

**Source Test Report for
2023 Compliance Emissions Testing
Boiler No. 2 (EUB0260-02)
University of Michigan
Central Power Plant
Ann Arbor, Michigan**

Prepared For:

**University of Michigan
1120 East Huron Street
Ann Arbor, MI 48104**

Prepared By:

**Montrose Air Quality Services, LLC
4949 Fernlee Avenue
Royal Oak, MI 48073**

For Submission To:

**Michigan Department of Environment, Great Lakes, and Energy
Constitution Hall, 2nd Floor South
525 W. Allegan Street
Lansing, MI 48933**

**Document Number: MW049AS-020674-RT-1189
Test Date: January 25, 2023
Submittal Date: March 14, 2023**

RECEIVED

MAR 28 2023

AIR QUALITY DIVISION



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:** 03 / 14 / 2023

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:** 03 / 14 / 2023

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

Table of Contents

<u>Section</u>	<u>Page</u>
1.0 Introduction	5
1.1 Summary of Test Program	5
1.2 Key Personnel	6
2.0 Plant and Sampling Location Descriptions.....	8
2.1 Process Description, Operation, and Control Equipment.....	8
2.2 Flue Gas Sampling Location	8
2.3 Operating Conditions and Process Data	8
3.0 Sampling and Analytical Procedures	9
3.1 Test Methods	9
3.1.1 EPA Method 3A.....	9
3.1.2 EPA Method 7E.....	9
3.1.3 EPA Method 19.....	9
3.2 Process Test Methods.....	10
4.0 Test Discussion and Results.....	11
4.1 Field Test Deviations and Exceptions.....	11
4.2 Presentation of Results.....	11
5.0 Internal QA/QC Activities	13
5.1 QA/QC Audits.....	13
5.2 QA/QC Discussion.....	13
5.3 Quality Statement	13

List of Appendices

A Field Data and Calculations	14
A.1 Sampling Locations.....	15
A.2 EUB0260-02 Data Sheets	18
A.3 Example Calculations	33
B Facility Process Data.....	36
B.1 EUB0260-02 Process Data	37
B.2 Fuel Analyses.....	52
C Quality Assurance/Quality Control	61
C.1 Units and Abbreviations.....	62
C.2 Instrumental Test Method QA/QC Data.....	71
C.3 Accreditation Information/Certifications.....	94

D	Regulatory Information.....	97
D.1	Regulatory Correspondence	98
D.2	Test Protocol.....	103

List of Tables

1-1	Summary of Test Program – NG as Fuel.....	5
1-2	Summary of Test Program – FO as Fuel	5
1-3	Summary of Average Compliance Results – EUB0260-02 (NG as Fuel).....	6
1-4	Summary of Average Compliance Results – EUB0260-02 (FO as Fuel)	6
1-5	Test Personnel and Observers.....	7
2-1	Sampling Location.....	8
4-1	NO _x Emissions Results - EUB0260-02 (NG as Fuel)	12
4-2	NO _x Emissions Results - EUB0260-02 (FO as Fuel)	12

List of Figures

3-1	EPA Methods 3A and 7E Sampling Train	10
-----	--	----

1.0 Introduction

1.1 Summary of Test Program

The University of Michigan contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance test program on the Boiler No. 2 (EUB0260-02) at the University of Michigan-Central Power Plant facility (State Registration No.: M0675) located in Ann Arbor, Michigan. Testing was performed on January 25, 2023, for the purpose of satisfying the emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operation Permit No. MI-ROP-M0675-2021b.

The specific objectives were to:

- Verify the emissions of NO_x (as NO₂) from the exhaust duct serving EUB0260-02 while burning natural gas (NG) and fuel oil (FO)
- Conduct the test program with a focus on safety

Montrose performed tests to measure the emission parameters listed in Tables 1-1 and 1-2.

Table 1-1
Summary of Test Program – NG as Fuel

Test Date(s)	Unit ID/ Source Name	Activity/Parameters	Test Methods	No. of Runs	Duration (Minutes)
1/25/2023	EUB0260-02	O ₂	EPA 3A	3	60
1/25/2023	EUB0260-02	NO _x	EPA 7E	3	60

Table 1-2
Summary of Test Program – FO as Fuel

Test Date(s)	Unit ID/ Source Name	Activity/Parameters	Test Methods	No. of Runs	Duration (Minutes)
1/25/2023	EUB0260-02	O ₂	EPA 3A	3	60
1/25/2023	EUB0260-02	NO _x	EPA 7E	3	60

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 average emission test results are summarized and compared to their respective permit limits in Tables 1-3 and 1-4. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The report follows the EGLE "Format for Submittal of Source Emission Test Plans and Report" guidelines dated November 2019.

The testing was conducted by the Montrose personnel listed in Table 1-5. The tests were conducted according to the test plan (protocol) dated November 7, 2022, that was submitted to and approved by the EGLE.

**Table 1-3
Summary of Average Compliance Results – EUB0260-02 (NG as Fuel)**

January 25, 2023

Parameter/Units	Average Results	Emission Limits
Nitrogen Oxides (NO_x as NO₂)		
lb/MMBtu	0.078	0.20

**Table 1-4
Summary of Average Compliance Results – EUB0260-02 (FO as Fuel)**

January 25, 2023

Parameter/Units	Average Results	Emission Limits
Nitrogen Oxides (NO_x as NO₂)		
lb/MMBtu	0.075	0.30

1.2 Key Personnel

A list of project participants is included below:

Facility Information

Source Location: University of Michigan
 Central Power Plant
 1239 Kipke Drive
 Ann Arbor, MI 48104

Project Contact: Brandi Campbell
 Role: Sr. Environmental Specialist

Company: University of Michigan
 Telephone: 734-647-9017
 Email: campbelb@umich.edu

Stephen O’Rielly
 Manager Environmental
 Protection & Permitting Program
 University of Michigan
 734-763-4642
 sorielly@umich.edu

2.0 Plant and Sampling Location Descriptions

2.1 Process Description, Operation, and Control Equipment

The University of Michigan-Central Power Plant operates four boilers and three turbines with heat recovery steam generators to generate steam and electricity for use by various campus buildings.

Boiler No. 2 (EUB0260-02) is rated at 157 MMBtu/hr heat input. The unit is fueled by natural gas or No. 2 fuel oil. Emissions are uncontrolled.

2.2 Flue Gas Sampling Location

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

**Table 2-1
Sampling Location**

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
SV-B0260-01	168	>336 / >2.0	>84 / >0.5	Gaseous: 3

See Appendix A.1 for more information.

2.3 Operating Conditions and Process Data

Emission tests were performed while the boiler was operating at the highest achievable load point.

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:

- F-Factor (F_d), dscf/MMBtu
- Natural gas and fuel oil analyses
- Main steam flow, klb/hr
- Natural gas flow, kscfh
- Fuel oil flow, gpm

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 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 O₂ and CO₂ in stack gas. The effluent gas is continuously or intermittently sampled and conveyed to analyzers that measure the concentration of O₂ and CO₂. The performance requirements of the method must be met to validate data.

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

3.1.2 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 NO₂. Conditioned gas is sent to an analyzer to measure the concentration of NO_x. NO and NO₂ can be measured separately or simultaneously together but, for the purposes of this method, NO_x is the sum of NO and NO₂. The performance requirements of the method must be met to validate the data.

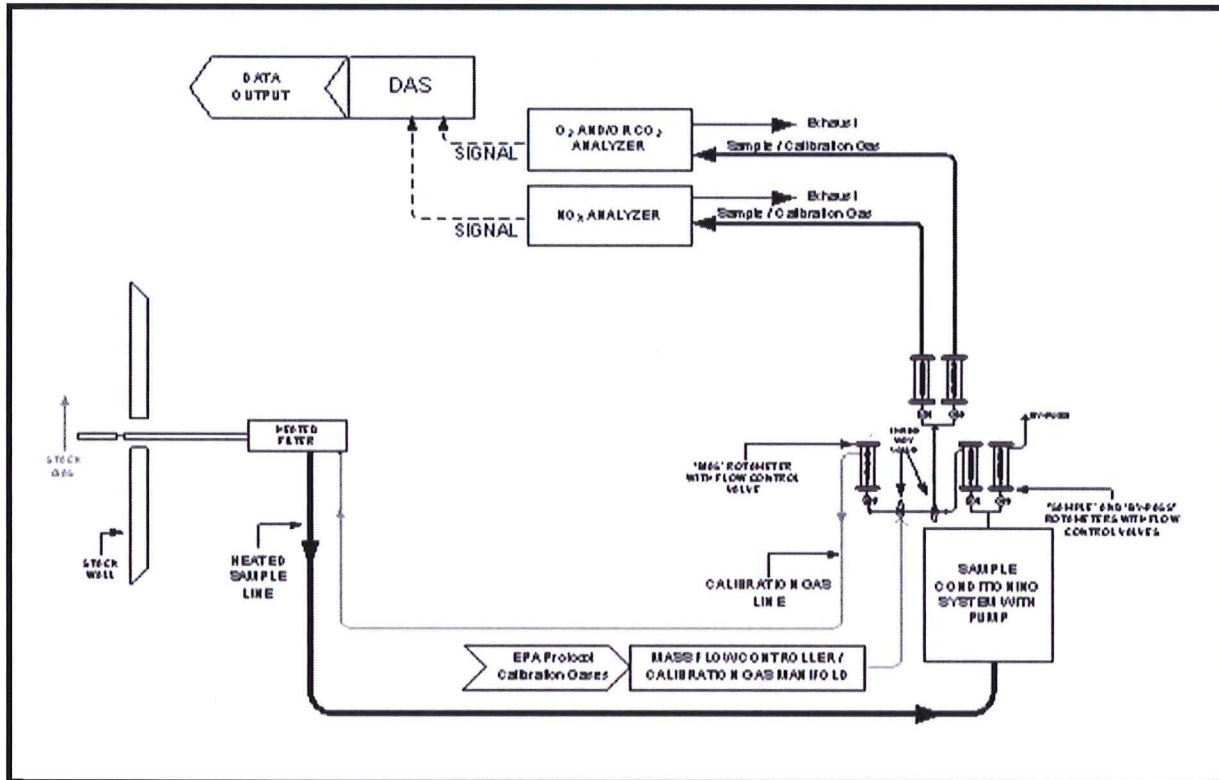
The typical sampling system is detailed in Figure 3-1.

3.1.3 EPA Method 19, Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

EPA Method 19 is a manual method used to determine (a) PM, SO₂, and NO_x emission rates; (b) sulfur removal efficiencies of fuel pretreatment and SO₂ control devices; and (c) overall reduction of potential SO₂ emissions. This method provides data reduction procedures, but does not include any sample collection or analysis procedures.

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.

Figure 3-1
EPA Methods 3A and 7E Sampling Train



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 1-3 and 1-4. 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
NO_x Emissions Results -
EUB0260-02 (NG as Fuel)

Parameter/Units	Run 1	Run 2	Run 3	Average
Date	1/25/2023	1/25/2023	1/25/2023	--
Time	14:30-15:30	15:45-16:45	17:00-18:00	--
Process Data *				
F-Factor (F _d), dscf/MMBtu	8,635	8,635	8,635	8,635
Sampling & Flue Gas Parameters				
sample duration, minutes	60	60	60	60
O ₂ , % volume dry	5.80	5.78	5.74	5.77
Nitrogen Oxides (NO_x)				
ppmvd	54.4	54.8	55.1	54.7
lb/MMBtu (as NO ₂)	0.078	0.078	0.078	0.078

* Process data was provided by University of Michigan personnel.

Table 4-2
NO_x Emissions Results -
EUB0260-02 (FO as Fuel)

Parameter/Units	Run 1	Run 2	Run 3	Average
Date	1/25/2023	1/25/2023	1/25/2023	--
Time	9:45-10:45	10:55-11:55	12:10-13:10	--
Process Data *				
F-Factor (F _d), dscf/MMBtu	9,190	9,190	9,190	9,190
Sampling & Flue Gas Parameters				
sample duration, minutes	60	60	60	60
O ₂ , % volume dry	10.79	10.69	10.73	10.73
Nitrogen Oxides (NO_x)				
ppmvd	33.2	34.4	32.5	33.4
lb/MMBtu (as NO ₂)	0.075	0.077	0.073	0.075

* Process data was provided by University of Michigan personnel.

5.0 Internal QA/QC Activities

5.1 QA/QC Audits

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 NO₂ to NO converter efficiency check of the analyzer was conducted per the procedures in EPA Method 7E, Section 8.2.4. The conversion efficiency met the criteria.

5.2 QA/QC Discussion

Montrose did not have a Qualified Individual (QI) for EPA Methods 3A and 7E onsite during the test event as per ASTM D7036-04 requirements. However, upon data review, all EPA Method 3A and 7E data quality objectives were met.

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).

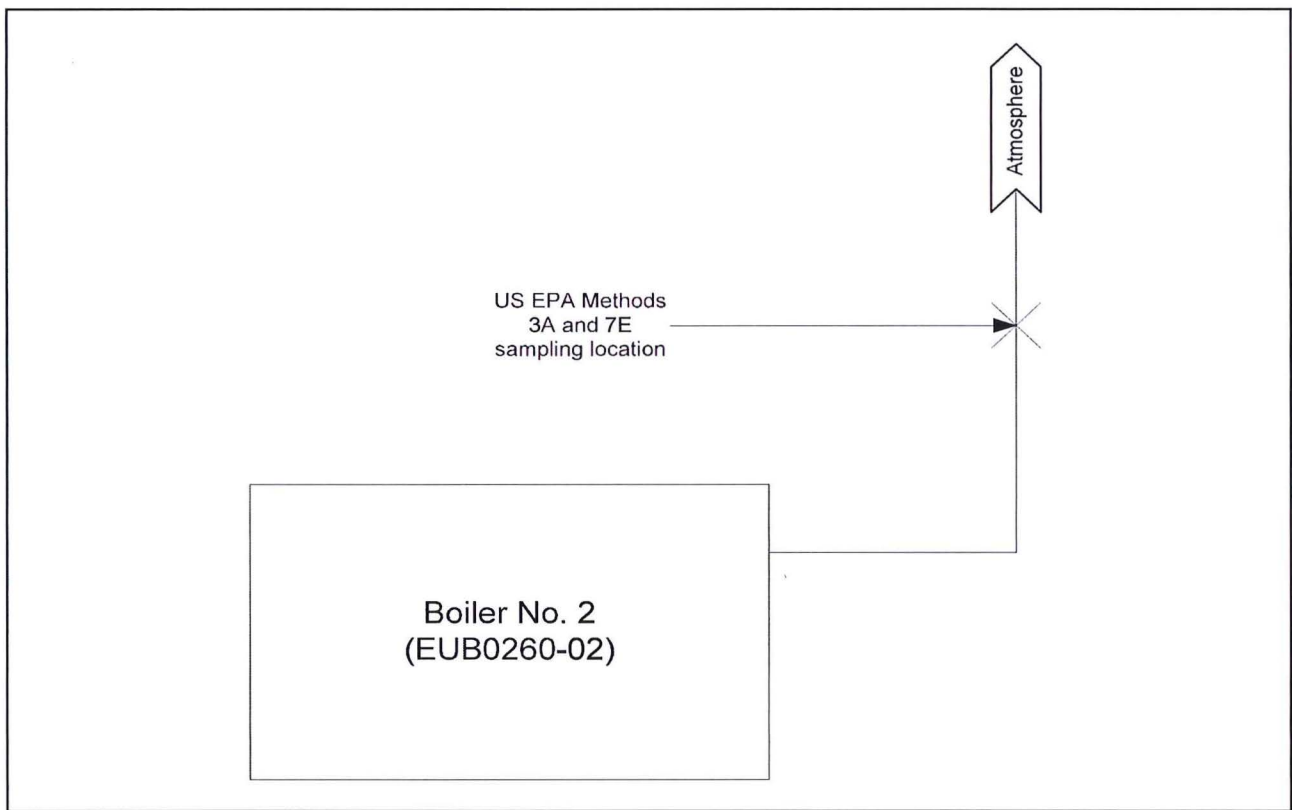
Appendix A

Field Data and Calculations

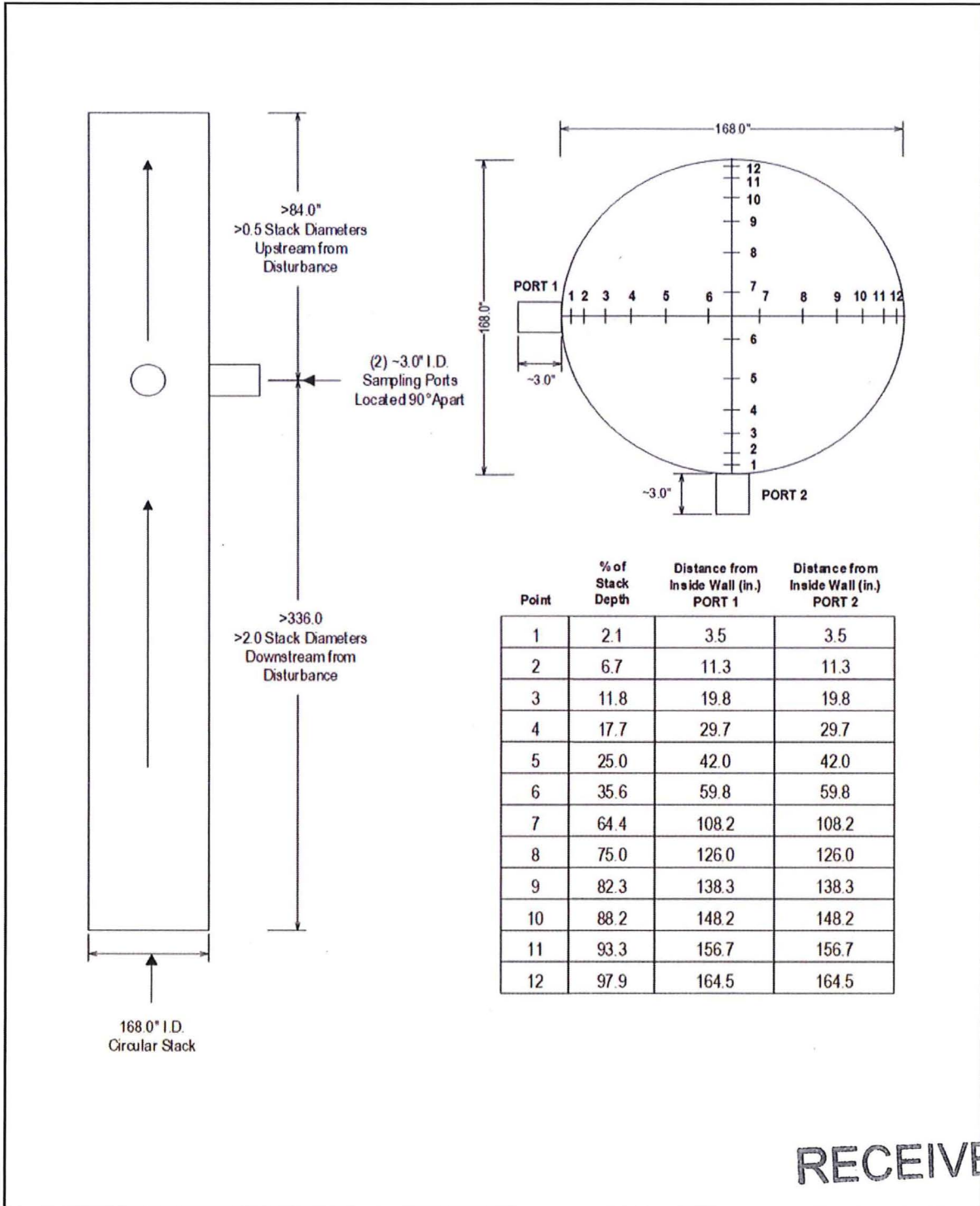
Appendix A.1

Sampling Locations

EUB0260-02 SAMPLING LOCATION SCHEMATIC



SV-B0260-01 (North Stack) TRAVERSE POINT LOCATION DRAWING



RECEIVED

MAR 28 2023

AIR QUALITY DIVISION

Appendix A.2

EUB0260-02 Data Sheets