SOURCE TEST REPORT
2019 DESTRUCTION EFFECIENCY TESTING
FORD MOTOR COMPANY
DEARBORN TRUCK PLANT
FGCONTROLS (Zeolite Carbon System & RTO)
DEARBORN, MI

Prepared For:

Ford Motor Company
Fairlane Plaza North Suite 800
290 Town Center Drive
Dearborn, MI 48126

For Submittal To:

Michigan Department of Environment, Great Lakes, and Energy

Prepared By:

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Document Number:	**M049AS-640501-RT-177**
Test Dates:	**October 2-3, 2019**
Submittal Date:	**October 30, 2019**

EXECUTIVE SUMMARY

Montrose Air Quality Services (MAQS) was retained by Ford Motor Company (Ford) to evaluate volatile organic compounds (VOC) destruction efficiency (DE) from the regenerative thermal oxidizer (RTO) and VOC removal efficiency (RE) from the zeolite carbon system at the Dearborn Truck Plant located in Dearborn, Michigan. The emissions test program was conducted on October 2nd and 3rd, 2019.

Testing of the RTO and zeolite carbon system consisted of triplicate 60-minute test runs at each unit. The emissions test program was required by EGLE Air Quality Division Renewable Operating Permit (ROP) No. MI-ROP-A8648-2015a. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: October 2nd and 3rd, 2019

Source	Average Destruction Efficiency
Zeolite Carbon System	99.1%
RTO	97.3%

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

SUMMARY TABLES

FIGURES

APPENDIX

1. Introduction

Montrose Air Quality Services (MAQS) was retained by Ford Motor Company (Ford) to evaluate volatile organic compounds (VOC) destruction efficiency (DE) from the regenerative thermal oxidizer (RTO) and VOC removal efficiency (RE) from the zeolite carbon system at the Dearborn Truck Plant located in Dearborn, Michigan. The emissions test program was conducted on October 2nd and 3rd, 2019.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (March 2018). 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 October 2nd and 3rd, 2019 at the Ford facility located in Dearborn, Michigan. The test program included evaluation of VOC DE emissions from the RTO system along with VOC RE emissions from the zeolite carbon system.

1.b Purpose of Testing

AQD issued Renewable Operating Permit No. MI-ROP-A8648-2015a to Ford. There are no specific emission limitations associated with FGCONTROLS.

1.c Source Description

The control device is a regenerative thermal oxidizer (RTO) and a zeolite carbon system.

1.d Test Program Contacts

The contact for the source and test report is:

Ms. Susan Hicks
Senior Environmental Engineer
Ford Motor Company-Environmental Quality Office
Fairlane Plaza North, Suite 800
290 Town Center Drive
Dearborn, MI 48126
Phone: (313) 594-3185

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

Table 1
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Steve Smith Client Project Manager	Montrose Air Quality Detroit Office 4949 Fernlee Ave Royal Oak, Michigan 48073	(248)-548-8070
Mr. Mike Nummer Field Technician	Montrose Air Quality Detroit Office 4949 Fernlee Ave Royal Oak, Michigan 48073	(248)-548-8070
Mr. Dave Trahan Field Technician	Montrose Air Quality Detroit Office 4949 Fernlee Ave Royal Oak, Michigan 48073	(248)-548-8070

2. Summary of Results

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

2.a Operating Data

Process data can be found in Appendix E.

2.b Applicable Permit

The applicable permit for this emissions test program is Renewable Operating Permit (ROP) No. MI-ROP-A8648-2015a.

2.c Results

The overall results of the emission test program are summarized by Table 2 (see Section 5.a).

3. Source Description

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

3.a Process Description

Dearborn Truck Plant is an automotive assembly plant located in Dearborn, Michigan. Vehicle body panels are stamped and assembled on site from sheet metal components. The bodies are cleaned, treated, and prepared for painting in the pre-treatment system. Drawing compounds, mill oils, and dirt are removed from the vehicle bodies utilizing both high pressure spray and immersion cleaning/rinsing techniques. Vehicle bodies then are dip coated in electro deposition corrosion primer paint for protection. The electro primer

(E-coat) is heat-cured to the vehicle body in a high-temperature bake oven. After completing the E-coat operation, vehicle bodies are conveyed to the sealer area for application of various sealants to body seams and joints. Vehicle bodies are then conveyed to an oven to cure the sealers.

After the sealer oven, the vehicles are routed to the Prime system. In the Prime system (spraybooth and oven), the bodies receive solvent-borne coatings: colored primer and tu-tone coatings. After exiting the prime oven, the vehicles are routed to the Topcoat system, where water-borne basecoat and solvent-borne clearcoat coatings are applied.

Air exhausted from the clearcoat zones are directed to the carbon concentrators. The concentrated exhaust from the carbon concentrators and oven exhausts are routed to the inlet of the RTO.

A portion of the clearcoat spraybooth exhausts are routed to the carbon media for abatment.

As of July 15, 2019, the exhaust from the prime abatement system has been routed to the topcoat zeolite carbon system for control.

3.b Process Flow Diagram

Due to the simplicity of the RTO and zeolite carbon system, a process flow diagram is not necessary.

3.c Raw and Finished Materials

The raw material used by the process are VOCs.

3.d Process Capacity

DTP operates at a maximum of 72 jobs per hour.

3.e Process Instrumentation

The RTO temperature was set to 1,380 °F.
The Carbon System temperature was set to 370 °F.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

USEPA Methods 1-4

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 - *"Location of the Sampling Site and Sampling Points"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Determination of Molecular Weight of Dry Stack Gas"(Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*

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, Section 4.1.1, 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 10 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 Method 4. Exhaust gas was extracted as part of the moisture sampling (see Section 3.2) and passed through (i) two impingers, each with 100 ml deionized water, (ii) an empty impinger, and (iii) an impinger filled with silica gel. Exhaust gas moisture content is then determined gravimetrically. A method 4 moisture test was conducted at the outlet per run and that result was used as the inlet moisture.

USEPA Method 25A

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 4-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 at the inlet of the RTO.

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 4-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).

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 4-second intervals on a PC equipped with IOtech® data acquisition software. MAQS used a JUM Model 109A Methane/Non-Methane THC hydrocarbon analyzer to determine the VOC concentration at the outlet of the RTO.

The JUM Model 109A analyzer utilizes two flame ionization detectors (FIDs) in order to report the average ppmv for total hydrocarbons (THC), as propane, as well as the average ppmv for methane (as methane). Upon entry, the analyzer splits the gas stream. One FID ionizes all of the hydrocarbons in the gas stream sample into carbon, which is then detected as a concentration of total hydrocarbons. Using an analog signal, specifically voltage, the concentration of THC is then sent to the data acquisition system (DAS), where recordings are taken at 4-second intervals to produce an average based on the overall duration of the test. This average is then used to determine the average ppmv for THC reported as the calibration gas, propane, in equivalent units.

The second FID reports methane only. The sample enters a chamber containing a catalyst that destroys all of the hydrocarbons present in the gas stream other than methane. As with the THC sample, the methane gas concentration is sent to the DAS and recorded. The methane concentration, reported as methane, can then be converted to methane, reported as propane, by dividing the measured methane concentration by the analyzer's response factor.

The analyzer's response factor is obtained by introducing a methane calibration gas to the calibrated J.U.M. 109A. The response of the analyzer's THC FID to the methane calibration gas, in ppmv as propane, is divided by the Methane analyzer's response to the methane calibration gas, in ppmv as methane.

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

This test program did not include laboratory samples, consequently, sample recovery and analysis was not applicable to this 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 3-6.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figure 3-6.

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 Table 3 and 4.

Table 2
Overall Emission Summary
Test Date: October 2nd and 3rd, 2019

Source	Average Destruction Efficiency
Zeolite Carbon System	99.1%
RTO	97.3%

5.b Discussion of Results

The RTO achieved a 97.3% DE average.
The Zeolite Carbon System achieved a 99.1% RE average.

5.c Sampling Procedure Variations

There were no sampling procedure variations.

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

The emissions test program was not a re-test.

5.g Audit Sample Analyses

No audit samples were collected as part of the test program.

5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix C.

5.i Sample Calculations

Sample calculations are provided in Appendix D.

5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix B

5.k Laboratory Data

There are no laboratory results for this test program. Raw CEM data is provided electronically in Appendix E.

MEASUREMENT UNCERTAINTY STATEMENT

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, Montrose Air Quality Services, LLC, (MAQS) personnel reduce the impact of these uncertainty factors through the use of approved and validated test methods. In addition, MAQS personnel perform routine instrument and equipment calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

Limitations

All testing performed was done in conformance to the ASTM D7036-04 standard. The information and opinions rendered in this report are exclusively for use by Ford Motor Company. MAQS will not distribute or publish this report without Ford Motor Company's consent except as required by law or court order. MAQS accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by: ______________ P.P.
Steve Smith
Client Project Manager

This report was reviewed by: ______________
Jacob Young
Environmental Engineer

Tables

Table 3
Zeolite Carbon System Removal Efficiency Summary
Ford Dearborn Truck Plant
Dearborn, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	10/2/2019	10/2/2019	10/2/2019	
Sampling Time	7:50-8:50	9:07-10:07	10:23-11:23	
Inlet Flowrate (scfm)	69,280	71,423	70,585	70,430
Outlet Flowrate (scfm)	58,499	57,570	61,282	59,117
Inlet VOC Concentration (ppmv propane)	184.2	181.8	160.0	175.4
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	180.2	178.4	157.0	171.9
Inlet VOC Mass Flowrate (lb/hr)	85.4	87.2	75.8	82.8
Outlet VOC Concentration (ppmv propane)	2.4	3.7	3.1	3.1
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	2.3	3.7	3.1	3.0
Outlet CH4 Concentration (ppmv methane)	2.6	3.9	3.4	3.3
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	2.2	3.5	2.8	2.8
Outlet VOC Concentration (- methane)	1.4	2.3	2.0	1.9
Outlet VOC Mass Emission Rate (lb/hr)	0.6	0.9	0.8	0.8
VOC Removal Efficiency (%)	**99.3**	**99.0**	**98.9**	**99.1**

Inlet VOC Correction			
Co	1.75	3.68	3.63
Cma	250	250	250
Cm	254.88	253.29	252.75

Outlet VOC Correction			
Co	0.13	0.01	0.00
Cma	50	50	50
Cm	50.04	50.15	49.67

Outlet CH4 Correction			
Co	0.42	0.40	0.56
Cma	50	50	50
Cm	50.65	50.31	50.32

scfm: standard cubic feet per minute
ppmv: parts per million on a volume to volume basis
lb/hr: pounds per hour
VOC: volatile organic compound
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

Equations

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

RF= 2.44

Table 4
RTO Destruction Efficiency Summary
Ford Dearborn Truck Plant
Dearborn, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	10/3/2019	10/3/2019	10/3/2019	
Sampling Time	8:00-9:00	9:35-10:35	11:25-12:25	
Inlet Flowrate (scfm)	51,612	51,628	51,710	51,650
Outlet Flowrate (scfm)	53,615	53,752	53,187	53,518
Inlet VOC Concentration (ppmv propane)	486.1	447.5	346.4	426.7
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	469.2	422.2	319.8	403.7
Inlet VOC Mass Flowrate (lb/hr)	165.7	149.2	113.2	142.7
Outlet VOC Concentration (ppmv propane)	12.5	11.5	10.6	11.5
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	11.9	10.4	9.5	10.6
Outlet CH4 Concentration (ppmv methane)	0.2	0.1	0.5	0.3
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E) *	0.0	0.2	0.9	0.4
Outlet VOC Concentration (- methane)	11.9	10.3	9.1	10.4
Outlet VOC Mass Emission Rate (lb/hr)	4.4	3.8	3.3	3.8
VOC Destruction Efficiency (%)	**97.4**	**97.5**	**97.1**	**97.3**

scfm: standard cubic feet per minute
ppmv: parts per million on a volume to volume basis
lb/hr: pounds per hour
VOC: volatile organic compound
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

Equations

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

Inlet VOC Correction			
Co	12.22	24.27	23.51
Cma	500	500	500
Cm	517.28	525.41	528.35

Outlet VOC Correction			
Co	0.96	1.62	1.41
Cma	50	50	50
Cm	49.60	49.22	49.65

Outlet CH4 Correction			
Co	0.45	-0.12	-0.41
Cma	50	50	50
Cm	49.83	48.83	48.61

Run 1 CH4 Corrected negative

RF=	2.29

Figures

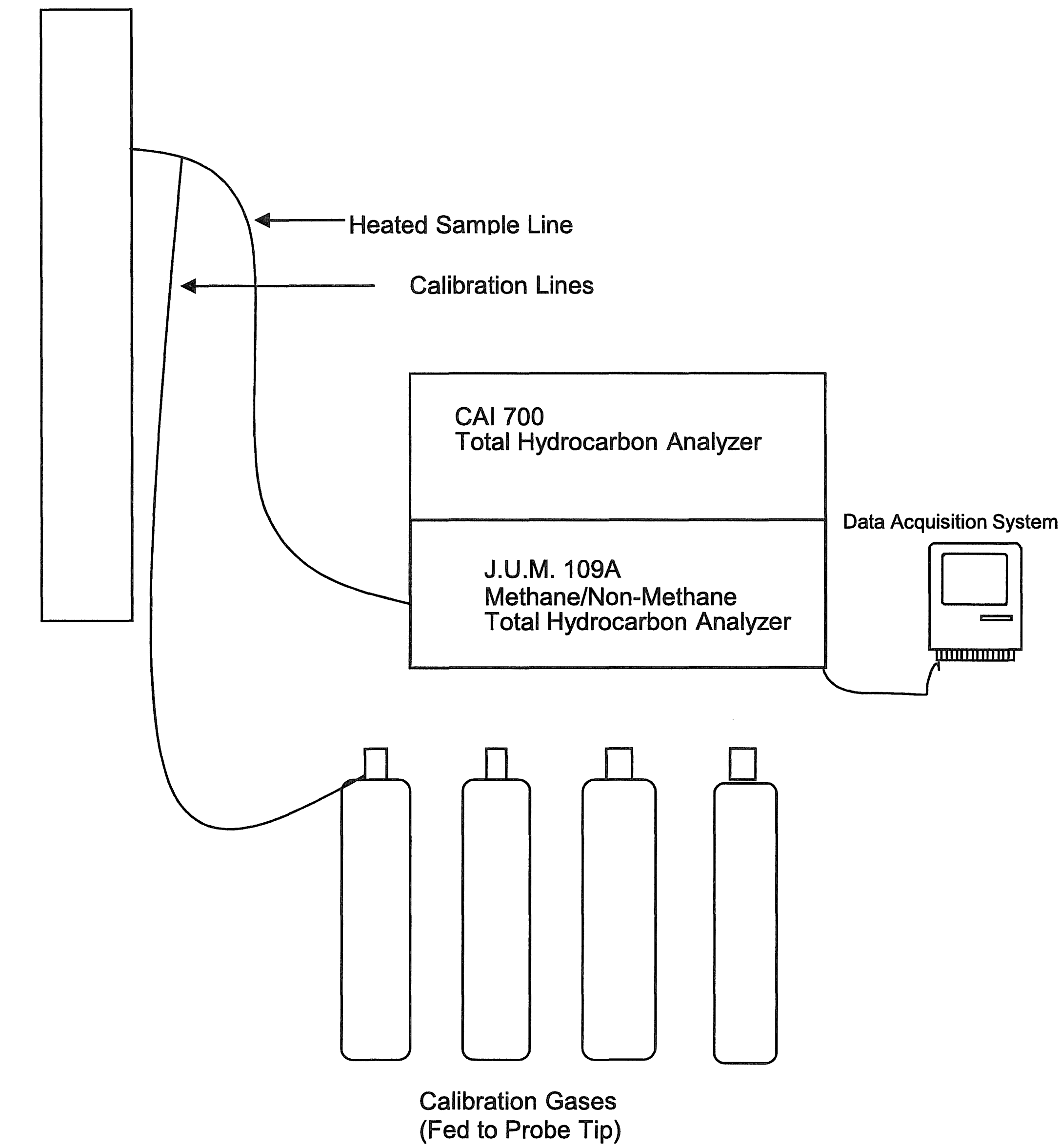


Figure No. 1

Site: **USEPA Method 25A** **Ford DTP** **Dearborn, Michigan**	**Sampling Date:** **October 2-3, 2019**	**Montrose Air Quality Services** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

MONTROSE AIR QUALITY SERVICES

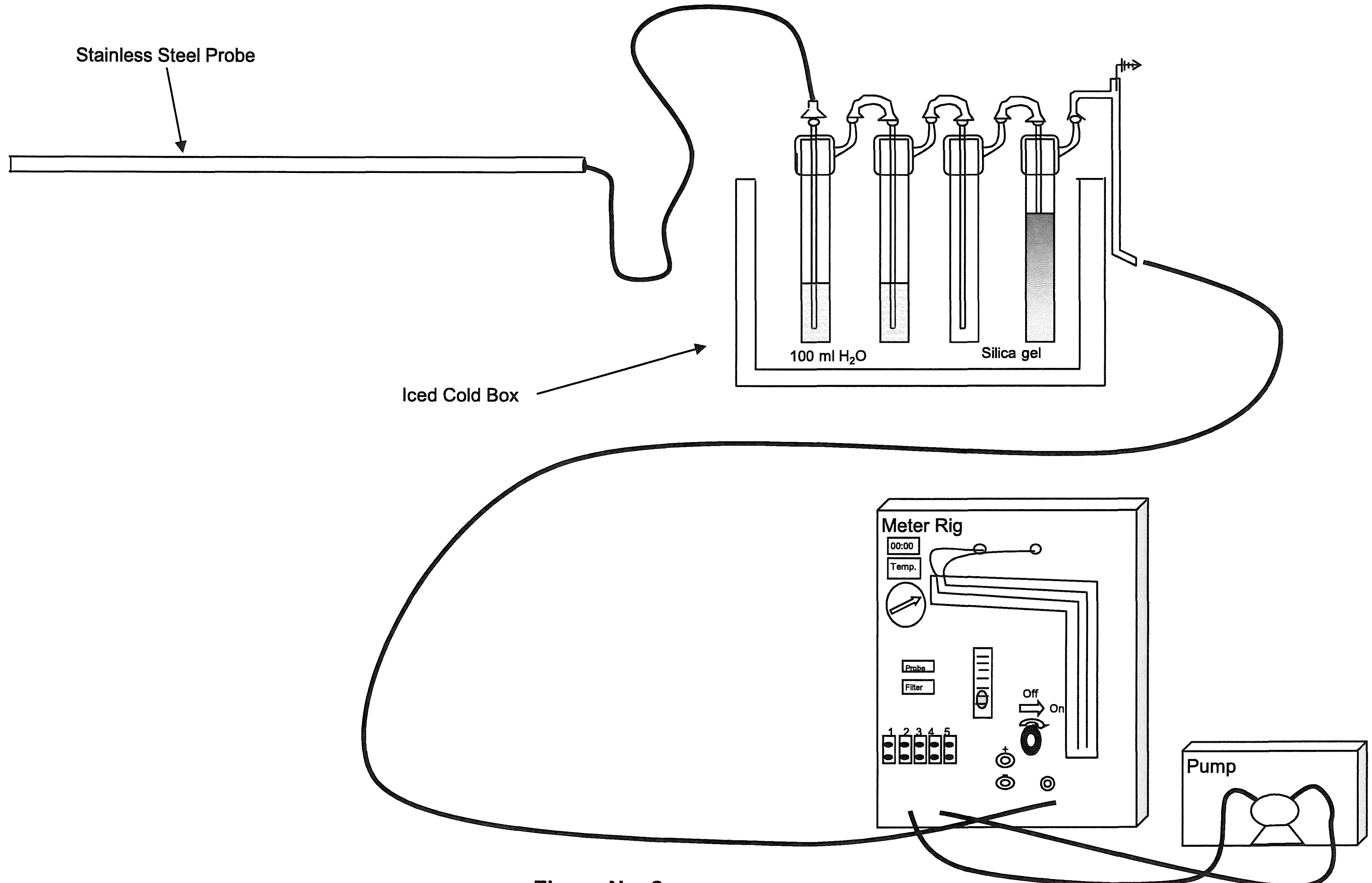
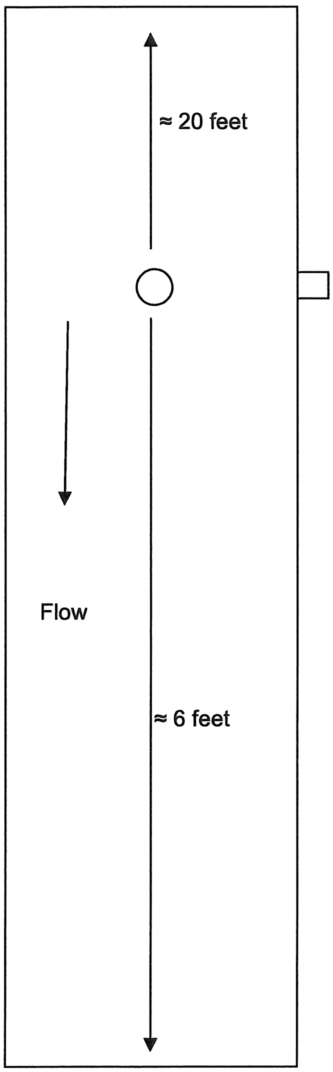
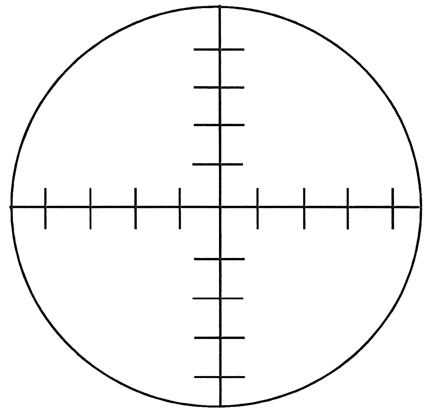


Figure No. 2

Site: **USEPA Method 4** **Ford DTP** **Dearborn, Michigan**	**Sampling Date:** **October 2-3, 2019**	**Montrose Air Quality Services** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

diameter = 63.5 inches





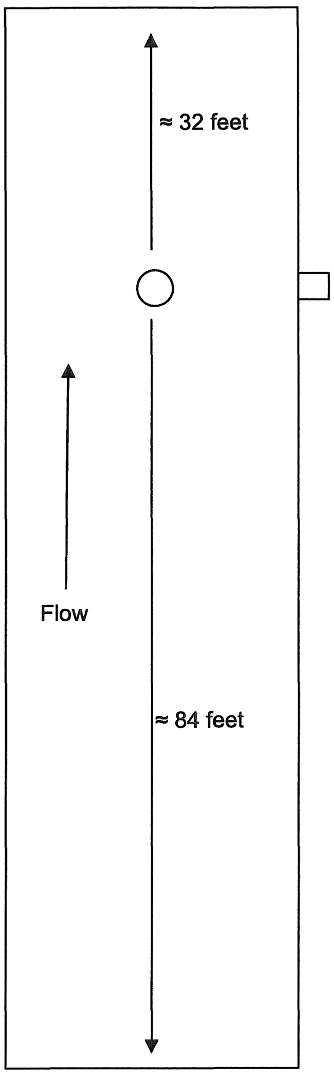
Not to Scale

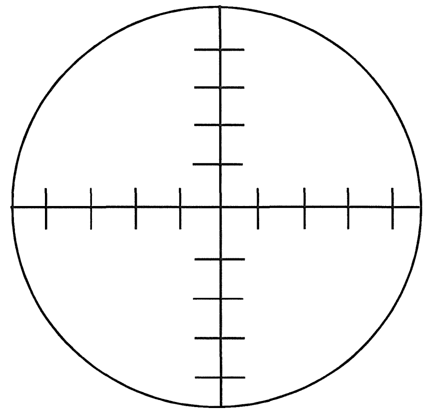
Points	Distance "
1	2.0
2	6.7
3	12.3
4	20.5
5	43.0
6	51.2
7	56.8
8	61.5

Figure No. 3

Site:	Sampling Date:	
RTO Inlet	**October 3, 2019**	**Montrose Air Quality Services**
Ford DTP		**4949 Fernlee Avenue**
Dearborn, Michigan		**Royal Oak, Michigan 48073**

diameter = 80 inches





Not to Scale

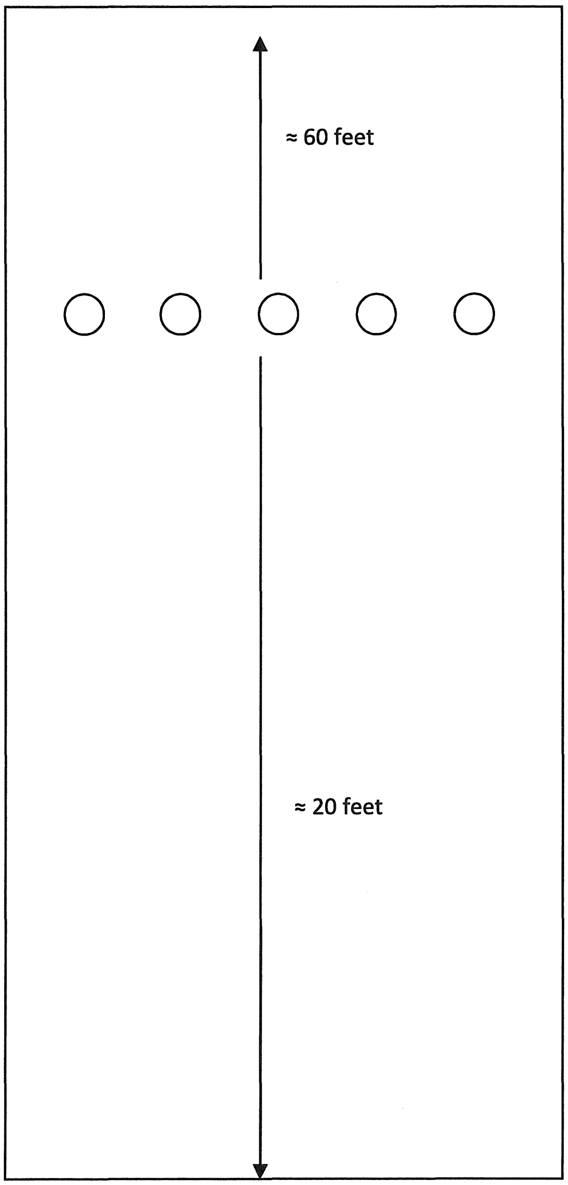
Points	Distance "
1	2.6
2	8.4
3	15.5
4	25.8
5	54.2
6	64.5
7	71.6
8	77.4

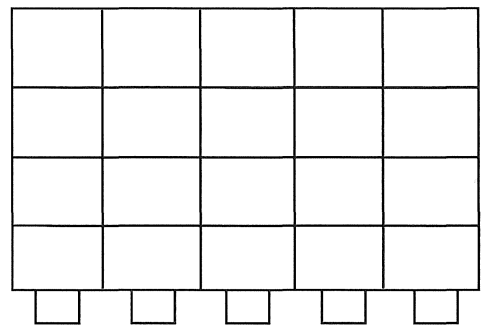
Figure No. 4

Site: **RTO Outlet** **Ford DTP** **Dearborn, Michigan**	**Sampling Date:** **October 3, 2019**	**Montrose Air Quality Services** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

Stack Dimensions:

Depth:	53	inches
Width:	124	inches





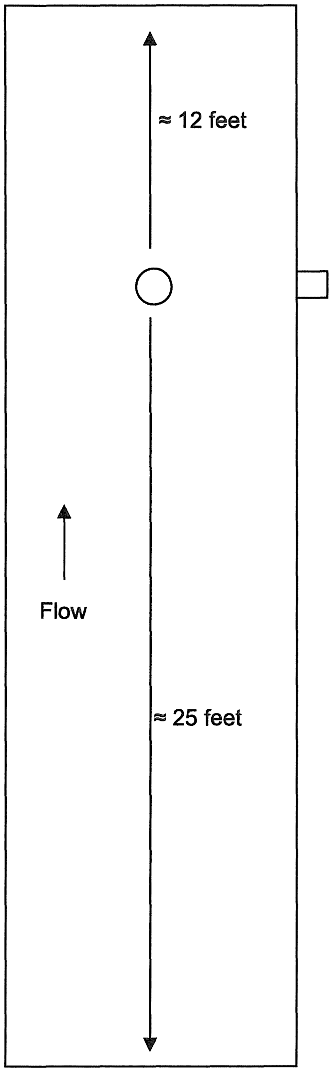
Not to Scale

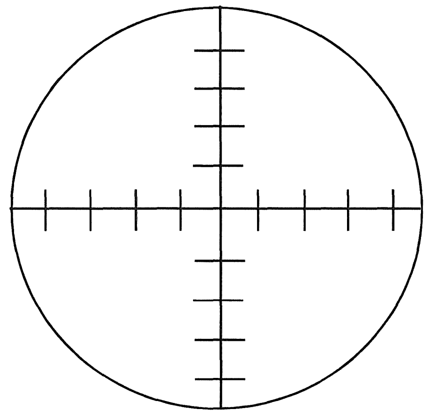
Points	Distance "
1	6.6
2	19.9
3	33.1
4	46.4

Figure No. 5

Site:	Sampling Date:	
Carbon System Inlet **Ford DTP** **Dearborn, Michigan**	**October 2, 2019**	**Montrose Air Quality Services** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

diameter = 75.5 inches





Not to Scale

Points	Distance "
1	2.4
2	7.9
3	14.6
4	24.4
5	51.1
6	60.9
7	67.6
8	73.1

Figure No. 6

Site:
Carbon System Outlet
Ford DTP
Dearborn, Michigan

Sampling Date:
October 2, 2019

Montrose Air Quality Services
4949 Fernlee Avenue
Royal Oak, Michigan 48073