Source Test Report for
2022 Initial Certification CEMS RATA Testing

Boiler No. 10 (EUBOILER#10)

Graphic Packaging International, LLC
Kalamazoo, Michigan

Prepared For:

Graphic Packaging International, LLC
1500 North Pitcher Street
Kalamazoo, MI 49007

Prepared By:

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For Submission To:

Michigan Department of Environment, Great Lakes, and Energy
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AIR QUALITY SERVICES

STAC

Review and Certification

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project.

Signature: *John Nestor*   **Date:** 08 / 02 / 2022

Name: John Nestor   **Title:** District Manager

I have reviewed, technically and editorially, details, calculations, results, conclusions, and other appropriate written materials contained herein. I hereby certify that, to the best of my knowledge, the presented material is authentic, accurate, and conforms to the requirements of the Montrose Quality Management System and ASTM D7036-04.

Signature: *robert j lisy jr*   **Date:** 08 / 03 / 2022

Name: Robert J. Lisy, Jr.   **Title:** Reporting Hub Manager

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1.0 Introduction

1.1 Summary of Test Program

Graphic Packaging International, LLC (Graphic Packaging) (State Registration No.: B1678) contracted Montrose Air Quality Services, LLC (Montrose) to perform the Initial Certification Relative Accuracy Test Audit (RATA) for the Continuous Emission Monitoring Systems (CEMS) associated with Boiler No. 10 (EUBOILER#10) at the Graphic Packaging facility located in Kalamazoo, Michigan. Testing was performed on June 8, 2022, for the purpose of satisfying the emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Permit-to-Install (PTI) No. 133-19A by evaluating the quality of the emissions data produced by Graphic Packaging's CEMS in accordance with 40 CFR Part 60, Appendices B and F.

The specific objectives were to:

- Verify the relative accuracy (RA) of the EUBOILER#10 CEMS for nitrogen oxides (NO_x) emissions (lb/MMBtu) (as NO_2), NO_x concentration (ppmvw), and carbon dioxide (CO_2) concentration (%-Wet) in accordance with Performance Specifications 2 (PS-2) and 3 (PS-3)

- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

Table 1-1
Summary of Test Program

Test Date(s)	Unit ID/ Source Name	Activity/Parameters	Test Methods	No. of Runs	Duration (Minutes)
6/8/2022	EUBOILER#10 CEMS	CO_2	EPA 3A	10	21
6/8/2022	EUBOILER#10 CEMS	Moisture	EPA 4	4	75, 30
6/8/2022	EUBOILER#10 CEMS	NO_x	EPA 7E	10	21

For the Part 60 RATA, of the ten (10) RATA runs performed, nine were used to determine the RA of the EUBOILER#10 CEMS.

To simplify this report, a list of Units and Abbreviations is included in Appendix C.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The RA test results are summarized and compared to their respective regulatory requirements in Table 1-2. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-3. The tests were conducted according to the test plan dated April 4, 2022, and revised April 11, 2022, that was submitted to EGLE.

Table 1-2
Summary of Part 60 RATA Results – EUBOILER#10 CEMS

June 8, 2022

Parameter/Units	Regulatory Reference	RA	Allowable
Part 60			
Carbon Dioxide (CO$_2$)			
% volume wet	PS-2, PS-3	0.00	≤ 1.0% CO$_2$
Nitrogen Oxides (NO$_x$)			
ppmvw	PS-2	10.9	≤ 20.0% of RM
lb/MMBtu (as NO$_2$)	PS-2	10.2	≤ 20.0% of RM

1.2 Key Personnel

A list of project participants is included below:

Facility Information

Source Location:	Graphic Packaging International, LLC
	1500 North Pitcher Street
	Kalamazoo, MI 49007
Project Contact:	Steven Smock
Role:	Environmental Manager
Company:	Graphic Packaging
Telephone:	269-383-5453
Email:	steven.smock@graphicpkg.com

Agency Information

Regulatory Agency:	EGLE
Agency Contact:	Lindsey Wells
Telephone:	517-282-2345
Email:	WellsL8@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC	
Contact:	Robert J. Lisy, Jr.	John Nestor
Title:	Reporting Hub Manager	District Manager
Telephone:	440-262-3760	248-548-8070
Email:	rlisy@montrose-env.com	jonestor@montrose-env.com

Test personnel and observers are summarized in Table 1-3.

Table 1-3
Test Personnel and Observers

Name	Affiliation	Role/Responsibility
John Nestor	Montrose	District Manager, QI
Shawn Jaworski	Montrose	Field Project Manager, QI
Scott Dater	Montrose	Field Technician, QI
Steven Smock	Graphic Packaging	Observer/Client Liaison/Test Coordinator
Lindsey Wells	EGLE	Observer

2.0 Plant and Sampling Location Descriptions

2.1 Process Description, Operation, and Control Equipment

Graphic Packaging International operates two natural gas-fired boilers (EUBOILER#10 and EUBOILER#11) to generate steam for use in facility operations. EUBOILER#10 is equipped with low NO_x burners and flue gas recirculation. It has a maximum heat input rate of 311 MMBtu/hr and was in operation for this test event.

2.2 Facility and Reference Method (RM) CEMS Descriptions

The Facility CEMS analyzer information is presented in Table 2-1, and the RM CEMS analyzer information is presented in Table 2-2.

Table 2-1
Facility CEMS Information

Analyzer Type	Manufacturer	Model No.	Serial No.	Range
CO_2	Thermo Scientific	iQ Series 410	1202759352	0-25%
NO_x	Thermo Scientific	iQ Series 42	1202759350	0-100 ppm

Table 2-2
RM CEMS Information

Analyzer Type	Manufacturer	Model No.	Serial No.	Range
CO_2	Teledyne	T802	197	0-20.59%
NO_x	Teledyne	T200H	84	0-90.83 ppm

2.3 Flue Gas Sampling Location

Information regarding the sampling location is presented in Table 2-3.

Table 2-3
Sampling Location

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	Number of Traverse Points
EUBOILER#10 Exhaust Stack (SVBLR10)	62.3	140.0 / 2.2	310.0 / 5.0	Flow: 12 (6/port) Gaseous: 3

The sampling location was verified in the field to conform to EPA Method 1. Acceptable cyclonic flow conditions were confirmed prior to testing using EPA Method 1, Section 11.4. See Appendix A.1 for more information.

2.4 Operating Conditions and Process Data

The CEMS RATA was performed while EUBOILER#10 was operating at greater than 50% of permitted capacity conditions.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The Facility CEMS and process data that was provided is presented in Appendix B. Data collected includes the following parameters:

- Facility CEMS data for each 21-minute RATA run
- Steam flow rate, lb/hr
- Gas flow rate, kscfh
- Heat input rate, MMBtu/hr

3.0 Sampling and Analytical Procedures

3.1 Test Methods

The test methods for this test program have been presented in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 1, Sample and Velocity Traverses for Stationary Sources

EPA Method 1 is used to assure that representative measurements of volumetric flow rate are obtained by dividing the cross-section of the stack or duct into equal areas, and then locating a traverse point within each of the equal areas. Acceptable sample locations must be located at least two stack or duct equivalent diameters downstream from a flow disturbance and one-half equivalent diameter upstream from a flow disturbance.

The sample port and traverse point locations are detailed in Appendix A.

3.1.2 EPA Method 3A, Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 3A is an instrumental test method used to measure the concentration of O_2 and CO_2 in stack gas. The effluent gas is continuously or intermittently sampled and conveyed to analyzers that measure the concentration of O_2 and CO_2. The performance requirements of the method must be met to validate data.

The typical sampling system is detailed in Figure 3-2.

3.1.3 EPA Method 4, Determination of Moisture Content in Stack Gas

EPA Method 4 is a manual, non-isokinetic method used to measure the moisture content of gas streams. Gas is sampled at a constant sampling rate through a probe and impinger train. Moisture is removed using a series of pre-weighed impingers containing methodology-specific liquids and silica gel immersed in an ice water bath. The impingers are weighed after each run to determine the percent moisture.

The typical sampling system is detailed in Figure 3-1.

Figure 3-1
EPA Method 4 Sampling Train
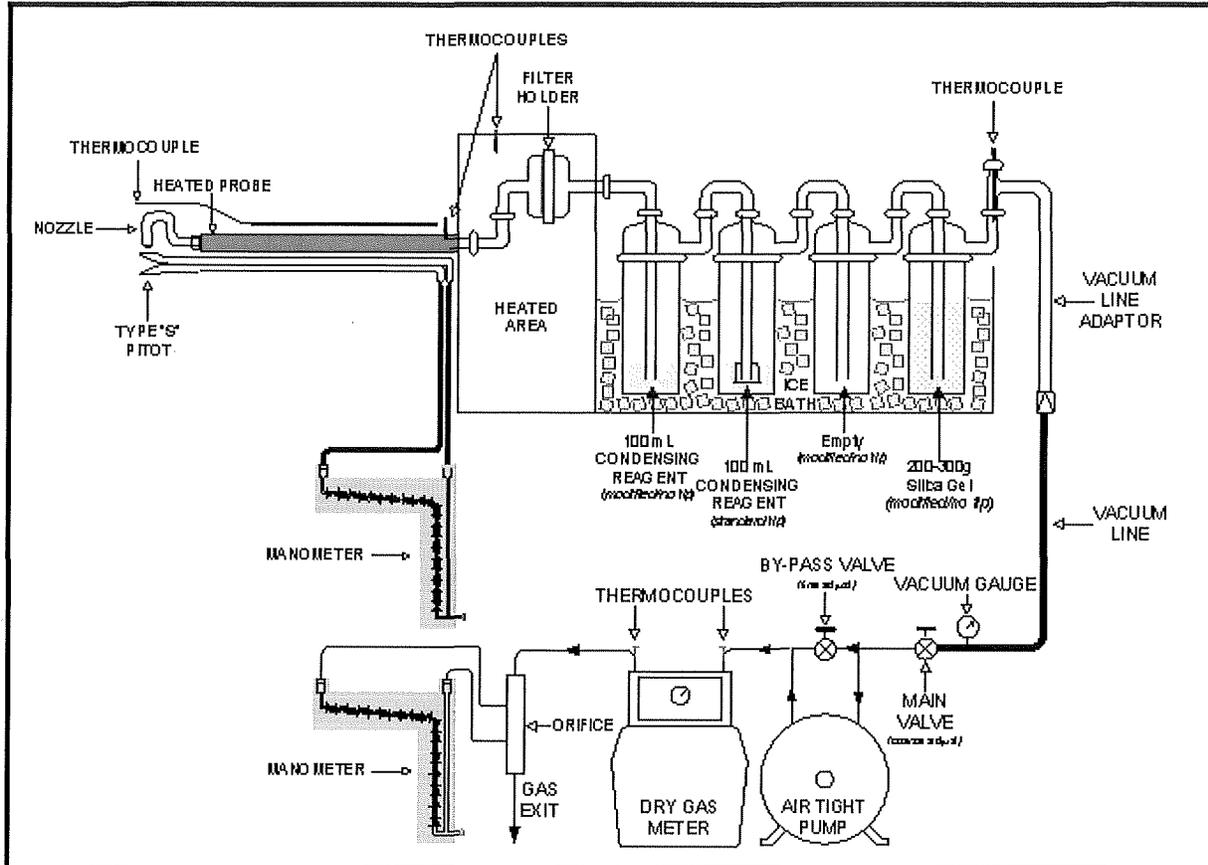
3.1.4 EPA Method 7E, Determination of Nitrogen Oxides Emissions from Stationary Source (Instrumental Analyzer Procedure)

EPA Method 7E is an instrumental test method used to continuously measure emissions of NO_x as NO_2. Conditioned gas is sent to an analyzer to measure the concentration of NO_x. NO and NO_2 can be measured separately or simultaneously together but, for the purposes of this method, NO_x is the sum of NO and NO_2. The performance requirements of the method must be met to validate the data.

The typical sampling system is detailed in Figure 3-2.

Figure 3-2
EPA Method 3A and 7E Sampling Train
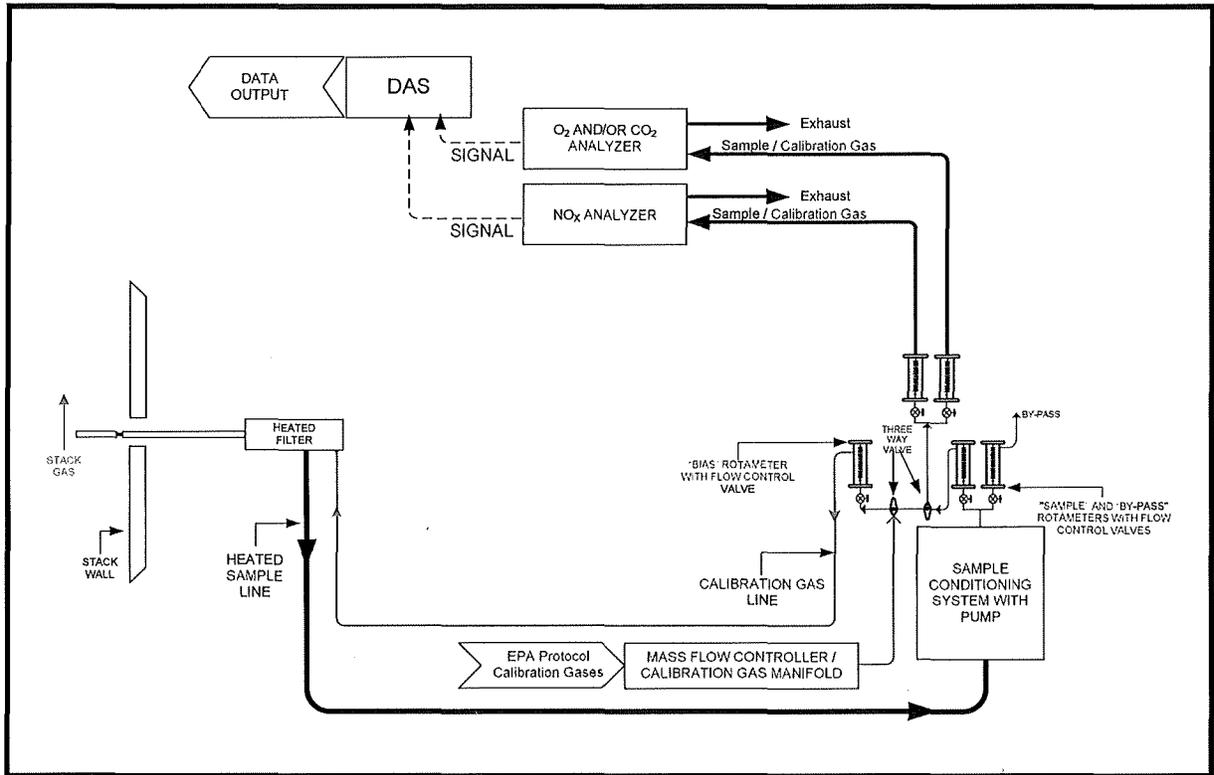
3.1.5 EPA Method 19, Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

EPA Method 19 is used to calculate mass emission rates in units of lb/MMBtu. EPA Method 19, Table 19-2 contains a list of assigned fuel factors for different types of fuels, which can be used for these calculations.

3.1.6 EPA Performance Specification 2, Specifications and Test Procedures for SO_2 and NO_x for Continuous Emission Monitoring Systems in Stationary Sources

EPA Performance Specification 2 is a specification used to evaluate the acceptability of SO_2 and NO_x CEMS. The evaluation is conducted at the time of installation or soon after, and whenever specified in the regulations. The CEMS may include, for certain stationary sources, a diluent (O_2 or CO_2) monitor. The RA and CD tests are conducted to determine conformance of the CEMS to the specification.

3.1.7 EPA Performance Specification 3, Specifications and Test Procedures for O_2 and CO_2 Continuous Monitoring Systems in Stationary Sources

EPA Performance Specification 3 is a specification used to evaluate the acceptability of O_2 and CO_2 CEMS. The evaluation is conducted at the time of installation or soon after, and whenever specified in the regulations. This specification applies to O_2 or CO_2 monitors that are not included under PS-2. The RA and CD tests are conducted to determine conformance of the CEMS to the specification.

3.2 Process Test Methods

The test plan did not require that process samples be collected during this test program; therefore, no process sample data are presented in this test report.

4.0 Test Discussion and Results

4.1 Field Test Deviations and Exceptions

The test plan submitted to EGLE was based on the Facility CEMS recording O_2 (%-Dry) and NO_x (ppmvd). However, once on-site, it was determined that the Facility CEMS recorded CO_2 (%-Wet) and NO_x (ppmvw). EPA Method 4 was added to the project to convert the measured RM concentrations to a wet-basis.

4.2 Presentation of Results

The RA results are compared to the regulatory requirements in Table 1-2. The results of individual test runs performed are presented in Tables 4-1 through 4-3. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

Table 4-1
NO$_x$ (lb/MMBtu) RATA Results –
EUBOILER#10 CEMS

Run #	Date	Time	RM	CEMS	Difference	Run Used (Y/N)	Heat Input (MMBtu/hr)
1	6/8/2022	7:50-8:11	0.027	0.029	-0.002	Y	207.4
2	6/8/2022	8:20-8:41	0.028	0.029	-0.001	Y	209.5
3	6/8/2022	8:55-9:16	0.027	0.029	-0.002	Y	208.7
4	6/8/2022	9:30-9:51	0.026	0.029	-0.003	Y	203.5
5	6/8/2022	10:05-10:26	0.026	0.029	-0.003	Y	208.6
6	6/8/2022	10:35-10:56	0.028	0.029	-0.001	Y	206.7
7	6/8/2022	11:15-11:36	0.028	0.030	-0.002	Y	211.0
8	6/8/2022	11:50-12:11	0.028	0.030	-0.002	Y	210.2
9	6/8/2022	12:20-12:41	0.027	0.030	-0.003	Y	211.0
10	6/8/2022	12:55-13:16	0.026	0.030	-0.004	N	204.7
Averages			0.027	0.029	-0.002		208.5
Standard Deviation			0.0007				
Confidence Coefficient (CC)			0.0005				
Unit Load			Normal	>50% of maximum rated capacity			
RA based on mean RM value			10.2	%			

Table 4-2
NOx (ppmvw) RATA Results –
EUBOILER#10 CEMS

Run #	Date	Time	RM	CEMS	Difference	Run Used (Y/N)	Heat Input (MMBtu/hr)
1	6/8/2022	7:50-8:11	17.62	19.60	-1.98	Y	207.4
2	6/8/2022	8:20-8:41	18.60	19.60	-1.00	Y	209.5
3	6/8/2022	8:55-9:16	18.35	19.50	-1.15	Y	208.7
4	6/8/2022	9:30-9:51	17.47	19.50	-2.03	Y	203.5
5	6/8/2022	10:05-10:26	17.74	19.60	-1.86	Y	208.6
6	6/8/2022	10:35-10:56	18.48	19.70	-1.22	Y	206.7
7	6/8/2022	11:15-11:36	18.61	19.90	-1.29	Y	211.0
8	6/8/2022	11:50-12:11	18.61	20.10	-1.49	Y	210.2
9	6/8/2022	12:20-12:41	18.06	20.50	-2.44	Y	211.0
10	6/8/2022	12:55-13:16	17.57	20.60	-3.03	N	204.7
Averages			18.17	19.78	-1.61		208.5
Standard Deviation			0.4876				
Confidence Coefficient (CC)			0.3748				
Unit Load			Normal	>50% of maximum rated capacity			
RA based on mean RM value			10.9	%			

Table 4-3
CO$_2$ (%-Wet) RATA Results –
EUBOILER#10 CEMS

Run #	Date	Time	RM	CEMS	Difference	Run Used (Y/N)	Heat Input (MMBtu/hr)
1	6/8/2022	7:50-8:11	8.24	8.30	-0.06	Y	207.4
2	6/8/2022	8:20-8:41	8.26	8.30	-0.04	Y	209.5
3	6/8/2022	8:55-9:16	8.35	8.30	0.05	Y	208.7
4	6/8/2022	9:30-9:51	8.29	8.30	-0.01	Y	203.5
5	6/8/2022	10:05-10:26	8.32	8.30	0.02	Y	208.6
6	6/8/2022	10:35-10:56	8.32	8.30	0.02	Y	206.7
7	6/8/2022	11:15-11:36	8.37	8.30	0.07	Y	211.0
8	6/8/2022	11:50-12:11	8.35	8.40	-0.05	Y	210.2
9	6/8/2022	12:20-12:41	8.38	8.40	-0.02	Y	211.0
10	6/8/2022	12:55-13:16	8.28	8.50	-0.22	N	204.7
Averages			8.32	8.32	0.00		208.5
Unit Load			Normal	>50% of maximum rated capacity			
RA based on | mean difference |			0.00	% as CO$_2$			

5.0 Internal QA/QC Activities

5.1 QA/QC Audits

Table 5-1 presents a summary of the gas cylinder information.

Table 5-1
Part 60 Gas Cylinder Information

Gas Type	Gas Concentrations	Cylinder ID	Expiration Date
CO_2, Balance N_2	10.09	CC469780	3/14/2030
CO_2, Balance N_2	20.59	CC21126	5/17/2029
NO_x, Balance N_2	49.94	ALM-066662	4/20/2023
NO_x, Balance N_2	90.83	CC194558	6/3/2029

EPA Method 3A and 7E calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks.

The NO_2 to NO converter efficiency check of the analyzer was conducted per the procedures in EPA Method 7E, Section 16.2.2. The conversion efficiency met the criteria.

5.2 QA/QC Discussion

All QA/QC criteria were met during this test program.

5.3 Quality Statement

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).
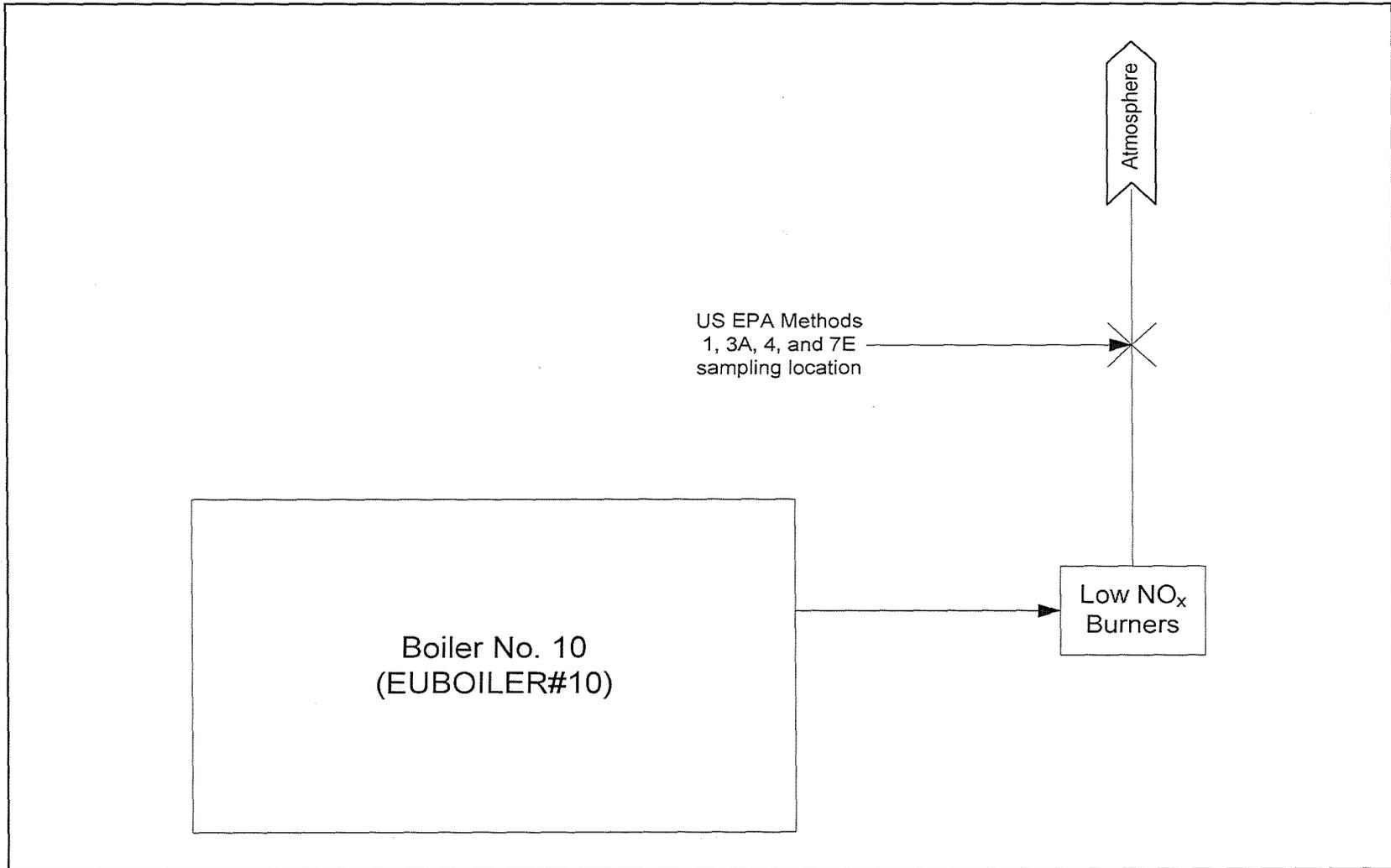
Appendix A
Field Data and Calculations

Appendix A.1
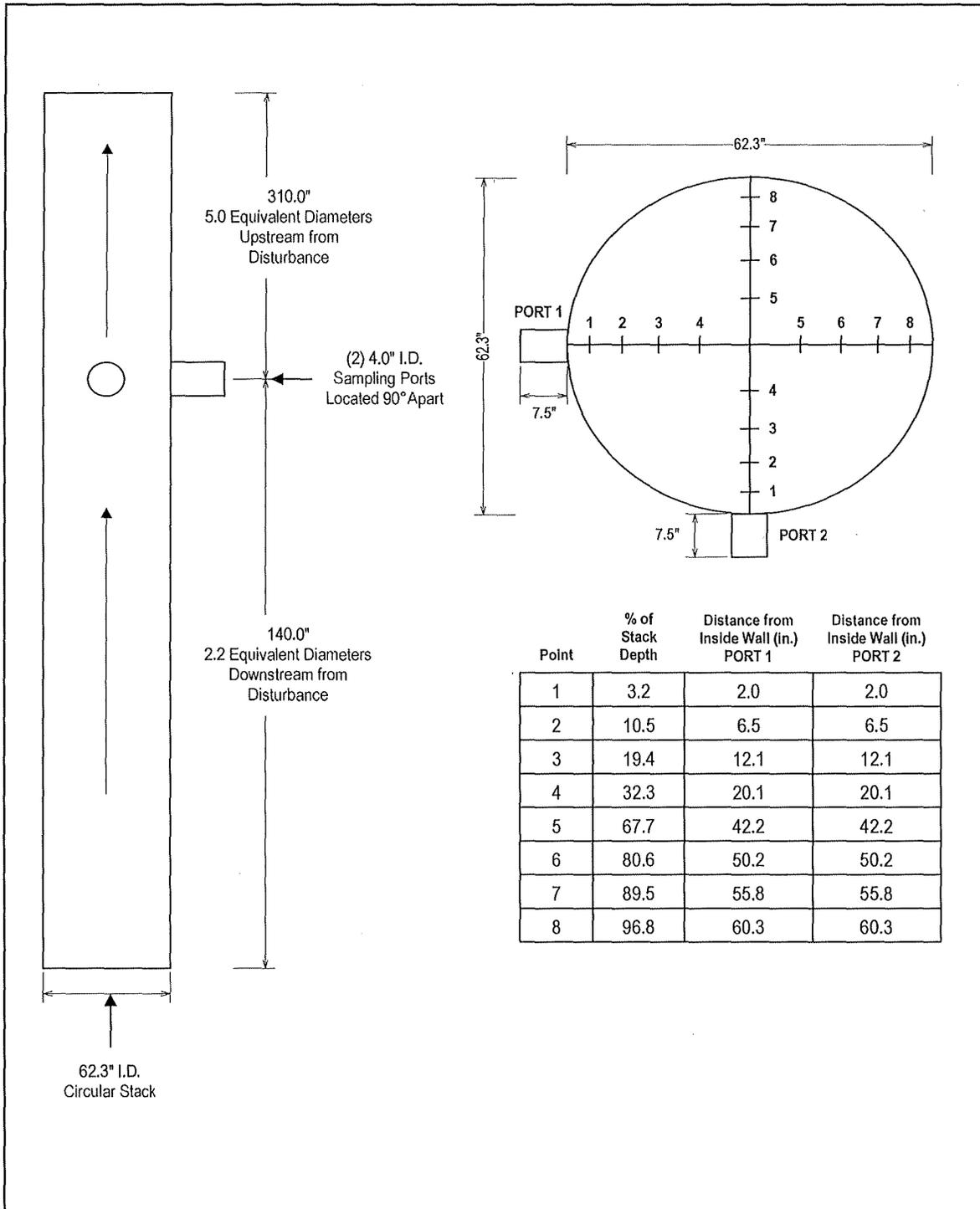# Sampling Locations

EUBOILER#10 SAMPLING LOCATION SCHEMATIC

US EPA Methods 1, 3A, 4, and 7E sampling location

Atmosphere

Low NO_x Burners

Boiler No. 10
(EUBOILER#10)

EUBOILER#10 EXHAUST STACK FLOW TRAVERSE POINT LOCATION DRAWING

310.0"
5.0 Equivalent Diameters
Upstream from
Disturbance

(2) 4.0" I.D.
Sampling Ports
Located 90° Apart

140.0"
2.2 Equivalent Diameters
Downstream from
Disturbance

62.3" I.D.
Circular Stack

62.3"

PORT 1

7.5"

7.5"   PORT 2

Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	3.2	2.0	2.0
2	10.5	6.5	6.5
3	19.4	12.1	12.1
4	32.3	20.1	20.1
5	67.7	42.2	42.2
6	80.6	50.2	50.2
7	89.5	55.8	55.8
8	96.8	60.3	60.3

EUBOILER#10 EXHAUST STACK CEMS TRAVERSE POINT LOCATION DRAWING

310.0"
5.0 Equivalent Diameters
Upstream from
Disturbance

(2) 4.0" I.D.
Sampling Ports
Located 90° Apart

140.0"
2.2 Equivalent Diameters
Downstream from
Disturbance

62.3" I.D.
Circular Stack

62.3"

PORT 1

7.5"

7.5"   PORT 2

Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	16.7	10.4	10.4
2	50.0	31.2	31.2
3	83.3	51.9	51.9
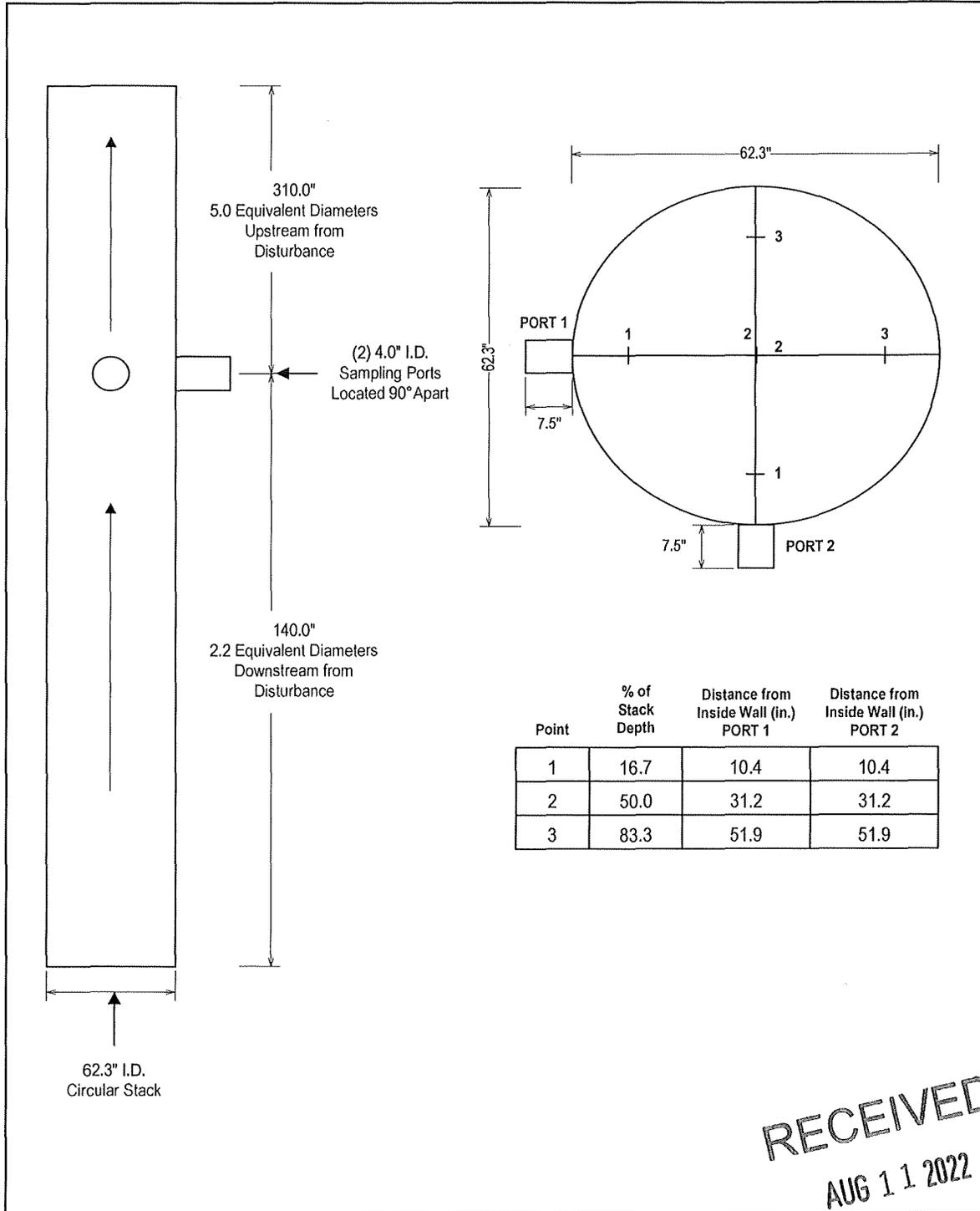
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