



**No. 2 Basic Oxygen Process
Electrostatic Precipitator
Particulate Emissions Test Report**

Prepared for:

United States Steel Corporation

Ecorse, Michigan

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AIR QUALITY DIV.

Great Lakes Works
No. 1 Quality Drive
Ecorse, Michigan 48229

BTEC Project No. 16-4955.01
January 26, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Ave
Royal Oak, Michigan 48073
(248) 548-8070



RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION

AIR QUALITY DIV.

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating (RO) Permit program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as described in General Condition No. 22 in the RO Permit and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name United States Steel Corporation Great Lakes Works County Wayne

Source Address #1 Quality Drive City Ecorse

AQD Source ID (SRN) A7809 RO Permit No. 199600132d RO Permit Section No. 1 & 5

Please check the appropriate box(es):

Annual Compliance Certification (General Condition No. 28 and No. 29 of the RO Permit)

Reporting period (provide inclusive dates): From _____ To _____

1. During the entire reporting period, this source was in compliance with ALL terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the RO Permit.

2. During the entire reporting period this source was in compliance with all terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference, EXCEPT for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the RO Permit, unless otherwise indicated and described on the enclosed deviation report(s).

Semi-Annual (or More Frequent) Report Certification (General Condition No. 23 of the RO Permit)

Reporting period (provide inclusive dates): From _____ To _____

1. During the entire reporting period, ALL monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred.

2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred, EXCEPT for the deviations identified on the enclosed deviation report(s).

Other Report Certification

Reporting period (provide inclusive dates): From Dec. 13, 2016 To Dec. 14, 2014

Additional monitoring reports or other applicable documents required by the RO Permit are attached as described:
Submittal of BOP ESP Stack Test results from the December 13-14, 2016 test.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete.

Ronald Kostyo	General Manager	313-749-2210
Name of Responsible Official (print or type)	Title	Phone Number
<u>Ronald Kostyo</u>		<u>2/8/17</u>
Signature of Responsible Official		Date

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Company (U. S. Steel) to evaluate particulate matter (PM) emission rates from the No. 2 Basic Oxygen Plant (BOP) Electrostatic Precipitator (ESP) located at No. 1 Quality Drive in Ecorse, Michigan. The emissions testing program was conducted on December 13-14, 2016. The purpose of this report is to document the results of the test program.

The ESP source is located at the U. S. Steel facility in Ecorse, Michigan. The testing was performed as a compliance demonstration for permit No. 199600132d. The applicable permit limit is 0.057 pound per 1,000 pounds dry gas.

The results of the emission test program are summarized by Table I.

Table I
Executive Summary Table PM Emission Rate Summary

Source	Pollutant	Limit	Results
ESP	PM	0.057 lb/1000 lb (dry) - Permit	0.004 lb/1000 lb (dry)
			0.002 gr/dscf
			8.37 lb/hr



1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Company (U. S. Steel) to evaluate particulate matter (PM) emission rates from the No. 2 Basic Oxygen Plant (BOP) Electrostatic Precipitator (ESP) located at No. 1 Quality Drive in Ecorse, Michigan. The emissions testing program was conducted on December 13-14, 2016. The purpose of this report is to document the results of the test program.

The testing was performed as a compliance demonstration for permit No. 199600132d. The applicable permit limit is 0.057 pound per 1,000 pounds dry gas.

The emissions testing for the No.2 BOP ESP exhaust stack consisted of a 93, 96 and 96 minute tests. Each of the test runs drew samples from four complete blowing operations at the vessel and subsequently combining the four separate heats (or blows).

The opacity was determined utilizing US EPA Method 9 and consisted of reading four complete blows at the No. 2 BOP roof monitor.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on December 13-14, 2016 at the U. S. Steel facility in Ecorse, Michigan. The test program included evaluation of particulate matter (PM) and opacity from the Electrostatic Precipitator (ESP) located at the No. 2 Basic Oxygen Plant (BOP).

1.b Purpose of Testing

The testing was performed as a compliance demonstration for permit No. 199600132d. Table 1 summarizes the limitations included in this permit.

Table 1
AQD Permit No. 199600132d Emission Limitations Summary

Source	Pollutant	Limit
ESP	PM	0.057 lb/1000 lb (dry) - Permit



1.c Source Description

Great Lakes Works of the United States Steel Corporation is a fully integrated steel manufacturer producing steel coils and flat rolled sheets. The #2 Basic Oxygen Plant (#2 BOP) is where the liquid iron is processed with other materials to produce liquid steel.

The #2 BOP has two top-blown, steel conversion vessels. The liquid iron is mixed with steel scrap in the vessels and oxygen is blown on the top of the mixture. During the conversion process, carbon and other impurities are removed, resulting in liquid steel that is further processed at the Great Lakes Works facility.

During the process when oxygen is blown on the top of the mixture, a hood is over the vessel to capture the BOP primary emissions. These emissions are captured and ducted to an electrostatic precipitator (ESP).

1.d Test Program Contact

The contact for the source and test report is:

Mr. Todd Wessel
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
Phone (616) 885-4013

Mr. Nathan Ganhs
U. S. Steel Environmental
United States Steel Corporation
No. 1 Quality Drive
Ecorse, Michigan 48192
Phone (313) 749 3857

1.e Testing Personnel

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

**Table 2
Test Personnel**

Name and Title	Affiliation	Telephone
Mr. Paul Molenda Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Mr. Dave Trahan Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Mr. Tom Gasloli Air Quality Division	MDEQ 525 W Allegan St. Lansing, MI 48909	(517) 284-6778

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

Operating data recorded includes COM (opacity), oxygen blow rate, length of time oxygen was blown, tons of steel tapped, and the number of ESP fields in operation. Operating data is included in Appendix E.

2.b Applicable Permit

Michigan Renewable Operating Permit Number 199600132d.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). Detailed results for each source can be found in table 4.

2.d Emission Regulation Comparison

The results summarized by table 3 (section 5.a) shows that the PM emissions are below the limits summarized by table 1 (section 1.b).

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

See section 1.c.

3.b Raw and Finished Materials

Approximately 430,000 lbs of molten iron is mixed with 120,000 lbs. of scrap steel.

3.c Process Capacity

The furnaces are rated for 250 tons of steel.

3.d Process Instrumentation

The process stack data will consist of documentation from the BOP control room. This includes amount of steel tapped and the timing of the start and stop of the oxygen blow. (blow duration and flow rate, lance on lance off, etc.)

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

To evaluate PM mass emission rates, BTEC utilized the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations:

- Method 1 - *“Sample and Velocity Traverses for Stationary Sources”*
- Method 2 - *“Determination of Stack Gas Velocity and Volumetric Flowrate”*
- Method 3 - *“Gas Analysis for the Determination of Dry Molecular Weight”*
(Fyrite Analysis)
- Method 4 - *“Determination of Moisture Content in Stack Gases”*
- Method 5 - *“Determination of Particulate Emissions from Stationary Sources”*
- Method 9 - *“Visual Determination of the Opacity of Emissions from Stationary Sources”*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. Figure 1 presents the test port and traverse/sampling point locations used. An S-type pitot tube and thermocouple assembly calibrated in accordance with Method 2, Section 4.1.1 was used to measure exhaust gas velocity pressures and temperatures during testing. Because the pitot tube dimensions outlined in Sections 2-6

through 2-8 were within the specified limits, the baseline pitot tube coefficient of 0.84 (dimensionless) was assigned for this testing.

Molecular weight determinations were conducted according to Method 3. The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite[®] combustion gas analyzers. Moisture content was determined from the condensate collected in the Method 5 sampling train according to Method 4.

40 CFR 60, Appendix A, Method 5, "*Determination of Particulate Emissions from Stationary Sources*" was used to measure PM concentrations and calculate PM emission rates (see Figure 2 for a schematic of the sampling train). A single 93-minute test run and duplicate 96-minute test runs were conducted on the ESP Stack.

BTEC's Nutech[®] Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) a heated glass probe, (3) a heated filter box, (4) a set of four Greensburg-Smith (GS) impingers with the first modified and second standard GS impingers each containing 100 milliliters (ml) of deionized water, a third dry modified GS impinger and a fourth modified GS impinger containing approximately 300 grams of silica gel desiccant, (5) a length of sample line, and (6) a Nutech[®] control case equipped with a pump, dry gas meter, and calibrated orifice.

After completion of the final leak test for each test run, the filters were recovered, and the nozzle, probe, and the front half of the filter holder assemblies of the Method 5 train were brushed and triple rinsed with acetone and collected in a pre-cleaned sample container. BTEC labeled the containers with the test number, test location, and test date, and marked the level of liquid on the outside of each container. BTEC personnel transported all samples to BTEC's laboratory in Royal Oak, Michigan for analysis.

4.b Recovery and Analytical Procedures

Recovery and analytical procedures were described in Section 4.a.

4.c Sampling Ports

The number of traverse points was determined in accordance with U.S. EPA Method 1 "Sample and Velocity traverses for stationary sources". The ESP stack is 210 inches in diameter. A total of twenty (20) measurement points were selected for sampling the exhaust stack. Four (4) sample ports were utilized for the testing, which resulted in the use of five (5) traverse points for each port. In the event that the blowing operation was not complete after 20 minutes BTEC re-sampled points 5, 4, and 3 as necessary to complete an entire blow.

4.d Traverse Points

A total of twenty (20) measurement points were selected for sampling the exhaust stack. Four (4) sample ports were utilized for the testing, which resulted in the use of five (5) traverse points for each port.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The results of the emissions test program are summarized by Table 3.

**Table 3
Test Program PM Emission Rate Summary**

Source	Pollutant	Limit	Results
ESP	PM	0.057 lb/1000 lb (dry) – Permit	0.004 lb/1000 lb (dry)
			0.002 gr/dscf
			8.37 lb/hr

Detailed data for each test run can be found in Table 4. Opacity data is presented in Appendix F.

5.b Discussion of Results

Emission limitations for Permit No. 199600132d are summarized by Table 1 (see section 1.b) and Table 3 (see section 5.a). The results of the emissions test program are summarized by Table 3 (see section 5.a).

5.c Sampling Procedure Variations

As noted in the testing protocol, BTEC proposed testing four (4) complete blows. In the event the blow is still going after 15 minutes BTEC will continue testing that port until the blow is complete. Therefore the actual test may exceed 60 minutes. This happened during the first test (11 points, 4 ports) resulting in a 93 minute test, the second test (12 points, 4 ports) resulting in a 96 minute test, and the third test (12 points, 4 ports) resulting in a 96 minute test run.

5.d Process or Control Device Upsets

No upset conditions occurred during testing.

5.e Control Device Maintenance

No maintenance was performed during the test program.

5.f Audit Sample Analyses

No audit samples were collected as part of the test program.



5.g Calibration Sheets

Relevant equipment calibration documents are provided as Appendix B.

5.h Sample Calculations

Sample calculations are provided in Appendix C.

5.i Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

5.j Laboratory Data

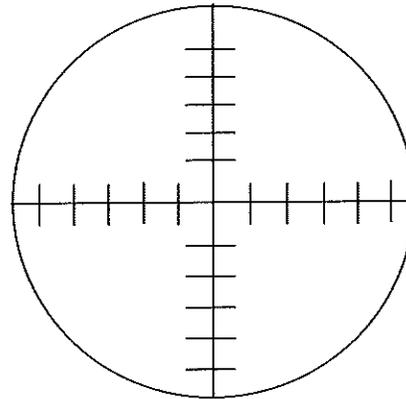
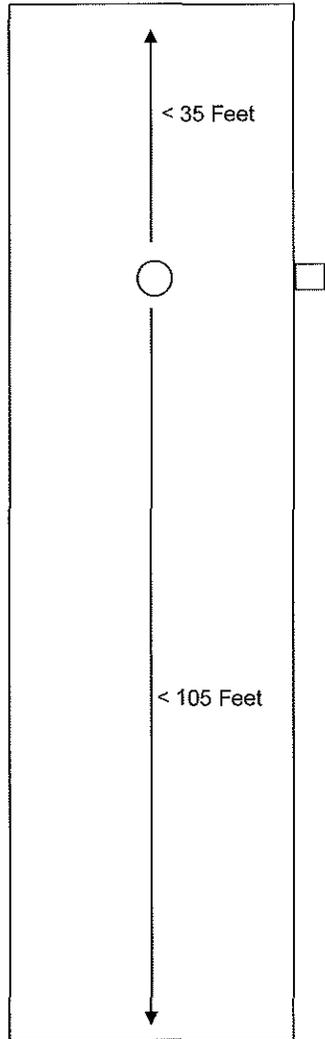
Laboratory results for this test program are provided in Appendix D.

Table 4
ESP Particulate Matter Emission Rates

Company	US Steel			
Source Designation	ESP			
Test Date	12/13/2016	12/13/2016-12	12/14/2016	
Meter/Nozzle Information				
	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	62.1	68.8	68.9	66.6
Meter Pressure - Pm (in. Hg)	29.6	29.6	29.6	29.6
Masured Sample Volume (Vm)	92.5	98.0	97.1	95.9
Sample Volume (Vm-Std ft3)	92.1	96.5	95.5	94.7
Sample Volume (Vm-Std m3)	2.61	2.73	2.71	2.68
Condensate Volume (Vw-std)	16.314	17.257	15.654	16.408
Gas Density (Ps(std) lbs/ft3) (wet)	0.0733	0.0732	0.0736	0.0734
Gas Density (Ps(std) lbs/ft3) (dry)	0.0780	0.0780	0.0780	0.0780
Total weight of sampled gas (m g lbs) (wet)	7.95	8.33	8.18	8.15
Total weight of sampled gas (m g lbs) (dry)	7.19	7.53	7.45	7.39
Nozzle Size - An (sq. ft.)	0.000481	0.000481	0.000481	0.000481
Isokinetic Variation - I	99.8	101.6	99.4	100.3
Stack Data				
Average Stack Temperature - Ts (F)	189.0	180.9	192.4	187.4
Molecular Weight Stack Gas- dry (Md)	30.2	30.2	30.2	30.2
Molecular Weight Stack Gas-wet (Ms)	28.3	28.3	28.5	28.4
Stack Gas Specific Gravity (Gs)	0.979	0.978	0.983	0.980
Percent Moisture (Bws)	15.04	15.17	14.08	14.77
Water Vapor Volume (fraction)	0.1504	0.1517	0.1408	0.1477
Pressure - Ps ("Hg)	29.4	29.4	29.4	29.4
Average Stack Velocity - Vs (ft/sec)	50.7	49.9	50.8	50.5
Area of Stack (ft2)	240.4	240.4	240.4	240.4
Exhaust Gas Flowrate				
Flowrate ft ³ (Actual)	731,414	720,181	732,647	728,081
Flowrate ft ³ (Standard Wet)	584,049	582,738	582,177	582,988
Flowrate ft ³ (Standard Dry)	496,184	494,321	500,216	496,907
Flowrate m ³ (standard dry)	14,050	13,998	14,165	14,071
Total Particulate Weights (mg)				
Nozzle/Probe/Filter	10.4	12.9	12.8	12.0
Total Particulate Concentration				
lb/1000 lb (wet)	0.003	0.003	0.003	0.003
lb/1000 lb (dry)	0.003	0.004	0.004	0.004
mg/dscm (dry)	4.0	4.7	4.7	4.5
gr/dscf	0.0017	0.0021	0.0021	0.0020
Total Particulate Emission Rate				
lb/ hr	7.44	8.78	8.90	8.37



diameter = 210 inches



Not to Scale

Points	Distance "
1	5.5
2	17.2
3	30.7
4	47.5
5	71.8
6	138.2
7	162.5
8	179.3
9	192.8
10	204.5

Figure No. 1

Site:
ESP
USS
Ecorse, Michigan

Sampling Date:
December 13-14, 2016

BT Environmental Consulting,
Inc.
4949 Fernlee
Royal Oak, Michigan

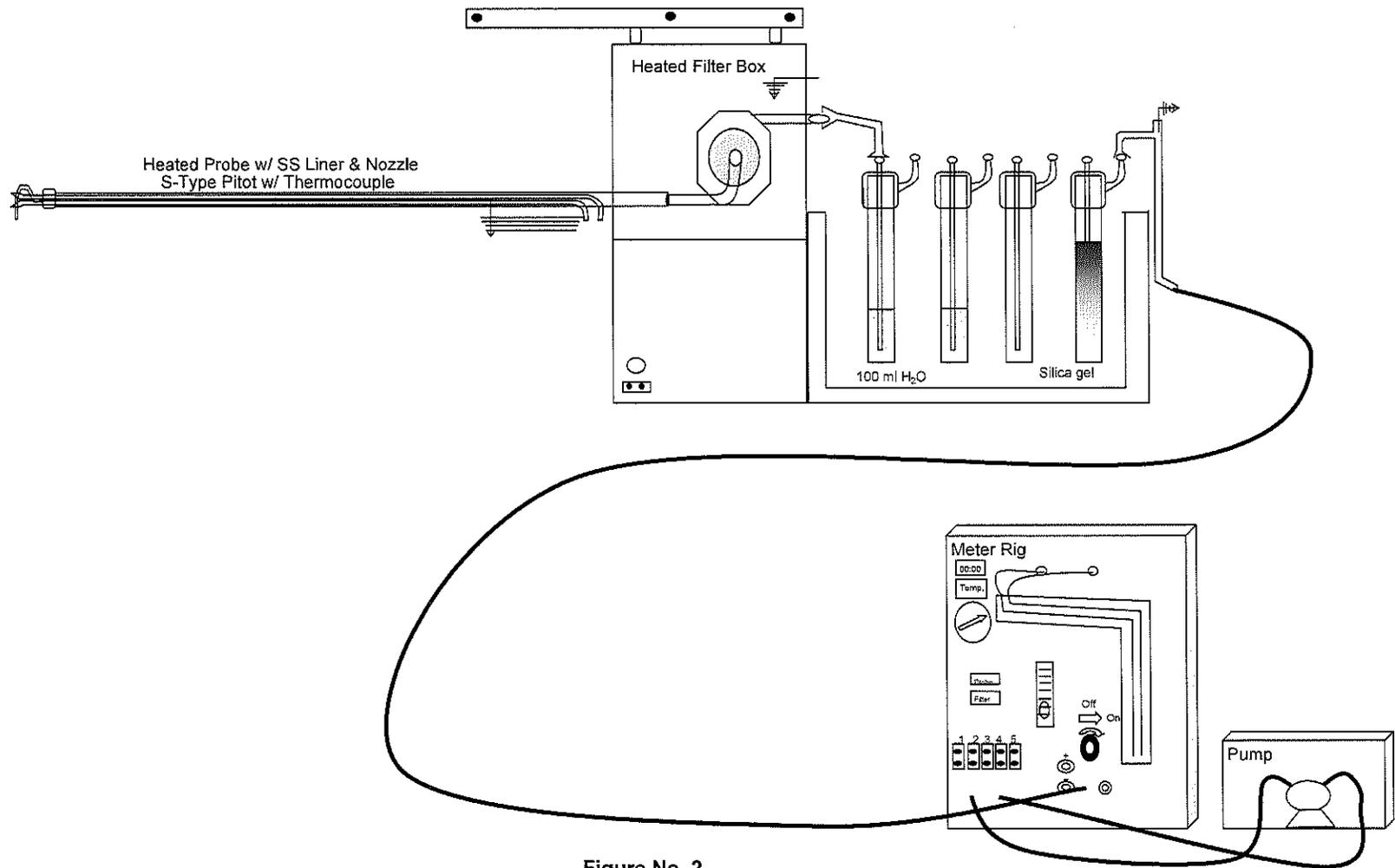


Figure No. 2

Site:
USEPA Method 5
US Steel Corporation
Ecorse, Michigan

Sampling Date:
December 13-14, 2016

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073