



RECEIVED

FEB 21 2023

QUALITY DIVISION

## Source Test Report

Cleveland-Cliffs Dearborn Works  
4001 Miller Road  
Dearborn, MI 48120  
Permit Number: MI-ROP-A8640-2016a  
Facility SRN: A8640; Wayne County

Source Tested: ESP Stack (SVBOFESP)  
Test Dates: December 20-21, 2022  
Report Submittal Date: January 23, 2023

Project No. AST-2022-3715

---

Prepared By  
Alliance Technical Group, LLC  
20 Parkway View Drive  
Pittsburgh, PA 15205

EGLE-AQD Detroit District Office  
Regina Angellotti  
AngellottiR1@Michigan.gov  
(313) 418-0895



**Regulatory Information**

*Permit Nos.* Michigan Department of Environment, Great Lakes, and Energy (EGLE)  
Renewable Operating Permit No. IM-ROP-A8640-2016a  
*Regulatory Citation* 40 CFR 63, Subpart FFFFF

**Source Information**

<i>Source Name</i>	<i>Source ID</i>	<i>Target Parameters</i>
ESP Stack	SVBOFESP	Pb, Mn, , Hg, PM, PM10, PM2.5, VE
SEC Baghouse Stack	SVBOFBH	Pb, Mn, Hg

**Contact Information**

<i>Test Location</i>	<i>Test Company</i>	<i>Analytical Laboratories</i>
Cleveland-Cliffs Dearborn Works 4001 Miller Road Dearborn, MI 48120	Alliance Technical Group, LLC 20 Parkway View Drive Pittsburgh, PA 15205	Alliance Technical Group, LLC 214 Central Circle SW Decatur, AL 35603 John Lawrence john.lawrence@stacktest.com (256) 351-0121 ext. 124
<i>Facility Contact</i> David Pate david.pate@clevelandcliffs.com 313-323-1261	<i>Operations Manager</i> Adam Robinson adam.robinson@alliancetg.com (412) 862-5351 <i>Field Team Leader</i>	<i>Eurofins TestAmerica</i> 5815 Middlebrook Pike Knoxville, TN 37921 Kevin Woodcock kevin.woodcock@testamericainc.com (865) 291-3000
	<i>Field Team Leader</i> Justin Bernard justin.bernard@alliancetg.com (412) 951-0576	
	<i>QA/QC Manager</i> Kathleen Shonk katie.shonk@alliancetg.com (812) 452-4785	
	<i>Report Coordinator</i> Lauren Carney lauren.carney@alliancetg.com (856) 372-9245	



Alliance Technical Group, LLC (Alliance) has completed the source testing as described in this report. Results apply only to the source(s) tested and operating condition(s) for the specific test date(s) and time(s) identified within this report. All results are intended to be considered in their entirety, and Alliance is not responsible for use of less than the complete test report without written consent. This report shall not be reproduced in full or in part without written approval from the customer.

To the best of my knowledge and abilities, all information, facts and test data are correct. Data presented in this report has been checked for completeness and is accurate, error-free and legible. Onsite testing was conducted in accordance with approved internal Standard Operating Procedures. Any deviations or problems are detailed in the relevant sections in the test report.

This report is only considered valid once an authorized representative of Alliance has signed in the space provided below; any other version is considered draft. This document was prepared in portable document format (.pdf) and contains pages as identified in the bottom footer of this document.



\_\_\_\_\_  
**Adam Robinson, QSTI**  
**Alliance Technical Group, LLC**

2/14/2023

\_\_\_\_\_  
Date



**TABLE OF CONTENTS**

1.0 Introduction ..... 1-1

    1.1 Facility Description ..... 1-1

    1.2 Project Team ..... 1-2

    1.3 Site Specific Test Plan & Notification ..... 1-2

    1.4 Test Comments and Method Deviations ..... 1-2

    1.5 Process Data ..... 1-3

2.0 Summary of Results ..... 2-1

3.0 Testing Methodology ..... 3-1

    3.1 U.S. EPA Reference Test Methods 1 and 2 – Sampling/Traverse Points and Volumetric Flow Rate ..... 3-1

    3.2 U.S. EPA Reference Test Method 3/3A – Oxygen/Carbon Dioxide ..... 3-1

    3.3 U.S. EPA Reference Test Method 4 – Moisture Content ..... 3-1

    3.4 U.S. EPA Reference Test Methods 5 and 202 – Total Particulate Matter ..... 3-1

    3.5 U.S. EPA Reference Test Method 9 – Visible Emissions Evaluations ..... 3-2

    3.6 U.S. EPA Reference Test Method 29 – Metals ..... 3-2

    3.7 Quality Assurance/Quality Control – U.S. EPA Reference Test Method 3/3A ..... 3-3

**LIST OF TABLES**

Table 1-1: Project Team ..... 1-2

Table 2-1: Summary of Results – ESP Baghouse (SVBOFESP) & SEC Baghouse (SVBOFBH) ..... 2-1

Table 3-1: Source Testing Methodology ..... 3-1

**APPENDICES**

- Appendix A Sample Calculations
- Appendix B Field Data
- Appendix C Laboratory Data
- Appendix D Quality Assurance/Quality Control Data
- Appendix E Process Operating/Control System Data
- Appendix F VEE Data
- Appendix G Test Protocol and Associated Documentation



## Introduction



## 1.0 Introduction

Alliance Technical Group, LLC (Alliance) was retained by Cleveland-Cliffs Dearborn Works (Cleveland-Cliffs) to conduct compliance testing at the Dearborn, MI facility. The facility operates under Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit No. MI-ROP-A8640-2016a. Testing was conducted to determine the concentration and emission rates of filterable particulate matter (PM), particulate matter less than 10 microns (PM10), and particulate matter less than 2.5 microns (PM2.5) from the Electrostatic Precipitator (ESP) and the lead (Pb), manganese (Mn) and mercury (Hg) emission rates for the ESP and SEC Baghouse combined after the completion of Phase IV of the ESP rebuild project. In addition, the testing was conducted as a retest from previous compliance testing conducted on the ESP and SEC Baghouse for Pb, Mn, and Hg in July 2022. Additional visible emissions evaluations (VEE) were also conducted on the ESP Stack and the BOF Roof Monitor concurrently with the particulate matter testing.

### 1.1 Facility Description

Cleveland-Cliffs Dearborn Works owns and operates a Basic Oxygen Furnace (BOF) Steel Shop 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 an ESP. The ESP is considered to be the "Primary" control device in the steel making process at CCDW's BOF shop. The dust-laden gases enter the ESP where the dust particulates are electrically charged. 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. A continuous opacity monitor (COMS) measures opacity of the clean gas on the stack. In addition to the ESP, a Secondary Emission Control Baghouse (SEBH) is in operation at the facility, which collects and controls particulate emissions during the hot metal charging and tapping operations that occur at the BOF vessels during the steel making process. Additionally, the BOF Secondary Baghouse controls emissions generated by the iron reladling operation.

RECEIVED  
FEB 21 2023  
AIR QUALITY DIVISION

**1.2 Project Team**

Personnel involved in this project are identified in the following table.

**Table 1-1: Project Team**

<b>Facility Personnel</b>	David Pate – Cleveland Cliffs
<b>Regulatory Personnel</b>	EGLE – Regina Angellotti EGLE – Katherine Koster
<b>Alliance Personnel</b>	Justin Bernard Dennis Haynes Dillan Jeffrey Calla Solomon Joe Stanger

**1.3 Site Specific Test Plan & Notification**

Testing was conducted in accordance with the Site Specific Test Plan (SSTP) submitted to the EGLE by Cleveland Cliffs on October 21, 2022 and response letter dated December 12, 2022.

**1.4 Test Comments and Method Deviations**

1. CCDW operates 2 BOF Vessels that exhaust to a common ESP. While oxygen blowing can only take place on vessel at a time, oxygen blowing could be occurring on a vessel while performing charging, tapping, and deslagging on the other vessel. Consequently, there was overlap into a heat on the other vessel when the end of the production cycle was reached on the reference vessel. When this occurred, all runs were ended at the end of the production cycle regardless of what was taking place on the other vessel. Production was pro-rated to account for these occurrences of overlap. This procedure was described in the pre-test plan.

2. No port changes took place during oxygen blowing on the ESP. When it was time for a port change, the probe was left in the port until the completion of the oxygen blow. Once the oxygen blow was completed, the probe was moved to the next port and sampling was resumed at the first point. This procedure was described in the pre-test plan.

3. In cases where the end of the sampling run did not correspond with the end of the heat, points were traversed in reverse order until the heat was completed. This was necessary to sample for integral heats. The procedure was described in the pre-test plan.

4. The test plan stated that a minimum 60 minute, 1 heat visible emission observation would be conducted on the ESP stack during each PM test run. Due to darkness, no VE readings were conducted during run 3. Instead, additional observations were conducted during run 2. This was approved in onsite discussions with the EGLE observers.

5. Run 1 of the ESP PM test did not include a scrap charge on one of the 2 heats sampled. This was due to the scrap charge taking place approximately 1 hour prior to the hot metal charge due to a process delay. Runs 2 and 3 of the PM test and Runs 2 and 3 of the metals testing started on hot metal charges. In each of these cases, the integral heat requirement was satisfied as the runs included additional partial heats in which the scrap charge was sampled.

### 1.5 Process Data

The following process data was collected during the test:

1. Steel Production Rate, TPH
2. Start and stop time of each steel production cycle and oxygen blow
3. Average oxygen blow rate per heat
4. Start and stop time of charging, tapping, and reladling per heat
5. Number and identification of the ESP casings, compartments, and fields in operation per heat.
6. Average ESP inlet draft during oxygen blowing on the oxygen blowing vessel measured per heat
7. Average primary louver position of the blowing vessel per heat
8. ESP COMS 1-hour and 6-minute block average data per heat
9. Baghouse pressure drop and bag leak detector readings per heat
10. Number of baghouse fans in operation, damper positions, and fan speeds
11. Identification of baghouse compartments in operation per heat
12. Manganese and Lead concentration in the hot metal per heat
13. Collection and analysis of dust sample for Lead and Manganese from the ESP hopper per test run

All process data is presented in Appendix E.



**Summary of Results**



**2.0 Summary of Results**

Alliance conducted compliance testing at the Cleveland Cliffs facility in Dearborn, MI on December 20-21, 2022. Testing consisted of determining the emission rates of PM, PM10 and PM2.5 from the ESP and Pb, Mn and Hg for the ESP and SEC Baghouse. VEEs were conducted on the ESP Baghouse and EUBOF Roof Monitor concurrently with the particulate matter testing.

Tables 2-1 provides a summary of the emission testing results with comparisons to the applicable EGLE permit limits. Any difference between the summary results listed in the following tables and the detailed results contained in appendices is due to rounding for presentation.

**Table 2-1: Summary of Results – ESP Baghouse (SVBOFESP) & SEC Baghouse (SVBOFBH)**

<b>ESP Baghouse – Particulate Matter</b>				
<b>Run Number</b>	<b>Run 1</b>	<b>Run 2</b>	<b>Run 3</b>	<b>Average</b>
<b>Date</b>	<b>12/20/22</b>	<b>12/20/22</b>	<b>12/20/22</b>	<b>--</b>
<b>Filterable Particulate Matter Data</b>				
Concentration, grain/dscf	0.0038	0.0019	0.0030	0.0029
Permit Limit, grain/dscf	--	--	--	0.0152
<b>Percent of Limit, %</b>	--	--	--	<b>19</b>
Emission Rate, lb/hr	15.2	7.2	11.5	11.3
Permit Limit, lb/hr	--	--	--	62.6
<b>Percent of Limit, %</b>	--	--	--	<b>18</b>
<b>Total Particulate Matter Data</b>				
Emission Rate, lb/hr	17.1	9.7	15.1	13.9
PM2.5 Permit Limit, lb/hr	--	--	--	46.85
<b>Percent of Limit, %</b>	--	--	--	<b>30</b>
PM10 Permit Limit, lb/hr	--	--	--	47.5
<b>Percent of Limit, %</b>	--	--	--	<b>29</b>
<b>Opacity (Average is highest observed)</b>				
ESP Baghouse Stack Opacity, %	0.0	0.0	0.0	0.0
Permit Limit, %, 6-min Average				20
EUBOF Roof Monitor Opacity, %	--	--	--	2
Permit Limit, %, 3-min Average	--	--	--	15
Subpart FFFFF Limit, %, 3-min Average	--	--	--	20
<b>Combined ESP &amp; SEC Baghouses - Metals</b>				
<b>Run Number</b>	<b>Run 1</b>	<b>Run 2</b>	<b>Run 3</b>	<b>Average</b>
<b>Date</b>	<b>12/21/22</b>	<b>12/21/22</b>	<b>12/21/22</b>	<b>--</b>
<b>Lead Data *</b>				
ESP Stack Emission Rate, lb/hr	0.0087	0.0127	0.0114	0.0109
SEC Baghouse Emission Rate, lb/hr	0.0063	0.0058	0.0037	0.0053
Combined SEC & ESP Emission Rate, lb/hr	0.015	0.018	0.015	0.016
Permit Limit, lb/hr	--	--	--	0.067
<b>Percent of Limit, %</b>	--	--	--	<b>24</b>
<b>Manganese Data</b>				
ESP Stack Emission Rate, lb/hr	0.062	0.038	0.057	0.052
SEC Baghouse Emission Rate, lb/hr	0.023	0.016	0.012	0.017
Combined SEC & ESP Emission Rate, lb/hr	0.085	0.054	0.069	0.07
Permit Limit, lb/hr	--	--	--	0.10
<b>Percent of Limit, %</b>	--	--	--	<b>70</b>
<b>Mercury Data</b>				
ESP Stack Emission Rate, lb/hr	0.0014	0.0015	0.0014	0.0014
SEC Baghouse Emission Rate, lb/hr	0.0014	0.0014	0.0018	0.0015
Combined SEC and ESP Emission Rate, lb/hr	0.0028	0.0029	0.0033	0.0030
Permit Limit, lb/hr	--	--	--	0.0086
<b>Percent of Limit, %</b>	--	--	--	<b>35</b>

\*The laboratory results for Pb Run 3 and Hg Runs 1-3 contain one or more sample fraction that returned a Non-Detect during analysis. MDL was used for emission calculations.

## Testing Methodology



### 3.0 Testing Methodology

The emission testing program was conducted in accordance with the test methods listed in Table 3-1. Method descriptions are provided below while quality assurance/quality control data is provided in Appendix D.

**Table 3-1: Source Testing Methodology**

Parameter	U.S. EPA Reference Test Methods	Notes/Remarks
Volumetric Flow Rate	1 & 2	Full Velocity Traverses
Oxygen/Carbon Dioxide	3/3A	Integrated Bag / Instrumental Analysis
Moisture Content	4	Gravimetric Analysis
Particulate Matter, PM10, PM2.5	5 / 202	Isokinetic Sampling
Visible Emissions Evaluation	9	Certified Observer
Lead, Manganese and Mercury	29	Isokinetic Testing

#### 3.1 U.S. EPA Reference Test Methods 1 and 2 – Sampling/Traverse Points and Volumetric Flow Rate

The sampling location and number of traverse (sampling) points were selected in accordance with U.S. EPA Reference Test Method 1. To determine the minimum number of traverse points, the upstream and downstream distances were equated into equivalent diameters and compared to Figure 1-1 in U.S. EPA Reference Test Method 1.

Full velocity traverses were conducted in accordance with U.S. EPA Reference Test Method 2 to determine the average stack gas velocity pressure, static pressure and temperature. The velocity and static pressure measurement system consisted of a pitot tube and inclined manometer. The stack gas temperature was measured with a K-type thermocouple and pyrometer.

Stack gas velocity pressure and temperature readings were recorded during each test run. The data collected was utilized to calculate the volumetric flow rate in accordance with U.S. EPA Reference Test Method 2.

#### 3.2 U.S. EPA Reference Test Method 3/3A – Oxygen/Carbon Dioxide

The oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) testing was conducted in accordance with U.S. EPA Reference Test Method 3/3A. One (1) integrated Tedlar bag sample was collected during each test run. The bag samples were analyzed on site with a gas analyzer. The remaining stack gas constituent was assumed to be nitrogen for the stack gas molecular weight determination. The quality control measures are described in Section 3.7.

#### 3.3 U.S. EPA Reference Test Method 4 – Moisture Content

The stack gas moisture content (BWS) was determined in accordance with U.S. EPA Reference Test Method 4. The gas conditioning train consisted of a series of chilled impingers. Prior to testing, each impinger was filled with a known quantity of liquid or silica gel. Each impinger was analyzed gravimetrically before and after each test run on the same balance to determine the amount of moisture condensed.

#### 3.4 U.S. EPA Reference Test Methods 5 and 202 – Total Particulate Matter

The total particulate matter (filterable and condensable PM) testing was conducted in accordance with U.S. EPA Reference Test Methods 5 and 202. The complete sampling system consisted of a glass nozzle, glass-lined probe,

pre-weighed quartz filter, coil condenser, un-weighed Teflon filter, gas conditioning train, pump and calibrated dry gas meter. The gas conditioning train consisted of a coiled condenser and five (5) chilled impingers. The first, and second impingers were initially empty, the third contained 100 mL of de-ionized water, an empty fourth impinger and the last impinger contained 200-300 grams of silica gel. The un-weighed 90 mm Teflon filter was placed between the second and third impingers. The probe liner heating system was maintained at a temperature of  $248 \pm 25^\circ\text{F}$ , and the impinger temperature was maintained at  $68^\circ\text{F}$  or less throughout testing. The temperature of the Teflon filter was maintained greater than  $65^\circ\text{F}$  but less than or equal to  $85^\circ\text{F}$ .

Following the completion of each test run, the sampling train was leak checked at a vacuum pressure greater than or equal to the highest vacuum pressure observed during the run. Condensate was collected in the first dry impinger, therefore the front-half of the sample train (the nozzle, probe, and heated pre-weighed filter) was removed in order to purge the back-half of the sample train (coil condenser, first and second impingers and CPM filter). A glass bubbler was inserted into the first impinger. If needed, de-ionized ultra-filtered (DIUF) water was added to the first impinger to raise the water level above the bubbler, then the coil condenser was replaced. Zero nitrogen was connected to the condenser, and a 60-minute purge at 14 liters per minute was conducted. After the completion of the nitrogen purge the impinger contents were measured for moisture gain.

The pre-weighed quartz filter was carefully removed and placed in container 1. The probe, nozzle and front half of the filter holder were rinsed three (3) times with acetone to remove any adhering particulate matter and these rinses were recovered in container 2. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for filterable particulate matter analysis.

The contents of impingers 1 and 2 were recovered in container CPM Cont. #1. The back half of the filterable PM filter holder, the coil condenser, impingers 1 and 2 and all connecting glassware were rinsed with DIUF water and then rinsed with acetone, followed by hexane. The water rinses were added to container CPM Cont. #1 while the solvent rinses were recovered in container CPM Cont. #2. The Teflon filter was removed from the filter holder and placed in container CPM Cont. #3. The front half of the condensable PM filter holder was rinsed with DIUF water and then with acetone, followed by hexane. The water rinse was added to container CPM Cont. #1 while the solvent rinses were added to container CPM Cont. #2. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for condensable particulate matter analysis. It should be noted that PM10 and PM2.5 were calculated as the sum of the filterable and condensable particulate matter fractions.

### **3.5 U.S. EPA Reference Test Method 9 – Visible Emissions Evaluations**

The stack gas opacity was determined in accordance with U.S. EPA Reference Test 9. Visible emission evaluations were conducted by a certified visible emissions evaluator. Opacity readings were recorded in 15-second intervals during each evaluation. A minimum of 180 minutes and 3 heats concurrent with the PM sampling were observed on the ESP stack and the BOF Roof Monitor.

### **3.6 U.S. EPA Reference Test Method 29 – Metals**

The metals testing was conducted in accordance with U.S. EPA Reference Test Method 29. The complete sampling system consisted of a glass nozzle, glass-lined probe, pre-cleaned heated quartz filter, gas conditioning system, pump and calibrated dry gas meter. The gas conditioning train consisted of six (6) chilled impingers. The first and second impingers contained 100 mL of  $\text{HNO}_3/\text{H}_2\text{O}_2$ , the third was empty, the fourth and fifth contained 100 mL of acidic  $\text{KMnO}_4$ , and the sixth contained 200-300 grams of silica gel. The probe liner and filter heating systems were maintained at a temperature of  $120 \pm 14^\circ\text{C}$  ( $248 \pm 25^\circ\text{F}$ ), and the impinger temperature was maintained at  $20^\circ\text{C}$

(68°F) or less throughout testing. Prior to testing, all glassware was cleaned and sealed in a controlled environment as outlined in the test method.

Following the completion of each test run, the sample train was leak checked at a vacuum pressure equal to or greater than the highest vacuum pressure observed during the run and the contents of the impingers were measured for moisture gain. The quartz filter was carefully removed and placed into container 1. The probe and nozzle were rinsed and brushed three (3) times with 0.1 N HNO<sub>3</sub> using a non-metallic brush and these rinses were placed in container 2. The front half of the filter holder was rinsed three (3) times with 0.1 N HNO<sub>3</sub> and these rinses were added to container 3. The contents of impingers 1, 2, and 3 were placed in container 4. Impingers 1, 2, and 3 along with the filter support, back half of the filter holder and all connecting glassware were triple-rinsed with 0.1 N HNO<sub>3</sub> and these rinses were added to container 4. The contents of impinger 4 were placed in container 5A. The impinger and connecting glassware were triple-rinsed with HNO<sub>3</sub> and these rinses added to container 5A. The contents of impingers 5 and 6 were placed in container 5B. The impingers and all connecting glassware were triple-rinsed with acidified KMNO<sub>4</sub> and then with de-ionized (DI) water and these rinses were added to container 5B. Impingers 5 and 6 were rinsed again with 25 mL of 8N HCl and this rinse was collected into container 5C, which contained 200 mL of DI water. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for analysis.

### 3.7 Quality Assurance/Quality Control – U.S. EPA Reference Test Method 3/3A

Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Low-Level gas was introduced directly to the analyzer. After adjusting the analyzer to the Low-Level gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas. For the Calibration Error Test, Low, Mid, and High-Level calibration gases were sequentially introduced directly to the analyzer. All values were within 2.0 percent of the Calibration Span or 0.5% absolute difference.

At the completion of testing, the data was also saved to the Alliance server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at Alliance's office, all written and electronic data was relinquished to the report coordinator and then a final review was performed by the Project Manager.

