BTEC Inc.

Tandem Mill Fume Exhaust 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-438587.01
August 16, 2018

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(248) 548-8070

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 PLTCM Tandem Mill Fume Exhaust (TMFE). This emissions testing program included evaluation of particulate matter less than 10 microns (PM_{10}). While the permit specifies an emission limit of 0.004 gr/dscf for filterable PM_{10}, CPM was also measured to quantify total PM_{10}. Testing took place on July 19, 2018.

Testing of the TMFE exhaust consisted of triplicate 60-Minute test runs. 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: July 19, 2018

Emission Unit	Pollutant	Permit Limit	Test Result
EUNTANDMILL	Particulate Matter less than 10 microns (filterable)	0.004 gr/dscf	0.001 gr/dscf

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 PLTCM Tandem Mill Fume Exhaust (TMFE). This emissions testing program included evaluation of particulate matter less than 10 microns (PM_{10}). While the permit specifies an emission limit of 0.004 gr/dscf for filterable PM_{10}, CPM was also measured to quantify total PM_{10}. Testing took place on July 19, 2018.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (March 2018). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document. All testing was performed in accordance with BTEC test plan 049AS-438587.01.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on July 19, 2018 at the AK Steel facility located in Dearborn, Michigan.

1.b Purpose of Testing

AQD issued PTI 120-16, condition EUNTANDMILL 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
TMFE	Particulate Matter Less Than 10 Microns (filterable)	0.004 gr/dscf

1.c Source Description

The pickling process uses a mineral acid (hydrochloric acid) to remove metal oxides formed when steel is hot rolled and cooled in the presence of oxygen. These oxides need to be removed to provide a smooth, clean surface for use as hot roll steel and/or to perform subsequent cold forming operations. The tandem mill operation is coupled to the pickling line and is a cold-rolling mill consisting of a series of five stands that compress the pickled coil in order to achieve a desired thickness and surface quality. Cold rolling imparts greater strength, a uniform and smoother surface, and reduces the steel sheet thickness. During the

cold rolling operations, oil is used as a lubricant between the rolls and steel coil. Oil mist generated from this process is collected and ducted to an oil mist eliminator rated at approximately 230,000 acfm. Steel is processed on a coil-by-coil basis; once the steel enters the process, it continues from the scale breaker to the pickling line and then to the tandem cold mill. Steel coils range from approximately 15 to 20 tons, depending on specific customer orders. Typical hourly production rates are approximately 175 to 250 tons/hour. Rolling oil is applied to the tandem cold mill stands in a very dilute concentration (typically 1 to 3% for stands 1-4 and 0.1 – 0.5% for stand 5, with water) and is kept at a relatively constant concentration; however, the concentration will purposely vary slightly from stand to stand depending on the function of the specific stand. Based on the concentration of oil in the stands, makeup oil is added into the system as needed. The oil mist eliminator is rated for 95% removal efficiency.

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. Steven Smith Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. David Trahan 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
Mrs. Regina Hines MDEQ	MDEQ Air Quality Division	(313) 418-0895

2. Summary of Results

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

2.a Operating Data

Tons and coils of steel produced, oil concentration in stands 1-4 (reported as a single value) and stand 5 (reported separately), and differential pressure across each fume exhaust cell 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

Steel is processed on a coil-by-coil basis; once a coil enters the process, it continues from the Scale Breaker to the Pickling Section and then to the Tandem Cold Mill. Steel coils range from approximately 15 to 20 tons, depending on specific customer orders. Rolling oil is applied to the tandem cold mill stands in a very dilute concentration (typically 1 to 3% for stands 1-4 and 0.1-0.5% for stand 5, with water) and is kept at a relatively constant concentration; however, the concentration will purposely vary slightly from stand to stand depending on the function of the specific stand. Usage of rolling oil is tracked on a monthly basis and is calculated based on inventory consignment.

3.d Process Capacity

Because the mill is designed to operate continuously when running, hourly capacity is very dependent upon the characteristics of the product that is going through the line. Steel coils range from approximately 15-20 tons, depending on specific customer orders. Hourly production rates are typically approximately 175-250 tons/hour depending on the product. During this testing, production averaged 346 TPH.

3.e Process Instrumentation

The oil mist eliminator typically operates at temperatures between 80 to 100 degrees Fahrenheit depending on ambient conditions. Typical moisture content ranges from 2-6%. Normal operating differential pressure across each cell of the mist eliminator is 0.1-3" W.C.

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 stainless steel 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 Maxxam's laboratory in Mississauga, Ontario 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 Maxxam's laboratory in Mississauga, Ontario.

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 Table 4.

Table 3
Overall Emission Summary
Test Date: July 19, 2018

Emission Unit	Pollutant	Permit Limit	Test Result
EUNTANDMILL	Particulate Matter less than 10 microns (filterable)	0.004 gr/dscf	0.001 gr/dscf

5.b Discussion of Results

The test results for filterable PM_{10} were in compliance with 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

There were no process upsets during the testing.

5.e Control Device Maintenance

Routine quarterly maintenance is conducted to determine the operational and physical condition of the fume exhaust. A detailed annual inspection is performed by the manufacturer. The last such inspection was in October 2017.

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.

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 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: _____

Paul Diven
Project Manager

This report was reviewed by: _____

Brandon Chase
QA/QC Manager

Table 4
TMFE Particulate Matter Emission Rates

Company	**AK Steel**			
Source Designation	**TMFE**			
Test Date	**7/19/2018**	**7/19/2018**	**7/19/2018**	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	93.5	85.4	89.1	89.3
Meter Pressure - Pm (in. Hg)	29.5	29.5	29.5	29.5
Measured Sample Volume (Vm)	45.4	46.3	46.9	46.2
Sample Volume (Vm-Std ft3)	43.7	45.2	45.6	44.8
Sample Volume (Vm-Std m3)	1.24	1.28	1.29	1.27
Condensate Volume (Vw-std)	2.871	3.164	2.461	2.832
Gas Density (Ps(std) lbs/ft3) (wet)	0.0728	0.0727	0.0731	0.0729
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.39	3.52	3.51	3.47
Total weight of sampled gas (m g lbs) (dry)	3.26	3.37	3.40	3.34
Nozzle Size - An (sq. ft.)	0.000475	0.000488	0.000488	0.000483
Isokinetic Variation - I	101.1	100.9	100.2	100.7
Stack Data				
Average Stack Temperature - Ts (F)	106.5	106.0	107.5	106.7
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.2	28.1	28.3	28.2
Stack Gas Specific Gravity (Gs)	0.973	0.971	0.977	0.973
Percent Moisture (Bws)	6.17	6.54	5.12	5.94
Water Vapor Volume (fraction)	0.0617	0.0654	0.0512	0.0594
Pressure - Ps ("Hg)	29.4	29.4	29.4	29.4
Average Stack Velocity -Vs (ft/sec)	29.4	29.8	29.9	29.7
Area of Stack (ft2)	109.9	109.9	109.9	109.9
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	194,015	196,453	196,965	195,811
Flowrate ft^3 (Standard Wet)	177,776	180,155	180,147	179,359
Flowrate ft^3 (Standard Dry)	166,814	168,379	170,916	168,703
Flowrate m^3 (standard dry)	4,724	4,768	4,840	4,777
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	1.2	2.2	1.8	1.7
Organic Condensible Particulate	< 1.0	< 1.0	< 1.0	< 1.0
Inorganic Condensible Particulate	3.9	4.0	4.4	4.1
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	< 2.9	< 3.0	< 3.4	< 3.1
Total Filterable and Condensible Particulate	< 4.1	< 5.2	< 5.2	< 4.8
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)	1.0	1.7	1.4	1.4
gr/dscf	0.000	0.001	0.001	0.001
Filterable Particulate Emission Rate				
lb/ hr	0.61	1.09	0.90	0.86
Condensible Particulate Concentration				
lb/1000 lb (wet)	< 0.002	< 0.002	< 0.002	< 0.002
lb/1000 lb (dry)	< 0.002	< 0.002	< 0.002	< 0.002
mg/dscm (dry)	< 2.3	< 2.3	< 2.6	< 2.4
gr/dscf	< 0.001	< 0.001	< 0.001	< 0.001
Condensible Particulate Emission Rate				
lb/ hr	< 1.47	< 1.48	< 1.69	< 1.55
Total Particulate Concentration				
lb/1000 lb (wet)	< 0.003	< 0.003	< 0.003	< 0.003
lb/1000 lb (dry)	< 0.003	< 0.003	< 0.003	< 0.003
mg/dscm (dry)	< 3.3	< 4.1	< 4.0	< 3.8
gr/dscf	< 0.001	< 0.002	< 0.002	< 0.002
Total Particulate Emission Rate				
lb/ hr	< 2.08	< 2.57	< 2.59	< 2.41

Note: The RDL was used the calculations for organic consensibles. Actual results are less than the reported results.

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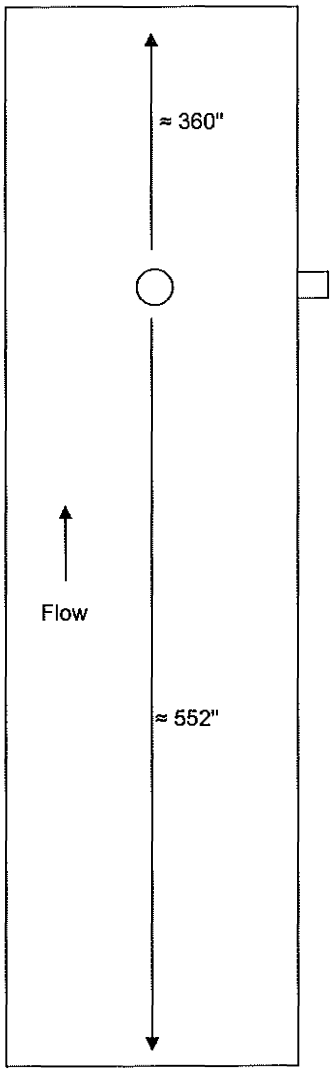
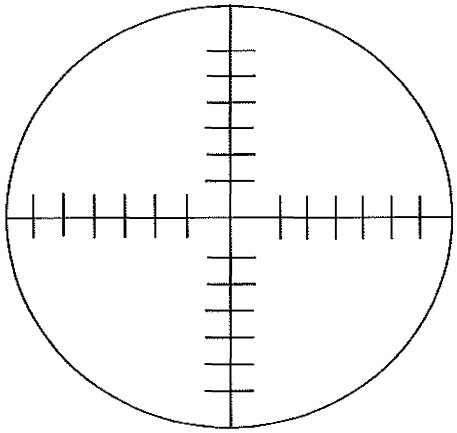
diameter = 142 inches





Not to Scale

Points	Distance "
1	3.0
2	9.5
3	16.8
4	25.1
5	35.5
6	50.6
7	91.4
8	106.5
9	116.9
10	125.2
11	132.5
12	139.0

Figure No. 1

Site: **TMFE** **AK Steel** **Dearborn, Michigan**	**Sampling Date:** **July 19, 2018**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

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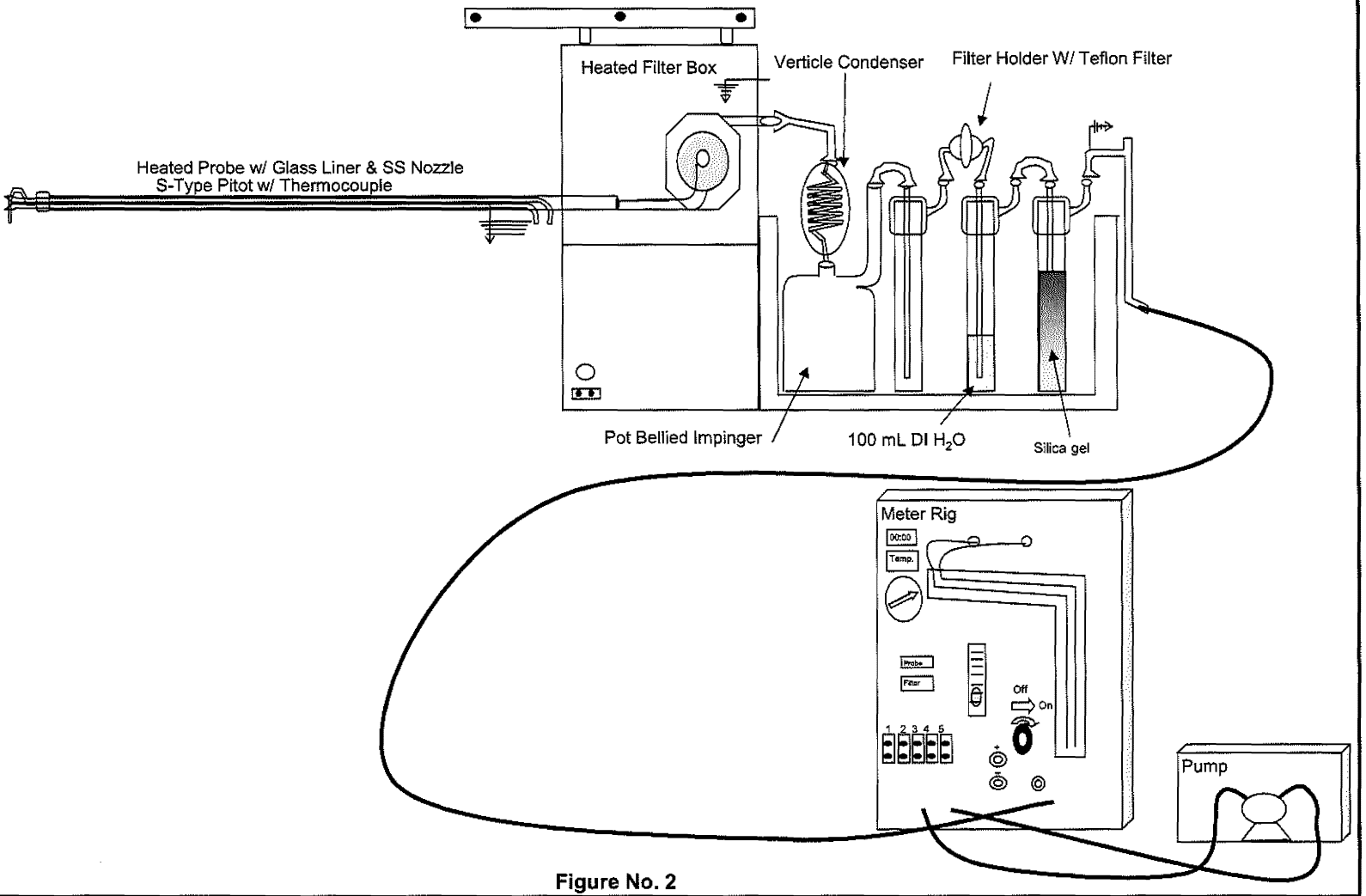

Figure No. 2

Site: **USEPA Method 5/202** **AK Steel** **Dearborn, MI**	**Sampling Date:** **July 19, 2018**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**