FINAL REPORT

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GENERAL MOTORS LLC
GM TECHNICAL CENTER

WARREN, MICHIGAN

**2023 RELATIVE ACCURACY TESTING AUDIT (RATA)
SOURCE TESTING REPORT: EU-BOILER1, EU-BOILER2, AND
EU-BOILER3**

RWDI #2302580

April 20, 2023

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by General Motors, LLC (GM) to complete the Relative Accuracy Testing Audit (RATA) emission sampling program at the General Motors Technical Center in Warren, Michigan. The test program was conducted to fulfill the requirements of the Michigan Department of Environment, Great Lakes and Energy (EGLE) MI-ROP-B4049-2019 in accordance with Appendix A, 40 CFR, Part 60, Subpart Db, US EPA Reference Methods 3A and 7E found in 40 CFR, Part 60, Appendix A, and Performance Specifications (PS) 2, 3, and 16 specified by 40 CFR, Part 60, Appendix B. The pollutants tested include oxygen (O_2) and nitrogen oxides (NO_x) from EU-BOILER1, EU-BOILER2, and EU-BOILER3

Executive Summary Table i: Summary of Results – EUBOILER1 – March 16, 2023

Parameter	EU-BOILER1		
	Oxides of Nitrogen (ppm)	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	7.4% *(Limit 20%)*	8.0% *(Limit 20%)*	11.4% *(Limit 20%)*
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	0.41	0.0007	0.40% *(Limit 1%)*
Bias Present?	No	Yes	Yes
Bias Factor	N/A	0.97	1.12

Notes: The average data is based on 9 of the 10 runs conducted on each source.

Executive Summary Table ii: Summary of Results – EUBOILER2 – March 15, 2023

Parameter	EU-BOILER2		
	Oxides of Nitrogen (ppm)	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	1.5% *(Limit 20%)*	2.3% *(Limit 20%)*	12.6% *(Limit 20%)*
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	0.04	0.0002	0.34% *(Limit 1%)*
Bias Present?	No	Yes	Yes
Bias Factor	N/A	0.98	0.91

Notes: The average data is based on 9 of the 10 runs conducted on each source.

Executive Summary Table iii: Summary of Results – EUBOILER3 – March 14, 2023

Parameter	EU-BOILER3		
	Oxides of Nitrogen (ppm)	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	2.2% *(Limit 20%)*	1.1% *(Limit 20%)*	8.4% *(Limit 20%)*
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	0.43	0.0001	0.28% *(Limit 1%)*
Bias Present?	Yes	Yes	Yes
Bias Factor	1.01	1.00	0.93

Notes: The average data is based on 9 of the 10 runs conducted on each source.

TABLE OF CONTENTS

LIST OF TABLES

(Found Within The Report Text)

LIST OF TABLES

(Found After The Report Text)

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

RWDI USA LLC (RWDI) was retained by General Motors LLC (GM) to complete the Relative Accuracy Testing Audit (RATA) emission sampling program at the General Motors Technical Center in Warren, Michigan. The test program was conducted to fulfill the requirements of the Michigan Department of Environment, Great Lakes and Energy (EGLE) MI-ROP-B4049-2019a in accordance with Appendix A, 40 CFR, Part 60, Subpart Db, US EPA Reference Methods 3A and 7E found in 40 CFR, Part 60, Appendix A, and Performance Specifications (PS) 2, 3, and 16 specified by 40 CFR, Part 60, Appendix B. The pollutants tested include oxygen (O_2) and nitrogen oxides (NO_x) from EU-BOILER1, EU-BOILER2, and EU-BOILER3.

1.1   Location and Dates of Testing

The test program was completed on March 14 to 16, 2023 at the GM Technical Center.

1.2   Purpose of Testing

The emissions test program is required by EGLE permit number MI-ROP-N4049-2019a. The facility SRN number is N4049. This report outlines the results for the 2023 RATA for EU-BOILER1, EU-BOILER2 and EU-BOILER3.

1.3   Description of Source

The General Motors Technical Center located in Warren, Michigan has three boilers that are capable of firing natural gas. Each of the boilers has an input capacity of 108 MMBtu/hr while firing NG. The steam from the boilers is utilized as process steam. Low-NOx burners minimize the emissions of nitrogen oxides from the boilers.

1.4   Personnel Involved in Testing

Table 1.4.1: Testing Personnel

Hunter Lyons Environmental Engineer	**General Motors – Global Technical Center** 30001 Van Dyke Ave Warren, MI 48093	(586) 506-4046
Matt Perko Environmental Engineer	**General Motors – Global Technical Center** 30001 Van Dyke Ave Warren, MI 48093	(586) 242-6763
Andrew Riley Air Quality Division	State of Michigan Department of Environment, Great Lakes & Energy (EGLE)	(586) 565-7379
Steve Smith Project Manager		(734) 751-9701
Ben Durham Senior Field Technician	**RWDI USA LLC** 2239 Star Court Rochester Hills, MI 48309	(734) 474-1731
Cade Smith Field Technician		(734) 552-7270

2.   SUMMARY OF RESULTS

2.1   Operating Data

Operational data collected during the testing includes:

> Heat Input (MMBTU/hr)
> Boiler steam load (klbs/hr)
> NO_x ppm concentration (ppm_{vd})
> NO_x ppm emission rate (lbs/MMBTU)
> O_2 ppm concentration (%)

This information can be found in **Appendices A, B and C**, respectively for EU-BOILER1, EU-BOILER2 and EU-BOILER3.

2.2   Applicable Permit Number

MI-ROP-N4049-2019a

3.   SOURCE DESCRIPTION

3.1   Description of Process and Emission Control Equipment

The General Motors Technical Center located in Warren, Michigan has three boilers that are capable of firing natural gas. Each of the boilers has an input capacity of 108 MMBtu/hr while firing NG. The steam from the boilers is utilized as process steam. Low-NOx burners minimize the emissions of nitrogen oxides from the boilers.

3.2   Predictive Emission Monitors (PEMS) Specifications

The SmartCEMS 60 Predictive Emissions Monitoring System (PEMS) provides continuous data recording and report generation for compliance with 40 CFR Part 60 regulations. The data acquisition system provides a secure and reliable means of collecting and retrieving compliance data. This application has been customized to meet the requirements of gas-fired boiler under 40 CFR Part 60, Subpart Db; and as a PEMS, an alternative to continuous emissions monitoring under 40 CFR Part 60, Performance Specification 16 for Predictive Emissions Monitoring Systems (PS-16).

Table 3.2.1: Summary of PEMS Units

	EU-BOILER1, EU-BOILER2, EU-BOILER3
NOx (PS-2) Limit	Less than 20% of RM or 10% of AS – ppmvd Less than 20% of RM or 10% of AS – lb/MMBtu
O_2 (PS-3) Limit	Less than 20% of RM or 1% Difference
PEMS Unit O_2	CMC Solutions – SmartCEMS-60 – GMBL 122042
PEMS Unit NOx	CMC Solutions – SmartCEMS-60 – GMBL 122041

3.3   Process Flow Sheet or Diagram

Each boiler has a single outlet. A process flow diagram can be provided if requested.

3.4   Type and Quantity of Raw and Finished Materials

Each boiler is fired by natural gas.

3.5   Normal Rated Capacity of Process

Each boiler has a maximum heat input rating of 108 MMBTU/hr. Each test was completed with the boilers (EU-BOILER1, EU-BOILER2 and EU-BOILER3) operating at greater than 50% capacity for each test. Process data is provided in **Appendices A, B, and C**.

3.6   Process Instrumentation Monitored During the Test

The following process instrumentation data was monitored during each test:

> ➢   Heat Input (MMBTU/hr)
> ➢   Boiler steam load (klbs/hr)
> ➢ NO_x ppm concentration (ppm_{vd})
> ➢ NO_x ppm emission rate (lbs/MMBTU)
> ➢ O_2 ppm concentration (%)

This information can be found in **Appendices A, B and C**, respectively for EU-BOILER1, EU-BOILER2 and EU-BOILER3.

4.   SAMPLING AND ANALYTICAL PROCEDURES

The following test methods were referenced in the test program. These methods can be found in 40 CFR, Part 60, Appendix A and B.

- **Method 3A:** Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources
- **Method 7E:** Determination of Nitrogen Oxides Emissions from Stationary Sources
- **Method 19:** Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide and Nitrogen Oxide Emission Rates
- **Performance Specification 2:** Specifications and Test Procedures for SO2 and NOx Continuous Emission Monitoring Systems in Stationary Sources
- **Performance Specification 3:** Specifications and Test Procedures for O_2 Continuous Emission Monitoring Systems in Stationary Sources
- **Performance Specification 16:** Specifications and Test Procedures for Predictive Emission Monitoring Systems in Stationary Sources

4.1   Relative Accuracy Testing Audit (RATA) NO_x and O_2

To satisfy the NO_x data accuracy requirement, the relative accuracy results of a minimum of nine performance test runs must meet the criteria outlined in section 8.4.4 of the US EPA PS 2 for NO_x and PS 3 for O_2. A 21-minute period was used for each run. As per Performance Specification 2, traverse points were located at 16.7, 50.0, and 83.3 percent of the stack diameter. Each point was sampled at for 7 minutes in duration for each RATA run.

Prior to the RATA, a NO_2-to-NO conversion efficiency check was performed. It met the criteria of $\geq$ 90%. Also prior to the RATA, an interference response test was performed on the analyzer used for this test program. The heated sample lines were operated at 250°F to avoid a buildup of condensation.

4.2   EPA Method 3A, and 7E (O_2, and NO_x)

A three-point (zero, mid-, and high-range) analyzer calibration error check was conducted on each reference analyzer before initiating the relative accuracy testing. This check was conducted (after final calibration adjustments are made) by injecting the calibration gases directly into each gas analyzer and recording the responses.

Zero and upscale calibration checks are conducted both before and after each test run 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 are introduced into the sampling system at the probe outlet so that the calibration gases are 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 measured 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 delivered the sample gases from the stack to the CEMs system. The heated sample line was designed to maintain the gas temperature above 250°F to prevent condensation of stack gas moisture within the line.

Before entering the analyzers, the gas sample passed directly into a refrigerated condenser, which cooled the gas to approximately 35°F to remove the stack gas moisture. After passing through the condenser, the dry gas entered a Teflon-head diaphragm pump and a flow control panel, which delivered the gas in series to the O_2 and NO_x analyzer. This analyzer measured the respective gas concentrations on a dry volumetric basis.

4.3   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 utilized 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 also used to determine the conversion factor for concentration (1.194×10^{-7}) 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 (%)

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4.4   Description of Recovery and Analytical Procedures

There were no samples to recover during this test program. All testing used real time data from the analyzers.

4.5   Sampling Port Description

All sampling ports meet USEPA Method 1 locations, not flow measurements were taken as emissions were determined via US EPA Method 19.

4.6   Internal Quality Assurance

Quality control procedures specific to the CEMS includes linearity checks to determine the instrument performance and reproducibility prior to its use in the testing program. Regular performance checks on the analyzers were also carried out during the testing program by performing zero and span calibration checks using EPA Protocol 1 gas standards. Sample system bias checks were also conducted. These checks were used to verify the ongoing precision of the monitor and sampling system over time. Pollutant-free nitrogen was introduced to perform the zero checks, followed by a known calibration (span) gas into the monitor. The response of the monitor to pollutant-free air and the corresponding sensitivity to the span gas was be recorded regularly during the tests. These records can be found in **Appendix E**.

5.   TEST RESULTS AND DISCUSSION

5.1   Results Summary

Table 5.1.1: Summary of Results – EUBOILER1 – March 16, 2023

Parameter	EU-BOILER1		
	Oxides of Nitrogen (ppm)	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	7.4% *(Limit 20%)*	8.0% *(Limit 20%)*	11.4% *(Limit 20%)*
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	0.41	0.0007	0.40% (Limit 1%)
Bias Present?	No	Yes	Yes
Bias Factor	N/A	0.97	1.12

Notes: The average data is based on 9 of the 10 runs conducted on each source.

Table 5.1.2: Summary of Results – EUBOILER2 – March 15, 2023

Parameter	EU-BOILER2		
	Oxides of Nitrogen (ppm)	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	1.5% *(Limit 20%)*	2.3% *(Limit 20%)*	12.6% *(Limit 20%)*
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	0.04	0.0002	0.34% *(Limit 1%)*
Bias Present?	No	Yes	Yes
Bias Factor	N/A	0.98	0.91

Notes: The average data is based on 9 of the 10 runs conducted on each source.

Table 5.1.3: Summary of Results – EUBOILER3 – March 14, 2023

Parameter	EU-BOILER3		
	Oxides of Nitrogen (ppm)	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	2.2% *(Limit 20%)*	1.1% *(Limit 20%)*	8.4% *(Limit 20%)*
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	0.43	0.0001	0.28% *(Limit 1%)*
Bias Present?	Yes	Yes	Yes
Bias Factor	1.01	1.00	0.93

Notes: The average data is based on 9 of the 10 runs conducted on each source.

5.2   Discussion of Results

Detailed results for each unit can be found in **Appendices A, B, and C**. Calibration documentation can be found in **Appendix D**. The calibration records for the Teledyne T200H NO_x and O_2 analyzer, in compliance with USEPA Methods 3A and 7E, can be found in **Appendix A, B, C, and E**. BOILER OPERATING CONDITIONS

Operating conditions during the sampling were monitored by GM personnel. Testing was performed while each of the boilers operated at greater than 50% load. Contact was kept between RWDI and boiler operators to ensure the boiler was running at all times during the testing.

5.3   Variations in Testing Procedures

There were no sampling variations.

5.4   Process Upset Conditions During Testing

There were normal operation of each boiler during the testing.

5.5   Maintenance Performed in Last Three Months

Normal general maintenance to boilers were completed.

5.6   Re-Test

This was not a retest.

5.7   Audit Samples

This test did not require any audit samples.

5.8   Flows and Moisture

No flow and moisture data was collected.

5.9   Calibration Data

Calibration data can be found in **Appendices A, B, C, and D**.

5.10   Process Data

Process data can be found in **Appendices A, B and C**.

5.11   Example Calculations

Example calculations can be found in **Section 4.3 and Appendix F**.

5.12   Laboratory Data

There was no laboratory data from this testing program.

6.   CONCLUSIONS

The purpose of the study was to perform 2023 RATA on the PEMS for EU-BOILER1, EU-BOILER2 and EU-BOILER3. PEMS determine concentrations for NO_x and O_2 and NO_x emission rate. All analyzers meet the relative accuracy requirements set out in Performance Specification in 40 CFR 60, Appendix B.

TABLES

Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
EU-BOILER1	10	O_2	U.S. EPA [1] Method 3A
	10	NO_x	U.S. EPA [1] Method 7E
EU-BOILER2	10	O_2	U.S. EPA [1] Method 3A
	10	NO_x	U.S. EPA [1] Method 7E
EU-BOILER3	10	O_2	U.S. EPA [1] Method 3A
	10	NO_x	U.S. EPA [1] Method 7E

Notes:
[1] U.S. EPA - United States Environmental Protection Agency

Table 2A: Sampling Summary - EU-BOILER1

Test #	Sampling Date	Start Time	End Time
1		8:05	8:25
2		8:35	8:55
3		9:07	9:27
4		9:38	9:58
5	16-Mar-23	10:11	10:31
6		10:43	11:03
7		11:16	11:36
8		11:48	12:08
9		12:19	12:39
10		12:50	13:10

Table 2B: Sampling Summary - EU-BOILER2

Test #	Sampling Date	Start Time	End Time
1		7:45	8:05
2		8:15	8:35
3		8:46	9:06
4		9:17	9:37
5	15-Mar-23	9:48	10:08
6		10:18	10:38
7		10:48	11:08
8		11:34	11:54
9		12:04	12:24
10		12:35	12:55

Table 2C: Sampling Summary - EU-BOILER3

Test #	Sampling Date	Start Time	End Time
1		8:00	8:20
2		8:30	8:50
3		9:06	9:26
4		9:38	9:58
5	14-Mar-23	10:07	10:27
6		10:36	10:56
7		11:07	11:27
8		11:38	11:58
9		12:09	12:29
10		12:40	13:00

Table 3: EU-BOILER1: RATA Results

Date: Thursday, March 16, 2023

Test	RWDI Time Start Time	RWDI Time End Time	NOx RM (dppm)	NOx RM (corppm)	NOx PEMS (ppm)	NOx di (ppm)	O₂ RM (d%)	O₂ RM (cor%)	O₂ PEMS (%)	O₂ di (%)	Emission Rate RM (lb/MMBTU)	Emission Rate PEMS (lb/MMBTU)	Emission Rate di (lb/MMBTU)	Load Steam (klb/hr)	Heat Input (MMBTU/hr)
1	8:05	8:25	18.33	18.38	20.71	-2.33	3.72	3.70	3.30	0.4	0.0232	0.0260	-0.0028	65.16	76.30
2	8:35	8:55	18.65	18.53	20.89	-2.36	3.63	3.64	3.30	0.3	0.0233	0.0260	-0.0027	62.61	73.67
3	9:07	9:27	**18.45**	**18.34**	**20.81**	**-2.47**	3.70	3.73	3.30	0.4	0.0232	0.0260	-0.0028	61.95	73.01
4	9:38	9:58	20.47	20.47	20.13	0.34	3.82	3.83	3.50	0.3	0.0261	0.0250	0.0011	53.79	66.06
5	10:11	10:31	20.92	20.86	19.63	1.23	3.87	3.87	3.50	0.4	0.0266	0.0250	0.0016	49.73	62.33
6	10:43	11:03	20.48	20.40	20.64	-0.24	**3.96**	**3.97**	**3.50**	**0.5**	0.0262	0.0260	0.0002	52.29	64.83
7	11:16	11:36	19.99	19.93	20.77	-0.84	3.90	3.90	3.50	0.4	0.0255	0.0260	-0.0005	54.20	66.39
8	11:48	12:08	19.96	19.89	20.99	-1.10	3.94	3.93	3.50	0.4	0.0255	0.0260	-0.0005	53.99	66.22
9	12:19	12:39	20.16	20.09	20.82	-0.73	3.94	3.92	3.50	0.4	0.0257	0.0260	-0.0003	53.30	65.71
10	12:50	13:10	21.32	21.49	19.16	2.33	4.10	4.08	3.60	0.5	**0.0278**	**0.0240**	**0.0038**	49.05	62.26
		AVERAGE	—	20.01	20.42	-0.41	—	3.8	3.4	0.4	0.0250	0.0258	-0.0007	55.61	67.68
		STDS	—	1.01	0.64	1.39	—	0.14	0.11	0.05	0.00138	0.00044	0.00166	—	—
		n	9				9				9				
		Full Scale	89.8				21				-				
		t₀.₉₇₅	2.306				2.306				2.306				
		l d l	0.41				0.40				0.0007				
		l cc l	1.07				0.04				0.0013				
		Bias present? (ldl > lccl)	no bias				bias present				bias present				
		Bias Factor	0.98				1.12				0.97				
		Relative Accuracy (20% limit)	7.4%				11.4%				8.0%				

Notes:
RM = Reference Method (RWDI measurements)
PEMS = Predictive Emission Monitor System (GM data)
di = Difference between PEMS and RM for each point
n = number of tests
l d l = Absolute mean difference between the PEMS and RM results
Bolded test runs were not used in the RA calculation

Table 4: EU-BOILER2: RATA Results

Date: Wednesday, March 15, 2023

Test	RWDI Time Start Time	End Time	NOx RM (dppm)	RM (corppm)	PEMS (ppm)	di (ppm)	O₂ RM (d%)	RM (cor%)	PEMS (%)	di (%)	Emission Rate RM (lb/MMBTU)	PEMS (lb/MMBTU)	di (lb/MMBTU)	Load Steam (klb/hr)	Heat Input (MMBTU/hr)
1	7:45	8:05	25.54	25.93	26.50	-0.57	3.28	3.37	3.60	-0.2	0.0321	0.0330	-0.0009	58.94	65.57
2	8:15	8:35	25.45	25.90	26.43	-0.53	3.35	3.44	3.70	-0.3	0.0322	0.0330	-0.0008	55.70	64.52
3	8:46	9:06	25.29	25.92	26.19	-0.27	3.37	3.47	3.70	-0.2	0.0323	0.0330	-0.0007	56.96	63.86
4	9:17	9:37	25.40	26.12	26.32	-0.20	3.31	3.43	3.70	-0.3	0.0325	0.0330	-0.0005	56.85	63.88
5	9:48	10:08	25.10	25.85	25.54	0.31	3.34	3.48	3.90	-0.4	0.0323	0.0330	-0.0007	53.15	60.20
6	10:18	10:38	24.86	25.42	24.89	0.53	3.31	3.45	4.00	-0.6	0.0317	0.0320	-0.0003	50.34	57.19
7	10:48	11:08	24.52	24.90	24.17	0.73	**3.33**	**3.47**	**4.10**	**-0.6**	0.0311	0.0310	0.0001	46.15	52.74
8	11:34	11:54	25.89	26.21	26.05	0.16	3.31	3.46	3.70	-0.2	0.0327	0.0330	-0.0003	57.80	64.70
9	12:04	12:24	25.70	25.93	25.76	0.17	3.33	3.50	3.80	-0.3	0.0324	0.0330	-0.0006	54.59	61.48
10	12:35	12:55	**25.33**	**25.64**	**24.40**	**1.24**	3.31	3.47	4.00	-0.5	**0.0320**	**0.0310**	**0.0010**	50.77	57.63
		AVERAGE	–	25.80	25.76	0.04	–	3.45	3.79	-0.3	0.0321	0.0327	-0.0005	54.13	61.18
		STDS	–	0.40	0.78	0.46	–	0.04	0.15	0.13	0.00049	0.00071	0.00028	–	–
		n	9				9				9				
		Full Scale	49.9				21.05				-				
		t₀.₉₇₅	2.306				2.306				2.306				
		I d I	0.04				0.34				0.0005				
		I cc I	0.35				0.10				0.0002				
		Bias present? (Idl > Iccl)	no bias				bias present				bias present				
		Bias Factor	1.00				0.91				0.98				
		Relative Accuracy (20% limit)	1.5%				12.6%				2.3%				

Notes:
RM = Reference Method (RWDI measurements)
PEMS = Predictive Emission Monitor System (GM data)
di = Difference between PMS and RM for each point
n = number of tests
I d I = Absolute mean difference between the PEMS and RM results
Bolded test runs were not used in the RA calculation

Table 5: EU-BOILER3 - RATA Results

Date: Tuesday, March 14, 2023

Test	RWDI Time Start Time	RWDI Time End Time	NOx RM (dppm)	NOx RM (corppm)	NOx PEMS (ppm)	NOx di (ppm)	O₂ RM (d%)	O₂ RM (cor%)	O₂ PEMS (%)	O₂ di (%)	Emission Rate RM (lb/MMBTU)	Emission Rate PEMS (lb/MMBTU)	Emission Rate di (lb/MMBTu)	Load Steam (klb/hr)	Heat Input (MMBTU/hr)
1	8:00	8:20	33.55	33.99	33.88	0.11	3.37	3.47	3.80	-0.3	0.0424	0.0430	-0.0006	53.42	59.59
2	8:30	8:50	33.71	33.93	33.89	0.04	3.40	3.54	3.80	-0.3	0.0425	0.0430	-0.0005	53.39	59.64
3	9:06	9:26	33.83	33.98	33.90	0.08	3.40	3.54	3.80	-0.3	0.0426	0.0430	-0.0004	53.40	59.64
4	9:38	9:58	33.85	34.04	33.91	0.13	3.40	3.53	3.80	-0.3	0.0426	0.0430	-0.0004	53.35	59.65
5	10:07	10:27	33.96	34.15	33.90	0.25	3.39	3.54	3.80	-0.3	0.0428	0.0430	-0.0002	53.20	59.66
6	10:36	10:56	34.09	34.27	33.90	0.37	3.38	3.53	3.80	-0.3	0.0429	0.0430	-0.0001	53.29	59.66
7	11:07	11:27	34.19	34.71	33.90	0.81	3.39	3.53	3.80	-0.3	0.0434	0.0430	0.0004	53.40	59.74
8	11:38	11:58	34.03	34.85	33.90	0.95	3.38	3.52	3.80	-0.3	0.0436	0.0430	0.0006	53.36	59.63
9	12:09	12:29	34.19	35.00	33.91	1.09	3.37	3.51	3.80	-0.3	0.0437	0.0430	0.0007	53.31	59.63
10	12:40	13:00	**34.29**	**35.22**	**33.91**	**1.31**	**3.37**	**3.52**	**3.80**	**-0.3**	**0.0440**	**0.0430**	**0.0010**	53.18	59.65
		AVERAGE	—	34.32	33.90	0.43	—	3.52	3.80	-0.3	0.0429	0.0430	-0.0001	53.33	59.65
		STDS	—	0.42	0.01	0.41	—	0.02	0.00	0.02	0.00052	0.00000	0.00052	—	—

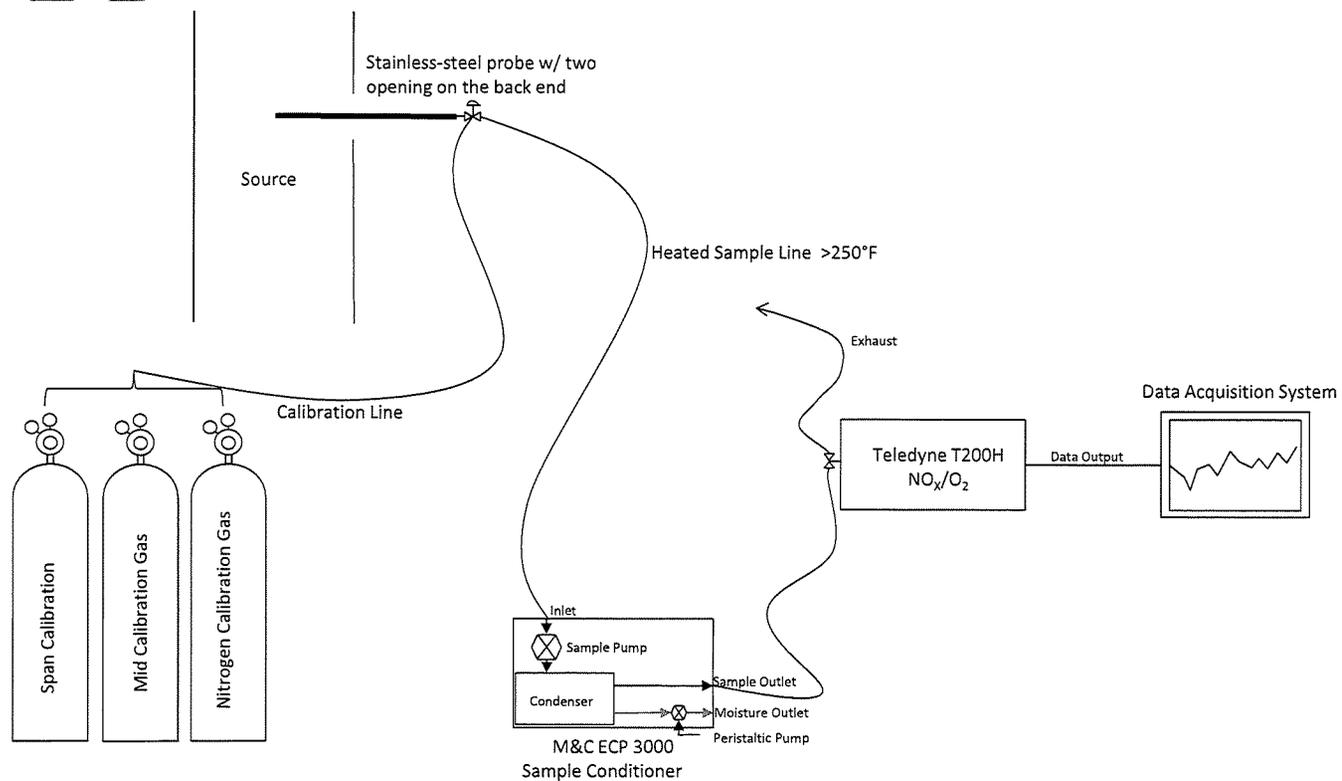|				
n	9		9	9
Full Scale	49.9		21	-
t₀.₉₇₅	2.306		2.306	2.306
I d I	0.43		0.28	0.0001
I cc I	0.32		0.02	0.0004
Bias present? (IdI > Iccl)	bias present		bias present	bias present
Bias Factor	1.01		0.93	1.00
Relative Accuracy (20% limit)	2.2%		8.4%	1.1%

Notes:
RM = Reference Method (RWDI measurements)
PEMS = Predictive Emission Monitor System (GM data)
di = Difference between PEMS and RM for each point
n = number of tests
I d I = Absolute mean difference between the PEMS and RM results
Bolded test runs were not used in the RA calculation

FIGURES

Figure No. 1: USEPA Method 3A and 7E Schematic

Stainless-steel probe w/ two opening on the back end

Source

Heated Sample Line >250°F

Exhaust

Calibration Line

Data Acquisition System

Teledyne T200H
NO_X/O_2

Data Output

Span Calibration

Mid Calibration Gas

Nitrogen Calibration Gas

Inlet

Sample Pump

Condenser

Sample Outlet

Moisture Outlet

Peristaltic Pump

M&C ECP 3000
Sample Conditioner

USEPA Method 3A and 7E

General Motors, LLC
GM Technical Center

Warren, Michigan

Project# 2302580

Date: March 14 - 16, 2023