EMISSIONS TEST REPORT

PCC STRUCTURALS, INC.

HEAT TREAT FURNACE #23 ENGINEERING TESTS

Prepared for:

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STACK TESTING ACCREDITATION COUNCIL
ACCREDITED TO ASTM D7036 ONLY CERT #4675.01

BISON ENGINEERING, INC.

PCCLP001011

EXECUTIVE SUMMARY

Stoel Rives LLP contracted Bison Engineering, Inc. to perform emissions testing at PCC Structurals, Inc.'s metal parts fabrication facility in Portland, Oregon. Testing was performed on the Heat Treat Furnace #23 to provide information to Stoel Rives LLP in support of legal counsel to PCC Structurals, Inc. This report presents emissions test data, describes the methods employed and details the quality assurance measures taken to ensure accurate data. Table 1 summarizes the test results.

Table 1: Results Summary

PCC Structurals, Inc. Heat Treat Furnace #23 Engineering Test Summary March 11, 2020			
Source	**Parameter**	**Units**	**Test Result**
Quick Draft Fan Inlet	Filterable PM	µg/dscm	115.95
		lb/ton metal	4.77E-03
	TSM	µg/dscm	< 36.00
		lb/ton metal	< 1.48E-03
	Hg	µg/dscm	1.55E-02
		lb/ton metal	6.39E-07
Discharge Stack Outlet	Filterable PM	µg/dscm	89.88
		lb/ton metal	1.20E-02
	TSM	µg/dscm	< 25.63
		lb/ton metal	< 3.42E-03
	Hg	µg/dscm	4.05E-03
		lb/ton metal	5.42E-07

PM – particulate matter
TSM – total selected metals
Hg – mercury
µg/dscm – micrograms per dry standard cubic meter
lb/ton metal – pounds per ton of metal processed

Note: The symbol '<' indicates results which were calculated using the minimum detection limit for front half or back half results that were non-detect. For TSM results, '<' indicates that that one or more values included in the sum was calculated using the minimum detection limit.

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REVIEW AND CERTIFICATION

All work, calculations, other activities, and tasks performed and documented in this report were carried out under my direction and supervision. This test project conforms to the requirements of Bison Engineering, Inc.'s quality manual and American Society for Testing and Materials (ASTM) D7036-04.

Project Manager: Kelly Dorsi, PhD

Title: Atmospheric Scientist

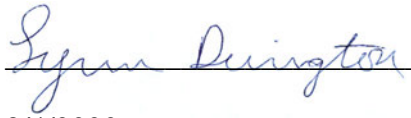
Signature: 

Date: 8/4/2020

I have reviewed all testing details, calculations, results, conclusions, and other appropriate written material contained herein, and hereby certify that the presented material is authentic and accurate.

Reviewer: Lynn Dunnington

Title: Environmental Analyst

Signature: 

Date: 8/4/2020

1.0 INTRODUCTION

1.1 Project Summary and Objectives

Stoel Rives LLP (Stoel), representative for PCC Structurals, Inc. (PCC) retained Bison Engineering, Inc. (Bison) to perform emissions testing on the Heat Treat Furnace #23 at PCC's facility in Portland, Oregon. Bison conducted testing under the direction of Stoel following test methods described by the Oregon Department of Environmental Quality (ODEQ) and the U.S. Environmental Protection Agency (EPA) in Title 40 Code of Federal Regulations (CFR) Part 60, Appendix A. Testing was conducted on the Furnace #23 discharge stack outlet and the inlet to the quick draw fan. The pollutants measured include filterable PM, Hg and TSM including aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, phosphorus, selenium, silver, thallium, vanadium, and zinc. Table 2 summarizes the test methods used during the test campaign.

Table 2: Project Matrix

PCC Structurals, Inc. Heat Treat Furnace #23 Engineering Test Matrix March 11, 2020			
Source	**EPA Method**	**Parameter**	**Test Plan and Comments**
Quick Draft Fan Inlet and Discharge Stack Outlet	1	Sampling Location / Traverse Points	One measurement per source prior to sampling.
	2	Volumetric Flow	Concurrent with Method 29 sampling. An assumed ambient molecular weight of 29 g/mol was used for flow calculations.
	4	Moisture	Concurrent with Method 29.
	29	Filterable PM, TSM	One 9-hour run.
	30B	Hg	Sorbent traps for mercury analysis were run concurrent with Method 29 sampling.

1.2 Project Contacts

Facility:	**PCC Structurals, Inc.**
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Contact:	Thomas Wood
Phone:	Office (503) 294-9396
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Consultant:	**Bison Engineering, Inc.**
Address:	3143 E. Lyndale Ave. Helena, MT 59601
Contact:	Kelly Dorsi
Phone:	Office (406) 442-5768
Email:	kdorsi@bison-eng.com

1.3 Testing Personnel

The Bison on-site testing team was led by Zach Harding, Qualified Source Testing Individual (QSTI), Project Scientist. He was assisted during field testing by Adam Bender, Qualified Individual (QI), Project Scientist and Jacob Rankin, QI, Environmental Engineer. Kelly Dorsi, PhD, Atmospheric Scientist, served as project manager. Lynn Dunnington, Environmental Analyst, performed a final quality assurance review of the data and test report.

Sherry Uchytil, Environmental Specialist, was the primary contact for PCC. Ms. Uchytil was present on-site for the duration of the testing. PCC staff members were responsible for monitoring process parameters during testing.

2.0 SOURCE DESCRIPTION

2.1 Facility Description

PCC owns and operates a metal parts casting foundry in Portland, Oregon. The facility makes custom metal alloy components for aerospace, energy and commercial applications. The Heat Treat Furnace #23 is located on PCC's Large Parts Campus (LPC), which consists of two business units: the super alloy casting plant (LPC-S) and the titanium casting plant (LPC-T).

Furnace #23 burns natural gas to heat cast metal parts to 2300 °F in an argon shielded atmosphere. The furnace body is insulated with ceramic and kaowool liners. Exhaust air exits the furnace through two pipes. The exhaust from these pipes is captured by a domed hood and vented out through the rooftop discharge stack via a quick draft fan and venturi. During the venting process, both room and outside air from the rooftop is entrained into the oven exhaust to cool it.

Inside Furnace #23, a cast metal part is placed on a metal hearth. A metal retort can is lowered over the part for the purpose of maintaining an argon atmosphere around the part. If argon gas escapes the retort, it is typically vented into the room. For the purposes of this test campaign, a temporary line was installed to release any argon into the domed fume hood to allow for the measurement of all PM, TSM and Hg emissions from the furnace.

2.2 Emission Source Description

Emissions were sampled at two locations: the Furnace #23 discharge stack and the inlet to the quick draft fan. The discharge stack is a vertical stack on the building rooftop. It is approximately 10 feet tall and 20.0 inches inner diameter. The stack has two purpose-built sampling ports that are approximately six feet above the rooftop. Method 29 sampling was conducted through one port for the entire nine-hour run, while Method 30B sampling utilized the other port for the duration of the run. This was done to achieve an uninterrupted test run that coincided with a single batch heating cycle.

PCC installed a piece of temporary horizontal ducting to the inlet of the quick draft fan to facilitate testing. The inlet duct was approximately five feet long and 10.0 inches inner diameter, with two sampling ports. As with the discharge stack, each port was dedicated to a single sample train for the duration of the test run.

Figures 1 and 2 (below) present photos of the sampling locations on the day of the test. While on-site, Bison verified that the discharge stack and inlet duct meet EPA Method 1 specifications; detailed Method 1 information is included in the appendices to this report.

Figure 1. Discharge Stack Photo

Figure 2. Quick Draft Fan Inlet Duct Photo

3.0 EMISSION TEST RESULTS

3.1 Summary of Results

Bison performed emissions testing on the Heat Treat Furnace #23 during one, nine-hour batch heating cycle. Sampling for each method, at each location, ran continuously for the duration of the heating cycle. The tables on the following pages summarize the test results. Additional supporting material, including raw data, plant data, example calculations and calibration records, can be found in the appendices to this report.

Table 3: Outlet Test Results

PCC Structurals, Inc. Heat Treat Furnace #23 Discharge Stack Outlet Engineering Test Results March 11, 2020		
Parameter	**Units**	**Run Results**
Run Start Time		12:46
Run End Time		21:50
Run Duration	min	544
Isokinetic Rate	%	100.3
Stack Moisture	% v/v	1.27
Stack Temperature	°F	183.9
Sample Volume	dscf	275.283
	dscm	7.795
Stack Flow Rate	dscfm	2,065.8
Filterable PM	gr/dscf	3.93E-05
	µg/dscm	89.88
	lb/ton metal	1.20E-02
Hg	µg/dscm	4.05E-03
	lb/ton metal	5.42E-07
Aluminum	µg/dscm	16.997
	lb/ton metal	2.27E-03
Antimony	µg/dscm	< 0.280
	lb/ton metal	< 3.73E-05
Arsenic	µg/dscm	< 0.314
	lb/ton metal	< 4.19E-05
Barium	µg/dscm	0.086
	lb/ton metal	1.14E-05
Beryllium	µg/dscm	< 0.009
	lb/ton metal	< 1.20E-06
Cadmium	µg/dscm	< 0.067
	lb/ton metal	< 8.936E-06
Chromium	µg/dscm	2.123
	lb/ton metal	2.83E-04
Cobalt	µg/dscm	< 0.094
	lb/ton metal	< 1.25E-05
Copper	µg/dscm	0.830
	lb/ton metal	1.11E-04

(table continues on next page)

min – minutes
% v/v – percent volume per volume
dscf – dry standard cubic feet
dscm – dry standard cubic meters
dscfm – dry standard cubic feet per minute
gr/dscf – grains per dry standard cubic foot

Table 3: Outlet Test Results (continued)

Parameter	Units	Run Results
Lead	µg/dscm	< 0.963
	lb/ton metal	< 1.28E-04
Manganese	µg/dscm	0.411
	lb/ton metal	5.48E-05
Nickel	µg/dscm	0.488
	lb/ton metal	6.51E-05
Phosphorus	µg/dscm	< 0.898
	lb/ton metal	< 1.20E-04
Selenium	µg/dscm	< 0.192
	lb/ton metal	< 2.57E-05
Silver	µg/dscm	< 0.090
	lb/ton metal	< 1.20E-05
Thallium	µg/dscm	< 0.449
	lb/ton metal	< 5.99E-05
Vanadium	µg/dscm	< 0.056
	lb/ton metal	< 7.43E-06
Zinc	µg/dscm	1.282
	lb/ton metal	1.71E-04
TSM*	**µg/dscm**	**< 25.63**
	lb/ton metal	**< 3.42E-03**

*TSM results are the sum of results for all metal analytes, excluding mercury. For TSM results, '<' indicates that that one or more values included in the sum was calculated using the minimum detection limit.

Table 4: Inlet Test Results

PCC Structurals, Inc. Heat Treat Furnace #23 Quick Draft Fan Inlet Engineering Test Results March 11, 2020		
Parameter	**Units**	**Run Results**
Run Start Time		12:46
Run End Time		21:50
Run Duration	min	544
Isokinetic Rate	%	98.4
Stack Moisture	% v/v	0.69
Stack Temperature	°F	56.0
Sample Volume	dscf	510.292
	dscm	14.450
Stack Flow Rate	dscfm	637.2
Filterable PM	gr/dscf	5.07E-05
	µg/dscm	115.95
	lb/ton metal	4.77E-03
Hg	µg/dscm	1.55E-02
	lb/ton metal	6.39E-07
Aluminum	µg/dscm	10.659
	lb/ton metal	4.39E-04
Antimony	µg/dscm	< 0.199
	lb/ton metal	< 8.20E-06
Arsenic	µg/dscm	< 0.222
	lb/ton metal	< 9.14E-06
Barium	µg/dscm	0.364
	lb/ton metal	1.50E-05
Beryllium	µg/dscm	< 0.005
	lb/ton metal	< 1.99E-07
Cadmium	µg/dscm	< 0.012
	lb/ton metal	< 4.84E-07
Chromium	µg/dscm	0.233
	lb/ton metal	9.59E-06
Cobalt	µg/dscm	< 0.459
	lb/ton metal	< 1.89E-05
Copper	µg/dscm	0.523
	lb/ton metal	2.15E-05
Lead	µg/dscm	< 0.214
	lb/ton metal	< 8.80E-06
Manganese	µg/dscm	0.596
	lb/ton metal	2.45E-05

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Table 4: Inlet Test Results (continued)

Parameter	Units	Run Results
Nickel	µg/dscm	0.666
	lb/ton metal	2.74E-05
Phosphorus	µg/dscm	< 14.948
	lb/ton metal	< 6.15E-04
Selenium	µg/dscm	< 0.398
	lb/ton metal	< 1.60E-05
Silver	µg/dscm	< 0.048
	lb/ton metal	< 1.99E-06
Thallium	µg/dscm	< 0.242
	lb/ton metal	< 9.96E-06
Vanadium	µg/dscm	< 0.026
	lb/ton metal	< 1.05E-06
Zinc	µg/dscm	6.197
	lb/ton metal	2.55E-04
TSM*	**µg/dscm**	**< 36.00**
	lb/ton metal	**< 1.48E-03**

*TSM results are the sum of results for all metal analytes, excluding mercury. For TSM results, '<' indicates that that one or more values included in the sum was calculated using the minimum detection limit.

3.2 Operating Conditions

The Heat Treat Furnace #23 operated normally without pause for the duration of the nine-hour test run. Representatives of PCC recorded details of furnace operations during testing. The quantity of natural gas burned during testing was not recorded. PCC personnel compiled the raw process data and provided it to Bison for use in this report. Process data is presented in the report appendices.

3.3 Field Observations

No adverse or unusual environmental conditions were noted that are known to have influenced the outcome of these tests. Testing was not paused or interrupted during the nine-hour batch heating cycle.

The metals emissions results reported in Tables 3 and 4 and the appendices to this report were calculated per EPA Method 29 specifications. Method 29 limits the mass of each metal in a sample blank that can be subtracted from the sample results in the blank correction calculations. In the case of aluminum, the amount detected in the filter blank and capture solution blank comprised a significant fraction of the total aluminum found in the field samples. Both were significantly higher than the Method 29 allowable blank weights. Method 29 results for aluminum are therefore biased high due to the allowable blank correction. Table 5 illustrates the differences in calculating net aluminum emissions using Method 29 allowable blank values versus the actual measured mass of aluminum in the sample blanks. Bison believes that the results shown in Table 5 are much more representative of actual aluminum emissions and recommends that this approach be used for any future Method 29 compliance testing that is conducted for aluminum.

Table 5: Alternative Blank-Corrected Aluminum Emissions

PCC Structurals, Inc. Heat Treat Furnace #23 Comparison of Aluminum Blank Correction Calculations March 11, 2020										
Source	Blanks Description	(A) FH Sample	(B) FH Blank	(C) FH Net (A-B)	(D) BH Sample	(E) BH Blank	(F) BH Net (D-E)	**FH+BH Net (C+F)**		
								µg	**µg/dscm**	**lb/ton metal**
Inlet	Allowable	123	11.63	111.37	44.9	2.245	42.655	**154.03**	**10.659**	**4.39E-04**
	Actual		102	21		9.32	35.58	**56.58**	**3.916**	**1.61E-04**
Outlet	Allowable	118	11.63	106.37	27.5	1.375	26.125	**132.50**	**16.997**	**2.27E-03**
	Actual		102	16		9.32	18.18	**34.18**	**4.385**	**5.85E-04**

Notes:
All weights are in µg unless otherwise noted.
Actual – actual weight of Al determined in blank analysis
Allowable – maximum Al blank weight as allowed by Method 29
FH – front half (Method 29 only)
BH – back half (Method 29 only)

Bison also notes that breakthrough and field recovery test criteria were not met for Method 30B sampling at the quick draft fan inlet. Failed breakthrough and field recovery checks are often observed for sources with very low mercury concentrations and may be related to mercury contamination in the back half of the sample sorbent tube or reduced precision of low concentration spiked traps. Bison recommends that future compliance testing consist of at least three sample runs to improve the chances of meeting breakthrough and field recovery results for all sources sampled.

4.0 EMISSION TEST METHODS AND PROCEDURES

4.1 Testing Methods and Procedures

Bison testing personnel performed the following EPA methods as described in 40 CFR 60, Appendix A.

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 results of Method 1 sampling location and sample or velocity point measurement locations are included in the appendices.

EPA Reference Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube)." The objective of Method 2 is to determine volumetric flow. The average velocity, temperature, static pressure, and source area are used to calculate volumetric flow for the source. This method is incorporated within the performance of Method 29. Method 2, Section 8.6 allows for the use of 29 g/mol as dry molecular weight for ambient sources, in lieu of performing actual measurements.

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. This method is incorporated within the performance of Method 29.

EPA Reference Method 29, "Determination of Metals Emissions from Stationary Sources" (Methods 2 & 4 Inclusive). The objective of Method 29 is to determine particulate matter and metals emissions from a source. Method 29 is an isokinetic sampling method. The exhaust gas stream is sampled along a cross-section of the stack and metal emissions are captured within the front half and back half of the sampling system. The front half includes the nozzle, probe, filter-bell, and glass fiber filter. The back half consists of the impinger solutions. The front half and back half samples are sent to a subcontracted lab for analysis. Filterable particulate matter concentrations are derived from analyses of the front half samples only. Both front and back half samples are analyzed for metals. Method 29 incorporates Method 2 “velocity measurements” and Method 4 “moisture measurements”.

EPA Reference Method 30B, “Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources using Carbon Sorbent Traps.” The objective of M30B is to determine elemental mercury and oxidized mercury emission from a source.

4.2 Sample Handling and Analytical Procedures

Field sample recoveries were performed by Bison personnel on-site. Method 29 filters and liquid fractions were hand-delivered by Bison to Chester LabNet in Tigard, Oregon, for analysis for TSM and filterable PM. Method 30B sorbent traps were sent by Bison to Ohio Lumex in Cleveland, Ohio for analysis on their low-level mercury analyzer. All analytical procedures complied with EPA methodology.

APPENDIX A: OUTLET TEST DATA

BISON ENGINEERING, INC.

COMPANY	**PCC**
FACILITY	**LPCS**
LOCATION	**Portland, OR**
SOURCE	**Furnace #23 Outlet**
DATE	**03/11/20**
METHOD	**29**
POLLUTANT	**PM and TSM**

EPA Method 1
Stack Parameters and Traverse Points

Client: PCC
Location: Portland, OR
Source: Furnace #23 Outlet
Facility: LPCS

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: 3.5 inches

Circular ID (Rectangular Depth): 20.00 inches
Port depth and/or wall thickness: inches
Stack width (Rectangular only): inches

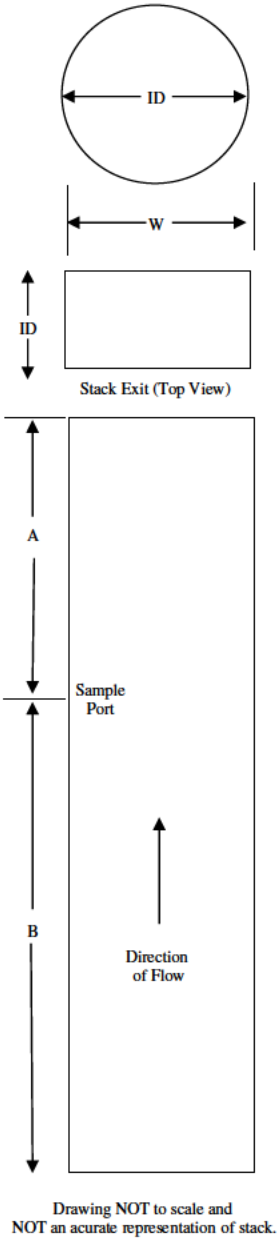
Equivalent Diameter
If rectangluar = $\frac{2*Depth*Width}{Depth + Width}$ = 20.00 inches (If circular = duct ID)
Stack/duct area = 2.182 sq.feet 314.2 sq.inches

Sample Port Location:	Downstream from flow disturbance from process B	Upstream from flow disturbance toward exit A
Number of Inches:	42.50	37.00
Number of Diameters:	2.13	1.85

Minimum Number of Traverse Points: 24

Points	% of diameter	Distance from inside wall (in.)	Distance including port (in.)
1	2.1	0.50	0 1/2
2	6.7	1.34	1 3/8
3	11.8	2.36	2 3/8
4	17.7	3.54	3 1/2
5	25.0	5.00	5
6	35.6	7.12	7 1/8
7	64.4	12.88	12 7/8
8	75.0	15.00	15
9	82.3	16.46	16 1/2
10	88.2	17.64	17 5/8
11	93.3	18.66	18 5/8
12	97.9	19.50	19 1/2

Reference Diagram



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

* One port was dedicated exclusively to Method 29 isokinetic sampling, while the other was dedicated to Method 30B sampling.

Pre Traverse Flow Information

Client: PCC
Location: Portland, OR
Source: Furnace #23 Outlet

Stack Temp: 100

Traverse Point	Velocity ΔP ("H_2O)	Null Angle
1	0.17	5.0
2	0.21	8.0
3	0.32	11.0
4	0.32	6.0
5	0.36	5.0
6	0.43	4.0
7	0.20	0.0
8	0.15	0.0
9	0.13	0.0
10	0.09	4.0
11	0.06	5.0
12	0.06	5.0
13	0.04	5.0
14	0.05	0.0
15	0.05	0.0
16	0.05	0.0
17	0.10	0.0
18	0.23	0.0
19	0.40	4.0
20	0.34	6.0
21	0.26	5.0
22	0.24	0.0
23	0.16	0.0
24	0.17	0.0
Average:	0.19	3.0

Flow is found to be:

Non-cyclonic	x
Cyclonic	

Isokinetic Field Data
Field Data Entry

Client:	**PCC**			**Run:**	**1**
Location:	**Portland, OR**			**Start Time:**	**12:46**
Source:	**Furnace #23 Outlet**	**Environmental Conditions/Test Notes:**		**End Time:**	**21:50**
EPA Method:	**29**	55 deg f cloudy calm		**Date:**	**3/11/2020**
Box Operator:	**AB**				
Technician(s):	**AB**				

Stack Dimensional Data:

Circular		
Diameter	20.000	in
Rectangular		
Width		in
Length		in
Stack Area	2.182	sq.ft.

Equipment:

Meterbox ID	12	Probe ID	3C	Liner type	glass		
Y factor	1.0003	Nozzle ID	0.313	Nozzle size	0.3127	inches	
ΔH@	1.93	Hot box ID	hb2	Nozzle area	0.000533	sq.ft.	
		Pitot Cp	0.84	Probe heat	250	F	
		Pitot ID	3c	Filter heat	250	F	

Source Information:

Barometric Pressure	30.05	"Hg	O_2	20.90	%
Static Pressure	-0.08	"H_2O	CO_2	0.00	%
Ave. ΔP	0.191	"H_2O	Rec. Nz.	0.316	inches
Stack Temperature	100	F			
Assumed moisture	2	%			
Assumed meter temp.	60	F			
Total number of points	24				
Time per point*	25	min			
Total run time	544	min			

*In order to correlate sampling with the batch heating cycle length, sampling time at point 22 was truncated and no sampling was conducted at points 23 and 24.

Leak Checks:

	Pre-test	Post-test
Pitot	x	x
Train leak rate, dcf	0.000	0.000
Leak check vacuum, "Hg	11	13

Nozzle check for roundness:

1	2	3	
0.313	0.312	0.313	inches
	Caliper ID#	ws1	

Post Test Calculations:

Sample volume	271.715	dcf	Ave. ΔP	0.1	"H_2O
Wet mol. weight	28.7	M_s (actual)	Ave. √ΔP	0.3128	"H_2O
Actual H_2O	1.27	%	Ave. ΔH	0.882	"H_2O
Std. meter vol.	275.283	dscf	Ave. T_s	183.9	°F
Isokinetic Average	100.3	%	Ave. T_m	64.5	°F

Moisture/Lab:

Filter	U783 #		
	Initial	Final	Gain
Impingers, g	200.0	230	30.0
Silica gel, g	466.7	511.8	45.1
		Total water gain:	75.1

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	25.0	11.500	0.07	113	56	0.69	0.69	1.5	255	50
2	50.0	23.130	0.08	153	60	0.74	0.74	1.5	250	52
3	75.0	34.110	0.07	168	63	0.64	0.64	1.5	253	58
4	100.0	45.600	0.08	172	65	0.73	0.73	1.5	251	50
5	125.0	55.900	0.06	158	70	0.56	0.56	1.5	253	53
6	150.0	66.150	0.06	169	72	0.55	0.55	1.5	249	54
7	175.0	77.680	0.08	174	71	0.73	0.73	2	251	55
8	200.0	88.800	0.07	167	74	0.65	0.65	1.5	254	55
9	225.0	101.750	0.10	169	74	0.93	0.93	2	251	54
10	250.0	114.960	0.10	139	73	0.97	0.97	2	251	55
11	275.0	128.300	0.10	175	73	0.92	0.92	1.5	256	56
12	300.0	139.720	0.08	173	71	0.73	0.73	1.5	255	54
13	325.0	152.810	0.11	210	68	0.95	0.95	2	253	54
14	350.0	165.930	0.11	210	67	0.95	0.95	2	252	54
15	375.0	179.670	0.13	226	65	1.09	1.09	2	254	54
16	400.0	193.640	0.13	223	61	1.08	1.08	2	255	52
17	425.0	206.980	0.12	213	59	1.01	1.01	2	251	51
18	450.0	219.700	0.11	205	57	0.93	0.93	2	252	50
19	475.0	233.200	0.13	210	56	1.09	1.09	2	251	50
20	500.0	247.470	0.14	205	55	1.18	1.18	2	248	50
21	525.0	261.770	0.14	207	54	1.18	1.18	2	251	51
22	544.0	271.715	0.12	206	54	1.01	1.10	2	250	53
23										
24										

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

Client:	**PCC**	**Run:**	**1**
Location:	**Portland, OR**	**Start Time:**	**12:46**
Source:	**Furnace #23 Outlet**	**End Time:**	**21:50**
Method:	**29**	**Date:**	**3/11/2020**

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						
25	11.500	0.69	56	1	0.07	113	0.2646
50	23.130	0.74	60	2	0.08	153	0.2828
75	34.110	0.64	63	3	0.07	168	0.2646
100	45.600	0.73	65	4	0.08	172	0.2828
125	55.900	0.56	70	5	0.06	158	0.2449
150	66.150	0.55	72	6	0.06	169	0.2449
175	77.680	0.73	71	7	0.08	174	0.2828
200	88.800	0.65	74	8	0.07	167	0.2646
225	101.750	0.93	74	9	0.10	169	0.3162
250	114.960	0.97	73	10	0.10	139	0.3162
275	128.300	0.92	73	11	0.10	175	0.3162
300	139.720	0.73	71	12	0.08	173	0.2828
325	152.810	0.95	68	13	0.11	210	0.3317
350	165.930	0.95	67	14	0.11	210	0.3317
375	179.670	1.09	65	15	0.13	226	0.3606
400	193.640	1.08	61	16	0.13	223	0.3606
425	206.980	1.01	59	17	0.12	213	0.3464
450	219.700	0.93	57	18	0.11	205	0.3317
475	233.200	1.09	56	19	0.13	210	0.3606
500	247.470	1.18	55	20	0.14	205	0.3742
525	261.770	1.18	54	21	0.14	207	0.3742
544	271.715	1.10	54	22	0.12	206	0.3464

Note: In order to correlate sampling with the batch heating cycle, sampling time at point 22 was truncated and no sampling was conducted at points 23 and 24.

Client:	**PCC**	**Run:**	**1**
Source:	**Furnace #23 Outlet**	**Date:**	**03/11/20**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	544.0	min	Circular		
Sample Time Interval	25.0	min	Diameter	20.000	in
Meter Volume, V_m	271.715	dcf	Rectangular		
Water Volume	75.1	ml (g)	Width		in
Nozzle Diameter, N_z	0.3127	in.	Length		in
Nozzle Area	0.000533	sq.ft.	Stack Area	2.182	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	30.05	"Hg	CO_2 Average	0.00	%vd
Static Pressure	-0.08	"H_2O	O_2 Average	20.90	%vd
Pitot Factor, cp	0.84				
Meter Cal Factor	1.0003	Y			

Field Data Averages

Meter			Stack		
ΔH	0.882	"H_2O	√Dp	0.3128	"H_2O
Temperature, T_m	64.5	^oF	Temperature, T_s	183.9	^oF
Temperature, T_m	524.5	^oA (^oR)	Temperature, T_s	643.9	^oA (R)
Pressure Meter, P_m	30.115	"Hg	Pressure Stack, P_s	30.044	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	275.283	dscf	Velocity, V_s	19.41	fps
	7.795	dscm	Volume (actual)	2,541.2	acfm
Actual Volume, $V_{m(actual)}$	338.760	awcf		2,508.9	adcfm
Gas Stream Moisture			Volume (standard)	125,543.6	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.534	scf		123,949.2	dscf/hr
Moisture, B_{ws}	0.0127			2,065.8	dscf/min
Moisture EPA M4	1.27	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.84	lb/lb-mole			
Wet, M_s	28.70	lb/lb-mole			
Percent Isokinetic	100.3	%			

Laboratory Results

EPA Method 29 (PM)

Filterable PM	0.00070	grams	Concentration, C_s	3.93E-05	gr/dscf
				89.88	µg/dscm

EPA Method 29 (PM)
Filterable Particulate Matter
Laboratory Gravimetric Data

Client: **PCC**
Location: **Portland, OR**
Source: **Furnace #23 Outlet**

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction	Corrected Gain (grams)
1	Probe Rinse (Acetone FH)	113	99.91507	99.91588	0.00081	1.09E-04	**0.00070**
	Filter	19-U783	0.45123	0.45033	-0.00090		**0.00000**
						Filterable PM (mg)	**0.70**
						Total PM (mg)	**0.70**
	Acetone Blank	465	50.20240	50.20285	0.00045	9.68E-07	g/g

Source:		**Furnace #23 Outlet**			**Sample Date:**		**03/11/20**
Run:		**1**					
Client ID:		**Filter + Front Half**		**Back Half**			
Analyte	**<**	**Result**	**<**	**Result**	**FH MDL**	**BH MDL**	**Units**
Aluminum		118		27.5	3.75	1.50	µg/sample
Antimony		1.68	<	MDL	1.25	0.500	µg/sample
Arsenic	<	MDL	<	MDL	1.75	0.700	µg/sample
Barium		4.52		0.608	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	<	MDL		0.422	0.100	0.040	µg/sample
Chromium		18.0		0.484	0.200	0.080	µg/sample
Cobalt	<	MDL		0.732	0.125	0.050	µg/sample
Copper		1.39		5.08	1.25	0.500	µg/sample
Lead	<	MDL		6.26	1.25	0.500	µg/sample
Manganese		2.76		0.582	0.075	0.030	µg/sample
Nickel		3.36		0.442	0.750	0.300	µg/sample
Phosphorus	<	MDL	<	MDL	5.00	2.00	µg/sample
Selenium	<	MDL	<	MDL	3.75	1.50	µg/sample
Silver	<	MDL	<	MDL	0.500	0.200	µg/sample
Thallium	<	MDL	<	MDL	2.50	1.00	µg/sample
Vanadium		0.334	<	MDL	0.250	0.100	µg/sample
Zinc		6.84		6.93	0.750	0.300	µg/sample
Lab ID:		20-S353		20-S354			
Sample Vol:		250		100			mL

Source: Furnace #23 Outlet

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
Aluminum		102	3.75		11.65	3.75	<	MDL	1.50
Antimony	<	MDL	1.250	<	MDL	1.25	<	MDL	0.50
Arsenic	<	MDL	1.750	<	MDL	1.75	<	MDL	0.70
Barium		4.460	0.125	<	MDL	0.13	<	MDL	0.05
Beryllium	<	MDL	0.050	<	MDL	0.05	<	MDL	0.02
Cadmium	<	MDL	0.100	<	MDL	0.10	<	MDL	0.04
Chromium		1.650	0.200		0.3525	0.20	<	MDL	0.08
Cobalt		0.374	0.125	<	MDL	0.13	<	MDL	0.05
Copper	<	MDL	1.250	<	MDL	1.25	<	MDL	0.50
Lead	<	MDL	1.250	<	MDL	1.25	<	MDL	0.50
Manganese		0.075	70.200		0.0778	0.08	<	MDL	0.03
Nickel	<	MDL	0.750	<	MDL	0.75	<	MDL	0.30
Phosphorus	<	MDL	5.000	<	MDL	5.00	<	MDL	2.00
Selenium		4.530	3.750	<	MDL	3.75	<	MDL	1.50
Silver	<	MDL	0.500	<	MDL	0.50	<	MDL	0.20
Thallium	<	MDL	2.500	<	MDL	2.50	<	MDL	1.00
Vanadium	<	MDL	0.250	<	MDL	0.25	<	MDL	0.10
Zinc		3.780	0.750	<	MDL	0.75	<	MDL	0.30
Lab ID:		20-S680			EPA 29 Back Half			EPA 29 Front Half	
Sample Vol, ml:		250			250			100	

PCC **Method 29 Metals Blank Calculations** **Run: 1**

Furnace #23 Outlet

03/11/20		**I**		**II**		**III**		**IV**		**V**		**VI**		**VII**	**VIII**	
		Sample* FH		**Blank* FH**		**Blank* FH**		**Sample* BH**		**Blank* BH**		**BH Blank* Corrected**		**BH Blank* Corrected**	**Allowable 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**		
Al		118.000	<	1.5000		102.000		27.500		0.0466		9.320	<	1.5000	9.320	**Aluminum**
Sb		1.680	<	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		4.520	<	0.0500		4.460		0.608	<	0.0005	<	0.100	<	0.0500	0.000	**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		0.422	<	0.0004	<	0.080	<	0.0400	0.000	**Cadmium**
Cr		18.000	<	0.0800		1.650		0.484		0.0014		0.282	<	0.0800	0.282	**Chromium**
Co	<	0.125	<	0.0500		0.374		0.732	<	0.0005	<	0.100	<	0.0500	0.000	**Cobalt**
Cu		1.390	<	0.5000	<	1.250		5.080	<	0.0050	<	1.000	<	0.5000	0.000	**Copper**
Pb	<	1.250	<	0.5000	<	1.250		6.260	<	0.0050	<	1.000	<	0.5000	0.000	**Lead**
Mn		2.760	<	0.0300		0.075		0.582		0.0003		0.062	<	0.0300	0.062	**Manganese**
Ni		3.360	<	0.3000	<	0.750		0.442	<	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		4.530	<	1.500	<	0.0150	<	3.000	<	1.5000	0.000	**Selenium**
Ag	<	0.500	<	0.2000	<	0.500	<	0.200	<	0.0020	<	0.400	<	0.2000	0.000	**Silver**
Tl	<	2.500	<	1.0000	<	2.500	<	1.000	<	0.0100	<	2.000	<	1.0000	0.000	**Thallium**
V		0.334	<	0.1000	<	0.250	<	0.100	<	0.0010	<	0.200	<	0.1000	0.000	**Vanadium**
Zn		6.840	<	0.3000		3.780		6.930	<	0.0030	<	0.600	<	0.3000	0.000	**Zinc**

		EPA 29 Front			**EPA 29 Back**		
Lab ID:	**20-S353**	**Half**	**20-S680**	**20-S354**	**Half**		
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

3/11/20

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
Al	11.630	102.000		5.900	5.900	11.63		106.370	**Aluminum**
Sb	0.000	0.000		0.084	0.000	11.63		1.680	**Antimony**
As	0.000	0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	4.460	4.460		0.226	0.226	11.63		0.060	**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	1.650	1.650		0.900	0.900	11.63		16.350	**Chromium**
Co	0.374	0.374	<	0.006	0.006	11.63	<	-0.249	**Cobalt**
Cu	0.000	0.000		0.070	0.000	11.63		1.390	**Copper**
Pb	0.000	0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.075	0.075		0.138	0.075	11.63		2.685	**Manganese**
Ni	0.000	0.000		0.168	0.000	11.63		3.360	**Nickel**
P	0.000	0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	4.530	4.530	<	0.188	0.188	11.63	<	-0.780	**Selenium**
Ag	0.000	0.000	<	0.025	0.000	11.63	<	0.500	**Silver**
Tl	0.000	0.000	<	0.125	0.000	11.63	<	2.500	**Thallium**
V	0.000	0.000		0.017	0.000	11.63		0.334	**Vanadium**
Zn	3.780	3.780		0.342	0.342	11.63		3.060	**Zinc**

Allowable FH Blank Calculation:
A = (area of filter, sq. in.)*(1.4 µg/sq.in.)= μg A= 11.63 μg
if A>blank>0, use blank derived
if blank > A, use greater of A or 5% of sample µg or FH blank whichever is lessor.

*** Blank Rules:**
"<" indicates value is below the minimum detection limit (MDL)
If Blank is a "<" value it is treated as zero.
If Sample is a "<" it used for emission rate calculations but the final answer contains a "<" to demonstrate the value is unknown

Species	XVI Allowable BH Blank, μg	XVII Blank BH Total		XVIII 5% of BH sample, μg	XIX Lessor of XVII or XVIII	XX Greater of 1μg or XIX		XXI BH Net Sample, μg		XXII FH Net Sample, μg		XXIII FH+BH Total Net Sample, μg	Species
Al	1.375	9.320		1.375	1.375	1.375		**26.125**		**106.370**		**132.495**	**Aluminum**
Sb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**		**1.680**	<	**2.180**	**Antimony**
As	0.000	0.000	<	0.035	0.000	1.000	<	**0.700**	<	**1.750**	<	**2.450**	**Arsenic**
Ba	0.000	0.000		0.030	0.000	1.000		**0.608**		**0.060**		**0.668**	**Barium**
Be	0.000	0.000	<	0.001	0.000	1.000	<	**0.020**	<	**0.050**	<	**0.070**	**Beryllium**
Cd	0.000	0.000		0.021	0.000	1.000		**0.422**	<	**0.100**	<	**0.522**	**Cadmium**
Cr	0.282	0.282		0.024	0.024	1.000		**0.202**		**16.350**		**16.552**	**Chromium**
Co	0.000	0.000		0.037	0.000	1.000		**0.732**	<	**0.000**	<	**0.732**	**Cobalt**
Cu	0.000	0.000		0.254	0.000	1.000		**5.080**		**1.390**		**6.470**	**Copper**
Pb	0.000	0.000		0.313	0.000	1.000		**6.260**	<	**1.250**	<	**7.510**	**Lead**
Mn	0.062	0.062		0.029	0.029	1.000		**0.520**		**2.685**		**3.205**	**Manganese**
Ni	0.000	0.000		0.022	0.000	1.000		**0.442**		**3.360**		**3.802**	**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**	<	**0.000**	<	**1.500**	**Selenium**
Ag	0.000	0.000	<	0.010	0.000	1.000	<	**0.200**	<	**0.500**	<	**0.700**	**Silver**
Tl	0.000	0.000	<	0.050	0.000	1.000	<	**1.000**	<	**2.500**	<	**3.500**	**Thallium**
V	0.000	0.000	<	0.005	0.000	1.000	<	**0.100**		**0.334**	<	**0.434**	**Vanadium**
Zn	0.000	0.000		0.347	0.000	1.000		**6.930**		**3.060**		**9.990**	**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

EPA Method 29 (PM)
Filterable Particulate Matter
Results Summary

Client: **PCC**
Source: **Furnace #23 Outlet**
Location: **Portland, OR**

Run			1
Date			3/11/2020
Run Start Time			12:46
Run End Time			21:50
Duration, min.			544
Barometric Pressure, "Hg			30.05
Nozzle Dia., in.			0.3127
Isokinetic Average, %			100.3
Sample Volume, dscf			275.283
Sample Volume, dscm			7.795
Stack Diameter, in.			20.00
Stack Area, sq.ft.			2.182
CO_2 %vd			0.00
O_2 %vd			20.90
Static Press., "H_2O			-0.08
H_2O %v			1.27
Wet Molecular Weight, lb/lb-mole			28.70
Velocity, FPS			19.41
ADCFM			2,508.9
ACFM			2,541.2
DSCFM			2,065.8
Stack Temperature, ^oF			183.9
Filterable Particulate	Concentration, C_s	gr/dscf	3.93E-05
		µg/dscm	89.88
	Mass	lb/ton metal	1.20E-02
Production Data	Metal Processed	ton	0.526

PCC **Test: M29**
Furnace #23 Outlet
Metals Results Summary

Run 1													
	Total				FH Net				BH Net				
Species		**µg**		**µg/dscm**		**lb/ton metal***		**µg**		**µg/dscm**		**lb/ton metal***	
Aluminum		132.495		16.997		2.27E-03		106.370		13.646		1.82E-03	**Al**
Antimony	<	2.180	<	0.280	<	3.73E-05		1.680		0.216		2.87E-05	**Sb**
Arsenic	<	2.450	<	0.314	<	4.19E-05	<	1.750	<	0.225	<	2.99E-05	**As**
Barium		0.668		0.086		1.14E-05		0.060		0.008		1.03E-06	**Ba**
Beryllium	<	0.070	<	0.009	<	1.20E-06	<	0.050	<	0.006	<	8.56E-07	**Be**
Cadmium	<	0.522	<	0.067	<	8.93E-06	<	0.100	<	0.013	<	1.71E-06	**Cd**
Chromium		16.552		2.123		2.83E-04		16.350		2.097		2.80E-04	**Cr**
Cobalt	<	0.732	<	0.094	<	1.25E-05	<	0.000	<	0.000	<	0.00E+00	**Co**
Copper		6.470		0.830		1.11E-04		1.390		0.178		2.38E-05	**Cu**
Lead	<	7.510	<	0.963	<	1.28E-04	<	1.250	<	0.160	<	2.14E-05	**Pb**
Manganese		3.205		0.411		5.48E-05		2.685		0.344		4.59E-05	**Mn**
Nickel		3.802		0.488		6.51E-05		3.360		0.431		5.75E-05	**Ni**
Phosphorus	<	7.000	<	0.898	<	1.20E-04	<	5.000	<	0.641	<	8.56E-05	**P**
Selenium	<	1.500	<	0.192	<	2.57E-05	<	0.000	<	0.000	<	0.00E+00	**Se**
Silver	<	0.700	<	0.090	<	1.20E-05	<	0.500	<	0.064	<	8.56E-06	**Ag**
Thallium	<	3.500	<	0.449	<	5.99E-05	<	2.500	<	0.321	<	4.28E-05	**Tl**
Vanadium	<	0.434	<	0.056	<	7.43E-06		0.334		0.043		5.71E-06	**V**
Zinc		9.990		1.282		1.71E-04		3.060		0.393		5.24E-05	**Zn**
Total:	**<**	**199.78**	**<**	**25.63**	**<**	**3.42E-03**	<	146.44	<	18.79	<	2.51E-03	

Total:	**<**	**199.78**	**<**	**25.63**	**<**	**3.42E-03**	<	146.44	<	18.79	<	2.51E-03	
	<	53.34	<	6.84	<	9.13E-04							

*Total metal processed: 0.526 tons

'<' 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:	**PCC**	**Run:**	**1**
Location:	**Portland, OR**	**Start Time:**	**12:46**
Source:	**Furnace #23 Outlet**	**End Time:**	**21:50**
Method:	**29**	**Date:**	**3/11/2020**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.115 "Hg

where Pb: 30.05 "Hg
ΔH: 0.882 "H_2O

2) $Ps = Pb + (Static\ Press./13.6) =$ 30.044 "Hg

where Pb: 30.05 "Hg
Static Press.: -0.08 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 275.283 dscf

where Vm: 271.715 dcf
Y: 1.0003
Pm: 30.115 "Hg
Tm: 524.5 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 3.534 scf

where H_2O: 75.10 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0127

where Vw(std): 3.534 scf
Vm(std): 275.283 dscf

6) % H_2O = Bws x 100 = 1.27 %v

7) $V_m(actual) = \left(\frac{Y\ x\ Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 338.760 awcf

where Y: 1.0003
Vm: 271.7149 dcf
Bws: 0.0127
Ts: 643.9 °A
Tm: 524.5 °A
Pm: 30.115 "Hg
Ps: 30.044 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.84 lb/lb-mole

where CO_2: 0.00 %vd
O_2 20.90 %vd
N_2+CO= (100-(O_2+CO_2): 79.10 %vd

Client: PCC **Run: 1**
Source: Furnace #23 Outlet **Date: 3/11/2020**

9) $M_s = M_d(1 - Bws) + (18 \times Bws)$ = 28.70 lb/lb-mole
where M_d: 28.84 lb/lb-mole
Bws: 0.0127

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 2.182 sq. ft.
where Stack ID: 20 inches

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

11) Velocity, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right)$ = 19.41 fps
where Cp: 0.84
Ave. Sqrt ΔP: 0.3128
Ts: 643.9 °A
Ps: 30.044 "Hg
Ms: 28.70 lb/lb-mole

12) ACFM = (V_s)(stack area)(60 sec/min) = 2,541.2 ACFM
where V_s: 19.41 ft/sec
Stack Area: 2.182 sq. ft

13) ADCFM = (ACFM)(1-Bws) = 2,508.9 ADCFM
where ACFM: 2,541.2
Bws: 0.0127

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right)$ = 125,543.6 wscf/hr
where V_s: 19.41 ft/sec
Stack Area: 2.1820 sq. ft.
Ts: 643.9 °A
Ps: 30.044 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 123,949.2 dscf/hr
where wscf/hr: 125,543.6
Bws: 0.0127

16) DSCFM= (dscf/hr)/60 mins/hr = 2,065.8 DSCFM
where dscf/hr: 123,949.2

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000533 sq. ft.
where Nozzle Size: 0.3127 inches

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

where Ts:	643.9	°A
Vm(Std):	275.283	dscf
Ps:	30.044	"Hg
Vs	19.41	ft/sec
Nozzle Area:	0.000533	sq. ft.
Sampling Time:	544	min.
Bws:	0.0127	

EPA Method 29:
Chromium

19) Cr Laboratory Results

Front half (FH):	16.350 µg/sample
Back half (BH):	0.202 µg/sample
Total (FH + BH):	16.552 µg/sample

20) Cs = µg/Vm(std) = 2.123 µg/dscm

where Run 1 Total:	16.552	µg/sample
Vm(std):	7.795	dscm

21) Emission Rate = (Cs)($\frac{0.0283168\ m^3}{ft^3}$)(stack flow)(run time)*($\frac{1\ lb}{4.536\ E8\ \mu g}$) /*tons metal*= 2.83E-04 lb/ton metal

where Cs:	2.123	µg/dscm
Stack Flow:	2,065.8	dscf/min
Run time:	544.0	min
Metal processed:	0.526	tons

BISON ENGINEERING, INC.

COMPANY	**PCC**
FACILITY	**LPCS**
LOCATION	**Portland, OR**
SOURCE	**Furnace #23 Outlet**
DATE(S)	**03/11/20**
METHOD	**30B**
POLLUTANT	**Mercury**

Method 30B Field Data
Field Data Entry

Client:	**PCC**	**Run:**	**1**
Location:	**Portland, OR**	**Start Time:**	**12:46**
Source:	**Furnace #23 Outlet**	**End Time:**	**21:51**
EPA Method:	**30B**	**Start Date:**	**3/11/2020**
Box Operator:	**JCR**	**End Date:**	**3/11/2020**
Technician(s):	**JCR**		

Pre-Test Information:

Barometric Pressure:	30.18	"Hg
Test duration:	545	min

Equipment:

Probe ID:	HG1		
Probe heat:	260	F	
	Side A	Side B	
Meterbox ID:	HLN2	HLN2	
Y factor:	1.0090	0.9890	
Desired sampling rate:	1.0	1.0	lpm
Trap ID#:	OL492743	OLC050333	
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	16	16	16
Train leak rate, lpm	0.000	0.000	0.000	0.000

Test Summary:

	Side A	Side B	
Sample Volume:	544.718	545.364	L
Ave. Meter Temp:	72.8	73.7	F

Clock Time (24 hr)	Time (min.)	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
		Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
12:46	0	0.000	0.000	113	113	56	56	0.1	0.1	260	260	1.000	1.000
12:51	5	4.700	4.710	113	113	57	58	0.1	0.1	260	260	0.940	0.942
12:56	10	10.260	10.360	113	113	59	60	0.1	0.1	260	260	1.112	1.130
13:01	15	14.840	14.800	113	113	60	61	0.1	0.1	260	260	0.916	0.888
13:06	20	19.780	19.400	113	113	62	62	0.1	0.1	260	260	0.988	0.920
13:11	25	25.060	25.130	153	153	63	64	0.1	0.1	260	260	1.056	1.146
13:16	30	30.020	30.130	153	153	63	65	0.1	0.1	260	260	0.992	1.000
13:21	35	34.950	35.110	153	153	64	66	0.1	0.1	260	260	0.986	0.996
13:26	40	39.900	40.090	153	153	65	67	0.1	0.1	260	260	0.990	0.996
13:31	45	44.860	45.080	153	153	66	68	0.1	0.1	260	260	0.992	0.998
13:36	50	49.880	50.100	168	168	67	70	0.1	0.1	260	260	1.004	1.004
13:41	55	54.900	55.110	168	168	68	70	0.1	0.1	260	260	1.004	1.002
13:46	60	59.920	60.130	168	168	69	71	0.1	0.1	260	260	1.004	1.004
13:51	65	64.950	65.150	168	168	70	71	0.1	0.1	260	260	1.006	1.004
13:56	70	69.980	70.170	168	168	71	72	0.1	0.1	260	260	1.006	1.004
14:01	75	75.000	75.170	172	172	71	74	0.1	0.1	260	260	1.004	1.000
14:06	80	80.020	80.180	172	172	71	75	0.1	0.1	260	260	1.004	1.002
14:11	85	85.010	85.200	172	172	72	75	0.1	0.1	260	260	0.998	1.004
14:16	90	90.030	90.200	172	172	73	76	0.1	0.1	260	260	1.004	1.000

Clock Time (24 hr)	Time (min.)	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
		Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
14:21	95	95.040	95.190	172	172	73	76	0.1	0.1	260	260	1.002	0.998
14:26	100	100.030	100.170	158	158	74	77	0.1	0.1	260	260	0.998	0.996
14:31	105	105.050	105.160	158	158	74	78	0.1	0.1	260	260	1.004	0.998
14:36	110	110.090	110.150	158	158	75	79	0.1	0.1	260	260	1.008	0.998
14:41	115	115.120	115.160	158	158	76	80	0.1	0.1	260	260	1.006	1.002
14:46	120	120.150	120.140	158	158	77	79	0.1	0.1	260	260	1.006	0.996
14:51	125	125.200	125.120	169	169	78	79	0.1	0.1	260	260	1.010	0.996
14:56	130	130.220	130.120	169	169	78	80	0.1	0.1	260	260	1.004	1.000
15:01	135	135.260	135.110	169	169	79	80	0.1	0.1	260	260	1.008	0.998
15:06	140	140.250	140.100	169	169	79	80	0.1	0.1	260	260	0.998	0.998
15:11	145	145.250	145.100	169	169	79	80	0.1	0.1	260	260	1.000	1.000
15:16	150	150.240	150.110	174	174	79	80	0.1	0.1	260	260	0.998	1.002
15:21	155	155.220	155.090	174	174	79	80	0.1	0.1	260	260	0.996	0.996
15:26	160	160.230	160.100	174	174	80	81	0.1	0.1	260	260	1.002	1.002
15:31	165	165.210	165.100	174	174	80	81	0.1	0.1	260	260	0.996	1.000
15:36	170	170.200	170.080	174	174	80	81	0.1	0.1	260	260	0.998	0.996
15:41	175	175.180	175.090	167	167	80	81	0.1	0.1	260	260	0.996	1.002
15:46	180	180.190	180.070	167	167	80	82	0.1	0.1	260	260	1.002	0.996
15:51	185	185.200	185.050	167	167	80	82	0.1	0.1	260	260	1.002	0.996
15:56	190	190.180	190.050	167	167	80	82	0.1	0.1	260	260	0.996	1.000
16:01	195	195.170	195.030	167	167	80	82	0.1	0.1	260	260	0.998	0.996
16:06	200	200.150	200.000	169	169	80	82	0.1	0.1	260	260	0.996	0.994
16:11	205	205.160	204.990	169	169	80	82	0.1	0.1	260	260	1.002	0.998
16:16	210	210.150	210.000	169	169	80	82	0.1	0.1	260	260	0.998	1.002
16:21	215	215.140	214.980	169	169	80	82	0.1	0.1	260	260	0.998	0.996
16:26	220	220.120	219.990	169	169	80	82	0.1	0.1	260	260	0.996	1.002
16:31	225	225.130	224.970	139	139	80	83	0.1	0.1	260	260	1.002	0.996
16:36	230	230.150	229.950	139	139	80	83	0.1	0.1	260	260	1.004	0.996
16:41	235	235.180	234.930	139	139	80	83	0.1	0.1	260	260	1.006	0.996
16:46	240	240.200	239.920	139	139	80	83	0.1	0.1	260	260	1.004	0.998
16:51	245	245.220	244.940	139	139	80	83	0.1	0.1	260	260	1.004	1.004
16:56	250	250.230	249.930	175	175	80	84	0.1	0.1	260	260	1.002	0.998
17:01	255	255.270	254.940	175	175	81	84	0.1	0.1	260	260	1.008	1.002
17:06	260	260.220	259.950	175	175	81	84	0.1	0.1	260	260	0.990	1.002
17:11	265	265.180	264.960	175	175	81	83	0.1	0.1	260	260	0.992	1.002
17:16	270	270.150	269.970	175	175	80	82	0.1	0.1	260	260	0.994	1.002
17:21	275	275.100	274.970	173	173	81	82	0.1	0.1	260	260	0.990	1.000
17:26	280	280.050	279.980	173	173	80	82	0.1	0.1	260	260	0.990	1.002
17:31	285	285.000	284.980	173	173	80	82	0.1	0.1	260	260	0.990	1.000
17:36	290	289.960	289.990	173	173	80	82	0.1	0.1	260	260	0.992	1.002
17:41	295	294.950	294.990	173	173	79	81	0.1	0.1	260	260	0.998	1.000
17:46	300	299.930	300.000	210	210	79	80	0.1	0.1	260	260	0.996	1.002
17:51	305	304.940	305.000	210	210	79	80	0.1	0.1	260	260	1.002	1.000
17:56	310	309.960	309.990	210	210	79	80	0.1	0.1	260	260	1.004	0.998
18:01	315	314.970	315.010	210	210	79	80	0.1	0.1	260	260	1.002	1.004
18:06	320	319.990	320.020	210	210	79	80	0.1	0.1	260	260	1.004	1.002
18:11	325	325.000	325.040	210	210	79	80	0.1	0.1	260	260	1.002	1.004
18:16	330	330.010	330.050	210	210	79	80	0.1	0.1	260	260	1.002	1.002
18:21	335	335.010	335.060	210	210	78	80	0.1	0.1	260	260	1.000	1.002
18:26	340	340.000	340.070	210	210	78	80	0.1	0.1	260	260	0.998	1.002

Clock Time (24 hr)	Time (min.)	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
		Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
18:31	345	345.020	345.080	210	210	78	80	0.1	0.1	260	260	1.004	1.002
18:36	350	350.030	350.100	226	226	77	79	0.1	0.1	260	260	1.002	1.004
18:41	355	355.010	355.090	226	226	77	77	0.1	0.1	260	260	0.996	0.998
18:46	360	360.050	360.090	226	226	77	76	0.1	0.1	260	260	1.008	1.000
18:51	365	365.040	365.100	226	226	77	75	0.1	0.1	260	260	0.998	1.002
18:56	370	370.050	370.110	226	226	77	74	0.1	0.1	260	260	1.002	1.002
19:01	375	375.050	375.120	223	223	76	74	0.1	0.1	260	260	1.000	1.002
19:06	380	380.040	380.130	223	223	75	73	0.1	0.1	260	260	0.998	1.002
19:11	385	385.030	385.150	223	223	74	73	0.1	0.1	260	260	0.998	1.004
19:16	390	390.050	390.150	223	223	73	71	0.1	0.1	260	260	1.004	1.000
19:21	395	395.060	395.140	223	223	72	71	0.1	0.1	260	260	1.002	0.998
19:26	400	400.050	400.130	213	213	70	70	0.1	0.1	260	260	0.998	0.998
19:31	405	405.000	405.120	213	213	69	70	0.1	0.1	260	260	0.990	0.998
19:36	410	410.010	410.110	213	213	69	69	0.1	0.1	260	260	1.002	0.998
19:41	415	415.030	415.100	213	213	69	68	0.1	0.1	260	260	1.004	0.998
19:46	420	420.020	420.130	213	213	69	67	0.1	0.1	260	260	0.998	1.006
19:51	425	425.000	425.150	205	205	68	66	0.1	0.1	260	260	0.996	1.004
19:56	430	430.010	430.160	205	205	68	66	0.1	0.1	260	260	1.002	1.002
20:01	435	435.000	435.170	205	205	68	66	0.1	0.1	260	260	0.998	1.002
20:06	440	439.990	440.180	205	205	68	65	0.1	0.1	260	260	0.998	1.002
20:11	445	444.990	445.190	205	205	67	65	0.1	0.1	260	260	1.000	1.002
20:16	450	449.980	450.200	210	210	67	65	0.1	0.1	260	260	0.998	1.002
20:21	455	454.980	455.210	210	210	67	65	0.1	0.1	260	260	1.000	1.002
20:26	460	459.990	460.220	210	210	67	65	0.1	0.1	260	260	1.002	1.002
20:31	465	465.000	465.230	210	210	66	65	0.1	0.1	260	260	1.002	1.002
20:36	470	470.020	470.240	210	210	66	65	0.1	0.1	260	260	1.004	1.002
20:41	475	475.060	475.250	205	205	65	64	0.1	0.1	260	260	1.008	1.002
20:46	480	480.050	480.250	205	205	65	64	0.1	0.1	260	260	0.998	1.000
20:51	485	485.000	485.260	205	205	65	64	0.1	0.1	260	260	0.990	1.002
20:56	490	489.960	490.280	205	205	65	64	0.1	0.1	260	260	0.992	1.004
21:01	495	494.950	495.280	205	205	65	64	0.1	0.1	260	260	0.998	1.000
21:06	500	499.920	500.290	207	207	65	64	0.1	0.1	260	260	0.994	1.002
21:11	505	504.900	505.300	207	207	64	64	0.1	0.1	260	260	0.996	1.002
21:16	510	509.890	510.300	207	207	64	64	0.1	0.1	260	260	0.998	1.000
21:21	515	514.880	515.310	207	207	64	64	0.1	0.1	260	260	0.998	1.002
21:26	520	519.860	520.320	207	207	64	64	0.1	0.1	260	260	0.996	1.002
21:31	525	524.850	525.330	206	206	64	64	0.1	0.1	260	260	0.998	1.002
21:36	530	529.820	530.340	206	206	63	64	0.1	0.1	260	260	0.994	1.002
21:41	535	534.800	535.340	206	206	63	64	0.1	0.1	260	260	0.996	1.000
21:46	540	539.750	540.350	206	206	63	64	0.1	0.1	260	260	0.990	1.002
21:51	545	544.718	545.364	206	206	63	63	0.1	0.1	260	260	0.994	1.003

Method 30B
Mercury Concentration

Client: PCC
Location: Portland, OR
Source: Furnace #23 Outlet
Test date: 3/11/2020

Meterbox Y:
Side A 1 0090
Side B 0 9890

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	3/11/2020	OL492743	5 0	5 7	1 2	1 9	1 90E-03	544 718	549 620	30 18	72 8	0 549	3 46E-03	4 05E-03
	B		OLC050333	0 0	1 7	0 8	2 5	2 50E-03	545 364	539 365		73 7	0 538	4 64E-03	

Trap Concentrations Example Calculations:
Run 1, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 1.9 ng
where Section 1: 5.7 ng
Section 2: 1.2 ng
Spike: 5.0 ng

2. Conversion to µg — Total Hg ng/1000 = 1.90E-03 µg
where Total Hg ng: 1.9 ng

3. Corrected sample volume = DGM reading x Meterbox Y factor = 549.620 L
where DGM reading: 544.718 L
Y: 1.009

4. Standard Volume (DSCM) = Sample Vol. (L) x $\left(\frac{528\,^{\circ}\mathrm{A}}{Tm+460}\right)$ x Bp/29.92 "Hg /1000 = 0.549 DSCM
where Sample vol.: 549.620 L
T_m: 72.8 F
B_p: 30.18 "Hg

5. Hg concentration µg/dscm = Total Hg µg / Volume DSCM = 3.46E-03 µg/dscm
where Total Hg: 1 90E-03 µg
DSCM: 0.549

6. Average Pair Concentration = (Side A Conc.+ Side B Conc.)/2 = 4.05E-03 µg/dscm
where Side A: 0.003 µg/dscm
Side B: 0 005 µg/dscm

Method 30B
Results QA/QC

Client: PCC
Location: Portland, OR
Source: Furnace #23 Outlet
Test date: 3/11/2020
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	3/11/2020	OL492743	5	5 7	1 2	1 9	3 46E-03	21 1	See emissions limit	7 91E-03	87 0	PASS	14 64	PASS
	B		OLC050333	0	1 7	0 8	2 5	4 64E-03	47 1	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: NA 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: PCC
Location: Portland, OR
Source: Furnace #23 Outlet
Test date: 3/11/2020

Run	Ave. Pair Hg Conc. µg/dscm	Stack Flow dscf/hr*	Stack Emissions lb/ton metal**
1	4.05E-03	123,949	5.42E-07

*From direct stack measurements made during concurrent M29 runs.
**Total metal processed: 0.526

APPENDIX B: INLET TEST DATA

BISON ENGINEERING, INC.

COMPANY	**PCC**
FACILITY	**LPCS**
LOCATION	**Portland, OR**
SOURCE	**Furnace #23 Inlet**
DATE	**03/11/20**
METHOD	**29**
POLLUTANT	**PM and TSM**

EPA Method 1
Stack Parameters and Traverse Points

Client: PCC
Location: Portland, OR
Source: Furnace #23 Inlet (Isokinetic Sampling Train only)
Facility: LPCS

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: 3.5 inches

Circular ID (Rectangular Depth): 10.00 inches
Port depth and/or wall thickness: inches
Stack width (Rectangular only): inches

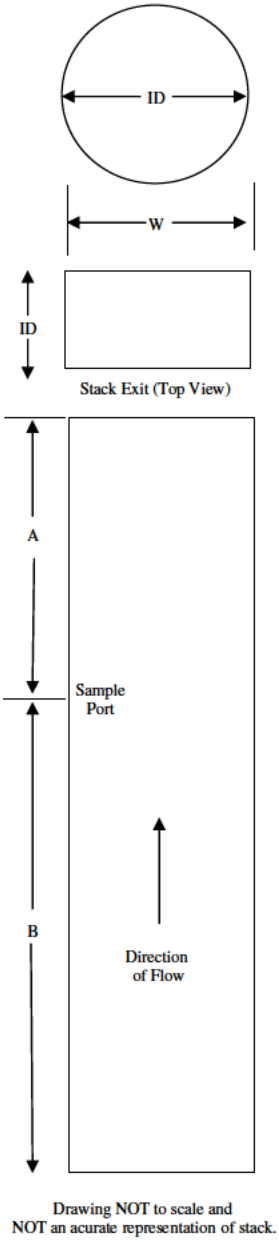
Equivalent Diameter
If rectangluar = $\frac{2*Depth*Width}{Depth + Width}$ = 10.00 inches (If circular = duct ID)
Stack/duct area = 0.545 sq.feet 78.5 sq.inches

Sample Port Location**:	Downstream from flow disturbance from process B	Upstream from flow disturbance toward exit A
Number of Inches:	40.00	20.00
Number of Diameters:	4.00	2.00

Minimum Number of Traverse Points: 24

Points	% of diameter	Distance from inside wall (in.)	Distance including port (in.)
1	2.1	0.50	0 1/2
2	6.7	0.67	0 5/8
3	11.8	1.18	1 1/8
4	17.7	1.77	1 3/4
5	25.0	2.50	2 1/2
6	35.6	3.56	3 1/2
7	64.4	6.44	6 1/2
8	75.0	7.50	7 1/2
9	82.3	8.23	8 1/4
10	88.2	8.82	8 7/8
11	93.3	9.33	9 3/8
12	97.9	9.50	9 1/2

Reference Diagram



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

*One port was dedicated exclusively to Method 29 isokinetic sampling, while the other was dedicated to Method 30B sampling. The port used for isokinetic sampling was >0.5 duct diameters upstream of the port used for Method 30B.

**Measurements apply only to the port used for isokinetic sampling.

Pre Traverse Flow Information

Client: PCC
Location: Portland, OR
Source: Furnace #23 Inlet

Stack Temp: 61

Traverse Point	Velocity ΔP ("H_2O)	Null Angle
1	0.19	0.0
2	0.18	0.0
3	0.12	0.0
4	0.10	0.0
5	0.09	0.0
6	0.10	0.0
7	0.09	0.0
8	0.07	0.0
9	0.09	0.0
10	0.09	0.0
11	0.08	0.0
12	0.08	0.0
13	0.19	0.0
14	0.12	0.0
15	0.13	0.0
16	0.08	0.0
17	0.09	0.0
18	0.10	0.0
19	0.08	0.0
20	0.10	0.0
21	0.09	0.0
22	0.10	0.0
23	0.10	0.0
24	0.09	0.0
Average:	0.106	0

Flow is found to be:

Non-cyclonic	x
Cyclonic	

Isokinetic Field Data
Field Data Entry

Client:	**PCC**			**Run:**	**1**
Location:	**Portland, OR**			**Start Time:**	**12:46**
Source:	**Furnace #23 Inlet**	**Environmental Conditions/Test Notes:**		**End Time:**	**21:50**
EPA Method:	**29**	55 deg f cloudy calm		**Date:**	**3/11/2020**
Box Operator:	**AB**				
Technician(s):	**AB**				

Stack Dimensional Data:

Circular		
Diameter	10.000	in
Rectangular		
Width		in
Length		in
Stack Area	0.545	sq.ft.

Equipment:

Meterbox ID	11	Probe ID	2B	Liner type	glass		
Y factor	0.9699	Nozzle ID	0.387	Nozzle size	0.3867	inches	
ΔH@	1.841	Hot box ID	hb3	Nozzle area	0.000816	sq.ft.	
		Pitot Cp	0.99	Probe heat	250	F	
		Pitot ID	2b	Filter heat	250	F	

Source Information:

Barometric Pressure	30.05	"Hg	O_2	20.90 %
Static Pressure	0.06	"H_2O	CO_2	0.00 %
Ave. ΔP	0.11	"H_2O	Rec. Nz.	0.354 inches
Stack Temperature	60	F		
Assumed moisture	1	%		
Assumed meter temp.	60	F		
Total number of points	24			
Time per point	25	min		
Total run time	544	min		

*In order to correlate sampling with the batch heating cycle timing, sampling time at point 22 was truncated and no sampling was conducted at points 23 and 24.

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	
0.387	0.386	0.387	inches
	Caliper ID#	ws1	

Post Test Calculations:

Sample volume	525.416	dcf	Ave. ΔP	0.086 "H_2O
Wet mol. weight	28.77	M_s (actual)	Ave. √ΔP	0.292 "H_2O
Actual H_2O	0.69	%	Ave. ΔH	2.196 "H_2O
Std. meter vol.	510.292	dscf	Ave. T_s	56 °F
Isokinetic Average	98.4	%	Ave. T_m	72.2 °F

Moisture/Lab:

Filter	U782 #		
	Initial	Final	Gain
Impingers, g	200.0	200.0	0.0
Silica gel, g	467.6	543.3	75.7
		Total water gain:	75.7

Traverse Point	Time (min.)	Meter Volume (dcf) 267.606	Velocity ΔP ("H_2O)	Stack Temp. (°F)	Meter Temp. (°F)	Calc. ΔH	Run ΔH	Vacuum ("Hg)	Filter Box (°F)	Condenser Temp (≤68°F)
1	25.0	285.200	0.06	59	60	1.49	1.49	2	263	54
2	50.0	307.320	0.08	57	68	2.02	2.02	2	260	56
3	75.0	331.600	0.10	55	76	2.58	2.58	2.5	260	64
4	100.0	352.200	0.06	54	74	1.54	1.54	2	259	51
5	125.0	373.600	0.07	58	76	1.79	1.79	2	258	52
6	150.0	394.700	0.06	59	82	1.55	1.55	2	257	54
7	175.0	419.000	0.08	61	78	2.05	2.05	2.5	259	55
8	200.0	443.590	0.08	62	85	2.07	2.07	3	260	59
9	225.0	469.630	0.10	62	85	2.59	2.59	3	260	56
10	250.0	496.820	0.10	58	83	2.60	2.60	3	258	56
11	275.0	521.800	0.09	59	80	2.32	2.32	3	259	57
12	300.0	547.360	0.09	58	79	2.32	2.32	3.5	262	56
13	325.0	572.300	0.10	58	73	2.55	2.55	3.5	259	57
14	350.0	597.660	0.09	58	74	2.30	2.30	3	258	56
15	375.0	623.450	0.10	56	69	2.54	2.54	3	261	58
16	400.0	650.700	0.11	54	67	2.79	2.79	3.5	260	55
17	425.0	674.920	0.08	53	66	2.03	2.03	3	260	52
18	450.0	699.400	0.08	53	64	2.02	2.02	3	258	52
19	475.0	724.000	0.10	53	63	2.53	2.53	3	260	51
20	500.0	749.000	0.09	50	63	2.29	2.29	3	260	52
21	525.0	772.380	0.08	47	61	2.04	2.04	3	261	49
22	544.0	793.022	0.09	47	62	2.30	2.30	3	261	55
23										
24										

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

Client:	**PCC**	**Run:**	**1**
Location:	**Portland, OR**	**Start Time:**	**12:46**
Source:	**Furnace #23 Inlet**	**End Time:**	**21:50**
Method:	**29**	**Date:**	**3/11/2020**

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**
	267.606						
25	285.200	1.49	60	1	0.06	59	0.2449
50	307.320	2.02	68	2	0.08	57	0.2828
75	331.600	2.58	76	3	0.10	55	0.3162
100	352.200	1.54	74	4	0.06	54	0.2449
125	373.600	1.79	76	5	0.07	58	0.2646
150	394.700	1.55	82	6	0.06	59	0.2449
175	419.000	2.05	78	7	0.08	61	0.2828
200	443.590	2.07	85	8	0.08	62	0.2828
225	469.630	2.59	85	9	0.10	62	0.3162
250	496.820	2.60	83	10	0.10	58	0.3162
275	521.800	2.32	80	11	0.09	59	0.3000
300	547.360	2.32	79	12	0.09	58	0.3000
325	572.300	2.55	73	13	0.10	58	0.3162
350	597.660	2.30	74	14	0.09	58	0.3000
375	623.450	2.54	69	15	0.10	56	0.3162
400	650.700	2.79	67	16	0.11	54	0.3317
425	674.920	2.03	66	17	0.08	53	0.2828
450	699.400	2.02	64	18	0.08	53	0.2828
475	724.000	2.53	63	19	0.10	53	0.3162
500	749.000	2.29	63	20	0.09	50	0.3000
525	772.380	2.04	61	21	0.08	47	0.2828
544	793.022	2.30	62	22	0.09	47	0.3000

Note: In order to correlate sampling with the batch heating cycle, sampling time at point 22 was truncated and no sampling was conducted at points 23 and 24.

Client:	**PCC**	**Run:**	**1**
Source:	**Furnace #23 Inlet**	**Date:**	**03/11/20**

Field Data Input Continued

Moisture Data			Stack Dimensional Data:		
Total Test Time	544.0	min	Circular		
Sample Time Interval	25.0	min	Diameter	10.000	in
Meter Volume, V_m	525.416	dcf	Rectangular		
Water Volume	75.7	ml (g)	Width		in
Nozzle Diameter, N_z	0.3867	in.	Length		in
Nozzle Area	0.000816	sq.ft.	Stack Area	0.545	sq.ft.
Traverse Data			Molecular Weight:		
Barometric Pressure, P_b	30.05	"Hg	CO_2 Average	0.00	%vd
Static Pressure	0.06	"H_2O	O_2 Average	20.90	%vd
Pitot Factor, cp	0.99				
Meter Cal Factor	0.9699	Y			

Field Data Averages

Meter			Stack		
ΔH	2.196	"H_2O	√Dp	0.2920	"H_2O
Temperature, T_m	72.2	^oF	Temperature, T_s	56.0	^oF
Temperature, T_m	532.2	^oA (^oR)	Temperature, T_s	516.0	^oA (R)
Pressure Meter, P_m	30.211	"Hg	Pressure Stack, P_s	30.054	"Hg

Field Data Calculations

Meter Box Capture			EPA Method 2 Stack Gas Flowrate:		
Standard Volume, $V_{m(std)}$	510.292	dscf	Velocity, V_s	19.09	fps
	14.450	dscm	Volume (actual)	624.2	acfm
Actual Volume, $V_{m(actual)}$	500.121	awcf		619.9	adcfm
Gas Stream Moisture			Volume (standard)	38,497.3	wscf/hr
Moisture Vapor, $Vw_{(std)}$	3.562	scf		38,231.7	dscf/hr
Moisture, B_{ws}	0.0069			637.2	dscf/min
Moisture EPA M4	0.69	%v			
EPA Method 3 Gas Density					
Dry, M_d	28.84	lb/lb-mole			
Wet, M_s	28.77	lb/lb-mole			
Percent Isokinetic	98.4	%			

Laboratory Results

EPA Method 29 (PM)

Filterable PM	0.00168	grams	Concentration, C_s	5.07E-05	gr/dscf
				115.95	µg/dscm

EPA Method 29 (PM)
Filterable Particulate Matter
Laboratory Gravimetric Data

Client: **PCC**
Location: **Portland, OR**
Source: **Furnace #23 Inlet**

Run	Sample Description	g, #	Initial (grams)	Final (grams)	Net Gain	Blank Correction	Corrected Gain (grams)
1	Probe Rinse (Acetone FH)	108	119.11058	119.11236	0.00178	1.05E-04	**0.00168**
	Filter	19-U782	0.44034	0.44011	-0.00023		**0.00000**
						Filterable PM (mg)	**1.68**
						Total PM (mg)	**1.68**
	Acetone Blank	465	50.20240	50.20285	0.00045	9.68E-07	g/g

Source:		**Furnace #23 Inlet**			**Sample Date:**		**03/11/20**
Run:		**1**					
Client ID:		**Filter + Front Half**		**Back Half**			
Analyte	<	**Result**	<	**Result**	**FH MDL**	**BH MDL**	**Units**
Aluminum		123		44.9	3.75	1.50	µg/sample
Antimony		2.38	<	MDL	1.25	0.500	µg/sample
Arsenic	<	MDL		1.46	1.75	0.700	µg/sample
Barium		4.86		4.86	0.125	0.050	µg/sample
Beryllium	<	MDL	<	MDL	0.050	0.020	µg/sample
Cadmium	<	MDL		0.070	0.100	0.040	µg/sample
Chromium		4.56		0.740	0.200	0.080	µg/sample
Cobalt	<	MDL		6.63	0.125	0.050	µg/sample
Copper		1.39		6.17	1.25	0.500	µg/sample
Lead	<	MDL		1.84	1.25	0.500	µg/sample
Manganese		2.48		6.27	0.075	0.030	µg/sample
Nickel		3.34		6.29	0.750	0.300	µg/sample
Phosphorus	<	MDL		211	5.00	2.00	µg/sample
Selenium		8.65	<	MDL	3.75	1.50	µg/sample
Silver	<	MDL	<	MDL	0.500	0.200	µg/sample
Thallium	<	MDL	<	MDL	2.50	1.00	µg/sample
Vanadium	<	MDL		0.119	0.250	0.100	µg/sample
Zinc		6.32		87.0	0.750	0.300	µg/sample
Lab ID:		20-S351		20-S352			
Sample Vol:		250		100		mL	

Source: Furnace #23 Inlet
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
Aluminum		102	3.75		**11.65**	**3.75**	<	**MDL**	**1.50**
Antimony	<	MDL	1.250	<	**MDL**	**1.25**	<	**MDL**	**0.50**
Arsenic	<	MDL	1.750	<	**MDL**	**1.75**	<	**MDL**	**0.70**
Barium		4.460	0.125	<	**MDL**	**0.13**	<	**MDL**	**0.05**
Beryllium	<	MDL	0.050	<	**MDL**	**0.05**	<	**MDL**	**0.02**
Cadmium	<	MDL	0.100	<	**MDL**	**0.10**	<	**MDL**	**0.04**
Chromium		1.650	0.200		**0.3525**	**0.20**	<	**MDL**	**0.08**
Cobalt		0.374	0.125	<	**MDL**	**0.13**	<	**MDL**	**0.05**
Copper	<	MDL	1.250	<	**MDL**	**1.25**	<	**MDL**	**0.50**
Lead	<	MDL	1.250	<	**MDL**	**1.25**	<	**MDL**	**0.50**
Manganese		0.075	70.200		**0.07775**	**0.08**	<	**MDL**	**0.03**
Nickel	<	MDL	0.750	<	**MDL**	**0.75**	<	**MDL**	**0.30**
Phosphorus	<	MDL	5.000	<	**MDL**	**5.00**	<	**MDL**	**2.00**
Selenium		4.530	3.750	<	**MDL**	**3.75**	<	**MDL**	**1.50**
Silver	<	MDL	0.500	<	**MDL**	**0.50**	<	**MDL**	**0.20**
Thallium	<	MDL	2.500	<	**MDL**	**2.50**	<	**MDL**	**1.00**
Vanadium	<	MDL	0.250	<	**MDL**	**0.25**	<	**MDL**	**0.10**
Zinc		3.780	0.750	<	**MDL**	**0.75**	<	**MDL**	**0.30**
Lab ID:		20-S680			EPA 29 Back Half			EPA 29 Front Half	
Sample Vol, ml:		250			250			100	

PCC **Method 29 Metals Blank Calculations** **Run: 1**

Furnace #23 Inlet

03/11/20		**I**		**II**		**III**		**IV**		**V**		**VI**		**VII**	**VIII**	
		Sample* FH		**Blank* FH**		**Blank* FH**		**Sample* BH**		**Blank* BH**		**BH Blank* Corrected**		**BH Blank* Corrected**	**Allowable 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**		
Al		123.000	<	1.5000		102.000		44.900		0.0466		9.320	<	1.5000	9.320	**Aluminum**
Sb		2.380	<	0.5000	<	1.250	<	0.500	<	0.0050	<	1.000	<	0.5000	0.000	**Antimony**
As	<	1.750	<	0.7000	<	1.750		1.460	<	0.0070	<	1.400	<	0.7000	0.000	**Arsenic**
Ba		4.860	<	0.0500		4.460		4.860	<	0.0005	<	0.100	<	0.0500	0.000	**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		0.070	<	0.0004	<	0.080	<	0.0400	0.000	**Cadmium**
Cr		4.560	<	0.0800		1.650		0.740		0.0014		0.282	<	0.0800	0.282	**Chromium**
Co	<	0.125	<	0.0500		0.374		6.630	<	0.0005	<	0.100	<	0.0500	0.000	**Cobalt**
Cu		1.390	<	0.5000	<	1.250		6.170	<	0.0050	<	1.000	<	0.5000	0.000	**Copper**
Pb	<	1.250	<	0.5000	<	1.250		1.840	<	0.0050	<	1.000	<	0.5000	0.000	**Lead**
Mn		2.480	<	0.0300		0.075		6.270		0.0003		0.062	<	0.0300	0.062	**Manganese**
Ni		3.340	<	0.3000	<	0.750		6.290	<	0.0030	<	0.600	<	0.3000	0.000	**Nickel**
P	<	5.000	<	2.0000	<	5.000		211.000	<	0.0200	<	4.000	<	2.0000	0.000	**Phosphorus**
Se		8.650	<	1.5000		4.530	<	1.500	<	0.0150	<	3.000	<	1.5000	0.000	**Selenium**
Ag	<	0.500	<	0.2000	<	0.500	<	0.200	<	0.0020	<	0.400	<	0.2000	0.000	**Silver**
Tl	<	2.500	<	1.0000	<	2.500	<	1.000	<	0.0100	<	2.000	<	1.0000	0.000	**Thallium**
V	<	0.250	<	0.1000	<	0.250		0.119	<	0.0010	<	0.200	<	0.1000	0.000	**Vanadium**
Zn		6.320	<	0.3000		3.780		87.000	<	0.0030	<	0.600	<	0.3000	0.000	**Zinc**

Lab:	**20-S351**	**EPA 29 Front Half**	**20-S680**	**20-S352**	**EPA 29 Back Half**		
Content:	$0.1NHNO_3$	$0.1NHNO_3$	$0.1NHNO_3$	$5\%HNO_3$/ $10\%H_2O_2$	$5\%HNO_3$/ $10\%H_2O_2$	$5\%HNO_3$/ $10\%H_2O_2$	$0.1NHNO_3$
	FH Filter & Probe Rinse			BH Imps 1&2			
	100ml 0.1N HNO_3 rinse			100ml .1N HNO_3 rinse			Same as FH
		Same as BH		200ml $5\%HNO_3/10\%H_2O_2$ reagent			Blank Wash
		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
Al	11.630		102.000		6.150	6.150	11.63		111.370	**Aluminum**
Sb	0.000		0.000		0.119	0.000	11.63		2.380	**Antimony**
As	0.000		0.000	<	0.088	0.000	11.63	<	1.750	**Arsenic**
Ba	4.460		4.460		0.243	0.243	11.63		0.400	**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	1.650		1.650		0.228	0.228	11.63		2.910	**Chromium**
Co	0.374		0.374	<	0.006	0.006	11.63	<	-0.249	**Cobalt**
Cu	0.000		0.000		0.070	0.000	11.63		1.390	**Copper**
Pb	0.000		0.000	<	0.063	0.000	11.63	<	1.250	**Lead**
Mn	0.075		0.075		0.124	0.075	11.63		2.405	**Manganese**
Ni	0.000		0.000		0.167	0.000	11.63		3.340	**Nickel**
P	0.000		0.000	<	0.250	0.000	11.63	<	5.000	**Phosphorus**
Se	4.530		4.530		0.433	0.433	11.63		4.120	**Selenium**
Ag	0.000		0.000	<	0.025	0.000	11.63	<	0.500	**Silver**
Tl	0.000		0.000	<	0.125	0.000	11.63	<	2.500	**Thallium**
V	0.000		0.000	<	0.013	0.000	11.63	<	0.250	**Vanadium**
Zn	3.780		3.780		0.316	0.316	11.63		2.540	**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
Al	2.245	9.320		2.245	2.245	2.245		**42.655**		**111.370**		**154.025**	**Aluminum**
Sb	0.000	0.000	<	0.025	0.000	1.000	<	**0.500**		**2.380**	<	**2.880**	**Antimony**
As	0.000	0.000		0.073	0.000	1.000		**1.460**	<	**1.750**	<	**3.210**	**Arsenic**
Ba	0.000	0.000		0.243	0.000	1.000		**4.860**		**0.400**		**5.260**	**Barium**
Be	0.000	0.000	<	0.001	0.000	1.000	<	**0.020**	<	**0.050**	<	**0.070**	**Beryllium**
Cd	0.000	0.000		0.004	0.000	1.000		**0.070**	<	**0.100**	<	**0.170**	**Cadmium**
Cr	0.282	0.282		0.037	0.037	1.000		**0.458**		**2.910**		**3.368**	**Chromium**
Co	0.000	0.000		0.332	0.000	1.000		**6.630**	<	**0.000**	<	**6.630**	**Cobalt**
Cu	0.000	0.000		0.309	0.000	1.000		**6.170**		**1.390**		**7.560**	**Copper**
Pb	0.000	0.000		0.092	0.000	1.000		**1.840**	<	**1.250**	<	**3.090**	**Lead**
Mn	0.062	0.062		0.314	0.062	1.000		**6.208**		**2.405**		**8.613**	**Manganese**
Ni	0.000	0.000		0.315	0.000	1.000		**6.290**		**3.340**		**9.630**	**Nickel**
P	0.000	0.000		10.550	0.000	1.000		**211.000**	<	**5.000**	<	**216.000**	**Phosphorus**
Se	0.000	0.000	<	0.075	0.000	1.000	<	**1.500**		**4.120**	<	**5.620**	**Selenium**
Ag	0.000	0.000	<	0.010	0.000	1.000	<	**0.200**	<	**0.500**	<	**0.700**	**Silver**
Tl	0.000	0.000	<	0.050	0.000	1.000	<	**1.000**	<	**2.500**	<	**3.500**	**Thallium**
V	0.000	0.000		0.006	0.000	1.000		**0.119**	<	**0.250**	<	**0.369**	**Vanadium**
Zn	0.000	0.000		4.350	0.000	1.000		**87.000**		**2.540**		**89.540**	**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

EPA Method 29 (PM)
Filterable Particulate Matter
Results Summary

Client: **PCC**
Source: **Furnace #23 Inlet**
Location: **Portland, OR**

Run			1
Date			3/11/2020
Run Start Time			12:46
Run End Time			21:50
Duration, min.			544
Barometric Pressure, "Hg			30.05
Nozzle Dia., in.			0.3867
Isokinetic Average, %			98.4
Sample Volume, dscf			510.292
Sample Volume, dscm			14.450
Stack Diameter, in.			10.00
Stack Area, sq.ft.			0.545
CO_2 %vd			0.00
O_2 %vd			20.90
Static Press., "H_2O			0.06
H_2O %v			0.69
Wet Molecular Weight, lb/lb-mole			28.77
Velocity, FPS			19.09
ADCFM			619.9
ACFM			624.2
DSCFM			637.2
Stack Temperature, ^oF			56.0
Filterable Particulate	Concentration, C_s	gr/dscf	5.07E-05
		µg/dscm	115.95
	Mass	lb/ton metal	4.77E-03
Production Data	Metal Processed	ton	0.526

PCC **Test: M29**
Furnace #23 Inlet
Metals Results Summary

Run 1												
	Total			FH Net			BH Net					
Species	**µg**	**µg/dscm**	**lb/ton metal***	**µg**	**µg/dscm**	**lb/ton metal***	**µg**	**µg/dscm**	**lb/ton metal***			
Aluminum	154.025	10.659	4.39E-04	111.370	7.707	3.17E-04	42.655	2.952	1.21E-04	**Al**		
Antimony	< 2.880	< 0.199	< 8.20E-06	2.380	0.165	6.78E-06	< 0.500	< 0.035	< 1.42E-06	**Sb**		
Arsenic	< 3.210	< 0.222	< 9.14E-06	< 1.750	< 0.121	< 4.98E-06	1.460	0.101	4.16E-06	**As**		
Barium	5.260	0.364	1.50E-05	0.400	0.028	1.14E-06	4.860	0.336	1.38E-05	**Ba**		
Beryllium	< 0.070	< 0.005	< 1.99E-07	< 0.050	< 0.003	< 1.42E-07	< 0.020	< 0.001	< 5.69E-08	**Be**		
Cadmium	< 0.170	< 0.012	< 4.84E-07	< 0.100	< 0.007	< 2.85E-07	0.070	0.005	1.99E-07	**Cd**		
Chromium	3.368	0.233	9.59E-06	2.910	0.201	8.28E-06	0.458	0.032	1.30E-06	**Cr**		
Cobalt	< 6.630	< 0.459	< 1.89E-05	< 0.000	< 0.000	< 0.00E+00	6.630	0.459	1.89E-05	**Co**		
Copper	7.560	0.523	2.15E-05	1.390	0.096	3.96E-06	6.170	0.427	1.76E-05	**Cu**		
Lead	< 3.090	< 0.214	< 8.80E-06	< 1.250	< 0.087	< 3.56E-06	1.840	0.127	5.24E-06	**Pb**		
Manganese	8.613	0.596	2.45E-05	2.405	0.166	6.85E-06	6.208	0.430	1.77E-05	**Mn**		
Nickel	9.630	0.666	2.74E-05	3.340	0.231	9.51E-06	6.290	0.435	1.79E-05	**Ni**		
Phosphorus	< 216.000	< 14.948	< 6.15E-04	< 5.000	< 0.346	< 1.42E-05	211.000	14.602	6.01E-04	**P**		
Selenium	< 5.620	< 0.389	< 1.60E-05	4.120	0.285	1.17E-05	< 1.500	< 0.104	< 4.27E-06	**Se**		
Silver	< 0.700	< 0.048	< 1.99E-06	< 0.500	< 0.035	< 1.42E-06	< 0.200	< 0.014	< 5.69E-07	**Ag**		
Thallium	< 3.500	< 0.242	< 9.96E-06	< 2.500	< 0.173	< 7.12E-06	< 1.000	< 0.069	< 2.85E-06	**Tl**		
Vanadium	< 0.369	< 0.026	< 1.05E-06	< 0.250	< 0.017	< 7.12E-07	0.119	0.008	3.39E-07	**V**		
Zinc	89.540	6.197	2.55E-04	2.540	0.176	7.23E-06	87.000	6.021	2.48E-04	**Zn**		
Total:	**< 520.24**	**< 36.00**	**< 1.48E-03**	< 142.26	< 9.84	< 4.05E-04	< 377.980	< 26.158	< 1.08E-03			

***Total metal processed:** **0.526 tons**

'<' 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:	**PCC**	**Run:**	**1**
Location:	**Portland, OR**	**Start Time:**	**12:46**
Source:	**Furnace #23 Inlet**	**End Time:**	**21:50**
Method:	**29**	**Date:**	**3/11/2020**

EPA Methods 1-4:

1) $P_m = Pb + (\Delta H/13.6) =$ 30.211 "Hg

where Pb: 30.05 "Hg
ΔH: 2.196 "H_2O

2) $Ps = Pb + (Static\ Press./13.6) =$ 30.054 "Hg

where Pb: 30.05 "Hg
Static Press.: 0.06 "H_2O

3) $V_m(std) = V_m(17.64)(Y)\left(\frac{Pm}{Tm}\right) =$ 510.292 dscf

where Vm: 525.416 dcf
Y: 0.9699
Pm: 30.211 "Hg
Tm: 532.2 °A

4) $V_w(std) = (0.04706)(H_2O) =$ 3.562 scf

where H_2O: 75.70 g

5) $Bws = \left(\frac{Vw(std)}{Vw(std)+Vm(std)}\right) =$ 0.0069

where Vw(std): 3.562 scf
Vm(std): 510.292 dscf

6) % H_2O = Bws x 100 = 0.69 %v

7) $V_m(actual) = \left(\frac{Y\ x\ Vm}{(1-Bws)}\right)\left(\frac{Ts}{Tm}\right)\left(\frac{Pm}{Ps}\right) =$ 500.121 awcf

where Y: 0.9699
Vm: 525.4160 dcf
Bws: 0.0069
Ts: 516.0 °A
Tm: 532.2 °A
Pm: 30.211 "Hg
Ps: 30.054 "Hg

8) $M_d = 0.44(CO_2) + 0.32(O_2) + 0.28(N_2 + CO) =$ 28.84 lb/lb-mole

where CO_2: 0.00 %vd
O_2 20.90 %vd
N_2+CO= (100-(O_2+CO_2): 79.10 %vd

Client: PCC **Run: 1**
Source: Furnace #23 Inlet **Date: 3/11/2020**

9) $M_s = M_d(1 - Bws) + (18 \times Bws) =$ 28.77 lb/lb-mole
where M_d: 28.84 lb/lb-mole
Bws: 0.0069

10) Stack Area(cir.) = 3.1416 (stack diameter/24)^2 = 0.545 sq. ft.
where Stack ID: 10 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, $V_s = 85.49(Cp)(\text{Ave. Sqrt } \Delta P)\left(\sqrt{\frac{Ts}{(Ps \times Ms)}}\right) =$ 19.09 fps
where Cp: 0.99
Ave. Sqrt ΔP: 0.2920
Ts: 516.0 °A
Ps: 30.054 "Hg
Ms: 28.77 lb/lb-mole

12) ACFM = (V_s)(stack area)(60 sec/min) = 624.2 ACFM
where V_s: 19.09 ft/sec
Stack Area: 0.545 sq. ft

13) ADCFM = (ACFM)(1-Bws) = 619.9 ADCFM
where ACFM: 624.2
Bws: 0.0069

14) $Qsw = 3600(V_s)(\text{stack area})\left(\frac{528°A}{Ts}\right)\left(\frac{Ps}{29.92\ "Hg}\right) =$ 38,497.3 wscf/hr
where V_s: 19.09 ft/sec
Stack Area: 0.5450 sq. ft.
Ts: 516.0 °A
Ps: 30.054 "Hg

15) Qsd = (wscf/hr)(1-Bws) = 38,231.7 dscf/hr
where wscf/hr: 38,497.3
Bws: 0.0069

16) DSCFM= (dscf/hr)/60 mins/hr = 637.2 DSCFM
where dscf/hr: 38,231.7

17) Nozzle Area = 3.1416 (Nozzle Size/24)^2 = 0.000816 sq. ft.
where Nozzle Size: 0.3867 inches

Client: PCC **Run: 1**
Source: Furnace #23 Inlet **Date: 3/11/2020**

18) Isokinetic % = $\left(\frac{0.0945(Ts)(Vm(std))}{Ps(V_s)(nozzle\ area)(sampling\ time)(1-Bws)}\right)$ = 98.4 %

where Ts:	516.0	°A
Vm(Std):	510.292	dscf
Ps:	30.054	"Hg
Vs	19.09	ft/sec
Nozzle Area:	0.000816	sq. ft.
Sampling Time:	544	min.
Bws:	0.0069	

EPA Method 29:
Chromium

19) Cr Laboratory Results

Front half (FH):	2.910 µg/sample
Back half (BH):	0.458 µg/sample
Total (FH + BH):	3.368 µg/sample

20) Cs = µg/Vm(std) = 0.233 µg/dscm

where Run 1 Total:	3.368	µg/sample
Vm(std):	14.450	dscm

21) Emission Rate = (Cs)($\frac{0.0283168\ m^3}{ft^3}$)(stack flow)(run time)*($\frac{1\ lb}{4.536\ E8\ \mu g}$) $/tons\ metal$= 9.59E-06 lb/ton metal

where Cs:	0.233	µg/dscm
Stack Flow:	637.2	dscf/min
Run time:	544.0	min
Metal processed:	0.526	tons

BISON ENGINEERING, INC.

COMPANY	**PCC**
FACILITY	**LPCS**
LOCATION	**Portland, OR**
SOURCE	**Furnace #23 Inlet**
DATE(S)	**03/11/20**
METHOD	**30B**
POLLUTANT	**Mercury**

Method 30B Field Data
Field Data Entry

Client:	**PCC**	**Run:**	**1**
Location:	**Portland, OR**	**Start Time:**	**12:46**
Source:	**Furnace #23 Inlet**	**End Time:**	**21:51**
EPA Method:	**30B**	**Start Date:**	**3/11/2020**
Box Operator:	**JCR**	**End Date:**	**3/11/2020**
Technician(s):	**JCR**		

Pre-Test Information:

Barometric Pressure:	30.18	"Hg
Test duration:	545	min

Equipment:

Probe ID:	HLN HG		
Probe heat:	250	F	
	Side A	Side B	
Meterbox ID:	BIL1	BIL1	
Y factor:	1.010	0.980	
Desired sampling rate:	1.0	1.0	lpm
Trap ID#:	OL492739	OLC050305	
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	17	16
Train leak rate, lpm	0.000	0.000	0.000	0.000

Test Summary:

	Side A	Side B	
Sample Volume:	545.373	545.298	L
Ave. Meter Temp:	61.4	63.6	F

		Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
Clock Time (24 hr)	**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**
12:46	0	0.000	0.000	59	59	57	61	0.25	0.1	250	250	1.000	1.000
12:51	5	4.960	5.000	59	59	58	63	0.25	0.1	250	250	0.992	1.000
12:56	10	9.700	10.070	59	59	59	63	0.25	0.1	250	250	0.948	1.014
13:01	15	14.810	14.800	59	59	60	62	0.25	0.1	250	250	1.022	0.946
13:06	20	20.300	19.860	59	59	60	62	0.25	0.1	250	250	1.098	1.012
13:11	25	25.070	25.050	57	57	60	63	0.25	0.1	250	250	0.954	1.038
13:16	30	29.840	30.080	57	57	61	64	0.25	0.1	251	251	0.954	1.006
13:21	35	35.120	34.980	57	57	61	64	0.25	0 1	251	251	1.056	0 980
13:26	40	39.870	40.200	57	57	62	64	0.25	0 1	251	251	0.950	1.044
13:31	45	45.430	44.630	57	57	62	65	0.25	0.1	250	250	1.112	0.886
13:36	50	50.020	50.100	55	55	63	66	0.25	0.1	250	250	0.918	1.094
13:41	55	55.040	55.090	55	55	63	68	0.25	0.1	250	250	1.004	0.998
13:46	60	60.000	59.980	55	55	63	68	0.25	0.1	250	250	0.992	0.978
13:51	65	65.100	65.010	55	55	64	68	0.25	0.1	250	250	1.020	1.006
13:56	70	70.700	70.200	55	55	64	69	0.25	0.1	250	250	1.120	1.038
14:01	75	75.330	75.160	54	54	64	71	0.25	0.1	250	250	0.926	0.992
14:06	80	80.260	80.150	54	54	64	72	0.25	0.1	250	250	0.986	0 998
14:11	85	85.300	85.190	54	54	65	72	0.25	0 1	250	250	1.008	1.008
14:16	90	89.790	90.120	54	54	65	74	0.25	0 1	250	250	0.898	0 986

Clock Time (24 hr)	Time (min.)	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
		Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
14:21	95	94.860	95.060	54	54	65	74	0.25	0.1	250	250	1.014	0.988
14:26	100	100.020	100.050	58	58	65	73	0.25	0.1	250	250	1.032	0.998
14:31	105	105.010	105.030	58	58	66	73	0.25	0.1	250	250	0.998	0.996
14:36	110	110.000	110.020	58	58	66	73	0.25	0.1	250	250	0.998	0.998
14:41	115	114.980	114.990	58	58	66	73	0.25	0.1	250	250	0.996	0.994
14:46	120	120.000	119.870	58	58	66	73	0.25	0.1	250	250	1.004	0.976
14:51	125	124.990	124.960	59	59	66	72	0.25	0.1	250	250	0.998	1.018
14:56	130	130.300	130.070	59	59	67	72	0.25	0.1	249	250	1.062	1.022
15:01	135	134.670	135.190	59	59	67	71	0.25	0 1	249	250	0.874	1.024
15:06	140	139.720	140.180	59	59	67	71	0.25	0.1	250	250	1.010	0.998
15:11	145	144.840	145.180	59	59	67	71	0.25	0.1	250	250	1.024	1.000
15:16	150	149.910	150.150	61	61	67	71	0.25	0.1	250	250	1.014	0.994
15:21	155	155.010	155.160	61	61	67	71	0.25	0.1	250	250	1.020	1.002
15:26	160	160.130	160.190	61	61	67	71	0.25	0.1	250	250	1.024	1.006
15:31	165	165.110	165.210	61	61	67	71	0.25	0.1	250	250	0.996	1.004
15:36	170	170.100	170.240	61	61	67	71	0.25	0.1	250	250	0.998	1.006
15:41	175	175.110	175.220	62	62	67	71	0.25	0.1	250	250	1.002	0.996
15:46	180	180.090	180.200	62	62	67	71	0.25	0.1	250	250	0.996	0.996
15:51	185	185.100	185.200	62	62	67	71	0.25	0.1	250	250	1.002	1.000
15:56	190	190.080	190.190	62	62	67	71	0.25	0.1	250	250	0.996	0.998
16:01	195	195.050	195.170	62	62	67	71	0.25	0.1	250	250	0.994	0.996
16:06	200	200.120	200.160	62	62	67	71	0.25	0.1	250	250	1.014	0.998
16:11	205	205.010	205.160	62	62	67	71	0.25	0.1	250	250	0.978	1.000
16:16	210	209.960	210.150	62	62	67	71	0.25	0.1	250	251	0.990	0.998
16:21	215	214.900	215.130	62	62	67	71	0.25	0.1	250	251	0.988	0.996
16:26	220	219.820	220.130	62	62	67	70	0.25	0.1	250	251	0.984	1.000
16:31	225	224.890	225.110	58	58	67	70	0.25	0.1	250	249	1.014	0.996
16:36	230	229.960	230.100	58	58	67	70	0.25	0.1	250	250	1.014	0.998
16:41	235	235.060	235.060	58	58	67	70	0.25	0.1	250	250	1.020	0.992
16:46	240	240.020	240.070	58	58	67	70	0.25	0.1	250	250	0.992	1.002
16:51	245	245.000	245.010	58	58	67	70	0.25	0.1	250	250	0.996	0.988
16:56	250	250.010	249.950	59	59	67	70	0.25	0.1	250	250	1.002	0.988
17:01	255	254.940	254.900	59	59	67	70	0.25	0.1	250	250	0.986	0.990
17:06	260	259.900	259.910	59	59	67	68	0.25	0.1	250	250	0.992	1.002
17:11	265	264.870	264.940	59	59	66	68	0.25	0.1	250	250	0.994	1.006
17:16	270	269.830	269.990	59	59	66	68	0.25	0.1	250	250	0.992	1.010
17:21	275	274.810	275.030	58	58	66	66	0.25	0.1	250	250	0.996	1.008
17:26	280	279.800	280.120	58	58	66	65	0.25	0.1	250	250	0.998	1.018
17:31	285	284.860	285.200	58	58	66	65	0.25	0.1	250	250	1.012	1.016
17:36	290	289.790	290.260	58	58	66	65	0.25	0.1	250	250	0.986	1.012
17:41	295	294.780	295.320	58	58	66	65	0.25	0.1	250	250	0.998	1.012
17:46	300	299.760	300.350	58	58	65	64	0.25	0.1	250	250	0.996	1.006
17:51	305	304.850	305.300	58	58	65	64	0.25	0.1	250	250	1.018	0.990
17:56	310	309.900	310.280	58	58	65	64	0.25	0.1	250	250	1.010	0.996
18:01	315	314.990	315.270	58	58	65	64	0.25	0.1	250	250	1.018	0.998
18:06	320	320.100	320.250	58	58	65	64	0.25	0.1	250	250	1.022	0.996
18:11	325	325.080	325.240	58	58	65	64	0.25	0.1	250	250	0.996	0.998
18:16	330	330.150	330.210	58	58	65	65	0.25	0.1	250	250	1.014	0.994
18:21	335	335.070	335.200	58	58	65	64	0.25	0.1	250	250	0.984	0.998
18:26	340	340.020	340.160	58	58	65	64	0.25	0.1	250	250	0.990	0.992

Clock Time (24 hr)	Time (min.)	Meter Volume (L)		Stack Temp. (°F)		Meter Temp. (°F)		Vacuum ("Hg)		Trap Temperature (°F)		Sampling Rate (Lpm)	
		Side A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
18:31	345	344.980	345.130	58	58	65	65	0.25	0.1	250	250	0.992	0.994
18:36	350	349.910	350.110	56	56	65	65	0.25	0.1	250	250	0.986	0.996
18:41	355	354.950	355.100	56	56	64	64	0.25	0.1	250	250	1.008	0.998
18:46	360	360.010	360.110	56	56	64	64	0.25	0.1	250	250	1.012	1.002
18:51	365	365.110	365.100	56	56	63	64	0.25	0.1	250	250	1.020	0.998
18:56	370	370.150	370.100	56	56	63	64	0.25	0.1	250	250	1.008	1.000
19:01	375	375.190	375.090	54	54	62	63	0.25	0.1	250	250	1.008	0.998
19:06	380	380.250	380.100	54	54	60	63	0.25	0.1	250	250	1.012	1.002
19:11	385	385.200	385.100	54	54	60	63	0.25	0.1	250	250	0.990	1.000
19:16	390	390.200	390.110	54	54	60	63	0.25	0.1	250	250	1.000	1.002
19:21	395	395.180	395.120	54	54	60	61	0.25	0.1	250	250	0.996	1.002
19:26	400	400.190	400.130	53	53	58	59	0.25	0.1	250	250	1.002	1.002
19:31	405	405.150	405.140	53	53	58	58	0.25	0.1	250	250	0.992	1.002
19:36	410	410.080	410.160	53	53	56	57	0.25	0.1	250	250	0.986	1.004
19:41	415	414.940	415.180	53	53	56	56	0.25	0.1	250	250	0.972	1.004
19:46	420	419.890	420.190	53	53	56	56	0.25	0.1	250	250	0.990	1.002
19:51	425	424.850	425.210	53	53	55	55	0.25	0.1	250	250	0.992	1.004
19:56	430	429.850	430.200	53	53	55	56	0.25	0.1	250	250	1.000	0.998
20:01	435	434.870	435.190	53	53	54	54	0.25	0.1	250	250	1.004	0.998
20:06	440	439.900	440.190	53	53	54	53	0.25	0.1	250	250	1.006	1.000
20:11	445	444.950	445.200	53	53	53	53	0.25	0.1	250	250	1.010	1.002
20:16	450	450.030	450.200	53	53	53	53	0.25	0.1	250	250	1.016	1.000
20:21	455	455.000	455.180	53	53	53	53	0.25	0.1	250	250	0.994	0.996
20:26	460	460.060	460.190	53	53	53	53	0.25	0.1	250	250	1.012	1.002
20:31	465	465.100	465.180	53	53	53	53	0.25	0.1	250	250	1.008	0.998
20:36	470	470.090	470.180	53	53	52	53	0.25	0.1	249	250	0.998	1.000
20:41	475	475.110	475.170	53	53	52	52	0.25	0.1	249	250	1.004	0.998
20:46	480	480.120	480.190	50	50	52	52	0.25	0.1	249	250	1.002	1.004
20:51	485	485.100	485.200	50	50	52	52	0.25	0.1	249	250	0.996	1.002
20:56	490	490.140	490.190	50	50	51	52	0.25	0.1	250	250	1.008	0.998
21:01	495	495.150	495.200	50	50	51	51	0.25	0.1	250	250	1.002	1.002
21:06	500	500.160	500.210	50	50	51	51	0.25	0.1	250	250	1.002	1.002
21:11	505	505.200	505.220	47	47	51	50	0.25	0.1	250	250	1.008	1.002
21:16	510	510.190	510.230	47	47	50	50	0.25	0.1	250	250	0.998	1.002
21:21	515	515.210	515.250	47	47	50	50	0.25	0.1	250	250	1.004	1.004
21:26	520	520.250	520.250	47	47	50	50	0.25	0.1	250	250	1.008	1.000
21:31	525	525.290	525.270	47	47	50	50	0.25	0.1	250	250	1.008	1.004
21:36	530	530.300	530.280	47	47	50	50	0.25	0.1	250	250	1.002	1.002
21:41	535	535.310	535.290	47	47	49	50	0.25	0.1	250	250	1.002	1.002
21:46	540	540.340	540.290	47	47	49	49	0.25	0.1	250	250	1.006	1.000
21:51	545	545.373	545.298	47	47	48	49	0.25	0.1	250	250	1.007	1.002

Method 30B
Mercury Concentration

Client: PCC
Location: Portland, OR
Source: Furnace #23 Inlet
Test date: 3/11/2020

Meterbox Y:
Side A 1 0100
Side B 0 9800

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	3/11/2020	OL492739	5.0	6 2	3.5	4.7	4.70E-03	545.373	550.827	30.18	61.4	0.563	8.35E-03	1.55E-02
	B		OLC050305	0.0	1 2	11.1	12.3	1.23E-02	545.298	534.392		63.6	0.544	2.26E-02	

Trap Concentrations Example Calculations:
Run 1, Side A

1. Total Hg — Total Hg = Section 1 + Section 2 - Spike = 4.7 ng
   where Section 1: 6.2 ng
   Section 2: 3.5 ng
   Spike: 5.0 ng

2. Conversion to µg — Total Hg ng/1000 = 4.70E-03 µg
   where Total Hg ng: 4.7 ng

3. Corrected sample volume = DGM reading x Meterbox Y factor = 550.827 L
   where DGM reading: 545.373 L
   Y: 1.010

4. Standard Volume (DSCM) = Sample Vol. (L) x $\left(\frac{528\ ^\circ A}{Tm+460}\right)$ x Bp/29.92 "Hg /1000 = 0.563 DSCM
   where Sample vol.: 550.827 L
   T_m: 61.4 F
   B_p: 30.18 "Hg

5. Hg concentration µg/dscm = Total Hg µg / Volume DSCM = 8 35E-03 µg/dscm
   where Total Hg: 4.70E-03 µg
   DSCM: 0.563

6. Average Pair Concentration = (Side A Conc.+ Side B Conc.)/2 = 1 55E-02 µg/dscm
   where Side A: 0.008 µg/dscm
   Side B: 0 023 µg/dscm

Method 30B
Results QA/QC

Client: PCC
Location: Portland, OR
Source: Furnace #23 Inlet
Test date: 3/11/2020
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	3/11/2020	OL492739 OLC050305	5 0	6 2 1 2	3 5 11 1	4 7 12 3	8 35E-03 2 26E-02	56 5 925 0	FAIL FAIL	5 39E-03	60 6	FAIL	46 08	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: NA 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: PCC
Location: Portland, OR
Source: Furnace #23 Inlet
Test date: 3/11/2020

Run	Ave. Pair Hg Conc. µg/dscm	Stack Flow dscf/hr*	Stack Emissions lb/ton metal**
1	1.55E-02	38,231.7	6.39E-07

*From direct stack measurements made during concurrent M29 runs.
** Total metal processed: 0.526 tons

APPENDIX C: LABORATORY REPORTS

BISON ENGINEERING

PROJECT: PCC220366

CLIENT # B020
REPORT # 20-116

SUBMITTED BY:
CHESTER LabNet
12242 S.W. GARDEN PLACE
TIGARD, OR 97223
(503)624-2183/FAX (503)624-2653
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CHESTER LabNet

12242 SW Garden Place❖Tigard, OR97223-8246❖USA
Telephone 503-624-2183 ❖ Fax 503-624-2653 ❖ www.chesterlab.net

Case Narrative

Date: March 31, 2020

General Information

Client:	Bison Engineering
Client Number:	B020
Report Number:	20-116
Sample Description:	Impinger Trains
Sample Numbers:	19-U782 – 19-U783, 20-S348 – 20-S349, 20-S351 – 20-S354

Analysis

Analytes:	Particulate Mass, Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, P, Se, Ag, Tl, V, Zn
Analytical Protocols:	EPA Method 5 (8/2/17 version) EPA Method 29 (8/2/17 version)
Analytical Notes:	No problems were encountered during the analyses. The 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.

3/31/20

Project Manager Date
Paul Duda

Bison Engineering
Project: PCC220366
Method 5 Data - Report # 20-116

Sample ID	Client ID	Site	Sample Date	Sample Volume (mL)	Net Weight (mg) Acetone Probe Rinse	Filter	Comments
Lab Blank					**0.02**		
Method Blank					**0.09**		
19-U782	M5/M29 Inlet	PCC	3/11/20			**-0.23**	
20-S348	M5 PR Inlet	PCC	3/11/20	108	**1.78**		
19-U783	M5/M29 Outlet	PCC	3/11/20			**-0.90**	
20-S349	M5 PR Outlet	PCC	3/11/20	113	**0.81**		

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ◆ Tigard, OR 97223
(503) 624-2183 ◆ www.chesterlab.net

Client: B020 - Bison Engineering
Report Number: 20-116

Lab ID: 20-S351
Client ID: Inlet FH
Site: PCC
Sample Date: 3/11/20

Analyte	Result	DL	Units
Aluminum, ICP	123.	3.75	µg/sample
Antimony, ICP	2.38	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	4.86	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	4.56	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.39	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	2.48	0.075	µg/sample
Nickel, ICP	3.34	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	8.65	3.75	µg/sample
Silver, ICP	< DL	0.500	µg/sample
Thallium, ICP	< DL	2.50	µg/sample
Vanadium, ICP	< DL	0.250	µg/sample
Zinc, ICP	6.32	0.750	µg/sample

Lab ID: 20-S352
Client ID: Inlet BH
Site: PCC
Sample Date: 3/11/20

Analyte	Result	DL	Units
Aluminum, ICP	44.9	1.50	µg/sample
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	1.46	0.700	µg/sample
Barium, ICP	4.86	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	0.070	0.040	µg/sample
Chromium, ICP	0.740	0.080	µg/sample
Cobalt, ICP	6.63	0.050	µg/sample
Copper, ICP	6.17	0.500	µg/sample
Lead, ICP	1.84	0.500	µg/sample
Manganese, ICP	6.27	0.030	µg/sample
Nickel, ICP	6.29	0.300	µg/sample
Phosphorus, ICP	211.	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Silver, ICP	< DL	0.200	µg/sample
Thallium, ICP	< DL	1.00	µg/sample
Vanadium, ICP	0.119	0.100	µg/sample
Zinc, ICP	87.0	0.300	µg/sample

Client: B020 - Bison Engineering
Report Number: 20-116

Lab ID: 20-S353
Client ID: Outlet FH
Site: PCC
Sample Date: 3/11/20

Analyte	Result	DL	Units
Aluminum, ICP	118.	3.75	µg/sample
Antimony, ICP	1.68	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	4.52	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	18.0	0.200	µg/sample
Cobalt, ICP	< DL	0.125	µg/sample
Copper, ICP	1.39	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	2.76	0.075	µg/sample
Nickel, ICP	3.36	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	< DL	3.75	µg/sample
Silver, ICP	< DL	0.500	µg/sample
Thallium, ICP	< DL	2.50	µg/sample
Vanadium, ICP	0.334	0.250	µg/sample
Zinc, ICP	6.84	0.750	µg/sample

Lab ID: 20-S354
Client ID: Outlet BH
Site: PCC
Sample Date: 3/11/20

Analyte	Result	DL	Units
Aluminum, ICP	27.5	1.50	µg/sample
Antimony, ICP	< DL	0.500	µg/sample
Arsenic, ICP	< DL	0.700	µg/sample
Barium, ICP	0.608	0.050	µg/sample
Beryllium, ICP	< DL	0.020	µg/sample
Cadmium, ICP	0.422	0.040	µg/sample
Chromium, ICP	0.484	0.080	µg/sample
Cobalt, ICP	0.732	0.050	µg/sample
Copper, ICP	5.08	0.500	µg/sample
Lead, ICP	6.26	0.500	µg/sample
Manganese, ICP	0.582	0.030	µg/sample
Nickel, ICP	0.442	0.300	µg/sample
Phosphorus, ICP	< DL	2.00	µg/sample
Selenium, ICP	< DL	1.50	µg/sample
Silver, ICP	< DL	0.200	µg/sample
Thallium, ICP	< DL	1.00	µg/sample
Vanadium, ICP	< DL	0.100	µg/sample
Zinc, ICP	6.93	0.300	µg/sample

All masses in grams (g)		M5 Acetone:	Bison 20-116					
Sx ID	Tare	Tare QC	Tare - QC	Gross	Gross QC	Gross - QC	*net (g)	net (mg)
date/init:	3/14/20 TP	3/16/20 JD		3/18/20 TP	3/19/20 TP		(total mass liq)	
time:	13:59	12:28		14:05	10:10			
		Ambient						
Rel. Humidity	36.7%	35.1%		39.9%	36.1%			
Temp (C/F)	21.1C / 70.0F	21.6C / 70.9F		21.8C / 71.2F	21.1C / 70.0F			
		Desiccator						
Rel. Humidity	0.8%	0.8%		0.8%	0.8%			
Temp (C/F)	20.8C / 69.4F	21.1C / 70.0F		21.6C / 70.9F	20.9C / 69.6F			
0.30000g QC	0.30001	0.29995		0.29999	0.30002			
3.00000g QC	3.00003	3.00003		2.99998	3.00003			
100.00000g QC	99.99999	99.99999		99.99998	99.99994			
Lab Blank	99.44407	99.44407	0.00000	99.44409	99.44386	0.00023	0.00002	0.02
Method Blank	114.85868	114.85836	0.00032	114.85877	114.85857	0.00020	0.00009	0.09
20-S348	119.11058	119.11040	0.00018	119.11236	119.11258	-0.00022	0.00178	1.78
20-S349	99.91507	99.91478	0.00029	99.91588	99.91600	-0.00012	0.00081	0.81
[redacted]								
*net mass = gross - tare (g)								
100g weight: S/N 27853 certified value: 99.999980 (99.99997 - 99.99999)								
Data collected electronically by proprietary BERT II software.								

All masses in grams (g)			M5 filter:	Bison 20-116				
Sx ID	Tare	Tare QC	Tare - QC	Gross	Gross QC	Gross - QC	Net Mass*	Net Mass
date/init:	10/25/19 TP	10/29/19 TP		3/14/20 TP	3/16/20 JD			(mg)
time:	09:06	10:19		13:23	12:50			
		Ambient						
Rel. Humidity	40.2%	35.2%		36.1%	35.1%			
Temp (C/F)	21.6C / 70.9F	20.9C / 69.6F		20.9C / 69.6F	21.8C / 71.2F			
		Desiccator						
Rel. Humidity	4.0%	1.4%		0.8%	0.8%			
Temp (C/F)	21.6C / 70.9F	21.3C / 70.3F		20.8C / 69.4F	21.1C / 70.0F			
0.30000g QC	0.30000	0.30003		0.30005	0.30002			
0.50000g QC	0.50003	0.50003		0.50001	0.50005			
3.00000g QC	3.00003	3.00005		3.00002	3.00001			
19-U782	0.44034	0.44028	0.00006	0.44011	0.43983	0.00028	-0.00023	-0.23
19-U783	0.45123	0.45093	0.00030	0.45033	0.45033	0.00000	-0.00090	-0.90
*net mass = gross - tare (g)								
Quartz tissue filters								
Data collected electronically by proprietary BERT II software.								

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Front Half
Report Number: 20-116

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
Ag	ICB	< DL	2.00
Ag	MB_FH	< DL	2.00
Ag	CCB	< DL	2.00
Ag	MB_BH	< DL	2.00
Ag	CCB	< DL	2.00
Al	ICB	< DL	15.0
Al	MB_FH	< DL	15.0
Al	CCB	< DL	15.0
Al	MB_BH	46.6	15.0
Al	CCB	< DL	15.0
As	ICB	< DL	7.00
As	Meth_Blk	< DL	7.00
As	CCB	< DL	7.00
Ba	ICB	< DL	0.500
Ba	MB_FH	< DL	0.500
Ba	CCB	< DL	0.500
Ba	MB_BH	< DL	0.500
Ba	CCB	< DL	0.500
Be	ICB	< DL	0.200
Be	Meth_Blk	< DL	0.200
Be	CCB	< DL	0.200
Cd	ICB	< DL	0.400
Cd	Meth_Blk	< DL	0.400
Cd	CCB	< DL	0.400
Co	ICB	< DL	0.500
Co	Meth_Blk	< DL	0.500
Co	CCB	< DL	0.500
Cr	ICB	< DL	0.800
Cr	Meth_Blk	< DL	0.800
Cr	CCB	< DL	0.800
Cu	ICB	< DL	5.00
Cu	Meth_Blk	< DL	5.00
Cu	CCB	< DL	5.00
Mn	ICB	< DL	0.300
Mn	Meth_Blk	< DL	0.300
Mn	CCB	< DL	0.300
Ni	ICB	< DL	3.00
Ni	Meth_Blk	< DL	3.00
Ni	CCB	< DL	3.00
P	ICB	< DL	20.0
P	Meth_Blk	< DL	20.0
P	CCB	< DL	20.0
Pb	ICB	< DL	5.00
Pb	Meth_Blk	< DL	5.00
Pb	CCB	< DL	5.00
Sb	ICB	< DL	5.00
Sb	Meth_Blk	< DL	5.00
Sb	CCB	< DL	5.00
Se	ICB	< DL	15.0
Se	Meth_Blk	< DL	15.0
Se	CCB	< DL	15.0
Tl	ICB	< DL	10.0
Tl	Meth_Blk	< DL	10.0
Tl	CCB	< DL	10.0
V	ICB	< DL	1.00
V	Meth_Blk	< DL	1.00
V	CCB	< DL	1.00
Zn	ICB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank
Method Blank is in control if Method Blank results are <10% of sample results

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Front Half
Report Number: 20-116

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
Zn	Meth_Blk	< DL	3.00
Zn	CCB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank
Method Blank is in control if Method Blank results are <10% of sample results

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Ag	ICV	2500	2450	97.9
Ag	LL-CCV	10.0	10.0	100.1
Ag	LL-LCS	9.00	9.30	103.3
Ag	CCV	2500	2260	90.4
Ag	LL-LCS	9.00	7.33	81.5
Ag	CCV	2500	2700	107.9
Al	ICV	2500	2310	92.5
Al	LL-CCV	150.	155.	103.1
Al	LL-LCS	35.0	35.7	101.9
Al	CCV	2500	2390	95.7
Al	LL-LCS	75.0	154.	205.9
Al	CCV	2500	2450	98.0
As	ICV	2500	2500	99.8
As	LL-CCV	35.0	33.1	94.6
As	LL-LCS	20.0	19.3	96.3
As	CCV	2500	2430	97.3
Ba	ICV	2500	2540	101.5
Ba	LL-CCV	2.50	2.73	109.3
Ba	LL-LCS	1.50	1.53	102.1
Ba	CCV	2500	2340	93.6
Ba	LL-LCS	1.50	1.42	94.9
Ba	CCV	2500	2360	94.4
Be	ICV	2500	2560	102.4
Be	LL-CCV	1.00	1.12	111.5
Be	LL-LCS	0.500	0.652	130.4
Be	CCV	2500	2700	108.0
Cd	ICV	2500	2530	101.1
Cd	LL-CCV	2.00	1.87	93.6
Cd	LL-LCS	1.50	1.42	94.8
Cd	CCV	2500	2520	100.6
Co	ICV	2500	2520	100.9
Co	LL-CCV	2.50	2.41	96.4
Co	LL-LCS	1.50	2.32	154.4
Co	CCV	2500	2650	105.9
Cr	ICV	2500	2560	102.4
Cr	LL-CCV	4.00	3.81	95.4
Cr	LL-LCS	1.50	1.61	107.3
Cr	CCV	2500	2510	100.4
Cu	ICV	2500	2440	97.4
Cu	LL-CCV	25.0	26.6	106.5
Cu	LL-LCS	15.0	15.8	105.3
Cu	CCV	2500	2430	97.2
Mn	ICV	2500	2600	104.1

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV (Low Level CCV) Limits: 60% - 140% Recovery
LL-LCS Limits: 50% - 150% Recovery
LL-LCS results are not significant if sample results are >10x LL-LCS concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Front Half
Report Number: 20-116

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Mn	LL-CCV	1.50	1.57	104.7
Mn	LL-LCS	1.00	1.14	113.7
Mn	CCV	2500	2560	102.2
Ni	ICV	2500	2450	97.9
Ni	LL-CCV	15.0	15.2	101.3
Ni	LL-LCS	6.00	6.73	112.1
Ni	CCV	2500	2380	95.2
P	ICV	2500	2560	102.5
P	LL-CCV	100.	109.	108.9
P	LL-LCS	75.0	74.3	99.0
P	CCV	2500	2380	95.2
Pb	ICV	2500	2500	100.0
Pb	LL-CCV	25.0	26.8	107.1
Pb	LL-LCS	15.0	16.7	111.6
Pb	CCV	2500	2420	96.6
Sb	ICV	2500	2510	100.5
Sb	LL-CCV	25.0	22.2	88.8
Sb	LL-LCS	15.0	14.3	95.2
Sb	CCV	2500	2480	99.3
Se	ICV	2500	2480	99.1
Se	LL-CCV	75.0	82.1	109.5
Se	LL-LCS	30.0	36.8	122.7
Se	CCV	2500	2410	96.4
Tl	ICV	2500	2500	100.1
Tl	LL-CCV	50.0	60.2	120.4
Tl	LL-LCS	30.0	42.6	142.0
Tl	CCV	2500	2610	104.3
V	ICV	2500	2520	100.6
V	LL-CCV	5.00	5.10	101.9
V	LL-LCS	3.00	3.11	103.6
V	CCV	2500	2500	100.0
Zn	ICV	2500	2520	100.6
Zn	LL-CCV	15.0	16.2	108.3
Zn	LL-LCS	6.00	8.29	138.2
Zn	CCV	2500	2460	98.6

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV (Low Level CCV) Limits: 60% - 140% Recovery
LL-LCS Limits: 50% - 150% Recovery
LL-LCS results are not significant if sample results are >10x LL-LCS concentration

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
Ag	20-S351	< 2	< 2	N/C #
Ag	20-S352	< 2	< 2	N/C #
Al	20-S351	492.0	492.7	0.14
Al	20-S352	449.2	447.0	0.49
As	20-S351	< 7	< 7	N/C #
Ba	20-S351	19.44	19.10	1.76
Ba	20-S352	48.58	49.67	2.22
Be	20-S351	< 0.2	< 0.2	N/C #

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
Replicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or replicate concentration is less than 5x the detection limit

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Front Half
Report Number: 20-116

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
Cd	20-S351	< 0.4	< 0.4	N/C #
Co	20-S351	< 0.5	< 0.5	N/C #
Cr	20-S351	18.25	17.06	6.74
Cu	20-S351	5.546	< 5	N/C #
Mn	20-S351	9.938	9.526	4.23
Ni	20-S351	13.36	12.83	4.05 #
P	20-S351	< 20	< 20	N/C #
Pb	20-S351	< 5	< 5	N/C #
Sb	20-S351	9.514	14.10	38.8 #
Se	20-S351	34.61	24.61	33.8 #
Tl	20-S351	< 10	< 10	N/C #
V	20-S351	< 1	< 1	N/C #
Zn	20-S351	25.28	24.98	1.19

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
Ag	LCS	< 2	2227.	2500.	89.1
Ag	LCS	< 2	2234.	2500.	89.4
Ag	20-S353	< 2	2093.	2500.	83.7
Ag	LCS	< 2	2071.	2500.	82.8
Ag	LCS	< 2	2053.	2500.	82.1
Ag	20-S354	< 2	1966.	2500.	78.6
Al	LCS	< 15	2407.	2500.	96.3
Al	LCS	< 15	2374.	2500.	95.0
Al	20-S353	472.3	3005.	2500.	101.
Al	LCS	46.63	2470.	2500.	96.9
Al	LCS	46.63	2262.	2500.	88.6
Al	20-S354	274.9	2390.	2500.	84.6
As	LCS	< 7	2551.	2500.	102.
As	LCS	< 7	2582.	2500.	103.
As	20-S353	< 7	2393.	2500.	95.7
Ba	LCS	< 0.5	2320.	2500.	92.8
Ba	LCS	< 0.5	2297.	2500.	91.9
Ba	20-S353	18.06	2116.	2500.	83.9
Ba	LCS	< 0.5	2101.	2500.	84.0
Ba	LCS	< 0.5	2113.	2500.	84.5
Ba	20-S354	6.084	2004.	2500.	79.9
Be	LCS	< 0.2	2614.	2500.	105.
Be	LCS	< 0.2	2665.	2500.	107.
Be	20-S353	< 0.2	2649.	2500.	106.
Cd	LCS	< 0.4	2630.	2500.	105.
Cd	LCS	< 0.4	2661.	2500.	106.
Cd	20-S353	< 0.4	2375.	2500.	95.0
Co	LCS	< 0.5	2559.	2500.	102.
Co	LCS	< 0.5	2572.	2500.	103.
Co	20-S353	< 0.5	2494.	2500.	99.8
Cr	LCS	< 0.8	2515.	2500.	101.
Cr	LCS	< 0.8	2544.	2500.	102.
Cr	20-S353	71.86	2442.	2500.	94.8

LCS Limit: 80% - 120% Recovery Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Front Half
Report Number: 20-116

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Cu	LCS	< 5	2492.	2500.	99.7
Cu	LCS	< 5	2537.	2500.	101.
Cu	20-S353	5.577	2534.	2500.	101.
Mn	LCS	< 0.3	2572.	2500.	103.
Mn	LCS	< 0.3	2606.	2500.	104.
Mn	20-S353	11.03	2439.	2500.	97.1
Ni	LCS	< 3	2464.	2500.	98.6
Ni	LCS	< 3	2500.	2500.	100.
Ni	20-S353	13.44	2263.	2500.	90.0
P	LCS	< 20	2564.	2500.	103.
P	LCS	< 20	2615.	2500.	105.
P	20-S353	< 20	2367.	2500.	94.7
Pb	LCS	< 5	2538.	2500.	102.
Pb	LCS	< 5	2579.	2500.	103.
Pb	20-S353	< 5	2211.	2500.	88.4
Sb	LCS	< 5	2581.	2500.	103.
Sb	LCS	< 5	2613.	2500.	105.
Sb	20-S353	6.737	2408.	2500.	96.1
Se	LCS	< 15	2603.	2500.	104.
Se	LCS	< 15	2654.	2500.	106.
Se	20-S353	< 15	2322.	2500.	92.9
Tl	LCS	< 10	2593.	2500.	104.
Tl	LCS	< 10	2612.	2500.	104.
Tl	20-S353	< 10	2430.	2500.	97.2
V	LCS	< 1	2471.	2500.	98.8
V	LCS	< 1	2518.	2500.	101.
V	20-S353	1.336	2367.	2500.	94.6
Zn	LCS	< 3	2642.	2500.	106.
Zn	LCS	< 3	2678.	2500.	107.
Zn	20-S353	27.36	2441.	2500.	96.5

LCS Limit: 80% - 120% Recovery Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
Ag	LCS-DUP	2230	2230	0.31
Ag	LCS-DUP	2070	2050	0.87
Al	LCS-DUP	2410	2370	1.38
Al	LCS-DUP	2470	2260	8.79
As	LCS-DUP	2550	2580	1.21
Ba	LCS-DUP	2320	2300	1.00
Ba	LCS-DUP	2100	2110	0.57
Be	LCS-DUP	2610	2660	1.93
Cd	LCS-DUP	2630	2660	1.17
Co	LCS-DUP	2560	2570	0.51
Cr	LCS-DUP	2520	2540	1.15
Cu	LCS-DUP	2490	2540	1.79
Mn	LCS-DUP	2570	2610	1.31
Ni	LCS-DUP	2460	2500	1.45
P	LCS-DUP	2560	2620	1.97
Pb	LCS-DUP	2540	2580	1.60
Sb	LCS-DUP	2580	2610	1.23
Se	LCS-DUP	2600	2650	1.94

Duplicate Limit: 20% RPD

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Front Half
Report Number: 20-116

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
Tl	LCS-DUP	2590	2610	0.73
V	LCS-DUP	2470	2520	1.88
Zn	LCS-DUP	2640	2680	1.35

Duplicate Limit: 20% RPD

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Back Half
Report Number: 20-116

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
Ag	ICB	< DL	2.00
Ag	MB_FH	< DL	2.00
Ag	CCB	< DL	2.00
Ag	MB_BH	< DL	2.00
Ag	CCB	< DL	2.00
Al	ICB	< DL	15.0
Al	MB_FH	< DL	15.0
Al	CCB	< DL	15.0
Al	MB_BH	46.6	15.0
Al	CCB	< DL	15.0
As	ICB	< DL	7.00
As	Meth_Blk	< DL	7.00
As	CCB	< DL	7.00
Ba	ICB	< DL	0.500
Ba	MB_FH	< DL	0.500
Ba	CCB	< DL	0.500
Ba	MB_BH	< DL	0.500
Ba	CCB	< DL	0.500
Be	ICB	< DL	0.200
Be	Meth_Blk	< DL	0.200
Be	CCB	< DL	0.200
Cd	ICB	< DL	0.400
Cd	Meth_Blk	< DL	0.400
Cd	CCB	< DL	0.400
Co	ICB	< DL	0.500
Co	Meth_Blk	< DL	0.500
Co	CCB	< DL	0.500
Cr	ICB	< DL	0.800
Cr	Meth_Blk	1.41	0.800
Cr	CCB	< DL	0.800
Cu	ICB	< DL	5.00
Cu	Meth_Blk	< DL	5.00
Cu	CCB	< DL	5.00
Mn	ICB	< DL	0.300
Mn	Meth_Blk	0.311	0.300
Mn	CCB	< DL	0.300
Ni	ICB	< DL	3.00
Ni	Meth_Blk	< DL	3.00
Ni	CCB	< DL	3.00
P	ICB	< DL	20.0
P	Meth_Blk	< DL	20.0
P	CCB	< DL	20.0
Pb	ICB	< DL	5.00
Pb	Meth_Blk	< DL	5.00
Pb	CCB	< DL	5.00
Sb	ICB	< DL	5.00
Sb	Meth_Blk	< DL	5.00
Sb	CCB	< DL	5.00
Se	ICB	< DL	15.0
Se	Meth_Blk	< DL	15.0
Se	CCB	< DL	15.0
Tl	ICB	< DL	10.0
Tl	Meth_Blk	< DL	10.0
Tl	CCB	< DL	10.0
V	ICB	< DL	1.00
V	Meth_Blk	< DL	1.00
V	CCB	< DL	1.00
Zn	ICB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank
Method Blank is in control if Method Blank results are <10% of sample results

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Back Half
Report Number: 20-116

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
Zn	Meth_Blk	< DL	3.00
Zn	CCB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank
Method Blank is in control if Method Blank results are <10% of sample results

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Ag	ICV	2500	2450	97.9
Ag	LL-CCV	10.0	10.0	100.1
Ag	LL-LCS	9.00	9.30	103.3
Ag	CCV	2500	2260	90.4
Ag	LL-LCS	9.00	7.33	81.5
Ag	CCV	2500	2700	107.9
Al	ICV	2500	2310	92.5
Al	LL-CCV	150.	155.	103.1
Al	LL-LCS	35.0	35.7	101.9
Al	CCV	2500	2390	95.7
Al	LL-LCS	75.0	154.	205.9
Al	CCV	2500	2450	98.0
As	ICV	2500	2520	100.9
As	LL-CCV	35.0	33.4	95.5
As	LL-LCS	20.0	21.5	107.6
As	CCV	2500	2500	100.2
Ba	ICV	2500	2540	101.5
Ba	LL-CCV	2.50	2.73	109.3
Ba	LL-LCS	1.50	1.53	102.1
Ba	CCV	2500	2340	93.6
Ba	LL-LCS	1.50	1.42	94.9
Ba	CCV	2500	2360	94.4
Be	ICV	2500	2540	101.5
Be	LL-CCV	1.00	1.08	108.0
Be	LL-LCS	0.500	0.432	86.4
Be	CCV	2500	2600	104.0
Cd	ICV	2500	2540	101.8
Cd	LL-CCV	2.00	2.34	117.2
Cd	LL-LCS	1.50	1.81	120.5
Cd	CCV	2500	2510	100.2
Co	ICV	2500	2530	101.1
Co	LL-CCV	2.50	2.26	90.3
Co	LL-LCS	1.50	1.25	83.2
Co	CCV	2500	2500	99.9
Cr	ICV	2500	2590	103.4
Cr	LL-CCV	4.00	4.78	119.6
Cr	LL-LCS	1.50	3.01	200.7
Cr	CCV	2500	2550	102.2
Cu	ICV	2500	2430	97.3
Cu	LL-CCV	25.0	25.8	103.2
Cu	LL-LCS	15.0	15.4	102.5
Cu	CCV	2500	2400	96.0
Mn	ICV	2500	2630	105.4

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV (Low Level CCV) Limits: 60% - 140% Recovery
LL-LCS Limits: 50% - 150% Recovery
LL-LCS results are not significant if sample results are >10x LL-LCS concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Back Half
Report Number: 20-116

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Mn	LL-CCV	1.50	1.63	108.7
Mn	LL-LCS	1.00	1.21	120.6
Mn	CCV	2500	2600	103.9
Ni	ICV	2500	2600	104.2
Ni	LL-CCV	15.0	15.7	104.5
Ni	LL-LCS	6.00	6.03	100.5
Ni	CCV	2500	2580	103.0
P	ICV	2500	2490	99.4
P	LL-CCV	100.	92.2	92.2
P	LL-LCS	75.0	65.4	87.2
P	CCV	2500	2560	102.5
Pb	ICV	2500	2540	101.8
Pb	LL-CCV	25.0	24.9	99.5
Pb	LL-LCS	15.0	19.3	128.9
Pb	CCV	2500	2530	101.2
Sb	ICV	2500	2540	101.5
Sb	LL-CCV	25.0	23.5	93.9
Sb	LL-LCS	15.0	12.7	84.7
Sb	CCV	2500	2520	100.8
Se	ICV	2500	2500	100.0
Se	LL-CCV	75.0	69.9	93.2
Se	LL-LCS	30.0	29.0	96.8
Se	CCV	2500	2490	99.6
Tl	ICV	2500	2490	99.6
Tl	LL-CCV	50.0	55.6	111.2
Tl	LL-LCS	30.0	22.9	76.4
Tl	CCV	2500	2510	100.3
V	ICV	2500	2560	102.2
V	LL-CCV	5.00	5.27	105.5
V	LL-LCS	3.00	3.30	110.0
V	CCV	2500	2510	100.5
Zn	ICV	2500	2540	101.7
Zn	LL-CCV	15.0	16.4	109.5
Zn	LL-LCS	6.00	8.76	146.0
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) Limits: 60% - 140% Recovery
LL-LCS Limits: 50% - 150% Recovery
LL-LCS results are not significant if sample results are >10x LL-LCS concentration

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
Ag	20-S351	< 2	< 2	N/C #
Ag	20-S352	< 2	< 2	N/C #
Al	20-S351	492.0	492.7	0.14
Al	20-S352	449.2	447.0	0.49
As	20-S352	14.57	8.554	52.0 #
Ba	20-S351	19.44	19.10	1.76
Ba	20-S352	48.58	49.67	2.22
Be	20-S352	< 0.2	< 0.2	N/C #

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
Replicate Limit: 20% RPD
#: per EPA CLP protocol, control limits do not apply if sample and/or replicate concentration is less than 5x the detection limit

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Back Half
Report Number: 20-116

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
Cd	20-S352	0.699	0.703	0.57 #
Co	20-S352	66.34	66.65	0.47
Cr	20-S352	7.398	6.805	8.35
Cu	20-S352	61.74	61.76	0.03
Mn	20-S352	62.68	63.21	0.84
Ni	20-S352	62.93	62.76	0.27
P	20-S352	2114.	2097.	0.81
Pb	20-S352	18.43	20.70	11.6 #
Sb	20-S352	< 5	< 5	N/C #
Se	20-S352	< 15	< 15	N/C #
Tl	20-S352	< 10	< 10	N/C #
V	20-S352	1.194	1.100	8.20 #
Zn	20-S352	870.0	875.8	0.66

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
Ag	LCS	< 2	2227.	2500.	89.1
Ag	LCS	< 2	2234.	2500.	89.4
Ag	20-S353	< 2	2093.	2500.	83.7
Ag	LCS	< 2	2071.	2500.	82.8
Ag	LCS	< 2	2053.	2500.	82.1
Ag	20-S354	< 2	1966.	2500.	78.6
Al	LCS	< 15	2407.	2500.	96.3
Al	LCS	< 15	2374.	2500.	95.0
Al	20-S353	472.3	3005.	2500.	101.
Al	LCS	46.63	2470.	2500.	96.9
Al	LCS	46.63	2262.	2500.	88.6
Al	20-S354	274.9	2390.	2500.	84.6
As	LCS	< 7	2446.	2500.	97.8
As	LCS	< 7	2475.	2500.	99.0
As	20-S354	< 7	2287.	2500.	91.5
Ba	LCS	< 0.5	2320.	2500.	92.8
Ba	LCS	< 0.5	2297.	2500.	91.9
Ba	20-S353	18.06	2116.	2500.	83.9
Ba	LCS	< 0.5	2101.	2500.	84.0
Ba	LCS	< 0.5	2113.	2500.	84.5
Ba	20-S354	6.084	2004.	2500.	79.9
Be	LCS	< 0.2	2467.	2500.	98.7
Be	LCS	< 0.2	2577.	2500.	103.
Be	20-S354	< 0.2	2310.	2500.	92.4
Cd	LCS	< 0.4	2444.	2500.	97.8
Cd	LCS	< 0.4	2455.	2500.	98.2
Cd	20-S354	4.224	2260.	2500.	90.2
Co	LCS	< 0.5	2458.	2500.	98.3
Co	LCS	< 0.5	2489.	2500.	99.6
Co	20-S354	7.322	2303.	2500.	91.8
Cr	LCS	1.413	2548.	2500.	102.
Cr	LCS	1.413	2589.	2500.	104.
Cr	20-S354	4.835	2413.	2500.	96.3

LCS Limit: 80% - 120% Recovery Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Back Half
Report Number: 20-116

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Cu	LCS	< 5	2371.	2500.	94.8
Cu	LCS	< 5	2455.	2500.	98.2
Cu	20-S354	50.75	2288.	2500.	89.5
Mn	LCS	0.311	2590.	2500.	104.
Mn	LCS	0.311	2624.	2500.	105.
Mn	20-S354	5.825	2443.	2500.	97.5
Ni	LCS	< 3	2512.	2500.	100.
Ni	LCS	< 3	2536.	2500.	101.
Ni	20-S354	4.423	2340.	2500.	93.4
P	LCS	< 20	2413.	2500.	96.5
P	LCS	< 20	2428.	2500.	97.1
P	20-S354	< 20	2246.	2500.	89.8
Pb	LCS	< 5	2444.	2500.	97.8
Pb	LCS	< 5	2461.	2500.	98.4
Pb	20-S354	62.55	2313.	2500.	90.0
Sb	LCS	< 5	2472.	2500.	98.9
Sb	LCS	< 5	2515.	2500.	101.
Sb	20-S354	< 5	2289.	2500.	91.6
Se	LCS	< 15	2419.	2500.	96.8
Se	LCS	< 15	2437.	2500.	97.5
Se	20-S354	< 15	2226.	2500.	89.0
Tl	LCS	< 10	2380.	2500.	95.2
Tl	LCS	< 10	2406.	2500.	96.2
Tl	20-S354	< 10	2201.	2500.	88.0
V	LCS	< 1	2523.	2500.	101.
V	LCS	< 1	2554.	2500.	102.
V	20-S354	< 1	2381.	2500.	95.2
Zn	LCS	< 3	2443.	2500.	97.7
Zn	LCS	< 3	2467.	2500.	98.7
Zn	20-S354	69.30	2317.	2500.	89.9

LCS Limit: 80% - 120% Recovery Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
Ag	LCS-DUP	2230	2230	0.31
Ag	LCS-DUP	2070	2050	0.87
Al	LCS-DUP	2410	2370	1.38
Al	LCS-DUP	2470	2260	8.79
As	LCS-DUP	2450	2480	1.18
Ba	LCS-DUP	2320	2300	1.00
Ba	LCS-DUP	2100	2110	0.57
Be	LCS-DUP	2470	2580	4.36
Cd	LCS-DUP	2440	2460	0.45
Co	LCS-DUP	2460	2490	1.25
Cr	LCS-DUP	2550	2590	1.60
Cu	LCS-DUP	2370	2460	3.48
Mn	LCS-DUP	2590	2620	1.30
Ni	LCS-DUP	2510	2540	0.95
P	LCS-DUP	2410	2430	0.62
Pb	LCS-DUP	2440	2460	0.69
Sb	LCS-DUP	2470	2520	1.72
Se	LCS-DUP	2420	2440	0.74

Duplicate Limit: 20% RPD

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: EPA 29 Back Half
Report Number: 20-116

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
Tl	LCS-DUP	2380	2410	1.09
V	LCS-DUP	2520	2550	1.22
Zn	LCS-DUP	2440	2470	0.98

Duplicate Limit: 20% RPD

ICP RAW DATA

Available upon request

CHESTER LABNET

SOURCE SAMPLE RECEIPT CHECKLIST

Client	Bison Engineering	Date	3/13/20
# Runs	[redacted]	Report #	20-116

Custody Seals Inspected, If Present	None	
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)	Not Stated	!!
M26 samples have Thiosulfate added in field?	NA	!!
M29 indicate FH/BH separate or combined?	As Past - separate	!!
Has Form Been Signed?	✓	
Have Date and Time Custody Released Been Noted on Form?	✓	
All Sample Containers Inspected	✓	
Does Number of Samples Match Number on CoC Form?	✓	!!
Do All Sample ID Numbers Match Those on the CoC Form?	✓	!!
Did client mark sample volumes prior to shipment?	✓	*
If required by method, did client vent samples prior to shipment?	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)	3/13/20	
Client contacted for verification of methodology?	[illegible]	
Corrective Actions Documented?		
Corrective Actions Accomplished?		

Items marked !! shall be addressed ***prior to any analytical work being started*** *.*
*Items marked * shall be* ***noted in case narrative*** *upon reporting of results to client.*

Signed Lia Bell

Notes

20-116

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: "		
City: "	State: "	Zip: "
PO #:	Project: PCC220	

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
(503) 624-2183
Fax (503) 624-2653
cln@chesterlab.net

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Report # 20-116

Page 22 of 24

LabNet ID	Field Sample ID	Site	Sample Date	Volume (m³)	Particle Size	Analysis Requested: M-5 and M-29	Remarks
U-782	M-5/29 inlet	PCC	3/11/20	n/a			
U-783	M-5/29 outlet	PCC	"	n/a			
[redacted]							
20-5348	Inlet M-5 probe rinse	PCC					
20-	Inlet M-29 probe rinse	PCC		100 ml			
20-5352	Inlet M-29 Cont.#4	PCC		280 ml			
20-5349	outlet M-5 probe rinse	PCC					
	outlet M-29 probe rinse	PCC		100 ml			
20-5354	outlet M-29 Cont.#4	PCC		330 ml			
[redacted]							

Turn Around Time
☒ Standard
☐ Rush _____ Specify

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	Notes: 220355
[signature] 3/12/20 12:15	[signature] 3/12/20 12:15	
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	

Lisa Ball

From: Kelly Dorsi <KDorsi@bison-eng.com>
Sent: Thursday, March 12, 2020 2:03 PM
To: Lisa Ball
Subject: RE: PCC220358

Yes please!

From: Lisa Ball <lball@chesterlab.net>
Sent: Thursday, March 12, 2020 3:02 PM
To: Kelly Dorsi <KDorsi@bison-eng.com>
Subject: RE: PCC220358

Kelly,

Aluminum and Vanadium are not on the M29 metals list. We can do them, but wanted to confirm.

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

From: Kelly Dorsi [mailto:KDorsi@bison-eng.com]
Sent: Thursday, March 12, 2020 1:52 PM
To: Lisa Ball <lball@chesterlab.net>
Subject: RE: PCC220358

Hi Lisa,

Thank you for asking. They want all the metals except mercury (since we used 30B for that). So by my count that puts us at:

aluminum, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, vanadium, antimony, thallium, barium, silver, zinc and phosphorus.

Let me know if any other questions come up. Oh, also, I can see from the subject line the crew gave you the incorrect project number. It should be PCC220366.

Thanks!

Kelly

From: Lisa Ball <lball@chesterlab.net>
Sent: Thursday, March 12, 2020 2:43 PM
To: Kelly Dorsi <KDorsi@bison-eng.com>
Subject: PCC220358

Kelly,

Can you confirm which metals you want analyzed on the 5/29 samples we received today.

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

This email has been scanned for spam and viruses by Proofpoint Essentials. Click here to report this email as spam.

BISON ENGINEERING

PROJECT: PCC220366

CLIENT # B020
REPORT # 20-196

SUBMITTED BY:
CHESTER LabNet
12242 S.W. GARDEN PLACE
TIGARD, OR 97223
(503)624-2183/FAX (503)624-2653
www.ChesterLab.Net

CHESTER LabNet

12242 SW Garden Place❖Tigard, OR97223-8246❖USA
Telephone 503-624-2183 ❖ Fax 503-624-2653 ❖ www.chesterlab.net

Case Narrative

Date: May 5, 2020

General Information

Client:	Bison Engineering
Client Number:	B020
Report Number:	20-196
Sample Description:	82mm Quartz Filter
Sample Numbers:	20-S680

Analysis

Analytes:	Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, P, Se, Ag, Tl, V, Zn
Analytical Protocols:	EPA Method 29 (8/2/17 version)
Analytical Notes:	Because no reagent blanks were submitted for report # 20-116, the client asked for a filter blank to be analyzed for the report. A filter blank from a different report from the same lot was identified to obtain some of the results required. This blank was digested on 1/28/20 and had been stored in the archives since it was originally analyzed in February. The sample was reanalyzed for the metals that were not in the original report. Since the sample was originally digested for a shorter list of analytes, not all QC elements are available for all of the analytes.
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 5/5/20

Project Manager Date
Paul Duda

Client: B020 - Bison Engineering
Report Number: 20-196

Lab ID: 20-S680
Client ID: Filter Blank

Analyte	Result	DL	Units
Aluminum, ICP	102.	3.75	µg/sample
Antimony, ICP	< DL	1.25	µg/sample
Arsenic, ICP	< DL	1.75	µg/sample
Barium, ICP	4.46	0.125	µg/sample
Beryllium, ICP	< DL	0.050	µg/sample
Cadmium, ICP	< DL	0.100	µg/sample
Chromium, ICP	1.65	0.200	µg/sample
Cobalt, ICP	0.374	0.125	µg/sample
Copper, ICP	< DL	1.25	µg/sample
Lead, ICP	< DL	1.25	µg/sample
Manganese, ICP	0.075	70.2	µg/sample
Nickel, ICP	< DL	0.750	µg/sample
Phosphorus, ICP	< DL	5.00	µg/sample
Selenium, ICP	4.53	3.75	µg/sample
Silver, ICP	< DL	0.500	µg/sample
Thallium, ICP	< DL	2.50	µg/sample
Vanadium, ICP	< DL	0.250	µg/sample
Zinc, ICP	3.78	0.750	µg/sample

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Filter Blank
Report Number: 20-196

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
Ag	ICB	< DL	2.00
Ag	Meth_Blk	< DL	2.00
Ag	CCB	< DL	2.00
Al	ICB	< DL	15.0
Al	Meth_Blk	< DL	15.0
Al	CCB	< DL	15.0
As	ICB	< DL	7.00
As	Meth_Blk	< DL	7.00
As	CCB	< 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	0.906	0.500
Ba	CCB	< DL	0.500
Be	ICB	< DL	0.200
Be	Meth_Blk	< DL	0.200
Be	CCB	< DL	0.200
Be	CCB	< DL	0.200
Cd	ICB	< DL	0.400
Cd	Meth_Blk	< DL	0.400
Cd	CCB	< DL	0.400
Cd	Meth_Blk	< DL	0.400
Cd	CCB	< DL	0.400
Cd	CCB	< DL	0.400
Co	ICB	< DL	0.500
Co	Meth_Blk	< DL	0.500
Co	CCB	< DL	0.500
Co	CCB	< DL	0.500
Cr	ICB	< DL	0.800
Cr	Meth_Blk	< DL	0.800
Cr	CCB	< DL	0.800
Cr	CCB	< DL	0.800
Cu	ICB	< DL	5.00
Cu	Meth_Blk	< DL	5.00
Cu	CCB	< DL	5.00
Cu	CCB	< DL	5.00
Mn	ICB	< DL	281.
Mn	Meth_Blk	< DL	281.
Mn	CCB	< DL	281.
Mn	CCB	< DL	281.
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
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
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

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank
Method Blank is in control if Method Blank results are <10% of sample results

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Filter Blank
Report Number: 20-196

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	DL Conc. µg/L
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
Tl	ICB	< DL	10.0
Tl	Meth_Blk	< DL	10.0
Tl	CCB	< DL	10.0
V	ICB	< DL	1.00
V	Meth_Blk	< DL	1.00
V	CCB	< DL	1.00
V	CCB	< DL	1.00
Zn	ICB	< DL	3.00
Zn	Meth_Blk	3.56	3.00
Zn	CCB	< DL	3.00

*: Sample Media Blank (SM_Blk) concentration in µg/filter
ICB: Initial Calibration Blank CCB: Continuing Calibration Blank
Method Blank is in control if Method Blank results are <10% of sample results

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Ag	ICV	2500	2380	95.0
Ag	LL-CCV	10.0	7.45	74.5
Ag	CCV	2500	2290	91.6
Al	ICV	2500	2410	96.5
Al	LL-CCV	150.	170.	113.3
Al	CCV	2500	2460	98.6
As	ICV	2500	2460	98.4
As	LL-CCV	35.0	34.3	98.0
As	LL-LCS	20.0	20.7	103.6
As	CCV	2500	2650	106.1
As	LL-LCS	20.0	20.4	102.2
As	CCV	2500	2450	97.9
As	CCV	2500	2500	100.2
Ba	ICV	2500	2400	96.1
Ba	LL-CCV	2.50	2.92	116.9
Ba	CCV	2500	2380	95.3
Be	ICV	2500	2600	103.9
Be	LL-CCV	1.00	1.03	103.2
Be	LL-LCS	0.500	0.566	113.2
Be	CCV	2500	2640	105.7
Be	CCV	2500	2580	103.1
Cd	ICV	2500	2490	99.7
Cd	LL-CCV	2.00	1.90	95.1
Cd	LL-LCS	1.50	1.67	111.5
Cd	CCV	2500	2750	110.0
Cd	LL-LCS	1.50	1.65	110.0
Cd	CCV	2500	2630	105.2
Cd	CCV	2500	2710	108.3

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV (Low Level CCV) Limits: 60% - 140% Recovery
LL-LCS Limits: 50% - 150% Recovery
LL-LCS results are not significant if sample results are >10x LL-LCS concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Filter Blank
Report Number: 20-196

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Co	ICV	2500	2450	98.2
Co	LL-CCV	2.50	2.43	97.1
Co	LL-LCS	1.50	1.36	90.9
Co	CCV	2500	2630	105.2
Co	CCV	2500	2490	99.6
Cr	ICV	2500	2560	102.4
Cr	LL-CCV	4.00	4.49	112.2
Cr	LL-LCS	1.50	1.70	113.3
Cr	CCV	2500	2620	104.8
Cr	CCV	2500	2560	102.5
Cu	ICV	2500	2460	98.3
Cu	LL-CCV	25.0	28.6	114.3
Cu	LL-LCS	15.0	17.4	116.1
Cu	CCV	2500	2690	107.7
Cu	CCV	2500	2510	100.4
Mn	ICV	2500	2620	104.6
Mn	LL-CCV	1.50	1.72	114.7
Mn	LL-LCS	1.00	1.11	110.8
Mn	CCV	2500	2680	107.2
Mn	CCV	2500	2630	105.3
Ni	ICV	2500	2390	95.4
Ni	LL-CCV	15.0	15.7	104.5
Ni	LL-LCS	6.00	7.76	129.3
Ni	CCV	2500	2460	98.4
Ni	LL-LCS	6.00	7.79	129.9
Ni	CCV	2500	2300	91.8
Ni	CCV	2500	2340	93.5
P	ICV	2500	2500	100.2
P	LL-CCV	75.0	81.8	109.0
P	LL-LCS	100.	78.5	78.5
P	CCV	2500	2730	109.2
P	CCV	2500	2550	102.2
Pb	ICV	2500	2460	98.2
Pb	LL-CCV	25.0	20.2	80.8
Pb	LL-LCS	15.0	16.1	107.6
Pb	CCV	2500	2640	105.6
Pb	CCV	2500	2500	100.1
Sb	ICV	2500	2510	100.6
Sb	LL-CCV	25.0	24.1	96.2
Sb	LL-LCS	15.0	13.8	92.0
Sb	CCV	2500	2740	109.8
Sb	CCV	2500	2570	102.7
Se	ICV	2500	2480	99.1
Se	LL-CCV	75.0	68.3	91.1
Se	LL-LCS	30.0	30.5	101.7
Se	CCV	2500	2700	108.2
Se	LL-LCS	30.0	28.7	95.8
Se	CCV	2500	2530	101.2
Se	CCV	2500	2590	103.5
Tl	ICV	2500	2370	94.9
Tl	LL-CCV	50.0	53.5	106.9
Tl	LL-LCS	30.0	32.6	108.8
Tl	CCV	2500	2330	93.1
V	ICV	2500	2480	99.1
V	LL-CCV	5.00	5.14	102.8
V	LL-LCS	3.00	3.03	100.9

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV (Low Level CCV) Limits: 60% - 140% Recovery
LL-LCS Limits: 50% - 150% Recovery
LL-LCS results are not significant if sample results are >10x LL-LCS concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Filter Blank
Report Number: 20-196

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
V	CCV	2500	2670	106.6
V	CCV	2500	2530	101.0
Zn	ICV	2500	2400	96.1
Zn	LL-CCV	15.0	18.2	121.1
Zn	LL-LCS	6.00	8.33	138.9
Zn	CCV	2500	2340	93.8

ICV: Initial Calibration Verification CCV: Continuing Calibration Verification
Calibration Verification Limits: 90% - 110% Recovery
LL-CCV (Low Level CCV) Limits: 60% - 140% Recovery
LL-LCS Limits: 50% - 150% Recovery
LL-LCS results are not significant if sample results are >10x LL-LCS concentration

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
As	20-S8	< 7	< 7	N/C #
As	20-S9	< 7	< 7	N/C #
Be	20-S8	< 0.2	< 0.2	N/C #
Cd	20-S8	< 0.4	< 0.4	N/C #
Cd	20-S9	0.672	0.588	13.3 #
Co	20-S8	2.214	2.216	0.09 #
Cr	20-S8	18.92	18.91	0.05
Mn	20-S8	22.78	22.66	0.53
Ni	20-S8	79.78	80.52	0.92
Ni	20-S9	35.70	36.30	1.67
Pb	20-S8	< 5	< 5	N/C #
Se	20-S8	< 15	< 15	N/C #
Se	20-S9	< 15	< 15	N/C #

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	2664.	2500.	107.
As	LCS	< 7	2612.	2500.	104.
As	20-S13	< 7	2662.	2500.	106.
As	LCS	< 7	2280.	2500.	91.2
As	LCS	< 7	2229.	2500.	89.2
As	20-S14	< 7	2396.	2500.	95.8
Be	LCS	< 0.2	2594.	2500.	104.
Be	LCS	< 0.2	2647.	2500.	106.
Be	20-S13	< 0.2	2493.	2500.	99.7
Cd	LCS	< 0.4	2761.	2500.	110.
Cd	LCS	< 0.4	2744.	2500.	110.
Cd	20-S13	< 0.4	2713.	2500.	109.
Cd	LCS	< 0.4	2506.	2500.	100.
Cd	LCS	< 0.4	2432.	2500.	97.3

LCS Limit: 80% - 120% Recovery Spike Limit: 75% - 125% Recovery
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Filter Blank
Report Number: 20-196

Laboratory Control Sample/Post Digestion Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Cd	20-S14	1.002	2689.	2500.	108.
Co	LCS	< 0.5	2634.	2500.	105.
Co	LCS	< 0.5	2593.	2500.	104.
Co	20-S13	1.309	2575.	2500.	103.
Cr	LCS	< 0.8	2543.	2500.	102.
Cr	LCS	< 0.8	2573.	2500.	103.
Cr	20-S13	8.093	2521.	2500.	101.
Cu	LCS	< 5	2640.	2500.	106.
Cu	LCS	< 5	2576.	2500.	103.
Mn	LCS	< 0.3	2607.	2500.	104.
Mn	LCS	< 0.3	2639.	2500.	106.
Mn	20-S13	6.907	2569.	2500.	102.
Ni	LCS	< 3	2561.	2500.	102.
Ni	LCS	< 3	2515.	2500.	101.
Ni	20-S13	52.44	2495.	2500.	97.7
Ni	LCS	< 3	2217.	2500.	88.7
Ni	LCS	< 3	2246.	2500.	89.8
Ni	20-S14	17.34	2325.	2500.	92.3
P	LCS	< 20	2767.	2500.	111.
P	LCS	< 20	2711.	2500.	108.
Pb	LCS	< 5	2675.	2500.	107.
Pb	LCS	< 5	2638.	2500.	106.
Pb	20-S13	< 5	2525.	2500.	101.
Sb	LCS	< 5	2713.	2500.	109.
Sb	LCS	< 5	2667.	2500.	107.
Se	LCS	< 15	2739.	2500.	110.
Se	LCS	< 15	2695.	2500.	108.
Se	20-S13	< 15	2653.	2500.	106.
Se	LCS	< 15	2309.	2500.	92.4
Se	LCS	< 15	2257.	2500.	90.3
Se	20-S14	< 15	2406.	2500.	96.2
Tl	LCS	< 10	2367.	2500.	94.7
Tl	LCS	< 10	2336.	2500.	93.4
V	LCS	< 1	2619.	2500.	105.
V	LCS	< 1	2579.	2500.	103.
Zn	LCS	3.558	2488.	2500.	99.4
Zn	LCS	3.558	2429.	2500.	97.0

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	2660	2610	1.97
As	LCS-DUP	2280	2230	2.26
Be	LCS-DUP	2590	2650	2.02
Cd	LCS-DUP	2760	2740	0.62
Cd	LCS-DUP	2510	2430	3.00
Co	LCS-DUP	2630	2590	1.57
Cr	LCS-DUP	2540	2570	1.17
Cu	LCS-DUP	2640	2580	2.45
Mn	LCS-DUP	2610	2640	1.22
Ni	LCS-DUP	2560	2520	1.81
Ni	LCS-DUP	2220	2250	1.30

Duplicate Limit: 20% RPD

QA/QC Report

Client Name: Bison Engineering
Project Number: B020
Analytical Technique: ICP - Optima 8300
Sample Description: Method 29 Filter Blank
Report Number: 20-196

Laboratory Control Sample Duplicate Data

Analyte	Sample ID	Spike Conc. µg/L	Duplicate Conc. µg/L	RPD
P	LCS-DUP	2770	2710	2.04
Pb	LCS-DUP	2680	2640	1.39
Sb	LCS-DUP	2710	2670	1.71
Se	LCS-DUP	2740	2700	1.62
Se	LCS-DUP	2310	2260	2.28
Tl	LCS-DUP	2370	2340	1.32
V	LCS-DUP	2620	2580	1.54
Zn	LCS-DUP	2490	2430	2.40

Duplicate Limit: 20% RPD

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

Sorbent Trap Analysis Report

Date	3/31/20	Company	Bison Engineering	Method	EPA 7473
Analyst[s]	James Zoller	Contact	Kelly Dorsi	Method Uncertainty	± 10%
Project	2021303	Phone	406-202-5232	MDL	0.27ng
Turnaround	Standard	Email	kdorsi@bison-eng.com	LOQ	2ng

Trap ID	Pre-Filter Mass [ng]	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	Affected Section
OL492739			6.2	3.5	9.7		5	56.5%		#23 Inlet		
OLC050305			1.2	11.1	12.3			903.1%		#23 Inlet		
OL492743			5.7	1.2	6.9		5	21.0%		#23 Outlet		
OLC050333			1.7	0.8	2.5			48.6%		#23 Outlet		

[1] Total Mass = PF+AGS+S1+S2

[2] Breakthrough = S2 / [PF+AGS+S1]

[3] For PS12B only Spike Recovery = S3 / Spike Level

[R] Data invalidation qualifier - refer to notes

Analyst	James Zoller	Temperature [°C]	680
File Name	200330_JPZ_Bison_Engineering_2021303	Flow Rate [L/min]	1
Analyzer	473	MDL [ng]	0.27
Cell type	Medium	SD	1.5

	Trap 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	Affected Section
1	OL492739			6.2	3.5			5	#23 Inlet		
2	OLC050305			1.2	11.1				#23 Inlet		
3	OL492743			5.7	1.2			5	#23 Outlet		
4	OLC050333			1.7	0.8				#23 Outlet		
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Additional Notes

Daily Calibration[1]		
Lot Std. ID	Std. [ng]	Calculated [ng]
P2-MEB678302	2	see cal. report
P2-MEB678302	5	see cal. report
P2-MEB686387	50	see cal. report
P2-MEB686387	100	see cal. report
P2-HG683300	500	see cal. report
P2-HG683300	1000	see cal. report

Continuing Calibration Verifications[3]		
Lot Std. ID	Std. [ng]	Calculated [ng]
P2-MEB686387	100.0	102.2

Active Hg Standard Bank[5]		
Kit Used	☐ A	☑ Field 6
Concentration [µg/mL]	Lot Std. ID	Exp. Date
0.1	P2-MEB678302	12/13/2020
1	P2-MEB686387	12/13/2020
10	P2-HG683300	12/13/2020
100	P2-MEB682112	12/13/2020
1 (Independent)	P2-HG681569	12/13/2020

Independent Calibration Verification[2]		
Lot Std. ID	Std. [ng]	Calculated [ng]
P2-HG681569	100.0	101.9

Response Factor (Method 30B Only)[4]		
Lot Std. ID	Std. [ng]	Area/Mass
P2-MEB678302	1	454

Other Reagents	
Sodium Carbonate	0000212240
Iodinated Activated Carbon	4C09

Pipette Identification
ER3

RF Pipette ID (if different from cal)

[1]Performed daily prior to analysis of sorbent traps, Refer to SOP for Instrument Calibration for acceptance criteria

[2]Performed immediately after calibration curve is verified, must come within 10% of expected value

[3]Performed between every 10 samples for method 30B and after every analytical batch

[4]Response factor value must fall between the LOQ and MDL

[5]Subject to change, for analyst convenience only

Immediately report any QA/QC failures or anything suspicious to the QA/QC Manager

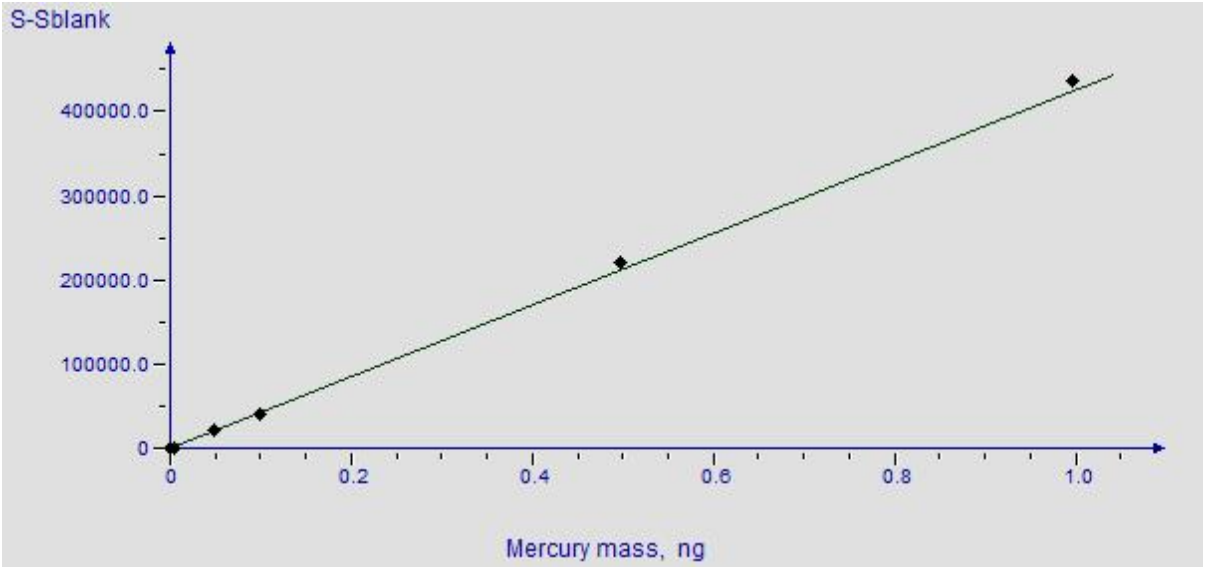
Analyst Signature

By signing this report I confirm that the above data are true to the best of my knowledge.

Date 3/30/2020

Calibration Report

Report created	30.03.2020 13:38:05
Instrument RA915+	Serial number 473
Calibration created	30.03.2020 12:06:32
Calibration name	200330_JPZ_2-1000



Results

N	Mercury mass, ng	S-Sblank	Ref.data, ng/g	Calculated, ng/g	d, %
1	1.00	440200	1000.0	1028.1	2.8
2	0.50	222200	500.0	518.9	3.8
3	0.10	42300	100.0	98.8	-1.2
4	0.05	22020	50.0	51.4	2.9
5	0.01	2014	5.0	4.7	-5.9
6	0.00	837	2.0	2.0	-2.3

Calibration	S - Sblank = a·m
Algorithm	WLSM
Correlation coefficient	0.999983
Residual standard deviation	10.714518
Coefficient	a = 428200.0000
Blank	Sblank = 0.0000

Trap ID

OL492739

OHIO LUMEX

* use low level Analyzer

Sorbent Trap Chain of Custody Form

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) Anna Batyreva

Production Lot: S-2C92 Carbon Lot: NC

☐ High Flow ☐ Coil Pre-filter ☐ 240 mm
☐ Static Pre-filter ☐ AGS ☐ 300 mm
☐ Fluffy Pre-filter ☒ 185 mm ☐ 450 mm

Spike Date: 8/20/2018 Spike Time: 1059

Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: #23 INLET

PRE-Run Leak Check (circle one): **PASS** FAIL

Boiler ID:

Run START: 3/11/20 (Date) 12:46 (Time)

Sampling Location: INLET (stack, FGD inlet, etc.)

Run Number (optional): 1

Run END: 3/11/20 (Date) 21:51 (Time)

Sampling Train (circle one): **A** B

POST-Run Leak Check (circle one): **PASS** FAIL

Notes: CALL KELLY DORSI W/ QUESTIONS ABOUT Hg MASS (406) 202-5232

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 55

Ave Trap Temp (F°): 250

Ave Flow Rate (cc/min): 1

Total Volume (L) 545.373 or (dscm):

Estimated Ave Hg Concentration (µg/dscm): UNKNOWN

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): UNKNOWN

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	3/11/20		**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	3/11/20		
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]	3/30/20	0823	Seal intact as received Yes ☐ No ☐
Trap analyzed by				Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: August 2021

Project: 2021303

Trap ID

OLC050333

OHIO LUMEX

* use low level Analyzer

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-A02 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: LPC #23 OUTLET

Boiler ID: _____

Sampling Location: OUTLET (stack, FGD inlet, etc.)

Run Number (optional): 1

Sampling Train (circle one): A (B)

PRE-Run Leak Check (circle one): (PASS) FAIL

Run START: 3/11/20 (Date) 12:46 (Time)

Run END: 3/11/20 (Date) 21:51 (Time)

POST-Run Leak Check (circle one): (PASS) FAIL

Notes: CALL KELLY DORSI W/ QUESTIONS ABOUT Hg MASS (406) 202-5232

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 130

Ave Trap Temp (F°): 260

Ave Flow Rate (cc/min): 1

Total Volume (L) 545.364 or (dscm): _____

Estimated Ave Hg Concentration (µg/dscm): UNKNOWN

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): UNKNOWN

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		3/11/20		**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by		3/11/20		
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Courier/Other (If Applicable)				Seal intact as received Yes ☐ No ☐
Trap received by lab		3/20/20	0823	Seal intact as received Yes ☐ No ☐
Trap analyzed by				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

OL492743

OHIO LUMEX

Sorbent Trap Chain of Custody Form

* use low level analyzer

☐ **Unspiked** ☒ **Spiked At:** 5ng

Spiking Method Cold Vapor Adsorption Via Impinger Sparging
Certified Accuracy ± 10%, Traceable to NIST

QA/QC Signature (Trap Maker) [signature]

QA/QC Signature (Spiker) Anna Batyreva

Production Lot: S-2C92 Carbon Lot: NC

☐ High Flow ☐ Coil Pre-filter ☐ 240 mm
☐ Static Pre-filter ☐ AGS ☐ 300 mm
☐ Fluffy Pre-filter ☒ 185 mm ☐ 450 mm

Spike Date: 8/20/2018 Spike Time: 1059

Type of Trap: 30B

TO BE FILLED OUT BY SAMPLING TECHNICIAN

Plant/Source: LPC #23 OUTLET

Boiler ID:

Sampling Location: OUTLET (stack, FGD inlet, etc.)

Run Number (optional): 1

Sampling Train (circle one): (A) B

PRE-Run Leak Check (circle one): (PASS) FAIL

Run START: 3/11/20 (Date) 12:46 (Time)

Run END: 3/11/20 (Date) 21:51 (Time)

POST-Run Leak Check (circle one): (PASS) FAIL

Notes: CALL KELLY DORSI W/ QUESTIONS ABOUT Hg MASS (406) 202-5232

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 130

Ave Trap Temp (F°): 260

Ave Flow Rate (cc/min): 1

Total Volume (l 544.718 or (dscm):

Estimated Ave Hg Concentration (µg/dscm): UNKNOWN

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): UNKNOWN

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	3/11/20		**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	3/11/20		
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]	3/30/20	0803	Seal intact as received Yes ☐ No ☐
Trap analyzed by				Seal intact as received Yes ☐ No ☐

Make sure all of your sampling conditions prevent moisture condensation in the trap media. Moisture condensation is a major cause of breakthrough and spike loss in sorbent traps and should be prevented at all costs.

Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy. Solon, OH 44139 USA
Phone: 888-876-2611 mail@ohiolumex.com

Deactivated glass and glass wool Impregnated Activated Carbon – Refer to SDS

Best Before: August 2021

Trap ID

OLC050305

OHIO LUMEX

* use low level analyzer

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-A02 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: LPC #23 INLET

Boiler ID: _____

Sampling Location: INLET (stack, FGD inlet, etc.)

Run Number (optional): 1

Sampling Train (circle one): A (B)

PRE-Run Leak Check (circle one): (PASS) FAIL

Run START: 3/11/20 (Date) 12:46 (Time)

Run END: 3/11/20 (Date) 21:51 (Time)

POST-Run Leak Check (circle one): (PASS) FAIL

Notes: CALL KELLY DORSI W/ QUESTIONS ABOUT Hg MASS (406) 202-5232

SAMPLING CONDITIONS AND PARAMETERS

Ave Duct Temp (F°): 55

Ave Trap Temp (F°): 250

Ave Flow Rate (cc/min): 1

Total Volume (L) 545.298 or (dscm):_____

Estimated Ave Hg Concentration (µg/dscm): UNKNOWN

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): UNKNOWN

Note: Analyzer calibration range will be set based on this value. Leaving this blank may result in out-of-calibration analysis. Please contact us if you require assistance estimating this value.

Chain Of Custody

Signatures along with Date/Time required for insertion, removal, lab receiving and lab analysis of trap.

	Signature	Date	Time	Security Seal
Trap inserted by	[signature]	3/11/20		**If Applicable** Place Chain of Custody seal here (See Security Seal Instruction Sheet)
Trap removed and sealed by	[signature]	3/11/20		
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]	3/30/20	0823	Seal intact as received Yes ☐ No ☐
Trap analyzed by				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

Analysis Request Form

CUSTOMER INFORMATION

Company	Bison Engineering	Report Recipient[s]	kdorsi@bison-eng.com
Sampling Location			zharding@bison-eng.com
Billing City/Team/Office	Helena		
Date	3/23/2020		
Main Contact	Kelly Dorsi		
Phone	406-202-5232		
Email	kdorsi@bison-eng.com		
Field Project No. (if applies)	PCC220366		

PAYMENT METHOD

■ PO number | PCC220366 ☐ Credit card (3.25% surcharge applies)

SAMPLE TYPE

Hg sorbent traps | ■ 30B ☐ PS12B RATA ☐ PS12B Long Term/Weekly ☐ Speciation ☐ Gold

Non-Hg sorbent traps | ☐NH_3 ☐SO_3 ☐HCl ☐ HBr ☐Se ☐ As

Other non-sorbent trap sample |

TURNAROUND TIME*

Hg sorbent traps | ☐ Same Day ☐ One Day ☐ Two Day ☐ Expedited Compliance ■ Standard 3-5 days

Non-Hg sorbent traps | Turnaround times as quoted * Refer to the Guidance Document for standard turnaround time explanations.

SAMPLE INFORMATION

Total number of samples | 4 Source | HT#23 Expected source concentration | LOW

	Sample ID	Notes		Sample ID	Notes		Sample ID	Notes
1	OLC050333	outlet	9			17		
2	OL492743	outlet-spike	10			18		
3	OLC050305	inlet	11			19		
4	OL492739	inlet-spike	12			20		
5			13			21		
6			14			22		
7			15			23		
8			16			24		

SHIPPING

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 and ship to ATTN: Ohio Lumex Laboratory at the address below.

ADDITIONAL INFORMATION OR SPECIAL INSTRUCTIONS

Use low level an analyzer please

1 440 264 2500 x315 lab
1 888 876 2611 toll free
www.ohiolumex.com
lab@ohiolumex.com
30350 Bruce Industrial Pkwy.
Cleveland, OH 44139 USA

APPENDIX D: PLANT OPERATING RECORDS

LPCS Heat Treat Furnace #23 Production Data	
Date	March 11, 2020
Casting Weight	1,051 lbs

APPENDIX E: CALIBRATIONS AND CERTIFICATIONS

STAC STACK TESTING ACCREDITATION COUNCIL

A2LA American Association for Laboratory Accreditation

Accredited Air Emission Testing Body

A2LA has accredited

BISON ENGINEERING, INC.

In recognition of the successful completion of the joint A2LA and Stack Testing Accreditation Council (STAC) evaluation process, this laboratory is accredited to perform testing activities in compliance with ASTM D7036:2004 - Standard Practice for Competence of Air Emission Testing Bodies.

Presented this 15th day of January 2020.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4675.01
Valid to November 30, 2021

This accreditation program is not included under the A2LA ILAC Mutual Recognition Arrangement.

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE A

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	Box 1
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	3-Mar-20	12:30
Barometric Pressure		25.81	in Hg
Calibration Technician		JBA	
Calibration Meter Gamma		1.0000	

<<<<<<<Your reference meter Y here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	42.947	42.947	64	65	0.000	42.993	42.993	68	69
10.00	3.00	0.000	31.047	31.047	65	67	0.000	31.013	31.013	69	69
10.00	2.00	0.000	21.090	21.090	67	68	0.000	21.126	21.126	69	69
10.00	1.00	0.000	10.159	10.159	68	69	0.000	10.311	10.311	69	69
10.00	0.50	0.000	5.219	5.219	69	69	0.000	5.482	5.482	69	69

Results

Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
37.295	3.729	37.052	3.705	0.9935	-0.017	PASS
26.884	2.688	26.702	2.670	0.9932	-0.017	PASS
18.210	1.821	18.190	1.819	0.9989	-0.011	PASS
8.755	0.876	8.878	0.888	1.0140	0.004	PASS
4.494	0.449	4.720	0.472	1.0504	0.040	FAIL
Pre-test Y	1.029	% Deviation	PASS	1.010	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0 02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature _____ JBA

Date _____ 3-Mar-20

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE B

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	Box 1
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	3-Mar-20	14:00
Barometric Pressure		25.81	in Hg
Calibration Technician		JBA	
Calibration Meter Gamma		1.0000	

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

<<<<<<<Your reference meter Y here

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	44.130	44.130	71	72	0.000	43.328	43.328	70	70
10.50	3.00	0.000	34.487	34.487	72	72	0.000	33.681	33.681	70	70
10.00	2.00	0.000	20.984	20.984	72	72	0.000	20.449	20.449	70	70
10.00	1.00	0.000	8.832	8.832	72	72	0.000	8.606	8.606	70	70
10.00	0.50	0.000	5.844	5.844	72	72	0.000	5.707	5.707	70	70

Results

Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
37.817	3.782	37.235	3.724	0.9846	0.004	PASS
29.526	2.812	28.945	2.757	0.9803	0.000	PASS
17.965	1.797	17.573	1.757	0.9782	-0.002	PASS
7.561	0.756	7.396	0.740	0.9781	-0.002	PASS
5.003	0.500	4.904	0.490	0.9802	0.000	PASS
Pre-test Y	1.011	% Deviation	PASS	0.980	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0 02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature _____ Date _____

JBA 3-Mar-20

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE A

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	Box 1
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	19-Mar-20	11:45
Barometric Pressure		26.06	in Hg
Calibration Technician		JBA	
Calibration Meter Gamma		1.0000	

<<<<<<<Your reference meter Y here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	42.063	42.063	65	65	0.000	42.007	42.007	68	68
10.00	3.00	0.000	31.886	31.886	65	67	0.000	31.593	31.593	68	68
10.00	2.00	0.000	21.705	21.705	67	68	0.000	21.664	21.664	68	69
10.00	1.00	0.000	9.923	9.923	68	70	0.000	10.136	10.136	69	70
10.75	0.50	0.000	6.140	6.140	70	72	0.000	6.274	6.274	70	70

Results

Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
36.846	3.685	36.588	3.659	0.9930	-0.011	PASS
27.878	2.788	27.517	2.752	0.9871	-0.017	PASS
18.923	1.892	18.851	1.885	0.9962	-0.008	PASS
8.626	0.863	8.803	0.880	1.0205	0.016	PASS
5.318	0.495	5.444	0.506	1.0238	0.020	PASS
Pre-test Y	1.010	% Deviation	PASS	1.004	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0 02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature _____ JBA

Date _____ 19-Mar-20

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE B

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	Box 1
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	19-Mar-20	13:00
Barometric Pressure		26.06	in Hg
Calibration Technician		JBA	
Calibration Meter Gamma		1.0000	

<<<<<<<Your reference meter Y here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	43.577	43.577	72	72	0.000	42.692	42.692	70	70
10.00	3.00	0.000	32.861	32.861	72	72	0.000	32.030	32.030	70	70
10.00	2.00	0.000	21.618	21.618	72	72	0.000	21.019	21.019	70	70
10.00	1.00	0.000	10.270	10.270	72	72	0.000	9.947	9.947	70	70
10.00	0.50	0.000	4.992	4.992	72	72	0.000	4.875	4.875	70	70

Results

Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
37.670	3.767	37.044	3.704	0.9834	0.005	PASS
28.406	2.841	27.793	2.779	0.9784	0.000	PASS
18.687	1.869	18.238	1.824	0.9760	-0.002	PASS
8.878	0.888	8.631	0.863	0.9722	-0.006	PASS
4.315	0.432	4.230	0.423	0.9802	0.002	PASS
Pre-test Y	0 980	% Deviation	PASS	0.978	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0 02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature JBA

Date 19-Mar-20

APEX INSTRUMENTS 204 Technology Park Lane Fuquay-Varina, North Carolina 27526 (919) 557-7300 FAX (919) 557-7110

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE A

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	Box 2
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	3-Mar-20	10:00
Barometric Pressure		25.78	in Hg
Calibration Technician		JBA	
Calibration Meter Gamma		1.0000	

<<<<<<<Your reference meter Y here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.50	4.00	0.000	42.717	42.717	62	64	0.000	43.450	43.450	63	64
10.00	3.00	0.000	29.775	29.775	64	66	0.000	30.011	30.011	64	64
10.00	2.00	0.000	21.098	21.098	69	72	0.000	20.992	20.992	65	65
10.00	1.00	0.000	9.380	9.380	65	69	0.000	9.356	9.356	64	65
10.00	0.50	0.000	5.222	5.222	72	73	0.000	5.217	5.217	65	66

Results

Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
37.158	3.539	37.760	3.596	1.0162	0.007	PASS
25.802	2.580	26.056	2.606	1.0098	0.001	PASS
18.093	1.809	18.191	1.819	1.0054	-0.004	PASS
8.097	0.810	8.115	0.812	1.0022	-0.007	PASS
4.461	0.446	4.517	0.452	1.0124	0.003	PASS
Pre-test Y	1.014	% Deviation	PASS	1.009	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0 02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature _____ JBA

Date _____ 3-Mar-20

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE B

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	Box 2
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	3-Mar-20	11:00
Barometric Pressure		25.78	in Hg
Calibration Technician		JBA	
Calibration Meter Gamma		1.0000	

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

<<<<<<<Your reference meter Y here

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	41.294	41.294	70	74	0.000	41.180	41.180	66	66
10.00	3.00	0.000	32.382	32.382	74	75	0.000	31.850	31.850	66	67
10.00	2.00	0.000	21.030	21.030	75	75	0.000	20.435	20.435	67	67
10.00	1.00	0.000	11.130	11.130	75	75	0.000	10.762	10.762	67	67
10.00	0.50	0.000	6.341	6.341	75	75	0.000	6.063	6.063	67	67

Results

Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
35.313	3.531	35.617	3.562	1.0086	0.019	PASS
27.562	2.756	27.521	2.752	0.9985	0.009	PASS
17.883	1.788	17.641	1.764	0.9865	-0.003	PASS
9.464	0.946	9.290	0.929	0.9816	-0.008	PASS
5.392	0.539	5.234	0.523	0.9707	-0.019	PASS
Pre-test Y	1.005	% Deviation	PASS	0.989	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature _____ JBA

Date _____ 3-Mar-20

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE A

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	Box 2
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	19-Mar-20	9:30
Barometric Pressure		26.02	in Hg
Calibration Technician		JBA	
Calibration Meter Gamma		1.0000	

<<<<<<<Your reference meter Y here

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	40.656	40.656	64	65	0.000	41.218	41.218	64	65
10.00	3.00	0.000	29.720	29.720	65	67	0.000	29.923	29.923	65	65
10.50	2.00	0.000	21.486	21.486	67	69	0.000	21.454	21.454	65	64
10.00	1.00	0.000	8.832	8.832	69	70	0.000	8.771	8.771	64	64
10.00	0.50	0.000	6.701	6.701	70	72	0.000	6.586	6.586	64	64

Results

Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
35.593	3.559	36.085	3.608	1.0138	0.008	PASS
25.944	2.594	26.171	2.617	1.0087	0.003	PASS
18.685	1.780	18.782	1.789	1.0052	0.000	PASS
7.659	0.766	7.686	0.769	1.0035	-0.002	PASS
5.795	0.579	5.771	0.577	0.9960	-0.009	PASS
Pre-test Y	1.009	% Deviation	PASS	1.005	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0 02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature _____ JBA

Date _____ 19-Mar-20

APEX INSTRUMENTS
LOW FLOW CONSOLE CALIBRATION
SIDE B

Console Information	
Low Flow Model Number	XC-260
Low Flow Serial Number	Box 2
Ref. DGM Model Number	SK25EX
Ref. DGM Serial Number	1402007

Calibration Conditions			
Date	Time	19-Mar-20	10:30
Barometric Pressure		26.02	in Hg
Calibration Technician		JBA	
Calibration Meter Gamma		1.0000	

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

<<<<<<<Your reference meter Y here

Calibration Data

Run Time	Metering Console						Reference Meter				
Elapsed	Rotameter	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
Θ minutes	L/min	V_{mi} Liters	V_{mf} Liters	V_m Liters	t_{Oi} °F	t_{Of} °F	V_{wi} Liters	V_{wf} Liters	V_w Liters	t_{wi} °F	t_{wf} °F
10.00	4.00	0.000	42.056	42.056	73	73	0.000	41.699	41.699	65	65
10.00	3.00	0.000	30.305	30.305	73	74	0.000	29.692	29.692	65	65
10.00	2.00	0.000	20.360	20.360	74	77	0.000	19.798	19.798	65	65
10.00	1.00	0.000	8.955	8.955	77	79	0.000	8.627	8.627	65	66
10.00	0.50	0.000	6.331	6.331	79	81	0.000	6.041	6.041	66	66

Results

Standardized Data				Dry Gas Meter Calibration Factor		
Dry Gas Meter		Calibration Meter		Value	Variation	PASS/FAIL
$V_{m(std)}$ Liters	$Q_{m(std)}$ L/min	$V_{w(std)}$ Liters	$Q_{w(std)}$ L/min	Y	ΔY	Tolerance (+/- 0.02)
36.231	3.623	36.471	3.647	1.0066	0.015	PASS
26.083	2.608	25.969	2.597	0.9956	0.004	PASS
17.458	1.746	17.316	1.732	0.9918	0.000	PASS
7.643	0.764	7.538	0.754	0.9863	-0.006	PASS
5.383	0.538	5.274	0.527	0.9796	-0.012	PASS
Pre-test Y	0 989	% Deviation	PASS	0.992	Y Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0 02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the low flow reference dry gas meter listed herein.

Signature JBA

Date 19-Mar-20

APEX INSTRUMENTS
METHOD 5 XC-522 CONSOLE CALIBRATION
for

Meter Console Information	
Console Model Number	11
Console Serial Number	2029
DGM Model Number	
DGM Serial Number	13966757

Calibration Conditions			
Date	Time	23-Dec-19	11:03
Barometric Pressure		26 00	in Hg
Calibration Technician		JCR	
Calibration Meter Gamma		0.9999	

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

<<<<<<<Your reference meter here

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	221.935	236.615	14.680	63	64	0.000	14.499	14.499	65	65
10.00	3.00	237.035	247.485	10.450	64	64	0.000	10.127	10.127	65	66
10.00	2.00	247.692	256.136	8.444	64	65	0.000	8.356	8.356	66	67
10.00	1.00	256.549	262.665	6.116	65	66	0.000	5.974	5.974	67	67
10.00	0.50	263.067	267.425	4.358	66	66	0.000	4.254	4.254	67	68

Results

Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	$\Delta H_@$	
				Value	Variation	Std & Corr	0.75 SCFM	Variation
$V_{m(std)}$ cubic feet	$Q_{m(std)}$ ft^3/min	$V_{w(std)}$ cubic feet	$Q_{w(std)}$ ft^3/min	Y	ΔY	$Q_{m(std)(corr)}$ ft^3/min	$\Delta H_@$ in H_2O	$\Delta\Delta H_@$
13.085	1.308	12.670	1.267	0.9683	-0.002	1.267	1.844	0.003
9.228	0.923	8.841	0.884	0.9581	-0.012	0.884	1.891	0.051
7.428	0.743	7.282	0.728	0.9802	0.010	0.728	1.857	0.017
5.355	0.536	5.200	0.520	0.9711	0.001	0.520	1.817	-0 023
3.807	0.381	3.700	0.370	0.9718	0.002	0.370	1.793	-0 047
				0.9699	**Y Average**		**1.841**	**$\Delta H_@$ 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 _____ Date _____

JCR 23-Dec-19

APEX INSTRUMENTS
METERBOX CALIBRATION USING REFERENCE DGM

Meter Console Information	
Console Model Number	11
Console Serial Number	2029
DGM Model Number	
DGM Serial Number	13966757

Calibration Conditions			
Date	Time	20-Mar-20	11:21
Barometric Pressure		26.15	in Hg
Calibration Technician		JCR	
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	794.058	808.671	14.613	65	67	0.000	14.452	14.452	68	69
10.50	3.00	808.845	819.784	10.939	67	69	0.000	10.697	10.697	69	70
10.00	2.00	828.626	837.099	8.473	71	72	0.000	8.228	8.228	70	71
10.00	1.00	837.605	843.732	6.127	72	74	0.000	5.943	5.943	71	71
10.00	0.50	843.924	848.313	4.389	74	75	0.000	4.245	4.245	71	71

Results

Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	$\Delta H_@$	
				Value	Variation	Std & Corr	0.75 SCFM	Variation
$V_{m(std)}$ cubic feet	$Q_{m(std)}$ ft^3/min	$V_{w(std)}$ cubic feet	$Q_{w(std)}$ ft^3/min	Y	ΔY	$Q_{m(std)(corr)}$ ft^3/min	$\Delta H_@$ in H_2O	$\Delta\Delta H_@$
13.037	1.304	12.617	1.262	0.9678	-0.001	1.262	1.861	0.010
9.641	0.918	9.322	0.888	0.9669	-0.002	0.888	1.872	0.022
7.398	0.740	7.156	0.716	0.9673	-0.002	0.716	1.908	0.058
5.320	0.532	5.164	0.516	0.9708	0.002	0.516	1.827	-0.024
3.795	0.379	3.689	0.369	0.9722	0.003	0.369	1.785	-0.066
Pre-test Y	0.970	% Deviation	PASS	**0.9690**	**Y Average**		**1.851**	**$\Delta H_@$ 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 _____ Date _____

JCR 20-Mar-20

APEX INSTRUMENTS
METERBOX CALIBRATION USING REFERENCE DGM

Meter Console Information	
Console Model Number	C-5000
Console Serial Number	2199-D
DGM Model Number	DGM-SK25EXSR-QC8
DGM Serial Number	1710021

Calibration Conditions			
Date	Time	3-Mar-20	13:00
Barometric Pressure		25.81	in Hg
Calibration Technician		JBA	
Calibration Meter Gamma		1.0000	

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

<<<<<<<Your reference meter here

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
10.50	6.00	0.000	14.564	14.564	68	69	0.000	14.737	14.737	63	65
10.50	3.00	0.000	10.290	10.290	69	70	0.000	10.458	10.458	65	67
10.00	2.00	0.000	8.095	8.095	70	71	0.000	8.077	8.077	67	69
10.00	1.00	0.000	5.924	5.924	71	71	0.000	5.897	5.897	69	71
10.00	0.50	0.000	4.214	4.214	71	72	0.000	4.189	4.189	71	72

Results

Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	$\Delta H_@$	
				Value	Variation	Std & Corr	0.75 SCFM	Variation
$V_{m(std)}$ cubic feet	$Q_{m(std)}$ ft^3/min	$V_{w(std)}$ cubic feet	$Q_{w(std)}$ ft^3/min	Y	ΔY	$Q_{m(std)(corr)}$ ft^3/min	$\Delta H_@$ in H_2O	$\Delta\Delta H_@$
12.766	1.216	12.810	1.220	1.0034	0.003	1.220	1.956	0.025
8.927	0.850	9.056	0.862	1.0144	0.014	0.862	1.953	0.023
6.990	0.699	6.967	0.697	0.9968	-0.004	0.697	1.991	0.061
5.096	0.510	5.068	0.507	0.9945	-0.006	0.507	1.880	-0.050
3.616	0.362	3.590	0.359	0.9926	-0.008	0.359	1.872	-0.058
Pre-test Y	0.996	% Deviation	PASS	**1.0003**	**Y Average**		**1.930**	**$\Delta H_@$ 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 _____ Date _____

JBA 3-Mar-20

APEX INSTRUMENTS
METERBOX CALIBRATION USING REFERENCE DGM

Meter Console Information	
Console Model Number	C-5000
Console Serial Number	2199-D
DGM Model Number	DGM-SK25EXSR-QC8
DGM Serial Number	1710021

Calibration Conditions			
Date	Time	13-Mar-20	15:00
Barometric Pressure		25.88	in Hg
Calibration Technician		JCR	
Calibration Meter Gamma		1.0000	

Standarized Factors/Conversions		
Temperature	528	R
Pressure	29.92	in Hg
K_1	17.647	R/in Hg

<<<<<<<Your reference meter here

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	13.865	13.865	49	56	0.000	14.724	14.724	67	68
10.00	3.00	0.000	10.027	10.027	56	61	0.000	10.318	10.318	68	68
10.00	2.00	0.000	8.145	8.145	61	66	0.000	8.257	8.257	68	68
11.50	1.00	0.000	6.851	6.851	66	69	0.000	6.868	6.868	68	69
10.00	0.50	0.000	4.289	4.289	69	71	0.000	4.266	4.266	69	69

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	$\Delta\Delta H_@$
12.566	1.257	12.748	1.275	1.0144	0.013	1.275	1.852	0.000
8.907	0.891	8.925	0.892	1.0020	0.000	0.892	1.868	0.015
7.146	0.715	7.142	0.714	0.9994	-0.002	0.714	1.926	0.073
5.948	0.517	5.935	0.516	0.9977	-0.004	0.516	1.830	-0.023
3.701	0.370	3.683	0.368	0.9951	-0.007	0.368	1.788	-0.065
Pre-test Y	1.000	% Deviation	PASS	**1.0017**	**Y Average**		**1.853**	**$\Delta H_@$ 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 _____ Date _____

JCR 13-Mar-20

BISON ENGINEERING, INC.

Field Barometer Calibration Form

Project #: PCC220366

IN OFFICE PRE-TEST CALIBRATION

Reference Standard Used:

Standard ID	Serial number	Adjusted on:	Calibration due:
Helena mercury barometer	BIS01	3/6/2020	Must be properly adjusted prior to every use

Field Barometer Verification:

Barometer ID: B1

Reference Value (in Hg)	Observed (in Hg)	Correction*	Tolerance (+/- 0.1 in Hg)**
26.18	26.13	-0.05	PASS

*Correction is the difference between the observed and reference values
**EPA Method 5, Section 6.1.2 and EPA Method 2, Section 6.5.

Technician: JCR

Date: 3/6/2020

Y:\SOURCE\Calibrations\BLANK CALIBRATION FORMS\Calibration Form Combined
Version: 7/30/2019

BISON ENGINEERING, INC.

Field Balance and Weights Calibration Form

Project #: PCC220366

IN OFFICE PRE-TEST CHECKS

Date: 3/6/2020

Performed by: JCR

Environmental conditions in the lab:

Temperature °F	Pressure "Hg
68	26.18

Reference Standard(s) Used:

Standard ID	Serial number(s)	Calibrated on:	Calibration due:
500g and 200g weight set	10696	1/23/2019	2/20/2021

Verification of Field Balance Against Reference Standard Weights:

Balance ID: HS1

Nominal Value (g)	Observed (g)	Correction*	Tolerance (+/- 0.5g)**
200	200.1	0.1	PASS
500	500.0	0.0	PASS

Verification of Field Standard Weights :

Weights ID: HS FW 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 VERIFICATION

Date: 3/10/2020
Performed by: JCR

Environmental conditions onsite:

Temperature °F	Pressure "Hg
48	30.05

Field Balance Verification:
Balance ID: HS1
Weights ID: HS FW 1

Nominal Value (g)	Observed (g)	Correction*	PASS/FAIL Tolerance (+/- 0.5g)
500	500.0	0.0	PASS
200	200.0	0.0	PASS

*Correction is the difference between the observed and nominal mass values

Technician: JCR

Date: 3/10/2020

BISON ENGINEERING, INC.

Field Caliper Calibration Form

Project #: PCC220366

IN OFFICE PRE-TEST CHECKS

Date: 3/6/2020
Performed by: JCR

Reference Standard Used:

Standard ID	Serial number	Calibrated on:	Calibration due:
HLN1 Aurora	77160806226	1/25/2019	2/20/2021

Caliper Verification:
Field Caliper ID: WS1
Inside Diameter

Reference Value (inches)	Observed (inches)	Correction*	Tolerance (+/- 0.0050 inch)
0.278	0.278	0.000	PASS

*Correction is the difference between the observed and reference values

Outside Diameter

Reference Value (inches)	Observed (inches)	Correction*	Tolerance (+/- 0.0050 inch)
0.373	0.374	0.001	PASS

*Correction is the difference between the observed and reference values

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Version: 7/30/2019

BISON ENGINEERING, INC.

Thermocouple Calibration Form

Project #: PCC220366

POST-TEST CHECKS

Reference Standard Used:

Standard ID	Serial number(s)	Calibrated on:	Calibration due:
Omega	T-318009	6/12/2019	6/12/2020

Temperature Meter Mode:

Thermocouple ID	Continuity (x = pass)	Observed Temp (°F)	Reference Temp (°F)	Correction*	Tolerance (+/- 2°F)**
2B Stack Temp	x	68.3	68.7	0.4	PASS
3C Stack Temp	x	67.9		0.8	PASS
2B Probe Liner	x	69.0		0.3	PASS
3C Probe Liner	x	69.1		0.4	PASS
HB2	x	67.8		0.9	PASS
HB3	x	67.6		1.1	PASS
GN2	x	68.3		0.4	PASS
GN3	x	68.5		0.2	PASS
Meter Box 11	x	67.9		0.8	PASS
Meter Box 12	x	67.8		0.9	PASS
Low Flow Box 1	x	67.9		0.8	PASS
Low Flow Box 2	x	67.8		0.9	PASS

Calibration Output Mode:

Switch the Omega from 'Meter Input' to 'Calibration Output' mode. Test the meter box temperature readout by sending a voltage output equivalent to a temperature similar to stack temperature.

Meter Box ID	Reference Temp Output (°F)	Meter Box Readout (°F)	Correction*	Tolerance (+/- 2°F)**
11	300.0	300	0.0	PASS
12		300	0.0	PASS

*Correction is the difference between the observed and reference values

**Alt-011 6/21/94 Alternative Method 2 Thermocouple Calibration Procedure:
Continuity Check - confirm the thermocouple is reading at the tip by subjecting it to a change in temperature (e.g. removing it from the stack, or touching it with a your hand).
Single-point temperature check at ambient temperature, or any temperature, within the range specified by the manufacturer.

Technician: JCR

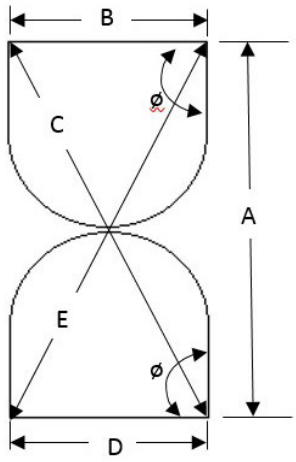
Date: 3/13/2020

Y:\SOURCE\Calibrations\BLANK CALIBRATION FORMS\Calibration Form Combined
Version: 7/30/2019

S-Type Pitot Tube Geometric Calibration

Pitot ID: 2B

Date of Geometric Calibration (< 6 months): 11/22/2019



A	0.9295
B	0.3755
C	0.982
D	0.376
E	0.9835

$$\frac{a^2+b^2-c^2}{2ab}=\cos\emptyset$$

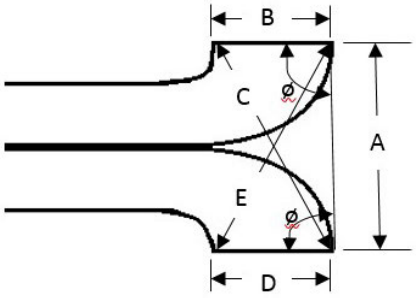
$$\frac{a^2+d^2-e^2}{2ad}=\cos\emptyset$$

ø	86.66

$(80° < \emptyset < 100°)$

ø	86.88

$(80° < \emptyset < 100°)$



A	0.9465
B	0.7255
C	1.1655
D	0.714
E	1.1695

$$\frac{a^2+b^2-c^2}{2ab}=\cos\emptyset$$

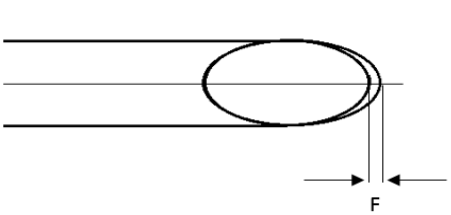
$$\frac{a^2+d^2-e^2}{2ad}=\cos\emptyset$$

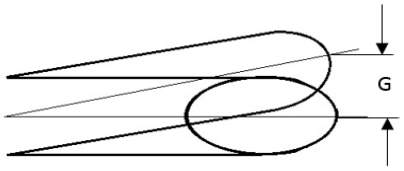
ø	87.34

$(85° < \emptyset < 95°)$

ø	88.39

$(85° < \emptyset < 95°)$





F=	0.07	(F < 0.125)	G=	0.00	(G < 0.032)

Results of the Post-Test Pitot Inspection (mark with x below)**:**

No change x

Damaged _____

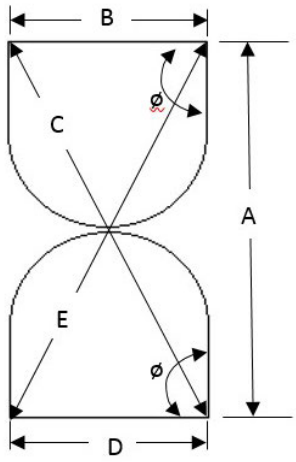
New Calibration _____

Technician: JCR **Date:** 3/13/2020

S-Type Pitot Tube Geometric Calibration

Pitot ID: 3C

Date of Geometric Calibration (< 6 months): 11/22/2019



A	0.9385
B	0.374
C	0.9895
D	0.3725
E	0.9765

$$\frac{a^2+b^2-c^2}{2ab}=\cos\emptyset$$

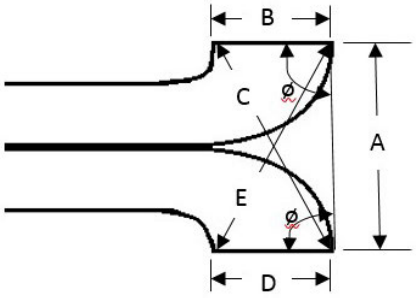
$$\frac{a^2+d^2-e^2}{2ad}=\cos\emptyset$$

ø	86.61

$(80° < \emptyset < 100°)$

ø	84.58

$(80° < \emptyset < 100°)$



A	0.942
B	0.6105
C	1.109
D	0.6105
E	1.114

$$\frac{a^2+b^2-c^2}{2ab}=\cos\emptyset$$

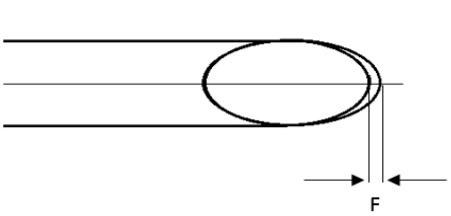
$$\frac{a^2+d^2-e^2}{2ad}=\cos\emptyset$$

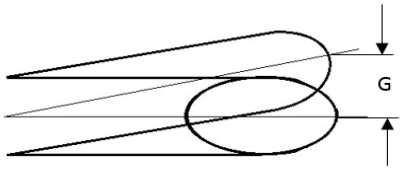
ø	88.50

$(85° < \emptyset < 95°)$

ø	89.05

$(85° < \emptyset < 95°)$





F=	0.07

(F < 0.125)

G=	0.00

(G < 0.032)

Results of the Post-Test Pitot Inspection (mark with x below)**:**

No change x

Damaged _____

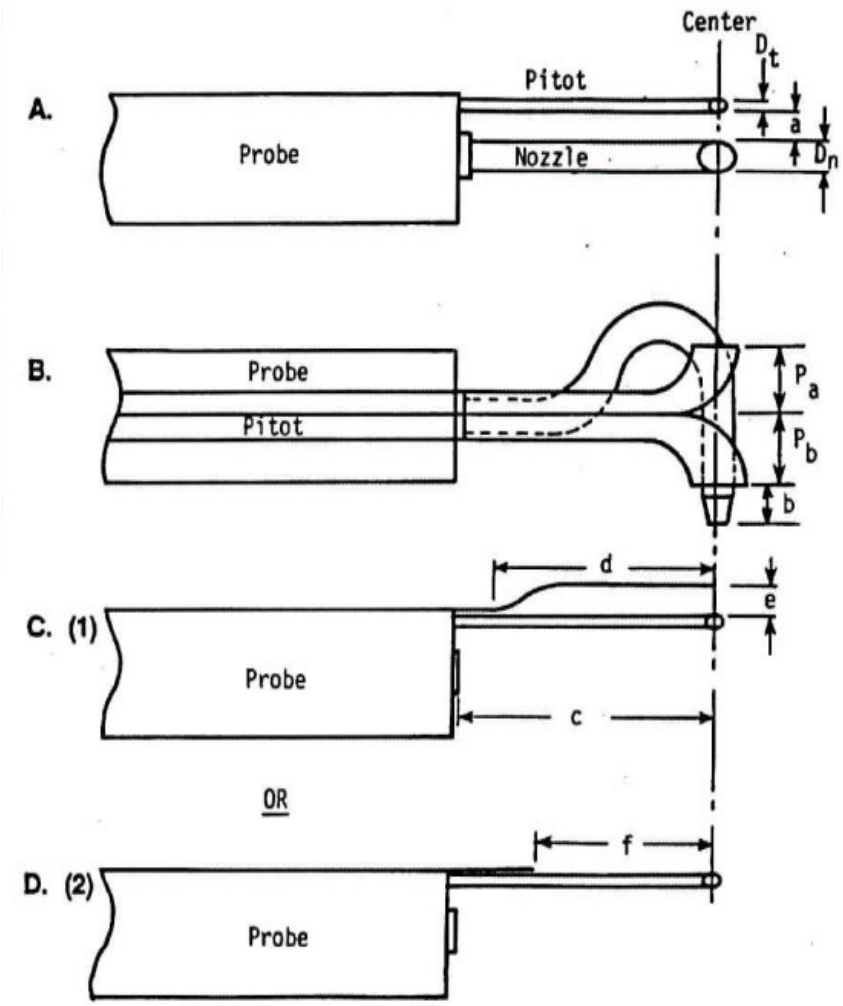
New Calibration _____

Technician: JCR **Date:** 3/13/2020

Probe Calibration

Probe ID: 2B

Date of calibration (< 6 months): 11/22/2019



		Measure (Inch)
Dt:	3/8	**Dt = 0.187 to 0.375**
Dn:	1/2	**Dn = 0.5**
a:	1	**a ≥ 0.750**
Pa:	1/2	**Pa = Pb**
Pb:	1/2	
b:	1	**B ≥ 0**
c:	4 2/5	**c ≥ 3.0**
d:	6	**d ≥ 3.0**
e:	4/5	**e ≥ 0.750**
or		
f:		**f ≥ 2.0**

Results of the Post-Test Probe Inspection (mark with x below)**:**

No change x

Damaged _____

New Calibration _____

Technician: JCR **Date:** 3/13/2020

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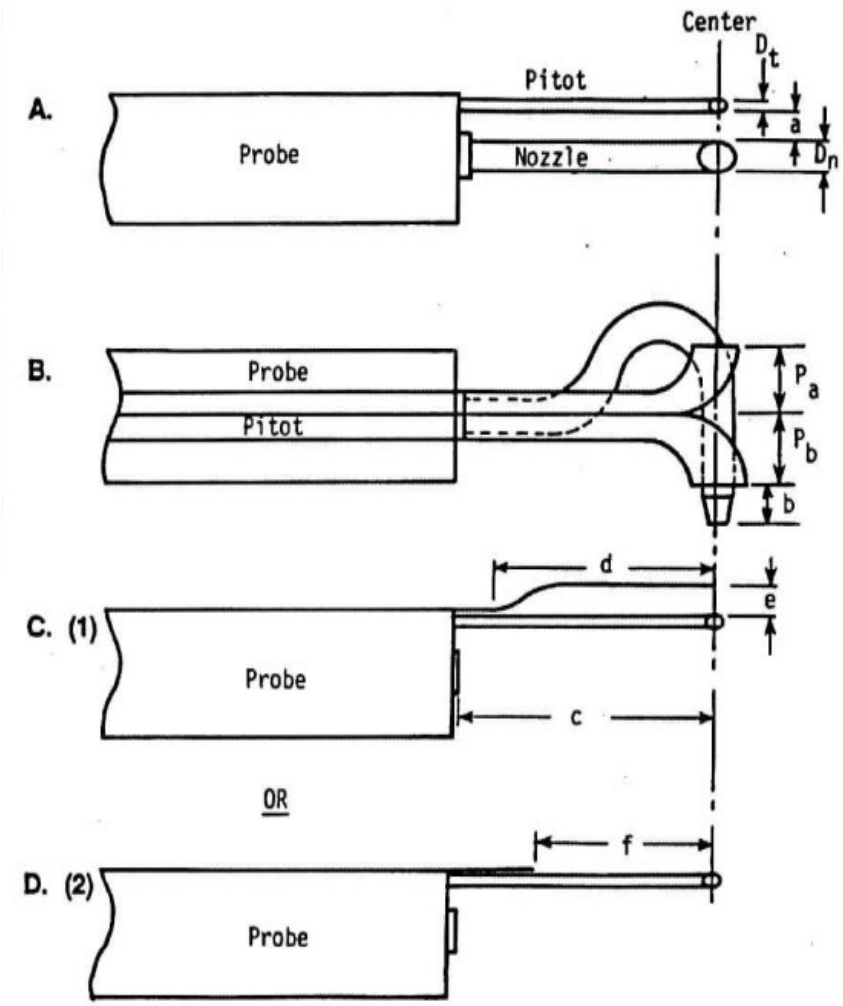
Probe Calibration

Probe ID: 3C

Date of calibration (< 6 months): 11/22/2019



	Measure (Inch)	
Dt:	3/8	**Dt = 0.187 to 0.375**
Dn:	1/2	**Dn = 0.5**
a:	3/4	**a ≥ 0.750**
Pa:	1/2	**Pa = Pb**
Pb:	1/2	
b:	1	**B ≥ 0**
c:	4 2/9	**c ≥ 3.0**
d:	14	**d ≥ 3.0**
e:	4/5	**e ≥ 0.750**
or		
f:		**f ≥ 2.0**

Results of the Post-Test Probe Inspection (mark with x below)**:**

No change x

Damaged _____

New Calibration _____

Technician: JCR **Date:** 3/13/2020

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