BTEC Inc.

LRF 1 and LRF 2 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-438585
October 11, 2018

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 filterable particulate matter (PM), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), lead (Pb), and Visual Emissions (VE) from the LRF 1 and LRF 2 baghouses. 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. In addition, visible emission observations were conducted on the LRF1 and LRF2 Roof Monitors concurrent with a portion of the PM testing. The emissions test program was conducted on August 20-24, 2018.

Testing of the LRF 1 and LRF 2 baghouses consisted of triplicate test runs for each pollutant. The emissions test program was required by the facility's Title V air permit, MI-ROP-A8640-2016a, Facility SRN A8640. In addition, this test was also conducted to satisfy performance testing requirements in the Iron and Steel NESHAP, 40 CFR 63, Subpart FFFFF. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: August 20-24, 2018

Emission Unit	Pollutant	Permit Limit	Test Result
LRF 1	PM	0.005 gr/dscf	0.0005 gr/dscf
		0.01 gr/dscf(1)	
		6.33 lb/hr	0.38 lb/hr
	$PM_{2.5}$, PM_{10}	6.65 lb/hr	0.84 lb/hr
	Lead	0.022 lb/hr	0.0009 lb/hr
	VE	5%-6 Minute Average	0%(2)
LRF 1 Roof Monitor	VE	No Visible Emissions	No Visible Emissions
		20%-3 minute Average(1)	0%(3)

Emission Unit	Pollutant	Permit Limit	Test Result
LRF 2	PM	0.005 gr/dscf	0.0014 gr/dscf
		0.01 gr/dscf(1)	
		3.72 lb/hr	0.62 lb/hr
	$PM_{2.5}$, PM_{10}	3.91 lb/hr	0.90 lb/hr
	Lead	0.013 lb/hr	0.0004 lb/hr
	VE	5%-6 Minute Average	0%(2)
LRF 2 Roof Monitor	VE	No Visible Emissions	No Visible Emissions
		20%-3 minute Average(1)	0%(3)

(1) 40 CFR 63 Subpart FFFFF Limit
(2) Calculated as highest 6-minute average observed
(3) Calculated as highest 3-minute average observed

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by AK Steel Corporation – Dearborn Works (AK Steel) to conduct an evaluation of filterable particulate matter (PM), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), lead (Pb), and Visual Emissions (VE) from the LRF 1 and LRF 2 baghouses. 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. In addition, visible emission observations were conducted on the LRF1 and LRF2 Roof Monitors concurrent with a portion of the PM testing. The emissions test program was conducted on August 20-24, 2018.

Testing of the LRF 1 and LRF 2 baghouses consisted of triplicate test runs for each pollutant. The emissions test program was required by the facility's Title V air permit, MI-ROP-A8640-2016a, Facility SRN A8640. In addition, this test was also conducted to satisfy performance testing requirements in the Iron and Steel NESHAP, 40 CFR 63, Subpart FFFFF. The results of the emission test program are summarized by Table 1.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on August 20-24, 2018 at the AK Steel facility located in Dearborn, Michigan.

1.b Purpose of Testing

Testing is required by the Title V Operating Permit MI-ROP-A8640-2016a as well as the Iron and Steel NESHAP, 40 CFR 63, Subpart FFFFF. The permit limits are summarized by Table 1.

Table 1
Emission Limitations
AK Steel Corporation – Dearborn Works
ROP MI-ROP-A8640-2016a Emission Limitations

Emission Unit	Pollutant	Permit Limit	Test Result
LRF 1	PM	0.005 gr/dscf	0.0005 gr/dscf
		0.01 gr/dscf(1)	
		6.33 lb/hr	0.38 lb/hr
	$PM_{2.5}$, PM_{10}	6.65 lb/hr	0.84 lb/hr
	Lead	0.022 lb/hr	0.0009 lb/hr
	VE	5%-6 Minute Average	0%(2)
LRF 1 Roof Monitor	VE	No Visible Emissions	No Visible Emissions
		20%-3 minute Average(1)	0%(3)

Table 1 (continued)
Emission Limitations
AK Steel Corporation – Dearborn Works
ROP MI-ROP-A8640-2016a Emission Limitations

Emission Unit	Pollutant	Permit Limit	Test Result
LRF 2	PM	0.005 gr/dscf	0.0014 gr/dscf
		0.01 gr/dscf(1)	
		3.72 lb/hr	0.62 lb/hr
	$PM_{2.5}$, PM_{10}	3.91 lb/hr	0.90 lb/hr
	Lead	0.013 lb/hr	0.0004 lb/hr
	VE	5%-6 Minute Average	0%(2)
LRF 2 Roof Monitor	VE	No Visible Emissions	No Visible Emissions
		20%-3 minute Average(1)	0%(3)

(1) 40 CFR 63 Subpart FFFFF Limit
(2) Calculated as highest 6-minute average observed
(3) Calculated as highest 3-minute average observed

1.c Source Description

LRF No. 1 Baghouse
The No. 1 LRF dust collector is a continuous automatic, suction type, pulse-jet baghouse. The baghouse consists of five (5) chambers in parallel and is manufactured by Flakt. One (1) main induced draft (ID) fan provides the suction for moving the fume and dust laden gases through the fume control system. The fan is of the radial tip design and designed to handle 175,000 actual cubic feet per minute (acfm).

LRF No.2 Baghouse
The No. 2 LRF dust collector is a continuous automatic, suction type, pulse-jet baghouse. The baghouse consists of six (6) chambers in parallel and is manufactured by Wheelabrator. One (1) main ID fan provides the suction for moving the fume and dust laden gases through the fume control system. The fan is of the radial tip design and designed to handle 100,000 acfm.

1.d Test Program Contacts

The contacts for the source and test report are:

Mr. David Pate
Senior 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. 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
Ms. 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

LRF 1 Baghouse

Temperature 100-150°F
Moisture Content 1-2%

LRF2 Baghouse

Temperature 100-200°F
Moisture Content 1-2%

2.b Applicable Permit

Michigan ROP MI-ROP-A8640-2016a, Facility SRN A8640

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 purpose of the LRF is to prepare the molten steel for casting through final temperature and chemistry adjustments. The LRF receives molten steel from the basic oxygen furnace (BOF). The steel is reheated by electricity and, if necessary, alloys are added to achieve the required alloy composition. Emissions from LRFs are controlled by their own individual pulse-jet baghouses equipped with a bag leak detection system that continuously monitors the particulate matter loading in the exhaust to ensure proper operation.

3.b Process Flow Diagram

A process flow diagram is available on request.

3.c Raw and Finished Materials

The LRFs receive molten steel from the BOF. The steel is reheated by electric power and, when necessary, alloys are added to achieve the required steel chemistry specification. Approximately 250 tons of molten steel are processed at the LRFs during each heat.

3.d Process Capacity

Note that the LRF production rates are highly dependent upon proper functioning of downstream equipment, customer demand, and the final desired chemistry of the steel. Typical approximate hourly rates are:

LRF No. 1 Process/Baghouse: Approximately 200-400 tons per hour
LRF No. 2 Process/Baghouse: Approximately 150-300 tons per hour

During the testing, the following average production rates were achieved:

LRF1 PM, PM_{10}, $PM_{2.5}$ Testing – 287.7 tons per hour
LRF1 Lead Testing – 321.1 tons per hour
LRF2 PM, PM_{10}, $PM_{2.5}$ Testing – 186.2 tons per hour
LRF2 Lead Testing – 195.9 tons per hour

3.e Process Instrumentation

To ensure the baghouses are operating correctly, a bag leak detection system has been installed on each LRF stack. The bag leak detection system monitors the particulate matter loading in the exhaust on a continuous basis. The baghouses are typically operated at an overall differential pressure of 2-10" W.C. for each baghouse. Typical differential pressures for each individual compartment for each baghouse range from 1-8" 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 3 and 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 lead sampling trains 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 51, Appendix M, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* were used to measure PM, $PM_{2.5}$, and PM_{10} concentrations and emission rates (see Figure 1 for a schematic of the sampling train). $PM_{2.5}$, and PM_{10} were calculated as the sum of the filterable and condensable fractions.

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 Enthalpy laboratory for analysis.

4.c *Lead (USEPA Method 12)*

40 CFR 60, Appendix A, Method 12, *"Determination of Lead Emissions From Stationary Sources"* was used to measure lead 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 glass fiber filter with Teflon filter support; (4) a set of four Greenburg-Smith (GS) impingers with the first two with 100 ml of a 0.1N HNO_3 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 three impingers were triple rinsed with 300 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, and 0.1N HNO_3 solutions, were collected. The samples were sent by courier to Maxxam's laboratory in Ontario, Canada for analysis.

4.d Recovery and Analytical Procedures

Filterable particulate matter samples were processed at BTEC's laboratory in Royal Oak, Michigan. Lead samples were sent to Maxxam and condensable particulate matter samples were sent to Enthalpy.

4.e Sampling Ports

Diagrams of the stacks showing sampling ports in relation to upstream and downstream disturbances are included as Figures 3 and 4.

4.f Traverse Points

Diagrams of the stacks indicating traverse point locations and stack dimensions are included as Figures 3 and 4.

4.g Visible Emissions (USEPA Method 9)

40 CFR 60, Appendix A, Method 9, "Determination of the Visible Emissions of Opacity from Stationary Sources" was used to determine visible emissions from the LRF stacks and roof monitors. Observations were conducted on each baghouse stack for a minimum of 1 hour during the lead testing. Observations were conducted on each LRF roof monitor for a minimum of 1 complete production cycle during each PM testing run. All readings were taken by a certified Method 9 reader. Data sheets and observer certification are included in Appendix E.

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 4-7.

Table 3
Overall Emission Summary
Test Date: August 20-24, 2018

Emission Unit	Pollutant	Permit Limit	Test Result
LRF 1	PM	0.005 gr/dscf	0.0005 gr/dscf
		0.01 gr/dscf(1)	
		6.33 lb/hr	0.38 lb/hr
	$PM_{2.5}$, PM_{10}	6.65 lb/hr	0.84 lb/hr
	Lead	0.022 lb/hr	0.001 lb/hr
	VE	5%-6 Minute Average	0%(2)
LRF 1 Roof Monitor	VE	No Visible Emissions	No Visible Emissions
		20%-3 minute Average(1)	0%(3)

Emission Unit	Pollutant	Permit Limit	Test Result
LRF 2	PM	0.005 gr/dscf	0.0014 gr/dscf
		0.01 gr/dscf(1)	
		3.72 lb/hr	0.62 lb/hr
	$PM_{2.5}$, PM_{10}	3.91 lb/hr	0.90 lb/hr
	Lead	0.013 lb/hr	0.0004 lb/hr
	VE	5%-6 Minute Average	0%(2)
LRF 2 Roof Monitor	VE	No Visible Emissions	No Visible Emissions
		20%-3 minute Average(1)	0%(3)

(1) 40 CFR 63 Subpart FFFFF Limit
(2) Calculated as highest 6-minute average observed
(3) Calculated as highest 3-minute average observed

5.b Discussion of Results

The test results for PM, $PM_{2.5}$, PM_{10}, lead, and VE were below the permit limits for LRF1 and LRF2.

5.c Sampling Procedure Variations

16 sampling points were used during the testing to better match the anticipated run times. The protocol specified that 12 points would be used. The use of more points than required is permitted by the method. There were no additional sampling procedure variations outside of what was presented in the test protocol and approved by the DEQ Air Quality Division.

5.d Process or Control Device Upsets

There were no process upsets during this test.

5.e Control Device Maintenance

Daily checks are made of the baghouse compartment and overall differential pressure. Weekly checks are performed on the dust hoppers to verify that dust is being collected. A monthly inspection of the baghouse cleaning system is performed to ensure that the baghouse is cleaning properly. A quarterly internal check is performed on the baghouse interior to check for bag leaks or damage to the baghouse interior. Vibration analysis is also performed on the baghouse ID fan at a minimum of once per quarter. Re-bagging of the compartments is performed on an as-needed basis. Between April and June 2018, a total of 3 compartments on LRF1 Baghouse were re-bagged.

5.f Re-Test

The emissions test program was not a re-test.

5.g Audit Sample Analyses

A lead audit sample was sent to Maxxam for Method 12. Results were flagged as acceptable.

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.

6. NESHAP and ROP Testing Requirements

Table 4 summarizes the NESHAP and ROP conditions as they relate to testing and notification requirements.

Table 4
NESHAP and ROP Testing Requirements

NESHAP Reference	ROP Reference	NESHAP/ROP Language	Comments
40 CFR 63.7821	EULADLEREFINE1 V.1 EULADLEREFINE2 V.1	Conduct performance tests for particulate matter emissions and opacity at least once every 5 years (or ROP Renewal Cycle).	Previous performance test was conducted on August 19-22, 2013. The test commenced with 5 years of the completion of the previous test.
40 CFR 63.7822(b)(1)	N/A	Determine the concentration of particulate matter according to the listed test methods in 40 CFR 63.7822(b)(1)(i-v)	The particulate matter concentration was determined in accordance with the required test methods.
40 CFR 63.7822(b)(2)	N/A	Collect a minimum of 60 dry standard cubic feet of gas during each particulate matter test run. Three valid test runs are needed to comprise a performance test.	Between 67.2 and 111.5 dry standard cubic feet of gas were collected during each particulate matter test run.
40 CFR 63.7822(h)	EULADLEREFINE1 V.2 EULADLEREFINE2 V.2	Sampling during the performance test will occur only when the operations being controlled are in operation.	Sampling only occurred when heats were being processed within the ladle refining furnaces. Testing was paused between heats.
40 CFR 63.7823(b)	N/A	Performance tests for visible emissions shall be conducted such that opacity observations overlap with the performance tests for particulate.	All opacity observations overlapped with the performance tests for particulate.

Table 4 (continued)
NESHAP and ROP Testing Requirements

NESHAP Reference	ROP Reference	NESHAP/ROP Language	Comments
40 CFR 63.7823(d)(1)(ii)	N/A	Record observations to the nearest 5 percent at 15-second intervals for at least three steel production cycles rather than using the procedure specified in Section 2.4 of Method 9.	One complete steel production cycle was observed during each PM test run for a total of three steel production cycles per LRF.
40 CFR 63.7823(d)(1)(iii)	N/A	Determine the 3-minute block average opacity from the average of 12 consecutive observations recorded at 15-second intervals.	Opacity was calculated using the 3-minute block averages in accordance with this requirement.
40 CFR 63.7840(d)	EULADLEREFINE1 VII.4 EULADLEREFINE2 VII.4	Submit a notification of intent to perform any performance testing under 40 CFR Part 63, Subpart FFFFF at least 60 calendar days before testing is to begin.	The notification was submitted on June 13, 2018, 68 days prior to the start of the testing.

BTEC Inc.

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: _____
Steve Smith
Project Manager

This report was reviewed by: _____
Brandon Chase
QA/QC Manager

Table 4
LRF 1 Particulate Matter Emission Rates

Company	**AK Steel**			
Source Designation	**LRF 1**			
Test Date	**8/23/2018**	**8/23/2018**	**8/23/2018**	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	71.8	84.4	87.7	81.3
Meter Pressure - Pm (in. Hg)	29.5	29.5	29.5	29.5
Measured Sample Volume (Vm)	69.6	78.0	119.0	88.9
Sample Volume (Vm-Std ft3)	67.2	73.6	111.5	84.1
Sample Volume (Vm-Std m3)	1.90	2.08	3.16	2.38
Condensate Volume (Vw-std)	1.150	1.216	1.584	1.317
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)	5.06	5.54	8.39	6.33
Total weight of sampled gas (m g lbs) (dry)	5.01	5.48	8.31	6.27
Nozzle Size - An (sq. ft.)	0.000587	0.000587	0.000587	0.000587
Isokinetic Variation - I	102.5	100.8	100.8	101.4
Stack Data				
Average Stack Temperature - Ts (F)	131.1	130.2	136.7	132.6
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)	1.68	1.63	1.40	1.57
Water Vapor Volume (fraction)	0.0168	0.0163	0.0140	0.0157
Pressure - Ps ("Hg)	29.3	29.3	29.3	29.3
Average Stack Velocity -Vs (ft/sec)	26.3	26.4	26.8	26.5
Area of Stack (ft2)	63.6	63.6	63.6	63.6
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	100,524	100,749	102,297	101,190
Flowrate ft^3 (Standard Wet)	88,062	88,386	88,772	88,407
Flowrate ft^3 (Standard Dry)	86,579	86,949	87,528	87,019
Flowrate m^3 (standard dry)	2,452	2,462	2,479	2,464
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	3.6	1.2	3.1	2.6
Organic Condensible Particulate	1.28	1.36	1.17	1.27
Inorganic Condensible Particulate	4.15	3.78	3.71	3.88
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	3.43	3.14	2.88	3.15
Total Filterable and Condensible Particulate	7.03	4.34	5.98	5.78
Filterable Particulate Concentration				
lb/1000 lb (wet)	0.002	0.000	0.001	0.001
lb/1000 lb (dry)	0.002	0.000	0.001	0.001
mg/dscm (dry)	1.9	0.6	1.0	1.1
gr/dscf	0.0008	0.0003	0.0004	0.0005
Filterable Particulate Emission Rate				
lb/ hr	0.62	0.19	0.32	0.38
Condensible Particulate Concentration				
lb/1000 lb (wet)	0.001	0.001	0.001	0.001
lb/1000 lb (dry)	0.002	0.001	0.001	0.001
mg/dscm (dry)	1.8	1.5	0.9	1.4
gr/dscf	0.0008	0.0007	0.0004	0.0006
Condensible Particulate Emission Rate				
lb/ hr	0.59	0.49	0.30	0.46
Total Particulate Concentration				
lb/1000 lb (wet)	0.003	0.001727	0.002	0.002
lb/1000 lb (dry)	0.003	0.001745	0.002	0.002
mg/dscm (dry)	3.7	2.1	1.9	2.6
gr/dscf	0.0016	0.0009	0.0008	0.0011
Total Particulate Emission Rate				
lb/ hr	1.20	0.68	0.62	0.84

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Table 5
LRF 1 Lead Emission Rates

Company	**AK Steel**			
Source Designation	**LRF 1**			
Test Date	**8/23/2018**	**8/24/2018**	**8/24/2018**	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	86.2	82.0	92.9	87.0
Meter Pressure - Pm (in. Hg)	29.5	29.6	29.6	29.5
Measured Sample Volume (Vm)	55.1	65.0	70.7	63.6
Sample Volume (Vm-Std ft3)	51.8	61.7	65.7	59.8
Sample Volume (Vm-Std m3)	1.47	1.75	1.86	1.69
Condensate Volume (Vw-std)	0.868	1.240	1.061	1.056
Gas Density (Ps(std) lbs/ft3) (wet)	0.0741	0.0740	0.0741	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)	3.90	4.65	4.95	4.50
Total weight of sampled gas (m g lbs) (dry)	3.86	4.60	4.90	4.45
Nozzle Size - An (sq. ft.)	0.000587	0.000587	0.000587	0.000587
Isokinetic Variation - I	100.6	100.7	100.3	100.5
Stack Data				
Average Stack Temperature - Ts (F)	143.6	137.2	135.4	138.7
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.7	28.6	28.7	28.6
Stack Gas Specific Gravity (Gs)	0.990	0.988	0.990	0.989
Percent Moisture (Bws)	1.65	1.97	1.59	1.74
Water Vapor Volume (fraction)	0.0165	0.0197	0.0159	0.0174
Pressure - Ps ("Hg)	29.3	29.4	29.4	29.4
Average Stack Velocity -Vs (ft/sec)	27.1	26.9	26.8	26.9
Area of Stack (ft2)	63.6	63.6	63.6	63.6
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	103,387	102,571	102,256	102,738
Flowrate ft^3 (Standard Wet)	88,694	89,083	89,074	88,950
Flowrate ft^3 (Standard Dry)	87,234	87,327	87,659	87,407
Flowrate m^3 (standard dry)	2,470	2,473	2,482	2,475
Total Metals Weights (ug)				
Lead	1.8	11.0	1.4	4.7
Metals Concentrations				
lb/1000 lb (wet)	0.000001	0.000005	0.000001	0.000002
lb/1000 lb (dry)	0.000001	0.000005	0.000001	0.000002
mg/dscm (dry)	0.001	0.006	0.001	0.003
gr/dscf	0.00000	0.00000	0.00000	0.00000
Metals Emission Rate				
lb/ hr	0.0004	0.0021	0.0002	0.0009

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Table 6
LRF 2 Particulate Matter Emission Rates

Company	**AK Steel**			
Source Designation	**LRF 2**			
Test Date	**8/20/2018**	**8/20/2018**	**8/20/2018**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	71.3	76.6	73.8	73.9
Meter Pressure - Pm (in. Hg)	29.4	29.4	29.3	29.4
Measured Sample Volume (Vm)	78.1	71.1	84.9	78.0
Sample Volume (Vm-Std ft3)	75.3	67.8	81.1	74.8
Sample Volume (Vm-Std m3)	2.13	1.92	2.30	2.12
Condensate Volume (Vw-std)	1.537	1.523	1.726	1.595
Gas Density (Ps(std) lbs/ft3) (wet)	0.0740	0.0739	0.0739	0.0739
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	5.69	5.12	6.13	5.65
Total weight of sampled gas (m g lbs) (dry)	5.62	5.05	6.05	5.57
Nozzle Size - An (sq. ft.)	0.000401	0.000401	0.000401	0.000401
Isokinetic Variation - I	101.0	101.0	100.7	100.9
Stack Data				
Average Stack Temperature - Ts (F)	174.7	199.5	169.3	181.2
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)	0.988	0.987	0.988	0.988
Percent Moisture (Bws)	2.00	2.20	2.08	2.09
Water Vapor Volume (fraction)	0.0200	0.0220	0.0208	0.0209
Pressure - Ps ("Hg)	29.3	29.3	29.2	29.2
Average Stack Velocity -Vs (ft/sec)	37.8	38.0	37.0	37.6
Area of Stack (ft2)	28.3	28.3	28.3	28.3
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	64,061	64,419	62,813	63,764
Flowrate ft^3 (Standard Wet)	52,163	50,431	51,396	51,330
Flowrate ft^3 (Standard Dry)	51,120	49,323	50,326	50,256
Flowrate m^3 (standard dry)	1,448	1,397	1,425	1,423
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	7.4	6.3	7.2	7.0
Organic Condensible Particulate	1.26	1.70	1.18	1.38
Inorganic Condensible Particulate	4.36	3.38	3.44	3.73
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	3.62	3.08	2.62	3.11
Total Filterable and Condensible Particulate	11.02	9.38	9.82	10.07
Filterable 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)	3.5	3.3	3.1	3.3
gr/dscf	0.0015	0.0014	0.0014	0.0014
Filterable Particulate Emission Rate				
lb/ hr	0.67	0.61	0.59	0.62
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)	1.7	1.6	1.1	1.5
gr/dscf	0.0007	0.0007	0.0005	0.0006
Condensible Particulate Emission Rate				
lb/ hr	0.33	0.30	0.22	0.28
Total Particulate Concentration				
lb/1000 lb (wet)	0.004	0.004	0.004	0.004
lb/1000 lb (dry)	0.004	0.004	0.004	0.004
mg/dscm (dry)	5.2	4.9	4.3	4.8
gr/dscf	0.0023	0.0021	0.0019	0.0021
Total Particulate Emission Rate				
lb/ hr	0.99	0.91	0.81	0.90

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Table 7
LRF 2 Lead Emission Rates

Company	**AK Steel**			
Source Designation	**LRF 2**			
Test Date	**8/21/2018**	**8/21/2018**	**8/21/2018**	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	76.3	77.3	77.9	77.2
Meter Pressure - Pm (in. Hg)	29.2	29.1	29.1	29.1
Measured Sample Volume (Vm)	64.1	48.7	56.6	56.5
Sample Volume (Vm-Std ft3)	60.6	45.9	53.3	53.3
Sample Volume (Vm-Std m3)	1.72	1.30	1.51	1.51
Condensate Volume (Vw-std)	1.674	1.221	1.348	1.415
Gas Density (Ps(std) lbs/ft3) (wet)	0.0738	0.0738	0.0738	0.0738
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	4.59	3.48	4.04	4.04
Total weight of sampled gas (m g lbs) (dry)	4.52	3.42	3.97	3.97
Nozzle Size - An (sq. ft.)	0.000401	0.000401	0.000401	0.000401
Isokinetic Variation - I	101.3	102.0	100.7	101.3
Stack Data				
Average Stack Temperature - Ts (F)	162.0	153.7	150.2	155.3
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.5	28.6	28.6	28.6
Stack Gas Specific Gravity (Gs)	0.986	0.986	0.986	0.986
Percent Moisture (Bws)	2.69	2.59	2.47	2.58
Water Vapor Volume (fraction)	0.0269	0.0259	0.0247	0.0258
Pressure - Ps ("Hg)	29.0	29.0	28.9	29.0
Average Stack Velocity -Vs (ft/sec)	36.1	34.5	36.0	35.5
Area of Stack (ft2)	28.3	28.3	28.3	28.3
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	61,260	58,448	61,036	60,248
Flowrate ft^3 (Standard Wet)	50,415	48,684	51,095	50,065
Flowrate ft^3 (Standard Dry)	49,060	47,422	49,835	48,773
Flowrate m^3 (standard dry)	1,389	1,343	1,411	1,381
Total Metals Weights (ug)				
Lead	3.6	3.8	1.3	2.9
Metals Concentrations				
lb/1000 lb (wet)	0.000002	0.000002	0.000001	0.000002
lb/1000 lb (dry)	0.000002	0.000002	0.000001	0.000002
mg/dscm (dry)	0.002	0.003	0.001	0.002
gr/dscf	0.00000	0.00000	0.00000	0.00000
Metals Emission Rate				
lb/ hr	0.0004	0.0005	0.0002	0.0004

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BTEC Inc.

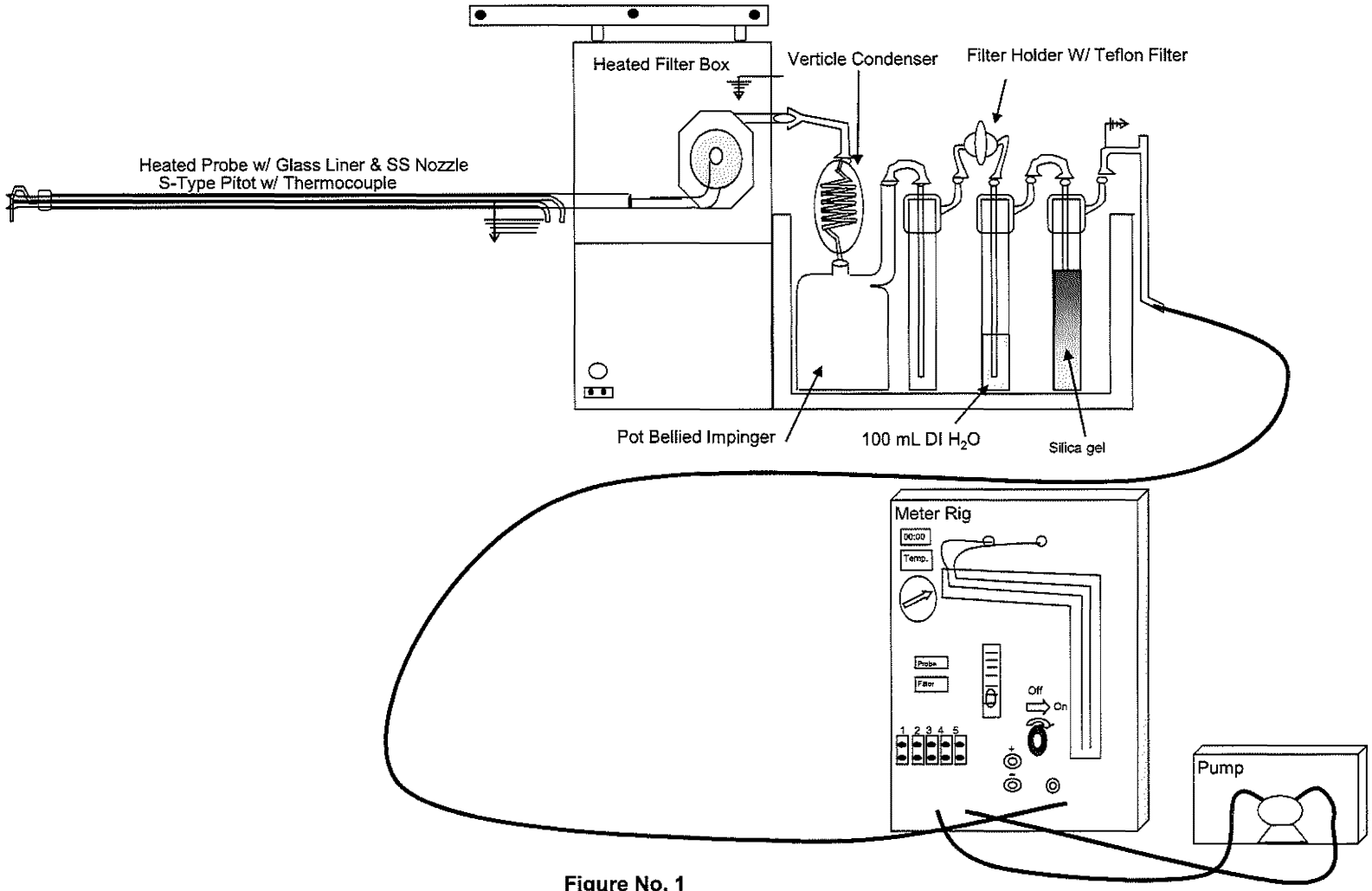


Figure No. 1

Site: **USEPA Method 5/202** **AK Steel** **Dearborn, Michigan**	**Sampling Date:** **August 20-23, 2018**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

BTEC Inc.

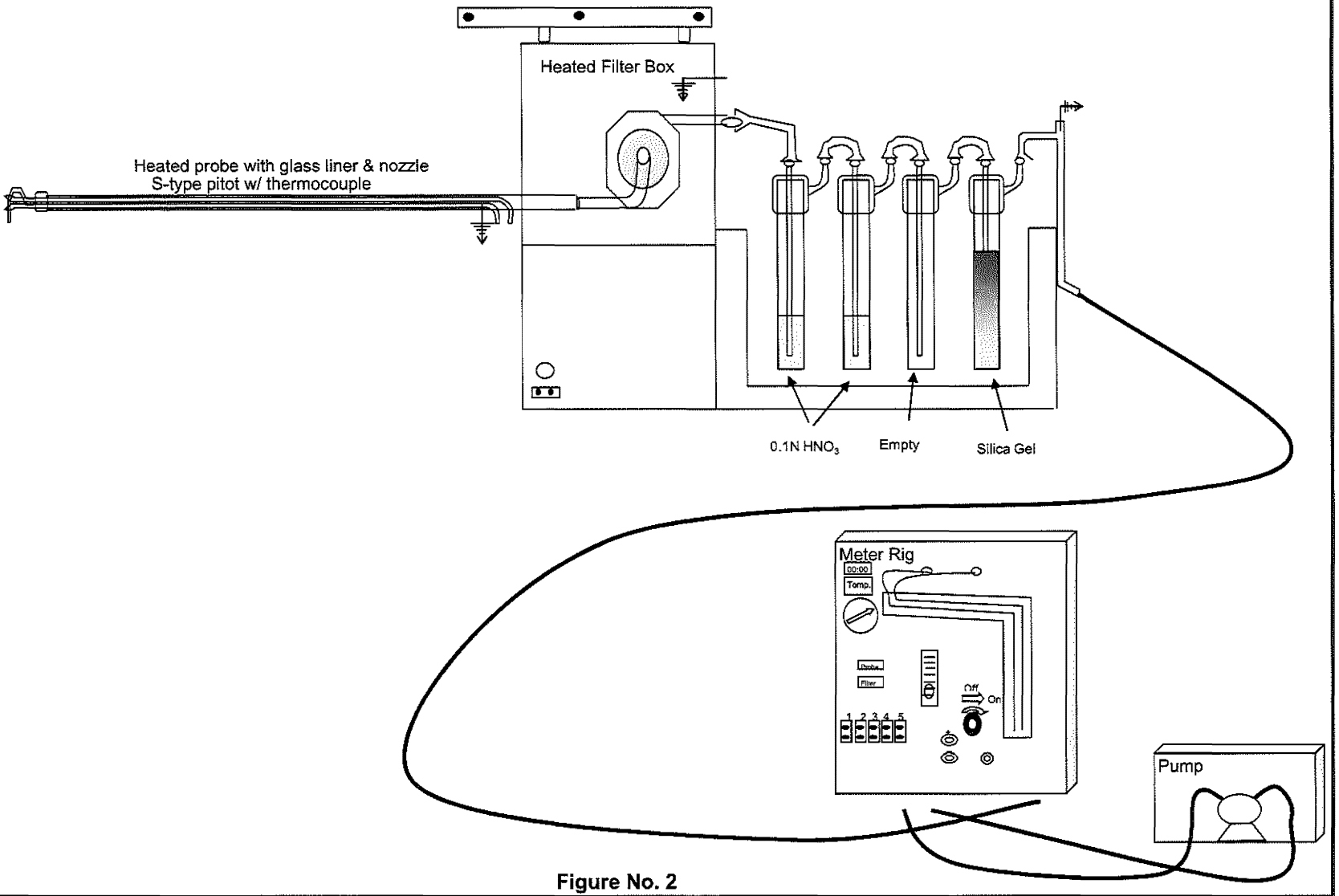
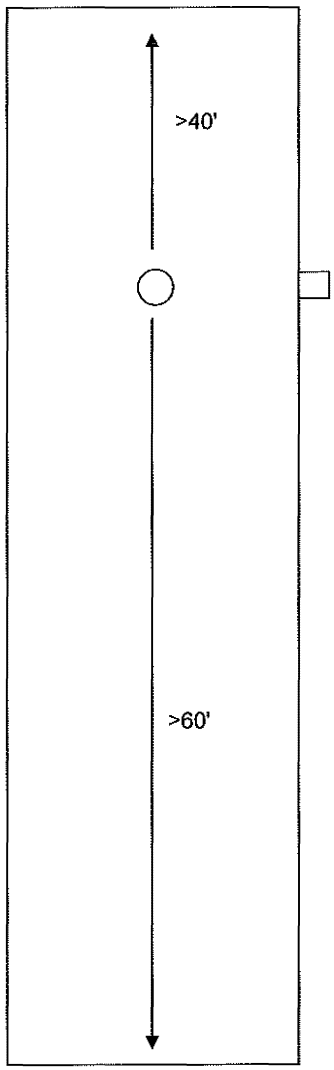


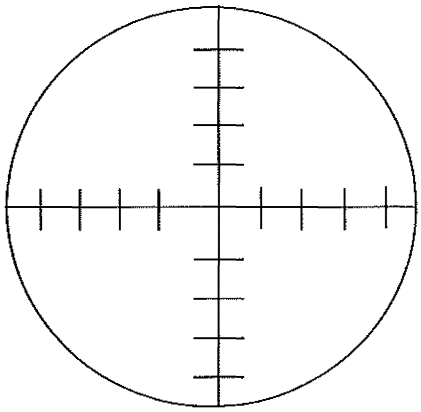
Figure No. 2

Site:	Sampling Date:	
USEPA Method 12 Sampling Train AK Steel Dearborn, MI	August 21-24, 2018	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073

BTEC Inc.

diameter = 108"





Not to Scale

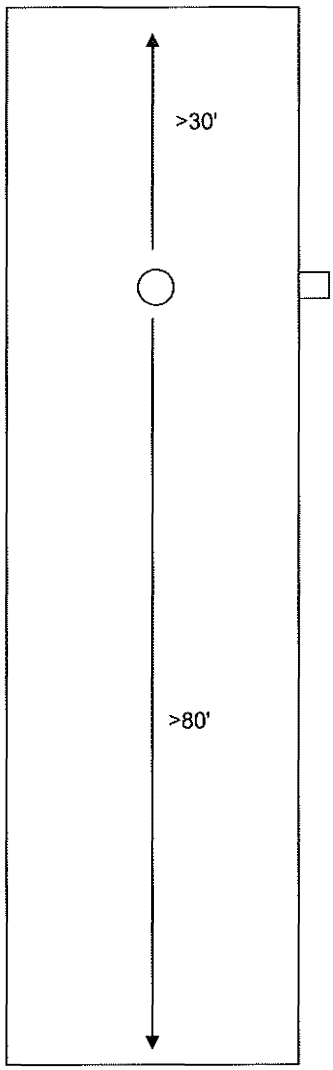
Points	Distance "
1	3.5
2	11.3
3	21.0
4	34.9
5	73.1
6	87.0
7	96.7
8	104.5

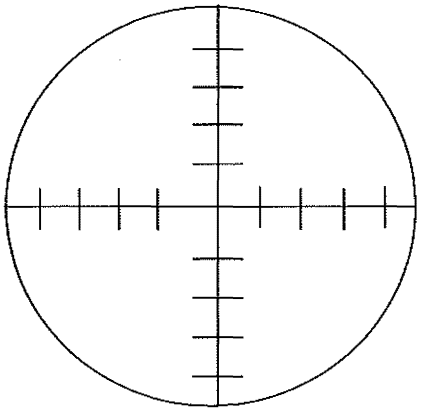
Figure No. 3

Site: **LRF 1** **AK Steel-Dearborn Works** **Dearborn, Michigan**	**Sampling Date:** **August 23-24, 2018**	**BT Environmental Consulting, Inc.** **4949 Fernlee** **Royal Oak, Michigan**

BTEC Inc.

diameter = 72"





Not to Scale

Points	Distance "
1	2.3
2	7.6
3	14.0
4	23.3
5	48.7
6	58.0
7	64.4
8	69.7

Figure No. 4

Site: **LRF 2** **AK Steel-Dearborn Works** **Dearborn, Michigan**	**Sampling Date:** **August 20-21, 2018**	**BT Environmental Consulting, Inc.** **4949 Fernlee** **Royal Oak, Michigan**