EXECUTIVE SUMMARY

Montrose Air Quality Services, LLC (MAQS) was retained by Pregis of Marysville (Pregis) to conduct a relative accuracy test audit (RATA) of the continuous emission monitoring (CEM) system serving the polyethylene foam manufacturing process. Testing was conducted on July 10-11, 2019 at the Pregis facility in Marysville, Michigan.

Testing consisted of ten flow rate measurements at each of the East and West ducts, and ten 21-minute test runs for VOC concentration at the common header that both ducts exhaust to. Table I summarizes the results of the RATA.

Table I
Overall Emissions Summary

Parameter	Result
Flow Rate (scfm)	10.5% RA
VOC (ppm)	4.7% RA
VOC (lb/hr)	11.0% RA

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLES

FIGURES

APPENDICES

1. Introduction

Montrose Air Quality Service, LLC (MAQS) was retained by Pregis of Marysville (Pregis) to conduct a relative accuracy test audit (RATA) of the continuous emission monitoring (CEM) system serving the polyethylene foam manufacturing process. Testing was conducted on July 10-11, 2019 at the Pregis facility in Marysville, Michigan.

Testing consisted of ten flow rate measurements at each of the East and West ducts, and ten 21-minute test runs for VOC concentration at the common header that both ducts exhaust to.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (March 2018). This document is provided as Appendix A. The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on July 10-11, 2019 at the Pregis facility located in Marysville, Michigan. Testing consisted of ten flow rate measurements at each of the East and West ducts, and ten 21-minute test runs for VOC concentration at the header common to both exhaust ducts.

1.b Purpose of Testing

The purpose of testing was to perform a RATA of the CEM system serving the polyethylene foam manufacturing process.

1.c Source Description

See section 3a.

1.d Test Program Contact

The contact for information regarding the test program as well as the test report is as follows:

Mr, John Von Zellen
Maintenance Manager/Environmental Supervisor
Pregis of Marysville
2700 Wills Street
Marysville, Michigan 48040
(810) 320-3002

1.e Testing Personnel

Names and affiliations for personnel who were present during the testing program are summarized by Table 1.

Table 1
Testing Personnel

Name	Affiliation
John Von Zellen	Pregis
David Patterson	EGLE
Kaitlyn Leffert	EGLE
Todd Wessel	MAQS
Randal Tysar	MAQS
Shane Rabideau	MAQS

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions test program.

2.a Operating Data

Process data monitored during the emissions test program includes:

a. Time
b. Bead usage rate
c. Isobutane use

2.b Applicable Permit

Emission limitations for the extruders and reclaim unit are summarized by AQD Renewable Operating Permit No. MI-ROP-N6944-2017. This permit limits VOC emissions to 476 pounds per 8-hour period and 178 tons per year.

2.c Results

The results of the RATA emissions test program are summarized by Table 2. Detailed results for the emissions test program are summarized by Tables 3 and 4.

2.d Emission Regulation Comparison

The RA limit is 20%. The RA of each parameter was less than 20%.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

Pregis manufactures extruded polyethylene foam products. The four extruders (one with 600 lb/hr capacity, two with 500 lb/hr capacity, and one with 1,400 lb/hr capacity) use polyethylene, or other polymer beads, and isobutane as raw materials. The melted plastic can be fed to either a profile or sheet die. There are three sets of downstream handling/takeoff equipment utilized for foam sheet and profile parts production.

The blowing agent, isobutane, is injected into the extruders to mix with the melted plastic. The melted plastic is transported down the barrel under pressure to mix the blowing agent and plastic thoroughly, and develop the correct pressure and temperature within the melt to produce the desired properties in the finished product. As the mix is pushed out of the die, the release of pressure allows the blowing agent to expand causing the formation of cells in the plastic, which produce the foam properly. Approximately 55% of the isobutane is released into the room during the production, cooling and packaging process; the remaining 45% is retained within the structure of the foam cells.

The facility recycles scrap foam from its production process. The recycled foam is ground and melted. The melted foam is extruded through a strand/pelletizing die and immediately cut into beads. This extrusion and cutting occurs in a water bath so that the beads are instantly cooled to prevent agglomeration and are then transported by the cooling water to a separator. After the water is removed, the beads are sent to a centrifugal bead dryer to remove any remaining moisture. The beads are boxed, stored, and eventually returned to the production line along with new feed stock and converted into foam. Captured isobutane that is in the foam cells is released during this process.

All of the isobutane emissions from the foam are released within the large manufacturing room. The room is filled with ionized oxygen, which reduces the isobutane in the air prior to being exhausted out of the building via two exhaust fans and ductwork designated as No.1 and No. 2.

3.b Process Flow Diagram

Due to the simplicity of the process, a process flow diagram is not necessary.

3.c Raw and Finished Materials

The raw materials used in the extrusion process are polyethylene or other polymer beads and isobutane. Low Density Polyethylene (LDPE) constitutes approximately 95% of the total formulation.

3.d Process Capacity

EU-EXTRUDER1- 500 lb/hr; EU-EXTRUDER2-500 lb/hr; EU-EXTRUDER3-600 lb/hr; EU-EXTRUDER4- 1,400 lb/hr.

3.e Process Instrumentation

Process data monitored during the emissions test program includes:

a. Time
b. Bead usage rate
c. Isobutane use

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used to verify the relative accuracy of CEM systems.

4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content was conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Gas Analysis for the determination of dry molecular weight" (Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases" (Wet Bulb/Dry Bulb Analysis)*
- Method 25A - *"Determination of Total Gaseous Organic Concentration using a Flame Ionization Analyzer"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Method 1 and Method 2. S-type pitot tubes with thermocouple assemblies, calibrated in accordance with Method 2 were used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The s-type pitot tube dimensions outlined in Sections 2-6 through 2-8 were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

Cyclonic flow checks were performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

Molecular weight determinations were evaluated according to USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Carbon dioxide and oxygen content were analyzed using the Fyrite® procedure.

Exhaust gas moisture content was evaluated using a wet bulb/dry bulb analysis. Exhaust gas moisture content was determined to be approximately 2%.

Volatile Organic compound (VOC) concentrations were measured according to 40 CFR 60, Appendix A, Method 25A. A sample of the gas stream was drawn through a stainless steel probe with an in-line glass fiber filter to remove any particulate, and a heated Teflon® sample line to prevent the condensation of any moisture from the sample before it enters the analyzer. Data was recorded at 10-second intervals on a PC equipped with Labview® II data acquisition software. MAQS used a VIG Model 20 THC hydrocarbon analyzer to determine the VOC concentration.

The VIG THC hydrocarbon analyzer channels a fraction of the gas sample through a capillary tube that directs the sample to the flame ionization detector (FID), where the hydrocarbons present in the sample are ionized into carbon. The carbon concentration is then determined by the detector in parts per million (ppm). This concentration is transmitted to the data acquisition system (DAS) at 10-second intervals in the form of an analog signal, specifically voltage, to produce data that can be averaged over the duration of the testing program. This data is then used to determine the average ppm for total hydrocarbons (THC) using the equivalent units of propane (calibration gas).

In accordance with Method 25A, a 4-point (zero, low, mid, and high) calibration check was performed on the THC analyzer. Calibration drift checks were performed at the completion of each run.

4.b Recovery and Analytical Procedures

Because all measurements were conducted using on-line analyzers, no samples were recovered during the test program.

4.c Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figures 2-3.

4.d Traverse Points

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figures 2-3.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 2. Detailed results for the emissions test program are summarized by Tables 3 and 4.

Table 2
Overall Emissions Summary

Parameter	Result
Flow Rate (scfm)	10.5% RA
VOC (ppm)	4.7% RA
VOC (lb/hr)	11.0% RA

5.b Discussion of Results

The RA limit is 20%. The RA of each parameter was less than 20%.

5.c Sampling Procedure Variations

There were no sampling variations used during the emission compliance test program other than the following:

(1) During Run 2, the CEMS monitor went into its daily automatic calibration sequence. The Run was aborted and re-started after the CEMS had completed its daily calibration.
(2) During Run 8 on July 10, the reference method VOC monitors failed due to excessive heat in the building. Run 8 was aborted and was re-started on July 11.

5.d Process or Control Device Upsets

No upset conditions occurred during testing.

5.e Control Device Maintenance

There was no control equipment maintenance performed during the emissions test program.

5.f Re-Test Changes

The emissions test program was not a re-test.

5.g Audit Sample Analyses

No audit samples were requested by AQD.

5.h Calibration Sheets

Relevant equipment calibration documents and certificates of analysis for the calibration gases are provided in Appendix B.

5.i Sample Calculations

Sample calculations are provided as Appendix C.

5.j Field Data Sheets

Copies of field data sheets and relevant field notes are provided as Appendix A.

5.k Laboratory Data

No laboratory analysis was included in this test program.

TABLES

Table 3
East and West Stack VOC Emission Rates
Pregis of Marysville
Marysville, MI

Sampling Dates: July 10 and 11, 2019

Parameter	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10	Average
Test Run Date	7/10/2019	7/10/2019	7/10/2019	7/10/2019	7/10/2019	7/10/2019	7/10/2019	7/11/2019	7/11/2019	7/11/2019	
Test Run Time											
East Stack Flowrate (scfm)	13,365	12,763	12,769	12,847	12,928	12,908	13,444	11,890	11,854	11,997	**12,676**
West Stack Flowrate (scfm)	13,852	13,738	13,815	13,901	13,716	13,868	13,341	13,508	13,150	13,463	**13,635**
Combined Flowrate (scfm)	27,218	26,501	26,584	26,748	26,643	26,776	26,785	25,398	25,004	25,460	**26,312**
East VOC Concentration (ppmv as propane)	224.1	280.7	210.1	161.1	148.1	153.9	168.3	139.3	139.3	136.8	**176.2**
East VOC Concentration (ppmv, corrected as per USEPA 7E)	224.3	281.7	212.7	164.0	151.5	158.0	170.9	139.3	139.2	136.4	**177.8**
East VOC Emission Rate as Propane (lb/hr)	**20.5**	**24.5**	**18.4**	**14.2**	**13.1**	**13.6**	**15.5**	**11.3**	**11.3**	**11.2**	**15.4**
East VOC Emission Rate as Propane(lb/hr) (corrected as per USEPA 7E)	**20.5**	**24.6**	**18.6**	**14.4**	**13.4**	**14.0**	**15.7**	**11.3**	**11.3**	**11.2**	**15.5**
West VOC Concentration (ppmv as propane)	177.4	234.5	163.8	127.2	119.6	124.3	131.0	83.1	90.4	98.5	**135.0**
West VOC Concentration (ppmv, corrected as per USEPA 7E)	177.7	235.3	165.5	128.8	121.1	126.4	132.6	83.4	90.8	98.5	**136.0**
West VOC Emission Rate as Propane (lb/hr)	**16.8**	**22.0**	**15.5**	**12.1**	**11.2**	**11.8**	**12.0**	**7.7**	**8.1**	**9.1**	**12.6**
West VOC Emission Rate as Propane(lb/hr) (corrected as per USEPA 7E)	**16.8**	**22.1**	**15.6**	**12.3**	**11.4**	**12.0**	**12.1**	**7.7**	**8.2**	**9.1**	**12.7**
Weighted Average VOC (ppmv as propane) (corrected as per USEPA 7E)	**200.6**	**257.6**	**188.1**	**145.7**	**135.8**	**141.6**	**151.8**	**109.6**	**113.7**	**116.3**	**156.1**
Total VOC (lb/hr)(corrected as per USEPA 7E)	**37.4**	**46.7**	**34.2**	**26.7**	**24.8**	**26.0**	**27.8**	**19.0**	**19.5**	**20.3**	**28.2**

scfm = standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (C_3H_8 = 44.10)
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

East VOC Correction

	1	2	3	4	5	6	7	8	9	10
Co	-0.60	-0.03	0.24	-0.19	-0.24	-0.26	-0.10	0.03	-0.11	-0.48
Cma	200	200	200	200	200	200	200	200	200	200
Cm	199.81	199.26	197.57	196.41	195.70	194.78	196.94	199.98	200.22	200.76

West VOC Correction

Co	0.01	0.55	0.84	0.77	0.86	1.24	1.00	0.11	-0.36	-0.61
Cma	200	200	200	200	200	200	200	200	200	200
Cm	199.61	199.40	197.82	197.07	197.00	195.93	197.05	199.21	199.64	200.70

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * *scfm* * 60 *for* VOC

Weighted Average $= \left(\dfrac{F_1}{F_1+F_2}\right) * C_1 + \left(\dfrac{F_2}{F_1+F_2}\right) * C_2$

Table 4
Relative Accuracy Test Audit Results
Pregis of Marysville
Marysville, MI
049AS-583878
Test Dates: July 10 and 11, 2019

Flow RA					Flow Absolute Difference (scfm)	
Test Run No.	RM	CEM	RM-CEM	d_i^2		
1*	27217.61	24000.00	3217.61	10353016.21	3217.6	
2	26501.02	24000.00	2501.02	6255103.27	2501.0	
3	26583.82	24000.00	2583.82	6676123.75	2583.8	
4	26747.91	24000.00	2747.91	7551014.35	2747.9	
5	26643.25	24000.00	2643.25	6986770.69	2643.3	
6	26776.08	24000.00	2776.08	7706602.33	2776.1	
7	26784.88	24000.00	2784.88	7755566.83	2784.9	
8	25397.59	24000.00	1397.59	1953246.89	1397.6	
9	25003.53	24000.00	1003.53	1007082.23	1003.5	
10	25460.22	24000.00	1460.22	2132230.32	1460.2	
	26210.92	24000.00	2210.92	48023740.67	2210.92	Average

Sd:	709.7678
cc:	545.5749
RA:	**10.5**

VOC CONCENTRATION RA					VOC Concentration Absolute Difference (ppmv)	
Test Run No.	RM	CEM	RM-CEM	d_i^2		
1	200.57	210.10	9.53	90.80	9.5	
2	257.64	254.90	2.74	7.49	2.7	
3	188.14	190.00	1.86	3.46	1.9	
4	145.74	147.90	2.16	4.68	2.2	
5	135.83	138.40	2.57	6.61	2.6	
6	141.65	141.40	0.25	0.06	0.2	
7	151.82	149.30	2.52	6.37	2.5	
8*	109.57	123.70	14.13	199.70	14.1	
9	113.73	125.70	11.97	143.31	12.0	
10	116.34	123.60	7.26	52.68	7.3	
	161.27	164.59	4.54	315.46	4.54	Average

Sd:	4.0302
cc:	3.0979
RA:	**4.7**

VOC EMISSION RATE					VOC Emission Rate Absolute Difference (lbs/hr)	
Test Run No.	RM	CEM	RM-CEM	d_i^2		
1	37.359	34.600	2.759	7.61	2.759	
2*	46.725	42.000	4.725	22.33	4.725	
3	34.228	31.300	2.928	8.57	2.928	
4	26.677	24.400	2.277	5.19	2.277	
5	24.766	22.800	1.966	3.87	1.966	
6	25.956	23.300	2.656	7.06	2.656	
7	27.830	24.600	3.230	10.43	3.230	
8	19.044	20.400	-1.356	1.84	1.356	
9	19.460	20.700	-1.240	1.54	1.240	
10	20.271	20.400	-0.129	0.02	0.129	
	26.18	24.72	1.45	46.12	2.06	Average

Sd:	1.8396
cc:	1.4140
RA:	**11.0**

*** Run excluded from calculations**

FIGURES

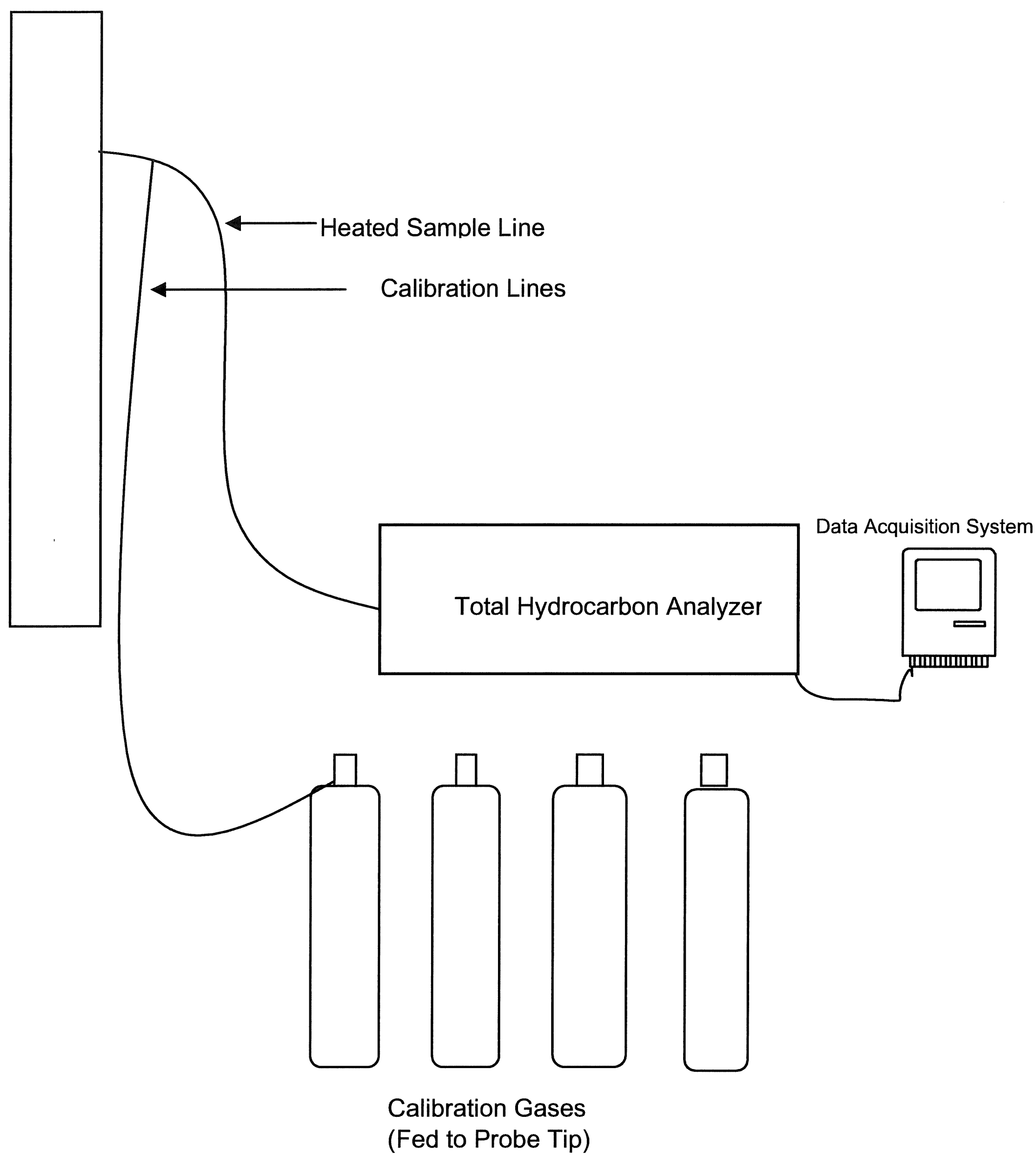
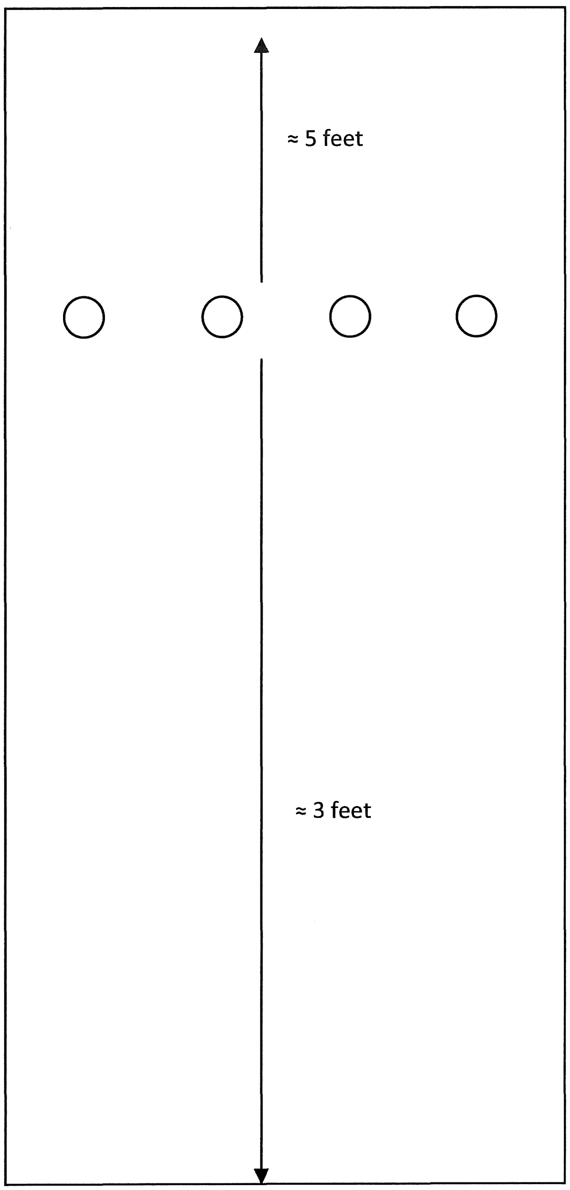


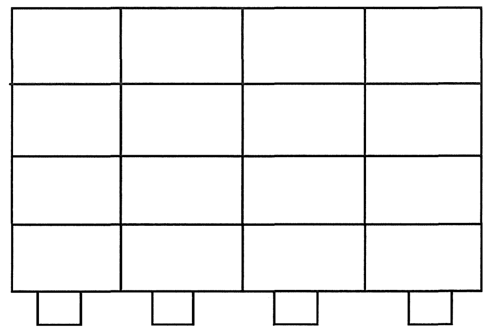
Figure No. 1

Site:	Sampling Dates:	
USEPA Method 25A Pregis of Marysville Marysville, Michigan	July 10 and 11, 2019	Montrose Air Quality Services, LLC 4949 Fernlee Avenue Royal Oak, Michigan 48073

Stack Dimensions:

Depth:	54	inches
Width:	56	inches





Not to Scale

Points	Distance "
1	6.8
2	20.3
3	33.8
4	47.3

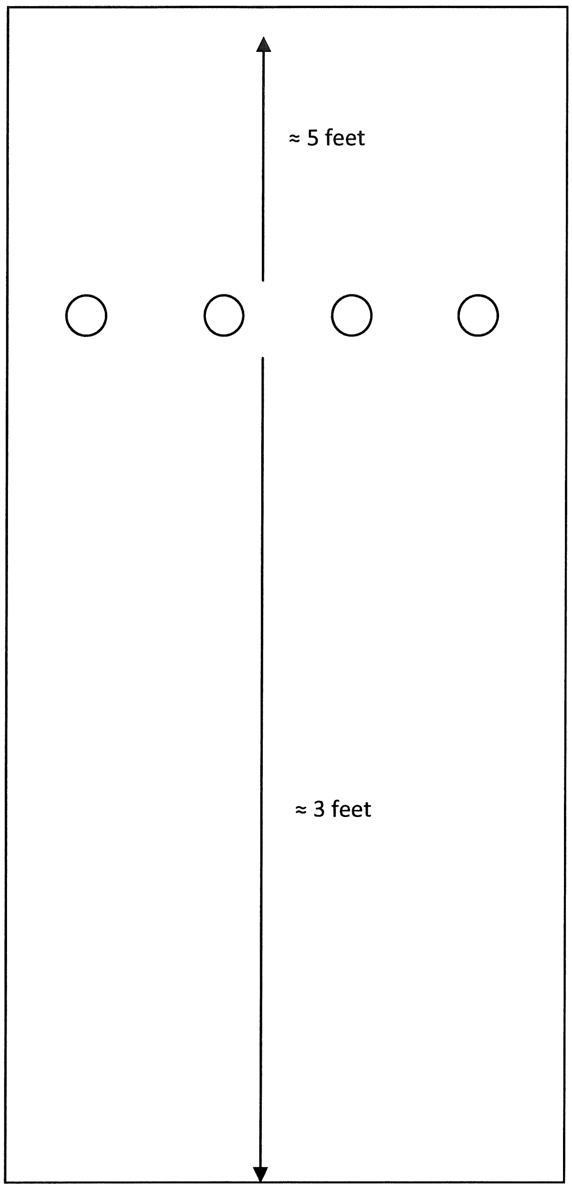
Figure No. 2

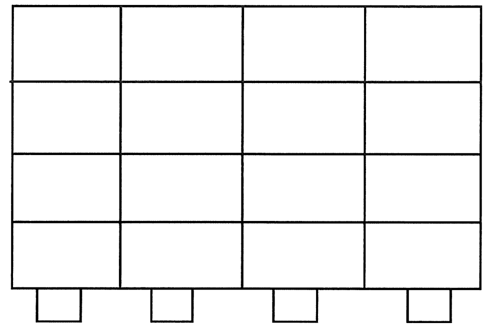
Site:	Sampling Dates:	Montrose Air Quality Services, LLC
East Duct Pregis of Marysville Marysville, Michigan	July 10 and 11, 2019	4949 Fernlee Avenue Royal Oak, Michigan 48073

MONTROSE AIR QUALITY SERVICES

Stack Dimensions:

Depth:	54	inches
Width:	56	inches





Not to Scale

Points	Distance "
1	6.8
2	20.3
3	33.8
4	47.3

Figure No. 3

Site: **West Duct** **Pregis of Marysville** **Marysville, Michigan**	**Sampling Dates:** **July 10 and 11, 2019**	**Montrose Air Quality Services, LLC** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**