A.Lanfranco & Associates Inc.
Environmental Consultants

Prepared for

WEIR CANADA INC.

Surrey, BC

EMISSION MONITORING REPORT

February 2021 Survey

Air Permit GVA 1081

Prepared by Carter Lanfranco

CERTIFICATION

The field monitoring was conducted by certified stack test technicians as required by the British Columbia Ministry of Environment (BC MOE) field sampling manual. The field crew consisted of:

Mr. C. Lanfranco (certified) and Mr. L. Agassiz.

The report was prepared by Mr. C. Lanfranco using reporting principles and guidelines generally acceptable to B.C. MOE and Metro Vancouver (MV).

The field crew and A. Lanfranco and Associates Inc. certify that the test methods used were EPA or B.C. MOE approved reference methods for the parameters investigated.

Report reviewed by:

M. Lanfranco, CST
President | Owner

TABLE OF CONTENTS

APPENDICES

SUMMARY

The following table presents the average emission results for the listed parameters from one source located at Weir Canada's manufacturing facility in Surrey, B.C. Testing was completed on Feb 9, 2021.

Parameter	Grit Booth	Permit Allowable
Test Date	9-Feb-21	
Particulate (mg/Sm^3)	2.95	0.20
Particulate (kg/hr)	0.09	
Dry Flow Rate (m^3/min)	533	566

All data is corrected to standard conditions (S) of 20 °C 101.325 kPa (dry)

1 TEST PROGRAM ORGANIZATION and INTRODUCTION

Plant Testing Coordinator:	Mr. Ricardo Parodi Training and SHE Coordinator Weir Canada Inc. 18933 43a Ave Surrey BC, V3Z 1A7 Email: ricardo.parodi@mail.weir
Project Manager/Sampling Contractor:	Mr. Mark Lanfranco President | Owner A. Lanfranco and Associates Inc. 101-9488 189 St Surrey, B.C. Canada V4N 4W7 Tel: (604) 881-2582 Email: mark.lanfranco@alanfranco.com
Sampling Crew:	Mr. C. Lanfranco - A. Lanfranco and Associates Inc. Tel: (604) 881-2582 Mr. L. Agassiz - A. Lanfranco and Associates Inc. Tel: (604) 992-6064

Weir Canada of Surrey, B.C. commissioned A. Lanfranco and Associates Inc. of Surrey, B.C., to conduct a duplicate emission retest, of the Grit Blast Booth associated with their manufacturing process.

The testing was conducted to provide information on emission sources to determine compliance with Air Permit GVA 1081 amended in February 2018. Emission tests were conducted on the Grit Blast Booth. The following parameters were measured:

- Discharge Rate (flow rate)
- Total Particulate Matter Concentration

A. Lanfranco and Associates was responsible for the gravimetric analysis this survey. Justin Ching, the lab manager for A. Lanfranco can be reached at 604-881-2582.

2 METHODOLOGY

The sampling and analytical methods used throughout this survey conform to the procedures outlined the British Columbia Ministry of Environment (BC MOE) stationary air emissions testing requirements as outlined in the "Field Sampling Manual, 2020."

2.1 Sampling and Analytical Methods

The following table lists the test methods used during this survey. The subsequent sections provide a brief description of the sampling and analytical techniques used.

Parameter	**Reference Method**
Sample and Velocity traverse points	EPS 1/RM/8 A Determination of Sampling Site and Traverse Points
Velocity and flowrate	EPS 1/RM/8 B Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Gas molecular weight (O_2/CO_2)	EPS 1/RM/8 C Determination of Molecular Weight by Gas Analysis
Flue gas Moisture	EPS 1/RM/8 D Determination of Moisture Content
Particulate Matter	EPS 1/RM/8 E Determination of Particulate Matter Emissions from Stationary Sources

Sampling Site and Traverse Points

Primary: EPS 1/RM/8 Method A

Supporting: EPA Method 1

This method is designed to aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source. A measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into several equal areas. Traverse points are then located within each of these equal areas.

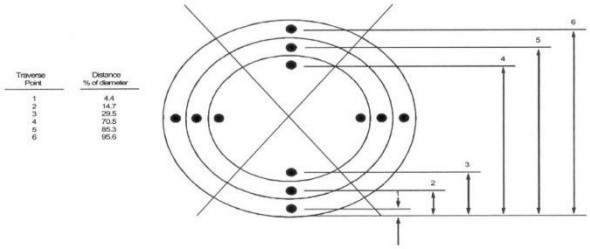


Figure 1. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points.

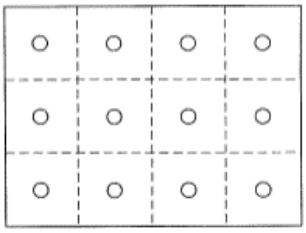


Figure 1A. Example showing rectangular stack cross section divided into 12 equal areas, with location of traverse points

Stack Gas Velocity and Volumetric Flow Rate

Primary: EPS 1/RM/8 Method B

Supporting: EPA Method 2

The average gas velocity in a stack or duct is determined from the gas density and from the measurement of velocity pressure with an S-type pitot tube. A standard pitot tube may be used where plugging of the tube openings due to particulate matter and/or moisture is not likely to occur. Stack gas volumetric flow rate is determined from measurements of stack gas velocity, temperature, absolute pressure, dry gas composition, moisture content, and stack diameter.

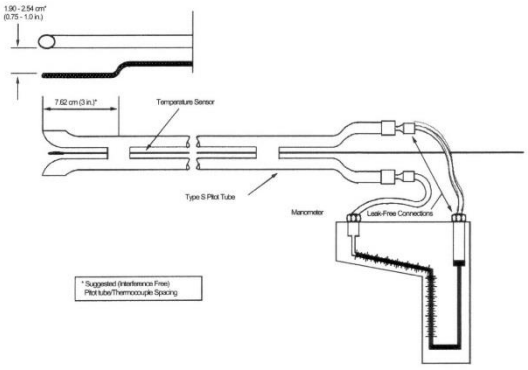


Figure 2. Type S Pitot Tube Manometer Assembly

Molecular Weight by Gas Analysis	Primary:	EPS 1/RM/8 Method C
	Supporting:	EPA Method 3

An integrated or grab sample is extracted from a single point in the gas stream and analyzed for its components using a Fyrite analyzer, a gas chromatograph, or calibrated continuous analyzers.

Moisture Content	Primary:	EPS 1/RM/8 Method D
	Supporting:	EPA Method 4

A gas sample is extracted from a single point in the enclosed gas stream being sampled. The moisture is condensed, and its weight measured. This weight, together with the volume of gas sampled, enables the stack gas moisture content to be calculated.

Particulate Matter	Primary:	EPS 1/RM/8 Method E
	Supporting:	EPA Method 5

Particulate matter is withdrawn isokinetically from a number of sampling or traverse points in an enclosed gas stream. The particulate sample is collected in the nozzle, probe, and on a glass fibre filter, all maintained at a temperature of 120 ± 14°C or such other temperature as is necessary to prevent blinding of the filter from condensation. The particulate weight is determined gravimetrically after removal of uncombined water. Simultaneous determinations of the gas stream moisture content, velocity, temperature, and molecular weight allow calculations of the particulate concentration and the particulate mass emission or release rate to be made.

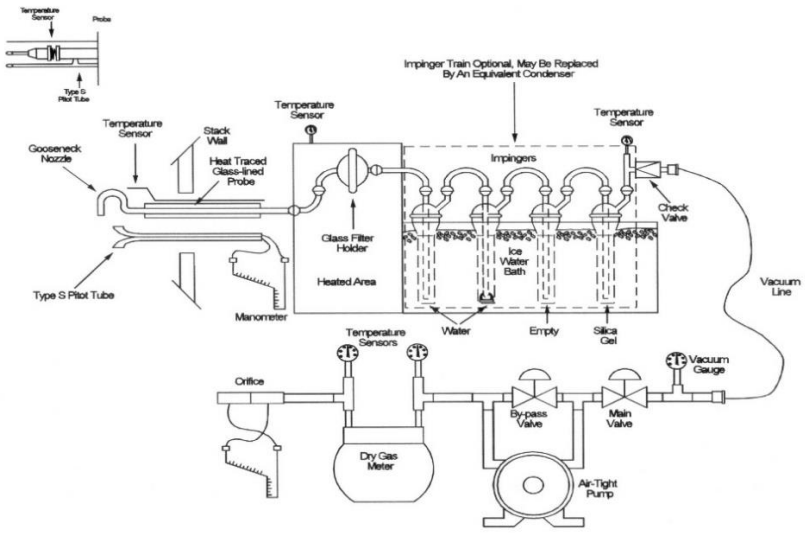


Figure 1: Method 5 Particulate Sampling Train

2.2 Calculations

The following sections show the equations and define the variables that were used for this survey. The equations are organized in three sections. Equations 1-10 were used to calculate parameter concentration at standard conditions on a dry basis. Equations 12-26 were used to sample within the 100 ± 10% isokinetic variation and to confirm that sampling meets this isokinetic variation threshold. Equations 27-29 were used to calculate the volumetric flowrate of the stack flue gas.

2.2.1 Parameter Concentration Calculations

$$c = \frac{m}{V_{std}} \quad \textbf{Equation 1}$$

$$m_{part} = m_{filter} + m_{pw} \quad \textbf{Equation 2}$$

$$m_i = m_{ana,i} - m_{blank} \quad \textbf{Equation 3}$$

$$V_{std} = \frac{V_{std(imp)}}{35.315} \quad \textbf{Equation 4}$$

$$V_{std(imp)} = \frac{V_{samp} \times y \times P_m \times (T_{std} + 459.67)}{P_{std} \times (T_{m(ave)} + 459.67)} \quad \textbf{Equation 5}$$

$$V_{samp} = V_{final} - V_{init} \quad \textbf{Equation 6}$$

$$P_m = P_B + \frac{\Delta H_{ave}}{13.6} \quad \textbf{Equation 7}$$

$$\Delta H_{ave} = \frac{1}{n}\sum_{i=1}^{n} \Delta H_{i(act)}, where\ n = the\ number\ of\ points \quad \textbf{Equation 8}$$

$$OC = \frac{20.9 - \%O_{2c}}{20.9 - \%O_{2m}} \quad \textbf{Equation 9}$$

$$\%O_{2m} = \frac{1}{n}\sum_{i=1}^{n} \%O_{2i}, where\ n = the\ number\ of\ O_2\ measurements \quad \textbf{Equation 10}$$

c	= *Parameter concentration*
m	= *Parameter mass*
m_i	= *Net analytical mass (mg, ng, or µg)*
$m_{ana,i}$	= *Analytical mass (mg, ng, or µg)*
m_{blank}	= *Blank analytical mass (mg, ng, or µg)*
m_{part}	= *Total particulate mass (mg)*
m_{filter}	= *Net particulate gain from filter (mg)*
m_{pw}	= *Net particulate gain from probe wash (mg)*
$V_{std(imp)}$	= *Sample volume at standard conditions (ft^3)*
V_{std}	= *Sample volume at standard conditions (m^3)*
V_{samp}	= *Sample volume at actual conditions (ft^3)*
V_{final}	= *Final gas meter reading (ft^3)*
V_{init}	= *Initial gas meter reading (ft^3)*
T_{std}	= *Standard temperature (68 °F)*
T_m	= *Gas meter temperature (°F)*
$T_{m(ave)}$	= *Average gas meter temperature (°F)*
P_m	= *Absolute meter pressure (inches of Hg)*
P_B	= *Barometric pressure (inches of Hg)*
P_{std}	= *Standard barometric pressure (29.92 inches of Hg)*
ΔH_{ave}	= *Average of individual point orifice pressures (inches of H_2O)*
$\Delta H_{i(act)}$	= *Individual recorded point orifice pressures (inches of H_2O)*
OC	= *Oxygen correction factor (dimensionless)*
$\%O_{2c}$	= *Oxygen concentration to correct to (% dry basis)*
$\%O_{2i}$	= *Individual oxygen measurements (% dry basis)*
$\%O_{2m}$	= *Average measured stack gas oxygen concentration (% dry basis)*

Equation 1 is the general concentration calculation used for all parameters. The mass, *m*, is the net analytic mass for the given parameter. For particulate, *m* is the sum of the mass contributed from probe washing and filter particulate.

2.2.2 Isokinetic Variation Calculations

$$\Delta H_i = \frac{2.62 \times 10^7 \times c_p \times A_n \times (1 - B_{wo}) \times M_D \times (T_m + 459.67) \times \Delta p_i}{k_o \times M_w \times (T_{Stk} + 459.67)}$$ **Equation 11**

$$R_m = 85.49 \times c_p \times \sqrt{\Delta p_i} \times \sqrt{\frac{(T_{stk_i} + 459.67)}{M_w \times P_B}} \times 60 \times A_n \times \frac{(T_{m_i} + 459.67) \times (1 - B_{wo})}{(T_{stk_i} + 459.67) \times y}$$ **Equation 12**

$$A_n = \pi \left(\frac{d_n}{24}\right)^2$$ **Equation 13**

$$M_w = M_D \times (1 - B_{wo}) + 18 \times B_{wo}$$ **Equation 14**

$$M_D = 0.44 \times \%CO_2 + 0.32 \times \%O_2 + 0.28 \times (100 - \%CO_2 - \%O_2)$$ **Equation 15**

$$T_{Stk} = \frac{1}{n} \sum_{i=1}^{n} T_{Stk_i}, where\ n = the\ number\ of\ points$$ **Equation 16**

$$B_{wo} = \frac{V_{cond}}{V_{cond} + V_{std(imp)}}$$ **Equation 17**

$$V_{cond} = 0.04707 \times V_{gain}$$ **Equation 18**

$$Iso = \frac{1}{n} \sum_{i=1}^{n} Iso_i, where\ n = the\ number\ of\ points$$ **Equation 19**

$$Iso_i = \frac{v_{nzi}}{v_i}$$ **Equation 20**

$$v_i = 85.49 \times c_p \times \sqrt{\Delta p_i} \times \sqrt{\frac{(T_{Stk_i} + 459.67)}{(P_{Stk} \times M_W)}}$$ **Equation 21**

$$v_{nzi} = \frac{(V_i - V_{i-1}) \times y \times (T_{Stk_i} + 459.67) \times (P_B + \frac{\Delta H_{i(act)}}{13.6})}{A_n \times t_i \times 60 \times (T_{m(i)} + 459.67) \times P_{stk} \times (1 - B_{wo})}$$ **Equation 22**

$$P_{stk} = P_B + \frac{P_g}{13.6}$$ **Equation 23**

$$v_{stk} = \frac{1}{n}\sum_{i=1}^{n} v_i \text{ , where } n = \text{the number of points}$$ **Equation 24**

$$v_{nz} = \frac{1}{n}\sum_{i=1}^{n} v_{nzi} \text{ , where } n = \text{the number of points}$$ **Equation 25**

Where,

A_n = *Nozzle area (ft^2)*
d_n = *Diameter of nozzle (inches)*
c_p = *Pitot coefficient (dimensionless)*
Δp_i = *Individual point differential pressures (inches of H_2O)*
T_{Stk} = *Average flue gas temperature (°F), second subscript i, indicates individual point measurements*
T_m = *Average gas meter temperature (°F), second subscript i, indicates individual point measurements*
k_o = *Gas meter calibration constant (dimensionless)*
y = *Gas meter calibration factor (dimensionless)*
$\Delta H_{i(act)}$ = *Calculated individual point orifice pressures (inches of H_2O)*
P_g = *Stack Static pressure (inches of H_2O)*
P_{stk} = *Absolute stack pressure (inches of Hg)*
M_w = *Wet gas molecular weight (g/gmol)*
M_D = *Dry gas molecular weight (g/gmol)*
$\%CO_2$ = *Stack gas carbon dioxide concentration (% dry basis)*
$\%O_2$ = *Stack gas oxygen concentration (% dry basis)*
B_{wo} = *Stack gas water vapour, proportion by volume*
V_i = *Gas meter reading at individual point(ft^3)*
t_i = *Sample time at each point (minutes)*
V_{cond} = *Total volume of water vapor collected, corrected to standard conditions (ft^3)*
V_{gain} = *Condensate gain of impinger contents (mL)*
P_{std} = *Standard pressure (29.92 inches of Hg)*
v_{stk} = *Average flue gas velocity (ft/sec)*
v_i = *Individual point flue gas velocity (ft/sec)*
v_{nz} = *Average velocity at nozzle(ft/sec)*
v_{nzi} = *Individual point velocity at nozzle(ft/sec)*
Iso_i = *Individual point isokinetic variation (%)*
Iso = *Average isokinetic variation (%)*
R_m = *Isokinetic sampling rate (ft^3/min)*

2.2.3 Volumetric Flowrate Calculations

$$Q_S = Q_A \times \frac{(T_{Std} + 459.67)}{(T_{Stk} + 459.67)} \times \frac{P_{Stk}}{P_{Std}}$$ **Equation 26**

$$Q_A = \frac{v_{stk} \times 60 \times A_{stk}}{35.315}$$ **Equation 27**

$$A_{stk} = \pi \left(\frac{d}{24}\right)^2$$ **Equation 28**

Where,

Q_A = *Actual flowrate (Am³/min)*
Q_S = *Flowrate (m³/min) at standard conditions on a dry basis*
A_{stk} = *Area of stack (ft²)*
d = *Diameter of stack (inches)*

3 PROCESS DESCRIPTIONS

3.1 Grit Blast Booth – Emission Source 08

Innovative Blast Technologies, pulse cleaning dust collector consisting of 25 cartridges with particulate matter filter.

Upstream Diameters: 0.4
Downstream Diameters: 0.8

4 DETAILED TEST RESULTS

The results of stack emissions were calculated using a "STACK" computer program developed by A. Lanfranco and Associates for BC MOE requirements.

Table 1 presents the detailed emission parameters tested for the source. Supporting data can be found in Table 2 and the appendices.

TABLE 1: GRIT BLAST BOOTH

Parameter	Run 1	Run 2	Average
Test Date - Particulate/Metals	9-Feb-21	9-Feb-21	
Test Time - Particulate/Metals	10:40 - 11:44	12:02-13:06	
Duration - Minutes	60	60	60
Stack Temperature (°C)	25	25	25
Average Gas Velocity (m/s)	18.3	17.7	18.0
Dry Flow Rate (m^3/min)	543	522	533
Moisture (Vol. %)	0.9	1.0	0.9
Oxygen (Vol. %)(dry basis)	21.0	21.0	21.0
Carbon Dioxide (Vol. %)(dry basis)	0.0	0.0	0.0
Particulate (mg/m^3)	3.39	2.51	2.95
Isokinetic Variation (%)	104	103	103

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry)

TABLE 2: PARTICULATE ANALYSIS

Filter Collection:

Test #	Initial (grams)	Final (grams)	Net Difference (grams)	Blank Adjusted (grams)
Grit Booth Blank	0.3632	0.3630	-0.0002	
Grit Booth Run 1	0.3631	0.3650	0.0019	0.0021
Grit Booth Run 2	0.3628	0.3655	0.0027	0.0029

Front Half Washings:

Test #	Initial (grams)	Final (grams)	Net Difference (grams)	Blank Adjusted (grams)
Grit Booth Blank	113.2605	113.2607	0.0002	
Grit Booth Run 1	99.1460	99.1487	0.0027	0.0025
Grit Booth Run 2	126.7388	126.7394	0.0006	0.0004

5 DISCUSSION

Weir Canada Inc. requested that A. Lanfranco and Associates Inc. perform two emission tests on the Grit Blast Booth for various parameters to determine the efficiency of the pollution control system.

Particulate results on the Grit Booth showed a significant decrease in filterable particulate matter, in comparison to the last two surveys. The filterable particulate result of 3.0 mg/Sm^3 is the lowest recorded since the first time this system was tested in March 2019.

Sampling was conducted in accordance with their respective reference methods and passed all appropriate quality assurance and quality control criteria.

All sampling was conducted/supervised by certified emission testing personnel, using calibrated source sampling equipment and quality-controlled reagents.

the source was measured during normal operating conditions such that the results are representative of day-to-day activities at Weir Canada.

There were no problems associated with the sampling and the results are therefore reported with a high level of confidence.

APPENDIX 1

COMPUTER OUTPUTS OF MEASURED AND CALCULATED

Client:	Weir Canada	**Date:**	9-Feb-21
Jobsite:	Weir - Surrey, BC	**Run:**	1 - Particulate/Metals
Source:	Grit Blast Booth	**Run Time:**	10:40 - 11:44

Concentrations:

Particulate	3.4	mg/dscm	0.0015	gr/dscf
	3.3	mg/Acm	0.0015	gr/Acf

Emission Rates:

Particulate	0.111	Kg/hr	0.244	lb/hr

Flue Gas Characteristics:

Flow	543	dscm/min	19184	dscf/min
	9.05	dscm/sec	320	dscf/sec
	555	Acm/min	19609	Acf/min
Velocity	18.343	m/sec	60.18	f/sec
Temperature	24.9	oC	76.9	oF
Moisture	0.9	%		
Gas Analysis	21.0	% O2		
	0.0	% CO2		
	28.840	Mol. Wt (g/gmole) Dry		
	28.744	Mol. Wt (g/gmole) Wet		

Sample Parameters:

Sample Volume	1.2963	dscm	45.777	dscf
Sample Time	60.0	minutes		
Isokineticity	103.9	%		

*** Standard Conditions:** Metric: 20 deg C, 101.325 kPa
Imperial: 68 deg F, 29.92 in.Hg

Client:	Weir Canada	**Date:**	9-Feb-21
Jobsite:	Weir - Surrey, BC	**Run:**	1 - Particulate/Metals
Source:	Grit Blast Booth	**Run Time:**	10:40 - 11:44

Control Unit (Y)	1.0054		**Collection:**			**Gas Analysis (Vol. %):**			**Condensate Collection:**	
Nozzle Diameter (in.)	0.1952		Filter (grams)	0.00190		CO2	O2		Impinger 1	1.0
Pitot Factor	0.8448		Washings (grams)	0.00250	Traverse 1	0.0	21.0		Impinger 2	0.0
Baro. Press. (in. Hg)	30.10				Traverse 2	0.0	21.0		Impinger 3	0.0
Static Press. (in. H20)	-0.95		**Total (grams)**	**0.00440**		0.0	21.0		Impinger 4	0.0
Stack Height (ft)	30					0.0	21.0		Impinger 5	0.0
Stack Diameter (in.)	23.0	34.0							Impinger 6	0.0
Stack Area (sq.ft.)	5.431								Gel	7.7
Minutes Per Reading	2.5					**0.0**	**21.0**		**Gain (grams)**	**8.7**
Minutes Per Point	2.5									

Traverse / Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Dry Gas Temperature Outlet (oF)	Vacuum (in. Hg.)	Stack Temp. (oF)	Wall Dist. (in.)	Isokin. (%)
Traverse 1	0.0	565.500								
1	2.5	567.690	1.66	2.29	42	42	4	76	1.5	104.6
2	5.0	569.840	1.60	2.21	42	42	4	76	5.6	104.6
3	7.5	571.960	1.52	2.10	44	44	4	76	10.2	105.4
4	10.0	574.010	1.46	2.01	44	44	4	77	14.0	104.0
5	12.5	575.970	1.32	1.82	45	45	4	76	18.9	104.3
6	15.0	577.840	1.20	1.66	46	46	4	76	21.7	104.1
Traverse 2	0.0	577.840								
1	2.5	579.990	1.60	2.21	45	45	4	76	1.5	104.0
2	5.0	582.090	1.52	2.10	44	44	4	76	5.6	104.4
3	7.5	584.170	1.50	2.07	44	44	4	77	10.2	104.2
4	10.0	586.260	1.50	2.07	45	45	4	77	14.0	104.5
5	12.5	588.240	1.35	1.86	46	46	4	77	18.9	104.1
6	15.0	590.120	1.22	1.68	47	47	4	78	21.7	103.8
Traverse 3	0.0	590.120								
1	2.5	592.090	1.35	1.86	45	45	3.5	77	1.5	103.7
2	5.0	594.070	1.35	1.86	46	46	3.5	78	5.6	104.2
3	7.5	595.930	1.20	1.66	46	46	3.5	77	10.2	103.6
4	10.0	597.590	0.95	1.31	47	47	4	78	14.0	103.7
5	12.5	599.110	0.80	1.10	47	47	4	78	18.9	103.5
6	15.0	600.600	0.77	1.06	47	47	4	77	21.7	103.3
Traverse 4	0.0	600.600								
1	2.5	602.140	0.82	1.13	47	47	4	77	1.5	103.5
2	5.0	603.650	0.78	1.08	48	48	4	77	5.6	103.8
3	7.5	605.030	0.66	0.91	47	47	4	77	10.2	103.3
4	10.0	606.320	0.58	0.80	48	48	4	77	14.0	102.8
5	12.5	607.540	0.50	0.69	49	49	4	77	18.9	104.4
6	15.0	608.690	0.46	0.63	49	49	4	77	21.7	102.6
Average:			1.153	1.590	45.8	45.8	3.9	76.9		103.9

Client:	Weir Canada	**Date:**	9-Feb-21
Jobsite:	Weir - Surrey, BC	**Run:**	1 - Particulate/Metals
Source:	Grit Blast Booth	**Run Time:**	11:52 - 12:55

Concentrations:

Particulate	2.51	mg/dscm	0.00110	gr/dscf
	2.45	mg/Acm	0.00107	gr/Acf

Emission Rates:

Particulate	0.079	Kg/hr	0.173	lb/hr

Flue Gas Characteristics:

Flow	522	dscm/min	18451	dscf/min
	8.71	dscm/sec	308	dscf/sec
	535	Acm/min	18893	Acf/min
Velocity	17.672	m/sec	57.98	f/sec
Temperature	25.2	oC	77.4	oF
Moisture	1.0	%		
Gas Analysis	21.0	% O2		
	0.0	% CO2		
	28.840	Mol. Wt (g/gmole) Dry		
	28.736	Mol. Wt (g/gmole) Wet		

Sample Parameters:

Sample Volume	1.2352	dscm	43.621	dscf
Sample Time	60.0	minutes		
Isokineticity	103.0	%		

*** Standard Conditions:** Metric: 20 deg C, 101.325 kPa
Imperial: 68 deg F, 29.92 in.Hg

Client:	Weir Canada	**Date:**	9-Feb-21
Jobsite:	Weir - Surrey, BC	**Run:**	1 - Particulate/Metals
Source:	Grit Blast Booth	**Run Time:**	11:52 - 12:55

Control Unit (Y)	1.0054
Nozzle Diameter (in.)	0.1952
Pitot Factor	0.8448
Baro. Press. (in. Hg)	30.10
Static Press. (in. H20)	-0.95
Stack Height (ft)	30
Stack Dimensions (in.)	23.0
Stack Area (sq.ft.)	5.431
Minutes Per Reading	2.5
Minutes Per Point	2.5

Collection:

Filter (grams)	0.00270
Washings (grams)	0.00040
Total (grams)	**0.00310**

Gas Analysis (Vol. %):

	CO2	O2
Traverse 1	0.0	21.0
Traverse 2	0.0	21.0
	0.0	21.0
	0.0	21.0
	0.0	**21.0**

Condensate Collection:

Impinger 1	1.0
Impinger 2	0.0
Impinger 3	0.0
Impinger 4	0.0
Impinger 5	0.0
Impinger 6	0.0
Gel	8.0
Gain (grams)	**9.0**

Traverse / Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Dry Gas Temperature Outlet (oF)	Vacuum (in. Hg.)	Stack Temp. (oF)	Wall Dist. (in.)	Isokin. (%)
Traverse 1	0.0	609.210								
1	2.5	610.730	0.80	1.10	47	47	4	76	1.5	103.3
2	5.0	612.260	0.80	1.10	48	48	4	77	5.6	103.9
3	7.5	613.700	0.72	0.99	47	47	4	77	10.2	103.3
4	10.0	614.990	0.58	0.80	48	48	4	77	14.0	102.8
5	12.5	616.190	0.50	0.69	49	49	4	77	18.9	102.8
6	15.0	617.320	0.44	0.61	49	49	4	77	21.7	103.2
Traverse 2	0.0	617.320								
1	2.5	619.140	1.15	1.59	48	48	4	77	1.5	103.2
2	5.0	621.020	1.22	1.68	49	49	4	78	5.6	103.4
3	7.5	622.700	0.97	1.34	49	49	4	78	10.2	103.6
4	10.0	624.260	0.84	1.16	50	50	4	78	14.0	103.1
5	12.5	625.710	0.72	0.99	49	49	4	79	18.9	103.8
6	15.0	627.120	0.68	0.94	50	50	4	79	21.7	103.6
Traverse 3	0.0	627.120								
1	2.5	629.200	1.50	2.07	49	49	4	78	1.5	103.3
2	5.0	631.250	1.45	2.00	50	50	4	77	5.6	103.2
3	7.5	633.220	1.37	1.89	50	50	4	77	10.2	102.0
4	10.0	635.170	1.30	1.79	52	52	4	78	14.0	103.4
5	12.5	637.050	1.22	1.68	51	51	4	77	18.9	102.9
6	15.0	638.830	1.10	1.52	50	50	4	78	21.7	102.9
Traverse 4	0.0	638.830								
1	2.5	640.990	1.60	2.21	50	50	4	78	1.5	103.7
2	5.0	643.080	1.52	2.10	51	51	4	77	5.6	102.6
3	7.5	645.180	1.45	2.00	51	51	4	77	10.2	105.5
4	10.0	647.140	1.33	1.84	51	51	4	77	14.0	102.8
5	12.5	649.040	1.25	1.73	52	52	4	77	18.9	102.6
6	15.0	650.690	1.07	1.48	52	52	4	77	21.7	96.2
Average:			1.066	1.471	49.7	49.7	4.0	77.4		103.0

APPENDIX 2

FIELD DATA SHEETS

A. Lanfranco and Associates Inc.

$\sqrt{1.70}$ 1.38ΔH

$\sqrt{1.70}$ 1.38ΔH $\sqrt{2.85}$ - 1.23 - 3.9 ΔH

CLIENT	WEIR	NOZZLE SS-B	DIAMETER, IN. .1952
SOURCE	Gov't Blast	PROBE ST 3A	Cp .8448
PARAMETER / RUN No	1 Basic		
DATE	Feb. 9 / 21	PORT LENGTH	
OPERATOR:	C.L	STATIC PRESSURE, IN. H2O	-0.95
CONTROL UNIT	AU15 Y 1.0051	STACK DIAMETER	23 X 34
	ΔH@	STACK HEIGHT	30'
BAROMETRIC PRESSURE, IN. Hg	30.1	INITIAL LEAK TEST	0.002 @ 15"
ASSUMED MOISTURE, Bw	12	FINAL LEAK TEST	0.002 @ 15"

IMPINGER VOLUMES	INITIAL (mL)	FINAL (mL)	TOTAL GAIN (mL)
Imp. #1	100	101	1
Imp. #2	100	—	—
Imp. #3			
Imp. #4			
Imp. #5			
Imp. #6			
Upstream Diameters			
Downstream Diameters			

25 Point	Clock Time	Dry Gas Meter ft³	Pitot ΔP IN. H_2O	Orifice ΔH IN. H_2O	Temperature °F: Dry Gas Outlet	Stack	Probe	Box	Impinger Exit	Pump Vac. IN. Hg	Fyrites: CO_2 Vol. %	Fyrites: O_2 Vol. %
	10:40	565.50										
1		567.69	.66	2.29	42	76	250	250	40	2	0	21
2		569.84	.60	2.21	42	76						
3		571.96	.52	2.10	44	76	250	250	42	2		
4		574.01	.46	2.01	42	77						
5		575.97	.32	1.82	45	76	250	250	44	2		
6		577.84	.20	1.66	46	76						
1		579.99	.60	2.21	45	76	250	250	48	2	0	21
2		582.09	.52	2.10	44	76						
3		584.17	.50	2.07	44	77	250	250	52	2		
4		586.26	.50	2.07	45	77						
5		588.24	.35	1.86	46	77	250	250	54	2		
6		590.12	.22	1.68	47	76						
1		592.09	.35	1.86	45	77	250	250	54	2		
2		594.07	.35	1.86	46	76						
3		595.93	.20	1.66	46	77	250	250	56	2		
4		597.59	.05	1.31	47	78						
5		599.11	.00	1.10	47	78	250	250	56	2	0	21
6		600.60	.77	1.06	47	77						
1		602.14	.82	1.13	47	77	250	250	52	2		
2		603.65	.78	1.08	48	77						
3		605.03	.66	.91	47	77	250	250	54	2		
4		606.30	.58	.80	48	77						
5		607.51	.59	.81	49	77	250	250	54			
6	11:44	608.69	.46	.63	49	77						

A. Lanfranco and Associates Inc.

$\sqrt{1.70}$ 1.38ΔH

CLIENT	WEIR			NOZZLE	S-B	DIAMETER, IN.	.1952		IMPINGER	INITIAL	FINAL	TOTAL GAIN					
SOURCE	Grit Blast			PROBE	ST 3A	Cp	.8448		VOLUMES	(mL)	(mL)	(mL)					
PARAMETER / RUN No	2 Basic								Imp. #1	100	101	1					
DATE	Feb. 9/21			PORT LENGTH					Imp. #2	100	—	—					
OPERATOR:	CL			STATIC PRESSURE, IN. H2O			-0.95		Imp. #3								
CONTROL UNIT	AV 15	Y	1.0054	STACK DIAMETER			23 & .34		Imp. #4								
		ΔH@		STACK HEIGHT			30'		Imp. #5								
									Imp. #6								
BAROMETRIC PRESSURE, IN. Hg	30.1			INITIAL LEAK TEST			0.002 @ 15"		Upstream Diameters								
ASSUMED MOISTURE, Bw	1%			FINAL LEAK TEST			0.002 @ 15"		Downstream Diameters								

Point	Clock Time	Dry Gas Meter ft³	Pitot ΔP IN. H_2O	Orifice ΔH IN. H_2O	Temperature °F					Pump Vac. IN. Hg	Fyrites			
					Dry Gas Outlet	Stack	Probe	Box	Impinger Exit		CO_2 Vol. %	O_2 Vol. %		
1	11:52	609.210	.80	1.10	47	76	250	250	45	2	0	21		
2		612.26	.80	1.10	48	77								
3		613.78	.72	.99	47	77	250	250	48	2				
4		614.99	.58	.80	48	77								
5		616.19	.50	.69	49	77	250	250	48	2				
6		617.32	.44	.61	49	77								
1		619.14	1.15	1.59	48	77	250	250	48	2	0	21		
2		621.02	1.22	1.68	49	78								
3		622.76	.97	1.34	49	78	250	250	50	2				
4		624.26	.84	1.16	50	78								
5		625.71	.72	.99	49	79	250	250	50	2				
6		627.12	.68	.94	50	79								
1		629.20	1.50	2.07	49	78	250	250	52	2	0	21		
2		631.25	1.45	2.00	50	77								
3		633.27	1.37	1.89	50	77	250	250	52	2				
4		635.17	1.30	1.79	52	78								
5		637.00	1.22	1.68	51	77	250	250	52	2				
6		638.83	1.10	1.52	50	78								
1		640.99	1.60	2.21	50	78	250	250	52	2	0	21		
2		643.08	1.52	2.10	51	77								
3		645.08	1.45	2.00	51	77	250	250	54	2				
4		647.01	1.33	1.84	51	77								
5		649.00	1.25	1.73	52	77	250	250	54	2				
6	12:55	650.89	1.07	1.48	52	77								

APPENDIX 3

CALIBRATION DATA and CERTIFICATES

A.Lanfranco & Associates inc.

EPA Method 5

Meter Box Calibration

English Meter Box Units, English K' Factor

Model #: AU 15
Serial #: 0028SPC-081915-1

Date: 08-Jan-21
Barometric Pressure: 30.03 (in. Hg)
Theoretical Critical Vacuum: 14.17 (in. Hg)

!!!!!!!!!
IMPORTANT For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.
IMPORTANT The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).
!!!!!!!!!

---------- DRY GAS METER READINGS ----------									-CRITICAL ORIFICE READINGS-					
					Initial Temps.		Final Temps.					-- Ambient Temperature --		
dH (in H2O)	Time (min)	Volume Initial (cu ft)	Volume Final (cu ft)	Volume Total (cu ft)	Inlet (deg F)	Outlet (deg F)	Inlet (deg F)	Outlet (deg F)	Orifice Serial# (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in Hg)	Initial (deg F)	Final (deg F)	Average (deg F)
3.65	15.00	418.400	434.427	16.027	76.0	76.0	79.0	79.0	73	0.8185	17.5	80.0	80.0	80.0
1.90	22.00	375.500	392.670	17.170	73.0	73.0	73.0	73.0	63	0.5956	20.5	62.0	63.0	62.5
1.10	31.00	393.000	411.593	18.593	72.0	72.0	75.0	75.0	55	0.4606	22.0	74.0	75.0	74.5
0.63	22.00	434.500	444.573	10.073	79.0	79.0	81.0	81.0	48	0.3560	23.0	81.0	84.0	82.5
0.23	18.00	411.700	417.334	5.634	75.0	75.0	75.0	75.0	40	0.2408	24.5	77.0	80.0	78.5

********** RESULTS **********

--- DRY GAS METER ---		--------- ORIFICE ---------			-- DRY GAS METER --		--------- ORIFICE ---------			
					CALIBRATION FACTOR Y		CALIBRATION FACTOR dH@			
VOLUME CORRECTED Vm(std) (cu ft)	VOLUME CORRECTED Vm(std) (liters)	VOLUME CORRECTED Vcr(std) (cu ft)	VOLUME CORRECTED Vcr(std) (liters)	VOLUME NOMINAL Vcr (cu ft)	Value (number)	Variation (number)	Value (in H2O)	Value (mm H2O)	Variation (in H2O)	Ko (value)
15.936	451.3	15.866	449.3	16.174	0.996	-0.010	1.809	45.96	0.163	0.718
17.144	485.5	17.214	487.5	16.979	1.004	-0.001	1.736	44.08	0.089	0.729
18.511	524.2	18.547	525.2	18.714	1.002	-0.003	1.717	43.61	0.071	0.735
9.897	280.3	10.098	286.0	10.341	1.020	0.015	1.651	41.93	0.004	0.736
5.582	158.1	5.609	158.8	5.702	1.005	0.000	1.320	33.52	-0.327	0.837
				Average Y--------->	**1.0054**	**Average dH@----->**	**1.646**	**41.8**	**Average Ko---->**	**0.751**

TEMPERATURE CALIBRATION

Calibration Standard -------> Omega Model CL23A S/N:T-218768

Reference Temperature Set-Point (deg F)	Temperature Device Reading (deg F)	Results Variation (degF)	Results Percent of Absolute
32	32	0	0.00%
100	100	0	0.00%
300	300	0	0.00%
500	500	0	0.00%
1000	1000	0	0.00%

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.
For Orifice Calibration Factor dH@, the orifice differential pressure in inches of H20 that equates to 0.75 cfm of air at 68 F and 29.92 inches of Hg, acceptable tolerance of individual values from the average is +-0.2.
For Temperature Devicee, the reading must be within 1.5% of certified calibration standard (absolute temperature) to be acceptable.

Calibrated by: Scott Ferguson Signature:  Date: January 8, 2021

Pitot Tube Calibration

Date: 01-Jan-21 Temp (R): 530
Pbar (in.Hg): 29.5 Dn (in.): 0.25

Pitot ID: **ST 3A**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.065	0.090	17.0	0.8413	0.0034
0.180	0.250	28.3	0.8400	0.0047
0.350	0.460	39.4	0.8636	0.0188
0.460	0.640	45.2	0.8393	0.0054
0.640	0.890	53.3	0.8395	0.0052
		Average :	0.8448	0.0075

Pitot ID: **3D**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.105	0.145	21.6	0.8425	0.0023
0.215	0.300	30.9	0.8381	0.0021
0.310	0.430	37.1	0.8406	0.0004
0.520	0.720	48.1	0.8413	0.0012
0.710	0.990	56.2	0.8384	0.0018
		Average :	0.8402	0.0015

Pitot ID: **ST 3B**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.065	0.090	17.0	0.8413	0.0050
0.145	0.200	25.4	0.8430	0.0034
0.250	0.340	33.3	0.8489	0.0026
0.400	0.550	42.2	0.8443	0.0020
0.655	0.880	54.0	0.8541	0.0078
		Average :	0.8463	0.0042

Pitot ID: **2A**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.050	0.070	14.9	0.8367	0.0075
0.135	0.185	24.5	0.8457	0.0015
0.280	0.380	35.3	0.8498	0.0057
0.520	0.710	48.1	0.8472	0.0031
0.650	0.900	53.8	0.8413	0.0028
		Average :	0.8442	0.0041

Pitot ID: **3C**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.050	0.070	14.9	0.8367	0.0079
0.170	0.230	27.5	0.8511	0.0065
0.300	0.410	36.5	0.8468	0.0023
0.450	0.630	44.7	0.8367	0.0079
0.640	0.865	53.3	0.8516	0.0070
		Average :	0.8446	0.0063

Pitot ID:

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		Average :	#DIV/0!	#DIV/0!

Pitot ID:

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
		Average :		

Pitot ID:

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
		Average :		

* Average absolute deviation must not exceed 0.01.

Calibrated by: Michael Goods Signature:  Date: January 1, 2021

A. LANFRANCO and ASSOCIATES INC.

ENVIRONMENTAL CONSULTANTS

NOZZLE DIAMETER CALIBRATION FORM

Calibrated by: Connor Laan
Date: January 4th, 2021

Signature: 

Nozzle I.D.	d1 (inch)	d2 (inch)	d3 (inch)	difference (inch)	average dia. (inch)	average area (ft^2)
ST01	0.1270	0.1280	0.1290	0.0020	0.1280	0.0000894
SS-7	0.1740	0.1700	0.1740	0.0040	0.1727	0.0001626
ST05	0.1720	0.1740	0.1760	0.0040	0.1740	0.0001651
SS-1	0.1700	0.1720	0.1700	0.0020	0.1707	0.0001589
SS-8	0.1970	0.1935	0.1950	0.0035	0.1952	0.0002077
ST11	0.2050	0.2070	0.2070	0.0020	0.2063	0.0002322
ST10	0.2110	0.2090	0.2070	0.0040	0.2090	0.0002382
SS-18	0.2310	0.2330	0.2310	0.0020	0.2317	0.0002927
ST15	0.2360	0.2340	0.2330	0.0030	0.2343	0.0002995
SS-2	0.2370	0.2410	0.2390	0.0040	0.2390	0.0003115
SS-3	0.2420	0.2420	0.2410	0.0010	0.2417	0.0003185
SS-24	0.2430	0.2410	0.2420	0.0020	0.2420	0.0003194
B	0.2450	0.2430	0.2420	0.0030	0.2433	0.0003229
ST30	0.2500	0.2480	0.2500	0.0020	0.2493	0.0003391
SS-14	0.2470	0.2470	0.2470	0.0000	0.2470	0.0003328
ST20	0.2520	0.2540	0.2530	0.0020	0.2530	0.0003491
A	0.2555	0.2580	0.2580	0.0025	0.2572	0.0003607
SS-9	0.2680	0.2710	0.2720	0.0040	0.2703	0.0003986
ST40	0.2840	0.2850	0.2830	0.0020	0.2840	0.0004399
SS-30	0.2990	0.2980	0.2980	0.0010	0.2983	0.0004854
SS-13	0.3010	0.2970	0.3010	0.0040	0.2997	0.0004898
ST50	0.3040	0.3040	0.3040	0.0000	0.3040	0.0005041
ST60	0.3070	0.3030	0.3050	0.0040	0.3050	0.0005074
SS-10	0.3150	0.3120	0.3140	0.0030	0.3137	0.0005366
SS-327	0.3290	0.3260	0.3260	0.0030	0.3270	0.0005832
ST65	0.3280	0.3300	0.3270	0.0030	0.3283	0.0005880
ST66	0.3370	0.3360	0.3370	0.0010	0.3367	0.0006182
ST80	0.3580	0.3590	0.3590	0.0010	0.3587	0.0007016
SS-5	0.3700	0.3680	0.3660	0.0040	0.3680	0.0007386
ST75	0.3680	0.3700	0.3690	0.0020	0.3690	0.0007426
ST76	0.3710	0.3710	0.3720	0.0010	0.3713	0.0007521
SS-16	0.3750	0.3720	0.3750	0.0030	0.3740	0.0007629
ST85	0.3970	0.4000	0.3990	0.0030	0.3987	0.0008669
DD	0.4060	0.4020	0.4050	0.0040	0.4043	0.0008917
SS-15	0.4040	0.4040	0.4010	0.0030	0.4030	0.0008858
ST70	0.4170	0.4170	0.4180	0.0010	0.4173	0.0009499
SS-11	0.4170	0.4200	0.4210	0.0040	0.4193	0.0009591
ST86	0.4550	0.4560	0.4550	0.0010	0.4553	0.0011308
C	0.4880	0.4890	0.4900	0.0020	0.4890	0.0013042
SS-49	0.4930	0.4920	0.4890	0.0040	0.4913	0.0013167
SS-491	0.4910	0.4900	0.4930	0.0030	0.4913	0.0013167
SS-6	0.4940	0.4970	0.4980	0.0040	0.4963	0.0013436
SS-492	0.4940	0.4970	0.4960	0.0030	0.4957	0.0013400
ST90	0.4990	0.4970	0.4990	0.0020	0.4983	0.0013545
ST92	0.5070	0.5050	0.5040	0.0030	0.5053	0.0013928
SS-558	0.5590	0.5580	0.5590	0.0010	0.5587	0.0017023
ST96	0.5570	0.5550	0.5530	0.0040	0.5550	0.0016800
SS-635	0.6350	0.6380	0.6340	0.0040	0.6357	0.0022039
SS-12	0.7440	0.7450	0.7460	0.0020	0.7450	0.0030272

Where:

(a) D1, D2, D3 = three different nozzle diameters; each diameter must be measured to within (0.025mm) 0.001 in.

(b) Difference = maximum difference between any two diameters; must be less than or equal to (0.1mm) 0.004 in.

(c) Average = average of D1, D2 and D3

BAROMETER CALIBRATION FORM

Device	Cal Date	Pbar Env Canada (kPa)	Pbar Env Canada (inches of Hg)	Device (inches of Hg) Reading	Device (inches of Hg) Elevation Corrected	Difference (Env Can - Elv Corr)
LA	6-Jan-21	101.8	30.07	29.94	30.01	0.05
DS	6-Jan-21	101.8	30.07	29.94	30.01	0.05
CL	6-Jan-21	101.8	30.07	29.94	30.01	0.05
ML	6-Jan-21	101.8	30.07	29.91	29.98	0.08
SB	6-Jan-21	101.8	30.07	29.93	30.00	0.06
SH	6-Jan-21	101.8	30.07	29.95	30.02	0.04
MG	6-Jan-21	101.8	30.07	29.94	30.01	0.05
SF	6-Jan-21	101.8	30.07	29.91	29.98	0.08
JG	6-Jan-21	101.8	30.07	29.89	29.96	0.10
JC	6-Jan-21	101.8	30.07	29.93	30.00	0.06
CNL	6-Jan-21	101.8	30.07	30.08	30.15	-0.09

Calibrated by: Jeremy Gibbs Signature:  Date: 06-Jan-21

Performance Specification is
Device Corrected for Elevation must be +/- 0.1 " Hg of ENV CANADA SEA-LEVEL Pbar
Enter Environment canada Pressure from their website for Vancouver (link below)
and the reading from your barometer on the ground floor of the office.

https://weather.gc.ca/city/pages/bc-74_metric_e.html

A. LANFRANCO and ASSOCIATES INC.

ENVIRONMENTAL CONSULTANTS

TEMPERATURE CALIBRATION FORM

Calibrated by: Justin Ching

Date: 07-Jan-21

Signature: 

TEMPERATURE DEVICE CALIBRATIONS

Reference Device			Temperature Settings (degrees F)													
Model CL23A Calibrator			32		100		200		300		500		800		1700	
Device	**ALA #**	**Serial #**	**Reading**	**Variation**	**Reading**	**Variation**	**Reading**	**Variation**	**Reading**	**Variation**	**Reading**	**Variation**	**Reading**	**Variation**	**Reading**	**Variation**
Omega HH11A	3	300132	32.3	0.06%	99.3	-0.13%	200	0.00%	301	0.13%	498	-0.21%	798	-0.16%	1698	-0.09%
Omega HH11A	4	200167		-6.51%		-17.87%		-30.32%		-39.49%		-52.10%		-63.51%		-78.72%
Omega HH11A	6	600059	33.1	0.22%	100	0.00%	202	0.30%	302	0.26%	499	-0.10%	798	-0.16%	1697	-0.14%
TPI 341K	7	2.0315E+10	30.5	-0.31%	98.3	-0.30%	198.1	-0.29%	298	-0.26%	497	-0.31%	796.4	-0.29%	1693	-0.32%
TPI 341K	8	2.0313E+10	32.1	0.02%	99.3	-0.13%	200.5	0.08%	299.9	-0.01%	499.3	-0.07%	798.7	-0.10%	1696	-0.19%
Cont Cmpny	10	102008464	30.2	-0.37%	97.5	-0.45%	197.8	-0.33%	297.7	-0.30%	497.7	-0.24%	795.9	-0.33%	1693.8	-0.29%
Omega HH11	14	409426		-6.51%		-17.87%		-30.32%		-39.49%		-52.10%		-63.51%		-78.72%
TPI 341K	16	400120029	30.7	-0.26%	99	-0.18%	199.4	-0.09%	299.2	-0.11%	499.6	-0.04%	800.2	0.02%	1703	0.14%
TPI 341K	18	2.0329E+10	31	-0.20%	98.9	-0.20%	198.9	-0.17%	298.7	-0.17%	498.5	-0.16%	798.4	-0.13%	1698	-0.09%
TPI 341K	20	2.0329E+10	30	-0.41%	98.2	-0.32%	198.1	-0.29%	297.7	-0.30%	497.2	-0.29%	797.1	-0.23%	1696	-0.19%
TPI 341K	22	2.0329E+10	30.5	-0.31%	98.6	-0.25%	198.5	-0.23%	298.3	-0.22%	497.7	-0.24%	797.4	-0.21%	1696	-0.19%
Reference device is a NIST certified digital thermocouple calibrator																
Variation expressed as a percentage of the absolute temperature must be within 1.5 %																

MOUNT ROYAL COLLEGE

Faculty of Continuing Education and Extension

Carter Lanfranco

has successfully completed

Stack Sampling

May 2009

Date

Norma D MacDonald

Dean
Faculty of Continuing Education and Extension

Walter Smith & Associates, Inc.

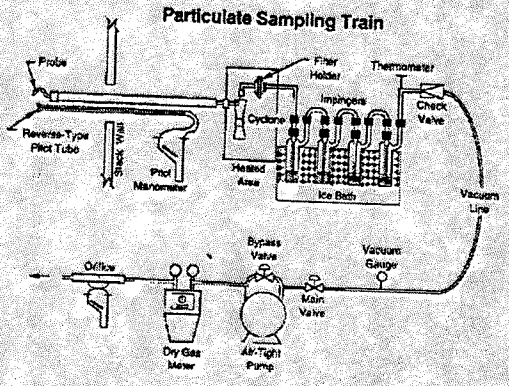
is hereby granted to:

Louis Agassiz

to certify that they have completed to satisfaction

Source Sampling & CEMS Workshop

Granted: March 11, 2011



Walter S, Smith, PE, DEE

3.5 CEU