CERAMIC FILTRATION UNITS
107, 114 AND 117
VERIFICATION OF EMISSION FACTORS
TEST REPORT

HOLLINGSWORTH & VOSE
FIBER COMPANY

Prepared for:

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Report Date:
August 13, 2018

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 2, CFUs 114 (Flame Blown) and 117 (Rotary Fine), and Glass Plant 1, CFU 107 (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 second round of testing H&V has conducted 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. 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 114 (Flame Blown) CFU 117 (Rotary Fine) CFU 107 (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 60-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; Dale Smith, Environmental Technician; 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 114 – Glass Plant 2 (GP2)

Stack diameter: 36 inches
Distance A (Method 1): 45 inches (1.25 duct diameters)
Distance B (Method 1): 134 inches (3.72 duct diameters)
Port depth: 4 inches
Number of traverse points utilized: 24

This unit controls the flame blown process. Testing was conducted on the vertical outlet stack using two orthogonal ports. The ports were accessed using scaffolding.

2.2.2 CFU 117 – GP2

Stack diameter: 30 inches
Distance A (Method 1): 42 inches (1.40 duct diameters)
Distance B (Method 1): 152 inches (5.07 duct diameters)
Port depth: 4 inches
Number of traverse points utilized: 20

CFU 117 is also located at GP2. The rotary fine process was tested on this stack. Two orthogonal sampling ports are located on vertical ductwork accessed via scaffolding.

2.2.3 CFU 107 – Glass Plant 1 (GP1)

Stack diameter: 30 inches
Distance A (Method 1): 44 inches (1.47 duct diameters)
Distance B (Method 1): 125 inches (4.17 duct diameters)
Port depth: 4 inches
Number of traverse points utilized: 24

CFU 107 is located at GP1. The rotary coarse process was tested on this stack. Two orthogonal sampling ports are located on vertical ductwork accessed via scaffolding.

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 June 6 – 14, 2018						
Source	**Date**	**Method**	**Run**	**Start Time**	**End Time**	**Run Duration**
CFU 114 Flame Blown	6/5/2018	M13B – Total Fluorides	1	10:31	12:40	2:09
	6/5/2018	M13B – Total Fluorides	2	13:10	15:21	2:11
	6/5/2018	M13B – Total Fluorides	3	15:50	17:59	2:09
	6/5/2018	M26 - HF	1	10:30	12:38	2:08
	6/5/2018	M26 - HF	2	13:10	15:20	2:10
	6/5/2018	M26 - HF	3	15:50	17:58	2:08
	6/6/2018	Gases\M5 - Particulate	1	9:40	11:49	2:09
	6/6/2018	Gases\M5 - Particulate	2	12:30	14:39	2:09
	6/6/2018	Gases\M5 - Particulate	3	15:15	17:23	2:08
	6/6/2018	M316 -Formaldehyde	1	9:41	11:50	2:09
	6/6/2018	M316 -Formaldehyde	2	12:31	14:40	2:09
	6/6/2018	M316 -Formaldehyde	3	15:16	17:25	2:09
	6/7/2018	M29 – Metals	1	8:05	11:12	3:07
	6/7/2018	M29 – Metals	2	11:40	14:48	3:08
	6/7/2018	M29 – Metals	3	15:05	18:10	3:05
	6/7/2018	M30B – Mercury	1	8:06	11:12	3:06
	6/7/2018	M30B – Mercury	2	11:40	14:49	3:09
	6/7/2018	M30B - Mercury	3	15:06	18:11	3:05
CFU 117 Rotary Fine	6/8/2018	M29 – Metals	1	7:35	10:44	3:09
	6/8/2018	M29 – Metals	2	11:05	14:12	3:07
	6/8/2018	M29 – Metals	3	14:27	17:34	3:07
	6/8/2018	M30B – Mercury	1	7:36	10:45	3:09
	6/8/2018	M30B – Mercury	2	11:06	14:13	3:07
	6/8/2018	M30B - Mercury	3	14:28	17:35	3:07
	6/9/2018	Gases\M5 - Particulate	1	8:15	10:22	2:07
	6/9/2018	Gases\M5 - Particulate	2	10:45	12:52	2:07
	6/9/2018	Gases\M5 - Particulate	3	13:20	15:32	2:12
	6/9/2018	M316 -Formaldehyde	1	8:16	10:23	2:07

CFU 117 Rotary Fine	6/9/2018	M316 -Formaldehyde	2	10:46	12:54	2:08
	6/9/2018	M316 -Formaldehyde	3	13:21	15:33	2:12
	6/9/2018	M13B – Total Fluorides	1	16:05	18:14	2:09
	6/10/2018	M13B – Total Fluorides	2	7:36	9:43	2:07
	6/10/2018	M13B – Total Fluorides	3	10:01	12:05	2:04
	6/9/2018	M26 - HF	1	16:05	18:10	2:05
	6/10/2018	M26 - HF	2	7:36	9:42	2:06
	6/10/2018	M26 - HF	3	10:00	12:06	2:06
CFU 107 Rotary Coarse	6/12/2018	M29 – Metals	1	8:35	12:00	3:25
	6/12/2018	M29 – Metals	2	12:25	15:27	3:02
	6/12/2018	M29 – Metals	3	15:55	18:59	3:04
	6/12/2018	M30B – Mercury	1	8:36	12:00	3:24
	6/12/2018	M30B – Mercury	2	12:25	15:27	3:02
	6/12/2018	M30B - Mercury	3	15:55	18:59	3:04
	6/13/2018	M13B – Total Fluorides	1	11:55	14:08	2:13
	6/13/2018	M13B – Total Fluorides	2	14:23	16:31	2:08
	6/13/2018	M13B – Total Fluorides	3	16:45	18:53	2:08
	6/13/2018	M26 - HF	1	11:55	14:07	2:12
	6/13/2018	M26 - HF	2	14:23	16:31	2:08
	6/13/2018	M26 - HF	3	16:46	18:53	2:07
	6/14/2018	Gases\M5 - Particulate	1	9:16	11:21	2:05
	6/14/2018	Gases\M5 - Particulate	2	11:51	13:56	2:05
	6/14/2018	Gases\M5 - Particulate	3	14:31	16:36	2:05
	6/14/2018	M316 -Formaldehyde	1	9:15	11:21	2:06
	6/14/2018	M316 -Formaldehyde	2	11:51	13:57	2:06
	6/14/2018	M316 -Formaldehyde	3	14:31	16:36	2:05

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 114 (Flame Blown) Non-Metals Test Results

Hollingsworth & Vose Corvallis, OR CFU 114 - Flame Blown Results Summary June 5 - 6, 2018					
Parameters	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	6/6/2018	6/6/2018	6/6/2018	-
Stack Temperature*	°F	291.7	296.8	296.6	295.0
Stack Moisture*	% v/v	1.94	2.11	2.02	2.02
Oxygen Content*	%	19.81	19.82	19.81	19.81
CO_2 Content*	%	0.71	0.72	0.71	0.71
Stack Flow Rate*	DSCFM	23,261.0	20,011.1	20,118.8	21,130.3
Sample Volume*	dscf	149.527	129.460	131.111	136.699
Filterable Particulate Matter (PM)	gr/dscf	9.95E-05	1.25E-04	1.13E-04	1.12E-04
	lbs/hr	1.98E-02	2.15E-02	1.94E-02	2.02E-02
	lb/lb glass	3.25E-04	3.52E-04	3.18E-04	3.32E-04
Condensable PM Inorganic	gr/dscf	1.29E-04	1.45E-04	4.15E-04	2.30E-04
	lbs/hr	2.58E-02	2.49E-02	7.16E-02	4.08E-02
	lb/lb glass	4.23E-04	4.09E-04	1.17E-03	6.68E-04
Condensable PM Organic	gr/dscf	2.36E-05	7.24E-05	9.25E-05	6.28E-05
	lbs/hr	4.70E-03	1.24E-02	1.59E-02	1.10E-02
	lb/lb glass	7.71E-05	2.03E-04	2.61E-04	1.81E-04
Total PM (Measured)†	gr/dscf	2.52E-04	3.43E-04	6.20E-04	4.05E-04
	lbs/hr	5.03E-02	5.88E-02	1.07E-01	7.20E-02
	lb/lb glass	8.25E-04	9.64E-04	1.75E-03	1.18E-03
Nitrogen Oxides (NO_x) Emissions	ppmvd	5.34	5.32	5.32	5.33
	lb/hr	0.89	0.76	0.77	0.81
	lb/lb glass	1.46E-02	1.25E-02	1.26E-02	1.32E-02
	lb/Mscf n.g.	0.15	0.13	0.13	0.14
Volatile Organic Compounds (VOCs) (Method 25A)	ppmvw	0.28	0.28	0.17	0.24
	lbs/hr	4.55E-02	3.92E-02	2.39E-02	3.62E-02
	lb/lb glass	7.46E-04	6.43E-04	3.92E-04	5.94E-04
	lb/Mscf n.g.	7.75E-03	6.60E-03	4.01E-03	6.12E-03

Hollingsworth & Vose
Corvallis, OR
CFU 114 - Flame Blown
Results Summary
June 5 - 6, 2018

Parameter	Units	Run 1	Run 2	Run 3	Average
Test Date – M5/M316/Gases	-	6/6/2018	6/6/2018	6/6/2018	-
Carbon Monoxide (CO)	ppmvd	135.50	137.23	136.12	136.28
	lb/hr	13.75	11.98	11.95	12.56
	lb/lb glass	0.23	0.20	0.20	0.21
	lb/Mscf n.g.	2.34	2.01	2.00	2.12
Formaldehyde (CH_2O)	lb/hr	1.15E-02	2.65E-02	1.20E-02	1.67E-02
	lb/lb glass	1.89E-04	4.34E-04	1.97E-04	2.73E-04
	lb/Mscf n.g.	1.96E-03	4.45E-03	2.01E-03	2.81E-03
Total VOCs (M25A + CH_2O)	lb/hr	5.70E-02	6.57E-02	3.59E-02	5.29E-02
	lb/lb glass	9.35E-04	1.08E-03	5.89E-04	8.67E-04
	lb/Mscf n.g.	9.71E-03	1.11E-02	6.02E-03	8.93E-03
Test Date – M13B/26A	-	6/5/2018	6/5/2018	6/5/2018	-
Hydrogen Fluorides (HF)	ppmvd	3.49E-03	3.82E-03	3.78E-03	3.70E-03
	lb/hr	2.27E-04	2.47E-04	2.42E-04	2.39E-04
	lb/lb glass	3.72E-06	4.04E-06	3.97E-06	3.91E-06
Total Fluorides	ppmvd	2.21E-02	<1.39E-02	<1.40E-02	<1.67E-02
	lb/hr	1.38E-03	<8.59E-04	<8.56E-04	<1.03E-03
	lb/lb glass	2.26E-05	<1.41E-05	<1.40E-05	<1.69E-05

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 114 (Flame Blown) Metals Results

Hollingsworth & Vose Corvallis, OR CFU 114 - Flame Blown Metals Results Summary June 7, 2018 Average Results				
Parameter	**Species**	**µg/dscm**	**lb/hr**	**lb/lb glass**
Metals (Method 29)	Antimony	<0.481	<3.79E-05	<6.20E-07
	Arsenic	<0.477	<3.75E-05	<6.16E-07
	Barium	0.081	6.37E-06	1.04E-07
	Beryllium	<0.014	<1.07E-06	<1.76E-08
	Cadmium	<0.027	<2.15E-06	<3.52E-08
	Chromium	0.032	2.53E-06	4.15E-08
	Cobalt	<0.034	<2.68E-06	<4.40E-08
	Copper	0.465	3.67E-05	6.02E-07
	Lead	<0.341	<2.68E-05	<4.40E-07
	Manganese	0.076	6.04E-06	9.89E-08
	Nickel	<0.133	<1.05E-05	<1.73E-07
	Phosphorus	<1.362	<1.07E-04	<1.76E-06
	Selenium	<1.022	<8.05E-05	<1.32E-06
	Zinc	1.701	1.34E-04	2.20E-06
Mercury (Method 30B)†	Mercury	3.60E-03	2.85E-07	4.67E-09

'<' denotes results calculated using the MDL for front half or back half results that were non-detect.
† Two-run average shown due to voided run. See section 3.3 for further details.

Table 5: CFU 117 (Rotary Fine) Non-Metals Results

Hollingsworth & Vose Corvallis, OR CFU 117 – Rotary Fine Results Summary June 9 - 10, 2018					
Parameters	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	6/9/2018	6/9/2018	6/9/2018	-
Stack Temperature*	°F	242.5	240.9	241.7	241.7
Stack Moisture*	% v/v	1.75	1.79	1.90	1.81
Oxygen Content*	%	19.90	19.96	19.91	19.92
CO_2 Content*	%	0.63	0.62	0.62	0.62
Stack Flow Rate*	DSCFM	18,701.2	19,503.4	18,748.3	18,984.3
Sample Volume*	dscf	118.128	122.493	117.848	119.490
Filterable Particulate Matter (PM)	gr/dscf	1.84E-04	8.19E-05	2.08E-04	1.58E-04
	lbs/hr	2.95E-02	1.37E-02	3.34E-02	2.55E-02
	lb/lb glass	2.51E-04	1.16E-04	2.84E-04	2.17E-04
Condensable PM Inorganic	gr/dscf	1.31E-04	1.65E-04	1.79E-04	1.58E-04
	lbs/hr	2.10E-02	2.75E-02	2.87E-02	2.58E-02
	lb/lb glass	1.79E-04	2.34E-04	2.44E-04	2.19E-04
Condensable PM Organic	gr/dscf	1.39E-04	1.69E-04	8.98E-05	1.33E-04
	lbs/hr	2.23E-02	2.83E-02	1.44E-02	2.17E-02
	lb/lb glass	1.90E-04	2.41E-04	1.23E-04	1.84E-04
Total PM (Measured)†	gr/dscf	4.54E-04	4.16E-04	4.76E-04	4.49E-04
	lbs/hr	7.28E-02	6.95E-02	7.65E-02	7.29E-02
	lb/lb glass	6.19E-04	5.92E-04	6.51E-04	6.21E-04
Nitrogen Oxides (NO_x) Emissions	ppmvd	2.86	2.89	2.95	2.90
	lb/hr	0.38	0.40	0.40	0.39
	lb/lb glass	3.26E-03	3.44E-03	3.37E-03	3.36E-03
	lb/Mscf n.g.	7.27E-02	7.66E-02	7.50E-02	7.48E-02
Volatile Organic Compounds (VOCs) (Method 25A)	ppmvw	0.93	0.82	0.83	0.86
	lbs/hr	0.12	0.11	0.11	0.11
	lb/lb glass	1.03E-03	9.50E-04	9.25E-04	9.69E-04
	lb/Mscf n.g.	2.30E-02	2.12E-02	2.06E-02	2.16E-02

Hollingsworth & Vose Corvallis, OR CFU 117 – Rotary Fine Results Summary June 9 - 10, 2018					
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
Test Date – M5/M316/Gases	-	6/9/2018	6/9/2018	6/9/2018	-
Carbon Monoxide (CO)	ppmvd	164.39	160.83	165.12	163.45
	lb/hr	13.41	13.68	13.50	13.53
	lb/lb glass	0.11	0.12	0.11	0.12
	lb/Mscf n.g.	2.54	2.60	2.55	2.56
Formaldehyde (CH_2O)	lb/hr	4.62E-02	4.39E-02	4.66E-02	4.56E-02
	lb/lb glass	3.93E-04	3.74E-04	3.97E-04	3.88E-04
	lb/Mscf n.g.	8.76E-03	8.33E-03	8.81E-03	8.63E-03
Total VOCs (M25A + CH_2O)	lb/hr	0.17	0.16	0.16	0.16
	lb/lb glass	1.43E-03	1.32E-03	1.32E-03	1.36E-03
	lb/Mscf n.g.	3.18E-02	2.95E-02	2.94E-02	3.02E-02
Test Date – M13B/26A	-	6/9/2019	6/10/2019	6/10/2019	-
Hydrogen Fluorides (HF)	ppmvd	6.28E-03	5.05E-03	5.06E-03	5.46E-03
	lb/hr	3.68E-04	2.97E-04	2.93E-04	3.20E-04
	lb/lb glass	3.14E-06	2.57E-06	2.55E-06	2.75E-06
Total Fluorides	ppmvd	1.45E-02	1.41E-02	1.63E-02	1.50E-02
	lb/hr	7.96E-04	7.96E-04	9.05E-04	8.32E-04
	lb/lb glass	6.77E-06	6.87E-06	7.86E-06	7.17E-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 C.

*Data from Method 5 (particulate) test

"<" represents results below the MDL that have been calculated at the MDL.

Table 6: CFU 117 (Rotary Fine) Metals Results

Hollingsworth & Vose Corvallis, OR CFU 117 – Rotary Fine Metals Results Summary June 8, 2018 Average Results				
Parameter	**Species**	**µg/dscm**	**lb/hr**	**lb/lb glass**
Metals (Method 29)	Antimony	<0.356	<2.54E-05	<2.20E-07
	Arsenic	<0.498	<3.56E-05	<3.09E-07
	Barium	0.074	5.32E-06	4.62E-08
	Beryllium	<0.014	<1.02E-06	<8.82E-09
	Cadmium	<0.028	<2.03E-06	<1.76E-08
	Chromium	0.021	1.53E-06	1.32E-08
	Cobalt	<0.036	<2.54E-06	<2.20E-08
	Copper	0.436	3.12E-05	2.71E-07
	Lead	<0.356	<2.54E-05	<2.20E-07
	Manganese	0.077	5.49E-06	4.77E-08
	Nickel	<0.097	<6.93E-06	<6.00E-08
	Phosphorus	<1.422	<1.02E-04	<8.82E-07
	Selenium	<1.067	<7.63E-05	<6.61E-07
	Zinc	0.838	6.00E-05	5.18E-07
Mercury (Method 30B)	Mercury	3.99E-03	2.85E-07	2.47E-09

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

Table 7: CFU 107 (Rotary Coarse) Non-Metals Results

Hollingsworth & Vose Corvallis, OR CFU 107 – Rotary Coarse Results Summary June 13 - 14, 2018					
Parameters	**Units**	**Run 1**	**Run 2**	**Run 3**	**Average**
M5/M316/Gases	-	6/14/2018	6/14/2018	6/14/2018	-
Stack Temperature*	°F	248.3	254.6	255.2	252.7
Stack Moisture*	% v/v	1.88	1.46	1.49	1.61
Oxygen Content*	%	20.01	19.89	19.89	19.93
CO_2 Content*	%	0.70	0.69	0.69	0.69
Stack Flow Rate*	DSCFM	15,499.4	15,738.4	15,750.5	15,662.8
Sample Volume*	dscf	132.734	135.101	134.805	134.213
Filterable Particulate Matter (PM)	gr/dscf	1.78E-04	1.78E-04	6.62E-05	1.41E-04
	lbs/hr	2.36E-02	2.40E-02	8.94E-03	1.88E-02
	lb/lb glass	6.48E-05	6.61E-05	2.47E-05	5.19E-05
Condensable PM Inorganic	gr/dscf	6.30E-05	1.14E-04	8.45E-05	8.71E-05
	lbs/hr	8.38E-03	1.53E-02	1.14E-02	1.17E-02
	lb/lb glass	2.30E-05	4.23E-05	3.15E-05	3.23E-05
Condensable PM Organic	gr/dscf	3.16E-05	0.00E+00	9.89E-05	4.35E-05
	lbs/hr	4.19E-03	0.00E+00	1.34E-02	5.85E-03
	lb/lb glass	1.15E-05	0.00E+00	3.69E-05	1.61E-05
Total PM (Measured)†	gr/dscf	2.72E-04	2.92E-04	2.50E-04	2.71E-04
	lbs/hr	3.62E-02	3.93E-02	3.37E-02	3.64E-02
	lb/lb glass	9.93E-05	1.08E-04	9.31E-05	1.00E-04
Nitrogen Oxides (NO_x) Emissions	ppmvd	3.57	3.81	3.73	3.70
	lb/hr	0.40	0.43	0.42	0.42
	lb/lb glass	1.09E-03	1.18E-03	1.16E-03	1.15E-03
	lb/Mscf n.g.	8.12E-02	8.56E-02	8.33E-02	8.34E-02
Volatile Organic Compounds (VOCs) (Method 25A)	ppmvw	0.22	0.25	0.20	0.22
	lbs/hr	2.38E-02	2.74E-02	2.19E-02	2.44E-02
	lb/lb glass	6.54E-05	7.55E-05	6.06E-05	6.71E-05
	lb/Mscf n.g.	4.88E-03	5.45E-03	4.34E-03	4.89E-03

Hollingsworth & Vose
Corvallis, OR
CFU 107 – Rotary Coarse
Results Summary
June 13 - 14, 2018

Parameter	Units	Run 1	Run 2	Run 3	Average
Test Date – M5/M316/Gases	-	6/14/2018	6/14/2018	6/14/2018	-
Carbon Monoxide (CO)	ppmvd	124.23	125.92	127.36	125.84
	lb/hr	8.40	8.65	8.75	8.60
	lb/lb glass	2.31E-02	2.38E-02	2.42E-02	2.37E-02
	lb/Mscf n.g.	1.72	1.72	1.73	1.72
Formaldehyde (CH_2O)	lb/hr	7.81E-03	8.45E-03	8.13E-03	8.13E-03
	lb/lb glass	2.14E-05	2.33E-05	2.25E-05	2.24E-05
	lb/Mscf n.g.	1.60E-03	1.68E-03	1.61E-03	1.63E-03
Total VOCs (M25A + CH_2O)	lb/hr	3.16E-02	3.58E-02	3.01E-02	3.25E-02
	lb/lb glass	8.68E-05	9.88E-05	8.30E-05	8.95E-05
	lb/Mscf n.g.	6.48E-03	7.14E-03	5.95E-03	6.52E-03
Test Date – M13B/26A	-	6/13/2018	6/13/2018	6/13/2018	-
Hydrogen Fluorides (HF)	ppmvd	5.84E-03	3.68E-03	2.21E-03	3.91E-03
	lb/hr	2.78E-04	1.77E-04	1.06E-04	1.87E-04
	lb/lb glass	7.43E-07	4.79E-07	2.90E-07	5.04E-07
Total Fluorides	ppmvd	3.57E-02	3.58E-02	4.05E-02	3.73E-02
	lb/hr	1.59E-03	1.58E-03	1.80E-03	1.66E-03
	lb/lb glass	4.25E-06	4.26E-06	4.90E-06	4.47E-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 6: CFU 107 (Rotary Coarse) Metals Results

Hollingsworth & Vose Corvallis, OR CFU 107 – Rotary Coarse Metals Results Summary June 12, 2018 Average Results				
Parameter	**Species**	**µg/dscm**	**lb/hr**	**lb/lb glass**
Metals (Method 29)	Antimony	<0.583	<3.16E-05	<8.72E-08
	Arsenic	<0.817	<4.43E-05	<1.22E-07
	Barium	0.122	6.61E-06	1.82E-08
	Beryllium	<0.023	<1.27E-06	<3.49E-09
	Cadmium	<0.047	<2.53E-06	<6.98E-09
	Chromium	0.048	2.63E-06	7.21E-09
	Cobalt	<0.058	<3.16E-06	<8.72E-09
	Copper	0.479	2.60E-05	7.18E-08
	Lead	<0.583	<3.16E-05	<8.72E-08
	Manganese	0.103	5.56E-06	1.53E-08
	Nickel	<0.390	<2.11E-05	<5.80E-08
	Phosphorus	<2.334	<1.26E-04	<3.49E-07
	Selenium	<1.750	<9.49E-05	<2.62E-07
	Zinc	1.481	8.00E-05	2.21E-07
Mercury (Method 30B)	Mercury	7.14E-03	3.85E-07	1.06E-09

'<' 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.

CFU 114, Run 2, 30B mercury results, showed high breakthrough on the Side B sorbent trap. This, in turn, caused a failed field recovery check. Run 2 has thus been voided and a two-run average has been used to calculate average emissions rates given for CFU 114 mercury.

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.

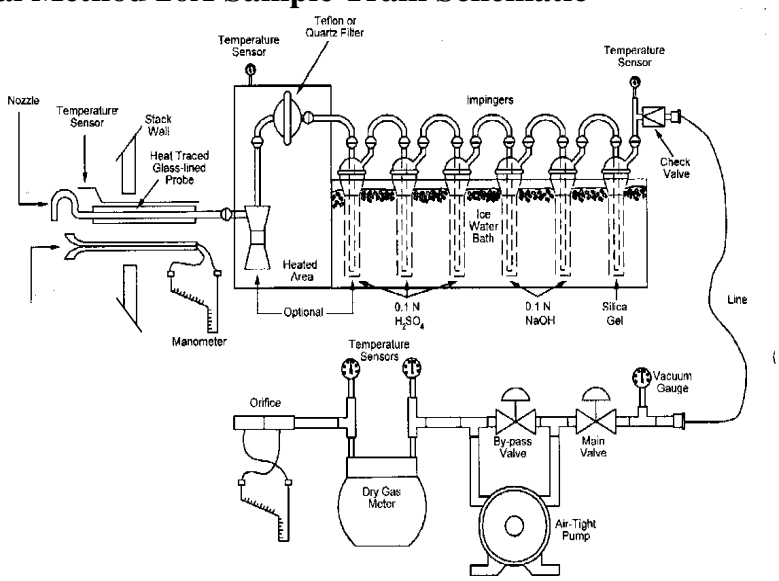
EPA Reference Method 13B "*Determination of Total Fluoride Emissions from Stationary Sources.*" The objective of the method is to determine the fluoride (F^-) emissions from sources as specified in the regulations; it does not measure fluorocarbons, such as freons. Stack gas is withdrawn isokinetically 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.

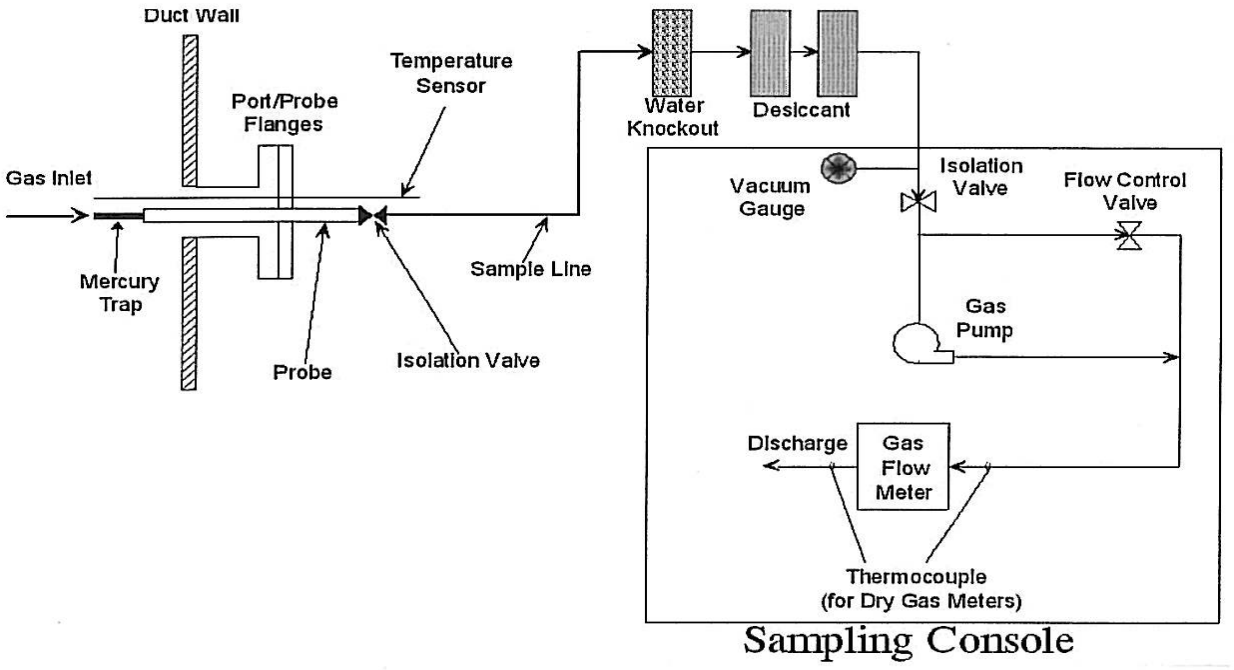
Figure 1: Typical Method 26A Sample Train Schematic



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.

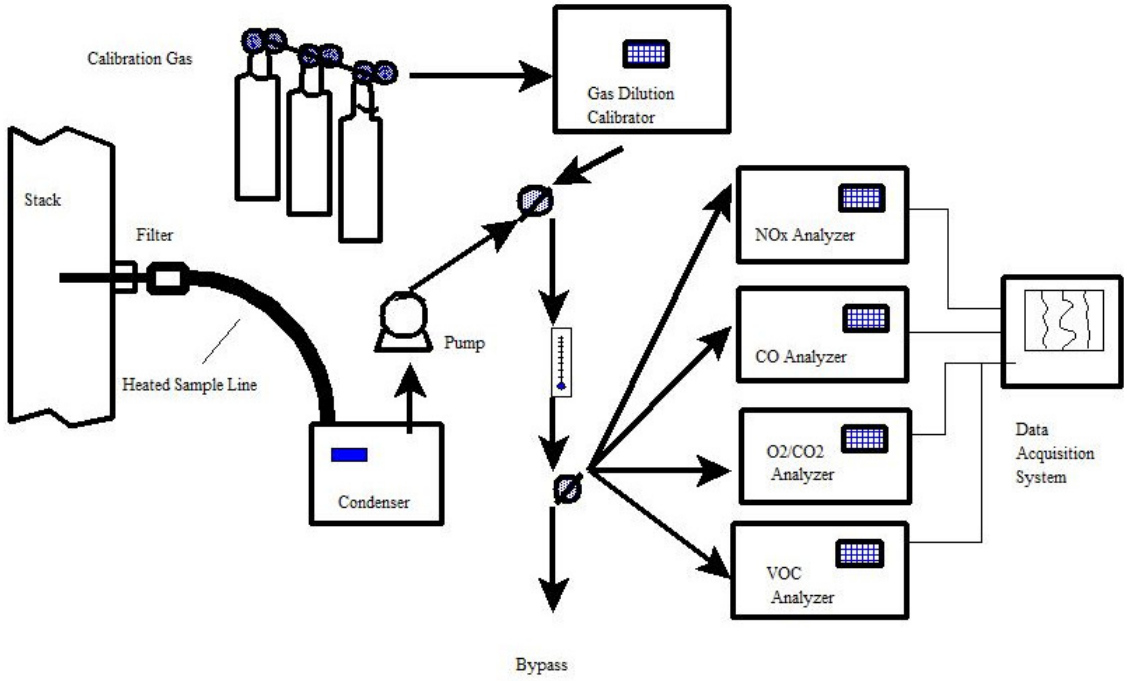
Figure 2: Method 30B Sampling Train



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:

BISON ENGINEERING, INC.
1400 11th Ave., Ste. 200
Helena, MT 59601
www.bison-eng.com

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 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.
- 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

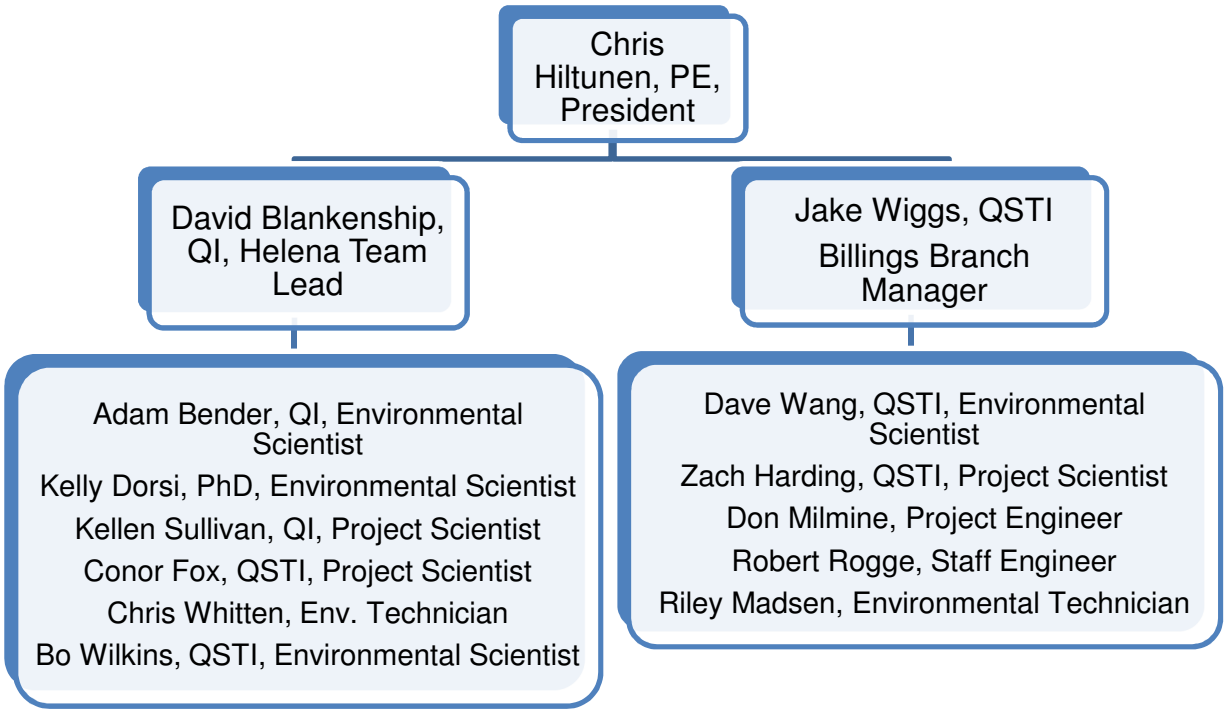
3.1 Testing Contractor

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

Hollingsworth & Vose Corvallis, OR Emissions Performance Testing Test Matrix			
Sources	**Method**	**Parameter**	**Test Plan and Comments**
Rotary Fine, Flame Blown, Rotary Coarse, Ultra-Rotary Coarse, Furnace Stack	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 or ODEQ Method 4	Moisture	Incorporated with Method 5
	Method 5	Filterable Particulate (with Oregon back-half)	Three 120-minute test runs per source
	Method 7E	NO_x	Three 60-minute test runs (minimum) 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 (minimum) per source
	Method 30B	Mercury (Hg)	
	Method 316	Formaldehyde	Three 60-minute (minimum) test runs per source

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*.

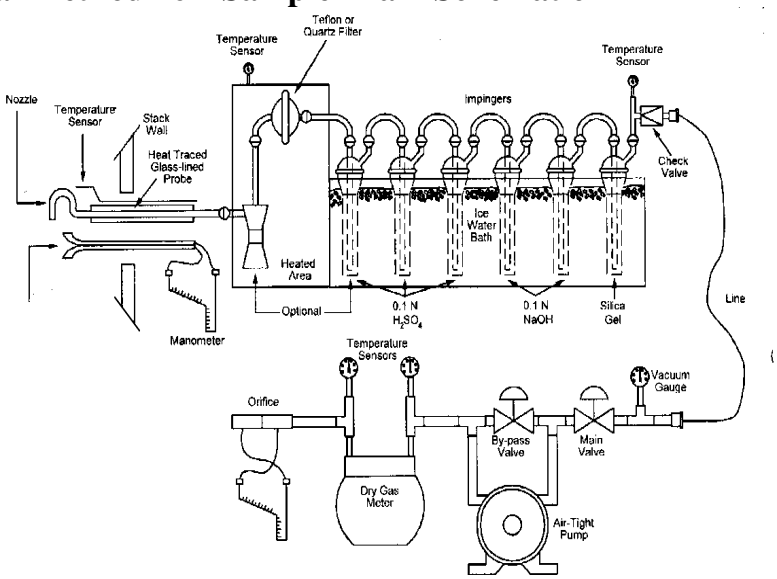
EPA Reference Method 13B "*Determination of Total Fluoride Emissions from Stationary Sources.*" The objective of the method is to determine the fluoride (F^-) emissions from sources as specified in the regulations; it does not measure fluorocarbons, such as freons. Stack gas is withdrawn isokinetically 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.*

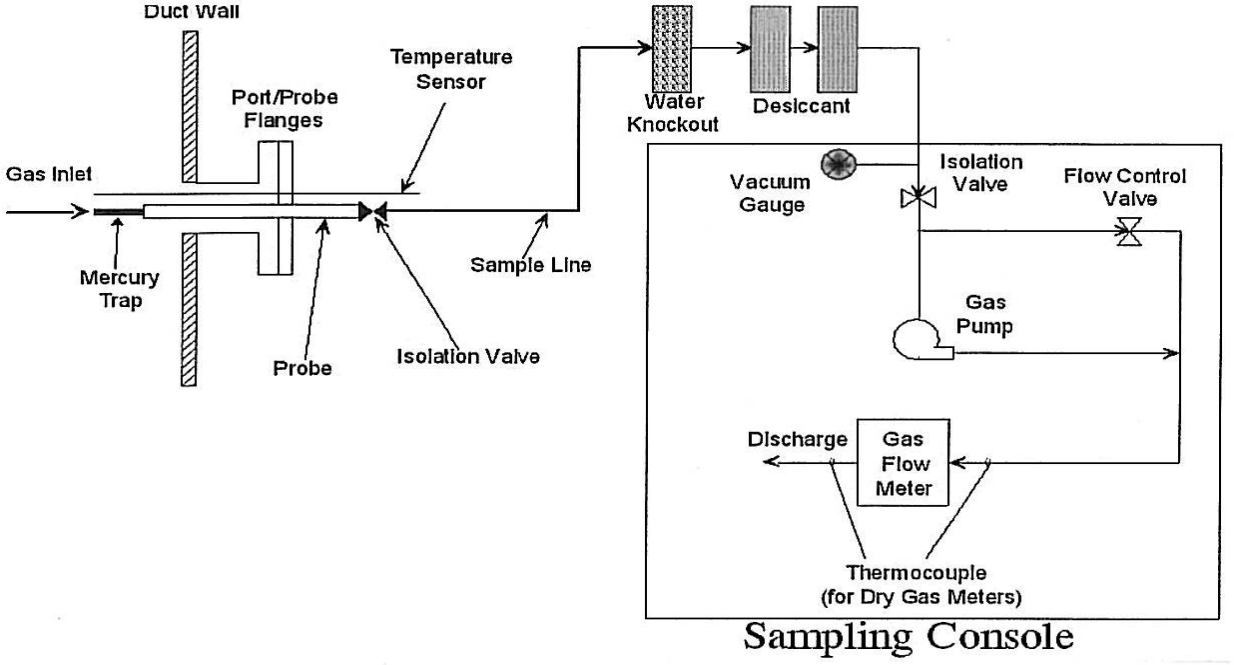
Figure 1: Typical Method 26A Sample Train Schematic



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^0) 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*.

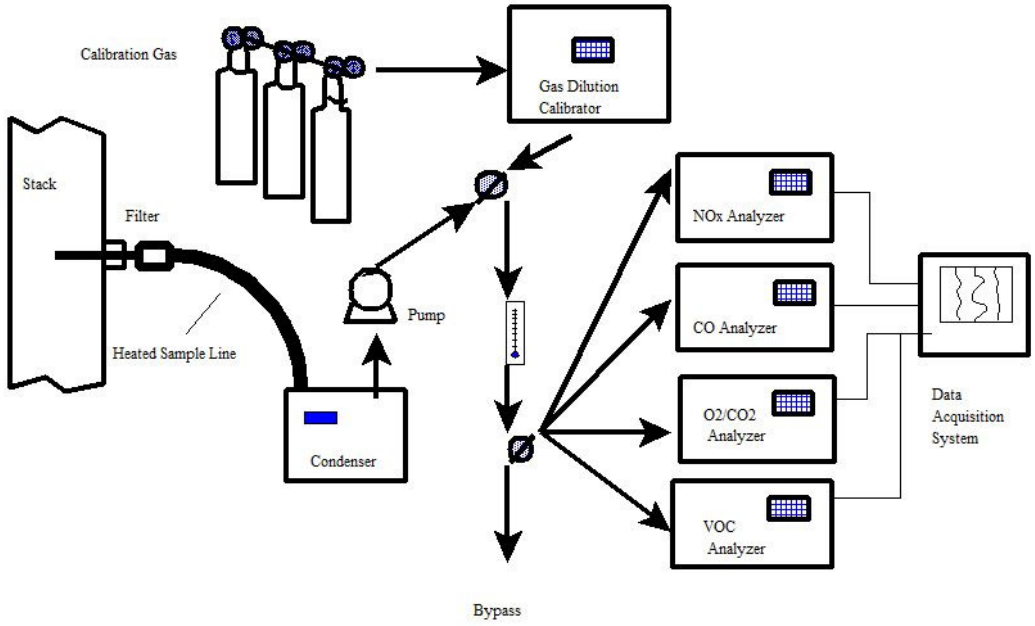
Figure 2: Method 30B Sampling Train



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.

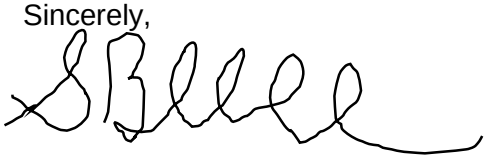
61. A copy of a completed Source Test Audit Report (STAR) for all applicable Methods performed must accompany the submittal of the Source Test Report. A copy of the STAR forms is available electronically from the regional source test coordinator.

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,



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

cc: Karen White-Fallon, DEQ

APPENDIX B: CFU 114 (FLAME BLOWN) TEST DATA

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis OR**
SOURCE	**CFU 114**
DATE	**06/05/18**
METHOD	**M26A**
POLLUTANT	**HF**

EPA Method 1
Stack Parameters and Traverse Points

Client: **Hollingsworth & Vose**
Location: **Corvallis OR**
Source: **CFU 114**
Facility: **GP2**

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: 5 inches

Circular ID (Rectangular Depth): 36.00 inches
Port depth and/or wall thickness: 4.00 inches
Stack width (Rectangular only): inches

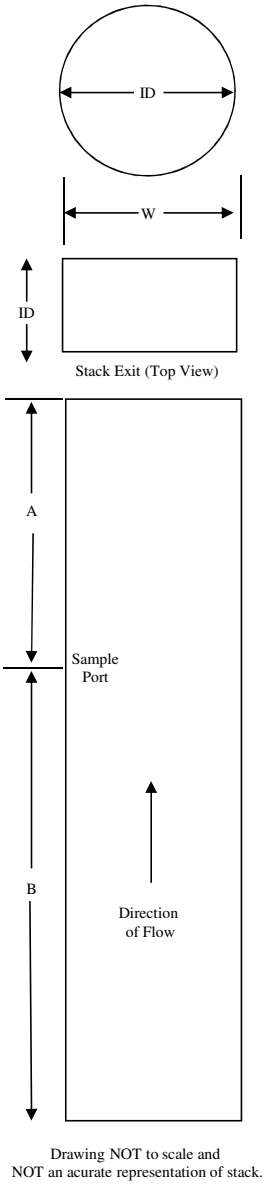
Equivalent Diameter
If rectangluar = $\frac{2*Depth*Width}{Depth + Width}$ = 36.00 inches (If circular = duct ID)
Stack/duct area = 7.069 sq.feet 1017.9 sq.inches

Sample Port Location:	Downstream from flow disturbance from process B	Upstream from flow disturbance toward exit A
Number of Inches:	134.00	45.00
Number of Diameters:	3.72	1.25

Minimum Number of Traverse Points: 24

Points	% of diameter	Distance from inside wall (in.)	Distance including port (in.)
1	2.1	0.76	4 3/4
2	6.7	2.41	6 3/8
3	11.8	4.25	8 1/4
4	17.7	6.37	10 3/8
5	25.0	9.00	13
6	35.6	12.82	16 7/8
7	64.4	23.18	27 1/8
8	75.0	27.00	31
9	82.3	29.63	33 5/8
10	88.2	31.75	35 3/4
11	93.3	33.59	37 5/8
12	97.9	35.24	39 1/4

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 114

Stack Temp: 270

Traverse Point	Velocity ΔP ("H_2O)	Null Angle
1	1.10	5.0
2	1.10	7.0
3	1.10	5.0
4	1.00	5.0
5	1.00	5.0
6	1.20	0.0
7	1.10	0.0
8	1.10	0.0
9	1.10	8.0
10	1.10	10.0
11	1.00	10.0
12	0.81	5.0
13	0.93	8.0
14	0.99	10.0
15	1.20	0.0
16	1.10	5.0
17	1.10	0.0
18	1.10	5.0
19	1.10	5.0
20	1.00	5.0
21	0.95	0.0
22	0.94	5.0
23	0.89	0.0
24	0.80	0.0
25		
26		
27		
28		
29		
30		
Average:	1.034	4.3

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:**	**10:30**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**	**End Time:**	**12:38**
EPA Method:	**M26A**	Sunny, 69F variable wind	**Date:**	**6/5/2018**
Box Operator:	**CMF**			
Technician(s):	**CSW**			

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	Box 12	Probe ID	4D	Liner type	Glass		
Y factor	0.9988	Nozzle ID	0.253	Nozzle size	0.2530	inches	
ΔH@	1.8338	Hot box ID	HB3	Nozzle area	0.000349	sq.ft.	
		Pitot Cp	0.84	Probe heat	248	F	
				Filter heat	248	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.60 %
Static Pressure	0.56	"H_2O	CO_2	0.68 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.221 inches
Stack Temperature	270	F		
Assumed moisture	1.75	%		
Assumed meter temp.	70	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	16	6

Nozzle check for roundness:

1	2	3	
0.253	0.253	0.253	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	123.593	dcf	Ave. ΔP	1.125 "H_2O
Wet mol. weight	28.66	M_s (actual)	Ave. √ΔP	1.0604 "H_2O
Actual H_2O	2.08	%	Ave. ΔH	3.575 "H_2O
Std. meter vol.	124.116	dscf	Ave. T_s	286.3 °F
Isokinetic Average	100.3	%	Ave. T_m	69.9 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	248.3	284.3	36.0
		Total water gain:	56.0

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	5.0	5.060	1.10	280	63	3.48	3.50	4	248	50
2	10.0	10.260	1.20	284	63	3.77	3.80	3	251	48
3	15.0	15.530	1.20	285	64	3.77	3.80	3	251	52
4	20.0	20.550	1.10	286	64	3.46	3.50	3	251	55
5	25.0	25.640	1.10	287	64	3.45	3.50	3	253	58
6	30.0	30.710	1.10	287	66	3.46	3.50	3	250	60
7	35.0	35.820	1.10	287	67	3.47	3.50	3	249	61
8	40.0	40.710	1.10	286	68	3.48	3.50	3	253	61
9	45.0	46.050	1.10	287	69	3.48	3.50	3	256	59
10	50.0	51.150	1.10	288	71	3.49	3.50	3	250	58
11	55.0	56.240	1.10	289	71	3.49	3.50	3	250	58
12	60.0	61.356	1.10	284	72	3.52	3.50	3	252	58
13	65.0	66.510	1.10	280	71	3.53	3.50	3	252	58
14	70.0	71.650	1.10	284	72	3.52	3.50	3	252	55
15	75.0	76.980	1.20	286	71	3.82	3.80	3	250	59
16	80.0	82.320	1.20	287	72	3.82	3.80	3	251	61
17	85.0	87.630	1.20	286	72	3.83	3.80	3	251	60
18	90.0	92.950	1.20	288	73	3.82	3.80	3	252	62
19	95.0	98.280	1.20	289	73	3.82	3.80	3	251	63
20	100.0	103.440	1.10	290	74	3.50	3.50	3	251	64
21	105.0	108.590	1.10	290	74	3.50	3.50	3	251	63
22	110.0	113.750	1.10	289	74	3.51	3.50	3	250	62
23	115.0	118.675	1.00	286	74	3.20	3.20	3	252	60
24	120.0	123.593	1.10	285	75	3.53	3.50	3	251	59

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:** **2**
Location:	**Corvallis OR**		**Start Time:** **13:10**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**	**End Time:** **15:20**
EPA Method:	**M26A**	Sunny, 69F variable wind	**Date:** **6/5/2018**
Box Operator:	**CMF**		
Technician(s):	**CSW**		

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	Box 12	Probe ID	4D	Liner type:	Glass		
Y factor	0.9988	Nozzle ID	0.253	Nozzle size:	0.2530	inches	
ΔH@	1.8338	Hot box ID	HB3	Nozzle area:	0.000349	sq.ft.	
		Pitot Cp	0.84	Probe heat:	248	F	
				Filter heat:	248	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.82 %
Static Pressure	0.56	"H_2O	CO_2	0.67 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.221 inches
Stack Temperature	270	F		
Assumed moisture	2.08	%		
Assumed meter temp.	69.9	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	0.009
Leak check vacuum, "Hg:	15	7

Nozzle check for roundness:

1	2	3	
0.253	0.253	0.253	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	123.944	dcf	Ave. ΔP	1.116 "H_2O
Wet mol. weight	28.68	M_s (actual)	Ave. √ΔP	1.0554 "H_2O
Actual H_2O	2.03	%	Ave. ΔH	3.546 "H_2O
Std. meter vol.	123.228	dscf	Ave. T_s	292.7 °F
Isokinetic Average	100.5	%	Ave. T_m	75.2 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	247.1	281.3	34.2
		Total water gain:	54.2

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	5.320	1.20	290	74	3.80	3.80	4	252	56
2	10.0	10.640	1.20	291	72	3.78	3.80	4	252	56
3	15.0	15.990	1.20	292	72	3.78	3.80	4	252	62
4	20.0	21.270	1.20	293	72	3.77	3.80	4	251	67
5	25.0	26.480	1.20	293	72	3.77	3.80	4	250	63
6	30.0	31.830	1.20	293	73	3.78	3.80	4	250	59
7	35.0	37.170	1.20	294	74	3.78	3.80	4	249	59
8	40.0	42.330	1.10	295	74	3.46	3.50	4	249	59
9	45.0	47.470	1.10	295	75	3.47	3.50	4	253	59
10	50.0	52.640	1.10	294	75	3.47	3.50	4	254	60
11	55.0	57.580	1.00	289	76	3.18	3.20	3	254	60
12	60.0	62.331	0.94	286	76	3.00	3.00	3	251	60
13	65.0	67.690	1.20	291	74	3.80	3.80	3	251	60
14	70.0	73.070	1.20	292	75	3.80	3.80	4	249	56
15	75.0	78.430	1.20	293	75	3.79	3.80	4	251	59
16	80.0	83.780	1.20	296	75	3.78	3.80	4	251	62
17	85.0	88.910	1.10	296	75	3.46	3.50	4	251	63
18	90.0	94.060	1.10	296	77	3.48	3.50	3	250	63
19	95.0	99.200	1.10	296	78	3.48	3.50	3	251	63
20	100.0	104.330	1.10	296	78	3.48	3.50	3	252	64
21	105.0	109.500	1.10	295	77	3.48	3.50	3	250	64
22	110.0	114.680	1.10	292	77	3.49	3.50	3	250	64
23	115.0	119.420	0.91	288	79	2.92	2.90	3	250	64
24	120.0	123.944	0.84	288	79	2.69	2.70	3	249	64

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**3**
Location:	**Corvallis OR**			**Start Time:**	**15:50**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**17:58**
EPA Method:	**M26A**	Sunny, 69F variable wind		**Date:**	**6/5/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	Box 12	Probe ID	4D	Liner type:	Glass	
Y factor	0.9988	Nozzle ID	0.253	Nozzle size:	0.2530	inches
ΔH@	1.8338	Hot box ID	HB3	Nozzle area:	0.000349	sq.ft.
		Pitot Cp	0.84	Probe heat:	248	F
				Filter heat:	248	F

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.81 %
Static Pressure	0.56	"H_2O	CO_2	0.70 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.22 inches
Stack Temperature	270	F		
Assumed moisture	2.03	%		
Assumed meter temp.	75.2	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:	13	7

Nozzle check for roundness:

1	2	3	
0.253	0.253	0.253	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	123.810	dcf	Ave. ΔP	1.104 "H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. √ΔP	1.05 "H_2O
Actual H_2O	1.89	%	Ave. ΔH	3.513 "H_2O
Std. meter vol.	122.510	dscf	Ave. T_s	295.8 °F
Isokinetic Average	100.5	%	Ave. T_m	77.7 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	216	16.0
Silica gel, g	250.1	284.2	34.1
		Total water gain:	50.1

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	5.280	1.20	297	75	3.78	3.80	5	253	72
2	10.0	10.610	1.20	297	75	3.78	3.80	5	252	61
3	15.0	15.920	1.20	296	74	3.77	3.80	5	251	64
4	20.0	21.240	1.20	297	75	3.78	3.80	5	250	65
5	25.0	26.390	1.10	296	75	3.47	3.50	5	251	67
6	30.0	31.520	1.10	296	75	3.47	3.50	5	251	67
7	35.0	36.630	1.10	297	76	3.47	3.50	5	253	67
8	40.0	41.750	1.10	298	77	3.47	3.50	5	251	67
9	45.0	46.930	1.10	298	78	3.48	3.50	5	251	67
10	50.0	52.090	1.10	297	78	3.48	3.50	5	251	67
11	55.0	57.220	1.10	295	79	3.50	3.50	5	252	66
12	60.0	62.196	1.00	291	79	3.19	3.20	5	250	66
13	65.0	67.370	1.10	289	79	3.52	3.50	5	250	65
14	70.0	72.560	1.10	293	78	3.50	3.50	5	252	59
15	75.0	77.740	1.10	293	78	3.50	3.50	5	249	62
16	80.0	82.890	1.10	293	78	3.50	3.50	5	251	63
17	85.0	88.040	1.10	295	78	3.49	3.50	5	251	63
18	90.0	93.370	1.20	297	79	3.80	3.80	5	252	63
19	95.0	98.680	1.20	298	79	3.80	3.80	5	250	63
20	100.0	103.890	1.10	299	80	3.48	3.50	5	250	63
21	105.0	109.050	1.10	299	80	3.48	3.50	5	251	65
22	110.0	114.230	1.10	298	80	3.49	3.50	5	250	65
23	115.0	119.220	1.00	295	79	3.18	3.20	5	251	64
24	120.0	123.810	0.80	295	80	2.55	2.60	5	252	64

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

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**10:30**
Source:	**CFU 114**	**End Time:**	**12:38**
Method:	**26A**	**Date:**	**6/5/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5.0	5.060	3.50	63	1	1.10	280	1.0488
10.0	10.260	3.80	63	2	1.20	284	1.0954
15.0	15.530	3.80	64	3	1.20	285	1.0954
20.0	20.550	3.50	64	4	1.10	286	1.0488
25.0	25.640	3.50	64	5	1.10	287	1.0488
30.0	30.710	3.50	66	6	1.10	287	1.0488
35.0	35.820	3.50	67	7	1.10	287	1.0488
40.0	40.710	3.50	68	8	1.10	286	1.0488
45.0	46.050	3.50	69	9	1.10	287	1.0488
50.0	51.150	3.50	71	10	1.10	288	1.0488
55.0	56.240	3.50	71	11	1.10	289	1.0488
60.0	61.356	3.50	72	12	1.10	284	1.0488
65.0	66.510	3.50	71	13	1.10	280	1.0488
70.0	71.650	3.50	72	14	1.10	284	1.0488
75.0	76.980	3.80	71	15	1.20	286	1.0954
80.0	82.320	3.80	72	16	1.20	287	1.0954
85.0	87.630	3.80	72	17	1.20	286	1.0954
90.0	92.950	3.80	73	18	1.20	288	1.0954
95.0	98.280	3.80	73	19	1.20	289	1.0954
100.0	103.440	3.50	74	20	1.10	290	1.0488
105.0	108.590	3.50	74	21	1.10	290	1.0488
110.0	113.750	3.50	74	22	1.10	289	1.0488
115.0	118.675	3.20	74	23	1.00	286	1.0000
120.0	123.593	3.50	75	24	1.10	285	1.0488

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 114**	**Date:**	**06/05/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5.0	min	Diameter	36.000	in
Meter Volume, V_m	123.593	dcf	Rectangular		
Water Volume	56.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2530	in.	Length		in
Nozzle Area	0.000349	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.68	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.60	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.575	"H_2O	√Dp	1.0604	"H_2O
Temperature, T_m	69.9	^oF	Temperature, T_s	286.3	^oF
Temperature, T_m	529.9	^oA (^oR)	Temperature, T_s	746.3	^oA (R)
Pressure Meter, P_m	30.203	"Hg	Pressure Stack, P_s	29.981	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	124.116	dscf	Velocity, V_s	70.97	fps
	3.515	dscm	Volume (actual)	30,101.2	awcfm
Actual Volume, $V_{m(actual)}$	178.865	awcf		29,475.1	adcfm
Gas Stream Moisture			Volume (standard)	1,280,384.2	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.635	scf		1,253,752.2	dscf/hr
Moisture, B_{ws}	0.0208			20,895.9	dscf/min
Moisture EPA M4	2.08	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	543.448	
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.66	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

HF	10.2	µg/sample			
HF	1.02E-05	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	1.27E-06	gr/dscf
	2.90	µg/dscm
	3.49E-03	ppmvd
Mass Emissions HF	2.27E-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:**	**13:10**
Source:	**CFU 114**	**End Time:**	**15:20**
Method:	**26A**	**Date:**	**06/05/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5.0	5.320	3.80	74	1	1.20	290	1.0954
10.0	10.640	3.80	72	2	1.20	291	1.0954
15.0	15.990	3.80	72	3	1.20	292	1.0954
20.0	21.270	3.80	72	4	1.20	293	1.0954
25.0	26.480	3.80	72	5	1.20	293	1.0954
30.0	31.830	3.80	73	6	1.20	293	1.0954
35.0	37.170	3.80	74	7	1.20	294	1.0954
40.0	42.330	3.50	74	8	1.10	295	1.0488
45.0	47.470	3.50	75	9	1.10	295	1.0488
50.0	52.640	3.50	75	10	1.10	294	1.0488
55.0	57.580	3.20	76	11	1.00	289	1.0000
60.0	62.331	3.00	76	12	0.94	286	0.9695
65.0	67.690	3.80	74	13	1.20	291	1.0954
70.0	73.070	3.80	75	14	1.20	292	1.0954
75.0	78.430	3.80	75	15	1.20	293	1.0954
80.0	83.780	3.80	75	16	1.20	296	1.0954
85.0	88.910	3.50	75	17	1.10	296	1.0488
90.0	94.060	3.50	77	18	1.10	296	1.0488
95.0	99.200	3.50	78	19	1.10	296	1.0488
100.0	104.330	3.50	78	20	1.10	296	1.0488
105.0	109.500	3.50	77	21	1.10	295	1.0488
110.0	114.680	3.50	77	22	1.10	292	1.0488
115.0	119.420	2.90	79	23	0.91	288	0.9539
120.0	123.944	2.70	79	24	0.84	288	0.9165

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 114**	**Date:**	**06/05/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5.0	min	Diameter	36.000	in
Meter Volume, V_m	123.944	dcf	Rectangular		
Water Volume	54.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.2530	in.	Length		in
Nozzle Area	0.000349	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.67	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.82	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.546	"H_2O	√Dp	1.0554	"H_2O
Temperature, T_m	75.2	^oF	Temperature, T_s	292.7	^oF
Temperature, T_m	535.2	^oA (^oR)	Temperature, T_s	752.7	^oA (R)
Pressure Meter, P_m	30.201	"Hg	Pressure Stack, P_s	29.981	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	123.227	dscf	Velocity, V_s	70.91	fps
	3.489	dscm	Volume (actual)	30,075.8	awcfm
Actual Volume, $V_{m(actual)}$	179.016	awcf		29,465.3	adcfm
Gas Stream Moisture			Volume (standard)	1,268,424.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.551	scf		1,242,675.1	dscf/hr
Moisture, B_{ws}	0.0203			20,711.3	dscf/min
Moisture EPA M4	2.03	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	548.109	
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.68	lb/lb-mole			
Percent Isokinetic	100.5	%			

Laboratory Results

HF	11.1	µg/sample		
HF	1.11E-05	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	1.39E-06	gr/dscf
	3.18	µg/dscm
	3.82E-03	ppmvd
Mass Emissions HF	2.47E-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:**	**15:50**
Source:	**CFU 114**	**End Time:**	**17:58**
Method:	**26A**	**Date:**	**06/05/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5.0	5.280	3.80	75	1	1.20	297	1.0954
10.0	10.610	3.80	75	2	1.20	297	1.0954
15.0	15.920	3.80	74	3	1.20	296	1.0954
20.0	21.240	3.80	75	4	1.20	297	1.0954
25.0	26.390	3.50	75	5	1.10	296	1.0488
30.0	31.520	3.50	75	6	1.10	296	1.0488
35.0	36.630	3.50	76	7	1.10	297	1.0488
40.0	41.750	3.50	77	8	1.10	298	1.0488
45.0	46.930	3.50	78	9	1.10	298	1.0488
50.0	52.090	3.50	78	10	1.10	297	1.0488
55.0	57.220	3.50	79	11	1.10	295	1.0488
60.0	62.196	3.20	79	12	1.00	291	1.0000
65.0	67.370	3.50	79	13	1.10	289	1.0488
70.0	72.560	3.50	78	14	1.10	293	1.0488
75.0	77.740	3.50	78	15	1.10	293	1.0488
80.0	82.890	3.50	78	16	1.10	293	1.0488
85.0	88.040	3.50	78	17	1.10	295	1.0488
90.0	93.370	3.80	79	18	1.20	297	1.0954
95.0	98.680	3.80	79	19	1.20	298	1.0954
100.0	103.890	3.50	80	20	1.10	299	1.0488
105.0	109.050	3.50	80	21	1.10	299	1.0488
110.0	114.230	3.50	80	22	1.10	298	1.0488
115.0	119.220	3.20	79	23	1.00	295	1.0000
120.0	123.810	2.60	80	24	0.80	295	0.8944

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 114**	**Date:**	**06/05/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5.0	min	Diameter	36.000	in
Meter Volume, V_m	123.810	dcf	Rectangular		
Water Volume	50.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.2530	in.	Length		in
Nozzle Area	0.000349	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.70	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.81	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.513	"H_2O	√Dp	1.0500	"H_2O
Temperature, T_m	77.7	^oF	Temperature, T_s	295.8	^oF
Temperature, T_m	537.7	^oA (^oR)	Temperature, T_s	755.8	^oA (R)
Pressure Meter, P_m	30.198	"Hg	Pressure Stack, P_s	29.981	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	122.510	dscf	Velocity, V_s	70.68	fps
	3.469	dscm	Volume (actual)	29,978.2	awcfm
Actual Volume, $V_{m(actual)}$	178.451	awcf		29,411.6	adcfm
Gas Stream Moisture			Volume (standard)	1,259,124.2	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.358	scf		1,235,326.8	dscf/hr
Moisture, B_{ws}	0.0189			20,588.8	dscf/min
Moisture EPA M4	1.89	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	550.366	
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	100.5	%			

Laboratory Results

HF	10.9	µg/sample		
HF	1.09E-05	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	1.37E-06	gr/dscf
	3.14	µg/dscm
	3.78E-03	ppmvd
Mass Emissions HF	2.42E-04	lb/hr

"<" represents MDL value

EPA Method 26A
Laboratory Results
HF

Client: **Hollingsworth & Vose**
Location: **Corvallis OR**
Source: **CFU 114**

Lab ID	Sample ID	Sample Date		Result	MDL	Sample Vol. (ml)	Units
18-S1051	M26A Cont. 3 Run 1	6/5/2018		10.2	3.79	360.0	µg/sample
18-S1052	M26A Cont. 3 Run 2	6/5/2018		11.1	3.84	365.0	µg/sample
18-S1053	M26A Cont. 3 Run 3	6/5/2018		10.9	3.90	370.0	µg/sample
18-S1054	0.1N H2SO4 Blank	6/5/2018	<	MDL	3.79	360.0	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 114**

Run			1	2	3	
Date			6/5/2018	6/5/2018	6/5/2018	
Run Start Time			10:30	13:10	15:50	
Run End Time			12:38	15:20	17:58	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.94	29.94	29.94	**29.94**
Nozzle Dia., in.			0.2530	0.2530	0.2530	**0.2530**
Isokinetic Average, %			100.3	100.5	100.5	**100.4**
Sample Volume, dscf			124.116	123.227	122.510	**123.284**
Sample Volume, dscm			3.515	3.489	3.469	**3.491**
Stack Diameter, in.			36.00	36.00	36.00	**36.00**
Stack Area, sq.ft.			7.069	7.069	7.069	**7.069**
CO_2 %vd			0.68	0.67	0.70	**0.68**
O_2 %vd			19.60	19.82	19.81	**19.74**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			2.08	2.03	1.89	**2.00**
Wet Molecular Weight, lb/lb-mole			28.66	28.68	28.69	**28.68**
Velocity, FPS			70.97	70.91	70.68	**70.85**
ADCFM			29,475.1	29,465.3	29,411.6	**29,450.7**
AWCFM			30,101.2	30,075.8	29,978.2	**30,051.7**
DSCFM			20,895.9	20,711.3	20,588.8	**20,732.0**
Stack Temperature, °F			286.3	292.7	295.8	**291.6**
HF	Concentration, C_s	gr/dscf	1.27E-06	1.39E-06	1.37E-06	**1.34E-06**
		µg/dscm	2.90	3.18	3.14	**3.08**
		ppmvd	3.49E-03	3.82E-03	3.78E-03	**3.70E-03**
	Mass	lb/hr	2.27E-04	2.47E-04	2.42E-04	**2.39E-04**
		lb/lb glass	3.72E-06	4.04E-06	3.97E-06	**3.91E-06**
Production Data	Glass Production	lbs/hr	61.0	61.0	61.0	**61.0**

"<" represents MDL value

EPA Methods 1-4, 26A
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**10:30**
Source:	**CFU 114**	**End Time:**	**12:38**
Method:	**26A**	**Date:**	**6/5/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.203 "Hg

where Pb: 29.94 "Hg
ΔH: 3.575 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.981 "Hg

where Pb: 29.94 "Hg
Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 124.116 dscf

where Vm: 123.593 dcf
Y: 0.9988
Pm: 30.203 "Hg
Tm: 529.9 °A

4) $V_w(std) = (0.04706)(H_2O)$ = 2.635 scf

where H_2O: 56.00 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0208

where Vw(std): 2.635 scf
Vm(std): 124.116 dscf

6) % H_2O = Bws x 100 = 2.08 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 178.865 awcf

where Y: 0.9988
Vm: 123.5930 dcf
Bws: 0.0208
Ts: 746.3 °A
Tm: 529.9 °A
Pm: 30.203 "Hg
Ps: 29.981 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO)$ = 28.89 lb/lb-mole

where CO_2: 0.68 %vd
O_2 19.60 %vd
N_2+CO= (100-(O_2+CO_2): 79.72 %vd

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 114 **Date: 6/5/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.66 lb/lb-mole
where M_d: 28.89 lb/lb-mole
Bws: 0.0208

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 7.069 sq. ft.
where Stack ID: 36 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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 70.97 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.0604
Ts: 746.3 °A
Ps: 29.981 "Hg
Ms: 28.66 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 30,101.2 AWCFM
where V_s: 70.97 ft/sec
Stack Area: 7.069 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 29,475.1 ADCFM
where AWCFM: 30,101.2
Bws: 0.0208

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 1,280,384.2 wscf/hr
where V_s: 70.97 ft/sec
Stack Area: 7.0690 sq. ft.
Ts: 746.3 °A
Ps: 29.981 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,253,752.2 dscf/hr
where wscf/hr: 1,280,384.2
Bws: 0.0208

16) DSCFM= (dscf/hr)/60 mins/hr = 20,895.9 DSCFM
where dscf/hr: 1,253,752.2

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000349 sq. ft.
where Nozzle Size: 0.2530 inches

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 114 **Date: 6/5/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.3 %

where Ts:	746.3	°A
Vm(Std):	124.116	dscf
Ps:	29.981	"Hg
Vs	70.97	ft/sec
Nozzle Area:	0.000349	sq. ft.
Sampling Time:	120	min.
Bws:	0.0208	

EPA Method 26A:

19) HF laboratory results 10.2 µg/sample

20) Blank correction = laboratory results-blank value = 10.2 µg/sample

where lab result:	10.2	µg/sample
H_2O blank value:	0	µg/sample

21) HF = (µg/sample)/1,000,000 = 1.02E-05 grams/sample

22) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 1.27E-06 gr/dscf

where Sample:	0.00001	grams
Vm(std)	124.116	dscf

23) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 2.9 µg/dscm

where Sample:	0.00001	grams
Vm(std)	3.515	dscm

24) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 543.448 Vol./Mole

where Ts:	746.3	°A
Ps:	29.981	"Hg

25) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 3.49E-03 ppmvd

where MW:	20.01	g/mol
lb/hr:	0.00	
Vol./Mole:	543.448	
ADCFM:	29475.1	

26) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 2.27E-04 lb/hr

where Cs:	1.27E-06	gr/dscf
Stack Flow:	1,253,752.2	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 114**
DATE	**06/05/18**
METHOD	**13B**
POLLUTANT	**Fluroides**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**10:31**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**	**End Time:**	**12:40**
EPA Method:	**13B**	Sunny, 69F variable wind	**Date:**	**6/5/2018**
Box Operator:	**DS**			
Technician(s):	**CW**			

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	BOX 13	Probe ID	4A	Liner type	GLASS		
Y factor	0.9963	Nozzle ID	0.223	Nozzle size	0.2227	inches	
ΔH@	1.8425	Hot box ID	1	Nozzle area	0.000271	sq.ft.	
		Pitot Cp	0.84	Probe heat	255	F	
				Filter heat	250	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.60 %
Static Pressure	0.56	"H_2O	CO_2	0.68 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.224 inches
Stack Temperature	270	F		
Assumed moisture	1.75	%		
Assumed meter temp.	55	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	16	11

.

Nozzle check for roundness:

1	2	3	
0.223	0.223	0.222	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	96.982	dcf	Ave. ΔP	1.146 "H_2O
Wet mol. weight	28.68	M_s (actual)	Ave. √ΔP	1.0696 "H_2O
Actual H_2O	1.91	%	Ave. ΔH	2.196 "H_2O
Std. meter vol.	97.077	dscf	Ave. T_s	285.2 °F
Isokinetic Average	100.0	%	Ave. T_m	68.5 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	245.6	265.7	20.1
		Total water gain:	40.1

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	3.718	1.00	277	63	1.91	1.90	3	249	60
2	10	7.610	1.10	282	63	2.09	2.10	3	249	54
3	15	11.690	1.20	283	63	2.28	2.30	3	250	55
4	20	15.640	1.10	285	64	2.09	2.10	3	249	57
5	25	19.710	1.20	287	65	2.28	2.30	3	250	57
6	30	24.060	1.30	288	66	2.47	2.50	3	249	59
7	35	28.140	1.20	287	66	2.28	2.30	3	246	59
8	40	32.270	1.20	286	67	2.29	2.30	3	251	58
9	45	36.500	1.20	285	68	2.29	2.30	3	250	58
10	50	40.480	1.10	285	68	2.10	2.10	3	250	59
11	55	44.610	1.20	284	68	2.30	2.30	3	250	59
12	60	48.796	1.20	285	71	2.31	2.30	3	249	60
13	65	52.530	0.90	264	71	1.78	1.80	3	250	59
14	70	56.210	1.00	277	70	1.94	1.90	3	250	59
15	75	60.240	1.10	285	70	2.11	2.10	3	250	60
16	80	64.210	1.10	289	70	2.10	2.10	3	251	60
17	85	68.100	1.10	289	71	2.10	2.10	3	249	61
18	90	72.330	1.20	290	71	2.29	2.30	3	250	63
19	95	76.490	1.20	289	71	2.30	2.30	3	250	63
20	100	80.480	1.10	289	72	2.11	2.10	3	250	63
21	105	84.490	1.20	289	71	2.30	2.30	3	251	63
22	110	88.650	1.20	289	71	2.30	2.30	3	251	62
23	115	92.850	1.20	290	72	2.30	2.30	3	250	62
24	120	96.982	1.20	290	72	2.30	2.30	3	250	63

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:** **2**
Location:	**Corvallis, OR**		**Start Time:** **13:10**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**	**End Time:** **15:21**
EPA Method:	**13B**	Sunny, 69F variable wind	**Date:** **6/5/2018**
Box Operator:	**DS**		
Technician(s):	**CW**		

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	BOX 13	Probe ID	4A	Liner type:	GLASS		
Y factor	0.9963	Nozzle ID	0.223	Nozzle size:	0.2227	inches	
ΔH@	1.8425	Hot box ID	1	Nozzle area:	0.00027	sq.ft.	
		Pitot Cp	0.84	Probe heat:	255	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.82 %
Static Pressure	0.56	"H_2O	CO_2	0.67 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.222 inches
Stack Temperature	270	F		
Assumed moisture	1.91	%		
Assumed meter temp.	68.5	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	0.002
Leak check vacuum, "Hg:	16	17

Nozzle check for roundness:

1	2	3	
0.223	0.223	0.222	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	97.446	dcf	Ave. ΔP	1.135 "H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. √ΔP	1.0645 "H_2O
Actual H_2O	1.89	%	Ave. ΔH	2.183 "H_2O
Std. meter vol.	96.718	dscf	Ave. T_s	291.5 °F
Isokinetic Average	100.9	%	Ave. T_m	73 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	243.9	263.6	19.7
		Total water gain:	39.7

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	3.980	1.10	291	69	2.08	2.10	3	250	65
2	10	7.790	1.00	288	70	1.91	1.90	3	251	65
3	15	11.740	1.10	283	70	2.11	2.10	3	251	65
4	20	15.730	1.10	292	70	2.08	2.10	3	250	65
5	25	19.710	1.10	293	70	2.08	2.10	3	250	61
6	30	23.730	1.10	293	71	2.09	2.10	3	251	61
7	35	27.840	1.20	293	72	2.28	2.30	3	251	57
8	40	32.000	1.20	293	72	2.28	2.30	3	251	57
9	45	35.970	1.10	294	73	2.09	2.10	3	249	57
10	50	40.050	1.10	294	73	2.09	2.10	3	250	57
11	55	44.240	1.20	294	73	2.28	2.30	3	250	57
12	60	48.434	1.20	293	74	2.29	2.30	3	250	57
13	65	52.000	0.85	293	73	1.62	1.60	3	251	57
14	70	55.780	1.00	263	73	1.98	2.00	3	250	57
15	75	59.740	1.10	289	73	2.11	2.10	3	252	54
16	80	63.900	1.20	291	74	2.29	2.30	3	251	54
17	85	68.060	1.20	292	74	2.29	2.30	3	251	54
18	90	72.110	1.10	295	74	2.09	2.10	3	250	57
19	95	76.500	1.30	295	75	2.48	2.50	3	250	57
20	100	80.980	1.30	295	75	2.48	2.50	3	251	58
21	105	85.150	1.20	295	75	2.29	2.30	3	250	58
22	110	89.210	1.20	296	76	2.29	2.30	3	250	58
23	115	93.290	1.10	296	76	2.10	2.30	3	250	59
24	120	97.446	1.20	295	76	2.29	2.30	3	251	59

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**3**
Location:	**Corvallis, OR**			**Start Time:**	**15:50**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**17:59**
EPA Method:	**13B**	Sunny, 69F variable wind		**Date:**	**6/5/2018**
Box Operator:	**DS**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	BOX 13	Probe ID	4A	Liner type:	GLASS		
Y factor	0.9963	Nozzle ID	0.223	Nozzle size:	0.2227	inches	
ΔH@	1.8425	Hot box ID	1	Nozzle area:	0.00027	sq.ft.	
		Pitot Cp	0.84	Probe heat:	255	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.81 %
Static Pressure	0.56	"H_2O	CO_2	0.70 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.221 inches
Stack Temperature	270	F		
Assumed moisture	1.89	%		
Assumed meter temp.	73	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	17

Nozzle check for roundness:

1	2	3	
0.223	0.223	0.222	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	97.033	dcf	Ave. ΔP	1.114 "H_2O
Wet mol. weight	28.66	M_s (actual)	Ave. √ΔP	1.0539 "H_2O
Actual H_2O	2.18	%	Ave. ΔH	2.138 "H_2O
Std. meter vol.	95.863	dscf	Ave. T_s	292 °F
Isokinetic Average	101.3	%	Ave. T_m	75.4 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	250.3	270.7	20.4
		Total water gain:	45.4

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	5	3.500	0.76	248	72	1.54	1.50	3	254	61
2	10	7.480	1.00	256	73	2.00	2.00	3	251	56
3	15	11.610	1.20	292	73	2.29	2.30	3	250	57
4	20	15.790	1.20	295	73	2.28	2.30	3	250	59
5	25	19.980	1.20	295	74	2.28	2.30	3	250	59
6	30	24.360	1.30	295	74	2.47	2.50	3	250	59
7	35	28.510	1.20	296	75	2.28	2.30	3	249	59
8	40	32.650	1.20	296	75	2.28	2.30	3	249	59
9	45	36.840	1.20	296	76	2.29	2.30	3	249	59
10	50	41.020	1.20	295	76	2.29	2.30	3	249	59
11	55	45.060	1.10	293	76	2.11	2.10	3	249	58
12	60	49.114	1.10	293	76	2.11	2.10	3	249	56
13	65	52.916	0.98	298	76	1.86	1.90	3	249	56
14	70	56.700	0.99	298	76	1.88	1.90	3	246	56
15	75	60.580	1.00	294	76	1.91	1.90	3	249	58
16	80	64.610	1.10	294	76	2.10	2.10	3	252	58
17	85	68.620	1.10	297	76	2.10	2.10	3	254	58
18	90	72.630	1.10	297	76	2.10	2.10	3	250	61
19	95	76.650	1.10	297	76	2.10	2.10	3	249	61
20	100	80.730	1.10	297	77	2.10	2.10	3	251	61
21	105	84.900	1.20	298	77	2.29	2.30	3	251	61
22	110	88.810	1.10	297	77	2.10	2.10	3	251	61
23	115	93.000	1.20	297	77	2.29	2.30	3	251	61
24	120	97.033	1.10	295	77	2.10	2.10	3	248	61

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

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:31**
Source:	**CFU 114**	**End Time:**	**12:40**
Method:	**13B**	**Date:**	**6/5/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5.0	3.718	1.90	63	1	1.00	277	1.0000
10.0	7.610	2.10	63	2	1.10	282	1.0488
15.0	11.690	2.30	63	3	1.20	283	1.0954
20.0	15.640	2.10	64	4	1.10	285	1.0488
25.0	19.710	2.30	65	5	1.20	287	1.0954
30.0	24.060	2.50	66	6	1.30	288	1.1402
35.0	28.140	2.30	66	7	1.20	287	1.0954
40.0	32.270	2.30	67	8	1.20	286	1.0954
45.0	36.500	2.30	68	9	1.20	285	1.0954
50.0	40.480	2.10	68	10	1.10	285	1.0488
55.0	44.610	2.30	68	11	1.20	284	1.0954
60.0	48.796	2.30	71	12	1.20	285	1.0954
65.0	52.530	1.80	71	13	0.90	264	0.9487
70.0	56.210	1.90	70	14	1.00	277	1.0000
75.0	60.240	2.10	70	15	1.10	285	1.0488
80.0	64.210	2.10	70	16	1.10	289	1.0488
85.0	68.100	2.10	71	17	1.10	289	1.0488
90.0	72.330	2.30	71	18	1.20	290	1.0954
95.0	76.490	2.30	71	19	1.20	289	1.0954
100.0	80.480	2.10	72	20	1.10	289	1.0488
105.0	84.490	2.30	71	21	1.20	289	1.0954
110.0	88.650	2.30	71	22	1.20	289	1.0954
115.0	92.850	2.30	72	23	1.20	290	1.0954
120.0	96.982	2.30	72	24	1.20	290	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 114**	**Date:**	**06/05/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5.0	min	Diameter	36.000	in
Meter Volume, V_m	96.982	dcf	Rectangular		
Water Volume	40.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.2227	in.	Length		in
Nozzle Area	0.000271	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.60	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.70	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	2.196	"H_2O	√Dp	1.0696	"H_2O
Temperature, T_m	68.5	^oF	Temperature, T_s	285.2	^oF
Temperature, T_m	528.5	^oA (^oR)	Temperature, T_s	745.2	^oA (R)
Pressure Meter, P_m	30.101	"Hg	Pressure Stack, P_s	29.981	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	97.077	dscf	Velocity, V_s	71.52	fps
	2.749	dscm	Volume (actual)	30,334.5	awcfm
Actual Volume, $V_{m(actual)}$	139.450	awcf		29,755.1	adcfm
Gas Stream Moisture			Volume (standard)	1,292,211.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.887	scf		1,267,530.3	dscf/hr
Moisture, B_{ws}	0.0191			21,125.5	dscf/min
Moisture EPA M4	1.91	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	542.647	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	99.9	%			

Laboratory Results

Fluoride	48.0	µg/sample		
Fluoride	4.80E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	7.63E-06	gr/dscf
	17.46	µg/dscm
	2.21E-02	ppmvd
Mass Emissions	1.38E-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:**	**13:10**
Source:	**CFU 114**	**End Time:**	**15:21**
Method:	**13B**	**Date:**	**06/05/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5.0	3.980	2.10	69	1	1.10	291	1.0488
10.0	7.790	1.90	70	2	1.00	288	1.0000
15.0	11.740	2.10	70	3	1.10	283	1.0488
20.0	15.730	2.10	70	4	1.10	292	1.0488
25.0	19.710	2.10	70	5	1.10	293	1.0488
30.0	23.730	2.10	71	6	1.10	293	1.0488
35.0	27.840	2.30	72	7	1.20	293	1.0954
40.0	32.000	2.30	72	8	1.20	293	1.0954
45.0	35.970	2.10	73	9	1.10	294	1.0488
50.0	40.050	2.10	73	10	1.10	294	1.0488
55.0	44.240	2.30	73	11	1.20	294	1.0954
60.0	48.434	2.30	74	12	1.20	293	1.0954
65.0	52.000	1.60	73	13	0.85	293	0.9220
70.0	55.780	2.00	73	14	1.00	263	1.0000
75.0	59.740	2.10	73	15	1.10	289	1.0488
80.0	63.900	2.30	74	16	1.20	291	1.0954
85.0	68.060	2.30	74	17	1.20	292	1.0954
90.0	72.110	2.10	74	18	1.10	295	1.0488
95.0	76.500	2.50	75	19	1.30	295	1.1402
100.0	80.980	2.50	75	20	1.30	295	1.1402
105.0	85.150	2.30	75	21	1.20	295	1.0954
110.0	89.210	2.30	76	22	1.20	296	1.0954
115.0	93.290	2.30	76	23	1.10	296	1.0488
120.0	97.446	2.30	76	24	1.20	295	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 114**	**Date:**	**06/05/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5.0	min	Diameter	36.000	in
Meter Volume, V_m	97.446	dcf	Rectangular		
Water Volume	39.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.2227	in.	Length		in
Nozzle Area	0.000270	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.60	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.70	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	2.183	"H_2O	√Dp	1.0645	"H_2O
Temperature, T_m	73.0	^oF	Temperature, T_s	291.5	^oF
Temperature, T_m	533.0	^oA (^oR)	Temperature, T_s	751.5	^oA (R)
Pressure Meter, P_m	30.101	"Hg	Pressure Stack, P_s	29.981	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	96.718	dscf	Velocity, V_s	71.48	fps
	2.739	dscm	Volume (actual)	30,317.5	awcfm
Actual Volume, $V_{m(actual)}$	140.080	awcf		29,744.5	adcfm
Gas Stream Moisture			Volume (standard)	1,280,661.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.868	scf		1,256,457.4	dscf/hr
Moisture, B_{ws}	0.0189			20,941.0	dscf/min
Moisture EPA M4	1.89	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	547.235	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	100.8	%			

Laboratory Results

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

Emissions:

Concentration, C_s	< 4.79E-06	gr/dscf
	< 10.95	µg/dscm
	< 1.39E-02	ppmvd
Mass Emissions	< 8.59E-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:**	**15:50**
Source:	**CFU 114**	**End Time:**	**17:59**
Method:	**13B**	**Date:**	**06/05/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5.0	3.500	1.50	72	1	0.76	248	0.8718
10.0	7.480	2.00	73	2	1.00	256	1.0000
15.0	11.610	2.30	73	3	1.20	292	1.0954
20.0	15.790	2.30	73	4	1.20	295	1.0954
25.0	19.980	2.30	74	5	1.20	295	1.0954
30.0	24.360	2.50	74	6	1.30	295	1.1402
35.0	28.510	2.30	75	7	1.20	296	1.0954
40.0	32.650	2.30	75	8	1.20	296	1.0954
45.0	36.840	2.30	76	9	1.20	296	1.0954
50.0	41.020	2.30	76	10	1.20	295	1.0954
55.0	45.060	2.10	76	11	1.10	293	1.0488
60.0	49.114	2.10	76	12	1.10	293	1.0488
65.0	52.916	1.90	76	13	0.98	298	0.9899
70.0	56.700	1.90	76	14	0.99	298	0.9950
75.0	60.580	1.90	76	15	1.00	294	1.0000
80.0	64.610	2.10	76	16	1.10	294	1.0488
85.0	68.620	2.10	76	17	1.10	297	1.0488
90.0	72.630	2.10	76	18	1.10	297	1.0488
95.0	76.650	2.10	76	19	1.10	297	1.0488
100.0	80.730	2.10	77	20	1.10	297	1.0488
105.0	84.900	2.30	77	21	1.20	298	1.0954
110.0	88.810	2.10	77	22	1.10	297	1.0488
115.0	93.000	2.30	77	23	1.20	297	1.0954
120.0	97.033	2.10	77	24	1.10	295	1.0488

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 114**	**Date:**	**06/05/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5.0	min	Diameter	36.000	in
Meter Volume, V_m	97.033	dcf	Rectangular		
Water Volume	45.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2227	in.	Length		in
Nozzle Area	0.000270	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.60	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.70	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	2.138	"H_2O	√Dp	1.0539	"H_2O
Temperature, T_m	75.4	^oF	Temperature, T_s	292.0	^oF
Temperature, T_m	535.4	^oA (^oR)	Temperature, T_s	752.0	^oA (R)
Pressure Meter, P_m	30.097	"Hg	Pressure Stack, P_s	29.981	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	95.863	dscf	Velocity, V_s	70.83	fps
	2.715	dscm	Volume (actual)	30,041.8	awcfm
Actual Volume, $V_{m(actual)}$	139.347	awcf		29,386.9	adcfm
Gas Stream Moisture			Volume (standard)	1,268,172.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.137	scf		1,240,526.3	dscf/hr
Moisture, B_{ws}	0.0218			20,675.4	dscf/min
Moisture EPA M4	2.18	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	547.599	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.64	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	< 4.83E-06	gr/dscf
	< 11.05	µg/dscm
	< 1.40E-02	ppmvd
Mass Emissions	< 8.56E-04	lb/hr

"<" represents MDL value

EPA Method 13B
Laboratory Results
Total Fluoride

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 114**

Lab ID	Sample ID	Sample Date		Result	MDL	Units
18-S1059	M13B Cont. 1 Run 1	6/5/2018		48.0	30.0	µg/sample
18-S1060	M13B Cont. 1 Run 2	6/5/2018	<	MDL	30.0	µg/sample
18-S1061	M13B Cont. 1 Run 3	6/5/2018	<	MDL	30.0	µg/sample
18-S1062	H20 + Filter Blank	6/5/2018	<	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 114**

Run			1	2	3	
Date			6/5/2018	6/5/2018	6/5/2018	
Run Start Time			10:31	13:10	15:50	
Run End Time			12:40	15:21	17:59	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.94	29.94	29.94	**29.94**
Nozzle Dia., in.			0.2227	0.2227	0.2227	**0.2227**
Isokinetic Average, %			99.9	100.8	101.2	**100.6**
Sample Volume, dscf			97.077	96.718	95.863	**96.553**
Sample Volume, dscm			2.749	2.739	2.715	**2.734**
Stack Diameter, in.			36.00	36.00	36.00	**36.00**
Stack Area, sq.ft.			7.069	7.069	7.069	**7.069**
CO_2 %vd			0.60	0.60	0.60	**0.60**
O_2 %vd			19.70	19.70	19.70	**19.70**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.91	1.89	2.18	**1.99**
Wet Molecular Weight, lb/lb-mole			28.67	28.67	28.64	**28.66**
Velocity, FPS			71.52	71.48	70.83	**71.28**
ADCFM			29,755.1	29,744.5	29,386.9	**29,628.8**
AWCFM			30,334.5	30,317.5	30,041.8	**30,231.3**
DSCFM			21,125.5	20,941.0	20,675.4	**20,914.0**
Stack Temperature, °F			285.2	291.5	292.0	**289.6**
Fluoride	Concentration, C_s	gr/dscf	7.63E-06	< 4.79E-06	< 4.83E-06	< **5.75E-06**
		µg/dscm	17.46	< 10.95	< 11.05	< **13.15**
		ppmvd	2.21E-02	< 1.39E-02	< 1.40E-02	< **1.67E-02**
	Mass	lb/hr	1.38E-03	< 8.59E-04	< 8.56E-04	< **1.03E-03**
		lb/lb glass	2.26E-05	< 1.41E-05	< 1.40E-05	< **1.69E-05**
Production Data	Glass Production	lbs/hr	61.0	61.0	61.0	**61.0**

"<" represents MDL value

EPA Methods 1-4, 13B
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:31**
Source:	**CFU 114**	**End Time:**	**12:40**
Method:	**13B**	**Date:**	**6/5/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.101 "Hg

where Pb: 29.94 "Hg
ΔH: 2.196 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.981 "Hg

where Pb: 29.94 "Hg
Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 97.077 dscf

where Vm: 96.982 dcf
Y: 0.9963
Pm: 30.101 "Hg
Tm: 528.5 °A

4) $V_w(std) = (0.04706)(H_2O)$ = 1.887 scf

where H_2O: 40.10 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0191

where Vw(std): 1.887 scf
Vm(std): 97.077 dscf

6) % H_2O = Bws x 100 = 1.91 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 139.450 awcf

where Y: 0.9963
Vm: 96.9820 dcf
Bws: 0.0191
Ts: 745.2 °A
Tm: 528.5 °A
Pm: 30.101 "Hg
Ps: 29.981 "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: 0.60 %vd
O_2 19.70 %vd
N_2+CO= (100-(O_2+CO_2): 79.70 %vd

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 114 **Date: 6/5/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.67 lb/lb-mole
where M_d: 28.88 lb/lb-mole
Bws: 0.0191

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 7.069 sq. ft.
where Stack ID: 36 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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 71.52 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.0696
Ts: 745.2 °A
Ps: 29.981 "Hg
Ms: 28.67 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 30,334.5 AWCFM
where V_s: 71.52 ft/sec
Stack Area: 7.069 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 29,755.1 ADCFM
where AWCFM: 30,334.5
Bws: 0.0191

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 1,292,211.5 wscf/hr
where V_s: 71.52 ft/sec
Stack Area: 7.0690 sq. ft.
Ts: 745.2 °A
Ps: 29.981 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,267,530.3 dscf/hr
where wscf/hr: 1,292,211.5
Bws: 0.0191

16) DSCFM= (dscf/hr)/60 mins/hr = 21,125.5 DSCFM
where dscf/hr: 1,267,530.3

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000271 sq. ft.
where Nozzle Size: 0.2227 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 114**	**Date:**	**6/5/2018**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 99.9 %

where Ts:	745.2	°A
Vm(Std):	97.077	dscf
Ps:	29.981	"Hg
Vs	71.52	ft/sec
Nozzle Area:	0.000271	sq. ft.
Sampling Time:	120	min.
Bws:	0.0191	

EPA Method 13B:

19) Fluoride laboratory results 48.0 µg/sample

20) Fluoride = (µg/sample)/1,000,000 = 4.80E-05 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 7.63E-06 gr/dscf

where Sample:	0.00005	grams
Vm(std)	97.077	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 17.46 µg/dscm

where Sample:	0.00005	grams
Vm(std)	2.749	dscm

23) Volume/Mole $= \left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 542.647 Vol./Mole

where Ts:	745.2	°A
Ps:	29.981	"Hg

24) ppmvd $= \left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 2.21E-02 ppmvd

where MW:	19.0	g/mol
lb/hr:	0.00	
Vol./Mole:	542.647	
ADCFM:	29755.1	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 1.38E-03 lb/hr

where Cs:	7.63E-06	gr/dscf
Stack Flow:	1,267,530.3	dscf/hr

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 114**
Facility	**Glass Plant 2**	Date	**June 5, 2018**
Location	**Corvallis, OR**		

Run	1	2	3	
Date	6/5/2018	6/5/2018	6/5/2018	
Run Start Time	10:30	13:10	15:50	
Run End Time	12:40	15:21	17:59	
CO_2 %vd	0.68	0.67	0.70	0.68
O_2 %vd	19.60	19.82	19.81	19.74

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

Company:	**Hollingsworth & Vose**	Source	**CFU 114**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 5, 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**		**System Cal Response**	**Post test System Cal. Bias**		**System Drift**		**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
				% of span	**pass/fail**		**% of span**	**pass/fail**	**% of span**	**pass/fail**				
	zero	0.01	0.07	0.30	pass	0.05	0.20	pass	-0.10	pass				
Run 1	upscale	9.93	10.14	1.05	pass	9.95	0.10	pass	-0.95	pass	20	19.63	19.60	10
	zero	0.01	0.05	0.20	pass	0.04	0.15	pass	-0.05	pass				
Run 2	upscale	9.93	9.95	0.10	pass	10.02	0.45	pass	0.35	pass	20	19.75	19.82	10
	zero	0.01	0.04	0.15	pass	0.06	0.25	pass	0.10	pass				
Run 3	upscale	9.93	10.02	0.45	pass	10.03	0.50	pass	0.05	pass	20	19.81	19.81	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.01	9.93	20.05
Analyzer Cal. Error	0.05	-0.35	0.25
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 114**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 5, 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**
	zero	0.09	0.08	-0.25	pass	0.09	0.00	pass	0.25	pass				
Run 1	upscale	1.99	1.82	-4.25	pass	2.03	1.00	pass	5.25	pass	4	0.71	0.68	2
	zero	0.09	0.09	0.00	pass	0.14	1.25	pass	1.25	pass				
Run 2	upscale	1.99	2.03	1.00	pass	1.94	-1.25	pass	-2.25	pass	4	0.74	0.67	2
	zero	0.09	0.14	1.25	pass	0.13	1.00	pass	-0.25	pass				
Run 3	upscale	1.99	1.94	-1.25	pass	1.91	-2.00	pass	-0.75	pass	4	0.76	0.70	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.09	1.99	4.03
Analyzer Cal. Error	2.25	-0.25	0.75
Analyzer Cal. Error < 2%*	pass	pass	pass

Bison Engineering, Inc.
Method 205 Dilution System Check

Company:	Hollingsworth & Vose	Source:	CFU 114	Instrument Make:	Environics
Facility:	Glass Plant 2	Date:	June 5, 2018	Instrument Model:	4040
Location:	Corvallis, OR			Instrument Serial #:	3880

		First	Second	Third	Average
High Level	10 % oxygen	9.98	9.97	9.97	9.97
Percent diff from avg recorded value	dilution system	0.1%	0.0%	0.0%	
Pass or Fail +/- 2%		PASS	PASS	PASS	
Percent diff from target of 10% O_2		-0.2%	-0.3%	-0.3%	-0.3%
Pass or Fail +/- 2% from target value					PASS

Mid Level	5 % oxygen	4.98	4.98	4.98	4.98
Percent diff from avg recorded value	dilution system	0.0%	0.0%	0.0%	
Pass or Fail +/- 2%		PASS	PASS	PASS	
Percent diff from target of 5% O_2		-0.4%	-0.4%	-0.4%	-0.4%
Pass or Fail +/- 2% from target value					PASS

							Tank value
Independent Mid Level Check	5% oxygen	9.84	9.85	9.87	9.85		9.893
	independent	Percent diff from avg				-0.40%	
	tank check	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.

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:30**
Source:	**CFU 114**	**End Time:**	**12:40**
Method:	**3A**	**Date:**	**6/5/2018**

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) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 1.05 %v

where C_{Dir}:	9.93	ppmv
C_S:	10.14	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.95 %v

where SB_{Final}:	0.10	ppmv
SB_i:	1.05	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.60 ppmv

where C_{Avg}:	19.63	ppmv
C_O:	0.06	ppmv
C_{MA}:	10.00	ppmv
C_M:	10.05	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**10:30**
Source:	**CFU 114**	**End Time:**	**12:40**
Method:	**3A**	**Date:**	**6/5/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.25 %v

where C_{Dir}: 1.99 ppmv
C_V: 2.00 ppmv
CS: 4.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -4.25 %v

where C_{Dir}: 1.99 ppmv
C_S: 1.82 ppmv
CS: 4.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 5.25 %v

where SB_{Final}: 1.00 ppmv
SB_i: -4.25 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.68 ppmv

where C_{Avg}: 0.71 ppmv
C_O: 0.09 ppmv
C_{MA}: 2.00 ppmv
C_M: 1.93 ppmv

Hollingsworth & Vose

6/5/2018

CFU 114

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
	Time stamp on Mountain				
6/5/2018	9:19:27	20.81	0.16		
6/5/2018	9:19:37	20.81	0.16		
6/5/2018	9:19:47	20.81	0.15		
6/5/2018	9:19:57	20.80	0.15		
6/5/2018	9:20:07	20.80	0.16		
6/5/2018	9:20:17	20.80	0.16		
6/5/2018	9:20:27	20.79	0.16		
6/5/2018	9:20:37	20.79	0.16		
6/5/2018	9:20:47	20.79	0.16		
6/5/2018	9:20:57	20.79	0.15		
6/5/2018	9:21:07	20.79	0.16		
6/5/2018	9:21:17	20.78	0.16		
6/5/2018	9:21:27	20.78	0.15		
6/5/2018	9:21:37	20.78	0.16		
6/5/2018	9:21:47	20.78	0.16		
6/5/2018	9:21:57	20.77	0.16		
6/5/2018	9:22:07	20.77	0.16		
6/5/2018	9:22:17	20.77	0.16		
6/5/2018	9:22:27	20.76	0.16		
6/5/2018	9:22:37	20.77	0.16		
6/5/2018	9:22:47	20.76	0.16		
6/5/2018	9:22:57	20.75	0.16		
6/5/2018	9:23:07	20.75	0.15		
6/5/2018	9:23:17	20.75	0.16		
6/5/2018	9:23:27	20.74	0.15		
6/5/2018	9:23:37	20.74	0.16		
6/5/2018	9:23:47	20.74	0.16		
6/5/2018	9:23:57	20.73	0.15		
6/5/2018	9:24:07	20.73	0.16		
6/5/2018	9:24:17	20.73	0.16		
6/5/2018	9:24:27	20.73	0.16		
6/5/2018	9:24:37	20.72	0.16		
6/5/2018	9:24:47	20.72	0.17		
6/5/2018	9:24:57	20.72	0.16		
6/5/2018	9:25:07	20.72	0.16		
6/5/2018	9:25:17	20.72	0.16		
6/5/2018	9:25:27	20.71	0.16		
6/5/2018	9:25:37	20.71	0.17		
6/5/2018	9:25:47	20.71	0.17		

Hollingsworth & Vose

6/5/2018

CFU 114

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	9:25:57	20.70	0.16		
6/5/2018	9:26:07	20.71	0.16		
6/5/2018	9:26:17	20.70	0.16		
6/5/2018	9:26:27	20.70	0.16		
6/5/2018	9:26:37	20.70	0.17		
6/5/2018	9:26:47	20.70	0.17		
6/5/2018	9:26:57	20.70	0.17		
6/5/2018	9:27:07	20.69	0.17		
6/5/2018	9:27:17	20.69	0.17		
6/5/2018	9:27:27	20.69	0.17		
6/5/2018	9:27:37	20.69	0.17		
6/5/2018	9:27:47	20.69	0.17		
6/5/2018	9:27:57	20.68	0.17		
6/5/2018	9:28:07	20.68	0.17		
6/5/2018	9:28:17	20.68	0.17		
6/5/2018	9:28:27	20.68	0.16		
6/5/2018	9:28:37	20.68	0.18		
6/5/2018	9:28:47	20.68	0.17		
6/5/2018	9:28:57	20.68	0.17		
6/5/2018	9:29:07	20.68	0.17		
6/5/2018	9:29:17	20.67	0.17		
6/5/2018	9:29:27	20.67	0.17		
6/5/2018	9:29:37	20.67	0.18		
6/5/2018	9:29:47	20.67	0.17		
6/5/2018	9:29:57	20.67	0.18		
6/5/2018	9:30:07	21.17	0.18		
6/5/2018	9:30:17	9.13	0.14		
6/5/2018	9:30:27	0.22	0.11		
6/5/2018	9:30:37	0.09	0.11		
6/5/2018	9:30:47	0.07	0.10		
6/5/2018	9:30:57	0.05	0.09		
6/5/2018	9:31:07	0.04	0.10		
6/5/2018	9:31:17	0.02	0.10		
6/5/2018	9:31:27	0.02	0.09		
6/5/2018	9:31:37	0.01	0.09		
6/5/2018	9:31:47	0.01	0.09	AZ	AZ
6/5/2018	9:31:57	0.01	0.09	0.01	0.09
6/5/2018	9:32:07	0.00	0.10		
6/5/2018	9:32:17	10.86	9.99		
6/5/2018	9:32:27	22.62	25.42		

Hollingsworth & Vose

6/5/2018

CFU 114

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	9:32:37	23.12	25.56		
6/5/2018	9:32:47	23.14	25.58		
6/5/2018	9:32:57	23.15	25.59		
6/5/2018	9:33:07	23.15	25.60		
6/5/2018	9:33:17	22.92	24.80		
6/5/2018	9:33:27	22.87	21.24		
6/5/2018	9:33:37	22.88	21.16		
6/5/2018	9:33:47	22.88	21.16		
6/5/2018	9:33:57	22.88	21.16		
6/5/2018	9:34:07	21.75	21.16		
6/5/2018	9:34:17	20.06	20.49		
6/5/2018	9:34:27	19.93	19.80		
6/5/2018	9:34:37	19.80	19.78		
6/5/2018	9:34:47	20.05	19.78		
6/5/2018	9:34:57	20.07	19.79		
6/5/2018	9:35:07	20.08	19.73		
6/5/2018	9:35:17	20.06	19.73		
6/5/2018	9:35:27	20.05	19.69		
6/5/2018	9:35:37	20.04	19.69		
6/5/2018	9:35:47	20.05	19.69		
6/5/2018	9:35:57	20.05	19.69	AS	
6/5/2018	9:36:07	20.05	19.69	20.05	
6/5/2018	9:36:17	20.06	19.69		
6/5/2018	9:36:27	20.06	19.69		
6/5/2018	9:36:37	15.90	9.82		
6/5/2018	9:36:47	10.14	0.22		
6/5/2018	9:36:57	10.02	0.13		
6/5/2018	9:37:07	10.11	0.11		
6/5/2018	9:37:17	9.98	0.10		
6/5/2018	9:37:27	9.99	0.10		
6/5/2018	9:37:37	9.99	0.09		
6/5/2018	9:37:47	9.99	0.09		
6/5/2018	9:37:57	9.97	0.09		
6/5/2018	9:38:07	9.93	0.08		
6/5/2018	9:38:17	9.93	0.08		
6/5/2018	9:38:27	9.93	0.07		
6/5/2018	9:38:37	9.93	0.07		
6/5/2018	9:38:47	9.93	0.07		
6/5/2018	9:38:57	9.93	0.07		
6/5/2018	9:39:07	9.93	0.07		

Hollingsworth & Vose

6/5/2018

CFU 114

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	9:39:17	9.93	0.06		
6/5/2018	9:39:27	9.93	0.07		
6/5/2018	9:39:37	9.93	0.06		
6/5/2018	9:39:47	9.93	0.06		
6/5/2018	9:39:57	9.93	0.05		
6/5/2018	9:40:07	9.93	0.06		
6/5/2018	9:40:17	9.93	0.05		
6/5/2018	9:40:27	9.93	0.06		
6/5/2018	9:40:37	9.93	0.05	AM	
6/5/2018	9:40:47	9.93	0.05	9.93	
6/5/2018	9:40:57	9.93	0.05		
6/5/2018	9:41:07	9.93	0.05		
6/5/2018	9:41:17	9.93	0.05		
6/5/2018	9:41:27	8.93	0.04		
6/5/2018	9:41:37	8.79	0.05		
6/5/2018	9:41:47	8.78	0.05		
6/5/2018	9:41:57	8.79	0.06		
6/5/2018	9:42:07	8.78	0.06		
6/5/2018	9:42:17	8.79	0.06		
6/5/2018	9:42:27	8.79	0.07		
6/5/2018	9:42:37	8.79	0.07		
6/5/2018	9:42:47	8.79	0.07		
6/5/2018	9:42:57	8.79	0.08		
6/5/2018	9:43:07	8.79	0.08		
6/5/2018	9:43:17	8.79	0.08		
6/5/2018	9:43:27	8.79	0.09		
6/5/2018	9:43:37	9.10	0.15		
6/5/2018	9:43:47	11.54	11.45		
6/5/2018	9:43:57	12.42	16.38		
6/5/2018	9:44:07	13.51	16.80		
6/5/2018	9:44:17	17.06	16.92		
6/5/2018	9:44:27	10.46	8.24		
6/5/2018	9:44:37	9.06	9.77		
6/5/2018	9:44:47	9.07	9.76		
6/5/2018	9:44:57	9.93	12.12		
6/5/2018	9:45:07	11.57	13.25		
6/5/2018	9:45:17	12.41	13.51		
6/5/2018	9:45:27	11.55	11.31		
6/5/2018	9:45:37	8.84	8.31		
6/5/2018	9:45:47	2.10	1.22		

Hollingsworth & Vose

6/5/2018

CFU 114

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	9:45:57	0.51	0.25		
6/5/2018	9:46:07	0.44	0.53		
6/5/2018	9:46:17	0.84	1.17		
6/5/2018	9:46:27	2.50	8.37		
6/5/2018	9:46:37	6.86	15.20		
6/5/2018	9:46:47	10.13	16.64		
6/5/2018	9:46:57	13.70	18.14		
6/5/2018	9:47:07	14.37	18.27		
6/5/2018	9:47:17	14.78	18.31		
6/5/2018	9:47:27	16.16	18.68		
6/5/2018	9:47:37	17.24	19.09		
6/5/2018	9:47:47	17.40	16.91		
6/5/2018	9:47:57	14.81	12.39		
6/5/2018	9:48:07	12.13	10.97		
6/5/2018	9:48:17	11.55	11.17		
6/5/2018	9:48:27	11.49	11.16		
6/5/2018	9:48:37	11.45	11.15		
6/5/2018	9:48:47	11.42	11.14		
6/5/2018	9:48:57	11.41	11.12		
6/5/2018	9:49:07	11.39	11.11		
6/5/2018	9:49:17	11.38	11.11		
6/5/2018	9:49:27	11.36	11.08		
6/5/2018	9:49:37	11.35	11.08		
6/5/2018	9:49:47	11.35	11.07		
6/5/2018	9:49:57	11.34	11.05		
6/5/2018	9:50:07	11.35	11.14		
6/5/2018	9:50:17	11.56	15.05		
6/5/2018	9:50:27	11.93	16.22		
6/5/2018	9:50:37	12.99	17.39		
6/5/2018	9:50:47	14.97	18.21		
6/5/2018	9:50:57	16.53	18.70		
6/5/2018	9:51:07	17.20	19.17		
6/5/2018	9:51:17	17.86	19.37		
6/5/2018	9:51:27	15.89	13.98		
6/5/2018	9:51:37	10.38	9.85		
6/5/2018	9:51:47	10.16	9.77		
6/5/2018	9:51:57	10.16	9.78		
6/5/2018	9:52:07	10.16	9.78		
6/5/2018	9:52:17	10.16	9.78		
6/5/2018	9:52:27	10.16	9.78		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	9:52:37	10.15	9.78		
6/5/2018	9:52:47	10.16	9.78		
6/5/2018	9:52:57	10.16	9.78		
6/5/2018	9:53:07	10.15	9.78		
6/5/2018	9:53:17	10.16	9.78		
6/5/2018	9:53:27	10.16	9.78		
6/5/2018	9:53:37	10.16	9.79		
6/5/2018	9:53:47	10.16	9.78		
6/5/2018	9:53:57	10.19	9.78		
6/5/2018	9:54:07	10.29	9.78		
6/5/2018	9:54:17	10.21	9.78		
6/5/2018	9:54:27	10.29	9.78		
6/5/2018	9:54:37	10.18	9.78	Begin M-205	
6/5/2018	9:54:47	10.11	9.78		
6/5/2018	9:54:57	10.08	9.77		
6/5/2018	9:55:07	9.98	9.70		
6/5/2018	9:55:17	9.98	9.69		
6/5/2018	9:55:27	10.01	9.70		
6/5/2018	9:55:37	9.96	9.70	9.98	
6/5/2018	9:55:47	9.87	9.69		
6/5/2018	9:55:57	9.88	9.69		
6/5/2018	9:56:07	6.54	6.02		
6/5/2018	9:56:17	4.86	4.99		
6/5/2018	9:56:27	4.98	5.04		
6/5/2018	9:56:37	4.98	5.05		
6/5/2018	9:56:47	4.98	5.05		
6/5/2018	9:56:57	4.98	5.05	4.98	
6/5/2018	9:57:07	9.97	10.06		
6/5/2018	9:57:17	10.00	9.79		
6/5/2018	9:57:27	9.97	9.77		
6/5/2018	9:57:37	9.97	9.77		
6/5/2018	9:57:47	9.97	9.76		
6/5/2018	9:57:57	9.97	9.77	9.97	
6/5/2018	9:58:07	8.06	7.48		
6/5/2018	9:58:17	4.68	4.82		
6/5/2018	9:58:27	4.97	5.05		
6/5/2018	9:58:37	4.98	5.07		
6/5/2018	9:58:47	4.98	5.05		
6/5/2018	9:58:57	4.98	5.06	4.98	
6/5/2018	9:59:07	9.72	9.82		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	9:59:17	10.01	9.79		
6/5/2018	9:59:27	9.97	9.77		
6/5/2018	9:59:37	9.97	9.77		
6/5/2018	9:59:47	9.97	9.77		
6/5/2018	9:59:57	9.97	9.77		
6/5/2018	10:00:07	9.97	9.77	9.97	
6/5/2018	10:00:17	9.97	9.77		
6/5/2018	10:00:27	9.96	9.77		
6/5/2018	10:00:37	9.97	9.77		
6/5/2018	10:00:47	9.97	9.77		
6/5/2018	10:00:57	9.97	9.77		
6/5/2018	10:01:07	9.76	9.52		
6/5/2018	10:01:17	4.56	4.24		
6/5/2018	10:01:27	4.95	5.05		
6/5/2018	10:01:37	4.98	5.05		
6/5/2018	10:01:47	4.98	5.06		
6/5/2018	10:01:57	4.99	5.05		
6/5/2018	10:02:07	4.98	5.06		
6/5/2018	10:02:17	4.98	5.05		
6/5/2018	10:02:27	4.98	5.06	4.98	
6/5/2018	10:02:37	4.98	5.05		
6/5/2018	10:02:47	4.94	5.05		
6/5/2018	10:02:57	4.41	5.01		
6/5/2018	10:03:07	3.63	3.42		
6/5/2018	10:03:17	0.18	0.10		
6/5/2018	10:03:27	0.05	0.07		
6/5/2018	10:03:37	0.04	0.07		
6/5/2018	10:03:47	0.04	0.06		
6/5/2018	10:03:57	0.04	0.06		
6/5/2018	10:04:07	0.04	0.06		
6/5/2018	10:04:17	0.04	0.05		
6/5/2018	10:04:27	0.04	0.05	0.04	
6/5/2018	10:04:37	0.04	0.05		
6/5/2018	10:04:47	0.04	0.05		
6/5/2018	10:04:57	0.05	0.05		
6/5/2018	10:05:07	0.04	0.05		
6/5/2018	10:05:17	0.04	0.04		
6/5/2018	10:05:27	0.04	0.05		
6/5/2018	10:05:37	0.04	0.04		
6/5/2018	10:05:47	0.04	0.04		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	10:05:57	0.04	0.04		
6/5/2018	10:06:07	0.04	0.04		
6/5/2018	10:06:17	0.03	0.04		
6/5/2018	10:06:27	2.60	0.05		
6/5/2018	10:06:37	9.51	0.03		
6/5/2018	10:06:47	9.80	0.03		
6/5/2018	10:06:57	9.83	0.03		
6/5/2018	10:07:07	9.83	0.03		
6/5/2018	10:07:17	9.84	0.03		
6/5/2018	10:07:27	9.84	0.03		
6/5/2018	10:07:37	9.84	0.02		
6/5/2018	10:07:47	9.84	0.03		
6/5/2018	10:07:57	9.84	0.03	9.84	
6/5/2018	10:08:07	7.69	0.02		
6/5/2018	10:08:17	0.34	0.03		
6/5/2018	10:08:27	0.05	0.03		
6/5/2018	10:08:37	0.04	0.02		
6/5/2018	10:08:47	0.05	0.02		
6/5/2018	10:08:57	0.04	0.02		
6/5/2018	10:09:07	0.04	0.02		
6/5/2018	10:09:17	0.04	0.02		
6/5/2018	10:09:27	0.04	0.02		
6/5/2018	10:09:37	0.04	0.02		
6/5/2018	10:09:47	0.04	0.02		
6/5/2018	10:09:57	0.04	0.02	0.04	
6/5/2018	10:10:07	0.04	0.01		
6/5/2018	10:10:17	0.04	0.01		
6/5/2018	10:10:27	7.67	0.02		
6/5/2018	10:10:37	9.76	0.01		
6/5/2018	10:10:47	9.81	0.01		
6/5/2018	10:10:57	9.82	0.02		
6/5/2018	10:11:07	9.82	0.01		
6/5/2018	10:11:17	9.82	0.01		
6/5/2018	10:11:27	9.84	0.01		
6/5/2018	10:11:37	9.85	0.01		
6/5/2018	10:11:47	9.85	0.01		
6/5/2018	10:11:57	9.85	0.01		
6/5/2018	10:12:07	9.85	0.01	9.85	
6/5/2018	10:12:17	9.86	0.00		
6/5/2018	10:12:27	9.86	0.00		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	10:12:37	9.87	0.01		
6/5/2018	10:12:47	3.38	0.01		
6/5/2018	10:12:57	0.09	0.00		
6/5/2018	10:13:07	0.05	0.01		
6/5/2018	10:13:17	0.05	0.00		
6/5/2018	10:13:27	0.04	0.01		
6/5/2018	10:13:37	0.05	0.00		
6/5/2018	10:13:47	0.04	0.00		
6/5/2018	10:13:57	0.05	0.01	0.05	
6/5/2018	10:14:07	0.04	0.00		
6/5/2018	10:14:17	0.85	0.01		
6/5/2018	10:14:27	8.97	0.01		
6/5/2018	10:14:37	9.78	0.01		
6/5/2018	10:14:47	9.81	0.00		
6/5/2018	10:14:57	9.81	0.01		
6/5/2018	10:15:07	9.81	0.00		
6/5/2018	10:15:17	9.81	0.00		
6/5/2018	10:15:27	9.81	0.01		
6/5/2018	10:15:37	9.86	0.01		
6/5/2018	10:15:47	9.86	0.01		
6/5/2018	10:15:57	9.86	0.01		
6/5/2018	10:16:07	9.87	0.01		
6/5/2018	10:16:17	9.87	0.00		
6/5/2018	10:16:27	9.86	0.00		
6/5/2018	10:16:37	9.87	0.00	9.87	
6/5/2018	10:16:47	9.87	0.00		
6/5/2018	10:16:57	9.54	0.00		
6/5/2018	10:17:07	8.73	0.00		
6/5/2018	10:17:17	8.29	0.31		
6/5/2018	10:17:27	4.55	0.30		
6/5/2018	10:17:37	2.81	2.70		
6/5/2018	10:17:47	4.33	4.28		
6/5/2018	10:17:57	4.29	4.36		
6/5/2018	10:18:07	4.32	4.39		
6/5/2018	10:18:17	4.34	4.41		
6/5/2018	10:18:27	4.35	4.20		
6/5/2018	10:18:37	4.37	3.99		
6/5/2018	10:18:47	4.38	4.01		
6/5/2018	10:18:57	4.39	4.02		
6/5/2018	10:19:07	4.40	4.02		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	10:19:17	4.41	4.03		AS
6/5/2018	10:19:27	4.40	4.04		4.03
6/5/2018	10:19:37	4.36	4.01		
6/5/2018	10:19:47	4.36	4.01		
6/5/2018	10:19:57	3.82	3.22		
6/5/2018	10:20:07	2.49	2.08		
6/5/2018	10:20:17	2.24	1.91		
6/5/2018	10:20:27	2.23	1.90		
6/5/2018	10:20:37	2.22	1.89		
6/5/2018	10:20:47	2.23	1.90		
6/5/2018	10:20:57	2.26	1.92		
6/5/2018	10:21:07	2.32	1.99		
6/5/2018	10:21:17	2.33	1.99		
6/5/2018	10:21:27	2.33	1.99		
6/5/2018	10:21:37	2.33	1.99		AM
6/5/2018	10:21:47	2.33	1.99		1.99
6/5/2018	10:21:57	2.33	2.00		
6/5/2018	10:22:07	2.33	1.99		
6/5/2018	10:22:17	2.33	2.00		
6/5/2018	10:22:27	2.34	2.00		
6/5/2018	10:22:37	2.33	2.00		
6/5/2018	10:22:47	2.33	2.00		
6/5/2018	10:22:57	2.33	2.00		
6/5/2018	10:23:07	2.33	2.00		
6/5/2018	10:23:17	2.33	2.00		
6/5/2018	10:23:27	2.34	2.00		
6/5/2018	10:23:37	2.33	2.00		
6/5/2018	10:23:47	2.32	2.01		
6/5/2018	10:23:57	2.07	1.97		
6/5/2018	10:24:07	2.07	1.98		
6/5/2018	10:24:17	7.48	1.96		
6/5/2018	10:24:27	17.36	1.30		
6/5/2018	10:24:37	15.07	1.81		
6/5/2018	10:24:47	12.77	1.47		
6/5/2018	10:24:57	11.68	1.32		
6/5/2018	10:25:07	10.84	1.27		
6/5/2018	10:25:17	11.12	1.25		
6/5/2018	10:25:27	11.33	1.24		
6/5/2018	10:25:37	11.25	1.24		
6/5/2018	10:25:47	11.31	1.24		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	10:25:57	11.33	1.24		
6/5/2018	10:26:07	11.28	1.25		
6/5/2018	10:26:17	11.24	1.25		
6/5/2018	10:26:27	11.25	1.26		
6/5/2018	10:26:37	11.91	1.21		
System					
6/5/2018	10:26:47	16.12	0.91		
6/5/2018	10:26:57	15.28	1.14		
6/5/2018	10:27:07	12.41	0.90		
6/5/2018	10:27:17	11.10	0.57		
6/5/2018	10:27:27	10.68	0.45		
6/5/2018	10:27:37	10.41	0.41		
6/5/2018	10:27:47	6.63	0.27		
6/5/2018	10:27:57	2.80	0.13		
6/5/2018	10:28:07	1.97	0.11		
6/5/2018	10:28:17	1.70	0.11		
6/5/2018	10:28:27	3.67	0.17		
6/5/2018	10:28:37	2.66	0.13		
6/5/2018	10:28:47	1.02	0.07		
6/5/2018	10:28:57	0.45	0.06		
6/5/2018	10:29:07	0.26	0.06		
6/5/2018	10:29:17	0.20	0.06		
6/5/2018	10:29:27	0.18	0.05		
6/5/2018	10:29:37	0.17	0.05		
6/5/2018	10:29:47	0.17	0.06		
6/5/2018	10:29:57	0.16	0.05		
6/5/2018	10:30:07	0.16	0.05		
6/5/2018	10:30:17	0.16	0.05		
6/5/2018	10:30:27	0.17	0.05		
6/5/2018	10:30:37	0.16	0.06		
6/5/2018	10:30:47	0.16	0.05		
6/5/2018	10:30:57	0.16	0.05		
6/5/2018	10:31:07	0.16	0.06		
6/5/2018	10:31:17	0.26	0.06		
6/5/2018	10:31:27	0.83	0.09		
6/5/2018	10:31:37	1.49	0.93		
6/5/2018	10:31:47	1.91	1.47		
6/5/2018	10:31:57	2.03	1.63		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	10:32:07	2.08	1.68		
6/5/2018	10:32:17	2.08	1.69		
6/5/2018	10:32:27	2.05	1.67		
6/5/2018	10:32:37	2.09	1.70		
6/5/2018	10:32:47	2.11	1.70		
6/5/2018	10:32:57	2.11	1.71		
6/5/2018	10:33:07	2.12	1.72		
6/5/2018	10:33:17	2.12	1.71		
6/5/2018	10:33:27	2.12	1.72		
6/5/2018	10:33:37	2.12	1.72		
6/5/2018	10:33:47	2.12	1.72		
6/5/2018	10:33:57	7.42	1.45		
6/5/2018	10:34:07	15.25	0.97		
6/5/2018	10:34:17	18.28	0.77		
6/5/2018	10:34:27	14.18	0.72		
6/5/2018	10:34:37	5.31	0.40		
6/5/2018	10:34:47	2.85	1.12		
6/5/2018	10:34:57	2.38	1.54		
6/5/2018	10:35:07	2.22	1.66		
6/5/2018	10:35:17	2.16	1.70		
6/5/2018	10:35:27	2.12	1.70		
6/5/2018	10:35:37	2.06	1.66		
6/5/2018	10:35:47	2.11	1.70		
6/5/2018	10:35:57	2.13	1.71		
6/5/2018	10:36:07	2.13	1.72		
6/5/2018	10:36:17	2.13	1.72		
6/5/2018	10:36:27	2.16	1.72		
6/5/2018	10:36:37	2.23	1.72		
6/5/2018	10:36:47	2.25	1.72		
6/5/2018	10:36:57	2.25	1.73		
6/5/2018	10:37:07	2.25	1.72		
6/5/2018	10:37:17	2.25	1.72		
6/5/2018	10:37:27	2.25	1.73		
6/5/2018	10:37:37	2.24	1.72		
6/5/2018	10:37:47	2.80	1.71		
6/5/2018	10:37:57	10.81	1.28		
6/5/2018	10:38:07	13.19	1.23		
6/5/2018	10:38:17	17.83	0.99		
6/5/2018	10:38:27	20.08	0.76		
6/5/2018	10:38:37	20.80	0.68		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	10:38:47	21.03	0.67		
6/5/2018	10:38:57	21.09	0.65		
6/5/2018	10:39:07	20.52	0.77		
6/5/2018	10:39:17	18.07	1.00		
6/5/2018	10:39:27	7.75	3.36		
6/5/2018	10:39:37	4.16	3.75		
6/5/2018	10:39:47	4.11	3.75		
6/5/2018	10:39:57	4.11	3.76		
6/5/2018	10:40:07	3.67	3.73		
6/5/2018	10:40:17	3.68	3.71		
6/5/2018	10:40:27	3.70	3.71		
6/5/2018	10:40:37	3.72	3.70		
6/5/2018	10:40:47	3.73	3.68		
6/5/2018	10:40:57	5.67	3.60		
6/5/2018	10:41:07	5.21	4.47		
6/5/2018	10:41:17	4.15	3.79		
6/5/2018	10:41:27	4.10	3.77		
6/5/2018	10:41:37	4.09	3.94		
6/5/2018	10:41:47	4.08	4.09		
6/5/2018	10:41:57	4.07	4.09		
6/5/2018	10:42:07	4.07	4.07		
6/5/2018	10:42:17	4.09	4.08		
6/5/2018	10:42:27	1.82	1.61		
6/5/2018	10:42:37	0.13	0.08		
6/5/2018	10:42:47	0.09	0.06		
6/5/2018	10:42:57	0.07	0.07		
6/5/2018	10:43:07	0.02	0.06		
6/5/2018	10:43:17	0.02	0.05		
6/5/2018	10:43:27	1.46	1.47		
6/5/2018	10:43:37	2.03	1.89		
6/5/2018	10:43:47	1.99	1.86		
6/5/2018	10:43:57	1.99	1.85		
6/5/2018	10:44:07	1.98	1.85		
6/5/2018	10:44:17	1.99	1.85		
6/5/2018	10:44:27	1.99	1.86		
6/5/2018	10:44:37	1.98	1.86		
6/5/2018	10:44:47	1.98	1.86		
6/5/2018	10:44:57	1.98	1.85		
6/5/2018	10:45:07	13.26	1.19		
6/5/2018	10:45:17	17.60	1.01		

Hollingsworth & Vose

6/5/2018

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	10:45:27	13.82	1.25		
6/5/2018	10:45:37	13.30	1.18		
6/5/2018	10:45:47	16.59	0.93		
6/5/2018	10:45:57	18.70	0.76		
6/5/2018	10:46:07	19.41	0.72		
6/5/2018	10:46:17	19.54	0.71		
6/5/2018	10:46:27	19.59	0.71		
6/5/2018	10:46:37	13.17	0.81		
6/5/2018	10:46:47	3.79	0.34		
6/5/2018	10:46:57	1.19	0.14		
6/5/2018	10:47:07	0.81	0.10		
6/5/2018	10:47:17	3.05	0.17		
6/5/2018	10:47:27	4.13	0.22		
6/5/2018	10:47:37	2.15	1.01		
6/5/2018	10:47:47	2.42	1.65		
6/5/2018	10:47:57	2.57	1.77		
6/5/2018	10:48:07	2.60	1.80		
6/5/2018	10:48:17	2.61	1.81		
6/5/2018	10:48:27	2.61	1.82		
6/5/2018	10:48:37	2.59	1.81		
6/5/2018	10:48:47	2.58	1.81		
6/5/2018	10:48:57	2.56	1.82		
6/5/2018	10:49:07	2.55	1.82		
6/5/2018	10:49:17	2.55	1.81		
6/5/2018	10:49:27	2.54	1.82		
6/5/2018	10:49:37	2.53	1.82		1.82
6/5/2018	10:49:47	5.97	1.62		
6/5/2018	10:49:57	10.89	1.34		
6/5/2018	10:50:07	15.42	1.01		
6/5/2018	10:50:17	16.40	1.95		
6/5/2018	10:50:27	12.17	6.88		
6/5/2018	10:50:37	10.47	8.79		
6/5/2018	10:50:47	10.10	9.28		
6/5/2018	10:50:57	10.11	9.35		
6/5/2018	10:51:07	10.13	9.35		
6/5/2018	10:51:17	10.14	9.35		
6/5/2018	10:51:27	10.14	9.34		
6/5/2018	10:51:37	10.14	9.34		
6/5/2018	10:51:47	10.15	9.35	10.14	
6/5/2018	10:51:57	10.15	9.35		

Hollingsworth & Vose

6/5/2018

CFU 114

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	10:52:07	9.79	9.04		
6/5/2018	10:52:17	4.55	4.09		
6/5/2018	10:52:27	1.44	1.25		
6/5/2018	10:52:37	0.89	0.51		
6/5/2018	10:52:47	0.80	0.24		
6/5/2018	10:52:57	0.78	0.16		
6/5/2018	10:53:07	0.79	0.14		
6/5/2018	10:53:17	0.78	0.13		
6/5/2018	10:53:27	0.78	0.13		
6/5/2018	10:53:37	0.75	0.11		
6/5/2018	10:53:47	0.67	0.11		
6/5/2018	10:53:57	0.58	0.10		
6/5/2018	10:54:07	3.00	0.18		
6/5/2018	10:54:17	4.74	0.27		
6/5/2018	10:54:27	1.43	0.13		
6/5/2018	10:54:37	0.42	0.09		
6/5/2018	10:54:47	0.17	0.08		
6/5/2018	10:54:57	0.09	0.07		
6/5/2018	10:55:07	0.07	0.07		
6/5/2018	10:55:17	0.07	0.08		
6/5/2018	10:55:27	0.07	0.07		
6/5/2018	10:55:37	0.07	0.08		
6/5/2018	10:55:47	0.07	0.08	0.07	0.08
6/5/2018	10:55:57	0.07	0.08		
6/5/2018	10:56:07	0.06	0.07		
6/5/2018	10:56:17	0.06	0.08		
6/5/2018	10:56:27	4.34	0.21		
6/5/2018	10:56:37	14.68	0.56		
6/5/2018	10:56:47	18.37	0.67		
6/5/2018	10:56:57	19.41	0.70		
6/5/2018	10:57:07	19.70	0.70		
6/5/2018	10:57:17	19.78	0.71		

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Run #1

Date	Time	O2 [%]	CO2 [%]
6/5/2018	10:32:14	19.64	0.71
6/5/2018	10:33:14	19.64	0.72
6/5/2018	10:34:14	19.64	0.72
6/5/2018	10:35:14	19.65	0.72
6/5/2018	10:36:14	19.65	0.72
6/5/2018	10:37:14	19.64	0.72
6/5/2018	10:38:14	19.64	0.72
6/5/2018	10:39:14	19.64	0.71
6/5/2018	10:40:14	19.64	0.72
6/5/2018	10:41:14	19.65	0.72
6/5/2018	10:42:14	19.65	0.71
6/5/2018	10:43:14	19.64	0.71
6/5/2018	10:44:14	19.64	0.71
6/5/2018	10:45:14	19.64	0.70
6/5/2018	10:46:14	19.65	0.70
6/5/2018	10:47:14	19.65	0.70
6/5/2018	10:48:14	19.64	0.70
6/5/2018	10:49:14	19.64	0.70
6/5/2018	10:50:14	19.64	0.70
6/5/2018	10:51:14	19.64	0.70
6/5/2018	10:52:14	19.65	0.70
6/5/2018	10:53:14	19.65	0.70
6/5/2018	10:54:14	19.64	0.71
6/5/2018	10:55:14	19.64	0.71
6/5/2018	10:56:14	19.64	0.71
6/5/2018	10:57:14	19.64	0.71
6/5/2018	10:58:14	19.65	0.72
6/5/2018	10:59:14	19.64	0.72
6/5/2018	11:00:14	19.63	0.72
6/5/2018	11:01:14	19.63	0.72
6/5/2018	11:02:14	19.64	0.72
6/5/2018	11:03:14	19.64	0.71
6/5/2018	11:04:14	19.64	0.71
6/5/2018	11:05:14	19.64	0.71
6/5/2018	11:06:14	19.63	0.71
6/5/2018	11:07:14	19.64	0.71
6/5/2018	11:08:14	19.64	0.71
6/5/2018	11:09:14	19.64	0.70
6/5/2018	11:10:14	19.64	0.70
6/5/2018	11:11:14	19.64	0.70
6/5/2018	11:12:14	19.63	0.70

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CFU 114

Run #1

Date	Time	O2 [%]	CO2 [%]
6/5/2018	11:13:14	19.63	0.70
6/5/2018	11:14:14	19.64	0.70
6/5/2018	11:15:14	19.64	0.70
6/5/2018	11:16:14	19.64	0.70
6/5/2018	11:17:14	19.63	0.70
6/5/2018	11:18:14	19.63	0.70
6/5/2018	11:19:14	19.63	0.70
6/5/2018	11:20:14	19.63	0.71
6/5/2018	11:21:14	19.64	0.71
6/5/2018	11:22:14	19.63	0.71
6/5/2018	11:23:14	19.62	0.71
6/5/2018	11:24:14	19.62	0.71
6/5/2018	11:25:14	19.63	0.71
6/5/2018	11:26:14	19.63	0.71
6/5/2018	11:27:14	19.63	0.72
6/5/2018	11:28:14	19.63	0.71
6/5/2018	11:29:14	19.62	0.71
6/5/2018	11:30:14	19.62	0.71
6/5/2018	11:31:14	19.62	0.71
6/5/2018	11:32:14	19.62	0.71
6/5/2018	11:33:14	19.62	0.71
6/5/2018	11:34:14	19.62	0.70
6/5/2018	11:35:14	19.62	0.70
6/5/2018	11:36:14	19.62	0.70
6/5/2018	11:37:14	19.62	0.70
6/5/2018	11:38:14	19.62	0.70
6/5/2018	11:39:14	19.62	0.70
6/5/2018	11:40:14	19.62	0.70
6/5/2018	11:41:14	19.61	0.70
6/5/2018	11:42:14	19.61	0.71
6/5/2018	11:43:14	19.61	0.71
6/5/2018	11:44:14	19.61	0.71
6/5/2018	11:45:14	19.62	0.71
6/5/2018	11:46:14	19.61	0.72
6/5/2018	11:47:14	19.60	0.72
6/5/2018	11:48:14	19.61	0.72
6/5/2018	11:49:14	19.62	0.71
6/5/2018	11:50:14	19.63	0.70
6/5/2018	11:51:14	19.64	0.70
6/5/2018	11:52:14	19.62	0.70
6/5/2018	11:53:14	19.62	0.71

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CFU 114

Run #1

Date	Time	O2 [%]	CO2 [%]
6/5/2018	11:54:14	19.61	0.72
6/5/2018	11:55:14	19.61	0.71
6/5/2018	11:56:14	19.62	0.71
6/5/2018	11:57:14	19.61	0.71
6/5/2018	11:58:14	19.60	0.70
6/5/2018	11:59:14	19.60	0.71
6/5/2018	12:00:14	19.60	0.71
6/5/2018	12:01:14	19.61	0.71
6/5/2018	12:02:14	19.62	0.71
6/5/2018	12:03:14	19.62	0.71
6/5/2018	12:04:14	19.61	0.71
6/5/2018	12:05:14	19.60	0.71
6/5/2018	12:06:14	19.61	0.71
6/5/2018	12:07:14	19.61	0.71
6/5/2018	12:08:14	19.61	0.72
6/5/2018	12:09:14	19.61	0.72
6/5/2018	12:10:14	19.60	0.73
6/5/2018	12:11:14	19.61	0.73
6/5/2018	12:12:14	19.61	0.73
6/5/2018	12:13:14	19.61	0.72
6/5/2018	12:14:14	19.62	0.73
6/5/2018	12:15:14	19.62	0.72
6/5/2018	12:16:14	19.61	0.72
6/5/2018	12:17:14	19.61	0.72
6/5/2018	12:18:14	19.62	0.72
6/5/2018	12:19:14	19.62	0.72
6/5/2018	12:20:14	19.63	0.72
6/5/2018	12:21:14	19.62	0.71
6/5/2018	12:22:14	19.61	0.71
6/5/2018	12:23:14	19.61	0.71
6/5/2018	12:24:14	19.62	0.71
6/5/2018	12:25:14	19.62	0.71
6/5/2018	12:26:14	19.63	0.71
6/5/2018	12:27:14	19.62	0.71
6/5/2018	12:28:14	19.61	0.72
6/5/2018	12:29:14	19.62	0.72
6/5/2018	12:30:14	19.62	0.72
6/5/2018	12:31:14	19.62	0.72
6/5/2018	12:32:14	19.63	0.72
	Average	**19.63**	**0.71**

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R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	12:40:54	19.61	0.72		
6/5/2018	12:41:04	19.61	0.72		
6/5/2018	12:41:14	19.62	0.73		
6/5/2018	12:41:24	19.62	0.73		
6/5/2018	12:41:34	19.62	0.72		
6/5/2018	12:41:44	19.62	0.73		
6/5/2018	12:41:54	19.62	0.73		
6/5/2018	12:42:04	19.62	0.73		
6/5/2018	12:42:14	19.62	0.73		
6/5/2018	12:42:24	19.62	0.73		
6/5/2018	12:42:34	19.62	0.73		
6/5/2018	12:42:44	19.60	0.73		
6/5/2018	12:42:54	19.62	0.73		
6/5/2018	12:43:04	18.84	0.71		
6/5/2018	12:43:14	15.92	2.36		
6/5/2018	12:43:24	11.84	7.09		
6/5/2018	12:43:34	10.44	8.89		
6/5/2018	12:43:44	10.09	9.34		
6/5/2018	12:43:54	10.00	9.46		
6/5/2018	12:44:04	9.97	9.49		
6/5/2018	12:44:14	9.96	9.51		
6/5/2018	12:44:24	9.96	9.51		
6/5/2018	12:44:34	9.95	9.52		
6/5/2018	12:44:44	9.95	9.52		
6/5/2018	12:44:54	9.95	9.53		
6/5/2018	12:45:04	9.95	9.52		
6/5/2018	12:45:14	9.95	9.52		
6/5/2018	12:45:24	9.95	9.52		
6/5/2018	12:45:34	9.94	9.53		
6/5/2018	12:45:44	9.94	9.53		
6/5/2018	12:45:54	9.95	9.53		
6/5/2018	12:46:04	9.95	9.53	9.95	
6/5/2018	12:46:14	9.95	9.53		
6/5/2018	12:46:24	9.92	9.53		
6/5/2018	12:46:34	13.05	6.87		
6/5/2018	12:46:44	13.77	6.06		
6/5/2018	12:46:54	10.35	4.69		
6/5/2018	12:47:04	13.42	2.25		
6/5/2018	12:47:14	6.57	2.19		
6/5/2018	12:47:24	3.12	1.94		
6/5/2018	12:47:34	2.31	1.92		

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R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	12:47:44	2.10	1.91		
6/5/2018	12:47:54	2.05	1.90		
6/5/2018	12:48:04	2.04	1.90		
6/5/2018	12:48:14	2.03	1.90		
6/5/2018	12:48:24	2.03	1.89		
6/5/2018	12:48:34	2.03	1.90		
6/5/2018	12:48:44	2.03	1.89	2.03	
6/5/2018	12:48:54	2.03	1.90		
6/5/2018	12:49:04	1.56	1.50		
6/5/2018	12:49:14	0.52	0.57		
6/5/2018	12:49:24	0.19	0.24		
6/5/2018	12:49:34	0.10	0.13		
6/5/2018	12:49:44	0.07	0.09		
6/5/2018	12:49:54	0.07	0.10		
6/5/2018	12:50:04	0.06	0.10		
6/5/2018	12:50:14	0.06	0.09		
6/5/2018	12:50:24	0.06	0.09		
6/5/2018	12:50:34	0.06	0.09		
6/5/2018	12:50:44	0.06	0.09		
6/5/2018	12:50:54	0.06	0.09		
6/5/2018	12:51:04	0.06	0.09		
6/5/2018	12:51:14	0.06	0.09		
6/5/2018	12:51:24	0.05	0.09		
6/5/2018	12:51:34	0.05	0.09		
6/5/2018	12:51:44	0.05	0.09		
6/5/2018	12:51:54	0.05	0.08	0.05	0.09

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Run #2

Date	Time	O2 [%]	CO2 [%]
6/5/2018	13:10:01	19.75	0.73
6/5/2018	13:11:01	19.87	0.73
6/5/2018	13:12:01	19.86	0.73
6/5/2018	13:13:01	19.86	0.73
6/5/2018	13:14:01	19.86	0.73
6/5/2018	13:15:01	19.86	0.73
6/5/2018	13:16:01	19.86	0.73
6/5/2018	13:17:01	19.87	0.74
6/5/2018	13:18:01	19.87	0.74
6/5/2018	13:19:01	19.86	0.74
6/5/2018	13:20:01	19.86	0.74
6/5/2018	13:21:01	19.79	0.74
6/5/2018	13:22:01	19.73	0.74
6/5/2018	13:23:01	19.73	0.74
6/5/2018	13:24:01	19.73	0.74
6/5/2018	13:25:01	19.72	0.74
6/5/2018	13:26:01	19.72	0.73
6/5/2018	13:27:01	19.73	0.73
6/5/2018	13:28:01	19.73	0.73
6/5/2018	13:29:01	19.73	0.73
6/5/2018	13:30:01	19.73	0.72
6/5/2018	13:31:01	19.72	0.73
6/5/2018	13:32:01	19.72	0.72
6/5/2018	13:33:01	19.73	0.73
6/5/2018	13:34:01	19.73	0.73
6/5/2018	13:35:01	19.74	0.73
6/5/2018	13:36:01	19.73	0.73
6/5/2018	13:37:01	19.72	0.73
6/5/2018	13:38:01	19.72	0.73
6/5/2018	13:39:01	19.73	0.73
6/5/2018	13:40:01	19.73	0.74
6/5/2018	13:41:01	19.73	0.74
6/5/2018	13:42:01	19.72	0.74
6/5/2018	13:43:01	19.72	0.74
6/5/2018	13:44:01	19.73	0.74
6/5/2018	13:45:01	19.73	0.74
6/5/2018	13:46:01	19.73	0.74
6/5/2018	13:47:01	19.73	0.74
6/5/2018	13:48:01	19.72	0.74
6/5/2018	13:49:01	19.73	0.74
6/5/2018	13:50:01	19.73	0.74

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Run #2

Date	Time	O2 [%]	CO2 [%]
6/5/2018	13:51:01	19.74	0.74
6/5/2018	13:52:01	19.74	0.74
6/5/2018	13:53:01	19.73	0.73
6/5/2018	13:54:01	19.73	0.73
6/5/2018	13:55:01	19.73	0.73
6/5/2018	13:56:01	19.74	0.73
6/5/2018	13:57:01	19.74	0.73
6/5/2018	13:58:01	19.74	0.73
6/5/2018	13:59:01	19.73	0.73
6/5/2018	14:00:01	19.73	0.73
6/5/2018	14:01:01	19.73	0.73
6/5/2018	14:02:01	19.74	0.73
6/5/2018	14:03:01	19.74	0.73
6/5/2018	14:04:01	19.74	0.74
6/5/2018	14:05:01	19.73	0.74
6/5/2018	14:06:01	19.73	0.74
6/5/2018	14:07:01	19.73	0.74
6/5/2018	14:08:01	19.74	0.75
6/5/2018	14:09:01	19.74	0.75
6/5/2018	14:10:01	19.74	0.74
6/5/2018	14:11:01	19.74	0.74
6/5/2018	14:12:01	19.74	0.74
6/5/2018	14:13:01	19.74	0.74
6/5/2018	14:14:01	19.74	0.74
6/5/2018	14:15:01	19.75	0.74
6/5/2018	14:16:01	19.74	0.74
6/5/2018	14:17:01	19.73	0.74
6/5/2018	14:18:01	19.74	0.74
6/5/2018	14:19:01	19.74	0.73
6/5/2018	14:20:01	19.75	0.73
6/5/2018	14:21:01	19.75	0.73
6/5/2018	14:22:01	19.74	0.73
6/5/2018	14:23:01	19.73	0.73
6/5/2018	14:24:01	19.74	0.73
6/5/2018	14:25:01	19.74	0.73
6/5/2018	14:26:01	19.75	0.73
6/5/2018	14:27:01	19.74	0.73
6/5/2018	14:28:01	19.73	0.73
6/5/2018	14:29:01	19.73	0.74
6/5/2018	14:30:01	19.74	0.74
6/5/2018	14:31:01	19.74	0.74

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Run #2

Date	Time	O2 [%]	CO2 [%]
6/5/2018	14:32:01	19.75	0.75
6/5/2018	14:33:01	19.74	0.75
6/5/2018	14:34:01	19.73	0.75
6/5/2018	14:35:01	19.74	0.75
6/5/2018	14:36:01	19.74	0.75
6/5/2018	14:37:01	19.75	0.75
6/5/2018	14:38:01	19.75	0.75
6/5/2018	14:39:01	19.73	0.75
6/5/2018	14:40:01	19.74	0.75
6/5/2018	14:41:01	19.74	0.75
6/5/2018	14:42:01	19.74	0.74
6/5/2018	14:43:01	19.75	0.74
6/5/2018	14:44:01	19.74	0.74
6/5/2018	14:45:01	19.73	0.74
6/5/2018	14:46:01	19.73	0.74
6/5/2018	14:47:01	19.74	0.74
6/5/2018	14:48:01	19.74	0.74
6/5/2018	14:49:01	19.76	0.73
6/5/2018	14:50:01	19.75	0.73
6/5/2018	14:51:01	19.75	0.73
6/5/2018	14:52:01	19.74	0.74
6/5/2018	14:53:01	19.74	0.74
6/5/2018	14:54:01	19.76	0.73
6/5/2018	14:55:01	19.76	0.73
6/5/2018	14:56:01	19.75	0.73
6/5/2018	14:57:01	19.73	0.75
6/5/2018	14:58:01	19.74	0.75
6/5/2018	14:59:01	19.74	0.75
6/5/2018	15:00:01	19.74	0.75
6/5/2018	15:01:01	19.73	0.75
6/5/2018	15:02:01	19.73	0.75
6/5/2018	15:03:01	19.73	0.75
6/5/2018	15:04:01	19.74	0.75
6/5/2018	15:05:01	19.74	0.75
6/5/2018	15:06:01	19.74	0.75
6/5/2018	15:07:01	19.73	0.75
6/5/2018	15:08:01	19.73	0.75
6/5/2018	15:09:01	19.74	0.75
6/5/2018	15:10:01	19.74	0.74
6/5/2018	15:11:01	19.74	0.74
6/5/2018	15:12:01	19.73	0.74

Hollingsworth & Vose

CFU 114

Run #2

Date	Time	O2 [%]	CO2 [%]
6/5/2018	15:13:01	19.72	0.74
6/5/2018	15:14:01	19.72	0.74
6/5/2018	15:15:01	19.73	0.74
6/5/2018	15:16:01	19.73	0.74
6/5/2018	15:17:01	19.73	0.74
6/5/2018	15:18:01	19.72	0.74
6/5/2018	15:19:01	19.72	0.74
6/5/2018	15:20:01	19.73	0.74
6/5/2018	15:21:01	19.73	0.74
	Final	**19.75**	**0.74**

Hollingsworth & Vose

CFU 114

R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	15:23:21	19.71	0.74		
6/5/2018	15:23:31	19.72	0.74		
6/5/2018	15:23:41	19.76	0.75		
6/5/2018	15:23:51	18.47	2.46		
6/5/2018	15:24:01	14.01	8.28		
6/5/2018	15:24:11	11.07	9.25		
6/5/2018	15:24:21	10.29	9.45		
6/5/2018	15:24:31	10.1	9.51		
6/5/2018	15:24:41	10.05	9.53		
6/5/2018	15:24:51	10.03	9.53		
6/5/2018	15:25:01	10.02	9.54		
6/5/2018	15:25:11	10.01	9.55	10.02	
6/5/2018	15:25:21	10.01	9.54		
6/5/2018	15:25:31	10.01	9.55		
6/5/2018	15:25:41	10	9.55		
6/5/2018	15:25:51	10.01	9.55		
6/5/2018	15:26:01	10	9.56		
6/5/2018	15:26:11	12.34	7.55		
6/5/2018	15:26:21	7.7	5.01		
6/5/2018	15:26:31	2.79	2.02		
6/5/2018	15:26:41	2.24	1.99		
6/5/2018	15:26:51	2.11	1.97		
6/5/2018	15:27:01	2.07	1.95		
6/5/2018	15:27:11	2.06	1.95		
6/5/2018	15:27:21	2.05	1.94		
6/5/2018	15:27:31	2.05	1.93		1.94
6/5/2018	15:27:41	2.05	1.94		
6/5/2018	15:27:51	0.54	0.37		
6/5/2018	15:28:01	0.02	0.15		
6/5/2018	15:28:11	0.05	0.14		
6/5/2018	15:28:21	0.04	0.14	0.04	0.14

Hollingsworth & Vose

CFU 114

Run #3

Date	Time	O2 [%]	CO2 [%]
6/5/2018	15:50:14	19.68	0.74
6/5/2018	15:51:14	19.68	0.73
6/5/2018	15:52:14	19.67	0.73
6/5/2018	15:53:14	19.67	0.73
6/5/2018	15:54:14	19.67	0.73
6/5/2018	15:55:14	19.67	0.73
6/5/2018	15:56:14	19.67	0.73
6/5/2018	15:57:14	19.67	0.74
6/5/2018	15:58:14	19.67	0.74
6/5/2018	15:59:14	19.66	0.74
6/5/2018	16:00:14	19.66	0.74
6/5/2018	16:01:14	19.67	0.74
6/5/2018	16:02:14	19.67	0.75
6/5/2018	16:03:14	19.67	0.75
6/5/2018	16:04:14	19.66	0.75
6/5/2018	16:05:14	19.66	0.75
6/5/2018	16:06:14	19.66	0.75
6/5/2018	16:07:14	19.66	0.75
6/5/2018	16:08:14	19.67	0.75
6/5/2018	16:09:14	19.68	0.75
6/5/2018	16:10:14	19.83	0.75
6/5/2018	16:11:14	19.84	0.75
6/5/2018	16:12:14	19.84	0.75
6/5/2018	16:13:14	19.85	0.75
6/5/2018	16:14:14	19.85	0.74
6/5/2018	16:15:14	19.85	0.74
6/5/2018	16:16:14	19.84	0.74
6/5/2018	16:17:14	19.84	0.74
6/5/2018	16:18:14	19.85	0.74
6/5/2018	16:19:14	19.85	0.74
6/5/2018	16:20:14	19.86	0.74
6/5/2018	16:21:14	19.85	0.74
6/5/2018	16:22:14	19.84	0.74
6/5/2018	16:23:14	19.85	0.74
6/5/2018	16:24:14	19.85	0.75
6/5/2018	16:25:14	19.86	0.75
6/5/2018	16:26:14	19.86	0.75
6/5/2018	16:27:14	19.85	0.75
6/5/2018	16:28:14	19.85	0.76
6/5/2018	16:29:14	19.85	0.76
6/5/2018	16:30:14	19.86	0.76

Hollingsworth & Vose

CFU 114

Run #3

Date	Time	O2 [%]	CO2 [%]
6/5/2018	16:31:14	19.86	0.76
6/5/2018	16:32:14	19.85	0.76
6/5/2018	16:33:14	19.85	0.76
6/5/2018	16:34:14	19.85	0.76
6/5/2018	16:35:14	19.86	0.76
6/5/2018	16:36:14	19.86	0.76
6/5/2018	16:37:14	19.86	0.76
6/5/2018	16:38:14	19.85	0.75
6/5/2018	16:39:14	19.85	0.75
6/5/2018	16:40:14	19.86	0.75
6/5/2018	16:41:14	19.86	0.75
6/5/2018	16:42:14	19.87	0.74
6/5/2018	16:43:14	19.86	0.75
6/5/2018	16:44:14	19.86	0.74
6/5/2018	16:45:14	19.86	0.74
6/5/2018	16:46:14	19.86	0.75
6/5/2018	16:47:14	19.87	0.75
6/5/2018	16:48:14	19.87	0.75
6/5/2018	16:49:14	19.85	0.76
6/5/2018	16:50:14	19.84	0.76
6/5/2018	16:51:14	19.86	0.76
6/5/2018	16:52:14	19.85	0.76
6/5/2018	16:53:14	19.85	0.76
6/5/2018	16:54:14	19.83	0.77
6/5/2018	16:55:14	19.83	0.77
6/5/2018	16:56:14	19.83	0.77
6/5/2018	16:57:14	19.83	0.77
6/5/2018	16:58:14	19.84	0.78
6/5/2018	16:59:14	19.84	0.77
6/5/2018	17:00:14	19.83	0.77
6/5/2018	17:01:14	19.83	0.77
6/5/2018	17:02:14	19.83	0.76
6/5/2018	17:03:14	19.83	0.76
6/5/2018	17:04:14	19.84	0.76
6/5/2018	17:05:14	19.84	0.76
6/5/2018	17:06:14	19.82	0.76
6/5/2018	17:07:14	19.82	0.76
6/5/2018	17:08:14	19.83	0.75
6/5/2018	17:09:14	19.83	0.76
6/5/2018	17:10:14	19.83	0.76
6/5/2018	17:11:14	19.84	0.76

Hollingsworth & Vose

CFU 114

Run #3

Date	Time	O2 [%]	CO2 [%]
6/5/2018	17:12:14	19.82	0.76
6/5/2018	17:13:14	19.82	0.76
6/5/2018	17:14:14	19.82	0.76
6/5/2018	17:15:14	19.83	0.76
6/5/2018	17:16:14	19.83	0.77
6/5/2018	17:17:14	19.83	0.77
6/5/2018	17:18:14	19.82	0.77
6/5/2018	17:19:14	19.82	0.77
6/5/2018	17:20:14	19.82	0.77
6/5/2018	17:21:14	19.83	0.77
6/5/2018	17:22:14	19.83	0.77
6/5/2018	17:23:14	19.83	0.77
6/5/2018	17:24:14	19.82	0.77
6/5/2018	17:25:14	19.82	0.77
6/5/2018	17:26:14	19.82	0.77
6/5/2018	17:27:14	19.83	0.77
6/5/2018	17:28:14	19.83	0.76
6/5/2018	17:29:14	19.84	0.77
6/5/2018	17:30:14	19.83	0.76
6/5/2018	17:31:14	19.83	0.76
6/5/2018	17:32:14	19.83	0.76
6/5/2018	17:33:14	19.84	0.75
6/5/2018	17:34:14	19.85	0.76
6/5/2018	17:35:14	19.84	0.76
6/5/2018	17:36:14	19.83	0.76
6/5/2018	17:37:14	19.83	0.76
6/5/2018	17:38:14	19.83	0.76
6/5/2018	17:39:14	19.84	0.76
6/5/2018	17:40:14	19.84	0.76
6/5/2018	17:41:14	19.84	0.76
6/5/2018	17:42:14	19.83	0.76
6/5/2018	17:43:14	19.83	0.77
6/5/2018	17:44:14	19.84	0.77
6/5/2018	17:45:14	19.84	0.77
6/5/2018	17:46:14	19.84	0.77
6/5/2018	17:47:14	19.71	0.77
6/5/2018	17:48:14	19.75	0.78
6/5/2018	17:49:14	19.75	0.77
6/5/2018	17:50:14	19.76	0.77
6/5/2018	17:51:14	19.77	0.77
6/5/2018	17:52:14	19.77	0.77

Hollingsworth & Vose

CFU 114

Run #3

Date	Time	O2 [%]	CO2 [%]
6/5/2018	17:53:14	19.76	0.77
6/5/2018	17:54:14	19.75	0.76
6/5/2018	17:55:14	19.76	0.76
6/5/2018	17:56:14	19.76	0.76
6/5/2018	17:57:14	19.76	0.76
6/5/2018	17:58:14	19.77	0.76
6/5/2018	17:59:14	19.76	0.75
	Final	**19.81**	**0.76**

Hollingsworth & Vose

CFU 114

R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	18:00:04	19.76	0.75		
6/5/2018	18:00:14	19.76	0.75		
6/5/2018	18:00:24	19.76	0.75		
6/5/2018	18:00:34	19.76	0.76		
6/5/2018	18:00:44	19.76	0.75		
6/5/2018	18:00:54	19.79	0.75		
6/5/2018	18:01:04	16.80	0.84		
6/5/2018	18:01:14	16.08	0.79		
6/5/2018	18:01:24	17.91	0.74		
6/5/2018	18:01:34	17.67	0.72		
6/5/2018	18:01:44	18.20	1.16		
6/5/2018	18:01:54	19.11	2.76		
6/5/2018	18:02:04	10.67	3.78		
6/5/2018	18:02:14	4.23	2.39		
6/5/2018	18:02:24	2.56	1.98		
6/5/2018	18:02:34	2.19	1.92		
6/5/2018	18:02:44	2.10	1.91		
6/5/2018	18:02:54	2.07	1.90		
6/5/2018	18:03:04	2.06	1.90		
6/5/2018	18:03:14	2.06	1.90		
6/5/2018	18:03:24	2.06	1.91		
6/5/2018	18:03:34	2.06	1.91		1.91
6/5/2018	18:03:44	5.13	1.73		
6/5/2018	18:03:54	14.21	1.14		
6/5/2018	18:04:04	12.53	1.10		
6/5/2018	18:04:14	11.23	6.01		
6/5/2018	18:04:24	10.02	8.36		
6/5/2018	18:04:34	9.76	8.99		
6/5/2018	18:04:44	9.97	9.39		
6/5/2018	18:04:54	10.02	9.49		
6/5/2018	18:05:04	10.03	9.52		
6/5/2018	18:05:14	10.03	9.53		
6/5/2018	18:05:24	10.03	9.53		
6/5/2018	18:05:34	10.03	9.54		
6/5/2018	18:05:44	10.03	9.54		
6/5/2018	18:05:54	10.03	9.55		
6/5/2018	18:06:04	10.03	9.55		
6/5/2018	18:06:14	10.03	9.55	10.03	
6/5/2018	18:06:24	10.03	9.56		
6/5/2018	18:06:34	10.04	9.56		
6/5/2018	18:06:44	7.08	6.81		

Hollingsworth & Vose

CFU 114

R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/5/2018	18:06:54	1.98	1.92		
6/5/2018	18:07:04	0.53	0.63		
6/5/2018	18:07:14	0.19	0.31		
6/5/2018	18:07:24	0.11	0.20		
6/5/2018	18:07:34	0.09	0.16		
6/5/2018	18:07:44	0.08	0.16		
6/5/2018	18:07:54	0.07	0.15		
6/5/2018	18:08:04	0.06	0.15		
6/5/2018	18:08:14	0.07	0.14		
6/5/2018	18:08:24	0.06	0.14		
6/5/2018	18:08:34	0.06	0.14		
6/5/2018	18:08:44	0.06	0.14		
6/5/2018	18:08:54	0.06	0.14		
6/5/2018	18:09:04	0.06	0.13		
6/5/2018	18:09:14	0.06	0.12		
6/5/2018	18:09:24	0.05	0.13		
6/5/2018	18:09:34	0.06	0.13	0.06	0.13

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 114**
DATE	**06/06/18**
METHOD	**5**
POLLUTANT	**Particulate Matter**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**9:40**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**11:49**
EPA Method:	**5**	Sunny 69F variable wind		**Date:**	**6/6/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	4D	Liner type	GLASS		
Y factor	0.9988	Nozzle ID	0.259	Nozzle size	0.2590	inches	
ΔH@	1.8338	Hot box ID	HB3	Nozzle area	0.000366	sq.ft.	
		Pitot Cp	0.99	Probe heat	248	F	
				Filter heat	248	F	

Source Information:

Barometric Pressure	29.85	"Hg	O_2	19.81 %
Static Pressure	0.56	"H_2O	CO_2	0.71 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.222 inches
Stack Temperature	280	F		
Assumed moisture	2	%		
Assumed meter temp.	72	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	0.003
Leak check vacuum, "Hg	16	12

Nozzle check for roundness:

1	2	3	
0.259	0.259	0.259	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	149.006	dcf	Ave. ΔP	1.013 "H_2O
Wet mol. weight	28.7	M_s (actual)	Ave. √ΔP	1.006 "H_2O
Actual H_2O	1.94	%	Ave. ΔH	3.492 "H_2O
Std. meter vol.	149.528	dscf	Ave. T_s	291.7 °F
Isokinetic Average	103.5	%	Ave. T_m	68.6 °F

Moisture/Lab:

Filter	Q1330 #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	239.5	277.5	38.0
		Total water gain:	63.0

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	5.999	0.95	282	60	3.26	3.30	5	252	72
2	10.0	12.050	1.00	284	60	3.42	3.40	5	252	68
3	15.0	18.590	1.10	286	61	3.76	3.80	6	252	60
4	20.0	24.920	1.10	289	62	3.75	3.80	6	252	60
5	25.0	30.850	0.95	290	63	3.24	3.20	5	251	59
6	30.0	37.020	1.00	291	65	3.42	3.40	5	251	61
7	35.0	43.120	1.00	291	66	3.43	3.40	5	251	61
8	40.0	49.380	1.00	292	67	3.43	3.40	5	251	61
9	45.0	55.440	1.00	293	68	3.43	3.40	6	250	60
10	50.0	61.580	1.00	293	69	3.44	3.40	6	251	62
11	55.0	67.950	1.10	293	69	3.78	3.80	6	251	62
12	60.0	74.285	1.00	293	70	3.44	3.40	7	251	61
13	65.0	80.600	1.00	290	69	3.45	3.50	7	250	56
14	70.0	86.880	1.00	292	70	3.45	3.50	7	252	58
15	75.0	93.190	1.10	293	70	3.79	3.80	7	250	58
16	80.0	99.650	1.10	294	71	3.79	3.80	7	250	58
17	85.0	106.010	1.00	295	71	3.44	3.40	7	250	58
18	90.0	112.270	1.00	294	72	3.45	3.50	7	249	58
19	95.0	118.554	1.00	294	73	3.46	3.50	7	251	61
20	100.0	124.960	1.10	295	73	3.80	3.80	7	250	62
21	105.0	131.440	1.10	296	73	3.79	3.80	7	251	62
22	110.0	137.900	1.00	298	74	3.45	3.50	7	251	61
23	115.0	144.110	0.94	296	75	3.25	3.30	7	251	61
24	120.0	149.006	0.78	286	75	2.74	2.70	6	250	62

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**12:30**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**14:39**
EPA Method:	**5**	Sunny 69F variable wind		**Date:**	**6/6/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	4D	Liner type:	GLASS		
Y factor	0.9988	Nozzle ID	0.259	Nozzle size:	0.2590	inches	
ΔH@	1.8338	Hot box ID	HB3	Nozzle area:	0.000366	sq.ft.	
		Pitot Cp	0.84	Probe heat:	248	F	
				Filter heat:	248	F	

Source Information:

Barometric Pressure	29.85	"Hg	O_2	19.82 %
Static Pressure	0.56	"H_2O	CO_2	0.72 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.222 inches
Stack Temperature	280	F		
Assumed moisture	1.94	%		
Assumed meter temp.	68.6	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	0.001
Leak check vacuum, "Hg:	15	14

Nozzle check for roundness:

1	2	3	
0.259	0.259	0.259	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	130.425	dcf	Ave. ΔP	1.052 "H_2O
Wet mol. weight	28.68	M_s (actual)	Ave. √ΔP	1.0248 "H_2O
Actual H_2O	2.11	%	Ave. ΔH	3.646 "H_2O
Std. meter vol.	129.460	dscf	Ave. T_s	296.8 °F
Isokinetic Average	104.2	%	Ave. T_m	74.6 °F

Moisture/Lab:

Filter	Q1331 #		
	Initial	Final	Gain
Impingers, g	200.0	230	30.0
Silica gel, g	262.1	291.3	29.2
		Total water gain:	59.2

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	5.470	1.10	296	70	3.78	3.80	5	251	56
2	10.0	10.900	1.10	296	71	3.78	3.80	5	252	52
3	15.0	16.430	1.10	296	71	3.78	3.80	5	251	55
4	20.0	22.160	1.10	297	71	3.78	3.80	5	252	56
5	25.0	27.590	1.10	298	71	3.77	3.80	5	249	57
6	30.0	33.100	1.10	299	72	3.78	3.80	5	251	58
7	35.0	38.620	1.10	300	73	3.78	3.80	5	250	59
8	40.0	44.070	1.10	301	73	3.77	3.80	5	251	59
9	45.0	49.670	1.10	301	75	3.79	3.80	5	250	60
10	50.0	55.350	1.10	301	75	3.79	3.80	5	253	60
11	55.0	60.650	0.95	301	76	3.28	3.30	5	252	61
12	60.0	65.382	0.80	297	76	2.77	2.80	5	249	61
13	65.0	70.820	0.96	292	75	3.34	3.30	5	251	64
14	70.0	76.010	1.00	295	75	3.47	3.50	5	251	64
15	75.0	81.280	1.00	281	75	3.54	3.50	4	252	60
16	80.0	86.820	1.10	298	75	3.80	3.80	5	250	61
17	85.0	92.260	1.10	298	76	3.81	3.80	5	252	63
18	90.0	97.780	1.10	298	76	3.81	3.80	5	252	63
19	95.0	103.350	1.10	299	76	3.80	3.80	5	251	63
20	100.0	108.950	1.10	297	77	3.82	3.80	5	251	63
21	105.0	114.260	0.97	294	78	3.39	3.40	5	251	63
22	110.0	119.580	0.96	294	78	3.35	3.40	5	251	63
23	115.0	124.920	1.00	296	78	3.48	3.50	5	251	64
24	120.0	130.425	1.10	298	78	3.82	3.80	5	251	64

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**3**
Location:	**Corvallis, OR**			**Start Time:**	**15:15**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**17:23**
EPA Method:	**5**	Sunny 69F variable wind		**Date:**	**6/6/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	4D	Liner type:	GLASS		
Y factor	0.9988	Nozzle ID	0.259	Nozzle size:	0.2590	inches	
ΔH@	1.8338	Hot box ID	HB3	Nozzle area:	0.000366	sq.ft.	
		Pitot Cp	0.84	Probe heat:	248	F	
				Filter heat:	248	F	

Source Information:

Barometric Pressure	29.85	"Hg	O_2	19.81 %
Static Pressure	0.56	"H_2O	CO_2	0.71 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.221 inches
Stack Temperature	280	F		
Assumed moisture	2.11	%		
Assumed meter temp.	74.6	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	0.001
Leak check vacuum, "Hg:	17	12

Nozzle check for roundness:

1	2	3	
0.259	0.259	0.259	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	132.990	dcf	Ave. ΔP	1.061 "H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. √ΔP	1.0295 "H_2O
Actual H_2O	2.02	%	Ave. ΔH	3.692 "H_2O
Std. meter vol.	131.112	dscf	Ave. T_s	296.6 °F
Isokinetic Average	105.0	%	Ave. T_m	78.3 °F

Moisture/Lab:

Filter	Q1332 #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	257.3	289.8	32.5
		Total water gain:	57.5

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	5.540	1.10	296	74	3.79	3.80	4	255	62
2	10.0	11.040	1.10	299	75	3.79	3.80	4	251	57
3	15.0	16.590	1.10	298	74	3.78	3.80	4	251	58
4	20.0	22.140	1.10	301	76	3.78	3.80	4	251	58
5	25.0	27.790	1.10	300	76	3.79	3.80	4	252	59
6	30.0	33.380	1.10	299	76	3.79	3.80	5	251	59
7	35.0	39.050	1.10	299	77	3.80	3.80	5	250	59
8	40.0	44.640	1.10	299	78	3.81	3.80	5	250	60
9	45.0	50.290	1.10	300	78	3.80	3.80	5	251	61
10	50.0	55.900	1.10	301	79	3.80	3.80	5	250	62
11	55.0	61.570	1.10	299	79	3.81	3.80	5	251	61
12	60.0	67.230	1.10	299	80	3.82	3.80	5	249	61
13	65.0	72.920	1.10	293	78	3.84	3.90	5	251	61
14	70.0	78.550	1.10	295	79	3.83	3.90	5	251	60
15	75.0	84.200	1.10	296	79	3.83	3.80	5	252	63
16	80.0	89.850	1.10	296	79	3.83	3.80	5	251	63
17	85.0	95.510	1.10	296	79	3.83	3.80	5	251	64
18	90.0	101.160	1.10	295	79	3.83	3.80	5	251	64
19	95.0	106.660	1.00	294	80	3.50	3.50	5	251	64
20	100.0	112.290	0.99	294	80	3.46	3.50	5	251	65
21	105.0	117.520	1.00	295	81	3.50	3.50	5	252	66
22	110.0	122.850	0.96	294	81	3.36	3.40	5	250	67
23	115.0	128.200	0.91	292	81	3.20	3.20	5	251	67
24	120.0	132.990	0.81	288	81	2.86	2.90	4	251	67

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

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:40**
Source:	**CFU 114**	**End Time:**	**11:49**
Method:	**ODEQ 5**	**Date:**	**6/6/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	5.999	3.30	60	1	0.95	282	0.9747
10	12.050	3.40	60	2	1.00	284	1.0000
15	18.590	3.80	61	3	1.10	286	1.0488
20	24.920	3.80	62	4	1.10	289	1.0488
25	30.850	3.20	63	5	0.95	290	0.9747
30	37.020	3.40	65	6	1.00	291	1.0000
35	43.120	3.40	66	7	1.00	291	1.0000
40	49.380	3.40	67	8	1.00	292	1.0000
45	55.440	3.40	68	9	1.00	293	1.0000
50	61.580	3.40	69	10	1.00	293	1.0000
55	67.950	3.80	69	11	1.10	293	1.0488
60	74.285	3.40	70	12	1.00	293	1.0000
65	80.600	3.50	69	13	1.00	290	1.0000
70	86.880	3.50	70	14	1.00	292	1.0000
75	93.190	3.80	70	15	1.10	293	1.0488
80	99.650	3.80	71	16	1.10	294	1.0488
85	106.010	3.40	71	17	1.00	295	1.0000
90	112.270	3.50	72	18	1.00	294	1.0000
95	118.554	3.50	73	19	1.00	294	1.0000
100	124.960	3.80	73	20	1.10	295	1.0488
105	131.440	3.80	73	21	1.10	296	1.0488
110	137.900	3.50	74	22	1.00	298	1.0000
115	144.110	3.30	75	23	0.94	296	0.9695
120	149.006	2.70	75	24	0.78	286	0.8832

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 114**	**Date:**	**06/06/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	36.000	in
Meter Volume, V_m	149.006	dcf	Rectangular		
Water Volume	63.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2590	in.	Length		in
Nozzle Area	0.000366	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.71	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.81	%vd
Pitot Factor, cp	0.99				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.492	"H_2O	√Dp	1.0060	"H_2O
Temperature, T_m	68.6	^oF	Temperature, T_s	291.7	^oF
Temperature, T_m	528.6	^oA (^oR)	Temperature, T_s	751.7	^oA (R)
Pressure Meter, P_m	30.107	"Hg	Pressure Stack, P_s	29.891	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	149.527	dscf	Velocity, V_s	79.70	fps
	4.234	dscm	Volume (actual)	33,804.0	awcfm
Actual Volume, $V_{m(actual)}$	217.387	awcf		33,148.2	adcfm
Gas Stream Moisture			Volume (standard)	1,423,269.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.965	scf		1,395,657.7	dscf/hr
Moisture, B_{ws}	0.0194			23,261.0	dscf/min
Moisture EPA M4	1.94	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	103.5	%			

Laboratory Results

EPA Method 5					
Filterable PM	0.00096	grams			
Emissions:					
Concentration, C_s	9.95E-05	gr/dscf			
	228	µg/dscm			
Mass Emissions	1.98E-02	lb/hr			
Back Half:					
Inorganic CPM	1.25E-03	grams	Organic CPM	2.29E-04	grams
Inorganic CPM, C_s	1.29E-04	gr/dscf	Organic CPM, C_s	2.36E-05	gr/dscf
	296	µg/dscm		54	µg/dscm
Mass Emissions	2.58E-02	lb/hr	Mass Emissions	4.70E-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:**	**12:30**
Source:	**CFU 114**	**End Time:**	**14:39**
Method:	**ODEQ 5**	**Date:**	**06/06/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	5.470	3.80	70	1	1.10	296	1.0488
10	10.900	3.80	71	2	1.10	296	1.0488
15	16.430	3.80	71	3	1.10	296	1.0488
20	22.160	3.80	71	4	1.10	297	1.0488
25	27.590	3.80	71	5	1.10	298	1.0488
30	33.100	3.80	72	6	1.10	299	1.0488
35	38.620	3.80	73	7	1.10	300	1.0488
40	44.070	3.80	73	8	1.10	301	1.0488
45	49.670	3.80	75	9	1.10	301	1.0488
50	55.350	3.80	75	10	1.10	301	1.0488
55	60.650	3.30	76	11	0.95	301	0.9747
60	65.382	2.80	76	12	0.80	297	0.8944
65	70.820	3.30	75	13	0.96	292	0.9798
70	76.010	3.50	75	14	1.00	295	1.0000
75	81.280	3.50	75	15	1.00	281	1.0000
80	86.820	3.80	75	16	1.10	298	1.0488
85	92.260	3.80	76	17	1.10	298	1.0488
90	97.780	3.80	76	18	1.10	298	1.0488
95	103.350	3.80	76	19	1.10	299	1.0488
100	108.950	3.80	77	20	1.10	297	1.0488
105	114.260	3.40	78	21	0.97	294	0.9849
110	119.580	3.40	78	22	0.96	294	0.9798
115	124.920	3.50	78	23	1.00	296	1.0000
120	130.425	3.80	78	24	1.10	298	1.0488

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 114**	**Date:**	**06/06/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	36.000	in
Meter Volume, V_m	130.425	dcf	Rectangular		
Water Volume	59.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.2590	in.	Length		in
Nozzle Area	0.000366	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.72	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.82	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.646	"H_2O	√Dp	1.0248	"H_2O
Temperature, T_m	74.6	^oF	Temperature, T_s	296.8	^oF
Temperature, T_m	534.6	^oA (^oR)	Temperature, T_s	756.8	^oA (R)
Pressure Meter, P_m	30.118	"Hg	Pressure Stack, P_s	29.891	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	129.460	dscf	Velocity, V_s	69.15	fps
	3.666	dscm	Volume (actual)	29,329.3	awcfm
Actual Volume, $V_{m(actual)}$	189.819	awcf		28,710.5	adcfm
Gas Stream Moisture			Volume (standard)	1,226,547.4	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.786	scf		1,200,667.2	dscf/hr
Moisture, B_{ws}	0.0211			20,011.1	dscf/min
Moisture EPA M4	2.11	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.68	lb/lb-mole			
Percent Isokinetic	104.2	%			

Laboratory Results

Front Half:					
Filterable PM	0.00105	grams			
Emissions:					
Concentration, C_s	1.25E-04	gr/dscf			
	286	µg/dscm			
Mass Emissions	2.15E-02	lb/hr			
Back Half:					
Inorganic CPM	1.22E-03	grams	Organic CPM	6.07E-04	grams
Inorganic CPM, C_s	1.45E-04	gr/dscf	Organic CPM, C_s	7.24E-05	gr/dscf
	333	µg/dscm		166	µg/dscm
Mass Emissions	2.49E-02	lb/hr	Mass Emissions	1.24E-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:**	**15:15**
Source:	**CFU 114**	**End Time:**	**17:23**
Method:	**ODEQ 5**	**Date:**	**06/06/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	5.540	3.80	74	1	1.10	296	1.0488
10	11.040	3.80	75	2	1.10	299	1.0488
15	16.590	3.80	74	3	1.10	298	1.0488
20	22.140	3.80	76	4	1.10	301	1.0488
25	27.790	3.80	76	5	1.10	300	1.0488
30	33.380	3.80	76	6	1.10	299	1.0488
35	39.050	3.80	77	7	1.10	299	1.0488
40	44.640	3.80	78	8	1.10	299	1.0488
45	50.290	3.80	78	9	1.10	300	1.0488
50	55.900	3.80	79	10	1.10	301	1.0488
55	61.570	3.80	79	11	1.10	299	1.0488
60	67.230	3.80	80	12	1.10	299	1.0488
65	72.920	3.90	78	13	1.10	293	1.0488
70	78.550	3.90	79	14	1.10	295	1.0488
75	84.200	3.80	79	15	1.10	296	1.0488
80	89.850	3.80	79	16	1.10	296	1.0488
85	95.510	3.80	79	17	1.10	296	1.0488
90	101.160	3.80	79	18	1.10	295	1.0488
95	106.660	3.50	80	19	1.00	294	1.0000
100	112.290	3.50	80	20	0.99	294	0.9950
105	117.520	3.50	81	21	1.00	295	1.0000
110	122.850	3.40	81	22	0.96	294	0.9798
115	128.200	3.20	81	23	0.91	292	0.9539
120	132.990	2.90	81	24	0.81	288	0.9000

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 114**	**Date:**	**06/06/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	36.000	in
Meter Volume, V_m	132.990	dcf	Rectangular		
Water Volume	57.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.2590	in.	Length		in
Nozzle Area	0.000366	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.71	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.81	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.692	"H_2O	√Dp	1.0295	"H_2O
Temperature, T_m	78.3	^oF	Temperature, T_s	296.6	^oF
Temperature, T_m	538.3	^oA (^oR)	Temperature, T_s	756.6	^oA (R)
Pressure Meter, P_m	30.121	"Hg	Pressure Stack, P_s	29.891	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	131.111	dscf	Velocity, V_s	69.44	fps
	3.713	dscm	Volume (actual)	29,452.3	awcfm
Actual Volume, $V_{m(actual)}$	192.013	awcf		28,857.4	adcfm
Gas Stream Moisture			Volume (standard)	1,232,016.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.706	scf		1,207,130.1	dscf/hr
Moisture, B_{ws}	0.0202			20,118.8	dscf/min
Moisture EPA M4	2.02	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	105.0	%			

Laboratory Results

Front Half:					
Filterable PM	0.00096	grams			
Emissions:					
Concentration, C_s	1.13E-04	gr/dscf			
	258	µg/dscm			
Mass Emissions	1.94E-02	lb/hr			
Back Half:					
Inorganic CPM	3.53E-03	grams	Organic CPM	7.86E-04	grams
Inorganic CPM, C_s	4.15E-04	gr/dscf	Organic CPM, C_s	9.25E-05	gr/dscf
	950	µg/dscm		211.61	µg/dscm
Mass Emissions	7.16E-02	lb/hr	Mass Emissions	1.59E-02	lb/hr

Oregon Method 5
Filterable and Condensable Particulate
Laboratory Gravimetric Data

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 114**

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction		Corrected Gain (grams)	
1	CPM Organics (Acetone BH)	120	52.48550	52.48570	0.00020	1.71E-04		**0.00003**	
	Probe Rinse (Acetone FH)	95	48.81560	48.81670	0.00110	1.36E-04		**0.00096**	
	Filter	Q1330	0.39190	0.39160	-0.00030			**0.00000**	
	CPM Inorganics (Water)	385	49.26145	49.26300	0.00155	2.96E-04		**0.00125**	
	CPM Organics (Hexane BH)	95	52.73670	52.73690	0.00020	0.00E+00		**0.00020**	
	Impinger H_2O Gain, mls		200	225	25.0				
						Filterable PM (mg)		**0.96**	
						Total PM (mg)		**2.45**	**ND**
2	CPM Organics (Acetone BH)	135	49.40750	49.40810	0.00060	1.93E-04		**0.00041**	
	Probe Rinse (Acetone FH)	105	53.30395	53.30470	0.00075	1.50E-04		**0.00060**	
	Filter	Q1331	0.39390	0.39435	0.00045			**0.00045**	
	CPM Inorganics (Water)	430	54.05805	54.05960	0.00155	3.31E-04		**0.00122**	
	CPM Organics (Hexane BH)	90	52.71670	52.71690	0.00020	0.00E+00		**0.00020**	
	Impinger H_2O Gain, mls		200	230	30.0				
						Filterable PM (mg)		**1.05**	
						Total PM (mg)		**2.88**	**ND**
3	CPM Organics (Acetone BH)	150	50.20220	50.20310	0.00090	2.14E-04		**0.00069**	
	Probe Rinse (Acetone FH)	100	52.31240	52.31350	0.00110	1.43E-04		**0.00096**	
	Filter	Q1332	0.36980	0.36940	-0.00040			**0.00000**	
	CPM Inorganics (Water)	420	51.22305	51.22690	0.00385	3.23E-04		**0.00353**	
	CPM Organics (Hexane BH)	95	51.39870	51.39880	0.00010	0.00E+00		**0.00010**	
	Impinger H_2O Gain, mls		200	225	25.0				
						Filterable PM (mg)		**0.96**	
						Total PM (mg)		**5.27**	**ND**
	Acetone Blank	175	48.25825	48.25850	0.00025	1.43E-06	g/g		
	Water Blank	195	51.37705	51.37720	0.00015	7.69E-07	g/g		
	Hexane Blank	95	49.02970	49.02970	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 114**
Location: **Corvallis, OR**

Run			1	2	3	
Date			6/6/2018	6/6/2018	6/6/2018	
Run Start Time			9:40	12:30	15:15	
Run End Time			11:49	14:39	17:23	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.85	29.85	29.85	**29.85**
Nozzle Dia., in.			0.2590	0.2590	0.2590	**0.2590**
Isokinetic Average, %			103.5	104.2	105.0	**104.2**
Sample Volume, dscf			149.527	129.460	131.111	**136.699**
Sample Volume, dscm			4.234	3.666	3.713	**3.871**
Stack Diameter, in.			36.00	36.00	36.00	**36.00**
Stack Area, sq.ft.			7.069	7.069	7.069	**7.069**
CO_2 %vd			0.71	0.72	0.71	**0.71**
O_2 %vd			19.81	19.82	19.81	**19.81**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.94	2.11	2.02	**2.02**
Wet Molecular Weight, lb/lb-mole			28.70	28.68	28.69	**28.69**
Velocity, FPS			79.70	69.15	69.44	**72.76**
ADCFM			33,148.2	28,710.5	28,857.4	**30,238.7**
AWCFM			33,804.0	29,329.3	29,452.3	**30,861.9**
DSCFM			23,261.0	20,011.1	20,118.8	**21,130.3**
Stack Temperature, °F			291.7	296.8	296.6	**295.0**
Filterable Particulate	Concentration, C_s	gr/dscf	9.95E-05	1.25E-04	1.13E-04	**1.12E-04**
		µg/dscm	228	286	258	**257**
	Mass	lb/hr	1.98E-02	2.15E-02	1.94E-02	**2.02E-02**
		lb/lb glass	3.25E-04	3.52E-04	3.18E-04	**3.32E-04**
Inorganic CPM	Concentration, C_s	gr/dscf	1.29E-04	1.45E-04	4.15E-04	**2.30E-04**
		µg/dscm	296	333	950	**526**
	Mass	lb/hr	2.58E-02	2.49E-02	7.16E-02	**4.08E-02**
		lb/lb glass	4.23E-04	4.09E-04	1.17E-03	**6.68E-04**
Organic CPM	Concentration, C_s	gr/dscf	2.36E-05	7.24E-05	9.25E-05	**6.28E-05**
		µg/dscm	54	166	212	**144**
	Mass	lb/hr	4.70E-03	1.24E-02	1.59E-02	**1.10E-02**
		lb/lb glass	7.71E-05	2.03E-04	2.61E-04	**1.81E-04**
Measured Total PM	Concentration, C_s	gr/dscf	ND 2.52E-04	ND 3.43E-04	ND 6.20E-04	ND **4.05E-04**
		µg/dscm	ND 578	ND 785	ND 1,419	ND **927**
	Mass	lb/hr	ND 5.03E-02	ND 5.88E-02	ND 1.07E-01	ND **7.20E-02**
		lb/lb glass	ND 8.25E-04	ND 9.64E-04	ND 1.75E-03	ND **1.18E-03**
Total PM @ Method Detection Limit (7 mg)	Mass	gr/dscf	< 7.22E-04	< 8.34E-04	< 8.34E-04	< **7.97E-04**
		lb/hr	< 1.44E-01	< 1.43E-01	< 1.44E-01	< **1.44E-01**
		lb/lb glass	< 2.36E-03	< 2.35E-03	< 2.36E-03	< **2.36E-03**
Production Data	Glass Production	lbs/hr	61.0	61.0	61.0	**61.0**

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

Oregon Methods 1-5
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:40**
Source:	**CFU 114**	**End Time:**	**11:49**
Method:	**ODEQ 5**	**Date:**	**6/6/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.107 "Hg

where Pb:	29.85	"Hg
ΔH:	3.492	"H_2O

2) Ps = Pb + (Static Press./13.6) = 29.891 "Hg

where Pb:	29.85	"Hg
Static Press.:	0.56	"H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 149.527 dscf

where Vm:	149.006	dcf
Y:	0.9988	
Pm:	30.107	"Hg
Tm:	528.6	°A

4) $V_w(std) = (0.04706)(H_2O)$ = 2.965 scf

where H_2O:	63.00	g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0194

where Vw(std):	2.965	scf
Vm(std):	149.527	dscf

6) % H_2O = Bws x 100 = 1.94 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 217.387 awcf

where Y:	0.9988	
Vm:	149.0059	dcf
Bws:	0.0194	
Ts:	751.7	°A
Tm:	528.6	°A
Pm:	30.107	"Hg
Ps:	29.891	"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	19.81	%vd
N_2+CO= (100-(O_2+CO_2):	79.48	%vd

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 114 **Date: 6/6/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.70 lb/lb-mole
where M_d: 28.91 lb/lb-mole
Bws: 0.0194

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 7.069 sq. ft.
where Stack ID: 36 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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 79.70 fps
where Cp: 0.99
Ave. Sqrt ΔP: 1.0060
Ts: 751.7 °A
Ps: 29.891 "Hg
Ms: 28.70 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 33,804.0 AWCFM
where V_s: 79.70 ft/sec
Stack Area: 7.069 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 33,148.2 ADCFM
where AWCFM: 33,804.0
Bws: 0.0194

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 1,423,269.1 wscf/hr
where V_s: 79.70 ft/sec
Stack Area: 7.0690 sq. ft.
Ts: 751.7 °A
Ps: 29.891 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,395,657.7 dscf/hr
where wscf/hr: 1,423,269.1
Bws: 0.0194

16) DSCFM= (dscf/hr)/60 mins/hr = 23,261.0 DSCFM
where dscf/hr: 1,395,657.7

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000366 sq. ft.
where Nozzle Size: 0.2590 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 114**	**Date:**	**6/6/2018**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 103.5 %

where Ts:	751.7	°A
Vm(Std):	149.527	dscf
Ps:	29.891	"Hg
Vs	79.70	ft/sec
Nozzle Area:	0.000366	sq. ft.
Sampling Time:	120	min.
Bws:	0.0194	

ODEQ Method 5:

Front Half:

19) Filterable PM = filter gain + probe rinse gain = 0.00096 grams

where Filter Gain:	0.00000	grams
Probe Rinse:	0.00096	grams

20) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 9.95E-05 gr/dscf

where Sample:	0.00096	grams
Vm(std):	149.527	dscf

21) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 227.7 µg/dscm

where Sample:	0.00096	grams
Vm(std):	4.234	dscm

22) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 1.98E-02 lb/hr

where Cs:	9.95E-05	gr/dscf
Stack Flow:	1,395,657.7	dscf/hr

Back Half:

23) Inorganic CPM = water fraction = 0.00125 grams
Organic CPM = acetone BH + hexane BH = 0.00023 grams

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

24) lb/lb glass produced = PM fraction/Glass production = 3.25E-04 lb/lb glass

where glass produced:	61.0	lb/hr
Filterable PM emissions:	1.98E-02	lb/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 114**
DATE	**06/06/18**
METHOD	**M316**
POLLUTANT	**Formaldehyde**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**9:41**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**11:50**
EPA Method:	**M316**	Sunny 69F variable wind		**Date:**	**6/6/2018**
Box Operator:	**DS**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	4A	Liner type	GLASS		
Y factor	0.9963	Nozzle ID	0.19	Nozzle size	0.1900	inches	
ΔH@	1.8425	Hot box ID	1	Nozzle area	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat	255	F	
				Filter heat	250	F	

Source Information:

Barometric Pressure	29.85	"Hg	O_2	19.81 %
Static Pressure	0.56	"H_2O	CO_2	0.71 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.224 inches
Stack Temperature	270	F		
Assumed moisture	1.75	%		
Assumed meter temp.	55	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	0.009
Leak check vacuum, "Hg	19	15

.

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	68.258 dcf	Ave. ΔP	1.068 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.0324 "H_2O
Actual H_2O	1.97 %	Ave. ΔH	1.064 "H_2O
Std. meter vol.	68.542 dscf	Ave. T_s	289.5 °F
Isokinetic Average	101.1 %	Ave. T_m	63.8 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	239.9	255.1	15.2
		Total water gain:	29.2

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	2.630	0.92	287	59	0.91	0.91	1	250	65
2	10	5.320	0.98	287	59	0.97	0.97	1	251	63
3	15	8.130	1.10	285	60	1.10	1.00	1	250	58
4	20	10.950	1.10	289	60	1.09	1.10	1	250	54
5	25	13.820	1.10	290	61	1.09	1.10	1	250	53
6	30	16.680	1.10	290	61	1.09	1.10	1	250	53
7	35	19.590	1.10	290	61	1.09	1.10	1	249	53
8	40	22.520	1.10	291	61	1.09	1.10	1	250	53
9	45	25.380	1.10	292	63	1.09	1.10	1	250	53
10	50	28.250	1.10	292	64	1.10	1.10	1	250	53
11	55	31.110	1.10	292	64	1.10	1.10	1	250	53
12	60	34.063	1.10	292	62	1.09	1.10	1	250	54
13	65	36.640	0.86	269	65	0.89	0.89	1	250	62
14	70	39.410	1.00	282	65	1.01	1.00	1	250	56
15	75	42.160	1.00	289	65	1.00	1.00	1	250	57
16	80	44.960	1.00	288	65	1.00	1.00	1	250	58
17	85	47.710	1.10	293	66	1.10	1.10	1	250	59
18	90	50.720	1.20	294	66	1.20	1.20	1	251	59
19	95	53.740	1.20	293	66	1.20	1.20	1	250	59
20	100	56.750	1.20	293	67	1.20	1.20	1	249	63
21	105	59.720	1.10	293	67	1.10	1.10	1	249	61
22	110	62.640	1.10	293	68	1.10	1.10	1	249	60
23	115	65.500	1.00	293	68	1.00	1.00	1	249	60
24	120	68.258	0.96	292	69	0.97	0.97	1	249	60

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**12:31**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**14:40**
EPA Method:	**M316**	Sunny 69F variable wind		**Date:**	**6/6/2018**
Box Operator:	**DS**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	4A	Liner type:	GLASS		
Y factor	0.9963	Nozzle ID	0.19	Nozzle size:	0.1900	inches	
ΔH@	1.8425	Hot box ID	1	Nozzle area:	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat:	255	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.85	"Hg	O_2	19.82 %
Static Pressure	0.56	"H_2O	CO_2	0.72 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.222 inches
Stack Temperature	270	F		
Assumed moisture	1.97	%		
Assumed meter temp.	63.8	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	0.004
Leak check vacuum, "Hg:	16	14

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	69.230	dcf	Ave. ΔP	1.075 "H_2O
Wet mol. weight	28.65	M_s (actual)	Ave. √ΔP	1.0356 "H_2O
Actual H_2O	2.38	%	Ave. ΔH	1.079 "H_2O
Std. meter vol.	68.590	dscf	Ave. T_s	293.9 °F
Isokinetic Average	101.5	%	Ave. T_m	70.9 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	222	22.0
Silica gel, g	260.0	273.5	13.5
		Total water gain:	35.5

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	2.710	1.00	294	67	1.00	1.00	4	252	61
2	10	5.520	1.10	295	68	1.10	1.10	4	250	51
3	15	8.410	1.00	295	68	1.00	1.00	6	250	52
4	20	11.290	1.10	296	68	1.09	1.10	6.5	250	53
5	25	14.160	1.10	298	68	1.09	1.10	6.5	250	54
6	30	17.200	1.20	298	69	1.19	1.20	7.5	250	54
7	35	20.240	1.20	298	70	1.19	1.20	8	250	54
8	40	23.250	1.20	298	70	1.19	1.20	1	250	54
9	45	26.340	1.20	298	70	1.19	1.20	1	250	56
10	50	29.280	1.20	298	68	1.19	1.20	1	250	56
11	55	32.210	1.10	298	71	1.10	1.10	1	250	56
12	60	35.068	1.00	297	71	1.00	1.00	1	250	55
13	65	37.960	1.10	298	71	1.10	1.10	1	251	56
14	70	40.930	1.10	298	72	1.10	1.10	1	251	56
15	75	43.866	1.00	295	72	1.00	1.00	1	250	55
16	80	46.650	1.10	291	72	1.11	1.10	1	250	57
17	85	49.510	1.10	291	72	1.11	1.10	1	250	58
18	90	52.440	1.10	296	73	1.10	1.10	1	250	58
19	95	55.440	1.10	298	73	1.10	1.10	1	251	58
20	100	58.310	1.10	298	73	1.10	1.10	1	250	58
21	105	60.910	0.90	289	74	0.91	0.90	1	250	59
22	110	63.590	0.85	273	74	0.88	0.90	1	250	59
23	115	66.350	0.95	269	74	0.99	1.00	1	250	59
24	120	69.230	0.99	294	74	1.00	1.00	1	250	60

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**3**
Location:	**Corvallis, OR**			**Start Time:**	**15:16**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**17:25**
EPA Method:	**M316**	Sunny 69F variable wind		**Date:**	**6/6/2018**
Box Operator:	**DS**				
Technician(s):	**CW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	4A	Liner type:	GLASS		
Y factor	0.9963	Nozzle ID	0.190	Nozzle size:	0.1900	inches	
ΔH@	1.8425	Hot box ID	1	Nozzle area:	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat:	255	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.85	"Hg	O_2	19.81 %
Static Pressure	0.56	"H_2O	CO_2	0.71 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.221 inches
Stack Temperature	270	F		
Assumed moisture	2.38	%		
Assumed meter temp.	70.9	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	0.002
Leak check vacuum, "Hg:	16	19

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	68.239	dcf	Ave. ΔP	1.04 "H_2O
Wet mol. weight	28.71	M_s (actual)	Ave. √ΔP	1.0195 "H_2O
Actual H_2O	1.79	%	Ave. ΔH	1.048 "H_2O
Std. meter vol.	67.199	dscf	Ave. T_s	292.6 °F
Isokinetic Average	100.5	%	Ave. T_m	74.1 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	212	12.0
Silica gel, g	251.6	265.6	14.0
		Total water gain:	26.0

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	5	2.810	0.99	291	73	0.99	1.00	1	250	57
2	10	5.610	0.95	294	73	0.95	0.96	1	250	57
3	15	8.410	1.00	296	73	1.00	1.00	1	250	57
4	20	11.280	1.00	299	73	0.99	1.00	1	251	58
5	25	14.060	1.00	298	73	0.99	1.00	1	251	58
6	30	16.870	1.00	298	73	0.99	1.00	1	250	58
7	35	19.650	1.00	298	73	0.99	1.00	1	250	58
8	40	22.450	1.00	298	73	0.99	1.00	1	251	58
9	45	25.320	1.10	298	73	1.09	1.10	1	251	58
10	50	28.220	1.10	299	73	1.09	1.10	1	251	60
11	55	31.070	1.10	298	73	1.09	1.10	1	251	60
12	60	33.945	1.00	252	73	1.06	1.10	1	251	60
13	65	36.660	0.96	284	73	0.97	0.98	1	251	58
14	70	39.390	0.97	284	75	0.99	1.00	1	251	58
15	75	42.190	1.00	290	75	1.01	1.00	1	250	56
16	80	44.980	1.00	295	75	1.00	1.00	1	250	56
17	85	47.690	1.00	296	75	1.00	1.00	1	251	57
18	90	50.750	1.20	295	75	1.20	1.20	1	250	58
19	95	53.740	1.10	294	74	1.10	1.10	1	251	58
20	100	56.710	1.10	292	76	1.11	1.10	1	250	59
21	105	59.700	1.10	292	76	1.11	1.10	1	250	59
22	110	62.610	1.10	291	76	1.11	1.10	1	250	61
23	115	65.300	1.10	295	76	1.10	1.10	1	250	60
24	120	68.239	1.10	295	76	1.10	1.10	1	250	61

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

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:41**
Source:	**CFU 114**	**End Time:**	**11:50**
Method:	**316**	**Date:**	**6/6/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	2.630	0.91	59	1	0.92	287	0.9592
10	5.320	0.97	59	2	0.98	287	0.9899
15	8.130	1.00	60	3	1.10	285	1.0488
20	10.950	1.10	60	4	1.10	289	1.0488
25	13.820	1.10	61	5	1.10	290	1.0488
30	16.680	1.10	61	6	1.10	290	1.0488
35	19.590	1.10	61	7	1.10	290	1.0488
40	22.520	1.10	61	8	1.10	291	1.0488
45	25.380	1.10	63	9	1.10	292	1.0488
50	28.250	1.10	64	10	1.10	292	1.0488
55	31.110	1.10	64	11	1.10	292	1.0488
60	34.063	1.10	62	12	1.10	292	1.0488
65	36.640	0.89	65	13	0.86	269	0.9274
70	39.410	1.00	65	14	1.00	282	1.0000
75	42.160	1.00	65	15	1.00	289	1.0000
80	44.960	1.00	65	16	1.00	288	1.0000
85	47.710	1.10	66	17	1.10	293	1.0488
90	50.720	1.20	66	18	1.20	294	1.0954
95	53.740	1.20	66	19	1.20	293	1.0954
100	56.750	1.20	67	20	1.20	293	1.0954
105	59.720	1.10	67	21	1.10	293	1.0488
110	62.640	1.10	68	22	1.10	293	1.0488
115	65.500	1.00	68	23	1.00	293	1.0000
120	68.258	0.97	69	24	0.96	292	0.9798

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 114**	**Date:**	**06/06/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	36.000	in
Meter Volume, V_m	68.258	dcf	Rectangular		
Water Volume	29.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.71	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.81	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.064	"H_2O	√Dp	1.0324	"H_2O
Temperature, T_m	63.8	^oF	Temperature, T_s	289.5	^oF
Temperature, T_m	523.8	^oA (^oR)	Temperature, T_s	749.5	^oA (R)
Pressure Meter, P_m	29.928	"Hg	Pressure Stack, P_s	29.891	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	68.542	dscf	Velocity, V_s	69.30	fps
	1.941	dscm	Volume (actual)	29,392.9	awcfm
Actual Volume, $V_{m(actual)}$	99.387	awcf		28,813.9	adcfm
Gas Stream Moisture			Volume (standard)	1,241,180.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.374	scf		1,216,729.0	dscf/hr
Moisture, B_{ws}	0.0197			20,278.8	dscf/min
Moisture EPA M4	1.97	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	547.422	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	101.1	%			

Laboratory Results

CH_2O	293.0	µg/sample		
CH_2O	2.93E-04	grams	MW CH_2O	30.031 g/mole

Emissions:

Concentration, C_s	6.60E-05	gr/dscf
	151.0	µg/dscm
	1.21E-01	ppmvd
Mass Emissions	1.15E-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:**	**12:31**
Source:	**CFU 114**	**End Time:**	**14:40**
Method:	**316**	**Date:**	**06/06/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	2.710	1.00	67	1	1.00	294	1.0000
10	5.520	1.10	68	2	1.10	295	1.0488
15	8.410	1.00	68	3	1.00	295	1.0000
20	11.290	1.10	68	4	1.10	296	1.0488
25	14.160	1.10	68	5	1.10	298	1.0488
30	17.200	1.20	69	6	1.20	298	1.0954
35	20.240	1.20	70	7	1.20	298	1.0954
40	23.250	1.20	70	8	1.20	298	1.0954
45	26.340	1.20	70	9	1.20	298	1.0954
50	29.280	1.20	68	10	1.20	298	1.0954
55	32.210	1.10	71	11	1.10	298	1.0488
60	35.068	1.00	71	12	1.00	297	1.0000
65	37.960	1.10	71	13	1.10	298	1.0488
70	40.930	1.10	72	14	1.10	298	1.0488
75	43.866	1.00	72	15	1.00	295	1.0000
80	46.650	1.10	72	16	1.10	291	1.0488
85	49.510	1.10	72	17	1.10	291	1.0488
90	52.440	1.10	73	18	1.10	296	1.0488
95	55.440	1.10	73	19	1.10	298	1.0488
100	58.310	1.10	73	20	1.10	298	1.0488
105	60.910	0.90	74	21	0.90	289	0.9487
110	63.590	0.90	74	22	0.85	273	0.9220
115	66.350	1.00	74	23	0.95	269	0.9747
120	69.230	1.00	74	24	0.99	294	0.9950

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 114**	**Date:**	**06/06/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	36.000	in
Meter Volume, V_m	69.230	dcf	Rectangular		
Water Volume	35.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.72	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.82	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.079	"H_2O	√Dp	1.0356	"H_2O
Temperature, T_m	70.9	^oF	Temperature, T_s	293.9	^oF
Temperature, T_m	530.9	^oA (^oR)	Temperature, T_s	753.9	^oA (R)
Pressure Meter, P_m	29.929	"Hg	Pressure Stack, P_s	29.891	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	68.590	dscf	Velocity, V_s	69.78	fps
	1.942	dscm	Volume (actual)	29,596.5	awcfm
Actual Volume, $V_{m(actual)}$	100.461	awcf		28,892.1	adcfm
Gas Stream Moisture			Volume (standard)	1,242,483.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.671	scf		1,212,912.0	dscf/hr
Moisture, B_{ws}	0.0238			20,215.2	dscf/min
Moisture EPA M4	2.38	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	550.636	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.65	lb/lb-mole			
Percent Isokinetic	101.5	%			

Laboratory Results

CH_2O	681.0	µg/sample			
CH_2O	6.81E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	1.53E-04	gr/dscf
	350.67	µg/dscm
	2.81E-01	ppmvd
Mass Emissions	2.65E-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:**	**15:16**
Source:	**CFU 114**	**End Time:**	**17:25**
Method:	**316**	**Date:**	**06/06/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	2.810	1.00	73	1	0.99	291	0.9950
10	5.610	0.96	73	2	0.95	294	0.9747
15	8.410	1.00	73	3	1.00	296	1.0000
20	11.280	1.00	73	4	1.00	299	1.0000
25	14.060	1.00	73	5	1.00	298	1.0000
30	16.870	1.00	73	6	1.00	298	1.0000
35	19.650	1.00	73	7	1.00	298	1.0000
40	22.450	1.00	73	8	1.00	298	1.0000
45	25.320	1.10	73	9	1.10	298	1.0488
50	28.220	1.10	73	10	1.10	299	1.0488
55	31.070	1.10	73	11	1.10	298	1.0488
60	33.945	1.10	73	12	1.00	252	1.0000
65	36.660	0.98	73	13	0.96	284	0.9798
70	39.390	1.00	75	14	0.97	284	0.9849
75	42.190	1.00	75	15	1.00	290	1.0000
80	44.980	1.00	75	16	1.00	295	1.0000
85	47.690	1.00	75	17	1.00	296	1.0000
90	50.750	1.20	75	18	1.20	295	1.0954
95	53.740	1.10	74	19	1.10	294	1.0488
100	56.710	1.10	76	20	1.10	292	1.0488
105	59.700	1.10	76	21	1.10	292	1.0488
110	62.610	1.10	76	22	1.10	291	1.0488
115	65.300	1.10	76	23	1.10	295	1.0488
120	68.239	1.10	76	24	1.10	295	1.0488

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 114**	**Date:**	**06/06/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	5	min	Diameter	36.000	in
Meter Volume, V_m	68.239	dcf	Rectangular		
Water Volume	26.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.85	"Hg	CO_2 Average	0.71	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.81	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.048	"H_2O	√Dp	1.0195	"H_2O
Temperature, T_m	74.1	^oF	Temperature, T_s	292.6	^oF
Temperature, T_m	534.1	^oA (^oR)	Temperature, T_s	752.6	^oA (R)
Pressure Meter, P_m	29.927	"Hg	Pressure Stack, P_s	29.891	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	67.199	dscf	Velocity, V_s	68.56	fps
	1.903	dscm	Volume (actual)	29,079.0	awcfm
Actual Volume, $V_{m(actual)}$	97.663	awcf		28,558.5	adcfm
Gas Stream Moisture			Volume (standard)	1,222,868.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.224	scf		1,200,979.4	dscf/hr
Moisture, B_{ws}	0.0179			20,016.3	dscf/min
Moisture EPA M4	1.79	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	549.686	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.71	lb/lb-mole			
Percent Isokinetic	100.4	%			

Laboratory Results

CH_2O	305.0	µg/sample		
CH_2O	3.05E-04	grams	MW CH_2O	30.031 g/mole

Emissions:

Concentration, C_s	7.00E-05	gr/dscf
	160.27	µg/dscm
	1.28E-01	ppmvd
Mass Emissions	1.20E-02	lb/hr

"<" represents MDL value

EPA Method 316
Laboratory Results
Formaldehyde

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR** **MDL** 0.0137 µg/mL
Source: **CFU 114**

Lab ID	Sample ID	Sample Date	<	Result	MDL	Sample Vol. (mL)	Units
4	CFU 114 M316 Run 1	6/6/2018		293	6.37	465.0	µg/sample
8	CFU 114 M316 Run 2	6/6/2018		681	6.33	462.0	µg/sample
9	Cfu 114 M316 Run 3	6/6/2018		305	6.11	446.0	µg/sample
10	Field Train Blank	6/6/2018	<	MDL	0.0137	1.0	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 114**

Run			1	2	3	
Date			6/6/2018	6/6/2018	6/6/2018	
Run Start Time			9:41	12:31	15:16	
Run End Time			11:50	14:40	17:25	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.85	29.85	29.85	**29.85**
Nozzle Dia., in.			0.1900	0.1900	0.1900	**0.1900**
Isokinetic Average, %			101.1	101.5	100.4	**101.0**
Sample Volume, dscf			68.542	68.590	67.199	**68.110**
Sample Volume, dscm			1.941	1.942	1.903	**1.929**
Stack Diameter, in.			36.00	36.00	36.00	**36.00**
Stack Area, sq.ft.			7.069	7.069	7.069	**7.069**
CO_2 %vd			0.71	0.72	0.71	**0.71**
O_2 %vd			19.81	19.82	19.81	**19.81**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.97	2.38	1.79	**2.05**
Wet Molecular Weight, lb/lb-mole			28.70	28.65	28.71	**28.69**
Velocity, FPS			69.30	69.78	68.56	**69.21**
ADCFM			28,813.9	28,892.1	28,558.5	**28,754.8**
AWCFM			29,392.9	29,596.5	29,079.0	**29,356.1**
DSCFM			20,278.8	20,215.2	20,016.3	**20,170.1**
Stack Temperature, °F			289.5	293.9	292.6	**292.0**
Formaldehyde	Concentration, C_s	gr/dscf	6.60E-05	1.53E-04	7.00E-05	**9.64E-05**
		µg/dscm	151.0	350.7	160.3	**220.6**
		ppmvd	1.21E-01	2.81E-01	1.28E-01	**1.77E-01**
	Mass	lb/hr	1.15E-02	2.65E-02	1.20E-02	**1.67E-02**
		lb/lb glass	1.88E-04	4.35E-04	1.97E-04	**2.73E-04**
Production Data	Glass Production	lbs/hr	61.0	61.0	61.0	**61.0**

"<" represents MDL value

EPA Methods 1-4, 316
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:41**
Source:	**CFU 114**	**End Time:**	**11:50**
Method:	**316**	**Date:**	**6/6/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 29.928 "Hg

where Pb:	29.85	"Hg
ΔH:	1.064	"H_2O

2) Ps = Pb + (Static Press./13.6) = 29.891 "Hg

where Pb:	29.85	"Hg
Static Press.:	0.56	"H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 68.542 dscf

where Vm:	68.258	dcf
Y:	0.9963	
Pm:	29.928	"Hg
Tm:	523.8	°A

4) $V_w(std) = (0.04706)(H_2O)$ = 1.374 scf

where H_2O:	29.20	g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0197

where Vw(std):	1.374	scf
Vm(std):	68.542	dscf

6) % H_2O = Bws x 100 = 1.97 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 99.387 awcf

where Y:	0.9963	
Vm:	68.2579	dcf
Bws:	0.0197	
Ts:	749.5	°A
Tm:	523.8	°A
Pm:	29.928	"Hg
Ps:	29.891	"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	19.81	%vd
N_2+CO= (100-(O_2+CO_2):	79.48	%vd

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 114 **Date: 6/6/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 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 = 7.069 sq. ft.
where Stack ID: 36 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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 69.30 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.0324
Ts: 749.5 °A
Ps: 29.891 "Hg
Ms: 28.70 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 29,392.9 AWCFM
where V_s: 69.30 ft/sec
Stack Area: 7.069 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 28,813.9 ADCFM
where AWCFM: 29,392.9
Bws: 0.0197

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 1,241,180.3 wscf/hr
where V_s: 69.30 ft/sec
Stack Area: 7.0690 sq. ft.
Ts: 749.5 °A
Ps: 29.891 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,216,729.0 dscf/hr
where wscf/hr: 1,241,180.3
Bws: 0.0197

16) DSCFM= (dscf/hr)/60 mins/hr = 20,278.8 DSCFM
where dscf/hr: 1,216,729.0

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000197 sq. ft.
where Nozzle Size: 0.1900 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 114**	**Date:**	**6/6/2018**

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

where Ts:	749.5	°A
Vm(Std):	68.542	dscf
Ps:	29.891	"Hg
Vs	69.30	ft/sec
Nozzle Area:	0.000197	sq. ft.
Sampling Time:	120	min.
Bws:	0.0197	

EPA Method 316:

19) Formaldehyde laboratory results 293.0 µg/sample

20) Formaldehyde = (µg/sample)/1,000,000 = 2.93E-04 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 6.60E-05 gr/dscf

where Sample:	0.00029	grams
Vm(std)	68.542	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 151.0 µg/dscm

where Sample:	0.00029	grams
Vm(std)	1.941	dscm

23) Volume/Mole = $\left(\frac{359\frac{ft^3}{lb-mol}@STP\ (Ts)\ (29.92"Hg)}{492°A\ (Ps)}\right)$ = 547.422 Vol./Mole

where Ts:	749.5	°A
Ps:	29.891	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 1.21E-01 ppmvd

where MW:	30.031	g/mol
lb/hr:	0.01	
Vol./Mole:	547.422	
ADCFM:	28813.9	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 1.15E-02 lb/hr

where Cs:	6.60E-05	gr/dscf
Stack Flow:	1,216,729.0	dscf/hr

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 114**
Facility	**Glass Plant 2**	Date	**June 6, 2018**
Location	**Corvallis, OR**		

Run			1	2	3	
Date			6/6/2018	6/6/2018	6/6/2018	
Run Start Time			9:40	12:30	15:15	
Run End Time			11:49	14:40	17:24	
CO_2 %vd			0.71	0.72	0.71	0.71
O_2 %vd			19.81	19.82	19.81	19.81
WSCFM*			23,721.2	20,442.5	20,533.6	21,565.7
DSCFM*			23,261.0	20,011.1	20,118.8	21,130.3
Nitrogen Oxides	Concentration, C_s	ppmvd	5.34	5.32	5.32	5.33
	Mass	lb/hr	0.89	0.76	0.77	0.81
	Emission Factor	lb/lb glass	1.46E-02	1.25E-02	1.26E-02	1.32E-02
		lb/Mscf nat. gas	0.15	0.13	0.13	0.14
Carbon Monoxide	Concentration, C_s	ppmvd	135.50	137.23	136.12	136.28
	Mass	lb/hr	13.75	11.98	11.95	12.56
	Emission Factor	lb/lb glass	0.23	0.20	0.20	0.21
		lb/Mscf nat. gas	2.34	2.01	2.00	2.12
VOC	Concentration, C_s	ppmvw	0.28	0.28	0.17	0.24
	Mass	lb/hr	4.55E-02	3.92E-02	2.39E-02	3.62E-02
	Emission Factor	lb/lb glass	7.46E-04	6.43E-04	3.92E-04	5.94E-04
		lb/Mscf nat. gas	7.75E-03	6.60E-03	4.01E-03	6.12E-03
Formaldehyde**	Mass	lb/hr	1.15E-02	2.65E-02	1.20E-02	1.67E-02
	Emission Factor	lb/lb glass	1.89E-04	4.34E-04	1.97E-04	2.73E-04
		lb/Mscf nat. gas	1.96E-03	4.45E-03	2.01E-03	2.81E-03
Total VOCs†	Mass	lb/hr	5.70E-02	6.57E-02	3.59E-02	5.29E-02
	Emission Factor	lb/lb glass	9.35E-04	1.08E-03	5.89E-04	8.67E-04
		lb/Mscf nat. gas	9.71E-03	1.11E-02	6.02E-03	8.93E-03

Production Rates	Glass Production	lb/hr	61.0	61.0	61.0	61.0
	Natural Gas Use	scf/hr	5874.6	5948.9	5970.4	5931.3
		Mscf/hr	5.8746	5.9489	5.9704	5.9313

*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 114**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 2**	Date:	**June 6, 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**
	zero	0.01	0.81	4.00	pass	0.63	3.10	pass	-0.90	pass				
Run 1	upscale	10.37	10.03	-1.70	pass	10.10	-1.35	pass	0.35	pass	20	5.71	5.34	10
	zero	0.01	0.63	3.10	pass	0.60	2.95	pass	-0.15	pass				
Run 2	upscale	10.37	10.10	-1.35	pass	9.96	-2.05	pass	-0.70	pass	20	5.62	5.32	10
	zero	0.01	0.60	2.95	pass	0.63	3.10	pass	0.15	pass				
Run 3	upscale	10.37	9.96	-2.05	pass	9.93	-2.20	pass	-0.15	pass	20	5.58	5.32	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.01	10.37	20.46
Analyzer Cal. Error %	0.05	1.85	2.30
Analyzer Cal. Error < 2%*	pass	pass	pass

NO2 CONVERTER TEST

NO2 Tank Value (ppm)	50.41
NO Check Value	47.84
NO2 to NO Conversion %	94.9%
NO2 Conversion > 90%	pass

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

Company:	**Hollingsworth & Vose**	Source:	**CFU 114**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 2**	Date:	**June 6, 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**		**System Cal Response**	**Post test System Cal. Bias**		**System Drift**		**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
				% of span	**pass/fail**		**% of span**	**pass/fail**	**% of span**	**pass/fail**				
	zero	0.12	0.24	0.04	pass	0.71	0.20	pass	0.16	pass				
Run 1	upscale	152.40	151.87	-0.18	pass	150.50	-0.63	pass	-0.46	pass	300	136.62	135.50	150
	zero	0.12	0.71	0.20	pass	0.60	0.16	pass	-0.04	pass				
Run 2	upscale	152.40	150.50	-0.63	pass	150.24	-0.72	pass	-0.09	pass	300	137.62	137.23	150
	zero	0.12	0.60	0.16	pass	-1.08	-0.40	pass	-0.56	pass				
Run 3	upscale	152.40	150.24	-0.72	pass	150.50	-0.63	pass	0.09	pass	300	136.43	136.12	150
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	150	300
Cal gas analyzer response	0.12	152.4	301.13
Analyzer Cal. Error	0.04	0.80	0.38
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 114**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 6, 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**
	zero	0.01	0.13	0.60	pass	0.09	0.40	pass	-0.20	pass				
Run 1	upscale	9.95	10.03	0.40	pass	9.96	0.05	pass	-0.35	pass	20	19.69	19.81	10
	zero	0.01	0.09	0.40	pass	0.10	0.45	pass	0.05	pass				
Run 2	upscale	9.95	9.96	0.05	pass	9.97	0.10	pass	0.05	pass	20	19.66	19.82	10
	zero	0.01	0.10	0.45	pass	0.12	0.55	pass	0.10	pass				
Run 3	upscale	9.95	9.97	0.10	pass	9.97	0.10	pass	0.00	pass	20	19.64	19.81	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.01	9.95	20.03
Analyzer Cal. Error	0.05	-0.25	0.15
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 114**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 6, 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**
	zero	0.05	0.07	0.50	pass	0.07	0.50	pass	0.00	pass				
Run 1	upscale	1.91	1.95	1.00	pass	1.95	1.00	pass	0.00	pass	4	0.74	0.71	2
	zero	0.05	0.07	0.50	pass	0.08	0.75	pass	0.25	pass				
Run 2	upscale	1.91	1.95	1.00	pass	1.96	1.25	pass	0.25	pass	4	0.75	0.72	2
	zero	0.05	0.08	0.75	pass	0.08	0.75	pass	0.00	pass				
Run 3	upscale	1.91	1.96	1.25	pass	1.97	1.50	pass	0.25	pass	4	0.75	0.71	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.05	1.91	4.08
Analyzer Cal. Error	1.25	-2.25	2.00
Analyzer Cal. Error < 2%*	pass	pass	pass

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 114**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 2**	Date:	**June 6, 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	0.01	0.01	0.00	pass			
Run 1	upscale	12.55	12.45	-0.40	pass	25	0.28	12.5
	zero	0.01	0.10	0.36	pass			
Run 2	upscale	12.55	12.34	-0.84	pass	25	0.28	12.5
	zero	0.01	0.01	0.00	pass			
Run 3	upscale	12.55	12.46	-0.36	pass	25	0.17	12.5
				≤ 3%				

Instrument Response Time(s):	
Time 1	120
Time 2	120
Time 3	120
Average:	120

SYSTEM CAL. ERROR	**Zero**	**Low**	**Mid**	**High**
Calibration gas standards	0.00	6.25	12.50	21.25
Calibration gas system response	0.01	6.18	12.55	21.17
Calibration Predicted Response		6.23	12.46	
Calibration Error		0.86	0.74	
Calibration Error < 5% ?	pass	pass	pass	pass

Stratification Check

Facility	Glass Plant 2				
Location	Corvallis, OR		**Date**	6/6/2018	
Source	CFU 114		**Stack Dimensions**	36	inches

3 POINT METHOD

% of diameter		Pt location	O_2 %	Diff (+/- 5%)	Pass/Fail
16.7%	1	6.01	19.74	0.00%	PASS
50.0%	2	18.00	19.74	0.00%	PASS
83.3%	3	29.99	19.74	0.00%	PASS
		AVERAGE:	19.74		

EPA Method 7E,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:40**
Source:	**CFU 114**	**End Time:**	**11:49**
Method:	**7E**	**Date:**	**6/6/2018**

EPA Methods 7E:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ 1.85 %v

where C_{Dir}: 10.37 ppmv
C_V: 10.00 ppmv
CS: 20.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -1.70 %v

where C_{Dir}: 10.37 ppmv
C_S: 10.03 ppmv
CS: 20.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.35 %v

where SB_{Final}: -1.35 ppmv
SB_i: -1.70 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 5.34 ppmv

where C_{Avg}: 5.71 ppmv
C_O: 0.72 ppmv
C_{MA}: 10.00 ppmv
C_M: 10.07 ppmv

NO_2 - NO Conversion Efficiency

5) $Eff_{NOx} = \left(\frac{C_{Dir}}{C_V}\right) \times 100 =$ 94.9 %v

where C_{Dir}: 47.84 ppmv
C_V: 50.41 ppmv

Emission Rates:

NO_x 1) lb/hr = (Stack Flow) (C) (46) (1.558×10^{-7}) = 0.89 lb/hr

where Stack Flow:	23261.00	DSCFM
C:	5.34	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:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:40**
Source:	**CFU 114**	**End Time:**	**11:49**
Method:	**10**	**Date:**	**6/6/2018**

EPA Methods 10:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ 0.80 %v

where C_{Dir}:	152.40 ppmv
C_V:	150.00 ppmv
CS:	300.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.18 %v

where C_{Dir}:	152.40 ppmv
C_S:	151.87 ppmv
CS:	300.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.46 %v

where SB_{Final}:	-0.63 ppmv
SB_i:	-0.18 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 135.50 ppmv

where C_{Avg}:	136.62 ppmv
C_O:	0.48 ppmv
C_{MA}:	150.00 ppmv
C_M:	151.19 ppmv

Emission Rates:

CO 1) lb/hr = (Stack Flow) (C) (28) (1.558×10^{-7}) = 13.75 lb/hr

where Stack Flow:	23261.00	DSCFM
C:	135.50	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:**	**9:40**
Source:	**CFU 114**	**End Time:**	**11:49**
Method:	**3A**	**Date:**	**6/6/2018**

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:	10.03	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.35 %v

where SB_{Final}:	0.05	ppmv
SB_i:	0.40	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.81 ppmv

where C_{Avg}:	19.69	ppmv
C_O:	0.11	ppmv
C_{MA}:	10.00	ppmv
C_M:	10.00	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:40**
Source:	**CFU 114**	**End Time:**	**11:49**
Method:	**3A**	**Date:**	**6/6/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -2.25 %v

where C_{Dir}: 1.91 ppmv
C_V: 2.00 ppmv
CS: 4.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 1.00 %v

where C_{Dir}: 1.91 ppmv
C_S: 1.95 ppmv
CS: 4.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.00 %v

where SB_{Final}: 1.00 ppmv
SB_i: 1.00 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}: 0.74 ppmv
C_O: 0.07 ppmv
C_{MA}: 2.00 ppmv
C_M: 1.95 ppmv

EPA Method 25A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:40**
Source:	**CFU 114**	**End Time:**	**11:49**
Method:	**25A**	**Date:**	**6/6/2018**

EPA Method 25A:

Predicted Low and Mid Level Calibration Response (Mid)

1) $PR = \left(\frac{CR_H - CRZ}{SS}\right) \times CS_M + CR_Z =$ 12.46 ppmv

where CR_H:	21.17 ppmv
CR_Z:	0.01 ppmv
SS:	21.25 ppmv
CS_M:	12.50 ppmv

Calibration Error Test

2) $CET = \left(\frac{SR - PR}{CGV}\right) \times 100 =$ 0.74 %v

where PR:	12.46 ppmv
SR:	12.55 ppmv
CGV	12.50 ppmv

Drift Determination (Mid)

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

where CSR:	12.55 ppmv
CSR_C:	12.45 ppmv
AS:	25.00 ppmv

Emission Rates:

VOC 1) lb/hr = (Stack Flow) (C) (44) (1.558×10^{-7}) = 0.04 lb/hr

where Stack Flow:	23261.00	DSCFM
C:	0.28	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

6/6/2018

CFU 114

Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4
6/6/2018	7:27:29	3.94	-1.36	-0.06	0.06	0.60	-0.76						
6/6/2018	7:27:39	4.00	-1.94	-0.07	0.05	0.58	-0.75						
6/6/2018	7:27:49	4.00	-2.25	-0.07	0.05	0.60	-0.69						
6/6/2018	7:27:59	3.93	-1.10	-0.06	0.05	0.60	-0.76						
6/6/2018	7:28:09	3.99	0.31	-0.07	0.06	0.58	-0.73						
6/6/2018	7:28:19	4.04	0.58	-0.07	0.06	0.58	-0.76						
6/6/2018	7:28:29	3.99	-0.16	-0.07	0.05	0.72	-0.76						
6/6/2018	7:28:39	4.02	-1.39	-0.07	0.06	0.49	-0.73						
6/6/2018	7:28:49	4.05	-1.90	-0.07	0.06	0.58	-0.81						
6/6/2018	7:28:59	3.96	-2.06	-0.07	0.05	0.60	-0.73						
6/6/2018	7:29:09	4.05	-1.27	-0.07	0.05	0.52	-0.84						
6/6/2018	7:29:19	1.28	0.48	-0.07	0.05	0.60	-0.78						
6/6/2018	7:29:29	0.07	0.63	-0.07	0.05	0.66	-0.75						
6/6/2018	7:29:39	-0.10	0.38	-0.08	0.05	0.53	-0.78						
6/6/2018	7:29:49	0.02	-0.90	-0.07	0.05	0.55	-0.79						
6/6/2018	7:29:59	-0.01	-1.95	-0.08	0.05	0.58	-0.76						
6/6/2018	7:30:09	-0.04	-1.97	-0.08	0.05	0.52	-0.75						
6/6/2018	7:30:19	0.02	-2.16	-0.05	0.05	0.55	-0.76						
6/6/2018	7:30:29	-0.04	-0.87	0.02	0.05	0.60	-0.82						
6/6/2018	7:30:39	0.00	0.93	0.02	0.05	0.55	-0.72						
6/6/2018	7:30:49	-0.03	0.61	0.01	0.05	0.55	-0.72						
6/6/2018	7:30:59	-0.06	-0.60	0.02	0.06	0.63	-0.76						
6/6/2018	7:31:09	-0.06	-1.18	0.01	0.05	0.66	-0.75						
6/6/2018	7:31:19	-0.03	-1.65	0.02	0.04	0.63	-0.68						
6/6/2018	7:31:29	-0.07	-2.57	0.01	0.05	0.58	0.24						
6/6/2018	7:31:39	-0.06	-1.62	0.01	0.04	0.58	0.25						
6/6/2018	7:31:49	-0.04	0.21	0.01	0.05	0.50	0.16						
6/6/2018	7:31:59	-0.06	0.76	0.01	0.05	0.55	0.01						
6/6/2018	7:32:09	-0.10	-0.12	0.01	0.05	0.52	0.05						
6/6/2018	7:32:19	0.00	-0.96	0.01	0.04	0.55	0.01						

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6/6/2018	7:32:29	0.05	-1.39	0.01	0.05	0.58	0.10						
6/6/2018	7:32:39	-0.03	-2.53	0.01	0.04	0.56	0.07						
6/6/2018	7:32:49	-0.04	-2.38	0.01	0.04	0.63	0.07						
6/6/2018	7:32:59	-0.03	-0.74	0.01	0.05	0.63	0.08						
6/6/2018	7:33:09	0.00	0.48	0.01	0.05	0.56	0.05						
6/6/2018	7:33:19	0.05	0.63	0.02	0.05	0.60	0.01	0.01	0.12	0.01	0.05		
6/6/2018	7:33:29	-0.01	-0.04	0.01	0.04	0.61	0.05						
6/6/2018	7:33:39	-0.03	-1.62	0.01	0.04	0.55	0.05						
6/6/2018	7:33:49	0.00	-1.89	0.01	0.04	0.55	-0.05						
6/6/2018	7:33:59	-0.04	-2.35	3.74	2.30	0.52	0.04						
6/6/2018	7:34:09	-0.04	-1.56	16.33	15.21	0.56	0.05						
6/6/2018	7:34:19	0.02	-0.20	20.03	19.04	0.60	0.04						
6/6/2018	7:34:29	0.95	1.76	20.17	19.09	0.58	0.07						
6/6/2018	7:34:39	3.29	0.70	20.18	19.10	0.63	-0.01						
6/6/2018	7:34:49	3.42	-1.35	20.18	19.11	0.66	0.02						
6/6/2018	7:34:59	1.96	-2.70	20.19	19.11	0.58	0.05						
6/6/2018	7:35:09	1.42	-3.95	20.19	19.11	0.60	0.02						
6/6/2018	7:35:19	1.35	-4.14	20.20	19.21	0.66	0.07						
6/6/2018	7:35:29	1.45	-2.73	20.08	19.21	0.63	0.07						
6/6/2018	7:35:39	1.41	-1.56	20.03	19.22	0.55	-0.01						
6/6/2018	7:35:49	1.47	-1.78	20.03	19.23	0.66	0.02						
6/6/2018	7:35:59	1.44	-2.72	20.03	19.22	0.61	-0.02						
6/6/2018	7:36:09	1.38	-3.72	20.03	19.23	0.52	0.01						
6/6/2018	7:36:19	0.55	-4.50	20.04	19.23	0.53	0.02			20.03			
6/6/2018	7:36:29	-0.03	-4.47	19.54	19.23	0.56	-0.04						
6/6/2018	7:36:39	0.00	-3.44	15.91	14.85	0.60	0.04						
6/6/2018	7:36:49	0.00	-1.82	9.76	9.42	0.60	-0.02						
6/6/2018	7:36:59	-0.04	-0.88	9.96	9.64	0.58	0.01						
6/6/2018	7:37:09	-0.03	-0.97	9.96	9.63	0.60	0.04						
6/6/2018	7:37:19	-0.07	-2.37	9.95	9.62	0.63	0.07						

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6/6/2018	7:37:29	-0.03	-3.46	9.95	9.62	0.60	0.07						
6/6/2018	7:37:39	-0.06	-3.76	9.94	9.61	0.50	0.04			9.95			
6/6/2018	7:37:49	-0.03	-3.25	9.94	9.61	0.49	0.04						
6/6/2018	7:37:59	-0.06	-2.15	8.89	9.53	0.46	-0.04						
6/6/2018	7:38:09	-0.06	-0.78	8.88	9.10	0.47	0.02						
6/6/2018	7:38:19	0.02	-0.71	0.97	0.54	0.47	0.07						
6/6/2018	7:38:29	-0.01	-1.43	0.14	0.15	0.53	0.07						
6/6/2018	7:38:39	0.02	-1.93	3.77	3.97	0.60	0.02						
6/6/2018	7:38:49	-0.01	-2.63	3.96	4.06	0.46	-0.01						
6/6/2018	7:38:59	-0.03	-2.84	3.95	4.07	0.60	0.01						
6/6/2018	7:39:09	0.05	-1.59	3.97	4.08	0.53	0.08						
6/6/2018	7:39:19	0.10	0.00	3.97	4.09	0.56	0.04				4.08		
6/6/2018	7:39:29	0.00	-0.43	3.98	4.09	0.61	-0.01						
6/6/2018	7:39:39	0.02	-1.12	2.41	2.30	0.53	0.05						
6/6/2018	7:39:49	0.86	-1.78	2.02	1.92	0.49	-0.02						
6/6/2018	7:39:59	1.44	-2.71	1.99	1.90	0.55	-0.10						
6/6/2018	7:40:09	1.44	-3.22	1.98	1.89	0.50	-0.02						
6/6/2018	7:40:19	1.44	-2.33	1.99	1.89	0.60	0.01						
6/6/2018	7:40:29	1.38	-0.84	1.99	1.88	0.56	0.05						
6/6/2018	7:40:39	1.44	-0.09	1.99	1.89	0.52	0.01						
6/6/2018	7:40:49	1.50	-0.43	1.99	1.89	0.50	0.02						
6/6/2018	7:40:59	1.41	-1.27	1.99	1.88	0.63	0.05						
6/6/2018	7:41:09	1.49	-2.18	1.99	1.88	0.47	0.02						
6/6/2018	7:41:19	1.47	-2.83	1.99	1.88	0.50	0.05						
6/6/2018	7:41:29	1.42	-2.99	1.99	1.89	0.47	0.04						
6/6/2018	7:41:39	1.49	-1.91	1.98	1.89	0.55	0.04						
6/6/2018	7:41:49	1.50	-0.18	1.98	1.92	0.61	0.01						
6/6/2018	7:41:59	1.42	0.17	1.98	1.91	0.47	-0.01						
6/6/2018	7:42:09	1.44	-0.99	1.98	1.91	0.50	0.05						
6/6/2018	7:42:19	1.45	-1.97	1.98	1.91	0.50	0.05				1.91		

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6/6/2018	7:42:29	1.49	-2.55	1.75	1.89	0.47	0.07						
6/6/2018	7:42:39	1.41	-3.00	2.10	2.06	0.44	0.10						
6/6/2018	7:42:49	1.42	-2.51	1.58	1.46	0.56	0.04						
6/6/2018	7:42:59	1.49	1.90	0.59	0.23	0.47	0.07						
6/6/2018	7:43:09	3.27	30.82	0.33	0.11	0.55	0.10						
6/6/2018	7:43:19	7.25	73.95	0.11	0.08	0.56	0.10						
6/6/2018	7:43:29	22.51	113.55	0.05	0.08	0.56	0.07						
6/6/2018	7:43:39	39.37	137.03	0.04	0.08	0.56	0.07						
6/6/2018	7:43:49	89.70	146.89	0.04	0.07	0.52	0.02						
6/6/2018	7:43:59	169.06	150.79	0.04	0.07	0.58	0.07						
6/6/2018	7:44:09	207.22	155.29	0.04	0.07	0.61	0.02						
6/6/2018	7:44:19	218.79	158.00	0.04	0.06	0.63	0.02						
6/6/2018	7:44:29	224.11	158.14	0.04	0.06	0.49	0.02						
6/6/2018	7:44:39	224.92	157.39	0.03	0.06	0.52	0.02						
6/6/2018	7:44:49	225.58	156.29	0.03	0.07	0.50	0.04						
6/6/2018	7:44:59	225.50	156.12	0.03	0.06	0.58	0.07						
6/6/2018	7:45:09	225.53	156.06	0.03	0.06	0.63	0.07						
6/6/2018	7:45:19	225.61	156.54	0.03	0.05	0.53	0.13						
6/6/2018	7:45:29	226.39	158.51	0.03	0.05	0.53	0.07						
6/6/2018	7:45:39	226.94	163.37	0.03	0.06	0.55	-0.01						
6/6/2018	7:45:49	226.92	174.88	0.03	0.05	0.49	0.10						
6/6/2018	7:45:59	227.04	188.87	0.03	0.05	0.61	0.07						
6/6/2018	7:46:09	227.00	198.28	0.03	0.05	0.67	0.05						
6/6/2018	7:46:19	227.04	201.68	0.02	0.05	0.70	0.07						
6/6/2018	7:46:29	227.06	202.91	0.03	0.05	0.53	0.11						
6/6/2018	7:46:39	226.97	204.45	0.03	0.05	0.52	0.07						
6/6/2018	7:46:49	226.94	206.57	0.03	0.05	0.63	0.07						
6/6/2018	7:46:59	226.97	206.85	0.03	0.04	0.63	0.08						
6/6/2018	7:47:09	226.92	205.29	0.03	0.04	0.63	0.05						
6/6/2018	7:47:19	227.00	204.11	0.02	0.04	0.53	0.07						

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6/6/2018	7:47:29	226.92	199.86	0.03	0.04	0.49	0.04						
6/6/2018	7:47:39	227.01	199.52	0.02	0.04	0.60	0.02						
6/6/2018	7:47:49	227.90	200.61	0.02	0.04	0.56	0.08						
6/6/2018	7:47:59	228.45	202.04	0.03	0.04	0.55	0.04						
6/6/2018	7:48:09	228.46	203.30	0.02	0.04	0.50	0.05						
6/6/2018	7:48:19	227.68	202.10	0.02	0.04	0.55	0.04						
6/6/2018	7:48:29	227.93	200.83	0.02	0.05	0.64	0.11						
6/6/2018	7:48:39	228.45	200.00	0.03	0.03	0.53	0.04						
6/6/2018	7:48:49	228.42	198.85	0.02	0.03	0.50	0.04						
6/6/2018	7:48:59	228.45	202.64	0.02	0.04	0.52	0.11						
6/6/2018	7:49:09	254.30	231.79	0.03	0.03	0.53	0.01						
6/6/2018	7:49:19	293.27	267.78	0.03	0.03	0.52	0.07						
6/6/2018	7:49:29	317.71	292.05	0.02	0.03	0.43	0.04						
6/6/2018	7:49:39	337.55	299.02	0.02	0.03	0.56	-0.01						
6/6/2018	7:49:49	346.31	299.78	0.03	0.04	0.49	0.01						
6/6/2018	7:49:59	346.31	298.57	0.03	0.03	0.60	0.05						
6/6/2018	7:50:09	346.25	298.22	0.03	0.04	0.61	0.07						
6/6/2018	7:50:19	346.32	298.23	0.03	0.03	0.60	0.07						
6/6/2018	7:50:29	346.38	300.39	0.03	0.03	0.56	0.07						
6/6/2018	7:50:39	346.29	302.50	0.02	0.03	0.52	-0.01						
6/6/2018	7:50:49	346.34	302.28	0.03	0.03	0.61	0.07						
6/6/2018	7:50:59	346.37	301.46	0.03	0.02	0.56	0.02						
6/6/2018	7:51:09	346.32	299.66	0.02	0.03	0.56	0.07		301.13				
6/6/2018	7:51:19	345.45	289.01	0.02	0.03	0.41	0.07						
6/6/2018	7:51:29	288.52	242.32	0.02	0.03	0.53	0.10						
6/6/2018	7:51:39	201.76	193.07	0.02	0.03	0.49	0.07						
6/6/2018	7:51:49	172.68	163.17	0.02	0.03	0.56	0.02						
6/6/2018	7:51:59	171.55	154.60	0.02	0.02	0.56	0.08						
6/6/2018	7:52:09	169.09	153.49	0.02	0.02	0.61	0.01						
6/6/2018	7:52:19	169.06	152.41	0.02	0.03	0.58	0.11						

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6/6/2018	7:52:29	169.14	150.78	0.02	0.02	0.69	0.08						
6/6/2018	7:52:39	169.14	150.00	0.02	0.03	0.60	0.08						
6/6/2018	7:52:49	169.07	149.66	0.02	0.03	0.60	0.04						
6/6/2018	7:52:59	169.04	149.44	0.01	0.03	0.63	-0.01						
6/6/2018	7:53:09	169.17	151.58	0.02	0.03	0.60	0.13						
6/6/2018	7:53:19	169.20	152.81	0.02	0.03	0.63	0.07						
6/6/2018	7:53:29	169.09	152.80	0.02	0.03	0.53	0.07		152.40				
6/6/2018	7:53:39	169.12	151.90	0.02	0.03	0.52	0.04						
6/6/2018	7:53:49	169.06	151.11	0.02	0.02	0.64	0.05						
6/6/2018	7:53:59	169.14	149.97	0.03	0.03	0.61	0.01						
6/6/2018	7:54:09	169.17	146.66	0.05	0.04	0.58	0.01						
6/6/2018	7:54:19	169.18	132.34	0.05	0.03	0.53	0.04						
6/6/2018	7:54:29	169.20	104.15	0.35	0.31	0.67	-0.01						
6/6/2018	7:54:39	170.08	76.17	0.06	0.05	0.70	-0.01						
6/6/2018	7:54:49	118.29	44.54	0.05	0.07	0.64	0.04						
6/6/2018	7:54:59	35.12	21.55	0.20	0.20	0.67	0.02						
6/6/2018	7:55:09	4.80	13.26	1.39	0.49	0.72	0.05						
6/6/2018	7:55:19	-1.23	38.93	0.09	0.03	0.67	-0.01						
6/6/2018	7:55:29	27.87	47.53	0.03	0.04	0.69	-0.02						
6/6/2018	7:55:39	90.32	41.61	0.02	0.03	0.64	-0.02						
6/6/2018	7:55:49	104.39	29.07	0.02	0.03	0.60	0.01						
6/6/2018	7:55:59	82.27	23.93	0.02	0.03	0.56	0.02						
6/6/2018	7:56:09	66.70	22.11	0.02	0.03	0.56	0.02						
6/6/2018	7:56:19	56.30	20.99	0.02	0.03	0.56	0.07						
6/6/2018	7:56:29	49.44	20.12	0.02	0.02	0.64	0.04						
6/6/2018	7:56:39	45.25	19.28	0.02	0.03	0.58	-0.01						
6/6/2018	7:56:49	41.63	19.00	0.02	0.03	0.56	0.02						
6/6/2018	7:56:59	39.57	19.66	0.02	0.03	0.58	0.10						
6/6/2018	7:57:09	37.25	21.50	0.01	0.02	0.60	0.04						
6/6/2018	7:57:19	35.13	21.70	0.02	0.03	0.64	0.01						

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6/6/2018	7:57:29	34.40	21.48	0.02	0.03	0.53	0.05						
6/6/2018	7:57:39	33.59	20.55	0.02	0.02	0.58	0.11						
6/6/2018	7:57:49	32.25	19.45	0.02	0.03	0.56	0.11						
6/6/2018	7:57:59	31.58	19.22	0.02	0.03	0.52	0.08						
6/6/2018	7:58:09	30.72	18.74	0.01	0.02	0.58	0.10						
6/6/2018	7:58:19	30.16	19.84	0.02	0.02	0.56	0.05						
6/6/2018	7:58:29	30.11	21.65	0.02	0.02	0.55	0.11						
6/6/2018	7:58:39	29.12	21.97	0.01	0.02	0.52	-0.01						
6/6/2018	7:58:49	28.54	21.28	0.01	0.03	0.53	0.11						
6/6/2018	7:58:59	28.55	20.30	0.01	0.03	0.56	0.05						
6/6/2018	7:59:09	28.49	19.86	0.02	0.03	0.61	0.05						
6/6/2018	7:59:19	27.73	19.25	0.01	0.03	0.60	0.05						
6/6/2018	7:59:29	27.06	18.92	0.02	0.03	0.64	0.05						
6/6/2018	7:59:39	27.09	20.02	0.02	0.03	0.66	0.02						
6/6/2018	7:59:49	27.04	21.60	0.01	0.03	0.56	0.08						
6/6/2018	7:59:59	27.09	21.99	0.01	0.03	0.50	0.02						
6/6/2018	8:00:09	27.09	20.94	0.01	0.03	0.64	0.59						
6/6/2018	8:00:19	26.20	20.44	0.02	0.03	0.72	2.68						
6/6/2018	8:00:29	25.61	19.34	0.01	0.03	0.56	2.68						
6/6/2018	8:00:39	25.64	19.24	0.01	0.03	0.63	2.65						
6/6/2018	8:00:49	25.62	18.90	0.01	0.03	0.60	2.69						
6/6/2018	8:00:59	25.58	20.23	0.01	0.03	0.66	2.68						
6/6/2018	8:01:09	25.56	21.48	0.01	0.03	0.64	2.66						
6/6/2018	8:01:19	25.62	21.89	0.01	0.03	0.63	2.62						
6/6/2018	8:01:29	24.40	21.01	0.01	0.03	0.61	2.65						
6/6/2018	8:01:39	21.67	19.81	0.02	0.04	0.64	2.59						
6/6/2018	8:01:49	19.98	19.55	0.02	0.03	0.64	2.63						
6/6/2018	8:01:59	19.78	18.84	0.01	0.02	0.69	2.69						
6/6/2018	8:02:09	19.84	18.94	0.01	0.03	0.61	2.66						
6/6/2018	8:02:19	19.77	20.00	0.02	0.04	0.58	2.60						

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6/6/2018	8:02:29	20.60	21.76	0.02	0.03	0.60	2.59						
6/6/2018	8:02:39	21.02	21.70	0.01	0.03	0.56	2.66	20.46					
6/6/2018	8:02:49	20.96	20.69	0.01	0.03	0.63	2.59						
6/6/2018	8:02:59	21.05	21.30	0.02	0.04	0.56	2.51						
6/6/2018	8:03:09	26.45	30.79	0.01	0.03	0.66	2.62						
6/6/2018	8:03:19	35.50	29.52	0.01	0.03	0.55	2.59						
6/6/2018	8:03:29	32.66	22.24	0.01	0.04	0.61	2.52						
6/6/2018	8:03:39	23.34	14.65	0.02	0.03	0.61	2.62						
6/6/2018	8:03:49	18.07	11.83	0.01	0.04	1.19	2.60						
6/6/2018	8:03:59	16.00	11.40	0.01	0.03	3.30	2.62						
6/6/2018	8:04:09	15.36	9.81	0.02	0.03	3.36	2.63						
6/6/2018	8:04:19	14.47	9.14	0.01	0.03	3.27	2.57						
6/6/2018	8:04:29	13.89	8.16	0.02	0.03	3.37	2.62						
6/6/2018	8:04:39	13.81	7.91	0.02	0.03	3.33	2.59						
6/6/2018	8:04:49	13.81	7.82	0.01	0.02	3.37	2.57						
6/6/2018	8:04:59	13.88	9.38	0.01	0.03	3.34	2.59						
6/6/2018	8:05:09	12.93	10.31	0.01	0.03	0.96	2.60						
6/6/2018	8:05:19	12.46	10.86	0.01	0.03	0.66	2.60						
6/6/2018	8:05:29	12.44	10.02	0.01	0.03	0.64	2.62						
6/6/2018	8:05:39	12.44	8.86	0.02	0.03	0.58	2.59						
6/6/2018	8:05:49	12.44	8.30	0.01	0.03	0.66	2.57						
6/6/2018	8:05:59	12.44	7.95	0.01	0.03	0.66	2.52						
6/6/2018	8:06:09	12.49	7.68	0.01	0.03	0.56	2.62						
6/6/2018	8:06:19	12.47	9.13	0.01	0.03	0.56	2.55						
6/6/2018	8:06:29	12.52	10.89	0.01	0.02	0.53	2.63						
6/6/2018	8:06:39	12.50	10.32	0.01	0.03	0.61	2.59						
6/6/2018	8:06:49	12.47	9.69	0.02	0.03	0.49	2.60						
6/6/2018	8:06:59	12.43	8.64	0.01	0.03	0.55	2.57						
6/6/2018	8:07:09	12.40	8.17	0.02	0.03	0.63	2.62						
6/6/2018	8:07:19	12.47	7.65	0.01	0.03	0.60	2.59						

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6/6/2018	8:07:29	12.36	8.28	0.01	0.03	0.60	3.18						
6/6/2018	8:07:39	12.43	9.50	0.01	0.03	0.58	3.99						
6/6/2018	8:07:49	12.47	10.90	0.01	0.02	0.73	4.02						
6/6/2018	8:07:59	68.50	10.54	0.02	0.03	0.61	3.96						
6/6/2018	8:08:09	572.42	9.70	0.02	0.02	0.55	4.02						
6/6/2018	8:08:19	570.98	8.74	0.01	0.03	0.67	4.07						
6/6/2018	8:08:29	458.11	8.02	0.01	0.02	0.55	4.03						
6/6/2018	8:08:39	6.53	7.87	0.01	0.02	0.58	3.88						
6/6/2018	8:08:49	6.52	7.96	0.01	0.02	0.60	2.63						
6/6/2018	8:08:59	6.51	9.44	0.01	0.03	0.64	2.57						
6/6/2018	8:09:09	8.45	10.69	0.01	0.03	0.58	2.60						
6/6/2018	8:09:19	11.38	10.43	0.01	0.03	0.56	2.63						
6/6/2018	8:09:29	11.36	9.40	0.01	0.02	0.61	2.62						
6/6/2018	8:09:39	11.35	8.43	0.01	0.02	0.61	2.60						
6/6/2018	8:09:49	11.35	8.18	0.01	0.01	0.67	2.59						
6/6/2018	8:09:59	11.35	7.71	0.02	0.02	0.53	2.62						
6/6/2018	8:10:09	11.33	7.72	0.01	0.01	0.63	2.59						
6/6/2018	8:10:19	11.13	9.85	0.01	0.02	0.69	2.59						
6/6/2018	8:10:29	10.46	10.71	0.02	0.02	0.61	2.68						
6/6/2018	8:10:39	10.46	10.08	0.01	0.02	0.60	2.62						
6/6/2018	8:10:49	10.46	9.48	0.02	0.02	0.60	2.60						
6/6/2018	8:10:59	10.44	8.55	0.01	0.02	0.55	2.59						
6/6/2018	8:11:09	10.41	7.61	0.01	0.02	0.60	2.65						
6/6/2018	8:11:19	10.38	7.88	0.01	0.02	0.56	2.62						
6/6/2018	8:11:29	10.37	8.13	0.01	0.01	0.58	2.66						
6/6/2018	8:11:39	10.37	9.88	0.01	0.01	0.58	2.62						
6/6/2018	8:11:49	10.37	10.72	0.01	0.02	0.58	2.57						
6/6/2018	8:11:59	10.37	10.39	0.02	0.02	0.61	2.62	10.37					
6/6/2018	8:12:09	10.37	9.02	0.01	0.02	0.66	2.63						
6/6/2018	8:12:19	10.37	8.38	0.02	0.01	0.53	2.63						

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6/6/2018	8:12:29	8.57	4.86	0.02	0.01	0.61	2.62						
6/6/2018	8:12:39	5.91	1.78	12.84	0.01	0.69	2.65						
6/6/2018	8:12:49	3.80	0.23	20.65	0.02	0.67	2.59						
6/6/2018	8:12:59	1.60	0.56	20.76	0.02	0.61	2.60						
6/6/2018	8:13:09	14.10	0.39	20.76	0.01	0.56	2.66						
6/6/2018	8:13:19	36.55	-0.62	20.75	0.01	0.60	2.60						
6/6/2018	8:13:29	46.20	-1.43	20.75	0.01	0.56	2.57						
6/6/2018	8:13:39	47.34	-2.45	20.76	0.01	0.61	2.59						
6/6/2018	8:13:49	47.81	-2.66	20.75	0.01	0.55	2.59						
6/6/2018	8:13:59	47.86	-2.96	20.75	0.01	0.60	2.59						
6/6/2018	8:14:09	47.90	-2.07	20.76	0.01	0.63	2.51						
6/6/2018	8:14:19	47.92	-0.51	20.75	0.01	0.56	2.60						
6/6/2018	8:14:29	47.92	0.31	20.76	0.01	0.55	2.62						
6/6/2018	8:14:39	47.90	-0.52	20.76	0.01	0.60	2.59						
6/6/2018	8:14:49	47.89	-1.20	20.76	0.01	0.60	2.63						
6/6/2018	8:14:59	47.87	-2.74	20.76	0.01	0.64	2.60						
6/6/2018	8:15:09	47.85	-2.45	20.76	0.01	0.66	2.63						
6/6/2018	8:15:19	47.84	-3.00	20.77	0.01	0.60	2.60						
6/6/2018	8:15:29	47.82	-2.06	20.76	0.01	0.58	2.54	NO2 Conversion Check					
6/6/2018	8:15:39	47.85	-0.44	20.74	0.01	0.58	2.57	47.84					
6/6/2018	8:15:49	47.89	0.29	20.15	0.01	0.61	2.60						
6/6/2018	8:15:59	47.95	-0.50	18.14	0.01	0.55	2.65						
6/6/2018	8:16:09	47.55	-1.07	18.12	0.01	0.66	2.55						
6/6/2018	8:16:19	46.82	-2.13	18.22	0.02	0.56	2.55						
6/6/2018	8:16:29	46.16	-2.76	9.23	0.03	0.52	2.60						
6/6/2018	8:16:39	45.56	-3.00	18.30	0.06	0.60	2.62						
6/6/2018	8:16:49	32.96	-2.63	14.51	0.05	0.60	2.60						
6/6/2018	8:16:59	12.42	-0.92	12.07	0.05	0.53	2.59						
6/6/2018	8:17:09	3.41	0.14	11.19	0.05	0.50	2.57						
6/6/2018	8:17:19	2.06	0.09	10.91	0.05	0.56	2.63						

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6/6/2018	8:17:29	1.46	-0.75	10.92	0.05	0.56	2.63						
6/6/2018	8:17:39	1.39	-1.93	11.10	0.05	0.56	2.57						
6/6/2018	8:17:49	1.33	-2.00	11.36	0.07	0.60	2.62						
6/6/2018	8:17:59	1.28	-2.98	11.65	0.06	0.58	2.55						
6/6/2018	8:18:09	1.23	-2.74	11.81	0.07	0.63	2.59						
6/6/2018	8:18:19	1.19	-2.08	11.93	0.07	0.63	2.63						
6/6/2018	8:18:29	1.14	-0.26	12.65	0.07	0.55	1.76						
6/6/2018	8:18:39	1.13	0.26	11.61	0.06	0.61	1.30						
6/6/2018	8:18:49	1.10	-0.19	11.25	0.07	0.52	1.27						
6/6/2018	8:18:59	1.05	-1.32	11.28	0.07	0.50	1.33						
6/6/2018	8:19:09	1.03	-2.24	11.34	0.07	0.58	1.36						
6/6/2018	8:19:19	1.01	-2.46	11.62	0.07	0.56	1.38						
6/6/2018	8:19:29	0.99	-3.09	11.53	0.07	0.53	1.33						
6/6/2018	8:19:39	0.98	-2.41	11.54	0.07	0.61	1.40						
6/6/2018	8:19:49	0.99	-0.59	13.14	0.07	0.63	1.32						
6/6/2018	8:19:59	0.97	0.45	18.21	0.09	0.56	1.26						
System													
6/6/2018	8:20:09	0.95	-0.43	20.10	0.10	0.60	1.26						
6/6/2018	8:20:19	0.95	-0.65	20.60	0.10	0.60	1.26						
6/6/2018	8:20:29	0.94	-1.88	20.72	0.10	0.61	1.26						
6/6/2018	8:20:39	0.92	-2.21	13.26	0.07	0.58	1.26						
6/6/2018	8:20:49	0.92	-2.55	5.01	0.07	0.60	1.27						
6/6/2018	8:20:59	0.92	-2.62	3.25	0.05	0.47	1.27						
6/6/2018	8:21:09	0.92	-1.70	2.81	0.06	0.52	1.29						
6/6/2018	8:21:19	0.92	0.18	2.69	0.06	0.64	1.29						
6/6/2018	8:21:29	0.90	0.32	2.66	0.05	0.55	1.27						
6/6/2018	8:21:39	0.89	-0.52	2.64	0.06	0.58	1.33						
6/6/2018	8:21:49	0.89	-1.33	2.64	0.05	0.50	1.29						

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6/6/2018	8:21:59	0.89	-2.13	2.64	0.05	0.61	1.30						
6/6/2018	8:22:09	0.88	-2.45	2.64	0.06	0.60	0.24						
6/6/2018	8:22:19	0.87	-2.93	2.64	0.06	0.58	0.01						
6/6/2018	8:22:29	0.87	-1.78	2.65	0.06	0.61	0.05						
6/6/2018	8:22:39	0.87	-0.37	2.64	0.06	0.58	-0.01						
6/6/2018	8:22:49	0.87	0.03	2.46	0.06	0.61	-0.04						
6/6/2018	8:22:59	0.87	-0.48	2.29	0.06	0.52	0.01						
6/6/2018	8:23:09	0.85	-1.46	2.25	0.07	0.55	0.01						
6/6/2018	8:23:19	0.84	-2.20	2.18	0.07	0.61	0.04						
6/6/2018	8:23:29	0.84	-2.55	2.01	0.07	0.58	0.02						
6/6/2018	8:23:39	0.84	-2.76	1.91	0.06	0.69	0.05						
6/6/2018	8:23:49	0.84	-2.21	2.00	0.06	0.52	-0.02						
6/6/2018	8:23:59	0.84	-0.82	2.16	0.07	0.58	-0.01						
6/6/2018	8:24:09	0.84	0.39	1.98	0.07	0.63	0.04						
6/6/2018	8:24:19	0.84	-0.18	1.81	0.06	0.58	-0.01						
6/6/2018	8:24:29	0.84	-1.16	1.80	0.07	0.69	0.10						
6/6/2018	8:24:39	0.86	-1.79	1.81	0.07	0.66	-0.01						
6/6/2018	8:24:49	0.85	-2.45	1.80	0.07	0.63	-0.05						
6/6/2018	8:24:59	0.84	-2.70	1.61	0.06	0.60	-0.07						
6/6/2018	8:25:09	0.84	-2.82	1.46	0.07	0.61	-0.01						
6/6/2018	8:25:19	0.84	-1.67	1.31	0.07	0.63	0.01						
6/6/2018	8:25:29	0.84	-0.08	1.01	0.07	0.58	0.02						
6/6/2018	8:25:39	0.84	-0.02	0.74	0.07	0.64	-0.02						
6/6/2018	8:25:49	0.82	-0.81	0.78	0.07	0.72	-0.01						
6/6/2018	8:25:59	0.81	-1.65	0.91	0.07	0.61	0.01						
6/6/2018	8:26:09	0.81	-2.26	0.99	0.07	0.61	-0.02						
6/6/2018	8:26:19	0.81	-2.65	0.75	0.07	0.60	0.02						
6/6/2018	8:26:29	0.81	-2.83	0.56	0.07	0.53	0.05						
6/6/2018	8:26:39	0.81	-2.37	0.42	0.07	0.67	0.01						
6/6/2018	8:26:49	0.81	-0.42	0.37	0.07	0.66	-0.04						

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6/6/2018	8:26:59	0.81	0.22	0.33	0.07	0.66	-0.07						
6/6/2018	8:27:09	0.81	-0.35	0.22	0.07	0.56	-0.02						
6/6/2018	8:27:19	0.81	-1.40	0.15	0.07	0.60	-0.02						
6/6/2018	8:27:29	0.81	-1.97	0.14	0.07	0.60	-0.04						
6/6/2018	8:27:39	0.81	-2.16	0.13	0.07	0.60	0.10						
6/6/2018	8:27:49	0.81	-0.38	0.12	0.07	0.66	0.01						
6/6/2018	8:27:59	0.81	-0.09	0.13	0.07	0.63	-0.02						
6/6/2018	8:28:09	0.81	1.19	0.13	0.07	0.67	0.07	0.81	0.24	0.13	0.07		
6/6/2018	8:28:19	0.81	2.58	0.12	0.07	0.70	0.02						
6/6/2018	8:28:29	0.81	2.37	0.12	0.07	0.61	0.01						
6/6/2018	8:28:39	0.81	1.39	0.12	0.07	0.61	0.07						
6/6/2018	8:28:49	0.81	0.93	0.12	0.07	0.53	0.01						
6/6/2018	8:28:59	0.79	0.44	0.12	0.07	0.60	-0.01						
6/6/2018	8:29:09	0.78	-0.34	0.39	0.07	0.66	0.05						
6/6/2018	8:29:19	0.78	-0.31	9.13	0.09	0.58	0.01						
6/6/2018	8:29:29	0.78	0.94	16.69	0.10	0.53	0.05						
6/6/2018	8:29:39	0.80	2.15	19.42	0.12	0.55	0.04						
6/6/2018	8:29:49	0.81	2.58	16.93	0.11	0.60	0.01						
6/6/2018	8:29:59	0.81	1.91	6.86	0.08	0.60	0.01						
6/6/2018	8:30:09	0.81	0.93	3.02	0.08	0.60	0.02						
6/6/2018	8:30:19	0.81	0.56	1.91	0.07	0.64	-0.04						
6/6/2018	8:30:29	0.86	0.07	1.53	0.07	0.63	-0.02						
6/6/2018	8:30:39	0.95	-0.42	1.41	0.07	0.63	0.89						
6/6/2018	8:30:49	0.95	0.21	1.36	0.07	0.61	1.30						
6/6/2018	8:30:59	0.87	1.68	1.35	0.07	0.66	1.29						
6/6/2018	8:31:09	0.84	2.80	1.34	0.07	0.67	1.24						
6/6/2018	8:31:19	0.82	2.66	1.21	0.07	0.52	1.26						
6/6/2018	8:31:29	0.81	1.82	0.61	0.07	0.70	1.27						
6/6/2018	8:31:39	0.76	2.31	0.28	0.07	0.56	1.26						
6/6/2018	8:31:49	2.57	4.22	0.18	0.06	0.64	0.74						

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6/6/2018	8:31:59	5.54	7.15	0.14	0.07	0.63	-0.02						
6/6/2018	8:32:09	7.57	8.82	0.13	0.06	0.56	0.01						
6/6/2018	8:32:19	9.10	11.08	0.12	0.07	0.60	-0.01						
6/6/2018	8:32:29	10.04	12.98	0.11	0.06	0.56	0.04						
6/6/2018	8:32:39	10.62	13.50	0.11	0.06	0.66	0.02						
6/6/2018	8:32:49	10.92	12.32	0.11	0.07	0.60	-0.02						
6/6/2018	8:32:59	11.01	11.87	0.11	0.07	0.60	0.01						
6/6/2018	8:33:09	11.03	11.10	0.11	0.06	0.56	0.02						
6/6/2018	8:33:19	11.02	10.48	0.11	0.07	0.64	0.01						
6/6/2018	8:33:29	10.98	9.89	0.11	0.06	0.61	0.01						
6/6/2018	8:33:39	10.92	10.62	0.11	0.06	0.53	0.11						
6/6/2018	8:33:49	10.84	11.55	0.10	0.06	0.67	0.10						
6/6/2018	8:33:59	10.78	13.35	0.10	0.06	0.60	0.02						
6/6/2018	8:34:09	10.68	13.00	0.11	0.06	0.70	0.04						
6/6/2018	8:34:19	10.58	12.18	0.10	0.06	0.63	0.10						
6/6/2018	8:34:29	10.52	11.41	0.11	0.07	0.56	-0.01						
6/6/2018	8:34:39	10.45	10.31	0.10	0.06	0.69	0.05						
6/6/2018	8:34:49	10.38	9.89	0.11	0.06	0.64	-0.04						
6/6/2018	8:34:59	10.29	9.97	0.10	0.06	0.67	0.05						
6/6/2018	8:35:09	10.21	11.43	0.10	0.07	0.69	0.04						
6/6/2018	8:35:19	10.16	12.97	0.10	0.06	0.66	0.02						
6/6/2018	8:35:29	10.13	13.01	0.11	0.06	0.56	-0.02						
6/6/2018	8:35:39	10.08	12.32	0.10	0.06	0.64	-0.02						
6/6/2018	8:35:49	10.07	11.74	0.10	0.05	0.61	0.05						
6/6/2018	8:35:59	10.10	10.89	0.10	0.05	0.66	0.01						
6/6/2018	8:36:09	10.08	10.46	0.10	0.06	0.70	-0.02						
6/6/2018	8:36:19	10.02	10.25	0.10	0.05	0.56	0.05						
6/6/2018	8:36:29	10.00	11.16	0.10	0.06	0.61	-0.01	10.03					
6/6/2018	8:36:39	9.98	12.99	0.10	0.06	0.70	0.01						
6/6/2018	8:36:49	9.95	13.36	1.18	0.06	0.60	0.10						

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6/6/2018	8:36:59	9.89	12.61	9.78	0.09	0.66	0.10						
6/6/2018	8:37:09	9.35	11.07	9.67	0.07	0.66	0.04						
6/6/2018	8:37:19	8.65	11.96	4.35	0.06	0.60	-0.01						
6/6/2018	8:37:29	11.63	34.55	1.53	0.06	0.58	0.01						
6/6/2018	8:37:39	15.84	72.03	0.59	0.05	0.61	0.04						
6/6/2018	8:37:49	43.03	108.94	0.28	0.05	0.63	-0.04						
6/6/2018	8:37:59	83.67	134.20	0.17	0.06	0.66	-0.04						
6/6/2018	8:38:09	99.66	145.94	0.13	0.05	0.63	-0.04						
6/6/2018	8:38:19	99.90	149.83	0.12	0.05	0.60	-0.07						
6/6/2018	8:38:29	99.90	151.34	0.12	0.05	0.55	-0.07						
6/6/2018	8:38:39	99.90	151.20	0.12	0.05	0.58	-0.09						
6/6/2018	8:38:49	99.90	151.18	0.12	0.05	0.60	0.01						
6/6/2018	8:38:59	99.90	151.12	0.11	0.06	0.53	0.02						
6/6/2018	8:39:09	99.90	151.65	0.11	0.06	0.64	-0.02						
6/6/2018	8:39:19	99.90	153.60	0.11	0.06	0.66	-0.02						
6/6/2018	8:39:29	99.90	155.21	0.11	0.05	0.55	-0.01						
6/6/2018	8:39:39	99.90	154.94	0.11	0.05	0.64	-0.04						
6/6/2018	8:39:49	99.90	154.20	0.11	0.06	0.61	0.04						
6/6/2018	8:39:59	99.90	152.36	0.11	0.05	0.53	-0.07						
6/6/2018	8:40:09	99.90	151.90	0.11	0.06	0.69	-0.09						
6/6/2018	8:40:19	99.90	151.36	0.11	0.05	0.60	0.01		151.87				
6/6/2018	8:40:29	99.90	151.51	0.11	0.05	0.67	-0.01						
6/6/2018	8:40:39	99.90	153.11	0.26	0.05	0.66	-0.01						
6/6/2018	8:40:49	99.90	155.19	8.01	0.07	0.67	-0.01						
6/6/2018	8:40:59	99.90	144.95	10.73	0.08	0.69	-0.01						
6/6/2018	8:41:09	98.23	119.15	8.16	2.75	0.69	-0.05						
6/6/2018	8:41:19	76.92	86.66	9.36	7.40	0.64	0.01						
6/6/2018	8:41:29	55.03	58.24	9.79	8.92	0.64	0.04						
6/6/2018	8:41:39	38.92	36.28	9.93	9.46	0.66	0.02						
6/6/2018	8:41:49	24.68	20.93	9.98	9.66	0.63	0.01						

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6/6/2018	8:41:59	11.92	11.34	10.00	9.73	0.61	0.02						
6/6/2018	8:42:09	5.50	6.57	10.01	9.75	0.66	-0.02						
6/6/2018	8:42:19	3.39	4.19	10.02	9.77	0.61	0.01						
6/6/2018	8:42:29	2.25	2.18	10.02	9.78	0.70	0.01						
6/6/2018	8:42:39	1.86	0.36	10.02	9.79	0.60	-0.04						
6/6/2018	8:42:49	1.61	-0.33	10.02	9.80	0.67	0.05						
6/6/2018	8:42:59	1.46	-1.29	10.02	9.79	0.58	-0.02						
6/6/2018	8:43:09	1.37	-1.24	10.03	9.80	0.58	0.02						
6/6/2018	8:43:19	1.30	0.18	10.03	9.80	0.63	-0.02						
6/6/2018	8:43:29	1.25	1.25	10.03	9.81	0.66	-0.02						
6/6/2018	8:43:39	1.19	1.32	10.03	9.81	0.60	0.02						
6/6/2018	8:43:49	1.14	0.32	10.02	9.81	0.56	0.02						
6/6/2018	8:43:59	1.11	-0.43	10.03	9.81	0.66	-0.01			10.03			
6/6/2018	8:44:09	1.08	-1.19	10.02	9.82	0.56	0.08						
6/6/2018	8:44:19	1.05	-1.60	10.02	9.82	0.60	0.08						
6/6/2018	8:44:29	1.02	-1.50	10.02	9.82	0.67	0.02						
6/6/2018	8:44:39	1.01	-0.36	10.02	9.81	0.55	0.10						
6/6/2018	8:44:49	0.99	1.43	10.03	9.82	0.56	0.05						
6/6/2018	8:44:59	0.97	1.65	10.02	9.82	0.66	0.04						
6/6/2018	8:45:09	0.96	0.44	10.02	9.82	0.61	0.10						
6/6/2018	8:45:19	0.96	-0.08	10.03	9.82	0.58	0.10						
6/6/2018	8:45:29	0.94	-1.10	10.02	9.82	0.69	0.08						
6/6/2018	8:45:39	0.92	-1.21	11.65	8.56	0.69	0.07						
6/6/2018	8:45:49	0.90	-1.71	14.27	4.60	0.63	0.08						
6/6/2018	8:45:59	0.89	-0.41	6.61	2.09	0.61	-0.04						
6/6/2018	8:46:09	0.95	1.99	3.00	0.99	0.55	0.11						
6/6/2018	8:46:19	1.04	2.90	2.32	1.53	0.61	0.11						
6/6/2018	8:46:29	1.00	2.34	2.16	1.80	0.52	0.07						
6/6/2018	8:46:39	0.89	0.95	2.10	1.89	0.64	0.04						
6/6/2018	8:46:49	0.84	0.03	2.08	1.93	0.61	0.02						

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6/6/2018	8:46:59	0.84	-0.60	2.08	1.95	0.61	0.01						
6/6/2018	8:47:09	0.82	-0.76	2.07	1.95	0.61	0.05						
6/6/2018	8:47:19	0.81	0.44	2.08	1.95	0.67	0.07						
6/6/2018	8:47:29	0.81	2.01	2.07	1.95	0.55	0.05						
6/6/2018	8:47:39	0.81	2.22	2.08	1.95	0.53	0.07						
6/6/2018	8:47:49	0.81	1.26	2.08	1.96	0.61	0.08						
6/6/2018	8:47:59	0.79	0.47	2.07	1.95	0.53	0.05						
6/6/2018	8:48:09	0.78	-0.36	2.07	1.95	0.64	0.05						
6/6/2018	8:48:19	0.78	-0.43	2.07	1.95	0.70	0.01				1.95		
6/6/2018	8:48:29	0.78	-0.79	2.07	1.95	0.63	0.04						
6/6/2018	8:48:39	0.78	0.96	2.52	1.92	0.70	0.08						
6/6/2018	8:48:49	0.78	2.22	10.32	1.21	0.66	-0.01						
6/6/2018	8:48:59	0.78	2.21	7.48	0.73	0.64	0.04						
6/6/2018	8:49:09	0.78	1.45	3.65	0.65	0.64	0.04						
6/6/2018	8:49:19	0.78	0.78	3.73	0.51	0.66	0.07						
6/6/2018	8:49:29	0.85	0.51	3.72	0.27	0.60	0.07						
6/6/2018	8:49:39	0.95	0.38	3.72	0.16	0.70	0.07						
6/6/2018	8:49:49	0.92	0.39	3.71	0.12	0.60	0.02						
6/6/2018	8:49:59	0.80	1.72	3.71	0.11	0.63	0.01						
6/6/2018	8:50:09	0.75	3.04	3.71	0.10	0.61	1.20						
6/6/2018	8:50:19	0.73	2.95	3.71	0.10	0.64	1.36						
6/6/2018	8:50:29	0.72	1.93	4.68	0.11	0.60	1.38						
6/6/2018	8:50:39	0.72	1.23	6.11	0.16	0.61	1.32						
6/6/2018	8:50:49	0.72	1.14	4.41	0.13	0.61	1.40						
6/6/2018	8:50:59	0.68	1.56	3.96	0.11	0.56	1.38						
6/6/2018	8:51:09	0.79	2.65	4.39	0.10	0.70	1.33						
6/6/2018	8:51:19	1.03	3.05	12.27	0.11	0.67	0.57						
6/6/2018	8:51:29	1.02	4.28	17.79	0.13	0.60	0.07						
6/6/2018	8:51:39	0.85	3.16	19.77	0.13	0.69	0.08						
6/6/2018	8:51:49	0.74	2.62	20.45	0.13	0.73	0.05						

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6/6/2018	8:51:59	0.70	1.21	20.68	0.13	0.64	0.05						
6/6/2018	8:52:09	0.69	0.73	20.19	0.13	0.58	0.04						
6/6/2018	8:52:19	0.69	0.38	10.81	0.11	0.66	0.05						
6/6/2018	8:52:29	0.69	0.30	7.40	0.10	0.67	0.34						
6/6/2018	8:52:39	0.71	2.14	15.28	0.12	0.60	1.36						
6/6/2018	8:52:49	0.72	3.29	18.90	0.12	0.63	1.40						
6/6/2018	8:52:59	0.72	3.13	20.16	0.13	0.60	1.40						
6/6/2018	8:53:09	0.72	2.25	20.59	0.13	0.53	1.33						
6/6/2018	8:53:19	0.72	1.42	20.74	0.13	0.66	1.38						
6/6/2018	8:53:29	0.72	1.01	20.79	0.13	0.64	1.32						
6/6/2018	8:53:39	0.70	0.42	20.80	0.13	0.58	1.32						
6/6/2018	8:53:49	0.69	0.59	20.81	0.13	0.66	1.33						
6/6/2018	8:53:59	0.69	2.26	20.81	0.13	0.64	1.29						
6/6/2018	8:54:09	0.69	3.40	20.78	0.13	0.56	1.33						
6/6/2018	8:54:19	0.69	3.39	18.83	0.14	0.53	1.30						
6/6/2018	8:54:29	0.69	2.79	16.58	0.18	0.70	1.30						
6/6/2018	8:54:39	0.64	4.95	16.38	0.14	0.55	1.33						
6/6/2018	8:54:49	0.97	6.74	18.80	0.13	0.70	1.30						
6/6/2018	8:54:59	1.68	5.72	20.12	0.13	0.63	2.28						
6/6/2018	8:55:09	1.69	5.00	20.58	0.13	0.63	2.63						
6/6/2018	8:55:19	1.15	4.35	20.73	0.12	0.60	2.59						
6/6/2018	8:55:29	0.87	4.33	20.79	0.13	0.58	2.54						
6/6/2018	8:55:39	0.77	3.46	20.80	0.12	0.66	2.60						
6/6/2018	8:55:49	0.72	2.44	20.81	0.13	0.72	2.63						
6/6/2018	8:55:59	0.72	1.45	20.81	0.13	0.61	2.62						
6/6/2018	8:56:09	0.72	0.90	20.82	0.12	0.61	2.66						
6/6/2018	8:56:19	0.72	0.05	20.82	0.13	0.64	2.60						
6/6/2018	8:56:29	0.72	1.06	20.82	0.12	0.61	2.60						
6/6/2018	8:56:39	0.72	2.47	20.83	0.12	0.63	2.62						
6/6/2018	8:56:49	0.70	3.54	20.83	0.12	0.72	2.59						

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6/6/2018	8:56:59	0.67	3.14	20.83	0.12	0.58	2.55						
6/6/2018	8:57:09	0.66	1.76	20.83	0.13	0.61	2.60						
6/6/2018	8:57:19	0.66	1.36	20.82	0.12	0.66	2.55						
6/6/2018	8:57:29	0.66	0.57	18.97	0.12	0.52	2.60						
6/6/2018	8:57:39	0.66	0.40	17.19	0.11	0.64	2.57						
6/6/2018	8:57:49	0.87	1.77	13.61	0.11	0.64	2.62						
6/6/2018	8:57:59	1.19	4.04	11.20	0.10	0.63	2.55						
6/6/2018	8:58:09	1.29	5.29	10.48	0.10	0.72	2.51						
6/6/2018	8:58:19	1.33	4.32	10.23	0.10	0.63	2.60						
6/6/2018	8:58:29	1.19	2.88	11.11	0.10	0.69	2.57						
6/6/2018	8:58:39	0.88	1.25	14.28	0.10	0.67	2.55						
6/6/2018	8:58:49	0.71	0.65	14.46	0.10	0.61	2.60						
6/6/2018	8:58:59	0.65	0.72	18.39	0.12	0.56	2.54						
6/6/2018	8:59:09	0.68	1.51	19.99	0.12	0.58	2.55						
6/6/2018	8:59:19	0.82	3.28	19.28	0.11	0.66	2.57						
6/6/2018	8:59:29	0.86	3.85	17.04	0.11	0.61	2.60						
6/6/2018	8:59:39	0.79	3.31	13.60	0.10	0.70	2.62						
6/6/2018	8:59:49	0.84	2.49	10.79	0.10	0.67	1.88						
6/6/2018	8:59:59	0.98	1.70	7.32	0.09	0.55	1.32						
6/6/2018	9:00:09	0.95	0.66	6.10	0.08	0.61	1.35						
6/6/2018	9:00:19	0.81	0.57	5.76	0.08	0.52	1.29						
6/6/2018	9:00:29	0.73	1.77	7.89	0.08	0.67	1.33						
6/6/2018	9:00:39	0.68	3.13	7.98	0.07	0.64	1.33						
6/6/2018	9:00:49	0.66	3.34	5.10	0.07	0.72	1.27						
6/6/2018	9:00:59	0.67	2.03	8.05	0.09	0.60	1.32						
6/6/2018	9:01:09	0.67	1.16	15.91	0.10	0.61	1.33						
6/6/2018	9:01:19	0.64	0.56	19.12	0.10	0.58	1.32						
6/6/2018	9:01:29	0.63	0.20	20.23	0.11	0.67	1.38						
6/6/2018	9:01:39	0.63	0.21	20.62	0.11	0.63	1.33						
6/6/2018	9:01:49	0.61	1.75	20.74	0.11	0.61	1.30						

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6/6/2018	9:01:59	0.60	3.27	20.79	0.12	0.66	1.32						
6/6/2018	9:02:09	0.60	3.17	20.80	0.11	0.67	1.30						
6/6/2018	9:02:19	0.60	2.23	20.82	0.11	0.63	1.26						
6/6/2018	9:02:29	0.60	1.32	20.82	0.11	0.56	1.30						
6/6/2018	9:02:39	0.60	0.86	20.82	0.11	0.61	1.30						
6/6/2018	9:02:49	0.60	0.14	20.83	0.11	0.64	1.29						
6/6/2018	9:02:59	0.60	1.19	20.83	0.11	0.55	1.30						
6/6/2018	9:03:09	0.60	2.55	20.83	0.11	0.60	1.32						
6/6/2018	9:03:19	0.60	3.83	20.83	0.12	0.58	1.33						
6/6/2018	9:03:29	0.60	2.74	20.83	0.11	0.58	2.17						
6/6/2018	9:03:39	0.60	2.11	20.82	0.11	0.63	2.62						
6/6/2018	9:03:49	0.60	1.38	20.83	0.11	0.56	2.66						
6/6/2018	9:03:59	0.60	0.72	20.82	0.11	0.60	2.68						
6/6/2018	9:04:09	0.60	0.85	20.81	0.11	0.53	2.65						
6/6/2018	9:04:19	0.60	2.08	20.81	0.11	0.60	2.62						
6/6/2018	9:04:29	0.60	3.56	20.82	0.12	0.49	2.63						
6/6/2018	9:04:39	0.60	3.46	20.82	0.11	0.55	2.65						
6/6/2018	9:04:49	0.60	2.64	20.83	0.11	0.56	2.63						
6/6/2018	9:04:59	0.60	1.94	16.82	0.11	0.58	2.59						
6/6/2018	9:05:09	0.60	1.41	8.60	0.08	0.56	2.65						
6/6/2018	9:05:19	0.60	0.68	6.90	0.08	0.56	2.62						
6/6/2018	9:05:29	0.60	0.91	13.91	0.10	0.67	2.62						
6/6/2018	9:05:39	0.62	2.42	18.41	0.11	0.64	2.71						
6/6/2018	9:05:49	0.63	3.38	19.99	0.11	0.56	2.65						
6/6/2018	9:05:59	0.61	3.18	20.54	0.12	0.50	2.59						
6/6/2018	9:06:09	0.60	2.07	20.73	0.12	0.52	22.70						
6/6/2018	9:06:19	0.60	1.40	20.79	0.12	0.63	345.32						
6/6/2018	9:06:29	0.60	0.88	20.81	0.11	0.63	509.17						
6/6/2018	9:06:39	0.60	0.25	20.18	0.11	0.60	1003.38						
6/6/2018	9:06:49	0.60	1.39	11.23	0.10	0.56	739.84						

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6/6/2018	9:06:59	0.60	2.95	6.08	0.08	0.46	903.72						
6/6/2018	9:07:09	0.60	3.27	7.08	0.08	0.58	923.56						
6/6/2018	9:07:19	0.62	2.16	9.33	0.09	0.52	1061.13						
6/6/2018	9:07:29	0.61	1.68	16.12	0.10	0.53	706.22						
6/6/2018	9:07:39	0.60	0.48	19.20	0.11	0.61	1077.61						
6/6/2018	9:07:49	0.60	0.26	20.27	0.11	0.50	1171.09						
6/6/2018	9:07:59	0.60	0.02	20.64	0.12	0.56	727.98						
6/6/2018	9:08:09	0.58	1.99	20.76	0.11	0.61	1080.35						
6/6/2018	9:08:19	0.57	3.41	20.80	0.11	0.58	1108.27						
6/6/2018	9:08:29	0.57	2.99	20.81	0.12	0.52	1321.27						
6/6/2018	9:08:39	0.57	2.46	20.82	0.12	0.64	1509.70						
6/6/2018	9:08:49	0.57	0.98	20.82	0.11	0.63	1389.83						
6/6/2018	9:08:59	0.57	0.80	20.82	0.12	0.61	1426.37						
6/6/2018	9:09:09	0.57	0.45	20.82	0.12	0.58	1180.83						
6/6/2018	9:09:19	0.57	1.00	20.82	0.12	0.58	1345.46						
6/6/2018	9:09:29	0.57	2.76	20.82	0.12	0.55	1260.08						
6/6/2018	9:09:39	0.57	3.89	20.82	0.12	0.52	1301.22						
6/6/2018	9:09:49	0.57	3.02	20.82	0.12	0.60	862.63						
6/6/2018	9:09:59	0.57	2.22	20.83	0.11	0.63	727.18						
6/6/2018	9:10:09	0.57	1.41	15.05	0.11	0.50	1445.94						
6/6/2018	9:10:19	0.57	0.48	5.51	0.09	0.55	1551.80						
6/6/2018	9:10:29	0.59	0.68	1.94	0.08	0.58	1721.90						
6/6/2018	9:10:39	0.51	2.91	0.81	0.10	0.53	1640.41						
6/6/2018	9:10:49	1.47	6.38	0.46	0.09	0.58	1180.44						
6/6/2018	9:10:59	3.32	7.20	0.34	0.08	0.64	1369.53						
6/6/2018	9:11:09	3.83	4.96	0.30	0.08	0.66	1302.58						
6/6/2018	9:11:19	3.40	3.18	0.31	0.09	0.60	1479.95						
6/6/2018	9:11:29	3.11	1.61	0.32	0.08	0.63	1429.24						
6/6/2018	9:11:39	2.86	0.44	0.34	0.08	0.53	1242.09						
6/6/2018	9:11:49	2.74	0.58	0.35	0.07	0.56	1193.87						

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6/6/2018	9:11:59	2.69	1.79	0.36	0.08	5.34	1152.98						
6/6/2018	9:12:09	2.66	3.15	0.37	0.08	12.48	1395.35						
6/6/2018	9:12:19	2.66	2.91	0.37	0.08	12.57	1585.45						
6/6/2018	9:12:29	2.68	2.27	0.37	0.07	12.51	1495.18						
6/6/2018	9:12:39	2.71	1.19	0.37	0.08	12.48	1442.05						
6/6/2018	9:12:49	2.74	0.76	0.36	0.08	12.44	1580.67						
6/6/2018	9:12:59	2.77	-0.08	0.37	0.08	12.51	1699.60						
6/6/2018	9:13:09	2.78	0.30	0.37	0.08	12.47	2515.94						
6/6/2018	9:13:19	2.76	1.71	0.37	0.08	8.65	3017.06						
6/6/2018	9:13:29	2.75	2.95	0.36	0.08	11.64	50.80						
6/6/2018	9:13:39	2.75	3.01	0.36	0.08	11.64	50.80						
6/6/2018	9:13:49	2.74	2.31	0.36	0.08	11.64	50.80						
6/6/2018	9:13:59	2.71	0.96	0.36	0.08	11.64	50.76						
6/6/2018	9:14:09	2.68	0.33	0.36	0.07	11.64	50.64						
6/6/2018	9:14:19	2.63	0.09	0.36	0.08	11.64	50.00						
6/6/2018	9:14:29	2.59	0.66	0.36	0.08	11.64	95.00						
6/6/2018	9:14:39	2.56	2.46	0.37	0.08	11.64	500.00						
6/6/2018	9:14:49	2.52	2.71	0.36	0.08	11.94	500.00						
6/6/2018	9:14:59	2.50	2.46	0.36	0.08	12.13	95.00						
6/6/2018	9:15:09	2.47	1.54	0.36	0.07	12.13	49.75						
6/6/2018	9:15:19	2.44	0.82	0.36	0.08	12.13	49.27						
6/6/2018	9:15:29	2.39	0.01	0.36	0.09	12.13	49.58						
6/6/2018	9:15:39	2.35	0.56	0.36	0.08	12.13	50.00						
6/6/2018	9:15:49	2.31	1.71	0.36	0.08	12.13	50.00						
6/6/2018	9:15:59	2.29	3.25	0.37	0.08	12.12	50.00						
6/6/2018	9:16:09	2.24	2.91	0.35	0.08	12.08	49.98						
6/6/2018	9:16:19	2.20	1.67	0.35	0.08	12.08	49.99						
6/6/2018	9:16:29	2.16	0.98	0.36	0.08	12.08	50.00						
6/6/2018	9:16:39	2.13	0.38	0.35	0.08	12.08	50.00						
6/6/2018	9:16:49	2.11	0.13	0.36	0.08	12.08	50.00						

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6/6/2018	9:16:59	2.08	0.85	0.35	0.08	12.08	50.00						
6/6/2018	9:17:09	2.05	3.01	0.35	0.08	12.08	49.99						
6/6/2018	9:17:19	2.02	3.04	0.36	0.08	12.13	50.00						
6/6/2018	9:17:29	2.01	2.62	0.35	-4.43	12.13	50.00						
6/6/2018	9:17:39	1.99	1.47	0.35	-0.17	12.13	49.99						
6/6/2018	9:17:49	1.96	1.03	0.35	-0.16	12.13	49.99						
6/6/2018	9:17:59	1.93	0.30	0.35	-0.17	12.13	49.99						
6/6/2018	9:18:09	1.90	0.33	0.35	-150.13	12.13	49.98						
6/6/2018	9:18:19	1.89	1.67	0.35	-132.31	12.13	49.95						
6/6/2018	9:18:29	1.87	3.09	0.35	0.08	12.14	49.70						
6/6/2018	9:18:39	1.84	2.63	0.42	0.08	12.15	49.47						
6/6/2018	9:18:49	1.82	2.09	7.95	0.09	12.15	50.00						
6/6/2018	9:18:59	1.81	1.03	16.18	0.12	12.15	50.00						
6/6/2018	9:19:09	1.62	0.64	19.21	0.12	12.14	50.00						
6/6/2018	9:19:19	1.31	0.12	20.24	0.12	12.15	50.00						
6/6/2018	9:19:29	1.05	1.00	20.60	0.13	12.15	50.00						
6/6/2018	9:19:39	0.79	2.68	20.72	0.13	12.15	49.99						
6/6/2018	9:19:49	0.65	3.33	20.76	0.13	12.16	49.98						
6/6/2018	9:19:59	0.61	2.22	20.78	0.13	12.16	49.97						
6/6/2018	9:20:09	0.60	1.99	20.80	0.12	12.16	49.76						
6/6/2018	9:20:19	0.58	0.75	15.05	0.12	12.16	49.89						
6/6/2018	9:20:29	0.57	0.55	5.79	0.09	12.16	49.98						
6/6/2018	9:20:39	0.57	0.55	3.92	0.08	12.16	49.98						
6/6/2018	9:20:49	0.64	2.54	4.34	0.08	10.94	13.50						
6/6/2018	9:20:59	0.71	3.60	4.42	0.08	-0.07	0.76						
6/6/2018	9:21:09	1.25	2.83	4.46	0.08	0.07	-0.17						
6/6/2018	9:21:19	2.17	2.19	4.46	0.08	0.02	-1.03						
6/6/2018	9:21:29	2.42	1.04	4.47	0.07	0.06	-5.33						
6/6/2018	9:21:39	2.21	0.06	4.48	0.07	-0.19	-20.75						
6/6/2018	9:21:49	2.00	0.25	4.48	0.06	-0.24	-24.70						

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6/6/2018	9:21:59	1.80	1.19	4.48	0.07	-0.84	-12.93						
6/6/2018	9:22:09	1.64	2.94	4.48	0.08	0.17	-16.98						
6/6/2018	9:22:19	1.49	3.42	4.48	0.07	45.04	40.00						
6/6/2018	9:22:29	1.37	2.49	4.48	0.07	50.00	50.00						
6/6/2018	9:22:39	1.28	1.33	4.49	0.07	50.00	50.00						
6/6/2018	9:22:49	1.19	0.89	4.49	0.08	50.00	50.00						
6/6/2018	9:22:59	1.12	-0.19	4.49	0.07	50.00	50.00						
6/6/2018	9:23:09	1.08	0.50	4.49	0.07	50.00	50.00						
6/6/2018	9:23:19	1.04	1.77	4.49	0.07	50.00	50.00						
6/6/2018	9:23:29	0.99	3.47	4.49	0.07	50.00	50.00						
6/6/2018	9:23:39	0.96	2.98	4.49	0.07	50.00	50.00						
6/6/2018	9:23:49	0.93	2.24	4.44	0.07	50.00	50.00						
6/6/2018	9:23:59	0.90	1.21	4.10	0.07	50.00	50.00						
6/6/2018	9:24:09	0.91	0.54	3.87	0.08	50.00	50.00						
6/6/2018	9:24:19	0.94	0.44	3.92	0.08	50.00	50.00						
6/6/2018	9:24:29	0.87	0.56	6.08	0.09	50.00	50.00						
6/6/2018	9:24:39	0.72	2.25	4.50	0.08	50.00	50.00						
6/6/2018	9:24:49	0.66	3.09	3.97	0.07	50.00	50.00						
6/6/2018	9:24:59	0.64	2.55	3.79	0.08	50.00	50.00						
6/6/2018	9:25:09	0.61	1.80	4.99	0.08	50.00	50.00						Alt 106
6/6/2018	9:25:19	0.60	0.63	9.53	0.08	50.00	50.00						50.00
6/6/2018	9:25:29	0.60	0.28	12.80	0.10	50.00	50.00						
6/6/2018	9:25:39	0.58	0.08	14.35	0.10	50.00	50.00						
6/6/2018	9:25:49	0.57	1.57	14.19	0.10	7.47	14.13						
6/6/2018	9:25:59	0.57	3.01	12.51	0.10	2.74	10.14						
6/6/2018	9:26:09	0.57	2.68	9.40	0.08	2.74	10.14						
6/6/2018	9:26:19	0.57	2.44	5.48	0.07	2.74	10.14						
6/6/2018	9:26:29	0.57	1.04	5.34	0.06	2.74	10.14						
6/6/2018	9:26:39	0.57	0.64	4.96	0.06	2.74	10.14						
6/6/2018	9:26:49	0.59	-0.10	4.62	0.07	2.74	10.14						

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4
6/6/2018	9:26:59	0.62	0.21	4.53	0.06	1.10	5.15						
6/6/2018	9:27:09	0.65	1.99	4.50	0.06	0.01	1.83						
6/6/2018	9:27:19	0.66	3.20	4.50	0.07	0.01	1.83						
6/6/2018	9:27:29	0.66	2.98	4.49	0.07	0.01	1.83						
6/6/2018	9:27:39	0.66	1.77	4.49	0.07	0.01	1.83					0.01	
6/6/2018	9:27:49	0.66	1.18	4.49	0.07	0.01	1.83						
6/6/2018	9:27:59	0.66	0.37	4.49	0.07	0.01	1.83						
6/6/2018	9:28:09	0.66	-0.13	4.49	0.06	6.35	1.35						
6/6/2018	9:28:19	0.66	0.29	4.49	0.07	21.16	0.23						
6/6/2018	9:28:29	0.66	2.03	4.50	0.06	21.16	0.23						
6/6/2018	9:28:39	0.66	2.95	4.49	0.07	21.16	0.23						
6/6/2018	9:28:49	0.66	2.73	4.32	0.07	21.16	0.23						
6/6/2018	9:28:59	0.66	1.32	3.27	0.06	21.16	0.23						
6/6/2018	9:29:09	0.66	0.98	2.85	0.07	21.16	0.23						
6/6/2018	9:29:19	0.66	0.02	2.74	0.07	21.16	0.23						
6/6/2018	9:29:29	0.66	-0.42	2.70	0.08	21.17	0.24						
6/6/2018	9:29:39	0.66	0.52	2.69	0.07	21.17	0.24						
6/6/2018	9:29:49	0.66	2.04	2.68	0.07	21.17	0.24						
6/6/2018	9:29:59	0.66	3.07	2.68	0.07	21.17	0.24						
6/6/2018	9:30:09	0.66	2.71	2.68	0.07	21.17	0.24						
6/6/2018	9:30:19	0.66	1.85	2.68	0.08	21.17	0.24						
6/6/2018	9:30:29	0.66	0.78	2.68	0.08	21.17	0.24					21.17	
6/6/2018	9:30:39	0.64	0.34	2.68	0.08	15.19	0.21						
6/6/2018	9:30:49	0.65	-0.37	2.67	0.07	12.63	0.20						
6/6/2018	9:30:59	0.66	1.15	2.68	0.07	12.63	0.20						
6/6/2018	9:31:09	0.66	2.68	2.54	0.08	12.63	0.20						
6/6/2018	9:31:19	0.66	2.98	1.86	0.07	12.63	0.20						
6/6/2018	9:31:29	0.87	2.29	1.55	0.07	12.63	0.20						
6/6/2018	9:31:39	1.19	1.30	1.44	0.07	12.63	0.20						
6/6/2018	9:31:49	1.41	0.51	1.40	0.07	12.60	0.12						

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4
6/6/2018	9:31:59	1.55	0.20	1.38	0.07	12.55	-0.01						
6/6/2018	9:32:09	1.52	-0.26	1.38	0.07	12.55	-0.01						
6/6/2018	9:32:19	1.34	0.84	1.38	0.07	12.55	-0.01						
6/6/2018	9:32:29	1.21	2.64	1.38	0.07	12.55	-0.01					12.55	
6/6/2018	9:32:39	1.14	2.98	1.38	0.07	12.55	-0.01						
6/6/2018	9:32:49	1.08	2.07	1.37	0.07	12.55	-0.01						
6/6/2018	9:32:59	1.04	1.29	1.37	0.08	11.94	0.05						
6/6/2018	9:33:09	1.00	0.49	1.37	0.07	6.43	0.63						
6/6/2018	9:33:19	0.97	0.11	1.37	0.07	6.43	0.63						
6/6/2018	9:33:29	0.95	0.07	1.37	0.08	6.42	0.63						
6/6/2018	9:33:39	0.93	1.35	1.37	0.08	6.43	0.63						
6/6/2018	9:33:49	0.92	2.74	1.37	0.07	6.42	0.63						
6/6/2018	9:33:59	0.91	3.08	1.37	0.07	6.43	0.63						
6/6/2018	9:34:09	0.89	1.99	1.37	0.07	6.43	0.63						
6/6/2018	9:34:19	0.88	1.52	1.37	0.07	6.23	0.12						
6/6/2018	9:34:29	0.87	0.19	1.37	0.08	6.18	-0.01						
6/6/2018	9:34:39	0.85	0.10	1.36	0.08	6.18	-0.01						
6/6/2018	9:34:49	0.84	-0.12	1.36	0.08	6.18	-0.01					6.18	

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Run #1

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	
6/6/2018	9:42:06	5.50	137.82	19.73	0.75	0.36	
6/6/2018	9:43:06	5.57	141.03	19.74	0.75	0.55	
6/6/2018	9:44:06	5.58	139.89	19.74	0.76	0.57	Stratification check
6/6/2018	9:45:06	5.57	138.14	19.73	0.76	0.58	
6/6/2018	9:46:06	5.61	137.89	19.73	0.76	0.37	
6/6/2018	9:47:06	5.59	136.77	19.74	0.76	0.28	
6/6/2018	9:48:06	5.60	135.69	19.74	0.76	0.35	
6/6/2018	9:49:06	5.61	134.25	19.75	0.76	0.14	
6/6/2018	9:50:06	5.62	135.51	19.74	0.76	0.54	19.74
6/6/2018	9:51:06	5.65	136.40	19.73	0.75	0.45	
6/6/2018	9:52:06	5.67	137.50	19.73	0.75	0.33	
6/6/2018	9:53:06	5.74	139.60	19.74	0.75	0.31	
6/6/2018	9:54:06	5.74	140.49	19.74	0.75	0.43	
6/6/2018	9:55:06	5.75	139.35	19.74	0.75	0.55	19.74
6/6/2018	9:56:06	5.74	137.26	19.73	0.74	0.53	
6/6/2018	9:57:06	5.72	137.84	19.73	0.74	0.50	
6/6/2018	9:58:06	5.69	136.57	19.73	0.74	0.50	
6/6/2018	9:59:06	5.68	134.89	19.74	0.74	0.52	
6/6/2018	10:00:06	5.71	136.86	19.74	0.75	0.57	19.74
6/6/2018	10:01:06	5.73	137.46	19.73	0.75	0.45	
6/6/2018	10:02:06	5.73	136.59	19.72	0.74	0.53	
6/6/2018	10:03:06	5.73	137.23	19.72	0.74	0.58	
6/6/2018	10:04:06	5.75	137.48	19.73	0.75	0.57	
6/6/2018	10:05:06	5.72	136.12	19.73	0.74	0.54	
6/6/2018	10:06:06	5.74	136.82	19.73	0.75	0.53	
6/6/2018	10:07:06	5.77	137.77	19.72	0.75	0.50	
6/6/2018	10:08:06	5.78	138.61	19.72	0.75	0.51	
6/6/2018	10:09:06	5.75	137.07	19.72	0.76	0.51	
6/6/2018	10:10:06	5.76	137.45	19.73	0.76	0.51	
6/6/2018	10:11:06	5.76	137.24	19.72	0.75	0.49	
6/6/2018	10:12:06	5.80	138.49	19.71	0.75	0.14	
6/6/2018	10:13:06	5.82	139.61	19.71	0.76	0.15	
6/6/2018	10:14:06	5.79	137.65	19.71	0.76	0.37	
6/6/2018	10:15:06	5.79	138.34	19.71	0.76	0.50	
6/6/2018	10:16:06	5.76	137.65	19.72	0.75	0.46	
6/6/2018	10:17:06	5.67	136.29	19.71	0.75	0.44	
6/6/2018	10:18:06	5.66	138.05	19.70	0.75	0.54	
6/6/2018	10:19:06	5.67	137.19	19.70	0.74	0.50	
6/6/2018	10:20:06	5.68	136.46	19.71	0.74	0.48	
6/6/2018	10:21:06	5.70	138.34	19.71	0.74	0.48	
6/6/2018	10:22:06	5.68	137.67	19.71	0.74	0.49	

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	10:23:06	5.68	138.40	19.70	0.74	0.50
6/6/2018	10:24:06	5.67	137.28	19.69	0.74	0.49
6/6/2018	10:25:06	5.65	135.70	19.69	0.74	0.50
6/6/2018	10:26:06	5.71	137.89	19.69	0.74	0.32
6/6/2018	10:27:06	5.72	136.55	19.70	0.74	0.17
6/6/2018	10:28:06	5.73	135.71	19.69	0.75	0.54
6/6/2018	10:29:06	5.66	135.68	19.68	0.75	0.44
6/6/2018	10:30:06	5.67	134.87	19.68	0.75	0.50
6/6/2018	10:31:06	5.73	136.82	19.68	0.75	0.51
6/6/2018	10:32:06	5.73	136.47	19.69	0.75	0.35
6/6/2018	10:33:06	5.74	136.09	19.69	0.76	0.08
6/6/2018	10:34:06	5.76	138.49	19.68	0.76	0.18
6/6/2018	10:35:06	5.83	140.29	19.67	0.75	0.14
6/6/2018	10:36:06	5.85	140.54	19.68	0.76	0.38
6/6/2018	10:37:06	5.83	140.48	19.68	0.75	0.29
6/6/2018	10:38:06	5.79	136.96	19.68	0.75	0.12
6/6/2018	10:39:06	5.76	137.32	19.68	0.75	0.22
6/6/2018	10:40:06	5.75	136.10	19.67	0.75	0.39
6/6/2018	10:41:06	5.76	136.02	19.67	0.74	0.16
6/6/2018	10:42:06	5.73	136.82	19.68	0.74	0.11
6/6/2018	10:43:06	5.76	134.97	19.68	0.74	0.11
6/6/2018	10:44:06	5.98	135.76	19.69	0.74	0.17
6/6/2018	10:45:06	6.11	135.45	19.69	0.74	0.43
6/6/2018	10:46:06	6.21	134.67	19.68	0.74	0.15
6/6/2018	10:47:06	5.91	129.92	19.85	0.64	0.12
6/6/2018	10:48:06	5.06	118.50	19.72	0.72	0.06
6/6/2018	10:49:06	5.87	135.93	19.69	0.73	0.05
6/6/2018	10:50:06	5.80	136.64	19.69	0.74	0.15
6/6/2018	10:51:06	5.80	136.03	19.69	0.74	0.09
6/6/2018	10:52:06	5.79	138.37	19.67	0.74	0.02
6/6/2018	10:53:06	5.76	136.58	19.68	0.74	0.01
6/6/2018	10:54:06	5.76	136.13	19.68	0.74	0.01
6/6/2018	10:55:06	5.73	136.01	19.68	0.75	0.09
6/6/2018	10:56:06	5.75	135.25	19.69	0.75	0.36
6/6/2018	10:57:06	5.76	137.56	19.68	0.75	0.24
6/6/2018	10:58:06	5.79	136.19	19.68	0.75	0.05
6/6/2018	10:59:06	5.82	136.37	19.68	0.75	0.08
6/6/2018	11:00:06	5.80	137.11	19.68	0.75	0.12
6/6/2018	11:01:06	5.76	136.08	19.69	0.74	0.10
6/6/2018	11:02:06	5.76	138.22	19.69	0.75	0.13
6/6/2018	11:03:06	5.78	137.40	19.68	0.74	0.17

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	11:04:06	5.78	137.73	19.68	0.74	0.17
6/6/2018	11:05:06	5.77	137.00	19.69	0.74	0.14
6/6/2018	11:06:06	5.72	133.49	19.69	0.73	0.11
6/6/2018	11:07:06	5.71	134.79	19.70	0.73	0.10
6/6/2018	11:08:06	5.73	134.58	19.70	0.73	0.23
6/6/2018	11:09:06	5.73	135.10	19.67	0.73	0.14
6/6/2018	11:10:06	5.74	136.31	19.67	0.73	0.13
6/6/2018	11:11:06	5.76	136.38	19.67	0.73	0.21
6/6/2018	11:12:06	5.78	138.39	19.68	0.73	0.28
6/6/2018	11:13:06	5.74	135.97	19.68	0.73	0.10
6/6/2018	11:14:06	5.71	136.01	19.67	0.74	0.09
6/6/2018	11:15:06	5.71	136.87	19.67	0.74	0.11
6/6/2018	11:16:06	5.69	134.88	19.67	0.74	0.05
6/6/2018	11:17:06	5.67	136.10	19.67	0.74	0.06
6/6/2018	11:18:06	5.68	135.77	19.68	0.75	0.16
6/6/2018	11:19:06	5.71	134.82	19.68	0.75	0.13
6/6/2018	11:20:06	5.67	136.00	19.67	0.75	0.46
6/6/2018	11:21:06	5.67	135.87	19.67	0.75	0.21
6/6/2018	11:22:06	5.68	135.45	19.67	0.74	0.20
6/6/2018	11:23:06	5.71	137.38	19.67	0.75	0.29
6/6/2018	11:24:06	5.72	136.96	19.67	0.75	0.07
6/6/2018	11:25:06	5.73	137.19	19.67	0.74	0.01
6/6/2018	11:26:06	5.68	136.46	19.66	0.74	0.16
6/6/2018	11:27:06	5.68	136.53	19.66	0.74	0.17
6/6/2018	11:28:06	5.67	136.26	19.66	0.73	0.13
6/6/2018	11:29:06	5.63	135.15	19.67	0.73	0.11
6/6/2018	11:30:06	5.63	134.29	19.67	0.73	0.15
6/6/2018	11:31:06	5.62	135.72	19.66	0.73	0.30
6/6/2018	11:32:06	5.64	136.08	19.66	0.73	0.37
6/6/2018	11:33:06	5.64	135.79	19.66	0.73	0.28
6/6/2018	11:34:06	5.66	137.70	19.67	0.73	0.27
6/6/2018	11:35:06	5.64	136.61	19.67	0.73	0.49
6/6/2018	11:36:06	5.61	134.47	19.67	0.73	0.39
6/6/2018	11:37:06	5.63	136.16	19.66	0.74	0.15
6/6/2018	11:38:06	5.61	135.54	19.66	0.74	0.05
6/6/2018	11:39:06	5.60	134.75	19.66	0.74	0.19
6/6/2018	11:40:06	5.61	136.23	19.67	0.75	0.45
6/6/2018	11:41:06	5.64	137.55	19.67	0.75	0.45
6/6/2018	11:42:06	5.68	139.85	19.66	0.75	0.01
6/6/2018	11:43:06	5.65	139.81	19.66	0.75	0.07
6/6/2018	11:44:06	5.65	138.08	19.66	0.75	0.13

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	11:45:06	5.63	136.84	19.67	0.74	0.16
6/6/2018	11:46:06	5.59	136.82	19.67	0.74	0.15
6/6/2018	11:47:06	5.57	134.63	19.67	0.74	0.13
6/6/2018	11:48:06	5.57	134.75	19.66	0.74	0.25
6/6/2018	11:49:06	5.54	134.92	19.66	0.74	0.19
	Final	**5.71**	**136.62**	**19.69**	**0.74**	**0.28**

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	11:51:16	5.55	135.45	19.67	0.73	0.12					
6/6/2018	11:51:26	5.55	134.35	19.67	0.73	0.13					
6/6/2018	11:51:36	5.55	134.04	19.67	0.74	0.13					
6/6/2018	11:51:46	5.55	133.82	19.67	0.73	0.14					
6/6/2018	11:51:56	5.56	133.75	19.67	0.73	0.17					
6/6/2018	11:52:06	5.58	135.02	19.68	0.73	0.17					
6/6/2018	11:52:16	5.58	136.92	19.67	0.73	0.17					
6/6/2018	11:52:26	5.56	137.95	19.67	0.73	0.17					
6/6/2018	11:52:36	5.59	137.63	19.68	0.73	0.17					
6/6/2018	11:52:46	5.61	136.26	19.69	0.73	0.17					
6/6/2018	11:52:56	5.61	135.34	19.69	0.73	0.17					
6/6/2018	11:53:06	5.59	135.02	19.67	0.73	0.18					
6/6/2018	11:53:16	5.61	134.76	19.68	0.73	0.18					
6/6/2018	11:53:26	5.61	134.91	19.68	0.73	0.18					
6/6/2018	11:53:36	5.61	135.75	19.68	0.74	0.18					
6/6/2018	11:53:46	5.62	137.44	19.67	0.73	0.18					
6/6/2018	11:53:56	5.65	138.54	19.66	0.73	0.18					
6/6/2018	11:54:06	5.66	138.02	19.67	0.73	0.18					
6/6/2018	11:54:16	5.63	136.97	19.67	0.73	0.38					
6/6/2018	11:54:26	5.61	136.16	19.66	0.73	0.4					
6/6/2018	11:54:36	5.61	135.24	19.67	0.73	0.4					
6/6/2018	11:54:46	5.61	134.76	19.66	0.73	0.4					
6/6/2018	11:54:56	5.61	134.65	19.66	0.73	0.4					
6/6/2018	11:55:06	5.61	135.52	19.66	0.73	0.4					
6/6/2018	11:55:16	5.61	137.45	19.67	0.73	0.4					
6/6/2018	11:55:26	5.61	138.48	19.67	0.74	0.36					
6/6/2018	11:55:36	5.62	138.03	19.66	0.74	0.33					
6/6/2018	11:55:46	5.64	136.78	19.67	0.74	0.33					
6/6/2018	11:55:56	5.64	135.52	19.67	0.74	0.33					
6/6/2018	11:56:06	5.62	134.92	19.67	0.74	0.33					
6/6/2018	11:56:16	5.64	134.67	19.67	0.73	0.33					
6/6/2018	11:56:26	5.64	134.22	19.67	0.73	0.33					
6/6/2018	11:56:36	5.61	134.6	19.67	0.73	0.36					
6/6/2018	11:56:46	5.59	136.39	19.67	0.73	0.44					
6/6/2018	11:56:56	5.61	137.8	19.67	0.73	0.44					
6/6/2018	11:57:06	5.61	137.7	19.67	0.73	0.44					
6/6/2018	11:57:16	5.61	136.58	19.67	0.73	0.44					
6/6/2018	11:57:26	5.59	135.64	19.68	0.74	0.44					
6/6/2018	11:57:36	5.61	135.17	19.68	0.74	0.44					
6/6/2018	11:57:46	5.61	134.73	19.69	0.73	0.44					
6/6/2018	11:57:56	5.61	134.51	16.63	0.63	0.41					
6/6/2018	11:58:06	5.57	129.56	7.06	0.31	0.41					
6/6/2018	11:58:16	5.54	111.31	3.13	0.16	0.41					
6/6/2018	11:58:26	5.4	80.64	1.98	0.1	0.41					
6/6/2018	11:58:36	4.34	48.69	1.68	0.11	0.41					
6/6/2018	11:58:46	3.26	25.59	2.22	0.08	0.41					
6/6/2018	11:58:56	2.35	13.28	2.56	0.07	0.41					
6/6/2018	11:59:06	1.54	6.82	2.62	0.07	0.45					
6/6/2018	11:59:16	1.32	2.99	2.64	0.07	0.47					
6/6/2018	11:59:26	1.12	0.86	2.65	0.07	0.47					
6/6/2018	11:59:36	1.03	-0.29	2.65	0.07	0.47					
6/6/2018	11:59:46	0.95	-0.02	2.65	0.07	0.47					
6/6/2018	11:59:56	0.92	1.36	2.65	0.07	0.47					

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	12:00:06	0.89	1.78	2.66	0.07	0.47					
6/6/2018	12:00:16	0.89	1.15	2.66	0.07	5.07					
6/6/2018	12:00:26	0.87	0.22	2.66	0.07	11.97					
6/6/2018	12:00:36	0.87	-0.34	2.66	0.07	11.97					
6/6/2018	12:00:46	0.84	-0.89	2.66	0.07	11.97					
6/6/2018	12:00:56	0.84	-1.23	2.66	0.06	11.97					
6/6/2018	12:01:06	0.84	-1.22	2.66	0.07	11.97					
6/6/2018	12:01:16	0.81	-0.51	2.66	0.07	11.97					
6/6/2018	12:01:26	0.81	1.25	2.66	0.08	12.01					
6/6/2018	12:01:36	0.8	1.54	2.66	0.08	12.37					
6/6/2018	12:01:46	0.78	0.85	2.66	0.07	12.37					
6/6/2018	12:01:56	0.78	0.15	2.66	0.08	12.37					
6/6/2018	12:02:06	0.78	-0.58	2.67	0.07	12.37					
6/6/2018	12:02:16	0.78	-1.25	2.66	0.08	12.37					
6/6/2018	12:02:26	0.78	-1.53	2.62	0.08	12.37					
6/6/2018	12:02:36	0.77	-1.33	1.54	0.08	12.37					
6/6/2018	12:02:46	0.75	-0.11	0.6	0.07	12.43					
6/6/2018	12:02:56	0.75	1.07	0.27	0.07	12.45					
6/6/2018	12:03:06	0.72	1.36	0.16	0.08	12.45					
6/6/2018	12:03:16	0.68	0.69	0.13	0.08	12.45					
6/6/2018	12:03:26	0.66	-0.18	0.11	0.08	12.45					12.45
6/6/2018	12:03:36	0.66	-0.7	0.11	0.07	12.45					
6/6/2018	12:03:46	0.63	-1.16	0.1	0.08	12.45					
6/6/2018	12:03:56	0.63	-1.51	0.1	0.08	7.36					
6/6/2018	12:04:06	0.63	-1.29	0.1	0.08	2.28					
6/6/2018	12:04:16	0.63	-0.38	0.1	0.08	2.28					
6/6/2018	12:04:26	0.63	1.19	0.1	0.08	2.28					
6/6/2018	12:04:36	0.63	1.64	0.1	0.08	2.28					
6/6/2018	12:04:46	0.63	0.78	0.1	0.08	2.28					
6/6/2018	12:04:56	0.63	-0.23	0.09	0.08	2.28					
6/6/2018	12:05:06	0.63	-0.68	0.09	0.07	1.82					
6/6/2018	12:05:16	0.63	-1.22	0.1	0.09	0.01					
6/6/2018	12:05:26	0.63	-1.57	0.09	0.09	0.01					
6/6/2018	12:05:36	0.63	-1.52	0.09	0.08	0.01					
6/6/2018	12:05:46	0.63	-0.27	0.09	0.07	0.01					
6/6/2018	12:05:56	0.63	1.17	0.09	0.07	0.01					
6/6/2018	12:06:06	0.63	1.23	0.09	0.08	0.01	0.63	0.71	0.09	0.07	0.01
6/6/2018	12:06:16	0.63	0.51	3.71	0.2	0.01					
6/6/2018	12:06:26	0.66	4.9	10.57	0.46	0.01					
6/6/2018	12:06:36	0.77	19.74	8.03	0.95	0.01					
6/6/2018	12:06:46	0.92	36.66	8.89	6.04	0.01					
6/6/2018	12:06:56	1.83	40.89	9.61	8.47	0.01					
6/6/2018	12:07:06	2.58	32.4	9.83	9.3	0.01					
6/6/2018	12:07:16	2.02	20.64	9.9	9.59	0.01					
6/6/2018	12:07:26	1.52	11.53	9.93	9.7	0.01					
6/6/2018	12:07:36	1.18	4.96	9.95	9.74	0.09					
6/6/2018	12:07:46	0.86	1.09	9.95	9.76	0.15					
6/6/2018	12:07:56	0.79	-1.12	9.95	9.77	0.15					
6/6/2018	12:08:06	0.72	-2.17	9.96	9.77	0.15					
6/6/2018	12:08:16	0.71	-2.71	9.96	9.78	0.15					
6/6/2018	12:08:26	0.69	-3.16	9.96	9.79	0.15			9.96		
6/6/2018	12:08:36	0.69	-2.9	9.96	9.79	0.15					
6/6/2018	12:08:46	0.69	-1.4	12.13	7.87	0.11					

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	12:08:56	0.68	5.75	15.37	4.89	0.01					
6/6/2018	12:09:06	0.86	23.44	12.07	3.19	0.01					
6/6/2018	12:09:16	2.01	43.58	4.74	1.24	0.01					
6/6/2018	12:09:26	2.77	50.04	2.48	1.02	0.01					
6/6/2018	12:09:36	2.16	40.21	2.21	1.65	0.01					
6/6/2018	12:09:46	1.7	24.19	2.11	1.82	0.01					
6/6/2018	12:09:56	1.27	11.12	2.07	1.91	0.01					
6/6/2018	12:10:06	0.83	4.16	2.06	1.94	0.01					
6/6/2018	12:10:16	0.76	2.25	2.05	1.95	0.01					
6/6/2018	12:10:26	0.66	2.15	2.06	1.95	0.01					
6/6/2018	12:10:36	0.66	1.05	2.05	1.95	0.01					
6/6/2018	12:10:46	0.66	-0.08	2.06	1.95	0.01					
6/6/2018	12:10:56	0.66	-1.18	2.05	1.95	0.01				1.95	
6/6/2018	12:11:06	0.66	-1.51	2.06	1.95	0.01					
6/6/2018	12:11:16	0.63	-1.62	6.61	1.66	0.01					
6/6/2018	12:11:26	0.7	4.03	6.81	1.53	0.01					
6/6/2018	12:11:36	1.03	16.62	2.68	0.78	0.01					
6/6/2018	12:11:46	1.84	26.25	0.97	0.36	0.01					
6/6/2018	12:11:56	5.07	26.62	0.39	0.19	0.01					
6/6/2018	12:12:06	7.96	20.73	0.21	0.13	0.01					
6/6/2018	12:12:16	9.38	14.88	0.14	0.11	0.01					
6/6/2018	12:12:26	10.52	11.77	0.11	0.1	0.01					
6/6/2018	12:12:36	11.01	10.17	0.1	0.09	0.01					
6/6/2018	12:12:46	11.49	9.3	0.1	0.09	0.01					
6/6/2018	12:12:56	11.62	8.98	0.09	0.09	0.01					
6/6/2018	12:13:06	11.76	9.57	0.1	0.08	0.01					
6/6/2018	12:13:16	11.74	11.34	0.09	0.08	0.01					
6/6/2018	12:13:26	11.71	11.81	0.1	0.08	0.01					
6/6/2018	12:13:36	11.6	11.19	0.09	0.08	0.01					
6/6/2018	12:13:46	11.5	10.46	0.09	0.09	0.01					
6/6/2018	12:13:56	11.39	9.77	0.09	0.08	0.01					
6/6/2018	12:14:06	11.29	9.08	0.09	0.08	0.01					
6/6/2018	12:14:16	11.18	8.65	0.09	0.07	0.01					
6/6/2018	12:14:26	11.09	8.9	0.09	0.07	0.01					
6/6/2018	12:14:36	11	10.07	0.09	0.07	0.01					
6/6/2018	12:14:46	10.91	11.45	0.09	0.08	0.01					
6/6/2018	12:14:56	10.82	11.84	0.09	0.07	0.01					
6/6/2018	12:15:06	10.71	11.18	0.09	0.07	0.01					
6/6/2018	12:15:16	10.65	10.29	0.09	0.07	0.01					
6/6/2018	12:15:26	10.56	9.59	0.09	0.07	0.01					
6/6/2018	12:15:36	10.47	9.21	0.09	0.07	0.01					
6/6/2018	12:15:46	10.39	8.81	0.09	0.07	0.01					
6/6/2018	12:15:56	10.33	8.69	0.09	0.07	0.01					
6/6/2018	12:16:06	10.27	9.38	0.08	0.06	0.01					
6/6/2018	12:16:16	10.21	11.09	0.08	0.07	0.01					
6/6/2018	12:16:26	10.15	11.98	0.09	0.07	0.01					
6/6/2018	12:16:36	10.1	11.47	0.08	0.06	0.01					
6/6/2018	12:16:46	10.05	10.5	0.08	0.07	0.01	10.10				
6/6/2018	12:16:56	10.01	9.61	0.08	0.07	0.01					
6/6/2018	12:17:06	9.96	9.17	1.69	0.12	0.01					
6/6/2018	12:17:16	9.92	11.23	5.17	0.27	0.01					
6/6/2018	12:17:26	10.03	19.91	2.06	0.14	0.01					
6/6/2018	12:17:36	10.53	34.17	6.68	0.31	0.01					

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	12:17:46	12.02	50.28	9.44	0.41	0.01					
6/6/2018	12:17:56	23.33	67.1	8.54	0.39	0.01					
6/6/2018	12:18:06	33.03	84.94	3.34	0.18	0.01					
6/6/2018	12:18:16	27.43	104.66	1.17	0.1	0.01					
6/6/2018	12:18:26	28.68	122.71	0.46	0.08	0.01					
6/6/2018	12:18:36	56.98	135.74	0.22	0.07	0.04					
6/6/2018	12:18:46	79.41	142.84	0.14	0.07	0.05					
6/6/2018	12:18:56	97.73	146.4	0.12	0.07	0.05					
6/6/2018	12:19:06	99.9	145.08	0.22	0.08	0.05					
6/6/2018	12:19:16	99.9	128.38	0.49	0.08	0.05					
6/6/2018	12:19:26	95.12	94.99	0.58	0.09	0.05					
6/6/2018	12:19:36	65.79	59.37	0.36	0.08	0.05					
6/6/2018	12:19:46	27.28	44.67	0.19	0.08	0.02					
6/6/2018	12:19:56	36.85	60.88	0.12	0.07	0.01					
6/6/2018	12:20:06	46.35	91.96	0.11	0.07	0.01					
6/6/2018	12:20:16	82.1	119.63	0.09	0.07	0.01					
6/6/2018	12:20:26	99.9	136.65	0.09	0.06	0.01					
6/6/2018	12:20:36	99.9	145.75	0.09	0.06	0.01					
6/6/2018	12:20:46	99.9	150.25	0.09	0.07	0.01					
6/6/2018	12:20:56	99.9	151.35	0.09	0.07	0.01					
6/6/2018	12:21:06	99.9	151	0.09	0.07	0.01					
6/6/2018	12:21:16	99.9	150.55	0.09	0.07	0.01					
6/6/2018	12:21:26	99.9	149.95	0.09	0.07	0.01		150.50			

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	12:30:32	5.62	137.36	19.66	0.74	0.49
6/6/2018	12:31:32	5.58	135.81	19.67	0.74	0.32
6/6/2018	12:32:32	5.60	138.24	19.67	0.74	0.30
6/6/2018	12:33:32	5.62	138.95	19.66	0.74	0.54
6/6/2018	12:34:32	5.57	136.57	19.68	0.73	0.49
6/6/2018	12:35:32	5.50	134.23	19.69	0.72	0.21
6/6/2018	12:36:32	5.52	135.71	19.69	0.73	0.06
6/6/2018	12:37:32	5.55	136.43	19.69	0.73	0.19
6/6/2018	12:38:32	5.53	134.86	19.69	0.73	0.39
6/6/2018	12:39:32	5.49	134.56	19.68	0.73	0.36
6/6/2018	12:40:32	5.48	133.60	19.67	0.74	0.41
6/6/2018	12:41:32	5.53	133.98	19.67	0.74	0.47
6/6/2018	12:42:32	5.55	135.63	19.67	0.75	0.51
6/6/2018	12:43:32	5.61	137.23	19.68	0.75	0.33
6/6/2018	12:44:32	5.61	136.39	19.67	0.76	0.07
6/6/2018	12:45:32	5.61	137.30	19.66	0.75	0.39
6/6/2018	12:46:32	5.63	138.68	19.66	0.75	0.02
6/6/2018	12:47:32	5.62	139.06	19.67	0.75	0.21
6/6/2018	12:48:32	5.61	139.11	19.67	0.75	0.40
6/6/2018	12:49:32	5.63	140.42	19.67	0.75	0.48
6/6/2018	12:50:32	5.61	137.06	19.66	0.75	0.39
6/6/2018	12:51:32	5.61	136.15	19.66	0.75	0.31
6/6/2018	12:52:32	5.61	138.70	19.67	0.75	0.45
6/6/2018	12:53:32	5.58	137.93	19.67	0.74	0.42
6/6/2018	12:54:32	5.59	135.94	19.67	0.74	0.41
6/6/2018	12:55:32	5.56	135.66	19.68	0.74	0.37
6/6/2018	12:56:32	5.59	136.49	19.66	0.74	0.15
6/6/2018	12:57:32	5.61	136.41	19.66	0.74	0.35
6/6/2018	12:58:32	5.63	137.49	19.67	0.74	0.47
6/6/2018	12:59:32	5.65	138.78	19.67	0.74	0.24
6/6/2018	13:00:32	5.59	136.17	19.68	0.73	0.18
6/6/2018	13:01:32	5.56	135.88	19.67	0.74	0.39
6/6/2018	13:02:32	5.58	137.89	19.66	0.74	0.10
6/6/2018	13:03:32	5.58	137.08	19.67	0.74	0.16
6/6/2018	13:04:32	5.58	136.11	19.67	0.75	0.31
6/6/2018	13:05:32	5.58	137.77	19.67	0.75	0.45
6/6/2018	13:06:32	5.59	137.53	19.67	0.75	0.44
6/6/2018	13:07:32	5.61	138.02	19.66	0.75	0.19
6/6/2018	13:08:32	5.64	140.00	19.65	0.76	0.45
6/6/2018	13:09:32	5.64	140.15	19.66	0.76	0.17
6/6/2018	13:10:32	5.61	137.13	19.66	0.76	0.13

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	13:11:32	5.58	136.73	19.67	0.76	0.25
6/6/2018	13:12:32	5.58	136.88	19.67	0.75	0.37
6/6/2018	13:13:32	5.57	135.20	19.66	0.75	0.19
6/6/2018	13:14:32	5.55	135.20	19.66	0.75	0.43
6/6/2018	13:15:32	5.58	137.61	19.66	0.75	0.41
6/6/2018	13:16:32	5.59	136.85	19.67	0.75	0.43
6/6/2018	13:17:32	5.62	137.32	19.67	0.74	0.34
6/6/2018	13:18:32	5.61	138.34	19.66	0.74	0.10
6/6/2018	13:19:32	5.61	137.83	19.66	0.74	0.11
6/6/2018	13:20:32	5.61	136.87	19.66	0.74	0.09
6/6/2018	13:21:32	5.60	137.84	19.66	0.74	0.23
6/6/2018	13:22:32	5.61	137.36	19.67	0.74	0.37
6/6/2018	13:23:32	5.60	135.34	19.67	0.74	0.35
6/6/2018	13:24:32	5.59	136.17	19.66	0.74	0.08
6/6/2018	13:25:32	5.58	137.26	19.66	0.74	0.44
6/6/2018	13:26:32	5.59	136.19	19.66	0.74	0.13
6/6/2018	13:27:32	5.56	135.40	19.66	0.75	0.24
6/6/2018	13:28:32	5.58	136.87	19.67	0.75	0.39
6/6/2018	13:29:32	5.59	136.28	19.66	0.76	0.38
6/6/2018	13:30:32	5.58	135.57	19.65	0.75	0.13
6/6/2018	13:31:32	5.58	137.54	19.66	0.76	0.33
6/6/2018	13:32:32	5.58	137.65	19.66	0.76	0.10
6/6/2018	13:33:32	5.63	137.78	19.66	0.76	0.16
6/6/2018	13:34:32	5.66	140.78	19.66	0.76	0.33
6/6/2018	13:35:32	5.67	140.51	19.66	0.75	0.37
6/6/2018	13:36:32	5.67	138.48	19.65	0.75	0.15
6/6/2018	13:37:32	5.67	140.07	19.65	0.75	0.34
6/6/2018	13:38:32	5.66	141.43	19.65	0.75	0.37
6/6/2018	13:39:32	5.62	139.78	19.66	0.75	0.38
6/6/2018	13:40:32	5.62	139.20	19.66	0.75	0.35
6/6/2018	13:41:32	5.64	140.55	19.66	0.74	0.22
6/6/2018	13:42:32	5.62	140.96	19.65	0.74	0.44
6/6/2018	13:43:32	5.61	139.94	19.65	0.74	0.46
6/6/2018	13:44:32	5.62	139.59	19.66	0.74	0.36
6/6/2018	13:45:32	5.59	138.30	19.66	0.74	0.32
6/6/2018	13:46:32	5.57	136.32	19.66	0.74	0.39
6/6/2018	13:47:32	5.58	136.04	19.65	0.75	0.24
6/6/2018	13:48:32	5.57	136.85	19.65	0.75	0.14
6/6/2018	13:49:32	5.58	136.64	19.66	0.75	0.10
6/6/2018	13:50:32	5.57	135.34	19.66	0.75	0.19
6/6/2018	13:51:32	5.62	137.66	19.66	0.75	0.31

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Run #2

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	13:52:32	5.66	140.25	19.66	0.75	0.31
6/6/2018	13:53:32	5.64	139.78	19.65	0.76	0.35
6/6/2018	13:54:32	5.66	139.58	19.65	0.76	0.39
6/6/2018	13:55:32	5.63	139.15	19.66	0.76	0.43
6/6/2018	13:56:32	5.64	138.52	19.66	0.76	0.41
6/6/2018	13:57:32	5.61	136.63	19.66	0.76	0.35
6/6/2018	13:58:32	5.59	136.59	19.65	0.76	0.41
6/6/2018	13:59:32	5.61	136.65	19.65	0.76	0.03
6/6/2018	14:00:32	5.61	135.36	19.65	0.75	0.26
6/6/2018	14:01:32	5.62	136.78	19.66	0.75	0.31
6/6/2018	14:02:32	5.62	137.12	19.66	0.75	0.26
6/6/2018	14:03:32	5.65	138.42	19.66	0.75	0.22
6/6/2018	14:04:32	5.69	140.03	19.65	0.75	0.14
6/6/2018	14:05:32	5.69	140.14	19.65	0.74	0.24
6/6/2018	14:06:32	5.70	139.36	19.65	0.74	0.32
6/6/2018	14:07:32	5.69	138.79	19.66	0.74	0.35
6/6/2018	14:08:32	5.65	138.72	19.66	0.74	0.36
6/6/2018	14:09:32	5.66	138.11	19.66	0.75	0.45
6/6/2018	14:10:32	5.65	137.03	19.65	0.75	0.13
6/6/2018	14:11:32	5.63	138.02	19.65	0.75	0.03
6/6/2018	14:12:32	5.64	138.62	19.65	0.75	0.22
6/6/2018	14:13:32	5.64	137.18	19.66	0.75	0.25
6/6/2018	14:14:32	5.63	137.87	19.67	0.76	0.03
6/6/2018	14:15:32	5.65	137.73	19.66	0.76	0.19
6/6/2018	14:16:32	5.65	137.16	19.65	0.76	0.26
6/6/2018	14:17:32	5.67	138.29	19.65	0.76	0.37
6/6/2018	14:18:32	5.65	138.95	19.66	0.76	0.33
6/6/2018	14:19:32	5.66	138.19	19.66	0.76	0.19
6/6/2018	14:20:32	5.69	138.70	19.67	0.76	0.07
6/6/2018	14:21:32	5.69	140.63	19.66	0.76	0.18
6/6/2018	14:22:32	5.70	139.60	19.66	0.76	0.18
6/6/2018	14:23:32	5.70	138.94	19.66	0.76	0.24
6/6/2018	14:24:32	5.71	139.94	19.66	0.75	0.20
6/6/2018	14:25:32	5.71	139.66	19.66	0.75	0.14
6/6/2018	14:26:32	5.71	139.00	19.66	0.75	0.36
6/6/2018	14:27:32	5.70	140.58	19.65	0.75	0.10
6/6/2018	14:28:32	5.67	139.83	19.65	0.75	0.04
6/6/2018	14:29:32	5.68	139.13	19.65	0.74	0.15
6/6/2018	14:30:32	5.62	136.52	19.66	0.74	0.28
6/6/2018	14:31:32	5.60	137.01	19.67	0.75	0.27
6/6/2018	14:32:32	5.60	135.50	19.66	0.74	0.10

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	14:33:32	5.60	135.90	19.65	0.75	0.10
6/6/2018	14:34:32	5.62	137.04	19.65	0.75	0.12
6/6/2018	14:35:32	5.64	135.88	19.65	0.75	0.13
6/6/2018	14:36:32	5.66	135.94	19.66	0.75	0.18
6/6/2018	14:37:32	5.62	136.67	19.67	0.75	0.35
6/6/2018	14:38:32	5.61	136.94	19.66	0.75	0.29
6/6/2018	14:39:32	5.61	135.47	19.66	0.76	0.17
	Final	**5.62**	**137.62**	**19.66**	**0.75**	**0.28**

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/6/2018	14:40:42	5.64	135.88	0.14	8.09	0.38					
6/6/2018	14:40:52	8.54	121.80	0.15	3.50	0.23					
6/6/2018	14:41:02	12.07	92.91	0.15	2.22	0.15					
6/6/2018	14:41:12	9.59	64.91	0.15	2.52	0.12					
6/6/2018	14:41:22	5.87	43.04	0.15	2.63	0.09					
6/6/2018	14:41:32	5.63	27.59	0.15	2.65	0.10					
6/6/2018	14:41:42	6.23	15.27	0.15	2.66	0.09					
6/6/2018	14:41:52	5.24	7.99	0.15	2.66	0.09					
6/6/2018	14:42:02	3.84	5.13	0.12	2.66	0.09					
6/6/2018	14:42:12	3.08	3.76	0.01	2.66	0.09					
6/6/2018	14:42:22	2.49	1.76	0.01	2.67	0.09					
6/6/2018	14:42:32	2.15	0.58	0.01	2.67	0.09					
6/6/2018	14:42:42	1.89	-0.60	0.01	2.67	0.09					
6/6/2018	14:42:52	1.73	-1.18	0.01	2.66	0.09					
6/6/2018	14:43:02	1.58	-1.65	0.01	2.67	0.09					
6/6/2018	14:43:12	1.48	-1.68	0.01	2.67	0.09					
6/6/2018	14:43:22	1.39	-0.68	10.98	2.67	0.09					
6/6/2018	14:43:32	1.32	0.75	12.20	2.67	0.09					
6/6/2018	14:43:42	1.26	1.47	12.20	2.68	0.09					
6/6/2018	14:43:52	1.20	0.67	12.20	2.67	0.09					
6/6/2018	14:44:02	1.17	-0.19	12.20	2.67	0.09					
6/6/2018	14:44:12	1.11	-0.84	12.20	2.68	0.09					
6/6/2018	14:44:22	1.08	-1.28	12.20	2.67	0.09					
6/6/2018	14:44:32	1.05	-1.92	12.24	2.67	0.09					
6/6/2018	14:44:42	1.02	-1.48	12.28	2.67	0.09					
6/6/2018	14:44:52	1.01	-0.37	12.28	2.67	0.09					
6/6/2018	14:45:02	0.99	1.09	12.28	2.67	0.09					
6/6/2018	14:45:12	0.96	1.91	12.28	6.65	0.26					
6/6/2018	14:45:22	0.93	5.94	12.27	4.53	0.22					
6/6/2018	14:45:32	1.59	14.93	12.28	1.59	0.13					
6/6/2018	14:45:42	2.37	17.77	12.30	0.60	0.10					
6/6/2018	14:45:52	1.89	13.37	12.34	0.27	0.09					
6/6/2018	14:46:02	1.16	6.46	12.34	0.17	0.09					
6/6/2018	14:46:12	0.90	2.15	12.34	0.13	0.09					
6/6/2018	14:46:22	0.73	1.42	12.34	0.12	0.09					
6/6/2018	14:46:32	0.67	1.81	12.34	0.11	0.08					
6/6/2018	14:46:42	0.64	1.45	12.35	0.11	0.08					
6/6/2018	14:46:52	0.63	0.49	12.34	0.11	0.09			12.34		
6/6/2018	14:47:02	0.63	-0.51	0.22	0.10	0.09					
6/6/2018	14:47:12	0.63	-1.73	0.22	0.11	0.08					
6/6/2018	14:47:22	0.63	-1.49	0.22	0.11	0.09					
6/6/2018	14:47:32	0.63	-1.84	0.22	0.11	0.08					
6/6/2018	14:47:42	0.61	-1.49	0.22	0.10	0.08					
6/6/2018	14:47:52	0.60	-0.05	0.22	0.11	0.09					
6/6/2018	14:48:02	0.60	1.10	0.22	0.10	0.08					
6/6/2018	14:48:12	0.60	0.64	0.07	0.10	0.08					
6/6/2018	14:48:22	0.60	0.05	0.01	0.10	0.09	0.60	0.60	0.10	0.10	0.08
6/6/2018	14:48:32	0.60	-0.88	0.01	0.32	0.09					
6/6/2018	14:48:42	0.60	-0.24	0.01	8.39	0.39					
6/6/2018	14:48:52	0.63	8.96	0.01	12.07	0.51					
6/6/2018	14:49:02	0.51	32.87	0.01	11.23	0.48					
6/6/2018	14:49:12	1.66	57.40	0.01	8.16	3.11					

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6/6/2018	14:49:22	3.27	64.62	0.01	9.41	7.58					
6/6/2018	14:49:32	3.62	52.87	0.01	9.78	8.99					
6/6/2018	14:49:42	3.69	32.98	0.01	9.91	9.47					
6/6/2018	14:49:52	2.81	16.91	0.01	9.94	9.65					
6/6/2018	14:50:02	1.64	6.76	0.01	9.96	9.71					
6/6/2018	14:50:12	1.21	0.96	0.01	9.96	9.73					
6/6/2018	14:50:22	0.95	-1.50	0.01	9.97	9.74					
6/6/2018	14:50:32	0.85	-2.53	0.01	9.97	9.75					
6/6/2018	14:50:42	0.81	-1.92	0.05	9.97	9.77					
6/6/2018	14:50:52	0.78	-0.34	0.05	9.97	9.76					
6/6/2018	14:51:02	0.76	-0.35	0.05	9.97	9.76					
6/6/2018	14:51:12	0.75	-1.34	0.05	9.97	9.77				9.97	
6/6/2018	14:51:22	0.73	-2.04	0.05	9.98	9.77					
6/6/2018	14:51:32	0.72	-2.87	0.05	9.97	9.78					
6/6/2018	14:51:42	0.72	-3.34	0.05	9.97	9.78					
6/6/2018	14:51:52	0.70	-3.52	0.01	9.97	9.77					
6/6/2018	14:52:02	0.69	-2.85	0.01	12.22	7.56					
6/6/2018	14:52:12	0.69	3.52	0.01	7.84	3.69					
6/6/2018	14:52:22	0.62	16.81	0.01	3.20	1.32					
6/6/2018	14:52:32	0.91	22.78	0.01	2.06	1.20					
6/6/2018	14:52:42	1.44	19.53	0.01	2.08	1.72					
6/6/2018	14:52:52	1.31	11.73	0.01	2.07	1.86					
6/6/2018	14:53:02	0.97	4.90	0.01	2.06	1.92					
6/6/2018	14:53:12	0.83	0.68	0.01	2.06	1.94					
6/6/2018	14:53:22	0.71	-1.25	0.01	2.06	1.94					
6/6/2018	14:53:32	0.67	-1.82	0.01	2.06	1.95					
6/6/2018	14:53:42	0.66	-1.17	0.01	2.06	1.96					
6/6/2018	14:53:52	0.64	0.50	0.01	2.07	1.96					1.96
6/6/2018	14:54:02	0.63	0.36	0.01	2.06	1.95					
6/6/2018	14:54:12	0.63	-0.20	0.01	2.99	1.90					
6/6/2018	14:54:22	0.63	0.88	0.01	10.00	1.48					
6/6/2018	14:54:32	0.75	12.12	0.01	5.99	1.27					
6/6/2018	14:54:42	0.78	30.31	0.01	2.14	0.60					
6/6/2018	14:54:52	5.96	39.61	0.01	0.77	0.29					
6/6/2018	14:55:02	12.36	36.19	0.01	0.32	0.17					
6/6/2018	14:55:12	13.42	26.88	0.01	0.18	0.12					
6/6/2018	14:55:22	13.22	19.81	0.01	0.13	0.10					
6/6/2018	14:55:32	12.90	15.22	0.01	0.12	0.10					
6/6/2018	14:55:42	12.64	12.43	0.01	0.11	0.10					
6/6/2018	14:55:52	12.44	10.65	0.01	0.11	0.09					
6/6/2018	14:56:02	12.31	9.46	0.01	0.11	0.09					
6/6/2018	14:56:12	12.20	8.82	0.01	0.10	0.10					
6/6/2018	14:56:22	12.06	8.79	0.01	0.10	0.10					
6/6/2018	14:56:32	11.93	9.19	0.01	0.10	0.09					
6/6/2018	14:56:42	11.82	10.90	0.01	0.10	0.09					
6/6/2018	14:56:52	11.68	11.44	0.01	0.10	0.09					
6/6/2018	14:57:02	11.55	11.08	0.01	0.10	0.09					
6/6/2018	14:57:12	11.43	10.25	0.01	0.10	0.09					
6/6/2018	14:57:22	11.34	9.28	0.01	0.10	0.09					
6/6/2018	14:57:32	11.25	9.06	0.01	0.10	0.08					
6/6/2018	14:57:42	11.13	8.65	0.01	0.09	0.09					
6/6/2018	14:57:52	11.04	8.89	0.01	0.10	0.08					

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/6/2018	14:58:02	10.92	9.77	0.01	0.10	0.08					
6/6/2018	14:58:12	10.86	11.58	0.01	0.10	0.09					
6/6/2018	14:58:22	10.82	11.62	0.01	0.10	0.08					
6/6/2018	14:58:32	10.72	10.93	0.01	0.10	0.08					
6/6/2018	14:58:42	10.60	9.76	0.01	0.09	0.09					
6/6/2018	14:58:52	10.51	9.15	0.01	0.10	0.08					
6/6/2018	14:59:02	10.44	8.65	0.01	0.09	0.07					
6/6/2018	14:59:12	10.38	8.52	0.01	0.09	0.08					
6/6/2018	14:59:22	10.32	8.94	0.01	0.09	0.08					
6/6/2018	14:59:32	10.24	10.42	0.01	0.09	0.08					
6/6/2018	14:59:42	10.17	11.76	0.01	0.09	0.09					
6/6/2018	14:59:52	10.12	11.55	0.01	0.09	0.08					
6/6/2018	15:00:02	10.09	10.23	0.01	0.09	0.09					
6/6/2018	15:00:12	10.06	9.79	0.01	0.09	0.08					
6/6/2018	15:00:22	10.03	9.03	0.01	0.09	0.09					
6/6/2018	15:00:32	10.00	8.47	0.01	0.09	0.08					
6/6/2018	15:00:42	9.95	8.55	0.01	0.09	0.08					
6/6/2018	15:00:52	9.97	8.86	0.01	0.09	0.09					
6/6/2018	15:01:02	9.96	10.40	0.01	0.09	0.09	9.96				
6/6/2018	15:01:12	9.95	11.65	0.01	0.09	0.09					
6/6/2018	15:01:22	9.97	11.41	0.01	0.58	0.09					
6/6/2018	15:01:32	9.76	11.91	0.01	8.83	0.41					
6/6/2018	15:01:42	9.75	21.26	0.01	12.78	0.54					
6/6/2018	15:01:52	8.85	44.88	0.01	6.62	0.33					
6/6/2018	15:02:02	7.84	74.07	0.01	2.25	0.16					
6/6/2018	15:02:12	18.44	101.77	0.01	0.80	0.11					
6/6/2018	15:02:22	29.65	123.55	0.01	0.33	0.09					
6/6/2018	15:02:32	61.40	138.52	0.01	0.18	0.09					
6/6/2018	15:02:42	93.68	146.77	0.03	0.13	0.09					
6/6/2018	15:02:52	99.90	149.11	0.22	0.11	0.09					
6/6/2018	15:03:02	99.90	142.33	0.22	0.28	0.10					
6/6/2018	15:03:12	99.90	118.69	0.22	0.50	0.10					
6/6/2018	15:03:22	94.85	82.14	0.22	0.57	0.10					
6/6/2018	15:03:32	63.66	47.11	0.22	0.60	0.11					
6/6/2018	15:03:42	22.49	24.12	0.22	0.55	0.11					
6/6/2018	15:03:52	10.11	16.82	0.22	0.29	0.10					
6/6/2018	15:04:02	2.83	31.91	0.05	0.16	0.10					
6/6/2018	15:04:12	37.04	66.98	0.01	0.12	0.09					
6/6/2018	15:04:22	78.01	102.93	0.01	0.10	0.09					
6/6/2018	15:04:32	97.12	127.51	0.01	0.10	0.09					
6/6/2018	15:04:42	99.90	139.66	0.01	0.10	0.09					
6/6/2018	15:04:52	99.90	144.63	0.01	0.10	0.09					
6/6/2018	15:05:02	99.90	146.68	0.01	0.09	0.09					
6/6/2018	15:05:12	99.90	148.39	0.01	0.10	0.09					
6/6/2018	15:05:22	99.90	150.40	0.01	0.09	0.09					
6/6/2018	15:05:32	99.90	152.32	0.01	0.10	0.09					
6/6/2018	15:05:42	99.90	153.18	0.01	0.09	0.09					
6/6/2018	15:05:52	99.90	151.93	0.01	0.10	0.10					
6/6/2018	15:06:02	99.90	150.93	0.01	0.10	0.09					
6/6/2018	15:06:12	99.90	150.03	0.01	0.10	0.09					
6/6/2018	15:06:22	99.90	149.77	0.01	0.09	0.09		150.24			

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	15:15:51	5.64	137.02	19.65	0.76	0.33
6/6/2018	15:16:51	5.66	138.75	19.65	0.76	0.24
6/6/2018	15:17:51	5.67	138.06	19.66	0.76	0.09
6/6/2018	15:18:51	5.67	138.22	19.66	0.76	0.13
6/6/2018	15:19:51	5.66	139.82	19.65	0.76	0.29
6/6/2018	15:20:51	5.64	137.38	19.65	0.76	0.31
6/6/2018	15:21:51	5.65	136.50	19.66	0.75	0.39
6/6/2018	15:22:51	5.66	138.10	19.66	0.75	0.44
6/6/2018	15:23:51	5.66	137.69	19.66	0.75	0.42
6/6/2018	15:24:51	5.65	136.15	19.66	0.75	0.37
6/6/2018	15:25:51	5.66	137.44	19.65	0.74	0.37
6/6/2018	15:26:51	5.67	138.68	19.65	0.75	0.38
6/6/2018	15:27:51	5.67	138.09	19.65	0.75	0.22
6/6/2018	15:28:51	5.66	137.94	19.66	0.75	0.06
6/6/2018	15:29:51	5.67	138.42	19.66	0.75	0.23
6/6/2018	15:30:51	5.67	137.69	19.65	0.75	0.20
6/6/2018	15:31:51	5.64	137.07	19.64	0.75	0.06
6/6/2018	15:32:51	5.64	137.49	19.64	0.75	0.13
6/6/2018	15:33:51	5.64	136.95	19.65	0.75	0.24
6/6/2018	15:34:51	5.63	136.60	19.65	0.76	0.31
6/6/2018	15:35:51	5.64	137.65	19.66	0.76	0.32
6/6/2018	15:36:51	5.63	138.64	19.65	0.76	0.03
6/6/2018	15:37:51	5.64	137.44	19.65	0.76	0.01
6/6/2018	15:38:51	5.60	136.72	19.65	0.76	0.01
6/6/2018	15:39:51	5.58	137.59	19.65	0.76	0.01
6/6/2018	15:40:51	5.58	137.06	19.66	0.76	0.02
6/6/2018	15:41:51	5.59	137.06	19.65	0.76	0.14
6/6/2018	15:42:51	5.58	137.24	19.64	0.76	0.11
6/6/2018	15:43:51	5.55	135.47	19.64	0.76	0.17
6/6/2018	15:44:51	5.56	135.92	19.65	0.76	0.20
6/6/2018	15:45:51	5.55	135.87	19.66	0.76	0.21
6/6/2018	15:46:51	5.53	133.86	19.66	0.75	0.32
6/6/2018	15:47:51	5.53	135.05	19.65	0.75	0.17
6/6/2018	15:48:51	5.50	134.82	19.65	0.75	0.34
6/6/2018	15:49:51	5.50	133.17	19.65	0.75	0.34
6/6/2018	15:50:51	5.52	135.58	19.65	0.75	0.23
6/6/2018	15:51:51	5.55	134.95	19.66	0.75	0.09
6/6/2018	15:52:51	5.54	136.13	19.65	0.75	0.07
6/6/2018	15:53:51	5.56	137.79	19.64	0.75	0.01
6/6/2018	15:54:51	5.58	136.19	19.64	0.75	0.21
6/6/2018	15:55:51	5.54	136.57	19.64	0.75	0.24

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	15:56:51	5.55	136.12	19.65	0.75	0.14
6/6/2018	15:57:51	5.52	134.71	19.66	0.75	0.05
6/6/2018	15:58:51	5.54	136.16	19.65	0.76	0.23
6/6/2018	15:59:51	5.55	135.38	19.64	0.76	0.18
6/6/2018	16:00:51	5.55	134.50	19.64	0.76	0.08
6/6/2018	16:01:51	5.53	136.19	19.64	0.76	0.02
6/6/2018	16:02:51	5.58	136.24	19.65	0.76	0.02
6/6/2018	16:03:51	5.56	136.46	19.65	0.76	0.02
6/6/2018	16:04:51	5.58	137.08	19.64	0.76	0.13
6/6/2018	16:05:51	5.59	135.53	19.63	0.76	0.14
6/6/2018	16:06:51	5.62	137.33	19.64	0.76	0.11
6/6/2018	16:07:51	5.60	137.44	19.64	0.76	0.09
6/6/2018	16:08:51	5.57	135.84	19.64	0.76	0.11
6/6/2018	16:09:51	5.58	137.54	19.65	0.75	0.35
6/6/2018	16:10:51	5.59	137.34	19.64	0.75	0.08
6/6/2018	16:11:51	5.58	136.41	19.64	0.75	0.02
6/6/2018	16:12:51	5.59	137.83	19.64	0.75	0.01
6/6/2018	16:13:51	5.57	136.36	19.64	0.75	0.04
6/6/2018	16:14:51	5.57	136.04	19.65	0.75	0.17
6/6/2018	16:15:51	5.56	136.56	19.65	0.75	0.07
6/6/2018	16:16:51	5.55	134.93	19.64	0.75	0.10
6/6/2018	16:17:51	5.55	136.80	19.64	0.75	0.19
6/6/2018	16:18:51	5.56	136.26	19.64	0.75	0.25
6/6/2018	16:19:51	5.56	135.21	19.64	0.75	0.20
6/6/2018	16:20:51	5.58	137.04	19.65	0.75	0.05
6/6/2018	16:21:51	5.56	134.99	19.64	0.76	0.27
6/6/2018	16:22:51	5.53	135.48	19.63	0.76	0.24
6/6/2018	16:23:51	5.52	135.02	19.64	0.77	0.17
6/6/2018	16:24:51	5.50	133.66	19.64	0.76	0.11
6/6/2018	16:25:51	5.56	136.11	19.64	0.76	0.11
6/6/2018	16:26:51	5.55	135.08	19.65	0.76	0.28
6/6/2018	16:27:51	5.56	137.38	19.64	0.76	0.06
6/6/2018	16:28:51	5.57	137.15	19.63	0.76	0.01
6/6/2018	16:29:51	5.62	137.90	19.63	0.76	0.07
6/6/2018	16:30:51	5.61	138.89	19.64	0.76	0.13
6/6/2018	16:31:51	5.64	136.95	19.64	0.75	0.03
6/6/2018	16:32:51	5.59	137.20	19.65	0.75	0.23
6/6/2018	16:33:51	5.55	134.75	19.63	0.75	0.29
6/6/2018	16:34:51	5.53	134.54	19.63	0.74	0.15
6/6/2018	16:35:51	5.56	136.06	19.64	0.74	0.03
6/6/2018	16:36:51	5.55	134.47	19.64	0.75	0.09

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	16:37:51	5.54	135.61	19.65	0.75	0.15
6/6/2018	16:38:51	5.54	134.61	19.64	0.75	0.07
6/6/2018	16:39:51	5.51	133.95	19.63	0.75	0.18
6/6/2018	16:40:51	5.54	137.16	19.63	0.75	0.22
6/6/2018	16:41:51	5.58	136.58	19.64	0.75	0.22
6/6/2018	16:42:51	5.60	138.20	19.64	0.75	0.30
6/6/2018	16:43:51	5.61	138.23	19.65	0.75	0.06
6/6/2018	16:44:51	5.64	137.80	19.65	0.76	0.11
6/6/2018	16:45:51	5.63	137.69	19.64	0.76	0.29
6/6/2018	16:46:51	5.59	134.68	19.64	0.76	0.38
6/6/2018	16:47:51	5.57	134.76	19.65	0.76	0.30
6/6/2018	16:48:51	5.55	134.90	19.64	0.76	0.22
6/6/2018	16:49:51	5.57	133.88	19.64	0.76	0.02
6/6/2018	16:50:51	5.58	135.77	19.63	0.76	0.02
6/6/2018	16:51:51	5.64	136.53	19.63	0.76	0.04
6/6/2018	16:52:51	5.61	136.25	19.63	0.76	0.04
6/6/2018	16:53:51	5.62	136.94	19.64	0.76	0.02
6/6/2018	16:54:51	5.62	137.47	19.64	0.76	0.27
6/6/2018	16:55:51	5.61	138.08	19.64	0.76	0.08
6/6/2018	16:56:51	5.63	138.63	19.63	0.75	0.20
6/6/2018	16:57:51	5.59	135.99	19.63	0.75	0.26
6/6/2018	16:58:51	5.55	134.65	19.63	0.75	0.19
6/6/2018	16:59:51	5.52	135.66	19.64	0.74	0.10
6/6/2018	17:00:51	5.54	135.30	19.65	0.75	0.23
6/6/2018	17:01:51	5.53	134.87	19.65	0.75	0.06
6/6/2018	17:02:51	5.52	135.83	19.64	0.75	0.01
6/6/2018	17:03:51	5.50	133.66	19.64	0.75	0.08
6/6/2018	17:04:51	5.55	134.87	19.64	0.75	0.25
6/6/2018	17:05:51	5.55	137.34	19.65	0.75	0.31
6/6/2018	17:06:51	5.60	135.25	19.65	0.76	0.36
6/6/2018	17:07:51	5.58	136.81	19.64	0.76	0.16
6/6/2018	17:08:51	5.55	137.82	19.63	0.76	0.21
6/6/2018	17:09:51	5.57	137.01	19.64	0.77	0.34
6/6/2018	17:10:51	5.55	138.01	19.64	0.76	0.26
6/6/2018	17:11:51	5.56	138.94	19.65	0.76	0.29
6/6/2018	17:12:51	5.60	137.57	19.65	0.76	0.12
6/6/2018	17:13:51	5.58	138.43	19.64	0.76	0.28
6/6/2018	17:14:51	5.58	137.97	19.64	0.76	0.30
6/6/2018	17:15:51	5.55	135.18	19.64	0.76	0.17
6/6/2018	17:16:51	5.53	135.86	19.65	0.76	0.41
6/6/2018	17:17:51	5.52	135.23	19.65	0.76	0.39

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Run #3

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	17:18:51	5.53	133.90	19.65	0.76	0.24
6/6/2018	17:19:51	5.53	134.88	19.64	0.75	0.09
6/6/2018	17:20:51	5.52	135.65	19.64	0.75	0.01
6/6/2018	17:21:51	5.53	134.94	19.65	0.75	0.03
6/6/2018	17:22:51	5.54	136.75	19.65	0.75	0.32
6/6/2018	17:23:51	5.53	136.11	19.66	0.75	0.26
	Final	**5.58**	**136.43**	**19.64**	**0.75**	**0.17**

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R-3 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	17:24:41	5.54	136.34	19.65	0.75	0.26					
6/6/2018	17:24:51	5.53	135.22	19.66	0.75	0.25					
6/6/2018	17:25:01	5.52	134.33	19.65	0.75	0.25					
6/6/2018	17:25:11	5.52	134.17	19.65	0.75	0.03					
6/6/2018	17:25:21	5.50	134.04	19.65	0.75	0.01					
6/6/2018	17:25:31	5.51	134.38	19.66	0.75	0.01					
6/6/2018	17:25:41	5.54	136.82	17.73	0.68	0.01					
6/6/2018	17:25:51	5.55	135.49	7.87	0.36	0.01					
6/6/2018	17:26:01	5.14	120.60	2.74	0.18	0.01					
6/6/2018	17:26:11	5.70	88.93	1.01	0.12	0.01					
6/6/2018	17:26:21	7.68	52.63	0.44	0.09	0.01					
6/6/2018	17:26:31	6.30	24.72	0.24	0.09	0.01					
6/6/2018	17:26:41	2.89	10.13	0.18	0.09	0.01					
6/6/2018	17:26:51	1.51	3.76	0.16	0.08	0.01					
6/6/2018	17:27:01	1.00	1.92	0.14	0.08	0.01					
6/6/2018	17:27:11	0.80	2.12	0.14	0.09	0.00					
6/6/2018	17:27:21	0.74	1.33	0.14	0.08	0.01					
6/6/2018	17:27:31	0.70	-0.38	0.14	0.08	0.01					
6/6/2018	17:27:41	0.67	-1.05	0.13	0.08	0.01					
6/6/2018	17:27:51	0.66	-1.67	0.13	0.08	0.01					
6/6/2018	17:28:01	0.66	-2.52	0.12	0.09	0.01					
6/6/2018	17:28:11	0.66	-2.58	0.12	0.08	0.01					
6/6/2018	17:28:21	0.64	-2.18	0.12	0.08	0.01					
6/6/2018	17:28:31	0.63	-1.37	0.12	0.08	0.01					
6/6/2018	17:28:41	0.63	0.30	0.12	0.08	0.01	0.63	-1.08	0.12	0.08	0.01
6/6/2018	17:28:51	0.63	0.75	0.12	0.08	0.01					
6/6/2018	17:29:01	0.63	-0.28	0.11	0.09	0.01					
6/6/2018	17:29:11	0.63	-1.12	0.11	0.08	0.01					
6/6/2018	17:29:21	0.63	-1.62	0.11	0.08	0.01					
6/6/2018	17:29:31	0.63	-2.27	0.11	0.09	0.01					
6/6/2018	17:29:41	0.61	-2.53	0.12	0.08	0.01					
6/6/2018	17:29:51	0.60	-2.23	0.11	0.08	0.01					
6/6/2018	17:30:01	0.60	-0.99	0.62	0.10	0.01					
6/6/2018	17:30:11	0.60	1.28	0.94	0.12	0.01					
6/6/2018	17:30:21	0.60	5.91	1.76	0.10	0.01					
6/6/2018	17:30:31	2.86	14.62	2.31	0.09	0.01					
6/6/2018	17:30:41	6.00	17.14	1.92	0.11	0.01					
6/6/2018	17:30:51	6.31	14.11	1.69	0.13	0.01					
6/6/2018	17:31:01	5.64	9.44	1.60	0.13	0.01					
6/6/2018	17:31:11	4.16	7.39	1.56	0.14	0.01					
6/6/2018	17:31:21	2.22	7.90	1.55	0.14	0.01					
6/6/2018	17:31:31	1.45	9.49	1.54	0.14	0.01					
6/6/2018	17:31:41	1.14	10.80	1.54	0.14	0.01					
6/6/2018	17:31:51	1.02	10.57	1.54	0.14	0.01					
6/6/2018	17:32:01	0.97	9.57	1.55	0.15	0.01					
6/6/2018	17:32:11	0.96	8.83	1.55	0.14	0.01					
6/6/2018	17:32:21	0.96	8.29	1.55	0.15	0.02					
6/6/2018	17:32:31	0.96	7.83	1.52	0.14	0.18					
6/6/2018	17:32:41	0.96	7.54	1.88	0.12	0.18					
6/6/2018	17:32:51	0.97	7.74	2.78	0.10	0.18					
6/6/2018	17:33:01	0.94	7.36	3.13	0.09	0.18					
6/6/2018	17:33:11	1.71	6.06	2.98	0.10	0.18					
6/6/2018	17:33:21	2.90	2.84	2.75	0.10	0.18					

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R-3 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	17:33:31	2.91	0.15	2.69	0.09	0.18					
6/6/2018	17:33:41	2.40	-0.82	2.68	0.10	0.04					
6/6/2018	17:33:51	2.08	-1.78	2.67	0.09	0.01					
6/6/2018	17:34:01	1.84	-1.89	2.67	0.09	0.01					
6/6/2018	17:34:11	1.67	-2.44	2.67	0.10	0.01					
6/6/2018	17:34:21	1.54	-1.60	2.67	0.09	0.01					
6/6/2018	17:34:31	1.43	0.42	2.67	0.09	0.01					
6/6/2018	17:34:41	1.34	0.79	2.67	0.10	0.01					
6/6/2018	17:34:51	1.27	-0.31	2.67	0.09	6.26					
6/6/2018	17:35:01	1.21	-0.82	2.66	0.10	12.50					
6/6/2018	17:35:11	1.15	-1.73	2.67	0.09	12.50					
6/6/2018	17:35:21	1.11	-2.28	2.67	0.10	12.50					
6/6/2018	17:35:31	1.08	-2.27	2.67	0.09	12.50					
6/6/2018	17:35:41	1.03	-1.98	7.09	0.27	12.50					
6/6/2018	17:35:51	1.02	4.83	13.13	0.53	12.50					
6/6/2018	17:36:01	0.89	27.83	17.09	0.67	12.49					
6/6/2018	17:36:11	1.91	59.27	16.45	1.32	12.46					
6/6/2018	17:36:21	3.43	86.01	12.16	5.94	12.46					
6/6/2018	17:36:31	4.33	87.24	10.71	8.39	12.46					
6/6/2018	17:36:41	5.14	66.38	10.22	9.27	12.46					
6/6/2018	17:36:51	4.20	38.27	10.06	9.58	12.46					
6/6/2018	17:37:01	2.43	17.83	10.00	9.68	12.46					
6/6/2018	17:37:11	1.61	5.87	9.98	9.74	12.46					12.46
6/6/2018	17:37:21	1.14	1.57	9.97	9.75	2.23					
6/6/2018	17:37:31	0.94	0.82	9.97	9.76	1.09					
6/6/2018	17:37:41	0.84	-0.07	9.98	9.77	1.09					
6/6/2018	17:37:51	0.81	-1.28	9.97	9.77	1.09					
6/6/2018	17:38:01	0.79	-2.58	9.97	9.77	1.09					
6/6/2018	17:38:11	0.76	-3.39	9.97	9.77	1.09					
6/6/2018	17:38:21	0.75	-3.92	9.97	9.78	1.09					
6/6/2018	17:38:31	0.73	-4.47	9.97	9.78	0.44					
6/6/2018	17:38:41	0.72	-3.91	9.97	9.78	0.01					
6/6/2018	17:38:51	0.72	-2.53	9.98	9.78	0.01			9.97		
6/6/2018	17:39:01	0.70	-1.05	9.98	9.79	0.01					
6/6/2018	17:39:11	0.69	-1.21	11.09	8.88	0.01					
6/6/2018	17:39:21	0.69	0.45	12.83	6.30	0.01					
6/6/2018	17:39:31	1.02	12.02	6.27	3.66	0.01					
6/6/2018	17:39:41	1.47	20.23	3.31	2.45	0.01					
6/6/2018	17:39:51	1.42	19.90	2.49	2.17	0.01					
6/6/2018	17:40:01	1.26	12.24	2.21	2.05	0.01					
6/6/2018	17:40:11	1.06	4.22	2.12	2.00	0.01					
6/6/2018	17:40:21	0.78	1.74	2.08	1.99	0.01					
6/6/2018	17:40:31	0.67	1.41	2.07	1.99	0.01					
6/6/2018	17:40:41	0.62	0.31	2.07	1.98	0.01					
6/6/2018	17:40:51	0.60	-0.70	2.07	1.98	0.01					
6/6/2018	17:41:01	0.60	-1.90	2.07	1.97	0.01					
6/6/2018	17:41:11	0.60	-2.77	2.06	1.97	0.01					
6/6/2018	17:41:21	0.60	-2.99	2.07	1.97	0.01				1.97	
6/6/2018	17:41:31	0.60	-3.11	2.07	1.97	0.01					
6/6/2018	17:41:41	0.61	-2.60	2.46	1.94	0.01					
6/6/2018	17:41:51	0.60	0.37	10.21	1.43	0.01					
6/6/2018	17:42:01	0.58	12.39	15.29	1.06	0.01					
6/6/2018	17:42:11	1.60	40.02	8.48	1.01	0.01					

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R-3 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	17:42:21	2.92	63.43	3.10	0.56	0.01					
6/6/2018	17:42:31	6.02	64.90	1.13	0.29	0.01					
6/6/2018	17:42:41	10.10	48.43	0.46	0.18	0.01					
6/6/2018	17:42:51	11.99	29.75	0.23	0.13	0.01					
6/6/2018	17:43:01	12.87	18.71	0.16	0.12	0.01					
6/6/2018	17:43:11	12.86	14.25	0.13	0.11	0.01					
6/6/2018	17:43:21	12.39	13.53	0.12	0.10	0.03					
6/6/2018	17:43:31	12.18	11.90	0.11	0.10	0.06					
6/6/2018	17:43:41	12.17	10.36	0.11	0.10	0.06					
6/6/2018	17:43:51	12.14	9.30	0.11	0.09	0.06					
6/6/2018	17:44:01	12.10	8.28	0.11	0.10	0.06					
6/6/2018	17:44:11	12.01	8.36	0.11	0.10	0.06					
6/6/2018	17:44:21	11.89	7.83	0.11	0.09	0.06					
6/6/2018	17:44:31	11.79	8.27	0.11	0.09	0.05					
6/6/2018	17:44:41	11.70	10.17	0.11	0.09	0.01					
6/6/2018	17:44:51	11.57	10.99	0.10	0.09	0.01					
6/6/2018	17:45:01	11.44	10.59	0.10	0.09	0.01					
6/6/2018	17:45:11	11.32	9.97	0.10	0.09	0.01					
6/6/2018	17:45:21	11.23	8.69	0.11	0.09	0.01					
6/6/2018	17:45:31	11.11	8.51	0.10	0.08	0.01					
6/6/2018	17:45:41	10.99	8.06	0.10	0.09	0.01					
6/6/2018	17:45:51	10.88	7.64	0.10	0.09	0.01					
6/6/2018	17:46:01	10.78	8.22	0.10	0.09	0.01					
6/6/2018	17:46:11	10.71	10.02	0.10	0.08	0.01					
6/6/2018	17:46:21	10.65	11.32	0.10	0.08	0.01					
6/6/2018	17:46:31	10.57	10.85	0.10	0.09	0.01					
6/6/2018	17:46:41	10.46	9.67	0.10	0.09	0.01					
6/6/2018	17:46:51	10.39	9.12	0.10	0.08	0.01					
6/6/2018	17:47:01	10.31	8.23	0.09	0.09	0.01					
6/6/2018	17:47:11	10.24	7.86	0.10	0.09	0.01					
6/6/2018	17:47:21	10.18	7.93	0.10	0.08	0.01					
6/6/2018	17:47:31	10.13	8.40	0.10	0.08	0.01					
6/6/2018	17:47:41	10.09	10.21	0.10	0.08	0.01					
6/6/2018	17:47:51	10.04	11.08	0.10	0.08	0.01					
6/6/2018	17:48:01	9.98	10.57	0.10	0.09	0.01					
6/6/2018	17:48:11	9.92	9.61	0.10	0.08	0.01					
6/6/2018	17:48:21	9.88	8.84	0.52	0.09	0.01	9.93				
6/6/2018	17:48:31	9.85	9.12	9.10	0.41	0.01					
6/6/2018	17:48:41	9.89	19.10	15.86	0.63	0.01					
6/6/2018	17:48:51	8.90	45.67	18.30	0.70	0.01					
6/6/2018	17:49:01	7.71	79.31	19.18	0.74	0.01					
6/6/2018	17:49:11	6.90	106.14	14.83	0.59	0.01					
6/6/2018	17:49:21	6.08	117.25	5.58	0.29	0.01					
6/6/2018	17:49:31	8.11	117.90	1.94	0.16	0.01					
6/6/2018	17:49:41	11.31	120.91	0.73	0.11	0.01					
6/6/2018	17:49:51	34.97	128.80	0.32	0.10	0.01					
6/6/2018	17:50:01	62.77	137.98	0.18	0.09	0.01					
6/6/2018	17:50:11	87.16	143.60	0.14	0.09	0.01					
6/6/2018	17:50:21	98.22	147.21	0.12	0.09	0.01					
6/6/2018	17:50:31	99.90	142.95	0.31	0.09	0.01					
6/6/2018	17:50:41	99.90	118.50	0.53	0.09	0.01					
6/6/2018	17:50:51	86.05	79.95	0.60	0.10	0.01					
6/6/2018	17:51:01	46.19	44.47	0.63	0.10	0.01					

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R-3 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/6/2018	17:51:11	23.50	22.61	0.63	0.11	0.01					
6/6/2018	17:51:21	9.62	11.26	0.64	0.10	0.01					
6/6/2018	17:51:31	4.11	6.42	0.64	0.10	0.01					
6/6/2018	17:51:41	2.33	4.70	0.65	0.10	0.01					
6/6/2018	17:51:51	1.57	5.01	0.65	0.10	0.01					
6/6/2018	17:52:01	1.28	5.09	0.65	0.11	0.01					
6/6/2018	17:52:11	1.15	4.14	0.66	0.11	0.01					
6/6/2018	17:52:21	1.07	3.09	0.67	0.11	0.01					
6/6/2018	17:52:31	1.02	2.40	0.67	0.11	0.01					
6/6/2018	17:52:41	0.99	1.59	0.67	0.11	0.01					
6/6/2018	17:52:51	0.96	2.11	0.67	0.11	0.01					
6/6/2018	17:53:01	0.93	2.63	0.67	0.11	0.01					
6/6/2018	17:53:11	0.92	4.19	0.66	0.11	0.01					
6/6/2018	17:53:21	0.92	4.90	0.65	0.11	0.01					
6/6/2018	17:53:31	0.90	4.27	0.63	0.10	0.01					
6/6/2018	17:53:41	0.88	3.28	0.62	0.11	0.01					
6/6/2018	17:53:51	0.87	2.19	0.62	0.11	0.01					
6/6/2018	17:54:01	0.87	1.85	0.61	0.11	0.01					
6/6/2018	17:54:11	0.87	1.32	0.60	0.10	0.01					
6/6/2018	17:54:21	0.85	2.15	0.38	0.10	0.01					
6/6/2018	17:54:31	1.11	12.62	0.20	0.09	0.01					
6/6/2018	17:54:41	-1.71	46.29	0.14	0.09	0.01					
6/6/2018	17:54:51	35.45	87.11	0.11	0.09	0.01					
6/6/2018	17:55:01	85.51	118.56	0.11	0.08	0.01					
6/6/2018	17:55:11	99.90	135.24	0.10	0.10	0.01					
6/6/2018	17:55:21	99.90	142.51	0.10	0.09	0.01					
6/6/2018	17:55:31	99.90	145.44	0.10	0.09	0.01					
6/6/2018	17:55:41	99.90	146.91	0.10	0.09	0.01					
6/6/2018	17:55:51	99.90	148.36	0.10	0.09	0.01					
6/6/2018	17:56:01	99.90	151.33	0.10	0.10	0.01					
6/6/2018	17:56:11	99.90	152.32	0.10	0.09	0.01					
6/6/2018	17:56:21	99.90	151.52	0.10	0.09	0.01					
6/6/2018	17:56:31	99.90	150.33	0.10	0.10	0.01					
6/6/2018	17:56:41	99.90	149.64	0.10	0.09	0.01		150.50			

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 114**
DATE	**06/07/18**
METHOD	**29**
POLLUTANT	**Metals**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**8:05**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**11:12**
EPA Method:	**29**	Overcast 60 F		**Date:**	**6/7/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	4A	Liner type	GLASS		
Y factor	0.9963	Nozzle ID	0.249	Nozzle size	0.2490	inches	
ΔH@	1.8425	Hot box ID	HB#3	Nozzle area	0.000338	sq.ft.	
		Pitot Cp	0.84	Probe heat	248	F	
				Filter heat	248	F	

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.81 %
Static Pressure	0.56	"H_2O	CO_2	0.72 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.224 inches
Stack Temperature	280	F		
Assumed moisture	2	%		
Assumed meter temp.	60	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	0.040
Leak check vacuum, "Hg	26	10

Nozzle check for roundness:

1	2	3	
0.249	0.249	0.249	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	183.224	dcf	Ave. ΔP	1.171 "H_2O
Wet mol. weight	28.7	M_s (actual)	Ave. √ΔP	1.0816 "H_2O
Actual H_2O	1.92	%	Ave. ΔH	3.488 "H_2O
Std. meter vol.	183.478	dscf	Ave. T_s	289.9 °F
Isokinetic Average	100.3	%	Ave. T_m	68.9 °F

Moisture/Lab:

Filter	Run1 #		
	Initial	Final	Gain
Impingers, g	200.0	234	34.0
Silica gel, g	240.8	283.3	42.5
		Total water gain:	76.5

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	7.380	1.10	280	61	3.25	3.30	4	248	56
2	15.0	14.680	1.10	285	62	3.24	3.20	4	250	51
3	22.5	22.280	1.20	289	63	3.52	3.50	4	250	52
4	30.0	29.960	1.20	288	65	3.54	3.50	4	250	55
5	37.5	37.650	1.20	288	66	3.54	3.50	4	247	58
6	45.0	45.620	1.30	289	67	3.84	3.80	4	250	58
7	52.5	53.260	1.20	289	68	3.55	3.60	4	252	59
8	60.0	61.000	1.20	290	70	3.56	3.60	4	252	59
9	67.5	68.940	1.20	290	70	3.56	3.60	4	250	53
10	75.0	76.360	1.10	290	70	3.26	3.20	4	250	53
11	82.5	84.120	1.20	291	71	3.56	3.60	4	250	51
12	90.0	91.275	1.00	285	71	2.99	3.00	4	250	52
13	97.5	99.060	1.20	288	69	3.56	3.60	4	248	58
14	105.0	106.800	1.20	291	70	3.56	3.60	4	249	51
15	112.5	114.540	1.20	292	71	3.56	3.60	4	252	52
16	120.0	122.260	1.20	293	70	3.55	3.60	4	250	54
17	127.5	129.950	1.20	293	71	3.55	3.60	4	255	54
18	135.0	137.730	1.20	292	71	3.56	3.60	4	251	55
19	142.5	145.450	1.20	292	71	3.56	3.60	4	248	57
20	150.0	153.160	1.20	292	71	3.56	3.60	4	252	56
21	157.5	160.900	1.20	292	71	3.56	3.60	4	253	55
22	165.0	168.360	1.10	293	71	3.26	3.30	4	253	55
23	172.5	175.790	1.10	292	72	3.27	3.30	4	252	56
24	180.0	183.224	1.10	293	72	3.26	3.30	4	249	56

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**11:40**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**		**End Time:**	**14:48**
EPA Method:	**29**	Overcast 60 F		**Date:**	**6/7/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	4A	Liner type:	GLASS		
Y factor	0.9963	Nozzle ID	0.249	Nozzle size:	0.2490	inches	
ΔH@	1.8425	Hot box ID	HB#3	Nozzle area:	0.000338	sq.ft.	
		Pitot Cp	0.84	Probe heat:	248	F	
				Filter heat:	248	F	

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.73 %
Static Pressure	0.56	"H_2O	CO_2	0.73 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.222 inches
Stack Temperature	280	F		
Assumed moisture	1.92	%		
Assumed meter temp.	68.9	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	0.003
Leak check vacuum, "Hg:	9	7

Nozzle check for roundness:

1	2	3	
0.249	0.249	0.249	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	180.661	dcf	Ave. ΔP	1.132 "H_2O
Wet mol. weight	28.71	M_s (actual)	Ave. √ΔP	1.0631 "H_2O
Actual H_2O	1.87	%	Ave. ΔH	3.379 "H_2O
Std. meter vol.	179.809	dscf	Ave. T_s	294.4 °F
Isokinetic Average	100.3	%	Ave. T_m	72 °F

Moisture/Lab:

Filter	Run 2 #		
	Initial	Final	Gain
Impingers, g	200.0	235	35.0
Silica gel, g	240.3	278.3	38.0
		Total water gain:	73.0

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	7.5	7.350	1.10	292	67	3.24	3.20	3	251	63
2	15.0	15.050	1.20	293	68	3.54	3.50	3	248	46
3	22.5	22.690	1.20	293	68	3.54	3.50	4	249	47
4	30.0	30.210	1.20	294	70	3.55	3.50	4	252	49
5	37.5	38.075	1.20	294	71	3.55	3.60	4	250	50
6	45.0	45.860	1.20	295	72	3.56	3.60	4	252	52
7	52.5	53.330	1.10	294	72	3.26	3.30	4	249	53
8	60.0	60.840	1.10	294	73	3.27	3.30	3	250	51
9	67.5	68.300	1.10	295	73	3.26	3.30	3	250	53
10	75.0	75.770	1.10	296	73	3.26	3.30	3	251	55
11	82.5	83.250	1.10	297	74	3.26	3.30	3	250	56
12	90.0	90.258	0.96	297	74	2.85	2.90	3	250	56
13	97.5	97.750	1.10	294	71	3.26	3.30	3	251	56
14	105.0	105.110	1.10	291	71	3.27	3.30	3	249	56
15	112.5	112.580	1.10	295	71	3.25	3.30	3	253	56
16	120.0	120.040	1.10	295	72	3.26	3.30	3	252	59
17	127.5	127.710	1.20	296	72	3.55	3.60	3	249	60
18	135.0	135.440	1.20	297	72	3.55	3.60	3	249	58
19	142.5	143.220	1.20	295	73	3.56	3.60	3	251	57
20	150.0	150.880	1.20	297	74	3.56	3.60	3	249	57
21	157.5	158.600	1.20	298	74	3.55	3.60	3	251	58
22	165.0	166.380	1.20	299	75	3.56	3.60	4	251	58
23	172.5	173.890	1.10	293	74	3.28	3.30	4	252	59
24	180.0	180.661	0.90	282	75	2.73	2.70	4	250	59

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**15:05**
Source:	**CFU 114**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:10**
EPA Method:	**29**	Overcast 60 F	**Date:**	**6/7/2018**
Box Operator:	**CMF**			
Technician(s):	**CSW**			

Stack Dimensional Data:

Circular		
Diameter	36.000	in
Rectangular		
Width		in
Length		in
Stack Area	7.069	sq.ft.

Equipment:

Meterbox ID	13	Probe ID	4A	Liner type:	GLASS	
Y factor	0.9963	Nozzle ID	0.249	Nozzle size:	0.2490	inches
ΔH@	1.8425	Hot box ID	HB#3	Nozzle area:	0.000338	sq.ft.
		Pitot Cp	0.84	Probe heat:	248	F
				Filter heat:	248	F

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.75 %
Static Pressure	0.56	"H_2O	CO_2	0.71 %
Ave. ΔP	0.988	"H_2O	Rec. Nz.	0.221 inches
Stack Temperature	280	F		
Assumed moisture	1.87	%		
Assumed meter temp.	72	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:	16	10

Nozzle check for roundness:

1	2	3	
0.249	0.249	0.249	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	183.256	dcf	Ave. ΔP	1.15 "H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. √ΔP	1.0715 "H_2O
Actual H_2O	1.94	%	Ave. ΔH	3.45 "H_2O
Std. meter vol.	181.134	dscf	Ave. T_s	295.8 °F
Isokinetic Average	100.4	%	Ave. T_m	75.8 °F

Moisture/Lab:

Filter	Run 3 #		
	Initial	Final	Gain
Impingers, g	200.0	238	38.0
Silica gel, g	244.5	282.8	38.3
		Total water gain:	76.3

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	7.5	7.540	1.10	290	72	3.28	3.30	4	252	51
2	15.0	15.240	1.20	296	73	3.56	3.60	4	252	52
3	22.5	23.160	1.20	296	73	3.56	3.60	4	250	53
4	30.0	30.800	1.20	296	74	3.57	3.60	4	250	55
5	37.5	38.600	1.20	299	75	3.56	3.60	4	250	56
6	45.0	46.370	1.20	300	75	3.55	3.60	4	250	57
7	52.5	54.150	1.20	300	76	3.56	3.60	4	249	57
8	60.0	61.910	1.20	301	76	3.56	3.60	4	250	59
9	67.5	69.720	1.20	300	77	3.57	3.60	4	250	62
10	75.0	77.200	1.10	298	76	3.27	3.30	4	250	57
11	82.5	84.610	1.10	297	76	3.28	3.30	4	249	55
12	90.0	91.551	0.95	298	77	2.83	2.80	4	248	54
13	97.5	99.440	1.20	291	75	3.60	3.60	4	250	54
14	105.0	107.150	1.20	297	76	3.57	3.60	4	252	54
15	112.5	114.940	1.20	297	76	3.57	3.60	4	251	57
16	120.0	122.810	1.20	298	76	3.57	3.60	4	250	58
17	127.5	130.470	1.20	298	77	3.58	3.60	4	250	58
18	135.0	138.310	1.20	296	77	3.59	3.60	4	251	58
19	142.5	146.140	1.20	295	77	3.59	3.60	4	250	58
20	150.0	153.970	1.20	295	78	3.60	3.60	4	250	59
21	157.5	161.460	1.10	294	77	3.30	3.30	4	250	60
22	165.0	169.150	1.10	294	77	3.30	3.30	4	250	60
23	172.5	176.600	1.10	294	77	3.30	3.30	4	251	59
24	180.0	183.256	0.85	280	77	2.60	2.60	4	251	59

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:05**
Source:	**CFU 114**	**End Time:**	**11:12**
Method:	**29**	**Date:**	**6/7/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
7.5	7.380	3.30	61	1	1.10	280	1.0488
15.0	14.680	3.20	62	2	1.10	285	1.0488
22.5	22.280	3.50	63	3	1.20	289	1.0954
30.0	29.960	3.50	65	4	1.20	288	1.0954
37.5	37.650	3.50	66	5	1.20	288	1.0954
45.0	45.620	3.80	67	6	1.30	289	1.1402
52.5	53.260	3.60	68	7	1.20	289	1.0954
60.0	61.000	3.60	70	8	1.20	290	1.0954
67.5	68.940	3.60	70	9	1.20	290	1.0954
75.0	76.360	3.20	70	10	1.10	290	1.0488
82.5	84.120	3.60	71	11	1.20	291	1.0954
90.0	91.275	3.00	71	12	1.00	285	1.0000
97.5	99.060	3.60	69	13	1.20	288	1.0954
105.0	106.800	3.60	70	14	1.20	291	1.0954
112.5	114.540	3.60	71	15	1.20	292	1.0954
120.0	122.260	3.60	70	16	1.20	293	1.0954
127.5	129.950	3.60	71	17	1.20	293	1.0954
135.0	137.730	3.60	71	18	1.20	292	1.0954
142.5	145.450	3.60	71	19	1.20	292	1.0954
150.0	153.160	3.60	71	20	1.20	292	1.0954
157.5	160.900	3.60	71	21	1.20	292	1.0954
165.0	168.360	3.30	71	22	1.10	293	1.0488
172.5	175.790	3.30	72	23	1.10	292	1.0488
180.0	183.224	3.30	72	24	1.10	293	1.0488

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 114**	**Date:**	**06/07/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	36.000	in
Meter Volume, V_m	183.224	dcf	Rectangular		
Water Volume	76.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.2490	in.	Length		in
Nozzle Area	0.000338	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.72	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.81	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	3.488	"H_2O	√Dp	1.0816	"H_2O
Temperature, T_m	68.9	^oF	Temperature, T_s	289.9	^oF
Temperature, T_m	528.9	^oA (^oR)	Temperature, T_s	749.9	^oA (^oR)
Pressure Meter, P_m	30.136	"Hg	Pressure Stack, P_s	29.921	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	183.478	dscf	Velocity, V_s	72.58	fps
	5.196	dscm	Volume (actual)	30,784.1	awcfm
Actual Volume, $V_{m(actual)}$	265.785	awcf		30,193.0	adcfm
Gas Stream Moisture			Volume (standard)	1,300,536.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.600	scf		1,275,566.2	dscf/hr
Moisture, B_{ws}	0.0192			21,259.4	dscf/min
Moisture EPA M4	1.92	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.3	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:40**
Source:	**CFU 114**	**End Time:**	**14:48**
Method:	**29**	**Date:**	**06/07/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
7.5	7.350	3.20	67	1	1.10	292	1.0488
15.0	15.050	3.50	68	2	1.20	293	1.0954
22.5	22.690	3.50	68	3	1.20	293	1.0954
30.0	30.210	3.50	70	4	1.20	294	1.0954
37.5	38.075	3.60	71	5	1.20	294	1.0954
45.0	45.860	3.60	72	6	1.20	295	1.0954
52.5	53.330	3.30	72	7	1.10	294	1.0488
60.0	60.840	3.30	73	8	1.10	294	1.0488
67.5	68.300	3.30	73	9	1.10	295	1.0488
75.0	75.770	3.30	73	10	1.10	296	1.0488
82.5	83.250	3.30	74	11	1.10	297	1.0488
90.0	90.258	2.90	74	12	0.96	297	0.9798
97.5	97.750	3.30	71	13	1.10	294	1.0488
105.0	105.110	3.30	71	14	1.10	291	1.0488
112.5	112.580	3.30	71	15	1.10	295	1.0488
120.0	120.040	3.30	72	16	1.10	295	1.0488
127.5	127.710	3.60	72	17	1.20	296	1.0954
135.0	135.440	3.60	72	18	1.20	297	1.0954
142.5	143.220	3.60	73	19	1.20	295	1.0954
150.0	150.880	3.60	74	20	1.20	297	1.0954
157.5	158.600	3.60	74	21	1.20	298	1.0954
165.0	166.380	3.60	75	22	1.20	299	1.0954
172.5	173.890	3.30	74	23	1.10	293	1.0488
180.0	180.661	2.70	75	24	0.90	282	0.9487

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 114**	**Date:**	**06/07/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	36.000	in
Meter Volume, V_m	180.661	dcf	Rectangular		
Water Volume	73.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2490	in.	Length		in
Nozzle Area	0.000338	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.73	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.73	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	3.379	"H_2O	√Dp	1.0631	"H_2O
Temperature, T_m	72.0	^oF	Temperature, T_s	294.4	^oF
Temperature, T_m	532.0	^oA (^oR)	Temperature, T_s	754.4	^oA (^oR)
Pressure Meter, P_m	30.128	"Hg	Pressure Stack, P_s	29.921	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	179.809	dscf	Velocity, V_s	71.54	fps
	5.092	dscm	Volume (actual)	30,343.0	awcfm
Actual Volume, $V_{m(actual)}$	261.901	awcf		29,775.6	adcfm
Gas Stream Moisture			Volume (standard)	1,274,254.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.435	scf		1,250,425.9	dscf/hr
Moisture, B_{ws}	0.0187			20,840.4	dscf/min
Moisture EPA M4	1.87	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.71	lb/lb-mole			
Percent Isokinetic	100.3	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**15:05**
Source:	**CFU 114**	**End Time:**	**18:10**
Method:	**29**	**Date:**	**06/07/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
7.5	7.540	3.30	72	1	1.10	290	1.0488
15.0	15.240	3.60	73	2	1.20	296	1.0954
22.5	23.160	3.60	73	3	1.20	296	1.0954
30.0	30.800	3.60	74	4	1.20	296	1.0954
37.5	38.600	3.60	75	5	1.20	299	1.0954
45.0	46.370	3.60	75	6	1.20	300	1.0954
52.5	54.150	3.60	76	7	1.20	300	1.0954
60.0	61.910	3.60	76	8	1.20	301	1.0954
67.5	69.720	3.60	77	9	1.20	300	1.0954
75.0	77.200	3.30	76	10	1.10	298	1.0488
82.5	84.610	3.30	76	11	1.10	297	1.0488
90.0	91.551	2.80	77	12	0.95	298	0.9747
97.5	99.440	3.60	75	13	1.20	291	1.0954
105.0	107.150	3.60	76	14	1.20	297	1.0954
112.5	114.940	3.60	76	15	1.20	297	1.0954
120.0	122.810	3.60	76	16	1.20	298	1.0954
127.5	130.470	3.60	77	17	1.20	298	1.0954
135.0	138.310	3.60	77	18	1.20	296	1.0954
142.5	146.140	3.60	77	19	1.20	295	1.0954
150.0	153.970	3.60	78	20	1.20	295	1.0954
157.5	161.460	3.30	77	21	1.10	294	1.0488
165.0	169.150	3.30	77	22	1.10	294	1.0488
172.5	176.600	3.30	77	23	1.10	294	1.0488
180.0	183.256	2.60	77	24	0.85	280	0.9220

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 114**	**Date:**	**06/07/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	7.5	min	Diameter	36.000	in
Meter Volume, V_m	183.256	dcf	Rectangular		
Water Volume	76.3	ml (g)	Width		in
Nozzle Diameter, N_z	0.2490	in.	Length		in
Nozzle Area	0.000338	sq.ft.	Stack Area	7.069	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.71	%vd
Static Pressure	0.56	"H_2O	O_2 Average	19.75	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	3.450	"H_2O	√Dp	1.0715	"H_2O
Temperature, T_m	75.8	^oF	Temperature, T_s	295.8	^oF
Temperature, T_m	535.8	^oA (^oR)	Temperature, T_s	755.8	^oA (^oR)
Pressure Meter, P_m	30.134	"Hg	Pressure Stack, P_s	29.921	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	181.134	dscf	Velocity, V_s	72.20	fps
	5.129	dscm	Volume (actual)	30,622.9	awcfm
Actual Volume, $V_{m(actual)}$	264.509	awcf		30,028.8	adcfm
Gas Stream Moisture			Volume (standard)	1,283,628.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.591	scf		1,258,725.7	dscf/hr
Moisture, B_{ws}	0.0194			20,978.8	dscf/min
Moisture EPA M4	1.94	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	100.4	%			

Source:	CFU 114				Sample Date:	06/07/18
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	3.940		0.567	0.125	0.050	µg/sample
Beryllium	< MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	< MDL	<	MDL	0.100	0.040	µg/sample
Chromium	1.110		0.295	0.200	0.080	µg/sample
Cobalt	< MDL	<	MDL	0.125	0.050	µg/sample
Copper	2.350		2.460	1.250	0.500	µg/sample
Lead	< MDL	<	MDL	1.250	0.500	µg/sample
Manganese	1.320		0.459	0.075	0.030	µg/sample
Nickel	2.980	<	MDL	0.750	0.300	µg/sample
Phosphorus	< MDL	<	MDL	5.000	2.000	µg/sample
Selenium	< MDL	<	MDL	3.750	1.500	µg/sample
Zinc	14.800		1.900	0.750	0.300	µg/sample
Lab ID:	18-S1067		18-S1068			
Sample Vol:	250		100		mL	

Source:	CFU 114				Sample Date:	06/07/18
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	3.790		0.487	0.125	0.050	µg/sample
Beryllium	< MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	< MDL	<	MDL	0.100	0.040	µg/sample
Chromium	1.090		0.187	0.200	0.080	µg/sample
Cobalt	< MDL	<	MDL	0.125	0.050	µg/sample
Copper	1.840		1.940	1.250	0.500	µg/sample
Lead	< MDL	<	MDL	1.250	0.500	µg/sample
Manganese	0.964		0.468	0.075	0.030	µg/sample
Nickel	2.020		0.405	0.750	0.300	µg/sample
Phosphorus	< MDL	<	MDL	5.000	2.000	µg/sample
Selenium	< MDL	<	MDL	3.750	1.500	µg/sample
Zinc	11.700		1.340	0.750	0.300	µg/sample
Lab ID:	18-S1069		18-S1070			
Sample Vol:	250		100		mL	

Source:	**CFU 114**			**Sample Date:**	**06/07/18**	
Run:	**3**					
Client ID:	**Filter + Front Half**		**Back Half**			
Analyte	**< Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Antimony	< MDL		2.660	1.250	0.500	µg/sample
Arsenic	< MDL	<	MDL	1.750	0.700	µg/sample
Barium	3.660		0.472	0.125	0.050	µg/sample
Beryllium	< MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	< MDL	<	MDL	0.100	0.040	µg/sample
Chromium	1.140		0.163	0.200	0.080	µg/sample
Cobalt	< MDL	<	MDL	0.125	0.050	µg/sample
Copper	1.830		1.780	1.250	0.500	µg/sample
Lead	< MDL	<	MDL	1.250	0.500	µg/sample
Manganese	0.911		0.428	0.075	0.030	µg/sample
Nickel	2.240	<	MDL	0.750	0.300	µg/sample
Phosphorus	< MDL	<	MDL	5.000	2.000	µg/sample
Selenium	< MDL	<	MDL	3.750	1.500	µg/sample
Zinc	2.700		1.440	0.750	0.300	µg/sample
Lab ID:	18-S1071		18-S1072			
Sample Vol:	250		100			mL

Source: **CFU 114**

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		3.200	0.125		0.462	0.050		0.452	0.125
Beryllium	<	MDL	0.050	<	MDL	0.020	<	MDL	0.050
Cadmium	<	MDL	0.100	<	MDL	0.040	<	MDL	0.100
Chromium		0.948	0.200		0.156	0.080	<	MDL	0.200
Cobalt	<	MDL	0.125	<	MDL	0.050	<	MDL	0.125
Copper	<	MDL	1.250		1.720	0.500		1.680	1.250
Lead	<	MDL	1.250	<	MDL	0.500	<	MDL	1.250
Manganese		0.546	0.075		0.389	0.030		0.313	0.075
Nickel		2.080	0.750	<	MDL	0.300	<	MDL	0.750
Phosphorus	<	MDL	5.000	<	MDL	2.000	<	MDL	5.000
Selenium	<	MDL	3.750	<	MDL	1.500	<	MDL	3.750
Zinc		1.780	0.750		0.376	0.300	<	MDL	0.750
Lab ID:		18-S1080			18-S1081			18-S1079	
Sample Vol, ml:		250			100			250	

Hollingsworth & Vose **Method 29 Metals Blank Calculations** **Run: 1**

CFU 114

06/07/18

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. µg/mL		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**				**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		3.940		0.1808		3.200		0.567		0.0046		0.924		0.1808	1.105	**Barium**
Be	<	0.050	<	0.0200	<	0.050	<	0.020	<	0.0002	<	0.040	<	0.0200	0.000	**Beryllium**
Cd	<	0.100	<	0.0400	<	0.100	<	0.040	<	0.0004	<	0.080	<	0.0400	0.000	**Cadmium**
Cr		1.110	<	0.0800		0.948		0.295		0.0016		0.312	<	0.0800	0.312	**Chromium**
Co	<	0.125	<	0.0500	<	0.125	<	0.050	<	0.0005	<	0.100	<	0.0500	0.000	**Cobalt**
Cu		2.350		0.6720	<	1.250		2.460		0.0172		3.440		0.6720	4.112	**Copper**
Pb	<	1.250	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000	0.000	**Lead**
Mn		1.320		0.1252		0.546		0.459		0.0039		0.778		0.1252	0.903	**Manganese**
Ni		2.980	<	0.3000		2.080	<	0.300	<	0.0030	<	0.600	<	0.3000	0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000	<	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		14.800	<	0.3000		1.780		1.900		0.0038		0.752	<	0.3000	0.752	**Zinc**
Lab:		**18-S1067**		**18-S1079**		**18-S1080**		**18-S1068**		**18-S1081**						
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	3.381	3.381		0.197	0.197	11.63		0.559	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.000	0.000	<	0.005	0.000	11.63	<	0.100	**Cadmium**
Cr	0.948	0.948		0.056	0.056	11.63		0.162	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.672	0.672		0.118	0.118	11.63		1.678	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.671	0.671		0.066	0.066	11.63		0.649	**Manganese**
Ni	2.080	2.080		0.149	0.149	11.63		0.900	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.780	1.780		0.740	0.740	11.63		13.020	**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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6/7/18

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	1.105		0.028	0.028	1.000		**0.000**		**0.559**		**0.559**	**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**	**<**	**0.100**	<	**0.140**	**Cadmium**
Cr	0.312	0.312		0.015	0.015	1.000		**0.000**		**0.162**		**0.162**	**Chromium**
Co	0.000	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000	4.112		0.123	0.123	1.000		**1.460**		**1.678**		**3.138**	**Copper**
Pb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Lead**
Mn	0.903	0.903		0.023	0.023	1.000		**0.000**		**0.649**		**0.649**	**Manganese**
Ni	0.000	0.000	<	0.015	0.000	1.000	<	**0.300**		**0.900**	<	**1.200**	**Nickel**
P	0.000	0.000	<	0.100	0.000	1.000	<	**2.000**	**<**	**5.000**	<	**7.000**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	0.752	0.752		0.095	0.095	1.000		**1.148**		**13.020**		**14.168**	**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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Hollingsworth & Vose | **Method 29 Metals Blank Calculations** | **Run: 2**

CFU 114

06/07/18

		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		3.790		0.1808		3.200		0.487		0.0046		0.924		0.1808	1.105	**Barium**
Be	<	0.050	<	0.0200	<	0.050	<	0.020	<	0.0002	<	0.040	<	0.0200	0.000	**Beryllium**
Cd	<	0.100	<	0.0400	<	0.100	<	0.040	<	0.0004	<	0.080	<	0.0400	0.000	**Cadmium**
Cr		1.090	<	0.0800		0.948		0.187		0.0016		0.312	<	0.0800	0.312	**Chromium**
Co	<	0.125	<	0.0500	<	0.125	<	0.050	<	0.0005	<	0.100	<	0.0500	0.000	**Cobalt**
Cu		1.840		0.6720	<	1.250		1.940		0.0172		3.440		0.6720	4.112	**Copper**
Pb	<	1.250	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000	0.000	**Lead**
Mn		0.964		0.1252		0.546		0.468		0.0039		0.778		0.1252	0.903	**Manganese**
Ni		2.020	<	0.3000		2.080		0.405	<	0.0030	<	0.600	<	0.3000	0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000	<	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		11.700	<	0.3000		1.780		1.340		0.0038		0.752	<	0.3000	0.752	**Zinc**
Lab:		**18-S1069**		**18-S1079**		**18-S1080**		**#REF!**		**18-S1081**						
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	3.381	3.381		0.190	0.190	11.63		0.409	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.000	0.000	<	0.005	0.000	11.63	<	0.100	**Cadmium**
Cr	0.948	0.948		0.055	0.055	11.63		0.142	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.672	0.672		0.092	0.092	11.63		1.168	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.671	0.671		0.048	0.048	11.63		0.293	**Manganese**
Ni	2.080	2.080		0.101	0.101	11.63		-0.060	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.780	1.780		0.585	0.585	11.63		9.920	**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

6/7/18

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	1.105	0.024	0.024	1.000	**0.000**	**0.409**	**0.409**	**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 <**	**0.100 <**	**0.140**	**Cadmium**
Cr	0.312	0.312	0.009	0.009	1.000	**0.000**	**0.142**	**0.142**	**Chromium**
Co	0.000	0.000 <	0.003	0.000	1.000 <	**0.050 <**	**0.125 <**	**0.175**	**Cobalt**
Cu	1.000	4.112	0.097	0.097	1.000	**0.940**	**1.168**	**2.108**	**Copper**
Pb	0.000	0.000 <	0.025	0.000	1.000 <	**0.500 <**	**1.250 <**	**1.750**	**Lead**
Mn	0.903	0.903	0.023	0.023	1.000	**0.000**	**0.293**	**0.293**	**Manganese**
Ni	0.000	0.000	0.020	0.000	1.000	**0.405**	**0.000**	**0.405**	**Nickel**
P	0.000	0.000 <	0.100	0.000	1.000 <	**2.000 <**	**5.000 <**	**7.000**	**Phosphorus**
Se	0.000	0.000 <	0.075	0.000	1.000 <	**1.500 <**	**3.750 <**	**5.250**	**Selenium**
Zn	0.752	0.752	0.067	0.067	1.000	**0.588**	**9.920**	**10.508**	**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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Hollingsworth & Vose | **Method 29 Metals Blank Calculations** | **Run: 3**

CFU 114

06/07/18

		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		2.660	<	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		3.660		0.1808		3.200		0.472		0.0046		0.924		0.1808		1.105	**Barium**
Be	<	0.050	<	0.0200	<	0.050	<	0.020	<	0.0002	<	0.040	<	0.0200		0.000	**Beryllium**
Cd	<	0.100	<	0.0400	<	0.100	<	0.040	<	0.0004	<	0.080	<	0.0400		0.000	**Cadmium**
Cr		1.140	<	0.0800		0.948		0.163		0.0016		0.312	<	0.0800		0.312	**Chromium**
Co	<	0.125	<	0.0500	<	0.125	<	0.050	<	0.0005	<	0.100	<	0.0500		0.000	**Cobalt**
Cu		1.830		0.6720	<	1.250		1.780		0.0172		3.440		0.6720		4.112	**Copper**
Pb	<	1.250	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000		0.000	**Lead**
Mn		0.911		0.1252		0.546		0.428		0.0039		0.778		0.1252		0.903	**Manganese**
Ni		2.240	<	0.3000		2.080	<	0.300	<	0.0030	<	0.600	<	0.3000		0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000	<	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		2.700	<	0.3000		1.780		1.440		0.0038		0.752	<	0.3000		0.752	**Zinc**
Lab:		**18-S1071**		**18-S1079**		**18-S1080**		**18-S1072**		**18-S1081**							
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	3.381	3.381		0.183	0.183	11.63		0.279	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.000	0.000	<	0.005	0.000	11.63	<	0.100	**Cadmium**
Cr	0.948	0.948		0.057	0.057	11.63		0.192	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.672	0.672		0.092	0.092	11.63		1.158	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.671	0.671		0.046	0.046	11.63		0.240	**Manganese**
Ni	2.080	2.080		0.112	0.112	11.63		0.160	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.780	1.780		0.135	0.135	11.63		0.920	**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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6/7/18

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		0.133	0.000	1.000		**2.660**	**<**	**1.250**	<	**3.910**	**Antimony**
As	0.000	0.000	<	0.035	0.000	1.000	<	**0.700**	**<**	**1.750**	<	**2.450**	**Arsenic**
Ba	1.000	1.105		0.024	0.024	1.000		**0.000**		**0.279**		**0.279**	**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**	**<**	**0.100**	<	**0.140**	**Cadmium**
Cr	0.312	0.312		0.008	0.008	1.000		**0.000**		**0.192**		**0.192**	**Chromium**
Co	0.000	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000	4.112		0.089	0.089	1.000		**0.780**		**1.158**		**1.938**	**Copper**
Pb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Lead**
Mn	0.903	0.903		0.021	0.021	1.000		**0.000**		**0.240**		**0.240**	**Manganese**
Ni	0.000	0.000	<	0.015	0.000	1.000	<	**0.300**		**0.160**	<	**0.460**	**Nickel**
P	0.000	0.000	<	0.100	0.000	1.000	<	**2.000**	**<**	**5.000**	<	**7.000**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	0.752	0.752		0.072	0.072	1.000		**0.688**		**0.920**		**1.608**	**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 114**
Location: **Corvallis, OR**

Run			1	2	3	
Date			6/7/2018	6/7/2018	6/7/2018	
Run Start Time			8:05	11:40	15:05	
Run End Time			11:12	14:48	18:10	
Duration, min.			180	180	180	Average
Barometric Pressure, "Hg			29.88	29.88	29.88	**29.88**
Nozzle Dia., in.			0.2490	0.2490	0.2490	**0.2490**
Isokinetic Average, %			100.3	100.3	100.4	**100.3**
Sample Volume, dscf			183.478	179.809	181.134	**181.474**
Sample Volume, dscm			5.196	5.092	5.129	**5.139**
Stack Diameter, in.			36.00	36.00	36.00	**36.00**
Stack Area, sq.ft.			7.069	7.069	7.069	**7.069**
CO_2 %vd			0.72	0.73	0.71	**0.72**
O_2 %vd			19.81	19.73	19.75	**19.76**
Static Press., "H_2O			0.56	0.56	0.56	**0.56**
H_2O %v			1.92	1.87	1.94	**1.91**
Wet Molecular Weight, lb/lb-mole			28.70	28.71	28.69	**28.70**
Velocity, FPS			72.58	71.54	72.20	**72.11**
ADCFM			30,193.0	29,775.6	30,028.8	**29,999.1**
AWCFM			30,784.1	30,343.0	30,622.9	**30,583.3**
DSCFM			21,259.4	20,840.4	20,978.8	**21,026.2**
Stack Temperature, ^oF			289.9	294.4	295.8	**293.4**
Production Data	Glass Production	lbs/hr	61.0	61.0	61.0	**61.0**

Hollingsworth & Vose **Test: M29**
CFU 114
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	< 0.337	< 2.68E-05	< 4.40E-07	< 1.250	< 0.241	< 1.92E-05	< 3.14E-07	< 0.500	< 0.096	< 7.66E-06	< 1.26E-07	**Sb**
Arsenic	< 2.450	< 0.472	< 3.75E-05	< 6.16E-07	< 1.750	< 0.337	< 2.68E-05	< 4.40E-07	< 0.700	< 0.135	< 1.07E-05	< 1.76E-07	**As**
Barium	0.559	0.108	8.57E-06	1.40E-07	0.559	0.108	8.57E-06	1.40E-07	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.013	< 1.07E-06	< 1.76E-08	< 0.050	< 0.010	< 7.66E-07	< 1.26E-08	< 0.020	< 0.004	< 3.07E-07	< 5.03E-09	**Be**
Cadmium	< 0.140	< 0.027	< 2.15E-06	< 3.52E-08	< 0.100	< 0.019	< 1.53E-06	< 2.51E-08	< 0.040	< 0.008	< 6.13E-07	< 1.00E-08	**Cd**
Chromium	0.162	0.031	2.48E-06	4.07E-08	0.162	0.031	2.48E-06	4.07E-08	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.034	< 2.68E-06	< 4.40E-08	< 0.125	< 0.024	< 1.92E-06	< 3.14E-08	< 0.050	< 0.010	< 7.66E-07	< 1.26E-08	**Co**
Copper	3.138	0.604	4.81E-05	7.88E-07	1.678	0.323	2.57E-05	4.22E-07	1.460	0.281	2.24E-05	3.67E-07	**Cu**
Lead	< 1.750	< 0.337	< 2.68E-05	< 4.40E-07	< 1.250	< 0.241	< 1.92E-05	< 3.14E-07	< 0.500	< 0.096	< 7.66E-06	< 1.26E-07	**Pb**
Manganese	0.649	0.125	9.94E-06	1.63E-07	0.649	0.125	9.94E-06	1.63E-07	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.200	< 0.231	< 1.84E-05	< 3.01E-07	0.900	0.173	1.38E-05	2.26E-07	< 0.300	< 0.058	< 4.60E-06	< 7.54E-08	**Ni**
Phosphorus	< 7.000	< 1.347	< 1.07E-04	< 1.76E-06	< 5.000	< 0.962	< 7.66E-05	< 1.26E-06	< 2.000	< 0.385	< 3.07E-05	< 5.02E-07	**P**
Selenium	< 5.250	< 1.010	< 8.05E-05	< 1.32E-06	< 3.750	< 0.722	< 5.75E-05	< 9.42E-07	< 1.500	< 0.289	< 2.30E-05	< 3.769E-07	**Se**
Zinc	14.168	2.727	2.17E-04	3.56E-06	13.020	2.506	2.00E-04	3.27E-06	1.148	0.221	1.76E-05	2.884E-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	< 0.344	< 2.68E-05	< 4.40E-07	< 1.250	< 0.245	< 1.92E-05	< 3.14E-07	< 0.500	< 0.098	< 7.67E-06	< 1.26E-07	**Sb**
Arsenic	< 2.450	< 0.481	< 3.76E-05	< 6.16E-07	< 1.750	< 0.344	< 2.68E-05	< 4.40E-07	< 0.700	< 0.137	< 1.07E-05	< 1.76E-07	**As**
Barium	0.409	0.080	6.27E-06	1.03E-07	0.409	0.080	6.27E-06	1.03E-07	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.014	< 1.07E-06	< 1.76E-08	< 0.050	< 0.010	< 7.67E-07	< 1.26E-08	< 0.020	< 0.004	< 3.07E-07	< 5.03E-09	**Be**
Cadmium	< 0.140	< 0.027	< 2.15E-06	< 3.52E-08	< 0.100	< 0.020	< 1.53E-06	< 2.51E-08	< 0.040	< 0.008	< 6.13E-07	< 1.00E-08	**Cd**
Chromium	0.142	0.028	2.18E-06	3.57E-08	0.142	0.028	2.18E-06	3.57E-08	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.034	< 2.68E-06	< 4.40E-08	< 0.125	< 0.025	< 1.92E-06	< 3.14E-08	< 0.050	< 0.010	< 7.67E-07	< 1.26E-08	**Co**
Copper	2.108	0.414	3.23E-05	5.30E-07	1.168	0.229	1.79E-05	2.94E-07	0.940	0.185	1.44E-05	2.36E-07	**Cu**
Lead	< 1.750	< 0.344	< 2.68E-05	< 4.40E-07	< 1.250	< 0.245	< 1.92E-05	< 3.14E-07	< 0.500	< 0.098	< 7.67E-06	< 1.26E-07	**Pb**
Manganese	0.293	0.058	4.49E-06	7.36E-08	0.293	0.058	4.49E-06	7.36E-08	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	0.405	0.080	6.21E-06	1.02E-07	0.000	0.000	0.00E+00	0.00E+00	0.405	0.080	6.21E-06	1.02E-07	**Ni**
Phosphorus	< 7.000	< 1.375	< 1.07E-04	< 1.76E-06	< 5.000	< 0.982	< 7.67E-05	< 1.26E-06	< 2.000	< 0.393	< 3.07E-05	< 5.03E-07	**P**
Selenium	< 5.250	< 1.031	< 8.05E-05	< 1.32E-06	< 3.750	< 0.736	< 5.75E-05	< 9.42E-07	< 1.500	< 0.295	< 2.30E-05	< 3.77E-07	**Se**
Zinc	10.508	2.064	1.61E-04	2.64E-06	9.920	1.948	1.52E-04	2.49E-06	0.588	0.115	9.01E-06	1.48E-07	**Zn**

Hollingsworth & Vose **Test: M29**
CFU 114
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	< 3.910	< 0.762	< 5.99E-05	< 9.82E-07	< 1.250	< 0.244	< 1.92E-05	< 3.14E-07	2.660	0.519	4.08E-05	6.68E-07	**Sb**
Arsenic	< 2.450	< 0.478	< 3.75E-05	< 6.15E-07	< 1.750	< 0.341	< 2.68E-05	< 4.40E-07	< 0.700	< 0.136	< 1.07E-05	< 1.76E-07	**As**
Barium	0.279	0.054	4.28E-06	7.01E-08	0.279	0.054	4.28E-06	7.01E-08	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.014	< 1.07E-06	< 1.76E-08	< 0.050	< 0.010	< 7.66E-07	< 1.26E-08	< 0.020	< 0.004	< 3.06E-07	< 5.02E-09	**Be**
Cadmium	< 0.140	< 0.027	< 2.15E-06	< 3.52E-08	< 0.100	< 0.019	< 1.53E-06	< 2.51E-08	< 0.040	< 0.008	< 6.13E-07	< 1.00E-08	**Cd**
Chromium	0.192	0.037	2.94E-06	4.82E-08	0.192	0.037	2.94E-06	4.82E-08	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.034	< 2.68E-06	< 4.40E-08	< 0.125	< 0.024	< 1.92E-06	< 3.14E-08	< 0.050	< 0.010	< 7.66E-07	< 1.26E-08	**Co**
Copper	1.938	0.378	2.97E-05	4.87E-07	1.158	0.226	1.77E-05	2.91E-07	0.780	0.152	1.20E-05	1.96E-07	**Cu**
Lead	< 1.750	< 0.341	< 2.68E-05	< 4.40E-07	< 1.250	< 0.244	< 1.92E-05	< 3.14E-07	< 0.500	< 0.097	< 7.66E-06	< 1.26E-07	**Pb**
Manganese	0.240	0.047	3.67E-06	6.02E-08	0.240	0.047	3.67E-06	6.02E-08	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 0.460	< 0.090	< 7.05E-06	< 1.16E-07	0.160	0.031	2.45E-06	4.02E-08	< 0.300	< 0.058	< 4.60E-06	< 7.53E-08	**Ni**
Phosphorus	< 7.000	< 1.365	< 1.07E-04	< 1.76E-06	< 5.000	< 0.975	< 7.66E-05	< 1.26E-06	< 2.000	< 0.390	< 3.06E-05	< 5.02E-07	**P**
Selenium	< 5.250	< 1.024	< 8.04E-05	< 1.32E-06	< 3.750	< 0.731	< 5.75E-05	< 9.42E-07	< 1.500	< 0.292	< 2.30E-05	< 3.767E-07	**Se**
Zinc	1.608	0.314	2.46E-05	4.04E-07	0.920	0.179	1.41E-05	2.31E-07	0.688	0.134	1.05E-05	1.728E-07	**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	< 2.470	< 0.481	< 3.79E-05	< 6.20E-07	< 1.250	< 0.243	< 1.92E-05	< 3.14E-07	< 1.220	< 0.238	< 1.87E-05	< 3.06E-07	**Sb**
Arsenic	< 2.450	< 0.477	< 3.75E-05	< 6.16E-07	< 1.750	< 0.341	< 2.68E-05	< 4.40E-07	< 0.700	< 0.136	< 1.07E-05	< 1.76E-07	**As**
Barium	0.416	0.081	6.37E-06	1.04E-07	0.416	0.081	6.37E-06	1.04E-07	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.014	< 1.07E-06	< 1.76E-08	< 0.050	< 0.010	< 7.66E-07	< 1.26E-08	< 0.020	< 0.004	< 3.07E-07	< 5.03E-09	**Be**
Cadmium	< 0.140	< 0.027	< 2.15E-06	< 3.52E-08	< 0.100	< 0.019	< 1.53E-06	< 2.51E-08	< 0.040	< 0.008	< 6.13E-07	< 1.00E-08	**Cd**
Chromium	0.165	0.032	2.53E-06	4.15E-08	0.165	0.032	2.53E-06	4.15E-08	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.034	< 2.68E-06	< 4.40E-08	< 0.125	< 0.024	< 1.92E-06	< 3.14E-08	< 0.050	< 0.010	< 7.66E-07	< 1.26E-08	**Co**
Copper	2.395	0.465	3.67E-05	6.02E-07	1.335	0.259	2.05E-05	3.35E-07	1.060	0.206	1.62E-05	2.66E-07	**Cu**
Lead	< 1.750	< 0.341	< 2.68E-05	< 4.40E-07	< 1.250	< 0.243	< 1.92E-05	< 3.14E-07	< 0.500	< 0.097	< 7.66E-06	< 1.26E-07	**Pb**
Manganese	0.394	0.076	6.04E-06	9.89E-08	0.394	0.076	6.04E-06	9.89E-08	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 0.688	< 0.133	< 1.05E-05	< 1.73E-07	0.353	0.068	5.41E-06	8.88E-08	< 0.335	< 0.065	< 5.13E-06	< 8.42E-08	**Ni**
Phosphorus	< 7.000	< 1.362	< 1.07E-04	< 1.76E-06	< 5.000	< 0.973	< 7.66E-05	< 1.26E-06	< 2.000	< 0.389	< 3.07E-05	< 5.02E-07	**P**
Selenium	< 5.250	< 1.022	< 8.05E-05	< 1.32E-06	< 3.750	< 0.730	< 5.75E-05	< 9.42E-07	< 1.500	< 0.292	< 2.30E-05	< 3.769E-07	**Se**
Zinc	8.761	1.701	1.34E-04	2.20E-06	7.953	1.544	1.22E-04	2.00E-06	0.808	0.157	1.24E-05	2.03E-07	**Zn**
Total:	**< 32.124**	**< 6.246**	**< 4.92E-04**	**< 8.07E-06**	< 23.891	< 4.645	< 3.66E-04	< 6.00E-06	< 8.233	< 1.602	< 1.26E-04	< 2.07E-06	

'<' 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:**	**8:05**
Source:	**CFU 114**	**End Time:**	**11:12**
Method:	**29**	**Date:**	**6/7/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.136 "Hg

where Pb: 29.88 "Hg
ΔH: 3.488 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.921 "Hg

where Pb: 29.88 "Hg
Static Press.: 0.56 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 183.478 dscf

where Vm: 183.224 dcf
Y: 0.9963
Pm: 30.136 "Hg
Tm: 528.9 °A

4) $V_w(std) = (0.04706)(H_2O)$ = 3.600 scf

where H_2O: 76.50 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0192

where Vw(std): 3.600 scf
Vm(std): 183.478 dscf

6) % H_2O = Bws x 100 = 1.92 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 265.785 awcf

where Y: 0.9963
Vm: 183.2239 dcf
Bws: 0.0192
Ts: 749.9 °A
Tm: 528.9 °A
Pm: 30.136 "Hg
Ps: 29.921 "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: 0.72 %vd
O_2 19.81 %vd
N_2+CO= (100-(O_2+CO_2): 79.47 %vd

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.70 lb/lb-mole
where M_d: 28.91 lb/lb-mole
Bws: 0.0192

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 7.069 sq. ft.
where Stack ID: 36 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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 72.58 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.0816
Ts: 749.9 °A
Ps: 29.921 "Hg
Ms: 28.70 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 30,784.1 AWCFM
where V_s: 72.58 ft/sec
Stack Area: 7.069 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 30,193.0 ADCFM
where AWCFM: 30,784.1
Bws: 0.0192

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\text{ "Hg}}\right)$ = 1,300,536.5 wscf/hr
where V_s: 72.58 ft/sec
Stack Area: 7.0690 sq. ft.
Ts: 749.9 °A
Ps: 29.921 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,275,566.2 dscf/hr
where wscf/hr: 1,300,536.5
Bws: 0.0192

16) DSCFM= (dscf/hr)/60 mins/hr = 21,259.4 DSCFM
where dscf/hr: 1,275,566.2

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000338 sq. ft.
where Nozzle Size: 0.2490 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 114**	**Date:**	**6/7/2018**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.3 %

where Ts:	749.9	°A
Vm(Std):	183.478	dscf
Ps:	29.921	"Hg
Vs	72.58	ft/sec
Nozzle Area:	0.000338	sq. ft.
Sampling Time:	180	min.
Bws:	0.0192	

EPA Method 29:
Chromium

19) Cr Laboratory Results (blank corrected)

Front half (FH):	0.162 µg/sample
Back half (BH):	0.000 µg/sample
Total (FH + BH):	0.162 µg/sample

20) Cs = µg/Vm(std) = 0.031 µg/dscm

where Run 1 Total:	0.162	µg/sample
Vm(std):	5.196	dscm

21) Emission Rate = (Cs)$\left(\frac{2.83168\ m^3}{ft^3}\right)$(stack flow)$\left(\frac{2.2046E-9\ lb}{\mu g}\right)$= 2.48E-06 lb/hr

where Cs:	0.031	µg/dscm
Stack Flow:	1,275,566.2	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 114**
DATE(S)	**06/07/18**
METHOD	**30B**
POLLUTANT	**Mercury**

Ohio Lumex Co., Inc.
30350 Bruce Industrial Parkway
Solon, OH 44139
Phone: (440)264-2500
www.ohiolumex.com

Sorbent Trap Spike Level Worksheet

C	Expected mercury concentration	0.00426	µg/dscm	
q	Expected average sample rate	2000	cm^3/min	cc/min
Ø	Expected sample duration	3	hours	
Vm	Total sample volume expected	0.36	dscm	Vm = q x Ø x 60 x 1e-6
M	Expected mass HG on sorbent trap	1.5336	ng	m = C x Vm x 1,000

S_{low}	Low range of spike	0.7668	ng	S_{low} = m x 0.5
S_{mid}	Mid range of spike	1.5336	ng	S_{mid} = m x 1
S_{high}	High range of spike	2.3004	ng	S_{high} = m x 1.5

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:06**
Source:	**CFU 114**	**End Time:**	**11:12**
EPA Method:	**30B**	**Start Date:**	**6/7/2018**
Box Operator:	**CMF**	**End Date:**	**6/7/2018**
Technician(s):	**CSW**		

Pre-Test Information:

Barometric Pressure:	29.88 "Hg
Test duration:	180 min

Equipment:

	Side A	Side B
Probe ID:	HLN 30B	
Probe heat:	250 F	
Meterbox ID:	Hln Duel #2	Hln Duel #2
Y factor:	1.0420	1.0460
Desired sampling rate:	2	2 lpm
Trap ID#:	OL464792	OLC055185
Spiked @:	5	0 ng
Orifice # (if used):		

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	17	16	25	25
Train leak rate, lpm	0.001	0.002	0.500	0.066

Test Summary:

	Side A	Side B	
Sample Volume:	360.592	360.566	L
Ave. Meter Temp:	80.9	85.1	°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	285	285	63	68	4	6	249	255	2.000	2.000
5	9.400	9.500	285	285	64	69	5	6	255	260	1.880	1.900
10	18.970	18.910	286	286	65	71	6	8	251	254	1.914	1.882
15	28.820	28.750	287	287	67	76	7	9	250	254	1.970	1.968
20	38.630	38.650	287	287	68	74	7	10	250	245	1.962	1.980
25	48.380	48.420	288	288	70	75	7	10	244	256	1.950	1.954
30	58.160	58.200	289	289	72	77	9	10	248	251	1.956	1.956
35	68.120	68.180	289	289	74	79	9	10	248	251	1.992	1.996
40	78.400	78.470	289	289	74	79	9	10	244	241	2.056	2.058
45	88.650	88.810	289	289	77	81	9	10	251	255	2.050	2.068
50	99.480	99.550	290	290	78	82	9	10	251	252	2.166	2.148
55	110.510	110.410	290	290	79	84	7	10	262	266	2.206	2.172
60	121.090	121.450	290	290	80	85	7	10	260	261	2.116	2.208
65	131.880	131.920	291	291	82	86	7	10	266	268	2.158	2.094
70	142.370	142.320	291	291	82	86	7	9	256	258	2.098	2.080
75	152.770	152.770	291	291	83	87	7	9	258	255	2.080	2.090
80	163.000	163.010	287	287	84	88	6	8	254	249	2.046	2.048
85	173.030	173.040	276	276	85	88	6	8	266	267	2.006	2.006
90	183.127	183.078	290	290	85	88	6	7	258	256	2.019	2.008
95	193.020	193.010	290	290	85	88	6	7	255	256	1.979	1.986
100	202.990	202.970	292	292	85	88	6	7	260	262	1.994	1.992
105	212.560	212.540	292	292	85	89	6	7	268	266	1.914	1.914
110	222.270	222.270	293	293	85	89	6	7	262	260	1.942	1.946
115	232.220	232.170	293	293	86	89	6	7	254	259	1.990	1.980
120	242.130	242.150	293	293	86	90	6	7	268	266	1.982	1.996
125	251.940	251.900	292	292	86	90	6	7	266	264	1.962	1.950
130	261.450	261.490	292	292	86	90	6	7	268	266	1.902	1.918
135	270.990	270.970	292	292	87	90	6	7	268	266	1.908	1.896
140	280.520	280.550	292	292	87	90	6	7	267	266	1.906	1.916
145	290.060	290.120	292	292	87	90	6	7	268	266	1.908	1.914
150	299.690	299.660	292	292	87	90	6	7	268	266	1.926	1.908
155	310.020	309.960	292	292	87	90	6	7	268	266	2.066	2.060
160	320.220	320.300	293	293	88	92	6	7	268	266	2.040	2.068
165	330.500	330.430	292	292	88	92	6	8	255	266	2.056	2.026
170	340.650	340.700	292	292	88	92	6	7	266	265	2.030	2.054
175	350.780	350.690	292	292	88	92	6	8	268	266	2.026	1.998
180	360.592	360.566	292	292	89	93	6	8	268	266	1.962	1.975

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:40**
Source:	**CFU 114**	**End Time:**	**14:49**
EPA Method:	**30B**	**Start Date:**	**6/7/2018**
Box Operator:	**CMF**	**End Date:**	**6/7/2018**
Technician(s):	**CSW**		

Pre-Test Information:

Barometric Pressure:	29.88 "Hg
Test duration:	180 min

Equipment:

Probe ID:	HLN 30B	
Probe heat:	250 F	
	Side A	Side B
Meterbox ID:	Hln Duel #2	Hln Duel #2
Y factor:	1.0420	1.0460
Desired sampling rate:	2	2 lpm
Trap ID#:	OL464794	OLC055071
Spiked @:	5	0 ng
Orifice # (if used):		

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	15	16	20	21
Train leak rate, lpm	0.017	0.005	0.009	0.008

Test Summary:

	Side A	Side B	
Sample Volume:	360.756	360.697	L
Ave. Meter Temp:	88.0	91.2	°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	292	292	85	87	5	7	266	268	2.000	2.000
5	9.740	9.750	292	292	84	86	6	7	266	268	1.948	1.950
10	19.900	19.900	292	292	83	86	6	7	266	268	2.032	2.030
15	30.090	30.080	292	292	83	87	6	7	266	268	2.038	2.036
20	40.320	40.290	294	294	84	87	6	7	266	268	2.046	2.042
25	50.400	50.390	294	294	84	87	6	7	266	268	2.016	2.020
30	60.510	60.490	295	295	86	89	6	7	266	268	2.022	2.020
35	70.610	70.670	295	295	86	89	6	7	266	268	2.020	2.036
40	80.730	80.730	295	295	86	90	6	7	267	268	2.024	2.012
45	90.900	91.000	295	295	87	91	6	7	266	268	2.034	2.054
50	101.070	101.030	294	294	87	91	6	7	266	268	2.034	2.006
55	111.220	111.190	294	294	88	92	6	7	266	268	2.030	2.032
60	121.338	121.380	295	295	88	92	6	7	266	268	2.024	2.038
65	131.570	131.570	296	296	89	93	6	7	266	268	2.046	2.038
70	141.750	141.750	296	296	89	93	6	7	266	268	2.036	2.036
75	151.920	151.880	296	296	89	93	6	7	266	268	2.034	2.026
80	161.640	161.700	294	294	89	93	6	7	266	268	1.944	1.964
85	171.330	171.340	287	287	90	83	6	7	266	268	1.938	1.928
90	181.046	181.005	285	285	90	93	6	7	266	268	1.943	1.933
95	191.250	191.260	294	294	89	92	6	7	266	268	2.041	2.051
100	201.010	201.010	294	294	88	91	6	7	266	268	1.952	1.950
105	211.020	210.990	294	294	88	91	6	7	266	268	2.002	1.996
110	221.050	221.000	294	294	88	91	6	7	266	268	2.006	2.002
115	230.860	230.850	295	295	88	91	6	7	266	268	1.962	1.970
120	240.700	240.760	295	295	89	91	6	7	266	268	1.968	1.982
125	250.310	250.490	297	297	88	92	6	7	266	268	1.922	1.946
130	260.040	260.080	297	297	89	92	6	7	266	268	1.946	1.918
135	270.080	270.080	296	296	89	92	6	7	266	268	2.008	2.000
140	280.140	280.160	296	296	89	93	6	7	266	268	2.012	2.016
145	290.200	290.240	298	298	90	94	6	7	266	268	2.012	2.016
150	300.260	300.260	297	297	90	94	6	7	266	268	2.012	2.004
155	310.330	310.310	298	298	90	94	6	7	266	268	2.014	2.010
160	320.420	320.360	298	298	91	95	6	7	266	268	2.018	2.010
165	330.490	330.490	282	282	91	95	6	7	266	268	2.014	2.026
170	340.590	340.650	282	282	91	95	6	7	266	268	2.020	2.032
175	350.650	350.650	284	284	91	95	6	7	266	267	2.012	2.000
180	360.756	360.697	284	284	91	95	6	7	266	267	2.021	2.009

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**15:06**
Source:	**CFU 114**	**End Time:**	**18:11**
EPA Method:	**30B**	**Start Date:**	**6/7/2018**
Box Operator:	**CMF**	**End Date:**	**6/7/2018**
Technician(s):	**CSW**		

Pre-Test Information:

Barometric Pressure:	29.88 "Hg
Test duration:	180 min

Equipment:

Probe ID:	HLN 30B	
Probe heat:	250 F	
	Side A	Side B
Meterbox ID:	Hln Duel #2	Hln Duel #2
Y factor:	1.0420	1.0460
Desired sampling rate:	2	2 lpm
Trap ID#:	OL464785	OL469648
Spiked @:	5	0 ng
Orifice # (if used):		

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	19	19	15	16
Train leak rate, lpm	0.001	0.002	0.004	0.009

Test Summary:

	Side A	Side B	
Sample Volume:	360.040	360.036	L
Ave. Meter Temp:	92.5	95.9	°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	296	296	90	93	6	7	266	268	2.000	2.000
5	10.020	10.050	297	297	90	93	6	7	266	268	2.004	2.010
10	20.120	20.120	296	296	90	93	6	7	268	266	2.020	2.014
15	30.280	30.290	296	296	89	93	6	8	266	268	2.032	2.034
20	40.320	40.320	296	296	89	94	6	8	267	267	2.008	2.006
25	50.460	50.460	298	298	90	94	6	8	266	268	2.028	2.028
30	60.590	60.560	299	299	90	94	6	8	266	268	2.026	2.020
35	70.640	70.720	300	300	91	95	6	8	268	268	2.010	2.032
40	80.740	80.740	299	299	91	95	6	8	266	267	2.020	2.004
45	90.850	90.890	301	301	91	95	6	8	268	266	2.022	2.030
50	100.960	100.950	301	301	92	95	6	8	268	266	2.022	2.012
55	111.080	111.050	301	301	92	96	6	8	268	266	2.024	2.020
60	121.190	121.200	300	300	92	96	6	9	268	266	2.022	2.030
65	131.350	131.330	299	299	93	96	6	9	268	266	2.032	2.026
70	141.440	141.450	298	298	93	96	6	8	268	266	2.018	2.024
75	151.550	151.610	297	297	93	96	6	9	267	267	2.022	2.032
80	161.640	161.640	298	298	93	97	6	9	268	266	2.018	2.006
85	171.700	171.690	290	290	94	97	6	9	268	269	2.012	2.010
90	181.929	181.871	292	292	94	97	6	9	268	266	2.046	2.036
95	191.620	191.610	297	297	94	97	6	9	268	266	1.938	1.948
100	201.340	201.330	298	298	93	96	6	8	268	266	1.944	1.944
105	211.200	211.150	297	297	93	96	6	8	268	266	1.972	1.964
110	220.990	220.960	298	298	93	96	6	8	268	266	1.958	1.962
115	230.500	230.410	298	298	93	96	6	8	268	266	1.902	1.890
120	240.210	240.280	298	298	93	96	6	8	267	267	1.942	1.974
125	250.250	250.170	298	298	93	96	6	8	268	266	2.008	1.978
130	260.310	260.260	296	296	93	97	6	8	267	267	2.012	2.018
135	270.340	270.360	295	295	94	97	6	8	266	268	2.006	2.020
140	280.420	280.380	295	295	94	97	6	8	266	268	2.016	2.004
145	290.530	290.410	295	295	94	97	6	8	268	269	2.022	2.006
150	300.550	300.510	294	294	94	97	6	8	266	268	2.004	2.020
155	310.630	310.650	294	294	94	97	6	8	266	267	2.016	2.028
160	320.690	320.700	294	294	94	97	6	8	266	268	2.012	2.010
165	330.460	330.520	294	294	94	97	6	7	266	267	1.954	1.964
170	340.250	340.190	293	293	94	97	6	7	266	268	1.958	1.934
175	349.990	349.990	293	293	94	98	6	7	267	268	1.948	1.960
180	360.040	360.036	293	293	94	98	6	7	267	268	2.010	2.009

Method 30B
Mercury Concentration

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 114
Test date: 6/7/2018

Meterbox Y:
Side A 1.0420
Side B 1.0460

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	6/7/2018	OL464792	5.0	5.9	0.2	1.1	1.10E-03	360.592	375.737	29.88	80.9	0.366	3.00E-03	3.15E-03
	B		OLC055185	0.0	0.9	0.3	1.2	1.20E-03	360.566	377.152		85.1	0.365	3.29E-03	
2	A	6/7/2018	OL464794	5.0	5.8	0.6	1.4	1.40E-03	360.756	375.908	29.88	88.0	0.362	3.87E-03	6.65E-03
	B		OLC055071	0.0	1.0	2.4	3.4	3.40E-03	360.697	377.289		91.2	0.361	9.42E-03	
3	A	6/7/2018	OL464785	5.0	5.8	0.5	1.3	1.30E-03	360.040	375.162	29.88	92.5	0.358	3.63E-03	4.05E-03
	B		OL469648	0.0	1.1	0.5	1.6	1.60E-03	360.036	376.598		95.9	0.357	4.48E-03	

Average: 4.62E-03

Trap Concentrations Example Calculations:
Run 1, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 1.1 ng
   where Section 1: 5.9 ng
   Section 2: 0.2 ng
   Spike: 5.0 ng

2. Conversion to µg — Total Hg ng/1000 = 1.10E-03 µg
   where Total Hg ng: 1.1 ng

3. Corrected sample volume — = DGM reading x Meterbox Y factor = 375.737 L
   where DGM reading: 360.592 L
   Y: 1.042

4. Standard Volume (DSCM) — = Sample Vol. (L) x $\left(\frac{528\,^{\circ}\text{A}}{Tm+460}\right)$ x Bp/29.92 "Hg /1000 = 0.366 DSCM
   where Sample vol.: 375.737 L
   T_m: 80.9 °F
   B_p: 29.88 "Hg

5. Hg concentration µg/dscm — = Total Hg µg / Volume DSCM = 0.003 µg/dscm
   where Total Hg: 1.10E-03 µg
   DSCM: 0.366

6. Average Pair Concentration — = (Side A Conc.+ Side B Conc.)/2 = 0.003 µg/dscm
   where Side A: 3.00E-03 µg/dscm
   Side B: 3.29E-03 µg/dscm

Method 30B
Results QA/QC

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 114
Test date: 6/7/2018
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 B	6/7/2018	OL464792 OLC055185	5 0	5.9 0.9	0.2 0.3	1.1 1.2	3.00E-03 3.29E-03	3.39 33.33	PASS See emissions limit	1.34E-02	97.9	PASS	4.55	PASS
2	A B	6/7/2018	OL464794 OLC055071	5 0	5.8 1.00	0.6 2.4	1.4 3.4	3.87E-03 9.42E-03	10.34 240.00	PASS Hg <0.1 µg/dscm	8.27E-03	59.9	FAIL	41.76	PASS
3	A B	6/7/2018	OL464785 OL469648	5 0	5.8 1.1	0.5 0.5	1.3 1.6	3.63E-03 4.48E-03	8.62 45.45	PASS See emissions limit	1.31E-02	93.9	PASS	10.46	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: 0.004615493 µg/dscm

2. Field Recovery Test

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 114
Test date: 6/7/2018

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	3.15E-03	1.96E-13	1,275,566.2	61.0	2.51E-07	4.11E-09
2	6.65E-03	4.15E-13	1,250,425.9	61.0	5.19E-07	8.50E-09
3	4.05E-03	2.53E-13	1,258,725.7	61.0	3.19E-07	5.22E-09
Average Results:	3.60E-03	2.25E-13	1,267,146.0	61.0	2.85E-07	4.67E-09

*From direct stack measurements made during concurrent M29 runs
Red = Run 2 was voided due to high breakthrough and failed QA checks.
averaged results are based on Runs 1 snd 3 only.

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 117**
Facility	**Glass Plant 2**	Date	**June 7, 2018**
Location	**Corvallis, OR**		

Run	1	2	3	
Date	6/7/2018	6/7/2018	6/7/2018	
Run Start Time	8:05	11:40	15:05	
Run End Time	11:12	14:49	18:12	
CO_2 %vd	0.72	0.73	0.71	0.72
O_2 %vd	19.81	19.73	19.75	19.76

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 7, 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**
	zero	0.06	0.09	0.15	pass	0.12	0.30	pass	0.15	pass				
Run 1	upscale	9.96	9.93	-0.15	pass	10.04	0.40	pass	0.55	pass	20	19.68	19.81	10
	zero	0.06	0.12	0.30	pass	0.14	0.40	pass	0.10	pass				
Run 2	upscale	9.96	10.04	0.40	pass	10.02	0.30	pass	-0.10	pass	20	19.66	19.73	10
	zero	0.06	0.14	0.40	pass	0.14	0.40	pass	0.00	pass				
Run 3	upscale	9.96	10.02	0.30	pass	10.01	0.25	pass	-0.05	pass	20	19.64	19.75	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.06	9.96	20.05
Analyzer Cal. Error	0.30	-0.20	0.25
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 7, 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**
	zero	0.05	0.11	1.50	pass	0.09	1.00	pass	-0.50	pass				
Run 1	upscale	1.89	1.89	0.00	pass	1.93	1.00	pass	1.00	pass	4	0.75	0.72	2
	zero	0.05	0.09	1.00	pass	0.08	0.75	pass	-0.25	pass				
Run 2	upscale	1.89	1.93	1.00	pass	1.90	0.25	pass	-0.75	pass	4	0.75	0.73	2
	zero	0.05	0.08	0.75	pass	0.10	1.25	pass	0.50	pass				
Run 3	upscale	1.89	1.90	0.25	pass	1.93	1.00	pass	0.75	pass	4	0.74	0.71	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.05	1.89	4.06
Analyzer Cal. Error	1.25	-2.75	1.50
Analyzer Cal. Error < 2%*	pass	pass	pass

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:05**
Source:	**CFU 117**	**End Time:**	**11:12**
Method:	**3A**	**Date:**	**6/7/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.20 %v

where C_{Dir}:	9.96	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}:	9.96	ppmv
C_S:	9.93	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.55 %v

where SB_{Final}:	0.40	ppmv
SB_i:	-0.15	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.81 ppmv

where C_{Avg}:	19.68	ppmv
C_O:	0.11	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:**	**8:05**
Source:	**CFU 117**	**End Time:**	**11:12**
Method:	**3A**	**Date:**	**6/7/2018**

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) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.00 %v

where C_{Dir}: 1.89 ppmv
C_S: 1.89 ppmv
CS: 4.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 1.00 %v

where SB_{Final}: 1.00 ppmv
SB_i: 0.00 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.72 ppmv

where C_{Avg}: 0.75 ppmv
C_O: 0.10 ppmv
C_{MA}: 2.00 ppmv
C_M: 1.91 ppmv

Hollingsworth & Vose

6/7/2018

CFU 114

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/7/2018	6:45:00	20.05	19.66		
6/7/2018	6:45:10	20.05	19.67		
6/7/2018	6:45:20	20.05	19.67		
6/7/2018	6:45:30	20.05	19.68	20.05	
6/7/2018	6:45:40	19.92	19.68		
6/7/2018	6:45:50	17.41	17.19		
6/7/2018	6:46:00	9.85	9.56		
6/7/2018	6:46:10	9.99	9.88		
6/7/2018	6:46:20	9.98	9.87		
6/7/2018	6:46:30	9.97	9.85		
6/7/2018	6:46:40	9.95	9.85		
6/7/2018	6:46:50	9.96	9.84	9.96	
6/7/2018	6:47:00	9.01	9.78		
6/7/2018	6:47:10	8.71	9.74		
6/7/2018	6:47:20	5.93	5.06		
6/7/2018	6:47:30	0.26	0.21		
6/7/2018	6:47:40	3.35	3.54		
6/7/2018	6:47:50	4.00	4.19		
6/7/2018	6:48:00	3.98	4.19		
6/7/2018	6:48:10	3.99	4.20		
6/7/2018	6:48:20	3.99	4.21		
6/7/2018	6:48:30	4.00	4.18		
6/7/2018	6:48:40	4.00	4.07		
6/7/2018	6:48:50	4.00	4.06		
6/7/2018	6:49:00	4.00	4.06		4.06
6/7/2018	6:49:10	4.00	4.06		
6/7/2018	6:49:20	2.34	2.23		
6/7/2018	6:49:30	2.01	1.92		
6/7/2018	6:49:40	2.01	1.89		
6/7/2018	6:49:50	2.01	1.89		
6/7/2018	6:50:00	2.01	1.89		
6/7/2018	6:50:10	2.01	1.89		
6/7/2018	6:50:20	2.01	1.89		
6/7/2018	6:50:30	2.01	1.88		1.89
6/7/2018	6:50:40	2.00	1.90		
6/7/2018	6:50:50	1.48	1.21		
6/7/2018	6:51:00	0.21	0.10		
6/7/2018	6:51:10	0.06	0.05		
6/7/2018	6:51:20	0.06	0.05		
6/7/2018	6:51:30	0.06	0.05		

Hollingsworth & Vose

6/7/2018

CFU 114

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/7/2018	6:51:40	0.06	0.05		
6/7/2018	6:51:50	0.06	0.05	0.06	0.05
System					
6/7/2018	6:52:00	0.06	0.05		
6/7/2018	6:52:10	15.21	0.96		
6/7/2018	6:52:20	21.91	0.25		
6/7/2018	6:52:30	15.98	0.76		
6/7/2018	6:52:40	13.44	0.46		
6/7/2018	6:52:50	4.93	0.22		
6/7/2018	6:53:00	1.53	0.13		
6/7/2018	6:53:10	0.59	0.11		
6/7/2018	6:53:20	0.23	0.11		
6/7/2018	6:53:30	0.14	0.10		
6/7/2018	6:53:40	0.12	0.10		
6/7/2018	6:53:50	0.10	0.11		
6/7/2018	6:54:00	0.09	0.10		
6/7/2018	6:54:10	0.09	0.10		
6/7/2018	6:54:20	0.09	0.10		
6/7/2018	6:54:30	0.09	0.10		
6/7/2018	6:54:40	0.09	0.11		
6/7/2018	6:54:50	0.09	0.11		
6/7/2018	6:55:00	0.09	0.10	0.09	0.11
6/7/2018	6:55:10	0.11	0.11		
6/7/2018	6:55:20	0.81	0.10		
6/7/2018	6:55:30	1.28	0.25		
6/7/2018	6:55:40	1.79	1.43		
6/7/2018	6:55:50	1.97	1.77		
6/7/2018	6:56:00	2.00	1.83		
6/7/2018	6:56:10	2.01	1.85		
6/7/2018	6:56:20	2.02	1.88		
6/7/2018	6:56:30	2.03	1.89		
6/7/2018	6:56:40	2.04	1.89		
6/7/2018	6:56:50	2.03	1.89		
6/7/2018	6:57:00	2.04	1.89		1.89
6/7/2018	6:57:10	2.73	1.86		
6/7/2018	6:57:20	13.03	0.95		
6/7/2018	6:57:30	15.64	1.80		

Hollingsworth & Vose

6/7/2018

CFU 114

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/7/2018	6:57:40	11.24	7.25		
6/7/2018	6:57:50	10.20	9.04		
6/7/2018	6:58:00	9.99	9.43		
6/7/2018	6:58:10	9.95	9.52		
6/7/2018	6:58:20	9.94	9.54		
6/7/2018	6:58:30	9.94	9.55		
6/7/2018	6:58:40	9.94	9.57		
6/7/2018	6:58:50	9.94	9.56		
6/7/2018	6:59:00	9.94	9.57		
6/7/2018	6:59:10	9.94	9.58		
6/7/2018	6:59:20	9.94	9.58		
6/7/2018	6:59:30	9.93	9.59		
6/7/2018	6:59:40	9.94	9.59		
6/7/2018	6:59:50	9.93	9.60		
6/7/2018	7:00:00	9.93	9.60		
6/7/2018	7:00:10	9.93	9.59		
6/7/2018	7:00:20	9.93	9.61	9.93	
6/7/2018	7:00:30	9.93	9.61		
6/7/2018	7:00:40	9.93	9.61		
6/7/2018	7:00:50	9.93	9.61		
6/7/2018	7:01:00	9.93	9.61		
6/7/2018	7:01:10	9.94	9.61		

Hollingsworth & Vose

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/7/2018	8:05:18	19.69	0.77
6/7/2018	8:06:18	19.70	0.77
6/7/2018	8:07:18	19.70	0.77
6/7/2018	8:08:18	19.69	0.77
6/7/2018	8:09:18	19.69	0.76
6/7/2018	8:10:18	19.69	0.77
6/7/2018	8:11:18	19.69	0.76
6/7/2018	8:12:18	19.70	0.76
6/7/2018	8:13:18	19.69	0.76
6/7/2018	8:14:18	19.68	0.76
6/7/2018	8:15:18	19.69	0.76
6/7/2018	8:16:18	19.69	0.76
6/7/2018	8:17:18	19.69	0.75
6/7/2018	8:18:18	19.69	0.75
6/7/2018	8:19:18	19.68	0.75
6/7/2018	8:20:18	19.68	0.75
6/7/2018	8:21:18	19.69	0.75
6/7/2018	8:22:18	19.70	0.75
6/7/2018	8:23:18	19.70	0.75
6/7/2018	8:24:18	19.68	0.75
6/7/2018	8:25:18	19.69	0.75
6/7/2018	8:26:18	19.69	0.75
6/7/2018	8:27:18	19.69	0.76
6/7/2018	8:28:18	19.70	0.76
6/7/2018	8:29:18	19.69	0.76
6/7/2018	8:30:18	19.69	0.76
6/7/2018	8:31:18	19.68	0.76
6/7/2018	8:32:18	19.69	0.77
6/7/2018	8:33:18	19.70	0.76
6/7/2018	8:34:18	19.70	0.76
6/7/2018	8:35:18	19.69	0.76
6/7/2018	8:36:18	19.69	0.76
6/7/2018	8:37:18	19.69	0.76
6/7/2018	8:38:18	19.70	0.76
6/7/2018	8:39:18	19.70	0.76
6/7/2018	8:40:18	19.69	0.76
6/7/2018	8:41:18	19.69	0.76
6/7/2018	8:42:18	19.69	0.76
6/7/2018	8:43:18	19.69	0.75
6/7/2018	8:44:18	19.70	0.75
6/7/2018	8:45:18	19.69	0.75

Hollingsworth & Vose

CFU-114

Run 1

Date	Time	O2 [%]	CO2 [%]
6/7/2018	8:46:18	19.69	0.75
6/7/2018	8:47:18	19.69	0.75
6/7/2018	8:48:18	19.69	0.75
6/7/2018	8:49:18	19.70	0.75
6/7/2018	8:50:18	19.69	0.75
6/7/2018	8:51:18	19.68	0.75
6/7/2018	8:52:18	19.69	0.75
6/7/2018	8:53:18	19.70	0.75
6/7/2018	8:54:18	19.71	0.74
6/7/2018	8:55:18	19.70	0.75
6/7/2018	8:56:18	19.68	0.76
6/7/2018	8:57:18	19.68	0.76
6/7/2018	8:58:18	19.69	0.76
6/7/2018	8:59:18	19.69	0.76
6/7/2018	9:00:18	19.70	0.76
6/7/2018	9:01:18	19.69	0.76
6/7/2018	9:02:18	19.68	0.76
6/7/2018	9:03:18	19.68	0.76
6/7/2018	9:04:18	19.68	0.76
6/7/2018	9:05:18	19.69	0.76
6/7/2018	9:06:18	19.69	0.76
6/7/2018	9:07:18	19.69	0.76
6/7/2018	9:08:18	19.68	0.75
6/7/2018	9:09:18	19.68	0.75
6/7/2018	9:10:18	19.69	0.75
6/7/2018	9:11:18	19.69	0.74
6/7/2018	9:12:18	19.69	0.74
6/7/2018	9:13:18	19.68	0.75
6/7/2018	9:14:18	19.68	0.74
6/7/2018	9:15:18	19.69	0.75
6/7/2018	9:16:18	19.69	0.75
6/7/2018	9:17:18	19.69	0.75
6/7/2018	9:18:18	19.68	0.75
6/7/2018	9:19:18	19.68	0.75
6/7/2018	9:20:18	19.68	0.75
6/7/2018	9:21:18	19.68	0.75
6/7/2018	9:22:18	19.69	0.76
6/7/2018	9:23:18	19.69	0.76
6/7/2018	9:24:18	19.68	0.76
6/7/2018	9:25:18	19.68	0.76
6/7/2018	9:26:18	19.68	0.76

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/7/2018	9:27:18	19.69	0.76
6/7/2018	9:28:18	19.69	0.76
6/7/2018	9:29:18	19.69	0.76
6/7/2018	9:30:18	19.68	0.76
6/7/2018	9:31:18	19.68	0.76
6/7/2018	9:32:18	19.69	0.76
6/7/2018	9:33:18	19.69	0.76
6/7/2018	9:34:18	19.69	0.76
6/7/2018	9:35:18	19.68	0.75
6/7/2018	9:36:18	19.68	0.75
6/7/2018	9:37:18	19.68	0.75
6/7/2018	9:38:18	19.69	0.75
6/7/2018	9:39:18	19.69	0.75
6/7/2018	9:40:18	19.69	0.75
6/7/2018	9:41:18	19.68	0.75
6/7/2018	9:42:18	19.68	0.75
6/7/2018	9:43:18	19.68	0.75
6/7/2018	9:44:18	19.69	0.75
6/7/2018	9:45:18	19.69	0.75
6/7/2018	9:46:18	19.69	0.75
6/7/2018	9:47:18	19.68	0.75
6/7/2018	9:48:18	19.68	0.76
6/7/2018	9:49:18	19.69	0.75
6/7/2018	9:50:18	19.69	0.76
6/7/2018	9:51:18	19.69	0.76
6/7/2018	9:52:18	19.68	0.76
6/7/2018	9:53:18	19.68	0.76
6/7/2018	9:54:18	19.68	0.76
6/7/2018	9:55:18	19.68	0.76
6/7/2018	9:56:18	19.68	0.76
6/7/2018	9:57:18	19.69	0.76
6/7/2018	9:58:18	19.68	0.76
6/7/2018	9:59:18	19.67	0.75
6/7/2018	10:00:18	19.68	0.75
6/7/2018	10:01:18	19.69	0.75
6/7/2018	10:02:18	19.69	0.75
6/7/2018	10:03:18	19.68	0.74
6/7/2018	10:04:18	19.67	0.75
6/7/2018	10:05:18	19.67	0.74
6/7/2018	10:06:18	19.68	0.75
6/7/2018	10:07:18	19.68	0.75

Hollingsworth & Vose

CFU-114

Run 1

Date	Time	O2 [%]	CO2 [%]
6/7/2018	10:08:18	19.68	0.75
6/7/2018	10:09:18	19.67	0.74
6/7/2018	10:10:18	19.68	0.75
6/7/2018	10:11:18	19.68	0.75
6/7/2018	10:12:18	19.68	0.75
6/7/2018	10:13:18	19.69	0.75
6/7/2018	10:14:18	19.68	0.75
6/7/2018	10:15:18	19.67	0.75
6/7/2018	10:16:18	19.68	0.76
6/7/2018	10:17:18	19.68	0.76
6/7/2018	10:18:18	19.68	0.76
6/7/2018	10:19:18	19.68	0.76
6/7/2018	10:20:18	19.67	0.76
6/7/2018	10:21:18	19.67	0.76
6/7/2018	10:22:18	19.67	0.75
6/7/2018	10:23:18	19.68	0.75
6/7/2018	10:24:18	19.68	0.75
6/7/2018	10:25:18	19.67	0.75
6/7/2018	10:26:18	19.67	0.75
6/7/2018	10:27:18	19.67	0.75
6/7/2018	10:28:18	19.67	0.75
6/7/2018	10:29:18	19.68	0.74
6/7/2018	10:30:18	19.68	0.74
6/7/2018	10:31:18	19.67	0.74
6/7/2018	10:32:18	19.67	0.74
6/7/2018	10:33:18	19.67	0.74
6/7/2018	10:34:18	19.67	0.74
6/7/2018	10:35:18	19.68	0.74
6/7/2018	10:36:18	19.68	0.74
6/7/2018	10:37:18	19.67	0.75
6/7/2018	10:38:18	19.67	0.75
6/7/2018	10:39:18	19.67	0.75
6/7/2018	10:40:18	19.67	0.75
6/7/2018	10:41:18	19.67	0.75
6/7/2018	10:42:18	19.67	0.76
6/7/2018	10:43:18	19.66	0.76
6/7/2018	10:44:18	19.66	0.76
6/7/2018	10:45:18	19.66	0.76
6/7/2018	10:46:18	19.67	0.75
6/7/2018	10:47:18	19.67	0.76
6/7/2018	10:48:18	19.67	0.75

Hollingsworth & Vose

CFU-114

Run 1

Date	Time	O2 [%]	CO2 [%]
6/7/2018	10:49:18	19.66	0.75
6/7/2018	10:50:18	19.66	0.75
6/7/2018	10:51:18	19.66	0.75
6/7/2018	10:52:18	19.67	0.75
6/7/2018	10:53:18	19.67	0.74
6/7/2018	10:54:18	19.67	0.74
6/7/2018	10:55:18	19.66	0.74
6/7/2018	10:56:18	19.66	0.74
6/7/2018	10:57:18	19.66	0.74
6/7/2018	10:58:18	19.67	0.74
6/7/2018	10:59:18	19.67	0.74
6/7/2018	11:00:18	19.66	0.74
6/7/2018	11:01:18	19.66	0.74
6/7/2018	11:02:18	19.66	0.74
6/7/2018	11:03:18	19.66	0.75
6/7/2018	11:04:18	19.67	0.75
6/7/2018	11:05:18	19.66	0.75
6/7/2018	11:06:18	19.65	0.75
6/7/2018	11:07:18	19.66	0.76
6/7/2018	11:08:18	19.66	0.75
6/7/2018	11:09:18	19.66	0.76
6/7/2018	11:10:18	19.66	0.75
6/7/2018	11:11:18	19.66	0.75
6/7/2018	11:12:18	19.65	0.75
	Final	**19.68**	**0.75**

Hollingsworth & Vose

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R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/7/2018	11:15:28	19.66	0.75		
6/7/2018	11:15:38	19.66	0.75		
6/7/2018	11:15:48	19.66	0.75		
6/7/2018	11:15:58	19.66	0.75		
6/7/2018	11:16:08	19.71	0.75		
6/7/2018	11:16:18	18.96	2.73		
6/7/2018	11:16:28	14.42	8.80		
6/7/2018	11:16:38	11.09	9.40		
6/7/2018	11:16:48	10.30	9.52		
6/7/2018	11:16:58	10.12	9.55		
6/7/2018	11:17:08	10.08	9.57		
6/7/2018	11:17:18	10.07	9.58		
6/7/2018	11:17:28	10.06	9.58		
6/7/2018	11:17:38	10.05	9.58		
6/7/2018	11:17:48	10.05	9.58		
6/7/2018	11:17:58	10.04	9.60		
6/7/2018	11:18:08	10.05	9.60		
6/7/2018	11:18:18	10.05	9.58		
6/7/2018	11:18:28	10.04	9.60		
6/7/2018	11:18:38	10.04	9.61		
6/7/2018	11:18:48	10.04	9.60	10.04	
6/7/2018	11:18:58	10.04	9.61		
6/7/2018	11:19:08	10.03	9.61		
6/7/2018	11:19:18	10.38	9.40		
6/7/2018	11:19:28	12.23	7.48		
6/7/2018	11:19:38	6.69	5.24		
6/7/2018	11:19:48	2.39	1.93		
6/7/2018	11:19:58	2.17	1.98		
6/7/2018	11:20:08	2.12	1.96		
6/7/2018	11:20:18	2.11	1.95		
6/7/2018	11:20:28	2.10	1.94		
6/7/2018	11:20:38	2.10	1.94		
6/7/2018	11:20:48	2.10	1.95		
6/7/2018	11:20:58	2.09	1.94		
6/7/2018	11:21:08	2.09	1.93		
6/7/2018	11:21:18	2.08	1.93		
6/7/2018	11:21:28	2.09	1.93		
6/7/2018	11:21:38	2.08	1.93		1.93
6/7/2018	11:21:48	2.09	1.93		
6/7/2018	11:21:58	2.09	1.93		
6/7/2018	11:22:08	2.09	1.93		

Hollingsworth & Vose

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R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/7/2018	11:22:33	18.43	0.87		
6/7/2018	11:22:43	19.38	0.79		
6/7/2018	11:22:53	18.19	0.84		
6/7/2018	11:23:03	6.84	0.57		
6/7/2018	11:23:13	1.59	0.23		
6/7/2018	11:23:23	0.45	0.14		
6/7/2018	11:23:33	0.20	0.12		
6/7/2018	11:23:43	0.15	0.11		
6/7/2018	11:23:53	0.13	0.10		
6/7/2018	11:24:03	0.12	0.11		
6/7/2018	11:24:13	0.12	0.10		
6/7/2018	11:24:23	0.12	0.10		
6/7/2018	11:24:33	0.12	0.10		
6/7/2018	11:24:43	0.12	0.09		
6/7/2018	11:24:53	0.12	0.10		
6/7/2018	11:25:03	0.12	0.09	0.12	0.09

Hollingsworth & Vose

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/7/2018	11:40:45	19.66	0.74
6/7/2018	11:41:45	19.66	0.74
6/7/2018	11:42:45	19.67	0.75
6/7/2018	11:43:45	19.67	0.75
6/7/2018	11:44:45	19.67	0.75
6/7/2018	11:45:45	19.67	0.76
6/7/2018	11:46:45	19.66	0.76
6/7/2018	11:47:45	19.66	0.76
6/7/2018	11:48:45	19.67	0.75
6/7/2018	11:49:45	19.67	0.75
6/7/2018	11:50:45	19.68	0.75
6/7/2018	11:51:45	19.67	0.75
6/7/2018	11:52:45	19.66	0.75
6/7/2018	11:53:45	19.67	0.75
6/7/2018	11:54:45	19.67	0.74
6/7/2018	11:55:45	19.68	0.75
6/7/2018	11:56:45	19.68	0.74
6/7/2018	11:57:45	19.67	0.74
6/7/2018	11:58:45	19.67	0.74
6/7/2018	11:59:45	19.67	0.74
6/7/2018	12:00:45	19.67	0.74
6/7/2018	12:01:45	19.67	0.74
6/7/2018	12:02:45	19.68	0.74
6/7/2018	12:03:45	19.67	0.74
6/7/2018	12:04:45	19.67	0.74
6/7/2018	12:05:45	19.67	0.75
6/7/2018	12:06:45	19.67	0.75
6/7/2018	12:07:45	19.68	0.75
6/7/2018	12:08:45	19.68	0.75
6/7/2018	12:09:45	19.67	0.75
6/7/2018	12:10:45	19.66	0.76
6/7/2018	12:11:45	19.67	0.75
6/7/2018	12:12:45	19.67	0.75
6/7/2018	12:13:45	19.68	0.75
6/7/2018	12:14:45	19.68	0.75
6/7/2018	12:15:45	19.67	0.75
6/7/2018	12:16:45	19.67	0.75
6/7/2018	12:17:45	19.67	0.75
6/7/2018	12:18:45	19.67	0.75
6/7/2018	12:19:45	19.67	0.75
6/7/2018	12:20:45	19.67	0.74

Hollingsworth & Vose

CFU-114

Run 2

Date	Time	O2 [%]	CO2 [%]
6/7/2018	12:21:45	19.67	0.74
6/7/2018	12:22:45	19.66	0.73
6/7/2018	12:23:45	19.67	0.74
6/7/2018	12:24:45	19.68	0.74
6/7/2018	12:25:45	19.68	0.74
6/7/2018	12:26:45	19.67	0.74
6/7/2018	12:27:45	19.66	0.74
6/7/2018	12:28:45	19.66	0.74
6/7/2018	12:29:45	19.67	0.74
6/7/2018	12:30:45	19.67	0.75
6/7/2018	12:31:45	19.68	0.75
6/7/2018	12:32:45	19.67	0.75
6/7/2018	12:33:45	19.66	0.75
6/7/2018	12:34:45	19.66	0.76
6/7/2018	12:35:45	19.67	0.75
6/7/2018	12:36:45	19.68	0.75
6/7/2018	12:37:45	19.68	0.75
6/7/2018	12:38:45	19.67	0.75
6/7/2018	12:39:45	19.66	0.75
6/7/2018	12:40:45	19.66	0.75
6/7/2018	12:41:45	19.67	0.75
6/7/2018	12:42:45	19.67	0.75
6/7/2018	12:43:45	19.67	0.75
6/7/2018	12:44:45	19.68	0.74
6/7/2018	12:45:45	19.66	0.74
6/7/2018	12:46:45	19.66	0.74
6/7/2018	12:47:45	19.67	0.74
6/7/2018	12:48:45	19.67	0.74
6/7/2018	12:49:45	19.67	0.74
6/7/2018	12:50:45	19.67	0.74
6/7/2018	12:51:45	19.66	0.74
6/7/2018	12:52:45	19.66	0.74
6/7/2018	12:53:45	19.66	0.74
6/7/2018	12:54:45	19.66	0.74
6/7/2018	12:55:45	19.66	0.75
6/7/2018	12:56:45	19.67	0.75
6/7/2018	12:57:45	19.66	0.75
6/7/2018	12:58:45	19.66	0.75
6/7/2018	12:59:45	19.66	0.75
6/7/2018	13:00:45	19.66	0.76
6/7/2018	13:01:45	19.67	0.75

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/7/2018	13:02:45	19.66	0.75
6/7/2018	13:03:45	19.65	0.75
6/7/2018	13:04:45	19.65	0.75
6/7/2018	13:05:45	19.66	0.75
6/7/2018	13:06:45	19.66	0.75
6/7/2018	13:07:45	19.66	0.75
6/7/2018	13:08:45	19.66	0.75
6/7/2018	13:09:45	19.65	0.75
6/7/2018	13:10:45	19.65	0.74
6/7/2018	13:11:45	19.65	0.74
6/7/2018	13:12:45	19.66	0.74
6/7/2018	13:13:45	19.66	0.74
6/7/2018	13:14:45	19.66	0.74
6/7/2018	13:15:45	19.65	0.74
6/7/2018	13:16:45	19.65	0.74
6/7/2018	13:17:45	19.65	0.74
6/7/2018	13:18:45	19.66	0.74
6/7/2018	13:19:45	19.66	0.75
6/7/2018	13:20:45	19.66	0.74
6/7/2018	13:21:45	19.65	0.75
6/7/2018	13:22:45	19.65	0.75
6/7/2018	13:23:45	19.65	0.75
6/7/2018	13:24:45	19.66	0.76
6/7/2018	13:25:45	19.66	0.75
6/7/2018	13:26:45	19.66	0.75
6/7/2018	13:27:45	19.65	0.75
6/7/2018	13:28:45	19.65	0.76
6/7/2018	13:29:45	19.65	0.75
6/7/2018	13:30:45	19.66	0.75
6/7/2018	13:31:45	19.66	0.75
6/7/2018	13:32:45	19.65	0.75
6/7/2018	13:33:45	19.64	0.74
6/7/2018	13:34:45	19.65	0.74
6/7/2018	13:35:45	19.65	0.74
6/7/2018	13:36:45	19.65	0.74
6/7/2018	13:37:45	19.66	0.74
6/7/2018	13:38:45	19.66	0.74
6/7/2018	13:39:45	19.65	0.74
6/7/2018	13:40:45	19.65	0.74
6/7/2018	13:41:45	19.65	0.74
6/7/2018	13:42:45	19.66	0.74

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/7/2018	13:43:45	19.66	0.74
6/7/2018	13:44:45	19.66	0.75
6/7/2018	13:45:45	19.65	0.75
6/7/2018	13:46:45	19.64	0.75
6/7/2018	13:47:45	19.65	0.75
6/7/2018	13:48:45	19.65	0.76
6/7/2018	13:49:45	19.66	0.75
6/7/2018	13:50:45	19.65	0.75
6/7/2018	13:51:45	19.65	0.75
6/7/2018	13:52:45	19.65	0.75
6/7/2018	13:53:45	19.65	0.75
6/7/2018	13:54:45	19.66	0.75
6/7/2018	13:55:45	19.66	0.75
6/7/2018	13:56:45	19.65	0.75
6/7/2018	13:57:45	19.65	0.74
6/7/2018	13:58:45	19.65	0.74
6/7/2018	13:59:45	19.66	0.73
6/7/2018	14:00:45	19.67	0.73
6/7/2018	14:01:45	19.67	0.73
6/7/2018	14:02:45	19.65	0.74
6/7/2018	14:03:45	19.65	0.73
6/7/2018	14:04:45	19.66	0.74
6/7/2018	14:05:45	19.66	0.74
6/7/2018	14:06:45	19.67	0.74
6/7/2018	14:07:45	19.67	0.74
6/7/2018	14:08:45	19.66	0.74
6/7/2018	14:09:45	19.65	0.74
6/7/2018	14:10:45	19.66	0.75
6/7/2018	14:11:45	19.66	0.75
6/7/2018	14:12:45	19.66	0.75
6/7/2018	14:13:45	19.66	0.75
6/7/2018	14:14:45	19.65	0.75
6/7/2018	14:15:45	19.65	0.75
6/7/2018	14:16:45	19.65	0.75
6/7/2018	14:17:45	19.66	0.75
6/7/2018	14:18:45	19.66	0.75
6/7/2018	14:19:45	19.66	0.75
6/7/2018	14:20:45	19.66	0.74
6/7/2018	14:21:45	19.65	0.74
6/7/2018	14:22:45	19.66	0.74
6/7/2018	14:23:45	19.66	0.74

Hollingsworth & Vose

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/7/2018	14:24:45	19.66	0.74
6/7/2018	14:25:45	19.66	0.73
6/7/2018	14:26:45	19.64	0.74
6/7/2018	14:27:45	19.65	0.74
6/7/2018	14:28:45	19.65	0.74
6/7/2018	14:29:45	19.65	0.74
6/7/2018	14:30:45	19.66	0.74
6/7/2018	14:31:45	19.65	0.74
6/7/2018	14:32:45	19.64	0.74
6/7/2018	14:33:45	19.65	0.74
6/7/2018	14:34:45	19.65	0.74
6/7/2018	14:35:45	19.65	0.74
6/7/2018	14:36:45	19.66	0.75
6/7/2018	14:37:45	19.65	0.75
6/7/2018	14:38:45	19.64	0.75
6/7/2018	14:39:45	19.64	0.75
6/7/2018	14:40:45	19.65	0.75
6/7/2018	14:41:45	19.65	0.75
6/7/2018	14:42:45	19.66	0.75
6/7/2018	14:43:45	19.65	0.74
6/7/2018	14:44:45	19.64	0.75
6/7/2018	14:45:45	19.64	0.74
6/7/2018	14:46:45	19.65	0.74
6/7/2018	14:47:45	19.65	0.74
6/7/2018	14:48:45	19.66	0.73
6/7/2018	14:49:45	19.63	0.73
	Final	**19.66**	**0.75**

Hollingsworth & Vose

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R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/7/2018	14:50:35	19.65	0.73		
6/7/2018	14:50:45	19.65	0.74		
6/7/2018	14:50:55	19.65	0.73		
6/7/2018	14:51:05	19.71	0.73		
6/7/2018	14:51:15	12.73	0.61		
6/7/2018	14:51:25	3.25	0.25		
6/7/2018	14:51:35	0.84	0.12		
6/7/2018	14:51:45	0.31	0.1		
6/7/2018	14:51:55	0.19	0.09		
6/7/2018	14:52:05	0.16	0.08		
6/7/2018	14:52:15	0.15	0.08		
6/7/2018	14:52:25	0.14	0.08		
6/7/2018	14:52:35	0.14	0.09		
6/7/2018	14:52:45	0.14	0.08		
6/7/2018	14:52:55	0.14	0.08	0.14	0.08
6/7/2018	14:53:05	0.13	0.08		
6/7/2018	14:53:15	0.13	0.09		
6/7/2018	14:53:25	0.14	0.08		
6/7/2018	14:53:35	0.13	0.09		
6/7/2018	14:53:45	0.85	0.72		
6/7/2018	14:53:55	1.78	1.44		
6/7/2018	14:54:05	1.99	1.71		
6/7/2018	14:54:15	2.03	1.8		
6/7/2018	14:54:25	2.05	1.84		
6/7/2018	14:54:35	2.06	1.85		
6/7/2018	14:54:45	2.06	1.86		
6/7/2018	14:54:55	2.07	1.87		
6/7/2018	14:55:05	2.07	1.88		
6/7/2018	14:55:15	2.07	1.88		
6/7/2018	14:55:25	2.07	1.89		
6/7/2018	14:55:35	2.07	1.9		
6/7/2018	14:55:45	2.07	1.9		
6/7/2018	14:55:55	2.08	1.9		
6/7/2018	14:56:05	2.08	1.9		
6/7/2018	14:56:15	2.07	1.91		1.90
6/7/2018	14:56:25	2.08	1.9		
6/7/2018	14:56:35	2.07	1.9		
6/7/2018	14:56:45	2.08	1.9		
6/7/2018	14:56:55	2.08	1.91		
6/7/2018	14:57:05	2.07	1.91		
6/7/2018	14:57:15	2.08	1.91		

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R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/7/2018	14:57:25	2.08	1.92		
6/7/2018	14:57:35	2.08	1.91		
6/7/2018	14:57:45	2.08	1.91		
6/7/2018	14:57:55	2.07	1.91		
6/7/2018	14:58:05	2.07	1.92		
6/7/2018	14:58:15	2.07	1.91		
6/7/2018	14:58:25	2.08	1.91		
6/7/2018	14:58:35	2.08	1.92		
6/7/2018	14:58:45	2.08	1.92		
6/7/2018	14:58:55	2.07	1.91		
6/7/2018	14:59:05	5.14	1.74		
6/7/2018	14:59:15	9.6	4.92		
6/7/2018	14:59:25	9.93	8.49		
6/7/2018	14:59:35	9.99	9.31		
6/7/2018	14:59:45	10	9.5		
6/7/2018	14:59:55	10.01	9.55		
6/7/2018	15:00:05	10.01	9.57		
6/7/2018	15:00:15	10.02	9.57		
6/7/2018	15:00:25	10.02	9.58		
6/7/2018	15:00:35	10.02	9.58		
6/7/2018	15:00:45	10.02	9.59		
6/7/2018	15:00:55	10.02	9.61	10.02	

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/7/2018	15:05:17	19.64	0.75
6/7/2018	15:06:17	19.65	0.75
6/7/2018	15:07:17	19.65	0.75
6/7/2018	15:08:17	19.65	0.75
6/7/2018	15:09:17	19.64	0.74
6/7/2018	15:10:17	19.65	0.74
6/7/2018	15:11:17	19.65	0.74
6/7/2018	15:12:17	19.65	0.73
6/7/2018	15:13:17	19.66	0.73
6/7/2018	15:14:17	19.65	0.73
6/7/2018	15:15:17	19.64	0.73
6/7/2018	15:16:17	19.65	0.74
6/7/2018	15:17:17	19.65	0.74
6/7/2018	15:18:17	19.65	0.73
6/7/2018	15:19:17	19.66	0.74
6/7/2018	15:20:17	19.65	0.74
6/7/2018	15:21:17	19.64	0.74
6/7/2018	15:22:17	19.64	0.74
6/7/2018	15:23:17	19.65	0.75
6/7/2018	15:24:17	19.65	0.75
6/7/2018	15:25:17	19.66	0.75
6/7/2018	15:26:17	19.65	0.75
6/7/2018	15:27:17	19.64	0.75
6/7/2018	15:28:17	19.64	0.75
6/7/2018	15:29:17	19.65	0.75
6/7/2018	15:30:17	19.65	0.74
6/7/2018	15:31:17	19.66	0.74
6/7/2018	15:32:17	19.64	0.74
6/7/2018	15:33:17	19.64	0.74
6/7/2018	15:34:17	19.64	0.74
6/7/2018	15:35:17	19.64	0.73
6/7/2018	15:36:17	19.65	0.73
6/7/2018	15:37:17	19.65	0.74
6/7/2018	15:38:17	19.64	0.74
6/7/2018	15:39:17	19.63	0.74
6/7/2018	15:40:17	19.64	0.74
6/7/2018	15:41:17	19.64	0.73
6/7/2018	15:42:17	19.64	0.74
6/7/2018	15:43:17	19.65	0.74
6/7/2018	15:44:17	19.64	0.74
6/7/2018	15:45:17	19.64	0.74

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/7/2018	15:46:17	19.64	0.74
6/7/2018	15:47:17	19.64	0.75
6/7/2018	15:48:17	19.65	0.75
6/7/2018	15:49:17	19.65	0.75
6/7/2018	15:50:17	19.64	0.75
6/7/2018	15:51:17	19.63	0.75
6/7/2018	15:52:17	19.63	0.75
6/7/2018	15:53:17	19.64	0.75
6/7/2018	15:54:17	19.64	0.75
6/7/2018	15:55:17	19.64	0.74
6/7/2018	15:56:17	19.64	0.74
6/7/2018	15:57:17	19.63	0.74
6/7/2018	15:58:17	19.63	0.74
6/7/2018	15:59:17	19.64	0.74
6/7/2018	16:00:17	19.64	0.73
6/7/2018	16:01:17	19.65	0.73
6/7/2018	16:02:17	19.64	0.73
6/7/2018	16:03:17	19.63	0.74
6/7/2018	16:04:17	19.63	0.73
6/7/2018	16:05:17	19.64	0.74
6/7/2018	16:06:17	19.64	0.74
6/7/2018	16:07:17	19.64	0.74
6/7/2018	16:08:17	19.63	0.74
6/7/2018	16:09:17	19.63	0.74
6/7/2018	16:10:17	19.63	0.74
6/7/2018	16:11:17	19.64	0.75
6/7/2018	16:12:17	19.64	0.75
6/7/2018	16:13:17	19.64	0.75
6/7/2018	16:14:17	19.63	0.75
6/7/2018	16:15:17	19.63	0.75
6/7/2018	16:16:17	19.63	0.75
6/7/2018	16:17:17	19.64	0.75
6/7/2018	16:18:17	19.64	0.75
6/7/2018	16:19:17	19.65	0.74
6/7/2018	16:20:17	19.64	0.75
6/7/2018	16:21:17	19.63	0.74
6/7/2018	16:22:17	19.64	0.74
6/7/2018	16:23:17	19.64	0.74
6/7/2018	16:24:17	19.64	0.73
6/7/2018	16:25:17	19.64	0.73
6/7/2018	16:26:17	19.64	0.73

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/7/2018	16:27:17	19.63	0.73
6/7/2018	16:28:17	19.64	0.74
6/7/2018	16:29:17	19.64	0.73
6/7/2018	16:30:17	19.65	0.74
6/7/2018	16:31:17	19.65	0.74
6/7/2018	16:32:17	19.64	0.74
6/7/2018	16:33:17	19.63	0.74
6/7/2018	16:34:17	19.64	0.74
6/7/2018	16:35:17	19.64	0.75
6/7/2018	16:36:17	19.64	0.75
6/7/2018	16:37:17	19.65	0.75
6/7/2018	16:38:17	19.64	0.75
6/7/2018	16:39:17	19.64	0.75
6/7/2018	16:40:17	19.64	0.75
6/7/2018	16:41:17	19.64	0.75
6/7/2018	16:42:17	19.64	0.75
6/7/2018	16:43:17	19.65	0.75
6/7/2018	16:44:17	19.64	0.75
6/7/2018	16:45:17	19.64	0.74
6/7/2018	16:46:17	19.64	0.74
6/7/2018	16:47:17	19.65	0.74
6/7/2018	16:48:17	19.65	0.73
6/7/2018	16:49:17	19.65	0.74
6/7/2018	16:50:17	19.65	0.74
6/7/2018	16:51:17	19.64	0.73
6/7/2018	16:52:17	19.64	0.74
6/7/2018	16:53:17	19.64	0.74
6/7/2018	16:54:17	19.64	0.74
6/7/2018	16:55:17	19.65	0.74
6/7/2018	16:56:17	19.65	0.74
6/7/2018	16:57:17	19.64	0.74
6/7/2018	16:58:17	19.64	0.74
6/7/2018	16:59:17	19.64	0.75
6/7/2018	17:00:17	19.65	0.75
6/7/2018	17:01:17	19.65	0.75
6/7/2018	17:02:17	19.65	0.75
6/7/2018	17:03:17	19.63	0.75
6/7/2018	17:04:17	19.64	0.75
6/7/2018	17:05:17	19.66	0.74
6/7/2018	17:06:17	19.67	0.74
6/7/2018	17:07:17	19.66	0.74

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/7/2018	17:08:17	19.67	0.74
6/7/2018	17:09:17	19.66	0.73
6/7/2018	17:10:17	19.66	0.73
6/7/2018	17:11:17	19.67	0.73
6/7/2018	17:12:17	19.67	0.72
6/7/2018	17:13:17	19.68	0.72
6/7/2018	17:14:17	19.67	0.72
6/7/2018	17:15:17	19.66	0.72
6/7/2018	17:16:17	19.66	0.73
6/7/2018	17:17:17	19.65	0.74
6/7/2018	17:18:17	19.65	0.74
6/7/2018	17:19:17	19.65	0.74
6/7/2018	17:20:17	19.65	0.74
6/7/2018	17:21:17	19.64	0.74
6/7/2018	17:22:17	19.64	0.75
6/7/2018	17:23:17	19.64	0.75
6/7/2018	17:24:17	19.65	0.75
6/7/2018	17:25:17	19.65	0.75
6/7/2018	17:26:17	19.65	0.75
6/7/2018	17:27:17	19.64	0.75
6/7/2018	17:28:17	19.64	0.75
6/7/2018	17:29:17	19.65	0.75
6/7/2018	17:30:17	19.65	0.75
6/7/2018	17:31:17	19.65	0.75
6/7/2018	17:32:17	19.65	0.75
6/7/2018	17:33:17	19.64	0.74
6/7/2018	17:34:17	19.64	0.74
6/7/2018	17:35:17	19.64	0.74
6/7/2018	17:36:17	19.65	0.74
6/7/2018	17:37:17	19.65	0.74
6/7/2018	17:38:17	19.65	0.73
6/7/2018	17:39:17	19.64	0.73
6/7/2018	17:40:17	19.64	0.74
6/7/2018	17:41:17	19.64	0.74
6/7/2018	17:42:17	19.65	0.74
6/7/2018	17:43:17	19.65	0.74
6/7/2018	17:44:17	19.65	0.74
6/7/2018	17:45:17	19.64	0.74
6/7/2018	17:46:17	19.64	0.75
6/7/2018	17:47:17	19.64	0.75
6/7/2018	17:48:17	19.65	0.75

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/7/2018	17:49:17	19.65	0.75
6/7/2018	17:50:17	19.65	0.75
6/7/2018	17:51:17	19.64	0.75
6/7/2018	17:52:17	19.64	0.75
6/7/2018	17:53:17	19.64	0.75
6/7/2018	17:54:17	19.65	0.75
6/7/2018	17:55:17	19.65	0.75
6/7/2018	17:56:17	19.65	0.75
6/7/2018	17:57:17	19.64	0.75
6/7/2018	17:58:17	19.64	0.75
6/7/2018	17:59:17	19.65	0.74
6/7/2018	18:00:17	19.65	0.74
6/7/2018	18:01:17	19.65	0.74
6/7/2018	18:02:17	19.65	0.74
6/7/2018	18:03:17	19.64	0.74
6/7/2018	18:04:17	19.64	0.74
6/7/2018	18:05:17	19.65	0.74
6/7/2018	18:06:17	19.65	0.74
6/7/2018	18:07:17	19.66	0.74
6/7/2018	18:08:17	19.65	0.74
6/7/2018	18:09:17	19.64	0.74
6/7/2018	18:10:17	19.65	0.75
6/7/2018	18:11:17	19.65	0.75
	Final	**19.64**	**0.74**

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R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/7/2018	18:11:47	19.65	0.75		
6/7/2018	18:11:57	19.65	0.75		
6/7/2018	18:12:07	19.67	0.76		
6/7/2018	18:12:17	19.24	1.10		
6/7/2018	18:12:27	12.79	4.96		
6/7/2018	18:12:37	4.07	2.07		
6/7/2018	18:12:47	1.03	0.59		
6/7/2018	18:12:57	0.35	0.24		
6/7/2018	18:13:07	0.20	0.14		
6/7/2018	18:13:17	0.17	0.12		
6/7/2018	18:13:27	0.15	0.11		
6/7/2018	18:13:37	0.15	0.11		
6/7/2018	18:13:47	0.14	0.10		
6/7/2018	18:13:57	0.14	0.11		
6/7/2018	18:14:07	0.14	0.10		
6/7/2018	18:14:17	0.14	0.10	0.14	0.10
6/7/2018	18:14:27	0.14	0.10		
6/7/2018	18:14:37	0.27	0.12		
6/7/2018	18:14:47	5.05	4.46		
6/7/2018	18:14:57	8.93	8.51		
6/7/2018	18:15:07	9.75	9.28		
6/7/2018	18:15:17	9.93	9.47		
6/7/2018	18:15:27	9.99	9.52		
6/7/2018	18:15:37	10.00	9.54		
6/7/2018	18:15:47	10.01	9.55		
6/7/2018	18:15:57	10.01	9.56		
6/7/2018	18:16:07	10.01	9.57		
6/7/2018	18:16:17	10.01	9.57		
6/7/2018	18:16:27	10.01	9.58	10.01	
6/7/2018	18:16:37	10.05	9.55		
6/7/2018	18:16:47	14.58	5.65		
6/7/2018	18:16:57	14.44	2.84		
6/7/2018	18:17:07	4.37	1.12		
6/7/2018	18:17:17	1.71	1.01		
6/7/2018	18:17:27	2.00	1.73		
6/7/2018	18:17:37	2.06	1.87		
6/7/2018	18:17:47	2.07	1.91		
6/7/2018	18:17:57	2.08	1.93		
6/7/2018	18:18:07	2.08	1.92		
6/7/2018	18:18:17	2.08	1.92		
6/7/2018	18:18:27	2.08	1.93		

Hollingsworth & Vose

CFU 114

R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/7/2018	18:18:37	2.08	1.93		
6/7/2018	18:18:47	2.08	1.93		1.93

SHEET NO. ____ OF ____
PROJECT NO. ____
DATE ____
BY ____
CHK'D ____

SUBJECT H & V

06/05/18 CFV 114 gaseous 109

M-13B/26A Wet test

O_2/CO_2 M-3A gaseous test
Leak check "0" Flow Pass
M-205

O_2 - 20/16/0 - Direct

O_2 - 10/5/10/5/10/5

O_2 direct - 0/0/0/0/0/0
CO_2 cals 0/2/4
Time on cals 1-hour advanced
reset clock To Pacific time

Tanks
O_2/CO_2 ~~Tanks~~
20.0/19.69

O_2 - 9.893

	Start	END
R-1	10:30	12:40
R-2	13:10	15:21
R-3	15:50	17:59

leak check "0" Flow pass

SHEET NO. _____ OF _____
PROJECT NO. _____
DATE _____
BY _____
CHK'D _____

SUBJECT H & V

06/06/18 CFU 114 gaseous log

M-316 / M-5 wet test

NO_x, CO, O_2, CO_2, NMOC, gas test

Leak check "0" Flow Pass

Begin calibrations @ 7:30

All Gasses zero analyzer ✓

	A 2✓ 3✓	S
O_2	20 / 10	✓0" / 10" ✓
CO_2	4"✓ / 5"✓	✓0" / 14" 2 ✓
NO_x	9✓ / 9✓ 10 / 20	✓0" / 12" 10 ✓
NO_2	50. 41	
CO	~~200~~ 300 / 100 ✓6 / 150 ✓7	✓0" / 13" ~~150~~ 5 ✓
NMOC	0/6.25✓/12.5✓/21.25✓	0/12.5

Air ✓ 106

50 ppm CH_4

begin stratification @ 9:45 DSB - 10:50 DSB

	Start	~~End test~~ End DSB
R-1 -	@9:40	11:49
R-2 -	12:30	14:40
R-3 -	15:15	17:24

	S	O First
C_3H_4	12.5"	0
O_2	10"	↓
CO_2	2"	
NO_x	10"	
CO	150"	

Leak Check "0" Flow Pass

SHEET NO. ____ OF ____
PROJECT NO. ____
DATE ____
BY ____
CHK'D ____

SUBJECT H & V

06/07/18 CFV 114 gas log

M-29/306 wet test

O_2/CO_2 gas test

leak check ⊖ Flow "pass"

A		S	
O_2	CO_2	O_2	CO_2
~~0~~	~~0~~	~~0~~	~~0~~
20	4	10	2
10	2		

begin cals @ 6:40

	start	End
R-1	08:05	11:12
R-2	11:40	14:49
R-3	15:05	18:12

Leak check ⊖ Flow "Pass"

APPENDIX C: CFU 117 (ROTARY FINE) TEST DATA

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 117**
DATE	**06/08/18**
METHOD	**29**
POLLUTANT	**Metals**

EPA Method 1
Stack Parameters and Traverse Points

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 117**
Facility: **GP2**

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: 5 inches

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

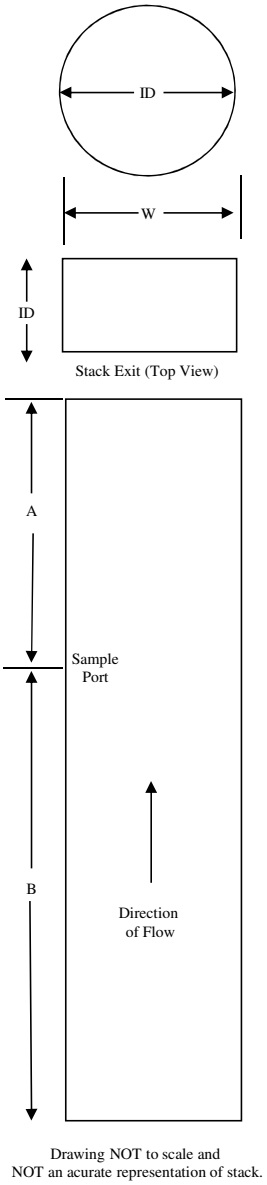
Equivalent Diameter
If rectangluar = $\frac{2*Depth*Width}{Depth + Width}$ = 30.00 inches (If circular = duct ID)
Stack/duct area = 4.909 sq.feet 706.9 sq.inches

Sample Port Location:	Downstream from flow disturbance from process B	Upstream from flow disturbance toward exit A
Number of Inches:	152.00	42.00
Number of Diameters:	5.07	1.40

Minimum Number of Traverse Points: 20

Points	% of diameter	Distance from inside wall (in.)	Distance including port (in.)
1	2.6	0.78	4 3/4
2	8.2	2.46	6 1/2
3	14.6	4.38	8 3/8
4	22.6	6.78	10 3/4
5	34.2	10.26	14 1/4
6	65.8	19.74	23 3/4
7	77.4	23.22	27 1/4
8	85.4	25.62	29 5/8
9	91.8	27.54	31 1/2
10	97.4	29.22	33 1/4

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 117

Stack Temp: 250

Traverse Point	Velocity ΔP ("H_2O)	Null Angle
1	1.90	0.0
2	2.00	5.0
3	1.90	5.0
4	1.90	5.0
5	2.00	10.0
6	2.00	5.0
7	2.00	5.0
8	1.90	0.0
9	1.70	0.0
10	1.60	5.0
11	1.90	5.0
12	1.90	5.0
13	1.90	5.0
14	1.90	5.0
15	2.00	0.0
16	1.90	0.0
17	1.80	5.0
18	1.80	5.0
19	1.60	5.0
20	1.60	0.0
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
Average:	1.86	3.8

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:**	**7:35**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**		**End Time:**	**10:44**
EPA Method:	**29**	60°F, scattered cloud cover, wind variable		**Date:**	**6/8/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

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	4A	Liner type	GLASS		
Y factor	0.9963	Nozzle ID	0.213	Nozzle size	0.2130	inches	
ΔH@	1.8425	Hot box ID	HLN #1	Nozzle area	0.000247	sq.ft.	
		Pitot Cp	0.84	Probe heat	248	F	
				Filter heat	248	F	

Source Information:

Barometric Pressure	29.97	"Hg	O_2	19.80 %
Static Pressure	0.6	"H_2O	CO_2	0.62 %
Ave. ΔP	1.6	"H_2O	Rec. Nz.	0.195 inches
Stack Temperature	248	F		
Assumed moisture	2	%		
Assumed meter temp.	69	F		
Total number of points	20			
Time per point	9			
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	13

Nozzle check for roundness:

1	2	3	
0.213	0.213	0.213	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	174.650	dcf	Ave. ΔP	1.86 "H_2O
Wet mol. weight	28.68	M_s (actual)	Ave. √ΔP	1.3625 "H_2O
Actual H_2O	1.89	%	Ave. ΔH	3.145 "H_2O
Std. meter vol.	174.444	dscf	Ave. T_s	248.2 °F
Isokinetic Average	100.5	%	Ave. T_m	71.4 °F

Moisture/Lab:

Filter	Run 1 #		
	Initial	Final	Gain
Impingers, g	200.0	228	28.0
Silica gel, g	241.9	285.4	43.5
		Total water gain:	71.5

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	9.0	8.970	2.00	246	64	3.34	3.30	5	252	38
2	18.0	17.860	2.00	248	66	3.34	3.30	5	250	38
3	27.0	26.910	2.00	248	67	3.35	3.40	5	250	43
4	36.0	35.910	2.00	248	68	3.35	3.40	5	250	51
5	45.0	44.960	2.00	248	70	3.37	3.40	5	251	58
6	54.0	53.810	1.90	248	70	3.20	3.20	5	250	61
7	63.0	62.390	1.80	248	72	3.04	3.00	5	250	61
8	72.0	70.880	1.70	248	72	2.87	2.90	5	251	60
9	81.0	79.245	1.70	248	72	2.87	2.90	5	247	58
10	90.0	87.402	1.60	248	73	2.71	2.70	5	252	57
11	99.0	96.290	1.90	244	70	3.22	3.20	5	250	53
12	108.0	104.970	1.80	244	71	3.05	3.10	5	253	55
13	117.0	114.020	2.00	247	71	3.38	3.40	5	250	58
14	126.0	123.050	2.00	248	72	3.38	3.40	5	250	58
15	135.0	132.100	2.00	248	74	3.39	3.40	5	250	60
16	144.0	141.190	2.00	250	73	3.38	3.40	5	250	60
17	153.0	150.120	1.90	253	75	3.21	3.20	5	257	60
18	162.0	158.700	1.80	253	76	3.04	3.00	5	250	60
19	171.0	166.540	1.50	248	75	2.55	2.60	5	250	60
20	180.0	174.650	1.60	250	76	2.72	2.70	5	250	60

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:** **2**
Location:	**Corvallis, OR**		**Start Time:** **11:05**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**	**End Time:** **14:12**
EPA Method:	**29**	60°F, scattered cloud cover, wind variable	**Date:** **6/8/2018**
Box Operator:	**CMF**		
Technician(s):	**CSW**		

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	4A	Liner type:	GLASS		
Y factor	0.9963	Nozzle ID	0.213	Nozzle size:	0.2130	inches	
ΔH@	1.8425	Hot box ID	HLN #1	Nozzle area:	0.000247	sq.ft.	
		Pitot Cp	0.84	Probe heat:	248	F	
				Filter heat:	248	F	

Source Information:

Barometric Pressure	29.97	"Hg	O_2	19.85 %
Static Pressure	0.6	"H_2O	CO_2	0.64 %
Ave. ΔP	1.6	"H_2O	Rec. Nz.	0.194 inches
Stack Temperature	248	F		
Assumed moisture	1.89	%		
Assumed meter temp.	71.4	F		
Total number of points	20			
Time per point	9			
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	11

Nozzle check for roundness:

1	2	3	
0.213	0.213	0.213	inches

Caliper ID# HLN #1

Post Test Calculations:

Sample volume	175.639 dcf	Ave. ΔP	1.88 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.3704 "H_2O
Actual H_2O	1.84 %	Ave. ΔH	3.15 "H_2O
Std. meter vol.	173.544 dscf	Ave. T_s	262.3 °F
Isokinetic Average	100.4 %	Ave. T_m	77.2 °F

Moisture/Lab:

Filter	Run 2 #		
	Initial	Final	Gain
Impingers, g	200.0	230	30.0
Silica gel, g	240.0	279.1	39.1
		Total water gain:	69.1

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	9.0	8.910	1.90	254	72	3.19	3.20	4	251	51
2	18.0	17.720	1.90	256	73	3.19	3.20	4	249	52
3	27.0	26.510	1.90	257	74	3.19	3.20	4	252	52
4	36.0	35.300	1.90	259	75	3.19	3.20	4	252	52
5	45.0	44.090	1.90	261	76	3.18	3.20	4	246	57
6	54.0	52.870	1.90	263	77	3.18	3.20	4	246	58
7	63.0	61.660	1.90	263	77	3.18	3.20	4	252	60
8	72.0	70.450	1.90	264	78	3.18	3.20	4	252	59
9	81.0	79.300	1.90	264	78	3.18	3.20	4	252	58
10	90.0	87.910	1.80	265	79	3.01	3.00	4	249	59
11	99.0	96.890	2.00	262	76	3.34	3.30	4	252	59
12	108.0	105.970	2.00	263	78	3.35	3.40	4	247	59
13	117.0	115.060	2.00	265	78	3.34	3.30	4	247	58
14	126.0	124.040	2.00	265	78	3.34	3.30	4	251	58
15	135.0	133.090	2.00	266	79	3.35	3.30	4	249	59
16	144.0	142.040	1.90	265	79	3.18	3.20	4	251	60
17	153.0	150.660	1.80	266	79	3.01	3.00	4	249	60
18	162.0	159.250	1.80	267	80	3.01	3.00	4	249	60
19	171.0	167.720	1.70	263	79	2.86	2.90	4	249	60
20	180.0	175.639	1.50	257	79	2.54	2.50	4	249	60

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**14:27**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**	**End Time:**	**17:34**
EPA Method:	**29**	60°F, scattered cloud cover, wind variable	**Date:**	**6/8/2018**
Box Operator:	**CMF**			
Technician(s):	**CSW**			

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	4A	Liner type:	GLASS		
Y factor	0.9963	Nozzle ID	0.213	Nozzle size:	0.2130	inches	
ΔH@	1.8425	Hot box ID	HLN #1	Nozzle area:	0.000247	sq.ft.	
		Pitot Cp	0.84	Probe heat:	248	F	
				Filter heat:	248	F	

Source Information:

Barometric Pressure	29.97	"Hg	O_2	19.86	%
Static Pressure	0.6	"H_2O	CO_2	0.65	%
Ave. ΔP	1.6	"H_2O	Rec. Nz.	0.193	inches
Stack Temperature	248	F			
Assumed moisture	1.84	%			
Assumed meter temp.	77.2	F			
Total number of points	20				
Time per point	9				
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:	16	10

Nozzle check for roundness:

1	2	3	
0.213	0.213	0.213	inches

Caliper ID# HLN #1

Post Test Calculations:

Sample volume	175.168	dcf	Ave. ΔP	1.865	"H_2O
Wet mol. weight	28.66	M_s (actual)	Ave. √ΔP	1.3646	"H_2O
Actual H_2O	2.2	%	Ave. ΔH	3.145	"H_2O
Std. meter vol.	173.396	dscf	Ave. T_s	260.6	°F
Isokinetic Average	100.9	%	Ave. T_m	76.2	°F

Moisture/Lab:

Filter	Run 3 #		
	Initial	Final	Gain
Impingers, g	200.0	245	45.0
Silica gel, g	244.8	282.6	37.8
		Total water gain:	82.8

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	9.0	8.990	2.00	259	76	3.36	3.40	4	249	60
2	18.0	17.950	2.00	259	76	3.36	3.40	4	249	55
3	27.0	26.950	1.90	259	76	3.19	3.20	4	251	52
4	36.0	35.730	1.90	262	77	3.19	3.20	4	251	52
5	45.0	44.530	2.00	262	78	3.36	3.40	4	251	52
6	54.0	53.910	2.10	263	78	3.52	3.50	4	253	52
7	63.0	63.150	2.00	263	78	3.36	3.40	4	253	52
8	72.0	71.750	1.80	258	78	3.04	3.00	4	253	52
9	81.0	80.200	1.70	258	78	2.87	2.90	4	253	52
10	90.0	88.434	1.60	258	78	2.70	2.70	4	249	51
11	99.0	97.390	1.90	258	74	3.19	3.20	4	250	51
12	108.0	106.260	1.90	261	75	3.18	3.20	4	250	51
13	117.0	115.310	1.90	262	75	3.17	3.20	4	250	51
14	126.0	124.100	1.90	261	75	3.18	3.20	4	250	52
15	135.0	132.880	2.00	260	75	3.35	3.40	4	250	53
16	144.0	141.720	1.90	261	75	3.18	3.20	4	250	54
17	153.0	150.330	1.80	262	76	3.01	3.00	4	251	54
18	162.0	159.100	1.80	262	75	3.01	3.00	4	250	54
19	171.0	167.090	1.60	262	75	2.67	2.70	4	250	54
20	180.0	175.168	1.60	261	76	2.68	2.70	4	250	54

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**7:35**
Source:	**CFU 117**	**End Time:**	**10:44**
Method:	**29**	**Date:**	**6/8/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
9.0	8.970	3.30	64	1	2.00	246	1.4142
18.0	17.860	3.30	66	2	2.00	248	1.4142
27.0	26.910	3.40	67	3	2.00	248	1.4142
36.0	35.910	3.40	68	4	2.00	248	1.4142
45.0	44.960	3.40	70	5	2.00	248	1.4142
54.0	53.810	3.20	70	6	1.90	248	1.3784
63.0	62.390	3.00	72	7	1.80	248	1.3416
72.0	70.880	2.90	72	8	1.70	248	1.3038
81.0	79.245	2.90	72	9	1.70	248	1.3038
90.0	87.402	2.70	73	10	1.60	248	1.2649
99.0	96.290	3.20	70	11	1.90	244	1.3784
108.0	104.970	3.10	71	12	1.80	244	1.3416
117.0	114.020	3.40	71	13	2.00	247	1.4142
126.0	123.050	3.40	72	14	2.00	248	1.4142
135.0	132.100	3.40	74	15	2.00	248	1.4142
144.0	141.190	3.40	73	16	2.00	250	1.4142
153.0	150.120	3.20	75	17	1.90	253	1.3784
162.0	158.700	3.00	76	18	1.80	253	1.3416
171.0	166.540	2.60	75	19	1.50	248	1.2247
180.0	174.650	2.70	76	20	1.60	250	1.2649

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 117**	**Date:**	**06/08/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	9.0	min	Diameter	30.000	in
Meter Volume, V_m	174.650	dcf	Rectangular		
Water Volume	71.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	0.62	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.80	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	3.145	"H_2O	√Dp	1.3625	"H_2O
Temperature, T_m	71.4	^oF	Temperature, T_s	248.2	^oF
Temperature, T_m	531.4	^oA (^oR)	Temperature, T_s	708.2	^oA (^oR)
Pressure Meter, P_m	30.201	"Hg	Pressure Stack, P_s	30.014	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	174.444	dscf	Velocity, V_s	88.75	fps
	4.940	dscm	Volume (actual)	26,140.4	awcfm
Actual Volume, $V_{m(actual)}$	237.836	awcf		25,646.3	adcfm
Gas Stream Moisture			Volume (standard)	1,173,016.7	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.365	scf		1,150,846.7	dscf/hr
Moisture, B_{ws}	0.0189			19,180.8	dscf/min
Moisture EPA M4	1.89	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.68	lb/lb-mole			
Percent Isokinetic	100.5	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:05**
Source:	**CFU 117**	**End Time:**	**14:12**
Method:	**29**	**Date:**	**06/08/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
9.0	8.910	3.20	72	1	1.90	254	1.3784
18.0	17.720	3.20	73	2	1.90	256	1.3784
27.0	26.510	3.20	74	3	1.90	257	1.3784
36.0	35.300	3.20	75	4	1.90	259	1.3784
45.0	44.090	3.20	76	5	1.90	261	1.3784
54.0	52.870	3.20	77	6	1.90	263	1.3784
63.0	61.660	3.20	77	7	1.90	263	1.3784
72.0	70.450	3.20	78	8	1.90	264	1.3784
81.0	79.300	3.20	78	9	1.90	264	1.3784
90.0	87.910	3.00	79	10	1.80	265	1.3416
99.0	96.890	3.30	76	11	2.00	262	1.4142
108.0	105.970	3.40	78	12	2.00	263	1.4142
117.0	115.060	3.30	78	13	2.00	265	1.4142
126.0	124.040	3.30	78	14	2.00	265	1.4142
135.0	133.090	3.30	79	15	2.00	266	1.4142
144.0	142.040	3.20	79	16	1.90	265	1.3784
153.0	150.660	3.00	79	17	1.80	266	1.3416
162.0	159.250	3.00	80	18	1.80	267	1.3416
171.0	167.720	2.90	79	19	1.70	263	1.3038
180.0	175.639	2.50	79	20	1.50	257	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 117**	**Date:**	**06/08/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	9.0	min	Diameter	30.000	in
Meter Volume, V_m	175.639	dcf	Rectangular		
Water Volume	69.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	0.64	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.85	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	3.150	"H_2O	√Dp	1.3704	"H_2O
Temperature, T_m	77.2	^oF	Temperature, T_s	262.3	^oF
Temperature, T_m	537.2	^oA (^oR)	Temperature, T_s	722.3	^oA (^oR)
Pressure Meter, P_m	30.202	"Hg	Pressure Stack, P_s	30.014	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	173.544	dscf	Velocity, V_s	90.12	fps
	4.914	dscm	Volume (actual)	26,543.9	awcfm
Actual Volume, $V_{m(actual)}$	241.196	awcf		26,055.5	adcfm
Gas Stream Moisture			Volume (standard)	1,167,872.2	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.252	scf		1,146,383.4	dscf/hr
Moisture, B_{ws}	0.0184			19,106.4	dscf/min
Moisture EPA M4	1.84	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.3	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**14:27**
Source:	**CFU 117**	**End Time:**	**17:34**
Method:	**29**	**Date:**	**06/08/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
9.0	8.990	3.40	76	1	2.00	259	1.4142
18.0	17.950	3.40	76	2	2.00	259	1.4142
27.0	26.950	3.20	76	3	1.90	259	1.3784
36.0	35.730	3.20	77	4	1.90	262	1.3784
45.0	44.530	3.40	78	5	2.00	262	1.4142
54.0	53.910	3.50	78	6	2.10	263	1.4491
63.0	63.150	3.40	78	7	2.00	263	1.4142
72.0	71.750	3.00	78	8	1.80	258	1.3416
81.0	80.200	2.90	78	9	1.70	258	1.3038
90.0	88.434	2.70	78	10	1.60	258	1.2649
99.0	97.390	3.20	74	11	1.90	258	1.3784
108.0	106.260	3.20	75	12	1.90	261	1.3784
117.0	115.310	3.20	75	13	1.90	262	1.3784
126.0	124.100	3.20	75	14	1.90	261	1.3784
135.0	132.880	3.40	75	15	2.00	260	1.4142
144.0	141.720	3.20	75	16	1.90	261	1.3784
153.0	150.330	3.00	76	17	1.80	262	1.3416
162.0	159.100	3.00	75	18	1.80	262	1.3416
171.0	167.090	2.70	75	19	1.60	262	1.2649
180.0	175.168	2.70	76	20	1.60	261	1.2649

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 117**	**Date:**	**06/08/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	180	min	Circular		
Sample Time Interval	9.0	min	Diameter	30.000	in
Meter Volume, V_m	175.168	dcf	Rectangular		
Water Volume	82.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	0.65	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.86	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	3.145	"H_2O	√Dp	1.3646	"H_2O
Temperature, T_m	76.2	^oF	Temperature, T_s	260.6	^oF
Temperature, T_m	536.2	^oA (^oR)	Temperature, T_s	720.6	^oA (^oR)
Pressure Meter, P_m	30.201	"Hg	Pressure Stack, P_s	30.014	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	173.395	dscf	Velocity, V_s	89.69	fps
	4.910	dscm	Volume (actual)	26,417.3	awcfm
Actual Volume, $V_{m(actual)}$	241.307	awcf		25,836.1	adcfm
Gas Stream Moisture			Volume (standard)	1,165,041.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.897	scf		1,139,410.9	dscf/hr
Moisture, B_{ws}	0.0220			18,990.2	dscf/min
Moisture EPA M4	2.20	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.66	lb/lb-mole			
Percent Isokinetic	100.9	%			

Source:	CFU 117				Sample Date:	06/08/18
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	3.840		0.501	0.125	0.050	µg/sample
Beryllium	< MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	< MDL	<	MDL	0.100	0.040	µg/sample
Chromium	1.030		0.186	0.200	0.080	µg/sample
Cobalt	< MDL	<	MDL	0.125	0.050	µg/sample
Copper	2.190		1.910	1.250	0.500	µg/sample
Lead	< MDL	<	MDL	1.250	0.500	µg/sample
Manganese	1.290		0.453	0.075	0.030	µg/sample
Nickel	2.250	<	MDL	0.750	0.300	µg/sample
Phosphorus	< MDL	<	MDL	5.000	2.000	µg/sample
Selenium	< MDL	<	MDL	3.750	1.500	µg/sample
Zinc	5.470		1.580	0.750	0.300	µg/sample
Lab ID:	18-S1073		18-S1074			
Sample Vol:	250		100		mL	

Source:	CFU 117				Sample Date:	06/08/18
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	3.630		0.481	0.125	0.050	µg/sample
Beryllium	< MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	< MDL	<	MDL	0.100	0.040	µg/sample
Chromium	1.080		0.156	0.200	0.080	µg/sample
Cobalt	< MDL	<	MDL	0.125	0.050	µg/sample
Copper	1.780		2.030	1.250	0.500	µg/sample
Lead	< MDL	<	MDL	1.250	0.500	µg/sample
Manganese	0.948		0.423	0.075	0.030	µg/sample
Nickel	2.290	<	MDL	0.750	0.300	µg/sample
Phosphorus	< MDL	<	MDL	5.000	2.000	µg/sample
Selenium	< MDL	<	MDL	3.750	1.500	µg/sample
Zinc	5.720		2.230	0.750	0.300	µg/sample
Lab ID:	18-S1075		18-S1076			
Sample Vol:	250		100		mL	

Source:	**CFU 117**			**Sample Date:**	**06/08/18**	
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		3.770		0.535	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	<	MDL	<	MDL	0.100	0.040	µg/sample
Chromium		1.050		0.206	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		1.530		2.020	1.250	0.500	µg/sample
Lead	<	MDL	<	MDL	1.250	0.500	µg/sample
Manganese		0.908		0.492	0.075	0.030	µg/sample
Nickel		2.230	<	MDL	0.750	0.300	µg/sample
Phosphorus	<	MDL	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		3.050		1.920	0.750	0.300	µg/sample
Lab ID:		18-S1077		18-S1078			
Sample Vol:		250		100		mL	

Source: **CFU 117**

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		3.200	0.125		0.462	0.050		0.452	0.125
Beryllium	<	MDL	0.050	<	MDL	0.020	<	MDL	0.050
Cadmium	<	MDL	0.100	<	MDL	0.040	<	MDL	0.100
Chromium		0.948	0.200		0.156	0.080	<	MDL	0.200
Cobalt	<	MDL	0.125	<	MDL	0.050	<	MDL	0.125
Copper	<	MDL	1.250		1.720	0.500		1.680	1.250
Lead	<	MDL	1.250	<	MDL	0.500	<	MDL	1.250
Manganese		0.546	0.075		0.389	0.030		0.313	0.075
Nickel		2.080	0.750	<	MDL	0.300	<	MDL	0.750
Phosphorus	<	MDL	5.000	<	MDL	2.000	<	MDL	5.000
Selenium	<	MDL	3.750	<	MDL	1.500	<	MDL	3.750
Zinc		1.780	0.750		0.376	0.300	<	MDL	0.750
Lab ID:		18-S1080			18-S1081			18-S1079	
Sample Vol, ml:		250			100			250	

Hollingsworth & Vose **Method 29 Metals Blank Calculations** **Run: 1**

CFU 117

06/08/18

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. µg/mL		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**				**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		3.840		0.1808		3.200		0.501		0.0046		0.924		0.1808	1.105	**Barium**
Be	<	0.050	<	0.0200	<	0.050	<	0.020	<	0.0002	<	0.040	<	0.0200	0.000	**Beryllium**
Cd	<	0.100	<	0.0400	<	0.100	<	0.040	<	0.0004	<	0.080	<	0.0400	0.000	**Cadmium**
Cr		1.030	<	0.0800		0.948		0.186		0.0016		0.312	<	0.0800	0.312	**Chromium**
Co	<	0.125	<	0.0500	<	0.125	<	0.050	<	0.0005	<	0.100	<	0.0500	0.000	**Cobalt**
Cu		2.190		0.6720	<	1.250		1.910		0.0172		3.440		0.6720	4.112	**Copper**
Pb	<	1.250	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000	0.000	**Lead**
Mn		1.290		0.1252		0.546		0.453		0.0039		0.778		0.1252	0.903	**Manganese**
Ni		2.250	<	0.3000		2.080	<	0.300	<	0.0030	<	0.600	<	0.3000	0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000	<	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		5.470	<	0.3000		1.780		1.580		0.0038		0.752	<	0.3000	0.752	**Zinc**
Lab:		**18-S1073**		**18-S1079**		**18-S1080**		**18-S1074**		**18-S1081**						
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

*** 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	3.381	3.381		0.192	0.192	11.63		0.459	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.000	0.000	<	0.005	0.000	11.63	<	0.100	**Cadmium**
Cr	0.948	0.948		0.052	0.052	11.63		0.082	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.672	0.672		0.110	0.110	11.63		1.518	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.671	0.671		0.065	0.065	11.63		0.619	**Manganese**
Ni	2.080	2.080		0.113	0.113	11.63		0.170	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.780	1.780		0.274	0.274	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 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	1.105		0.025	0.025	1.000		**0.000**		**0.459**		**0.459**	**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**	**<**	**0.100**	<	**0.140**	**Cadmium**
Cr	0.312	0.312		0.009	0.009	1.000		**0.000**		**0.082**		**0.082**	**Chromium**
Co	0.000	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000	4.112		0.096	0.096	1.000		**0.910**		**1.518**		**2.428**	**Copper**
Pb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Lead**
Mn	0.903	0.903		0.023	0.023	1.000		**0.000**		**0.619**		**0.619**	**Manganese**
Ni	0.000	0.000	<	0.015	0.000	1.000	<	**0.300**		**0.170**	<	**0.470**	**Nickel**
P	0.000	0.000	<	0.100	0.000	1.000	<	**2.000**	**<**	**5.000**	<	**7.000**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	0.752	0.752		0.079	0.079	1.000		**0.828**		**3.690**		**4.518**	**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 117

06/08/18

		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		3.630		0.1808		3.200		0.481		0.0046		0.924		0.1808		1.105	**Barium**
Be	<	0.050	<	0.0200	<	0.050	<	0.020	<	0.0002	<	0.040	<	0.0200		0.000	**Beryllium**
Cd	<	0.100	<	0.0400	<	0.100	<	0.040	<	0.0004	<	0.080	<	0.0400		0.000	**Cadmium**
Cr		1.080	<	0.0800		0.948		0.156		0.0016		0.312	<	0.0800		0.312	**Chromium**
Co	<	0.125	<	0.0500	<	0.125	<	0.050	<	0.0005	<	0.100	<	0.0500		0.000	**Cobalt**
Cu		1.780		0.6720	<	1.250		2.030		0.0172		3.440		0.6720		4.112	**Copper**
Pb	<	1.250	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000		0.000	**Lead**
Mn		0.948		0.1252		0.546		0.423		0.0039		0.778		0.1252		0.903	**Manganese**
Ni		2.290	<	0.3000		2.080	<	0.300	<	0.0030	<	0.600	<	0.3000		0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000	<	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		5.720	<	0.3000		1.780		2.230		0.0038		0.752	<	0.3000		0.752	**Zinc**
Lab:		**18-S1075**		**18-S1079**		**18-S1080**		**18-S1076**		**18-S1081**							
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

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	3.381	3.381		0.182	0.182	11.63		0.249	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.000	0.000	<	0.005	0.000	11.63	<	0.100	**Cadmium**
Cr	0.948	0.948		0.054	0.054	11.63		0.132	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.672	0.672		0.089	0.089	11.63		1.108	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.671	0.671		0.047	0.047	11.63		0.277	**Manganese**
Ni	2.080	2.080		0.115	0.115	11.63		0.210	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.780	1.780		0.286	0.286	11.63		3.940	**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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If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

6/8/18

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	1.105		0.024	0.024	1.000		**0.000**		**0.249**		**0.249**	**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**	**<**	**0.100**	<	**0.140**	**Cadmium**
Cr	0.312	0.312		0.008	0.008	1.000		**0.000**		**0.132**		**0.132**	**Chromium**
Co	0.000	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000	4.112		0.102	0.102	1.000		**1.030**		**1.108**		**2.138**	**Copper**
Pb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Lead**
Mn	0.903	0.903		0.021	0.021	1.000		**0.000**		**0.277**		**0.277**	**Manganese**
Ni	0.000	0.000	<	0.015	0.000	1.000	<	**0.300**		**0.210**	<	**0.510**	**Nickel**
P	0.000	0.000	<	0.100	0.000	1.000	<	**2.000**	**<**	**5.000**	<	**7.000**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	0.752	0.752		0.112	0.112	1.000		**1.478**		**3.940**		**5.418**	**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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Hollingsworth & Vose | **Method 29 Metals Blank Calculations** | **Run: 3**

CFU 117

06/08/18

		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		3.770		0.1808		3.200		0.535		0.0046		0.924		0.1808		1.105	**Barium**
Be	<	0.050	<	0.0200	<	0.050	<	0.020	<	0.0002	<	0.040	<	0.0200		0.000	**Beryllium**
Cd	<	0.100	<	0.0400	<	0.100	<	0.040	<	0.0004	<	0.080	<	0.0400		0.000	**Cadmium**
Cr		1.050	<	0.0800		0.948		0.206		0.0016		0.312	<	0.0800		0.312	**Chromium**
Co	<	0.125	<	0.0500	<	0.125	<	0.050	<	0.0005	<	0.100	<	0.0500		0.000	**Cobalt**
Cu		1.530		0.6720	<	1.250		2.020		0.0172		3.440		0.6720		4.112	**Copper**
Pb	<	1.250	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000		0.000	**Lead**
Mn		0.908		0.1252		0.546		0.492		0.0039		0.778		0.1252		0.903	**Manganese**
Ni		2.230	<	0.3000		2.080	<	0.300	<	0.0030	<	0.600	<	0.3000		0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000	<	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		3.050	<	0.3000		1.780		1.920		0.0038		0.752	<	0.3000		0.752	**Zinc**
Lab:		**18-S1077**		**18-S1079**		**18-S1080**		**18-S1078**		**18-S1081**							
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	3.381	3.381		0.189	0.189	11.63		0.389	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.000	0.000	<	0.005	0.000	11.63	<	0.100	**Cadmium**
Cr	0.948	0.948		0.053	0.053	11.63		0.102	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.672	0.672		0.077	0.077	11.63		0.858	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.671	0.671		0.045	0.045	11.63		0.237	**Manganese**
Ni	2.080	2.080		0.112	0.112	11.63		0.150	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.780	1.780		0.153	0.153	11.63		1.270	**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 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	1.105		0.027	0.027	1.000		**0.000**		**0.389**		**0.389**	**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**	**<**	**0.100**	<	**0.140**	**Cadmium**
Cr	0.312	0.312		0.010	0.010	1.000		**0.000**		**0.102**		**0.102**	**Chromium**
Co	0.000	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000	4.112		0.101	0.101	1.000		**1.020**		**0.858**		**1.878**	**Copper**
Pb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Lead**
Mn	0.903	0.903		0.025	0.025	1.000		**0.000**		**0.237**		**0.237**	**Manganese**
Ni	0.000	0.000	<	0.015	0.000	1.000	<	**0.300**		**0.150**	<	**0.450**	**Nickel**
P	0.000	0.000	<	0.100	0.000	1.000	<	**2.000**	**<**	**5.000**	<	**7.000**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	0.752	0.752		0.096	0.096	1.000		**1.168**		**1.270**		**2.438**	**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 117**
Location: **Corvallis, OR**

Run			1	2	3	
Date			6/8/2018	6/8/2018	6/8/2018	
Run Start Time			7:35	11:05	14:27	
Run End Time			10:44	14:12	17:34	
Duration, min.			180	180	180	Average
Barometric Pressure, "Hg			29.97	29.97	29.97	**29.97**
Nozzle Dia., in.			0.2130	0.2130	0.2130	**0.2130**
Isokinetic Average, %			100.5	100.3	100.9	**100.6**
Sample Volume, dscf			174.444	173.544	173.395	**173.794**
Sample Volume, dscm			4.940	4.914	4.910	**4.921**
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			0.62	0.64	0.65	**0.64**
O_2 %vd			19.80	19.85	19.86	**19.84**
Static Press., "H_2O			0.60	0.60	0.60	**0.60**
H_2O %v			1.89	1.84	2.20	**1.98**
Wet Molecular Weight, lb/lb-mole			28.68	28.70	28.66	**28.68**
Velocity, FPS			88.75	90.12	89.69	**89.52**
ADCFM			25,646.3	26,055.5	25,836.1	**25,846.0**
AWCFM			26,140.4	26,543.9	26,417.3	**26,367.2**
DSCFM			19,180.8	19,106.4	18,990.2	**19,092.5**
Stack Temperature, ^oF			248.2	262.3	260.6	**257.0**
Production Data	Glass Production	lbs/hr	114.3	117.5	114.3	**115.4**

Hollingsworth & Vose **Test: M29**
CFU 117
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	< 0.354	< 2.55E-05	< 2.23E-07	< 1.250	< 0.253	< 1.82E-05	< 1.59E-07	<	0.500	< 0.101	< 7.27E-06	< 6.36E-08	**Sb**
Arsenic	< 2.450	< 0.496	< 3.56E-05	< 3.12E-07	< 1.750	< 0.354	< 2.55E-05	< 2.23E-07	<	0.700	< 0.142	< 1.02E-05	< 8.91E-08	**As**
Barium	0.459	0.093	6.68E-06	5.84E-08	0.459	0.093	6.68E-06	5.84E-08		0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.014	< 1.02E-06	< 8.91E-09	< 0.050	< 0.010	< 7.27E-07	< 6.36E-09	<	0.020	< 0.004	< 2.91E-07	< 2.55E-09	**Be**
Cadmium	< 0.140	< 0.028	< 2.04E-06	< 1.78E-08	< 0.100	< 0.020	< 1.45E-06	< 1.27E-08	<	0.040	< 0.008	< 5.82E-07	< 5.09E-09	**Cd**
Chromium	0.082	0.017	1.19E-06	1.04E-08	0.082	0.017	1.19E-06	1.04E-08		0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.035	< 2.55E-06	< 2.23E-08	< 0.125	< 0.025	< 1.82E-06	< 1.59E-08	<	0.050	< 0.010	< 7.27E-07	< 6.36E-09	**Co**
Copper	2.428	0.491	3.53E-05	3.09E-07	1.518	0.307	2.21E-05	1.93E-07		0.910	0.184	1.32E-05	1.16E-07	**Cu**
Lead	< 1.750	< 0.354	< 2.55E-05	< 2.23E-07	< 1.250	< 0.253	< 1.82E-05	< 1.59E-07	<	0.500	< 0.101	< 7.27E-06	< 6.36E-08	**Pb**
Manganese	0.619	0.125	9.00E-06	7.87E-08	0.619	0.125	9.00E-06	7.87E-08		0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 0.470	< 0.095	< 6.84E-06	< 5.98E-08	0.170	0.034	2.47E-06	2.16E-08	<	0.300	< 0.061	< 4.36E-06	< 3.82E-08	**Ni**
Phosphorus	< 7.000	< 1.417	< 1.02E-04	< 8.91E-07	< 5.000	< 1.012	< 7.27E-05	< 6.36E-07	<	2.000	< 0.405	< 2.91E-05	< 2.54E-07	**P**
Selenium	< 5.250	< 1.063	< 7.64E-05	< 6.68E-07	< 3.750	< 0.759	< 5.45E-05	< 4.77E-07	<	1.500	< 0.304	< 2.18E-05	< 1.909E-07	**Se**
Zinc	4.518	0.915	6.57E-05	5.75E-07	3.690	0.747	5.37E-05	4.70E-07		0.828	0.168	1.20E-05	1.054E-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	< 0.356	< 2.55E-05	< 2.17E-07	< 1.250	< 0.254	< 1.82E-05	< 1.55E-07	<	0.500	< 0.102	< 7.28E-06	< 6.20E-08	**Sb**
Arsenic	< 2.450	< 0.499	< 3.57E-05	< 3.04E-07	< 1.750	< 0.356	< 2.55E-05	< 2.17E-07	<	0.700	< 0.142	< 1.02E-05	< 8.68E-08	**As**
Barium	0.249	0.051	3.63E-06	3.09E-08	0.249	0.051	3.63E-06	3.09E-08		0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.014	< 1.02E-06	< 8.67E-09	< 0.050	< 0.010	< 7.28E-07	< 6.20E-09	<	0.020	< 0.004	< 2.91E-07	< 2.48E-09	**Be**
Cadmium	< 0.140	< 0.028	< 2.04E-06	< 1.74E-08	< 0.100	< 0.020	< 1.46E-06	< 1.24E-08	<	0.040	< 0.008	< 5.83E-07	< 4.96E-09	**Cd**
Chromium	0.132	0.027	1.92E-06	1.64E-08	0.132	0.027	1.92E-06	1.64E-08		0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.036	< 2.55E-06	< 2.17E-08	< 0.125	< 0.025	< 1.82E-06	< 1.55E-08	<	0.050	< 0.010	< 7.28E-07	< 6.20E-09	**Co**
Copper	2.138	0.435	3.11E-05	2.65E-07	1.108	0.225	1.61E-05	1.37E-07		1.030	0.210	1.50E-05	1.28E-07	**Cu**
Lead	< 1.750	< 0.356	< 2.55E-05	< 2.17E-07	< 1.250	< 0.254	< 1.82E-05	< 1.55E-07	<	0.500	< 0.102	< 7.28E-06	< 6.20E-08	**Pb**
Manganese	0.277	0.056	4.03E-06	3.43E-08	0.277	0.056	4.03E-06	3.43E-08		0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 0.510	< 0.104	< 7.43E-06	< 6.32E-08	0.210	0.043	3.06E-06	2.60E-08	<	0.300	< 0.061	< 4.37E-06	< 3.72E-08	**Ni**
Phosphorus	< 7.000	< 1.425	< 1.02E-04	< 8.68E-07	< 5.000	< 1.018	< 7.28E-05	< 6.20E-07	<	2.000	< 0.407	< 2.91E-05	< 2.48E-07	**P**
Selenium	< 5.250	< 1.068	< 7.65E-05	< 6.51E-07	< 3.750	< 0.763	< 5.46E-05	< 4.65E-07	<	1.500	< 0.305	< 2.18E-05	< 1.859E-07	**Se**
Zinc	5.418	1.103	7.89E-05	6.72E-07	3.940	0.802	5.74E-05	4.88E-07		1.478	0.301	2.15E-05	1.832E-07	**Zn**

Hollingsworth & Vose **Test: M29**
CFU 117
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	< 0.356	< 2.54E-05	< 2.22E-07	< 1.250	< 0.255	< 1.81E-05	< 1.58E-07	< 0.500	< 0.102	< 7.24E-06	< 6.34E-08	**Sb**
Arsenic	< 2.450	< 0.499	< 3.55E-05	< 3.11E-07	< 1.750	< 0.356	< 2.54E-05	< 2.22E-07	< 0.700	< 0.143	< 1.01E-05	< 8.87E-08	**As**
Barium	0.389	0.079	5.64E-06	4.93E-08	0.389	0.079	5.64E-06	4.93E-08	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.014	< 1.01E-06	< 8.87E-09	< 0.050	< 0.010	< 7.24E-07	< 6.33E-09	< 0.020	< 0.004	< 2.90E-07	< 2.54E-09	**Be**
Cadmium	< 0.140	< 0.029	< 2.03E-06	< 1.77E-08	< 0.100	< 0.020	< 1.45E-06	< 1.27E-08	< 0.040	< 0.008	< 5.79E-07	< 5.07E-09	**Cd**
Chromium	0.102	0.021	1.48E-06	1.29E-08	0.102	0.021	1.48E-06	1.29E-08	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.036	< 2.54E-06	< 2.22E-08	< 0.125	< 0.025	< 1.81E-06	< 1.58E-08	< 0.050	< 0.010	< 7.24E-07	< 6.33E-09	**Co**
Copper	1.878	0.382	2.72E-05	2.38E-07	0.858	0.175	1.24E-05	1.09E-07	1.020	0.208	1.48E-05	1.29E-07	**Cu**
Lead	< 1.750	< 0.356	< 2.54E-05	< 2.22E-07	< 1.250	< 0.255	< 1.81E-05	< 1.58E-07	< 0.500	< 0.102	< 7.24E-06	< 6.34E-08	**Pb**
Manganese	0.237	0.048	3.43E-06	3.00E-08	0.237	0.048	3.43E-06	3.00E-08	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 0.450	< 0.092	< 6.52E-06	< 5.70E-08	0.150	0.031	2.17E-06	1.90E-08	< 0.300	< 0.061	< 4.35E-06	< 3.80E-08	**Ni**
Phosphorus	< 7.000	< 1.426	< 1.01E-04	< 8.87E-07	< 5.000	< 1.018	< 7.24E-05	< 6.34E-07	< 2.000	< 0.407	< 2.90E-05	< 2.53E-07	**P**
Selenium	< 5.250	< 1.069	< 7.61E-05	< 6.65E-07	< 3.750	< 0.764	< 5.43E-05	< 4.75E-07	< 1.500	< 0.305	< 2.17E-05	< 1.901E-07	**Se**
Zinc	2.438	0.497	3.53E-05	3.09E-07	1.270	0.259	1.84E-05	1.61E-07	1.168	0.238	1.69E-05	1.48E-07	**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	< 0.356	< 2.54E-05	< 2.20E-07	< 1.250	< 0.254	< 1.82E-05	< 1.57E-07	< 0.500	< 0.102	< 7.27E-06	< 6.30E-08	**Sb**
Arsenic	< 2.450	< 0.498	< 3.56E-05	< 3.09E-07	< 1.750	< 0.356	< 2.54E-05	< 2.20E-07	< 0.700	< 0.142	< 1.02E-05	< 8.82E-08	**As**
Barium	0.366	0.074	5.32E-06	4.62E-08	0.366	0.074	5.32E-06	4.62E-08	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.014	< 1.02E-06	< 8.82E-09	< 0.050	< 0.010	< 7.26E-07	< 6.30E-09	< 0.020	< 0.004	< 2.91E-07	< 2.52E-09	**Be**
Cadmium	< 0.140	< 0.028	< 2.03E-06	< 1.76E-08	< 0.100	< 0.020	< 1.45E-06	< 1.26E-08	< 0.040	< 0.008	< 5.81E-07	< 5.04E-09	**Cd**
Chromium	0.105	0.021	1.53E-06	1.32E-08	0.105	0.021	1.53E-06	1.32E-08	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.036	< 2.54E-06	< 2.20E-08	< 0.125	< 0.025	< 1.82E-06	< 1.57E-08	< 0.050	< 0.010	< 7.26E-07	< 6.30E-09	**Co**
Copper	2.148	0.436	3.12E-05	2.71E-07	1.161	0.236	1.69E-05	1.46E-07	0.987	0.201	1.43E-05	1.24E-07	**Cu**
Lead	< 1.750	< 0.356	< 2.54E-05	< 2.20E-07	< 1.250	< 0.254	< 1.82E-05	< 1.57E-07	< 0.500	< 0.102	< 7.27E-06	< 6.30E-08	**Pb**
Manganese	0.377	0.077	5.49E-06	4.77E-08	0.377	0.077	5.49E-06	4.77E-08	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 0.477	< 0.097	< 6.93E-06	< 6.00E-08	0.177	0.036	2.57E-06	2.22E-08	< 0.300	< 0.061	< 4.36E-06	< 3.78E-08	**Ni**
Phosphorus	< 7.000	< 1.422	< 1.02E-04	< 8.82E-07	< 5.000	< 1.016	< 7.27E-05	< 6.30E-07	< 2.000	< 0.406	< 2.91E-05	< 2.52E-07	**P**
Selenium	< 5.250	< 1.067	< 7.63E-05	< 6.61E-07	< 3.750	< 0.762	< 5.45E-05	< 4.72E-07	< 1.500	< 0.305	< 2.18E-05	< 1.89E-07	**Se**
Zinc	4.125	0.838	6.00E-05	5.18E-07	2.967	0.602	4.31E-05	3.73E-07	1.158	0.235	1.68E-05	1.455E-07	**Zn**
Total:	**< 26.183**	**< 5.320**	**< 3.81E-04**	**< 3.30E-06**	< 18.428	< 3.744	< 2.68E-04	< 2.32E-06	< 7.755	< 1.576	< 1.13E-04	< 9.77E-07	

'<' denotes results which were 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:**	**7:35**
Source:	**CFU 117**	**End Time:**	**10:44**
Method:	**29**	**Date:**	**6/8/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.201 "Hg

where Pb: 29.97 "Hg
ΔH: 3.145 "H_2O

2) $Ps = Pb + (Static\ Press./13.6) =$ 30.014 "Hg

where Pb: 29.97 "Hg
Static Press.: 0.60 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 174.444 dscf

where Vm: 174.650 dcf
Y: 0.9963
Pm: 30.201 "Hg
Tm: 531.4 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 3.365 scf

where H_2O: 71.50 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0189

where Vw(std): 3.365 scf
Vm(std): 174.444 dscf

6) % H_2O = Bws x 100 = 1.89 %v

7) $V_m(actual) = \left(\frac{Y\ x\ Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 237.836 awcf

where Y: 0.9963
Vm: 174.6499 dcf
Bws: 0.0189
Ts: 708.2 °A
Tm: 531.4 °A
Pm: 30.201 "Hg
Ps: 30.014 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.89 lb/lb-mole

where CO_2: 0.62 %vd
O_2 19.80 %vd
N_2+CO= (100-(O_2+CO_2): 79.58 %vd

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.68 lb/lb-mole
where M_d: 28.89 lb/lb-mole
Bws: 0.0189

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 88.75 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.3625
Ts: 708.2 °A
Ps: 30.014 "Hg
Ms: 28.68 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 26,140.4 AWCFM
where V_s: 88.75 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 25,646.3 ADCFM
where AWCFM: 26,140.4
Bws: 0.0189

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 1,173,016.7 wscf/hr
where V_s: 88.75 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 708.2 °A
Ps: 30.014 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,150,846.7 dscf/hr
where wscf/hr: 1,173,016.7
Bws: 0.0189

16) DSCFM= (dscf/hr)/60 mins/hr = 19,180.8 DSCFM
where dscf/hr: 1,150,846.7

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000247 sq. ft.
where Nozzle Size: 0.2130 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 117**	**Date:**	**6/8/2018**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.5 %

where Ts:	708.2	°A
Vm(Std):	174.444	dscf
Ps:	30.014	"Hg
Vs	88.75	ft/sec
Nozzle Area:	0.000247	sq. ft.
Sampling Time:	180	min.
Bws:	0.0189	

EPA Method 29:
Chromium

19) Cr Laboratory Results (blank corrected)

Front half (FH):	0.082 µg/sample
Back half (BH):	0.000 µg/sample
Total (FH + BH):	0.082 µg/sample

20) Cs = µg/Vm(std) = 0.017 µg/dscm

where Run 1 Total:	0.082	µg/sample
Vm(std):	4.940	dscm

21) Emission Rate = (Cs)$\left(\frac{2.83168\ m^3}{ft^3}\right)$(stack flow)$\left(\frac{2.2046E-9\ lb}{\mu g}\right)$= 1.19E-06 lb/hr

where Cs:	0.017	µg/dscm
Stack Flow:	1,150,846.7	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 117**
DATE(S)	**06/08/18**
METHOD	**30B**
POLLUTANT	**Mercury**

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**7:36**
Source:	**CFU 117**	**End Time:**	**10:45**
EPA Method:	**30B**	**Start Date:**	**6/8/2018**
Box Operator:	**CMF**	**End Date:**	**6/8/2018**
Technician(s):	**CSW**		

Pre-Test Information:

Barometric Pressure:	29.97 "Hg
Test duration:	180 min

Equipment:

Probe ID:	HLN 30B	
Probe heat:	260 F	
	Side A	Side B
Meterbox ID:	HLN Duel #2	HLN Duel #2
Y factor:	1.0420	1.0460
Desired sampling rate:	2	2 lpm
Trap ID#:	OLC047447	OL469508
Spiked @:	5	0 ng
Orifice # (if used):		

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	15	15	15	16
Train leak rate, lpm	0.008	0.015	0.007	0.015

Test Summary:

	Side A	Side B	
Sample Volume:	360.317	360.294	L
Ave. Meter Temp:	77.6	80.6	°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	247	247	59	59	5	7	266	269	2.000	2.000
5	9.740	9.820	247	247	59	60	5	7	266	269	1.948	1.964
10	19.410	19.350	248	248	60	60	5	7	266	269	1.934	1.906
15	29.400	29.380	248	248	61	63	6	7	266	269	1.998	2.006
20	39.340	39.340	248	248	63	65	6	7	266	268	1.988	1.992
25	49.510	49.590	248	248	65	68	6	7	266	268	2.034	2.050
30	59.710	59.750	248	248	67	70	6	7	266	269	2.040	2.032
35	69.900	69.880	248	248	70	73	6	8	266	268	2.038	2.026
40	80.160	80.150	248	248	70	73	6	8	266	267	2.052	2.054
45	90.310	90.330	248	248	72	76	6	8	268	267	2.030	2.036
50	100.510	100.510	249	249	74	77	6	8	266	268	2.040	2.036
55	110.580	110.680	248	248	75	78	6	8	266	268	2.014	2.034
60	120.940	120.890	248	248	76	80	6	8	267	267	2.072	2.042
65	131.190	131.210	248	248	77	81	6	8	266	268	2.050	2.064
70	141.420	141.380	248	248	78	81	6	8	268	268	2.046	2.034
75	151.440	151.460	248	248	79	83	6	8	266	268	2.004	2.016
80	161.430	161.490	248	248	80	83	6	8	266	269	1.998	2.006
85	171.510	171.450	246	246	81	84	6	8	267	268	2.016	1.992
90	181.768	181.835	246	246	81	85	6	8	269	269	2.052	2.077
95	191.700	191.630	245	245	82	84	6	8	266	268	1.986	1.959
100	201.650	201.640	248	248	82	84	6	8	266	268	1.990	2.002
105	211.610	211.570	246	246	82	85	6	8	266	268	1.992	1.986
110	221.590	221.590	247	247	82	85	6	8	266	267	1.996	2.004
115	231.550	231.540	248	248	82	86	6	8	268	269	1.992	1.990
120	241.620	241.590	248	248	82	86	6	8	268	269	2.014	2.010
125	251.630	251.620	248	248	84	87	6	8	266	268	2.002	2.006
130	261.350	261.350	249	249	84	88	6	8	266	268	1.944	1.946
135	271.330	271.360	250	250	85	88	6	8	266	268	1.996	2.002
140	280.970	280.860	253	253	85	88	6	8	266	268	1.928	1.900
145	290.750	290.750	253	253	85	88	6	8	267	269	1.956	1.978
150	300.650	300.650	254	254	86	90	6	8	266	267	1.980	1.980
155	310.530	310.520	251	251	87	90	6	8	266	268	1.976	1.974
160	320.230	320.220	250	250	87	90	6	8	266	268	1.940	1.940
165	330.040	330.100	251	251	87	91	6	9	267	269	1.962	1.976
170	339.910	339.980	251	251	87	91	6	9	266	268	1.974	1.976
175	350.020	350.010	251	251	87	91	7	9	266	267	2.022	2.006
180	360.317	360.294	251	251	88	92	7	9	266	267	2.059	2.057

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:06**
Source:	**CFU 117**	**End Time:**	**14:13**
EPA Method:	**30B**	**Start Date:**	**6/8/2018**
Box Operator:	**CMF**	**End Date:**	**6/8/2018**
Technician(s):	**CSW**		

Pre-Test Information:

Barometric Pressure:	29.97	"Hg
Test duration:	180	min

Equipment:

	Side A	Side B	
Probe ID:	HLN 30B		
Probe heat:	260	F	
Meterbox ID:	HLN Duel #2	HLN Duel #2	
Y factor:	1.0420	1.0460	
Desired sampling rate:	2	2	lpm
Trap ID#:	OL419232	OL469573	
Spiked @:	5	0	ng
Orifice # (if used):			

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	16	15	16	17
Train leak rate, lpm	0.011	0.016	0.005	0.012

Test Summary:

	Side A	Side B	
Sample Volume:	360.480	360.479	L
Ave. Meter Temp:	90.8	94.1	°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	255	255	87	90	7	9	266	268	2.000	2.000
5	10.170	10.180	256	256	87	89	7	9	266	268	2.034	2.036
10	20.320	20.340	256	256	86	89	7	9	266	268	2.030	2.032
15	30.480	30.510	256	256	86	89	7	9	266	268	2.032	2.034
20	40.620	40.660	256	256	87	90	7	9	266	267	2.028	2.030
25	50.700	50.720	258	258	87	90	7	9	267	269	2.016	2.012
30	60.870	60.820	259	259	88	91	7	9	266	267	2.034	2.020
35	71.060	71.120	259	259	88	91	7	9	266	267	2.038	2.060
40	81.170	81.120	263	263	89	92	7	9	266	268	2.022	2.000
45	91.200	91.350	263	263	89	92	7	9	267	269	2.006	2.046
50	101.250	101.210	263	263	90	93	7	9	266	269	2.010	1.972
55	111.310	111.300	263	263	90	93	7	9	267	267	2.012	2.018
60	121.310	121.370	264	264	91	94	7	9	267	267	2.000	2.014
65	131.290	131.290	264	264	91	94	7	9	266	268	1.996	1.984
70	141.420	141.380	263	263	91	95	7	9	266	268	2.026	2.018
75	151.460	151.550	264	264	91	95	7	9	268	269	2.008	2.034
80	161.540	161.530	265	265	92	95	7	9	267	268	2.016	1.996
85	171.510	171.440	263	263	92	95	7	9	266	268	1.994	1.982
90	181.573	181.697	263	263	92	96	7	9	266	268	2.013	2.051
95	191.700	191.780	263	263	92	94	7	9	266	268	2.025	2.017
100	201.550	201.500	263	263	91	94	7	9	266	268	1.970	1.944
105	211.220	211.190	265	265	91	95	7	9	266	268	1.934	1.938
110	221.010	220.990	265	265	91	95	7	9	266	268	1.958	1.960
115	230.760	230.760	265	265	92	96	7	9	267	267	1.950	1.954
120	240.550	240.530	266	266	92	95	7	9	267	269	1.958	1.954
125	250.390	250.420	266	266	92	95	7	9	267	269	1.968	1.978
130	260.160	260.120	266	266	92	96	7	9	268	266	1.954	1.940
135	269.920	269.990	265	265	92	96	7	9	268	267	1.952	1.974
140	279.920	279.900	265	265	92	96	7	9	267	269	2.000	1.982
145	290.050	290.150	266	266	95	96	7	9	269	269	2.026	2.050
150	300.070	300.010	267	267	95	97	7	9	269	269	2.004	1.972
155	310.160	310.150	264	264	93	97	7	9	270	266	2.018	2.028
160	320.220	320.190	263	263	93	97	7	9	266	268	2.012	2.008
165	330.270	330.280	260	260	93	97	7	9	266	268	2.010	2.018
170	340.340	340.280	260	260	93	97	7	9	268	266	2.014	2.000
175	350.430	350.410	249	249	94	97	7	9	268	266	2.018	2.026
180	360.480	360.479	249	249	94	97	7	9	268	267	2.010	2.014

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**14:28**
Source:	**CFU 117**	**End Time:**	**17:35**
EPA Method:	**30B**	**Start Date:**	**6/8/2018**
Box Operator:	**CMF**	**End Date:**	**6/8/2018**
Technician(s):	**CSW**		

Pre-Test Information:

Barometric Pressure:	29.97 "Hg
Test duration:	180 min

Equipment:

Probe ID:	HLN 30B	
Probe heat:	260 F	
	Side A	Side B
Meterbox ID:	HLN Duel #2	HLN Duel #2
Y factor:	1.0420	1.0460
Desired sampling rate:	2	2 lpm
Trap ID#:	OL464757	OL485992
Spiked @:	5	0 ng
Orifice # (if used):		

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	16	15	15	15
Train leak rate, lpm	0.008	0.008	0.000	0.000

Test Summary:

	Side A	Side B
Sample Volume:	360.342	360.317 L
Ave. Meter Temp:	90.1	93.5 °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	259	259	92	94	7	9	266	267	2.000	2.000
5	10.260	10.270	257	257	92	94	7	9	266	267	2.052	2.054
10	20.420	20.410	259	259	91	93	7	9	266	267	2.032	2.028
15	30.560	30.630	259	259	90	93	7	9	266	268	2.028	2.044
20	40.620	40.590	261	261	90	93	7	9	266	268	2.012	1.992
25	50.620	50.630	261	261	90	93	7	9	266	268	2.000	2.008
30	60.480	60.540	262	262	91	94	7	9	266	268	1.972	1.982
35	70.420	70.390	262	262	91	94	7	9	266	269	1.988	1.970
40	80.370	80.340	263	263	91	94	7	9	266	269	1.990	1.990
45	90.290	90.300	263	263	91	94	7	9	266	269	1.984	1.992
50	100.240	100.230	263	263	91	95	7	9	266	268	1.990	1.986
55	110.100	110.090	258	258	92	95	7	9	267	268	1.972	1.972
60	120.160	120.160	258	258	92	95	7	9	268	266	2.012	2.014
65	130.240	130.230	258	258	92	95	7	9	268	266	2.016	2.014
70	140.190	140.170	258	258	83	95	7	9	268	266	1.990	1.988
75	150.200	150.190	259	259	92	95	7	9	268	266	2.002	2.004
80	160.320	160.480	260	260	92	95	7	9	268	267	2.024	2.058
85	170.220	170.380	261	261	92	95	7	9	268	266	1.980	1.980
90	180.241	180.200	262	262	92	95	7	9	268	266	2.004	1.964
95	190.310	190.310	262	262	90	93	7	9	268	267	2.014	2.022
100	200.350	200.350	262	262	90	93	7	9	267	268	2.008	2.008
105	210.380	210.400	261	261	90	93	7	9	268	266	2.006	2.010
110	220.380	220.360	262	262	90	93	7	9	266	267	2.000	1.992
115	230.400	230.390	260	260	89	92	7	9	266	267	2.004	2.006
120	240.470	240.460	260	260	89	93	7	9	269	267	2.014	2.014
125	250.500	250.500	261	261	89	92	7	9	270	266	2.006	2.008
130	260.520	260.520	261	261	89	93	7	9	270	266	2.004	2.004
135	270.550	270.580	261	261	89	92	7	9	268	266	2.006	2.012
140	280.520	280.550	262	262	89	92	7	9	266	267	1.994	1.994
145	290.500	290.510	262	262	89	93	7	9	266	267	1.996	1.992
150	300.470	300.500	262	262	89	93	7	9	266	268	1.994	1.998
155	310.450	310.420	263	263	89	93	7	9	266	268	1.996	1.984
160	320.440	320.490	263	263	89	93	7	9	266	268	1.998	2.014
165	330.430	330.430	261	261	89	93	7	9	266	268	1.998	1.988
170	340.430	340.400	261	261	89	93	7	9	266	268	2.000	1.994
175	350.380	350.340	259	259	89	93	7	9	267	267	1.990	1.988
180	360.342	360.317	259	259	89	93	7	9	267	267	1.992	1.995

Method 30B
Mercury Concentration

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 117
Test date: 6/8/2018

Meterbox Y:
Side A 1.0420
Side B 1.0460

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	6/8/2018	OLC047447	5.0	6.1	0.4	1.5	1.50E-03	360.317	375.450	29.97	77.6	0.369	4.06E-03	3.79E-03
	B		OL469508	0.0	1.1	0.2	1.3	1.30E-03	360.294	376.868		80.6	0.369	3.53E-03	
2	A	6/8/2018	OL419232	5.0	6.0	0.6	1.6	1.60E-03	360.480	375.620	29.97	90.8	0.361	4.44E-03	4.02E-03
	B		OL469573	0.0	1.1	0.2	1.3	1.30E-03	360.479	377.061		94.1	0.360	3.61E-03	
3	A	6/8/2018	OL464757	5.0	6.1	0.3	1.4	1.40E-03	360.342	375.476	29.97	90.1	0.361	3.88E-03	4.16E-03
	B		OL485992	0.0	1.3	0.3	1.6	1.60E-03	360.317	376.892		93.5	0.360	4.44E-03	

Trap Concentrations Example Calculations: Average: 3.99E-03
Run 1, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 1.5 ng
where Section 1: 6.1 ng
Section 2: 0.4 ng
Spike: 5.0 ng

2. Conversion to µg — Total Hg ng/1000 = 1.50E-03 µg
where Total Hg ng: 1.5 ng

3. Corrected sample volume — = DGM reading x Meterbox Y factor = 375.450 L
where DGM reading: 360.317 L
Y: 1.042

4. Standard Volume (DSCM) — = Sample Vol. (L) x $\left(\frac{528\,^{\circ}\text{A}}{Tm+460}\right)$ x Bp/29.92 "Hg /1000 = 0.369 DSCM
where Sample vol.: 375.450 L
T_m: 77.6 °F
B_p: 29.97 "Hg

5. Hg concentration µg/dscm — = Total Hg µg / Volume DSCM = 4.06E-03 µg/dscm
where Total Hg: 1.50E-03 µg
DSCM: 0.369

6. Average Pair Concentration — = (Side A Conc.+ Side B Conc.)/2 = 3.79E-03 µg/dscm
where Side A: 0.004 µg/dscm
Side B: 0.004 µg/dscm

Method 30B
Results QA/QC

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 117
Test date: 6/8/2018
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	6/8/2018	OLC047447	5	6.1	0.4	1.5	4.06E-03	6.56	PASS	1.41E-02	104.0	PASS	7.05	PASS
	B		OL469508	0	1.1	0.2	1.3	3.53E-03	18.18	PASS					
2	A	6/8/2018	OL419232	5	6	0.6	1.6	4.44E-03	10.00	PASS	1.47E-02	105.9	PASS	10.24	PASS
	B		OL469573	0	1.1	0.2	1.3	3.61E-03	18.18	PASS					
3	A	6/8/2018	OL464757	5	6.1	0.3	1.4	3.88E-03	4.92	PASS	1.33E-02	95.9	PASS	6.79	PASS
	B		OL485992	0	1.3	0.3	1.6	4.44E-03	23.08	See emissions limit					

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: 0.00399271 µg/dscm

2. Field Recovery Test Field Recovery 3-run Average (%): 101.9 **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 117
Test date: 6/8/2018

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	3.79E-03	2.37E-13	1,150,846.7	114.3	2.73E-07	2.38E-09
2	4.02E-03	2.51E-13	1,146,383.4	117.5	2.88E-07	2.45E-09
3	4.16E-03	2.60E-13	1,139,410.9	114.3	2.96E-07	2.59E-09
Average Results:	3.99E-03	2.49E-13	1,145,547.0	115.4	2.85E-07	2.47E-09

*From direct stack measurements made during concurrent M29 runs

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 117**
Facility	**Glass Plant 2**	Date	**June 8, 2018**
Location	**Corvallis, OR**		

Run	1	2	3	
Date	6/8/2018	6/8/2018	6/8/2018	
Run Start Time	7:35	11:05	14:27	
Run End Time	10:45	14:13	17:35	
CO_2 %vd	0.62	0.64	0.65	0.64
O_2 %vd	19.80	19.85	19.86	19.84

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 8, 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**
	zero	0.11	0.04	-0.35	pass	0.03	-0.40	pass	-0.05	pass				
Run 1	upscale	9.98	9.96	-0.10	pass	9.93	-0.25	pass	-0.15	pass	20	19.66	19.80	10
	zero	0.11	0.03	-0.40	pass	0.06	-0.25	pass	0.15	pass				
Run 2	upscale	9.98	9.93	-0.25	pass	9.93	-0.25	pass	0.00	pass	20	19.67	19.85	10
	zero	0.11	0.06	-0.25	pass	0.06	-0.25	pass	0.00	pass				
Run 3	upscale	9.98	9.93	-0.25	pass	9.98	0.00	pass	0.25	pass	20	19.71	19.86	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.11	9.98	20.09
Analyzer Cal. Error	0.55	-0.10	0.45
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 8, 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**
	zero	0.13	0.15	0.50	pass	0.11	-0.50	pass	-1.00	pass				
Run 1	upscale	1.94	1.99	1.25	pass	1.93	-0.25	pass	-1.50	pass	4	0.70	0.62	2
	zero	0.13	0.11	-0.50	pass	0.13	0.00	pass	0.50	pass				
Run 2	upscale	1.94	1.93	-0.25	pass	1.95	0.25	pass	0.50	pass	4	0.70	0.64	2
	zero	0.13	0.13	0.00	pass	0.13	0.00	pass	0.00	pass				
Run 3	upscale	1.94	1.95	0.25	pass	1.93	-0.25	pass	-0.50	pass	4	0.72	0.65	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.13	1.94	4.14
Analyzer Cal. Error	3.25	-1.50	3.50
Analyzer Cal. Error < 2%*	pass	pass	pass

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**7:35**
Source:	**CFU 117**	**End Time:**	**10:45**
Method:	**3A**	**Date:**	**6/8/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

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

where C_{Dir}: 9.98 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}: 9.98 ppmv
C_S: 9.96 ppmv
CS: 20.00 ppmv

Drift Assessment (Upscale)

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

where SB_{Final}: -0.25 ppmv
SB_i: -0.10 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O) \left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.80 ppmv

where C_{Avg}: 19.66 ppmv
C_O: 0.04 ppmv
C_{MA}: 10.00 ppmv
C_M: 9.95 ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**7:35**
Source:	**CFU 117**	**End Time:**	**10:45**
Method:	**3A**	**Date:**	**6/8/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -1.50 %v

where C_{Dir}:	1.94	ppmv
C_V:	2.00	ppmv
CS:	4.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 1.25 %v

where C_{Dir}:	1.94	ppmv
C_S:	1.99	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

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

where SB_{Final}:	-0.25	ppmv
SB_i:	1.25	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.62 ppmv

where C_{Avg}:	0.70	ppmv
C_O:	0.13	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.96	ppmv

Hollingsworth & Vose

6/8/2018

CFU 117

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	6:53:04	18.21	0.21		
6/8/2018	6:53:14	18.21	0.21		
6/8/2018	6:53:24	18.22	0.20		
6/8/2018	6:53:34	18.22	0.21		
6/8/2018	6:53:44	18.21	0.20		
6/8/2018	6:53:54	18.21	0.20		
6/8/2018	6:54:04	18.21	0.20		
6/8/2018	6:54:14	18.21	0.21		
6/8/2018	6:54:24	18.22	0.20		
6/8/2018	6:54:34	18.22	0.20		
6/8/2018	6:54:44	18.21	0.20		
6/8/2018	6:54:54	18.84	0.26		
6/8/2018	6:55:04	17.68	9.47		
6/8/2018	6:55:14	3.98	0.90		
6/8/2018	6:55:24	0.50	0.20		
6/8/2018	6:55:34	0.27	0.16		
6/8/2018	6:55:44	0.24	0.14		
6/8/2018	6:55:54	0.23	0.14		
6/8/2018	6:56:04	0.20	0.14		
6/8/2018	6:56:14	0.18	0.13		
6/8/2018	6:56:24	0.26	0.15		
6/8/2018	6:56:34	0.21	0.15		
6/8/2018	6:56:44	0.17	0.14		
6/8/2018	6:56:54	0.16	0.13		
6/8/2018	6:57:04	0.11	0.13		
6/8/2018	6:57:14	0.11	0.13		
6/8/2018	6:57:24	0.11	0.13	0.11	0.13
6/8/2018	6:57:34	0.06	0.13		
6/8/2018	6:57:44	0.02	0.13		
6/8/2018	6:57:54	0.02	0.13		
6/8/2018	6:58:04	2.31	1.99		
6/8/2018	6:58:14	10.05	9.89		
6/8/2018	6:58:24	10.02	9.56		
6/8/2018	6:58:34	10.03	9.57		
6/8/2018	6:58:44	10.04	9.59		
6/8/2018	6:58:54	9.33	9.56		
6/8/2018	6:59:04	8.97	9.47		
6/8/2018	6:59:14	3.63	2.96		
6/8/2018	6:59:24	0.49	0.34		
6/8/2018	6:59:34	4.06	4.33		

Hollingsworth & Vose

6/8/2018

CFU 117

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	6:59:44	3.99	4.10		
6/8/2018	6:59:54	3.99	4.11		
6/8/2018	7:00:04	4.00	4.12		
6/8/2018	7:00:14	4.01	4.12		
6/8/2018	7:00:24	4.02	4.13		
6/8/2018	7:00:34	4.02	4.14		
6/8/2018	7:00:44	4.03	4.14		
6/8/2018	7:00:54	4.03	4.14		4.14
6/8/2018	7:01:04	4.03	4.13		
6/8/2018	7:01:14	2.96	2.92		
6/8/2018	7:01:24	2.09	2.02		
6/8/2018	7:01:34	2.01	1.95		
6/8/2018	7:01:44	2.01	1.94		
6/8/2018	7:01:54	2.01	1.94		
6/8/2018	7:02:04	2.01	1.94		
6/8/2018	7:02:14	2.01	1.94		
6/8/2018	7:02:24	2.01	1.93		
6/8/2018	7:02:34	2.01	1.94		1.94
6/8/2018	7:02:44	1.99	1.93		
6/8/2018	7:02:54	1.75	1.92		
6/8/2018	7:03:04	1.81	1.91		
6/8/2018	7:03:14	14.15	12.73		
6/8/2018	7:03:24	20.16	19.17		
6/8/2018	7:03:34	20.34	19.22		
6/8/2018	7:03:44	20.35	19.23		
6/8/2018	7:03:54	20.36	19.24		
6/8/2018	7:04:04	20.36	19.25		
6/8/2018	7:04:14	20.36	19.25		
6/8/2018	7:04:24	20.37	19.25		
6/8/2018	7:04:34	20.37	19.26		
6/8/2018	7:04:44	20.37	19.27		
6/8/2018	7:04:54	20.35	19.26		
6/8/2018	7:05:04	20.11	19.26		
6/8/2018	7:05:14	20.09	19.27		
6/8/2018	7:05:24	20.09	19.27		
6/8/2018	7:05:34	20.10	19.27	20.09	
6/8/2018	7:05:44	19.25	19.24		
6/8/2018	7:05:54	14.81	13.48		
6/8/2018	7:06:04	9.89	9.60		

Hollingsworth & Vose

6/8/2018

CFU 117

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	7:06:14	10.00	9.71		
6/8/2018	7:06:24	10.00	9.70		
6/8/2018	7:06:34	9.99	9.69		
6/8/2018	7:06:44	9.99	9.68		
6/8/2018	7:06:54	9.98	9.68		
6/8/2018	7:07:04	9.98	9.68		
6/8/2018	7:07:14	9.98	9.67		
6/8/2018	7:07:24	9.98	9.67		
6/8/2018	7:07:34	9.98	9.67	9.98	
6/8/2018	7:07:44	9.98	9.67		
6/8/2018	7:07:54	9.73	9.67		
6/8/2018	7:08:04	9.71	9.66		
6/8/2018	7:08:14	9.61	9.65		
System					
6/8/2018	7:08:24	13.78	6.50		
6/8/2018	7:08:34	18.86	0.87		
6/8/2018	7:08:44	16.14	3.70		
6/8/2018	7:08:54	18.03	2.31		
6/8/2018	7:09:04	16.61	3.92		
6/8/2018	7:09:14	11.56	8.21		
6/8/2018	7:09:24	10.27	9.33		
6/8/2018	7:09:34	9.99	9.57		
6/8/2018	7:09:44	9.93	9.64		
6/8/2018	7:09:54	9.91	9.65		
6/8/2018	7:10:04	9.90	9.67		
6/8/2018	7:10:14	9.90	9.68		
6/8/2018	7:10:24	9.90	9.68		
6/8/2018	7:10:34	9.90	9.68		
6/8/2018	7:10:44	9.96	9.68		
6/8/2018	7:10:54	9.96	9.68		
6/8/2018	7:11:04	9.96	9.68	9.96	
6/8/2018	7:11:14	9.96	9.68		
6/8/2018	7:11:24	13.43	6.66		
6/8/2018	7:11:34	18.26	2.18		
6/8/2018	7:11:44	9.25	1.70		
6/8/2018	7:11:54	2.83	0.74		
6/8/2018	7:12:04	2.10	1.63		

Hollingsworth & Vose

6/8/2018

CFU 117

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	7:12:14	2.04	1.90		
6/8/2018	7:12:24	2.02	1.97		
6/8/2018	7:12:34	2.02	1.99		
6/8/2018	7:12:44	2.01	1.99		
6/8/2018	7:12:54	2.01	1.99		
6/8/2018	7:13:04	2.01	1.99		
6/8/2018	7:13:14	2.01	1.99		1.99
6/8/2018	7:13:24	1.99	1.96		
6/8/2018	7:13:34	1.01	1.09		
6/8/2018	7:13:44	0.27	0.41		
6/8/2018	7:13:54	0.10	0.24		
6/8/2018	7:14:04	0.06	0.19		
6/8/2018	7:14:14	0.05	0.17		
6/8/2018	7:14:24	0.05	0.17		
6/8/2018	7:14:34	0.04	0.17		
6/8/2018	7:14:44	0.04	0.17		
6/8/2018	7:14:54	0.04	0.16		
6/8/2018	7:15:04	0.05	0.16		
6/8/2018	7:15:14	0.04	0.17		
6/8/2018	7:15:24	0.04	0.16		
6/8/2018	7:15:34	0.04	0.16		
6/8/2018	7:15:44	0.05	0.16		
6/8/2018	7:15:54	0.04	0.16		
6/8/2018	7:16:04	0.04	0.15		
6/8/2018	7:16:14	0.04	0.15	0.04	0.15
6/8/2018	7:16:24	0.04	0.16		
6/8/2018	7:16:34	0.11	0.15		
6/8/2018	7:16:44	8.73	0.42		

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/8/2018	7:34:34	19.69	0.71
6/8/2018	7:35:34	19.69	0.71
6/8/2018	7:36:34	19.67	0.71
6/8/2018	7:37:34	19.67	0.71
6/8/2018	7:38:34	19.67	0.71
6/8/2018	7:39:34	19.68	0.71
6/8/2018	7:40:34	19.67	0.71
6/8/2018	7:41:34	19.66	0.71
6/8/2018	7:42:34	19.66	0.71
6/8/2018	7:43:34	19.67	0.71
6/8/2018	7:44:34	19.67	0.71
6/8/2018	7:45:34	19.66	0.71
6/8/2018	7:46:34	19.65	0.70
6/8/2018	7:47:34	19.65	0.70
6/8/2018	7:48:34	19.66	0.70
6/8/2018	7:49:34	19.66	0.70
6/8/2018	7:50:34	19.65	0.70
6/8/2018	7:51:34	19.64	0.70
6/8/2018	7:52:34	19.65	0.70
6/8/2018	7:53:34	19.65	0.70
6/8/2018	7:54:34	19.66	0.70
6/8/2018	7:55:34	19.65	0.70
6/8/2018	7:56:34	19.65	0.70
6/8/2018	7:57:34	19.65	0.70
6/8/2018	7:58:34	19.65	0.70
6/8/2018	7:59:34	19.66	0.70
6/8/2018	8:00:34	19.65	0.71
6/8/2018	8:01:34	19.64	0.71
6/8/2018	8:02:34	19.69	0.71
6/8/2018	8:03:34	19.69	0.71
6/8/2018	8:04:34	19.69	0.71
6/8/2018	8:05:34	19.68	0.71
6/8/2018	8:06:34	19.68	0.71
6/8/2018	8:07:34	19.68	0.71
6/8/2018	8:08:34	19.69	0.71
6/8/2018	8:09:34	19.69	0.71
6/8/2018	8:10:34	19.68	0.71
6/8/2018	8:11:34	19.68	0.70
6/8/2018	8:12:34	19.68	0.70
6/8/2018	8:13:34	19.68	0.70
6/8/2018	8:14:34	19.69	0.70

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CFU-117

Run 1

Date	Time	O2 [%]	CO2 [%]
6/8/2018	8:15:34	19.68	0.70
6/8/2018	8:16:34	19.68	0.70
6/8/2018	8:17:34	19.68	0.69
6/8/2018	8:18:34	19.68	0.70
6/8/2018	8:19:34	19.68	0.70
6/8/2018	8:20:34	19.68	0.70
6/8/2018	8:21:34	19.67	0.70
6/8/2018	8:22:34	19.67	0.70
6/8/2018	8:23:34	19.67	0.70
6/8/2018	8:24:34	19.68	0.70
6/8/2018	8:25:34	19.67	0.70
6/8/2018	8:26:34	19.66	0.71
6/8/2018	8:27:34	19.66	0.71
6/8/2018	8:28:34	19.66	0.71
6/8/2018	8:29:34	19.66	0.71
6/8/2018	8:30:34	19.66	0.71
6/8/2018	8:31:34	19.65	0.71
6/8/2018	8:32:34	19.66	0.71
6/8/2018	8:33:34	19.66	0.71
6/8/2018	8:34:34	19.67	0.71
6/8/2018	8:35:34	19.67	0.71
6/8/2018	8:36:34	19.66	0.70
6/8/2018	8:37:34	19.66	0.70
6/8/2018	8:38:34	19.66	0.70
6/8/2018	8:39:34	19.66	0.70
6/8/2018	8:40:34	19.67	0.69
6/8/2018	8:41:34	19.66	0.69
6/8/2018	8:42:34	19.65	0.70
6/8/2018	8:43:34	19.66	0.69
6/8/2018	8:44:34	19.66	0.70
6/8/2018	8:45:34	19.66	0.70
6/8/2018	8:46:34	19.66	0.69
6/8/2018	8:47:34	19.65	0.70
6/8/2018	8:48:34	19.65	0.70
6/8/2018	8:49:34	19.65	0.70
6/8/2018	8:50:34	19.66	0.70
6/8/2018	8:51:34	19.66	0.70
6/8/2018	8:52:34	19.65	0.70
6/8/2018	8:53:34	19.65	0.71
6/8/2018	8:54:34	19.65	0.71
6/8/2018	8:55:34	19.66	0.71

Hollingsworth & Vose

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/8/2018	8:56:34	19.66	0.71
6/8/2018	8:57:34	19.65	0.71
6/8/2018	8:58:34	19.65	0.71
6/8/2018	8:59:34	19.65	0.71
6/8/2018	9:00:34	19.65	0.71
6/8/2018	9:01:34	19.65	0.70
6/8/2018	9:02:34	19.65	0.70
6/8/2018	9:03:34	19.65	0.70
6/8/2018	9:04:34	19.65	0.70
6/8/2018	9:05:34	19.65	0.69
6/8/2018	9:06:34	19.65	0.69
6/8/2018	9:07:34	19.65	0.69
6/8/2018	9:08:34	19.64	0.69
6/8/2018	9:09:34	19.64	0.69
6/8/2018	9:10:34	19.64	0.69
6/8/2018	9:11:34	19.65	0.69
6/8/2018	9:12:34	19.65	0.69
6/8/2018	9:13:34	19.65	0.69
6/8/2018	9:14:34	19.64	0.69
6/8/2018	9:15:34	19.63	0.70
6/8/2018	9:16:34	19.64	0.70
6/8/2018	9:17:34	19.64	0.70
6/8/2018	9:18:34	19.65	0.70
6/8/2018	9:19:34	19.64	0.70
6/8/2018	9:20:34	19.63	0.70
6/8/2018	9:21:34	19.63	0.70
6/8/2018	9:22:34	19.64	0.70
6/8/2018	9:23:34	19.64	0.70
6/8/2018	9:24:34	19.64	0.70
6/8/2018	9:25:34	19.63	0.70
6/8/2018	9:26:34	19.63	0.70
6/8/2018	9:27:34	19.63	0.70
6/8/2018	9:28:34	19.63	0.70
6/8/2018	9:29:34	19.64	0.70
6/8/2018	9:30:34	19.64	0.69
6/8/2018	9:31:34	19.63	0.69
6/8/2018	9:32:34	19.63	0.69
6/8/2018	9:33:34	19.62	0.69
6/8/2018	9:34:34	19.63	0.69
6/8/2018	9:35:34	19.63	0.69
6/8/2018	9:36:34	19.62	0.69

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/8/2018	9:37:34	19.62	0.69
6/8/2018	9:38:34	19.63	0.69
6/8/2018	9:39:34	19.64	0.69
6/8/2018	9:40:34	19.64	0.69
6/8/2018	9:41:34	19.64	0.69
6/8/2018	9:42:34	19.63	0.70
6/8/2018	9:43:34	19.63	0.70
6/8/2018	9:44:34	19.63	0.70
6/8/2018	9:45:34	19.63	0.70
6/8/2018	9:46:34	19.64	0.70
6/8/2018	9:47:34	19.63	0.70
6/8/2018	9:48:34	19.62	0.70
6/8/2018	9:49:34	19.62	0.70
6/8/2018	9:50:34	19.63	0.70
6/8/2018	9:51:34	19.63	0.70
6/8/2018	9:52:34	19.63	0.70
6/8/2018	9:53:34	19.62	0.70
6/8/2018	9:54:34	19.61	0.70
6/8/2018	9:55:34	19.62	0.70
6/8/2018	9:56:34	19.62	0.69
6/8/2018	9:57:34	19.62	0.69
6/8/2018	9:58:34	19.63	0.69
6/8/2018	9:59:34	19.62	0.69
6/8/2018	10:00:34	19.61	0.69
6/8/2018	10:01:34	19.62	0.69
6/8/2018	10:02:34	19.62	0.69
6/8/2018	10:03:34	19.62	0.69
6/8/2018	10:04:34	19.62	0.69
6/8/2018	10:05:34	19.61	0.69
6/8/2018	10:06:34	19.61	0.69
6/8/2018	10:07:34	19.61	0.70
6/8/2018	10:08:34	19.61	0.70
6/8/2018	10:09:34	19.62	0.70
6/8/2018	10:10:34	19.62	0.70
6/8/2018	10:11:34	19.61	0.70
6/8/2018	10:12:34	19.61	0.70
6/8/2018	10:13:34	19.61	0.70
6/8/2018	10:14:34	19.61	0.70
6/8/2018	10:15:34	19.61	0.70
6/8/2018	10:16:34	19.61	0.70
6/8/2018	10:17:34	19.60	0.69

Hollingsworth & Vose

CFU-117

Run 1

Date	Time	O2 [%]	CO2 [%]
6/8/2018	10:18:34	19.60	0.70
6/8/2018	10:19:34	19.56	0.69
6/8/2018	10:20:34	19.69	0.69
6/8/2018	10:21:34	19.73	0.69
6/8/2018	10:22:34	19.73	0.68
6/8/2018	10:23:34	19.72	0.68
6/8/2018	10:24:34	19.72	0.68
6/8/2018	10:25:34	19.72	0.68
6/8/2018	10:26:34	19.73	0.68
6/8/2018	10:27:34	19.73	0.69
6/8/2018	10:28:34	19.72	0.69
6/8/2018	10:29:34	19.72	0.69
6/8/2018	10:30:34	19.72	0.69
6/8/2018	10:31:34	19.72	0.69
6/8/2018	10:32:34	19.73	0.69
6/8/2018	10:33:34	19.73	0.70
6/8/2018	10:34:34	19.72	0.69
6/8/2018	10:35:34	19.72	0.70
6/8/2018	10:36:34	19.72	0.70
6/8/2018	10:37:34	19.72	0.70
6/8/2018	10:38:34	19.73	0.70
6/8/2018	10:39:34	19.73	0.70
6/8/2018	10:40:34	19.71	0.70
6/8/2018	10:41:34	19.71	0.70
6/8/2018	10:42:34	19.72	0.69
6/8/2018	10:43:34	19.72	0.69
6/8/2018	10:44:34	19.73	0.69
6/8/2018	10:45:34	19.72	0.69
	Final	**19.66**	**0.70**

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R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	10:49:04	19.71	0.69		
6/8/2018	10:49:14	19.71	0.69		
6/8/2018	10:49:24	19.71	0.68		
6/8/2018	10:49:34	19.71	0.69		
6/8/2018	10:49:44	19.73	0.69		
6/8/2018	10:49:54	19.15	0.68		
6/8/2018	10:50:04	8.71	0.47		
6/8/2018	10:50:14	2.01	0.20		
6/8/2018	10:50:24	0.49	0.13		
6/8/2018	10:50:34	0.17	0.12		
6/8/2018	10:50:44	0.09	0.11		
6/8/2018	10:50:54	0.06	0.11		
6/8/2018	10:51:04	0.05	0.11		
6/8/2018	10:51:14	0.05	0.11		
6/8/2018	10:51:24	0.05	0.11		
6/8/2018	10:51:34	0.05	0.12		
6/8/2018	10:51:44	0.04	0.11		
6/8/2018	10:51:54	0.04	0.11		
6/8/2018	10:52:04	0.04	0.11		
6/8/2018	10:52:14	0.03	0.11		
6/8/2018	10:52:24	0.04	0.11		
6/8/2018	10:52:34	0.03	0.11		
6/8/2018	10:52:44	0.03	0.11	0.03	0.11
6/8/2018	10:52:54	0.03	0.12		
6/8/2018	10:53:04	0.03	0.11		
6/8/2018	10:53:14	0.03	0.11		
6/8/2018	10:53:24	0.15	0.22		
6/8/2018	10:53:34	1.34	1.26		
6/8/2018	10:53:44	1.83	1.67		
6/8/2018	10:53:54	1.92	1.82		
6/8/2018	10:54:04	1.95	1.86		
6/8/2018	10:54:14	1.96	1.87		
6/8/2018	10:54:24	1.97	1.89		
6/8/2018	10:54:34	1.97	1.90		
6/8/2018	10:54:44	1.97	1.91		
6/8/2018	10:54:54	1.98	1.92		
6/8/2018	10:55:04	1.98	1.92		
6/8/2018	10:55:14	1.98	1.92		
6/8/2018	10:55:24	1.98	1.93		
6/8/2018	10:55:34	1.98	1.93		
6/8/2018	10:55:44	1.99	1.93		

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CFU 117

R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	10:55:54	1.99	1.93		1.93
6/8/2018	10:56:04	1.99	1.94		
6/8/2018	10:56:14	1.99	1.93		
6/8/2018	10:56:24	7.59	1.58		
6/8/2018	10:56:34	15.68	1.08		
6/8/2018	10:56:44	11.95	5.51		
6/8/2018	10:56:54	10.28	8.57		
6/8/2018	10:57:04	10.00	9.35		
6/8/2018	10:57:14	9.94	9.52		
6/8/2018	10:57:24	9.93	9.57		
6/8/2018	10:57:34	9.93	9.59		
6/8/2018	10:57:44	9.93	9.60		
6/8/2018	10:57:54	9.93	9.61		
6/8/2018	10:58:04	9.93	9.61		
6/8/2018	10:58:14	9.93	9.62		
6/8/2018	10:58:24	9.93	9.62		
6/8/2018	10:58:34	9.93	9.63		
6/8/2018	10:58:44	9.93	9.64		
6/8/2018	10:58:54	9.93	9.65		
6/8/2018	10:59:04	9.93	9.64		
6/8/2018	10:59:14	9.93	9.65	9.93	

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/8/2018	11:05:45	19.70	0.70
6/8/2018	11:06:45	19.71	0.70
6/8/2018	11:07:45	19.72	0.70
6/8/2018	11:08:45	19.71	0.69
6/8/2018	11:09:45	19.70	0.69
6/8/2018	11:10:45	19.70	0.68
6/8/2018	11:11:45	19.70	0.69
6/8/2018	11:12:45	19.71	0.69
6/8/2018	11:13:45	19.71	0.68
6/8/2018	11:14:45	19.70	0.69
6/8/2018	11:15:45	19.69	0.69
6/8/2018	11:16:45	19.69	0.70
6/8/2018	11:17:45	19.70	0.69
6/8/2018	11:18:45	19.70	0.69
6/8/2018	11:19:45	19.70	0.70
6/8/2018	11:20:45	19.69	0.70
6/8/2018	11:21:45	19.68	0.70
6/8/2018	11:22:45	19.69	0.70
6/8/2018	11:23:45	19.69	0.71
6/8/2018	11:24:45	19.70	0.70
6/8/2018	11:25:45	19.70	0.70
6/8/2018	11:26:45	19.69	0.70
6/8/2018	11:27:45	19.68	0.70
6/8/2018	11:28:45	19.68	0.70
6/8/2018	11:29:45	19.69	0.70
6/8/2018	11:30:45	19.69	0.70
6/8/2018	11:31:45	19.70	0.70
6/8/2018	11:32:45	19.68	0.70
6/8/2018	11:33:45	19.68	0.69
6/8/2018	11:34:45	19.67	0.69
6/8/2018	11:35:45	19.68	0.69
6/8/2018	11:36:45	19.68	0.69
6/8/2018	11:37:45	19.68	0.69
6/8/2018	11:38:45	19.68	0.69
6/8/2018	11:39:45	19.67	0.69
6/8/2018	11:40:45	19.68	0.69
6/8/2018	11:41:45	19.68	0.70
6/8/2018	11:42:45	19.68	0.70
6/8/2018	11:43:45	19.68	0.70
6/8/2018	11:44:45	19.67	0.70
6/8/2018	11:45:45	19.67	0.70

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/8/2018	11:46:45	19.67	0.71
6/8/2018	11:47:45	19.67	0.71
6/8/2018	11:48:45	19.68	0.71
6/8/2018	11:49:45	19.68	0.71
6/8/2018	11:50:45	19.67	0.71
6/8/2018	11:51:45	19.66	0.70
6/8/2018	11:52:45	19.66	0.71
6/8/2018	11:53:45	19.66	0.71
6/8/2018	11:54:45	19.67	0.71
6/8/2018	11:55:45	19.67	0.70
6/8/2018	11:56:45	19.66	0.70
6/8/2018	11:57:45	19.66	0.69
6/8/2018	11:58:45	19.66	0.69
6/8/2018	11:59:45	19.66	0.69
6/8/2018	12:00:45	19.66	0.69
6/8/2018	12:01:45	19.67	0.69
6/8/2018	12:02:45	19.66	0.70
6/8/2018	12:03:45	19.65	0.69
6/8/2018	12:04:45	19.65	0.70
6/8/2018	12:05:45	19.66	0.70
6/8/2018	12:06:45	19.66	0.70
6/8/2018	12:07:45	19.66	0.70
6/8/2018	12:08:45	19.66	0.71
6/8/2018	12:09:45	19.65	0.71
6/8/2018	12:10:45	19.65	0.71
6/8/2018	12:11:45	19.66	0.71
6/8/2018	12:12:45	19.66	0.71
6/8/2018	12:13:45	19.67	0.71
6/8/2018	12:14:45	19.65	0.71
6/8/2018	12:15:45	19.65	0.71
6/8/2018	12:16:45	19.64	0.70
6/8/2018	12:17:45	19.65	0.70
6/8/2018	12:18:45	19.66	0.70
6/8/2018	12:19:45	19.66	0.70
6/8/2018	12:20:45	19.65	0.70
6/8/2018	12:21:45	19.64	0.69
6/8/2018	12:22:45	19.64	0.69
6/8/2018	12:23:45	19.65	0.69
6/8/2018	12:24:45	19.65	0.69
6/8/2018	12:25:45	19.66	0.70
6/8/2018	12:26:45	19.65	0.70

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/8/2018	12:27:45	19.64	0.70
6/8/2018	12:28:45	19.65	0.70
6/8/2018	12:29:45	19.65	0.70
6/8/2018	12:30:45	19.65	0.70
6/8/2018	12:31:45	19.66	0.71
6/8/2018	12:32:45	19.65	0.71
6/8/2018	12:33:45	19.64	0.71
6/8/2018	12:34:45	19.65	0.72
6/8/2018	12:35:45	19.65	0.71
6/8/2018	12:36:45	19.66	0.71
6/8/2018	12:37:45	19.67	0.71
6/8/2018	12:38:45	19.66	0.71
6/8/2018	12:39:45	19.66	0.71
6/8/2018	12:40:45	19.65	0.71
6/8/2018	12:41:45	19.66	0.71
6/8/2018	12:42:45	19.67	0.71
6/8/2018	12:43:45	19.67	0.70
6/8/2018	12:44:45	19.66	0.70
6/8/2018	12:45:45	19.66	0.70
6/8/2018	12:46:45	19.66	0.70
6/8/2018	12:47:45	19.66	0.70
6/8/2018	12:48:45	19.67	0.70
6/8/2018	12:49:45	19.67	0.70
6/8/2018	12:50:45	19.66	0.70
6/8/2018	12:51:45	19.66	0.70
6/8/2018	12:52:45	19.66	0.71
6/8/2018	12:53:45	19.66	0.70
6/8/2018	12:54:45	19.67	0.71
6/8/2018	12:55:45	19.68	0.71
6/8/2018	12:56:45	19.67	0.71
6/8/2018	12:57:45	19.66	0.72
6/8/2018	12:58:45	19.66	0.72
6/8/2018	12:59:45	19.67	0.72
6/8/2018	13:00:45	19.67	0.72
6/8/2018	13:01:45	19.67	0.72
6/8/2018	13:02:45	19.66	0.72
6/8/2018	13:03:45	19.65	0.72
6/8/2018	13:04:45	19.66	0.71
6/8/2018	13:05:45	19.66	0.71
6/8/2018	13:06:45	19.66	0.71
6/8/2018	13:07:45	19.67	0.71

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/8/2018	13:08:45	19.66	0.70
6/8/2018	13:09:45	19.66	0.70
6/8/2018	13:10:45	19.66	0.70
6/8/2018	13:11:45	19.66	0.70
6/8/2018	13:12:45	19.66	0.70
6/8/2018	13:13:45	19.67	0.70
6/8/2018	13:14:45	19.66	0.70
6/8/2018	13:15:45	19.66	0.70
6/8/2018	13:16:45	19.66	0.70
6/8/2018	13:17:45	19.66	0.71
6/8/2018	13:18:45	19.67	0.71
6/8/2018	13:19:45	19.67	0.71
6/8/2018	13:20:45	19.66	0.71
6/8/2018	13:21:45	19.65	0.72
6/8/2018	13:22:45	19.66	0.72
6/8/2018	13:23:45	19.66	0.72
6/8/2018	13:24:45	19.67	0.72
6/8/2018	13:25:45	19.67	0.72
6/8/2018	13:26:45	19.66	0.72
6/8/2018	13:27:45	19.66	0.71
6/8/2018	13:28:45	19.66	0.71
6/8/2018	13:29:45	19.67	0.71
6/8/2018	13:30:45	19.68	0.71
6/8/2018	13:31:45	19.68	0.71
6/8/2018	13:32:45	19.67	0.70
6/8/2018	13:33:45	19.66	0.70
6/8/2018	13:34:45	19.67	0.70
6/8/2018	13:35:45	19.67	0.70
6/8/2018	13:36:45	19.68	0.70
6/8/2018	13:37:45	19.68	0.70
6/8/2018	13:38:45	19.67	0.70
6/8/2018	13:39:45	19.67	0.70
6/8/2018	13:40:45	19.67	0.71
6/8/2018	13:41:45	19.67	0.71
6/8/2018	13:42:45	19.68	0.71
6/8/2018	13:43:45	19.68	0.71
6/8/2018	13:44:45	19.67	0.71
6/8/2018	13:45:45	19.67	0.72
6/8/2018	13:46:45	19.67	0.72
6/8/2018	13:47:45	19.68	0.72
6/8/2018	13:48:45	19.68	0.71

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/8/2018	13:49:45	19.68	0.72
6/8/2018	13:50:45	19.67	0.72
6/8/2018	13:51:45	19.67	0.72
6/8/2018	13:52:45	19.67	0.71
6/8/2018	13:53:45	19.68	0.71
6/8/2018	13:54:45	19.68	0.71
6/8/2018	13:55:45	19.68	0.71
6/8/2018	13:56:45	19.67	0.70
6/8/2018	13:57:45	19.67	0.70
6/8/2018	13:58:45	19.67	0.70
6/8/2018	13:59:45	19.68	0.70
6/8/2018	14:00:45	19.68	0.70
6/8/2018	14:01:45	19.69	0.70
6/8/2018	14:02:45	19.68	0.70
6/8/2018	14:03:45	19.67	0.70
6/8/2018	14:04:45	19.67	0.70
6/8/2018	14:05:45	19.68	0.70
6/8/2018	14:06:45	19.68	0.71
6/8/2018	14:07:45	19.69	0.71
6/8/2018	14:08:45	19.68	0.71
6/8/2018	14:09:45	19.67	0.72
6/8/2018	14:10:45	19.68	0.72
6/8/2018	14:11:45	19.68	0.71
6/8/2018	14:12:45	19.69	0.71
	Final	**19.67**	**0.70**

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R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	14:12:35	19.69	0.72		
6/8/2018	14:12:45	19.68	0.72		
6/8/2018	14:12:55	19.69	0.72		
6/8/2018	14:13:05	19.69	0.71		
6/8/2018	14:13:15	19.69	0.72		
6/8/2018	14:13:25	19.69	0.71		
6/8/2018	14:13:35	19.68	0.71		
6/8/2018	14:13:45	19.74	0.72		
6/8/2018	14:13:55	16.49	1.20		
6/8/2018	14:14:05	4.92	0.67		
6/8/2018	14:14:15	1.08	0.27		
6/8/2018	14:14:25	0.30	0.17		
6/8/2018	14:14:35	0.14	0.14		
6/8/2018	14:14:45	0.09	0.15		
6/8/2018	14:14:55	0.08	0.14		
6/8/2018	14:15:05	0.07	0.13		
6/8/2018	14:15:15	0.06	0.13		
6/8/2018	14:15:25	0.06	0.14		
6/8/2018	14:15:35	0.06	0.13	0.06	0.13
6/8/2018	14:15:45	0.05	0.13		
6/8/2018	14:15:55	0.05	0.13		
6/8/2018	14:16:05	0.56	0.31		
6/8/2018	14:16:15	6.34	5.91		
6/8/2018	14:16:25	9.18	8.82		
6/8/2018	14:16:35	9.75	9.37		
6/8/2018	14:16:45	9.88	9.50		
6/8/2018	14:16:55	9.90	9.54		
6/8/2018	14:17:05	9.92	9.56		
6/8/2018	14:17:15	9.92	9.57		
6/8/2018	14:17:25	9.93	9.58		
6/8/2018	14:17:35	9.93	9.58		
6/8/2018	14:17:45	9.93	9.58		
6/8/2018	14:17:55	9.93	9.58	9.93	
6/8/2018	14:18:05	9.95	9.57		
6/8/2018	14:18:15	14.43	5.70		
6/8/2018	14:18:25	14.85	2.86		
6/8/2018	14:18:35	4.43	1.20		
6/8/2018	14:18:45	1.67	1.10		
6/8/2018	14:18:55	1.95	1.79		
6/8/2018	14:19:05	1.99	1.91		
6/8/2018	14:19:15	2.00	1.95		

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R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	14:19:25	2.00	1.95		
6/8/2018	14:19:35	2.00	1.96		
6/8/2018	14:19:45	2.00	1.96		
6/8/2018	14:19:55	2.00	1.95		
6/8/2018	14:20:05	2.00	1.95		
6/8/2018	14:20:15	2.00	1.95		
6/8/2018	14:20:25	2.01	1.96		
6/8/2018	14:20:35	2.01	1.95		
6/8/2018	14:20:45	2.00	1.95		
6/8/2018	14:20:55	2.00	1.95		
6/8/2018	14:21:05	2.00	1.95		
6/8/2018	14:21:15	2.00	1.95		1.95

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/8/2018	14:27:02	19.67	0.71
6/8/2018	14:28:02	19.68	0.71
6/8/2018	14:29:02	19.68	0.70
6/8/2018	14:30:02	19.68	0.71
6/8/2018	14:31:02	19.69	0.71
6/8/2018	14:32:02	19.68	0.71
6/8/2018	14:33:02	19.67	0.71
6/8/2018	14:34:02	19.67	0.71
6/8/2018	14:35:02	19.67	0.71
6/8/2018	14:36:02	19.68	0.71
6/8/2018	14:37:02	19.68	0.71
6/8/2018	14:38:02	19.68	0.72
6/8/2018	14:39:02	19.67	0.72
6/8/2018	14:40:02	19.67	0.72
6/8/2018	14:41:02	19.67	0.72
6/8/2018	14:42:02	19.68	0.72
6/8/2018	14:43:02	19.68	0.72
6/8/2018	14:44:02	19.68	0.72
6/8/2018	14:45:02	19.67	0.72
6/8/2018	14:46:02	19.67	0.71
6/8/2018	14:47:02	19.67	0.71
6/8/2018	14:48:02	19.68	0.71
6/8/2018	14:49:02	19.69	0.71
6/8/2018	14:50:02	19.68	0.71
6/8/2018	14:51:02	19.67	0.70
6/8/2018	14:52:02	19.67	0.70
6/8/2018	14:53:02	19.67	0.71
6/8/2018	14:54:02	19.68	0.71
6/8/2018	14:55:02	19.69	0.70
6/8/2018	14:56:02	19.68	0.71
6/8/2018	14:57:02	19.67	0.71
6/8/2018	14:58:02	19.67	0.71
6/8/2018	14:59:02	19.68	0.71
6/8/2018	15:00:02	19.68	0.71
6/8/2018	15:01:02	19.69	0.71
6/8/2018	15:02:02	19.68	0.72
6/8/2018	15:03:02	19.68	0.72
6/8/2018	15:04:02	19.68	0.72
6/8/2018	15:05:02	19.68	0.72
6/8/2018	15:06:02	19.69	0.72
6/8/2018	15:07:02	19.69	0.72

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/8/2018	15:08:02	19.68	0.72
6/8/2018	15:09:02	19.67	0.72
6/8/2018	15:10:02	19.68	0.72
6/8/2018	15:11:02	19.68	0.71
6/8/2018	15:12:02	19.69	0.71
6/8/2018	15:13:02	19.69	0.71
6/8/2018	15:14:02	19.68	0.71
6/8/2018	15:15:02	19.68	0.70
6/8/2018	15:16:02	19.68	0.70
6/8/2018	15:17:02	19.68	0.71
6/8/2018	15:18:02	19.69	0.71
6/8/2018	15:19:02	19.68	0.71
6/8/2018	15:20:02	19.68	0.71
6/8/2018	15:21:02	19.68	0.71
6/8/2018	15:22:02	19.68	0.71
6/8/2018	15:23:02	19.68	0.71
6/8/2018	15:24:02	19.69	0.71
6/8/2018	15:25:02	19.69	0.71
6/8/2018	15:26:02	19.67	0.72
6/8/2018	15:27:02	19.67	0.72
6/8/2018	15:28:02	19.68	0.73
6/8/2018	15:29:02	19.68	0.72
6/8/2018	15:30:02	19.68	0.72
6/8/2018	15:31:02	19.68	0.72
6/8/2018	15:32:02	19.67	0.72
6/8/2018	15:33:02	19.67	0.72
6/8/2018	15:34:02	19.67	0.72
6/8/2018	15:35:02	19.68	0.72
6/8/2018	15:36:02	19.67	0.72
6/8/2018	15:37:02	19.67	0.72
6/8/2018	15:38:02	19.67	0.72
6/8/2018	15:39:02	19.67	0.71
6/8/2018	15:40:02	19.67	0.71
6/8/2018	15:41:02	19.68	0.71
6/8/2018	15:42:02	19.67	0.71
6/8/2018	15:43:02	19.67	0.71
6/8/2018	15:44:02	19.66	0.72
6/8/2018	15:45:02	19.66	0.72
6/8/2018	15:46:02	19.66	0.72
6/8/2018	15:47:02	19.66	0.72
6/8/2018	15:48:02	19.67	0.72

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/8/2018	15:49:02	19.67	0.72
6/8/2018	15:50:02	19.66	0.72
6/8/2018	15:51:02	19.66	0.72
6/8/2018	15:52:02	19.67	0.73
6/8/2018	15:53:02	19.67	0.73
6/8/2018	15:54:02	19.67	0.73
6/8/2018	15:55:02	19.70	0.73
6/8/2018	15:56:02	19.71	0.73
6/8/2018	15:57:02	19.71	0.73
6/8/2018	15:58:02	19.72	0.73
6/8/2018	15:59:02	19.73	0.72
6/8/2018	16:00:02	19.74	0.72
6/8/2018	16:01:02	19.73	0.72
6/8/2018	16:02:02	19.72	0.72
6/8/2018	16:03:02	19.73	0.72
6/8/2018	16:04:02	19.73	0.72
6/8/2018	16:05:02	19.73	0.72
6/8/2018	16:06:02	19.74	0.71
6/8/2018	16:07:02	19.73	0.71
6/8/2018	16:08:02	19.73	0.71
6/8/2018	16:09:02	19.73	0.71
6/8/2018	16:10:02	19.73	0.71
6/8/2018	16:11:02	19.74	0.71
6/8/2018	16:12:02	19.75	0.72
6/8/2018	16:13:02	19.73	0.72
6/8/2018	16:14:02	19.72	0.72
6/8/2018	16:15:02	19.73	0.72
6/8/2018	16:16:02	19.74	0.72
6/8/2018	16:17:02	19.73	0.73
6/8/2018	16:18:02	19.75	0.73
6/8/2018	16:19:02	19.74	0.73
6/8/2018	16:20:02	19.73	0.73
6/8/2018	16:21:02	19.74	0.73
6/8/2018	16:22:02	19.74	0.73
6/8/2018	16:23:02	19.74	0.73
6/8/2018	16:24:02	19.74	0.73
6/8/2018	16:25:02	19.73	0.73
6/8/2018	16:26:02	19.73	0.72
6/8/2018	16:27:02	19.73	0.73
6/8/2018	16:28:02	19.74	0.72
6/8/2018	16:29:02	19.74	0.72

Hollingsworth & Vose

CFU-117

Run 3

Date	Time	O2 [%]	CO2 [%]
6/8/2018	16:30:02	19.74	0.72
6/8/2018	16:31:02	19.73	0.72
6/8/2018	16:32:02	19.72	0.72
6/8/2018	16:33:02	19.73	0.72
6/8/2018	16:34:02	19.73	0.72
6/8/2018	16:35:02	19.74	0.72
6/8/2018	16:36:02	19.74	0.72
6/8/2018	16:37:02	19.73	0.72
6/8/2018	16:38:02	19.73	0.72
6/8/2018	16:39:02	19.73	0.72
6/8/2018	16:40:02	19.74	0.73
6/8/2018	16:41:02	19.74	0.73
6/8/2018	16:42:02	19.73	0.73
6/8/2018	16:43:02	19.73	0.73
6/8/2018	16:44:02	19.74	0.73
6/8/2018	16:45:02	19.74	0.74
6/8/2018	16:46:02	19.74	0.73
6/8/2018	16:47:02	19.75	0.73
6/8/2018	16:48:02	19.74	0.73
6/8/2018	16:49:02	19.73	0.73
6/8/2018	16:50:02	19.74	0.73
6/8/2018	16:51:02	19.74	0.73
6/8/2018	16:52:02	19.74	0.73
6/8/2018	16:53:02	19.74	0.73
6/8/2018	16:54:02	19.73	0.72
6/8/2018	16:55:02	19.73	0.72
6/8/2018	16:56:02	19.74	0.72
6/8/2018	16:57:02	19.74	0.72
6/8/2018	16:58:02	19.75	0.72
6/8/2018	16:59:02	19.75	0.72
6/8/2018	17:00:02	19.74	0.72
6/8/2018	17:01:02	19.74	0.72
6/8/2018	17:02:02	19.75	0.72
6/8/2018	17:03:02	19.75	0.72
6/8/2018	17:04:02	19.75	0.72
6/8/2018	17:05:02	19.74	0.72
6/8/2018	17:06:02	19.73	0.73
6/8/2018	17:07:02	19.74	0.73
6/8/2018	17:08:02	19.74	0.73
6/8/2018	17:09:02	19.75	0.74
6/8/2018	17:10:02	19.75	0.74

Hollingsworth & Vose

CFU-117

Run 3

Date	Time	O2 [%]	CO2 [%]
6/8/2018	17:11:02	19.73	0.74
6/8/2018	17:12:02	19.74	0.74
6/8/2018	17:13:02	19.74	0.73
6/8/2018	17:14:02	19.75	0.74
6/8/2018	17:15:02	19.75	0.73
6/8/2018	17:16:02	19.75	0.73
6/8/2018	17:17:02	19.74	0.73
6/8/2018	17:18:02	19.75	0.73
6/8/2018	17:19:02	19.75	0.72
6/8/2018	17:20:02	19.76	0.72
6/8/2018	17:21:02	19.76	0.72
6/8/2018	17:22:02	19.74	0.72
6/8/2018	17:23:02	19.74	0.72
6/8/2018	17:24:02	19.74	0.72
6/8/2018	17:25:02	19.75	0.72
6/8/2018	17:26:02	19.76	0.72
6/8/2018	17:27:02	19.76	0.72
6/8/2018	17:28:02	19.74	0.72
6/8/2018	17:29:02	19.74	0.73
6/8/2018	17:30:02	19.75	0.73
6/8/2018	17:31:02	19.76	0.73
6/8/2018	17:32:02	19.76	0.73
6/8/2018	17:33:02	19.76	0.73
6/8/2018	17:34:02	19.75	0.73
6/8/2018	17:35:02	19.75	0.74
6/8/2018	17:36:02	19.75	0.73
6/8/2018	17:37:02	19.76	0.74
6/8/2018	17:38:02	19.76	0.73
	Final	**19.71**	**0.72**

Hollingsworth & Vose

CFU 117

R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	17:38:52	19.76	0.73		
6/8/2018	17:39:02	19.76	0.72		
6/8/2018	17:39:12	19.76	0.73		
6/8/2018	17:39:22	19.83	0.74		
6/8/2018	17:39:32	13.97	0.79		
6/8/2018	17:39:42	3.73	0.38		
6/8/2018	17:39:52	0.90	0.20		
6/8/2018	17:40:02	0.28	0.16		
6/8/2018	17:40:12	0.14	0.15		
6/8/2018	17:40:22	0.09	0.14		
6/8/2018	17:40:32	0.08	0.13		
6/8/2018	17:40:42	0.08	0.13		
6/8/2018	17:40:52	0.07	0.14		
6/8/2018	17:41:02	0.07	0.14		
6/8/2018	17:41:12	0.06	0.14		
6/8/2018	17:41:22	0.06	0.14		
6/8/2018	17:41:32	0.06	0.14		
6/8/2018	17:41:42	0.06	0.13		
6/8/2018	17:41:52	0.06	0.14		
6/8/2018	17:42:02	0.06	0.13	0.06	0.13
6/8/2018	17:42:12	0.06	0.14		
6/8/2018	17:42:22	0.06	0.13		
6/8/2018	17:42:32	0.38	0.43		
6/8/2018	17:42:42	1.56	1.40		
6/8/2018	17:42:52	1.90	1.74		
6/8/2018	17:43:02	1.96	1.85		
6/8/2018	17:43:12	1.99	1.88		
6/8/2018	17:43:22	1.99	1.89		
6/8/2018	17:43:32	2.00	1.91		
6/8/2018	17:43:42	2.01	1.90		
6/8/2018	17:43:52	2.01	1.91		
6/8/2018	17:44:02	2.01	1.92		
6/8/2018	17:44:12	2.01	1.92		
6/8/2018	17:44:22	2.01	1.93		
6/8/2018	17:44:32	2.02	1.93		
6/8/2018	17:44:42	2.02	1.93		1.93
6/8/2018	17:44:52	2.01	1.93		
6/8/2018	17:45:02	5.77	1.71		
6/8/2018	17:45:12	15.53	1.04		
6/8/2018	17:45:22	18.78	0.81		
6/8/2018	17:45:32	15.26	2.94		

Hollingsworth & Vose

CFU 117

R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/8/2018	17:45:42	11.03	7.74		
6/8/2018	17:45:52	10.21	9.15		
6/8/2018	17:46:02	10.03	9.47		
6/8/2018	17:46:12	9.99	9.54		
6/8/2018	17:46:22	9.99	9.56		
6/8/2018	17:46:32	9.98	9.58		
6/8/2018	17:46:42	9.98	9.58		
6/8/2018	17:46:52	9.98	9.58		
6/8/2018	17:47:02	9.98	9.59		
6/8/2018	17:47:12	9.98	9.59		
6/8/2018	17:47:22	9.98	9.59	9.98	
6/8/2018	17:47:32	9.98	9.59		
6/8/2018	17:47:42	9.96	9.60		
6/8/2018	17:47:52	12.86	7.15		
6/8/2018	17:48:02	17.83	2.41		
6/8/2018	17:48:12	19.27	1.16		
6/8/2018	17:48:22	19.61	0.87		
6/8/2018	17:48:32	19.69	0.79		

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 117**
DATE	**06/09/18**
METHOD	**5**
POLLUTANT	**Particulate Matter**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**8:15**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**		**End Time:**	**10:22**
EPA Method:	**5**	53 f Scattered winds variable		**Date:**	**6/9/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

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	4D	Liner type	GLASS		
Y factor	0.9988	Nozzle ID	0.213	Nozzle size	0.2130	inches	
ΔH@	1.8338	Hot box ID	1	Nozzle area	0.000247	sq.ft.	
		Pitot Cp	0.84	Probe heat	248	F	
				Filter heat	248	F	

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.90	%
Static Pressure	0.6	"H_2O	CO_2	0.63	%
Ave. ΔP	1.86	"H_2O	Rec. Nz.	0.187	inches
Stack Temperature	240	F			
Assumed moisture	1.9	%			
Assumed meter temp.	67	F			
Total number of points	20				
Time per point	6				
Total run time	120				

Leak Checks:

	Pre-test	Post-test
Pitot	X	X
Train leak rate, dcf	0.000	0.003
Leak check vacuum, "Hg	16	14

Nozzle check for roundness:

1	2	3	
0.213	0.213	0.213	inches
	Caliper ID#	HLN#1	

Post Test Calculations:

Sample volume	117.176	dcf	Ave. ΔP	1.755	"H_2O
Wet mol. weight	28.71	M_s (actual)	Ave. √ΔP	1.3239	"H_2O
Actual H_2O	1.75	%	Ave. ΔH	2.95	"H_2O
Std. meter vol.	118.128	dscf	Ave. T_s	242.5	°F
Isokinetic Average	104.7	%	Ave. T_m	66	°F

Moisture/Lab:

Filter	Q1333 #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	239.8	264.6	24.8
		Total water gain:	44.8

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	6.0	5.850	1.80	232	60	3.03	3.00	4	251	39
2	12.0	11.820	1.80	237	60	3.01	3.00	4	251	39
3	18.0	17.750	1.80	239	62	3.01	3.00	4	251	45
4	24.0	23.680	1.80	241	63	3.01	3.00	4	252	49
5	30.0	29.620	1.80	242	62	3.00	3.00	4	252	52
6	36.0	35.600	1.80	244	65	3.01	3.00	4	252	54
7	42.0	41.510	1.80	245	66	3.01	3.00	4	251	55
8	48.0	47.390	1.70	245	67	2.85	2.90	4	252	55
9	54.0	52.850	1.50	246	67	2.51	2.50	4	250	56
10	60.0	58.209	1.40	243	68	2.36	2.40	4	250	56
11	66.0	63.970	1.70	244	66	2.85	2.90	4	250	50
12	72.0	69.710	1.70	243	67	2.86	2.90	4	251	48
13	78.0	75.470	1.70	244	67	2.85	2.90	4	251	50
14	84.0	81.310	1.80	245	67	3.02	3.00	4	251	50
15	90.0	87.190	1.80	248	68	3.01	3.00	4	251	51
16	96.0	93.110	1.80	244	69	3.03	3.00	4	251	51
17	102.0	99.170	1.90	242	69	3.21	3.20	4	250	51
18	108.0	105.460	2.00	241	69	3.38	3.40	4	250	51
19	114.0	111.420	1.80	242	69	3.04	3.00	4	250	51
20	120.0	117.176	1.70	243	69	2.87	2.90	4	250	51

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:** **2**
Location:	**Corvallis, OR**		**Start Time:** **10:45**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**	**End Time:** **12:52**
EPA Method:	**5**	53 f Scattered winds variable	**Date:** **6/92018**
Box Operator:	**CMF**		
Technician(s):	**CSW**		

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	4D	Liner type:	GLASS	
Y factor	0.9988	Nozzle ID	0.213	Nozzle size:	0.2130	inches
ΔH@	1.8338	Hot box ID	1	Nozzle area:	0.000247	sq.ft.
		Pitot Cp	0.84	Probe heat:	248	F
				Filter heat:	248	F

Source Information:

Barometric Pressure	29.88 "Hg	O_2	19.96 %
Static Pressure	0.6 "H_2O	CO_2	0.62 %
Ave. ΔP	1.86 "H_2O	Rec. Nz.	0.187 inches
Stack Temperature	240 F		
Assumed moisture	1.75 %		
Assumed meter temp.	66 F		
Total number of points	20		
Time per point	6		
Total run time	120		

Leak Checks:

	Pre-test	Post-test
Pitot:	X	X
Train leak rate, dcf:	0.000	0.003
Leak check vacuum, "Hg:	14	6

Nozzle check for roundness:

1	2	3	
0.213	0.213	0.213	inches
	Caliper ID#	HLN#1	

Post Test Calculations:

Sample volume	121.960 dcf	Ave. ΔP	1.905 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.3795 "H_2O
Actual H_2O	1.79 %	Ave. ΔH	3.215 "H_2O
Std. meter vol.	122.493 dscf	Ave. T_s	240.9 °F
Isokinetic Average	104.1 %	Ave. T_m	68.3 °F

Moisture/Lab:

Filter	Q1334 #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	238.7	266.1	27.4
		Total water gain:	47.4

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	6.0	5.730	1.70	239	65	2.87	2.90	3	242	47
2	12.0	11.550	1.80	236	65	3.05	3.00	3	253	47
3	18.0	17.470	1.80	237	65	3.05	3.00	3	250	59
4	24.0	23.360	1.80	238	65	3.04	3.00	3	253	59
5	30.0	29.520	1.90	236	67	3.23	3.20	3	251	48
6	36.0	35.810	1.90	239	67	3.22	3.20	3	251	49
7	42.0	41.890	1.90	242	68	3.21	3.20	3	251	49
8	48.0	48.420	2.20	243	68	3.71	3.70	4	251	51
9	54.0	54.610	2.00	244	69	3.38	3.40	4	252	51
10	60.0	60.801	2.00	242	69	3.39	3.40	4	251	52
11	66.0	66.810	1.90	242	68	3.21	3.20	4	253	54
12	72.0	73.070	2.00	243	68	3.38	3.40	3	251	50
13	78.0	79.320	2.00	242	69	3.39	3.40	3	250	51
14	84.0	85.660	2.00	241	69	3.39	3.40	3	253	51
15	90.0	91.720	1.90	243	70	3.22	3.20	3	253	54
16	96.0	97.910	2.00	243	70	3.39	3.40	3	253	54
17	102.0	104.050	1.90	243	71	3.22	3.20	3	250	54
18	108.0	110.110	1.90	243	70	3.22	3.20	3	251	55
19	114.0	116.350	1.90	242	70	3.22	3.20	3	251	55
20	120.0	121.960	1.60	240	73	2.74	2.70	3	251	55

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**13:20**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**	**End Time:**	**15:32**
EPA Method:	**5**	53 f Scattered winds variable	**Date:**	**6/9/2018**
Box Operator:	**CMF**			
Technician(s):	**CSW**			

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	4D	Liner type:	GLASS		
Y factor	0.9988	Nozzle ID	0.213	Nozzle size:	0.2130	inches	
ΔH@	1.8338	Hot box ID	1	Nozzle area:	0.000247	sq.ft.	
		Pitot Cp	0.84	Probe heat:	248	F	
				Filter heat:	248	F	

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.91	%
Static Pressure	0.6	"H_2O	CO_2	0.62	%
Ave. ΔP	1.86	"H_2O	Rec. Nz.	0.187	inches
Stack Temperature	240	F			
Assumed moisture	1.79	%			
Assumed meter temp.	68.3	F			
Total number of points	20				
Time per point	6				
Total run time	120				

Leak Checks:

	Pre-test	Post-test
Pitot:	X	X
Train leak rate, dcf:	0.000	0.003
Leak check vacuum, "Hg:	15	15

Nozzle check for roundness:

1	2	3	
0.213	0.213	0.213	inches
	Caliper ID#	HLN#1	

Post Test Calculations:

Sample volume	117.575	dcf	Ave. ΔP	1.765 "H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. √ΔP	1.3281 "H_2O
Actual H_2O	1.9	%	Ave. ΔH	2.99 "H_2O
Std. meter vol.	117.848	dscf	Ave. T_s	241.7 °F
Isokinetic Average	104.2	%	Ave. T_m	69.1 °F

Moisture/Lab:

Filter Q1335 #

	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	253.0	276.5	23.5
		Total water gain:	48.5

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	6.0	5.900	1.80	229	69	3.10	3.10	4	251	55
2	12.0	11.680	1.80	236	69	3.07	3.10	4	251	48
3	18.0	17.660	1.80	235	69	3.08	3.10	4	249	49
4	24.0	23.390	1.70	231	69	2.92	2.90	4	252	45
5	30.0	29.390	1.80	233	68	3.08	3.10	4	254	44
6	36.0	35.370	1.80	237	68	3.06	3.10	4	255	44
7	42.0	41.520	1.80	241	67	3.04	3.00	4	250	45
8	48.0	47.120	1.70	243	68	2.87	2.90	4	251	45
9	54.0	52.740	1.70	243	68	2.87	2.90	4	252	46
10	60.0	58.133	1.50	243	68	2.53	2.50	4	251	47
11	66.0	63.960	1.70	243	67	2.86	2.90	4	251	48
12	72.0	69.760	1.70	245	68	2.86	2.90	4	251	48
13	78.0	75.650	1.80	247	68	3.02	3.00	4	252	52
14	84.0	81.600	1.80	249	69	3.02	3.00	4	252	54
15	90.0	87.560	1.80	248	70	3.03	3.00	4	252	55
16	96.0	93.600	1.90	245	71	3.21	3.20	4	247	53
17	102.0	99.630	1.80	245	71	3.05	3.10	4	250	52
18	108.0	105.650	1.80	246	71	3.04	3.00	4	252	53
19	114.0	111.620	1.80	247	72	3.04	3.00	4	252	53
20	120.0	117.575	1.80	247	72	3.04	3.00	4	252	53

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

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:15**
Source:	**CFU 117**	**End Time:**	**10:22**
Method:	**ODEQ 5**	**Date:**	**6/9/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	5.850	3.00	60	1	1.80	232	1.3416
12	11.820	3.00	60	2	1.80	237	1.3416
18	17.750	3.00	62	3	1.80	239	1.3416
24	23.680	3.00	63	4	1.80	241	1.3416
30	29.620	3.00	62	5	1.80	242	1.3416
36	35.600	3.00	65	6	1.80	244	1.3416
42	41.510	3.00	66	7	1.80	245	1.3416
48	47.390	2.90	67	8	1.70	245	1.3038
54	52.850	2.50	67	9	1.50	246	1.2247
60	58.209	2.40	68	10	1.40	243	1.1832
66	63.970	2.90	66	11	1.70	244	1.3038
72	69.710	2.90	67	12	1.70	243	1.3038
78	75.470	2.90	67	13	1.70	244	1.3038
84	81.310	3.00	67	14	1.80	245	1.3416
90	87.190	3.00	68	15	1.80	248	1.3416
96	93.110	3.00	69	16	1.80	244	1.3416
102	99.170	3.20	69	17	1.90	242	1.3784
108	105.460	3.40	69	18	2.00	241	1.4142
114	111.420	3.00	69	19	1.80	242	1.3416
120	117.176	2.90	69	20	1.70	243	1.3038

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 117**	**Date:**	**06/09/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	117.176	dcf	Rectangular		
Water Volume	44.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.63	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.90	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	2.950	"H_2O	√Dp	1.3239	"H_2O
Temperature, T_m	66.0	^oF	Temperature, T_s	242.5	^oF
Temperature, T_m	526.0	^oA (^oR)	Temperature, T_s	702.5	^oA (R)
Pressure Meter, P_m	30.097	"Hg	Pressure Stack, P_s	29.924	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	118.128	dscf	Velocity, V_s	85.97	fps
	3.345	dscm	Volume (actual)	25,321.6	awcfm
Actual Volume, $V_{m(actual)}$	160.010	awcf		24,878.5	adcfm
Gas Stream Moisture			Volume (standard)	1,142,057.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.108	scf		1,122,071.9	dscf/hr
Moisture, B_{ws}	0.0175			18,701.2	dscf/min
Moisture EPA M4	1.75	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.71	lb/lb-mole			
Percent Isokinetic	104.7	%			

Laboratory Results

EPA Method 5					
Filterable PM	0.00141	grams			
Emissions:					
Concentration, C_s	1.84E-04	gr/dscf			
	421	µg/dscm			
Mass Emissions	2.95E-02	lb/hr			
Back Half:					
Inorganic CPM	1.00E-03	grams	Organic CPM	1.06E-03	grams
Inorganic CPM, C_s	1.31E-04	gr/dscf	Organic CPM, C_s	1.39E-04	gr/dscf
	300	µg/dscm		318	µg/dscm
Mass Emissions	2.10E-02	lb/hr	Mass Emissions	2.23E-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:**	**10:45**
Source:	**CFU 117**	**End Time:**	**12:52**
Method:	**ODEQ 5**	**Date:**	**6/92018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	5.730	2.90	65	1	1.70	239	1.3038
12	11.550	3.00	65	2	1.80	236	1.3416
18	17.470	3.00	65	3	1.80	237	1.3416
24	23.360	3.00	65	4	1.80	238	1.3416
30	29.520	3.20	67	5	1.90	236	1.3784
36	35.810	3.20	67	6	1.90	239	1.3784
42	41.890	3.20	68	7	1.90	242	1.3784
48	48.420	3.70	68	8	2.20	243	1.4832
54	54.610	3.40	69	9	2.00	244	1.4142
60	60.801	3.40	69	10	2.00	242	1.4142
66	66.810	3.20	68	11	1.90	242	1.3784
72	73.070	3.40	68	12	2.00	243	1.4142
78	79.320	3.40	69	13	2.00	242	1.4142
84	85.660	3.40	69	14	2.00	241	1.4142
90	91.720	3.20	70	15	1.90	243	1.3784
96	97.910	3.40	70	16	2.00	243	1.4142
102	104.050	3.20	71	17	1.90	243	1.3784
108	110.110	3.20	70	18	1.90	243	1.3784
114	116.350	3.20	70	19	1.90	242	1.3784
120	121.960	2.70	73	20	1.60	240	1.2649

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 117**	**Date:**	**6/92018**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	121.960	dcf	Rectangular		
Water Volume	47.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.62	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.96	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.215	"H_2O	√Dp	1.3795	"H_2O
Temperature, T_m	68.3	^oF	Temperature, T_s	240.9	^oF
Temperature, T_m	528.3	^oA (^oR)	Temperature, T_s	700.9	^oA (R)
Pressure Meter, P_m	30.116	"Hg	Pressure Stack, P_s	29.924	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	122.493	dscf	Velocity, V_s	89.49	fps
	3.469	dscm	Volume (actual)	26,358.4	awcfm
Actual Volume, $V_{m(actual)}$	165.612	awcf		25,886.6	adcfm
Gas Stream Moisture			Volume (standard)	1,191,532.7	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.231	scf		1,170,204.3	dscf/hr
Moisture, B_{ws}	0.0179			19,503.4	dscf/min
Moisture EPA M4	1.79	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	104.1	%			

Laboratory Results

Front Half:					
Filterable PM	0.00065	grams			
Emissions:					
Concentration, C_s	8.19E-05	gr/dscf			
	187	µg/dscm			
Mass Emissions	1.37E-02	lb/hr			
Back Half:					
Inorganic CPM	1.31E-03	grams	Organic CPM	1.34E-03	grams
Inorganic CPM, C_s	1.65E-04	gr/dscf	Organic CPM, C_s	1.69E-04	gr/dscf
	377	µg/dscm		387	µg/dscm
Mass Emissions	2.75E-02	lb/hr	Mass Emissions	2.83E-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:**	**13:20**
Source:	**CFU 117**	**End Time:**	**15:32**
Method:	**ODEQ 5**	**Date:**	**06/09/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	5.900	3.10	69	1	1.80	229	1.3416
12	11.680	3.10	69	2	1.80	236	1.3416
18	17.660	3.10	69	3	1.80	235	1.3416
24	23.390	2.90	69	4	1.70	231	1.3038
30	29.390	3.10	68	5	1.80	233	1.3416
36	35.370	3.10	68	6	1.80	237	1.3416
42	41.520	3.00	67	7	1.80	241	1.3416
48	47.120	2.90	68	8	1.70	243	1.3038
54	52.740	2.90	68	9	1.70	243	1.3038
60	58.133	2.50	68	10	1.50	243	1.2247
66	63.960	2.90	67	11	1.70	243	1.3038
72	69.760	2.90	68	12	1.70	245	1.3038
78	75.650	3.00	68	13	1.80	247	1.3416
84	81.600	3.00	69	14	1.80	249	1.3416
90	87.560	3.00	70	15	1.80	248	1.3416
96	93.600	3.20	71	16	1.90	245	1.3784
102	99.630	3.10	71	17	1.80	245	1.3416
108	105.650	3.00	71	18	1.80	246	1.3416
114	111.620	3.00	72	19	1.80	247	1.3416
120	117.575	3.00	72	20	1.80	247	1.3416

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 117**	**Date:**	**06/09/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	117.575	dcf	Rectangular		
Water Volume	48.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.2130	in.	Length		in
Nozzle Area	0.000247	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.62	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.91	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	2.990	"H_2O	√Dp	1.3281	"H_2O
Temperature, T_m	69.1	^oF	Temperature, T_s	241.7	^oF
Temperature, T_m	529.1	^oA (^oR)	Temperature, T_s	701.7	^oA (R)
Pressure Meter, P_m	30.100	"Hg	Pressure Stack, P_s	29.924	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	117.848	dscf	Velocity, V_s	86.22	fps
	3.337	dscm	Volume (actual)	25,395.2	awcfm
Actual Volume, $V_{m(actual)}$	159.693	awcf		24,912.7	adcfm
Gas Stream Moisture			Volume (standard)	1,146,684.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.282	scf		1,124,897.8	dscf/hr
Moisture, B_{ws}	0.0190			18,748.3	dscf/min
Moisture EPA M4	1.90	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	104.2	%			

Laboratory Results

Front Half:					
Filterable PM	0.00159	grams			
Emissions:					
Concentration, C_s	2.08E-04	gr/dscf			
	475	µg/dscm			
Mass Emissions	3.34E-02	lb/hr			
Back Half:					
Inorganic CPM	1.37E-03	grams	Organic CPM	6.86E-04	grams
Inorganic CPM, C_s	1.79E-04	gr/dscf	Organic CPM, C_s	8.98E-05	gr/dscf
	409	µg/dscm		205	µg/dscm
Mass Emissions	2.87E-02	lb/hr	Mass Emissions	1.44E-02	lb/hr

Oregon Method 5
Filterable and Condensable Particulate
Laboratory Gravimetric Data

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 117**

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction	Corrected Gain (grams)	
1	CPM Organics (Acetone BH)	130	49.81045	49.81140	0.00095	1.86E-04	**0.00076**	
	Probe Rinse (Acetone FH)	100	51.49975	51.50130	0.00155	1.43E-04	**0.00141**	
	Filter	Q1333	0.37275	0.37235	-0.00040		**0.00000**	
	CPM Inorganics (Water)	385	46.23450	46.23580	0.00130	2.96E-04	**0.00100**	
	CPM Organics (Hexane BH)	95	49.23900	49.23930	0.00030	0.00E+00	**0.00030**	
	Impinger H_2O Gain, mls		200	220	20.0			
						Filterable PM (mg)	**1.41**	
						Total PM (mg)	**3.48**	**ND**
2	CPM Organics (Acetone BH)	110	50.75985	50.76090	0.00105	1.57E-04	**0.00089**	
	Probe Rinse (Acetone FH)	70	51.45775	51.45850	0.00075	1.00E-04	**0.00065**	
	Filter	Q1334	0.37425	0.37370	-0.00055		**0.00000**	
	CPM Inorganics (Water)	380	51.44880	51.45040	0.00160	2.92E-04	**0.00131**	
	CPM Organics (Hexane BH)	90	48.97255	48.97300	0.00045	0.00E+00	**0.00045**	
	Impinger H_2O Gain, mls		200	220	20.0			
						Filterable PM (mg)	**0.65**	
						Total PM (mg)	**3.30**	**ND**
3	CPM Organics (Acetone BH)	115	47.84380	47.84460	0.00080	1.64E-04	**0.00064**	
	Probe Rinse (Acetone FH)	80	50.36650	50.36770	0.00120	1.14E-04	**0.00109**	
	Filter	Q1335	0.37100	0.37150	0.00050		**0.00050**	
	CPM Inorganics (Water)	370	50.03935	50.04100	0.00165	2.85E-04	**0.00137**	
	CPM Organics (Hexane BH)	90	51.06785	51.06790	0.00005	0.00E+00	**0.00005**	
	Impinger H_2O Gain, mls		200	225	25.0			
						Filterable PM (mg)	**1.59**	
						Total PM (mg)	**3.64**	**ND**
	Acetone Blank	175	48.25825	48.25850	0.00025	1.43E-06	g/g	
	Water Blank	195	51.37705	51.37720	0.00015	7.69E-07	g/g	
	Hexane Blank	95	49.02970	49.02970	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 117**
Location: **Corvallis, OR**

Run			1	2	3	
Date			6/9/2018	6/92018	6/9/2018	
Run Start Time			8:15	10:45	13:20	
Run End Time			10:22	12:52	15:32	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.88	29.88	29.88	**29.88**
Nozzle Dia., in.			0.2130	0.2130	0.2130	**0.2130**
Isokinetic Average, %			104.7	104.1	104.2	**104.3**
Sample Volume, dscf			118.128	122.493	117.848	**119.490**
Sample Volume, dscm			3.345	3.469	3.337	**3.384**
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			0.63	0.62	0.62	**0.62**
O_2 %vd			19.90	19.96	19.91	**19.92**
Static Press., "H_2O			0.60	0.60	0.60	**0.60**
H_2O %v			1.75	1.79	1.90	**1.81**
Wet Molecular Weight, lb/lb-mole			28.71	28.70	28.69	**28.70**
Velocity, FPS			85.97	89.49	86.22	**87.23**
ADCFM			24,878.5	25,886.6	24,912.7	**25,225.9**
AWCFM			25,321.6	26,358.4	25,395.2	**25,691.7**
DSCFM			18,701.2	19,503.4	18,748.3	**18,984.3**
Stack Temperature, °F			242.5	240.9	241.7	**241.7**
Filterable Particulate	Concentration, C_s	gr/dscf	1.84E-04	8.19E-05	2.08E-04	**1.58E-04**
		µg/dscm	421	187	475	**361**
	Mass	lb/hr	2.95E-02	1.37E-02	3.34E-02	**2.55E-02**
		lb/lb glass	2.51E-04	1.16E-04	2.84E-04	**2.17E-04**
Inorganic CPM	Concentration, C_s	gr/dscf	1.31E-04	1.65E-04	1.79E-04	**1.58E-04**
		µg/dscm	300	377	409	**362**
	Mass	lb/hr	2.10E-02	2.75E-02	2.87E-02	**2.58E-02**
		lb/lb glass	1.79E-04	2.34E-04	2.44E-04	**2.19E-04**
Organic CPM	Concentration, C_s	gr/dscf	1.39E-04	1.69E-04	8.98E-05	**1.33E-04**
		µg/dscm	318	387	205	**304**
	Mass	lb/hr	2.23E-02	2.83E-02	1.44E-02	**2.17E-02**
		lb/lb glass	1.90E-04	2.41E-04	1.23E-04	**1.84E-04**
Measured Total PM	Concentration, C_s	gr/dscf	ND 4.54E-04	ND 4.16E-04	ND 4.76E-04	ND **4.49E-04**
		µg/dscm	ND 1,039	ND 951	ND 1,090	ND **1,027**
	Mass	lb/hr	ND 7.28E-02	ND 6.95E-02	ND 7.65E-02	ND **7.29E-02**
		lb/lb glass	ND 6.19E-04	ND 5.92E-04	ND 6.51E-04	ND **6.21E-04**
Total PM @ Method Detection Limit (7 mg)	Mass	gr/dscf	< 9.14E-04	< 8.82E-04	< 8.82E-04	< **8.93E-04**
		lb/hr	< 1.47E-01	< 1.47E-01	< 1.42E-01	< **1.45E-01**
		lb/lb glass	< 1.25E-03	< 1.25E-03	< 1.21E-03	< **1.24E-03**
Production Data	Glass Production	lbs/hr	117.5	117.5	117.5	**117.5**

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

Oregon Methods 1-5
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:15**
Source:	**CFU 117**	**End Time:**	**10:22**
Method:	**ODEQ 5**	**Date:**	**6/9/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.097 "Hg

where Pb: 29.88 "Hg
ΔH: 2.950 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.924 "Hg

where Pb: 29.88 "Hg
Static Press.: 0.60 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 118.128 dscf

where Vm: 117.176 dcf
Y: 0.9988
Pm: 30.097 "Hg
Tm: 526.0 °A

4) $V_w(std) = (0.04706)(H_2O)$ = 2.108 scf

where H_2O: 44.80 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0175

where Vw(std): 2.108 scf
Vm(std): 118.128 dscf

6) % H_2O = Bws x 100 = 1.75 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 160.010 awcf

where Y: 0.9988
Vm: 117.1759 dcf
Bws: 0.0175
Ts: 702.5 °A
Tm: 526.0 °A
Pm: 30.097 "Hg
Ps: 29.924 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO)$ = 28.90 lb/lb-mole

where CO_2: 0.63 %vd
O_2 19.90 %vd
N_2+CO= (100-(O_2+CO_2): 79.47 %vd

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 117 **Date: 6/9/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.71 lb/lb-mole
where M_d: 28.90 lb/lb-mole
Bws: 0.0175

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 85.97 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.3239
Ts: 702.5 °A
Ps: 29.924 "Hg
Ms: 28.71 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 25,321.6 AWCFM
where V_s: 85.97 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 24,878.5 ADCFM
where AWCFM: 25,321.6
Bws: 0.0175

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 1,142,057.9 wscf/hr
where V_s: 85.97 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 702.5 °A
Ps: 29.924 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,122,071.9 dscf/hr
where wscf/hr: 1,142,057.9
Bws: 0.0175

16) DSCFM= (dscf/hr)/60 mins/hr = 18,701.2 DSCFM
where dscf/hr: 1,122,071.9

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000247 sq. ft.
where Nozzle Size: 0.2130 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 117**	**Date:**	**6/9/2018**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 104.7 %

where Ts:	702.5	°A
Vm(Std):	118.128	dscf
Ps:	29.924	"Hg
Vs	85.97	ft/sec
Nozzle Area:	0.000247	sq. ft.
Sampling Time:	120	min.
Bws:	0.0175	

ODEQ Method 5:

Front Half:

19) Filterable PM = filter gain + probe rinse gain = 0.00141 grams

where Filter Gain:	0.00000	grams
Probe Rinse:	0.00141	grams

20) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 1.84E-04 gr/dscf

where Sample:	0.00141	grams
Vm(std)	118.128	dscf

21) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 421 µg/dscm

where Sample:	0.00141	grams
Vm(std)	3.345	dscm

22) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 2.95E-02 lb/hr

where Cs:	1.84E-04	gr/dscf
Stack Flow:	1,122,071.9	dscf/hr

Back Half:

23) Inorganic CPM = water fraction = 0.00100 grams
Organic CPM = acetone BH + hexane BH = 0.00106 grams

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

24) lb/lb glass produced = PM fraction/Glass production = 2.51E-04 lb/lb glass

where glass produced:	117.5	lb/hr
Filterable PM emissions:	2.95E-02	lb/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 117**
DATE	**06/09/18**
METHOD	**316**
POLLUTANT	**Formaldehyde**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**8:16**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**		**End Time:**	**10:23**
EPA Method:	**316**	53 f, Scattered clouds, winds variable		**Date:**	**6/9/2018**
Box Operator:	**DS**				
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	4A	Liner type	Glass		
Y factor	0.9963	Nozzle ID	0.193	Nozzle size	0.1927	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area	0.000203	sq.ft.	
		Pitot Cp	0.84	Probe heat	250	F	
				Filter heat	250	F	

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.90	%
Static Pressure	0.6	"H_2O	CO_2	0.63	%
Ave. ΔP	1.86	"H_2O	Rec. Nz.	0.191	inches
Stack Temperature	250	F			
Assumed moisture	2	%			
Assumed meter temp.	52	F			
Total number of points	20				
Time per point	6				
Total run time	120				

Leak Checks:

	Pre-test	Post-test
Pitot	X	x
Train leak rate, dcf	0.002	0.003
Leak check vacuum, "Hg	16	16

Nozzle check for roundness:

1	2	3	
0.193	0.193	0.192	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	93.160	dcf	Ave. ΔP	1.78	"H_2O
Wet mol. weight	28.75	M_s (actual)	Ave. √ΔP	1.3335	"H_2O
Actual H_2O	1.34	%	Ave. ΔH	1.99	"H_2O
Std. meter vol.	93.514	dscf	Ave. T_s	241.9	°F
Isokinetic Average	99.7	%	Ave. T_m	65.7	°F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	206	6.0
Silica gel, g	256.1	277	20.9
		Total water gain:	26.9

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	6	4.630	1.80	233	59	2.03	2.00	3	251	38
2	12	9.130	1.70	238	60	1.91	1.90	3	249	38
3	18	13.770	1.80	239	61	2.02	2.00	3	248	44
4	24	18.570	1.90	240	63	2.14	2.10	3	251	46
5	30	23.280	1.90	242	64	2.14	2.10	3	249	49
6	36	28.110	1.90	245	65	2.13	2.10	3	249	49
7	42	32.830	1.80	244	66	2.03	2.00	3	251	51
8	48	37.500	1.80	245	64	2.02	2.00	3	250	55
9	54	42.210	1.80	246	67	2.02	2.00	3	249	56
10	60	46.922	1.80	246	68	2.03	2.00	3	250	55
11	66	51.340	1.60	245	66	1.80	1.80	3	249	50
12	72	55.610	1.50	245	67	1.69	1.70	3	249	48
13	78	60.060	1.60	234	67	1.83	1.80	3	251	48
14	84	64.610	1.70	243	67	1.92	1.90	3	251	48
15	90	69.300	1.80	240	68	2.05	2.00	3	249	50
16	96	74.050	1.80	245	68	2.03	2.00	3	253	50
17	102	78.810	1.80	243	68	2.04	2.00	3	251	50
18	108	83.510	1.80	240	68	2.05	2.00	3	249	48
19	114	88.350	1.90	242	69	2.16	2.20	3	250	48
20	120	93.160	1.90	242	69	2.16	2.20	3	249	48

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**10:46**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**		**End Time:**	**12:54**
EPA Method:	**316**	53 f, Scattered clouds, winds variable		**Date:**	**6/9/2018**
Box Operator:	**DS**				
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	4A	Liner type:	Glass		
Y factor	0.9963	Nozzle ID	0.193	Nozzle size:	0.1927	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000202	sq.ft.	
		Pitot Cp	0.84	Probe heat:	250	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.96 %
Static Pressure	0.6	"H_2O	CO_2	0.62 %
Ave. ΔP	1.86	"H_2O	Rec. Nz.	0.188 inches
Stack Temperature	250	F		
Assumed moisture	1.34	%		
Assumed meter temp.	65.7	F		
Total number of points	20			
Time per point	6			
Total run time	120			

Leak Checks:

	Pre-test	Post-test
Pitot:	x	x
Train leak rate, dcf:	0.002	0.002
Leak check vacuum, "Hg:	15	16

Nozzle check for roundness:

1	2	3	
0.193	0.193	0.192	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	93.441 dcf	Ave. ΔP	1.79 "H_2O
Wet mol. weight	28.72 M_s (actual)	Ave. √ΔP	1.3363 "H_2O
Actual H_2O	1.67 %	Ave. ΔH	2.026 "H_2O
Std. meter vol.	93.415 dscf	Ave. T_s	241.6 °F
Isokinetic Average	100.2 %	Ave. T_m	67.9 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	247.8	267.5	19.7
		Total water gain:	33.7

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	6	3.760	1.20	234	65	1.38	1.30	1	251	50
2	12	8.090	1.60	236	67	1.84	1.80	1	251	47
3	18	12.640	1.70	236	66	1.96	1.90	1	251	48
4	24	17.280	1.80	239	66	2.06	2.00	1	248	48
5	30	21.940	1.80	238	66	2.06	2.00	1	248	48
6	36	26.750	1.90	239	66	2.18	2.20	1	251	47
7	42	31.560	1.90	243	68	2.17	2.20	1	246	48
8	48	36.420	1.90	243	68	2.17	2.20	1	250	48
9	54	41.290	1.90	244	68	2.17	2.20	1	250	48
10	60	46.147	1.90	244	69	2.17	2.10	1	250	48
11	66	50.850	1.70	245	67	1.93	1.90	1	250	48
12	72	55.410	1.70	244	68	1.94	1.92	1	250	49
13	78	60.100	1.80	243	68	2.06	2.00	1	253	52
14	84	64.790	1.80	244	68	2.05	2.00	1	253	52
15	90	69.750	2.00	245	68	2.28	2.20	1	251	54
16	96	74.540	1.90	245	68	2.17	2.10	1	251	56
17	102	79.390	1.90	243	70	2.18	2.20	1	251	57
18	108	84.120	1.80	243	70	2.07	2.10	1	251	57
19	114	88.630	1.80	243	70	2.07	2.10	1	251	57
20	120	93.441	1.80	241	71	2.08	2.10	1	251	57

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**3**
Location:	**Corvallis, OR**			**Start Time:**	**13:21**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**		**End Time:**	**15:33**
EPA Method:	**316**	53 f, Scattered clouds, winds variable		**Date:**	**6/9/2018**
Box Operator:	**DS**				
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	4A	Liner type:	Glass		
Y factor	0.9963	Nozzle ID	0.193	Nozzle size:	0.1927	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000202	sq.ft.	
		Pitot Cp	0.84	Probe heat:	250	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.91	%
Static Pressure	0.6	"H_2O	CO_2	0.62	%
Ave. ΔP	1.86	"H_2O	Rec. Nz.	0.188	inches
Stack Temperature	250	F			
Assumed moisture	1.67	%			
Assumed meter temp.	67.9	F			
Total number of points	20				
Time per point	6				
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:	16	14

Nozzle check for roundness:

1	2	3	
0.193	0.193	0.192	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	92.970	dcf	Ave. ΔP	1.755	"H_2O
Wet mol. weight	28.7	M_s (actual)	Ave. √ΔP	1.3237	"H_2O
Actual H_2O	1.84	%	Ave. ΔH	2.01	"H_2O
Std. meter vol.	92.835	dscf	Ave. T_s	243.3	°F
Isokinetic Average	100.7	%	Ave. T_m	68.5	°F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	243.2	260.1	16.9
		Total water gain:	36.9

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	6	4.580	1.60	244	68	1.82	1.80	2	247	55
2	12	9.000	1.60	244	68	1.82	1.80	2	250	53
3	18	13.650	1.70	234	68	1.96	2.00	2	250	45
4	24	18.390	1.80	232	68	2.08	2.10	2	252	45
5	30	23.240	1.90	238	67	2.17	2.20	2	254	45
6	36	27.980	1.90	238	67	2.17	2.20	2	250	43
7	42	32.600	1.80	240	67	2.05	2.10	2	251	44
8	48	37.340	1.80	242	67	2.04	2.10	2	250	45
9	54	42.090	1.80	244	68	2.04	2.10	2	250	45
10	60	46.618	1.70	244	68	1.93	1.90	2	250	46
11	66	50.810	1.40	240	68	1.60	1.60	2	250	52
12	72	55.140	1.50	244	68	1.70	1.70	2	251	47
13	78	59.640	1.70	249	68	1.92	1.90	2	251	49
14	84	64.340	1.80	250	69	2.03	2.00	2	249	50
15	90	69.138	1.90	250	69	2.14	2.10	2	249	50
16	96	73.700	1.80	250	70	2.03	2.00	2	249	50
17	102	78.610	1.90	245	70	2.16	2.20	2	249	51
18	108	83.450	1.90	245	70	2.16	2.20	2	252	51
19	114	88.190	1.80	246	71	2.05	2.10	2	247	51
20	120	92.970	1.80	247	71	2.05	2.10	2	247	50

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

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:16**
Source:	**CFU 117**	**End Time:**	**10:23**
Method:	**316**	**Date:**	**6/9/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	4.630	2.00	59	1	1.80	233	1.3416
12	9.130	1.90	60	2	1.70	238	1.3038
18	13.770	2.00	61	3	1.80	239	1.3416
24	18.570	2.10	63	4	1.90	240	1.3784
30	23.280	2.10	64	5	1.90	242	1.3784
36	28.110	2.10	65	6	1.90	245	1.3784
42	32.830	2.00	66	7	1.80	244	1.3416
48	37.500	2.00	64	8	1.80	245	1.3416
54	42.210	2.00	67	9	1.80	246	1.3416
60	46.922	2.00	68	10	1.80	246	1.3416
66	51.340	1.80	66	11	1.60	245	1.2649
72	55.610	1.70	67	12	1.50	245	1.2247
78	60.060	1.80	67	13	1.60	234	1.2649
84	64.610	1.90	67	14	1.70	243	1.3038
90	69.300	2.00	68	15	1.80	240	1.3416
96	74.050	2.00	68	16	1.80	245	1.3416
102	78.810	2.00	68	17	1.80	243	1.3416
108	83.510	2.00	68	18	1.80	240	1.3416
114	88.350	2.20	69	19	1.90	242	1.3784
120	93.160	2.20	69	20	1.90	242	1.3784

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 117**	**Date:**	**06/09/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	93.160	dcf	Rectangular		
Water Volume	26.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.1927	in.	Length		in
Nozzle Area	0.000203	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.63	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.90	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.990	"H_2O	√Dp	1.3335	"H_2O
Temperature, T_m	65.7	^oF	Temperature, T_s	241.9	^oF
Temperature, T_m	525.7	^oA (^oR)	Temperature, T_s	701.9	^oA (R)
Pressure Meter, P_m	30.026	"Hg	Pressure Stack, P_s	29.924	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	93.514	dscf	Velocity, V_s	86.50	fps
	2.648	dscm	Volume (actual)	25,477.7	awcfm
Actual Volume, $V_{m(actual)}$	126.036	awcf		25,136.3	adcfm
Gas Stream Moisture			Volume (standard)	1,150,080.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.266	scf		1,134,669.8	dscf/hr
Moisture, B_{ws}	0.0134			18,911.2	dscf/min
Moisture EPA M4	1.34	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	512.09	
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.75	lb/lb-mole			
Percent Isokinetic	99.7	%			

Laboratory Results

CH_2O	1728.0	µg/sample		
CH_2O	1.73E-03	grams	MW CH_2O	30.031 g/mole

Emissions:

Concentration, C_s	2.85E-04	gr/dscf
	652.57	µg/dscm
	5.23E-01	ppmvd
Mass Emissions	4.62E-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:**	**10:46**
Source:	**CFU 117**	**End Time:**	**12:54**
Method:	**316**	**Date:**	**06/09/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	3.760	1.30	65	1	1.20	234	1.0954
12	8.090	1.80	67	2	1.60	236	1.2649
18	12.640	1.90	66	3	1.70	236	1.3038
24	17.280	2.00	66	4	1.80	239	1.3416
30	21.940	2.00	66	5	1.80	238	1.3416
36	26.750	2.20	66	6	1.90	239	1.3784
42	31.560	2.20	68	7	1.90	243	1.3784
48	36.420	2.20	68	8	1.90	243	1.3784
54	41.290	2.20	68	9	1.90	244	1.3784
60	46.147	2.10	69	10	1.90	244	1.3784
66	50.850	1.90	67	11	1.70	245	1.3038
72	55.410	1.92	68	12	1.70	244	1.3038
78	60.100	2.00	68	13	1.80	243	1.3416
84	64.790	2.00	68	14	1.80	244	1.3416
90	69.750	2.20	68	15	2.00	245	1.4142
96	74.540	2.10	68	16	1.90	245	1.3784
102	79.390	2.20	70	17	1.90	243	1.3784
108	84.120	2.10	70	18	1.80	243	1.3416
114	88.630	2.10	70	19	1.80	243	1.3416
120	93.441	2.10	71	20	1.80	241	1.3416

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 117**	**Date:**	**06/09/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	93.441	dcf	Rectangular		
Water Volume	33.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.1927	in.	Length		in
Nozzle Area	0.000202	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.62	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.96	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	2.026	"H_2O	√Dp	1.3363	"H_2O
Temperature, T_m	67.9	^oF	Temperature, T_s	241.6	^oF
Temperature, T_m	527.9	^oA (^oR)	Temperature, T_s	701.6	^oA (R)
Pressure Meter, P_m	30.029	"Hg	Pressure Stack, P_s	29.924	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	93.415	dscf	Velocity, V_s	86.70	fps
	2.645	dscm	Volume (actual)	25,536.6	awcfm
Actual Volume, $V_{m(actual)}$	126.270	awcf		25,110.1	adcfm
Gas Stream Moisture			Volume (standard)	1,153,232.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.586	scf		1,133,973.9	dscf/hr
Moisture, B_{ws}	0.0167			18,899.6	dscf/min
Moisture EPA M4	1.67	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	511.871	
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.72	lb/lb-mole			
Percent Isokinetic	100.2	%			

Laboratory Results

CH_2O	1641.0	µg/sample			
CH_2O	1.64E-03	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	2.71E-04	gr/dscf
	620.42	µg/dscm
	4.97E-01	ppmvd
Mass Emissions	4.39E-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:**	**13:21**
Source:	**CFU 117**	**End Time:**	**15:33**
Method:	**316**	**Date:**	**06/09/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	4.580	1.80	68	1	1.60	244	1.2649
12	9.000	1.80	68	2	1.60	244	1.2649
18	13.650	2.00	68	3	1.70	234	1.3038
24	18.390	2.10	68	4	1.80	232	1.3416
30	23.240	2.20	67	5	1.90	238	1.3784
36	27.980	2.20	67	6	1.90	238	1.3784
42	32.600	2.10	67	7	1.80	240	1.3416
48	37.340	2.10	67	8	1.80	242	1.3416
54	42.090	2.10	68	9	1.80	244	1.3416
60	46.618	1.90	68	10	1.70	244	1.3038
66	50.810	1.60	68	11	1.40	240	1.1832
72	55.140	1.70	68	12	1.50	244	1.2247
78	59.640	1.90	68	13	1.70	249	1.3038
84	64.340	2.00	69	14	1.80	250	1.3416
90	69.138	2.10	69	15	1.90	250	1.3784
96	73.700	2.00	70	16	1.80	250	1.3416
102	78.610	2.20	70	17	1.90	245	1.3784
108	83.450	2.20	70	18	1.90	245	1.3784
114	88.190	2.10	71	19	1.80	246	1.3416
120	92.970	2.10	71	20	1.80	247	1.3416

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 117**	**Date:**	**06/09/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	92.970	dcf	Rectangular		
Water Volume	36.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.1927	in.	Length		in
Nozzle Area	0.000202	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.62	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.91	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	2.010	"H_2O	√Dp	1.3237	"H_2O
Temperature, T_m	68.5	^oF	Temperature, T_s	243.3	^oF
Temperature, T_m	528.5	^oA (^oR)	Temperature, T_s	703.3	^oA (R)
Pressure Meter, P_m	30.028	"Hg	Pressure Stack, P_s	29.924	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	92.835	dscf	Velocity, V_s	86.02	fps
	2.629	dscm	Volume (actual)	25,336.3	awcfm
Actual Volume, $V_{m(actual)}$	126.009	awcf		24,870.1	adcfm
Gas Stream Moisture			Volume (standard)	1,141,422.2	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.737	scf		1,120,420.0	dscf/hr
Moisture, B_{ws}	0.0184			18,673.7	dscf/min
Moisture EPA M4	1.84	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	513.112	
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.7	%			

Laboratory Results

CH_2O	1753.0	µg/sample		
CH_2O	1.75E-03	grams	MW CH_2O	30.031 g/mole

Emissions:

Concentration, C_s	2.91E-04	gr/dscf
	666.79	µg/dscm
	5.34E-01	ppmvd
Mass Emissions	4.66E-02	lb/hr

"<" represents MDL value

EPA Method 316
Laboratory Results
Formaldehyde

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR** **MDL** 0.0137 µg/mL
Source: **CFU 117**

Lab ID	Sample ID	Sample Date	<	Result	MDL	Sample Vol. (mL)	Units
11	Run 1	6/9/2018		1728	6.44	470.0	µg/sample
17	Run 2	6/9/2018		1641	6.23	455.0	µg/sample
18	Run 3	6/9/2018		1753	6.58	480.0	µg/sample
20	H_20 Blank	6/9/2018	<	MDL	5.27	385.0	µg/sample
19	Field Train Blank	6/9/2018	<	MDL	6.17	450.0	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 117**

Run			1	2	3	
Date			6/9/2018	6/9/2018	6/9/2018	
Run Start Time			8:16	10:46	13:21	
Run End Time			10:23	12:54	15:33	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.88	29.88	29.88	**29.88**
Nozzle Dia., in.			0.1927	0.1927	0.1927	**0.1927**
Isokinetic Average, %			99.7	100.2	100.7	**100.2**
Sample Volume, dscf			93.514	93.415	92.835	**93.255**
Sample Volume, dscm			2.648	2.645	2.629	**2.641**
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			0.63	0.62	0.62	**0.62**
O_2 %vd			19.90	19.96	19.91	**19.92**
Static Press., "H_2O			0.60	0.60	0.60	**0.60**
H_2O %v			1.34	1.67	1.84	**1.62**
Wet Molecular Weight, lb/lb-mole			28.75	28.72	28.70	**28.72**
Velocity, FPS			86.50	86.70	86.02	**86.41**
ADCFM			25,136.3	25,110.1	24,870.1	**25,038.8**
AWCFM			25,477.7	25,536.6	25,336.3	**25,450.2**
DSCFM			18,911.2	18,899.6	18,673.7	**18,828.1**
Stack Temperature, °F			241.9	241.6	243.3	**242.3**
Formaldehyde	Concentration, C_s	gr/dscf	2.85E-04	2.71E-04	2.91E-04	**2.83E-04**
		µg/dscm	652.6	620.4	666.8	**646.6**
		ppmvd	5.23E-01	4.97E-01	5.34E-01	**5.18E-01**
	Mass	lb/hr	4.62E-02	4.39E-02	4.66E-02	**4.56E-02**
		lb/lb glass	3.93E-04	3.74E-04	3.97E-04	**3.88E-04**
Production Data	Glass Production	lbs/hr	117.5	117.5	117.5	**117.5**

"<" represents MDL value

EPA Methods 1-4, 316
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:16**
Source:	**CFU 117**	**End Time:**	**10:23**
Method:	**316**	**Date:**	**6/9/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.026 "Hg

where Pb: 29.88 "Hg

ΔH: 1.990 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.924 "Hg

where Pb: 29.88 "Hg

Static Press.: 0.60 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 93.514 dscf

where Vm: 93.160 dcf

Y: 0.9963

Pm: 30.026 "Hg

Tm: 525.7 °A

4) $V_w(std) = (0.04706)(H_2O)$ = 1.266 scf

where H_2O: 26.90 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0134

where Vw(std): 1.266 scf

Vm(std): 93.514 dscf

6) % H_2O = Bws x 100 = 1.34 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 126.036 awcf

where Y: 0.9963

Vm: 93.1600 dcf

Bws: 0.0134

Ts: 701.9 °A

Tm: 525.7 °A

Pm: 30.026 "Hg

Ps: 29.924 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO)$ = 28.90 lb/lb-mole

where CO_2: 0.63 %vd

O_2 19.90 %vd

N_2+CO= (100-(O_2+CO_2): 79.47 %vd

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 117 **Date: 6/9/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.75 lb/lb-mole
where M_d: 28.90 lb/lb-mole
Bws: 0.0134

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 86.50 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.3335
Ts: 701.9 °A
Ps: 29.924 "Hg
Ms: 28.75 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 25,477.7 AWCFM
where V_s: 86.50 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 25,136.3 ADCFM
where AWCFM: 25,477.7
Bws: 0.0134

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 1,150,080.9 wscf/hr
where V_s: 86.50 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 701.9 °A
Ps: 29.924 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,134,669.8 dscf/hr
where wscf/hr: 1,150,080.9
Bws: 0.0134

16) DSCFM= (dscf/hr)/60 mins/hr = 18,911.2 DSCFM
where dscf/hr: 1,134,669.8

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000203 sq. ft.
where Nozzle Size: 0.1927 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 117**	**Date:**	**6/9/2018**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 99.7 %

where Ts:	701.9	°A
Vm(Std):	93.514	dscf
Ps:	29.924	"Hg
Vs	86.50	ft/sec
Nozzle Area:	0.000203	sq. ft.
Sampling Time:	120	min.
Bws:	0.0134	

EPA Method 316:

19) Formaldehyde laboratory results 1728.00000 µg/sample

20) Formaldehyde = (µg/sample)/1,000,000 = 1.73E-03 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 2.85E-04 gr/dscf

where Sample:	0.00173	grams
Vm(std)	93.514	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 652.6 µg/dscm

where Sample:	0.00173	grams
Vm(std)	2.648	dscm

23) Volume/Mole $= \left(\frac{359\frac{ft^3}{lb-mol}@STP\ (Ts)\ (29.92"Hg)}{492°A\ (Ps)}\right)$ = 512.090 Vol./Mole

where Ts:	701.9	°A
Ps:	29.924	"Hg

24) ppmvd $= \left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 5.23E-01 ppmvd

where MW:	30.031	g/mol
lb/hr:	0.05	
Vol./Mole:	512.090	
ADCFM:	25136.3	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 4.62E-02 lb/hr

where Cs:	2.85E-04	gr/dscf
Stack Flow:	1,134,669.8	dscf/hr

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 117**
Facility	**Glass Plant 2**	Date	**June 9, 2018**
Location	**Corvallis, OR**		

Run			1	2	3	
Date			6/9/2018	6/9/2018	6/9/2018	
Run Start Time			8:15	10:45	13:20	
Run End Time			10:23	12:53	15:33	
CO_2 %vd			0.63	0.62	0.62	0.62
O_2 %vd			19.90	19.96	19.91	19.93
WSCFM*			19,034.3	19,858.9	19,111.4	19,334.9
DSCFM*			18,701.2	19,503.4	18,748.3	18,984.3
Nitrogen Oxides	Concentration, C_s	ppmvd	2.86	2.89	2.95	2.90
	Mass	lb/hr	0.38	0.40	0.40	0.39
	Emission Factor	lb/lb glass	3.26E-03	3.44E-03	3.37E-03	3.36E-03
		lb/Mscf nat. gas	7.27E-02	7.66E-02	7.50E-02	7.48E-02
Carbon Monoxide	Concentration, C_s	ppmvd	164.39	160.83	165.12	163.45
	Mass	lb/hr	13.41	13.68	13.50	13.53
	Emission Factor	lb/lb glass	0.11	0.12	0.11	0.12
		lb/Mscf nat. gas	2.54	2.60	2.55	2.56
VOC	Concentration, C_s	ppmvw	0.93	0.82	0.83	0.86
	Mass	lb/hr	0.12	0.11	0.11	0.11
	Emission Factor	lb/lb glass	1.03E-03	9.50E-04	9.25E-04	9.69E-04
		lb/Mscf nat. gas	2.30E-02	2.12E-02	2.06E-02	2.16E-02
Formaldehyde**	Mass	lb/hr	4.62E-02	4.39E-02	4.66E-02	4.56E-02
	Emission Factor	lb/lb glass	3.93E-04	3.74E-04	3.97E-04	3.88E-04
		lb/Mscf nat. gas	8.76E-03	8.33E-03	8.81E-03	8.63E-03
Total VOCs†	Mass	lb/hr	0.17	0.16	0.16	0.16
	Emission Factor	lb/lb glass	1.43E-03	1.32E-03	1.32E-03	1.36E-03
		lb/Mscf nat. gas	3.18E-02	2.95E-02	2.94E-02	3.02E-02

Production Rates	Glass Production	lb/hr	117.5	117.5	117.5	117.5
	Natural Gas Use	scf/hr	5273.3	5270.7	5287.1	5277.0
		Mscf/hr	5.2733	5.2707	5.2871	5.2770

*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 117**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 2**	Date:	**June 9, 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**
	zero	0.25	0.56	1.55	pass	0.39	0.70	pass	-0.85	pass				
Run 1	upscale	9.94	10.04	0.50	pass	10.26	1.60	pass	1.10	pass	20	3.24	2.86	10
	zero	0.25	0.39	0.70	pass	0.45	1.00	pass	0.30	pass				
Run 2	upscale	9.94	10.26	1.60	pass	10.04	0.50	pass	-1.10	pass	20	3.23	2.89	10
	zero	0.25	0.45	1.00	pass	0.45	1.00	pass	0.00	pass				
Run 3	upscale	9.94	10.04	0.50	pass	10.27	1.65	pass	1.15	pass	20	3.31	2.95	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.25	9.94	20.34
Analyzer Cal. Error %	1.25	-0.30	1.70
Analyzer Cal. Error < 2%*	pass	pass	pass

NO2 CONVERTER TEST	
NO2 Tank Value (ppm)	50.41
NO Check Value	46.58
NO2 to NO Conversion %	92.4%
NO2 Conversion > 90%	pass

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

Company:	**Hollingsworth & Vose**	Source:	**CFU 117**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 2**	Date:	**June 9, 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**		**System Cal Response**	**Post test System Cal. Bias**		**System Drift**		**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
				% of span	**pass/fail**		**% of span**	**pass/fail**	**% of span**	**pass/fail**				
	zero	0.79	-0.42	-0.40	pass	-0.23	-0.34	pass	0.06	pass				
Run 1	upscale	148.66	151.12	0.82	pass	150.03	0.46	pass	-0.36	pass	300	165.05	164.39	150
	zero	0.79	-0.23	-0.34	pass	-2.96	-1.25	pass	-0.91	pass				
Run 2	upscale	148.66	150.03	0.46	pass	148.38	-0.09	pass	-0.55	pass	300	160.09	160.83	150
	zero	0.79	-2.96	-1.25	pass	-3.13	-1.31	pass	-0.06	pass				
Run 3	upscale	148.66	148.38	-0.09	pass	148.80	0.05	pass	0.14	pass	300	163.87	165.12	150
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	150	300
Cal gas analyzer response	0.79	148.66	301.3
Analyzer Cal. Error	0.26	-0.45	0.43
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 9, 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**
	zero	0.01	0.04	0.15	pass	0.05	0.20	pass	0.05	pass				
Run 1	upscale	9.92	10.00	0.40	pass	9.95	0.15	pass	-0.25	pass	20	19.81	19.90	10
	zero	0.01	0.05	0.20	pass	0.04	0.15	pass	-0.05	pass				
Run 2	upscale	9.92	9.95	0.15	pass	9.94	0.10	pass	-0.05	pass	20	19.81	19.96	10
	zero	0.01	0.04	0.15	pass	0.04	0.15	pass	0.00	pass				
Run 3	upscale	9.92	9.94	0.10	pass	9.96	0.20	pass	0.10	pass	20	19.77	19.91	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.01	9.92	20
Analyzer Cal. Error	0.05	-0.40	0.00
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 9, 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**
	zero	0.08	0.07	-0.25	pass	0.09	0.25	pass	0.50	pass				
Run 1	upscale	1.92	1.92	0.00	pass	1.94	0.50	pass	0.50	pass	4	0.66	0.63	2
	zero	0.08	0.09	0.25	pass	0.08	0.00	pass	-0.25	pass				
Run 2	upscale	1.92	1.94	0.50	pass	1.96	1.00	pass	0.50	pass	4	0.66	0.62	2
	zero	0.08	0.08	0.00	pass	0.09	0.25	pass	0.25	pass				
Run 3	upscale	1.92	1.96	1.00	pass	1.96	1.00	pass	0.00	pass	4	0.67	0.62	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.08	1.92	4.17
Analyzer Cal. Error	2.00	-2.00	4.25
Analyzer Cal. Error < 2%*	pass	pass	pass

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 117**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 2**	Date:	**June 9, 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	0.00	0.10	0.40	pass			
Run 1	upscale	12.54	12.51	-0.12	pass	25	0.93	12.5
	zero	0.00	0.01	0.04	pass			
Run 2	upscale	12.54	12.45	-0.36	pass	25	0.82	12.5
	zero	0.00	0.01	0.04	pass			
Run 3	upscale	12.54	12.53	-0.04	pass	25	0.83	12.5
				≤ 3%				

Instrument Response Time(s):	
Time 1	120
Time 2	120
Time 3	120
Average:	120

SYSTEM CAL. ERROR	**Zero**	**Low**	**Mid**	**High**
Calibration gas standards	0.00	6.25	12.50	21.25
Calibration gas system response	0.00	6.01	12.54	21.28
Calibration Predicted Response		6.26	12.52	
Calibration Error		3.98	0.18	
Calibration Error < 5% ?	pass	pass	pass	pass

Stratification Check

Facility	Glass Plant 2				
Location	Corvallis, OR		**Date**	6/9/2018	
Source	CFU 117		**Stack Dimensions**	30	inches

3 POINT METHOD

% of diameter		Pt location	O_2 %	Diff (+/- 5%)	Pass/Fail
16.7%	1	5.01	19.82	0.00%	PASS
50.0%	2	15.00	19.82	0.00%	PASS
83.3%	3	24.99	19.82	0.00%	PASS
		AVERAGE:	19.82		

*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:**	**8:15**
Source:	**CFU 117**	**End Time:**	**10:23**
Method:	**7E**	**Date:**	**6/9/2018**

EPA Methods 7E:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.30 %v

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

System Bias (Upscale)

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

where C_{Dir}: 9.94 ppmv
C_S: 10.04 ppmv
CS: 20.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 1.10 %v

where SB_{Final}: 1.60 ppmv
SB_i: 0.50 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 2.86 ppmv

where C_{Avg}: 3.24 ppmv
C_O: 0.48 ppmv
C_{MA}: 10.00 ppmv
C_M: 10.15 ppmv

NO_2 - NO Conversion Efficiency

5) $Eff_{NOx} = \left(\frac{C_{Dir}}{C_V}\right) \times 100 =$ 92.4 %v

where C_{Dir}: 46.58 ppmv
C_V: 50.41 ppmv

Emission Rates:

NO_x 1) lb/hr = (Stack Flow) (C) (46) (1.558×10^{-7}) = 0.38 lb/hr

where Stack Flow:	18701.20	DSCFM
C:	2.86	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:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:15**
Source:	**CFU 117**	**End Time:**	**10:23**
Method:	**10**	**Date:**	**6/9/2018**

EPA Methods 10:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.45 %v

where C_{Dir}: 148.66 ppmv
C_V: 150.00 ppmv
CS: 300.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.82 %v

where C_{Dir}: 148.66 ppmv
C_S: 151.12 ppmv
CS: 300.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.36 %v

where SB_{Final}: 0.46 ppmv
SB_i: 0.82 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O) \left(\frac{C_{MA}}{C_M - CO}\right) =$ 164.39 ppmv

where C_{Avg}: 165.05 ppmv
C_O: -0.33 ppmv
C_{MA}: 150.00 ppmv
C_M: 150.58 ppmv

Emission Rates:

CO 1) lb/hr = (Stack Flow) (C) (28) (1.558×10^{-7}) = 13.41 lb/hr

where Stack Flow:	18701.20	DSCFM
C:	164.39	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:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:15**
Source:	**CFU 117**	**End Time:**	**10:23**
Method:	**3A**	**Date:**	**6/9/2018**

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) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.40 %v

where C_{Dir}:	9.92	ppmv
C_S:	10.00	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.25 %v

where SB_{Final}:	0.15	ppmv
SB_i:	0.40	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.90 ppmv

where C_{Avg}:	19.81	ppmv
C_O:	0.05	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.98	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:15**
Source:	**CFU 117**	**End Time:**	**10:23**
Method:	**3A**	**Date:**	**6/9/2018**

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) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.00 %v

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

Drift Assessment (Upscale)

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

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

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.63 ppmv

where C_{Avg}:	0.66 ppmv
C_O:	0.08 ppmv
C_{MA}:	2.00 ppmv
C_M:	1.93 ppmv

EPA Method 25A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:15**
Source:	**CFU 117**	**End Time:**	**10:23**
Method:	**25A**	**Date:**	**6/9/2018**

EPA Method 25A:

Predicted Low and Mid Level Calibration Response (Mid)

1) $PR = \left(\frac{CR_H - CRZ}{SS}\right) \times CS_M + CR_Z =$ 12.52 ppmv

where CR_H:	21.28 ppmv
CR_Z:	0.00 ppmv
SS:	21.25 ppmv
CS_M:	12.50 ppmv

Calibration Error Test

2) $CET = \left(\frac{SR - PR}{CGV}\right) \times 100 =$ 0.18 %v

where PR:	12.52 ppmv
SR:	12.54 ppmv
CGV	12.50 ppmv

Drift Determination (Mid)

3) $D = \left(\frac{CSR - CSRC}{CSRS}\right) \times 100 =$ 0.12 %v

where CSR:	12.54 ppmv
CSR_C:	12.51 ppmv
AS:	25.00 ppmv

Emission Rates:

VOC 1) lb/hr = (Stack Flow) (C) (44) (1.558×10^{-7}) = 0.12 lb/hr

where Stack Flow:	18701.20	DSCFM
C:	0.93	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

6/9/2018

CFU 117

Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4 [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4 [PPM]
6/9/2018	6:54:47	2.45	163.76	16.58	0.65	0.01	-0.01						
6/9/2018	6:54:57	2.42	162.96	16.60	0.65	0.01	-0.01						
6/9/2018	6:55:07	2.42	162.00	13.85	0.86	0.01	-0.01						
6/9/2018	6:55:17	2.43	151.14	0.75	0.18	0.01	-0.01						
6/9/2018	6:55:27	2.32	120.54	0.05	0.09	0.01	-0.01						
6/9/2018	6:55:37	1.66	80.40	0.03	0.09	0.01	-0.01						
6/9/2018	6:55:47	1.08	47.82	0.02	0.09	0.01	-0.01						
6/9/2018	6:55:57	0.69	30.01	0.02	0.09	0.01	-0.01						
6/9/2018	6:56:07	0.31	22.03	0.02	0.09	0.01	-0.01						
6/9/2018	6:56:17	0.30	18.51	0.02	0.10	0.01	-0.01						
6/9/2018	6:56:27	0.30	16.70	0.01	0.09	0.01	-0.01						
6/9/2018	6:56:37	0.28	16.21	0.02	0.09	0.00	-0.01						
6/9/2018	6:56:47	0.28	16.81	0.01	0.08	0.01	-0.01						
6/9/2018	6:56:57	0.28	17.83	0.01	0.08	0.01	-0.01						
6/9/2018	6:57:07	0.28	5.20	0.02	0.09	0.01	-0.01						
6/9/2018	6:57:17	0.28	-1.02	0.01	0.09	0.01	-0.01						
6/9/2018	6:57:27	0.28	-1.74	0.01	0.09	0.01	-0.01						
6/9/2018	6:57:37	0.28	-0.09	0.01	0.08	0.01	-0.01						
6/9/2018	6:57:47	0.28	0.10	0.01	0.09	0.01	-0.01						
6/9/2018	6:57:57	0.28	1.52	0.01	0.08	0.01	-0.01						
6/9/2018	6:58:07	0.28	2.43	0.01	0.09	0.01	-0.01						
6/9/2018	6:58:17	0.27	2.22	0.01	0.08	0.01	-0.01						
6/9/2018	6:58:27	0.25	1.66	0.01	0.07	0.01	-0.01						
6/9/2018	6:58:37	0.25	0.60	0.00	0.08	0.01	-0.01						
6/9/2018	6:58:47	0.25	0.10	0.01	0.08	0.01	-0.01	0.25	0.79	0.01	0.08		
6/9/2018	6:58:57	0.25	0.38	0.00	0.07	0.01	-0.01						
6/9/2018	6:59:07	0.25	1.39	0.00	0.08	0.01	-0.01						
6/9/2018	6:59:17	0.25	2.42	5.09	3.13	0.01	-0.01						
6/9/2018	6:59:27	0.26	2.30	18.55	18.61	0.01	-0.01						
6/9/2018	6:59:37	0.29	1.82	19.54	19.08	0.01	-0.01						
6/9/2018	6:59:47	0.44	1.00	19.59	19.12	0.01	-0.01						

Hollingsworth & Vose

6/9/2018

CFU 117

Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4 [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4 [PPM]
6/9/2018	6:59:57	1.59	-0.51	19.60	19.14	0.01	-0.01						
6/9/2018	7:00:07	2.51	-1.88	19.61	19.15	0.01	-0.01						
6/9/2018	7:00:17	1.58	-1.64	19.61	19.16	0.01	-0.01						
6/9/2018	7:00:27	0.73	-1.77	19.61	19.16	0.01	-0.01						
6/9/2018	7:00:37	0.63	-2.32	19.62	19.17	0.01	-0.01						
6/9/2018	7:00:47	0.53	-3.46	19.62	19.16	0.01	-0.01						
6/9/2018	7:00:57	0.50	-4.33	19.62	19.17	0.00	-0.01						
6/9/2018	7:01:07	0.45	-5.00	19.82	19.17	0.00	-0.01						
6/9/2018	7:01:17	0.42	-5.26	19.57	19.17	0.01	-0.01						
6/9/2018	7:01:27	0.41	-5.80	19.65	19.17	0.01	-0.01						
6/9/2018	7:01:37	0.40	-8.05	19.67	19.17	0.00	-0.01						
6/9/2018	7:01:47	0.40	-10.97	20.00	19.19	0.01	-0.01						
6/9/2018	7:01:57	0.39	-13.91	20.00	19.19	0.01	-0.01						
6/9/2018	7:02:07	0.37	-15.85	20.00	19.19	0.01	-0.01						
6/9/2018	7:02:17	0.37	-16.76	20.00	19.19	0.00	-0.01						
6/9/2018	7:02:27	0.37	-16.79	20.00	19.19	0.01	-0.01			20.00			
6/9/2018	7:02:37	0.36	-15.66	20.00	19.19	0.01	-0.01						
6/9/2018	7:02:47	0.34	-14.47	20.01	19.20	0.01	-0.01						
6/9/2018	7:02:57	0.34	-14.02	20.01	19.54	0.01	-0.01						
6/9/2018	7:03:07	0.34	-14.89	19.30	19.58	0.01	-0.01						
6/9/2018	7:03:17	0.34	-15.60	15.42	14.29	0.01	-0.01						
6/9/2018	7:03:27	0.34	-14.69	9.84	9.71	0.01	-0.01						
6/9/2018	7:03:37	0.37	-13.64	9.96	9.85	0.01	-0.01						
6/9/2018	7:03:47	0.39	-12.87	9.93	9.83	0.01	-0.01						
6/9/2018	7:03:57	0.36	-12.43	9.93	9.82	0.01	-0.01						
6/9/2018	7:04:07	0.31	-12.81	9.92	9.81	0.01	-0.01						
6/9/2018	7:04:17	0.31	-13.66	9.92	9.80	0.01	-0.01						
6/9/2018	7:04:27	0.30	-14.58	9.92	9.79	0.01	-0.01			9.92			
6/9/2018	7:04:37	0.31	-15.72	9.91	9.79	0.01	-0.01						
6/9/2018	7:04:47	0.31	-16.12	8.98	9.73	0.01	-0.01						
6/9/2018	7:04:57	0.31	-11.01	9.07	9.72	0.01	-0.01						

Hollingsworth & Vose

6/9/2018

CFU 117

Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4 [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4 [PPM]
6/9/2018	7:05:07	0.30	3.76	3.40	2.80	0.01	-0.01						
6/9/2018	7:05:17	0.31	14.28	0.52	0.39	0.01	-0.01						
6/9/2018	7:05:27	0.30	9.63	3.93	4.41	0.01	-0.01						
6/9/2018	7:05:37	0.27	-1.85	3.92	4.16	0.01	-0.01						
6/9/2018	7:05:47	0.25	-10.76	3.92	4.17	0.01	-0.01						
6/9/2018	7:05:57	0.28	-14.29	3.93	4.17	0.01	-0.01						
6/9/2018	7:06:07	0.28	-14.62	3.93	4.17	0.01	-0.01						
6/9/2018	7:06:17	0.28	-13.46	3.94	4.18	0.01	-0.01						
6/9/2018	7:06:27	0.28	-12.66	3.94	4.18	0.01	-0.01						
6/9/2018	7:06:37	0.28	-13.10	3.94	4.17	0.00	-0.01						
6/9/2018	7:06:47	0.28	-14.19	3.94	4.17	0.01	-0.01						
6/9/2018	7:06:57	0.28	-15.01	3.95	4.17	0.01	-0.01				4.17		
6/9/2018	7:07:07	0.28	-15.28	3.95	4.17	0.01	-0.01						
6/9/2018	7:07:17	0.28	-15.16	3.96	4.17	0.01	-0.01						
6/9/2018	7:07:27	0.28	-13.67	2.69	2.70	0.01	-0.01						
6/9/2018	7:07:37	0.28	-12.45	2.03	2.00	0.01	-0.01						
6/9/2018	7:07:47	0.43	-12.56	1.97	1.94	0.01	-0.01						
6/9/2018	7:07:57	1.20	-13.43	1.96	1.93	0.01	-0.01						
6/9/2018	7:08:07	1.76	-14.59	1.97	1.93	0.01	-0.01						
6/9/2018	7:08:17	1.42	-15.23	1.96	1.93	0.01	-0.01						
6/9/2018	7:08:27	1.14	-15.00	1.97	1.93	0.01	-0.01						
6/9/2018	7:08:37	1.05	-13.67	1.97	1.92	0.01	-0.01						
6/9/2018	7:08:47	0.97	-12.29	1.97	1.92	0.01	-0.01						
6/9/2018	7:08:57	0.91	-12.39	1.97	1.92	0.01	-0.01						
6/9/2018	7:09:07	0.86	-13.44	1.97	1.92	0.01	-0.01						
6/9/2018	7:09:17	0.83	-14.50	1.97	1.92	0.01	-0.01				1.92		
6/9/2018	7:09:27	0.80	-15.04	1.97	1.92	0.01	-0.01						
6/9/2018	7:09:37	0.77	-14.42	1.78	1.90	0.01	-0.01						
6/9/2018	7:09:47	0.74	-7.77	1.76	1.91	0.01	-0.01						
6/9/2018	7:09:57	0.71	10.37	2.76	2.59	0.01	-0.01						
6/9/2018	7:10:07	0.69	27.23	1.37	0.78	0.01	-0.01						

Hollingsworth & Vose

6/9/2018

CFU 117

Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4 [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	CH4 [PPM]
6/9/2018	7:10:17	0.67	29.39	0.12	0.12	0.01	-0.01						
6/9/2018	7:10:27	1.77	20.32	0.04	0.10	0.01	-0.01						
6/9/2018	7:10:37	7.61	11.13	0.03	0.08	0.01	-0.01						
6/9/2018	7:10:47	12.20	7.68	0.09	0.14	0.01	-0.01						
6/9/2018	7:10:57	12.05	7.62	0.14	0.20	0.01	-0.01						
6/9/2018	7:11:07	11.80	5.75	0.03	0.08	0.00	-0.01						
6/9/2018	7:11:17	10.71	0.05	0.01	0.08	0.01	-0.01						
6/9/2018	7:11:27	9.03	-6.19	0.01	0.07	0.01	-0.01						
6/9/2018	7:11:37	4.34	-9.98	0.01	0.06	0.01	-0.01						
6/9/2018	7:11:47	0.44	-11.34	0.01	0.07	0.01	-0.01						
6/9/2018	7:11:57	0.38	-11.06	0.01	0.06	0.01	-0.01						
6/9/2018	7:12:07	0.30	-9.90	0.01	0.07	0.00	-0.01						
6/9/2018	7:12:17	0.28	-8.68	0.01	0.06	0.01	-0.01						
6/9/2018	7:12:27	0.28	-8.14	0.01	0.06	0.01	-0.01						
6/9/2018	7:12:37	0.27	-8.95	0.07	0.14	0.01	-0.01						
6/9/2018	7:12:47	0.27	-8.33	0.02	0.07	0.01	-0.01						
6/9/2018	7:12:57	0.14	-4.50	0.00	0.06	0.01	-0.01						
6/9/2018	7:13:07	1.47	1.11	0.00	0.06	0.01	-0.01						
6/9/2018	7:13:17	12.89	5.65	0.00	0.06	0.01	-0.01						
6/9/2018	7:13:27	22.93	8.25	0.00	0.06	0.01	-0.01						
6/9/2018	7:13:37	23.80	9.23	0.00	0.06	0.01	-0.01						
6/9/2018	7:13:47	24.59	8.42	0.01	0.06	0.01	-0.01						
6/9/2018	7:13:57	24.72	7.26	0.00	0.07	0.01	-0.01						
6/9/2018	7:14:07	24.79	6.59	0.00	0.06	0.01	-0.01						
6/9/2018	7:14:17	24.71	6.22	0.00	0.06	0.01	-0.01						
6/9/2018	7:14:27	24.61	7.05	0.00	0.06	0.01	-0.01						
6/9/2018	7:14:37	23.54	8.51	0.00	0.06	0.01	-0.01						
6/9/2018	7:14:47	21.32	8.91	0.00	0.06	0.01	-0.01						
6/9/2018	7:14:57	19.90	8.18	0.00	0.06	0.01	-0.01						
6/9/2018	7:15:07	19.73	7.48	0.00	0.05	0.01	-0.01						
6/9/2018	7:15:17	19.58	6.70	0.00	0.05	0.01	-0.01						

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6/9/2018	7:15:27	19.60	6.11	0.00	0.05	0.01	-0.01						
6/9/2018	7:15:37	19.49	6.92	0.00	0.06	0.01	-0.01						
6/9/2018	7:15:47	20.75	8.52	0.00	0.05	0.01	-0.01						
6/9/2018	7:15:57	20.70	8.78	0.00	0.06	0.01	-0.01						
6/9/2018	7:16:07	20.50	8.45	0.00	0.06	0.01	-0.01						
6/9/2018	7:16:17	20.38	7.55	0.00	0.05	0.01	-0.01						
6/9/2018	7:16:27	20.13	5.16	0.01	0.06	0.01	-0.01	20.34					
6/9/2018	7:16:37	19.42	1.77	0.00	0.06	0.01	-0.01						
6/9/2018	7:16:47	18.36	-0.58	0.00	0.05	0.01	-0.01						
6/9/2018	7:16:57	14.04	-1.32	0.00	0.05	0.01	-0.01						
6/9/2018	7:17:07	10.19	-1.26	0.00	0.06	0.01	-0.01						
6/9/2018	7:17:17	10.23	-1.91	0.00	0.06	0.01	-0.01						
6/9/2018	7:17:27	10.26	-2.90	0.00	0.05	0.01	-0.01						
6/9/2018	7:17:37	10.20	-3.58	0.00	0.06	0.01	-0.01						
6/9/2018	7:17:47	10.15	-4.40	0.00	0.06	0.01	-0.01						
6/9/2018	7:17:57	10.10	-3.59	0.00	0.06	0.01	-0.01						
6/9/2018	7:18:07	10.04	-2.16	0.00	0.05	0.01	-0.01						
6/9/2018	7:18:17	10.01	-1.33	0.00	0.06	0.01	-0.01						
6/9/2018	7:18:27	9.98	-1.69	0.00	0.06	0.01	-0.01						
6/9/2018	7:18:37	9.92	-2.78	0.00	0.05	0.01	-0.01						
6/9/2018	7:18:47	9.87	-3.69	0.00	0.07	0.01	-0.01						
6/9/2018	7:18:57	9.86	-4.21	0.00	0.06	0.01	-0.01						
6/9/2018	7:19:07	9.83	-3.94	0.00	0.07	0.01	-0.01						
6/9/2018	7:19:17	9.80	-2.37	0.00	0.06	0.01	-0.01						
6/9/2018	7:19:27	9.78	-1.38	0.00	0.06	0.01	-0.01						
6/9/2018	7:19:37	9.77	-1.82	0.00	0.06	0.01	-0.01						
6/9/2018	7:19:47	9.75	-2.78	0.00	0.06	0.01	-0.01						
6/9/2018	7:19:57	9.74	-3.62	0.00	0.07	0.01	-0.01						
6/9/2018	7:20:07	9.71	-4.19	0.00	0.06	0.01	-0.01						
6/9/2018	7:20:17	9.68	-3.67	0.00	0.06	0.01	-0.01						
6/9/2018	7:20:27	9.65	-2.37	0.00	0.06	0.01	-0.01						

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6/9/2018	7:20:37	9.62	-1.43	0.00	0.06	0.01	-0.01						
6/9/2018	7:20:47	9.73	-1.86	0.00	0.06	0.01	-0.01						
6/9/2018	7:20:57	9.99	-2.88	0.00	0.06	0.01	-0.01						
6/9/2018	7:21:07	9.99	-3.60	0.00	0.05	0.01	-0.01						
6/9/2018	7:21:17	9.98	-4.28	0.00	0.06	0.01	-0.01						
6/9/2018	7:21:27	9.96	-3.89	0.00	0.06	0.01	-0.01						
6/9/2018	7:21:37	9.95	-2.71	0.01	0.06	0.01	-0.01						
6/9/2018	7:21:47	9.92	0.56	0.02	0.07	0.01	-0.01	9.94					
6/9/2018	7:21:57	9.88	11.21	-0.04	0.06	0.01	-0.01						
6/9/2018	7:22:07	9.82	21.79	0.03	0.06	0.00	-0.01						
6/9/2018	7:22:17	9.83	20.43	0.34	0.37	0.01	-0.01						
6/9/2018	7:22:27	9.31	9.83	0.01	0.06	0.01	-0.01						
6/9/2018	7:22:37	4.83	-2.04	0.03	0.08	0.01	-0.01						
6/9/2018	7:22:47	0.86	-1.63	0.56	0.32	0.01	-0.01						
6/9/2018	7:22:57	0.54	43.48	0.24	0.06	0.01	-0.01						
6/9/2018	7:23:07	4.95	129.61	0.03	0.05	0.01	-0.01						
6/9/2018	7:23:17	26.42	208.91	0.01	0.06	0.01	-0.01						
6/9/2018	7:23:27	48.77	253.90	0.00	0.06	0.01	-0.01						
6/9/2018	7:23:37	99.90	268.48	0.00	0.05	0.01	-0.01						
6/9/2018	7:23:47	99.90	272.90	0.01	0.05	0.01	-0.01						
6/9/2018	7:23:57	99.90	276.14	0.01	0.05	0.01	-0.01						
6/9/2018	7:24:07	99.90	278.79	0.01	0.05	0.01	-0.01						
6/9/2018	7:24:17	99.90	280.12	0.01	0.05	0.01	-0.01						
6/9/2018	7:24:27	99.90	279.29	0.00	0.05	0.01	-0.01						
6/9/2018	7:24:37	99.90	278.23	0.00	0.05	0.01	-0.01						
6/9/2018	7:24:47	99.90	277.49	0.01	0.05	0.01	-0.01						
6/9/2018	7:24:57	99.90	277.42	0.00	0.04	0.01	-0.01						
6/9/2018	7:25:07	99.90	278.98	0.01	0.05	0.01	-0.01						
6/9/2018	7:25:17	99.90	281.25	0.00	0.05	0.01	-0.01						
6/9/2018	7:25:27	99.90	282.08	0.00	0.05	0.01	-0.01						
6/9/2018	7:25:37	99.90	280.98	0.01	0.05	0.01	-0.01						

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6/9/2018	7:25:47	99.90	279.56	0.01	0.05	0.01	-0.01						
6/9/2018	7:25:57	99.90	278.60	0.00	0.05	0.01	-0.01						
6/9/2018	7:26:07	99.90	278.25	0.00	0.05	0.01	-0.01						
6/9/2018	7:26:17	99.90	293.19	0.00	0.05	0.01	-0.01						
6/9/2018	7:26:27	99.90	304.30	0.00	0.04	0.01	-0.01						
6/9/2018	7:26:37	99.90	304.98	0.01	0.05	0.01	-0.01						
6/9/2018	7:26:47	99.90	304.23	0.00	0.05	0.01	-0.01						
6/9/2018	7:26:57	99.90	302.31	0.00	0.05	0.01	-0.01						
6/9/2018	7:27:07	99.90	301.01	0.01	0.05	0.01	-0.01						
6/9/2018	7:27:17	99.90	300.59	0.01	0.04	0.01	-0.01		301.30				
6/9/2018	7:27:27	99.90	300.51	0.01	0.05	0.01	-0.01						
6/9/2018	7:27:37	99.90	276.64	0.02	0.04	0.01	-0.01						
6/9/2018	7:27:47	99.90	224.08	0.00	0.05	0.01	-0.01						
6/9/2018	7:27:57	99.90	175.99	0.00	0.05	0.01	-0.01						
6/9/2018	7:28:07	99.90	151.09	0.00	0.05	0.01	-0.01						
6/9/2018	7:28:17	99.90	145.61	0.00	0.05	0.01	-0.01						
6/9/2018	7:28:27	99.90	145.00	0.00	0.04	0.01	-0.01						
6/9/2018	7:28:37	99.90	146.00	0.00	0.05	0.01	-0.01						
6/9/2018	7:28:47	99.90	148.00	0.00	0.05	0.01	-0.01						
6/9/2018	7:28:57	99.90	149.08	0.00	0.04	0.01	-0.01						
6/9/2018	7:29:07	99.90	148.89	0.00	0.04	0.01	-0.01		148.66				
6/9/2018	7:29:17	99.90	147.61	0.00	0.04	0.01	-0.01						
6/9/2018	7:29:27	99.90	146.31	0.00	0.04	0.01	-0.01						
6/9/2018	7:29:37	99.90	145.74	0.01	0.04	0.01	-0.01						
6/9/2018	7:29:47	99.90	141.28	10.92	0.05	0.01	-0.01						
6/9/2018	7:29:57	99.90	117.42	20.57	0.04	0.01	-0.01						
6/9/2018	7:30:07	97.75	72.95	20.87	0.02	0.01	-0.01						
6/9/2018	7:30:17	80.06	28.59	20.88	0.04	0.01	-0.01						
6/9/2018	7:30:27	44.31	-0.17	20.88	0.04	0.01	-0.01						
6/9/2018	7:30:37	46.87	-11.75	20.89	0.03	0.01	-0.01						
6/9/2018	7:30:47	46.74	-15.06	20.89	0.03	0.01	-0.01						

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6/9/2018	7:30:57	46.68	-15.94	20.89	0.04	0.01	-0.01						
6/9/2018	7:31:07	46.60	-9.44	20.90	0.04	0.01	-0.01	NO2 converter check					
6/9/2018	7:31:17	46.45	0.81	20.90	0.03	0.01	-0.01	46.58					
6/9/2018	7:31:27	46.31	1.36	20.90	0.03	0.00	-0.01						
6/9/2018	7:31:37	46.25	0.61	20.91	0.04	0.01	-0.01						
6/9/2018	7:31:47	46.18	-0.53	20.86	0.03	0.01	-0.01						
6/9/2018	7:31:57	46.21	-1.39	18.87	0.04	0.01	-0.01						
System													
6/9/2018	7:32:07	45.86	5.99	18.23	0.04	0.01	-0.01						
6/9/2018	7:32:17	43.98	32.74	19.75	0.18	0.01	-0.01						
6/9/2018	7:32:27	42.10	69.27	20.09	0.54	0.01	-0.01						
6/9/2018	7:32:37	40.36	100.52	20.13	0.55	0.01	-0.01						
6/9/2018	7:32:47	35.47	122.89	20.10	0.55	0.01	-0.01						
6/9/2018	7:32:57	18.15	137.39	20.08	0.56	0.01	-0.01						
6/9/2018	7:33:07	4.25	146.59	20.09	0.56	0.01	-0.01						
6/9/2018	7:33:17	3.53	151.60	18.77	0.99	0.01	-0.01						
6/9/2018	7:33:27	2.93	152.35	13.59	0.87	0.01	-0.01						
6/9/2018	7:33:37	2.50	150.42	16.72	0.64	0.01	-0.01						
6/9/2018	7:33:47	2.12	148.10	12.40	0.42	0.01	-0.01						
6/9/2018	7:33:57	9.50	135.56	3.99	0.17	0.01	-0.01						
6/9/2018	7:34:07	16.71	103.71	1.19	0.09	0.01	-0.01						
6/9/2018	7:34:17	9.84	62.02	0.39	0.08	0.01	-0.01						
6/9/2018	7:34:27	3.14	28.11	0.16	0.07	0.01	-0.01						
6/9/2018	7:34:37	2.01	10.34	0.09	0.07	0.01	-0.01						
6/9/2018	7:34:47	0.92	3.99	0.06	0.08	0.01	-0.01						
6/9/2018	7:34:57	0.78	2.61	0.05	0.07	0.01	-0.01						
6/9/2018	7:35:07	0.65	1.52	0.05	0.07	0.01	-0.01						
6/9/2018	7:35:17	0.62	0.19	0.05	0.07	0.01	-0.01						
6/9/2018	7:35:27	0.60	-0.64	0.04	0.07	0.01	-0.01						

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6/9/2018	7:35:37	0.57	-1.21	0.04	0.06	0.01	-0.01						
6/9/2018	7:35:47	0.56	-0.86	0.04	0.07	0.01	-0.01						
6/9/2018	7:35:57	0.54	0.81	0.05	0.07	0.01	-0.01	0.56	-0.42	0.04	0.07		
6/9/2018	7:36:07	0.54	1.78	0.04	0.07	0.01	-0.01						
6/9/2018	7:36:17	0.53	1.21	0.04	0.07	0.01	-0.01						
6/9/2018	7:36:27	0.51	0.26	0.05	0.07	0.01	-0.01						
6/9/2018	7:36:37	0.51	-0.61	0.04	0.07	0.01	-0.01						
6/9/2018	7:36:47	0.51	-1.28	0.04	0.07	0.01	-0.01						
6/9/2018	7:36:57	0.50	-0.93	0.04	0.07	0.01	-0.01						
6/9/2018	7:37:07	0.50	0.95	0.04	0.07	0.01	-0.01						
6/9/2018	7:37:17	0.58	1.97	0.04	0.08	0.01	-0.01						
6/9/2018	7:37:27	0.61	1.37	0.04	0.07	0.01	-0.01						
6/9/2018	7:37:37	0.47	7.44	0.04	0.07	0.01	-0.01						
6/9/2018	7:37:47	5.65	35.57	0.05	0.08	0.01	-0.01						
6/9/2018	7:37:57	31.95	81.08	0.04	0.08	0.01	-0.01						
6/9/2018	7:38:07	56.18	122.76	0.05	0.08	0.01	-0.01						
6/9/2018	7:38:17	85.39	149.15	0.04	0.07	0.01	-0.01						
6/9/2018	7:38:27	99.90	160.74	0.05	0.08	0.01	-0.01						
6/9/2018	7:38:37	99.90	163.52	0.04	0.07	0.01	-0.01						
6/9/2018	7:38:47	99.90	163.54	0.05	0.07	0.01	-0.01						
6/9/2018	7:38:57	99.90	162.96	0.05	0.07	0.01	-0.01						
6/9/2018	7:39:07	99.90	162.17	0.04	0.07	0.01	-0.01						
6/9/2018	7:39:17	99.90	162.10	0.05	0.08	0.01	-0.01						
6/9/2018	7:39:27	99.90	163.86	0.04	0.08	0.01	-0.01						
6/9/2018	7:39:37	99.90	165.78	0.05	0.08	0.01	-0.01						
6/9/2018	7:39:47	99.90	157.56	0.05	0.08	0.01	-0.01						
6/9/2018	7:39:57	99.90	152.56	0.04	0.07	0.01	-0.01						
6/9/2018	7:40:07	99.90	151.54	0.04	0.08	0.01	-0.01						
6/9/2018	7:40:17	99.90	150.73	0.05	0.07	0.01	-0.01						
6/9/2018	7:40:27	99.90	150.61	0.04	0.07	0.01	-0.01						
6/9/2018	7:40:37	99.90	152.06	0.05	0.08	0.01	-0.01						

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6/9/2018	7:40:47	99.90	153.61	0.05	0.08	0.01	-0.01						
6/9/2018	7:40:57	99.90	154.13	0.04	0.08	0.01	-0.01						
6/9/2018	7:41:07	99.90	153.30	0.04	0.09	0.01	-0.01						
6/9/2018	7:41:17	99.90	151.70	0.05	0.07	0.01	-0.01						
6/9/2018	7:41:27	99.90	150.79	0.05	0.08	0.01	-0.01						
6/9/2018	7:41:37	99.90	150.86	0.17	0.08	0.01	-0.01		151.12				
6/9/2018	7:41:47	99.90	152.02	7.48	0.32	0.01	-0.01						
6/9/2018	7:41:57	99.90	155.00	10.00	0.38	0.01	-0.01						
6/9/2018	7:42:07	99.90	159.58	9.40	0.37	0.01	-0.01						
6/9/2018	7:42:17	97.96	156.61	9.27	0.36	0.01	-0.01						
6/9/2018	7:42:27	84.13	138.69	9.23	0.36	0.01	-0.01						
6/9/2018	7:42:37	53.84	114.02	9.21	0.36	0.01	-0.01						
6/9/2018	7:42:47	28.43	94.17	9.20	0.37	0.01	-0.01						
6/9/2018	7:42:57	20.38	84.83	9.20	0.37	0.01	-0.01						
6/9/2018	7:43:07	12.44	82.03	9.19	0.37	0.01	-0.01						
6/9/2018	7:43:17	11.06	80.85	9.18	0.36	0.01	-0.01						
6/9/2018	7:43:27	9.75	79.72	9.18	0.37	0.01	-0.01						
6/9/2018	7:43:37	9.44	78.28	9.18	0.37	0.01	-0.01						
6/9/2018	7:43:47	9.16	77.08	9.18	0.37	0.01	-0.01						
6/9/2018	7:43:57	8.95	77.06	9.19	0.37	0.01	-0.01						
6/9/2018	7:44:07	8.73	78.35	9.19	0.37	0.01	-0.01						
6/9/2018	7:44:17	8.59	79.82	9.19	0.37	0.26	3.66						
6/9/2018	7:44:27	8.46	80.36	9.20	0.38	0.37	5.24						
6/9/2018	7:44:37	8.36	79.81	9.19	0.37	0.37	5.24						
6/9/2018	7:44:47	8.27	78.83	9.67	0.39	0.37	5.24						
6/9/2018	7:44:57	8.15	78.64	6.63	0.29	0.37	5.24						
6/9/2018	7:45:07	7.98	73.31	2.30	0.16	0.37	5.24						
6/9/2018	7:45:17	7.55	59.68	0.79	0.11	0.37	5.24						
6/9/2018	7:45:27	7.44	42.00	0.30	0.10	0.42	5.27						
6/9/2018	7:45:37	9.33	26.64	0.13	0.09	0.51	5.36						
6/9/2018	7:45:47	10.93	17.40	0.09	0.09	0.51	5.36						

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6/9/2018	7:45:57	10.97	12.71	0.06	0.08	0.51	5.36						
6/9/2018	7:46:07	11.03	10.40	0.05	0.09	0.51	5.36						
6/9/2018	7:46:17	10.97	9.47	0.05	0.09	0.51	5.36						
6/9/2018	7:46:27	10.89	10.04	0.05	0.09	0.51	5.36						
6/9/2018	7:46:37	10.75	11.19	0.05	0.09	0.51	5.36						
6/9/2018	7:46:47	10.61	12.46	0.05	0.09	0.12	0.53						
6/9/2018	7:46:57	10.52	12.23	0.04	0.09	0.02	-0.01						
6/9/2018	7:47:07	10.41	11.02	0.05	0.09	0.02	-0.01						
6/9/2018	7:47:17	10.32	10.24	0.05	0.09	0.02	-0.01						
6/9/2018	7:47:27	10.24	9.45	0.05	0.09	0.02	-0.01						
6/9/2018	7:47:37	10.21	9.94	0.04	0.09	0.02	-0.01						
6/9/2018	7:47:47	10.17	11.16	0.04	0.09	0.02	-0.01						
6/9/2018	7:47:57	10.10	12.47	0.05	0.09	0.01	-0.01						
6/9/2018	7:48:07	10.04	12.14	0.05	0.09	0.01	-0.01						
6/9/2018	7:48:17	9.97	11.22	0.05	0.09	0.01	-0.01	10.04					
6/9/2018	7:48:27	9.88	10.07	1.07	0.12	0.01	-0.01						
6/9/2018	7:48:37	9.83	13.11	10.52	0.42	0.01	-0.01						
6/9/2018	7:48:47	9.44	32.84	15.28	0.54	0.01	-0.01						
6/9/2018	7:48:57	7.85	66.02	7.63	0.31	0.01	-0.01						
6/9/2018	7:49:07	6.47	83.51	2.70	0.33	0.01	-0.01						
6/9/2018	7:49:17	4.85	73.99	2.03	1.24	0.01	-0.01						
6/9/2018	7:49:27	4.09	51.57	1.99	1.66	0.01	-0.01						
6/9/2018	7:49:37	8.60	29.73	1.99	1.80	0.01	-0.01						
6/9/2018	7:49:47	11.50	14.82	2.00	1.86	0.01	-0.01						
6/9/2018	7:49:57	6.96	5.63	2.00	1.89	0.01	-0.01						
6/9/2018	7:50:07	3.11	2.01	2.01	1.90	0.01	-0.01						
6/9/2018	7:50:17	2.30	1.72	2.02	1.91	0.01	-0.01						
6/9/2018	7:50:27	1.54	1.44	2.02	1.90	0.11	0.41						
6/9/2018	7:50:37	1.33	0.50	2.01	1.92	0.15	0.59						
6/9/2018	7:50:47	1.14	-0.60	2.02	1.92	0.15	0.59						
6/9/2018	7:50:57	1.06	-1.77	2.02	1.92	0.15	0.59						

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6/9/2018	7:51:07	0.97	-1.95	2.02	1.93	0.15	0.59				1.92		
6/9/2018	7:51:17	0.92	-1.26	2.02	1.93	0.15	0.59						
6/9/2018	7:51:27	0.88	0.24	4.32	1.78	0.15	0.59						
6/9/2018	7:51:37	0.83	7.21	7.64	1.24	0.11	0.41						
6/9/2018	7:51:47	0.89	22.39	7.23	3.90	0.01	-0.01						
6/9/2018	7:51:57	1.30	33.70	9.07	7.91	0.01	-0.01						
6/9/2018	7:52:07	1.57	31.60	9.69	9.11	0.00	-0.01						
6/9/2018	7:52:17	1.25	20.65	9.89	9.53	0.01	-0.01						
6/9/2018	7:52:27	0.98	10.11	9.97	9.68	0.01	-0.01						
6/9/2018	7:52:37	0.84	4.67	9.99	9.72	0.00	-0.01						
6/9/2018	7:52:47	0.71	1.94	9.99	9.73	0.01	-0.01						
6/9/2018	7:52:57	0.65	0.23	9.99	9.75	0.34	3.21						
6/9/2018	7:53:07	0.63	-1.22	9.99	9.75	0.37	3.57						
6/9/2018	7:53:17	0.60	-2.30	10.00	9.75	0.37	3.57						
6/9/2018	7:53:27	0.57	-2.80	10.00	9.75	0.37	3.57			10.00			
6/9/2018	7:53:37	0.56	-2.21	10.00	9.77	0.37	3.57						
6/9/2018	7:53:47	0.54	-0.72	9.99	9.76	0.37	3.57						
6/9/2018	7:53:57	0.53	-0.26	10.18	9.59	0.37	3.57						
6/9/2018	7:54:07	0.51	2.37	14.42	5.63	0.19	1.87						
6/9/2018	7:54:17	0.50	19.00	10.80	3.18	0.01	0.17						
6/9/2018	7:54:27	0.56	41.63	3.83	1.20	0.01	0.17						
6/9/2018	7:54:37	1.10	48.63	1.35	0.61	0.01	0.17						
6/9/2018	7:54:47	1.55	37.94	0.61	0.45	0.01	0.17						
6/9/2018	7:54:57	1.43	21.98	0.36	0.37	0.01	0.17						
6/9/2018	7:55:07	1.29	10.68	0.26	0.29	0.01	0.17						
6/9/2018	7:55:17	1.20	4.99	0.24	0.20	0.06	0.89						
6/9/2018	7:55:27	1.13	2.46	0.23	0.14	0.51	7.37						
6/9/2018	7:55:37	1.13	1.09	0.23	0.13	0.51	7.37						
6/9/2018	7:55:47	1.13	0.51	0.24	0.12	0.51	7.37						
6/9/2018	7:55:57	1.13	0.60	0.26	0.11	0.51	7.37						
6/9/2018	7:56:07	1.13	1.52	0.28	0.10	0.51	7.37						

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6/9/2018	7:56:17	1.13	2.13	0.29	0.10	0.51	7.37						
6/9/2018	7:56:27	1.13	1.70	0.30	0.10	0.51	7.37						
6/9/2018	7:56:37	1.13	0.56	0.30	0.10	2.64	3.55						
6/9/2018	7:56:47	1.13	-0.56	0.29	0.10	3.55	1.92						
6/9/2018	7:56:57	1.13	-1.06	0.30	0.09	3.55	1.92						
6/9/2018	7:57:07	1.13	-0.85	0.30	0.09	3.55	1.92						
6/9/2018	7:57:17	1.13	0.39	0.30	0.10	3.55	1.92						
6/9/2018	7:57:27	1.13	1.39	0.30	0.09	3.55	1.92						
6/9/2018	7:57:37	1.12	1.46	0.30	0.09	3.55	1.92						
6/9/2018	7:57:47	1.11	0.50	0.30	0.09	2.89	1.34						
6/9/2018	7:57:57	1.13	-0.47	0.30	0.09	1.37	-0.01						
6/9/2018	7:58:07	1.13	-1.22	0.30	0.09	1.37	-0.01						
6/9/2018	7:58:17	1.10	-0.91	0.30	0.09	1.37	-0.01						
6/9/2018	7:58:27	1.10	0.54	0.30	0.09	1.37	-0.01						
6/9/2018	7:58:37	1.10	1.57	0.30	0.09	1.36	-0.01						
6/9/2018	7:58:47	1.10	1.35	0.30	0.09	1.37	-0.01						
6/9/2018	7:58:57	1.10	0.45	0.30	0.08	1.37	-0.01						
6/9/2018	7:59:07	1.10	-0.45	0.30	0.09	1.33	-0.01						
6/9/2018	7:59:17	1.10	-1.23	0.30	0.08	1.32	-0.01						
6/9/2018	7:59:27	1.10	-0.53	0.30	0.08	1.32	-0.01						
6/9/2018	7:59:37	1.10	0.72	0.30	0.08	1.32	-0.01						
6/9/2018	7:59:47	1.07	1.68	0.29	0.09	1.32	-0.01						
6/9/2018	7:59:57	1.07	1.42	0.29	0.08	1.32	-0.01						
6/9/2018	8:00:07	1.07	0.35	0.28	0.09	1.32	-0.01						
6/9/2018	8:00:17	1.07	-0.27	0.68	0.11	1.31	-0.01						
6/9/2018	8:00:27	1.04	0.26	1.23	0.12	1.30	-0.01						
6/9/2018	8:00:37	0.89	3.27	0.96	0.11	1.30	-0.01						
6/9/2018	8:00:47	0.76	6.91	0.37	0.09	1.30	-0.01						
6/9/2018	8:00:57	0.66	8.08	0.16	0.08	1.30	-0.01						
6/9/2018	8:01:07	0.56	6.22	0.07	0.09	1.30	-0.01						
6/9/2018	8:01:17	0.53	3.16	0.05	0.08	1.30	-0.01						

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6/9/2018	8:01:27	0.50	0.75	0.04	0.08	1.30	0.04						
6/9/2018	8:01:37	0.58	-0.63	0.04	0.08	0.43	0.47						
6/9/2018	8:01:47	0.64	-1.34	0.05	0.09	0.43	0.47						
6/9/2018	8:01:57	0.67	-0.54	0.09	0.08	0.43	0.47						
6/9/2018	8:02:07	0.69	0.84	0.17	0.08	0.43	0.46						
6/9/2018	8:02:17	0.69	1.57	0.23	0.08	0.43	0.47						
6/9/2018	8:02:27	0.69	1.01	0.26	0.08	0.43	0.47						
6/9/2018	8:02:37	0.70	-0.13	0.27	0.08	0.43	0.47						
6/9/2018	8:02:47	0.72	-0.81	0.28	0.09	0.13	0.13						
6/9/2018	8:02:57	0.72	-1.37	0.29	0.08	0.01	-0.01						
6/9/2018	8:03:07	0.72	-0.78	0.28	0.08	0.01	-0.01						
6/9/2018	8:03:17	0.72	0.79	0.29	0.08	0.00	-0.01						
6/9/2018	8:03:27	0.72	1.70	0.29	0.08	0.00	-0.01					0.00	
6/9/2018	8:03:37	0.73	1.15	0.29	0.08	0.00	-0.01						
6/9/2018	8:03:47	0.75	0.05	0.29	0.07	0.01	-0.01						
6/9/2018	8:03:57	0.75	-0.63	0.29	0.09	3.39	13.41						
6/9/2018	8:04:07	0.75	-1.05	0.28	0.08	11.28	44.70						
6/9/2018	8:04:17	0.75	-0.60	0.29	0.08	11.28	44.70						
6/9/2018	8:04:27	0.75	0.77	0.29	0.08	11.28	44.70						
6/9/2018	8:04:37	0.78	1.50	0.29	0.08	11.28	44.70						
6/9/2018	8:04:47	0.78	1.01	0.29	0.09	11.28	44.70						
6/9/2018	8:04:57	0.78	0.07	0.29	0.08	11.28	44.71						
6/9/2018	8:05:07	0.78	-0.68	0.29	0.08	11.28	44.70						
6/9/2018	8:05:17	0.81	-1.34	0.28	0.08	11.88	48.04						
6/9/2018	8:05:27	0.81	-0.77	0.29	0.08	12.03	48.41						
6/9/2018	8:05:37	0.81	0.45	0.29	0.09	12.03	48.41						
6/9/2018	8:05:47	0.81	1.62	0.29	0.08	12.03	48.41						
6/9/2018	8:05:57	0.81	1.66	0.29	0.08	12.03	48.41						
6/9/2018	8:06:07	0.81	0.61	0.28	0.08	12.03	48.41						
6/9/2018	8:06:17	0.84	-0.23	0.29	0.08	12.03	48.41						
6/9/2018	8:06:27	0.84	-1.05	0.32	0.08	12.09	48.83						

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6/9/2018	8:06:37	0.84	0.16	6.58	0.29	12.15	49.24						
6/9/2018	8:06:47	0.89	14.07	6.86	0.29	12.15	49.24						
6/9/2018	8:06:57	1.15	34.58	3.68	0.36	12.15	49.24						
6/9/2018	8:07:07	1.32	42.22	6.32	0.35	12.15	49.24						
6/9/2018	8:07:17	1.27	40.28	10.43	0.43	12.15	49.24						
6/9/2018	8:07:27	1.33	46.65	10.13	0.39	12.15	49.24						
6/9/2018	8:07:37	1.75	60.79	5.93	0.23	12.15	49.26						
6/9/2018	8:07:47	2.00	63.90	5.36	0.13	12.20	49.42						
6/9/2018	8:07:57	1.56	49.73	5.20	0.10	12.20	49.42						
6/9/2018	8:08:07	1.19	29.38	4.71	0.09	12.20	49.42						Alt-106
6/9/2018	8:08:17	0.92	13.91	4.52	0.10	12.20	49.42						49.42
6/9/2018	8:08:27	0.68	5.41	4.47	0.09	12.20	49.42						
6/9/2018	8:08:37	0.65	1.56	4.46	0.09	12.20	49.42						
6/9/2018	8:08:47	0.63	-0.33	4.45	0.09	12.20	49.42						
6/9/2018	8:08:57	0.63	-0.99	4.45	0.08	15.83	21.17						
6/9/2018	8:09:07	0.63	-0.48	4.45	0.10	18.25	9.07						
6/9/2018	8:09:17	0.63	1.17	4.45	0.09	18.25	9.07						
6/9/2018	8:09:27	0.63	1.70	4.45	0.10	18.25	9.07						
6/9/2018	8:09:37	0.63	1.11	4.19	0.09	18.25	9.07						
6/9/2018	8:09:47	0.60	-0.16	3.13	0.09	18.25	9.07						
6/9/2018	8:09:57	0.59	-0.94	2.77	0.09	18.25	9.07						
6/9/2018	8:10:07	0.57	-1.31	2.68	0.10	19.16	6.40						
6/9/2018	8:10:17	0.56	-0.70	2.64	0.10	21.28	0.16						
6/9/2018	8:10:27	0.54	0.68	2.63	0.09	21.28	0.16						
6/9/2018	8:10:37	0.54	1.70	2.63	0.10	21.28	0.16						
6/9/2018	8:10:47	0.54	1.50	2.62	0.10	21.28	0.16					21.28	
6/9/2018	8:10:57	0.54	0.33	2.62	0.09	21.28	0.16						
6/9/2018	8:11:07	0.54	-0.60	2.62	0.09	21.28	0.16						
6/9/2018	8:11:17	0.53	-1.34	2.62	0.09	21.28	0.16						
6/9/2018	8:11:27	0.51	-0.97	2.62	0.10	14.36	0.01						
6/9/2018	8:11:37	0.51	0.31	2.62	0.09	12.63	-0.01						

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6/9/2018	8:11:47	0.51	1.46	2.62	0.09	12.63	-0.01						
6/9/2018	8:11:57	0.51	1.30	2.62	0.09	12.63	-0.01						
6/9/2018	8:12:07	0.51	0.56	2.55	0.10	12.63	-0.01						
6/9/2018	8:12:17	0.51	-0.40	1.86	0.09	12.63	-0.01						
6/9/2018	8:12:27	0.55	-1.11	1.47	0.09	12.63	-0.01						
6/9/2018	8:12:37	0.72	-1.17	1.34	0.09	12.60	-0.01						
6/9/2018	8:12:47	0.86	-0.29	1.30	0.10	12.54	-0.01						
6/9/2018	8:12:57	0.80	1.18	1.29	0.10	12.54	-0.01						
6/9/2018	8:13:07	0.77	1.82	1.27	0.09	12.54	-0.01						
6/9/2018	8:13:17	0.71	0.89	1.27	0.09	12.54	-0.01					12.54	
6/9/2018	8:13:27	0.69	-0.29	1.28	0.09	12.54	-0.01						
6/9/2018	8:13:37	0.68	-0.89	1.28	0.09	12.54	-0.01						
6/9/2018	8:13:47	0.66	-1.27	1.28	0.09	12.54	0.30						
6/9/2018	8:13:57	0.65	-0.70	1.27	0.09	6.87	3.04						
6/9/2018	8:14:07	0.63	0.91	1.28	0.09	6.87	3.04						
6/9/2018	8:14:17	0.63	1.52	1.28	0.09	6.87	3.04						
6/9/2018	8:14:27	0.63	1.21	1.27	0.10	6.87	3.04						
6/9/2018	8:14:37	0.62	0.38	1.27	0.09	6.87	3.04						
6/9/2018	8:14:47	0.60	-0.81	1.27	0.09	6.87	3.04						
6/9/2018	8:14:57	0.60	-1.39	1.27	0.09	6.87	3.04						
6/9/2018	8:15:07	0.60	-1.07	1.27	0.09	6.35	0.90						
6/9/2018	8:15:17	0.60	0.05	1.27	0.10	6.01	-0.01						
6/9/2018	8:15:27	0.60	1.24	1.92	0.11	6.01	-0.01						
6/9/2018	8:15:37	0.59	5.28	10.43	0.40	6.01	-0.01						
6/9/2018	8:15:47	0.68	25.45	16.49	0.58	6.01	-0.01					6.01	

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Run 1

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	O2 [%]
6/9/2018	8:17:47	3.05	173.58	19.84	0.66	1.01	
6/9/2018	8:18:47	3.08	173.60	19.85	0.66	0.97	
6/9/2018	8:19:47	3.12	173.58	19.84	0.66	0.99	Stratification Check
6/9/2018	8:20:47	3.16	173.76	19.80	0.66	0.98	
6/9/2018	8:21:47	3.28	172.13	19.81	0.66	0.98	
6/9/2018	8:22:47	3.29	170.04	19.82	0.66	1.09	
6/9/2018	8:23:47	3.23	169.85	19.82	0.66	1.01	
6/9/2018	8:24:47	3.20	169.28	19.83	0.66	0.94	19.82
6/9/2018	8:25:47	3.21	170.73	19.82	0.67	0.94	
6/9/2018	8:26:47	3.19	170.98	19.82	0.67	0.96	
6/9/2018	8:27:47	3.19	171.17	19.82	0.67	0.94	
6/9/2018	8:28:47	3.20	170.44	19.82	0.67	1.01	
6/9/2018	8:29:47	3.20	170.40	19.83	0.67	1.01	19.82
6/9/2018	8:30:47	3.19	170.10	19.82	0.67	0.99	
6/9/2018	8:31:47	3.19	169.71	19.82	0.67	0.96	
6/9/2018	8:32:47	3.22	169.59	19.82	0.68	0.94	
6/9/2018	8:33:47	3.30	168.74	19.82	0.67	0.89	
6/9/2018	8:34:47	3.28	168.62	19.82	0.67	0.94	19.82
6/9/2018	8:35:47	3.23	168.85	19.81	0.67	0.97	
6/9/2018	8:36:47	3.19	168.85	19.82	0.67	0.97	
6/9/2018	8:37:47	3.15	168.65	19.82	0.67	0.96	
6/9/2018	8:38:47	3.15	168.07	19.82	0.67	0.95	
6/9/2018	8:39:47	3.15	167.67	19.83	0.66	0.95	
6/9/2018	8:40:47	3.16	168.01	19.82	0.66	0.95	
6/9/2018	8:41:47	3.19	168.94	19.81	0.66	0.95	
6/9/2018	8:42:47	3.21	168.88	19.82	0.66	0.97	
6/9/2018	8:43:47	3.23	168.02	19.82	0.66	1.01	
6/9/2018	8:44:47	3.21	166.56	19.82	0.66	0.95	
6/9/2018	8:45:47	3.19	166.21	19.81	0.66	1.00	
6/9/2018	8:46:47	3.16	166.20	19.81	0.66	0.98	
6/9/2018	8:47:47	3.16	166.58	19.81	0.66	0.96	
6/9/2018	8:48:47	3.17	165.47	19.82	0.66	0.97	
6/9/2018	8:49:47	3.19	165.96	19.82	0.66	0.95	
6/9/2018	8:50:47	3.23	165.04	19.81	0.66	0.94	
6/9/2018	8:51:47	3.27	165.83	19.81	0.67	0.94	
6/9/2018	8:52:47	3.22	166.43	19.81	0.67	0.96	
6/9/2018	8:53:47	3.26	165.71	19.81	0.67	0.99	
6/9/2018	8:54:47	3.25	165.45	19.82	0.67	0.96	
6/9/2018	8:55:47	3.23	164.86	19.81	0.67	0.93	
6/9/2018	8:56:47	3.23	164.81	19.81	0.67	0.93	
6/9/2018	8:57:47	3.27	165.33	19.81	0.67	0.93	
6/9/2018	8:58:47	3.28	165.06	19.82	0.67	0.93	
6/9/2018	8:59:47	3.22	164.52	19.82	0.67	0.95	
6/9/2018	9:00:47	3.19	164.33	19.81	0.67	0.91	
6/9/2018	9:01:47	3.18	162.20	19.81	0.67	0.91	
6/9/2018	9:02:47	3.21	162.57	19.81	0.67	0.92	
6/9/2018	9:03:47	3.22	164.60	19.81	0.66	0.92	

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	O2 [%]
6/9/2018	9:04:47	3.25	164.49	19.81	0.66	0.89	
6/9/2018	9:05:47	3.24	162.69	19.81	0.66	0.94	
6/9/2018	9:06:47	3.25	163.31	19.81	0.65	0.96	
6/9/2018	9:07:47	3.28	163.60	19.81	0.66	0.98	
6/9/2018	9:08:47	3.23	161.13	19.81	0.65	0.97	
6/9/2018	9:09:47	3.22	163.66	19.81	0.65	0.95	
6/9/2018	9:10:47	3.23	163.21	19.81	0.66	0.93	
6/9/2018	9:11:47	3.25	163.34	19.80	0.65	0.96	
6/9/2018	9:12:47	3.22	163.40	19.80	0.66	0.98	
6/9/2018	9:13:47	3.19	163.98	19.81	0.66	0.97	
6/9/2018	9:14:47	3.21	164.24	19.81	0.66	0.94	
6/9/2018	9:15:47	3.18	163.12	19.81	0.66	0.92	
6/9/2018	9:16:47	3.17	162.66	19.80	0.67	1.03	
6/9/2018	9:17:47	3.17	162.80	19.80	0.67	1.01	
6/9/2018	9:18:47	3.17	163.35	19.81	0.67	0.95	
6/9/2018	9:19:47	3.17	163.35	19.81	0.67	0.90	
6/9/2018	9:20:47	3.17	162.72	19.81	0.67	0.90	
6/9/2018	9:21:47	3.14	159.72	19.81	0.66	0.93	
6/9/2018	9:22:47	3.13	159.79	19.80	0.66	0.92	
6/9/2018	9:23:47	3.15	161.94	19.80	0.66	0.92	
6/9/2018	9:24:47	3.15	162.27	19.81	0.66	0.93	
6/9/2018	9:25:47	3.15	161.87	19.81	0.66	0.95	
6/9/2018	9:26:47	3.16	161.07	19.81	0.66	0.93	
6/9/2018	9:27:47	3.14	160.39	19.80	0.66	0.93	
6/9/2018	9:28:47	3.15	161.58	19.80	0.66	0.97	
6/9/2018	9:29:47	3.16	161.71	19.81	0.66	0.97	
6/9/2018	9:30:47	3.14	161.41	19.81	0.65	0.93	
6/9/2018	9:31:47	3.16	161.67	19.81	0.65	0.96	
6/9/2018	9:32:47	3.17	162.32	19.80	0.66	0.87	
6/9/2018	9:33:47	3.17	163.44	19.79	0.66	0.91	
6/9/2018	9:34:47	3.20	163.82	19.80	0.66	0.94	
6/9/2018	9:35:47	3.17	162.53	19.81	0.65	0.94	
6/9/2018	9:36:47	3.16	160.53	19.80	0.66	0.90	
6/9/2018	9:37:47	3.17	161.53	19.79	0.66	0.94	
6/9/2018	9:38:47	3.16	161.20	19.79	0.66	0.94	
6/9/2018	9:39:47	3.19	163.12	19.79	0.66	0.94	
6/9/2018	9:40:47	3.21	162.76	19.79	0.66	0.94	
6/9/2018	9:41:47	3.23	162.37	19.80	0.66	0.92	
6/9/2018	9:42:47	3.26	161.98	19.80	0.66	0.97	
6/9/2018	9:43:47	3.26	162.08	19.79	0.67	0.96	
6/9/2018	9:44:47	3.30	162.26	19.80	0.67	0.96	
6/9/2018	9:45:47	3.32	162.40	19.80	0.67	0.96	
6/9/2018	9:46:47	3.34	161.96	19.80	0.67	0.92	
6/9/2018	9:47:47	3.36	162.23	19.80	0.67	0.88	
6/9/2018	9:48:47	3.42	163.05	19.79	0.67	0.91	
6/9/2018	9:49:47	3.43	163.61	19.79	0.67	0.92	
6/9/2018	9:50:47	3.42	162.45	19.80	0.66	0.92	

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Run 1

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	O2 [%]
6/9/2018	9:51:47	3.41	161.80	19.80	0.66	0.90	
6/9/2018	9:52:47	3.43	162.22	19.80	0.66	0.90	
6/9/2018	9:53:47	3.47	163.89	19.79	0.66	0.93	
6/9/2018	9:54:47	3.43	165.38	19.79	0.66	0.89	
6/9/2018	9:55:47	3.41	164.68	19.80	0.66	0.88	
6/9/2018	9:56:47	3.43	163.25	19.80	0.65	0.90	
6/9/2018	9:57:47	3.40	163.72	19.80	0.65	0.93	
6/9/2018	9:58:47	3.37	165.18	19.80	0.65	0.90	
6/9/2018	9:59:47	3.36	165.25	19.79	0.66	0.93	
6/9/2018	10:00:47	3.38	164.65	19.80	0.66	0.96	
6/9/2018	10:01:47	3.35	165.08	19.80	0.66	0.93	
6/9/2018	10:02:47	3.34	165.26	19.81	0.66	0.85	
6/9/2018	10:03:47	3.32	162.64	19.81	0.66	0.86	
6/9/2018	10:04:47	3.30	163.67	19.80	0.66	0.89	
6/9/2018	10:05:47	3.29	164.59	19.80	0.66	0.91	
6/9/2018	10:06:47	3.30	164.68	19.81	0.67	0.89	
6/9/2018	10:07:47	3.31	166.80	19.81	0.67	0.85	
6/9/2018	10:08:47	3.29	164.83	19.81	0.67	0.89	
6/9/2018	10:09:47	3.27	165.13	19.81	0.67	0.84	
6/9/2018	10:10:47	3.29	165.85	19.81	0.67	0.83	
6/9/2018	10:11:47	3.26	164.05	19.81	0.67	0.84	
6/9/2018	10:12:47	3.26	164.80	19.82	0.67	0.85	
6/9/2018	10:13:47	3.25	165.16	19.82	0.67	0.86	
6/9/2018	10:14:47	3.25	164.93	19.81	0.67	0.81	
6/9/2018	10:15:47	3.22	164.52	19.81	0.67	0.86	
6/9/2018	10:16:47	3.21	163.84	19.81	0.66	0.71	
6/9/2018	10:17:47	3.22	164.41	19.82	0.66	0.65	
6/9/2018	10:18:47	3.22	164.74	19.82	0.66	0.82	
6/9/2018	10:19:47	3.20	163.05	19.81	0.65	0.81	
6/9/2018	10:20:47	3.21	164.91	19.81	0.65	0.82	
6/9/2018	10:21:47	3.22	165.34	19.81	0.65	0.83	
6/9/2018	10:22:47	3.23	166.74	19.81	0.66	0.84	
6/9/2018	10:23:47	3.23	166.36	19.82	0.65	0.87	
	Final	**3.24**	**165.05**	**19.81**	**0.66**	**0.93**	

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	10:24:47	3.23	165.84	13.81	0.48	0.86					
6/9/2018	10:24:57	3.23	152.65	5.49	0.25	0.86					
6/9/2018	10:25:07	3.22	117.16	2.38	0.14	0.86					
6/9/2018	10:25:17	2.80	72.58	2.28	0.10	0.87					
6/9/2018	10:25:27	2.40	35.38	2.56	0.09	0.87					
6/9/2018	10:25:37	1.90	13.47	2.59	0.09	0.87					
6/9/2018	10:25:47	1.37	4.43	2.60	0.08	0.90					
6/9/2018	10:25:57	1.07	2.04	2.60	0.07	0.90					
6/9/2018	10:26:07	0.80	1.77	2.60	0.08	0.90					
6/9/2018	10:26:17	0.74	1.01	2.60	0.08	0.90					
6/9/2018	10:26:27	0.68	-0.08	2.61	0.08	0.90					
6/9/2018	10:26:37	0.66	-1.08	2.61	0.08	0.90					
6/9/2018	10:26:47	0.66	-1.76	2.61	0.08	0.90					
6/9/2018	10:26:57	0.63	-1.64	2.61	0.08	9.88					
6/9/2018	10:27:07	0.60	-0.19	2.61	0.08	12.12					
6/9/2018	10:27:17	0.60	0.93	2.61	0.08	12.12					
6/9/2018	10:27:27	0.60	0.93	2.61	0.08	12.12					
6/9/2018	10:27:37	0.57	-0.09	2.61	0.08	12.12					
6/9/2018	10:27:47	0.57	-1.19	2.61	0.08	12.12					
6/9/2018	10:27:57	0.56	-1.89	2.61	0.08	12.12					
6/9/2018	10:28:07	0.54	-1.90	2.61	0.08	12.29					
6/9/2018	10:28:17	0.54	-0.87	2.61	0.08	12.45					
6/9/2018	10:28:27	0.54	0.63	2.61	0.08	12.45					
6/9/2018	10:28:37	0.54	0.89	2.61	0.08	12.45					
6/9/2018	10:28:47	0.53	0.17	2.61	0.09	12.45					
6/9/2018	10:28:57	0.51	-0.92	2.61	0.09	12.45					
6/9/2018	10:29:07	0.51	-1.54	4.75	0.16	12.45					
6/9/2018	10:29:17	0.51	5.29	13.13	0.46	12.46					
6/9/2018	10:29:27	0.58	32.47	17.11	0.57	12.51					
6/9/2018	10:29:37	1.32	74.77	13.84	0.47	12.51					
6/9/2018	10:29:47	2.03	106.53	11.99	0.43	12.51					
6/9/2018	10:29:57	2.81	111.97	5.08	0.23	12.51					
6/9/2018	10:30:07	3.51	93.02	1.78	0.13	12.51					
6/9/2018	10:30:17	2.45	60.52	0.65	0.11	12.50					12.51
6/9/2018	10:30:27	1.53	30.74	0.26	0.09	12.51					
6/9/2018	10:30:37	1.05	12.52	0.12	0.09	4.64					
6/9/2018	10:30:47	0.56	5.41	0.07	0.09	2.67					
6/9/2018	10:30:57	0.50	2.87	0.05	0.09	2.67					
6/9/2018	10:31:07	0.42	1.22	0.05	0.08	2.67					
6/9/2018	10:31:17	0.42	-0.38	0.04	0.09	2.67					
6/9/2018	10:31:27	0.42	-1.41	0.04	0.09	2.67					
6/9/2018	10:31:37	0.42	-1.79	0.04	0.09	2.67					
6/9/2018	10:31:47	0.39	-1.67	0.04	0.09	1.13					
6/9/2018	10:31:57	0.39	-0.16	0.04	0.09	0.10					
6/9/2018	10:32:07	0.40	1.14	0.06	0.09	0.10	0.39	-0.23	0.05	0.09	0.10
6/9/2018	10:32:17	0.39	1.50	0.06	0.09	0.10					
6/9/2018	10:32:27	0.62	2.88	0.05	0.10	0.10					
6/9/2018	10:32:37	3.46	4.89	0.04	0.09	0.10					
6/9/2018	10:32:47	5.94	6.49	0.04	0.09	0.10					
6/9/2018	10:32:57	6.94	7.41	0.04	0.09	0.07					
6/9/2018	10:33:07	7.92	7.63	0.23	0.10	0.02					
6/9/2018	10:33:17	6.25	7.29	0.51	0.11	0.02					

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	10:33:27	4.84	6.27	0.66	0.11	0.02					
6/9/2018	10:33:37	3.03	5.44	0.72	0.12	0.02					
6/9/2018	10:33:47	1.19	4.78	0.75	0.12	0.02					
6/9/2018	10:33:57	0.92	4.37	0.75	0.11	0.02					
6/9/2018	10:34:07	0.66	4.21	0.46	0.11	0.02					
6/9/2018	10:34:17	0.61	5.29	0.19	0.10	0.05					
6/9/2018	10:34:27	0.79	7.53	0.08	0.09	0.05					
6/9/2018	10:34:37	4.48	9.75	0.05	0.09	0.05					
6/9/2018	10:34:47	7.75	10.42	0.03	0.09	0.05					
6/9/2018	10:34:57	8.85	9.95	0.03	0.09	0.05					
6/9/2018	10:35:07	10.09	9.05	0.03	0.09	0.05					
6/9/2018	10:35:17	10.24	8.75	0.03	0.10	0.05					
6/9/2018	10:35:27	10.43	8.63	0.03	0.10	0.11					
6/9/2018	10:35:37	10.43	9.86	0.03	0.09	0.14					
6/9/2018	10:35:47	10.45	11.22	0.02	0.09	0.14					
6/9/2018	10:35:57	10.39	11.40	0.03	0.09	0.14					
6/9/2018	10:36:07	10.36	10.47	0.02	0.09	0.14					
6/9/2018	10:36:17	10.30	9.55	0.03	0.09	0.14					
6/9/2018	10:36:27	10.27	8.73	0.02	0.09	0.14					
6/9/2018	10:36:37	10.21	8.31	1.84	0.15	0.08	10.26				
6/9/2018	10:36:47	10.12	13.10	5.94	0.28	0.00					
6/9/2018	10:36:57	9.96	27.38	2.50	0.16	0.00					
6/9/2018	10:37:07	10.45	48.89	0.89	0.11	0.00					
6/9/2018	10:37:17	15.05	77.63	0.33	0.10	0.00					
6/9/2018	10:37:27	21.94	106.41	0.13	0.09	0.01					
6/9/2018	10:37:37	51.65	128.93	0.06	0.09	0.01					
6/9/2018	10:37:47	75.63	140.97	0.04	0.09	0.03					
6/9/2018	10:37:57	95.21	146.41	0.03	0.09	0.29					
6/9/2018	10:38:07	99.90	149.85	0.03	0.09	0.29					
6/9/2018	10:38:17	99.90	152.12	0.03	0.09	0.29					
6/9/2018	10:38:27	99.90	152.85	0.03	0.09	0.29					
6/9/2018	10:38:37	99.90	151.90	0.03	0.09	0.29					
6/9/2018	10:38:47	99.90	150.95	0.03	0.10	0.29					
6/9/2018	10:38:57	99.90	150.19	0.03	0.09	0.29					
6/9/2018	10:39:07	99.90	149.67	0.03	0.08	0.06					
6/9/2018	10:39:17	99.90	150.24	0.53	0.10	0.00		150.03			
6/9/2018	10:39:27	99.90	152.45	4.80	0.25	0.00					
6/9/2018	10:39:37	99.90	148.33	2.28	0.16	0.01					
6/9/2018	10:39:47	98.44	126.60	1.29	0.47	0.01					
6/9/2018	10:39:57	80.75	90.10	1.70	1.30	0.00					
6/9/2018	10:40:07	38.67	55.07	1.88	1.68	0.00					
6/9/2018	10:40:17	29.37	29.16	1.93	1.81	0.03					
6/9/2018	10:40:27	18.84	14.05	1.96	1.87	0.06					
6/9/2018	10:40:37	12.76	6.38	1.97	1.89	0.06					
6/9/2018	10:40:47	6.35	3.29	1.98	1.91	0.06					
6/9/2018	10:40:57	4.74	1.33	1.98	1.92	0.06					
6/9/2018	10:41:07	3.06	-0.20	1.99	1.92	0.06					
6/9/2018	10:41:17	2.55	-1.31	1.99	1.92	0.06					
6/9/2018	10:41:27	2.04	-2.04	2.00	1.93	0.05					
6/9/2018	10:41:37	1.84	-2.17	1.99	1.94	0.01					
6/9/2018	10:41:47	1.62	-1.30	2.00	1.94	0.00				1.94	
6/9/2018	10:41:57	1.47	0.09	1.99	1.93	0.01					

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	10:42:07	1.33	1.23	6.18	1.64	0.00					
6/9/2018	10:42:17	1.24	10.85	12.84	1.68	0.01					
6/9/2018	10:42:27	1.20	35.34	11.24	6.03	0.01					
6/9/2018	10:42:37	1.95	53.84	10.40	8.42	0.01					
6/9/2018	10:42:47	2.60	49.96	10.11	9.28	0.00					
6/9/2018	10:42:57	1.95	32.65	10.00	9.59	0.00					
6/9/2018	10:43:07	1.37	16.40	9.97	9.69	0.01					
6/9/2018	10:43:17	1.13	6.97	9.96	9.74	0.01					
6/9/2018	10:43:27	0.88	1.93	9.95	9.75	0.01					
6/9/2018	10:43:37	0.80	-0.71	9.95	9.77	0.01					
6/9/2018	10:43:47	0.75	-2.48	9.95	9.77	0.01			9.95		

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Run 2

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	10:45:25	3.35	167.64	19.77	0.68	0.12
6/9/2018	10:46:25	3.39	168.36	19.76	0.67	0.90
6/9/2018	10:47:25	3.43	167.78	19.77	0.66	0.98
6/9/2018	10:48:25	3.39	167.22	19.78	0.66	0.99
6/9/2018	10:49:25	3.37	168.06	19.79	0.66	0.98
6/9/2018	10:50:25	3.32	168.52	19.80	0.66	0.97
6/9/2018	10:51:25	3.31	167.81	19.79	0.66	0.88
6/9/2018	10:52:25	3.40	167.17	19.79	0.66	0.92
6/9/2018	10:53:25	3.42	167.40	19.80	0.66	0.95
6/9/2018	10:54:25	3.42	167.05	19.81	0.66	0.95
6/9/2018	10:55:25	3.39	166.85	19.82	0.67	0.94
6/9/2018	10:56:25	3.33	167.61	19.81	0.66	0.90
6/9/2018	10:57:25	3.33	166.29	19.81	0.67	0.88
6/9/2018	10:58:25	3.32	165.24	19.82	0.67	0.94
6/9/2018	10:59:25	3.35	164.48	19.82	0.67	0.92
6/9/2018	11:00:25	3.32	167.05	19.82	0.67	0.89
6/9/2018	11:01:25	3.29	166.77	19.82	0.67	0.89
6/9/2018	11:02:25	3.27	165.37	19.81	0.67	0.92
6/9/2018	11:03:25	3.24	162.92	19.82	0.67	0.93
6/9/2018	11:04:25	3.32	165.70	19.82	0.67	0.91
6/9/2018	11:05:25	3.38	167.41	19.82	0.67	0.91
6/9/2018	11:06:25	3.34	167.47	19.82	0.66	0.93
6/9/2018	11:07:25	3.33	166.69	19.82	0.67	0.95
6/9/2018	11:08:25	3.34	166.02	19.82	0.67	0.89
6/9/2018	11:09:25	3.32	165.48	19.82	0.66	0.92
6/9/2018	11:10:25	3.30	166.49	19.83	0.66	0.93
6/9/2018	11:11:25	3.38	166.88	19.83	0.66	0.91
6/9/2018	11:12:25	3.38	166.03	19.82	0.66	0.89
6/9/2018	11:13:25	3.33	164.16	19.82	0.66	0.88
6/9/2018	11:14:25	3.30	163.61	19.82	0.66	0.92
6/9/2018	11:15:25	3.28	163.86	19.83	0.65	0.93
6/9/2018	11:16:25	3.25	164.13	19.83	0.66	0.92
6/9/2018	11:17:25	3.25	164.96	19.82	0.66	0.90
6/9/2018	11:18:25	3.25	163.94	19.82	0.66	0.91
6/9/2018	11:19:25	3.23	164.18	19.82	0.66	0.94
6/9/2018	11:20:25	3.24	165.84	19.83	0.66	0.86
6/9/2018	11:21:25	3.24	165.42	19.83	0.66	0.88
6/9/2018	11:22:25	3.23	163.95	19.82	0.67	0.88
6/9/2018	11:23:25	3.24	163.46	19.82	0.67	0.88
6/9/2018	11:24:25	3.28	164.47	19.82	0.67	0.93
6/9/2018	11:25:25	3.30	166.28	19.82	0.67	0.89

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Run 2

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	11:26:25	3.30	163.07	19.83	0.67	0.90
6/9/2018	11:27:25	3.32	162.77	19.82	0.67	0.93
6/9/2018	11:28:25	3.35	165.92	19.81	0.67	0.95
6/9/2018	11:29:25	3.36	166.24	19.82	0.67	0.95
6/9/2018	11:30:25	3.32	167.40	19.82	0.67	0.93
6/9/2018	11:31:25	3.29	167.74	19.83	0.67	0.92
6/9/2018	11:32:25	3.29	167.01	19.83	0.66	0.93
6/9/2018	11:33:25	3.34	165.20	19.82	0.66	0.92
6/9/2018	11:34:25	3.33	162.34	19.82	0.66	0.92
6/9/2018	11:35:25	3.26	161.82	19.82	0.66	0.94
6/9/2018	11:36:25	3.30	162.67	19.82	0.66	0.87
6/9/2018	11:37:25	3.31	162.60	19.83	0.65	0.91
6/9/2018	11:38:25	3.28	163.03	19.82	0.65	0.90
6/9/2018	11:39:25	3.25	162.86	19.81	0.66	0.87
6/9/2018	11:40:25	3.24	164.52	19.82	0.65	0.87
6/9/2018	11:41:25	3.24	163.52	19.82	0.66	0.92
6/9/2018	11:42:25	3.23	162.73	19.83	0.66	0.88
6/9/2018	11:43:25	3.23	161.89	19.82	0.66	0.88
6/9/2018	11:44:25	3.21	161.65	19.81	0.66	0.88
6/9/2018	11:45:25	3.20	161.64	19.81	0.66	0.89
6/9/2018	11:46:25	3.20	162.30	19.81	0.66	0.89
6/9/2018	11:47:25	3.19	161.49	19.82	0.66	0.89
6/9/2018	11:48:25	3.18	160.78	19.83	0.67	0.87
6/9/2018	11:49:25	3.19	160.01	19.82	0.67	0.86
6/9/2018	11:50:25	3.16	157.17	19.82	0.67	0.85
6/9/2018	11:51:25	3.18	157.87	19.82	0.67	0.85
6/9/2018	11:52:25	3.20	159.33	19.82	0.67	0.84
6/9/2018	11:53:25	3.20	161.06	19.82	0.67	0.89
6/9/2018	11:54:25	3.19	161.00	19.81	0.67	0.86
6/9/2018	11:55:25	3.18	159.94	19.81	0.66	0.87
6/9/2018	11:56:25	3.18	159.35	19.81	0.66	0.88
6/9/2018	11:57:25	3.18	159.72	19.82	0.66	0.89
6/9/2018	11:58:25	3.17	159.94	19.82	0.66	0.88
6/9/2018	11:59:25	3.18	159.03	19.82	0.66	0.87
6/9/2018	12:00:25	3.17	158.60	19.81	0.65	0.85
6/9/2018	12:01:25	3.18	158.68	19.81	0.65	0.86
6/9/2018	12:02:25	3.17	159.27	19.82	0.65	0.87
6/9/2018	12:03:25	3.15	158.76	19.82	0.65	0.87
6/9/2018	12:04:25	3.17	157.62	19.82	0.65	0.88
6/9/2018	12:05:25	3.20	157.52	19.81	0.65	0.87
6/9/2018	12:06:25	3.21	157.79	19.81	0.65	0.67

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Run 2

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	12:07:25	3.17	155.81	19.81	0.65	0.71
6/9/2018	12:08:25	3.17	156.46	19.81	0.65	0.88
6/9/2018	12:09:25	3.16	157.01	19.82	0.66	0.88
6/9/2018	12:10:25	3.19	157.76	19.81	0.66	0.88
6/9/2018	12:11:25	3.17	157.24	19.81	0.66	0.63
6/9/2018	12:12:25	3.16	156.31	19.81	0.66	0.74
6/9/2018	12:13:25	3.17	156.14	19.81	0.67	0.88
6/9/2018	12:14:25	3.17	156.14	19.82	0.66	0.89
6/9/2018	12:15:25	3.17	156.34	19.81	0.66	0.83
6/9/2018	12:16:25	3.17	155.67	19.81	0.66	0.86
6/9/2018	12:17:25	3.15	152.38	19.81	0.66	0.86
6/9/2018	12:18:25	3.14	154.81	19.81	0.66	0.72
6/9/2018	12:19:25	3.14	155.47	19.81	0.66	0.65
6/9/2018	12:20:25	3.13	151.93	19.82	0.66	0.82
6/9/2018	12:21:25	3.13	153.87	19.81	0.66	0.55
6/9/2018	12:22:25	3.14	154.96	19.81	0.66	0.80
6/9/2018	12:23:25	3.12	152.55	19.81	0.65	0.67
6/9/2018	12:24:25	3.12	153.26	19.81	0.65	0.59
6/9/2018	12:25:25	3.14	154.94	19.81	0.64	0.59
6/9/2018	12:26:25	3.15	155.44	19.80	0.65	0.55
6/9/2018	12:27:25	3.15	154.36	19.80	0.65	0.55
6/9/2018	12:28:25	3.14	152.91	19.80	0.65	0.55
6/9/2018	12:29:25	3.11	153.68	19.81	0.65	0.71
6/9/2018	12:30:25	3.13	153.10	19.81	0.64	0.73
6/9/2018	12:31:25	3.14	151.75	19.80	0.65	0.52
6/9/2018	12:32:25	3.13	152.47	19.80	0.65	0.57
6/9/2018	12:33:25	3.14	152.79	19.80	0.65	0.58
6/9/2018	12:34:25	3.13	151.24	19.80	0.65	0.61
6/9/2018	12:35:25	3.12	150.50	19.81	0.65	0.62
6/9/2018	12:36:25	3.14	153.68	19.80	0.66	0.60
6/9/2018	12:37:25	3.13	151.29	19.79	0.66	0.55
6/9/2018	12:38:25	3.11	150.37	19.79	0.66	0.81
6/9/2018	12:39:25	3.13	152.20	19.79	0.66	0.81
6/9/2018	12:40:25	3.13	153.16	19.80	0.66	0.77
6/9/2018	12:41:25	3.12	152.80	19.80	0.66	0.68
6/9/2018	12:42:25	3.14	152.16	19.80	0.66	0.56
6/9/2018	12:43:25	3.14	153.05	19.79	0.66	0.54
6/9/2018	12:44:25	3.15	153.08	19.79	0.66	0.82
6/9/2018	12:45:25	3.14	151.93	19.79	0.65	0.63
6/9/2018	12:46:25	3.14	152.48	19.80	0.65	0.57
6/9/2018	12:47:25	3.14	153.27	19.80	0.65	0.66

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Run 2

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	12:48:25	3.15	152.61	19.79	0.64	0.82
6/9/2018	12:49:25	3.14	152.02	19.79	0.64	0.87
6/9/2018	12:50:25	3.15	153.19	19.79	0.64	0.79
6/9/2018	12:51:25	3.16	152.68	19.80	0.64	0.64
6/9/2018	12:52:25	3.17	151.38	19.80	0.64	0.56
6/9/2018	12:53:25	3.17	153.13	19.75	0.68	0.59
	Final	**3.23**	**160.09**	**19.81**	**0.66**	**0.82**

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	12:53:05	3.17	150.36	19.80	0.65	0.54					
6/9/2018	12:53:15	3.17	151.34	19.79	0.64	0.54					
6/9/2018	12:53:25	3.17	153.41	19.79	0.64	0.54					
6/9/2018	12:53:35	3.17	154.15	19.79	0.64	0.54					
6/9/2018	12:53:45	3.17	153.99	19.79	0.65	0.54					
6/9/2018	12:53:55	3.17	152.94	19.78	0.65	0.54					
6/9/2018	12:54:05	3.17	152.47	19.80	0.65	0.61					
6/9/2018	12:54:15	3.17	151.79	19.57	0.86	0.79					
6/9/2018	12:54:25	3.17	149.38	13.76	3.39	0.79					
6/9/2018	12:54:35	3.20	134.83	5.43	1.54	0.79					
6/9/2018	12:54:45	3.28	100.50	1.90	0.65	0.79					
6/9/2018	12:54:55	2.70	60.52	0.69	0.30	0.79					
6/9/2018	12:55:05	2.08	28.60	0.28	0.16	0.79					
6/9/2018	12:55:15	1.44	10.38	0.14	0.10	0.79					
6/9/2018	12:55:25	0.76	2.11	0.09	0.09	0.86					
6/9/2018	12:55:35	0.61	-1.56	0.06	0.09	0.86					
6/9/2018	12:55:45	0.50	-2.65	0.06	0.09	0.86					
6/9/2018	12:55:55	0.48	-3.31	0.05	0.07	0.87					
6/9/2018	12:56:05	0.46	-2.85	0.05	0.08	0.86					
6/9/2018	12:56:15	0.46	-1.34	0.05	0.08	0.87					
6/9/2018	12:56:25	0.45	-0.36	0.04	0.08	0.87					
6/9/2018	12:56:35	0.45	-0.90	0.04	0.08	0.26					
6/9/2018	12:56:45	0.45	-1.63	0.04	0.09	0.01					
6/9/2018	12:56:55	0.45	-2.50	0.04	0.09	0.01					
6/9/2018	12:57:05	0.45	-3.01	0.04	0.08	0.01					
6/9/2018	12:57:15	0.45	-3.38	0.03	0.08	0.01	0.45	-2.96	0.04	0.08	0.01
6/9/2018	12:57:25	0.43	-3.06	0.03	0.08	0.01					
6/9/2018	12:57:35	0.42	-1.37	1.87	1.67	0.01					
6/9/2018	12:57:45	0.42	0.11	6.82	6.89	0.01					
6/9/2018	12:57:55	0.72	0.72	8.85	8.72	0.01					
6/9/2018	12:58:05	1.04	0.35	9.54	9.37	0.01					
6/9/2018	12:58:15	0.97	-0.72	9.80	9.61	0.01					
6/9/2018	12:58:25	0.88	-2.75	9.88	9.70	0.01					
6/9/2018	12:58:35	0.79	-3.96	9.92	9.73	0.01					
6/9/2018	12:58:45	0.67	-4.53	9.93	9.76	0.01					
6/9/2018	12:58:55	0.64	-3.63	9.93	9.76	0.01					
6/9/2018	12:59:05	0.61	-2.26	9.93	9.77	0.01					
6/9/2018	12:59:15	0.57	-2.48	9.94	9.77	0.01					
6/9/2018	12:59:25	0.57	-2.92	9.94	9.77	0.01			9.94		
6/9/2018	12:59:35	0.54	-3.87	9.93	9.78	0.01					
6/9/2018	12:59:45	0.54	-4.49	9.94	9.79	0.01					
6/9/2018	12:59:55	0.54	-4.84	9.93	9.79	0.01					
6/9/2018	13:00:05	0.54	-5.09	9.94	9.79	0.01					
6/9/2018	13:00:15	0.54	-4.31	9.91	9.79	0.01					
6/9/2018	13:00:25	0.51	-2.10	12.17	7.68	0.01					
6/9/2018	13:00:35	0.51	6.62	16.64	3.56	0.01					
6/9/2018	13:00:45	0.46	33.05	11.48	2.47	0.01					
6/9/2018	13:00:55	1.31	60.47	4.25	1.10	0.01					
6/9/2018	13:01:05	2.27	62.57	2.52	1.53	0.01					
6/9/2018	13:01:15	1.71	43.29	2.18	1.80	0.01					
6/9/2018	13:01:25	0.97	20.26	2.05	1.90	0.01					
6/9/2018	13:01:35	0.77	5.58	2.01	1.94	0.01					

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	13:01:45	0.56	1.07	2.00	1.96	0.01					
6/9/2018	13:01:55	0.52	0.14	1.99	1.96	0.01					
6/9/2018	13:02:05	0.49	-0.82	1.99	1.96	0.01					
6/9/2018	13:02:15	0.48	-1.68	2.00	1.96	0.01					
6/9/2018	13:02:25	0.48	-2.97	1.99	1.97	0.01					
6/9/2018	13:02:35	0.48	-3.63	1.99	1.96	0.01					
6/9/2018	13:02:45	0.48	-3.97	1.99	1.96	0.01					
6/9/2018	13:02:55	0.48	-4.29	1.99	1.96	0.01					
6/9/2018	13:03:05	0.48	-3.47	1.99	1.96	0.01				1.96	
6/9/2018	13:03:15	0.48	-1.90	1.99	1.96	0.01					
6/9/2018	13:03:25	0.48	-0.87	1.99	1.96	0.01					
6/9/2018	13:03:35	0.48	-1.73	1.99	1.96	0.01					
6/9/2018	13:03:45	0.48	-2.43	1.99	1.96	0.01					
6/9/2018	13:03:55	0.48	-3.19	1.99	1.95	0.01					
6/9/2018	13:04:05	0.48	-3.83	1.99	1.96	0.01					
6/9/2018	13:04:15	0.46	-4.19	1.99	1.96	0.01					
6/9/2018	13:04:25	0.45	-3.78	1.99	1.97	0.01					
6/9/2018	13:04:35	0.45	-2.51	1.99	1.96	0.01					
6/9/2018	13:04:45	0.46	-1.26	1.99	1.96	0.01					
6/9/2018	13:04:55	0.45	-1.16	1.99	1.96	0.00					
6/9/2018	13:05:05	0.45	-2.22	2.00	1.96	0.01					
6/9/2018	13:05:15	0.45	-3.03	1.99	1.96	0.01					
6/9/2018	13:05:25	0.45	-3.70	2.59	1.91	0.01					
6/9/2018	13:05:35	0.45	-1.42	10.54	1.33	0.01					
6/9/2018	13:05:45	0.45	15.21	16.37	0.93	0.01					
6/9/2018	13:05:55	1.09	53.19	17.65	0.82	0.01					
6/9/2018	13:06:05	1.70	93.78	9.41	0.86	0.01					
6/9/2018	13:06:15	2.23	110.50	3.39	0.47	0.01					
6/9/2018	13:06:25	2.76	94.08	1.18	0.25	0.02					
6/9/2018	13:06:35	7.27	62.73	0.42	0.14	0.02					
6/9/2018	13:06:45	11.86	34.41	0.17	0.12	0.02					
6/9/2018	13:06:55	12.22	18.25	0.07	0.11	0.02					
6/9/2018	13:07:05	12.36	11.18	0.04	0.10	0.02					
6/9/2018	13:07:15	12.20	8.72	0.03	0.10	0.02					
6/9/2018	13:07:25	12.02	9.17	0.02	0.10	0.02					
6/9/2018	13:07:35	11.92	10.20	0.02	0.09	0.11					
6/9/2018	13:07:45	11.83	9.97	0.02	0.10	0.11					
6/9/2018	13:07:55	11.69	9.02	0.02	0.09	0.11					
6/9/2018	13:08:05	11.54	8.29	0.02	0.09	0.11					
6/9/2018	13:08:15	11.42	7.49	0.02	0.09	0.11					
6/9/2018	13:08:25	11.27	7.51	0.02	0.09	0.11					
6/9/2018	13:08:35	11.15	7.25	0.02	0.09	0.11					
6/9/2018	13:08:45	11.03	8.19	0.01	0.09	0.09					
6/9/2018	13:08:55	10.91	9.73	0.01	0.09	0.09					
6/9/2018	13:09:05	10.79	9.99	0.01	0.09	0.09					
6/9/2018	13:09:15	10.68	9.18	0.02	0.09	0.09					
6/9/2018	13:09:25	10.56	8.26	0.02	0.09	0.08					
6/9/2018	13:09:35	10.47	7.80	0.01	0.08	0.09					
6/9/2018	13:09:45	10.38	7.46	0.01	0.08	0.09					
6/9/2018	13:09:55	10.26	7.19	0.01	0.08	0.06					
6/9/2018	13:10:05	10.17	7.76	0.01	0.09	0.03					
6/9/2018	13:10:15	10.12	9.10	0.01	0.08	0.03					

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	13:10:25	10.03	10.22	0.01	0.08	0.03					
6/9/2018	13:10:35	9.97	9.31	0.01	0.08	0.03	10.04				
6/9/2018	13:10:45	9.90	8.77	0.01	0.08	0.03					
6/9/2018	13:10:55	9.95	7.92	0.46	0.10	0.03					
6/9/2018	13:11:05	9.76	9.59	8.97	0.36	0.03					
6/9/2018	13:11:15	9.64	22.13	9.22	0.36	0.01					
6/9/2018	13:11:25	9.77	47.29	3.45	0.19	0.01					
6/9/2018	13:11:35	7.64	67.14	1.19	0.12	0.01					
6/9/2018	13:11:45	5.20	89.26	0.42	0.09	0.01					
6/9/2018	13:11:55	25.13	110.92	0.15	0.08	0.01					
6/9/2018	13:12:05	42.94	130.04	0.06	0.08	0.01					
6/9/2018	13:12:15	74.43	140.78	0.03	0.07	0.01					
6/9/2018	13:12:25	97.68	145.22	0.02	0.08	0.44					
6/9/2018	13:12:35	99.90	146.43	0.02	0.07	0.55					
6/9/2018	13:12:45	99.90	147.50	0.01	0.07	0.55					
6/9/2018	13:12:55	99.90	149.05	0.02	0.08	0.55					
6/9/2018	13:13:05	99.90	151.11	0.01	0.07	0.55					
6/9/2018	13:13:15	99.90	151.04	0.02	0.07	0.55					
6/9/2018	13:13:25	99.90	150.28	0.01	0.07	0.55					
6/9/2018	13:13:35	99.90	149.18	0.02	0.07	0.28					
6/9/2018	13:13:45	99.90	148.29	0.01	0.07	0.00					
6/9/2018	13:13:55	99.90	148.26	2.35	0.15	0.01					
6/9/2018	13:14:05	99.90	147.70	12.06	0.45	0.01					
6/9/2018	13:14:15	99.90	149.18	14.88	0.50	0.00		148.38			
6/9/2018	13:14:25	99.90	149.28	6.84	0.32	0.01					
6/9/2018	13:14:35	77.43	134.84	3.20	0.38	0.01					
6/9/2018	13:14:45	35.72	103.68	2.75	0.19	0.01					
6/9/2018	13:14:55	31.29	67.47	2.63	0.11	0.01					
6/9/2018	13:15:05	30.66	36.88	2.58	0.09	0.01					
6/9/2018	13:15:15	20.75	16.06	2.57	0.08	0.01					
6/9/2018	13:15:25	9.82	4.62	2.56	0.07	0.01					
6/9/2018	13:15:35	6.63	0.00	2.56	0.07	0.01					
6/9/2018	13:15:45	3.98	-0.34	2.57	0.07	0.01					
6/9/2018	13:15:55	3.09	0.07	2.57	0.07	0.01					
6/9/2018	13:16:05	2.38	-0.16	2.58	0.07	10.27					
6/9/2018	13:16:15	2.05	-1.11	2.57	0.07	11.41					
6/9/2018	13:16:25	1.78	-2.13	2.58	0.07	11.41					
6/9/2018	13:16:35	1.62	-2.73	2.58	0.07	11.41					
6/9/2018	13:16:45	1.45	-3.08	2.58	0.07	11.41					
6/9/2018	13:16:55	1.35	-2.91	2.58	0.07	11.41					
6/9/2018	13:17:05	1.26	-1.81	2.58	0.07	11.41					
6/9/2018	13:17:15	1.20	-0.22	2.58	0.07	12.03					
6/9/2018	13:17:25	1.11	-0.53	2.58	0.06	12.45					
6/9/2018	13:17:35	1.05	-1.23	2.58	0.07	12.45					
6/9/2018	13:17:45	1.02	-2.25	2.58	0.07	12.45					
6/9/2018	13:17:55	0.96	-2.71	2.58	0.07	12.45					12.45

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	13:20:21	3.34	157.86	19.77	0.65	1.44
6/9/2018	13:21:21	3.32	159.25	19.77	0.64	0.96
6/9/2018	13:22:21	3.30	158.68	19.77	0.65	1.01
6/9/2018	13:23:21	3.28	157.57	19.78	0.64	0.95
6/9/2018	13:24:21	3.29	158.58	19.79	0.64	0.89
6/9/2018	13:25:21	3.29	157.33	19.79	0.65	0.87
6/9/2018	13:26:21	3.28	157.27	19.78	0.65	0.88
6/9/2018	13:27:21	3.29	158.81	19.78	0.65	0.92
6/9/2018	13:28:21	3.29	160.55	19.79	0.65	0.92
6/9/2018	13:29:21	3.29	161.01	19.80	0.65	0.89
6/9/2018	13:30:21	3.29	160.37	19.80	0.66	0.90
6/9/2018	13:31:21	3.28	159.65	19.79	0.65	0.97
6/9/2018	13:32:21	3.28	160.43	19.80	0.66	1.02
6/9/2018	13:33:21	3.26	160.32	19.80	0.66	0.90
6/9/2018	13:34:21	3.26	159.14	19.81	0.66	0.89
6/9/2018	13:35:21	3.24	157.33	19.80	0.66	0.90
6/9/2018	13:36:21	3.26	160.16	19.80	0.66	0.90
6/9/2018	13:37:21	3.27	161.00	19.80	0.67	0.87
6/9/2018	13:38:21	3.26	160.59	19.80	0.66	0.83
6/9/2018	13:39:21	3.27	160.28	19.81	0.66	0.84
6/9/2018	13:40:21	3.26	162.07	19.81	0.66	0.85
6/9/2018	13:41:21	3.27	162.67	19.81	0.66	0.87
6/9/2018	13:42:21	3.26	162.08	19.80	0.66	0.73
6/9/2018	13:43:21	3.26	162.16	19.80	0.66	0.64
6/9/2018	13:44:21	3.26	162.63	19.80	0.65	0.80
6/9/2018	13:45:21	3.25	161.73	19.81	0.65	0.85
6/9/2018	13:46:21	3.15	152.02	19.80	0.65	0.85
6/9/2018	13:47:21	3.15	151.88	19.79	0.66	0.82
6/9/2018	13:48:21	3.15	153.29	19.79	0.66	0.81
6/9/2018	13:49:21	3.15	153.84	19.79	0.66	0.84
6/9/2018	13:50:21	3.14	153.25	19.80	0.66	0.89
6/9/2018	13:51:21	3.16	153.27	19.80	0.66	0.89
6/9/2018	13:52:21	3.17	154.47	19.79	0.66	0.83
6/9/2018	13:53:21	3.17	154.65	19.79	0.66	0.83
6/9/2018	13:54:21	3.19	154.36	19.79	0.66	0.84
6/9/2018	13:55:21	3.20	154.56	19.80	0.66	0.84
6/9/2018	13:56:21	3.18	154.58	19.80	0.67	0.84
6/9/2018	13:57:21	3.20	156.39	19.79	0.67	0.87
6/9/2018	13:58:21	3.24	157.67	19.78	0.67	0.86
6/9/2018	13:59:21	3.23	157.68	19.79	0.68	0.88
6/9/2018	14:00:21	3.23	157.34	19.79	0.67	0.83

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Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	14:01:21	3.23	158.68	19.79	0.67	0.61
6/9/2018	14:02:21	3.24	159.58	19.79	0.67	0.88
6/9/2018	14:03:21	3.24	159.95	19.78	0.67	0.88
6/9/2018	14:04:21	3.27	159.82	19.78	0.67	0.89
6/9/2018	14:05:21	3.26	160.51	19.78	0.67	0.88
6/9/2018	14:06:21	3.26	160.45	19.79	0.66	0.88
6/9/2018	14:07:21	3.28	160.95	19.79	0.66	0.97
6/9/2018	14:08:21	3.29	160.04	19.78	0.66	0.85
6/9/2018	14:09:21	3.28	160.32	19.78	0.66	0.86
6/9/2018	14:10:21	3.28	160.89	19.78	0.66	0.87
6/9/2018	14:11:21	3.27	159.72	19.79	0.66	0.89
6/9/2018	14:12:21	3.26	162.25	19.79	0.66	0.91
6/9/2018	14:13:21	3.29	163.52	19.78	0.66	0.81
6/9/2018	14:14:21	3.28	162.41	19.78	0.66	0.84
6/9/2018	14:15:21	3.28	162.75	19.78	0.66	0.81
6/9/2018	14:16:21	3.33	164.62	19.78	0.66	0.80
6/9/2018	14:17:21	3.34	163.57	19.79	0.66	0.82
6/9/2018	14:18:21	3.33	163.91	19.78	0.67	0.85
6/9/2018	14:19:21	3.32	164.57	19.78	0.67	0.89
6/9/2018	14:20:21	3.31	165.00	19.78	0.67	0.87
6/9/2018	14:21:21	3.32	165.22	19.78	0.68	0.88
6/9/2018	14:22:21	3.32	165.05	19.78	0.68	0.88
6/9/2018	14:23:21	3.32	165.31	19.78	0.67	0.85
6/9/2018	14:24:21	3.31	165.58	19.77	0.68	0.81
6/9/2018	14:25:21	3.31	164.27	19.78	0.67	0.86
6/9/2018	14:26:21	3.26	160.03	19.78	0.68	0.84
6/9/2018	14:27:21	3.27	162.43	19.78	0.67	0.82
6/9/2018	14:28:21	3.31	168.27	19.78	0.67	0.82
6/9/2018	14:29:21	3.31	167.57	19.77	0.67	0.80
6/9/2018	14:30:21	3.30	167.04	19.76	0.67	0.51
6/9/2018	14:31:21	3.29	166.79	19.75	0.67	0.77
6/9/2018	14:32:21	3.30	167.98	19.76	0.67	0.85
6/9/2018	14:33:21	3.29	167.87	19.77	0.66	0.86
6/9/2018	14:34:21	3.29	167.35	19.77	0.66	0.86
6/9/2018	14:35:21	3.28	165.89	19.76	0.66	0.92
6/9/2018	14:36:21	3.29	164.87	19.77	0.66	0.88
6/9/2018	14:37:21	3.30	165.94	19.77	0.66	0.87
6/9/2018	14:38:21	3.37	165.83	19.77	0.66	0.85
6/9/2018	14:39:21	3.41	164.56	19.77	0.66	0.84
6/9/2018	14:40:21	3.38	165.25	19.76	0.67	0.86
6/9/2018	14:41:21	3.38	167.09	19.76	0.67	0.89

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Run 3

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	14:42:21	3.38	167.93	19.76	0.67	0.86
6/9/2018	14:43:21	3.37	166.89	19.77	0.67	0.85
6/9/2018	14:44:21	3.39	166.59	19.76	0.68	0.72
6/9/2018	14:45:21	3.35	167.22	19.76	0.68	0.63
6/9/2018	14:46:21	3.37	167.46	19.75	0.68	0.90
6/9/2018	14:47:21	3.39	167.52	19.76	0.68	0.55
6/9/2018	14:48:21	3.37	166.46	19.76	0.68	0.79
6/9/2018	14:49:21	3.45	166.72	19.76	0.68	0.85
6/9/2018	14:50:21	3.45	164.15	19.77	0.68	0.86
6/9/2018	14:51:21	3.39	163.23	19.76	0.68	0.88
6/9/2018	14:52:21	3.48	163.99	19.76	0.68	0.87
6/9/2018	14:53:21	3.48	165.28	19.77	0.67	0.85
6/9/2018	14:54:21	3.44	165.94	19.77	0.67	0.87
6/9/2018	14:55:21	3.44	165.68	19.77	0.67	0.89
6/9/2018	14:56:21	3.41	165.49	19.76	0.67	0.92
6/9/2018	14:57:21	3.41	169.99	19.76	0.66	0.94
6/9/2018	14:58:21	3.41	169.42	19.76	0.66	0.63
6/9/2018	14:59:21	3.39	168.12	19.77	0.66	0.82
6/9/2018	15:00:21	3.36	166.74	19.77	0.66	0.69
6/9/2018	15:01:21	3.35	167.13	19.76	0.66	0.69
6/9/2018	15:02:21	3.36	168.64	19.76	0.67	0.84
6/9/2018	15:03:21	3.37	171.90	19.76	0.67	0.85
6/9/2018	15:04:21	3.37	171.20	19.77	0.67	0.81
6/9/2018	15:05:21	3.38	172.09	19.77	0.67	0.85
6/9/2018	15:06:21	3.36	171.56	19.77	0.67	0.83
6/9/2018	15:07:21	3.35	168.03	19.76	0.67	0.74
6/9/2018	15:08:21	3.32	163.71	19.77	0.67	0.64
6/9/2018	15:09:21	3.30	165.20	19.77	0.68	0.89
6/9/2018	15:10:21	3.34	168.08	19.77	0.68	0.83
6/9/2018	15:11:21	3.39	170.50	19.77	0.68	0.84
6/9/2018	15:12:21	3.39	170.85	19.76	0.68	0.86
6/9/2018	15:13:21	3.38	172.06	19.76	0.68	0.87
6/9/2018	15:14:21	3.38	170.43	19.77	0.68	0.85
6/9/2018	15:15:21	3.36	169.15	19.77	0.68	0.82
6/9/2018	15:16:21	3.36	169.16	19.77	0.68	0.63
6/9/2018	15:17:21	3.34	168.37	19.77	0.67	0.71
6/9/2018	15:18:21	3.35	167.41	19.77	0.67	0.81
6/9/2018	15:19:21	3.32	163.79	19.77	0.67	0.80
6/9/2018	15:20:21	3.31	163.24	19.78	0.67	0.57
6/9/2018	15:21:21	3.35	167.99	19.77	0.66	0.77
6/9/2018	15:22:21	3.35	168.35	19.77	0.66	0.61

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Run 3

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	15:23:21	3.36	168.17	19.76	0.66	0.68
6/9/2018	15:24:21	3.35	168.41	19.77	0.66	0.82
6/9/2018	15:25:21	3.34	165.75	19.78	0.66	0.84
6/9/2018	15:26:21	3.31	162.49	19.78	0.66	0.89
6/9/2018	15:27:21	3.34	165.74	19.77	0.67	0.58
6/9/2018	15:28:21	3.35	168.04	19.77	0.67	0.75
6/9/2018	15:29:21	3.36	168.53	19.77	0.67	0.85
6/9/2018	15:30:21	3.38	173.65	19.77	0.68	0.80
6/9/2018	15:31:21	3.42	180.43	19.77	0.68	0.81
6/9/2018	15:32:21	3.43	180.07	19.77	0.68	0.83
6/9/2018	15:33:21	3.44	179.64	19.76	0.68	0.66
6/9/2018	15:34:21	3.42	175.02	18.71	0.65	0.75
	Final	**3.31**	**163.87**	**19.77**	**0.67**	**0.83**

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R-3 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	15:33:21	3.44	178.31	19.76	0.68	0.82					
6/9/2018	15:33:31	3.44	178.47	19.76	0.68	0.69					
6/9/2018	15:33:41	3.44	179.64	19.76	0.69	0.60					
6/9/2018	15:33:51	3.44	181.19	19.77	0.68	0.60					
6/9/2018	15:34:01	3.44	181.07	19.76	0.68	0.60					
6/9/2018	15:34:11	3.44	179.14	19.77	0.68	0.60					
6/9/2018	15:34:21	3.44	177.55	19.77	0.68	0.60					
6/9/2018	15:34:31	3.43	175.35	19.77	0.69	0.60					
6/9/2018	15:34:41	3.40	174.15	19.77	0.68	0.69					
6/9/2018	15:34:51	3.40	173.25	19.78	0.68	0.88					
6/9/2018	15:35:01	3.41	174.61	19.79	0.68	0.88					
6/9/2018	15:35:11	3.41	175.23	13.40	0.50	0.88					
6/9/2018	15:35:21	3.40	159.62	4.94	0.26	0.88					
6/9/2018	15:35:31	3.06	120.43	1.73	0.14	0.88					
6/9/2018	15:35:41	2.43	71.99	0.64	0.11	0.88					
6/9/2018	15:35:51	1.79	33.35	0.26	0.10	0.88					
6/9/2018	15:36:01	1.07	10.99	0.14	0.09	0.83					
6/9/2018	15:36:11	0.65	1.68	0.09	0.08	0.83					
6/9/2018	15:36:21	0.54	-0.71	0.07	0.09	0.83					
6/9/2018	15:36:31	0.48	-0.37	0.06	0.10	0.83					
6/9/2018	15:36:41	0.47	-0.51	0.05	0.09	0.83					
6/9/2018	15:36:51	0.45	-1.32	0.05	0.09	0.83					
6/9/2018	15:37:01	0.45	-2.29	0.05	0.09	0.83					
6/9/2018	15:37:11	0.45	-3.11	0.05	0.08	0.25					
6/9/2018	15:37:21	0.45	-3.20	0.04	0.08	0.01					
6/9/2018	15:37:31	0.45	-3.67	0.04	0.09	0.01					
6/9/2018	15:37:41	0.44	-2.53	0.04	0.09	0.01	0.45	-3.13	0.04	0.09	0.01
6/9/2018	15:37:51	0.42	-1.18	0.04	0.09	0.01					
6/9/2018	15:38:01	0.42	-0.81	0.04	0.08	0.01					
6/9/2018	15:38:11	0.42	-1.78	1.09	0.12	0.01					
6/9/2018	15:38:21	0.42	0.42	10.01	0.41	0.01					
6/9/2018	15:38:31	0.62	23.10	16.24	0.59	0.01					
6/9/2018	15:38:41	0.94	66.35	14.62	2.37	0.01					
6/9/2018	15:38:51	1.56	99.72	11.49	6.93	0.01					
6/9/2018	15:39:01	2.59	98.92	10.47	8.72	0.01					
6/9/2018	15:39:11	2.89	71.78	10.13	9.39	0.01					
6/9/2018	15:39:21	2.41	39.98	10.01	9.63	0.01					
6/9/2018	15:39:31	1.90	16.85	9.97	9.72	0.07					
6/9/2018	15:39:41	1.28	4.20	9.96	9.75	0.64					
6/9/2018	15:39:51	0.90	-1.54	9.95	9.77	0.64					
6/9/2018	15:40:01	0.77	-4.20	9.96	9.77	0.64					
6/9/2018	15:40:11	0.68	-5.09	9.96	9.79	0.64			9.96		
6/9/2018	15:40:21	0.63	-5.09	9.95	9.79	0.64					
6/9/2018	15:40:31	0.60	-3.32	9.94	9.79	0.64					
6/9/2018	15:40:41	0.59	-2.41	10.39	9.38	0.64					
6/9/2018	15:40:51	0.56	0.03	14.99	5.10	0.13					
6/9/2018	15:41:01	0.51	21.68	12.34	3.16	0.01					
6/9/2018	15:41:11	0.94	49.26	4.71	1.29	0.01					
6/9/2018	15:41:21	1.90	57.27	2.51	1.43	0.01					
6/9/2018	15:41:31	2.02	43.04	2.18	1.77	0.01					

Hollingsworth & Vose

CFU 117

R-3 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	15:41:41	1.24	21.84	2.06	1.88	0.01					
6/9/2018	15:41:51	0.78	8.11	2.02	1.93	0.01					
6/9/2018	15:42:01	0.63	2.46	2.01	1.95	0.22					
6/9/2018	15:42:11	0.53	-0.04	2.00	1.95	0.43					
6/9/2018	15:42:21	0.51	-1.79	2.00	1.96	0.43					
6/9/2018	15:42:31	0.50	-3.11	2.00	1.96	0.43				1.96	
6/9/2018	15:42:41	0.48	-3.70	2.00	1.96	0.43					
6/9/2018	15:42:51	0.48	-4.17	3.23	1.87	0.43					
6/9/2018	15:43:01	0.49	-1.11	10.37	1.32	0.43					
6/9/2018	15:43:11	0.72	21.86	6.30	1.03	0.34					
6/9/2018	15:43:21	1.13	46.44	2.33	0.52	0.01					
6/9/2018	15:43:31	3.42	53.07	0.83	0.27	0.01					
6/9/2018	15:43:41	7.53	41.32	0.31	0.16	0.01					
6/9/2018	15:43:51	9.85	25.08	0.13	0.13	0.01					
6/9/2018	15:44:01	10.59	14.67	0.07	0.11	0.01					
6/9/2018	15:44:11	10.97	9.56	0.04	0.10	0.01					
6/9/2018	15:44:21	10.93	7.80	0.03	0.09	0.01					
6/9/2018	15:44:31	10.90	7.32	0.04	0.09	0.37					
6/9/2018	15:44:41	10.86	8.75	0.03	0.10	0.41					
6/9/2018	15:44:51	10.81	9.78	0.03	0.09	0.41					
6/9/2018	15:45:01	10.75	9.60	0.03	0.08	0.41					
6/9/2018	15:45:11	10.71	8.54	0.02	0.09	0.41					
6/9/2018	15:45:21	10.66	7.72	0.02	0.08	0.41					
6/9/2018	15:45:31	10.61	7.23	0.03	0.08	0.41					
6/9/2018	15:45:41	10.55	6.67	0.02	0.08	0.19					
6/9/2018	15:45:51	10.49	6.76	0.02	0.08	0.03					
6/9/2018	15:46:01	10.43	8.16	0.02	0.07	0.03					
6/9/2018	15:46:11	10.36	9.38	0.02	0.08	0.03					
6/9/2018	15:46:21	10.26	9.59	0.02	0.07	0.03					
6/9/2018	15:46:31	10.19	8.84	3.63	0.19	0.03	10.27				
6/9/2018	15:46:41	10.14	15.37	8.15	0.34	0.03					
6/9/2018	15:46:51	9.33	34.43	3.36	0.18	0.03					
6/9/2018	15:47:01	7.86	56.67	1.17	0.11	0.01					
6/9/2018	15:47:11	15.15	82.74	0.41	0.09	0.01					
6/9/2018	15:47:21	29.43	108.89	0.16	0.08	0.01					
6/9/2018	15:47:31	53.06	130.52	0.07	0.08	0.01					
6/9/2018	15:47:41	85.14	143.03	0.04	0.07	0.01					
6/9/2018	15:47:51	99.90	147.55	0.03	0.07	0.01					
6/9/2018	15:48:01	99.90	148.05	0.03	0.08	0.01					
6/9/2018	15:48:11	99.90	148.16	0.02	0.07	0.15					
6/9/2018	15:48:21	99.90	147.26	0.02	0.08	0.15					
6/9/2018	15:48:31	99.90	147.48	0.02	0.08	0.15					
6/9/2018	15:48:41	99.90	147.80	0.02	0.07	0.15					
6/9/2018	15:48:51	99.90	149.83	0.02	0.07	0.15					
6/9/2018	15:49:01	99.90	151.11	0.02	0.08	0.15					
6/9/2018	15:49:11	99.90	150.54	0.02	0.07	0.15					
6/9/2018	15:49:21	99.90	149.80	0.02	0.07	0.05					
6/9/2018	15:49:31	99.90	148.66	0.02	0.07	0.01					
6/9/2018	15:49:41	99.90	147.94	0.02	0.07	0.01		148.80			
6/9/2018	15:49:51	99.90	147.44	0.02	0.07	0.01					

Hollingsworth & Vose

CFU 117

R-3 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]	NOx [PPM]	CO [PPM]	O2 [%]	CO2 [%]	VOC [PPM]
6/9/2018	15:50:01	99.90	147.72	0.03	0.07	0.01					
6/9/2018	15:50:11	99.90	149.24	5.20	0.25	0.01					
6/9/2018	15:50:21	99.90	151.40	4.77	0.23	0.01					
6/9/2018	15:50:31	99.00	140.04	2.28	0.36	0.01					
6/9/2018	15:50:41	84.94	112.14	2.37	0.21	0.01					
6/9/2018	15:50:51	62.80	76.13	2.52	0.12	0.01					
6/9/2018	15:51:01	43.19	43.70	2.55	0.08	0.01					
6/9/2018	15:51:11	26.74	20.16	2.56	0.09	0.01					
6/9/2018	15:51:21	14.65	6.73	2.56	0.08	0.01					
6/9/2018	15:51:31	7.22	1.40	2.57	0.08	0.01					
6/9/2018	15:51:41	4.74	0.45	2.57	0.07	0.55					
6/9/2018	15:51:51	3.13	0.10	2.58	0.08	5.41					
6/9/2018	15:52:01	2.51	-0.74	2.58	0.08	5.41					
6/9/2018	15:52:11	2.07	-1.79	2.58	0.08	5.41					
6/9/2018	15:52:21	1.83	-2.56	2.58	0.07	5.40					
6/9/2018	15:52:31	1.62	-3.19	2.58	0.07	5.41					
6/9/2018	15:52:41	1.47	-3.65	2.59	0.08	5.41					
6/9/2018	15:52:51	1.36	-3.47	2.59	0.08	5.41					
6/9/2018	15:53:01	1.27	-2.06	2.59	0.08	11.06					
6/9/2018	15:53:11	1.19	-0.71	2.59	0.08	12.48					
6/9/2018	15:53:21	1.13	-0.93	2.59	0.07	12.48					
6/9/2018	15:53:31	1.07	-1.67	2.59	0.08	12.48					
6/9/2018	15:53:41	1.03	-2.52	2.59	0.07	12.48					
6/9/2018	15:53:51	0.98	-3.40	2.59	0.08	12.48					
6/9/2018	15:54:01	0.94	-3.80	2.59	0.08	12.48					
6/9/2018	15:54:11	0.91	-3.59	2.59	0.07	12.50					
6/9/2018	15:54:21	0.88	-2.35	2.59	0.08	12.52					
6/9/2018	15:54:31	0.87	-0.89	2.59	0.08	12.52					
6/9/2018	15:54:41	0.86	-0.90	2.59	0.08	12.52					
6/9/2018	15:54:51	0.83	-1.56	2.59	0.07	12.52					
6/9/2018	15:55:01	0.79	-2.55	2.59	0.08	12.52					
6/9/2018	15:55:11	0.78	-3.25	2.59	0.08	12.52					
6/9/2018	15:55:21	0.78	-3.60	2.59	0.09	12.52					
6/9/2018	15:55:31	0.77	-3.42	2.59	0.07	12.54					12.53
6/9/2018	15:55:41	0.74	-2.04	2.59	0.08	12.54					
6/9/2018	15:55:51	0.72	-0.70	3.66	0.12	12.54					
6/9/2018	15:56:01	0.72	2.26	11.64	0.42	12.54					
6/9/2018	15:56:11	0.93	25.05	8.95	0.33	12.54					

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 117**
DATE	**6/9-10/2018**
METHOD	**26A**
POLLUTANT	**HF**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**1**
Location:	**Corvallis, OR**		**Start Time:**	**16:05**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:10**
EPA Method:	**26A**	50 degrees, light rain	**Date:**	**6/9/2019**
Box Operator:	**CMF**			
Technician(s):	**CSW**			

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	4D	Liner type	Glass	
Y factor	0.9988		Nozzle ID	0.213	Nozzle size	0.2190	inches
ΔH@	1.8338		Hot box ID	1	Nozzle area	0.000262	sq.ft.
			Pitot Cp	0.84	Probe heat	248	F
					Filter heat	248	F

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.93 %
Static Pressure	0.6	"H_2O	CO_2	0.62 %
Ave. ΔP	1.765	"H_2O	Rec. Nz.	0.189 inches
Stack Temperature	242	F		
Assumed moisture	1.75	%		
Assumed meter temp.	69	F		
Total number of points	20			
Time per point	6			
Total run time	120			

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.003	0.000
Leak check vacuum, "Hg	15	10

Nozzle check for roundness:

1	2	3	
0.219	0.219	0.219	inches
	Caliper ID#	HLN#1	

Post Test Calculations:

Sample volume	120.507 dcf	Ave. ΔP	1.785 "H_2O
Wet mol. weight	28.7 M_s (actual)	Ave. √ΔP	1.3357 "H_2O
Actual H_2O	1.80 %	Ave. ΔH	3.385 "H_2O
Std. meter vol.	121.017 dscf	Ave. T_s	244.4 °F
Isokinetic Average	100.4 %	Ave. T_m	68.6 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	258.2	291.4	33.2
		Total water gain:	47.2

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	6.0	6.001	1.70	234	68	3.25	3.30	4	255	41
2	12.0	11.780	1.70	230	67	3.26	3.30	4	259	43
3	18.0	17.820	1.80	239	66	3.40	3.40	4	259	45
4	24.0	23.820	1.80	243	67	3.39	3.40	4	259	49
5	30.0	29.830	1.80	244	67	3.38	3.40	4	249	51
6	36.0	35.980	1.90	247	67	3.56	3.60	4	245	52
7	42.0	42.190	1.90	249	68	3.55	3.60	4	252	52
8	48.0	48.370	1.90	250	68	3.55	3.60	5	254	56
9	54.0	54.310	1.70	251	69	3.18	3.20	5	254	56
10	60.0	60.056	1.60	249	70	3.00	3.00	5	246	58
11	66.0	66.150	1.80	249	68	3.37	3.40	5	257	61
12	72.0	72.100	1.80	247	69	3.38	3.40	5	251	55
13	78.0	78.130	1.80	247	69	3.38	3.40	5	252	57
14	84.0	84.180	1.80	247	69	3.38	3.40	5	251	59
15	90.0	90.220	1.80	248	69	3.38	3.40	5	247	60
16	96.0	96.250	1.80	246	70	3.39	3.40	5	249	60
17	102.0	102.330	1.80	242	70	3.41	3.40	5	249	60
18	108.0	108.380	1.70	237	70	3.25	3.30	5	249	59
19	114.0	114.420	1.80	243	70	3.41	3.40	5	249	61
20	120.0	120.507	1.80	246	70	3.39	3.40	5	249	61

*In the original version of this field datasheet, the meter box Y was incorrectly entered as 0.9980. This was discovered and corrected during data QA/QC. KJD 6/11/2018

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**7:36**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**		**End Time:**	**9:42**
EPA Method:	**26A**	50 degrees, cloudy		**Date:**	**6/10/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

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	4D	Liner type:	Glass	
Y factor	0.9988		Nozzle ID	0.213	Nozzle size:	0.2190	inches
ΔH@	1.8338		Hot box ID	1	Nozzle area:	0.000262	sq.ft.
			Pitot Cp	0.84	Probe heat:	248	F
					Filter heat:	248	F

Source Information:

Barometric Pressure	30.00	"Hg	O_2	19.00 %
Static Pressure	0.6	"H_2O	CO_2	0.78 %
Ave. ΔP	1.765	"H_2O	Rec. Nz.	0.190 inches
Stack Temperature	242	F		
Assumed moisture	1.8	%		
Assumed meter temp.	68.6	F		
Total number of points	20			
Time per point	6			
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:	18	10

Nozzle check for roundness:

1	2	3	
0.219	0.219	0.219	inches

Caliper ID# HLN#1

Post Test Calculations:

Sample volume	118.909	dcf	Ave. ΔP	1.77 "H_2O
Wet mol. weight	28.68	M_s (actual)	Ave. √ΔP	1.3299 "H_2O
Actual H_2O	1.81	%	Ave. ΔH	3.346 "H_2O
Std. meter vol.	121.113	dscf	Ave. T_s	236 °F
Isokinetic Average	100.1	%	Ave. T_m	63.2 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	216	16.0
Silica gel, g	244.2	275.6	31.4
		Total water gain:	47.4

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	6.0	5.800	1.80	238	55	3.33	3.30	4	251	41
2	12.0	11.730	1.80	236	57	3.36	3.40	4	251	42
3	18.0	17.670	1.80	235	58	3.37	3.40	4	252	47
4	24.0	23.610	1.80	238	60	3.37	3.40	4	252	57
5	30.0	29.570	1.80	237	61	3.38	3.40	4	250	58
6	36.0	35.510	1.80	238	63	3.38	3.40	4	251	64
7	42.0	41.490	1.80	239	64	3.39	3.40	4	251	63
8	48.0	47.470	1.80	239	64	3.39	3.40	4	251	56
9	54.0	53.330	1.60	238	65	3.02	3.00	4	251	54
10	60.0	58.944	1.60	236	65	3.03	3.00	4	251	54
11	66.0	64.860	1.70	229	64	3.24	3.30	4	251	52
12	72.0	70.770	1.80	231	64	3.43	3.40	4	251	50
13	78.0	76.840	1.80	235	64	3.41	3.40	4	250	52
14	84.0	82.780	1.80	235	65	3.41	3.40	4	251	54
15	90.0	88.750	1.80	236	65	3.41	3.41	4	251	55
16	96.0	94.920	1.90	236	66	3.60	3.60	4	251	55
17	102.0	101.110	1.90	236	66	3.60	3.60	4	251	54
18	108.0	107.130	1.80	236	66	3.41	3.40	4	251	53
19	114.0	113.170	1.80	236	66	3.41	3.40	4	250	53
20	120.0	118.909	1.50	236	66	2.84	2.90	4	250	54

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:** **3**
Location:	**Corvallis, OR**		**Start Time:** **10:00**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**	**End Time:** **12:06**
EPA Method:	**26A**	50 degrees, cloudy	**Date:** **6/10/2018**
Box Operator:	**CMF**		
Technician(s):	**CSW**		

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	4D	Liner type:	Glass
Y factor	0.9988		Nozzle ID	0.213	Nozzle size:	0.2190 inches
ΔH@	1.8338		Hot box ID	1	Nozzle area:	0.000262 sq.ft.
			Pitot Cp	0.84	Probe heat:	248 F
					Filter heat:	248 F

Source Information:

Barometric Pressure	30.00	"Hg	O_2	18.78 %
Static Pressure	0.6	"H_2O	CO_2	0.85 %
Ave. ΔP	1.765	"H_2O	Rec. Nz.	0.191 inches
Stack Temperature	242	F		
Assumed moisture	1.81	%		
Assumed meter temp.	63.2	F		
Total number of points	20			
Time per point	6			
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	
0.219	0.219	0.219	inches

Caliper ID# HLN#1

Post Test Calculations:

Sample volume	117.780 dcf	Ave. ΔP	1.72 "H_2O
Wet mol. weight	28.69 M_s (actual)	Ave. √ΔP	1.311 "H_2O
Actual H_2O	1.82 %	Ave. ΔH	3.25 "H_2O
Std. meter vol.	119.207 dscf	Ave. T_s	236.6 °F
Isokinetic Average	100.0 %	Ave. T_m	66.4 °F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	234.6	267.6	33.0
Total water gain:			47.0

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	6.0	5.790	1.70	239	63	3.19	3.20	4	253	48
2	12.0	11.580	1.70	232	64	3.23	3.20	4	252	50
3	18.0	17.240	1.60	233	63	3.03	3.00	4	252	51
4	24.0	23.240	1.80	235	64	3.40	3.40	4	250	52
5	30.0	29.250	1.80	235	64	3.40	3.40	4	251	55
6	36.0	35.110	1.80	235	65	3.41	3.40	4	250	56
7	42.0	41.150	1.80	237	66	3.41	3.40	4	250	56
8	48.0	47.010	1.70	237	66	3.22	3.20	4	250	57
9	54.0	52.840	1.70	237	66	3.22	3.20	4	251	57
10	60.0	58.585	1.60	233	67	3.05	3.10	4	251	58
11	66.0	64.620	1.80	234	66	3.42	3.40	5	247	53
12	72.0	70.660	1.80	235	67	3.42	3.40	5	255	55
13	78.0	76.680	1.80	236	67	3.42	3.40	5	255	57
14	84.0	82.710	1.80	238	67	3.41	3.40	5	243	58
15	90.0	88.750	1.80	239	67	3.40	3.40	5	252	58
16	96.0	94.799	1.80	239	68	3.41	3.40	5	249	59
17	102.0	100.750	1.70	240	69	3.22	3.20	5	254	59
18	108.0	106.550	1.60	241	69	3.03	3.00	5	252	61
19	114.0	112.350	1.60	240	69	3.03	3.00	5	248	62
20	120.0	117.780	1.50	236	70	2.87	2.90	5	252	63

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

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**16:05**
Source:	**CFU 117**	**End Time:**	**18:10**
Method:	**26A**	**Date:**	**6/9/2019**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	6.001	3.30	68	1	1.70	234	1.3038
12	11.780	3.30	67	2	1.70	230	1.3038
18	17.820	3.40	66	3	1.80	239	1.3416
24	23.820	3.40	67	4	1.80	243	1.3416
30	29.830	3.40	67	5	1.80	244	1.3416
36	35.980	3.60	67	6	1.90	247	1.3784
42	42.190	3.60	68	7	1.90	249	1.3784
48	48.370	3.60	68	8	1.90	250	1.3784
54	54.310	3.20	69	9	1.70	251	1.3038
60	60.056	3.00	70	10	1.60	249	1.2649
66	66.150	3.40	68	11	1.80	249	1.3416
72	72.100	3.40	69	12	1.80	247	1.3416
78	78.130	3.40	69	13	1.80	247	1.3416
84	84.180	3.40	69	14	1.80	247	1.3416
90	90.220	3.40	69	15	1.80	248	1.3416
96	96.250	3.40	70	16	1.80	246	1.3416
102	102.330	3.40	70	17	1.80	242	1.3416
108	108.380	3.30	70	18	1.70	237	1.3038
114	114.420	3.40	70	19	1.80	243	1.3416
120	120.507	3.40	70	20	1.80	246	1.3416

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 117**	**Date:**	**06/09/19**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	120.507	dcf	Rectangular		
Water Volume	47.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.2190	in.	Length		in
Nozzle Area	0.000262	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.62	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.93	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.385	"H_2O	√Dp	1.3357	"H_2O
Temperature, T_m	68.6	^oF	Temperature, T_s	244.4	^oF
Temperature, T_m	528.6	^oA (^oR)	Temperature, T_s	704.4	^oA (R)
Pressure Meter, P_m	30.129	"Hg	Pressure Stack, P_s	29.924	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	121.017	dscf	Velocity, V_s	86.87	fps
	3.427	dscm	Volume (actual)	25,586.7	awcfm
Actual Volume, $V_{m(actual)}$	164.451	awcf		25,126.1	adcfm
Gas Stream Moisture			Volume (standard)	1,150,901.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.221	scf		1,130,184.9	dscf/hr
Moisture, B_{ws}	0.0180			18,836.4	dscf/min
Moisture EPA M4	1.80	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	513.914	
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.4	%			

Laboratory Results

HF	17.9	µg/sample		
HF	1.79E-05	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	2.28E-06	gr/dscf
	5.22	µg/dscm
	6.28E-03	ppmvd
Mass Emissions HF	3.68E-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:**	**7:36**
Source:	**CFU 117**	**End Time:**	**9:42**
Method:	**26A**	**Date:**	**06/10/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	5.800	3.30	55	1	1.80	238	1.3416
12	11.730	3.40	57	2	1.80	236	1.3416
18	17.670	3.40	58	3	1.80	235	1.3416
24	23.610	3.40	60	4	1.80	238	1.3416
30	29.570	3.40	61	5	1.80	237	1.3416
36	35.510	3.40	63	6	1.80	238	1.3416
42	41.490	3.40	64	7	1.80	239	1.3416
48	47.470	3.40	64	8	1.80	239	1.3416
54	53.330	3.00	65	9	1.60	238	1.2649
60	58.944	3.00	65	10	1.60	236	1.2649
66	64.860	3.30	64	11	1.70	229	1.3038
72	70.770	3.40	64	12	1.80	231	1.3416
78	76.840	3.40	64	13	1.80	235	1.3416
84	82.780	3.40	65	14	1.80	235	1.3416
90	88.750	3.41	65	15	1.80	236	1.3416
96	94.920	3.60	66	16	1.90	236	1.3784
102	101.110	3.60	66	17	1.90	236	1.3784
108	107.130	3.40	66	18	1.80	236	1.3416
114	113.170	3.40	66	19	1.80	236	1.3416
120	118.909	2.90	66	20	1.50	236	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 117**	**Date:**	**06/10/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	118.909	dcf	Rectangular		
Water Volume	47.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2190	in.	Length		in
Nozzle Area	0.000262	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	30.00	"Hg	CO_2 Average	0.78	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.00	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.346	"H_2O	√Dp	1.3299	"H_2O
Temperature, T_m	63.2	^oF	Temperature, T_s	236.0	^oF
Temperature, T_m	523.2	^oA (^oR)	Temperature, T_s	696.0	^oA (R)
Pressure Meter, P_m	30.246	"Hg	Pressure Stack, P_s	30.044	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	121.113	dscf	Velocity, V_s	85.83	fps
	3.430	dscm	Volume (actual)	25,280.4	awcfm
Actual Volume, $V_{m(actual)}$	161.986	awcf		24,822.8	adcfm
Gas Stream Moisture			Volume (standard)	1,155,461.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.231	scf		1,134,547.6	dscf/hr
Moisture, B_{ws}	0.0181			18,909.1	dscf/min
Moisture EPA M4	1.81	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	505.758	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.68	lb/lb-mole			
Percent Isokinetic	100.1	%			

Laboratory Results

HF	14.4	µg/sample			
HF	1.44E-05	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	1.83E-06	gr/dscf
	4.20	µg/dscm
	5.05E-03	ppmvd
Mass Emissions HF	2.97E-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:**	**10:00**
Source:	**CFU 117**	**End Time:**	**12:06**
Method:	**26A**	**Date:**	**06/10/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	5.790	3.20	63	1	1.70	239	1.3038
12	11.580	3.20	64	2	1.70	232	1.3038
18	17.240	3.00	63	3	1.60	233	1.2649
24	23.240	3.40	64	4	1.80	235	1.3416
30	29.250	3.40	64	5	1.80	235	1.3416
36	35.110	3.40	65	6	1.80	235	1.3416
42	41.150	3.40	66	7	1.80	237	1.3416
48	47.010	3.20	66	8	1.70	237	1.3038
54	52.840	3.20	66	9	1.70	237	1.3038
60	58.585	3.10	67	10	1.60	233	1.2649
66	64.620	3.40	66	11	1.80	234	1.3416
72	70.660	3.40	67	12	1.80	235	1.3416
78	76.680	3.40	67	13	1.80	236	1.3416
84	82.710	3.40	67	14	1.80	238	1.3416
90	88.750	3.40	67	15	1.80	239	1.3416
96	94.799	3.40	68	16	1.80	239	1.3416
102	100.750	3.20	69	17	1.70	240	1.3038
108	106.550	3.00	69	18	1.60	241	1.2649
114	112.350	3.00	69	19	1.60	240	1.2649
120	117.780	2.90	70	20	1.50	236	1.2247

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 117**	**Date:**	**06/10/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	117.780	dcf	Rectangular		
Water Volume	47.0	ml (g)	Width		in
Nozzle Diameter, N_z	0.2190	in.	Length		in
Nozzle Area	0.000262	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	30.00	"Hg	CO_2 Average	0.85	%vd
Static Pressure	0.60	"H_2O	O_2 Average	18.78	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.250	"H_2O	√Dp	1.3110	"H_2O
Temperature, T_m	66.4	^oF	Temperature, T_s	236.6	^oF
Temperature, T_m	526.4	^oA (^oR)	Temperature, T_s	696.6	^oA (R)
Pressure Meter, P_m	30.239	"Hg	Pressure Stack, P_s	30.044	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	119.206	dscf	Velocity, V_s	84.63	fps
	3.376	dscm	Volume (actual)	24,926.9	awcfm
Actual Volume, $V_{m(actual)}$	159.589	awcf		24,473.2	adcfm
Gas Stream Moisture			Volume (standard)	1,138,325.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.212	scf		1,117,608.1	dscf/hr
Moisture, B_{ws}	0.0182			18,626.8	dscf/min
Moisture EPA M4	1.82	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	506.194	
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	100.0	%			

Laboratory Results

HF	14.2	µg/sample		
HF	1.42E-05	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	1.84E-06	gr/dscf
	4.21	µg/dscm
	5.06E-03	ppmvd
Mass Emissions HF	2.93E-04	lb/hr

"<" represents MDL value

EPA Method 26A
Laboratory Results
HF

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 117**

Lab ID	Sample ID	Sample Date		Result	MDL	Sample Vol. (ml)	Units
18-S1055	M26A Cont. 3 R-1	6/9/2018		17.9	3.58	340.0	µg/sample
18-S1056	M26A Cont. 3 R-2	6/10/2018		14.4	3.90	370.0	µg/sample
18-S1057	M26A Cont. 3 R-3	6/10/2018		14.2	3.95	375.0	µg/sample
10-S1054	0.1N H2SO4 Blank	6/5/2018	<	MDL	3.79	360.0	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 117**

Run			1	2	3	
Date			6/9/2019	6/10/2018	6/10/2018	
Run Start Time			16:05	7:36	10:00	
Run End Time			18:10	9:42	12:06	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.88	30.00	30.00	**29.96**
Nozzle Dia., in.			0.2190	0.2190	0.2190	**0.2190**
Isokinetic Average, %			100.4	100.1	100.0	**100.2**
Sample Volume, dscf			121.017	121.113	119.206	**120.445**
Sample Volume, dscm			3.427	3.430	3.376	**3.411**
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			0.62	0.78	0.85	**0.75**
O_2 %vd			19.93	19.00	18.78	**19.24**
Static Press., "H_2O			0.60	0.60	0.60	**0.60**
H_2O %v			1.80	1.81	1.82	**1.81**
Wet Molecular Weight, lb/lb-mole			28.70	28.68	28.69	**28.69**
Velocity, FPS			86.87	85.83	84.63	**85.78**
ADCFM			25,126.1	24,822.8	24,473.2	**24,807.4**
AWCFM			25,586.7	25,280.4	24,926.9	**25,264.7**
DSCFM			18,836.4	18,909.1	18,626.8	**18,790.8**
Stack Temperature, °F			244.4	236.0	236.6	**239.0**
HF	Concentration, C_s	gr/dscf	2.28E-06	1.83E-06	1.84E-06	**1.98E-06**
		µg/dscm	5.22	4.20	4.21	**4.54**
		ppmvd	6.28E-03	5.05E-03	5.06E-03	**5.46E-03**
	Mass	lb/hr	3.68E-04	2.97E-04	2.93E-04	**3.20E-04**
		lb/lb glass	3.14E-06	2.57E-06	2.55E-06	**2.75E-06**
Production Data	Glass Production	lbs/hr	117.5	115.9	115.1	**116.2**

"<" represents MDL value

EPA Methods 1-4, 26A
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**16:05**
Source:	**CFU 117**	**End Time:**	**18:10**
Method:	**26A**	**Date:**	**6/9/2019**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.129 "Hg

where Pb:	29.88	"Hg
ΔH:	3.385	"H_2O

2) Ps = Pb + (Static Press./13.6) = 29.924 "Hg

where Pb:	29.88	"Hg
Static Press.:	0.60	"H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 121.017 dscf

where Vm:	120.507	dcf
Y:	0.9988	
Pm:	30.129	"Hg
Tm:	528.6	°A

4) $V_w(std) = (0.04706)(H_2O)$ = 2.221 scf

where H_2O:	47.20	g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0180

where Vw(std):	2.221	scf
Vm(std):	121.017	dscf

6) % H_2O = Bws x 100 = 1.80 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 164.451 awcf

where Y:	0.9988	
Vm:	120.5069	dcf
Bws:	0.0180	
Ts:	704.4	°A
Tm:	528.6	°A
Pm:	30.129	"Hg
Ps:	29.924	"Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO)$ = 28.90 lb/lb-mole

where CO_2:	0.62	%vd
O_2	19.93	%vd
N_2+CO= (100-(O_2+CO_2)):	79.45	%vd

Client: Hollingsworth & Vose		**Run:**	**1**
Source: CFU 117		**Date:**	**6/9/2019**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.70 lb/lb-mole

where M_d: 28.90 lb/lb-mole

Bws: 0.0180

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 86.87 fps

where Cp: 0.84

Ave. Sqrt ΔP: 1.3357

Ts: 704.4 °A

Ps: 29.924 "Hg

Ms: 28.70 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 25,586.7 AWCFM

where V_s: 86.87 ft/sec

Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 25,126.1 ADCFM

where AWCFM: 25,586.7

Bws: 0.0180

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 1,150,901.1 wscf/hr

where V_s: 86.87 ft/sec

Stack Area: 4.9090 sq. ft.

Ts: 704.4 °A

Ps: 29.924 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,130,184.9 dscf/hr

where wscf/hr: 1,150,901.1

Bws: 0.0180

16) DSCFM= (dscf/hr)/60 mins/hr = 18,836.4 DSCFM

where dscf/hr: 1,130,184.9

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000262 sq. ft.

where Nozzle Size: 0.2190 inches

Client: Hollingsworth & Vose		**Run:**	**1**
Source: CFU 117		**Date:**	**6/9/2019**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.4 %

where Ts:	704.4	°A
Vm(Std):	121.017	dscf
Ps:	29.924	"Hg
Vs	86.87	ft/sec
Nozzle Area:	0.000262	sq. ft.
Sampling Time:	120	min.
Bws:	0.0180	

EPA Method 26A:

19) HF laboratory results 17.9 µg/sample

20) HF = (µg/sample)/1,000,000 = 1.79E-05 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 2.28E-06 gr/dscf

where Sample:	0.00002	grams
Vm(std)	121.017	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 5.2 µg/dscm

where Sample:	0.00002	grams
Vm(std)	3.427	dscm

23) Volume/Mole $= \left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 513.914 Vol./Mole

where Ts:	704.4	°A
Ps:	29.924	"Hg

24) ppmvd $= \left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 6.28E-03 ppmvd

where MW:	20.01	g/mol
lb/hr:	0.00	
Vol./Mole:	513.914	
ADCFM:	25126.1	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 3.68E-04 lb/hr

where Cs:	2.28E-06	gr/dscf
Stack Flow:	1,130,184.9	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP2**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 117**
DATE	**6/9-10/2018**
METHOD	**13B**
POLLUTANT	**Total Fluorides**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**16:05**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**		**End Time:**	**18:14**
EPA Method:	**13B**	50 degrees, light rain		**Date:**	**6/9/2018**
Box Operator:	**DS**				
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	4A	Liner type	GLASS		
Y factor	0.9963	Nozzle ID	0.193	Nozzle size	0.1927	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area	0.000203	sq.ft.	
		Pitot Cp	0.84	Probe heat	250	F	
				Filter heat	250	F	

Source Information:

Barometric Pressure	29.88	"Hg	O_2	19.93	%
Static Pressure	0.6	"H_2O	CO_2	0.62	%
Ave. ΔP	1.86	"H_2O	Rec. Nz.	0.191	inches
Stack Temperature	250	F			
Assumed moisture	2	%			
Assumed meter temp.	52	F			
Total number of points	20				
Time per point	6				
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	16	11

Nozzle check for roundness:

1	2	3	
0.193	0.193	0.192	inches

Caliper ID# HLN#1

Post Test Calculations:

Sample volume	92.570	dcf	Ave. ΔP	1.745	"H_2O
Wet mol. weight	28.66	M_s (actual)	Ave. √ΔP	1.3196	"H_2O
Actual H_2O	2.20	%	Ave. ΔH	1.95	"H_2O
Std. meter vol.	92.525	dscf	Ave. T_s	243.7	°F
Isokinetic Average	100.5	%	Ave. T_m	67.9	°F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	239.4	263.6	24.2
		Total water gain:	44.2

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	6	4.430	1.60	241	67	1.81	1.80	2	247	45
2	12	8.830	1.60	238	66	1.82	1.80	2	247	45
3	18	13.390	1.70	243	66	1.92	1.90	2	250	45
4	24	18.040	1.80	243	66	2.03	2.00	2	250	49
5	30	22.850	1.90	244	66	2.14	2.10	2	245	50
6	36	27.680	1.90	247	66	2.13	2.10	2	245	51
7	42	32.500	1.90	249	67	2.13	2.10	2	249	53
8	48	37.310	1.90	250	67	2.12	2.10	2	249	55
9	54	42.130	1.90	252	68	2.12	2.10	2	249	55
10	60	46.896	1.90	250	68	2.13	2.10	2	251	57
11	66	51.290	1.50	234	68	1.72	1.70	2	251	57
12	72	55.830	1.70	238	68	1.94	1.90	2	248	57
13	78	60.420	1.80	238	69	2.05	2.10	2	248	57
14	84	65.020	1.70	247	69	1.92	1.90	2	248	57
15	90	69.510	1.60	246	69	1.81	1.80	2	256	58
16	96	73.820	1.50	240	69	1.71	1.70	2	256	59
17	102	78.210	1.50	241	69	1.71	1.70	2	254	59
18	108	82.650	1.60	242	69	1.82	1.80	2	255	59
19	114	87.720	2.00	245	70	2.26	2.20	2	255	59
20	120	92.570	1.90	245	70	2.15	2.10	2	252	59

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:** **2**
Location:	**Corvallis, OR**		**Start Time:** **7:36**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**	**End Time:** **9:43**
EPA Method:	**13B**	50 degrees, cloudy	**Date:** **6/10/2018**
Box Operator:	**DS**		
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	4A	Liner type:	GLASS		
Y factor	0.9963	Nozzle ID	0.193	Nozzle size:	0.1927	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000202	sq.ft.	
		Pitot Cp	0.84	Probe heat:	250	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	30.00	"Hg	O_2	19.00 %
Static Pressure	0.6	"H_2O	CO_2	0.78 %
Ave. ΔP	1.86	"H_2O	Rec. Nz.	0.188 inches
Stack Temperature	250	F		
Assumed moisture	2.2	%		
Assumed meter temp.	67.9	F		
Total number of points	20			
Time per point	6			
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:	16	11

Nozzle check for roundness:

1	2	3	
0.193	0.193	0.192	inches

Caliper ID# HLN#1

Post Test Calculations:

Sample volume	93.714	dcf	Ave. ΔP	1.83 "H_2O
Wet mol. weight	28.63	M_s (actual)	Ave. √ΔP	1.3522 "H_2O
Actual H_2O	2.3	%	Ave. ΔH	2.061 "H_2O
Std. meter vol.	95.354	dscf	Ave. T_s	236.8 °F
Isokinetic Average	101.0	%	Ave. T_m	60.8 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	230	30.0
Silica gel, g	242.4	260.2	17.8
		Total water gain:	47.8

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	6	4.410	1.70	238	54	1.88	1.90	2	255	45
2	12	8.860	1.70	239	54	1.88	1.90	2	253	38
3	18	13.450	1.80	237	56	2.00	2.00	2	253	42
4	24	18.060	1.90	239	57	2.11	2.10	2	253	45
5	30	22.850	1.90	239	59	2.12	2.10	2	254	48
6	36	27.623	1.90	239	60	2.12	2.10	2	253	50
7	42	32.400	1.90	239	61	2.12	2.12	2	250	51
8	48	37.100	1.80	238	61	2.02	2.00	2	250	50
9	54	41.730	1.80	238	62	2.02	2.00	2	250	49
10	60	46.355	1.80	237	62	2.02	2.00	2	251	49
11	66	50.710	1.50	232	61	1.69	1.70	2	253	49
12	72	55.380	1.70	231	61	1.92	1.90	2	253	50
13	78	60.120	1.90	236	62	2.14	2.20	2	253	51
14	84	64.870	1.90	236	63	2.14	2.10	2	253	50
15	90	69.630	1.90	238	63	2.14	2.10	2	251	50
16	96	74.490	1.90	237	64	2.14	2.20	2	251	48
17	102	79.280	1.90	235	64	2.15	2.20	2	251	48
18	108	84.110	1.90	235	64	2.15	2.20	2	252	48
19	114	88.950	1.90	236	64	2.15	2.20	2	255	48
20	120	93.714	1.90	236	64	2.15	2.20	2	249	48

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**3**
Location:	**Corvallis, OR**			**Start Time:**	**10:01**
Source:	**CFU 117**	**Environmental Conditions/Test Notes:**		**End Time:**	**12:05**
EPA Method:	**13B**	50 degrees, cloudy		**Date:**	**6/10/2018**
Box Operator:	**DS**				
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	4A	Liner type:	GLASS		
Y factor	0.9963	Nozzle ID	0.193	Nozzle size:	0.1927	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000202	sq.ft.	
		Pitot Cp	0.84	Probe heat:	250	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	30	"Hg	O_2	18.78	%
Static Pressure	0.6	"H_2O	CO_2	0.85	%
Ave. ΔP	1.86	"H_2O	Rec. Nz.	0.19	inches
Stack Temperature	250	F			
Assumed moisture	2.3	%			
Assumed meter temp.	60.8	F			
Total number of points	20				
Time per point	6				
Total run time	120				

Leak Checks:

	Pre-test	Post-test
Pitot:	X	X
Train leak rate, dcf:	0.002	0.000
Leak check vacuum, "Hg:	14	13

Nozzle check for roundness:

1	2	3	
0.193	0.193	0.192	inches

Caliper ID# HLN#1

Post Test Calculations:

Sample volume	92.055	dcf	Ave. ΔP	1.755	"H_2O
Wet mol. weight	28.62	M_s (actual)	Ave. √ΔP	1.3239	"H_2O
Actual H_2O	2.46	%	Ave. ΔH	1.955	"H_2O
Std. meter vol.	92.963	dscf	Ave. T_s	237.2	°F
Isokinetic Average	100.7	%	Ave. T_m	64.6	°F

Moisture/Lab:

Filter NA #

	Initial	Final	Gain
Impingers, g	200.0	232	32.0
Silica gel, g	237.1	255	17.9
		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	6	4.360	1.50	238	62	1.68	1.70	2	252	45
2	12	8.640	1.50	237	62	1.68	1.70	2	256	45
3	18	13.150	1.70	234	62	1.92	1.90	2	251	45
4	24	17.660	1.70	236	62	1.91	1.90	2	251	46
5	30	22.380	1.90	236	63	2.14	2.10	2	251	47
6	36	27.040	1.80	237	63	2.02	2.00	2	251	47
7	42	31.790	1.80	236	64	2.03	2.00	2	252	48
8	48	36.500	1.80	236	64	2.03	2.00	2	252	48
9	54	41.360	1.90	237	65	2.14	2.10	2	252	49
10	60	46.058	1.90	236	65	2.15	2.10	2	252	49
11	66	50.340	1.50	232	64	1.70	1.70	2	252	48
12	72	54.890	1.70	236	65	1.92	1.90	2	246	49
13	78	59.420	1.80	239	65	2.02	2.00	2	259	50
14	84	64.060	1.80	240	65	2.02	2.00	2	250	50
15	90	68.810	1.80	241	66	2.02	2.00	2	252	52
16	96	73.490	1.80	240	66	2.03	2.00	2	254	52
17	102	78.190	1.80	239	66	2.03	2.00	2	252	52
18	108	82.910	1.80	239	67	2.03	2.00	2	248	52
19	114	87.450	1.80	239	67	2.03	2.00	2	248	52
20	120	92.055	1.80	236	68	2.05	2.00	2	247	52

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

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**16:05**
Source:	**CFU 117**	**End Time:**	**18:14**
Method:	**13B**	**Date:**	**6/9/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	4.430	1.80	67	1	1.60	241	1.2649
12	8.830	1.80	66	2	1.60	238	1.2649
18	13.390	1.90	66	3	1.70	243	1.3038
24	18.040	2.00	66	4	1.80	243	1.3416
30	22.850	2.10	66	5	1.90	244	1.3784
36	27.680	2.10	66	6	1.90	247	1.3784
42	32.500	2.10	67	7	1.90	249	1.3784
48	37.310	2.10	67	8	1.90	250	1.3784
54	42.130	2.10	68	9	1.90	252	1.3784
60	46.896	2.10	68	10	1.90	250	1.3784
66	51.290	1.70	68	11	1.50	234	1.2247
72	55.830	1.90	68	12	1.70	238	1.3038
78	60.420	2.10	69	13	1.80	238	1.3416
84	65.020	1.90	69	14	1.70	247	1.3038
90	69.510	1.80	69	15	1.60	246	1.2649
96	73.820	1.70	69	16	1.50	240	1.2247
102	78.210	1.70	69	17	1.50	241	1.2247
108	82.650	1.80	69	18	1.60	242	1.2649
114	87.720	2.20	70	19	2.00	245	1.4142
120	92.570	2.10	70	20	1.90	245	1.3784

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 117**	**Date:**	**06/09/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	92.570	dcf	Rectangular		
Water Volume	44.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.1927	in.	Length		in
Nozzle Area	0.000203	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.88	"Hg	CO_2 Average	0.62	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.93	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.950	"H_2O	√Dp	1.3196	"H_2O
Temperature, T_m	67.9	^oF	Temperature, T_s	243.7	^oF
Temperature, T_m	527.9	^oA (^oR)	Temperature, T_s	703.7	^oA (R)
Pressure Meter, P_m	30.023	"Hg	Pressure Stack, P_s	29.924	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	92.525	dscf	Velocity, V_s	85.84	fps
	2.620	dscm	Volume (actual)	25,283.3	awcfm
Actual Volume, $V_{m(actual)}$	126.122	awcf		24,727.1	adcfm
Gas Stream Moisture			Volume (standard)	1,138,386.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.080	scf		1,113,341.8	dscf/hr
Moisture, B_{ws}	0.0220			18,555.7	dscf/min
Moisture EPA M4	2.20	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	513.404	
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.66	lb/lb-mole			
Percent Isokinetic	100.5	%			

Laboratory Results

Fluoride	< 30.0	µg/sample		
Fluoride	< 3.00E-05	grams	MW F	19.0 g/mole
Emissions:				
Concentration, C_s	< 5.00E-06	gr/dscf		
	< 11.5	µg/dscm		
	< 1.45E-02	ppmvd		
Mass Emissions	< 7.96E-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:**	**7:36**
Source:	**CFU 117**	**End Time:**	**9:43**
Method:	**13B**	**Date:**	**06/10/18**

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**	**√Dp**
	0.000						
6	4.410	1.90	54	1	1.70	238	1.3038
12	8.860	1.90	54	2	1.70	239	1.3038
18	13.450	2.00	56	3	1.80	237	1.3416
24	18.060	2.10	57	4	1.90	239	1.3784
30	22.850	2.10	59	5	1.90	239	1.3784
36	27.623	2.10	60	6	1.90	239	1.3784
42	32.400	2.12	61	7	1.90	239	1.3784
48	37.100	2.00	61	8	1.80	238	1.3416
54	41.730	2.00	62	9	1.80	238	1.3416
60	46.355	2.00	62	10	1.80	237	1.3416
66	50.710	1.70	61	11	1.50	232	1.2247
72	55.380	1.90	61	12	1.70	231	1.3038
78	60.120	2.20	62	13	1.90	236	1.3784
84	64.870	2.10	63	14	1.90	236	1.3784
90	69.630	2.10	63	15	1.90	238	1.3784
96	74.490	2.20	64	16	1.90	237	1.3784
102	79.280	2.20	64	17	1.90	235	1.3784
108	84.110	2.20	64	18	1.90	235	1.3784
114	88.950	2.20	64	19	1.90	236	1.3784
120	93.714	2.20	64	20	1.90	236	1.3784

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 117**	**Date:**	**06/10/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	93.714	dcf	Rectangular		
Water Volume	47.8	ml (g)	Width		in
Nozzle Diameter, N_z	0.1927	in.	Length		in
Nozzle Area	0.000202	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	30.00	"Hg	CO_2 Average	0.78	%vd
Static Pressure	0.60	"H_2O	O_2 Average	19.00	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	2.061	"H_2O	√Dp	1.3522	"H_2O
Temperature, T_m	60.8	^oF	Temperature, T_s	236.8	^oF
Temperature, T_m	520.8	^oA (^oR)	Temperature, T_s	696.8	^oA (R)
Pressure Meter, P_m	30.152	"Hg	Pressure Stack, P_s	30.044	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	95.354	dscf	Velocity, V_s	87.40	fps
	2.700	dscm	Volume (actual)	25,742.8	awcfm
Actual Volume, $V_{m(actual)}$	128.320	awcf		25,150.7	adcfm
Gas Stream Moisture			Volume (standard)	1,175,246.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.249	scf		1,148,215.6	dscf/hr
Moisture, B_{ws}	0.0230			19,136.9	dscf/min
Moisture EPA M4	2.30	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	506.339	
Dry, M_d	28.88	lb/lb-mole			
Wet, M_s	28.63	lb/lb-mole			
Percent Isokinetic	101.0	%			

Laboratory Results

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

Emissions:

Concentration, C_s	< 4.85E-06	gr/dscf
	< 11.1	µg/dscm
	< 1.41E-02	ppmvd
Mass Emissions	< 7.96E-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:**	**10:01**
Source:	**CFU 117**	**End Time:**	**12:05**
Method:	**13B**	**Date:**	**06/10/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
6	4.360	1.70	62	1	1.50	238	1.2247
12	8.640	1.70	62	2	1.50	237	1.2247
18	13.150	1.90	62	3	1.70	234	1.3038
24	17.660	1.90	62	4	1.70	236	1.3038
30	22.380	2.10	63	5	1.90	236	1.3784
36	27.040	2.00	63	6	1.80	237	1.3416
42	31.790	2.00	64	7	1.80	236	1.3416
48	36.500	2.00	64	8	1.80	236	1.3416
54	41.360	2.10	65	9	1.90	237	1.3784
60	46.058	2.10	65	10	1.90	236	1.3784
66	50.340	1.70	64	11	1.50	232	1.2247
72	54.890	1.90	65	12	1.70	236	1.3038
78	59.420	2.00	65	13	1.80	239	1.3416
84	64.060	2.00	65	14	1.80	240	1.3416
90	68.810	2.00	66	15	1.80	241	1.3416
96	73.490	2.00	66	16	1.80	240	1.3416
102	78.190	2.00	66	17	1.80	239	1.3416
108	82.910	2.00	67	18	1.80	239	1.3416
114	87.450	2.00	67	19	1.80	239	1.3416
120	92.055	2.00	68	20	1.80	236	1.3416

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 117**	**Date:**	**06/10/18**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	120	min	Circular		
Sample Time Interval	6	min	Diameter	30.000	in
Meter Volume, V_m	92.055	dcf	Rectangular		
Water Volume	49.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.1927	in.	Length		in
Nozzle Area	0.000202	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	30.00	"Hg	CO_2 Average	0.85	%vd
Static Pressure	0.60	"H_2O	O_2 Average	18.78	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.955	"H_2O	√Dp	1.3239	"H_2O
Temperature, T_m	64.6	^oF	Temperature, T_s	237.2	^oF
Temperature, T_m	524.6	^oA (^oR)	Temperature, T_s	697.2	^oA (R)
Pressure Meter, P_m	30.144	"Hg	Pressure Stack, P_s	30.044	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	92.963	dscf	Velocity, V_s	85.61	fps
	2.632	dscm	Volume (actual)	25,215.6	awcfm
Actual Volume, $V_{m(actual)}$	125.380	awcf		24,595.3	adcfm
Gas Stream Moisture			Volume (standard)	1,150,516.2	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.348	scf		1,122,213.5	dscf/hr
Moisture, B_{ws}	0.0246			18,703.6	dscf/min
Moisture EPA M4	2.46	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	506.63	
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.62	lb/lb-mole			
Percent Isokinetic	100.7	%			

Laboratory Results

Fluoride	34.0	µg/sample			
Fluoride	3.40E-05	grams	MW F	19.0	g/mole

Emissions:

Concentration, C_s	5.64E-06	gr/dscf
	12.9	µg/dscm
	1.63E-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 117**

Lab ID	Sample ID	Sample Date		Result	MDL	Units
18-S1063	M13B Cont. 1 Run 1	6/9/2018	<	MDL	30.0	µg/sample
18-S1064	M13B Cont. 1 Run 2	6/10/2018	<	MDL	30.0	µg/sample
18-S1065	M13B Cont. 1 Run 3	6/10/2018		34.0	30.0	µg/sample
18-S1062	H20 + Filter Blank	6/5/2018	<	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 117**

Run			1	2	3	
Date			6/9/2018	6/10/2018	6/10/2018	
Run Start Time			16:05	7:36	10:01	
Run End Time			18:14	9:43	12:05	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.88	30.00	30.00	**29.96**
Nozzle Dia., in.			0.1927	0.1927	0.1927	**0.1927**
Isokinetic Average, %			100.5	101.0	100.7	**100.7**
Sample Volume, dscf			92.525	95.354	92.963	**93.614**
Sample Volume, dscm			2.620	2.700	2.632	**2.651**
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			0.62	0.78	0.85	**0.75**
O_2 %vd			19.93	19.00	18.78	**19.24**
Static Press., "H_2O			0.60	0.60	0.60	**0.60**
H_2O %v			2.20	2.30	2.46	**2.32**
Wet Molecular Weight, lb/lb-mole			28.66	28.63	28.62	**28.64**
Velocity, FPS			85.84	87.40	85.61	**86.28**
ADCFM			24,727.1	25,150.7	24,595.3	**24,824.4**
AWCFM			25,283.3	25,742.8	25,215.6	**25,413.9**
DSCFM			18,555.7	19,136.9	18,703.6	**18,798.7**
Stack Temperature, °F			243.7	236.8	237.2	**239.2**
Fluoride	Concentration, C_s	gr/dscf	< 5.00E-06	< 4.85E-06	5.64E-06	< **5.17E-06**
		µg/dscm	< 11.5	< 11.1	12.9	< **11.8**
		ppmvd	< 1.45E-02	< 1.41E-02	1.63E-02	< **1.50E-02**
	Mass	lb/hr	< 7.96E-04	< 7.96E-04	9.05E-04	< **8.32E-04**
		lb/lb glass	< 6.77E-06	< 6.87E-06	7.86E-06	< **7.17E-06**
Production Data	Glass Production	lbs/hr	117.5	115.9	115.1	**116.2**

"<" represents MDL value

EPA Methods 1-4, 13B
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**16:05**
Source:	**CFU 117**	**End Time:**	**18:14**
Method:	**13B**	**Date:**	**6/9/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.023 "Hg

where Pb: 29.88 "Hg
ΔH: 1.950 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.924 "Hg

where Pb: 29.88 "Hg
Static Press.: 0.60 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 92.525 dscf

where Vm: 92.570 dcf
Y: 0.9963
Pm: 30.023 "Hg
Tm: 527.9 °A

4) $V_w(std) = (0.04706)(H_2O)$ = 2.080 scf

where H_2O: 44.20 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0220

where Vw(std): 2.080 scf
Vm(std): 92.525 dscf

6) % H_2O = Bws x 100 = 2.20 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 126.122 awcf

where Y: 0.9963
Vm: 92.5700 dcf
Bws: 0.0220
Ts: 703.7 °A
Tm: 527.9 °A
Pm: 30.023 "Hg
Ps: 29.924 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO)$ = 28.90 lb/lb-mole

where CO_2: 0.62 %vd
O_2 19.93 %vd
N_2+CO= (100-(O_2+CO_2): 79.45 %vd

Client: Hollingsworth & Vose		**Run:**	**1**
Source: CFU 117		**Date:**	**6/9/2018**

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

where M_d: 28.90 lb/lb-mole

Bws: 0.0220

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 85.84 fps

where Cp: 0.84

Ave. Sqrt ΔP: 1.3196

Ts: 703.7 °A

Ps: 29.924 "Hg

Ms: 28.66 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 25,283.3 AWCFM

where V_s: 85.84 ft/sec

Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 24,727.1 ADCFM

where AWCFM: 25,283.3

Bws: 0.0220

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 1,138,386.3 wscf/hr

where V_s: 85.84 ft/sec

Stack Area: 4.9090 sq. ft.

Ts: 703.7 °A

Ps: 29.924 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 1,113,341.8 dscf/hr

where wscf/hr: 1,138,386.3

Bws: 0.0220

16) DSCFM= (dscf/hr)/60 mins/hr = 18,555.7 DSCFM

where dscf/hr: 1,113,341.8

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000203 sq. ft.

where Nozzle Size: 0.1927 inches

Client: Hollingsworth & Vose		**Run:**	**1**
Source: CFU 117		**Date:**	**6/9/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.5 %

where Ts:	703.7	°A
Vm(Std):	92.525	dscf
Ps:	29.924	"Hg
Vs	85.84	ft/sec
Nozzle Area:	0.000203	sq. ft.
Sampling Time:	120	min.
Bws:	0.0220	

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) = < 5.00E-06 gr/dscf

where Sample:	0.00003	grams
Vm(std)	92.525	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 11.5 µg/dscm

where Sample:	0.00003	grams
Vm(std)	2.620	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 513.404 Vol./Mole

where Ts:	703.7	°A
Ps:	29.924	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 1.45E-02 ppmvd

where MW:	19.0	g/mol
lb/hr:	0.00	
Vol./Mole:	513.404	
ADCFM:	24727.1	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 7.96E-04 lb/hr

where Cs:	5.00E-06	gr/dscf
Stack Flow:	1,113,341.8	dscf/hr

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**
Facility	**Glass Plant 2**
Location	**Corvallis, OR**

Run	1
Date	6/9/2018
Run Start Time	16:05
Run End Time	18:11
CO_2 %vd	0.62
O_2 %vd	19.93

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 9, 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**		**System Cal Response**	**Post test System Cal. Bias**		**System Drift**		**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
				% of span	**pass/fail**		**% of span**	**pass/fail**	**% of span**	**pass/fail**				
	zero	0.01	0.04	0.15	pass	0.08	0.35	pass	0.20	pass				
Run 1	upscale	9.92	9.96	0.20	pass	9.98	0.30	pass	0.10	pass	20	19.81	19.93	10
	zero	0.01	0.04	0.15	pass	0.08	0.35	pass	0.20	pass				
Run 2	upscale	9.92	9.96	0.20	pass	9.98	0.30	pass	0.10	pass	20	0.00	-0.06	10
	zero	0.01	0.04	0.15	pass	0.08	0.35	pass	0.20	pass				
Run 3	upscale	9.92	9.96	0.20	pass	9.98	0.30	pass	0.10	pass	20	0.00	-0.06	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.01	9.92	20
Analyzer Cal. Error	0.05	-0.40	0.00
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 9, 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**
	zero	0.08	0.09	0.25	pass	0.12	1.00	pass	0.75	pass				
Run 1	upscale	1.92	1.96	1.00	pass	1.97	1.25	pass	0.25	pass	4	0.68	0.62	2
	zero	0.08	0.09	0.25	pass	0.12	1.00	pass	0.75	pass				
Run 2	upscale	1.92	1.96	1.00	pass	1.97	1.25	pass	0.25	pass	4	0.00	-0.11	2
	zero	0.08	0.09	0.25	pass	0.12	1.00	pass	0.75	pass				
Run 3	upscale	1.92	1.96	1.00	pass	1.97	1.25	pass	0.25	pass	4	0.00	-0.11	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.08	1.92	4.17
Analyzer Cal. Error	2.00	-2.00	4.25
Analyzer Cal. Error < 2%*	pass	pass	pass

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**16:05**
Source:	**CFU 117**	**End Time:**	**18:11**
Method:	**3A**	**Date:**	**6/9/2018**

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) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.20 %v

where C_{Dir}:	9.92	ppmv
C_S:	9.96	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.10 %v

where SB_{Final}:	0.30	ppmv
SB_i:	0.20	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.93 ppmv

where C_{Avg}:	19.81	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:**	**16:05**
Source:	**CFU 117**	**End Time:**	**18:11**
Method:	**3A**	**Date:**	**6/9/2018**

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) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 1.00 %v

where C_{Dir}:	1.92 ppmv
C_S:	1.96 ppmv
CS:	4.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.25 %v

where SB_{Final}:	1.25 ppmv
SB_i:	1.00 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.62 ppmv

where C_{Avg}:	0.68 ppmv
C_O:	0.11 ppmv
C_{MA}:	2.00 ppmv
C_M:	1.97 ppmv

Hollingsworth & Vose

CFU-117

Run 1

Date	Time	O2 [%]	CO2 [%]
6/9/2018	16:05:03	19.77	0.67
6/9/2018	16:06:03	19.78	0.67
6/9/2018	16:07:03	19.78	0.67
6/9/2018	16:08:03	19.79	0.67
6/9/2018	16:09:03	19.79	0.67
6/9/2018	16:10:03	19.79	0.67
6/9/2018	16:11:03	19.79	0.68
6/9/2018	16:12:03	19.80	0.68
6/9/2018	16:13:03	19.80	0.68
6/9/2018	16:14:03	19.79	0.68
6/9/2018	16:15:03	19.79	0.69
6/9/2018	16:16:03	19.79	0.69
6/9/2018	16:17:03	19.79	0.69
6/9/2018	16:18:03	19.80	0.69
6/9/2018	16:19:03	19.80	0.68
6/9/2018	16:20:03	19.80	0.68
6/9/2018	16:21:03	19.80	0.68
6/9/2018	16:22:03	19.80	0.68
6/9/2018	16:23:03	19.80	0.68
6/9/2018	16:24:03	19.81	0.68
6/9/2018	16:25:03	19.80	0.67
6/9/2018	16:26:03	19.80	0.67
6/9/2018	16:27:03	19.80	0.67
6/9/2018	16:28:03	19.80	0.67
6/9/2018	16:29:03	19.81	0.67
6/9/2018	16:30:03	19.80	0.67
6/9/2018	16:31:03	19.80	0.68
6/9/2018	16:32:03	19.80	0.67
6/9/2018	16:33:03	19.81	0.68
6/9/2018	16:34:03	19.81	0.68
6/9/2018	16:35:03	19.81	0.68
6/9/2018	16:36:03	19.80	0.68
6/9/2018	16:37:03	19.80	0.69
6/9/2018	16:38:03	19.81	0.69
6/9/2018	16:39:03	19.81	0.69
6/9/2018	16:40:03	19.81	0.69
6/9/2018	16:41:03	19.80	0.69
6/9/2018	16:42:03	19.80	0.69
6/9/2018	16:43:03	19.80	0.69
6/9/2018	16:44:03	19.81	0.69
6/9/2018	16:45:03	19.81	0.69

Hollingsworth & Vose

CFU-117

Run 1

Date	Time	O2 [%]	CO2 [%]
6/9/2018	16:46:03	19.80	0.69
6/9/2018	16:47:03	19.80	0.69
6/9/2018	16:48:03	19.80	0.68
6/9/2018	16:49:03	19.81	0.68
6/9/2018	16:50:03	19.81	0.68
6/9/2018	16:51:03	19.80	0.67
6/9/2018	16:52:03	19.80	0.68
6/9/2018	16:53:03	19.80	0.68
6/9/2018	16:54:03	19.81	0.68
6/9/2018	16:55:03	19.81	0.68
6/9/2018	16:56:03	19.81	0.68
6/9/2018	16:57:03	19.80	0.68
6/9/2018	16:58:03	19.80	0.68
6/9/2018	16:59:03	19.81	0.68
6/9/2018	17:00:03	19.81	0.68
6/9/2018	17:01:03	19.81	0.68
6/9/2018	17:02:03	19.81	0.69
6/9/2018	17:03:03	19.81	0.69
6/9/2018	17:04:03	19.81	0.69
6/9/2018	17:05:03	19.81	0.69
6/9/2018	17:06:03	19.81	0.69
6/9/2018	17:07:03	19.80	0.69
6/9/2018	17:08:03	19.80	0.69
6/9/2018	17:09:03	19.81	0.69
6/9/2018	17:10:03	19.81	0.69
6/9/2018	17:11:03	19.81	0.69
6/9/2018	17:12:03	19.80	0.69
6/9/2018	17:13:03	19.80	0.68
6/9/2018	17:14:03	19.80	0.68
6/9/2018	17:15:03	19.81	0.67
6/9/2018	17:16:03	19.81	0.67
6/9/2018	17:17:03	19.81	0.68
6/9/2018	17:18:03	19.80	0.67
6/9/2018	17:19:03	19.80	0.68
6/9/2018	17:20:03	19.81	0.67
6/9/2018	17:21:03	19.81	0.68
6/9/2018	17:22:03	19.81	0.67
6/9/2018	17:23:03	19.80	0.67
6/9/2018	17:24:03	19.81	0.67
6/9/2018	17:25:03	19.81	0.68
6/9/2018	17:26:03	19.81	0.68

Hollingsworth & Vose

CFU-117

Run 1

Date	Time	O2 [%]	CO2 [%]
6/9/2018	17:27:03	19.81	0.69
6/9/2018	17:28:03	19.80	0.69
6/9/2018	17:29:03	19.80	0.69
6/9/2018	17:30:03	19.80	0.69
6/9/2018	17:31:03	19.81	0.69
6/9/2018	17:32:03	19.81	0.69
6/9/2018	17:33:03	19.80	0.69
6/9/2018	17:34:03	19.80	0.68
6/9/2018	17:35:03	19.80	0.68
6/9/2018	17:36:03	19.80	0.68
6/9/2018	17:37:03	19.81	0.68
6/9/2018	17:38:03	19.81	0.68
6/9/2018	17:39:03	19.80	0.68
6/9/2018	17:40:03	19.80	0.67
6/9/2018	17:41:03	19.81	0.67
6/9/2018	17:42:03	19.81	0.67
6/9/2018	17:43:03	19.81	0.67
6/9/2018	17:44:03	19.80	0.67
6/9/2018	17:45:03	19.80	0.68
6/9/2018	17:46:03	19.80	0.68
6/9/2018	17:47:03	19.81	0.67
6/9/2018	17:48:03	19.82	0.67
6/9/2018	17:49:03	19.83	0.68
6/9/2018	17:50:03	19.82	0.68
6/9/2018	17:51:03	19.82	0.68
6/9/2018	17:52:03	19.82	0.68
6/9/2018	17:53:03	19.83	0.69
6/9/2018	17:54:03	19.83	0.69
6/9/2018	17:55:03	19.82	0.69
6/9/2018	17:56:03	19.82	0.69
6/9/2018	17:57:03	19.83	0.69
6/9/2018	17:58:03	19.83	0.69
6/9/2018	17:59:03	19.83	0.69
6/9/2018	18:00:03	19.83	0.69
6/9/2018	18:01:03	19.82	0.69
6/9/2018	18:02:03	19.82	0.68
6/9/2018	18:03:03	19.83	0.68
6/9/2018	18:04:03	19.83	0.68
6/9/2018	18:05:03	19.83	0.67
6/9/2018	18:06:03	19.82	0.68
6/9/2018	18:07:03	19.83	0.67

Hollingsworth & Vose

CFU-117

Run 1

Date	Time	O2 [%]	CO2 [%]
6/9/2018	18:08:03	19.83	0.67
6/9/2018	18:09:03	19.83	0.67
6/9/2018	18:10:03	19.83	0.68
6/9/2018	18:11:03	19.82	0.68
	FINAL	**19.81**	**0.68**

Hollingsworth & Vose

CFU 117

R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]		
6/9/2018	18:11:53	19.82	0.68		
6/9/2018	18:12:03	19.80	0.68		
6/9/2018	18:12:13	19.57	0.68		
6/9/2018	18:12:23	18.68	0.65		
6/9/2018	18:12:33	16.18	1.83		
6/9/2018	18:12:43	7.81	1.95		
6/9/2018	18:12:53	4.02	1.99		
6/9/2018	18:13:03	2.73	1.94		
6/9/2018	18:13:13	1.38	1.07		
6/9/2018	18:13:23	0.08	0.51		
6/9/2018	18:13:33	0.08	0.27		
6/9/2018	18:13:43	0.08	0.17		
6/9/2018	18:13:53	0.08	0.14		
6/9/2018	18:14:03	0.08	0.12		
6/9/2018	18:14:13	0.08	0.12		
6/9/2018	18:14:23	0.08	0.12		
6/9/2018	18:14:33	0.08	0.12	0.08	0.12
6/9/2018	18:14:43	0.08	0.12		
6/9/2018	18:14:53	0.08	0.12		
6/9/2018	18:15:03	0.08	0.12		
6/9/2018	18:15:13	0.08	0.11		
6/9/2018	18:15:23	2.15	0.18		
6/9/2018	18:15:33	2.06	0.19		
6/9/2018	18:15:43	1.65	0.16		
6/9/2018	18:15:53	6.41	0.34		
6/9/2018	18:16:03	7.41	0.77		
6/9/2018	18:16:13	8.56	4.87		
6/9/2018	18:16:23	9.55	8.16		
6/9/2018	18:16:33	9.83	9.20		
6/9/2018	18:16:43	9.92	9.56		
6/9/2018	18:16:53	9.96	9.70		
6/9/2018	18:17:03	9.97	9.75		
6/9/2018	18:17:13	9.97	9.77		
6/9/2018	18:17:23	9.98	9.78		
6/9/2018	18:17:33	9.97	9.79		
6/9/2018	18:17:43	9.98	9.79		
6/9/2018	18:17:53	9.98	9.79		
6/9/2018	18:18:03	9.98	9.80		
6/9/2018	18:18:13	9.98	9.80		
6/9/2018	18:18:23	9.98	9.80	9.98	
6/9/2018	18:18:33	9.98	9.81		

Hollingsworth & Vose

CFU 117

R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]	
6/9/2018	18:18:43	9.98	9.81	
6/9/2018	18:18:53	9.98	9.81	
6/9/2018	18:19:03	9.97	9.81	
6/9/2018	18:19:13	11.70	8.18	
6/9/2018	18:19:23	14.30	5.83	
6/9/2018	18:19:33	14.32	3.40	
6/9/2018	18:19:43	5.98	1.52	
6/9/2018	18:19:53	2.48	1.11	
6/9/2018	18:20:03	2.15	1.70	
6/9/2018	18:20:13	2.05	1.86	
6/9/2018	18:20:23	2.02	1.93	
6/9/2018	18:20:33	2.01	1.95	
6/9/2018	18:20:43	2.01	1.97	
6/9/2018	18:20:53	2.01	1.96	
6/9/2018	18:21:03	2.01	1.97	
6/9/2018	18:21:13	2.01	1.96	
6/9/2018	18:21:23	2.01	1.97	1.97

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 117**
Facility	**Glass Plant 2**	Date	**June 10, 2018**
Location	**Corvallis, OR**		

Run	2	3	
Date	6/10/2018	6/10/2018	
Run Start Time	7:35	10:00	
Run End Time	9:43	12:07	Average:
CO_2 %vd	0.78	0.85	0.81
O_2 %vd	19.00	18.78	18.89

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 10, 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**		**System Cal Response**	**Post test System Cal. Bias**		**System Drift**		**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
				% of span	**pass/fail**		**% of span**	**pass/fail**	**% of span**	**pass/fail**				
	zero	0.06	0.04	-0.10	pass	0.05	-0.05	pass	0.05	pass				
Run 2	upscale	9.88	9.98	0.50	pass	9.87	-0.05	pass	-0.55	pass	20	18.82	19.00	10
	zero	0.06	0.05	-0.05	pass	0.04	-0.10	pass	-0.05	pass				
Run 3	upscale	9.88	9.87	-0.05	pass	9.85	-0.15	pass	-0.10	pass	20	18.48	18.78	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.06	9.88	20.01
Analyzer Cal. Error	0.30	-0.60	0.05
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 117**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 2**	Date	**June 10, 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**		**System Cal Response**	**Post test System Cal. Bias**		**System Drift**		**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
				% of span	**pass/fail**		**% of span**	**pass/fail**	**% of span**	**pass/fail**				
	zero	0.14	0.10	-1.00	pass	0.11	-0.75	pass	0.25	pass				
Run 2	upscale	1.92	1.94	0.50	pass	1.95	0.75	pass	0.25	pass	4	0.82	0.78	2
	zero	0.14	0.11	-0.75	pass	0.09	-1.25	pass	-0.50	pass				
Run 3	upscale	1.92	1.95	0.75	pass	1.91	-0.25	pass	-1.00	pass	4	0.88	0.85	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.14	1.92	4.11
Analyzer Cal. Error	3.50	-2.00	2.75
Analyzer Cal. Error < 2%*	pass	pass	pass

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**7:35**
Source:	**CFU 117**	**End Time:**	**9:43**
Method:	**3A**	**Date:**	**6/10/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.60 %v

where C_{Dir}:	9.88	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

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

where C_{Dir}:	9.88	ppmv
C_S:	9.98	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.55 %v

where SB_{Final}:	-0.05	ppmv
SB_i:	0.50	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.00 ppmv

where C_{Avg}:	18.82	ppmv
C_O:	0.05	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.93	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**7:35**
Source:	**CFU 117**	**End Time:**	**9:43**
Method:	**3A**	**Date:**	**6/10/2018**

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) $D = | SB_{Final} - SB_i | =$ 0.25 %v

where SB_{Final}:	0.75 ppmv
SB_i:	0.50 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.78 ppmv

where C_{Avg}:	0.82 ppmv
C_O:	0.11 ppmv
C_{MA}:	2.00 ppmv
C_M:	1.95 ppmv

Hollingsworth & Vose

6/10/2018

CFU 117

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/10/2018	7:11:39	20.16	19.69		
6/10/2018	7:11:49	20.17	19.70		
6/10/2018	7:11:59	20.17	19.70		
6/10/2018	7:12:09	20.17	19.70		
6/10/2018	7:12:19	20.17	19.69		
6/10/2018	7:12:29	20.17	19.71		
6/10/2018	7:12:39	20.05	19.69		
6/10/2018	7:12:49	20.01	19.71		
6/10/2018	7:12:59	20.01	19.70		
6/10/2018	7:13:09	20.01	19.70		
6/10/2018	7:13:19	20.01	19.70	20.01	
6/10/2018	7:13:29	20.01	19.69		
6/10/2018	7:13:39	20.01	19.70		
6/10/2018	7:13:49	16.57	14.51		
6/10/2018	7:13:59	0.99	0.46		
6/10/2018	7:14:09	0.12	0.19		
6/10/2018	7:14:19	0.08	0.16		
6/10/2018	7:14:29	0.07	0.16		
6/10/2018	7:14:39	0.07	0.15		
6/10/2018	7:14:49	0.06	0.14		
6/10/2018	7:14:59	0.06	0.14		
6/10/2018	7:15:09	0.06	0.13	0.06	0.14
6/10/2018	7:15:19	0.05	0.13		
6/10/2018	7:15:29	0.06	0.13		
6/10/2018	7:15:39	0.05	0.12		
6/10/2018	7:15:49	0.05	0.12		
6/10/2018	7:15:59	0.05	0.11		
6/10/2018	7:16:09	0.02	0.11		
6/10/2018	7:16:19	0.07	0.11		
6/10/2018	7:16:29	6.05	6.69		
6/10/2018	7:16:39	9.81	9.81		
6/10/2018	7:16:49	9.84	9.75		
6/10/2018	7:16:59	9.85	9.76		
6/10/2018	7:17:09	9.86	9.77		
6/10/2018	7:17:19	9.86	9.78		
6/10/2018	7:17:29	9.87	9.78		
6/10/2018	7:17:39	9.87	9.79		
6/10/2018	7:17:49	9.87	9.79		
6/10/2018	7:17:59	9.88	9.79		
6/10/2018	7:18:09	9.88	9.79		

Hollingsworth & Vose

6/10/2018

CFU 117

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/10/2018	7:18:19	9.88	9.80		
6/10/2018	7:18:29	9.88	9.80	9.88	
6/10/2018	7:18:39	9.88	9.79		
6/10/2018	7:18:49	9.80	9.80		
6/10/2018	7:18:59	8.70	9.70		
6/10/2018	7:19:09	9.07	9.69		
6/10/2018	7:19:19	4.03	2.73		
6/10/2018	7:19:29	0.43	0.41		
6/10/2018	7:19:39	3.84	4.42		
6/10/2018	7:19:49	3.95	4.17		
6/10/2018	7:19:59	3.95	4.18		
6/10/2018	7:20:09	3.96	4.19		
6/10/2018	7:20:19	3.96	4.18		
6/10/2018	7:20:29	3.97	4.18		
6/10/2018	7:20:39	3.97	4.14		
6/10/2018	7:20:49	3.97	4.11		
6/10/2018	7:20:59	3.97	4.12		
6/10/2018	7:21:09	3.98	4.10		
6/10/2018	7:21:19	3.98	4.11		4.11
6/10/2018	7:21:29	3.38	3.21		
6/10/2018	7:21:39	2.11	2.01		
6/10/2018	7:21:49	1.99	1.90		
6/10/2018	7:21:59	1.98	1.91		
6/10/2018	7:22:09	1.98	1.90		
6/10/2018	7:22:19	1.98	1.90		
6/10/2018	7:22:29	1.99	1.92		
6/10/2018	7:22:39	1.98	1.92		
6/10/2018	7:22:49	1.98	1.92		
6/10/2018	7:22:59	1.98	1.92		
6/10/2018	7:23:09	1.98	1.92		
6/10/2018	7:23:19	1.98	1.92		
6/10/2018	7:23:29	1.98	1.92		
6/10/2018	7:23:39	1.98	1.92		1.92
6/10/2018	7:23:49	1.97	1.91		
6/10/2018	7:23:59	1.97	1.92		
6/10/2018	7:24:09	1.98	1.91		
6/10/2018	7:24:19	1.98	1.92		
6/10/2018	7:24:29	1.98	1.91		
6/10/2018	7:24:39	1.98	1.91		

Hollingsworth & Vose

6/10/2018

CFU 117

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/10/2018	7:24:49	1.82	1.90		
6/10/2018	7:24:59	1.77	1.90		
6/10/2018	7:25:09	1.77	1.96		
6/10/2018	7:25:19	3.28	3.04		
6/10/2018	7:25:29	2.56	2.23		
6/10/2018	7:25:39	5.02	1.72		
6/10/2018	7:25:49	19.52	1.11		
6/10/2018	7:25:59	17.61	2.49		
6/10/2018	7:26:09	13.58	1.72		
6/10/2018	7:26:19	11.95	1.51		
6/10/2018	7:26:29	11.35	1.40		
6/10/2018	7:26:39	11.13	1.37		
6/10/2018	7:26:49	11.04	1.36		
6/10/2018	7:26:59	11.01	1.36		
6/10/2018	7:27:09	10.97	1.37		
6/10/2018	7:27:19	13.02	1.21		
6/10/2018	7:27:29	17.43	0.90		
6/10/2018	7:27:39	19.38	0.75		
6/10/2018	7:27:49	20.11	0.70		
6/10/2018	7:27:59	20.38	0.68		
6/10/2018	7:28:09	20.48	0.68		
6/10/2018	7:28:19	20.51	0.66		
6/10/2018	7:28:29	20.56	0.67		
6/10/2018	7:28:39	19.21	0.78		
6/10/2018	7:28:49	14.57	0.74		
6/10/2018	7:28:59	13.56	0.82		
6/10/2018	7:29:09	17.44	0.74		
6/10/2018	7:29:19	19.36	0.69		
6/10/2018	7:29:29	20.09	0.67		
6/10/2018	7:29:39	20.39	0.67		
6/10/2018	7:29:49	20.04	0.72		
6/10/2018	7:29:59	11.51	0.65		
System					
6/10/2018	7:30:09	4.48	0.43		
6/10/2018	7:30:19	1.85	0.39		
6/10/2018	7:30:29	0.71	0.22		
6/10/2018	7:30:39	0.29	0.15		

Hollingsworth & Vose

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/10/2018	7:30:49	0.14	0.12		
6/10/2018	7:30:59	0.08	0.10		
6/10/2018	7:31:09	0.07	0.10		
6/10/2018	7:31:19	0.06	0.10		
6/10/2018	7:31:29	0.04	0.10		
6/10/2018	7:31:39	0.05	0.11		
6/10/2018	7:31:49	0.04	0.10		
6/10/2018	7:31:59	0.04	0.10	0.04	0.10
6/10/2018	7:32:09	0.05	0.11		
6/10/2018	7:32:19	0.18	0.12		
6/10/2018	7:32:29	0.85	0.14		
6/10/2018	7:32:39	1.43	1.07		
6/10/2018	7:32:49	1.82	1.66		
6/10/2018	7:32:59	1.94	1.81		
6/10/2018	7:33:09	1.98	1.87		
6/10/2018	7:33:19	1.99	1.89		
6/10/2018	7:33:29	2.00	1.90		
6/10/2018	7:33:39	2.00	1.91		
6/10/2018	7:33:49	2.01	1.92		
6/10/2018	7:33:59	2.01	1.93		
6/10/2018	7:34:09	2.01	1.92		
6/10/2018	7:34:19	2.01	1.93		
6/10/2018	7:34:29	2.01	1.93		
6/10/2018	7:34:39	2.01	1.94		
6/10/2018	7:34:49	2.01	1.94		1.94
6/10/2018	7:34:59	2.23	1.92		
6/10/2018	7:35:09	9.50	1.41		
6/10/2018	7:35:19	15.97	0.99		
6/10/2018	7:35:29	13.49	4.43		
6/10/2018	7:35:39	11.11	7.96		
6/10/2018	7:35:49	10.34	9.11		
6/10/2018	7:35:59	10.10	9.50		
6/10/2018	7:36:09	10.01	9.64		
6/10/2018	7:36:19	9.99	9.68		
6/10/2018	7:36:29	9.98	9.70		
6/10/2018	7:36:39	9.98	9.70		
6/10/2018	7:36:49	9.98	9.72		
6/10/2018	7:36:59	9.98	9.72		
6/10/2018	7:37:09	9.98	9.73	9.98	

Hollingsworth & Vose

CFU-117

Run 2

Date	Time	O2 [%]	CO2 [%]
6/10/2018	7:39:19	19.84	0.68
6/10/2018	7:40:19	19.84	0.68
6/10/2018	7:41:19	19.85	0.67
6/10/2018	7:42:19	19.85	0.67
6/10/2018	7:43:19	19.84	0.66
6/10/2018	7:44:19	19.84	0.66
6/10/2018	7:45:19	19.81	0.66
6/10/2018	7:46:19	19.75	0.66
6/10/2018	7:47:19	19.74	0.66
6/10/2018	7:48:19	19.75	0.66
6/10/2018	7:49:19	19.75	0.66
6/10/2018	7:50:19	19.74	0.66
6/10/2018	7:51:19	19.73	0.66
6/10/2018	7:52:19	19.73	0.66
6/10/2018	7:53:19	19.73	0.66
6/10/2018	7:54:19	19.73	0.66
6/10/2018	7:55:19	19.73	0.67
6/10/2018	7:56:19	19.72	0.67
6/10/2018	7:57:19	19.72	0.67
6/10/2018	7:58:19	19.73	0.67
6/10/2018	7:59:19	19.73	0.67
6/10/2018	8:00:19	19.71	0.67
6/10/2018	8:01:19	19.71	0.67
6/10/2018	8:02:19	19.70	0.67
6/10/2018	8:03:19	19.70	0.67
6/10/2018	8:04:19	19.70	0.67
6/10/2018	8:05:19	19.70	0.67
6/10/2018	8:06:19	19.70	0.66
6/10/2018	8:07:19	19.71	0.66
6/10/2018	8:08:19	19.72	0.66
6/10/2018	8:09:19	19.70	0.66
6/10/2018	8:10:19	19.70	0.65
6/10/2018	8:11:19	19.70	0.65
6/10/2018	8:12:19	19.70	0.65
6/10/2018	8:13:19	19.69	0.65
6/10/2018	8:14:19	19.69	0.66
6/10/2018	8:15:19	19.69	0.65
6/10/2018	8:16:19	19.69	0.65
6/10/2018	8:17:19	19.69	0.65
6/10/2018	8:18:19	19.69	0.65
6/10/2018	8:19:19	19.68	0.66

Hollingsworth & Vose

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/10/2018	8:20:19	19.69	0.65
6/10/2018	8:21:19	19.70	0.66
6/10/2018	8:22:19	19.70	0.66
6/10/2018	8:23:19	19.69	0.66
6/10/2018	8:24:19	19.69	0.67
6/10/2018	8:25:19	19.69	0.67
6/10/2018	8:26:19	19.69	0.66
6/10/2018	8:27:19	19.69	0.66
6/10/2018	8:28:19	19.68	0.67
6/10/2018	8:29:19	19.68	0.66
6/10/2018	8:30:19	19.68	0.66
6/10/2018	8:31:19	19.69	0.66
6/10/2018	8:32:19	19.69	0.66
6/10/2018	8:33:19	19.69	0.66
6/10/2018	8:34:19	19.68	0.66
6/10/2018	8:35:19	19.69	0.66
6/10/2018	8:36:19	19.69	0.66
6/10/2018	8:37:19	19.69	0.65
6/10/2018	8:38:19	19.68	0.65
6/10/2018	8:39:19	19.68	0.65
6/10/2018	8:40:19	19.69	0.65
6/10/2018	8:41:19	19.69	0.65
6/10/2018	8:42:19	19.67	0.65
6/10/2018	8:43:19	19.68	0.65
6/10/2018	8:44:19	19.68	0.65
6/10/2018	8:45:19	19.68	0.66
6/10/2018	8:46:19	19.69	0.66
6/10/2018	8:47:19	19.69	0.65
6/10/2018	8:48:19	19.67	0.66
6/10/2018	8:49:19	19.68	0.66
6/10/2018	8:50:19	19.68	0.66
6/10/2018	8:51:19	19.69	0.66
6/10/2018	8:52:19	19.69	0.67
6/10/2018	8:53:19	19.68	0.66
6/10/2018	8:54:19	19.68	0.66
6/10/2018	8:55:19	19.68	0.66
6/10/2018	8:56:19	19.69	0.66
6/10/2018	8:57:19	19.69	0.66
6/10/2018	8:58:19	19.68	0.66
6/10/2018	8:59:19	19.68	0.66
6/10/2018	9:00:19	19.69	0.66

Hollingsworth & Vose

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/10/2018	9:01:19	19.69	0.66
6/10/2018	9:02:19	19.69	0.65
6/10/2018	9:03:19	19.69	0.65
6/10/2018	9:04:19	19.69	0.65
6/10/2018	9:05:19	19.69	0.65
6/10/2018	9:06:19	19.69	0.65
6/10/2018	9:07:19	19.69	0.65
6/10/2018	9:08:19	19.68	0.65
6/10/2018	9:09:19	19.68	0.65
6/10/2018	9:10:19	19.68	0.65
6/10/2018	9:11:19	19.69	0.65
6/10/2018	9:12:19	19.69	0.65
6/10/2018	9:13:19	19.69	0.65
6/10/2018	9:14:19	19.69	0.65
6/10/2018	9:15:19	19.69	0.66
6/10/2018	9:16:19	19.69	0.66
6/10/2018	9:17:19	19.69	0.66
6/10/2018	9:18:19	19.68	0.67
6/10/2018	9:19:19	19.68	0.66
6/10/2018	9:20:19	19.68	0.66
6/10/2018	9:21:19	19.68	0.66
6/10/2018	9:22:19	19.69	0.66
6/10/2018	9:23:19	19.69	0.66
6/10/2018	9:24:19	19.68	0.66
6/10/2018	9:25:19	19.68	0.66
6/10/2018	9:26:19	19.68	0.66
6/10/2018	9:27:19	19.69	0.66
6/10/2018	9:28:19	19.68	0.66
6/10/2018	9:29:19	19.68	0.66
6/10/2018	9:30:19	19.68	0.65
6/10/2018	9:31:19	19.68	0.65
6/10/2018	9:32:19	19.68	0.65
6/10/2018	9:33:19	19.68	0.66
6/10/2018	9:34:19	19.67	0.65
6/10/2018	9:35:19	19.67	0.65
6/10/2018	9:36:19	19.68	0.66
6/10/2018	9:37:19	19.68	0.66
6/10/2018	9:38:19	19.68	0.66
6/10/2018	9:39:19	19.67	0.66
6/10/2018	9:40:19	19.67	0.66
6/10/2018	9:41:19	19.67	0.66

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/10/2018	9:42:19	19.68	0.66
6/10/2018	9:43:19	19.67	0.66
6/10/2018	9:44:19	9.62	0.59
6/10/2018	9:45:19	0.10	0.12
6/10/2018	9:46:19	0.06	0.11
6/10/2018	9:47:19	8.31	8.21
6/10/2018	9:48:19	9.87	9.70
6/10/2018	9:49:19	7.92	4.09
6/10/2018	9:50:19	2.00	1.93
6/10/2018	9:51:19	1.99	1.95
	FINAL	**18.82**	**0.82**

Hollingsworth & Vose

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R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/10/2018	9:44:29	19.54	0.81		
6/10/2018	9:44:39	12.27	1.14		
6/10/2018	9:44:49	4.28	0.51		
6/10/2018	9:44:59	1.44	0.26		
6/10/2018	9:45:09	0.52	0.16		
6/10/2018	9:45:19	0.22	0.13		
6/10/2018	9:45:29	0.12	0.12		
6/10/2018	9:45:39	0.08	0.11		
6/10/2018	9:45:49	0.06	0.12		
6/10/2018	9:45:59	0.06	0.11		
6/10/2018	9:46:09	0.05	0.11		
6/10/2018	9:46:19	0.05	0.12	0.05	0.11
6/10/2018	9:46:29	0.05	0.11		
6/10/2018	9:46:39	0.05	0.10		
6/10/2018	9:46:49	0.04	0.11		
6/10/2018	9:46:59	0.04	0.11		
6/10/2018	9:47:09	0.11	0.12		
6/10/2018	9:47:19	3.66	3.66		
6/10/2018	9:47:29	7.79	7.82		
6/10/2018	9:47:39	9.18	9.04		
6/10/2018	9:47:49	9.63	9.46		
6/10/2018	9:47:59	9.79	9.61		
6/10/2018	9:48:09	9.84	9.66		
6/10/2018	9:48:19	9.86	9.68		
6/10/2018	9:48:29	9.87	9.69		
6/10/2018	9:48:39	9.87	9.70		
6/10/2018	9:48:49	9.87	9.71		
6/10/2018	9:48:59	9.87	9.70		
6/10/2018	9:49:09	9.87	9.72	9.87	
6/10/2018	9:49:19	9.85	9.70		
6/10/2018	9:49:29	12.95	6.68		
6/10/2018	9:49:39	14.16	3.63		
6/10/2018	9:49:49	5.99	1.57		
6/10/2018	9:49:59	2.46	1.21		
6/10/2018	9:50:09	2.13	1.74		
6/10/2018	9:50:19	2.03	1.87		
6/10/2018	9:50:29	2.00	1.92		
6/10/2018	9:50:39	1.99	1.93		
6/10/2018	9:50:49	1.99	1.96		
6/10/2018	9:50:59	1.98	1.95		
6/10/2018	9:51:09	1.99	1.95		

Hollingsworth & Vose

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R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/10/2018	9:51:19	1.99	1.95		
6/10/2018	9:51:29	1.99	1.95		
6/10/2018	9:51:39	1.99	1.94		
6/10/2018	9:51:49	1.99	1.95		
6/10/2018	9:51:59	1.99	1.95		
6/10/2018	9:52:09	1.99	1.96		
6/10/2018	9:52:19	1.99	1.94		
6/10/2018	9:52:29	1.99	1.95		
6/10/2018	9:52:39	1.99	1.95		1.95

Hollingsworth & Vose

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/10/2018	10:00:30	19.66	0.66
6/10/2018	10:01:30	19.67	0.66
6/10/2018	10:02:30	19.68	0.66
6/10/2018	10:03:30	19.68	0.66
6/10/2018	10:04:30	19.67	0.66
6/10/2018	10:05:30	19.67	0.66
6/10/2018	10:06:30	19.67	0.66
6/10/2018	10:07:30	19.67	0.67
6/10/2018	10:08:30	19.68	0.67
6/10/2018	10:09:30	19.67	0.67
6/10/2018	10:10:30	19.67	0.67
6/10/2018	10:11:30	19.67	0.67
6/10/2018	10:12:30	19.66	0.67
6/10/2018	10:13:30	19.68	0.67
6/10/2018	10:14:30	19.67	0.67
6/10/2018	10:15:30	19.67	0.66
6/10/2018	10:16:30	19.67	0.66
6/10/2018	10:17:30	19.68	0.66
6/10/2018	10:18:30	19.68	0.65
6/10/2018	10:19:30	19.68	0.66
6/10/2018	10:20:30	19.67	0.66
6/10/2018	10:21:30	19.66	0.65
6/10/2018	10:22:30	19.67	0.65
6/10/2018	10:23:30	19.67	0.65
6/10/2018	10:24:30	19.68	0.65
6/10/2018	10:25:30	19.67	0.65
6/10/2018	10:26:30	19.67	0.65
6/10/2018	10:27:30	19.67	0.65
6/10/2018	10:28:30	19.67	0.66
6/10/2018	10:29:30	19.67	0.66
6/10/2018	10:30:30	19.67	0.66
6/10/2018	10:31:30	19.67	0.66
6/10/2018	10:32:30	19.67	0.66
6/10/2018	10:33:30	19.67	0.67
6/10/2018	10:34:30	19.67	0.67
6/10/2018	10:35:30	19.67	0.67
6/10/2018	10:36:30	19.66	0.67
6/10/2018	10:37:30	19.66	0.66
6/10/2018	10:38:30	19.67	0.66
6/10/2018	10:39:30	19.67	0.67
6/10/2018	10:40:30	19.67	0.66

Hollingsworth & Vose

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/10/2018	10:41:30	19.66	0.66
6/10/2018	10:42:30	19.66	0.66
6/10/2018	10:43:30	19.66	0.66
6/10/2018	10:44:30	19.66	0.66
6/10/2018	10:45:30	19.66	0.66
6/10/2018	10:46:30	19.66	0.65
6/10/2018	10:47:30	19.66	0.65
6/10/2018	10:48:30	19.66	0.65
6/10/2018	10:49:30	19.66	0.65
6/10/2018	10:50:30	19.67	0.65
6/10/2018	10:51:30	19.66	0.65
6/10/2018	10:52:30	19.66	0.65
6/10/2018	10:53:30	19.66	0.65
6/10/2018	10:54:30	19.66	0.66
6/10/2018	10:55:30	19.67	0.66
6/10/2018	10:56:30	19.65	0.66
6/10/2018	10:57:30	19.65	0.66
6/10/2018	10:58:30	19.65	0.66
6/10/2018	10:59:30	19.66	0.66
6/10/2018	11:00:30	19.66	0.67
6/10/2018	11:01:30	19.66	0.67
6/10/2018	11:02:30	19.65	0.67
6/10/2018	11:03:30	19.65	0.67
6/10/2018	11:04:30	19.65	0.67
6/10/2018	11:05:30	19.66	0.67
6/10/2018	11:06:30	19.66	0.67
6/10/2018	11:07:30	19.65	0.66
6/10/2018	11:08:30	19.65	0.66
6/10/2018	11:09:30	19.65	0.66
6/10/2018	11:10:30	19.66	0.66
6/10/2018	11:11:30	19.66	0.65
6/10/2018	11:12:30	19.65	0.66
6/10/2018	11:13:30	19.65	0.65
6/10/2018	11:14:30	19.65	0.65
6/10/2018	11:15:30	19.65	0.65
6/10/2018	11:16:30	19.66	0.65
6/10/2018	11:17:30	19.65	0.65
6/10/2018	11:18:30	19.65	0.65
6/10/2018	11:19:30	19.65	0.65
6/10/2018	11:20:30	19.65	0.65
6/10/2018	11:21:30	19.65	0.66

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/10/2018	11:22:30	19.65	0.66
6/10/2018	11:23:30	19.64	0.66
6/10/2018	11:24:30	19.64	0.66
6/10/2018	11:25:30	19.65	0.66
6/10/2018	11:26:30	19.65	0.67
6/10/2018	11:27:30	19.65	0.67
6/10/2018	11:28:30	19.65	0.66
6/10/2018	11:29:30	19.64	0.66
6/10/2018	11:30:30	19.64	0.67
6/10/2018	11:31:30	19.65	0.66
6/10/2018	11:32:30	19.65	0.66
6/10/2018	11:33:30	19.64	0.66
6/10/2018	11:34:30	19.64	0.66
6/10/2018	11:35:30	19.64	0.66
6/10/2018	11:36:30	19.64	0.66
6/10/2018	11:37:30	19.65	0.66
6/10/2018	11:38:30	19.65	0.65
6/10/2018	11:39:30	19.64	0.65
6/10/2018	11:40:30	19.64	0.65
6/10/2018	11:41:30	19.65	0.65
6/10/2018	11:42:30	19.65	0.65
6/10/2018	11:43:30	19.64	0.65
6/10/2018	11:44:30	19.64	0.65
6/10/2018	11:45:30	19.64	0.65
6/10/2018	11:46:30	19.64	0.65
6/10/2018	11:47:30	19.65	0.66
6/10/2018	11:48:30	19.65	0.66
6/10/2018	11:49:30	19.64	0.66
6/10/2018	11:50:30	19.64	0.66
6/10/2018	11:51:30	19.64	0.66
6/10/2018	11:52:30	19.64	0.67
6/10/2018	11:53:30	19.64	0.67
6/10/2018	11:54:30	19.64	0.66
6/10/2018	11:55:30	19.63	0.67
6/10/2018	11:56:30	19.63	0.67
6/10/2018	11:57:30	19.64	0.66
6/10/2018	11:58:30	19.64	0.66
6/10/2018	11:59:30	19.63	0.66
6/10/2018	12:00:30	19.63	0.66
6/10/2018	12:01:30	19.63	0.66
6/10/2018	12:02:30	19.64	0.66

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/10/2018	12:03:30	19.64	0.65
6/10/2018	12:04:30	19.63	0.65
6/10/2018	12:05:30	19.63	0.65
6/10/2018	12:06:30	19.63	0.65
6/10/2018	12:07:30	11.47	0.48
6/10/2018	12:08:30	0.12	0.09
6/10/2018	12:09:30	0.03	0.09
6/10/2018	12:10:30	0.08	0.11
6/10/2018	12:11:30	1.77	1.69
6/10/2018	12:12:30	1.96	1.90
6/10/2018	12:13:30	1.97	1.92
6/10/2018	12:14:30	7.21	2.54
6/10/2018	12:15:30	9.99	9.42
6/10/2018	12:16:30	9.85	9.71
6/10/2018	12:17:30	9.87	9.70
	FINAL	**18.48**	**0.88**

Hollingsworth & Vose

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R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/10/2018	12:07:40	19.68	0.65		
6/10/2018	12:07:50	17.84	0.73		
6/10/2018	12:08:00	8.08	0.48		
6/10/2018	12:08:10	2.7	0.23		
6/10/2018	12:08:20	0.92	0.13		
6/10/2018	12:08:30	0.34	0.11		
6/10/2018	12:08:40	0.15	0.09		
6/10/2018	12:08:50	0.08	0.09		
6/10/2018	12:09:00	0.06	0.09		
6/10/2018	12:09:10	0.05	0.09		
6/10/2018	12:09:20	0.05	0.09		
6/10/2018	12:09:30	0.04	0.09		
6/10/2018	12:09:40	0.04	0.09		
6/10/2018	12:09:50	0.04	0.09	0.04	0.09
6/10/2018	12:10:00	0.03	0.09		
6/10/2018	12:10:10	0.03	0.09		
6/10/2018	12:10:20	0.03	0.09		
6/10/2018	12:10:30	0.03	0.09		
6/10/2018	12:10:40	0.03	0.09		
6/10/2018	12:10:50	0.02	0.09		
6/10/2018	12:11:00	0.03	0.09		
6/10/2018	12:11:10	0.05	0.09		
6/10/2018	12:11:20	0.34	0.21		
6/10/2018	12:11:30	1.23	1.17		
6/10/2018	12:11:40	1.71	1.59		
6/10/2018	12:11:50	1.87	1.78		
6/10/2018	12:12:00	1.91	1.84		
6/10/2018	12:12:10	1.93	1.86		
6/10/2018	12:12:20	1.94	1.88		
6/10/2018	12:12:30	1.95	1.89		
6/10/2018	12:12:40	1.96	1.9		
6/10/2018	12:12:50	1.96	1.9		
6/10/2018	12:13:00	1.96	1.91		
6/10/2018	12:13:10	1.96	1.9		
6/10/2018	12:13:20	1.96	1.92		
6/10/2018	12:13:30	1.96	1.92		1.91
6/10/2018	12:13:40	1.97	1.92		
6/10/2018	12:13:50	1.97	1.92		
6/10/2018	12:14:00	1.96	1.92		
6/10/2018	12:14:10	1.97	1.93		
6/10/2018	12:14:20	1.97	1.93		

Hollingsworth & Vose

CFU 117

R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/10/2018	12:14:30	1.97	1.93		
6/10/2018	12:14:40	1.97	1.93		
6/10/2018	12:14:50	2.52	1.88		
6/10/2018	12:15:00	10.53	1.3		
6/10/2018	12:15:10	14.57	1.8		
6/10/2018	12:15:20	11.67	6.43		
6/10/2018	12:15:30	10.44	8.58		
6/10/2018	12:15:40	10.04	9.31		
6/10/2018	12:15:50	9.91	9.56		
6/10/2018	12:16:00	9.86	9.66		
6/10/2018	12:16:10	9.86	9.69		
6/10/2018	12:16:20	9.85	9.7		
6/10/2018	12:16:30	9.85	9.71		
6/10/2018	12:16:40	9.85	9.7		
6/10/2018	12:16:50	9.85	9.71		
6/10/2018	12:17:00	9.85	9.72		
6/10/2018	12:17:10	9.85	9.72		
6/10/2018	12:17:20	9.85	9.72		
6/10/2018	12:17:30	9.85	9.72		
6/10/2018	12:17:40	9.85	9.73		
6/10/2018	12:17:50	9.85	9.72		
6/10/2018	12:18:00	9.85	9.72	9.85	
6/10/2018	12:18:10	9.84	9.73		
6/10/2018	12:18:20	9.98	9.57		

SHEET NO. ____ OF ____
PROJECT NO. ____
DATE ____
BY ____
CHK'D ____

SUBJECT Hi V

06/08/18 CFV-117 gas log

M24/30B wet test

O_2 / CO_2 gas test

Leak check

A O_2	S CO_2
0	0
20	4
10	2

begin cals @ 6:45

	start	end
R-1	7:35	10:45
R-2	11:05	14:13
R-3	14:27	17:35

Leak check "0" Flow "pass"

SHEET NO. 1 OF 2

PROJECT NO.

DATE

BY

SUBJECT CHK'D

06/09/18 CFV 117

M-316 / M-5 wet test

NO_x, CO, O_2, CO_2, NMOC, CH_4

leak check 0 Flow "pass"

begin Calibrations ~6:45

All gasses

	A	S	ALT 106
O_2	0 - All gasses	0/10	√50
	√20		√√ 0 - All
	√10		√√ 10 - O_2
CO_2	√4	0/2	√√ 2 - CO_2
	√2		√√ 10 - NO_x
	√0		√√ 150 - CO
NO_x	√20	0/10	12.5 - VOC
	√10		
CO	√300	0/150	
	150		
~~NMOC 21.25~~ DSB		NMOC 0/6.25/12.5/21.25	
NO_2	50.41		

begin strut check - @ - 08:20 - 8:35

End -

S

	Begin	end
R-1	08:15	10:23
R-2	10:45	12:53
R-3	13:20	15:33

M 13B/26A — over

SHEET NO. 2 OF 2
PROJECT NO.
DATE
BY
CHK'D

SUBJECT CFU 117 cont.

06/09 continued . . .

~~R-1 DSB~~ M-13B/26A

start end
R-1 16:05 - 18:11

leak check 0 flow "pass"

06/10 M-13B/26A - wet test
O_2/CO_2 - gasses

R-2 07:35 - 09:43
R-3 10:00 - 12:07

	A		S	
O_2	20		O_2	0
	10			10
	0			
CO_2	4		CO_2	0
	2			2
	0			

leak check 0 flow "pass"

APPENDIX D: CFU 107 (ROTARY COARSE) TEST DATA

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 107**
DATE	**06/12/18**
METHOD	**29**
POLLUTANT	**Metals**

EPA Method 1
Stack Parameters and Traverse Points

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 107**
Facility: **GP1**

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

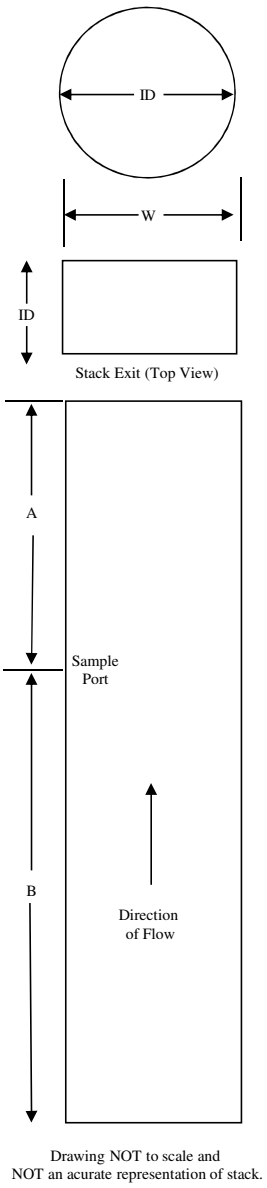
Equivalent Diameter
If rectangluar = $\frac{2*Depth*Width}{Depth + Width}$ = 30.00 inches (If circular = duct ID)
Stack/duct area = 4.909 sq.feet 706.9 sq.inches

Sample Port Location:	Downstream from flow disturbance from process B	Upstream from flow disturbance toward exit A
Number of Inches:	125.00	44.00
Number of Diameters:	4.17	1.47

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 107

Stack Temp: 240

Traverse Point	Velocity ΔP ("H_2O)	Null Angle
1	1.20	0.0
2	1.20	5.0
3	1.10	5.0
4	1.00	0.0
5	1.30	0.0
6	1.20	5.0
7	1.30	0.0
8	1.20	0.0
9	1.00	0.0
10	1.10	10.0
11	0.90	5.0
12	1.00	5.0
13	1.20	5.0
14	1.10	5.0
15	1.10	0.0
16	1.10	0.0
17	1.10	0.0
18	1.30	0.0
19	1.30	0.0
20	1.30	5.0
21	1.20	0.0
22	1.20	0.0
23	1.10	5.0
24	1.10	5.0
25		
26		
27		
28		
29		
30		
Average:	1.15	2.5

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:**	**8:35**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**12:00**
EPA Method:	**29**	60 degrees, clear		**Date:**	**6/12/2018**
Box Operator:	**DS**				
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	4A	Liner type	Glass		
Y factor	0.9963	Nozzle ID	0.19	Nozzle size	0.1900	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat	250	F	
				Filter heat	250	F	

Source Information:

Barometric Pressure	29.76	"Hg	O_2	19.94	%
Static Pressure	0.71	"H_2O	CO_2	0.65	%
Ave. ΔP	1.48	"H_2O	Rec. Nz.	0.198	inches
Stack Temperature	209	F			
Assumed moisture	1.0	%			
Assumed meter temp.	50	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	12

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	107.934	dcf	Ave. ΔP	1.117	"H_2O
Wet mol. weight	28.67	M_s (actual)	Ave. √ΔP	1.0561	"H_2O
Actual H_2O	2.14	%	Ave. ΔH	1.217	"H_2O
Std. meter vol.	107.808	dscf	Ave. T_s	254.8	°F
Isokinetic Average	101.5	%	Ave. T_m	65.2	°F

Moisture/Lab:

Filter	Run 1 #		
	Initial	Final	Gain
Impingers, g	200.0	232	32.0
Silica gel, g	242.4	260.5	18.1
		Total water gain:	50.1

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	7.5	4.556	1.10	246	58	1.17	1.20	3	252	56
2	15.0	9.000	1.10	248	58	1.17	1.20	3	252	51
3	22.5	13.390	1.10	248	58	1.17	1.20	3	252	51
4	30.0	17.781	1.10	248	58	1.17	1.20	3	251	51
5	37.5	22.300	1.10	249	58	1.16	1.20	3	251	51
6	45.0	26.900	1.20	251	60	1.27	1.30	3	249	55
7	52.5	31.530	1.20	251	61	1.27	1.30	3	249	55
8	60.0	36.210	1.20	251	62	1.28	1.30	3	249	54
9	67.5	40.820	1.20	251	63	1.28	1.30	3	249	54
10	75.0	45.290	1.10	251	64	1.17	1.20	3	249	54
11	82.5	49.560	1.10	255	64	1.17	1.20	3	251	54
12	90.0	53.615	0.90	254	65	0.96	1.00	3	251	56
13	97.5	58.080	1.10	254	66	1.17	1.20	3	251	58
14	105.0	62.540	1.10	255	67	1.17	1.20	3	251	61
15	112.5	66.910	1.10	255	67	1.17	1.20	3	251	62
16	120.0	71.350	1.10	267	68	1.16	1.20	3	250	55
17	127.5	75.950	1.10	258	69	1.17	1.20	3	250	55
18	135.0	80.740	1.20	259	70	1.28	1.30	2	250	55
19	142.5	85.460	1.20	259	71	1.28	1.30	2	250	55
20	150.0	90.130	1.20	260	71	1.28	1.30	2	249	55
21	157.5	94.850	1.20	261	71	1.28	1.30	2	249	55
22	165.0	99.350	1.10	261	72	1.18	1.20	2	249	55
23	172.5	103.640	1.00	261	72	1.07	1.10	2	249	57
24	180.0	107.934	1.00	261	72	1.07	1.10	2	249	59

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**12:25**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**15:27**
EPA Method:	**29**	60 degrees, clear		**Date:**	**6/12/2018**
Box Operator:	**DS**				
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	4A	Liner type:	Glass		
Y factor	0.9963	Nozzle ID	0.19	Nozzle size:	0.1900	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat:	250	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.76	"Hg	O_2	19.72 %
Static Pressure	0.71	"H_2O	CO_2	0.65 %
Ave. ΔP	1.48	"H_2O	Rec. Nz.	0.196 inches
Stack Temperature	209	F		
Assumed moisture	2.14	%		
Assumed meter temp.	65.2	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:	15	11

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	105.688	dcf	Ave. ΔP	1.032 "H_2O
Wet mol. weight	28.67	M_s (actual)	Ave. √ΔP	1.0135 "H_2O
Actual H_2O	2.04	%	Ave. ΔH	1.088 "H_2O
Std. meter vol.	102.660	dscf	Ave. T_s	266.7 °F
Isokinetic Average	101.4	%	Ave. T_m	79.9 °F

Moisture/Lab:

Filter	Run 2 #		
	Initial	Final	Gain
Impingers, g	200.0	224	24.0
Silica gel, g	250.4	271.8	21.4
		Total water gain:	45.4

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	4.620	1.10	262	74	1.16	1.20	3	250	55
2	15.0	9.160	1.10	262	74	1.16	1.20	3	250	56
3	22.5	13.530	1.10	261	75	1.16	1.20	3	250	56
4	30.0	18.000	1.10	265	75	1.15	1.20	3	250	57
5	37.5	22.640	1.10	266	76	1.15	1.20	3	250	57
6	45.0	27.140	1.10	267	77	1.15	1.20	3	250	56
7	52.5	31.650	1.10	266	77	1.16	1.20	3	250	56
8	60.0	36.210	1.10	265	78	1.16	1.20	3	250	58
9	67.5	40.500	1.00	265	78	1.05	1.10	3	250	59
10	75.0	44.720	0.95	265	78	1.00	1.00	3	249	60
11	82.5	48.300	0.65	248	79	0.70	0.70	3	248	61
12	90.0	52.127	0.80	260	79	0.85	0.90	3	250	61
13	97.5	56.710	1.10	269	80	1.16	1.20	3	251	61
14	105.0	61.300	1.10	269	80	1.16	1.20	3	252	61
15	112.5	65.780	1.10	270	81	1.16	1.20	3	248	62
16	120.0	70.320	1.10	270	81	1.16	1.20	3	250	63
17	127.5	75.010	1.10	270	83	1.16	1.20	3	252	64
18	135.0	79.570	1.10	271	83	1.16	1.20	3	252	64
19	142.5	84.110	1.10	271	84	1.16	1.20	3	252	59
20	150.0	88.710	1.10	271	84	1.16	1.20	3	252	59
21	157.5	93.350	1.10	272	84	1.16	1.20	3	252	60
22	165.0	97.780	1.00	272	85	1.06	1.10	3	252	60
23	172.5	101.890	0.91	272	85	0.96	0.10	3	250	60
24	180.0	105.688	0.75	272	87	0.80	0.80	3	250	61

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**15:55**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:59**
EPA Method:	**29**	60 degrees, clear	**Date:**	**6/12/2018**
Box Operator:	**DS**			
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	4A	Liner type:	Glass	
Y factor	0.9963	Nozzle ID	0.19	Nozzle size:	0.1900	inches
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000197	sq.ft.
		Pitot Cp	0.84	Probe heat:	250	F
				Filter heat:	250	F

Source Information:

Barometric Pressure	29.76	"Hg	O_2	19.70 %
Static Pressure	0.71	"H_2O	CO_2	0.66 %
Ave. ΔP	1.48	"H_2O	Rec. Nz.	0.194 inches
Stack Temperature	209	F		
Assumed moisture	2.04	%		
Assumed meter temp.	79.9	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:	25	16

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	112.111 dcf	Ave. ΔP	1.125 "H_2O
Wet mol. weight	28.67 M_s (actual)	Ave. √ΔP	1.0587 "H_2O
Actual H_2O	2.03 %	Ave. ΔH	1.267 "H_2O
Std. meter vol.	107.434 dscf	Ave. T_s	261.3 °F
Isokinetic Average	101.2 %	Ave. T_m	87.5 °F

Moisture/Lab:

Filter	Run 3 #		
	Initial	Final	Gain
Impingers, g	200.0	228	28.0
Silica gel, g	254.0	273.4	19.4
		Total water gain:	47.4

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	4.780	1.20	271	87	1.28	1.30	3	250	65
2	15.0	9.621	1.20	271	87	1.28	1.30	3	250	63
3	22.5	14.400	1.20	269	87	1.28	1.30	3	250	58
4	30.0	19.230	1.20	269	87	1.28	1.30	3	250	56
5	37.5	24.100	1.20	269	88	1.28	1.30	3	250	57
6	45.0	29.000	1.20	269	88	1.28	1.30	3	250	57
7	52.5	33.800	1.20	269	88	1.28	1.30	3	250	57
8	60.0	38.410	1.10	267	88	1.18	1.20	3	250	57
9	67.5	43.100	1.10	265	88	1.18	1.20	3	250	58
10	75.0	47.720	1.10	265	89	1.19	1.20	3	250	59
11	82.5	52.330	1.10	265	89	1.19	1.20	3	251	59
12	90.0	56.802	1.00	260	88	1.08	1.10	3	249	57
13	97.5	61.590	1.20	258	87	1.30	1.30	3	249	59
14	105.0	66.420	1.20	256	87	1.30	1.30	3	249	59
15	112.5	71.200	1.20	255	87	1.31	1.30	3	250	59
16	120.0	76.020	1.20	256	88	1.31	1.30	3	250	56
17	127.5	80.850	1.20	256	86	1.30	1.30	3	250	56
18	135.0	85.710	1.20	255	86	1.30	1.30	3	250	56
19	142.5	90.540	1.20	255	88	1.31	1.30	3	250	56
20	150.0	95.140	1.10	255	88	1.20	1.20	3	250	56
21	157.5	99.820	1.10	255	88	1.20	1.20	3	250	57
22	165.0	104.210	0.98	255	88	1.07	1.10	3	252	57
23	172.5	108.350	0.90	253	86	0.98	1.00	3	251	58
24	180.0	112.111	0.71	253	86	0.77	1.80	3	251	60

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:35**
Source:	**CFU 107**	**End Time:**	**12:00**
Method:	**29**	**Date:**	**6/12/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
7.5	4.556	1.20	58	1	1.10	246	1.0488
15.0	9.000	1.20	58	2	1.10	248	1.0488
22.5	13.390	1.20	58	3	1.10	248	1.0488
30.0	17.781	1.20	58	4	1.10	248	1.0488
37.5	22.300	1.20	58	5	1.10	249	1.0488
45.0	26.900	1.30	60	6	1.20	251	1.0954
52.5	31.530	1.30	61	7	1.20	251	1.0954
60.0	36.210	1.30	62	8	1.20	251	1.0954
67.5	40.820	1.30	63	9	1.20	251	1.0954
75.0	45.290	1.20	64	10	1.10	251	1.0488
82.5	49.560	1.20	64	11	1.10	255	1.0488
90.0	53.615	1.00	65	12	0.90	254	0.9487
97.5	58.080	1.20	66	13	1.10	254	1.0488
105.0	62.540	1.20	67	14	1.10	255	1.0488
112.5	66.910	1.20	67	15	1.10	255	1.0488
120.0	71.350	1.20	68	16	1.10	267	1.0488
127.5	75.950	1.20	69	17	1.10	258	1.0488
135.0	80.740	1.30	70	18	1.20	259	1.0954
142.5	85.460	1.30	71	19	1.20	259	1.0954
150.0	90.130	1.30	71	20	1.20	260	1.0954
157.5	94.850	1.30	71	21	1.20	261	1.0954
165.0	99.350	1.20	72	22	1.10	261	1.0488
172.5	103.640	1.10	72	23	1.00	261	1.0000
180.0	107.934	1.10	72	24	1.00	261	1.0000

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 107**	**Date:**	**06/12/18**

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	107.934	dcf	Rectangular		
Water Volume	50.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.76	"Hg	CO_2 Average	0.65	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.94	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.217	"H_2O	√Dp	1.0561	"H_2O
Temperature, T_m	65.2	^oF	Temperature, T_s	254.8	^oF
Temperature, T_m	525.2	^oA (^oR)	Temperature, T_s	714.8	^oA (^oR)
Pressure Meter, P_m	29.849	"Hg	Pressure Stack, P_s	29.812	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	107.808	dscf	Velocity, V_s	69.36	fps
	3.053	dscm	Volume (actual)	20,429.3	awcfm
Actual Volume, $V_{m(actual)}$	149.741	awcf		19,992.1	adcfm
Gas Stream Moisture			Volume (standard)	902,159.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.358	scf		882,853.7	dscf/hr
Moisture, B_{ws}	0.0214			14,714.2	dscf/min
Moisture EPA M4	2.14	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.90	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	101.5	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:25**
Source:	**CFU 107**	**End Time:**	**15:27**
Method:	**29**	**Date:**	**06/12/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
7.5	4.620	1.20	74	1	1.10	262	1.0488
15.0	9.160	1.20	74	2	1.10	262	1.0488
22.5	13.530	1.20	75	3	1.10	261	1.0488
30.0	18.000	1.20	75	4	1.10	265	1.0488
37.5	22.640	1.20	76	5	1.10	266	1.0488
45.0	27.140	1.20	77	6	1.10	267	1.0488
52.5	31.650	1.20	77	7	1.10	266	1.0488
60.0	36.210	1.20	78	8	1.10	265	1.0488
67.5	40.500	1.10	78	9	1.00	265	1.0000
75.0	44.720	1.00	78	10	0.95	265	0.9747
82.5	48.300	0.70	79	11	0.65	248	0.8062
90.0	52.127	0.90	79	12	0.80	260	0.8944
97.5	56.710	1.20	80	13	1.10	269	1.0488
105.0	61.300	1.20	80	14	1.10	269	1.0488
112.5	65.780	1.20	81	15	1.10	270	1.0488
120.0	70.320	1.20	81	16	1.10	270	1.0488
127.5	75.010	1.20	83	17	1.10	270	1.0488
135.0	79.570	1.20	83	18	1.10	271	1.0488
142.5	84.110	1.20	84	19	1.10	271	1.0488
150.0	88.710	1.20	84	20	1.10	271	1.0488
157.5	93.350	1.20	84	21	1.10	272	1.0488
165.0	97.780	1.10	85	22	1.00	272	1.0000
172.5	101.890	0.10	85	23	0.91	272	0.9539
180.0	105.688	0.80	87	24	0.75	272	0.8660

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 107**	**Date:**	**06/12/18**

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	105.688	dcf	Rectangular		
Water Volume	45.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.76	"Hg	CO_2 Average	0.65	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.72	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.088	"H_2O	√Dp	1.0135	"H_2O
Temperature, T_m	79.9	^oF	Temperature, T_s	266.7	^oF
Temperature, T_m	539.9	^oA (^oR)	Temperature, T_s	726.7	^oA (^oR)
Pressure Meter, P_m	29.840	"Hg	Pressure Stack, P_s	29.812	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	102.660	dscf	Velocity, V_s	67.11	fps
	2.907	dscm	Volume (actual)	19,766.6	awcfm
Actual Volume, $V_{m(actual)}$	144.816	awcf		19,363.4	adcfm
Gas Stream Moisture			Volume (standard)	858,600.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.137	scf		841,084.9	dscf/hr
Moisture, B_{ws}	0.0204			14,018.1	dscf/min
Moisture EPA M4	2.04	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	101.4	%			

Isokinetic Field Data
Field Data and Calculations
Gas Stream Characteristics

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**15:55**
Source:	**CFU 107**	**End Time:**	**18:59**
Method:	**29**	**Date:**	**06/12/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
7.5	4.780	1.30	87	1	1.20	271	1.0954
15.0	9.621	1.30	87	2	1.20	271	1.0954
22.5	14.400	1.30	87	3	1.20	269	1.0954
30.0	19.230	1.30	87	4	1.20	269	1.0954
37.5	24.100	1.30	88	5	1.20	269	1.0954
45.0	29.000	1.30	88	6	1.20	269	1.0954
52.5	33.800	1.30	88	7	1.20	269	1.0954
60.0	38.410	1.20	88	8	1.10	267	1.0488
67.5	43.100	1.20	88	9	1.10	265	1.0488
75.0	47.720	1.20	89	10	1.10	265	1.0488
82.5	52.330	1.20	89	11	1.10	265	1.0488
90.0	56.802	1.10	88	12	1.00	260	1.0000
97.5	61.590	1.30	87	13	1.20	258	1.0954
105.0	66.420	1.30	87	14	1.20	256	1.0954
112.5	71.200	1.30	87	15	1.20	255	1.0954
120.0	76.020	1.30	88	16	1.20	256	1.0954
127.5	80.850	1.30	86	17	1.20	256	1.0954
135.0	85.710	1.30	86	18	1.20	255	1.0954
142.5	90.540	1.30	88	19	1.20	255	1.0954
150.0	95.140	1.20	88	20	1.10	255	1.0488
157.5	99.820	1.20	88	21	1.10	255	1.0488
165.0	104.210	1.10	88	22	0.98	255	0.9899
172.5	108.350	1.00	86	23	0.90	253	0.9487
180.0	112.111	1.80	86	24	0.71	253	0.8426

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 107**	**Date:**	**06/12/18**

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	112.111	dcf	Rectangular		
Water Volume	47.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.76	"Hg	CO_2 Average	0.66	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.70	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.267	"H_2O	√Dp	1.0587	"H_2O
Temperature, T_m	87.5	^oF	Temperature, T_s	261.3	^oF
Temperature, T_m	547.5	^oA (^oR)	Temperature, T_s	721.3	^oA (^oR)
Pressure Meter, P_m	29.853	"Hg	Pressure Stack, P_s	29.812	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	107.434	dscf	Velocity, V_s	69.84	fps
	3.042	dscm	Volume (actual)	20,570.7	awcfm
Actual Volume, $V_{m(actual)}$	150.409	awcf		20,153.1	adcfm
Gas Stream Moisture			Volume (standard)	900,217.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.231	scf		881,942.7	dscf/hr
Moisture, B_{ws}	0.0203			14,699.0	dscf/min
Moisture EPA M4	2.03	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.89	lb/lb-mole			
Wet, M_s	28.67	lb/lb-mole			
Percent Isokinetic	101.2	%			

Source:	**CFU 107**				**Sample Date:**	**06/12/18**
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		3.740		0.499	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	<	MDL	<	MDL	0.100	0.040	µg/sample
Chromium		1.150		0.284	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		1.330		1.670	1.250	0.500	µg/sample
Lead	<	MDL	<	MDL	1.250	0.500	µg/sample
Manganese		1.000		0.693	0.075	0.030	µg/sample
Nickel		2.360		1.420	0.750	0.300	µg/sample
Phosphorus	<	MDL	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		3.400		2.760	0.750	0.300	µg/sample
Lab ID:		18-S1084		18-S1085			
Sample Vol:		250		100		mL	

Source:	**CFU 107**				**Sample Date:**	**06/12/18**
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		3.770		0.449	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	<	MDL	<	MDL	0.100	0.040	µg/sample
Chromium		1.080		0.184	0.200	0.080	µg/sample
Cobalt	<	MDL	<	MDL	0.125	0.050	µg/sample
Copper		1.460		1.560	1.250	0.500	µg/sample
Lead	<	MDL	<	MDL	1.250	0.500	µg/sample
Manganese		0.989		0.469	0.075	0.030	µg/sample
Nickel		2.890	<	MDL	0.750	0.300	µg/sample
Phosphorus	<	MDL	<	MDL	5.000	2.000	µg/sample
Selenium	<	MDL	<	MDL	3.750	1.500	µg/sample
Zinc		5.490		2.620	0.750	0.300	µg/sample
Lab ID:		18-S1086		18-S1087			
Sample Vol:		250		100		mL	

Source:	CFU 107				Sample Date: 06/12/18	
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	3.730		0.493	0.125	0.050	µg/sample
Beryllium	< MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	< MDL	<	MDL	0.100	0.040	µg/sample
Chromium	1.050		0.193	0.200	0.080	µg/sample
Cobalt	< MDL	<	MDL	0.125	0.050	µg/sample
Copper	1.730		1.580	1.250	0.500	µg/sample
Lead	< MDL	<	MDL	1.250	0.500	µg/sample
Manganese	0.947		0.404	0.075	0.030	µg/sample
Nickel	2.480	<	MDL	0.750	0.300	µg/sample
Phosphorus	< MDL	<	MDL	5.000	2.000	µg/sample
Selenium	< MDL	<	MDL	3.750	1.500	µg/sample
Zinc	4.550		2.050	0.750	0.300	µg/sample
Lab ID:	18-S1088		18-S1089			
Sample Vol:	250		100			mL

Source: CFU 107
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		3.200	0.125		0.462	0.050		0.452	0.125
Beryllium	<	MDL	0.050	<	MDL	0.020	<	MDL	0.050
Cadmium	<	MDL	0.100	<	MDL	0.040	<	MDL	0.100
Chromium		0.948	0.200		0.156	0.080	<	MDL	0.200
Cobalt	<	MDL	0.125	<	MDL	0.050	<	MDL	0.125
Copper	<	MDL	1.250		1.720	0.500		1.680	1.250
Lead	<	MDL	1.250	<	MDL	0.500	<	MDL	1.250
Manganese		0.546	0.075		0.389	0.030		0.313	0.075
Nickel		2.080	0.750	<	MDL	0.300	<	MDL	0.750
Phosphorus	<	MDL	5.000	<	MDL	2.000	<	MDL	5.000
Selenium	<	MDL	3.750	<	MDL	1.500	<	MDL	3.750
Zinc		1.780	0.750		0.376	0.300	<	MDL	0.750
Lab ID:		18-S1080			18-S1081			18-S1079	
Sample Vol, ml:		250			100			250	

CFU 107

06/12/18

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. µg/mL		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**				**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		3.740		0.1808		3.200		0.499		0.0046		0.924		0.1808	1.105	**Barium**
Be	<	0.050	<	0.0200	<	0.050	<	0.020	<	0.0002	<	0.040	<	0.0200	0.000	**Beryllium**
Cd	<	0.100	<	0.0400	<	0.100	<	0.040	<	0.0004	<	0.080	<	0.0400	0.000	**Cadmium**
Cr		1.150	<	0.0800		0.948		0.284		0.0016		0.312	<	0.0800	0.312	**Chromium**
Co	<	0.125	<	0.0500	<	0.125	<	0.050	<	0.0005	<	0.100	<	0.0500	0.000	**Cobalt**
Cu		1.330		0.6720	<	1.250		1.670		0.0172		3.440		0.6720	4.112	**Copper**
Pb	<	1.250	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000	0.000	**Lead**
Mn		1.000		0.1252		0.546		0.693		0.0039		0.778		0.1252	0.903	**Manganese**
Ni		2.360	<	0.3000		2.080		1.420	<	0.0030	<	0.600	<	0.3000	0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000	<	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		3.400	<	0.3000		1.780		2.760		0.0038		0.752	<	0.3000	0.752	**Zinc**
Lab:		**18-S1084**		**18-S1079**		**18-S1080**		**18-S1085**		**18-S1081**						
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

*** 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	3.381	3.381		0.187	0.187	11.63		0.359	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.000	0.000	<	0.005	0.000	11.63	<	0.100	**Cadmium**
Cr	0.948	0.948		0.058	0.058	11.63		0.202	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.672	0.672		0.067	0.067	11.63		0.658	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.671	0.671		0.050	0.050	11.63		0.329	**Manganese**
Ni	2.080	2.080		0.118	0.118	11.63		0.280	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.780	1.780		0.170	0.170	11.63		1.620	**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 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	1.105		0.025	0.025	1.000		**0.000**		**0.359**		**0.359**	**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**	**<**	**0.100**	<	**0.140**	**Cadmium**
Cr	0.312	0.312		0.014	0.014	1.000		**0.000**		**0.202**		**0.202**	**Chromium**
Co	0.000	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000	4.112		0.084	0.084	1.000		**0.670**		**0.658**		**1.328**	**Copper**
Pb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Lead**
Mn	0.903	0.903		0.035	0.035	1.000		**0.000**		**0.329**		**0.329**	**Manganese**
Ni	0.000	0.000		0.071	0.000	1.000		**1.420**		**0.280**		**1.700**	**Nickel**
P	0.000	0.000	<	0.100	0.000	1.000	<	**2.000**	**<**	**5.000**	<	**7.000**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	0.752	0.752		0.138	0.138	1.000		**2.008**		**1.620**		**3.628**	**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 107

06/12/18

		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		3.770		0.1808		3.200		0.449		0.0046		0.924		0.1808		1.105	**Barium**
Be	<	0.050	<	0.0200	<	0.050	<	0.020	<	0.0002	<	0.040	<	0.0200		0.000	**Beryllium**
Cd	<	0.100	<	0.0400	<	0.100	<	0.040	<	0.0004	<	0.080	<	0.0400		0.000	**Cadmium**
Cr		1.080	<	0.0800		0.948		0.184		0.0016		0.312	<	0.0800		0.312	**Chromium**
Co	<	0.125	<	0.0500	<	0.125	<	0.050	<	0.0005	<	0.100	<	0.0500		0.000	**Cobalt**
Cu		1.460		0.6720	<	1.250		1.560		0.0172		3.440		0.6720		4.112	**Copper**
Pb	<	1.250	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000		0.000	**Lead**
Mn		0.989		0.1252		0.546		0.469		0.0039		0.778		0.1252		0.903	**Manganese**
Ni		2.890	<	0.3000		2.080	<	0.300	<	0.0030	<	0.600	<	0.3000		0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000	<	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		5.490	<	0.3000		1.780		2.620		0.0038		0.752	<	0.3000		0.752	**Zinc**
Lab:		**18-S1086**		**18-S1079**		**18-S1080**		**18-S1087**		**18-S1081**							
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)

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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	3.381	3.381		0.189	0.189	11.63		0.389	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.000	0.000	<	0.005	0.000	11.63	<	0.100	**Cadmium**
Cr	0.948	0.948		0.054	0.054	11.63		0.132	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.672	0.672		0.073	0.073	11.63		0.788	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.671	0.671		0.049	0.049	11.63		0.318	**Manganese**
Ni	2.080	2.080		0.145	0.145	11.63		0.810	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.780	1.780		0.275	0.275	11.63		3.710	**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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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 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		1.105		0.022	0.022	1.000		**0.000**		**0.389**		**0.389**	**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**	**<**	**0.100**	<	**0.140**	**Cadmium**
Cr	0.312		0.312		0.009	0.009	1.000		**0.000**		**0.132**		**0.132**	**Chromium**
Co	0.000	<	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000		4.112		0.078	0.078	1.000		**0.560**		**0.788**		**1.348**	**Copper**
Pb	0.000	<	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Lead**
Mn	0.903		0.903		0.023	0.023	1.000		**0.000**		**0.318**		**0.318**	**Manganese**
Ni	0.000	<	0.000	<	0.015	0.000	1.000	<	**0.300**		**0.810**	<	**1.110**	**Nickel**
P	0.000	<	0.000	<	0.100	0.000	1.000	<	**2.000**	**<**	**5.000**	<	**7.000**	**Phosphorus**
Se	0.000	<	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	0.752		0.752		0.131	0.131	1.000		**1.868**		**3.710**		**5.578**	**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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Hollingsworth & Vose | **Method 29 Metals Blank Calculations** | **Run: 3**

CFU 107

06/12/18

		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		3.730		0.1808		3.200		0.493		0.0046		0.924		0.1808		1.105	**Barium**
Be	<	0.050	<	0.0200	<	0.050	<	0.020	<	0.0002	<	0.040	<	0.0200		0.000	**Beryllium**
Cd	<	0.100	<	0.0400	<	0.100	<	0.040	<	0.0004	<	0.080	<	0.0400		0.000	**Cadmium**
Cr		1.050	<	0.0800		0.948		0.193		0.0016		0.312	<	0.0800		0.312	**Chromium**
Co	<	0.125	<	0.0500	<	0.125	<	0.050	<	0.0005	<	0.100	<	0.0500		0.000	**Cobalt**
Cu		1.730		0.6720	<	1.250		1.580		0.0172		3.440		0.6720		4.112	**Copper**
Pb	<	1.250	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000		0.000	**Lead**
Mn		0.947		0.1252		0.546		0.404		0.0039		0.778		0.1252		0.903	**Manganese**
Ni		2.480	<	0.3000		2.080	<	0.300	<	0.0030	<	0.600	<	0.3000		0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000	<	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		4.550	<	0.3000		1.780		2.050		0.0038		0.752	<	0.3000		0.752	**Zinc**
Lab:		**18-S1088**		**18-S1079**		**18-S1080**		**18-S1089**		**18-S1081**							
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	3.381	3.381		0.187	0.187	11.63		0.349	**Barium**
Be	0.000	0.000	<	0.003	0.000	11.63	<	0.050	**Beryllium**
Cd	0.000	0.000	<	0.005	0.000	11.63	<	0.100	**Cadmium**
Cr	0.948	0.948		0.053	0.053	11.63		0.102	**Chromium**
Co	0.000	0.000	<	0.006	0.000	11.63	<	0.125	**Cobalt**
Cu	0.672	0.672		0.087	0.087	11.63		1.058	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.671	0.671		0.047	0.047	11.63		0.276	**Manganese**
Ni	2.080	2.080		0.124	0.124	11.63		0.400	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	0.000	0.000	<	0.188	0.000	11.63	<	3.750	**Selenium**
Zn	1.780	1.780		0.228	0.228	11.63		2.770	**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 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	1.105		0.025	0.025	1.000		**0.000**		**0.349**		**0.349**	**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**	**<**	**0.100**	<	**0.140**	**Cadmium**
Cr	0.312	0.312		0.010	0.010	1.000		**0.000**		**0.102**		**0.102**	**Chromium**
Co	0.000	0.000	<	0.003	0.000	1.000	<	**0.050**	**<**	**0.125**	<	**0.175**	**Cobalt**
Cu	1.000	4.112		0.079	0.079	1.000		**0.580**		**1.058**		**1.638**	**Copper**
Pb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**	**<**	**1.250**	<	**1.750**	**Lead**
Mn	0.903	0.903		0.020	0.020	1.000		**0.000**		**0.276**		**0.276**	**Manganese**
Ni	0.000	0.000	<	0.015	0.000	1.000	<	**0.300**		**0.400**	<	**0.700**	**Nickel**
P	0.000	0.000	<	0.100	0.000	1.000	<	**2.000**	**<**	**5.000**	<	**7.000**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**	**<**	**3.750**	<	**5.250**	**Selenium**
Zn	0.752	0.752		0.103	0.103	1.000		**1.298**		**2.770**		**4.068**	**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 107**
Location: **Corvallis, OR**

Run			1	2	3	
Date			6/12/2018	6/12/2018	6/12/2018	
Run Start Time			8:35	12:25	15:55	
Run End Time			12:00	15:27	18:59	
Duration, min.			180	180	180	Average
Barometric Pressure, "Hg			29.76	29.76	29.76	**29.76**
Nozzle Dia., in.			0.1900	0.1900	0.1900	**0.1900**
Isokinetic Average, %			101.5	101.4	101.2	**101.4**
Sample Volume, dscf			107.808	102.660	107.434	**105.967**
Sample Volume, dscm			3.053	2.907	3.042	**3.001**
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			0.65	0.65	0.66	**0.65**
O_2 %vd			19.94	19.72	19.70	**19.79**
Static Press., "H_2O			0.71	0.71	0.71	**0.71**
H_2O %v			2.14	2.04	2.03	**2.07**
Wet Molecular Weight, lb/lb-mole			28.67	28.67	28.67	**28.67**
Velocity, FPS			69.36	67.11	69.84	**68.77**
ADCFM			19,992.1	19,363.4	20,153.1	**19,836.2**
AWCFM			20,429.3	19,766.6	20,570.7	**20,255.5**
DSCFM			14,714.2	14,018.1	14,699.0	**14,477.1**
Stack Temperature, ^oF			254.8	266.7	261.3	**260.9**
Production Data	Glass Production	lbs/hr	369.0	363.5	355.3	**362.6**

Hollingsworth & Vose **Test: M29**
CFU 107
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	< 0.573	< 3.16E-05	< 8.56E-08	< 1.250	< 0.409	< 2.26E-05	< 6.12E-08	<	0.500	< 0.164	< 9.03E-06	< 2.45E-08	**Sb**
Arsenic	< 2.450	< 0.802	< 4.42E-05	< 1.20E-07	< 1.750	< 0.573	< 3.16E-05	< 8.56E-08	<	0.700	< 0.229	< 1.26E-05	< 3.42E-08	**As**
Barium	0.359	0.118	6.48E-06	1.76E-08	0.359	0.118	6.48E-06	1.76E-08		0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.023	< 1.26E-06	< 3.43E-09	< 0.050	< 0.016	< 9.03E-07	< 2.45E-09	<	0.020	< 0.007	< 3.61E-07	< 9.78E-10	**Be**
Cadmium	< 0.140	< 0.046	< 2.53E-06	< 6.85E-09	< 0.100	< 0.033	< 1.81E-06	< 4.89E-09	<	0.040	< 0.013	< 7.22E-07	< 1.96E-09	**Cd**
Chromium	0.202	0.066	3.65E-06	9.88E-09	0.202	0.066	3.65E-06	9.88E-09		0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.057	< 3.16E-06	< 8.56E-09	< 0.125	< 0.041	< 2.26E-06	< 6.12E-09	<	0.050	< 0.016	< 9.03E-07	< 2.45E-09	**Co**
Copper	1.328	0.435	2.40E-05	6.50E-08	0.658	0.216	1.19E-05	3.22E-08		0.670	0.219	1.21E-05	3.28E-08	**Cu**
Lead	< 1.750	< 0.573	< 3.16E-05	< 8.56E-08	< 1.250	< 0.409	< 2.26E-05	< 6.12E-08	<	0.500	< 0.164	< 9.03E-06	< 2.45E-08	**Pb**
Manganese	0.329	0.108	5.94E-06	1.61E-08	0.329	0.108	5.94E-06	1.61E-08		0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	1.700	0.557	3.07E-05	8.32E-08	0.280	0.092	5.06E-06	1.37E-08		1.420	0.465	2.56E-05	6.95E-08	**Ni**
Phosphorus	< 7.000	< 2.293	< 1.26E-04	< 3.42E-07	< 5.000	< 1.638	< 9.03E-05	< 2.45E-07	<	2.000	< 0.655	< 3.61E-05	< 9.78E-08	**P**
Selenium	< 5.250	< 1.720	< 9.48E-05	< 2.57E-07	< 3.750	< 1.228	< 6.77E-05	< 1.83E-07	<	1.500	< 0.491	< 2.71E-05	< 7.338E-08	**Se**
Zinc	3.628	1.188	6.55E-05	1.77E-07	1.620	0.531	2.92E-05	7.93E-08		2.008	0.658	3.63E-05	9.824E-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	< 0.602	< 3.16E-05	< 8.70E-08	< 1.250	< 0.430	< 2.26E-05	< 6.21E-08	<	0.500	< 0.172	< 9.03E-06	< 2.48E-08	**Sb**
Arsenic	< 2.450	< 0.843	< 4.43E-05	< 1.22E-07	< 1.750	< 0.602	< 3.16E-05	< 8.70E-08	<	0.700	< 0.241	< 1.26E-05	< 3.48E-08	**As**
Barium	0.389	0.134	7.03E-06	1.93E-08	0.389	0.134	7.03E-06	1.93E-08		0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.024	< 1.26E-06	< 3.48E-09	< 0.050	< 0.017	< 9.03E-07	< 2.48E-09	<	0.020	< 0.007	< 3.61E-07	< 9.93E-10	**Be**
Cadmium	< 0.140	< 0.048	< 2.53E-06	< 6.96E-09	< 0.100	< 0.034	< 1.81E-06	< 4.97E-09	<	0.040	< 0.014	< 7.22E-07	< 1.99E-09	**Cd**
Chromium	0.132	0.045	2.38E-06	6.56E-09	0.132	0.045	2.38E-06	6.56E-09		0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.060	< 3.16E-06	< 8.70E-09	< 0.125	< 0.043	< 2.26E-06	< 6.21E-09	<	0.050	< 0.017	< 9.03E-07	< 2.48E-09	**Co**
Copper	1.348	0.464	2.43E-05	6.70E-08	0.788	0.271	1.42E-05	3.92E-08		0.560	0.193	1.01E-05	2.78E-08	**Cu**
Lead	< 1.750	< 0.602	< 3.16E-05	< 8.70E-08	< 1.250	< 0.430	< 2.26E-05	< 6.21E-08	<	0.500	< 0.172	< 9.03E-06	< 2.48E-08	**Pb**
Manganese	0.318	0.109	5.74E-06	1.58E-08	0.318	0.109	5.74E-06	1.58E-08		0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.110	< 0.382	< 2.00E-05	< 5.52E-08	0.810	0.279	1.46E-05	4.02E-08	<	0.300	< 0.103	< 5.42E-06	< 1.49E-08	**Ni**
Phosphorus	< 7.000	< 2.408	< 1.26E-04	< 3.48E-07	< 5.000	< 1.720	< 9.03E-05	< 2.48E-07	<	2.000	< 0.688	< 3.61E-05	< 9.94E-08	**P**
Selenium	< 5.250	< 1.806	< 9.48E-05	< 2.61E-07	< 3.750	< 1.290	< 6.77E-05	< 1.86E-07	<	1.500	< 0.516	< 2.71E-05	< 7.453E-08	**Se**
Zinc	5.578	1.919	1.01E-04	2.77E-07	3.710	1.276	6.70E-05	1.84E-07		1.868	0.643	3.37E-05	9.282E-08	**Zn**

Hollingsworth & Vose **Test: M29**
CFU 107
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	< 0.575	< 3.17E-05	< 8.91E-08	< 1.250	< 0.411	< 2.26E-05	< 6.37E-08	< 0.500	< 0.164	< 9.05E-06	< 2.55E-08	**Sb**
Arsenic	< 2.450	< 0.805	< 4.43E-05	< 1.25E-07	< 1.750	< 0.575	< 3.17E-05	< 8.91E-08	< 0.700	< 0.230	< 1.27E-05	< 3.57E-08	**As**
Barium	0.349	0.115	6.32E-06	1.78E-08	0.349	0.115	6.32E-06	1.78E-08	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.023	< 1.27E-06	< 3.57E-09	< 0.050	< 0.016	< 9.05E-07	< 2.55E-09	< 0.020	< 0.007	< 3.62E-07	< 1.02E-09	**Be**
Cadmium	< 0.140	< 0.046	< 2.53E-06	< 7.13E-09	< 0.100	< 0.033	< 1.81E-06	< 5.09E-09	< 0.040	< 0.013	< 7.24E-07	< 2.04E-09	**Cd**
Chromium	0.102	0.034	1.85E-06	5.20E-09	0.102	0.034	1.85E-06	5.20E-09	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.058	< 3.17E-06	< 8.91E-09	< 0.125	< 0.041	< 2.26E-06	< 6.37E-09	< 0.050	< 0.016	< 9.05E-07	< 2.55E-09	**Co**
Copper	1.638	0.538	2.96E-05	8.34E-08	1.058	0.348	1.91E-05	5.39E-08	0.580	0.191	1.05E-05	2.95E-08	**Cu**
Lead	< 1.750	< 0.575	< 3.17E-05	< 8.91E-08	< 1.250	< 0.411	< 2.26E-05	< 6.37E-08	< 0.500	< 0.164	< 9.05E-06	< 2.55E-08	**Pb**
Manganese	0.276	0.091	4.99E-06	1.41E-08	0.276	0.091	4.99E-06	1.41E-08	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 0.700	< 0.230	< 1.27E-05	< 3.57E-08	0.400	0.131	7.24E-06	2.04E-08	< 0.300	< 0.099	< 5.43E-06	< 1.53E-08	**Ni**
Phosphorus	< 7.000	< 2.301	< 1.27E-04	< 3.57E-07	< 5.000	< 1.644	< 9.05E-05	< 2.55E-07	< 2.000	< 0.657	< 3.62E-05	< 1.02E-07	**P**
Selenium	< 5.250	< 1.726	< 9.50E-05	< 2.67E-07	< 3.750	< 1.233	< 6.79E-05	< 1.91E-07	< 1.500	< 0.493	< 2.71E-05	< 7.641E-08	**Se**
Zinc	4.068	1.337	7.36E-05	2.07E-07	2.770	0.911	5.01E-05	1.41E-07	1.298	0.427	2.35E-05	6.612E-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	< 0.583	< 3.16E-05	< 8.72E-08	< 1.250	< 0.417	< 2.26E-05	< 6.23E-08	< 0.500	< 0.167	< 9.04E-06	< 2.49E-08	**Sb**
Arsenic	< 2.450	< 0.817	< 4.43E-05	< 1.22E-07	< 1.750	< 0.583	< 3.16E-05	< 8.72E-08	< 0.700	< 0.233	< 1.27E-05	< 3.49E-08	**As**
Barium	0.366	0.122	6.61E-06	1.82E-08	0.366	0.122	6.61E-06	1.82E-08	0.000	0.000	0.00E+00	0.00E+00	**Ba**
Beryllium	< 0.070	< 0.023	< 1.27E-06	< 3.49E-09	< 0.050	< 0.017	< 9.04E-07	< 2.49E-09	< 0.020	< 0.007	< 3.61E-07	< 9.97E-10	**Be**
Cadmium	< 0.140	< 0.047	< 2.53E-06	< 6.98E-09	< 0.100	< 0.033	< 1.81E-06	< 4.98E-09	< 0.040	< 0.013	< 7.23E-07	< 1.99E-09	**Cd**
Chromium	0.145	0.048	2.63E-06	7.21E-09	0.145	0.048	2.63E-06	7.21E-09	0.000	0.000	0.00E+00	0.00E+00	**Cr**
Cobalt	< 0.175	< 0.058	< 3.16E-06	< 8.72E-09	< 0.125	< 0.042	< 2.26E-06	< 6.23E-09	< 0.050	< 0.017	< 9.04E-07	< 2.49E-09	**Co**
Copper	1.438	0.479	2.60E-05	7.18E-08	0.835	0.278	1.51E-05	4.17E-08	0.603	0.201	1.09E-05	3.01E-08	**Cu**
Lead	< 1.750	< 0.583	< 3.16E-05	< 8.72E-08	< 1.250	< 0.417	< 2.26E-05	< 6.23E-08	< 0.500	< 0.167	< 9.04E-06	< 2.49E-08	**Pb**
Manganese	0.307	0.103	5.56E-06	1.53E-08	0.307	0.103	5.56E-06	1.53E-08	0.000	0.000	0.00E+00	0.00E+00	**Mn**
Nickel	< 1.170	< 0.390	< 2.11E-05	< 5.80E-08	0.497	0.167	8.98E-06	2.48E-08	< 0.673	< 0.222	< 1.22E-05	< 3.32E-08	**Ni**
Phosphorus	< 7.000	< 2.334	< 1.26E-04	< 3.49E-07	< 5.000	< 1.667	< 9.04E-05	< 2.49E-07	< 2.000	< 0.667	< 3.61E-05	< 9.97E-08	**P**
Selenium	< 5.250	< 1.750	< 9.49E-05	< 2.62E-07	< 3.750	< 1.250	< 6.78E-05	< 1.87E-07	< 1.500	< 0.500	< 2.71E-05	< 7.478E-08	**Se**
Zinc	4.425	1.481	8.00E-05	2.21E-07	2.700	0.906	4.88E-05	1.35E-07	1.725	0.576	3.12E-05	8.573E-08	**Zn**
Total:	**< 26.436**	**< 8.820**	**< 4.78E-04**	**< 1.32E-06**	< 18.125	< 6.050	< 3.28E-04	< 9.04E-07	< 8.311	< 2.769	< 1.50E-04	< 4.14E-07	

'<' denotes results which were 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:**	**8:35**
Source:	**CFU 107**	**End Time:**	**12:00**
Method:	**29**	**Date:**	**6/12/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 29.849 "Hg

where Pb: 29.76 "Hg
ΔH: 1.217 "H_2O

2) $Ps = Pb + (Static\ Press./13.6) =$ 29.812 "Hg

where Pb: 29.76 "Hg
Static Press.: 0.71 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 107.808 dscf

where Vm: 107.934 dcf
Y: 0.9963
Pm: 29.849 "Hg
Tm: 525.2 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 2.358 scf

where H_2O: 50.10 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0214

where Vw(std): 2.358 scf
Vm(std): 107.808 dscf

6) % H_2O = Bws x 100 = 2.14 %v

7) $V_m(actual) = \left(\frac{Y\ x\ Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 149.741 awcf

where Y: 0.9963
Vm: 107.9340 dcf
Bws: 0.0214
Ts: 714.8 °A
Tm: 525.2 °A
Pm: 29.849 "Hg
Ps: 29.812 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.90 lb/lb-mole

where CO_2: 0.65 %vd
O_2 19.94 %vd
N_2+CO= (100-(O_2+CO_2): 79.41 %vd

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.67 lb/lb-mole
where M_d: 28.90 lb/lb-mole
Bws: 0.0214

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 69.36 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.0561
Ts: 714.8 °A
Ps: 29.812 "Hg
Ms: 28.67 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 20,429.3 AWCFM
where V_s: 69.36 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 19,992.1 ADCFM
where AWCFM: 20,429.3
Bws: 0.0214

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 902,159.9 wscf/hr
where V_s: 69.36 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 714.8 °A
Ps: 29.812 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 882,853.7 dscf/hr
where wscf/hr: 902,159.9
Bws: 0.0214

16) DSCFM= (dscf/hr)/60 mins/hr = 14,714.2 DSCFM
where dscf/hr: 882,853.7

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000197 sq. ft.
where Nozzle Size: 0.1900 inches

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 107**	**Date:**	**6/12/2018**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 101.5 %

where Ts:	714.8	°A
Vm(Std):	107.808	dscf
Ps:	29.812	"Hg
Vs	69.36	ft/sec
Nozzle Area:	0.000197	sq. ft.
Sampling Time:	180	min.
Bws:	0.0214	

EPA Method 29:
Chromium

19) Cr Laboratory Results (blank corrected)

Front half (FH):	0.202 µg/sample
Back half (BH):	0.000 µg/sample
Total (FH + BH):	0.202 µg/sample

20) Cs = µg/Vm(std) = 0.066 µg/dscm

where Run 1 Total:	0.202	µg/sample
Vm(std):	3.053	dscm

21) Emission Rate = (Cs)$\left(\frac{2.83168\ m^3}{ft^3}\right)$(stack flow)$\left(\frac{2.2046E-9\ lb}{\mu g}\right)$= 3.65E-06 lb/hr

where Cs:	0.066	µg/dscm
Stack Flow:	882,853.7	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 107**
DATE(S)	**06/12/18**
METHOD	**30B**
POLLUTANT	**Mercury**

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**8:36**
Source:	**CFU 107**	**End Time:**	**12:00**
EPA Method:	**30B**	**Start Date:**	**6/12/2018**
Box Operator:	**DS**	**End Date:**	**6/12/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.76 "Hg
Test duration:	180 min

Equipment:

Probe ID:	HLN 30B	
Probe heat:	250 F	
	Side A	Side B
Meterbox ID:	DUAL #2	DUAL #2
Y factor:	1.0420	1.0460
Desired sampling rate:	2	2 lpm
Trap ID#:	OLC047377	OLC055128
Spiked @:	5	0 ng
Orifice # (if used):		

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	20	20	15	16
Train leak rate, lpm	0.000	0.000	0.007	0.012

Test Summary:

	Side A	Side B	
Sample Volume:	358.169	358.210	L
Ave. Meter Temp:	76.9	79.0	°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	246	246	51	51	8	9	273	269	2.000	2.000
5	9.651	9.521	246	246	52	52	8	9	273	269	1.930	1.904
10	19.851	19.850	246	246	53	54	8	9	273	269	2.040	2.066
15	29.980	30.010	248	248	57	56	8	7	271	270	2.026	2.032
20	40.090	40.050	248	248	59	60	7	8	270	270	2.022	2.008
25	50.010	49.980	248	248	61	63	7	7	270	269	1.984	1.986
30	59.950	59.970	249	249	63	65	7	8	268	266	1.988	1.998
35	69.840	69.820	251	251	64	66	7	8	268	266	1.978	1.970
40	79.520	79.490	251	251	67	69	7	8	268	266	1.936	1.934
45	89.140	89.520	252	252	67	69	7	8	268	266	1.924	2.006
50	99.150	99.230	252	252	67	69	7	8	268	266	2.002	1.942
55	108.900	108.850	252	252	67	69	7	8	266	268	1.950	1.924
60	118.500	118.410	252	252	70	69	7	8	266	268	1.920	1.912
65	128.210	128.190	252	252	75	74	7	8	266	268	1.942	1.956
70	137.920	137.940	251	251	77	79	7	8	266	268	1.942	1.950
75	147.950	147.520	251	251	77	79	7	8	266	268	2.006	1.916
80	158.100	158.000	251	251	79	82	6	8	266	268	2.030	2.096
85	168.050	167.980	251	251	79	82	5	9	266	268	1.990	1.996
90	178.000	178.100	251	251	79	82	4	9	266	268	1.990	2.024
95	187.540	187.920	255	255	80	83	4	9	266	268	1.908	1.964
100	198.000	197.960	255	255	83	86	4	9	266	268	2.092	2.008
105	208.000	207.950	255	255	83	87	4	9	266	268	2.000	1.998
110	218.000	217.960	255	255	84	87	4	8	266	268	2.000	2.002
115	228.210	228.100	255	255	84	87	4	7	266	268	2.042	2.028
120	238.050	238.120	255	255	89	90	4	7	267	269	1.968	2.004
125	247.550	247.560	259	259	89	90	4	7	267	266	1.900	1.888
130	258.000	258.010	259	259	88	91	7	8	266	269	2.090	2.090
135	268.450	268.520	259	259	88	91	7	8	266	268	2.090	2.102
140	278.380	278.415	259	259	88	92	7	7	266	269	1.986	1.979
145	288.320	288.290	260	260	89	92	8	8	266	269	1.988	1.975
150	298.35	298.25	259	259	90	93	8	8	266	269	2.006	1.992
155	308.280	308.150	259	259	90	92	8	8	266	268	1.986	1.980
160	318.240	318.310	259	259	90	94	8	8	266	268	1.992	2.032
165	328.310	328.420	259	259	92	94	8	8	266	268	2.014	2.022
170	338.260	338.350	252	252	92	95	8	8	266	268	1.990	1.986
175	348.321	348.296	261	261	92	95	8	8	266	268	2.012	1.989
180	358.169	358.210	259	259	92	95	8	8	266	268	1.970	1.983

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**12:25**
Source:	**CFU 107**	**End Time:**	**15:27**
EPA Method:	**30B**	**Start Date:**	**6/12/2018**
Box Operator:	**DS**	**End Date:**	**6/12/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.76	"Hg
Test duration:	180	min

Equipment:

Probe ID:	HLN 30B		
Probe heat:	250	F	
	Side A	Side B	
Meterbox ID:	DUAL #2	DUAL #2	
Y factor:	1.0420	1.0460	
Desired sampling rate:	2	2	lpm
Trap ID#:	OLC047441	OL485944	
Spiked @:	5	0	ng
Orifice # (if used):			

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	15	16	15	15
Train leak rate, lpm	0.000	0.000	0.000	0.000

Test Summary:

	Side A	Side B	
Sample Volume:	359.241	359.336	L
Ave. Meter Temp:	97.9	100.7	°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	263	263	91	92	7	7	266	268	2.000	2.000
5	9.810	9.850	263	263	90	92	7	7	266	268	1.962	1.970
10	19.890	19.910	262	262	91	92	7	7	266	268	2.016	2.012
15	29.790	29.840	261	261	91	92	7	7	266	268	1.980	1.986
20	40.210	40.130	261	261	91	92	7	7	266	268	2.084	2.058
25	50.120	50.310	266	266	91	92	7	7	266	268	1.982	2.036
30	60.140	60.312	266	266	92	94	7	7	266	268	2.004	2.000
35	70.360	70.270	266	266	92	95	7	7	266	268	2.044	1.992
40	80.290	80.190	266	266	92	94	7	7	266	268	1.986	1.984
45	90.240	90.190	266	266	92	94	7	7	266	268	1.990	2.000
50	100.190	100.210	266	266	92	95	7	8	266	268	1.990	2.004
55	109.990	109.950	266	266	93	95	8	8	266	268	1.960	1.948
60	119.750	119.680	266	266	93	96	8	9	266	268	1.952	1.946
65	129.570	129.400	265	265	94	97	9	10	266	268	1.964	1.944
70	139.360	139.290	265	265	98	100	9	10	266	268	1.958	1.978
75	149.210	149.160	265	265	98	101	9	10	266	268	1.970	1.974
80	159.260	159.270	260	260	99	101	9	10	266	268	2.010	2.022
85	169.310	169.240	260	260	98	101	9	8	266	268	2.010	1.994
90	179.156	179.250	260	260	98	101	9	8	266	268	1.969	2.002
95	189.180	189.200	269	269	98	103	9	10	266	268	2.005	1.990
100	199.150	199.200	269	269	98	103	9	10	266	268	1.994	2.000
105	209.140	209.090	269	269	100	104	9	10	266	268	1.998	1.978
110	219.220	219.190	269	269	101	104	9	10	266	268	2.016	2.020
115	229.140	229.220	270	270	102	104	9	10	266	268	1.984	2.006
120	239.070	239.140	270	270	102	105	9	9	266	268	1.986	1.984
125	249.180	249.200	271	271	103	106	9	9	266	268	2.022	2.012
130	259.200	259.180	271	271	103	105	9	9	266	268	2.004	1.996
135	269.341	269.310	271	271	103	105	9	9	266	268	2.028	2.026
140	279.370	279.410	271	271	103	106	9	9	266	268	2.006	2.020
145	289.100	289.210	271	271	103	106	9	9	266	268	1.946	1.960
150	299.250	299.310	271	271	103	106	9	9	266	268	2.030	2.020
155	309.120	309.050	271	271	104	108	9	10	266	268	1.974	1.948
160	319.240	319.390	272	272	104	108	9	10	266	268	2.024	2.068
165	329.310	329.190	272	272	105	109	9	10	266	268	2.014	1.960
170	339.400	339.310	272	272	105	109	9	10	266	268	2.018	2.024
175	349.350	349.210	272	272	105	109	9	10	266	268	1.990	1.980
180	359.241	359.336	272	272	105	109	9	10	266	268	1.978	2.025

Method 30B Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**15:55**
Source:	**CFU 107**	**End Time:**	**18:59**
EPA Method:	**30B**	**Start Date:**	**6/12/2018**
Box Operator:	**DS**	**End Date:**	**6/12/2018**
Technician(s):	**CW**		

Pre-Test Information:

Barometric Pressure:	29.76 "Hg
Test duration:	180 min

Equipment:

Probe ID:	HLN 30B	
Probe heat:	250 F	
	Side A	Side B
Meterbox ID:	DUAL #2	DUAL #2
Y factor:	1.0420	1.0460
Desired sampling rate:	2	2 lpm
Trap ID#:	OL462333	OLC055082
Spiked @:	5	0 ng
Orifice # (if used):		

Leak Checks:

	Pre-test		Post-test	
	Side A	Side B	Side A	Side B
Leak check vacuum, "Hg	16	15	16	18
Train leak rate, lpm	0.010	0.000	0.000	0.000

Test Summary:

	Side A	Side B	
Sample Volume:	361.200	361.340	L
Ave. Meter Temp:	107.6	108.8	°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	271	271	104	105	10	11	269	268	2.000	2.000
5	9.840	9.860	271	271	104	104	10	11	269	268	1.968	1.972
10	19.900	19.700	271	271	104	105	10	10	269	268	2.012	1.968
15	29.490	29.510	271	271	105	105	7	10	269	268	1.918	1.962
20	39.100	39.150	271	271	105	105	7	10	269	268	1.922	1.928
25	49.330	49.410	271	271	105	105	7	11	269	268	2.046	2.052
30	59.410	59.420	269	269	105	107	9	11	269	268	2.016	2.002
35	69.350	69.510	269	269	105	108	9	11	269	268	1.988	2.018
40	79.610	79.720	269	269	107	109	9	11	269	268	2.052	2.042
45	90.100	90.150	269	269	107	109	9	11	269	268	2.098	2.086
50	100.100	100.210	269	269	107	109	9	11	269	268	2.000	2.012
55	110.000	110.120	269	269	107	110	8	10	269	268	1.980	1.982
60	120.021	120.020	265	265	107	111	8	9	269	268	2.004	1.980
65	130.120	130.200	265	265	107	111	8	9	269	268	2.020	2.036
70	140.200	140.190	265	265	107	111	8	10	269	268	2.016	1.998
75	150.210	150.150	265	265	107	111	8	10	269	268	2.002	1.992
80	158.560	158.550	262	262	111	111	8	11	269	268	1.670	1.680
85	168.750	168.750	262	262	111	111	8	11	269	268	2.038	2.040
90	179.300	179.320	262	262	111	111	8	11	269	268	2.110	2.114
95	189.450	189.360	262	262	111	111	8	11	269	268	2.030	2.008
100	199.940	200.050	258	258	110	111	8	11	269	268	2.098	2.138
105	210.100	210.210	258	258	110	111	8	11	269	268	2.032	2.032
110	220.210	220.150	256	256	110	111	8	11	269	268	2.022	1.988
115	230.350	230.290	256	256	110	111	8	11	269	268	2.028	2.028
120	240.390	240.340	256	256	110	111	8	11	269	268	2.008	2.010
125	250.990	250.840	256	256	110	110	8	11	269	268	2.120	2.100
130	260.910	260.920	256	256	110	110	8	11	269	268	1.984	2.016
135	270.810	270.610	256	256	110	110	8	11	269	268	1.980	1.938
140	280.690	280.520	255	255	109	110	8	11	269	268	1.976	1.982
145	289.840	289.640	255	255	109	110	8	11	269	268	1.830	1.824
150	300.120	300.220	255	255	109	110	8	11	269	268	2.056	2.116
155	310.220	310.410	255	255	107	108	8	11	269	268	2.020	2.038
160	320.560	320.610	255	255	107	108	8	11	269	268	2.068	2.040
165	330.690	330.670	253	253	106	107	8	11	269	268	2.026	2.012
170	341.000	341.210	246	246	106	106	8	11	269	268	2.062	2.108
175	351.110	351.250	246	246	106	106	8	11	269	268	2.022	2.008
180	361.200	361.340	241	241	104	106	8	11	269	268	2.018	2.018

Method 30B
Mercury Concentration

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 107
Test date: 6/12/2018

Meterbox Y:
Side A 1.0420
Side B 1.0460

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	6/12/2018	OLC047377	5.0	6.4	0.3	1.7	1.70E-03	358.169	373.212	29.76	76.9	0.365	4.66E-03	6.30E-03
	B		OLC055128	0.0	2.5	0.4	2.9	2.90E-03	358.210	374.688		79.0	0.365	7.94E-03	
2	A	6/12/2018	OLC047441	5.0	7.8	0.6	3.4	3.40E-03	359.241	374.329	29.76	97.9	0.352	9.65E-03	9.23E-03
	B		OL485944	0.0	2.7	0.4	3.1	3.10E-03	359.336	375.865		100.7	0.352	8.81E-03	
3	A	6/12/2018	OL462333	5.0	6.7	0.4	2.1	2.10E-03	361.200	376.370	29.76	107.6	0.348	6.03E-03	5.88E-03
	B		OLC055082	0.0	1.6	0.4	2.0	2.00E-03	361.340	377.962		108.8	0.349	5.73E-03	

Trap Concentrations Example Calculations: Average: 7.14E-03
Run 1, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 1.7 ng
where Section 1: 6.4 ng
Section 2: 0.3 ng
Spike: 5.0 ng

2. Conversion to µg — Total Hg ng/1000 = 1.70E-03 µg
where Total Hg ng: 1.7 ng

3. Corrected sample volume — = DGM reading x Meterbox Y factor = 373.212 L
where DGM reading: 358.169 L
Y: 1.042

4. Standard Volume (DSCM) — = Sample Vol. (L) x $\left(\frac{528\,^{\circ}\mathrm{A}}{Tm+460}\right)$ x Bp/29.92 "Hg /1000 = 0.365 DSCM
where Sample vol.: 373.212 L
T_m: 76.9 °F
B_p: 29.76 "Hg

5. Hg concentration µg/dscm — = Total Hg µg / Volume DSCM = 4.66E-03 µg/dscm
where Total Hg: 1.70E-03 µg
DSCM: 0.365

6. Average Pair Concentration — = (Side A Conc.+ Side B Conc.)/2 = 6.30E-03 µg/dscm
where Side A: 0.005 µg/dscm
Side B: 0.008 µg/dscm

Method 30B
Results QA/QC

Client: Hollingsworth & Vose
Location: Corvallis, OR
Source: CFU 107
Test date: 6/12/2018
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	6/12/2018	OLC047377	5	6.4	0.3	1.7	4.66E-03	4.69	PASS	1.04E-02	76.0	26.08	PASS
	B		OLC055128	0	2.5	0.4	2.9	7.94E-03	16.00	PASS				
2	A	6/12/2018	OLC047441	5	7.8	0.6	3.4	9.65E-03	7.69	PASS	1.50E-02	105.9	4.57	PASS
	B		OL485944	0	2.7	0.4	3.1	8.81E-03	14.81	PASS				
3	A	6/12/2018	OL462333	5	6.7	0.4	2.1	6.03E-03	5.97	PASS	1.47E-02	102.1	2.54	PASS
	B		OLC055082	0	1.6	0.4	2.0	5.73E-03	25.00	See emissions limit				

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: 0.007136005 µg/dscm

2. Field Recovery Test Field Recovery 3-run Average (%): 94.7 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 107
Test date: 6/12/2018

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	6.30E-03	3.93E-13	882,853.7	369.0	3.47E-07	9.41E-10
2	9.23E-03	5.76E-13	841,084.9	363.5	4.84E-07	1.33E-09
3	5.88E-03	3.67E-13	881,942.7	355.3	3.24E-07	9.11E-10
Average Results:	7.14E-03	4.45E-13	868,627.1	362.6	3.85E-07	1.06E-09

*From direct stack measurements made during concurrent M29 runs

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-107**
Facility	**Glass Plant 1**	Date	**June 12, 2018**
Location	**Corvallis OR**		

Run	1	2	3	
Date	6/12/2018	6/12/2018	6/12/2018	
Run Start Time	8:35	12:25	15:55	
Run End Time	12:00	15:27	18:59	
CO_2 %vd	0.65	0.65	0.66	0.65
O_2 %vd	19.94	19.72	19.70	19.79

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

Company:	**Hollingsworth & Vose**	Source	**CFU-107**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**June 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**	**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**
	zero	0.00	0.11	0.55	pass	0.13	0.65	pass	0.10	pass				
Run 1	upscale	10.03	9.97	-0.30	pass	9.99	-0.20	pass	0.10	pass	20	19.78	19.94	10
	zero	0.00	0.13	0.65	pass	0.12	0.60	pass	-0.05	pass				
Run 2	upscale	10.03	9.99	-0.20	pass	10.09	0.30	pass	0.50	pass	20	19.68	19.72	10
	zero	0.00	0.12	0.60	pass	0.14	0.70	pass	0.10	pass				
Run 3	upscale	10.03	10.09	0.30	pass	10.06	0.15	pass	-0.15	pass	20	19.72	19.70	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0	10.03	20.01
Analyzer Cal. Error	0.00	0.15	0.05
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU-107**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**June 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**	**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**
	zero	0.08	0.09	0.20	pass	0.12	0.80	pass	0.60	pass				
Run 1	upscale	2.48	2.47	-0.20	pass	2.54	1.20	pass	1.40	pass	5	0.73	0.65	2.5
	zero	0.08	0.12	0.80	pass	0.11	0.60	pass	-0.20	pass				
Run 2	upscale	2.48	2.54	1.20	pass	2.53	1.00	pass	-0.20	pass	5	0.74	0.65	2.5
	zero	0.08	0.11	0.60	pass	0.12	0.80	pass	0.20	pass				
Run 3	upscale	2.48	2.53	1.00	pass	2.54	1.20	pass	0.20	pass	5	0.75	0.66	2.5
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2.5	5
Cal gas analyzer response	0.08	2.48	5.05
Analyzer Cal. Error	1.60	-0.40	1.00
Analyzer Cal. Error < 2%*	pass	pass	pass

Bison Engineering, Inc.
Method 205 Dilution System Check

Company:	Hollingsworth & Vose	Source:	CFU-107	Instrument Make:	Environics
Facility:	Glass Plant 1	Date:	June 12, 2018	Instrument Model:	4040
Location:	Corvallis OR			Instrument Serial #:	3880

		First	Second	Third	Average
High Level	10 % oxygen	10.05	10.01	10.02	10.03
Percent diff from avg recorded value	dilution system	0.2%	-0.2%	-0.1%	
Pass or Fail +/- 2%		PASS	PASS	PASS	
Percent diff from target of 10% O_2		0.5%	0.1%	0.2%	0.3%
Pass or Fail +/- 2% from target value					PASS

Mid Level	5 % oxygen	4.98	4.98	4.98	4.98
Percent diff from avg recorded value	dilution system	0.0%	0.0%	0.0%	
Pass or Fail +/- 2%		PASS	PASS	PASS	
Percent diff from target of 5% O_2		-0.5%	-0.4%	-0.4%	-0.4%
Pass or Fail +/- 2% from target value					PASS

							Tank value
Independent Mid Level Check	5% oxygen	9.90	9.87	9.99	9.92		9.893
	independent	Percent diff from avg				0.26%	
	tank check	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.

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**8:35**
Source:	**CFU-107**	**End Time:**	**12:00**
Method:	**3A**	**Date:**	**6/12/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ 0.15 %v

where C_{Dir}: 10.03 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}: 10.03 ppmv
C_S: 9.97 ppmv
CS: 20.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.10 %v

where SB_{Final}: -0.20 ppmv
SB_i: -0.30 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.94 ppmv

where C_{Avg}: 19.78 ppmv
C_O: 0.12 ppmv
C_{MA}: 10.00 ppmv
C_M: 9.98 ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**8:35**
Source:	**CFU-107**	**End Time:**	**12:00**
Method:	**3A**	**Date:**	**6/12/2018**

EPA Method 3A (CO_2):

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.40 %v

where C_{Dir}: 2.48 ppmv
C_V: 2.50 ppmv
CS: 5.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.20 %v

where C_{Dir}: 2.48 ppmv
C_S: 2.47 ppmv
CS: 5.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 1.40 %v

where SB_{Final}: 1.20 ppmv
SB_i: -0.20 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O) \left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.65 ppmv

where C_{Avg}: 0.73 ppmv
C_O: 0.11 ppmv
C_{MA}: 2.50 ppmv
C_M: 2.51 ppmv

Hollingsworth & Vose

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	7:38:23	8.78	9.46		
6/12/2018	7:38:33	9.47	9.41		
6/12/2018	7:38:43	1.96	0.89		
6/12/2018	7:38:53	0.05	0.11		
6/12/2018	7:39:03	0.01	0.10		
6/12/2018	7:39:13	0.00	0.09		
6/12/2018	7:39:23	0.00	0.09		
6/12/2018	7:39:33	0.00	0.09		
6/12/2018	7:39:43	-0.01	0.08	0.00	
6/12/2018	7:39:53	-0.01	0.08		
6/12/2018	7:40:03	0.00	0.08		
6/12/2018	7:40:13	1.95	2.25		
6/12/2018	7:40:23	9.91	10.09		
6/12/2018	7:40:33	10.09	9.65		
6/12/2018	7:40:43	10.06	9.79		
6/12/2018	7:40:53	10.03	9.92		
6/12/2018	7:41:03	10.03	9.91		
6/12/2018	7:41:13	10.03	9.91	10.03	
6/12/2018	7:41:23	10.03	9.92		
6/12/2018	7:41:33	11.29	10.98		
6/12/2018	7:41:43	19.09	19.61		
6/12/2018	7:41:53	20.21	19.92		
6/12/2018	7:42:03	19.99	19.92		
6/12/2018	7:42:13	20.00	19.93		
6/12/2018	7:42:23	20.01	19.94		
6/12/2018	7:42:33	20.02	19.93		
6/12/2018	7:42:43	20.01	19.94		
6/12/2018	7:42:53	20.01	19.94		
6/12/2018	7:43:03	20.02	19.95	20.01	
6/12/2018	7:43:13	19.27	19.89		
6/12/2018	7:43:23	15.58	13.79		
6/12/2018	7:43:33	9.68	9.70		
6/12/2018	7:43:43	9.99	9.90		
6/12/2018	7:43:53	10.03	9.93		
6/12/2018	7:44:03	10.04	9.94		
6/12/2018	7:44:13	10.05	9.94		
6/12/2018	7:44:23	10.06	9.94	10.05	
6/12/2018	7:44:33	9.81	9.37		
6/12/2018	7:44:43	4.51	4.17		
6/12/2018	7:44:53	4.90	5.10		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	7:45:03	4.96	5.13		
6/12/2018	7:45:13	4.97	5.14		
6/12/2018	7:45:23	4.98	5.14		
6/12/2018	7:45:33	4.98	5.14	4.98	
6/12/2018	7:45:43	9.94	10.31		
6/12/2018	7:45:53	10.14	9.99		
6/12/2018	7:46:03	10.03	9.93		
6/12/2018	7:46:13	10.01	9.93		
6/12/2018	7:46:23	10.01	9.92		
6/12/2018	7:46:33	10.01	9.92	10.01	
6/12/2018	7:46:43	10.00	9.91		
6/12/2018	7:46:53	5.23	4.63		
6/12/2018	7:47:03	4.87	5.08		
6/12/2018	7:47:13	4.96	5.13		
6/12/2018	7:47:23	4.97	5.13		
6/12/2018	7:47:33	4.98	5.14		
6/12/2018	7:47:43	4.98	5.13		
6/12/2018	7:47:53	4.98	5.14		
6/12/2018	7:48:03	4.98	5.14		
6/12/2018	7:48:13	4.98	5.14	4.98	
6/12/2018	7:48:23	4.99	5.14		
6/12/2018	7:48:33	4.99	5.13		
6/12/2018	7:48:43	9.37	9.76		
6/12/2018	7:48:53	10.14	9.99		
6/12/2018	7:49:03	10.05	9.93		
6/12/2018	7:49:13	10.03	9.91		
6/12/2018	7:49:23	10.02	9.91		
6/12/2018	7:49:33	10.02	9.91		
6/12/2018	7:49:43	10.01	9.91	10.02	
6/12/2018	7:49:53	10.01	9.90		
6/12/2018	7:50:03	5.25	4.63		
6/12/2018	7:50:13	4.88	5.07		
6/12/2018	7:50:23	4.98	5.11		
6/12/2018	7:50:33	5.01	5.13		
6/12/2018	7:50:43	4.95	5.02	4.98	
6/12/2018	7:50:53	4.96	5.12		
6/12/2018	7:51:03	3.55	3.52		
6/12/2018	7:51:13	3.62	3.78		
6/12/2018	7:51:23	3.62	3.79		
6/12/2018	7:51:33	1.57	1.18		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	7:51:43	0.07	0.08		
6/12/2018	7:51:53	0.03	0.07		
6/12/2018	7:52:03	0.03	0.07		
6/12/2018	7:52:13	0.03	0.07		
6/12/2018	7:52:23	0.03	0.07		
6/12/2018	7:52:33	0.03	0.07	0.03	
6/12/2018	7:52:43	0.03	0.06		
6/12/2018	7:52:53	0.03	0.05		
6/12/2018	7:53:03	0.03	0.05		
6/12/2018	7:53:13	0.03	0.05		
6/12/2018	7:53:23	6.06	0.09		
6/12/2018	7:53:33	9.76	0.05		
6/12/2018	7:53:43	9.89	0.05		
6/12/2018	7:53:53	9.90	0.04		
6/12/2018	7:54:03	9.90	0.05		
6/12/2018	7:54:13	9.90	0.04		
6/12/2018	7:54:23	9.90	0.04		
6/12/2018	7:54:33	9.90	0.04	9.90	
6/12/2018	7:54:43	9.90	0.04		
6/12/2018	7:54:53	9.90	0.04		
6/12/2018	7:55:03	9.86	0.04		
6/12/2018	7:55:13	4.69	0.05		
6/12/2018	7:55:23	0.15	0.04		
6/12/2018	7:55:33	0.04	0.04		
6/12/2018	7:55:43	0.03	0.03		
6/12/2018	7:55:53	0.03	0.04		
6/12/2018	7:56:03	0.04	0.04		
6/12/2018	7:56:13	0.03	0.04	0.03	
6/12/2018	7:56:23	7.67	0.05		
6/12/2018	7:56:33	9.79	0.03		
6/12/2018	7:56:43	9.87	0.03		
6/12/2018	7:56:53	9.87	0.03		
6/12/2018	7:57:03	9.87	0.03		
6/12/2018	7:57:13	9.87	0.03	9.87	
6/12/2018	7:57:23	9.87	0.03		
6/12/2018	7:57:33	9.78	0.03		
6/12/2018	7:57:43	2.09	0.05		
6/12/2018	7:57:53	0.08	0.03		
6/12/2018	7:58:03	0.04	0.03		
6/12/2018	7:58:13	0.03	0.03		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	7:58:23	0.03	0.03	0.03	
6/12/2018	7:58:33	0.03	0.03		
6/12/2018	7:58:43	5.65	0.06		
6/12/2018	7:58:53	9.74	0.03		
6/12/2018	7:59:03	9.94	0.03		
6/12/2018	7:59:13	9.94	0.03		
6/12/2018	7:59:23	9.95	0.03		
6/12/2018	7:59:33	9.95	0.03		
6/12/2018	7:59:43	9.98	0.03		
6/12/2018	7:59:53	9.99	0.03		
6/12/2018	8:00:03	9.99	0.03		
6/12/2018	8:00:13	9.99	0.03		
6/12/2018	8:00:23	9.98	0.03	9.99	
6/12/2018	8:00:33	9.98	0.03		
6/12/2018	8:00:43	9.98	0.03		
6/12/2018	8:00:53	9.03	0.03		
6/12/2018	8:01:03	8.72	0.03		
6/12/2018	8:01:13	8.77	0.04		
6/12/2018	8:01:23	11.80	7.18		
6/12/2018	8:01:33	15.49	15.29		
6/12/2018	8:01:43	13.77	13.14		
6/12/2018	8:01:53	10.50	10.29		
6/12/2018	8:02:03	10.23	10.27		
6/12/2018	8:02:13	10.38	10.73		
6/12/2018	8:02:23	10.91	10.71		
6/12/2018	8:02:33	9.17	10.57		
6/12/2018	8:02:43	11.44	13.20		
6/12/2018	8:02:53	13.60	13.63		
6/12/2018	8:03:03	13.30	13.30		
6/12/2018	8:03:13	13.23	13.21		
6/12/2018	8:03:23	12.77	12.71		
6/12/2018	8:03:33	6.33	4.53		
6/12/2018	8:03:43	0.21	0.10		
6/12/2018	8:03:53	0.07	0.08		
6/12/2018	8:04:03	0.05	0.08		
6/12/2018	8:04:13	0.05	0.07		0.08
6/12/2018	8:04:23	0.07	0.06		
6/12/2018	8:04:33	3.20	3.63		
6/12/2018	8:04:43	3.31	3.39		
6/12/2018	8:04:53	4.70	5.19		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	8:05:03	4.74	5.12		
6/12/2018	8:05:13	4.78	5.13		
6/12/2018	8:05:23	5.09	5.18		
6/12/2018	8:05:33	5.06	5.06		
6/12/2018	8:05:43	5.07	5.06		
6/12/2018	8:05:53	5.07	5.04		
6/12/2018	8:06:03	5.07	5.04		5.05
6/12/2018	8:06:13	5.06	5.03		
6/12/2018	8:06:23	5.06	5.04		
6/12/2018	8:06:33	4.34	3.96		
6/12/2018	8:06:43	2.72	2.62		
6/12/2018	8:06:53	2.53	2.51		
6/12/2018	8:07:03	2.50	2.49		
6/12/2018	8:07:13	2.49	2.48		
6/12/2018	8:07:23	2.49	2.48		
6/12/2018	8:07:33	2.49	2.48		
6/12/2018	8:07:43	2.48	2.47		2.48
6/12/2018	8:07:53	2.48	2.47		
6/12/2018	8:08:03	2.49	2.47		
6/12/2018	8:08:13	7.80	0.96		
System					
6/12/2018	8:08:23	19.58	0.28		
6/12/2018	8:08:33	15.46	0.37		
6/12/2018	8:08:43	11.88	0.20		
6/12/2018	8:08:53	9.93	0.15		
6/12/2018	8:09:03	7.01	0.12		
6/12/2018	8:09:13	5.84	0.11		
6/12/2018	8:09:23	5.46	0.10		
6/12/2018	8:09:33	5.38	0.10		
6/12/2018	8:09:43	5.40	0.10		
6/12/2018	8:09:53	5.35	0.10		
6/12/2018	8:10:03	5.06	0.10		
6/12/2018	8:10:13	2.73	0.10		
6/12/2018	8:10:23	1.06	0.10		
6/12/2018	8:10:33	0.45	0.10		
6/12/2018	8:10:43	0.23	0.09		
6/12/2018	8:10:53	0.16	0.09		
6/12/2018	8:11:03	0.12	0.09		

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Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	8:11:13	0.11	0.10		
6/12/2018	8:11:23	0.11	0.09		
6/12/2018	8:11:33	0.11	0.09		
6/12/2018	8:11:43	0.11	0.10	0.11	0.09
6/12/2018	8:11:53	0.11	0.09		
6/12/2018	8:12:03	0.11	0.09		
6/12/2018	8:12:13	0.13	0.10		
6/12/2018	8:12:23	0.74	0.72		
6/12/2018	8:12:33	1.90	1.80		
6/12/2018	8:12:43	2.33	2.23		
6/12/2018	8:12:53	2.48	2.40		
6/12/2018	8:13:03	2.53	2.47		
6/12/2018	8:13:13	2.53	2.47		
6/12/2018	8:13:23	2.48	2.42		
6/12/2018	8:13:33	2.53	2.49		
6/12/2018	8:13:43	2.55	2.50		2.47
6/12/2018	8:13:53	2.56	2.52		
6/12/2018	8:14:03	2.56	2.52		
6/12/2018	8:14:13	2.56	2.52		
6/12/2018	8:14:23	2.57	2.53		
6/12/2018	8:14:33	2.57	2.53		
6/12/2018	8:14:43	4.89	2.16		
6/12/2018	8:14:53	9.03	4.41		
6/12/2018	8:15:03	9.68	7.81		
6/12/2018	8:15:13	9.89	9.02		
6/12/2018	8:15:23	10.02	9.45		
6/12/2018	8:15:33	10.02	9.61		
6/12/2018	8:15:43	9.97	9.66		
6/12/2018	8:15:53	9.97	9.69		
6/12/2018	8:16:03	9.96	9.69		
6/12/2018	8:16:13	9.97	9.70		
6/12/2018	8:16:23	9.97	9.70	9.97	
6/12/2018	8:16:33	9.97	9.71		
6/12/2018	8:16:43	9.97	9.71		
6/12/2018	8:16:53	9.97	9.71		
6/12/2018	8:17:03	9.97	9.71		
6/12/2018	8:17:13	9.97	9.71		

Hollingsworth & Vose

CFU-107

Run 1

Date	Time	O2 [%]	CO2 [%]
6/12/2018	8:35:34	19.59	0.74
6/12/2018	8:36:34	19.57	0.74
6/12/2018	8:37:34	19.58	0.74
6/12/2018	8:38:34	19.58	0.73
6/12/2018	8:39:34	19.58	0.73
6/12/2018	8:40:34	19.57	0.73
6/12/2018	8:41:34	19.57	0.73
6/12/2018	8:42:34	19.57	0.73
6/12/2018	8:43:34	19.57	0.73
6/12/2018	8:44:34	19.57	0.72
6/12/2018	8:45:34	19.57	0.72
6/12/2018	8:46:34	19.56	0.72
6/12/2018	8:47:34	19.56	0.72
6/12/2018	8:48:34	19.57	0.72
6/12/2018	8:49:34	19.56	0.73
6/12/2018	8:50:34	19.55	0.73
6/12/2018	8:51:34	19.56	0.73
6/12/2018	8:52:34	19.56	0.73
6/12/2018	8:53:34	19.56	0.73
6/12/2018	8:54:34	19.55	0.73
6/12/2018	8:55:34	19.55	0.73
6/12/2018	8:56:34	19.55	0.73
6/12/2018	8:57:34	19.55	0.74
6/12/2018	8:58:34	19.85	0.73
6/12/2018	8:59:34	19.86	0.74
6/12/2018	9:00:34	19.85	0.74
6/12/2018	9:01:34	19.85	0.74
6/12/2018	9:02:34	19.85	0.73
6/12/2018	9:03:34	19.86	0.73
6/12/2018	9:04:34	19.85	0.73
6/12/2018	9:05:34	19.84	0.73
6/12/2018	9:06:34	19.84	0.73
6/12/2018	9:07:34	19.84	0.73
6/12/2018	9:08:34	19.85	0.74
6/12/2018	9:09:34	19.85	0.73
6/12/2018	9:10:34	19.84	0.73
6/12/2018	9:11:34	19.84	0.72
6/12/2018	9:12:34	19.85	0.72
6/12/2018	9:13:34	19.85	0.72
6/12/2018	9:14:34	19.84	0.72
6/12/2018	9:15:34	19.83	0.72

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/12/2018	9:16:34	19.83	0.72
6/12/2018	9:17:34	19.84	0.72
6/12/2018	9:18:34	19.85	0.72
6/12/2018	9:19:34	19.84	0.72
6/12/2018	9:20:34	19.83	0.72
6/12/2018	9:21:34	19.84	0.73
6/12/2018	9:22:34	19.84	0.72
6/12/2018	9:23:34	19.85	0.73
6/12/2018	9:24:34	19.84	0.73
6/12/2018	9:25:34	19.83	0.73
6/12/2018	9:26:34	19.83	0.73
6/12/2018	9:27:34	19.84	0.73
6/12/2018	9:28:34	19.84	0.74
6/12/2018	9:29:34	19.84	0.73
6/12/2018	9:30:34	19.84	0.73
6/12/2018	9:31:34	19.83	0.73
6/12/2018	9:32:34	19.84	0.73
6/12/2018	9:33:34	19.84	0.73
6/12/2018	9:34:34	19.84	0.73
6/12/2018	9:35:34	19.83	0.73
6/12/2018	9:36:34	19.83	0.72
6/12/2018	9:37:34	19.83	0.72
6/12/2018	9:38:34	19.84	0.72
6/12/2018	9:39:34	19.84	0.72
6/12/2018	9:40:34	19.83	0.72
6/12/2018	9:41:34	19.83	0.72
6/12/2018	9:42:34	19.83	0.72
6/12/2018	9:43:34	19.83	0.72
6/12/2018	9:44:34	19.83	0.72
6/12/2018	9:45:34	19.82	0.73
6/12/2018	9:46:34	19.83	0.72
6/12/2018	9:47:34	19.83	0.73
6/12/2018	9:48:34	19.83	0.73
6/12/2018	9:49:34	19.83	0.73
6/12/2018	9:50:34	19.82	0.73
6/12/2018	9:51:34	19.82	0.73
6/12/2018	9:52:34	19.83	0.74
6/12/2018	9:53:34	19.84	0.73
6/12/2018	9:54:34	19.83	0.74
6/12/2018	9:55:34	19.82	0.74
6/12/2018	9:56:34	19.82	0.73

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/12/2018	9:57:34	19.82	0.74
6/12/2018	9:58:34	19.82	0.74
6/12/2018	9:59:34	19.83	0.73
6/12/2018	10:00:34	19.82	0.73
6/12/2018	10:01:34	19.82	0.73
6/12/2018	10:02:34	19.82	0.73
6/12/2018	10:03:34	19.83	0.73
6/12/2018	10:04:34	19.83	0.72
6/12/2018	10:05:34	19.82	0.72
6/12/2018	10:06:34	19.82	0.72
6/12/2018	10:07:34	19.82	0.72
6/12/2018	10:08:34	19.82	0.72
6/12/2018	10:09:34	19.80	0.72
6/12/2018	10:10:34	19.80	0.72
6/12/2018	10:11:34	19.80	0.72
6/12/2018	10:12:34	19.80	0.73
6/12/2018	10:13:34	19.80	0.73
6/12/2018	10:14:34	19.81	0.73
6/12/2018	10:15:34	19.81	0.73
6/12/2018	10:16:34	19.81	0.73
6/12/2018	10:17:34	19.80	0.73
6/12/2018	10:18:34	19.81	0.74
6/12/2018	10:19:34	19.81	0.74
6/12/2018	10:20:34	19.81	0.74
6/12/2018	10:21:34	19.80	0.74
6/12/2018	10:22:34	19.80	0.74
6/12/2018	10:23:34	19.80	0.74
6/12/2018	10:24:34	19.81	0.74
6/12/2018	10:25:34	19.80	0.74
6/12/2018	10:26:34	19.80	0.74
6/12/2018	10:27:34	19.79	0.73
6/12/2018	10:28:34	19.80	0.73
6/12/2018	10:29:34	19.80	0.73
6/12/2018	10:30:34	19.80	0.73
6/12/2018	10:31:34	19.79	0.73
6/12/2018	10:32:34	19.79	0.72
6/12/2018	10:33:34	19.79	0.72
6/12/2018	10:34:34	19.79	0.72
6/12/2018	10:35:34	19.79	0.73
6/12/2018	10:36:34	19.79	0.73
6/12/2018	10:37:34	19.78	0.73

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/12/2018	10:38:34	19.79	0.73
6/12/2018	10:39:34	19.78	0.73
6/12/2018	10:40:34	19.79	0.73
6/12/2018	10:41:34	19.79	0.73
6/12/2018	10:42:34	19.78	0.74
6/12/2018	10:43:34	19.78	0.74
6/12/2018	10:44:34	19.79	0.74
6/12/2018	10:45:34	19.80	0.74
6/12/2018	10:46:34	19.80	0.74
6/12/2018	10:47:34	19.78	0.74
6/12/2018	10:48:34	19.78	0.74
6/12/2018	10:49:34	19.79	0.74
6/12/2018	10:50:34	19.79	0.74
6/12/2018	10:51:34	19.79	0.74
6/12/2018	10:52:34	19.79	0.73
6/12/2018	10:53:34	19.78	0.74
6/12/2018	10:54:34	19.79	0.73
6/12/2018	10:55:34	19.79	0.73
6/12/2018	10:56:34	19.80	0.73
6/12/2018	10:57:34	19.80	0.72
6/12/2018	10:58:34	19.79	0.72
6/12/2018	10:59:34	19.79	0.73
6/12/2018	11:00:34	19.79	0.73
6/12/2018	11:01:34	19.80	0.73
6/12/2018	11:02:34	19.79	0.73
6/12/2018	11:03:34	19.78	0.73
6/12/2018	11:04:34	19.79	0.73
6/12/2018	11:05:34	19.80	0.73
6/12/2018	11:06:34	19.80	0.73
6/12/2018	11:07:34	19.80	0.73
6/12/2018	11:08:34	19.79	0.74
6/12/2018	11:09:34	19.79	0.74
6/12/2018	11:10:34	19.79	0.74
6/12/2018	11:11:34	19.80	0.74
6/12/2018	11:12:34	19.81	0.74
6/12/2018	11:13:34	19.80	0.74
6/12/2018	11:14:34	19.79	0.74
6/12/2018	11:15:34	19.80	0.74
6/12/2018	11:16:34	19.79	0.74
6/12/2018	11:17:34	19.80	0.74
6/12/2018	11:18:34	19.80	0.74

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/12/2018	11:19:34	19.79	0.74
6/12/2018	11:20:34	19.79	0.74
6/12/2018	11:21:34	19.81	0.73
6/12/2018	11:22:34	19.81	0.73
6/12/2018	11:23:34	19.80	0.73
6/12/2018	11:24:34	19.79	0.73
6/12/2018	11:25:34	19.79	0.73
6/12/2018	11:26:34	19.79	0.73
6/12/2018	11:27:34	19.80	0.73
6/12/2018	11:28:34	19.80	0.73
6/12/2018	11:29:34	19.79	0.73
6/12/2018	11:30:34	19.79	0.73
6/12/2018	11:31:34	19.79	0.74
6/12/2018	11:32:34	19.80	0.74
6/12/2018	11:33:34	19.80	0.73
6/12/2018	11:34:34	19.79	0.74
6/12/2018	11:35:34	19.78	0.74
6/12/2018	11:36:34	19.79	0.75
6/12/2018	11:37:34	19.80	0.75
6/12/2018	11:38:34	19.80	0.75
6/12/2018	11:39:34	19.79	0.75
6/12/2018	11:40:34	19.78	0.75
6/12/2018	11:41:34	19.79	0.74
6/12/2018	11:42:34	19.79	0.74
6/12/2018	11:43:34	19.80	0.74
6/12/2018	11:44:34	19.80	0.74
6/12/2018	11:45:34	19.79	0.74
6/12/2018	11:46:34	19.80	0.73
6/12/2018	11:47:34	19.80	0.73
6/12/2018	11:48:34	19.81	0.73
6/12/2018	11:49:34	19.80	0.73
6/12/2018	11:50:34	19.79	0.73
6/12/2018	11:51:34	19.79	0.73
6/12/2018	11:52:34	19.80	0.73
6/12/2018	11:53:34	19.81	0.73
6/12/2018	11:54:34	19.80	0.73
6/12/2018	11:55:34	19.79	0.73
6/12/2018	11:56:34	19.79	0.73
6/12/2018	11:57:34	19.79	0.73
6/12/2018	11:58:34	19.79	0.73
6/12/2018	11:59:34	19.80	0.74

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/12/2018	12:00:34	19.79	0.74
6/12/2018	12:01:34	19.79	0.74
6/12/2018	12:02:34	19.79	0.74
	Final	**19.78**	**0.73**

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R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	12:06:12	0.13	0.12		
6/12/2018	12:06:22	0.13	0.11		
6/12/2018	12:06:32	0.12	0.12	0.13	0.12
6/12/2018	12:06:42	0.13	0.11		
6/12/2018	12:06:52	0.13	0.11		
6/12/2018	12:07:02	1.06	0.16		
6/12/2018	12:07:12	5.62	3.43		
6/12/2018	12:07:22	4.61	3.38		
6/12/2018	12:07:32	2.93	2.50		
6/12/2018	12:07:42	2.67	2.49		
6/12/2018	12:07:52	2.58	2.49		
6/12/2018	12:08:02	2.56	2.50		
6/12/2018	12:08:12	2.55	2.51		
6/12/2018	12:08:22	2.55	2.52		
6/12/2018	12:08:32	2.55	2.53		
6/12/2018	12:08:42	2.56	2.53		
6/12/2018	12:08:52	2.56	2.53		
6/12/2018	12:09:02	2.56	2.54		
6/12/2018	12:09:12	2.56	2.54		2.54
6/12/2018	12:09:22	2.56	2.54		
6/12/2018	12:09:32	2.83	2.50		
6/12/2018	12:09:42	6.34	4.27		
6/12/2018	12:09:52	9.63	6.76		
6/12/2018	12:10:02	10.10	8.23		
6/12/2018	12:10:12	10.04	9.14		
6/12/2018	12:10:22	10.01	9.48		
6/12/2018	12:10:32	10.00	9.61		
6/12/2018	12:10:42	10.00	9.66		
6/12/2018	12:10:52	10.00	9.68		
6/12/2018	12:11:02	10.00	9.69		
6/12/2018	12:11:12	10.00	9.70		
6/12/2018	12:11:22	9.99	9.70		
6/12/2018	12:11:32	10.00	9.71		
6/12/2018	12:11:42	9.99	9.71	9.99	
6/12/2018	12:11:52	10.00	9.71		
6/12/2018	12:12:02	9.99	9.71		
6/12/2018	12:12:12	10.00	9.72		
6/12/2018	12:12:22	10.00	9.71		
6/12/2018	12:12:32	10.00	9.72		

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/12/2018	12:24:31	19.72	0.74
6/12/2018	12:25:31	19.73	0.74
6/12/2018	12:26:31	19.69	0.73
6/12/2018	12:27:31	19.71	0.74
6/12/2018	12:28:31	19.72	0.73
6/12/2018	12:29:31	19.72	0.73
6/12/2018	12:30:31	19.72	0.73
6/12/2018	12:31:31	19.71	0.74
6/12/2018	12:32:31	19.70	0.74
6/12/2018	12:33:31	19.71	0.74
6/12/2018	12:34:31	19.72	0.74
6/12/2018	12:35:31	19.72	0.74
6/12/2018	12:36:31	19.72	0.74
6/12/2018	12:37:31	19.70	0.74
6/12/2018	12:38:31	19.71	0.74
6/12/2018	12:39:31	19.71	0.75
6/12/2018	12:40:31	19.72	0.75
6/12/2018	12:41:31	19.71	0.75
6/12/2018	12:42:31	19.71	0.75
6/12/2018	12:43:31	19.71	0.75
6/12/2018	12:44:31	19.71	0.75
6/12/2018	12:45:31	19.70	0.75
6/12/2018	12:46:31	19.71	0.75
6/12/2018	12:47:31	19.70	0.75
6/12/2018	12:48:31	19.70	0.74
6/12/2018	12:49:31	19.71	0.74
6/12/2018	12:50:31	19.71	0.74
6/12/2018	12:51:31	19.72	0.74
6/12/2018	12:52:31	19.71	0.73
6/12/2018	12:53:31	19.70	0.73
6/12/2018	12:54:31	19.70	0.73
6/12/2018	12:55:31	19.70	0.74
6/12/2018	12:56:31	19.71	0.74
6/12/2018	12:57:31	19.70	0.73
6/12/2018	12:58:31	19.70	0.73
6/12/2018	12:59:31	19.70	0.74
6/12/2018	13:00:31	19.70	0.74
6/12/2018	13:01:31	19.71	0.74
6/12/2018	13:02:31	19.71	0.74
6/12/2018	13:03:31	19.71	0.74
6/12/2018	13:04:31	19.70	0.74

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/12/2018	13:05:31	19.71	0.75
6/12/2018	13:06:31	19.71	0.75
6/12/2018	13:07:31	19.71	0.75
6/12/2018	13:08:31	19.69	0.75
6/12/2018	13:09:31	19.69	0.75
6/12/2018	13:10:31	19.69	0.75
6/12/2018	13:11:31	19.70	0.75
6/12/2018	13:12:31	19.70	0.75
6/12/2018	13:13:31	19.69	0.75
6/12/2018	13:14:31	19.69	0.74
6/12/2018	13:15:31	19.69	0.74
6/12/2018	13:16:31	19.69	0.74
6/12/2018	13:17:31	19.69	0.74
6/12/2018	13:18:31	19.68	0.74
6/12/2018	13:19:31	19.69	0.73
6/12/2018	13:20:31	19.69	0.73
6/12/2018	13:21:31	19.69	0.74
6/12/2018	13:22:31	19.70	0.74
6/12/2018	13:23:31	19.69	0.74
6/12/2018	13:24:31	19.69	0.74
6/12/2018	13:25:31	19.68	0.74
6/12/2018	13:26:31	19.69	0.74
6/12/2018	13:27:31	19.69	0.74
6/12/2018	13:28:31	19.68	0.75
6/12/2018	13:29:31	19.67	0.75
6/12/2018	13:30:31	19.67	0.75
6/12/2018	13:31:31	19.69	0.75
6/12/2018	13:32:31	19.69	0.75
6/12/2018	13:33:31	19.69	0.75
6/12/2018	13:34:31	19.68	0.75
6/12/2018	13:35:31	19.68	0.75
6/12/2018	13:36:31	19.68	0.74
6/12/2018	13:37:31	19.69	0.75
6/12/2018	13:38:31	19.68	0.75
6/12/2018	13:39:31	19.67	0.75
6/12/2018	13:40:31	19.68	0.75
6/12/2018	13:41:31	19.68	0.74
6/12/2018	13:42:31	19.69	0.74
6/12/2018	13:43:31	19.68	0.74
6/12/2018	13:44:31	19.68	0.74
6/12/2018	13:45:31	19.67	0.73

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/12/2018	13:46:31	19.67	0.74
6/12/2018	13:47:31	19.68	0.74
6/12/2018	13:48:31	19.68	0.74
6/12/2018	13:49:31	19.67	0.74
6/12/2018	13:50:31	19.67	0.74
6/12/2018	13:51:31	19.67	0.74
6/12/2018	13:52:31	19.68	0.74
6/12/2018	13:53:31	19.68	0.74
6/12/2018	13:54:31	19.68	0.74
6/12/2018	13:55:31	19.68	0.74
6/12/2018	13:56:31	19.67	0.75
6/12/2018	13:57:31	19.67	0.75
6/12/2018	13:58:31	19.69	0.75
6/12/2018	13:59:31	19.69	0.75
6/12/2018	14:00:31	19.67	0.75
6/12/2018	14:01:31	19.67	0.75
6/12/2018	14:02:31	19.67	0.75
6/12/2018	14:03:31	19.67	0.75
6/12/2018	14:04:31	19.68	0.74
6/12/2018	14:05:31	19.67	0.74
6/12/2018	14:06:31	19.67	0.74
6/12/2018	14:07:31	19.67	0.74
6/12/2018	14:08:31	19.67	0.74
6/12/2018	14:09:31	19.67	0.74
6/12/2018	14:10:31	19.67	0.73
6/12/2018	14:11:31	19.67	0.73
6/12/2018	14:12:31	19.67	0.73
6/12/2018	14:13:31	19.67	0.74
6/12/2018	14:14:31	19.67	0.73
6/12/2018	14:15:31	19.66	0.74
6/12/2018	14:16:31	19.66	0.74
6/12/2018	14:17:31	19.66	0.74
6/12/2018	14:18:31	19.67	0.74
6/12/2018	14:19:31	19.67	0.74
6/12/2018	14:20:31	19.67	0.75
6/12/2018	14:21:31	19.66	0.75
6/12/2018	14:22:31	19.66	0.75
6/12/2018	14:23:31	19.66	0.75
6/12/2018	14:24:31	19.66	0.75
6/12/2018	14:25:31	19.66	0.75
6/12/2018	14:26:31	19.66	0.75

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/12/2018	14:27:31	19.66	0.75
6/12/2018	14:28:31	19.65	0.75
6/12/2018	14:29:31	19.66	0.75
6/12/2018	14:30:31	19.66	0.75
6/12/2018	14:31:31	19.65	0.74
6/12/2018	14:32:31	19.66	0.74
6/12/2018	14:33:31	19.65	0.74
6/12/2018	14:34:31	19.65	0.74
6/12/2018	14:35:31	19.66	0.73
6/12/2018	14:36:31	19.65	0.74
6/12/2018	14:37:31	19.65	0.73
6/12/2018	14:38:31	19.65	0.73
6/12/2018	14:39:31	19.66	0.74
6/12/2018	14:40:31	19.66	0.73
6/12/2018	14:41:31	19.65	0.74
6/12/2018	14:42:31	19.64	0.74
6/12/2018	14:43:31	19.65	0.74
6/12/2018	14:44:31	19.65	0.74
6/12/2018	14:45:31	19.65	0.75
6/12/2018	14:46:31	19.66	0.75
6/12/2018	14:47:31	19.65	0.75
6/12/2018	14:48:31	19.66	0.75
6/12/2018	14:49:31	19.65	0.75
6/12/2018	14:50:31	19.65	0.75
6/12/2018	14:51:31	19.65	0.75
6/12/2018	14:52:31	19.64	0.75
6/12/2018	14:53:31	19.64	0.75
6/12/2018	14:54:31	19.64	0.74
6/12/2018	14:55:31	19.65	0.74
6/12/2018	14:56:31	19.65	0.74
6/12/2018	14:57:31	19.65	0.74
6/12/2018	14:58:31	19.64	0.73
6/12/2018	14:59:31	19.64	0.73
6/12/2018	15:00:31	19.65	0.73
6/12/2018	15:01:31	19.65	0.73
6/12/2018	15:02:31	19.64	0.74
6/12/2018	15:03:31	19.64	0.74
6/12/2018	15:04:31	19.65	0.73
6/12/2018	15:05:31	19.65	0.73
6/12/2018	15:06:31	19.65	0.73
6/12/2018	15:07:31	19.65	0.73

Hollingsworth & Vose

CFU-107

Run 2

Date	Time	O2 [%]	CO2 [%]
6/12/2018	15:08:31	19.65	0.73
6/12/2018	15:09:31	19.64	0.73
6/12/2018	15:10:31	19.64	0.74
6/12/2018	15:11:31	19.65	0.74
6/12/2018	15:12:31	19.65	0.75
6/12/2018	15:13:31	19.64	0.75
6/12/2018	15:14:31	19.64	0.75
6/12/2018	15:15:31	19.64	0.75
6/12/2018	15:16:31	19.64	0.75
6/12/2018	15:17:31	19.65	0.75
6/12/2018	15:18:31	19.64	0.75
6/12/2018	15:19:31	19.63	0.75
6/12/2018	15:20:31	19.63	0.75
6/12/2018	15:21:31	19.63	0.74
6/12/2018	15:22:31	19.64	0.74
6/12/2018	15:23:31	19.65	0.74
6/12/2018	15:24:31	19.64	0.74
6/12/2018	15:25:31	19.63	0.73
6/12/2018	15:26:31	19.64	0.73
6/12/2018	15:27:31	19.64	0.73
	Final	**19.68**	**0.74**

Hollingsworth & Vose

CFU 107

R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	15:34:12	0.12	0.11		
6/12/2018	15:34:22	0.13	0.11		
6/12/2018	15:34:32	0.12	0.11		
6/12/2018	15:34:42	0.12	0.11		
6/12/2018	15:34:52	0.12	0.11	0.12	0.11
6/12/2018	15:35:02	0.12	0.11		
6/12/2018	15:35:12	0.11	0.10		
6/12/2018	15:35:22	0.10	0.10		
6/12/2018	15:35:32	0.10	0.10		
6/12/2018	15:35:42	0.10	0.10		
6/12/2018	15:35:52	0.10	0.11		
6/12/2018	15:36:02	0.09	0.10		
6/12/2018	15:36:12	0.09	0.10		
6/12/2018	15:36:22	2.01	2.22		
6/12/2018	15:36:32	3.71	3.83		
6/12/2018	15:36:42	2.97	2.94		
6/12/2018	15:36:52	2.55	2.51		
6/12/2018	15:37:02	2.45	2.44		
6/12/2018	15:37:12	2.48	2.49		
6/12/2018	15:37:22	2.49	2.50		
6/12/2018	15:37:32	2.50	2.51		
6/12/2018	15:37:42	2.51	2.52		
6/12/2018	15:37:52	2.51	2.52		
6/12/2018	15:38:02	2.51	2.52		
6/12/2018	15:38:12	2.52	2.53		
6/12/2018	15:38:22	2.52	2.53		
6/12/2018	15:38:32	2.52	2.53		2.53
6/12/2018	15:38:42	2.53	2.54		
6/12/2018	15:38:52	5.33	3.84		
6/12/2018	15:39:02	8.29	7.50		
6/12/2018	15:39:12	9.27	8.86		
6/12/2018	15:39:22	9.63	9.37		
6/12/2018	15:39:32	9.76	9.55		
6/12/2018	15:39:42	9.81	9.63		
6/12/2018	15:39:52	9.83	9.65		
6/12/2018	15:40:02	9.84	9.65		
6/12/2018	15:40:12	9.84	9.67		
6/12/2018	15:40:22	9.84	9.68		
6/12/2018	15:40:32	9.97	9.68		
6/12/2018	15:40:42	10.08	9.69		
6/12/2018	15:40:52	10.09	9.69		

Hollingsworth & Vose

CFU 107

R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	15:41:02	10.09	9.69		
6/12/2018	15:41:12	10.09	9.69		
6/12/2018	15:41:22	10.09	9.69		
6/12/2018	15:41:32	10.09	9.69	10.09	
6/12/2018	15:41:42	10.09	9.70		
6/12/2018	15:41:52	10.09	9.70		

Hollingsworth & Vose

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/12/2018	15:55:26	19.89	0.74
6/12/2018	15:56:26	19.89	0.74
6/12/2018	15:57:26	19.88	0.74
6/12/2018	15:58:26	19.88	0.73
6/12/2018	15:59:26	19.88	0.73
6/12/2018	16:00:26	19.88	0.73
6/12/2018	16:01:26	19.89	0.73
6/12/2018	16:02:26	19.88	0.73
6/12/2018	16:03:26	19.88	0.73
6/12/2018	16:04:26	19.89	0.73
6/12/2018	16:05:26	19.89	0.73
6/12/2018	16:06:26	19.89	0.74
6/12/2018	16:07:26	19.89	0.74
6/12/2018	16:08:26	19.88	0.74
6/12/2018	16:09:26	19.88	0.74
6/12/2018	16:10:26	19.88	0.75
6/12/2018	16:11:26	19.88	0.75
6/12/2018	16:12:26	19.88	0.75
6/12/2018	16:13:26	19.88	0.75
6/12/2018	16:14:26	19.87	0.75
6/12/2018	16:15:26	19.88	0.74
6/12/2018	16:16:26	19.88	0.74
6/12/2018	16:17:26	19.89	0.74
6/12/2018	16:18:26	19.89	0.74
6/12/2018	16:19:26	19.87	0.74
6/12/2018	16:20:26	19.87	0.74
6/12/2018	16:21:26	19.87	0.74
6/12/2018	16:22:26	19.88	0.74
6/12/2018	16:23:26	19.88	0.73
6/12/2018	16:24:26	19.88	0.73
6/12/2018	16:25:26	19.87	0.73
6/12/2018	16:26:26	19.88	0.73
6/12/2018	16:27:26	19.88	0.73
6/12/2018	16:28:26	19.88	0.73
6/12/2018	16:29:26	19.88	0.73
6/12/2018	16:30:26	19.87	0.73
6/12/2018	16:31:26	19.88	0.73
6/12/2018	16:32:26	19.88	0.73
6/12/2018	16:33:26	19.89	0.74
6/12/2018	16:34:26	19.89	0.74
6/12/2018	16:35:26	19.88	0.74

Hollingsworth & Vose

CFU-107

Run 3

Date	Time	O2 [%]	CO2 [%]
6/12/2018	16:36:26	19.87	0.75
6/12/2018	16:37:26	19.87	0.75
6/12/2018	16:38:26	19.88	0.75
6/12/2018	16:39:26	19.88	0.75
6/12/2018	16:40:26	19.87	0.75
6/12/2018	16:41:26	19.85	0.75
6/12/2018	16:42:26	19.86	0.75
6/12/2018	16:43:26	19.87	0.75
6/12/2018	16:44:26	19.88	0.74
6/12/2018	16:45:26	19.89	0.74
6/12/2018	16:46:26	19.88	0.74
6/12/2018	16:47:26	19.87	0.74
6/12/2018	16:48:26	19.87	0.73
6/12/2018	16:49:26	19.88	0.73
6/12/2018	16:50:26	19.88	0.73
6/12/2018	16:51:26	19.89	0.73
6/12/2018	16:52:26	19.88	0.73
6/12/2018	16:53:26	19.88	0.73
6/12/2018	16:54:26	19.89	0.73
6/12/2018	16:55:26	19.89	0.73
6/12/2018	16:56:26	19.89	0.74
6/12/2018	16:57:26	19.88	0.74
6/12/2018	16:58:26	19.88	0.74
6/12/2018	16:59:26	19.88	0.75
6/12/2018	17:00:26	19.89	0.75
6/12/2018	17:01:26	19.89	0.75
6/12/2018	17:02:26	19.89	0.75
6/12/2018	17:03:26	19.88	0.75
6/12/2018	17:04:26	19.88	0.75
6/12/2018	17:05:26	19.89	0.75
6/12/2018	17:06:26	19.89	0.75
6/12/2018	17:07:26	19.89	0.75
6/12/2018	17:08:26	19.88	0.75
6/12/2018	17:09:26	19.88	0.74
6/12/2018	17:10:26	19.89	0.74
6/12/2018	17:11:26	19.89	0.74
6/12/2018	17:12:26	19.90	0.74
6/12/2018	17:13:26	19.89	0.74
6/12/2018	17:14:26	19.89	0.74
6/12/2018	17:15:26	19.89	0.74
6/12/2018	17:16:26	19.89	0.74

Hollingsworth & Vose

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/12/2018	17:17:26	19.90	0.74
6/12/2018	17:18:26	19.90	0.74
6/12/2018	17:19:26	19.89	0.74
6/12/2018	17:20:26	19.89	0.75
6/12/2018	17:21:26	19.89	0.74
6/12/2018	17:22:26	19.90	0.74
6/12/2018	17:23:26	19.90	0.75
6/12/2018	17:24:26	19.90	0.75
6/12/2018	17:25:26	19.89	0.75
6/12/2018	17:26:26	19.90	0.76
6/12/2018	17:27:26	19.90	0.76
6/12/2018	17:28:26	19.91	0.76
6/12/2018	17:29:26	19.91	0.75
6/12/2018	17:30:26	19.89	0.75
6/12/2018	17:31:26	19.89	0.76
6/12/2018	17:32:26	19.90	0.75
6/12/2018	17:33:26	19.90	0.76
6/12/2018	17:34:26	19.91	0.75
6/12/2018	17:35:26	19.91	0.75
6/12/2018	17:36:26	19.40	0.75
6/12/2018	17:37:26	19.38	0.74
6/12/2018	17:38:26	19.38	0.74
6/12/2018	17:39:26	19.38	0.74
6/12/2018	17:40:26	19.37	0.74
6/12/2018	17:41:26	19.37	0.74
6/12/2018	17:42:26	19.38	0.74
6/12/2018	17:43:26	19.39	0.74
6/12/2018	17:44:26	19.39	0.74
6/12/2018	17:45:26	19.39	0.74
6/12/2018	17:46:26	19.39	0.74
6/12/2018	17:47:26	19.39	0.74
6/12/2018	17:48:26	19.38	0.75
6/12/2018	17:49:26	19.39	0.75
6/12/2018	17:50:26	19.39	0.75
6/12/2018	17:51:26	19.38	0.76
6/12/2018	17:52:26	19.37	0.76
6/12/2018	17:53:26	19.38	0.76
6/12/2018	17:54:26	19.39	0.75
6/12/2018	17:55:26	19.39	0.75
6/12/2018	17:56:26	19.38	0.76
6/12/2018	17:57:26	19.38	0.75

Hollingsworth & Vose

CFU-107

Run 3

Date	Time	O2 [%]	CO2 [%]
6/12/2018	17:58:26	19.38	0.75
6/12/2018	17:59:26	19.39	0.75
6/12/2018	18:00:26	19.38	0.75
6/12/2018	18:01:26	19.38	0.75
6/12/2018	18:02:26	19.38	0.75
6/12/2018	18:03:26	19.39	0.74
6/12/2018	18:04:26	19.39	0.74
6/12/2018	18:05:26	19.40	0.74
6/12/2018	18:06:26	19.40	0.74
6/12/2018	18:07:26	19.39	0.74
6/12/2018	18:08:26	19.39	0.74
6/12/2018	18:09:26	19.39	0.74
6/12/2018	18:10:26	19.39	0.74
6/12/2018	18:11:26	19.39	0.75
6/12/2018	18:12:26	19.39	0.75
6/12/2018	18:13:26	19.39	0.75
6/12/2018	18:14:26	19.39	0.75
6/12/2018	18:15:26	19.40	0.75
6/12/2018	18:16:26	19.40	0.76
6/12/2018	18:17:26	19.40	0.76
6/12/2018	18:18:26	19.40	0.75
6/12/2018	18:19:26	19.40	0.76
6/12/2018	18:20:26	19.41	0.76
6/12/2018	18:21:26	19.41	0.76
6/12/2018	18:22:26	19.39	0.76
6/12/2018	18:23:26	19.39	0.76
6/12/2018	18:24:26	19.40	0.75
6/12/2018	18:25:26	19.40	0.75
6/12/2018	18:26:26	19.40	0.75
6/12/2018	18:27:26	19.39	0.75
6/12/2018	18:28:26	19.39	0.75
6/12/2018	18:29:26	19.38	0.75
6/12/2018	18:30:26	19.40	0.75
6/12/2018	18:31:26	19.40	0.75
6/12/2018	18:32:26	19.39	0.74
6/12/2018	18:33:26	19.70	0.75
6/12/2018	18:34:26	19.78	0.75
6/12/2018	18:35:26	19.79	0.75
6/12/2018	18:36:26	19.80	0.74
6/12/2018	18:37:26	19.80	0.75
6/12/2018	18:38:26	19.79	0.75

Hollingsworth & Vose

CFU-107

Run 3

Date	Time	O2 [%]	CO2 [%]
6/12/2018	18:39:26	19.79	0.75
6/12/2018	18:40:26	19.80	0.75
6/12/2018	18:41:26	19.79	0.76
6/12/2018	18:42:26	19.80	0.76
6/12/2018	18:43:26	19.79	0.76
6/12/2018	18:44:26	19.79	0.76
6/12/2018	18:45:26	19.80	0.76
6/12/2018	18:46:26	19.81	0.76
6/12/2018	18:47:26	19.81	0.76
6/12/2018	18:48:26	19.80	0.76
6/12/2018	18:49:26	19.80	0.75
6/12/2018	18:50:26	19.80	0.75
6/12/2018	18:51:26	19.80	0.75
6/12/2018	18:52:26	19.81	0.75
6/12/2018	18:53:26	19.81	0.75
6/12/2018	18:54:26	19.79	0.75
6/12/2018	18:55:26	19.80	0.74
6/12/2018	18:56:26	19.80	0.75
6/12/2018	18:57:26	19.81	0.74
	Final	**19.72**	**0.75**

Hollingsworth & Vose

CFU 107

R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/12/2018	19:03:03	2.91	0.37		
6/12/2018	19:03:13	1.10	0.22		
6/12/2018	19:03:23	0.48	0.15		
6/12/2018	19:03:33	0.27	0.13		
6/12/2018	19:03:43	0.19	0.13		
6/12/2018	19:03:53	0.16	0.13		
6/12/2018	19:04:03	0.15	0.12		
6/12/2018	19:04:13	0.15	0.13		
6/12/2018	19:04:23	0.14	0.12		
6/12/2018	19:04:33	0.14	0.11		
6/12/2018	19:04:43	0.14	0.12	0.14	0.12
6/12/2018	19:04:53	0.93	0.88		
6/12/2018	19:05:03	2.43	2.23		
6/12/2018	19:05:13	2.24	2.04		
6/12/2018	19:05:23	2.55	2.49		
6/12/2018	19:05:33	2.43	2.36		
6/12/2018	19:05:43	2.46	2.42		
6/12/2018	19:05:53	2.51	2.48		
6/12/2018	19:06:03	2.53	2.51		
6/12/2018	19:06:13	2.54	2.52		
6/12/2018	19:06:23	2.54	2.53		
6/12/2018	19:06:33	2.54	2.53		
6/12/2018	19:06:43	2.55	2.54		
6/12/2018	19:06:53	2.54	2.54		2.54
6/12/2018	19:07:03	2.55	2.54		
6/12/2018	19:07:13	2.55	2.54		
6/12/2018	19:07:23	4.08	2.37		
6/12/2018	19:07:33	7.80	5.40		
6/12/2018	19:07:43	9.15	8.16		
6/12/2018	19:07:53	9.74	9.13		
6/12/2018	19:08:03	9.95	9.46		
6/12/2018	19:08:13	10.01	9.59		
6/12/2018	19:08:23	10.03	9.65		
6/12/2018	19:08:33	10.05	9.66		
6/12/2018	19:08:43	10.06	9.68		
6/12/2018	19:08:53	10.06	9.68		
6/12/2018	19:09:03	10.05	9.69		
6/12/2018	19:09:13	10.06	9.69	10.06	
6/12/2018	19:09:23	10.05	9.70		
6/12/2018	19:09:33	9.91	9.69		

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth and Vose**
FACILITY	**GP1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 107**
DATE	**06/13/18**
METHOD	**26A**
POLLUTANT	**HF**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth and Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**11:55**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**14:07**
EPA Method:	**26A**	60 degrees, cloudy		**Date:**	**6/13/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

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	4D	Liner type	Glass		
Y factor	0.9988	Nozzle ID	0.25	Nozzle size	0.2503	inches	
ΔH@	1.8338	Hot box ID	1	Nozzle area	0.000342	sq.ft.	
		Pitot Cp	0.84	Probe heat	248	F	
				Filter heat	248	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.89 %
Static Pressure	0.71	"H_2O	CO_2	0.74 %
Ave. ΔP	1.03	"H_2O	Rec. Nz.	0.217 inches
Stack Temperature	240	F		
Assumed moisture	2	%		
Assumed meter temp.	67	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	16	8

Nozzle check for roundness:

1	2	3	
0.250	0.250	0.251	inches

Caliper ID# HLN #1

Post Test Calculations:

Sample volume	126.405	dcf	Ave. ΔP	1.204 "H_2O
Wet mol. weight	28.66	M_s (actual)	Ave. √ΔP	1.0968 "H_2O
Actual H_2O	2.25	%	Ave. ΔH	3.804 "H_2O
Std. meter vol.	127.856	dscf	Ave. T_s	257.7 °F
Isokinetic Average	100.1	%	Ave. T_m	66.4 °F

Moisture/Lab:

Filter na #

	Initial	Final	Gain
Impingers, g	200.0	230	30.0
Silica gel, g	236.9	269.5	32.6
		Total water gain:	62.6

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	5.380	1.30	257	61	4.03	4.00	4	251	51
2	10.0	10.610	1.20	256	64	3.75	3.80	4	252	51
3	15.0	15.780	1.20	256	64	3.75	3.80	4	253	51
4	20.0	21.020	1.20	256	64	3.75	3.80	4	249	51
5	25.0	26.160	1.20	256	65	3.76	3.80	4	251	52
6	30.0	31.390	1.20	256	65	3.76	3.80	4	251	52
7	35.0	36.670	1.20	257	65	3.75	3.80	4	251	53
8	40.0	41.910	1.20	258	66	3.75	3.80	4	250	53
9	45.0	47.140	1.20	258	66	3.75	3.80	4	252	53
10	50.0	52.370	1.20	258	66	3.75	3.80	4	252	54
11	55.0	57.600	1.20	257	66	3.76	3.80	4	250	54
12	60.0	62.854	1.20	257	67	3.77	3.80	4	250	54
13	65.0	67.940	1.10	256	67	3.46	3.50	4	260	53
14	70.0	73.220	1.20	256	66	3.76	3.80	4	260	53
15	75.0	78.300	1.10	258	67	3.45	3.50	4	254	57
16	80.0	83.350	1.10	260	67	3.44	3.50	4	251	59
17	85.0	88.500	1.10	261	67	3.43	3.40	4	251	60
18	90.0	94.450	1.50	261	67	4.68	4.70	5	251	60
19	95.0	99.690	1.20	262	68	3.75	3.80	4	251	61
20	100.0	105.170	1.30	259	68	4.08	4.10	4	251	62
21	105.0	110.490	1.20	257	69	3.78	3.80	4	250	62
22	110.0	115.770	1.20	257	69	3.78	3.80	4	251	61
23	115.0	121.090	1.20	258	70	3.78	3.80	4	249	62
24	120.0	126.405	1.20	257	70	3.79	3.80	4	252	62

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth and Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**14:23**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**16:31**
EPA Method:	**26A**	60 degrees, cloudy		**Date:**	**6/13/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

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	4D	Liner type:	Glass		
Y factor	0.9988	Nozzle ID	0.25	Nozzle size:	0.2503	inches	
ΔH@	1.8338	Hot box ID	1	Nozzle area:	0.000342	sq.ft.	
		Pitot Cp	0.84	Probe heat:	248	F	
				Filter heat:	248	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.85 %
Static Pressure	0.71	"H_2O	CO_2	0.73 %
Ave. ΔP	1.03	"H_2O	Rec. Nz.	0.218 inches
Stack Temperature	240	F		
Assumed moisture	2.25	%		
Assumed meter temp.	66.4	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:	17	14

Nozzle check for roundness:

1	2	3	
0.250	0.250	0.251	inches
	Caliper ID#	HLN #1	

Post Test Calculations:

Sample volume	128.496	dcf	Ave. ΔP	1.229 "H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. √ΔP	1.1082 "H_2O
Actual H_2O	2.05	%	Ave. ΔH	3.883 "H_2O
Std. meter vol.	129.235	dscf	Ave. T_s	257.6 °F
Isokinetic Average	100.0	%	Ave. T_m	69.5 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	217	17.0
Silica gel, g	232.7	273.1	40.4
		Total water gain:	57.4

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	4.810	1.00	260	70	3.13	3.10	4	251	66
2	10.0	9.750	1.10	260	70	3.44	3.50	4	251	61
3	15.0	15.140	1.20	258	70	3.77	3.80	4	252	59
4	20.0	20.660	1.30	258	70	4.08	4.10	4	251	58
5	25.0	26.150	1.30	258	70	4.08	4.10	4	251	58
6	30.0	31.290	1.20	258	70	3.77	3.80	4	251	59
7	35.0	36.650	1.20	258	70	3.77	3.80	4	251	60
8	40.0	42.050	1.20	257	70	3.77	3.80	4	249	60
9	45.0	47.310	1.20	255	69	3.78	3.80	4	253	60
10	50.0	52.650	1.20	253	70	3.79	3.80	4	254	60
11	55.0	57.980	1.20	252	70	3.80	3.80	4	253	60
12	60.0	63.317	1.20	252	70	3.80	3.80	4	248	60
13	65.0	68.680	1.20	255	70	3.78	3.80	4	250	60
14	70.0	74.050	1.20	257	70	3.77	3.80	4	251	56
15	75.0	79.390	1.20	258	69	3.76	3.80	4	249	58
16	80.0	84.730	1.20	258	69	3.76	3.80	4	251	59
17	85.0	90.180	1.30	259	69	4.07	4.10	4	252	60
18	90.0	95.690	1.30	259	69	4.07	4.10	4	251	61
19	95.0	101.230	1.30	259	69	4.07	4.10	4	251	62
20	100.0	106.670	1.30	259	69	4.07	4.10	4	251	62
21	105.0	112.130	1.30	259	69	4.07	4.10	4	251	62
22	110.0	117.550	1.30	260	69	4.06	4.10	4	253	62
23	115.0	123.050	1.30	260	69	4.06	4.10	4	251	62
24	120.0	128.496	1.30	261	69	4.06	4.10	4	251	63

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth and Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**16:46**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:53**
EPA Method:	**26A**	60 degrees, cloudy	**Date:**	**6/13/2018**
Box Operator:	**CMF**			
Technician(s):	**CSW**			

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	4D	Liner type:	Glass
Y factor	0.9988	Nozzle ID	0.25	Nozzle size:	0.2503 inches
ΔH@	1.8338	Hot box ID	1	Nozzle area:	0.000342 sq.ft.
		Pitot Cp	0.84	Probe heat:	248 F
				Filter heat:	248 F

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.83 %
Static Pressure	0.71	"H_2O	CO_2	0.71 %
Ave. ΔP	1.03	"H_2O	Rec. Nz.	0.217 inches
Stack Temperature	240	F		
Assumed moisture	2.05	%		
Assumed meter temp.	69.5	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:	0.001	0.000
Leak check vacuum, "Hg:	16	10

Nozzle check for roundness:

1	2	3	
0.250	0.250	0.251	inches

Caliper ID# HLN #1

Post Test Calculations:

Sample volume	129.312	dcf	Ave. ΔP	1.229 "H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. √ΔP	1.108 "H_2O
Actual H_2O	2.06	%	Ave. ΔH	3.917 "H_2O
Std. meter vol.	128.896	dscf	Ave. T_s	258.2 °F
Isokinetic Average	99.8	%	Ave. T_m	74.3 °F

Moisture/Lab:

Filter na #

	Initial	Final	Gain
Impingers, g	200.0	226	26.0
Silica gel, g	242.1	273.6	31.5
		Total water gain:	57.5

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	5.280	1.20	261	69	3.76	3.80	4	250	63
2	10.0	10.500	1.20	260	69	3.76	3.80	4	253	50
3	15.0	15.750	1.20	261	69	3.76	3.80	4	254	51
4	20.0	20.990	1.20	260	70	3.77	3.80	4	252	50
5	25.0	26.220	1.20	260	70	3.77	3.80	4	254	50
6	30.0	31.510	1.20	261	70	3.76	3.80	4	252	52
7	35.0	37.000	1.30	261	70	4.08	4.10	4	250	51
8	40.0	42.480	1.30	260	71	4.09	4.10	4	253	51
9	45.0	48.380	1.50	260	71	4.72	4.70	5	251	52
10	50.0	54.050	1.30	260	73	4.11	4.10	5	251	52
11	55.0	59.360	1.20	260	73	3.79	3.80	5	251	52
12	60.0	64.628	1.20	259	74	3.80	3.80	5	255	54
13	65.0	69.460	1.00	259	74	3.17	3.20	4	252	52
14	70.0	74.770	1.20	261	75	3.80	3.80	4	250	52
15	75.0	80.090	1.20	256	76	3.83	3.80	4	252	55
16	80.0	85.440	1.20	256	77	3.84	3.80	4	252	55
17	85.0	90.800	1.20	258	77	3.83	3.80	4	249	57
18	90.0	96.380	1.30	257	78	4.16	4.20	4	252	57
19	95.0	102.000	1.30	256	79	4.18	4.20	4	251	57
20	100.0	107.430	1.20	254	79	3.87	3.90	4	251	57
21	105.0	112.900	1.20	254	79	3.87	3.90	4	251	58
22	110.0	118.230	1.20	254	79	3.87	3.90	4	251	58
23	115.0	123.870	1.30	255	80	4.19	4.20	4	251	58
24	120.0	129.312	1.20	254	80	3.87	3.90	4	252	58

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

Client:	**Hollingsworth and Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**11:55**
Source:	**CFU 107**	**End Time:**	**14:07**
Method:	**26A**	**Date:**	**6/13/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	5.380	4.00	61	1	1.30	257	1.1402
10	10.610	3.80	64	2	1.20	256	1.0954
15	15.780	3.80	64	3	1.20	256	1.0954
20	21.020	3.80	64	4	1.20	256	1.0954
25	26.160	3.80	65	5	1.20	256	1.0954
30	31.390	3.80	65	6	1.20	256	1.0954
35	36.670	3.80	65	7	1.20	257	1.0954
40	41.910	3.80	66	8	1.20	258	1.0954
45	47.140	3.80	66	9	1.20	258	1.0954
50	52.370	3.80	66	10	1.20	258	1.0954
55	57.600	3.80	66	11	1.20	257	1.0954
60	62.854	3.80	67	12	1.20	257	1.0954
65	67.940	3.50	67	13	1.10	256	1.0488
70	73.220	3.80	66	14	1.20	256	1.0954
75	78.300	3.50	67	15	1.10	258	1.0488
80	83.350	3.50	67	16	1.10	260	1.0488
85	88.500	3.40	67	17	1.10	261	1.0488
90	94.450	4.70	67	18	1.50	261	1.2247
95	99.690	3.80	68	19	1.20	262	1.0954
100	105.170	4.10	68	20	1.30	259	1.1402
105	110.490	3.80	69	21	1.20	257	1.0954
110	115.770	3.80	69	22	1.20	257	1.0954
115	121.090	3.80	70	23	1.20	258	1.0954
120	126.405	3.80	70	24	1.20	257	1.0954

Client:	**Hollingsworth and Vose**	**Run:**	**1**
Source:	**CFU 107**	**Date:**	**06/13/18**

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	126.405	dcf	Rectangular		
Water Volume	62.6	ml (g)	Width		in
Nozzle Diameter, N_z	0.2503	in.	Length		in
Nozzle Area	0.000342	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.74	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.89	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.804	"H_2O	√Dp	1.0968	"H_2O
Temperature, T_m	66.4	^oF	Temperature, T_s	257.7	^oF
Temperature, T_m	526.4	^oA (^oR)	Temperature, T_s	717.7	^oA (R)
Pressure Meter, P_m	30.220	"Hg	Pressure Stack, P_s	29.992	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	127.856	dscf	Velocity, V_s	71.97	fps
	3.620	dscm	Volume (actual)	21,198.0	awcfm
Actual Volume, $V_{m(actual)}$	177.436	awcf		20,721.0	adcfm
Gas Stream Moisture			Volume (standard)	937,954.7	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.946	scf		916,850.7	dscf/hr
Moisture, B_{ws}	0.0225			15,280.8	dscf/min
Moisture EPA M4	2.25	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	522.43	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.66	lb/lb-mole			
Percent Isokinetic	100.1	%			

Laboratory Results

HF	17.6	µg/sample			
HF	1.76E-05	grams	MW HF	20.01	g/mole

Emissions:

Concentration HF, C_s	2.12E-06	gr/dscf
	4.86	µg/dscm
	5.84E-03	ppmvd
Mass Emissions HF	2.78E-04	lb/hr

"<" represents MDL value

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

Client:	**Hollingsworth and Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**14:23**
Source:	**CFU 107**	**End Time:**	**16:31**
Method:	**26A**	**Date:**	**06/13/18**

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**	**√Dp**
	0.000						
5	4.810	3.10	70	1	1.00	260	1.0000
10	9.750	3.50	70	2	1.10	260	1.0488
15	15.140	3.80	70	3	1.20	258	1.0954
20	20.660	4.10	70	4	1.30	258	1.1402
25	26.150	4.10	70	5	1.30	258	1.1402
30	31.290	3.80	70	6	1.20	258	1.0954
35	36.650	3.80	70	7	1.20	258	1.0954
40	42.050	3.80	70	8	1.20	257	1.0954
45	47.310	3.80	69	9	1.20	255	1.0954
50	52.650	3.80	70	10	1.20	253	1.0954
55	57.980	3.80	70	11	1.20	252	1.0954
60	63.317	3.80	70	12	1.20	252	1.0954
65	68.680	3.80	70	13	1.20	255	1.0954
70	74.050	3.80	70	14	1.20	257	1.0954
75	79.390	3.80	69	15	1.20	258	1.0954
80	84.730	3.80	69	16	1.20	258	1.0954
85	90.180	4.10	69	17	1.30	259	1.1402
90	95.690	4.10	69	18	1.30	259	1.1402
95	101.230	4.10	69	19	1.30	259	1.1402
100	106.670	4.10	69	20	1.30	259	1.1402
105	112.130	4.10	69	21	1.30	259	1.1402
110	117.550	4.10	69	22	1.30	260	1.1402
115	123.050	4.10	69	23	1.30	260	1.1402
120	128.496	4.10	69	24	1.30	261	1.1402

Client:	**Hollingsworth and Vose**	**Run:**	**2**
Source:	**CFU 107**	**Date:**	**06/13/18**

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	128.496	dcf	Rectangular		
Water Volume	57.4	ml (g)	Width		in
Nozzle Diameter, N_z	0.2503	in.	Length		in
Nozzle Area	0.000342	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.73	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.85	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.883	"H_2O	√Dp	1.1082	"H_2O
Temperature, T_m	69.5	^oF	Temperature, T_s	257.6	^oF
Temperature, T_m	529.5	^oA (^oR)	Temperature, T_s	717.6	^oA (R)
Pressure Meter, P_m	30.226	"Hg	Pressure Stack, P_s	29.992	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	129.235	dscf	Velocity, V_s	72.68	fps
	3.660	dscm	Volume (actual)	21,407.2	awcfm
Actual Volume, $V_{m(actual)}$	178.960	awcf		20,968.4	adcfm
Gas Stream Moisture			Volume (standard)	947,339.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.701	scf		927,919.3	dscf/hr
Moisture, B_{ws}	0.0205			15,465.3	dscf/min
Moisture EPA M4	2.05	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	522.358	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	100.0	%			

Laboratory Results

HF	11.2	µg/sample		
HF	1.12E-05	grams	MW HF	20.01 g/mole

Emissions:

Concentration HF, C_s	1.34E-06	gr/dscf
	3.06	µg/dscm
	3.68E-03	ppmvd
Mass Emissions HF	1.77E-04	lb/hr

"<" represents MDL value

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

Client:	**Hollingsworth and Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**16:46**
Source:	**CFU 107**	**End Time:**	**18:53**
Method:	**26A**	**Date:**	**06/13/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	5.280	3.80	69	1	1.20	261	1.0954
10	10.500	3.80	69	2	1.20	260	1.0954
15	15.750	3.80	69	3	1.20	261	1.0954
20	20.990	3.80	70	4	1.20	260	1.0954
25	26.220	3.80	70	5	1.20	260	1.0954
30	31.510	3.80	70	6	1.20	261	1.0954
35	37.000	4.10	70	7	1.30	261	1.1402
40	42.480	4.10	71	8	1.30	260	1.1402
45	48.380	4.70	71	9	1.50	260	1.2247
50	54.050	4.10	73	10	1.30	260	1.1402
55	59.360	3.80	73	11	1.20	260	1.0954
60	64.628	3.80	74	12	1.20	259	1.0954
65	69.460	3.20	74	13	1.00	259	1.0000
70	74.770	3.80	75	14	1.20	261	1.0954
75	80.090	3.80	76	15	1.20	256	1.0954
80	85.440	3.80	77	16	1.20	256	1.0954
85	90.800	3.80	77	17	1.20	258	1.0954
90	96.380	4.20	78	18	1.30	257	1.1402
95	102.000	4.20	79	19	1.30	256	1.1402
100	107.430	3.90	79	20	1.20	254	1.0954
105	112.900	3.90	79	21	1.20	254	1.0954
110	118.230	3.90	79	22	1.20	254	1.0954
115	123.870	4.20	80	23	1.30	255	1.1402
120	129.312	3.90	80	24	1.20	254	1.0954

Client:	**Hollingsworth and Vose**	**Run:**	**3**
Source:	**CFU 107**	**Date:**	**06/13/18**

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	129.312	dcf	Rectangular		
Water Volume	57.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.2503	in.	Length		in
Nozzle Area	0.000342	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.71	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.83	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9988	Y			

Field Data Averages

Meter			Stack		
ΔH	3.917	"H_2O	√Dp	1.1080	"H_2O
Temperature, T_m	74.3	^oF	Temperature, T_s	258.2	^oF
Temperature, T_m	534.3	^oA (^oR)	Temperature, T_s	718.2	^oA (R)
Pressure Meter, P_m	30.228	"Hg	Pressure Stack, P_s	29.992	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	128.896	dscf	Velocity, V_s	72.69	fps
	3.650	dscm	Volume (actual)	21,410.1	awcfm
Actual Volume, $V_{m(actual)}$	178.657	awcf		20,969.1	adcfm
Gas Stream Moisture			Volume (standard)	946,678.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.706	scf		927,177.0	dscf/hr
Moisture, B_{ws}	0.0206			15,453.0	dscf/min
Moisture EPA M4	2.06	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	522.794	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	99.8	%			

Laboratory Results

HF	6.7	µg/sample			
HF	6.71E-06	grams	MW HF	20.01	g/mole
Emissions:					
Concentration HF, C_s	8.03E-07	gr/dscf			
	1.84	µg/dscm			
	2.21E-03	ppmvd			
Mass Emissions HF	1.06E-04	lb/hr			

"<" represents MDL value

EPA Method 26A
Laboratory Results
HF

Client: **Hollingsworth and Vose**
Location: **Corvallis, OR**
Source: **CFU 107**

Lab ID	Sample ID	Sample Date		Result	MDL	Sample Vol. (ml)	Units
18-S1093	M26A Cont. 3 R-1	6/13/2018		17.6	4.00	380.0	µg/sample
18-S1094	M26A Cont. 3 R-2	6/13/2018		11.2	4.00	380.0	µg/sample
18-S1095	M26A Cont. 3 R-3	6/13/2018		6.71	3.95	375.0	µg/sample
18-S1054	0.1N H2SO4 Blank	6/5/2018	<	MDL	3.79	360.0	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 and Vose**
Location: **Corvallis, OR**
Source: **CFU 107**

Run			1	2	3	
Date			6/13/2018	6/13/2018	6/13/2018	
Run Start Time			11:55	14:23	16:46	
Run End Time			14:07	16:31	18:53	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.94	29.94	29.94	**29.94**
Nozzle Dia., in.			0.2503	0.2503	0.2503	**0.2503**
Isokinetic Average, %			100.1	100.0	99.8	**100.0**
Sample Volume, dscf			127.856	129.235	128.896	**128.662**
Sample Volume, dscm			3.620	3.660	3.650	**3.643**
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			0.74	0.73	0.71	**0.73**
O_2 %vd			19.89	19.85	19.83	**19.86**
Static Press., "H_2O			0.71	0.71	0.71	**0.71**
H_2O %v			2.25	2.05	2.06	**2.12**
Wet Molecular Weight, lb/lb-mole			28.66	28.69	28.69	**28.68**
Velocity, FPS			71.97	72.68	72.69	**72.45**
ADCFM			20,721.0	20,968.4	20,969.1	**20,886.2**
AWCFM			21,198.0	21,407.2	21,410.1	**21,338.4**
DSCFM			15,280.8	15,465.3	15,453.0	**15,399.7**
Stack Temperature, °F			257.7	257.6	258.2	**257.8**
HF	Concentration, C_s	gr/dscf	2.12E-06	1.34E-06	8.03E-07	**1.42E-06**
		µg/dscm	4.86	3.06	1.84	**3.25**
		ppmvd	5.84E-03	3.68E-03	2.21E-03	**3.91E-03**
	Mass	lb/hr	2.78E-04	1.77E-04	1.06E-04	**1.87E-04**
		lb/lb glass	7.43E-07	4.79E-07	2.90E-07	**5.04E-07**
Production Data	Glass Production	lbs/hr	374.6	369.8	367.4	**370.6**

"<" represents MDL value

EPA Methods 1-4, 26A
Example Calculations

Client:	**Hollingsworth and Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**11:55**
Source:	**CFU 107**	**End Time:**	**14:07**
Method:	**26A**	**Date:**	**6/13/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.220 "Hg

where Pb: 29.94 "Hg

ΔH: 3.804 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.992 "Hg

where Pb: 29.94 "Hg

Static Press.: 0.71 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 127.856 dscf

where Vm: 126.405 dcf

Y: 0.9988

Pm: 30.220 "Hg

Tm: 526.4 °A

4) $V_w(std) = (0.04706)(H_2O)$ = 2.946 scf

where H_2O: 62.60 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0225

where Vw(std): 2.946 scf

Vm(std): 127.856 dscf

6) % H_2O = Bws x 100 = 2.25 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 177.436 awcf

where Y: 0.9988

Vm: 126.4050 dcf

Bws: 0.0225

Ts: 717.7 °A

Tm: 526.4 °A

Pm: 30.220 "Hg

Ps: 29.992 "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: 0.74 %vd

O_2 19.89 %vd

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

Client: Hollingsworth and Vose		**Run:**	**1**
Source: CFU 107		**Date:**	**6/13/2018**

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

where M_d: 28.91 lb/lb-mole

Bws: 0.0225

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 71.97 fps

where Cp: 0.84

Ave. Sqrt ΔP: 1.0968

Ts: 717.7 °A

Ps: 29.992 "Hg

Ms: 28.66 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 21,198.0 AWCFM

where V_s: 71.97 ft/sec

Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 20,721.0 ADCFM

where AWCFM: 21,198.0

Bws: 0.0225

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 937,954.7 wscf/hr

where V_s: 71.97 ft/sec

Stack Area: 4.9090 sq. ft.

Ts: 717.7 °A

Ps: 29.992 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 916,850.7 dscf/hr

where wscf/hr: 937,954.7

Bws: 0.0225

16) DSCFM= (dscf/hr)/60 mins/hr = 15,280.8 DSCFM

where dscf/hr: 916,850.7

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000342 sq. ft.

where Nozzle Size: 0.2503 inches

Client:	**Hollingsworth and Vose**	**Run:**	**1**
Source:	**CFU 107**	**Date:**	**6/13/2018**

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

where Ts:	717.7	°A
Vm(Std):	127.856	dscf
Ps:	29.992	"Hg
Vs	71.97	ft/sec
Nozzle Area:	0.000342	sq. ft.
Sampling Time:	120	min.
Bws:	0.0225	

EPA Method 26A:

19) HF laboratory results 17.6 µg/sample

20) HF = (µg/sample)/1,000,000 = 1.76E-05 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 2.12E-06 gr/dscf

where Sample:	0.00002	grams
Vm(std)	127.856	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 4.9 µg/dscm

where Sample:	0.00002	grams
Vm(std)	3.620	dscm

23) Volume/Mole $= \left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 522.430 Vol./Mole

where Ts:	717.7	°A
Ps:	29.992	"Hg

24) ppmvd $= \left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 5.84E-03 ppmvd

where MW:	20.01	g/mol
lb/hr:	0.00	
Vol./Mole:	522.430	
ADCFM:	20721.0	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 2.78E-04 lb/hr

where Cs:	2.12E-06	gr/dscf
Stack Flow:	916,850.7	dscf/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 107**
DATE	**06/13/18**
METHOD	**13B**
POLLUTANT	**Total Fluorides**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**11:55**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**14:08**
EPA Method:	**13B**	60 degrees, cloudy		**Date:**	**6/13/2018**
Box Operator:	**DS**				
Technician(s):	**CW**				

Stack Dimensional Data:

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

Equipment:

Meterbox ID	13	Probe ID	4A	Liner type	Glass		
Y factor	0.9963	Nozzle ID	0.19	Nozzle size	0.1900	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat	250	F	
				Filter heat	250	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.89 %
Static Pressure	0.71	"H_2O	CO_2	0.74 %
Ave. ΔP	1.1	"H_2O	Rec. Nz.	0.214 inches
Stack Temperature	240	F		
Assumed moisture	2	%		
Assumed meter temp.	67	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	0.000
Leak check vacuum, "Hg	14	7

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	73.901	dcf	Ave. ΔP	1.171 "H_2O
Wet mol. weight	28.69	M_s (actual)	Ave. √ΔP	1.0814 "H_2O
Actual H_2O	2.05	%	Ave. ΔH	1.25 "H_2O
Std. meter vol.	73.972	dscf	Ave. T_s	258 °F
Isokinetic Average	101.9	%	Ave. T_m	67.3 °F

Moisture/Lab:

Filter	Run 1 #		
	Initial	Final	Gain
Impingers, g	200.0	220	20.0
Silica gel, g	236.3	249.2	12.9
		Total water gain:	32.9

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	2.900	1.00	255	62	1.04	1.00	3	249	56
2	10.0	5.730	1.00	256	63	1.04	1.00	3	249	56
3	15.0	8.600	1.10	256	63	1.14	1.10	3	253	51
4	20.0	11.550	1.10	257	64	1.14	1.10	3	251	51
5	25.0	14.640	1.20	258	64	1.25	1.30	3	252	52
6	30.0	17.700	1.20	257	64	1.25	1.30	3	252	52
7	35.0	20.860	1.20	258	65	1.25	1.30	3	252	52
8	40.0	23.980	1.20	258	66	1.25	1.30	3	252	52
9	45.0	27.080	1.20	253	66	1.26	1.30	3	252	52
10	50.0	30.160	1.20	255	67	1.26	1.30	3	252	55
11	55.0	33.310	1.20	257	68	1.26	1.30	3	252	55
12	60.0	36.439	1.20	255	68	1.26	1.30	3	252	55
13	65.0	39.480	1.10	258	68	1.15	1.20	3	252	55
14	70.0	42.510	1.10	258	68	1.15	1.20	3	252	56
15	75.0	45.490	1.10	259	68	1.15	1.20	3	252	56
16	80.0	48.490	1.10	260	69	1.15	1.20	3	252	56
17	85.0	51.510	1.20	261	69	1.25	1.20	3	252	57
18	90.0	54.730	1.30	261	69	1.36	1.40	3	251	57
19	95.0	57.820	1.20	261	69	1.25	1.30	3	248	57
20	100.0	61.110	1.20	260	70	1.26	1.30	3	249	57
21	105.0	64.330	1.30	259	71	1.37	1.40	3	249	57
22	110.0	67.530	1.30	260	71	1.37	1.40	3	259	57
23	115.0	70.740	1.20	260	72	1.26	1.30	3	259	57
24	120.0	73.901	1.20	259	72	1.26	1.30	3	259	57

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**14:23**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**16:31**
EPA Method:	**13B**	60 degrees, cloudy		**Date:**	**6/13/2018**
Box Operator:	**DS**				
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	4A	Liner type:	Glass		
Y factor	0.9963	Nozzle ID	0.19	Nozzle size:	0.1900	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat:	250	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.85 %
Static Pressure	0.71	"H_2O	CO_2	0.73 %
Ave. ΔP	1.1	"H_2O	Rec. Nz.	0.214 inches
Stack Temperature	240	F		
Assumed moisture	2.05	%		
Assumed meter temp.	67.3	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:	12	10

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	73.050	dcf	Ave. ΔP	1.146 "H_2O
Wet mol. weight	28.64	M_s (actual)	Ave. √ΔP	1.0697 "H_2O
Actual H_2O	2.49	%	Ave. ΔH	1.242 "H_2O
Std. meter vol.	72.403	dscf	Ave. T_s	258.3 °F
Isokinetic Average	101.2	%	Ave. T_m	72.5 °F

Moisture/Lab:

Filter	Run 2 #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	242.3	256.6	14.3
		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	5.0	3.000	1.00	258	72	1.05	1.10	2	254	66
2	10.0	5.890	1.00	258	72	1.05	1.10	2	254	66
3	15.0	8.870	1.20	258	72	1.26	1.30	2	250	56
4	20.0	11.890	1.10	267	72	1.15	1.20	2	250	56
5	25.0	14.940	1.10	257	76	1.17	1.20	2	250	54
6	30.0	18.180	1.30	258	72	1.37	1.40	2	250	54
7	35.0	21.290	1.20	260	72	1.26	1.30	2	250	54
8	40.0	24.500	1.20	258	73	1.27	1.30	2	250	54
9	45.0	27.600	1.20	258	73	1.27	1.30	2	251	53
10	50.0	30.780	1.20	259	73	1.27	1.30	2	251	53
11	55.0	33.790	1.20	256	73	1.27	1.20	2	251	53
12	60.0	36.812	1.20	255	73	1.27	1.30	2	251	53
13	65.0	39.810	1.10	256	72	1.16	1.20	2	251	56
14	70.0	42.810	1.10	258	73	1.16	1.20	2	251	56
15	75.0	45.800	1.10	259	73	1.16	1.20	2	251	56
16	80.0	48.710	1.10	260	73	1.16	1.20	2	251	56
17	85.0	52.050	1.30	262	72	1.36	1.40	2	248	55
18	90.0	55.200	1.20	262	72	1.26	1.30	2	248	55
19	95.0	58.300	1.20	258	72	1.26	1.30	2	248	57
20	100.0	61.260	1.10	257	72	1.16	1.20	2	248	57
21	105.0	64.210	1.10	256	72	1.16	1.20	2	251	56
22	110.0	67.150	1.10	256	72	1.16	1.20	2	251	56
23	115.0	70.210	1.20	257	72	1.27	1.30	2	248	56
24	120.0	73.050	1.00	257	72	1.06	1.10	2	248	56

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**16:45**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**	**End Time:**	**18:53**
EPA Method:	**13B**	60 degrees, cloudy	**Date:**	**6/13/2018**
Box Operator:	**DS**			
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	4A	Liner type:	Glass		
Y factor	0.9963	Nozzle ID	0.19	Nozzle size:	0.1900	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat:	250	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.94	"Hg	O_2	19.83 %
Static Pressure	0.71	"H_2O	CO_2	0.71 %
Ave. ΔP	1.1	"H_2O	Rec. Nz.	0.213 inches
Stack Temperature	240	F		
Assumed moisture	2.49	%		
Assumed meter temp.	72.5	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	15

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches

Caliper ID# HLN1

Post Test Calculations:

Sample volume	73.811	dcf	Ave. ΔP	1.162 "H_2O
Wet mol. weight	28.7	M_s (actual)	Ave. √ΔP	1.0763 "H_2O
Actual H_2O	1.91	%	Ave. ΔH	1.242 "H_2O
Std. meter vol.	72.884	dscf	Ave. T_s	259.4 °F
Isokinetic Average	100.8	%	Ave. T_m	74.5 °F

Moisture/Lab:

Filter	Run 3 #		
	Initial	Final	Gain
Impingers, g	200.0	215	15.0
Silica gel, g	263.7	278.9	15.2
		Total water gain:	30.2

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	3.047	1.10	256	71	1.15	1.20	2	252	60
2	10.0	5.890	1.00	262	71	1.04	1.00	2	251	52
3	15.0	8.810	1.00	262	71	1.04	1.00	2	251	52
4	20.0	11.780	1.10	262	71	1.14	1.20	2	251	49
5	25.0	14.820	1.20	261	71	1.25	1.30	2	250	49
6	30.0	18.400	1.60	263	71	1.66	1.70	2	250	49
7	35.0	21.760	1.40	263	71	1.45	1.50	2	250	50
8	40.0	24.910	1.20	260	73	1.25	1.30	2	250	51
9	45.0	27.910	1.10	260	73	1.15	1.20	2	250	51
10	50.0	30.900	1.10	261	73	1.15	1.20	2	250	51
11	55.0	33.880	1.10	259	74	1.15	1.20	2	250	51
12	60.0	36.878	1.10	258	74	1.16	1.20	2	250	51
13	65.0	39.690	0.98	258	74	1.03	1.00	2	250	51
14	70.0	42.690	1.10	261	74	1.15	1.20	2	251	53
15	75.0	45.710	1.10	259	74	1.15	1.20	2	251	53
16	80.0	48.720	1.10	259	72	1.15	1.20	2	251	53
17	85.0	51.770	1.20	258	77	1.27	1.30	2	251	53
18	90.0	54.820	1.20	260	78	1.27	1.30	2	251	53
19	95.0	57.990	1.20	256	78	1.27	1.30	2	251	53
20	100.0	61.220	1.20	256	78	1.27	1.30	2	251	53
21	105.0	64.400	1.20	257	79	1.27	1.30	2	251	53
22	110.0	67.530	1.20	257	79	1.27	1.20	2	251	53
23	115.0	70.680	1.20	259	80	1.27	1.20	2	251	53
24	120.0	73.811	1.20	258	80	1.27	1.30	2	252	53

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

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**11:55**
Source:	**CFU 107**	**End Time:**	**14:08**
Method:	**13B**	**Date:**	**6/13/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	2.900	1.00	62	1	1.00	255	1.0000
10	5.730	1.00	63	2	1.00	256	1.0000
15	8.600	1.10	63	3	1.10	256	1.0488
20	11.550	1.10	64	4	1.10	257	1.0488
25	14.640	1.30	64	5	1.20	258	1.0954
30	17.700	1.30	64	6	1.20	257	1.0954
35	20.860	1.30	65	7	1.20	258	1.0954
40	23.980	1.30	66	8	1.20	258	1.0954
45	27.080	1.30	66	9	1.20	253	1.0954
50	30.160	1.30	67	10	1.20	255	1.0954
55	33.310	1.30	68	11	1.20	257	1.0954
60	36.439	1.30	68	12	1.20	255	1.0954
65	39.480	1.20	68	13	1.10	258	1.0488
70	42.510	1.20	68	14	1.10	258	1.0488
75	45.490	1.20	68	15	1.10	259	1.0488
80	48.490	1.20	69	16	1.10	260	1.0488
85	51.510	1.20	69	17	1.20	261	1.0954
90	54.730	1.40	69	18	1.30	261	1.1402
95	57.820	1.30	69	19	1.20	261	1.0954
100	61.110	1.30	70	20	1.20	260	1.0954
105	64.330	1.40	71	21	1.30	259	1.1402
110	67.530	1.40	71	22	1.30	260	1.1402
115	70.740	1.30	72	23	1.20	260	1.0954
120	73.901	1.30	72	24	1.20	259	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 107**	**Date:**	**06/13/18**

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	73.901	dcf	Rectangular		
Water Volume	32.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.74	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.89	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.250	"H_2O	√Dp	1.0814	"H_2O
Temperature, T_m	67.3	^oF	Temperature, T_s	258.0	^oF
Temperature, T_m	527.3	^oA (^oR)	Temperature, T_s	718.0	^oA (R)
Pressure Meter, P_m	30.032	"Hg	Pressure Stack, P_s	29.992	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	73.972	dscf	Velocity, V_s	70.94	fps
	2.095	dscm	Volume (actual)	20,894.7	awcfm
Actual Volume, $V_{m(actual)}$	102.490	awcf		20,466.4	adcfm
Gas Stream Moisture			Volume (standard)	924,144.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.548	scf		905,199.8	dscf/hr
Moisture, B_{ws}	0.0205			15,086.7	dscf/min
Moisture EPA M4	2.05	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	522.649	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.69	lb/lb-mole			
Percent Isokinetic	101.9	%			

Laboratory Results

Fluoride	59.0	µg/sample			
Fluoride	5.90E-05	grams	MW F	19.0	g/mole
Emissions:					
Concentration, C_s	1.23E-05	gr/dscf			
	28.2	µg/dscm			
	3.57E-02	ppmvd			
Mass Emissions	1.59E-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:**	**14:23**
Source:	**CFU 107**	**End Time:**	**16:31**
Method:	**13B**	**Date:**	**06/13/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	3.000	1.10	72	1	1.00	258	1.0000
10	5.890	1.10	72	2	1.00	258	1.0000
15	8.870	1.30	72	3	1.20	258	1.0954
20	11.890	1.20	72	4	1.10	267	1.0488
25	14.940	1.20	76	5	1.10	257	1.0488
30	18.180	1.40	72	6	1.30	258	1.1402
35	21.290	1.30	72	7	1.20	260	1.0954
40	24.500	1.30	73	8	1.20	258	1.0954
45	27.600	1.30	73	9	1.20	258	1.0954
50	30.780	1.30	73	10	1.20	259	1.0954
55	33.790	1.20	73	11	1.20	256	1.0954
60	36.812	1.30	73	12	1.20	255	1.0954
65	39.810	1.20	72	13	1.10	256	1.0488
70	42.810	1.20	73	14	1.10	258	1.0488
75	45.800	1.20	73	15	1.10	259	1.0488
80	48.710	1.20	73	16	1.10	260	1.0488
85	52.050	1.40	72	17	1.30	262	1.1402
90	55.200	1.30	72	18	1.20	262	1.0954
95	58.300	1.30	72	19	1.20	258	1.0954
100	61.260	1.20	72	20	1.10	257	1.0488
105	64.210	1.20	72	21	1.10	256	1.0488
110	67.150	1.20	72	22	1.10	256	1.0488
115	70.210	1.30	72	23	1.20	257	1.0954
120	73.050	1.10	72	24	1.00	257	1.0000

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 107**	**Date:**	**06/13/18**

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	73.050	dcf	Rectangular		
Water Volume	39.3	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.73	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.85	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.242	"H_2O	√Dp	1.0697	"H_2O
Temperature, T_m	72.5	^oF	Temperature, T_s	258.3	^oF
Temperature, T_m	532.5	^oA (^oR)	Temperature, T_s	718.3	^oA (R)
Pressure Meter, P_m	30.031	"Hg	Pressure Stack, P_s	29.992	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	72.403	dscf	Velocity, V_s	70.25	fps
	2.050	dscm	Volume (actual)	20,691.4	awcfm
Actual Volume, $V_{m(actual)}$	100.812	awcf		20,176.2	adcfm
Gas Stream Moisture			Volume (standard)	914,773.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.849	scf		891,996.0	dscf/hr
Moisture, B_{ws}	0.0249			14,866.6	dscf/min
Moisture EPA M4	2.49	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	522.867	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.64	lb/lb-mole			
Percent Isokinetic	101.2	%			

Laboratory Results

Fluoride	58.0	µg/sample		
Fluoride	5.80E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	1.24E-05	gr/dscf
	28.3	µg/dscm
	3.58E-02	ppmvd
Mass Emissions	1.58E-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:**	**16:45**
Source:	**CFU 107**	**End Time:**	**18:53**
Method:	**13B**	**Date:**	**06/13/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	3.047	1.20	71	1	1.10	256	1.0488
10	5.890	1.00	71	2	1.00	262	1.0000
15	8.810	1.00	71	3	1.00	262	1.0000
20	11.780	1.20	71	4	1.10	262	1.0488
25	14.820	1.30	71	5	1.20	261	1.0954
30	18.400	1.70	71	6	1.60	263	1.2649
35	21.760	1.50	71	7	1.40	263	1.1832
40	24.910	1.30	73	8	1.20	260	1.0954
45	27.910	1.20	73	9	1.10	260	1.0488
50	30.900	1.20	73	10	1.10	261	1.0488
55	33.880	1.20	74	11	1.10	259	1.0488
60	36.878	1.20	74	12	1.10	258	1.0488
65	39.690	1.00	74	13	0.98	258	0.9899
70	42.690	1.20	74	14	1.10	261	1.0488
75	45.710	1.20	74	15	1.10	259	1.0488
80	48.720	1.20	72	16	1.10	259	1.0488
85	51.770	1.30	77	17	1.20	258	1.0954
90	54.820	1.30	78	18	1.20	260	1.0954
95	57.990	1.30	78	19	1.20	256	1.0954
100	61.220	1.30	78	20	1.20	256	1.0954
105	64.400	1.30	79	21	1.20	257	1.0954
110	67.530	1.20	79	22	1.20	257	1.0954
115	70.680	1.20	80	23	1.20	259	1.0954
120	73.811	1.30	80	24	1.20	258	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 107**	**Date:**	**06/13/18**

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	73.811	dcf	Rectangular		
Water Volume	30.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.94	"Hg	CO_2 Average	0.71	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.83	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.242	"H_2O	√Dp	1.0763	"H_2O
Temperature, T_m	74.5	^oF	Temperature, T_s	259.4	^oF
Temperature, T_m	534.5	^oA (^oR)	Temperature, T_s	719.4	^oA (R)
Pressure Meter, P_m	30.031	"Hg	Pressure Stack, P_s	29.992	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	72.884	dscf	Velocity, V_s	70.66	fps
	2.064	dscm	Volume (actual)	20,812.2	awcfm
Actual Volume, $V_{m(actual)}$	101.035	awcf		20,414.7	adcfm
Gas Stream Moisture			Volume (standard)	918,705.9	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.421	scf		901,158.6	dscf/hr
Moisture, B_{ws}	0.0191			15,019.3	dscf/min
Moisture EPA M4	1.91	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	523.668	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.8	%			

Laboratory Results

Fluoride	66.0	µg/sample		
Fluoride	6.60E-05	grams	MW F	19.0 g/mole

Emissions:

Concentration, C_s	1.40E-05	gr/dscf
	32.0	µg/dscm
	4.05E-02	ppmvd
Mass Emissions	1.80E-03	lb/hr

"<" represents MDL value

EPA Method 13B
Laboratory Results
Total Fluoride

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR**
Source: **CFU 107**

Lab ID	Sample ID	Sample Date		Result	MDL	Units
18-S1090	M13B Cont. 1 Run 1	6/13/2018		59.0	30.0	µg/sample
18-S1091	M13B Cont. 1 Run 2	6/13/2018		58.0	30.0	µg/sample
18-S1092	M13B Cont. 1 Run 3	6/13/2018		66.0	30.0	µg/sample
18-S1062	H20 + Filter Blank	6/5/2018	<	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 107**

Run			1	2	3	
Date			6/13/2018	6/13/2018	6/13/2018	
Run Start Time			11:55	14:23	16:45	
Run End Time			14:08	16:31	18:53	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.94	29.94	29.94	**29.94**
Nozzle Dia., in.			0.1900	0.1900	0.1900	**0.1900**
Isokinetic Average, %			101.9	101.2	100.8	**101.3**
Sample Volume, dscf			73.972	72.403	72.884	**73.086**
Sample Volume, dscm			2.095	2.050	2.064	**2.070**
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			0.74	0.73	0.71	**0.73**
O_2 %vd			19.89	19.85	19.83	**19.86**
Static Press., "H_2O			0.71	0.71	0.71	**0.71**
H_2O %v			2.05	2.49	1.91	**2.15**
Wet Molecular Weight, lb/lb-mole			28.69	28.64	28.70	**28.68**
Velocity, FPS			70.94	70.25	70.66	**70.62**
ADCFM			20,466.4	20,176.2	20,414.7	**20,352.4**
AWCFM			20,894.7	20,691.4	20,812.2	**20,799.4**
DSCFM			15,086.7	14,866.6	15,019.3	**14,990.9**
Stack Temperature, °F			258.0	258.3	259.4	**258.6**
Fluoride	Concentration, C_s	gr/dscf	1.23E-05	1.24E-05	1.40E-05	**1.29E-05**
		µg/dscm	28.2	28.3	32.0	**29.5**
		ppmvd	3.57E-02	3.58E-02	4.05E-02	**3.73E-02**
	Mass	lb/hr	1.59E-03	1.58E-03	1.80E-03	**1.66E-03**
		lb/lb glass	4.25E-06	4.26E-06	4.90E-06	**4.47E-06**
Production Data	Glass Production	lbs/hr	374.6	369.8	367.4	**370.6**

"<" represents MDL value

EPA Methods 1-4, 13B
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**11:55**
Source:	**CFU 107**	**End Time:**	**14:08**
Method:	**13B**	**Date:**	**6/13/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.032 "Hg

where Pb: 29.94 "Hg
ΔH: 1.250 "H_2O

2) Ps = Pb + (Static Press./13.6) = 29.992 "Hg

where Pb: 29.94 "Hg
Static Press.: 0.71 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 73.972 dscf

where Vm: 73.901 dcf
Y: 0.9963
Pm: 30.032 "Hg
Tm: 527.3 °A

4) $V_w(std) = (0.04706)(H_2O)$ = 1.548 scf

where H_2O: 32.90 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0205

where Vw(std): 1.548 scf
Vm(std): 73.972 dscf

6) % H_2O = Bws x 100 = 2.05 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 102.490 awcf

where Y: 0.9963
Vm: 73.9010 dcf
Bws: 0.0205
Ts: 718.0 °A
Tm: 527.3 °A
Pm: 30.032 "Hg
Ps: 29.992 "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: 0.74 %vd
O_2 19.89 %vd
N_2+CO= (100-(O_2+CO_2): 79.37 %vd

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 107 **Date: 6/13/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.69 lb/lb-mole
where M_d: 28.91 lb/lb-mole
Bws: 0.0205

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 70.94 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.0814
Ts: 718.0 °A
Ps: 29.992 "Hg
Ms: 28.69 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 20,894.7 AWCFM
where V_s: 70.94 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 20,466.4 ADCFM
where AWCFM: 20,894.7
Bws: 0.0205

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 924,144.8 wscf/hr
where V_s: 70.94 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 718.0 °A
Ps: 29.992 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 905,199.8 dscf/hr
where wscf/hr: 924,144.8
Bws: 0.0205

16) DSCFM= (dscf/hr)/60 mins/hr = 15,086.7 DSCFM
where dscf/hr: 905,199.8

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000197 sq. ft.
where Nozzle Size: 0.1900 inches

Client: Hollingsworth & Vose		**Run:**	**1**
Source: CFU 107		**Date:**	**6/13/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 101.9 %

where Ts:	718.0	°A
Vm(Std):	73.972	dscf
Ps:	29.992	"Hg
Vs	70.94	ft/sec
Nozzle Area:	0.000197	sq. ft.
Sampling Time:	120	min.
Bws:	0.0205	

EPA Method 13B:

19) Fluoride laboratory results < 59.0 µg/sample

20) Fluoride = (µg/sample)/1,000,000 = < 5.90E-05 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = < 1.23E-05 gr/dscf

where Sample:	0.00006	grams
Vm(std)	73.972	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = < 28.2 µg/dscm

where Sample:	0.00006	grams
Vm(std)	2.095	dscm

23) Volume/Mole = $\left(\frac{359\ (Ts)\ (29.92"Hg)}{492\ (Ps)}\right)$ = 522.649 Vol./Mole

where Ts:	718.0	°A
Ps:	29.992	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = < 3.57E-02 ppmvd

where MW:	19.0	g/mol
lb/hr:	0.00	
Vol./Mole:	522.649	
ADCFM:	20466.4	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = < 1.59E-03 lb/hr

where Cs:	1.23E-05	gr/dscf
Stack Flow:	905,199.8	dscf/hr

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU-107**
Facility	**Glass Plant 1**	Date	**June 13, 2018**
Location	**Corvallis OR**		

Run	1	2	3	
Date	6/13/2018	6/13/2018	6/13/2018	
Run Start Time	11:55	14:23	16:46	
Run End Time	14:08	16:31	18:53	
CO_2 %vd	0.74	0.73	0.71	0.72
O_2 %vd	19.89	19.85	19.83	19.86

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

Company:	**Hollingsworth & Vose**	Source	**CFU-107**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**June 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**	**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**
	zero	0.03	0.08	0.25	pass	0.12	0.45	pass	0.20	pass				
Run 1	upscale	9.97	9.97	0.00	pass	9.91	-0.30	pass	-0.30	pass	20	19.67	19.89	10
	zero	0.03	0.12	0.45	pass	0.12	0.45	pass	0.00	pass				
Run 2	upscale	9.97	9.91	-0.30	pass	10.01	0.20	pass	0.50	pass	20	19.65	19.85	10
	zero	0.03	0.12	0.45	pass	0.09	0.30	pass	-0.15	pass				
Run 3	upscale	9.97	10.01	0.20	pass	10.01	0.20	pass	0.00	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	0.03	9.97	20.01
Analyzer Cal. Error	0.15	-0.15	0.05
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU-107**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**June 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**	**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**
	zero	0.10	0.08	-0.50	pass	0.11	0.25	pass	0.75	pass				
Run 1	upscale	1.93	1.93	0.00	pass	1.93	0.00	pass	0.00	pass	4	0.77	0.74	2
	zero	0.10	0.11	0.25	pass	0.10	0.00	pass	-0.25	pass				
Run 2	upscale	1.93	1.93	0.00	pass	1.93	0.00	pass	0.00	pass	4	0.77	0.73	2
	zero	0.10	0.10	0.00	pass	0.12	0.50	pass	0.50	pass				
Run 3	upscale	1.93	1.93	0.00	pass	1.97	1.00	pass	1.00	pass	4	0.76	0.71	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.1	1.93	4.18
Analyzer Cal. Error	2.50	-1.75	4.50
Analyzer Cal. Error < 2%*	pass	pass	pass

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis OR**	**Start Time:**	**11:55**
Source:	**CFU-107**	**End Time:**	**14:08**
Method:	**3A**	**Date:**	**6/13/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.15 %v

where C_{Dir}:	9.97	ppmv
C_V:	10.00	ppmv
CS:	20.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 0.00 %v

where C_{Dir}:	9.97	ppmv
C_S:	9.97	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.30 %v

where SB_{Final}:	-0.30	ppmv
SB_i:	0.00	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 19.89 ppmv

where C_{Avg}:	19.67	ppmv
C_O:	0.10	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:**	**11:55**
Source:	**CFU-107**	**End Time:**	**14:08**
Method:	**3A**	**Date:**	**6/13/2018**

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -1.75 %v

where C_{Dir}:	1.93	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}:	1.93	ppmv
C_S:	1.93	ppmv
CS:	4.00	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) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.74 ppmv

where C_{Avg}:	0.77	ppmv
C_O:	0.10	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.93	ppmv

Hollingsworth & Vose

6/13/2018

CFU 107

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/13/2018	7:00:15	0.05	0.09		
6/13/2018	7:00:25	7.99	11.08		
6/13/2018	7:00:35	12.64	17.34		
6/13/2018	7:00:45	13.37	16.96		
6/13/2018	7:00:55	13.90	16.72		
6/13/2018	7:01:05	14.28	16.49		
6/13/2018	7:01:15	14.54	16.26		
6/13/2018	7:01:25	14.74	16.03		
6/13/2018	7:01:35	14.89	15.77		
6/13/2018	7:01:45	14.98	15.52		
6/13/2018	7:01:55	15.02	15.30		
6/13/2018	7:02:05	15.03	15.07		
6/13/2018	7:02:15	15.83	14.34		
6/13/2018	7:02:25	18.52	16.94		
6/13/2018	7:02:35	18.98	19.41		
6/13/2018	7:02:45	19.11	19.45		
6/13/2018	7:02:55	19.86	19.50		
6/13/2018	7:03:05	19.78	19.51		
6/13/2018	7:03:15	19.92	19.51		
6/13/2018	7:03:25	20.00	19.52		
6/13/2018	7:03:35	20.01	19.52		
6/13/2018	7:03:45	20.01	19.52		
6/13/2018	7:03:55	20.01	19.52	20.01	
6/13/2018	7:04:05	17.96	19.38		
6/13/2018	7:04:15	17.51	19.18		
6/13/2018	7:04:25	11.56	8.63		
6/13/2018	7:04:35	0.51	0.32		
6/13/2018	7:04:45	2.82	3.34		
6/13/2018	7:04:55	3.97	4.18		
6/13/2018	7:05:05	3.95	4.18		
6/13/2018	7:05:15	3.96	4.18		
6/13/2018	7:05:25	3.96	4.18		
6/13/2018	7:05:35	3.97	4.18		
6/13/2018	7:05:45	3.97	4.18		
6/13/2018	7:05:55	3.96	4.19		
6/13/2018	7:06:05	3.97	4.18		4.18
6/13/2018	7:06:15	3.97	4.18		
6/13/2018	7:06:25	3.97	4.17		
6/13/2018	7:06:35	3.97	4.17		
6/13/2018	7:06:45	3.80	3.93		

Hollingsworth & Vose

6/13/2018

CFU 107

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/13/2018	7:06:55	2.31	2.20		
6/13/2018	7:07:05	2.00	1.97		
6/13/2018	7:07:15	1.98	1.95		
6/13/2018	7:07:25	1.97	1.94		
6/13/2018	7:07:35	1.98	1.94		
6/13/2018	7:07:45	1.98	1.93		
6/13/2018	7:07:55	1.98	1.93		1.93
6/13/2018	7:08:05	1.88	1.93		
6/13/2018	7:08:15	1.76	1.96		
6/13/2018	7:08:25	1.77	1.97		
6/13/2018	7:08:35	2.35	2.10		
6/13/2018	7:08:45	2.93	2.53		
6/13/2018	7:08:55	0.49	0.20		
6/13/2018	7:09:05	0.07	0.14		
6/13/2018	7:09:15	0.05	0.13		
6/13/2018	7:09:25	0.04	0.11		
6/13/2018	7:09:35	0.03	0.11		
6/13/2018	7:09:45	0.03	0.10		
6/13/2018	7:09:55	0.03	0.10	0.03	0.10
6/13/2018	7:10:05	0.23	0.31		
6/13/2018	7:10:15	5.44	4.73		
6/13/2018	7:10:25	9.21	7.51		
6/13/2018	7:10:35	9.97	9.64		
6/13/2018	7:10:45	9.97	9.64		
6/13/2018	7:10:55	9.97	9.64		
6/13/2018	7:11:05	9.97	9.64		
6/13/2018	7:11:15	9.97	9.64		
6/13/2018	7:11:25	9.97	9.64		
6/13/2018	7:11:35	9.97	9.64	9.97	
6/13/2018	7:11:45	9.97	9.64		
6/13/2018	7:11:55	9.97	9.63		
6/13/2018	7:12:05	3.12	7.63		
6/13/2018	7:12:15	0.51	1.08		
6/13/2018	7:12:25	0.02	0.08		
6/13/2018	7:12:35	0.02	0.08		
6/13/2018	7:12:45	0.02	0.07		
6/13/2018	7:12:55	0.02	0.07		
6/13/2018	7:13:05	0.01	0.08		
6/13/2018	7:13:15	0.01	0.07		
6/13/2018	7:13:25	0.01	0.08		

Hollingsworth & Vose

6/13/2018

CFU 107

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/13/2018	7:13:35	0.01	0.08		
6/13/2018	7:13:45	0.01	0.07		
6/13/2018	7:13:55	0.01	0.07		
System					
6/13/2018	7:43:05	0.07	0.08		
6/13/2018	7:43:15	0.07	0.07		
6/13/2018	7:43:25	0.07	0.08		
6/13/2018	7:43:35	0.08	0.08		
6/13/2018	7:43:45	0.07	0.08		
6/13/2018	7:43:55	0.08	0.08		
6/13/2018	7:44:05	0.07	0.07		
6/13/2018	7:44:15	0.07	0.07		
6/13/2018	7:44:25	0.08	0.07		
6/13/2018	7:44:35	0.08	0.08		
6/13/2018	7:44:45	0.08	0.08	0.08	0.08
6/13/2018	7:44:55	0.08	0.08		
6/13/2018	7:45:05	0.37	0.08		
6/13/2018	7:45:15	7.41	0.10		
6/13/2018	7:45:25	13.81	0.12		
6/13/2018	7:45:35	10.00	0.68		
6/13/2018	7:45:45	6.56	2.34		
6/13/2018	7:45:55	5.11	3.34		
6/13/2018	7:46:05	4.48	3.76		
6/13/2018	7:46:15	4.20	3.95		
6/13/2018	7:46:25	4.08	4.04		
6/13/2018	7:46:35	4.04	4.08		
6/13/2018	7:46:45	4.01	4.10		
6/13/2018	7:46:55	3.53	3.55		
6/13/2018	7:47:05	2.65	2.60		
6/13/2018	7:47:15	2.29	2.23		
6/13/2018	7:47:25	2.15	2.06		
6/13/2018	7:47:35	2.08	1.98		
6/13/2018	7:47:45	2.05	1.95		
6/13/2018	7:47:55	2.04	1.94		
6/13/2018	7:48:05	2.04	1.92		
6/13/2018	7:48:15	2.04	1.93		
6/13/2018	7:48:25	2.03	1.93		
6/13/2018	7:48:35	2.04	1.93		

Hollingsworth & Vose

6/13/2018

CFU 107

Daily Calibrations

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/13/2018	7:48:45	2.04	1.93		
6/13/2018	7:48:55	2.03	1.94		1.93
6/13/2018	7:49:05	2.03	1.93		
6/13/2018	7:49:15	2.93	1.84		
6/13/2018	7:49:25	10.39	1.15		
6/13/2018	7:49:35	15.90	0.63		
6/13/2018	7:49:45	18.46	0.38		
6/13/2018	7:49:55	19.61	0.27		
6/13/2018	7:50:05	20.12	0.22		
6/13/2018	7:50:15	20.36	0.18		
6/13/2018	7:50:25	20.47	0.16		
6/13/2018	7:50:35	20.58	0.16		
6/13/2018	7:50:45	19.05	0.88		
6/13/2018	7:50:55	14.31	5.04		
6/13/2018	7:51:05	11.93	7.57		
6/13/2018	7:51:15	10.86	8.70		
6/13/2018	7:51:25	10.38	9.25		
6/13/2018	7:51:35	10.15	9.49		
6/13/2018	7:51:45	10.06	9.60		
6/13/2018	7:51:55	10.01	9.67		
6/13/2018	7:52:05	9.99	9.69		
6/13/2018	7:52:15	9.97	9.70		
6/13/2018	7:52:25	9.97	9.71		
6/13/2018	7:52:35	9.96	9.72	9.97	
6/13/2018	7:52:45	9.96	9.72		
6/13/2018	7:52:55	12.17	7.71		
6/13/2018	7:53:05	16.57	3.86		

Hollingsworth & Vose

CFU-107

Run 1

Date	Time	O2 [%]	CO2 [%]
6/13/2018	11:55:15	19.68	0.77
6/13/2018	11:56:15	19.67	0.77
6/13/2018	11:57:15	19.66	0.77
6/13/2018	11:58:15	19.67	0.77
6/13/2018	11:59:15	19.67	0.77
6/13/2018	12:00:15	19.67	0.77
6/13/2018	12:01:15	19.67	0.77
6/13/2018	12:02:15	19.66	0.77
6/13/2018	12:03:15	19.66	0.76
6/13/2018	12:04:15	19.67	0.75
6/13/2018	12:05:15	19.68	0.75
6/13/2018	12:06:15	19.68	0.76
6/13/2018	12:07:15	19.67	0.76
6/13/2018	12:08:15	19.67	0.76
6/13/2018	12:09:15	19.68	0.76
6/13/2018	12:10:15	19.68	0.76
6/13/2018	12:11:15	19.69	0.76
6/13/2018	12:12:15	19.69	0.76
6/13/2018	12:13:15	19.67	0.76
6/13/2018	12:14:15	19.68	0.77
6/13/2018	12:15:15	19.68	0.77
6/13/2018	12:16:15	19.69	0.77
6/13/2018	12:17:15	19.69	0.77
6/13/2018	12:18:15	19.68	0.77
6/13/2018	12:19:15	19.68	0.77
6/13/2018	12:20:15	19.67	0.78
6/13/2018	12:21:15	19.67	0.77
6/13/2018	12:22:15	19.68	0.77
6/13/2018	12:23:15	19.68	0.77
6/13/2018	12:24:15	19.68	0.77
6/13/2018	12:25:15	19.67	0.77
6/13/2018	12:26:15	19.67	0.77
6/13/2018	12:27:15	19.68	0.77
6/13/2018	12:28:15	19.67	0.77
6/13/2018	12:29:15	19.66	0.77
6/13/2018	12:30:15	19.66	0.76
6/13/2018	12:31:15	19.66	0.76
6/13/2018	12:32:15	19.67	0.76
6/13/2018	12:33:15	19.68	0.76
6/13/2018	12:34:15	19.67	0.76
6/13/2018	12:35:15	19.66	0.76

Hollingsworth & Vose

CFU-107

Run 1

Date	Time	O2 [%]	CO2 [%]
6/13/2018	12:36:15	19.66	0.76
6/13/2018	12:37:15	19.67	0.77
6/13/2018	12:38:15	19.67	0.77
6/13/2018	12:39:15	19.66	0.77
6/13/2018	12:40:15	19.66	0.78
6/13/2018	12:41:15	19.66	0.78
6/13/2018	12:42:15	19.67	0.78
6/13/2018	12:43:15	19.67	0.77
6/13/2018	12:44:15	19.67	0.78
6/13/2018	12:45:15	19.66	0.78
6/13/2018	12:46:15	19.66	0.78
6/13/2018	12:47:15	19.66	0.78
6/13/2018	12:48:15	19.67	0.78
6/13/2018	12:49:15	19.67	0.77
6/13/2018	12:50:15	19.66	0.77
6/13/2018	12:51:15	19.66	0.77
6/13/2018	12:52:15	19.66	0.77
6/13/2018	12:53:15	19.67	0.76
6/13/2018	12:54:15	19.67	0.76
6/13/2018	12:55:15	19.67	0.76
6/13/2018	12:56:15	19.66	0.76
6/13/2018	12:57:15	19.67	0.76
6/13/2018	12:58:15	19.67	0.76
6/13/2018	12:59:15	19.67	0.77
6/13/2018	13:00:15	19.67	0.76
6/13/2018	13:01:15	19.67	0.77
6/13/2018	13:02:15	19.67	0.77
6/13/2018	13:03:15	19.67	0.77
6/13/2018	13:04:15	19.67	0.77
6/13/2018	13:05:15	19.67	0.78
6/13/2018	13:06:15	19.66	0.78
6/13/2018	13:07:15	19.66	0.78
6/13/2018	13:08:15	19.66	0.78
6/13/2018	13:09:15	19.67	0.78
6/13/2018	13:10:15	19.67	0.78
6/13/2018	13:11:15	19.67	0.78
6/13/2018	13:12:15	19.66	0.77
6/13/2018	13:13:15	19.67	0.77
6/13/2018	13:14:15	19.67	0.77
6/13/2018	13:15:15	19.67	0.77
6/13/2018	13:16:15	19.67	0.77

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/13/2018	13:17:15	19.66	0.77
6/13/2018	13:18:15	19.65	0.76
6/13/2018	13:19:15	19.66	0.76
6/13/2018	13:20:15	19.67	0.76
6/13/2018	13:21:15	19.67	0.76
6/13/2018	13:22:15	19.66	0.77
6/13/2018	13:23:15	19.66	0.76
6/13/2018	13:24:15	19.66	0.77
6/13/2018	13:25:15	19.66	0.76
6/13/2018	13:26:15	19.67	0.77
6/13/2018	13:27:15	19.67	0.77
6/13/2018	13:28:15	19.66	0.77
6/13/2018	13:29:15	19.66	0.78
6/13/2018	13:30:15	19.66	0.78
6/13/2018	13:31:15	19.67	0.78
6/13/2018	13:32:15	19.67	0.78
6/13/2018	13:33:15	19.67	0.77
6/13/2018	13:34:15	19.65	0.78
6/13/2018	13:35:15	19.66	0.78
6/13/2018	13:36:15	19.66	0.78
6/13/2018	13:37:15	19.66	0.78
6/13/2018	13:38:15	19.65	0.77
6/13/2018	13:39:15	19.65	0.77
6/13/2018	13:40:15	19.66	0.77
6/13/2018	13:41:15	19.66	0.77
6/13/2018	13:42:15	19.66	0.76
6/13/2018	13:43:15	19.66	0.76
6/13/2018	13:44:15	19.65	0.76
6/13/2018	13:45:15	19.66	0.76
6/13/2018	13:46:15	19.66	0.76
6/13/2018	13:47:15	19.66	0.76
6/13/2018	13:48:15	19.66	0.77
6/13/2018	13:49:15	19.65	0.76
6/13/2018	13:50:15	19.65	0.77
6/13/2018	13:51:15	19.66	0.77
6/13/2018	13:52:15	19.66	0.76
6/13/2018	13:53:15	19.67	0.77
6/13/2018	13:54:15	19.66	0.77
6/13/2018	13:55:15	19.65	0.77
6/13/2018	13:56:15	19.65	0.78
6/13/2018	13:57:15	19.64	0.78

Hollingsworth & Vose

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Run 1

Date	Time	O2 [%]	CO2 [%]
6/13/2018	13:58:15	19.65	0.78
6/13/2018	13:59:15	19.65	0.78
6/13/2018	14:00:15	19.65	0.78
6/13/2018	14:01:15	19.65	0.78
6/13/2018	14:02:15	19.65	0.77
6/13/2018	14:03:15	19.66	0.77
6/13/2018	14:04:15	19.66	0.77
6/13/2018	14:05:15	19.65	0.77
6/13/2018	14:06:15	19.64	0.77
6/13/2018	14:07:15	19.65	0.76
6/13/2018	14:08:15	19.65	0.76
	FINAL	**19.67**	**0.77**

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/13/2018	14:23:15	19.62	0.78
6/13/2018	14:24:15	19.63	0.78
6/13/2018	14:25:15	19.64	0.78
6/13/2018	14:26:15	19.63	0.77
6/13/2018	14:27:15	19.62	0.78
6/13/2018	14:28:15	19.63	0.77
6/13/2018	14:29:15	19.64	0.77
6/13/2018	14:30:15	19.64	0.77
6/13/2018	14:31:15	19.63	0.77
6/13/2018	14:32:15	19.63	0.76
6/13/2018	14:33:15	19.63	0.76
6/13/2018	14:34:15	19.64	0.76
6/13/2018	14:35:15	19.64	0.76
6/13/2018	14:36:15	19.65	0.76
6/13/2018	14:37:15	19.64	0.76
6/13/2018	14:38:15	19.64	0.76
6/13/2018	14:39:15	19.64	0.76
6/13/2018	14:40:15	19.64	0.76
6/13/2018	14:41:15	19.64	0.77
6/13/2018	14:42:15	19.64	0.77
6/13/2018	14:43:15	19.64	0.77
6/13/2018	14:44:15	19.64	0.77
6/13/2018	14:45:15	19.64	0.77
6/13/2018	14:46:15	19.65	0.77
6/13/2018	14:47:15	19.64	0.77
6/13/2018	14:48:15	19.64	0.77
6/13/2018	14:49:15	19.64	0.77
6/13/2018	14:50:15	19.64	0.77
6/13/2018	14:51:15	19.65	0.77
6/13/2018	14:52:15	19.66	0.77
6/13/2018	14:53:15	19.64	0.77
6/13/2018	14:54:15	19.64	0.77
6/13/2018	14:55:15	19.66	0.77
6/13/2018	14:56:15	19.67	0.77
6/13/2018	14:57:15	19.68	0.76
6/13/2018	14:58:15	19.66	0.76
6/13/2018	14:59:15	19.65	0.76
6/13/2018	15:00:15	19.65	0.76
6/13/2018	15:01:15	19.66	0.76
6/13/2018	15:02:15	19.67	0.76
6/13/2018	15:03:15	19.67	0.76

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/13/2018	15:04:15	19.65	0.77
6/13/2018	15:05:15	19.66	0.77
6/13/2018	15:06:15	19.67	0.77
6/13/2018	15:07:15	19.67	0.77
6/13/2018	15:08:15	19.68	0.77
6/13/2018	15:09:15	19.66	0.78
6/13/2018	15:10:15	19.66	0.78
6/13/2018	15:11:15	19.67	0.77
6/13/2018	15:12:15	19.67	0.78
6/13/2018	15:13:15	19.68	0.78
6/13/2018	15:14:15	19.66	0.78
6/13/2018	15:15:15	19.66	0.78
6/13/2018	15:16:15	19.67	0.77
6/13/2018	15:17:15	19.67	0.77
6/13/2018	15:18:15	19.68	0.77
6/13/2018	15:19:15	19.66	0.77
6/13/2018	15:20:15	19.65	0.77
6/13/2018	15:21:15	19.65	0.76
6/13/2018	15:22:15	19.65	0.76
6/13/2018	15:23:15	19.66	0.76
6/13/2018	15:24:15	19.65	0.76
6/13/2018	15:25:15	19.65	0.76
6/13/2018	15:26:15	19.65	0.76
6/13/2018	15:27:15	19.66	0.76
6/13/2018	15:28:15	19.66	0.77
6/13/2018	15:29:15	19.66	0.77
6/13/2018	15:30:15	19.65	0.76
6/13/2018	15:31:15	19.65	0.77
6/13/2018	15:32:15	19.65	0.77
6/13/2018	15:33:15	19.66	0.77
6/13/2018	15:34:15	19.66	0.77
6/13/2018	15:35:15	19.65	0.78
6/13/2018	15:36:15	19.65	0.78
6/13/2018	15:37:15	19.65	0.78
6/13/2018	15:38:15	19.66	0.78
6/13/2018	15:39:15	19.67	0.77
6/13/2018	15:40:15	19.66	0.78
6/13/2018	15:41:15	19.64	0.78
6/13/2018	15:42:15	19.65	0.78
6/13/2018	15:43:15	19.66	0.77
6/13/2018	15:44:15	19.66	0.77

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/13/2018	15:45:15	19.66	0.77
6/13/2018	15:46:15	19.65	0.77
6/13/2018	15:47:15	19.66	0.76
6/13/2018	15:48:15	19.65	0.76
6/13/2018	15:49:15	19.65	0.76
6/13/2018	15:50:15	19.66	0.76
6/13/2018	15:51:15	19.66	0.76
6/13/2018	15:52:15	19.66	0.76
6/13/2018	15:53:15	19.65	0.77
6/13/2018	15:54:15	19.65	0.77
6/13/2018	15:55:15	19.66	0.77
6/13/2018	15:56:15	19.66	0.77
6/13/2018	15:57:15	19.65	0.77
6/13/2018	15:58:15	19.65	0.77
6/13/2018	15:59:15	19.66	0.77
6/13/2018	16:00:15	19.66	0.78
6/13/2018	16:01:15	19.66	0.78
6/13/2018	16:02:15	19.65	0.78
6/13/2018	16:03:15	19.65	0.78
6/13/2018	16:04:15	19.64	0.78
6/13/2018	16:05:15	19.65	0.78
6/13/2018	16:06:15	19.66	0.78
6/13/2018	16:07:15	19.66	0.78
6/13/2018	16:08:15	19.66	0.77
6/13/2018	16:09:15	19.66	0.77
6/13/2018	16:10:15	19.65	0.76
6/13/2018	16:11:15	19.66	0.76
6/13/2018	16:12:15	19.67	0.76
6/13/2018	16:13:15	19.66	0.76
6/13/2018	16:14:15	19.65	0.76
6/13/2018	16:15:15	19.64	0.76
6/13/2018	16:16:15	19.64	0.76
6/13/2018	16:17:15	19.65	0.76
6/13/2018	16:18:15	19.65	0.76
6/13/2018	16:19:15	19.64	0.76
6/13/2018	16:20:15	19.65	0.76
6/13/2018	16:21:15	19.66	0.76
6/13/2018	16:22:15	19.66	0.77
6/13/2018	16:23:15	19.66	0.76
6/13/2018	16:24:15	19.65	0.77
6/13/2018	16:25:15	19.65	0.77

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Run 2

Date	Time	O2 [%]	CO2 [%]
6/13/2018	16:26:15	19.65	0.78
6/13/2018	16:27:15	19.65	0.78
6/13/2018	16:28:15	19.65	0.77
6/13/2018	16:29:15	19.65	0.77
6/13/2018	16:30:15	19.64	0.77
6/13/2018	16:31:15	19.64	0.77
	FINAL	**19.65**	**0.77**

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/13/2018	16:46:15	19.72	0.78
6/13/2018	16:47:15	19.73	0.77
6/13/2018	16:48:15	19.74	0.77
6/13/2018	16:49:15	19.75	0.77
6/13/2018	16:50:15	19.74	0.78
6/13/2018	16:51:15	19.74	0.77
6/13/2018	16:52:15	19.74	0.77
6/13/2018	16:53:15	19.74	0.77
6/13/2018	16:54:15	19.75	0.77
6/13/2018	16:55:15	19.75	0.77
6/13/2018	16:56:15	19.75	0.77
6/13/2018	16:57:15	19.74	0.77
6/13/2018	16:58:15	19.74	0.77
6/13/2018	16:59:15	19.75	0.77
6/13/2018	17:00:15	19.76	0.76
6/13/2018	17:01:15	19.76	0.76
6/13/2018	17:02:15	19.74	0.76
6/13/2018	17:03:15	19.75	0.75
6/13/2018	17:04:15	19.75	0.76
6/13/2018	17:05:15	19.75	0.76
6/13/2018	17:06:15	19.75	0.75
6/13/2018	17:07:15	19.74	0.76
6/13/2018	17:08:15	19.74	0.75
6/13/2018	17:09:15	19.75	0.76
6/13/2018	17:10:15	19.75	0.75
6/13/2018	17:11:15	19.75	0.76
6/13/2018	17:12:15	19.75	0.76
6/13/2018	17:13:15	19.74	0.76
6/13/2018	17:14:15	19.74	0.77
6/13/2018	17:15:15	19.74	0.77
6/13/2018	17:16:15	19.74	0.78
6/13/2018	17:17:15	19.75	0.77
6/13/2018	17:18:15	19.75	0.77
6/13/2018	17:19:15	19.75	0.77
6/13/2018	17:20:15	19.75	0.77
6/13/2018	17:21:15	19.76	0.76
6/13/2018	17:22:15	19.76	0.76
6/13/2018	17:23:15	19.75	0.76
6/13/2018	17:24:15	19.74	0.76
6/13/2018	17:25:15	19.75	0.76
6/13/2018	17:26:15	19.76	0.76

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/13/2018	17:27:15	19.76	0.75
6/13/2018	17:28:15	19.76	0.76
6/13/2018	17:29:15	19.75	0.75
6/13/2018	17:30:15	19.75	0.75
6/13/2018	17:31:15	19.75	0.75
6/13/2018	17:32:15	19.77	0.75
6/13/2018	17:33:15	19.77	0.75
6/13/2018	17:34:15	19.76	0.75
6/13/2018	17:35:15	19.76	0.75
6/13/2018	17:36:15	19.76	0.76
6/13/2018	17:37:15	19.76	0.76
6/13/2018	17:38:15	19.78	0.76
6/13/2018	17:39:15	19.78	0.77
6/13/2018	17:40:15	19.70	0.77
6/13/2018	17:41:15	19.81	0.77
6/13/2018	17:42:15	19.81	0.77
6/13/2018	17:43:15	19.82	0.77
6/13/2018	17:44:15	19.82	0.77
6/13/2018	17:45:15	19.82	0.76
6/13/2018	17:46:15	19.80	0.77
6/13/2018	17:47:15	19.81	0.76
6/13/2018	17:48:15	19.82	0.76
6/13/2018	17:49:15	19.82	0.76
6/13/2018	17:50:15	19.82	0.76
6/13/2018	17:51:15	19.82	0.75
6/13/2018	17:52:15	19.81	0.75
6/13/2018	17:53:15	19.82	0.75
6/13/2018	17:54:15	19.83	0.75
6/13/2018	17:55:15	19.83	0.75
6/13/2018	17:56:15	19.82	0.75
6/13/2018	17:57:15	19.81	0.75
6/13/2018	17:58:15	19.81	0.76
6/13/2018	17:59:15	19.81	0.76
6/13/2018	18:00:15	19.83	0.76
6/13/2018	18:01:15	19.70	0.77
6/13/2018	18:02:15	19.70	0.76
6/13/2018	18:03:15	19.70	0.76
6/13/2018	18:04:15	19.71	0.76
6/13/2018	18:05:15	19.70	0.77
6/13/2018	18:06:15	19.71	0.77
6/13/2018	18:07:15	19.70	0.77

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/13/2018	18:08:15	19.70	0.77
6/13/2018	18:09:15	19.70	0.77
6/13/2018	18:10:15	19.71	0.76
6/13/2018	18:11:15	19.72	0.76
6/13/2018	18:12:15	19.72	0.76
6/13/2018	18:13:15	19.70	0.77
6/13/2018	18:14:15	19.70	0.76
6/13/2018	18:15:15	19.70	0.76
6/13/2018	18:16:15	19.71	0.75
6/13/2018	18:17:15	19.72	0.75
6/13/2018	18:18:15	19.71	0.75
6/13/2018	18:19:15	19.71	0.75
6/13/2018	18:20:15	19.70	0.75
6/13/2018	18:21:15	19.71	0.76
6/13/2018	18:22:15	19.72	0.76
6/13/2018	18:23:15	19.72	0.75
6/13/2018	18:24:15	19.71	0.76
6/13/2018	18:25:15	19.70	0.76
6/13/2018	18:26:15	19.71	0.76
6/13/2018	18:27:15	19.72	0.76
6/13/2018	18:28:15	19.72	0.76
6/13/2018	18:29:15	19.72	0.77
6/13/2018	18:30:15	19.71	0.77
6/13/2018	18:31:15	19.71	0.77
6/13/2018	18:32:15	19.71	0.77
6/13/2018	18:33:15	19.72	0.77
6/13/2018	18:34:15	19.73	0.76
6/13/2018	18:35:15	19.72	0.76
6/13/2018	18:36:15	19.71	0.76
6/13/2018	18:37:15	19.71	0.76
6/13/2018	18:38:15	19.72	0.76
6/13/2018	18:39:15	19.72	0.76
6/13/2018	18:40:15	19.73	0.75
6/13/2018	18:41:15	19.72	0.75
6/13/2018	18:42:15	19.72	0.75
6/13/2018	18:43:15	19.72	0.75
6/13/2018	18:44:15	19.73	0.75
6/13/2018	18:45:15	19.72	0.75
6/13/2018	18:46:15	19.71	0.75
6/13/2018	18:47:15	19.72	0.76
6/13/2018	18:48:15	19.72	0.75

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Run 3

Date	Time	O2 [%]	CO2 [%]
6/13/2018	18:49:15	19.72	0.76
6/13/2018	18:50:15	19.73	0.76
6/13/2018	18:51:15	19.73	0.76
6/13/2018	18:52:15	19.72	0.76
6/13/2018	18:53:15	19.72	0.76
	FINAL	**19.75**	**0.76**

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R-1 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/13/2018	14:15:15	10.78	0.37		
6/13/2018	14:15:25	3.06	0.19		
6/13/2018	14:15:35	0.90	0.13		
6/13/2018	14:15:45	0.34	0.12		
6/13/2018	14:15:55	0.19	0.11		
6/13/2018	14:16:05	0.15	0.11		
6/13/2018	14:16:15	0.13	0.11		
6/13/2018	14:16:25	0.12	0.11		
6/13/2018	14:16:35	0.11	0.11		
6/13/2018	14:16:45	0.12	0.11	0.12	0.11
6/13/2018	14:16:55	0.11	0.10		
6/13/2018	14:17:05	0.11	0.11		
6/13/2018	14:17:15	0.10	0.11		
6/13/2018	14:17:25	0.20	0.12		
6/13/2018	14:17:35	3.89	2.60		
6/13/2018	14:17:45	8.20	7.73		
6/13/2018	14:17:55	9.45	9.12		
6/13/2018	14:18:05	9.78	9.50		
6/13/2018	14:18:15	9.87	9.62		
6/13/2018	14:18:25	9.90	9.66		
6/13/2018	14:18:35	9.91	9.67		
6/13/2018	14:18:45	9.91	9.68	9.91	
6/13/2018	14:18:55	9.92	9.69		
6/13/2018	14:19:05	9.91	9.69		
6/13/2018	14:19:15	12.85	6.89		
6/13/2018	14:19:25	10.46	3.50		
6/13/2018	14:19:35	3.77	1.14		
6/13/2018	14:19:45	2.06	0.75		
6/13/2018	14:19:55	1.98	1.59		
6/13/2018	14:20:05	2.00	1.82		
6/13/2018	14:20:15	2.00	1.88		
6/13/2018	14:20:25	2.00	1.90		
6/13/2018	14:20:35	2.01	1.91		
6/13/2018	14:20:45	2.01	1.92		
6/13/2018	14:20:55	2.01	1.92		
6/13/2018	14:21:05	2.01	1.93		
6/13/2018	14:21:15	2.01	1.93		1.93
6/13/2018	14:21:25	2.01	1.93		
6/13/2018	14:21:35	4.86	1.74		

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R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/13/2018	16:37:55	19.65	0.76		
6/13/2018	16:38:05	17.85	0.77		
6/13/2018	16:38:15	7.19	0.42		
6/13/2018	16:38:25	2.03	0.20		
6/13/2018	16:38:35	0.64	0.12		
6/13/2018	16:38:45	0.26	0.11		
6/13/2018	16:38:55	0.17	0.10		
6/13/2018	16:39:05	0.13	0.10		
6/13/2018	16:39:15	0.12	0.10		
6/13/2018	16:39:25	0.12	0.10		
6/13/2018	16:39:35	0.11	0.09	0.12	0.10
6/13/2018	16:39:45	0.11	0.10		
6/13/2018	16:39:55	0.11	0.10		
6/13/2018	16:40:05	0.09	0.10		
6/13/2018	16:40:15	0.11	0.09		
6/13/2018	16:40:25	1.54	0.17		
6/13/2018	16:40:35	1.72	0.15		
6/13/2018	16:40:45	1.47	0.15		
6/13/2018	16:40:55	1.53	0.41		
6/13/2018	16:41:05	1.93	1.37		
6/13/2018	16:41:15	2.01	1.73		
6/13/2018	16:41:25	2.02	1.83		
6/13/2018	16:41:35	2.04	1.88		
6/13/2018	16:41:45	2.04	1.90		
6/13/2018	16:41:55	2.04	1.91		
6/13/2018	16:42:05	2.04	1.93		
6/13/2018	16:42:15	2.05	1.92		
6/13/2018	16:42:25	2.05	1.93		
6/13/2018	16:42:35	2.05	1.93		1.93
6/13/2018	16:42:45	2.05	1.94		
6/13/2018	16:42:55	2.29	1.92		
6/13/2018	16:43:05	10.32	1.38		
6/13/2018	16:43:15	15.05	1.76		
6/13/2018	16:43:25	11.52	6.54		
6/13/2018	16:43:35	10.41	8.83		
6/13/2018	16:43:45	10.11	9.46		
6/13/2018	16:43:55	10.04	9.65		
6/13/2018	16:44:05	10.02	9.69		
6/13/2018	16:44:15	10.01	9.71		
6/13/2018	16:44:25	10.01	9.73		
6/13/2018	16:44:35	10.01	9.73		

Hollingsworth & Vose

CFU 107

R-2 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/13/2018	16:44:45	10.01	9.74	10.01	

Hollingsworth & Vose

CFU 107

R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/13/2018	18:54:35	19.67	0.82		
6/13/2018	18:54:45	15.32	4.72		
6/13/2018	18:54:55	11.21	8.40		
6/13/2018	18:55:05	10.30	9.40		
6/13/2018	18:55:15	10.09	9.64		
6/13/2018	18:55:25	10.05	9.70		
6/13/2018	18:55:35	10.03	9.72		
6/13/2018	18:55:45	10.03	9.72		
6/13/2018	18:55:55	10.02	9.73		
6/13/2018	18:56:05	10.02	9.73		
6/13/2018	18:56:15	10.02	9.73		
6/13/2018	18:56:25	10.02	9.74		
6/13/2018	18:56:35	10.02	9.74		
6/13/2018	18:56:45	10.02	9.73		
6/13/2018	18:56:55	10.01	9.74		
6/13/2018	18:57:05	10.02	9.76		
6/13/2018	18:57:15	10.01	9.75		
6/13/2018	18:57:25	10.01	9.76	10.01	
6/13/2018	18:57:35	10.02	9.75		
6/13/2018	18:57:45	10.01	9.75		
6/13/2018	18:57:55	11.47	8.36		
6/13/2018	18:58:05	16.97	3.11		
6/13/2018	18:58:15	16.49	2.19		
6/13/2018	18:58:25	5.87	1.16		
6/13/2018	18:58:35	2.21	0.94		
6/13/2018	18:58:45	2.09	1.75		
6/13/2018	18:58:55	2.07	1.90		
6/13/2018	18:59:05	2.06	1.96		
6/13/2018	18:59:15	2.07	1.97		
6/13/2018	18:59:25	2.06	1.97		
6/13/2018	18:59:35	2.07	1.97		
6/13/2018	18:59:45	2.07	1.96		
6/13/2018	18:59:55	2.07	1.97		
6/13/2018	19:00:05	2.07	1.97		
6/13/2018	19:00:15	2.07	1.97		
6/13/2018	19:00:25	2.07	1.97		
6/13/2018	19:00:35	2.07	1.97		1.97
6/13/2018	19:00:45	2.07	1.97		
6/13/2018	19:00:55	2.07	1.98		
6/13/2018	19:01:05	2.07	1.97		
6/13/2018	19:01:15	2.06	1.97		

Hollingsworth & Vose

CFU 107

R-3 Bias Check

Date	Time	O2 [%]	CO2 [%]	O2 [%]	CO2 [%]
6/13/2018	19:01:25	2.07	1.97		
6/13/2018	19:01:35	1.56	1.47		
6/13/2018	19:01:45	0.51	0.52		
6/13/2018	19:01:55	0.19	0.24		
6/13/2018	19:02:05	0.12	0.16		
6/13/2018	19:02:15	0.11	0.14		
6/13/2018	19:02:25	0.10	0.13		
6/13/2018	19:02:35	0.10	0.14		
6/13/2018	19:02:45	0.09	0.13		
6/13/2018	19:02:55	0.09	0.13		
6/13/2018	19:03:05	0.09	0.13		
6/13/2018	19:03:15	0.09	0.12		
6/13/2018	19:03:25	0.09	0.12	0.09	0.12

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth and Vose**
FACILITY	**GP1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 107**
DATE	**06/14/18**
METHOD	**5**
POLLUTANT	**Particulate Matter**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth and Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**9:16**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**11:21**
EPA Method:	**5**	Scattered cloud cover, 54F, calm		**Date:**	**6/14/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

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	4D	Liner type	Glass	
Y factor	0.9980		Nozzle ID	0.25	Nozzle size	0.2502	inches
ΔH@	1.8338		Hot box ID	1	Nozzle area	0.000341	sq.ft.
			Pitot Cp	0.84	Probe heat	248	F
					Filter heat	248	F

Source Information:

Barometric Pressure	29.97	"Hg	O_2	20.01 %
Static Pressure	0.71	"H_2O	CO_2	0.70 %
Ave. ΔP	1.2	"H_2O	Rec. Nz.	0.211 inches
Stack Temperature	260	F		
Assumed moisture	2	%		
Assumed meter temp.	67	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	12	13

Nozzle check for roundness:

1	2	3	
0.250	0.251	0.250	inches
	Caliper ID#	HLN#1	

Post Test Calculations:

Sample volume	130.841	dcf	Ave. ΔP	1.214 "H_2O
Wet mol. weight	28.7	M_s (actual)	Ave. √ΔP	1.1012 "H_2O
Actual H_2O	1.88	%	Ave. ΔH	3.842 "H_2O
Std. meter vol.	132.734	dscf	Ave. T_s	248.3 °F
Isokinetic Average	102.8	%	Ave. T_m	65 °F

Moisture/Lab:

Filter	Q1336 #		
	Initial	Final	Gain
Impingers, g	200.0	225	25.0
Silica gel, g	262.5	291.4	28.9
		Total water gain:	53.9

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	4.710	0.94	232	60	3.01	3.00	3	249	51
2	10.0	9.860	1.10	232	60	3.52	3.50	3	252	49
3	15.0	15.350	1.20	232	60	3.84	3.80	3	251	54
4	20.0	20.650	1.20	246	61	3.77	3.80	3	251	54
5	25.0	25.940	1.20	250	62	3.76	3.80	3	251	60
6	30.0	31.650	1.30	250	62	4.07	4.10	4	251	62
7	35.0	37.550	1.40	250	63	4.40	4.40	4	251	62
8	40.0	43.150	1.30	251	64	4.08	4.10	4	250	65
9	45.0	48.690	1.30	249	64	4.09	4.10	4	252	64
10	50.0	54.170	1.20	250	64	3.77	3.80	4	251	55
11	55.0	59.610	1.20	252	65	3.77	3.80	4	251	55
12	60.0	65.036	1.20	249	65	3.79	3.80	4	251	50
13	65.0	70.550	1.20	250	66	3.79	3.80	4	249	50
14	70.0	76.050	1.20	249	66	3.79	3.80	4	251	49
15	75.0	81.250	1.20	252	67	3.79	3.80	4	252	49
16	80.0	86.700	1.20	252	67	3.79	3.80	4	252	49
17	85.0	92.250	1.20	252	68	3.79	3.80	4	251	50
18	90.0	97.870	1.30	251	68	4.11	4.10	4	252	51
19	95.0	103.540	1.30	251	68	4.11	4.10	4	252	51
20	100.0	108.930	1.20	251	68	3.80	3.80	4	252	51
21	105.0	114.310	1.20	251	68	3.80	3.80	4	252	51
22	110.0	119.800	1.20	252	68	3.79	3.80	4	252	51
23	115.0	125.320	1.20	253	68	3.79	3.80	4	252	51
24	120.0	130.841	1.20	252	68	3.79	3.80	4	252	51

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth and Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**11:51**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**13:56**
EPA Method:	**5**	Scattered cloud cover, 54F, calm		**Date:**	**6/14/2018**
Box Operator:	**CMF**				
Technician(s):	**CSW**				

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	4D	Liner type:	Glass	
Y factor	0.9980		Nozzle ID	0.25	Nozzle size:	0.2502	inches
ΔH@	1.8338		Hot box ID	1	Nozzle area:	0.000341	sq.ft.
			Pitot Cp	0.84	Probe heat:	248	F
					Filter heat:	248	F

Source Information:

Barometric Pressure	29.97	"Hg	O_2	19.89 %
Static Pressure	0.71	"H_2O	CO_2	0.69 %
Ave. ΔP	1.2	"H_2O	Rec. Nz.	0.211 inches
Stack Temperature	260	F		
Assumed moisture	1.88	%		
Assumed meter temp.	65	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:	0.004	0.002
Leak check vacuum, "Hg:	14	15

Nozzle check for roundness:

1	2	3	
0.250	0.251	0.250	inches

Caliper ID# HLN#1

Post Test Calculations:

Sample volume	134.977	dcf	Ave. ΔP	1.254 "H_2O
Wet mol. weight	28.75	M_s (actual)	Ave. √ΔP	1.1193 "H_2O
Actual H_2O	1.46	%	Ave. ΔH	3.996 "H_2O
Std. meter vol.	135.101	dscf	Ave. T_s	254.6 °F
Isokinetic Average	103.0	%	Ave. T_m	72.3 °F

Moisture/Lab:

Filter	Q1337 #		
	Initial	Final	Gain
Impingers, g	200.0	210	10.0
Silica gel, g	254.7	287.2	32.5
		Total water gain:	42.5

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	5.750	1.30	254	67	4.10	4.10	4	249	59
2	10.0	11.090	1.20	255	68	3.78	3.80	4	252	59
3	15.0	16.780	1.30	254	68	4.10	4.10	4	252	56
4	20.0	22.170	1.20	255	68	3.78	3.80	4	251	56
5	25.0	27.890	1.30	255	70	4.11	4.10	4	250	57
6	30.0	33.420	1.30	256	70	4.11	4.10	4	240	59
7	35.0	39.080	1.30	257	71	4.11	4.10	4	249	60
8	40.0	45.020	1.40	257	71	4.43	4.40	4	255	61
9	45.0	50.960	1.30	258	72	4.11	4.10	5	249	62
10	50.0	56.590	1.30	259	73	4.11	4.10	5	252	63
11	55.0	62.090	1.20	259	73	3.80	3.80	5	250	62
12	60.0	67.629	1.20	257	74	3.81	3.80	4	256	62
13	65.0	72.990	1.10	250	73	3.52	3.70	4	256	68
14	70.0	78.450	1.10	250	73	3.52	3.50	4	252	61
15	75.0	83.670	1.10	250	74	3.53	3.50	4	251	64
16	80.0	89.330	1.30	253	74	4.16	4.20	4	251	64
17	85.0	94.850	1.20	254	75	3.84	3.80	5	253	66
18	90.0	100.800	1.40	254	75	4.48	4.50	5	253	67
19	95.0	106.350	1.20	254	74	3.83	3.80	5	254	67
20	100.0	112.060	1.30	253	74	4.16	4.20	5	250	56
21	105.0	117.800	1.20	254	74	3.83	3.80	5	252	53
22	110.0	123.490	1.30	254	74	4.15	4.20	5	252	52
23	115.0	129.160	1.30	254	74	4.15	4.20	5	252	52
24	120.0	134.977	1.30	254	76	4.17	4.20	5	255	51

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth and Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**14:31**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**	**End Time:**	**16:36**
EPA Method:	**5**	Scattered cloud cover, 54F, calm	**Date:**	**6/14/2018**
Box Operator:	**CMF**			
Technician(s):	**CSW**			

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	4D	Liner type:	Glass	
Y factor	0.9980	Nozzle ID	0.25	Nozzle size:	0.2502	inches
ΔH@	1.8338	Hot box ID	1	Nozzle area:	0.000341	sq.ft.
		Pitot Cp	0.84	Probe heat:	248	F
				Filter heat:	248	F

Source Information:

Barometric Pressure	29.97	"Hg	O_2	19.89 %
Static Pressure	0.71	"H_2O	CO_2	0.69 %
Ave. ΔP	1.2	"H_2O	Rec. Nz.	0.209 inches
Stack Temperature	260	F		
Assumed moisture	1.46	%		
Assumed meter temp.	72.3	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:	0.002	0.003
Leak check vacuum, "Hg:	15	12

Nozzle check for roundness:

1	2	3	
0.250	0.251	0.250	inches

Caliper ID# HLN#1

Post Test Calculations:

Sample volume	136.607	dcf	Ave. ΔP	1.258 "H_2O
Wet mol. weight	28.75	M_s (actual)	Ave. √ΔP	1.1211 "H_2O
Actual H_2O	1.49	%	Ave. ΔH	4.067 "H_2O
Std. meter vol.	134.805	dscf	Ave. T_s	255.2 °F
Isokinetic Average	102.7	%	Ave. T_m	80 °F

Moisture/Lab:

Filter	Q1338 #		
	Initial	Final	Gain
Impingers, g	200.0	210	10.0
Silica gel, g	257.9	291.1	33.2
		Total water gain:	43.2

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	5.020	1.00	253	74	3.22	3.20	4	249	50
2	10.0	10.350	1.10	248	75	3.57	3.60	4	250	46
3	15.0	15.900	1.20	258	75	3.84	3.80	4	252	50
4	20.0	21.540	1.20	252	76	3.88	3.90	4	253	52
5	25.0	27.338	1.30	257	77	4.18	4.20	5	251	53
6	30.0	33.080	1.30	257	78	4.19	4.20	5	253	55
7	35.0	38.870	1.30	258	79	4.19	4.20	5	254	56
8	40.0	44.670	1.30	256	80	4.21	4.20	5	254	57
9	45.0	50.390	1.20	254	81	3.91	3.90	5	251	57
10	50.0	56.110	1.20	253	81	3.91	3.90	5	251	57
11	55.0	61.880	1.30	253	82	4.25	4.20	5	252	59
12	60.0	67.765	1.30	253	82	4.25	4.20	5	252	60
13	65.0	73.300	1.20	253	81	3.91	3.90	4	250	60
14	70.0	78.850	1.30	255	82	4.24	4.20	5	251	60
15	75.0	84.750	1.30	256	82	4.23	4.20	5	252	64
16	80.0	90.460	1.30	256	82	4.23	4.20	5	256	66
17	85.0	96.200	1.30	256	82	4.23	4.20	5	252	66
18	90.0	101.900	1.30	257	83	4.23	4.20	5	252	66
19	95.0	107.750	1.30	257	82	4.22	4.20	5	252	67
20	100.0	113.610	1.40	258	81	4.53	4.50	5	250	62
21	105.0	119.400	1.30	258	81	4.21	4.20	5	253	57
22	110.0	125.200	1.30	257	81	4.22	4.20	5	247	57
23	115.0	131.050	1.30	255	81	4.23	4.20	5	252	55
24	120.0	136.607	1.20	255	81	3.90	3.90	5	249	56

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

Client:	**Hollingsworth and Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:16**
Source:	**CFU 107**	**End Time:**	**11:21**
Method:	**ODEQ 5**	**Date:**	**6/14/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	4.710	3.00	60	1	0.94	232	0.9695
10	9.860	3.50	60	2	1.10	232	1.0488
15	15.350	3.80	60	3	1.20	232	1.0954
20	20.650	3.80	61	4	1.20	246	1.0954
25	25.940	3.80	62	5	1.20	250	1.0954
30	31.650	4.10	62	6	1.30	250	1.1402
35	37.550	4.40	63	7	1.40	250	1.1832
40	43.150	4.10	64	8	1.30	251	1.1402
45	48.690	4.10	64	9	1.30	249	1.1402
50	54.170	3.80	64	10	1.20	250	1.0954
55	59.610	3.80	65	11	1.20	252	1.0954
60	65.036	3.80	65	12	1.20	249	1.0954
65	70.550	3.80	66	13	1.20	250	1.0954
70	76.050	3.80	66	14	1.20	249	1.0954
75	81.250	3.80	67	15	1.20	252	1.0954
80	86.700	3.80	67	16	1.20	252	1.0954
85	92.250	3.80	68	17	1.20	252	1.0954
90	97.870	4.10	68	18	1.30	251	1.1402
95	103.540	4.10	68	19	1.30	251	1.1402
100	108.930	3.80	68	20	1.20	251	1.0954
105	114.310	3.80	68	21	1.20	251	1.0954
110	119.800	3.80	68	22	1.20	252	1.0954
115	125.320	3.80	68	23	1.20	253	1.0954
120	130.841	3.80	68	24	1.20	252	1.0954

Client:	**Hollingsworth and Vose**	**Run:**	**1**
Source:	**CFU 107**	**Date:**	**06/14/18**

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	130.841	dcf	Rectangular		
Water Volume	53.9	ml (g)	Width		in
Nozzle Diameter, N_z	0.2502	in.	Length		in
Nozzle Area	0.000341	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	0.70	%vd
Static Pressure	0.71	"H_2O	O_2 Average	20.01	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9980	Y			

Field Data Averages

Meter			Stack		
ΔH	3.842	"H_2O	√Dp	1.1012	"H_2O
Temperature, T_m	65.0	^oF	Temperature, T_s	248.3	^oF
Temperature, T_m	525.0	^oA (^oR)	Temperature, T_s	708.3	^oA (R)
Pressure Meter, P_m	30.253	"Hg	Pressure Stack, P_s	30.022	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	132.734	dscf	Velocity, V_s	71.70	fps
	3.759	dscm	Volume (actual)	21,118.5	awcfm
Actual Volume, $V_{m(actual)}$	180.927	awcf		20,721.5	adcfm
Gas Stream Moisture			Volume (standard)	947,784.1	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.537	scf		929,965.8	dscf/hr
Moisture, B_{ws}	0.0188			15,499.4	dscf/min
Moisture EPA M4	1.88	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	102.8	%			

Laboratory Results

EPA Method 5					
Filterable PM	0.00153	grams			
Emissions:					
Concentration, C_s	1.78E-04	gr/dscf			
	407	µg/dscm			
Mass Emissions	2.36E-02	lb/hr			
Back Half:					
Inorganic CPM	5.42E-04	grams	Organic CPM	2.71E-04	grams
Inorganic CPM, C_s	6.30E-05	gr/dscf	Organic CPM, C_s	3.16E-05	gr/dscf
	144	µg/dscm		72	µg/dscm
Mass Emissions	8.38E-03	lb/hr	Mass Emissions	4.19E-03	lb/hr

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

Client:	**Hollingsworth and Vose**	**Run:**	**2**
Location:	**Corvallis, OR**	**Start Time:**	**11:51**
Source:	**CFU 107**	**End Time:**	**13:56**
Method:	**ODEQ 5**	**Date:**	**06/14/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	5.750	4.10	67	1	1.30	254	1.1402
10	11.090	3.80	68	2	1.20	255	1.0954
15	16.780	4.10	68	3	1.30	254	1.1402
20	22.170	3.80	68	4	1.20	255	1.0954
25	27.890	4.10	70	5	1.30	255	1.1402
30	33.420	4.10	70	6	1.30	256	1.1402
35	39.080	4.10	71	7	1.30	257	1.1402
40	45.020	4.40	71	8	1.40	257	1.1832
45	50.960	4.10	72	9	1.30	258	1.1402
50	56.590	4.10	73	10	1.30	259	1.1402
55	62.090	3.80	73	11	1.20	259	1.0954
60	67.629	3.80	74	12	1.20	257	1.0954
65	72.990	3.70	73	13	1.10	250	1.0488
70	78.450	3.50	73	14	1.10	250	1.0488
75	83.670	3.50	74	15	1.10	250	1.0488
80	89.330	4.20	74	16	1.30	253	1.1402
85	94.850	3.80	75	17	1.20	254	1.0954
90	100.800	4.50	75	18	1.40	254	1.1832
95	106.350	3.80	74	19	1.20	254	1.0954
100	112.060	4.20	74	20	1.30	253	1.1402
105	117.800	3.80	74	21	1.20	254	1.0954
110	123.490	4.20	74	22	1.30	254	1.1402
115	129.160	4.20	74	23	1.30	254	1.1402
120	134.977	4.20	76	24	1.30	254	1.1402

Client:	**Hollingsworth and Vose**	**Run:**	**2**
Source:	**CFU 107**	**Date:**	**06/14/18**

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	134.977	dcf	Rectangular		
Water Volume	42.5	ml (g)	Width		in
Nozzle Diameter, N_z	0.2502	in.	Length		in
Nozzle Area	0.000341	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	0.69	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.89	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9980	Y			

Field Data Averages

Meter			Stack		
ΔH	3.996	"H_2O	√Dp	1.1193	"H_2O
Temperature, T_m	72.3	^oF	Temperature, T_s	254.6	^oF
Temperature, T_m	532.3	^oA (^oR)	Temperature, T_s	714.6	^oA (R)
Pressure Meter, P_m	30.264	"Hg	Pressure Stack, P_s	30.022	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	135.101	dscf	Velocity, V_s	73.14	fps
	3.826	dscm	Volume (actual)	21,542.7	awcfm
Actual Volume, $V_{m(actual)}$	185.000	awcf		21,228.2	adcfm
Gas Stream Moisture			Volume (standard)	958,295.5	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.000	scf		944,304.4	dscf/hr
Moisture, B_{ws}	0.0146			15,738.4	dscf/min
Moisture EPA M4	1.46	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.75	lb/lb-mole			
Percent Isokinetic	103.0	%			

Laboratory Results

Front Half:					
Filterable PM	0.00156	grams			
Emissions:					
Concentration, C_s	1.78E-04	gr/dscf			
	407	µg/dscm			
Mass Emissions	2.40E-02	lb/hr			
Back Half:					
Inorganic CPM	9.96E-04	grams	Organic CPM	0.00E+00	grams
Inorganic CPM, C_s	1.14E-04	gr/dscf	Organic CPM, C_s	0.00E+00	gr/dscf
	260	µg/dscm		0	µg/dscm
Mass Emissions	1.53E-02	lb/hr	Mass Emissions	0.00E+00	lb/hr

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

Client:	**Hollingsworth and Vose**	**Run:**	**3**
Location:	**Corvallis, OR**	**Start Time:**	**14:31**
Source:	**CFU 107**	**End Time:**	**16:36**
Method:	**ODEQ 5**	**Date:**	**06/14/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	5.020	3.20	74	1	1.00	253	1.0000
10	10.350	3.60	75	2	1.10	248	1.0488
15	15.900	3.80	75	3	1.20	258	1.0954
20	21.540	3.90	76	4	1.20	252	1.0954
25	27.338	4.20	77	5	1.30	257	1.1402
30	33.080	4.20	78	6	1.30	257	1.1402
35	38.870	4.20	79	7	1.30	258	1.1402
40	44.670	4.20	80	8	1.30	256	1.1402
45	50.390	3.90	81	9	1.20	254	1.0954
50	56.110	3.90	81	10	1.20	253	1.0954
55	61.880	4.20	82	11	1.30	253	1.1402
60	67.765	4.20	82	12	1.30	253	1.1402
65	73.300	3.90	81	13	1.20	253	1.0954
70	78.850	4.20	82	14	1.30	255	1.1402
75	84.750	4.20	82	15	1.30	256	1.1402
80	90.460	4.20	82	16	1.30	256	1.1402
85	96.200	4.20	82	17	1.30	256	1.1402
90	101.900	4.20	83	18	1.30	257	1.1402
95	107.750	4.20	82	19	1.30	257	1.1402
100	113.610	4.50	81	20	1.40	258	1.1832
105	119.400	4.20	81	21	1.30	258	1.1402
110	125.200	4.20	81	22	1.30	257	1.1402
115	131.050	4.20	81	23	1.30	255	1.1402
120	136.607	3.90	81	24	1.20	255	1.0954

Client:	**Hollingsworth and Vose**	**Run:**	**3**
Source:	**CFU 107**	**Date:**	**06/14/18**

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	136.607	dcf	Rectangular		
Water Volume	43.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.2502	in.	Length		in
Nozzle Area	0.000341	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	0.69	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.89	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9980	Y			

Field Data Averages

Meter			Stack		
ΔH	4.067	"H_2O	√Dp	1.1211	"H_2O
Temperature, T_m	80.0	^oF	Temperature, T_s	255.2	^oF
Temperature, T_m	540.0	^oA (^oR)	Temperature, T_s	715.2	^oA (R)
Pressure Meter, P_m	30.269	"Hg	Pressure Stack, P_s	30.022	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	134.805	dscf	Velocity, V_s	73.28	fps
	3.817	dscm	Volume (actual)	21,583.9	awcfm
Actual Volume, $V_{m(actual)}$	184.806	awcf		21,262.3	adcfm
Gas Stream Moisture			Volume (standard)	959,324.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	2.033	scf		945,030.4	dscf/hr
Moisture, B_{ws}	0.0149			15,750.5	dscf/min
Moisture EPA M4	1.49	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.75	lb/lb-mole			
Percent Isokinetic	102.7	%			

Laboratory Results

Front Half:					
Filterable PM	0.00058	grams			
Emissions:					
Concentration, C_s	6.62E-05	gr/dscf			
	152	µg/dscm			
Mass Emissions	8.94E-03	lb/hr			
Back Half:					
Inorganic CPM	7.38E-04	grams	Organic CPM	8.64E-04	grams
Inorganic CPM, C_s	8.45E-05	gr/dscf	Organic CPM, C_s	9.89E-05	gr/dscf
	193	µg/dscm		226	µg/dscm
Mass Emissions	1.14E-02	lb/hr	Mass Emissions	1.34E-02	lb/hr

Oregon Method 5
Filterable and Condensable Particulate
Laboratory Gravimetric Data

Client: **Hollingsworth and Vose**
Location: **Corvallis, OR**
Source: **CFU 107**

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction		Corrected Gain (grams)	
1	CPM Organics (Acetone BH)	125	47.64125	47.64170	0.00045	1.79E-04		**0.00027**	
	Probe Rinse (Acetone FH)	120	51.88180	51.88350	0.00170	1.71E-04		**0.00153**	
	Filter	Q1336	0.37365	0.37355	-0.00010			**0.00000**	
	CPM Inorganics (Water)	400	47.26055	47.26140	0.00085	3.08E-04		**0.00054**	
	CPM Organics (Hexane BH)	100	50.58565	50.58550	-0.00015	0.00E+00		**0.00000**	
	Impinger H_2O Gain, mls		200	225	25.0				
						Filterable PM (mg)		**1.53**	
						Total PM (mg)		**2.34**	**ND**
2	CPM Organics (Acetone BH)	95	50.06530	50.06540	0.00010	1.36E-04		**0.00000**	
	Probe Rinse (Acetone FH)	100	52.66235	52.66370	0.00135	1.43E-04		**0.00121**	
	Filter	Q1337	0.37370	0.37405	0.00035			**0.00035**	
	CPM Inorganics (Water)	395	50.08180	50.08310	0.00130	3.04E-04		**0.00100**	
	CPM Organics (Hexane BH)	95	49.55250	49.55200	-0.00050	0.00E+00		**0.00000**	
	Impinger H_2O Gain, mls		200	210	10.0				
						Filterable PM (mg)		**1.56**	
						Total PM (mg)		**2.55**	**ND**
3	CPM Organics (Acetone BH)	165	47.59960	47.60010	0.00050	2.36E-04		**0.00026**	
	Probe Rinse (Acetone FH)	260	49.48400	49.48470	0.00070	3.71E-04		**0.00033**	
	Filter	Q1338	0.37005	0.37030	0.00025			**0.00025**	
	CPM Inorganics (Water)	405	49.63885	49.63990	0.00105	3.12E-04		**0.00074**	
	CPM Organics (Hexane BH)	100	54.04490	54.04550	0.00060	0.00E+00		**0.00060**	
	Impinger H_2O Gain, mls		200	210	10.0				
						Filterable PM (mg)		**0.58**	
						Total PM (mg)		**2.18**	**ND**
	Acetone Blank	175	48.25825	48.25850	0.00025	1.43E-06	g/g		
	Water Blank	195	51.37705	51.37720	0.00015	7.69E-07	g/g		
	Hexane Blank	95	49.02970	49.02970	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 and Vose**
Source: **CFU 107**
Location: **Corvallis, OR**

Run			1	2	3	
Date			6/14/2018	6/14/2018	6/14/2018	
Run Start Time			9:16	11:51	14:31	
Run End Time			11:21	13:56	16:36	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.97	29.97	29.97	**29.97**
Nozzle Dia., in.			0.2502	0.2502	0.2502	**0.2502**
Isokinetic Average, %			102.8	103.0	102.7	**102.8**
Sample Volume, dscf			132.734	135.101	134.805	**134.213**
Sample Volume, dscm			3.759	3.826	3.817	**3.801**
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	0.69	0.69	**0.69**
O_2 %vd			20.01	19.89	19.89	**19.93**
Static Press., "H_2O			0.71	0.71	0.71	**0.71**
H_2O %v			1.88	1.46	1.49	**1.61**
Wet Molecular Weight, lb/lb-mole			28.70	28.75	28.75	**28.73**
Velocity, FPS			71.70	73.14	73.28	**72.71**
ADCFM			20,721.5	21,228.2	21,262.3	**21,070.7**
AWCFM			21,118.5	21,542.7	21,583.9	**21,415.0**
DSCFM			15,499.4	15,738.4	15,750.5	**15,662.8**
Stack Temperature, °F			248.3	254.6	255.2	**252.7**
Filterable Particulate	Concentration, C_s	gr/dscf	1.78E-04	1.78E-04	6.62E-05	**1.41E-04**
		µg/dscm	407	407	152	**322**
	Mass	lb/hr	2.36E-02	2.40E-02	8.94E-03	**1.88E-02**
		lb/lb glass	6.48E-05	6.61E-05	2.47E-05	**5.19E-05**
Inorganic CPM	Concentration, C_s	gr/dscf	6.30E-05	1.14E-04	8.45E-05	**8.71E-05**
		µg/dscm	144	260	193	**199**
	Mass	lb/hr	8.38E-03	1.53E-02	1.14E-02	**1.17E-02**
		lb/lb glass	2.30E-05	4.23E-05	3.15E-05	**3.23E-05**
Organic CPM	Concentration, C_s	gr/dscf	3.16E-05	0.00E+00	9.89E-05	**4.35E-05**
		µg/dscm	72	0	226	**100**
	Mass	lb/hr	4.19E-03	0.00E+00	1.34E-02	**5.85E-03**
		lb/lb glass	1.15E-05	0.00E+00	3.69E-05	**1.61E-05**
Measured Total PM	Concentration, C_s	gr/dscf	ND 2.72E-04	ND 2.92E-04	ND 2.50E-04	ND **2.71E-04**
		µg/dscm	ND 623	ND 667	ND 571	ND **621**
	Mass	lb/hr	ND 3.62E-02	ND 3.93E-02	ND 3.37E-02	ND **3.64E-02**
		lb/lb glass	ND 9.93E-05	ND 1.08E-04	ND 9.31E-05	ND **1.00E-04**
Total PM @ Method Detection Limit (7 mg)	Mass	gr/dscf	< 8.14E-04	< 7.99E-04	< 7.99E-04	< **8.04E-04**
		lb/hr	< 1.08E-01	< 1.08E-01	< 1.08E-01	< **1.08E-01**
		lb/lb glass	< 2.97E-04	< 2.97E-04	< 2.98E-04	< **2.97E-04**
Production Data	Glass Production	lbs/hr	364.3	362.7	361.9	**363.0**

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

Oregon Methods 1-5
Example Calculations

Client:	**Hollingsworth and Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:16**
Source:	**CFU 107**	**End Time:**	**11:21**
Method:	**ODEQ 5**	**Date:**	**6/14/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.253 "Hg

where Pb: 29.97 "Hg
ΔH: 3.842 "H_2O

2) Ps = Pb + (Static Press./13.6) = 30.022 "Hg

where Pb: 29.97 "Hg
Static Press.: 0.71 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 132.734 dscf

where Vm: 130.841 dcf
Y: 0.9980
Pm: 30.253 "Hg
Tm: 525.0 °A

4) $V_w(std) = (0.04706)(H_2O)$ = 2.537 scf

where H_2O: 53.90 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0188

where Vw(std): 2.537 scf
Vm(std): 132.734 dscf

6) % H_2O = Bws x 100 = 1.88 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 180.927 awcf

where Y: 0.9980
Vm: 130.8409 dcf
Bws: 0.0188
Ts: 708.3 °A
Tm: 525.0 °A
Pm: 30.253 "Hg
Ps: 30.022 "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 20.01 %vd
N_2+CO= (100-(O_2+CO_2): 79.29 %vd

Client: Hollingsworth and Vose		**Run:**	**1**
Source: CFU 107		**Date:**	**6/14/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.70 lb/lb-mole

where M_d: 28.91 lb/lb-mole

Bws: 0.0188

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 71.70 fps

where Cp: 0.84

Ave. Sqrt ΔP: 1.1012

Ts: 708.3 °A

Ps: 30.022 "Hg

Ms: 28.70 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 21,118.5 AWCFM

where V_s: 71.70 ft/sec

Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 20,721.5 ADCFM

where AWCFM: 21,118.5

Bws: 0.0188

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 947,784.1 wscf/hr

where V_s: 71.70 ft/sec

Stack Area: 4.9090 sq. ft.

Ts: 708.3 °A

Ps: 30.022 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 929,965.8 dscf/hr

where wscf/hr: 947,784.1

Bws: 0.0188

16) DSCFM= (dscf/hr)/60 mins/hr = 15,499.4 DSCFM

where dscf/hr: 929,965.8

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000341 sq. ft.

where Nozzle Size: 0.2502 inches

Client:	**Hollingsworth and Vose**	**Run:**	**1**
Source:	**CFU 107**	**Date:**	**6/14/2018**

18) Isokinetic % $= \left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 102.8 %

where Ts:	708.3	°A
Vm(Std):	132.734	dscf
Ps:	30.022	"Hg
Vs	71.70	ft/sec
Nozzle Area:	0.000341	sq. ft.
Sampling Time:	120	min.
Bws:	0.0188	

ODEQ Method 5:

Front Half:

19) Filterable PM = filter gain + probe rinse gain = 0.00153 grams

where Filter Gain:	0.00000	grams
Probe Rinse:	0.00153	grams

20) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 1.78E-04 gr/dscf

where Sample:	0.00153	grams
Vm(std)	132.734	dscf

21) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 407 µg/dscm

where Sample:	0.00153	grams
Vm(std)	3.759	dscm

22) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 2.36E-02 lb/hr

where Cs:	1.78E-04	gr/dscf
Stack Flow:	929,965.8	dscf/hr

Back Half:

23) Inorganic CPM = water fraction = 0.00054 grams
Organic CPM = acetone BH + hexane BH = 0.00027 grams

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

24) lb/lb glass produced = PM fraction/Glass production = 6.48E-05 lb/lb glass

where glass produced:	364.3	lb/hr
Filterable PM emissions:	2.36E-02	lb/hr

BISON ENGINEERING, INC.

COMPANY	**Hollingsworth & Vose**
FACILITY	**GP1**
LOCATION	**Corvallis, OR**
SOURCE	**CFU 107**
DATE	**06/14/18**
METHOD	**316**
POLLUTANT	**Formaldehyde**

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**1**
Location:	**Corvallis, OR**			**Start Time:**	**9:15**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**11:21**
EPA Method:	**316**	Scattered cloud cover, 54F, calm		**Date:**	**6/14/2018**
Box Operator:	**DS**				
Technician(s):	**CW**				

Stack Dimensional Data:

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

Equipment:

Meterbox ID	13	Probe ID	4A	Liner type	Glass		
Y factor	0.9963	Nozzle ID	0.19	Nozzle size	0.1900	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat	250	F	
				Filter heat	250	F	

Source Information:

Barometric Pressure	29.97	"Hg	O_2	20.01 %
Static Pressure	0.71	"H_2O	CO_2	0.70 %
Ave. ΔP	1.16	"H_2O	Rec. Nz.	0.212 inches
Stack Temperature	255	F		
Assumed moisture	2	%		
Assumed meter temp.	67	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	12

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	72.505	dcf	Ave. ΔP	1.153 "H_2O
Wet mol. weight	28.71	M_s (actual)	Ave. √ΔP	1.0728 "H_2O
Actual H_2O	1.80	%	Ave. ΔH	1.246 "H_2O
Std. meter vol.	72.813	dscf	Ave. T_s	251.2 °F
Isokinetic Average	100.3	%	Ave. T_m	66.1 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	214	14.0
Silica gel, g	242.3	256.6	14.3
		Total water gain:	28.3

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	2.800	0.95	246	60	1.00	1.00	1	251	55
2	10.0	5.510	0.93	248	59	0.97	1.00	1	251	55
3	15.0	8.430	1.10	250	59	1.15	1.20	1	250	53
4	20.0	11.410	1.10	251	60	1.15	1.20	1	250	50
5	25.0	14.370	1.10	250	61	1.15	1.20	1	250	50
6	30.0	17.290	1.10	248	62	1.15	1.20	1	248	51
7	35.0	20.300	1.10	260	63	1.14	1.20	1	248	51
8	40.0	23.430	1.20	251	63	1.26	1.20	1	248	51
9	45.0	26.580	1.30	251	65	1.37	1.40	1	248	52
10	50.0	29.750	1.30	251	65	1.37	1.40	1	248	52
11	55.0	32.900	1.30	252	66	1.37	1.40	1	248	52
12	60.0	36.053	1.30	252	66	1.37	1.40	1	248	52
13	65.0	38.910	1.00	251	66	1.05	1.10	1	248	52
14	70.0	41.860	1.10	251	67	1.16	1.20	1	248	52
15	75.0	44.750	1.00	252	69	1.06	1.10	1	248	52
16	80.0	47.840	1.20	253	69	1.27	1.30	1	248	52
17	85.0	50.830	1.20	253	70	1.27	1.30	1	248	53
18	90.0	53.900	1.20	253	70	1.27	1.30	1	248	55
19	95.0	56.970	1.20	253	71	1.27	1.30	1	248	55
20	100.0	60.050	1.20	250	71	1.28	1.30	1	250	55
21	105.0	63.190	1.20	251	71	1.28	1.30	1	250	57
22	110.0	66.250	1.20	250	71	1.28	1.30	1	250	57
23	115.0	69.370	1.20	250	71	1.28	1.30	1	250	56
24	120.0	72.505	1.20	251	71	1.28	1.30	1	251	58

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**			**Run:**	**2**
Location:	**Corvallis, OR**			**Start Time:**	**11:51**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**		**End Time:**	**13:57**
EPA Method:	**316**	Scattered cloud cover, 54F, calm		**Date:**	**6/14/2018**
Box Operator:	**DS**				
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	4A	Liner type:	Glass		
Y factor	0.9963	Nozzle ID	0.19	Nozzle size:	0.1900	inches	
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000197	sq.ft.	
		Pitot Cp	0.84	Probe heat:	250	F	
				Filter heat:	250	F	

Source Information:

Barometric Pressure	29.97	"Hg	O_2	19.89 %
Static Pressure	0.71	"H_2O	CO_2	0.69 %
Ave. ΔP	1.16	"H_2O	Rec. Nz.	0.212 inches
Stack Temperature	255	F		
Assumed moisture	1.8	%		
Assumed meter temp.	66.1	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	14

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	75.130	dcf	Ave. ΔP	1.213 "H_2O
Wet mol. weight	28.72	M_s (actual)	Ave. √ΔP	1.0993 "H_2O
Actual H_2O	1.72	%	Ave. ΔH	1.304 "H_2O
Std. meter vol.	74.315	dscf	Ave. T_s	255.3 °F
Isokinetic Average	100.2	%	Ave. T_m	74.2 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	210	10.0
Silica gel, g	253.3	270.9	17.6
		Total water gain:	27.6

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	2.840	1.00	251	70	1.07	1.10	1	251	55
2	10.0	5.690	1.00	255	70	1.06	1.10	1	251	55
3	15.0	8.600	1.10	255	71	1.17	1.20	1	251	55
4	20.0	11.620	1.20	255	70	1.27	1.30	1	251	55
5	25.0	14.950	1.30	256	70	1.37	1.40	1	251	52
6	30.0	18.510	1.60	257	70	1.69	1.70	1	251	52
7	35.0	22.050	1.60	258	70	1.69	1.70	1	251	53
8	40.0	25.110	1.20	258	73	1.27	1.30	1	251	53
9	45.0	28.180	1.20	258	73	1.27	1.30	1	251	54
10	50.0	31.260	1.20	257	74	1.28	1.30	1	251	54
11	55.0	34.370	1.20	256	74	1.28	1.30	1	251	54
12	60.0	37.481	1.20	255	74	1.28	1.30	1	251	54
13	65.0	40.510	1.10	253	76	1.18	1.20	1	251	54
14	70.0	43.560	1.10	257	76	1.17	1.20	1	250	54
15	75.0	46.510	1.10	255	76	1.18	1.20	1	250	54
16	80.0	49.500	1.10	255	76	1.18	1.20	1	250	55
17	85.0	52.520	1.20	253	76	1.29	1.20	1	250	55
18	90.0	55.660	1.20	253	77	1.29	1.20	1	250	57
19	95.0	58.900	1.30	254	77	1.40	1.40	1	249	58
20	100.0	62.140	1.30	255	77	1.40	1.40	1	249	58
21	105.0	65.430	1.30	256	76	1.39	1.40	1	249	58
22	110.0	68.650	1.20	256	78	1.29	1.30	1	246	58
23	115.0	71.940	1.20	253	78	1.29	1.30	1	246	58
24	120.0	75.130	1.20	256	78	1.29	1.30	1	256	58

Isokinetic Field Data
Field Data Entry

Client:	**Hollingsworth & Vose**		**Run:**	**3**
Location:	**Corvallis, OR**		**Start Time:**	**14:31**
Source:	**CFU 107**	**Environmental Conditions/Test Notes:**	**End Time:**	**16:36**
EPA Method:	**316**	Scattered cloud cover, 54F, calm	**Date:**	**6/14/2018**
Box Operator:	**DS**			
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	4A	Liner type:	Glass	
Y factor	0.9963	Nozzle ID	0.19	Nozzle size:	0.1900	inches
ΔH@	1.8425	Hot box ID	HB3	Nozzle area:	0.000197	sq.ft.
		Pitot Cp	0.84	Probe heat:	250	F
				Filter heat:	250	F

Source Information:

Barometric Pressure	29.97	"Hg	O_2	19.89 %
Static Pressure	0.71	"H_2O	CO_2	0.69 %
Ave. ΔP	1.16	"H_2O	Rec. Nz.	0.21 inches
Stack Temperature	255	F		
Assumed moisture	1.72	%		
Assumed meter temp.	74.2	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:	13	14

Nozzle check for roundness:

1	2	3	
0.190	0.190	0.190	inches
	Caliper ID#	HLN1	

Post Test Calculations:

Sample volume	74.418	dcf	Ave. ΔP	1.15 "H_2O
Wet mol. weight	28.74	M_s (actual)	Ave. √ΔP	1.0717 "H_2O
Actual H_2O	1.54	%	Ave. ΔH	1.242 "H_2O
Std. meter vol.	72.700	dscf	Ave. T_s	256.3 °F
Isokinetic Average	100.4	%	Ave. T_m	80.8 °F

Moisture/Lab:

Filter	NA #		
	Initial	Final	Gain
Impingers, g	200.0	210	10.0
Silica gel, g	249.4	263.6	14.2
		Total water gain:	24.2

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	2.920	1.00	255	76	1.07	1.10	1	252	55
2	10.0	5.810	1.00	255	77	1.07	1.10	1	252	55
3	15.0	8.820	1.10	255	77	1.18	1.20	1	250	55
4	20.0	11.770	1.10	257	77	1.18	1.20	1	250	55
5	25.0	14.800	1.20	258	77	1.28	1.30	1	250	54
6	30.0	17.950	1.20	256	77	1.29	1.30	1	250	54
7	35.0	21.230	1.20	256	79	1.29	1.30	1	250	54
8	40.0	24.510	1.30	257	79	1.40	1.40	1	250	54
9	45.0	27.670	1.20	257	80	1.29	1.00	1	250	54
10	50.0	30.890	1.20	257	81	1.30	1.40	1	250	54
11	55.0	34.000	1.20	257	82	1.30	1.30	1	250	54
12	60.0	37.196	1.20	257	82	1.30	1.30	1	250	54
13	65.0	40.230	1.10	255	82	1.19	1.20	1	250	54
14	70.0	43.300	1.10	255	83	1.20	1.20	1	250	56
15	75.0	46.300	1.00	256	83	1.09	1.10	1	248	57
16	80.0	49.350	1.10	256	83	1.19	1.20	1	248	57
17	85.0	52.420	1.10	259	84	1.19	1.20	1	248	57
18	90.0	55.730	1.30	259	84	1.41	1.40	1	248	57
19	95.0	58.790	1.10	257	83	1.19	1.20	1	248	57
20	100.0	61.830	1.20	257	83	1.30	1.20	1	248	57
21	105.0	64.990	1.20	256	83	1.30	1.30	1	252	59
22	110.0	68.180	1.20	256	83	1.30	1.30	1	252	60
23	115.0	71.360	1.20	254	82	1.30	1.30	1	252	60
24	120.0	74.418	1.10	253	82	1.20	1.30	1	252	60

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 107**	**End Time:**	**11:21**
Method:	**316**	**Date:**	**6/14/2018**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	2.800	1.00	60	1	0.95	246	0.9747
10	5.510	1.00	59	2	0.93	248	0.9644
15	8.430	1.20	59	3	1.10	250	1.0488
20	11.410	1.20	60	4	1.10	251	1.0488
25	14.370	1.20	61	5	1.10	250	1.0488
30	17.290	1.20	62	6	1.10	248	1.0488
35	20.300	1.20	63	7	1.10	260	1.0488
40	23.430	1.20	63	8	1.20	251	1.0954
45	26.580	1.40	65	9	1.30	251	1.1402
50	29.750	1.40	65	10	1.30	251	1.1402
55	32.900	1.40	66	11	1.30	252	1.1402
60	36.053	1.40	66	12	1.30	252	1.1402
65	38.910	1.10	66	13	1.00	251	1.0000
70	41.860	1.20	67	14	1.10	251	1.0488
75	44.750	1.10	69	15	1.00	252	1.0000
80	47.840	1.30	69	16	1.20	253	1.0954
85	50.830	1.30	70	17	1.20	253	1.0954
90	53.900	1.30	70	18	1.20	253	1.0954
95	56.970	1.30	71	19	1.20	253	1.0954
100	60.050	1.30	71	20	1.20	250	1.0954
105	63.190	1.30	71	21	1.20	251	1.0954
110	66.250	1.30	71	22	1.20	250	1.0954
115	69.370	1.30	71	23	1.20	250	1.0954
120	72.505	1.30	71	24	1.20	251	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Source:	**CFU 107**	**Date:**	**06/14/18**

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	72.505	dcf	Rectangular		
Water Volume	28.3	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	0.70	%vd
Static Pressure	0.71	"H_2O	O_2 Average	20.01	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.246	"H_2O	√Dp	1.0728	"H_2O
Temperature, T_m	66.1	^oF	Temperature, T_s	251.2	^oF
Temperature, T_m	526.1	^oA (^oR)	Temperature, T_s	711.2	^oA (R)
Pressure Meter, P_m	30.062	"Hg	Pressure Stack, P_s	30.022	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	72.813	dscf	Velocity, V_s	69.98	fps
	2.062	dscm	Volume (actual)	20,611.9	awcfm
Actual Volume, $V_{m(actual)}$	99.575	awcf		20,240.9	adcfm
Gas Stream Moisture			Volume (standard)	921,275.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.332	scf		904,692.8	dscf/hr
Moisture, B_{ws}	0.0180			15,078.2	dscf/min
Moisture EPA M4	1.80	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	517.182	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.71	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

CH_2O	285.0	µg/sample		
CH_2O	2.85E-04	grams	MW CH_2O	30.031 g/mole

Emissions:

Concentration, C_s	6.04E-05	gr/dscf
	138.22	µg/dscm
	1.11E-01	ppmvd
Mass Emissions	7.81E-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:**	**11:51**
Source:	**CFU 107**	**End Time:**	**13:57**
Method:	**316**	**Date:**	**06/14/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	2.840	1.10	70	1	1.00	251	1.0000
10	5.690	1.10	70	2	1.00	255	1.0000
15	8.600	1.20	71	3	1.10	255	1.0488
20	11.620	1.30	70	4	1.20	255	1.0954
25	14.950	1.40	70	5	1.30	256	1.1402
30	18.510	1.70	70	6	1.60	257	1.2649
35	22.050	1.70	70	7	1.60	258	1.2649
40	25.110	1.30	73	8	1.20	258	1.0954
45	28.180	1.30	73	9	1.20	258	1.0954
50	31.260	1.30	74	10	1.20	257	1.0954
55	34.370	1.30	74	11	1.20	256	1.0954
60	37.481	1.30	74	12	1.20	255	1.0954
65	40.510	1.20	76	13	1.10	253	1.0488
70	43.560	1.20	76	14	1.10	257	1.0488
75	46.510	1.20	76	15	1.10	255	1.0488
80	49.500	1.20	76	16	1.10	255	1.0488
85	52.520	1.20	76	17	1.20	253	1.0954
90	55.660	1.20	77	18	1.20	253	1.0954
95	58.900	1.40	77	19	1.30	254	1.1402
100	62.140	1.40	77	20	1.30	255	1.1402
105	65.430	1.40	76	21	1.30	256	1.1402
110	68.650	1.30	78	22	1.20	256	1.0954
115	71.940	1.30	78	23	1.20	253	1.0954
120	75.130	1.30	78	24	1.20	256	1.0954

Client:	**Hollingsworth & Vose**	**Run:**	**2**
Source:	**CFU 107**	**Date:**	**06/14/18**

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	75.130	dcf	Rectangular		
Water Volume	27.6	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	0.69	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.89	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.304	"H_2O	√Dp	1.0993	"H_2O
Temperature, T_m	74.2	^oF	Temperature, T_s	255.3	^oF
Temperature, T_m	534.2	^oA (^oR)	Temperature, T_s	715.3	^oA (R)
Pressure Meter, P_m	30.066	"Hg	Pressure Stack, P_s	30.022	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	74.315	dscf	Velocity, V_s	71.90	fps
	2.104	dscm	Volume (actual)	21,177.4	awcfm
Actual Volume, $V_{m(actual)}$	102.131	awcf		20,813.1	adcfm
Gas Stream Moisture			Volume (standard)	941,126.8	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.299	scf		924,939.4	dscf/hr
Moisture, B_{ws}	0.0172			15,415.7	dscf/min
Moisture EPA M4	1.72	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	520.163	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.72	lb/lb-mole			
Percent Isokinetic	100.2	%			

Laboratory Results

CH_2O	308.0	µg/sample		
CH_2O	3.08E-04	grams	MW CH_2O	30.031 g/mole

Emissions:

Concentration, C_s	6.39E-05	gr/dscf
	146.39	µg/dscm
	1.17E-01	ppmvd
Mass Emissions	8.45E-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 107**	**End Time:**	**16:36**
Method:	**316**	**Date:**	**06/14/18**

Sampling Data				Traverse Data			
Time	**Meter**	**ΔH**	**Meter**	**Traverse**	**Dp**	**Stack**	
min.	**ft^3**	**"H_2O**	**T_m °F**	**Point**	**"H_2O**	**T_s °F**	**√Dp**
	0.000						
5	2.920	1.10	76	1	1.00	255	1.0000
10	5.810	1.10	77	2	1.00	255	1.0000
15	8.820	1.20	77	3	1.10	255	1.0488
20	11.770	1.20	77	4	1.10	257	1.0488
25	14.800	1.30	77	5	1.20	258	1.0954
30	17.950	1.30	77	6	1.20	256	1.0954
35	21.230	1.30	79	7	1.20	256	1.0954
40	24.510	1.40	79	8	1.30	257	1.1402
45	27.670	1.00	80	9	1.20	257	1.0954
50	30.890	1.40	81	10	1.20	257	1.0954
55	34.000	1.30	82	11	1.20	257	1.0954
60	37.196	1.30	82	12	1.20	257	1.0954
65	40.230	1.20	82	13	1.10	255	1.0488
70	43.300	1.20	83	14	1.10	255	1.0488
75	46.300	1.10	83	15	1.00	256	1.0000
80	49.350	1.20	83	16	1.10	256	1.0488
85	52.420	1.20	84	17	1.10	259	1.0488
90	55.730	1.40	84	18	1.30	259	1.1402
95	58.790	1.20	83	19	1.10	257	1.0488
100	61.830	1.20	83	20	1.20	257	1.0954
105	64.990	1.30	83	21	1.20	256	1.0954
110	68.180	1.30	83	22	1.20	256	1.0954
115	71.360	1.30	82	23	1.20	254	1.0954
120	74.418	1.30	82	24	1.10	253	1.0488

Client:	**Hollingsworth & Vose**	**Run:**	**3**
Source:	**CFU 107**	**Date:**	**06/14/18**

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	74.418	dcf	Rectangular		
Water Volume	24.2	ml (g)	Width		in
Nozzle Diameter, N_z	0.1900	in.	Length		in
Nozzle Area	0.000197	sq.ft.	Stack Area	4.909	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	29.97	"Hg	CO_2 Average	0.69	%vd
Static Pressure	0.71	"H_2O	O_2 Average	19.89	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	0.9963	Y			

Field Data Averages

Meter			Stack		
ΔH	1.242	"H_2O	√Dp	1.0717	"H_2O
Temperature, T_m	80.8	^oF	Temperature, T_s	256.3	^oF
Temperature, T_m	540.8	^oA (^oR)	Temperature, T_s	716.3	^oA (R)
Pressure Meter, P_m	30.061	"Hg	Pressure Stack, P_s	30.022	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	72.700	dscf	Velocity, V_s	70.12	fps
	2.059	dscm	Volume (actual)	20,653.1	awcfm
Actual Volume, $V_{m(actual)}$	99.869	awcf		20,335.0	adcfm
Gas Stream Moisture			Volume (standard)	916,546.4	wscf/hr
Moisture Vapor, $Vw_{(std)}$	1.139	scf		902,431.6	dscf/hr
Moisture, B_{ws}	0.0154			15,040.5	dscf/min
Moisture EPA M4	1.54	%v			
EPA Method 3 Gas Density			Volume/Mole, V/M	520.89	
Dry, M_d	28.91	lb/lb-mole			
Wet, M_s	28.74	lb/lb-mole			
Percent Isokinetic	100.4	%			

Laboratory Results

CH_2O	297.0	µg/sample			
CH_2O	2.97E-04	grams	MW CH_2O	30.031	g/mole

Emissions:

Concentration, C_s	6.30E-05	gr/dscf
	144.24	µg/dscm
	1.16E-01	ppmvd
Mass Emissions	8.13E-03	lb/hr

"<" represents MDL value

EPA Method 316
Laboratory Results
Formaldehyde

Client: **Hollingsworth & Vose**
Location: **Corvallis, OR** **MDL** 0.0137 µg/mL
Source: **CFU 107**

Lab ID	Sample ID	Sample Date	<	Result	MDL	Sample Vol. (mL)	Units
21	Run 1	6/14/2018		285	6.51	475.0	µg/sample
27	Run 2	6/14/2018		308	6.17	450.0	µg/sample
28	Run 3	6/14/2018		297	6.25	456.0	µg/sample
29	Field Train Blank	6/14/2018	<	MDL	6.44	470.0	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 107**

Run			1	2	3	
Date			6/14/2018	6/14/2018	6/14/2018	
Run Start Time			9:15	11:51	14:31	
Run End Time			11:21	13:57	16:36	
Duration, min.			120	120	120	Average
Barometric Pressure, "Hg			29.97	29.97	29.97	**29.97**
Nozzle Dia., in.			0.1900	0.1900	0.1900	**0.1900**
Isokinetic Average, %			100.3	100.2	100.4	**100.3**
Sample Volume, dscf			72.813	74.315	72.700	**73.276**
Sample Volume, dscm			2.062	2.104	2.059	**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			0.70	0.69	0.69	**0.69**
O_2 %vd			20.01	19.89	19.89	**19.93**
Static Press., "H_2O			0.71	0.71	0.71	**0.71**
H_2O %v			1.80	1.72	1.54	**1.69**
Wet Molecular Weight, lb/lb-mole			28.71	28.72	28.74	**28.72**
Velocity, FPS			69.98	71.90	70.12	**70.67**
ADCFM			20,240.9	20,813.1	20,335.0	**20,463.0**
AWCFM			20,611.9	21,177.4	20,653.1	**20,814.1**
DSCFM			15,078.2	15,415.7	15,040.5	**15,178.1**
Stack Temperature, °F			251.2	255.3	256.3	**254.3**
Formaldehyde	Concentration, C_s	gr/dscf	6.04E-05	6.39E-05	6.30E-05	**6.25E-05**
		µg/dscm	138.2	146.4	144.2	**142.9**
		ppmvd	1.11E-01	1.17E-01	1.16E-01	**1.14E-01**
	Mass	lb/hr	7.81E-03	8.45E-03	8.13E-03	**8.13E-03**
		lb/lb glass	2.14E-05	2.33E-05	2.25E-05	**2.24E-05**
Production Data	Glass Production	lbs/hr	364.3	362.7	361.9	**363.0**

"<" represents MDL value

EPA Methods 1-4, 316
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:15**
Source:	**CFU 107**	**End Time:**	**11:21**
Method:	**316**	**Date:**	**6/14/2018**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6)$ = 30.062 "Hg

where Pb:	29.97	"Hg
ΔH:	1.246	"H_2O

2) Ps = Pb + (Static Press./13.6) = 30.022 "Hg

where Pb:	29.97	"Hg
Static Press.:	0.71	"H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right)$ = 72.813 dscf

where Vm:	72.505	dcf
Y:	0.9963	
Pm:	30.062	"Hg
Tm:	526.1	°A

4) $V_w(std) = (0.04706)(H_2O)$ = 1.332 scf

where H_2O:	28.30	g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right)$ = 0.0180

where Vw(std):	1.332	scf
Vm(std):	72.813	dscf

6) % H_2O = Bws x 100 = 1.80 %v

7) $V_m(actual) = \left(\frac{Y \times Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right)$ = 99.575 awcf

where Y:	0.9963	
Vm:	72.5050	dcf
Bws:	0.0180	
Ts:	711.2	°A
Tm:	526.1	°A
Pm:	30.062	"Hg
Ps:	30.022	"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	20.01	%vd
N_2+CO= (100-(O_2+CO_2):	79.29	%vd

Client: Hollingsworth & Vose **Run: 1**
Source: CFU 107 **Date: 6/14/2018**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.71 lb/lb-mole
where M_d: 28.91 lb/lb-mole
Bws: 0.0180

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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 69.98 fps
where Cp: 0.84
Ave. Sqrt ΔP: 1.0728
Ts: 711.2 °A
Ps: 30.022 "Hg
Ms: 28.71 lb/lb-mole

12) AWCFM = (V_s)(stack area)(60 sec/min) = 20,611.9 AWCFM
where V_s: 69.98 ft/sec
Stack Area: 4.909 sq. ft

13) ADCFM = (AWCFM)(1-Bws) = 20,240.9 ADCFM
where AWCFM: 20,611.9
Bws: 0.0180

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 921,275.8 wscf/hr
where V_s: 69.98 ft/sec
Stack Area: 4.9090 sq. ft.
Ts: 711.2 °A
Ps: 30.022 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 904,692.8 dscf/hr
where wscf/hr: 921,275.8
Bws: 0.0180

16) DSCFM= (dscf/hr)/60 mins/hr = 15,078.2 DSCFM
where dscf/hr: 904,692.8

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000197 sq. ft.
where Nozzle Size: 0.1900 inches

Client: Hollingsworth & Vose		**Run:**	**1**
Source: CFU 107		**Date:**	**6/14/2018**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 100.3 %

where Ts:	711.2	°A
Vm(Std):	72.813	dscf
Ps:	30.022	"Hg
Vs	69.98	ft/sec
Nozzle Area:	0.000197	sq. ft.
Sampling Time:	120	min.
Bws:	0.0180	

EPA Method 316:

19) Formaldehyde laboratory results 285.00000 µg/sample

20) Formaldehyde = (µg/sample)/1,000,000 = 2.85E-04 grams/sample

21) Cs = (Sample grams/Vm(Std))(15.43grains/gram) = 6.04E-05 gr/dscf

where Sample:	0.00029	grams
Vm(std)	72.813	dscf

22) Cs = (Sample grams*1,000,000 µg/gram)/Vm(std) = 138.2 µg/dscm

where Sample:	0.00029	grams
Vm(std)	2.062	dscm

23) Volume/Mole = $\left(\frac{359\frac{ft^3}{lb-mol}@STP\ (Ts)\ (29.92"Hg)}{492°A\ (Ps)}\right)$ = 517.182 Vol./Mole

where Ts:	711.2	°A
Ps:	30.022	"Hg

24) ppmvd = $\left(\frac{\frac{lb}{hr}\ x\ \frac{Vol.}{Mole}}{(MW\ x\ 0.00006\ x\ ADCFM}\right)$ = 1.11E-01 ppmvd

where MW:	30.031	g/mol
lb/hr:	0.01	
Vol./Mole:	517.182	
ADCFM:	20240.9	

25) Mass Emission Rate = (Cs)(Stack flow)/7000gr/lb = 7.81E-03 lb/hr

where Cs:	6.04E-05	gr/dscf
Stack Flow:	904,692.8	dscf/hr

BISON ENGINEERING GASEOUS TESTING SUMMARY

Company	**Hollingsworth & Vose**	Source	**CFU 107**
Facility	**Glass Plant 1**	Date	**June 14, 2018**
Location	**Corvallis, OR**		

Run			1	2	3	
Date			6/14/2018	6/14/2018	6/14/2018	
Run Start Time			9:15	11:51	14:31	
Run End Time			11:21	13:57	16:36	
CO_2 %vd			0.70	0.69	0.69	0.69
O_2 %vd			20.01	19.89	19.89	19.93
WSCFM*			15,796.4	15,971.6	15,988.7	15,918.9
DSCFM*			15,499.4	15,738.4	15,750.5	15,662.8
Nitrogen Oxides	Concentration, C_s	ppmvd	3.57	3.81	3.73	3.70
	Mass	lb/hr	0.40	0.43	0.42	0.42
	Emission Factor	lb/lb glass	1.09E-03	1.18E-03	1.16E-03	1.15E-03
		lb/Mscf nat. gas	8.12E-02	8.56E-02	8.33E-02	8.34E-02
Carbon Monoxide	Concentration, C_s	ppmvd	124.23	125.92	127.36	125.84
	Mass	lb/hr	8.40	8.65	8.75	8.60
	Emission Factor	lb/lb glass	2.31E-02	2.38E-02	2.42E-02	2.37E-02
		lb/Mscf nat. gas	1.72	1.72	1.73	1.72
VOC	Concentration, C_s	ppmvw	0.22	0.25	0.20	0.22
	Mass	lb/hr	2.38E-02	2.74E-02	2.19E-02	2.44E-02
	Emission Factor	lb/lb glass	6.54E-05	7.55E-05	6.06E-05	6.71E-05
		lb/Mscf nat. gas	4.88E-03	5.45E-03	4.34E-03	4.89E-03
Formaldehyde**	Mass	lb/hr	7.81E-03	8.45E-03	8.13E-03	8.13E-03
	Emission Factor	lb/lb glass	2.14E-05	2.33E-05	2.25E-05	2.24E-05
		lb/Mscf nat. gas	1.60E-03	1.68E-03	1.61E-03	1.63E-03
Total VOCs†	Mass	lb/hr	3.16E-02	3.58E-02	3.01E-02	3.25E-02
	Emission Factor	lb/lb glass	8.68E-05	9.88E-05	8.30E-05	8.95E-05
		lb/Mscf nat. gas	6.48E-03	7.14E-03	5.95E-03	6.52E-03

Production Rates	Glass Production	lb/hr	364.3	362.7	361.9	363.0
	Natural Gas Use	scf/hr	4883.2	5019.5	5052.8	4985.2
		Mscf/hr	4.8832	5.0195	5.0528	4.9852

*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 107**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**June 14, 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**		**System Cal Response**	**Post test System Cal. Bias**		**System Drift**		**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
				% of span	**pass/fail**		**% of span**	**pass/fail**	**% of span**	**pass/fail**				
	zero	0.34	0.99	3.25	pass	0.51	0.85	pass	-2.40	pass				
Run 1	upscale	9.78	10.41	3.15	pass	10.00	1.10	pass	-2.05	pass	20	4.13	3.57	10
	zero	0.34	0.51	0.85	pass	0.45	0.55	pass	-0.30	pass				
Run 2	upscale	9.78	10.00	1.10	pass	10.27	2.45	pass	1.35	pass	20	4.16	3.81	10
	zero	0.34	0.45	0.55	pass	0.43	0.45	pass	-0.10	pass				
Run 3	upscale	9.78	10.27	2.45	pass	10.50	3.60	pass	1.15	pass	20	4.15	3.73	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	0.34	9.78	19.87
Analyzer Cal. Error %	1.70	-1.10	-0.65
Analyzer Cal. Error < 2%*	pass	pass	pass

NO2 CONVERTER TEST	
NO2 Tank Value (ppm)	50.41
NO Check Value	50.86
NO2 to NO Conversion %	100.9%
NO2 Conversion > 90%	pass

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

Company:	**Hollingsworth & Vose**	Source:	**CFU 107**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**June 14, 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**		**System Cal Response**	**Post test System Cal. Bias**		**System Drift**		**Analyzer Span**	**Raw Avg Gas Conc**	**Corrected Gas Conc**	**Instrument Cal. Reference Gas**
				% of span	**pass/fail**		**% of span**	**pass/fail**	**% of span**	**pass/fail**				
	zero	-4.04	3.02	2.35	pass	3.72	2.59	pass	0.23	pass				
Run 1	upscale	152.37	150.49	-0.63	pass	150.95	-0.47	pass	0.15	pass	300	125.41	124.23	150
	zero	-4.04	3.72	2.59	pass	4.05	2.70	pass	0.11	pass				
Run 2	upscale	152.37	150.95	-0.47	pass	150.53	-0.61	pass	-0.14	pass	300	127.16	125.92	150
	zero	-4.04	4.05	2.70	pass	3.06	2.37	pass	-0.33	pass				
Run 3	upscale	152.37	150.53	-0.61	pass	150.92	-0.48	pass	0.13	pass	300	128.51	127.36	150
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	150	300
Cal gas analyzer response	-4.04	152.37	300.17
Analyzer Cal. Error	-1.35	0.79	0.06
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 107**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**June 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**	**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**
	zero	-0.01	0.09	0.50	pass	0.11	0.60	pass	0.10	pass				
Run 1	upscale	9.94	9.83	-0.55	pass	9.95	0.05	pass	0.60	pass	20	19.69	20.01	10
	zero	-0.01	0.11	0.60	pass	0.14	0.75	pass	0.15	pass				
Run 2	upscale	9.94	9.95	0.05	pass	9.96	0.10	pass	0.05	pass	20	19.68	19.89	10
	zero	-0.01	0.14	0.75	pass	0.15	0.80	pass	0.05	pass				
Run 3	upscale	9.94	9.96	0.10	pass	9.96	0.10	pass	0.00	pass	20	19.67	19.89	10
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	10	20
Cal gas analyzer response	-0.01	9.94	19.98
Analyzer Cal. Error	-0.05	-0.30	-0.10
Analyzer Cal. Error < 2%*	pass	pass	pass

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

Company:	**Hollingsworth & Vose**	Source	**CFU 107**	Instrument Make:	**Servomex**
Facility:	**Glass Plant 1**	Date	**June 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**	**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**
	zero	0.11	0.09	-0.50	pass	0.09	-0.50	pass	0.00	pass				
Run 1	upscale	1.95	1.92	-0.75	pass	1.95	0.00	pass	0.75	pass	4	0.74	0.70	2
	zero	0.11	0.09	-0.50	pass	0.11	0.00	pass	0.50	pass				
Run 2	upscale	1.95	1.95	0.00	pass	1.97	0.50	pass	0.50	pass	4	0.74	0.69	2
	zero	0.11	0.11	0.00	pass	0.12	0.25	pass	0.25	pass				
Run 3	upscale	1.95	1.97	0.50	pass	1.95	0.00	pass	-0.50	pass	4	0.75	0.69	2
				< 5%*			**< 5%***		**< 3%***					

ANALYZER CAL. ERROR	**Zero**	**Mid**	**High**
Calibration gas standards	0	2	4
Cal gas analyzer response	0.11	1.95	4.17
Analyzer Cal. Error	2.75	-1.25	4.25
Analyzer Cal. Error < 2%*	pass	pass	pass

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 107**	Instrument Make:	**Thermo Environmental**
Facility:	**Glass Plant 1**	Date:	**June 14, 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	0.06	-0.04	pass			
Run 1	upscale	12.49	12.24	-1.00	pass	25	0.22	12.49
	zero	0.07	0.07	0.00	pass			
Run 2	upscale	12.49	12.25	-0.96	pass	25	0.25	12.49
	zero	0.07	0.06	-0.04	pass			
Run 3	upscale	12.49	12.25	-0.96	pass	25	0.20	12.49
				≤ 3%				

Instrument Response Time(s):	
Time 1	120
Time 2	120
Time 3	120
Average:	120

SYSTEM CAL. ERROR	**Zero**	**Low**	**Mid**	**High**
Calibration gas standards	0.07	6.17	12.49	21.26
Calibration gas system response	0.07	6.17	12.49	21.26
Calibration Predicted Response		6.22	12.52	
Calibration Error		0.81	0.23	
Calibration Error < 5% ?	pass	pass	pass	pass

Stratification Check

Facility	Glass Plant 1				
Location	Corvallis, OR		**Date**	6/14/2018	
Source	CFU 107		**Stack Dimensions**	30	inches

3 POINT METHOD

% of diameter		Pt location	O_2 %	Diff (+/- 5%)	Pass/Fail
16.7%	1	5.01	19.68	-0.07%	PASS
50.0%	2	15.00	19.70	0.03%	PASS
83.3%	3	24.99	19.70	0.03%	PASS
		AVERAGE:	19.69		

*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:**	**9:15**
Source:	**CFU 107**	**End Time:**	**11:21**
Method:	**7E**	**Date:**	**6/14/2018**

EPA Methods 7E:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -1.10 %v

where C_{Dir}: 9.78 ppmv
C_V: 10.00 ppmv
CS: 20.00 ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ 3.15 %v

where C_{Dir}: 9.78 ppmv
C_S: 10.41 ppmv
CS: 20.00 ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 2.05 %v

where SB_{Final}: 1.10 ppmv
SB_i: 3.15 ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 3.57 ppmv

where C_{Avg}: 4.13 ppmv
C_O: 0.75 ppmv
C_{MA}: 10.00 ppmv
C_M: 10.21 ppmv

NO_2 - NO Conversion Efficiency

5) $Eff_{NOx} = \left(\frac{C_{Dir}}{C_V}\right) \times 100 =$ 100.9 %v

where C_{Dir}: 50.86 ppmv
C_V: 50.41 ppmv

Emission Rates:

NO_x 1) lb/hr = (Stack Flow) (C) (46) (1.558×10^{-7}) = 0.40 lb/hr

where Stack Flow:	15499.40	DSCFM
C:	3.57	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:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:15**
Source:	**CFU 107**	**End Time:**	**11:21**
Method:	**10**	**Date:**	**6/14/2018**

EPA Methods 10:

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ 0.79 %v

where C_{Dir}:	152.37	ppmv
C_V:	150.00	ppmv
CS:	300.00	ppmv

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.63 %v

where C_{Dir}:	152.37	ppmv
C_S:	150.49	ppmv
CS:	300.00	ppmv

Drift Assessment (Upscale)

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

where SB_{Final}:	-0.47	ppmv
SB_i:	-0.63	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 124.23 ppmv

where C_{Avg}:	125.41	ppmv
C_O:	3.37	ppmv
C_{MA}:	150.00	ppmv
C_M:	150.72	ppmv

Emission Rates:

CO 1) lb/hr = (Stack Flow) (C) (28) (1.558×10^{-7}) = 8.40 lb/hr

where Stack Flow:	15499.40	DSCFM
C:	124.23	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:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:15**
Source:	**CFU 107**	**End Time:**	**11:21**
Method:	**3A**	**Date:**	**6/14/2018**

EPA Method 3A (O_2):

Analyzer Calibration Error (Mid)

1) $ACE = \left(\frac{C_{Dir} - CV}{CS}\right) \times 100 =$ -0.30 %v

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

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.55 %v

where C_{Dir}:	9.94	ppmv
C_S:	9.83	ppmv
CS:	20.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.60 %v

where SB_{Final}:	0.05	ppmv
SB_i:	-0.55	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 20.01 ppmv

where C_{Avg}:	19.69	ppmv
C_O:	0.10	ppmv
C_{MA}:	10.00	ppmv
C_M:	9.89	ppmv

EPA Method 3A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:15**
Source:	**CFU 107**	**End Time:**	**11:21**
Method:	**3A**	**Date:**	**6/14/2018**

EPA Method 3A (CO_2):

EPA Method 3A (CO_2):

Analyzer Calibration Error (Mid)

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

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

System Bias (Upscale)

2) $SB = \left(\frac{C_S - CDir}{CS}\right) \times 100 =$ -0.75 %v

where C_{Dir}:	1.95	ppmv
C_S:	1.92	ppmv
CS:	4.00	ppmv

Drift Assessment (Upscale)

3) $D = | SB_{Final} - SB_i | =$ 0.75 %v

where SB_{Final}:	0.00	ppmv
SB_i:	-0.75	ppmv

Effluent Gas Concentration

4) $C_{Gas} = (C_{Avg} - C_O)\left(\frac{C_{MA}}{C_M - CO}\right) =$ 0.70 ppmv

where C_{Avg}:	0.74	ppmv
C_O:	0.09	ppmv
C_{MA}:	2.00	ppmv
C_M:	1.94	ppmv

EPA Method 25A,
Example Calculations

Client:	**Hollingsworth & Vose**	**Run:**	**1**
Location:	**Corvallis, OR**	**Start Time:**	**9:15**
Source:	**CFU 107**	**End Time:**	**11:21**
Method:	**25A**	**Date:**	**6/14/2018**

EPA Method 25A:

Predicted Low and Mid Level Calibration Response (Mid)

1) $PR = \left(\frac{CR_H - CRZ}{SS}\right) \times CS_M + CR_Z =$ 12.52 ppmv

where CR_H:	21.26 ppmv
CR_Z:	0.07 ppmv
SS:	21.26 ppmv
CS_M:	12.49 ppmv

Calibration Error Test

2) $CET = \left(\frac{SR - PR}{CGV}\right) \times 100 =$ -0.23 %v

where PR:	12.52 ppmv
SR:	12.49 ppmv
CGV	12.49 ppmv

Drift Determination (Mid)

3) $D = \left(\frac{CSR - CSRC}{CSRS}\right) \times 100 =$ 1.00 %v

where CSR:	12.49 ppmv
CSR_C:	12.24 ppmv
AS:	25.00 ppmv

Emission Rates:

VOC 1) lb/hr = (Stack Flow) (C) (44) (1.558×10^{-7}) = 0.02 lb/hr

where Stack Flow:	15499.40	DSCFM
C:	0.22	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

6/14/2018

CFU 107

Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
6/14/2018	7:42:23	21.78	-2.81	0.07	0.98	0.13	50.00						
6/14/2018	7:42:33	20.07	-2.13	0.06	-0.04	0.13	50.00						
6/14/2018	7:42:43	18.42	-1.16	0.06	-0.07	0.13	50.00						
6/14/2018	7:42:53	10.43	-1.46	0.06	-0.08	0.12	50.00						
6/14/2018	7:43:03	1.52	-2.22	0.06	-0.08	0.12	50.00						
6/14/2018	7:43:13	0.55	-3.33	0.06	-0.09	0.12	50.00						
6/14/2018	7:43:23	0.46	-4.02	0.06	-0.10	0.11	50.00						
6/14/2018	7:43:33	0.42	-4.58	0.06	-0.10	0.11	50.00						
6/14/2018	7:43:43	0.40	-3.70	0.06	-0.11	0.11	50.00						
6/14/2018	7:43:53	0.40	-3.02	0.07	-0.06	0.12	50.00						
6/14/2018	7:44:03	0.37	-1.60	0.06	0.00	0.12	50.00						
6/14/2018	7:44:13	0.37	-1.70	0.07	0.00	0.11	50.00						
6/14/2018	7:44:23	0.34	-2.66	0.06	0.00	0.12	50.00						
6/14/2018	7:44:33	0.34	-3.25	0.07	-0.01	0.11	50.00						
6/14/2018	7:44:43	0.34	-4.08	0.07	-0.01	0.11	50.00						
6/14/2018	7:44:53	0.34	-4.21	0.07	-0.01	0.11	50.00						
6/14/2018	7:45:03	0.34	-3.82	0.07	-0.01	0.11	50.00	0.34	-4.04		-0.01	0.11	
6/14/2018	7:45:13	0.34	-2.50	0.06	-0.01	0.11	50.00						
6/14/2018	7:45:23	0.34	-1.51	0.06	-0.02	0.11	50.00						
6/14/2018	7:45:33	0.31	-2.10	0.06	-0.01	0.10	50.00						
6/14/2018	7:45:43	0.31	-2.78	0.07	-0.02	0.11	50.00						
6/14/2018	7:45:53	0.30	-3.59	0.07	0.00	0.10	50.00						
6/14/2018	7:46:03	0.30	-4.34	0.06	7.90	6.07	50.00						
6/14/2018	7:46:13	0.31	-4.33	0.06	19.07	19.36	50.00						
6/14/2018	7:46:23	0.03	-2.47	0.06	19.89	19.63	50.00						
6/14/2018	7:46:33	0.20	-0.44	0.06	19.92	19.64	50.00						
6/14/2018	7:46:43	0.93	-0.92	0.06	19.93	19.67	50.00						
6/14/2018	7:46:53	0.96	-2.85	0.06	19.94	19.67	50.00						
6/14/2018	7:47:03	0.61	-4.90	0.06	19.95	19.67	50.00						
6/14/2018	7:47:13	0.52	-5.92	0.07	19.95	19.67	50.00						
6/14/2018	7:47:23	0.46	-7.14	0.06	19.96	19.69	50.00						

Hollingsworth & Vose

6/14/2018

CFU 107

Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
6/14/2018	7:47:33	0.42	-6.56	0.06	19.97	19.70	50.00						
6/14/2018	7:47:43	0.42	-5.41	0.06	19.97	19.70	50.00						
6/14/2018	7:47:53	0.40	-4.34	0.05	19.97	19.69	50.00						
6/14/2018	7:48:03	0.40	-4.38	0.07	19.98	19.70	50.00						
6/14/2018	7:48:13	0.37	-5.20	0.06	19.98	19.70	50.00						
6/14/2018	7:48:23	0.37	-5.83	0.06	19.98	19.69	50.00						
6/14/2018	7:48:33	0.37	-6.55	0.06	19.98	19.70	50.00						
6/14/2018	7:48:43	0.37	-7.06	0.07	19.98	19.69	50.00						
6/14/2018	7:48:53	0.37	-6.49	0.06	19.98	19.70	50.00				19.98		
6/14/2018	7:49:03	0.34	-4.99	0.06	19.98	19.70	50.00						
6/14/2018	7:49:13	0.34	-4.21	0.07	19.99	19.70	50.00						
6/14/2018	7:49:23	0.34	-4.75	0.07	19.99	19.71	50.00						
6/14/2018	7:49:33	0.34	-5.76	0.06	19.99	19.70	50.00						
6/14/2018	7:49:43	0.34	-6.40	0.06	20.00	19.70	50.00						
6/14/2018	7:49:53	0.34	-4.08	0.06	19.99	19.70	50.00						
6/14/2018	7:50:03	0.34	0.07	0.06	20.00	19.70	50.00						
6/14/2018	7:50:13	0.34	0.90	0.12	19.41	19.65	50.00						
6/14/2018	7:50:23	0.34	2.61	0.19	12.41	10.96	50.00						
6/14/2018	7:50:33	0.34	3.38	0.20	9.98	9.90	50.00						
6/14/2018	7:50:43	0.34	3.74	0.19	9.98	9.90	50.00						
6/14/2018	7:50:53	0.34	3.17	0.21	9.96	9.91	50.00						
6/14/2018	7:51:03	0.31	1.83	0.20	9.95	9.89	50.00						
6/14/2018	7:51:13	0.30	1.05	0.19	9.95	9.88	50.00						
6/14/2018	7:51:23	0.31	0.68	0.17	9.94	9.87	50.00						
6/14/2018	7:51:33	0.31	1.77	0.06	9.95	9.88	50.00						
6/14/2018	7:51:43	0.31	3.17	0.05	9.94	9.86	50.00						
6/14/2018	7:51:53	0.31	3.50	0.06	9.93	9.86	50.00						
6/14/2018	7:52:03	0.31	2.74	0.06	9.94	9.86	50.00				9.94		
6/14/2018	7:52:13	0.31	1.92	0.05	9.93	9.85	50.00						
6/14/2018	7:52:23	0.31	1.25	0.05	9.93	9.84	50.00						
6/14/2018	7:52:33	0.31	0.83	0.06	9.56	9.83	50.00						

Hollingsworth & Vose

6/14/2018

CFU 107

Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
6/14/2018	7:52:43	0.31	1.09	0.18	8.73	9.75	50.00						
6/14/2018	7:52:53	0.31	1.93	0.19	7.53	6.47	50.00						
6/14/2018	7:53:03	0.30	3.85	0.19	2.26	2.05	50.00						
6/14/2018	7:53:13	1.21	4.69	0.19	2.03	2.02	50.00						
6/14/2018	7:53:23	2.18	4.47	0.20	2.02	2.01	50.00						
6/14/2018	7:53:33	1.54	3.37	0.19	2.01	2.01	50.00						
6/14/2018	7:53:43	0.69	2.25	0.19	2.02	2.00	50.00						
6/14/2018	7:53:53	0.57	1.86	0.19	2.02	2.00	50.00						
6/14/2018	7:54:03	0.52	1.84	0.19	2.01	2.00	50.00						
6/14/2018	7:54:13	0.51	3.16	0.19	2.02	1.99	50.00						
6/14/2018	7:54:23	0.49	4.35	0.19	2.01	1.99	50.00						
6/14/2018	7:54:33	0.48	4.58	0.20	2.02	1.99	50.00						
6/14/2018	7:54:43	0.46	3.68	0.18	2.01	1.99	50.00						
6/14/2018	7:54:53	0.45	2.85	0.18	1.94	1.90	50.00						
6/14/2018	7:55:03	0.45	2.35	0.19	0.39	0.23	50.00						
6/14/2018	7:55:13	0.45	2.02	0.18	1.09	1.31	50.00						
6/14/2018	7:55:23	0.45	2.26	0.19	3.91	4.26	50.00						
6/14/2018	7:55:33	0.40	3.24	0.19	3.93	4.13	50.00						
6/14/2018	7:55:43	0.32	4.66	0.19	3.95	4.15	50.00						
6/14/2018	7:55:53	0.31	4.55	0.19	3.96	4.16	50.00						
6/14/2018	7:56:03	0.30	3.41	0.18	3.97	4.17	50.00						
6/14/2018	7:56:13	0.31	2.59	0.19	3.98	4.17	50.00						
6/14/2018	7:56:23	0.30	1.51	0.20	3.99	4.17	50.00					4.17	
6/14/2018	7:56:33	0.31	1.29	0.19	3.99	4.19	50.00						
6/14/2018	7:56:43	0.30	1.60	0.19	4.00	4.18	50.00						
6/14/2018	7:56:53	0.30	2.78	0.19	3.73	3.75	50.00						
6/14/2018	7:57:03	0.28	4.19	0.19	2.33	2.27	50.00						
6/14/2018	7:57:13	0.30	4.14	0.19	2.03	1.97	50.00						
6/14/2018	7:57:23	0.33	3.55	0.19	2.02	1.95	50.00						
6/14/2018	7:57:33	0.41	2.72	0.19	2.01	1.95	50.00						
6/14/2018	7:57:43	0.47	1.81	0.18	2.01	1.95	50.00						

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
6/14/2018	7:57:53	0.46	1.80	0.19	2.01	1.95	50.00						
6/14/2018	7:58:03	0.42	1.94	0.19	2.02	1.95	50.00					1.95	
6/14/2018	7:58:13	0.42	3.38	0.19	1.82	1.94	50.00						
6/14/2018	7:58:23	0.42	4.41	0.19	1.91	1.75	50.00						
6/14/2018	7:58:33	0.42	4.29	0.18	1.31	0.39	50.00						
6/14/2018	7:58:43	0.42	3.81	0.19	1.27	0.42	50.00						
6/14/2018	7:58:53	0.35	2.82	0.20	0.25	0.22	50.00						
6/14/2018	7:59:03	0.28	2.52	0.19	0.06	0.10	50.00						
6/14/2018	7:59:13	0.28	2.35	0.19	0.05	0.09	50.00						
6/14/2018	7:59:23	0.27	2.52	0.19	0.05	0.08	50.00						
6/14/2018	7:59:33	0.28	4.26	0.19	0.05	0.09	50.00						
6/14/2018	7:59:43	0.28	5.31	0.19	0.05	0.09	50.00						
6/14/2018	7:59:53	0.25	5.07	0.19	0.05	0.09	50.00						
6/14/2018	8:00:03	0.25	4.27	0.19	0.09	0.09	50.00						
6/14/2018	8:00:13	0.25	3.50	0.18	1.66	1.71	50.00						
6/14/2018	8:00:23	0.25	2.88	0.19	3.76	0.56	50.00						
6/14/2018	8:00:33	0.73	2.43	0.19	3.44	0.24	50.00						
6/14/2018	8:00:43	1.20	2.73	0.20	0.83	0.11	50.00						
6/14/2018	8:00:53	1.22	3.74	0.19	0.10	0.08	50.00						
6/14/2018	8:01:03	1.25	5.11	0.19	0.07	0.07	50.00						
6/14/2018	8:01:13	0.83	5.46	0.20	0.07	0.08	50.00						
6/14/2018	8:01:23	0.35	4.32	0.19	0.49	0.13	50.00						
6/14/2018	8:01:33	0.28	3.59	0.19	0.18	0.08	50.00						
6/14/2018	8:01:43	0.28	3.06	0.20	0.16	0.09	50.00						
6/14/2018	8:01:53	0.30	2.42	0.19	0.16	0.09	50.00						
6/14/2018	8:02:03	0.36	2.78	0.19	0.16	0.10	50.00						
6/14/2018	8:02:13	0.37	3.84	0.19	0.16	0.10	50.00						
6/14/2018	8:02:23	0.34	5.31	0.13	0.08	0.08	50.00						
6/14/2018	8:02:33	0.41	5.52	0.06	0.09	0.08	50.00						
6/14/2018	8:02:43	0.56	4.59	0.06	0.09	0.09	50.00						
6/14/2018	8:02:53	0.49	3.85	0.05	0.09	0.09	50.00						

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
6/14/2018	8:03:03	0.38	3.47	0.06	0.09	0.10	50.00						
6/14/2018	8:03:13	2.52	2.98	0.06	0.23	0.14	50.00						
6/14/2018	8:03:23	4.84	4.34	0.07	0.11	0.09	50.00						
6/14/2018	8:03:33	6.08	10.38	0.79	0.06	0.08	50.00						
6/14/2018	8:03:43	6.32	18.74	3.72	0.05	0.07	50.00						
6/14/2018	8:03:53	12.07	24.12	3.73	0.05	0.07	50.00						
6/14/2018	8:04:03	19.06	25.62	3.71	0.05	0.08	50.00						
6/14/2018	8:04:13	19.85	25.38	3.72	0.06	0.07	50.00						
6/14/2018	8:04:23	19.94	24.59	3.72	0.06	0.08	50.00						
6/14/2018	8:04:33	19.87	24.37	3.72	0.05	0.07	50.00						
6/14/2018	8:04:43	19.81	24.88	3.72	0.06	0.08	50.00	19.87					
6/14/2018	8:04:53	19.73	25.97	1.61	0.05	0.07	50.00						
6/14/2018	8:05:03	19.64	27.53	1.37	0.06	0.08	50.00						
6/14/2018	8:05:13	19.60	27.19	1.38	0.06	0.07	50.00						
6/14/2018	8:05:23	19.60	26.54	1.38	0.05	0.07	50.00						
6/14/2018	8:05:33	19.57	25.62	1.38	0.06	0.07	50.00						
6/14/2018	8:05:43	19.54	24.52	1.38	0.05	0.07	50.00						
6/14/2018	8:05:53	19.51	24.55	1.38	0.06	0.07	50.00						
6/14/2018	8:06:03	19.45	24.60	0.90	0.06	0.06	50.00						
6/14/2018	8:06:13	19.42	25.76	0.59	0.05	0.07	50.00						
6/14/2018	8:06:23	19.39	27.26	0.58	0.06	0.07	50.00						
6/14/2018	8:06:33	19.41	27.21	0.59	0.06	0.07	50.00						
6/14/2018	8:06:43	19.78	26.61	0.58	0.06	0.07	50.00						
6/14/2018	8:06:53	19.80	25.48	0.59	0.05	0.07	50.00						
6/14/2018	8:07:03	19.83	25.06	0.59	0.06	0.07	50.00						
6/14/2018	8:07:13	19.81	24.56	0.48	0.05	0.07	50.00						
6/14/2018	8:07:23	19.78	24.35	0.19	0.05	0.08	50.00						
6/14/2018	8:07:33	19.77	25.61	0.19	0.06	0.07	50.00						
6/14/2018	8:07:43	19.74	26.98	0.19	0.06	0.07	50.00						
6/14/2018	8:07:53	19.74	27.20	0.20	0.05	0.07	50.00						
6/14/2018	8:08:03	19.74	25.85	0.18	0.06	0.07	50.00						

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6/14/2018	8:08:13	19.72	23.09	0.19	0.06	0.07	50.00						
6/14/2018	8:08:23	19.92	18.45	0.19	0.06	0.07	50.00						
6/14/2018	8:08:33	15.70	15.16	0.06	0.06	0.07	50.00						
6/14/2018	8:08:43	10.40	13.80	0.06	0.06	0.07	50.00						
6/14/2018	8:08:53	9.79	15.10	0.06	0.06	0.07	50.00						
6/14/2018	8:09:03	9.73	16.12	0.06	0.06	0.08	50.00						
6/14/2018	8:09:13	9.72	16.17	0.06	0.06	0.08	50.00						
6/14/2018	8:09:23	9.69	15.09	0.07	0.06	0.08	50.00						
6/14/2018	8:09:33	9.70	14.17	0.06	0.06	0.07	50.00						
6/14/2018	8:09:43	9.78	13.74	0.07	0.06	0.08	50.00						
6/14/2018	8:09:53	9.78	13.41	0.06	0.05	0.08	50.00						
6/14/2018	8:10:03	9.78	13.71	0.05	0.06	0.08	50.00						
6/14/2018	8:10:13	9.78	14.93	0.06	0.06	0.08	50.00						
6/14/2018	8:10:23	9.78	15.99	0.06	0.05	0.08	50.00						
6/14/2018	8:10:33	9.78	16.29	0.06	0.07	0.08	50.00						
6/14/2018	8:10:43	9.78	15.19	0.06	0.09	0.07	50.00	9.78					
6/14/2018	8:10:53	9.75	14.18	0.12	0.08	0.08	50.00						
6/14/2018	8:11:03	9.73	18.56	0.19	0.29	0.09	50.00						
6/14/2018	8:11:13	9.77	57.80	0.20	0.22	0.08	50.00						
6/14/2018	8:11:23	10.31	151.96	0.19	0.09	0.08	50.00						
6/14/2018	8:11:33	57.90	244.21	0.20	0.07	0.08	50.00						
6/14/2018	8:11:43	95.88	300.26	0.19	0.07	0.08	50.00						
6/14/2018	8:11:53	99.86	317.23	0.19	0.07	0.07	50.00						
6/14/2018	8:12:03	99.90	319.02	0.18	0.08	0.07	50.00						
6/14/2018	8:12:13	99.90	318.58	0.05	0.07	0.07	50.00						
6/14/2018	8:12:23	99.90	317.72	0.06	0.08	0.07	50.00						
6/14/2018	8:12:33	99.90	317.16	0.06	0.07	0.08	50.00						
6/14/2018	8:12:43	99.90	318.25	0.06	0.07	0.08	50.00						
6/14/2018	8:12:53	99.90	320.02	0.06	0.08	0.07	50.00						
6/14/2018	8:13:03	99.90	321.57	0.05	0.08	0.07	50.00						
6/14/2018	8:13:13	99.90	320.91	0.06	0.08	0.07	50.00						

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6/14/2018	8:13:23	99.90	319.69	0.05	0.08	0.08	50.00						
6/14/2018	8:13:33	99.90	315.01	0.05	0.08	0.07	50.00						
6/14/2018	8:13:43	99.90	299.09	0.05	0.09	0.07	50.00						
6/14/2018	8:13:53	99.90	299.08	0.07	0.08	0.07	50.00						
6/14/2018	8:14:03	99.90	299.53	0.06	0.08	0.08	50.00						
6/14/2018	8:14:13	99.90	301.91	0.06	0.08	0.08	50.00		300.17				
6/14/2018	8:14:23	99.90	303.33	0.05	0.08	0.07	50.00						
6/14/2018	8:14:33	99.90	301.90	0.06	0.07	0.07	50.00						
6/14/2018	8:14:43	99.90	289.02	0.05	0.07	0.07	50.00						
6/14/2018	8:14:53	99.90	242.49	0.06	0.07	0.07	50.00						
6/14/2018	8:15:03	99.90	194.99	0.06	0.07	0.08	50.00						
6/14/2018	8:15:13	99.90	163.32	0.05	0.07	0.07	50.00						
6/14/2018	8:15:23	99.90	154.06	0.06	0.07	0.06	50.00						
6/14/2018	8:15:33	99.90	153.88	0.07	0.07	0.07	50.00						
6/14/2018	8:15:43	99.90	155.16	0.06	0.07	0.07	50.00						
6/14/2018	8:15:53	99.90	155.06	0.06	0.07	0.07	50.00						
6/14/2018	8:16:03	99.90	153.94	0.05	0.07	0.07	50.00						
6/14/2018	8:16:13	99.90	153.36	0.06	0.07	0.06	50.00						
6/14/2018	8:16:23	99.90	152.27	0.06	0.07	0.07	50.00						
6/14/2018	8:16:33	99.90	152.25	0.05	0.08	0.07	50.00						
6/14/2018	8:16:43	99.90	152.58	0.05	0.09	0.07	50.00		152.37				
6/14/2018	8:16:53	99.90	153.58	0.06	0.27	0.07	50.00						
6/14/2018	8:17:03	99.90	146.00	0.06	14.80	0.07	50.00						
6/14/2018	8:17:13	99.90	117.78	0.06	20.69	0.06	50.00						
6/14/2018	8:17:23	99.90	70.93	0.07	20.92	0.07	50.00						
6/14/2018	8:17:33	99.90	31.84	0.06	20.92	0.06	50.00						
6/14/2018	8:17:43	56.69	10.94	0.06	20.93	0.07	50.00						
6/14/2018	8:17:53	51.49	3.80	0.06	20.51	0.07	50.00						
6/14/2018	8:18:03	50.93	3.14	0.06	20.97	0.07	50.00						
6/14/2018	8:18:13	50.91	3.79	0.06	20.98	0.06	50.00						
6/14/2018	8:18:23	50.93	4.59	0.07	20.98	0.07	50.00						

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6/14/2018	8:18:33	50.91	4.53	0.06	20.97	0.06	50.00						
6/14/2018	8:18:43	50.85	3.53	0.06	20.92	0.06	50.00	NO2 conversion					
6/14/2018	8:18:53	50.81	3.19	0.06	19.04	0.07	50.00	50.86					
6/14/2018	8:19:03	50.78	7.05	0.05	18.36	0.07	50.00						
6/14/2018	8:19:13	49.26	27.26	0.05	18.38	0.06	50.00						
6/14/2018	8:19:23	47.58	57.55	0.54	18.08	0.06	50.00						
6/14/2018	8:19:33	46.72	83.32	1.65	18.01	0.07	50.00						
6/14/2018	8:19:43	45.94	98.69	1.65	17.94	0.07	50.00						
6/14/2018	8:19:53	45.36	105.96	1.65	17.87	0.08	50.00						
6/14/2018	8:20:03	44.81	110.13	1.65	17.80	0.08	50.00						
6/14/2018	8:20:13	39.79	112.86	1.64	17.73	0.07	50.00						
6/14/2018	8:20:23	34.23	114.69	1.65	17.67	0.07	50.00						
6/14/2018	8:20:33	24.81	115.32	1.65	16.14	0.08	50.00						
System													
6/14/2018	8:20:43	15.13	116.53	0.46	9.62	0.41	50.00						
6/14/2018	8:20:53	30.31	124.01	0.46	17.10	0.62	50.00						
6/14/2018	8:21:03	47.60	129.14	0.47	9.40	0.36	50.00						
6/14/2018	8:21:13	34.75	130.44	0.47	4.31	0.21	50.00						
6/14/2018	8:21:23	15.64	133.15	0.45	2.01	0.13	50.00						
6/14/2018	8:21:33	53.55	138.20	0.47	0.99	0.09	50.00						
6/14/2018	8:21:43	95.71	143.48	0.46	0.53	0.09	50.00						
6/14/2018	8:21:53	99.90	147.52	0.47	0.33	0.08	50.00						
6/14/2018	8:22:03	99.90	149.60	0.46	0.24	0.08	50.00						
6/14/2018	8:22:13	99.90	151.84	0.46	0.15	0.09	50.00						
6/14/2018	8:22:23	99.90	153.62	0.47	0.12	0.08	50.00						
6/14/2018	8:22:33	99.90	154.01	0.46	0.11	0.07	50.00						
6/14/2018	8:22:43	99.90	153.25	0.46	0.11	0.09	50.00						
6/14/2018	8:22:53	99.90	151.84	0.47	0.09	0.09	50.00						
6/14/2018	8:23:03	99.90	151.02	0.31	0.09	0.08	30.00						

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
6/14/2018	8:23:13	99.90	150.37	0.06	0.09	0.09	-0.01						
6/14/2018	8:23:23	99.90	150.06	0.06	0.09	0.08	-0.01						
6/14/2018	8:23:33	99.90	151.03	0.06	0.09	0.09	-0.01		150.49		0.09	0.09	
6/14/2018	8:23:43	99.90	152.62	0.05	0.09	0.08	-0.01						
6/14/2018	8:23:53	99.90	153.38	0.06	0.09	0.08	-0.01						
6/14/2018	8:24:03	99.90	152.44	0.06	0.18	0.08	-0.01						
6/14/2018	8:24:13	99.90	151.60	0.05	5.78	0.30	-0.01						
6/14/2018	8:24:23	99.90	149.35	0.06	12.86	0.53	-0.01						
6/14/2018	8:24:33	99.90	145.27	0.06	16.50	0.63	-0.01						
6/14/2018	8:24:43	94.27	139.34	0.06	18.23	0.68	-0.01						
6/14/2018	8:24:53	65.34	135.05	0.07	13.87	0.53	-0.01						
6/14/2018	8:25:03	30.09	132.10	0.06	6.87	0.32	-0.01						
6/14/2018	8:25:13	33.06	123.92	0.06	3.29	0.20	-0.01						
6/14/2018	8:25:23	37.42	104.60	0.06	1.60	0.14	-0.01						
6/14/2018	8:25:33	32.49	77.44	0.28	0.80	0.11	40.00						
6/14/2018	8:25:43	29.33	51.45	0.33	0.43	0.11	50.00						
6/14/2018	8:25:53	23.44	32.49	0.34	0.26	0.09	50.00						
6/14/2018	8:26:03	16.25	21.51	0.33	0.17	0.09	50.00						
6/14/2018	8:26:13	13.80	16.66	0.34	0.13	0.09	50.00						
6/14/2018	8:26:23	11.69	14.84	0.33	0.11	0.09	50.00						
6/14/2018	8:26:33	11.63	14.93	0.32	0.10	0.09	50.00						
6/14/2018	8:26:43	11.62	14.35	0.19	0.09	0.08	25.00						
6/14/2018	8:26:53	12.02	13.77	0.06	0.09	0.09	-0.01						
6/14/2018	8:27:03	12.59	13.32	0.05	0.09	0.08	-0.01						
6/14/2018	8:27:13	12.57	13.24	0.06	0.09	0.09	-0.01						
6/14/2018	8:27:23	12.50	13.03	0.07	0.09	0.09	-0.01						
6/14/2018	8:27:33	12.37	13.01	0.06	0.09	0.09	-0.01						
6/14/2018	8:27:43	12.23	14.62	0.05	0.08	0.10	-0.01						
6/14/2018	8:27:53	12.08	15.68	0.06	0.09	0.09	-0.01						
6/14/2018	8:28:03	11.95	15.09	0.06	0.09	0.09	-0.01						
6/14/2018	8:28:13	11.81	14.56	0.05	0.08	0.09	-0.01						

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6/14/2018	8:28:23	11.66	13.57	0.06	0.08	0.09	-0.01						
6/14/2018	8:28:33	11.57	13.45	0.06	0.08	0.09	-0.01						
6/14/2018	8:28:43	11.48	12.80	0.06	0.08	0.09	-0.01						
6/14/2018	8:28:53	11.36	12.84	0.06	0.08	0.09	-0.01						
6/14/2018	8:29:03	11.27	14.62	0.06	0.08	0.09	-0.01						
6/14/2018	8:29:13	11.20	15.55	0.06	0.08	0.09	-0.01						
6/14/2018	8:29:23	11.12	15.20	0.06	0.08	0.09	-0.01						
6/14/2018	8:29:33	11.05	14.47	0.05	0.08	0.09	-0.01						
6/14/2018	8:29:43	11.00	13.58	0.06	0.08	0.09	-0.01						
6/14/2018	8:29:53	10.93	12.92	0.06	0.07	0.09	-0.01						
6/14/2018	8:30:03	10.87	12.50	0.06	0.09	0.09	-0.01						
6/14/2018	8:30:13	10.85	12.75	0.06	0.08	0.10	-0.01						
6/14/2018	8:30:23	10.79	13.62	0.07	0.08	0.09	-0.01						
6/14/2018	8:30:33	10.73	14.86	0.06	0.08	0.09	-0.01						
6/14/2018	8:30:43	10.67	15.36	0.06	0.08	0.10	-0.01						
6/14/2018	8:30:53	10.66	14.83	0.07	0.08	0.10	-0.01						
6/14/2018	8:31:03	10.64	13.73	0.06	0.08	0.09	-0.01						
6/14/2018	8:31:13	10.62	13.27	0.06	0.08	0.10	-0.01						
6/14/2018	8:31:23	10.59	12.54	0.06	0.08	0.10	-0.01						
6/14/2018	8:31:33	10.55	13.06	0.07	0.07	0.10	-0.01						
6/14/2018	8:31:43	10.52	14.04	0.07	0.08	0.10	-0.01						
6/14/2018	8:31:53	10.50	15.20	0.06	0.08	0.09	-0.01						
6/14/2018	8:32:03	10.47	15.20	0.06	0.08	0.10	-0.01						
6/14/2018	8:32:13	10.43	14.44	0.06	0.08	0.10	-0.01						
6/14/2018	8:32:23	10.41	13.93	0.05	3.70	0.23	-0.01						
6/14/2018	8:32:33	10.40	17.07	0.05	11.01	0.47	-0.01	10.41					
6/14/2018	8:32:43	10.51	31.48	0.06	7.75	0.35	-0.01						
6/14/2018	8:32:53	8.90	47.38	0.06	3.76	0.32	-0.01						
6/14/2018	8:33:03	7.19	49.62	0.06	2.62	1.03	-0.01						
6/14/2018	8:33:13	5.20	40.00	0.07	2.31	1.48	-0.01						
6/14/2018	8:33:23	3.03	26.30	0.06	2.18	1.70	-0.01						

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6/14/2018	8:33:33	2.39	15.35	0.06	2.12	1.81	-0.01						
6/14/2018	8:33:43	1.87	8.76	0.05	2.10	1.86	-0.01						
6/14/2018	8:33:53	1.63	5.14	0.06	2.09	1.90	-0.01						
6/14/2018	8:34:03	1.37	3.79	0.06	2.09	1.93	-0.01						
6/14/2018	8:34:13	1.26	2.49	0.07	2.08	1.95	-0.01						
6/14/2018	8:34:23	1.15	2.51	0.06	2.08	1.95	-0.01						
6/14/2018	8:34:33	1.11	3.89	0.06	2.10	1.96	-0.01						
6/14/2018	8:34:43	1.05	4.35	0.06	1.92	1.95	-0.01						
6/14/2018	8:34:53	1.02	4.36	0.07	1.84	1.93	-0.01						
6/14/2018	8:35:03	0.99	3.62	0.06	1.84	1.93	-0.01						
6/14/2018	8:35:13	0.99	2.94	0.06	1.84	1.93	-0.01						
6/14/2018	8:35:23	0.99	2.50	0.07	1.84	1.91	-0.01	0.99	3.02			1.92	
6/14/2018	8:35:33	1.04	2.08	0.06	1.84	1.92	-0.01						
6/14/2018	8:35:43	1.05	2.38	0.07	4.23	2.62	-0.01						
6/14/2018	8:35:53	2.64	3.93	0.06	9.84	9.92	-0.01						
6/14/2018	8:36:03	4.45	4.72	0.06	9.92	9.76	-0.01						
6/14/2018	8:36:13	5.41	4.80	0.06	9.84	9.91	-0.01						
6/14/2018	8:36:23	6.28	3.98	0.05	9.93	9.78	-0.01						
6/14/2018	8:36:33	7.11	3.18	0.07	9.82	9.81	-0.01						
6/14/2018	8:36:43	7.95	2.85	0.06	9.84	9.71	-0.01						
6/14/2018	8:36:53	8.67	2.72	0.06	9.84	9.91	-0.01				9.83		
6/14/2018	8:37:03	9.38	2.63	0.06	3.84	2.09	-0.01						
6/14/2018	8:37:13	10.08	3.87	0.07	1.85	1.90	-0.01						
6/14/2018	8:37:23	10.75	4.90	0.06	1.84	1.89	-0.01						
6/14/2018	8:37:33	11.38	5.35	0.06	1.84	1.89	-0.01						
6/14/2018	8:37:43	12.00	4.90	0.06	1.85	1.82	40.00						
6/14/2018	8:37:53	12.54	3.90	0.06	1.85	1.72	50.00						
6/14/2018	8:38:03	13.08	3.62	0.06	1.85	1.65	50.00						
6/14/2018	8:38:13	13.56	3.00	0.05	1.85	1.59	50.00						
6/14/2018	8:38:23	14.02	2.85	0.05	1.85	1.53	50.00						
6/14/2018	8:38:33	14.49	3.70	0.06	1.86	1.47	50.00						

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6/14/2018	8:38:43	14.97	5.24	0.06	1.86	1.41	50.00						
6/14/2018	8:38:53	15.36	5.76	0.05	1.86	1.36	50.00						
6/14/2018	8:39:03	15.73	5.05	0.06	1.86	1.31	50.00						
6/14/2018	8:39:13	16.17	4.86	0.05	1.86	1.27	50.00						
6/14/2018	8:39:23	16.62	3.97	0.06	1.86	1.22	50.00						
6/14/2018	8:39:33	16.90	3.42	0.05	1.87	1.19	50.00						
6/14/2018	8:39:43	17.17	3.41	0.06	1.87	1.14	50.00						
6/14/2018	8:39:53	17.45	3.73	0.05	1.87	1.10	50.00						
6/14/2018	8:40:03	17.72	5.51	0.06	1.87	1.06	50.00						
6/14/2018	8:40:13	18.00	6.45	0.05	1.87	1.03	50.00						
6/14/2018	8:40:23	18.30	5.55	0.06	1.87	0.99	50.00						
6/14/2018	8:40:33	18.54	4.88	0.07	1.88	0.96	50.00						
6/14/2018	8:40:43	18.75	4.20	0.06	1.88	0.92	50.00						
6/14/2018	8:40:53	18.98	3.40	0.07	1.88	0.89	50.00						
6/14/2018	8:41:03	19.22	3.45	0.07	1.88	0.86	50.00						
6/14/2018	8:41:13	19.43	3.56	0.06	1.88	0.84	50.00						
6/14/2018	8:41:23	19.64	4.69	0.06	1.88	0.79	50.00						
6/14/2018	8:41:33	19.78	6.01	0.06	1.89	0.77	50.00						
6/14/2018	8:41:43	19.93	6.08	0.06	1.90	0.74	50.00						
6/14/2018	8:41:53	20.11	5.40	0.06	1.90	0.72	50.00						
6/14/2018	8:42:03	20.25	4.53	0.06	1.91	0.69	50.00						
6/14/2018	8:42:13	20.43	4.01	0.06	1.92	0.67	50.00						
6/14/2018	8:42:23	20.61	3.50	0.06	1.94	0.65	50.00						
6/14/2018	8:42:33	20.76	3.61	0.14	1.96	0.64	50.00						
6/14/2018	8:42:43	20.89	4.25	0.19	1.98	0.61	50.00						
6/14/2018	8:42:53	20.99	5.77	0.20	2.01	0.59	50.00						
6/14/2018	8:43:03	21.05	6.45	0.19	2.05	0.58	50.00						
6/14/2018	8:43:13	21.16	5.78	0.20	2.10	0.56	50.00						
6/14/2018	8:43:23	21.31	4.82	0.20	2.15	0.54	50.00						
6/14/2018	8:43:33	21.43	4.04	0.19	2.20	0.53	50.00						
6/14/2018	8:43:43	21.53	3.87	0.14	2.27	0.51	50.00						

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6/14/2018	8:43:53	21.62	3.47	0.07	2.34	0.49	50.00						
6/14/2018	8:44:03	21.68	4.10	0.06	2.43	0.48	50.00						
6/14/2018	8:44:13	21.80	5.81	0.05	2.57	0.56	50.00						
6/14/2018	8:44:23	21.91	6.36	0.07	3.50	1.72	50.00						
6/14/2018	8:44:33	22.00	5.74	0.05	2.61	1.28	50.00						
6/14/2018	8:44:43	22.18	4.62	0.07	1.31	0.64	50.00						
6/14/2018	8:44:53	13.50	3.27	0.07	0.73	0.34	50.00						
6/14/2018	8:45:03	3.92	2.89	0.06	0.50	0.21	50.00						
6/14/2018	8:45:13	2.32	2.25	0.06	0.40	0.14	50.00						
6/14/2018	8:45:23	1.52	2.54	0.06	0.36	0.12	50.00						
6/14/2018	8:45:33	1.32	3.83	0.07	0.34	0.11	50.00						
6/14/2018	8:45:43	1.21	4.72	0.06	0.34	0.10	50.00						
6/14/2018	8:45:53	1.19	4.50	0.06	0.33	0.10	50.00						
6/14/2018	8:46:03	1.17	3.66	0.07	0.33	0.10	50.00						
6/14/2018	8:46:13	1.16	3.11	8.40	0.33	0.10	50.00						
6/14/2018	8:46:23	1.14	2.44	11.96	0.33	0.10	50.00						
6/14/2018	8:46:33	1.13	2.06	11.97	0.33	0.10	50.00						
6/14/2018	8:46:43	1.13	2.10	11.96	0.33	0.09	50.00						
6/14/2018	8:46:53	1.13	3.25	11.96	0.33	0.09	50.00						
6/14/2018	8:47:03	1.11	4.33	11.96	0.33	0.09	50.00						
6/14/2018	8:47:13	1.11	4.88	11.97	0.33	0.09	50.00						
6/14/2018	8:47:23	1.11	4.13	12.00	0.33	0.09	50.00						
6/14/2018	8:47:33	1.10	3.27	12.09	0.33	0.10	50.00						
6/14/2018	8:47:43	1.10	2.37	12.08	0.33	0.09	50.00						
6/14/2018	8:47:53	1.11	2.33	12.09	0.33	0.10	50.00						
6/14/2018	8:48:03	1.08	1.91	12.09	0.33	0.10	50.00						
6/14/2018	8:48:13	1.08	2.43	12.09	0.33	0.10	50.00						
6/14/2018	8:48:23	1.08	3.82	12.08	0.33	0.10	50.00						
6/14/2018	8:48:33	1.08	4.82	12.08	0.32	0.10	50.00						
6/14/2018	8:48:43	1.08	4.32	12.09	0.33	0.09	50.00						
6/14/2018	8:48:53	1.08	3.72	12.09	0.33	0.09	50.00						

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6/14/2018	8:49:03	1.08	2.85	12.08	0.33	0.10	50.00						
6/14/2018	8:49:13	1.08	2.28	12.08	0.32	0.09	50.00						
6/14/2018	8:49:23	1.08	2.21	12.09	0.33	0.10	50.00						
6/14/2018	8:49:33	1.08	1.92	12.09	0.25	0.10	50.00						
6/14/2018	8:49:43	1.08	2.76	12.08	0.36	0.23	50.00						
6/14/2018	8:49:53	0.97	4.31	12.08	1.26	0.30	50.00						
6/14/2018	8:50:03	0.86	4.64	12.09	1.74	0.18	50.00						
6/14/2018	8:50:13	1.03	4.09	12.09	1.94	0.13	50.00						
6/14/2018	8:50:23	1.21	3.27	12.09	2.03	0.10	50.00						
6/14/2018	8:50:33	1.30	2.40	12.08	2.06	0.10	50.00						
6/14/2018	8:50:43	1.39	1.74	12.09	2.09	0.10	50.00						
6/14/2018	8:50:53	1.40	1.91	12.09	2.09	0.09	50.00						
6/14/2018	8:51:03	1.40	2.43	42.33	2.10	0.10	50.00						
6/14/2018	8:51:13	1.40	3.88	87.69	2.10	0.09	50.00						
6/14/2018	8:51:23	1.38	4.66	87.69	2.11	0.09	50.00						
6/14/2018	8:51:33	1.35	4.23	87.70	2.11	0.09	50.00						
6/14/2018	8:51:43	1.31	3.75	87.69	2.11	0.09	50.00						
6/14/2018	8:51:53	1.29	2.86	87.69	2.11	0.10	50.00						
6/14/2018	8:52:03	1.25	2.43	87.69	2.12	0.10	50.00						
6/14/2018	8:52:13	1.23	2.07	87.69	2.12	0.10	50.00						
6/14/2018	8:52:23	1.20	1.94	87.69	2.11	0.09	50.00						
6/14/2018	8:52:33	1.17	3.40	87.68	2.12	0.10	50.00						
6/14/2018	8:52:43	1.14	4.64	87.70	2.12	0.10	50.00						
6/14/2018	8:52:53	1.11	4.57	87.69	2.12	0.10	50.00						
6/14/2018	8:53:03	1.08	4.13	87.69	2.11	0.09	50.00						
6/14/2018	8:53:13	1.05	3.27	87.70	2.12	0.09	50.00						
6/14/2018	8:53:23	1.05	2.46	87.70	2.12	0.10	50.00						
6/14/2018	8:53:33	1.02	2.33	87.69	2.12	0.10	50.00						
6/14/2018	8:53:43	0.99	1.83	87.69	2.12	0.10	50.00						
6/14/2018	8:53:53	0.99	2.26	87.69	2.12	0.10	50.00						
6/14/2018	8:54:03	0.96	3.83	87.68	2.12	0.10	50.00						

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6/14/2018	8:54:13	0.96	4.52	87.69	2.12	0.09	50.00						
6/14/2018	8:54:23	0.93	4.84	87.69	2.12	0.09	50.00						
6/14/2018	8:54:33	0.93	3.86	87.69	2.12	0.10	50.00						
6/14/2018	8:54:43	0.90	2.87	87.69	2.12	0.10	50.00						
6/14/2018	8:54:53	0.90	2.84	97.19	2.12	0.10	41.29						
6/14/2018	8:55:03	0.87	2.18	99.55	2.12	0.10	330.60						
6/14/2018	8:55:13	0.88	1.95	99.56	2.12	0.10	766.03						
6/14/2018	8:55:23	0.87	2.75	99.55	2.12	0.11	4031.72						
6/14/2018	8:55:33	0.85	4.33	99.57	2.12	0.10	766.04						
6/14/2018	8:55:43	0.84	4.95	99.56	2.12	0.10	403.18						
6/14/2018	8:55:53	0.84	4.41	99.56	2.12	0.10	403.18						
6/14/2018	8:56:03	0.81	3.35	99.55	2.12	0.10	403.17						
6/14/2018	8:56:13	0.81	2.73	99.55	2.12	0.10	403.18						
6/14/2018	8:56:23	0.81	2.34	99.57	2.12	0.10	403.18						
6/14/2018	8:56:33	0.78	1.89	99.55	2.12	0.09	403.18						
6/14/2018	8:56:43	0.78	2.31	99.56	2.12	0.10	403.18						
6/14/2018	8:56:53	0.78	3.16	99.56	2.12	0.11	403.17						
6/14/2018	8:57:03	0.78	4.96	99.55	2.12	0.10	403.17						
6/14/2018	8:57:13	0.78	4.51	99.56	2.12	0.10	403.17						
6/14/2018	8:57:23	0.78	3.79	99.56	2.12	0.10	403.17						
6/14/2018	8:57:33	0.76	3.24	99.55	2.12	0.11	403.17						
6/14/2018	8:57:43	0.75	2.27	99.56	2.12	0.11	403.18						
6/14/2018	8:57:53	0.75	2.16	99.57	2.12	0.11	403.17						
6/14/2018	8:58:03	0.75	2.05	99.56	2.12	0.11	403.19						
6/14/2018	8:58:13	0.75	2.71	99.56	2.12	0.11	403.30						
6/14/2018	8:58:23	0.73	4.27	99.56	2.12	0.11	403.30						
6/14/2018	8:58:33	0.73	4.56	99.55	2.12	0.10	403.31						
6/14/2018	8:58:43	0.72	4.15	99.56	2.12	0.11	403.30						
6/14/2018	8:58:53	0.73	3.56	99.56	2.12	0.10	403.29						
6/14/2018	8:59:03	0.73	2.65	99.56	2.12	0.11	403.30						
6/14/2018	8:59:13	0.72	2.48	99.56	2.12	0.10	403.31						

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6/14/2018	8:59:23	0.72	2.12	99.50	2.12	0.10	403.22						
6/14/2018	8:59:33	0.73	2.01	99.43	2.12	0.10	403.17						
6/14/2018	8:59:43	0.70	3.33	99.43	2.12	0.11	403.17						
6/14/2018	8:59:53	0.72	4.47	99.44	1.82	0.11	403.18						
6/14/2018	9:00:03	0.72	4.83	99.43	0.90	0.11	403.17						
6/14/2018	9:00:13	0.70	3.92	99.44	0.54	0.11	403.17						
6/14/2018	9:00:23	0.67	3.21	99.43	0.41	0.11	403.18						
6/14/2018	9:00:33	0.81	2.61	99.38	0.36	0.10	403.09						
6/14/2018	9:00:43	0.96	2.18	99.18	0.34	0.10	402.91						
6/14/2018	9:00:53	0.99	2.12	99.17	0.34	0.11	402.91						
6/14/2018	9:01:03	0.99	2.10	99.17	0.33	0.10	402.91						
6/14/2018	9:01:13	0.99	3.92	99.17	0.33	0.10	402.92						
6/14/2018	9:01:23	0.96	4.66	99.18	0.33	0.10	402.91						
6/14/2018	9:01:33	0.93	4.60	99.17	0.33	0.10	402.92						
6/14/2018	9:01:43	0.93	3.68	99.17	0.33	0.10	402.92						
6/14/2018	9:01:53	0.93	2.92	12.36	0.33	0.12	49.41						
6/14/2018	9:02:03	0.90	2.30	12.35	0.33	0.11	49.41						
6/14/2018	9:02:13	0.90	2.19	12.36	0.33	0.11	49.40						
6/14/2018	9:02:23	0.90	2.04	12.36	0.33	0.10	49.41						
6/14/2018	9:02:33	0.90	2.57	12.36	0.32	0.10	49.41						
6/14/2018	9:02:43	0.88	4.06	12.38	0.33	0.10	49.40						
6/14/2018	9:02:53	0.87	4.84	12.38	0.30	0.10	49.41						49.41
6/14/2018	9:03:03	0.87	4.41	12.27	0.18	0.11	49.33						
6/14/2018	9:03:13	0.85	3.62	12.24	0.13	0.10	49.31						
6/14/2018	9:03:23	0.82	2.64	12.25	1.59	0.16	49.30						
6/14/2018	9:03:33	0.73	3.84	12.24	7.45	0.38	49.30						
6/14/2018	9:03:43	0.62	12.81	12.23	4.11	0.24	49.30						
6/14/2018	9:03:53	1.22	24.12	12.24	1.71	0.15	49.31						
6/14/2018	9:04:03	1.94	27.19	12.24	0.73	0.13	49.30						
6/14/2018	9:04:13	1.49	23.09	7.80	0.34	0.12	31.29						
6/14/2018	9:04:23	0.93	15.12	1.12	0.19	0.10	4.26						

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Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
6/14/2018	9:04:33	0.77	8.62	1.13	0.13	0.11	4.26						
6/14/2018	9:04:43	0.65	5.33	1.12	0.09	0.10	4.26						
6/14/2018	9:04:53	0.61	3.93	1.12	0.24	0.10	4.26						
6/14/2018	9:05:03	0.58	2.98	1.13	1.06	0.13	4.26						
6/14/2018	9:05:13	0.68	3.47	1.12	1.62	0.16	4.26						
6/14/2018	9:05:23	0.77	6.00	1.12	2.74	0.13	3.83						
6/14/2018	9:05:33	0.86	9.45	0.07	3.73	0.11	-0.08						
6/14/2018	9:05:43	0.95	10.05	0.06	4.16	0.10	-0.08						
6/14/2018	9:05:53	0.88	8.36	0.05	4.33	0.10	-0.08						
6/14/2018	9:06:03	0.79	5.36	0.06	4.41	0.10	-0.09						
6/14/2018	9:06:13	0.76	3.92	0.07	4.44	0.10	-0.09						
6/14/2018	9:06:23	0.70	3.14	0.07	4.45	0.10	-0.08			0.07			-0.09
6/14/2018	9:06:33	0.69	2.19	0.07	4.46	0.10	-0.08						
6/14/2018	9:06:43	0.69	2.60	15.90	4.46	0.09	0.87						
6/14/2018	9:06:53	0.69	3.78	19.86	4.46	0.09	1.11						
6/14/2018	9:07:03	0.67	5.02	19.86	4.46	0.09	1.11						
6/14/2018	9:07:13	0.66	4.57	19.86	4.46	0.10	1.10						
6/14/2018	9:07:23	0.66	3.96	19.86	4.46	0.09	1.10						
6/14/2018	9:07:33	0.66	3.31	19.87	4.46	0.10	1.10						
6/14/2018	9:07:43	0.66	2.20	19.87	4.46	0.09	1.10						
6/14/2018	9:07:53	0.66	2.34	20.42	4.46	0.09	0.64						
6/14/2018	9:08:03	0.67	2.06	21.26	4.46	0.10	0.18						
6/14/2018	9:08:13	0.66	2.72	21.26	4.46	0.09	0.18						
6/14/2018	9:08:23	0.64	4.43	21.27	4.37	0.09	0.17						
6/14/2018	9:08:33	0.66	4.89	21.27	3.46	0.09	0.18						
6/14/2018	9:08:43	0.66	4.50	21.25	2.96	0.09	0.18						
6/14/2018	9:08:53	0.64	3.48	21.26	2.77	0.09	0.18						
6/14/2018	9:09:03	0.63	2.85	21.26	2.70	0.09	0.16						
6/14/2018	9:09:13	0.63	2.46	21.27	2.68	0.09	0.04						
6/14/2018	9:09:23	0.63	2.01	21.26	2.66	0.09	0.04			21.26			
6/14/2018	9:09:33	0.63	2.82	21.26	2.65	0.09	0.05						

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Daily Calibrations

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	CH4 [PPM]
6/14/2018	9:09:43	0.63	4.24	21.26	2.65	0.08	0.05						
6/14/2018	9:09:53	0.63	4.80	21.26	2.65	0.09	0.05						
6/14/2018	9:10:03	0.63	4.07	21.26	2.65	0.09	0.05						
6/14/2018	9:10:13	0.63	3.48	21.26	2.64	0.09	0.05						
6/14/2018	9:10:23	0.64	2.80	14.25	2.65	0.08	0.05						
6/14/2018	9:10:33	0.63	2.11	12.49	2.65	0.10	0.05						
6/14/2018	9:10:43	0.63	2.04	12.50	2.65	0.09	0.05						
6/14/2018	9:10:53	0.63	2.09	12.50	2.64	0.09	0.05						
6/14/2018	9:11:03	0.63	3.64	12.49	2.15	0.09	0.05						
6/14/2018	9:11:13	0.61	4.83	12.49	1.69	0.09	0.05						
6/14/2018	9:11:23	0.61	4.65	12.49	1.48	0.10	0.05						
6/14/2018	9:11:33	0.68	3.67	12.49	1.40	0.09	0.05			12.49			
6/14/2018	9:11:43	0.79	3.27	12.49	1.37	0.09	0.05						
6/14/2018	9:11:53	0.79	2.73	12.49	1.36	0.09	0.05						
6/14/2018	9:12:03	0.76	2.15	12.50	1.35	0.09	0.05						
6/14/2018	9:12:13	0.75	2.55	12.50	1.35	0.09	0.05						
6/14/2018	9:12:23	0.73	3.73	12.50	1.34	0.09	0.05						
6/14/2018	9:12:33	0.72	4.77	12.50	1.35	0.09	0.04						
6/14/2018	9:12:43	0.72	4.53	11.24	1.35	0.09	0.05						
6/14/2018	9:12:53	0.72	3.62	6.16	1.35	0.09	0.05						
6/14/2018	9:13:03	0.72	3.12	6.16	1.35	0.09	0.05						
6/14/2018	9:13:13	0.69	2.26	6.18	1.35	0.09	0.05						
6/14/2018	9:13:23	0.69	1.86	6.16	1.34	0.09	0.05						
6/14/2018	9:13:33	0.69	2.66	6.16	3.47	0.18	0.05			6.17			

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Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	O2 [%]
6/14/2018	9:16:47	4.07	124.05	0.45	19.68	0.74	Begin Stratification check
6/14/2018	9:17:47	4.05	123.81	0.33	19.69	0.74	
6/14/2018	9:18:47	4.04	123.10	0.44	19.69	0.74	
6/14/2018	9:19:47	4.06	123.05	0.38	19.68	0.74	
6/14/2018	9:20:47	4.14	127.12	0.27	19.68	0.74	19.68
6/14/2018	9:21:47	4.18	128.17	0.22	19.69	0.73	
6/14/2018	9:22:47	4.12	124.49	0.33	19.70	0.73	
6/14/2018	9:23:47	4.10	122.42	0.46	19.70	0.73	
6/14/2018	9:24:47	4.10	123.07	0.46	19.70	0.73	
6/14/2018	9:25:47	4.05	120.64	0.39	19.70	0.73	19.70
6/14/2018	9:26:47	4.04	119.06	0.34	19.70	0.73	
6/14/2018	9:27:47	4.09	122.87	0.32	19.69	0.73	
6/14/2018	9:28:47	4.15	126.43	0.19	19.70	0.74	
6/14/2018	9:29:47	4.16	126.59	0.32	19.70	0.74	
6/14/2018	9:30:47	4.19	127.80	0.33	19.70	0.74	19.70
6/14/2018	9:31:47	4.22	128.32	0.26	19.69	0.74	
6/14/2018	9:32:47	4.22	129.10	0.23	19.69	0.74	
6/14/2018	9:33:47	4.21	128.15	0.32	19.69	0.75	
6/14/2018	9:34:47	4.13	123.97	0.06	19.71	0.74	
6/14/2018	9:35:47	4.08	121.46	0.16	19.71	0.74	
6/14/2018	9:36:47	4.07	122.21	0.28	19.70	0.75	
6/14/2018	9:37:47	4.13	125.81	0.33	19.70	0.75	
6/14/2018	9:38:47	4.14	124.81	0.33	19.70	0.75	
6/14/2018	9:39:47	4.11	122.89	0.33	19.70	0.74	
6/14/2018	9:40:47	4.14	125.50	0.33	19.69	0.74	
6/14/2018	9:41:47	4.28	131.78	0.42	19.69	0.75	
6/14/2018	9:42:47	4.26	130.53	0.39	19.69	0.74	
6/14/2018	9:43:47	4.21	128.30	0.33	19.69	0.74	
6/14/2018	9:44:47	4.17	126.73	0.33	19.69	0.74	
6/14/2018	9:45:47	4.18	126.76	0.34	19.69	0.74	
6/14/2018	9:46:47	4.17	127.53	0.34	19.69	0.73	
6/14/2018	9:47:47	4.12	126.51	0.24	19.71	0.73	
6/14/2018	9:48:47	4.07	124.30	0.26	19.70	0.73	
6/14/2018	9:49:47	4.06	122.93	0.33	19.70	0.73	
6/14/2018	9:50:47	4.00	120.92	0.33	19.69	0.73	
6/14/2018	9:51:47	4.06	124.05	0.06	19.69	0.74	
6/14/2018	9:52:47	4.11	126.93	0.28	19.68	0.74	
6/14/2018	9:53:47	4.14	128.35	0.33	19.69	0.74	
6/14/2018	9:54:47	4.07	124.52	0.34	19.69	0.74	
6/14/2018	9:55:47	4.06	123.14	0.33	19.69	0.74	
6/14/2018	9:56:47	4.14	128.08	0.33	19.69	0.75	
6/14/2018	9:57:47	4.19	129.52	0.33	19.69	0.75	
6/14/2018	9:58:47	4.13	127.22	0.14	19.69	0.75	
6/14/2018	9:59:47	4.17	128.01	0.20	19.69	0.75	
6/14/2018	10:00:47	4.14	125.28	0.34	19.69	0.75	
6/14/2018	10:01:47	4.07	123.58	0.34	19.69	0.75	
6/14/2018	10:02:47	4.14	126.85	0.34	19.69	0.75	
6/14/2018	10:03:47	4.10	124.59	0.21	19.69	0.75	
6/14/2018	10:04:47	4.07	123.97	0.20	19.69	0.74	

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Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	O2 [%]
6/14/2018	10:05:47	4.15	128.42	0.26	19.68	0.75	
6/14/2018	10:06:47	4.16	128.43	0.34	19.68	0.75	
6/14/2018	10:07:47	4.13	126.05	0.34	19.68	0.74	
6/14/2018	10:08:47	4.14	128.45	0.07	19.69	0.73	
6/14/2018	10:09:47	4.12	126.23	0.16	19.69	0.73	
6/14/2018	10:10:47	4.10	126.23	0.27	19.70	0.73	
6/14/2018	10:11:47	4.05	122.98	0.34	19.70	0.73	
6/14/2018	10:12:47	4.03	123.79	0.34	19.69	0.73	
6/14/2018	10:13:47	4.05	125.09	0.34	19.68	0.74	
6/14/2018	10:14:47	4.04	123.10	0.34	19.69	0.74	
6/14/2018	10:15:47	4.11	121.05	0.33	19.69	0.73	
6/14/2018	10:16:47	4.12	121.27	0.33	19.70	0.73	
6/14/2018	10:17:47	4.11	123.57	0.33	19.68	0.74	
6/14/2018	10:18:47	4.14	124.66	0.33	19.68	0.74	
6/14/2018	10:19:47	4.14	125.95	0.19	19.68	0.74	
6/14/2018	10:20:47	4.16	127.10	0.20	19.68	0.75	
6/14/2018	10:21:47	4.16	126.10	0.28	19.68	0.75	
6/14/2018	10:22:47	4.14	125.00	0.28	19.69	0.75	
6/14/2018	10:23:47	4.11	125.37	0.18	19.69	0.75	
6/14/2018	10:24:47	4.10	123.23	0.07	19.68	0.75	
6/14/2018	10:25:47	4.11	123.48	0.06	19.68	0.75	
6/14/2018	10:26:47	4.10	124.63	0.06	19.68	0.75	
6/14/2018	10:27:47	4.12	124.66	0.21	19.68	0.75	
6/14/2018	10:28:47	4.13	124.13	0.34	19.69	0.75	
6/14/2018	10:29:47	4.14	125.87	0.33	19.68	0.74	
6/14/2018	10:30:47	4.19	127.11	0.20	19.67	0.74	
6/14/2018	10:31:47	4.21	126.80	0.08	19.67	0.74	
6/14/2018	10:32:47	4.19	127.01	0.06	19.68	0.73	
6/14/2018	10:33:47	4.16	125.78	0.06	19.68	0.73	
6/14/2018	10:34:47	4.14	123.81	0.09	19.69	0.73	
6/14/2018	10:35:47	4.12	123.99	0.20	19.68	0.73	
6/14/2018	10:36:47	4.10	123.90	0.06	19.68	0.73	
6/14/2018	10:37:47	4.10	122.79	0.06	19.68	0.73	
6/14/2018	10:38:47	4.16	125.95	0.06	19.67	0.73	
6/14/2018	10:39:47	4.19	126.72	0.11	19.68	0.73	
6/14/2018	10:40:47	4.19	125.24	0.20	19.67	0.73	
6/14/2018	10:41:47	4.22	128.60	0.20	19.67	0.74	
6/14/2018	10:42:47	4.24	128.22	0.08	19.68	0.74	
6/14/2018	10:43:47	4.18	124.16	0.06	19.68	0.74	
6/14/2018	10:44:47	4.15	123.95	0.12	19.69	0.74	
6/14/2018	10:45:47	4.18	124.39	0.20	19.69	0.74	
6/14/2018	10:46:47	4.16	122.44	0.19	19.69	0.75	
6/14/2018	10:47:47	4.18	125.25	0.19	19.68	0.75	
6/14/2018	10:48:47	4.19	126.57	0.20	19.68	0.75	
6/14/2018	10:49:47	4.20	125.68	0.20	19.68	0.74	
6/14/2018	10:50:47	4.13	125.02	0.20	19.69	0.74	
6/14/2018	10:51:47	4.17	125.71	0.17	19.68	0.74	
6/14/2018	10:52:47	4.18	125.32	0.06	19.68	0.74	
6/14/2018	10:53:47	4.16	126.86	0.06	19.68	0.74	

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Run #1

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	O2 [%]
6/14/2018	10:54:47	4.17	126.39	0.07	19.68	0.73	
6/14/2018	10:55:47	4.14	125.00	0.13	19.68	0.73	
6/14/2018	10:56:47	4.15	126.51	0.24	19.69	0.72	
6/14/2018	10:57:47	4.13	126.33	0.32	19.69	0.72	
6/14/2018	10:58:47	4.18	127.33	0.07	19.68	0.72	
6/14/2018	10:59:47	4.21	129.29	0.06	19.67	0.72	
6/14/2018	11:00:47	4.17	127.39	0.05	19.68	0.73	
6/14/2018	11:01:47	4.11	124.32	0.17	19.69	0.72	
6/14/2018	11:02:47	4.14	125.40	0.30	19.69	0.73	
6/14/2018	11:03:47	4.15	126.49	0.19	19.68	0.73	
6/14/2018	11:04:47	4.13	126.50	0.05	19.68	0.73	
6/14/2018	11:05:47	4.12	124.58	0.05	19.68	0.73	
6/14/2018	11:06:47	4.09	124.46	0.13	19.68	0.74	
6/14/2018	11:07:47	4.11	124.22	0.15	19.68	0.74	
6/14/2018	11:08:47	4.08	122.77	0.09	19.68	0.74	
6/14/2018	11:09:47	4.13	126.67	0.33	19.68	0.74	
6/14/2018	11:10:47	4.11	126.01	0.20	19.68	0.74	
6/14/2018	11:11:47	4.13	124.79	0.19	19.68	0.74	
6/14/2018	11:12:47	4.14	125.28	0.13	19.68	0.74	
6/14/2018	11:13:47	4.19	126.45	0.09	19.69	0.74	
6/14/2018	11:14:47	4.19	126.92	0.18	19.69	0.74	
6/14/2018	11:15:47	4.17	127.66	0.06	19.69	0.74	
6/14/2018	11:16:47	4.16	127.13	0.06	19.68	0.74	
6/14/2018	11:17:47	4.14	124.95	0.06	19.68	0.73	
6/14/2018	11:18:47	4.11	125.22	0.06	19.68	0.73	
6/14/2018	11:19:47	4.07	122.83	0.06	19.69	0.72	
6/14/2018	11:20:47	4.12	124.47	0.06	19.68	0.73	
6/14/2018	11:21:47	4.13	125.41	0.18	19.68	0.72	
	FINAL	**4.13**	**125.41**	**0.22**	**19.69**	**0.74**	

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R-1 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	11:24:17	4.17	126.90	0.19	18.44	0.67					
6/14/2018	11:24:27	4.18	123.85	0.19	9.84	0.39					
6/14/2018	11:24:37	4.19	110.31	0.19	4.05	0.22					
6/14/2018	11:24:47	3.85	85.38	0.19	1.70	0.14					
6/14/2018	11:24:57	2.50	56.07	0.19	0.76	0.11					
6/14/2018	11:25:07	1.44	32.55	0.18	0.40	0.10					
6/14/2018	11:25:17	1.03	17.76	0.19	0.25	0.10					
6/14/2018	11:25:27	0.70	9.94	1.39	0.18	0.09					
6/14/2018	11:25:37	0.61	5.68	1.52	0.15	0.09					
6/14/2018	11:25:47	0.54	3.76	1.51	0.14	0.09					
6/14/2018	11:25:57	0.54	2.67	1.52	0.14	0.08					
6/14/2018	11:26:07	0.54	2.93	1.52	0.14	0.09					
6/14/2018	11:26:17	0.51	4.01	1.52	0.13	0.09					
6/14/2018	11:26:27	0.51	4.08	1.52	0.13	0.09					
6/14/2018	11:26:37	0.52	3.31	0.79	0.13	0.10					
6/14/2018	11:26:47	0.52	2.64	0.06	0.12	0.09					
6/14/2018	11:26:57	0.52	1.93	0.07	0.13	0.09					
6/14/2018	11:27:07	0.52	1.47	0.06	0.12	0.09					
6/14/2018	11:27:17	0.52	1.21	0.06	0.12	0.09					
6/14/2018	11:27:27	0.52	1.38	0.07	0.12	0.10					
6/14/2018	11:27:37	0.52	2.46	0.06	0.12	0.09					
6/14/2018	11:27:47	0.52	3.75	0.06	0.12	0.09					
6/14/2018	11:27:57	0.51	4.00	0.06	0.12	0.09					
6/14/2018	11:28:07	0.51	3.41	0.07	0.12	0.09					
6/14/2018	11:28:17	0.51	2.52	0.06	0.12	0.09					
6/14/2018	11:28:27	0.51	2.04	0.07	0.12	0.09					
6/14/2018	11:28:37	0.51	1.63	0.05	0.10	0.09					
6/14/2018	11:28:47	0.51	1.36	0.05	0.11	0.09					

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R-1 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	11:28:57	0.51	1.46	0.07	0.11	0.09					
6/14/2018	11:29:07	0.51	2.34	0.06	0.11	0.09					
6/14/2018	11:29:17	0.51	3.70	0.06	0.11	0.09					
6/14/2018	11:29:27	0.51	4.09	0.07	0.11	0.09					
6/14/2018	11:29:37	0.51	3.37	0.06	0.10	0.10	0.51	3.72	0.06	0.11	0.09
6/14/2018	11:29:47	0.51	2.80	0.06	0.40	0.10					
6/14/2018	11:29:57	0.51	2.20	0.07	1.58	0.09					
6/14/2018	11:30:07	0.58	1.77	0.07	2.18	0.10					
6/14/2018	11:30:17	0.90	1.44	0.06	2.44	0.09					
6/14/2018	11:30:27	1.04	1.64	0.06	2.55	0.09					
6/14/2018	11:30:37	0.84	2.81	0.06	2.60	0.10					
6/14/2018	11:30:47	0.71	4.03	0.06	2.62	0.10					
6/14/2018	11:30:57	0.65	4.02	0.06	2.63	0.09					
6/14/2018	11:31:07	0.59	3.23	0.05	2.64	0.09					
6/14/2018	11:31:17	0.57	2.65	0.06	2.64	0.09					
6/14/2018	11:31:27	0.58	2.08	4.82	2.65	0.10					
6/14/2018	11:31:37	0.58	1.49	11.96	2.65	0.10					
6/14/2018	11:31:47	0.58	1.28	11.95	2.65	0.10					
6/14/2018	11:31:57	0.56	1.52	11.96	2.65	0.10					
6/14/2018	11:32:07	0.54	3.13	11.97	2.65	0.10					
6/14/2018	11:32:17	0.54	4.07	11.95	2.66	0.10					
6/14/2018	11:32:27	0.54	3.70	11.95	2.65	0.10					
6/14/2018	11:32:37	0.54	2.91	11.99	2.66	0.10					
6/14/2018	11:32:47	0.54	2.37	12.24	2.66	0.10					
6/14/2018	11:32:57	0.54	1.82	12.24	2.65	0.11					
6/14/2018	11:33:07	0.54	1.30	12.25	2.65	0.09					
6/14/2018	11:33:17	0.54	1.45	12.23	2.66	0.10					
6/14/2018	11:33:27	0.54	3.11	12.23	5.19	0.22			12.24		

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R-1 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	11:33:37	0.53	8.16	12.24	8.78	0.37					
6/14/2018	11:33:47	0.75	18.66	12.24	4.24	0.23					
6/14/2018	11:33:57	1.54	26.43	12.34	2.23	0.43					
6/14/2018	11:34:07	1.89	25.37	12.38	2.15	1.20					
6/14/2018	11:34:17	1.28	18.00	12.36	2.09	1.61					
6/14/2018	11:34:27	0.99	10.16	12.37	2.07	1.77					
6/14/2018	11:34:37	1.49	5.66	12.36	2.05	1.86					
6/14/2018	11:34:47	1.74	4.81	12.36	2.05	1.91					
6/14/2018	11:34:57	1.42	4.61	12.37	2.05	1.93					
6/14/2018	11:35:07	1.15	3.83	6.94	2.05	1.94					
6/14/2018	11:35:17	0.98	3.04	1.52	2.05	1.95					
6/14/2018	11:35:27	0.83	2.26	1.52	2.05	1.95					
6/14/2018	11:35:37	0.76	1.42	1.51	2.05	1.95					
6/14/2018	11:35:47	0.72	0.96	1.53	2.05	1.95					
6/14/2018	11:35:57	0.68	0.89	1.53	2.05	1.96					1.95
6/14/2018	11:36:07	0.66	2.08	1.52	2.05	1.96					
6/14/2018	11:36:17	0.65	3.14	1.24	2.05	1.96					
6/14/2018	11:36:27	0.64	3.06	0.06	2.05	1.97					
6/14/2018	11:36:37	0.63	2.29	0.05	2.61	1.91					
6/14/2018	11:36:47	0.61	3.27	0.06	9.83	1.41					
6/14/2018	11:36:57	0.58	14.63	0.06	13.29	2.11					
6/14/2018	11:37:07	0.87	33.93	0.06	11.31	6.21					
6/14/2018	11:37:17	2.07	45.86	0.05	10.50	8.29					
6/14/2018	11:37:27	2.66	43.60	0.07	10.16	9.17					
6/14/2018	11:37:37	1.75	32.06	0.06	10.03	9.52					
6/14/2018	11:37:47	1.06	19.74	0.07	9.98	9.67					
6/14/2018	11:37:57	0.82	10.49	0.05	9.96	9.73					
6/14/2018	11:38:07	0.63	5.18	0.06	9.95	9.76					

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	11:38:17	0.59	2.42	0.05	9.95	9.78					
6/14/2018	11:38:27	0.53	1.04	0.06	9.95	9.78				9.95	
6/14/2018	11:38:37	0.51	0.56	0.06	9.95	9.79					
6/14/2018	11:38:47	0.52	0.98	0.07	9.95	9.79					
6/14/2018	11:38:57	0.51	1.97	0.06	10.08	9.66					
6/14/2018	11:39:07	0.52	3.57	0.06	12.73	6.63					
6/14/2018	11:39:17	0.50	10.67	0.06	8.32	3.81					
6/14/2018	11:39:27	0.69	19.68	0.06	3.57	1.62					
6/14/2018	11:39:37	1.42	24.26	0.06	1.49	0.80					
6/14/2018	11:39:47	2.90	22.60	0.07	0.67	0.44					
6/14/2018	11:39:57	6.27	18.16	0.06	0.34	0.28					
6/14/2018	11:40:07	8.76	15.50	0.06	0.20	0.21					
6/14/2018	11:40:17	9.60	15.10	0.06	0.15	0.16					
6/14/2018	11:40:27	10.36	14.88	0.06	0.13	0.15					
6/14/2018	11:40:37	10.56	13.92	0.06	0.12	0.14					
6/14/2018	11:40:47	10.73	12.79	0.06	0.11	0.14					
6/14/2018	11:40:57	10.73	12.13	0.05	0.11	0.13					
6/14/2018	11:41:07	10.73	11.88	0.06	0.10	0.12					
6/14/2018	11:41:17	10.73	11.59	0.07	0.10	0.12					
6/14/2018	11:41:27	10.72	12.36	0.06	0.10	0.12					
6/14/2018	11:41:37	10.69	13.61	0.06	0.09	0.11					
6/14/2018	11:41:47	10.66	14.34	0.05	0.09	0.10					
6/14/2018	11:41:57	10.63	13.62	0.06	0.10	0.11					
6/14/2018	11:42:07	10.59	12.70	0.06	0.09	0.11					
6/14/2018	11:42:17	10.53	12.17	0.05	0.10	0.10					
6/14/2018	11:42:27	10.48	11.74	0.07	0.10	0.10					
6/14/2018	11:42:37	10.45	11.30	0.06	0.10	0.11					
6/14/2018	11:42:47	10.42	12.21	0.07	0.10	0.10					

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	11:42:57	10.39	13.62	0.06	0.09	0.10					
6/14/2018	11:43:07	10.35	14.47	0.06	0.10	0.11					
6/14/2018	11:43:17	10.30	13.84	0.06	0.09	0.10					
6/14/2018	11:43:27	10.28	13.30	0.06	0.09	0.10					
6/14/2018	11:43:37	10.27	12.51	0.07	0.09	0.09					
6/14/2018	11:43:47	10.24	11.82	0.06	0.09	0.09					
6/14/2018	11:43:57	10.23	11.51	0.06	0.09	0.10					
6/14/2018	11:44:07	10.21	12.06	0.06	0.09	0.09					
6/14/2018	11:44:17	10.16	13.45	0.06	0.09	0.09					
6/14/2018	11:44:27	10.14	14.31	0.07	0.09	0.10					
6/14/2018	11:44:37	10.13	14.18	0.07	0.09	0.09					
6/14/2018	11:44:47	10.11	13.38	0.06	0.09	0.09					
6/14/2018	11:44:57	10.09	12.34	0.06	0.09	0.09					
6/14/2018	11:45:07	10.07	11.89	0.06	0.09	0.10					
6/14/2018	11:45:17	10.02	11.73	0.06	0.09	0.09					
6/14/2018	11:45:27	10.00	12.26	0.07	0.09	0.09					
6/14/2018	11:45:37	10.00	13.86	0.06	0.55	0.10					
6/14/2018	11:45:47	9.99	15.68	0.06	8.24	0.39	10.00				
6/14/2018	11:45:57	10.01	24.99	0.07	14.84	0.60					
6/14/2018	11:46:07	9.50	46.11	0.06	17.70	0.67					
6/14/2018	11:46:17	7.65	72.13	0.06	15.46	0.58					
6/14/2018	11:46:27	5.86	90.74	0.06	7.07	0.32					
6/14/2018	11:46:37	5.28	101.39	0.06	2.89	0.19					
6/14/2018	11:46:47	10.68	111.56	0.06	1.21	0.12					
6/14/2018	11:46:57	29.03	124.34	0.06	0.55	0.10					
6/14/2018	11:47:07	50.74	135.88	0.05	0.28	0.10					
6/14/2018	11:47:17	83.51	142.37	0.20	0.18	0.09					
6/14/2018	11:47:27	99.90	145.66	0.33	0.13	0.09					

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R-1 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	11:47:37	99.90	146.92	0.33	0.11	0.09					
6/14/2018	11:47:47	99.90	147.63	0.33	0.11	0.09					
6/14/2018	11:47:57	99.90	148.11	0.33	0.10	0.09					
6/14/2018	11:48:07	99.90	149.85	0.34	0.10	0.10					
6/14/2018	11:48:17	99.90	151.12	0.33	0.10	0.09					
6/14/2018	11:48:27	99.90	151.16	0.27	0.11	0.10					
6/14/2018	11:48:37	99.90	150.58	0.06	0.09	0.09		150.95			
6/14/2018	11:48:47	99.90	149.68	0.05	0.10	0.09					
6/14/2018	11:48:57	99.90	148.90	0.05	0.75	0.11					
6/14/2018	11:49:07	99.90	148.21	0.06	8.81	0.41					
6/14/2018	11:49:17	99.90	146.96	0.05	15.10	0.60					
6/14/2018	11:49:27	98.21	144.30	0.07	17.80	0.68					
6/14/2018	11:49:37	79.34	139.45	0.07	18.89	0.71					
6/14/2018	11:49:47	40.10	134.00	0.07	19.34	0.72					

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Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	11:50:47	4.56	130.62	0.27	19.65	0.73
6/14/2018	11:51:47	4.53	130.03	0.40	19.64	0.74
6/14/2018	11:52:47	4.30	128.39	0.41	19.68	0.74
6/14/2018	11:53:47	4.21	126.60	0.33	19.69	0.74
6/14/2018	11:54:47	4.17	126.64	0.33	19.69	0.74
6/14/2018	11:55:47	4.16	127.67	0.33	19.69	0.75
6/14/2018	11:56:47	4.13	124.45	0.33	19.69	0.74
6/14/2018	11:57:47	4.01	119.13	0.33	19.70	0.74
6/14/2018	11:58:47	4.02	119.43	0.33	19.70	0.74
6/14/2018	11:59:47	4.01	120.26	0.33	19.71	0.74
6/14/2018	12:00:47	4.05	123.96	0.33	19.70	0.74
6/14/2018	12:01:47	4.11	126.03	0.33	19.70	0.74
6/14/2018	12:02:47	4.16	126.62	0.41	19.69	0.74
6/14/2018	12:03:47	4.11	125.42	0.42	19.70	0.74
6/14/2018	12:04:47	4.12	125.90	0.33	19.69	0.74
6/14/2018	12:05:47	4.16	128.00	0.33	19.70	0.73
6/14/2018	12:06:47	4.15	128.13	0.34	19.70	0.73
6/14/2018	12:07:47	4.11	127.01	0.13	19.70	0.73
6/14/2018	12:08:47	4.14	127.20	0.20	19.70	0.73
6/14/2018	12:09:47	4.20	128.55	0.33	19.70	0.73
6/14/2018	12:10:47	4.23	127.26	0.33	19.70	0.74
6/14/2018	12:11:47	4.18	125.43	0.33	19.71	0.74
6/14/2018	12:12:47	4.09	123.10	0.33	19.72	0.73
6/14/2018	12:13:47	4.07	122.00	0.33	19.72	0.74
6/14/2018	12:14:47	4.07	123.41	0.33	19.71	0.74
6/14/2018	12:15:47	4.08	123.87	0.33	19.71	0.74
6/14/2018	12:16:47	4.06	123.05	0.33	19.72	0.74
6/14/2018	12:17:47	4.09	125.30	0.07	19.71	0.75
6/14/2018	12:18:47	4.19	130.22	0.28	19.71	0.75
6/14/2018	12:19:47	4.18	130.42	0.34	19.71	0.75
6/14/2018	12:20:47	4.14	128.94	0.28	19.71	0.75
6/14/2018	12:21:47	4.13	128.12	0.21	19.71	0.75
6/14/2018	12:22:47	4.09	125.57	0.33	19.71	0.75
6/14/2018	12:23:47	4.09	124.63	0.34	19.71	0.75
6/14/2018	12:24:47	4.09	124.27	0.33	19.71	0.75
6/14/2018	12:25:47	4.02	121.20	0.34	19.70	0.75
6/14/2018	12:26:47	4.03	121.84	0.30	19.70	0.75
6/14/2018	12:27:47	4.05	123.71	0.20	19.71	0.74
6/14/2018	12:28:47	4.06	124.25	0.34	19.71	0.74
6/14/2018	12:29:47	4.09	126.59	0.33	19.71	0.74
6/14/2018	12:30:47	4.13	128.71	0.34	19.71	0.73

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Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	12:31:47	4.11	126.96	0.33	19.71	0.73
6/14/2018	12:32:47	4.11	125.81	0.33	19.70	0.74
6/14/2018	12:33:47	4.08	125.24	0.33	19.70	0.73
6/14/2018	12:34:47	4.09	125.33	0.20	19.70	0.74
6/14/2018	12:35:47	4.07	124.73	0.30	19.70	0.74
6/14/2018	12:36:47	4.10	126.14	0.33	19.69	0.74
6/14/2018	12:37:47	4.11	126.00	0.33	19.69	0.75
6/14/2018	12:38:47	4.13	127.00	0.32	19.69	0.75
6/14/2018	12:39:47	4.16	128.93	0.19	19.70	0.75
6/14/2018	12:40:47	4.20	130.80	0.32	19.70	0.75
6/14/2018	12:41:47	4.15	127.81	0.42	19.70	0.76
6/14/2018	12:42:47	4.16	128.04	0.29	19.70	0.75
6/14/2018	12:43:47	4.18	128.83	0.06	19.70	0.76
6/14/2018	12:44:47	4.22	130.41	0.06	19.69	0.76
6/14/2018	12:45:47	4.22	130.06	0.06	19.70	0.75
6/14/2018	12:46:47	4.20	129.07	0.28	19.71	0.75
6/14/2018	12:47:47	4.24	130.06	0.34	19.70	0.75
6/14/2018	12:48:47	4.23	129.36	0.33	19.70	0.75
6/14/2018	12:49:47	4.16	127.87	0.30	19.70	0.75
6/14/2018	12:50:47	4.16	127.54	0.06	19.69	0.75
6/14/2018	12:51:47	4.18	128.36	0.18	19.70	0.75
6/14/2018	12:52:47	4.18	126.90	0.29	19.71	0.74
6/14/2018	12:53:47	4.16	126.41	0.20	19.71	0.74
6/14/2018	12:54:47	4.18	127.69	0.13	19.71	0.74
6/14/2018	12:55:47	4.11	126.92	0.32	19.71	0.74
6/14/2018	12:56:47	4.19	128.37	0.06	19.71	0.74
6/14/2018	12:57:47	4.14	126.54	0.29	19.72	0.74
6/14/2018	12:58:47	4.14	126.14	0.17	19.72	0.74
6/14/2018	12:59:47	4.12	125.55	0.12	19.71	0.74
6/14/2018	13:00:47	4.19	128.95	0.22	19.71	0.74
6/14/2018	13:01:47	4.25	130.54	0.34	19.70	0.75
6/14/2018	13:02:47	4.24	132.78	0.08	19.70	0.75
6/14/2018	13:03:47	4.26	132.82	0.17	19.70	0.75
6/14/2018	13:04:47	4.22	130.77	0.12	19.70	0.75
6/14/2018	13:05:47	4.23	131.13	0.10	19.70	0.76
6/14/2018	13:06:47	4.25	131.36	0.21	19.69	0.76
6/14/2018	13:07:47	4.26	130.82	0.34	19.70	0.76
6/14/2018	13:08:47	4.22	129.06	0.21	19.71	0.76
6/14/2018	13:09:47	4.21	128.63	0.20	19.71	0.75
6/14/2018	13:10:47	4.22	129.18	0.26	19.71	0.76
6/14/2018	13:11:47	4.22	128.95	0.31	19.70	0.76

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Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	13:12:47	4.20	127.78	0.19	19.70	0.75
6/14/2018	13:13:47	4.16	125.09	0.20	19.71	0.75
6/14/2018	13:14:47	4.16	126.62	0.20	19.71	0.75
6/14/2018	13:15:47	4.17	128.04	0.28	19.71	0.75
6/14/2018	13:16:47	4.20	129.50	0.28	19.70	0.75
6/14/2018	13:17:47	4.25	131.63	0.20	19.70	0.74
6/14/2018	13:18:47	4.22	130.59	0.20	19.70	0.74
6/14/2018	13:19:47	4.22	131.46	0.33	19.71	0.74
6/14/2018	13:20:47	4.21	130.38	0.24	19.71	0.74
6/14/2018	13:21:47	4.19	128.65	0.33	19.71	0.74
6/14/2018	13:22:47	4.15	126.66	0.39	19.71	0.74
6/14/2018	13:23:47	4.12	125.50	0.19	19.71	0.74
6/14/2018	13:24:47	4.08	124.28	0.19	19.71	0.74
6/14/2018	13:25:47	4.09	125.27	0.20	19.72	0.74
6/14/2018	13:26:47	4.14	125.86	0.12	19.71	0.75
6/14/2018	13:27:47	4.16	126.93	0.06	19.71	0.75
6/14/2018	13:28:47	4.18	127.83	0.09	19.70	0.75
6/14/2018	13:29:47	4.16	127.26	0.19	19.69	0.75
6/14/2018	13:30:47	4.16	128.15	0.19	19.70	0.75
6/14/2018	13:31:47	4.14	127.62	0.40	19.70	0.76
6/14/2018	13:32:47	4.14	127.99	0.39	19.70	0.75
6/14/2018	13:33:47	4.17	127.14	0.29	19.70	0.75
6/14/2018	13:34:47	4.16	126.10	0.21	19.70	0.75
6/14/2018	13:35:47	4.26	127.38	0.34	19.70	0.75
6/14/2018	13:36:47	4.24	128.76	0.21	19.70	0.75
6/14/2018	13:37:47	4.19	128.24	0.11	19.70	0.75
6/14/2018	13:38:47	4.14	125.92	0.06	19.70	0.75
6/14/2018	13:39:47	4.07	124.35	0.13	19.70	0.75
6/14/2018	13:40:47	4.10	125.44	0.34	19.69	0.74
6/14/2018	13:41:47	4.19	128.52	0.34	19.69	0.74
6/14/2018	13:42:47	4.22	130.88	0.34	19.70	0.74
6/14/2018	13:43:47	4.14	128.48	0.25	19.70	0.73
6/14/2018	13:44:47	4.11	127.29	0.15	19.70	0.74
6/14/2018	13:45:47	4.11	127.07	0.09	19.69	0.74
6/14/2018	13:46:47	4.07	124.69	0.19	19.70	0.74
6/14/2018	13:47:47	4.09	126.07	0.07	19.70	0.74
6/14/2018	13:48:47	4.16	131.46	0.27	19.69	0.75
6/14/2018	13:49:47	4.15	130.08	0.27	19.70	0.74
6/14/2018	13:50:47	4.08	124.12	0.16	19.70	0.74
6/14/2018	13:51:47	4.06	123.59	0.09	19.70	0.75
6/14/2018	13:52:47	4.14	127.56	0.34	19.70	0.75

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Run #2

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	13:53:47	4.13	127.22	0.10	19.70	0.75
6/14/2018	13:54:47	4.13	127.26	0.24	19.70	0.75
6/14/2018	13:55:47	4.12	126.66	0.22	19.70	0.75
6/14/2018	13:56:47	4.27	126.58	0.06	19.65	0.75
6/14/2018	13:57:47	4.14	126.56	0.06	16.71	0.66
	TOTAL	**4.16**	**127.16**	**0.25**	**19.68**	**0.74**

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	13:58:07	4.16	128.72	0.06	19.70	0.75					
6/14/2018	13:58:17	4.15	127.98	0.07	19.72	0.76					
6/14/2018	13:58:27	4.12	126.56	0.06	14.98	0.60					
6/14/2018	13:58:37	4.00	120.81	0.06	6.46	0.34					
6/14/2018	13:58:47	3.97	103.44	0.20	2.63	0.21					
6/14/2018	13:58:57	6.04	76.08	0.19	1.14	0.16					
6/14/2018	13:59:07	7.76	48.69	0.20	0.55	0.13					
6/14/2018	13:59:17	4.67	28.61	0.20	0.31	0.12					
6/14/2018	13:59:27	1.84	16.93	0.19	0.22	0.12					
6/14/2018	13:59:37	1.27	10.09	0.20	0.18	0.12					
6/14/2018	13:59:47	0.73	6.13	0.19	0.17	0.11					
6/14/2018	13:59:57	0.64	4.09	0.10	0.16	0.11					
6/14/2018	14:00:07	0.53	3.19	0.06	0.16	0.12					
6/14/2018	14:00:17	0.51	3.40	0.06	0.15	0.11					
6/14/2018	14:00:27	0.48	4.48	0.07	0.15	0.12					
6/14/2018	14:00:37	0.48	4.63	0.06	0.15	0.11					
6/14/2018	14:00:47	0.48	4.03	0.06	0.15	0.11					
6/14/2018	14:00:57	0.48	3.30	0.07	0.15	0.11					
6/14/2018	14:01:07	0.48	2.35	0.07	0.14	0.11					
6/14/2018	14:01:17	0.48	1.80	0.06	0.15	0.11					
6/14/2018	14:01:27	0.48	2.20	0.06	0.14	0.11					
6/14/2018	14:01:37	0.45	3.24	0.07	0.14	0.10					
6/14/2018	14:01:47	0.45	4.52	0.07	0.14	0.11					
6/14/2018	14:01:57	0.45	4.39	0.07	0.14	0.11	0.45	4.05	0.07	0.14	0.11
6/14/2018	14:02:07	0.45	3.85	0.06	1.44	0.89					
6/14/2018	14:02:17	0.45	4.79	0.07	5.96	5.72					
6/14/2018	14:02:27	0.92	7.67	0.06	8.36	8.11					
6/14/2018	14:02:37	3.42	10.04	0.07	9.31	9.07					

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	14:02:47	5.10	9.73	0.07	9.69	9.45					
6/14/2018	14:02:57	3.61	8.47	0.06	9.85	9.63					
6/14/2018	14:03:07	2.40	6.83	0.06	9.91	9.69					
6/14/2018	14:03:17	1.81	4.46	0.07	9.94	9.72					
6/14/2018	14:03:27	1.31	2.89	0.06	9.95	9.74					
6/14/2018	14:03:37	1.12	1.67	0.07	9.96	9.75					
6/14/2018	14:03:47	0.94	0.78	0.07	9.96	9.75				9.96	
6/14/2018	14:03:57	0.88	0.78	0.07	9.96	9.76					
6/14/2018	14:04:07	0.80	1.73	0.06	9.97	9.77					
6/14/2018	14:04:17	0.77	3.00	0.07	9.97	9.76					
6/14/2018	14:04:27	0.72	3.05	0.06	11.30	8.47					
6/14/2018	14:04:37	0.68	6.62	0.05	15.74	4.33					
6/14/2018	14:04:47	0.85	22.46	0.06	15.72	2.88					
6/14/2018	14:04:57	1.78	45.75	0.06	7.70	1.55					
6/14/2018	14:05:07	2.38	57.69	0.05	3.52	1.20					
6/14/2018	14:05:17	2.03	51.60	0.07	2.63	1.67					
6/14/2018	14:05:27	1.80	36.48	0.06	2.29	1.83					
6/14/2018	14:05:37	1.31	22.26	0.06	2.16	1.91					
6/14/2018	14:05:47	0.82	12.85	0.06	2.11	1.95					
6/14/2018	14:05:57	0.73	7.55	0.06	2.09	1.96					
6/14/2018	14:06:07	0.62	4.30	0.06	2.09	1.97					
6/14/2018	14:06:17	0.60	2.79	0.06	2.08	1.97					
6/14/2018	14:06:27	0.57	2.11	0.06	2.08	1.97					
6/14/2018	14:06:37	0.57	2.11	0.06	2.09	1.97					
6/14/2018	14:06:47	0.57	3.41	0.06	2.08	1.98					
6/14/2018	14:06:57	0.57	4.15	0.07	2.09	1.97					
6/14/2018	14:07:07	0.57	3.73	0.07	2.09	1.97					
6/14/2018	14:07:17	0.57	3.04	0.07	2.09	1.97					1.97

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	14:07:27	0.56	2.13	0.07	2.08	1.97					
6/14/2018	14:07:37	0.54	1.39	0.07	2.08	1.97					
6/14/2018	14:07:47	0.54	1.43	0.07	4.32	1.79					
6/14/2018	14:07:57	0.54	6.22	0.06	12.33	1.24					
6/14/2018	14:08:07	0.74	23.35	0.06	10.86	0.96					
6/14/2018	14:08:17	1.70	44.49	0.06	4.65	0.51					
6/14/2018	14:08:27	2.31	51.76	0.06	1.89	0.29					
6/14/2018	14:08:37	1.78	42.92	0.06	0.89	0.29					
6/14/2018	14:08:47	1.41	29.75	0.06	0.69	0.45					
6/14/2018	14:08:57	1.12	23.97	0.06	0.38	0.27					
6/14/2018	14:09:07	1.74	24.48	0.05	0.23	0.18					
6/14/2018	14:09:17	6.76	24.62	0.07	0.17	0.14					
6/14/2018	14:09:27	10.83	22.27	0.06	0.15	0.13					
6/14/2018	14:09:37	11.75	18.92	0.06	0.13	0.11					
6/14/2018	14:09:47	12.66	16.31	0.06	0.13	0.11					
6/14/2018	14:09:57	12.62	13.96	0.05	0.12	0.11					
6/14/2018	14:10:07	12.61	12.94	0.06	0.12	0.12					
6/14/2018	14:10:17	12.44	12.55	0.06	0.13	0.11					
6/14/2018	14:10:27	12.29	12.85	0.07	0.12	0.11					
6/14/2018	14:10:37	12.15	14.24	0.06	0.13	0.10					
6/14/2018	14:10:47	12.03	14.97	0.05	0.12	0.10					
6/14/2018	14:10:57	11.88	14.36	0.07	0.12	0.11					
6/14/2018	14:11:07	11.75	13.78	0.06	0.12	0.11					
6/14/2018	14:11:17	11.65	12.85	0.07	0.12	0.10					
6/14/2018	14:11:27	11.54	12.13	0.07	0.12	0.11					
6/14/2018	14:11:37	11.45	12.00	0.05	0.12	0.11					
6/14/2018	14:11:47	11.36	12.80	0.07	0.12	0.10					
6/14/2018	14:11:57	11.27	14.37	0.06	0.11	0.10					

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	14:12:07	11.18	14.90	0.07	0.11	0.10					
6/14/2018	14:12:17	11.12	14.36	0.06	0.12	0.10					
6/14/2018	14:12:27	11.06	13.28	0.06	0.12	0.10					
6/14/2018	14:12:37	10.98	12.55	0.07	0.11	0.10					
6/14/2018	14:12:47	10.91	12.04	0.06	0.11	0.11					
6/14/2018	14:12:57	10.86	12.06	0.07	0.11	0.11					
6/14/2018	14:13:07	10.80	13.09	0.06	0.11	0.11					
6/14/2018	14:13:17	10.74	14.39	0.06	0.11	0.10					
6/14/2018	14:13:27	10.69	14.68	0.06	0.11	0.10					
6/14/2018	14:13:37	10.65	14.09	0.06	0.11	0.10					
6/14/2018	14:13:47	10.60	13.21	0.06	0.11	0.10					
6/14/2018	14:13:57	10.56	12.47	0.06	0.11	0.11					
6/14/2018	14:14:07	10.51	12.09	0.06	0.11	0.11					
6/14/2018	14:14:17	10.48	12.70	0.07	0.11	0.10					
6/14/2018	14:14:27	10.45	14.18	0.07	0.11	0.11					
6/14/2018	14:14:37	10.42	14.86	0.07	0.11	0.11					
6/14/2018	14:14:47	10.39	14.34	0.05	0.11	0.10					
6/14/2018	14:14:57	10.36	13.61	0.05	0.11	0.11					
6/14/2018	14:15:07	10.34	12.67	0.06	0.11	0.11					
6/14/2018	14:15:17	10.33	12.16	0.06	0.10	0.11					
6/14/2018	14:15:27	10.30	12.20	0.06	0.11	0.11					
6/14/2018	14:15:37	10.27	13.51	0.06	0.11	0.10					
6/14/2018	14:15:47	10.24	14.87	0.06	0.11	0.10	10.27				
6/14/2018	14:15:57	10.21	14.95	0.06	3.70	0.25					
6/14/2018	14:16:07	10.13	18.72	0.07	12.48	0.55					
6/14/2018	14:16:17	9.90	34.11	0.06	16.75	0.66					
6/14/2018	14:16:27	9.45	59.13	0.06	18.19	0.70					
6/14/2018	14:16:37	7.20	83.00	0.07	11.44	0.47					

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	14:16:47	5.72	98.34	0.06	4.66	0.26					
6/14/2018	14:16:57	7.83	108.75	0.06	1.88	0.17					
6/14/2018	14:17:07	15.96	119.42	0.07	0.80	0.13					
6/14/2018	14:17:17	47.41	130.23	0.06	0.39	0.12					
6/14/2018	14:17:27	74.10	139.10	0.06	0.22	0.12					
6/14/2018	14:17:37	97.00	143.99	0.06	0.17	0.11					
6/14/2018	14:17:47	99.90	146.07	0.07	0.14	0.11					
6/14/2018	14:17:57	99.90	147.86	0.06	0.13	0.12					
6/14/2018	14:18:07	99.90	149.98	0.06	0.13	0.12					
6/14/2018	14:18:17	99.90	151.78	0.06	0.13	0.11					
6/14/2018	14:18:27	99.90	152.03	0.06	0.12	0.12					
6/14/2018	14:18:37	99.90	151.33	0.06	0.12	0.12					
6/14/2018	14:18:47	99.90	150.45	0.06	0.12	0.12					
6/14/2018	14:18:57	99.90	149.39	0.06	0.12	0.12					
6/14/2018	14:19:07	99.90	149.33	0.06	0.11	0.11					
6/14/2018	14:19:17	99.90	150.38	0.06	0.12	0.11					
6/14/2018	14:19:27	99.90	151.88	0.06	0.12	0.11		150.53			
6/14/2018	14:19:37	99.90	152.32	0.06	1.55	0.17					
6/14/2018	14:19:47	99.90	151.28	0.06	10.32	0.49					
6/14/2018	14:19:57	99.90	148.17	0.06	15.79	0.65					
6/14/2018	14:20:07	98.27	142.53	0.06	11.89	0.49					
6/14/2018	14:20:17	80.70	131.30	0.05	5.26	0.46					
6/14/2018	14:20:27	35.15	112.16	0.06	3.42	0.35					
6/14/2018	14:20:37	27.69	87.37	0.05	2.92	0.21					
6/14/2018	14:20:47	20.12	61.92	0.06	2.75	0.16					
6/14/2018	14:20:57	17.05	39.98	0.06	2.68	0.13					
6/14/2018	14:21:07	13.85	23.96	0.06	2.66	0.13					
6/14/2018	14:21:17	9.59	14.15	0.06	2.66	0.12					

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	14:21:27	5.53	8.36	0.06	2.66	0.12					
6/14/2018	14:21:37	4.38	5.23	0.06	2.66	0.12					
6/14/2018	14:21:47	3.29	4.00	3.40	2.65	0.11					
6/14/2018	14:21:57	2.83	4.31	11.18	2.66	0.12					
6/14/2018	14:22:07	2.41	5.30	11.17	2.66	0.12					
6/14/2018	14:22:17	2.20	4.99	11.18	2.67	0.12					
6/14/2018	14:22:27	1.98	4.17	11.18	2.67	0.12					
6/14/2018	14:22:37	1.84	3.34	11.18	2.67	0.12					
6/14/2018	14:22:47	1.73	2.71	11.18	2.67	0.12					
6/14/2018	14:22:57	1.62	2.22	11.18	2.68	0.12					
6/14/2018	14:23:07	1.53	2.33	12.10	2.67	0.12					
6/14/2018	14:23:17	1.44	3.74	12.09	2.67	0.11					
6/14/2018	14:23:27	1.37	4.71	12.10	2.67	0.11					
6/14/2018	14:23:37	1.33	4.54	12.08	2.67	0.11					
6/14/2018	14:23:47	1.27	3.72	12.09	2.67	0.11					
6/14/2018	14:23:57	1.21	2.92	12.10	2.67	0.11					
6/14/2018	14:24:07	1.15	2.35	12.09	2.67	0.11					
6/14/2018	14:24:17	1.12	2.29	12.10	2.67	0.11					
6/14/2018	14:24:27	1.07	3.07	12.10	2.67	0.11					
6/14/2018	14:24:37	1.04	4.51	12.09	2.67	0.12					
6/14/2018	14:24:47	1.01	4.95	12.10	2.68	0.11					
6/14/2018	14:24:57	0.98	4.16	12.09	2.67	0.12					
6/14/2018	14:25:07	0.98	3.18	12.08	2.67	0.11					
6/14/2018	14:25:17	0.95	2.44	12.08	2.67	0.11					
6/14/2018	14:25:27	0.92	2.28	12.15	2.67	0.11					
6/14/2018	14:25:37	0.90	2.44	12.24	2.68	0.10					
6/14/2018	14:25:47	0.89	3.22	12.24	2.68	0.10					
6/14/2018	14:25:57	0.87	4.32	12.25	2.67	0.11					

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R-2 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	14:26:07	0.86	4.51	12.24	2.67	0.11					
6/14/2018	14:26:17	0.84	3.90	12.24	2.68	0.11					
6/14/2018	14:26:27	0.84	2.99	12.24	2.67	0.11					
6/14/2018	14:26:37	0.81	2.37	12.25	2.68	0.11					
6/14/2018	14:26:47	0.81	1.99	12.25	2.67	0.10					
6/14/2018	14:26:57	0.80	2.63	12.25	2.68	0.10					
6/14/2018	14:27:07	0.78	3.84	12.25	2.67	0.11					
6/14/2018	14:27:17	0.78	4.47	12.25	3.52	0.14					
6/14/2018	14:27:27	0.78	6.32	12.25	10.90	0.46					
6/14/2018	14:27:37	0.74	17.76	12.25	16.07	0.63			12.25		

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	14:31:47	4.19	129.45	0.47	19.67	0.74
6/14/2018	14:32:47	4.22	129.70	0.47	19.69	0.74
6/14/2018	14:33:47	4.24	131.53	0.37	19.68	0.74
6/14/2018	14:34:47	4.19	129.13	0.34	19.70	0.74
6/14/2018	14:35:47	4.13	126.31	0.34	19.69	0.74
6/14/2018	14:36:47	4.09	124.57	0.33	19.69	0.74
6/14/2018	14:37:47	4.04	123.57	0.33	19.69	0.74
6/14/2018	14:38:47	4.13	128.99	0.22	19.69	0.75
6/14/2018	14:39:47	4.17	130.58	0.29	19.69	0.75
6/14/2018	14:40:47	4.18	129.31	0.27	19.69	0.75
6/14/2018	14:41:47	4.09	124.35	0.17	19.70	0.75
6/14/2018	14:42:47	4.10	124.86	0.06	19.69	0.75
6/14/2018	14:43:47	4.11	126.77	0.33	19.68	0.75
6/14/2018	14:44:47	4.11	126.82	0.34	19.68	0.75
6/14/2018	14:45:47	4.12	126.84	0.33	19.69	0.75
6/14/2018	14:46:47	4.10	125.37	0.28	19.69	0.75
6/14/2018	14:47:47	4.08	124.89	0.20	19.69	0.75
6/14/2018	14:48:47	4.09	126.37	0.20	19.69	0.75
6/14/2018	14:49:47	4.14	127.40	0.08	19.69	0.75
6/14/2018	14:50:47	4.14	126.36	0.25	19.69	0.75
6/14/2018	14:51:47	4.16	128.33	0.21	19.69	0.75
6/14/2018	14:52:47	4.11	125.62	0.09	19.69	0.75
6/14/2018	14:53:47	4.09	125.55	0.19	19.68	0.74
6/14/2018	14:54:47	4.17	129.43	0.19	19.67	0.74
6/14/2018	14:55:47	4.19	131.37	0.20	19.68	0.74
6/14/2018	14:56:47	4.17	130.63	0.28	19.68	0.74
6/14/2018	14:57:47	4.13	128.10	0.24	19.68	0.74
6/14/2018	14:58:47	4.12	126.19	0.12	19.68	0.74
6/14/2018	14:59:47	4.06	123.98	0.34	19.68	0.74
6/14/2018	15:00:47	4.10	127.53	0.20	19.67	0.74
6/14/2018	15:01:47	4.17	130.95	0.20	19.67	0.75
6/14/2018	15:02:47	4.20	130.89	0.20	19.67	0.75
6/14/2018	15:03:47	4.16	129.91	0.24	19.68	0.75
6/14/2018	15:04:47	4.15	130.52	0.34	19.68	0.75
6/14/2018	15:05:47	4.14	130.01	0.34	19.67	0.76
6/14/2018	15:06:47	4.13	128.58	0.22	19.67	0.76
6/14/2018	15:07:47	4.13	128.93	0.20	19.67	0.75
6/14/2018	15:08:47	4.15	130.71	0.14	19.66	0.76
6/14/2018	15:09:47	4.17	131.12	0.09	19.67	0.75
6/14/2018	15:10:47	4.14	128.96	0.19	19.67	0.75
6/14/2018	15:11:47	4.17	129.26	0.34	19.67	0.75

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	15:12:47	4.15	129.26	0.23	19.66	0.76
6/14/2018	15:13:47	4.16	130.15	0.20	19.66	0.75
6/14/2018	15:14:47	4.13	128.76	0.20	19.67	0.75
6/14/2018	15:15:47	4.13	127.95	0.19	19.67	0.74
6/14/2018	15:16:47	4.13	127.87	0.19	19.67	0.74
6/14/2018	15:17:47	4.09	126.01	0.19	19.67	0.73
6/14/2018	15:18:47	4.10	127.30	0.10	19.67	0.74
6/14/2018	15:19:47	4.16	131.54	0.06	19.67	0.74
6/14/2018	15:20:47	4.20	132.77	0.06	19.67	0.74
6/14/2018	15:21:47	4.14	127.73	0.06	19.67	0.74
6/14/2018	15:22:47	4.07	123.29	0.06	19.67	0.74
6/14/2018	15:23:47	4.07	123.19	0.18	19.67	0.74
6/14/2018	15:24:47	4.09	124.15	0.20	19.67	0.74
6/14/2018	15:25:47	4.09	125.88	0.15	19.67	0.74
6/14/2018	15:26:47	4.10	126.75	0.09	19.67	0.74
6/14/2018	15:27:47	4.12	127.09	0.19	19.67	0.75
6/14/2018	15:28:47	4.16	129.59	0.19	19.67	0.75
6/14/2018	15:29:47	4.14	129.38	0.10	19.66	0.76
6/14/2018	15:30:47	4.15	128.82	0.07	19.66	0.76
6/14/2018	15:31:47	4.16	128.36	0.06	19.67	0.75
6/14/2018	15:32:47	4.16	125.95	0.08	19.67	0.75
6/14/2018	15:33:47	4.13	126.04	0.19	19.67	0.75
6/14/2018	15:34:47	4.14	126.38	0.32	19.66	0.75
6/14/2018	15:35:47	4.12	126.00	0.24	19.66	0.75
6/14/2018	15:36:47	4.11	124.28	0.26	19.67	0.75
6/14/2018	15:37:47	4.16	128.58	0.30	19.67	0.75
6/14/2018	15:38:47	4.18	129.98	0.20	19.67	0.74
6/14/2018	15:39:47	4.20	130.74	0.34	19.66	0.74
6/14/2018	15:40:47	4.21	130.35	0.12	19.66	0.74
6/14/2018	15:41:47	4.19	130.90	0.07	19.66	0.74
6/14/2018	15:42:47	4.17	128.83	0.11	19.66	0.74
6/14/2018	15:43:47	4.12	126.68	0.19	19.67	0.74
6/14/2018	15:44:47	4.14	129.00	0.20	19.67	0.74
6/14/2018	15:45:47	4.18	131.13	0.19	19.66	0.74
6/14/2018	15:46:47	4.18	131.10	0.19	19.65	0.74
6/14/2018	15:47:47	4.18	130.99	0.20	19.66	0.74
6/14/2018	15:48:47	4.19	130.01	0.19	19.66	0.75
6/14/2018	15:49:47	4.17	129.13	0.18	19.67	0.75
6/14/2018	15:50:47	4.13	127.99	0.06	19.66	0.75
6/14/2018	15:51:47	4.10	126.07	0.17	19.66	0.75
6/14/2018	15:52:47	4.15	126.20	0.19	19.66	0.75

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	15:53:47	4.19	130.04	0.19	19.66	0.76
6/14/2018	15:54:47	4.28	134.57	0.19	19.66	0.76
6/14/2018	15:55:47	4.23	133.24	0.19	19.67	0.76
6/14/2018	15:56:47	4.20	130.76	0.33	19.66	0.76
6/14/2018	15:57:47	4.18	129.35	0.23	19.67	0.75
6/14/2018	15:58:47	4.16	129.04	0.19	19.67	0.75
6/14/2018	15:59:47	4.19	130.31	0.19	19.66	0.76
6/14/2018	16:00:47	4.20	131.13	0.19	19.66	0.75
6/14/2018	16:01:47	4.19	130.42	0.19	19.66	0.75
6/14/2018	16:02:47	4.15	129.29	0.19	19.67	0.75
6/14/2018	16:03:47	4.15	129.68	0.10	19.66	0.74
6/14/2018	16:04:47	4.13	128.52	0.06	19.66	0.74
6/14/2018	16:05:47	4.13	127.48	0.13	19.67	0.74
6/14/2018	16:06:47	4.12	126.99	0.33	19.67	0.74
6/14/2018	16:07:47	4.11	126.97	0.19	19.67	0.74
6/14/2018	16:08:47	4.13	127.43	0.19	19.66	0.74
6/14/2018	16:09:47	4.13	128.59	0.11	19.66	0.74
6/14/2018	16:10:47	4.12	127.65	0.16	19.67	0.74
6/14/2018	16:11:47	4.13	128.73	0.29	19.67	0.75
6/14/2018	16:12:47	4.17	131.66	0.06	19.67	0.75
6/14/2018	16:13:47	4.18	130.35	0.18	19.66	0.74
6/14/2018	16:14:47	4.19	129.95	0.19	19.66	0.75
6/14/2018	16:15:47	4.18	129.25	0.12	19.66	0.75
6/14/2018	16:16:47	4.18	129.06	0.06	19.66	0.76
6/14/2018	16:17:47	4.17	129.08	0.07	19.66	0.76
6/14/2018	16:18:47	4.17	128.90	0.06	19.66	0.76
6/14/2018	16:19:47	4.12	127.91	0.17	19.66	0.75
6/14/2018	16:20:47	4.12	127.87	0.19	19.66	0.76
6/14/2018	16:21:47	4.12	127.59	0.19	19.66	0.76
6/14/2018	16:22:47	4.12	126.92	0.19	19.67	0.75
6/14/2018	16:23:47	4.09	125.53	0.19	19.66	0.75
6/14/2018	16:24:47	4.12	127.57	0.34	19.66	0.75
6/14/2018	16:25:47	4.11	127.80	0.12	19.66	0.75
6/14/2018	16:26:47	4.11	127.44	0.06	19.66	0.75
6/14/2018	16:27:47	4.15	128.11	0.16	19.66	0.75
6/14/2018	16:28:47	4.19	130.62	0.31	19.66	0.75
6/14/2018	16:29:47	4.19	131.30	0.19	19.66	0.74
6/14/2018	16:30:47	4.20	130.90	0.20	19.66	0.74
6/14/2018	16:31:47	4.17	131.04	0.30	19.66	0.74
6/14/2018	16:32:47	4.18	130.73	0.20	19.65	0.75
6/14/2018	16:33:47	4.16	130.88	0.09	19.66	0.74

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	16:34:47	4.15	131.21	0.19	19.66	0.74
6/14/2018	16:35:47	4.14	129.37	0.19	19.65	0.75
6/14/2018	16:36:47	4.18	129.36	0.31	19.65	0.75
	TOTAL	**4.15**	**128.51**	**0.20**	**19.67**	**0.75**

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	16:38:07	4.19	131.66	0.23	19.65	0.75					
6/14/2018	16:38:17	4.19	130.07	0.19	19.65	0.75					
6/14/2018	16:38:27	4.16	129.27	0.19	19.65	0.75					
6/14/2018	16:38:37	4.16	128.69	0.19	19.65	0.75					
6/14/2018	16:38:47	4.16	128.75	0.19	19.65	0.75					
6/14/2018	16:38:57	4.13	129.62	0.20	19.65	0.75					
6/14/2018	16:39:07	4.13	130.59	0.20	19.65	0.75					
6/14/2018	16:39:17	4.13	130.10	0.14	19.65	0.75					
6/14/2018	16:39:27	4.13	129.12	0.06	19.66	0.76					
6/14/2018	16:39:37	4.13	128.28	0.05	19.55	0.75					
6/14/2018	16:39:47	4.13	126.45	0.06	13.15	0.51					
6/14/2018	16:39:57	4.13	117.61	0.06	5.42	0.29					
6/14/2018	16:40:07	4.02	95.99	0.06	2.20	0.19					
6/14/2018	16:40:17	2.92	67.48	0.06	0.95	0.14					
6/14/2018	16:40:27	1.90	40.72	0.09	0.47	0.13					
6/14/2018	16:40:37	1.31	22.42	0.34	0.29	0.13					
6/14/2018	16:40:47	0.71	12.42	0.34	0.22	0.12					
6/14/2018	16:40:57	0.59	7.09	0.34	0.18	0.12					
6/14/2018	16:41:07	0.49	4.27	0.34	0.16	0.12					
6/14/2018	16:41:17	0.48	3.11	0.34	0.16	0.11					
6/14/2018	16:41:27	0.45	3.40	0.34	0.16	0.11					
6/14/2018	16:41:37	0.45	4.52	0.34	0.15	0.11					
6/14/2018	16:41:47	0.45	4.78	0.13	0.14	0.12					
6/14/2018	16:41:57	0.45	3.99	0.06	0.15	0.12					
6/14/2018	16:42:07	0.42	3.08	0.07	0.15	0.11					
6/14/2018	16:42:17	0.42	2.11	0.06	0.15	0.12	0.43	3.06	0.06	0.15	0.12
6/14/2018	16:42:27	0.42	1.69	0.06	0.15	0.12					
6/14/2018	16:42:37	0.42	2.00	0.05	0.86	0.12					

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	16:42:47	0.54	4.09	0.07	1.91	0.13					
6/14/2018	16:42:57	1.73	7.12	0.06	2.35	0.12					
6/14/2018	16:43:07	2.73	8.49	0.06	2.52	0.12					
6/14/2018	16:43:17	2.23	7.45	0.07	2.60	0.12					
6/14/2018	16:43:27	1.80	5.34	0.06	2.63	0.12					
6/14/2018	16:43:37	1.43	3.31	0.07	2.65	0.11					
6/14/2018	16:43:47	1.10	2.50	0.06	2.66	0.12					
6/14/2018	16:43:57	1.00	2.62	0.06	2.66	0.11					
6/14/2018	16:44:07	0.89	3.66	2.31	2.68	0.11					
6/14/2018	16:44:17	0.86	4.36	11.31	2.67	0.12					
6/14/2018	16:44:27	0.81	3.88	11.31	2.68	0.11					
6/14/2018	16:44:37	0.81	3.20	11.31	2.68	0.11					
6/14/2018	16:44:47	0.78	2.66	11.31	2.67	0.12					
6/14/2018	16:44:57	0.75	1.95	11.32	2.68	0.11					
6/14/2018	16:45:07	0.75	1.70	11.31	2.68	0.11					
6/14/2018	16:45:17	0.72	2.79	11.31	2.68	0.11					
6/14/2018	16:45:27	0.72	4.03	12.00	2.68	0.11					
6/14/2018	16:45:37	0.72	4.22	12.09	2.68	0.11					
6/14/2018	16:45:47	0.69	3.35	12.09	2.68	0.12					
6/14/2018	16:45:57	0.69	2.68	12.09	2.69	0.11					
6/14/2018	16:46:07	0.66	2.21	12.09	2.68	0.11					
6/14/2018	16:46:17	0.66	1.84	12.09	2.68	0.11					
6/14/2018	16:46:27	0.66	1.73	12.09	2.68	0.11					
6/14/2018	16:46:37	0.66	3.06	12.09	2.67	0.12					
6/14/2018	16:46:47	0.63	4.34	12.09	2.68	0.11					
6/14/2018	16:46:57	0.63	4.29	12.08	2.68	0.11					
6/14/2018	16:47:07	0.63	3.51	12.08	2.67	0.11					
6/14/2018	16:47:17	0.63	2.64	12.09	2.68	0.12					

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	16:47:27	0.63	2.10	12.09	2.68	0.11					
6/14/2018	16:47:37	0.60	1.59	12.08	2.68	0.11					
6/14/2018	16:47:47	0.60	1.74	12.09	2.68	0.11					
6/14/2018	16:47:57	0.60	2.94	12.09	2.68	0.12					
6/14/2018	16:48:07	0.57	4.39	12.10	2.68	0.11					
6/14/2018	16:48:17	0.57	4.24	12.10	2.68	0.11					
6/14/2018	16:48:27	0.57	3.52	12.09	2.68	0.11					
6/14/2018	16:48:37	0.57	3.01	12.09	6.87	0.30					
6/14/2018	16:48:47	0.61	8.23	12.08	12.57	0.51					
6/14/2018	16:48:57	0.92	24.28	12.09	7.02	0.32					
6/14/2018	16:49:07	1.13	40.18	12.25	3.01	0.30					
6/14/2018	16:49:17	1.38	42.86	12.24	2.36	1.05					
6/14/2018	16:49:27	1.73	33.50	12.25	2.20	1.54					
6/14/2018	16:49:37	1.45	20.80	12.25	2.12	1.76					
6/14/2018	16:49:47	1.13	11.47	12.25	2.09	1.85					
6/14/2018	16:49:57	1.11	6.31	12.25	2.07	1.90			12.25		
6/14/2018	16:50:07	1.12	3.58	12.25	2.07	1.92					
6/14/2018	16:50:17	0.94	2.29	5.28	2.07	1.94					
6/14/2018	16:50:27	0.80	2.26	2.28	2.07	1.94					
6/14/2018	16:50:37	0.75	3.36	2.29	2.07	1.95					
6/14/2018	16:50:47	0.69	3.92	2.28	2.07	1.95					
6/14/2018	16:50:57	0.66	3.44	2.28	2.07	1.94					
6/14/2018	16:51:07	0.60	2.51	2.28	2.07	1.95					
6/14/2018	16:51:17	0.60	1.56	2.29	2.11	1.96					1.95
6/14/2018	16:51:27	0.60	1.64	1.39	7.47	1.56					
6/14/2018	16:51:37	0.57	8.77	0.06	13.48	1.44					
6/14/2018	16:51:47	0.63	28.27	0.06	11.75	5.27					
6/14/2018	16:51:57	1.82	46.42	0.05	10.65	7.96					

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Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	16:52:07	2.84	48.70	0.06	10.22	9.02					
6/14/2018	16:52:17	1.96	36.68	0.05	10.05	9.44					
6/14/2018	16:52:27	1.16	21.92	0.06	9.99	9.61					
6/14/2018	16:52:37	0.89	11.37	0.08	9.96	9.69					
6/14/2018	16:52:47	0.63	5.53	0.18	9.96	9.72					
6/14/2018	16:52:57	0.57	2.89	0.20	9.95	9.73					
6/14/2018	16:53:07	0.51	2.73	0.19	9.96	9.73					
6/14/2018	16:53:17	0.51	3.27	0.20	9.96	9.75					
6/14/2018	16:53:27	0.48	3.05	0.18	9.96	9.75				9.96	
6/14/2018	16:53:37	0.48	2.03	0.20	9.96	9.75					
6/14/2018	16:53:47	0.48	1.31	0.19	9.96	9.76					
6/14/2018	16:53:57	0.48	0.43	0.09	9.96	9.75					
6/14/2018	16:54:07	0.46	0.03	0.06	10.89	8.90					
6/14/2018	16:54:17	0.45	0.35	0.07	15.28	4.77					
6/14/2018	16:54:27	0.45	2.38	0.06	10.38	3.01					
6/14/2018	16:54:37	0.45	9.47	0.06	4.33	1.33					
6/14/2018	16:54:47	2.28	29.60	0.07	1.76	0.67					
6/14/2018	16:54:57	20.86	61.30	0.06	0.77	0.39					
6/14/2018	16:55:07	39.32	93.90	0.06	0.39	0.26					
6/14/2018	16:55:17	74.14	118.30	0.08	0.24	0.19					
6/14/2018	16:55:27	99.90	133.01	0.06	0.18	0.17					
6/14/2018	16:55:37	99.90	141.67	0.05	0.16	0.15					
6/14/2018	16:55:47	99.90	146.67	0.07	0.15	0.15					
6/14/2018	16:55:57	99.90	149.50	0.07	0.14	0.14					
6/14/2018	16:56:07	99.90	150.32	0.06	0.14	0.13					
6/14/2018	16:56:17	99.90	149.91	0.07	0.13	0.13					
6/14/2018	16:56:27	99.90	149.54	0.06	0.13	0.13					
6/14/2018	16:56:37	99.90	148.63	0.07	0.13	0.12					

Hollingsworth & Vose

CFU 107

R-3 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	16:56:47	99.90	148.79	0.06	0.13	0.12					
6/14/2018	16:56:57	99.90	149.75	0.06	0.13	0.11					
6/14/2018	16:57:07	99.90	151.55	0.06	0.17	0.12					
6/14/2018	16:57:17	99.90	151.47	0.06	5.80	0.13		150.92			
6/14/2018	16:57:27	99.90	143.91	0.06	5.40	0.14					
6/14/2018	16:57:37	99.90	125.58	0.05	2.29	0.14					
6/14/2018	16:57:47	98.75	102.89	0.07	0.95	0.13					
6/14/2018	16:57:57	86.46	78.63	0.06	0.44	0.12					
6/14/2018	16:58:07	66.64	55.48	0.06	0.24	0.12					
6/14/2018	16:58:17	47.34	37.59	0.06	0.16	0.12					
6/14/2018	16:58:27	27.99	27.21	0.06	0.14	0.11					
6/14/2018	16:58:37	23.36	21.76	0.05	0.13	0.11					
6/14/2018	16:58:47	18.55	17.84	0.06	0.12	0.12					
6/14/2018	16:58:57	17.03	15.21	0.07	0.12	0.12					
6/14/2018	16:59:07	15.48	13.57	0.06	0.11	0.11					
6/14/2018	16:59:17	14.79	12.59	0.07	0.11	0.11					
6/14/2018	16:59:27	14.12	12.05	0.06	0.11	0.11					
6/14/2018	16:59:37	13.72	12.76	0.06	0.12	0.11					
6/14/2018	16:59:47	13.28	14.22	0.06	0.11	0.11					
6/14/2018	16:59:57	12.98	14.83	0.07	0.11	0.11					
6/14/2018	17:00:07	12.65	14.33	0.06	0.11	0.11					
6/14/2018	17:00:17	12.45	13.33	0.06	0.11	0.11					
6/14/2018	17:00:27	12.25	12.48	0.06	0.11	0.12					
6/14/2018	17:00:37	12.10	11.87	0.06	0.11	0.12					
6/14/2018	17:00:47	11.92	11.86	0.07	0.11	0.12					
6/14/2018	17:00:57	11.78	12.72	0.05	0.11	0.11					
6/14/2018	17:01:07	11.63	14.18	0.07	0.11	0.12					
6/14/2018	17:01:17	11.52	14.77	0.07	0.11	0.11					

Hollingsworth & Vose

CFU 107

R-3 Bias Check

Date	Time	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]	NOx [PPM]	CO [PPM]	VOC [PPM]	O2 [%]	CO2 [%]
6/14/2018	17:01:27	11.42	14.02	0.06	0.11	0.11					
6/14/2018	17:01:37	11.31	12.96	0.06	0.11	0.11					
6/14/2018	17:01:47	11.22	12.43	0.06	0.10	0.11					
6/14/2018	17:01:57	11.13	11.86	0.06	0.11	0.11					
6/14/2018	17:02:07	11.04	11.84	0.05	0.11	0.12					
6/14/2018	17:02:17	10.98	13.34	0.06	0.10	0.11					
6/14/2018	17:02:27	10.92	14.64	0.06	0.10	0.11					
6/14/2018	17:02:37	10.86	14.65	0.06	0.11	0.11					
6/14/2018	17:02:47	10.81	13.65	0.05	0.10	0.11					
6/14/2018	17:02:57	10.78	12.86	0.06	0.11	0.11					
6/14/2018	17:03:07	10.75	12.13	0.06	0.10	0.11					
6/14/2018	17:03:17	10.69	11.46	0.05	0.11	0.12					
6/14/2018	17:03:27	10.63	12.06	0.06	0.10	0.12					
6/14/2018	17:03:37	10.57	12.93	0.06	0.10	0.11					
6/14/2018	17:03:47	10.54	14.34	0.06	0.11	0.12					
6/14/2018	17:03:57	10.49	14.54	0.06	0.10	0.11					
6/14/2018	17:04:07	10.46	13.96	0.06	0.10	0.12	10.50				

SHEET NO. ____ OF ____

PROJECT NO. ____

DATE 06/12/17

BY ____

SUBJECT ____ CHK'D ____

CFU 107 notes

	O_2	CO_2
Hi	20	5
Mid	10	25

205

✓

System

O_2	CO_2
10	2.5

~~R#~~	Start Time	End Time	Notes
R-1	8:35	12:00	Change Desicant In middle of run
R-2	12:25	15:27	
R-3	15:55	18:59	

SHEET NO. ____ OF ____
PROJECT NO. ____
DATE 06-13
BY ____
CHK'D ____

SUBJECT H&U

CFU - 107

~~M-316~~ / ~~M-5~~ wet test 13B / 26A — shifted tests too M316/5A
All gasses

leak ck. θ flow "ok" Did not pass

	A	S
	θ All	θ All ✓
O_2	20 ✓	10
	10 ✓	
CO_2	4 ✓	2 ✓
	2 ✓	
~~NO_x~~	~~20 ✓~~	10 ✓
	~~10 ✓~~	
~~CO~~	~~300 ✓~~	150 ✓
	~~150 ✓~~	

~~MMOC + 106~~
~~21.25 ✓~~
~~12.50~~
~~6.25~~
~~0~~ Failed

~~50.41~~ CH_4

no gasses

NO_2 conv. 50.41 ✓

R-1 11:55 - 14:08
R-2 ~~14:23~~ DSB 14:23 - 16:31
R-3 16:46 - 18:53

SHEET NO. ____ OF ____
PROJECT NO. ____
DATE ~~06/15~~
BY 06/14
CHK'D ____

SUBJECT H & V

CFV - 107

All gasses
wet test 13B/26A

leak check ⊖ Flow "ok"

A	S	
~~O_2~~ ⊖ all ✓	0 - All ✓✓✓	NMOC +106
O_2 20 ✓ 10 ✓	10 ✓ ✓✓	21.25 ✓ ✓✓✓ 12.50 ✓ 6.25 ✓ ⊖ ✓ CH4 50
CO_2 4 ✓ 2 ✓	2 ✓ ✓✓✓	
NO_x 20 ✓ 10 ✓	10 ✓ ✓✓✓	
CO 300 ✓ 150 ✓	150 ✓ ✓✓✓	

NO_2 conv 50.41 ✓

R-1 09:15 - 11:21

R-2 11:51 - 13:57

R-3 14:31 - 16:36

leak check OK ⊖ flow pass

APPENDIX E: PROCESS DATA

MEMORANDUM

To:	Ms. Kelly Dorsi, PhD	Date:	July 27, 2018
From:	Chad Darby	Project No.:	1421.01.01

RE: Production data for June 2018 Source Test Campaign - Hollingsworth & Vose Fiber Company, Corvallis, Oregon

On June 5 through June 14, 2018, emission testing was conducted at Hollingsworth & Vose Fiber Company (H&V) in Corvallis, Oregon. The purpose of the testing was to verify emission factors per Mutual Agreement and Order (MAO) No. AQ/V-WR-15-132 Addendum 2 for the new ceramic filtration units (CFUs), identified as CFU-107, CFU-114, and CFU-117. This source test campaign represents the second round of testing conducted per MAO instruction.

On May 24, 2018, the Oregon Department of Environmental Quality (DEQ) provided approval of the source test protocol to Ms. Anita Ragan (H&V) and Mr. Chris Hiltunen (Bison Engineering). The letter of approval required assessment, measurement and/or reporting of the following production parameters:

1. Glass production rate, tons/hr
2. Product type
3. Natural gas usage where applicable (cf/hr)
4. CFU pressure drop
5. Dry bulking agent injection rate in lbs/hr (if possible)
6. Bulking agent composition

Each parameter is discussed in detail below.

CFU PRODUCTION DATA

Tables 1 through 4 present the total hourly glass production rate (lbs/hr) and the type of glass fiber produced during each test period. Note, CFU-107 represents rotary coarse production, CFU-114 represents flameblown production, and CFU-117 represents rotary fine production. Table 5 presents the total hourly natural gas usage (cf/hr) as measured during each test period. Note, source test method 7E, 10, 25A, and 316 are run concurrently.

CFU DIFFERENTIAL PRESSURE DROP

Table 6 provides the pressure drop across each CFU as measured during each test period.

DRY BULKING AGENT INJECTION RATE

The dry bulking agent is a powder injected into the fiberizer exhaust upstream of the CFU to increase the mass of particulate, making it easier to remove during the cleaning cycle. The bulking agent delivery system uses weigh bins to meter the amount injected into the fiberizer exhaust. The bulking agent passes through a splitter (a branch in the delivery piping) upstream of the CFUs which splits the bulking agent for delivery to multiple CFU inlets. There is no means to measure the mass of the bulking agent at the inlet to each CFU individually. As specified in the DEQ approval letter, H&V has evaluated this system and determined it is not possible to provide an accurate measure of the bulking agent to each tested CFU.

The bulking agent is not a critical item in the filtration and emission control of the CFUs. It serves to ensure that 1) the cleaning cycle of the CFUs functions properly, 2) particles in the CFUs do not form cobwebbing between the individual ceramic filters, and 3) particles fall at a sufficient rate into the collection hopper during the cleaning cycle. If the amount of bulking agent is inadequate, the pressure drop will increase as the CFUs become less efficient in cleaning the filter surface. The delivery system is not designed to precisely measure the rate of bulking agent to each unit. Differential pressure is the appropriate parameter for monitoring proper operation of the CFUs.

BULKING AGENT COMPOSITION

Currently, the facility is using hydrated lime as the bulking agent. The bulking agent is selected based on properties of particle agglomeration and cost. Thus, the current bulking agent may change in the future.

Table 1
Production Data Summary - June 2018 Source Test Campaign - Method 5, 7E, 10, and 25A
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Product Type	Source Test ID	Source Test Time	Total Hourly Fiber Pull Rate (lbs/hr)								
				CFU-114			CFU-117			CFU-107		
				L4F1	L4F2	Total	L4R6	L4R7	Total	L1R11	L1R12	Total
06/06/2018 CFU-114 Outlet	FB	Run 1	09:40 - 11:49 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Run 2	12:30 - 14:39 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Run 3	15:15 - 17:23 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Average		**30.5**	**30.5**	**61.0**	--	--	--	--	--	--
06/09/2018 CFU-117 Outlet	RF	Run 1	08:15 - 10:22 (1)	--	--	--	58.7 (3)	58.7 (3)	117.5	--	--	--
		Run 2	10:45 - 12:52 (1)	--	--	--	58.7 (4)	58.7 (4)	117.5	--	--	--
		Run 3	13:20 - 15:32 (1)	--	--	--	58.7 (4)	58.7 (4)	117.5	--	--	--
		Average		--	--	--	**58.7**	**58.7**	**117.5**	--	--	--
06/14/2018 CFU-107 Outlet	RC	Run 1	09:16 - 11:21 (1)	--	--	--	--	--	--	180.1 (3)	184.1 (3)	364.3
		Run 2	11:51 - 13:56 (1)	--	--	--	--	--	--	179.4 (3)	183.3 (3)	362.7
		Run 3	14:31 - 16:36 (1)	--	--	--	--	--	--	184.1 (3)	177.8 (3)	361.9
		Average		--	--	--	--	--	--	**181.2**	**181.7**	**362.9**

FB = Flameblown

RC = Rotary Coarse

RF = Rotary Fine

Notes:

(a) Hourly flameblown fiber pull rate (lbs.hr) = (assumed flameblown production rate [lbs/hr]) / (number of fiberizer positions per stack)

Assumed flameblown production rate (lbs/hr) = 61.0 (2)

Number of fiberizer positions per stack = 2

References:

(1) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018.

(2) Information provided by Hollingsworth & Vose Fiber Company. Assumes constant flameblown production rate from previous data monitoring.

(3) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018. Value represents the average pull rate measured over the source test time.

(4) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018. Value represents the average pull rate of the nearest before and after source test time pull rates measured.

Table 2
Production Data Summary - June 2018 Source Test Campaign - Method 13B and 26A
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Product Type	Source Test ID	Source Test Time	Total Hourly Fiber Pull Rate (lbs/hr)								
				CFU-114			CFU-117			CFU-107		
				L4F1	L4F2	Total	L4R6	L4R7	Total	L1R11	L1R12	Total
06/05/2018 CFU-114 Outlet	FB	Run 1	10:31 - 12:40 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Run 2	13:10 - 15:21 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Run 3	15:50 - 17:59 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Average		**30.5**	**30.5**	**61.0**	--	--	--	--	--	--
06/09-10/2018 CFU-117 Outlet	RF	Run 1	16:05 - 18:14 (1)	--	--	--	58.7 (3)	58.7 (3)	117.5	--	--	--
		Run 2	07:36 - 09:43 (1)	--	--	--	57.1 (3)	58.7 (3)	115.9	--	--	--
		Run 3	10:01 - 12:05 (1)	--	--	--	57.1 (4)	57.9 (4)	115.1	--	--	--
		Average		--	--	--	**57.7**	**58.5**	**116.1**	--	--	--
06/13/2018 CFU-107 Outlet	RC	Run 1	11:55 - 14:08 (1)	--	--	--	--	--	--	181.7 (3)	192.8 (3)	374.6
		Run 2	14:25 - 16:31 (1)	--	--	--	--	--	--	186.5 (3)	183.3 (3)	369.8
		Run 3	16:45 - 18:53 (1)	--	--	--	--	--	--	184.9 (3)	182.5 (3)	367.4
		Average		--	--	--	--	--	--	**184.4**	**186.2**	**370.6**

FB = Flameblown

RC = Rotary Coarse

RF = Rotary Fine

Notes:

(a) Hourly flameblown fiber pull rate (lbs.hr) = (assumed flameblown production rate [lbs/hr]) / (number of fiberizer positions per stack)

Assumed flameblown production rate (lbs/hr) = 61.0 (2)

Number of fiberizer positions per stack = 2

References:

(1) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated June 11, 2018.

(2) Information provided by Hollingsworth & Vose Fiber Company. Assumes constant flameblown production rate from previous data monitoring.

(3) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018. Value represents the average pull rate measured over the source test time.

(4) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018. Value represents the average pull rate of the nearest before and after source test time pull rates measured.

Table 3
Production Data Summary - June 2018 Source Test Campaign - Method 29 and 30B
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Product Type	Source Test ID	Source Test Time	Total Hourly Fiber Pull Rate (lbs/hr)								
				CFU-114			CFU-117			CFU-107		
				L4F1	L4F2	Total	L4R6	L4R7	Total	L1R11	L1R12	Total
06/07/2018 CFU-114 Outlet	FB	Run 1	08:05 - 11:12 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Run 2	11:40 - 14:48 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Run 3	15:05 - 18:10 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Average		**30.5**	**30.5**	**61.0**	--	--	--	--	--	--
06/08/2018 CFU-117 Outlet	RF	Run 1	07:35 - 10:44 (1)	--	--	--	55.5 (3)	58.7 (3)	114.3	--	--	--
		Run 2	11:05 - 14:12 (1)	--	--	--	58.7 (3)	58.7 (3)	117.5	--	--	--
		Run 3	14:27 - 17:34 (1)	--	--	--	55.5 (3)	58.7 (3)	114.3	--	--	--
		Average		--	--	--	**56.6**	**58.7**	**115.3**	--	--	--
06/12/2018 CFU-107 Outlet	RC	Run 1	08:35 - 12:00 (1)	--	--	--	--	--	--	185.7 (3)	183.3 (3)	369.0
		Run 2	12:25 - 15:27 (1)	--	--	--	--	--	--	184.1 (3)	179.4 (3)	363.5
		Run 3	15:55 - 18:59 (1)	--	--	--	--	--	--	178.6 (3)	176.7 (3)	355.3
		Average		--	--	--	--	--	--	**182.8**	**179.8**	**362.6**

FB = Flameblown

RC = Rotary Coarse

RF = Rotary Fine

Notes:

(a) Hourly flameblown fiber pull rate (lbs.hr) = (assumed flameblown production rate [lbs/hr]) / (number of fiberizer positions per stack)

Assumed flameblown production rate (lbs/hr) = 61.0 (2)

Number of fiberizer positions per stack = 2

References:

(1) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated June 11, 2018.

(2) Information provided by Hollingsworth & Vose Fiber Company. Assumes constant flameblown production rate from previous data monitoring.

(3) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018. Value represents the average pull rate measured over the source test time.

Table 4
Production Data Summary - June 2018 Source Test Campaign - Method 316
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Product Type	Source Test ID	Source Test Time	Total Hourly Fiber Pull Rate (lbs/hr)								
				CFU-114			CFU-117			CFU-107		
				L4F1	L4F2	Total	L4R6	L4R7	Total	L1R11	L1R12	Total
06/06/2018 CFU-114 Outlet	FB	Run 1	09:41 - 11:50 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Run 2	12:31 - 14:40 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Run 3	15:16 - 17:25 (1)	30.5 (a)	30.5 (a)	61.0	--	--	--	--	--	--
		Average		**30.5**	**30.5**	**61.0**	--	--	--	--	--	--
06/09/2018 CFU-117 Outlet	RF	Run 1	08:16 - 10:23 (1)	--	--	--	58.7 (3)	58.7 (3)	117.5	--	--	--
		Run 2	10:46 - 12:54 (1)	--	--	--	58.7 (4)	58.7 (4)	117.5	--	--	--
		Run 3	13:21 - 15:33 (1)	--	--	--	58.7 (4)	58.7 (4)	117.5	--	--	--
		Average		**--**	**--**	**--**	**58.7**	**58.7**	**117.5**	--	--	--
06/14/2018 CFU-107 Outlet	RC	Run 1	09:15 - 11:21 (1)	--	--	--	--	--	--	180.1 (3)	184.1 (3)	364.3
		Run 2	11:51 - 13:57 (1)	--	--	--	--	--	--	179.4 (3)	183.3 (3)	362.7
		Run 3	14:31 - 16:36 (1)	--	--	--	--	--	--	184.1 (3)	177.8 (3)	361.9
		Average		--	--	--	--	--	--	**181.2**	**181.7**	**362.9**

FB = Flameblown
RC = Rotary Coarse
RF = Rotary Fine

Notes:

(a) Hourly flameblown fiber pull rate (lbs.hr) = (assumed flameblown production rate [lbs/hr]) / (number of fiberizer positions per stack)
Assumed flameblown production rate (lbs/hr) = 61.0 (2)
Number of fiberizer positions per stack = 2

References:

(1) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated June 11, 2018.
(2) Information provided by Hollingsworth & Vose Fiber Company. Assumes constant flameblown production rate from previous data monitoring.
(3) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018. Value represents the average pull rate measured over the source test time.
(4) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018. Value represents the average pull rate of the nearest before and after source test time pull rates measured.

Table 5
Natural Gas Usage - June 2018 Source Test Campaign - 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 [2] (cf/hr)								
				CFU-114			CFU-117			CFU-107		
				L4F1	L4F2	Total	L4R6	L4R7	Total	L1R11	L1R12	Total
06/06/2018 CFU-114 Outlet	FB	Run 1	09:40 - 11:49	2,886.1	2,988.5	5,874.6	--	--	--	--	--	--
		Run 2	12:30 - 14:39	2,920.2	3,028.6	5,948.9	--	--	--	--	--	--
		Run 3	15:15 - 17:23	2,937.0	3,033.5	5,970.4	--	--	--	--	--	--
		Average		**2,914.4**	**3,016.9**	**5,931.3**	--	--	--	--	--	--
06/09/2018 CFU-117 Outlet	RF	Run 1	08:15 - 10:22	--	--	--	2,584.3	2,689.0	5,273.3	--	--	--
		Run 2	10:45 - 12:52	--	--	--	2,583.4	2,687.3	5,270.7	--	--	--
		Run 3	13:20 - 15:32	--	--	--	2,607.4	2,679.8	5,287.1	--	--	--
		Average		--	--	--	**2,591.7**	**2,685.4**	**5,277.1**	--	--	--
06/14/2018 CFU-107 Outlet	RC	Run 1	09:15 - 11:21	--	--	--	--	--	--	2,389.6	2,493.6	4,883.2
		Run 2	11:51 - 13:57	--	--	--	--	--	--	2,395.9	2,623.6	5,019.5
		Run 3	14:31 - 16:36	--	--	--	--	--	--	2,401.9	2,650.9	5,052.8
		Average		--	--	--	--	--	--	2,395.8	2,589.4	4,985.2

FB = Flameblown
RC = Rotary Coarse
RF = Rotary Fine

References:

(1) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018.
(2) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018. Value represents the average natural gas usage measured over the source test time.

Table 6
Pressure Differentials - June 2018 Source Test Campaign
Hollingsworth & Vose Fiber Company - Corvallis, OR

Source Test	Method	Product Type	Source Test ID	Source Test Time [1]	Pressure Differential [2] (" w.c.)
06/05/2018 CFU-114 Outlet	M13B & M26A	FB	Run 1	10:31 - 12:40	3.338
			Run 2	13:10 - 15:21	3.367
			Run 3	15:50 - 17:59	3.329
			Average		**3.345**
06/06/2018 CFU-114 Outlet	M316	FB	Run 1	09:41 - 11:50	3.259
			Run 2	12:31 - 14:40	3.287
			Run 3	15:16 - 17:25	3.250
			Average		**3.265**
06/06/2018 CFU-114 Outlet	M5 & Gaseous	FB	Run 1	09:40 - 11:49	3.259
			Run 2	12:30 - 14:39	3.289
			Run 3	15:15 - 17:23	3.252
			Average		**3.266**
06/07/2018 CFU-114 Outlet	M29 & M30B	FB	Run 1	08:05 - 11:12	3.264
			Run 2	11:40 - 14:48	3.267
			Run 3	15:05 - 18:10	3.277
			Average		**3.269**
06/08/2018 CFU-117 Outlet	M29 & M30B	RF	Run 1	07:35 - 10:44	4.362
			Run 2	11:05 - 14:12	4.398
			Run 3	14:27 - 17:34	4.342
			Average		**4.367**
06/09/2018 CFU-117 Outlet	M316	RF	Run 1	08:16 - 10:23	4.233
			Run 2	10:46 - 12:54	4.379
			Run 3	13:21 - 15:33	4.370
			Average		**4.327**
06/09/2018 CFU-117 Outlet	M5 & Gaseous	RF	Run 1	08:15 - 10:22	4.233
			Run 2	10:45 - 12:52	4.377
			Run 3	13:20 - 15:32	4.370
			Average		**4.326**
06/09-10/2018 CFU-117 Outlet	M13B & M26A	RF	Run 1	16:05 - 18:14	4.394
			Run 2	07:36 - 09:43	4.536
			Run 3	10:01 - 12:05	4.489
			Average		**4.473**
06/12/2018 CFU-107 Outlet	M29 & M30B	RC	Run 1	08:35 - 12:00	5.310
			Run 2	12:25 - 15:27	5.301
			Run 3	15:55 - 18:59	5.395
			Average		**5.335**
06/13/2018 CFU-107 Outlet	M13B & M26A	RC	Run 1	11:55 - 14:08	5.423
			Run 2	14:25 - 16:31	5.368
			Run 3	16:45 - 18:53	5.256
			Average		**5.349**
06/14/2018 CFU-107 Outlet	M5 & Gaseous	RC	Run 1	09:16 - 11:21	5.300
			Run 2	11:51 - 13:56	5.316
			Run 3	14:31 - 16:36	5.354
			Average		**5.323**
06/14/2018 CFU-107 Outlet	M316	RC	Run 1	09:15 - 11:21	5.300
			Run 2	11:51 - 13:57	5.316
			Run 3	14:31 - 16:36	5.354
			Average		**5.323**

FB = Flameblown
RF = Rotary Fine
RC = Rotary Coarse

References:

(1) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018.
(2) Information provided by Hollingsworth & Vose Fiber Company via correspondence dated July 11, 2018. Value represents the average pressure differential measured over the source test time.

APPENDIX F: LABORATORY REPORTS

Gravimetric Information

Client: Hollingsworth & Vose

Location: Corvallis, OR

Job number: HAV218718

Dates: 6/5-14/2018

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
HAV218718 CFU114 M5 Run 1	Q1330	5/17/2018	0.3918	5/22/2018	0.3920	0.0002	0.39190	Q1330	6/26/2018	0.3917	7/3/2018	0.3915	-0.0002	0.39160	-0.00030
HAV218718 CFU114 M5 Run 2	Q1331	5/17/2018	0.3940	05/158/22	0.3938	-0.0002	0.39390	Q1331	6/26/2018	0.3942	7/3/2018	0.3945	0.0003	0.39435	0.00045
HAV218718 CFU114 M5 Run 3	Q1332	5/17/2018	0.3697	5/23/2018	0.3699	0.0002	0.36980	Q1332	6/26/2018	0.3695	7/3/2018	0.3693	-0.0002	0.36940	-0.00040
HAV218718 CFU117 M5 Run 1	Q1333	5/17/2018	0.3728	05/158/23	0.3727	-0.0001	0.37275	Q1333	6/26/2018	0.3723	7/3/2018	0.3724	0.0001	0.37235	-0.00040
HAV218718 CFU117 M5 Run 2	Q1334	5/17/2018	0.3742	5/24/2018	0.3743	0.0001	0.37425	Q1334	6/26/2018	0.3736	7/3/2018	0.3738	0.0002	0.37370	-0.00055
HAV218718 CFU117 M5 Run 3	Q1335	5/17/2018	0.3709	05/158/24	0.3711	0.0002	0.37100	Q1335	6/26/2018	0.3713	7/3/2018	0.3717	0.0004	0.37150	0.00050
HAV218718 CFU107 M5 Run 1	Q1336	5/17/2018	0.3736	5/25/2018	0.3737	0.0001	0.37365	Q1336	6/26/2018	0.3734	7/3/2018	0.3737	0.0003	0.37355	-0.00010
HAV218718 CFU107 M5 Run 2	Q1337	5/17/2018	0.3737	05/158/25	0.3737	0.0000	0.37370	Q1337	6/26/2018	0.3741	7/3/2018	0.3740	-0.0001	0.37405	0.00035
HAV218718 CFU107 M5 Run 3	Q1338	5/17/2018	0.3702	5/26/2018	0.3699	-0.0003	0.37005	Q1338	6/26/2018	0.3702	7/3/2018	0.3704	0.0002	0.37030	0.00025

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
125	HAV218718 CFU107 M5 Cont #5 Acetone Rinse Run 1	46	6/5/2018	47.6414	6/6/2018	47.6411	0.0003	47.64125	46	6/25/2018	47.6419	6/26/2018	47.6415	0.0004	47.64170	0.00045
95	HAV218718 CFU107 M5 Cont #5 Acetone Rinse Run 2	47	6/5/2018	50.0653	6/6/2018	50.0653	0.0000	50.06530	47	6/25/2018	50.0656	6/26/2018	50.0652	0.0004	50.06540	0.00010
165	HAV218718 CFU107 M5 Cont #5 Acetone Rinse Run 3	48	6/5/2018	47.5997	6/6/2018	47.5995	0.0002	47.59960	48	6/25/2018	47.6000	6/26/2018	47.6001	-0.0001	47.60010	0.00050
100	HAV218718 CFU107 Cont #6 Run 1	49	6/6/2018	50.5857	6/7/2018	50.5856	0.0001	50.58565	49	6/25/2018	50.5856	6/26/2018	50.5853	0.0003	50.58550	-0.00015
95	HAV218718 CFU107 Cont #6 Run 2	50	6/6/2018	49.5524	6/7/2018	49.5526	-0.0002	49.55250	50	6/25/2018	49.5522	6/26/2018	49.5518	0.0004	49.55200	-0.00050
100	HAV218718 CFU107 Cont #6 Run 3	51	6/6/2018	54.0449	6/7/2018	54.0449	0.0000	54.04490	51	6/25/2018	54.0453	6/26/2018	54.0456	-0.0003	54.04550	0.00060
120	HAV218718 CFU114 M5 Cont #5 Acetone Rinse Run 1	52	6/6/2018	52.4855	6/7/2018	52.4855	0.0000	52.48550	52	6/25/2018	52.4859	6/26/2018	52.4855	0.0004	52.48570	0.00020
135	HAV218718 CFU114 M5 Cont #5 Acetone Rinse Run 2	53	6/6/2018	49.4076	6/7/2018	49.4074	0.0002	49.40750	53	6/25/2018	49.4080	6/26/2018	49.4081	-0.0001	49.40810	0.00060
150	HAV218718 CFU114 M5 Cont #5 Acetone Rinse Run 3	54	6/6/2018	50.2023	6/7/2018	50.2021	0.0002	50.20220	54	6/25/2018	50.2030	6/26/2018	50.2031	-0.0001	50.20310	0.00090
95	HAV218718 CFU114 Cont #6 Run 1	55	6/6/2018	52.7367	6/7/2018	52.7367	0.0000	52.73670	55	6/25/2018	52.7369	6/26/2018	52.7368	0.0001	52.73690	0.00020
90	HAV218718 CFU114 Cont #6 Run 2	56	6/6/2018	52.7167	6/7/2018	52.7167	0.0000	52.71670	56	6/25/2018	52.7169	6/26/2018	52.7168	0.0001	52.71690	0.00020
95	HAV218718 CFU114 Cont #6 Run 3	57	6/6/2018	51.3987	6/7/2018	51.3987	0.0000	51.39870	57	6/25/2018	51.3989	6/26/2018	51.3987	0.0002	51.39880	0.00010
130	HAV218718 CFU117 M5 Cont #5 Acetone Rinse Run 1	58	6/6/2018	49.8104	6/7/2018	49.8105	-0.0001	49.81045	58	6/25/2018	49.8115	6/26/2018	49.8112	0.0003	49.81140	0.00095
110	HAV218718 CFU117 M5 Cont #5 Acetone Rinse Run 2	59	6/6/2018	50.7598	6/7/2018	50.7599	-0.0001	50.75985	59	6/25/2018	50.7609	6/26/2018	50.7608	0.0001	50.76090	0.00105
115	HAV218718 CFU117 M5 Cont #5 Acetone Rinse Run 3	60	6/6/2018	47.8438	6/7/2018	47.8438	0.0000	47.84380	60	6/25/2018	47.8447	6/26/2018	47.8445	0.0002	47.84460	0.00080
95	HAV218718 CFU117 Cont #6 Run 1	61	6/6/2018	49.2390	6/7/2018	49.2390	0.0000	49.23900	61	6/25/2018	49.2392	6/26/2018	49.2394	-0.0002	49.23930	0.00030
90	HAV218718 CFU117 Cont #6 Run 2	62	6/6/2018	48.9725	6/7/2018	48.9726	-0.0001	48.97255	62	6/25/2018	48.9730	6/26/2018	48.9729	0.0001	48.97300	0.00045
90	HAV218718 CFU117 Cont #6 Run 3	63	6/6/2018	51.0680	6/7/2018	51.0677	0.0003	51.06785	63	6/25/2018	51.0679	6/26/2018	51.0679	0.0000	51.06790	0.00005
120	HAV218718 CFU107 Probe Rinse Run 1	64	6/6/2018	51.8819	6/7/2018	51.8817	0.0002	51.88180	64	6/25/2018	51.8834	6/26/2018	51.8836	-0.0002	51.88350	0.00170
100	HAV218718 CFU107 Probe Rinse Run 2	65	6/6/2018	52.6624	6/7/2018	52.6623	0.0001	52.66235	65	6/25/2018	52.6637	6/26/2018	52.6637	0.0000	52.66370	0.00135
260	HAV218718 CFU107 Probe Rinse Run 3	66	6/6/2018	49.4841	6/7/2018	49.4839	0.0002	49.48400	66	6/25/2018	49.4847	6/26/2018	49.4847	0.0000	49.48470	0.00070
95	HAV218718 CFU114 Probe Rinse Run 1	67	6/6/2018	48.8155	6/7/2018	48.8157	-0.0002	48.81560	67	6/25/2018	48.8168	6/26/2018	48.8165	0.0003	48.81670	0.00110
105	HAV218718 CFU114 Probe Rinse Run 2	68	6/6/2018	53.3040	6/7/2018	53.3039	0.0001	53.30395	68	6/25/2018	53.3048	6/26/2018	53.3046	0.0002	53.30470	0.00075
100	HAV218718 CFU114 Probe Rinse Run 3	69	6/6/2018	52.3124	6/7/2018	52.3124	0.0000	52.31240	69	6/25/2018	52.3136	6/26/2018	52.3134	0.0002	52.31350	0.00110
100	HAV218718 CFU117 Probe Rinse Run 1	70	6/6/2018	51.4998	6/7/2018	51.4997	0.0001	51.49975	70	6/25/2018	51.5013	6/26/2018	51.5013	0.0000	51.50130	0.00155
70	HAV218718 CFU117 Probe Rinse Run 2	71	6/6/2018	51.4578	6/7/2018	51.4577	0.0001	51.45775	71	6/25/2018	51.4585	6/26/2018	51.4585	0.0000	51.45850	0.00075
80	HAV218718 CFU117 Probe Rinse Run 3	72	6/6/2018	50.3664	6/7/2018	50.3666	-0.0002	50.36650	72	6/25/2018	50.3677	6/26/2018	50.3676	0.0001	50.36770	0.00120
175	HAV218718 M5 Acetone Blank	73	6/6/2018	48.2583	6/7/2018	48.2582	0.0001	48.25825	73	6/25/2018	48.2585	6/26/2018	48.2585	0.0000	48.25850	0.00025
425	HAV218718 M5 CFU107 Cont #4 Run 1	74	6/6/2018	47.2605	6/7/2018	47.2606	-0.0001	47.26055	74	7/2/2018	47.2616	7/3/2018	47.2611	0.0005	47.26140	0.00085
405	HAV218718 M5 CFU107 Cont #4 Run 2	75	6/6/2018	50.0817	6/7/2018	50.0819	-0.0002	50.08180	75	7/2/2018	50.0833	7/3/2018	50.0828	0.0005	50.08310	0.00130
415	HAV218718 M5 CFU107 Cont #4 Run 3	76	6/6/2018	49.6388	6/7/2018	49.6389	-0.0001	49.63885	76	7/2/2018	49.6401	7/3/2018	49.6397	0.0004	49.63990	0.00105
410	HAV218718 M5 CFU114 Cont #4 Run 1	77	6/6/2018	49.2616	6/7/2018	49.2613	0.0003	49.26145	77	7/2/2018	49.2632	7/3/2018	49.2627	0.0005	49.26300	0.00155
460	HAV218718 M5 CFU114 Cont #4 Run 2	78	6/6/2018	54.0579	6/7/2018	54.0582	-0.0003	54.05805	78	7/2/2018	54.0597	7/3/2018	54.0594	0.0003	54.05960	0.00155
445	HAV218718 M5 CFU114 Cont #4 Run 3	79	6/6/2018	51.2230	6/7/2018	51.2231	-0.0001	51.22305	79	7/2/2018	51.2271	7/3/2018	51.2266	0.0005	51.22690	0.00385
405	HAV218718 M5 CFU117 Cont #4 Run 1	80	6/6/2018	46.2345	6/7/2018	46.2345	0.0000	46.23450	80	7/2/2018	46.2359	7/3/2018	46.2357	0.0002	46.23580	0.00130
400	HAV218718 M5 CFU117 Cont #4 Run 2	81	6/6/2018	51.4489	6/7/2018	51.4487	0.0002	51.44880	81	7/2/2018	51.4506	7/3/2018	51.4502	0.0004	51.45040	0.00160
395	HAV218718 M5 CFU117 Cont #4 Run 3	82	6/6/2018	50.0394	6/7/2018	50.0393	0.0001	50.03935	82	7/2/2018	50.0412	7/3/2018	50.0407	0.0005	50.04100	0.00165
195	HAV218718 M5 HPLC Blank	83	6/6/2018	51.3770	6/7/2018	51.3771	-0.0001	51.37705	83	7/2/2018	51.3772	7/3/2018	51.3772	0.0000	51.37720	0.00015

HAV 218718

[redacted]

Page 1 of 1

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR

Source: CFU 114 **Date(s):** 6/5/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
13B	1	Initial: 200 Rinse vol: 290	Final: 220 Gain: 20ml	n/a	Initial: 245.6 #: 1	Final: 265.7 Gain: 20.1
26A	1	Initial: 200 Rinse vol: 145ml	Final: 220 Gain: 20ml		Initial: 248.3 #: 2	Final: 284.3 Gain: 36.0g.
13B	2	Initial: 200 Rinse vol: ~~265ml~~ 310ml AB 6/5/18	Final: 220 Gain: 20ml		Initial: 243.9 #: 3	Final: 263.6 Gain: 19.7
26A	2	Initial: 200 Rinse vol: 150ml	Final: 220 Gain: 20ml		Initial: 247.1 #: 4	Final: 281.3 Gain: 34.2g.
13B	3	Initial: 200 Rinse vol: 315	Final: 225 Gain: 25ml		Initial: 250.3 #: 5	Final: 270.7 Gain: 20.4
26A	3	Initial: 200 Rinse vol: 155 ml.	Final: 216 Gain: 16	✓	Initial: 250.1 #: 6	Final: 284.2 Gain: 34.1

Field Moisture Log:

Client: HoV **Location:** Corvallis, OR

Source: CFU 114 **Date(s):** 6/6/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
5	1	Initial: 200 Rinse vol: 190	Final: 225 Gain: 25	Q1330	Initial: ~~262.1~~ AB 6/6/18 239.5 #: 7	Final: 277.5 Gain: 38
316	1	Initial: 200 Rinse vol: 250	Final: 214 Gain: 14	n/a	Initial: 239.9 #: 8	Final: 255.1 Gain: 15.2
5	2	Initial: 200 Rinse vol: 205	Final: 230 Gain: 30	Q1331	Initial: 262.1 #: 9	Final: 291.3 Gain: 29.2
316	2	Initial: 200 Rinse vol: 240	Final: 222 Gain: 22	n/a	Initial: 260.0 #: 10	Final: 273.5 Gain: 13.5
5	3	Initial: 200 Rinse vol: 190	Final: 225 Gain: 25	Q1332	Initial: 257.3 #: 11	Final: 289.8 Gain: 32.5
316	3	Initial: 200 Rinse vol: 234	Final: 212 Gain: 12	n/a	Initial: 251.6 #: 12	Final: 265.6 Gain: 14

Field Moisture Log:

Client: H2V

Source: CFU 114

Location: Corvallis, OR

Date(s): 6/7/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
29	1	Initial: 200 Rinse vol: 100	Final: 234 Gain: 34	n/a	Initial: 240.8 #: 13	Final: 283.3 Gain: 42.5
29	2	Initial: 200 Rinse vol: 100	Final: 235 Gain: 35	n/a	Initial: 240.3 #: 14	Final: 278.3 Gain: 38.0
29	3	Initial: 200 Rinse vol: 100	Final: 238 Gain: 38	n/a	Initial: 244.5 #: 15	Final: 282.8 Gain: 38.3
		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 117 **Date(s):** ~~6/7~~ 6/8/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
29	1	Initial: 200 Rinse vol: 100	Final: 228 Gain: +28 ml	n/a	Initial: 241.9 #: 16	Final: 285.4 Gain: +43.5
29	2	Initial: 200 Rinse vol: 100	Final: 230 Gain: +30 ml	n/a	Initial: 240.0 #: 17	Final: 279.1 Gain: +39.1
29	3	Initial: 200 Rinse vol: 100	Final: ~~23~~245 Gain: +45 m	n/a	Initial: 244.8 #: 18	Final: 282.6 Gain: 37.8
		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: HzV **Location:** Corvallis, OR

Source: CFU117 **Date(s):** 6/9/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
5	1	Initial: 200 Rinse vol: 170	Final: 220 Gain: 20	Q1333	Initial: 239.8 #: 19	Final: 264.6 Gain: 24.8
316	1	Initial: 200 Rinse vol: 260	Final: 206 Gain: 6	n/a	Initial: 256.1 #: 20	Final: 277 Gain: 20.9
5	2	Initial: 200 Rinse vol: 198	Final: 220 Gain: 20	Q1334	Initial: 238.7 #: 21	Final: 266.1 Gain: 27.4
316	2	Initial: 200 Rinse vol: ~~220~~ 240 ARB 6/9/18	Final: 214 Gain: 14	n/a	Initial: 247.8 #: 22	Final: 267.5 Gain: 19.7
5	3	Initial: 200 Rinse vol: 160	Final: 225 Gain: 25	Q1335	Initial: 253 #: 23	Final: 276.5 Gain: 23.5
316	3	Initial: 200 Rinse vol: 260	Final: 220 Gain: 20	n/a	Initial: 243.2 #: 24	Final: 260.1 Gain: 16.9

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR

Source: CFU 117 **Date(s):** 6/9-6/10/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
13B	1	Initial: 200 Rinse vol: 310	Final: 220 Gain: 20	n/a	Initial: 239.4 #: 25	Final: 263.6 Gain: 24.2
26A	1	Initial: 200 Rinse vol: 136	Final: 214 Gain: 14	n/a	Initial: 258.2 #: 26	Final: 291.4 Gain: 33.2
13B	2	Initial: 200 Rinse vol: 295	Final: 230 Gain: 30	n/a	Initial: 242.4 #: 27	Final: 260.2 Gain: 17.8
26A	2	Initial: 200 Rinse vol: 160	Final: 216 Gain: 16	n/a	Initial: 244.2 #: 28	Final: 275.6 Gain: 31.2
13B	3	Initial: 200 Rinse vol: 300	Final: 232 Gain: 32	n/a	Initial: 237.1 #: 29	Final: 255 Gain: 17.9
26A	3	Initial: 200 Rinse vol: 162	Final: 214 Gain: 14	n/a	Initial: 234.6 #: 30	Final: 267.6 Gain: 33

Field Moisture Log:

Client: H2V **Location:** Corvallis, OR

Source: CFU 107 **Date(s):** 6/12/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
29	1	Initial: 200 Rinse vol: 100	Final: 232 Gain: 32	n/a	Initial: 242.4 #: 31	Final: 260.5 Gain: 18.1
29	2	Initial: 200 Rinse vol: 100	Final: 224 Gain: 24	n/a	Initial: 250.4 #: 32	Final: 271.8 Gain: 21.4
29	3	Initial: 200 Rinse vol: 100	Final: 228 Gain: 28	n/a	Initial: 254.0 #: 33	Final: 273.4 Gain: 19.4
		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 107 **Date(s):** 6/13 ~~6/14/18~~ ARB 6/13/19

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
13B	1	Initial: 200 Rinse vol: 315	Final: 220 Gain: 20	n/a	Initial: 236.3 #: 34	Final: 249.2 Gain: 12.9
26A	1	Initial: 200 Rinse vol: 158	Final: 230 Gain: 30	n/a	Initial: 236.9 #: 35	Final: 269.5 Gain: 32.6
13B	2	Initial: 200 Rinse vol: 320	Final: 225 Gain: 25	n/a	Initial: 242.3 #: 36	Final: 256.6 Gain: 14.3
26A	2	Initial: 200 Rinse vol: 170	Final: 217 Gain: 17	n/a	Initial: 232.7 #: 37	Final: 273.1 Gain: 40.4
13B	3	Initial: 200 Rinse vol: 310	Final: 215 Gain: 15	n/a	Initial: 263.7 #: 38	Final: 278.9 Gain: 15.2
26A	3	Initial: 200 Rinse vol: 152	Final: 226 Gain: 26	n/a	Initial: 242.1 #: 39	Final: 273.6 Gain: 31.5

Field Moisture Log:

Client: H&V **Location:** Corvallis, OR

Source: CFU107 **Date(s):** 6/14/18

Method	Run #	Impingers (g)		Filter #	Silica gel (g)	
5	1	**Initial:** 200 **Rinse vol:** 190	**Final:** 225 **Gain:** 25	Q1336 #: 40	**Initial:** 262.5	**Final:** 291.4 **Gain:** 28.9
316	1	**Initial:** 200 **Rinse vol:** 260	**Final:** 214 **Gain:** 14	n/a #: 41	**Initial:** 242.3	**Final:** 256.6 **Gain:** 14.3
5	2	**Initial:** 200 **Rinse vol:** 180	**Final:** 210 **Gain:** 10	Q1337 #: 42	**Initial:** 254.7	**Final:** 287.2 **Gain:** 32.5
316	2	**Initial:** 200 **Rinse vol:** 240	**Final:** 210 **Gain:** 10	n/a #: 43	**Initial:** 253.3	**Final:** 270.9 **Gain:** 17.6
5	3	**Initial:** 200 **Rinse vol:** 185	**Final:** 210 **Gain:** 10	Q1338 #: 44	**Initial:** 257.9	**Final:** 291.1 **Gain:** 33.2
316	3	**Initial:** 200 **Rinse vol:** 246	**Final:** 210 **Gain:** 10	n/a #: 45	**Initial:** 249.4	**Final:** 263.6 **Gain:** 14.2

BISON ENGINEERING

CLIENT # B020
REPORT # 18-141

SUBMITTED BY:
CHESTER LabNet
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TIGARD, OR 97223
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CHESTER LabNet

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Case Narrative

Date: April 26, 2018

General Information

Client:	Bison Engineering
Client Number:	B020
Report Number:	18-141
Sample Description:	Filter Blanks
Sample Numbers:	18-S455 – 18-S457

Analysis

Analytes:	F
Analytical Protocols:	EPA Method 13B
Analytical Notes:	The analysis was performed by ion chromatography instead of ion selective electrode per client request. 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.

4/26/18

Project Manager Date
Paul Duda

Client: B020 - Bison Engineering
Report Number: 18-141

Lab ID: 18-S455
Client ID: Filter Blank 1

Analyte	Result	DL	Units
Fluoride, IC	< DL	15.0	µg/sample

Lab ID: 18-S456
Client ID: Filter Blank 2

Analyte	Result	DL	Units
Fluoride, IC	< DL	15.0	µg/sample

Lab ID: 18-S457
Client ID: Filter Blank 3

Analyte	Result	DL	Units
Fluoride, IC	< DL	15.0	µg/sample

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: Ion Chromatography
Sample Description: Whatman Grade 1 Filter
Report Number: 18-141

Blank Data

Analyte	Sample ID	Measured Conc. mg/L	MDL Conc. mg/L
F	ICB	< MDL	0.030
F	Meth_Blk	< MDL	0.030
F	CCB	< MDL	0.030

Calibration QC

Analyte	Sample ID	Standard Conc. mg/L	Measured Conc. mg/L	Percent Recovery
F	ICV	1.00	1.04	103.5
F	LL-LCS	0.030	0.03	113.3
F	CCV	1.00	1.04	103.9

Duplicate Data

Insufficient sample to perform Duplicate
and/or Duplicate not required

Matrix Spike Analysis

Insufficient sample to perform spike
and/or matrix spike not required

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: ± 20% RPD *Spikes: ± 25%*

No
Chain of Custody
Provided

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
503-624-2183
www.chesterlab.net

RAW DATA

Available upon request

BISON ENGINEERING

PROJECT: HAV218718

CLIENT # B020
REPORT # 18-236

SUBMITTED BY:
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Case Narrative

Date: July 3, 2018

General Information

Client:	Bison Engineering
Client Number:	B020
Report Number:	18-236
Sample Description:	Impinger Trains
Sample Numbers:	18-S1051 – 18-S1095

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:	No 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 7/3/18

Project Manager Date
Paul Duda

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1059
Client ID: M13B Run 1
Source: CFU114
Sample Date: 6/ 5/18

Analyte	Result	DL	Units
Fluoride, IC	48.0	30.0	µg/sample

Lab ID: 18-S1060
Client ID: M13B Run 2
Source: CFU114
Sample Date: 6/ 5/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S1061
Client ID: M13B Run 3
Source: CFU114
Sample Date: 6/ 5/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S1062
Client ID: M13B DI H2O Blank
Sample Date: 6/ 5/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S1063
Client ID: M13B Run 1
Source: CFU117
Sample Date: 6/ 9/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Lab ID: 18-S1064
Client ID: M13B Run 2
Source: CFU117
Sample Date: 6/10/18

Analyte	Result	DL	Units
Fluoride, IC	< DL	30.0	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1065
Client ID: M13B Run 3
Source: CFU117
Sample Date: 6/10/18

Analyte	Result	DL	Units
Fluoride, IC	34.0	30.0	µg/sample

Lab ID: 18-S1066
Client ID: M13B Audit SSAS331

Analyte	Result	DL	Units
Fluoride, IC	5,860	30.0	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1090
Client ID: M13B Run 1
Source: CFU107
Sample Date: 6/13/18

Analyte	Result	DL	Units
Fluoride, IC	59.0	30.0	µg/sample

Lab ID: 18-S1091
Client ID: M13B Run 2
Source: CFU107
Sample Date: 6/13/18

Analyte	Result	DL	Units
Fluoride, IC	58.0	30.0	µg/sample

Lab ID: 18-S1092
Client ID: M13B Run 3
Source: CFU107
Sample Date: 6/13/18

Analyte	Result	DL	Units
Fluoride, IC	66.0	30.0	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1051
Client ID: M26A Run 1
Source: CFU114
Sample Date: 6/ 5/18
Sample Volume: 360. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	0.028	0.011	10.2	3.79

Lab ID: 18-S1052
Client ID: M26A Run 2
Source: CFU114
Sample Date: 6/ 5/18
Sample Volume: 365. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	0.031	0.011	11.1	3.84

Lab ID: 18-S1053
Client ID: M26A Run 3
Source: CFU114
Sample Date: 6/ 5/18
Sample Volume: 370. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	0.029	0.011	10.9	3.90

Lab ID: 18-S1054
Client ID: M26A 0.1N H2SO4 Blank
Sample Date: 6/ 5/18
Sample Volume: 360. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	< DL	0.011	< DL	3.79

Lab ID: 18-S1055
Client ID: M26A Run 1
Source: CFU117
Sample Date: 6/ 9/18
Sample Volume: 340. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	0.053	0.011	17.9	3.58

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1056
Client ID: M26A Run 2
Source: CFU117
Sample Date: 6/10/18
Sample Volume: 370. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	0.039	0.011	14.4	3.90

Lab ID: 18-S1057
Client ID: M26A Run 3
Source: CFU117
Sample Date: 6/10/18
Sample Volume: 375. mL

Analyte	mg/L Conc.	mg/L DL	µg/sample Conc.	µg/sample DL
HF	0.038	0.011	14.2	3.95

Lab ID: 18-S1058
Client ID: M26A Audit SSAS331

Analyte	mg/L Conc.	mg/L DL
HF	19.3	0.011

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1093
Client ID: M26A Run 1
Source: CFU107
Sample Date: 6/13/18
Sample Volume: 380. mL

	mg/L		µg/sample	
Analyte	Conc.	DL	Conc.	DL
HF	0.046	0.011	17.6	4.00

Lab ID: 18-S1094
Client ID: M26A Run 2
Source: CFU107
Sample Date: 6/13/18
Sample Volume: 380. mL

	mg/L		µg/sample	
Analyte	Conc.	DL	Conc.	DL
HF	0.029	0.011	11.2	4.00

Lab ID: 18-S1095
Client ID: M26A Run 3
Source: CFU107
Sample Date: 6/13/18
Sample Volume: 375. mL

	mg/L		µg/sample	
Analyte	Conc.	DL	Conc.	DL
HF	0.018	0.011	6.71	3.95

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1067
Client ID: M29 Cont. 1&3 Run 1
Source: CFU114
Sample Date: 6/ 7/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.94	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.11	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	2.35	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.32	0.075	µg/sample
Nickel, ICP	2.98	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	14.8	0.750	µg/sample

Lab ID: 18-S1068
Client ID: M29 Cont. 4 Run 1
Source: CFU114
Sample Date: 6/ 7/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.567	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.295	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	0.459	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	1.90	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1069
Client ID: M29 Cont. 1&3 Run 2
Source: CFU114
Sample Date: 6/ 7/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.79	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.09	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.84	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	0.964	0.075	µg/sample
Nickel, ICP	2.02	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	11.7	0.750	µg/sample

Lab ID: 18-S1070
Client ID: M29 Cont. 4 Run 2
Source: CFU114
Sample Date: 6/ 7/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.487	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.187	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	1.94	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.468	0.030	µg/sample
Nickel, ICP	0.405	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	1.34	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1071
Client ID: M29 Cont. 1&3 Run 3
Source: CFU114
Sample Date: 6/ 7/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.66	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.14	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.83	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	0.911	0.075	µg/sample
Nickel, ICP	2.24	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	2.70	0.750	µg/sample

Lab ID: 18-S1072
Client ID: M29 Cont. 4 Run 3
Source: CFU114
Sample Date: 6/ 7/18

Analyte	Result	DL	Units
Antimony, ICP	2.66	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.472	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.163	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	1.78	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.428	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	1.44	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1073
Client ID: M29 Cont. 1&3 Run 1
Source: CFU117
Sample Date: 6/ 8/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.84	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.03	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	2.19	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.29	0.075	µg/sample
Nickel, ICP	2.25	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	5.47	0.750	µg/sample

Lab ID: 18-S1074
Client ID: M29 Cont. 4 Run 1
Source: CFU117
Sample Date: 6/ 8/18

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	0.186	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	1.91	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.453	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	1.58	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1075
Client ID: M29 Cont. 1&3 Run 2
Source: CFU117
Sample Date: 6/ 8/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.63	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.08	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.78	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	0.948	0.075	µg/sample
Nickel, ICP	2.29	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	5.72	0.750	µg/sample

Lab ID: 18-S1076
Client ID: M29 Cont. 4 Run 2
Source: CFU117
Sample Date: 6/ 8/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.481	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.156	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	2.03	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.423	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	2.23	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1077
Client ID: M29 Cont. 1&3 Run 3
Source: CFU117
Sample Date: 6/ 8/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.77	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.05	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.53	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	0.908	0.075	µg/sample
Nickel, ICP	2.23	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	3.05	0.750	µg/sample

Lab ID: 18-S1078
Client ID: M29 Cont. 4 Run 3
Source: CFU117
Sample Date: 6/ 8/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	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	0.206	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	2.02	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.492	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	1.92	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1079
Client ID: M29 0.1N HNO3 Blank
Sample Date: 6/ 7/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	0.452	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	1.68	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	0.313	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-S1080
Client ID: M29 Filter Blank
Sample Date: 6/ 7/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.20	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	0.948	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	0.546	0.075	µg/sample
Nickel, ICP	2.08	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	1.78	0.750	µg/sample

Lab ID: 18-S1081
Client ID: M29 5%HNO3/10%H2O2 Blank
Sample Date: 6/ 7/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.462	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.156	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	1.72	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.389	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	0.376	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1082
Client ID: M29 Filter Audit SSAS331

Analyte	Result	DL	Units
Antimony, ICP	29.9	1.25	µg/sample
Arsenic, ICP	16.3	1.75	µg/sample
Barium, ICP	25.8	0.125	µg/sample
Beryllium, ICP	11.9	0.050	µg/sample
Cadmium, ICP	14.1	0.100	µg/sample
Chromium, ICP	19.3	0.200	µg/sample
Cobalt, ICP	13.3	0.125	µg/sample
Copper, ICP	13.1	1.25	µg/sample
Lead, ICP	23.2	1.25	µg/sample
Manganese, ICP	13.9	0.075	µg/sample
Nickel, ICP	24.7	0.750	µg/sample
Phosphorus, ICP	51.6	5.00	µg/sample
Selenium, ICP	21.7	3.75	µg/sample
Zinc, ICP	27.2	0.750	µg/sample

Lab ID: 18-S1083
Client ID: M29 Impinger Audit SSAS331

Analyte	Result	DL	Units
Antimony, ICP	16.2	0.00200	µg/mL
Arsenic, ICP	18.9	0.00280	µg/mL
Barium, ICP	17.5	0.00020	µg/mL
Beryllium, ICP	16.6	0.00008	µg/mL
Cadmium, ICP	19.4	0.00016	µg/mL
Chromium, ICP	20.7	0.00032	µg/mL
Cobalt, ICP	17.9	0.00020	µg/mL
Copper, ICP	18.1	0.00200	µg/mL
Lead, ICP	16.5	0.00200	µg/mL
Manganese, ICP	18.2	0.00012	µg/mL
Nickel, ICP	21.0	0.00120	µg/mL
Phosphorus, ICP	0.321	0.00800	µg/mL
Selenium, ICP	17.6	0.00600	µg/mL
Zinc, ICP	17.5	0.00120	µg/mL

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1084
Client ID: M29 Cont. 1&3 Run 1
Source: CFU107
Sample Date: 6/12/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.74	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.15	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.33	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	1.00	0.075	µg/sample
Nickel, ICP	2.36	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	3.40	0.750	µg/sample

Lab ID: 18-S1085
Client ID: M29 Cont. 4 Run 1
Source: CFU107
Sample Date: 6/12/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.499	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.284	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	1.67	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.693	0.030	µg/sample
Nickel, ICP	1.42	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Zinc, ICP	2.76	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1086
Client ID: M29 Cont. 1&3 Run 2
Source: CFU107
Sample Date: 6/12/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.77	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.08	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.46	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	0.989	0.075	µg/sample
Nickel, ICP	2.89	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	5.49	0.750	µg/sample

Lab ID: 18-S1087
Client ID: M29 Cont. 4 Run 2
Source: CFU107
Sample Date: 6/12/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.449	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.184	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	1.56	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.469	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	2.62	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 18-236

Lab ID: 18-S1088
Client ID: M29 Cont. 1&3 Run 3
Source: CFU107
Sample Date: 6/12/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	3.73	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.05	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.73	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	0.947	0.075	µg/sample
Nickel, ICP	2.48	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Zinc, ICP	4.55	0.750	µg/sample

Lab ID: 18-S1089
Client ID: M29 Cont. 4 Run 3
Source: CFU107
Sample Date: 6/12/18

Analyte	Result	DL	Units
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.493	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	< DL	0.040	µg/sample
Chromium, ICP	0.193	0.080	µg/sample
Cobalt, ICP	< DL	0.050	µg/sample
Copper, ICP	1.58	0.500	µg/sample
Lead, ICP	< DL	0.500	µg/sample
Manganese, ICP	0.404	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	2.05	0.300	µg/sample

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: Ion Chromatography
Sample Description: Method 13B
Report Number: 18-236

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
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	1.01	100.8
F	CCV	1.00	1.01	100.9
F	CCV	1.00	1.01	101.4
F	CCV	1.00	1.02	101.7

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-S1090	0.059	0.058	1.71 #

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	1.02	1.00	102.
F	LCS	< 0.03	0.997	1.00	99.7
F	18-S1091	0.058	1.06	1.00	100.

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	1.02	0.997	1.79

RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100
Duplicate Limit: 20% RPD

LCS Limit: 80% - 120% Recovery

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QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: Ion Chromatography
Sample Description: Method 26A
Report Number: 18-236

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	1.01	101.4
F	CCV	1.00	1.01	101.0
F	CCV	1.00	1.02	101.5
F	CCV	1.00	1.01	101.4

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-S1051	0.027	1.04	1.00	102.
F	18-S1055	0.050	1.06	1.00	101.
F	18-S1093	0.044	1.03	1.00	99.0

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

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29
Report Number: 18-236

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	ICB	< 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	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	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	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	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	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	Meth_Blk	< 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	Meth_Blk	< DL	20.0
P	CCB	< DL	20.0
P	CCB	< DL	20.0
Pb	ICB	< DL	5.00
Pb	Meth_Blk	< 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: Method 29
Report Number: 18-236

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
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	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	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	Meth_Blk	< 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	2450	98.2
As	LL-CCV	35.0	33.8	96.7
As	CCV	2500	2410	96.5
As	CCV	2500	2420	96.7
Ba	ICV	2500	2360	94.5
Ba	LL-CCV	2.50	2.34	93.7
Ba	CCV	2500	2360	94.4
Ba	CCV	2500	2400	96.1
Ba	CCV	2500	2390	95.6
Ba	CCV	2500	2400	95.9
Ba	ICV	2500	2390	95.6
Ba	LL-CCV	2.50	2.36	94.4
Ba	CCV	2500	2430	97.1
Be	ICV	2500	2480	99.0
Be	LL-CCV	1.00	0.93	92.8
Be	CCV	2500	2440	97.8
Be	CCV	2500	2440	97.4
Be	CCV	2500	2450	97.9
Be	CCV	2500	2480	99.2
Cd	ICV	2500	2480	99.4
Cd	LL-CCV	2.00	2.06	103.1
Cd	CCV	2500	2450	98.1
Cd	CCV	2500	2450	98.1
Co	ICV	2500	2480	99.0

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
Report Number: 18-236

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Co	LL-CCV	2.50	2.49	99.6
Co	CCV	2500	2460	98.4
Co	CCV	2500	2460	98.2
Cr	ICV	2500	2460	98.3
Cr	LL-CCV	4.00	4.22	105.5
Cr	CCV	2500	2440	97.8
Cr	CCV	2500	2440	97.6
Cr	CCV	2500	2460	98.2
Cr	CCV	2500	2470	98.9
Cu	ICV	2500	2430	97.0
Cu	LL-CCV	25.0	27.1	108.2
Cu	CCV	2500	2440	97.7
Cu	CCV	2500	2420	96.9
Mn	ICV	2500	2550	101.9
Mn	LL-CCV	1.50	1.58	105.3
Mn	CCV	2500	2530	101.3
Mn	CCV	2500	2530	101.0
Mn	CCV	2500	2540	101.6
Mn	CCV	2500	2560	102.4
Ni	ICV	2500	2480	99.4
Ni	LL-CCV	15.0	15.9	106.1
Ni	CCV	2500	2460	98.6
Ni	CCV	2500	2460	98.6
Ni	CCV	2500	2470	99.0
Ni	CCV	2500	2480	99.3
P	ICV	2500	2450	98.0
P	LL-CCV	100.	97.2	97.2
P	CCV	2500	2370	94.8
P	CCV	2500	2360	94.5
Pb	ICV	2500	2440	97.7
Pb	LL-CCV	25.0	25.9	103.7
Pb	CCV	2500	2350	93.9
Pb	CCV	2500	2380	95.4
Pb	CCV	2500	2410	96.5
Pb	CCV	2500	2420	96.6
Sb	ICV	2500	2490	99.5
Sb	LL-CCV	25.0	26.6	106.2
Sb	CCV	2500	2440	97.4
Sb	CCV	2500	2440	97.8
Se	ICV	2500	2480	99.2
Se	LL-CCV	75.0	72.0	96.0
Se	CCV	2500	2400	96.0
Se	CCV	2500	2400	96.2
Se	CCV	2500	2380	95.1
Se	CCV	2500	2350	94.1
Zn	ICV	2500	2530	101.1
Zn	LL-CCV	15.0	17.0	113.3
Zn	CCV	2500	2500	100.2
Zn	CCV	2500	2500	99.9
Zn	CCV	2500	2510	100.5
Zn	CCV	2500	2510	100.6

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: Method 29
Report Number: 18-236

Duplicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
As	18-S1067	< 7	< 7	N/C #
Ba	18-S1067	15.76	15.77	0.06
Ba	18-S1068	5.667	5.784	2.04
Be	18-S1067	< 0.2	< 0.2	N/C #
Be	18-S1068	< 0.2	< 0.2	N/C #
Cd	18-S1067	< 0.4	< 0.4	N/C #
Co	18-S1067	< 0.5	< 0.5	N/C #
Cr	18-S1067	4.456	4.720	5.75
Cr	18-S1068	2.951	2.871	2.75 #
Cu	18-S1067	9.389	8.473	10.3 #
Mn	18-S1067	5.265	5.417	2.85
Mn	18-S1068	4.592	4.510	1.80
Ni	18-S1067	11.91	12.34	3.55 #
Ni	18-S1068	< 3	< 3	N/C #
P	18-S1067	< 20	< 20	N/C #
Pb	18-S1067	< 5	< 5	N/C #
Pb	18-S1068	< 5	< 5	N/C #
Sb	18-S1067	< 5	< 5	N/C #
Se	18-S1067	< 15	< 15	N/C #
Se	18-S1068	< 15	< 15	N/C #
Zn	18-S1067	59.38	60.52	1.90
Zn	18-S1068	19.05	19.06	0.05

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	2747.	2500.	110.
As	LCS	< 7	2771.	2500.	111.
As	18-S1069	< 7	2506.	2500.	100.
Ba	LCS	< 0.5	2652.	2500.	106.
Ba	LCS	< 0.5	2626.	2500.	105.
Ba	18-S1069	15.15	2456.	2500.	97.6
Ba	LCS	< 0.5	2576.	2500.	103.
Ba	LCS	< 0.5	2637.	2500.	105.
Ba	18-S1070	4.866	2371.	2500.	94.6
Be	LCS	< 0.2	2612.	2500.	104.
Be	LCS	< 0.2	2600.	2500.	104.
Be	18-S1069	< 0.2	2308.	2500.	92.3
Be	LCS	< 0.2	2721.	2500.	109.
Be	LCS	< 0.2	2392.	2500.	95.7
Be	18-S1070	< 0.2	2250.	2500.	90.0
Cd	LCS	< 0.4	2835.	2500.	113.
Cd	LCS	< 0.4	2842.	2500.	114.
Cd	18-S1069	< 0.4	2538.	2500.	102.
Co	LCS	< 0.5	2765.	2500.	111.
Co	LCS	< 0.5	2768.	2500.	111.
Co	18-S1069	< 0.5	2499.	2500.	100.
Cr	LCS	< 0.8	2707.	2500.	108.
Cr	LCS	< 0.8	2708.	2500.	108.

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
Report Number: 18-236

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Cr	18-S1069	4.364	2518.	2500.	101.
Cr	LCS	< 0.8	2936.	2500.	117.
Cr	LCS	< 0.8	2584.	2500.	103.
Cr	18-S1070	1.866	2466.	2500.	98.6
Cu	LCS	< 5	2669.	2500.	107.
Cu	LCS	< 5	2666.	2500.	107.
Cu	18-S1069	7.373	2588.	2500.	103.
Mn	LCS	< 0.3	2805.	2500.	112.
Mn	LCS	< 0.3	2811.	2500.	112.
Mn	18-S1069	3.855	2590.	2500.	103.
Mn	LCS	< 0.3	3019.	2500.	121.
Mn	LCS	< 0.3	2651.	2500.	106.
Mn	18-S1070	4.682	2524.	2500.	101.
Ni	LCS	< 3	2796.	2500.	112.
Ni	LCS	< 3	2809.	2500.	112.
Ni	18-S1069	8.076	2523.	2500.	101.
Ni	LCS	< 3	2894.	2500.	116.
Ni	LCS	< 3	2551.	2500.	102.
Ni	18-S1070	4.050	2414.	2500.	96.4
P	LCS	< 20	2689.	2500.	108.
P	LCS	< 20	2728.	2500.	109.
P	18-S1069	< 20	2486.	2500.	99.4
Pb	LCS	< 5	2749.	2500.	110.
Pb	LCS	< 5	2779.	2500.	111.
Pb	18-S1069	< 5	2414.	2500.	96.6
Pb	LCS	< 5	2816.	2500.	113.
Pb	LCS	< 5	2477.	2500.	99.1
Pb	18-S1070	< 5	2356.	2500.	94.2
Sb	LCS	< 5	2746.	2500.	110.
Sb	LCS	< 5	2782.	2500.	111.
Sb	18-S1069	< 5	2513.	2500.	101.
Se	LCS	< 15	2731.	2500.	109.
Se	LCS	< 15	2768.	2500.	111.
Se	18-S1069	< 15	2451.	2500.	98.0
Se	LCS	< 15	2716.	2500.	109.
Se	LCS	< 15	2389.	2500.	95.6
Se	18-S1070	< 15	2271.	2500.	90.8
Zn	LCS	< 3	2947.	2500.	118.
Zn	LCS	< 3	2956.	2500.	118.
Zn	18-S1069	46.92	2714.	2500.	107.
Zn	LCS	< 3	2928.	2500.	117.
Zn	LCS	< 3	2578.	2500.	103.
Zn	18-S1070	13.36	2430.	2500.	96.7

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	2750	2770	0.87
Ba	LCS-DUP	2650	2630	0.99
Ba	LCS-DUP	2580	2640	2.34
Be	LCS-DUP	2610	2600	0.46
Be	LCS-DUP	2720	2390	12.9

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
Report Number: 18-236

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
Cd	LCS-DUP	2840	2840	0.25
Co	LCS-DUP	2760	2770	0.11
Cr	LCS-DUP	2710	2710	0.04
Cr	LCS-DUP	2940	2580	12.8
Cu	LCS-DUP	2670	2670	0.11
Mn	LCS-DUP	2800	2810	0.21
Mn	LCS-DUP	3020	2650	13.0
Ni	LCS-DUP	2800	2810	0.46
Ni	LCS-DUP	2890	2550	12.6
P	LCS-DUP	2690	2730	1.44
Pb	LCS-DUP	2750	2780	1.09
Pb	LCS-DUP	2820	2480	12.8
Sb	LCS-DUP	2750	2780	1.30
Se	LCS-DUP	2730	2770	1.35
Se	LCS-DUP	2720	2390	12.8
Zn	LCS-DUP	2950	2960	0.30
Zn	LCS-DUP	2930	2580	12.7

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
Report Number: 18-236

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	ICB	< 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	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	Meth_Blk	< 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	Meth_Blk	< 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	Meth_Blk	< DL	3.00
Ni	CCB	< DL	3.00
Ni	Meth_Blk	< DL	3.00
Ni	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
Report Number: 18-236

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
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
P	CCB	< DL	20.0
P	CCB	< DL	20.0
P	CCB	< DL	20.0
P	ICB	< DL	20.0
P	CCB	< DL	20.0
P	CCB	< DL	20.0
Pb	ICB	< DL	5.00
Pb	Meth_Blk	< 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	Meth_Blk	< 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	Meth_Blk	< 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	2450	97.9
As	LL-CCV	35.0	36.4	103.9
As	CCV	2500	2390	95.7
As	CCV	2500	2400	95.8
As	CCV	2500	2400	95.9
As	CCV	2500	2390	95.8
Ba	ICV	2500	2360	94.5
Ba	LL-CCV	2.50	2.34	93.7
Ba	CCV	2500	2360	94.4

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: Method 29
Report Number: 18-236

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Ba	CCV	2500	2400	96.1
Ba	CCV	2500	2390	95.6
Ba	CCV	2500	2400	95.9
Ba	ICV	2500	2390	95.6
Ba	LL-CCV	2.50	2.36	94.4
Ba	CCV	2500	2430	97.1
Be	ICV	2500	2480	99.0
Be	LL-CCV	1.00	0.93	92.8
Be	CCV	2500	2440	97.8
Be	CCV	2500	2440	97.4
Be	CCV	2500	2450	97.9
Be	CCV	2500	2480	99.2
Cd	ICV	2500	2480	99.4
Cd	LL-CCV	2.00	2.14	107.0
Cd	CCV	2500	2450	98.1
Cd	CCV	2500	2450	98.1
Cd	CCV	2500	2480	99.1
Cd	CCV	2500	2500	100.0
Co	ICV	2500	2520	100.7
Co	LL-CCV	2.50	3.08	123.4
Co	CCV	2500	2450	98.0
Co	CCV	2500	2470	98.6
Co	CCV	2500	2480	99.4
Co	CCV	2500	2480	99.0
Cr	ICV	2500	2460	98.3
Cr	LL-CCV	4.00	4.22	105.5
Cr	CCV	2500	2440	97.8
Cr	CCV	2500	2440	97.6
Cr	CCV	2500	2460	98.2
Cr	CCV	2500	2470	98.9
Cu	ICV	2500	2470	98.8
Cu	LL-CCV	25.0	29.7	118.6
Cu	CCV	2500	2570	102.7
Cu	CCV	2500	2560	102.6
Cu	CCV	2500	2550	102.0
Cu	CCV	2500	2510	100.4
Mn	ICV	2500	2550	101.9
Mn	LL-CCV	1.50	1.58	105.3
Mn	CCV	2500	2530	101.3
Mn	CCV	2500	2530	101.0
Mn	CCV	2500	2540	101.6
Mn	CCV	2500	2560	102.4
Ni	ICV	2500	2480	99.4
Ni	LL-CCV	15.0	15.9	106.1
Ni	CCV	2500	2460	98.6
Ni	CCV	2500	2460	98.6
Ni	CCV	2500	2470	99.0
Ni	CCV	2500	2480	99.3
P	ICV	2500	2420	96.9
P	LL-CCV	100.	83.1	83.1
P	CCV	2500	2340	93.7
P	CCV	2500	2320	93.0
P	CCV	2500	2360	94.5
P	CCV	2500	2380	95.3
P	ICV	2500	2340	93.6
P	LL-CCV	100.	97.3	97.3
P	CCV	2500	2290	91.4

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: Method 29
Report Number: 18-236

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
P	CCV	2500	2270	90.6
Pb	ICV	2500	2440	97.7
Pb	LL-CCV	25.0	25.9	103.7
Pb	CCV	2500	2350	93.9
Pb	CCV	2500	2380	95.4
Pb	CCV	2500	2410	96.5
Pb	CCV	2500	2420	96.6
Sb	ICV	2500	2490	99.4
Sb	LL-CCV	25.0	25.9	103.6
Sb	CCV	2500	2430	97.4
Sb	CCV	2500	2440	97.7
Sb	CCV	2500	2460	98.5
Sb	CCV	2500	2480	99.1
Se	ICV	2500	2480	99.2
Se	LL-CCV	75.0	72.0	96.0
Se	CCV	2500	2400	96.0
Se	CCV	2500	2400	96.2
Se	CCV	2500	2380	95.1
Se	CCV	2500	2350	94.1
Zn	ICV	2500	2530	101.1
Zn	LL-CCV	15.0	17.0	113.3
Zn	CCV	2500	2500	100.2
Zn	CCV	2500	2500	99.9
Zn	CCV	2500	2510	100.5
Zn	CCV	2500	2510	100.6

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

Duplicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD	
As	18-S1068	< 7	< 7	N/C	#
Ba	18-S1067	15.76	15.77	0.06	
Ba	18-S1068	5.667	5.784	2.04	
Be	18-S1067	< 0.2	< 0.2	N/C	#
Be	18-S1068	< 0.2	< 0.2	N/C	#
Cd	18-S1068	< 0.4	< 0.4	N/C	#
Co	18-S1068	< 0.5	< 0.5	N/C	#
Cr	18-S1067	4.456	4.720	5.75	
Cr	18-S1068	2.951	2.871	2.75	#
Cu	18-S1068	24.65	23.03	6.80	#
Mn	18-S1067	5.265	5.417	2.85	
Mn	18-S1068	4.592	4.510	1.80	
Ni	18-S1067	11.91	12.34	3.55	#
Ni	18-S1068	< 3	< 3	N/C	#
P	18-S1068	< 20	< 20	N/C	#
Pb	18-S1067	< 5	< 5	N/C	#
Pb	18-S1068	< 5	< 5	N/C	#
Sb	18-S1068	< 5	< 5	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: Method 29
Report Number: 18-236

Duplicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
Se	18-S1067	< 15	< 15	N/C #
Se	18-S1068	< 15	< 15	N/C #
Zn	18-S1067	59.38	60.52	1.90
Zn	18-S1068	19.05	19.06	0.05

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	2782.	2500.	111.
As	LCS	< 7	2448.	2500.	97.9
As	18-S1070	< 7	2336.	2500.	93.4
Ba	LCS	< 0.5	2652.	2500.	106.
Ba	LCS	< 0.5	2626.	2500.	105.
Ba	18-S1069	15.15	2456.	2500.	97.6
Ba	LCS	< 0.5	2576.	2500.	103.
Ba	LCS	< 0.5	2637.	2500.	105.
Ba	18-S1070	4.866	2371.	2500.	94.6
Be	LCS	< 0.2	2612.	2500.	104.
Be	LCS	< 0.2	2600.	2500.	104.
Be	18-S1069	< 0.2	2308.	2500.	92.3
Be	LCS	< 0.2	2721.	2500.	109.
Be	LCS	< 0.2	2392.	2500.	95.7
Be	18-S1070	< 0.2	2250.	2500.	90.0
Cd	LCS	< 0.4	2884.	2500.	115.
Cd	LCS	< 0.4	2537.	2500.	101.
Cd	18-S1070	< 0.4	2397.	2500.	95.9
Co	LCS	< 0.5	2688.	2500.	108.
Co	LCS	< 0.5	2388.	2500.	95.5
Co	18-S1070	< 0.5	2253.	2500.	90.1
Cr	LCS	< 0.8	2707.	2500.	108.
Cr	LCS	< 0.8	2708.	2500.	108.
Cr	18-S1069	4.364	2518.	2500.	101.
Cr	LCS	< 0.8	2936.	2500.	117.
Cr	LCS	< 0.8	2584.	2500.	103.
Cr	18-S1070	1.866	2466.	2500.	98.6
Cu	LCS	< 5	2819.	2500.	113.
Cu	LCS	< 5	2499.	2500.	100.
Cu	18-S1070	19.43	2375.	2500.	94.2
Mn	LCS	< 0.3	2805.	2500.	112.
Mn	LCS	< 0.3	2811.	2500.	112.
Mn	18-S1069	3.855	2590.	2500.	103.
Mn	LCS	< 0.3	3019.	2500.	121.
Mn	LCS	< 0.3	2651.	2500.	106.
Mn	18-S1070	4.682	2524.	2500.	101.
Ni	LCS	< 3	2796.	2500.	112.
Ni	LCS	< 3	2809.	2500.	112.
Ni	18-S1069	8.076	2523.	2500.	101.
Ni	LCS	< 3	2894.	2500.	116.
Ni	LCS	< 3	2551.	2500.	102.

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
Report Number: 18-236

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Ni	18-S1070	4.050	2414.	2500.	96.4
P	LCS	< 20	2525.	2500.	101.
P	LCS	< 20	2215.	2500.	88.6
P	18-S1070	< 20	2104.	2500.	84.2
Pb	LCS	< 5	2749.	2500.	110.
Pb	LCS	< 5	2779.	2500.	111.
Pb	18-S1069	< 5	2414.	2500.	96.6
Pb	LCS	< 5	2816.	2500.	113.
Pb	LCS	< 5	2477.	2500.	99.1
Pb	18-S1070	< 5	2356.	2500.	94.2
Sb	LCS	< 5	2877.	2500.	115.
Sb	LCS	< 5	2545.	2500.	102.
Sb	18-S1070	< 5	2391.	2500.	95.6
Se	LCS	< 15	2731.	2500.	109.
Se	LCS	< 15	2768.	2500.	111.
Se	18-S1069	< 15	2451.	2500.	98.0
Se	LCS	< 15	2716.	2500.	109.
Se	LCS	< 15	2389.	2500.	95.6
Se	18-S1070	< 15	2271.	2500.	90.8
Zn	LCS	< 3	2947.	2500.	118.
Zn	LCS	< 3	2956.	2500.	118.
Zn	18-S1069	46.92	2714.	2500.	107.
Zn	LCS	< 3	2928.	2500.	117.
Zn	LCS	< 3	2578.	2500.	103.
Zn	18-S1070	13.36	2430.	2500.	96.7

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	2780	2450	12.8
Ba	LCS-DUP	2650	2630	0.99
Ba	LCS-DUP	2580	2640	2.34
Be	LCS-DUP	2610	2600	0.46
Be	LCS-DUP	2720	2390	12.9
Cd	LCS-DUP	2880	2540	12.8
Co	LCS-DUP	2690	2390	11.8
Cr	LCS-DUP	2710	2710	0.04
Cr	LCS-DUP	2940	2580	12.8
Cu	LCS-DUP	2820	2500	12.0
Mn	LCS-DUP	2800	2810	0.21
Mn	LCS-DUP	3020	2650	13.0
Ni	LCS-DUP	2800	2810	0.46
Ni	LCS-DUP	2890	2550	12.6
P	LCS-DUP	2520	2220	13.1
Pb	LCS-DUP	2750	2780	1.09
Pb	LCS-DUP	2820	2480	12.8
Sb	LCS-DUP	2880	2540	12.2
Se	LCS-DUP	2730	2770	1.35
Se	LCS-DUP	2720	2390	12.8
Zn	LCS-DUP	2950	2960	0.30
Zn	LCS-DUP	2930	2580	12.7

Duplicate Limit: 20% RPD
RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100

CHESTER LABNET
SOURCE SAMPLE RECEIPT CHECKLIST

Client: Bison Engineering Date: 6/11/18 + 6/15/18

Runs: 9 + Blank Report #: 18-236

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 Yes	!!
M26 samples have Thiosulfate added in field?	N/A	!!
M29 indicate FH/BH separate or combined?	Complies ✓	!!
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?	NA	
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?	6/15/18	
Corrective Actions Documented?	SMB	
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: Lisa Ball

Notes: _____

Lisa Ball

From: Kelly Dorsi <KDorsi@bison-eng.com>
Sent: Monday, June 11, 2018 3:30 PM
To: Lisa Ball
Subject: RE: HAV218718 M29

Hi Lisa,

Looks good. Should be all the metals except thallium, silver and mercury. Front and back half split. Normal TAT. Thanks for checking!

Kelly

From: Lisa Ball <lball@chesterlab.net>
Sent: Monday, June 11, 2018 4:26 PM
To: Kelly Dorsi <KDorsi@bison-eng.com>
Subject: HAV218718 M29

Hi Kelly,

I just need to confirm which metals we are analyzing for the M29 samples we received today. Previously we have analyzed the following: Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, P, Se, Zn.

Thanks,

Lisa Ball
CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
lball@chesterlab.net
http:\\www.chesterlab.net
(503)624-2183
fax (503)624-2653

18-230

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	HAV218718

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Fax (503) 624-2653
cln@chesterlab.net

CHAIN-OF-CUSTODY RECORD

Report # 18-236

Analysis Requested

M-26A
M-13B
HF

Turn Around Time
☒ Standard
☐ Rush _____ Specify

LabNet ID	Field Sample ID	Site	Sample Date	Volume (ml)	Particle Size	Remarks
13B	M-13B cont.#1 Run1	CFU 114	6/5/18	510		18-S1059
26-A	M-26A cont.#3 Run1			365		18-S1051
13B	M-13B cont.#1 Run2			485		S1060
26-A	M-26A cont.#3 Run2			370		S1052
13B	M-13B cont.#1 Run3			540		S1061
26-A	M-26A cont.#3 Run3			371		S1053
13B	M-13B cont.#2 D.I. H2O Blank			500		S1062
26-A	M-26A 0.1N H2SO4 blank	↓	↓	360		S1054

Relinquished By: (Signature) Date/Time: [signature] 6/11/18 14:50	Received By: (Signature) Date/Time: [signature] 6/11/18 14:50
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time

Notes:

87

18-236

Company Name: Bison Engineering		
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: same as above		
City:	State:	Zip:
PO #:	Project:	

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
(503) 624-2183
Fax (503) 624-2653
cln@chesterlab.net

CHAIN-OF-CUSTODY RECORD

LabNet ID	Field Sample ID	Site	Sample Date	Volume (~~m³~~)	Particle Size	Analysis Requested: M-13B	Analysis Requested: M-26A (HF)	Remarks
	M-13B R-1 Cont. #1	CFU-117	06/09	530		X		18-S1063
	M26A R-1 Cont. #3	"	06/09	350			X	18-S1055
	M13B R-2 Cont. #1	"	06/10	525		X		S1064
	M26A R-2 Cont. #3	"	↓	376			X	18-S1056
	M-13B R-3 Cont. #1	"		532		X		S1065
	M26A R-3 Cont. #3	"		376			X	18-S1057
	sigma audit samples	SSAS331				X	X	18S1058 - M26
								18S1066 - M13B

Turn Around Time
☒ Standard
☐ Rush _____ Specify

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	Notes:
06/11 14:50	Lisa Ball 6/11/18 14:50	
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	

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: HAV218718	

CHESTER LabNet
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Tigard, OR 97223
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cln@chesterlab.net

CHAIN-OF-CUSTODY RECORD

LabNet ID	Field Sample ID	Site	Sample Date	Volume (m^3) ml	Particle Size	Analysis Requested: 26A	Analysis Requested: 13B	Remarks
	Run1 cont.#1	CFU107	6/13/18	535			X	18-51090
	Run2 cont.#1	CFU107	6/13/18	545			X	51091
	Run3 cont.#1	CFU107	6/13/18	525			X	51092
	Run1 cont.#3	CFU107	6/13/18	390		X		18-51093
	Run2 cont.#3	CFU107	6/13/18	387		X		51094
	Run3 cont.#3	CFU107	6/13/18	378		X		51095

Turn Around Time
☒ Standard
☐ Rush _____ Specify

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time 6.15.18 0935
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time

Notes:

18-236

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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: 11			
City: 11	State: 11	Zip: 11	
PO #:	Project: HAV218718		

Analysis Requested: M-29

Turn Around Time: ☒ Standard ☐ Rush _____ (Specify)

LabNet ID	Field Sample ID	Site	Sample Date	Volume (m³)	Particle Size	Remarks
	D.I. H2O Blank	n/a	6/7/18	100		
18-S1067	M-29 Probe rinse Run1	CFU114	6/7/18	100		
18-S1068	M-29 cont.#4 Run1	CFU114	6/7/18	334		
	M-29 Filter Run1	CFU114	6/7/18	n/a		
18-S1069	M-29 Probe rinse Run2	CFU114	6/7/18	100		
18-S1070	M-29 cont.#4 Run2	CFU114	6/7/18	335		
	M-29 filter Run2	CFU114	6/7/18	n/a		
18-S1071	M-29 Probe rinse Run3	CFU114	6/7/18	100		
S1072	M-29 cont.#4 Run3	CFU114	6/7/18			
	M-29 filter Run3	n/a	6/7/18	n/a		
18-S1073	M-29 filter Blank	n/a	6/7/18	n/a		
18-S1074	0.1N HNO3 Blank	n/a	6/7/18	300		
18-S1081	5% HNO3 10% H2O2 Blank	n/a	6/7/18	200		

Relinquished By: (Signature) Date/Time: 6/11/18 14:50	Received By: (Signature) Date/Time: 6/11/18 14:50
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time

Notes:

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: HAV218718	

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cln@chesterlab.net

CHAIN-OF-CUSTODY RECORD

Report # 18-236

LabNet ID	Field Sample ID	Site	Sample Date	Volume ~~(m³)~~ ml	Particle Size	Analysis Requested: M-29	Remarks
	Quartzfilterrun1	CFU 117	6/8/18	n/a			
	Quartzfilterrun2	↓	↓	n/a			
	Quartzfilterrun3	↓	↓	n/a			
18-S1073	Proberinserun1	↓	↓	100			
S1075	Proberinserun2	↓	↓	100			
S1077	Proberinserun3	↓	↓	100			
S1074	Cont.#4 Run1	↓	↓	328			
S1076	Cont.#4 Run2	↓	↓	330			
S1078	Cont.#4 Run3	↓	↓				
18-1082	Sigmaauditsamples	Filter					
1083	↓	Imp					

Turn Around Time
☒ Standard
☐ Rush _____ Specify

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	Notes:
6/11/18 14:50	6/11/18 1450	
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	

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: HAV218718	

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cln@chesterlab.net

CHAIN-OF-CUSTODY RECORD

Report # 18-236

LabNet ID	Field Sample ID	Site	Sample Date	Volume (m³) ml	Particle Size	Analysis Requested: M-29	Remarks
18-S1084	Run 1 Quartz filter	CFU107	6/12/18	n/a			
S1086	Run 2 Quartz filter	CFU107	6/12/18	n/a			
S1088	Run 3 Quartz filter	CFU107	6/12/18	n/a			
	Run 1 probe rinse	CFU107	6/12/18	100			
	Run 2 probe rinse	CFU107	6/12/18	100			
	Run 3 probe rinse	CFU107	6/12/18	100			
18-S1085	Run 1 cont. #4	CFU107	6/12/18	335			
S1087	Run 2 cont. #4	CFU107	6/12/18	325			
S1089	Run 3 cont. #4	CFU107	6/12/18	330			

Turn Around Time
☒ Standard
☐ Rush _____ Specify

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	Notes:
[signature]	[signature] 6.15.18 0935	
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	

792

RAW DATA

Available upon request

Bison Engineering, Inc.

1400 11th Avenue
Helena, MT 59601

CFU 114
Corvallis, OR
Project # HAV 218718

Analytical Report
(0618-049)

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

ENTHALPY ANALYTICAL

Summary of Results

Enthalpy Analytical

Company: Bison Engineering

Job No.: 0618-049 EPA Method 316

Client No.: HAV 218718

Compound	Sample ID / Catch Weight (µg)		
	CFU 114 M316 Run 1	***CFU 114 M316 Run 2***	***CFU 114 M316 Run 3***
Formaldehyde	293	681	305
	CFU 114 M316 Field Train Blank		
Formaldehyde	0.0137 ND		

Results

Enthalpy Analytical

Company: Bison Engineering
Job No.: 0618-049 EPA Method 316
Client No.: HAV 218718

MDL 0.0137 (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
CFU 114 M316 Run 1	4	0.2743	0.6299	1	465	293	
CFU 114 M316 Run 2	8	0.3209	0.7369	2	462	681	
CFU 114 M316 Run 3	9	0.2977	0.6835	1	446	305	
CFU 114 M316 Field Train Blank	10	0.0000	0.0137	1	1.00	0.0137	ND
Snowball II 2009 #MB	10	0.0007	0.0137	1	1.00	0.0137	ND
Snowball II 2009 #MB1	3	0.0000	0.0137	1	1.00	0.0137	ND
Snowball II 2009 #MB2	14	0.0008	0.0137	1	1.00	0.0137	ND
Snowball II 2009 #MB3	25	0.0010	0.0137	1	1.00	0.0137	ND
Snowball II 2009 #MB4	36	0.0003	0.0137	1	1.00	0.0137	ND
LD / CFU 114 M316 Run 1	5	0.2751	0.6316	1	465	294	
					% Difference	0.3%	
AD / CFU 114 M316 Run 1	7	0.1399	0.3213	2	465	299	
					%Difference	2.0%	
MS / CFU 114 M316 Run 1	6	0.6581	1.5111	1	2.50	3.78	
					spike amount (ug)	2.19	
					native amount (ug)	1.56	
					Spike recovery	101%	

Narrative Summary

ENTHALPY
ANALYTICAL

Enthalpy Analytical Narrative Summary

Company	Bison Engineering Inc.
Job #	0618-049 EPA Method 316
Client #	HAV 218718

Custody	Matthew Saint Lawrence of Enthalpy Analytical received the samples on 6/8/18 at 3.7 °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). Any sample dilutions were performed on an aliquot of the original sample prior to the addition of pararosaniline reagent. The sample volumes as provided on the COC were used to determine the sample catch weights. 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 field and labatory blanks exhibited no formaldehyde at concentrations greater than the MDL. A matrix spike was prepared using aliquots of sample ***CFU 114 M316 Run 1***. The matrix spike was analyzed in the same manner as the samples and exhibited a spike recovery of 101%. Laboratory duplicate (LD) and alternate dilution (AD) analyses were performed using sample ***CFU 114 M316 Run 1***. The results of the duplicate analyses did not differ from those of the original analyses by more than 2.0%. All sample were analyzed within the 14-day holding specified by the method.
Reporting Notes	The results presented in this report are representative of the samples as provided to the laboratory. 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.

ENTHALPY ANALYTICAL

General Reporting Notes

The following are general reporting notes that are applicable to all Enthalpy Analytical, Inc. 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.
- 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).
- 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).

General Reporting Notes

(continued)

- 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.
- **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

Chain of Custody Record

ENTHALPY analytical, inc

Page____of____

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: A Bison Engineering
Project Manager: Kelly Dorsi
Report To: Kelly Dorsi

Project Number: HAV218718
Site Name: CFU 114
Location: Corvallis Oregon

PO#: HAV218718
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.

Special Instructions:

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	Sample Containers: # of VOA Vials	# of Glass	# of Plastic	# of Bags	# of Canisters	# of Tubes	# Other	Analyses:	Notes:
CFU 114	M-316 Run1 Cont. 1	6-6-18	13:30	465 ml.											
CFU 114	M-316 Run2 Cont. 1	6-6-18	13:30	462 ml.											
CFU 114	M-316 Run3 Cont. 1	6-6-18	13:30	456 ml.											
CFU 114	M-316 Field train blk	6-6-18	13:30												

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Condition Upon Receipt:
		Matt Anderson	6/6/18	8:30AM	☒ 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

Good condition 3.7°C Raytek 5
Samples received on ice MST 6/6/18

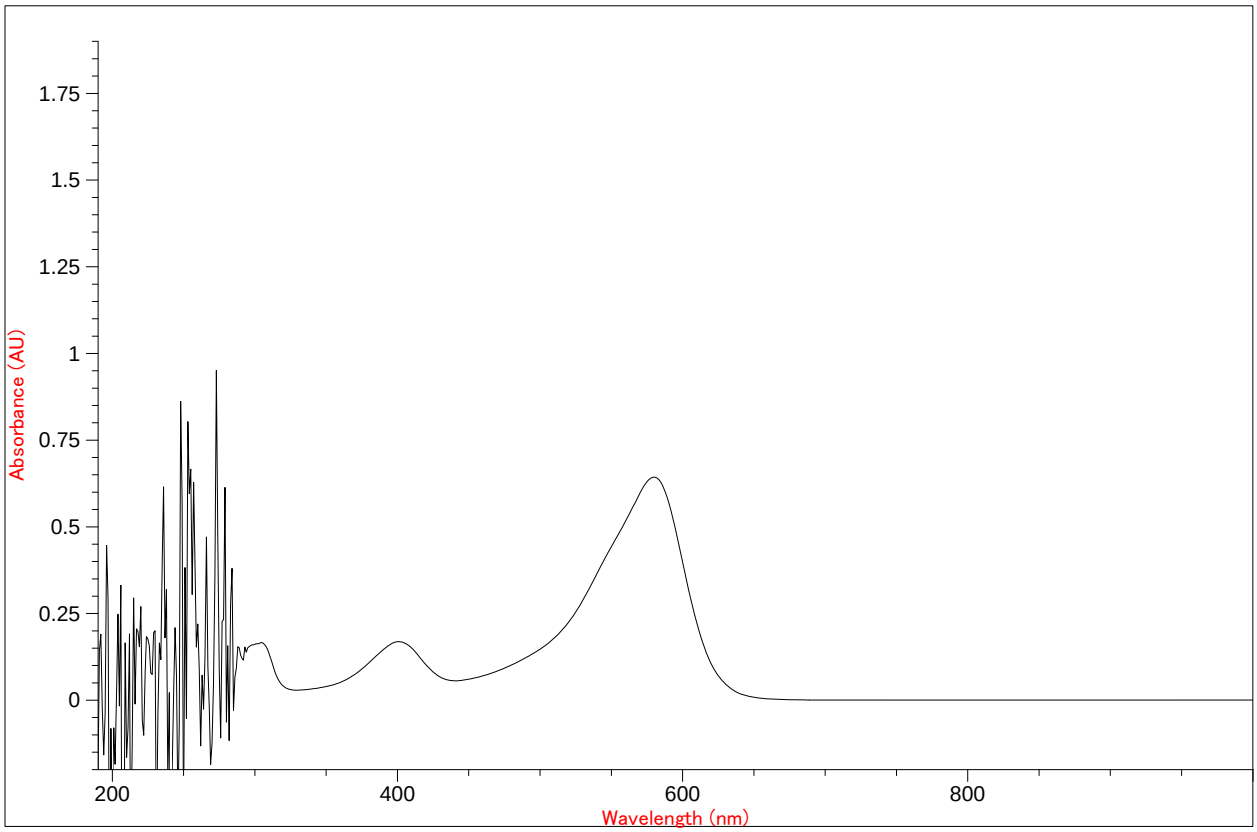
Raw Data

ENTHALPY ANALYTICAL

Sample 1

Sample Name	Snowball II 2053 #SS1 (#8)
Operator	Patricia Mann
Date	6/19/18
Time	15:34:26
Path Length	1
Path Length Unit	cm

Sample Spectrum



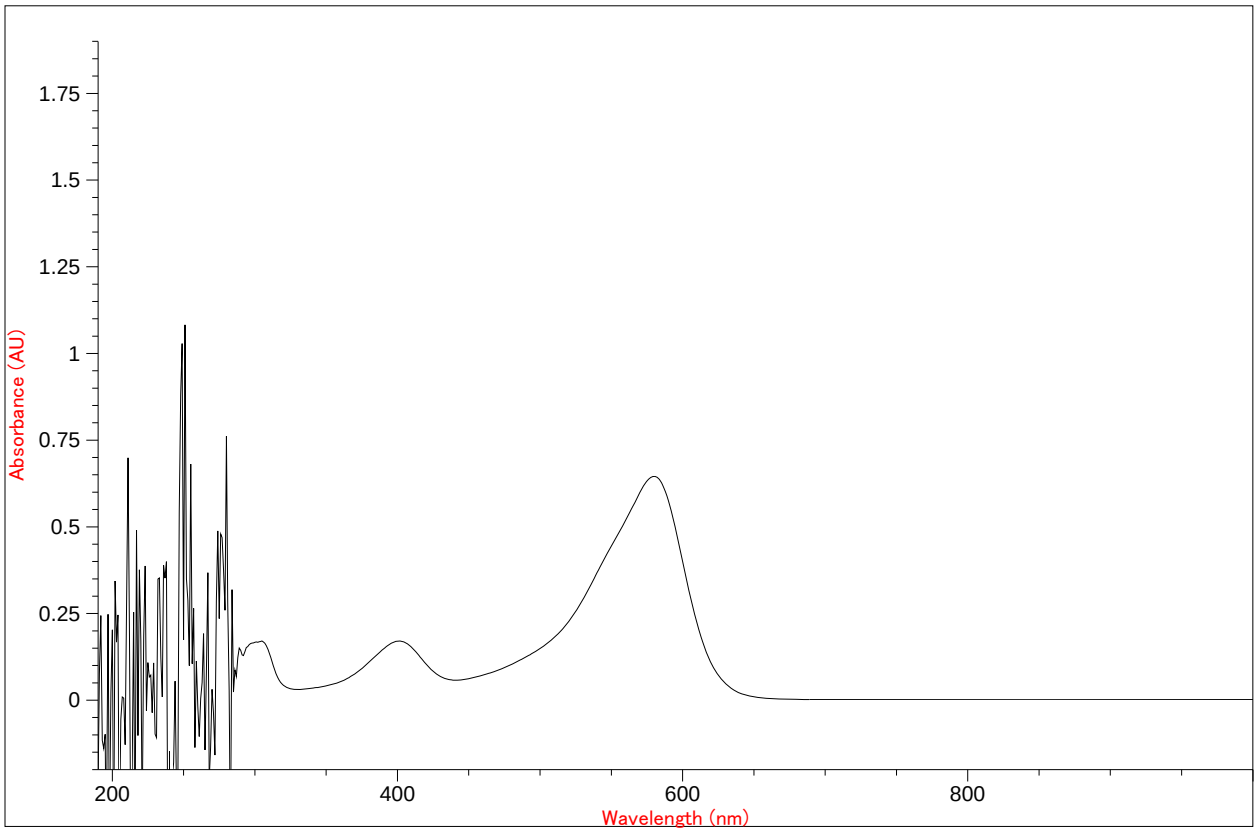
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37010	ug/mL	0.00826

Sample 2

Sample Name	Snowball II 2053 #SS2 (#9)
Operator	Patricia Mann
Date	6/19/18
Time	15:34:37
Path Length	1
Path Length Unit	cm

Sample Spectrum



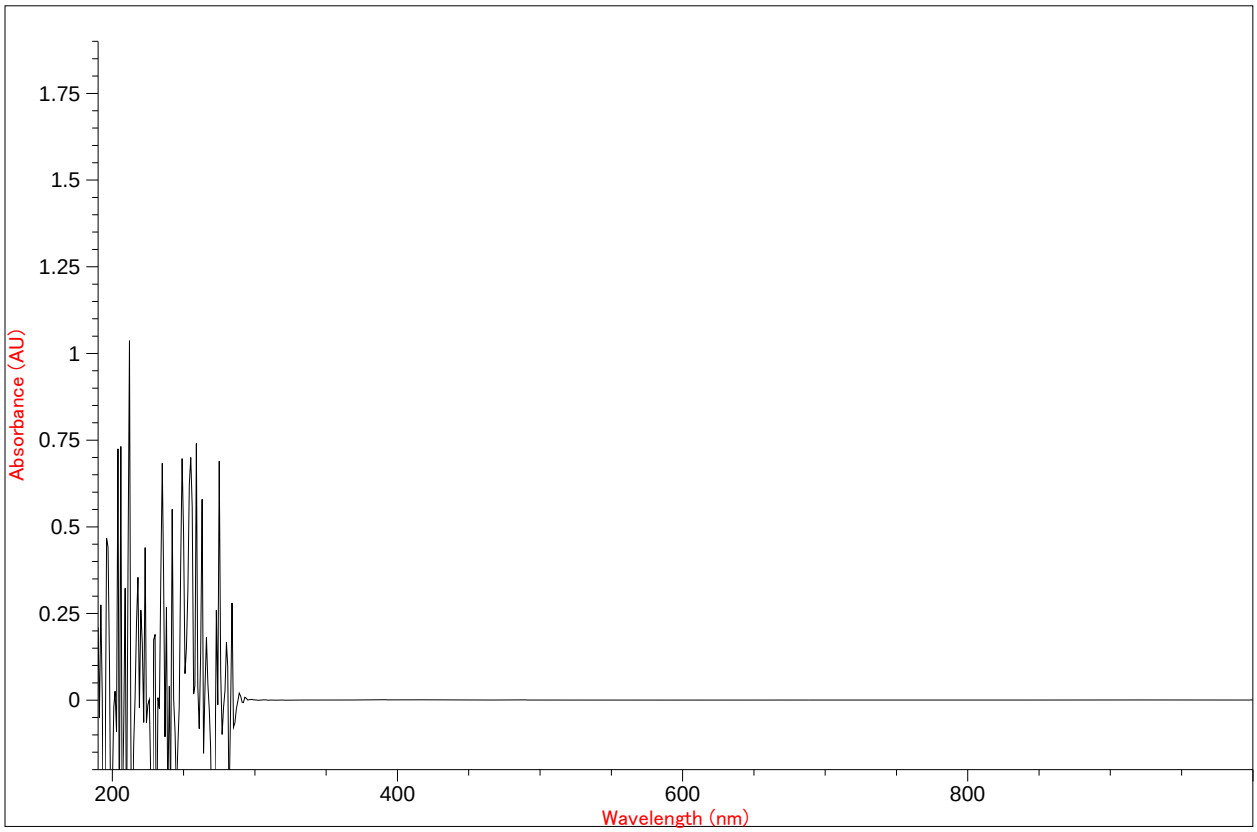
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37494	ug/mL	0.00826

Sample 3

Sample Name	Snowball II 2053 #MB (#10)
Operator	Patricia Mann
Date	6/19/18
Time	15:34:55
Path Length	1
Path Length Unit	cm

Sample Spectrum



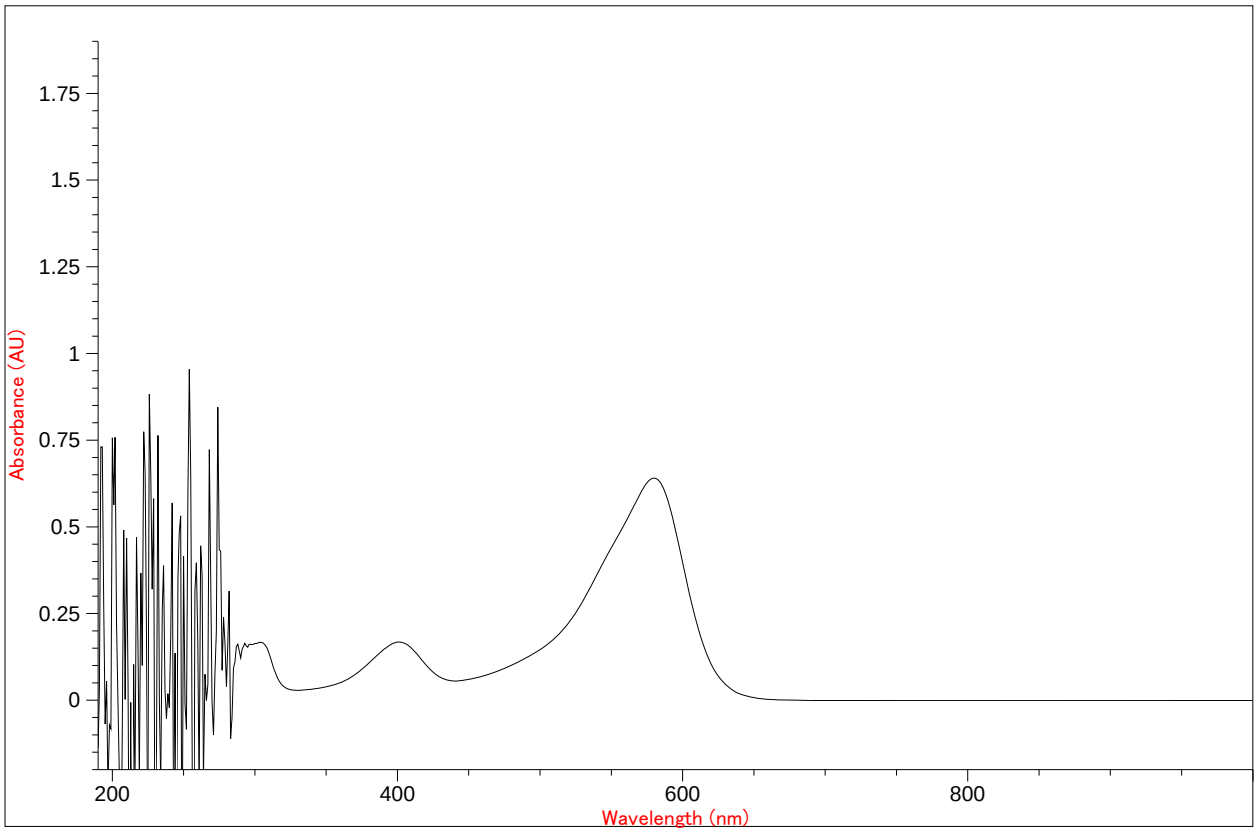
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00150	ug/mL	0.00784

Sample 4

Sample Name	Snowball II 2053 #SSA (#2)
Operator	Patricia Mann
Date	6/19/18
Time	16:57:33
Path Length	1
Path Length Unit	cm

Sample Spectrum



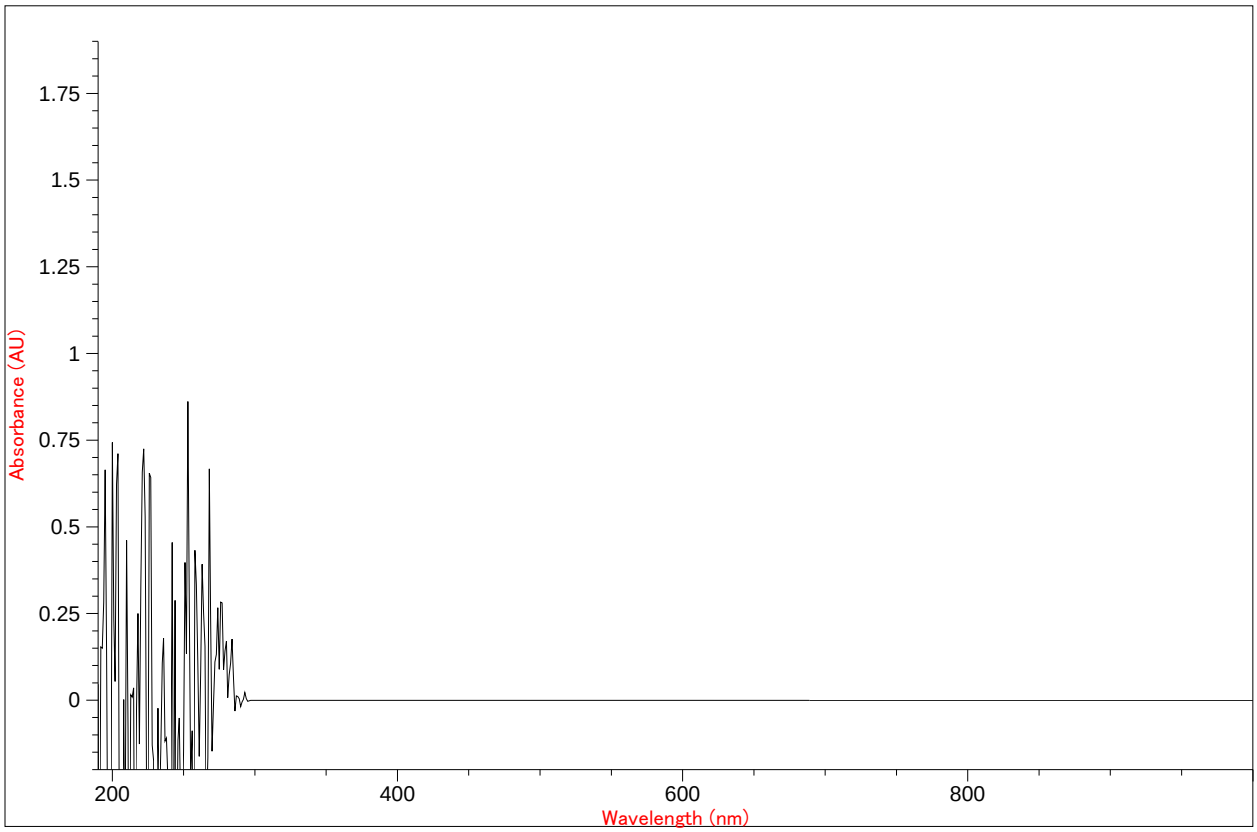
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.36327	ug/mL	0.00826

Sample 5

Sample Name	Snowball II 2053 #MB1 (#3)
Operator	Patricia Mann
Date	6/19/18
Time	16:57:48
Path Length	1
Path Length Unit	cm

Sample Spectrum



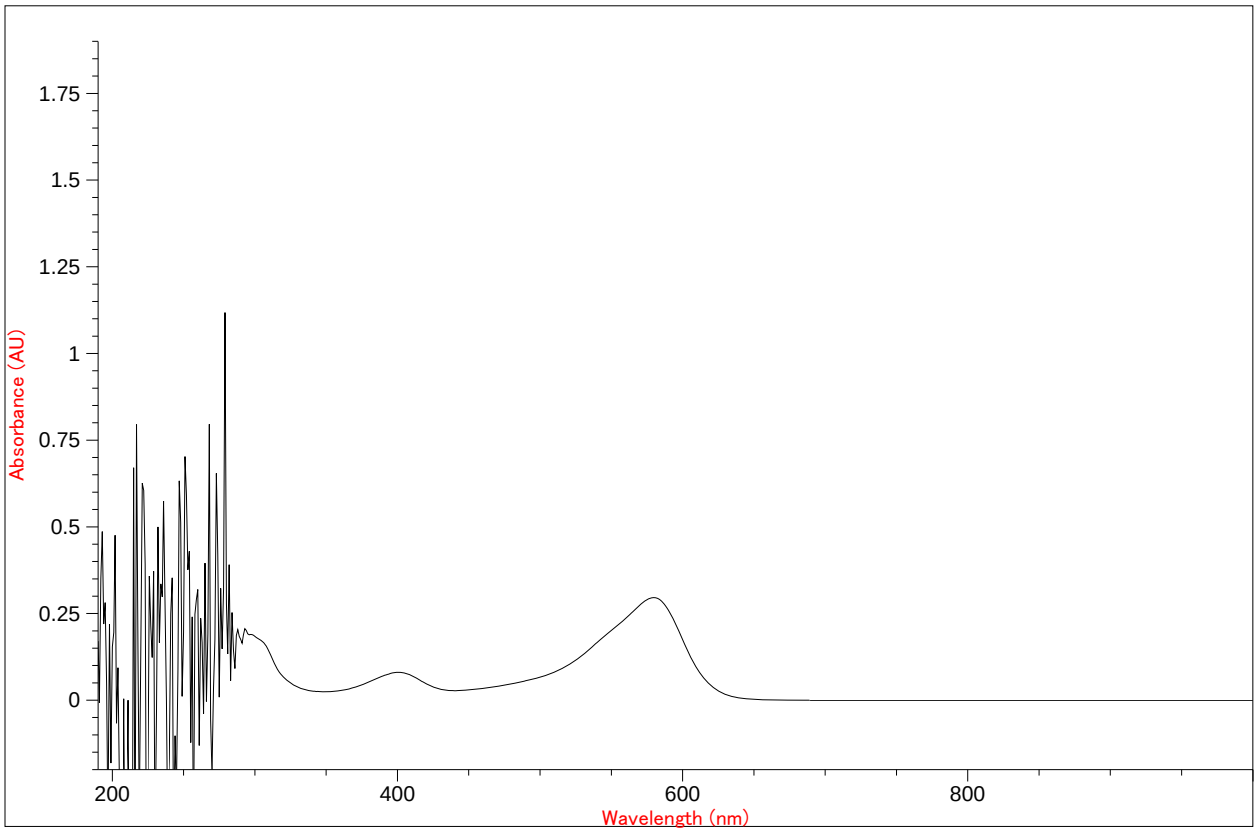
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00054	ug/mL	0.00784

Sample 6

Sample Name	0618-049.R1.Cond (#4)
Operator	Patricia Mann
Date	6/19/18
Time	16:58:09
Path Length	1
Path Length Unit	cm

Sample Spectrum



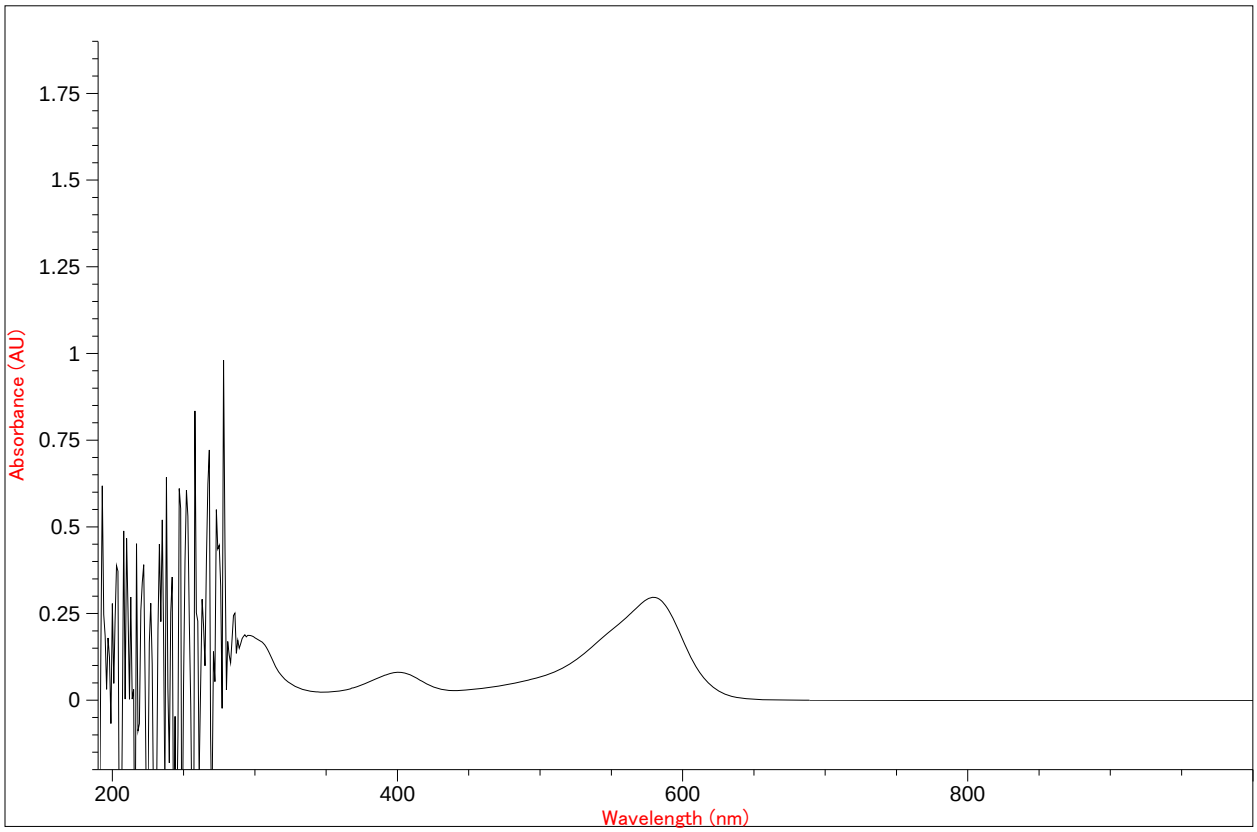
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.62991	ug/mL	0.00793

Sample 7

Sample Name	0618-049.LD-R1.Cond (#5)
Operator	Patricia Mann
Date	6/19/18
Time	16:58:20
Path Length	1
Path Length Unit	cm

Sample Spectrum



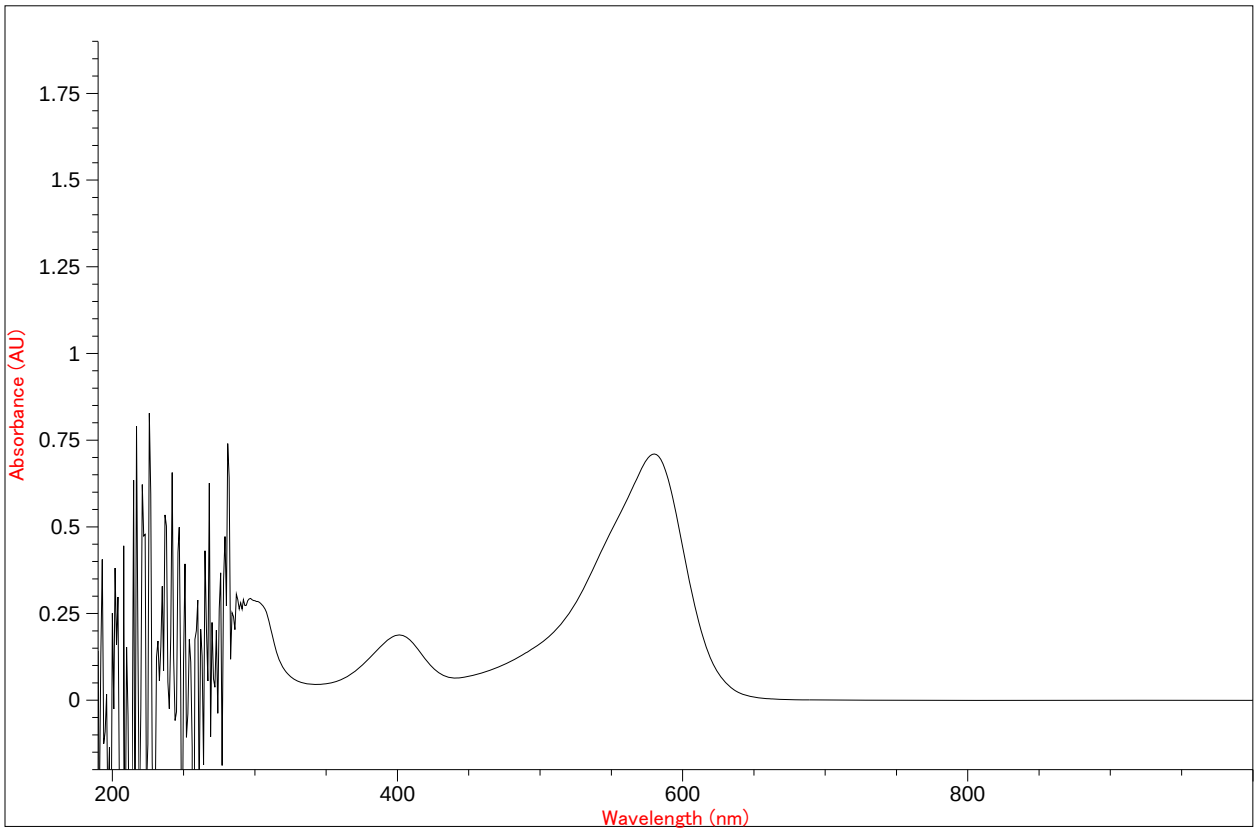
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.63163	ug/mL	0.00793

Sample 8

Sample Name	0618-049.MS-R1.Cond (#6)
Operator	Patricia Mann
Date	6/19/18
Time	16:58:36
Path Length	1
Path Length Unit	cm

Sample Spectrum



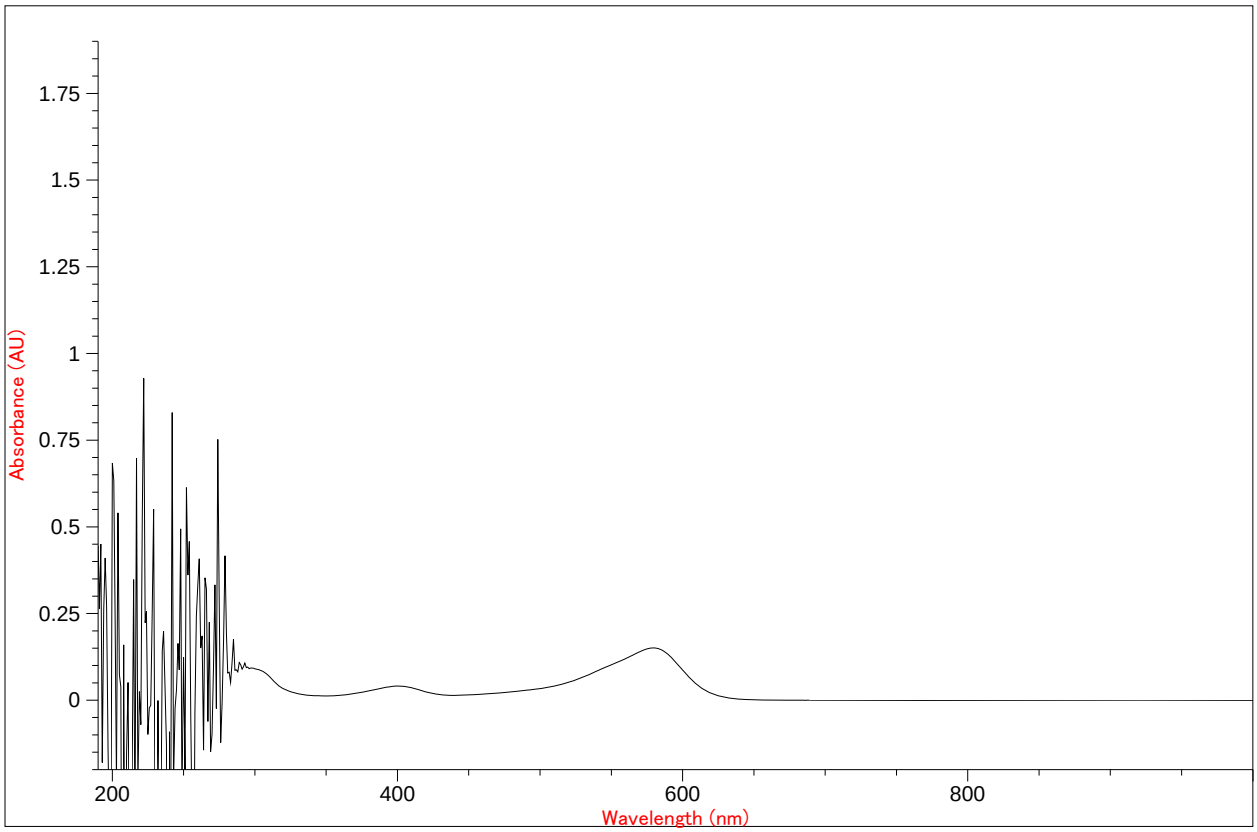
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.51111	ug/mL	0.00835

Sample 9

Sample Name	0618-049.AD-R1*2.Cond (#7)
Operator	Patricia Mann
Date	6/19/18
Time	16:58:48
Path Length	1
Path Length Unit	cm

Sample Spectrum



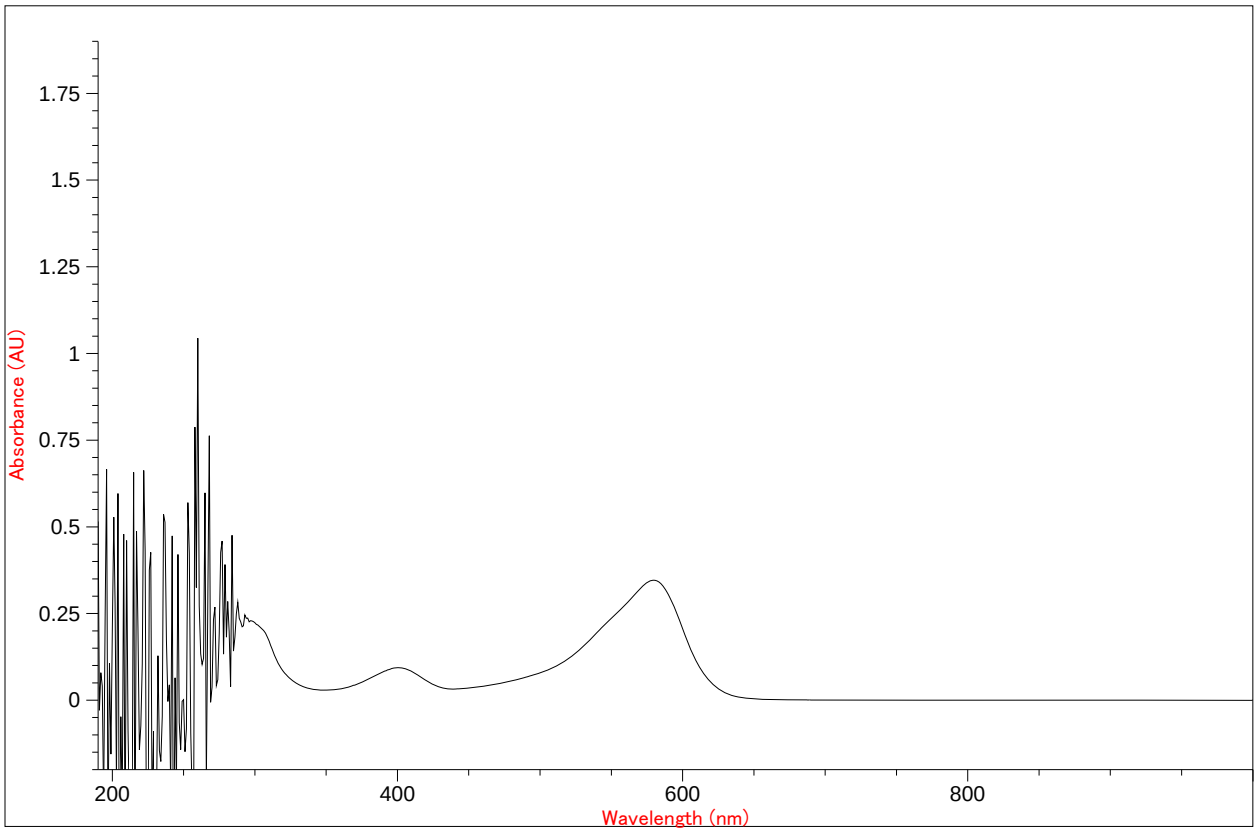
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.32127	ug/mL	0.00787

Sample 10

Sample Name	0618-049.R2.Cond (#8)
Operator	Patricia Mann
Date	6/19/18
Time	16:59:02
Path Length	1
Path Length Unit	cm

Sample Spectrum



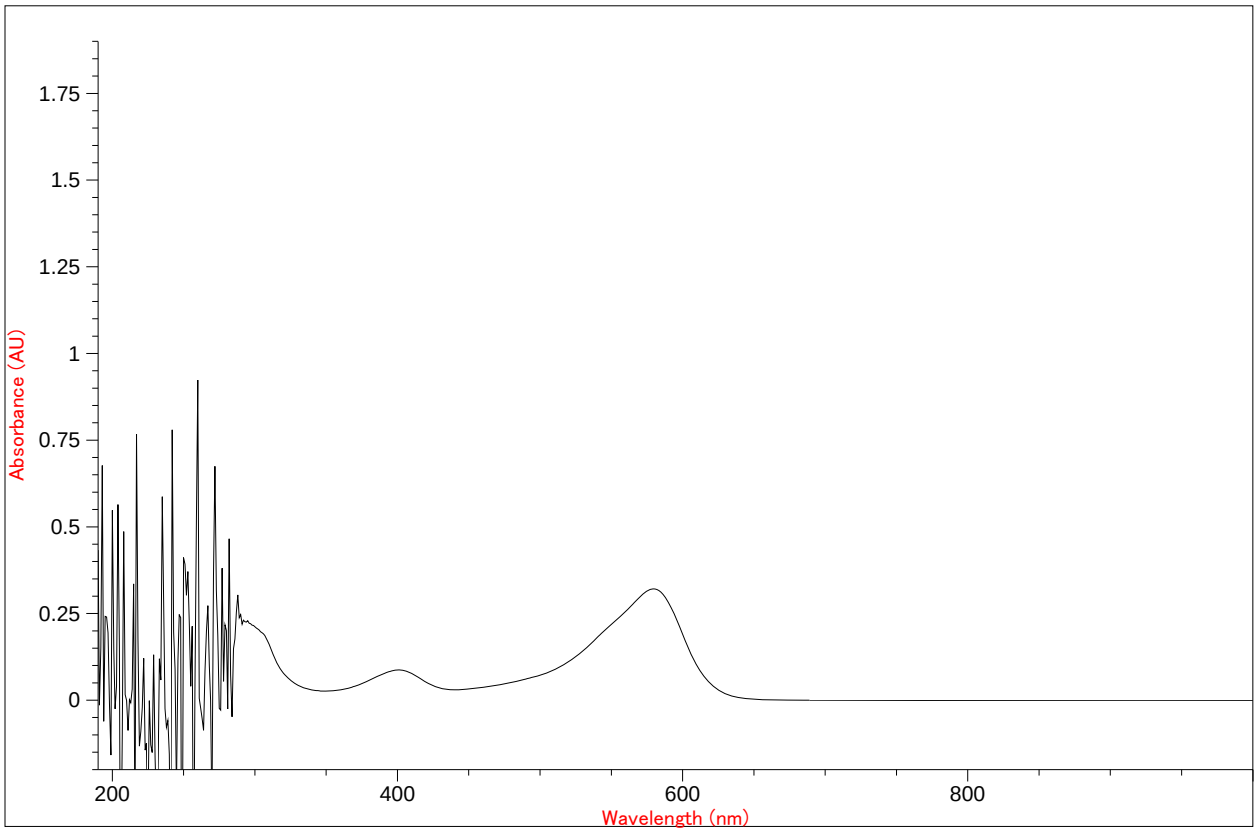
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.73688	ug/mL	0.00797

Sample 11

Sample Name	0618-049.R3.Cond (#9)
Operator	Patricia Mann
Date	6/19/18
Time	16:59:23
Path Length	1
Path Length Unit	cm

Sample Spectrum



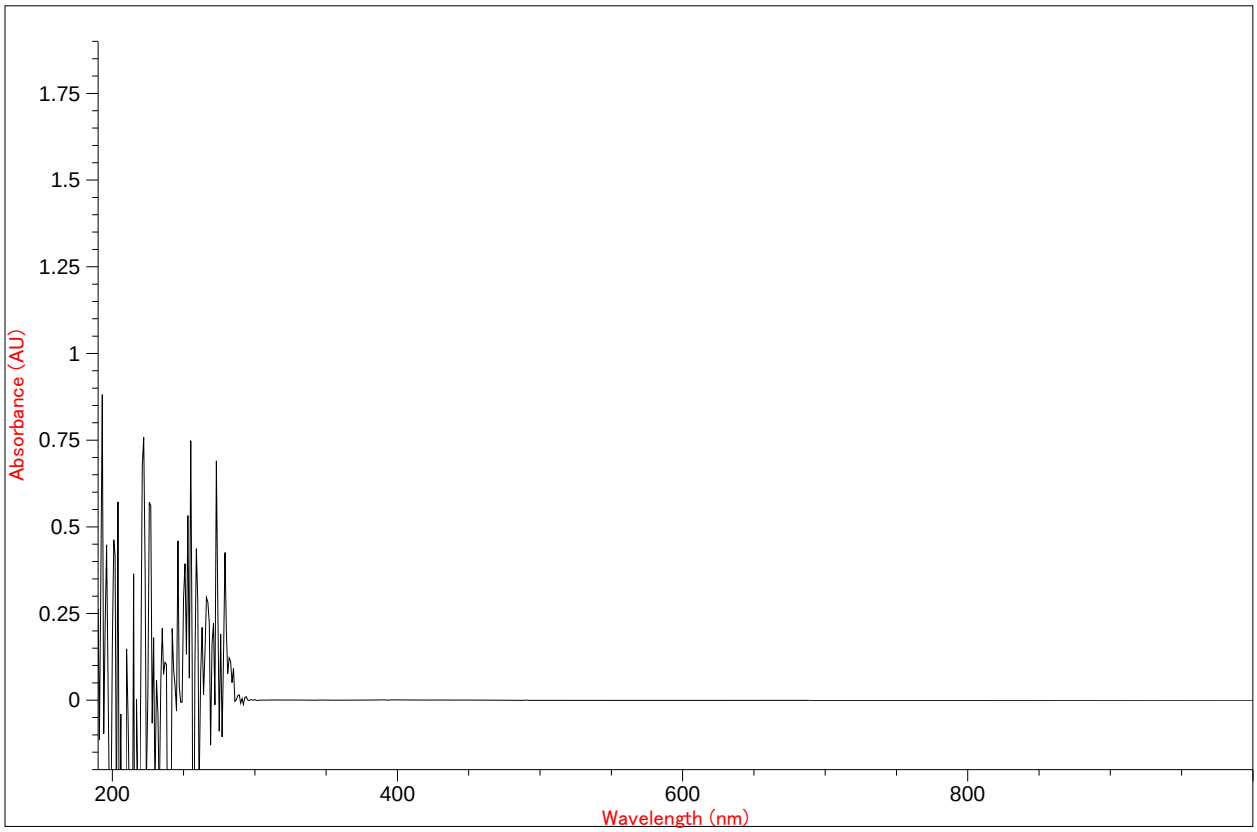
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.68351	ug/mL	0.00795

Sample 12

Sample Name	0618-049.FTB.Cond (#10)
Operator	Patricia Mann
Date	6/19/18
Time	16:59:41
Path Length	1
Path Length Unit	cm

Sample Spectrum



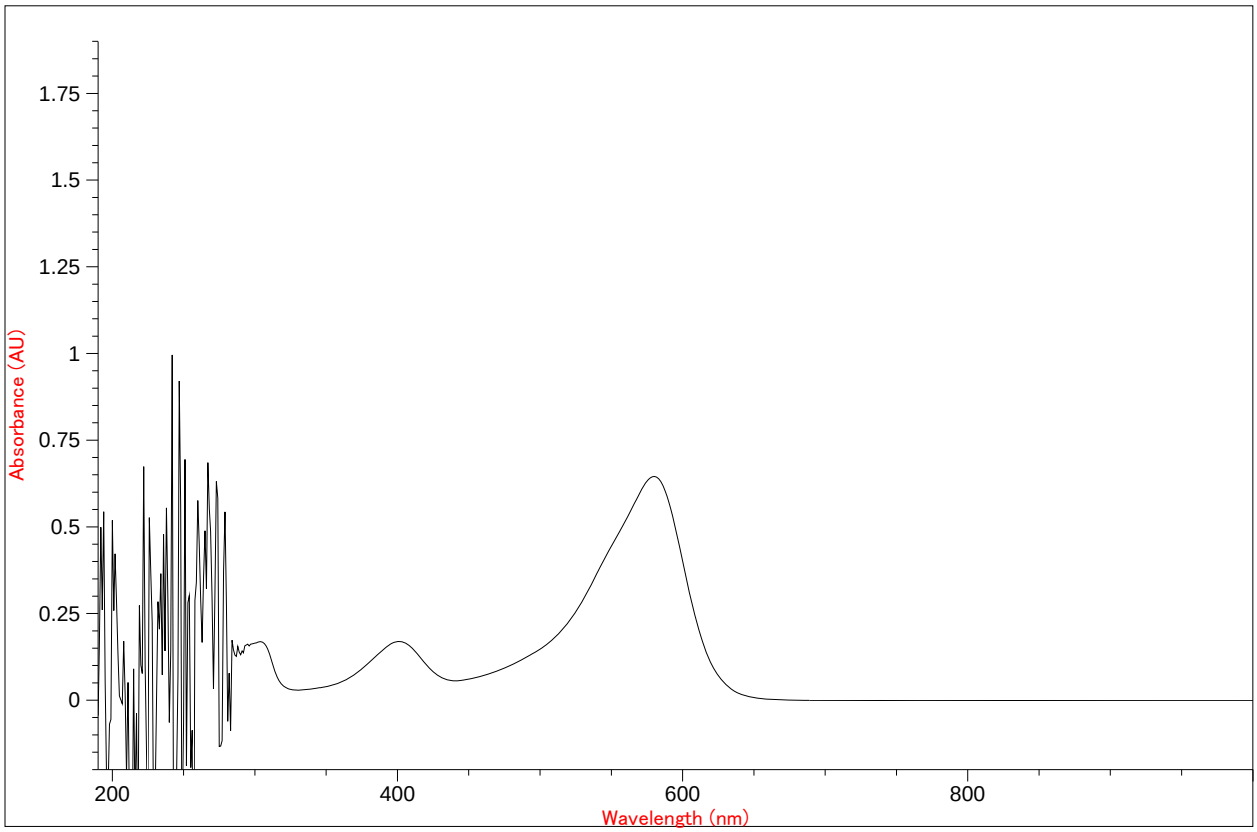
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00082	ug/mL	0.00784

Sample 13

Sample Name	Snowball II 2053 #SSB (#13)
Operator	Patricia Mann
Date	6/19/18
Time	17:00:38
Path Length	1
Path Length Unit	cm

Sample Spectrum



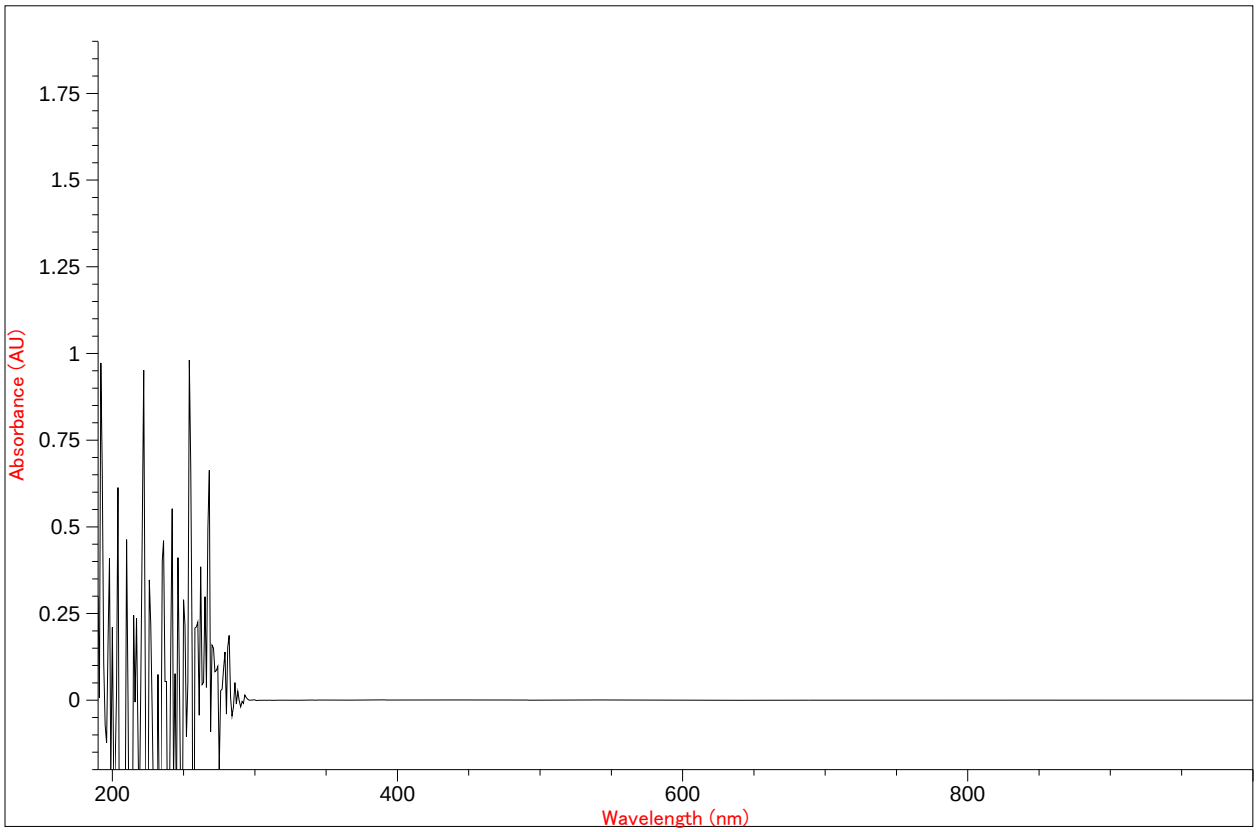
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37399	ug/mL	0.00826

Sample 14

Sample Name	Snowball II 2053 #MB2 (#14)
Operator	Patricia Mann
Date	6/19/18
Time	17:00:49
Path Length	1
Path Length Unit	cm

Sample Spectrum



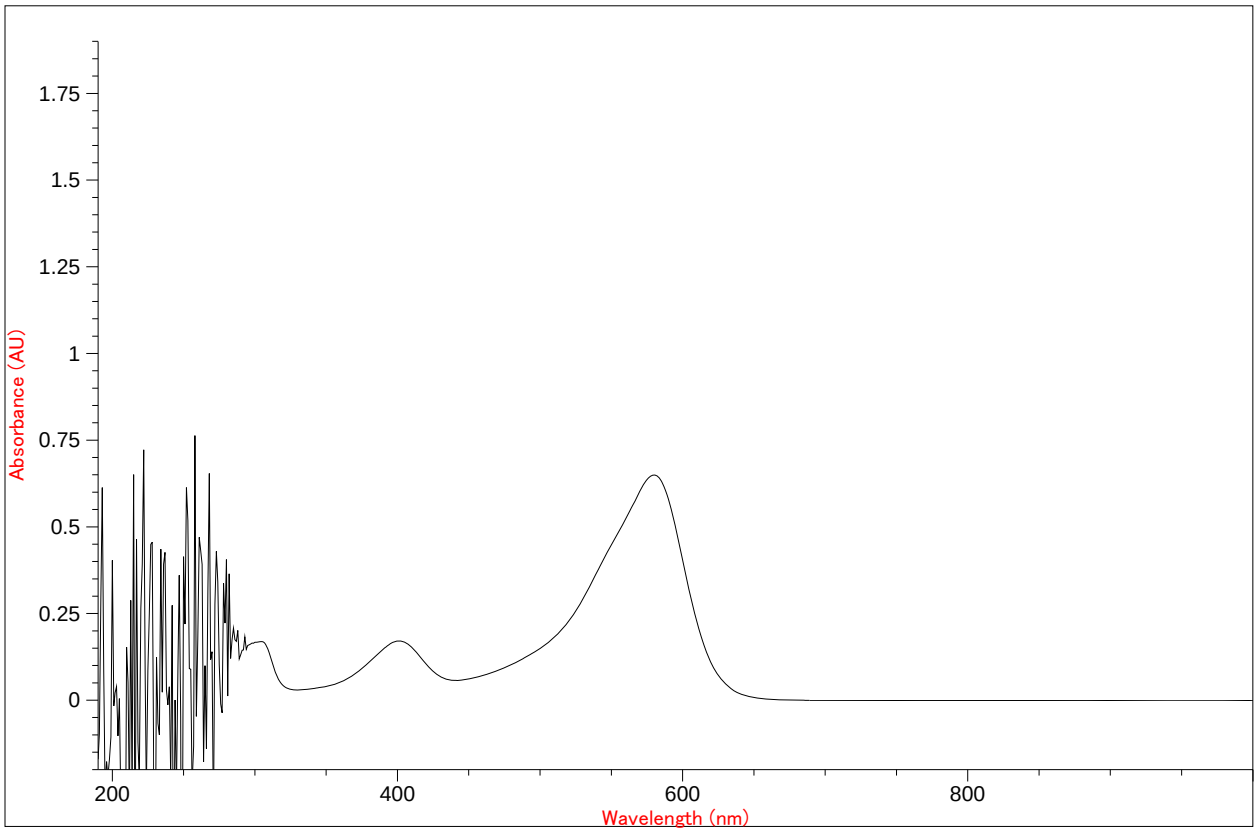
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00185	ug/mL	0.00784

Sample 15

Sample Name	Snowball II 2053 #SSC (#24)
Operator	Patricia Mann
Date	6/19/18
Time	17:03:28
Path Length	1
Path Length Unit	cm

Sample Spectrum



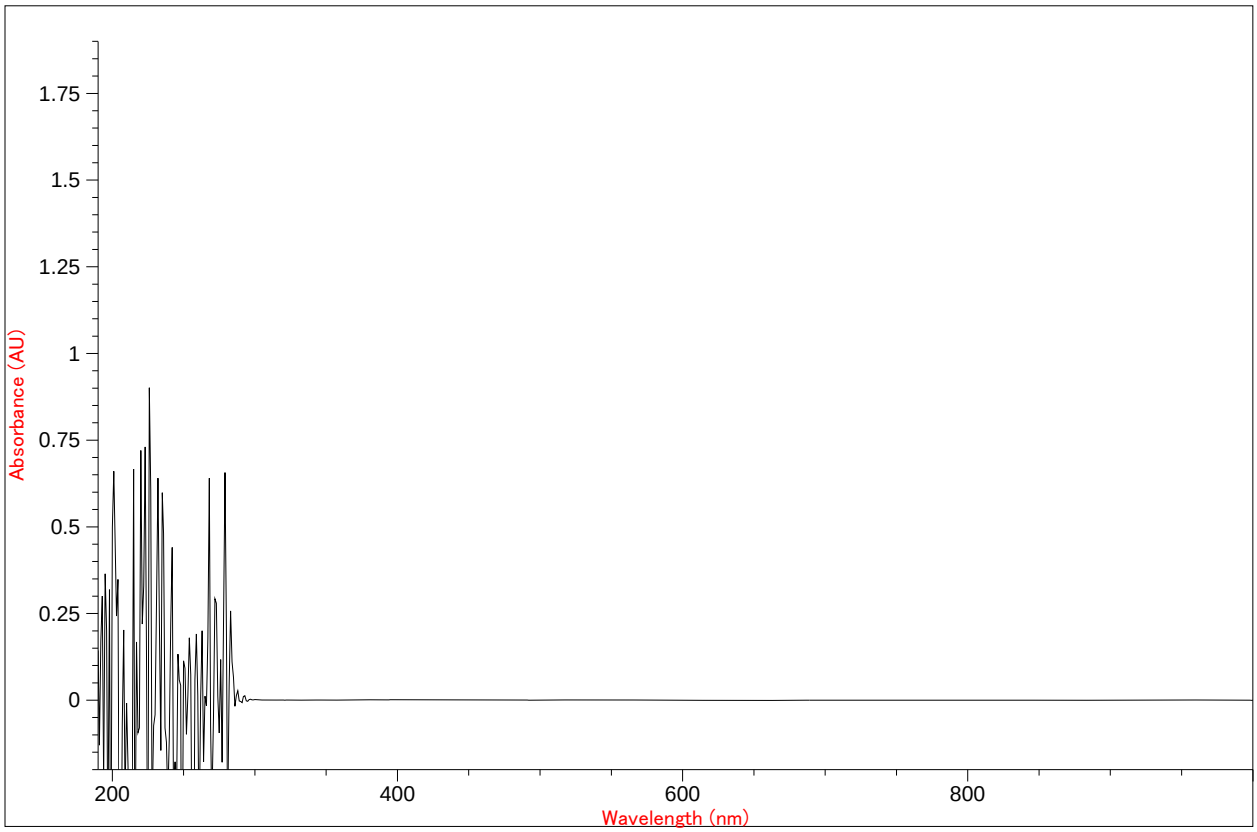
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.38410	ug/mL	0.00827

Sample 16

Sample Name	Snowball II 2053 #MB3 (#25)
Operator	Patricia Mann
Date	6/19/18
Time	17:03:43
Path Length	1
Path Length Unit	cm

Sample Spectrum



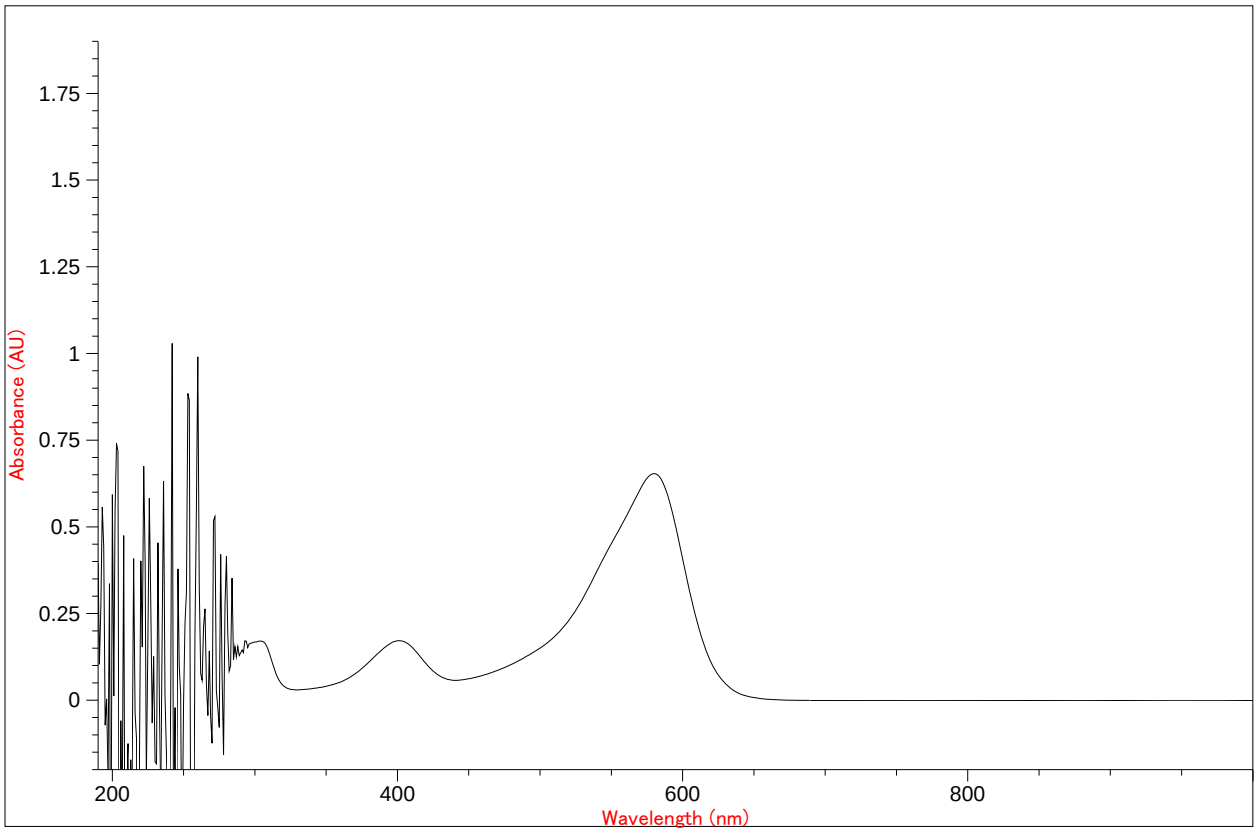
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00237	ug/mL	0.00784

Sample 17

Sample Name	Snowball II 2053 #SSD (#35)
Operator	Patricia Mann
Date	6/19/18
Time	17:07:25
Path Length	1
Path Length Unit	cm

Sample Spectrum



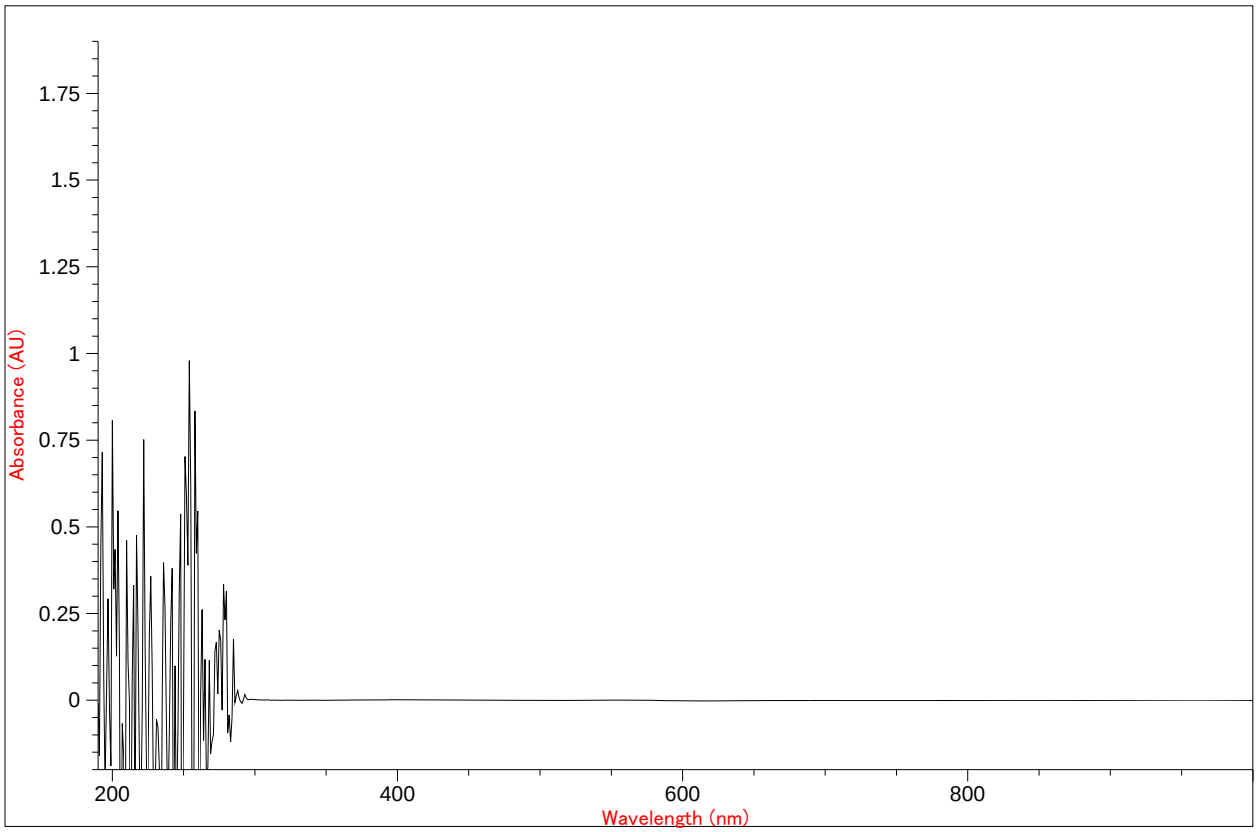
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.39333	ug/mL	0.00827

Sample 18

Sample Name	Snowball II 2053 #MB4 (#36)
Operator	Patricia Mann
Date	6/19/18
Time	17:07:44
Path Length	1
Path Length Unit	cm

Sample Spectrum



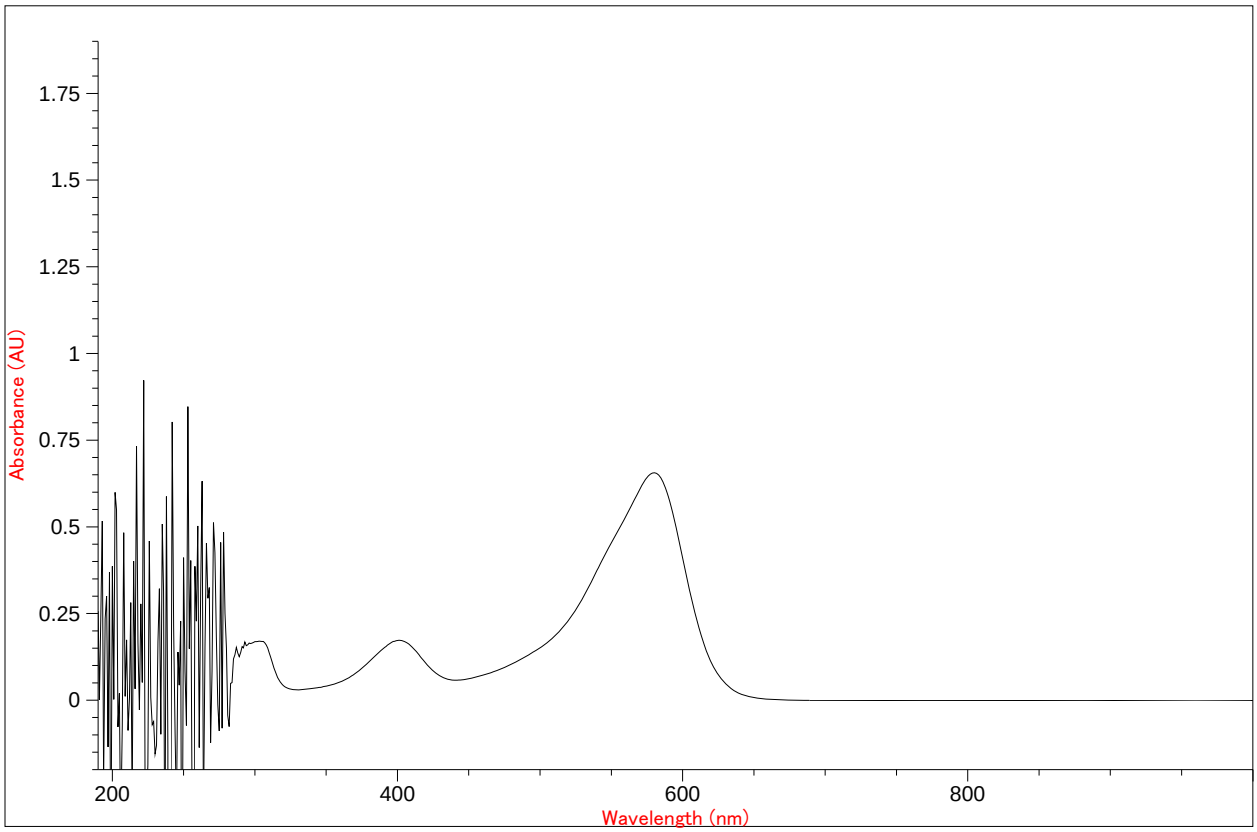
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00059	ug/mL	0.00784

Sample 19

Sample Name	Snowball II 2053 #SSE (#41)
Operator	Patricia Mann
Date	6/19/18
Time	17:09:54
Path Length	1
Path Length Unit	cm

Sample Spectrum



Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.39817	ug/mL	0.00828

Results Summary

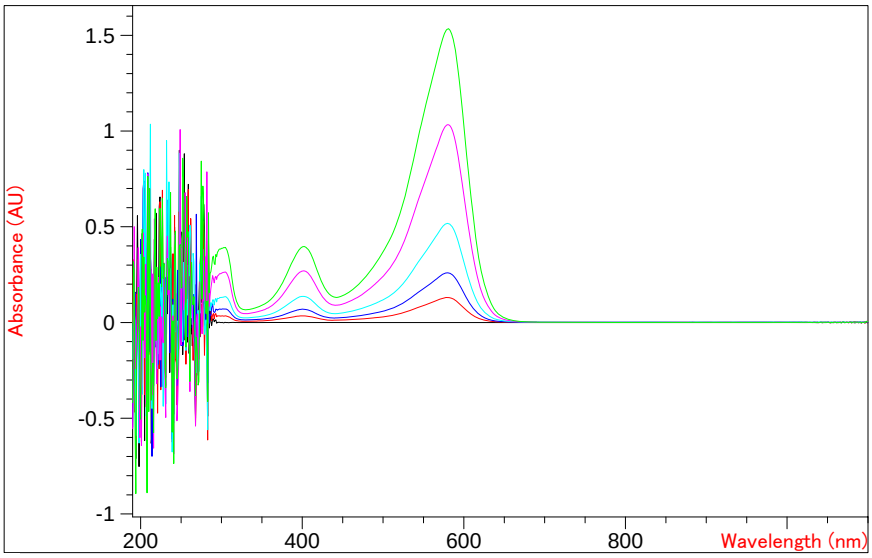
Sample Name	Data Value	Result Value	Unit	Std.Dev.
Snowball II 2053 #SS1 (#8)	0.59666	1.37010	ug/mL	0.00826
Snowball II 2053 #SS2 (#9)	0.59877	1.37494	ug/mL	0.00826
Snowball II 2053 #MB (#10)	0.00065	0.00150	ug/mL	0.00784
Snowball II 2053 #SSA (#2)	0.59368	1.36327	ug/mL	0.00826
Snowball II 2053 #MB1 (#3)	-0.00024	-0.00054	ug/mL	0.00784
0618-049.R1.Cond (#4)	0.27432	0.62991	ug/mL	0.00793
0618-049.LD-R1.Cond (#5)	0.27507	0.63163	ug/mL	0.00793
0618-049.MS-R1.Cond (#6)	0.65807	1.51111	ug/mL	0.00835
0618-049.AD-R1*2.Cond (#7)	0.13991	0.32127	ug/mL	0.00787
0618-049.R2.Cond (#8)	0.32090	0.73688	ug/mL	0.00797
0618-049.R3.Cond (#9)	0.29766	0.68351	ug/mL	0.00795
0618-049.FTB.Cond (#10)	-0.00036	-0.00082	ug/mL	0.00784
Snowball II 2053 #SSB (#13)	0.59835	1.37399	ug/mL	0.00826
Snowball II 2053 #MB2 (#14)	0.00081	0.00185	ug/mL	0.00784
Snowball II 2053 #SSC (#24)	0.60276	1.38410	ug/mL	0.00827
Snowball II 2053 #MB3 (#25)	0.00103	0.00237	ug/mL	0.00784
Snowball II 2053 #SSD (#35)	0.60677	1.39333	ug/mL	0.00827
Snowball II 2053 #MB4 (#36)	0.00026	0.00059	ug/mL	0.00784
Snowball II 2053 #SSE (#41)	0.60889	1.39817	ug/mL	0.00828

*** End Results Report ***

*** Calibration Report ***

Number of Standards 6

Standard Spectra



#	Standard	Path Length	Unit	Date	Time
1	Snowball II 2053	1.000	cm	6/19/18	15:33:01
2	Snowball II 2053	1.000	cm	6/19/18	15:33:24
3	Snowball II 2053	1.000	cm	6/19/18	15:33:40
4	Snowball II 2053	1.000	cm	6/19/18	15:33:53
5	Snowball II 2053	1.000	cm	6/19/18	15:34:06
6	Snowball II 2053	1.000	cm	6/19/18	15:34:16

Data Analysis:

Spectral Processing:

Absorbance

Use Wavelength(s):

Single (nm): 570

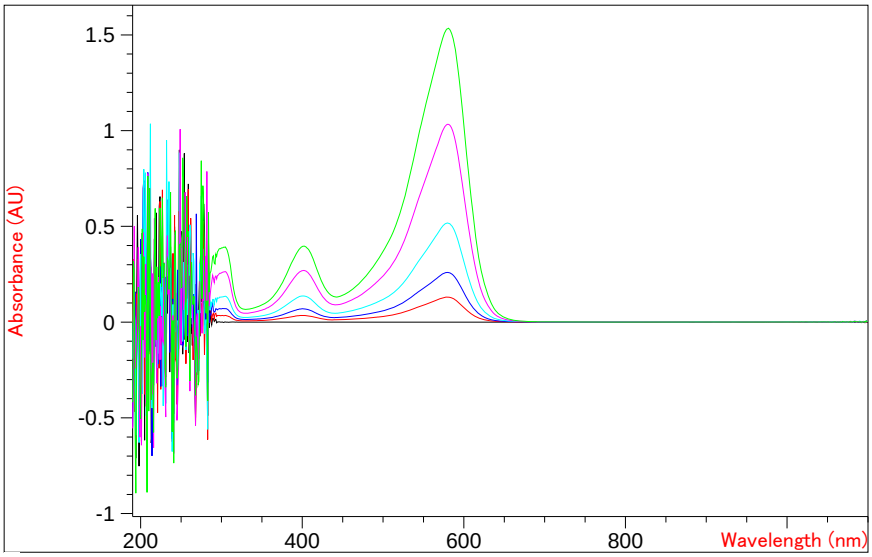
Evaluation: SCA

Calibrated at: Date 6/19/2018 Time 3:35:43 PM
Operator: Patricia Mann

Weighting Method: Least squares
Calibration Curve: C = k1 * A

Analyte Name	Unit
Formaldehyde	ug/mL

Processed Standard Spectra



Coefficients

k#	Value
1	2.29628

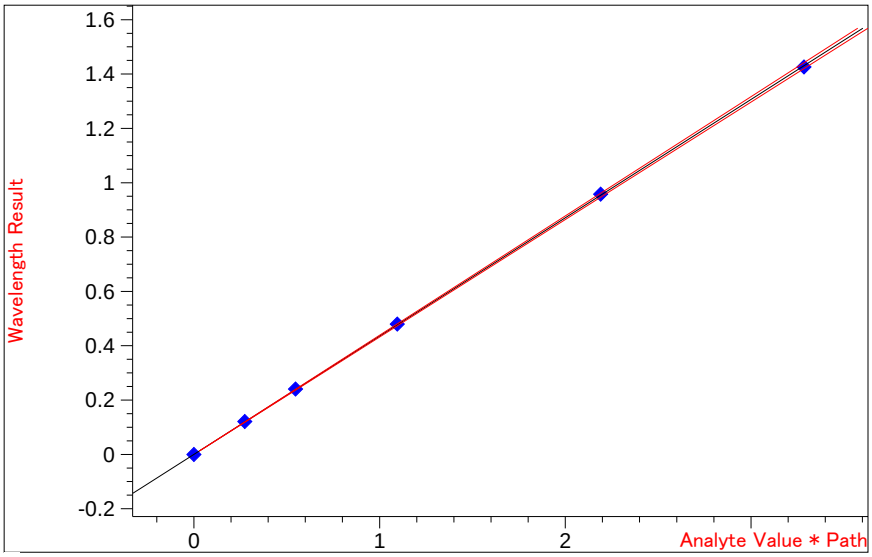
Used Wavelength Results (Absorbance (AU))

#	Value	#	Value	#	Value
1	-0.00019	3	0.24093	5	0.95812
2	0.12128	4	0.47970	6	1.42606

Calibration Table of Formaldehyde (ug/mL)

#	Standard Name	Value	Fitted Val.	Error (%)
1	Snowball II 2053	0.00000	-0.00043	-100.0
2	Snowball II 2053	0.27380	0.27848	-1.7
3	Snowball II 2053	0.54750	0.55324	-1.0
4	Snowball II 2053	1.09500	1.10152	-0.6
5	Snowball II 2053	2.19000	2.20012	-0.5
6	Snowball II 2053	3.28500	3.27464	0.3

Calibration Curve (Data Analysis)



SCA Summary

Analyte Name	Formaldehyde
Number of Standards	6
Calculation Method	LSQ
Calibration Curve	C = k1 * A
Coefficient k1	2.29630 ug/mL
Std.Dev. of k1	4.3472E-3 ug/mL
Std.Dev. of Calibration	7.8425E-3 ug/mL
Correl. Coeff. (R^2)	0.99998
Uncertainty	0.78 %

*** End Calibration Report ***

This Is The Last Page Of This Report.

Bison Engineering, Inc.

1400 11th Avenue
Helena, MT 59601

CFU117
Corvallis, OR
Project # HAV218718

Analytical Report
(0618-065)

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

ENTHALPY ANALYTICAL

Summary of Results

Enthalpy Analytical

Company: Bison Engineering

Job No.: 0618-065 EPA Method 316

Client No.: HAV218718

Summary Table

Compound	Sample ID / Catch Weight (µg)		
	Run 1	***Run 2***	***Run 3***
Formaldehyde	1,728	1,641	1,753
	FTB	***DiBlank***	
Formaldehyde	6.17 ND	5.27 ND	

Results

Enthalpy Analytical

Company: Bison Engineering

Job No.: 0618-065 EPA Method 316

Client No.: HAV218718

Formaldehyde

MDL	0.0137	(µg/mL)	Lower Curve Limit	0.274	(µg/mL)
LOQ	0.274	(µg/mL)	Upper Curve Limit	3.29	(µg/mL)

Sample ID	Lab ID	Absorbance	Analytical Concentration (µg/mL)	Dilution	Volume (mL)	Catch Weight (ug)	Qual
Run 1	11	0.8007	1.84	2	470	1,728	
Run 2	17	0.7854	1.80	2	455	1,641	
Run 3	18	0.7951	1.83	2	480	1,753	
FTB	19	0.0000	0.0137	1	450	6.17	ND
DiBlank	20	0.0000	0.0137	1	385	5.27	ND
Snowball II 2053 #MB	10	0.0007	0.0137	1	1.00	0.0137	ND
Snowball II 2053 #MB	3	0.0000	0.0137	1	1.00	0.0137	ND
Snowball II 2053 #MB	14	0.0008	0.0137	1	1.00	0.0137	ND
Snowball II 2053 #MB	25	0.0010	0.0137	1	1.00	0.0137	ND
Snowball II 2053 #MB	36	0.0003	0.0137	1	1.00	0.0137	ND

Enthalpy Analytical

Company: Bison Engineering

Job No.: 0618-065 EPA Method 316

Client No.: HAV218718

Formaldehyde

MDL	0.0137	(µg/mL)	Lower Curve Limit	0.274	(µg/mL)
LOQ	0.274	(µg/mL)	Upper Curve Limit	3.29	(µg/mL)

Sample ID	Lab ID	Absorbance	Analytical Concentration (µg/mL)	Dilution	Volume (mL)	Catch Weight (ug)	Qual
LD/Run 1	12	0.7986	1.83	2	470	1,724	
					% Difference	0.3%	
AD/Run 1	16	0.3234	0.743	5	470	1,745	
					% Difference	1.0%	
MS/Run 1	15	1.1833	2.72	1	2.50	6.79	
					Spike Amount (ug)	2.19	
					Native Amount (ug)	4.56	
					Spike Recovery	102%	
Snowball II 2053 #SS1	8	0.5967	1.37	1	1.00	1.37	
					Tag Amount (ug)	1.31	
					Spike Recovery	104%	
Snowball II 2053 #SS2	9	0.5988	1.37	1	1.00	1.37	
					Tag Amount (ug)	1.31	
					Spike Recovery	105%	

Narrative Summary

Enthalpy Analytical Narrative Summary

Company	Bison Engineering, Inc.
Analyst	PRM
Parameters	EPA Method 316

Client #	HAV218718
Job #	0618-065
# Samples	3, 2 Blanks

Custody

Tiffany Stein received the samples on 6/12/18 after being relinquished by Bison Engineering, Inc. The samples were received at 10.2 °C 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 for these analyses.

Calibration

The calibration curve is included in the Raw Data section of this report. The slope of the calibration curve was outside of our in-house limits as determined by our control chart. It was determined that the effect of the high slope value would have little effect on the overall data and has therefore been used to quantitate the data.

QC Notes

The client's blanks were analyzed with the samples and did not contain formaldehyde at levels above the detection limit. Therefore no blank correction has been applied to the sample results.

The laboratory duplicate and alternate dilution analyses (LD and AD) of sample ***Run 1*** differed from the initial results by no more than 1.0%.

A matrix spike (MS) was performed on an aliquot of sample ***Run 1*** which exhibited a recovery of 102%.

The samples were analyzed within the 14-day holding time recommended by the method.

The second source standards were analyzed as Laboratory Control Samples (LCS) and had spike recovery values of 104% and 105%.

ENTHALPY ANALYTICAL

Enthalpy Analytical Narrative Summary
(continued)

Reporting Notes	The client provided volumes for each of the samples on their chain of custody. The client's volumes were confirmed by the laboratory and have been used to calculate total catch weight. 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.

ENTHALPY ANALYTICAL

General Reporting Notes

The following are general reporting notes that are applicable to all Enthalpy Analytical, Inc. 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.
- 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).
- 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).

General Reporting Notes

(continued)

- 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.
- **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

ENTHALPY
ANALYTICAL

Chain of Custody Record

ENTHALPY analytical, inc.

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

Project Number: HAV18718
Site Name: CFU 117
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.

Special Instructions:

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 formaldehyde	Notes:
(470ml) M-316 cont#1 Run1	6/9/18	11:00	~~390ml~~	~~H2O~~	H_2O									
M-316 cont#1 Run2		13:00	(455ml)											
M-316 cont#1 Run3		14:05		480ml										
M-316 Fieldtrainblank		11:00	~~380ml~~	450ml										
D.I. H2O blank	↓	11:00	385ml		↓									

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Condition Upon Receipt:
[signature]	6/11/18	[signature]	6/12/18	9am	[X] Iced [ ] Ambient [X] °C 10.2 Gun 5
					[ ] Iced [ ] Ambient [ ] °C _____
					[ ] Iced [ ] Ambient [ ] °C _____

800-1 Capitola Drive • Durham, NC 27713 • (919) 850-4392 • FAX (919) 850-9012 • www.enthalpy.com

Good condition Sample received on ice
10.2°C Raytek5 MST 6/12/18

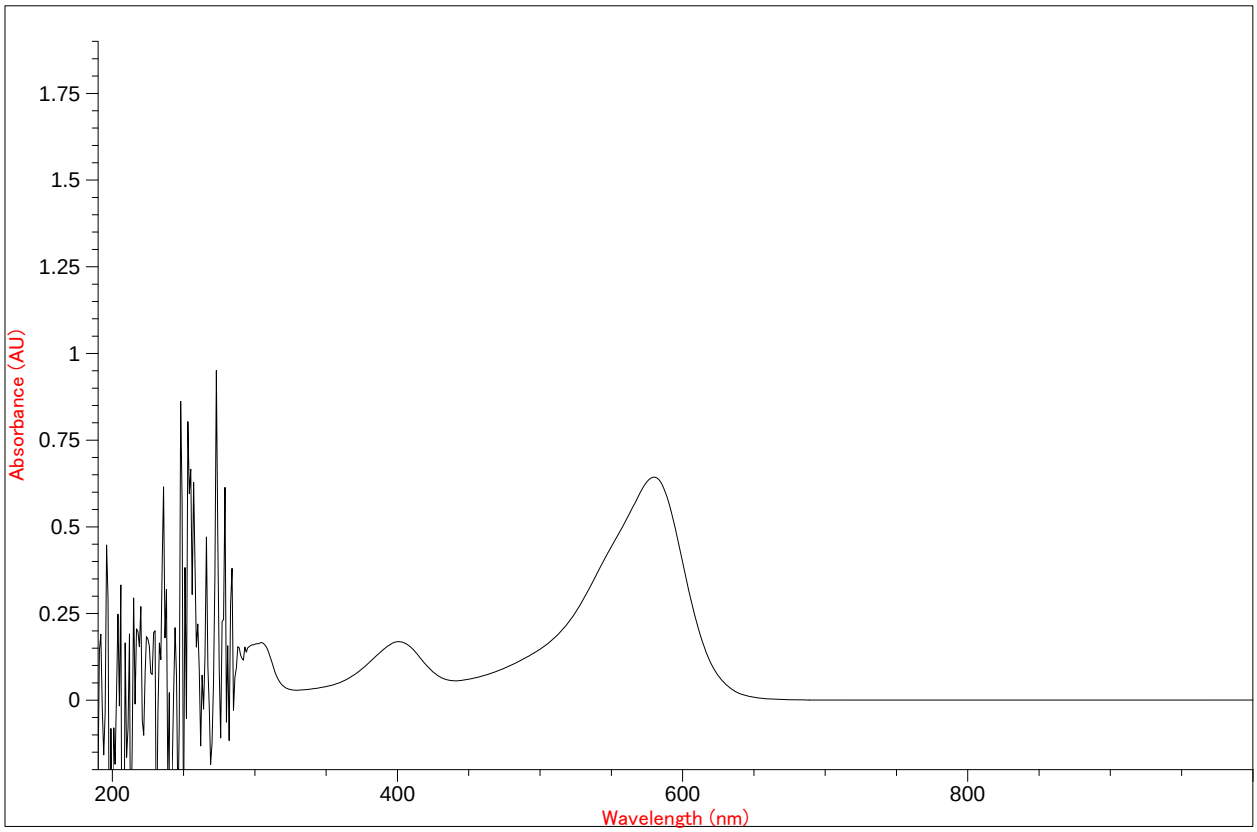
Raw Data

ENTHALPY ANALYTICAL

Sample 1

Sample Name	Snowball II 2053 #SS1 (#8)
Operator	Patricia Mann
Date	6/19/18
Time	15:34:26
Path Length	1
Path Length Unit	cm

Sample Spectrum



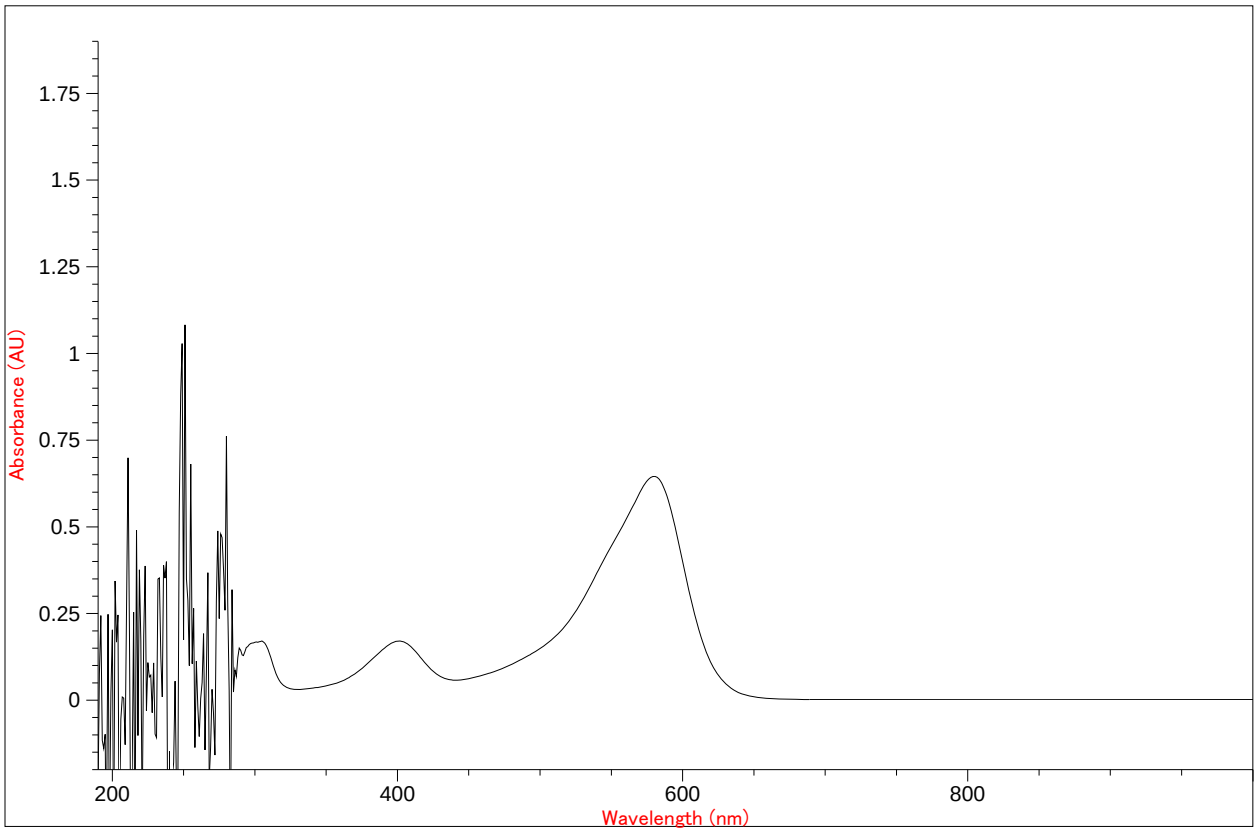
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37010	ug/mL	0.00826

Sample 2

Sample Name	Snowball II 2053 #SS2 (#9)
Operator	Patricia Mann
Date	6/19/18
Time	15:34:37
Path Length	1
Path Length Unit	cm

Sample Spectrum



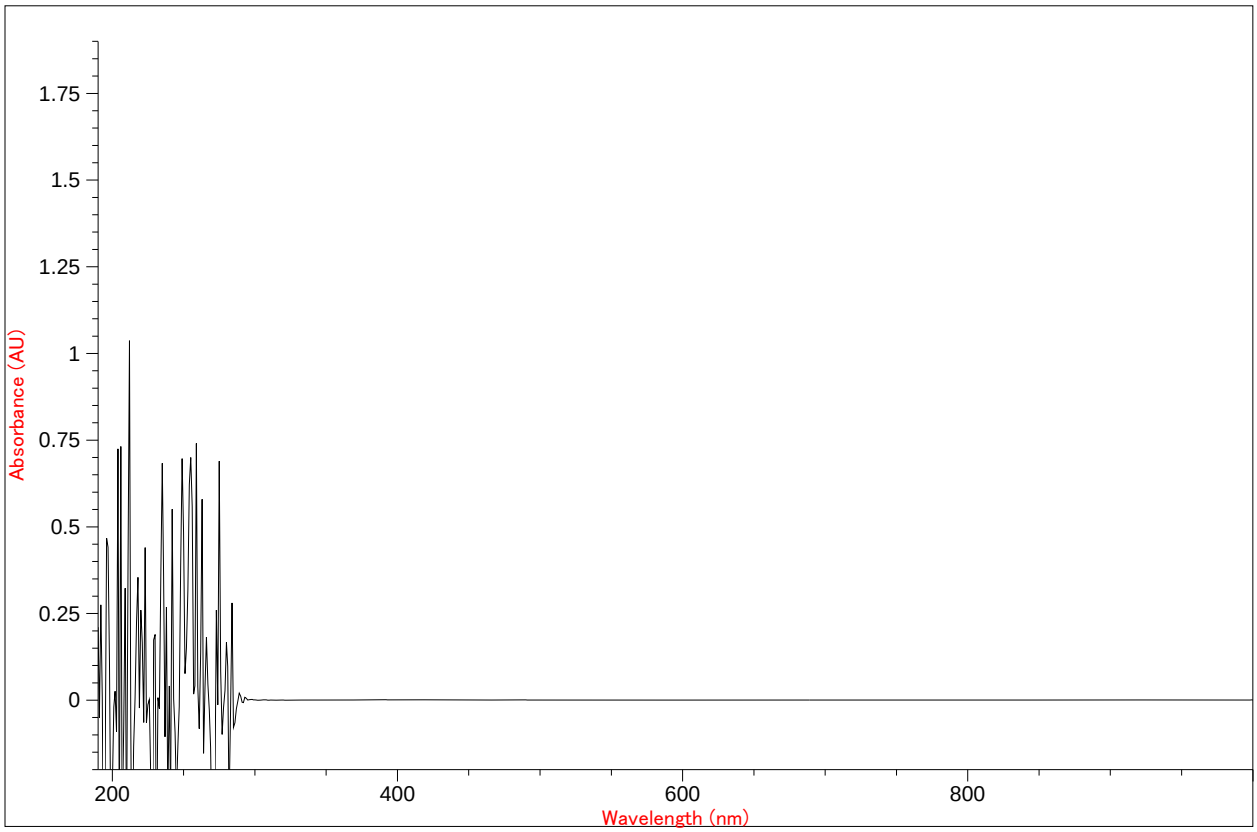
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37494	ug/mL	0.00826

Sample 3

Sample Name	Snowball II 2053 #MB (#10)
Operator	Patricia Mann
Date	6/19/18
Time	15:34:55
Path Length	1
Path Length Unit	cm

Sample Spectrum



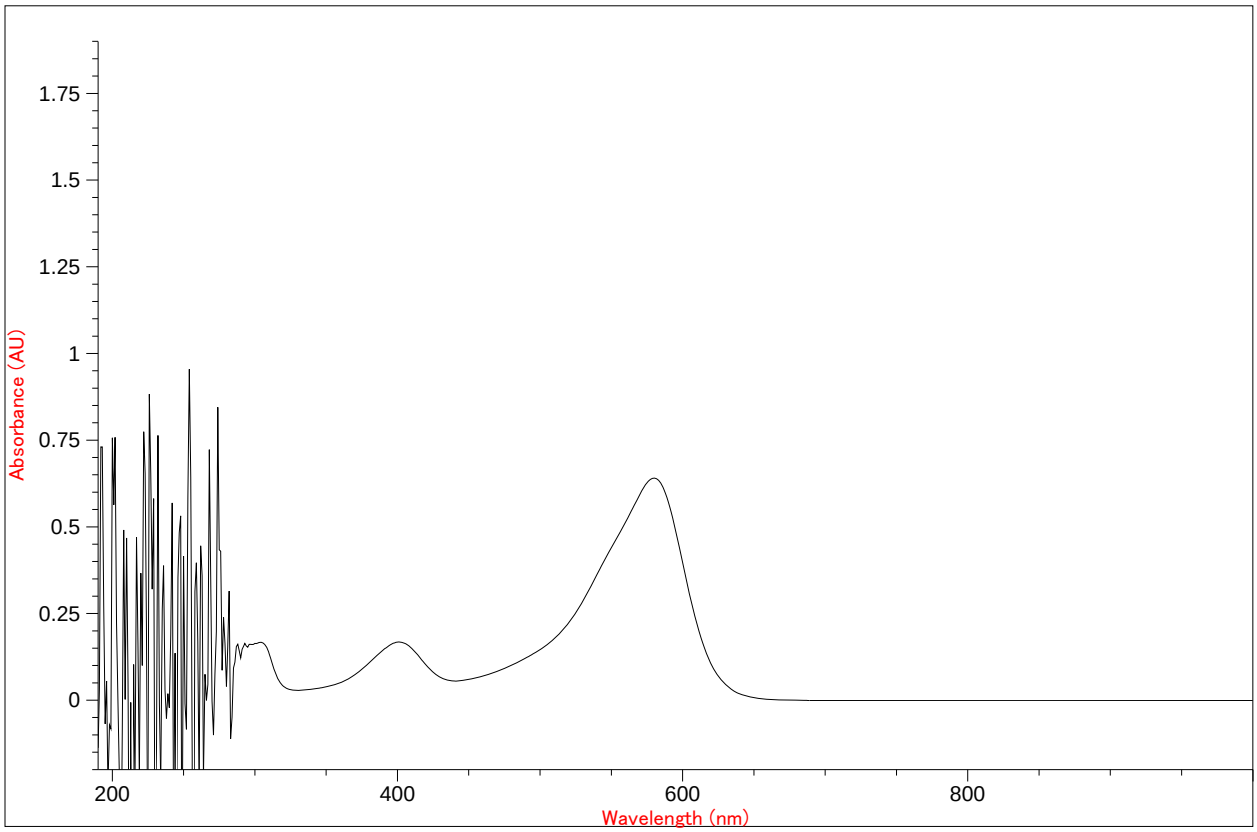
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00150	ug/mL	0.00784

Sample 4

Sample Name	Snowball II 2053 #SSA (#2)
Operator	Patricia Mann
Date	6/19/18
Time	16:57:33
Path Length	1
Path Length Unit	cm

Sample Spectrum



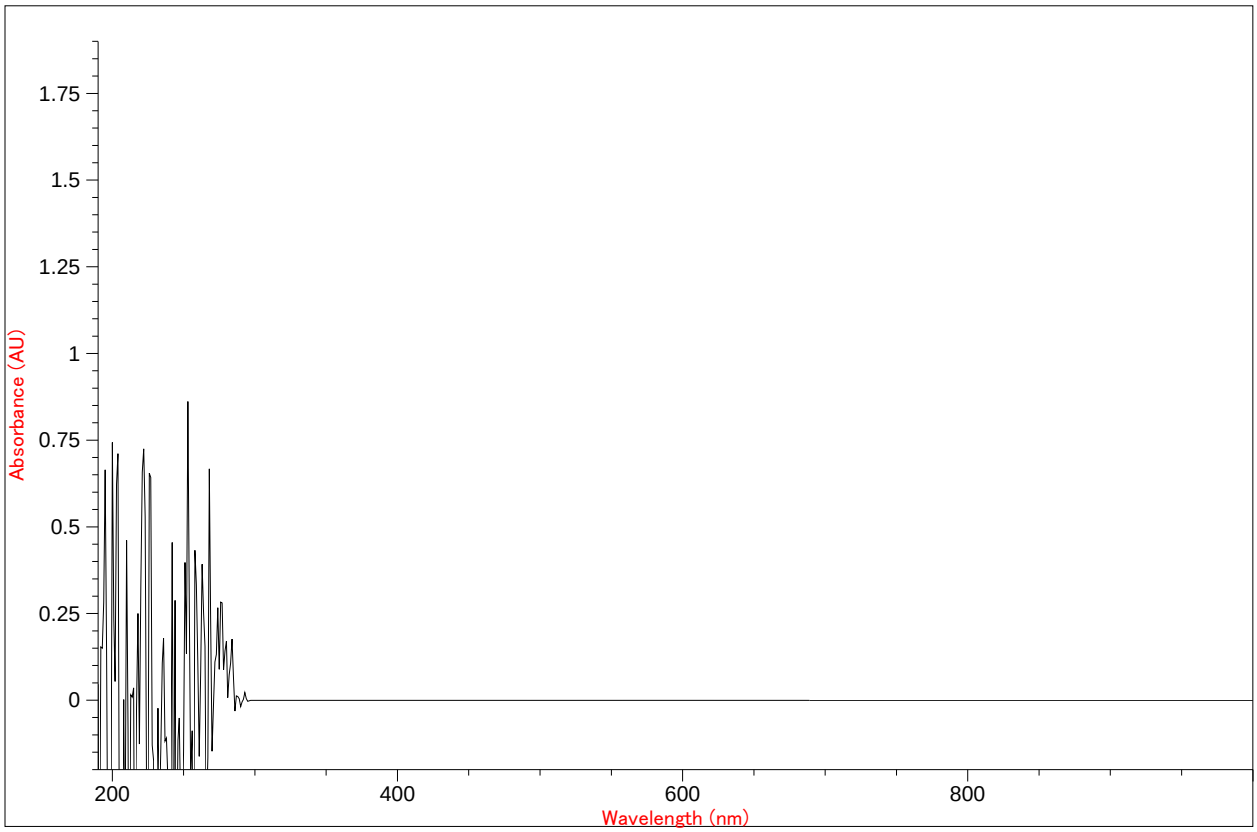
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.36327	ug/mL	0.00826

Sample 5

Sample Name	Snowball II 2053 #MB1 (#3)
Operator	Patricia Mann
Date	6/19/18
Time	16:57:48
Path Length	1
Path Length Unit	cm

Sample Spectrum



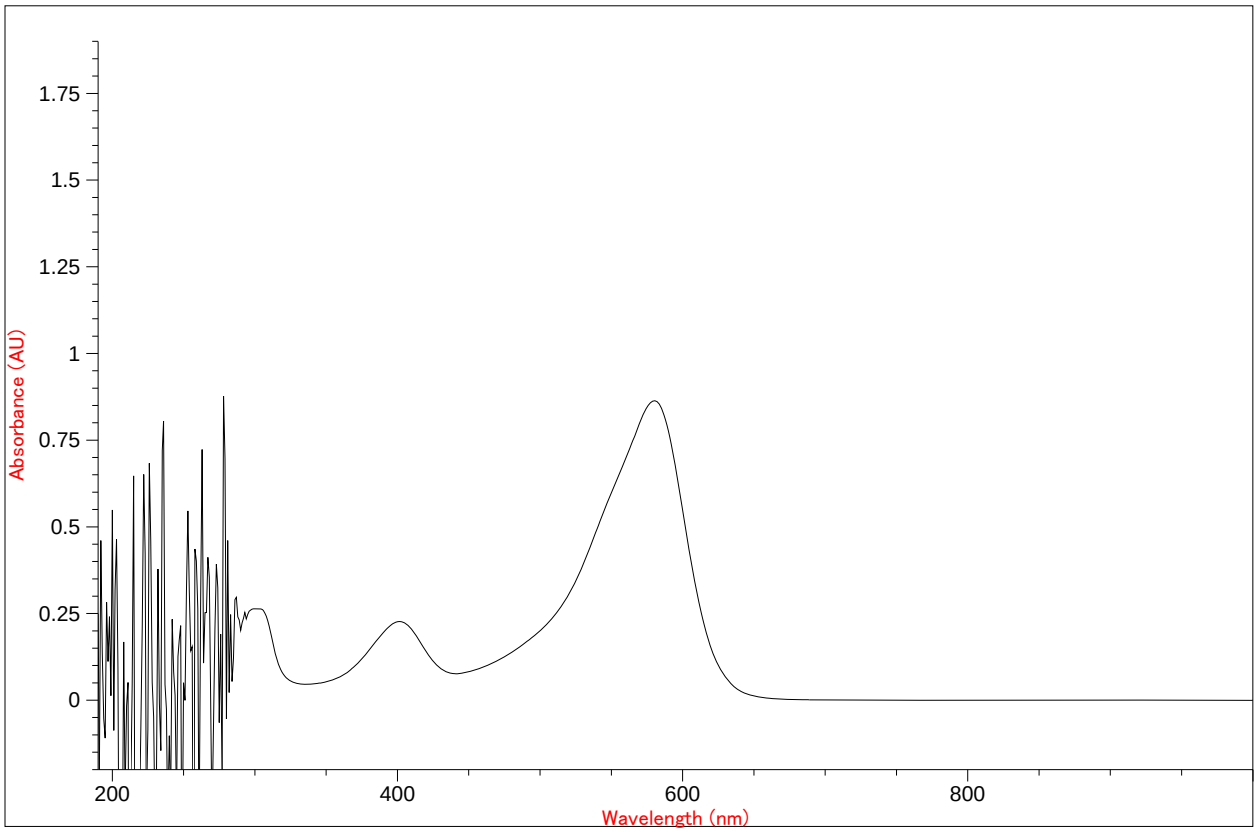
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00054	ug/mL	0.00784

Sample 6

Sample Name	0618-065.R1*2.Cond (#11)
Operator	Patricia Mann
Date	6/19/18
Time	16:59:58
Path Length	1
Path Length Unit	cm

Sample Spectrum



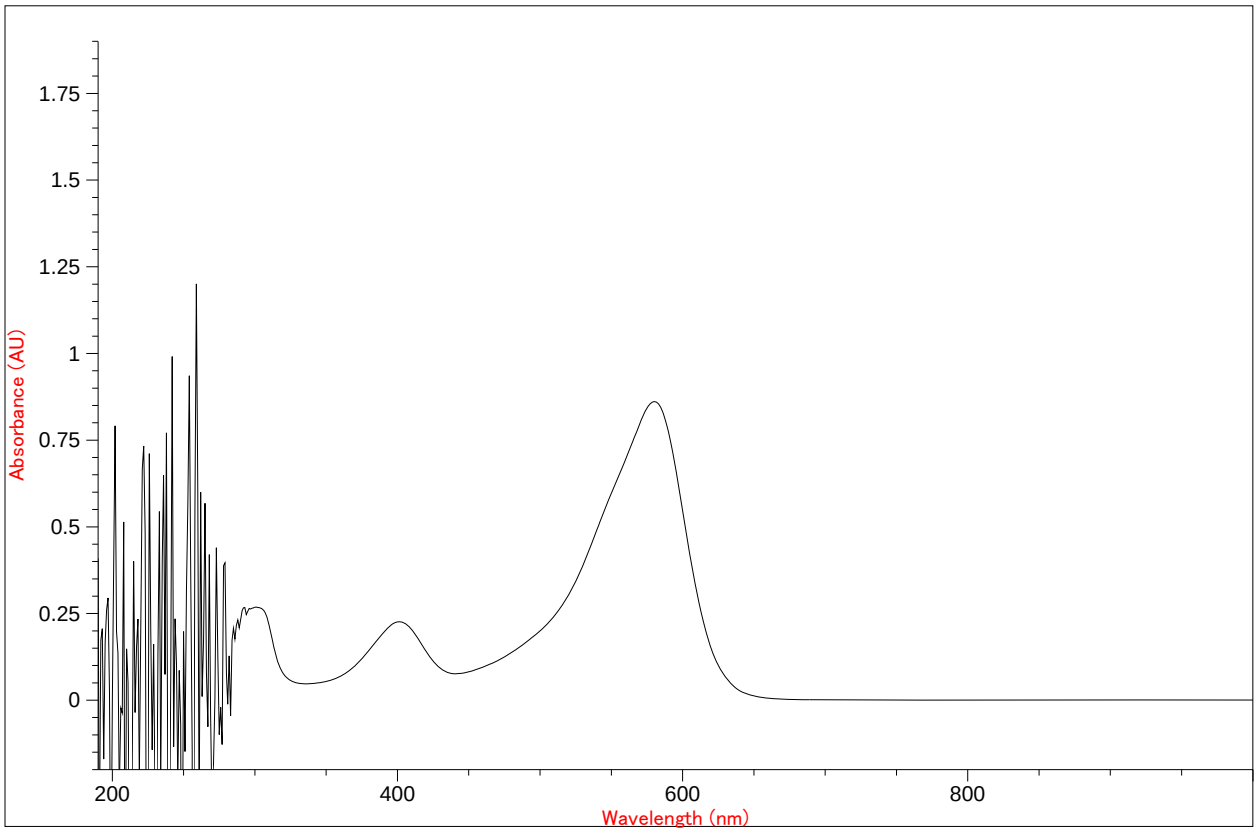
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.83864	ug/mL	0.00858

Sample 7

Sample Name	0618-065.LD-R1*2.Cond (#12)
Operator	Patricia Mann
Date	6/19/18
Time	17:00:15
Path Length	1
Path Length Unit	cm

Sample Spectrum



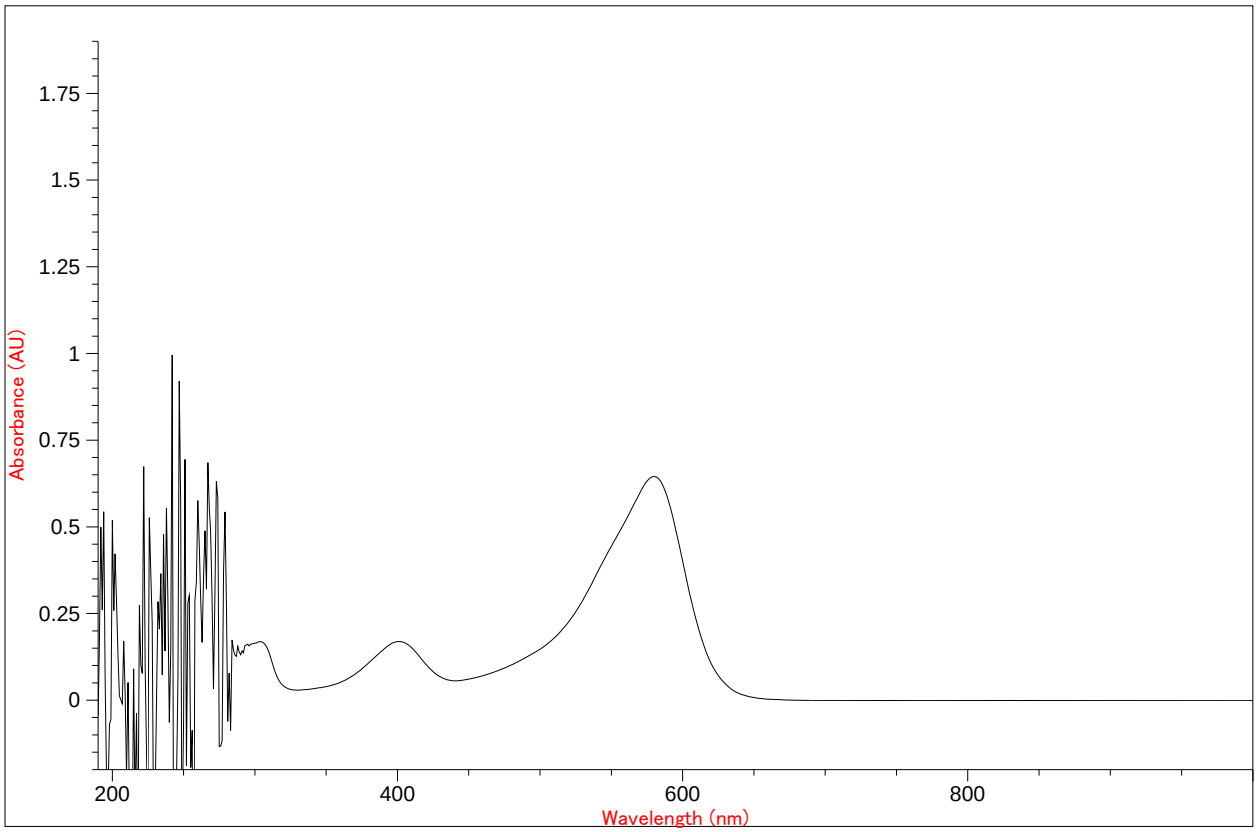
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.83369	ug/mL	0.00858

Sample 8

Sample Name	Snowball II 2053 #SSB (#13)
Operator	Patricia Mann
Date	6/19/18
Time	17:00:38
Path Length	1
Path Length Unit	cm

Sample Spectrum



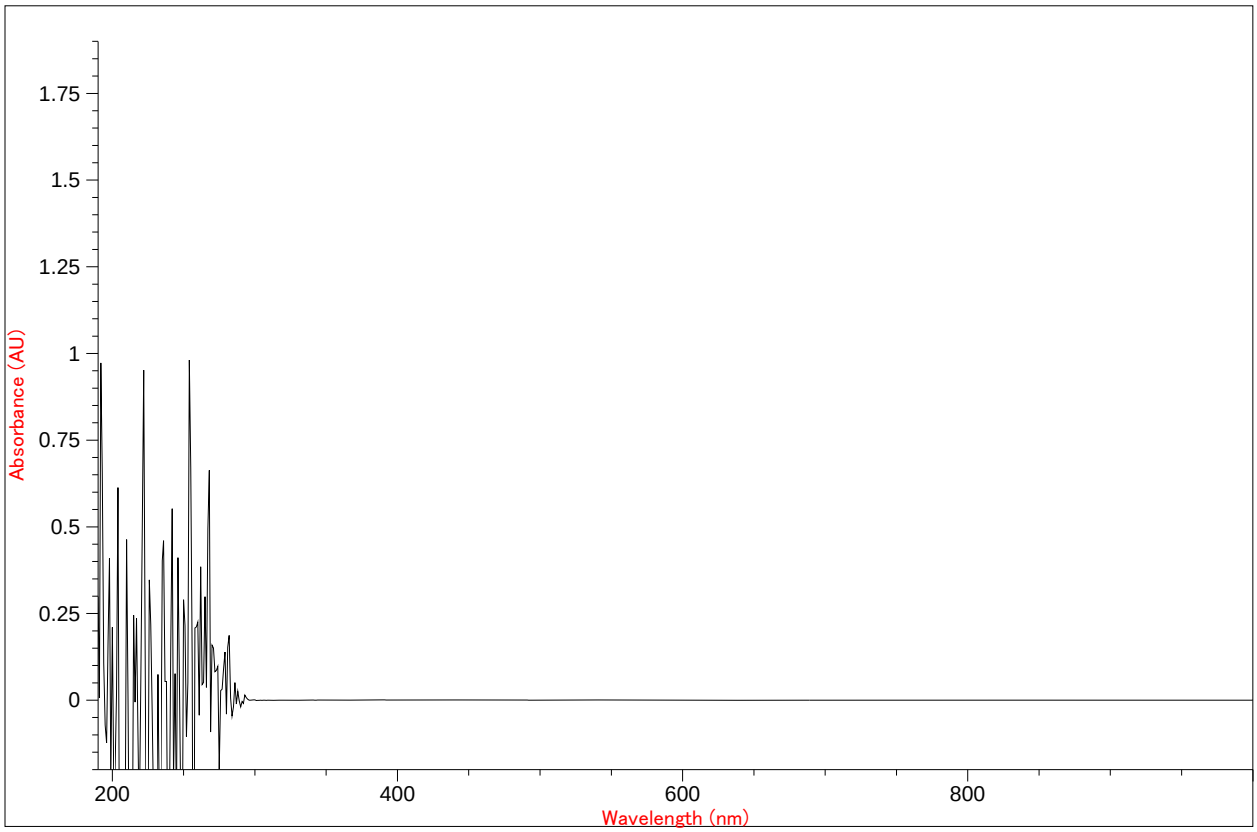
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37399	ug/mL	0.00826

Sample 9

Sample Name	Snowball II 2053 #MB2 (#14)
Operator	Patricia Mann
Date	6/19/18
Time	17:00:49
Path Length	1
Path Length Unit	cm

Sample Spectrum



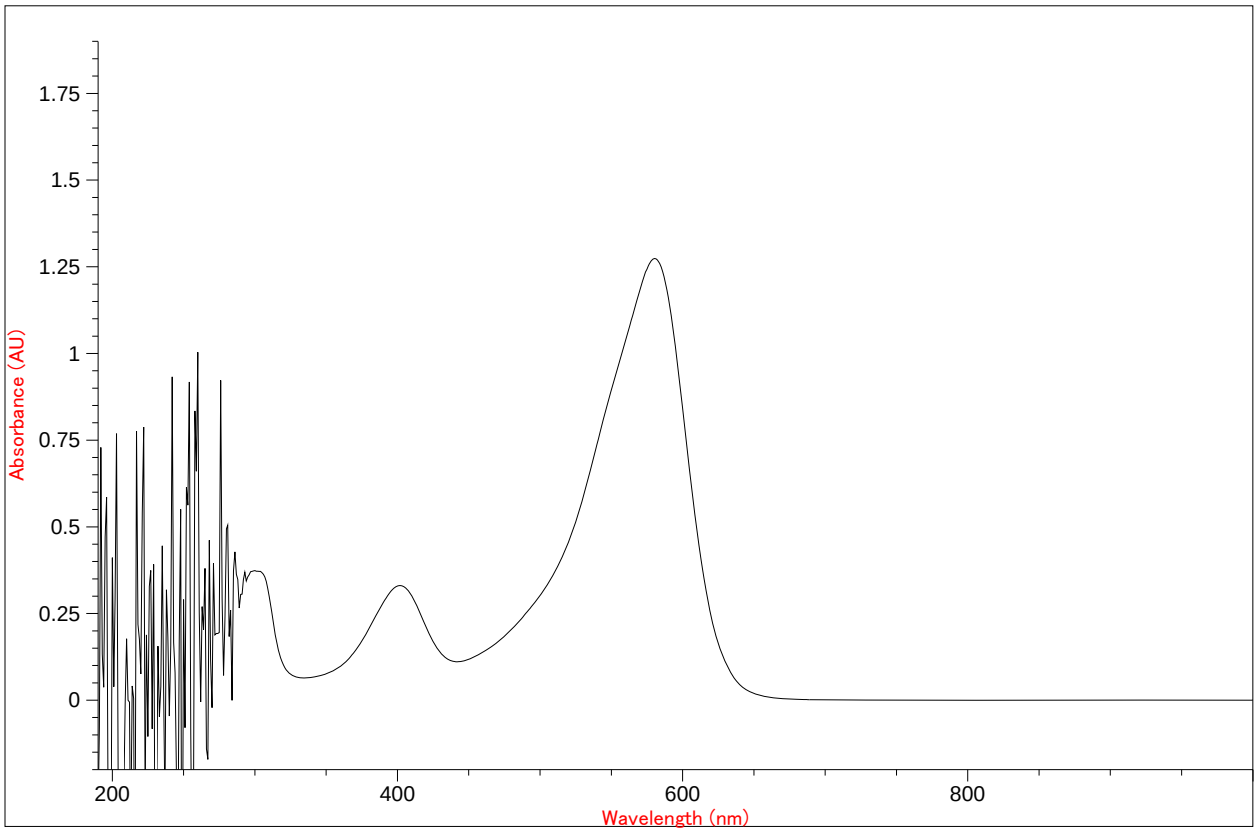
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00185	ug/mL	0.00784

Sample 10

Sample Name	0618-065.MS-R1*2.Cond (#15)
Operator	Patricia Mann
Date	6/19/18
Time	17:01:00
Path Length	1
Path Length Unit	cm

Sample Spectrum



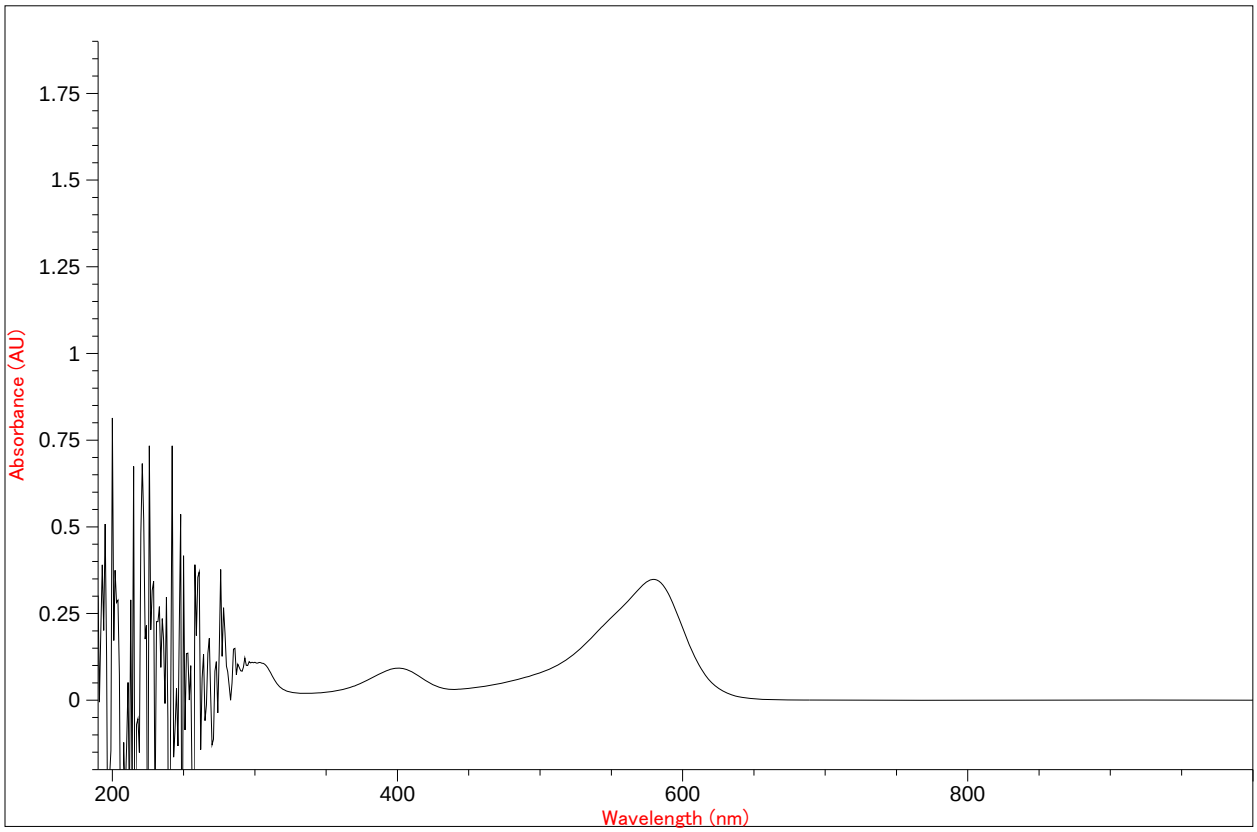
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	2.71725	ug/mL	0.00938

Sample 11

Sample Name	0618-065.AD-R1*5.Cond (#16)
Operator	Patricia Mann
Date	6/19/18
Time	17:01:12
Path Length	1
Path Length Unit	cm

Sample Spectrum



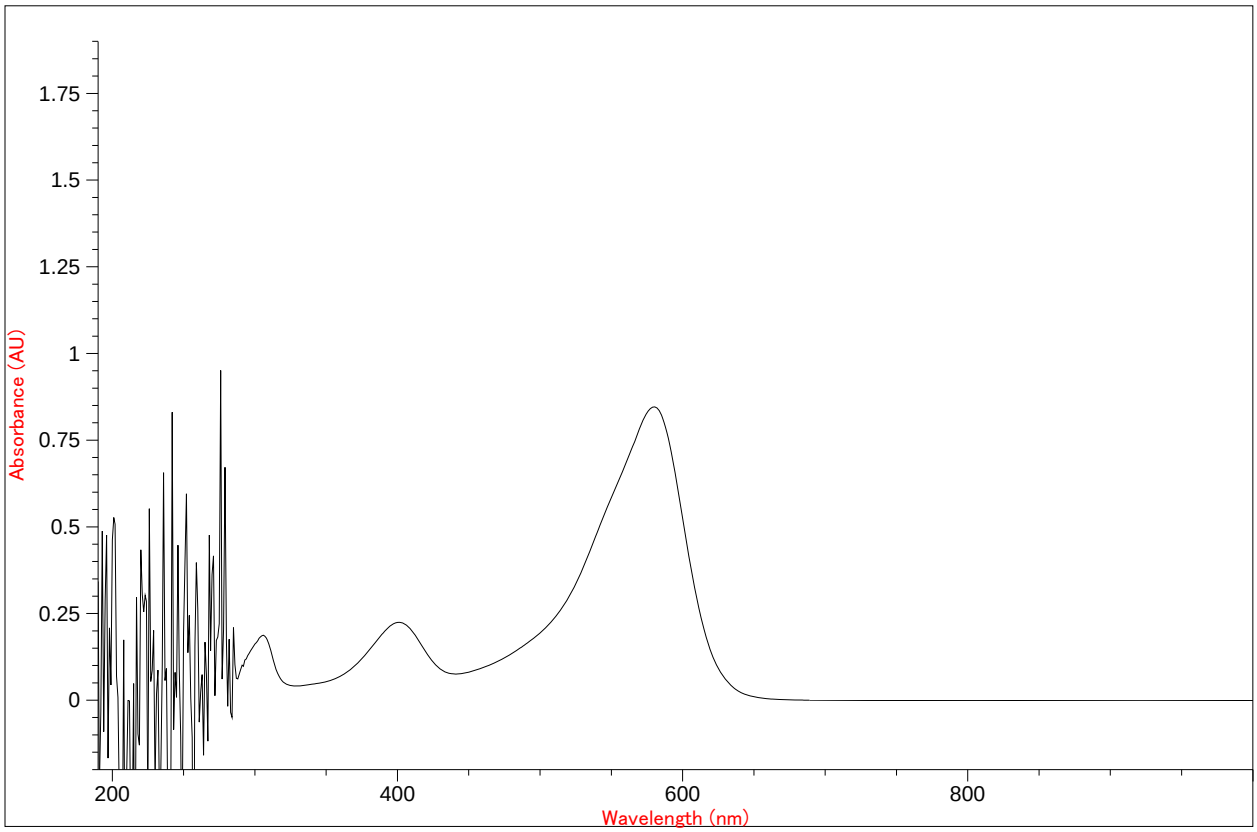
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.74268	ug/mL	0.00797

Sample 12

Sample Name	0618-065.R2*2.Cond (#17)
Operator	Patricia Mann
Date	6/19/18
Time	17:01:24
Path Length	1
Path Length Unit	cm

Sample Spectrum



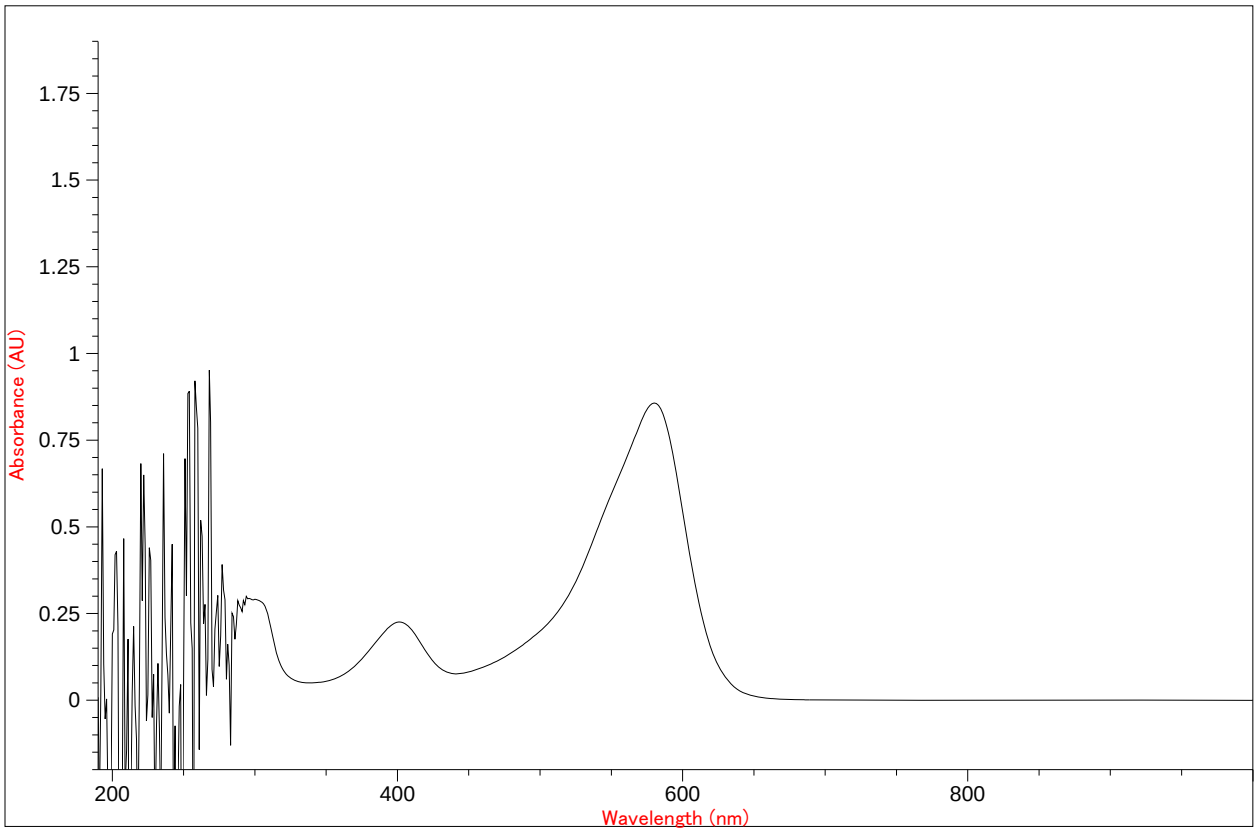
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.80359	ug/mL	0.00855

Sample 13

Sample Name	0618-065.R3*2.Cond (#18)
Operator	Patricia Mann
Date	6/19/18
Time	17:01:40
Path Length	1
Path Length Unit	cm

Sample Spectrum



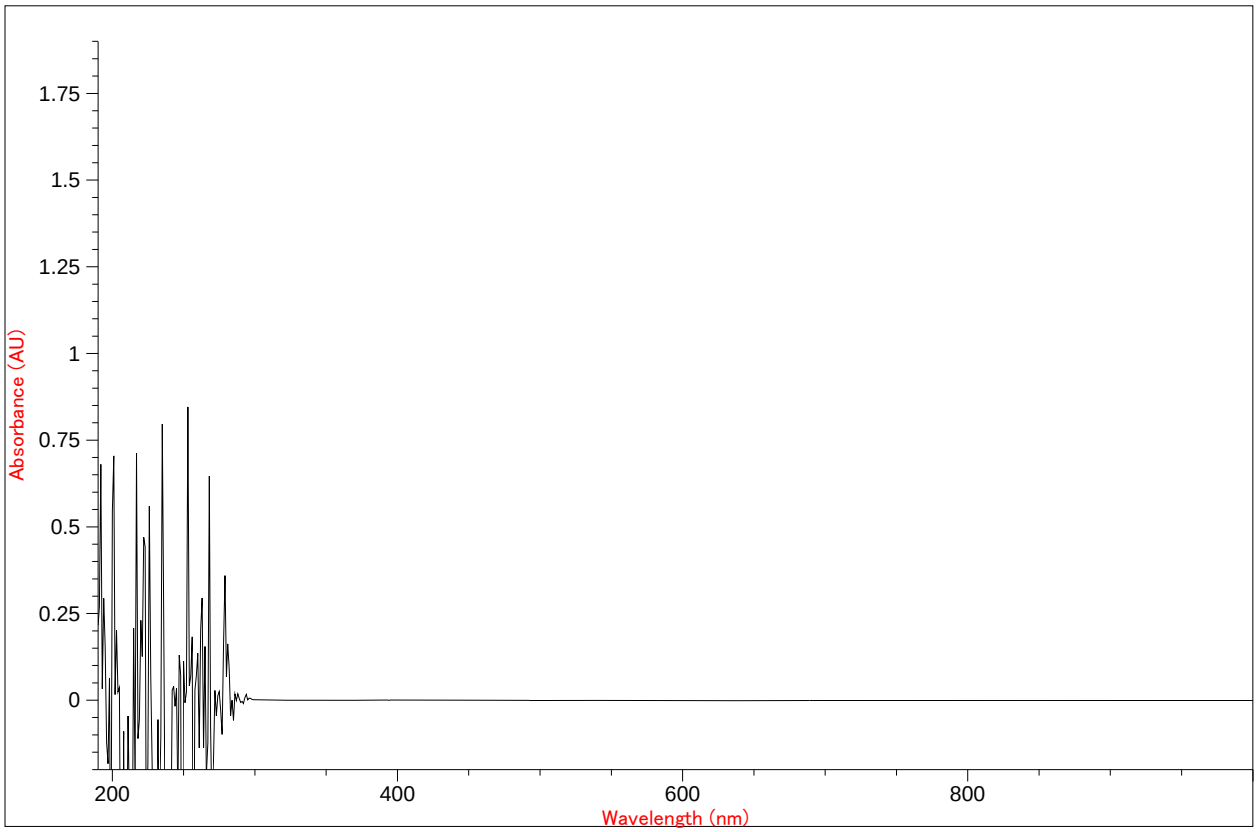
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.82579	ug/mL	0.00857

Sample 14

Sample Name	0618-065.FTB.Cond (#19)
Operator	Patricia Mann
Date	6/19/18
Time	17:02:04
Path Length	1
Path Length Unit	cm

Sample Spectrum



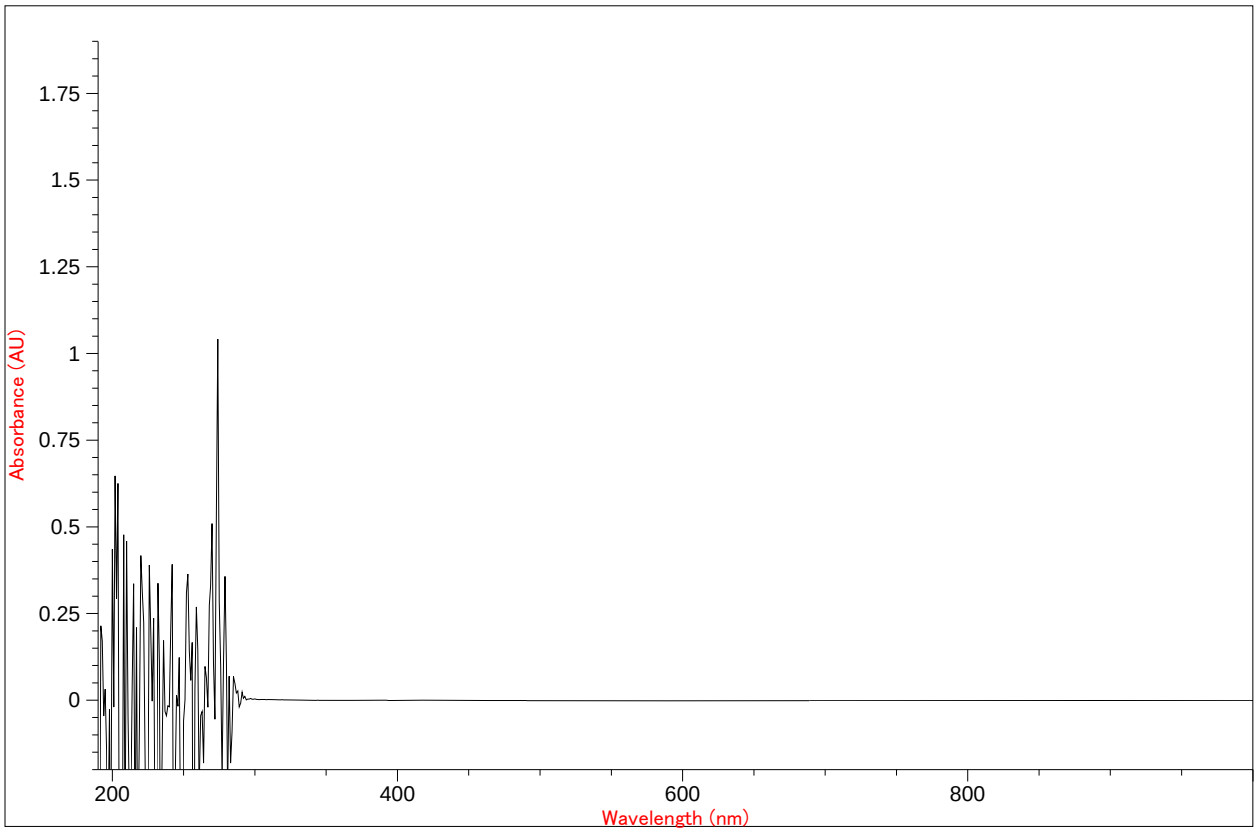
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00164	ug/mL	0.00784

Sample 15

Sample Name	0618-065.DiBlk.Cond (#20)
Operator	Patricia Mann
Date	6/19/18
Time	17:02:23
Path Length	1
Path Length Unit	cm

Sample Spectrum



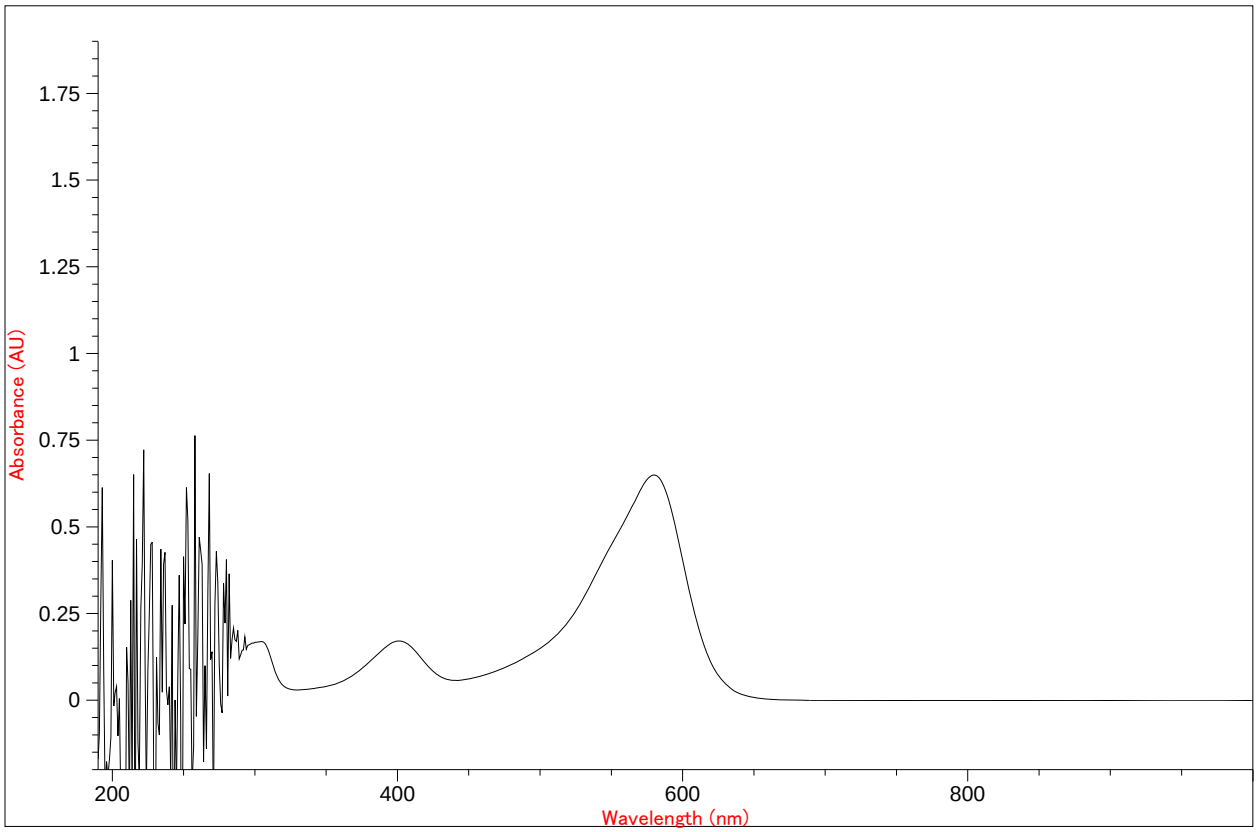
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00282	ug/mL	0.00784

Sample 16

Sample Name	Snowball II 2053 #SSC (#24)
Operator	Patricia Mann
Date	6/19/18
Time	17:03:28
Path Length	1
Path Length Unit	cm

Sample Spectrum



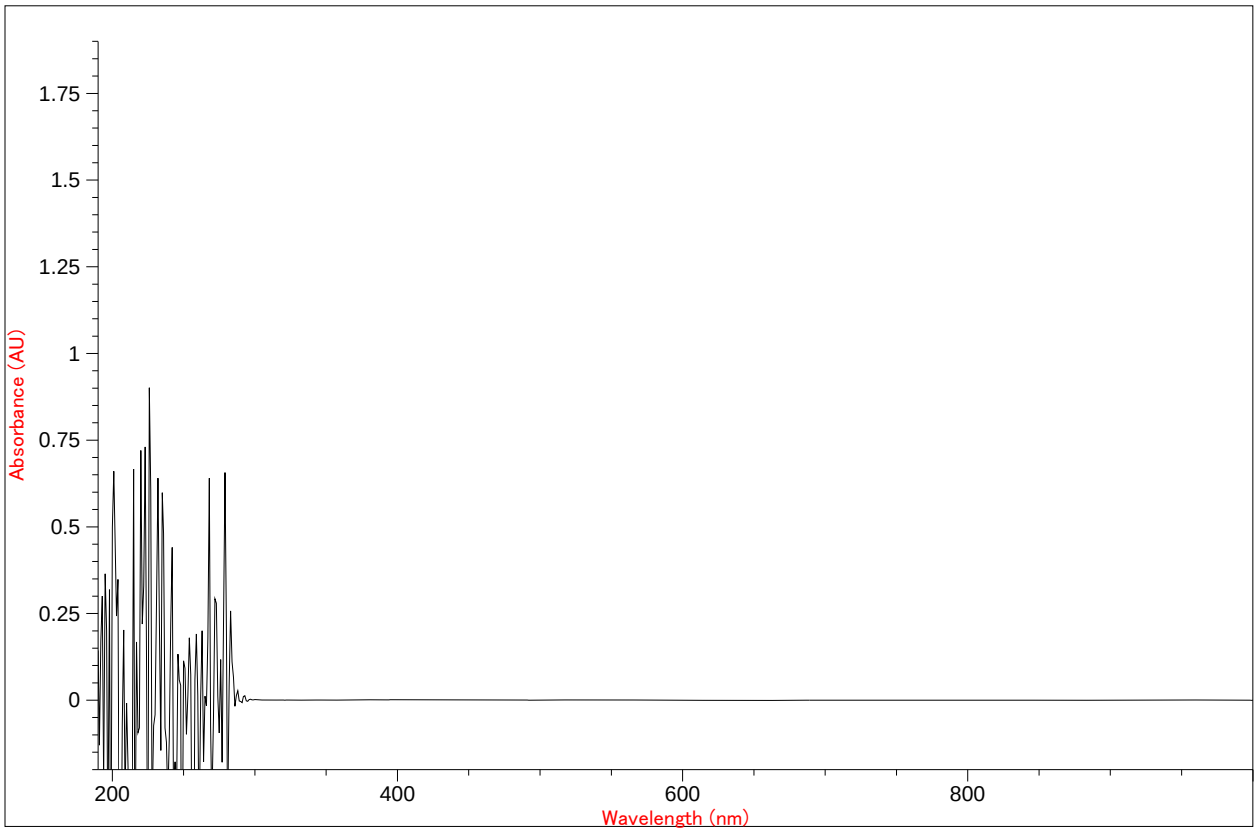
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.38410	ug/mL	0.00827

Sample 17

Sample Name	Snowball II 2053 #MB3 (#25)
Operator	Patricia Mann
Date	6/19/18
Time	17:03:43
Path Length	1
Path Length Unit	cm

Sample Spectrum



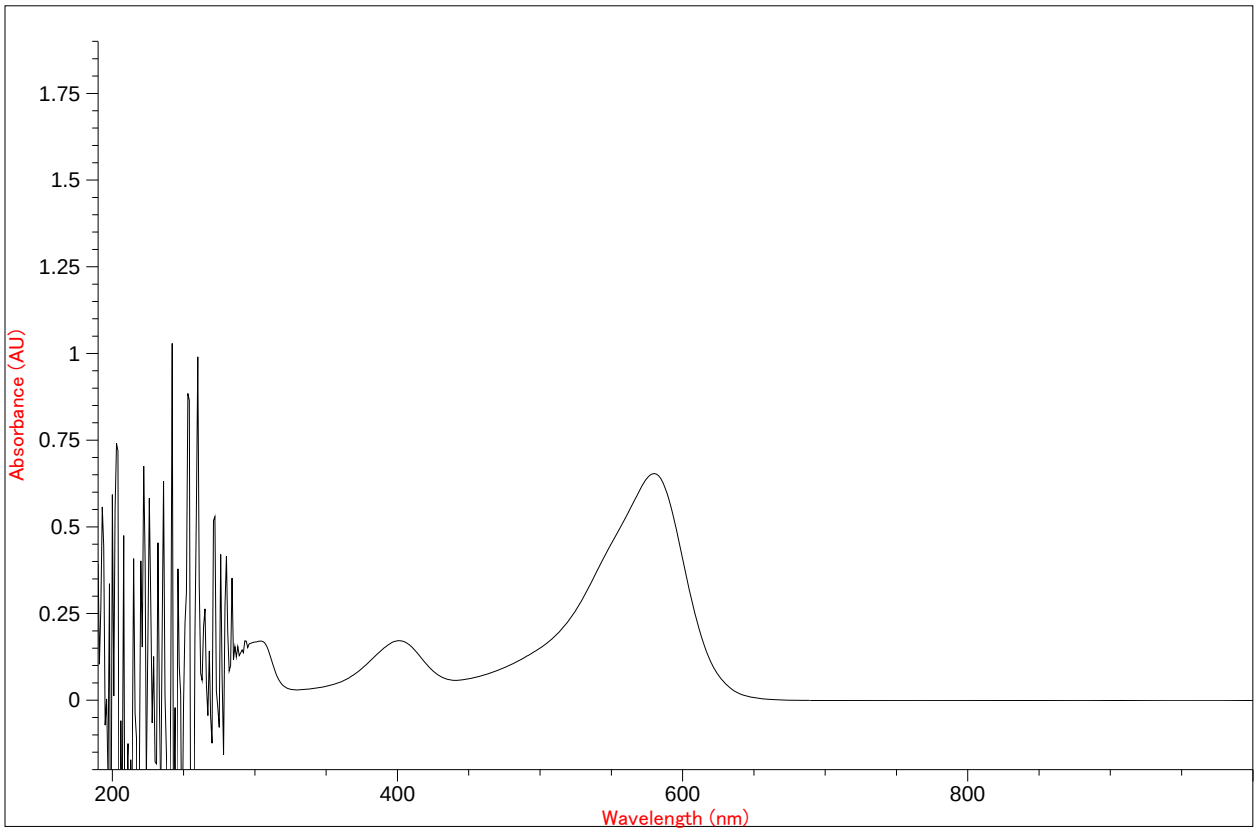
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00237	ug/mL	0.00784

Sample 18

Sample Name	Snowball II 2053 #SSD (#35)
Operator	Patricia Mann
Date	6/19/18
Time	17:07:25
Path Length	1
Path Length Unit	cm

Sample Spectrum



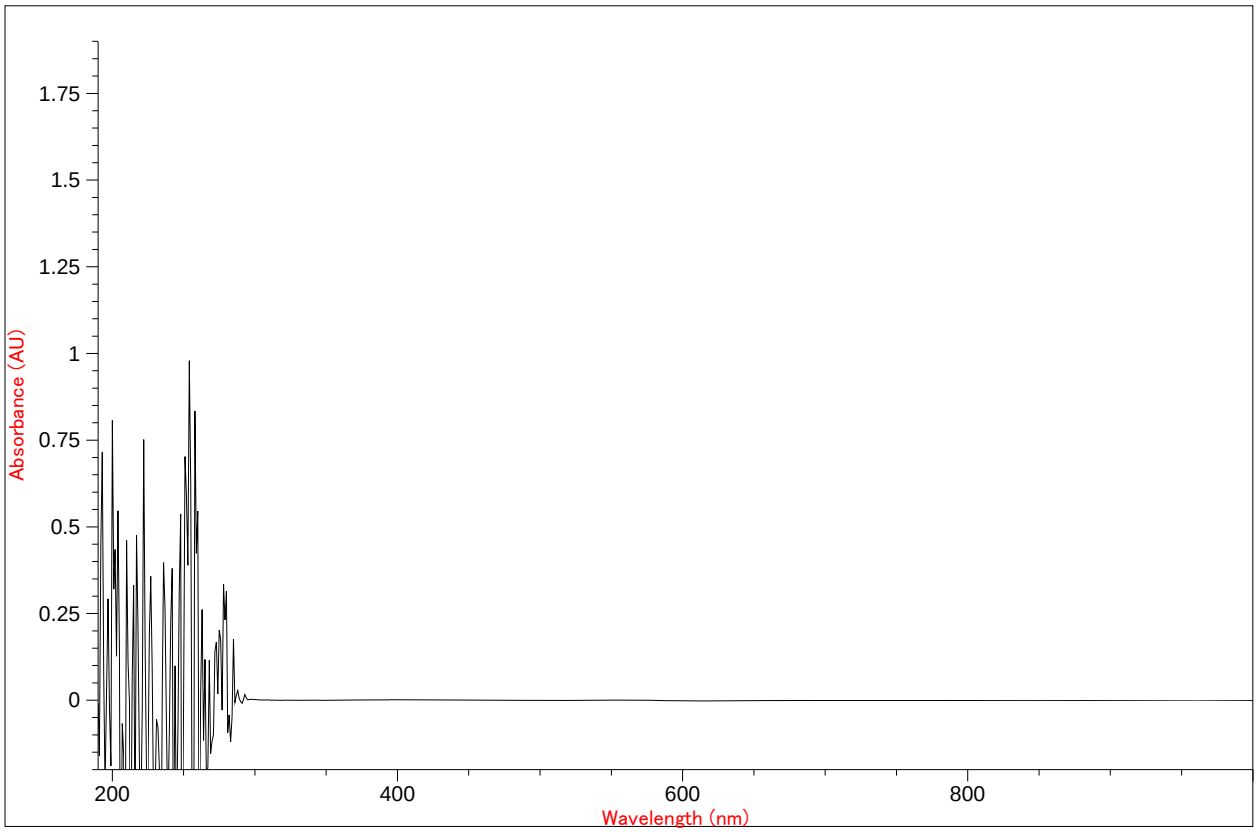
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.39333	ug/mL	0.00827

Sample 19

Sample Name	Snowball II 2053 #MB4 (#36)
Operator	Patricia Mann
Date	6/19/18
Time	17:07:44
Path Length	1
Path Length Unit	cm

Sample Spectrum



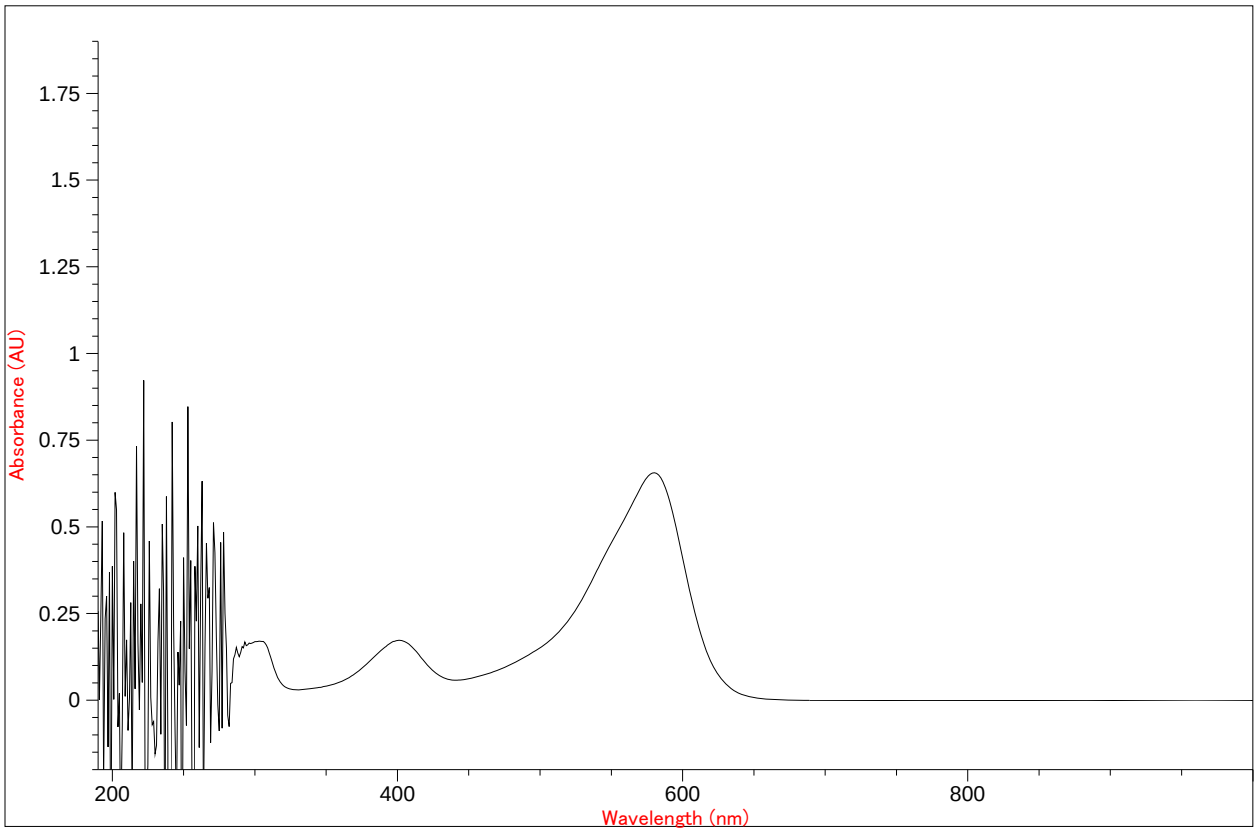
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00059	ug/mL	0.00784

Sample 20

Sample Name	Snowball II 2053 #SSE (#41)
Operator	Patricia Mann
Date	6/19/18
Time	17:09:54
Path Length	1
Path Length Unit	cm

Sample Spectrum



Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.39817	ug/mL	0.00828

Results Summary

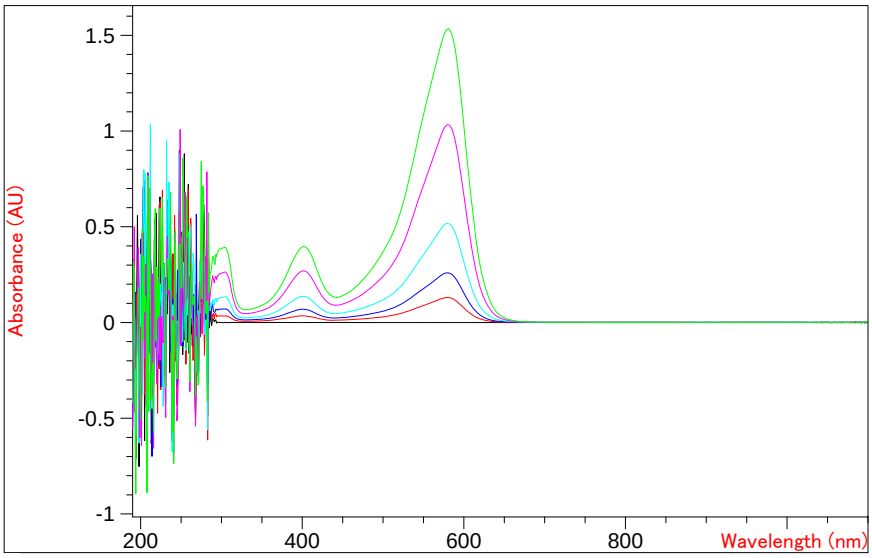
Sample Name	Data Value	Result Value	Unit	Std.Dev.
Snowball II 2053 #SS1 (#8)	0.59666	1.37010	ug/mL	0.00826
Snowball II 2053 #SS2 (#9)	0.59877	1.37494	ug/mL	0.00826
Snowball II 2053 #MB (#10)	0.00065	0.00150	ug/mL	0.00784
Snowball II 2053 #SSA (#2)	0.59368	1.36327	ug/mL	0.00826
Snowball II 2053 #MB1 (#3)	-0.00024	-0.00054	ug/mL	0.00784
0618-065.R1*2.Cond (#11)	0.80070	1.83864	ug/mL	0.00858
0618-065.LD-R1*2.Cond (#12)	0.79855	1.83369	ug/mL	0.00858
Snowball II 2053 #SSB (#13)	0.59835	1.37399	ug/mL	0.00826
Snowball II 2053 #MB2 (#14)	0.00081	0.00185	ug/mL	0.00784
0618-065.MS-R1*2.Cond (#15)	1.18333	2.71725	ug/mL	0.00938
0618-065.AD-R1*5.Cond (#16)	0.32343	0.74268	ug/mL	0.00797
0618-065.R2*2.Cond (#17)	0.78544	1.80359	ug/mL	0.00855
0618-065.R3*2.Cond (#18)	0.79511	1.82579	ug/mL	0.00857
0618-065.FTB.Cond (#19)	-0.00072	-0.00164	ug/mL	0.00784
0618-065.DiBlk.Cond (#20)	-0.00123	-0.00282	ug/mL	0.00784
Snowball II 2053 #SSC (#24)	0.60276	1.38410	ug/mL	0.00827
Snowball II 2053 #MB3 (#25)	0.00103	0.00237	ug/mL	0.00784
Snowball II 2053 #SSD (#35)	0.60677	1.39333	ug/mL	0.00827
Snowball II 2053 #MB4 (#36)	0.00026	0.00059	ug/mL	0.00784
Snowball II 2053 #SSE (#41)	0.60889	1.39817	ug/mL	0.00828

*** End Results Report ***

*** Calibration Report ***

Number of Standards 6

Standard Spectra



#	Standard	Path Length	Unit	Date	Time
1	Snowball II 2053	1.000	cm	6/19/18	15:33:01
2	Snowball II 2053	1.000	cm	6/19/18	15:33:24
3	Snowball II 2053	1.000	cm	6/19/18	15:33:40
4	Snowball II 2053	1.000	cm	6/19/18	15:33:53
5	Snowball II 2053	1.000	cm	6/19/18	15:34:06
6	Snowball II 2053	1.000	cm	6/19/18	15:34:16

Data Analysis:

Spectral Processing:

Absorbance

Use Wavelength(s):

Single (nm): 570

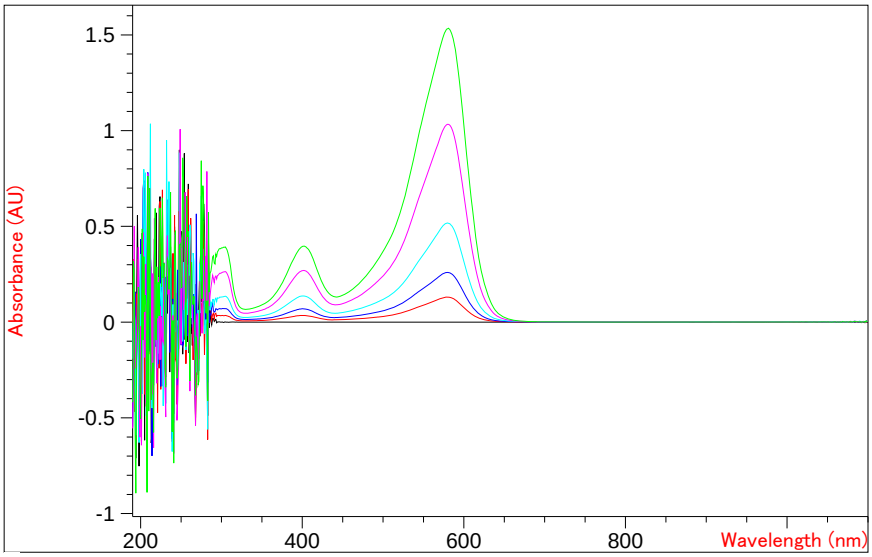
Evaluation: SCA

Calibrated at: Date 6/19/2018 Time 3:35:43 PM
Operator: Patricia Mann

Weighting Method: Least squares
Calibration Curve: C = k1 * A

Analyte Name	Unit
Formaldehyde	ug/mL

Processed Standard Spectra



Coefficients

k#	Value
1	2.29628

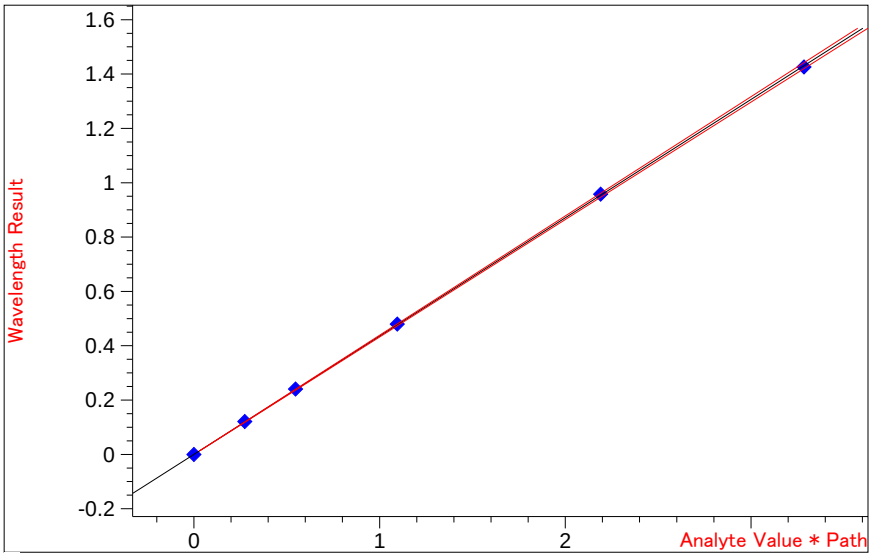
Used Wavelength Results (Absorbance (AU))

#	Value	#	Value	#	Value
1	-0.00019	3	0.24093	5	0.95812
2	0.12128	4	0.47970	6	1.42606

Calibration Table of Formaldehyde (ug/mL)

#	Standard Name	Value	Fitted Val.	Error (%)
1	Snowball II 2053	0.00000	-0.00043	-100.0
2	Snowball II 2053	0.27380	0.27848	-1.7
3	Snowball II 2053	0.54750	0.55324	-1.0
4	Snowball II 2053	1.09500	1.10152	-0.6
5	Snowball II 2053	2.19000	2.20012	-0.5
6	Snowball II 2053	3.28500	3.27464	0.3

Calibration Curve (Data Analysis)



SCA Summary

Analyte Name	Formaldehyde
Number of Standards	6
Calculation Method	LSQ
Calibration Curve	C = k1 * A
Coefficient k1	2.29630 ug/mL
Std.Dev. of k1	4.3472E-3 ug/mL
Std.Dev. of Calibration	7.8425E-3 ug/mL
Correl. Coeff. (R^2)	0.99998
Uncertainty	0.78 %

*** End Calibration Report ***

This Is The Last Page Of This Report.

Bison Engineering, Inc.

1400 11th Avenue
Helena, MT 59601

CFU107
Project # HAV218718

Analytical Report
(0618-102)

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

ENTHALPY ANALYTICAL

Summary of Results

Enthalpy Analytical

Company: Bison Engineering, Inc.

Job No.: 0618-102 EPA Method 316

Client No.: HAV218718

Summary Table

Compound	Sample ID / Catch Weight (µg)		
	Run 1	***Run 2***	***Run 3***
Formaldehyde	285	308	297
	FTB		
Formaldehyde	6.44 ND		

Results

Enthalpy Analytical

Company: Bison Engineering, Inc.

Job No.: 0618-102 EPA Method 316

Client No.: HAV218718

Formaldehyde

MDL	0.0137	(µg/mL)	Lower Curve Limit	0.274	(µg/mL)
LOQ	0.274	(µg/mL)	Upper Curve Limit	3.29	(µg/mL)

Sample ID	Lab ID	Absorbance	Analytical Concentration (µg/mL)	Dilution	Volume (mL)	Catch Weight (ug)	Qual
Run 1	21	0.2614	0.600	1	475	285	
Run 2	27	0.2980	0.684	1	450	308	
Run 3	28	0.2840	0.652	1	456	297	
FTB	29	0.0000	0.0137	1	470	6.44	ND
Snowball II 2053 #MB	10	0.0007	0.0137	1	1.00	0.0137	ND
Snowball II 2053 #MB	3	0.0000	0.0137	1	1.00	0.0137	ND
Snowball II 2053 #MB	14	0.0008	0.0137	1	1.00	0.0137	ND
Snowball II 2053 #MB	25	0.0010	0.0137	1	1.00	0.0137	ND
Snowball II 2053 #MB	36	0.0003	0.0137	1	1.00	0.0137	ND
LD-Run 1	22	0.2615	0.601	1	475	285	
					% Difference	0.0%	
AD-Run 1	26	0.1341	0.308	2	475	293	
					% Difference	2.6%	
MS-Run 1	23	0.6530	1.50	1	2.50	3.75	
					Spike Amount (ug)	2.19	
					Native Amount (ug)	1.49	
					Spike Recovery	103%	

Enthalpy Analytical

Company: Bison Engineering, Inc.

Job No.: 0618-102 EPA Method 316

Client No.: HAV218718

Formaldehyde

MDL	0.0137	(µg/mL)	Lower Curve Limit	0.274	(µg/mL)
LOQ	0.274	(µg/mL)	Upper Curve Limit	3.29	(µg/mL)

Sample ID	Lab ID	Absorbance	Analytical Concentration (µg/mL)	Dilution	Volume (mL)	Catch Weight (ug)	Qual
Snowball II 2053 #SS1	8	0.5967	1.37	1	1.00	1.37	
					Tag Amount (ug)	1.31	
					Spike Recovery	104%	
Snowball II 2053 #SS2	9	0.5988	1.37	1	1.00	1.37	
					Tag Amount (ug)	1.31	
					Spike Recovery	105%	

Narrative Summary

Enthalpy Analytical Narrative Summary

Company	Bison Engineering, Inc.
Analyst	PRM
Parameters	EPA Method 316

Client #	HAV218718
Job #	0618-102
# Samples	3, 1 Blank

Custody	Matthew St. Lawrence received the samples on 6/18/18 after being relinquished by Bison Engineering, Inc. The samples were received at 3.4 °C 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 operating at 570 nm for these analyses.
Calibration	The calibration curve is included in the Raw Data section of this report. The slope of the calibration curve was outside of our in-house limits as determined by our control chart. It was determined that the effect of the high slope value would have little effect on the overall data and has therefore been used to quantitate the data.
QC Notes	The client's ***Field Train Blank*** was analyzed with the samples and did not contain formaldehyde at a level above the detection limit. Therefore no blank correction has been applied to the sample results. The analyses of the laboratory method blanks did not show formaldehyde at concentrations greater than the detection limit. The laboratory duplicate and alternate dilution analyses (LD and AD) of sample ***Run 1*** differed from the initial results by 0.0% and 2.6%, respectively. A matrix spike (MS) was performed on an aliquot of sample ***Run 1*** which exhibited a recovery of 103%. The second source standards were analyzed as Laboratory Control Samples (LCS) and had spike recovery values of 104% and 105%. The samples were analyzed within the 14-day holding time recommended by the method.

ENTHALPY ANALYTICAL

Enthalpy Analytical Narrative Summary
(continued)

Reporting Notes	The client provided volumes for each of the samples on their chain of custody. The client's volumes were confirmed by the laboratory and have been used to calculate total catch weight. 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.

ENTHALPY ANALYTICAL

General Reporting Notes

The following are general reporting notes that are applicable to all Enthalpy Analytical, Inc. 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.
- 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).
- 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).

General Reporting Notes

(continued)

- 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.
- **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

ENTHALPY
ANALYTICAL

ENTHALPY analytical, inc

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

Project Number: HAV218718
Site Name: CFU107
Location:

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.

Special Instructions:
Attn: Dean Brayboy

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 formaldehyde	Notes:
Run1 cont.#1	6/14/18	12:30	475ml					1						
Run2 cont.#1	6/14/18	15:15	450ml					1						
Run3 cont.#1	6/14/18		456ml					1						
M-316 field train blank	6/14/18	12:30	470ml					1						

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Condition Upon Receipt:
[signature]	6/14/18	Matt A. Lawrence	6/18/18	9:00am	☒ 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

Good condition
3.4°C Raytek 5

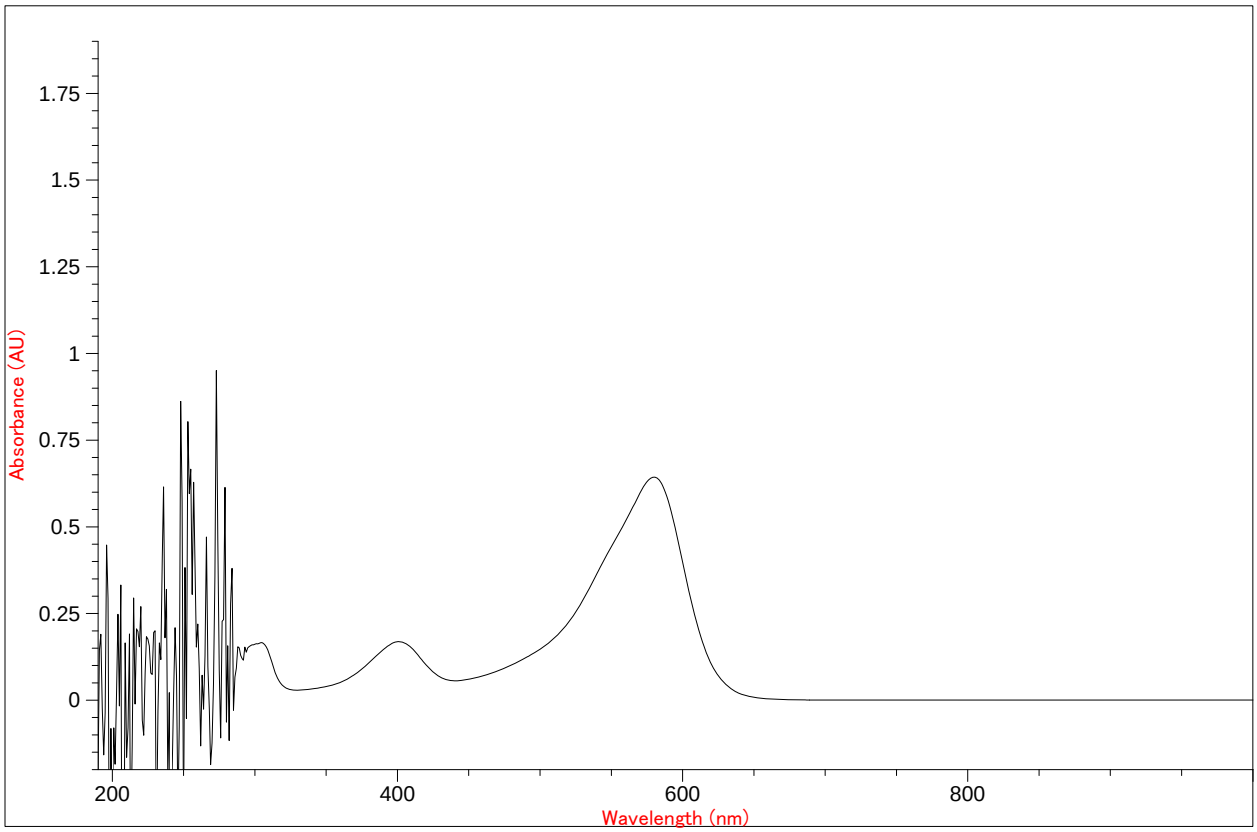
Mst 6/18/18
Samples received on ice.

Raw Data

Sample 1

Sample Name	Snowball II 2053 #SS1 (#8)
Operator	Patricia Mann
Date	6/19/18
Time	15:34:26
Path Length	1
Path Length Unit	cm

Sample Spectrum



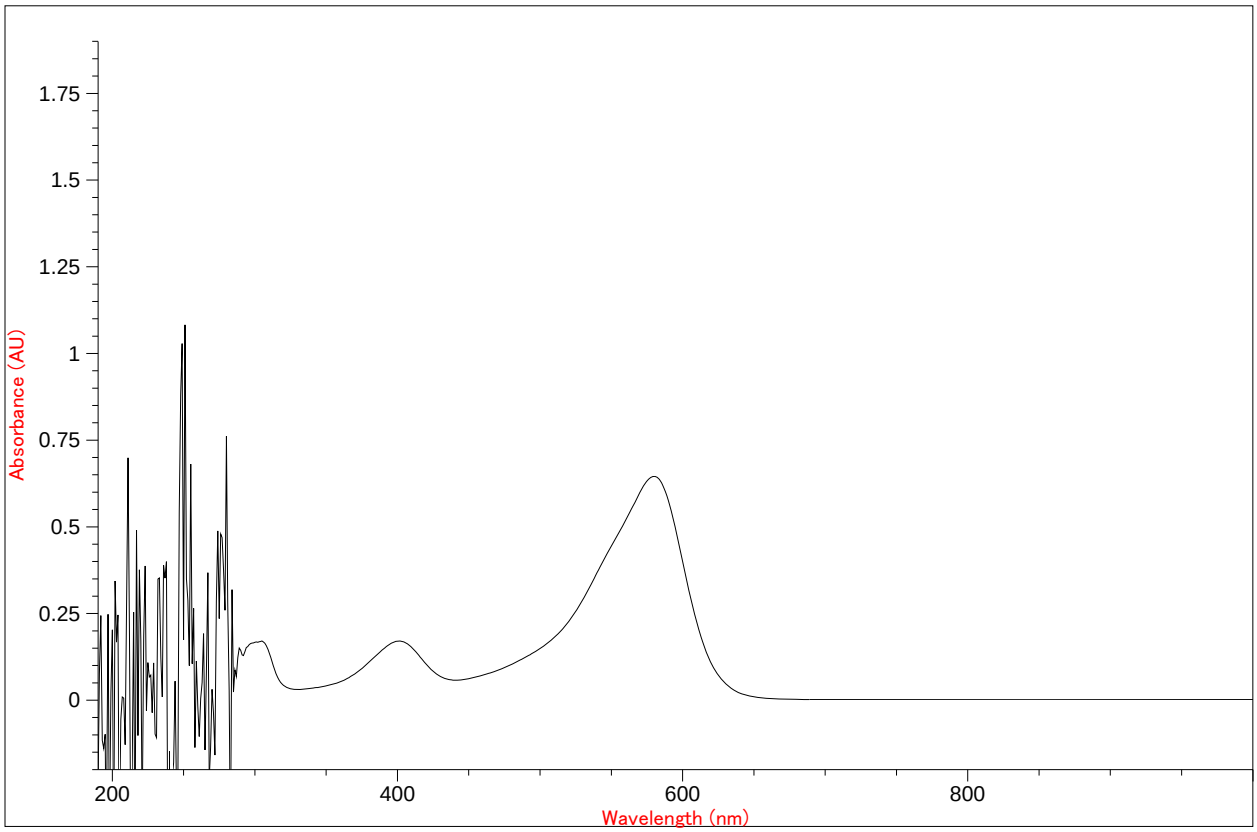
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37010	ug/mL	0.00826

Sample 2

Sample Name	Snowball II 2053 #SS2 (#9)
Operator	Patricia Mann
Date	6/19/18
Time	15:34:37
Path Length	1
Path Length Unit	cm

Sample Spectrum



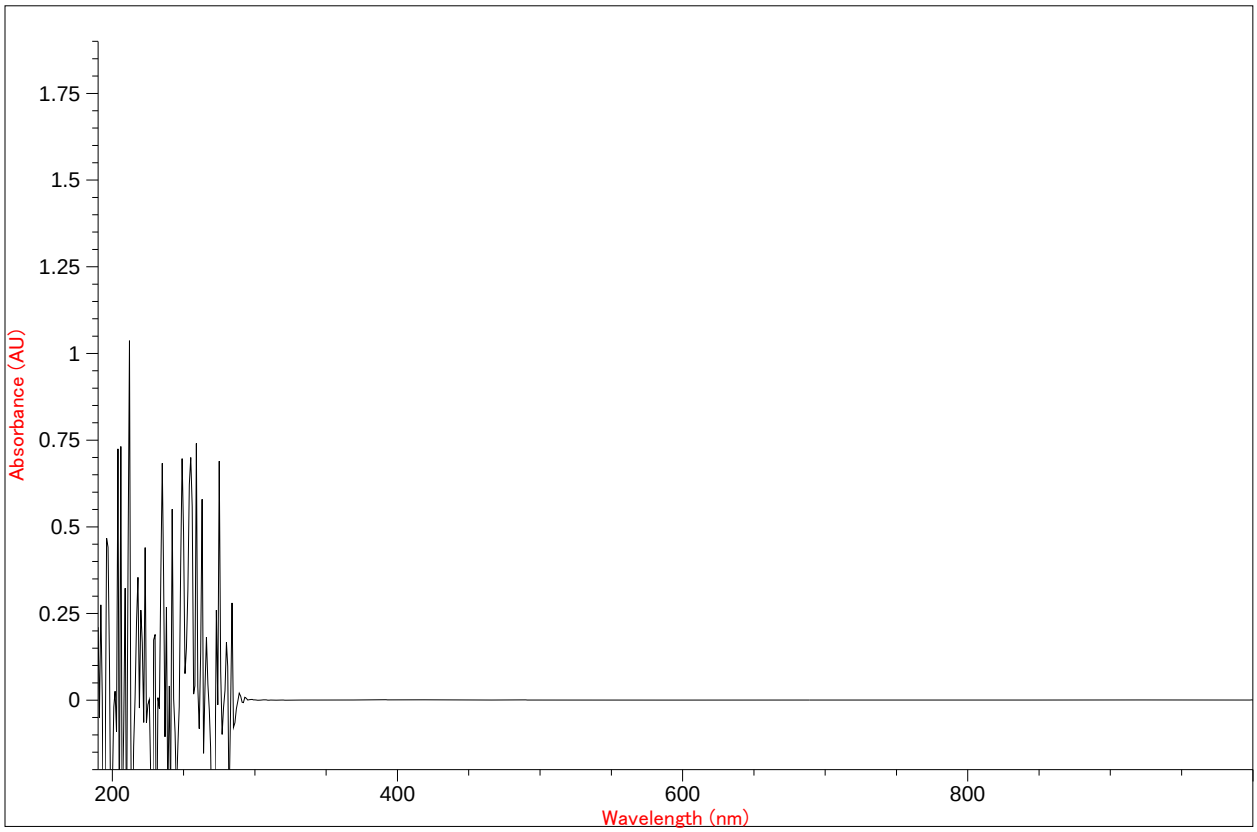
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37494	ug/mL	0.00826

Sample 3

Sample Name	Snowball II 2053 #MB (#10)
Operator	Patricia Mann
Date	6/19/18
Time	15:34:55
Path Length	1
Path Length Unit	cm

Sample Spectrum



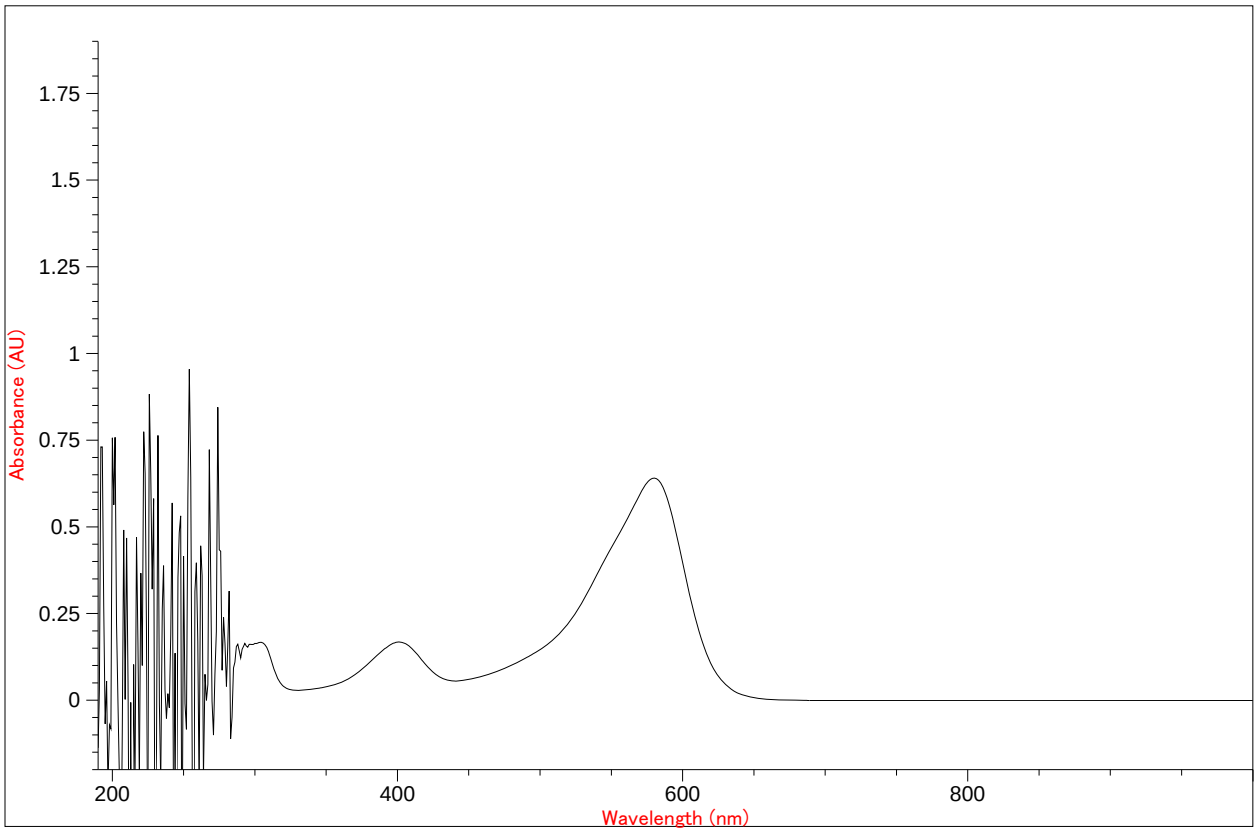
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00150	ug/mL	0.00784

Sample 4

Sample Name	Snowball II 2053 #SSA (#2)
Operator	Patricia Mann
Date	6/19/18
Time	16:57:33
Path Length	1
Path Length Unit	cm

Sample Spectrum



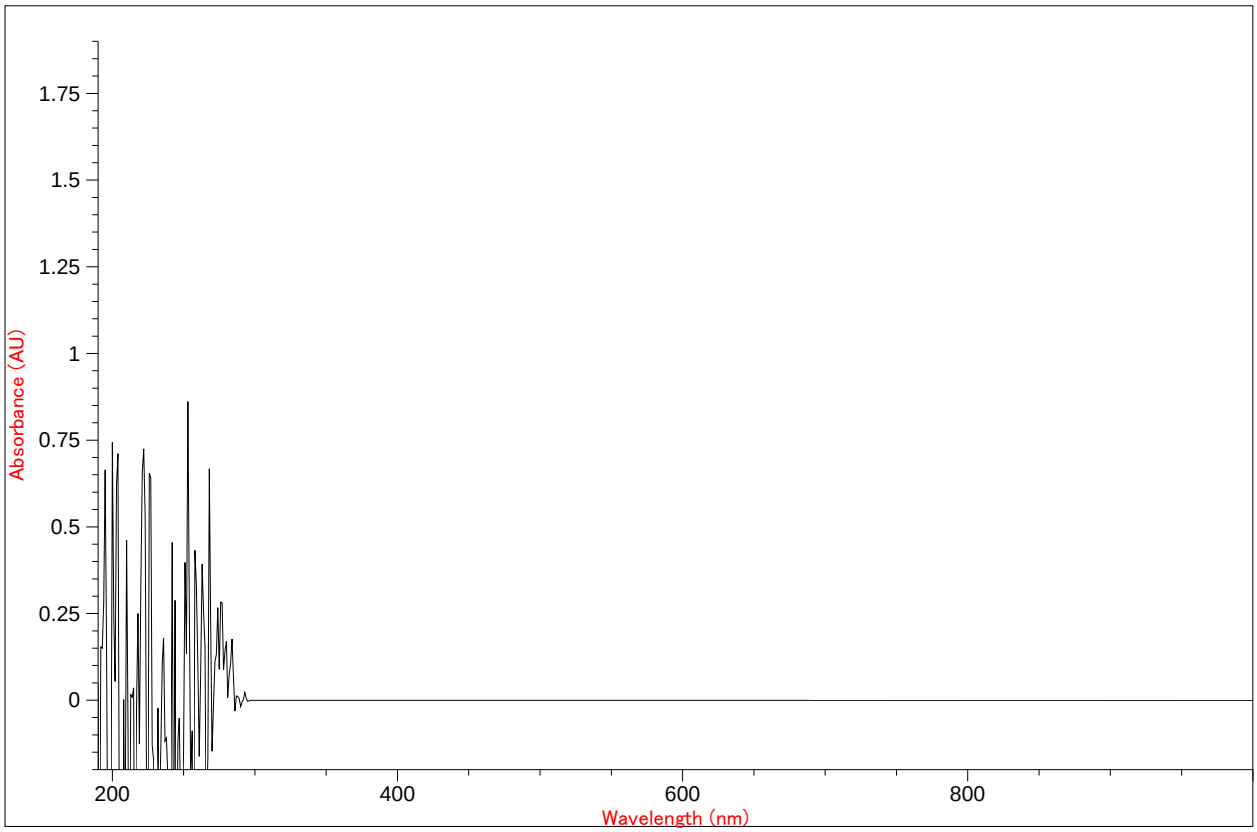
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.36327	ug/mL	0.00826

Sample 5

Sample Name	Snowball II 2053 #MB1 (#3)
Operator	Patricia Mann
Date	6/19/18
Time	16:57:48
Path Length	1
Path Length Unit	cm

Sample Spectrum



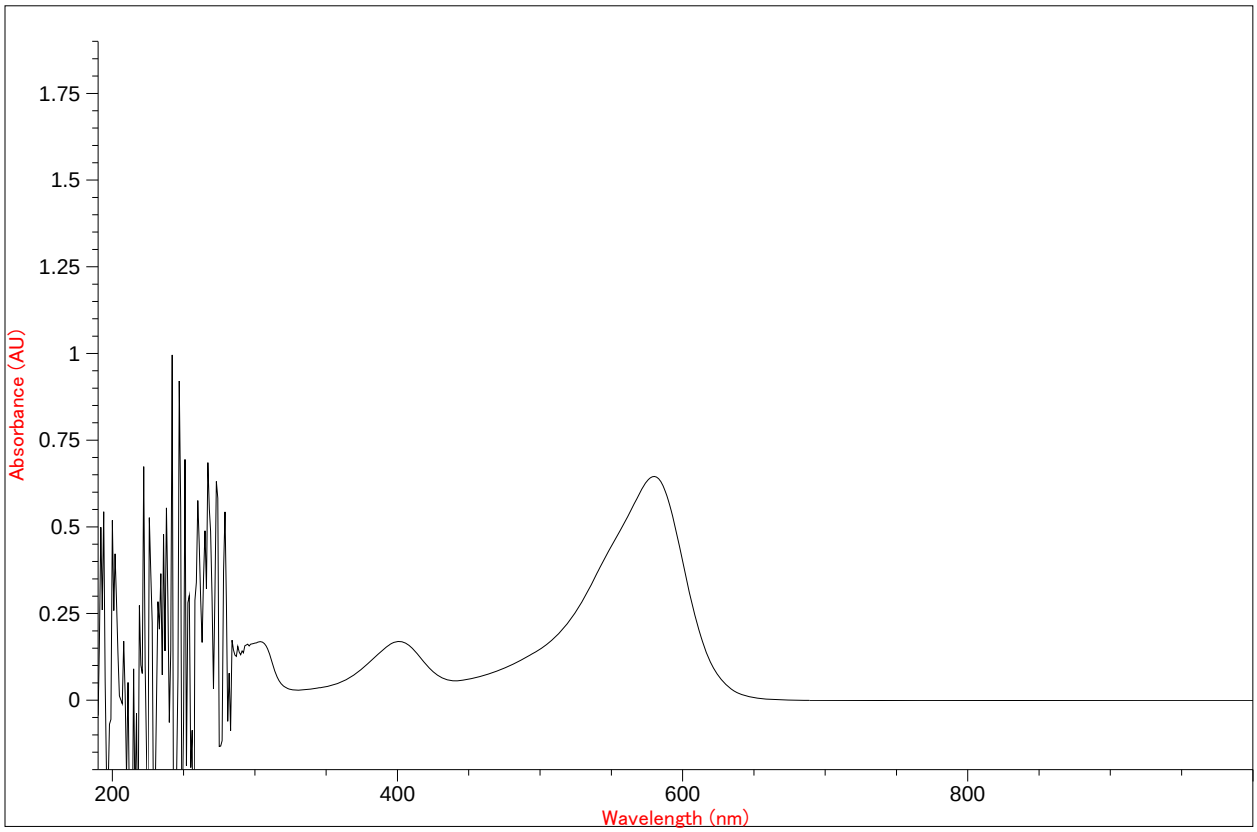
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00054	ug/mL	0.00784

Sample 6

Sample Name	Snowball II 2053 #SSB (#13)
Operator	Patricia Mann
Date	6/19/18
Time	17:00:38
Path Length	1
Path Length Unit	cm

Sample Spectrum



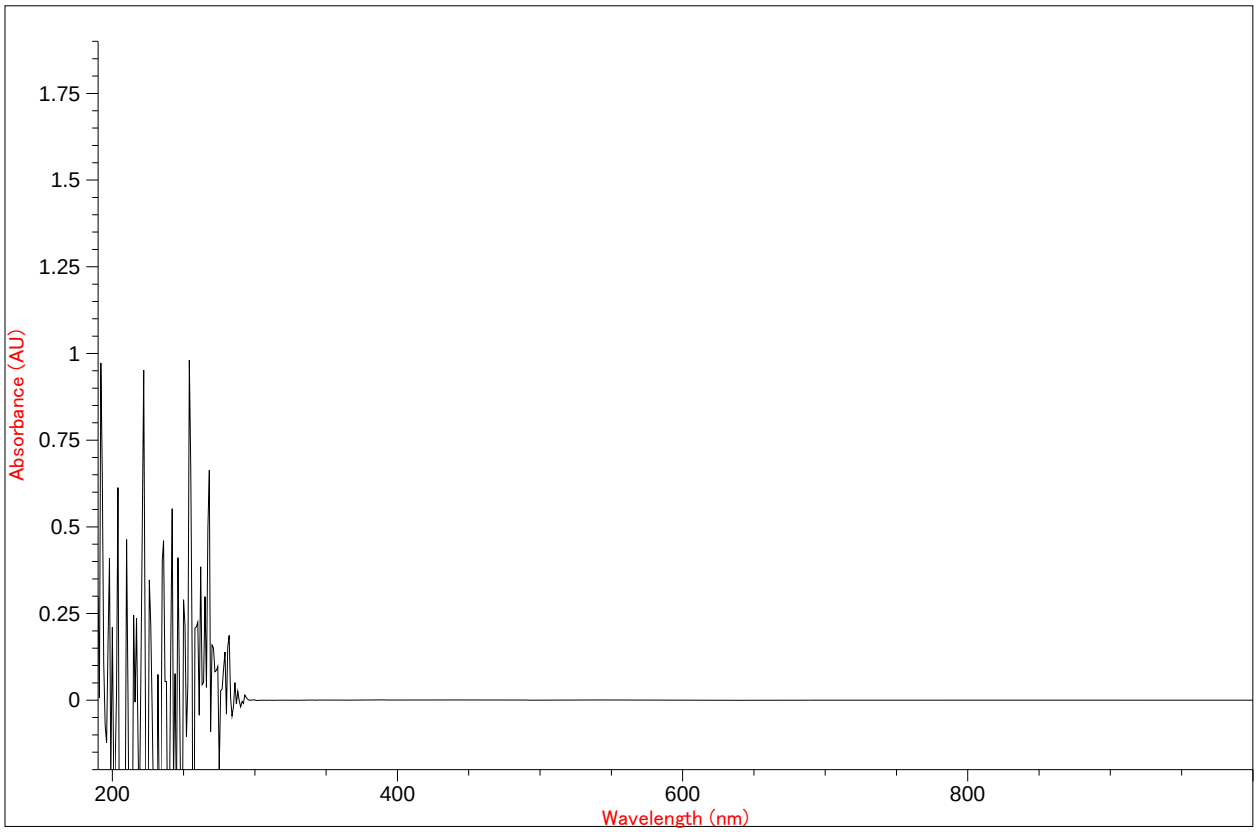
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.37399	ug/mL	0.00826

Sample 7

Sample Name	Snowball II 2053 #MB2 (#14)
Operator	Patricia Mann
Date	6/19/18
Time	17:00:49
Path Length	1
Path Length Unit	cm

Sample Spectrum



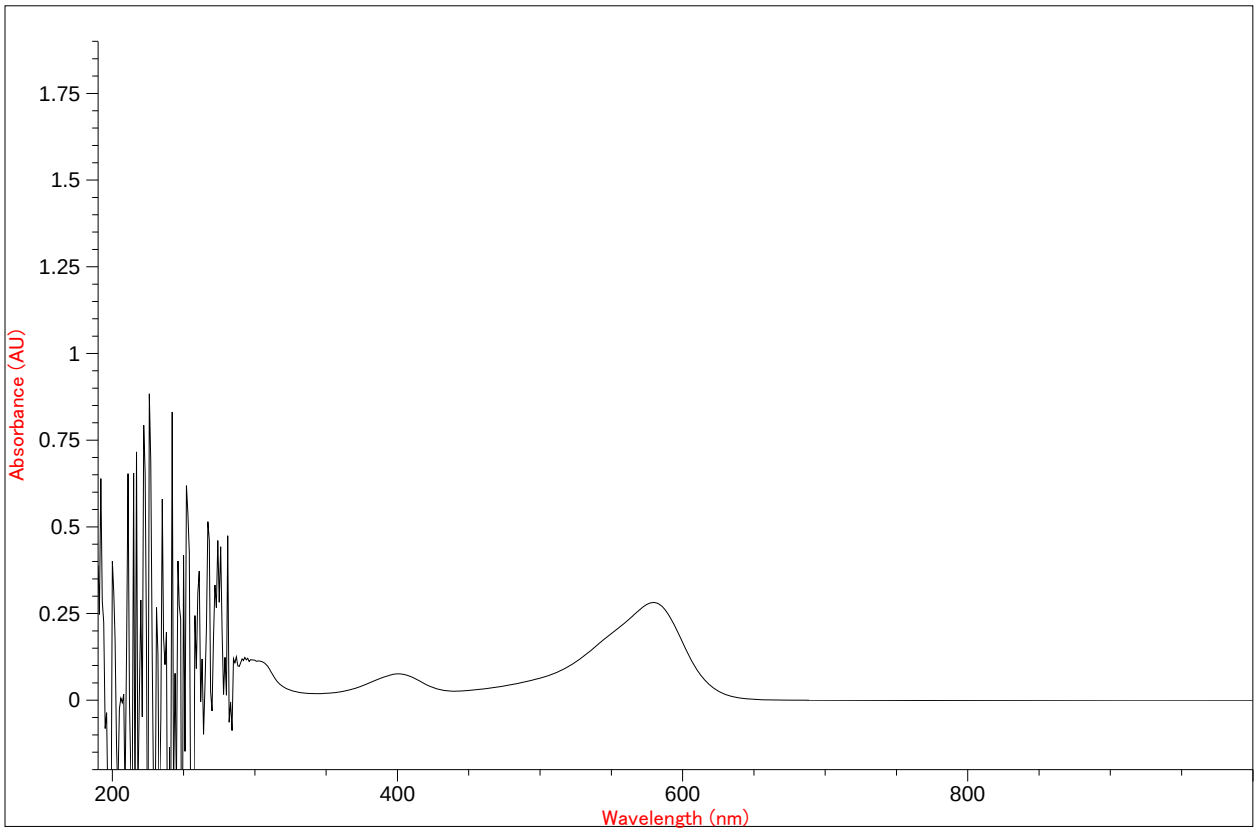
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00185	ug/mL	0.00784

Sample 8

Sample Name	0618-102.R1.Cond (#21)
Operator	Patricia Mann
Date	6/19/18
Time	17:02:39
Path Length	1
Path Length Unit	cm

Sample Spectrum



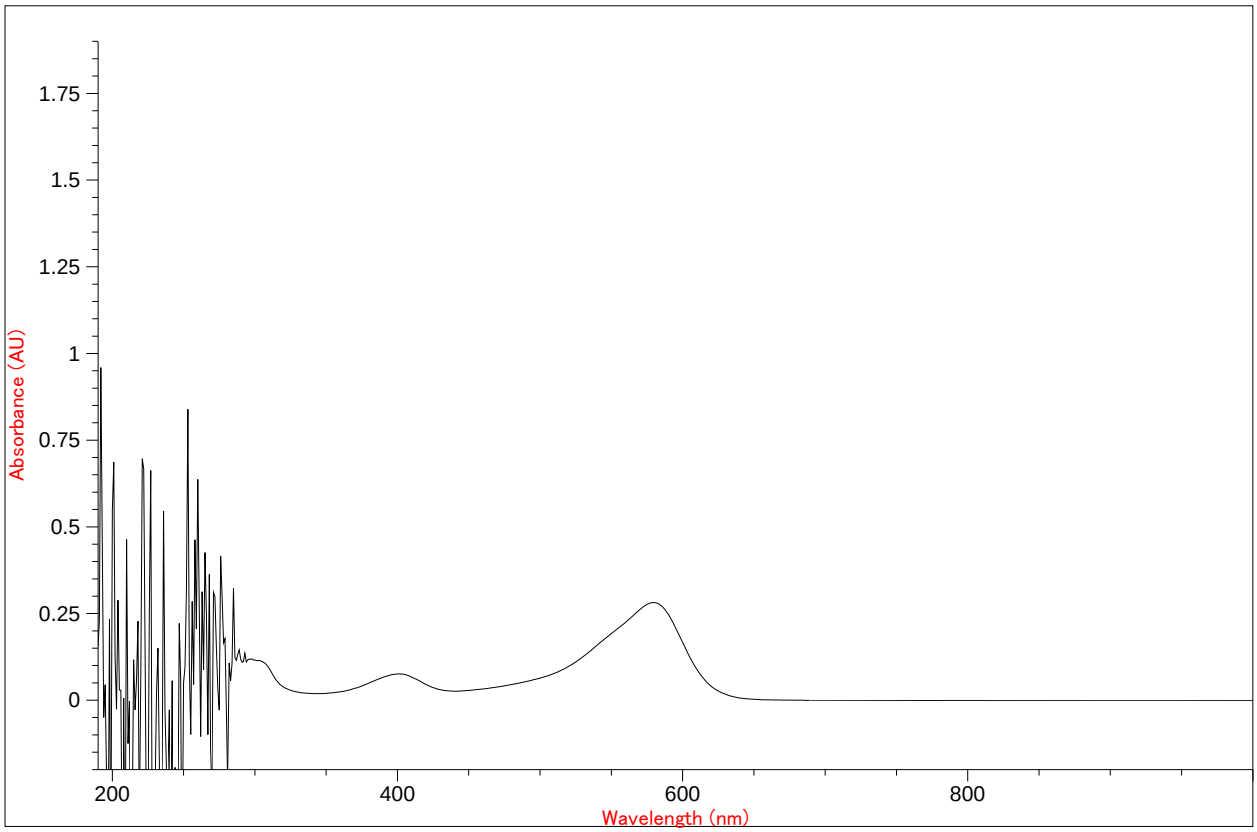
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.60024	ug/mL	0.00792

Sample 9

Sample Name	0618-102.LD-R1.Cond (#22)
Operator	Patricia Mann
Date	6/19/18
Time	17:02:50
Path Length	1
Path Length Unit	cm

Sample Spectrum



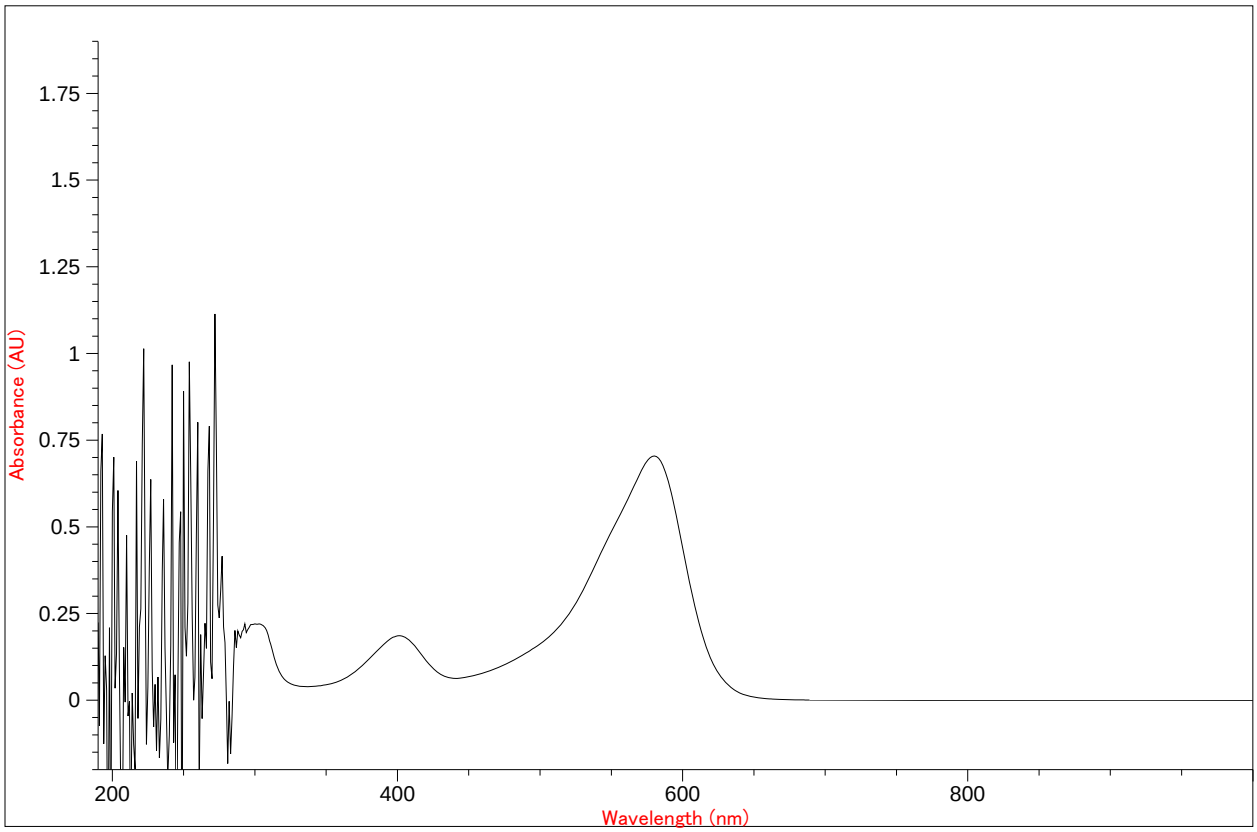
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.60053	ug/mL	0.00792

Sample 10

Sample Name	0618-102.MS-R1.Cond (#23)
Operator	Patricia Mann
Date	6/19/18
Time	17:03:09
Path Length	1
Path Length Unit	cm

Sample Spectrum



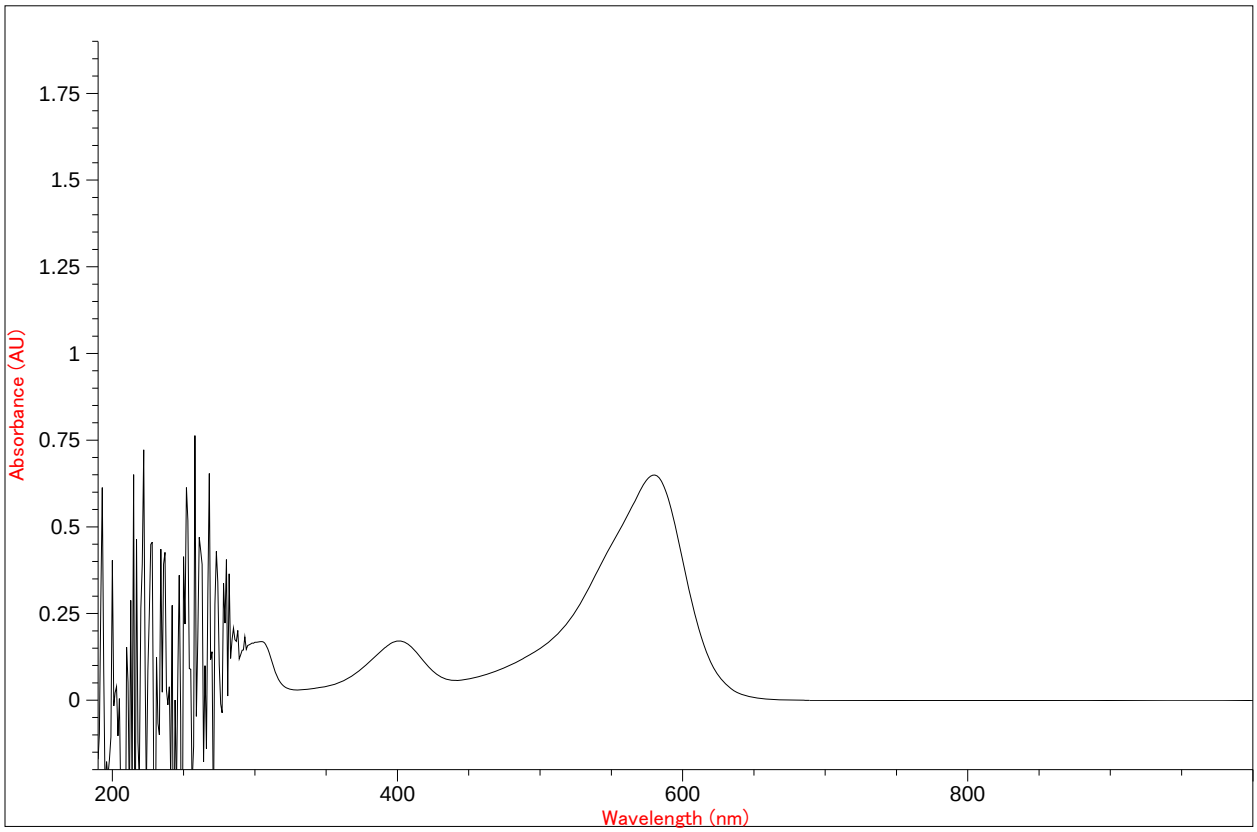
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.49958	ug/mL	0.00834

Sample 11

Sample Name	Snowball II 2053 #SSC (#24)
Operator	Patricia Mann
Date	6/19/18
Time	17:03:28
Path Length	1
Path Length Unit	cm

Sample Spectrum



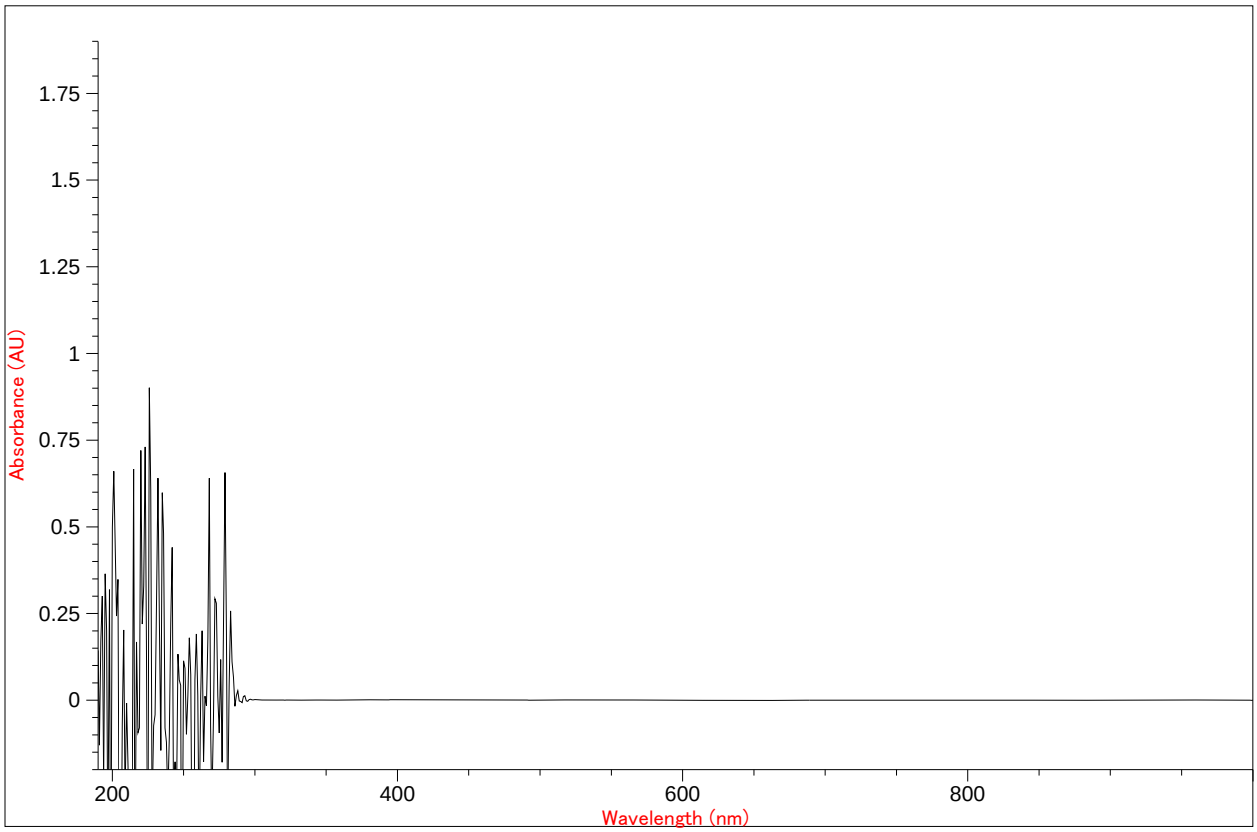
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.38410	ug/mL	0.00827

Sample 12

Sample Name	Snowball II 2053 #MB3 (#25)
Operator	Patricia Mann
Date	6/19/18
Time	17:03:43
Path Length	1
Path Length Unit	cm

Sample Spectrum



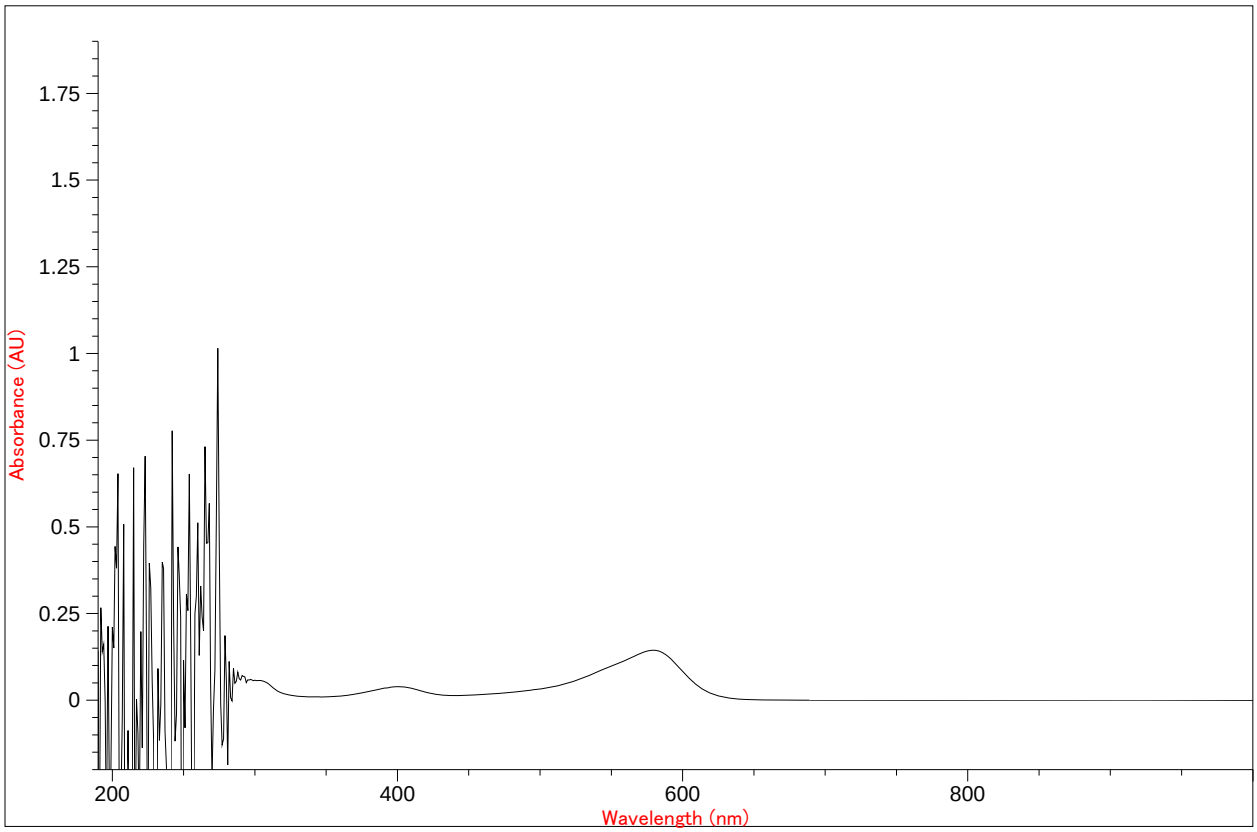
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00237	ug/mL	0.00784

Sample 13

Sample Name	0618-102.AD-R1*2.Cond (#26)
Operator	Patricia Mann
Date	6/19/18
Time	17:04:03
Path Length	1
Path Length Unit	cm

Sample Spectrum



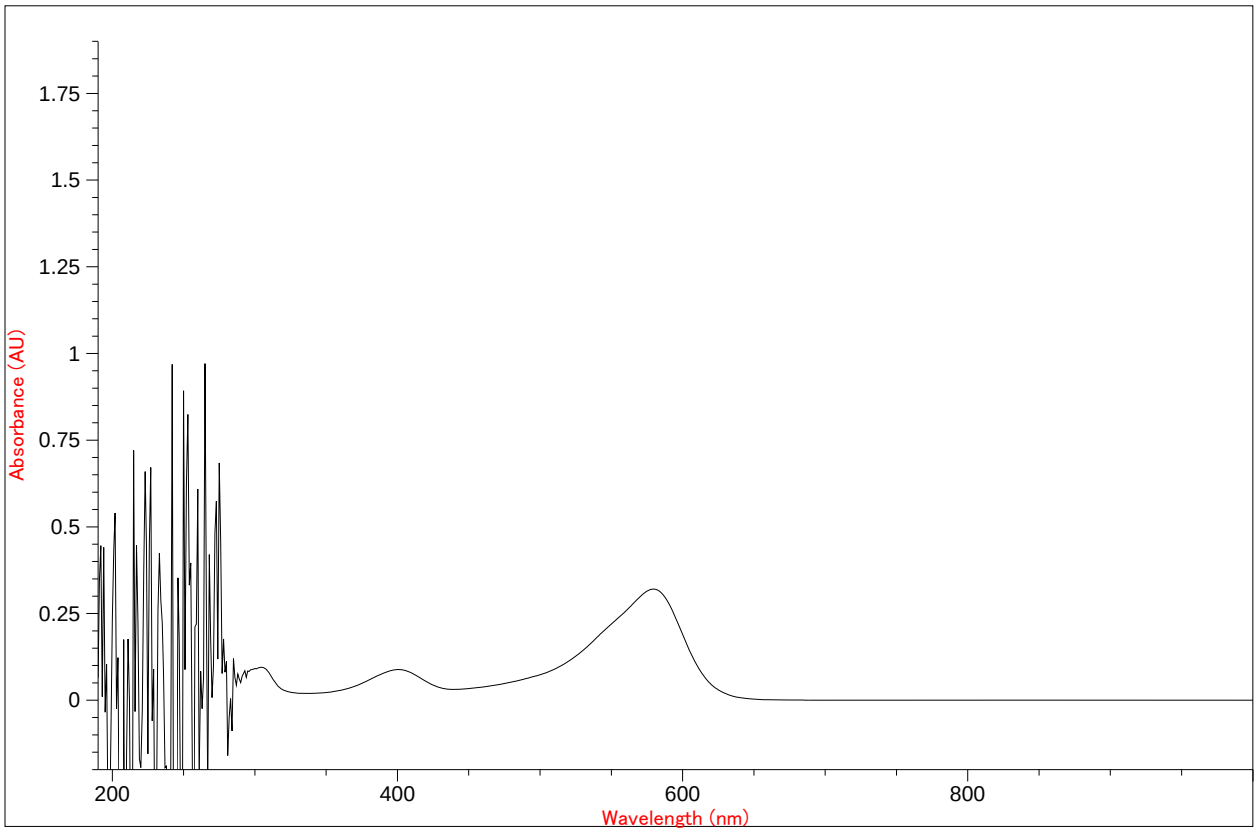
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.30795	ug/mL	0.00786

Sample 14

Sample Name	0618-102.R2.Cond (#27)
Operator	Patricia Mann
Date	6/19/18
Time	17:04:19
Path Length	1
Path Length Unit	cm

Sample Spectrum



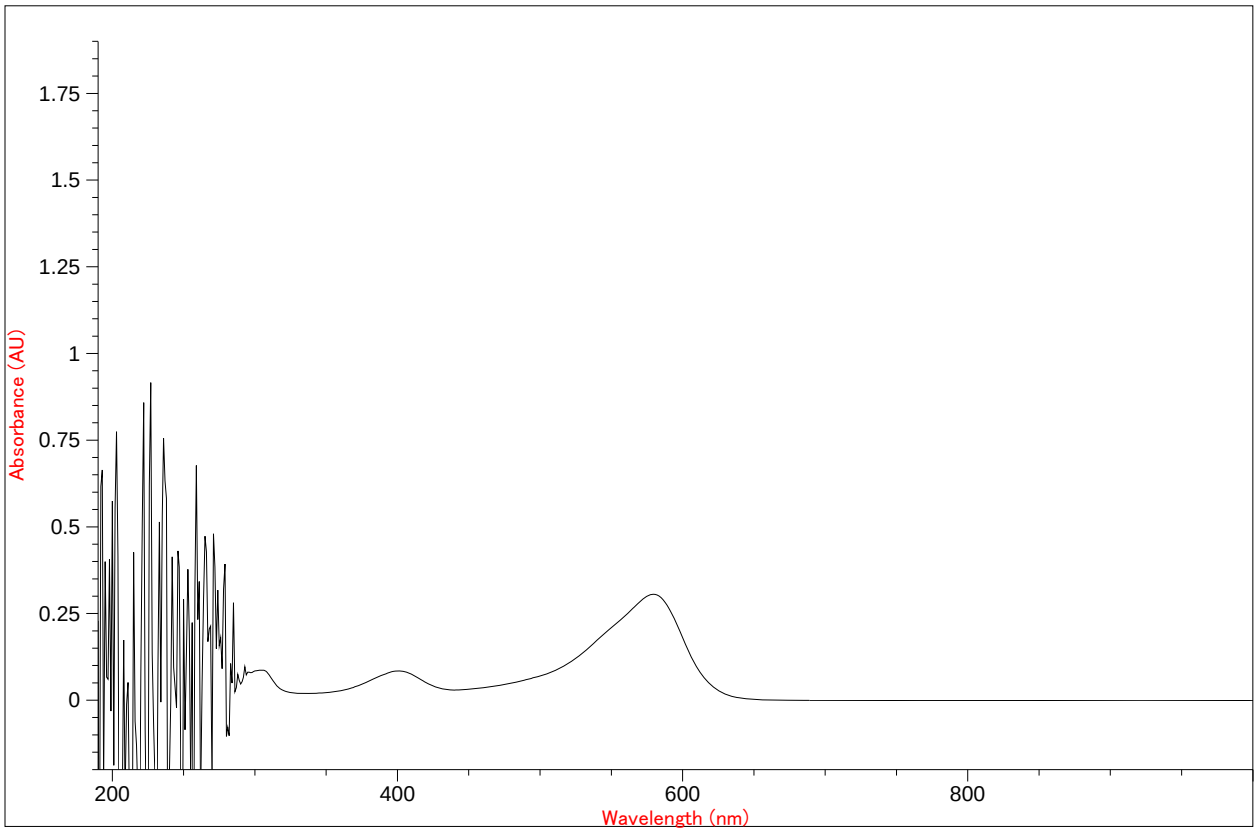
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.68418	ug/mL	0.00795

Sample 15

Sample Name	0618-102.R3.Cond (#28)
Operator	Patricia Mann
Date	6/19/18
Time	17:04:38
Path Length	1
Path Length Unit	cm

Sample Spectrum



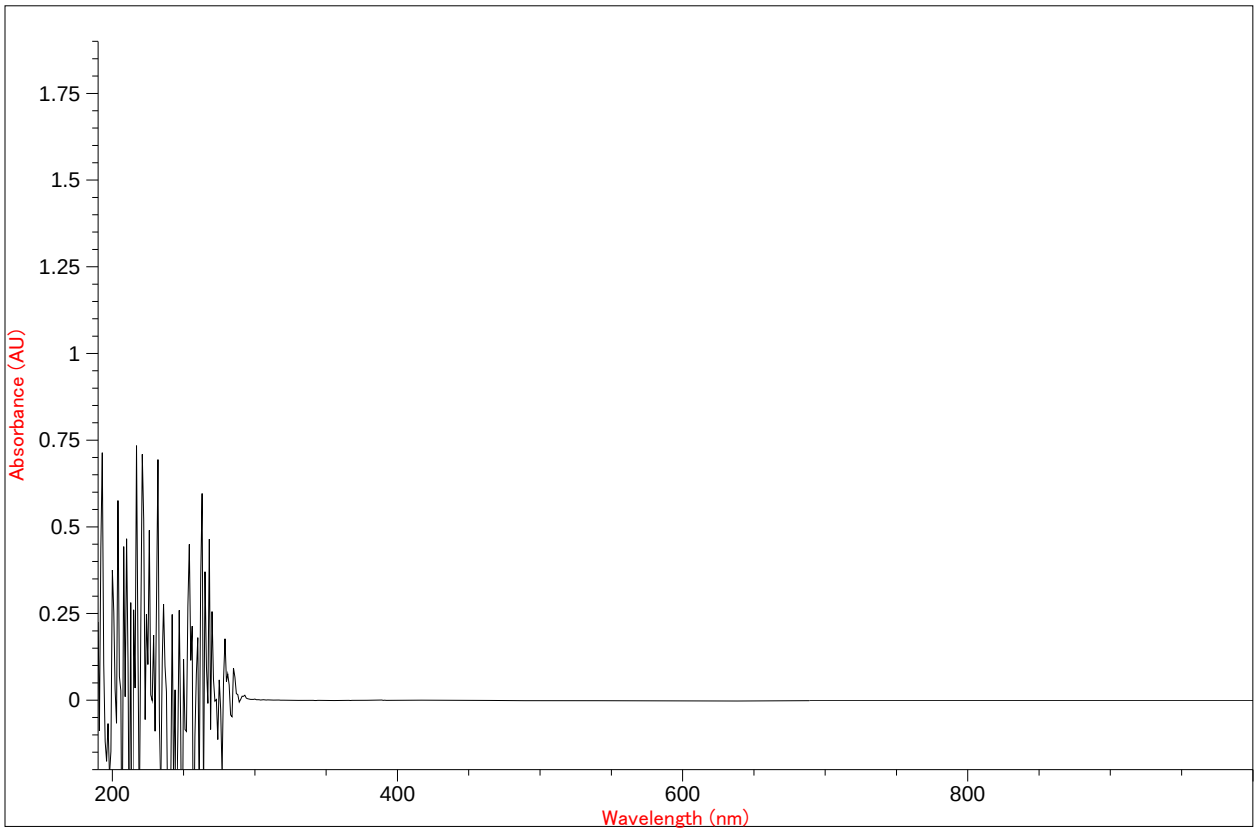
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.65223	ug/mL	0.00794

Sample 16

Sample Name	0618-102.FTB.Cond (#29)
Operator	Patricia Mann
Date	6/19/18
Time	17:04:57
Path Length	1
Path Length Unit	cm

Sample Spectrum



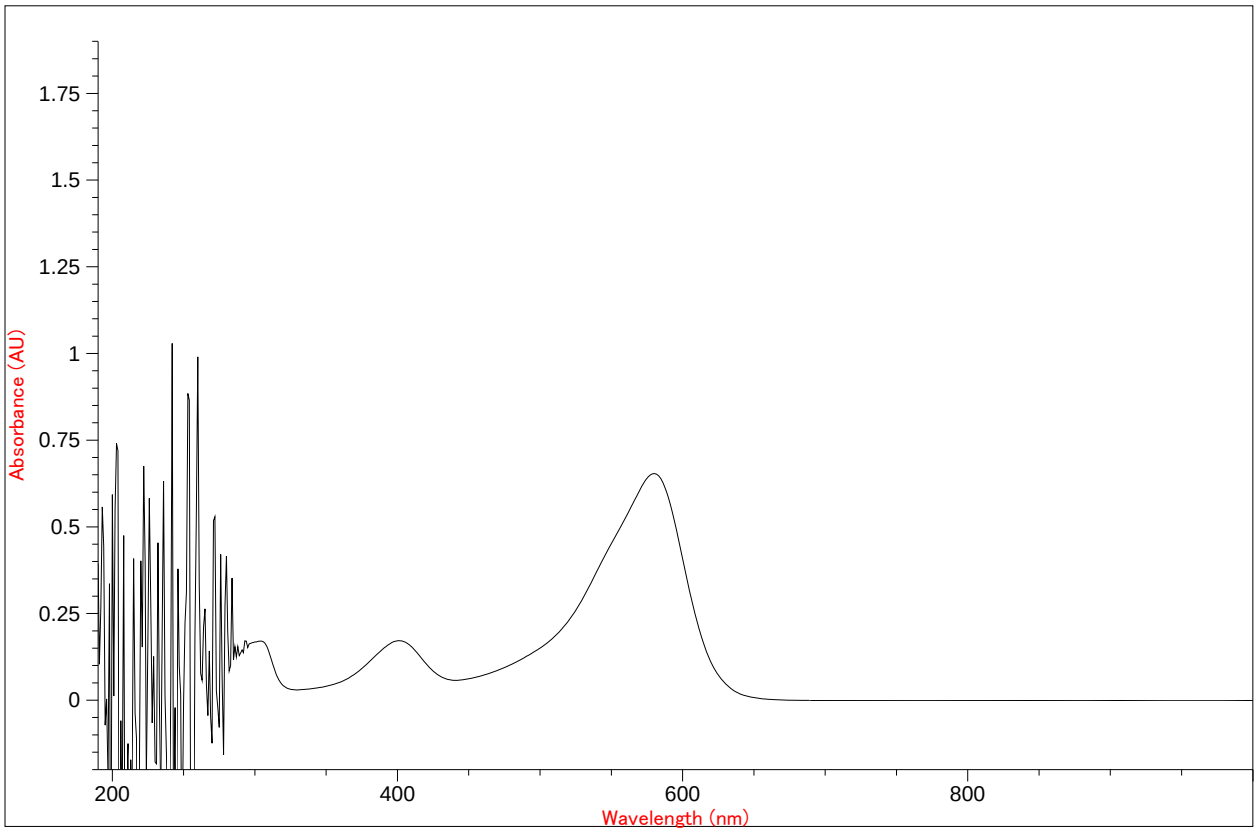
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	-0.00356	ug/mL	0.00784

Sample 17

Sample Name	Snowball II 2053 #SSD (#35)
Operator	Patricia Mann
Date	6/19/18
Time	17:07:25
Path Length	1
Path Length Unit	cm

Sample Spectrum



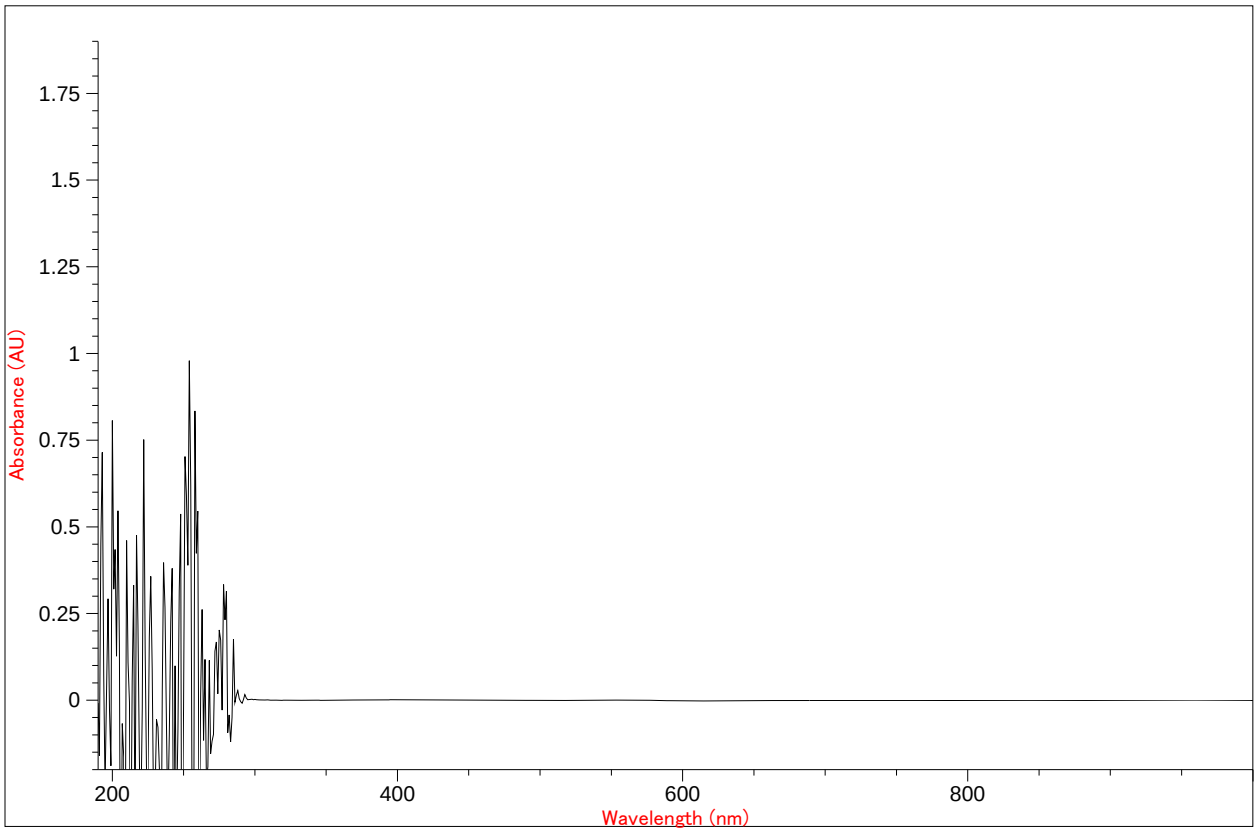
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.39333	ug/mL	0.00827

Sample 18

Sample Name	Snowball II 2053 #MB4 (#36)
Operator	Patricia Mann
Date	6/19/18
Time	17:07:44
Path Length	1
Path Length Unit	cm

Sample Spectrum



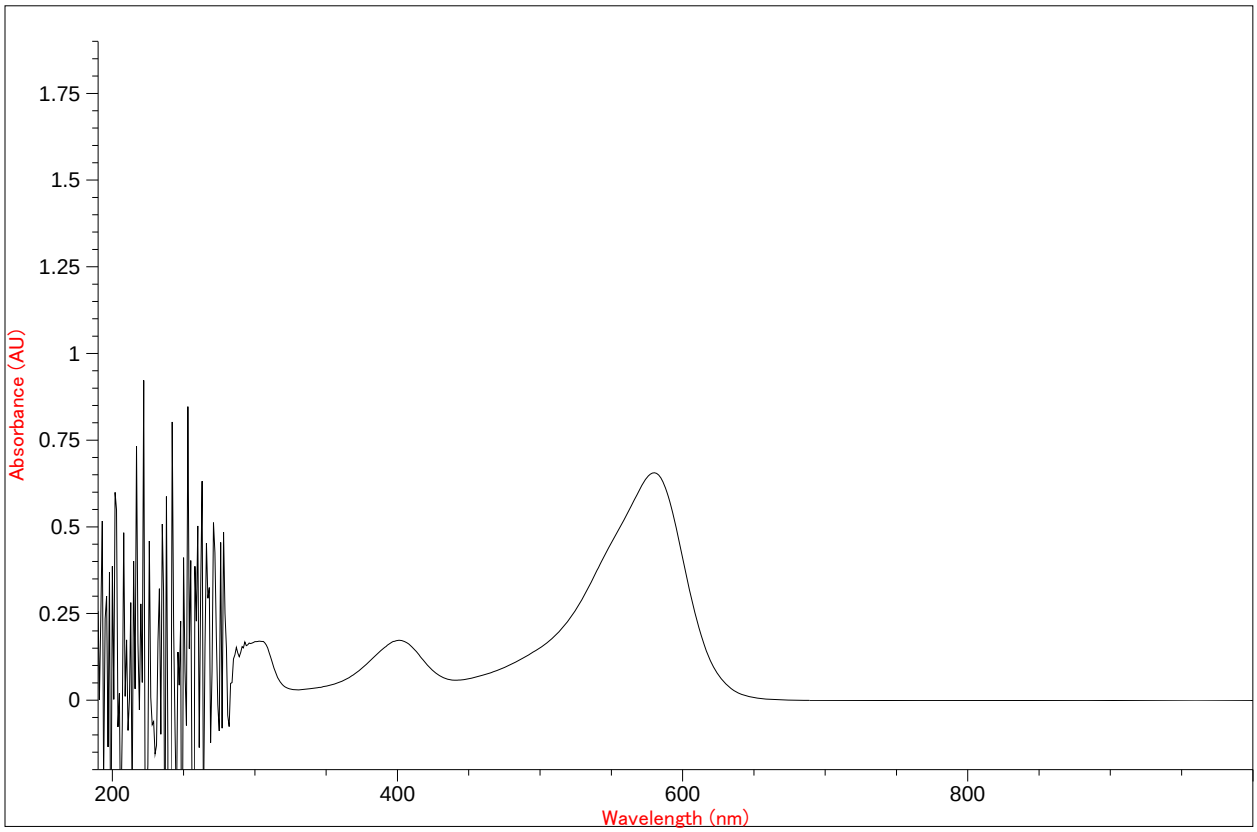
Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	0.00059	ug/mL	0.00784

Sample 19

Sample Name	Snowball II 2053 #SSE (#41)
Operator	Patricia Mann
Date	6/19/18
Time	17:09:54
Path Length	1
Path Length Unit	cm

Sample Spectrum



Data Analysis Results

#	Analyte Name	Value	Unit	Std. Dev.
1	Formaldehyde	1.39817	ug/mL	0.00828

Results Summary

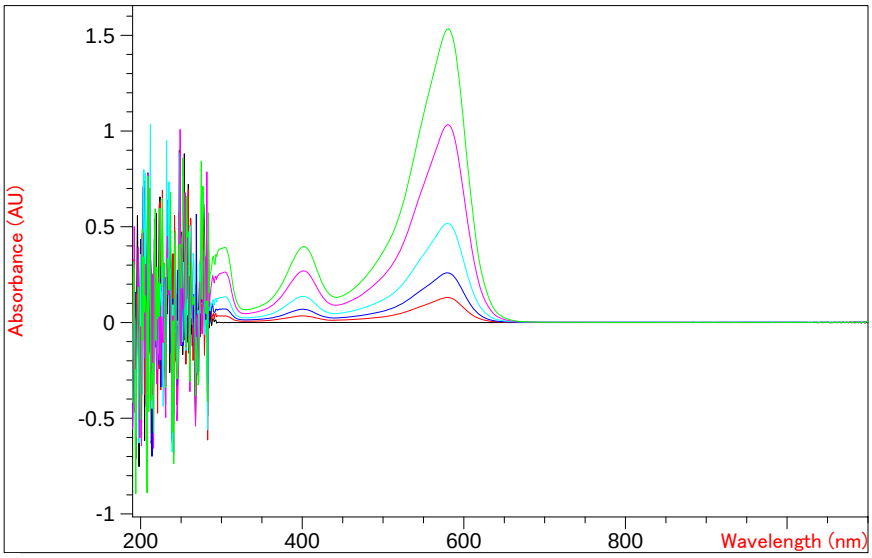
Sample Name	Data Value	Result Value	Unit	Std.Dev.
Snowball II 2053 #SS1 (#8)	0.59666	1.37010	ug/mL	0.00826
Snowball II 2053 #SS2 (#9)	0.59877	1.37494	ug/mL	0.00826
Snowball II 2053 #MB (#10)	0.00065	0.00150	ug/mL	0.00784
Snowball II 2053 #SSA (#2)	0.59368	1.36327	ug/mL	0.00826
Snowball II 2053 #MB1 (#3)	-0.00024	-0.00054	ug/mL	0.00784
Snowball II 2053 #SSB (#13)	0.59835	1.37399	ug/mL	0.00826
Snowball II 2053 #MB2 (#14)	0.00081	0.00185	ug/mL	0.00784
0618-102.R1.Cond (#21)	0.26140	0.60024	ug/mL	0.00792
0618-102.LD-R1.Cond (#22)	0.26152	0.60053	ug/mL	0.00792
0618-102.MS-R1.Cond (#23)	0.65304	1.49958	ug/mL	0.00834
Snowball II 2053 #SSC (#24)	0.60276	1.38410	ug/mL	0.00827
Snowball II 2053 #MB3 (#25)	0.00103	0.00237	ug/mL	0.00784
0618-102.AD-R1*2.Cond (#26)	0.13411	0.30795	ug/mL	0.00786
0618-102.R2.Cond (#27)	0.29795	0.68418	ug/mL	0.00795
0618-102.R3.Cond (#28)	0.28404	0.65223	ug/mL	0.00794
0618-102.FTB.Cond (#29)	-0.00155	-0.00356	ug/mL	0.00784
Snowball II 2053 #SSD (#35)	0.60677	1.39333	ug/mL	0.00827
Snowball II 2053 #MB4 (#36)	0.00026	0.00059	ug/mL	0.00784
Snowball II 2053 #SSE (#41)	0.60889	1.39817	ug/mL	0.00828

*** End Results Report ***

*** Calibration Report ***

Number of Standards 6

Standard Spectra



#	Standard	Path Length	Unit	Date	Time
1	Snowball II 2053	1.000	cm	6/19/18	15:33:01
2	Snowball II 2053	1.000	cm	6/19/18	15:33:24
3	Snowball II 2053	1.000	cm	6/19/18	15:33:40
4	Snowball II 2053	1.000	cm	6/19/18	15:33:53
5	Snowball II 2053	1.000	cm	6/19/18	15:34:06
6	Snowball II 2053	1.000	cm	6/19/18	15:34:16

Data Analysis:

Spectral Processing:

Absorbance

Use Wavelength(s):

Single (nm): 570

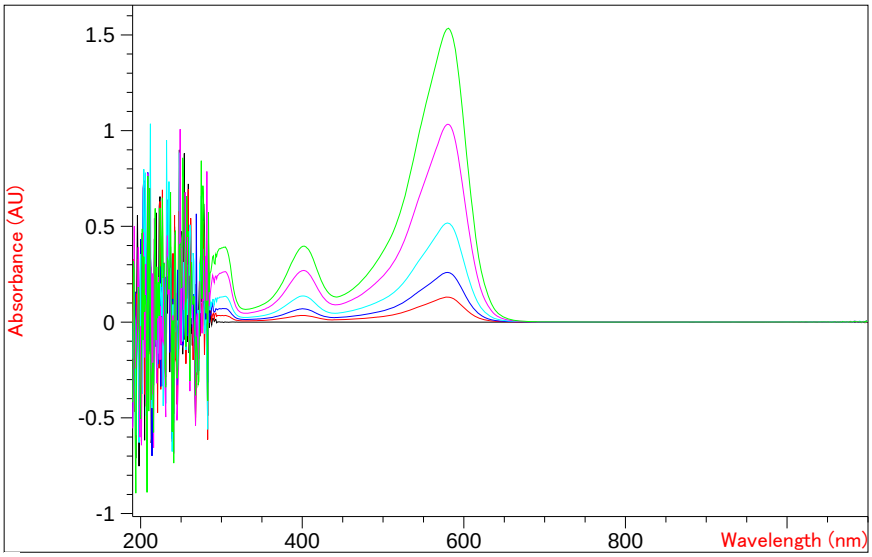
Evaluation: SCA

Calibrated at: Date 6/19/2018 Time 3:35:43 PM
Operator: Patricia Mann

Weighting Method: Least squares
Calibration Curve: C = k1 * A

Analyte Name	Unit
Formaldehyde	ug/mL

Processed Standard Spectra



Coefficients

k#	Value
1	2.29628

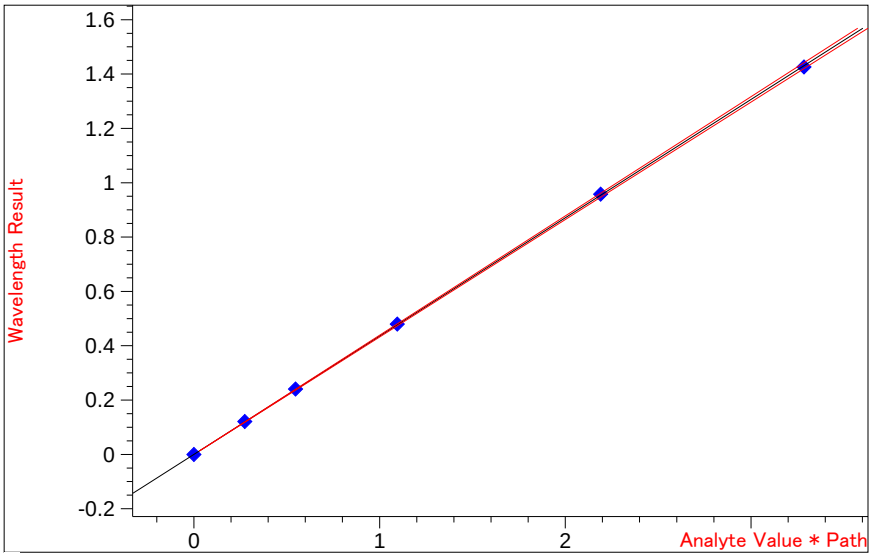
Used Wavelength Results (Absorbance (AU))

#	Value	#	Value	#	Value
1	-0.00019	3	0.24093	5	0.95812
2	0.12128	4	0.47970	6	1.42606

Calibration Table of Formaldehyde (ug/mL)

#	Standard Name	Value	Fitted Val.	Error (%)
1	Snowball II 2053	0.00000	-0.00043	-100.0
2	Snowball II 2053	0.27380	0.27848	-1.7
3	Snowball II 2053	0.54750	0.55324	-1.0
4	Snowball II 2053	1.09500	1.10152	-0.6
5	Snowball II 2053	2.19000	2.20012	-0.5
6	Snowball II 2053	3.28500	3.27464	0.3

Calibration Curve (Data Analysis)



SCA Summary

Analyte Name	Formaldehyde
Number of Standards	6
Calculation Method	LSQ
Calibration Curve	C = k1 * A
Coefficient k1	2.29630 ug/mL
Std.Dev. of k1	4.3472E-3 ug/mL
Std.Dev. of Calibration	7.8425E-3 ug/mL
Correl. Coeff. (R^2)	0.99998
Uncertainty	0.78 %

*** End Calibration Report ***

This Is The Last Page Of This Report.

Sorbent Trap Analysis Report

Project Number: 2014305

Turn-around: Standard

Plant: Bison Engineering
Contact: Kelly Dorsi
Phone: 406 442 57 68
Email: kdorsi@bison-eng.com

Date: 6/25/2018
Analyst(s): Joe Simon
Method: EPA 7473
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
OLC047337		6.4	0.3	**6.7**		5	5.21%		H&V CFU-107 Stack	Run 1
OLC055128		2.5	0.4	**2.9**			15.65%		H&V CFU-107 Stack	Run 1
OLC047441		7.8	0.6	**8.4**		5	7.17%		H&V CFU-107 Stack	Run 2
OL485944		2.7	0.4	**3.1**			14.49%		H&V CFU-107 Stack	Run 2
OL462333		6.7	0.4	**7.1**		5	6.49%		H&V CFU-107 Stack	Run 3
OLC055082		1.6	0.4	**2.0**			23.08%		H&V CFU-107 Stack	Run 3
OL464792		5.9	0.2	**6.1**		5	4.23%		H&V CFU-114 Stack	Run 1
OLC055185		0.9	0.3	**1.2**			31.94%		H&V CFU-114 Stack	Run 1
OL464794		5.8	0.6	**6.4**		5	9.81%		H&V CFU-114 Stack	Run 2
OLC055071		1.0	2.4	**3.4**			240.00%		H&V CFU-114 Stack	Run 2
OL464785		5.8	0.5	**6.3**		5	8.64%		H&V CFU-114 Stack	Run 3
OL469648		1.1	0.5	**1.6**			46.09%		H&V CFU-114 Stack	Run 3
OLC047447		6.1	0.4	**6.5**		5	7.30%		H&V CFU-117 Stack	Run 1
OL469508		1.1	0.2	**1.3**			20.14%		H&V CFU-117 Stack	Run 1
OL419232		6.0	0.6	**6.6**		5	10.15%		H&V CFU-117 Stack	Run 2
OL469573		1.1	0.2	**1.3**			19.23%		H&V CFU-117 Stack	Run 2
OL464757		6.1	0.3	**6.4**		5	4.94%		H&V CFU-117 Stack	Run 3
OL485992		1.3	0.3	**1.6**			25.64%		H&V CFU-117 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 Co., Inc. | 30350 Bruce Industrial Pkwy | Cleveland, OH 44139 | p: 1 440 264 2500 | lab@ohiolumex.com

Bison Engineering

Date: June 25, 2018

Analyst: Joe Simon
File Name: 180625_JWS_BisonEngineering
Analyzer: 140
Cell type: Medium
Temperature (°C): 680
Flow Rate (L/min): 1.00
MDL (ng): 0.19
SD: 2.8

	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	OLC047337			6.4	0.3			5	H&V CFU-107 Stack	Run 1
2	OLC055128			2.5	0.4				H&V CFU-107 Stack	Run 1
3	OLC047441			7.8	0.6			5	H&V CFU-107 Stack	Run 2
4	OL485944			2.7	0.4				H&V CFU-107 Stack	Run 2
5	OL462333			6.7	0.4			5	H&V CFU-107 Stack	Run 3
6	OLC055082			1.6	0.4				H&V CFU-107 Stack	Run 3
7	OL464792			5.9	0.2			5	H&V CFU-114 Stack	Run 1
8	OLC055185			0.9	0.3				H&V CFU-114 Stack	Run 1
9	OL464794			5.8	0.6			5	H&V CFU-114 Stack	Run 2
10	OLC055071			1.0	2.4				H&V CFU-114 Stack	Run 2
11	OL464785			5.8	0.5			5	H&V CFU-114 Stack	Run 3
12	OL469648			1.1	0.5				H&V CFU-114 Stack	Run 3
13	OLC047447			6.1	0.4			5	H&V CFU-117 Stack	Run 1
14	OL469508			1.1	0.2				H&V CFU-117 Stack	Run 1
15	OL419232			6.0	0.6			5	H&V CFU-117 Stack	Run 2
16	OL469573			1.1	0.2				H&V CFU-117 Stack	Run 2
17	OL464757			6.1	0.3			5	H&V CFU-117 Stack	Run 3
18	OL485992			1.3	0.3				H&V CFU-117 Stack	Run 3
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-MEB658995 B	50.0	*see cal. report*
M2-MEB658995 B	100.0	*see cal. report*
K2-HG650192 B	500.0	*see cal. report*
K2-HG650192 B	1000.0	*see cal. report*
		see cal. report

Independent Calibration Verification**		
Lot # Std.	Std. (ng)	Calculated (ng)
M2-HG657626	50.0	47.7

Response Factor (Method 30B Only)***		
Lot # Std.	Std. (ng)	(area count/mass)
M2-MEB656771 B	1.0	501
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)
OL439416	50.0	52.2
OL486161	10.0	9.9
OL486031	25.0	24.9
OL485776	10.0	10.5
M2-HG657626	50.0	48.0

*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	12/4/2018
10	K2-HG650192 B	9/13/2018
100	M2-MEB662005 B	1/17/2019
1000	J2-HG02140	5/21/2019
0.1	M2-MEB656771 A	7/17/2018
1	M2-MEB658995 A	4/17/2019
10	M2-HG657392 A	12/4/2018
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

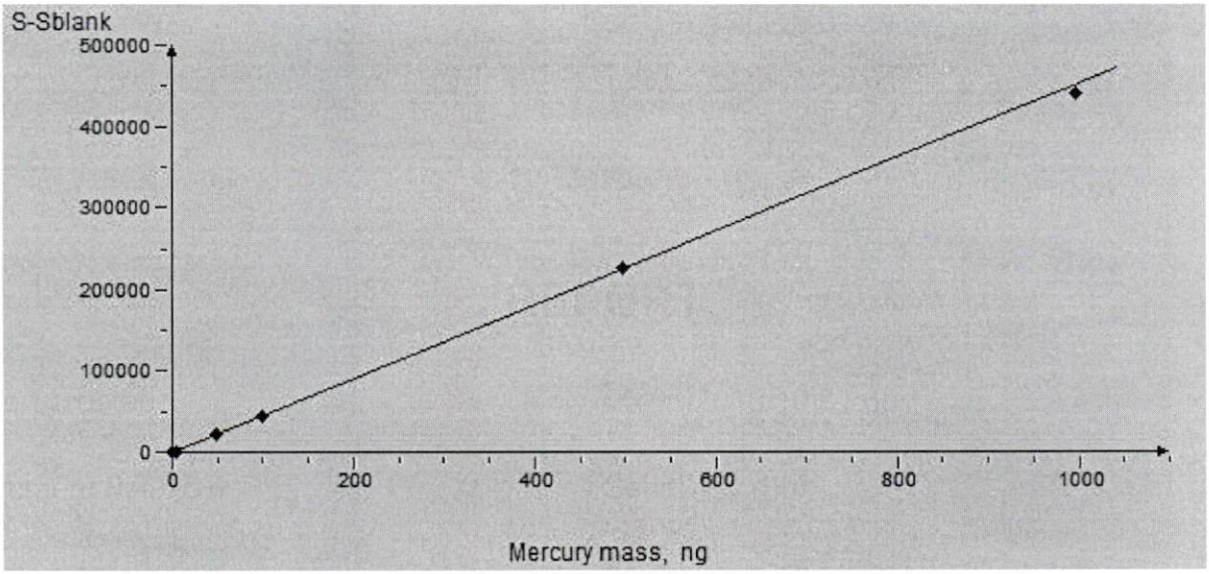
Analyst Signature: _____ Date: 6/25/18

By signing this report I confirm that the above data are true to the best of my knowledge.

OHIO LUMEX

REPORT

Report created	25.06.2018 10:31:38
Instrument RA915+	Serial number 140
Calibration created	25.06.2018 10:22:49
Calibration name	180625_JWS_2-1000



Results

N	Mercury mass, ng	S-Sblank	Ref.data, ng/g	Calculated, ng/g	d, %
1	1000.00	444600	1000.0	973.2	-2.7
2	500.00	229200	500.0	501.7	0.3
3	100.00	46140	100.0	101.0	1.0
4	50.00	23360	50.0	51.1	2.3
5	5.00	2157	5.0	4.7	-5.6
6	2.00	956	2.0	2.1	4.6

Calibration	S - Sblank = a·m
Algorithm	WLSM
Correlation coefficient	0.999905
Residual standard deviation	8.518327

Trap ID

OLC047337

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) _____

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: _____

Boiler ID: _____

Sampling Location: _____ *(stack, FGD inlet, etc.)*

Run Number (optional): _____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: _____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): _____

Ave Trap Temp (F°): _____

Ave Flow Rate (cc/min): _____

Total Volume (L) _____ or (dscm): _____

Estimated Ave Hg Concentration (µg/dscm): _____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1022	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S.	6/25/18	14:20	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 2020

Trap ID

OLC055128

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)_____

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:_____

Boiler ID:_____

Sampling Location:_____ *(stack, FGD inlet, etc.)*

Run Number (optional):_____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:_____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):_____

Ave Trap Temp (F°):_____

Ave Flow Rate (cc/min):_____

Total Volume (L)_____ or (dscm):_____

Estimated Ave Hg Concentration (µg/dscm):_____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1022	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S	6/25/18	14:27	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

OLC047441

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) _____

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: _____

Boiler ID: _____

Sampling Location: _____ *(stack, FGD inlet, etc.)*

Run Number (optional): _____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: _____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): _____

Ave Trap Temp (F°): _____

Ave Flow Rate (cc/min): _____

Total Volume (L) _____ or (dscm): _____

Estimated Ave Hg Concentration (µg/dscm): _____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06·18·18	1022	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S	6/25/18	14:30	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

OL485944

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) _____

QA/QC Signature (Spiker) _____

Production Lot: U-B5F 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:_____

Boiler ID:_____

Sampling Location:_____ *(stack, FGD inlet, etc.)*

Run Number (optional):_____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:_____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):_____

Ave Trap Temp (F°):_____

Ave Flow Rate (cc/min):_____

Total Volume (L)_____ or (dscm):_____

Estimated Ave Hg Concentration (µg/dscm):_____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06·18·18	1021	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S.	6/25/18	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: March 2021

Trap ID

OL462333

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) _____

QA/QC Signature (Spiker) _____

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: _____

Boiler ID: _____

Sampling Location: _____ *(stack, FGD inlet, etc.)*

Run Number (optional): _____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: _____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): _____

Ave Trap Temp (F°): _____

Ave Flow Rate (cc/min): _____

Total Volume (L) _____ or (dscm): _____

Estimated Ave Hg Concentration (µg/dscm): _____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1021	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S.	6/25/18	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: April 2021

Trap ID

OLC055082

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)_____

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:_____

Boiler ID:_____

Sampling Location:_____
(stack, FGD inlet, etc.)

Run Number (optional):_____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:_____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):_____

*Ave Trap Temp (F°):*_____

Ave Flow Rate (cc/min):_____

Total Volume (L)_____or (dscm):_____

Estimated Ave Hg Concentration (µg/dscm):_____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1020	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	14:53	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: July 2020

Trap ID

OL464792

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: H & V

Boiler ID: CFV-114

Sampling Location: stack (stack, FGD inlet, etc.)

Run Number (optional): 1

Sampling Train (circle one): (A) B

PRE-Run Leak Check (circle one): (PASS) FAIL

Run START: 06/07/18 (Date) 08:06 (Time)

Run END: 06/07/18 (Date) 11:12 (Time)

POST-Run Leak Check (circle one): (PASS) FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 290

Ave Trap Temp (F°): 290

Ave Flow Rate (cc/min): 2 l/min

Total Volume (L) 360.592 or (dscm): 1.4

Estimated Ave Hg Concentration (µg/dscm): 1.6

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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	chris whitten	06/07/18	08:00	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	chris whitten	06/07/18	11:12	
Courier/Other (If Applicable)	Fed ex			Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab	[signature]	06.18.18	1024	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S.	6/25/18	14:57	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

OLC055185

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: H & V

Boiler ID: CFV-114

Sampling Location: stack
(stack, FGD inlet, etc.)

Run Number (optional): 1

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: 06/07/18 (Date) 0810 DSB 08:05 (Time)

Run END: 06/07/18 (Date) 11:12 (Time)

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: _____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 290

Ave Trap Temp (F°): 290

Ave Flow Rate (cc/min): 2l/min

Total Volume (L) 360.566 or (dscm): _____

Estimated Ave Hg Concentration (µg/dscm): 1.6

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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): 1.4

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	CW	06/07/18	0805	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	CW	06/07/18	11:12	
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]	06.18.18	1024	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	15:01	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

OL464794

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: H & V

Boiler ID: CFV - 1/4

Sampling Location: Stack
(stack, FGD inlet, etc.)

Run Number (optional): 2

Sampling Train (circle one): (A) B

PRE-Run Leak Check (circle one): (PASS) FAIL

Run START: 06/07/18 (Date) 11:40 (Time)

Run END: 06/07/18 (Date) 14:49 (Time)

POST-Run Leak Check (circle one): (PASS) FAIL

Notes:

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 290

Ave Trap Temp (F°): 290

Ave Flow Rate (cc/min): 2 l/min

Total Volume (L) 360.756 or (dscm):

Estimated Ave Hg Concentration (µg/dscm): 1.6

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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): 1.4

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	CW	06/07/18	11:40	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	CW	"	14:49	
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]	06.18.18	1023	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	15:05	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

OLC055071

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: H & V

Boiler ID: CFU-114

Sampling Location: Stack (stack, FGD inlet, etc.)

Run Number (optional): 2

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: 06/07/18 (Date) 11:40 (Time)

Run END: 06/07/18 (Date) 14:49 (Time)

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:_____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 290

Ave Trap Temp (F°): 290

Ave Flow Rate (cc/min): 2 l/min

Total Volume (L) 360.697 or (dscm):_____

Estimated Ave Hg Concentration (µg/dscm): 1.6

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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): 1.4

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	CW	06/07/18	11:40	**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by		06/07/18	14:49	
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]	06.18.18	1023	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S.	6/25/18	15:09	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

OL464785

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) _____

QA/QC Signature (Spiker) _____

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: _____

Boiler ID: _____

Sampling Location: _____ (stack, FGD inlet, etc.)

Run Number (optional): _____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: _____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): _____

Ave Trap Temp (F°): _____

Ave Flow Rate (cc/min): _____

Total Volume (L) _____ or (dscm): _____

Estimated Ave Hg Concentration (µg/dscm): _____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06·18·18	1023	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	15:23	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

OL469648

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) _____

QA/QC Signature (Spiker) _____

Production Lot: U-B52 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:_____

Boiler ID:_____

Sampling Location:_____
(stack, FGD inlet, etc.)

Run Number (optional):_____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:_____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):_____

Ave Trap Temp (F°):_____

Ave Flow Rate (cc/min):_____

Total Volume (L)_____ or (dscm):_____

Estimated Ave Hg Concentration (µg/dscm):_____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1022	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	15:31	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: February 2021

Trap ID

OLC047447

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) _____

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: _____

Boiler ID: _____

Sampling Location: _____ *(stack, FGD inlet, etc.)*

Run Number (optional): _____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: _____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): _____

Ave Trap Temp (F°): _____

Ave Flow Rate (cc/min): _____

Total Volume (L) _____ or (dscm): _____

Estimated Ave Hg Concentration (µg/dscm): _____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06·18·18	1024	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	15:36	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 2020

Trap ID

OL469508

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-B52 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:_____

Boiler ID:_____

Sampling Location:_____ *(stack, FGD inlet, etc.)*

Run Number (optional):_____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:_____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):_____

Ave Trap Temp (F°):_____

Ave Flow Rate (cc/min):_____

Total Volume (L)_____ or (dscm):_____

Estimated Ave Hg Concentration (µg/dscm):_____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1024	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	15:41	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: February 2021

Trap ID

OL419232

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) _____

QA/QC Signature (Spiker) _____

Production Lot: S-1E85 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: 5/16/2017 Spike Time: 1030

Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: _____

Boiler ID: _____

Sampling Location: _____ *(stack, FGD inlet, etc.)*

Run Number (optional): _____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: _____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): _____

Ave Trap Temp (F°): _____

Ave Flow Rate (cc/min): _____

Total Volume (L) _____ or (dscm): _____

Estimated Ave Hg Concentration (µg/dscm): _____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1025	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	15:44	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 2020

Trap ID

OL469573

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-B52 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:_____

Boiler ID:_____

Sampling Location:_____ *(stack, FGD inlet, etc.)*

Run Number (optional):_____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:_____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):_____

Ave Trap Temp (F°):_____

Ave Flow Rate (cc/min):_____

Total Volume (L)_____ or (dscm):_____

Estimated Ave Hg Concentration (µg/dscm):_____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1025	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	15:52	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: February 2021

Trap ID

OL464757

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: _____

Boiler ID: _____

Sampling Location: _____ *(stack, FGD inlet, etc.)*

Run Number (optional): _____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes: _____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): _____

Ave Trap Temp (F°): _____

Ave Flow Rate (cc/min): _____

Total Volume (L) _____ or (dscm): _____

Estimated Ave Hg Concentration (µg/dscm): _____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1025	Seal intact as received Yes ☐ No ☐
Trap analyzed by	[signature]	6/25/18	15:57	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

OL485992

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)_____

QA/QC Signature (Spiker)_____

Production Lot: U-B5F 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:_____

Boiler ID:_____

Sampling Location:_____ *(stack, FGD inlet, etc.)*

Run Number (optional):_____

Sampling Train (circle one): **A** **B**

PRE-Run Leak Check (circle one): **PASS** **FAIL**

Run START: _____ Date _____ Time

Run END: _____ Date _____ Time

POST-Run Leak Check (circle one): **PASS** **FAIL**

Notes:_____

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°):_____

Ave Trap Temp (F°):_____

Ave Flow Rate (cc/min):_____

Total Volume (L)_____or (dscm):_____

Estimated Ave Hg Concentration (µg/dscm):_____

Circle Event if Occurred During Sampling:

STARTUP **SHUTDOWN**

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]	06.18.18	1025	Seal intact as received Yes ☐ No ☐
Trap analyzed by	Joseph S.	6/25/18	16:01	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: March 2021

OHIO LUMEX

ANALYSIS SAMPLE RETURN FORM

Source: CFU 107

FROM:	SHIP TO:
Contact Name: Click here to enter text. Bison Engineering, INC. ~~H+V~~	**Name:** Ohio Lumex Analytical Laboratory
Company/Plant: H+V	**Company:** Ohio Lumex Co., Inc.
Date: 6/12/18	**Address:** 30350 Bruce Industrial Pkwy
Email: Kdorsi@bison-eng.com	Solon, OH 44139
Phone Number: 406-442-5768	**Phone:** (440) 264-2500

Source Type: ☐ Coal Fired Power ☐ Cement Kiln ☐ Industrial Boiler ☒ Other: glass

	Sample Quantity:	Sample IDs	Sampling Method / Expected Capture Source Concentration / Notes:
Run1A	1	OLC047337 (spiked @ 5ng)	Low Hg concentration analyzer
Run1B	1	OLC055128	
Run2A	1	OLC047441 (spiked @ 5ng)	
Run2B	1	OL4859444	
Run3A	1	OL462333 (spiked @ 5ng)	
Run3B	1	OLC055082	

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

*Long-term compliance contract required

OHIO LUMEX

Analysis Sample Return Form

CFU 114

From:	
Contact Name:	Click here to enter text.
Company/Plant:	~~Hg~~ DSB Bison Engineering
Date:	06/07/18
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: glass

Sample Quantity	Sample IDs	Sampling Method / Expected Capture Source Concentration / Notes
1	OL464792	Low concentration Hg
1	~~OL464~~ DSB OLC055185	" "
1	OL464794	" "
1	OLC055071	" "
1	OL464785	" "
1	OL469648	" "

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:
Low concentration analyzer

*Long-term compliance contract required

OHIO LUMEX

ANALYSIS SAMPLE RETURN FORM

Source: CFU117

FROM:	SHIP TO:
Contact Name: Click here to enter text.	**Name:** Ohio Lumex Analytical Laboratory
Company/Plant: Bison Engineering, Inc. H+V	**Company:** Ohio Lumex Co., Inc.
Date: 6/8/18	**Address:** 30350 Bruce Industrial Pkwy
Email: kdorsi@bison-eng.com	Solon, OH 44139
Phone Number: 406-442-5768	**Phone:** (440) 264-2500

Source Type: ☐ Coal Fired Power ☐ Cement Kiln ☐ Industrial Boiler ☒ Other: glass

	Sample Quantity:	Sample IDs	Sampling Method / Expected Capture Source Concentration / Notes:
R-1	1	OLC047447 spiked @ 5ng.	Low Hg concentration analyzer!
R-1	1	OL469508	
R-2	1	OL419232 spiked @ 5ng.	
R-2	1	OL469573	
R-3	1	OL464757 spiked @ 5ng.	
R-3	1	OL485992	

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

*Long-term compliance contract required

APPENDIX G: AUDIT SAMPLES

PERFORMANCE EVALUATION

Scheduled Study

SSAS331

29-May-2018 Through 03-Jul-2018

50205534

RTC Labcode

EPA Labcode

Participating Laboratory:

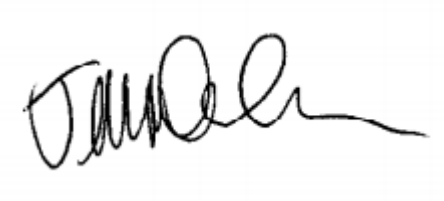
Chester Labnet
Paul Duda
12242 SW Garden Place
Tigard OR 97223 US

Thank you for participating in study SSAS331. Additional information about this study may be found online at www.sigmaaldrich.com/pt.

Sigma-Aldrich RTC Inc.
2931 Soldier Springs Road
Laramie, WY 82070 USA
1-307-742-5452
www.sigmaaldrich.com

This report shall not be reproduced except in full, without written approval of the laboratory. The data and results reported in this document are the property of the participating laboratory and are confidential. If you wish to appeal an evaluation listed in this report, please call our QA Supervisor at (307) 742-5452 or email RTCreports@sial.com

Sincerely,



Jennifer Duhon
Proficiency Testing Supervisor

Accreditors

Evaluations of this dataset will be sent to the accreditor(s) listed below using your laboratory's labcode listed above each accrediting agency. If any of the information listed below is incorrect, please contact RTC immediately.

RTC is accredited to perform PT programs for the scope of accreditation to ISO/IEC 17043 under ANAB certificate AP-1469

Miscellaneous Analytes

Method:EPA 13B (2000) [10402105]

Analyte	Result Units	Assigned Value	Accept. Window	Z	Evaluation
Fluoride [1,2] 1730 / PEA1940-20ML - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-26	5.86 mg/dscm *Evaluation Criteria - 8* ☐*Voluntary*	6.01	5.11 to 6.91	-0.33 *Evaluation Parameter - a:1, b:0, c:0.075, d:0*	Acceptable

Method:EPA Method 26A (2000) [10403200]

Analyte	Result Units	Assigned Value	Accept. Window	Z	Evaluation
Hydrogen fluoride [1,2] 1775 / PEA1941-20ML - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-18	19.3 mg/L *Evaluation Criteria - 8* ☐*Voluntary*	18.2	16.4 to 20	1.21 *Evaluation Parameter - a:1, b:0, c:0.05, d:0*	Acceptable

Method:EPA Method 29 (ICP) (2000) [10403608]

Analyte	Result Units	Assigned Value	Accept. Window	Z	Evaluation
Antimony, Sb [1,2] 1005 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	16.2 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	16	12 to 20	0.1 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Antimony, Sb [1,2] 1005 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	29.9 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	28.1	21.1 to 35.1	0.51 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Arsenic, As [1,2] 1010 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	16.3 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	21.7	16.3 to 27.1	-1.99 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Arsenic, As [1,2] 1010 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	18.9 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	19.2	14.4 to 24.1	-0.12 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable

Barium, Ba [1,2] 1015 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	17.5 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	16.9	12.7 to 21.1	0.28 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Barium, Ba [1,2] 1015 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	25.8 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	21.6	16.2 to 27	1.56 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Beryllium, Be [1,2] 1020 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	11.9 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	12.3	9.2 to 15.3	-0.26 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Beryllium, Be [1,2] 1020 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	16.6 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	17.4	13.1 to 21.8	-0.37 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Cadmium, Cd [1,2] 1030 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	19.4 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	18.2	14.6 to 21.9	0.66 *Evaluation Parameter - a:1, b:0, c:0.10, d:0*	Acceptable

Method:EPA Method 29 (ICP) (2000) (Continued)

Analyte	Result Units	Assigned Value	Accept. Window	Z	Evaluation
Cadmium, Cd [1,2] 1030 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	14.1 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	12.4	9.88 to 14.8	1.37 *Evaluation Parameter - a:1, b:0, c:0.10, d:0*	Acceptable
Chromium, Cr (total) [1,2] 1040 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	19.3 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	17.1	13.7 to 20.6	1.29 *Evaluation Parameter - a:1, b:0, c:0.10, d:0*	Acceptable
Chromium, Cr (total) [1,2] 1040 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	20.7 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	19.4	15.5 to 23.2	0.67 *Evaluation Parameter - a:1, b:0, c:0.10, d:0*	Acceptable
Cobalt, Co [1,2] 1050 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	17.9 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	17.9	13.4 to 22.3	0 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Cobalt, Co [1,2] 1050 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	13.3 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	11.9	8.94 to 14.9	0.94 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Copper, Cu [1,2] 1055 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	13.1 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	12.5	9.38 to 15.6	0.38 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Copper, Cu [1,2] 1055 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	18.1 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	18.1	13.6 to 22.6	0 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Lead, Pb [1,2] 1075 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	16.5 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	16.5	12.4 to 20.7	0 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Lead, Pb [1,2]	23.2 ug/filter	21.8	17.4 to 26.1	0.64	Acceptable

1075 / PEA1945-1EA - Lot SSAS331
/Analyst:/ Analysis Date: 2018-06-27

Evaluation Criteria - 8
☐ *Voluntary*

Evaluation Parameter - a:1, b:0, c:0.10, d:0

Method:EPA Method 29 (ICP) (2000) (Continued)

Analyte	Result Units	Assigned Value	Accept. Window	Z	Evaluation
Manganese, Mn [1,2] 1090 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	13.9 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	12.7	8.89 to 16.5	0.63 *Evaluation Parameter - a:1, b:0, c:0.15, d:0*	Acceptable
Manganese, Mn [1,2] 1090 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	18.2 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	17.5	13.1 to 21.8	0.32 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Nickel, Ni [1,2] 1105 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	21.0 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	19.5	15.6 to 23.4	0.77 *Evaluation Parameter - a:1, b:0, c:0.10, d:0*	Acceptable
Nickel, Ni [1,2] 1105 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	24.7 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	21.5	15 to 27.9	0.99 *Evaluation Parameter - a:1, b:0, c:0.15, d:0*	Acceptable
Selenium, Se [1,2] 1140 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	21.7 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	21.6	15.1 to 28.1	0.03 *Evaluation Parameter - a:1, b:0, c:0.15, d:0*	Acceptable
Selenium, Se [1,2] 1140 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	17.6 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	18.2	13.7 to 22.8	-0.26 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Zinc, Zn [1,2] 1190 / PEA1948-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	17.5 ug/ml *Evaluation Criteria - 8* ☐*Voluntary*	16.1	12 to 20.1	0.7 *Evaluation Parameter - a:1, b:0, c:0.125, d:0*	Acceptable
Zinc, Zn [1,2] 1190 / PEA1945-1EA - Lot SSAS331 /Analyst:/ Analysis Date: 2018-06-27	27.2 ug/filter *Evaluation Criteria - 8* ☐*Voluntary*	22.6	15.8 to 29.3	1.36 *Evaluation Parameter - a:1, b:0, c:0.15, d:0*	Acceptable

Group Analysis Summary

Acceptable : 28 / 28

Score : 100% - (Acceptable)

Sample Information

FLUORIDE IN IMPINGER SOLUTION

PEA1940-20ML / Lot SSAS331

Analytes	Units	Gravimetric Value	Study Mean	Study Std. Dev.
Fluoride [1,2] 1730	mg/dscm	6.01±0.0306	0	0

Hydrogen Halides/Halogens in Impinger Solution

PEA1941-20ML / Lot SSAS331

Analytes	Units	Gravimetric Value	Study Mean	Study Std. Dev.
Hydrogen chloride [1,2] 1770	mg/L	22.3±0.114	0	0
Hydrogen fluoride [1,2] 1775	mg/L	18.2±0.0928	0	0

Metals on Filter Paper

PEA1945-1EA / Lot SSAS331

Analytes	Units	Gravimetric Value	Study Mean	Study Std. Dev.
Antimony, Sb [1,2] 1005	ug/filter	28.074±0.14318	0	0
Arsenic, As [1,2] 1010	ug/filter	21.692±0.11165	0	0
Barium, Ba [1,2] 1015	ug/filter	21.589±0.11011	0	0
Beryllium, Be [1,2] 1020	ug/filter	12.272±0.06259	0	0
Cadmium, Cd [1,2] 1030	ug/filter	12.352±0.06299	0	0
Chromium, Cr (total) [1,2] 1040	ug/filter	17.126±0.08734	0	0
Cobalt, Co [1,2] 1050	ug/filter	11.920±0.06079	0	0
Copper, Cu [1,2] 1055	ug/filter	12.502±0.06376	0	0
Lead, Pb [1,2] 1075	ug/filter	21.757±0.11096	0	0
Manganese, Mn [1,2] 1090	ug/filter	12.706±0.06480	0	0
Nickel, Ni [1,2] 1105	ug/filter	21.487±0.10958	0	0
Selenium, Se [1,2] 1140	ug/filter	21.595±0.11013	0	0
Silver, Ag [1,2] 1150	ug/filter	32.718±0.16686	0	0
Thallium, Tl [1,2] 1165	ug/filter	32.324±0.16485	0	0
Zinc, Zn [1,2] 1190	ug/filter	22.550±0.11500	0	0

Metals in Impinger Solution

PEA1948-1EA / Lot SSAS331

Analytes	Units	Gravimetric Value	Study Mean	Study Std. Dev.
Antimony, Sb [1,2] 1005	ug/ml	16.029±0.0817	0	0
Arsenic, As [1,2] 1010	ug/ml	19.245±0.0982	0	0
Barium, Ba [1,2] 1015	ug/ml	16.874±0.0861	0	0
Beryllium, Be [1,2] 1020	ug/ml	17.435±0.0889	0	0
Cadmium, Cd [1,2] 1030	ug/ml	18.223±0.0929	0	0
Chromium, Cr (total) [1,2] 1040	ug/ml	19.365±0.0988	0	0
Cobalt, Co [1,2] 1050	ug/ml	17.866±0.0911	0	0
Copper, Cu [1,2] 1055	ug/ml	18.069±0.0922	0	0
Lead, Pb [1,2] 1075	ug/ml	16.544±0.0844	0	0
Manganese, Mn [1,2] 1090	ug/ml	17.477±0.0891	0	0
Nickel, Ni [1,2] 1105	ug/ml	19.536±0.0996	0	0
Selenium, Se [1,2] 1140	ug/ml	18.236±0.0930	0	0
Silver, Ag [1,2] 1150	ug/ml	17.526±0.0894	0	0
Thallium, Tl [1,2] 1165	ug/ml	18.179±0.0927	0	0
Zinc, Zn [1,2] 1190	ug/ml	16.050±0.0819	0	0

Definitions and Interpretation of Statistical Analysis:

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).

Accept. Window: The range of values that constitute acceptable performance for a laboratory participating in this PT study.

Z: A Z-Score tells 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 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 statisitical model (RTC employs the 'Biweight Program'). 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 statisicals (Biweight).

Gravimetric Value: The 'prepared to' value, determined by gravimetric means. The uncertainty associated to this value is standard uncertainty and based on RTC's gravimetric tolerances.

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 base 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 - Reserved

8 - 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.

Proficiency Test Item Preparation, Homogeneity and Stability Assessment - RTC uses proprietary and published methods for the manufacture, homogeneity and stability testing of proficiency test items. RTC's proficiency test materials meet requirements of ISO Guide 34. For more information contact RTC. Additionally RTC complies with TNI Volume 3 'General Requirements for Environmental Proficiency Test Providers', EL-V3-2009, 2009 for all TNI Fields of Proficiency Testing analytes.

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.

Statistical Analysis - RTC uses robust statistics to calculate study means and standard deviations - Reference - Kafadar, K, A Biweight Approach to the One-Sample Problem, Journal of the American Statistical Association, Vol. 77, No. 378, June, 1982, pp. 416-424.

Additional Information - Go to www.pt.sigmainformatics.com for additional information on summary statistics for specific methods, advice on the interpretation of the statistical analysis, and additional comments/recommendations. If you failed an analyte it may be required to perform a corrective action and/or retest. RTC recommends that you contact your accreditation body for specific instruction.

Program analyte accrediting footnotes

[1] NELAC Compliant, covered by RTC's ANAB Proficiency Testing Provider accreditation, Cert. AP-1469

[2] ISO 17043 Accredited, covered by RTC's ANAB Proficiency Testing Provider accreditation, Cert AP-1469

Authorizing Officer: _____ Date: 7/5/2018

Patrick Brumfield, ASQ CQA

QA Manager

This section of the report is for informational purposes only. If you are unsure about specific accreditation requirements, please contact your state coordinator.

UNACCEPTABLE ANALYTES

PASS RATE

Number of Reported Results:	28
Number of Passing Results:	28
Pass Rate:	100%

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.

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION CORPORATE SEAL 1978 DISTRICT OF COLUMBIA A2LA

Presented this 26th day of February 2018.

President and CEO
For the Accreditation Council
Certificate Number 4675.01
Valid to November 30, 2019

This accreditation program is not included under the A2LA ILAC Mutual Recognition Arrangement.

APEX INSTRUMENTS METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING CALIBRATED CRITICAL ORIFICES
5-POINT ENGLISH UNITS

Meter Console Information	
Box Number	12
Console Serial Number	2199-D
DGM Model Number	Itron
DGM Serial Number	3605480

Calibration Conditions			
Date	Time	24-May-18	9:30
Barometric Pressure		26.0	in Hg
Theoretical Critical Vacuum[1]		12.3	in Hg
Calibration Technician		CSW	

Factors/Conversions		
Std Temp	528	°R
Std Press	29.92	in Hg
K_1	17.647	oR/in Hg

[1]For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.

[2]The Critical Orifice Coefficient, K', must be entered in English units, $(ft^3°R^{1/2})/(in.Hg*min)$.

Calibration Data

Run Time	Metering Console					Critical Orifice				
Elapsed	DGM Orifice ΔH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Serial Number	Coefficient	Amb Temp Initial	Amb Temp Final	Actual Vacuum
(Θ)	(P_m)	(V_{mi})	(V_{mf})	(t_{mi})	(t_{mf})		K'	(t_{amb})	(t_{amb})	
min	in H_2O	cubic feet	cubic feet	°F	°F		see above2	°F	°F	in Hg
10.0	0.25	0.000	2.996	68	68	QM-40	0.2300	71	71	22
10.0	0.55	2.996	7.451	68	69	QM-48	0.3428	71	71	21
10.0	0.94	7.451	13.206	69	69	QM-55	0.4425	71	71	20
10.0	1.70	13.206	20.917	69	70	QM-63	0.5946	71	71	18
10.0	2.90	20.917	31.030	70	70	QM-73	0.7845	71	71	16

Results

Standardized Data				Dry Gas Meter				
				Calibration Factor		Flowrate	ΔH @	
Dry Gas Meter		Critical Orifice		Value	Variation	Std & Corr	0.75 SCFM	Variation
($V_{m(std)}$)	($Q_{m(std)}$)	($Vcr_{(std)}$)	($Q_{cr(std)}$)	(Y)	(ΔY)	($Q_{m(std)(corr)}$)	(ΔH@)	(ΔΔH@)
cubic feet	cfm	cubic feet	cfm			cfm	in H2O	
2.604	0.260	2.594	0.259	0.996	-0.003	0.259	1.819	-0.015
3.872	0.387	3.866	0.387	0.998	0.000	0.387	1.803	-0.031
5.003	0.500	4.991	0.499	0.998	-0.001	0.499	1.852	0.018
6.711	0.671	6.706	0.671	0.999	0.000	0.671	1.861	0.027
8.823	0.882	8.848	0.885	1.003	0.004	0.885	1.834	0.000
				0.999	Y Average		1.834	ΔH@ Average

AVERAGE **Y=** **0.9988**

AVERAGE **H=** **1.8338**

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 Calibration Factor H, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.20.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR Title 40, Part 60, Appendix A-3, Method 5, 16.2.3

Signature _____ Date 5-24-18

APEX INSTRUMENTS

METHOD 5 XC-522 CONSOLE CALIBRATION

for

Meter Console Information	
Console Model Number	Box 12
Console Serial Number	2199-D
DGM Model Number	Itron
DGM Serial Number	3605480

Calibration Conditions			
Date	Time	5-Jul-18	13:45
Barometric Pressure		26.17	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	14.011	14.011	69	70	0.000	14.359	14.359	70	71
10.00	3.00	0.000	9.928	9.928	70	71	0.000	10.030	10.030	71	72
10.00	2.00	0.000	8.217	8.217	71	72	0.000	8.262	8.262	72	72
10.00	1.00	0.000	5.944	5.944	72	73	0.000	5.952	5.952	72	72
10.00	0.50	0.000	4.207	4.207	73	73	0.000	4.199	4.199	72	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	$\Delta\Delta H_@$
12.426	1.243	12.499	1.250	1.0058	0.006	1.250	1.885	0.007
8.716	0.872	8.714	0.871	0.9999	0.000	0.871	1.936	0.057
7.180	0.718	7.171	0.717	0.9988	-0.001	0.717	1.902	0.024
5.170	0.517	5.166	0.517	0.9993	-0.001	0.517	1.829	-0.049
3.650	0.365	3.641	0.364	0.9975	-0.003	0.364	1.839	-0.039
				1.0003	**Y Average**		**1.878**	**$\Delta H_@$ 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).

Signature Chris Whitten

csw

5-Jul-18

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APEX INSTRUMENTS METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING CALIBRATED CRITICAL ORIFICES
5-POINT ENGLISH UNITS

Meter Console Information	
Box Number	13
Console Serial Number	2200-D
DGM Model Number	Itron
DGM Serial Number	3605481

Calibration Conditions			
Date	Time	24-May-18	11:30
Barometric Pressure		26.0	in Hg
Theoretical Critical Vacuum[1]		12.3	in Hg
Calibration Technician		CSW	

Factors/Conversions		
Std Temp	528	°R
Std Press	29.92	in Hg
K_1	17.647	oR/in Hg

[1]For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.

[2]The Critical Orifice Coefficient, K', must be entered in English units, $(ft^3°R^{1/2})/(in.Hg*min)$.

Calibration Data

Run Time	Metering Console					Critical Orifice				
Elapsed	DGM Orifice ΔH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Serial Number	Coefficient	Amb Temp Initial	Amb Temp Final	Actual Vacuum
(Θ)	(P_m)	(V_{mi})	(V_{mf})	(t_{mi})	(t_{mf})		K'	(t_{amb})	(t_{amb})	
min	in H_2O	cubic feet	cubic feet	°F	°F		see above2	°F	°F	in Hg
10.0	0.25	0.000	2.975	64	65	QM-40	0.2300	71	71	21
10.0	0.55	2.975	7.418	65	66	QM-48	0.3428	71	71	20
11.0	0.94	7.418	13.728	66	67	QM-55	0.4425	71	71	19
10.0	1.70	13.728	21.431	67	68	QM-63	0.5946	71	71	18
10.0	2.90	21.431	31.576	68	69	QM-73	0.7845	71	71	16

Results

Standardized Data				Dry Gas Meter				
				Calibration Factor		Flowrate	ΔH @	
Dry Gas Meter		Critical Orifice		Value	Variation	Std & Corr	0.75 SCFM	Variation
($V_{m(std)}$)	($Q_{m(std)}$)	($Vcr_{(std)}$)	($Q_{cr(std)}$)	(Y)	(ΔY)	($Q_{m(std)(corr)}$)	(ΔH@)	(ΔΔH@)
cubic feet	cfm	cubic feet	cfm			cfm	in H2O	
2.603	0.260	2.594	0.259	0.996	0.000	0.259	1.831	-0.011
3.884	0.388	3.866	0.387	0.996	-0.001	0.387	1.813	-0.029
5.511	0.501	5.490	0.499	0.996	0.000	0.499	1.861	0.018
6.730	0.673	6.706	0.671	0.997	0.000	0.671	1.868	0.025
8.876	0.888	8.848	0.885	0.997	0.001	0.885	1.839	-0.003
				0.996	Y Average		1.843	ΔH@ Average

AVERAGE **Y=** **0.9963**

AVERAGE **H=** **1.8425**

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 Calibration Factor H, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.20.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR Title 40, Part 60, Appendix A-3, Method 5, 16.2.3

Signature _____ Date 5-24-18

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	5-Jul-18	15:15
Barometric Pressure		26.16	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	14.120	14.120	67	69	0.000	14.493	14.493	71	71
10.00	3.00	0.000	10.217	10.217	69	71	0.000	10.270	10.270	71	72
10.00	2.00	0.000	8.361	8.361	71	72	0.000	8.349	8.349	72	72
10.00	1.00	0.000	5.996	5.996	72	73	0.000	5.960	5.960	72	72
10.00	0.50	0.000	4.266	4.266	73	74	0.000	4.229	4.229	72	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	$\Delta\Delta H_@$
12.554	1.255	12.599	1.260	1.0036	0.009	1.260	1.860	0.018
8.974	0.897	8.920	0.892	0.9939	-0.001	0.892	1.849	0.007
7.303	0.730	7.245	0.724	0.9920	-0.003	0.724	1.863	0.021
5.213	0.521	5.171	0.517	0.9921	-0.003	0.517	1.825	-0.017
3.697	0.370	3.666	0.367	0.9916	-0.003	0.367	1.812	-0.029
				0.9946	**Y Average**		**1.842**	**$\Delta H_@$ 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).

Signature Chris Whitten CSW

Date 7/5/2018 5-Jul-18

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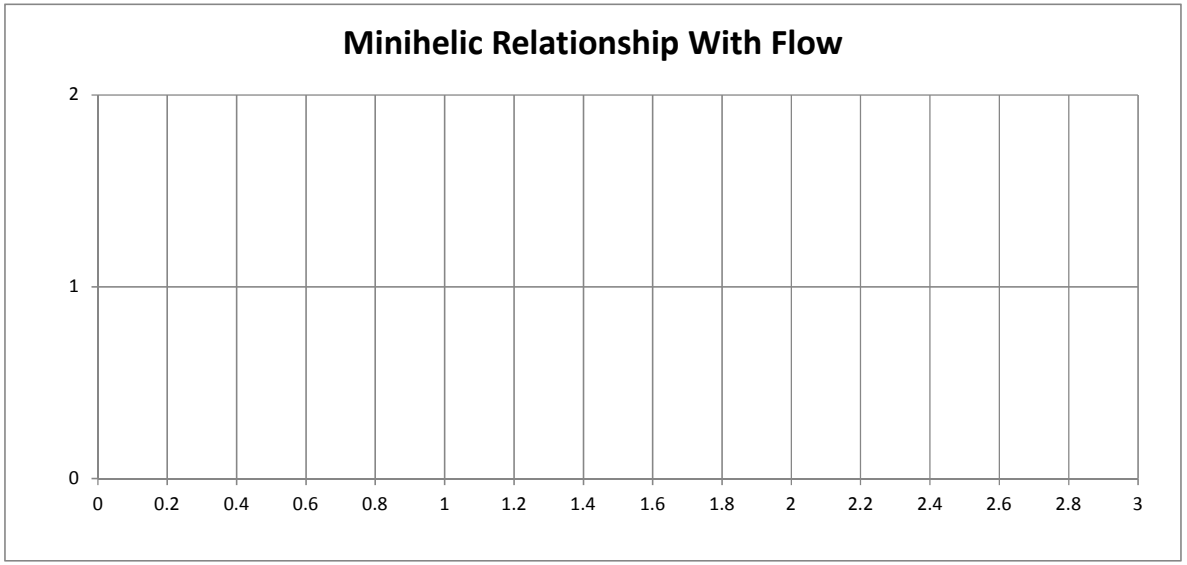
Low Flow Console Calibration

Side A | Bison Dual Box 2 (Helena) | Apex Instruments Model XC-260 S/N 1608012 | April 17, 2018

orifice cnfgration	Bubble Tube Volume Cbc Cm	Average Bubble Tube Time	Run Time min.	Minihelic mm of W.	Vaccume In. Hg	Rotameter	DGM Volume Liters	Bubble Tube Run Volume	First Bubble Time Seconds	Second Bubble Time Seconds	Third Bubble Time Seconds	Fourth Bubble Time Seconds	Fifth Bubble Time Seconds	Yi	Bubble Tube Flow Rate LPM	Temperature Of The Test Degrees F	Barometric Pressure In.Hg	Orifice Indicated Flowrate LPM
	700	17.004	4.866667		0	2.3	11.461	12.0207	17	17.03	16.93	17.06	17	1.049	2.4700071	74	26.51	
	700	21.888	3.95		0	1.8	7.281	7.579496	21.91	21.81	22.06	21.94	21.72	1.041	1.9188596			
	600	34.244	7.333333		0	1.2	7.361	7.70938	34.22	34.21	34.26	34.26	34.27	1.047	1.0512791			
	100	7.976	7.6		0	0.8	5.52	5.717151	7.97	7.91	8	8	8	1.036	0.7522568			
	100	11.424	10.4		0	0.5	5.26	5.462185	11.41	11.47	11.37	11.43	11.44	1.038	0.5252101			

Minihelic Indication



Average Y 1.042

Durant Multiplier

Entries are made in Cells only.

Volume Correction at Calibration Conditions:

0.896003

Enter Current Conditions Here \/

Current Conditions:

Current Barometric Pressure In In. Hg 26.86

Current Temperature degrees F 73

Volume Correction at Current Conditions:

0.906302

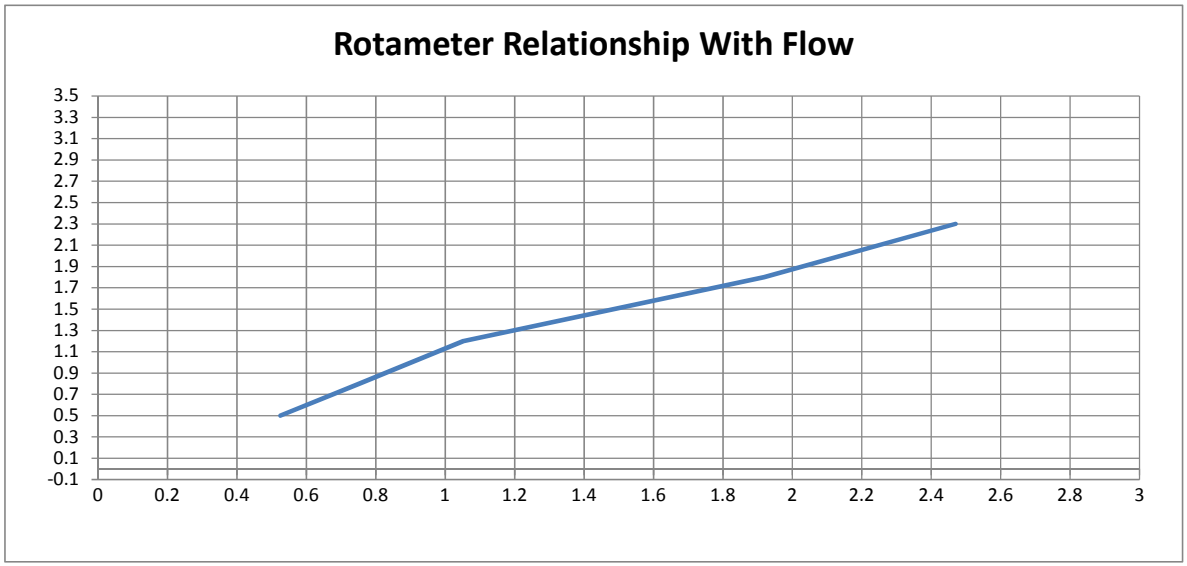
Slope	intercept	Corr.COEF.
#DIV/0!	#DIV/0!	#DIV/0!

Desired flowrate (liters/minute) 0.73

Minihelic reading for flow #DIV/0!

Flow in LPM (Actual)

Rotameter Indication



897.7516 mb

Slope	intercept	Corr.COEF.
1.114367	-0.1274419	0.993099

Desired flowrate (liters/minute) 0.73

Rotameter reading for flow 0.78

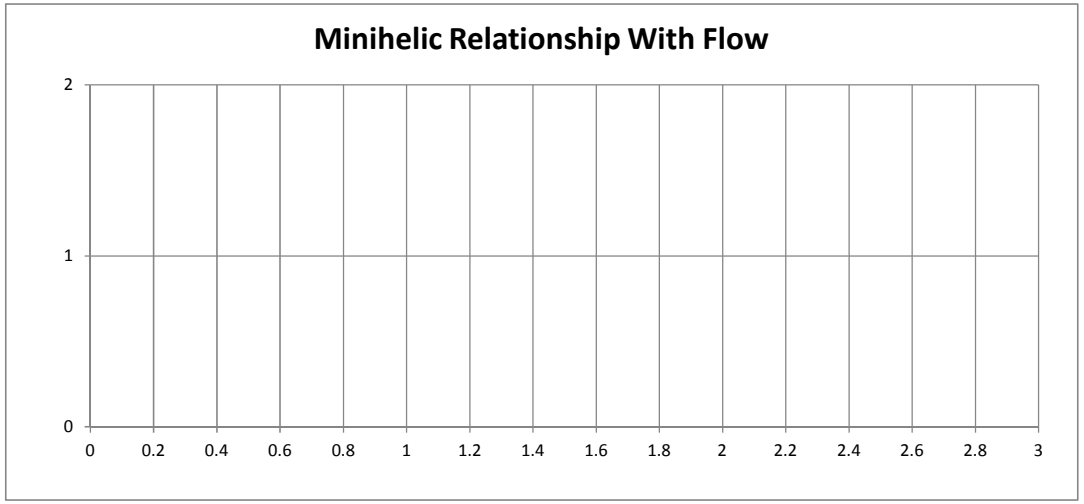
Flow in LPM (Actual)

Low Flow Console Calibration

Side B | Bison Dual Box 2 (Helena) | Apex Instruments Model XC-260 S/N 1608012 | April 17, 2018

orifice cnfgration	Bubble Tube Volume Cbc Cm	Average Bubble Tube Time	DGM Run Time min.	Minihelic mm of W. (	Vaccume In. Hg	Rotameter	DGM Volume Liters	Bubble Tube Run Volume	First Bubble Time Seconds	Second Bubble Time Seconds	Third Bubble Time Seconds	Fourth Bubble Time Seconds	Fifth Bubble Time Seconds	Yi	Bubble Tube Flow Rate LPM	Temperature Of The Test Degrees F	Test Barometric Pressure In.Hg	Orifice Indicated Flowrate LPM
700	13.684	2.666667		0	3	7.827	8.184741	13.76	13.7	13.71	13.57	13.68	1.046	3.069278	74	26.51	
700	17.1	4.233333		0	2.2	9.982	10.39766	17.09	17.06	17.11	17.15	17.09	1.042	2.4561404			
500	16.572	3.4		0	1.7	5.87	6.15496	16.56	16.47	16.65	16.65	16.53	1.049	1.8102824			
100	6.248	5.6		0	1.1	5.14	5.377721	6.22	6.25	6.28	6.27	6.22	1.046	0.9603073			
100	13.534	12.1		0	0.4	5.118	5.364268	13.53	13.54	13.53	13.54	13.53	1.048	0.4433279			

Minihelic Indication



Average Y 1.046

Durant Multiplier

Entries are made in Cells only.

Volume Correction at Calibration Conditions:

0.896003

Enter Current Conditions Here ⋁

Current Conditions:

Current Barometric Pressure In In. Hg 26.86

Current Temperature degrees F 73

Volume Correction at Current Conditions:

0.906302

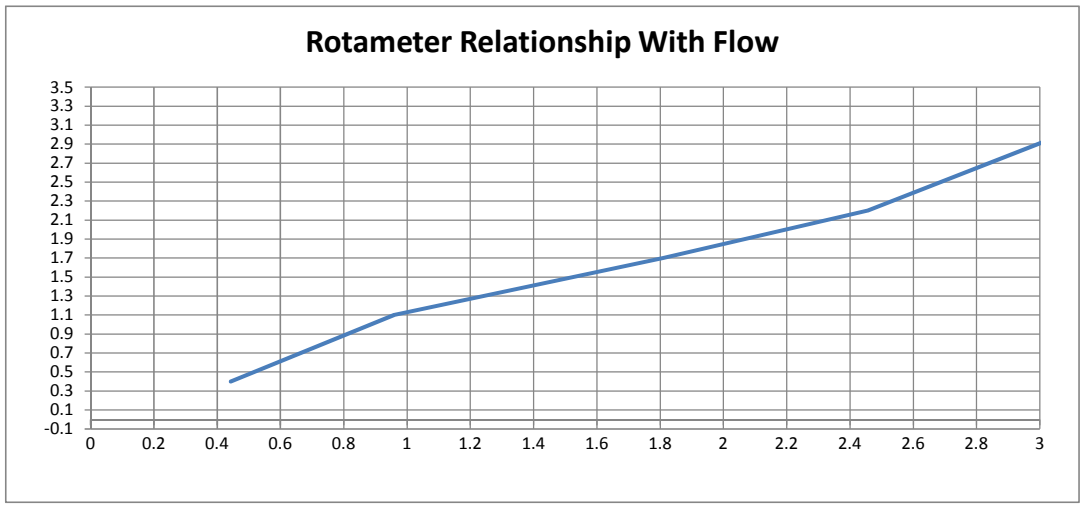
Slope	intercept	Corr.COEF.
#DIV/0!	#DIV/0!	#DIV/0!

Desired flowrate (liters/minute) 0.73

Minihelic reading for flow #DIV/0!

Flow in LPM (Actual)

Rotameter Indication



906.895

Slope	intercept	Corr.COEF.
1.063292	-0.038463	0.992874

Desired flowrate (liters/minute) 0.71

Rotameter reading for flow 0.71

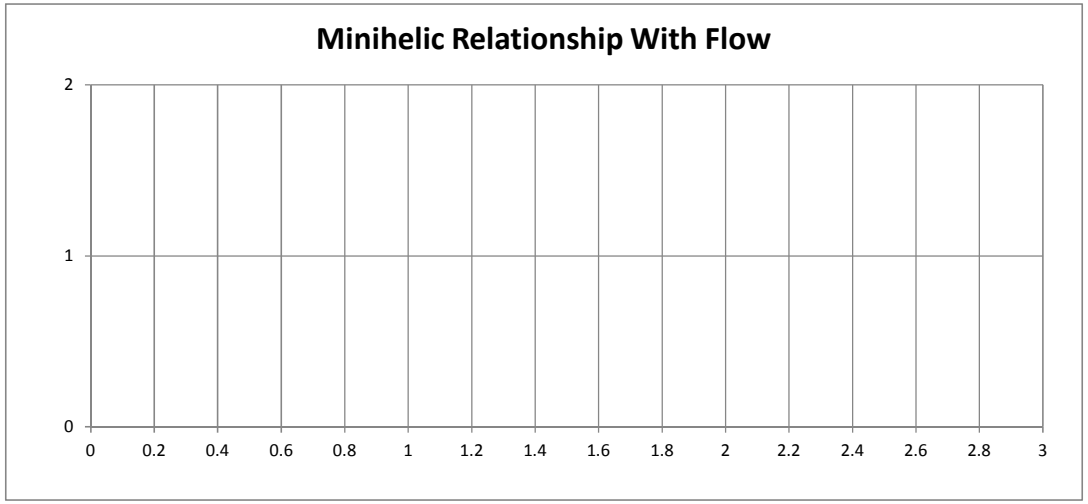
Flow in LPM (Actual)

Low Flow Console Calibration

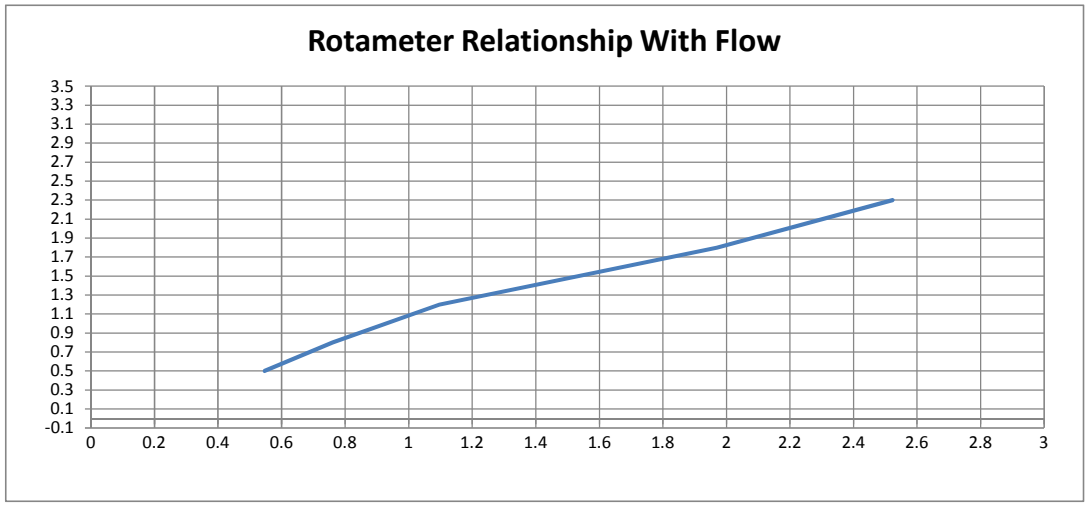
Side A | Bison Dual Box 2 (Helena) | Apex Instruments Model XC-260 S/N 1608012 | July 7, 2018

orifice cnfgration	Bubble Tube Volume Cbc Cm	Average Bubble Tube Time	Run Time min.	Minihelic mm of W. (	Vaccume In. Hg	Rotameter	DGM Volume Liters	Bubble Tube Run Volume	First Bubble Time Seconds	Second Bubble Time Seconds	Third Bubble Time Seconds	Fourth Bubble Time Seconds	Fifth Bubble Time Seconds	Yi	Bubble Tube Flow Rate LPM	Temperature Of The Test Degrees F	Barometric Pressure In.Hg	Orifice Indicated Flowrate LPM
700	16.65	2.983333		0	2.3	7.218	7.525526	16.65	16.59	16.81	16.66	16.54	1.043	2.5225225	73	26.44	
700	21.322	3.733333		0	1.8	7.01	7.353907	21.47	21.34	21.34	21.25	21.21	1.049	1.9697965			
600	32.82	6.616667		0	1.2	6.954	7.25777	32.88	32.84	32.78	32.75	32.85	1.044	1.0968921			
200	15.762	7.25		0	0.8	5.312	5.519604	15.69	15.81	15.69	15.87	15.75	1.039	0.7613247			
100	10.966	10.96667		0	0.5	5.747	6.000365	10.97	10.95	11	10.97	10.94	1.044	0.5471457			

Minihelic Indication



Rotameter Indication



Average Y 1.044

Durant Multiplier

Entries are made in Cells only.

Volume Correction at Calibration Conditions:

0.89213

Enter Current Conditions Here \/

Current Conditions:

Current Barometric Pressure In In. Hg 26.86

Current Temperature degrees F 73

Volume Correction at Current Conditions:

0.906302

Slope	intercept	Corr.COEF.
#DIV/0!	#DIV/0!	#DIV/0!

Desired flowrate (liters/minute) 0.73

Minihelic reading for flow #DIV/0!

Flow in LPM (Actual)

895.3811 mb

Slope	intercept	Corr.COEF.
1.136592	-0.1207647	0.99377

Desired flowrate (liters/minute) 0.73

Rotameter reading for flow 0.76

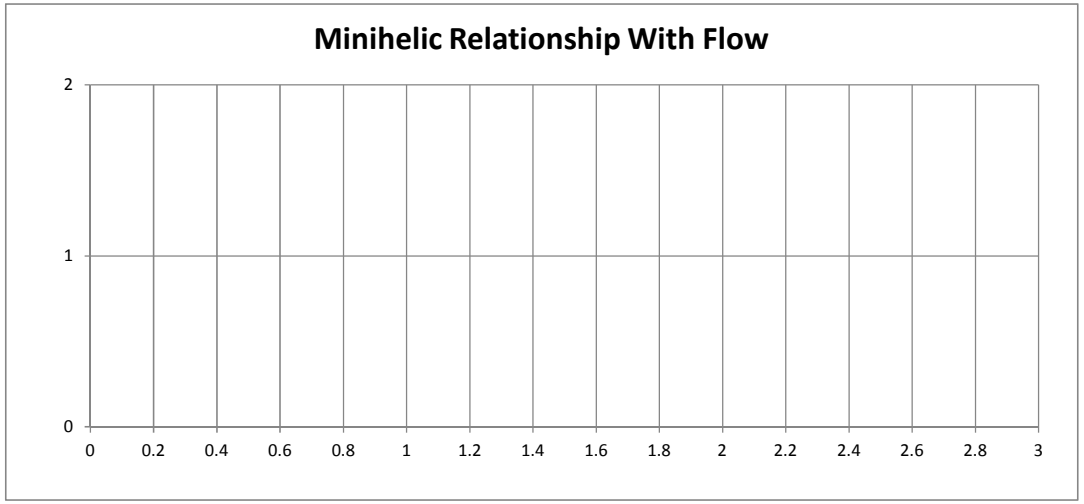
Flow in LPM (Actual)

Low Flow Console Calibration

Side B | Bison Dual Box 2 (Helena) | Apex Instruments Model XC-260 S/N 1608012 | July 7, 2018

orifice cnfgration	Bubble Tube Volume Cbc Cm	Average Bubble Tube Time	DGM Run Time min.	Minihelic mm of W. (	Vaccume In. Hg	Rotameter	DGM Volume Liters	Bubble Tube Run Volume	First Bubble Time Seconds	Second Bubble Time Seconds	Third Bubble Time Seconds	Fourth Bubble Time Seconds	Fifth Bubble Time Seconds	Yi	Bubble Tube Flow Rate LPM	Temperature Of The Test Degrees F	Test Barometric Pressure In.Hg	Orifice Indicated Flowrate LPM
	700	13.764	3.2		0	3	9.328	9.764603	13.66	13.69	13.72	13.87	13.88	1.047	3.0514385	73	26.44	
	700	17.372	3.25		0	2.2	7.491	7.857472	17.31	17.35	17.37	17.39	17.44	1.049	2.4176836			
	500	16.3	3.216667		0	1.7	5.658	5.920245	16.28	16.21	16.4	16.43	16.18	1.046	1.8404908			
	200	12.53	5.666667		0	1	5.215	5.426975	12.5	12.56	12.5	12.53	12.56	1.041	0.9577015			
	100	13.798	12.43333		0	0.5	5.173	5.406581	13.84	13.78	13.87	13.78	13.72	1.045	0.4348456			

Minihelic Indication



Average Y 1.046

Durant Multiplier

Entries are made in Cells only.

Volume Correction at Calibration Conditions:

0.89213

Enter Current Conditions Here ⋁

Current Conditions:

Current Barometric Pressure In In. Hg 26.86

Current Temperature degrees F 73

Volume Correction at Current Conditions:

0.906302

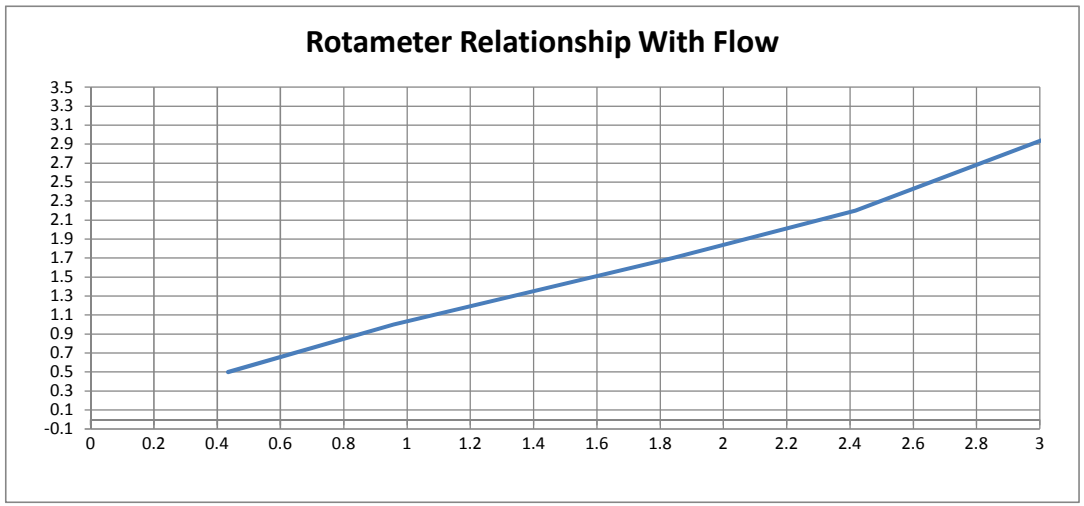
Slope	intercept	Corr.COEF.
#DIV/0!	#DIV/0!	#DIV/0!

Desired flowrate (liters/minute) 0.73

Minihelic reading for flow #DIV/0!

Flow in LPM (Actual)

Rotameter Indication



906.895

Slope	intercept	Corr.COEF.
1.074858	-0.0653288	0.996011

Desired flowrate (liters/minute) 0.71

Rotameter reading for flow 0.73

Flow in LPM (Actual)

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

962

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
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:	E03NI99E15A3787	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:	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
an Air Liquide company

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
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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

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

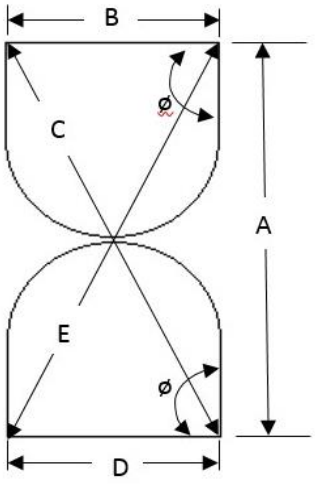
	Flow Setting	Flow (Standard Conditions)
100%	1,000 sccm	1,001 sccm
90%	900 sccm	897.5 sccm
80%	800 sccm	794.5 sccm
70%	700 sccm	698.5 sccm
60%	600 sccm	597.6 sccm
50%	500 sccm	494.9 sccm
40%	400 sccm	393.5 sccm
30%	300 sccm	293.1 sccm
20%	200 sccm	192.5 sccm
10%	100 sccm	91.17 sccm
5%	50 sccm	40.55 sccm

Performed By: Steven R Hall

Date: 01-19-2018

S-Type Pitot Tube Geometeric Calibration

Pitot Tube Identification: 4A



A	1.005
B	0.372
C	1.073
D	0.379
E	1.055

$$\frac{a^2+b^2-c^2}{2ab}=\cos\emptyset$$

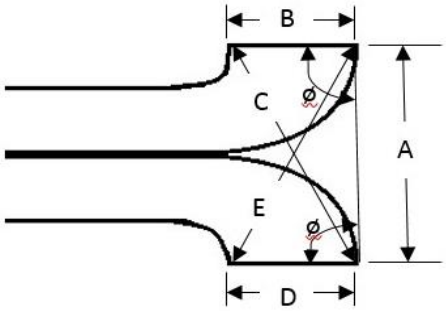
$$\frac{a^2+d^2-e^2}{2ad}=\cos\emptyset$$

ø	90.22

$(80° < \emptyset < 100°)$

ø	86.94

$(80° < \emptyset < 100°)$



A	1.003
B	0.592
C	1.154
D	0.558
E	1.13

$$\frac{a^2+b^2-c^2}{2ab}=\cos\emptyset$$

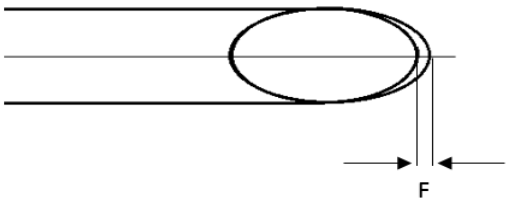
$$\frac{a^2+d^2-e^2}{2ad}=\cos\emptyset$$

ø	88.81

$(85° < \emptyset < 95°)$

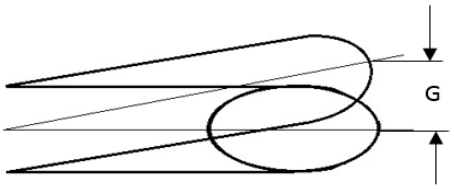
ø	87.93

$(85° < \emptyset < 95°)$



F=	0

$(f < 1/8\text{ "})$



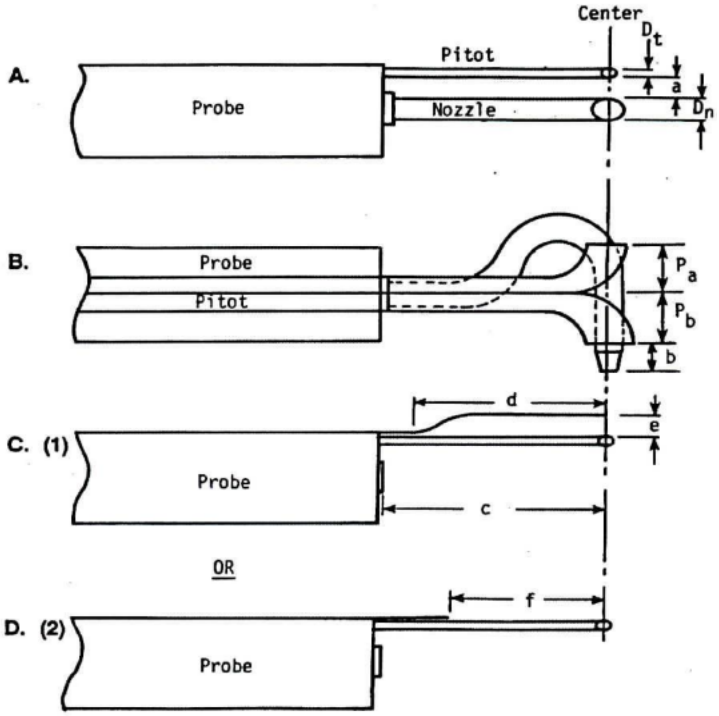
G=	0

$(g < 1/32\text{ "})$

Technician Signature: Zach Harding **Date:** 1/26/2018

Probe Calibration

Probe Identifiction: 4A
Date: 1/26/2018
Calibration Technician: Zach Harding



Dt:	3/8
Dn:	1/2
a:	1 1/8

$D_t = {}^{3}/_{16}\ to\ {}^{3}/_{8}$
$D_n = {}^{1}/_{2}"$
$a \geq {}^{3}/_{4}"$

Pa:	1/2
Pb:	1/2
b:	1 1/8

$P_a = P_b$
$B \geq 0$

c:	4 1/2
d:	8
e:	1 1/2

$c \geq 3"$
$d \geq 3"$
$e \geq {}^{3}/_{4}"$

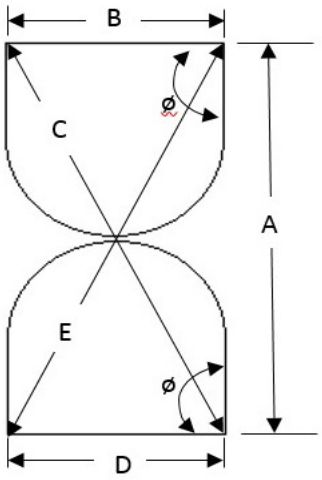
or

f:	

$f \geq 2"$

S-Type Pitot Tube Geometeric Calibration

Pitot Tube Identification: 4A



A	1.007
B	0.374
C	1.079
D	0.374
E	1.069

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos \emptyset$$

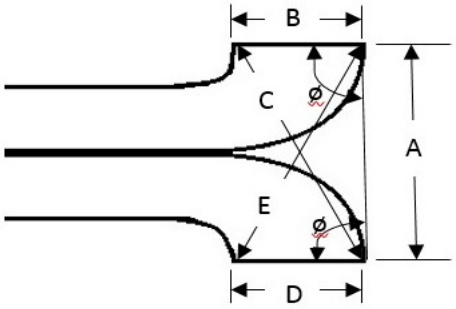
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos \emptyset$$

ø	90.78

$(80° < \emptyset < 100°)$

ø	89.15

$(80° < \emptyset < 100°)$



A	1.007
B	0.374
C	1.075
D	0.378
E	1.072

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos \emptyset$$

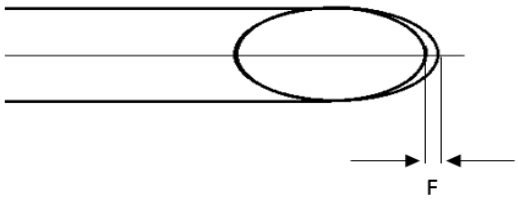
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos \emptyset$$

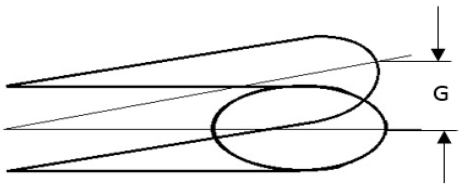
ø	90.13

$(85° < \emptyset < 95°)$

ø	89.42

$(85° < \emptyset < 95°)$





F=	0.07

$(f < 1/8")$

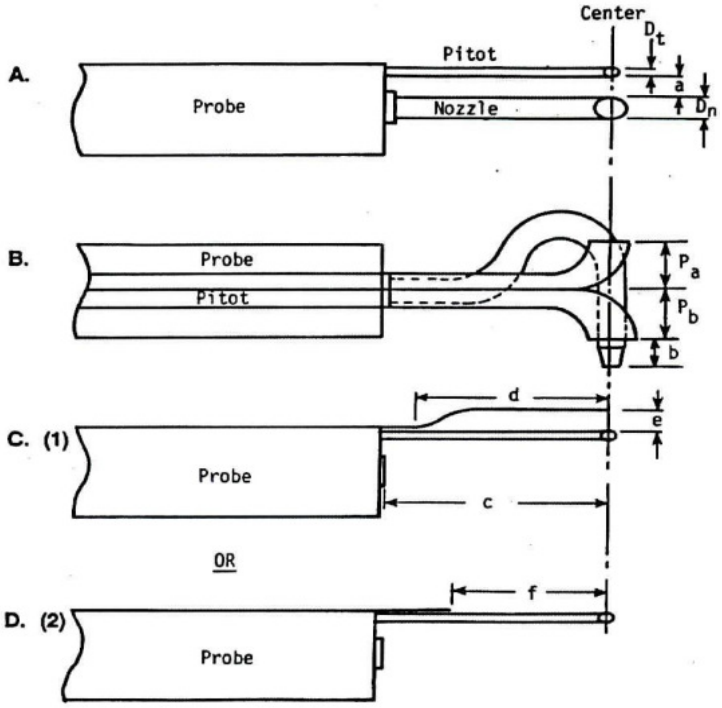
G=	0.00

$(g < 1/32")$

Technician Signature: CSW **Date:** 6/27/2018

Probe Calibration

Probe Identifiction: 4A
Date: 6/27/2018
Calibration Technician: CSW



Dt:	0.37
Dn:	0.44
a:	0.93

$D_t = {}^{3}/_{16}$ to ${}^{3}/_{8}$
$D_n = {}^{1}/_{2}$"
$a \geq {}^{3}/_{4}$"

Pa:	0.48
Pb:	0.48
b:	1.07

$P_a = P_b$
$B \geq 0$

c:	4.38
d:	4.63
e:	0.81

$c \geq 3$"
$d \geq 3$"
$e \geq {}^{3}/_{4}$"

or

f:	N/A

$f \geq 2$"

BISON ENGINEERING

Method 2, section 10.1.3.1

Post Test Thermocouple calibrations

Client: H&V

Location: Corvallis, Oregon

Probe ID #: 4A

Alt-011 6/21/94 Alternative Method 2 Thermocouple Calibration Procedure

Check at Ambient Temperature, or any temperature within the range specified by the manufacturer

ASTM reference thermometer	Thermocouple reading	Difference	Limitation
68 °F	68 °F	0	+/- 2 °F

OR

Method 2 Section 10.3.1

Avg source temp.: ____ °F / 459.7 °R

+ / - Calibration Ranges				
+ 10%	46 °F	=	506 °R	
- 10%	-42 °F	=	418 °R	

Thermocouple			NIST Thermometer			% Diff	Limitation
____ °C	=	273.15 °K	____ °C	=	273.15 °K	0.00%	+/- 1.5%
OR							
____ °F	=	460.67 °R	____ °F	=	460.67 °R	0.00%	+/- 1.5%

Temperatures are not corrected for Bp.

Calibration perfomed by: Chris Whitten

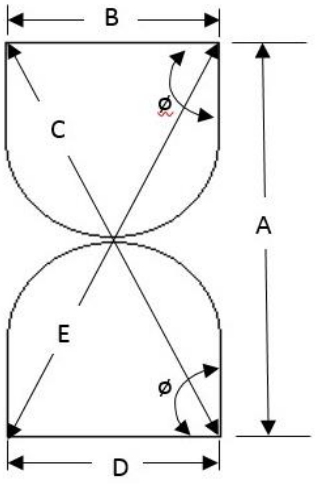
Date of Calibration: 7/5/2018

EPA Reference Method 2. Section 10.0 Calibration and Standardization

10.3.1 After each field use, calibrate dial thermometers, liquid-filled bulb thermometers, thermocouple-potentiometer systems, and other sensors at a temperature within 10 percent of the average absolute stack temperature. For temperatures up to 405°C (761°F), use an ASTM mercury-in-glass reference thermometer, or equivalent, as a reference. Alternatively, either a reference thermocouple and potentiometer (calibrated against NIST standards) or thermometric fixed points (e.g., ice bath and boiling water, corrected for barometric pressure) may be used. For temperatures above 405°C (761°F), use a reference thermocouple-potentiometer system calibrated against NIST standards or an alternative reference, subject to the approval of the Administrator.

S-Type Pitot Tube Geometeric Calibration

Pitot Tube Identification: 4D



A	1.028
B	0.376
C	1.078
D	0.377
E	1.077

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos \emptyset$$

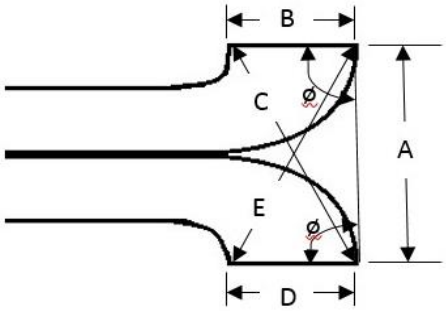
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos \emptyset$$

ø	87.33

$(80° < \emptyset < 100°)$

ø	87.12

$(80° < \emptyset < 100°)$



A	1.039
B	0.571
C	1.166
D	0.574
E	1.161

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos \emptyset$$

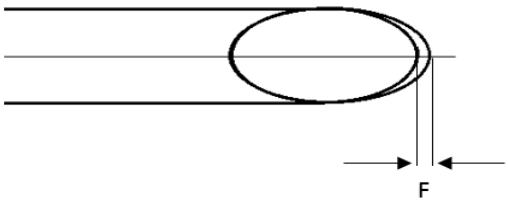
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos \emptyset$$

ø	87.78

$(85° < \emptyset < 95°)$

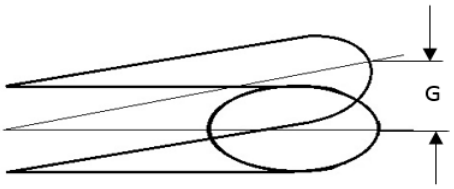
ø	87.06

$(85° < \emptyset < 95°)$



F=	0

$(f < 1/8\ ")$



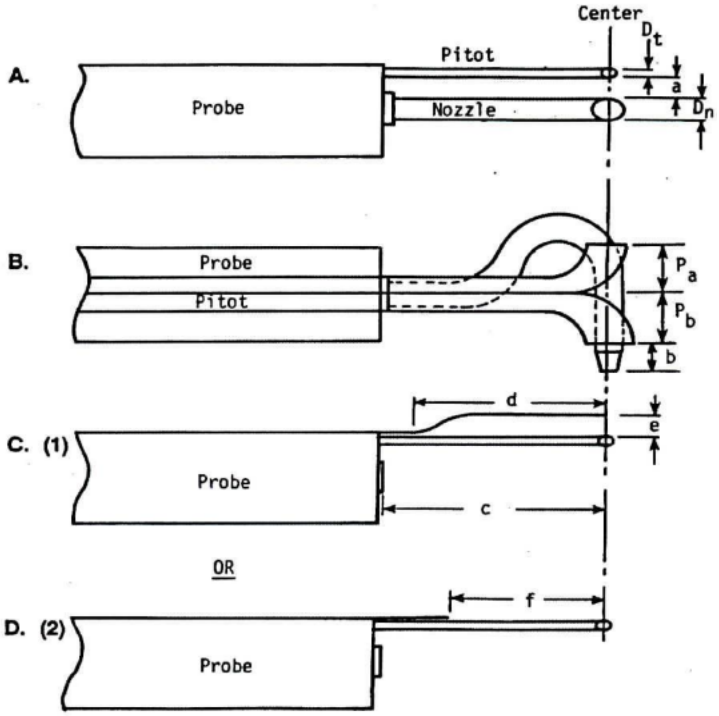
G=	0

$(g < 1/32\ ")$

Technician Signature: Zach Harding **Date:** 1/26/2018

Probe Calibration

Probe Identifiction: 4D
Date: 1/26/2018
Calibration Technician: Zach Harding



Dt:	3/8
Dn:	1/2
a:	1 1/6

$D_t = {}^{3}/_{16}\ to\ {}^{3}/_{8}$
$D_n = {}^{1}/_{2}"$
$a \geq {}^{3}/_{4}"$

Pa:	1/2
Pb:	1/2
b:	1

$P_a = P_b$
$B \geq 0$

c:	4 1/2
d:	4 3/5
e:	1 4/5

$c \geq 3"$
$d \geq 3"$
$e \geq {}^{3}/_{4}"$

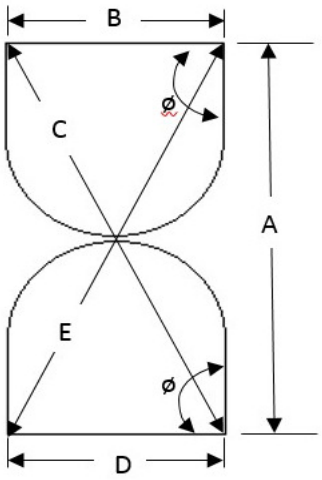
or

f:	

$f \geq 2"$

S-Type Pitot Tube Geometeric Calibration

Pitot Tube Identification: 4D



A	0.933
B	0.39
C	1.025
D	0.389
E	1.022

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos \emptyset$$

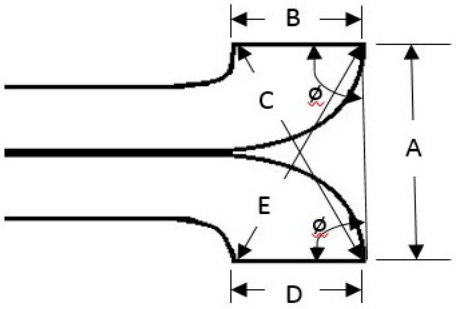
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos \emptyset$$

ø	92.21

$(80° < \emptyset < 100°)$

ø	91.79

$(80° < \emptyset < 100°)$



A	0.934
B	0.571
C	1.09
D	0.57
E	1.08

$$\frac{a^2 + b^2 - c^2}{2ab} = \cos \emptyset$$

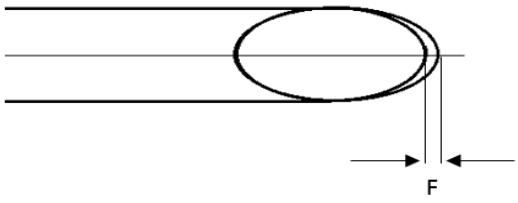
$$\frac{a^2 + d^2 - e^2}{2ad} = \cos \emptyset$$

ø	89.45

$(85° < \emptyset < 95°)$

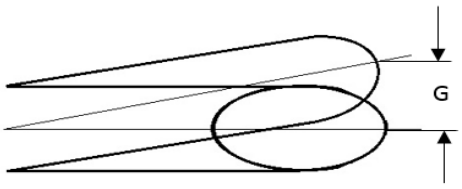
ø	88.34

$(85° < \emptyset < 95°)$



F=	0.07

$(f < 1/8")$



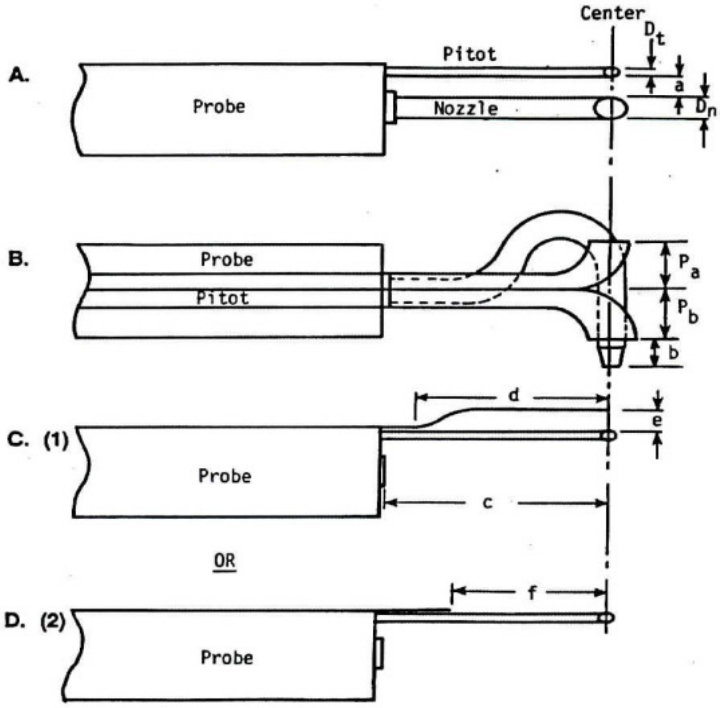
G=	0

$(g < 1/32")$

Technician Signature: CSW **Date:** 6/27/2018

Probe Calibration

Probe Identifiction: 4D
Date: 6/27/2018
Calibration Technician CSW



Dt:	0.36
Dn:	0.44
a:	0.82

$D_t = {}^{3}/_{16}$ to ${}^{3}/_{8}$
$D_n = {}^{1}/_{2}$ "
$a \geq {}^{3}/_{4}$ "

Pa:	0.45
Pb:	0.45
b:	1 1/2

$P_a = P_b$
$B \geq 0$

c:	4.75
d:	3.50
e:	1.06

$c \geq 3$"
$d \geq 3$"
$e \geq {}^{3}/_{4}$ "

or

f:	N/A

$f \geq 2$"

BISON ENGINEERING

Method 2, section 10.1.3.1

Post Test Thermocouple calibrations

Client: H&V

Location: Corvallis, Oregon

Probe ID #: 4D

Alt-011 6/21/94 Alternative Method 2 Thermocouple Calibration Procedure

Check at Ambient Temperature, or any temperature within the range specified by the manufacturer

ASTM reference thermometer	Thermocouple reading	Difference	Limitation
68 °F	69 °F	1	+/- 2 °F

OR

Method 2 Section 10.3.1

Avg source temp.: ____ °F / 459.7 °R

+ / - Calibration Ranges				
+ 10%	46 °F	=	506 °R	
- 10%	-42 °F	=	418 °R	

Thermocouple		NIST Thermometer		% Diff	Limitation
____ °C = 273.15 °K		____ °C = 273.15 °K		0.00%	+/- 1.5%
OR					
Thermocouple		NIST Thermometer		% Diff	
____ °F = 460.67 °R		____ °F = 460.67 °R		0.00%	+/- 1.5%

Temperatures are not corrected for Bp.

Calibration perfomed by: Chris Whitten

Date of Calibration: 7/5/2018

EPA Reference Method 2. Section 10.0 Calibration and Standardization

10.3.1 After each field use, calibrate dial thermometers, liquid-filled bulb thermometers, thermocouple-potentiometer systems, and other sensors at a temperature within 10 percent of the average absolute stack temperature. For temperatures up to 405°C (761°F), use an ASTM mercury-in-glass reference thermometer, or equivalent, as a reference. Alternatively, either a reference thermocouple and potentiometer (calibrated against NIST standards) or thermometric fixed points (e.g., ice bath and boiling water, corrected for barometric pressure) may be used. For temperatures above 405°C (761°F), use a reference thermocouple-potentiometer system calibrated against NIST standards or an alternative reference, subject to the approval of the Administrator.

BISON ENGINEERING, INC.

Handheld Barometer Calibration Form

Branch Location: Helena, MT

IN OFFICE PRE-TEST CHECKS

Date: 5/8/2018

Performed by: RMB

NIST Reference Standard Barometer Used:

Standard ID	Serial number	Calibrated on:	Calibration due:
Helena mercury Barometer	BIS01	5/8/2018	NA

Handheld Barometer Verification:

Barometer ID: SS160499022

Reference Value (g)	Observed (g)	Correction*	Tolerance (+/- 0.10)
26.17	26.17	0.00	PASS

*Correction is the difference between the observed and reference values

BISON ENGINEERING, INC.

Field Balance and Weights Calibration Form

Branch Location: Helena **Project #:** HAV218718

IN OFFICE PRE-TEST CHECKS

Date: 6/4/2018
Performed by: CSW

Environmental conditions in the lab:

Temperature °F	Pressure "Hg	Humidity %RH
70	26.18	18

NIST Reference Standards Used:

Standard ID	Serial number(s)	Calibrated on:	Calibration due:
Helena Ref. Standard Weights 200 and 500g	10696	1/18/2018	1/18/2019

Verification of Balance Against Reference Standards:

Balance ID: Helena Scale #1

Nominal Value (g)	Observed (g)	Correction*	Tolerance (+/- 0.5g)**
200	200.1	0.1	PASS
500	500.1	0.1	PASS

Verification of Field Standard Weights :

Weights ID: HLN Field Weights 1

Nominal Value (g)	Observed (g)	Correction*	Tolerance (+/- 0.5g)**
200	200.0	0.0	PASS
500	500.1	0.1	PASS

*Correction is the difference between the observed and nominal mass values
**EPA Method 5, Section 6.3.4

ONSITE BALANCE VERIFCATION

Date: 6/5/2018
Performed by: CSW

Environmental conditions onsite:

Temperature °F	Pressure "Hg
69	29.94

Field Balance Verification:

Balance ID: Helena Scale #1
Weights ID: HLN Field weights 1

Nominal Value (g)	Observed (g)	Correction*	PASS/FAIL Tolerance (+/- 0.5g)
500	500.1	0.1	Pass
200	200.0	0.0	Pass

*Correction is the difference between the observed and nominal mass values

Signed: Chris Whitten

Date: 6/5/2018

Version: 1/20/2018
Y:\SOURCE\Calibrations\BLANK CALIBRATION FORMS\Working Balance Verifcation

Established 1974

Supplement to Report of Calibration Issued 02/09/18

QUALITY CONTROL SERVICES

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A2LA ACCREDITED 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	50
200 g	200.0111	11.1	1.0	20

*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 ASTM Class 6 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, Supplement 02/09/18

Signature David S. Thompson

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A2LA ACCREDITED
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

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

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ACCREDITED
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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Calibration Services
Certificate Number: 1550.01
Laboratory code: 115953

Report of Calibration

Firm: Bison Engineering
Address: 1400 11th Avenue
City/State/Zip: Helena, MT 59601

Test Completed: 09/08/17
Submitted by: Robyn Barkley
Traceable Number: 20171650

Test Item: 100g to 1mg Weight Set
Serial No.: 10482

Manufacturer: Troemner

Material	Assumed Density	Range	Tolerance Class
Stainless Steel	8.03 g/cm^3	100g	ASTM Class 1
Stainless Steel	7.95 g/cm^3	10mg	ASTM Class 1
Stainless Steel	2.7 g/cm^3	1mg	ASTM Class 1

Method and Traceability
The procedure used for this calibration is NIST IR 6969 SOP 4 Double 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:
100g to 1mg Working Standards Were Calibrated: 03/03/17 Due: 03/31/18 Standards ID: 723318
Mass Comparators Used: MET-04, 05 **Tested by:** S. King

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. 8.0g/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.

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Date: 09/08/17

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Certificate Number: 1550.01
Laboratory code: 115953

Report of Calibration

Firm: Bison Engineering
Address: 1400 11th Avenue
City/State/Zip: Helena, MT 59601

Test Completed: 09/08/17
Submitted by: Robyn Barkley
Traceable Number: 20171650

Test Item: 100g to 1mg Weight Set
Serial No.: 10482

Manufacturer: Troemner

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
22.207	759.81	48.23

Conventional Mass Value

Nominal Value	As Found Value (g)	As Found Correction* (mg)	As Left Value (g)	As Left Correction* (mg)	Uncertainty (mg)	Tolerance (mg)
100g	100.000079	0.079	100.000079	0.079	0.024	0.25
10mg	0.0100020	0.0020	0.0100020	0.0020	0.0020	0.01
1mg	N/A	N/A	0.0010042	0.0042	0.0014	0.01

*Correction is the difference between the conventional mass value of a weight and its nominal value.

Comments: The 1mg weight was missing As Found and was replaced with a new 1mg Troemner weight and was within ASTM Class 1 tolerances As Left. All other weights listed above were received in good condition and were within ASTM Class 1 tolerances As Found.

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: 09/08/17

Signature David S. Thompson

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Calibration Services
Certificate Number: 1550.01
Laboratory code: 115953

Bison Engineering
1400 11th Avenue
Helena, MT 59601

Report Number: BISE0132350167170731

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	7/31/17	7/22/16	7/2018

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. 20.0000	5. 20.0001	9. 20.0001
2. 20.0000	6. 20.0001	10. 20.0000
3. 20.0000	7. 20.0001	Result
4. 20.0000	8. 20.0000	0.00005

ENVIRONMENTAL CONDITIONS
☐ Good ☑ Fair ☐ Poor
Temperature: 23.1°C

A2LA ACCREDITED SECTION OF REPORT

Standard	As-Found	As-Left	Expanded Uncertainty
100	99.9997	100.0000	0.00015
50	49.9999	50.0001	0.00015
20	19.9999	20.0000	0.00015
10	10.0000	10.0000	0.00015
1	1.0000	1.0000	0.00015
0.1	0.1000	0.1000	0.00015

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	R.Lake/Troemner	1MG-25KG	1265	11/22/16	11/2017	20162225

Permanent Information Concerning this Equipment:

Comments/Info Concerning this Calibration:
7/17 Adjusted Span

Report prepared/reviewed by: _____ **Date:** _____ **Technician:** G. Cahill

Report revised by: _____ **Date:** _____ **Signature:** G. Cahill

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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.

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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

ThermoFisher 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.

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ThermoFisher 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.