EXECUTIVE SUMMARY

RWDI AIR Inc. (RWDI) was retained by FCA US LLC (FCA) to complete a source testing program on four (4) natural gas fired boilers identified as EU-BOILER1, EU-BOILER2, EU-BOILER3, AND EU-BOILER4 at their Jefferson North Assembly Plant (JNAP) located in Detroit, Michigan. The purpose of this testing was to evaluate the emissions levels for Nitrogen Oxides (NOx) and Carbon Monoxide (CO) from each noted boilers. The facility operates under Renewable Operating Permit (ROP) MI-ROP-N2155-2017.

Testing consisted of three (3) 60-minute test runs for nitrogen oxide and carbon monoxide emissions on EUBOILER3, and one (1) 60-minute test runs on EUBOILER1, 2, and 4. The sampling was conducted on January 20, 2021 and January 27, 2021. Sampling was witnessed by Ms. Regina Angellotti from the Southeast Michigan Air Quality Division of the State of Michigan Department of Environment, Great Lakes, and Energy (EGLE). FCA representatives were on-site to ensure the process conditions and boiler operations were within representative operating conditions and included Mr. Thomas Caltrider and Mr. Steven Szura.

Results of the sampling program are outlined in the table below. Results of individual tests are presented in the Tables and Appendices section of the test report.

Table: Sampling Results Summary

	NOx			CO		
Emission Unit (EU)	**Concentration (ppm_d)**	**Emission Rate (lb/hr)**	**Emission Rate (lb/MMBTU)**	**Concentration (ppm_d)**	**Emission Rate (lb/hr)**	**Emission Rate (lb/MMBTU)**
EU-BOILER1	77.1	8.2	0.153	0.5	0.030	0.00055
EU-BOILER2	79.3	9.0	0.155	1.0	0.072	0.0012
EU-BOILER3	57.3	6.3	0.113	0.3	0.020	0.00036
EU-BOILER4	60.4	6.3	0.098	0.4	0.030	0.00040

Notes: "d" indicated based on dry conditions

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1 INTRODUCTION

RWDI AIR Inc. (RWDI) was retained by FCA US LLC (FCA) to complete a source testing program on four (4) natural gas fired boilers identified as EUBOILER1, EUBOILER2, EUBOILER3 and EUBOILER4 at their Jefferson North Assembly Plant (JNAP) located in Detroit, Michigan. The purpose of this testing was to determine the current emission levels for Nitrogen Oxides (NOx) and Carbon Monoxide (CO) with respect to each boiler. The facility operates under Renewable Operating Permit MI-ROP-N2155-2017.

Testing consisted of three (3) 60-minute test runs for nitrogen oxide and carbon monoxide emissions. The sampling was conducted on January 20th (EUBOILERs 3 and 4) and January 27th (EUBOILERs 1 and 2), 2021.

Testing of emissions was conducted by Mr. Alec Smith, Mr. Mason Sakshaug and Mr. Brad Bergeron of RWDI. Mr. Thomas Caltrider and Mr. Steve Szura were on-site to monitor the process operation and witness the testing on behalf of FCA. Ms. Regina Angellotti from the State of Michigan Department of Environment, Great Lakes and Energy (EGLE) was present during the testing (both dates). FCA representatives were on-site to ensure the process conditions and boiler operations were within representative operating conditions and included Mr. Thomas Caltrider and Mr. Steven Szura.

2 PROCESS DESCRIPTION

JNAP is located at 2101 Conner Avenue, in Detroit, Michigan. The facility completes assembly and paint operations for FCA products. The boilers tested produce steam and heat used during the automobile manufacturing process. During the testing periods, each of the boilers were able to obtain >75% load. This is considered a representative production rate for the Energy Center.

Each hot water boiler provides building heat for JNAP. EU-BOILERS 1, 2 3 and 4 are equipped with low NOx burners and flue gas recirculation.

3 SAMPLING LOCATIONS AND METHODS

3.1 Sampling Location

The exhaust stacks are located on the roof of the Powerhouse and each boiler is equipped with its own exhaust stack. Sampling ports are located inside the Energy Center as well as on the roof. The exhaust duct has two sets of sampling ports, 90 degrees apart. The sampling ports were 4 inches in diameter and located approximately 8 duct diameters upstream and more than 2 duct diameters downstream of any flow disturbances. All sampling was completed inside of the Energy Center.

3.2 Test Methods

3.2.1 Velocity, Temperature and Volumetric Flow Rate Determination

The exhaust velocities and flow rates were determined following U.S. EPA Method 2, "Determination of Stack Gas Velocity and Volumetric 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 U.S. 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 calibrated digital temperature indicator.

The dry molecular weight of the stack gas was determined following calculations outlined in U.S. EPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight". The stack was assumed to be at ambient conditions for the determination of the dry molecular weight. Stack moisture content was determined through direct condensation and according to U.S. EPA Method 4, "Determination of Moisture Content of Stack Gases".

3.2.2 Sampling for Nitrogen Oxides, Carbon Monoxide, Oxygen and Carbon Dioxide

Oxygen (O_2), carbon dioxide (CO_2), carbon monoxide (CO) and nitrogen oxides (NO_x) concentrations were determined utilizing RWDI's continuous emissions monitoring (CEM) system.

Prior to testing, 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 is 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 waws used to confirm that the analyzer did not drift greater than ±3% throughout a test run.

Zero and upscale calibration checks were conducted both before and after each test run in order to quantify measurement system calibration drift and sampling system bias. Upscale is either the mid- or high-range gas, whichever most closely approximates the flue gas level. During these checks, the calibration gases were introduced into the sampling system at the probe outlet so that the calibration gases be analyzed in the same manner as the flue gas samples.

A gas sample was continuously extracted from the stack and delivered to a series of gas analyzers, which measure the pollutant or diluent concentrations in the gas. The analyzers were calibrated on-site using EPA Protocol No. 1 certified calibration mixtures. The probe tip was equipped with a sintered stainless-steel filter for particulate removal. The end of the probe was connected to a heated Teflon sample line, which delivers the sample gases from the stack to the CEM system. The heated sample line was designed to maintain the gas temperature above 250°F in order to prevent condensation of stack gas moisture within the line.

Before entering the analyzers, the gas sample passed directly into a refrigerated condenser, which cools the gas to approximately 35°F to remove the stack gas moisture. After passing through the condenser, the dry gas then enters a Teflon-head diaphragm pump and a flow control panel, which delivered the gas in series to the CO, O_2, CO_2, and NO_x analyzers (as applicable). Each of these analyzers measured the respective gas concentrations on a dry volumetric basis.

3.3 Quality Assurance/ Quality Control Measures

Applicable quality assurance measures were implemented during the sampling program to ensure the integrity of the results. These measures included detailed documentation of field data and equipment calibrations for all measured parameters. **Table 2** of the Tables Section presents a sample log and summarizes the sampling times.

All samplers were bench tested and calibrated in RWDI's office prior to field deployment. For moisture collected with a Method 4 sampling train, both pre- and post- leak checks were conducted by plugging the inlet and drawing a vacuum of equal to or greater than the vacuum recorded during the test. Dry gas meter reading leakage rates greater than 4 percent of the average sampling rate or 0.00057 m^3/min (0.02 cfm), whichever is less, were considered unacceptable. Similar leak check procedures for pitot tube and pressure lines were also conducted. Daily temperature sensor audits were completed by noting the ambient temperature, as measured by a reference thermometer, and comparing these values to those obtained from the stack sensor. Leak checks for each test were documented on the field data sheets presented in the applicable appendices for each sample parameter.

4 RESULTS

The average emission results for this study are presented in the 'Tables' section of this report. Detailed information for each test run can be found in the appendices. Below is a table identifying each parameter, the corresponding table and appendices where results can be found.

Table 4.0: Summary of Data References

Parameter	Table	Appendix
NOx, CO, O_2, CO_2	3,4a, 4b, 5a, 5b, 6a, 6b, 7a, 7b	C
Flows and Moisture	N/A	D
Emission Rate Summary	3	N/A

All sampling field notes are provided in **Appendix E**. All calibration information for the equipment used for this study is included in **Appendix E and F.**

4.1 Discussion of Results

Sampling was completed on January 20th and 27th, 2021 and no issues occurred during the sampling process. EU-BOILER1 and EU-BOILER2 were not operational during the week of January 18th, 2021 and therefore were postponed in testing until January 27, 2021. FCA notified EGLE of this postponement on January 20th, 2021. A summary of the results can be found in the tables section of this report and the more detailed calculations can be found in **Appendices C, and D.** The results have been summarized below in **Table 4.1**.

All concentrations were corrected to reference conditions of 68°F, and 29.92 in. Hg. Operating conditions during the sampling were monitored by RWDI and FCA personnel. All equipment was operated under representative operating conditions. A summary of the process data during each of the testing events is provided in **Appendix H**. Field notes from the testing program can be found in **Appendix G** and sample calculations are presented in **Appendix I**.

Contact was maintained between the operator and the sampling team. A member of the RWDI sampling team contacted the operator before each test, to ensure that the process was at representative maximum operating conditions.

Table 4.1.: Sampling Results Summary

	NOx			CO		
Emission Unit (EU)	**Concentration (ppm_d)**	**Emission Rate (lb/hr)**	**Emission Rate (lb/MMBTU)**	**Concentration (ppm_d)**	**Emission Rate (lb/hr)**	**Emission Rate (lb/MMBTU)**
EU-BOILER1	77.1	8.2	0.153	0.5	0.030	0.00055
EU-BOILER2	79.3	9.0	0.155	1.0	0.072	0.0012
EU-BOILER3	57.3	6.3	0.113	0.3	0.020	0.00036
EU-BOILER4	60.4	6.3	0.098	0.4	0.030	0.00040

Notes: "d" indicated based on dry conditions

5 CONCLUSIONS

Testing was successfully completed on January 20, 2021 and January 27, 2021. All parameters were tested in accordance with USEPA referenced methodologies.

Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
EUBOILER 1,2,4	1	Volumetric Flow Rate	U.S. EPA [1] Methods 1-4
	1	Nitrogen Oxides	U.S. EPA [1] Method 7E
	1	Carbon Monoxide	U.S. EPA [1] Method 10
EUBOILER 3	3	Volumetric Flow Rate	U.S. EPA [1] Methods 1-4
	3	Nitrogen Oxides	U.S. EPA [1] Method 7E
	3	Carbon Monoxide	U.S. EPA [1] Method 10

[1] United States Environmental Protection Agency

Table 2: Sampling Times

FCA JNAP

Source and Test #	Sampling Date	Start Time	End Time
EUBOILER 1			
Test #1	27-Jan-21	7:06 AM	8:05 AM
EUBOILER 2			
Test #1	27-Jan-21	9:01 AM	12:00 AM
EUBOILER 3			
Test #1	20-Jan-21	7:29 AM	8:28 AM
Test #2	20-Jan-21	8:46 AM	9:45 AM
Test #3	20-Jan-21	10:01 AM	11:00 AM
EUBOILER 4			
Test #1	20-Jan-21	12:11 PM	1:10 PM

Table 3: Emissions Summary Table

	NO_x			CO		
Unit	Concentration (ppm_d)	Emission Rate (lb/hr)	Emission Rate (lb/MMBtu)	Concentration (ppm_d)	Emission Rate (lb/hr)	Emission Rate (lb/MMBtu)
EUBOILER1	77.1	8.2	0.153	0.5	0.030	0.00055
EUBOILER2	79.3	9.0	0.155	1.0	0.072	0.0012
EUBOILER3	57.3	6.3	0.113	0.3	0.020	0.00036
EUBOILER4	60.4	6.3	0.098	0.41	0.030	0.00040

Notes:
"d" indicated based on dry conditions

Table 4a - Boiler #1 NOx Testing Summary

RWDI Project #2100845

Boiler #1				O_2	CO_2	NOx	NOx (as $NO_{2)}$	NOx Emission Rate	NOx Emission Rate	Power Output	NOx Emission Rate
Test ID	**Date**	**Start**	**End**	**%**	**%**	**ppm**	**mg/m3**	**lb/dscf**	**lb/hr**	**mmbtu/hr**	**lb/mmbtu**
1	2021-01-27	7:06	8:05	4.1	9.7	77.1	147.5	0.0000092	8.2	53.4	0.153

Flow Rate dry, ref (ft^3/min)

Test 1 = 14,774

dscf = dry standard cubic foot

Table 4b - Boiler #1 CO Testing Summary

RWDI Project #2100845

Boiler #1				O_2	CO_2	CO	CO Emission Rate	CO Emission Rate	Power Output	CO Emission Rate
Test ID	**Date**	**Start**	**End**	**%**	**%**	**ppm**	**lb/dscf**	**lb/hr**	**mmbtu/hr**	**lb/mmbtu**
1	2021-01-27	7:06	8:05	4.1	9.7	0.5	0.00000003	0.030	53.4	0.00055

Flow Rate dry, ref (ft^3/min)

Test 1 = 14,774

dscf = dry standard cubic foot

Table 5a - Boiler #2 NOx Testing Summary

RWDI Project #2100845

Boiler #2				O_2	CO_2	NOx	NOx Emission Rate	NOx Emission Rate	Power Output	NOx Emission Rate
Test ID	**Date**	**Start**	**End**	**%**	**%**	**ppm**	**lb/dscf**	**lb/hr**	**mmbtu/hr**	**lb/mmbtu**
1	2021-01-27	9:01	10:00	4.3	9.5	79.3	0.0000095	9.0	58.0	0.155

Flow Rate dry, ref (ft^3/min)

Test 1 = 15,828

dscf = dry standard cubic foot

Table 5b - Boiler #2 CO Testing Summary

RWDI Project #2100845

Boiler #2				O_2	CO_2	CO	CO Emission Rate	CO Emission Rate	Power Output	CO Emission Rate
Test ID	**Date**	**Start**	**End**	**%**	**%**	**ppm**	**lb/dscf**	**lb/hr**	**mmbtu/hr**	**lb/mmbtu**
1	2021-01-27	9:01	10:00	4.3	9.5	1.0	0.0000001	0.072	58.0	0.0012

Flow Rate dry, ref (ft^3/min)

Test 1 = 15,828

dscf = dry standard cubic foot

Table 6a - Boiler #3 NOx Testing Summary

RWDI Project #2100845

Boiler #3				O_2	CO_2	NOx	NOx Emission Rate	NOx Emission Rate	Power Output	NOx Emission Rate
Test ID	**Date**	**Start**	**End**	**%**	**%**	**ppm**	**lb/dscf**	**lb/hr**	**mmbtu/hr**	**lb/mmbtu**
1	2021-01-20	7:29	8:28	4.8	9.3	58.0	0.0000069	6.5	55.2	0.118
2	2021-01-20	8:46	9:45	4.9	9.2	57.1	0.0000068	6.2	55.5	0.111
3	2021-01-20	10:01	11:00	4.9	9.3	56.7	0.0000068	6.1	55.5	0.111
		Average		4.9	9.3	57.3	0.0000068	6.3	55.4	0.113

Flow Rate dry, ref (ft^3/min)

Test 1 = 15,680

Test 2 = 15,064

Test 3 = 15,097

dscf = dry standard cubic foot

Table 6b - Boiler #3 CO Testing Summary

RWDI Project #2100845

Boiler #3				O_2	CO_2	CO	CO Emission Rate	CO Emission Rate	Power Output	CO Emission Rate
Test ID	**Date**	**Start**	**End**	**%**	**%**	**ppm**	**lb/dscf**	**lb/hr**	**mmbtu/hr**	**lb/mmbtu**
1	2021-01-20	7:29	8:28	4.8	9.3	0.3	0.00000002	0.021	55.2	0.00037
2	2021-01-20	8:46	9:45	4.9	9.2	0.3	0.00000002	0.019	55.5	0.00033
3	2021-01-20	10:01	11:00	4.9	9.3	0.3	0.00000002	0.020	55.5	0.00036
		Average		4.9	9.3	0.3	0.00000002	0.020	55.4	0.00036

Flow Rate dry, ref (ft^3/min)

Test 1 = 15,680

Test 2 = 15,064

Test 3 = 15,097

dscf = dry standard cubic foot

Table 7a - Boiler #4 NOx Testing Summary

RWDI Project #2100845

Boiler #4				O_2	CO_2	NOx	NOx Emission Rate	NOx Emission Rate	Power Output	NOx Emission Rate
Test ID	**Date**	**Start**	**End**	**%**	**%**	**ppm**	**lb/dscf**	**lb/hr**	**mmbtu/hr**	**lb/mmbtu**
1	2021-01-21	12:11	13:10	4.3	9.6	60.4	0.0000072	6.3	64.7	0.098

Flow Rate dry, ref (ft^3/min)

Test 1 = 14,608

dscf = dry standard cubic foot

Table 7b - Boiler #4 CO Testing Summary

RWDI Project #2100845

Boiler #4				O_2	CO_2	CO	CO Emission Rate	CO Emission Rate	Power Output	CO Emission Rate
Test ID	**Date**	**Start**	**End**	**%**	**%**	**ppm**	**lb/dscf**	**lb/hr**	**mmbtu/hr**	**lb/mmbtu**
1	2021-01-21	12:11	13:10	4.3	9.6	0.41	0.0000000	0.03	64.7	0.00040

Flow Rate dry, ref (ft^3/min)

Test 1 = 14,608

dscf = dry standard cubic foot