BTEC Inc.

BOF Secondary Emissions Baghouse Particulate Matter Emissions Test Report

Prepared for:

AK Steel Dearborn Works

Dearborn, Michigan

AK Steel Dearborn Works
4001 Miller Rd.
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Project No. 14-4634.00
December 29, 2014

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Executive Summary

BT Environmental Consulting, Inc. (BTEC) was retained by AK Steel to evaluate air pollutant emission rates from the BOF Secondary Emissions Baghouse at the AK Steel facility located in Dearborn, Michigan. The test project consisted of evaluating exhaust gas flowrates and filterable particulate matter (PM) emission rates. Testing for this project was conducted from December 2nd through December 5th, 2014. The purpose of the test was to reestablish operating parameters for the BOF Secondary Emissions Baghouse in accordance with 40CFR 63.7823 and 63.7824

The test program consisted of six tests of varying duration. Sampling was performed utilizing United States Environmental Protection Agency (USEPA) reference test methods. The average results of the emissions test program are summarized by Table 1.

Table 1
Overall Emission Summary

Source	PM Emission Limit (PTI 182-05C) gr/dscf	PM Emission Limit (MACT) gr/dscf	PM Emission Rate gr/dscf
BOF Secondary Emissions Baghouse Stack	0.003	0.01	0.00031

In addition, Method 9 observations were conducted for 3 complete production cycles at the BOF Roof Monitors and the results are summarized in Table 1A.

Table 1 A
Roof Monitor Opacity Summary

Source	Opacity Limit	Highest 3 Minute Block Average Opacity
BOF Roof Monitor	20%, 3 minute block average	3%

1.0 Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by AK Steel to evaluate air pollutant emission rates from the BOF Secondary Emissions Baghouse at the AK Steel facility located in Dearborn, Michigan. The test project consisted of evaluating exhaust gas flowrates and filterable particulate matter (PM) emission rates. Testing for this project was conducted from December 2nd through December 5th, 2014. The purpose of the test was to reestablish operating parameters for the BOF Secondary Emissions Baghouse in accordance with 40CFR 63.7823 and 63.7824

The following BTEC professionals participated in conducting this study: Ken Lievense and Matthew Young, Project Managers; and Paul Molenda and Steve Smith, Environmental Technicians.

The purpose of the project was to evaluate the exhaust gas flow rates and PM concentrations and calculate the resultant emission rates from the BOF Secondary Emissions Baghouse exhaust stack. The emissions data will be utilized for compliance purposes. Mr. Jim Earl with the Environmental Affairs Department provided the on-site coordination for this project along with Steve Szura with Civil & Environmental Consultants Inc (CEC). Process data and operating parameters were monitored and recorded by Katie Kistler of AK Steel Corporate Environmental Affairs and Steve Felton of ENCOSS. Tony Babb of CEC was on site to oversee the stack testing team. Method 9 observations of the roof monitors were conducted by Robert Bingham of Derenzo & Associates.

Tom Maza of the MDEQ Air Quality Division was on site December 2 to oversee the testing.

2.0 Process Description

Scrap steel is charged into the BOF vessel and then molten iron is charged into the vessel on top of the scrap. Fluxing agents are also added during the steelmaking process. Oxygen is blown into the molten iron/scrap mixture causing the scrap to melt and refining the iron into steel by reducing the carbon content (which results in emissions of CO). The heat for the steelmaking process comes from the reaction of oxygen with the dissolved carbon in the molten iron. Particulate emissions consisting of iron oxides and various other metal oxides are also produced. In order to remove the large amounts of particulate, the flue gas is controlled by a 32-field electrostatic precipitator (ESP). The ESP is considered to be the "Primary" control device in the steel making process at Severstal Dearborn's BOF shop. The dust-laden gases enter the ESP and the dust particles are electrically energized (negative charge) prior to entering the ESP. The charged particles then migrate over to the positively charged collector plates, where the particulate matter is collected. Rappers are used to impart a vibration to both the discharge electrodes and the collection plates to dislodge the accumulated dust. The clean gases pass through the ID fans and are discharged out the stack passing through the COM light pathway.

In addition to the ESP, a Secondary Emissions Control Baghouse (BOF Baghouse) is in operation at the facility, which collects and controls particulate emissions during the hot metal charging and tapping operations that occur at the BOF vessels during the steel making heats. Additionally, the BOF Baghouse controls emissions generated by the iron Reladling operation.

2.1 TYPE AND QUANTITY OF RAW AND FINISHED MATERIALS USED IN THE PROCESS

Once the molten iron has completed the desulfurization process, it is poured into the BOF vessel, which has already been charged with scrap steel. Once the charge is complete, the oxygen blow begins. Following the oxygen blow, the BOF vessel is tapped to remove the molten steel. Approximately 250 tons of molten steel is produced at the BOF during each heat.

2.2 DESCRIPTION OF ANY OPERATIONS THAT COULD PRODUCE VARIABLE EMISSIONS

The operation of the BOF is a batch process that takes approximately 40 minutes to complete, including a twenty-minute oxygen blow. Emissions are expected to occur during scrap and hot metal charging, oxygen blowing, turndown (vessel sampling), additional oxygen blowing (if required), tapping and deslagging operations. In addition, the BOF Baghouse controls emissions from the iron Reladling operation.

2.3 BASIC OPERATING PARAMETERS USED TO REGULATE THE PROCESS

During the various BOF operations, the fan suction pressure are controlled to draw the fumes through the hoods and ductwork for both the ESP and Secondary Emission Baghouse based upon which operations are occurring within the BOF.

3.0 Sampling and Analytical Methodologies

Sampling and analytical methodologies for the emissions test program can be separated into two categories as follows:

(1) Measurement of exhaust gas velocity, molecular weight, and moisture content; and,
(2) Measurement of filterable particulate matter using Method 5.

Descriptions of sampling and analytical methodologies by category are summarized by Sections 3.1 through 3.2, respectively.

Sampling was only conducted from scrap steel charge through 3 minutes after slagging off during each steel production cycle and an integral number of production cycles were sampled each test run as required in 40 CFR 63.7822(g).

3.1 Exhaust Gas Velocity, Molecular Weight, and Moisture Content

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at 40 CFR 60, Appendix A:

Method 1 - *"Location of the Sampling Site and Sampling Points"*
Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flow rate"*
Method 3 - *"Determination of Molecular Weight of Dry Stack Gas" (Fyrite)*
Method 4 - *"Determination of Moisture Content in Stack Gases"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2 (see Figure 1 for exhaust stack traverse point diagram). An S-type pitot tube with a thermocouple assembly, calibrated in accordance with Method 2, Section 4.1.1, was used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

Molecular weight was determined according to USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Carbon dioxide and oxygen content were analyzed using the Fyrite® procedure.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the PM sampling train (see figure 2 for a schematic of the sampling train) and passed through (i) two impingers, each with 100 ml of a mixture of ethylene glycol and water (approved by Tom Maza with the MDEQ), (ii) an empty impinger, and (iii) an impinger filled with silica gel. Exhaust gas moisture content is then determined gravimetrically.

3.2 Particulate Matter (USEPA Method 5)

40 CFR 60, Appendix A, Method 5, *"Determination of Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate appropriate emission rates (see Figure 2 for a schematic of the sampling train). Six test runs were conducted on the BOF Baghouse exhaust under normal operating conditions.

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless steel nozzle, (2) a glass probe, (3) a set of four Greenburg-Smith (GS) impingers with the first two with 100 ml of H_2O (ii) an empty impinger, (iii) and an impinger filled with approximately 300 grams of silica gel, (4) a length of sample line, and (5) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

Upon completion of the final leak test for each test run, the filter was recovered, and the nozzle, probe, and the front half of the filter holder assembly were brushed and triple rinsed with 100 ml of acetone which was collected in a pre-cleaned sample container.

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

After the 2nd test run was completed and the impinger box and filter holder disassembled from the sampling train and lowered to the ground, it was observed there was a crack in the center of the filter about 2 inches long. This was examined by Tom Maza of MDEQ, Tony Babb of CEC, and the stack test team. It was determined that this crack had occurred after testing, This determination was made by Tom Maza based on the fact that 1) there was no discoloration of the filter at the crack which would most likely have occurred due to most of the air flow going through this crack and bypassing the filter if it had been there during the test and 2) there was no notice of a pressure drop change in the sampling train during the run which would have occurred if the crack occurred during testing. Tom Maza stated he was okay with the test run and he did not see this as an issue and indicated that it should be noted in the test report.

4.0 Test Results

The results of the emissions test program are summarized by Table 1.

Table 1
Overall Emission Summary

Source	PM Emission Limit (PTI 182-05C) gr/dscf	PM Emission Limit (MACT) gr/dscf	PM Emission Rate gr/dscf
BOF Secondary Emissions Baghouse Stack	0.003	0.01	0.00031

Field and computer generated data for each test run are available in Appendix A, as well as all other applicable field data. Equipment calibration information is presented in Appendix B. Example calculations for equations used to determine emission rates are presented in Appendix C. Laboratory analysis is available in Appendix D. Process data is available in Appendix E.

Table 1 A
Roof Monitor Opacity Summary

Source	Opacity Limit	Highest 3 Minute Block Average Opacity
BOF Roof Monitor	20%, 3 minute block average	3%

The Method 9 observation forms along with the observer's training certificate are in Appendix F.

Limitations

The information and opinions rendered in this report are exclusively for use by AK Steel. BTEC will not distribute or publish this report without AK Steel'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: Brandon Chase

Brandon Chase
Staff Environmental Engineer

This report was reviewed by: Brandon Chase

pp Matthew Young
Project Manager

Table 2
BOF BH Particulate Matter Emission Rates

Company	**AK Steel**						
Source Designation	**BOF BH**						
Test Date	**12/2/2014**	**12/2/2014**	**12/3/2014**	**12/4/2014**	**12/4/2014**	**12/5/2014**	
Meter/Nozzle Information	P-1	P-2	P-3	P-4	P-5	P-6	Average
Meter Temperature Tm (F)	47.2	56.3	45.3	46.1	47.4	48.9	48.5
Meter Pressure - Pm (in. Hg)	29.8	29.8	29.4	29.9	29.9	29.8	29.8
Measured Sample Volume (Vm)	85.2	78.8	87.9	156.6	116.8	101.9	104.5
Sample Volume (Vm-Std ft3)	87.3	79.4	89.2	165.7	121.2	106.6	108.2
Sample Volume (Vm-Std m3)	2.47	2.25	2.53	4.69	3.43	3.02	3.07
Condensate Volume (Vw-std)	0.236	0.377	0.566	0.519	0.377	0.613	0.448
Gas Density (Ps(std) lbs/ft3) (wet)	0.0745	0.0744	0.0744	0.0744	0.0744	0.0744	0.0744
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	6.52	5.94	6.67	12.38	9.05	7.97	8.09
Total weight of sampled gas (m g lbs) (dry)	6.51	5.92	6.65	12.35	9.03	7.95	8.07
Nozzle Size - An (sq. ft.)	0.000333	0.000333	0.000327	0.000395	0.000395	0.000395	0.000363
Isokinetic Variation - I	95.1	97.6	99.0	96.9	98.1	98.3	97.5
Stack Data							
Average Stack Temperature - Ts (F)	70.6	80.8	74.8	69.4	71.3	81.5	74.7
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.8	28.8	28.8	28.8	28.8	28.8	28.8
Stack Gas Specific Gravity (Gs)	0.995	0.994	0.993	0.995	0.995	0.994	0.994
Percent Moisture (Bws)	0.27	0.47	0.63	0.31	0.31	0.57	0.43
Water Vapor Volume (fraction)	0.0027	0.0047	0.0063	0.0031	0.0031	0.0057	0.0043
Pressure - Ps ("Hg)	29.7	29.7	29.3	29.7	29.7	29.6	29.6
Average Stack Velocity -Vs (ft/sec)	33.3	37.1	33.1	39.3	38.5	36.2	36.3
Area of Stack (ft2)	268.7	268.7	268.7	268.7	268.7	268.7	268.7
Exhaust Gas Flowrate							
Flowrate ft^3(Actual)	537,557	597,312	534,083	633,658	619,924	583,915	584,408
Flowrate ft^3 (Standard Wet)	531,154	579,139	516,603	627,712	610,998	562,751	571,393
Flowrate ft^3 (Standard Dry)	529,724	576,402	513,347	625,754	609,102	559,534	568,977
Flowrate m^3 (standard dry)	15,000	16,322	14,536	17,719	17,248	15,844	16,112
Total Particulate Weights (mg)							
Nozzle/Probe/Filter	1.8	0.3	1.9	1.4	3.3	4.2	2.2
Total Particulate Concentration							
lb/1000 lb (wet)	0.0006	0.0001	0.0006	0.0002	0.0008	0.0012	0.0006
lb/1000 lb (dry)	0.0006	0.0001	0.0006	0.0002	0.0008	0.0012	0.0006
mg/dscm (dry)	0.7	0.1	0.8	0.3	1.0	1.4	0.7
gr/dscf	0.00032	0.00006	0.00033	0.00013	0.00042	0.00061	0.00031
Total Particulate Emission Rate							
lb/ hr	1.45	0.29	1.45	0.70	2.20	2.93	1.50

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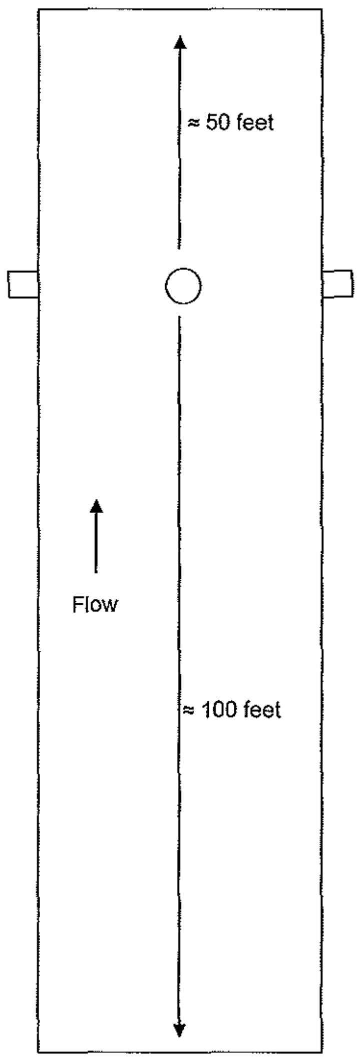
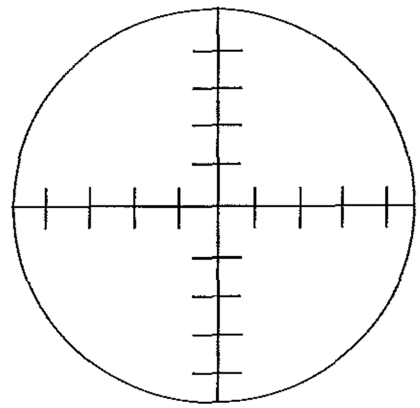
diameter = 222 inches





Not to Scale

Points	Distance "
1	7.1
2	23.3
3	43.1
4	71.7
5	150.3
6	178.9
7	198.7
8	214.9

Figure No. 1

Site:	Sampling Date:	
BOF Baghouse Exhaust AK Steel Dearborn, Michigan	December 2-5, 2014	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073

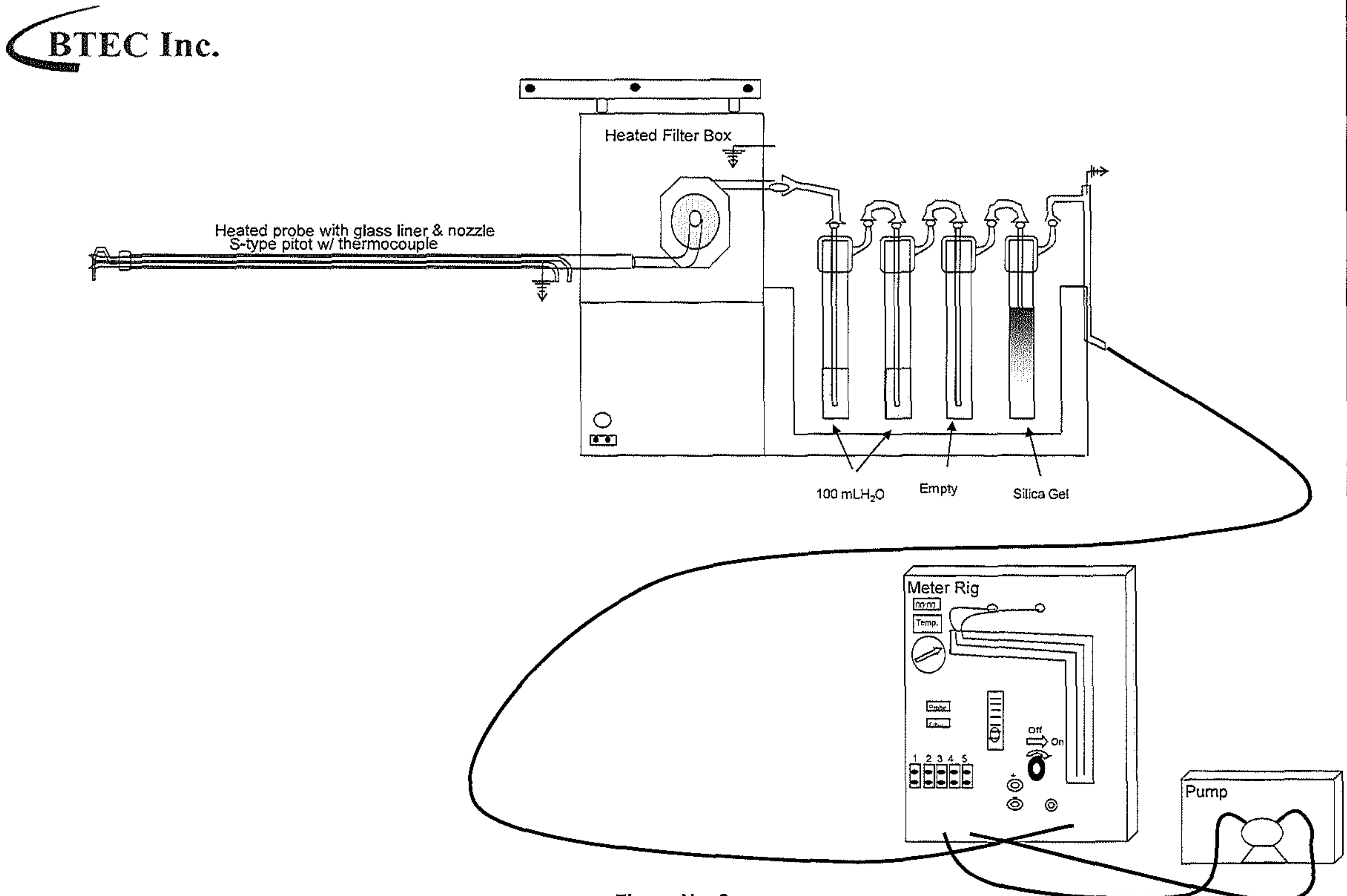


Figure No. 2

Site: USEPA Method 5 AK Steel Dearborn, Michigan	Sampling Date: December 2-5, 2014	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073