1 INTRODUCTION

RWDI AIR Inc. (RWDI) was retained by Fiat Chrysler Automobiles US LLC (FCA) to complete an air sampling program on two (2) boilers identified as EU-BOILER1 and EU-BOILER5 under FG-BLR1&BLR5 at the Trenton Engine Complex (TEC) located at 2300 Van Horn Road, Trenton, Michigan. The test program was conducted to evaluate the Carbon Monoxide (CO) and Nitrogen Oxides (NOx) concentrations and emission rates as well as several other parameters as discussed below. The purpose of this testing was to evaluate compliance with Nitrogen Oxides (NOx) and Carbon Monoxide (CO) emission limits specified by Renewable Operating Permit MI-ROP-B3350-2014. The testing followed United states Environmental Protection Agency (USEPA) Test Methods 7E and 10.

The original program was to complete emission testing on EU-BOILER1 and EU-Boiler 5, as outlined in FG-BLR1&BLR5, during the same sampling period. Unfortunately, EU-BOILER5 was unable to operate during the testing period as the boiler was down for repairs. AS discussed with MDEQ, EU-BOILER5 testing was completed on January 12, 2018.

In addition Oxygen, Carbon Dioxide, stack gas velocity and flow rate were measured in order to determine stack gas composition and emission rates.

The Intent-To-Test Plan (ITTP) was submitted to the Michigan Department of Environmental Quality (MDEQ) on October 25th, 2017 and a correspondence document was issued by the MDEQ on November 13th, 2017. The ITTP and MDEQ correspondence document can be found in **Appendix A** of this report.

Testing consisted of three (3) 60-minute test runs for nitrogen oxide and carbon monoxide emissions.

The sampling was conducted on November 28th, 2017 for EU-BOILER1 and January 12th for EU-BOILER5. Sampling on November 28th, 2017 was witnessed by Mr. Todd Zynda. Communication with Mr. Mark Dziadosz from the Southeast Michigan Air Quality Division of the State of Michigan Department of Environmental Quality was held prior to testing and noted that Mr. Mark Dziadosz was unable to attend the source testing event. For the January 12th testing of EU-BOILER5, communication with Mr. Todd Zynda and Mr. Mark Dziadosz from Michigan Department of Environmental Quality was held prior to testing and noted that neither Mr. Zynda nor Mr. Dziadosz were able to attend the source testing event. Mr. Rohitkumar Patel and Ms. Amy Berendt from FCA were on-site to ensure the process was operating at normal standard conditions.

Table 3: Source, Parameter and Test Date

Source	Parameter	Test Date
EU-BOILER1	Carbon Monoxide, Oxides of Nitrogen, Oxygen, Carbon Dioxide, Velocity, Temperature and Flow Rate	November 28, 2017
EU-BOILER5	Carbon Monoxide, Oxides of Nitrogen, Oxygen, Carbon Dioxide, Velocity, Temperature and Flow Rate	January 12, 2018

2 SOURCE DESCRIPTION

2.1 Facility Description

TEC operates an engine manufacturing plant that produces six-cylinder engines for Chrysler, Dodge and Jeep vehicles. Under Flexible Group FG-BLR1&BLR5 two (2) boilers are fired by natural gas in order to provide heat and steam to the TEC site. There are no controls associated with these boilers. Since EU-BOILER5 was unable to be tested this section only discusses EU-BOILER1.

Table 4: Emission Unit Description

Units	Capacity
EU-BOILER1	One natural gas fired boilers rated at 60 MMBTU/hr. There is no designated pollution control equipment.
EU-BOILER5	One natural gas fired boilers rated at 180 MMBTU/hr. There is no designated pollution control equipment.

2.2 EU-BOILER1 & EU-BOILER5 Overview

2.2.1 Source Testing Location Overview

The sampling locations for EU-BOILER1, under FG-BLR1&BLR5, is located outside on the roof of the Power House.

EU-BOILER1 stack with an inside diameter of 66 inches having two sampling ports, 90 degrees apart and 4 inches in diameter. The sampling ports are located more than 1.5 duct diameters downstream and more than 2.5 duct diameters upstream of any flow disturbances. A stratification test was performed and the flue gas was determined to be uniform or un-stratified.

Table 5: Summary of Sampling Program – EU-BOILER1

	EU-BOILER1
Emission Unit Description [Including Process Equipment & Control Device(s)]	One natural gas fired boiler rated at 60 MMBTU/hr. There is no designated pollution control equipment.
Parameter Tested	Carbon Monoxide and Nitrogen Oxide and addition sampling for stack gas velocity, stack gas composition (carbon dioxide and oxygen), and moisture.
Exhaust Temperature **Exhaust Flow Rate**	424°F (Average) 13,098 DSCFM (Average)

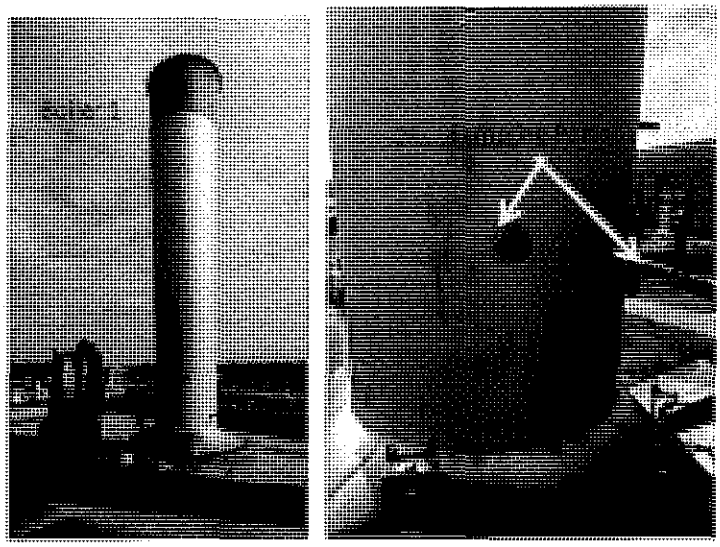


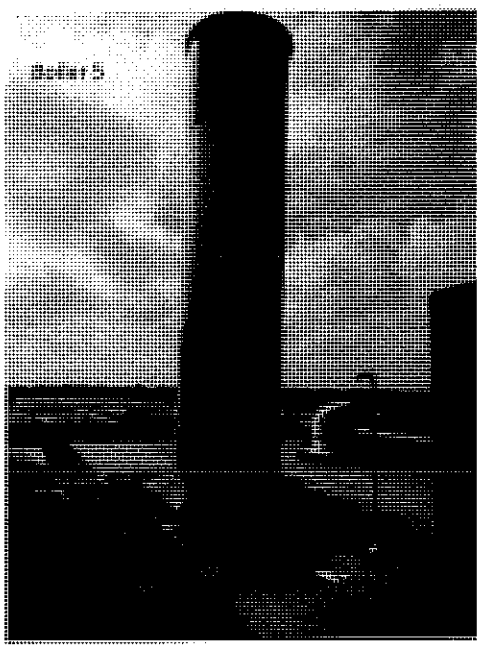
Figure 2.2.1a: Source Photos of EU-BOILER1

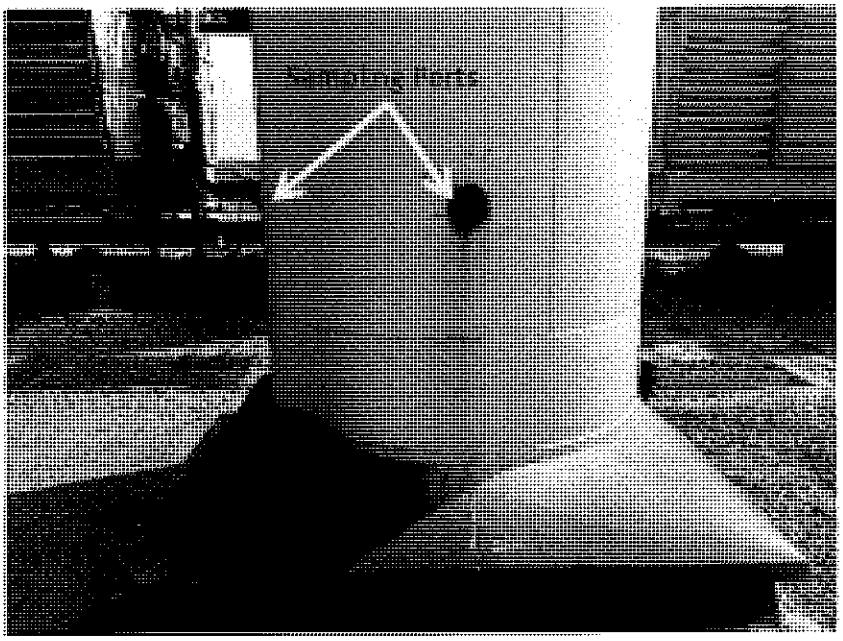
EU-BOILER5 stack with an inside diameter of 84 inches having two sampling ports, 90 degrees apart and 4 inches in diameter. The sampling ports are located more than 3 duct diameters downstream and more than 2.5 duct diameters upstream of any flow disturbances.

Table 6: Summary of Sampling Program – EU-BOILER5

	EU-BOILER5
Emission Unit Description [Including Process Equipment & Control Device(s)]	One natural gas fired boiler rated at 180 MMBTU/hr. There is no designated pollution control equipment.
Parameter Tested	Carbon Monoxide and Nitrogen Oxide and addition sampling for stack gas velocity, stack gas composition (carbon dioxide and oxygen), and moisture.
Exhaust Temperature **Exhaust Flow Rate**	255°F (Average) 23,713 DSCFM (Average)

Figure 2.2.1b: Source Photos of EU-BOILER5





3 SAMPLING METHODOLOGY

3.1 Testing Methodology

The following table summarizes the test methodologies that were followed during this 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)
Carbon Monoxide	USEPA[1] Method 10 (CEM)
Nitrogen Oxide Emission Rates	U.S. EPA Method 19

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

3.2 Description of Testing Methodology

The following section provides brief descriptions of the sampling methods.

3.2.1 USEPA Method 1-4

The exhaust velocities and flow rates were determined following the United States Environmental Protection Agency (USEPA) 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. Velocity and sampling points for each traverse were determined from USEPA Method 1, "Sample and Velocity Traverses for Stationary Sources". Volumetric flow rates were determined following the equal area method as outlined in USEPA Method 2. Temperature measurements were made simultaneously with the velocity measurements and 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 USEPA Method 3a, "Gas Analysis for the Determination of Dry Molecular Weight". Stack moisture content was determined through direct condensation and according to USEPA Method 4, "Determination of Moisture Content in Stack Gases". Detailed flow and moisture information is located in **Appendix D**.

3.2.2 USEPA Method 10

USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources (Instrument Analyzer Procedure)", was used to measure the carbon monoxide concentration of the flue gas. The exhaust gas sample was withdrawn from a single point at the centre 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. The sample was then routed through a manifold system and introduced to the individual CEM's for measurement. A Rosemount Model NGA-2000 paramagnetic analyzer was used for CO, O_2 and CO_2 measurements. A schematic of the sampling system apparatus is located in **Appendix B.**

Prior to testing at the exhaust port sampling location, 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 CO 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. Stratification information is included in **Appendix E**.

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 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.

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 C contains detailed data for CO and NOx emissions, including summary of results and 1 minute averages. Calibration error check and system bias check information is located in **Appendix E** with calibration gas Certificates of Accuracy located in **Appendix F**.

3.2.3 USEPA Method 7E

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 centre 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. The sample was then routed through a manifold system and introduced to the individual CEM's for measurement.

A NO/NO_2 conversion check was performed prior to the start of the sampling 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. NO/NO_2 conversion data is located in Appendix E.

Calibration error and system-bias checks were performed as described in section 4.2.2.

3.2.4 Nitrogen Oxides Emission Rate Calculation (US EPA Methods 19)

USEPA Method 19, "Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide and Nitrogen Oxide Emission Rates," was used to calculate a NO_x emission factor based on Oxygen concentrations and appropriate F-factors. Equation 19-1 from the method was used. Table 19-1 was used to determine the conversion factor for concentration (1.194×10^{-7}) was used for NO_x. Table 19-2 was used for the F-Factor (natural gas 8,710 dscf/10^6 BTU).

$$E = (1.194 \times 10^{-7}) \times C_d \times F_d \times ((20.9/(20.9-\%O_{2d}))$$

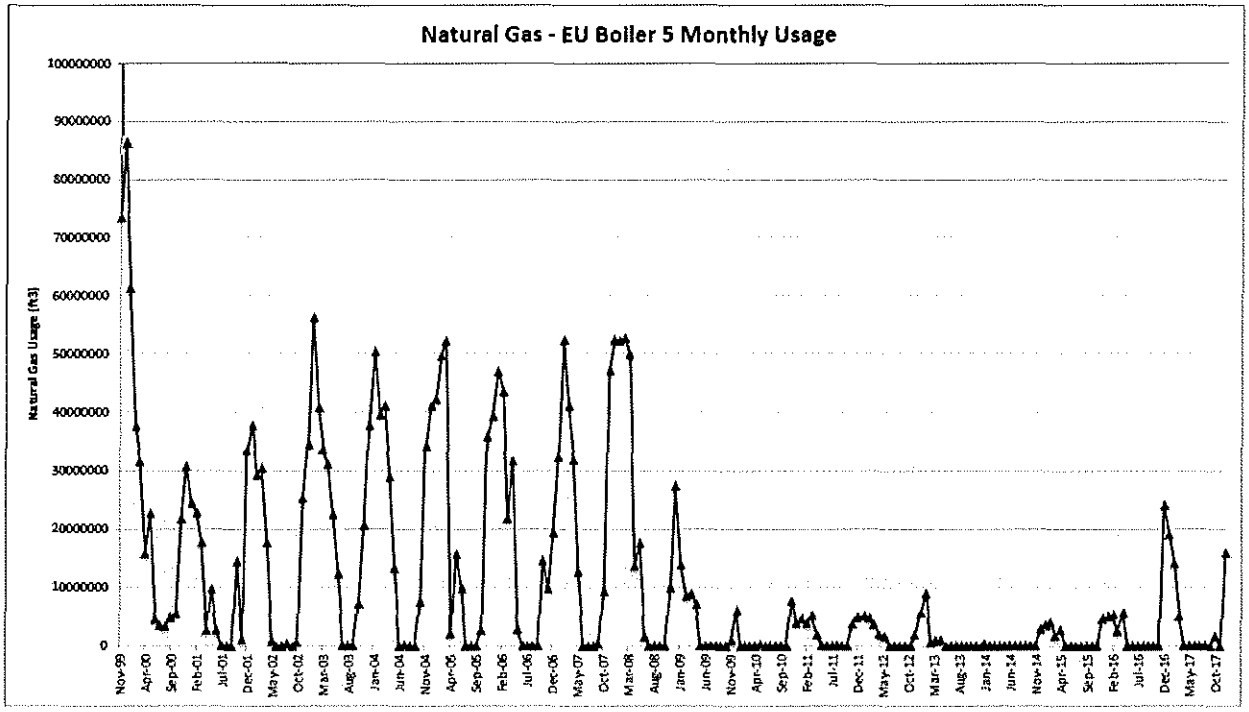
Where:

E = Pollutant Emission Rate (lb/10^6 BTU)
C_d = Pollutant Concentration, Dry Basis (ppm)
F_d = Fuel Factor, Dry Basis (dscf/10^6 BTU)
$\%O_{2d}$ = Oxygen Concentration, Dry Basis (%)

3.2.5 Special Situations and Modifications

The original program was to complete emission testing on EU-BOILER1 and EU-BOILER 5, as outlined in FG-BLR1&BLR5, during the same sampling period. Unfortunately, EU-BOILER5 was unable to operate during the testing period as the boiler was down for repairs. The testing for EU-BOILER5 was completed on January 12th of 2018. Notification was provided to MDEQ prior to scheduling the testing on EU-BOILER5.

EU-BOILER5 stream demand has significantly reduced since the last testing program in 2001. In 2001, there was sufficient demand and venting capacity to allow for a maximum steam load of 130,000 lbs per hour (on average) to be tested during the last source testing program. Since this time, TEC has completed numerous steam to natural gas conversion projects as well as reduced the requirements for tempered air within the facility for energy reduction projects at the facility. The demand has lowered to a rate of approximately 30,000 lbs per hour of stream. During the testing, the facility was able obtain plant demand of approximately 25,000 lbs per hour and vent an additional approximate 25,000 lbs per hour to operate at 50,000 lbs per hour during the test. Since the variation of steam load is significant from the past source testing event, TEC communicated with Mr. Todd Zynda of MDEQ prior to testing. As discussed, if TEC was to require more than 50,000 lbs per hour of steam for production, TEC would repeat the testing program. At this time, steam load above 50,000 lbs per hour is not anticipated. Below is a graph from TEC noting the quantity of natural gas usage for Boiler 5 decreasing over time with the completion of the energy reduction projects.



4 PROCESS DATA

TEC representatives provided production information during testing of the boilers including load capacity (%) and natural gas usage per test (ft^3/hr). Below is a table showing steam load and gas usage during testing.

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

Parameter		Run 1	Run 2	Run 3	Average
EU-BOILER1	Date:	28-Nov-2017	28-Nov-2017	28-Nov-2017	--
	Time:	10:57am to 11:57am	1:23pm to 2:23pm	2:55pm to 3:55pm	--
	Natural Gas Usage: (ft^3/hr)	37,210	37,000	37,320	37,177
	Steam Load: (pounds per hour)	40,000 (See Appendix H)	40,000 (See Appendix H)	40,000 (See Appendix H)	40,000 (See Appendix H)
	Gross Calorie Value	1044.28 btu/ft^3			

Note: The Gross Calorie Value of the fuel used was provided by DTE/Constellation

Table 9: Steam Load and Gas Usage during Testing – EU-BOILER5

Parameter		Run 1	Run 2	Run 3	Average
EU-BOILER1	Date:	12-Jan-2018	12-Jan-2018	12-Jan-2018	--
	Time:	8:43am to 9:42am	9:54pm to 10:53am	11:59am to 12:58pm	--
	Natural Gas Usage: (ft^3/hr)	80,010	83,110	83,810	82,310
	Steam Load: (pounds per hour)	50,000 (See Appendix H)	50,000 (See Appendix H)	50,000 (See Appendix H)	50,000 (See Appendix H)
	Gross Calorie Value	1044.28 btu/ft^3			

Note: The Gross Calorie Value of the fuel used was provided by DTE/Constellation

Steam Load was monitored via trend from the Boiler Operator PLC. Steam Load data is provided in **Appendix H.**

Prior to commencing the testing, Mr. Patel and/or the Boiler Operators confirmed that the process was operating normally and load was within 50-70% of full operating capacity for EU-BOILER1 and approximately 30% for EU-BOILER5.

5 RESULTS

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

Table 1: EU-BOILER1 Nitrogen Oxides and Carbon Monoxide Results

Parameter	Run 1		Run 2		Run 3		Average	
	lb/MMBtu	lb/hr	lb/MMBtu	lb/hr	lb/MMBtu	lb/hr	lb/MMBtu	lb/hr
Nitrogen Oxides	0.10	6.5	0.10	6.3	0.10	6.6	0.10	6.5
Carbon Monoxide	0.005	0.21	0.001	0.05	0.003	0.12	0.003	0.12

Notes: lb/MMBtu – pounds per million British Thermal Units
lb/hr – pounds per hour

Table 2: EU-BOILER5 Nitrogen Oxides and Carbon Monoxide Results

Parameter	Run 1		Run 2		Run 3		Average	
	lb/MMBtu	lb/hr	lb/MMBtu	lb/hr	lb/MMBtu	lb/hr	lb/MMBtu	lb/hr
Nitrogen Oxides	0.11	10.1	0.11	10.3	0.11	10.7	0.11	10.4
Carbon Monoxide	0.006	0.55	0.005	0.48	0.006	0.57	0.006	0.54

Notes: lb/MMBtu – pounds per million British Thermal Units
lb/hr – pounds per hour

6 CONCLUSIONS

Testing was successfully completed on November 28th, 2017 for EU-BOILER1 as required under FG-BLR1&BLR5 Section of the Renewable Operating Permit MI-ROP-B3350-2014. All parameters were tested in accordance with USEPA referenced methodologies. Testing for EU-BOILER5 was completed on January 12th of 2018.