

1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

AK Steel Corporation - Dearborn Works (State Registration Number: A8640) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance emissions test program on the Basic Oxygen Furnace (EUBOF) at the AK Steel Corporation facility located in Dearborn, Michigan. The tests were conducted to satisfy the emissions testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit MI-ROP-A8640-2016a and NESHAP for Integrated Iron and Steel Manufacturing, 40 CFR 63, Subpart FFFFF. The testing was performed on October 13-14, 2020.

The specific objectives were to:

- Verify the filterable particulate matter (FPM) emissions from the electrostatic precipitator (ESP) associated with EUBOF
- Simultaneously verify the percent opacity of visible emissions (VEs) from the BOF Shop Building
- 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)*
10/13/2020- 10/14/2020	EUBOF ESP	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	144-168
10/13/2020- 10/14/2020	EUBOF ESP	O ₂ , CO ₂	EPA 3A	3	144-168
10/13/2020- 10/14/2020	EUBOF ESP	Moisture	EPA 4	3	144-168
10/13/2020- 10/14/2020	EUBOF ESP	FPM	EPA 5	3	144-168
10/13/2020- 10/14/2020	EUBOF Roof Monitor	Opacity	EPA 9	3	52-120

* Each run was a minimum of two heats.

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

AK Steel Corporation - Dearborn Works
2020 Compliance Source Test Report

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 May 5, 2020 that was submitted to and approved by the EGLE.

**TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS -
EUBOF
OCTOBER 13-14, 2020**

Parameter/Units	Average Results	Emission Limits
Filterable Particulate Matter (FPM)		
gr/dscf	0.0048	0.0152
gr/dscf (MACT)	0.0048	0.02
lb/hr	23.2	62.6
Visible Emissions (VEs) (Maximum 3-Minute Average)		
% opacity	10	20

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location: AK Steel Corporation
Dearborn Works
4001 Miller Road
Dearborn, MI 48120

Project Contact: David Pate
Role: Senior Environmental Engineer
Company: AK Steel Corporation
Telephone: 313-323-1261
Email: david.pate@aksteel.com

Agency Information

Regulatory Agency: EGLE
Agency Contact: Karen Kajjya-Mills
Telephone: 517-256-0880
Email: Kajjya-millsk@michigan.gov

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Testing Company Information

Testing Firm: Montrose Air Quality Services, LLC
Contact: Matthew Young Steven Smith
 Title: Client Project Manager Client Project Manager
Telephone: 248-548-8070 248-548-8070
 Email: myoung@montrose-env.com ssmith@montrose-env.com

Laboratory Information

Laboratory: Montrose Detroit
City, State: Royal Oak, MI
Method: EPA Method 5

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

**TABLE 1-3
TEST PERSONNEL AND OBSERVERS**

Name	Affiliation	Role/Responsibility
Mason Sakshaug	Montrose	Field Project Manager, QI
David Trahan	Montrose	Field Project Manager, QI
David Koponen	Montrose	Field Technician
Jeff Peitzsch	Montrose	Certified VE Observer
David Pate	AK Steel	Observer/Client Liaison/Test Coordinator
Katherine Koster	EGLE	Observer
Regina Angellotti	EGLE	Observer

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

AK Steel owns and operates an ESP located in Dearborn, Michigan. Scrap steel is charged into the BOF vessel and then molten iron is charged into the vessel on top of the scrap. Fluxing agents are also added during the steelmaking process. Oxygen is blown into the molten iron/scrap mixture causing the scrap to melt and refining the iron into steel by reducing the carbon content. The heat for the steelmaking process comes from the reaction of oxygen with the dissolved carbon in the molten iron.

Particulate emissions consisting of iron oxides and various other metal oxides are also produced. In order to remove the large amounts of particulate, flue gas is controlled by a 32-field electrostatic precipitator (ESP). The ESP is considered to be the "Primary" control device in the steel-making process at AK Steel -- Dearborn's BOF shop. The dust-laden gases enter the ESP and the dust particulates are electrically energized (negative charge) prior to entering the ESP. The charged particles then migrate over to the positively charged collector plates, where the particulate matter is collected. Rappers are used to impart a vibration to both the discharge electrodes and the collection plates to dislodge the accumulated dust. The clean gases pass through the ID fans and are discharged out the stack passing through the COM light pathway.

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.)	
SVBOFESP	204	600.0 / 2.9	600.0 / 2.9	Isokinetic: 24 (6/port); Gaseous: 12 (3/port)

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.

2.3 OPERATING CONDITIONS AND PROCESS DATA

Approximately 200 tons of iron per heat was charged into the BOF vessel. This was charged on top of approximately 70-80 tons of scrap. Lime was added as a flux. Once oxygen blowing was complete, the vessel was tapped and various alloys were added to obtain a desired chemistry depending on the grade of steel. Typical tap weights were between 240 and 260 tons. Approximately 30 tons of slag was also generated per heat.

Testing was performed during normal operations.

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:

- Production rate, TPH
- Steel production cycle, start and stop times
- COMS data, 1-hour and 6-minute block averages
- Number of compartments and ESP fields in operation

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TEST METHODS

The test methods for this test program were presented previously 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 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 (Stausscheibe) 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.

The sampling apparatus is detailed in Figure 3-2.

3.1.3 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.

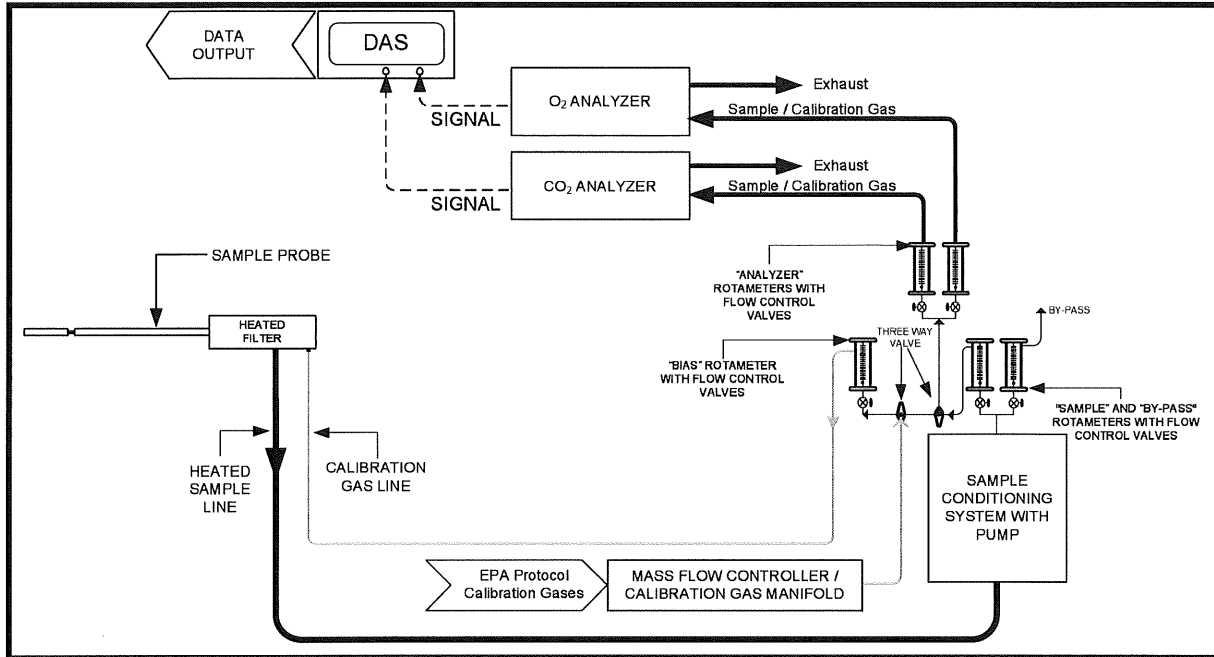
The typical sampling system is detailed in Figure 3-1.

3.1.4 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.

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

FIGURE 3-1
EPA METHODS 3A (O₂/CO₂) SAMPLING TRAIN

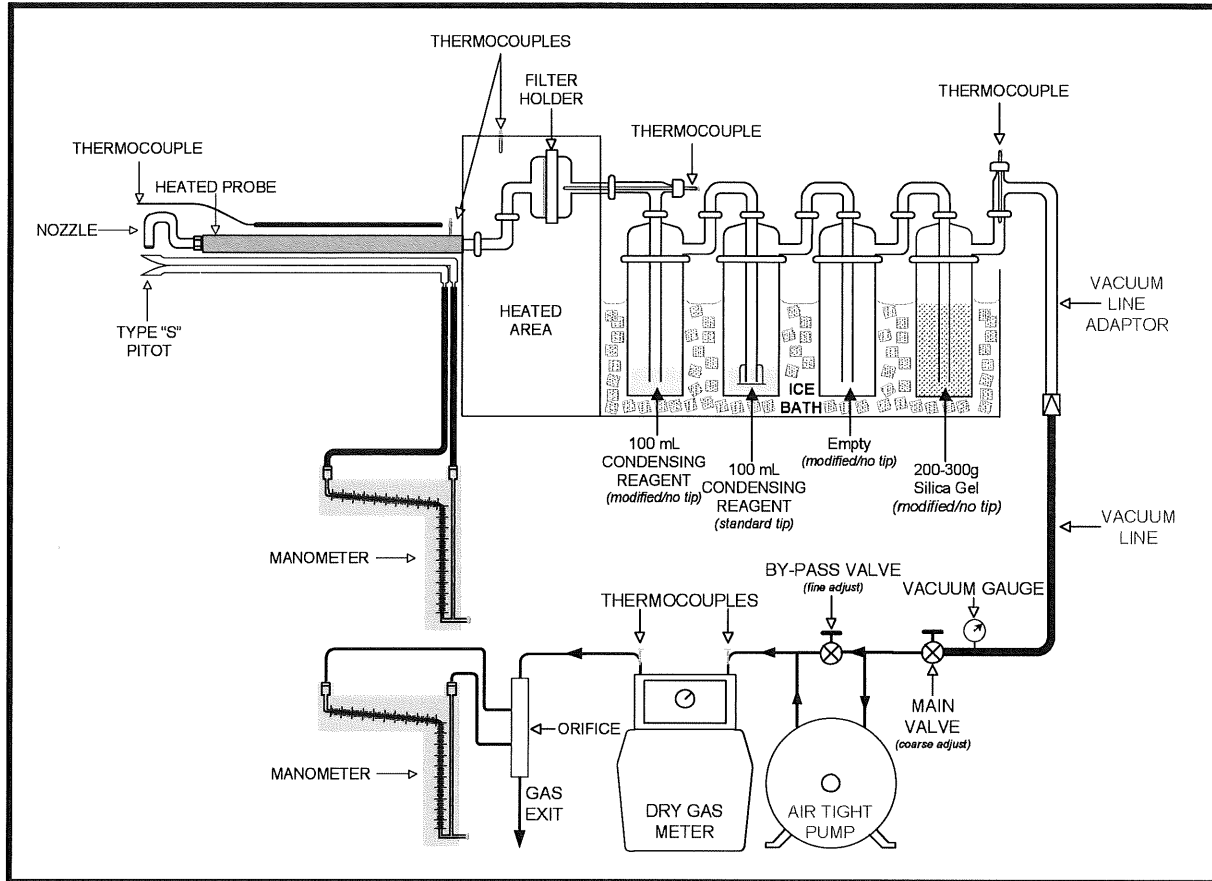


3.1.5 EPA Method 5, Determination of Particulate Matter from Stationary Sources

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 3-2.

**FIGURE 3-2
US EPA METHOD 5 SAMPLING TRAIN**



3.1.6 EPA Method 9, Visual Determination of the Opacity of Emissions

EPA Method 9 is used to observe the visual opacity of emissions (opacity). The observer stands at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to their back. The line of vision is perpendicular to the plume direction and does not include more than one plume diameter. Observations are recorded at 15-second intervals and are made to the nearest 5% opacity. The qualified observer is certified according to the requirements of EPA Method 9, section 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

4.1.1 Process Issue

Near the end of Run 1, two ESP ID fans tripped out of service due to a power loss. This caused a period of elevated and non-representative emissions. After discussion with the onsite EGLE representation, Run 1 was voided; and an additional run (Run 4) was performed. Run 1 results are not included in Table 4-1, but Run 1 data has been included in Appendix A-2.

4.1.2 Method Deviations

Proposed method deviations presented in the test plan (see Appendix E) were followed with the following comments:

- Since there was no exceedence of the roof monitor opacity limit, no investigation was required to determine the source of the emissions
- A Method 29 back half was not used. The back-half was set up in accordance with Method 5

4.2 PRESENTATION OF RESULTS

The average results are compared to the permit limits in Table 1-2. The results of individual compliance test runs performed are presented in Table 4-1. 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.

AK Steel Corporation - Dearborn Works
2020 Compliance Source Test Report

**TABLE 4-1
PMEMISSIONS RESULTS -
EUBOF**

Run Number	2	3	4	Average
Date	10/13/2020	10/14/2020	10/14/2020	--
Time	14:06-17:39	8:34-11:25	11:58-14:42	--
Process Data				
Production Rate, TPH	323.1	333.2	365.4	340.6
Flue Gas Parameters				
O ₂ , % volume dry	19.38	19.43	18.81	19.20
CO ₂ , % volume dry	2.20	2.14	3.01	2.45
flue gas temperature, °F	205.7	194.9	222.8	207.8
moisture content, % volume	13.05	12.13	14.17	13.12
volumetric flow rate, dscfm	555,686	567,872	562,445	562,001
Filterable Particulate Matter (PM)				
gr/dscf	0.0044	0.0052	0.0049	0.0048
lb/hr	20.8	25.4	23.5	23.2
Visible Emissions (VEs) (Maximum 3-Minute Average)				
% opacity	10.00	6.25	3.33	--

NOTE: Run 1 was voided due to process issue. Refer to Section 4.1.

5.0 NESHAP AND ROP TESTING REQUIREMENTS

Table 5-1 summarizes the NESHAP and ROP conditions as they relate to testing and notification requirements:

**TABLE 5-1
NESHAP AND ROP TESTING REQUIREMENTS**

NESHAP Reference	ROP Reference	NESHAP/ROP Language	Comments
40 CFR 63.7821	EUBOF V.1 and V.2	Conduct performance tests for particulate matter emissions and opacity at least twice during the ROP renewal period.	This was the second test conducted within the current ROP Renewal Period (commenced April 22, 2016, Previous test performed October 10-11, 2018)
40 CFR 63.7822(b)(1)	N/A	Determine the concentration of particulate matter according to the the listed test methods in 40 CFR 63.7822(b)(1)(i-v)	The particulate matter concentration was determined in accordance with the required test methods.
40 CFR 63.7822(b)(2)	N/A	Collect a minimum of 60 dry standard cubic feet of gas during each particulate matter test run. Three valid test runs are needed to comprise a performance test.	Between 111.142 and 128.710 dry standard cubic feet of gas were collected during each particulate matter test run.
40 CFR 63.7822(g)(1) and 40 CFR 63.7823(d)(5)	EUBOF V.1 and V.6	Sample only during the steel production cycle. Conduct sampling under conditions that are representative of normal operation. Record the start and stop time of each steel production cycle and each abnormal operation.	Sampling only occurred during the steel production cycle. The start and stop time of each steel production cycle and each abnormal operation was recorded as required.

**TABLE 5-1 continued
 NESHAP AND ROP TESTING REQUIREMENTS**

NESHAP Reference	ROP Reference	NESHAP/ROP Language	Comments
40 CFR 63.7822(g)(2)	EUBOF V.1	Sample for an integral number of steel production cycles. The steel production cycle begins when the scrap is charged to the furnace and ends 3 minutes after the slag is emptied from the vessel into the slag pot.	Sampling was conducted for an integral number of cycles subject to the limitation discussed in Test Comment 1 in the test plan. The cycle as described was documented and followed.
40 CFR 63.7823(d)(1)(ii)	EUBOF V.4	Record observations to the nearest 5 percent at 15-second intervals for at least three steel production cycles rather than using the procedure specified in Section 2.4 of Method 9.	A minimum of one complete steel production cycle was observed during each PM test run for a total of at least three steel production cycles.
40 CFR 63.7823(d)(1)(iii)	EUBOF V.4	Determine the 3-minute block average opacity from the average of 12 consecutive observations recorded at 15-second intervals.	Opacity was calculated using the 3-minute block averages in accordance with this requirement.

**TABLE 5-1 continued
 NESHAP AND ROP TESTING REQUIREMENTS**

NESHAP Reference	ROP Reference	NESHAP/ROP Language	Comments
40 CFR 63.7823(d)(4)	EUBOF V.5	Opacity observations from the roof monitors must cover at least 3 steel production cycles. The steel production cycle begins when the scrap is charged to the furnace and ends 3 minutes after the slag is emptied from the vessel into the slag pot.	An observation was conducted on a minimum of one complete steel production cycle per run for a total of at least three steel production cycles.
40 CFR 63.7823(b)	EUBOF V.2	Performance tests shall be conducted such that the opacity observations overlap with the performance test for particulate.	All opacity observations overlapped with the performance test for particulate.
40 CFR 63.7840(d)	EUBOF VII.4	Submit a notification of intent to perform any performance testing under 40 CFR Part 63, Subpart FFFFF at least 60 calendar days before testing is to begin.	The notification was submitted on May 5, 2020, 161 days prior to the start of the testing. Additional correspondence concerning movement of the test dates in presented in Appendix E.

6.0 INTERNAL QA/QC ACTIVITIES

6.1 QA/QC AUDITS

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, minimum sample durations, and percent isokinetics met the applicable QA/QC criteria.

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

EPA Method 9 was performed by a certified Visible Emissions Evaluator. For quality assurance, the observer obtained a view of the emissions with the best available contrasting background and with the sun oriented in the 140° sector to their back. Readings were taken every 15 seconds and made to the nearest 5% opacity.

EPA Method 5 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met. 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 blank. The blank did not exceed the maximum residue allowed.

6.2 QA/QC DISCUSSION

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

6.3 QUALITY STATEMENT

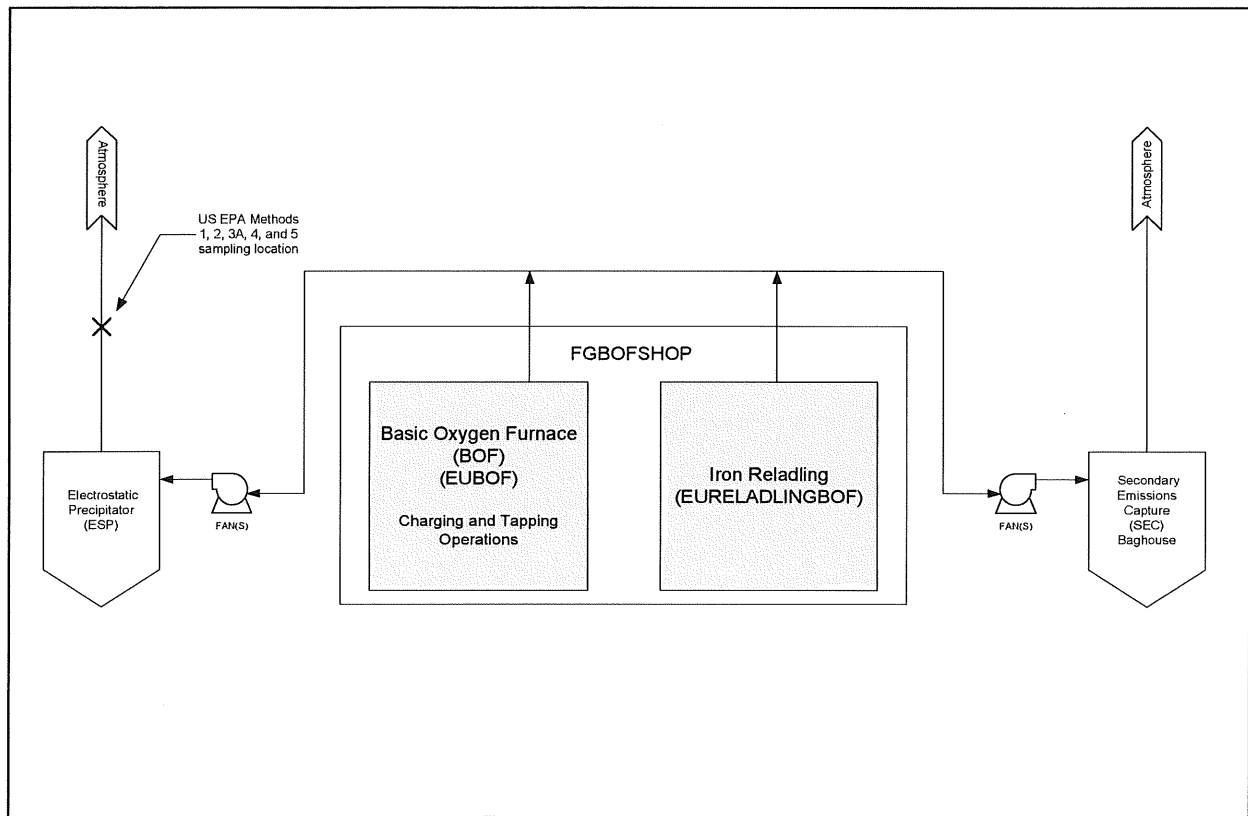
Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 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

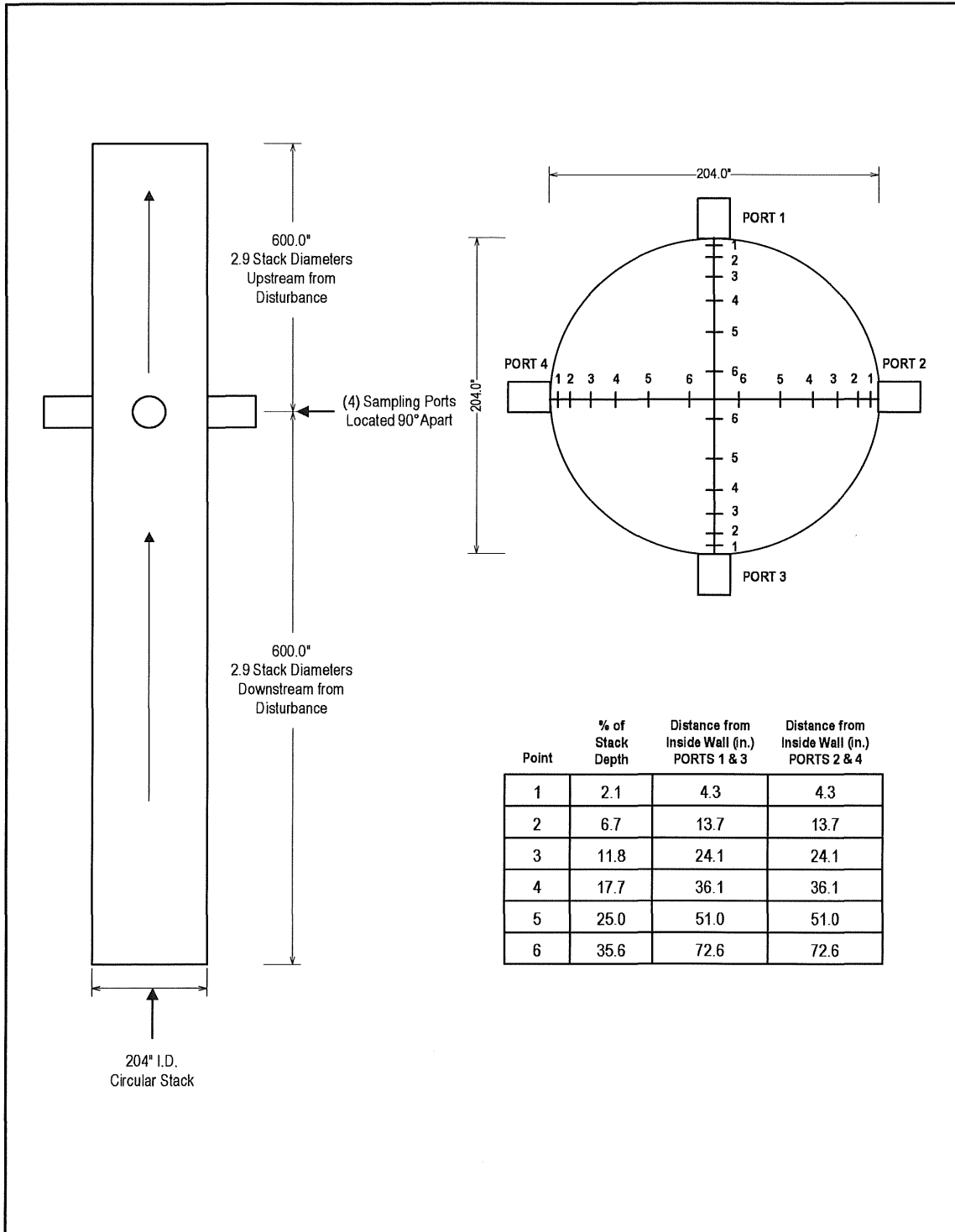
Appendix A.1 Sampling Locations

AK Steel Corporation - Dearborn Works
October 2020 Basic Oxygen Furnace (EUBOF) Compliance Test

FGBOFSHOP SAMPLING LOCATION SCHEMATIC



SVBOFESP EXHAUST STACK FLOW TRAVERSE POINT LOCATION DRAWING



SVBOFESP EXHAUST STACK CEMS TRAVERSE POINT LOCATION DRAWING

