BTEC Inc.

EU Shell Furnace PM, and CO Emissions Test Report

Prepared for:

Blue Diamond Casting LLC

125 Sturm Road
Pigeon, Michigan 48755

Project No. 16-4877.00
August 24, 2016

BT Environmental Consulting, Inc.
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EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Blue Diamond Casting, LLC (Blue Diamond) to evaluate fugitive emissions, filterable and condensable particulate matter (PM) and carbon monoxide (CO) concentrations and emissions from the EU Shell Furnace exhaust stack at the Blue Diamond facility located in Pigeon, Michigan. The emissions test program was conducted on July 6, 2016.

Testing of the source consisted of triplicate 72-minute test runs for each pollutant at the Furnace exhaust stack conducted simultaneously. The Air Quality Division (AQD) of Michigan's Department of Environmental Quality issued Permit to Install No. 129-08D to Blue Diamond Steel Casting, LLC (Blue Diamond) for a new steel foundry in Pigeon, Michigan. The results of the emission test program are summarized by Table I.

Table I
EU Shell Furnace Overall Emission Summary
Test Date: July 6th, 2016

EU Shell Furnace		
Pollutant	**Average Emission Rate**	**Emission Limit**
Particulate Matter (PM)	0.0009 grains/dscf	0.005 grains/dscf
	0.06 lb/ton of metal charged	0.1 lb/ton of metal charged
PM_{10}	0.35 lb/hr	2.14 lb/hr
Carbon Monoxide (CO)	1.7 lb/hr	N/A
Fugitive Emissions	0%	< 20% (6-minute average), except for one 6-minute average per hour that does not exceed 30 percent.

Permit 129-08D has no emission limit for CO. CO testing for informational testing only.

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Blue Diamond Casting, LLC (Blue Diamond) to evaluate fugitive emissions, filterable and condensable particulate matter (PM) and carbon monoxide (CO) concentrations and emissions from the EU Shell Furnace exhaust stack at the Blue Diamond facility located in Pigeon, Michigan. The emissions test program was conducted on July 6, 2016. The purpose of this report is to document the results of the test program.

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 July 6, 2016 at the Blue Diamond facility located in Pigeon, Michigan. The test program included evaluation of PM, CO, and fugitive CO emissions from EU Shell Furnace.

1.b Purpose of Testing

Particulate matter emissions from the shell furnaces (EU-SHELLFURNACE) 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_{10}) to 2.14 pounds per hour.

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-SHELLFURNACE 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-SHELLFURNACE 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).

Permit No. 129-08D has no emission limit for CO. CO testing is being performed for informational testing only.

This permit limits emissions from each turbine as summarized by Table 1.

Table 1
Emission Limitations
Blue Diamond Casting

Source	Pollutant	Emission Limit
EU Shell Furnace	PM	0.1 lbs/ton of metal charged
		0.005 grains/dscf
	PM_{10}	2.14 lb/hr

In addition, 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.

1.c Source Description

The shell furnace line consists of three 8-ton capacity electric induction furnaces for an expected melting capacity of 200 tons per day.

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

Mr. Barry P. Boulianne
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal, 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. Mike Peterson Environmental Engineer	Blue Diamond Steel Casting LLC 125 Sturm Road Pigeon, Michigan 48755	(989)-453-3933
Mr. Matthew Young Senior Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 744-9133
Mr. Paul Diven Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 756-0159
Mr. Shane Rabideau Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(810) 895-1431
Mr. Jake Zott Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(586) 453-3153
David Patterson	MDEQ Air Quality Division	(517) 284-6782

2. Summary of Results

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

2.a Operating Data

The shell furnace line consists of three 8-ton capacity electric induction furnaces for an expected melting capacity of 200 tons per day.

2.b Applicable Permit

The applicable permit for this emissions test program is Permit to Install No. 129-08D.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). The particulate matter emissions from the shell line were below the corresponding limits of 0.005 gr/dscf and 0.1 lb/ton of metal charged. All PM is assumed to be PM_{10}. PM_{10} emission rates are below the corresponding limit of 2.14 lb/hr. Permit 129-08D has no emission limit for CO. CO testing for informational testing only. CO emissions for the shell line are 1.7 lb/hr. The fugitive emissions were determined to be zero for the entire 60-minute observation.

3. Source Description

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

3.a Process Description

The shell furnace line consists of three 8-ton capacity electric induction furnaces for an expected melting capacity of 200 tons per day. The furnace is controlled by a 50,000 cfm baghouse (BH-06) with the exhaust re-circulated back in the plant.

3.b Process Flow Diagram

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

3.c Raw and Finished Materials

Scrap steel, alloy metals, and anti-slag compound are added the shell furnace line. The total quantity added is a maximum of eleven tons per melt.

3.d Process Capacity

The furnaces have a total melt capacity of eight tons each for a total expected melting capacity of 200 tons per day. Only two furnaces are in operation at a time. One is used for pouring, one is used for charging, and one is being relined.

3.e Process Instrumentation

Production data is included 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 analytical methodologies for the emissions test program can be separated into four categories as follows:

(1) Measurement of exhaust gas velocity, molecular weight, and moisture content;
(2) Measurement of exhaust gas filterable and condensable PM concentration using USEPA Methods 5/202
(3) Measurement of exhaust gas CO concentration using USEPA Method 10

(4) Measurement of fugitive emissions using USEPA Method 22

Sampling and analytical methodologies by category are summarized below.

Exhaust Gas Velocity, Molecular Weight, and Moisture Content

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. The S-type pitot tube dimensions outlined in Sections 2-6 through 2-8 were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned. A diagram of the sample points is provided in Figure 3.

Cyclonic flow checks were performed at each 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. The null angle was determined to be less than 20 degrees at each sampling point.

The Molecular Weight of the gas stream was evaluated according to procedures outlined in Title 40, Part 60, Appendix A, Method 3A. The O_2 /CO_2 content of the gas stream was measured using a Fyrite combustion analyzer.

Exhaust gas was extracted as part of the PM sampling train. Exhaust gas moisture content was then determined gravimetrically.

Filterable and Condensable PM (USEPA Method 5 /202)

40 CFR 60, Appendix A, Method 5, *"Determination of Particulate Emissions from Stationary"* and 40 CFR 60, Appendix A, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission rates (see Figure 1 for a schematic of the sampling train). Triplicate 72-minute test runs were conducted.

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) a glass probe, (3) a stainless-steel filter housing, (4) a Teflon connecting line to the impingers (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® 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, the nozzle, probe and front

half of the filter housing were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. 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 double 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. DI water and organic samples were hand delivered to Maxxam for analysis.

Carbon Monoxide (USEPA Method 10)

The CO content of the exhaust gas was evaluated according to procedures outlined in 40 CFR 60, Appendix A, Method 10. The CO content of the gas stream was measured using a TECO 48 CO gas analyzer (see Figure 2 for a schematic of the sampling train). The gas stream was drawn through a stainless-steel probe with a heated in-line filter to remove any particulate, a heated Teflon® sample line, through a refrigerated sample conditioner with a peristaltic pump to remove the moisture from the sample before it entered the analyzer. Data was recorded on a PC equipped with Labview® II data acquisition software. Recorded CO concentrations were averaged and reported for the duration of each test (as drift corrected per Method 7E). The analyzer was calibrated for a range of 0 to 100 ppm.

In accordance with Method 10, a 3-point (zero, mid, and high) calibration check was performed on the CO analyzer. Calibration drift checks were performed at the completion of each run.

4.b Recovery and Analytical Procedures

Descriptions of the recovery procedures are provided in section 4.a for each sampling method.

4.c Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as figure No. 3

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as figure No. 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 and 5.

Table 3
EU Shell Furnace Overall Emission Summary
Test Date: July 6th, 2016

EU Shell Furnace		
Pollutant	**Average Emission Rate**	**Emission Limit**
Particulate Matter (PM)	0.0009 grains/dscf	0.005 grains/dscf
	0.06 lb/ton of metal charged	0.1 lb/ton of metal charged
PM_{10}	0.35 lb/hr	2.14 lb/hr
Carbon Monoxide (CO)	1.7 lb/hr	N/A
Fugitive Emissions	0%	< 20% (6-minute average), except for one 6-minute average per hour that does not exceed 30 percent.

Permit 129-08D has no emission limit for CO. CO testing for informational testing only.

5.b Discussion of Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). The particulate matter emissions from the shell line were below the corresponding limits of 0.005 gr/dscf and 0.1 lb/ton of metal charged. All PM is assumed to be PM_{10}. PM_{10} emission rates are below the corresponding limit of 2.14 lb/hr. Permit 129-08D has no emission limit for CO. CO testing for informational testing only. CO emissions for the shell line are 1.7 lb/hr. The fugitive emissions were determined to be zero for the entire 60-minute observation.

5.c Sampling Procedure Variations

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

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 are provided in Appendix D. Raw CEM data is provided electronically in Appendix F.

Table 4
EU Shell Furnace CO Emissions
Blue Diamond Casting
Pigeon, Michigan
BTEC Project No. 16-4877.00
Sampling Dates: July 6, 2016

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	7/6/2016	7/6/2016	7/6/2016	
Test Run Time	8:30-9:53	10:41-12:10	12:57-14:14	
Outlet Flowrate (dscfm)	43,578	45,297	43992	**44,289**
Outlet Flowrate (scfm)	44,530	46,423	44,914	**45,289**
Outlet Carbon Monoxide Concentration (ppmv)	12.71	8.16	5.09	**8.65**
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)	12.70	8.06	4.98	**8.58**
CO Emission Rate (lb/hr)	**2.4**	**1.6**	**1.0**	**1.7**
CO Emission Rate (lb/hr) (corrected as per USEPA 7E)	**2.4**	**1.6**	**1.0**	**1.6**

scfm = standard cubic feet per minute

dscfm = dry standard cubic feet per minute

ppmv = parts per million on a volume-to-volume basis

lb/hr = pounds per hour

MW = molecular weight (CO = 28.01)

24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)

35.31 = ft^3 per m^3

453600 = mg per lb

Equations

lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * ***dcfm*** * 60

Table 5
EU Shell Furnace Particulate Matter Emission Rates

Company	Blue Diamond			
Source Designation	Shell Furnace			
Test Date	7/6/2016	7/6/2016	7/6/2016	
Meter/Nozzle Information	Run 1	Run 2	Run 3	Average
Meter Temperature Tm (F)	86.9	84.8	84.0	85.2
Meter Pressure - Pm (in. Hg)	29.5	29.6	29.5	29.5
Measured Sample Volume (Vm)	83.3	87.8	84.9	85.3
Sample Volume (Vm-Std ft3)	79.2	83.8	81.1	81.4
Sample Volume (Vm-Std m3)	2.24	2.37	2.30	2.31
Condensate Volume (Vw-std)	1.730	2.084	1.702	1.839
Gas Density (Ps(std) lbs/ft3) (wet)	0.0739	0.0739	0.0740	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)	5.98	6.35	6.13	6.15
Total weight of sampled gas (m g lbs) (dry)	5.90	6.25	6.05	6.07
Nozzle Size - An (sq. ft.)	0.000401	0.000404	0.000401	0.000402
Isokinetic Variation - I	98.3	99.4	99.8	99.2
Stack Data				
Average Stack Temperature - Ts (F)	106.7	104.2	103.8	104.9
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	0.987
Percent Moisture (Bws)	2.14	2.43	2.05	2.21
Water Vapor Volume (fraction)	0.0214	0.0243	0.0205	0.0221
Pressure - Ps ("Hg)	29.2	29.2	29.2	29.2
Average Stack Velocity -Vs (ft/scc)	52.3	54.3	52.5	53.1
Area of Stack (ft2)	15.6	15.6	15.6	15.6
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	48,989	50,845	49,164	49,666
Flowrate ft^3 (Standard Wet)	44,530	46,423	44,914	45,289
Flowrate ft^3 (Standard Dry)	43,578	45,297	43,992	44,289
Flowrate m^3 (standard dry)	1,234	1,283	1,246	1,254
Production Data				
Tons of metal charged per hour	6.17	5.58	6.45	6.07
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	0.0	5.1	0.7	1.9
Organic Condensible Particulate	1.7	1.1	0.6	1.1
Inorganic Condensible Particulate	3.3	3.8	4.4	3.8
Condensible Blank Correction	2.0	2.0	2.0	2.0
Total Condensible Particulate	3.0	2.9	3.0	3.0
Total Filterable and Condensible Particulate	3.0	8.0	3.7	4.9
Filterable Particulate Concentration				
lb/1000 lb (wet)	0.000	0.002	0.000	0.001
lb/1000 lb (dry)	0.000	0.002	0.000	0.001
mg/dscm (dry)	0.0	2.1	0.3	0.8
gr/dscf	0.0000	0.0009	0.0001	0.0004
Filterable Particulate Emission Rate				
lb/ hr	0.00	0.37	0.05	0.14
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)	1.3	1.2	1.3	1.3
gr/dscf	0.0006	0.0005	0.0006	0.0006
Condensible Particulate Emission Rate				
lb/ hr	0.22	0.21	0.22	0.21
Total Particulate Concentration				
lb/1000 lb (wet)	0.001	0.003	0.001	0.002
lb/1000 lb (dry)	0.001	0.003	0.001	0.002
mg/dscm (dry)	1.3	3.4	1.6	2.1
gr/dscf	0.0006	0.0015	0.0007	0.0009
Total Particulate Emission Rate				
lb/ hr	0.22	0.57	0.27	0.35
lb/ton of metal charged	0.04	0.10	0.04	0.06

Figures

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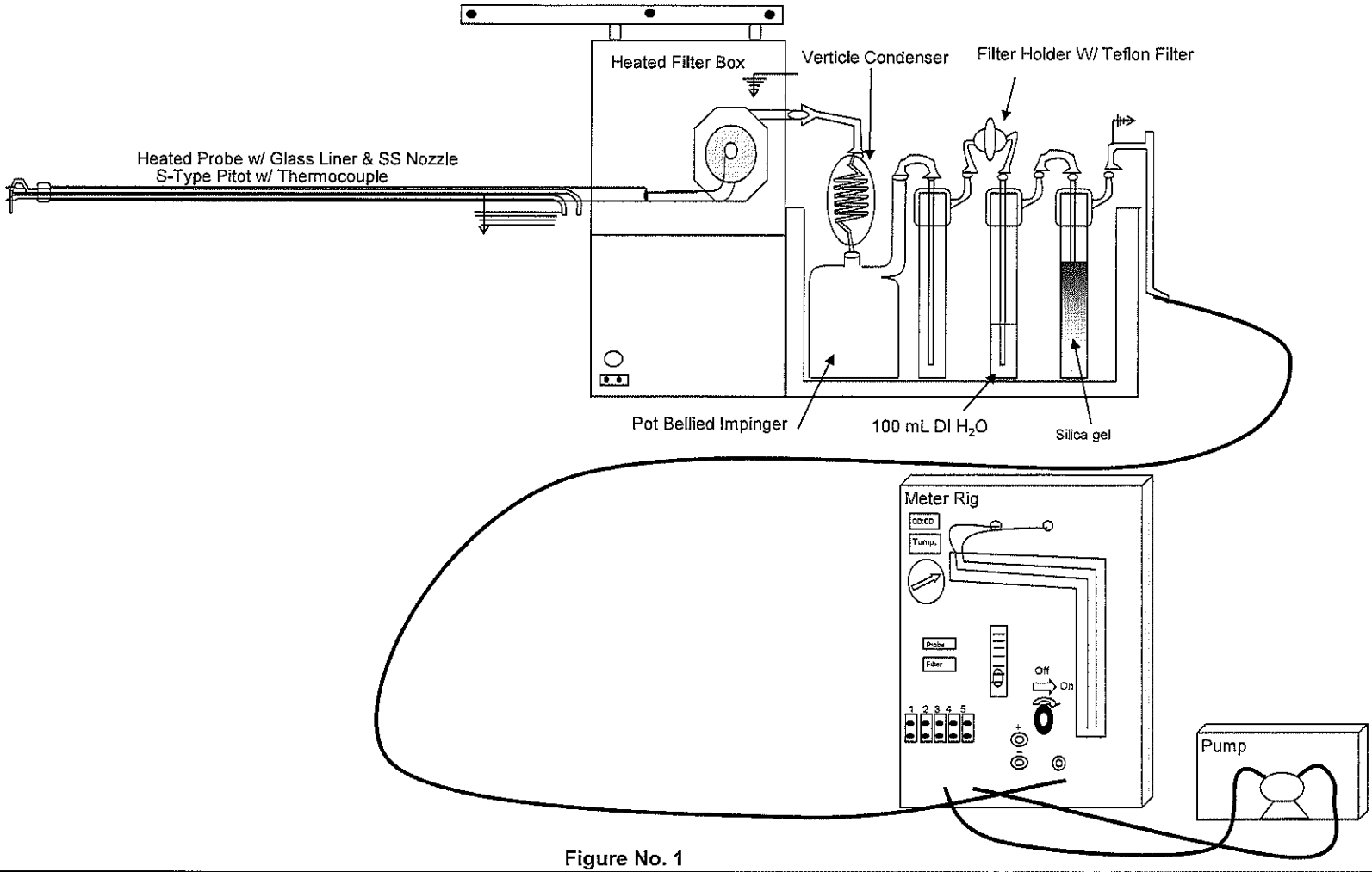

Figure No. 1

Site: EU Shell Furnace USEPA Method 5/202 Blue Diamond Casting Pigeon, Michigan	Sampling Date: July 6, 2016	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073

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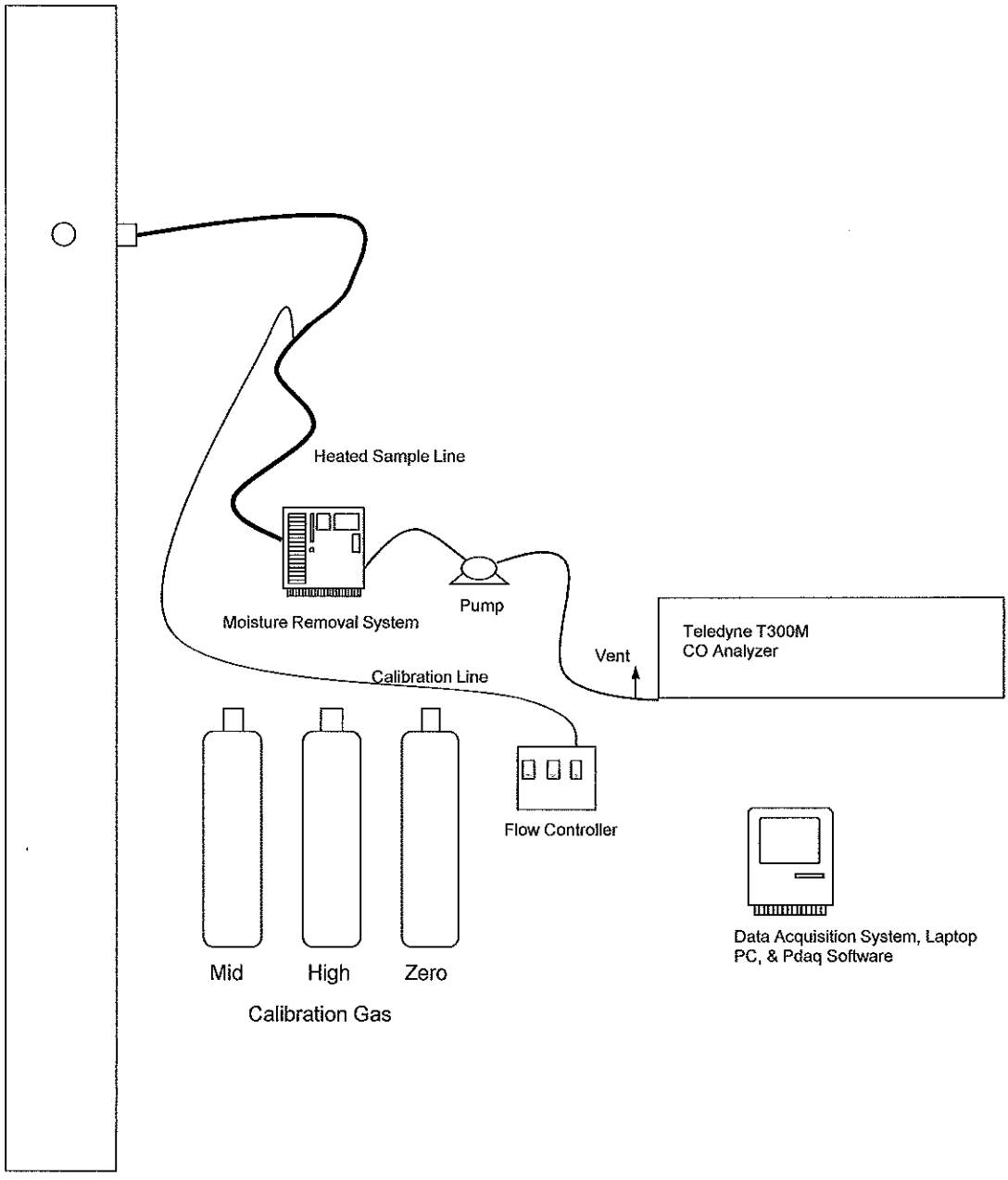

Figure No. 2

Site:	Sampling Date:	
EU Shell Furnace USEPA Method 10 Blue Diamond Casting Pigeon, Michigan	July 6, 2016	BT Environmental Consulting Inc. 4949 Fernlee Avenue Royal Oak, MI 48073

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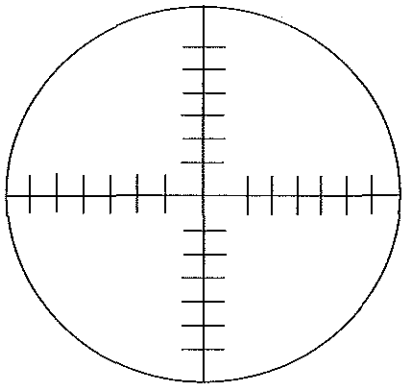
diameter = 53.5 inches

Points	Distance "
1	1.1
2	3.6
3	6.3
4	9.5
5	13.4
6	19.0
7	34.45
8	40.13
9	44.03
10	47.19
11	49.92
12	52.38



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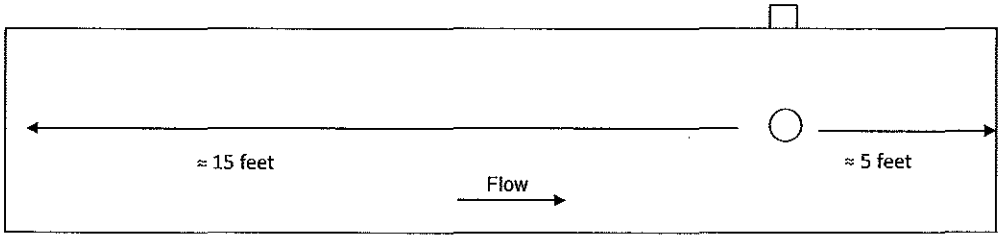

Figure No. 3

Site:	Sampling Date:	
EU Shell Furnace	July 6, 2016	BT Environmental Consulting, Inc.
Blue Diamond Casting		4949 Fernlee Avenue
Pigeon, Michigan		Royal Oak, Michigan 48073