured under ISO Guide 34 in conjunction with ISO/IEC 17025.

6 Additional Information

Go to merck-pt.com for additional information on summary statistics for specific methods, advice on the interpretation of the statistical analysis and additional comments/recommendations. Sigma-Aldrich RTC recommends that you contact your accreditation body for specific instruction.

7 References

[1] ISO 13528: Statistical methods for use in proficiency testing by interlaboratory comparison, August 2015

[2] ISO/IEC 17025:2017: General requirements for the competence of testing and calibration laboratories

[3] ISO/IEC 17043:2010: Conformity assessment - General requirements for proficiency testing, May 2010

[4] S. Uhlig und P. Henschel (1997): Limits of tolerance and z-scores in ring tests. Fresenius' J. Anal. Chem., Vol. 358, pp. 761-766.

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2018 - 10431
06/2018

APPENDIX H: CALIBRATIONS & CERTIFICATIONS

STAC
STACK TESTING ACCREDITATION COUNCIL

A2LA

American Association for Laboratory Accreditation

Accredited Air Emission Testing Body

A2LA has accredited

Bison Engineering, Inc.

In recognition of the successful completion of the joint A2LA and Stack Testing Accreditation Council (STAC) evaluation process, this laboratory is accredited to perform testing activities in compliance with ASTM D7036:2004 - Standard Practice for Competence of Air Emission Testing Bodies.

Presented this 26th day of February 2018.

President and CEO
For the Accreditation Council
Certificate Number 4675.01
Valid to November 30, 2019

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

This accreditation program is not included under the A2LA ILAC Mutual Recognition Arrangement.

APEX INSTRUMENTS
METHOD 5 XC-522 CONSOLE CALIBRATION
for

Meter Console Information	
Console Model Number	12
Console Serial Number	2199-D
DGM Model Number	Itron
DGM Serial Number	3605480

Calibration Conditions			
Date	Time	Aug/27/18	12:50
Barometric Pressure		25.95	in Hg
Calibration Technician		CSW	
Calibration Meter Gamma		0.9999	

<<<<<<<Your reference meter here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Manometer ΔH	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	P_m in H_2O	V_{mi} cubic feet	V_{mf} cubic feet	V_m cubic feet	t_{Oi} °F	t_{Of} °F	V_{wi} cubic feet	V_{wf} cubic feet	V_w cubic feet	t_{wi} °F	t_{wf} °F
10.00	6.00	0.000	14.154	14.154	68	69	0.000	14.609	14.609	72	72
10.00	3.00	0.000	10.148	10.148	69	71	0.000	10.283	10.283	72	72
10.00	2.00	0.000	8.358	8.358	71	72	0.000	8.416	8.416	72	73
10.00	1.00	0.000	5.949	5.949	72	73	0.000	5.962	5.962	73	73
10.00	0.50	0.000	4.246	4.246	73	73	0.000	4.242	4.242	73	73

Results

Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	$\Delta H_@$	
				Value	Variation	Std & Corr	0.75 SCFM	Variation
$V_{m(std)}$ cubic feet	$Q_{m(std)}$ ft^3/min	$V_{w(std)}$ cubic feet	$Q_{w(std)}$ ft^3/min	Y	ΔY	$Q_{m(std)(corr)}$ ft^3/min	$\Delta H_@$ in H_2O	$\Delta\Delta H_@$
12.473	1.247	12.574	1.257	1.0081	0.007	1.257	1.851	0.004
8.843	0.884	8.850	0.885	1.0008	0.000	0.885	1.863	0.016
7.242	0.724	7.237	0.724	0.9992	-0.002	0.724	1.852	0.006
5.131	0.513	5.121	0.512	0.9982	-0.003	0.512	1.845	-0.001
3.653	0.365	3.644	0.364	0.9974	-0.003	0.364	1.821	-0.025
				1.0008	Y Average		**1.846**	$\Delta H_@$ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

Note: For $DH_@$, orifice pressure differential that equates to 0.75cfm (0.0212m^3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is +-0.2inches (5.1mm) H_20.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 157, certified 05/26/2006 using Pi Tape S/N 20700139, which is traceable to the National Bureau of Standards (NIST).

Chris Whitten
Signature ______________________
CSW

Aug/27/18
Date ______________________
Aug/27/18

APEX INSTRUMENTS · 204 Technology Park Lane · Fuquay-Varina, North Carolina 27526 · (919) 557-7300 · FAX (919) 557-7110

APEX INSTRUMENTS
METHOD 5 XC-522 CONSOLE CALIBRATION
for

Meter Console Information	
Console Model Number	12
Console Serial Number	2199-D
DGM Model Number	Itron
DGM Serial Number	3605480

Calibration Conditions			
Date	Time	3-Oct-18	
Barometric Pressure		26.04	in Hg
Calibration Technician		CSW	
Calibration Meter Gamma		0.9999	

<<<<<<<Your reference meter here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data										
Run Time	Metering Console						Reference Meter			
Elapsed	Manometer ΔH	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	P_m in H_2O	V_{mi} cubic feet	V_{mf} cubic feet	V_m cubic feet	t_{Oi} °F	t_{Of} °F	V_{wi} cubic feet	V_{wf} cubic feet	V_w cubic feet	t_{wi} °F	t_{wf} °F
10.00	6.00	0.000	14.066	14.066	64	67	0.000	14.494	14.494	67	68
10.00	3.00	0.000	10.142	10.142	67	69	0.000	10.269	10.269	68	69
10.00	2.00	0.000	8.313	8.313	69	71	0.000	8.363	8.363	69	70
10.00	1.00	0.000	6.040	6.040	71	73	0.000	6.056	6.056	70	72
10.00	0.50	0.000	4.340	4.340	73	73	0.000	4.341	4.341	72	72

Results									
Standardized Data				Dry Gas Meter					
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	$\Delta H_@$	
				Value	Variation	Std & Corr	0.75 SCFM	Variation
$V_{m(std)}$ cubic feet	$Q_{m(std)}$ ft^3/min	$V_{w(std)}$ cubic feet	$Q_{w(std)}$ ft^3/min	Y	ΔY	$Q_{m(std)(corr)}$ ft^3/min	$\Delta H_@$ in H_2O	$\Delta\Delta H_@$
12.509	1.251	12.625	1.262	1.0093	0.006	1.262	1.853	0.044
8.902	0.890	8.928	0.893	1.0030	0.000	0.893	1.844	0.035
7.248	0.725	7.257	0.726	1.0013	-0.002	0.726	1.853	0.044
5.232	0.523	5.241	0.524	1.0017	-0.002	0.524	1.770	-0.039
3.747	0.375	3.749	0.375	1.0006	-0.003	0.375	1.726	-0.083
				1.0032	**Y Average**		**1.809**	**$\Delta H_@$ Average**

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

Note: For $DH_@$, orifice pressure differential that equates to 0.75cfm ($0.0212m^3/min$) at standard temperature and pressure, acceptable tolerance of individual values from the average is +-0.2inches (5.1mm) H_20.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 157, certified 05/26/2006 using Pi Tape S/N 20700139, which is traceable to the National Bureau of Standards (NIST).

Chris Whitten
Signature ______________________
CSW

10/3/2018
Date ______________________
3-Oct-18

1350

APEX INSTRUMENTS
METHOD 5 XC-522 CONSOLE CALIBRATION
for

Meter Console Information	
Console Model Number	13
Console Serial Number	2200-D
DGM Model Number	Itron
DGM Serial Number	3605481

Calibration Conditions			
Date	Time	Aug/27/18	10:30
Barometric Pressure		25.96	in Hg
Calibration Technician		CSW	
Calibration Meter Gamma		0.9999	

<<<<<<<Your reference meter here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Manometer ΔH	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	P_m in H_2O	V_{mi} cubic feet	V_{mf} cubic feet	V_m cubic feet	t_{Oi} °F	t_{Of} °F	V_{wi} cubic feet	V_{wf} cubic feet	V_w cubic feet	t_{wi} °F	t_{wf} °F
11.00	6.00	0.000	15.801	15.801	64	68	0.000	16.429	16.429	72	73
10.00	3.00	0.000	10.410	10.410	68	71	0.000	10.558	10.558	73	73
10.00	2.00	0.000	8.410	8.410	71	73	0.000	8.453	8.453	73	74
10.00	1.00	0.000	6.096	6.096	73	74	0.000	6.085	6.085	74	74
10.00	0.50	0.000	4.263	4.263	74	74	0.000	4.240	4.240	74	74

Results

Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	$\Delta H_@$	
				Value	Variation	Std & Corr	0.75 SCFM	Variation
$V_{m(std)}$ cubic feet	$Q_{m(std)}$ ft^3/min	$V_{w(std)}$ cubic feet	$Q_{w(std)}$ ft^3/min	Y	ΔY	$Q_{m(std)(corr)}$ ft^3/min	$\Delta H_@$ in H_2O	$\Delta\Delta H_@$
13.996	1.272	14.132	1.285	1.0098	0.011	1.285	1.782	-0.017
9.083	0.908	9.074	0.907	0.9989	0.000	0.907	1.774	-0.025
7.283	0.728	7.258	0.726	0.9965	-0.002	0.726	1.840	0.041
5.249	0.525	5.219	0.522	0.9943	-0.004	0.522	1.774	-0.025
3.662	0.366	3.637	0.364	0.9930	-0.005	0.364	1.825	0.026
				0.9985	Y Average		**1.799**	$\Delta H_@$ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

Note: For $DH_@$, orifice pressure differential that equates to 0.75cfm ($0.0212m^3/min$) at standard temperature and pressure, acceptable tolerance of individual values from the average is +-0.2inches (5.1mm) H_20.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 157, certified 05/26/2006 using Pi Tape S/N 20700139, which is traceable to the National Bureau of Standards (NIST).

Chris Whitten
Signature ______________________
CSW

Aug/27/18
Date ______________________
Aug/27/18

1351

APEX INSTRUMENTS
METHOD 5 XC-522 CONSOLE CALIBRATION
for

Meter Console Information	
Console Model Number	13
Console Serial Number	2200-D
DGM Model Number	Itron
DGM Serial Number	3605481

Calibration Conditions			
Date	Time	3-Oct-18	14:45
Barometric Pressure		26.01	in Hg
Calibration Technician		CSW	
Calibration Meter Gamma		0.9999	<<<<<<<Your reference meter here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Manometer ΔH	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	P_m in H_2O	V_{mi} cubic feet	V_{mf} cubic feet	V_m cubic feet	t_{Oi} °F	t_{Of} °F	V_{wi} cubic feet	V_{wf} cubic feet	V_w cubic feet	t_{wi} °F	t_{wf} °F
10.00	6.00	0.000	14.186	14.186	66	70	0.000	14.708	14.708	72	73
10.00	3.00	0.000	10.178	10.178	70	72	0.000	10.319	10.319	73	74
10.00	2.00	0.000	8.421	8.421	72	74	0.000	8.464	8.464	74	74
10.00	1.00	0.000	6.002	6.002	74	74	0.000	5.995	5.995	74	74
10.00	0.50	0.000	4.314	4.314	74	75	0.000	4.291	4.291	74	75

Results

Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	$\Delta H_@$	
				Value	Variation	Std & Corr	0.75 SCFM	Variation
$V_{m(std)}$ cubic feet	$Q_{m(std)}$ ft^3/min	$V_{w(std)}$ cubic feet	$Q_{w(std)}$ ft^3/min	Y	ΔY	$Q_{m(std)(corr)}$ ft^3/min	$\Delta H_@$ in H_2O	$\Delta\Delta H_@$
12.541	1.254	12.677	1.268	1.0108	0.011	1.268	1.827	0.004
8.873	0.887	8.877	0.888	1.0005	0.001	0.888	1.852	0.029
7.293	0.729	7.274	0.727	0.9974	-0.002	0.727	1.832	0.009
5.174	0.517	5.152	0.515	0.9959	-0.004	0.515	1.823	0.000
3.710	0.371	3.684	0.368	0.9931	-0.006	0.368	1.780	-0.042
				0.9995	**Y Average**		**1.823**	**$\Delta H_@$ Average**

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

Note: For $DH_@$, orifice pressure differential that equates to 0.75cfm (0.0212m^3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is +-0.2inches (5.1mm) H_20.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 157, certified 05/26/2006 using Pi Tape S/N 20700139, which is traceable to the National Bureau of Standards (NIST).

Chris Whitten

Signature ______________________

CSW

10/3/2018

Date ______________________

3-Oct-18

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE A

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	1608012
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	21-Aug-18	12:30
Barometric Pressure		26.28	in Hg
Calibration Technician		Kelly Dorsi	
Calibration Meter Gamma		1.0000	<<<<<<<Your reference meter Y here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data											
Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} cubic feet	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	42.045	42.045	74	76	0.000	44.024	44.024	74	76
10.00	3.00	0.000	30.837	30.837	69	69	0.000	32.580	32.580	69	69
10.00	2.00	0.000	20.561	20.561	69	72	0.000	21.491	21.491	69	72
10.00	1.00	0.000	8.654	8.654	72	73	0.000	8.981	8.981	72	73
10.00	0.50	0.000	6.447	6.447	73	74	0.000	6.722	6.722	73	74

Results						
Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
36.447	3.645	38.162	3.816	1.0471	0.001	PASS
27.034	2.703	28.562	2.856	1.0565	0.011	PASS
17.974	1.797	18.787	1.879	1.0452	-0.001	PASS
7.537	0.754	7.822	0.782	1.0378	-0.008	PASS
5.604	0.560	5.843	0.584	1.0427	-0.003	PASS
				1.046	**Y Average**	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature Kelly Dorsi
Kelly Dorsi

Date 8/21/2018
21-Aug-18

1353

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE B

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	1608012
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	21-Aug-18	12:30
Barometric Pressure		26.28	in Hg
Calibration Technician		Kelly Dorsi	
Calibration Meter Gamma		1.0000	<<<<<<<Your reference meter Y here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data												
Run Time	Metering Console						Reference Meter					
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} cubic feet	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	40.989	40.989	74	76	0.000	43.001	43.001	74	76
10.00	3.00	0.000	30.480	30.480	76	77	0.000	31.722	31.722	76	77
10.00	2.00	0.000	21.134	21.134	77	78	0.000	21.976	21.976	77	78
10.00	1.00	0.000	8.707	8.707	78	79	0.000	9.011	9.011	78	79
10.00	0.50	0.000	6.504	6.504	79	79	0.000	6.667	6.667	79	79

Results						
Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
35.531	3.553	37.275	3.728	1.0491	0.011	PASS
26.348	2.635	27.421	2.742	1.0407	0.003	PASS
18.235	1.823	18.961	1.896	1.0398	0.002	PASS
7.499	0.750	7.760	0.776	1.0349	-0.003	PASS
5.596	0.560	5.736	0.574	1.0251	-0.013	PASS
				1.038	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature Kelly Dorsi ______________________ Date 8/21/2018

Kelly Dorsi 21-Aug-18

1354

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE A

Console Information	
Low Flow Model Number	0
Low Flow Serial Number	0
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	19-Nov-18	9:30
Barometric Pressure		26.14	in Hg
Calibration Technician		CSW	
Calibration Meter Gamma		1.0000	<<<<<<<Your reference meter Y here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	39.826	39.826	60	61	0.000	42.818	42.818	62	62
10.00	3.00	0.000	30.059	30.059	61	64	0.000	31.946	31.946	62	63
10.00	2.00	0.000	21.671	21.671	64	67	0.000	22.783	22.783	63	63
10.00	1.00	0.000	9.013	9.013	67	69	0.000	9.458	9.458	63	64
10.00	0.50	0.000	6.338	6.338	69	70	0.000	6.530	6.530	64	64

Results

Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
35.296	3.530	37.838	3.784	1.0720	0.014	PASS
26.538	2.654	28.204	2.820	1.0628	0.005	PASS
19.023	1.902	20.095	2.009	1.0563	-0.002	PASS
7.874	0.787	8.334	0.833	1.0584	0.000	PASS
5.522	0.552	5.749	0.575	1.0411	-0.017	PASS
				1.058	**Y Average**	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Chris Whitten — 11/19/2018

Signature ______ CSW

Date ______ 19-Nov-18

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE B

Console Information	
Low Flow Model Number	0
Low Flow Serial Number	0
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	19-Nov-18	11:00
Barometric Pressure		26.14	in Hg
Calibration Technician		CSW	
Calibration Meter Gamma		1.0000	<<<<<<<Your reference meter Y here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data											
Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	40.456	40.456	66	69	0.000	43.017	43.017	65	66
10.00	3.00	0.000	30.265	30.265	69	71	0.000	31.851	31.851	66	66
10.00	2.00	0.000	21.644	21.644	71	73	0.000	22.585	22.585	66	66
10.00	1.00	0.000	8.570	8.570	73	73	0.000	8.922	8.922	66	67
11.00	0.50	0.000	6.964	6.964	73	74	0.000	7.131	7.131	67	67

Results						
Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
35.378	3.538	37.761	3.776	1.0674	0.013	PASS
26.342	2.634	27.933	2.793	1.0604	0.006	PASS
18.767	1.877	19.807	1.981	1.0554	0.001	PASS
7.417	0.742	7.817	0.782	1.0539	-0.001	PASS
6.021	0.547	6.242	0.567	1.0366	-0.018	PASS
				1.055	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature Chris Whitten
CSW

Date 11/19/2018
19-Nov-18

Airgas

Airgas

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Airgas Specialty Gases
525 North Industrial Loop Road
Tooele, UT 84074
435-882-1412
Airgas.com

Part Number:	E02NI90E15A0228	Reference Number:	153-124493385-6
Cylinder Number:	CC464758	Cylinder Volume:	145.2 CF
Laboratory:	ASG - Tooele - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72015	Valve Outlet:	590
Gas Code:	O2,BALN	Certification Date:	May 26, 2015

Expiration Date: May 26, 2023

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
OXYGEN	10.00 %	9.893 %	G1	+/- 1.0% NIST Traceable	05/26/2015
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	1	CC195919	9.898 % OXYGEN/NITROGEN	1%	Jul 26, 2018

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba MPA-510 W603MM58 O2	O2 Paramagnetic (Mason)	May 03, 2015

Triad Data Available Upon Request

O_2 9.893

CO_2 ~~0~~

~~Signature on file~~

Approved for Release

Airgas

Airgas Specialty Gases
525 North Industrial Loop Road
Tooele, UT 84074
435-241-5662 Fax: 435-241-5664
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E03NI60E15A0286	Reference Number:	153-124595059-1
Cylinder Number:	ALM-038559	Cylinder Volume:	159.6 CF
Laboratory:	124 - Tooele - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72016	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Dec 27, 2016

Expiration Date: Dec 27, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	20.00 %	19.69 %	G1	+/- 0.7% NIST Traceable	12/27/2016
OXYGEN	20.00 %	20.00 %	G1	+/- 0.5% NIST Traceable	12/27/2016
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12061556	CC354899	19.87 % CARBON DIOXIDE/NITROGEN	0.6%	Jan 27, 2018
NTRM	09061433	CC282486	22.53 % OXYGEN/NITROGEN	0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA-510 SV4MEUTJ CO2	CO2 NDIR (Dixon)	Dec 16, 2016
Horiba MPA-510 X9A4UGL8 O2	O2 Paramagnetic (Dixon)	Dec 22, 2016

Triad Data Available Upon Request

Approved for Release

Airgas

Airgas Specialty Gases
525 North Industrial Loop Road
Tooele, UT 84074
435-241-5662 Fax: 435-241-5664
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E03NI99E15A2038	Reference Number:	153-124542837-4A
Cylinder Number:	CC85329	Cylinder Volume:	144.3 CF
Laboratory:	ASG - Tooele - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72016	Valve Outlet:	660
Gas Code:	CO,NO,NOX,BALN	Certification Date:	Mar 21, 2016

Expiration Date: Mar 21, 2024

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
NOX	100.0 PPM	101.9 PPM	G1	+/- 1.1% NIST Traceable	03/14/2016, 03/21/2016
CARBON MONOXIDE	100.0 PPM	99.93 PPM	G1	+/- 0.7% NIST Traceable	03/14/2016
NITRIC OXIDE	100.0 PPM	101.8 PPM	G1	+/- 1.1% NIST Traceable	03/14/2016, 03/21/2016
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM/CM	12062209	CC19582	97.56 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	May 25, 2018
PRM	12328	680179	10.01 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Oct 15, 2014
NTRM/NO	13061215	CC403892	49.40 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Nov 19, 2019
NTRM	1	CC403906	49.40 PPM NITRIC OXIDE/NITROGEN	0.8%	Nov 19, 2019
GMIS	1	CC500970	4.805 PPM NITROGEN DIOXIDE/NITROGEN	2.0%	Aug 12, 2017

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AMP0900119 CO MCO	FTIR	Feb 26, 2016
Nicolet 6700 AMP0900119 NO LNO	FTIR	Mar 09, 2016
Nicolet 6700 AMP0900119 NO2 impurity	FTIR NO2 impurity	Mar 10, 2016

Triad Data Available Upon Request

Approved for Release

Airgas

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
www.airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E03NI99E15A3797	Reference Number:	54-124409081-1
Cylinder Number:	CC112244@	Cylinder Volume:	144.4 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12013	Valve Outlet:	660
Gas Code:	CO,NO,BALN	Certification Date:	Dec 20, 2013

Expiration Date: Dec 20, 2021

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
NOX	2000 PPM	2018 PPM	G1	+/- 1.4% NIST Traceable	12/13/2013, 12/20/2013
CARBON MONOXIDE	2000 PPM	2033 PPM	G1	+/- 1.1% NIST Traceable	12/13/2013
NITRIC OXIDE	2000 PPM	2012 PPM	G1	+/- 1.4% NIST Traceable	12/13/2013, 12/20/2013
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM/CO	12060727	CC356175	2498 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Dec 21, 2017
ntrm/nox	06120501	CC217507	1982 PPM NITRIC OXIDE/NITROGEN	+/- 0.6%	Aug 17, 2016
NO2	124206889130	CC323209	4.824 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Oct 25, 2015

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nexus 470 AEP0000428	FTIR	Nov 21, 2013
Nexus 470 AEP0000428	FTIR	Nov 21, 2013
Nexus 470 AEP0000428	FTIR	Nov 21, 2013

Triad Data Available Upon Request

Notes:

Approved for Release

Airgas

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
www.airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E03AI99E15A0PK1	Reference Number:	54-124409082-1
Cylinder Number:	CC1522	Cylinder Volume:	146.4 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12013	Valve Outlet:	590
Gas Code:	CH4,PPN,BALA	Certification Date:	Dec 17, 2013

Expiration Date: Dec 17, 2021

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
PROPANE	1000 PPM	996.3 PPM	G1	+/- 1% NIST Traceable	12/17/2013
METHANE	4000 PPM	4027 PPM	G1	+/- 0.7% NIST Traceable	12/16/2013
AIR	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM/C3H8	11060915	CC343413	1000.3 PPM PROPANE/NITROGEN	+/- 0.7%	Mar 04, 2017
CH4	10061306	CC282514	1.029 % METHANE/NITROGEN	+/- 0.6%	Jul 27, 2016

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801332	FTIR	Nov 22, 2013
(V-1)VARIAN CP3800 FID	FID	Dec 16, 2013

Triad Data Available Upon Request

Notes:

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Airgas Specialty Gases
525 North Industrial Loop Road
Tooele, UT 84074
435-241-5662 Fax: 435-241-5664
Airgas.com

Part Number:	E02AI99E15A1704	Reference Number:	153-124539631-1
Cylinder Number:	CC502914	Cylinder Volume:	146.2 CF
Laboratory:	ASG - Tooele - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72016	Valve Outlet:	660
Gas Code:	NO2,BALA	Certification Date:	Feb 23, 2016

Expiration Date: Feb 23, 2019

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
NITROGEN DIOXIDE	50.00 PPM	50.41 PPM	G1	+/- 2%	02/16/2016, 02/23/2016
AIR	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
GMIS	1	CC502151	99.60 PPM NITROGEN DIOXIDE/NITROGEN	1.20%	Jan 05, 2018
PRM	12358	APEX930720	100.3 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.0%	Jun 01, 2015

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS 18143349 NO2	FTIR	Feb 18, 2016

Triad Data Available Upon Request

Approved for Release

Airgas Specialty Gases
Airgas USA, LLC
525 North Industrial Loop Road
Tooele, UT 84074
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E02AI99E15A0465	Reference Number:	153-124573625-1
Cylinder Number:	EB0081576	Cylinder Volume:	146.2 CF
Laboratory:	124 - Tooele - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72016	Valve Outlet:	590
Gas Code:	PPN,BALA	Certification Date:	Aug 29, 2016

Expiration Date: Aug 29, 2024

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
PROPANE	100.0 PPM	99.03 PPM	G1	+/- 0.5% NIST Traceable	08/29/2016
AIR	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM/C3H8	08061008	CC262362	49.62 PPM PROPANE/AIR	+/- 0.3%	May 14, 2018

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AMP0900119 C3H8 MC3H8	FTIR	Aug 17, 2016

Triad Data Available Upon Request

Signature on file
Approved for Release

Airgas
an Air Liquide company

Airgas USA, LLC
525 North Industrial Loop Road
Tooele, UT 84074
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E03NI60E15A0286	Reference Number:	153-401197268-1
Cylinder Number:	ALM052887	Cylinder Volume:	159.6 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72018	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	May 08, 2018

Expiration Date: May 08, 2026

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

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	20.00 %	19.84 %	G1	+/- 0.8% NIST Traceable	05/08/2018
OXYGEN	20.00 %	19.98 %	G1	+/- 0.4% NIST Traceable	05/08/2018
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060713	CC413626	16.939 % CARBON DIOXIDE/NITROGEN	0.6	May 08, 2019
NTRM	09061433	CC282486	22.53 % OXYGEN/NITROGEN	0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA-510 SV4MEUTJ CO2	CO2 NDIR (Dixon)	Apr 19, 2018
Horiba MPA-510 X9A4UGL8 O2	O2 Paramagnetic (Dixon)	Apr 18, 2018

Triad Data Available Upon Request

Approved for Release

BISON ENGINEERING, INC.

ENVIRONICS MODEL 4040 GAS DILUTION CALIBRATOR
SERIAL NO. 3880
MASS FLOW CONTROLLER CERTIFICATION

Flow measurement standards:
Gilibrator Flow Cell S/N 1104013-H (2 - 30 lpm)
Certified NIST-Traceable by Sensidyne, LP on February 24, 2017

Gilibrator Flow Cell S/N 1104052-S (20 - 6,000 cc/min)
Certified NIST-Traceable by Sensidyne, LP on February 24, 2017

Standard Conditions referenced to 0 °C and 29.92 inches Hg

MFC #1 / RANGE: 10,000 SCCM / SN 3463700001

	Flow Setting	Flow (Standard Conditions)
100%	10,000 sccm	10,207 sccm
90%	9,000 sccm	9,196 sccm
80%	8,000 sccm	8,179 sccm
70%	7,000 sccm	7,248 sccm
60%	6,000 sccm	6,271 sccm
50%	5,000 sccm	5,307 sccm
40%	4,000 sccm	4,333 sccm
30%	3,000 sccm	3,382 sccm
20%	2,000 sccm	2,381 sccm
10%	1,000 sccm	1,384 sccm
5%	500 sccm	881.0 sccm

MFC #2 / RANGE: 10,000 SCCM / SN 346370002

	Flow Setting	Flow (Standard Conditions)
100%	10,000 sccm	9,895 sccm
90%	9,000 sccm	8,894 sccm
80%	8,000 sccm	7,903 sccm
70%	7,000 sccm	6,951 sccm
60%	6,000 sccm	6,001 sccm
50%	5,000 sccm	5,032 sccm
40%	4,000 sccm	4,071 sccm
30%	3,000 sccm	3,161 sccm
20%	2,000 sccm	2,148 sccm
10%	1,000 sccm	1,142 sccm
5%	500 sccm	634.5 sccm

MFC #3 / RANGE: 1,000 SCCM / SN 3474100001

	Flow Setting	Flow (Standard Conditions)
100%	1,000 sccm	1,001 sccm
90%	900 sccm	897.5 sccm
80%	800 sccm	794.5 sccm
70%	700 sccm	698.5 sccm
60%	600 sccm	597.6 sccm
50%	500 sccm	494.9 sccm
40%	400 sccm	393.5 sccm
30%	300 sccm	293.1 sccm
20%	200 sccm	192.5 sccm
10%	100 sccm	91.17 sccm
5%	50 sccm	40.55 sccm

Performed By: Steven R Hach

Date: 01-19-2018

BISON ENGINEERING, INC.

Field Barometer Calibration Form

Project #: HAV218775

IN OFFICE PRE-TEST CALIBRATION

Reference Standard Used:

Standard ID	Serial number	Adjusted on:	Calibration due:
Helena mercury barometer	BIS01	8/31/2018	Must be properly adjusted prior to every use

Field Barometer Verification:
Barometer ID:

Reference Value (in Hg)	Observed (in Hg)	Correction*	Tolerance (+/- 0.1 in Hg)**
26.26	26.26	0.00	PASS

*Correction is the difference between the observed and reference values
**EPA Method 5, Section 6.1.2 and EPA Method 2, Section 6.5.

Technician: ARB

Date: 8/31/2018

BISON ENGINEERING, INC.

Field Balance and Weights Calibration Form

Project #: HAV218775

IN OFFICE PRE-TEST CHECKS

Date: 8/31/2018

Performed by: ARB

Environmental conditions in the lab:

Temperature °F	Pressure "Hg
71	26.26

Reference Standard(s) Used:

Standard ID	Serial number(s)	Calibrated on:	Calibration due:
500g and 200g weight set	10696	1/18/2018	1/18/2019

Verification of Field Balance Against Reference Standard Weights:

Balance ID: Helena Field Balance #2

Nominal Value (g)	Observed (g)	Correction*	Tolerance (+/- 0.5g)**
200	200.1	0.1	PASS
500	499.9	0.1	PASS

Verification of Field Standard Weights :

Weights ID: Helena Field Weights #2

Nominal Value (g)	Observed (g)	Correction*	Tolerance (+/- 0.5g)**
200	200.1	0.1	PASS
500	500.0	0.0	PASS

*Correction is the difference between the observed and nominal mass values

**EPA Method 5, Section 6.3.4

ONSITE BALANCE VERIFCATION

Date: 9/11/2018
Performed by: ARB

Environmental conditions onsite:

Temperature °F	Pressure "Hg
60	29.91

Field Balance Verification:

Balance ID: Helena Field Balance #2
Weights ID: Helena Field Weights #2

Nominal Value (g)	Observed (g)	Correction*	PASS/FAIL Tolerance (+/- 0.5g)
500	499.9	0.1	PASS
200	200.0	0.0	PASS

*Correction is the difference between the observed and nominal mass values

BISON ENGINEERING, INC.

Field Caliper
Calibration Form

Project #: HAV218775

IN OFFICE PRE-TEST CHECKS

Date: 8/31/2018
Performed by: ARB

Reference Standard Used:

Standard ID	Serial number	Calibrated on:	Calibration due:
HLN1	77160806226	10/9/2017	10/9/2018

Field Caliper Verification:

Caliper ID: MN-2

Inside Diameter

Reference Value (g)	Observed (g)	Correction*	Tolerance (+/- 0.0050 inch)
0.695	0.696	0.001	PASS

*Correction is the difference between the observed and reference values

Outside Diameter

Reference Value (g)	Observed (g)	Correction*	Tolerance (+/- 0.0050 inch)
0.750	0.752	0.002	PASS

*Correction is the difference between the observed and reference values

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Version: 8/24/2018

BISON ENGINEERING, INC.

Thermocouple Calibration Form

Project #: HAV218775

POST-TEST CHECKS

Reference Standard Used:

Standard ID	Serial number(s)	Calibrated on:	Calibration due:
Omega	T-318009	5/22/2018	5/22/2019

Temperature Meter Mode:

Thermocouple ID	Continuity (x = pass)	Observed Temp (°F)	Reference Temp (°F)	Correction*	Tolerance (+/- 2°F)**
Stack Temp - Probe 3B	x	69.5	69.3	0.2	PASS
Stack Temp - Probe 3C	x	69.4		0.1	PASS
Stack Temp - Probe 1307999	x	69.0		0.3	PASS
Probe Liner - 3B	x	69.7		0.4	PASS
Probe Liner - 3C	x	69.2		0.1	PASS
Probe Liner - 1307999	x	70.0		0.7	PASS
Hot box HB3	x	69.5		0.2	PASS
Hot box M5-HB	x	69.8		0.5	PASS
Condenser - GN1	x	68.5		0.8	PASS
Condenser - GN2	x	69.0		0.3	PASS
Condenser - GN3	x	69.2		0.1	PASS
Condenser - GN4	x	69.1		0.2	PASS
DGM 12 Outlet	x	69.4		0.1	PASS
DGM 13 Outlet	x	69.3		0.0	PASS

Calibration Output Mode:

Switch the Omega from 'Meter Input' to 'Calibration Output' mode. Test the meter box temperature readout by sending a voltage output equivalent to a temperature similar to stack temperature.

Meter Box ID	Reference Temp Output (°F)	Meter Box Readout (°F)	Correction*	Tolerance (+/- 2°F)**
12	120.0	120	0.0	PASS
13		121	1.0	PASS

*Correction is the difference between the observed and reference values
**Alt-011 6/21/94 Alternative Method 2 Thermocouple Calibration Procedure:
Continuity Check - confirm the thermocouple is reading at the tip by subjecting it to a change in temperature (e.g. removing it from the stack, or touching with an ice cube).
Single-point temperature check at ambient temperature, or any temperature, within the range specified by the manufacturer.

Technician: Kelly Dorsi

Date: 10/25/2018

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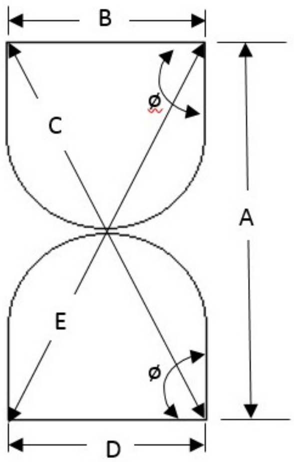
Version: 8/24/2018

S-Type Pitot Tube Geometric Calibration

Pitot ID: 3B

Date of Geometric Calibration (< 6 months): 10/25/2018



A	0.892
B	0.391
C	0.937
D	0.38
E	0.941

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos \emptyset$$

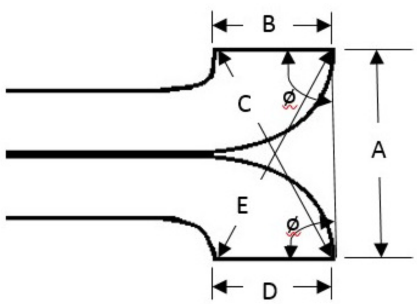
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos \emptyset$$

ø	84.19

$(80° < \emptyset < 100°)$

ø	85.38

$(80° < \emptyset < 100°)$



A	0.893
B	0.62
C	1.123
D	0.623
E	1.086

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos \emptyset$$

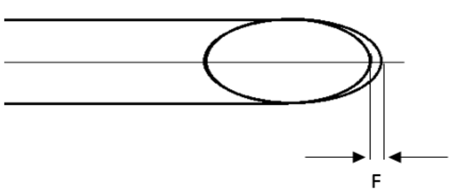
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos \emptyset$$

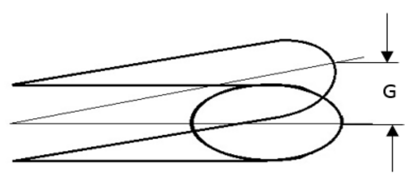
ø	94.11

$(85° < \emptyset < 95°)$

ø	89.68

$(85° < \emptyset < 95°)$





F=	0.04

(F < 0.125)

G=	0.00

(G < 0.032)

Results of the Post-Test Pitot Inspection (mark with x below)**:**

No change __________

Damaged __________

New Calibration x

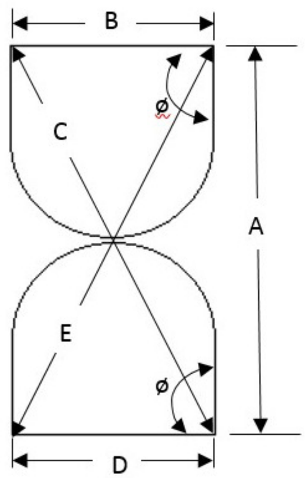
Technician: CSW

Date: 10/25/2018

S-Type Pitot Tube Geometric Calibration

Pitot ID: 3C

Date of Geometric Calibration (< 6 months): 10/25/2018



A	0.93
B	0.375
C	0.988
D	0.375
E	0.988

$$\frac{a^2+b^2-c^2}{2ab} = \cos \emptyset$$

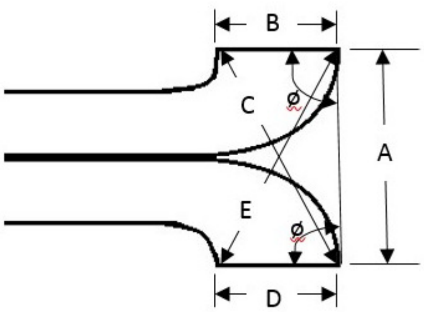
$$\frac{a^2+d^2-e^2}{2ad} = \cos \emptyset$$

ø	87.59

$(80° < \emptyset < 100°)$

ø	87.59

$(80° < \emptyset < 100°)$



A	0.921
B	0.605
C	1.12
D	0.605
E	1.12

$$\frac{a^2+b^2-c^2}{2ab} = \cos \emptyset$$

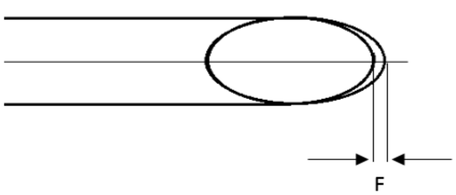
$$\frac{a^2+d^2-e^2}{2ad} = \cos \emptyset$$

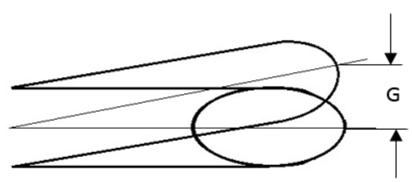
ø	92.06

$(85° < \emptyset < 95°)$

ø	92.06

$(85° < \emptyset < 95°)$





F=	0.06

(F < 0.125)

G=	0.00

(G < 0.032)

Results of the Post-Test Pitot Inspection (mark with x below)**:**

No change ________

Damaged ________

New Calibration x

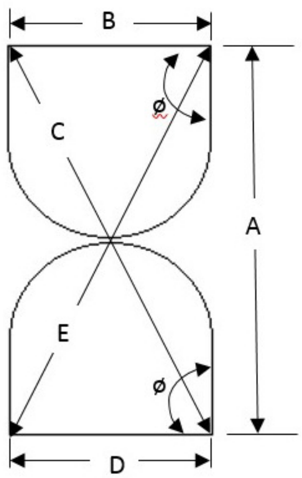
Technician: CSW

Date: 10/25/2018

S-Type Pitot Tube Geometric Calibration

Pitot ID: 1307999

Date of Geometric Calibration (< 6 months): 10/25/2018



A	0.931
B	0.387
C	0.995
D	0.39
E	0.97

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos Ø$$

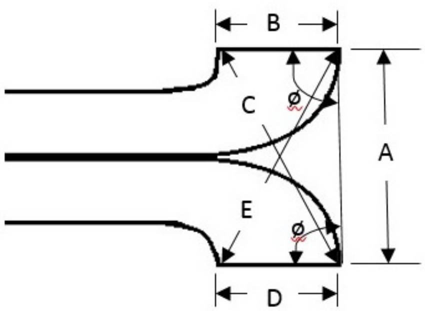
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos Ø$$

ø	87.89

$(80° < Ø < 100°)$

ø	83.84

$(80° < Ø < 100°)$



A	0.933
B	0.56
C	1.094
D	0.587
E	1.08

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos Ø$$

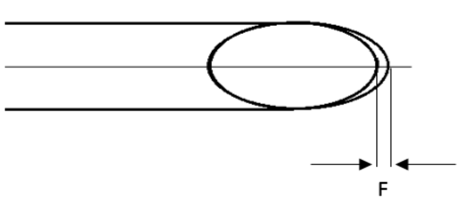
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos Ø$$

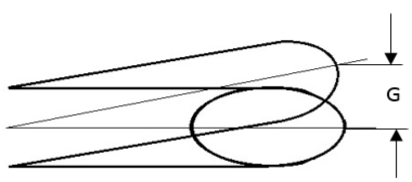
ø	90.70

$(85° < Ø < 95°)$

ø	87.45

$(85° < Ø < 95°)$





F=	0.06

(F < 0.125)

G=	0.00

(G < 0.032)

Results of the Post-Test Pitot Inspection (mark with x below)**:**

No change ________

Damaged ________

New Calibration x

Technician: CSW

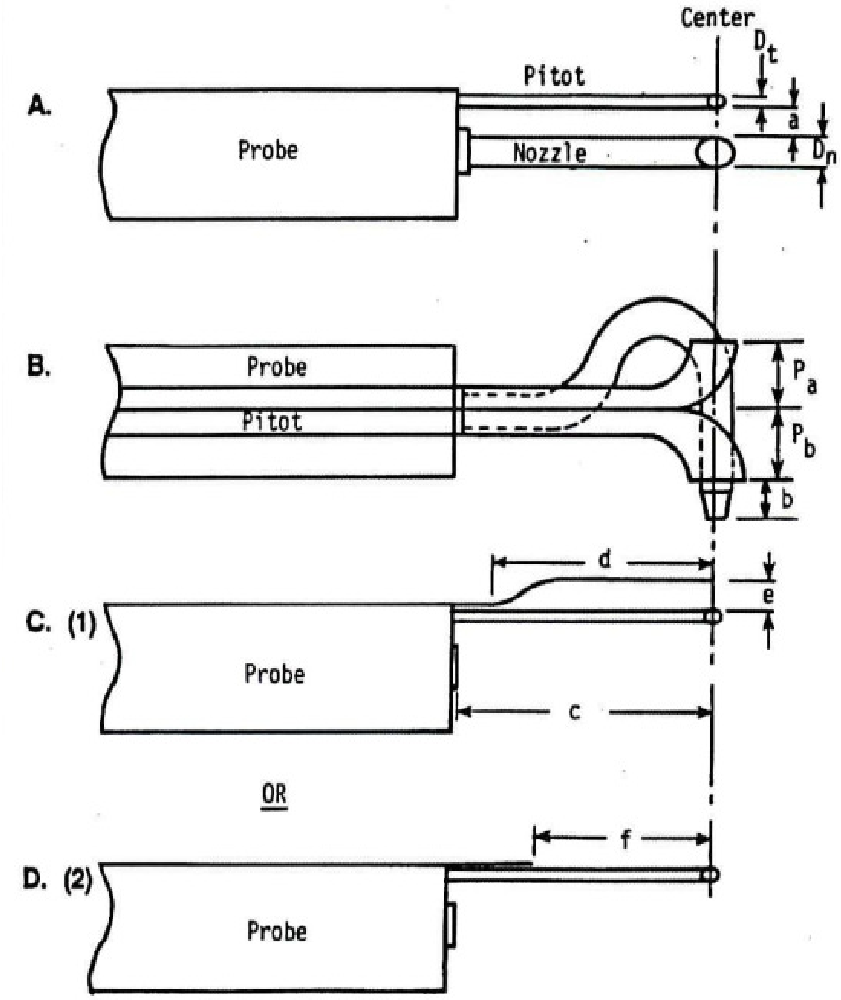
Date: 10/25/2018

Probe Calibration

Probe ID: 3B

Date of calibration (< 6 months): 10/25/2018

Measure (Inch)



Dt:	3/8	Dt = 0.187 to 0.375
Dn:	1/2	Dn = 0.5
a:	8/9	a ≥ 0.750

Pa:	2/5	Pa = Pb
Pb:	2/5	
b:	4/5	B ≥ 0

c:	3 2/5	c ≥ 3.0
d:	6 1/2	d ≥ 3.0
e:	1 1/2	e ≥ 0.750

or

f:		f ≥ 2.0

Results of the Post-Test Probe Inspection (mark with x below)**:**

No change ________

Damaged ________

New Calibration x

Technician: CSW **Date:** 10/25/2018

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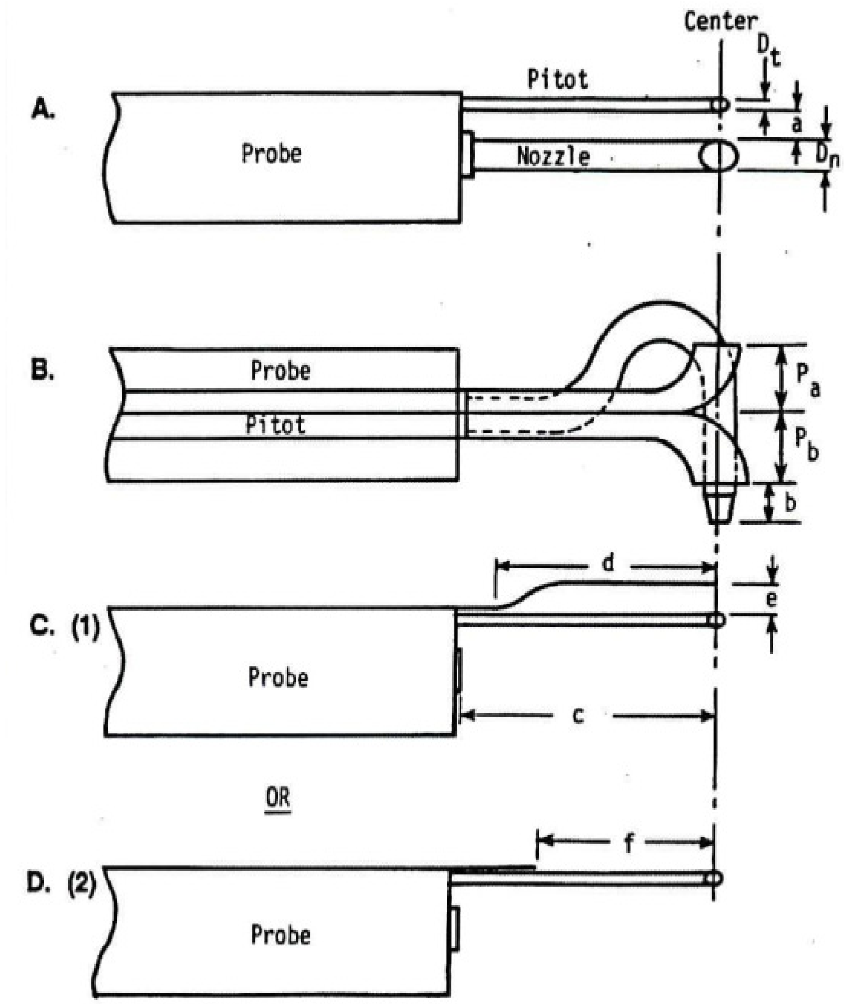
Version: 8/24/2018

Probe Calibration

BISON ENGINEERING, INC.

Probe ID: 3C

Date of calibration (< 6 months): 10/25/2018



Measure (Inch)

Dt:	3/8	**Dt = 0.187 to 0.375**
Dn:	1/2	**Dn = 0.5**
a:	5/6	**a ≥ 0.750**

Pa:	3/8	**Pa = Pb**
Pb:	3/8	
b:	1 1/2	**B ≥ 0**

c:	4 4/9	**c ≥ 3.0**
d:	4	**d ≥ 3.0**
e:	1 1/8	**e ≥ 0.750**

or

f:		**f ≥ 2.0**

Results of the Post-Test Probe Inspection (mark with x below)**:**

No change ________

Damaged ________

New Calibration ___x___

Technician: CSW **Date:** 10/25/2018

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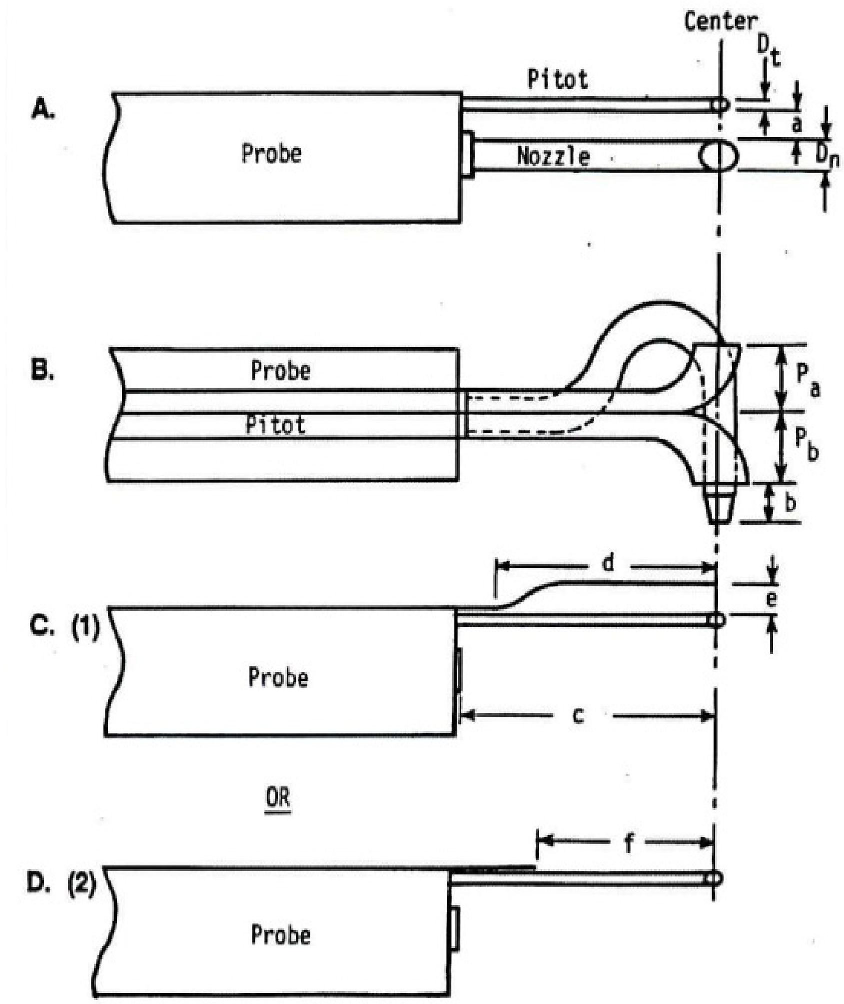
Version: 8/24/2018

Probe Calibration

Probe ID: 1307999
Date of calibration (< 6 months): 10/25/2018

Measure (Inch)



Dt:	1/2	Dt = 0.187 to 0.375
Dn:	1/2	Dn = 0.5
a:	3/4	a ≥ 0.750

Pa:	4/9	Pa = Pb
Pb:	4/9	
b:	1 1/4	B ≥ 0

c:	4 5/9	c ≥ 3.0
d:	5 3/8	d ≥ 3.0
e:	1 3/5	e ≥ 0.750

or

f:		f ≥ 2.0

Results of the Post-Test Probe Inspection (mark with x below)**:**

No change _________

Damaged _________

New Calibration ____x____

Technician: CSW **Date:** 10/25/2018

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Version: 8/24/2018

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A2LA ACCREDITED
CERTIFICATE #1550.01

Bison Engineering
1400 11th Avenue
Helena, MT 59601

Report Number: BISE0132350167180719

A2LA ACCREDITED
CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Balance	Sartorius	Practum124-1S	32350167	N/A	Lab
Units	**Readability**	**SOP**	**Cal Date**	**Last Cal Date**	**Cal Due Date**
g	0.0001	QC012	7/19/18	7/31/17	7/2019

FUNCTIONAL CHECKS

ECCENTRICITY
Test Wt: 100 Tol: 0.0003
As-Found: Pass: ☑ Fail: ☐
As-Left: Pass: ☑ Fail: ☐

LINEARITY
Test Wt: 25 x 4 Tol: 0.0002
As-Found: Pass: ☑ Fail: ☐
As-Left: Pass: ☑ Fail: ☐

STANDARD DEVIATION
Test Wt: 20 Tol: 0.0001

1. 19.9999	5. 19.9999	9. 19.9999
2. 19.9999	6. 20.0000	10. 19.9999
3. 20.0000	7. 20.0001	**Result**
4. 20.0000	8. 20.0000	0.00007

ENVIRONMENTAL CONDITIONS
☐ Good ☑ Fair ☐ Poor
Temperature: 23.5°C

A2LA ACCREDITED SECTION OF REPORT

Standard	As-Found	As-Left	Expanded Uncertainty
100	99.9997	100.0000	0.00018
50	49.9999	50.0000	0.00018
20	19.9999	20.0000	0.00018
10	9.9999	10.0000	0.00018
1	1.0000	1.0000	0.00018
0.1	0.0999	0.1000	0.00018

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	Rice Lake	5kg to 1mg	10565	6/21/18	6/2019	20181224

Permanent Information Concerning this Equipment:
7/18 Relative humidity = 23.5%

Comments/Info Concerning this Calibration:
7/18 Adjusted span.

Report prepared/reviewed by: [signature] **Date:** 7.19.18 **Technician:** D.Oudeans
Signature: [signature]

The uncertainty is calculated according to the ISO Guide to the Expression of Uncertainty in Measurement and includes the uncertainty of standards used combined with the observed standard deviation and readability of the unit under test. The uncertainty is expanded with a k factor of 2 for an approximate 95% level of confidence. Instruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy. Calibrations comply with ISO/IEC 17025 and ANSI/Z540-1-1994 quality standards.

PT ID: BISE01

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ACCREDITED
CERTIFICATE #1550.01

Report of Calibration

Firm: Bison Engineering	Test Completed: 01/18/18
Address: 1400 11th Avenue	Purchase Order: RMB121517
City/State/Zip: Helena, MT 59601	Traceable Number: 20180079

Test Item: 500 g and 200 g Weight Set
Serial No.: 10696

Manufacturer: Rice Lake

Material	Assumed Density	Range	Tolerance Class
Stainless Steel	7.84 g/cm^3	500 g & 200 g	NIST HB 105-1 (F)

Method and Traceability
The procedure used for this calibration is NIST IR 6969 SOP 7 Single Substitution Weighing Design. Standards used for comparison are traceable to the National Institute of Standards and Technology (reports on file) and are part of a comprehensive measurement assurance program for ensuring continued accuracy and traceability within the level of uncertainty reported. The Traceable Number listed above is Traceable to National Standards through an unbroken chain of comparison each having stated uncertainties.

Standards Used:
20 kg to 200 g Working Standards Were Calibrated: 02/21/17 Due: 02/28/18 Standards ID: 75388
Mass Comparators Used: MET-08 **Tested by:** D. Thompson

Conventional Mass: "The conventional value of the result of weighing a body in air is equal to the mass of a standard, of conventionally chosen density, at a conventionally chosen temperature, which balances this body at this reference temperature in air of conventionally chosen density. International Recommendation 33 (OIML IR 33 1973, 1979). "Conventional Value of the Result of Weighing in Air" **(Previously known as "Apparent Mass vs. 8.0 g/cm^3).**

Uncertainty Statement: The uncertainty conforms to the ISO Guide to the Expressions of Uncertainty in Measurement. Uncertainty as reported is based on a coverage factor k=2 for an approximate 95 percent level of uncertainty. Uncertainty components include the standard deviation of the process, the uncertainty of the standard used, an uncertainty component associated with the potential drift of the standard used, and the estimated uncertainty related to measuring and determining the air buoyancy effect.

Conventional Mass Values are listed on page 2 of this report.

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 01/18/18

Signature David S. Thompson

 1378

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CERTIFICATE #1550.01

Report of Calibration

Firm: Bison Engineering
Address: 1400 11th Avenue
City/State/Zip: Helena, MT 59601

Test Completed: 01/18/18
Purchase Order: RMB121517
Traceable Number: 20180079

Test Item: 500 g and 200 g Weight Set
Serial No.: 10696

Manufacturer: Rice Lake

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
21.943	758.09	49.46

Conventional Mass Value

Nominal Value	As Found Value (g)	As Found Correction (mg)	Uncertainty (mg)	Tolerance (mg)
500 g	500.0192	19.2	1.0	70
200 g	200.0111	11.1	1.0	40

*Correction is the difference between the conventional mass value of a weight and its nominal value.

Comments: These weights were new from the manufacturer and were within NIST Handbook 105-1 Class F tolerances As Found. No adjustments or changes were made so As Found values should be considered to be As Left values.

Accredited by the American Association for Laboratory Accreditation (A2LA) under Calibration Laboratory Code 115953 and Certificate Number 1550.01. This laboratory meets the requirements of ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories.* This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration.

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 01/18/18

Signature David S. Thompson

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To Whom It May Concern:

In an effort to assist our customers with meeting the requirements of the Instrumental Methods for testing, 3A, 6C, 7E, 10, and 20, we are providing a summary of interferences for certain Thermo Scientific analyzers.

The requirement for conducting analyzer interference checks for potential interfering gases is the responsibility of the testing organizations. The Methods do, however, allow the manufacturer of instruments to provide this data. Test are required to be conducted on the same "make and model" as those being used for method testing.

The information contained in the accompanying tables pertains to the "make" of analyzers under the names of; Thermo Electron Corporation, Thermo Environmental Instruments and Thermo Scientific. The "model" are models; Model 42 for NO, NO_2, NO_x, Model 43 for SO_2, and Model 410i for CO_2. The specific pollutant detection and analytical technology for each of the above listed specific models have remained the same for the various series of analyzers manufactured over the past years. Therefore, the interference test results shown for iSeries analyzers would produce essentially the same results for C Series and earlier Series of these models.

The potential interference gases test results shown in the tables to follow indicate that none of the Thermo Scientific analyzers tested have a collective analytical detection interference that would sum more than 0.06% of analyzer span value. The acceptance criterion is; the sum of the interference responses must not be greater than 2.5% of analyzer span value.

If you have any questions regarding the information contained herein please do no hesitate to contact us.

Thermo Fisher Scientific

Frank Duckett
Product Manager, Continuous Gas Analyzers
Air Quality Instruments

Air Quality Instruments | 27 Forge Parkway | Franklin, MA | (508) 520-0430 | www.thermofisher.com
Environmental Instruments | 02038 | (508) 520-1460 fax

Thermo Fisher SCIENTIFIC

Thermo Scientific Model 42 NO-NO_2-NO_x Analyzer
Potential Interference Gas Responses

Potential Interferent		*Model 42iLS*			*Model 42iHL*		
Test Gas	***Concentration***	***NO***	***NO_2***	***NO_x***	***NO***	***NO_2***	***NO_x***
CO_2	5.20%	0.001	0.004	0.004	0.001	0.003	0.004
CO_2	15.60%	0	0.003	0.003	0.001	0.004	0.005
H_2O	1.00%	0	0	0	0.003	0.001	0.004
NO	15 ppm	14.9	0.1	15	15	-0.06	14.99
NO_2	15 ppm	1.1	14	15	0.4	14.6	15
N_2O	10 ppm	0	0	0	0	0	0
CO	50 ppm	0	0	0	0	0	0
SO_2	21 ppm	-0.01	0	-0.01	0.007	0	0.007
CH_4	50 ppm	0	0	0	0	0	0
HCl	10 ppm	0	0.006	0.006	0	0.004	0.004
NH_3[1]	10 ppm	0	0	0	0.17	8.9	9.1
Sum of Responses		**0.011**	**0.01**	**0.02**	**0.011**	**0.009**	**0.02**
Span Value		**160**	**152**	**160**	**160**	**152**	**160**
% of Calibration Span		**0.01%**	**0.01%**	**0.01%**	**0.01%**	**0.01%**	**0.01%**

Acceptance Criteria found in Section 13.4 of Method 7E is the sum of responses must not be greater than 2.5% of the analyzer calibration span value.

[1]NH_3 interferent results shown for the Model 42iHL was not used in calculation of interference response check because it is a known interferent with an approximate 1 ppm to 1 ppm positive bias in analyzers using stainless steel NO_2 to NO converters. Thermo recommends that NO_x analyzers with stainless steel NO_2 to NO converters must use a NH_3 scrubber when testing sources with potential NH_3 in the flue gas.

This document is subject to change without notice.

Thermo Fisher SCIENTIFIC

Thermo Scientific Model 43 SO_2 and Model 410i CO_2 Analyzer Potential Interference Gas Responses

Potential Interferent		***Model 43iLH***	***Model 410iHL***
Test Gas	***Concentration***	***SO_2***	***CO_2***
CO_2	5.20%	0.03	5.2
CO_2	15.60%	0.14	15.6
H_2O	1.00%	-0.05	0
NO	15 ppm	0.2	0
NO_2	15 ppm	0.06	0
N_2O	10 ppm	0	0
CO	50 ppm	0	0
SO_2	21 ppm	21	0
CH_4	50 ppm	0	0
HCl	10 ppm	0	0
NH_3	10 ppm	0	0
Sum of Responses		**0.45**	**0**
Span Value		**800**	**16**
% of Calibration Span		**0.06%**	**0%**

Acceptance Criteria found in Section 13.4 of Method 7E is the sum of responses must not be greater than 2.5% of the analyzer calibration span value.

This document is subject to change without notice.

This is the last page
of the report.