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

August 30, 2018

MDEQ Air Quality Division
Cadillac District Office
120 West Chapin St
Cadillac, MI 49601

Ms. Wilhemina McLemore, Supervisor
Department of Environmental Quality
Air Quality Division
Cadillac Place, Suite 2-300
3058 West Grand Boulevard
Detroit, Michigan 48202-6058

Re: **UNITED STATES STEEL CORPORATION – GREAT LAKES WORKS**
ROP 199600132d, SRN A7809

Subject: **Submittal of Rule 216 Minor Modification – Table E-01.14, Section III.A.2.1**

Dear Ms. McLemore:

United States Steel, Great Lakes Works, is submitting the C-001 and M-001 forms requesting a minor modification to ROP Permit Number 199600132d. The requested change is to update Table E-01.14, Section III.A.2.1, pressure drop range for the D4 Baghouse from 1-12 to 1-16 inches of water column based upon the April 3, 2018 Compliance Test for the D4 baghouse. The D4 baghouse successfully demonstrated compliance with ROP 199600132d with an overall DP of 12 – 14 inches of water column during testing.

This change will not cause non-compliance with the 0.0052 gr/dscf particulate emission limit and will not result in any increase in emissions. This change is effective September 1, 2018.

If you have any questions, please contact me at (313) 749-3900.

Sincerely,

Alexis Piscitelli
Director, Environmental
Great Lakes Works
United States Steel

DEQ Michigan Department Of Environmental Quality - Air Quality Division

RENEWABLE OPERATING PERMIT APPLICATION
C-001: CERTIFICATION

This information is required by Article II, Chapter 1, part 55 (Air Pollution Control) of P.A. 451 of 1994, as amended, and the Federal Clean Air Act of 1990. Failure to obtain a permit required by Part 55 may result in penalties and/or imprisonment. Please type or print clearly.

This form is completed and included as part of RO Permit initial and renewal applications, notifications of change, amendments, modifications, and additional information.

Form Type **C-001**	SRN A7809

Stationary Source Name UNITED STATES STEEL CORPORATION, GREAT LAKES WORKS	
City ECORSE	County WAYNE

SUBMITTAL CERTIFICATION INFORMATION

1. Type of Submittal *Check only one box.*

☐ Initial Application (Rule 210) ☒ Notification/Administrative Amendment/Modification (Rules 215/216)

☐ Renewal (Rule 210) ☐ Other, describe on AI-001

2. If this RO Permit has more than one Section, list the Section(s) that this Certification applies to:

SECTION 1_____

3. Submittal Media

☒ E-mail ☐ FTP ☐ Disk ☒ Paper

4. Operator's Additional Information ID - Create an Additional Information (AI) ID that is used to provide supplemental information on AI-001 regarding a submittal.

AI

This form must be signed and dated by the Responsible Official.

5. Name and Title of the Responsible Official. *Print or type.*

Ron Kostyo, General Manager

As a Responsible Official, I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this submittal are true, accurate and complete.

Ron Kostyo

Signature of Responsible Official

8/30/18

Date

Michigan Department of Environmental Quality
Air Quality Division

RENEWABLE OPERATING PERMIT
M-001: RULE 215 CHANGE NOTIFICATION
RULE 216 AMENDMENT/MODIFICATION APPLICATION

This information is required by Part 55, Air Pollution Control, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, and the Federal Clean Air Act of 1990. Failure to obtain a permit required by Part 55 may result in penalties and/or imprisonment.

1. SRN A7809	2. ROP Number 199600132d	3. County Wayne
4. Stationary Source Name	United States Steel Corporation Great Lakes Works	
5. Location Address	1 Quality Drive	6. City Ecorse

7. Submittal Type - *The submittal must meet the criteria for the box checked below. Check only one box. Attach a mark-up of the affected ROP pages for applications for Rule 216 changes.*

- ☐ **Rule 215(1) Notification of change**. *Complete Items 7 – 10.*
- ☐ **Rule 215(2) Notification of change**. *Complete Items 7 – 10.*
- ☐ **Rule 215(3) Notification of change**. *Complete Items 7 – 11.*
- ☐ **Rule 216(1)(a)(i)-(iv) Administrative Amendment**. *Complete Items 7 – 10.*
- ☐ **Rule 216(1)(a)(v) Administrative Amendment**. *Complete Items 7 – 13. Results of testing, monitoring & recordkeeping must be submitted. See detailed instructions.*
- ☒ **Rule 216(2) Minor Modification**. *Complete Items 7 – 12.*
- ☐ **Rule 216(3) Significant Modification**. *Complete Items 7 – 12 and provide any additional information needed on ROP application forms. See detailed instructions.*
- ☐ **Rule 216(4) State-Only Modification**. *Complete Items 7 – 12.*

8. Effective date of the change. (MM/DD/YYYY) *See detailed instructions.* 9/1/2018	9. Change in emissions? ☐ Yes ☒ No

10. Description of Change - *Describe any changes or additions to the ROP, including any changes in emissions and/or pollutants that will occur. If additional space is needed, complete an Additional Information form (AI-001).*

Change ROP, Table E-01.14, Section III.A.2.1 pressure drop range for D4 Baghouse from 1-12 to 1-16 inches of water column. This change will not cause non-compliance with the 0.0052 gr/dscf particulate emission limit and will not result in any increase in emissions.

See attached April 2018 Compliance Test and associated documents.

11. New Source Review Permit(s) to Install (PTI) associated with this application? ☐ Yes ☒ No

If Yes, enter the PTI Number(s) ____ - ____ ____ - ____ ____ - ____ ____ - ____ ____ - ____

12. Compliance Status - *A narrative compliance plan, including a schedule for compliance, must be submitted using an AI-001 if any of the following are checked No.*

a. Is the change identified above in compliance with the associated applicable requirement(s)? ☒ Yes ☐ No

b. Will the change identified above continue to be in compliance with the associated applicable requirement(s)? ☒ Yes ☐ No

c. If the change includes a future applicable requirement(s), will timely compliance be achieved? ☒ Yes ☐ No

13. Operator's Additional Information ID - *Create an Additional Information (AI) ID for the associated AI-001 form used to provide supplemental information.* **AI**

14. Contact Name	Telephone No.	E-mail Address
Nathan Ganhs	313-749-3857	naganhs@uss.com

15. This submittal also updates the ROP renewal application submitted on ____/____/____ ☐ Yes ☒ N/A
(If yes, a mark-up of the affected pages of the ROP must be attached.)

M-001 Instructions

NOTE: A CERTIFICATION FORM (C-001) SIGNED BY A RESPONSIBLE OFFICIAL MUST ACCOMPANY ALL SUBMITTALS

BTEC Inc.

D Blast Furnace Baghouse Particulate Test Report

Prepared for:

United States Steel Corporation

Ecorse, Michigan

United States Steel Corporation
Great Lakes Works
No. 1 Quality Drive
Ecorse, Michigan 48229

Project No. 049AS-278010
May 18, 2018

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak Michigan 48073
(248) 548-8072

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. a Montrose Environmental Company (BTEC) was retained by United States Steel Corporation (U. S. Steel) to provide compliance air testing for Particulate Matter (PM) rates and opacity from the D4 Blast Furnace Baghouse exhaust. The D4 Blast Furnace Baghouse is located at the U. S. Steel facility on Zug Island in River Rouge, Michigan. The testing is being performed as a compliance demonstration for permit No. 199600132d. The particulate testing program was conducted on April 3, 2018.

Testing consisted of triplicate test runs measuring 87, 93, and 204 minutes in length. The emissions test program is required by MDEQ Air Quality Division Renewable Operating Permit No. 199600132d. The results of the emission test program are summarized by Table I.

Table I

Executive Summary Table PM Emission Rate Summary

Source	Emission Rate	Emission Factor
D4 Blast Furnace Baghouse	0.002 gr/dscf	0.019 lb PM/ton iron
	4.52 lb/hr	
	7.56 lb/cycle	

BTEC Inc.

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BTEC Inc.

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SUMMARY TABLES

FIGURES

APPENDIX

1. Introduction

BT Environmental Consulting, Inc. a Montrose Environmental Company (BTEC) was retained by United States Steel Corporation (U. S. Steel) to provide compliance air testing for Particulate Matter (PM) from the D4 Blast Furnace Baghouse exhaust. The D4 Blast Furnace Baghouse is located at the U. S. Steel facility on Zug Island in River Rouge, Michigan. The testing is being performed as a compliance demonstration for permit No. 199600132d. The particulate testing program was conducted on April 3, 2018. The purpose of this report is to document the results of the test program.

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 plan in the format suggested by the AQD test plan format guide.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on April 3, 2018 at the U. S. Steel facility on Zug Island in River Rouge, Michigan. The test program included evaluation of PM emissions from the D4 Blast Furnace Baghouse exhaust stack.

1.b Purpose of Testing

Michigan Renewable Operating Permit No. 199600132d includes (in Tables E-01.14 and F-01.05) the emission limitations listed in Table 1. As per Permit 199600132d Table F-01.05, Section B (page 90), U. S. Steel is required to develop a particulate emission factor for the blast furnace control device. Testing for the emission factor shall encompass at least one full cycle of production operations (i.e., cast to cast) per run. In addition, the production rates shall be measured.

In addition, the D4 Blast Furnace is affected by the National Emission Standard for Hazardous Air Pollutants for Integrated Iron and Steel Manufacturing Facilities codified at Title 40, Part 63, Subpart FFFFF of the Code of Federal Regulations (40 CFR 63, Subpart FFFFF).

Table 1
Renewable Operating Permit No. 199600132d Emission Limitations

Pollutant	Emission Limitation	Emission Limitation Units
PM	0.0052	gr/dscf (Permit)
PM	0.01	gr/dscf (NESHAP)
Opacity	10% (6 minute average) Baghouse Stack	%
Opacity	20% (6 minute average) Casthouse Roof Monitor	%

1.c Source Description

The source tested is the D4 Blast Furnace Baghouse exhaust stack.

1.d Test Program Contact

The contacts for the source are:

Mr. Todd Wessel
Client Project Manager
BT Environmental Consulting, Inc. a
Montrose Air Quality Company
4949 Fernlee Avenue
Royal Oak, Michigan 48073
Phone (616) 885-4013

Mr. Nathan Ganhs
U. S. Steel Environmental
United States Steel Corporation
Great Lakes Works
No. 1 Quality Drive
Ecorse, Michigan 48229
(313) 749-2744

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. Nathan Ganhs Environmental Department	U. S. Steel No. 1 Quality Drive Ecorse, Michigan 48229	(313) 749-3857
Mr. Todd Wessel Senior Project Manager	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(616) 885-4013
Mr. Paul Molenda Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8072
Mr. Mark Dziadoaz Technical Programs Unit Field Operations Section Air Quality Division	Department of Environmental Quality Air Quality Division 3058 W. Grand Blvd., Suite 2-300 Detroit Michigan 48202-6058	586-753-3745

2. Summary of Results

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

2.a Operating Data

Relevant operating data is available in Appendix E.

2.b Applicable Permit

The applicable permit for this emissions test program is ROP No. 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 run can be found in Table 4.

2.d Emission Regulation Comparison

The results summarized by table 2 (section 5.a) shows that the PM emissions are below the limits summarized by section 1.b.

3. Source Description

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

3.a Process Description

The blast furnace is a tall shaft-type furnace with a vertical stack superimposed over a crucible-like hearth. Iron-bearing materials (iron ore, pellets, mill scale, steel making slag, scrap, etc.), coke and flux (limestone calcite), are charged into the top of the shaft. A blast of heated air and also, in most instances, a gaseous, liquid or powdered fuel are introduced through openings at the bottom of the shaft just above the hearth crucible. The heated air burns the injected fuel and most of the coke charged in from the top to produce the heat required by the process and to provide reducing gas that removes oxygen from the ore. The reduced iron melts and runs down to the bottom of the hearth. The flux combines with the impurities in the ore to produce a slag that also melts and accumulates on top of the liquid iron in the hearth. From time to time, the iron and slag are drained from the furnace through a tap hole

3.b Raw and Finished Materials

Iron ore, pellets, mill scale, steel making slag, scrap, etc., coke and flux (limestone calcite).

3.c Process Capacity

The FGBLASTFURNACES-A, B&D are limited to 3,718,000 tons of iron produced per 12-month rolling time period at the end of each calendar month (R336.1205(3)).

3.d Process Instrumentation

Process instrumentation measured during the test program includes iron ore charge, scrap charge, natural gas flow, and the pressure drop across the baghouse.

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

Measurement of exhaust gas velocity, molecular weight, and moisture content was conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *"Location of the Sampling Site and Sampling Points"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Determination of Molecular Weight of Dry Stack Gas"*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*
- Method 17 - *"Determination of Particulate Emissions from Stationary Sources"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. Figure 2 presents the test port and traverse/sampling point locations used. A cyclonic flow evaluation was conducted at each sampling location. 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 17 sampling train according to Method 4.

Method 17 was used to measure particulate concentrations and calculate particulate emission rates from the exhaust stack (see Figure 1 for sampling train schematic diagram) BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel button-hook nozzle, (2) a stainless steel in stack filter holder with a tarred glass fiber filter (3) steel sample probe, (4) a set of four Greenburg-Smith (GS) impingers with the first and third modified and second standard GS impingers each containing 100 ml of deionized water, and a fourth modified GS impinger containing approximately 300 g 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.

A sampling train and pitot tube leak test was conducted before and after each test run. Upon completion of the final leak check for each test run, the filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container.

BTEC labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. In addition blank samples of the acetone and filter were collected. BTEC personnel transported the filters and acetone fractions to BTEC's laboratory in Royal Oak, Michigan for gravimetric analysis.

40 CFR 60, Appendix A, Method 9, *"Visual Determination of the Opacity of Emissions from Stationary Sources"* was used to measure opacity. Triplicate test runs of varying durations were conducted during casting operations. Individual opacity run data can be found in Appendix F.

4.b Recovery and Analytical Procedures

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

4.c Sampling Ports

Sampling ports are located on the stack and meet method 1 criteria.

4.d Traverse Points

Sampling port and traverse point locations for the D4 Blast Furnace Baghouse exhaust stack are illustrated by Figure 2.

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	Emission Rate	Emission Factor
D4 Blast Furnace Baghouse	0.002 gr/dscf	0.019 lbs PM/ton iron
	4.52 lb/hr	
	7.56 lb/cycle	

Detailed data for each test run can be found in Table 4.

5.b Discussion of Results

Emission limitations for Permit No. 199900014 are summarized by section 1b. The results of the emissions test program are summarized by Table 3 (see section 5.a). Detailed results for each run are summarized by Table 4.

5.c Sampling Procedure Variations

None

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. Opacity data sheets are presented in Appendix F.

5.j Laboratory Data

Laboratory results are presented in Appendix D.

BTEC Inc.

MEASUREMENT UNCERTAINTY STATEMENT

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, Montrose Air Quality Services, LLC, (MAQS) personnel reduce the impact of these uncertainty factors through the use of approved and validated test methods. In addition, MAQS personnel perform routine instrument and equipment calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

Limitations

All testing performed was done in conformance to the ASTM D7036-04 standard. The information and opinions rendered in this report are exclusively for use by United States Steel Corporation. BTEC will not distribute or publish this report without United States Steel Corporation's consent except as required by law or court order. BTEC accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by:_____

Paul Diven
Field Project Manager

This report was reviewed by:_____

Brandon Chase
QA/QC Manager

Tables

Table 4
D4 Blast Furnace Particulate Matter Emission Rates

Company	US Steel			
Source Designation	D Blast furnace Baghouse			
Test Date	4/3/2018	4/3/2018	4/3/2018	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	62.9	72.6	75.2	70.2
Meter Pressure - Pm (in. Hg)	29.6	29.4	29.3	29.5
Measured Sample Volume (Vm)	73.2	83.1	174.6	110.3
Sample Volume (Vm-Std ft3)	74.8	82.8	172.4	110.0
Sample Volume (Vm-Std m3)	2.12	2.34	4.88	3.11
Condensate Volume (Vw-std)	0.613	0.613	1.650	0.959
Gas Density (Ps(std) lbs/ft3) (wet)	0.0743	0.0743	0.0743	0.0743
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	5.60	6.20	12.92	8.24
Total weight of sampled gas (m g lbs) (dry)	5.57	6.17	12.85	8.20
Nozzle Size - An (sq. ft.)	0.000299	0.000299	0.000299	0.000299
Isokinetic Variation - I	98.9	97.9	99.0	98.6
Stack Data				
Average Stack Temperature - Ts (F)	96.2	98.3	105.4	100.0
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.7	28.8	28.7	28.7
Stack Gas Specific Gravity (Gs)	0.993	0.993	0.992	0.993
Percent Moisture (Bws)	0.81	0.73	0.95	0.83
Water Vapor Volume (fraction)	0.0081	0.0073	0.0095	0.0083
Pressure - Ps ("Hg)	29.4	29.2	29.1	29.2
Average Stack Velocity -Vs (ft/sec)	52.4	55.4	52.9	53.6
Area of Stack (ft2)	90.7	90.7	90.7	90.7
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	285,264	301,745	287,827	291,612
Flowrate ft^3 (Standard Wet)	266,259	278,380	261,769	268,803
Flowrate ft^3 (Standard Dry)	264,094	276,334	259,286	266,572
Flowrate m^3 (standard dry)	7,478	7,825	7,342	7,549
Total Particulate Weights (mg)				
Nozzle/Probe/Filter	13.2	8.9	17.1	13.1
Total Particulate Concentration				
lb/1000 lb (wet)	0.005	0.003	0.003	0.004
lb/1000 lb (dry)	0.005	0.003	0.003	0.004
mg/dscm (dry)	6.2	3.8	3.5	4.5
gr/dscf	0.0027	0.0017	0.0015	0.0020
Total Particulate Emission Rate				
lb/ hr	6.19	3.94	3.42	4.52
Number of Cycles	1	1	2	
Cycle length (min)	95	109	233	
Cycle length (hr)	1.58	1.82	3.88	2.43
Total Iron Cast (tons)	408	440	739	529
lbs / cycle *	9.80	7.17	6.63	7.56
Emission Factor (lb PM/ton Iron)	0.024	0.016	0.018	0.019

* lb / cycle average is weighted for number of cycles per run

Figures

BTEC Inc.

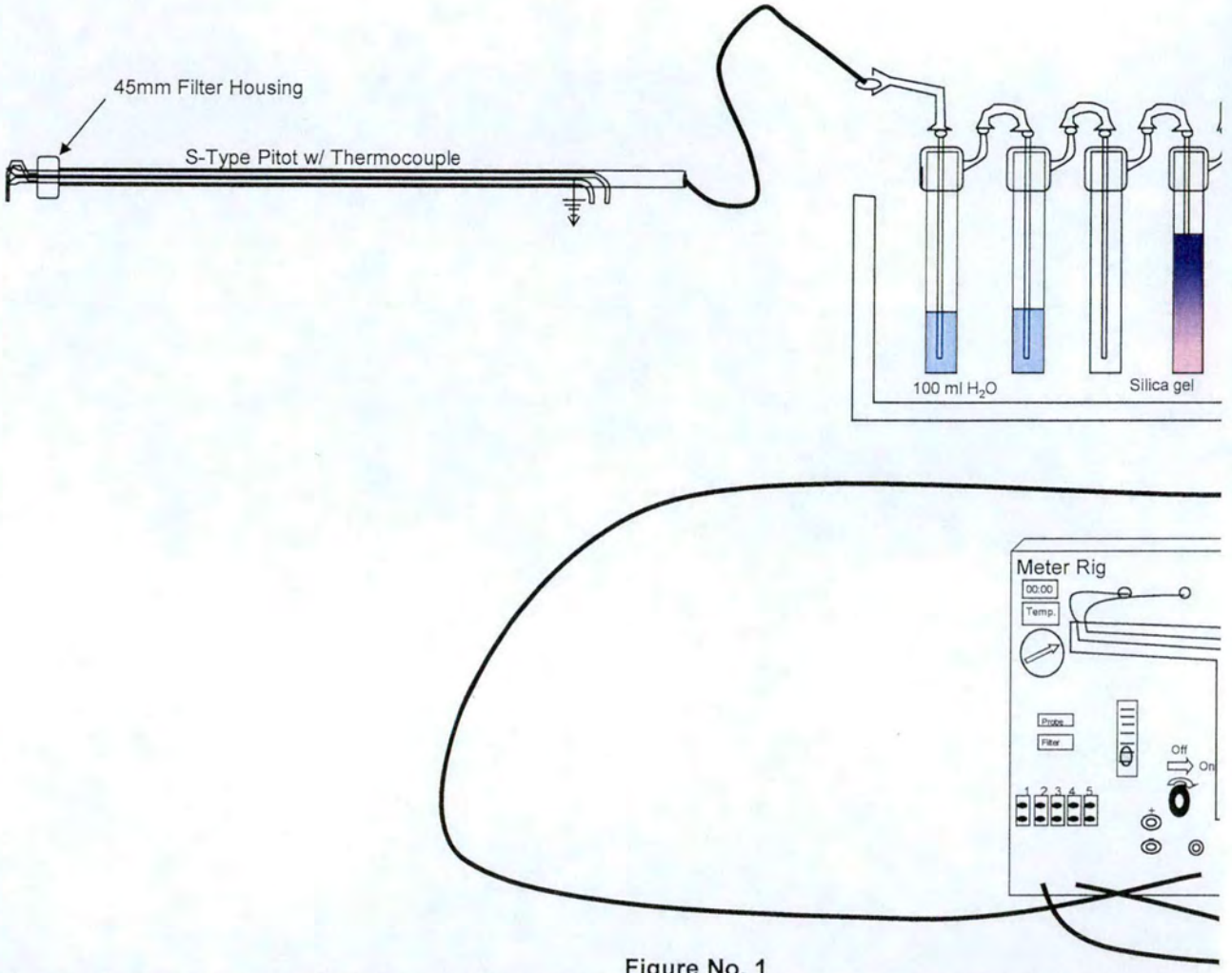
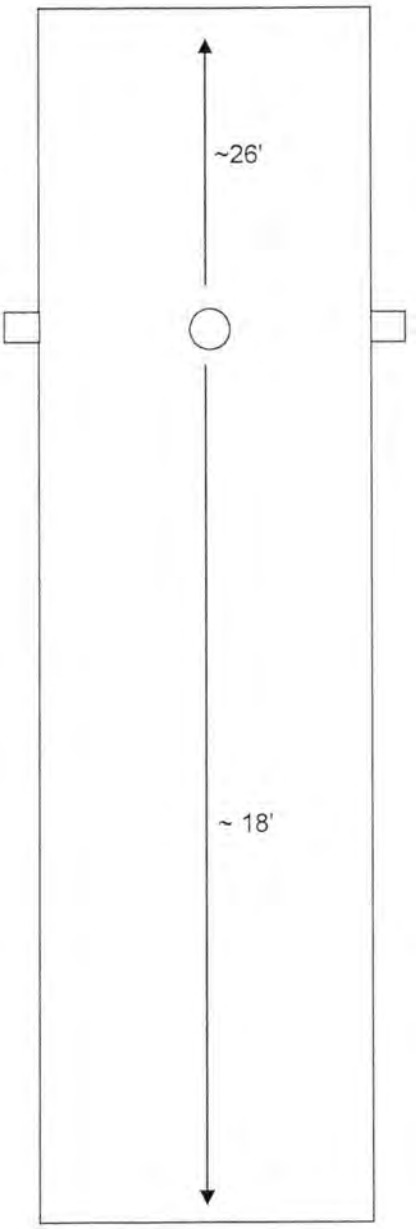


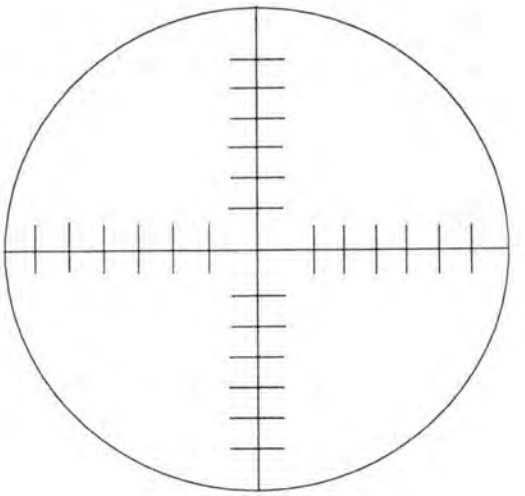
Figure No. 1

Site:	Sampling Date:	
USEPA Method 17 US Steel Ecorse, Michigan	April 3, 2018	BT Environmental Con 4949 Fernlee Avenue Royal Oak, Michigan

BTEC Inc.

diameter = 129"





Not to Scale

Points	Distance "
1	2.7
2	8.6
3	15.2
4	22.8
5	32.3
6	45.9
7	83.1
8	96.8
9	106.2
10	113.8
11	120.4
12	126.3

Figure No. 2

Site: D-Blast Furnace US Steel Ecorse, Michigan	Sampling Dates: 4/3/2018	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073

Appendix A
Field and Computer Generated Raw Data and Field Notes

aghouse

Assumed Moisture (Bws)	2	Barometric Pressure at Sea Level ("Hg)	30.12
Condensate Volume (Vlc)	-1	Site elevation (ft)	580
Silica Gel Weight Gain (Vlc)	14	Port Elevation Above Ground(ft)	70
Nozzle Diameter (in.)	0.234		
Leak Rate Initial	0.001	@ 12" of Hg	
Leak Rate Final	0.000	@ 9" of Hg	
Traverse points	24		
Pitot Corr. Factor (Cp)	0.84		
Meter Corr. Factor (Y)	1.022		
Fyrite Results (%)			
CO2	0		
O2	20.9		

ıck Temp. (F) Ts	Velocity Pres. ("H2O) ΔPs	Desired Orifice Differential ("H2O) ΔH	Actual Orifice Differential ("H2O) ΔH	Sample Volume (cubic feet) Vm	Dry Gas Meter Temp. Inlet (F) Tm	Outlet (F) Tm	Last Impinger Temperature (F)	Probe Temperature (F)	Filter Box Temperature (F)	Filter Box Exit Temperature (F)	Expected DGM (cubic feet)	Isokinetic Variation %
95	0.90	2.39	1.80	244.100	53	53	42	NA	NA	NA	246.72	99.3
93	1.10	2.92	2.90	246.70	53	53	43				249.60	100.3
92	1.20	3.18	3.10	249.60	53	53	43				252.63	96.0
92	1.20	3.18	3.10	252.50	54	53	44				255.53	99.2
94	1.20	3.18	3.10	255.50	57	53	44				258.54	99.1
93	1.30	3.45	3.40	258.50	59	54	46				261.67	100.6
				261.68								
89	0.70	1.86	1.80	261.68	58	55	45				264.02	99.3
94	0.85	2.26	2.20	264.00	61	55	45				266.57	97.3
96	0.90	2.39	2.40	266.50	62	55	45				269.14	98.5
96	1.00	2.65	2.60	269.10	65	56	44				271.90	100.3
97	1.00	2.65	2.60	271.90	66	57	44				274.70	100.2
97	1.00	2.65	2.60	274.70	67	58	44				277.50	100.0
				277.50								
90	0.55	1.46	1.50	277.50	65	58	43				279.59	100.4
97	0.61	1.62	1.60	279.60	67	59	43				281.79	100.3
97	0.58	1.54	1.50	281.80	69	60	42				283.94	102.5
97	0.58	1.54	1.50	284.00	69	60	42				286.14	102.5
97	0.62	1.65	1.60	286.20	70	61	42				288.42	99.0
95	0.60	1.59	1.60	288.40	71	61	42				290.59	100.3
				290.60								
90	0.67	1.78	1.80	290.60	70	61	41				292.92	103.3
94	0.73	1.94	1.90	293.00	70	62	42				295.42	103.4
96	0.70	1.86	1.90	295.50	72	63	42				297.87	101.2
98	0.73	1.94	1.90	297.90	73	64	42				300.32	99.1
99	0.80	2.12	2.10	300.30	74	64	42				302.84	102.6
100	0.80	2.12	2.10	302.90	74	64	43				305.43	98.8
				305.40								
100	0.69	1.83	1.80	305.40	75	65	43				307.76	97.6
102	0.70	1.86	1.90	307.70	75	65	43				310.07	101.3
103	0.70	1.86	1.90	310.10	75	66	44				312.47	101.3
104	0.68	1.80	1.80	312.50	76	66	44				314.84	98.5
103	0.77	2.04	2.10	314.80	76	66	45				317.29	99.5
				317.28								
96.2	0.82	2.18	2.14	73.175	66.5	59.3	43.2	#DIV/0!	#DIV/0!	#DIV/0!		100.1
					62.91							

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baghouse

Assumed Moisture (Bws)	2	Barometric Pressure at Sea Level ("Hg)	29.89
Condensate Volume (Vlc)	-2	Site elevation (ft)	580
Silica Gel Weight Gain (Vlc)	15	Port Elevation Above Ground(ft)	70
Nozzle Diameter (in.)	0.234		
Leak Rate Initial	0.001	@ 15" of Hg	
Leak Rate Final	0	@ 8" of Hg	
Traverse points	24		
Pitot Corr. Factor (Cp)	0.84		
Meter Corr. Factor (Y)	1.022		
Fyrite Results (%)			
CO2	0		
O2	20.9		

tack Temp. (F) Ts	Velocity Pres. ("H2O) ΔPs	Desired Orifice Differential ("H2O) ΔH	Actual Orifice Differential ("H2O) ΔH	Sample Volume (cubic feet) Vm	Dry Gas Meter Temp. Inlet (F) Tm	Outlet (F) Tm	Last Impinger Temperature (F)	Probe Temperature (F)	Filter Box Temperature (F)	Filter Box Exit Temperature (F)	Expected DGM (cubic feet)	Isokinetic Variation %
83	0.77	2.07	2.10	317.800	66	66	42	NA	NA	NA	320.32	99.3
86	0.72	1.94	2.00	320.30	67	66	43				322.73	98.7
90	0.72	1.94	2.00	322.70	67	66	43				325.12	103.2
91	0.70	1.88	1.90	325.20	69	66	42				327.59	100.4
92	0.78	2.10	2.10	327.60	70	66	42				330.12	95.1
93	0.87	2.34	2.40	330.00	72	66	43				332.67	101.3
				332.70								
89	0.60	1.61	1.60	332.70	69	66	43				334.92	103.6
96	0.63	1.70	1.70	335.00	72	67	44				337.26	101.4
96	0.63	1.70	1.70	337.30	73	67	45				339.57	96.9
98	0.65	1.75	1.80	339.50	74	67	45				341.80	99.9
98	0.65	1.75	1.80	341.80	75	67	45				344.10	99.8
98	0.63	1.70	1.70	344.10	76	68	45				346.37	101.1
				346.40								
90	0.71	1.91	1.90	346.40	73	68	44				348.82	99.0
97	0.88	2.37	2.40	348.80	75	68	44				351.48	96.9
97	0.92	2.48	2.50	351.40	77	69	44				354.15	98.2
99	1.10	2.96	3.00	354.10	77	69	44				357.10	100.1
100	1.10	2.96	3.00	357.10	78	70	45				360.11	100.0
100	1.10	2.96	3.00	360.10	79	70	45				363.11	99.9
				363.10								
96	0.85	2.29	2.30	363.10	74	70	44				365.74	98.4
99	1.10	2.96	3.00	365.70	77	70	44				368.71	100.0
101	1.10	2.96	3.00	368.70	79	71	45				371.71	99.9
101	1.20	3.23	3.20	371.70	80	71	45				374.85	98.7
102	1.20	3.23	3.20	374.80	81	71	45				377.95	98.7
104	1.20	3.23	3.20	377.90	81	72	46				381.04	82.9
				380.50								
106	0.83	2.23	2.20	380.50	82	73	47				383.12	99.4
107	1.00	2.69	2.70	383.10	81	73	46				385.97	97.8
107	1.10	2.96	3.00	385.90	82	73	46				388.91	99.9
108	1.10	2.96	3.00	388.90	82	73	46				391.91	100.0
108	1.10	2.96	3.00	391.90	82	73	47				394.91	100.0
108	1.10	2.96	3.00	394.90	83	73	47				397.91	99.9
				397.90								
108	1.10	2.96	3.00	397.90	83	73	47				400.91	99.9
				400.90								
98.3	0.91	2.44	2.46	83.100	76.0	69.3	44.6	#DIV/0!	#DIV/0!	#DIV/0!		99.0
					72.65							

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	US Steel				
dignation	D Blast Furnace Baghouse				
	4 3/2018	Assumed Moisture (Bws)	2	Barometric Pressure at Sea Level ("Hg)	29.79
ıer	3	Condensate Volume (Vlc)	6	Site elevation (ft)	380
	TW, PM	Silica Gel Weight Gain (Vlc)	29	Port Elevation Above Ground(ft)	70
ıber	475	Nozzle Diameter (in.)	0.234		
c Pressure (Pb)	29.14	Leak Rate Initial	0.002	@ 16" of Hg	
ic Pressure (Pg)		Leak Rate Final	0	@ 9" of Hg	
ensions 1 (in.)	129	Traverse points	24		
nensions 2 (in.)		Pitot Corr. Factor (Cp)	0.84		
Number	51	Meter Corr. Factor (Y)	1.022		
aber	MB5	Fyrite Results (%)			
Number	19	CO2	0		
ş	1.64	O2	20.9		

Sampling Time (Minutes) θ	Clock Time (24 hour)	Sampling Train Vac. ("Hg)	Stack Temp. (F) Ts	Velocity Pres. ("H2O) ΔPs	Desired Orifice Differential ("H2O) ΔH	Actual Orifice Differential ("H2O) ΔH	Sample Volume (cubic feet) Vm	Dry Gas Meter Temp. Inlet (F) Tm	Outlet (F) Tm	Last Impinger Temperature (F)	Probe Temperature (F)	Filter Box Temperature (F)	Filter Box Exit Temperature (F)	Expected DGM (cubic feet)	Isokinetic Variation %
0	12:27	4	93	0.91	2.43	2.50	401.300	71	71	40				404.05	98.5
3		4	95	1.10	2.94	3.00	404.00	71	71	39				407.01	99.8
6		5	98	1.20	3.21	3.20	407.00	71	71	37				410.14	99.1
9		5	99	1.20	3.21	3.20	410.10	73	71	37				413.24	99.0
12		6	100	1.30	3.48	3.50	413.20	74	71	39				416.47	95.2
15		6	101	1.30	3.48	3.50	416.30	76	71	42				419.57	98.4
18	12:45						419.51								
18	12:49	4	90	0.65	1.74	1.80	419.51	73	71	42				421.84	98.2
21		4	101	0.77	2.06	2.10	421.80	75	71	42				424.32	99.4
24		4	101	0.85	2.27	2.30	424.30	76	71	42				426.95	102.1
27		5	99	0.95	2.54	2.50	427.00	78	71	42				429.81	103.4
30		5	101	0.95	2.54	2.50	429.90	79	71	42				432.71	99.9
33		5	102	1.00	2.68	2.70	432.70	80	72	42				435.58	97.3
36	13:07						435.50								
36	13:10	4	92	0.57	1.53	1.50	435.50	79	72	42				437.69	100.2
39		4	104	0.57	1.53	1.50	437.70	79	72	42				439.87	101.3
42		4	107	0.57	1.53	1.50	439.90	79	72	42				442.06	101.5
45		4	108	0.60	1.61	1.60	442.10	80	72	42				444.32	103.5
48		4	110	0.60	1.61	1.60	444.40	80	73	42				446.62	99.1
51		4	111	0.60	1.61	1.60	446.60	80	73	42				448.82	103.7
54	13:28						448.90								
54	13:30	4	105	0.72	1.93	1.90	448.90	79	73	42				451.34	98.4
57	13:36	4	114	0.72	1.93	1.90	451.30	80	73	43				453.72	97.8
60	14:05	4	99	0.65	1.74	1.80	453.67	71	71	40				455.98	100.9
63		4	102	0.75	2.01	2.00	456.00	71	71	39				458.47	101.1
66		4	102	0.79	2.11	2.10	458.50	71	71	39				461.04	98.5
69		4	102	0.87	2.33	2.30	461.00	72	71	39				463.67	101.4
72							463.70								
72	14:17	4	102	0.75	2.01	2.00	463.70	74	71	39				466.18	99.6
75		4	102	0.75	2.01	2.00	466.17	75	71	41				468.65	101.9
78		4	103	0.70	1.87	1.90	468.70	76	71	42				471.10	100.1
81		4	103	0.75	2.01	1.90	471.10	77	71	43				473.58	100.6
84		4	104	0.80	2.14	2.10	473.60	77	71	44				476.16	101.4
87		5	104	0.88	2.35	2.40	476.20	78	71	44				478.89	96.7
90	14:35						478.80								
90	14:39	4	104	0.55	1.47	1.50	478.80	78	71	45				480.93	103.3
93		4	103	0.60	1.61	1.60	481.00	76	71	44				483.22	99.0
96		4	104	0.60	1.61	1.60	483.20	77	71	44				485.42	99.0
99		4	104	0.60	1.61	1.60	485.40	78	72	44				487.62	98.8
102		4	104	0.66	1.77	1.80	487.60	78	72	44				489.93	98.5
105		4	104	0.66	1.77	1.80	489.90	79	72	44				492.24	100.2
108	14:57						492.24								
108	14:59	4	102	0.75	2.01	2.00	492.24	79	72	43				494.73	98.7
111		4	99	0.75	2.01	2.00	494.70	78	72	42				497.20	100.1
114		5	101	0.95	2.54	2.60	497.20	79	72	42				500.01	99.8
117		5	103	1.00	2.68	2.70	500.00	80	73	42				502.88	101.0
120		6	106	1.10	2.94	3.00	502.90	81	73	42				505.92	99.7
123		6	108	1.10	2.94	3.00	505.90	81	73	42				508.91	99.8
126	15:17						508.90								
126	15:20	5	92	0.95	2.54	2.60	508.90	77	73	41				511.73	99.1
129		6	108	1.00	2.68	2.70	511.70	79	73	43				514.57	97.8
132		6	109	1.10	2.94	3.00	514.50	80	73	44				517.51	100.0
135		6	110	1.10	2.94	3.00	517.50	81	73	44				520.51	100.0
138		6	110	1.10	2.94	3.00	520.50	81	73	45				523.51	100.0
141		6	110	1.20	3.21	3.20	523.50	82	73	46				526.64	100.2
144	15:38						526.64								
144	15:41	5	100	0.65	1.74	1.80	526.64	78	74	45				528.97	101.3
147		5	111	0.70	1.87	1.90	529.00	79	74	44				531.39	100.2
150		5	112	0.82	2.19	2.20	531.40	79	74	43				533.99	100.5
153		5	111	0.90	2.41	2.40	534.00	80	74	43				536.72	99.5
156		5	111	1.10	2.94	3.00	536.70	81	74	43				539.71	100.0
159		6	103	1.00	2.68	2.70	539.70	82	74	43				542.59	104.0
162	15:59						542.70								
162	16:03	4	91	0.55	1.47	1.50	542.70	78	74	43				544.86	99.9
165		4	108	0.62	1.66	1.70	544.86	79	74	42				547.12	100.0
168		4	109	0.62	1.66	1.70	547.12	80	74	43				549.38	100.8
171		4	109	0.62	1.66	1.70	549.40	81	74	43				551.66	99.9
174		4	110	0.57	1.53	1.50	551.66	81	74	43				553.83	103.3
177		4	110	0.57	1.53	1.50	553.90	81	74	43				556.07	100.0
180	16:21						556.07								
180	16:24	4	101	0.60	1.61	1.60	556.07	78	74	42				558.30	99.7
183		4	116	0.70	1.87	1.90	558.30	79	74	43				560.68	100.6
186		6	118	0.76	2.03	2.00	560.70	80	74	44				563.18	99.9
189		6	120	0.76	2.03	2.00	563.18	81	74	44				565.66	97.6
192		7	121	0.90	2.41	2.40	565.60	81	74	45				568.30	100.2
195		7	124	0.95	2.54	2.60	568.30	82	74	45				571.07	100.3
198	16:42						571.07								
198	16:44	7	124	0.73	1.95	2.00	571.07	79	74	44				573.49	98.4
201		7	123	0.73	1.95	2.00	573.45	80	74	45				575.87	99.9
204	16:50						575.87								
204			105.4	0.82	2.18	2.19	174.570	77.9	72.4	42.4	#DIV/0!	#DIV/0!	#DIV/0!		100.0
								75.17							

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BTEC Inc. Field Sampling Data Sheet

2063

Company U.S. Steel	Static Pressure (Ps) −0.7	Leak Rate Initial 0.002 @ 12" Hg	Source Diagram (Sketch)
Source #1-Blast Furnace	Stack Diameter (in.) 129	Leak Rate Final 0.000 @ 9"	
Test Date 4/3/18	Pitot Tube Number S1	Traverse Points 24	
Test Method 17	Meter Number MGS	Pitot Tube Corr. Factor (Cp) 0.84	
Test Number 3	Computer Number 19	Meter Corr. Factor (Y) 1.022	
Operators TW PM	Delta ΔH @ 1.64	Fyrite Results (%)	
Filter Number 475	Assumed Moisture (Bws) 2	CO2 0.0	Weather conditions:
Barometric Pressure (Pbar) 29.74	Condensate Volume 6	O2 20.9	
Site Elevation (ft) 580	Silica Gel Weight Gain 29		
Port Height Above Ground (ft) 70	Nozzle Diameter (in.) 0.234		

Traverse Point Number	Sampling Time Minutes	Clock Time (24 hour)	Sample Train Vacuum ("Hg)	Stack Temp (°F) Ts	Velocity Pres. ("H2O) ΔPs	Orifice Differential ("H2O) ΔH	Sample Volume (Vm) (Cubic Feet)	Dry Gas Meter Temp Inlet (°F) Tm	Dry Gas Meter Temp Outlet (°F) Tm	Last Impinger Temp (°F)	Probe Temp. (°F)	Filter Box Temp. (°F)	Filter Box Exit Temp. (°F)	CPM Filter (°F)
1:15 1	75	14:17	4	102	0.75	2.0	463.7	74	71	39	NA	NA	NA	NA
18 2	78		4	102	0.75	2.0	466.17	75	71	41				
21 3	81		4	103	0.70	1.9	468.7	76	71	42				
24 4	84		4	103	0.75	2.0	471.1	77	71	43				
1:27 5	87		4	104	0.80	2.1	473.6	77	71	44				
1:30 6	190		5	104	0.80	2.4	476.2	78	71	44				
33 1	93	14:39	4	104	0.55	1.5	478.8	78	71	45				
36 2	96		4	103	0.60	1.6	481.0	76	71	44				
39 3	99		4	104	0.60	1.6	483.2	77	71	44				
41 4	102	5-18-18	4	104	0.60	1.6	485.4	78	72	44				
1:44 5	104	BC	4	104	0.60	1.8	487.6	78	72	44				
1:47 6	107		4	104	0.60	1.8	489.9	79	72	44				
50 1	110	14:49	4	102	0.75	2.0	492.24	79	72	43				
53 2	113		4	99	0.75	2.0	494.7	78	72	42				
56 3	116		5	101	0.95	2.6	497.2	79	72	42				
59 4	119		5	105	1.0	2.7	500	80	73	42				
2:02 5	122		6	106	1.1	3.0	502.9	81	73	42				
2:05 6	125		6	108	1.1	3.0	505.9	81	73	42				
8 1		15:20	5	92	0.95	2.6	508.9	77	73	41				
11 2			6	108	1.0	2.7	511.7	79	73	43				
14 3			6	109	1.1	3.0	514.5	80	73	44				
17 4			6	110	1.1	3.0	517.5	81	73	44				
20 5			6	110	1.1	3.0	520.5	81	73	45				
2:23 6			6	110	1.2	3.2	523.5	82	73	46				
26 1		15:41	5	100	0.605	1.75	526.14	78	74	45				
29 2			5	111	0.70	1.9	529.0	79	74	44				
32 3			5	112	0.82	2.2	531.4	79	74	43				
35 4			5	111	0.9	2.4	534.0	80	74	43				
38 5			5	111	1.1	3.0	536.7	81	74	43				
2:41 6			6	109	1.0	2.7	539.7	82	74	43				
44 1		16:03	4	91	0.55	1.5	542.7	78	74	43				
47 2			4	108	0.62	1.7	544.80	79	74	42				

Revision 6.0
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BTEC Inc. Field Sampling Data Sheet

16" Run 3

Company U.S. Steel
Source D-Blast Furnace
Test Date 4/3/18
Test Method 17
Test Number 3
Operators TW, DM
Filter Number A75
Barometric Pressure (Pbar) 29.79
Site Elevation (ft) 580
Port Height Above Ground (ft) 70

Static Pressure (Ps) -0.7
Stack Diameter (in.) 129
Pitot Tube Number S1F
Meter Number MB5
Computer Number 19
Delta ΔH @ 1.64
Assumed Moisture (Bws) 2
Condensate Volume 4
Silica Gel Weight Gain 29
Nozzle Diameter (in.) 0.234

Leak Rate Initial 0.0026 @
Leak Rate Final 0.000 @ 9"
Traverse Points 24
Pitot Tube Corr. Factor (Cp) 0.84
Meter Corr. Factor (Y) 1.022
Fyrite Results (%)
CO2 0.0
O2 20.9

Source Diagram (Sketch)

Weather conditions:

Traverse Point Number	Sampling Time Minutes	Clock Time (24 hour)	Sample Train Vacuum ("Hg)	Stack Temp (°F) Ts	Velocity Pres. ("H2O) ΔPs	Orifice Differential ("H2O) ΔH	Sample Volume (Vm) (Cubic Feet)	Dry Gas Meter Temp Inlet (°F) Tm	Dry Gas Meter Temp Outlet (°F) Tm	Last Impinger Temp (°F)	Probe Temp. (°F)	Filter Box Temp. (°F)	Filter Box Exit Temp. (°F)	CPM Filter (°F)
3	2:50	16:09	4	109	0.62	1.7	547.12	80	74	43	NA	NA	NA	
4	2:53		4	109	0.62	1.7	549.4	80	74	43				
5	2:56		4	110	0.57	1.5	551.66	81	74	43				
6	2:59		4	110	0.57	1.5	553.9	81	74	43				
							550.07							
1	3:02	16:24	4	101	0.60	1.6	556.07	78	74	42				
2	3:09		4	116	0.70	1.9	558.3	79	74	43				
3	3:09		6	118	0.71	2.0	560.7	80	74	44				
4	1		6	120	0.76	2.0	563.18	81	74	44				
5	14		7	121	0.90	2.4	565.6	81	74	45				
6	3:17		7	124	0.95	2.6	568.3	82	74	45				
1	3:20	16:44	7	123	0.73	2.0	571.07	79	74	44				
2	23		7	123	0.73	2.0	573.45	80	74	45				
3	~~23~~	16:50					575.87							
4														
5														
6														
	5-18-18 BC													

Starting on Port 6 Point 5 sample time is recorded as 1min less than actual. ~~2:23~~ 3:24 min test 5-18-18 BC

Appendix B
Equipment Calibration Documents

THERMOCOUPLE CALIBRATION

Date: 1-3-18
Calibrator: MN SR

Probe: 5'F	ICE H2O		BOILING H2O		BOILING OIL	
	TC	Thermometer	TC	Thermometer	TC	Thermometer
Cal 1	34	34	202	202	378	382
Cal 2	34	34	202	202	380	382
Cal 3	34	34	202	202	382	382
Average	34	34	202	202	380	382

PITOT TUBE INSPECTION CRITERIA CHECKLIST

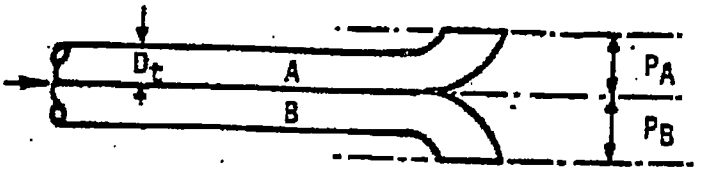
PITOT TUBE NUMBER 5'F

DATE 1-3-18

Operator MW SR

Pitot Tube not on Probe

$3/16 \leq Dt \leq 3/8$
.48cm .95cm
$P_A = P_B$

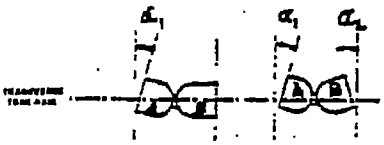


YES NO

$1.05\ Dt \leq P_{A,B} \leq 1.5\ Dt$

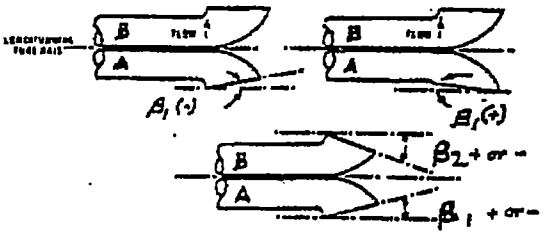
YES NO

α_1 and $\alpha_2 < 10°$



α YES NO

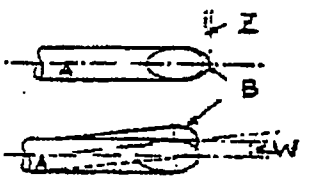
β_1 and $\beta_2 < 5°$



β YES NO

$z < 0.32$ cm (1/8 in)

$w < 0.08$ cm (1/32 in)



z YES NO

w YES NO

Pitot Tube Correction Factor .84

Pitot on Probe
Component Spacing OK

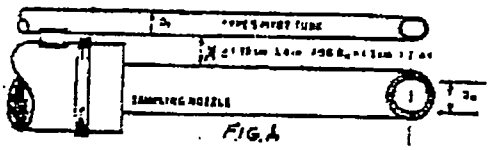


FIG. A

Figure

A. $x \geq 1.9$ cm

B-1. $z \geq 1.9$ cm
$w \geq 7.62$ cm

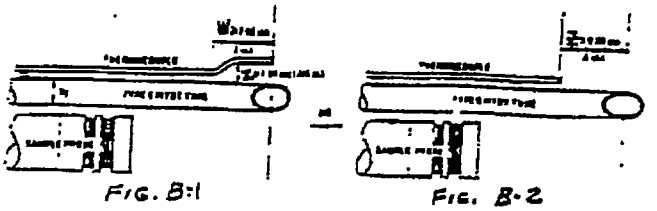


FIG. B-1 FIG. B-2

A. YES NO

B-1 YES NO

or

B-2. $Z \geq 5.08$ cm

C. $Y \geq 7.62$ cm

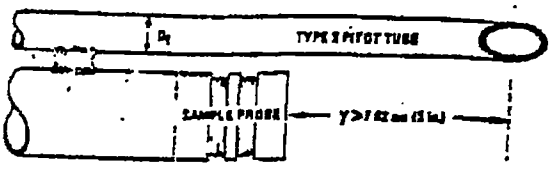


FIG. C

B-2 YES NO

C YES NO

Pitot Tube Correction Factor: .84

THERMOCOUPLE CALIBRATION

Date: 1-5-18
Calibrator: MN

Probe: 5'I	ICE H2O		BOILING H2O		BOILING OIL	
	TC	Thermometer	TC	Thermometer	TC	Thermometer
Cal 1	34	34	210	208	396	398
Cal 2	35	34	210	208	398	398
Cal 3	33	34	210	208	400	398
Average	34	34	210	208	398	398

PITOT TUBE INSPECTION CRITERIA CHECKLIST

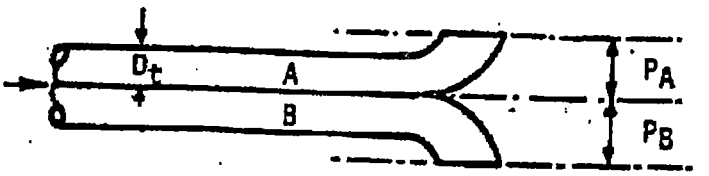
PITOT TUBE NUMBER S' I

DATE 1-5-18

Operator MN

Pitot Tube not on Probe

$3/16 \leq Dt \leq 3/8$
.48cm .95cm
$P_A = P_B$

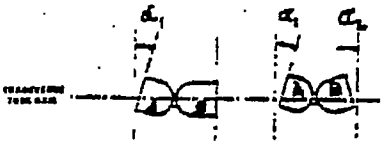


YES NO
YES NO

$1.05\ Dt \leq P_{A,B} \leq 1.5\ Dt$

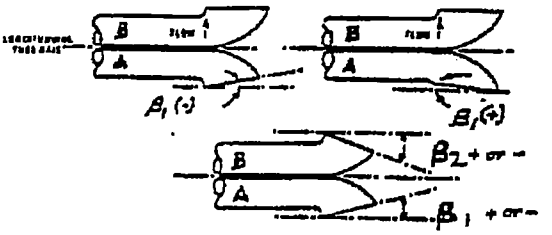
YES NO

α_1 and $\alpha_2 < 10°$



α YES NO

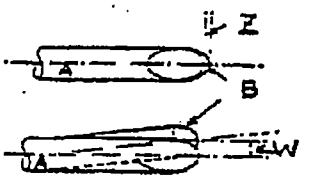
β_1 and $\beta_2 < 5°$



β YES NO

$z < 0.32$ cm (1/8 in)

$w < 0.08$ cm (1/32 in)



z YES NO
w YES NO

Pitot Tube Correction Factor .84

Pitot on Probe
Component Spacing OK

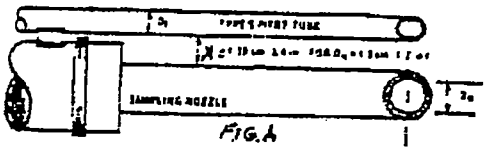


FIG. A

FIGURE

A. $x \geq 1.9$ cm

B-1. $z \geq 1.9$ cm
$w \geq 7.62$ cm

or

B-2. $Z \geq 5.08$ cm

C. $Y \geq 7.62$ cm

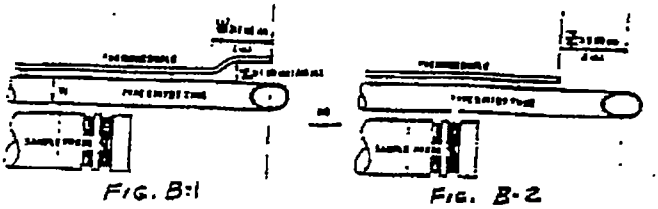


FIG. B-1 FIG. B-2

A. YES NO

B-1 YES NO

B-2 YES NO

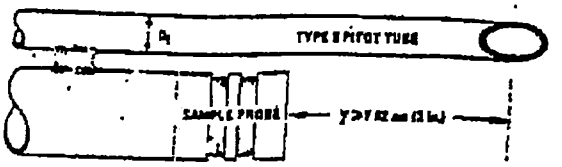


FIG. C

C YES NO

Pitot Tube Correction Factor: _____

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

Quality - Service - Reliability

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record data and information in the **GREEN** cells, YELLOW cells are calculated.

DATE: 1-5-18 | METER SERIAL #: 13857998 | BAROMETRIC PRESSURE (in Hg): INITIAL 30.26, FINAL 30.28, AVG (P_{bar}) 30.27

METER PART #: MB5 | CRITICAL ORIFICE SET SERIAL #: 1447

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS (FT^3) FINAL	DGM READINGS (FT^3) NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)
32	1	0.8305	15	801.430	807.770	6.340	53	59	61	58	58	59	6.00	3.6	6.5838
	2	0.8305	15	807.770	814.120	6.350	60	61	63	58	59	60.25	6.00	3.6	6.5783
	3	0.8305	15	814.120	820.490	6.370	61	63	64	59	59	61.25	6.00	3.6	6.5863
18	1	0.4847	15	820.620	826.075	5.455	58	59	60	59	59	59.25	9.00	1.2	5.6293
	2	0.4847	15	826.075	831.555	5.480	58	60	61	59	59	59.75	9.00	1.2	5.6496
	3	0.4847	15	831.555	837.050	5.495	61	61	62	59	59	60.25	9.00	1.2	5.6596
12	1	0.3326	15	784.750	789.680	4.930	57	53	57	52	54	54	12.00	0.51	5.1309
	2	0.3326	15	789.680	794.650	4.970	59	57	59	54	56	56.5	12.00	0.51	5.1475
	3	0.3326	15	794.650	799.620	4.970	60	59	60	56	57	58	12.00	0.51	5.1326

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION F

AVE

(1) $$Vm_{(std)} = K_1 * Tm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions

K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$\Delta H_{@}$ =

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

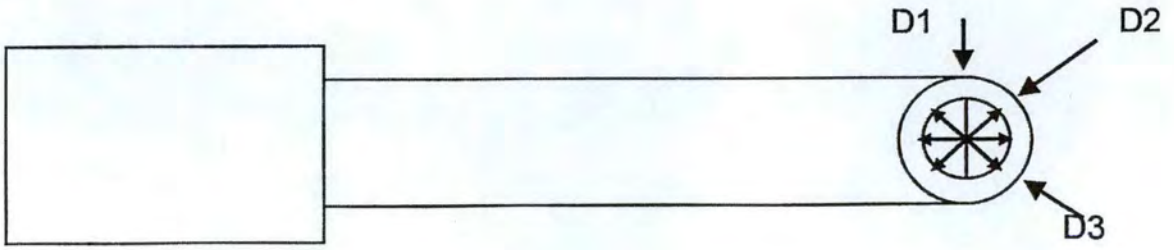
NOZZLE CALIBRATION

BTEC Inc.
Environmental Consulting

Sample Location: D-Blast Furnace
Plant: U.S. Steel
Inspector: TW
Date: 4-2-18

Nozzle Inside Diameter (inches)					
Nozzle ID	D1	D2	D3	ΔD	D (average)
	0.234	0.234	0.235	0.001	0.234

Where:
D1, D2, and D3 = nozzle diameter on a different diameter reported in inches.
Accuracy within 0.001 inches.
Δ = maximum difference in any two measurements
Tolerance = 0.004 inches.
D (average) = average of D1, D2, and D3



Appendix C
Example Calculations

EXAMPLE CALCULATIONS

Note: answers obtained by sample calculations may deviate from that presented within the report because of rounding differences.

USEPA METHOD 1-4, 17

Moisture Content

$$V_{wc} = K_1 \cdot V_1$$

Where: V_{wc} = volume of water vapor condensed in impingers and silica gel at standard conditions (ft^3)
$K_1 = 0.04715\ ft^3/g$ water
V_1 = mass of water collected in impingers (g)

For example, for Run 2 of the PM testing at the D Blast Furnace Exhaust, -2 g of water were condensed in the impingers, and 15 g of water were collected by the silica gel. The volume of water collected in each section of the sampling train, in ft^3, was calculated as follows:

$$V_{wc} = \left(0.04715 \frac{ft^3}{g}\right)(-2 + 15\ g) = 0.61295\ ft^3$$

The total volume of water collected was 0.61295 ft^3.

Gas Volume Standardization

$$V_{std} = V_m Y_m \left(\frac{T_{std}}{P_{std}}\right)\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m}\right)$$

Where: V_{std} = volume of gas sampled at standard conditions
V_m = volume of gas measured by dry gas meter (ft^3)
Y_m = dry gas meter correction factor (dimensionless)
T_{std} = standard temperature ($^\circ R = 460 + ^\circ F$)
P_{std} = standard pressure ("Hg)
P_b = barometric pressure ("Hg)
ΔH = average orifice differential pressure ("H_2O)
T_m = average meter temperature ($^\circ R$)

For example, the volume of gas measured at the dry gas meter for Run 2 of the PM testing at the D Blast Furnace Exhaust was 83.10 ft^3. The dry gas meter correction factor was 1.022. Standard temperature and pressure are 528°R and 29.92"Hg, respectively. The barometric pressure at the time of testing was 29.24"Hg. The average orifice differential, and meter temperature were 2.46 and 532.65°R, respectively. The volume of gas sampled was corrected to standard conditions as follows:

$$V_{std} = (83.10\,ft^3)(1.022)\left(\frac{528^\circ R}{29.92\,"Hg}\right)\left(\frac{29.24"Hg + \frac{2.46"H_2O}{13.6\frac{"H_2O}{"Hg}}}{532.65^\circ R}\right) = 82.79\,ft^3, \text{standard}$$

Moisture Fraction

$$B_{ws} = \frac{V_{wc}}{V_{wc} + V_{std}}$$

Where: B_{ws} = exhaust gas moisture content

For example, from previously calculated values, the exhaust gas moisture fraction for Run 2 of the PM testing at the D Blast Furnace Exhaust was calculated as follows:

$$B_{ws} = \frac{0.61295\,ft^3}{0.61295\,ft^3 + 82.79\,ft^3} = 0.007$$

Absolute Stack Gas Temperature, T_s (°R)

$$T_s = 460 + t_s$$

Where: t_s = Measured stack gas temperature (°F)

For example, for Run 2 of the PM testing at the D Blast Furnace Exhaust, the average stack temperature was 98.3°F. The average temperature in degrees Rankine is therefore 98.3 + 460 = 558.3°R.

Absolute Stack Gas Pressure, P_s (in. Hg)

$$P_s = P_{bar} + \left(\frac{P_{stat}}{13.6}\right)$$

Where: P_{bar} = Barometric pressure at test site (in. Hg)
P_{stat} = Stack static pressure (in. Hg)

For example, for Run 2 of the PM testing at the D Blast Furnace Exhaust, the barometric and stack static pressures were 29.24"Hg, and -0.7"H_2O, respectively. The absolute stack pressure is then:

$$P_s = 29.24 + \left(\frac{-0.7}{13.6}\right) = 29.19" Hg$$

Stack Gas Molecular Weight, Dry Basis (lb/lb mole)

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$

For example, for Run 2 of the PM testing at the D Blast Furnace Exhaust, the average O_2 content of the exhaust gas stream was 20.9% (from Fyrite). The CO_2 content of the gas stream was 0% (from Fyrite). The CO content was assumed to be negligible, and the N_2 content is assumed to make up the balance of the gas content (i.e. 100-20.9 = 79.1%). The dry stack gas molecular weight is therefore:

$$M_d = 0.44(0\%) + 0.32(20.9\%) + 0.28(79.1\%) = 28.836 \frac{\text{lb}}{\text{lb mol}}$$

Stack Gas Molecular Weight, Wet Basis (lb/lb mole)

$$M_s = M_d\left(1-\frac{B_{ws}}{100}\right)+18\left(\frac{B_{ws}}{100}\right)$$

The stack gas moisture content for Run 2 of the PM testing at the D Blast Furnace Exhaust was 0.7%. The wet stack gas molecular weight is then:

$$M_s = 28.836\frac{\text{lb}}{\text{lb mol}}\left(1-\frac{0.7}{100}\right)+18\left(\frac{0.7}{100}\right)=28.76\frac{\text{lb}}{\text{lb mol}}$$

Stack Gas Velocity, V_s (fpm)

$$V_s=\left(60\frac{\text{sec}}{\text{min}}\right)K_pC_p\Delta P\sqrt{\frac{T_s}{P_sM_s}}$$

Where: K_p = Pitot tube constant equal to $85.49\ \frac{ft}{\text{sec}}\sqrt{\frac{(lb/lb\cdot mole)(in.Hg)}{(^oR)(in.H_2O)}}$

C_p = Pitot tube coefficient, dimensionless

ΔP = The average square root of the velocity head of stack gas (in. H_2O)

M_s = Molecular weight of the stack gas, wet basis (lb/lb mole)

For example, for Run 2 of the PM testing at the D Blast Furnace Exhaust, the average square root of the velocity head of the stack gas was 0.947"H_2O. Using values already calculated, the average stack gas velocity was calculated as follows:

$$V_s=\left(60\frac{\text{sec}}{\text{min}}\right)\left(85.49\frac{ft}{\text{sec}}\sqrt{\frac{(\text{lb/lb mol})(in.Hg)}{(^oR)(in.H_2O)}}\right)(0.84)$$

$$0.947\cdot\sqrt{\frac{(558.3^oR)}{(29.19in.Hg)\left(28.76\frac{\text{lb}}{\text{lb mol}}\right)}}=3{,}328\frac{ft}{\text{min}}$$

Average Stack Gas Volumetric Flowrate, Q_s (cfm)

$$Q_s = V_s \cdot A$$

Where: V_s = Stack gas velocity (fpm)
A = Cross-sectional area of stack (ft^2)

For example, the D Blast Furnace Exhaust has a diameter of 129 in. The cross-sectional area of the stack is calculated as follows:

$$\frac{\pi}{4}\left(\frac{129in}{12in/ft}\right)^2 = 90.76\,ft^2$$

For Run 2 of the PM testing at the D Blast Furnace Exhaust, the stack gas volumetric flowrate was then calculated as follows:

$$Q_s = \left(3{,}328\frac{ft}{\min}\right)\cdot\left(90.76\,ft^2\right) = 302{,}049\frac{ft^3}{\min}$$

Standard Stack Gas Volumetric Flowrate, Q_{std} (scfm)

$$Q_{std} = Q_s\left(\frac{528^o R}{T_s}\right)\left(\frac{P_s}{29.92in.Hg}\right)$$

Where: T_s = Absolute stack gas temperature (^oR)
P_s = Absolute stack gas pressure (in. Hg)

For example, for Run 2 of the PM testing at the D Blast Furnace Exhaust, the standard stack gas volumetric flowrate was calculated as follows:

$$Q_{std} = 302{,}049\frac{ft^3}{\min}\left(\frac{528^o R}{558.3^o R}\right)\left(\frac{29.19in.Hg}{29.92in.Hg}\right) = 278{,}687\frac{ft^3}{\min}, \text{standard}$$

Dry Standard Stack Gas Volumetric Flowrate, $Q_{std,dry}$ (dscfm)

$$Q_{std,dry} = Q_{std}(1 - B_{ws})$$

For example, for Run 2 of the PM testing at the D Blast Furnace Exhaust, the dry standard stack gas volumetric flowrate was calculated as follows:

$$Q_{std,dry} = 278{,}687 \frac{ft^3}{\min}, \text{standard}(1 - 0.007) = 276{,}736 \frac{ft^3}{\min}, \text{standard dry}$$

PM Concentration, C_1 (lb/ft^3, dry basis)

$$C_1 = \frac{m}{453{,}600 V_t}$$

Where: m = mass of particulate/PM (mg).
V_t = total volume of gas sampled (ft^3).
453,600 = conversion factor, milligrams to pounds.

For example, for Run 2 of the PM testing at the D Blast Furnace Exhaust, the total mass of PM measured from the filter and acetone rinse was 8.9 mg. The total standardized (dry) volume of gas sampled was 82.79 ft^3. The dry PM concentration of the gas stream is then:

$$C_1 = \frac{8.9 mg}{453{,}600 \frac{mg}{lb}(82.79 ft^3)} = 2.37 * 10^{-7} \frac{lb}{ft^3}$$

Mass Emission Rate (lb/hr)

$$\text{Emission Rate} = C_1 Q_{std,dry}\left(60 \frac{\min}{hr}\right)$$

Where: $Q_{std,dry}$ = dry standard stack gas volumetric flowrate (ft^3/min).

For example, from the previous calculation, $C_1 = 2.37 * 10^{-7}$ lb/ft^3. The dry standard flowrate for Run 2 of the PM testing at the D Blast Furnace Exhaust was 276,736 ft^3/min. The mass PM loading in pounds per hour is then:

$$\text{Emission Rate} = 2.37 * 10^{-7} \frac{lb}{ft^3}\left(276{,}736 \frac{ft^3}{\min}\right)\left(60 \frac{\min}{hr}\right) = 3.9 \frac{lb}{hr}$$

Mass Loading (lb/1000 lb, dry)

$$Loading = 1000 \cdot \frac{C_1\left(386.9\frac{ft^3}{lb \cdot mol}\right)}{MW_d}$$

Where: MW_d = stack gas molecular weight, dry (lb/lb mol).
386.9 ft^3/lb mol = from the ideal gas law.

For example, $C_1 = 2.37*10^{-7}$ lb/ft^3 on a dry basis for Run 2 of the PM testing at the D Blast Furnace Exhaust. The stack gas dry molecular weight for this run was 28.836 lb/lb mol. The PM loading is then:

$$Loading = 1000 \cdot \frac{2.37*10^{-7}\frac{lb}{ft^3}\left(386.9\frac{ft^3}{lb \cdot mol}\right)}{28.836\frac{lb}{lb \cdot mol}} = 0.003\frac{lb}{1000lb}$$

Appendix D
Laboratory Analytical Results

Gravimetric Analytical Report
Front Half Particulate Matter Emissions
US Steel
Ecorse MI
BTEC Project No. 049AS-278010
Sampling Dates: 4-3-18

Source ID	Test #	Filter Number	Filter initial wt. (g)	Filter Final wt. (g)	Beaker Volume (mL)	Filter net wt. gain (g)	Beaker blank correction (g)	Filter net wt. gain Corrected (g)
Filters								
D Blast	1	J-468	0.1209	0.1295	NA	0.0086	NA	0.0086
D Blast	2	J-473	0.1124	0.1181	NA	0.0057	NA	0.0057
D Blast	3	J-475	0.1262	0.1396	NA	0.0134	NA	0.0134
	blank	J-374	0.1206	0.1208	NA	0.0002	NA	

Source ID	Test #	Beaker Number	Beaker initial wt. (g)	Beaker Final wt. (g)	Beaker Volume (mL)	Beaker net wt. gain (g)	Beaker blank correction (g)	Beaker net wt. gain Corrected (g)
Beakers								
D Blast	1	1B	117.4261	117.4307	90	0.0046	0.0000	0.0046
D Blast	2	Y8	108.8188	108.8220	90	0.0032	0.0000	0.0032
D Blast	3	Z1	108.1947	108.1984	90	0.0037	0.0000	0.0037
	blank	18	102.3819	102.3820	90	0.0001		

Limit of Detection: 0.5 mg
Analytical Method (USEPA): 5

Equations

$C_a = m_a/(V_a * p_a)$, eq 5-4

$W_a = C_a * V_{aw} * p_a$, eq 5-5

Where:

Ca = acetone blank residue concentration
ma = mass of residue in blank
pa = density of acetone, 0.788 mg/ml
Va = Volume of acetone in blank
Vaw = Volume of acetone in sample
Wa = weight of residue in acetone wash (blank correction)

Density of acetone:	0.78800	g/cm^3
Acetone blank concentration:	1.4E-06	Ca
Total acetone weight (blank):	70.92	g
maximum correction:	0.001	%
maximum correction:	0.0007	g

Particulate Analytical Laboratory Report

for

USS D BLAST

BTEC Project No. 04945-278010

Test Date: 4-3-18

Date:				4-6-18	4-11-18			
Time :				12:00	15:30			
Relative Humidity:				46	45			
Temperature (*F):				52	61			
Pressure (in Hg):				28.97	29.15			
Initials:				DT	DT			
Source ID	Test #	Filter / Beaker #	Filter/Beaker initial wt. (g)	Filter/Beaker Final wt. (g)	Filter/Beaker Final wt. (g)	Filter/Beaker Final wt. (g)	Filter/Beaker net wt. gain (g)	Beaker Volume (ml)
D BLAST	1	1B	117.4261	117.4306	117.4308	✓		90
"	2	Y8	108.8188	108.8220	108.8220	✓		90
"	3	Z1	108.1947	108.1982	108.1986	✓		90
D BLAST	1	J-468	.1209	.1295	.1294	✓		
"	2	J-473	.1124	.1182	.1180	✓		
"	3	J-475	.1262	.1347	.1394	✓		
BLANK	-	18	102.3819	102.3819	102.3820	✓		90
"	-	J-374	.1206	.1208	.1207	✓		

Limit of Detection: 0.5 mg

Analytical Method (USEPA): 5

Appendix E
Production Data

4/3/2020

D4 Blast Furnace Casthouse Baghouse Stack Test

Time	Fan #1 Amps	Fan #2 Amps	Fan #3 Amps	BLD Reading	DP
8:00	81	79	Ø	off	11.6
8:15	79	80	Ø	off	13
8:30	81	80	Ø	off	12.2
8:45	80	80	Ø	off	12.1
9:00	80	79	Ø	off	13.3
9:15	80	80	Ø	off	13.4
9:30	79	80	Ø	off	12.2

Fan dampers are in fixed positions.
BLD is on/off alarm

Cast # 27218 ~~27218~~

Start Cast 8:00 AM

Stop Cast 9:35

Tons Iron 408

4/3/2018 Run 2

D4 Blast Furnace Casthouse Baghouse Stack Test

Time	Fan #1 Amps	Fan #2 Amps	Fan #3 Amps	BLD Reading	DP
10:06	80.0	80.0	Ø	~~off~~	11.8
10:21	79.0	80.0	Ø	off	11.0
10:36	81.0	80.0	Ø	off	12.7
10:51	80.0	80.0	Ø	off	13.0
11:06	80.0	80.0	Ø	off	13.4
11:21	80.0	80.0	Ø	off	13.4
11:36	80.0	80.0	Ø	off	13.4
11:51	80.0	80.0	Ø	off	13.4

Fan dampers are in fixed positions.
BLD is on/off alarm

Cast # 27219

Start Cast 10:06

Stop Cast 11:55

Tons Iron ~~440~~ NG
440

1/3/2010 Run 5

Short Cast.

D4 Blast Furnace Casthouse Baghouse Stack Test

Time	Fan #1 Amps	Fan #2 Amps	Fan #3 Amps	BLD Reading	DP
12:27	80	80	~~0~~	off	12.3
12:42	80	80	~~0~~	off	12.9
12:57	80	81	~~0~~	off	13.4
1:12	80	81	~~0~~	off	13.7
1:27	79	80	~~0~~	off	13.5
1:42					

Cast # 27220

Start Cast 12:27

Stop Cast 1:35

Tons Iron 257

Fan dampers are in fixed positions.
BLD is on/off alarm

4/3/2018 Run's cont'd

D4 Blast Furnace Casthouse Baghouse Stack Test

Time	Fan #1 Amps	Fan #2 Amps	Fan #3 Amps	BLD Reading	DP
2:05	80.0	80.0	Ø	off	12.7
2:20	80.0	80.0	Ø	off	12.5
2:35	80	81	Ø	off	13.1
2:50	79	81	Ø	off	12.7
3:05	80	80	Ø	off	11.9
3:20	80	80	Ø	off	13.4
3:35	80	80	Ø	off	12.9
3:50	80	80	Ø	off	13.2
4:05	80	80	Ø	off	13.4
4:20	80	80	Ø	off	12.7

Fan dampers are in fixed positions.
BLD is on/off alarm

Cast # 27221

Start Cast 2:05

Stop Cast 4:50

Tons Iron 482

D4 Blast Furnace Casthouse Baghouse Stack Test

Time	Fan #1 Amps	Fan #2 Amps	Fan #3 Amps	BLD Reading	DP
4:35	78	80	Ø	off	12.3
4:50	79	80	Ø	off	14.1

Cast # 27221

Start Cast 2:05

Stop Cast 4:80

Tons Iron 482

Fan dampers are in fixed positions.
BLD is on/off alarm

Appendix F
Opacity Data Sheets

Visual Determination of Opacity — Run 1

DATE: 4-3-18

FACILITY: D4 Blast Fce East Hse Roof

Start Time: 8:00 Am — End Time: 9:35 Am

OBSERVER: Bud Bush - Veolia Water

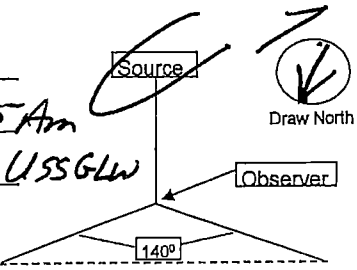
LOCATION: ZI D4 Blast Fce USSGLW

Wind Direction and Speed: VE 10-15mph — Sky Condition: overcast — Temp: 37°F

OBSERVER'S LOCATION: NW from Fce ~ 150 yards

Comments: D4 Bg Hse stack test Cast # 27218 Blower: Stephen Drum temp: 2739

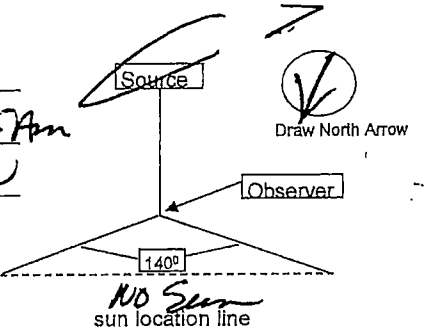
BACKGROUND



HOUR	MIN	SECONDS 0	15	30	45	Comments
8:00	0	10	15	20	15	Start VEo
	1	10	0	0	0	
	2	0	0	0	0	
	3	0	0	0	0	
	4	0	0	0	0	
	5	0	0	0	0	
	6	0	0	0	0	
	7	0	0	0	0	
	8	0	0	0	0	
	9	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	
8:30	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
8:51	51	0	0	15	25	Red dirt
	52	10	10	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

Visual Determination of Opacity — Run 1 — DATE 4-3-18

FACILITY: D4 Blast Fce Cast Hse Roof
Start Time: 8:00 Am — End Time: 9:35 Am
OBSERVER: Paul Bush - Veolia Water
LOCATION: ZI D4 Fce USSGLW
Wind Direction and Speed: NE 10-15 mph — Sky Condition: overcast — Temp: 37°F
OBSERVER'S LOCATION: NW from D4 ~150 yards
Comments: D4 Bghse Stack test, Cast # 7218
BACKGROUND



HOUR	MIN	SECONDS 0	15	30	45	Comments
8:00	0	0	0	0	0	
	1	0	0	0	0	
	2	0	0	0	0	
	3	0	0	0	0	
	4	0	0	0	0	
	5	0	0	0	0	
	6	0	0	0	0	
	7	0	5	5	5	whitish
	8	5	5	5	5	
	9	5	5	5	5	
	10	10	5	5	5	
	11	5	5	5	5	
	12	5	5	5	5	
	13	5	10	10	10	
	14	10	10	5	5	
	15	5	10	5	5	
	16	0	0	0	0	
	17	5	5	5	5	
	18	10	10	5	5	
	19	10	5	5	10	
	20	10	10	10	10	
	21	10	10	15	15	
	22	15	15	15	10	
	23	10	10	10	10	
	24	10	10	10	10	
	25	5	10	10	5	
	26	5	5	5	5	
	27	5	5	5	5	
	28	5	5	5	5	
	29	10	10	5	5	

HOUR	MIN	SECONDS 0	15	30	45	Comments
9:30	30	5	5	10	5	
	31	5	5	5	5	
	32	5	5	5	5	
	33	0	0	0	0	
	34	0	5	5	10	End Cast
	35	10	10	0	0	End Obs
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

pg 2 of 2

Visual Determination of Opacity RUN # 1

DATE 4-3-18

FACILITY D4 BLAST FCE BGHSE STK

Start Time 8:00 AM End Time 9:00 AM

OBSERVER P. Krystyak - Vadim Watts

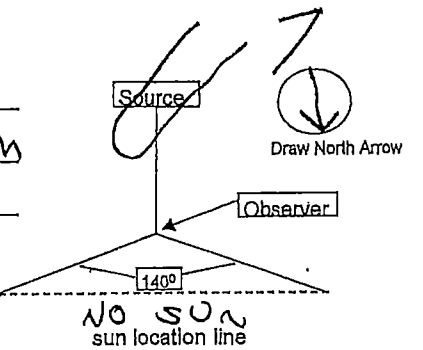
LOCATION E.I. USS GLW

Wind Direction and Speed NE 10-15 Sky Condition OVERCAST Temp: 35°

OBSERVER'S LOCATION N ~ 110 YDS FROM D4

Comments: ~~STK TEST~~ D4 BGHSE STK TEST CAST # 27218

BACKGROUND



HOUR	MIN	SECONDS 0	15	30	45	Comments	HOUR	MIN	SECONDS 0	15	30	45	Comments
8:00	0	0	0	0	0	START V.E.O.	8:30	30	0	0	0	0	
	1	0	0	0	0			31	0	0	0	0	
	2	0	0	0	0			32	0	0	0	0	
	3	0	0	0	0			33	0	0	0	0	
	4	0	0	0	0			34	0	0	0	0	
	5	0	0	0	0			35	0	0	0	0	
	6	0	0	0	0			36	0	0	0	0	
	7	0	0	0	0			37	0	0	0	0	
	8	0	0	0	0			38	0	0	0	0	
	9	0	0	0	0			39	0	0	0	0	
	10	0	0	0	0			40	0	0	0	0	
	11	0	0	0	0			41	0	0	0	0	
	12	0	0	0	0			42	0	0	0	0	
	13	0	0	0	0			43	0	0	0	0	
	14	0	0	0	0			44	0	0	0	0	
	15	0	0	0	0			45	0	0	0	0	
	16	0	0	0	0			46	0	0	0	0	
	17	0	0	0	0			47	0	0	0	0	
	18	0	0	0	0			48	0	0	0	0	
	19	0	0	0	0			49	0	0	0	0	
	20	0	0	0	0			50	0	0	0	0	
	21	0	0	0	0			51	0	0	0	0	
	22	0	0	0	0			52	0	0	0	0	
	23	0	0	0	0			53	0	0	0	0	
	24	0	0	0	0			54	0	0	0	0	
	25	0	0	0	0			55	0	0	0	0	
	26	0	0	0	0			56	0	0	0	0	
	27	0	0	0	0			57	0	0	0	0	
	28	0	0	0	0			58	0	0	0	0	
	29	0	0	0	0		9:00	59	0	0	0	0	END V.E.O.

Visual Determination of Opacity — Run 2

DATE: 4-3-18

FACILITY: D4 Blast Fce Cast Hse Roof

Start Time: 10:06 Am — End Time: 11:56 Am

OBSERVER: Paul Bush - Veolia Water

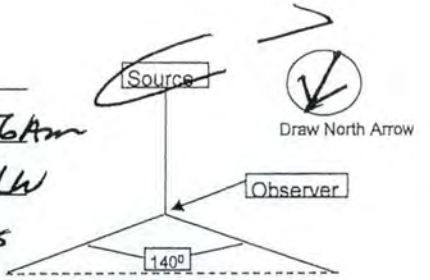
LOCATION: ZI D4 Fce 455 GLW

Wind Direction and Speed: ENE 10-15 mph — Sky Condition: overcast — Temp: 37°F

OBSERVER'S LOCATION: NW from D4 ~150 yards

Comments: D4 Bghse stack test, Cast # 27219, Blower: Stephen

BACKGROUND: Run temps: 2738



HOUR	MIN	SECONDS 0	15	30	45	Comments
10:00	0					
	1					
	2					
	3					
	4					
	5					
10:06	6	0	0	0	0	Start VEO
	7	0	0	0	0	
	8	0	5	15	0	
	9	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

HOUR	MIN	SECONDS 0	15	30	45	Comments
10:30	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

Visual Determination of Opacity Run 2 | DATE 4-3-18

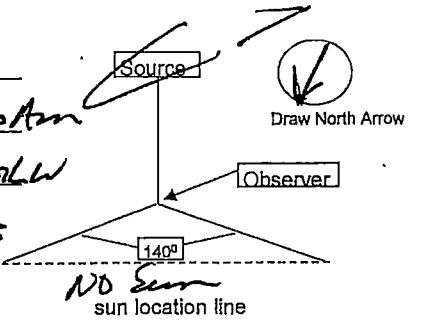
FACILITY D4 Blast Fce Cast House Roof | Start Time 10:06 Am | End Time 11:56 Am

OBSERVER Paul Bush - Verdin Water | LOCATION EI D4 Fce USSGLW

Wind Direction and Speed NE 10-15 mph | Sky Condition overcast | Temp: 37°F | OBSERVER'S LOCATION NW from D4 ~ 150 yards

Comments: D4 Bghse Stack test / Cast #: 27219,

BACKGROUND



HOUR	MIN	SECONDS 0	15	30	45	Comments
1:00	0	0	0	0	0	
	1	0	0	0	0	
	2	0	0	0	0	
	3	0	0	0	0	
	4	0	0	0	0	
	5	0	0	0	0	
	6	0	0	0	0	
	7	0	0	0	0	
	8	0	0	0	0	
	9	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	5	10	5	
	14	5	5	5	5	Bluish/whitish
	15	5	5	5	5	
	16	5	10	5	5	
	17	5	5	5	5	
	18	5	5	5	5	
	19	10	10	5	5	
	20	5	5	5	5	
	21	5	5	5	5	
	22	5	5	5	5	
	23	10	10	10	10	
	24	10	10	10	5	
	25	5	5	5	5	
	26	5	5	5	10	
	27	5	5	5	5	
	28	5	5	5	5	
	29	5	5	5	5	

HOUR	MIN	SECONDS 0	15	30	45	Comments
11:30	30	10	10	10	5	
	31	5	10	15	10	
	32	10	10	10	10	
	33	10	10	10	10	
	34	5	5	5	10	
	35	5	10	5	5	
	36	5	5	5	5	
	37	5	5	5	5	
	38	5	5	10	10	
	39	10	5	5	10	
	40	15	15	5	5	
	41	5	15	10	5	
	42	5	10	10	5	
	43	5	5	5	5	
	44	5	5	10	10	
	45	5	5	5	5	
	46	5	5	5	5	
	47	5	5	10	5	
	48	10	10	5	5	
	49	5	5	5	5	
	50	5	5	5	10	
	51	10	10	5	5	
	52	5	10	10	5	
	53	5	10	10	10	
	54	5	5	5	15	
	55	10	10	10	10	End Cast
	56	15	15	15	20	
	57					
	58					
	59					

pg 2 of 2

Visual Determination of Opacity RUN # 2

DATE 4-3-18

FACILITY
D4 BLAST FCE BGHSE STK

Start Time 10:06 AM End Time 11:06 AM

OBSERVER
P. Kyzivat - Vectra Water

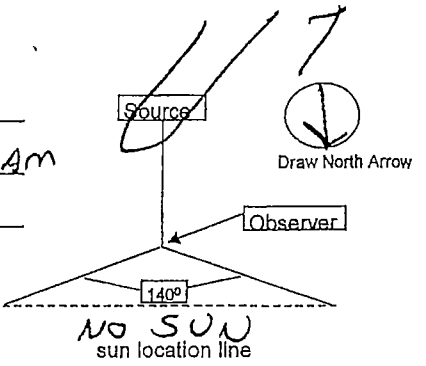
LOCATION
E.I. USS GLW

Wind Direction and Speed NE 10-15 Sky Condition OVERCAST Temp: 36°

OBSERVER'S LOCATION
N 110 YDS FROM D4

Comments:
D4 BGHSE STK TEST CAST # 27219

BACKGROUND



HOUR	MIN	SECONDS 0	15	30	45	Comments	HOUR	MIN	SECONDS 0	15	30	45	Comments
11:00	0	0	0	0	0		10:30	30	0	0	0	0	
	1	0	0	0	0			31	0	0	0	0	
	2	0	0	0	0			32	0	0	0	0	
	3	0	0	0	0			33	0	0	0	0	
	4	0	0	0	0			34	0	0	0	0	
:06	5	0	0	0	0	END V.E.O.		35	0	0	0	0	
0:06	6	0	0	0	0	START V.E.O.		36	0	0	0	0	
	7	0	0	0	0			37	0	0	0	0	
	8	0	0	0	0			38	0	0	0	0	
	9	0	0	0	0			39	0	0	0	0	
	10	0	0	0	0			40	0	0	0	0	
	11	0	0	0	0			41	0	0	0	0	
	12	0	0	0	0			42	0	0	0	0	
	13	0	0	0	0			43	0	0	0	0	
	14	0	0	0	0			44	0	0	0	0	
	15	0	0	0	0			45	0	0	0	0	
	16	0	0	0	0			46	0	0	0	0	
	17	0	0	0	0			47	0	0	0	0	
	18	0	0	0	0			48	0	0	0	0	
	19	0	0	0	0			49	0	0	0	0	
	20	0	0	0	0			50	0	0	0	0	
	21	0	0	0	0			51	0	0	0	0	
	22	0	0	0	0			52	0	0	0	0	
	23	0	0	0	0			53	0	0	0	0	
	24	0	0	0	0			54	0	0	0	0	
	25	0	0	0	0			55	0	0	0	0	
	26	0	0	0	0			56	0	0	0	0	
	27	0	0	0	0			57	0	0	0	0	
	28	0	0	0	0			58	0	0	0	0	
	29	0	0	0	0			59	0	0	0	0	

Visual Determination of Opacity Run 3

DATE 4-3-18

FACILITY D4 Blast Fce Cast Hse Roof

Start Time 12:26 pm End Time 1:36 pm

OBSERVER Paul Brush - Veolia Water

LOCATION EI D4 Fce USSGLW

Wind Direction and Speed ENE 15-20

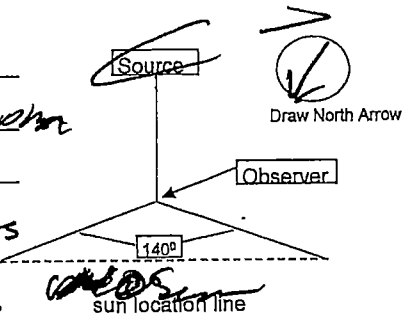
Sky Condition overcast

Temp: 38°F

OBSERVER'S LOCATION NW from D4 ~150 yards

Comments: D4 Bghse Stack test, Cast #27220, Blower: Stephen

BACKGROUND Drum Temp: 2752

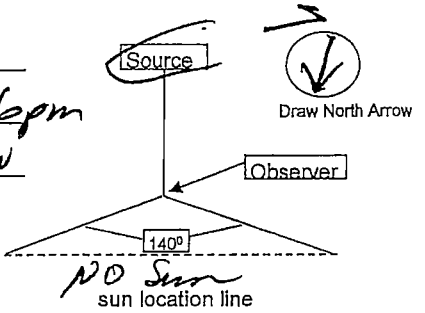


HOUR	MIN	SECONDS 0	15	30	45	Comments
	0					
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
2:26	26	0	0	0	0	Start VEO
	27	0	0	15	10	
	28	5	0	0	0	
	29	0	0	0	0	

HOUR	MIN	SECONDS 0	15	30	45	Comments
12:30	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

Visual Determination of Opacity — Run 3 — DATE 4-3-18

FACILITY: D4 Blast Fce Cast Hse Roof
Start Time: 12:26 pm — End Time: 1:36 pm
OBSERVER: Paul Bush - Veolia Water
LOCATION: ZI D4 Fce USSGLW
Wind Direction and Speed: ENE 5-20 mph — Sky Condition: overcast — Temp: 38°F
OBSERVER'S LOCATION: NW from D4 ~ 150 yards
Comments: D4 Bghse Stack test, Cast # 27220
BACKGROUND

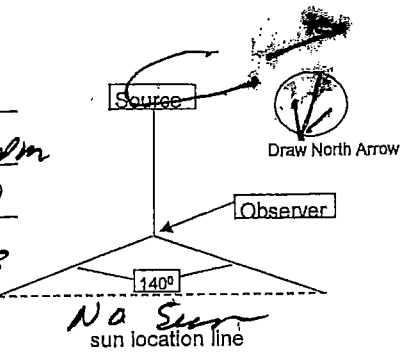


HOUR	MIN	SECONDS 0	15	30	45	Comments	HOUR	MIN	SECONDS 0	15	30	45	Comments
1300	0	0	0	0	0		1330	30	10	5	10	10	
	1	0	0	0	0			31	10	10	5	5	
	2	0	0	0	0			32	5	5	10	5	
	3	0	0	0	0			33	5	5	10	10	
	4	0	0	0	0			34	10	20	10	15	
	5	0	0	0	0			35	15	20	15	10	End Cast
	6	0	0	0	0		1336	36	10	10	5	5	End VEO
	7	0	0	0	0			37					
	8	0	15	20	15	whitish/Blueish		38					
	9	15	5	10	10			39					
	10	10	5	5	5			40					
	11	15	20	10	10			41					
	12	5	5	5	5			42					
	13	5	5	5	5			43					
	14	5	0	0	10			44					
	15	5	10	5	5			45					
	16	10	15	10	10			46					
	17	5	10	10	5			47					
	18	5	5	15	10			48					
	19	10	15	10	10			49					
	20	5	5	5	10			50					
	21	5	5	10	10			51					
	22	15	10	15	10			52					
	23	10	10	5	10			53					
	24	10	10	5	10			54					
	25	10	5	5	10			55					
	26	10	10	5	5			56					
	27	5	5	5	5			57					
	28	15	5	5	5			58					
	29	15	5	5	5			59					

pg 2 of 2

Visual Determination of Opacity — Run 3 Cont. — DATE 4-3-18

FACILITY: D4 Blast Fce Cent Hse Roof
Start Time: 2:05 pm — End Time: 4:50 pm
OBSERVER: Paul Bush - Veolia Water
LOCATION: ZF D4 Fce USSGLW
Wind Direction and Speed: NE 15-20 mph — Sky Condition: overcast — Temp: 38°F
OBSERVER'S LOCATION: NW from D4 ~180 yards
Comments: D4 Bghse stack test; Cast# 27221, Meter temp: 250
BACKGROUND



HOUR	MIN	SECONDS 0	15	30	45	Comments
	0					
	1					
	2					
	3					
	4					
2:05	5	0	0	0	0	Starts VEO
	6	0	0	10	20	
	7	15	10	10	5	
	8	0	0	0	0	
	9	0	0	0	0	
	10	0	0	0	0	
	11	5	10	10	10	Bluish / whitish
	12	5	5	10	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	10	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

HOUR	MIN	SECONDS 0	15	30	45	Comments
2:30	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	10	Brownish
	54	10	10	5	5	
	55	5	5	5	5	
	56	5	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

Visual Determination of Opacity — Run 3 Cont — DATE 4-3-18

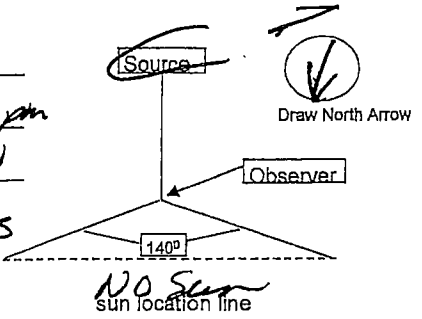
FACILITY D4 Blast Fce Cast Hse Roof — Start Time 2:05 pm — End Time 4:50 pm

OBSERVER Paul Bush - Veolia Water — LOCATION ZI D4 Fce USSGLW

Wind Direction and Speed ENE 15-20 mph — Sky Condition overcast — Temp: 38°F — OBSERVER'S LOCATION NW from D4 ~150 yards

Comments: D4 Bghse Stk test Cast # 27221

BACKGROUND

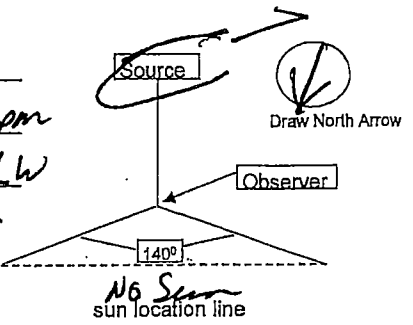


HOUR	MIN	SECONDS 0	15	30	45	Comments	HOUR	MIN	SECONDS 0	15	30	45	Comments
3:00	0	0	0	0	0		3:30	30	0	0	0	0	
	1	0	0	0	0			31	0	0	0	0	
	2	0	0	0	0			32	0	0	0	0	
	3	0	0	0	0			33	0	0	0	0	
	4	0	0	0	0			34	0	0	0	0	
	5	0	0	0	0			35	0	0	0	0	
	6	0	0	0	0			36	0	0	0	0	
	7	0	0	0	0			37	0	0	0	0	
	8	0	0	0	0			38	0	0	0	0	
	9	0	0	0	0			39	0	0	0	0	
	10	0	0	0	0			40	0	0	0	0	
	11	0	0	0	0			41	0	0	0	0	
	12	0	0	0	0			42	0	0	0	0	
	13	0	0	0	0			43	0	0	0	0	
	14	0	0	0	0			44	0	0	0	0	
	15	0	0	0	0			45	0	0	0	0	
	16	0	0	0	0			46	0	0	0	0	
	17	0	0	0	0			47	0	0	0	0	
	18	0	0	0	0			48	0	0	0	0	
	19	0	0	0	0			49	0	0	0	0	
	20	0	0	0	0			50	0	0	0	0	
	21	0	0	0	0			51	0	0	0	0	
	22	0	0	0	0			52	0	0	0	0	
	23	0	0	0	0			53	0	0	0	0	
	24	0	0	0	0			54	0	0	0	0	
	25	0	0	0	0			55	0	0	0	0	
	26	0	0	0	0			56	10	10	15	10	
	27	0	0	0	0			57	0	0	0	0	
	28	0	0	0	0			58	0	0	0	0	
	29	0	0	0	0			59	0	10	10	15	whitish / Bluish

Pg 2 of 3

Visual Determination of Opacity — Run 3 Cont. — DATE 4-3-18

FACILITY: D4 Blast Fce Cast Hse Roof
Start Time: 2:05pm — End Time: 4:50pm
OBSERVER: Paul Bush - Veolia Water
LOCATION: ZF D4 Fce USSGLW
Wind Direction and Speed: NE 10-15 mph — Sky Condition: overcast — Temp: 38F
OBSERVER'S LOCATION: NW from D4 ~150 yds
Comments: D4 Bghse Stack East, Cast # 27224
BACKGROUND



HOUR	MIN	SECONDS 0	15	30	45	Comments
2:00	0	10	10	10	10	
	1	5	5	10	10	
	2	10	5	5	10	
	3	10	10	10	10	
	4	10	5	5	10	
	5	10	10	10	15	
	6	5	5	5	5	
	7	5	5	5	5	
	8	5	5	5	5	
	9	5	5	5	5	
	10	5	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	10	10	
	17	5	5	5	5	
	18	5	5	5	5	
	19	10	15	10	5	
	20	5	5	10	5	
	21	10	10	10	5	
	22	5	5	5	5	
	23	10	5	5	10	
	24	15	5	5	5	
	25	5	5	5	10	
	26	5	5	5	5	
	27	5	5	5	5	
	28	10	5	5	5	
	29	5	5	5	5	
4:30	30	5	10	10	5	
	31	10	5	10	10	
	32	5	5	10	10	
	33	5	5	10	10	
	34	5	5	5	5	
	35	5	5	5	5	
	36	5	5	5	10	
	37	10	5	5	10	
	38	5	5	5	5	
	39	5	10	10	10	
	40	5	5	10	10	
	41	5	5	5	5	
	42	0	0	10	10	
	43	5	5	10	5	
	44	5	5	5	5	
	45	5	5	5	5	
	46	10	10	5	5	
	47	5	5	5	15	
	48	15	25	30	20	Brownish
	49	20	15	10	10	Ending Cast
4:50	50	5	5	0	0	End VEO
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

/isual Determination of Opacity RUN #3

DATE 4-3-18

ACILITY
)4 BLAST FCE BGHSE STK

Start Time 12:26 P.M End Time 1:26 P.M.

BSERVER
P. Krystyniak - Vedia Water

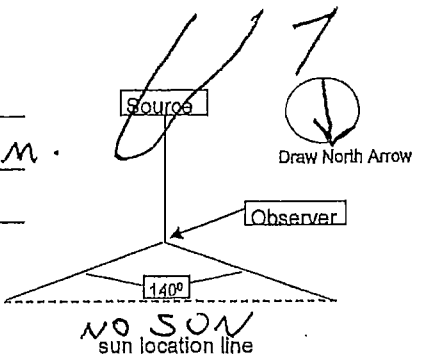
LOCATION
Z, I, USS GLW

Vind Direction and Speed NE 10-15 Sky Condition OVERCAST Temp: 39°

OBSERVER'S LOCATION
N 110 YDS FROM D4

omments:
)4 BGHSE STK TEST CAST # 27220

ACKGROUND



HOUR	MIN	SECONDS 0	15	30	45	Comments
,00	0	0	0	0	0	
	1	0	0	0	0	
	2	0	0	0	0	
	3	0	0	0	0	
	4	0	0	0	0	
	5	0	0	0	0	
	6	0	0	0	0	
	7	0	0	0	0	
	8	0	0	0	0	
	9	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
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	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
26	25	0	0	0	0	END V.E.O.
:26	26	0	0	0	0	START V.E.O.
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

HOUR	MIN	SECONDS 0	15	30	45	Comments
12:30	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
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	53	0	0	0	0	
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	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

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