Source Test Report for 2022 Compliance Emissions Testing

Boiler No. 10 (EUBOILER#10) and Boiler No. 11 (EUBOILER#11)

Graphic Packaging International, LLC Kalamazoo, Michigan

Prepared For:

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1500 North Pitcher Street
Kalamazoo, MI 49007

Prepared By:

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For Submission To:

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MONTROSE AIR QUALITY SERVICES

STAC STACK TESTING ACCREDITATION COUNCIL

ACCREDITED TO ASTM D7036 ONLY CERT #3923.01

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) (Facility ID: B1678) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance test program on Boilers No. 10 (EUBOILER#10) and 11 (EUBOILER#11) at the Graphic Packaging facility located in Kalamazoo, Michigan. Testing was performed on June 8-9, 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.

The specific objectives were to:

- Verify the emissions of particulate matter (PM) under 2.5-µm ($PM_{2.5}$), PM under 10-µm (PM_{10}), and nitrogen oxides (NO_x) (as NO_2) from the exhaust stacks (SVBLR1 and SVBLR2) serving EUBOILER#10 and EUBOILER#11
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1. All Total PM (TPM) emissions are to be considered as $PM_{2.5}$ and PM_{10} for compliance determination.

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	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	60
6/8/2022	EUBOILER#10	O_2, CO_2	EPA 3A	3	60
6/8/2022	EUBOILER#10	Moisture	EPA 4	3	60
6/8/2022	EUBOILER#10	FPM, CPM	EPA 5/202	3	60
6/8/2022	EUBOILER#10	NO_x	EPA 7E	3	60
6/9/2022	EUBOILER#11	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	60
6/9/2022	EUBOILER#11	O_2, CO_2	EPA 3A	3	60
6/9/2022	EUBOILER#11	Moisture	EPA 4	3	60
6/9/2022	EUBOILER#11	FPM, CPM	EPA 5/202	3	60
6/9/2022	EUBOILER#11	NO_x	EPA 7E	3	60

To simplify this report, a list of Units and Abbreviations is included in Appendix D. 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 average emission test results are summarized and compared to their respective permit limits in Tables 1-2 and 1-3. 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 1-4. 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 Average Compliance Results – EUBOILER#10

June 8, 2022

Parameter/Units	Average Results	Emission Limits
Total Particulate Matter ($PM_{2.5}$ / PM_{10})		
lb/MMBtu	0.0046	0.004
Nitrogen Oxides (NO_x)		
lb/MMBtu	0.025	0.036

Table 1-3
Summary of Average Compliance Results – EUBOILER#11

June 9, 2022

Parameter/Units	Average Results	Emission Limits
Total Particulate Matter ($PM_{2.5}$ / PM_{10})		
lb/MMBtu	0.0039	0.004
Nitrogen Oxides (NO_x)		
lb/MMBtu	0.025	0.036

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

Laboratory Information

Laboratory:	Montrose Chicago North Laboratory
City, State:	Wauconda, IL 60084
Method:	EPA Methods 5 and 202

Test personnel and observers are summarized in Table 1-4.

Table 1-4
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 311 MMBtu/hr natural gas-fired boilers (EUBOILER#10 and EUBOILER#11) (FGBOILERS10-11) to generate steam and hot water for use in facility operations. EUBOILER#10 and EUBOILER#11 are equipped with low NO_x burners and flue gas recirculation. They have maximum heat input rates of 311 MMBtu/hr and were in operation for this test event.

2.2 Flue Gas Sampling Locations

Information regarding the sampling locations is presented in Table 2-1.

Table 2-1
Sampling Locations

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EUBOILER#10 Exhaust Stack (SVBLR10)	62.3	140.0 / 2.2	310.0 / 5.0	Isokinetic: 24 (12/port) Gaseous: 3
EUBOILER#11 Exhaust Stack (SVBLR11)	62.3	140.0 / 2.2	310.0 / 5.0	Isokinetic: 24 (12/port) Gaseous: 3

Sample locations were 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.

2.3 Operating Conditions and Process Data

Emission tests were performed while the boilers operated at greater than 90% of its rated capacity.

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

- Gas flow rate, kscfh
- Steam Load, lb/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.

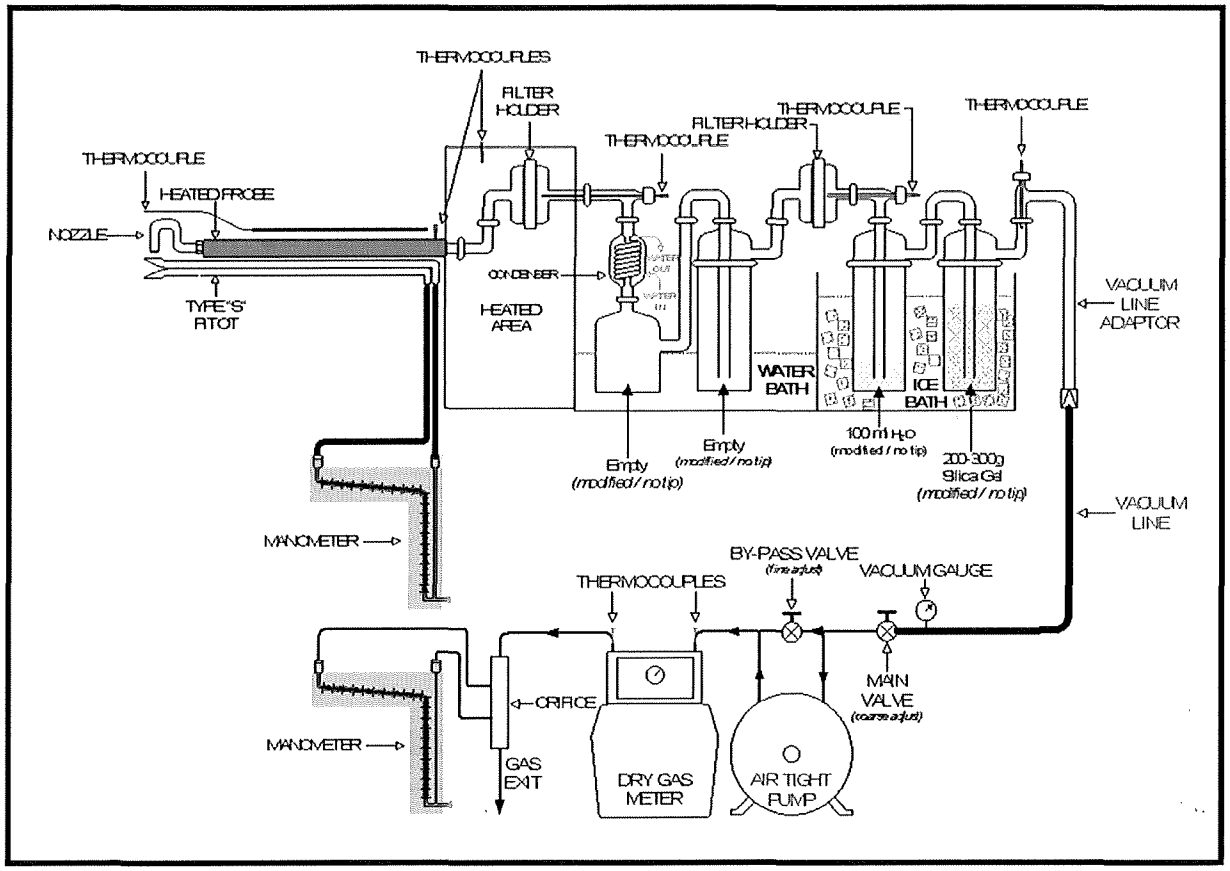
The typical sampling system is detailed in Figure 3-1.

3.1.4 EPA Method 5, Determination of Particulate Matter from Stationary Sources

EPA Method 5 is a manual, isokinetic method used to measure FPM emissions. The samples are analyzed gravimetrically. This method is performed in conjunction with EPA Methods 1 through 4. The stack gas is sampled through a nozzle, probe, filter, and impinger train. FPM results are reported in emission concentration and emission rate units.

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

Figure 3-1
EPA Method 5/202 Sampling Train

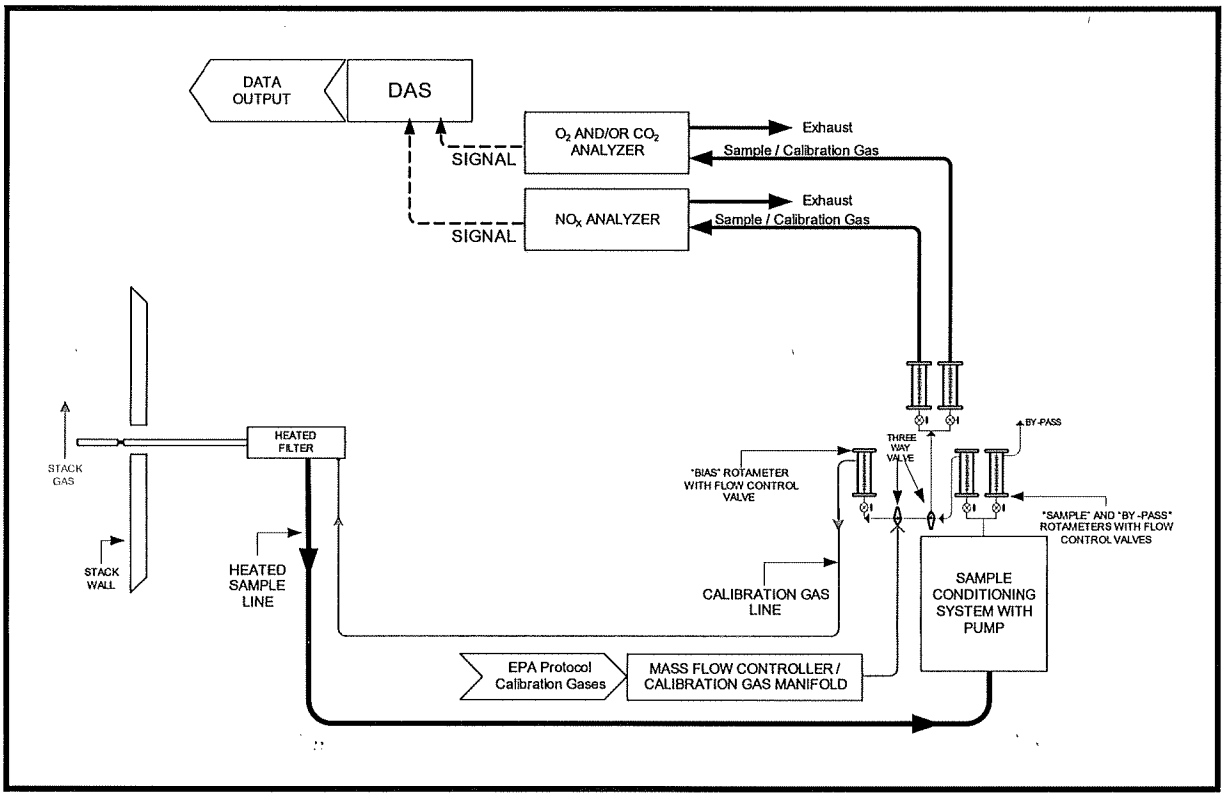


3.1.5 EPA Method 7E, Determination of Nitrogen Oxides Emissions from Stationary Source (Instrumental Analyzer Procedure)

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



3.1.6 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.

3.1.7 EPA Method 202, Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources

The CPM is collected in dry impingers after filterable PM has been collected on a filter maintained as specified in either Method 5 of Appendix A-3 to 40 CFR 60, Method 17 of Appendix A-6 to 40 CFR 60, or Method 201A of Appendix M to 40 CFR 51. The organic and aqueous fractions of the impingers and an out-of-stack CPM filter are then taken to dryness and weighed. The total of the impinger fractions and the CPM filter represents the CPM. Compared to the version of Method 202 that was promulgated on December 17, 1991, this method eliminates the use of water as the collection media in impingers and includes the addition of a condenser followed by a water dropout impinger immediately after the final in-stack or heated filter. This method also includes the addition of one modified Greenburg Smith impinger (backup impinger) and a CPM filter following the water dropout impinger.

CPM is collected in the water dropout impinger, the modified Greenburg Smith impinger, and the CPM filter of the sampling train as described in this method. The impinger contents are purged with nitrogen immediately after sample collection to remove dissolved SO_2 gases from the impinger. The CPM filter is extracted with water and hexane. The impinger solution is then extracted with hexane. The organic and aqueous fractions are dried and the residues are weighed. The total of the aqueous and organic fractions represents the CPM.

The potential artifacts from SO_2 are reduced using a condenser and water dropout impinger to separate CPM from reactive gases. No water is added to the impingers prior to the start of sampling. To improve the collection efficiency of CPM, an additional filter (the "CPM filter") is placed between the second and third impingers

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

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

No field deviations or exceptions from the test plan or test methods occurred during this test program.

4.2 Presentation of Results

The average results are compared to the permit limits in Tables 1-2 and 1-3. The results of individual compliance test runs performed are presented in Tables 4-1 and 4-2. 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
$PM_{2.5}/PM_{10}$ and NO_x Emissions Results - EUBOILER#10

Parameter/Units	Run 1	Run 2	Run 3	Average
Date	6/8/2022	6/8/2022	6/8/2022	--
Time	15:25-16:30	17:06-18:12	18:33-19:36	--
Process Data				
Gas flow rate, kscfh *	209.8	207.8	209.7	209.1
Steam load, klb/hr *	169.4	167.8	169.8	169.0
heat input rate, MMBtu/hr	217.9	227.9	235.5	227.1
Sampling & Flue Gas Parameters				
sample duration, minutes	60	60	60	--
O_2, % volume dry	3.68	3.74	3.68	3.70
CO_2, % volume dry	9.99	10.08	10.19	10.09
flue gas temperature, °F	268.1	263.5	265.1	265.6
moisture content, % volume	17.29	16.67	16.00	16.65
volumetric flow rate, dscfm	37,434	39,189	40,067	38,897
Filterable Particulate Matter (FPM)				
gr/dscf	0.00113	0.00049	0.00015	0.00059
lb/hr	0.363	0.165	0.050	0.193
lb/MMBtu	0.00168	0.00072	0.00021	0.00087
Condensable Particulate Matter (CPM)				
gr/dscf	0.00097	0.00312	0.00346	0.00251
lb/hr	0.310	1.047	1.187	0.848
lb/MMBtu	0.0014	0.0046	0.0050	0.0037
Total Particulate Matter ($PM_{2.5}/PM_{10}$)				
gr/dscf	0.0021	0.0036	0.0036	0.0031
lb/hr	0.67	1.21	1.24	1.04
lb/MMBtu	0.0031	0.0053	0.0053	0.0046
Nitrogen Oxides (NO_x)				
ppmvd	21.7	19.3	20.6	20.5
lb/hr (as NO_2)	5.81	5.41	5.92	5.71
lb/MMBtu (as NO_2)	0.027	0.024	0.025	0.025

* Process data was provided by Graphic Packaging personnel.

Table 4-2
$PM_{2.5}/PM_{10}$ and NO_x Emissions Results - EUBOILER#11

Parameter/Units	Run 1	Run 2	Run 3	Average
Date	6/9/2022	6/9/2022	6/9/2022	--
Time	13:24-14:32	14:55-15:58	16:20-17:23	--
Process Data				
Gas flow rate, kscfh *	209.0	211.7	209.0	209.9
Steam load, klb/hr *	170.4	174.2	172.2	172.3
heat input rate, MMBtu/hr	232.5	232.0	229.9	231.5
Sampling & Flue Gas Parameters				
sample duration, minutes	60	60	60	--
O_2, % volume dry	4.44	4.46	4.50	4.47
CO_2, % volume dry	9.62	9.70	9.72	9.68
flue gas temperature, °F	268.2	269.7	270.0	269.3
moisture content, % volume	15.95	15.70	16.08	15.91
volumetric flow rate, dscfm	41,495	41,442	40,987	41,308
Filterable Particulate Matter (FPM)				
gr/dscf	0.00044	0.00072	0.00035	0.00050
lb/hr	0.16	0.25	0.12	0.18
lb/MMBtu	0.00069	0.00110	0.00053	0.00077
Condensable Particulate Matter (CPM)				
gr/dscf	0.0016	0.0033	0.0013	0.0020
lb/hr	0.56	1.17	0.44	0.73
lb/MMBtu	0.0024	0.0051	0.0019	0.0031
Total Particulate Matter ($PM_{2.5}/PM_{10}$)				
gr/dscf	0.0020	0.0040	0.0016	0.0026
lb/hr	0.72	1.43	0.57	0.90
lb/MMBtu	0.0031	0.0062	0.0025	0.0039
Nitrogen Oxides (NO_x)				
ppmvd	19.6	18.7	19.2	19.1
lb/hr (as NO_2)	5.82	5.54	5.62	5.66
lb/MMBtu (as NO_2)	0.025	0.024	0.024	0.025

* Process data was provided by Graphic Packaging personnel.

5.0 Internal QA/QC Activities

5.1 QA/QC Audits

The meter boxes and sampling trains used during sampling performed within the requirements of their respective methods. All post-test leak checks, minimum metered volumes, minimum sample durations, and percent isokinetics met the applicable QA/QC criteria.

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.

EPA Method 5 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met, except if noted in Section 5.2. An EPA Method 5 reagent blank was analyzed. The maximum allowable amount that can be subtracted is 0.001% of the weight of the acetone used. The blank did not exceed the maximum residue allowed.

EPA Method 202 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met. An EPA Method 202 Field Train Recovery Blank (FTRB) was performed for each source category. The maximum allowable amount that can be subtracted is 0.002 g (2.0 mg). For this project, the FTRB had a mass of 1.90 mg, and 1.90 mg was subtracted.

5.2 QA/QC Discussion

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

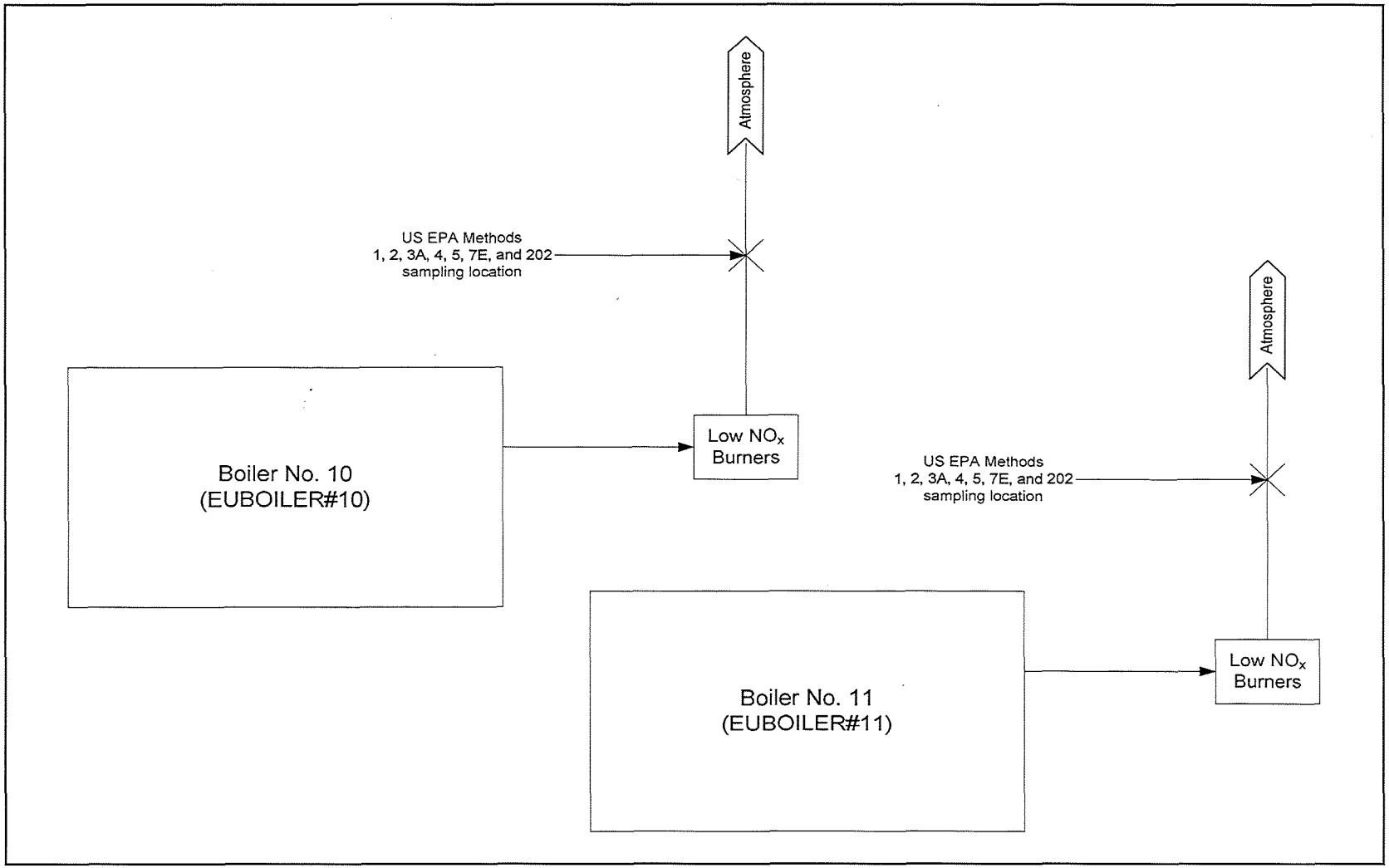
5.3 Quality Statement

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).

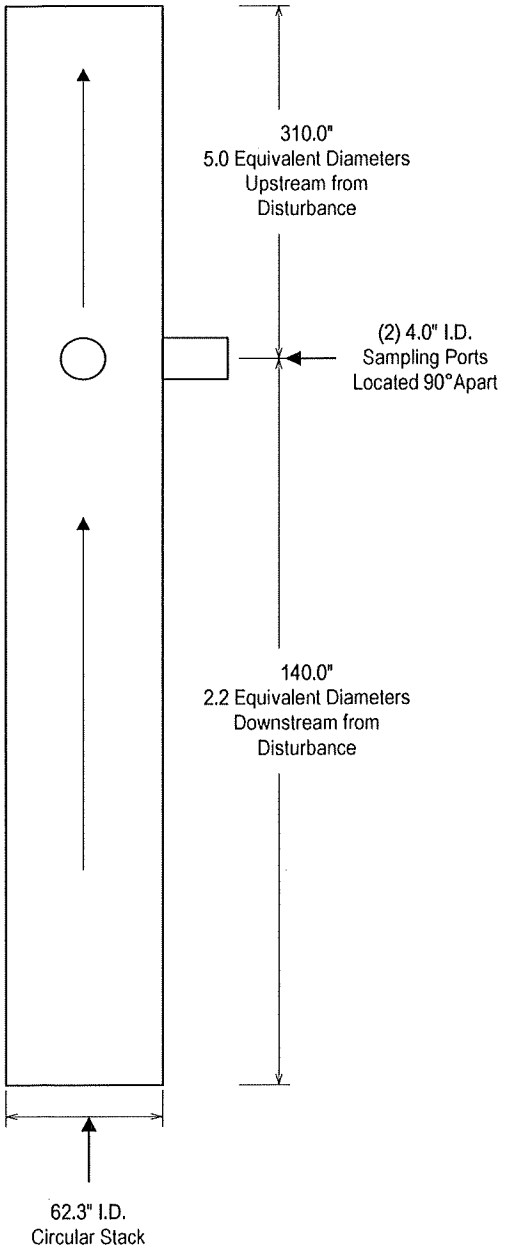
Appendix A
Field Data and Calculations

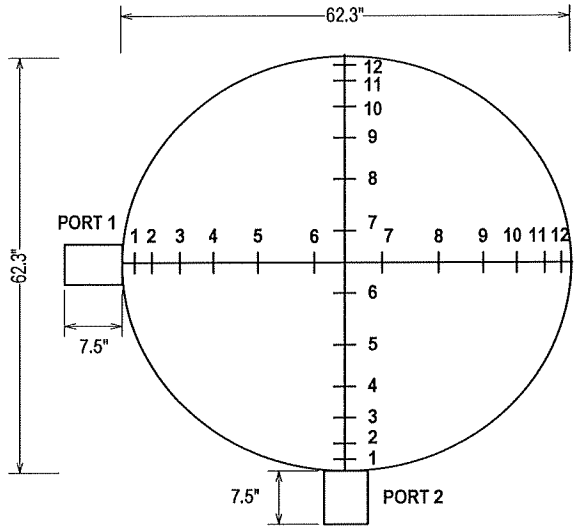
Appendix A.1
Sampling Locations

EUBOILER#10 AND EUBOILER#11 SAMPLING LOCATION SCHEMATIC



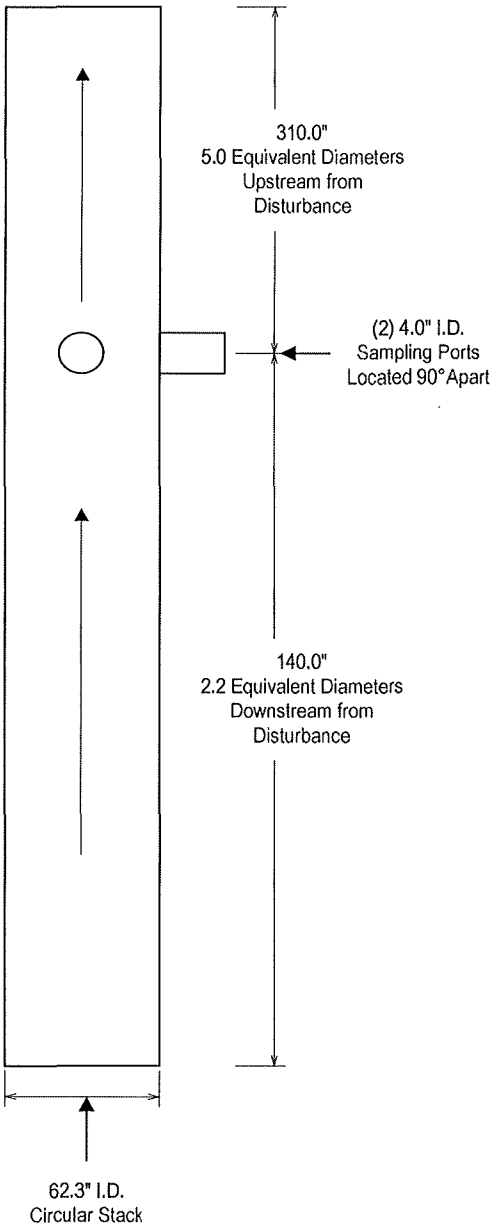
EUBOILER#10 EXHAUST ISOKINETIC TRAVERSE POINT LOCATION DRAWING

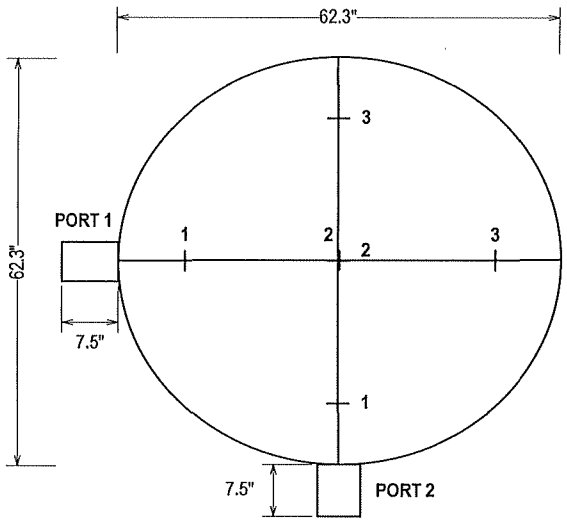




Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	2.1	1.3	1.3
2	6.7	4.2	4.2
3	11.8	7.4	7.4
4	17.7	11.0	11.0
5	25.0	15.6	15.6
6	35.6	22.2	22.2
7	64.4	40.1	40.1
8	75.0	46.7	46.7
9	82.3	51.3	51.3
10	88.2	54.9	54.9
11	93.3	58.1	58.1
12	97.9	61.0	61.0

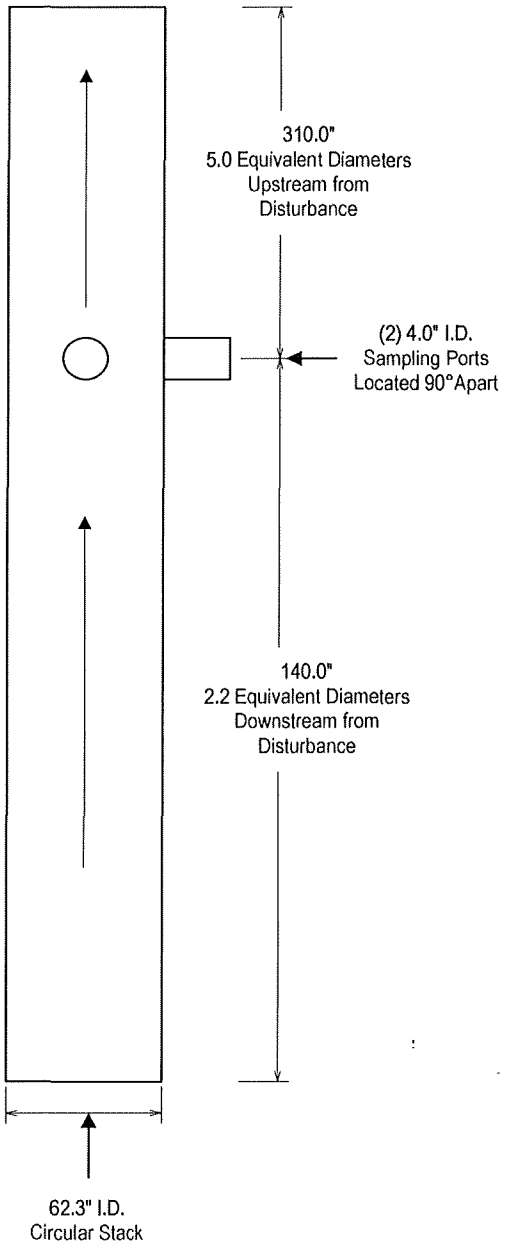
EUBOILER#10 EXHAUST CEMS TRAVERSE POINT LOCATION DRAWING

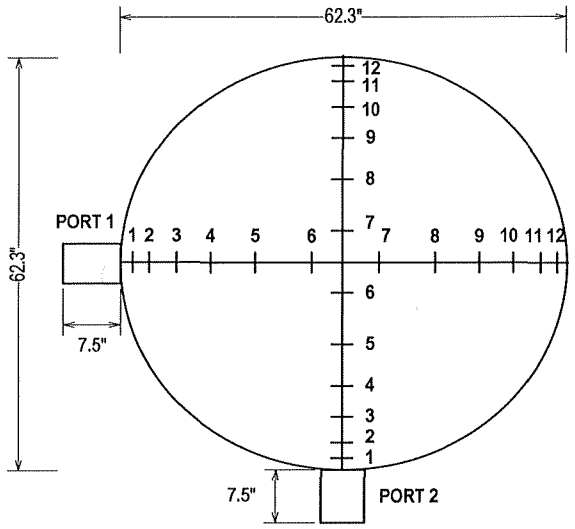




Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	16.7	10.4	10.4
2	50.0	31.2	31.2
3	83.3	51.9	51.9

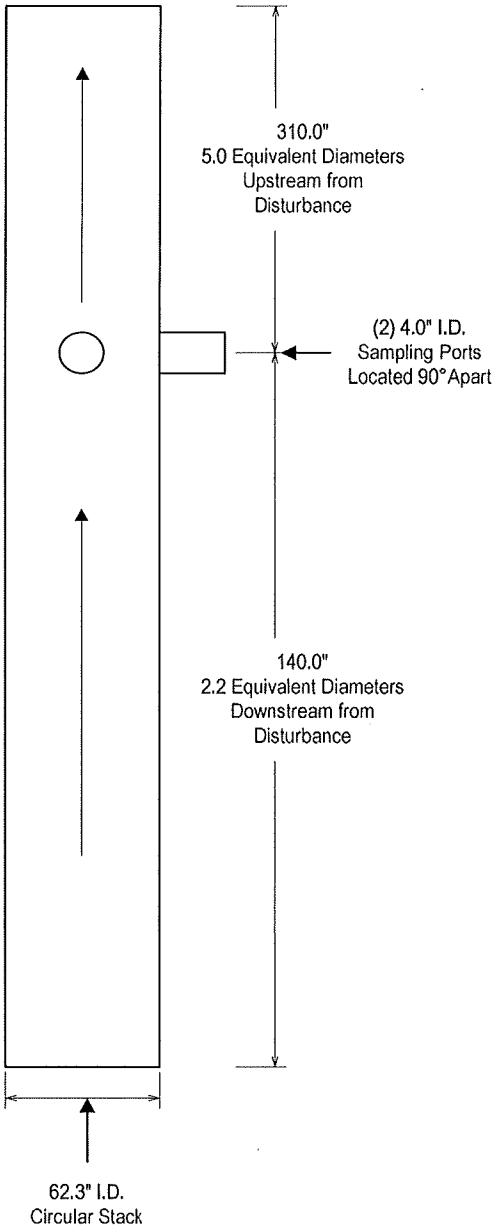
EUBOILER#11 EXHAUST ISOKINETIC TRAVERSE POINT LOCATION DRAWING

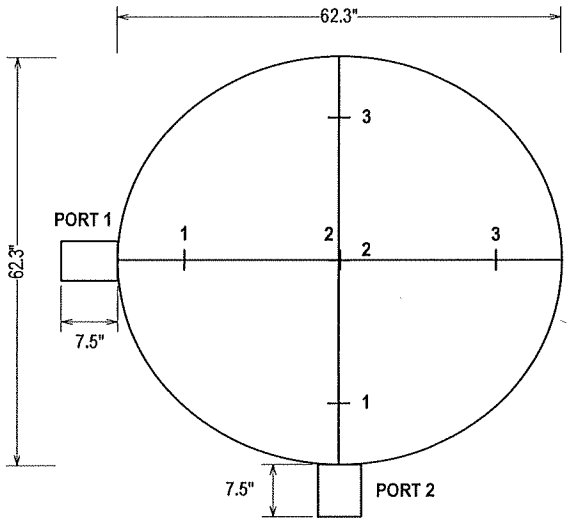




Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	2.1	1.3	1.3
2	6.7	4.2	4.2
3	11.8	7.4	7.4
4	17.7	11.0	11.0
5	25.0	15.6	15.6
6	35.6	22.2	22.2
7	64.4	40.1	40.1
8	75.0	46.7	46.7
9	82.3	51.3	51.3
10	88.2	54.9	54.9
11	93.3	58.1	58.1
12	97.9	61.0	61.0

EUBOILER#11 EXHAUST CEMS TRAVERSE POINT LOCATION DRAWING





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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Appendix A.2
EUBOILER#10 Data Sheets