BTEC Inc.

Mold Line 6 Emissions Test Report

Prepared for:

General Motors

Saginaw, Michigan

GM SMCO
1629 N. Washington St.
Saginaw, Michigan

Project No. 14-4533.02
November 19, 2014

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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. 2009a 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.

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☐ **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 10-6-2014 To 10-7-2014

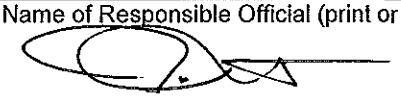
Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Mold Line 6 Emissions Test Report, Compliance Stack Test Certification

Report Number 14-4533.02

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



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Signature of Responsible Official — Date

* 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 conduct a compliance evaluation of particulate matter (PM) emission rates from the EU-6ML-EF-03 and EU-6ML-EF-04, and particulate matter less than 10 microns (PM_{10}) and VOC emission rates from the EU-6ML-GV-02 exhaust stacks associated with Mold Line 6 at the GM Saginaw Metal Casting Operations (SMCO) located in Saginaw, Michigan. Sampling was conducted on October 6-7th, 2014.

Testing consisted of triplicate 60-minute test runs for EU-6ML-EF-03 and EU-6ML-EF-04. Testing consisted of two 60-minute test runs for VOC on EU-6ML-GV-02 and two approximate 60 minute test runs for PM_{10} on EU-6ML-GV-02. Sampling was performed utilizing United States Environmental Protection Agency (USEPA) test methods. The results of the emissions test program are highlighted by Table E-I.

Table E-I
Overall Results Summary
Sampling Dates: October 6-7, 2014

Source	Pollutant	Average Test Result	Emission Limit (PM_{10})
EU-6ML-EF-03	PM	1.38 lbs/hr	22.6 lbs/hr 0.1 lb/1000 exhaust gas, dry
		0.008 lb/1000 exhaust gas, dry	
EU-6ML-EF-04	PM	2.89 lbs/hr	
		0.014 lb/1000 exhaust gas, dry	
EU-6ML-GV-02	PM_{10}	2.46 lbs/hr	4.1 lbs/hr
		0.024 lb/1000 exhaust gas, dry	0.04 lb/1000 exhaust gas, dry
	VOC	0.13 lbs/hr	0.92 lbs/hr

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1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by General Motors LLC (GM) to conduct a compliance evaluation of particulate matter (PM) emission rates from the EU-6ML-EF-03 and EU-6ML-EF-04, and particulate matter less than 10 microns (PM_{10}) and VOC emission rates from the EU-6ML-GV-02 exhaust stacks associated with Mold Line 6 at the GM Saginaw Metal Casting Operations (SMCO) located in Saginaw, Michigan. Sampling was conducted on October 6-7th, 2014.

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 sources tested are located at the GM Saginaw Metal Casting Operations located in Saginaw, Michigan. Testing on all sources was conducted October 6-7th, 2014.

1.b Purpose of Testing

The purpose of the testing is to demonstrate compliance with Michigan PTI 36-12B.

1.c Source Description

Sources identified under this project specifically include, FG-6ML-ALMELT (EU-6ML-GV-02) and FG-6ML-MOLDCNVYR (EU-6ML-EF-03 and EU-6ML-EF-04). EU-6ML-GV-02 is the aluminum reverberatory furnace #2 (East). EU-6ML-EF-03 services #6ML mold conveyor (Basement cooling conveyor, degate cells #1-#3) and #6 Drag flask Pick-off. While EU-6MLEF-04 #6ML exhausts mold conveyor (Basement cooling conveyor, 1st floor conveyor).

1.d Test Program Contact

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

Jennifer Tegen
GECS - Facility Air Compliance & Permit
GM Warren Technical Center
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Saginaw Metal Casting Operations
1629 North Washington Avenue
Saginaw, Michigan 48601
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renee.mietz@gm.com

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
Jennifer Tegen	GM- GECS
Renee Mietz	GM-SMCO
Matthew Young	BTEC
Todd Wessel	BTEC
Brandon Chase	BTEC
Paul Molenda	BTEC
Nathan Hude	MDEQ
Kathy Brewer	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 A.

2.b Applicable Permit

The emission units tested for Mold Line 6 are included in PTI 36-12B.

2.c Results

The results of the emissions test program are summarized by Table 1. Detailed results for are summarized in Tables 4-8.

2.d Emission Regulation Comparison

The Emission regulations are summarized by the following table.

Table 3
PTI 36-12B Emission Limitations

Emission Unit	Pollutant	Permit Limit
EU-6ML-EF-03	PM_{10}	22.6 lbs/hr 0.1 lb/1000 exhaust gas, dry
EU-6ML-EF-04		
EU-6ML-GV-02	PM_{10} (fluxing/drossing)	0.04 lb / 1,000 lb of exhaust gas, dry
		4.1 lb / hr
	VOC	0.92 lb / hr

3. Source Description

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

3.a Process Description

The Mold Line 6 process generates aluminum engine heads. The mold line activity includes the melting of aluminum ingot and sow, generation of a greensand mold, pouring, cooling, shakeout, or removal of the casting, and the finishing operations. To generate the casting package, a two part resin is used to coat sand and molded sand grains are packed together into a form (a core) and cured with an amine catalyst, DMIPA. DMIPA is scrubbed out of the air with H_2SO_4. At the same time, sand, clay and water are 'mulled' together to create greensand. There are no chemical binders used in this step. The greensand is then packed into a large base and a cover mold that will form the outside of the casting. This is called a "greensand" mold. The core is set into the "greensand" molds and the cover, made of greensand, and is placed on top. The cover has a pouring cup, which acts as a funnel for the aluminum. Aluminum is melted to 1325-1450° F and poured into the mold to create the casting. The casting is cooled and the loose sand is shaken from the part. The (heads) parts are then processed through a heat treat oven, quenched with water to set up the microstructure of the key places on the casting and excess sand is cleaned from the ports using a water blast. Then the parts enter an initial machining phase prior to inspection and shipping.

Sources identified under this project specifically include FG-6ML-ALMELT (EU-6ML-GV-02) and FG-6ML-MOLDCNVYR (EU-6ML-EF-03 and EU-6ML-EF-04). EU-6ML-GV-02 is the aluminum reverberatory furnace #2 (East). EU-6ML-EF-03 services the #6ML mold conveyor (Basement cooling conveyor, degate cells #1-#3) and the #6 Drag flask Pick-off. While EU-6MLEF-04 #6ML exhausts the mold conveyor (Basement cooling conveyor, 1st floor conveyor).

3.b Process Flow Diagram

Due to the simplicity of the Mold Line 6 operations, a process flow diagram is not necessary.

3.c Raw and Finished Materials

The raw materials used in the Mold Line 6 processes include molten aluminum, sand, and resin. See section 3.a.

3.d Process Capacity

Mold Line 6 has a current target production rate of 180 molds/hr.

3.e Process Instrumentation

Process instrumentation relevant to the emissions test program includes monitoring the number of molds and sand usage (based on number of molds) for EU-6ML-EF-03 and EU-6ML-EF-04. Process instrumentation relevant to EU-6ML-GV-02 included monitoring natural gas usage during high and low fire cycles.

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 four categories as follows:

(1) Measurement of exhaust gas velocity, molecular weight, and moisture content;
(2) Measurement of exhaust gas filterable PM concentration using USEPA Method 5;
(3) Measurement of exhaust gas filterable/condensable PM concentration using USEPA Method 201a/202; and
(4) 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 1-3.

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 Particulate Matter – Method 5

40 CFR 60, Appendix A, Method 5, *"Determination of Particulate Emissions from Stationary Sources"* was used to measure filterable PM concentrations and calculate PM emission rates at EU-6ML-EF-03 and EU-6ML-EF-04(see Figure 5 for a schematic of the sampling train).

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a steel nozzle, (2) a glass probe, (3) a Teflon connecting line to the impingers, (4) a set of four Greenburg-Smith (GS) impingers with the (i) first two with 100 ml of deionized water (ii) an empty impinger, (iii) and an impinger filled with approximately 300 grams of silica gel. (5) a length of sample line, and (6) 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, and the probe, nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container.

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 and filter were collected. The samples were taken by BTEC personnel to BTEC's laboratory in Royal Oak, MI to be analyzed. Field and computer generated PM data is presented in Appendix D. Laboratory data can be found in Appendix E.

PM_{10} and Condensable Particulate Matter (USEPA Method 201A/202)

40 CFR 60, Appendix A, Method 201A, *"Determination of PM_{10} and $PM_{2.5}$ Emissions from Stationary Sources (Constant Sampling Rate Procedure)"* 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 for EU-6ML-GV-02 (see Figure 4 for a schematic of the sampling train).

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) a stainless-steel PM_{10} head, (3) an in stack stainless-steel filter housing, (4) a borosilicate glass probe liner, (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, PM_{10} head, and front half of the filter housing were brushed and triple rinsed with acetone, separating the run into two fractions, PM_{10} and greater than PM_{10}. The acetone rinses were collected in a pre-cleaned sample containers. The impinger train was then purged with nitrogen for one hour at a flow rate of 14 liters per minute. 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 triple 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. Samples were transported to the Bureau Veritas Laboratory in Livonia Michigan for Method 202 analysis.

Volatile Organic Compounds

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 data acquisition software. BTEC used a J.U.M 109 Methane/Nonmethane hydrocarbon analyzer to determine the VOC concentration. (see figure 6 for a schematic of the sampling train.)

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. 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). The analyzer was calibrated for a range of 0-100 ppm.

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 day of testing.

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.

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 stack showing sampling ports are included as Figures 1-3.

4.d Traverse Points

Diagrams of the stack showing traverse points are included as Figures 1-3.

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 1. Emission limits are summarized by Table 3. Detailed results for the emissions test program are summarized by Table 4-8.

5.b Discussion of Results

The average results of the Testing Program are below the corresponding limits.

Table 1
Overall Results Summary
Sampling Dates: June 25, 2014

Source	Pollutant	Average Test Result	Emission Limit (PM_{10})
EU-6ML-EF-03	PM	1.38 lbs/hr	22.6 lbs/hr 0.1 lb/1000 exhaust gas, dry
		0.008 lb/1000 exhaust gas, dry	
EU-6ML-EF-04	PM	2.89 lbs/hr	
		0.014 lb/1000 exhaust gas, dry	
EU-6ML-GV-02	PM_{10}	2.46 lbs/hr	4.1 lbs/hr
		0.024 lb/1000 exhaust gas, dry	0.04 lb/1000 exhaust gas, dry
	VOC	0.13 lbs/hr	0.92 lbs/hr

5.c Sampling Procedure Variations

Nathan Hude with the MDEQ requested that during the PM sampling on EU-6ML-EF-03 and EU-6ML-EF-04 that the probe and filter box not be heated. This was to confirm that no condensable PM passed through the filter and condensed in the impingers (and thus would be excluded from Method 5 analysis) during sampling. During run 2 on EF-04 the Amphenol electrical connector was accidently plugged in which resulted in heating the filter box. The results of all runs on EF-04 are consistent and replicable and the heating of the filter appears to have had no effect on the amount of PM recovered.

Run 1 on EU-6ML-GV-02 was stopped prematurely due to a clogged filter. Once the filter was clogged it was not possible to maintain an acceptable sampling rate, and there was insufficient time to recover and replace the filter before the end of the fluxing operation, therefore the run was ended prematurely at 49 minutes. An additional run was performed at the request of GM personnel (see paragraph below).

The test plan originally specified a single run for PM_{10} would be performed on EU-6ML-GV-02 during fluxing, and a another single run would be performed during drossing. GM personnel requested an additional test be performed on EU-6ML-GV-02 between the fluxing and drossing operations. The results of all three test runs have been included on Tables 6 and 7. Run 1 (fluxing) and Run 2 (drossing) perfomed on EU-6ML-GV-02 are summarized as the average test result.

Several sampling points on runs 1 and 2 at EU-6ML-GV-02 were outside of the specified cut size of 10µ +/- 1µ. Nathan Hude requested that PM greater than 10µ be recovered from the cyclone and presented alongside the PM_{10} results. The results of the PM_{10} sampling, excluding PM greater than 10µ, are presented in Table 6. The results of the PM_{10} sampling, including PM greater than 10µ, are presented in Table 7. The average result in both cases is below the permitted limit for PM_{10}.

The isokinetic sampling variation on EU-6ML-GV-02 was outside of Method 201a's requirement of 100% +/- 20% (overall average was 139%). This is due to the high variance in stack temperature which is much greater than allowed by Method 201a. The minimum stack temperature recorded was 166°F, and the maximum stack temperature recorded was 601°F. With such high variance in stack temperature an accurate ΔH value cannot be sustained for the duration of the test.

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 D.

5.j Laboratory Data

Laboratory analysis is provided in Appendix E.