BTEC Inc.

Stack Melter Particulate Matter, VOC, CO, and NOx Emissions Test Summary Report

Prepared for:

General Motors

Saginaw, Michigan

GM SMCO
1629 N. Washington Ave.
Saginaw, Michigan

Project No. 15-4756.00
April 19, 2016

BT Environmental Consulting, Inc.
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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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.

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: GM LLC Saginaw Metal Casting Operations — County: Saginaw

Source Address: 1629 N. Washington — City: Saginaw

AQD Source ID (SRN): B1991 — ROP No.: B1991-2015a — 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 3-3-2016 To 3-4-2016

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

EU-SPMALUMINUM(Stack Melter) Emissions Test Report Certification, Project No. 15-4756.00 for SV-Z05-BH-4, dated April 19, 2016.

Note: EU-SPMALUMINUM is covered under MI-ROP-B1991-2015s, revision date March 22, 2016. EU-SPMSLUMINUM is also under PTI 36-12E, not yet incorporated into the active ROP.

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

John Lancaster	Plant Manager	989-757-1432
Name of Responsible Official (print or type)	Title	Phone Number

Signature of Responsible Official — Date: 4/28/16

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

Executive Summary

BT Environmental Consulting, Inc. (BTEC) was retained by General Motors, LLC (GM) to evaluate nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), particulate matter (PM), and condensable particulate matter (CPM) emission rates from the stack melter fabric filter collector exhaust. The PM and CPM emission rates at the inlet of the stack melter fabric filter collector were also evaluated. The inlet and outlet were tested simultaneously under three conditions (Charge, Hold, and Flux/Dross) at the GM facility in Saginaw, Michigan. The emissions test program was conducted on March 3rd and 4th, 2016. The stack melter is covered by Permit to Install No. 36-12E EU-SPMALUMINUM.

Testing of the inlet and outlet consisted of triplicate 60-minute test runs at each condition (charge, hold, and flux/dross). Sampling was performed utilizing United States Environmental Protection Agency (USEPA) reference test methods. The results of the emissions test program are summarized by Table 1. The permit does not contain PM limits at the inlet to the fabric filter collector and does not require inlet testing. GM tested PM at the inlet to evaluate the need for PM emissions control during the three operating conditions. Of particular interest was the determination of the inlet PM loading during hold only conditions.

Table 1
Overall Results Summary – EU-SPMALUMINUM
Sampling Dates: March 3-4, 2016

Source	Pollutant	PTI 36-12E Emission Limitation (lb/hr)	Emission Rate (lb/hr)		
			Charge	Hold	Flux/Dross
Inlet	PM	NA	0.17	0.09	0.36
Outlet	NOx	2.75	0.73	0.43	0.45
	CO	2.06	0.37	0.35	0.45
	VOC	1.20	0.05	0.04	0.04
	PM	1.13	0.09	0.09	0.11
	PM_{10}	1.13			
	$PM_{2.5}$	1.13			

All PM reported as $PM_{2.5}$

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by General Motors, LLC (GM) to evaluate nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), particulate matter (PM), and condensable particulate matter (CPM) emission rates from the stack melter fabric filter collector exhaust. The PM and CPM emission rates at the inlet of the stack melter fabric filter collector were also evaluated. The inlet and outlet were tested simultaneously under three conditions (Charge, Hold, and Flux/Dross) at the GM facility in Saginaw, Michigan. The emissions test program was conducted on March 3rd and 4th, 2016. The stack melter is covered by Permit to Install No. 36-12E, EU-SPMALUMINUM. In addition, SMCO evaluated the PM present in the inlet to the fabric filter collector. The inlet test results may be used to evaluate the need for particulate emissions control during the three operating conditions. Of particular interest was the determination of the inlet PM loading during hold only conditions. Inlet testing is not required by the permit.

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 source tested is located at the GM Saginaw Metal Casting Operations located in Saginaw, Michigan. Testing on all sources was conducted March 3rd and 4th, 2016.

1.b Purpose of Testing

The purpose of the testing is to demonstrate compliance with emission limitations for EU-SPMALUMINUM under Michigan PTI 36-12E.

1.c Source Description

Sources identified under this project specifically include, EU-SPMALUMINUM.

1.d Test Program Contact

The contacts for information regarding the test program as well as the test report are:

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GECS - Facility Air Compliance & Permit
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8175 Millett Highway
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BTEC Inc.

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4949 Fernlee Avenue
Royal Oak, MI 48073
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1.e Test Personnel

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

Table 2
Test Personnel

Name	Affiliation
Karen Carlson	GM- GECS
Renee Mietz	GM-SMCO
Barry Boulianne	BTEC
Matthew Young	BTEC
Brandon Chase	BTEC
Paul Molenda	BTEC
Mike Nummer	BTEC
Tom Gasloli	MDEQ
Sydney Bruestle	MDEQ

2. Summary of Results

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

2.a Operating Data

Process and control equipment operating data relevant to the emissions test program is provided in Appendix D.

2.b Applicable Permit

The emission units tested for EU-SPMALUMINUM are included in PTI 36-12E.

2.c Results

The results of the emissions test program are summarized by Table 1. Detailed results are summarized in Tables 3-5.

2.d Emission Regulation Comparison

PTI 36-12E Emission Limitations

Source	Pollutant	Emission Limit
EU-SPMALUMINUM	PM	1.13 lb/hr
	PM_{10}	1.13 lb/hr
	$PM_{2.5}$	1.13 lb/hr
	VOC	1.20 lb/hr
	NOx	2.75 lb/hr
	CO	2.06 lb/hr

3. Source Description

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

3.a Process Description

Molten Aluminum Supply – a natural gas-fired aluminum melting/holding furnace for aluminum/alloy production using "clean charge" with flux addition, drossing, and degassing well (argon). The melting burners' design heat input rate is 14.5 MMBtu/hr gas-fired for 5.5 tons/hr melt rate and the holding burners' design heat input rate is 4.25 MMBtu/hr. Due to the furnace design, all melting burners and holding burners may operate simultaneously. Electrically heated launder systems vented in-plant. Three electric Ladle furnaces also with degassing (argon) capability and flux addition, vented in-plant.

Key components of the aluminum supply system are described below:

- A gas-fired stack melting furnace that melts clean aluminum ingots and remelts clean internal scrap from the gating system. Aluminum is loaded into the "stack" and melted using the melting gas-fired burners. The melted aluminum flows into the holding portion of the furnace where proper temperature is maintained using the holding gas-fired burners.
- The electrically heated launder system transports molten aluminum to each of the three ladle furnaces (one for each cast line.)

The holding portion of the furnace is fluxed and drossed for the removal of impurities such as hydrogen in the molten metal. Fluxing helps to extend the life of the furnace refractory and keeps the furnace walls clean while also removing the metal impurities. Fluxing is the process that causes suspended aluminum particles and metal oxides, combined with flux chemicals, to float to the top of the molten aluminum to form dross. This dross is skimmed from the furnace surface and removed. Fluxing is done by injecting the flux material below the metal surface. Approximately 20 pounds of flux is used, and the entire fluxing / drossing process duration is approximately 40 minutes.

Emissions from the melting/holding furnace, including products of combustion and fluxing are vented to and controlled by a maximum rated 33,000 scfm fabric filter collector.

Emissions from the launder systems and ladle furnaces are released to the internal plant environment.

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

3.b Process Flow Diagram

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

3.c Raw and Finished Materials

The type of raw materials used in the processes includes molten aluminum and injection flux. See section 3.a

3.d Process Capacity

Process Production Capacities

Process	Maximum Production Rate	Current Targeted Production Rate	Current Average Production Rate	Target Production Rate Emission Testing
EU-SPMAluminum	14.5 mmbtu/hr melting burners 4.25 mmbtu/hr holding burners 20 lb Flux per event 5.5 tons/hr melt rate	14.5 mmbtu/hr melting burners 4.25 mmbtu/hr holding burners 20 lb Flux per even 1 ton/hr melt rate average	14.5 mmbtu/hr melting burners 4.25 mmbtu/hr holding burners 20 lb Flux per event 0.75 ton/hr melt rate average	14.5 mmbtu/hr melting burners 4.25 mmbtu/hr holding burners 20 lb Flux per event 2.8 ton/hr melt rate

3.e Process Instrumentation

The fabric filter pressure drop (in. H2O), the melting burners and holding burners natural gas usage, flux usage, and metal charge rate was recorded during every run of the compliance test. This data is included in Appendix D.

4. Sampling and Analytical Procedures

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

4.a Sampling Train and Field Procedures

Sampling and analytical methodologies for the emissions test program can be separated into five categories as follows:

(1) Measurement of exhaust gas velocity, molecular weight, and moisture content;
(2) Measurement of exhaust gas filterable and condensable PM concentration using USEPA Methods 5/202
(3) Measurement of exhaust gas NOx concentration using USEPA Method 7E
(4) Measurement of exhaust gas CO concentration using USEPA Method 10
(5) Measurement of exhaust gas VOC concentration using USEPA Method 25A.

Sampling and analytical methodologies by category are summarized below.

Exhaust Gas Velocity, Molecular Weight, and Moisture Content

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. A diagram of the sample points is provided in Figures 1-2.

Cyclonic flow checks were performed at each 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.

The Molecular Weight of the gas stream was evaluated according to procedures outlined in Title 40, Part 60, Appendix A, Method 3A. The O_2 /CO_2 content of the gas stream was measured using a Fyrite combustion analyzer.

Exhaust gas was extracted as part of the sampling train. Exhaust gas moisture content was then determined gravimetrically.

Filterable and Condensable PM (USEPA Method 5 /202)

40 CFR 60, Appendix A, Method 5, *"Determination of Particulate Emissions from Stationary"* and 40 CFR 60, Appendix A, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission rates (see Figure 3 for a schematic of the sampling train). Triplicate 60-minute test runs were conducted.

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) a glass probe, (3) a stainless-steel filter housing, (4) a Teflon connecting line to the impingers (5) a vertical condenser, (6) an empty pot bellied impinger, (7) an empty modified Greenburg-Smith (GS) impinger, (8) unheated borosilicate filter holder with a teflon filter and Teflon filter support, (9) a second modified GS impinger with 100 ml of deionized water, and a third modified GS impinger containing approximately 300 g of silica gel desiccant, (10) a length of sample line, and (11) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

A sampling train leak test was conducted before and after each test run. After completion of the final leak test for each test run, the filter was recovered, the nozzle, probe and front half of the filter housing were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. The CPM filter was recovered and placed in a petri dish. The back half of the filter housing, the condenser, the pot bellied impinger, the moisture drop out impinger, and the front half of the CPM filter housing and all connecting glassware were double rinsed with deionized water which was collected in a pre-cleaned sample container. The same glassware was then rinsed with acetone which was collected in a pre-cleaned sample container labeled as the organic fraction. The glassware was then double rinsed with hexane which was added to the same organic fraction sample bottle.

BTEC labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. In addition, blank samples of the acetone, DI water, hexane, and filter were collected. BTEC personnel carried all samples to BTEC's laboratory (for filter and acetone gravimetric analysis) in Royal Oak, Michigan. DI water and organic samples were hand delivered to Maxxam for analysis.

NOx (USEPA Method 7E)

The NOx content of the gas stream was measured using a Thermo Model 42i NOx gas analyzer. The gas stream was drawn through a stainless-steel probe with a heated in-line filter to remove any particulate, a heated Teflon® sample line, through a refrigerated Teflon® sample conditioner to remove the moisture from the sample before it entered the NOx analyzer. Data was recorded on a PC equipped with data acquisition software. Recorded NOx concentrations were averaged and reported for the duration of each 60-

minute test (as drift corrected per Method 7E). A drawing of the sampling train used for the testing program is presented as Figure 4.

In accordance with Method 7E, a 3-point (zero, mid, and high) bias check and calibration check was performed on the NOx analyzer prior to initiating the test program. Following each test run, a 2-point (zero and high) calibration drift check was performed. The NOx analyzer was operated at the 0-50 ppm range.

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.

CO (USEPA Method 10)

The CO content of the exhaust gas was evaluated according to procedures outlined in 40 CFR 60, Appendix A, Method 10. The CO content of the gas stream was measured using a TECO 48 CO gas analyzer (see Figure 4 for a schematic of the sampling train). The gas stream was drawn through a stainless-steel probe with a heated in-line filter to remove any particulate, a heated Teflon® sample line, through a refrigerated sample conditioner with a peristaltic pump to remove the moisture from the sample before it entered the analyzer. Data was recorded on a PC equipped with Labview® II data acquisition software. Recorded CO concentrations were averaged and reported for the duration of each 60-minute test (as drift corrected per Method 7E). The analyzer was calibrated for a range of 0 to 50 ppm.

In accordance with Method 10, a 3-point (zero, mid, and high) calibration check was performed on the CO analyzer. Calibration drift checks were performed at the completion of each run. Calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System.

Volatile Organic Compounds (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

IOtech® data acquisition software. BTEC used a JUM Model 109A Methane/Non-Methane THC hydrocarbon analyzer to determine the VOC concentration.

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. The response factor determined during testing was 2.46, and 2.38.

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. Calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System

4.b Recovery and Analytical Procedures

Descriptions of the recovery procedures are provided in section 4.a for each sampling method.

4.c Sampling Ports

Diagrams of the stacks showing sampling ports are included as Figures 1 and 2.

4.d Traverse Points

Diagrams of the stacks showing traverse points are included as Figures 1 and 2.

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 1. Detailed results for the emissions test program are summarized by Tables 3-5.

5.b Discussion of Results

All of the PM and CPM measured is reported as PM less than 2.5 microns ($PM_{2.5}$). Results for all pollutants under all three operating conditions are well below the corresponding limits. Additionally, it should be noted that the hourly PM loading to the fabric filter collector is less than the emission limitations for the outlet from the fabric filter collector under all three operating conditions.

Table 1
Overall Results Summary – EU-SPMALUMINUM
Sampling Dates: March 3-4, 2016

Source	Pollutant	PTI 36-12E Emission Limitation (lb/hr)	Emission Rate (lb/hr)		
			Charge	Hold	Flux/Dross
Inlet	PM	NA	0.17	0.09	0.36
Outlet	NOx	2.75	0.73	0.43	0.45
	CO	2.06	0.37	0.35	0.45
	VOC	1.20	0.05	0.04	0.04
	PM	1.13	0.09	0.09	0.11
	PM_{10}	1.13			
	$PM_{2.5}$	1.13			

All PM reported as $PM_{2.5}$

5.c Sampling Procedure Variations

No sampling procedure variations occurred during the emissions test program

5.d Process or Control Device Upsets

No process or control device upsets occurred during the emissions test program.

5.e Control Device Maintenance

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

5.f Audit Sample Analyses

Audit samples were not analyzed as part of this emissions test program.

5.g Calibration Sheets

Calibration documents are provided as Appendix B.

5.h Sample Calculations

Sample calculations are provided as Appendix C.

5.i Field Data Sheets

Field data sheets are provided in Appendix A.

5.j Laboratory Data

Laboratory analysis is provided in Appendix E.

Table 3
Stack Melter Outlet Particulate Matter Emission Rates

Company	GM SMCO			
Source Designation	Melter Exhaust			
Test Date	3/3/2016	3/4/2016	3/4/2016	
Meter/Nozzle Information	Charge	Flux/Dross	Hold	Average
Meter Temperature Tm (F)	61.5	50.5	53.2	55.1
Meter Pressure - Pm (in. Hg)	29.6	29.7	29.6	29.6
Measured Sample Volume (Vm)	49.3	43.9	42.7	45.3
Sample Volume (Vm-Std ft3)	48.9	44.5	43.0	45.5
Sample Volume (Vm-Std m3)	1.39	1.26	1.22	1.29
Condensate Volume (Vw-std)	1.320	0.533	0.533	0.795
Gas Density (Ps(std) lbs/ft3) (wet)	0.0738	0.0742	0.0742	0.0741
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.71	3.34	3.23	3.43
Total weight of sampled gas (m g lbs) (dry)	3.65	3.31	3.20	3.39
Nozzle Size - An (sq. ft.)	0.000425	0.000425	0.000425	0.000425
Isokinetic Variation - I	101.9	94.2	99.9	98.7
Stack Data				
Average Stack Temperature - Ts (F)	168.1	141.5	139.7	149.8
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.6	28.7	28.7	28.7
Stack Gas Specific Gravity (Gs)	0.986	0.991	0.991	0.989
Percent Moisture (Bws)	2.63	1.18	1.22	1.68
Water Vapor Volume (fraction)	0.0263	0.0118	0.0122	0.0168
Pressure - Ps ("Hg)	29.5	29.5	29.5	29.5
Average Stack Velocity -Vs (ft/sec)	36.5	36.2	30.8	34.5
Area of Stack (ft2)	9.4	9.4	9.4	9.4
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	20,581	20,367	17,353	19,434
Flowrate ft^3 (Standard Wet)	17,037	17,603	15,044	16,562
Flowrate ft^3 (Standard Dry)	16,590	17,395	14,860	16,282
Flowrate m^3 (standard dry)	470	493	421	461
Total Particulate Weights (mg)				
Nozzle/Probe/Filter	< 0.5	< 0.5	< 0.5	0.5
Total Particulate Concentration				
lb/1000 lb (wet)	0.000	0.000	0.000	0.000
lb/1000 lb (dry)	0.000	0.000	0.000	0.000
mg/dscm (dry)	0.4	0.4	0.4	0.4
gr/dscf	0.0002	0.0002	0.0002	0.0002
Total Particulate Emission Rate				
lb/ hr	0.023	0.026	0.023	0.024
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	< 0.5	< 0.5	< 0.5	0.5
Organic Condensible Particulate	2.2	2.4	2.3	2.3
Inorganic Condensible Particulate	1.2	1.2	1.1	1.2
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	1.4	1.6	1.4	1.5
Total Filterable and Condensible Particulate	1.9	2.1	1.9	2.0
Filterable Particulate Concentration				
lb/1000 lb (wet)	0.000	0.000	0.000	0.000
lb/1000 lb (dry)	0.000	0.000	0.000	0.000
mg/dscm (dry)	0.4	0.4	0.4	0.4
gr/dscf	0.0002	0.0002	0.0002	0.0002
Filterable Particulate Emission Rate				
lb/ hr	0.02	0.03	0.02	0.02
Condensible Particulate Concentration				
lb/1000 lb (wet)	0.001	0.001	0.001	0.001
lb/1000 lb (dry)	0.001	0.001	0.001	0.001
mg/dscm (dry)	1.0	1.3	1.2	1.1
gr/dscf	0.0004	0.0006	0.0005	0.0005
Condensible Particulate Emission Rate				
lb/ hr	0.06	0.08	0.06	0.07
Total Particulate Concentration				
lb/1000 lb (wet)	0.001	0.001	0.001	0.001
lb/1000 lb (dry)	0.001	0.001	0.001	0.001
mg/dscm (dry)	1.4	1.7	1.6	1.5
gr/dscf	0.0006	0.0007	0.0007	0.0007
Total Particulate Emission Rate				
lb/ hr	0.09	0.11	0.09	0.09

Table 4
Stack Melter Inlet Particulate Matter Emission Rates

Company	**General Motors SMCO**			
Source Designation	**Stack Melter Inlet**			
Test Date	**3/3/2016**	**3/4/2016**	**3/4/2016**	
Meter/Nozzle Information	Charge	Flux/Dross	Hold	Average
Meter Temperature Tm (F)	33.6	21.8	30.4	28.6
Meter Pressure - Pm (in. Hg)	29.6	29.6	29.6	29.6
Measured Sample Volume (Vm)	39.4	44.2	36.6	40.1
Sample Volume (Vm-Std ft3)	41.9	48.2	39.2	43.1
Sample Volume (Vm-Std m3)	1.19	1.37	1.11	1.22
Condensate Volume (Vw-std)	0.877	0.882	0.745	0.835
Gas Density (Ps(std) lbs/ft3) (wet)	0.0740	0.0740	0.0740	0.0740
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.16	3.63	2.96	3.25
Total weight of sampled gas (m g lbs) (dry)	3.12	3.59	2.92	3.21
Nozzle Size - An (sq. ft.)	0.000401	0.000401	0.000401	0.000401
Isokinetic Variation - I	99.4	100.2	98.4	99.3
Stack Data				
Average Stack Temperature - Ts (F)	225.4	200.4	199.9	208.6
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.6	28.6	28.6	28.6
Stack Gas Specific Gravity (Gs)	0.988	0.989	0.989	0.989
Percent Moisture (Bws)	2.05	1.80	1.86	1.90
Water Vapor Volume (fraction)	0.0205	0.0180	0.0186	0.0190
Pressure - Ps ("Hg)	29.2	29.2	29.2	29.2
Average Stack Velocity -Vs (ft/sec)	39.7	43.6	36.1	39.8
Area of Stack (ft2)	9.4	9.4	9.4	9.4
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	22,370	24,559	20,340	22,423
Flowrate ft^3 (Standard Wet)	16,823	19,148	15,870	17,280
Flowrate ft^3 (Standard Dry)	16,478	18,804	15,575	16,952
Flowrate m^3 (standard dry)	467	532	441	480
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	1.9	6.4	< 0.5	2.9
Organic Condensible Particulate	2.1	1.5	2.1	1.9
Inorganic Condensible Particulate	1.2	1.1	1.2	1.2
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	1.3	0.6	1.3	1.1
Total Filterable and Condensible Particulate	3.2	7.0	1.8	4.0
Filterable Particulate Concentration				
lb/1000 lb (wet)	0.001	0.004	0.000	0.002
lb/1000 lb (dry)	0.001	0.004	0.000	0.002
mg/dscm (dry)	1.6	4.7	0.5	2.2
gr/dscf	0.0007	0.0020	0.0002	0.0010
Filterable Particulate Emission Rate				
lb/ hr	0.10	0.33	0.03	0.15
Condensible Particulate Concentration				
lb/1000 lb (wet)	0.001	0.000	0.001	0.001
lb/1000 lb (dry)	0.001	0.000	0.001	0.001
mg/dscm (dry)	1.1	0.4	1.2	0.9
gr/dscf	0.0005	0.0002	0.0005	0.0004
Condensible Particulate Emission Rate				
lb/ hr	0.07	0.03	0.07	0.06
Total Particulate Concentration				
lb/1000 lb (wet)	0.002	0.004	0.001	0.003
lb/1000 lb (dry)	0.002	0.004	0.001	0.003
mg/dscm (dry)	2.7	5.1	1.6	3.1
gr/dscf	0.0012	0.0022	0.0007	0.0014
Total Particulate Emission Rate				
lb/ hr	0.17	0.36	0.09	0.21

Table 5
Stack Melter NOx,, VOC, and CO Emission Rates
General Motors
Saginaw, MI
BTEC Project No. 15-4756.00
Sampling Dates: 3/3/16-3/4/16

Parameter	Run 1	Run 2	Run 3	Average
	Charge	Flux/Dross	Hold	
Test Run Date	3/3/2016	3/4/2016	3/4/2016	
Test Run Time	15:20-16:20	6:54-7:54	10:08-11:08	
Outlet Flowrate (dscfm)	16,590	17,395	14,860	**16,282**
Outlet Flowrate (scfm)	17,037	17,603	15,044	**16,562**
Outlet Oxides of Nitrogen Concentration (ppmv)	6.4	3.5	4.0	**4.6**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	6.1	3.6	4.1	**4.6**
NOx Emission Rate (lb/hr)	**0.76**	**0.44**	**0.43**	**0.54**
NOx Emission Rate (lb/hr) (corrected as per USEPA 7E)	**0.73**	**0.45**	**0.43**	**0.54**
Outlet Carbon Monoxide Concentration (ppmv)	4.9	6.5	5.7	**5.7**
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)	5.2	6.0	5.4	**5.5**
CO Emission Rate (lb/hr)	**0.35**	**0.49**	**0.36**	**0.40**
CO Emission Rate (lb/hr) (corrected as per USEPA 7E)	**0.37**	**0.45**	**0.35**	**0.39**
Outlet VOC Concentration (ppmv as propane)	2.3	2.6	3.1	**2.7**
Outlet Methane Concentration (ppmv as methane)	4.4	5.0	6.2	**5.2**
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	2.2	2.4	2.9	**2.5**
Outlet Methane Concentration (ppmv, corrected as per USEPA 7E)	4.3	4.9	6.1	**5.1**
Outlet VOC Concentration (ppmv propane, -Methane)	0.5	0.4	0.5	**0.5**
Outlet VOC Concentration (ppmv propane, -Methane, corrected as per USEPA 7E)	0.4	0.4	0.3	**0.4**
VOC Emission Rate as Propane (lb/hr) (-Methane)	**0.06**	**0.05**	**0.06**	**0.06**
VOC Emission Rate as Propane(lb/hr) (-Methane) (corrected as per USEPA 7E)	**0.05**	**0.04**	**0.04**	**0.04**

NOx Correction			
Co	0.18	0.08	0.08
Cma	24.95	24.95	24.95
Cm	25.36	23.91	24.36

CO Correction			
Co	-0.20	0.65	0.32
Cma	24.1	24.1	24.1
Cm	23.40	24.36	24.08

VOC Correction			
Co	0.18	0.14	0.22
Cma	15	15	15
Cm	14.94	15.13	15.20

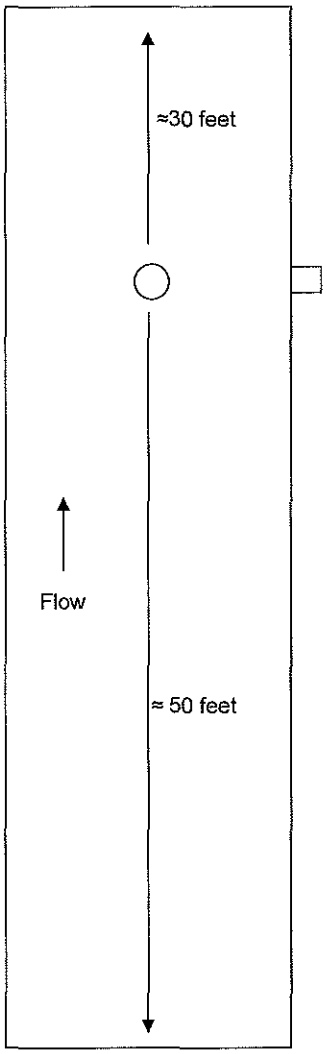
Methane Correction			
Co	0.14	0.15	0.09
Cma	15	15	15
Cm	14.81	15.16	14.97

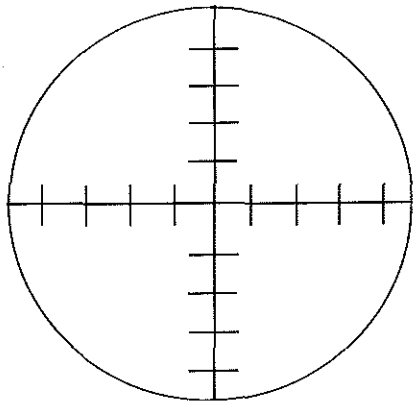
scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (CO = 28.01, NOx = 46.01, C_3H_8 = 44.10)
24.14 = molar volume of air at standard conditions (70 °F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb
Response factor obtained from introducing propane into methane analyzer: **2.46** **2.38**

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

BTEC Inc.

diameter = 41.5 inches





Not to Scale

Points	Distance "
1	1.3
2	4.4
3	8.1
4	13.4
5	28.1
6	33.4
7	37.1
8	40.2

Figure No. 1

Site: **Stack Melter Outlet** **General Motors, LLC** **Saginaw, Michigan**	**Sampling Date:** **March 3-4, 2016**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

BTEC Inc.

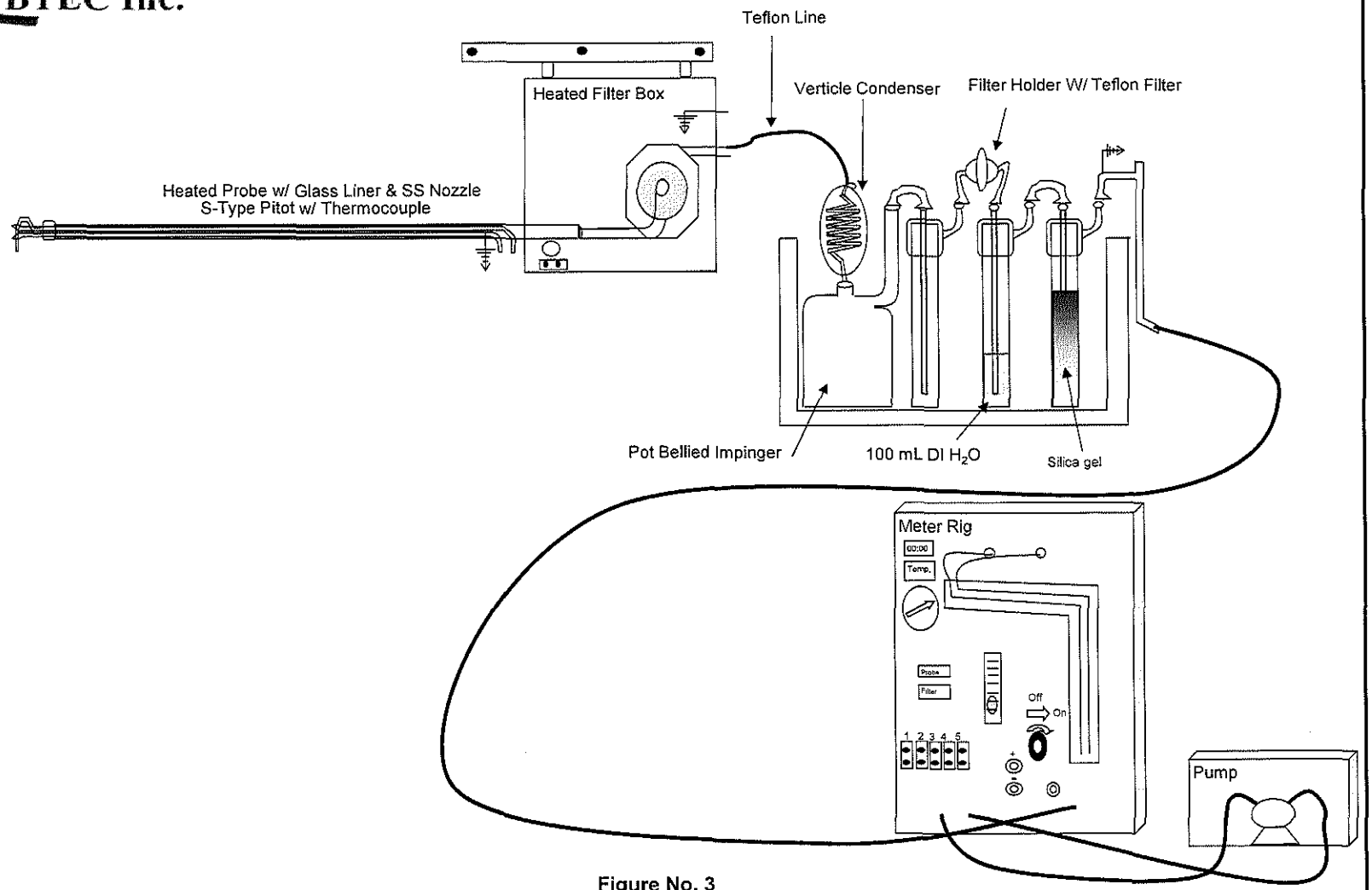


Figure No. 3

Site:	Sampling Date:	
USEPA Method 5/202 General Motors, LLC Saginaw, Michigan	March 3-4, 2016	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073

BTEC Inc.

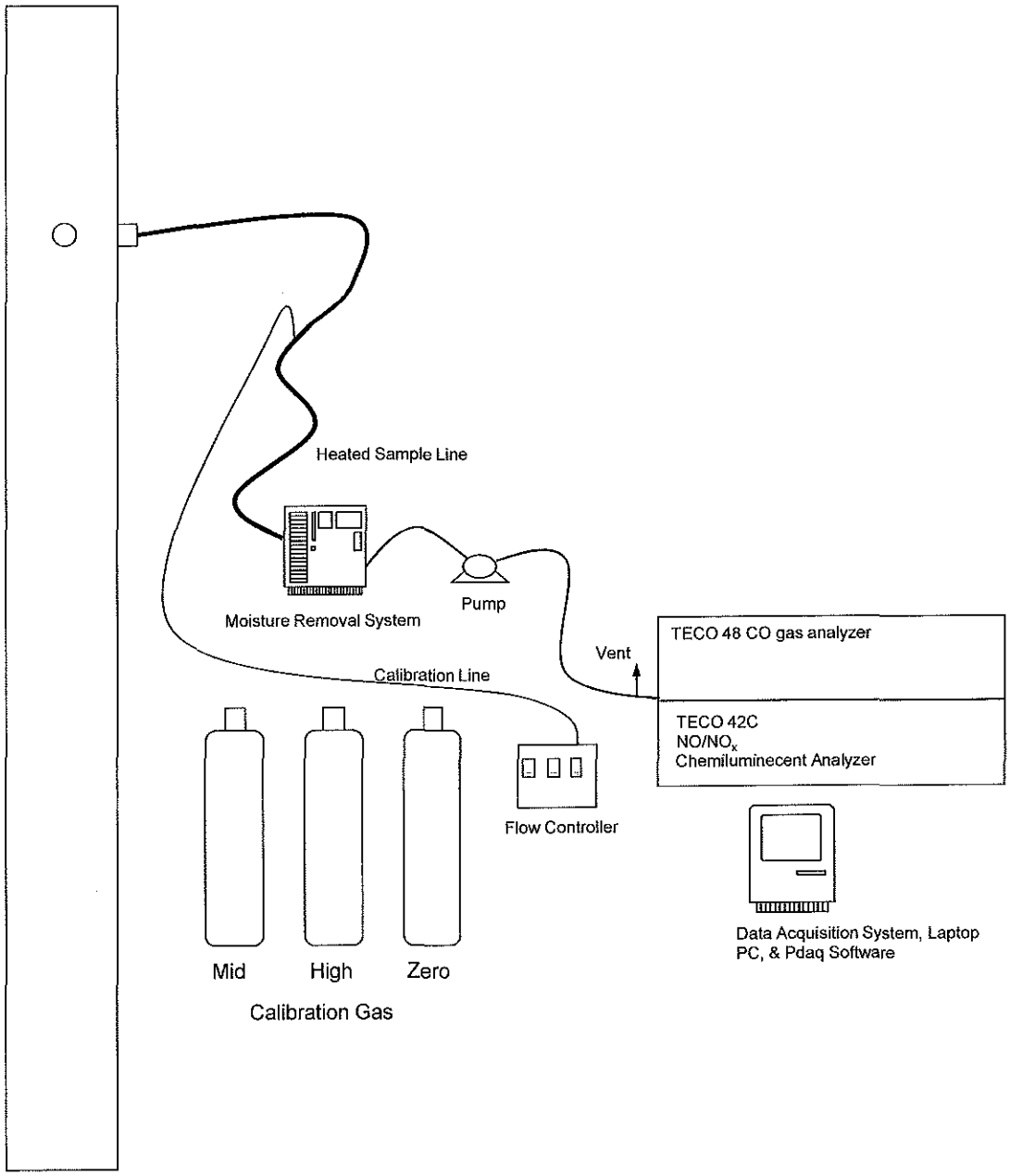


Figure No. 4

Site:	Sampling Date:	
USEPA Method 7E, and 10 General Motors, LLC Saginaw, Michigan	March 3-4, 2016	BT Environmental Consulting Inc. 4949 Fernlee Avenue Royal Oak, MI 48073

BTEC Inc.

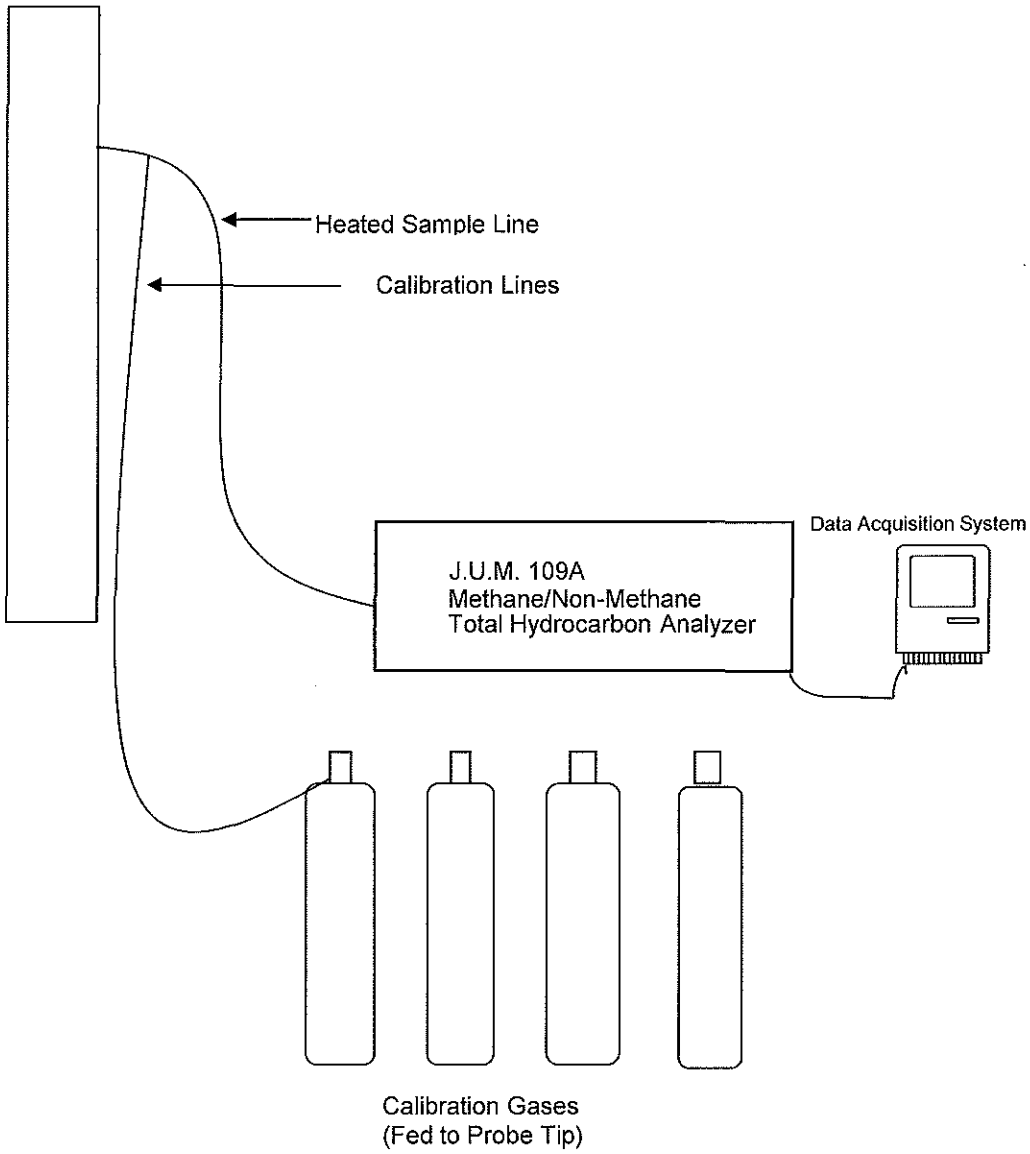


Figure No. 5

Site: **USEPA Method 25A** **General Motors, LLC** **Saginaw, Michigan**	**Sampling Date:** **March 3-4, 2016**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**