FINAL REPORT

PACKAGING CORPORATION OF AMERICA

FILER CITY, MICHIGAN

2024 RELATIVE ACCURACY TEST AUDIT (RATA) TESTING: EUBOILER2 AND EUBOILER4A

RWDI #2402009

August 12, 2024

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by Packaging Corporation of America (PCA) to conduct a Relative Accuracy Testing Audit (RATA) at the PCA Filer City Mill location at 2246 Udell Street located in Filer City, Michigan. The RATA was completed from June 19th to 20th, 2024, on EUBOILER2 and EUBOILER4A for Nitrogen Oxides (NO_x) and Oxygen (O_2). EUBOILER5 for NO_x, O_2, and Carbon Monoxide (CO) was completed on June 18th, 2024 and is provided under separate cover.

Executive Summary Table i: Summary of RATA Results - EU-BOILER2 and EU-BOILER4A

Parameter	EUBOILER2	EUBOILER4A	Limit
Oxides of Nitrogen Concentration Absolute Difference (ppmvd)	0.04	3.54	--
Oxides of Nitrogen Concentration Relative Accuracy	0.5%	6.7%	20%
Oxides of Nitrogen Emission Rate Absolute Difference (lb/MMBtu)	0.0013	0.0056	N/A
Oxides of Nitrogen Emission Rate Relative Accuracy	3.0%	7.9%	20%
Oxygen (O_2) Concentration Absolute Difference (%)	0.27%	0.18%	1%
Oxygen (O_2) Concentration Relative Accuracy	5.4%	4.3%	--

The RATA is conducted annually and is a requirement under the facility permit to install (PTI) 209-18A. NO_x and O_2 measurements were collected using U.S. EPA Methods 3A, 7E and 19 under 40 CFR, Part 60 and Performance Specifications (PS) 2 and 4 stipulated in 40 CFR, Part 60.

The CEMS audited during this testing program include oxides of nitrogen (NO_x) and oxygen (O_2). Data was collected for twelve (12) 21-minute periods on each of the boilers and of the 12 runs, nine (9) were used for validation purposes of each boilers operations as per PS-2.

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1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by Packaging Corporation of America (PCA) to conduct a Relative Accuracy Testing Audit (RATA) at the PCA Filer City Mill location at 2246 Udell Street located in Filer City, Michigan.

The RATA was completed from June 19th-20th. 2024, on EUBOILER2 and EUBOILER4A for Nitrogen Oxides (NO_x) and Oxygen (O_2). EUBOILER5 for NO_x, O_2, and Carbon Monoxide (CO) was completed on June 18th, 2024 and is provided under separate cover.

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The CEMS audited during this testing program include oxides of nitrogen (NO_X) and oxygen (O_2). Data was collected for twelve (12) 21-minute periods on each of the boilers and nine (9) of the runs were used for validation purposes.

Table 1.2: Test Personnel

Company	Position	Individual
RWDI	Project Manager	Steve Smith
RWDI	Technical Director	Brad Bergeron
RWDI	Senior Field Technician	Dave Trahan
RWDI	Field Technician	Kate Strang
PCA	Environmental Manager	Zebadiah Jones

2 PLANT AND SOURCE DESCRIPTION

2.1 Plant Overview

Boiler 2 – A maximum heat input rating of 186 MMBTU/hr. and is equipped with low NO_x burners. The boiler was firing natural gas. Non-condensable gases (NCGs) from the low volume, high concentration (LVHC) system was primarily routed to Boiler 1 for destruction, with Boiler 2 and Boiler 4A as backup.

Boiler 4A – A natural gas and biogas fired Babcock and Wilcox Model Number FM120-97 boiler. The boilers maximum heat input rating is 227 MMBTU/hr. and is equipped with low NO_x burners. NCGs from the LVHC system were primarily routed to Boiler 1 for destruction, with Boiler 2 and 4A as backup.

Table 2.1.1: Summary of Emission Unit Descriptions

Emission Unit Description	EUBOILER2	EUBOILER4A
Capacity	EUBOILER2 – 186 MMBTU/hr. and EUBOILER4A – 227 MMBTU/hr.	
Parameter Tested	Oxygen and Nitrogen Oxides NO_x lb./MMBTU must be less than 20% RA	
Testing Monitoring Methods	EPA Method 3A and 7E	

2.2 Continuous Emission Monitors Specifications

The CEMS records data continuously and generates reports in compliance with 40 CFR Part 60 regulations. These reports were printed at the conclusion of each test. This data can be found in **Appendices A-B** for each boiler.

Table 2.2.1: Summary of RWDI Analyzers

Source	Monitor Manufacturer/Model Number
Boiler 2	NOx - Thermo Scientific 42i-HL Serial No. 117034009
Boiler 4	NOx - Thermo Scientific 42i-IS Serial No. 1202751582

3 REFERENCE METHOD SAMPLING

The following section provides an overview of the sampling methodologies employed by the sampling program. The table below summarizes the reference methods used in this study.

Table 3.1: Summary of Sampling Methodologies

Parameter	Reference Method
RATA Methodology and Calculations	U.S EPA Performance Specifications 2 and 4
Oxides of Nitrogen	U.S. EPA Method 7E
Oxygen	U.S. EPA Method 3A
Nitrogen Oxide Emission Rates	U.S. EPA Method 19

3.1 Relative Accuracy Testing Audit

To satisfy the NO_x data accuracy requirement, the relative accuracy result for a total of twelve (12) performance test runs were completed of which nine (9) were used to meet the criteria outlined in section 8.4.4 of the US EPA PS 2 for NO_x. 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 sample for 7 minutes in duration for each RATA run. Prior to the RATA, a NO_2-to-NO conversion efficiency check was performed. The criteria of ≥ 90% was met. RWDI used a heated line over 250°F to avoid any condensation. All NO_x, CO, and O_2 data recorded was provided to EGLE.

3.1.1 Method Listing

The following test methods were used during 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.

3.2 O_2 (EPA Method 3A) and NOx (EPA Method 7E)

Zero and upscale calibration checks were conducted both before and after each test run to quantify measurement system calibration drift and sampling system bias. Upscale was 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 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 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 delivered the sample gases from the stack to the CEM 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 cools the gas to approximately 35°F to remove the stack gas moisture. After passing through the condenser, the dry gas enters a Teflon-head diaphragm pump and a flow control panel, which delivers the gas in series to the O_2, and NO_x analyzers. Each of these analyzers measured the respective gas concentrations on a dry volumetric basis.

3.3 Gas Dilution (US EPA Method 205)

Calibration gas was mixed using an Environics 4040 Gas Dilution System. 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. The calibration is done yearly, and the records are included in **Appendix C.** A multi-point EPA Method 205 check was executed in the field prior to testing to ensure accurate gas-mixtures. The gas dilution system consisting of calibrated orifices or mass flow controllers and dilutes a high-level calibration gas to within ±2% of predicted values. The gas divider is capable of diluting gases at set increments and were be evaluated for accuracy in the field in accordance with US EPA Method 205 "*Verification of Gas Dilution Systems for Field Instrument Calibrations*". The gas divider dilutions were measured to evaluate that the responses are within ±2% of predicted values. In addition, a certified mid-level calibration gas within ±10% of one of the tested dilution gases was introduced into an analyzer to ensure the response of the gas calibration is within ±2% of gas divider dilution concentration.

3.4 Nitrogen Oxides Emission Rate Calculation (EPA Methods 19)

3.4.1 Nitrogen Oxide Emission Rate Calculation

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 rate based on Oxygen concentrations and appropriate F-factors. Table 19-1 was used to determine the conversion factor for NO_x concentration (1.194×10^{-7}). Table 19-2 was used for the F-Factor (natural gas 8,710 dscf/10^6 BTU) on EUBOILER2. Due to the mixed fuels used in EUBOILER5, the F-factor calculated by PCA based on a minute-by-minute fuel ratio was used in lieu of the Table 19-2 F-factor. These F-factors can be found in **Appendix C.**

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

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 (%)

3.5 Quality Assurance and Quality Control Procedures

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.

Quality control procedures specific to the CEMS monitoring included linearity checks, to determine the instrument performance, and reproducibility checks prior to its use in the field. 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 (zero) air 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 were recorded regularly during the tests. Calibration certifications can be found in **Appendix C.** All field notes related to the testing can be found in **Appendix D.**

4 BOILER OPERATING CONDITIONS

Operating conditions during the sampling were monitored by PCA 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 RESULTS

The respective results for each boiler were within the applicable limits.

Table 5.1: Summary of RATA Results – EU-BOILER2 and EU-BOILER4A

Parameter	EUBOILER2	EUBOILER4A	Limit
Oxides of Nitrogen Concentration Absolute Difference (ppmvd)	0.04	3.54	--
Oxides of Nitrogen Concentration Relative Accuracy	0.5%	6.7%	20%
Oxides of Nitrogen Emission Rate Absolute Difference (lb/MMBtu)	0.0013	0.0056	N/A
Oxides of Nitrogen Emission Rate Relative Accuracy	3.0%	7.9%	20%
Oxygen (O_2) Concentration Absolute Difference (%)	0.27%	0.18%	1%
Oxygen (O_2) Concentration Relative Accuracy	5.4%	4.3%	--

6 CONCLUSIONS

The RATA is conducted annually and is a requirement under the facility permit to install (PTI) 209-18A. NO_x and O_2 measurements were collected using U.S. EPA Methods 3A, 7E, and 19 under 40 CFR, Part 60 and Performance Specifications (PS) 2 and 4 stipulated in 40 CFR, Part 60.

EU-BOILER2 and EU-BOILER4A met the criteria as outlined in Performance Specification 2.

TABLES

Table 1 - Boiler 2 RATA 2024 Results

Date: Wednesday, June 19, 2024

Test	RWDI Time		NOx				O_2				Emission Rate			Natural Gas
	Start Time	End Time	RM (dppm)	RM cor	CEMS (ppm)	di (ppm)	RM (d%)	RM (cor%)	CEMS (%)	di (%)	RM (lb/MMBTU	CEMS (lb/MMBTU)	di (lb/min)	(KSCFH)
1	7:52	8:12	~~35.01~~	~~34.84~~	~~36.20~~	~~-1.36~~	5.68	5.78	5.95	-0.17	~~0.0501~~	~~0.0530~~	~~-0.0029~~	93.03
2	8:22	8:42	37.72	38.07	38.50	-0.43	5.78	5.90	6.13	-0.23	0.0552	0.0570	-0.0018	89.82
3	8:51	9:11	~~45.12~~	~~45.73~~	~~46.40~~	~~-0.67~~	~~6.73~~	~~6.86~~	~~7.38~~	~~-0.52~~	~~0.0708~~	~~0.0750~~	~~-0.0042~~	89.80
4	9:19	9:39	44.79	45.17	45.20	-0.03	~~6.48~~	~~6.61~~	~~7.02~~	~~-0.41~~	~~0.0687~~	~~0.0710~~	~~-0.0023~~	89.79
5	9:46	10:06	43.64	43.90	44.00	-0.10	~~6.27~~	~~6.39~~	~~6.78~~	~~-0.39~~	0.0658	0.0680	-0.0022	89.82
6	10:12	10:32	42.08	42.33	42.20	0.13	6.05	6.16	6.54	-0.38	0.0624	0.0640	-0.0016	89.82
7	10:39	10:59	41.36	41.56	41.60	-0.04	5.92	6.03	6.38	-0.35	0.0607	0.0620	-0.0013	89.76
8	11:05	11:25	40.18	40.48	40.60	-0.12	5.82	5.94	6.24	-0.30	0.0588	0.0600	-0.0012	89.62
9	11:34	11:54	39.48	39.72	39.90	-0.18	5.78	5.88	6.13	-0.25	0.0575	0.0590	-0.0015	89.47
10	12:01	12:21	39.60	39.84	39.80	0.04	5.78	5.88	6.14	-0.26	0.0576	0.0590	-0.0014	89.34
11	12:29	12:49	~~38.98~~	~~39.56~~	~~39.00~~	~~0.56~~	5.73	5.81	6.04	-0.23	0.0570	0.0570	0.0000	89.16
12	12:58	13:18	38.52	39.32	38.90	0.42	5.71	5.77	6.02	-0.25	0.0565	0.0570	-0.0005	89.07
	AVERAGE		--	41.15	41.19	-0.04	--	5.91	6.17	-0.27	0.0591	0.0603	-0.0013	89.88
	STDS		--	2.30	2.28	0.23	--	0.13	0.19	0.06	0.0034	0.0037	0.0007	--
	n		9				9				9			
	Full Scale		100				21.05				-			
	$t_{0.975}$		2.306				2.306				2.306			
	I d I		0.04				0.27				0.0013			
	I cc I		0.18				0.05				0.0005			
	Relative Accuracy (20% limit)		**0.5%**				**5.4%**				**3.0%**			

Notes:

RM = Reference Method (RWDI measurements)
CEMS = Continuous Emission Monitors
di = Difference between CEMS and RM for each point
n = number of tests
I d I = Absolute mean difference between the CEMS and RM results
I cc I = Confidence coefficient
VOID

Table 2 - Boiler 4 RATA 2024 Results

Date: Thursday, June 20, 2024

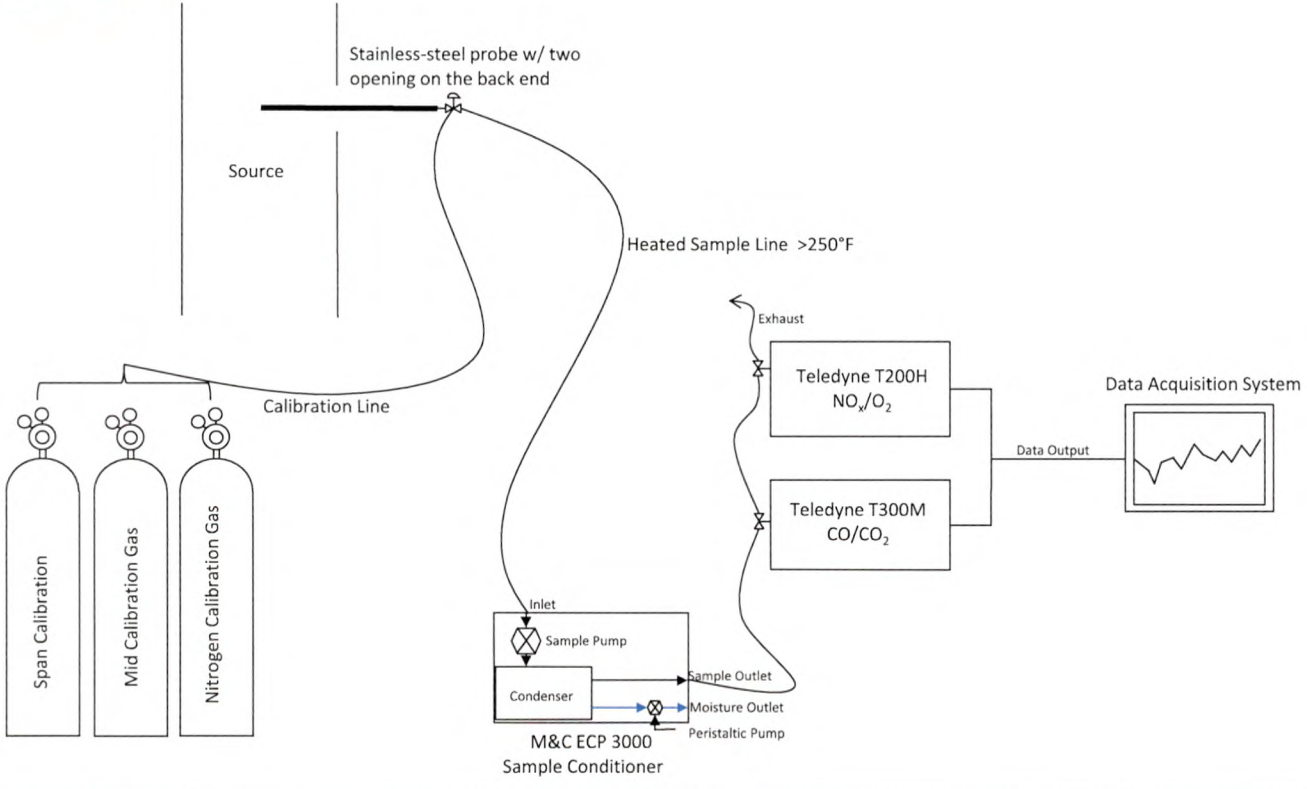
Test	RWDI Time		NOx				O_2				Emission Rate			Total Heat Input	Combined F-Factor
	Start Time	End Time	RM (dppm)	RM cor	CEMS (ppm)	di (ppm)	RM (d%)	RM (cor%)	CEMS (%)	di (%)	RM (lb/MMBTU	CEMS (lb/MMBTU)	di (lb/min)	(MMBTU)	(DSCF/MMBTU)
1	7:48	8:08	58.15	57.53	54.7	2.83	~~4.57~~	~~4.57~~	~~4.30~~	~~0.27~~	0.0766	0.0720	0.0046	100.90	8,710
2	8:17	8:37	58.43	57.37	54.7	2.67	~~4.54~~	~~4.54~~	~~4.91~~	~~-0.37~~	0.0762	0.0720	0.0042	100.60	8,710
3	8:47	9:07	58.95	58.84	55.1	3.74	4.38	4.48	4.33	0.15	0.0779	0.0720	0.0059	102.30	8,710
4	9:16	9:36	~~58.77~~	~~58.94~~	~~54.9~~	~~4.04~~	4.39	4.53	4.32	0.21	0.0783	0.0720	0.0063	102.20	8,710
5	9:43	10:03	58.58	58.41	54.6	3.81	4.40	4.51	4.33	0.18	0.0775	0.0720	0.0055	102.20	8,710
6	10:11	10:31	58.45	58.18	54.4	3.78	4.43	4.54	4.35	0.19	~~0.0773~~	~~0.0710~~	~~0.0063~~	102.20	8,710
7	10:39	10:59	58.13	57.90	54.2	3.70	~~4.41~~	~~4.53~~	~~4.30~~	~~0.23~~	0.0769	0.0710	0.0059	102.10	8,710
8	11:06	11:26	~~58.01~~	~~58.48~~	~~54.3~~	~~4.18~~	4.45	4.58	4.37	0.21	~~0.0779~~	~~0.0710~~	~~0.0069~~	102.00	8,710
9	11:33	11:53	~~57.05~~	~~57.59~~	~~53.2~~	~~4.39~~	4.42	4.54	4.36	0.18	~~0.0765~~	~~0.0700~~	~~0.0065~~	102.00	8,710
10	12:00	12:20	57.01	56.99	53.3	3.69	4.43	4.55	4.38	0.17	0.0758	0.0700	0.0058	102.00	8,710
11	12:27	12:47	57.06	57.00	53.4	3.60	4.43	4.55	4.38	0.17	0.0758	0.0700	0.0058	101.90	8,710
12	12:54	13:14	56.91	57.20	53.2	4.00	4.46	4.59	4.40	0.19	0.0762	0.0700	0.0062	101.80	8,710
		AVERAGE	--	57.71	54.18	3.54	--	4.54	4.36	0.18	0.0768	0.0712	0.0056	101.85	8,710
		STDS	--	0.66	0.70	0.46	--	0.03	0.03	0.02	0.0009	0.0010	0.0007	--	--
		n	9				9				9				
		Full Scale	100				21.13				-				
		$t_{0.975}$	2.306				2.306				2.306				
		I d I	3.54				0.18				0.0056				
		I cc I	0.35				0.01				0.0005				
		Relative Accuracy (20% limit)	**6.7%**				**4.3%**				**7.9%**				

Notes:

RM = Reference Method (RWDI measurements)
CEMS = Continuous Emission Monitors
di = Difference between CEMS and RM for each point
n = number of tests
I d I = Absolute mean difference between the CEMS and RM results
I cc I = Confidence coefficient
VOID

FIGURES

Figure No. 1: USEPA Method 3A,7E,10 Schematic



USEPA Method 3A,7E,10

Packaging Corporation of America

Filer City, Michigan

Date: June 17th, 2024