A.Lanfranco & Associates Inc.
Environmental Consultants

Prepared for

METRO VANCOUVER

Metrotower III 4730 Kingsway
Burnaby, BC V5H 0C6

Annual Trace Organics Emission Report
Waste-to-Energy Facility

August 2020 Survey
Operational Certificate 107051
Report Issued: September 25, 2020

CERTIFICATION

The field monitoring for this survey 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. L. Agassiz (certified), Mr. C. Lanfranco (certified), Mr. J. Gibbs (certified) and Mr. S. Baker.

The report was prepared by Mr. L. Agassiz using reporting principles and guidelines generally acceptable to Metro Vancouver (MV).

The field crew and A. Lanfranco and Associates Inc. certify that the test methods used were BC MOE/MV approved reference methods for the parameters investigated.

Mark Lanfranco, CST
President | Owner

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TEST PROGRAM ORGANIZATION

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SUMMARY

The following tables present the average of triplicate test results on Unit 3 for various trace organics on August 18-19, 2020. Additional emission parameters were measured by the facility's certified continuous emission monitoring system.

Parameter		Unit 3	Limit
PCDD/PCDF	(TEQ ng/Sm^3 @ 11% O_2)	0.0018	0.08
PCDD/PCDF Mass Emission	(TEQ g/day)	3.26E-06	
PAH	(µg/Sm^3 @ 11% O_2)	0.0884	5.0
HCB*	(µg/Sm^3 @ 11% O_2)	0.0012	
Total CB	(µg/Sm^3 @ 11% O_2)	0.2490	1.0
Total CP*	(µg/Sm^3 @ 11% O_2)	0.0062	1.0
Total PCB	(µg/Sm^3 @ 11% O_2)	0.0025	1.0
Flowrate	(Sm^3/min)	1148	
Temperature	(°C)	153	
O_2	(vol % dry)	9.9	

Standard conditions (S) of 20 °C and 101.325 kPa (dry)
*Calculated using half DL convention.

Note: PCDD/PCDF results are in nanograms per cubic meter and grams/day, PAH/HCB/CB/CP are reported in micrograms per cubic meter.

1 INTRODUCTION

Metro Vancouver (MV) commissioned an emissions monitoring survey at the Waste-to-Energy Facility (WTEF) in Burnaby, B.C. This report documents the results of a semi-volatile organics survey for dioxin/furan (PCDD/PCDF), polychlorinated biphenyl (PCB), polycyclic aromatic hydrocarbons (PAH), hexachlorobenzenes (HCB), chlorobenzenes (CB), and chlorophenols (CP) during normal operations at the facility.

This report includes detailed emission results, a brief outline of methods employed, equipment used, and a discussion of the survey. Supporting data is presented in the appendices section of this report.

The individual source monitored for 2020 was Unit 3.

2 METHODOLOGY

All services provided by A. Lanfranco and Associates were conducted in accordance with approved reference methods as issued by:

- Metro Vancouver
- BC Ministry of Environment & Climate Change Strategy
- Environment Canada (EC)
- US Environmental Protection Agency (EPA)

2.1 Sampling and Analytical Methods

The following table lists the test methods used for the different parameters measured. The subsequent paragraphs briefly describe each method.

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
Dioxin/Furan (sampling)	EPS 1/RM/2 Reference Method for Source Testing - Measurement of Releases of Semi-Volatile Organic Compounds from Stationary Sources EPA Method 23 Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans from Stationary Sources supporting
Dioxin/Furan (analytical)	Methodology for Organic Analysis - A Method for the Analysis of Polychlorinated Dibenzopara-Dioxins (PCDD's), Polychlorinated Dibenzofurans (PCDF's) Environment Canada, December 1989

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 a number of equal areas. Traverse points are then located within each of these equal areas.

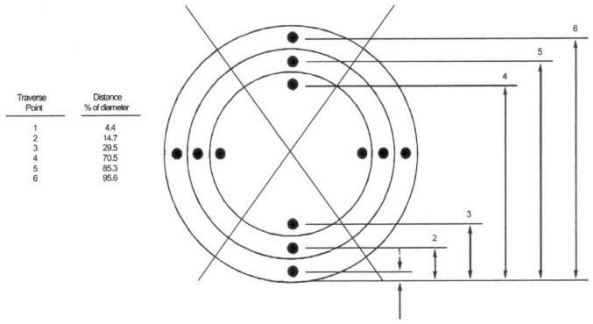


Figure 1. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points.

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.

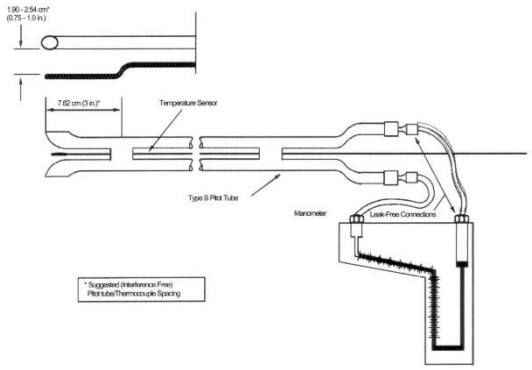


Figure 2. Type S Pitot Tube Manometer Assembly

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.

Dioxins / Furans	Primary:	EPS 1/RM/2, 1/RM/3, 1/RM/23
	Supporting:	EPA Method 23

This method is applicable to the determination of emissions of polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and other semi-volatile organic compounds from stationary sources. An integrated gas sample is isokinetically withdrawn from the stack similar to Method 5. Semi-volatile organic compounds associated with particulate matter are collected in the front half components with remaining compounds not collected by the filter, being absorbed in an Amberlite XAD-2 resin trap.

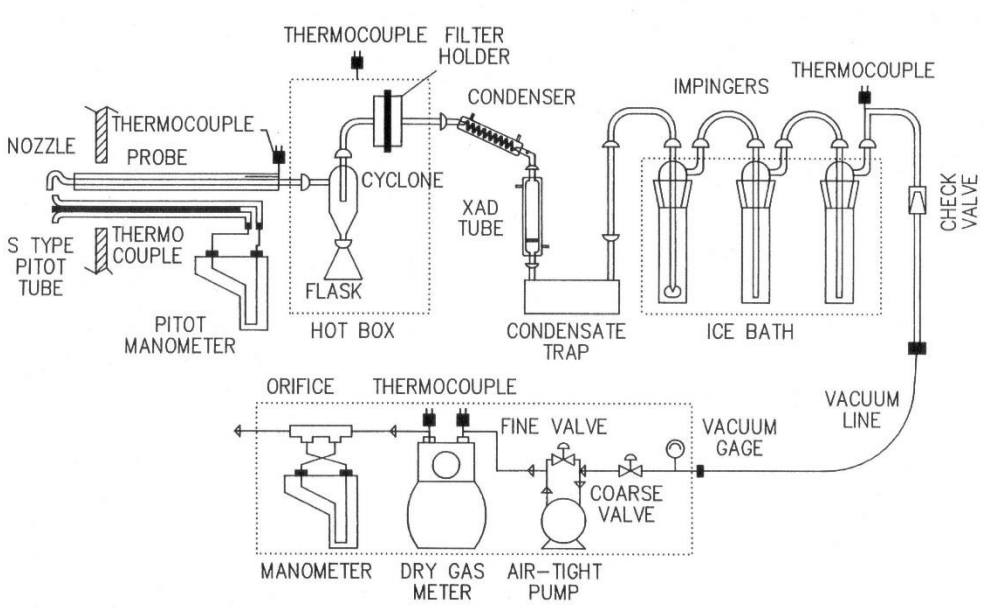


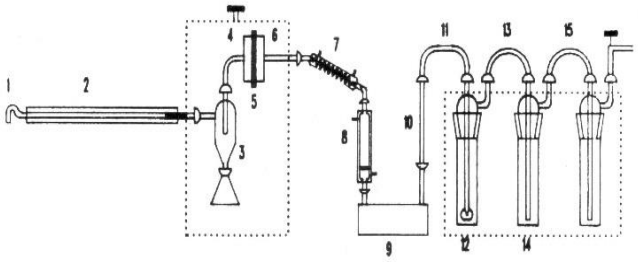
Figure 3 - Dioxin / Furan Sampling Train

Due to the sensitivity of this test method, extra care and precautions are used. All sample trains were cleaned professionally at an accredited laboratory. A solvent proof of the glassware and XAD was archived as suggested by the method.

The train was operated for duration of 240 minutes. Upon completion, it was removed to a clean area for recovery. The recovered sample consists of 6 individual components:

• Filter Rinses	• Front Half Rinses
• XAD Trap	• Soak
• Impingers	• Final Rinse

Complete sampling and recovery procedures can be supplied upon request.



Container or Sample	Component(s)	Recovery Procedure
1	1, 2, 3, 4	Wash and brush 3 times each with hexane (H) and acetone (A). Rinse 3 times each with H and A.
2	5	Remove carefully from holder. Place on pre-cleaned foil. Fold in half. Place in pre-cleaned glass petri dish.
3	6, 7	Soak 5 minutes each with H and A. Rinse 3 times each with H and A.
4	8	Cap ends and wrap in foil.
5	9, 12	Empty contents into container and rinse each 3 times with HPLC water.
6	6 to 15 except 8	Rinse 3 times each with H and A.

Mark liquid levels on all bottles.
All sample containers are pre-cleaned amber glass bottles with pre-cleaned Teflon lid liners.

Figure 4 Recovery Procedures for Semi-Volatile Organics

Samples are analyzed on a high-resolution GS/MS at Pacific Rim Laboratories Inc. of Surrey, BC. Following is a description, in very simplified terms, of the basic procedures used to process the sample train and blank train components.

Initially the sample components are separated into liquid (containers 1, 4, 5 and 6) or solid phases (containers 2 and 3) and surrogate compounds (for recovery calculations) are injected into the solid phases of the front and back half samples. Liquid and solid samples are extracted with various solvents (usually benzene), sometimes under acid conditions. Figure 5 and Figure 6 demonstrate the step by step procedures used to extract the components of interest into a solvent phase which is ready for detailed splitting and clean-up. The concentrated extracts from Figure 5 are combined and are processed per procedures detailed in Figure 6.

When each target group has been isolated, as indicated in Figure 4, the extract volumes are dried, concentrated, and analysed by GC/MS analytical instrumentation. Prior to actual analysis, all samples were spiked with a performance standard for laboratory QA/QC purposes.

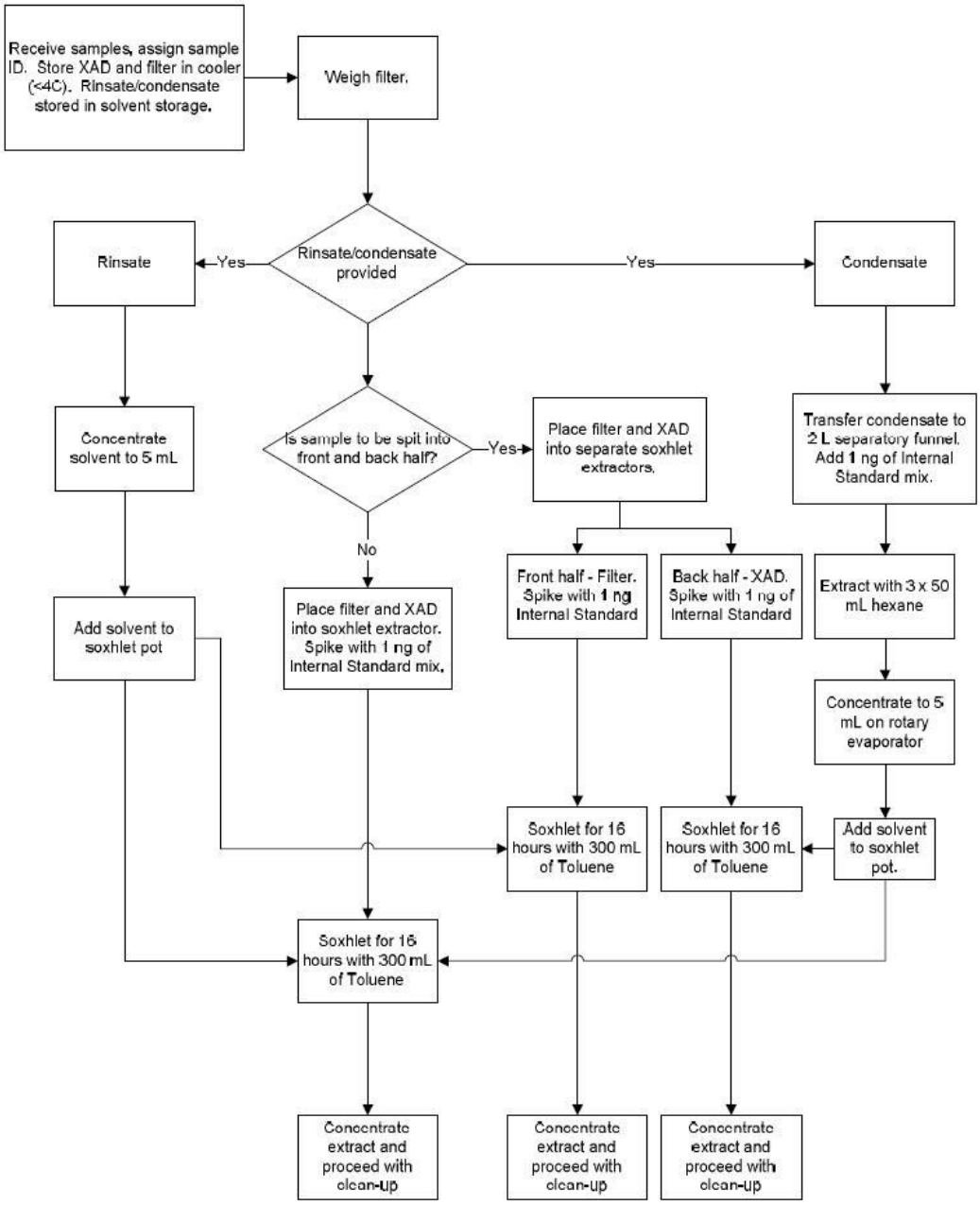


Figure 5 - Semi-Volatile Organics XAD and Filter Recovery Schematic

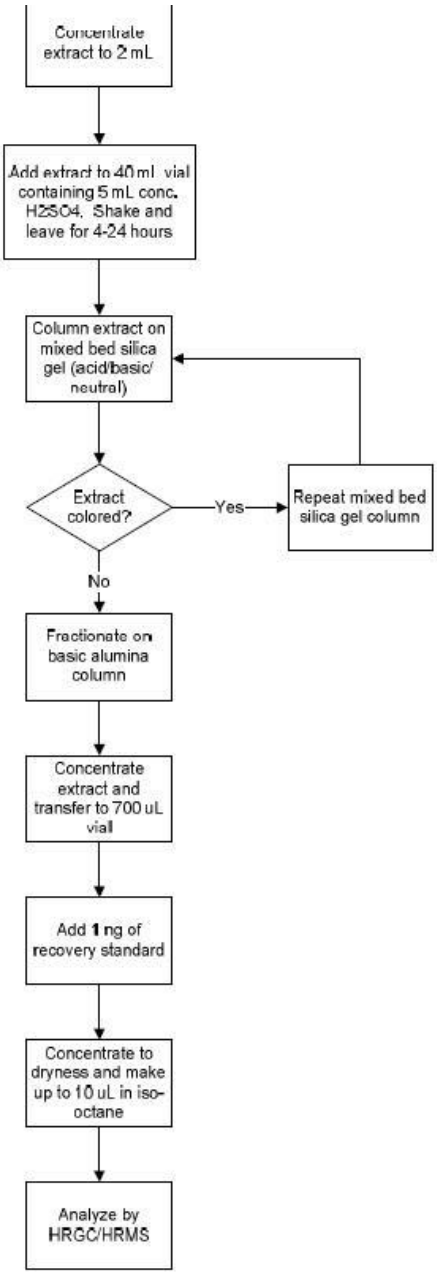


Figure 6 - Schematic of analytical methodology for dioxins and furans

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 1-11 were used to calculate particulate 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 Contaminant Concentration Calculations

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

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

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

$$m_{HF} = \frac{20.006}{18.998}(m_F - m_{blank})/1000 \quad \textbf{Equation 4}$$

$$V_{std} = \frac{V_{std(imp)}}{35.315} \quad \textbf{Equation 5}$$

$$V_{std(imp)} = \frac{V_{samp} \times y \times P_m \times (T_{std} + 459.67)}{P_{std} \times (T_{m(ave)} + 459.67)} \quad \textbf{Equation 6}$$

$$V_{samp} = V_{final} - V_{init} \quad \textbf{Equation 7}$$

$$P_m = P_B + \frac{\Delta H_{ave}}{13.6} \quad \textbf{Equation 8}$$

$$\Delta H_{ave} = \frac{1}{n}\sum_{i=1}^{n} \Delta H_{i(act)}, where\ n = the\ number\ of\ points \quad \textbf{Equation 9}$$

$$OC = \frac{20.9 - \%O_{2c}}{20.9 - \%O_{2m}} \quad \textbf{Equation 10}$$

$$\%O_{2m} = \frac{1}{n}\sum_{i=1}^{n} \%O_{2i}, where\ n = the\ number\ of\ O_2\ measurements \quad \textbf{Equation 11}$$

Where,

c	= *Contaminant concentration*
m	= *Contaminant 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)*
$V_{std(imp)}$	= *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)*
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)*
$\%O_{2m}$	= *Average measured stack gas oxygen concentration (% dry basis)*

Equation 1 is the general concentration calculation used for all contaminants. The contaminant mass, *m*, is the net analytic mass for the given contaminant.

The dioxins/furans and other semi-volatile organic compounds were treated slightly different. The blank results for all trace organic species are used as a Quality Assurance check and are not used to correct the analytic results. Also, according to the terms of the service agreement, individual trace organic species were reported as "non-detect" (ND) if all three tests for that species are below the detection limit. If one (or more) of the triplicate samples has a reportable value, the corresponding ND samples from the other test runs were reported at half the detection limit. For calculating of summarized results (PCDD& PCDF TEQ, Total PAHs, Total Chlorobenzenes, Total Chlorophenols, and Total PCBs) the substitution of half DL for each individual species, as detailed above, was performed prior to calculating the sums.

All results are reported in the units outlined in the service agreement. The following unit conversions were used throughout:

$$1 \text{ mg} = 10^{-3} \text{ g}$$

$$1 \text{ µg} = 10^{-6} \text{ g}$$

$$1 \text{ ng} = 10^{-9} \text{ g}$$

$$1 \text{ tonne} = 10^{6} \text{ g}$$

Oxygen corrections were applied by multiplying the result of Equation 1 by the result of Equation 10 for each individual result.

2.2.2 Isokinetic Variation Calculations

$$\Delta H_i = \frac{2.62 \times 10^7 \times c_p \times A_n \times (1 - B_{wo}) \times M_D \times (T_m + 459.67) \times \Delta p_i}{k_o \times M_w \times (T_{Stk} + 459.67)} \quad \textbf{Equation 12}$$

$$R_m = 85.49 \times c_p \times \sqrt{\Delta p_i} \times \sqrt{\frac{(T_{stk_i} + 459.67)}{M_w \times P_B}} \times 60 \times A_n \times \frac{(T_{m_i} + 459.67) \times (1 - B_{wo})}{(T_{stk_i} + 459.67) \times y} \quad \textbf{Equation 13}$$

$$A_n = \pi \left(\frac{d_n}{24}\right)^2 \quad \textbf{Equation 14}$$

$$M_w = M_D \times (1 - B_{wo}) + 18 \times B_{wo} \quad \textbf{Equation 15}$$

$$M_D = 0.44 \times \%CO_2 + 0.32 \times \%O_2 + 0.28 \times (100 - \%CO_2 - \%O_2) \quad \textbf{Equation 16}$$

$$T_{Stk} = \frac{1}{n} \sum_{i=1}^{n} T_{Stk_i}, where\ n = the\ number\ of\ points \quad \textbf{Equation 17}$$

$$B_{wo} = \frac{V_{cond}}{V_{cond} + V_{std(imp)}} \quad \textbf{Equation 18}$$

$$V_{cond} = 0.04707 \times V_{gain} \quad \textbf{Equation 19}$$

$$Iso = \frac{1}{n} \sum_{i=1}^{n} Iso_i, where\ n = the\ number\ of\ points \quad \textbf{Equation 20}$$

$$Iso_i = \frac{v_{nzi}}{v_i}$$ **Equation 21**

$$v_i = 85.49 \times c_p \times \sqrt{\Delta p_i} \times \sqrt{\frac{(T_{Stk_i} + 459.67)}{(P_{Stk} \times M_W)}}$$ **Equation 22**

$$v_{nzi} = \frac{(V_i - V_{i-1}) \times y \times (T_{Stk_i} + 459.67) \times (P_B + \frac{\Delta H_{i(act)}}{13.6})}{A_n \times t_i \times 60 \times (T_{m(i)} + 459.67) \times P_{stk} \times (1 - B_{wo})}$$ **Equation 23**

$$P_{stk} = P_B + \frac{P_g}{13.6}$$ **Equation 24**

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

$$v_{nz} = \frac{1}{n}\sum_{i=1}^{n} v_{nzi} \, , where\ n = the\ number\ of\ points$$ **Equation 26**

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*
$\Delta H_{i(act)}$ = *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_{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 27**

$$Q_A = \frac{v_{stk} \times 60 \times A_{stk}}{35.315}$$ **Equation 28**

$$A_{stk} = \pi \left(\frac{d}{24}\right)^2$$ **Equation 29**

Where,

Q_A = *Actual flowrate (Am^3/min)*
Q_S = *Flowrate (m^3/min) at standard conditions on a dry basis*
A_{stk} = *Area of stack (ft^2)*
d = *Diameter of stack (inches)*

2.3 Quality Assurance/Quality Control (QA/QC) Techniques

QA/QC of this survey was accomplished by the following mechanisms.

1. Pre and Post-test leak checks.
2. Calibration of volume measuring and monitoring instrumentation.
3. Proofing of organic glassware and supplies.
4. Analysis of all blank solutions and materials.
5. Surrogate spiking of XAD using EPA protocols
6. Internal standard spiking and recovery analysis of organic trains to Env. Canada specs
7. Blank train sampling of leak check average volume

3 TEST RESULTS

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

Table 1 presents summarized trace organic results using the Hazardous Waste Regulation TEQ's, as well as additional organic species. Table 2 presents detailed PCDD/PCDF data and Table 3 presents trace organics results as a mass emission (not corrected for O_2). Detailed PAH and additional chlorinated organic species emission concentrations are presented in Table 4 and Appendix 2.

Trace organic results were recovery corrected according to surrogate recovery efficiencies determined for each organic analysis. Surrogates added and the recoveries determined are listed in the analytical data presented in the Appendices.

A stratification check was performed in 2018 and a cyclonic flow check was performed in 2006. Neither condition was present at the Unit 3 sampling location.

TABLE 1: UNIT 3 TRACE ORGANICS RESULTS TABLE

Parameter		Test 1	Test 2	Test 3	Average
Test Date		18-Aug-20	19-Aug-20	19-Aug-20	
Test Time		08:55 - 12:57	08:28 - 12:30	13:40 - 17:42	
Duration	(minutes)	240	240	240	240
PCDD & PCDF TEQ	(ng/Sm^3)	0.0023	0.0014	0.0022	0.0020
PCDD & PCDF TEQ	**(ng/Sm^3 @ 11% O_2)**	**0.0020**	**0.0012**	**0.0021**	**0.0018**
Total PAH	($\mu g/Sm^3$)	0.0910	0.0468	0.1536	0.0971
Total PAH	**($\mu g/Sm^3$ @ 11% O_2)**	**0.0798**	**0.0422**	**0.1431**	**0.0884**
Total HCB*	($\mu g/Sm^3$)	0.0013	0.0014	0.0014	0.0014
Total HCB*	**($\mu g/Sm^3$ @ 11% O_2)**	**0.0012**	**0.0012**	**0.0013**	**0.0012**
Total CB	($\mu g/Sm^3$)	0.2363	0.2692	0.3183	0.2746
Total CB	**($\mu g/Sm^3$ @ 11% O_2)**	**0.2073**	**0.2430**	**0.2966**	**0.2490**
Total CP*	($\mu g/Sm^3$)	0.0067	0.0069	0.0071	0.0069
Total CP*	**($\mu g/Sm^3$ @ 11% O_2)**	**0.0059**	**0.0062**	**0.0066**	**0.0062**
Total PCB	($\mu g/Sm^3$)	0.0033	0.0024	0.0024	0.0027
Total PCB	**($\mu g/Sm^3$ @ 11% O_2)**	**0.0029**	**0.0022**	**0.0023**	**0.0025**
Stack Temperature	(°C)	150	153	158	153
Flowrate	(Sm^3/min)	1151	1136	1157	1148
Oxygen (O_2)	(vol % dry)	9.6	9.9	10.3	9.9
Carbon Dioxide (CO_2)	(vol % dry)	10.4	10.2	10.0	10.2
Moisture	(vol %)	14.9	13.8	14.6	14.4
Isokinetic Variation	(%)	103	101	100	101

Standard conditions (S) of 20 °C and 101.325 kPa (dry)
*Calculated using half DL convention.

TABLE 2: Detailed PCDD/PCDF Emission Results

		Test 1		Test 2		Test 3	
Test Date:		18-Aug-20		19-Aug-20		19-Aug-20	
Test Time:		08:55 - 12:57		08:28 - 12:30		13:40 - 17:42	
Component	**TEF**	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)
2378 TCDD	1.0000	0.0000	ND	0.0000	ND	0.0000	ND
12378 PCDD	0.5000	0.0000	ND	0.0000	ND	0.0000	ND
123478 HxCDD	0.1000	0.0000	ND	0.0000	ND	0.0000	ND
123678 HxCDD	0.1000	0.0057	0.0006	0.0020	0.0002	0.0150	0.0015
123789 HxCDD	0.1000	0.0000	ND	0.0000	ND	0.0000	ND
1234678 HpCDD	0.0100	0.0430	0.0004	0.0230	0.0002	0.0600	0.0006
OCDD	0.0010	0.0700	0.00007	0.1100	0.00011	0.1100	0.00011
2378 TCDF	0.1000	0.0000	ND	0.0000	ND	0.0000	ND
12378 PCDF	0.0500	0.0000	ND	0.0000	ND	0.0000	ND
23478 PCDF	0.5000	0.0100	0.0050	0.0020	0.0010	0.0020	0.0010
123478 HxCDF	0.1000	0.0020	0.0002	0.0130	0.0013	0.0170	0.0017
123678 HxCDF	0.1000	0.0067	0.0007	0.0062	0.0006	0.0079	0.0008
234678 HxCDF	0.1000	0.0140	0.0014	0.0120	0.0012	0.0140	0.0014
123789 HxCDF	0.1000	0.0000	ND	0.0000	ND	0.0000	ND
1234678 HpCDF	0.0100	0.0390	0.00039	0.0260	0.00026	0.0670	0.00067
1234789 HpCDF	0.0100	0.0000	ND	0.0000	ND	0.0000	ND
OCDF	0.0010	0.0000	ND	0.0000	ND	0.0000	ND
Summed PCDD & PCDF TEQ (ng)			**0.0087**		**0.0049**		**0.0078**
Sample Volume (dscm)			**3.7375**		**3.6329**		**3.5153**
PCDD & PCDF TEQ	**ng/dscm**		**0.00234**		**0.00135**		**0.00221**
PCDD & PCDF TEQ	**ng/dscm @ 11% O_2**		**0.00205**		**0.00122**		**0.00206**
PCDD & PCDF TEQ	**grams/day**		**0.000004**		**0.000002**		**0.000004**

TABLE 3: UNIT 3 TRACE ORGANICS MASS EMISSIONS RESULTS

Parameter		Test 1	Test 2	Test 3	Average
PCDD & PCDF TEQ	**(g/sec)**	**4.48E-11**	**2.56E-11**	**4.26E-11**	**3.77E-11**
PCDD & PCDF TEQ	**(tonnes/annum)**	**1.41E-09**	**8.09E-10**	**1.34E-09**	**1.19E-09**
Total PAH	**(g/sec)**	**1.74E-06**	**8.86E-07**	**2.96E-06**	**1.86E-06**
Total PAH	**(tonnes/annum)**	**5.50E-05**	**2.79E-05**	**9.34E-05**	**5.88E-05**
Total HCB*	**(g/sec)**	**2.57E-08**	**2.61E-08**	**2.74E-08**	**2.64E-08**
Total HCB*	**(tonnes/annum)**	**8.09E-07**	**8.22E-07**	**8.65E-07**	**8.32E-07**
Total CB	**(g/sec)**	**4.53E-06**	**5.10E-06**	**6.14E-06**	**5.26E-06**
Total CB	**(tonnes/annum)**	**1.43E-04**	**1.61E-04**	**1.94E-04**	**1.66E-04**
Total CP*	**(g/sec)**	**1.28E-07**	**1.30E-07**	**1.37E-07**	**1.32E-07**
Total CP*	**(tonnes/annum)**	**4.05E-06**	**4.11E-06**	**4.32E-06**	**4.16E-06**
Total PCB	**(g/sec)**	**6.31E-08**	**4.64E-08**	**4.72E-08**	**5.22E-08**
Total PCB	**(tonnes/annum)**	**1.99E-06**	**1.46E-06**	**1.49E-06**	**1.65E-06**

Standard conditions (S) of 20 °C and 101.325 kPa (dry)
*Calculated using half DL convention.
Note - tonnes/annum based on 8760 operating hours

TABLE 4: Detailed PCB/PAH/CB/CP Emission Results

	Test 1	Test 2	Test 3
Test Date:	18-Aug-20	19-Aug-20	19-Aug-20
Test Time:	08:55 - 12:57	08:28 - 12:30	13:40 - 17:42
Component	**Analyzed** (ug)	**Analyzed** (ug)	**Analyzed** (ug)
Benz(a)anthracene	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND
Benzo(b,j) fluoranthene	ND	ND	ND
Benzo(e)pyrene	0.010	0.005	0.040
Benzo(g,h,i)perylene	0.040	0.005	0.060
Benzo(k)fluoranthene	ND	ND	ND
Chrysene	ND	ND	ND
Dibenz(a,j)acridine	ND	ND	ND
Dibenz(a,h)acridine	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND
Dibenzo(a,i)pyrene	ND	ND	ND
Fluoranthene	0.040	0.020	0.110
Indeno(1,2,3-c,d)pyrene	ND	ND	ND
Phenanthrene	0.160	0.080	0.230
Pyrene	0.050	0.030	0.060
7H-dibenzo(c,g)carbazole	ND	ND	ND
Acenaphthene	**ND**	**ND**	**ND**
Acenaphthylene	**ND**	**ND**	**ND**
Fluorene	**0.040**	**0.030**	**0.040**
Dibenzo(a,e) fluoranthene	**ND**	**ND**	**ND**
3-Methylcholanthrene	**ND**	**ND**	**ND**
5-Methylchrysene	**ND**	**ND**	**ND**
7,12-Dimethylbenz(a)anthracene	**ND**	**ND**	**ND**
Dibenzo(a,h)pyrene	**ND**	**ND**	**ND**
Dibenzo(a,e)pyrene	**ND**	**ND**	**ND**
Dibenzo(a,l)pyrene	**ND**	**ND**	**ND**
Quinoline	**ND**	**ND**	**ND**
Total CP	**0.0250**	**0.0250**	**0.0250**
Total CB	**0.8830**	**0.9780**	**1.1190**
HCB	**0.0050**	**0.0050**	**0.0050**
* ND = Less than detection limit			
PCB Total (ng)	**12.3**	**8.9**	**8.6**
Total PAH (ug)	**0.340**	**0.170**	**0.540**
Sample Volume (dscm)	**3.74**	**3.63**	**3.52**

4 DISCUSSION

The emissions monitoring for this survey was preformed during normal processing of municipal solid waste at the Waste-to-Energy facility. Three sample runs for each test parameter were conducted over three days to determine final results.

Results from this survey indicate that emissions are below the operational certificate limits for each pollutant.

Trace organics results are similar to data from 2018 and 2019; however, there was a notable decrease in total chlorobenzenes (CB) and in total polychlorinated biphenyl (PCB).

Dioxin/Furan results are expressed using the International Toxic Equivalents (I-TEQ). In this report, individual species that were measured below detection limits were reported as zero or "non-detect" if there was no detection in any of the three test runs.

In the blank sample, no dioxin/furan congeners were detected, and minimal congeners were detected at levels only very slightly above the detection limit for PCB, CB and CP. There were a number of PAH's detected in the blank sample. Primarily phenanthrene, fluoranthene and pyrene. It is likely that the samples were not impacted; however, it is possible that the average result for PAH this survey has some positive bias related to the elevated blank.

The QA/QC program showed very low or non-detectable levels of target contaminants in the blank sample, which used the same solid sorbent resin and clean-up solvents as those used for samples. Additionally, the proof analysis of the glassware and XAD (prior recent blanks) showed no significant PCDD/PCDF.

For all tests and the blank test, internal standard recoveries ranged from 57 to 90%.

EPA Method 23 surrogate recoveries ranged from 80 to 124% for each sample. The recovery QA/QC data is expected to meet EPA performance specifications (M23) of 70 to 130% for pre-test spiked surrogates. The M23 spiking protocol is not required in Canada and is included in the sampling/analytical protocol for additional QA/QC and information purposes only.

There were no problems associated with sample collection or analysis. Sampling was conducted in accordance with the respective reference methods and passed all appropriate quality assurance and quality control criteria. It is therefore stated that these results are reported with a high degree of confidence and are an accurate representation of emission characteristics for the operating conditions maintained on the test dates.

APPENDIX 1

ANALYTICAL DATA and

QA/QC RESULTS

SAMPLE RECEIPT FORM / CHEMICAL ANALYSIS FORM

FILE #: PR201666

CLIENT: A. Lanfranco & Associates
Unit 101 9488 – 189 St.
Surrey, BC
V4N 4W7

Phone: (604) 881-2582
Email: mark.lanfranco@alanfranco.com

RECEIVED BY: M. MacLennan
CONDITION: Okay, 13.8°C

DATE/TIME: August 21, 2020 (12:30 p.m.)

# of Containers	Sample Type	Sample (Client Codes)	Lab Codes	Test Requested
5	Stack	MV Unit 3 - DF - Blank	PR201666	PCDD/F, PCB, PAH/HCB, CB, CP
5	Stack	MV Unit 3 - DF - Run 1	PR201667	PCDD/F, PCB, PAH/HCB, CB, CP
5	Stack	MV Unit 3 - DF - Run 2	PR201668	PCDD/F, PCB, PAH/HCB, CB, CP
5	Stack	MV Unit 3 - DF - Run 3	PR201669	PCDD/F, PCB, PAH/HCB, CB, CP

STORAGE: XAD and filter stored at 4°C, rinses stored at ambient temperature.

ANALYTES: HRGC/HRMS analysis for polychlorinated dibenzo(p)dioxins and dibenzofurans (PCDD/F), polychlorinated biphenyls (PCB) and polycyclic aromatic hydrocarbons (PAH).

SPECIAL INSTRUCTIONS: none

METHODOLOGY

Reference Method: PCDD/F: SOP LAB01; EPA Method 23, Environment Canada 1-RM-3
PCB: SOP LAB02; EPA Method 1668C
PAH/HCB/CB/CP: SOP LAB13; in house

Data summarized in Data Report attached.

Report sent to: Mark Lanfranco Date: September 22, 2020

Comments: Results relate only to items tested.

Digitally signed by Patrick Pond
DN: cn=Patrick Pond, o=Pacific Rim Laboratories Inc., ou=CTO, email=Pat@pacificrimlabs.com, c=CA
Date: 2020.09.22 14:26:21 -07'00'

Patrick Pond, C.Chem, CTO

METHOD 23/1-RM-3 DATA REPORT

Client:	A. Lanfranco & Associates	**Sample Date:**	18-Aug-20
Client ID:	MV Unit 3 - DF - Blank	**Date Extracted:**	31-Aug-20
PRL ID:	PR201666	**Date Analysed:**	19-Sep-20
		Filter Wt.:	0.35g

DIOXINS		DL	# of	I-TEQs		
				(ND=0)	(ND=½DL)	(ND=DL)
Congeners	pg	pg	peaks	pg	pg	pg
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	ND	2	0			
1,2,3,7,8-PeCDD	ND	4		ND	1	2
Total PeCDD	19	4	1			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	5.7	4		0.57	0.57	0.57
1,2,3,7,8,9-HxCDD	ND	4		ND	0.2	0.4
Total HxCDD	100	4	3			
1,2,3,4,6,7,8-HpCDD	36	4		0.36	0.36	0.36
Total HpCDD	82	4	2			
OCDD	100	15	1	0.1	0.1	0.1
		Total Dioxin TEQ		**1.0**	**3.4**	**5.8**

FURANS		DL	# of	I-TEQs		
				(ND=0)	(ND=½DL)	(ND=DL)
Congeners	pg	pg	peaks	pg	pg	pg
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	7.8	4		3.9	3.9	3.9
Total PeCDF	40	4	3			
1,2,3,4,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDF	8.9	4		0.89	0.89	0.89
1,2,3,7,8,9-HxCDF	4	4		0.4	0.4	0.4
2,3,4,6,7,8-HxCDF	15	4		1.5	1.5	1.5
Total HxCDF	69	4	4			
1,2,3,4,6,7,8-HpCDF	29	4		0.29	0.29	0.29
1,2,3,4,7,8,9-HpCDF	ND	4		ND	0.02	0.04
Total HpCDF	51	4	2			
OCDF	ND	15	0	ND	0.0075	0.015
		Total Furan TEQ		**7.0**	**7.4**	**7.8**

Total PCDD/PCDF Toxic Equivalent (pg)	**8.0**	**10.8**	**13.7**

Surrogate Recoveries (%)

$^{37}Cl_4$ -2,3,7,8-TCDD	102
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	120
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	127
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	119
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	100

ND - none detected

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	65
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	85
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	69
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	79
$^{13}C_{12}$ -OCDD	82
$^{13}C_{12}$ -2,3,7,8-TCDF	58
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	76
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	68
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	76

METHOD 23/1-RM-3 DATA REPORT

Client:	A. Lanfranco & Associates	**Sample Date:**	18-Aug-20
Client ID:	MV Unit 3 - DF - Run 1	**Date Extracted:**	31-Aug-20
PRL ID:	PR201667	**Date Analysed:**	19-Sep-20
		Filter Wt.:	0.35g

DIOXINS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	pg	pg	peaks	pg	pg	pg
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	ND	2	0			
1,2,3,7,8-PeCDD	ND	4		ND	1	2
Total PeCDD	16	4	1			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	5.7	4		0.57	0.57	0.57
1,2,3,7,8,9-HxCDD	ND	4		ND	0.2	0.4
Total HxCDD	93	4	3			
1,2,3,4,6,7,8-HpCDD	43	4		0.43	0.43	0.43
Total HpCDD	79	4	2			
OCDD	70	15	1	0.07	0.07	0.07
		Total Dioxin TEQ		1.1	3.5	5.9

FURANS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	pg	pg	peaks	pg	pg	pg
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	10	4		5	5	5
Total PeCDF	25	4	2			
1,2,3,4,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDF	6.7	4		0.67	0.67	0.67
1,2,3,7,8,9-HxCDF	ND	4		ND	0.2	0.4
2,3,4,6,7,8-HxCDF	14	4		1.4	1.4	1.4
Total HxCDF	36	4	3			
1,2,3,4,6,7,8-HpCDF	39	4		0.39	0.39	0.39
1,2,3,4,7,8,9-HpCDF	ND	4		ND	0.02	0.04
Total HpCDF	42	4	2			
OCDF	ND	15	0	ND	0.0075	0.015
		Total Furan TEQ		7.5	8.1	8.7

Total PCDD/PCDF Toxic Equivalent (pg)	8.5	11.6	14.6

Surrogate Recoveries (%)

$^{37}Cl_4$ -2,3,7,8-TCDD	112
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	111
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	101
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	124
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	101

ND - none detected

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	63
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	79
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	72
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	84
$^{13}C_{12}$ -OCDD	84
$^{13}C_{12}$ -2,3,7,8-TCDF	57
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	74
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	66
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	84

METHOD 23/1-RM-3 DATA REPORT

Client:	A. Lanfranco & Associates	**Sample Date:**	19-Aug-20
Client ID:	MV Unit 3 - DF - Run 2	**Date Extracted:**	31-Aug-20
PRL ID:	PR201668	**Date Analysed:**	19-Sep-20
		Filter Wt.:	0.36g

DIOXINS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	pg	pg	peaks	pg	pg	pg
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	ND	2	0			
1,2,3,7,8-PeCDD	ND	4		ND	1	2
Total PeCDD	ND	4	0			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDD	ND	4		ND	0.2	0.4
Total HxCDD	120	4	3			
1,2,3,4,6,7,8-HpCDD	23	4		0.23	0.23	0.23
Total HpCDD	64	4	2			
OCDD	110	15	1	0.11	0.11	0.11
		Total Dioxin TEQ		**0.3**	**2.9**	**5.5**

FURANS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	pg	pg	peaks	pg	pg	pg
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	ND	4		ND	1	2
Total PeCDF	ND	4	0			
1,2,3,4,7,8-HxCDF	13	4		1.3	1.3	1.3
1,2,3,6,7,8-HxCDF	6.2	4		0.62	0.62	0.62
1,2,3,7,8,9-HxCDF	ND	4		ND	0.2	0.4
2,3,4,6,7,8-HxCDF	12	4		1.2	1.2	1.2
Total HxCDF	31	4	3			
1,2,3,4,6,7,8-HpCDF	26	4		0.26	0.26	0.26
1,2,3,4,7,8,9-HpCDF	ND	4		ND	0.02	0.04
Total HpCDF	33	4	2			
OCDF	ND	15	0	ND	0.0075	0.015
		Total Furan TEQ		**3.4**	**4.8**	**6.2**

Total PCDD/PCDF Toxic Equivalent (pg)	**3.7**	**7.7**	**11.8**

Surrogate Recoveries (%)

$^{37}Cl_4$ -2,3,7,8-TCDD	106
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	111
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	96
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	117
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	80

ND - none detected

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	64
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	72
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	77
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	86
$^{13}C_{12}$ -OCDD	90
$^{13}C_{12}$ -2,3,7,8-TCDF	58
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	70
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	72
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	86

METHOD 23/1-RM-3 DATA REPORT

Client:	A. Lanfranco & Associates	**Sample Date:**	19-Aug-20
Client ID:	MV Unit 3 - DF - Run 3	**Date Extracted:**	31-Aug-20
PRL ID:	PR201669	**Date Analysed:**	19-Sep-20
		Filter Wt.:	0.36g

DIOXINS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	pg	pg	peaks	pg	pg	pg
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	ND	2	0			
1,2,3,7,8-PeCDD	ND	4		ND	1	2
Total PeCDD	17	4	1			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	15	4		1.5	1.5	1.5
1,2,3,7,8,9-HxCDD	ND	4		ND	0.2	0.4
Total HxCDD	190	4	3			
1,2,3,4,6,7,8-HpCDD	60	4		0.6	0.6	0.6
Total HpCDD	120	4	2			
OCDD	110	15	1	0.11	0.11	0.11
		Total Dioxin TEQ		**2.2**	**4.6**	**7.0**

FURANS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	pg	pg	peaks	pg	pg	pg
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	ND	4		ND	1	2
Total PeCDF	74	4	3			
1,2,3,4,7,8-HxCDF	17	4		1.7	1.7	1.7
1,2,3,6,7,8-HxCDF	7.9	4		0.79	0.79	0.79
1,2,3,7,8,9-HxCDF	ND	4		ND	0.2	0.4
2,3,4,6,7,8-HxCDF	14	4		1.4	1.4	1.4
Total HxCDF	71	4	5			
1,2,3,4,6,7,8-HpCDF	67	4		0.67	0.67	0.67
1,2,3,4,7,8,9-HpCDF	ND	4		ND	0.02	0.04
Total HpCDF	85	4	2			
OCDF	ND	15	0	ND	0.0075	0.015
		Total Furan TEQ		**4.6**	**6.0**	**7.4**

Total PCDD/PCDF Toxic Equivalent (pg)	**6.8**	**10.6**	**14.4**

Surrogate Recoveries (%)

$^{37}Cl_4$ -2,3,7,8-TCDD	106
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	108
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	107
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	111
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	91

ND - none detected

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	64
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	86
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	62
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	86
$^{13}C_{12}$ -OCDD	86
$^{13}C_{12}$ -2,3,7,8-TCDF	56
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	74
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	67
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	79

METHOD 23/1-RM-3 DATA REPORT

Client:	A. Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	BLANK	**Date Extracted:**	31-Aug-20
PRL ID:	DF200527B	**Date Analysed:**	19-Sep-20

DIOXINS		DL	# of	I-TEQs (ND=0)	I-TEQs (ND=½DL)	I-TEQs (ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	ND	2	0			
1,2,3,7,8-PeCDD	ND	4		ND	1	2
Total PeCDD	ND	4	0			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDD	ND	4		ND	0.2	0.4
Total HxCDD	ND	4	0			
1,2,3,4,6,7,8-HpCDD	ND	4		ND	0.02	0.04
Total HpCDD	ND	4	0			
OCDD	ND	15	0	ND	0.0075	0.015
		Total Dioxin TEQ		**0.0**	**2.6**	**5.3**

FURANS		DL	# of	I-TEQs (ND=0)	I-TEQs (ND=½DL)	I-TEQs (ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	ND	4		ND	1	2
Total PeCDF	ND	4	0			
1,2,3,4,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDF	ND	4		ND	0.2	0.4
2,3,4,6,7,8-HxCDF	ND	4		ND	0.2	0.4
Total HxCDF	ND	4	0			
1,2,3,4,6,7,8-HpCDF	ND	4		ND	0.02	0.04
1,2,3,4,7,8,9-HpCDF	ND	4		ND	0.02	0.04
Total HpCDF	ND	4	0			
OCDF	ND	15	0	ND	0.0075	0.015
		Total Furan TEQ		**0.0**	**2.0**	**4.1**

Total PCDD/PCDF Toxic Equivalent (pg)	**0.0**	**4.7**	**9.4**

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	63
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	82
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	62
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	79
$^{13}C_{12}$ -OCDD	86
$^{13}C_{12}$ -2,3,7,8-TCDF	56
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	71
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	63
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	84

ND - none detected

QC REPORT - SPIKE

Client:	A. Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	SPIKE	**Date Extracted:**	31-Aug-20
PRL ID:	DF200528S	**Date Analysed:**	19-Sep-20

DIOXINS			Acceptable Recovery		Pass/Fail	Int. Std Recoveries
	LOF	Recovery	Min	Max		
Congeners	pg	%	%	%		%
2,3,7,8-TCDD	200	91	80	120	Pass	62
1,2,3,7,8-PeCDD	200	96	80	120	Pass	87
1,2,3,4,7,8-HxCDD	400	114	80	120	Pass	-
1,2,3,6,7,8-HxCDD	400	99	80	120	Pass	73
1,2,3,7,8,9-HxCDD	400	114	80	120	Pass	-
1,2,3,4,6,7,8-HpCDD	400	97	80	120	Pass	99
OCDD	1000	108	80	120	Pass	106

FURANS			Acceptable Recovery		Pass/Fail	Int. Std Recoveries
	LOF	Recovery	Min	Max		
Congeners	pg	%	%	%		%
2,3,7,8-TCDF	200	91	80	120	Pass	58
1,2,3,7,8-PeCDF	200	107	80	120	Pass	76
2,3,4,7,8-PeCDF	200	100	80	120	Pass	-
1,2,3,4,7,8-HxCDF	400	118	80	120	Pass	-
1,2,3,6,7,8-HxCDF	400	104	80	120	Pass	68
1,2,3,7,8,9-HxCDF	400	108	80	120	Pass	-
2,3,4,6,7,8-HxCDF	400	119	80	120	Pass	-
1,2,3,4,6,7,8-HpCDF	400	95	80	120	Pass	97
1,2,3,4,7,8,9-HpCDF	400	92	80	120	Pass	-
OCDF	1000	101	80	120	Pass	-

LOF - Level of Fortification

DATA REPORT

Client:	A. Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	MV Unit 3 - DF - Blank	**Date Extracted:**	31-Aug-20
PRL ID:	PR201666	**Date Analysed:**	16-Sep-20

Dioxin-like PCBs				Surrogate Recoveries
			DL	
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**
3,4,4',5-TeCB	PCB 81	ND	0.02	80
3,3',4,4'-TeCB	PCB 77	ND	0.02	80
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	84
2,3',4,4',5-PeCB	PCB 118	0.05	0.02	88
2,3,4,4',5-PeCB	PCB 114	ND	0.02	88
2,3,3',4,4'-PeCB	PCB 105	0.021	0.02	92
3,3',4,4',5-PeCB	PCB 126	ND	0.02	92
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	68
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	80
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	80
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	76
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	88
		Toxic Equivalent (WHO-TEQ)		

WHO-TEQs (2005)	
(ND=0)	(ND=DL)
ng	ng
ND	6.00E-06
ND	2.00E-06
ND	6.00E-07
1.46E-06	1.46E-06
ND	6.00E-07
6.22E-07	6.22E-07
ND	2.00E-03
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	6.00E-04
ND	6.00E-07
2.08E-06	2.61E-03

Total PCB		
		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	ND	0.05
Dichlorobiphenyls	2.89	0.05
Trichlorobiphenyls	1.06	0.05
Tetrachlorobiphenyls	0.44	0.05
Pentachlorobiphenyls	0.095	0.05
Hexachlorobiphenyls	0.053	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	4.54	

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	28
13C12-4,4'-DiCB	15L	64
13C12-2,2',6'-TrCB	19L	56
13C12-3,4,4'-TrCB	37L	80
13C12-2,2',6,6'-TeCB	54L	56
13C12-2,2',4,6,6'-PeCB	104L	68
13C12-2,2',4,4',6,6'-HxCB	155L	64
13C12-2,2',3,4',5,6,6'-HpCB	188L	80
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	76
13C12-2,3,3',4,4',5,5',6-OcCB	205L	72
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	92
13C12-DeCB	209L	96

ND - none detected

DATA REPORT

Client:	A. Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	MV Unit 3 - DF - Run 1	**Date Extracted:**	31-Aug-20
PRL ID:	PR201667	**Date Analysed:**	16-Sep-20

Dioxin-like PCBs				Surrogate Recoveries	WHO-TEQs (2005) (ND=0)	WHO-TEQs (2005) (ND=DL)
			DL			
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**	**ng**	**ng**
3,4,4',5-TeCB	PCB 81	ND	0.02	80	ND	6.00E-06
3,3',4,4'-TeCB	PCB 77	ND	0.02	84	ND	2.00E-06
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	88	ND	6.00E-07
2,3',4,4',5-PeCB	PCB 118	ND	0.02	88	ND	6.00E-07
2,3,4,4',5-PeCB	PCB 114	ND	0.02	88	ND	6.00E-07
2,3,3',4,4'-PeCB	PCB 105	ND	0.02	88	ND	6.00E-07
3,3',4,4',5-PeCB	PCB 126	ND	0.02	92	ND	2.00E-03
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	84	ND	6.00E-07
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	80	ND	6.00E-07
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	80	ND	6.00E-07
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	72	ND	6.00E-04
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	96	ND	6.00E-07
		Toxic Equivalent (WHO-TEQ)			0.00E+00	2.61E-03

Total PCB		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	0.428	0.05
Dichlorobiphenyls	8.89	0.05
Trichlorobiphenyls	2.18	0.05
Tetrachlorobiphenyls	0.80	0.05
Pentachlorobiphenyls	ND	0.05
Hexachlorobiphenyls	ND	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	12.3	

ND - none detected

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	20
13C12-4,4'-DiCB	15L	52
13C12-2,2',6'-TrCB	19L	48
13C12-3,4,4'-TrCB	37L	72
13C12-2,2',6,6'-TeCB	54L	48
13C12-2,2',4,6,6'-PeCB	104L	52
13C12-2,2',4,4',6,6'-HxCB	155L	64
13C12-2,2',3,4',5,6,6'-HpCB	188L	84
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	76
13C12-2,3,3',4,4',5,5',6-OcCB	205L	76
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	96
13C12-DeCB	209L	112

DATA REPORT

Client:	A. Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	MV Unit 3 - DF - Run 2	**Date Extracted:**	31-Aug-20
PRL ID:	PR201668	**Date Analysed:**	16-Sep-20

Dioxin-like PCBs				Surrogate Recoveries
			DL	
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**
3,4,4',5-TeCB	PCB 81	ND	0.02	60
3,3',4,4'-TeCB	PCB 77	ND	0.02	64
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	72
2,3',4,4',5-PeCB	PCB 118	ND	0.02	76
2,3,4,4',5-PeCB	PCB 114	ND	0.02	80
2,3,3',4,4'-PeCB	PCB 105	ND	0.02	80
3,3',4,4',5-PeCB	PCB 126	ND	0.02	80
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	80
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	76
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	76
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	64
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	84
		Toxic Equivalent (WHO-TEQ)		

WHO-TEQs (2005)	
(ND=0)	(ND=DL)
ng	ng
ND	6.00E-06
ND	2.00E-06
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	2.00E-03
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	6.00E-04
ND	6.00E-07
0.00E+00	2.61E-03

Total PCB		
		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	0.663	0.05
Dichlorobiphenyls	7.10	0.05
Trichlorobiphenyls	0.82	0.05
Tetrachlorobiphenyls	0.30	0.05
Pentachlorobiphenyls	ND	0.05
Hexachlorobiphenyls	ND	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	8.9	

ND - none detected

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	16
13C12-4,4'-DiCB	15L	40
13C12-2,2',6'-TrCB	19L	48
13C12-3,4,4'-TrCB	37L	56
13C12-2,2',6,6'-TeCB	54L	44
13C12-2,2',4,6,6'-PeCB	104L	56
13C12-2,2',4,4',6,6'-HxCB	155L	56
13C12-2,2',3,4',5,6,6'-HpCB	188L	76
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	80
13C12-2,3,3',4,4',5,5',6-OcCB	205L	76
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	100
13C12-DeCB	209L	104

DATA REPORT

Client:	A. Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	MV Unit 3 - DF - Run 3	**Date Extracted:**	31-Aug-20
PRL ID:	PR201669	**Date Analysed:**	16-Sep-20

Dioxin-like PCBs				Surrogate Recoveries	WHO-TEQs (2005) (ND=0)	WHO-TEQs (2005) (ND=DL)
			DL			
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**	**ng**	**ng**
3,4,4',5-TeCB	PCB 81	ND	0.02	72	ND	6.00E-06
3,3',4,4'-TeCB	PCB 77	ND	0.02	68	ND	2.00E-06
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	68	ND	6.00E-07
2,3',4,4',5-PeCB	PCB 118	ND	0.02	72	ND	6.00E-07
2,3,4,4',5-PeCB	PCB 114	ND	0.02	76	ND	6.00E-07
2,3,3',4,4'-PeCB	PCB 105	ND	0.02	76	ND	6.00E-07
3,3',4,4',5-PeCB	PCB 126	ND	0.02	88	ND	2.00E-03
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	80	ND	6.00E-07
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	80	ND	6.00E-07
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	84	ND	6.00E-07
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	72	ND	6.00E-04
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	76	ND	6.00E-07
		Toxic Equivalent (WHO-TEQ)			0.00E+00	2.61E-03

Total PCB		
		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	0.339	0.05
Dichlorobiphenyls	6.83	0.05
Trichlorobiphenyls	1.10	0.05
Tetrachlorobiphenyls	0.31	0.05
Pentachlorobiphenyls	ND	0.05
Hexachlorobiphenyls	ND	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	8.6	

ND - none detected

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	16
13C12-4,4'-DiCB	15L	40
13C12-2,2',6'-TrCB	19L	44
13C12-3,4,4'-TrCB	37L	48
13C12-2,2',6,6'-TeCB	54L	44
13C12-2,2',4,6,6'-PeCB	104L	56
13C12-2,2',4,4',6,6'-HxCB	155L	56
13C12-2,2',3,4',5,6,6'-HpCB	188L	84
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	80
13C12-2,3,3',4,4',5,5',6-OcCB	205L	76
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	100
13C12-DeCB	209L	104

DATA REPORT

Client:	A. Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	BLANK	**Date Extracted:**	31-Aug-20
PRL ID:	PC200527B	**Date Analysed:**	16-Sep-20

Dioxin-like PCBs				Surrogate Recoveries	WHO-TEQs (2005) (ND=0)	WHO-TEQs (2005) (ND=DL)
			DL			
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**	**ng**	**ng**
3,4,4',5-TeCB	PCB 81	ND	0.02	52	ND	6.00E-06
3,3',4,4'-TeCB	PCB 77	ND	0.02	60	ND	2.00E-06
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	68	ND	6.00E-07
2,3',4,4',5-PeCB	PCB 118	ND	0.02	72	ND	6.00E-07
2,3,4,4',5-PeCB	PCB 114	ND	0.02	72	ND	6.00E-07
2,3,3',4,4'-PeCB	PCB 105	ND	0.02	76	ND	6.00E-07
3,3',4,4',5-PeCB	PCB 126	ND	0.02	88	ND	2.00E-03
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	76	ND	6.00E-07
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	80	ND	6.00E-07
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	80	ND	6.00E-07
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	76	ND	6.00E-04
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	88	ND	6.00E-07
		Toxic Equivalent (WHO-TEQ)			0.00E+00	2.61E-03

Total PCB		
		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	ND	0.05
Dichlorobiphenyls	ND	0.05
Trichlorobiphenyls	ND	0.05
Tetrachlorobiphenyls	ND	0.05
Pentachlorobiphenyls	ND	0.05
Hexachlorobiphenyls	ND	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	ND	

ND - none detected

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	12
13C12-4,4'-DiCB	15L	24
13C12-2,2',6'-TrCB	19L	24
13C12-3,4,4'-TrCB	37L	40
13C12-2,2',6,6'-TeCB	54L	28
13C12-2,2',4,6,6'-PeCB	104L	32
13C12-2,2',4,4',6,6'-HxCB	155L	40
13C12-2,2',3,4',5,6,6'-HpCB	188L	60
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	72
13C12-2,3,3',4,4',5,5',6-OcCB	205L	76
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	96
13C12-DeCB	209L	104

QC REPORT - SPIKE

Client:	A. Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	**SPIKE**	**Date Extracted:**	31-Aug-20
PRL ID:	PC200528S	**Date Analysed:**	16-Sep-20

Dioxin-like PCBs			**Acceptable Recovery**		**Pass/Fail**	**Surrogate Recoveries**
	LOF	**Recovery**	**Min**	**Max**		
Chemical Name	**ng**	**%**	**%**	**%**		**%**
3,4,4',5-TeCB (81)	1	76	50	150	Pass	51
3,3',4,4'-TeCB (77)	1	75	50	150	Pass	56
2,3',4,4',5'-PeCB (123)	1	89	50	150	Pass	53
2,3',4,4',5-PeCB (118)	1	88	50	150	Pass	56
2,3,4,4',5-PeCB (114)	1	85	50	150	Pass	55
2,3,3',4,4'-PeCB (105)	1	88	50	150	Pass	63
3,3',4,4',5-PeCB (126)	1	82	50	150	Pass	68
2,3',4,4',5,5'-HxCB (167)	1	76	50	150	Pass	64
2,3,3',4,4',5-HxCB (156)	1	75	50	150	Pass	67
2,3,3',4,4',5'-HxCB (157)	1	82	50	150	Pass	72
3,3',4,4',5,5'-HxCB (169)	1	78	50	150	Pass	68
2,3,3',4,4',5,5'-HpCB (189)	1	73	50	150	Pass	63

Total PCB			**Acceptable Recovery**		**Pass/Fail**
	LOF	**Recovery**	**Min**	**Max**	
Homologs	**ng**	**%**	**%**	**%**	
Monochlorobiphenyls	2	89			
Dichlorobiphenyls	4	77			
Trichlorobiphenyls	6	91			
Tetrachlorobiphenyls	12	92			
Pentachlorobiphenyls	13	74			
Hexachlorobiphenyls	15	66			
Heptachlorobiphenyls	11	74			
Octachlorobiphenyls	6	78			
Nonachlorobiphenyls	2	79			
Decachlorobiphenyl	1	110			
Total PCB	72	78	50	150	Pass

LOF - Level of Fortification

DATA REPORT

Client: A. Lanfranco & Associates
Contact: Mark Lanfranco

Date Extracted: 31-Aug-20
Date Analysed: 15-Sep-20

Client ID:		MV Unit 3 - DF - Blank	MV Unit 3 - DF - Run 1	MV Unit 3 - DF - Run 2	MV Unit 3 - DF - Run 3		BLANK
PRL ID:		PR201666	PR201667	PR201668	PR201669		PH200527B
NPRI PAH	**DL**						
	µg	µg	µg	µg	µg		µg
Acenaphthylene	0.05	ND	ND	ND	ND		ND
Acenaphthene	0.05	ND	ND	ND	ND		ND
Fluorene	0.02	0.03	0.04	0.03	0.03		ND
Phenanthrene	0.02	0.13	0.16	0.08	0.23		ND
Fluoranthene	0.01	0.05	0.04	0.02	0.11		ND
Pyrene	0.01	0.06	0.05	0.03	0.06		ND
Benz(a)anthracene	0.02	ND	ND	ND	ND		ND
Chrysene	0.02	ND	ND	ND	ND		ND
Benzo(b)fluoranthene	0.01	ND	ND	ND	ND		ND
Benzo(k)fluoranthene	0.01	ND	ND	ND	ND		ND
Benzo(a)pyrene	0.01	ND	ND	ND	ND		ND
Indeno(1,2,3-cd)pyrene	0.01	ND	ND	ND	ND		ND
Dibenz(a,h)anthracene	0.01	ND	ND	ND	ND		ND
Benzo(ghi)perylene	0.01	0.08	0.04	ND	0.06		ND
1-Nitropyrene	0.05	ND	ND	ND	ND		ND
5-Methylchrysene	0.05	ND	ND	ND	ND		ND
7,12-Dimethylbenz(a)anthr	0.05	ND	ND	ND	ND		ND
3-Methylcholanthrene	0.05	ND	ND	ND	ND		ND
Benzo(e)pyrene	0.01	0.04	0.01	ND	0.04		ND
Perylene	0.05	ND	ND	ND	ND		ND
Dibenz(a,h)acridine	0.05	ND	ND	ND	ND		ND
Dibenz(a,j)acridine	0.05	ND	ND	ND	ND		ND
7H-Dibenzo(c,g)carbazole	0.05	ND	ND	ND	ND		ND
Dibenzo(a,e)fluoranthene	0.05	ND	ND	ND	ND		ND
Dibenzo(a,e)pyrene	0.05	ND	ND	ND	ND		ND
Dibenzo(a,h)pyrene	0.05	ND	ND	ND	ND		ND
Dibenzo(a,l)pyrene	0.05	ND	ND	ND	ND		ND
Dibenzo(a,i)pyrene	0.05	ND	ND	ND	ND		ND
Quinoline	0.05	ND	ND	ND	ND		ND
Other PAH							
Naphthalene	0.05	2.20	2.50	2.70	2.00		ND
Anthracene	0.05	ND	ND	ND	ND		ND
Chlorobenzenes							
Hexachlorobenzene	0.01	ND	ND	ND	ND		ND

DATA REPORT

Client: A. Lanfranco & Associates
Contact: Mark Lanfranco

Date Extracted: 31-Aug-20
Date Analysed: 15-Sep-20

	Client ID:	MV Unit 3 - DF - Blank	MV Unit 3 - DF - Run 1	MV Unit 3 - DF - Run 2	MV Unit 3 - DF - Run 3		BLANK
	PRL ID:	PR201666	PR201667	PR201668	PR201669		PH200527B
NPRI PAH	**DL**						
Surrogate Recoveries (%)							
d8-Naphthalene		76	64	60	76		68
d10-Acenaphthylene		76	80	72	88		72
d10-Acenaphthene		84	80	72	92		80
d10-Fluorene		84	80	72	88		76
d10-Phenanthrene		68	68	76	80		88
d10-Fluoranthene		92	96	96	104		96
d10-Pyrene		92	100	96	104		92
d12-Chrysene		72	88	80	80		116
d12-Benzo(b)fluoranthene		88	92	88	96		112
d12-Benzo(a)pyrene		88	92	88	92		92
d14-Dibenz(a,h)anthracene		88	92	88	96		96
13C6-Hexachlorobenzene		72	72	84	92		92

ND - none detected

DATA REPORT

Client: A. Lanfranco & Associates
Contact: Mark Lanfranco

Date Extracted: 31-Aug-20
Date Analysed: 15-Sep-20

Client ID: SPIKE
PRL ID: PH200528S

NPRI PAH

	µg/g	LOF	Recovery	Acceptable	Pass/Fail
Acenaphthene	1.22	1	122%	50-150%	pass
Acenaphthylene	1.16	1	116%	50-150%	pass
Benz(a)anthracene	0.95	1	95%	50-150%	pass
Benzo(a)pyrene	0.97	1	97%	50-150%	pass
Benzo(b)fluoranthene	1.01	1	101%	50-150%	pass
Benzo(ghi)perylene	1.11	1	111%	50-150%	pass
Benzo(k)fluoranthene	1.02	1	102%	50-150%	pass
Chrysene	0.95	1	95%	50-150%	pass
Dibenz(a,h)anthracene	0.98	1	98%	50-150%	pass
Fluoranthene	1.12	1	112%	50-150%	pass
Fluorene	1.19	1	119%	50-150%	pass
Indeno(1,2,3-cd)pyrene	1.06	1	106%	50-150%	pass
Phenanthrene	1.07	1	107%	50-150%	pass
Pyrene	1.01	1	101%	50-150%	pass
Dibenz(a,h)acridine	1.10	1	110%		
Dibenz(a,j)acridine	0.97	1	97%		
7H-Dibenzo(c,g)carbazole	1.01	1	101%		
Dibenzo(a,e)fluoranthene	1.18	1	118%		
Dibenzo(a,h)pyrene	1.21	1	121%		
Dibenzo(a,e)pyrene	1.16	1	116%		
Dibenzo(a,i)pyrene	1.15	1	115%		
Dibenzo(a,l)pyrene	1.18	1	118%		
7,12-Dimethylbenz(a)anthracene	0.71	1	71%		
3-Methylcholanthrene	1.13	1	113%		
5-Methylchrysene	1.07	1	107%		
1-Nitropyrene	0.97	1	97%		
Perylene	1.09	1	109%		
Other PAH					
Naphthalene	1.16	1	116%	50-150%	pass
Chlorobenzenes					
Hexachlorobenzene	0.66	1	66%	50-150%	pass

DATA REPORT

Client: A. Lanfranco & Associates
Contact: Mark Lanfranco

Date Extracted: 31-Aug-20
Date Analysed: 18-Sep-20

	Client ID:	MV Unit 3 - DF - Blank	MV Unit 3 - DF - Run 1	MV Unit 3 - DF - Run 2	MV Unit 3 - DF - Run 3		BLANK
	PRL ID:	PR201666	PR201667	PR201668	PR201669		CP200527B
Compound	DL µg	µg	µg	µg	µg		µg
Trichlorobenzenes	0.05	ND	0.677	0.753	0.858		ND
Tetrachlorobenzenes	0.05	ND	0.206	0.225	0.261		ND
Pentachlorobenzene	0.05	ND	ND	ND	ND		ND
Hexachlorobenzene	0.01	ND	ND	ND	ND		ND
Surrogate Recoveries (%)							
13C6-Hexachlorobenzene		140	112	104	108		72

Compound	DL µg	µg	µg	µg	µg		µg
Trichlorophenols	0.05	ND	ND	ND	ND		ND
Tetrachlorophenols	0.05	ND	ND	ND	ND		ND
Pentachlorophenol	0.05	ND	ND	ND	ND		ND
Surrogate Recoveries (%)							
13C6-Trichlorophenol		52	71	34	78		133
13C6-Tetrachlorophenol		97	108	50	122		86
13C6-Pentachlorophenol		42	101	104	104		81

ND - none detected

QC REPORT - SPIKE

Client: A. Lanfranco & Associates
Contact: Mark Lanfranco

Date Extracted: 31-Aug-20
Date Analysed: 18-Sep-20

Client ID: SPIKE
PRL ID: CP200528S

Compound	LOF µg	µg	Recovery
Trichlorobenzenes	2.0	1.45	72%
Tetrachlorobenzenes	3.0	2.68	89%
Pentachlorobenzene	1.0	0.75	75%
Hexachlorobenzene	1.0	0.72	72%
Trichlorophenols	0.2	0.16	82%
Tetrachlorophenols	0.2	0.17	86%
Pentachlorophenol	0.2	0.22	109%

LOF - level of fortification

Acronyms used in reporting dioxins and furans:

TCDD = Tetrachlorodibenzo-*p*-dioxin
PeCDD = Pentachlorodibenzo-*p*-dioxin
HxCDD = Hexachlorodibenzo-*p*-dioxin
HpCDD = Heptachlorodibenzo-*p*-dioxin
OCDD = Octachlorodibenzo-*p*-dioxin

TCDF = Tetrachlorodibenzofuran
PeCDF = Pentachlorodibenzofuran
HxCDF = Hexachlorodibenzofuran
HpCDF = Heptachlorodibenzofuran
OCDF = Octachlorodibenzofuran

Acceptable recoveries for surrogates	**EPA Method 23**	
	Min (%)	**Max (%)**
$^{37}Cl_4$ -2,3,7,8-TCDD	70	130
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	70	130
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	70	130
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	70	130
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	70	130

Acceptable recoveries for Internal Standards

	EPA Method 23		**Env. Can. 1-RM-3**	
	Min (%)	**Max (%)**	**Min (%)**	**Max (%)**
$^{13}C_{12}$ -2,3,7,8-TCDD	40	130	40	130
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	40	130	40	130
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	40	130	40	130
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	25	130	40	130
$^{13}C_{12}$ -OCDD	25	130	40	130
$^{13}C_{12}$ -2,3,7,8-TCDF	40	130	40	130
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	40	130		
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	40	130		
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	25	130		

Acronyms used in reporting Polychlorinated Biphenyls (PCBs)

MoCB = Monochlorobiphenyl
DiCB = Dichlorobiphenyl
TrCB = Trichlorobiphenyl
TeCB = Tetrachlorobiphenyl
PeCB = Pentachlorobiphenyl
HxCB = Hexachlorobiphenyl
HpCB = Heptachlorobiphenyl
OcCB = Octachlorobiphenyl
NoCB = Nonachlorobiphenyl
DeCB = Decachlorobiphenyl

Acceptable recoveries for PCB Internal Standards - EPA 1668C

Chemical Name	IUPAC #	Min	Max
$^{13}C_{12}$-2-MoCB	1L	5	145
$^{13}C_{12}$-4-MoCB	3L	5	145
$^{13}C_{12}$-2,2'-DiCB	4L	5	145
$^{13}C_{12}$-4,4'-DiCB	15L	5	145
$^{13}C_{12}$-2,2',6'-TrCB	19L	5	145
$^{13}C_{12}$-3,4,4'-TrCB	37L	5	145
$^{13}C_{12}$-2,2',6,6'-TeCB	54L	5	145
$^{13}C_{12}$-3,4,4',5-TeCB	81L	10	145
$^{13}C_{12}$-3,3',4,4'-TeCB	77L	10	145
$^{13}C_{12}$-2,2',4,6,6'-PeCB	104L	10	145
$^{13}C_{12}$-2',3,4,4',5-PeCB	123L	10	145
$^{13}C_{12}$-2,3',4,4',5-PeCB	118L	10	145
$^{13}C_{12}$-2,3,4,4',5-PeCB	114L	10	145
$^{13}C_{12}$-2,3,3',4,4'-PeCB	105L	10	145
$^{13}C_{12}$-3,3',4,4',5-PeCB	126L	10	145
$^{13}C_{12}$-2,2',4,4',6,6'-HxCB	155L	10	145
$^{13}C_{12}$-2,3',4,4',5,5'-HxCB	167L	10	145
$^{13}C_{12}$-2,3,3',4,4',5-HxCB	156L	10	145
$^{13}C_{12}$-2,3,3',4,4',5'-HxCB	157L	10	145
$^{13}C_{12}$-3,3',4,4',5,5'-HxCB	169L	10	145
$^{13}C_{12}$-2,2',3,4',5,6,6'-HpCB	188L	10	145
$^{13}C_{12}$-2,3,3',4,4',5,5'-HpCB	189L	10	145
$^{13}C_{12}$-2,2',3,3',5,5',6,6'-OcCB	202L	10	145
$^{13}C_{12}$-2,3,3',4,4',5,5',6-OcCB	205L	10	145
$^{13}C_{12}$-2,2',3,3',4',5,5',6,6'-NoCB	208L	10	145
$^{13}C_{12}$-2,2',3,3',4,4',5,5',6-NoCB	206L	10	145
$^{13}C_{12}$-DeCB	209L	10	145
$^{13}C_{12}$-2,4,4'-TrCB	28L	5	145
$^{13}C_{12}$-2,3,3',5,5'-PeCB	111L	10	145
$^{13}C_{12}$-2,2',3,3',5,5',6-HpCB	178L	10	145

Acceptable recoveries for Polycyclic Aromatic Hydrocarbon Standards in Environmental Samples

	Surrogate Recovery	
	Min (%)	Max (%)
Naphthalene-d8	0	135
Biphenyl-d10	15	135
Acenaphthene-d10	15	135
Fluorene-d10	30	135
Phenanthrene-d10	30	135
Fluoranthene-d10	30	135
Pyrene-d10	30	135
Chrysene-d12	30	150
Benzo(b)fluoranthene-d12	30	150
Benzo(a)pyrene-d12	15	150
Dibenz(a,h)anthracene-d14	30	150

PACIFIC RIM LABORATORIES INC

CHAIN OF CUSTODY RECORD / ANALYSIS REQUEST

Pacific Rim Laboratories Inc. #103, 19575 - 55A Avenue, Surrey, BC V3S 8P8 Tel: 604-532-8711 Fax: 604-532-8712

COMPANY: A. Lanfranco & Associates Inc.
101-9488 189 Street
Surrey, BC Canada V4N 4W7

CONTACT: Mark Lanfranco

PHONE: *604-881-2582*

EMAIL: mark.lanfranco@alanfranco.com

DATE: 21-Aug-20

CLIENT: Metro Vancouver WTE

SOURCE: Unit - 3

SAMPLE ID	PRL ID	DATE SAMPLED	SAMPLE MATRIX	NUMBER OF CONTAINERS	DIOXIN/FURAN	PCB - dioxin-like (12)	PCB - 209 congener	PAH	HCB	TBT	Nonylphenol	PBDE	CB, CP	COMMENTS
MV Unit 3 - DF - Blank	PR201666 1 to 5	18-Aug-20		5	X	X		X	X				X	3 bottles, ~~filter~~, trap
MV Unit 3 - DF - Run 1	PR201667	18-Aug-20		5	X	X		X	X				X	3 bottles, filter, trap
MV Unit 3 - DF - Run 2	1668	19-Aug-20		5	X	X		X	X				X	"
MV Unit 3 - DF - Run 3	1669	19-Aug-20		5	X	X		X	X				X	"

Sampler's Signature	Relinquished by:	Company	Date	Time	Received by
			Aug 21, 2020	12:30p	M-MacLennan
Comments:	Method of Shipment	Waybill No.	Rec'd for PRL	Date	Time
				Aug 21, 2020	12:30pm
	Shipment Condition	Temp.	Cooler Opened By		
		13.8°C Trap	Matthew MacLennan		

Tel (604) 532-8711 | Fax (604) 532-8712 | info@pacificrimlabs.com | pacificrimlabs.com
Pacific Rim Laboratories Inc. - #103, 19575 - 55A Ave. Surrey, BC V3S 8P8, Canada

PACIFIC RIM LABORATORIES INC

APPENDIX 2

COMPUTER OUTPUTS OF MEASURED and CALCULATED DATA

Client:	Metro Vancouver	**Date:**	18-Aug-20
Jobsite:	WTE (Burnaby, BC)	**Run:**	1 PCDD-PCDF
Source:	Unit 3	**Run Time:**	08:55 - 12:57

Dioxin Concentration:	**2.3**	**pg/dscm**	0.0010	gr/dscf
	1.3	**pg/dscm**	0.0006	gr/Acf
	2.0	pg/dscm (@ 11% O2)	0.0009	gr/dscf (@ 11% O2)

Emission Rate: see D/F data Table 2

Sample Gas Volume:	3.7375	dscm	131.989	dscf
Total Sample Time:	240.0	minutes		
Average Isokineticity:	102.6	%		

Flue Gas Characteristics

Moisture:	14.91	%		
Temperature	149.7	oC	301.4	oF
Flow	1150.7	dscm/min	40636	dscf/min
	19.18	dscm/sec	677.3	dscf/sec
	2034.3	Acm/min	71840	Acf/min
Velocity	13.311	m/sec	43.67	f/sec
Gas Analysis	9.62	% O2	10.38	% CO2
	30.045	Mol. Wt (g/gmole) Dry	28.249	Mol. Wt (g/gmole) Wet

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

Client:	Metro Vancouver	**Date:**	18-Aug-20
Jobsite:	WTE (Burnaby, BC)	**Run:**	1 PCDD-PCDF
Source:	Unit 3	**Run Time:**	08:55 - 12:57

Control Unit (Y)	1.0019
Nozzle Diameter (in.)	0.2575
Pitot Factor	0.8525
Baro. Press. (in. Hg)	30.02
Static Press. (in. H2O)	-18.10
Stack Height (ft)	30
Stack Diameter (in.)	70.9
Stack Area (sq.ft.)	27.417
Minutes Per Reading	5.0
Minutes Per Point	10.0

Gas Analysis (Vol. %):

	CO2	O2
Trav 1	10.25	9.70
Trav 2	10.50	9.53
Average =	**10.38**	**9.62**

Condensate Collection:

Impinger 1 (grams)	471.0
Impinger 2 (grams)	12.0
Impinger 3 (grams)	0.0
Impinger 4 (grams)	8.4
Total Gain (grams)	**491.4**

Collection:

D/F TEQ (ng) **0.0087**

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Outlet (oF)	Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	504.249							
1	1	5.0	507.330	0.480	1.45	71	71	299	1.5	102.8
		10.0	510.430	0.485	1.47	71	71	298	1.5	102.8
	2	15.0	513.480	0.470	1.43	72	72	298	4.7	102.5
		20.0	516.550	0.475	1.44	72	72	298	4.7	102.7
	3	25.0	519.790	0.530	1.61	72	72	298	8.4	102.6
		30.0	522.980	0.510	1.55	73	73	298	8.4	102.8
	4	35.0	526.110	0.490	1.49	74	74	298	12.5	102.7
		40.0	529.270	0.500	1.52	74	74	298	12.5	102.6
	5	45.0	532.340	0.470	1.44	75	75	298	17.7	102.6
		50.0	535.400	0.465	1.42	76	76	297	17.7	102.6
	6	55.0	538.350	0.430	1.32	77	77	297	25.2	102.6
		60.0	541.260	0.420	1.29	77	77	298	25.2	102.5
	7	65.0	543.690	0.290	0.89	78	78	298	45.6	102.7
		70.0	546.070	0.280	0.86	78	78	298	45.6	102.4
	8	75.0	548.420	0.270	0.83	79	79	298	53.2	102.7
		80.0	550.720	0.260	0.80	79	79	299	53.2	102.5
	9	85.0	552.960	0.245	0.75	80	80	300	58.3	102.7
		90.0	555.260	0.260	0.80	80	80	301	58.3	102.5
	10	95.0	557.480	0.240	0.74	80	80	297	62.5	102.6
		100.0	559.690	0.240	0.74	81	81	300	62.5	102.2
	11	105.0	561.860	0.230	0.71	81	81	300	66.1	102.5
		110.0	564.050	0.235	0.72	81	81	301	66.1	102.4
	12	115.0	566.170	0.220	0.68	82	82	302	69.4	102.3
		120.0	568.290	0.220	0.68	82	82	301	69.4	102.3
		0.0	568.290							
2	1	5.0	570.730	0.290	0.89	82	82	301	1.5	102.6
		10.0	573.290	0.320	0.98	82	82	303	1.5	102.6
	2	15.0	575.970	0.350	1.08	83	83	303	4.7	102.5
		20.0	578.680	0.360	1.11	82	82	303	4.7	102.4
	3	25.0	581.240	0.320	0.98	83	83	305	8.4	102.5
		30.0	583.880	0.340	1.04	83	83	305	8.4	102.6
	4	35.0	586.370	0.300	0.92	84	84	304	12.5	102.7

		40.0	588.810	0.290	0.89	83	83	305	12.5	102.6
	5	45.0	591.170	0.270	0.83	83	83	303	17.7	102.7
		50.0	593.550	0.275	0.85	83	83	303	17.7	102.7
	6	55.0	596.040	0.300	0.93	84	84	303	25.2	102.7
		60.0	598.530	0.300	0.93	84	84	303	25.2	102.7
	7	65.0	601.740	0.500	1.54	84	84	303	45.6	102.7
		70.0	605.010	0.520	1.60	84	84	303	45.6	102.6
	8	75.0	608.380	0.550	1.69	84	84	304	53.2	102.9
		80.0	611.780	0.560	1.73	84	84	304	53.2	102.9
	9	85.0	615.240	0.580	1.73	85	85	305	58.3	102.8
		90.0	618.700	0.580	1.73	85	85	306	58.3	102.8
	10	95.0	622.040	0.540	1.66	85	85	306	62.5	102.8
		100.0	625.420	0.550	1.70	86	86	305	62.5	102.9
	11	105.0	628.670	0.510	1.58	86	86	305	66.1	102.7
		110.0	631.890	0.500	1.54	86	86	306	66.1	102.8
	12	115.0	635.070	0.490	1.51	86	86	306	69.4	102.6
		120.0	638.260	0.490	1.52	87	87	305	69.4	102.6
			Average:	0.392	1.200	80.5	80.5	301.4		102.6

Client:	Metro Vancouver	**Date:**	19-Aug-20
Jobsite:	WTE (Burnaby, BC)	**Run:**	2 PCDD-PCDF
Source:	Unit 3	**Run Time:**	08:28 - 12:30

Dioxin Concentration:	**1.35**	**pg/dscm**	0.0006	gr/dscf
	0.8	**pg/dscm**	0.0003	gr/Acf
	1.22	pg/dscm (@ 11% O2)	0.0005	gr/dscf (@ 11% O2)

Emission Rate: see D/F data Table 2

Sample Gas Volume:	3.6329	dscm	128.295	dscf
Total Sample Time:	240.0	minutes		
Average Isokineticity:	100.9	%		

Flue Gas Characteristics

Moisture:	13.82	%		
Temperature	152.6	oC	306.7	oF
Flow	1136.3	dscm/min	40129	dscf/min
	18.94	dscm/sec	668.8	dscf/sec
	2003.1	Acm/min	70740	Acf/min
Velocity	13.107	m/sec	43.00	f/sec
Gas Analysis	9.93	% O2	10.17	% CO2
	30.024	Mol. Wt (g/gmole) Dry	28.363	Mol. Wt (g/gmole) Wet

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

Client:	Metro Vancouver	**Date:**	19-Aug-20
Jobsite:	WTE (Burnaby, BC)	**Run:**	2 PCDD-PCDF
Source:	Unit 3	**Run Time:**	08:28 - 12:30

Control Unit (Y)	1.0019
Nozzle Diameter (in.)	0.2575
Pitot Factor	0.8525
Baro. Press. (in. Hg)	29.95
Static Press. (in. H2O)	-18.30
Stack Height (ft)	30
Stack Diameter (in.)	70.9
Stack Area (sq.ft.)	27.417
Minutes Per Reading	5.0
Minutes Per Point	10.0

Gas Analysis (Vol. %):

	CO2	O2
Trav 1	10.25	9.85
Trav 2	10.08	10.02
Average =	**10.17**	**9.93**

Condensate Collection:

Impinger 1 (grams)	417.0
Impinger 2 (grams)	12.0
Impinger 3 (grams)	0.0
Impinger 4 (grams)	8.0
Total Gain (grams)	**437.0**

Collection:

D/F TEQ (ng) **0.0049**

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Outlet (oF)	Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	639.818							
1	1	5.0	642.910	0.490	1.47	69	69	305	1.5	101.7
		10.0	646.000	0.490	1.46	69	69	306	1.5	101.7
	2	15.0	649.070	0.480	1.44	70	70	304	4.7	101.7
		20.0	652.140	0.480	1.44	70	70	304	4.7	101.7
	3	25.0	655.240	0.490	1.47	71	71	304	8.4	101.5
		30.0	658.410	0.510	1.53	71	71	304	8.4	101.7
	4	35.0	661.490	0.480	1.45	72	72	303	12.5	101.6
		40.0	664.600	0.490	1.48	72	72	304	12.5	101.6
	5	45.0	667.840	0.530	1.60	73	73	303	17.7	101.6
		50.0	670.930	0.480	1.45	74	74	303	17.7	101.6
	6	55.0	673.990	0.470	1.42	74	74	304	25.2	101.7
		60.0	677.070	0.475	1.44	75	75	304	25.2	101.6
	7	65.0	679.510	0.300	0.91	75	75	306	45.6	101.3
		70.0	681.810	0.290	0.88	76	76	306	45.6	96.9
	8	75.0	683.850	0.250	0.76	77	77	306	53.2	92.4
		80.0	685.930	0.260	0.79	77	77	306	53.2	92.4
	9	85.0	687.930	0.240	0.73	78	78	306	58.3	92.3
		90.0	690.080	0.220	0.70	78	78	305	58.3	103.5
	10	95.0	692.230	0.230	0.70	78	78	304	62.5	101.2
		100.0	694.390	0.230	0.70	79	79	303	62.5	101.4
	11	105.0	696.450	0.210	0.64	79	79	304	66.1	101.3
		110.0	698.460	0.200	0.64	79	79	304	66.1	101.3
	12	115.0	700.430	0.190	0.58	80	80	303	69.4	101.6
		120.0	702.400	0.190	0.58	80	80	304	69.4	101.6
								.		
		0.0	702.400							
2	1	5.0	704.740	0.270	0.83	81	81	306	1.5	101.3
		10.0	707.130	0.280	0.86	81	81	306	1.5	101.6
	2	15.0	709.560	0.290	0.89	81	81	307	4.7	101.5
		20.0	711.990	0.290	0.89	82	82	306	4.7	101.3
	3	25.0	714.460	0.300	0.92	82	82	307	8.4	101.3
		30.0	717.020	0.320	0.98	82	82	307	8.4	101.7
	4	35.0	719.490	0.300	0.91	82	82	310	12.5	101.5
		40.0	721.940	0.295	0.90	82	82	311	12.5	101.6

	5	45.0	724.430	0.305	0.93	83	83	311	17.7	101.4
		50.0	726.880	0.295	0.90	83	83	311	17.7	101.4
	6	55.0	729.310	0.290	0.88	83	83	310	25.2	101.4
		60.0	731.780	0.300	0.92	83	83	310	25.2	101.3
	7	65.0	734.880	0.470	1.44	83	83	311	45.6	101.8
		70.0	737.950	0.460	1.40	84	84	311	45.6	101.7
	8	75.0	741.020	0.460	1.41	84	84	310	53.2	101.6
		80.0	744.220	0.500	1.53	84	84	310	53.2	101.6
	9	85.0	747.420	0.500	1.53	84	84	310	58.3	101.6
		90.0	750.590	0.490	1.50	84	84	309	58.3	101.6
	10	95.0	753.950	0.550	1.69	84	84	308	62.5	101.7
		100.0	757.280	0.540	1.65	84	84	309	62.5	101.7
	11	105.0	760.510	0.510	1.56	84	84	309	66.1	101.5
		110.0	763.710	0.500	1.53	84	84	310	66.1	101.6
	12	115.0	766.890	0.490	1.50	85	85	309	69.4	101.8
		120.0	770.030	0.480	1.47	85	85	310	69.4	101.6
			Average:	0.378	1.152	79.0	79.0	306.7		100.9

Client:	Metro Vancouver	**Date:**	19-Aug-20
Jobsite:	WTE (Burnaby, BC)	**Run:**	3 - PCDD-PCDF
Source:	Unit 3	**Run Time:**	13:40 - 17:42

Dioxin Concentration:	**2.2 pg/dscm**	0.0010	gr/dscf
	1.2 pg/Acm	0.0005	gr/Acf
	2.1 pg/dscm (@ 11% O2)	0.0009	gr/dscf (@ 11% O2)

Emission Rate: see D/F data Table 2

Sample Gas Volume:	3.5153	dscm	124.142 dscf
Total Sample Time:	240.0	minutes	
Average Isokineticity:	100.1	%	

Flue Gas Characteristics

Moisture:	14.59	%	
Temperature	157.6	oC	315.7 oF
Flow	1156.7	dscm/min	40850 dscf/min
	19.28	dscm/sec	680.8 dscf/sec
	2091.0	Acm/min	73842 Acf/min
Velocity	13.682	m/sec	44.89 f/sec
Gas Analysis	10.28	% O2	10.00 % CO2
	30.011	Mol. Wt (g/gmole) Dry	28.258 Mol. Wt (g/gmole) Wet

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

Client:	Metro Vancouver	**Date:**	19-Aug-20
Jobsite:	WTE (Burnaby, BC)	**Run:**	3 - PCDD-PCDF
Source:	Unit 3	**Run Time:**	13:40 - 17:42

Control Unit (Y)	0.9977
Nozzle Diameter (in.)	0.2523
Pitot Factor	0.8328
Baro. Press. (in. Hg)	29.91
Static Press. (in. H2O)	-19.50
Stack Height (ft)	30
Stack Diameter (in.)	70.9
Stack Area (sq.ft.)	27.417
Minutes Per Reading	5.0
Minutes Per Point	10.0

Gas Analysis (Vol. %):

	CO2	O2
Trav 1	10.00	10.25
Trav 2	10.00	10.30
Average =	**10.00**	**10.28**

Condensate Collection:

Impinger 1 (grams)	430.0
Impinger 2 (grams)	9.0
Impinger 3 (grams)	0.0
Impinger 4 (grams)	11.6
Total Gain (grams)	**450.6**

Collection:

D/F TEQ (ng)	**0.0078**

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Outlet (oF)	Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	534.000							
1	1	5.0	537.010	0.540	1.14	90	90	316	1.5	97.7
		10.0	540.020	0.540	1.14	91	91	316	1.5	97.5
	2	15.0	542.980	0.520	1.10	92	92	316	4.7	97.5
		20.0	545.820	0.480	1.02	92	92	316	4.7	97.4
	3	25.0	548.780	0.520	1.10	93	93	314	8.4	97.2
		30.0	551.690	0.500	1.06	94	94	314	8.4	97.3
	4	35.0	554.580	0.500	1.06	94	94	315	12.5	96.7
		40.0	557.420	0.480	1.02	95	95	315	12.5	96.8
	5	45.0	560.260	0.480	1.02	96	96	314	17.7	96.6
		50.0	563.100	0.480	1.02	96	96	314	17.7	96.6
	6	55.0	566.110	0.540	1.14	97	97	314	25.2	96.3
		60.0	569.070	0.520	1.10	98	98	315	25.2	96.4
	7	65.0	571.460	0.340	0.72	99	99	316	45.6	96.1
		70.0	573.780	0.320	0.68	99	99	316	45.6	96.1
	8	75.0	576.170	0.300	0.64	99	99	316	53.2	102.3
		80.0	578.490	0.280	0.59	100	100	316	53.2	102.6
	9	85.0	580.670	0.250	0.58	101	101	316	58.3	101.8
		90.0	582.850	0.250	0.58	102	102	316	58.3	101.6
	10	95.0	584.890	0.220	0.51	102	102	315	62.5	101.3
		100.0	586.940	0.220	0.51	102	102	316	62.5	101.8
	11	105.0	588.990	0.220	0.51	102	102	308	66.1	101.3
		110.0	591.040	0.220	0.51	103	103	305	66.1	100.9
	12	115.0	593.090	0.220	0.51	104	104	303	69.4	100.6
		120.0	595.040	0.200	0.46	106	106	302	69.4	100.0
		0.0	595.040							
2	1	5.0	597.870	0.420	0.97	104	104	318	1.5	101.6
		10.0	600.630	0.400	0.92	105	105	316	1.5	101.3
	2	15.0	603.390	0.400	0.92	104	104	319	4.7	101.6
		20.0	606.150	0.400	0.92	105	105	320	4.7	101.5
	3	25.0	608.800	0.370	0.85	104	104	319	8.4	101.4
		30.0	611.450	0.370	0.85	104	104	320	8.4	101.5
	4	35.0	614.030	0.350	0.81	104	104	320	12.5	101.6
		40.0	616.500	0.320	0.74	104	104	320	12.5	101.7

	5	45.0	618.970	0.320	0.74	104	104	319	17.7	101.6
		50.0	621.440	0.320	0.74	104	104	318	17.7	101.6
	6	55.0	623.830	0.300	0.69	104	104	318	25.2	101.5
		60.0	626.220	0.300	0.69	104	104	318	25.2	101.5
	7	65.0	629.300	0.500	1.16	104	104	318	45.6	101.4
		70.0	632.370	0.490	1.13	104	104	319	45.6	102.2
	8	75.0	635.800	0.620	1.43	104	104	317	53.2	101.4
		80.0	639.180	0.600	1.39	104	104	317	53.2	101.6
	9	85.0	642.560	0.600	1.39	104	104	317	58.3	101.6
		90.0	645.940	0.600	1.39	105	105	317	58.3	101.4
	10	95.0	649.460	0.650	1.50	105	105	316	62.5	101.4
		100.0	653.030	0.670	1.55	105	105	316	62.5	101.4
	11	105.0	656.360	0.580	1.34	105	105	317	66.1	101.6
		110.0	659.590	0.550	1.27	106	106	317	66.1	101.0
	12	115.0	662.820	0.550	1.27	105	105	316	69.4	101.1
		120.0	665.970	0.520	1.20	105	105	316	69.4	101.4
			Average:	0.424	0.950	101.1	101.1	315.7		100.1

APPENDIX 3

FIELD DATA SHEETS

1082 LA

A. Lanfranco and Associates Inc.

CLIENT	MV-WTE	NOZZLE D DIAMETER, IN. 0.2575	IMPINGER VOLUMES / INITIAL (mL) / FINAL (mL) / TOTAL GAIN (mL)
SOURCE	Unit 3	PROBE 7C Cp 0.8525	Imp. #1: 9 / 471
PARAMETER / RUN No	DF Run 1	PORT LENGTH	Imp. #2: 188 / 112
DATE	18 Aug 2020	STATIC PRESSURE, IN. H2O -18.1	Imp. #3: 0 / 0
OPERATOR:	LA	STACK DIAMETER 70.9"	Imp. #4: Gel /
CONTROL UNIT	Std 14 Y 1.0019	STACK HEIGHT	Imp. #5: /
	ΔH@ 2.081		Imp. #6: /
BAROMETRIC PRESSURE, IN. Hg	30.02	INITIAL LEAK TEST 0.003@15"	Upstream Diameters
ASSUMED MOISTURE, Bw	15%	FINAL LEAK TEST 0.002@15"	Downstream Diameters

Testo 1

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. %	CO (ppm)	NOx (ppm)	XAD Temp (°F)
1	0855	504.249	0.48	1.45	71	299	256	255	59	5					43
1		510.43	0.485	1.47	71	298					10.5	9.5	49	72	
2		513.48	0.47	1.43	72	298	257	254	55	6					44
2		516.55	0.475	1.44	72	298									
3		519.79	0.53	1.61	73	298	254	252	55	7					44
3		522.98	0.51	1.55	73	298					10.5	9.3	39	74	
4		526.11	0.49	1.49	74	298	252	251	57	7					43
4		529.37	0.50	1.52	74	298									
5		532.34	0.47	1.44	75	298	251	251	53	7					43
5		535.40	0.463	1.42	76	297					10	9.6	39	71	
6		538.35	0.43	1.32	77	297	250	250	55	7					45
6		541.26	0.42	1.29	77	298									
7		543.69	0.29	0.89	78	298	250	251	55	6					45
7		546.07	0.28	0.86	78	298					10	10.2	42	68	
8		548.42	0.27	0.83	79	298	251	251	56	6					43
8		550.72	0.26	0.80	79	299									
9		552.96	0.245	0.75	80	300	250	250	57	6					44
9		555.26	0.26	0.80	90	301					10	10.0	50	66	
10		557.48	0.24	0.74	80	297	250	251	57	6					45
10		559.69	0.24	0.74	81	300									
11		561.86	0.23	0.71	81	300	250	251	58	6					46
11		564.05	0.235	0.72	81	301					10.5	9.6	53	80	
12		566.17	0.22	0.68	82	302	249	250	57	6					45
12	1055	568.29	0.22	0.68	82	301									

Initial LC Start: 503.658

A. Lanfranco and Associates Inc.

CLIENT	MV-WTE				NOZZLE	DIAMETER, IN.				IMPINGER	INITIAL	FINAL	TOTAL GAIN				
SOURCE	Unit 3				PROBE	Cp				VOLUMES	(mL)	(mL)	(mL)				
PARAMETER / RUN No	DE Run 1 (con't)									Imp. #1	0	471					
DATE					PORT LENGTH					Imp. #2	100	112					
OPERATOR					STATIC PRESSURE, IN. H2O					Imp. #3	0	0					
CONTROL UNIT	Y				STACK DIAMETER					imp. #4	Gel						
	ΔH@				STACK HEIGHT					Imp. #5							
										Imp. #6							
BAROMETRIC PRESSURE, IN. Hg					INITIAL LEAK TEST					Upstream Diameters							
ASSUMED MOISTURE, Bw					FINAL LEAK TEST					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		CO (ppm)	NO_x (ppm)	XAD Temp (°F)
					Dry Gas Outlet	Stack	Probe	Box	Impinger Exit		CO_2 Vol. %	O_2 Vol. %			
	1057	568.29													
1		570.73	0.29	0.89	82	301	250	254	55	6					41
1		573.29	0.32	0.98	82	303					10.5	9.6	65	77	
2		575.97	0.35	1.08	83	303	250	251	56	6.5					44
2		578.68	0.36	1.11	82	303									
3		581.24	0.32	0.98	83	305	252	250	57	6.5					45
3		583.88	0.34	1.04	83	305					11	9.0	53	75	
4		586.37	0.30	0.92	84	304	250	251	57	6.5					43
4		588.81	0.29	0.89	83	305									
5		591.17	0.27	0.83	83	303	250	250	57	6					44
5		593.55	0.275	0.85	83	303					10.5	9.2	54	84	
6		596.04	0.30	0.93	84	303	250	250	57	6					42
6		598.53	0.30	0.93	84	303									
7		601.74	0.50	1.54	84	303	253	251	55	7.5					41
7		605.01	0.52	1.60	84	303					10.5	9.7	55	78	
8		608.38	0.55	1.69	84	304	250	249	55	8.0					41
8		611.78	0.56	1.73	84	304									
9		615.24	0.58	1.79	85	305	250	250	55	8					42
9		618.70	0.58	1.79	85	306					10.5	9.6	45	70	
10		622.04	0.54	1.66	85	306	252	250	55	8					42
10		625.43	0.55	1.70	86	305									
11		628.67	0.51	1.58	86	305	251	251	56	8					43
11		631.89	0.50	1.54	86	306					10.0	10.1	43	76	
12		635.07	0.49	1.51	86	306	250	250	56	8					43
12	1257	638.26	0.49	1.52	87	305									

Final WC end: 638.534

A. Lanfranco and Associates Inc.

CLIENT	MV WTE			NOZZLE	P	DIAMETER, IN.	0.2575	IMPINGER	INITIAL	FINAL	TOTAL GAIN						
SOURCE	Unit 3			PROBE	TC	Cp	0.8525	VOLUMES	(mL)	(mL)	(mL)						
PARAMETER / RUN No	DF Run 2							Imp. #1	0	417							
DATE	19 Aug 2020			PORT LENGTH				Imp. #2	100	112							
OPERATOR:	LA			STATIC PRESSURE, IN. H2O			-18.3	Imp. #3	2	0							
CONTROL UNIT	JU 14	Y	1.0019	STACK DIAMETER				Imp. #4	Gel								
		ΔH@	2.098	STACK HEIGHT				Imp. #5									
BAROMETRIC PRESSURE, IN. Hg	29.45							Imp. #6									
ASSUMED MOISTURE, Bw	15%			INITIAL LEAK TEST	0.002 @ 15"			Upstream Diameters									
				FINAL LEAK TEST	0.003 @ 15"			Downstream Diameters									

Test a 1

Point	Clock Time	Dry Gas Meter ft³	Pitot ΔP IN. H_2O	Orifice ΔH IN. H_2O	Temperature °F					Pump Vac. IN. Hg	Fyrites		CO (ppm)	NO_x (ppm)	XAD Temp (°F)
					Dry Gas Outlet	Stack	Probe	Box	Impinger Exit		CO_2 Vol. %	O_2 Vol. %			
	0828	639.818													
1		642.91	0.49	1.47	69	305	251	253	57	6					42
1		646.00	0.49	1.46	69	306					10.5	9.5	35	63	
2		649.27	0.48	1.44	70	304	251	252	54	7					41
2		652.14	0.48	1.44	70	304									
3		655.24	0.49	1.47	71	304	251	252	53	7					40
3		658.41	0.51	1.53	71	304					10	10.1	45	78	
4		661.49	0.48	1.45	72	303	250	251	52	7					41
4		664.60	0.49	1.48	72	304									
5		667.84	0.53	1.60	73	303	250	249	52	7					39
5		670.93	0.48	1.45	74	303					10	10.1	40	80	
6		673.99	0.47	1.42	74	304	250	250	53	7					40
6		677.07	0.475	1.44	75	304									
7		679.51	0.30	0.91	75	306	251	250	54	5					41
7		681.81	0.29	0.88	76	306					10	10.2	41	71	
8		683.85	0.25	0.76	77	306	250	251	55	6					41
8		685.93	0.26	0.79	77	306									
9		687.93	0.24	0.73	78	306	250	252	56	6					41
9		690.08	0.23	0.70	78	305					10.5	9.6	40	58	
10		692.23	0.23	0.70	78	304	251	250	57	5					41
10		694.39	0.23	0.70	79	303									
11		696.45	0.21	0.64	79	304	250	250	57	5					41
11		698.46	0.20	0.61	79	304					10.5	9.6	40	63	
12		700.43	0.19	0.58	80	303	251	251	57	5					41
12	1028	702.40	0.19	0.58	80	304									

Initial C/C Start: 638.534

Final C/C Stop: 770.181

A. Lanfranco and Associates Inc.

CLIENT	MV WTE	NOZZLE DIAMETER, IN.		IMPINGER VOLUMES	INITIAL (mL) / FINAL (mL) / TOTAL GAIN (mL)
SOURCE	Unit 3	PROBE Cp		Imp. #1	
PARAMETER / RUN No	DF Run 2 (con't)	PORT LENGTH		Imp. #2	
DATE	19 Aug 2020	STATIC PRESSURE, IN. H2O		Imp. #3	
OPERATOR:	LA	STACK DIAMETER		Imp. #4	
CONTROL UNIT	Y	STACK HEIGHT		Imp. #5	
	ΔH@			Imp. #6	
BAROMETRIC PRESSURE, IN. Hg		INITIAL LEAK TEST		Upstream Diameters	
ASSUMED MOISTURE, Bw		FINAL LEAK TEST		Downstream Diameters	

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. %	CO (ppm)	NO_x (ppm)	XAD Temp (°F)
1		704.74	0.27	0.83	81	306	250	251	59	5					39
1		707.13	0.28	0.86	81	306					10	10.1	42	64	
2		709.56	0.29	0.89	81	307	251	252	56	5					40
2		711.99	0.29	0.89	82	306									
3		714.46	0.30	0.92	82	307	251	250	56	6					40
3		717.02	0.32	0.98	82	307					10.5	9.6	47	75	
4		719.49	0.30	0.91	82	310	250	249	55	6					40
4		721.94	0.295	0.90	82	311									
5		724.43	0.305	0.93	83	311	250	250	56	6					40
5		726.88	0.295	0.90	83	311					10	10.2	39	61	
6		729.31	0.29	0.88	83	310	250	249	57	6					40
6		731.78	0.30	0.92	83	310									
7		734.88	0.47	1.44	84	311	253	250	58	7			41		42
7		737.95	0.46	1.40	84	311					9.5	10.5	[illegible]	68	
8		741.02	0.46	1.41	84	310	251	249	56	7					40
8		744.22	0.50	1.53	84	310									
9		747.42	0.50	1.53	84	310	251	251	56	7					41
9		750.59	0.49	1.50	84	309					10	10.1	93	56	
10		753.95	0.55	1.69	84	308	251	250	56	8					41
10		757.28	0.54	1.65	84	309									
11		760.51	0.51	1.56	84	309	251	250	57	8					41
11		763.71	0.50	1.53	84	310					10.5	9.6	43	77	
12		766.89	0.49	1.50	85	309	250	249	57	7					
12	1230	770.03	0.48	1.47	85	310									

A. Lanfranco and Associates Inc.

√4.10 2.12 ΔH
4.24
-4.36 -2.31

4

CLIENT	MVRD			NOZZLE	G-253	DIAMETER, IN.	.2523		IMPINGER	INITIAL	FINAL	TOTAL GAIN					
				PROBE	HL GUFD	Cp	.8328		VOLUMES	(mL)	(mL)	(mL)					
SOURCE	Unit #3								Imp. #1	0	~~250~~ 430	~~250~~ 430					
PARAMETER / RUN No	3 PDOD / PDOF			PORT LENGTH					Imp. #2	100	~~180~~ 109	~~80~~ 9					
DATE	Aug. 19/20			STATIC PRESSURE, IN. H2O	-19.50				Imp. #3	0	~~109~~ 0	~~9~~ 0					
OPERATOR:	J.C.			STACK DIAMETER	70.9				Imp. #4								
CONTROL UNIT	G-105	Y	.9977	STACK HEIGHT	30'				Imp. #5								
		ΔH@							Imp. #6								
BAROMETRIC PRESSURE, IN. Hg	29.91			INITIAL LEAK TEST	0.002 @ 15"				Upstream Diameters								
ASSUMED MOISTURE, Bw	15%			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		XAD	
					Dry Gas Outlet	Stack	Probe	Box	Impinger Exit		CO_2 Vol. %	O_2 Vol. %		
1	13:40	534.00	.54	1.14	90	316	250	250	49	5			52	
1		537.01	.54	1.14	91	316					10.0	10.0		
2		540.02	.52	1.10	92	316	250	250	49	5			46	
2		542.98	.48	1.02	93	316								
3		545.93	.52	1.10	93	314	250	250	54	5			48	
3		548.78	.50	1.06	94	314								
4		551.69	.50	1.06	94	315	250	250	58	5	10.0	10.5	47	
4		554.58	.48	1.02	95	315								
5		557.42	.48	1.02	96	314	250	250	62	5			48	
5		560.26	.48	1.02	96	314								
6		563.10	.48	1.02	97	314	250	250	64	5			48	
6		566.11	.54	1.14	98	315					10.0	10.5		
7		569.07	.52	1.10	99	316	250	250	66	5			50	
7		571.46	.34	.72	99	316								
8		573.78	.32	.68	99	316	250	250	67	5			52	
8		576.17	.30	.64	99	316								
9		578.49	.28	.59	100	316	250	250	68	5			51	
9		580.67	.25	.58	101	316					10.0	10.0		
10		582.85	.25	.58	102	316	250	250	68	5			50	
10		584.89	.22	.51	102	316								
11		586.94	.22	.51	102	308	250	250	~~60~~	4			50	
11		588.99	.22	.51	103	305								
12		591.04	.22	.51	104	303	250	250	62	4	10.0	10.5	52	
12		593.09	.22	.51	106	302								
		595.04	.20	.46										
1		597.87	.42	.97	104	318	250	250	60	5			50	
1		600.63	.40	.92	105	316								
2		603.39	.40	.92	104	319	250	250	62	5	10.0	10.0	52	
2		606.15	.40	.92	105	320								
3		608.80	.37	.85	104	319	250	250	64	5				

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$\sqrt{4.36}$ 2.31 ΔH

4

CLIENT MVRD					NOZZLE DIAMETER, IN.					IMPINGER	INITIAL	FINAL	TOTAL GAIN				
					PROBE Cp					VOLUMES	(mL)	(mL)	(mL)				
SOURCE Unit #3										Imp. #1							
PARAMETER / RUN No 3 PCDD/PCDF					PORT LENGTH					Imp. #2							
DATE Continued					STATIC PRESSURE, IN. H2O					Imp. #3							
OPERATOR:					STACK DIAMETER					Imp. #4							
CONTROL UNIT Y					STACK HEIGHT					Imp. #5							
ΔH@										Imp. #6							
BAROMETRIC PRESSURE, IN. Hg					INITIAL LEAK TEST					Upstream Diameters							
ASSUMED MOISTURE, Bw					FINAL LEAK TEST					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		XAD	
					Dry Gas Outlet	Stack	Probe	Box	Impinger Exit		CO_2 Vol. %	O_2 Vol. %		
	Continued.	608.80												
3		611.45	.37	.85	104	320	250	250	66	5			47	
4		614.03	.35	.81	104	320					10.0	10.5		
4		616.50	.32	.74	104	320	250	250	66	5			48	
5		618.97	.32	.74	104	319								
5		621.44	.32	.74	104	318	250	250	67	5			48	
6		623.83	.30	.69	104	318								
6		626.22	.30	.69	104	318	250	250	68	5	10.0	10.5	49	
7		629.30	.50	1.16	104	318								
7		632.37	.49	1.13	104	319	250	250	66	5			47	
8		635.80	.62	1.43	104	317								
8		639.18	.60	1.39	104	317	250	250	64	6			47	
9		642.56	.60	1.39	104	317								
9		645.94	.60	1.39	105	317	250	250	63	6	10.0	10.0	47	
10		649.46	.65	1.50	105	316								
10		653.03	.67	1.55	105	316	250	250	62	6			46	
11		656.36	.58	1.34	105	317								
11		659.59	.56	1.27	106	317	250	250	62	6			45	
12		662.82	.55	1.27	105	316					10.0	10.5		
12	18:42	665.97	.52	1.20	105	316	250	250	63	6				

APPENDIX 4

CALIBRATION DATA and

CERTIFICATION

A.Lanfranco & Associates inc.

EPA Method 5

Meter Box Calibration

English Meter Box Units, English K' Factor

Model #: CAE G10J

Serial #: 0028-1X1310-1

Date: 29-Jun-20

Barometric Pressure: 29.99 (in. Hg)

Theoretical Critical Vacuum: 14.15 (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	55.900	72.111	16.211	76.0	76.0	82.0	82.0	73	0.8185	16.5	74.0	78.0	76.0
1.90	16.00	72.800	85.357	12.557	83.0	83.0	86.0	86.0	63	0.5956	19.0	79.0	84.0	81.5
1.10	28.00	85.500	102.637	17.137	83.0	83.0	88.0	88.0	55	0.4606	20.5	82.0	86.0	84.0
0.64	17.00	102.700	110.649	7.949	87.0	87.0	87.0	87.0	48	0.3560	22.0	86.0	89.0	87.5
0.33	15.00	110.700	115.535	4.835	89.0	89.0	89.0	89.0	40	0.2408	23.0	87.0	87.0	87.0

********** 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)
16.053	454.6	15.904	450.4	16.114	0.991	-0.007	1.793	45.55	0.030	0.719
12.257	347.1	12.282	347.8	12.571	1.002	0.004	1.763	44.78	0.000	0.719
16.664	471.9	16.583	469.6	17.052	0.995	-0.003	1.711	43.47	-0.052	0.735
7.700	218.1	7.757	219.7	8.028	1.007	0.010	1.673	42.49	-0.091	0.735
4.663	132.1	4.632	131.2	4.789	0.993	-0.004	1.877	47.67	0.113	0.704
				Average Y---------->	**0.9977**		**Average dH@----->**	**1.764**	**44.8**	**Average Ko----->**	**0.723**

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: June 29, 2020

A.Lanfranco & Associates inc.

EPA Method 5

Meter Box Calibration

English Meter Box Units, English K' Factor

Model #: JU 14
Serial #: 0028-030615-1

Date: 30-Jun-20
Barometric Pressure: 29.80 (in. Hg)
Theoretical Critical Vacuum: 14.06 (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)
4.10	22.00	574.500	597.911	23.411	71.0	71.0	73.0	73.0	73	0.8185	15.5	69.0	74.0	71.5
2.20	18.00	598.600	612.539	13.939	73.0	73.0	74.0	74.0	63	0.5956	17.0	75.0	75.0	75.0
1.40	18.00	613.100	623.930	10.830	74.0	74.0	74.0	74.0	55	0.4606	18.5	80.0	76.0	78.0
0.76	27.00	624.500	636.842	12.342	74.0	74.0	75.0	75.0	48	0.3560	20.0	76.0	80.0	78.0
0.36	17.00	636.900	642.251	5.351	75.0	75.0	75.0	75.0	40	0.2408	21.0	75.0	76.0	75.5

********** 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)
23.367	661.7	23.276	659.2	23.534	0.996	-0.006	2.037	51.73	-0.044	0.674
13.809	391.1	13.812	391.2	14.057	1.000	-0.002	2.072	52.62	-0.009	0.667
10.698	303.0	10.652	301.7	10.902	0.996	-0.006	2.215	56.25	0.134	0.649
12.161	344.4	12.349	349.7	12.639	1.015	0.014	2.011	51.07	-0.070	0.668
5.262	149.0	5.272	149.3	5.370	1.002	0.000	2.070	52.58	-0.011	0.668
				Average Y---------->	**1.0019**	**Average dH@----->**	**2.081**	**52.8**	**Average Ko---->**	**0.665**

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: June 30, 2020

A. LANFRANCO and ASSOCIATES INC.

ENVIRONMENTAL CONSULTANTS

GLASS NOZZLE DIAMETER CALIBRATION FORM

Calibrated by: Justin Ching
Date: June 29th, 2020

Signature: 

Nozzle I.D.	d1 (inch)	d2 (inch)	d3 (inch)	difference (inch)	average dia. (inch)	average area (ft^2)
A	0.1250	0.1240	0.1245	0.0010	0.1245	0.0000845
G-165	0.1640	0.1655	0.1660	0.0020	0.1652	0.0001488
G-178	0.1780	0.1780	0.1790	0.0010	0.1783	0.0001735
J	0.1880	0.1880	0.1880	0.0000	0.1880	0.0001928
E	0.1880	0.1895	0.1882	0.0015	0.1886	0.0001939
L	0.2112	0.2120	0.2105	0.0015	0.2112	0.0002434
Q	0.2190	0.2170	0.2185	0.0020	0.2182	0.0002596
G-218	0.2180	0.2175	0.2190	0.0015	0.2182	0.0002596
G-223	0.2220	0.2230	0.2225	0.0010	0.2225	0.0002700
G-225	0.2245	0.2250	0.2240	0.0010	0.2245	0.0002749
G-2251	0.2230	0.2260	0.2245	0.0030	0.2245	0.0002749
P-18	0.2375	0.2370	0.2380	0.0010	0.2375	0.0003076
G-247	0.2450	0.2470	0.2470	0.0020	0.2463	0.0003310
G-253	0.2525	0.2520	0.2525	0.0005	0.2523	0.0003473
G-257	0.2570	0.2570	0.2570	0.0000	0.2570	0.0003602
P	0.2580	0.2570	0.2575	0.0010	0.2575	0.0003616
G-275	0.2750	0.2740	0.2750	0.0010	0.2747	0.0004115
G-278	0.2780	0.2770	0.2780	0.0010	0.2777	0.0004205
P-2	0.2787	0.2790	0.2785	0.0005	0.2787	0.0004237
G-287	0.2870	0.2880	0.2860	0.0020	0.2870	0.0004493
G-292	0.2922	0.2920	0.2926	0.0006	0.2923	0.0004659
G-304	0.3040	0.3050	0.3040	0.0010	0.3043	0.0005052
MV-02	0.3050	0.3040	0.3055	0.0015	0.3048	0.0005068
MV-01	0.3050	0.3045	0.3055	0.0010	0.3050	0.0005074
G-3071	0.3075	0.3070	0.3070	0.0005	0.3072	0.0005146
G-3072	0.3070	0.3070	0.3080	0.0010	0.3073	0.0005152
G-310	0.3090	0.3105	0.3095	0.0015	0.3097	0.0005230
G-316	0.3160	0.3160	0.3170	0.0010	0.3163	0.0005458
V-06	0.3200	0.3210	0.3210	0.0010	0.3207	0.0005608
G-337	0.3380	0.3365	0.3380	0.0015	0.3375	0.0006213
P-27	0.3387	0.3385	0.3390	0.0005	0.3387	0.0006258
I	0.3785	0.3785	0.3785	0.0000	0.3785	0.0007814
P-14	0.3910	0.3935	0.3920	0.0025	0.3922	0.0008388
C	0.4255	0.4225	0.4235	0.0030	0.4238	0.0009798
G-437	0.4350	0.4345	0.4355	0.0010	0.4350	0.0010321
G-468	0.4677	0.4670	0.4670	0.0007	0.4672	0.0011907
P-29	0.4680	0.4680	0.4690	0.0010	0.4683	0.0011963
P-7	0.4965	0.4940	0.4930	0.0035	0.4945	0.0013337
B	0.5015	0.5030	0.5025	0.0015	0.5023	0.0013763
G-540	0.5405	0.5400	0.5405	0.0005	0.5403	0.0015924

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

Pitot Tube Calibration

Date: 29-Jun-20 Temp (R): 530
Pbar (in.Hg): 29.69 Dn (in.): 0.25

Pitot ID: **7A-1**

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	0.0024
0.100	0.140	21.0	0.8367	0.0024
0.150	0.210	25.7	0.8367	0.0024
0.350	0.490	39.3	0.8367	0.0024
0.590	0.850	51.0	0.8248	0.0095
		Average :	0.8343	0.0038

Pitot ID: **ST 8A**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.040	0.055	13.3	0.8443	0.0027
0.080	0.110	18.8	0.8443	0.0027
0.180	0.250	28.2	0.8400	0.0016
0.300	0.420	36.4	0.8367	0.0049
0.500	0.690	47.0	0.8427	0.0011
		Average :	0.8416	0.0026

Pitot ID: **7B**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.030	0.040	11.5	0.8574	0.0056
0.120	0.160	23.0	0.8574	0.0056
0.200	0.270	29.7	0.8521	0.0003
0.380	0.520	41.0	0.8463	0.0055
0.730	1.000	56.8	0.8459	0.0059
		Average :	0.8518	0.0046

Pitot ID: **ST 8B**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.060	0.080	16.3	0.8574	0.0039
0.090	0.120	19.9	0.8574	0.0039
0.190	0.260	29.0	0.8463	0.0072
0.320	0.430	37.6	0.8540	0.0006
0.630	0.850	52.8	0.8523	0.0012
		Average :	0.8535	0.0033

Pitot ID: **AL GVRD 1**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.060	0.085	16.3	0.8318	0.0011
0.090	0.125	19.9	0.8400	0.0072
0.145	0.200	25.3	0.8430	0.0101
0.290	0.420	35.8	0.8226	0.0102
0.530	0.760	48.4	0.8267	0.0061
		Average :	0.8328	0.0069

Pitot ID: **ST 8C**

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	0.0053
0.085	0.120	19.4	0.8332	0.0018
0.190	0.270	29.0	0.8305	0.0009
0.420	0.600	43.1	0.8283	0.0031
0.630	0.900	52.8	0.8283	0.0031
		Average :	0.8314	0.0028

Pitot ID: **7C**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.030	0.040	11.5	0.8574	0.0048
0.060	0.080	16.3	0.8574	0.0048
0.110	0.150	22.0	0.8478	0.0047
0.210	0.280	30.5	0.8574	0.0048
0.500	0.690	47.0	0.8427	0.0098
		Average :	0.8525	0.0058

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: June 29, 2020

BAROMETER CALIBRATION FORM						
		Pbar Env Canada		Device (inches of Hg)		Difference
Device	Cal Date	(kPa)	(inches of Hg)	Reading	Elevation Corrected	(Env Can - Elv Corr)
LA	July 6, 2020	101.8	30.07	29.94	30.01	0.05
DS	July 6, 2020	101.8	30.07	29.94	30.01	0.05
CL	July 6, 2020	101.8	30.07	29.96	30.03	0.03
ML	July 6, 2020	101.8	30.07	29.92	29.99	0.07
SB	July 6, 2020	101.8	30.07	29.94	30.01	0.05
SH	July 6, 2020	101.8	30.07	29.95	30.02	0.04
JB	July 6, 2020	101.8	30.07	29.99	30.06	0.00
SF	July 6, 2020	101.8	30.07	29.92	29.99	0.07
JG	July 6, 2020	101.8	30.07	29.96	30.03	0.03

Calibrated by: Louis Agassiz Signature:  Date: July 6, 2020

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.

http://www.weatheroffice.gc.ca/city/pages/bc-74_metric_e.html

A. LANFRANCO and ASSOCIATES INC.

ENVIRONMENTAL CONSULTANTS

TEMPERATURE CALIBRATION FORM

Calibrated by: Scott Ferguson

Date: 6-Jul-20

Signature: 

TEMPERATURE DEVICE CALIBRATIONS

Reference Device Model CL23A Calibrator			Temperature Settings (degrees F)													
			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	33	0.20%	101	0.18%	200	0.00%	300	0.00%	499	-0.10%	800	0.00%	1700	0.00%
Omega HH11A	4	200167	33	0.20%	101	0.18%	200	0.00%	301	0.13%	500	0.00%	801	0.08%	1699	-0.05%
Omega HH11A	6	600059	32	0.00%	100	0.00%	199	-0.15%	299	-0.13%	501	0.10%	799	-0.08%	1699	-0.05%
TPI 341K	7	2.0315E+10	29.8	-0.45%	98	-0.36%	197	-0.45%	297	-0.39%	496.4	-0.38%	796	-0.32%	1693	-0.32%
TPI 341K	8	2.0313E+10	31	-0.20%	98	-0.36%	200	0.00%	300	0.00%	500	0.00%	800	0.00%	1697	-0.14%
Cont Cmpny	10	102008464	32	0.00%	99	-0.18%	199	-0.15%	299	-0.13%	498.6	-0.15%	796	-0.32%	1698	-0.09%
Omega HH11	14	409426	33	0.20%	100	0.00%	202	0.30%	302	0.26%	500	0.00%	799	-0.08%	1699	-0.05%
TPI 341K	16	400120029	32	0.00%	99	-0.18%	200	0.00%	301	0.13%	500	0.00%	800	0.00%	1700	0.00%
TPI 341K	18	2.0329E+10	32	0.00%	101	0.18%	200	0.00%	300	0.00%	501	0.10%	799	-0.08%	1699	-0.05%
TPI 341K	20	2.0329E+10	30	-0.41%	98	-0.36%	198	-0.30%	298	-0.26%	497.1	-0.30%	797	-0.24%	1695	-0.23%
Reference device is a NIST certified digital thermocouple calibrator																
Variation expressed as a percentage of the absolute temperature must be within 1.5 %																

Calibration Certificate

Date: 07-Jul-20
Calibrated by: Louis Agassiz
Authorizing Signature:

Insrtument Calibrated: Testo 1 (330-2LL)
Serial #: 03101345
Customer: ALA

Ambient Conditions: Temperature: 15 °C Barometric Pressure: 101.7 kPa Relative Humidity: 63%

A. Lanfranco and Associates Inc. certifies that the described instrument has been inspected and tested following calibration procedures in the Environment Canada Report EPS 1/PG/7 (Revised 2005). Below are the observed readings after calibrations are complete. Calibration checks should be completed at least every 6 months.

O_2	Initial Evaluation				After Calibration				
Gas	Instrument Reading (vol %)	% Calibration Error	Pass/Fail	Notes	Instrument Reading (vol %)	% Calibration Error	Pass/Fail	Notes	Certified Value (vol %)
Zero	0.1	0.10	Pass		0	0.00	Pass		0
O_2	11.2	0.23	Pass	Recal on Amb	11.0	0.03	Pass		10.97
Ambient	21.1	0.14	Pass		21.0	0.04	Pass		20.96

Performance Specification: +/- 1% O_2 (absolute diff)

CO	Initial Evaluation				After Calibration				
Gas	Instrument Reading (ppm)	% Calibration Error	Pass/Fail	Notes	Instrument Reading (ppm)	% Calibration Error	Pass/Fail	Notes	Certified Value (ppm)
Zero	0	0.0%	Pass		0	0.0%	Pass		0
1 Gas	1940	1.9%	Pass		1904	0.0%	Pass		1904
2 Gas	1950	1.9%	Pass	Recal w 3 gas	1910	0.2%	Pass		1914
3 Gas	470	4.9%	Pass		449	0.2%	Pass		448
4 Gas	258	2.7%	Pass		251	0.1%	Pass		251

Performance Specification: +/- 5% of Certified Gas Value

NO	Initial Evaluation				After Calibration				
Gas	Instrument Reading (ppm)	% Calibration Error	Pass/Fail	Notes	Instrument Reading (ppm)	% Calibration Error	Pass/Fail	Notes	Certified Value (ppm)
Zero	0	0.0%	Pass		0	0.0%	Pass		0
1 Gas	247	4.3%	Pass		258	0.0%	Pass		258
2 Gas	103	3.9%	Pass	Recal w 3 gas	99	0.1%	Pass		99.13
3 Gas	448	3.4%	Pass		465	0.2%	Pass		464
4 Gas	47.5	4.1%	Pass		46	0.9%	Pass		45.61

Performance Specification: +/- 5% of Certified Gas Value

NIST Traceable Calibration Gases:

Cylinder	Cylinder ID Number	Certification Date	Expiration Date	Cylinder Pressure (PSI)	O_2 (Vol. %)	CO (ppm)	NO (ppm)
Zero Gas (N_2)	340943	21-Jan-2020	20-Jan-2025	2150	0	0	0
1 Gas	CC320634	23-Mar-2018	23-Mar-2026	1420	-	1904	258
2 Gas	CC336011	24-Feb-2020	25-Feb-2028	1480	-	1914	99.13
3 Gas	CC222743	13-Jan-2017	13-Jan-2025	5400	-	448	464
4 Gas	CC14093	5-Aug-2019	6-Aug-2027	1850	-	251.3	45.61
O_2/CO_2	CC28009	5-Dec-2018	5-Dec-2026	580	10.97	-	-

Note: National Institute of Standards and Technology traceable certificates are available upon request.

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

MOUNT ROYAL UNIVERSITY

Faculty of Continuing Education and Extension

Jeremy Shawn Gibbs

has successfully completed

Stack Sampling

35 Hours / 2019

May 22, 2019

Date

Dean
Faculty of Continuing Education and Extension

MOUNT ROYAL
UNIVERSITY
1910

Walter Smith & Associates, Inc.

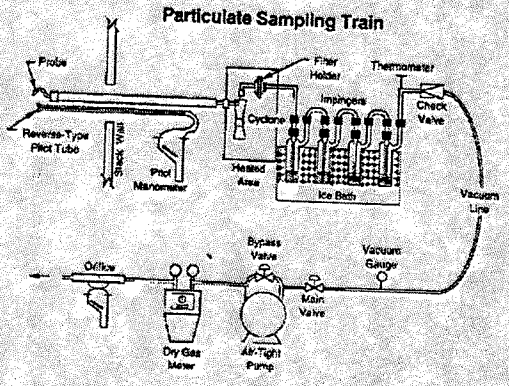
is hereby granted to:

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