BTEC Inc.

SEC BOF Baghouse Emissions Test Report

Prepared for:

AK Steel Corporation – Dearborn Works

Dearborn, Michigan

AK Steel Corporation – Dearborn Works
4001 Miller Road
Dearborn, Michigan 48120

Project No. 16-4886.00
November 15, 2016

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
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EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by AK Steel Corporation – Dearborn Works (AK Steel) to conduct an evaluation of particulate matter (PM), condensable particulate matter (CPM), metals (lead (Pb), manganese (Mn), and mercury (Hg)), oxides of nitrogen (NOx), and Visual Emissions (VE) from the Basic Oxygen Furnace (BOF) SEC baghouse. Particulate matter less than 10 and 2.5 microns (PM_{10} and $PM_{2.5}$) were determined as the sum of the filterable and condensable PM fractions. The emissions test program was conducted on September 27-29, 2016.

Testing of the BOF SEC baghouse consisted of triplicate test runs. Each run was at least 3-4 heats in duration. The emissions test program was required by MDEQ Air Quality Division PTI 182-05C, Facility SRN A8640. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: September 27-29, 2016

Emission Unit	Pollutant	Permit Limit	Test Result
SEC BOF Baghouse Stack	PM	0.003 gr/dscf	0.0007
		15.6 lb/hr	3.3
	PM_{10}	17.71 lb/hr	5.36
	$PM_{2.5}$	17.71 lb/hr	5.36
	Manganese	0.07 lb/hr	0.006
		0.10 lb/hr$_{(1)}$	0.006
	Lead	0.067 lb/hr$_{(1)}$	0.0017
	Mercury	0.0086 lb/hr$_{(1)}$	0.00239
	NOx	10.2 lb/hr	2.0
	VE	20%, 3 minute average	0%$_{(2)}$

(1) Baghouse and ESP stacks combined.
(2) Calculated as highest 3-minute average observed

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1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by AK Steel Corporation – Dearborn Works (AK Steel) to conduct an evaluation of particulate matter (PM), condensable particulate matter (CPM), metals (lead (Pb), manganese (Mn), and mercury (Hg)), oxides of nitrogen (NOx), and Visual Emissions (VE) from the Basic Oxygen Furnace (BOF) SEC baghouse. Particulate matter less than 10 and 2.5 microns (PM_{10} and $PM_{2.5}$) were determined as the sum of the filterable and condensable PM fractions. The emissions test program was conducted on September 27-29, 2016.

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

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on September 27-29, 2016 at the AK Steel facility located in Dearborn, Michigan.

1.b Purpose of Testing

AQD issued Permit to Install No. 182-05C, Facility SRN A8640 to AK Steel. The permit required stack testing on the SEC Baghouse within 3 years of the permit issuance date. The permit limits from the SEC Baghouse are summarized by Table 1.

Table 1
Emission Limitations
AK Steel Corporation – Dearborn Works
PTI 182-05C Emission Limitations

Emission Unit	Pollutant	Permit Limit
SEC BOF Baghouse Stack	PM	0.003 gr/dscf
		15.6 lb/hr
	PM_{10}	17.71 lb/hr
	$PM_{2.5}$	17.71 lb/hr
	Manganese	0.07 lb/hr
		0.10 lb/hr(1)
	Lead	0.067 lb/hr(1)
	Mercury	0.0086 lb/hr(1)
	NOx	10.2 lb/hr
	VE	20%, 3 minute average

(1) Baghouse and ESP stacks combined.

1.c Source 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 Emission 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 Secondary Baghouse controls emissions generated by the iron reladling operation.

1.d Test Program Contacts

The contacts for the source and test report are:

Mr. David Pate
Environmental Engineer
AK Steel Corporation – Dearborn Works
4001 Miller Rd.
Dearborn, Michigan
(313) 323-1261

Mr. Barry Boulianne
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(313) 449-2361

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. Steve Smith Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Dave Trahan Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Jake Zott Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Mike Nummer Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Robert Bingham Visible Emissions Observer	Smoke Reader, LLC 7608 Tulane St. Taylor, MI 48180	(586) 942-8548
Mr. Mark Dziados MDEQ	MDEQ Air Quality Division	(586) 753-3745
Ms. Katherine Koster	MDEQ Detroit District Office	(313) 456-4678

2. Summary of Results

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

2.a Operating Data

BOF SEC Baghouse
Temperature 100-150°F
Moisture Content 1-5%

2.b Applicable Permit

AQD issued Permit to Install No. 182-05C, Facility SRN A8640
to AK Steel.

2.c Results

See Table 1 in Section 1.b.

3. Source Description

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

3.a Process Description

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.

3.b Process Flow Diagram

A process flow diagram is available on request.

3.c Raw and Finished Materials

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.

3.d Process Capacity

Normal production for the BOF is 250-350 TPH. Production during the testing ranged from 287-348 tph.

3.e Process Instrumentation

Section 3.d provides summary.

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 were 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 3A - *"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources"(Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Method 1 and Method 2 (see Figure 4 for a schematic of the sampling location). S-type pitot tubes with thermocouple assemblies, calibrated in accordance with Method 2, Section 4.1.1, were 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.

A cyclonic flow check was performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angle is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

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 and metals sampling train and passed through the impinger configuration (see Figures 2-3). Exhaust gas moisture content was then determined gravimetrically.

4.b *Particulate Matter (USEPA Method 5/202)*

40 CFR 60, Appendix A, Method 5, *"Determination of Particulate Emissions from Stationary Sources"* and 40 CFR 60, Appendix A, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* was used to measure PM and CPM concentrations and emission rates (see Figure 2 for a schematic of the sampling train). Triplicate test runs of a minimum of three heats in duration were conducted.

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a borosilicate glass nozzle, (2) a glass probe, (3) a heated filter holder, (4) a vertical condenser, (5) an empty pot bellied impinger, (6) an empty modified Greenburg-Smith (GS) impinger, (7) unheated filter holder with a teflon filter, (8) a second modified GS impinger with 100 ml of deionized water, and a third modified GS impinger containing approximately 300 g of silica gel desiccant, (9) a length of sample line, and (10) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

A sampling train leak test was conducted before and after each test run. After completion of the final leak test 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. The impinger train was then purged with nitrogen for one hour at a flow rate of 14 liters per minute. The CPM filter was recovered and placed in a petri dish. The back half of the filter housing, the condenser, the pot bellied impinger, the moisture drop out impinger, and the front half of the CPM filter housing and all connecting glassware were triple rinsed with deionized water which was collected in a pre-cleaned sample container. The same glassware was then rinsed with acetone which was collected in a pre-cleaned sample container labeled as the organic fraction. The glassware was then double rinsed with hexane which was added to the same organic fraction sample bottle.

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, DI water, hexane, and filter were collected. BTEC personnel carried all samples to BTEC's laboratory (for filter and acetone gravimetric analysis) in Royal Oak, Michigan. ALS Environmental personnel picked up the M202 samples and transported them to the ALS Environmental's laboratory in Ontario.

4.c *NOx Concentration (USEPA Method 7E)*

The NOx content of the gas stream was measured using a Thermo Model 42i NOx gas analyzer. The gas stream was drawn through a stainless-steel probe with a heated in-line filter to remove any particulate, a heated Teflon® sample line, through a refrigerated Teflon® sample conditioner to remove the moisture from the sample before it entered the NOx analyzer. Data was recorded on a PC equipped with data acquisition software. Recorded NOx concentrations were averaged and reported for the duration of each test (as drift corrected per Method 7E). A drawing of the sampling train used for the testing program is presented as Figure 1.

In accordance with Method 7E, a 3-point (zero, mid, and high) bias check and calibration check was performed on the NOx analyzer prior to initiating the test program. Following each test run, a 2-point (zero and high) calibration drift check was performed. The NOx analyzer was operated at the 0-50 ppm range.

4.d *Metals (USEPA Method 29)*

40 CFR 60, Appendix A, Method 29, *"Determination of Metals Emissions From Stationary Sources"* was used to measure predetermined metals concentrations and calculate appropriate emission rates (see Figure 3 for a schematic of the sampling train).

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a borosilicate glass nozzle, (2) a borosilicate glass probe, (3) a heated borosilicate or quartz glass filter holder containing a pre-weighed 90-mm diameter quartz filter with Teflon filter support; (4) a set of six Greenburg-Smith (GS) impingers with the first two containing 100 ml of a 5% HNO_3 / 10% H_2O_2 solution (ii) an empty impinger, two with 100 ml of a 4% $KMnO_4$ / 10% H2SO4 solution, (iii) and an impinger filled with approximately 300 grams of silica gel. (5) a length of sample line, and (6) 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 and the front half of the filter holder assembly were brushed and triple rinsed with 100 ml of 0.1N HNO_3. The rinses were collected in a pre-cleaned sample container and prepared for transport.

The back half of the filter housing and first two impingers were a triple rinsed with 100 ml of 0.1N HNO_3. The third impinger (empty) was also rinsed with 100 ml of 0.1N HNO_3. The fourth and fifth impingers were first triple rinsed with 100 ml of acidified $KMnO_4$, followed by a triple rinse with 100 ml of H_20 and placed their respective sample containers. The impingers were then triple rinsed 25 ml of 8N HCL and placed in sample container with 200 ml H_20.

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. In addition, blank samples of the filter, acetone, DI water, O.1N HNO_3, 5% HNO_3 / 10% H_2O_2, Acidified $KMnO_4$, and 8N HCL solutions, were collected. The samples were sent by courier to ALS Environmental ALS Environmental's laboratory in Ontario to be analyzed.

4.e Recovery and Analytical Procedures

The samples were all sent to ALS Environmental in Ontario, Canada.

4.f Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figure 4.

4.g Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figure 4.

5. Test Results and Discussion

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

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 3. Detailed results for the emissions test program are summarized by Tables 4-6.

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Table 3
Overall Emission Summary
Test Date: September 27-29, 2016

Emission Unit	Pollutant	Permit Limit	Test Result
SEC BOF Baghouse Stack	PM	0.003 gr/dscf	0.0007
		15.6 lb/hr	3.3
	PM_{10}	17.71 lb/hr	5.36
	$PM_{2.5}$	17.71 lb/hr	5.36
	Manganese	0.07 lb/hr	0.006
		0.10 lb/hr(1)	0.006
	Lead	0.067 lb/hr(1)	0.0017
	Mercury	0.0086 lb/hr(1)	0.00239
	NOx	10.2 lb/hr	2.0
	VE	20%, 3 minute average	0%(2)

(1) Baghouse and ESP stacks combined.
(2) Calculated as highest 3-minute average observed

5.b Discussion of Results

All of the test results for each pollutant were below the permit limits.

5.c Sampling Procedure Variations

There were no sampling variations used during the emission compliance test program.

5.d Process or Control Device Upsets

There were no process upsets during this test.

5.e Control Device Maintenance

Maintenance is documented in Appendix H.

5.f Re-Test

The emissions test program was not a re-test.

5.g Audit Sample Analyses

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

5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix B.

5.i Sample Calculations

Sample calculations are provided in Appendix C.

5.j Field Data Sheets

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

5.k Laboratory Data

Laboratory analytical results for this test program are presented in Appendix E.
Raw CEM data is provided electronically in Appendix D.

Table 4
BOF SEC Particulate Matter Detailed Emission Test Results Summary

Company	**AK Steel**			
Source Designation	**SEC BOF**			
Test Date	**9/28/2016**	**9/28/2016**	**9/29/2016**	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	65.9	70.3	74.0	70.1
Meter Pressure - Pm (in. Hg)	29.4	29.5	29.8	29.6
Measured Sample Volume (Vm)	116.1	107.7	114.1	112.6
Sample Volume (Vm-Std ft3)	114.2	105.1	111.8	110.4
Sample Volume (Vm-Std m3)	3.24	2.98	3.17	3.13
Condensate Volume (Vw-std)	1.518	1.872	2.249	1.880
Gas Density (Ps(std) lbs/ft3) (wet)	0.0742	0.0740	0.0740	0.0741
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	8.59	7.92	8.44	8.31
Total weight of sampled gas (m g lbs) (dry)	8.51	7.83	8.33	8.23
Nozzle Size - An (sq. ft.)	0.000395	0.000395	0.000395	0.000395
Isokinetic Variation - I	102.3	99.0	99.4	100.2
Stack Data				
Average Stack Temperature - Ts (F)	104.6	101.9	99.9	102.1
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.7	28.6	28.6	28.7
Stack Gas Specific Gravity (Gs)	0.991	0.989	0.988	0.989
Percent Moisture (Bws)	1.31	1.75	1.97	1.68
Water Vapor Volume (fraction)	0.0131	0.0175	0.0197	0.0168
Pressure - Ps ("Hg)	29.2	29.2	29.6	29.3
Average Stack Velocity -Vs (ft/sec)	38.7	41.1	36.6	38.8
Area of Stack (ft2)	268.7	268.7	268.7	268.7
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	624,547	662,350	589,830	625,575
Flowrate ft^3 (Standard Wet)	570,592	608,067	549,881	576,180
Flowrate ft^3 (Standard Dry)	563,109	597,427	539,038	566,525
Flowrate m^3 (standard dry)	15,946	16,917	15,264	16,042
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	8.1	3.2	3.5	4.9
Organic Condensible Particulate	2.0	2.5	2.8	2.4
Inorganic Condensible Particulate	2.8	2.9	1.9	2.5
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	2.8	3.4	2.7	3.0
Total Filterable and Condensible Particulate	10.9	6.6	6.2	7.9
Filterable Particulate Concentration				
lb/1000 lb (wet)	0.002	0.001	0.001	0.001
lb/1000 lb (dry)	0.002	0.001	0.001	0.001
mg/dscm (dry)	2.5	1.1	1.1	1.6
gr/dscf	0.0011	0.0005	0.0005	0.0007
Filterable Particulate Emission Rate				
lb/ hr	5.30	2.42	2.24	3.32
Condensible Particulate Concentration				
lb/1000 lb (wet)	0.001	0.001	0.001	0.001
lb/1000 lb (dry)	0.001	0.001	0.001	0.001
mg/dscm (dry)	0.9	1.1	0.9	1.0
gr/dscf	0.0004	0.0005	0.0004	0.0004
Condensible Particulate Emission Rate				
lb/ hr	1.83	2.57	1.73	2.04
Total Particulate Concentration				
lb/1000 lb (wet)	0.003	0.002	0.002	0.002
lb/1000 lb (dry)	0.003	0.002	0.002	0.002
mg/dscm (dry)	3.4	2.2	2.0	2.5
gr/dscf	0.0015	0.0010	0.0009	0.0011
Total Particulate Emission Rate				
lb/ hr	7.13	4.98	3.97	5.36

Table 5
BOF SEC Metals Detailed Emission Test Results Summary

Company	**AK Steel**			
Source Designation	**SEC BOF**			
Test Date	**9/27/2016**	**9/27/2016**	**9/28/2016**	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	75.6	79.0	70.8	75.1
Meter Pressure - Pm (in. Hg)	29.5	29.5	29.5	29.5
Measured Sample Volume (Vm)	158.6	114.9	124.5	132.7
Sample Volume (Vm-Std ft3)	153.8	110.6	121.6	128.7
Sample Volume (Vm-Std m3)	4.36	3.13	3.44	3.64
Condensate Volume (Vw-std)	1.381	0.745	1.570	1.232
Gas Density (Ps(std) lbs/ft3) (wet)	0.0743	0.0743	0.0742	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)	11.53	8.28	9.14	9.65
Total weight of sampled gas (m g lbs) (dry)	11.46	8.24	9.07	9.59
Nozzle Size - An (sq. ft.)	0.000481	0.000481	0.000481	0.000481
Isokinetic Variation - I	98.7	98.0	101.1	99.3
Stack Data				
Average Stack Temperature - Ts (F)	108.4	109.7	108.9	109.0
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)	0.992	0.993	0.991	0.992
Percent Moisture (Bws)	0.89	0.67	1.27	0.94
Water Vapor Volume (fraction)	0.0089	0.0067	0.0127	0.0094
Pressure - Ps ("Hg)	29.2	29.2	29.2	29.2
Average Stack Velocity -Vs (ft/sec)	40.0	36.2	37.9	38.0
Area of Stack (ft2)	268.7	268.7	268.7	268.7
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	644,807	583,823	610,190	612,940
Flowrate ft^3 (Standard Wet)	585,137	528,649	553,289	555,692
Flowrate ft^3 (Standard Dry)	579,928	525,111	546,238	550,426
Flowrate m^3 (standard dry)	16,422	14,870	15,468	15,586
Total Metals Weights (ug)				
Front Half Lead	1.5	1.4	1.1	1.3
Back Half Lead	2.6	1.4	1.0	1.7
Front Half Manganese	6.0	10.1	6.1	7.4
Back Half Manganese	3.6	2.0	3.7	3.1
Mercury	4.2	5.4	2.8	4.1
Totals	17.8	20.4	14.7	17.7
Lead Concentrations				
lb/1000 lb (wet)	7.74E-07	7.62E-07	5.03E-07	6.80E-07
lb/1000 lb (dry)	7.79E-07	7.65E-07	5.08E-07	6.84E-07
mg/dscm (dry)	9.30E-04	9.13E-04	6.06E-04	8.16E-04
gr/dscf	4.06E-07	3.99E-07	2.65E-07	3.57E-07
Lead Emission Rate				
lb/ hr	2.03E-03	1.80E-03	1.24E-03	1.69E-03
Manganese Concentrations				
lb/1000 lb (wet)	1.84E-06	3.23E-06	2.37E-06	2.48E-06
lb/1000 lb (dry)	1.85E-06	3.24E-06	2.39E-06	2.50E-06
mg/dscm (dry)	2.21E-03	3.87E-03	2.85E-03	2.98E-03
gr/dscf	9.67E-07	1.69E-06	1.25E-06	1.30E-06
Manganese Emission Rate				
lb/ hr	4.83E-03	7.64E-03	5.86E-03	6.11E-03
Mercury Concentrations				
lb/1000 lb (wet)	7.94E-07	1.45E-06	6.74E-07	9.72E-07
lb/1000 lb (dry)	7.98E-07	1.46E-06	6.79E-07	9.78E-07
mg/dscm (dry)	9.53E-04	1.74E-03	8.11E-04	1.17E-03
gr/dscf	4.17E-07	7.59E-07	3.54E-07	5.10E-07
Mercury Emission Rate				
lb/ hr	2.08E-03	3.43E-03	1.66E-03	2.39E-03

Table 6
BOF SEC NOx Detailed Emission Test Results Summary
AK Steel
Dearborn, Michigan
BTEC Project No. 16-4886.00
Sampling Dates: 9/27/2016-9/28/2016

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	9/27/2016	9/27/2016	9/28/2016	
Test Run Time	9:06-11:57	13:01-15:21	8:35-10:58	
Outlet Flowrate (dscfm)	579,928	525,111	546,238	**550,426**
Outlet Oxides of Nitrogen Concentration (ppmv)	0.67	0.46	0.87	**0.67**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	0.48	0.36	0.70	**0.51**
NOx Emission Rate (lb/hr)	**2.77**	**1.72**	**3.39**	**2.63**
NOx Emission Rate (lb/hr) (corrected as per USEPA 7E)	**1.99**	**1.35**	**2.73**	**2.02**

scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (NOx = 46.01)
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * ***dcfm*** * 60

BTEC Inc.

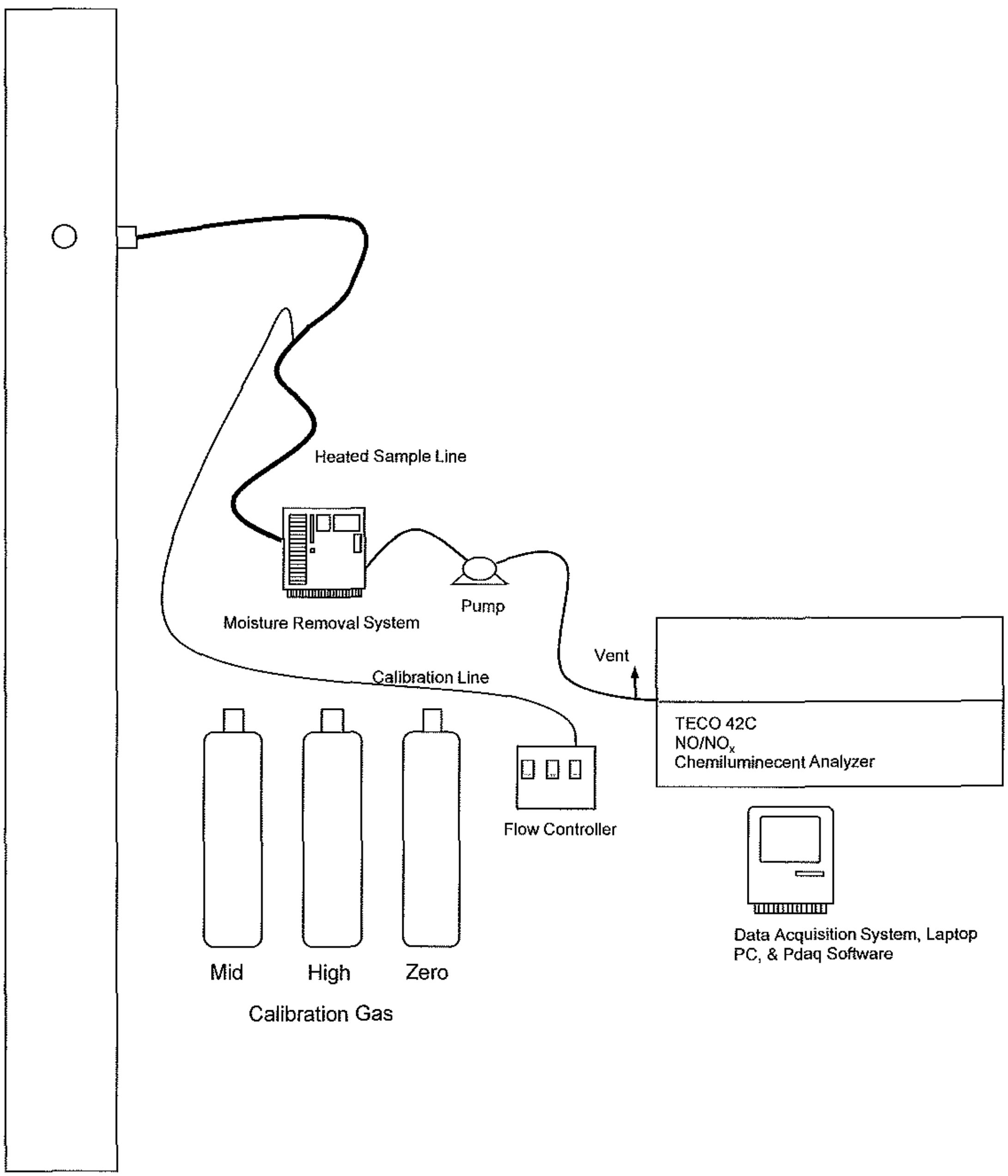


Figure No. 1

Site: **USEPA Method 7E** **AK Steel** **Dearborn, Michigan**	**Sampling Date:** **September 27-29, 2016**	**BT Environmental Consulting Inc.** **4949 Fernlee Avenue** **Royal Oak, MI 48073**

BTEC Inc.

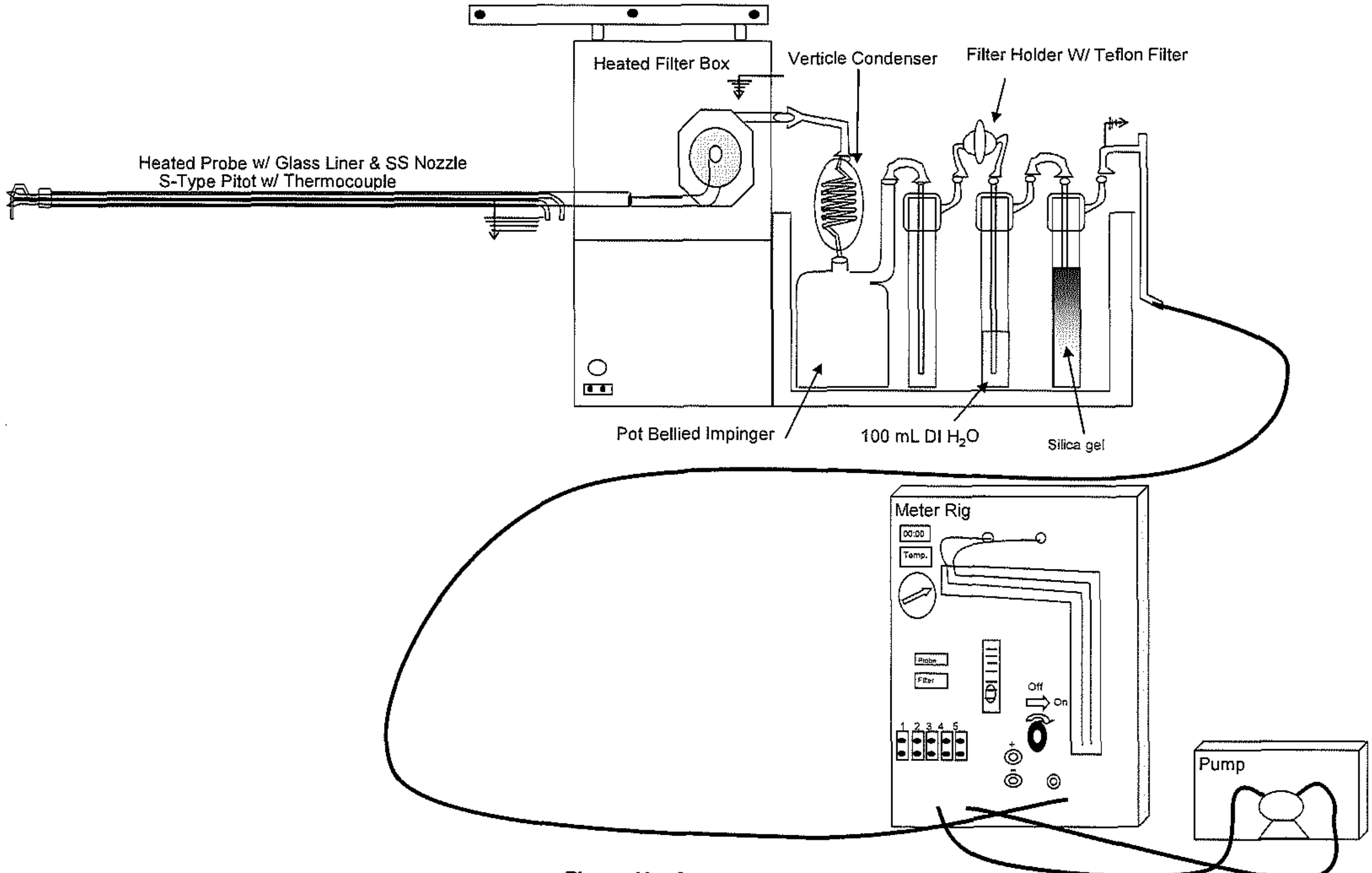


Figure No. 2

Site: **USEPA Method 5/202** **AK Steel** **Dearborn, Michigan**	**Sampling Date:** **September 27-29, 2016**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

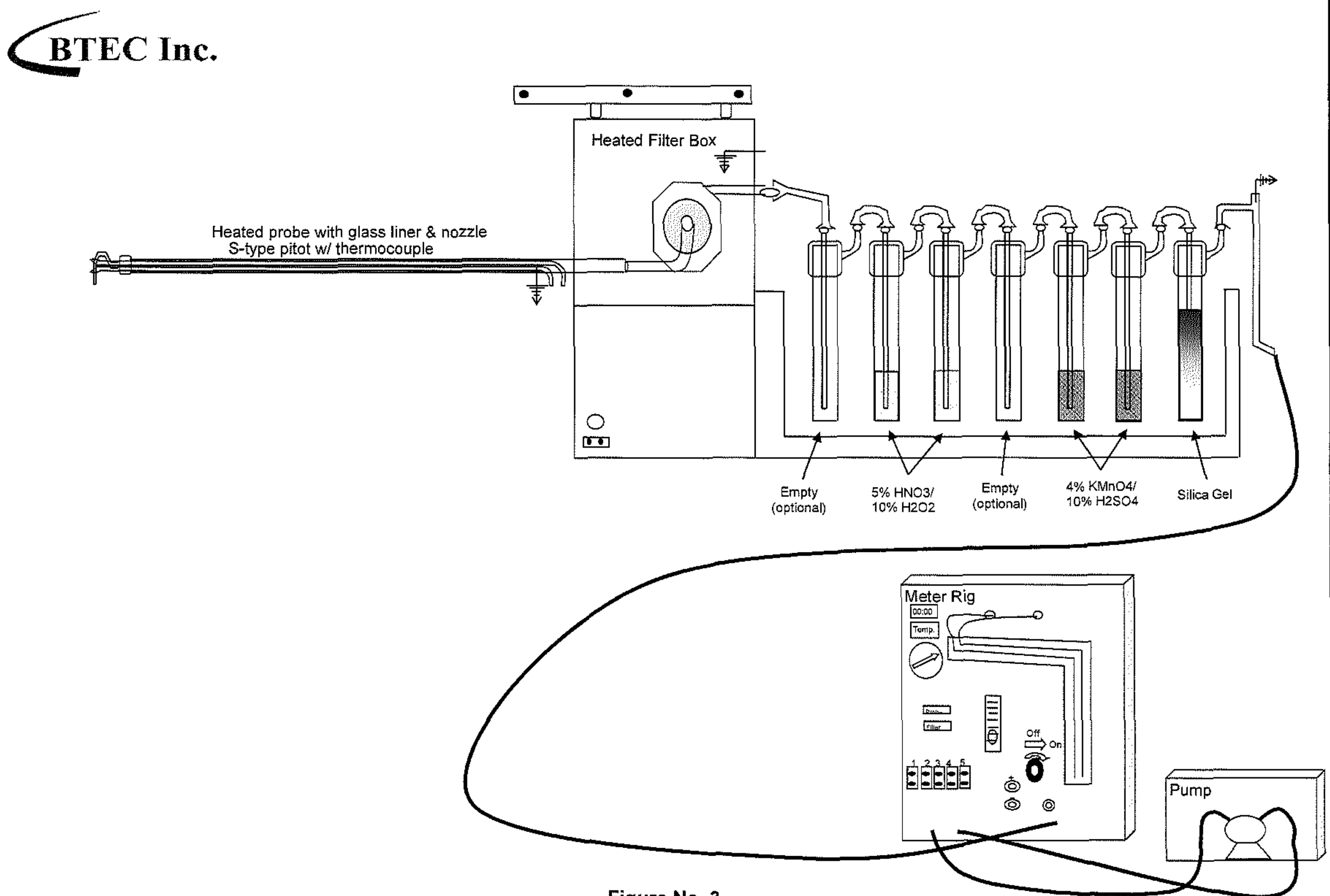
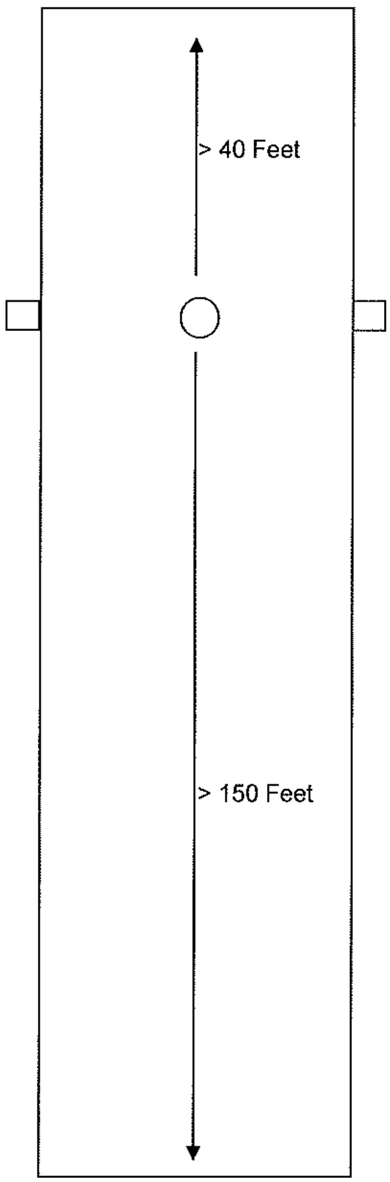


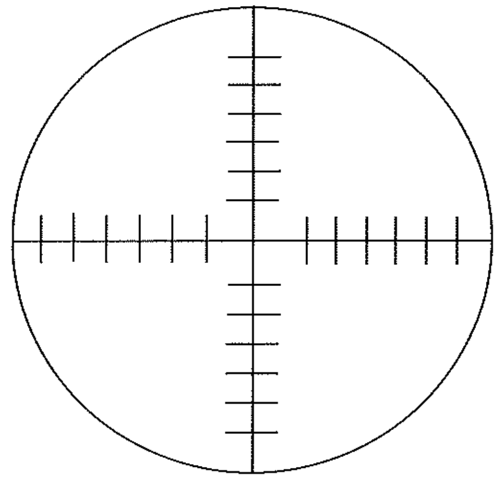
Figure No. 3

Site: **USEPA Method 5/Method 29 Sampling Train** **AK Steel** **Dearborn, Michigan**	**Sampling Date:** **September 27-29, 2016**	**BT Environmental Consulting, Inc.** **4949 Fernlee** **Royal Oak, Michigan**

BTEC Inc.

diameter = 222





Not to Scale

Points	Distance "
1	4.7
2	14.9
3	26.2
4	39.3
5	55.5
6	79.0
7	143.0
8	166.5
9	182.7
10	195.8
11	207.1
12	217.3

Figure 4

Site:	Sampling Dates:	BT Environmental Consulting, Inc.
AK Steel	September 27-29, 2016	4949 Fernlee
Dearborn, Michigan		Royal Oak, Michigan
BOF SEC		