SOURCE TESTING REPORT

FCA US LLC

STERLING HEIGHTS, MICHIGAN

STERLING HEIGHTS ASSEMBLY PLANT:
SOURCE TESTING REPORT (ITT) EU-BOILER1, EU-BOILER 2 AND EU-BOILER 3

RWDI #1801649

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SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI AIR Inc. (RWDI) was retained by Fiat Chrysler Automobiles US LLC (FCA) to complete the emission sampling program at their Sterling Heights Assembly Plant (SHAP) located at 38111 Van Dyke, Sterling Heights, Michigan. SHAP operates an automobile assembly plant that produces Ram trucks. Under Flexible Group FG-Facility Group three (3) boilers are fired by natural gas in order to provide heat and steam to the SHAP.

The test program included measurements of Nitrogen Oxides (NOx), and Particulate (PM, PM_{10}, $PM_{2.5}$, and condensable particulate) on three (3) Boilers (EU-BOILER1, EU-BOILER2 and EU-BOILER3). The testing was completed to fulfill the requirements from the Michigan Department of Environmental Quality (MDEQ) under the Renewable Operating Permit (ROP) Permit (Permit Number MI-ROP-B7248-2014a). Under the FG-Facility group, testing is required to be tested every five (5) years.

RWDI also completed flue gas velocity measurements and moisture content measurements for each NOx and Particulate (PM_{10} and $PM_{2.5}$) tests completed. RWDI utilized the methods outlined by the United States Environmental Protection Agency (U.S. EPA) Methods 1,2,3,4,3A,7E and 201a and 202. For NOx, three (3) 60-minute tests were completed on boiler EU-BOILER2 and a single 60-minute test was completed on EU-BOILER1 and EU-BOILER3. For Particulate (PM_{10} and $PM_{2.5}$), three (3) 120-minute test runs were completed on boilers EU-BOILER2 and a single 120-minute test was completed on EU-BOILER1 and EU-BOILER3. The NOx and Particulate results provided the emission rate in pounds per hour (lb/hr) and pounds per million British Thermal Units per hour (lbs/MMBTU/hr). SHAP personnel recorded and determined the total natural gas usage during each test, total steam load and percentage of capacity during each testing for each boiler.

The Intent-To-Test Plan (ITTP) was submitted to the Michigan Department of Environmental Quality (MDEQ) on November 28th, 2017 and a correspondence document was issued by the MDEQ on December 13th, 2017. The ITTP and MDEQ correspondence document can be found in **Appendix A** of this report.

The Results of the sampling program are outlined in the table below. Results of individual tests are presented in the Appendices.

Table 1: EU-BOILER1 Nitrogen Oxides and Particulate Results

Parameter	Run 1		
US EPA Method 7E	**lbs/dscf**	**lb/hr**	**lb/MMBtu**
Nitrogen Oxides	0.0000075	6.6	0.0898
US EPA Method 201A/202	**gr/dscf**	**lb/hr**	**lb/MMBtu**
Total Particulate	0.0021	0.268	0.0046
PM_{10}	0.0019	0.240	0.0042
$PM_{2.5}$	0.0017	0.213	0.0037
Condensable Particulate	0.0015	0.190	0.0033

Notes: lb/MMBtu – pounds per million British Thermal Units
lb/hr – pounds per hour
lb/dscf – pounds per dry standard cubic foot
gr/dscf – grains/ dry standard cubic foot

Table 2: EU-BOILER2 Nitrogen Oxides and Particulate Results

Parameter	Run 1			Run 2			Run 3			Average		
US EPA Method 7E	**lbs/ dscf**	**lb/ hr**	**lb/ MMBtu**	**lbs/ dscf**	**lb/ hr**	**lb/ MMBtu**	**lbs/ dscf**	**lb/ hr**	**lb/ MMBtu**	**lbs/ dscf**	**lb/ hr**	**lb/ MMBtu**
Nitrogen Oxides	5.1E-06	4.1	0.0611	5.1E-06	4.4	0.0626	5.1E-06	4.1	0.0625	5.1E-06	4.2	0.0621
US EPA Method 201A/202	**gr/ dscf**	**lb/ hr**	**lb/ MMBtu**	**gr/ dscf**	**lb/ hr**	**lb/ MMBtu**	**gr/ dscf**	**lb/ hr**	**lb/ MMBtu**	**gr/ dscf**	**lb/ hr**	**lb/ MMBtu**
Total Particulate	0.0046	0.562	0.0094	0.0028	0.340	0.0060	0.0023	0.275	0.0048	0.0023	0.275	0.0048
PM_{10}	0.0044	0.536	0.0090	0.0026	0.314	0.0055	0.0021	0.250	0.0043	0.0021	0.250	0.0043
$PM_{2.5}$	0.0041	0.497	0.0083	0.0024	0.287	0.0050	0.0020	0.232	0.0040	0.0020	0.232	0.0040
Condensable Particulate	0.0040	0.480	0.0081	0.0022	0.270	0.0047	0.0020	0.232	0.0040	0.0020	0.232	0.0040

Notes: lb/MMBtu – pounds per million British Thermal Units
lb/hr – pounds per hour
lb/dscf – pounds per dry standard cubic foot
gr/dscf – grains/ dry standard cubic foot

Table 3: EU-BOILER3 Nitrogen Oxides and Particulate Results

Parameter	Run 1		
US EPA Method 7E	**lbs/dscf**	**lb/hr**	**lb/MMBtu**
Nitrogen Oxides	0.0000046	4.5	0.0554
US EPA Method 201A/202	**gr/dscf**	**lb/hr**	**lb/MMBtu**
Total Particulate	0.0022	0.307	0.0053
PM_{10}	0.0021	0.287	0.0050
$PM_{2.5}$	0.0018	0.252	0.0044
Condensable Particulate	0.0017	0.233	0.0041

Notes: lb/MMBtu – pounds per million British Thermal Units
lb/hr – pounds per hour
lb/dscf – pounds per dry standard cubic foot
gr/dscf – grains/ dry standard cubic foot

Testing was successfully completed under normal maximum operating conditions on January 9th, 2018 for EU-BOILER2 and January 10th, 2018 for EU-BOILER1 and EU-BOILER3. All parameters were tested in accordance with USEPA referenced methodologies.

1 INTRODUCTION

1.1 Overview

RWDI AIR Inc. (RWDI) was retained by Fiat Chrysler Automobiles US LLC (FCA) to complete the emission sampling program at their Sterling Heights Assembly Plant (SHAP) located at 38111 Van Dyke, Sterling Heights, Michigan. SHAP operates an automobile assembly plant that produces Ram trucks. Under Flexible Group FG-Facility Group three (3) boilers are fired by natural gas in order to provide heat and steam to the SHAP.

The test program included measurements of Nitrogen Oxides (NOx), and Particulate (PM, PM_{10}, $PM_{2.5}$, and condensable particulate) on three (3) Boilers (EU-BOILER1, EU-BOILER2 and EU-BOILER3). The testing was completed to fulfill the requirements from the Michigan Department of Environmental Quality (MDEQ) under the Renewable Operating Permit (ROP) Permit (Permit Number MI-ROP-B7248-2014a). Under the FG-Facility group, testing is required to be tested every five (5) years.

The Intent-To-Test Plan (ITTP) was submitted to the Michigan Department of Environmental Quality (MDEQ) on November 28th, 2017 and a correspondence document was issued by the MDEQ on December 13th, 2017. The ITTP and MDEQ correspondence document can be found in **Appendix A** of this report. The sampling was conducted on January 9, 2018 for EU-BOILER2 and January 10th, 2018 for EU-BOILER1 and EU-BOILER3. Sampling on January 9th, 2018 was witnessed by Mr. Rem Pinga and Ms. Regina Hines (MDEQ) and Mr. Rohitkumar Patel and Mr. Adekunle Sanni from FCA were on-site to ensure the process was operating at normal maximum conditions.

Table 4: Source, Parameter and Test Date

Source	Parameter	Test Date
EU-BOILER1	Oxides of Nitrogen, Oxygen, Carbon Dioxide, Velocity, Temperature, Flow Rate, Particulate Matter (PM_{10}.$PM_{2.5}$,and Condensable PM)	January 10, 2018
EU-BOILER2	Oxides of Nitrogen, Oxygen, Carbon Dioxide, Velocity, Temperature, Flow Rate, Particulate Matter (PM_{10}.$PM_{2.5}$,and Condensable PM)	January 9, 2018
EU-BOILER3	Oxides of Nitrogen, Oxygen, Carbon Dioxide, Velocity, Temperature, Flow Rate, Particulate Matter (PM_{10}.$PM_{2.5}$,and Condensable PM)	January 10, 2018

2 SOURCE DESCRIPTION

2.1 Facility Description

SHAP operates an automobile assembly plant that produces Light Duty Trucks for FCA US LLC. Under Flexible Group FG-Facility, three (3) boilers are fired by natural gas in order to provide heat and steam to the SHAP site. There are no controls associated with these boilers on the exhaust. EU-BOILER 2 and EU-BOILER3 are equipped with low NOx burner technology.

Table 5: Emission Unit Description

Units	Capacity
EU-Boiler 1	One (1) natural gas fired boilers rated at 85 MMBTU/hr. There is no designated pollution control equipment.
EU-Boiler 2 and EU-Boiler 3	Two (2) natural gas fired boilers rated at 118 MMBTU/hr. EU-BOILER2 and EU-BOILER3 is equipped with low NOx burner technology.

2.2 FG-Facility Overview

2.2.1 Source Testing Location Overview

The sampling locations for EU-BOILER1, EU-BOILER2 and EU-BOILER3, under FG-Facility, are located outside on the roof of the Power House.

EU-BOILER1 stack with an inside diameter of 62 inches having two sampling ports, 90 degrees apart and 6 inches in diameter. The sampling ports are located more than 5.8 duct diameters downstream and more than 2.0 duct diameters upstream of any flow disturbances.

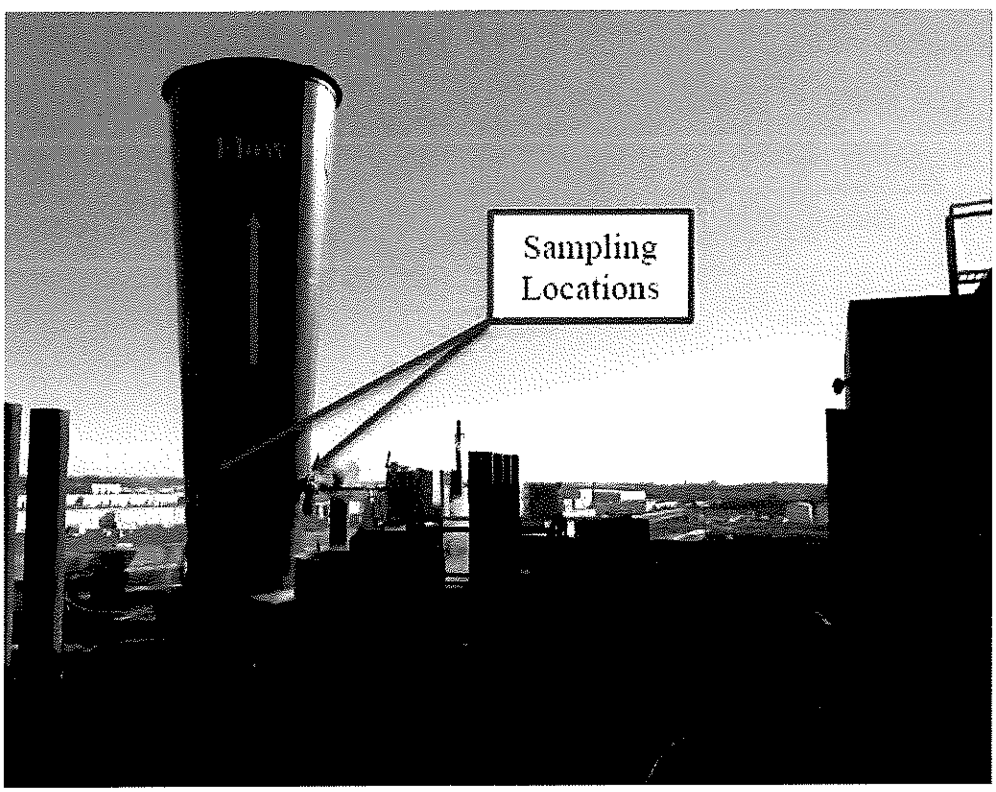
EU-BOILER2 stack with an inside diameter of 62 inches having two sampling ports, 90 degrees apart and 6 inches in diameter. The sampling ports are located more than 5.8 duct diameters downstream and more than 2.0 duct diameters upstream of any flow disturbances.

EU-BOILER3 stack with an inside diameter of 62 inches having two sampling ports, 90 degrees apart and 6 inches in diameter. The sampling ports are located more than 5.8 duct diameters downstream and more than 2.0 duct diameters upstream of any flow disturbances.

Table 6: Summary of Sampling Program – EU-BOILER1, EU-BOILER2 and EU-BOILER3

	EU-BOILER1	EU-BOILER2	EU-BOILER3
Emission Unit Description [Including Process Equipment & Control Device(s)]	Natural gas fired boilers rated at 85 MMBTU/hr. There is no designated pollution control equipment.	Natural gas fired boilers rated at 118 MMBTU/hr. Equipped with low NOx burner technology.	Natural gas fired boilers rated at 118 MMBTU/hr. Equipped with low NOx burner technology.
Parameter Tested	Particulate and Nitrogen Oxide and addition sampling for stack gas velocity, stack gas composition (carbon dioxide and oxygen), and moisture.		
Exhaust Temperature **Exhaust Flow Rate**	267°F (average) 14,543 SCFM	298°F (average) 14,000 SCFM (average)	300°F (average) 16,002 SCFM

Figure 2.1.1a: Source Photos of EU-BOILER1



Source: Bureau Veritas "Air Emission Test EU-BOILER1, EU-BOILER2 and EU-BOILER3", February 21, 2013

3 TEST PROGRAM

3.1 Testing Methodology

The following table summarizes the test methodologies that were followed during the program

Table 7: Summary of Test Methodology

Parameter	Proposed Method
Temperature, Flow Rate and Moisture	USEPA[1] Method 1-4
Oxides of Nitrogen (NOx)	USEPA[1] Method 7E (CEM)
PM_{10} and $PM_{2.5}$	USEPA[1] Method 201A
Condensable Particulate	USEPA[1] Method 202

Notes: [1] USEPA = United States Environmental Protection Agency

3.2 Description of Testing Methodologies

The following section provides brief descriptions of the sampling methods and discusses any modifications to the reference test methods.

3.2.1 Stack Velocity, Temperature, and Volumetric Flow Rate Determination

The exhaust velocities and flow rates were determined following the US EPA Method 2, "Determination of Stack Gas Velocity and Flow Rate (Type S Pitot Tube)". Velocity measurements were taken with a pre-calibrated S-Type pitot tube and incline manometer. Volumetric flow rates were determined following the equal area method as outlined in US EPA Method 2. Temperature measurements were made simultaneously with the velocity measurements and were conducted using a chromel-alumel type "k" thermocouple in conjunction with a digital temperature indicator.

The dry molecular weight of the stack gas was determined following calculations outlined in US EPA Method 3, "Determination of Molecular Weight of Dry Stack Gas". Stack moisture content was determined through direct condensation and according to US EPA Method 4, "Determination of Moisture Content of Stack Gas". Moisture was collected in the US EPA method 202 sampling train. Detailed flow and moisture information is located in **Appendix B.**

3.2.2 Sampling for Nitrogen Oxides and Oxygen

NOx emissions were measured following USEPA Method 7E, "Determination of Nitrogen Oxides Emissions from Stationary Sources." The NOx concentration was measured using a Teledyne 43i Chemiluminescence gas analyzer. The exhaust gas sample was withdrawn from a single point at the center of the duct/stack using a stainless steel probe. The sample proceeded through a heated filter where particulate matter was removed. The sample was then transferred via a heated Teflon® line to a sample conditioner. The Teflon line was heated to 120°C (250°F) to prevent any condensation and then the sample conditioner cooled the sample below 35°F to remove any moisture. The sample was then routed through a manifold system and introduced to the individual CEM's for measurement. A schematic of the sampling system apparatus is located in **Appendix C.**

Prior to testing at the exhaust port sampling location, a NO/NO_2 conversion check was performed prior by introducing NO_2 gas into the NO_x analyzer. The analyzers NO_x concentration readout was greater than 90% of the introduced calibration gas; therefore, the conversion met the converter efficiency requirement of section 13.5 of USEPA Method 7E.

Following the conversion check, a 3-point analyzer calibration error check was conducted using USEPA protocol gases. The calibration error check was performed by introducing zero, mid and high level calibration gases directly into the analyzer. The calibration error check was performed to confirm that the analyzer response was within ±2% of the certified calibration gas introduced. Prior to each test run, a system-bias test was performed

where known concentrations of calibration gases were introduced at the probe tip to measure if the analyzers response was within ±5% of the introduced calibration gas concentrations. At the conclusion of each test run a system-bias check was performed to evaluate the percent drift from pre and post-test system bias checks. The system bias checks confirmed that the analyzer did not drift greater than ±3% throughout a test run.

Prior to testing, a 3-point stratification test was conducted at 16.7, 50 and 83.3 percent of the stack diameter for at least twice the response time as outlined in the method. At this location the NO_x concentration was measured to be uniform in the stack cross section and was less than ±5% of the mean concentration and 0.5ppm of the mean concentration for all three traverse points. The gas stream was considered to be unstratified and a single sampling point, located at the centroid of the stack was used for sampling.

Data acquisition was provided using a data logger system programmed to collect and record data at one second intervals. Average one minute concentrations were calculated from the one second measurements.

Appendix D contains detailed data for NOx emissions, including summary of results and 1 minute averages. Detailed converter checks, stratification checks, calibration error checks, and system bias check information is located in **Appendix E** with calibration gas Certificates of Accuracy located in **Appendix G**.

3.2.3 Sampling for Particulate Matter (PM_{10}, $PM_{2.5}$, and Condensable PM)

Particulate matter ($PM/PM_{10}/PM_{2.5}$/condensable PM) will be sample following procedures outlined in U.S. EPA Method 201a "Determination of PM10 and PM2.5 Emissions from Stationary Sources" and Method 202 "Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources". This program used a modified version of US EPA method 202 by omitting the nitrogen purge from the sample recovery. This modification was approved by the MDEQ Administrator because of the absence of sulfur in natural gas fired boilers.

Leak checks were performed on the Method 201A/202 sampling train by plugging the sample inlet and pulling a representative vacuum. This check was done by plugging the nozzle prior to the each test run and plugging after the cyclone at the conclusion of each test. Similar leak check procedures for pitot tube and pressure lines were also conducted. Leak checks for each test were documented on the field data sheets located in **Appendix H.**

4 PROCESS DATA

During the emissions testing, plant process data was monitored and collected by SHAP personnel to ensure representative operation of the facility. Below are tables showing the applicable process data for each test run.

Table 8: Steam Load and Gas Usage during Testing – EU-BOILER1

Parameter		NOx Run 1	Particulate Run 1
EU-BOILER1	Date:	January 10, 2018	January 10, 2018
	Time:	11:15 AM – 12:15 AM	11:15 – 13:28
	Natural Gas Usage:	60,000 ft^3/hr	60,000 ft^3/hr
	Steam Load: (pounds per hour)	50,769	51,429
	Gross Calorie Value	1038 btu/ft^3	1038 btu/ft^3

Table 9: Steam Load and Gas Usage during Testing – EU-BOILER2

Parameter		Run 1	Run 2	Run 3
EU-BOILER2	Date:	January 9, 2018	January 9, 2018	January 9, 2018
	NOx Sampling Time:	08:45 - 09:45	11:53 - 12:53	14:45 – 15:45
	Natural Gas Usage during NOx Sampling:	60,845 ft^3/hr	58,185 ft^3/hr	58,161 ft^3/hr
	Steam Load during NOx Sampling: (pounds per hour)	45,760	49,846	52,603
	Particulate Sampling Time:	08:42 -10:53	11:53 - 13:58	14:45 – 16:49
	Natural Gas Usage during Particulate Sampling:	61,818 ft^3/hr	59,040 ft^3/hr	60,000 ft^3/hr
	Steam Load during Particulate Sampling: (pounds per hour)	43,182	51,840	52,258
	Gross Calorie Value	1038 btu/ft^3		

Table 10: Steam Load and Gas Usage during Testing – EU-BOILER3

Parameter		Run 1	Particulate Run 1
EU-BOILER3	Date:	January 10, 2018	January 10, 2018
	Time:	08:08 – 09:08	08:08 – 10:15
	Natural Gas Usage: (ft^3/hr)	60,000	59,528
	Steam Load: (pounds per hour)	50,000	50,551
	Gross Calorie Value	1038 btu/ft^3	1038 btu/ft^3

5 RESULTS

The average emission results for this study are presented in the tables below. Detailed information regarding each test run can be found in **Appendix B** and **D**.

Table 1: EU-BOILER1 Nitrogen Oxides and Particulate Results

Parameter	Run 1		
US EPA Method 7E	**lbs/dscf**	**lb/hr**	**lb/MMBtu**
Nitrogen Oxides	0.0000075	6.6	0.0898
US EPA Method 201A/202	**gr/dscf**	**lb/hr**	**lb/MMBtu**
Total Particulate	0.0021	0.268	0.0046
PM_{10}	0.0019	0.240	0.0042
$PM_{2.5}$	0.0017	0.213	0.0037
Condensable Particulate	0.0015	0.190	0.0033

Notes: lb/MMBtu – pounds per million British Thermal Units
lb/hr – pounds per hour
lb/dscf – pounds per dry standard cubic foot
gr/dscf – grains/ dry standard cubic foot

Table 2: EU-BOILER2 Nitrogen Oxides and Particulate Results

Parameter	Run 1			Run 2			Run 3			Average		
US EPA Method 7E	**lbs/ dscf**	**lb/ hr**	**lb/ MMBtu**	**lbs/ dscf**	**lb/ hr**	**lb/ MMBtu**	**lbs/ dscf**	**lb/ hr**	**lb/ MMBtu**	**lbs/ dscf**	**lb/ hr**	**lb/ MMBtu**
Nitrogen Oxides	$5.1E^{-06}$	4.1	0.0611	$5.1E^{-06}$	4.4	0.0626	$5.1E^{-06}$	4.1	0.0625	$5.1E^{-06}$	4.2	0.0621
US EPA Method 201A/202	**gr/ dscf**	**lb/ hr**	**lb/ MMBtu**	**gr/ dscf**	**lb/ hr**	**lb/ MMBtu**	**gr/ dscf**	**lb/ hr**	**lb/ MMBtu**	**gr/ dscf**	**lb/ hr**	**lb/ MMBtu**
Total Particulate	0.0046	0.562	0.0094	0.0028	0.340	0.0060	0.0023	0.275	0.0048	0.0023	0.275	0.0048
PM_{10}	0.0044	0.536	0.0090	0.0026	0.314	0.0055	0.0021	0.250	0.0043	0.0021	0.250	0.0043
$PM_{2.5}$	0.0041	0.497	0.0083	0.0024	0.287	0.0050	0.0020	0.232	0.0040	0.0020	0.232	0.0040
Condensable Particulate	0.0040	0.480	0.0081	0.0022	0.270	0.0047	0.0020	0.232	0.0040	0.0020	0.232	0.0040

Notes: lb/MMBtu – pounds per million British Thermal Units
lb/hr – pounds per hour
lb/dscf – pounds per dry standard cubic foot
gr/dscf – grains/ dry standard cubic foot

Table 3: EU-BOILER3 Nitrogen Oxides and Particulate Results

Parameter	Run 1		
US EPA Method 7E	**lbs/dscf**	**lb/hr**	**lb/MMBtu**
Nitrogen Oxides	0.0000046	4.5	0.0554
US EPA Method 201A/202	**gr/dscf**	**lb/hr**	**lb/MMBtu**
Total Particulate	0.0022	0.307	0.0053
PM_{10}	0.0021	0.287	0.0050
$PM_{2.5}$	0.0018	0.252	0.0044
Condensable Particulate	0.0017	0.233	0.0041

Notes: lb/MMBtu – pounds per million British Thermal Units
lb/hr – pounds per hour
lb/dscf – pounds per dry standard cubic foot
gr/dscf – grains/ dry standard cubic foot
gr/dscf – grains/ dry standard cubic foot

6 CONCLUSIONS

Testing was successfully completed on January 9th, 2018 for EU-BOILER2 and January 10th, 2018 for EU-BOILER1 and EU-BOILER3. All parameters were tested in accordance with USEPA referenced methodologies and met the requirements specified in FG-Facility group of their Renewable Operating Permit (ROP) Permit (Permit Number MI-ROP-B7248-2014a).