



# LMF and EAF Baghouse Emissions Test Report

*Prepared for:*

**Gerdau Special Steel – North America**

Monroe, Michigan

Gerdau Special Steel  
3000 E. Front Street  
Monroe, Michigan

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**NOV 05 2018**

**AIR QUALITY DIVISION**

Project No. 049AS-437936  
October 30, 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 Gerdau Special Steel North America (GSS) to conduct an evaluation on two sources at the GSS facility in Monroe, Michigan. The emission test program included evaluation of mercury (Hg) from the Ladle Metallurgic Furnace (LMF) and the Electric Arc Furnace (EAF). The emissions test program was conducted on August 30-31, 2018.

Testing of the LMF and EAF stacks consisted of triplicate 300-minute test runs conducted simultaneously for Hg. The emissions test program was required by MDEQ Air Quality Division ROP-MI-B7061-2016. The results of the emission test program are summarized by Table I.

**Table I**  
**Overall Emission Summary**  
**Test Date: August 30-31, 2018**

<b>Emission Unit</b>	<b>Pollutant</b>	<b>Permit Limit</b>	<b>Test Result</b>
EAF+LMF Baghouse Stacks	Hg	0.033 lb/hr	0.003 lb/hr

## 1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Gerdau Special Steel North America (GSS) to conduct an evaluation on two sources at the GSS facility in Monroe, Michigan. The emission test program included evaluation of mercury (Hg) from the Ladle Metallurgic Furnace (LMF) and the Electric Arc Furnace (EAF). The emissions test program was conducted on August 30-31, 2018.

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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 August 30-31, 2018 at the GSS facility located in Monroe, Michigan.

### 1.b Purpose of Testing

AQD issued ROP-MI-B7061-2016. The permit limits emissions from the sources as summarized by Table 1.

**Table 1**  
**Emission Limitations**

Test Parameter	Combined FG Melt Shop Limits (EAF,LMF,VTD)
	Limit
Hg	0.033 lb/hr

### 1.c Source Description

The electric arc furnace (EAF) melts steel scrap in a batch operation. The EAF is a refractory lined cylindrical vessel with a bowl-shaped hearth and dome shaped roof. Electrodes are lowered and raised through the furnace roof for melting the steel scrap.

The LMF is a complete ladle metallurgy system which includes arc reheating, alloy additions, powder injections and stirring.

## 1.d Test Program Contacts

The contact for the source and test report is:

Mr. Craig Metzger  
Environmental Manager  
Gerdau Special Steel North America – Monroe Mill  
3000 E. Front Street  
Monroe, Michigan  
(734) 818-7113

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

**Table 2**  
**Test Personnel**

<b>Name and Title</b>	<b>Affiliation</b>	<b>Telephone</b>
Mr. Steve Smith Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Dave Trahan Field Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Jake Young Field Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Mike Nummer Field Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Todd Wessel Client Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
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

**EAF Baghouse**  
Temperature 149-232°F  
Moisture Content ~4%

## **LMF Baghouse**

Temperature 118-145°F

Moisture Content ~2%

### **2.b Applicable Permit**

AQD ROP-MI-B7061-2016

### **2.c Results**

See Table 3 in Section 5.a.

## **3. Source Description**

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

### **3.a Process Description**

#### LMF Baghouse

The LMF is controlled by a baghouse. Emissions from the LMF will be directed to the baghouse (DVLMBAGHOUSE) via removable covers or decks, which are located over the ladle while the process is operating.

#### EAF Baghouse

The EAF is evacuated with a positive pressure baghouse (DVBAGHOUSE-01) with reverse air cleaning to control particulate emissions. The evacuation is by means of three main exhaust fans and one direct evacuation control (DEC) fan with a single stack emission point. CO is combusted in a DEC combustion chamber. Dust disposal is accomplished by means of hopper screw conveyors to a pneumatic conveying system, which loads the dust into a storage silo.

### **3.b Process Flow Diagram**

A process flow diagram is available upon request.

### **3.c Raw and Finished Materials**

On average, approximately 134.6 tons of scrap steel is charged per heat into the EAF. During this same time frame an average of 9.9 tons of additives, alloys, and fluxes are added to each heat.

### **3.d Process Capacity**

The rated capacity of the process is 850,000 liquid steel tons per year.

### 3.e Process Instrumentation

Section 3.d provides summary.

## 4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

### 4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *“Location of the Sampling Site and Sampling Points”*
- Method 2 - *“Determination of Stack Gas Velocity and Volumetric Flowrate”*
- Method 3 - *“Determination of Molecular Weight of Dry Stack Gas” (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. 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. Calibrated s-type pitot tubes were used during this test (0.84).

Cyclonic flow checks were 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 angles is greater than 20 degrees, cyclonic flow exists.

Molecular weight determinations were evaluated according to USEPA Method 3, “Gas Analysis for the Determination of Dry Molecular Weight.” The equipment used for this evaluation consist 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 Hg sampling train. Exhaust gas moisture content is then determined gravimetrically.

#### **Mercury (USEPA Method 29):**

40 CFR 60, Appendix A, Method 29, *“Determination of Metals Emissions From Stationary Sources”* was used to measure predetermined metals concentrations and

calculate appropriate emission rates (see Figure 1 for a schematic of the sampling train). Triplicate 300-minute test runs were conducted.

BTEC's Nutech<sup>®</sup> 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 90-mm diameter quartz filter with Teflon filter support; (4) a set of six Greenburg-Smith (GS) impingers with the first two with 100 ml of a 5% HNO<sub>3</sub> / 10% H<sub>2</sub>O<sub>2</sub> solution (ii) an empty impinger, two with 100 ml of a 4% KMnO<sub>4</sub> / 10% H<sub>2</sub>SO<sub>4</sub> solution, (iii) and an impinger filled with approximately 300 grams of silica gel. (5) a length of sample line, and (6) a Nutech<sup>®</sup> 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<sub>3</sub>. 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 triple rinsed with 100 ml of 0.1N HNO<sub>3</sub>. The third impinger (empty) was also rinsed with 100 ml of 0.1N HNO<sub>3</sub>. The fourth and fifth impingers were first triple rinsed with 100 ml of KMnO<sub>4</sub>, followed by a triple rinse with 100 ml of H<sub>2</sub>O and placed their respective sample containers. The impingers were then triple rinsed 25 ml of 8N HCL and placed in sample container with 200 ml H<sub>2</sub>O.

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, 0.1N HNO<sub>3</sub>, 5% HNO<sub>3</sub> / 10% H<sub>2</sub>O<sub>2</sub>, Acidified KMnO<sub>4</sub>, and 8N HCL solutions, were collected. The samples were carried by Enthalpy personnel to First Analytical lab in Durham, NC.

#### **4.b Recovery and Analytical Procedures**

The samples were sent to First Analytical in Durham, North Carolina.

#### **4.c Sampling Ports**

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figures 2 and 3.

#### **4.d Traverse Points**

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figures 2 and 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: August 30-31, 2018**

<b>Emission Unit</b>	<b>Pollutant</b>	<b>Permit Limit</b>	<b>Test Result</b>
EAF+LMF Baghouse Stacks	Hg	0.033 lb/hr	0.003 lb/hr

### 5.b Discussion of Results

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

### 5.c Sampling Procedure Variations

There were no variations.

### 5.d Process or Control Device Upsets

There were no process upsets during this test.

### 5.e Control Device Maintenance

There was no non-routine maintenance done on the system.

### 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.

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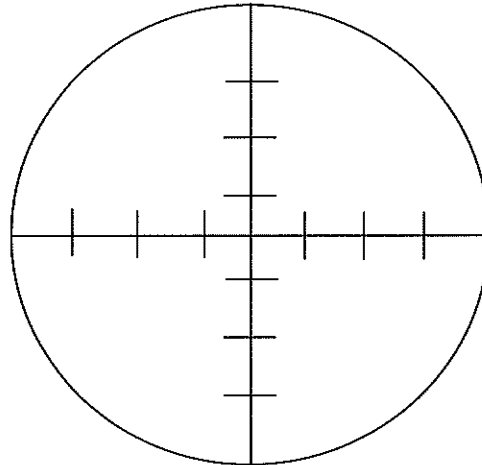
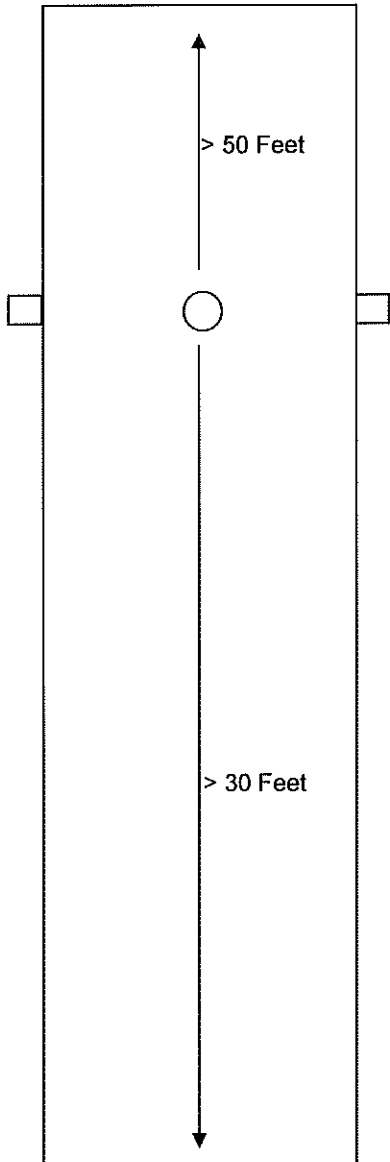
**Table 4**  
**Mercury Emission Rates**

Company Source Designation Test Date	Gerdau EAF			Average
	8/30/2018	8/30/2018	8/31/2018	
<b>Meter/Nozzle Information</b>				
	P-1	P-2	P-3	
Meter Temperature Tm (F)	81.7	101.3	92.2	91.7
Meter Pressure - Pm (in. Hg)	29.6	29.6	29.6	29.6
Measured Sample Volume (Vm)	207.1	213.4	212.1	210.9
Sample Volume (Vm-Std ft3)	198.3	197.3	199.6	198.4
Sample Volume (Vm-Std m3)	5.62	5.59	5.65	5.62
Condensate Volume (Vw-std)	7.959	8.746	8.256	8.320
Gas Density (Ps(std) lbs/ft3) (wet)	0.0737	0.0735	0.0736	0.0736
Gas Density (Ps(std) lbs/ft3) (dry)	0.0747	0.0747	0.0747	0.0747
Total weight of sampled gas (m g lbs) (wet)	15.19	15.15	15.30	15.22
Total weight of sampled gas (m g lbs) (dry)	14.82	14.75	14.92	14.83
Nozzle Size - An (sq. ft.)	0.000241	0.000241	0.000241	0.000241
Isokinetic Variation - I	100.8	101.2	101.3	101.1
<b>Stack Data</b>				
Average Stack Temperature - Ts (F)	181.8	189.9	185.2	185.6
Molecular Weight Stack Gas- dry (Md)	28.9	28.9	28.9	28.9
Molecular Weight Stack Gas-wet (Ms)	28.5	28.5	28.5	28.5
Stack Gas Specific Gravity (Gs)	0.984	0.983	0.984	0.983
Percent Moisture (Bws)	3.86	4.24	3.97	4.03
Water Vapor Volume (fraction)	0.0386	0.0424	0.0397	0.0403
Pressure - Ps ("Hg)	29.4	29.4	29.4	29.4
Average Stack Velocity - Vs (ft/sec)	58.5	58.9	58.9	58.8
Area of Stack (ft2)	100.8	100.8	100.8	100.8
<b>Exhaust Gas Flowrate</b>				
Flowrate ft <sup>3</sup> (Actual)	353,811	356,409	356,102	355,440
Flowrate ft <sup>3</sup> (Standard Wet)	285,983	284,500	286,640	285,707
Flowrate ft <sup>3</sup> (Standard Dry)	274,949	272,423	275,253	274,208
Flowrate m <sup>3</sup> (standard dry)	7,786	7,714	7,794	7,765
<b>Total Hg Weights (ug)</b>				
Frac 1B	< 0.1	< 0.1	0.8	< 0.3
Frac 2B	10.7	17.5	6.6	11.6
Frac 3A	< 0.1	0.1	< 0.1	< 0.1
Frac 3B	< 0.2	< 0.2	< 0.2	< 0.2
Frac 3C	6.1	6.1	6.1	6.1
Total Mercury	< 17.2	< 24.0	< 13.8	< 18.3
<b>Hg Concentrations</b>				
lb/1000 lb (wet)	< 0.0000025	< 0.0000035	< 0.0000020	< 0.0000027
lb/1000 lb (dry)	< 0.0000026	< 0.0000036	< 0.0000020	< 0.0000027
mg/dscm (dry)	< 0.0031	< 0.0043	< 0.0024	< 0.0033
gr/dscf	< 0.000001	< 0.000002	< 0.000001	< 0.000001
<b>Hg Emission Rate</b>				
lb/ hr	< 0.0032	< 0.0044	< 0.0025	< 0.0034

**Table 5  
Mercury Emission Rates**

Company Source Designation Test Date	Gerdau LMF			Average
	8/30/2018	8/30/2018	8/31/2018	
<b>Meter/Nozzle Information</b>				
	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	82.0	89.3	89.3	86.9
Meter Pressure - Pm (in. Hg)	29.6	29.6	29.6	29.6
Measured Sample Volume (Vm)	213.2	213.5	207.7	211.5
Sample Volume (Vm-Std ft3)	206.1	203.6	198.3	202.7
Sample Volume (Vm-Std m3)	5.84	5.77	5.61	5.74
Condensate Volume (Vw-std)	4.159	4.107	4.588	4.284
Gas Density (Ps(std) lbs/ft3) (wet)	0.0740	0.0740	0.0739	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)	15.55	15.37	14.99	15.30
Total weight of sampled gas (m g lbs) (dry)	15.36	15.18	14.78	15.11
Nozzle Size - An (sq. ft.)	0.000167	0.000167	0.000167	0.000167
Isokinetic Variation - I	100.3	100.1	100.1	100.2
<b>Stack Data</b>				
Average Stack Temperature - Ts (F)	131.1	136.2	134.7	134.0
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	0.988	0.987	0.988
Percent Moisture (Bws)	1.98	1.98	2.26	2.07
Water Vapor Volume (fraction)	0.0198	0.0198	0.0226	0.0207
Pressure - Ps ("Hg)	29.3	29.3	29.4	29.4
Average Stack Velocity -Vs (ft/sec)	79.6	79.4	77.3	78.8
Area of Stack (ft2)	66.0	66.0	66.0	66.0
<b>Exhaust Gas Flowrate</b>				
Flowrate ft <sup>3</sup> (Actual)	314,881	314,384	306,089	311,785
Flowrate ft <sup>3</sup> (Standard Wet)	275,848	273,058	266,796	271,901
Flowrate ft <sup>3</sup> (Standard Dry)	270,392	267,660	260,763	266,272
Flowrate m <sup>3</sup> (standard dry)	7,657	7,579	7,384	7,540
<b>Total Hg Weights (ug)</b>				
Frac 1B	< 0.1	< 0.1	< 0.1	< 0.1
Frac 2B	< 0.4	< 0.3	< 0.4	< 0.4
Frac 3A	< 0.1	< 0.1	< 0.1	< 0.1
Frac 3B	< 0.2	< 0.2	< 0.2	< 0.2
Frac 3C	< 0.3	0.4	< 0.3	< 0.3
Total Mercury	< 1.1	< 1.1	< 1.1	< 1.1
<b>Hg Concentrations</b>				
lb/1000 lb (wet)	< 0.0000002	< 0.0000002	< 0.0000002	< 0.0000002
lb/1000 lb (dry)	< 0.0000002	< 0.0000002	< 0.0000002	< 0.0000002
mg/dscm (dry)	< 0.0002	< 0.0002	< 0.0002	< 0.0002
gr/dscf	< 0.0000001	< 0.0000001	< 0.0000001	< 0.0000001
<b>Hg Emission Rate</b>				
lb/ hr	< 0.0002	< 0.0002	< 0.0002	< 0.0002

diameter = 136



Not to Scale

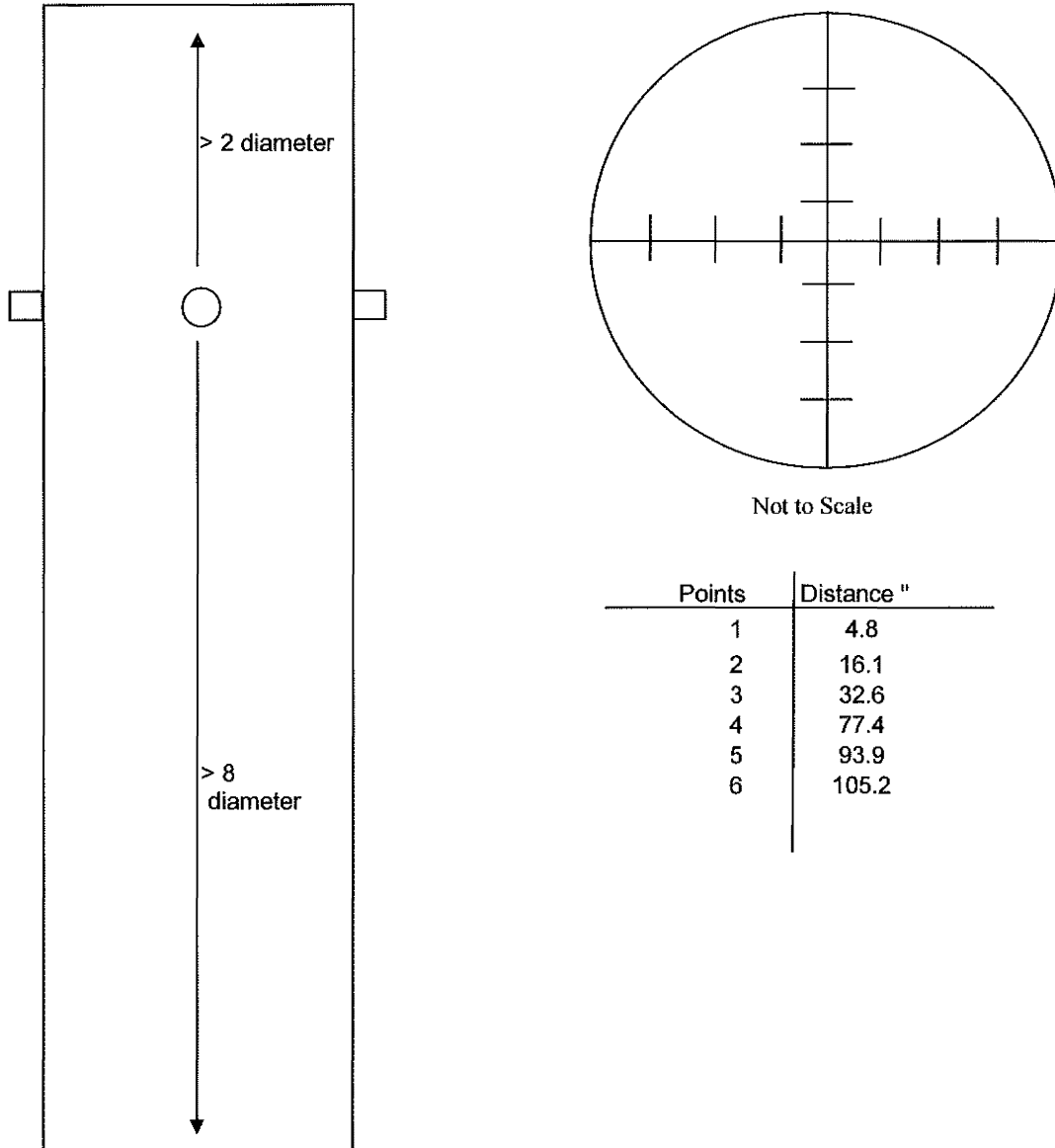
Points	Distance "
1	6.0
2	19.9
3	40.3
4	95.7
5	116.1
6	130.0

**Figure 2**

**Site:**  
**Gerdau Special Steel**  
**Monroe, Michigan**  
**EAF Stack**

**Sampling Dates:**  
**August 30-31, 2018**

**BT Environmental Consulting,**  
**Inc.**  
**4949 Fernlee**  
**Royal Oak, Michigan**



Points	Distance "
1	4.8
2	16.1
3	32.6
4	77.4
5	93.9
6	105.2

**Figure 3**

**Site:**  
**Gerdau Special Steel**  
**Monroe, Michigan**  
**LMF Stack**

**Sampling Dates:**  
**August 30-31, 2018**

**BT Environmental Consulting,**  
**Inc.**  
**4949 Fernlee**  
**Royal Oak, Michigan**