1.0 PROJECT OVERVIEW

1.1 GENERAL

Montrose Air Quality Services, LLC (Montrose) located at 1371 Brummel Avenue, Elk Grove Village, Illinois was contracted by We Energies to perform an air emissions test program at the Presque Isle Power Plant (PIPP) located in Marquette, Michigan. The objective of the test program was to perform testing for filterable particulate matter (PM) and hydrogen chloride (HCl) from the exhaust of Unit 9. Testing was conducted to meet the requirements of We Energies, the Michigan Department of Quality (MDEQ) and the United States Environmental Protection Agency (U.S. EPA); and 40 CFR Part 60 and 63, Subpart UUUUU, as applicable.

Testing was performed on February 28, 2019. Coordinating the field aspects of the test program were:

Rob Bregger – We Energies - (414) 221-4772

Blu Kaput – Montrose Air Quality Services, LLC – (630) 860-4740

1.2 EXECUTIVE SUMMARY

The results of the Method 5 PM and Method 26A HCl testing are summarized in the table below. Testing was performed according to Test Plan No. 042AS-339307-PP-1. The procedures outlined in that document were followed except where noted.

TABLE 1-1
EXECUTIVE SUMMARY

Unit	Constituent	Run 1	Run 2	Run 3	Average	MATS Limit
9	Filterable PM (lb/mmBtu)	0.000776	0.000784	0.000893	**0.000818**	0.03
9	Filterable PM (lb/hr)	0.692	0.693	0.772	**0.719**	
9	HCl (lb/mmBtu)	0.000493	0.000504	0.000566	**0.000521**	0.002
9	HCl (lb/hr)	0.439	0.445	0.489	**0.458**	

1.3 QUALITY STATEMENT

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is presented in the report appendices.

1.3.2 Quality Statement

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for

Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10.

1.4 ASTM D7036-04(2011)

All applicable Montrose field personnel used on-site for this test program were compliant with ASTM D7036-04(2011) "Standard Practice for Competence of Air Emissions Testing Bodies" for all tests performed. This includes having the appropriate QSTI directly supervise the testing.

The following table summarizes the key personnel that were involved with this project:

TABLE 1 – 2
PROJECT PERSONNEL

Personnel	Position on Project	Date of QSTI Exam
Brandon Check, Q.S.T.I.	Project Manager	3/31/2016
Blu Kaput, Q.S.T.I.	Overall Test Leader	05/05/2017

1.5 METHODOLOGY

1.5.1 Particulate Matter and Hydrogen Chloride Testing Methodology

EPA Methods 5 and 26A were used to determine the PM and HCl concentrations at the test location in a combined sample train. In Method 5, a sample of the gas stream was withdrawn isokinetically from the stack. The PM in the sample gas stream was collected in a glass lined sample probe and on a glass fiber filter. The weight of PM collected with the sample train combined with the volume of dry gas withdrawn from the stack was used to calculate the particulate concentration.

EPA Method 26A was used to determine the HCl concentration at the test location. In Method 26A, a sample of the gas stream was withdrawn isokinetically from the stack. The HCl in the sample gas stream passed through a probe and filter assembly and collected in an impinger condenser system. The impingers contained a solution of dilute sulfuric acid to collect the HCl. After each test run, the impinger contents were recovered and subsequently analyzed at the Element One laboratory located in Wilmington, North Carolina using ion chromatography (IC).

In order to convert the concentration of each constituent to a mass emissions rate, the volumetric gas flow rate through the test location was determined concurrently with each test run, using EPA Methods 1, 2, 3 and 4.

Results for PM and HCl are expressed in units of pounds per million British thermal units (lb/mmBtu). Three test runs were conducted for PM and HCl at the test location. Testing was conducted as close to maximum load as possible.

The PM test was conducted using a probe temperature of 248°F (+/- 25°F) as allowed by the EPA in letters dated May 11, 2016 and March 8, 2017 and the MDEQ dated May 5, 2017. The volume collected was increased nominally by a factor of two as required for conducting emissions testing to demonstrate LEE status.

1.6 SPECIAL CONSIDERATIONS

Per the requirements of 40 CFR Part 63, Subpart UUUUU, the following strategies were utilized:

- Under §63.10005(h)(2)(i), the minimum sample volume specified in Table 2 was increased nominally by a factor of two (i.e. 2x1.00 dscm; 2x0.75)
- Under §63.10007(A) (2), the unit was operated at maximum normal operating load conditions during each periodic (e.g., quarterly) performance test. Maximum normal operating load was generally between 90 and 110 percent of design capacity but was representative of site specific normal operations during each test run.
- Under Table 5 (1) (f) and 5 (3) (f), emissions concentrations for PM and HCl were converted to lb/MMBtu or lb/MWh emissions rates, using the calculations found in EPA Method 19. The F-factor was 9,820 for subbituminous coal.
- Per the Stationary Source Audit Program (SSAP) for testing requirements under 40 CFR parts 51, 60, 61 and 63 the owner or operator of a stationary source is required to use an audit sample during a compliance test which applies to all test methods for which a commercially available audit exists (i.e. Method 26A)

1.7 PARAMETERS

The following parameters were determined at the Unit 9 test location during each test run:

- gas velocity
- gas temperature
- oxygen concentration
- carbon dioxide concentration
- moisture content
- filterable particulate matter concentration
- hydrogen chloride concentration

1.8 RESULTS

A complete summary of test results may be found in Table 2-1.

An HCl audit sample was submitted for analysis. The results of the audit sample may be found in the Laboratory section of the Appendix.

2.0 SUMMARY OF RESULTS

TABLE 2 – 1
SUMMARY OF UNIT 9 PM & HCl RESULTS

Test Parameters	**Run 1**	**Run 2**	**Run 3**	**Average**
Date	2/28/19	2/28/19	2/28/19	
Start Time	6:57	9:14	11:32	
Stop Time	9:02	11:19	13:38	
Fd Factor	9,820	9,820	9,820	
Gas Conditions				
Temperature (°F)	333	328	335	**332**
Volume Metered Standard, $V_{m(std)}$ (ft^3)	83.29	81.38	81.92	**82.20**
Volumetric Flow Rate (acfm)	344,200	339,900	342,400	**342,200**
Volumetric Flow Rate (scfm)	224,600	223,300	223,000	**223,600**
Volumetric Flow Rate (dscfm)	197,400	198,300	196,800	**197,500**
Carbon Dioxide (% dry)	13.8	13.7	13.7	**13.7**
Oxygen (% dry)	5.5	5.7	5.9	**5.7**
Moisture (%)	12.1	11.2	11.8	**11.7**
Particulate Results				
Concentration (grains/dscf)	0.000409	0.000407	0.000458	**0.000425**
Emission Rate (lb/MMBtu, F_d)	0.000776	0.000784	0.000893	**0.000818**
Emission Rate (lb/hr)	0.692	0.693	0.772	**0.719**
Hydrogen Chloride Results				
Concentration (lb/dscf)	3.71E-08	3.74E-08	4.14E-08	**3.86E-08**
Concentration (ppmdv)	0.392	0.395	0.438	**0.408**
Emission Rate (lb/MMBtu, Fd)	0.000493	0.000504	0.000566	**0.000521**
Emission Rate (lb/hr)	0.439	0.445	0.489	**0.458**

3.0 TEST PROCEDURES

3.1 METHOD LISTING

The following EPA test methods were referenced for the test program. These methods can be found in 40 CFR Part 60 Appendix A.

Method 1	Sample and velocity traverse for stationary sources
Method 2	Determination of stack gas velocity and volumetric flow rate (type S pitot tube)
Method 3	Gas analysis for the determination of dry molecular weight
Method 4	Determination of moisture content in stack gases
Method 5	Determination of particulate emissions from stationary sources
Method 19	Determination of sulfur dioxide removal efficiency and particulate matter, sulfur dioxide, and nitrogen oxides emission rates
Method 26A	Determination of hydrogen halide and halogen emissions from stationary sources - isokinetic method

3.2 METHOD DESCRIPTIONS

3.2.1 Method 1

Method 1 was used to determine the suitability of each test location and to determine the sample points used for the gas velocity and particulate concentration determinations. Each test location conformed to the minimum requirements of being located at least 2.0 diameters downstream and at least 0.5 diameters upstream from the nearest flow disturbance.

The Unit 9 test location is a round, vertical duct with a diameter of 114.0 inches. Three points in each of the four test ports were traversed for each volumetric flow test run. The test location was located approximately 15.8 diameters downstream and approximately 10.5 diameters upstream from the nearest flow disturbance. A cross-section of the test location, indicating the traverse points is shown in Figure 1 of the Appendix.

3.2.2 Method 2

Method 2 was used to determine the gas velocity through the test location using a Type-S pitot tube and an incline plane oil manometer. The values measured in Method 2, along with the measurements made in Methods 3 and 4, were used to calculate the volumetric flow rate through the test locations. A diagram of the Method 2 apparatus is shown as part of the Method 5/26A sampling train in Figure 2 of the Appendix.

The manometer was leveled and "zeroed" prior to each test run. The sample train was leak checked before and after each run by pressurizing the positive side, or "high" side, of the pitot tube, creating a deflection on the manometer of at least three inches H2O. The leak check was considered valid if the manometer remained stable for 15 seconds. This procedure was repeated on the negative side by generating a vacuum of at least three inches H2O. The velocity head pressure and gas temperature were then determined at each point specified in Method 1. The static pressure of the stack was measured using a water filled U-tube manometer. In addition, the barometric pressure was measured and recorded.

3.2.3 Method 3

The carbon dioxide and oxygen contents were determined at the test location using EPA Method 3. A gas sample was collected into a Tedlar bag from the back of each sample train for the duration of each test run. Analysis was performed using an Orsat gas analyzer within eight hours of collection.

The analyzer was leak checked prior to analysis by raising the liquid levels in each pipette to a reference mark on the capillary tubes and then closing the pipette valves. The burette solution was then raised to bring the meniscus onto the graduated portion of the burette and the manifold valve was closed. A leak check was considered valid if the pipette meniscus did not fall below the reference mark and the burette meniscus did not fall by more than 0.2 ml after four minutes.

The carbon dioxide content and oxygen content were used to calculate the dry molecular weight of the gas stream. The molecular weight was then used, along with the moisture content determined by EPA Method 4, for the calculation of the volumetric flow rate. For these calculations, the balance of the gas stream was assumed to be nitrogen since the other gas stream components are insignificant for the purposes of calculating molecular weight.

3.2.4 Method 4

The moisture content at the test location was determined using Method 4. A known volume of sample gas was withdrawn from the source and the moisture was condensed and measured. The dry standard volume of the sample gas was then compared to the volume of moisture collected to determine the moisture content of the sample gas. A diagram of the Method 4 apparatus is shown as part of the Method 5/26A train in Figure 2 of the Appendix.

To condense the water vapor the gas sample passed through a series of impingers. The impingers were charged as outlined in each individual method. The sample train was leak checked prior to the test run by capping the probe tip and pulling a vacuum greater than the highest vacuum expected during the test run. A leak check was considered valid if the leak rate was below 0.02 cubic feet per minute.

The volume of dry gas exiting the gas condenser system was measured with a dry gas meter. After leaving the dry gas meter, the sample stream passed through an orifice used to meter the flow rate through the sample train. The pressure drop across the orifice was measured with an incline plane, oil manometer. The gas meter reading, gas meter inlet and outlet temperatures, gas meter static pressure and pump vacuum were recorded for each sample point.

After the test run, the sample train was leak checked at the highest vacuum encountered during the test run. The tests were considered valid since the leak rate was less than 0.02 cfm. The amount of water collected in the condenser system was measured gravimetrically. The net weight gain of water was converted to a volume of wet gas and then compared to the amount of dry gas sampled to determine the moisture content.

3.2.5 Methods 5/26A

EPA Methods 5 and 26A in a combined sample train were used to determine the PM and HCl concentrations at the test location. A sample of the gas stream was withdrawn isokinetically from the stack and the PM in the sample gas stream was collected in a glass probe and on a glass fiber filter. The HCl was collected in impingers containing a dilute sulfuric acid solution. A diagram of the Method 5/26A sample train is shown in Figure 2 in the Appendix.

To prevent contamination, all components of the sample train were constructed of glass with no metal connections. Prior to testing the components were washed using detergent and then rinsed with tap water, deionized water and lastly with acetone. After drying, all components were sealed with parafilm or Teflon tape.

The sample probe that was used consisted of a glass liner and glass nozzle. Sample gas passed through the nozzle and probe assembly and then through a glass fiber filter heated to 248°F (± 25°F). After exiting the filter, the sample gas was passed through a series of four glass impingers. The first and second impingers each contained 100 ml of 0.1 N H_2SO_4. The third impinger was initially empty. The fourth contained a known weight of silica gel to absorb any remaining water vapor. The dry gas exiting the moisture condenser system then passed through a sample pump and a dry gas meter to measure the gas volume. After leaving the dry gas meter, the sample stream passed through an orifice, which was used to meter the flow rate through the sample train. The pressure drop across the orifice was measured with an incline plane oil manometer.

85mm Whatman quartz filters were used as the substrate for the particulate sampling. The filter was loaded into a glass filter holder with a Teflon support screen that was prepared in the same manner as the other components of the sample train. Prior to the test run, the filter was desiccated for at least 24 hours and then weighed to the nearest 0.0001g until a constant weight was achieved. The weight of the filter was considered constant only when two consecutive weights taken at least six hours apart are within 0.0005g of each other.

The probe was thoroughly pre-cleaned with acetone and the probe wash saved prior to each test run as a quality assurance check. The impingers were pre cleaned with distilled water and loaded with the appropriate impinger contents. The sample train was leak checked prior to the test run by capping the probe tip and pulling a vacuum of at least 15 in.Hg. A leak check was considered valid if the leak rate was below 0.02 cfm. When not in operation inside the stack, the nozzle was sealed with Teflon tape.

The probe tip was placed at each of the sample points determined in Method 1. The velocity at the sample point was determined using Method 2 by reading the velocity pressure from the manometer. Sample was withdrawn from the source at a rate such that the velocity at the opening of the nozzle matched the velocity of the stack gas at the sample point (isokinetically). During the test run the train was moved to each of the Method 1 sample points. The sample time at each point was calculated based on the number of sample points and the maximum allowable run time. The gas velocity pressure (ΔP), gas meter reading, gas meter inlet and outlet temperatures, gas meter orifice pressure (ΔH) and pump vacuum was recorded for each sample point.

After the test run the train was leak checked at the highest vacuum encountered during the test run. The probe liner and nozzle were washed with acetone and the rinse saved. The filter was removed from the filter holder, transferred to a container and sealed. The H_2SO_4 impinger contents were recovered separately and stored in HDPE sample jars.

Analysis of the samples for particulate matter was performed at the Montrose laboratory located in Elk Grove Village, Illinois. The probe rinses were transferred to a tared beaker, evaporated to dryness under ambient temperature and pressure conditions, desiccated for 24 hours and weighed to a constant weight. The filters were desiccated for 24 hours and weighed to a constant weight. The weight gain of the probe rinse and filters yield the total weight of particulate collected. To eliminate interference in establishing a constant weight, both the analytical balance and the desiccators were equipped with an ion generating polonium strip designed to eliminate static electricity that may collect on the samples.

Analysis of the samples for HCl was performed at the Element One laboratory located in Wilmington, North Carolina.

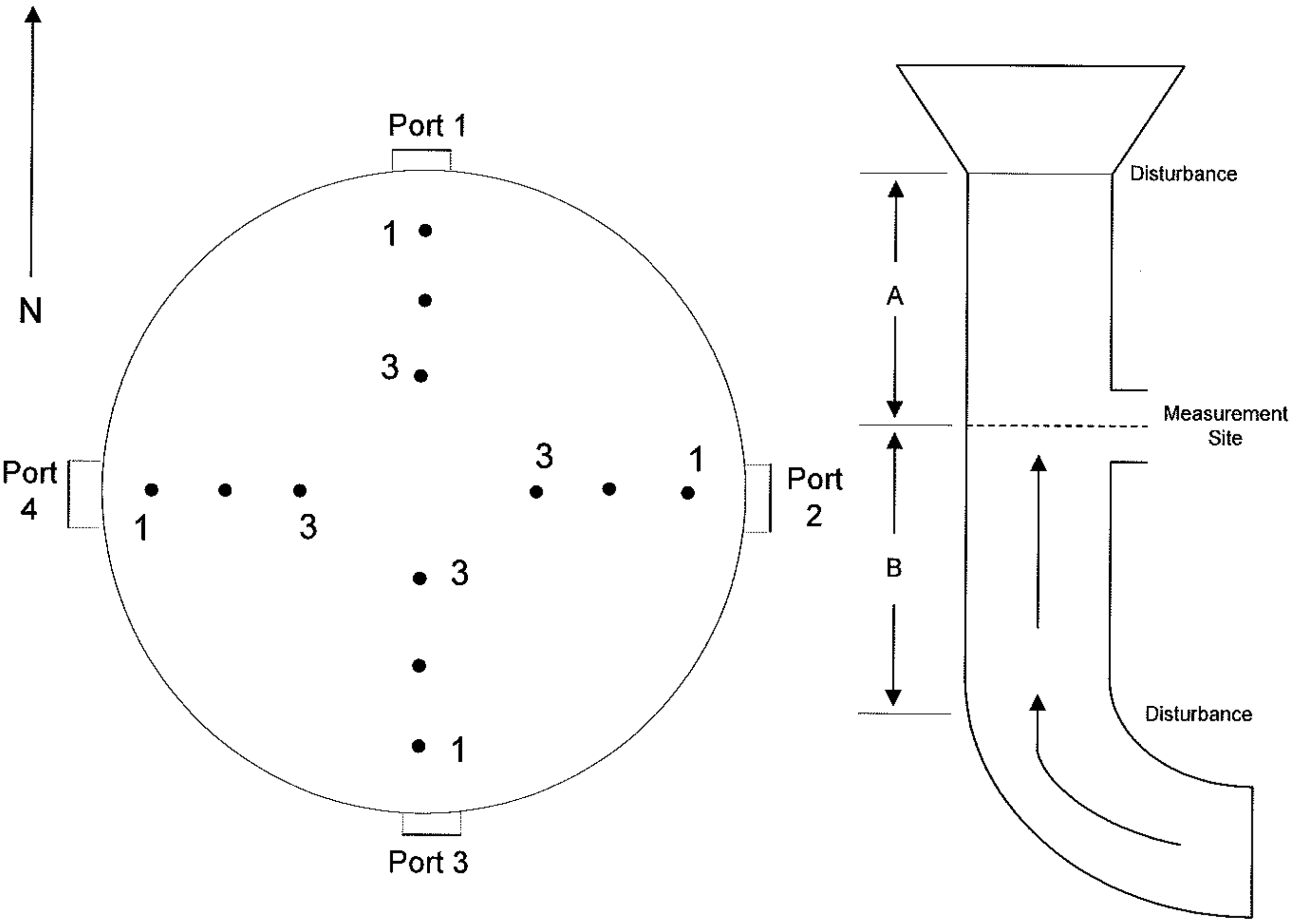
3.2.6 Method 19

The equations in EPA Method 19 were used to calculate the emission rates of various pollutants from the test location in units of lb/mmBtu. The calculations were based on the O_2 concentration of the sample gas and an appropriate F factor, which is the ratio of combustion gas volumes to heat inputs. In order to calculate the lb/mmBtu emission rate, an Fd factor of 9,820 dscf/mmBtu was used as per 40CFR Part 75 for sub-bituminous coal.

4.0 DESCRIPTION OF INSTALLATION

Boilers #7-9 are Riley pulverized coal wall fired dry bottom utility boilers which use distillate oil start-up guns. Each boiler's nameplate steam capacity rating is 615,000 lb/hr with a heat input capacity of approximately 1010 MMBTU/hr. Each boiler serves a GE steam turbine/generator set rated at 78,982 KW. Mercury emissions from Boilers #7, #8, and #9 are controlled with a TOXECON TM mercury control demonstration system installed in 2005. Each boiler is equipped with an electrostatic precipitator and the TOXECON TM fabric filter baghouse common to Boilers #7 through #9.

APPENDIX A
FIGURES

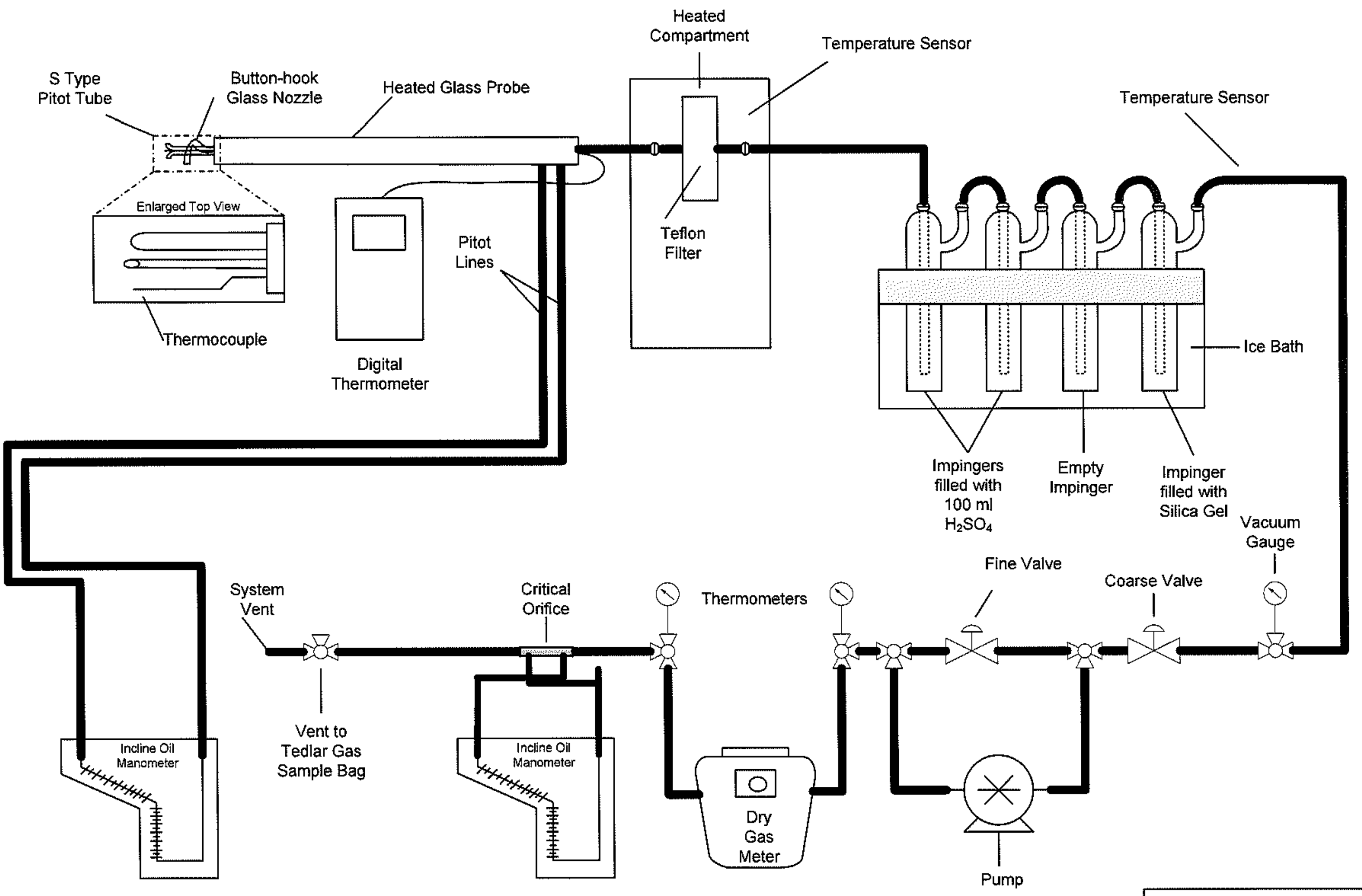


Diameter (in.)	114
Port Length (in.)	7.0
Distance A (Duct Diameters)	10.5
Distance B (Duct Diameters)	15.8

Point	Distance From Wall (in.)
1	4.9
2	16.7
3	33.7

Cross Section of Unit 9
We Energies - PIPP

Figure 1



EPA Methods 2, 3, 4, and 5/26A:
Sampling Train
Figure 2

MONTROSE
AIR QUALITY SERVICES

APPENDIX B
SAMPLE CALCULATIONS

Sample Calculations for Unit 9, Run 1

Area of Sample Location

$$\mathrm{A_s} = (\pi)\left(\frac{d_s}{2\times 12}\right)^2$$

$$\mathrm{A_s} = (\pi)\left(\frac{114}{2\times 12}\right)^2$$

$$\mathrm{A_s} = 70.9 ft^2$$

where:

A_s = area of stack (ft^2)
d_s = diameter of stack (in)
12 = conversion factor (in/ft)
2 = conversion factor (diameter to radius)

Stack Pressure Absolute

$$P_a = P_b + \frac{P_s}{13.6}$$

$$P_a = 29.41 + \frac{-0.7}{13.6}$$

$$P_a = 29.36 in.Hg$$

where:

P_a = stack pressure absolute (in. Hg)
P_b = barometric pressure (in. Hg)
P_s = static pressure (in. H_2O)
13.6 = conversion factor (in. H_2O/in. Hg)

Volume of Dry Gas Collected Corrected to Standard Conditions

$$V_{m(std)} = \frac{17.64(V_m)(Y_d)\left(P_b + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{m(std)} = \frac{17.64(80.39)(0.9987)\left(29.41 + \frac{1.53}{13.6}\right)}{(71.1 + 460)}$$

$$V_{m(std)} = 78.72 scf$$

where:

$V_{m(std)}$	= volume of gas collected at standard conditions (scf)
V_m	= volume of gas sampled at meter conditions (ft^3)
Y_d	= gas meter correction factor (dimensionless)
P_b	= barometric pressure (in. Hg)
ΔH	= average sample pressure (in. H_2O)
T_m	= average gas meter temperature (°F)
13.6	= conversion factor (in. H_2O/in. Hg)
17.64	= ratio of standard temperature over standard pressure (°R/in. Hg)
460	= conversion (°F to °R)

Volume of Water Vapor Collected Corrected to Standard Conditions

$$V_{w(std)} = 0.04715 \times V_{wc} + 0.04715 \times V_{wsg}$$

$$V_{w(std)} = 0.04715 \times 186.9 + 0.04715 \times 9.5$$

$$V_{w(std)} = 9.26 scf$$

where:

$V_{w(std)}$	= volume of water vapor at standard conditions (scf)
V_{wc}	= weight of liquid collected (g)
V_{wsg}	= weight gain of silica gel (g)
0.04715	= volume occupied by one gram water at standard conditions (ft^3/g)

Percent Moisture[1]

$$B_{ws} = 100 \times \left[\frac{V_{w(std)}}{\left(V_{m(std)} + V_{w(std)}\right)} \right]$$

$$B_{ws} = 100 \times \left[\frac{9.26}{\left(78.72 + 9.26\right)} \right]$$

$$B_{ws} = 10.5\%$$

where:

B_{ws}	= moisture content of the gas stream (%)
$V_{m(std)}$	= volume of gas collected at standard conditions (scf)
$V_{w(std)}$	= volume of water vapor at standard conditions (scf)
100	= conversion factor

Molecular Weight of Dry Gas Stream[2]

$$M_d = \left(44 \times \frac{\%CO_2}{100}\right) + \left(32 \times \frac{\%O_2}{100}\right) + \left(28 \times \frac{(\%N_2)}{100}\right)$$

$$M_d = \left(44 \times \frac{13.3}{100}\right) + \left(32 \times \frac{6.4}{100}\right) + \left(28 \times \frac{80.3}{100}\right)$$

$$M_d = 30.38 lbs / lb - mole$$

where:

M_d	= molecular weight of the dry gas stream (lb/lb-mole)
$\%CO_2$	= carbon dioxide content of the dry gas stream (%)
44	= molecular weight of carbon dioxide (lb/lb-mole)
$\%O_2$	= oxygen content of the dry gas stream (%)
32	= molecular weight of oxygen (lb/lb-mole)
%CO	= carbon monoxide content of the dry gas stream (%)
$\%N_2$	= nitrogen content of the dry gas stream (%)
28	= molecular weight of nitrogen (lb/lb-mole)
100	= conversion factor

---

[1] In the event that the measured moisture concentration exceeds the calculated saturation point of the stack gas, the saturated moisture values are used in all ensuing calculations.

[2] The remainder of the gas stream after subtracting carbon dioxide and oxygen is assumed to be nitrogen.

Molecular Weight of Wet Gas Stream

$$M_s = \left(M_d \times \left(1 - \frac{B_{ws}}{100}\right)\right) + \left(18 \times \frac{B_{ws}}{100}\right)$$

$$M_s = \left(30.38 \times \left(1 - \frac{10.5}{100}\right)\right) + \left(18 \times \frac{10.5}{100}\right)$$

$$M_s = 29.07\, lbs / lb - mole$$

where:

M_s = molecular weight of the wet gas stream (lb/lb-mole)
M_d = molecular weight of the dry gas stream (lb/lb-mole)
B_{ws} = moisture content of the gas stream (%)
18 = molecular weight of water (lb/lb-mole)
100 = conversion factor

Velocity of Gas Stream

$$V_s = 85.49\left(C_p\right)\left(\sqrt{\Delta P}\right)\sqrt{\frac{\left(T_s + 460\right)}{\left(M_s\right)\left(P_a\right)}}$$

$$V_s = 85.49\left(0.84\right)\left(1.16\right)\sqrt{\frac{\left(328 + 460\right)}{\left(29.07\right)\left(29.36\right)}}$$

$$V_s = 80.3\, ft / \sec$$

where:

V_s = average velocity of the gas stream (ft/sec)
C_p = pitot tube coefficient (dimensionless)
$\sqrt{\Delta P}$ = average square root of velocity pressures (in. H_2O)$^{1/2}$
T_s = average stack temperature (°F)
M_s = molecular weight of the wet gas stream (lb/lb-mole)
P_a = stack pressure absolute (in. Hg)
85.49 = pitot tube constant (ft/sec)([(lb/lb-mole)(in. Hg)]/[(°R)(in. H_2O)])$^{1/2}$
460 = conversion (°F to °R)

Volumetric Flow of Gas Stream - Actual Conditions

$$Q_a = 60(V_s)(A_s)$$
$$Q_a = 60(80.3)(70.9)$$
$$Q_a = 341{,}502 \, acfm$$

where:

Q_a = volumetric flow rate of the gas stream at actual conditions (acfm)
V_s = average velocity of the gas stream (ft/sec)
A_s = area of duct or stack (ft^2)
60 = conversion factor (sec/min)

Volumetric Flow of Gas Stream - Standard Conditions

$$Q_{std} = \frac{17.64(Q_a)(P_a)}{(T_s + 460)}$$
$$Q_{std} = \frac{17.64(341{,}502)(29.36)}{(328 + 460)}$$
$$Q_{std} = 224{,}487 \, scfm$$

where:

Q_{std} = volumetric flow rate of the gas stream at standard conditions (scfm)
Q_a = volumetric flow rate of the gas stream at actual conditions (acfm)
T_s = average stack temperature (°F)
P_a = stack pressure absolute (in. Hg)
17.64 = ratio of standard temperature over standard pressure (°R/in. Hg)
460 = conversion (°F to °R)

Volumetric Flow of Gas Stream - Standard Conditions - Dry Basis

$$Q_{dstd} = Q_{std}\left(1 - \frac{B_{ws}}{100}\right)$$

$$Q_{dstd} = 224,487\left(1 - \frac{10.5}{100}\right)$$

$$Q_{dstd} = 200,940 dscfm$$

where:

Q_{dstd} = volumetric flow rate of the dry gas stream at standard conditions (dscfm)
Q_{std} = volumetric flow rate of the gas stream at standard conditions (scfm)
B_{ws} = moisture content of the gas stream (%)
100 = conversion factor

Area of Nozzle

$$A_n = \pi \times \left(\frac{d_n}{2 \times 12}\right)^2$$

$$A_n = \pi \times \left(\frac{0.205}{2 \times 12}\right)^2$$

$$A_n = 0.000229 ft^2$$

where:

A_n = area of nozzle (ft^2)
d_n = diameter of nozzle (in)
12 = conversion factor (in/ft)
2 = conversion factor (diameter to radius)

Percent Isokinetic

$$I=\frac{0.0945\left(T_s+460\right)\left(V_{m(std)}\right)}{\left(P_a\right)\left(V_s\right)\left(A_n\right)(\Theta)\left(1-\frac{B_{ws}}{100}\right)}$$

$$I=\frac{0.0945(328+460)(78.72)}{(29.36)(80.3)(0.000229)(120)\left(1-\frac{10.5}{100}\right)}$$

$$I=101.0\%$$

where:

I	= percent isokinetic (%)
T_s	= average stack temperature (°F)
460	= conversion (°F to °R)
$V_{m(std)}$	= volume of gas collected at standard conditions (scf)
P_a	= stack pressure absolute (in. Hg)
V_s	= average velocity of the gas stream (ft/sec)
A_n	= cross sectional area of nozzle (ft^2)
Θ	= sample time (min)
B_{wsat}	= moisture saturation point of the gas stream (%)
0.0945	= constant K_4 (((in.Hg)(min))/((°R)(sec)))
100	= conversion factor

Acetone Wash Blank-Particulate

$$W_a=\frac{\left(m_{ab}\right)\left(v_{aw}\right)}{v_{awb}}$$

$$W_a=\frac{(0.0012)(101)}{226}$$

$$W_a=0.0006g$$

where:

W_a	= particulate mass in acetone wash, blank corrected (g)
m_{ab}	= mass collected, acetone wash blank (g)
v_{aw}	= volume of acetone wash (ml)
v_{awb}	= volume of acetone wash blank (ml)

Mass in Front Half, Acetone Blank Corrected

$$m_f = m_{fil} + (m_a - W_a)$$

$$m_f = 0.0000 + (0.0017 - 0.0006)$$

$$m_f = 0.0011g$$

where:

m_f = mass in front half filter, and acetone wash, blank corrected (g)
m_{fil} = mass in front half filter (g)
m_a = mass in acetone wash (g)
Wa = particulate mass in acetone wash blank (g)

Total Particulate Concentration, grains/dscf

$$C_{gr/dscf} = \frac{(M_n)(15.43)}{V_{m(std)}}$$

$$C_{gr/dscf} = \frac{(0.0011)(15.43)}{78.72}$$

$$C_{gr/dscf} = 0.000224 grains / dscf$$

where:

$C_{gr/dscf}$ = particulate concentration (grains/dscf)
M_n = total particulate catch (g)
$V_{m(std)}$ = volume of gas collected at standard conditions (scf)
453.6 = conversion factor (grains/g)

Particulate Emission Rate, lb/mmBtu [3]

$$E_{PM} = \frac{(M_n)(F_d)(20.9)}{(V_{m(std)})(453.6)(20.9 - O_2)}$$

$$E_{PM} = \frac{(0.0011)(9,820)(20.9)}{(78.72)(453.6)(20.9 - 6.4)}$$

$$E_{PM} = 0.000451 lb / mmBtu$$

where:

E_{PM} = particulate matter emission rate, (lb/mmBtu)
M_n = particulate catch (g)
F_d = fuel factor (dcsf/mmBtu)
20.9 = oxygen content of ambient air (%)
$V_{m(std)}$ = volume of gas collected at standard temperature and pressure (scf)
453.6 = conversion factor (g/lb)
O_2 = oxygen content of the dry gas stream (%)

Total Particulate Emission Rate, lb/hr

$$E_{lb/hr} = \frac{(M_n)(Q_{dstd})(60)}{(V_{m(std)})(453.6)}$$

$$E_{lb/hr} = \frac{(0.0011)(200,940)(60)}{(78.72)(453.6)}$$

$$E_{lb/hr} = 0.385 lb / hr$$

where:

$E_{lb/hr}$ = particulate emission rate (lb/hr)
M_n = total particulate catch (g)
$V_{m(std)}$ = volume of gas collected at standard conditions (scf)
Q_{dstd} = volumetric flow rate of the dry gas stream at standard conditions (dscfm)
60 = conversion factor (min/hr)
453.7 = conversion factor (g/lb)

---

[3] All particulate emission rates are calculated in a similar manner.

Concentration of Hydrogen Chloride in Flue Gas (lb/dscf)

$$C_{HCL} = \frac{\left(M_{HCl}\right)}{\left(V_{m(std)}\right)\left(10^{3}\right)\left(453.59\right)}$$

$$C_{HCl} = \frac{\left(1.15\right)}{\left(78.72\right)\left(10^{3}\right)\left(453.59\right)}$$

$$C_{HCl} = 3.22 \times 10^{-8}\, lb/dscf$$

where:

C_{HCl} = concentration of hydrogen chloride in flue gas (lb/dscf)
M_{HCl} = mass of hydrogen chloride collected in sample (mg)
$V_{m(std)}$ = volume of gas collected at standard temperature and pressure (scf)
10^3 = conversion factor (mg/g)
453.59 = conversion factor (g/lb)

Concentration of Hydrogen Chloride in Flue Gas, ppmdv

$$C_{ppmv} = \frac{\left(M_{HCl}\right)\left(385.3\right)\left(10^{6}\right)}{\left(MW_{HCl}\right)\left(V_{m(std)}\right)\left(10^{3}\right)\left(453.59\right)}$$

$$C_{ppmv} = \frac{\left(1.15\right)\left(385.3\right)\left(10^{6}\right)}{\left(36.46\right)\left(78.72\right)\left(10^{3}\right)\left(453.59\right)}$$

$$C_{ppmv} = 0.340\, ppmdv$$

where:

C_{ppmdv} = concentration of hydrogen chloride in flue gas (ppmdv)
M_{HCl} = mass of hydrogen chloride collected in sample (mg)
385.3 = conversion factor (ft^3/lb-mole)
10^6 = conversion factor (ppm)
MW_{HCl} = molecular weight of hydrogen chloride (lb/lb-mole)
$V_{m(std)}$ = volume of gas collected at standard temperature and pressure (scf)
10^3 = conversion factor (mg/g)
453.59 = conversion factor (g/lb)

Hydrogen Chloride Emission Rate, lb/mmBtu[4]

$$E_{HCl} = \frac{\left(C_{HCl}\right)\left(F_d\right)\left(MW\right)\left(20.9\right)}{\left(20.9 - O_2\right)\left(385.3\right)\left(10^6\right)}$$

$$E_{HCl} = \frac{\left(0.340\right)\left(9,820\right)\left(36.46\right)\left(20.9\right)}{\left(20.9 - 6.4\right)\left(385.3\right)\left(10^6\right)}$$

$$E_{HCl} = 0.000454 lb / mmBtu$$

where:

E_{HCl} = hydrogen chloride emission rate, (lb/mmBtu)
C_{HCl} = hydrogen chloride concentration, (ppm)
F_d =fuel factor (dcsf/mmBtu)
20.9 = oxygen content of ambient air (%)
%O_2 = oxygen content of the dry gas stream (%)
MW = molecular weight of hydrogen chloride (lb/lbmole)
385.3 = volume occupied by one pound gas at standard conditions (dscf/lbmole)

Hydrogen Chloride Emission Rate, lb/hr

$$E_{HCl} = \frac{\left(C_{ppmwv}\right)\left(MW\right)\left(Q_{std}\right)\left(60\right)}{385.3 \times 10^6}$$

$$E_{HCl} = \frac{\left(0.340\right)\left(36.46\right)\left(200,940\right)\left(60\right)}{385.3 \times 10^6}$$

$$E_{HCl} = 0.388 lb / hr$$

where:

E_{HCl} = hydrogen chloride emission rate, (lb/hr)
C_{ppmdv} = hydrogen chloride concentration, dry basis, (ppmdv)
Q_{dstd} = volumetric flow rate of the dry gas stream at standard conditions (dscfm)
MW = molecular weight of hydrogen chloride (lb/lbmole)
60 = conversion factor (min/hr)
385.3 = volume occupied by one pound gas at standard conditions (dscf/lbmole)
10^6 = conversion factor (fraction to ppm)

---

[4] All lb/mmBtu calculations were performed in a similar manner.

APPENDIX C
PARAMETERS

EPA Methods 1-4 Parameters	Run 1	Run 2	Run 3
Date	2/28/2019	2/28/2019	2/28/2019
Start Time	6:57	9:14	11:32
Stop Time	9:02	11:19	13:38
Dimensions of Sample Location, D_s (in)	114.0	114.0	114.0
Velocity Pressure, $\Delta P^{1/2}$ avg (in. $H_2O^{1/2}$)	1.17	1.16	1.16
Barometric Pressure, P_b (Inches Hg)	29.40	29.40	29.40
Static Pressure, P_s (Inches H_2O)	-0.7	-0.7	-0.7
Pitot Coefficient, C_p	0.84	0.84	0.84
Sample Location Temperature, T_s (°F)	333	328	335
Volume Metered, V_m (ft^3)	81.74	80.80	82.09
Meter Temperature, T_m (°F)	48.0	54.0	58.8
Average Sample Pressure, ΔH_{avg} (in. H_2O)	1.62	1.58	1.63
Gas Meter Correction Factor, Y_d	0.9942	0.9942	0.9942
Carbon Dioxide (% dry)	13.8	13.7	13.7
Oxygen (% dry)	5.5	5.7	5.9
Weight of Water Collected, V_{wc} (g)	229.6	204.5	214.4
Silica Gel Net Weight, V_{wsg} (g)	14.1	13.5	18.0
Diameter of Nozzle, D_n (in)	0.210	0.210	0.210
Run Time, θ (minutes)	120	120	120

EPA METHODS 1-4 RESULTS			
Area of Sample Location, A_s (ft^2)	70.9	70.9	70.9
Stack Pressure Absolute (inches Hg)	29.35	29.35	29.35
Volume Metered Standard, $V_{m(std)}$ (ft^3)	83.29	81.38	81.92
Volume of Water Vapor, $V_{w(std)}$ (ft^3)	11.49	10.28	10.96
Percent Moisture, B_{ws} (%)	12.1	11.2	11.8
Moisture Saturation Point, B_{wsat} (%)	100	100	100
Dry Molecular Weight, M_d (lbs/lb mole)	30.43	30.42	30.42
Wet Molecular Weight, M_s (lbs/lb mole)	28.92	29.03	28.96
Gas Velocity, V_s (ft/sec)	80.9	79.9	80.5
Average Flowrate, Q_a (acfm)	344,203	339,859	342,398
Standard Flowrate, Q_{std} (scfm)	224,594	223,260	222,994
Dry Standard Flowrate, Q_{dstd} (dscfm)	197,446	198,303	196,766
Area of Nozzle, A_n (ft^2)	0.000241	0.000241	0.000241
Isokinetics (%)	103.7	100.8	102.3
Oxygen-based Fuel Factor, F_d, (dscf/MMBtu)	9,820	9,820	9,820
Front-Half Particulate (g)	0.0022	0.0021	0.0024
Concentration (grains/dscf)	0.000409	0.000407	0.000458
Emission Rate, Fd (lb/mmBtu)	0.000776	0.000784	0.000893
Emission Rate (lb/hr)	0.692	0.693	0.772
Hydrogen Chloride (mg)	1.40	1.38	1.54
Hydrogen Chloride Concentration (lb/dscf)	3.71E-08	3.74E-08	4.14E-08
Hydrogen Chloride Concentration (ppmdv)	0.392	0.395	0.438
Hydrogen Chloride Emission Rate, F_d (lb/MMBtu)	0.000493	0.000504	0.000566
Hydrogen Chloride Emission Rate (lb/hr)	0.439	0.445	0.489

APPENDIX D
FIELD DATA PRINTOUTS

Project Number	023AS-554128
Client	We Energies
Plant	Presque Isle, MI
Location	Unit 9
Date	2/28/2019
Meter ID	M-28
Y_d	0.9942
Pitot C_p	0.84

Nozzle Diameter (in)	0.210
Filter ID	31826
Train Type	IMP
Train ID	IMP-1
P_b (Inches Hg)	29.40
P_s (Inches H_2O)	-0.7
Start Time	6:57
Stop Time	9:02

Place an "x" in the appropriate Box

Circular?	x
Rectangular?	
Diameter	114
Length	
Width	

Moisture	Tare Wt (g)	Final Wt (g)	Net Wt (g)
Impinger 1	747.0	1013.4	266.4
Impinger 2	576.8	586.1	9.3
Impinger 3	594.1	598.0	3.9
DI Rinse			-50.0
Silica Gel	787.8	801.9	14.1
Weight of Water Collected, V_{wc} (g)			229.6
Silica Gel Net Weight, V_{wsg} (g)			14.1

Analyzer	%CO_2	%CO_2+%O_2	%O_2
Trial 1	13.8	19.2	5.4
Trial 2	13.8	19.4	5.6
Trial 3	13.8	19.2	5.4
Average	13.8	NA	5.5

Run 1

Traverse Point	Min/Pt 10 Elapsed Time	Velocity Pressure Δ P (in. H_2O)	Orifice Setting Δ H (in. H_2O)	Gas Sample Volume Initial (ft³) 135.70	Stack Temp. (°F)	DGM Inlet (°F)	DGM Outlet (°F)	Square Root Δ P	Stack Gas Velocity Vs (ft/sec)	Volume Metered Vmstd (ft³)	Isokinetics (%)
1-1	10	1.80	2.10	143.59	337	43	43	1.342	93.4	8.130	105.7
1-2	20	1.40	1.60	150.43	336	45	43	1.183	82.3	7.026	103.5
1-3	30	0.96	1.10	155.96	335	46	43	0.980	68.1	5.667	100.8
2-1	40	1.70	2.00	163.60	335	48	44	1.304	90.6	7.824	104.6
2-2	50	1.50	1.80	170.85	336	50	44	1.225	85.2	7.406	105.4
2-3	60	0.97	1.10	176.38	335	51	45	0.985	68.4	5.628	99.6
3-1	70	1.70	2.00	184.05	334	53	45	1.304	90.6	7.808	104.3
3-2	80	1.30	1.50	190.42	333	54	46	1.140	79.1	6.464	98.7
3-3	90	0.98	1.20	196.70	332	55	46	0.990	68.7	6.362	111.8
4-1	100	1.80	2.10	204.57	331	55	47	1.342	93.0	7.983	103.4
4-2	110	1.50	1.80	211.85	329	56	47	1.225	84.8	7.372	104.5
4-3	120	0.94	1.10	217.44	328	56	48	0.970	67.1	5.645	101.0
Totals and Averages											
	120		1.62	81.74	333	48.0		1.166	80.9	83.29	103.7

Project Number	023AS-554128
Client	We Energies
Plant	Presque Isle, MI
Location	Unit 9
Date	2/28/2019
Meter ID	M-28
Y_d	0.9942
Pitot C_p	0.84

Nozzle Diameter (in)	0.210
Filter ID	31827
Train Type	IMP
Train ID	IMP-10
P_b (Inches Hg)	29.40
P_s (Inches H_2O)	-0.7
Start Time	9:14
Stop Time	11:19

Place an "x" in the appropriate Box

Circular?	x
Rectangular?	
Diameter	114
Length	
Width	

Moisture	Tare Wt (g)	Final Wt (g)	Net Wt (g)
Impinger 1	694.7	938.3	243.6
Impinger 2	636.7	643.7	7.0
Impinger 3	588.8	592.7	3.9
DI Rinse			-50.0
Silica Gel	822.0	835.5	13.5
Weight of Water Collected, V_{wc} (g)			204.5
Silica Gel Net Weight, V_{wsg} (g)			13.5

Analyzer	%CO_2	%CO_2+%O_2	%O_2
Trial 1	13.8	19.4	5.6
Trial 2	13.6	19.4	5.8
Trial 3	13.8	19.4	5.6
Average	13.7	NA	5.7

Run 2

Traverse Point	Min/Pt 10 Elapsed Time	Velocity Pressure ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume Initial (ft^3) 217.90	Stack Temp. (°F)	DGM Inlet (°F)	DGM Outlet (°F)	Square Root ΔP	Stack Gas Velocity Vs (ft/sec)	Volume Metered Vmstd (ft^3)	Isokinetics (%)
4-1	10	1.70	2.00	225.52	329	50	50	1.304	90.3	7.742	103.1
4-2	20	1.40	1.60	232.42	328	52	50	1.183	81.9	6.990	102.5
4-3	30	0.96	1.10	237.97	327	53	51	0.980	67.8	5.604	99.2
3-1	40	1.80	2.10	245.89	328	53	51	1.342	92.8	8.018	103.7
3-2	50	1.30	1.50	252.60	327	55	51	1.140	78.8	6.769	102.9
3-3	60	0.96	1.10	258.20	327	56	52	0.980	67.8	5.633	99.7
2-1	70	1.80	2.10	266.11	328	56	52	1.342	92.8	7.976	103.1
2-2	80	1.40	1.60	272.93	329	58	53	1.183	81.9	6.849	100.5
2-3	90	0.94	1.10	278.51	328	59	53	0.970	67.1	5.591	100.0
1-1	100	1.70	2.00	286.24	329	59	54	1.304	90.3	7.755	103.3
1-2	110	1.40	1.60	293.18	329	59	54	1.183	81.9	6.956	102.1
1-3	120	0.95	1.10	298.70	328	60	54	0.975	67.4	5.520	98.3
Totals and Averages											
	120		1.58	80.80	328	54.0		1.157	80.9	83.29	100.8

Project Number	023AS-554128
Client	We Energies
Plant	Presque Isle, MI
Location	Unit 9
Date	2/28/2019
Meter ID	M-28
Y_d	0.9942
Pitot C_p	0.84

Nozzle Diameter (in)	0.210
Filter ID	31828
Train Type	IMP
Train ID	IMP-14
P_b (Inches Hg)	29.40
P_s (Inches H_2O)	-0.7
Start Time	11:32
Stop Time	13:38

Place an "x" in the appropriate Box

Circular?	x
Rectangular?	
Diameter	114
Length	
Width	

Moisture	Tare Wt (g)	Final Wt (g)	Net Wt (g)
Impinger 1	750.6	1000.7	250.1
Impinger 2	714.2	724.8	10.6
Impinger 3	609.3	613.0	3.7
DI Rinse			-50.0
Silica Gel	809.3	827.3	18.0
Weight of Water Collected, V_{wc} (g)			214.4
Silica Gel Net Weight, V_{wsg} (g)			18.0

Analyzer	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$
Trial 1	13.8	19.4	5.6
Trial 2	13.6	19.6	6.0
Trial 3	13.6	19.6	6.0
Average	13.7	NA	5.9

Run 3

Traverse Point	Min/Pt 10 Elapsed Time	Velocity Pressure ΔP (In. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume Initial (ft^3) 299.10	Stack Temp. (°F)	DGM Inlet (°F)	DGM Outlet (°F)	Square Root ΔP	Stack Gas Velocity Vs (ft/sec)	Volume Metered Vmstd (ft^3)	Isokinetics (%)
1-1	10	1.70	2.00	306.88	334	55	55	1.304	90.6	7.828	104.6
1-2	20	1.40	1.70	313.94	334	57	55	1.183	82.2	7.085	104.3
1-3	30	0.98	1.20	319.50	333	58	55	0.990	68.7	5.567	97.9
2-1	40	1.80	2.10	327.46	336	58	56	1.342	93.3	7.980	103.7
2-2	50	1.40	1.70	334.51	335	60	56	1.183	82.2	7.047	103.8
2-3	60	0.96	1.10	340.14	334	61	56	0.980	68.1	5.614	99.8
3-1	70	1.70	2.00	347.90	336	61	57	1.304	90.7	7.748	103.6
3-2	80	1.30	1.60	354.74	336	62	57	1.140	79.3	6.816	104.2
3-3	90	0.97	1.20	360.58	335	63	57	0.985	68.4	5.808	102.8
4-1	100	1.80	2.10	368.40	336	65	58	1.342	93.3	7.772	101.0
4-2	110	1.40	1.70	375.59	335	66	58	1.183	82.2	7.132	105.0
4-3	120	0.95	1.10	381.19	335	66	58	0.975	67.7	5.547	99.2
Totals and Averages											
	120		1.63	82.09	335	58.8		1.159	80.9	83.29	102.3

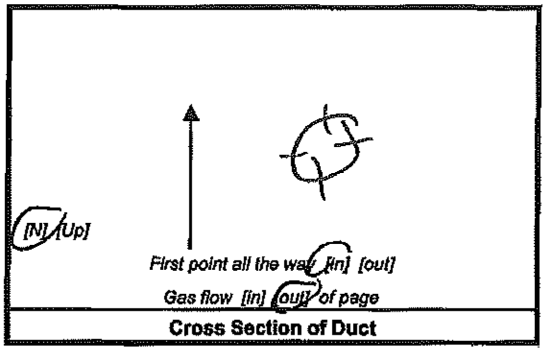
APPENDIX E
FIELD DATA

MONTROSE AIR QUALITY SERVICES, LLC

EPA Method 1
Sample and Velocity Traverses Datasheet

LOCATION unit 9

Client	P.PP
Project No:	554128
Plant	marquette, MI
Date	2/28/19
Technician	BR
Duct Diameter (in.)	114
Port Diameter (in.)	—
Port Length (in.)	7
Port Type	male Flange
Distance A (ft)	99.75
Distance B (ft)	150.1
Distance A (Duct Diameters)	10.5
Distance B (Duct Diameters)	15.8



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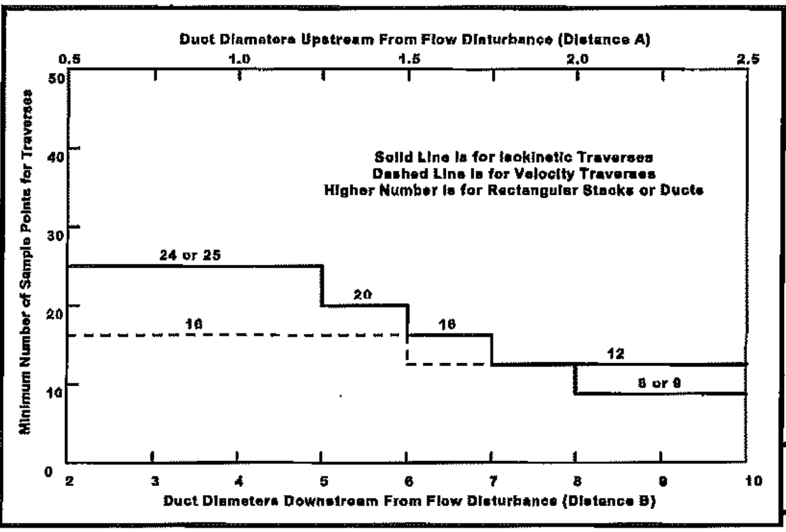
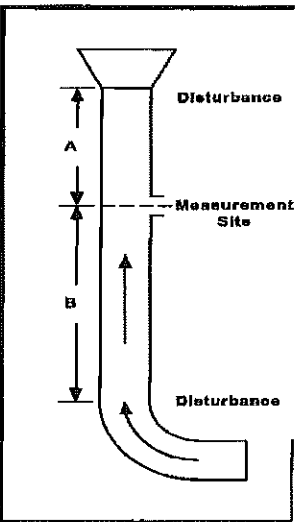
Gas flow [in] [✓ [out]] of page

Cross Section of Duct

For rectangular ducts

E





Loca

1	11.9
2	23.7
3	40.7
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

Indicate sample ports, height from grade, types of disturbances, access, unistrut configuration, etc.

Distance to point must include length of port

MONTROSE AIR QUALITY SERVICES, LLC

General Testing Datasheet

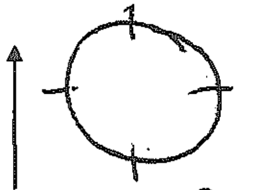
TESTING TYPE: PM/HCL

RUN NO. 1

METHOD NO. 5/26a

Page 1 **of** 1

Client	WE ENERGIES				
Plant	MARQUETTE, MI				
Location	UNIT 9				
Date	02-28-19	**Project No.**			
Meter Operator	JD				
Probe Operator	BK				
Meter ID	M-28	**Yd**	.9942	**Pitot Cp**	.84
ΔH@	1.895	**Kf**	1.17	**Leak check**	✓
Pre Leak Check	.000	**[cfm] [lpm] @**	17	**(inHg)**	
Post Leak Check	.000	**[cfm] [lpm] @**	3	**(inHg)**	



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First point all the way [✓ in] [out]

Gas flow [in] [✓ out] of page

Cross Section of Duct

Barometric (in. Hg)	29.40	**Water (ml) (g)**	
Ambient Temp. (°F)	37°F	**Silica gel (g)**	
Static (in. H_2O)	-0.7	**Total Vlc**	
Probe ID AE	5-4-9	**Liner Type**	GLASS
Nozzle ID	.210	**Nozzle Dia (in.)**	.210
Filter ID	31836	—	—
Train ID	1B-1	**Train Type**	IMP
Duct Dim. (in.)	114"	**Port Lgth. (in.)**	12"
Start Time	657	**Stop Time**	902

Traverse Point	Min/Point 10 Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (in H_2O)	Gas Sample Volume Initial [✓ ft³] [l] 135.70	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	Auxiliary Temp (°F)	Notes
1-1	10	1.8	2.1	143.59	337	257	253	38	43	43	6	N/A	
2	20	1.4	1.6	150.43	336	258	256	39	45	43	5		
3	30	.96	1.1	155.96	335	260	257	41	46	43	4		
2-1	40	1.7	2.0	163.60	335	252	251	43	48	44	6		
2	50	1.5	1.8	170.85	336	254	253	44	50	44	6		
3	60	.97	1.1	176.38	335	256	254	46	51	45	4		
3-1	70	1.7	2.0	184.05	334	256	256	47	53	45	6		
2	80	1.3	1.5	190.42	333	255	255	49	54	46	5		
3	90	.98	1.2	196.70	332	257	254	51	55	46	4		
4-1	100	1.8	2.1	204.57	331	256	255	52	55	47	6		
2	110	1.5	1.8	211.85	329	255	253	54	56	47	6		
3	120	.94	1.1	217.44	328	254	251	55	56	48	4		
Total	120	14.2017	19.40	81.74	4031.00				612.00	541.00			
Average		1.1835	1.62		333.42				48.04				

Circle correct bracketed [ ] units
Train Type denotes impingers, knockouts, etc.

MONTROSE AIR QUALITY SERVICES, LLC

General Testing Datasheet

TESTING TYPE: PM/HCL

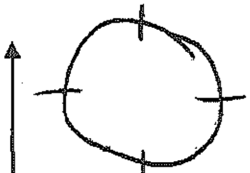
RUN NO. 2

METHOD NO. 5/26a

Page	1	of	1

Client	WE ENERGIES				
Plant	MARQUETTE, MI				
Location	UNIT 9				
Date	02-28-19	Project No.			
Meter Operator	JD				
Probe Operator	BR				
Meter ID	M-28	Yd	.9942	Pitot Cp	.84
ΔH@	1.8975	Kf	1.16	Leak check	
Pre Leak Check	.000	[✓ cfm] [lpm] @	18	(inHg)	
Post Leak Check	.000	[✓ cfm] [lpm] @	9	(inHg)	

[✓ IN] [Up]



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Gas flow [in] [✓ out] of page

Cross Section of Duct

Barometric (in. Hg)	29.40	Water (ml) (g)	
Ambient Temp. (°F)	38°F	Silica gel (g)	
Static (in. H_2O)	-0.7	Total Vlc	
Probe ID AE	5.4.9	Liner Type	GLASS
Nozzle ID	.210	Nozzle Dia (in.)	.210
Filter ID 31827	~~31850~~	—	—
Train ID	1B-10	Train Type	IMP
Duct Dim. (in.)	114"	Port Lgth. (in.)	12"
Start Time	914	Stop Time	1119

Traverse Point	Min/Point 10 Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (in H_2O)	Gas Sample Volume Initial [✓ ft³] [l] 217.90	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	Auxiliary Temp (°F)	Notes
4-1	10	1.7	2.0	225.52	329	254	251	36	50	50	6	N/A	
2	20	1.4	1.6	232.42	328	256	259	38	52	50	5		
3	30	.96	1.1	237.97	327	257	258	40	53	51	4		
3-1	40	1.8	2.1	245.89	328	254	256	42	53	51	6		
2	50	1.3	1.5	252.60	327	253	252	43	55	51	5		
3	60	.96	1.1	258.20	327	254	256	44	56	52	4		
2-1	70	1.8	2.1	266.11	328	253	256	46	56	52	6		
2	80	1.4	1.6	272.93	329	255	254	47	58	53	5		
3	90	.94	1.1	278.51	328	256	255	49	59	53	4		
1-1	100	1.7	2.0	286.34	329	254	257	51	59	54	6		
2	110	1.4	1.6	293.18	329	252	255	52	59	54	5		
3	120	.95	1.1	298.70	328	250	252	54	60	54	4		
Total	120.00	13.8846	18.90	80.80	3937.00				670.00	625.00			
Average		1.1570	1.58		328.08				53.96				

Circle correct bracketed [ ] units
Train Type denotes impingers, knockouts, etc.

MONTROSE AIR QUALITY SERVICES, LLC

General Testing Datasheet

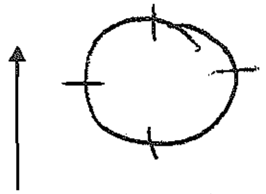
TESTING TYPE: PM/HCL

RUN NO. 3

METHOD NO. 5/26a

Page	1	**of**	1

Client	WE ENERGIES				
Plant	MARQUETTE, MI				
Location	UNIT 9				
Date	02·28·19	**Project No.**			
Meter Operator	JD				
Probe Operator	BK				
Meter ID	M·28	**Yd**	.9942	**Pitot Cp**	.84
ΔH@	1.895	**Kf**	1.19	**Leak check**	✓
Pre Leak Check	.000	[✓ cfm] [lpm] @	17	(inHg)	
Post Leak Check	.000	[✓ cfm] [lpm] @	8	(inHg)	



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Gas flow [in] [✓ out] of page

Cross Section of Duct

Barometric (in. Hg)	29.40	**Water (ml) (g)**	
Ambient Temp. (°F)	38°F	**Silica gel (g)**	
Static (in. H₂O)	-0.7	**Total Vlc**	
Probe ID AE	5·4·9	**Liner Type**	GLASS
Nozzle ID	.210	**Nozzle Dia (in.)**	.210
Filter ID	31828	—	—
Train ID	18-14	**Train Type**	IMP
Duct Dim. (in.)	114"	**Port Lgth. (in.)**	12"
Start Time	1132	**Stop Time**	1338

Traverse Point	Min/Point 10 Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (in H_2O)	Gas Sample Volume Initial [✓ ft³] [l]	Stack Temp (°F)	Probe Temp (°F)	Filter Temp (°F)	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	Auxiliary Temp (°F)	Notes
				299.10		250	250						
1-1	10	1.7	2.0	306.88	334	253	251	37	55	55	6	N/A	
2	20	1.4	1.7	313.94	334	257	255	39	57	55	5		
3	30	.98	1.2	319.50	333	256	256	41	58	55	4		
2-1	40	1.8	2.1	327.46	336	256	257	43	58	56	6		
2	50	1.4	1.7	334.51	335	256	255	45	60	56	5		
3	60	.96	1.1	340.14	334	255	256	46	61	56	4		
3-1	70	1.7	2.0	347.90	336	256	256	48	61	57	6		
2	80	1.3	1.6	354.74	336	255	256	49	62	57	5		
3	90	.97	1.2	360.58	335	255	257	51	63	57	4		
4-1	100	1.8	2.1	368.40	336	256	257	53	65	58	6		
2	110	1.4	1.7	375.59	335	254	255	54	66	58	5		
3	120	.95	1.1	381.19	335	252	253	55	66	58	4		
Total	120.00	13.9101	14.56	82.09	4019.00				732.00	678.00			
Average		1.1592	1.63		334.92				58.75				

Circle correct bracketed [ ] units
Train Type denotes impingers, knockouts, etc.

MONTROSE AIR QUALITY SERVICES, LLC

Impinger Weights Datasheet

PROJECT NO. 554128

Page		of	

Client	PIPP
Plant	Marquette, MI
Location	unit 9
Date	2/28/19 **Unit**
Operator	BR

Run No.	1				
Method No.	5126A	**Train ID**	1B-1	**Filter No.**	31826
	Contents	**Tare with Contents (g)**	**Final (g)**	**Total (g)**	**Notes**
Impinger No. 1	H2SO4	747.0	1013.4	266.4	
Impinger No. 2	H2SO4	576.8	586.1	9.3	
Impinger No. 3	MT	594.1	598.0	3.9	
Impinger No. 4	silica	787.8	801.9	14.1	
Impinger No. 5					
Impinger No. 6					
Impinger No. 7					
Additional Rinse					
			Net Weight (g)	293.7	

Run No.	2				
Method No.	5126A	**Train ID**	1B-10	**Filter No.**	31827
	Contents	**Tare with Contents (g)**	**Final (g)**	**Total (g)**	**Notes**
Impinger No. 1	H2SO4	694.7	938.3	243.6	
Impinger No. 2	H2SO4	636.7	643.7	7.0	
Impinger No. 3	MT	588.8	592.7	3.9	
Impinger No. 4	silica	822.0	835.5	13.5	
Impinger No. 5					
Impinger No. 6					
Impinger No. 7					
Additional Rinse				50 ml DI Rinse	
			Net Weight (g)	268.0	

Run No.	3				
Method No.	5126A	**Train ID**	1B14	**Filter No.**	31828
	Contents	**Tare with Contents (g)**	**Final (g)**	**Total (g)**	**Notes**
Impinger No. 1	H2SO4	750.6	1000.7	250.1	
Impinger No. 2	H2SO4	714.2	724.8	10.6	
Impinger No. 3	MT	609.3	613.0	3.7	
Impinger No. 4	silica	809.3	827.3	18.0	
Impinger No. 5					
Impinger No. 6					
Impinger No. 7					
Additional Rinse				50 ml DI	
			Net Weight (g)	282.4	

MONTROSE AIR QUALITY SERVICES, LLC

EPAMethod 3

Orsat Analyzer Datasheet

Page	/	of	/

Client	P.P.P		
Plant	Marquette, MI	**Project Number**	554128
Location	Unit 9	**Date**	2/28/19
Analyzer Type	Orsat	**Leak Check**	0.000

$$F_O = \frac{(20.9 - O_2\%)}{CO_2\%}$$

Run No.	Trial No.	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$	Analyst	Date	Time
Ambient Air	Check	0	20.8	20.8		2/28/19	
Run No.	**Trial No.**	**$\%CO_2$**	**$\%CO_2+\%O_2$**	**$\%O_2$**	**Analyst**	**Date**	**Time**
1	1	13.8	19.2	5.4		2/28/19	
	2	13.8	19.4	5.6			
	3	13.8	19.2	5.4			
	Average						
Run No.	**Trial No.**	**$\%CO_2$**	**$\%CO_2+\%O_2$**	**$\%O_2$**	**Analyst**	**Date**	**Time**
2	1	13.8	19.4	5.6		2/28/19	
	2	13.6	19.4	5.8			
	3	13.8	19.4	5.6			
	Average						
Run No.	**Trial No.**	**$\%CO_2$**	**$\%CO_2+\%O_2$**	**$\%O_2$**	**Analyst**	**Date**	**Time**
3	1	13.8	19.4	5.6		2/28/19	
	2	13.6	19.6	6.0			
	3	13.6	19.6	6.0			
	Average						
Run No.	**Trial No.**	**$\%CO_2$**	**$\%CO_2+\%O_2$**	**$\%O_2$**	**Analyst**	**Date**	**Time**
	1						
	2						
	3						
	Average						
Run No.	**Trial No.**	**$\%CO_2$**	**$\%CO_2+\%O_2$**	**$\%O_2$**	**Analyst**	**Date**	**Time**
	1						
	2						
	3						
	Average						
Run No.	**Trial No.**	**$\%CO_2$**	**$\%CO_2+\%O_2$**	**$\%O_2$**	**Analyst**	**Date**	**Time**
	1						
	2						
	3						
	Average						
Run No.	**Trial No.**	**$\%CO_2$**	**$\%CO_2+\%O_2$**	**$\%O_2$**	**Analyst**	**Date**	**Time**
	1						
	2						
	3						
	Average						
Run No.	**Trial No.**	**$\%CO_2$**	**$\%CO_2+\%O_2$**	**$\%O_2$**	**Analyst**	**Date**	**Time**
	1						
	2						
	3						
	Average						

Notes:

Run an ambient air check to verify Oxsorb.

Measurements must be made to the nearest 0.2%.

Three different trails should be performed for each sample.

The differences between the trials must not be greater than 0.2% overall.

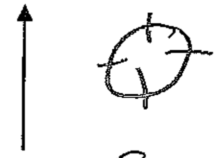
Expected F_o Ranges

Wood Bark	1.000-1.120	Residual Oil	1.210-1.370
Anthracite/Lignite	1.015-1.130	Distillate Oil	1.260-1.413
Municipal Waste	1.043-1.177	Nat. Gas	1.600-1.836
Bituminous	1.083-1.230		

MONTROSE AIR QUALITY SERVICES, LLC
EPA Method 2
Cyclonic Flow Traverse Datasheet

Page	1	of	1

Client	P.P.P		
Project No.	554128		
Plant	marquette, MI		
Location	unit 7, 8, 9	Duct size (in)	114
Date	~~2/27/19~~	Port Length (in)	7
Probe ID	AE 2-6-13	Pitot Cp	.84



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First point all the way [✓ in] [out]

Gas flow [In] or [✓ out] of page

Cross Section of Duct

unit 7 2/27/19

Run Number	1		
Start Time	7:30		
Stop Time	7:53		
Barometric (inHg)	29.4		
Static (inH_2O)	-0.7		
Probe Operator	JD		
Data Recorder	BR		
Pre Leak Check	✓		
Post Leak Check	✓		
Traverse Point	Pressure ΔP @ 0° (in H_2O)	Angle α (< 20°)	Notes
1-1	.04	8.6	
2	.02	7.4	
3	.02	7.2	
2-1	.05	9.1	
2	.03	8.3	
3	.01	4.4	
3-1	.04	9.2	
2	.03	7.6	
3	.03	8.1	
4-1	.03	5.7	
2	.02	6.3	
3	.03	7.0	
Total		88.9	
Average		7.41	

unit 8 2/27/19

Run Number	1		
Start Time	08:00		
Stop Time	08:27		
Barometric (inHg)	29.4		
Static (inH_2O)	-0.7		
Probe Operator	JD		
Data Recorder	BR		
Pre Leak Check	✓		
Post Leak Check	✓		
Traverse Point	Pressure ΔP @ 0° (in H_2O)	Angle α (< 20°)	Notes
1-1	.02	4.7	
2	.02	5.6	
3	.01	5.2	
2-1	-.01	3.8	
2	0	0	
3	.01	2.6	
3-1	.02	9.5	
2	.01	5.8	
3	.01	7.4	
4-1	.02	7.5	
2	.02	6.3	
3	.01	6.9	
Total		60.3	
Average		5.02	

unit 9 2/28/19

Run Number	1		
Start Time	07:15		
Stop Time	07:48		
Barometric (inHg)	29.4		
Static (inH_2O)	-0.7		
Probe Operator	JD		
Data Recorder	BR		
Pre Leak Check	✓		
Post Leak Check	✓		
Traverse Point	Pressure ΔP @ 0° (in H_2O)	Angle α (< 20°)	Notes
1-1	.02	4.6	
2	.03	7.4	
3	0	0	
2-1	.04	10.7	
2	.03	9.6	
3	.03	8.4	
3-1	.03	9.4	
2	.03	7.1	
3	.02	7.2	
4-1	.02	6.6	
2	-.01	3.2	
3	0	0	
Total		74.2	
Average		6.2	