BTEC Inc.

Desulf 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. 16-4887.00
November 16, 2016

BT Environmental Consulting, Inc.
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BTEC Inc.

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) and condensable particulate matter (CPM), metals (lead (Pb) and manganese (Mn)), and Visual Emissions (VE) from the Desulf baghouse. Particulate matter less than 2.5 and 10 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 October 4-6, 2016.

Testing of the Desulf baghouse consisted of triplicate test runs for each pollutant. 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: October 4-6, 2016

Emission Unit	Pollutant	Permit Limit	Test Result
Desulfurization Baghouse Stack	PM	0.01 gr/dscf	0.0007 gr/dscf
		7.7 lb/hr	0.5 lb/hr
	$PM_{2.5}$, PM_{10}	3.6 lb/hr	1.0 lb/hr
	Manganese	0.013 lb/hr	0.002 lb/hr
	Lead	0.0016 lb/hr	0.0009 lb/hr
BOF Roof Monitor	VE	15%(1)	16%

(1) Calculated as highest 3-minute average observed. 15% limit applies to EUBOF and EURELADLINGBOF emissions. The emissions observed were determined to be from the vessel during an oxygen blow and not from the desulfurization station.

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) and condensable particulate matter (CPM) and metals (lead (Pb) and manganese (Mn)) from the Desulf baghouse. At the request of the MDEQ, concurrent observations were conducted on the BOF roof monitor for a minimum of 1 hour and 2 desulfurization heats during the PM/CPM runs. 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 October 4-6, 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 October 4-6, 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 limits emissions as summarized by Table 1.

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

Emission Unit	Pollutant	Permit Limit
Desulfurization Baghouse Stack	PM	0.01 gr/dscf
		7.7 lb/hr
	$PM_{2.5}$, PM_{10}	3.6 lb/hr
	Manganese	0.013 lb/hr
	Lead	0.0016 lb/hr
BOF Roof Monitor	VE	15%(1)

(1) Calculated as highest 3-minute average observed. 15% limit applies to EUBOF and EURELADLINGBOF emissions.

1.c Source Description

At the Desulfurization Station, a movable hood and lances are moved into position over the iron ladle. Once in position, the lances are lowered into the hot metal (molten iron) and inject desulfurizing reagents (magnesium and lime) with a nitrogen carrier into the hot metal. This process converts the sulfur in the hot metal to sulfides. The sulfides rise to the surface of the hot metal and become bound in the slag. The fume and dust emissions produced during the desulfurization operation are captured in the hood and sent to a baghouse. Once the desulfurization is complete, the lances are raised. The ladle is then tilted and the slag is skimmed from the surface of the molten iron using a hydraulic powered skimming arm, with a refractory paddle. The slag skimmed from the surface of the hot metal drops into a slag pot located below the Desulfurization Station. Emissions from slag skimming are also captured by the movable hood and sent to the same baghouse. The baghouse is equipped with a bag leak detection system that continuously monitors the particulate matter loading in the exhaust to ensure proper operation.

1.d Test Program Contacts

The contacts for the source and test report are:

Mr. David Pate
Environmental Engineer
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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. Paul Molenda 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. David Patterson MDEQ	MDEQ Air Quality Division	(517) 284-6782
Ms. Katherine Koster MDEQ	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 Desulfurization Baghouse
Temperature 100 -200°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 desulfurization and slag skimming process is a batch process that takes between approximately 15-25 minutes to complete. The process consists of a desulfurization step where magnesium and lime are injected into the molten iron to create a slag. Sulfur in the iron is converted to sulfides which bind to the slag. After desulfurization, the lances are removed from the bath and the iron ladle is tilted. A hydraulic powered skimming arm with a refractory paddle is used to skim the slag into a slag pot. Both of these operations are controlled by a baghouse. At the end of the initial desulfurization step, a sample is taken and analyzed for sulfur content. If the sample analysis results are within specification, the heat is shipped off after the slag skimming is complete. If the sample analysis results are not in specification, the heat is re-shot for a short period of time and then re-skimmed.

3.b Process Flow Diagram

A process flow diagram is available on request.

3.c Raw and Finished Materials

At the desulfurization station, magnesium and lime with a nitrogen carrier are injected into the molten iron. The iron is further processed into steel at the BOF vessels. The skimmed slag is watered at the Desulf slag watering station and then further processed by the slag contractor.

3.d Process Capacity

Desulfurization Station – Normal production for the desulfurization operation is 250-350 tons per clock hour. During the test, production for the desulfurization station ranged between 476 and 690 tons per testing hour and 229 – 318 tons per clock hour.

3.e Process Instrumentation

Differential pressure gauges and bag leak detection are used to verify proper operation of 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 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 1-2). 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 1 for a schematic of the sampling train). Triplicate test runs of a minimum of 3 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. Maxxam Laboratory personnel picked up the M202 samples and transported them to their laboratory in Ontario, Canada.

4.c *Metals (USEPA Method 29)*

40 CFR 60, Appendix A, Method 29, *"Determination of Metals Emissions From Stationary Sources"* was used to measure lead and manganese concentrations and to calculate appropriate emission rates (see Figure 2 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 four Greenburg-Smith (GS) impingers with the first two with 100 ml of a 5% HNO_3 / 10% H_2O_2 solution (ii) an empty impinger, (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.

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 solutions, were collected. The samples were sent by courier to Maxxam Analytical's laboratory in Ontario, Canada to be analyzed.

4.d Recovery and Analytical Procedures

The samples were all sent to Maxxam Laboratories in Ontario, Canada.

4.e Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figure 3.

4.f Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figure 3.

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 4-5.

Table 3
Overall Emission Summary
Test Date: October 4-6, 2016

Emission Unit	Pollutant	Permit Limit	Test Result
Desulfurization Baghouse Stack	PM	0.01 gr/dscf	0.0007 gr/dscf
		7.7 lb/hr	0.5 lb/hr
	$PM_{2.5}$, PM_{10}	3.6 lb/hr	1.0 lb/hr
	Manganese	0.013 lb/hr	0.002 lb/hr
	Lead	0.0016 lb/hr	0.0009 lb/hr
BOF Roof Monitor	VE	15%$_{(1)}$	16%

(1) Calculated as highest 3-minute average observed. 15% limit applies to EUBOF and EURELADLINGBOF emissions. The emissions observed were determined to be from the vessel during an oxygen blow and not from the desulfurization station.

5.b Discussion of Results

The test results for PM, PM2.5, PM10, manganese, and lead were below the permit limits. The visible emissions from the BOF Roof Monitor exceeded the 15% standard that applies to EUBOF and EURELADLINGBOF emissions. The emissions observed were determined to be from the vessel during an oxygen blow and not from the desulfurization station. A copy of the opacity investigation sheet and the state 14-day notification letter is included with this report.

5.c Sampling Procedure Variations

Due to the short batch times involved with this process, the request was made to the MDEQ to not change test ports until a batch was complete. In these cases, the probe was traversed in the same port until the batch was completed. The probe was then moved to the next port and placed at the point that the probe would have been at under a normal time schedule. This was done to avoid not testing parts of the heat while the desulf baghouse was operating. This approach was approved by the MDEQ prior to testing. A copy of the correspondence is presented in Appendix I.

The test protocol specified that visible emissions observations would be conducted on the desulf baghouse stack during the PM testing. The MDEQ informed AK Steel that this was not required by the permit and requested that visible emission observations be conducted on the BOF roof monitor during the PM test instead. AK Steel agreed to this request. VE data sheets for the BOF Roof Monitor are included in Appendix E.

5.d Process or Control Device Upsets

There were no process upsets during this test.

5.e Control Device Maintenance

Routine weekly, monthly, and quarterly MACT inspections have been conducted within the last 3 months on the baghouse. The July Monthly MACT Inspection identified dust buildup and some broken bags in compartment 6 on July 26, 2016. This was further confirmed in a quarterly inspection of the tubesheet on August 9, 2016. The compartment was isolated on July 26. Structural repairs to the compartment were conducted and the compartment was completely rebagged. The compartment was returned to service on September 14, 2016.

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 D.

Table 4
Desulfurization Baghouse Particulate Matter Emission Rates

Company	**AK Steel**			
Source Designation	**Desulf**			
Test Date	**10/4/2016**	**10/4/2016**	**10/5/2016**	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	72.0	77.6	73.9	74.5
Meter Pressure - Pm (in. Hg)	29.8	29.8	29.7	29.8
Measured Sample Volume (Vm)	90.7	86.2	79.2	85.4
Sample Volume (Vm-Std ft3)	90.0	84.6	78.2	84.3
Sample Volume (Vm-Std m3)	2.55	2.40	2.21	2.39
Condensate Volume (Vw-std)	1.547	1.400	1.311	1.419
Gas Density (Ps(std) lbs/ft3) (wet)	0.0741	0.0741	0.0741	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)	6.78	6.37	5.89	6.35
Total weight of sampled gas (m g lbs) (dry)	6.71	6.31	5.83	6.28
Nozzle Size - An (sq. ft.)	0.000252	0.000252	0.000252	0.000252
Isokinetic Variation - I	99.5	100.0	99.6	99.7
Stack Data				
Average Stack Temperature - Ts (F)	134.3	134.7	131.4	133.5
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.7	28.7	28.7	28.7
Stack Gas Specific Gravity (Gs)	0.989	0.990	0.990	0.990
Percent Moisture (Bws)	1.69	1.63	1.65	1.66
Water Vapor Volume (fraction)	0.0169	0.0163	0.0165	0.0166
Pressure - Ps ("Hg)	29.6	29.6	29.5	29.5
Average Stack Velocity -Vs (ft/sec)	61.9	62.4	62.4	62.2
Area of Stack (ft2)	23.8	23.8	23.8	23.8
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	88,514	89,149	89,209	88,957
Flowrate ft^3 (Standard Wet)	77,683	78,192	78,593	78,156
Flowrate ft^3 (Standard Dry)	76,371	76,919	77,297	76,862
Flowrate m^3 (standard dry)	2,163	2,178	2,189	2,177
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	4.4	2.5	5.3	4.1
Organic Condensible Particulate	1.5	1.2	0.8	1.2
Inorganic Condensible Particulate	4.6	4.9	5.2	4.9
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	4.1	4.1	4.0	4.1
Total Filterable and Condensible Particulate	8.5	6.6	9.3	8.1
Filterable Particulate Concentration				
lb/1000 lb (wet)	0.001	0.001	0.002	0.001
lb/1000 lb (dry)	0.001	0.001	0.002	0.001
mg/dscm (dry)	1.7	1.0	2.4	1.7
gr/dscf	0.0008	0.0005	0.0010	0.0008
Filterable Particulate Emission Rate				
lb/ hr	0.50	0.30	0.70	0.50
Condensible Particulate Concentration				
lb/1000 lb (wet)	0.001	0.001	0.001	0.001
lb/1000 lb (dry)	0.001	0.001	0.002	0.001
mg/dscm (dry)	1.6	1.7	1.8	1.7
gr/dscf	0.0007	0.0007	0.0008	0.0007
Condensible Particulate Emission Rate				
lb/ hr	0.46	0.49	0.52	0.49
Total Particulate Concentration				
lb/1000 lb (wet)	0.003	0.002	0.003	0.003
lb/1000 lb (dry)	0.003	0.002	0.004	0.003
mg/dscm (dry)	3.3	2.8	4.2	3.4
gr/dscf	0.0015	0.0012	0.0018	0.0015
Total Particulate Emission Rate				
lb/ hr	0.96	0.80	1.22	0.99

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Table 5
Desulfurization Baghouse Lead and Manganese Emission Rates

Company	**AK Steel**			
Source Designation	**Desulf**			
Test Date	**10/5/2016**	**10/6/2016**	**10/6/2016**	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	81.1	77.3	84.4	80.9
Meter Pressure - Pm (in. Hg)	29.7	29.7	29.8	29.7
Measured Sample Volume (Vm)	95.7	96.3	107.2	99.7
Sample Volume (Vm-Std ft3)	93.18	94.5	104.0	97.3
Sample Volume (Vm-Std m3)	2.64	2.68	2.95	2.75
Condensate Volume (Vw-std)	1.726	1.848	2.122	1.899
Gas Density (Ps(std) lbs/ft3) (wet)	0.0740	0.0740	0.0740	0.0740
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	7.03	7.13	7.85	7.34
Total weight of sampled gas (m g lbs) (dry)	6.94	7.05	7.75	7.25
Nozzle Size - An (sq. ft.)	0.000252	0.000252	0.000252	0.000252
Isokinetic Variation - I	99.9	100.0	100.0	100.0
Stack Data				
Average Stack Temperature - Ts (F)	133.0	123.1	134.9	130.3
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.6	28.6	28.6	28.6
Stack Gas Specific Gravity (Gs)	0.989	0.989	0.988	0.989
Percent Moisture (Bws)	1.82	1.92	2.00	1.91
Water Vapor Volume (fraction)	0.0182	0.0192	0.0200	0.0191
Pressure - Ps ("Hg)	29.5	29.5	29.6	29.5
Average Stack Velocity -Vs (ft/sec)	61.7	61.5	62.5	61.9
Area of Stack (ft2)	23.8	23.8	23.8	23.8
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	88,137	87,897	89,383	88,472
Flowrate ft^3 (Standard Wet)	77,384	78,568	78,391	78,114
Flowrate ft^3 (Standard Dry)	75,977	77,062	76,824	76,621
Flowrate m^3 (standard dry)	2,151	2,182	2,175	2,170
Total Metals Weights (ug)				
Front Half Lead	0.70	0.62	1.90	1.07
Back Half Lead	8.11	5.98	9.60	7.90
Total Lead	8.81	6.60	11.50	8.97
Front Half Manganese	4.10	5.50	4.60	4.73
Back Half Manganese	29.30	9.10	7.09	15.16
Total Manganese	33.40	14.60	11.69	19.90
Total Metals	42.21	21.20	23.19	28.87
Front Half Lead Concentrations				
lb/1000 lb (wet)	2.20E-07	1.92E-07	5.33E-07	3.15E-07
lb/1000 lb (dry)	2.22E-07	1.94E-07	5.40E-07	3.19E-07
mg/dscm (dry)	2.65E-04	2.32E-04	6.45E-04	3.81E-04
gr/dscf	1.16E-07	1.01E-07	2.82E-07	1.66E-07
Front Half Lead Emission Rate				
lb/ hr	7.58E-05	6.71E-05	1.86E-04	1.10E-04
Back Half Lead Concentrations				
lb/1000 lb (wet)	2.55E-06	1.85E-06	2.70E-06	2.36E-06
lb/1000 lb (dry)	2.57E-06	1.87E-06	2.73E-06	2.39E-06
mg/dscm (dry)	3.07E-03	2.23E-03	3.26E-03	2.86E-03
gr/dscf	1.34E-06	9.76E-07	1.42E-06	1.25E-06
Back Half Lead Emission Rate				
lb/ hr	8.78E-04	6.47E-04	9.41E-04	8.22E-04
Total Lead Concentrations				
lb/1000 lb (wet)	2.76E-06	2.04E-06	3.23E-06	2.68E-06
lb/1000 lb (dry)	2.80E-06	2.07E-06	3.27E-06	2.71E-06
mg/dscm (dry)	3.34E-03	2.47E-03	3.90E-03	3.24E-03
gr/dscf	1.46E-06	1.08E-06	1.71E-06	1.41E-06
Total Lead Emission Rate				
lb/ hr	9.54E-04	7.14E-04	1.13E-03	9.32E-04
Front Half Manganese Concentrations				
lb/1000 lb (wet)	1.29E-06	1.70E-06	1.29E-06	1.43E-06
lb/1000 lb (dry)	1.30E-06	1.72E-06	1.31E-06	1.44E-06
mg/dscm (dry)	1.55E-03	2.05E-03	1.56E-03	1.72E-03
gr/dscf	6.79E-07	8.98E-07	6.82E-07	7.53E-07
Front Half Manganese Emission Rate				
lb/ hr	4.44E-04	5.95E-04	4.51E-04	4.97E-04
Back Half Manganese Concentrations				
lb/1000 lb (wet)	9.19E-06	2.81E-06	1.99E-06	4.67E-06
lb/1000 lb (dry)	9.30E-06	2.85E-06	2.02E-06	4.72E-06
mg/dscm (dry)	1.11E-02	3.40E-03	2.41E-03	5.64E-03
gr/dscf	4.85E-06	1.49E-06	1.05E-06	2.46E-06
Back Half Manganese Emission Rate				
lb/ hr	3.17E-03	9.85E-04	6.95E-04	1.62E-03
Total Manganese Concentrations				
lb/1000 lb (wet)	1.05E-05	4.51E-06	3.28E-06	6.09E-06
lb/1000 lb (dry)	1.06E-05	4.57E-06	3.32E-06	6.16E-06
mg/dscm (dry)	1.27E-02	5.45E-03	3.97E-03	7.36E-03
gr/dscf	5.53E-06	2.38E-06	1.73E-06	3.22E-06
Total Manganese Emission Rate				
lb/ hr	3.62E-03	1.58E-03	1.15E-03	2.11E-03
Total Metals Concentrations				
lb/1000 lb (wet)	1.32E-05	6.55E-06	6.51E-06	8.77E-06
lb/1000 lb (dry)	1.34E-05	6.63E-06	6.59E-06	8.88E-06
mg/dscm (dry)	1.60E-02	7.92E-03	7.87E-03	1.06E-02
gr/dscf	6.99E-06	3.46E-06	3.44E-06	4.63E-06
Total Metals Emission Rate				
lb/ hr	4.57E-03	2.29E-03	2.27E-03	3.05E-03

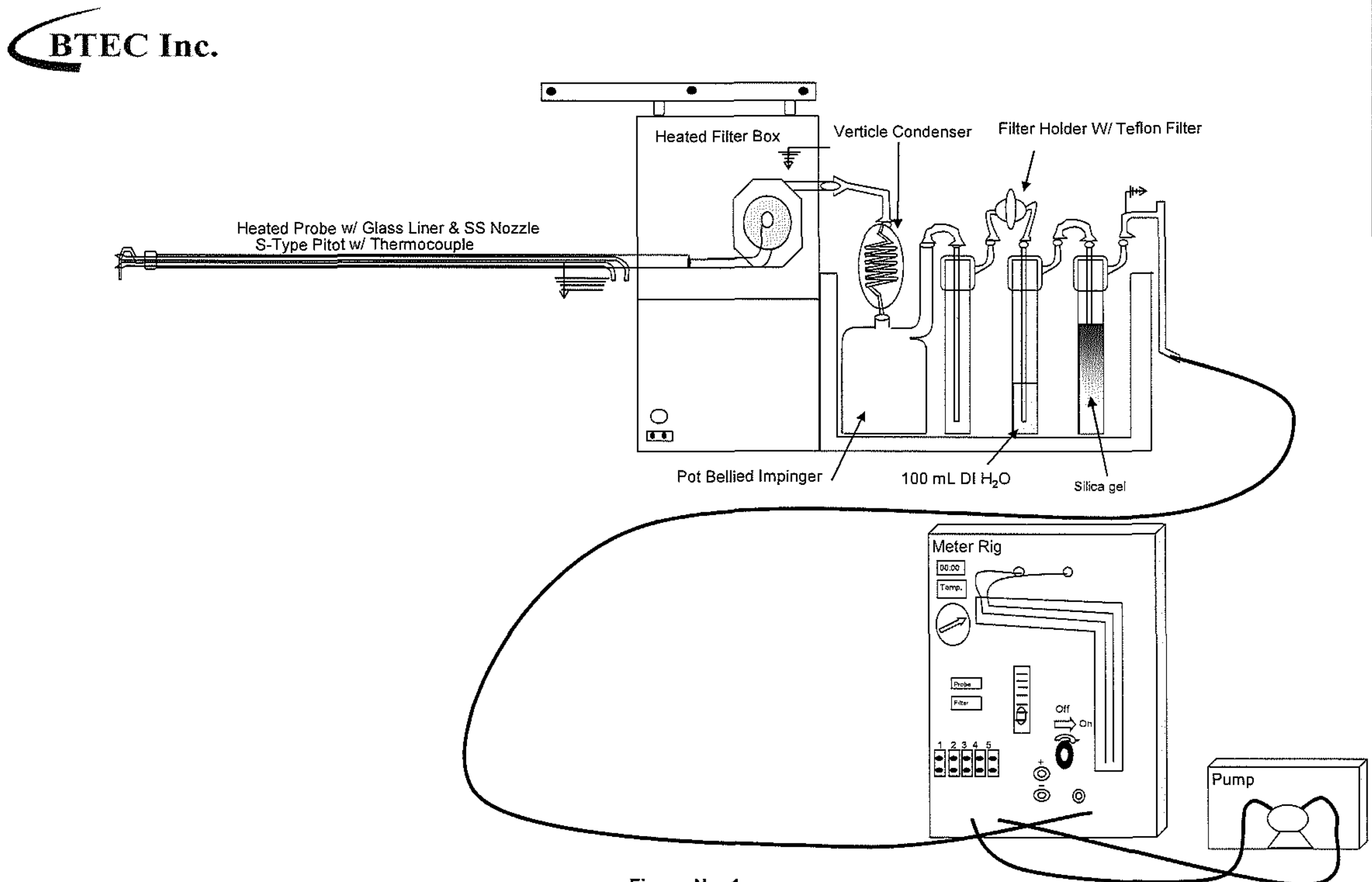


Figure No. 1

Site:	Sampling Date:	
USEPA Method 5/202 AK Steel Dearborn, Michigan	October 4, 2016	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073

BTEC Inc.

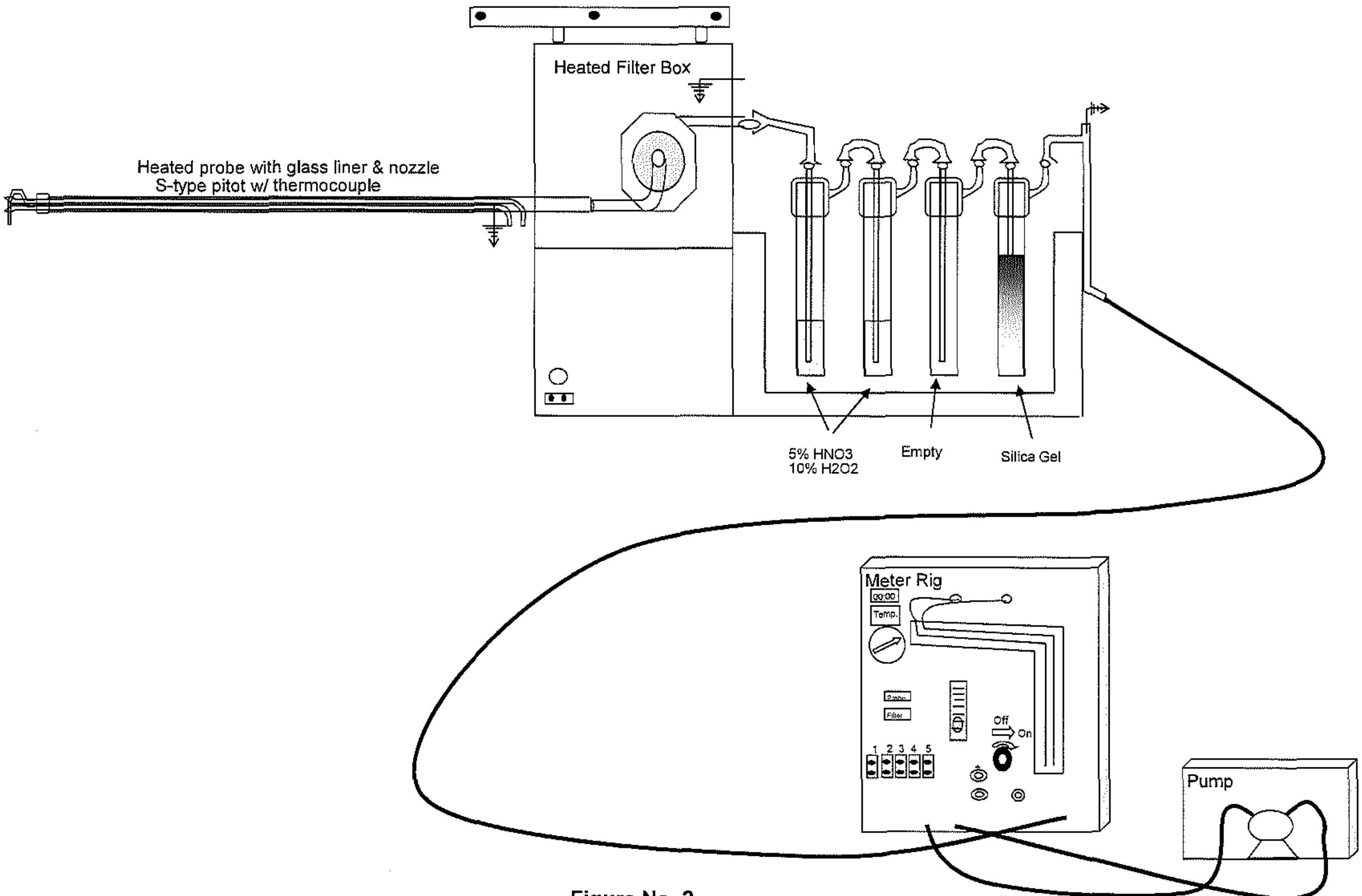
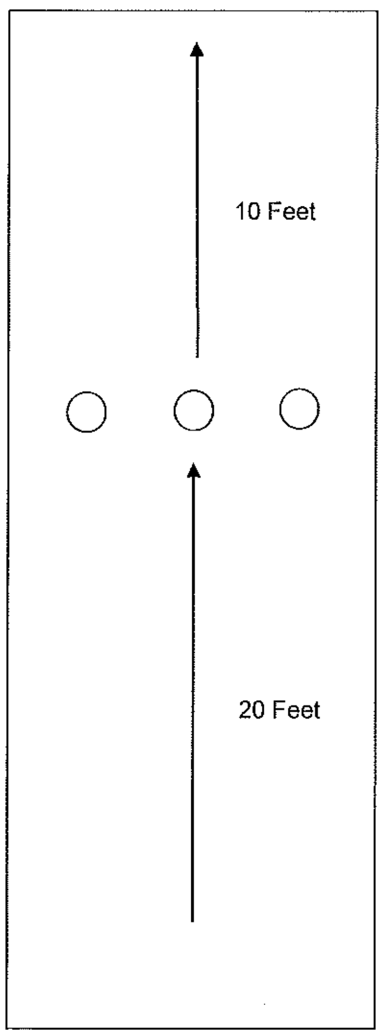


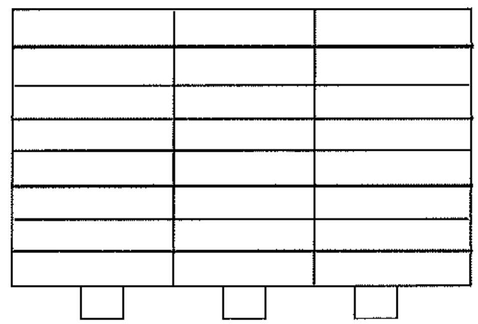
Figure No. 2

Site: USEPA 29 Sampling Train AK Steel Dearborn, MI	Sampling Date: October 5, 2016	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073

BTEC Inc.

Stack Dimensions: 47W" X 73D"





Not to Scale

Points	Distance "
1	4.6
2	13.7
3	22.8
4	31.9
5	41.1
6	50.2
7	59.3
8	68.4

Figure No. 3

Site:	Sampling	
Desulf BH **AK Steel** **Dearborn, Michigan**	**October 4-5, 2016**	**<u>BT Environmental Consulting, Inc.</u>** **4949 Fernlee** **Royal Oak, Michigan**