



# Electric Induction Furnace Emissions Test Report

*Prepared for:*

**Blue Diamond Steel Casting LLC**

Pigeon, Michigan

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**AIR QUALITY DIV.**

Blue Diamond Steel Casting LLC  
125 Sturm Road  
Pigeon, Michigan 48755

Project No. 16-4975.00  
April 28, 2017

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

**EXECUTIVE SUMMARY**

**AIR QUALITY DIV.**

BT Environmental Consulting, Inc. (BTEC) was retained by Blue Diamond Steel Casting, LLC (Blue Diamond) to evaluate fugitive emissions, and particulate matter (PM) emission rates from one electric induction steel induction furnace and one electric arc ladle reheat station of a no bake furnace line in Pigeon, Michigan. This steel foundry is affected by the National Emission Standards for Hazardous Air Pollutants for Iron and Steel Foundries Area Sources codified at Title 40, Part 63, Subpart ZZZZZ of the Code of Federal Regulations (40 CFR 63, Subpart ZZZZZ) and PTI 129-08D. The emissions test program was conducted on February 28, 2017.

Testing of electric induction steel induction furnace and electric arc ladle consisted of triplicate approximate 2-hour test runs while operating under normal conditions. The results of the emission test program are summarized by Table I.

**Table I**  
**Overall Emission Summary**  
**Test Date: February 28<sup>th</sup>, 2017**

<b>EU-NBFURNACE</b>		
<b>Pollutant</b>	<b>Average Emission Rate</b>	<b>Emission Limit</b>
Fugitive Emissions	0%	Shall not exceed a six-minute average of 5%
Particulate (PM <sub>10</sub> )	0.99 lb/hr	2.14 lb/hr
Particulate (Total PM)	0.001 grains/dscf	0.005 grains/dscf
	0.24 lbs per ton of metal charged	0.1 lbs per ton of metal charged



## 1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Blue Diamond Steel Casting, LLC (Blue Diamond) to evaluate particulate matter (PM) emission rates from one electric induction steel induction furnace and one electric arc ladle reheat station of a no bake furnace line in Pigeon, Michigan. This steel foundry is affected by the National Emission Standards for Hazardous Air Pollutants for Iron and Steel Foundries Area Sources codified at Title 40, Part 63, Subpart ZZZZZ of the Code of Federal Regulations (40 CFR 63, Subpart ZZZZZ) and PTI 129-08D. The emissions test program was conducted on February 28, 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 February 28, 2017 at the Blue Diamond facility located in Pigeon, Michigan. The test program included evaluation of PM<sub>10</sub>, PM<sub>2.5</sub>, and total particulate matter emissions.

### 1.b Purpose of Testing

AQD issued Permit to Install No. 129-08D to Blue Diamond on March 16, 2016. This permit limits emissions from the electric induction steel induction furnace and electric arc ladle reheat station as summarized by Table 1.

**Table 1**  
**Particulate Matter, Fugitive Emission Limitations**  
**Blue Diamond Casting**  
**Pigeon, Michigan**

Facility	Permit No.	PM Emission Limit	PM <sub>10</sub> Emission Limit	Fugitive Emission Limit
Blue Diamond Casting	PTI No. 129-08D	0.005 grains/dscf	2.14 lb/hr	Shall not exceed a six-minute average of five percent opacity

Particulate matter emissions from the no bake furnace (EU-NBFURNACE) is also limited to 0.1 pounds per ton of metal charged by 40 CFR 63.10895(c)(1).

**1.c Source Description**

The no bake furnace line consists of one electric induction furnace- 8 ton capacity melt (*permitted for two*): one electric arc ladle reheat station, and a vacuum degassing unit for an expected melting capacity of 200 tons per day. The furnaces are controlled by a 50,000 cfm baghouse (BH-01) & by a 80000 cfm baghouse (BH-22) with the exhaust re-circulated back into the furnace area.

**1.d Test Program Contacts**

The contact for the source and test report is:

Mr. Mike Peterson  
 Environmental Engineer  
 Blue Diamond Steel Casting, LLC  
 125 Sturm Road  
 Pigeon, Michigan 48755  
 (989) 453-3933, ext. 218

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. Mike Peterson Environmental Engineer	Blue Diamond Steel Casting, LLC 125 Sturm Road Pigeon, Michigan 48755	(989)453-3933 Ext. 218
Mr. Randal Tysar Senior Environmental Engineer	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Matthew Young Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Paul Diven 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. Mike Nummer Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070

Mr. Shane Rabideau Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. David Patterson	MDEQ Air Quality Division	(517) 284-6782
Ms. Sydney Bruestle	MDEQ Air Quality Division	(989) 894-6216

## 2. Summary of Results

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

### 2.a Operating Data

Operating data is included as Appendix E.

### 2.b Applicable Permit

Particulate matter emissions from the no bake furnace (EU-NBFURNACE) are limited to 0.1 pounds per ton of metal charged by 40 CFR 63.10895(c)(1). In addition, particulate matter emissions are limited to 0.005 grains per dry standard cubic foot of exhaust gas by Permit No. 129-08D. Permit No. 129-08D also limits emissions of particulate matter less than 10 microns in diameter (PM<sub>10</sub>) to 2.14 pounds per hour. However, testing of PM<sub>10</sub> emission rates is required by neither 40 CFR 63, Subpart ZZZZZ nor Permit No. 129-08D.

In addition to the particulate matter emission limitations included in 40 CFR 63, Subpart ZZZZZ and Permit No. 129-08D:

- (1) Permit No. 129-08D limits visible emissions from EU-NBFURNACE to not more than a six-minute average of five percent opacity, and
- (2) Pursuant to 40 CFR 63.10895(e), fugitive emissions from foundry operations must not exhibit opacity greater than 20 percent (6-minute average), except for one 6-minute average per hour that does not exceed 30 percent.

Verification of visible emissions from EU-NBFURNACE is not required by Permit No. 129-08D. However, verification of the opacity of fugitive emissions from foundry operations is required by 40 CFR 63.10898(h).

Testing for particulate matter less than 2.5 microns in diameter (PM<sub>2.5</sub>) is not required, and there is no permitted emission limit for PM<sub>2.5</sub>. Blue Diamond's draft renewable operating permit will have a PM<sub>2.5</sub> limit. The PM<sub>2.5</sub> results of this testing will be used for internal engineering purposes.

## **2.c Results**

See section 5a.

## **3. Source Description**

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

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

The electric induction furnace is operated as a batch operation with a minimum cycle time of approximately two hours. Scrap steel is charged to the furnace and melted and then alloy metals are added along with anti-slag compound. When complete, the steel is sampled and analyzed and, if acceptable, the steel is tipped into ladles and the ladles used to pour the molten steel into molds. The melted steel is transferred to the electric arc ladle reheat station and then to the degassing station.

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

Due to the simplicity of the furnaces, a process flow diagram is not necessary.

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

Scrap steel, alloy metals, and anti-slag compound are added to the no bake furnace line. The total quantity added is a maximum of 10 tons per melt.

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

The furnaces have a total permitted capacity of 200 tons per day. The baghouses are rated at 50,000 cfm. and 80,000 cfm.

### **3.e Process Instrumentation**

Process data monitored during the test is available in Appendix E.

## **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**

Sampling and analysis procedures followed the methodologies specified by the following methods codified at 40 CFR 60, Appendix A:

- Method 1 - *“Sample and Velocity Traverses for Stationary Sources”* will be

used to determine the velocity traverse points

- Method 2 - *“Determination of Stack Gas Velocity and Volumetric Flowrate”* will be used to determine exhaust gas velocity
- Method 3 - *“Gas Analysis for the Determination of Dry Molecular Weight”(Fyrite Procedure)* will be used to determine exhaust gas molecular weight
- Method 4 - *“Determination of Moisture Content in Stack Gases”* will be used to determine exhaust gas moisture content
- Method 201A- *“Determination of Particulate Matter (PM<sub>2.5</sub> and PM<sub>10</sub>) Emissions from Stationary Sources”* will be used to determine particulate matter concentrations and emission rates.
- Method 202- *“Determination of Condensable Particulate Matter Emissions from Stationary Sources”* will be used to determine condensable particulate matter concentrations and emission rates.
- Method 22 - *“Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares”* will be used to determine the opacity of fugitive emissions from foundry operations.

BTEC’s Nutech<sup>®</sup> Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2a) a stainless-steel PM<sub>10</sub> head, (2b) a stainless-steel PM<sub>2.5</sub> head, (3) an in stack stainless-steel filter housing, (4) a borosilicate glass probe liner, (5) a vertical condenser, (6) an empty pot bellied impinger, (7) an empty modified Greenburg-Smith (GS) impinger, (8) unheated borosilicate filter holder with a teflon filter and Teflon filter support, (9) 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, (10) a length of sample line, and (11) a Nutech<sup>®</sup> control case equipped with a pump, dry gas meter, and calibrated orifice.

A sampling train leak test is conducted before and after each test run. After completion of the final leak test for each test run, the filter is recovered, the nozzle, probe, PM<sub>10</sub> and PM<sub>2.5</sub> heads and front half of the filter housing are brushed and triple rinsed with acetone. The acetone rinses are collected in a pre-cleaned sample container. The impinger train is then purged with nitrogen for one hour at a flow rate of 14 liters per minute. The CPM filter is 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 are triple rinsed with deionized water which is collected in a pre-cleaned sample container. The same glassware is then rinsed with acetone which was collected in a pre-cleaned sample container labeled as the organic fraction. The glassware is then double rinsed with hexane which is added to the same organic fraction sample bottle.



BTEC labels 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 are collected.

**4.b Recovery and Analytical Procedures**

See section 4.a.

**4.c Sampling Ports**

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

**4.d Traverse Points**

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figures 2-3.

**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 through 9.

**Table 3  
Overall Emission Summary  
Test Date: February 28<sup>th</sup>, 2017**

<b>EU-NBFURNACE</b>		
<b>Pollutant</b>	<b>Average Emission Rate</b>	<b>Emission Limit</b>
Fugitive Emissions	0%	Shall not exceed a six-minute average of 5%
Particulate (PM <sub>10</sub> )	0.99 lb/hr	2.14 lb/hr
Particulate (Total PM)	0.001 grains/dscf	0.005 grains/dscf
	0.24 lbs per ton of metal charged	0.1 lbs per ton of metal charged

### **5.b Discussion of Results**

PM<sub>10</sub> emissions are less than the corresponding limit of 2.14 lb/hr. The total PM concentration is less than the corresponding limit of 0.005 gr/dscf. The total PM emission rate in lb PM per ton of metal charged is greater than the corresponding limit of 0.1 lbs per ton of metal charged.

Filterable PM results for Run 1 are significantly higher than Runs 2 and 3 for both sources. Blue Diamond speculates this may be due to particulate matter being knocked loose from the stack walls prior to the emissions test program, or possibly from excess lime dust from the baghouse filter.

### **5.c Sampling Procedure Variations**

The minimum required sample volume of 60 dscf per test run was not obtained. This is due to the sampling rate limitations of Method 201A, and the length of time the process takes to complete. This was discussed with Mike Peterson of Blue Diamond and David Patterson of the MDEQ and approval was given to obtain less than 60 dscf per test run.

The average stack temperature of both sources is less than 85 °F for each run, therefore the use of Method 202 is not required to obtain total PM emission rates. Consequently, Method 202 was performed but has not been included in the emissions tables. Method 202 laboratory results are available in Appendix D.

### **5.d Process or Control Device Upsets**

No upset conditions occurred during testing.

### **5.e Control Device Maintenance**

There was no control equipment maintenance performed during the emissions test program.

### **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  
EU-NBFURNACE Inside Total PM Emissions Summary

Company Source Designation Test Date	Blue Diamond No Bake Inside			Average
	2/28/2017	2/28/2017	2/28/2017	
<b>Meter/Nozzle Information</b>				
	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	62.9	68.3	72.4	67.9
Meter Pressure - Pm (in. Hg)	29.4	29.3	29.2	29.3
Measured Sample Volume (Vm)	48.7	47.9	48.6	48.4
Sample Volume (Vm-Std ft3)	48.8	47.3	47.4	47.8
Sample Volume (Vm-Std m3)	1.38	1.34	1.34	1.35
Condensate Volume (Vw-std)	0.533	0.519	0.556	0.536
Gas Density (Ps(std) lbs/ft3) (wet)	0.0742	0.0742	0.0742	0.0742
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.66	3.55	3.56	3.59
Total weight of sampled gas (m g lbs) (dry)	3.64	3.53	3.53	3.57
Nozzle Size - An (sq. ft.)	0.000210	0.000210	0.000210	0.000210
Isokinetic Variation - I	94.4	94.2	92.5	93.7
<b>Stack Data</b>				
Average Stack Temperature - Ts (F)	76.7	78.7	78.1	77.8
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)	0.992	0.992	0.991	0.992
Percent Moisture (Bws)	1.08	1.08	1.16	1.11
Water Vapor Volume (fraction)	0.0108	0.0108	0.0116	0.0111
Pressure - Ps ("Hg)	29.4	29.3	29.1	29.3
Average Stack Velocity -Vs (ft/sec)	34.7	34.5	35.0	34.7
Area of Stack (ft2)	27.1	27.1	27.1	27.1
<b>Production Data</b>				
Metal Charged (Tons)	8.00	8.00	8.00	8.00
Length of Test (Minutes)	94.0	76.5	61.0	77.2
Metal Charged (Tons/hr)	5.11	6.27	7.87	6.42
<b>Exhaust Gas Flowrate</b>				
Flowrate ft <sup>3</sup> (Actual)	56,492	56,029	56,905	56,475
Flowrate ft <sup>3</sup> (Standard Wet)	54,596	53,727	54,384	54,236
Flowrate ft <sup>3</sup> (Standard Dry)	54,007	53,144	53,753	53,635
Flowrate m <sup>3</sup> (standard dry)	1,529	1,505	1,522	1,519
<b>Total Particulate Weights (mg)</b>				
Total Nozzle/Probe/Filter	10.6	1.3	4.9	5.6
<b>Total Particulate Concentration</b>				
lb/1000 lb (wet)	0.006	0.001	0.003	0.003
lb/1000 lb (dry)	0.006	0.001	0.003	0.003
mg/dscm (dry)	7.7	1.0	3.7	4.1
gr/dscf	0.0034	0.0004	0.0016	0.0018
<b>Total Particulate Emission Rate</b>				
lb/ hr	1.56	0.19	0.74	0.83
lb/ton metal charged	0.3	0.0	0.1	0.1
<b>Total Outside Particulate Emission Rate</b>				
lb/ hr	1.21	0.35	0.00	0.52
lb/ton metal charged	0.2	0.1	0.0	0.1
<b>Total Combined Particulate Emission Rate</b>				
lb/ hr	2.77	0.54	0.74	1.35
mg/dscm (dry)	6.93	1.36	1.85	3.38
gr/dscf	0.003	0.001	0.001	0.001
lb/ton metal charged	0.54	0.09	0.09	0.24

**Table 5**  
**EU-NBFURNACE Inside PM<sub>10</sub> Emissions Summary**

Company Source Designation Test Date	Blue Diamond No Bake Inside			Average
	2/28/2017	2/28/2017	2/28/2017	
<b>Meter/Nozzle Information</b>				
	P-1	P-2	P-3	Average
Meter Temperature T <sub>m</sub> (F)	62.9	68.3	72.4	67.9
Meter Pressure - P <sub>m</sub> (in. Hg)	29.4	29.3	29.2	29.3
Measured Sample Volume (V <sub>m</sub> )	48.7	47.9	48.6	48.4
Sample Volume (V <sub>m</sub> -Std ft <sup>3</sup> )	48.8	47.3	47.4	47.8
Sample Volume (V <sub>m</sub> -Std m <sup>3</sup> )	1.38	1.34	1.34	1.35
Condensate Volume (V <sub>w</sub> -std)	0.533	0.519	0.556	0.536
Gas Density (P <sub>s</sub> (std) lbs/ft <sup>3</sup> ) (wet)	0.0742	0.0742	0.0742	0.0742
Gas Density (P <sub>s</sub> (std) lbs/ft <sup>3</sup> ) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.66	3.55	3.56	3.59
Total weight of sampled gas (m g lbs) (dry)	3.64	3.53	3.53	3.57
Nozzle Size - A <sub>n</sub> (sq. ft.)	0.000210	0.000210	0.000210	0.000210
Isokinetic Variation - I	94.4	94.2	92.5	93.7
<b>Stack Data</b>				
Average Stack Temperature - T <sub>s</sub> (F)	76.7	78.7	78.1	77.8
Molecular Weight Stack Gas- dry (M <sub>d</sub> )	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (M <sub>s</sub> )	28.7	28.7	28.7	28.7
Stack Gas Specific Gravity (G <sub>s</sub> )	0.992	0.992	0.991	0.992
Percent Moisture (B <sub>w</sub> s)	1.08	1.08	1.16	1.11
Water Vapor Volume (fraction)	0.0108	0.0108	0.0116	0.0111
Pressure - P <sub>s</sub> ("Hg)	29.4	29.3	29.1	29.3
Average Stack Velocity - V <sub>s</sub> (ft/sec)	34.7	34.5	35.0	34.7
Area of Stack (ft <sup>2</sup> )	27.1	27.1	27.1	27.1
<b>Production Data</b>				
Metal Charged (Tons)	8.00	8.00	8.00	8.00
Length of Test (Minutes)	94.0	76.5	61.0	77.2
Metal Charged (Tons/hr)	5.11	6.27	7.87	6.42
<b>Exhaust Gas Flowrate</b>				
Flowrate ft <sup>3</sup> (Actual)	56,492	56,029	56,905	56,475
Flowrate ft <sup>3</sup> (Standard Wet)	54,596	53,727	54,384	54,236
Flowrate ft <sup>3</sup> (Standard Dry)	54,007	53,144	53,753	53,635
Flowrate m <sup>3</sup> (standard dry)	1,529	1,505	1,522	1,519
<b>Total PM<sub>10</sub> Weights (mg)</b>				
Total Nozzle/Probe/Filter	9.2	0.1	2.9	4.1
<b>Total PM<sub>10</sub> Concentration</b>				
lb/1000 lb (wet)	0.006	0.000	0.002	0.002
lb/1000 lb (dry)	0.006	0.000	0.002	0.002
mg/dscm (dry)	6.7	0.1	2.2	3.0
gr/dscf	0.0029	0.0000	0.0009	0.0013
<b>Total PM<sub>10</sub> Emission Rate</b>				
lb/ hr	1.35	0.01	0.44	0.60
lb/ton metal charged	0.3	0.0	0.1	0.1
<b>Total Outside PM<sub>10</sub> Emission Rate</b>				
lb/ hr	0.81	0.35	0.00	0.38
lb/ton metal charged	0.2	0.1	0.0	0.1
<b>Total Combined PM<sub>10</sub> Emission Rate</b>				
lb/ hr	2.16	0.36	0.44	0.99
lb/ton metal charged	0.42	0.06	0.06	0.18

**Table 6**  
**EU-NBFURNACE Inside PM<sub>2.5</sub> Emissions Summary**

Company Source Designation Test Date	Blue Diamond No Bake Inside			Average
	2/28/2017	2/28/2017	2/28/2017	
<b>Meter/Nozzle Information</b>				
	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	62.9	68.3	72.4	67.9
Meter Pressure - Pm (in. Hg)	29.4	29.3	29.2	29.3
Measured Sample Volume (Vm)	48.7	47.9	48.6	48.4
Sample Volume (Vm-Std ft3)	48.8	47.3	47.4	47.8
Sample Volume (Vm-Std m3)	1.38	1.34	1.34	1.35
Condensate Volume (Vw-std)	0.533	0.519	0.556	0.536
Gas Density (Ps(std) lbs/ft3) (wet)	0.0742	0.0742	0.0742	0.0742
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.66	3.55	3.56	3.59
Total weight of sampled gas (m g lbs) (dry)	3.64	3.53	3.53	3.57
Nozzle Size - An (sq. ft.)	0.000210	0.000210	0.000210	0.000210
Isokinetic Variation - I	94.4	94.2	92.5	93.7
<b>Stack Data</b>				
Average Stack Temperature - Ts (F)	76.7	78.7	78.1	77.8
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)	0.992	0.992	0.991	0.992
Percent Moisture (Bws)	1.08	1.08	1.16	1.11
Water Vapor Volume (fraction)	0.0108	0.0108	0.0116	0.0111
Pressure - Ps ("Hg)	29.4	29.3	29.1	29.3
Average Stack Velocity - Vs (ft/sec)	34.7	34.5	35.0	34.7
Area of Stack (ft2)	27.1	27.1	27.1	27.1
<b>Production Data</b>				
Metal Charged (Tons)	8.00	8.00	8.00	8.00
Length of Test (Minutes)	94.0	76.5	61.0	77.2
Metal Charged (Tons/hr)	5.11	6.27	7.87	6.42
<b>Exhaust Gas Flowrate</b>				
Flowrate ft <sup>3</sup> (Actual)	56,492	56,029	56,905	56,475
Flowrate ft <sup>3</sup> (Standard Wet)	54,596	53,727	54,384	54,236
Flowrate ft <sup>3</sup> (Standard Dry)	54,007	53,144	53,753	53,635
Flowrate m <sup>3</sup> (standard dry)	1,529	1,505	1,522	1,519
<b>Total PM<sub>2.5</sub> Weights (mg)</b>				
Total Nozzle/Probe/Filter	7.6	0.1	1.4	3.0
<b>Total PM<sub>2.5</sub> Concentration</b>				
lb/1000 lb (wet)	0.005	0.000	0.001	0.002
lb/1000 lb (dry)	0.005	0.000	0.001	0.002
mg/dscm (dry)	5.5	0.1	1.0	2.2
gr/dscf	0.0024	0.0000	0.0005	0.0010
<b>Total PM<sub>2.5</sub> Emission Rate</b>				
lb/ hr	1.12	0.01	0.21	0.45
lb/ton metal charged	0.2	0.0	0.0	0.1
<b>Total Outside PM<sub>2.5</sub> Emission Rate</b>				
lb/ hr	0.40	0.21	0.00	0.20
lb/ton metal charged	0.1	0.0	0.0	0.0
<b>Total Combined PM<sub>2.5</sub> Emission Rate</b>				
lb/ hr	1.52	0.23	0.21	0.65
lb/ton metal charged	0.30	0.04	0.03	0.12

**Table 7**  
**EU-NBFURNACE Outside Total PM Emissions Summary**

Company Source Designation Test Date	Blue Diamond No Bake Outside			Average
	2/28/2017	2/28/2017	2/28/2017	
<b>Meter/Nozzle Information</b>				
	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	58.0	70.8	71.8	66.8
Meter Pressure - Pm (in. Hg)	29.4	29.3	29.2	29.3
Measured Sample Volume (Vm)	46.3	47.2	47.4	47.0
Sample Volume (Vm-Std ft3)	46.5	46.1	46.0	46.2
Sample Volume (Vm-Std m3)	1.32	1.30	1.30	1.31
Condensate Volume (Vw-std)	0.467	0.429	0.396	0.431
Gas Density (Ps(std) lbs/ft3) (wet)	0.0743	0.0743	0.0743	0.0743
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.49	3.45	3.45	3.46
Total weight of sampled gas (m g lbs) (dry)	3.47	3.43	3.43	3.44
Nozzle Size - An (sq. ft.)	0.000124	0.000124	0.000124	0.000124
Isokinetic Variation - I	94.2	93.3	94.7	94.1
<b>Stack Data</b>				
Average Stack Temperature - Ts (F)	74.7	78.6	79.4	77.6
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)	0.992	0.992	0.993	0.992
Percent Moisture (Bws)	0.99	0.92	0.85	0.92
Water Vapor Volume (fraction)	0.0099	0.0092	0.0085	0.0092
Pressure - Ps ("Hg)	29.4	29.3	29.1	29.3
Average Stack Velocity -Vs (ft/sec)	58.3	58.7	58.5	58.5
Area of Stack (ft2)	15.6	15.6	15.6	15.6
<b>Production Data</b>				
Metal Charged (Tons)	8.00	8.00	8.00	8.00
Length of Test (Minutes)	94.0	76.5	61.0	77.2
Metal Charged (Tons/hr)	5.11	6.27	7.87	6.42
<b>Exhaust Gas Flowrate</b>				
Flowrate ft <sup>3</sup> (Actual)	54,558	54,990	54,785	54,777
Flowrate ft <sup>3</sup> (Standard Wet)	52,937	52,752	52,241	52,643
Flowrate ft <sup>3</sup> (Standard Dry)	52,411	52,265	51,795	52,157
Flowrate m <sup>3</sup> (standard dry)	1,484	1,480	1,467	1,477
<b>Total Particulate Weights (mg)</b>				
Total Nozzle/Probe/Filter	8.1	2.3	0.0	3.5
<b>Total Particulate Concentration</b>				
lb/1000 lb (wet)	0.005	0.001	0.000	0.002
lb/1000 lb (dry)	0.005	0.001	0.000	0.002
mg/dscm (dry)	6.1	1.8	0.0	2.6
gr/dscf	0.0027	0.0008	0.0000	0.0012
<b>Total Particulate Emission Rate</b>				
lb/ hr	1.21	0.35	0.00	0.52
lb/ton metal charged	0.2	0.1	0.0	0.1

**Table 8**  
**EU-NBFURNACE Outside PM<sub>10</sub> Emissions Summary**

Company Source Designation Test Date	Blue Diamond No Bake Outside			Average
	2/28/2017	2/28/2017	2/28/2017	
<b>Meter/Nozzle Information</b>				
	P-1	P-2	P-3	
Meter Temperature Tm (F)	58.0	70.8	71.8	66.8
Meter Pressure - Pm (in. Hg)	29.4	29.3	29.2	29.3
Measured Sample Volume (Vm)	46.3	47.2	47.4	47.0
Sample Volume (Vm-Std ft3)	46.5	46.1	46.0	46.2
Sample Volume (Vm-Std m3)	1.32	1.30	1.30	1.31
Condensate Volume (Vw-std)	0.467	0.429	0.396	0.431
Gas Density (Ps(std) lbs/ft3) (wet)	0.0743	0.0743	0.0743	0.0743
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.49	3.45	3.45	3.46
Total weight of sampled gas (m g lbs) (dry)	3.47	3.43	3.43	3.44
Nozzle Size - An (sq. ft.)	0.000124	0.000124	0.000124	0.000124
Isokinetic Variation - I	94.2	93.3	94.7	94.1
<b>Stack Data</b>				
Average Stack Temperature - Ts (F)	74.7	78.6	79.4	77.6
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)	0.992	0.992	0.993	0.992
Percent Moisture (Bws)	0.99	0.92	0.85	0.92
Water Vapor Volume (fraction)	0.0099	0.0092	0.0085	0.0092
Pressure - Ps ("Hg)	29.4	29.3	29.1	29.3
Average Stack Velocity - Vs (ft/sec)	58.3	58.7	58.5	58.5
Area of Stack (ft2)	15.6	15.6	15.6	15.6
<b>Production Data</b>				
Metal Charged (Tons)	8.00	8.00	8.00	8.00
Length of Test (Minutes)	94.0	76.5	61.0	77.2
Metal Charged (Tons/hr)	5.11	6.27	7.87	6.42
<b>Exhaust Gas Flowrate</b>				
Flowrate ft <sup>3</sup> (Actual)	54,558	54,990	54,785	54,777
Flowrate ft <sup>3</sup> (Standard Wet)	52,937	52,752	52,241	52,643
Flowrate ft <sup>3</sup> (Standard Dry)	52,411	52,265	51,795	52,157
Flowrate m <sup>3</sup> (standard dry)	1,484	1,480	1,467	1,477
<b>Total PM<sub>10</sub> Weights (mg)</b>				
Total Nozzle/Probe/Filter	5.4	2.3	0.0	2.6
<b>Total PM<sub>10</sub> Concentration</b>				
lb/1000 lb (wet)	0.003	0.001	0.000	0.002
lb/1000 lb (dry)	0.003	0.001	0.000	0.002
mg/dscm (dry)	4.1	1.8	0.0	2.0
gr/dscf	0.0018	0.0008	0.0000	0.0009
<b>Total PM<sub>10</sub> Emission Rate</b>				
lb/ hr	0.81	0.35	0.00	0.38
lb/ton metal charged	0.2	0.1	0.0	0.1

**Table 9**  
**EU-NBFURNACE Outside PM<sub>2.5</sub> Emissions Summary**

<b>Company</b>	<b>Blue Diamond</b>			
<b>Source Designation</b>	<b>No Bake Outside</b>			
<b>Test Date</b>	<b>2/28/2017</b>	<b>2/28/2017</b>	<b>2/28/2017</b>	
<b>Meter/Nozzle Information</b>				
	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	58.0	70.8	71.8	66.8
Meter Pressure - Pm (in. Hg)	29.4	29.3	29.2	29.3
Measured Sample Volume (Vm)	46.3	47.2	47.4	47.0
Sample Volume (Vm-Std ft3)	46.5	46.1	46.0	46.2
Sample Volume (Vm-Std m3)	1.32	1.30	1.30	1.31
Condensate Volume (Vw-std)	0.467	0.429	0.396	0.431
Gas Density (Ps(std) lbs/ft3) (wet)	0.0743	0.0743	0.0743	0.0743
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.49	3.45	3.45	3.46
Total weight of sampled gas (m g lbs) (dry)	3.47	3.43	3.43	3.44
Nozzle Size - An (sq. ft.)	0.000124	0.000124	0.000124	0.000124
Isokinetic Variation - I	94.2	93.3	94.7	94.1
<b>Stack Data</b>				
Average Stack Temperature - Ts (F)	74.7	78.6	79.4	77.6
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)	0.992	0.992	0.993	0.992
Percent Moisture (Bws)	0.99	0.92	0.85	0.92
Water Vapor Volume (fraction)	0.0099	0.0092	0.0085	0.0092
Pressure - Ps ("Hg)	29.4	29.3	29.1	29.3
Average Stack Velocity -Vs (ft/sec)	58.3	58.7	58.5	58.5
Area of Stack (ft2)	15.6	15.6	15.6	15.6
<b>Production Data</b>				
Metal Charged (Tons)	8.00	8.00	8.00	8.00
Length of Test (Minutes)	94.0	76.5	61.0	77.2
Metal Charged (Tons/hr)	5.11	6.27	7.87	6.42
<b>Exhaust Gas Flowrate</b>				
Flowrate ft <sup>3</sup> (Actual)	54,558	54,990	54,785	54,777
Flowrate ft <sup>3</sup> (Standard Wet)	52,937	52,752	52,241	52,643
Flowrate ft <sup>3</sup> (Standard Dry)	52,411	52,265	51,795	52,157
Flowrate m <sup>3</sup> (standard dry)	1,484	1,480	1,467	1,477
<b>Total PM<sub>2.5</sub> Weights (mg)</b>				
Total Nozzle/Probe/Filter	2.7	1.4	0.0	1.4
<b>Total PM<sub>2.5</sub> Concentration</b>				
lb/1000 lb (wet)	0.002	0.001	0.000	0.001
lb/1000 lb (dry)	0.002	0.001	0.000	0.001
mg/dscm (dry)	2.0	1.1	0.0	1.0
gr/dscf	0.0009	0.0005	0.0000	0.0005
<b>Total PM<sub>2.5</sub> Emission Rate</b>				
lb/ hr	0.40	0.21	0.00	0.20
lb/ton metal charged	0.1	0.0	0.0	0.0

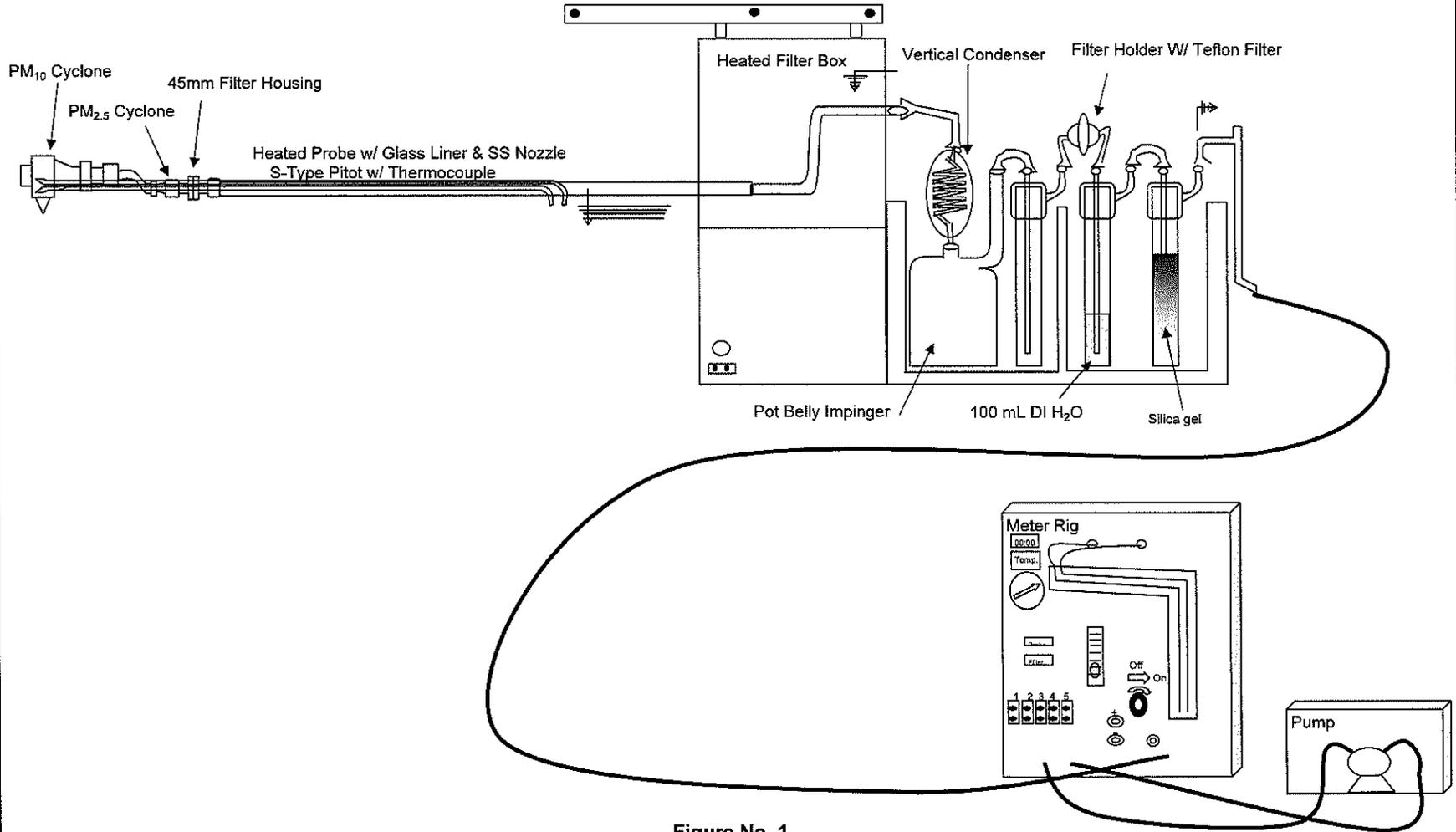


Figure No. 1

Site:  
USEPA Method 201A/202  
Blue Diamond Casting  
Pigeon, Michigan

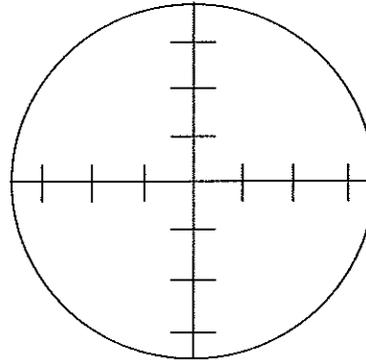
Sampling Date:  
February 28, 2017

BT Environmental Consulting, Inc.  
4949 Fernlee Avenue  
Royal Oak, Michigan 48073



diameter = 70.5 inches

Points	Distance "
1	3.1
2	10.3
3	20.9
4	49.6
5	60.2
6	67.4



Not to Scale

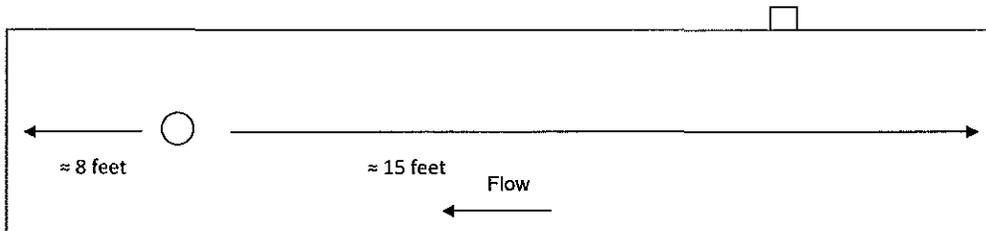


Figure No. 2

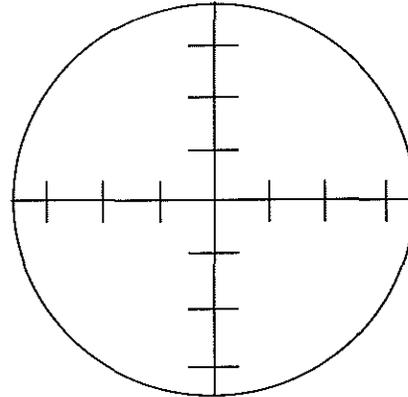
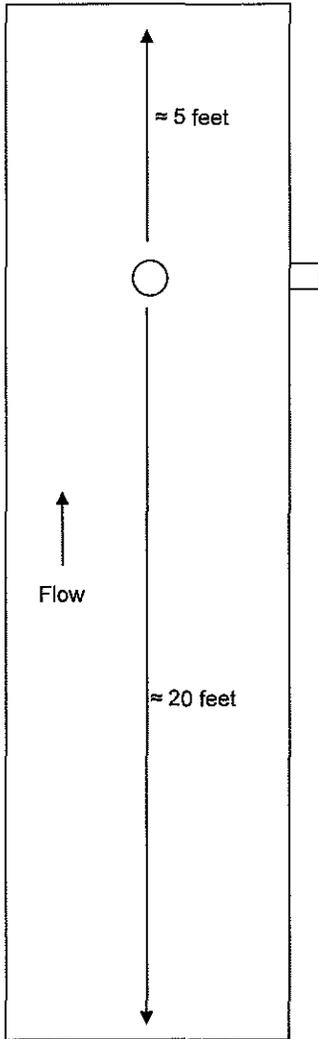
Site:  
No Bake Line-Inside  
Blue Steel Diamond  
Pigeon, Michigan

Sampling Date:  
February 28, 2017

BT Environmental Consulting, Inc.  
4949 Fernlee Avenue  
Royal Oak, Michigan 48073



diameter = 53.5 inches



Not to Scale

Points	Distance "
1	2.4
2	7.8
3	15.8
4	37.7
5	45.7
6	51.1

Figure No. 3

Site:  
No Bake Line-Outside  
Blue Diamond Steel  
Pigeon, Michigan

Sampling Date:  
February 28, 2017

BT Environmental Consulting, Inc.  
4949 Fernlee Avenue  
Royal Oak, Michigan 48073