SOURCE TEST REPORT
COMPLIANCE TESTING
C-BLAST FURNACE BAGHOUSE
AK STEEL DEARBORN WORKS
DEARBORN, MICHIGAN

Prepared for:

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1. INTRODUCTION

Environmental Quality Management, Inc. (EQM) was retained by AK Steel Dearborn Works to plan and conduct a compliance air sampling program at the C-Blast Furnace Baghouse exhaust. The compliance program was conducted to evaluate emissions of filterable particulate (PM) from the C-Blast Furnace Baghouse and visible emissions (VEs) from the C-Blast Furnace Casthouse Roof Monitors. Five sampling runs (each run at least 1 cast in duration) were conducted for each method. Visible emissions observations were conducted concurrently with the PM testing to the extent that all operating scenarios were observed. EPA-approved sampling methods and laboratory analysis procedures were used to meet the objectives of the sampling program.

An outline of the test program is presented in Table 1-1. Project participants and responsibilities are presented in Table 1-2.

Table 1-1. Sampling Requirements for AK Steel Dearborn, Michigan

Test Point No.	Test Point Name	Parameter Tested	Test Method
1	C-Blast Furnace Baghouse	Flow Moisture PM O_2, CO_2	EPA Method 2 EPA Method 4 EPA Method 5 EPA Method 3
2	C-Blast Furnace North Casthouse	Opacity	EPA Method 9
3	C-Blast Furnace East Casthouse	Opacity	EPA Method 9

Table 1-2. Project Participants

Name/Company	Responsibility
David Pate/AK Steel	Coordinate process operation and sampling activities Site/Process preparation Process information
Regina Angellotti/EGLE Jonathan Lamb/EGLE	Agency Review of Process and Sampling Procedures
Dan Scheffel/EQM Chris Janzen/EQM Ben Fern/EQM Doug Allen/EQM Eric Zang/EQM Robert Bingham/Smoke Reader LLC	Project Manager Field sampling crew Field sampling crew Field sampling crew Field sampling crew VE observations

2. SUMMARY OF TEST RESULTS

The emission measurement program was performed on June 18-20, 2019. Table 2-1 presents the average results and limit comparison. Table 2-2 presents a summary of stack gas conditions. Table 2-3 presents filterable particulate concentrations and mass emission rates. The first three runs were conducted with two fans operating. The last two runs were conducted while running a single fan. The emissions reported for particulate matter are an average of all five test runs. The opacity reported is the highest 6-minute block average observed during the testing on each casthouse.

Appendix A summarizes emission and example calculations, Appendix B presents field data, Appendix C presents laboratory results, Appendix D presents calibration data, Appendix E presents process data, Appendix F presents visible emissions data, and Appendix G presents the test protocol and regulatory letter regarding the test effort.

Table 2-1. Average Results and Limit Comparison

Source	Parameter	Emission Limit	Test Result
C-Blast Furnace Baghouse	Particulate Matter	0.01 gr/dscf[a] 0.003 gr/dscf[b] 13.87 lb/hr[b]	0.00018 gr/dscf 0.57 lb/hr
C-Blast Furnace North Casthouse Roof Monitor	Opacity	20% (6-minute block average)	6%
C-Blast Furnace East Casthouse Roof Monitor	Opacity	20% (6-minute block average)	4%

[a]NESHAP FFFFF Emission Limit
[b]ROP MI-ROP-A8640-2016a Emission Limit

Table 2-2. Stack Gas Conditions
C-Blast Furnace Baghouse

June 18-20, 2019 AK Steel, Dearborn Works

Run No.	Date/Time	Stack Gas Velocity, fps[a]	Volumetric Flow Rate		Stack Temperature, °F	Moisture Content, % H_2O	CO_2, %	O_2, %
			acfm[b]	dscfm[c]				
Two Fans Condition Test Runs								
1	6/18/2019 0916-1456	53.1	401,116	343,184	147	1.6	0.0	21.0
2	6/18/2019 1506-1916	75.0	566,763	484,930	147	1.6	0.0	21.0
3	6/19/2019 1313-1718	77.0	581,849	493,579	148	1.7	0.0	21.0
Average		**68.3**	**516,576**	**440,564**	**147**	**1.6**	**0.0**	**21.0**
Single Fan Condition Test Runs								
4	6/20/2019 0819-1037	48.1	363,756	311,412	135	2.3	0.0	21.0
5	6/20/2019 1058-1302	49.3	372,612	315,085	142	2.4	0.0	21.0
Average		**48.7**	**368,184**	**313,249**	**139**	**2.4**	**0.0**	**21.0**
Overall Average		**60.5**	**457,219**	**389,638**	**144**	**1.9**	**0.0**	**21.0**

[a]Feet per second.
[b]Actual cubic feet per minute.
[c]Dry standard cubic feet per minute.

Table 2-3. Filterable Particulate Emissions
C-Blast Furnace Baghouse

June 18-20, 2019 AK Steel, Dearborn Works

Run No.	Date/Time	Filterable Particulate Matter	
		Concentration, gr/dscf[a]	Mass Rate, lb/hr[b]
Two Fans Condition Test Runs			
1	6/18/2019 0916-1456	1.61E-04	0.47
2	6/18/2019 1506-1916	1.88E-04	0.78
3	6/19/2019 1313-1718	9.52E-05	0.40
Average		1.48E-04	0.55
Single Fan Condition Test Runs			
4	6/20/2019 0819-1037	1.90E-04	0.51
5	6/20/2019 1058-1302	2.51E-04	0.68
Average		**2.21E-04**	**0.59**
Overall Average		**1.77E-04**	**0.57**

[a]Grains per dry standard cubic foot.
[b]Pounds per hour.

3. SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used in this test program conform to EPA Reference Methods 1 through 4, 5, and 9, as published in the Federal Register.

3.1 Location of Measurement Sites

EPA Method 1, "Sample Velocity Traverses for Stationary Sources," was used to select representative measurement sites. The sampling location was at the exhaust of the C-Blast Furnace baghouse. A schematic of the test location is shown in Figure 4-1 in Section 4.

3.2 Stack Gas Volumetric Flow Rate

EPA Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rates," was used to determine stack gas volumetric flow rates. Type "S" pitot tubes meeting EPA specifications and an inclined manometer were used to measure velocity pressures. A calibrated Type "K" thermocouple attached directly to the pitot tube was used to measure stack gas temperature. The stack gas velocity was calculated from the average square root of the stack gas velocity pressure, average stack gas temperature, stack gas molecular weight, and absolute static pressure. The volumetric flow rate is the product of velocity and stack cross-sectional area.

3.3 Stack Gas Dry Molecular Weight

EPA Reference Method 3, "Gas Analysis for the Determination of Dry Molecular Weight," was used for the compliance testing on the C-Blast Furnace Baghouse to determine CO_2 and O_2 concentrations. Grab samples were collected and analyzed with a Fyrite gas analyzer once per run.

3.4 Stack Gas Moisture Content

EPA Reference Method 4, "Determination of Moisture Content in Stack Gases," was used to determine stack gas moisture content. This method was conducted as part of each particulate measurement run. The initial and final contents of all impingers were determined gravimetrically.

3.5 Filterable Particulate and Condensable

EPA Method 5 was used to measure the concentration and mass emission rate of filterable particulate matter. Five sampling runs were collected at the baghouse stack outlet location. Figures 3-2 presents schematics of the sampling train for Method 5.

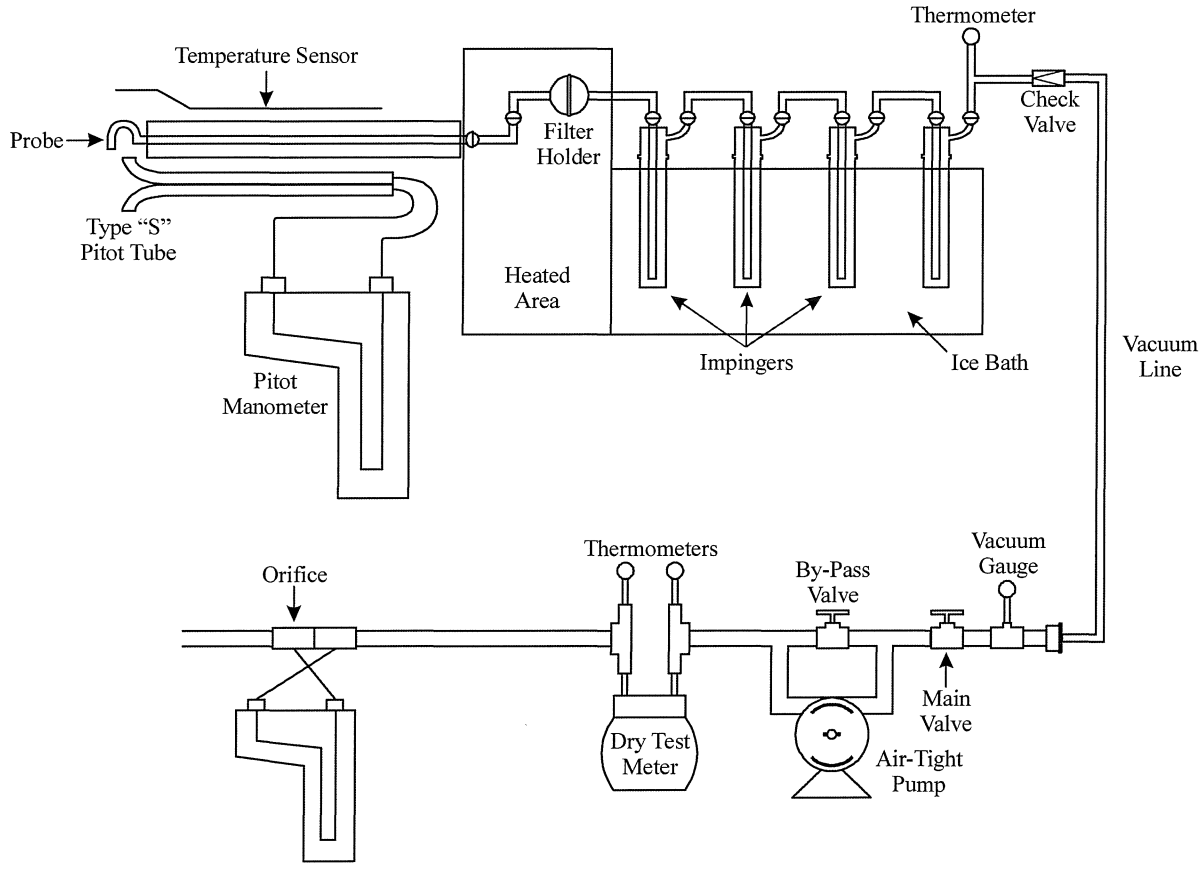


Figure 3-1. Method 5 Sampling Train

3.6 Opacity

EPA Method 9, "Visual Determination of the Opacity of Emissions from Stationary Sources," was used to measure visible emissions from the C-Blast Furnace North and East Casthouse for the test program. Observations were conducted to overlap with the particulate matter test while also covering all operating scenarios. Results are reported as the highest 6-minute block average opacity observed.

3.7 Test Comments

Test comments are presented below:

1. If EQM completed a full traverse with the sampling prior to the cast being completed, the traverse was restarted at Point 1. Sampling was continued until the cast was completed. All traverse points sampled were used in the velocity calculations.
2. The test plan presented the methodology for testing under single-fan and dual-fan operating conditions. AK Steel performed the testing as stated in the test plan, and all opacity and particulate matter results were verified to be in compliance with the standards for each fan condition. Because of this, results are reported as a 5-run average for PM. The results reported for opacity include the single-fan operating condition in the data set.

3.8 NESHAP Considerations

Table 3-1 summarizes the NESHAP and ROP conditions as they relate to testing and notification requirements.

Table 3-1. NESHAP and ROP Testing Requirements

NESHAP Reference	ROP Reference	NESHAP/ROP Language	Comments
40 CFR 63.7821(c)	EUCFURNACE V.1	Conduct performance tests for particulate matter emissions and opacity at least once every 5 years. (No less frequently than once during each term of the Title V operating permit stated in the MACT regulation)	This was the first test conducted within the current ROP Renewal Period (commenced April 22, 2016). Testing was conducted within 5 years of the previous test (Dec. 2014).
40 CFR 63.7822(b)(1)	N/A	Determine the concentration of particulate matter according to 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.

Table 3-1. NESHAP and ROP Testing Requirements (continued)

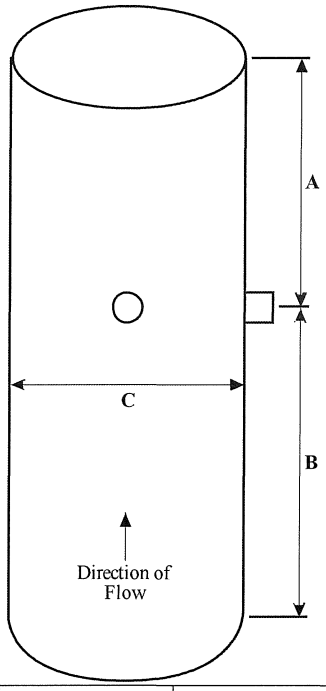
NESHAP Reference	ROP Reference	NESHAP / ROP Language	Comments
40 CFR 63.7822(b)(2)	N/A	Collect a minimum of 60 dscf of gas during the particulate matter test run. Three valid test runs are needed to comprise a performance test.	Between 76 and 227 dscf of gas were collected during each particulate matter test run. A total of 5 particulate matter test runs were performed.
40 CFR 63.7822(e)	EUCFURNACE V.2	Sample for an integral number of furnace tapping operations to obtain at least 1 hour of sampling for each test run.	Each test run consisted of 1 to 2 integral heats and was greater than 1 hour in duration.
40 CFR 63.7823(b)	EUCFURNACE V.3	Performance tests for visible emissions shall be conducted such that the opacity observations overlap with the performance test for particulate.	All visible emission observations overlapped with the PM testing.
40 CFR 63.7823(c)(1) and (c)(2)	EUCFURNACE V.4	The permittee shall demonstrate compliance with the opacity limitation with a certified observer of Method 9 visible emissions using Method 9. The performance test for visible emissions shall consist of 30 6-minute block averages during tapping of the furnace.	Observations were conducted in accordance with Method 9 using a certified Method 9 observer. More than 30 6-minute block averages were observed on both the North and East Casthouses during the testing.
40 CFR 63.7840(d)	EUCFURNACE VII.4	Submit a notification of intent to perform any performance testing under 40 CFR Part 63, Subpart FFFFF, at least 60 days before testing is to begin.	The notification was submitted on April 17, 2019, 62 days prior to testing.
40 CFR 63.7824(a)	EUCFURNACE V.5	Certify that the baghouse capture system operated during the performance test at the site-specific operating limits established in the operation and maintenance plan using procedures in 40 CFR 63.7824(a)(1-4)	The relevant certification is attached to this report. The O&M plan will be revised to reflect the new operating limits.
40 CFR 63.7824(c)	EUCFURNACE V.6	The operating limits for the baghouse capture system may be changed if the requirements in 40 CFR 63.7824(c)(1-3) are met.	All requirements of 40 CFR 63.7824(c)(1-3) were met. The O&M plan will be revised to reflect the new operating limits.

4. PROCESS DESCRIPTION/SAMPLING LOCATIONS

Molten iron (hot metal) 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 casthouse. 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 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 collection hoods and routed to a baghouse that is used to control particulate emissions from the process. Figure 4-1 presents the sampling location.



Location	Upstream A	Downstream B	Inside Diameter C
C Blast Furnace Baghouse	>25 ft	>101 ft	152 in.
4 Sampling Ports	Three Traverse Points per Port		12 Total Sampling Points
Traverse Pt 1: 5.69 in.	Travers Pt 2: 22.19 in.		Traverse Pt 3: 44.99 in.

Figure 4-1. Sampling Location

5. QUALITY ASSURANCE AND QUALITY CONTROL

The field sampling quality assurance for this project included the use of calibrated source sampling equipment, reference test methods, and traceability protocols for recording and calculating data. The analytical quality assurance includes use of validated analytical procedures, calibration of equipment, and analysis of control samples and blanks. The calibration and quality control procedures used for this test program are described in the following subsection.

5.1 Calibration Procedures and Frequency

All manual stack gas sampling equipment is calibrated before the start of the test program in accordance with the procedures outlined in the *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III*, EPA-600/4-72-027B. Table 5-1 is a summary of the stack gas sampling equipment calibrations that are performed in preparation for this project. The meter boxes are re-calibrated after the test.

Table 5-2 lists additional calibration checks performed on the sampling equipment on site, just prior to the testing, to ensure that equipment was not damaged during transport.

Table 5-1. Field Equipment Calibration Summary[a]

Equipment	Calibrated Against	Allowable Error
Method 5 meter box	Reference test meter	Y ±0.02 Y ΔH@ ±0.20 ΔH@ post-test Y ±0.05 Y
Pitot tube	Geometric specifications	See EPA Method 2
Thermocouple	ASTM-3F thermometer	±1.5%
Impinger (or condenser thermometer)	ASTM-3F	±2°F
Dry gas meter thermometer	ASTM-3F	±5°F
Probe nozzles	Caliper	±0.004 in.
Barometer	NBS traceable barometer	±0.1 in. Hg

[a]As recommended in the *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III. Stationary Source-Specific Methods*. EPA-600/4-77-027b, August 1977.

Table 5-2. Field Checks of Sampling Equipment

Equipment	Checked Against	Allowable Difference
Pitot tube	Inspection	No visible damage
Thermocouples	ASTM 2F or 3F	±1.5%
Probe nozzles	Caliper	±0.004 in.