



Main Paint Line VOC Destruction Efficiency Emissions Test Report

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AIR QUALITY DIV, Prepared for:

General Motors LLC

Detroit, Michigan

Flint Assembly
G-3100 Van Slyke Road
Flint, Michigan

Project No. 14-4546.00
July 28, 2014

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(248) 548-8070



MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

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Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name General Motors LLC - Flint Assembly County Genesee

Source Address G-3100 Van Slyke Road City Flint

AQD Source ID (SRN) B1606 ROP No. MI-ROP-B1606-2009b ROP Section No. 1

Please check the appropriate box(es):

Annual Compliance Certification (Pursuant to Rule 213(4)(c))

Reporting period (provide inclusive dates): From _____ To _____

1. During the entire reporting period, this source was in compliance with ALL terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, EXCEPT for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))

Reporting period (provide inclusive dates): From _____ To _____

1. During the entire reporting period, ALL monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, EXCEPT for the deviations identified on the enclosed deviation report(s).

Other Report Certification

Reporting period (provide inclusive dates): From _____ To _____

Additional monitoring reports or other applicable documents required by the ROP are attached as described:
VOC Destruction Efficiency Emissions Test Report (dated July 28, 2014)

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Amy D. Farmer Complex Director 810-577-9003
Name of Responsible Official (print or type) Title Phone Number

[Signature] August 13, 2014
Signature of Responsible Official Date

* Photocopy this form as needed.



EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by General Motors LLC to conduct a thermal oxidizer system volatile organic compound (VOC) destruction efficiency (DE) compliance test program on the Main Paint Line regenerative thermal oxidizer (RTO) under three and two chamber operating modes at the General Motors Flint Assembly Plant in Flint, Michigan. VOC DE Testing of the Main Paint Line RTO was conducted on June 19th, 2014.

The Main Paint Line RTO achieved an average VOC destruction efficiency of 97.4% while operating under two chamber mode and 97.2% while operating under three chamber mode.

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1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by General Motors LLC to conduct a thermal oxidizer system volatile organic compound (VOC) destruction efficiency (DE) compliance test program on the Main Paint Line regenerative thermal oxidizer (RTO) under three and two chamber operating modes at the General Motors Flint Assembly (FA) Plant in Flint, Michigan.

The Air Quality Division (AQD) of Michigan's Department of Environmental Quality has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). 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

The RTO unit is located at the FA facility (G-3100 Van Slyke, Flint, Michigan). VOC DE Testing of the Main Paint Line RTO was conducted on June 19th, 2014.

1.b Purpose of Testing

The purpose of the test program was to determine VOC destruction efficiency of the RTO on EU-12PRIMERSURF and EU-14TOPCOAT. This testing is required by MI-ROP-B1606-2009b.

1.c Source Description

The General Motors FA facility is a truck assembly center and the RTO unit addressed in this test report controls emissions from the Primer Surfacer and Topcoat systems. The exhaust gases from the primer and topcoat ovens as well as the heated flash are routed to the RTO for VOC emission control.

1.d Test Program Contacts

The contact for the source and test report is:

Mrs. Irene Bashore
Sr. Environmental Engineer
GM – Flint Assembly
G-3100 Van Slyke Road
Mail code: 485-402-250
Flint MI 48551
Cell: (810) 577-9003
Desk: (810) 236-5684



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
Mrs. Irene Bashore Sr. Environmental Engineer	GM – Flint Assembly G-3100 Van Slyke Road Mail code: 485-402-250 Flint MI 48551	(810) 577-9003
Mr. Ken Lievens Project Manager	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Mr. Paul Molenda Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Mr. Paul Drape Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Mr. Steve Smith Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 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 related to the emission test program includes RTO operating temperature, number of chambers in operation, daily production rates and average surface coating rates.

During the individual test runs, the paint modules (i.e., spray booths and ovens) were kept as full as possible to achieve the highest RTO inlet loading.

2.b Applicable Permit

The applicable permit for this emissions test program is Renewable Operating Permit (ROP) No. MI-ROP-B1606-2009b.

2.c Results

The results of the emissions test program are summarized by Tables 2 and 3.

3. Source Description

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

3.a Process Description

The General Motors FA facility is a truck assembly center and the RTO unit addressed in this test report controls emissions from the Primer Surfacer and Topcoat systems. The exhaust gases from the primer and topcoat ovens as well as the heated flash are routed to the RTO for VOC emission control.

3.b Process Flow Diagram

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

3.c Raw and Finished Materials

The raw materials used in the coating process line include various automotive surface coatings.

3.d Process Capacity

The normal operating rate of the coating line is 32 jobs per hour. The Main Paint Line RTO is rated for a VOC destruction efficiency of 95% with a maximum exhaust gas flowrate of 48,000 cfm.

3.e Process Instrumentation

Process data related to the emission test program includes RTO operating temperature, number of chambers in operation, daily production rates and average surface coating rates. Process data is included as Appendix E.

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

Measurement of exhaust gas velocity, molecular weight, and moisture content was conducted using the following reference test methods codified at 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 Methods 1 and 2. An S-type or standard pitot tube with a thermocouple assembly, calibrated in accordance with Method 2, Section 4.1.1, was used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type and standard pitot tube dimensions were within specified limits, therefore, baseline pitot tube coefficients of 0.84 (dimensionless) was assigned.

A cyclonic flow check was 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 average null angle was determined to be less than 20 degrees at each of the applicable sampling location.

Molecular weight was determined 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 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 was then determined volumetrically (liquid impingers) and gravimetrically (silica gel impinger). A schematic drawing of the Method 4 sampling train is provided as Figure 1.

VOC concentrations were measured at the inlet and outlet of each RTO using the procedures found in 40 CFR 60, Appendix A, Method 25A, “Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer.” Triplicate 60-minute test runs were conducted on the RTO under three and two chamber operating modes.

RTO inlet concentrations were measured using a VIG Industries Model 20 THC gas analyzer. The outlet VOC concentrations were measured using a JUM 109A Methane/Non-Methane Analyzer. For each sampling location, 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 Laptop PC equipped with data acquisition software.

The VIG THC hydrocarbon analyzer directs the sample to the flame ionization detector (FID), where the hydrocarbons present in the sample will be ionized into carbon. The carbon concentration is then determined by the detector in parts per million (ppm). This concentration is sent 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).

The J.U.M. Model 109A utilizes two flame ionization detectors (FID) to determine the average concentration (ppm) for THC (as propane) and the average concentration for methane. Upon entry, the gas stream is split by the analyzer. 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 a data acquisition system (DAS), where 4-second interval data points are recorded to produce an average based on the overall duration of the test. This average is then used to determine the average concentration for THC reported as the calibration gas, propane, in equivalent units.

The analyzer's response factor is obtained by introducing a methane calibration gas to the calibrated J.U.M. 109A. The response of the methane analyzer's response, in ppm as methane, is divided by the THC FID's response to the methane calibration gas, in ppm, as propane. The average response factor obtained during the test program was 2.21.

For analyzer calibrations, calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System. The Series 4040 consists of a single chassis with four mass flow controllers. The mass flow controllers are factory-calibrated using a primary flow standard traceable to the United States National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. A field quality assurance check of the system was performed pursuant to Method 205 by setting the diluted concentration to a value identical to a Protocol 1 calibration gas and then verifying that the analyzer response is the same with the diluted gas as with the Protocol 1 gas.

A drawing of the Method 25A sampling train used for the testing program is presented as Figure 2. Protocol 1 gas certification sheets for the calibration gases used for this testing program are presented in Appendix B.

4.b Recovery and Analytical Procedures

This test program did not include laboratory samples, consequently, sample recovery and analysis is not applicable to this test program.

4.c Sampling Ports

The THC sampling probes for the RTO were placed at the inlet and exhaust of the RTO at a single fixed position for the 60-minute duration of each test run. Gas flowrates were measured at three inlet locations and one outlet of the Main Paint Line RTO. The inlet flowrates for the Main Paint Line RTO is the sum of the flowrates measured at each of three exhaust header legs.



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 Figures 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 results of the emissions test program are summarized by Tables 2 and 3. Exhaust gas flowrates measured at each flowrates sampling location are summarized in Appendix A. Equipment calibration data is summarized in Appendix B. One-minute average VOC concentration data is summarized in Appendix C. Example calculations are presented in Appendix D, and raw analyzer data and process data is included in Appendix E.

5.b Discussion of Results

The Main Paint Line RTO achieved an average VOC destruction efficiency of 97.4% while operating under two chamber mode and 97.2% while operating under three chamber mode.

5.c Sampling Procedure Variations

There were no sampling variations used during the emission compliance test program.

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 B.

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 A

5.k Laboratory Data

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

Table 2
Main Paint Line RTO (3 Chamber) Test Results
General Motors
Flint, MI

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	6/19/2014	6/19/2014	6/19/2014	
Sampling Time	9:20-10:20	10:45-11:45	12:10-13:10	
Inlet Flowrate (scfm)	29,809	28,613	29,124	29,182
Outlet Flowrate (scfm)	29,710	28,220	28,974	28,968
Inlet VOC Concentration (ppmv propane)	170.6	165.4	204.4	180.1
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	167.9	162.0	204.0	178.0
Inlet VOC Mass Flowrate (standard lb/hr)	34.3	31.7	40.7	35.5
Outlet VOC Concentration (ppmv propane)	5.0	4.8	6.0	5.3
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	5.0	4.7	6.2	5.3
Outlet CH4 Concentration (ppmv methane)	0.5	0.8	1.1	0.8
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	0.3	0.4	0.8	0.5
Outlet VOC Concentration (- methane)	4.9	4.5	5.8	5.1
Outlet VOC Mass Emission Rate (standard lb/hr)	1.0	0.9	1.2	1.0
VOC Destruction Efficiency (%)	97.1	97.3	97.2	97.2

Inlet VOC Correction			
Co	2.75	6.08	6.99
Cma	249	249	249
Cm	251.57	250.93	247.94

Outlet VOC Correction			
Co	0.13	0.42	0.14
Cma	29.8	29.8	29.8
Cm	29.19	28.38	28.40

Outlet CH4 Correction			
Co	0.23	0.37	0.40
Cma	29.8	29.8	29.8
Cm	28.40	28.47	29.13

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 (C₃H₈ = 44.10)

24.14: molar volume of air at standard conditions (70°F, 29.92" Hg)

35.31: ft³ per m³

453600: mg per lb

Response factor obtained from introducing methane into propane analyzer:

2.21

Equations

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

DE = (VOC in - VOC out)/VOC in

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Table 3
Main Paint Line RTO (2 Chamber) Test Results
General Motors
Flint, MI

Parameter	Run 4	Run 5	Run 6	Average
Sampling Date	6/19/2014	6/19/2014	6/19/2014	
Sampling Time	14:00-15:00	15:20-16:20	16:37-17:37	
Inlet Flowrate (scfm)	28,924	29,135	29,791	29,283
Outlet Flowrate (scfm)	29,696	29,581	30,880	30,052
Inlet VOC Concentration (ppmv propane)	198.9	155.4	174.2	176.1
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	199.8	153.8	173.7	175.8
Inlet VOC Mass Flowrate (standard lb/hr)	39.6	30.7	35.4	35.2
Outlet VOC Concentration (ppmv propane)	5.5	3.9	4.5	4.6
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	5.4	3.9	4.6	4.6
Outlet CH4 Concentration (ppmv methane)	1.1	0.3	0.4	0.6
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	0.8	0.2	0.3	0.4
Outlet VOC Concentration (- methane)	5.0	3.8	4.5	4.4
Outlet VOC Mass Emission Rate (standard lb/hr)	1.0	0.8	0.9	0.9
VOC Destruction Efficiency (%)	97.4	97.5	97.3	97.4

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 (C₃H₈ = 44.10)

24.14: molar volume of air at standard conditions (70°F, 29.92" Hg)

35.31: ft³ per m³

453600: mg per lb

Response factor obtained from introducing methane into propane analyzer:

2.21

Equations

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

DE = (VOC in - VOC out)/VOC in

Inlet VOC Correction			
Co	5.93	6.06	5.88
Cma	249	249	249
Cm	246.35	247.73	247.21

Outlet VOC Correction			
Co	0.36	0.16	0.14
Cma	29.8	29.8	29.8
Cm	28.69	28.80	28.61

Outlet CH4 Correction			
Co	0.30	0.14	0.12
Cma	29.8	29.8	29.8
Cm	29.28	29.40	29.60

Figures

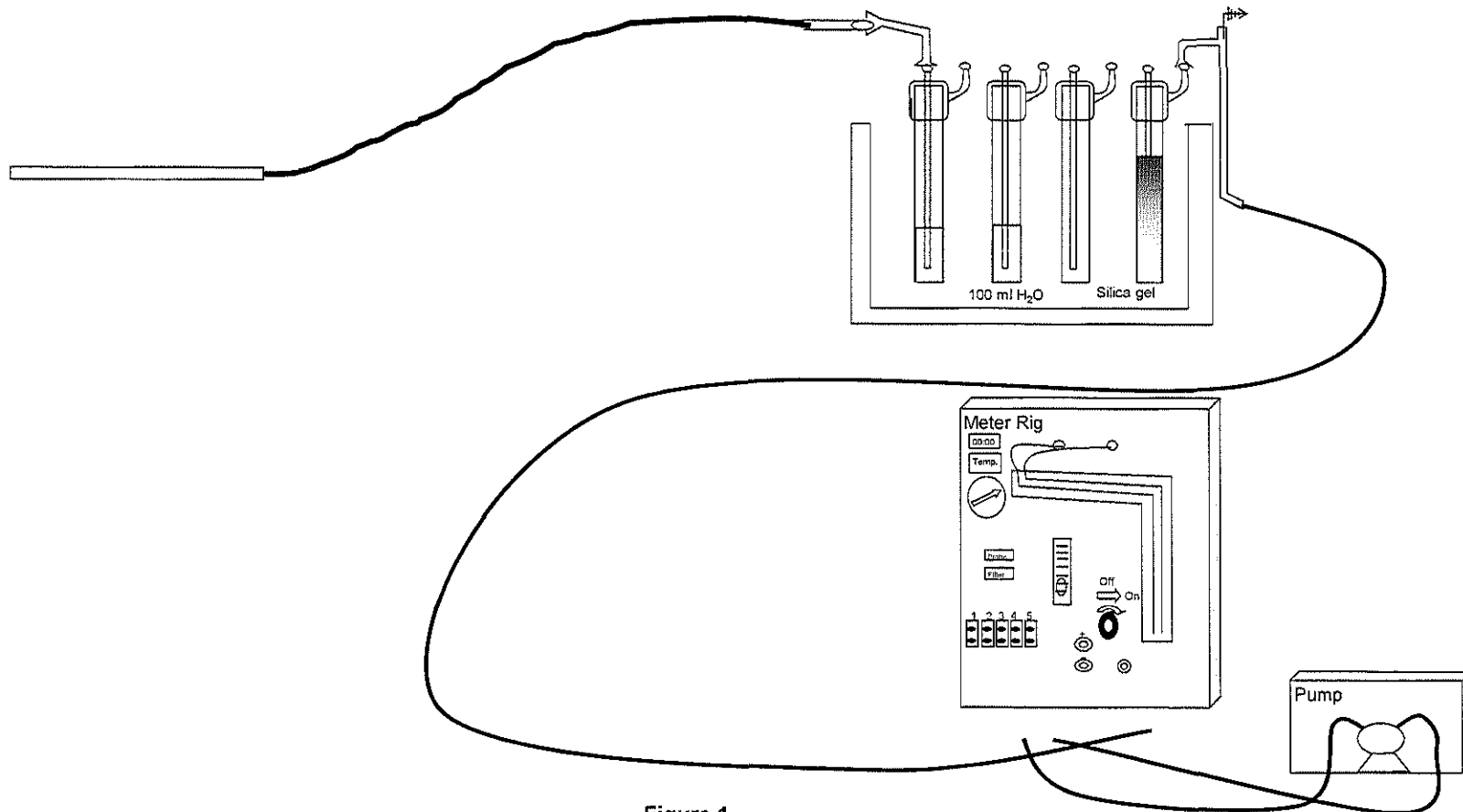


Figure 1

Site:
USEPA Method 4
General Motors LLC
Flint Assembly

Sampling Dates:
June 19, 2014

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073

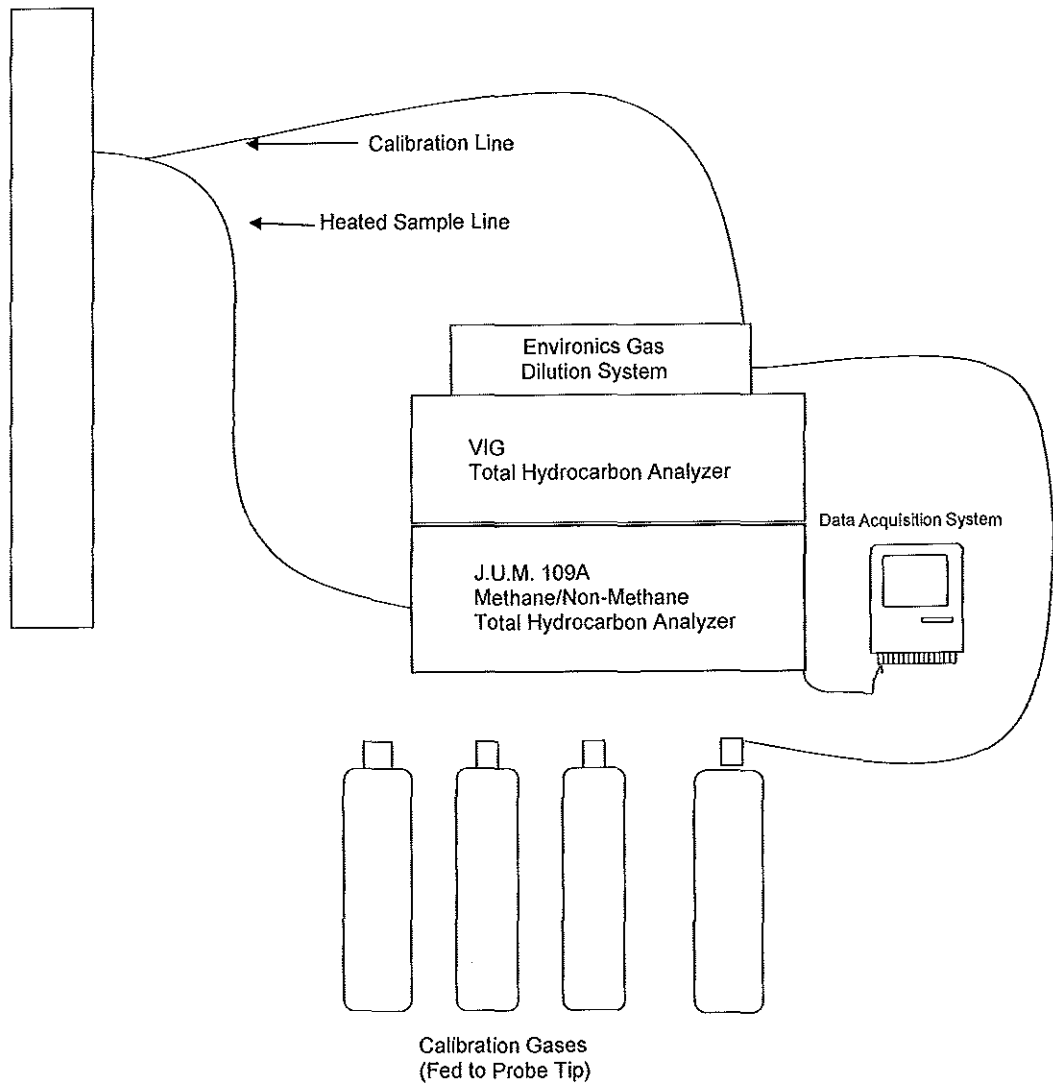


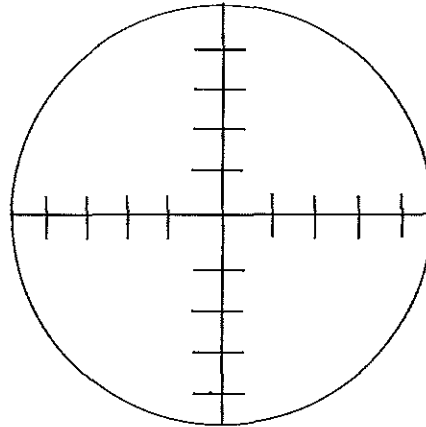
Figure 2

<p>Site: USEPA Method 25A General Motors LLC Flint Assembly</p>	<p>Sampling Date: June 19, 2014</p>	<p>BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073</p>
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Stack Diameter: 59.5 inches

Points	Distance "
1	1.9
2	6.2
3	11.5
4	19.2
5	40.3
6	48.0
7	53.3
8	57.6



Not to Scale

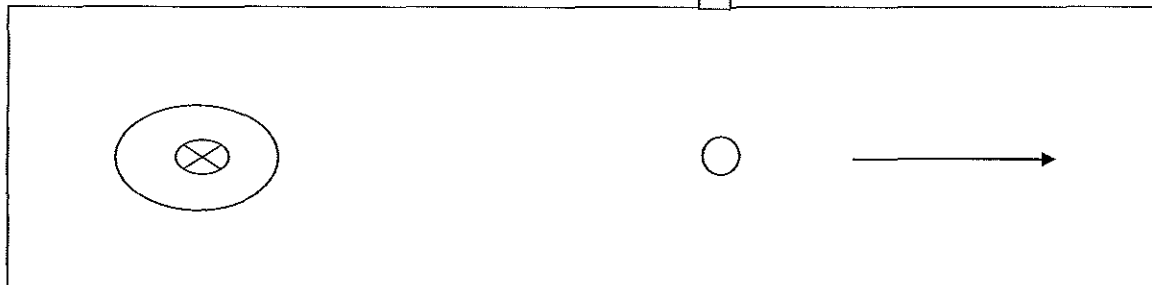


Figure No. 3

Site:
General Motors LLC
Flint Assembly
Main Paint Line
RTO Inlet Traverse Point Diagram

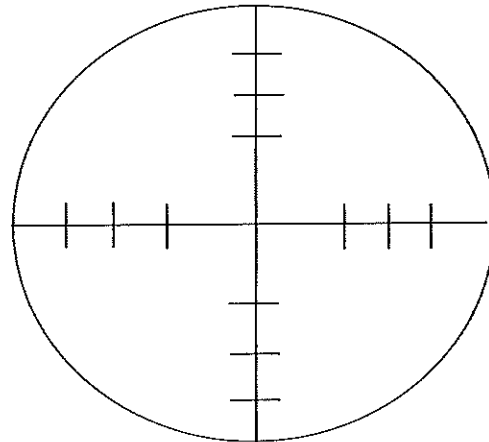
Sampling Date:
June 19, 2014

BT Environmental Consulting, Inc.
4949 Fernlee
Royal Oak, Michigan



Stack Diameter : 20.75 inches

Points	Distance "
1	0.9
2	3.0
3	6.1
4	14.6
5	17.7
6	19.8



Not to Scale

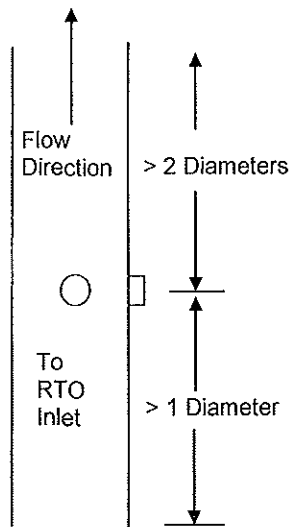


Figure 4

Site:
General Motors LLC
Flint Assembly
Main Paint Line
Zone 4 RTO Inlet Traverse Point Diagram

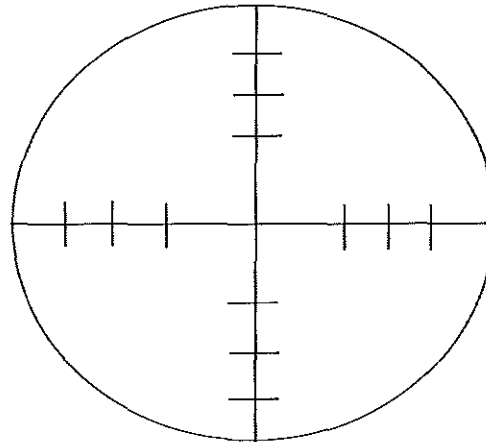
Sampling Date:
June 19, 2014

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073



Stack Diameter : 20.75 inches

Points	Distance "
1	0.9
2	3.0
3	6.1
4	14.6
5	17.7
6	19.8



Not to Scale

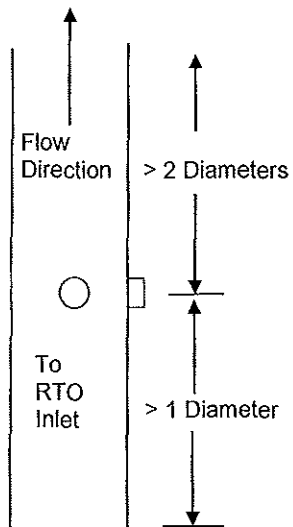


Figure 5

Site:
General Motors LLC
Flint Assembly
Main Paint Line
Zone 5 RTO Inlet Traverse Point Diagram

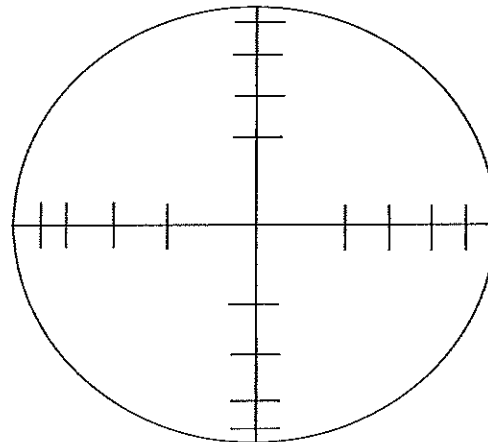
Sampling Date:
June 19, 2014

BT Environmental Consulting,
Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073



Stack Diameter : 64 inches

Points	Distance "
8	2.0
7	6.7
6	12.4
5	20.7
4	43.3
3	51.6
2	57.3
1	62.0



Not to Scale

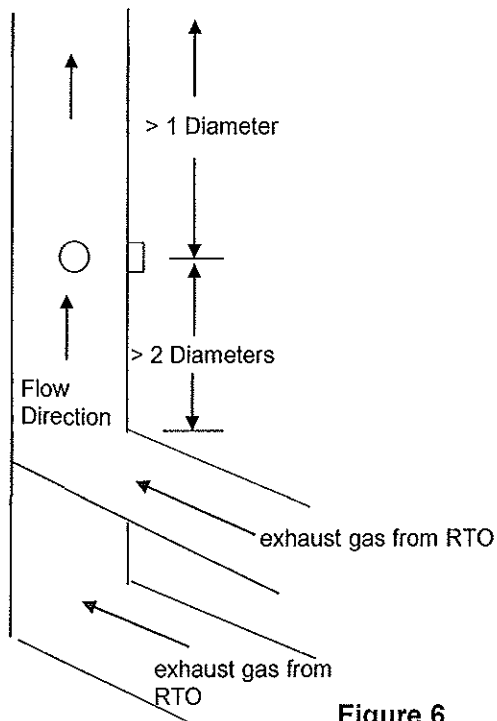


Figure 6

Site:
 General Motors LLC
 Flint Assembly
 Main Paint Line
 RTO Outlet Traverse Point Diagram

Sampling Date:
 June 19, 2014

BT Environmental Consulting,
Inc.
 4949 Fernlee Avenue
 Royal Oak, Michigan 48073