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:	[signature]	**Date:**	July 3, 2023
Name:	John Nestor	**Title:**	District Manager

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1.0 Introduction

1.1 Summary of Test Program

Cleveland-Cliffs Inc., Dearborn Works (CCDW) (Facility ID: A8640) contracted Montrose Air Quality Services, LLC (Montrose) to perform the Annual Quality Assurance (QA) Relative Accuracy Test Audit (RATA) for the Continuous Emission Monitoring Systems (CEMS) associated with the "C" Blast Furnace (EUCFURNACE) Baghouse at the CCDW facility located in Dearborn, Michigan. Testing was performed on May 11, 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-A8640-2016a by evaluating the quality of the emissions data produced by CCDW'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 EUCFURNACE Baghouse CEMS for sulfur dioxide (SO_2) emissions (lb/hr), SO_2 concentration (ppmvd), and volumetric flow rate (scfm) in accordance with Performance Specifications 2 (PS-2) and 6 (PS-6)
- 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)
May 11, 2023	EUCFURNACE Baghouse	Velocity/Volumetric Flow Rate	EPA 1 & 2	10	5-10
May 11, 2023	EUCFURNACE Baghouse	CO_2	EPA 3A	10	21
May 11, 2023	EUCFURNACE Baghouse	O_2	EPA 3A	10	21
May 11, 2023	EUCFURNACE Baghouse	Moisture	EPA 4	5	42
May 11, 2023	EUCFURNACE Baghouse	SO_2	EPA 6C	10	21

For the Part 60 RATA, of the 10 RATA runs performed, nine were used to determine the RA of the EUCFURNACE Baghouse 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 average emission test results are summarized and compared to their respective permit limits 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 (protocol) dated March 22, 2023, that was submitted to EGLE.

Table 1-2
Summary of Part 60 RATA Results – EUCFURNACE Baghouse

May 11, 2023

Parameter/Units	Regulatory Reference	RA	Allowable
Part 60			
Volumetric Flow Rate			
scfm	PS-6	4.2	≤ 20% RA
Sulfur Dioxide (SO_2)			
ppmvd	PS-2	6.9	≤ 10% RA
lb/hr	PS-6	5.0	≤ 10% RA

1.2 Key Personnel

A list of project participants is included below:

Facility Information

Source Location: Cleveland-Cliffs Inc., Dearborn Works (CCDW)
4001 Miller Road
Dearborn, MI 48120
Project Contact: David Pate
Role: Senior Environmental Engineer
Company: CCDW
Telephone: 313-323-1261
Email: David.pate@clevelandcliffs.com

Agency Information

Regulatory Agency: EGLE
Agency Contact: Jeremy Howe
Email: Howej1@michigan.gov

Testing Company Information

Testing Firm: Montrose Air Quality Services, LLC
Contact: John Nestor
Title: District Manager
Telephone: 248-765-5032
Email: 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	Project Manager, QI
Roy Zimmer	Montrose	Field Technician
Clayton DeRonne	Montrose	Field Technician
David Pate	CCDW	Observer/Client Liaison/Test Coordinator
Andrew Riley	EGLE	Observer

2.0 Plant and Sampling Location Descriptions

2.1 Process Description, Operation, and Control Equipment

Molten iron is produced in the blast furnaces by heating iron ore pellets and other iron-bearing materials, coke, limestone, slag, or other fluxing material. Burden materials consisting of iron ore pellets, flux material (slag, limestone, or dolomite), and a carbon source (usually coke) are delivered to and charged into the top of the furnace. Additional carbon is supplied to the furnace by injecting natural gas and pulverized coal into the hot blast section of the furnace. Preheated combustion (hot blast) air is pushed vertically through the burden material in the furnace from tuyeres located at the bottom of the furnace. The components of the burden chemically react with the hot blast air to reduce the iron oxides into elemental iron and melt. The blast furnace produces molten iron, blast furnace gas, and slag.

Periodically, the molten iron and slag are cast from the furnace into a trough and iron runners in the floor of the cast house. The slag is separated from the molten iron in the trough prior to entering refractory-lined bottle cars. The slag is then diverted to slag pots. The molten iron is transported in bottle cars to the basic oxygen furnace (BOF) for use in the steelmaking process.

Emissions generated within the casthouse from the molten iron and slag that are cast from the C Blast Furnace are captured by numerous collection hoods and are routed to a baghouse that is used to control particulate emissions from the process.

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
SO_2	TECO	43iHL	1226354722	0-300 ppm (Dual Range)
Flow	Monitoring Solutions, Inc.	CEMFLOW (Type-S)	--	--

Table 2-2
RM CEMS Information

Analyzer Type	Manufacturer	Model No.	Serial No.	Range
SO_2	Bovar Engineering	100EH	VW-721M-8562-1	0-88.98 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		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EUCFURNACE Baghouse Exhaust Stack	148.5	1,200.0 / 8.1	840.0 / 5.7	Flow: 12 (3/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 the EUCFURNACE was operating at greater than 50% of permitted capacity. Iron production during the test averaged 294.0 ton/hr.

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
- Iron production rate, ton/hr and tons/cast
- Cast number, start and end times
- Baghouse Switch Settings

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.

3.1.2 EPA Method 2, Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

EPA Method 2 is used to measure the gas velocity using an S-type pitot tube connected to a pressure measurement device, and to measure the gas temperature using a calibrated thermocouple connected to a thermocouple indicator. Typically, Type S (Stauβcheibe) pitot tubes conforming to the geometric specifications in the test method are used, along with an inclined manometer. The measurements are made at traverse points specified by EPA Method 1. One flow measurement was conducted per run.

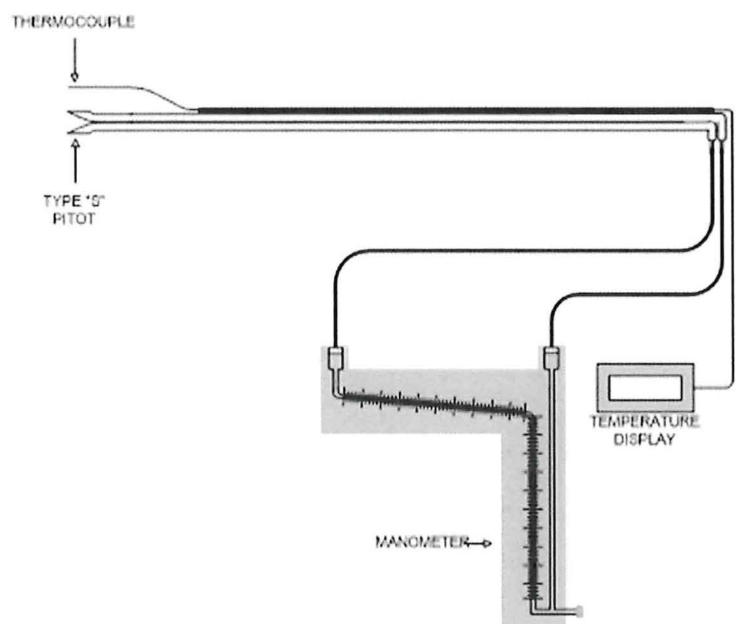
The typical sampling system is detailed in Figure 3-1.

3.1.3 EPA Method 3A, Gas Analysis for the Determination of Dry Molecular Weight

EPA Method 3A is an instrumental test method for measuring 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. These gases were measured for the purpose of determining molecular weight during this test event.

This method was paired with EPA Method 6C. The typical sampling system is detailed in Figure 3-3.

Figure 3-1
EPA Method 2 Sampling Train

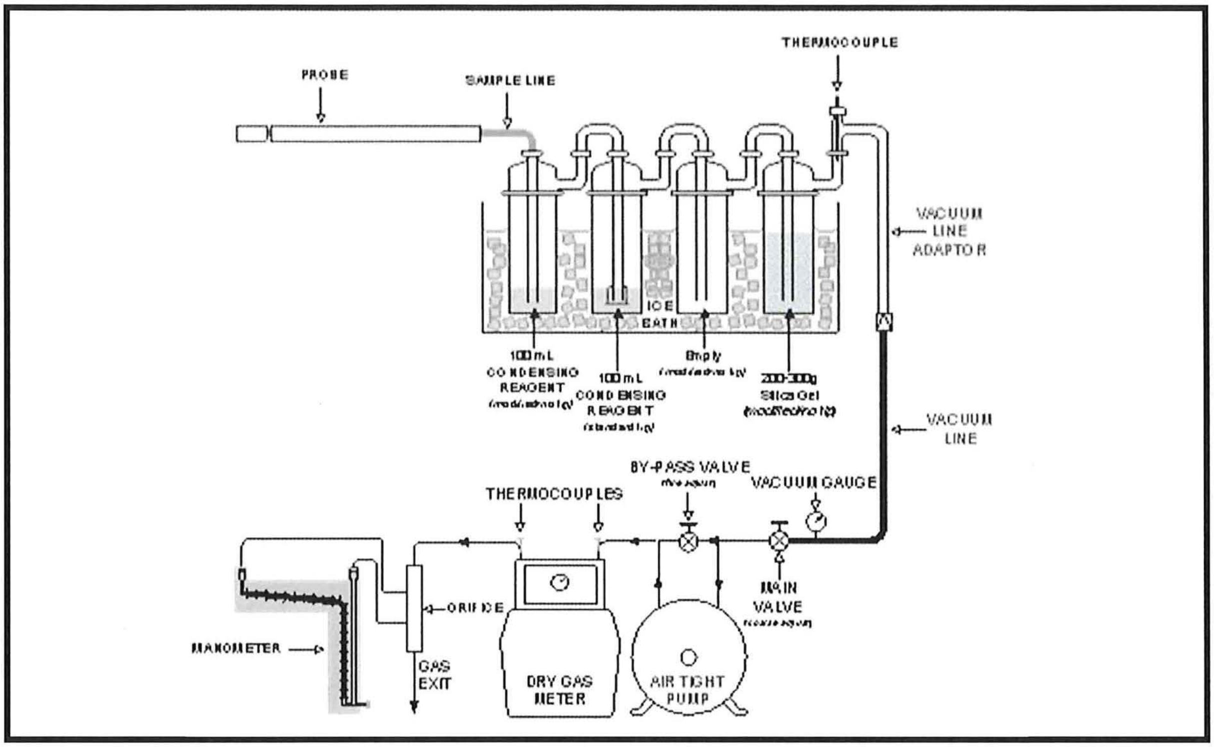


3.1.4 EPA Method 4, Determination of Moisture Content in Stack Gas

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. One moisture measurement was conducted for every two RATA runs.

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

Figure 3-2
EPA Method 4 Sampling Train

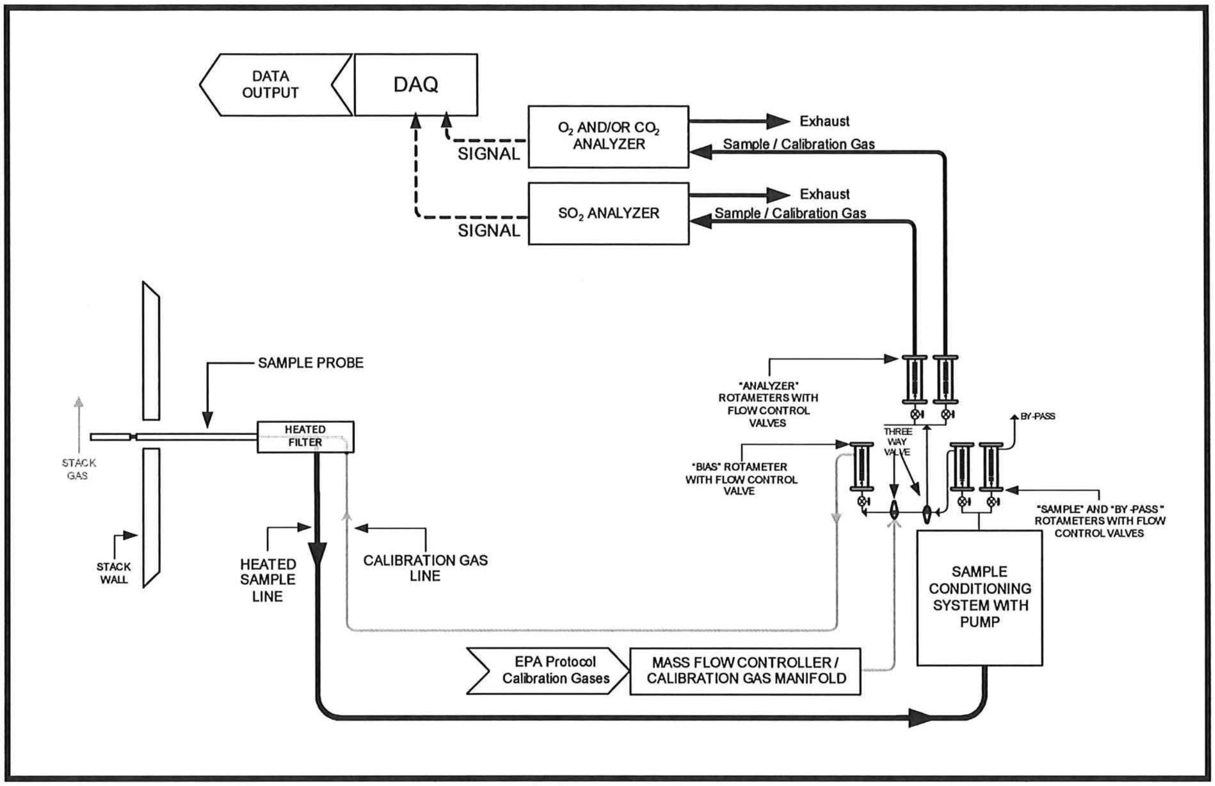


3.1.5 EPA Method 6C, Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 6C is an instrumental test method used to continuously measure emissions of SO_2. Conditioned gas is sent to an ultraviolet (UV) absorption analyzer to measure the concentration of SO_2. The performance requirements of the method must be met to validate the data.

The typical sampling system is detailed in Figure 3-4.

Figure 3-3
EPA Method 3A and 6C Sampling Train



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 tests are conducted to determine conformance of the CEMS to the specification.

3.1.7 EPA Performance Specification 6, Specifications and Test Procedures for Continuous Emission Rate Monitoring Systems in Stationary Sources

EPA Performance Specification 6 is a specification used to evaluate the acceptability of CERMS. The evaluation is conducted at the time of installation or soon after, and whenever specified in the regulations. The RA tests are conducted to determine conformance of the CERMS to the specification.

3.1.8 Relative Accuracy Test Audit

A relative accuracy test audit (RATA) was conducted in accordance with 40 CFR, Part 60, Appendix B, Specification 2 for sulfur dioxide and 40 CFR, Part 60, Appendix B, Specification 6 for rate. The audit equipment was completely separate but parallel to the installed continuous emission measurement equipment. The SO_2 parts per million data was recorded by an electronic data logger on a once-per-second basis. SO_2 parts per million data was averaged and stored as 1-minute average data points, emulating the CEMS installation. The reference method data was averaged and compared to the corresponding CEMS data. CEMS time and reference method times was checked and coordinated to minimize any time differentials. A single flow traverse was conducted during each RATA run to convert reference method parts per million to pounds per hour.

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 test method or test plan deviations occurred during the RATA program.

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.

All times for this RATA utilize facility CEMS times which was 77 minutes behind actual daylight savings time.

Table 4-1
SO_2 (lb/hr) RATA Results - EUCFURNACE Baghouse

Run #*	Date	Time	RM	CEMS	Difference	Run Used (Y/N)
1	5/11/2023	10:30-10:50	117.2	95.0	22.2	N
2	5/11/2023	10:23-10:43	33.3	34.7	-1.4	Y
3	5/11/2023	12:03-12:23	135.2	123.3	11.9	Y
4	5/11/2023	12:50-13:10	28.7	29.7	-1.0	Y
5	5/11/2023	13:25-13:45	72.4	80.2	-7.8	Y
6	5/11/2023	14:00-14:20	78.6	85.8	-7.2	Y
7	5/11/2023	15:13-15:33	46.4	42.6	3.8	Y
8	5/11/2023	15:50-16:10	91.1	80.0	11.1	Y
9	5/11/2023	16:25-16:45	103.6	97.2	6.4	Y
10	5/11/2023	17:27-17:47	33.4	22.2	11.2	Y
Averages			69.2	66.2		
Applicable Standard (AS)			179.65	lb/hr		
Standard Deviation			7.75			
Confidence Coefficient (CC)			5.95			
Unit Load			Normal			
RA based on AS			5.0	%		

Table 4-2
SO_2 (ppmvd) RATA Results - EUCFURNACE Baghouse

Run #*	Date	Time	RM	CEMS	Difference	Run Used (Y/N)
1	5/11/2023	10:30-10:50	26.5	20.5	6.0	N
2	5/11/2023	10:23-10:43	10.4	10.7	-0.3	Y
3	5/11/2023	12:03-12:23	33.7	30.3	3.4	Y
4	5/11/2023	12:50-13:10	7.4	8.4	-1.0	Y
5	5/11/2023	13:25-13:45	16.5	17.0	-0.5	Y
6	5/11/2023	14:00-14:20	19.2	18.4	0.8	Y
7	5/11/2023	15:13-15:33	13.5	13.2	0.3	Y
8	5/11/2023	15:50-16:10	23.5	19.5	4.0	Y
9	5/11/2023	16:25-16:45	26.9	23.6	3.3	Y
10	5/11/2023	17:27-17:47	10.3	6.3	4.0	Y
Averages			17.9	16.4		
Applicable Standard (AS)			45.9	ppm		
Standard Deviation			2.08			
Confidence Coefficient (CC)			1.60			
Unit Load			Normal			
RA based on AS			6.9	%		

Table 4-3
Volumetric Flow Rate (scfm) RATA Results - EUCFURNACE Baghouse

Run #*	Date	Time	RM	CEMS	Difference	Run Used (Y/N)
1	5/11/2023	10:30-10:50	472,494	471,800	694	Y
2	5/11/2023	10:23-10:43	342,382	331,100	11,282	Y
3	5/11/2023	12:03-12:23	428,547	416,300	12,247	Y
4	5/11/2023	12:50-13:10	413,677	360,300	53,377	N
5	5/11/2023	13:25-13:45	468,593	479,800	-11,207	Y
6	5/11/2023	14:00-14:20	437,308	475,300	-37,992	Y
7	5/11/2023	15:13-15:33	367,455	329,600	37,855	Y
8	5/11/2023	15:50-16:10	414,035	419,100	-5,065	Y
9	5/11/2023	16:25-16:45	411,525	419,200	-7,675	Y
10	5/11/2023	17:27-17:47	345,999	358,000	-12,001	Y
Averages			409,816	411,133		
Standard Deviation			20,895			
Confidence Coefficient (CC)			16,061			
Unit Load			Normal			
RA based on mean RM value			4.2	%		

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
O_2, Balance N_2	11.49%	CC420718	11/30/2028
O_2, Balance N_2	24.99%	CC701453	11/5/2027
CO_2, Balance N_2	11.31%	CC420718	11/30/2028
CO_2, Balance N_2	24.36%	CC701453	11/5/2027
SO_2, Balance N_2	24.80 ppmv	XC034660B	8/26/2025
SO_2, Balance N_2	49.58 ppmv	CC89314	11/17/2023

The meter box and sampling train used during sampling performed within the requirements of their respective methods. All post-test leak checks, minimum metered volumes met the applicable QA/QC criteria.

EPA Method 3A and 6C calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks.

5.2 QA/QC Discussion

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

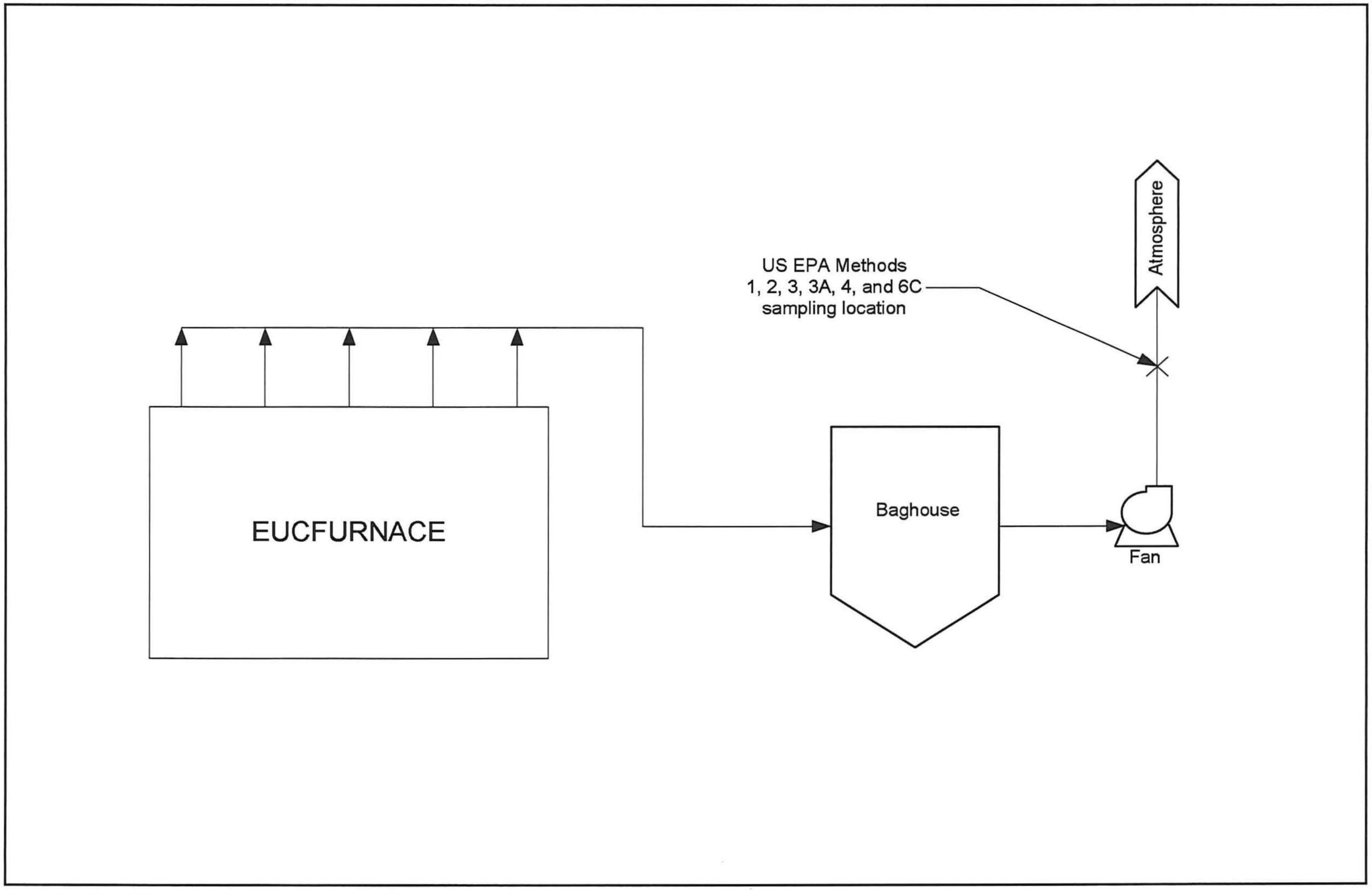
5.3 Quality Statement

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).

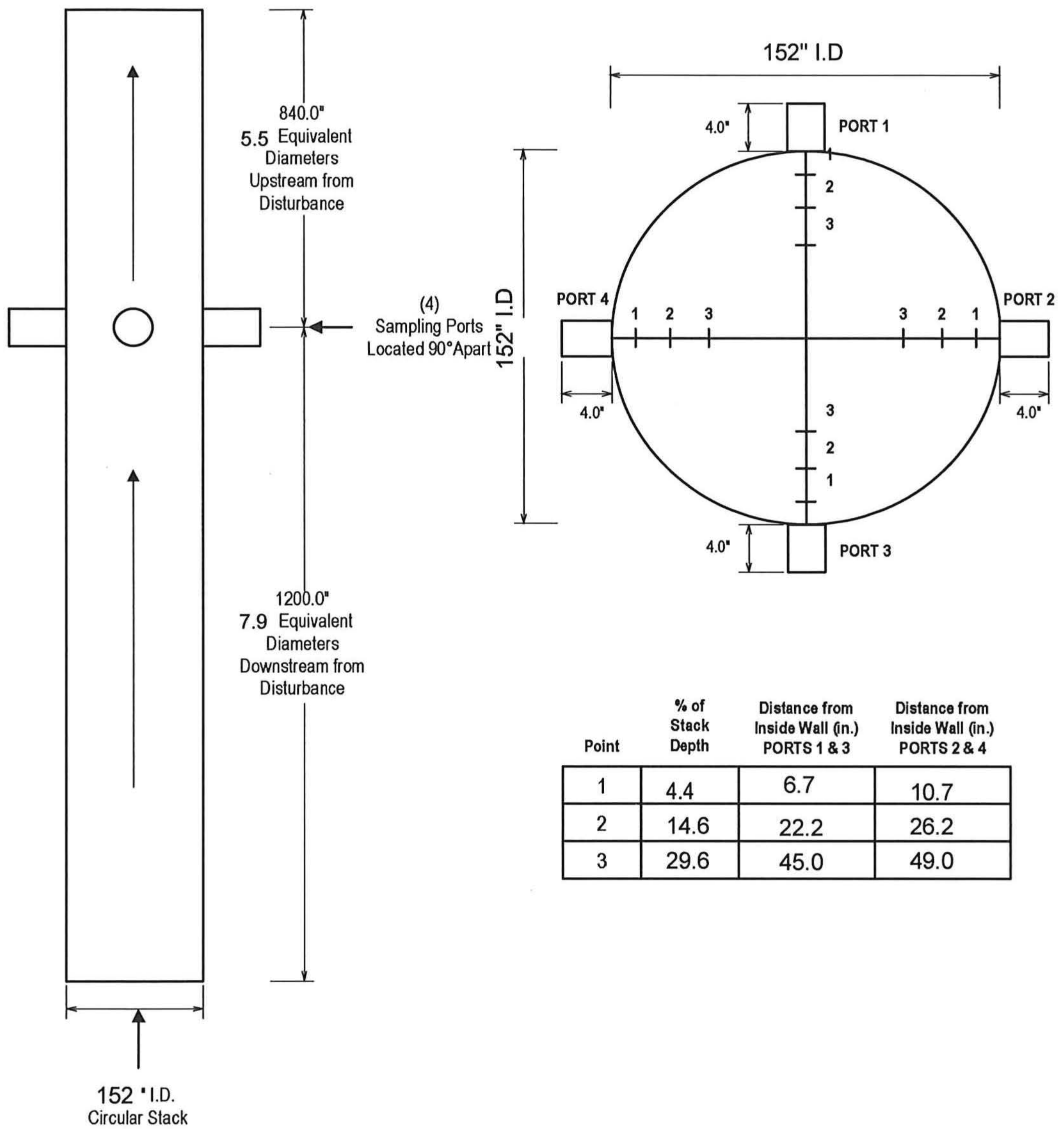
Appendix A
Field Data and Calculations

Appendix A.1
Sampling Locations

EUCFURNACE BAGHOUSE SAMPLING LOCATION SCHEMATIC

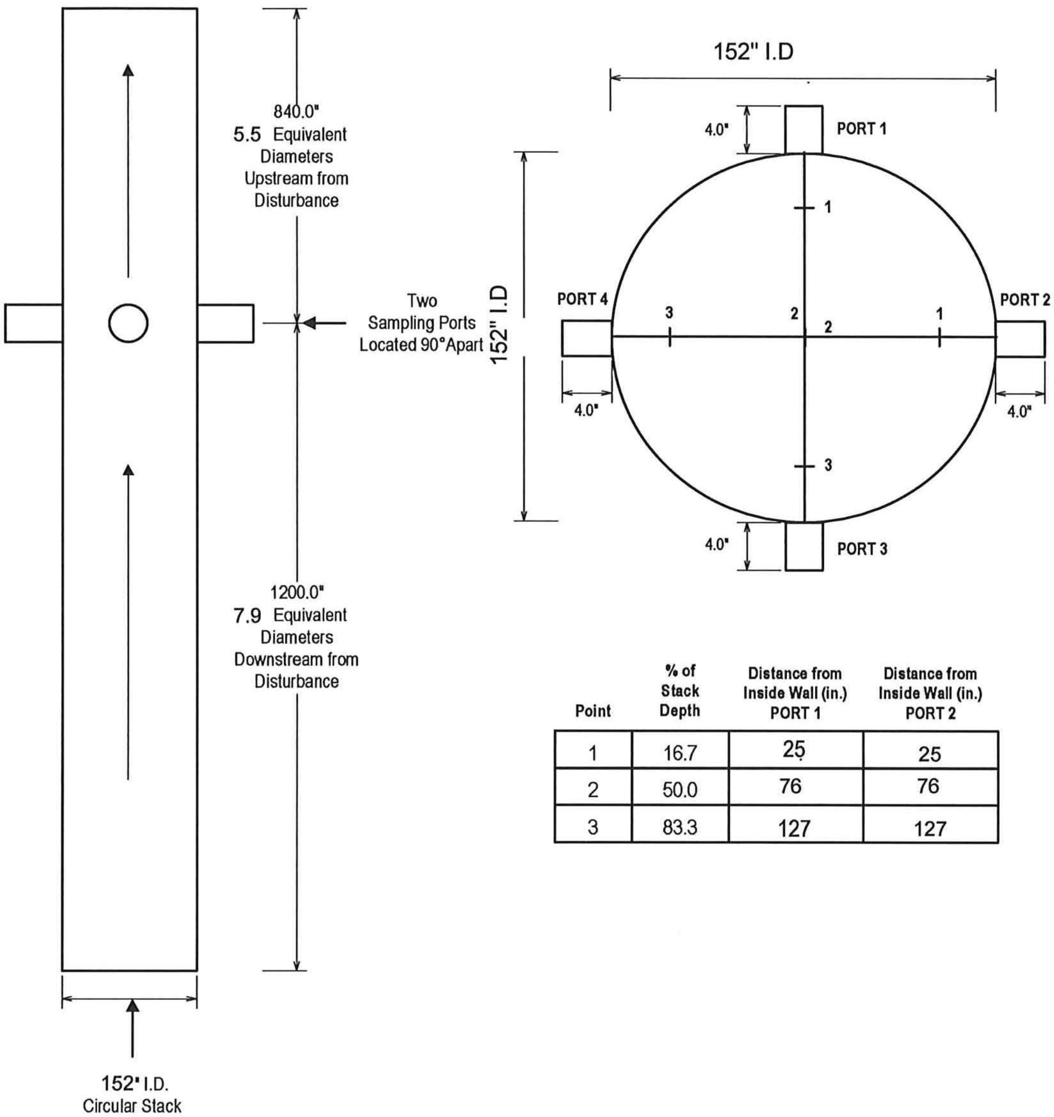


EUCFURNACE BAGHOUSE EXHAUST (FLOW) TRAVERSE POINT LOCATION DRAWING



Point	% of Stack Depth	Distance from Inside Wall (in.) PORTS 1 & 3	Distance from Inside Wall (in.) PORTS 2 & 4
1	4.4	6.7	10.7
2	14.6	22.2	26.2
3	29.6	45.0	49.0

EUCFURNACE BAGHOUSE 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	25	25
2	50.0	76	76
3	83.3	127	127