BTEC Inc.

Pre-Cleaner
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. 049AS-259119
January 5, 2018

BT Environmental Consulting, Inc.
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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) and condensable particulate matter (CPM) on the Pre-Cleaner exhaust. This emissions testing program included evaluation of particulate matter less than 10 microns (PM_{10}). While the permit specifies an emission limit of 0.441 pounds per hour for filterable PM_{10}, also condensable particle matter (CPM) from the Pre-Cleaner exhaust was measured to quantify total PM_{10}. The pollutants were measured at two different scrubber flowrates. Testing took place on November 14, 2017 and November 15, 2017.

Testing of the Pre-cleaner exhaust consisted of triplicate 90-Minute test runs for each of the two conditions. The emissions test program was required by MDEQ Air Quality Division Permit to Install (PTI) 120-16. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: November 14-15, 2017

Emission Unit	Pollutant	Condition	Permit Limit	Test Result
EUHDGLCLEANER (Pre-Cleaner)	Particulate Matter less than 10 microns (filterable)	Condition 1 Flowrate = 8-9 LPM (11-14-17)	0.441 lbs/hr	0.078 lbs/hr
		Condition 2 Flowrate = 5-6 LPM (11-15-17)		0.042 lbs/hr

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) on the Pre-Cleaner exhaust. This emissions testing program included evaluation of particulate matter less than 10 microns (PM_{10}). While the permit specifies an emission limit of 0.441 pounds per hour for filterable PM_{10}, condensable particle matter (CPM) from the Pre-Cleaner exhaust was measured to quantify total PM_{10}. The pollutants were measured at two different operating conditions. Testing took place on November 14, 2017 and November 15, 2017.

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 November 14 to November 15, 2017 at the AK Steel facility located in Dearborn, Michigan.

1.b Purpose of Testing

AQD issued PTI 120-16, condition EUHDGLCLEANER V.1 requires testing once per ROP permit term. This test was conducted to satisfy that requirement. The permit limits are summarized by Table 1.

Table 1
Emission Limitations
AK Steel Corporation – Dearborn Works
PTI 120-16 Emission Limitations

Emission Unit	Pollutant	Permit Limit
Pre-Cleaner	Particulate Matter Less Than 10 Microns (filterable)	0.441 lbs/hr

1.c Source Description

BTEC sampled the Hot Dip Galvanizing Line (HDGL) Pre-Cleaner outlet stack. The following is a description of the process.

Coils of steel are loaded into the entry end of the process and are uncoiled and straightened. Each leading edge of the next coil is welded to the preceding coil in order to allow the process to run continuously while production is occurring. In the Pre-Cleaner section of the HDGL process, the straightened coils are cleaned within caustic solution tanks, which are heated by a hot water and heat exchanger system. Emissions of dilute caustic generated in the cleaning process tanks are controlled by a mist eliminator and a scrubber before being exhausted to the outer atmosphere through the Pre-Cleaner stack.

After cleaning and rinsing, the coil is dried with hot air. After drying, the coil enters the Annealing Furnace. The coil is heated according to required specifications within the Annealing Furnace and then proceeds to the zinc pot where the steel is given a zinc coating (i.e. galvanized). Excess zinc is removed immediately upon exit of the molten zinc pot, and the zinc-coated steel strip is allowed to dry as it travels in a vertical direction. After air cooling, the strip is quenched in water, dried, inspected, and packaged for customer delivery.

The emissions from the Annealing Furnace are controlled by a Selective Catalytic Reduction (SCR) control device. Emissions exiting the SCR are exhausted through the exhaust stack that also exhausts uncontrolled combustion by-product emissions from the HDGL Hot Water Heater system.

1.d Test Program Contacts

The contacts for the source and test report are:

Mr. David Pate
Senior Environmental Engineer
AK Steel Dearborn Works
4001 Miller Rd.
Dearborn, Michigan 48120
(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. Paul Diven Project Manager	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. Jake Zott Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Mason Sakshaug Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Tom Gasloli MDEQ	MDEQ Air Quality Division	(517) 284-6778
Mr. Jonathan Lamb MDEQ	MDEQ Detroit District Office	(313) 456-4683

2. Summary of Results

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

2.a Operating Data

Line speed, coil weight, number of coils, tons per hour, scrubber liquid flow rate, and scrubber pressure drop, were recorded during each run and can be found in Appendix E.

2.b Applicable Permit

AQD issued Permit To Install No. 120-16, 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

See section 1.c.

3.b Process Flow Diagram

A process flow diagram is available on request.

3.c Raw and Finished Materials

The raw material used for coating the strip is zinc. A water scrubber and a mesh pad mist eliminator are used to control pre-cleaner emissions.

3.d Process Capacity

The annual capacity of the HDGL is approximately 500,000 tons of final product. The mill is designed to operate continuously when running. Hourly capacity is very dependent upon the products being made. Hourly production can range from approximately 30 to 80 tons per hour depending on the final product.

3.e Process Instrumentation

Line speed, zinc coating thickness, furnace temperature, and final process/inspection steps regulate how the process is fed through the continuous operation and are closely regulated during the coating of each zinc coated steel coil.

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 3 - *"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 1 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 sampling trains and passed through the impinger configuration (see Figure 2). Exhaust gas moisture content was then determined gravimetrically.

4.b *Particulate Matter less than 10 Microns (USEPA Method 5/202)*

40 CFR 60, Appendix A, Method 5, *"Determination of Particulate Emissions from Stationary Sources"* and 40 CFR 51, Appendix M, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* were used to measure PM concentrations and emission rates (see Figure 2 for a schematic of the sampling train). All collected filterable particulate was assumed to be PM_{10}.

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. The condensable particulate samples were sent by courier to Montrose Air Quality Service's laboratory in Cleveland, Ohio for analysis.

4.c Recovery and Analytical Procedures

Filterable particulate matter samples were processed at BTEC's laboratory in Royal Oak, Michigan. Condensable particulate matter samples were sent to Montrose Air Quality Service's laboratory in Cleveland, Ohio.

4.d Sampling Ports

Diagrams of the stacks showing sampling ports in relation to upstream and downstream disturbances are included as Figure 1.

4.e Traverse Points

Diagrams of the stacks indicating traverse point locations and stack dimensions are included as Figure 1.

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 and 5.

Table 3
Overall Emission Summary
Test Date: November 14-15, 2017

Emission Unit	Pollutant	Condition	Permit Limit	Test Result
EUHDGLCLEANER (Pre-Cleaner)	Particulate Matter less than 10 microns (filterable)	Condition 1 Flowrate = 8-9 LPM (11-14-17)	0.441 lbs/hr	0.078 lbs/hr
		Condition 2 Flowrate = 5-6 LPM (11-15-17)		0.042 lbs/hr

5.b Discussion of Results

The test results for filterable PM_{10} were below the permit limit.

5.c Sampling Procedure Variations

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

5.d Process or Control Device Upsets

A line stop during run 2 of the 11/15/17 test occurred. Testing was paused when the line stopped and was resumed when the line was restarted and reached a normal operating speed.

5.e Control Device Maintenance

An inspection of the mist eliminator and scrubber internals is conducted on a semi-annual basis. The most recent inspection was completed on 9/18/17.

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
Pre-Cleaner Condition 1 Emission Rates

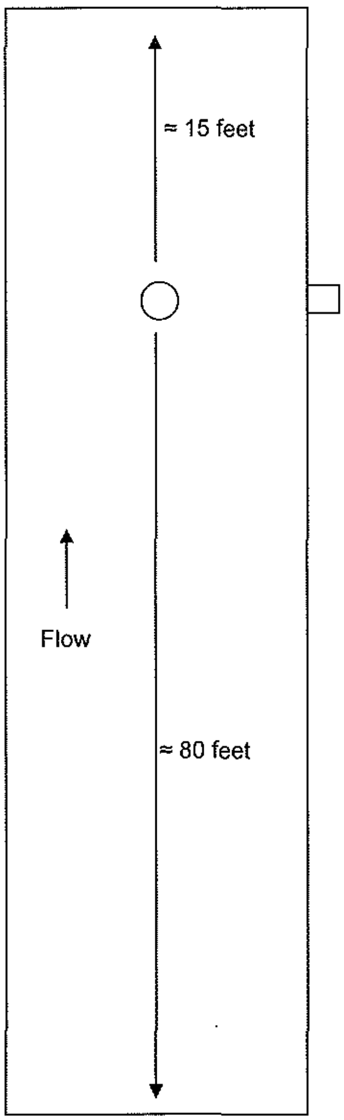
Company	**AK Steel**			
Source Designation	**Pre-cleaner Condition 1**			
Test Date	**11/14/2017**	**11/14/2017**	**11/14/2017**	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	91.6	93.2	95.2	93.3
Meter Pressure - Pm (in. Hg)	29.8	29.8	29.8	29.8
Measured Sample Volume (Vm)	77.8	84.4	85.1	82.4
Sample Volume (Vm-Std ft3)	73.6	79.7	79.9	77.8
Sample Volume (Vm-Std m3)	2.08	2.26	2.26	2.20
Condensate Volume (Vw-std)	5.884	8.016	6.747	6.882
Gas Density (Ps(std) lbs/ft3) (wet)	0.0725	0.0720	0.0724	0.0723
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	5.76	6.31	6.27	6.12
Total weight of sampled gas (m g lbs) (dry)	5.49	5.94	5.96	5.80
Nozzle Size - An (sq. ft.)	0.000234	0.000234	0.000234	0.000234
Isokinetic Variation - I	93.1	100.9	100.2	98.1
Stack Data				
Average Stack Temperature - Ts (F)	102.3	109.2	103.2	104.9
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.0	27.8	28.0	28.0
Stack Gas Specific Gravity (Gs)	0.968	0.962	0.967	0.965
Percent Moisture (Bws)	7.40	9.14	7.78	8.11
Water Vapor Volume (fraction)	0.0740	0.0914	0.0778	0.0811
Pressure - Ps ("Hg)	29.6	29.6	29.6	29.6
Average Stack Velocity -Vs (ft/sec)	72.8	75.0	74.0	73.9
Area of Stack (ft2)	2.8	2.8	2.8	2.8
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	12,048	12,425	12,249	12,241
Flowrate ft^3 (Standard Wet)	11,205	11,407	11,350	11,321
Flowrate ft^3 (Standard Dry)	10,376	10,365	10,467	10,403
Flowrate m^3 (standard dry)	294	294	296	295
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	6.6	3.5	2.8	4.3
Organic Condensible Particulate	1.8	1.0	0.7	1.2
Inorganic Condensible Particulate	6.3	1.7	1.5	3.2
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	6.1	0.7	0.2	2.3
Total Filterable and Condensible Particulate	12.7	4.2	3.0	6.6
Filterable Particulate Concentration				
lb/1000 lb (wet)	0.003	0.001	0.001	0.002
lb/1000 lb (dry)	0.003	0.001	0.001	0.002
mg/dscm (dry)	3.2	1.6	1.2	2.0
gr/dscf	0.0014	0.0007	0.0005	0.0009
Filterable Particulate Emission Rate				
lb/ hr	0.124	0.060	0.049	0.078
Condensible Particulate Concentration				
lb/1000 lb (wet)	0.002	0.000	0.000	0.001
lb/1000 lb (dry)	0.002	0.000	0.000	0.001
mg/dscm (dry)	2.9	0.3	0.1	1.1
gr/dscf	0.0013	0.0001	0.0000	0.0005
Condensible Particulate Emission Rate				
lb/ hr	0.114	0.012	0.004	0.043
Total Particulate Concentration				
lb/1000 lb (wet)	0.005	0.001	0.001	0.002
lb/1000 lb (dry)	0.005	0.002	0.001	0.003
mg/dscm (dry)	6.1	1.9	1.3	3.1
gr/dscf	0.0027	0.0008	0.0006	0.0014
Total Particulate Emission Rate				
lb/ hr	0.238	0.073	0.053	0.121

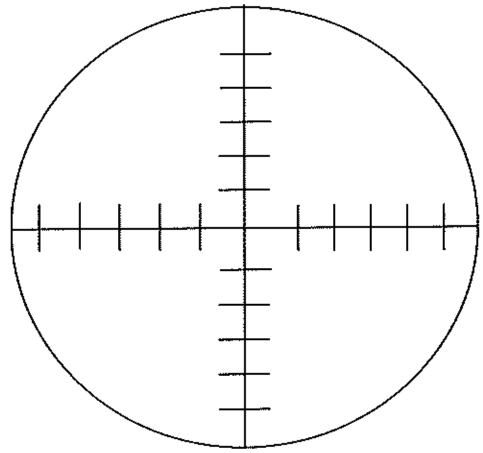
Table 5
Pre-Cleaner Condition 2 Emission Rates

Company	**AK Steel**			
Source Designation	**Pre-cleaner Condition 2**			
Test Date	**11/15/2017**	**11/15/2017**	**11/15/2017**	
Meter/Nozzle Information	Run 4	Run 5	Run 6	Average
Meter Temperature Tm (F)	88.5	88.4	88.3	88.4
Meter Pressure - Pm (in. Hg)	29.5	29.4	29.3	29.4
Measured Sample Volume (Vm)	88.2	74.0	77.5	79.9
Sample Volume (Vm-Std ft3)	83.1	69.3	72.4	75.0
Sample Volume (Vm-Std m3)	2.35	1.96	2.05	2.12
Condensate Volume (Vw-std)	6.092	5.828	6.285	6.068
Gas Density (Ps(std) lbs/ft3) (wet)	0.0726	0.0724	0.0723	0.0724
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	6.48	5.44	5.69	5.87
Total weight of sampled gas (m g lbs) (dry)	6.20	5.17	5.40	5.59
Nozzle Size - An (sq. ft.)	0.000234	0.000234	0.000234	0.000234
Isokinetic Variation - I	99.5	100.5	100.0	100.0
Stack Data				
Average Stack Temperature - Ts (F)	99.7	104.4	104.9	103.0
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.1	28.0	28.0	28.0
Stack Gas Specific Gravity (Gs)	0.970	0.967	0.966	0.968
Percent Moisture (Bws)	6.83	7.75	7.99	7.52
Water Vapor Volume (fraction)	0.0683	0.0775	0.0799	0.0752
Pressure - Ps ("Hg)	29.3	29.2	29.1	29.2
Average Stack Velocity -Vs (ft/sec)	77.0	64.9	68.7	70.2
Area of Stack (ft2)	2.8	2.8	2.8	2.8
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	12,748	10,750	11,370	11,623
Flowrate ft^3 (Standard Wet)	11,770	9,817	10,326	10,638
Flowrate ft^3 (Standard Dry)	10,966	9,056	9,502	9,841
Flowrate m^3 (standard dry)	311	256	269	279
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	2.7	1.5	3.1	2.4
Organic Condensible Particulate	0.9	1.2	1.3	1.1
Inorganic Condensible Particulate	1.6	1.7	1.7	1.7
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	0.5	0.9	1.0	0.8
Total Filterable and Condensible Particulate	3.2	2.4	4.1	3.2
Filterable 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)	1.1	0.8	1.5	1.1
gr/dscf	0.0005	0.0003	0.0007	0.0005
Filterable Particulate Emission Rate				
lb/ hr	0.047	0.026	0.054	0.042
Condensible Particulate Concentration				
lb/1000 lb (wet)	0.000	0.000	0.000	0.000
lb/1000 lb (dry)	0.000	0.000	0.000	0.000
mg/dscm (dry)	0.2	0.5	0.5	0.4
gr/dscf	0.0001	0.0002	0.0002	0.0002
Condensible Particulate Emission Rate				
lb/ hr	0.009	0.016	0.017	0.014
Total 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)	1.4	1.2	2.0	1.5
gr/dscf	0.0006	0.0005	0.0009	0.0007
Total Particulate Emission Rate				
lb/ hr	0.056	0.042	0.071	0.056

BTEC Inc.

diameter = 22.5 inches





Not to Scale

Points	Distance "
1	0.6
2	1.8
3	3.3
4	5.1
5	7.7
6	14.8
7	17.4
8	19.2
9	20.7
10	21.9

Figure No. 1

Site: **Pre-Cleaner** **AK Steel** **Dearborn, MI**	**Sampling Date:** **November 14-15, 2017**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

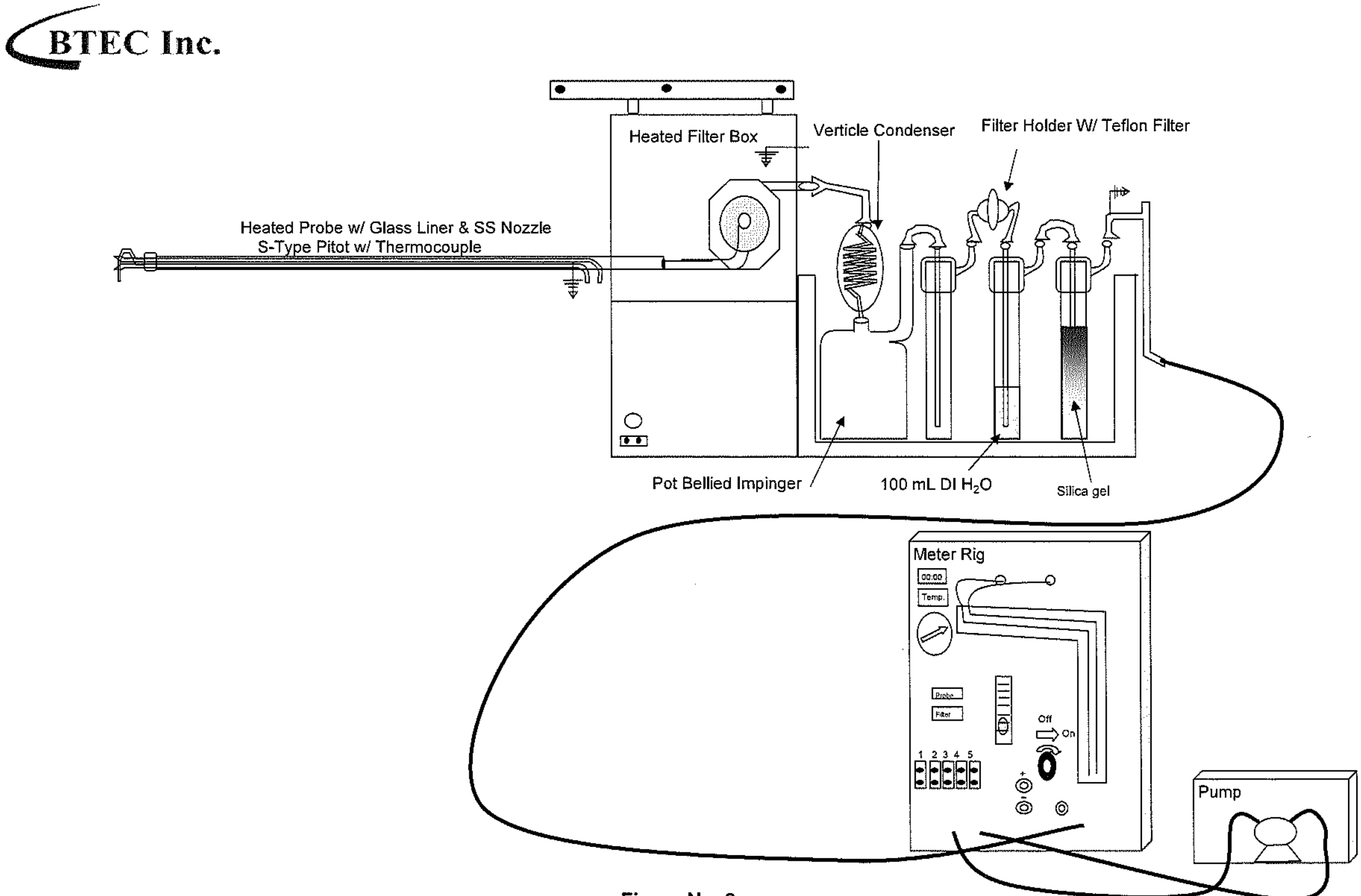


Figure No. 2

Site: **USEPA Method 5/202** **AK Steel** **Dearborn, MI**	**Sampling Date:** **November 15-16, 2017**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**