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 2019 Survey**

**Operational Certificate 107051**

## 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. D. Sampson (certified), and Mr. M. Goods.

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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**APPENDICES**

## TEST PROGRAM ORGANIZATION

| | |
|---|---|
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| **Sampling Crew:** | Mr. D. Sampson – A. Lanfranco and Associates Inc.<br>Mr. M. Goods – A. Lanfranco and Associates Inc. |

## SUMMARY

The following tables present the average of triplicate test results on Unit 2 for various trace organics on August 19-21, 2019. Additional emission parameters were measured by the facility's certified continuous emission monitoring system.

| Parameter | | Unit 2 | Limit |
|---|---|---|---|
| PCDD/PCDF | (TEQ ng/$Sm^3$ @ 11% $O_2$) | 0.0023 | 0.08 |
| PCDD/PCDF Mass Emission | (TEQ g/day) | 4.39E-06 | |
| PAH | (µg/$Sm^3$ @ 11% $O_2$) | 0.0738 | 5.0 |
| HCB | (µg/$Sm^3$ @ 11% $O_2$) | 0.0032 | |
| Total CB | (µg/$Sm^3$ @ 11% $O_2$) | 0.5945 | 1.0 |
| Total CP | (µg/$Sm^3$ @ 11% $O_2$) | 0.0086 | 1.0 |
| Total PCB | (µg/$Sm^3$ @ 11% $O_2$) | 0.0114 | 1.0 |
| Flowrate | ($Sm^3$/min) | 1127 | |
| Temperature | (°C) | 159.0 | |
| $O_2$ | (vol % dry) | 9.5 | |

Standard conditions (S) of 20 °C and 101.325 kPa (dry)

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

## 1.0 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.

For 2019, the individual source that was monitored is identified as Unit 2.

## 2.0 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<br><br>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.

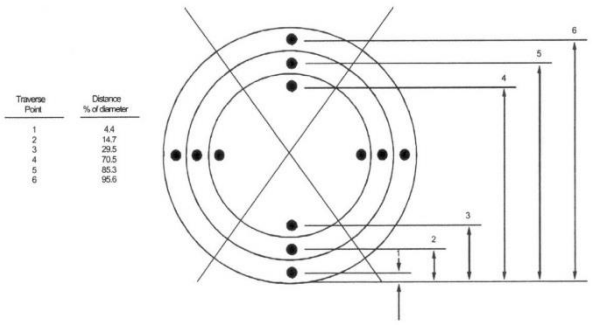



**Figure 1.** Example showing circular stack cross section divided into 12 equal areas, with location of traverse points.

| | | |
|---|---|---|
| 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.

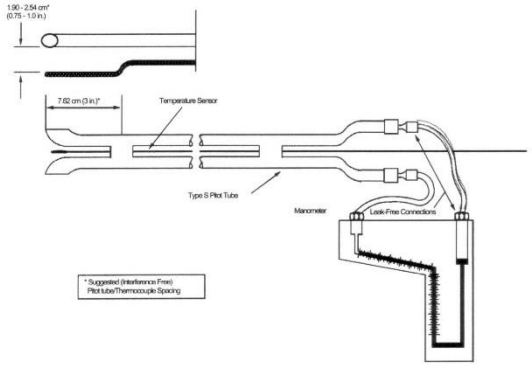



**Figure 2.** Type S Pitot Tube Manometer Assembly

| | | |
|---|---|---|
| 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.

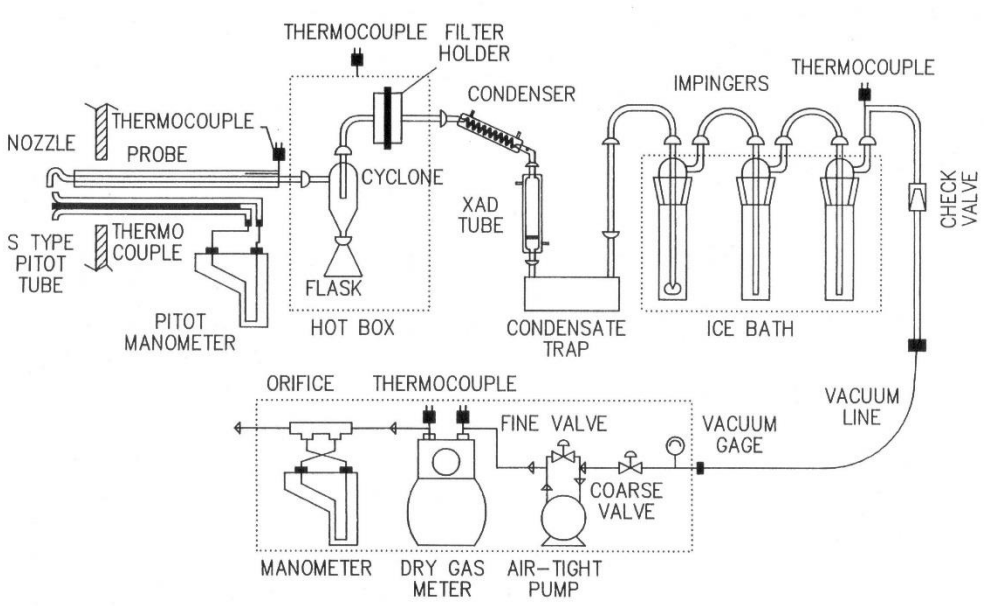


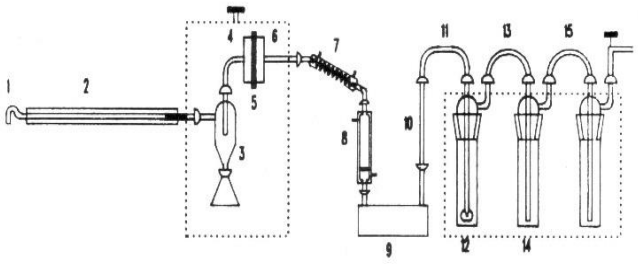

**Figure 3 -** Dioxin / Furan Sampling Train

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.

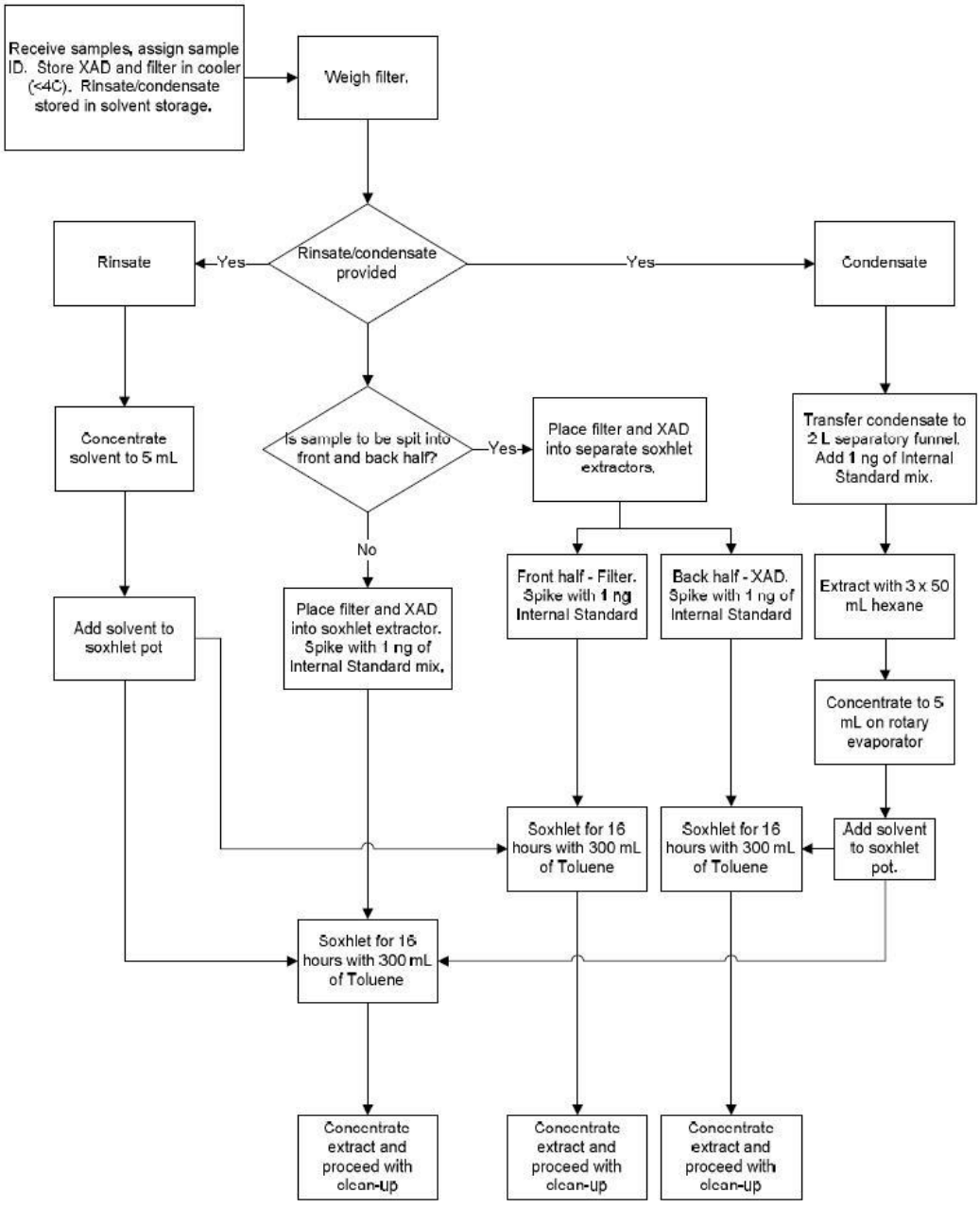



**Figure 5 - Semi-Volatile Organics XAD and Filter Recovery Schematic**

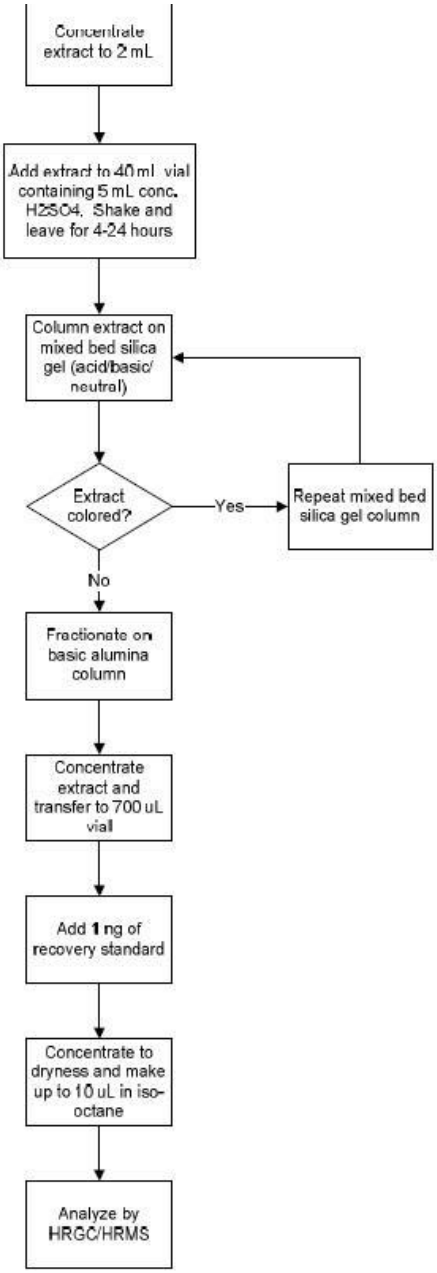



**Figure 6 - Schematic of analytical methodology for dioxins and furans**

## 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) |
| $\Delta H_{ave}$ | = 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

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

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

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

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

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

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

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

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

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

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

$$v_i = 85.49 \times c_p \times \sqrt{\Delta p_i} \times \sqrt{\frac{\left(T_{Stk_i} + 459.67\right)}{(P_{Stk} \times M_W)}}$$ **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 (ft²)* |
| $d_n$ | = *Diameter of nozzle (inches)* |
| $c_p$ | = *Pitot coefficient (dimensionless)* |
| $\Delta p_i$ | = *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 (ft³)* |
| $V_{gain}$ | = *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

## 3.0 TEST RESULTS

Most of the results of stack emissions were calculated using a "STACK" computer program developed by A. Lanfranco and Associates for 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 2 sampling location.

## TABLE 1: UNIT 2 TRACE ORGANICS RESULTS TABLE

| Parameter | | Test 1 | Test 2 | Test 3 | Average |
|---|---|---|---|---|---|
| Test Date | | 19-Aug-19 | 20-Aug-19 | 21-Aug-19 | |
| Test Time | | 10:35 - 14:38 | 09:37 - 13:39 | 09:07 - 13:09 | |
| Duration | (minutes) | 240 | 240 | 240 | 240 |
| PCDD & PCDF TEQ | ($ng/Sm^3$) | 0.0053 | 0.0011 | 0.0017 | 0.0027 |
| **PCDD & PCDF TEQ** | **($ng/Sm^3$ @ 11% $O_2$)** | **0.0046** | **0.0010** | **0.0015** | **0.0023** |
| Total PAH | ($\mu g/Sm^3$) | 0.0956 | 0.0733 | 0.0862 | 0.0851 |
| **Total PAH** | **($\mu g/Sm^3$ @ 11% $O_2$)** | **0.0832** | **0.0643** | **0.0739** | **0.0738** |
| Total HCB | ($\mu g/Sm^3$) | 0.0036 | 0.0029 | 0.0047 | 0.0037 |
| **Total HCB** | **($\mu g/Sm^3$ @ 11% $O_2$)** | **0.0032** | **0.0025** | **0.0040** | **0.0032** |
| Total CB | ($\mu g/Sm^3$) | 0.7759 | 0.4723 | 0.8106 | 0.6863 |
| **Total CB** | **($\mu g/Sm^3$ @ 11% $O_2$)** | **0.6748** | **0.4141** | **0.6948** | **0.5945** |
| Total CP | ($\mu g/Sm^3$) | 0.0070 | 0.0072 | 0.0157 | 0.0100 |
| **Total CP** | **($\mu g/Sm^3$ @ 11% $O_2$)** | **0.0061** | **0.0063** | **0.0135** | **0.0086** |
| Total PCB | ($\mu g/Sm^3$) | 0.0330 | 0.0032 | 0.0032 | 0.0131 |
| **Total PCB** | **($\mu g/Sm^3$ @ 11% $O_2$)** | **0.0287** | **0.0028** | **0.0027** | **0.0114** |
| Stack Temperature | (°C) | 158 | 158 | 161 | 159 |
| Flowrate | ($Sm^3$/min) | 1134 | 1131 | 1114 | 1127 |
| Oxygen ($O_2$) | (vol % dry) | 9.5 | 9.6 | 9.4 | 9.5 |
| Carbon Dioxide ($CO_2$) | (vol % dry) | 10.1 | 9.9 | 10.3 | 10.1 |
| Moisture | (vol %) | 17.0 | 17.3 | 17.4 | 17.2 |
| Isokinetic Variation | (%) | 105 | 103 | 103 | 104 |

Standard conditions (S) of 20 °C and 101.325 kPa (dry)

**TABLE 2 Detailed PCDD/PCDF Emission Results**

| | | Test 1 | | Test 2 | | Test 3 | |
|---|---|---|---|---|---|---|---|
| Test Date: | | 19-Aug-19 | | 20-Aug-19 | | 21-Aug-19 | |
| Test Time: | | 10:35 - 14:38 | | 09:37 - 13:39 | | 09:07 - 13:09 | |
| **Component** | **TEF** | **Analyzed** (ng) | **TEQ** (ng) | **Analyzed** (ng) | **TEQ** (ng) | **Analyzed** (ng) | **TEQ** (ng) |
| 2378 TCDD | 1.0000 | 0.0055 | 0.0055 | 0.0010 | 0.0010 | 0.0010 | 0.0010 |
| 12378 PCDD | 0.5000 | 0.0000 | ND | 0.0000 | ND | 0.0000 | ND |
| 123478 HxCDD | 0.1000 | 0.0063 | 0.0006 | 0.0020 | 0.0002 | 0.0020 | 0.0002 |
| 123678 HxCDD | 0.1000 | 0.0081 | 0.0008 | 0.0020 | 0.0002 | 0.0020 | 0.0002 |
| 123789 HxCDD | 0.1000 | 0.0087 | 0.0009 | 0.0020 | 0.0002 | 0.0020 | 0.0002 |
| 1234678 HpCDD | 0.0100 | 0.0590 | 0.0006 | 0.0290 | 0.0003 | 0.0380 | 0.00038 |
| OCDD | 0.0010 | 0.0990 | 0.00010 | 0.0530 | 0.00005 | 0.0570 | 0.00006 |
| 2378 TCDF | 0.1000 | 0.0082 | 0.0008 | 0.0010 | 0.0001 | 0.0010 | 0.0001 |
| 12378 PCDF | 0.0500 | 0.0000 | ND | 0.0000 | ND | 0.0000 | ND |
| 23478 PCDF | 0.5000 | 0.0084 | 0.0042 | 0.0020 | 0.0010 | 0.0020 | 0.0010 |
| 123478 HxCDF | 0.1000 | 0.0150 | 0.0015 | 0.0020 | 0.0002 | 0.0110 | 0.0011 |
| 123678 HxCDF | 0.1000 | 0.0130 | 0.0013 | 0.0020 | 0.0002 | 0.0020 | 0.0002 |
| 234678 HxCDF | 0.1000 | 0.0180 | 0.0018 | 0.0020 | 0.0002 | 0.0110 | 0.0011 |
| 123789 HxCDF | 0.1000 | 0.0000 | ND | 0.0000 | ND | 0.0000 | ND |
| 1234678 HpCDF | 0.0100 | 0.0570 | 0.00057 | 0.0220 | 0.00022 | 0.0340 | 0.00034 |
| 1234789 HpCDF | 0.0100 | 0.0090 | 0.0001 | 0.0020 | 0.00002 | 0.0020 | 0.00002 |
| OCDF | 0.0010 | 0.0150 | 0.000015 | 0.0075 | 7.5E-06 | 0.0075 | 7.50E-06 |
| **Summed PCDD & PCDF TEQ (ng)** | | | **0.0188** | | **0.0039** | | **0.0059** |
| **Sample Volume (dscm)** | | | **3.5766** | | **3.4915** | | **3.4321** |
| **PCDD & PCDF TEQ** | **ng/dscm** | | **0.00525** | | **0.00111** | | **0.00172** |
| **PCDD & PCDF TEQ** | **ng/dscm @ 11% $O_2$** | | **0.00457** | | **0.00098** | | **0.00147** |
| **PCDD & PCDF TEQ** | **grams/day** | | **0.000009** | | **0.000002** | | **0.000003** |
| **Flowrate (dscm/min)** | | | 1134 | | 1131 | | 1114 |
| **Oxygen (Vol. %)** | | | 9.5 | | 9.6 | | 9.4 |
| **Carbon Dioxide (Vol. %)** | | | 10.1 | | 9.9 | | 10.3 |
| **Moisture (Vol. %)** | | | 17.0 | | 17.3 | | 17.4 |
| **Temperature (oC)** | | | 158 | | 158 | | 161 |
| **Isokinetic Variation (%)** | | | 105 | | 103 | | 103 |

## TABLE 3: UNIT 2 TRACE ORGANICS MASS EMISSIONS RESULTS

| Parameter | | Test 1 | Test 2 | Test 3 | Average |
|---|---|---|---|---|---|
| PCDD & PCDF TEQ | (g/sec) | 9.93E-11 | 2.10E-11 | 3.19E-11 | 5.08E-11 |
| PCDD & PCDF TEQ | (tonnes/annum) | 3.13E-09 | 6.63E-10 | 1.01E-09 | 1.60E-09 |
| Total PAH | (g/sec) | 1.81E-06 | 1.38E-06 | 1.60E-06 | 1.60E-06 |
| Total PAH | (tonnes/annum) | 5.70E-05 | 4.36E-05 | 5.05E-05 | 5.04E-05 |
| Total HCB | (g/sec) | 6.87E-08 | 5.40E-08 | 8.66E-08 | 6.98E-08 |
| Total HCB | (tonnes/annum) | 2.17E-06 | 1.70E-06 | 2.73E-06 | 2.20E-06 |
| Total CB | (g/sec) | 1.47E-05 | 8.91E-06 | 1.51E-05 | 1.29E-05 |
| Total CB | (tonnes/annum) | 4.63E-04 | 2.81E-04 | 4.75E-04 | 4.06E-04 |
| Total CP | (g/sec) | 1.32E-07 | 1.35E-07 | 2.92E-07 | 1.86E-07 |
| Total CP | (tonnes/annum) | 4.17E-06 | 4.26E-06 | 9.21E-06 | 5.88E-06 |
| Total PCB | (g/sec) | 6.24E-07 | 6.10E-08 | 5.95E-08 | 2.48E-07 |
| Total PCB | (tonnes/annum) | 1.97E-05 | 1.92E-06 | 1.88E-06 | 7.82E-06 |

Standard conditions (S) of 20 °C and 101.325 kPa (dry)

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: | 19-Aug-19 | 20-Aug-19 | 21-Aug-19 |
| Test Time: | 10:35 - 14:38 | 09:37 - 13:39 | 09:07 - 13:09 |
| **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 | 0.016 | 0.022 | 0.015 |
| Benzo(g,h,i)perylene | 0.018 | 0.042 | 0.016 |
| 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 | 0.063 | 0.030 | 0.047 |
| Indeno(1,2,3-c,d)pyrene | ND | ND | ND |
| Phenanthrene | 0.100 | 0.073 | 0.064 |
| Pyrene | 0.110 | 0.044 | 0.088 |
| 7H-dibenzo(c,g)carbazole | ND | ND | ND |
| **Acenaphthene** | **ND** | **ND** | **ND** |
| **Acenaphthylene** | **ND** | **ND** | **ND** |
| **Fluorene** | **0.010** | **0.020** | **0.010** |
| **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** | **0.025** | **0.025** | **0.056** |
| **Total CP** | **0.0250** | **0.0250** | **0.0540** |
| **Total CB** | **2.7750** | **1.6490** | **2.7820** |
| **HCB** | **0.0130** | **0.0100** | **0.0160** |
| * ND = Less than detection limit | | | |
| **PCB Total (ng)** | **118.000** | **11.300** | **11.000** |
| **Total PAH (ug)** | **0.342** | **0.256** | **0.296** |
| **Sample Volume (dscm)** | **3.58** | **3.49** | **3.43** |
| **Oxygen** | 9.5 | 9.6 | 9.4 |
| **PAH ug/dscm** | **0.0956** | **0.0733** | **0.0862** |
| **HCB ug/dscm** | **0.0036** | **0.0029** | **0.0047** |
| **CB Total ug/dscm** | **0.7759** | **0.4723** | **0.8106** |
| **CP Total ug/dscm** | **0.0070** | **0.0072** | **0.0157** |
| **PCB Total ug/dscm** | **0.0330** | **0.0032** | **0.0032** |
| **PAH ug/dscm @ 11% $O_2$** | **0.0832** | **0.0643** | **0.0739** |
| **HCB ug/dscm @ 11% $O_2$** | **0.0032** | **0.0025** | **0.0040** |
| **CB Total ug/dscm @ 11% $O_2$** | **0.6748** | **0.4141** | **0.6948** |
| **CP Total ug/dscm @ 11% $O_2$** | **0.0061** | **0.0063** | **0.0135** |
| **PCB Total ug/dscm @ 11% $O_2$** | **0.0287** | **0.0028** | **0.0027** |

## 4.0 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 2017 and 2018; however, there was a notable decrease in chlorophenols for 2019 and a notable increase in total PCB, largely resulting from a Run 1 result for dichlorobiphenyl.

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" as long as 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 51 to 94%.

EPA Method 23 surrogate recoveries ranged from 80 to 117% 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 #: PR192073

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

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

**RECEIVED BY:** P. Pond
**CONDITION:** Okay, 15.4°C

**DATE/TIME:** August 22, 2019 (12:02 p.m.)

| # of Containers | Sample Type | Sample (Client Codes) | Lab Codes | Test Requested |
|---|---|---|---|---|
| 5 | Stack | Blk Dioxin | PR192073 | PCDD/F, PCB, PAH/HCB, CB, CP |
| 5 | Stack | Run 1 - Dioxin | PR192074 | PCDD/F, PCB, PAH/HCB, CB, CP |
| 5 | Stack | Run 2 - Dioxin | PR192075 | PCB, PAH/HCB, CB, CP |
| 5 | Stack | Run 3 - Dioxin | PR192076 | 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 LAB02F; EPA Method 1668C
PAH/CB/CP: SOP LAB013; in house

Data summarized in Data Report attached.

Report sent to: Mark Lanfranco Date: September 18, 2019

Comments: Results relate only to items tested.

_____
David Hope, P.Chem, CEO

# METHOD 23/1-RM-3 DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Sample Date:** | Mark Lanfranco |
| **Client ID:** | Blk Dioxin | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PR192073 | **Date Analysed:** | 13-Sep-19 |
| | | **Filter Wt.:** | 0.34g |

## 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** |

**Surrogate Recoveries (%)**

| | |
|---|---|
| $^{37}Cl_4$ -2,3,7,8-TCDD | 105 |
| $^{13}C_{12}$ -2,3,4,7,8-PeCDF | 97 |
| $^{13}C_{12}$ -1,2,3,4,7,8-HxCDD | 78 |
| $^{13}C_{12}$ -1,2,3,4,7,8-HxCDF | 70 |
| $^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF | 96 |

ND - none detected

**Internal Standards (%)**

| | |
|---|---|
| $^{13}C_{12}$ -2,3,7,8-TCDD | 51 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDD | 52 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDD | 90 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD | 66 |
| $^{13}C_{12}$ -OCDD | 60 |
| $^{13}C_{12}$ -2,3,7,8-TCDF | 50 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDF | 55 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDF | 60 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF | 61 |

# METHOD 23/1-RM-3 DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Sample Date:** | Mark Lanfranco |
| **Client ID:** | Run 1 - Dioxin | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PR192074 | **Date Analysed:** | 13-Sep-19 |
| | | **Filter Wt.:** | 0.35g |

## 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 | 5.5 | 2 | | 5.5 | 5.5 | 5.5 |
| Total TCDD | 5.5 | 2 | 1 | | | |
| | | | | | | |
| 1,2,3,7,8-PeCDD | ND | 4 | | ND | 1 | 2 |
| Total PeCDD | ND | 4 | 0 | | | |
| | | | | | | |
| 1,2,3,4,7,8-HxCDD | 6.3 | 4 | | 0.63 | 0.63 | 0.63 |
| 1,2,3,6,7,8-HxCDD | 8.1 | 4 | | 0.81 | 0.81 | 0.81 |
| 1,2,3,7,8,9-HxCDD | 8.7 | 4 | | 0.87 | 0.87 | 0.87 |
| Total HxCDD | 91 | 4 | 5 | | | |
| | | | | | | |
| 1,2,3,4,6,7,8-HpCDD | 59 | 4 | | 0.59 | 0.59 | 0.59 |
| Total HpCDD | 130 | 4 | 2 | | | |
| | | | | | | |
| OCDD | 99 | 15 | 1 | 0.099 | 0.099 | 0.099 |
| | | **Total Dioxin TEQ** | | **8.5** | **9.5** | **10.5** |

## 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 | 8.2 | 2 | | 0.82 | 0.82 | 0.82 |
| Total TCDF | 17 | 2 | 2 | | | |
| | | | | | | |
| 1,2,3,7,8-PeCDF | ND | 4 | | ND | 0.1 | 0.2 |
| 2,3,4,7,8-PeCDF | 8.4 | 4 | | 4.2 | 4.2 | 4.2 |
| Total PeCDF | 55 | 4 | 2 | | | |
| | | | | | | |
| 1,2,3,4,7,8-HxCDF | 15 | 4 | | 1.5 | 1.5 | 1.5 |
| 1,2,3,6,7,8-HxCDF | 13 | 4 | | 1.3 | 1.3 | 1.3 |
| 1,2,3,7,8,9-HxCDF | ND | 4 | | ND | 0.2 | 0.4 |
| 2,3,4,6,7,8-HxCDF | 18 | 4 | | 1.8 | 1.8 | 1.8 |
| Total HxCDF | 93 | 4 | 6 | | | |
| | | | | | | |
| 1,2,3,4,6,7,8-HpCDF | 57 | 4 | | 0.57 | 0.57 | 0.57 |
| 1,2,3,4,7,8,9-HpCDF | 9 | 4 | | 0.09 | 0.09 | 0.09 |
| Total HpCDF | 67 | 4 | 2 | | | |
| | | | | | | |
| OCDF | 15 | 15 | 1 | 0.015 | 0.015 | 0.015 |
| | | **Total Furan TEQ** | | **10.3** | **10.6** | **10.9** |

| | | | |
|---|---|---|---|
| **Total PCDD/PCDF Toxic Equivalent (pg)** | | **18.8** | **20.1** | **21.4** |

**Surrogate Recoveries (%)**

| | |
|---|---|
| $^{37}Cl_4$ -2,3,7,8-TCDD | 101 |
| $^{13}C_{12}$ -2,3,4,7,8-PeCDF | 116 |
| $^{13}C_{12}$ -1,2,3,4,7,8-HxCDD | 117 |
| $^{13}C_{12}$ -1,2,3,4,7,8-HxCDF | 87 |
| $^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF | 87 |

ND - none detected

**Internal Standards (%)**

| | |
|---|---|
| $^{13}C_{12}$ -2,3,7,8-TCDD | 68 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDD | 51 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDD | 61 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD | 75 |
| $^{13}C_{12}$ -OCDD | 76 |
| $^{13}C_{12}$ -2,3,7,8-TCDF | 60 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDF | 61 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDF | 77 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF | 78 |

# METHOD 23/1-RM-3 DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Sample Date:** | Mark Lanfranco |
| **Client ID:** | Run 2 - Dioxin | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PR192075 | **Date Analysed:** | 13-Sep-19 |
| | | **Filter Wt.:** | 0.35g |

## 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 | 48 | 4 | 1 | | | |
| | | | | | | |
| 1,2,3,4,6,7,8-HpCDD | 29 | 4 | | 0.29 | 0.29 | 0.29 |
| Total HpCDD | 72 | 4 | 2 | | | |
| | | | | | | |
| OCDD | 53 | 15 | 1 | 0.053 | 0.053 | 0.053 |
| | | **Total Dioxin TEQ** | | **0.3** | **2.9** | **5.5** |

## 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 | 22 | 4 | | 0.22 | 0.22 | 0.22 |
| 1,2,3,4,7,8,9-HpCDF | ND | 4 | | ND | 0.02 | 0.04 |
| Total HpCDF | 22 | 4 | 1 | | | |
| | | | | | | |
| OCDF | ND | 15 | 0 | ND | 0.0075 | 0.015 |
| | | **Total Furan TEQ** | | **0.2** | **2.2** | **4.3** |

| **Total PCDD/PCDF Toxic Equivalent (pg)** | **0.6** | **5.2** | **9.8** |
|---|---|---|---|

**Surrogate Recoveries (%)**

| | |
|---|---|
| $^{37}Cl_4$ -2,3,7,8-TCDD | 101 |
| $^{13}C_{12}$ -2,3,4,7,8-PeCDF | 99 |
| $^{13}C_{12}$ -1,2,3,4,7,8-HxCDD | 108 |
| $^{13}C_{12}$ -1,2,3,4,7,8-HxCDF | 80 |
| $^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF | 81 |

ND - none detected

**Internal Standards (%)**

| | |
|---|---|
| $^{13}C_{12}$ -2,3,7,8-TCDD | 76 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDD | 72 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDD | 71 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD | 92 |
| $^{13}C_{12}$ -OCDD | 85 |
| $^{13}C_{12}$ -2,3,7,8-TCDF | 71 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDF | 80 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDF | 96 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF | 94 |

# METHOD 23/1-RM-3 DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Sample Date:** | Mark Lanfranco |
| **Client ID:** | Run 3 - Dioxin | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PR192076 | **Date Analysed:** | 13-Sep-19 |
| | | **Filter Wt.:** | 0.35g |

## 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 | 65 | 4 | 1 | | | |
| | | | | | | |
| 1,2,3,4,6,7,8-HpCDD | 38 | 4 | | 0.38 | 0.38 | 0.38 |
| Total HpCDD | 85 | 4 | 2 | | | |
| | | | | | | |
| OCDD | 57 | 15 | 1 | 0.057 | 0.057 | 0.057 |
| | | **Total Dioxin TEQ** | | **0.4** | **3.0** | **5.6** |

## 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 | 13 | 4 | 1 | | | |
| | | | | | | |
| 1,2,3,4,7,8-HxCDF | 11 | 4 | | 1.1 | 1.1 | 1.1 |
| 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 | 11 | 4 | | 1.1 | 1.1 | 1.1 |
| Total HxCDF | 22 | 4 | 2 | | | |
| | | | | | | |
| 1,2,3,4,6,7,8-HpCDF | 34 | 4 | | 0.34 | 0.34 | 0.34 |
| 1,2,3,4,7,8,9-HpCDF | ND | 4 | | ND | 0.02 | 0.04 |
| Total HpCDF | 34 | 4 | 1 | | | |
| | | | | | | |
| OCDF | ND | 15 | 0 | ND | 0.0075 | 0.015 |
| | | **Total Furan TEQ** | | **2.5** | **4.2** | **5.8** |

| **Total PCDD/PCDF Toxic Equivalent (pg)** | **3.0** | **7.2** | **11.4** |
|---|---|---|---|

**Surrogate Recoveries (%)**

| | |
|---|---|
| $^{37}Cl_4$ -2,3,7,8-TCDD | 110 |
| $^{13}C_{12}$ -2,3,4,7,8-PeCDF | 111 |
| $^{13}C_{12}$ -1,2,3,4,7,8-HxCDD | 110 |
| $^{13}C_{12}$ -1,2,3,4,7,8-HxCDF | 88 |
| $^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF | 93 |

ND - none detected

**Internal Standards (%)**

| | |
|---|---|
| $^{13}C_{12}$ -2,3,7,8-TCDD | 72 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDD | 68 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDD | 71 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD | 92 |
| $^{13}C_{12}$ -OCDD | 87 |
| $^{13}C_{12}$ -2,3,7,8-TCDF | 66 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDF | 67 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDF | 94 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF | 87 |

# METHOD 23/1-RM-3 DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Contact:** | Mark Lanfranco |
| **Client ID:** | BLANK | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | DF190663B | **Date Analysed:** | 13-Sep-19 |

## 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 | 86 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDD | 80 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDD | 84 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD | 90 |
| $^{13}C_{12}$ -OCDD | 82 |
| $^{13}C_{12}$ -2,3,7,8-TCDF | 68 |
| $^{13}C_{12}$ -1,2,3,7,8-PeCDF | 84 |
| $^{13}C_{12}$ -1,2,3,6,7,8-HxCDF | 88 |
| $^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF | 88 |

ND - none detected

# QC REPORT - SPIKE

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Contact:** | Mark Lanfranco |
| **Client ID:** | SPIKE | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | DF190664S | **Date Analysed:** | 13-Sep-19 |

| DIOXINS | | | Acceptable Recovery | | Pass/Fail | Int. Std |
|---|---|---|---|---|---|---|
| | LOF | Recovery | Min | Max | | Recoveries |
| Congeners | pg | % | % | % | | % |
| 2,3,7,8-TCDD | 200 | 103 | 80 | 120 | Pass | 57 |
| | | | | | | |
| 1,2,3,7,8-PeCDD | 200 | 119 | 80 | 120 | Pass | 67 |
| | | | | | | |
| 1,2,3,4,7,8-HxCDD | 400 | 80 | 80 | 120 | Pass | - |
| 1,2,3,6,7,8-HxCDD | 400 | 89 | 80 | 120 | Pass | 68 |
| 1,2,3,7,8,9-HxCDD | 400 | 103 | 80 | 120 | Pass | - |
| | | | | | | |
| 1,2,3,4,6,7,8-HpCDD | 400 | 108 | 80 | 120 | Pass | 79 |
| | | | | | | |
| OCDD | 1000 | 112 | 80 | 120 | Pass | 64 |

| FURANS | | | Acceptable Recovery | | Pass/Fail | Int. Std |
|---|---|---|---|---|---|---|
| | LOF | Recovery | Min | Max | | Recoveries |
| Congeners | pg | % | % | % | | % |
| 2,3,7,8-TCDF | 200 | 102 | 80 | 120 | Pass | 53 |
| | | | | | | |
| 1,2,3,7,8-PeCDF | 200 | 111 | 80 | 120 | Pass | 68 |
| 2,3,4,7,8-PeCDF | 200 | 85 | 80 | 120 | Pass | - |
| | | | | | | |
| 1,2,3,4,7,8-HxCDF | 400 | 83 | 80 | 120 | Pass | - |
| 1,2,3,6,7,8-HxCDF | 400 | 96 | 80 | 120 | Pass | 77 |
| 1,2,3,7,8,9-HxCDF | 400 | 84 | 80 | 120 | Pass | - |
| 2,3,4,6,7,8-HxCDF | 400 | 81 | 80 | 120 | Pass | - |
| | | | | | | |
| 1,2,3,4,6,7,8-HpCDF | 400 | 91 | 80 | 120 | Pass | 74 |
| 1,2,3,4,7,8,9-HpCDF | 400 | 82 | 80 | 120 | Pass | - |
| | | | | | | |
| OCDF | 1000 | 104 | 80 | 120 | Pass | - |

LOF - Level of Fortification

# DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Contact:** | Mark Lanfranco |
| **Client ID:** | Blk Dioxin | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PR192073 | **Date Analysed:** | 14-Sep-19 |

| Dioxin-like PCBs | | | | Surrogate | WHO-TEQs (2005) | |
|---|---|---|---|---|---|---|
| | | | DL | Recoveries | (ND=0) | (ND=DL) |
| **Chemical Name** | **IUPAC #** | **ng** | **ng** | **%** | **ng** | **ng** |
| 3,4,4',5-TeCB | PCB 81 | ND | 0.02 | 76 | 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 | 64 | ND | 6.00E-07 |
| 2,3',4,4',5-PeCB | PCB 118 | 0.119 | 0.02 | 60 | 3.57E-06 | 3.57E-06 |
| 2,3,4,4',5-PeCB | PCB 114 | ND | 0.02 | 64 | ND | 6.00E-07 |
| 2,3,3',4,4'-PeCB | PCB 105 | ND | 0.02 | 64 | ND | 6.00E-07 |
| 3,3',4,4',5-PeCB | PCB 126 | ND | 0.02 | 72 | ND | 2.00E-03 |
| 2,3',4,4',5,5'-HxCB | PCB 167 | ND | 0.02 | 68 | ND | 6.00E-07 |
| 2,3,3',4,4',5-HxCB | PCB 156 | ND | 0.02 | 76 | ND | 6.00E-07 |
| 2,3,3',4,4',5'-HxCB | PCB 157 | 0.046 | 0.02 | 84 | 1.37E-06 | 1.37E-06 |
| 3,3',4,4',5,5'-HxCB | PCB 169 | ND | 0.02 | 88 | ND | 6.00E-04 |
| 2,3,3',4,4',5,5'-HpCB | PCB 189 | ND | 0.02 | 68 | ND | 6.00E-07 |
| | | **Toxic Equivalent (WHO-TEQ)** | | | 4.94E-06 | 2.62E-03 |

| Total PCB | | |
|---|---|---|
| | | DL |
| **Homologs** | **ng** | **ng** |
| Monochlorobiphenyls | 0.069 | 0.05 |
| Dichlorobiphenyls | 2.54 | 0.05 |
| Trichlorobiphenyls | 1.33 | 0.05 |
| Tetrachlorobiphenyls | 0.725 | 0.05 |
| Pentachlorobiphenyls | 0.609 | 0.05 |
| Hexachlorobiphenyls | 0.290 | 0.05 |
| Heptachlorobiphenyls | ND | 0.05 |
| Octachlorobiphenyls | 0.050 | 0.05 |
| Nonachlorobiphenyls | ND | 0.05 |
| Decachlorobiphenyl | ND | 0.05 |
| **Total PCB** | 5.61 | |

ND - none detected

| Surrogate Recoveries | | |
|---|---|---|
| **Chemical Name** | **IUPAC #** | **%** |
| 13C12-2-MoCB | 1L | 48 |
| 13C12-4,4'-DiCB | 15L | 56 |
| 13C12-2,2',6'-TrCB | 19L | 84 |
| 13C12-3,4,4'-TrCB | 37L | 64 |
| 13C12-2,2',6,6'-TeCB | 54L | 60 |
| 13C12-2,2',4,6,6'-PeCB | 104L | 52 |
| 13C12-2,2',4,4',6,6'-HxCB | 155L | 68 |
| 13C12-2,2',3,4',5,6,6'-HpCB | 188L | 64 |
| 13C12-2,2',3,3',5,5',6,6'-OcCB | 202L | 80 |
| 13C12-2,3,3',4,4',5,5',6-OcCB | 205L | 68 |
| 13C12-2,2',3,3',4,4',5,5',6-NoCB | 206L | 64 |
| 13C12-DeCB | 209L | 72 |

# DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Contact:** | Mark Lanfranco |
| **Client ID:** | Run 1 - Dioxin | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PR192074 | **Date Analysed:** | 14-Sep-19 |

| Dioxin-like PCBs | | | | Surrogate | WHO-TEQs (2005) | |
|---|---|---|---|---|---|---|
| | | | DL | Recoveries | (ND=0) | (ND=DL) |
| **Chemical Name** | **IUPAC #** | **ng** | **ng** | **%** | **ng** | **ng** |
| 3,4,4',5-TeCB | PCB 81 | ND | 0.02 | 88 | ND | 6.00E-06 |
| 3,3',4,4'-TeCB | PCB 77 | 0.083 | 0.02 | 96 | 8.31E-06 | 8.31E-06 |
| 2,3',4,4',5'-PeCB | PCB 123 | ND | 0.02 | 60 | ND | 6.00E-07 |
| 2,3',4,4',5-PeCB | PCB 118 | 0.112 | 0.02 | 60 | 3.37E-06 | 3.37E-06 |
| 2,3,4,4',5-PeCB | PCB 114 | ND | 0.02 | 64 | ND | 6.00E-07 |
| 2,3,3',4,4'-PeCB | PCB 105 | 0.101 | 0.02 | 64 | 3.04E-06 | 3.04E-06 |
| 3,3',4,4',5-PeCB | PCB 126 | ND | 0.02 | 80 | ND | 2.00E-03 |
| 2,3',4,4',5,5'-HxCB | PCB 167 | 0.039 | 0.02 | 76 | 1.18E-06 | 1.18E-06 |
| 2,3,3',4,4',5-HxCB | PCB 156 | 0.039 | 0.02 | 84 | 1.18E-06 | 1.18E-06 |
| 2,3,3',4,4',5'-HxCB | PCB 157 | 0.057 | 0.02 | 84 | 1.70E-06 | 1.70E-06 |
| 3,3',4,4',5,5'-HxCB | PCB 169 | 0.041 | 0.02 | 92 | 1.23E-03 | 1.23E-03 |
| 2,3,3',4,4',5,5'-HpCB | PCB 189 | 0.038 | 0.02 | 72 | 1.13E-06 | 1.13E-06 |
| | | **Toxic Equivalent (WHO-TEQ)** | | | 1.25E-03 | 3.26E-03 |

| Total PCB | | |
|---|---|---|
| | | DL |
| **Homologs** | **ng** | **ng** |
| Monochlorobiphenyls | 1.47 | 0.05 |
| Dichlorobiphenyls | 111 | 0.05 |
| Trichlorobiphenyls | 3.13 | 0.05 |
| Tetrachlorobiphenyls | 1.19 | 0.05 |
| Pentachlorobiphenyls | 0.526 | 0.05 |
| Hexachlorobiphenyls | 0.514 | 0.05 |
| Heptachlorobiphenyls | 0.242 | 0.05 |
| Octachlorobiphenyls | 0.220 | 0.05 |
| Nonachlorobiphenyls | 0.056 | 0.05 |
| Decachlorobiphenyl | 0.057 | 0.05 |
| **Total PCB** | 118 | |

ND - none detected

| Surrogate Recoveries | | |
|---|---|---|
| **Chemical Name** | **IUPAC #** | **%** |
| 13C12-2-MoCB | 1L | 44 |
| 13C12-4,4'-DiCB | 15L | 52 |
| 13C12-2,2',6'-TrCB | 19L | 76 |
| 13C12-3,4,4'-TrCB | 37L | 72 |
| 13C12-2,2',6,6'-TeCB | 54L | 60 |
| 13C12-2,2',4,6,6'-PeCB | 104L | 52 |
| 13C12-2,2',4,4',6,6'-HxCB | 155L | 72 |
| 13C12-2,2',3,4',5,6,6'-HpCB | 188L | 60 |
| 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 | 68 |
| 13C12-DeCB | 209L | 76 |

# DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Contact:** | Mark Lanfranco |
| **Client ID:** | Run 2 - Dioxin | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PR192075 | **Date Analysed:** | 14-Sep-19 |

| Dioxin-like PCBs | | | | Surrogate | WHO-TEQs (2005) | |
|---|---|---|---|---|---|---|
| | | | DL | Recoveries | (ND=0) | (ND=DL) |
| **Chemical Name** | **IUPAC #** | **ng** | **ng** | **%** | **ng** | **ng** |
| 3,4,4',5-TeCB | PCB 81 | ND | 0.02 | 92 | ND | 6.00E-06 |
| 3,3',4,4'-TeCB | PCB 77 | 0.033 | 0.02 | 100 | 3.27E-06 | 3.27E-06 |
| 2,3',4,4',5'-PeCB | PCB 123 | ND | 0.02 | 80 | ND | 6.00E-07 |
| 2,3',4,4',5-PeCB | PCB 118 | 0.105 | 0.02 | 84 | 3.16E-06 | 3.16E-06 |
| 2,3,4,4',5-PeCB | PCB 114 | ND | 0.02 | 88 | ND | 6.00E-07 |
| 2,3,3',4,4'-PeCB | PCB 105 | 0.052 | 0.02 | 88 | 1.56E-06 | 1.56E-06 |
| 3,3',4,4',5-PeCB | PCB 126 | ND | 0.02 | 132 | ND | 2.00E-03 |
| 2,3',4,4',5,5'-HxCB | PCB 167 | ND | 0.02 | 120 | ND | 6.00E-07 |
| 2,3,3',4,4',5-HxCB | PCB 156 | 0.024 | 0.02 | 136 | 7.25E-07 | 7.25E-07 |
| 2,3,3',4,4',5'-HxCB | PCB 157 | 0.026 | 0.02 | 128 | 7.82E-07 | 7.82E-07 |
| 3,3',4,4',5,5'-HxCB | PCB 169 | ND | 0.02 | 136 | ND | 6.00E-04 |
| 2,3,3',4,4',5,5'-HpCB | PCB 189 | ND | 0.02 | 72 | ND | 6.00E-07 |
| | | **Toxic Equivalent (WHO-TEQ)** | | | 9.49E-06 | 2.62E-03 |

| Total PCB | | |
|---|---|---|
| | | DL |
| **Homologs** | **ng** | **ng** |
| Monochlorobiphenyls | 0.398 | 0.05 |
| Dichlorobiphenyls | 7.55 | 0.05 |
| Trichlorobiphenyls | 2.05 | 0.05 |
| Tetrachlorobiphenyls | 0.814 | 0.05 |
| Pentachlorobiphenyls | 0.221 | 0.05 |
| Hexachlorobiphenyls | 0.201 | 0.05 |
| Heptachlorobiphenyls | 0.070 | 0.05 |
| Octachlorobiphenyls | ND | 0.05 |
| Nonachlorobiphenyls | ND | 0.05 |
| Decachlorobiphenyl | ND | 0.05 |
| **Total PCB** | 11.3 | |

ND - none detected

| Surrogate Recoveries | | |
|---|---|---|
| **Chemical Name** | **IUPAC #** | **%** |
| 13C12-2-MoCB | 1L | 40 |
| 13C12-4,4'-DiCB | 15L | 64 |
| 13C12-2,2',6'-TrCB | 19L | 96 |
| 13C12-3,4,4'-TrCB | 37L | 76 |
| 13C12-2,2',6,6'-TeCB | 54L | 64 |
| 13C12-2,2',4,6,6'-PeCB | 104L | 60 |
| 13C12-2,2',4,4',6,6'-HxCB | 155L | 80 |
| 13C12-2,2',3,4',5,6,6'-HpCB | 188L | 84 |
| 13C12-2,2',3,3',5,5',6,6'-OcCB | 202L | 144 |
| 13C12-2,3,3',4,4',5,5',6-OcCB | 205L | 72 |
| 13C12-2,2',3,3',4,4',5,5',6-NoCB | 206L | 68 |
| 13C12-DeCB | 209L | 80 |

# DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Contact:** | Mark Lanfranco |
| **Client ID:** | Run 3 - Dioxin | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PR192076 | **Date Analysed:** | 14-Sep-19 |

| Dioxin-like PCBs | | | | Surrogate | WHO-TEQs (2005) | |
|---|---|---|---|---|---|---|
| | | | DL | Recoveries | (ND=0) | (ND=DL) |
| **Chemical Name** | **IUPAC #** | **ng** | **ng** | **%** | **ng** | **ng** |
| 3,4,4',5-TeCB | PCB 81 | ND | 0.02 | 76 | 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 | 64 | ND | 6.00E-07 |
| 2,3',4,4',5-PeCB | PCB 118 | 0.126 | 0.02 | 64 | 3.77E-06 | 3.77E-06 |
| 2,3,4,4',5-PeCB | PCB 114 | ND | 0.02 | 64 | ND | 6.00E-07 |
| 2,3,3',4,4'-PeCB | PCB 105 | 0.084 | 0.02 | 64 | 2.53E-06 | 2.53E-06 |
| 3,3',4,4',5-PeCB | PCB 126 | 0.056 | 0.02 | 84 | 5.63E-03 | 5.63E-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 | 88 | ND | 6.00E-07 |
| 2,3,3',4,4',5'-HxCB | PCB 157 | 0.038 | 0.02 | 88 | 1.15E-06 | 1.15E-06 |
| 3,3',4,4',5,5'-HxCB | PCB 169 | ND | 0.02 | 96 | ND | 6.00E-04 |
| 2,3,3',4,4',5,5'-HpCB | PCB 189 | ND | 0.02 | 72 | ND | 6.00E-07 |
| | | **Toxic Equivalent (WHO-TEQ)** | | | 5.64E-03 | 6.25E-03 |

| Total PCB | | |
|---|---|---|
| | | DL |
| **Homologs** | **ng** | **ng** |
| Monochlorobiphenyls | 0.357 | 0.05 |
| Dichlorobiphenyls | 7.37 | 0.05 |
| Trichlorobiphenyls | 1.74 | 0.05 |
| Tetrachlorobiphenyls | 0.862 | 0.05 |
| Pentachlorobiphenyls | 0.337 | 0.05 |
| Hexachlorobiphenyls | 0.187 | 0.05 |
| Heptachlorobiphenyls | 0.080 | 0.05 |
| Octachlorobiphenyls | 0.060 | 0.05 |
| Nonachlorobiphenyls | ND | 0.05 |
| Decachlorobiphenyl | ND | 0.05 |
| **Total PCB** | 11.0 | |

ND - none detected

| Surrogate Recoveries | | |
|---|---|---|
| **Chemical Name** | **IUPAC #** | **%** |
| 13C12-2-MoCB | 1L | 36 |
| 13C12-4,4'-DiCB | 15L | 48 |
| 13C12-2,2',6'-TrCB | 19L | 72 |
| 13C12-3,4,4'-TrCB | 37L | 64 |
| 13C12-2,2',6,6'-TeCB | 54L | 56 |
| 13C12-2,2',4,6,6'-PeCB | 104L | 52 |
| 13C12-2,2',4,4',6,6'-HxCB | 155L | 68 |
| 13C12-2,2',3,4',5,6,6'-HpCB | 188L | 60 |
| 13C12-2,2',3,3',5,5',6,6'-OcCB | 202L | 88 |
| 13C12-2,3,3',4,4',5,5',6-OcCB | 205L | 72 |
| 13C12-2,2',3,3',4,4',5,5',6-NoCB | 206L | 68 |
| 13C12-DeCB | 209L | 76 |

# DATA REPORT

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Contact:** | Mark Lanfranco |
| **Client ID:** | BLANK | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PC190663B | **Date Analysed:** | 14-Sep-19 |

| Dioxin-like PCBs | | | | Surrogate | WHO-TEQs (2005) | |
|---|---|---|---|---|---|---|
| | | | DL | Recoveries | (ND=0) | (ND=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 | 76 | ND | 2.00E-06 |
| 2,3',4,4',5'-PeCB | PCB 123 | ND | 0.02 | 60 | ND | 6.00E-07 |
| 2,3',4,4',5-PeCB | PCB 118 | ND | 0.02 | 60 | ND | 6.00E-07 |
| 2,3,4,4',5-PeCB | PCB 114 | ND | 0.02 | 60 | ND | 6.00E-07 |
| 2,3,3',4,4'-PeCB | PCB 105 | ND | 0.02 | 60 | ND | 6.00E-07 |
| 3,3',4,4',5-PeCB | PCB 126 | ND | 0.02 | 68 | ND | 2.00E-03 |
| 2,3',4,4',5,5'-HxCB | PCB 167 | ND | 0.02 | 68 | ND | 6.00E-07 |
| 2,3,3',4,4',5-HxCB | PCB 156 | ND | 0.02 | 76 | ND | 6.00E-07 |
| 2,3,3',4,4',5'-HxCB | PCB 157 | ND | 0.02 | 76 | ND | 6.00E-07 |
| 3,3',4,4',5,5'-HxCB | PCB 169 | ND | 0.02 | 88 | ND | 6.00E-04 |
| 2,3,3',4,4',5,5'-HpCB | PCB 189 | ND | 0.02 | 68 | 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 | 0.138 | 0.05 |
| Trichlorobiphenyls | 0.078 | 0.05 |
| Tetrachlorobiphenyls | 0.078 | 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** | 0.294 | |

ND - none detected

| Surrogate Recoveries | | |
|---|---|---|
| **Chemical Name** | **IUPAC #** | **%** |
| 13C12-2-MoCB | 1L | 44 |
| 13C12-4,4'-DiCB | 15L | 52 |
| 13C12-2,2',6'-TrCB | 19L | 72 |
| 13C12-3,4,4'-TrCB | 37L | 60 |
| 13C12-2,2',6,6'-TeCB | 54L | 56 |
| 13C12-2,2',4,6,6'-PeCB | 104L | 48 |
| 13C12-2,2',4,4',6,6'-HxCB | 155L | 64 |
| 13C12-2,2',3,4',5,6,6'-HpCB | 188L | 52 |
| 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 | 72 |
| 13C12-DeCB | 209L | 84 |

# QC REPORT - SPIKE

| | | | |
|---|---|---|---|
| **Client:** | A. Lanfranco & Associates | **Contact:** | Mark Lanfranco |
| **Client ID:** | SPIKE | **Date Extracted:** | 26-Aug-19 |
| **PRL ID:** | PC190664S | **Date Analysed:** | 14-Sep-19 |

| **Dioxin-like PCBs** | | | **Acceptable Recovery** | | **Pass/Fail** | **Surrogate Recoveries** |
|---|---|---|---|---|---|---|
| | **LOF** | **Recovery** | **Min** | **Max** | | |
| **Chemical Name** | **ng** | **%** | **%** | **%** | | **%** |
| 3,4,4',5-TeCB (81) | 1 | 89 | 50 | 150 | Pass | 60 |
| 3,3',4,4'-TeCB (77) | 1 | 89 | 50 | 150 | Pass | 68 |
| 2,3',4,4',5'-PeCB (123) | 1 | 95 | 50 | 150 | Pass | 48 |
| 2,3',4,4',5-PeCB (118) | 1 | 109 | 50 | 150 | Pass | 48 |
| 2,3,4,4',5-PeCB (114) | 1 | 103 | 50 | 150 | Pass | 48 |
| 2,3,3',4,4'-PeCB (105) | 1 | 108 | 50 | 150 | Pass | 48 |
| 3,3',4,4',5-PeCB (126) | 1 | 99 | 50 | 150 | Pass | 52 |
| 2,3',4,4',5,5'-HxCB (167) | 1 | 87 | 50 | 150 | Pass | 56 |
| 2,3,3',4,4',5-HxCB (156) | 1 | 84 | 50 | 150 | Pass | 64 |
| 2,3,3',4,4',5'-HxCB (157) | 1 | 87 | 50 | 150 | Pass | 64 |
| 3,3',4,4',5,5'-HxCB (169) | 1 | 86 | 50 | 150 | Pass | 76 |
| 2,3,3',4,4',5,5'-HpCB (189) | 1 | 87 | 50 | 150 | Pass | 60 |

| **Total PCB** | | | **Acceptable Recovery** | | **Pass/Fail** |
|---|---|---|---|---|---|
| | **LOF** | **Recovery** | **Min** | **Max** | |
| **Homologs** | **ng** | **%** | **%** | **%** | |
| Monochlorobiphenyls | 2 | 104 | | | |
| Dichlorobiphenyls | 4 | 108 | | | |
| Trichlorobiphenyls | 6 | 87 | | | |
| Tetrachlorobiphenyls | 12 | 107 | | | |
| Pentachlorobiphenyls | 13 | 96 | | | |
| Hexachlorobiphenyls | 15 | 73 | | | |
| Heptachlorobiphenyls | 11 | 79 | | | |
| Octachlorobiphenyls | 6 | 94 | | | |
| Nonachlorobiphenyls | 2 | 97 | | | |
| Decachlorobiphenyl | 1 | 96 | | | |
| Total PCB | 72 | 90 | 50 | 150 | Pass |

LOF - Level of Fortification

# DATA REPORT

**Client:** A. Lanfranco & Associates
**Contact:** Mark Lanfranco
**Project:**

**Date Extracted:** 26-Aug-19
**Date Analysed:** 12-Sep-19

| | Client ID: | Blk Dioxin | Run 1 - Dioxin | Run 2 - Dioxin | Run 3 - Dioxin | | BLANK |
|---|---|---|---|---|---|---|---|
| | PRL ID: | PR192073 | PR192074 | PR192075 | PR192076 | | PH190663B |
| **NPRI PAH** | **DL** | | | | | | |
| | **µg** | **µg** | **µg** | **µg** | **µg** | | **µg** |
| Acenaphthylene | 0.05 | 0.25 | ND | ND | ND | | ND |
| Acenaphthene | 0.05 | ND | ND | ND | ND | | ND |
| Fluorene | 0.02 | ND | ND | 0.020 | ND | | ND |
| Phenanthrene | 0.02 | 0.071 | 0.10 | 0.073 | 0.064 | | ND |
| Fluoranthene | 0.01 | 0.077 | 0.063 | 0.03 | 0.047 | | ND |
| Pyrene | 0.01 | 0.23 | 0.11 | 0.044 | 0.088 | | 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 | 0.019 | 0.018 | 0.042 | 0.016 | | 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 | ND | 0.016 | 0.022 | 0.015 | | 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 | 0.056 | | ND |
| | | | | | | | |
| **Other PAH** | | | | | | | |
| Naphthalene | 0.05 | 0.29 | 0.86 | 0.54 | 0.87 | | ND |
| Anthracene | 0.05 | ND | ND | ND | ND | | ND |
| | | | | | | | |
| **Chlorobenzenes** | | | | | | | |
| Hexachlorobenzene | 0.01 | ND | 0.011 | ND | 0.013 | | ND |
| | | | | | | | |

# DATA REPORT

**Client:** A. Lanfranco & Associates
**Contact:** Mark Lanfranco
**Project:**

**Date Extracted:** 26-Aug-19
**Date Analysed:** 12-Sep-19

| Client ID: | Blk Dioxin | Run 1 - Dioxin | Run 2 - Dioxin | Run 3 - Dioxin | | BLANK |
|---|---|---|---|---|---|---|
| PRL ID: | PR192073 | PR192074 | PR192075 | PR192076 | | PH190663B |
| | | | | | | |
| **NPRI PAH** **DL** | | | | | | |
| **Surrogate Recoveries (%)** | | | | | | |
| d8-Naphthalene | 64 | 48 | 52 | 56 | | 68 |
| d10-Acenaphthylene | 72 | 68 | 72 | 76 | | 76 |
| d10-Acenaphthene | 84 | 68 | 72 | 72 | | 80 |
| d10-Fluorene | 96 | 92 | 96 | 96 | | 80 |
| d10-Phenanthrene | 88 | 88 | 84 | 88 | | 80 |
| d10-Fluoranthene | 88 | 88 | 88 | 88 | | 84 |
| d10-Pyrene | 88 | 88 | 88 | 88 | | 84 |
| d12-Chrysene | 88 | 96 | 96 | 92 | | 88 |
| d12-Benzo(b)fluoranthene | 96 | 92 | 100 | 96 | | 96 |
| d12-Benzo(a)pyrene | 92 | 96 | 96 | 96 | | 84 |
| d14-Dibenz(a,h)anthracene | 96 | 92 | 96 | 96 | | 96 |
| 13C6-Hexachlorobenzene | 64 | 56 | 52 | 40 | | 52 |

ND - none detected

# DATA REPORT

**Client:** A. Lanfranco & Associates
**Contact:** Mark Lanfranco
**Project:**

**Date Extracted:** 26-Aug-19
**Date Analysed:** 12-Sep-19

**Client ID:** SPIKE
**PRL ID:** PH190664S

**NPRI PAH**

| | µg/g | LOF | Recovery | Acceptable | Pass/Fail |
|---|---|---|---|---|---|
| Acenaphthene | 0.77 | 1 | 77% | 50-150% | pass |
| Acenaphthylene | 0.78 | 1 | 78% | 50-150% | pass |
| Benz(a)anthracene | 0.77 | 1 | 77% | 50-150% | pass |
| Benzo(a)pyrene | 0.73 | 1 | 73% | 50-150% | pass |
| Benzo(b)fluoranthene | 0.74 | 1 | 74% | 50-150% | pass |
| Benzo(ghi)perylene | 0.83 | 1 | 83% | 50-150% | pass |
| Benzo(k)fluoranthene | 0.80 | 1 | 80% | 50-150% | pass |
| Chrysene | 0.88 | 1 | 88% | 50-150% | pass |
| Dibenz(a,h)anthracene | 0.69 | 1 | 69% | 50-150% | pass |
| Fluoranthene | 0.81 | 1 | 81% | 50-150% | pass |
| Fluorene | 0.73 | 1 | 73% | 50-150% | pass |
| Indeno(1,2,3-cd)pyrene | 0.78 | 1 | 78% | 50-150% | pass |
| Phenanthrene | 0.83 | 1 | 83% | 50-150% | pass |
| Pyrene | 0.73 | 1 | 73% | 50-150% | pass |
| Dibenz(a,h)acridine | 0.71 | 1 | 71% | | |
| Dibenz(a,j)acridine | 0.86 | 1 | 86% | | |
| 7H-Dibenzo(c,g)carbazole | 0.66 | 1 | 66% | | |
| Dibenzo(a,e)fluoranthene | 0.75 | 1 | 75% | | |
| Dibenzo(a,h)pyrene | 0.77 | 1 | 77% | | |
| Dibenzo(a,e)pyrene | 0.66 | 1 | 66% | | |
| Dibenzo(a,i)pyrene | 0.67 | 1 | 67% | | |
| Dibenzo(a,l)pyrene | 0.72 | 1 | 72% | | |
| 7,12-Dimethylbenz(a)anthracene | 0.52 | 1 | 52% | | |
| 3-Methylcholanthrene | 0.57 | 1 | 57% | | |
| 5-Methylchrysene | 0.74 | 1 | 74% | | |
| 1-Nitropyrene | 0.60 | 1 | 60% | | |
| Perylene | 0.84 | 1 | 84% | | |
| | | | | | |
| **Other PAH** | | | | | |
| Naphthalene | 0.70 | 1 | 70% | 50-150% | pass |
| | | | | | |
| **Chlorobenzenes** | | | | | |
| Hexachlorobenzene | 0.95 | 1 | 95% | 50-150% | pass |

# DATA REPORT

**Client:** A. Lanfranco & Associates
**Contact:** Mark Lanfranco

**Date Extracted:** 26-Aug-19
**Date Analysed:** 16-Sep-19

| | Client ID: | Blk Dioxin | Run 1 - Dioxin | Run 2 - Dioxin | Run 3 - Dioxin | | BLANK |
|---|---|---|---|---|---|---|---|
| | PRL ID: | PR192073 | PR192074 | PR192075 | PR192076 | | CP190663B |
| **Compound** | **DL µg** | **µg** | **µg** | **µg** | **µg** | | **µg** |
| Trichlorobenzenes | 0.05 | ND | 2.10 | 1.18 | 2.11 | | ND |
| Tetrachlorobenzenes | 0.05 | ND | 0.58 | 0.40 | 0.57 | | ND |
| Pentachlorobenzene | 0.05 | ND | 0.082 | 0.059 | 0.086 | | ND |
| Hexachlorobenzene | 0.01 | ND | 0.013 | 0.010 | 0.016 | | ND |
| **Surrogate Recoveries (%)** | | | | | | | |
| 13C6-Hexachlorobenzene | | 120 | 68 | 64 | 48 | | 60 |

| **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 | 0.054 | | ND |
| **Surrogate Recoveries (%)** | | | | | | | |
| 13C6-Trichlorophenol | | 100 | 96 | 56 | 76 | | 68 |
| 13C6-Tetrachlorophenol | | 56 | 40 | 128 | 92 | | 152 |
| 13C6-Pentachlorophenol | | 56 | 92 | 112 | 52 | | 104 |

ND - none detected

# QC REPORT - SPIKE

**Client:** A. Lanfranco & Associates
**Contact:** Mark Lanfranco

**Date Extracted:** 26-Aug-19
**Date Analysed:** 16-Sep-19

**Client ID:** SPIKE
**PRL ID:** CP190664S

| Compound | LOF µg | µg | Recovery |
|---|---|---|---|
| Trichlorobenzenes | 2.0 | 1.30 | 65% |
| Tetrachlorobenzenes | 3.0 | 2.95 | 98% |
| Pentachlorobenzene | 1.0 | 0.96 | 96% |
| Hexachlorobenzene | 1.0 | 1.02 | 102% |
| | | | |
| Trichlorophenols | 0.5 | 0.54 | 107% |
| Tetrachlorophenols | 0.5 | 0.40 | 80% |
| Pentachlorophenol | 0.5 | 0.45 | 90% |

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 $^{13}C$-Labeled Polycyclic Aromatic Hydrocarbon Standards**

| | Surrogate Recovery | |
|---|---|---|
| | **Min (%)** | **Max (%)** |
| $^{13}C_6$-Naphthalene | 5 | 135 |
| $^{13}C_6$-Acenaphthylene | 15 | 135 |
| $^{13}C_6$-Acenaphthene | 15 | 135 |
| $^{13}C_6$-Fluorene | 30 | 135 |
| $^{13}C_6$-Phenanthrene | 30 | 135 |
| $^{13}C_6$-Anthracene | 30 | 135 |
| $^{13}C_6$-Fluoranthene | 30 | 135 |
| $^{13}C_3$-Pyrene | 30 | 135 |
| $^{13}C_6$-Benz(a)anthracene | 30 | 150 |
| $^{13}C_6$-Chrysene | 30 | 150 |
| $^{13}C_6$-Benzo(b+j)fluoranthene | 30 | 150 |
| $^{13}C_6$-Benzo(k)fluoranthene | 30 | 150 |
| $^{13}C_4$-Benzo(a)pyrene | 30 | 150 |
| $^{13}C_6$-Indeno(1,2,3-cd)pyrene | 30 | 150 |
| $^{13}C_6$-Dibenz(a,h)anthracene | 30 | 150 |
| $^{13}C_{12}$-Benzo(ghi)perylene | 30 | 150 |

PACIFIC RIM LABORATORIES INC

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Pacific Rim Laboratories Inc. - #103, 19575 - 55A Ave. Surrey, BC V3S 8P8, Canada

# 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: 22-Aug-19

CLIENT: Metro Vancouver WTE

SOURCE: Unit 1

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blk Dioxin | PR19 2073 | 20-Aug-19 | STACK | 5 | X | X | | X | X | | | | X | |
| Run 1 - Dioxin | PR19 2074 | 19-Aug-19 | | 5 | X | X | | X | X | | | | X | |
| Run 2- Dioxin | PR19 2075 | 20-Aug-19 | | 5 | | X | | X | X | | | | X | |
| Run 3 - Dioxin | PR19 2076 | 21-Aug-19 | | 5 | X | X | | X | X | | | | X | |

| Sampler's Signature | Relinquished by: | Company | Date | Time | Received by: | |
|---|---|---|---|---|---|---|
| Comments: | Method of Shipment | Waybill No.: | Rec'd for PRL: | | Date | Time |
| | Shipment Condition | Temp.: | Cooler Opened By: | | | |

# APPENDIX 2

# COMPUTER OUTPUTS OF MEASURED AND CALCULATED DATA

| | | | |
|---|---|---|---|
| **Client:** | Metro Vancouver | **Date:** | 19-Aug-19 |
| **Jobsite:** | WTE (Burnaby, BC) | **Run:** | 1 PCDD-PCDF |
| **Source:** | Unit 2 | **Run Time:** | 10:35 - 14:38 |

| | | | | |
|---|---|---|---|---|
| **Dioxin Concentration:** | **5.3** | **pg/dscm** | 0.0023 | gr/dscf |
| | 2.8 | **pg/dscm** | 0.0012 | gr/Acf |
| | 4.6 | pg/dscm (@ 11% O2) | 0.0020 | gr/dscf (@ 11% O2) |

**Emission Rate:** see D/F data Table 2

| | | | | |
|---|---|---|---|---|
| **Sample Gas Volume:** | 3.5766 | dscm | 126.307 | dscf |
| **Total Sample Time:** | 240.0 | minutes | | |
| **Average Isokineticity:** | 105.3 | % | | |

**Flue Gas Characteristics**

| | | | | |
|---|---|---|---|---|
| **Moisture:** | 17.00 | % | | |
| **Temperature** | 158.0 | oC | 316.4 | oF |
| **Flow** | 1134.3 | dscm/min | 40056 | dscf/min |
| | 18.90 | dscm/sec | 667.6 | dscf/sec |
| | 2110.7 | Acm/min | 74541 | Acf/min |
| **Velocity** | 13.812 | m/sec | 45.31 | f/sec |
| **Gas Analysis** | 9.52 | % O2 | 10.08 | % CO2 |
| | 29.994 | Mol. Wt (g/gmole) Dry | 27.955 | 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-19 |
| **Jobsite:** | WTE (Burnaby, BC) | **Run:** | 1 PCDD-PCDF |
| **Source:** | Unit 2 | **Run Time:** | 10:35 - 14:38 |

| | |
|---|---|
| **Control Unit (Y)** | 1.0021 |
| **Nozzle Diameter (in.)** | 0.2505 |
| **Pitot Factor** | 0.8465 |
| **Baro. Press. (in. Hg)** | 29.96 |
| **Static Press. (in. H2O)** | -20.00 |
| **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 | 9.92 | 9.72 |
| Trav 2 | 10.25 | 9.32 |
| **Average =** | **10.08** | **9.52** |

**Condensate Collection:**

| | |
|---|---|
| Impinger 1 (grams) | 530.0 |
| Impinger 2 (grams) | 4.0 |
| Impinger 3 (grams) | 1.0 |
| Impinger 4 (grams) | 14.6 |
| **Total Gain (grams)** | **549.6** |

**Collection:**

**D/F TEQ (ng)** **0.0188**

| 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 | 982.308 | | | | | | | |
| 1 | 1 | 5.0 | 985.300 | 0.520 | 1.15 | 73 | 73 | 321 | 1.5 | 105.2 |
| | | 10.0 | 988.300 | 0.530 | 1.18 | 73 | 73 | 321 | 1.5 | 104.5 |
| | 2 | 15.0 | 991.400 | 0.560 | 1.24 | 73 | 73 | 321 | 4.7 | 105.1 |
| | | 20.0 | 994.480 | 0.550 | 1.22 | 73 | 73 | 320 | 4.7 | 105.3 |
| | 3 | 25.0 | 997.420 | 0.500 | 1.11 | 74 | 74 | 319 | 8.4 | 105.1 |
| | | 30.0 | 1000.240 | 0.460 | 1.03 | 74 | 74 | 318 | 8.4 | 105.0 |
| | 4 | 35.0 | 1003.070 | 0.460 | 1.03 | 75 | 75 | 317 | 12.5 | 105.1 |
| | | 40.0 | 1005.850 | 0.440 | 0.98 | 75 | 75 | 317 | 12.5 | 105.6 |
| | 5 | 45.0 | 1008.430 | 0.350 | 0.85 | 76 | 76 | 315 | 17.7 | 109.5 |
| | | 50.0 | 1010.920 | 0.350 | 0.79 | 76 | 76 | 315 | 17.7 | 105.7 |
| | 6 | 55.0 | 1013.400 | 0.350 | 0.79 | 77 | 77 | 312 | 25.2 | 104.8 |
| | | 60.0 | 1015.930 | 0.360 | 0.82 | 78 | 78 | 312 | 25.2 | 105.3 |
| | 7 | 65.0 | 1018.170 | 0.280 | 0.64 | 79 | 79 | 310 | 45.6 | 105.3 |
| | | 70.0 | 1020.450 | 0.290 | 0.66 | 79 | 79 | 310 | 45.6 | 105.3 |
| | 8 | 75.0 | 1022.910 | 0.340 | 0.77 | 79 | 79 | 311 | 53.2 | 105.0 |
| | | 80.0 | 1025.180 | 0.290 | 0.66 | 80 | 80 | 311 | 53.2 | 104.7 |
| | 9 | 85.0 | 1027.300 | 0.250 | 0.57 | 80 | 80 | 311 | 58.3 | 105.3 |
| | | 90.0 | 1029.380 | 0.240 | 0.55 | 80 | 80 | 312 | 58.3 | 105.5 |
| | 10 | 95.0 | 1031.540 | 0.260 | 0.59 | 80 | 80 | 312 | 62.5 | 105.3 |
| | | 100.0 | 1033.750 | 0.270 | 0.61 | 80 | 80 | 312 | 62.5 | 105.7 |
| | 11 | 105.0 | 1035.870 | 0.250 | 0.57 | 81 | 81 | 312 | 66.1 | 105.2 |
| | | 110.0 | 1037.900 | 0.230 | 0.52 | 80 | 80 | 312 | 66.1 | 105.2 |
| | 12 | 115.0 | 1040.020 | 0.250 | 0.57 | 81 | 81 | 310 | 69.4 | 105.1 |
| | | 120.0 | 1042.090 | 0.240 | 0.55 | 81 | 81 | 309 | 69.4 | 104.6 |
| | | | | | | | | | | |
| | | 0.0 | 1042.090 | | | | | | | |
| 2 | 1 | 5.0 | 1044.450 | 0.310 | 0.70 | 82 | 82 | 316 | 1.5 | 105.3 |
| | | 10.0 | 1046.780 | 0.300 | 0.68 | 82 | 82 | 316 | 1.5 | 105.7 |
| | 2 | 15.0 | 1049.060 | 0.290 | 0.66 | 82 | 82 | 317 | 4.7 | 105.2 |
| | | 20.0 | 1051.400 | 0.310 | 0.70 | 82 | 82 | 316 | 4.7 | 104.4 |
| | 3 | 25.0 | 1053.680 | 0.290 | 0.66 | 82 | 82 | 316 | 8.4 | 105.1 |
| | | 30.0 | 1055.920 | 0.280 | 0.63 | 82 | 82 | 317 | 8.4 | 105.2 |
| | 4 | 35.0 | 1058.120 | 0.270 | 0.61 | 83 | 83 | 316 | 12.5 | 104.9 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 40.0 | 1060.280 | 0.260 | 0.59 | 83 | 83 | 316 | 12.5 | 105.0 |
| | 5 | 45.0 | 1062.490 | 0.270 | 0.61 | 83 | 83 | 315 | 17.7 | 105.4 |
| | | 50.0 | 1064.620 | 0.250 | 0.57 | 83 | 83 | 315 | 17.7 | 105.5 |
| | 6 | 55.0 | 1067.180 | 0.360 | 0.82 | 83 | 83 | 315 | 25.2 | 105.7 |
| | | 60.0 | 1069.560 | 0.340 | 0.77 | 83 | 83 | 315 | 25.2 | 101.1 |
| | 7 | 65.0 | 1073.080 | 0.600 | 1.49 | 84 | 84 | 319 | 45.6 | 112.9 |
| | | 70.0 | 1076.400 | 0.620 | 1.41 | 84 | 84 | 320 | 45.6 | 104.8 |
| | 8 | 75.0 | 1079.890 | 0.680 | 1.54 | 85 | 85 | 321 | 53.2 | 105.1 |
| | | 80.0 | 1083.350 | 0.670 | 1.52 | 84 | 84 | 322 | 53.2 | 105.2 |
| | 9 | 85.0 | 1086.940 | 0.720 | 1.63 | 85 | 85 | 323 | 58.3 | 105.2 |
| | | 90.0 | 1090.400 | 0.680 | 1.54 | 85 | 85 | 323 | 58.3 | 104.3 |
| | 10 | 95.0 | 1093.760 | 0.630 | 1.43 | 85 | 85 | 322 | 62.5 | 105.2 |
| | | 100.0 | 1097.100 | 0.620 | 1.41 | 86 | 86 | 321 | 62.5 | 105.1 |
| | 11 | 105.0 | 1100.550 | 0.670 | 1.52 | 86 | 86 | 322 | 66.1 | 104.5 |
| | | 110.0 | 1104.050 | 0.680 | 1.55 | 86 | 86 | 321 | 66.1 | 105.2 |
| | 12 | 115.0 | 1107.500 | 0.660 | 1.50 | 86 | 86 | 322 | 69.4 | 105.3 |
| | | 120.0 | 1110.890 | 0.640 | 1.46 | 86 | 86 | 320 | 69.4 | 104.9 |
| | | | | | | | | | | |
| | | | **Average:** | 0.417 | 0.947 | 80.6 | 80.6 | 316.4 | | 105.3 |

| | | | |
|---|---|---|---|
| **Client:** | Metro Vancouver | **Date:** | 20-Aug-19 |
| **Jobsite:** | WTE (Burnaby, BC) | **Run:** | 2 PCDD-PCDF |
| **Source:** | Unit 2 | **Run Time:** | 09:37 - 13:39 |

| | | | | |
|---|---|---|---|---|
| **Dioxin Concentration:** | **1.11** | **pg/dscm** | 0.0005 | gr/dscf |
| | 0.6 | **pg/dscm** | 0.0003 | gr/Acf |
| | **0.98** | pg/dscm (@ 11% O2) | 0.0004 | gr/dscf (@ 11% O2) |

**Emission Rate:** see D/F data Table 2

| | | | | |
|---|---|---|---|---|
| **Sample Gas Volume:** | 3.4915 | dscm | 123.303 | dscf |
| **Total Sample Time:** | 240.0 | minutes | | |
| **Average Isokineticity:** | 103.0 | % | | |

**Flue Gas Characteristics**

| | | | | |
|---|---|---|---|---|
| **Moisture:** | 17.30 | % | | |
| **Temperature** | 157.8 | oC | 316.1 | oF |
| **Flow** | 1131.4 | dscm/min | 39955 | dscf/min |
| | 18.86 | dscm/sec | 665.9 | dscf/sec |
| | 2116.6 | Acm/min | 74749 | Acf/min |
| **Velocity** | 13.850 | m/sec | 45.44 | f/sec |
| **Gas Analysis** | 9.61 | % O2 | 9.92 | % CO2 |
| | 29.971 | Mol. Wt (g/gmole) Dry | 27.900 | 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:** | 20-Aug-19 |
| **Jobsite:** | WTE (Burnaby, BC) | **Run:** | 2 PCDD-PCDF |
| **Source:** | Unit 2 | **Run Time:** | 09:37 - 13:39 |

| | |
|---|---|
| **Control Unit (Y)** | 1.0021 |
| **Nozzle Diameter (in.)** | 0.2505 |
| **Pitot Factor** | 0.8465 |
| **Baro. Press. (in. Hg)** | 29.90 |
| **Static Press. (in. H2O)** | -20.00 |
| **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 | 9.83 | 9.73 |
| Trav 2 | 10.00 | 9.48 |
| **Average =** | **9.92** | **9.61** |

**Condensate Collection:**

| | |
|---|---|
| Impinger 1 (grams) | 522.0 |
| Impinger 2 (grams) | 12.0 |
| Impinger 3 (grams) | 1.0 |
| Impinger 4 (grams) | 13.0 |
| **Total Gain (grams)** | **548.0** |

**Collection:**

**D/F TEQ (ng)** **0.0039**

| 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 | 111.133 | | | | | | | |
| 1 | 1 | 5.0 | 114.020 | 0.500 | 1.08 | 72 | 72 | 310 | 1.5 | 103.2 |
| | | 10.0 | 116.860 | 0.490 | 1.05 | 71 | 71 | 314 | 1.5 | 103.0 |
| | 2 | 15.0 | 119.680 | 0.480 | 1.03 | 72 | 72 | 314 | 4.7 | 103.1 |
| | | 20.0 | 122.500 | 0.480 | 1.03 | 72 | 72 | 314 | 4.7 | 103.1 |
| | 3 | 25.0 | 125.290 | 0.470 | 1.01 | 73 | 73 | 314 | 8.4 | 102.9 |
| | | 30.0 | 128.200 | 0.510 | 1.09 | 73 | 73 | 314 | 8.4 | 103.1 |
| | 4 | 35.0 | 131.140 | 0.520 | 1.11 | 73 | 73 | 314 | 12.5 | 103.1 |
| | | 40.0 | 134.030 | 0.500 | 1.07 | 74 | 74 | 315 | 12.5 | 103.2 |
| | 5 | 45.0 | 136.830 | 0.470 | 1.01 | 75 | 75 | 315 | 17.7 | 103.0 |
| | | 50.0 | 139.620 | 0.460 | 0.99 | 76 | 76 | 313 | 17.7 | 103.4 |
| | 6 | 55.0 | 142.510 | 0.500 | 1.08 | 77 | 77 | 314 | 25.2 | 102.6 |
| | | 60.0 | 145.400 | 0.500 | 1.08 | 79 | 79 | 314 | 25.2 | 102.2 |
| | 7 | 65.0 | 147.820 | 0.340 | 0.74 | 79 | 79 | 313 | 45.6 | 103.6 |
| | | 70.0 | 150.150 | 0.320 | 0.69 | 80 | 80 | 315 | 45.6 | 102.8 |
| | 8 | 75.0 | 152.380 | 0.290 | 0.63 | 80 | 80 | 315 | 53.2 | 103.3 |
| | | 80.0 | 154.530 | 0.270 | 0.59 | 81 | 81 | 315 | 53.2 | 103.0 |
| | 9 | 85.0 | 156.760 | 0.290 | 0.63 | 81 | 81 | 317 | 58.3 | 103.3 |
| | | 90.0 | 158.880 | 0.260 | 0.57 | 83 | 83 | 316 | 58.3 | 103.2 |
| | 10 | 95.0 | 161.020 | 0.270 | 0.59 | 83 | 83 | 317 | 62.5 | 102.3 |
| | | 100.0 | 163.220 | 0.280 | 0.61 | 83 | 83 | 315 | 62.5 | 103.2 |
| | 11 | 105.0 | 165.400 | 0.280 | 0.61 | 84 | 84 | 316 | 66.1 | 102.1 |
| | | 110.0 | 167.680 | 0.300 | 0.65 | 84 | 84 | 317 | 66.1 | 103.2 |
| | 12 | 115.0 | 169.890 | 0.280 | 0.61 | 85 | 85 | 315 | 69.4 | 103.2 |
| | | 120.0 | 171.980 | 0.250 | 0.55 | 85 | 85 | 312 | 69.4 | 103.1 |
| | | | | | | | | . | | |
| | | 0.0 | 171.980 | | | | | | | |
| 2 | 1 | 5.0 | 174.320 | 0.320 | 0.70 | 87 | 87 | 320 | 1.5 | 102.2 |
| | | 10.0 | 176.780 | 0.350 | 0.76 | 86 | 86 | 321 | 1.5 | 103.0 |
| | 2 | 15.0 | 179.250 | 0.350 | 0.76 | 87 | 87 | 321 | 4.7 | 103.3 |
| | | 20.0 | 181.750 | 0.360 | 0.78 | 87 | 87 | 321 | 4.7 | 103.1 |
| | 3 | 25.0 | 184.180 | 0.340 | 0.74 | 87 | 87 | 322 | 8.4 | 103.1 |
| | | 30.0 | 186.500 | 0.310 | 0.68 | 88 | 88 | 322 | 8.4 | 102.9 |
| | 4 | 35.0 | 188.780 | 0.300 | 0.65 | 88 | 88 | 323 | 12.5 | 102.9 |
| | | 40.0 | 191.100 | 0.310 | 0.68 | 88 | 88 | 323 | 12.5 | 103.0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 45.0 | 193.230 | 0.260 | 0.57 | 89 | 89 | 322 | 17.7 | 103.0 |
| | | 50.0 | 195.360 | 0.260 | 0.57 | 89 | 89 | 322 | 17.7 | 103.0 |
| | 6 | 55.0 | 197.400 | 0.240 | 0.53 | 89 | 89 | 319 | 25.2 | 102.4 |
| | | 60.0 | 199.500 | 0.250 | 0.55 | 89 | 89 | 316 | 25.2 | 103.1 |
| | 7 | 65.0 | 202.520 | 0.520 | 1.14 | 89 | 89 | 316 | 45.6 | 103.0 |
| | | 70.0 | 205.580 | 0.530 | 1.17 | 89 | 89 | 316 | 45.6 | 103.4 |
| | 8 | 75.0 | 208.840 | 0.600 | 1.32 | 90 | 90 | 316 | 53.2 | 103.3 |
| | | 80.0 | 212.000 | 0.570 | 1.26 | 90 | 90 | 315 | 53.2 | 102.7 |
| | 9 | 85.0 | 215.280 | 0.610 | 1.35 | 90 | 90 | 314 | 58.3 | 103.0 |
| | | 90.0 | 218.480 | 0.580 | 1.28 | 90 | 90 | 314 | 58.3 | 103.0 |
| | 10 | 95.0 | 221.760 | 0.610 | 1.35 | 91 | 91 | 314 | 62.5 | 102.8 |
| | | 100.0 | 224.990 | 0.590 | 1.31 | 91 | 91 | 314 | 62.5 | 102.9 |
| | 11 | 105.0 | 228.230 | 0.590 | 1.31 | 92 | 92 | 315 | 66.1 | 103.1 |
| | | 110.0 | 231.400 | 0.570 | 1.26 | 92 | 92 | 315 | 66.1 | 102.6 |
| | 12 | 115.0 | 234.540 | 0.550 | 1.22 | 92 | 92 | 312 | 69.4 | 103.3 |
| | | 120.0 | 237.640 | 0.540 | 1.20 | 92 | 92 | 310 | 69.4 | 102.8 |
| | | | | | | | | | | |
| | | | **Average:** | 0.413 | 0.901 | 83.7 | 83.7 | 316.1 | | 103.0 |

| | | | |
|---|---|---|---|
| **Client:** | Metro Vancouver | **Date:** | 21-Aug-19 |
| **Jobsite:** | WTE (Burnaby, BC) | **Run:** | 3 - PCDD-PCDF |
| **Source:** | Unit 1 | **Run Time:** | 09:07 - 13:09 |

| | | | | |
|---|---|---|---|---|
| **Dioxin Concentration:** | **1.7** | **pg/dscm** | 0.0008 | gr/dscf |
| | 0.9 | pg/Acm | 0.0004 | gr/Acf |
| | 1.5 | pg/dscm (@ 11% O2) | 0.0006 | gr/dscf (@ 11% O2) |

**Emission Rate:** see D/F data Table 2

| | | | | |
|---|---|---|---|---|
| **Sample Gas Volume:** | 3.4321 | dscm | 121.204 | dscf |
| **Total Sample Time:** | 240.0 | minutes | | |
| **Average Isokineticity:** | 102.9 | % | | |

**Flue Gas Characteristics**

| | | | | |
|---|---|---|---|---|
| **Moisture:** | 17.44 | % | | |
| **Temperature** | 161.3 | oC | 322.4 | oF |
| **Flow** | 1114.2 | dscm/min | 39350 | dscf/min |
| | 18.57 | dscm/sec | 655.8 | dscf/sec |
| | 2105.2 | Acm/min | 74344 | Acf/min |
| **Velocity** | 13.775 | m/sec | 45.19 | f/sec |
| **Gas Analysis** | 9.35 | % O2 | 10.25 | % CO2 |
| | 30.014 | Mol. Wt (g/gmole) Dry | 27.918 | 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:** | 21-Aug-19 |
| **Jobsite:** | WTE (Burnaby, BC) | **Run:** | 3 - PCDD-PCDF |
| **Source:** | Unit 1 | **Run Time:** | 09:07 - 13:09 |

| | |
|---|---|
| **Control Unit (Y)** | 1.0021 |
| **Nozzle Diameter (in.)** | 0.2505 |
| **Pitot Factor** | 0.8465 |
| **Baro. Press. (in. Hg)** | 29.90 |
| **Static Press. (in. H2O)** | -20.00 |
| **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 | 10.33 | 9.27 |
| Trav 2 | 10.17 | 9.43 |
| **Average =** | **10.25** | **9.35** |

**Condensate Collection:**

| | |
|---|---|
| Impinger 1 (grams) | 516.0 |
| Impinger 2 (grams) | 12.0 |
| Impinger 3 (grams) | 2.0 |
| Impinger 4 (grams) | 14.1 |
| **Total Gain (grams)** | **544.1** |

**Collection:**

| | |
|---|---|
| **D/F TEQ (ng)** | **0.0059** |

| 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 | 237.821 | | | | | | | |
| 1 | 1 | 5.0 | 240.630 | 0.490 | 1.02 | 70 | 70 | 324 | 1.5 | 102.9 |
| | | 10.0 | 243.480 | 0.500 | 1.04 | 71 | 71 | 325 | 1.5 | 103.2 |
| | 2 | 15.0 | 246.350 | 0.510 | 1.06 | 71 | 71 | 325 | 4.7 | 103.0 |
| | | 20.0 | 249.200 | 0.500 | 1.05 | 72 | 72 | 325 | 4.7 | 103.1 |
| | 3 | 25.0 | 252.100 | 0.520 | 1.09 | 72 | 72 | 325 | 8.4 | 102.8 |
| | | 30.0 | 254.990 | 0.520 | 1.09 | 72 | 72 | 325 | 8.4 | 102.5 |
| | 4 | 35.0 | 257.850 | 0.500 | 1.05 | 73 | 73 | 325 | 12.5 | 103.2 |
| | | 40.0 | 260.680 | 0.490 | 1.03 | 73 | 73 | 325 | 12.5 | 103.2 |
| | 5 | 45.0 | 263.450 | 0.470 | 0.99 | 74 | 74 | 325 | 17.7 | 102.9 |
| | | 50.0 | 266.250 | 0.480 | 1.01 | 74 | 74 | 325 | 17.7 | 102.9 |
| | 6 | 55.0 | 268.980 | 0.450 | 0.95 | 75 | 75 | 326 | 25.2 | 103.5 |
| | | 60.0 | 271.680 | 0.440 | 0.93 | 75 | 75 | 325 | 25.2 | 103.5 |
| | 7 | 65.0 | 273.950 | 0.310 | 0.66 | 76 | 76 | 322 | 45.6 | 103.2 |
| | | 70.0 | 276.150 | 0.290 | 0.62 | 76 | 76 | 320 | 45.6 | 103.2 |
| | 8 | 75.0 | 278.240 | 0.260 | 0.55 | 76 | 76 | 317 | 53.2 | 103.4 |
| | | 80.0 | 280.250 | 0.240 | 0.51 | 76 | 76 | 318 | 53.2 | 103.5 |
| | 9 | 85.0 | 282.340 | 0.260 | 0.56 | 77 | 77 | 314 | 58.3 | 103.0 |
| | | 90.0 | 284.480 | 0.270 | 0.58 | 77 | 77 | 312 | 58.3 | 103.3 |
| | 10 | 95.0 | 286.560 | 0.260 | 0.56 | 76 | 76 | 315 | 62.5 | 102.7 |
| | | 100.0 | 288.680 | 0.270 | 0.57 | 76 | 76 | 317 | 62.5 | 102.9 |
| | 11 | 105.0 | 290.800 | 0.270 | 0.56 | 76 | 76 | 320 | 66.1 | 103.1 |
| | | 110.0 | 292.950 | 0.280 | 0.59 | 76 | 76 | 318 | 66.1 | 102.5 |
| | 12 | 115.0 | 295.010 | 0.260 | 0.55 | 75 | 75 | 320 | 69.4 | 102.3 |
| | | 120.0 | 297.040 | 0.250 | 0.53 | 75 | 75 | 315 | 69.4 | 102.4 |
| | | | | | | | | | | |
| | | 0.0 | 297.040 | | | | | | | |
| 2 | 1 | 5.0 | 299.340 | 0.320 | 0.68 | 75 | 75 | 320 | 1.5 | 103.0 |
| | | 10.0 | 301.580 | 0.310 | 0.65 | 75 | 75 | 322 | 1.5 | 102.0 |
| | 2 | 15.0 | 303.880 | 0.320 | 0.67 | 75 | 75 | 323 | 4.7 | 103.1 |
| | | 20.0 | 306.200 | 0.330 | 0.70 | 76 | 76 | 324 | 4.7 | 102.3 |
| | 3 | 25.0 | 308.430 | 0.310 | 0.65 | 74 | 74 | 324 | 8.4 | 101.9 |
| | | 30.0 | 310.690 | 0.310 | 0.65 | 75 | 75 | 324 | 8.4 | 103.0 |
| | 4 | 35.0 | 312.830 | 0.280 | 0.59 | 75 | 75 | 325 | 12.5 | 102.7 |
| | | 40.0 | 315.000 | 0.290 | 0.61 | 75 | 75 | 325 | 12.5 | 102.3 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 45.0 | 317.200 | 0.300 | 0.63 | 74 | 74 | 326 | 17.7 | 102.3 |
| | | 50.0 | 319.490 | 0.320 | 0.67 | 75 | 75 | 326 | 17.7 | 102.9 |
| | 6 | 55.0 | 321.780 | 0.320 | 0.67 | 75 | 75 | 326 | 25.2 | 102.9 |
| | | 60.0 | 324.100 | 0.330 | 0.69 | 75 | 75 | 327 | 25.2 | 102.7 |
| | 7 | 65.0 | 327.200 | 0.590 | 1.24 | 75 | 75 | 326 | 45.6 | 102.7 |
| | | 70.0 | 330.330 | 0.600 | 1.26 | 75 | 75 | 326 | 45.6 | 102.9 |
| | 8 | 75.0 | 333.540 | 0.630 | 1.32 | 75 | 75 | 326 | 53.2 | 103.0 |
| | | 80.0 | 336.790 | 0.650 | 1.37 | 75 | 75 | 326 | 53.2 | 102.6 |
| | 9 | 85.0 | 339.880 | 0.580 | 1.22 | 75 | 75 | 327 | 58.3 | 103.3 |
| | | 90.0 | 343.000 | 0.600 | 1.26 | 75 | 75 | 326 | 58.3 | 102.5 |
| | 10 | 95.0 | 345.840 | 0.500 | 1.05 | 75 | 75 | 325 | 62.5 | 102.1 |
| | | 100.0 | 348.680 | 0.490 | 1.03 | 75 | 75 | 323 | 62.5 | 103.0 |
| | 11 | 105.0 | 351.480 | 0.470 | 1.00 | 75 | 75 | 320 | 66.1 | 103.5 |
| | | 110.0 | 354.300 | 0.480 | 1.02 | 75 | 75 | 319 | 66.1 | 103.1 |
| | 12 | 115.0 | 357.250 | 0.520 | 1.11 | 75 | 75 | 315 | 69.4 | 103.4 |
| | | 120.0 | 360.120 | 0.500 | 1.07 | 75 | 75 | 314 | 69.4 | 102.5 |
| | | | | | | | | | | |
| | | | **Average:** | 0.405 | 0.853 | 74.6 | 74.6 | 322.4 | | 102.9 |

# APPENDIX 3

# FIELD DATA SHEETS

A. Lanfranco and Associates Inc.

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| | | | |
|---|---|---|---|
| CLIENT M.V. WTE. | NOZZLE G-250 DIAMETER, IN. 0.2505 | IMPINGER | INITIAL / FINAL / TOTAL GAIN |
| SOURCE Unit #2 | PROBE 7C Cp 0.8465 | VOLUMES | (mL) / (mL) / (mL) |
| PARAMETER / RUN No PCDD/PCDF / Run #1 | PORT LENGTH | Imp. #1 | 0 / 530 / 530 |
| DATE Aug. 19 2019 | STATIC PRESSURE, IN. H2O -20.0" | Imp. #2 | 100 / 104 / 4 |
| OPERATOR: DS + MG | STACK DIAMETER 70.9" | Imp. #3 | 0 / 1 / 1 |
| CONTROL UNIT AV 15 Y 1.002 | STACK HEIGHT 30.0' | Imp. #4 | 200g |
| ΔH@ 1.770 | | Imp. #5 | |
| BAROMETRIC PRESSURE, IN. Hg 29.96 | INITIAL LEAK TEST 0.003 @ 15" | Imp. #6 | |
| ASSUMED MOISTURE, Bw 15% | FINAL LEAK TEST 0.005 @ 15" | Upstream Diameters | |
| | | Downstream Diameters | |

| 10 Point Run | 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. % | XAD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10:35 | 982.308 | | | | | | | | | | | | |
| 1 | | 985.30 | 0.52 | 1.15 | 73 | 321 | 238 | 250 | 63 | 5 | | | 40 | |
| 1 | | 988.30 | 0.53 | 1.18 | 73 | 321 | | | | | 10.0 | 10.1 | | |
| 2 | | 991.40 | 0.56 | 1.24 | 73 | 321 | 252 | 258 | 61 | 6 | | | 41 | |
| 2 | | 994.48 | 0.55 | 1.22 | 73 | 320 | | | | | | | | |
| 3 | | 997.47 | 0.50 | 1.11 | 74 | 319 | 253 | 252 | 57 | 7 | | | 41 | |
| 3 | | 1000.24 | 0.46 | 1.03 | 74 | 318 | | | | | 9.5 | 10.2 | | |
| 4 | | 1003.07 | 0.46 | 1.03 | 75 | 317 | 248 | 251 | 57 | 6.5 | | | 42 | |
| 4 | | 1005.85 | 0.44 | 0.98 | 75 | 317 | | | | | | | | |
| 5 | | 1008.43 | 0.38 | 0.85 | 76 | 315 | 250 | 250 | 58 | 6 | | | 44 | |
| 5 | | 1010.92 | 0.35 | 0.79 | 76 | 315 | | | | | 10.0 | 9.3 | | |
| 6 | | 1013.40 | 0.35 | 0.79 | 77 | 312 | 253 | 249 | 59 | 5.5 | | | 45 | |
| 6 | | 1015.93 | 0.36 | 0.82 | 78 | 312 | | | | | | | | |
| 7 | | 1018.17 | 0.28 | 0.64 | 79 | 310 | 250 | 249 | 59 | 5 | | | 47 | |
| 7 | | 1020.45 | 0.29 | 0.66 | 79 | 310 | | | | | 10.0 | 9.4 | | |
| 8 | | 1022.91 | 0.34 | 0.77 | 79 | 311 | 252 | 250 | 59 | 5 | | | 40 | |
| 8 | | 1025.18 | 0.29 | 0.66 | 80 | 311 | | | | | | | | |
| 9 | | 1027.30 | 0.25 | 0.57 | 80 | 311 | 251 | 250 | 60 | 5 | | | 41 | |
| 9 | | 1029.38 | 0.24 | 0.55 | 80 | 312 | | | | | 10.0 | 9.6 | | |
| 10 | | 1031.54 | 0.26 | 0.59 | 80 | 312 | 251 | 250 | 60 | 5 | | | 41 | |
| 10 | | 1033.75 | 0.27 | 0.61 | 80 | 312 | | | | | | | | |
| 11 | | 1035.87 | 0.25 | 0.57 | 81 | 312 | 251 | 250 | 61 | 5 | | | 43 | |
| 11 | | 1037.90 | 0.23 | 0.52 | 80 | 317 | | | | | | | | |
| 12 | | 1040.02 | 0.25 | 0.57 | 81 | 310 | 251 | 251 | 62 | 5 | 10.0 | 9.7 | 45 | |
| 12 | 12:35 | 1042.09 | 0.24 | 0.55 | 81 | 309 | | | | | | | | |

A. Lanfranco and Associates Inc.

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLIENT | M.V. W.T.E. | | | | NOZZLE | G-250 | DIAMETER, IN. | 0.1505 | | IMPINGER | INITIAL | FINAL | TOTAL GAIN | | | |
| SOURCE | Unit #2 | | | | PROBE | 7C | Cp | 0.8465 | | VOLUMES | (mL) | (mL) | (mL) | | | |
| PARAMETER / RUN No | PCDD/PCDF / Run 1 Conf. | | | | | | | | | Imp. #1 | | | | | | |
| DATE | Aug. 19, 2019 | | | | PORT LENGTH | | | | | Imp. #2 | 100 | | | | | |
| OPERATOR: | D.C. & M.G. | | | | STATIC PRESSURE, IN. H2O | | | -20.0" | | Imp. #3 | 0 | | | | | |
| CONTROL UNIT | | Y | | | STACK DIAMETER | | | 70.94" | | Imp. #4 | Gel | 200g | | | | |
| | | ΔH@ | | | STACK HEIGHT | | | 30.0' | | Imp. #5 | | | | | | |
| | | | | | | | | | | Imp. #6 | | | | | | |
| BAROMETRIC PRESSURE, IN. Hg | | | | | INITIAL LEAK TEST | | | | | Upstream Diameters | | | | | | |
| ASSUMED MOISTURE, Bw | | | | | FINAL LEAK TEST | | | | | Downstream Diameters | | | | | | |

| 10 Point Run | 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 | 12:37 | 1042.09 | 0.31 | 0.70 | 82 | 316 | 255 | 252 | 58 | 5.5 | | | 39 | | |
| 1 | | 1046.78 | 0.30 | 0.68 | 82 | 315 | | | | | 9.5 | 10.2 | | | |
| 2 | | 1049.06 | 0.29 | 0.66 | 87 | 317 | 252 | 250 | 57 | 5.5 | | | 40 | | |
| 2 | | 1051.40 | 0.31 | 0.70 | 82 | 316 | | | | | | | | | |
| 3 | | 1053.68 | 0.29 | 0.66 | 82 | 316 | 250 | 250 | 57 | 5 | | | 41 | | |
| 3 | | 1055.92 | 0.28 | 0.63 | 82 | 317 | | | | | 9.0 | 10.3 | | | |
| 4 | | 1058.12 | 0.27 | 0.61 | 83 | 316 | 251 | 251 | 57 | 5 | | | 42 | | |
| 4 | | 1060.28 | 0.26 | 0.59 | 83 | 316 | | | | | | | | | |
| 5 | | 1062.49 | 0.27 | 0.61 | 83 | 315 | 251 | 249 | 57 | 5 | | | 41 | | |
| 5 | | 1064.62 | 0.25 | 0.57 | 83 | 315 | | | | | 11.0 | 8.3 | | | |
| 6 | | 1067.18 | 0.36 | 0.82 | 83 | 315 | 251 | 251 | 58 | 5.5 | | | 40 | | |
| 6 | | 1069.65 | 0.34 | 0.77 | 83 | 315 | | | | | | | | | |
| 7 | | 1073.08 | 0.60 | 1.49 | 84 | 319 | 253 | 250 | 58 | 6 | | | 42 | | |
| 7 | | 1076.40 | 0.62 | 1.41 | 84 | 320 | | | | | 11.0 | 8.6 | | | |
| 8 | | 1079.89 | 0.68 | 1.54 | 85 | 321 | 252 | 250 | 55 | 7 | | | 42 | | |
| 8 | | 1083.35 | 0.67 | 1.52 | 84 | 322 | | | | | | | | | |
| 9 | | 1086.94 | 0.72 | 1.63 | 85 | 323 | 251 | 250 | 56 | 7 | | | 42 | | |
| 9 | | 1090.40 | 0.68 | 1.54 | 85 | 323 | | | | | 10.0 | 9.5 | | | |
| 10 | | 1093.76 | 0.63 | 1.43 | 85 | 322 | 252 | 250 | 56 | 7 | | | 43 | | |
| 10 | | 1097.10 | 0.62 | 1.41 | 86 | 321 | | | | | | | | | |
| 11 | | 1100.55 | 0.67 | 1.52 | 86 | 322 | 250 | 250 | 57 | 8 | | | 44 | | |
| 11 | | 1104.05 | 0.68 | 1.55 | 86 | 321 | | | | | 11.0 | 9.0 | | | |
| 12 | | 1107.50 | 0.66 | 1.50 | 86 | 322 | 252 | 250 | 58 | 8 | | | 46 | | |
| 12 | 14:38 | 1110.89 | 0.64 | 1.46 | 86 | 320 | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
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A. Lanfranco and Associates Inc.

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLIENT | M.V. W.T.E | | | | NOZZLE | G-25D | DIAMETER, IN. | 0.2505 | | IMPINGER | INITIAL | FINAL | TOTAL GAIN | | | | |
| SOURCE | Unit #2 | | | | PROBE | HC | Cp | 0.8465 | | VOLUMES | (mL) | (mL) | (mL) | | | | |
| PARAMETER / RUN No | PCDD/PCDF / Run #2 | | | | | | | | | Imp. #1 | 0 | 522 | 522 | | | | |
| DATE | Aug. 20, 2019 | | | | PORT LENGTH | | | | | Imp. #2 | 100 | 112 | 12 | | | | |
| OPERATOR: | DS + MG | | | | STATIC PRESSURE, IN. H2O | -20.0" | | | | Imp. #3 | 0 | 1 | 1 | | | | |
| CONTROL UNIT | AV 15 | Y | 1.007 | | STACK DIAMETER | 70.9" | | | | Imp. #4 | 200g | | | | | | |
| | | ΔH@ | 1.770 | | STACK HEIGHT | 30.0' | | | | Imp. #5 | | | | | | | |
| | | | | | | | | | | Imp. #6 | | | | | | | |
| BAROMETRIC PRESSURE, IN. Hg | 29.90 | | | | INITIAL LEAK TEST | 0.004 @ 15" | | | | Upstream Diameters | | | | | | | |
| ASSUMED MOISTURE, Bw | 17% | | | | FINAL LEAK TEST | 0.003 @ 15" | | | | Downstream Diameters | | | | | | | |

| ID Point Run | 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 | 09:37 | 111.133 | 0.50 | 1.08 | 77 | 310 | 262 | 242 | 64 | 5 | | | 47 | | |
| 1 | | 116.83 | 0.49 | 1.05 | 77 | 314 | | | 63 | | 10.0 | 9.7 | | | |
| 2 | | 119.68 | 0.48 | 1.03 | 77 | 314 | 261 | 255 | | 6 | | | 47 | | |
| 2 | | 122.50 | 0.48 | 1.03 | 77 | 314 | | | 59 | | | | | | |
| 3 | | 125.29 | 0.47 | 1.01 | 73 | 314 | 252 | 253 | | 7 | | | 47 | | |
| 3 | | 128.20 | 0.51 | 1.09 | 73 | 314 | | | 59 | | 9.5 | 9.8 | | | |
| 4 | | 131.14 | 0.52 | 1.11 | 73 | 314 | 258 | 252 | | 7 | | | 48 | | |
| 4 | | 134.03 | 0.50 | 1.07 | 74 | 315 | | | 60 | | | | | | |
| 5 | | 136.83 | 0.47 | 1.01 | 75 | 315 | 251 | 250 | | 7 | | | 47 | | |
| 5 | | 139.62 | 0.46 | 0.99 | 76 | 313 | | | 60 | | 9.5 | 9.9 | | | |
| 6 | | 142.51 | 0.50 | 1.08 | 77 | 314 | 251 | 250 | | 6 | | | 43 | | |
| 6 | | 145.40 | 0.50 | 1.08 | 79 | 314 | | | 59 | | | | | | |
| 7 | | 147.82 | 0.34 | 0.74 | 79 | 313 | 251 | 251 | | 6 | | | 43 | | |
| 7 | | 150.15 | 0.32 | 0.69 | 80 | 315 | | | 58 | | 10.0 | 9.6 | | | |
| 8 | | 152.38 | 0.29 | 0.63 | 80 | 315 | 252 | 251 | | 5.5 | | | 43 | | |
| 8 | | 154.53 | 0.27 | 0.59 | 81 | 315 | | | 60 | | | | | | |
| 9 | | 156.76 | 0.29 | 0.63 | 81 | 317 | 252 | 249 | | 5 | | | 44 | | |
| 9 | | 158.88 | 0.26 | 0.57 | 83 | 316 | | | 62 | | 10.0 | 9.7 | | | |
| 10 | | 161.02 | 0.27 | 0.59 | 83 | 317 | 252 | 250 | | 5 | | | 45 | | |
| 10 | | 163.27 | 0.28 | 0.61 | 83 | 315 | | | 62 | | | | | | |
| 11 | | 165.40 | 0.28 | 0.61 | 84 | 315 | 250 | 250 | | 5 | | | 45 | | |
| 11 | | 167.68 | 0.30 | 0.65 | 84 | 317 | | | 63 | | 10.0 | 9.7 | | | |
| 12 | | 169.89 | 0.28 | 0.61 | 85 | 315 | 251 | 250 | | 5 | | | 46 | | |
| 12 | 11:37 | 171.98 | 0.25 | 0.55 | 85 | 312 | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLIENT | M.V. W.T.E. | | | | NOZZLE | DIAMETER, IN. | | | | IMPINGER | INITIAL | FINAL | TOTAL GAIN | | | | |
| SOURCE | Unit #2 | | | | PROBE | Cp | | | | VOLUMES | (mL) | (mL) | (mL) | | | | |
| PARAMETER / RUN No | PCDD/PCDF / Run 2 Cont. | | | | | | | | | Imp. #1 | | | | | | | |
| DATE | Aug. 20, 2019 | | | | PORT LENGTH | | | | | Imp. #2 | | | | | | | |
| OPERATOR: | D.S. + M.G. | | | | STATIC PRESSURE, IN. H2O | | | | | Imp. #3 | | | | | | | |
| CONTROL UNIT | AVIS | Y | 1.0021 | | STACK DIAMETER | | | | | Imp. #4 | | | | | | | |
| | | ΔH@ | | | STACK HEIGHT | | | | | Imp. #5 | | | | | | | |
| | | | | | | | | | | Imp. #6 | | | | | | | |
| BAROMETRIC PRESSURE, IN. Hg | | | | | INITIAL LEAK TEST | | | | | Upstream Diameters | | | | | | | |
| ASSUMED MOISTURE, Bw | | | | | FINAL LEAK TEST | | | | | Downstream Diameters | | | | | | | |

| 10 Point Run | 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. % | | | |
| | 11:39 | 171.98 | | | | | | | | | | | | | |
| 1 | | 174.32 | 0.32 | 0.70 | 87 | 320 | 252 | 250 | 60 | 5.5 | | | 43 | | |
| 1 | | 176.78 | 0.35 | 0.76 | 86 | 321 | | | | | 10.0 | 9.4 | | | |
| 2 | | 179.25 | 0.35 | 0.76 | 87 | 321 | 251 | 250 | 59 | 5 | | | 43 | | |
| 2 | | 181.75 | 0.36 | 0.78 | 87 | 321 | | | | | | | | | |
| 3 | | 184.18 | 0.34 | 0.74 | 87 | 322 | 252 | 251 | 61 | 6 | | | 45 | | |
| 3 | | 186.50 | 0.31 | 0.68 | 88 | 322 | | | | | 9.5 | 10.0 | | | |
| 4 | | 188.78 | 0.30 | 0.65 | 88 | 323 | 251 | 250 | 57 | 6 | | | 47 | | |
| 4 | | 191.10 | 0.31 | 0.68 | 88 | 323 | | | | | | | | | |
| 5 | | 193.23 | 0.26 | 0.57 | 89 | 322 | 251 | 250 | 59 | 6 | | | 47 | | |
| 5 | | 195.36 | 0.26 | 0.57 | 89 | 321 | | | | | 10.5 | 9.2 | | | |
| 6 | | 197.40 | 0.24 | 0.53 | 89 | 319 | 250 | 250 | 59 | 5.5 | | | 48 | | |
| 6 | | 199.50 | 0.25 | 0.55 | 89 | 316 | | | | | | | | | |
| 7 | | 202.52 | 0.52 | 1.14 | 89 | 316 | 250 | 250 | 60 | 5 | | | 48 | | |
| 7 | | 205.58 | 0.53 | 1.17 | 89 | 316 | | | | | 10.0 | 9.5 | | | |
| 8 | | 208.84 | 0.60 | 1.32 | 90 | 316 | 251 | 251 | 61 | 6.5 | | | 48 | | |
| 8 | | 212.00 | 0.57 | 1.26 | 90 | 315 | | | | | | | | | |
| 9 | | 215.28 | 0.61 | 1.35 | 90 | 314 | 252 | 250 | 61 | 7.5 | | | 46 | | |
| 9 | | 218.48 | 0.58 | 1.28 | 90 | 314 | | | | | 10.0 | 9.5 | | | |
| 10 | | 221.76 | 0.61 | 1.35 | 91 | 314 | 251 | 250 | 57 | 8 | | | 47 | | |
| 10 | | 224.99 | 0.59 | 1.31 | 91 | 314 | | | | | | | | | |
| 11 | | 228.23 | 0.59 | 1.31 | 92 | 315 | 252 | 250 | 58 | 8 | | | 47 | | |
| 11 | | 231.40 | 0.57 | 1.26 | 92 | 315 | | | | | 10.0 | 9.3 | | | |
| 12 | | 234.54 | 0.55 | 1.22 | 92 | 317 | 251 | 249 | 58 | 8 | | | 47 | | |
| 12 | 13:39 | 237.64 | 0.54 | 1.20 | 92 | 310 | | | | | | | | | |

A. Lanfranco and Associates Inc.

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLIENT | M.V. W.T.E. | | | | NOZZLE | G-250 | DIAMETER, IN. | 0.2505 | | IMPINGER | INITIAL | FINAL | TOTAL GAIN | | | | |
| SOURCE | Unit #2 | | | | PROBE | 7C | Cp | 0.8465 | | VOLUMES | (mL) | (mL) | (mL) | | | | |
| PARAMETER / RUN No | PCDD/PCDF / Run #3 | | | | | | | | | Imp. #1 | 0 | 516 | 516 | | | | |
| DATE | Aug. 21, 2019 | | | | PORT LENGTH | | | | | Imp. #2 | 100 | 112 | 12 | | | | |
| OPERATOR: | DS+MG | | | | STATIC PRESSURE, IN. H2O | -20.0" | | | | Imp. #3 | 0 | 2 | 2 | | | | |
| CONTROL UNIT | AUTO | Y | 1.002 | | STACK DIAMETER | 70.9" | | | | Imp. #4 | 200g | | | | | | |
| | | ΔH@ | 1.770 | | STACK HEIGHT | 30.0 | | | | Imp. #5 | | | | | | | |
| | | | | | | | | | | Imp. #6 | | | | | | | |
| BAROMETRIC PRESSURE, IN. Hg | 29.90 | | | | INITIAL LEAK TEST | 0.003 @ 15" | | | | Upstream Diameters | | | | | | | |
| ASSUMED MOISTURE, Bw | 17% | | | | FINAL LEAK TEST | 0.003 @ 15" | | | | Downstream Diameters | | | | | | | |

| 10 Point Min | 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 | 9:07 | 237.821 | 0.49 | 1.02 | 70 | 324 | 250 | 234 | 65 | 6 | | | 43 | |
| 1 | | 243.48 | 0.50 | 1.04 | 71 | 325 | | | | | 11.0 | 9.0 | | |
| 2 | | 246.35 | 0.51 | 1.06 | 71 | 325 | 264 | 254 | 63 | 7 | | | 43 | |
| 2 | | 249.20 | 0.50 | 1.05 | 72 | 325 | | | | | | | | |
| 3 | | 252.10 | 0.52 | 1.09 | 72 | 325 | 254 | 252 | 62 | 8 | | | 44 | |
| 3 | | 254.99 | 0.52 | 1.09 | 72 | 325 | | | | | 10.5 | 9.1 | | |
| 4 | | 257.85 | 0.50 | 1.05 | 73 | 325 | 252 | 252 | 57 | 8 | | | 44 | |
| 4 | | 260.68 | 0.49 | 1.03 | 73 | 325 | | | | | | | | |
| 5 | | 263.45 | 0.47 | 0.99 | 74 | 325 | 251 | 250 | 56 | 8 | | | 43 | |
| 5 | | 266.25 | 0.48 | 1.01 | 74 | 325 | | | | | 10.0 | 9.5 | | |
| 6 | | 268.98 | 0.45 | 0.95 | 75 | 326 | 252 | 250 | 55 | 8 | | | 44 | |
| 6 | | 271.68 | 0.44 | 0.93 | 75 | 325 | | | | | | | | |
| 7 | | 273.95 | 0.31 | 0.66 | 76 | 322 | 280 | 248 | 56 | 6 | | | 44 | |
| 7 | | 276.15 | 0.29 | 0.62 | 76 | 320 | | | | | 10.5 | 9.1 | | |
| 8 | | 278.24 | 0.26 | 0.55 | 76 | 317 | 250 | 248 | 56 | 6 | | | 45 | |
| 8 | | 280.25 | 0.24 | 0.51 | 76 | 318 | | | | | | | | |
| 9 | | 282.34 | 0.26 | 0.56 | 77 | 314 | 251 | 251 | 57 | 5.5 | | | 45 | |
| 9 | | 284.48 | 0.27 | 0.58 | 77 | 312 | | | | | 10.5 | 9.0 | | |
| 10 | | 286.56 | 0.26 | 0.56 | 76 | 315 | 250 | 249 | 58 | 6 | | | 44 | |
| 10 | | 288.68 | 0.27 | 0.57 | 76 | 317 | | | | | | | | |
| 11 | | 290.80 | 0.27 | 0.57 | 76 | 320 | 252 | 250 | 57 | 6.5 | | | 44 | |
| 11 | | 292.95 | 0.28 | 0.59 | 76 | 319 | | | | | 9.5 | 9.9 | | |
| 12 | | 295.01 | 0.26 | 0.55 | 75 | 320 | 250 | 250 | 57 | 6 | | | 44 | |
| 12 | 11:07 | 297.04 | 0.25 | 0.53 | 75 | 315 | | | | | | | | |

A. Lanfranco and Associates Inc.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLIENT | Metro Van W.T.E. | | | | NOZZLE | DIAMETER, IN. | | | | IMPINGER | INITIAL | FINAL | TOTAL GAIN | | | |
| SOURCE | Unit #2 | | | | PROBE | Cp | | | | VOLUMES | (mL) | (mL) | (mL) | | | |
| PARAMETER / RUN No | PCDD/PCDF / Run 3 Cont... | | | | | | | | | Imp. #1 | | | | | | |
| DATE | Aug. 21, 2019 | | | | PORT LENGTH | | | | | Imp. #2 | | | | | | |
| OPERATOR: | DS + MG | | | | STATIC PRESSURE, IN. H2O | | | | | Imp. #3 | | | | | | |
| CONTROL UNIT | Y | | | | STACK DIAMETER | | | | | Imp. #4 | | | | | | |
| | ΔH@ | | | | STACK HEIGHT | | | | | Imp. #5 | | | | | | |
| BAROMETRIC PRESSURE, IN. Hg | | | | | | | | | | Imp. #6 | | | | | | |
| ASSUMED MOISTURE, Bw | | | | | INITIAL LEAK TEST | | | | | Upstream Diameters | | | | | | |
| | | | | | FINAL LEAK TEST | | | | | Downstream Diameters | | | | | | |

| 10 Point Run N | 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. % | | | |
| | 11:09 | 297.04 | | | | | | | | | | | | | |
| 1 | | 299.34 | 0.32 | 0.68 | 75 | 320 | 250 | 248 | 56 | 6.5 | 10.0 | 9.6 | 43 | | |
| 1 | | 301.58 | 0.31 | 0.65 | 75 | 322 | | | | | | | | | |
| 2 | | 303.88 | 0.32 | 0.67 | 75 | 323 | 253 | 251 | 58 | 7.5 | | | 44 | | |
| 2 | | 306.20 | 0.33 | 0.70 | 76 | 324 | | | | | | | | | |
| 3 | | 308.43 | 0.31 | 0.65 | 74 | 324 | 251 | 251 | 55 | 7.5 | 10.5 | 9.3 | 44 | | |
| 3 | | 310.69 | 0.31 | 0.65 | 75 | 324 | | | | | | | | | |
| 4 | | 312.83 | 0.28 | 0.59 | 75 | 325 | 252 | 251 | 55 | 7.5 | | | 45 | | |
| 4 | | 315.0 | 0.29 | 0.61 | 75 | 325 | | | | | | | | | |
| 5 | | 317.20 | 0.30 | 0.63 | 74 | 326 | 251 | 250 | 56 | 7 | 10.0 | 9.6 | 46 | | |
| 5 | | 319.49 | 0.32 | 0.67 | 75 | 326 | | | | | | | | | |
| 6 | | 321.78 | 0.32 | 0.67 | 75 | 326 | 252 | 251 | 56 | 7 | | | 46 | | |
| 6 | | 324.10 | 0.33 | 0.69 | 75 | 327 | | | | | | | | | |
| 7 | | 327.20 | 0.59 | 1.24 | 75 | 326 | 252 | 250 | 57 | 7 | 10.0 | 9.8 | 45 | | |
| 7 | | 330.33 | 0.60 | 1.26 | 75 | 326 | | | | | | | | | |
| 8 | | 333.54 | 0.63 | 1.32 | 75 | 326 | 250 | 249 | 58 | 9 | | | 44 | | |
| 8 | | 336.79 | 0.65 | 1.37 | 75 | 326 | | | | | | | | | |
| 9 | | 339.88 | 0.58 | 1.22 | 75 | 327 | 251 | 251 | 57 | 10 | 10.0 | 9.2 | 42 | | |
| 9 | | 343.00 | 0.60 | 1.26 | 75 | 326 | | | | | | | | | |
| 10 | | 345.84 | 0.50 | 1.05 | 75 | 325 | 251 | 250 | 56 | 10 | | | 42 | | |
| 10 | | 348.68 | 0.49 | 1.03 | 75 | 323 | | | | | | | | | |
| 11 | | 351.48 | 0.47 | 1.00 | 75 | 320 | 250 | 250 | 56 | 10 | 10.5 | 9.1 | 41 | | |
| 11 | | 354.30 | 0.48 | 1.07 | 75 | 319 | | | | | | | | | |
| 12 | | 357.25 | 0.52 | 1.11 | 75 | 315 | 251 | 250 | 57 | 9 | | | 45 | | |
| 12 | 13:09 | 360.12 | 0.50 | 1.07 | 75 | 314 | | | | | | | | | |

# APPENDIX 4

# CALIBRATION DATA and

# CERTIFICATION

# Pitot Tube Calibration

Date: 15-Jul-19
Pbar (in.Hg): 29.69

Temp (R): 530
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) |
|---|---|---|---|---|
| 0.355 | 0.495 | 39.6 | 0.8384 | 0.0116 |
| 0.455 | 0.660 | 44.8 | 0.8220 | 0.0048 |
| 0.525 | 0.760 | 48.2 | 0.8228 | 0.0040 |
| 0.630 | 0.900 | 52.8 | 0.8283 | 0.0015 |
| 0.680 | 0.985 | 54.8 | 0.8226 | 0.0042 |
| | | Average : | 0.8268 | 0.0052 |

Pitot ID:

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

Pitot ID: **7B**

| Reference Pitot (in H2O) | S-Type Pitot (in H2O) | Air Velocity (ft/s) | Pitot Coeff. Cp | Deviation (absolute) |
|---|---|---|---|---|
| 0.345 | 0.465 | 39.0 | 0.8527 | 0.0045 |
| 0.490 | 0.650 | 46.5 | 0.8596 | 0.0023 |
| 0.565 | 0.770 | 50.0 | 0.8480 | 0.0092 |
| 0.655 | 0.865 | 53.8 | 0.8615 | 0.0042 |
| 0.770 | 1.010 | 58.3 | 0.8644 | 0.0072 |
| | | Average : | 0.8572 | 0.0055 |

Pitot ID:

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

Pitot ID: **AL GVRD 1**

| Reference Pitot (in H2O) | S-Type Pitot (in H2O) | Air Velocity (ft/s) | Pitot Coeff. Cp | Deviation (absolute) |
|---|---|---|---|---|
| 0.115 | 0.155 | 22.5 | 0.8527 | 0.0020 |
| 0.205 | 0.280 | 30.1 | 0.8471 | 0.0077 |
| 0.360 | 0.480 | 39.9 | 0.8574 | 0.0026 |
| 0.550 | 0.730 | 49.3 | 0.8593 | 0.0045 |
| 0.750 | 1.000 | 57.6 | 0.8574 | 0.0026 |
| | | Average : | 0.8548 | 0.0039 |

Pitot ID:

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

Pitot ID: **7C**

| Reference Pitot (in H2O) | S-Type Pitot (in H2O) | Air Velocity (ft/s) | Pitot Coeff. Cp | Deviation (absolute) |
|---|---|---|---|---|
| 0.025 | 0.034 | 10.5 | 0.8489 | 0.0024 |
| 0.150 | 0.205 | 25.7 | 0.8468 | 0.0003 |
| 0.285 | 0.399 | 35.5 | 0.8367 | 0.0098 |
| 0.500 | 0.685 | 47.0 | 0.8458 | 0.0007 |
| 0.730 | 0.980 | 56.8 | 0.8544 | 0.0079 |
| | | Average : | 0.8465 | 0.0042 |

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: Jeremy Gibbs Signature: Date: July 15, 2019

# A.Lanfranco & Associates inc.

EPA Method 5

Meter Box Calibration

English Meter Box Units, English K' Factor

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

Date: 26-Jun-19
Barometric Pressure: 30.00 (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) |
| 3.60 | 21.00 | 609.800 | 632.250 | 22.450 | 76.0 | 76.0 | 79.0 | 79.0 | 73 | 0.8185 | 15.0 | 78.0 | 77.0 | 77.5 |
| 1.95 | 23.00 | 632.900 | 650.860 | 17.960 | 79.0 | 79.0 | 80.0 | 80.0 | 63 | 0.5956 | 17.5 | 78.0 | 79.0 | 78.5 |
| 1.15 | 19.00 | 651.100 | 662.630 | 11.530 | 80.0 | 80.0 | 80.0 | 80.0 | 55 | 0.4606 | 18.5 | 80.0 | 83.0 | 81.5 |
| 0.64 | 16.00 | 663.000 | 670.385 | 7.385 | 80.0 | 80.0 | 80.0 | 80.0 | 48 | 0.3560 | 20.0 | 81.0 | 82.0 | 81.5 |
| 0.31 | 23.00 | 670.500 | 677.735 | 7.235 | 80.0 | 80.0 | 79.0 | 79.0 | 40 | 0.2408 | 21.0 | 82.0 | 84.0 | 83.0 |

********** 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) |
| 22.298 | 631.5 | 22.242 | 629.9 | 22.591 | 0.997 | -0.005 | 1.778 | 45.16 | 0.008 | 0.721 |
| 17.701 | 501.3 | 17.710 | 501.5 | 18.021 | 1.000 | -0.002 | 1.815 | 46.11 | 0.046 | 0.713 |
| 11.331 | 320.9 | 11.282 | 319.5 | 11.545 | 0.996 | -0.006 | 1.799 | 45.68 | 0.029 | 0.720 |
| 7.249 | 205.3 | 7.343 | 208.0 | 7.514 | 1.013 | 0.011 | 1.676 | 42.56 | -0.094 | 0.734 |
| 7.102 | 201.1 | 7.130 | 201.9 | 7.316 | 1.004 | 0.002 | 1.780 | 45.22 | 0.011 | 0.719 |
| | | | | **Average Y---------->** | **1.0021** | | **Average dH@----->** | **1.770** | **44.9** | **Average Ko----->** | **0.721** |

## 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 26, 2019

| 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 | January 17, 2019 | 99.9 | 29.51 | 29.43 | 29.50 | 0.00 |
| DS | July 8, 2019 | 102.1 | 30.16 | 30.03 | 30.10 | 0.05 |
| CL | July 8, 2019 | 102.1 | 30.16 | 30.04 | 30.11 | 0.04 |
| ML | July 8, 2019 | 102.1 | 30.16 | 30.01 | 30.08 | 0.07 |
| SB | January 17, 2019 | 99.9 | 29.51 | 29.43 | 29.50 | 0.00 |
| SH | January 17, 2019 | 99.9 | 29.51 | 29.40 | 29.47 | 0.03 |
| MG | January 7, 2019 | 101.2 | 29.89 | 29.80 | 29.87 | 0.02 |
| JB | January 17, 2019 | 99.9 | 29.51 | 29.42 | 29.49 | 0.01 |
| SF | July 8, 2019 | 102.1 | 30.16 | 30.07 | 30.14 | 0.01 |
| JG | January 17, 2019 | 99.9 | 29.51 | 29.4 | 29.47 | 0.03 |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Calibrated by: Daryl Sampson Signature:  Date: July 8, 2019

**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**

## GLASS NOZZLE DIAMETER CALIBRATION FORM

Calibrated by: Michael Goods
Date: July 7th 2019

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 |
| P-20 | 0.1855 | 0.1865 | 0.1835 | 0.0030 | 0.1852 | 0.0001870 |
| 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 |
| G-215 | 0.2160 | 0.2150 | 0.2130 | 0.0030 | 0.2147 | 0.0002513 |
| Q | 0.2190 | 0.2170 | 0.2185 | 0.0020 | 0.2182 | 0.0002596 |
| G-222 | 0.2215 | 0.2220 | 0.2215 | 0.0005 | 0.2217 | 0.0002680 |
| G-225 | 0.2245 | 0.2250 | 0.2240 | 0.0010 | 0.2245 | 0.0002749 |
| P-18 | 0.2375 | 0.2370 | 0.2380 | 0.0010 | 0.2375 | 0.0003076 |
| V-07 | 0.2447 | 0.2450 | 0.2445 | 0.0005 | 0.2447 | 0.0003267 |
| G-250 | 0.2500 | 0.2505 | 0.2510 | 0.0010 | 0.2505 | 0.0003422 |
| G-252 | 0.2525 | 0.2520 | 0.2530 | 0.0010 | 0.2525 | 0.0003477 |
| P | 0.2580 | 0.2570 | 0.2575 | 0.0010 | 0.2575 | 0.0003616 |
| G-278 | 0.2775 | 0.2785 | 0.2790 | 0.0015 | 0.2783 | 0.0004225 |
| P-2 | 0.2787 | 0.2790 | 0.2785 | 0.0005 | 0.2787 | 0.0004237 |
| G-292 | 0.2922 | 0.2920 | 0.2926 | 0.0006 | 0.2923 | 0.0004659 |
| MV-02 | 0.3050 | 0.3040 | 0.3055 | 0.0015 | 0.3048 | 0.0005068 |
| MV-01 | 0.3060 | 0.3065 | 0.3055 | 0.0010 | 0.3060 | 0.0005107 |
| G-309 | 0.3095 | 0.3095 | 0.3085 | 0.0010 | 0.3092 | 0.0005213 |
| V-06 | 0.3200 | 0.3210 | 0.3210 | 0.0010 | 0.3207 | 0.0005608 |
| G-330 | 0.3295 | 0.3300 | 0.3305 | 0.0010 | 0.3300 | 0.0005940 |
| G-337 | 0.3380 | 0.3355 | 0.3365 | 0.0025 | 0.3367 | 0.0006182 |
| P-27 | 0.3387 | 0.3385 | 0.3390 | 0.0005 | 0.3387 | 0.0006258 |
| G-343 | 0.3435 | 0.3430 | 0.3435 | 0.0005 | 0.3433 | 0.0006429 |
| G-349 | 0.3490 | 0.3495 | 0.3495 | 0.0005 | 0.3493 | 0.0006656 |
| P-9 | 0.3648 | 0.3650 | 0.3645 | 0.0005 | 0.3648 | 0.0007257 |
| G-372 | 0.3710 | 0.3730 | 0.3740 | 0.0030 | 0.3727 | 0.0007575 |
| 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 |
| P-17 | 0.4070 | 0.4075 | 0.4065 | 0.0010 | 0.4070 | 0.0009035 |
| 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 |
| P-29 | 0.4680 | 0.4680 | 0.4690 | 0.0010 | 0.4683 | 0.0011963 |
| G-468 | 0.4677 | 0.4670 | 0.4670 | 0.0007 | 0.4672 | 0.0011907 |
| 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

# A. LANFRANCO and ASSOCIATES INC.

**ENVIRONMENTAL CONSULTANTS**

## TEMPERATURE CALIBRATION FORM

Calibrated by: Daryl Sampson

Date: 9-Jul-19

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 | 32 | 0.00% | 100 | 0.00% | 200 | 0.00% | 299 | -0.13% | 500 | 0.00% | 798 | -0.16% | 1698 | -0.09% |
| 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 | 31 | -0.20% | 100 | 0.00% | 201 | 0.15% | 300 | 0.00% | 499 | -0.10% | 799 | -0.08% | 1699 | -0.05% |
| Omega HH11 | 14 | 409426 | 33 | 0.20% | 101 | 0.18% | 201 | 0.15% | 300 | 0.00% | 499 | -0.10% | 801 | 0.08% | 1698 | -0.09% |
| 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 | 33 | 0.20% | 100 | 0.00% | 201 | 0.15% | 299 | -0.13% | 499 | -0.10% | 798 | -0.16% | 1698 | -0.09% |

Reference device is a NIST certified digital thermocouple calibrator

Variation expressed as a percentage of the absolute temperature must be within 1.5 %

# A. LANFRANCO and ASSOCIATES INC.

**ENVIRONMENTAL CONSULTANTS**

## TEMPERATURE CALIBRATION FORM

Calibrated by: Daryl Sampson

Date: July 9, 2019

Signature: 

## K-TYPE THERMOCOUPLE CALIBRATIONS

| Probe/TC ID | Hg Thermometer Temp (°F) | CL23A Readout (F) | | Probe/TC ID | Hg Thermometer Temp (°F) | CL23A Readout (F) |
|---|---|---|---|---|---|---|
| 3B | 211 | 210 | | TC 3-3 | 210 | 212 |
| 3C | 212 | 211 | | TC 4-3 | 212 | 212 |
| 4A | 211 | 213 | | TC 4-4 | 211 | 211 |
| 4B | 212 | 212 | | TC 5-4 | 212 | 211 |
| 5A | 212 | 212 | | TC 5-5 | n/a | n/a |
| 5B | 211 | 212 | | TC 5-6 | 212 | 212 |
| 5C | 212 | 211 | | TC 6-4 | 211 | 211 |
| 5D | 212 | 212 | | TC 10-3 | 211 | 210 |
| 6A | 213 | 212 | | | | |
| 6B | 212 | 212 | | | | |
| 6C | 212 | 211 | | | | |
| 7C | 212 | 211 | | | | |
| 8A | 210 | 211 | | | | |
| 8B | 211 | 213 | | | | |
| 10A | 211 | 212 | | | | |
| 10B | 210 | 212 | | | | |
| 11A | 212 | 211 | | | | |
| 12A | 211 | 210 | | | | |
| 12B | 211 | 210 | | | | |

* n/a denotes not in service

# Walter Smith & Associates, Inc.

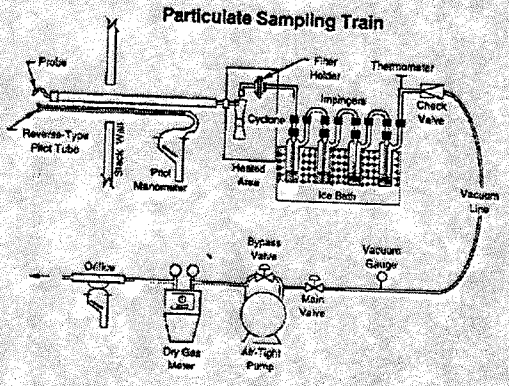
*is hereby granted to:*

**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**

BRITISH COLUMBIA INSTITUTE OF TECHNOLOGY

BCIT

# Shawn Harrington

*has met the requirements of*

# Stack Testing for Pollutants

## ( CHSC 7760 )

*School of Process, Energy and Natural Resources*
*Chemical Sciences Program*

*Endorsed by:*

Greater Vancouver Regional District

Environment Canada Environnement Canada

Province of British Columbia
Ministry of Environment, Lands and Parks

*Marsh Hemekey, Dean*
*School of Process, Energy and Natural Resources*

JUNE 21, 2001
*Dated*