BTEC Inc.

# No. 2 Basic Oxygen Process Electrostatic Precipitator Particulate Emissions Test Report

*Prepared for:*

## United States Steel Corporation

Ecorse, Michigan

Great Lakes Works
No.1 Quality Drive
Ecorse, Michigan 48229



BTEC Project No. 16-4972.00
January 26, 2017

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

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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# RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

*Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.*

**Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating (RO) Permit program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as described in General Condition No. 22 in the RO Permit and be made available to the Department of Environmental Quality, Air Quality Division upon request.**

Source Name: United States Steel Corporation Great Lakes Works — County: Wayne

Source Address: #1 Quality Drive — City: Ecorse

AQD Source ID (SRN): A7809 — RO Permit No.: 199600132d — RO Permit Section No.: 1 & 5

Please check the appropriate box(es):

☐ **Annual Compliance Certification (General Condition No. 28 and No. 29 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the RO Permit.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the RO Permit, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (General Condition No. 23 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From Dec. 15, 2016 To Dec. 15, 2014

Additional monitoring reports or other applicable documents required by the RO Permit are attached as described:

Submittal of BOP ESP Stack Test results from the December 15, 2016 test.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete.

| Ronald Kostyo | General Manager | 313-749-2210 |
|---|---|---|
| Name of Responsible Official (print or type) | Title | Phone Number |
| Ronald Kostyo | | 2/8/17 |
| Signature of Responsible Official | | Date |

* Photocopy this form as needed.

EQP 5736 (Rev 9/01)

## EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Company (U. S. Steel) to evaluate particulate matter (PM) emission rates from the No.2 Basic Oxygen Plant (BOP) located at No. 1 Quality Drive in Ecorse, Michigan. The emissions testing program was conducted on December 15, 2016. The purpose of this report is to document the results of the test program.

The testing was performed as a compliance demonstration for the Iron and Steel MACT 40 CFR Part 63 requirements. The MACT standard emissions limit for the No.2 BOP is 0.02 gr/dscf.

The results of the emission test program are summarized by Table I.

**Table I**
**Executive Summary Table PM Emission Rate Summary**

| Source | Pollutant | Limit | Results |
|---|---|---|---|
| No.2 BOP | PM | 0.02 gr/dscf - MACT | 0.002 gr/dscf |

## 1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by United States Steel Company (U. S. Steel) to evaluate particulate matter (PM) emission rates from the No.2 BOP at No. 1 Quality Drive in Ecorse, Michigan. The emissions testing program was conducted on December 15, 2016. The purpose of this report is to document the results of the test program.

The testing was performed as a compliance demonstration for the Iron and Steel MACT 40 CFR Part 63 requirements. The MACT standard limit is 0.02 gr/dscf.

The opacity was determined utilizing US EPA Method 9 and consisted of reading four complete blows at the No. 2 BOP roof monitor.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). This document is provided as Appendix A. 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 December 15, 2016 at the U. S. Steel facility in Ecorse, Michigan. The test program included evaluation of particulate matter (PM) from the No.2 BOP.

### 1.b Purpose of Testing

The testing was performed as a compliance demonstration for the Iron and Steel MACT 40 CFR Part 63 requirements. Table 1 summarizes the limitations included in this permit.

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

| Source | Pollutant | Limit |
|---|---|---|
| No.2 BOP | PM | 0.02 gr/dscf - MACT |

### 1.c Source Description

U. S. Steel is a fully integrated steel manufacturer producing steel coils and flat rolled sheets. The #2 Basic Oxygen Plant (No.2 BOP) is where the liquid iron is processed with other materials to produce liquid steel.

The #2 BOP has two top-blown, steel conversion vessels and two desulfurization/slag skimming stations at the facility. The process steps at the No. 2 BOP Shop Hot Metal Processing stations are as follows:

1. Hot Metal in torpedo cars is delivered from the blast furnaces
2. Scrap is charged into the vessel
3. Hot metal is transferred (poured) from the torpedo car into a charging ladle
4. The charging ladle is moved into position at the desulfurization station. A lance is lowered in the charging ladle into position
5. A powdered desulfurization agent is blown through the lance using an inert carrier gas and injected by fluid momentum into the hot metal bath. Desulfurization agent is injected for time periods and in amounts calculated to meet the desired sulfur specification.
6. The charging ladle is tilted to the slag skimming position where the slag is skimmed from the surface of the hot metal.
7. After skimming the charging ladle is removed from the desulfurization/slag skimming station and is tapped (draining the liquid steel) for further processing.

During the process when oxygen is blown on the top of the mixture, a hood is over the vessel to capture the BOP primary emissions. These emissions are captured and ducted to an electrostatic precipitator (ESP).

All of the testing conducted on the ESP stack encompassed all phases of the steel making process and sampled a minimum of sixty (60) dry standard cubic feet of gas. Each of the test runs captured emissions from scrap charge, hot metal transfer, desulfurization (or blowing), slag skimming and tapping.

### 1.d Test Program Contact

The contact for the source and test plan is:

Mr. Todd Wessel
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
Phone (616) 885-4013

Mr. Nathan Ganhs
U. S. Steel Environmental
United States Steel Corporation
No. 1 Quality Drive
Ecorse, Michigan 48192
Phone (313) 749 3857

### 1.e Testing Personnel

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

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

| Name and Title | Affiliation | Telephone |
|---|---|---|
| Mr. Paul Molenda<br>Environmental Technician | BTEC<br>4949 Fernlee Ave.<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. David Trahan<br>Environmental Technician | BTEC<br>4949 Fernlee Ave.<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Tom Maza<br>Air Quality Division | MDEQ<br>3058 W Grand Blvd<br>Detroit, MI 48202 | (313) 456-4709 |

## 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 recorded includes, fan amps, hot metal tons, and scrap charge. The operating data is included in Appendix F.

### 2.b Applicable Permit

Steel MACT Standard 40 CFR Part 63.

### 2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). Detailed results for the source can be found in table 4.

### 2.d Emission Regulation Comparison

The results summarized by table 3 (section 5.a) shows that the PM emissions are below the limits summarized by table 1 (section 1.b).

## 3. Source Description

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

### 3.a Process Description

See section 1.c.

### 3.b Raw and Finished Materials

Approximately 430,000 lbs of molten iron is mixed with 120,000 lbs. of scrap steel.

### 3.c Process Capacity

The furnaces are rated for 250 tons of steel.

### 3.d Process Instrumentation

The process stack data consist of documentation from the BOP control room. This includes amount of scrap and iron charged and the timing of each process step.

## 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

To evaluate PM mass emission rates from the baghouse, BTEC utilized the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations:

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Gas Analysis for the Determination of Dry Molecular Weight" (Fyrite Analysis)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*
- Method 5 - *"Determination of Particulate Emissions from Stationary Sources"*
- Method 9 - *"Visual Determination of the Opacity of Emissions from Stationary Sources"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. Figure 1 presents the test port and traverse/sampling point locations used. An S-type pitot tube and thermocouple assembly calibrated in accordance with Method 2, Section 4.1.1 was used to measure exhaust gas velocity pressures and temperatures during testing. Because the pitot tube dimensions outlined in Sections 2-6 through 2-8 were within the specified limits, the baseline pitot tube coefficient of 0.84 (dimensionless) was assigned for this testing.

Molecular weight determinations were conducted according to Method 3. The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Moisture content was determined from the condensate collected in the Method 5 sampling train according to Method 4.

40 CFR 60, Appendix A, Method 5, *"Determination of Particulate Emissions from Stationary Sources"* was used to measure PM concentrations and calculate PM emission rates (see Figure 2 for a schematic of the sampling train). A single 75 minute test run and duplicate 72-minute test runs were conducted on the ESP Stack.

BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) a heated glass probe, (3) a heated filter box, (4) a set of four Greensburg-Smith (GS) impingers with the first modified and second standard GS impingers each containing 100 milliliters (ml) of deionized water, a third dry modified GS impinger and a fourth modified GS impinger containing approximately 300 grams of silica gel desiccant, (5) a length of sample line, and (6) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

All of the testing conducted on the ESP stack encompassed all phases of the steel making process and sampled a minimum of sixty (60) dry standard cubic feet of gas. Each of the test runs captured emissions from scrap charge, hot metal transfer, desulfurization (or blowing), slag skimming and tapping.

After completion of the final leak test for each test run, the filters were recovered, and the nozzle, probe, and the front half of the filter holder assemblies of the Method 5 train were brushed and triple rinsed with acetone and collected in a pre-cleaned sample container. BTEC labeled the containers with the test number, test location, and test date, and marked the level of liquid on the outside of each container. BTEC personnel transported all samples to BTEC's laboratory in Royal Oak, Michigan for analysis.

### 4.b Recovery and Analytical Procedures

Recovery and analytical procedures were described in Section 4.a.

### 4.c Sampling Ports

The ESP stack has four (4) test ports which resulted in six (6) traverse points per port.

### 4.d Traverse Points

The ESP testing utilized a total of twenty four traverse points. Six points per test port.

## 5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

### 5.a Results Tabulation

The results of the emissions test program are summarized by Table 3.

**Table 3**
**Test Program PM Emission Rate Summary**

| Source | Pollutant | Limit | Results |
|---|---|---|---|
| No.2 BOP | PM | 0.02 gr/dscf - MACT | 0.002 gr/dscf |

Detailed data for each test run can be found in Table 4.

### 5.b Discussion of Results

Emission limitations are summarized by Table 1 (see section 1.b) and Table 3 (see section 5.a).

### 5.c Sampling Procedure Variations

There were no sampling variations.

### 5.d Process or Control Device Upsets

Insert upsets.

### 5.e Control Device Maintenance

No maintenance was performed during the test program.

### 5.f Audit Sample Analyses

No audit samples were collected as part of the test program.

### 5.g Calibration Sheets

Relevant equipment calibration documents are provided as Appendix B.

### 5.h Sample Calculations

Sample calculations are provided in Appendix C.

### 5.i Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

**Table 4**
**No. 2 BOP ESP Particulate Matter Emission Rates**

| | | | | |
|---|---|---|---|---|
| **Company** | **US Steel** | | | |
| **Source Designation** | **ESP** | | | |
| **Test Date** | **12/15/2016** | **12/15/2016** | **12/15/2016** | |
| **Meter/Nozzle Information** | Run 1 | Run 2 | Run 3 | Average |
| Meter Temperature Tm (F) | 61.6 | 69.9 | 74.2 | 68.6 |
| Meter Pressure - Pm (in. Hg) | 29.8 | 29.8 | 29.8 | 29.8 |
| Measured Sample Volume (Vm) | 77.7 | 77.3 | 78.9 | 77.9 |
| Sample Volume (Vm-Std ft3) | 77.8 | 76.3 | 77.3 | 77.1 |
| Sample Volume (Vm-Std m3) | 2.20 | 2.16 | 2.19 | 2.18 |
| Condensate Volume (Vw-std) | 8.063 | 6.460 | 8.864 | 7.795 |
| Gas Density (Ps(std) lbs/ft3) (wet) | 0.0745 | 0.0750 | 0.0742 | 0.0746 |
| Gas Density (Ps(std) lbs/ft3) (dry) | 0.0774 | 0.0774 | 0.0774 | 0.0774 |
| Total weight of sampled gas (m g lbs) (wet) | 6.39 | 6.21 | 6.39 | 6.33 |
| Total weight of sampled gas (m g lbs) (dry) | 6.02 | 5.91 | 5.98 | 5.97 |
| Nozzle Size - An (sq. ft.) | 0.000481 | 0.000481 | 0.000481 | 0.000481 |
| Isokinetic Variation - I | 98.5 | 101.0 | 102.3 | 100.6 |
| **Stack Data** | | | | |
| Average Stack Temperature - Ts (F) | 188.4 | 171.8 | 184.9 | 181.7 |
| Molecular Weight Stack Gas- dry (Md) | 29.9 | 29.9 | 29.9 | 29.9 |
| Molecular Weight Stack Gas-wet (Ms) | 28.8 | 29.0 | 28.7 | 28.8 |
| Stack Gas Specific Gravity (Gs) | 0.995 | 1.002 | 0.991 | 0.996 |
| Percent Moisture (Bws) | 9.39 | 7.80 | 10.29 | 9.16 |
| Water Vapor Volume (fraction) | 0.0939 | 0.0780 | 0.1029 | 0.0916 |
| Pressure - Ps ("Hg) | 29.5 | 29.5 | 29.5 | 29.5 |
| Average Stack Velocity -Vs (ft/sec) | 50.2 | 47.8 | 50.1 | 49.4 |
| Area of Stack (ft2) | 240.4 | 240.4 | 240.4 | 240.4 |
| **Exhaust Gas Flowrate** | | | | |
| Flowrate $ft^3$(Actual) | 723,532 | 689,787 | 723,339 | 712,219 |
| Flowrate $ft^3$ (Standard Wet) | 580,652 | 568,856 | 584,463 | 577,990 |
| Flowrate $ft^3$ (Standard Dry) | 526,121 | 524,470 | 524,324 | 524,972 |
| Flowrate $m^3$ (standard dry) | 14,898 | 14,851 | 14,847 | 14,866 |
| **Total Particulate Weights (mg)** | | | | |
| Nozzle/Probe/Filter | 10.9 | 8.3 | 13.9 | 11.0 |
| **Total Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.004 | 0.003 | 0.005 | 0.004 |
| lb/1000 lb (dry) | 0.004 | 0.003 | 0.005 | 0.004 |
| mg/dscm (dry) | 4.9 | 3.8 | 6.4 | 5.0 |
| gr/dscf | 0.0022 | 0.0017 | 0.0028 | 0.0022 |
| **Total Particulate Emission Rate** | | | | |
| lb/ hr | 9.79 | 7.57 | 12.52 | 9.96 |

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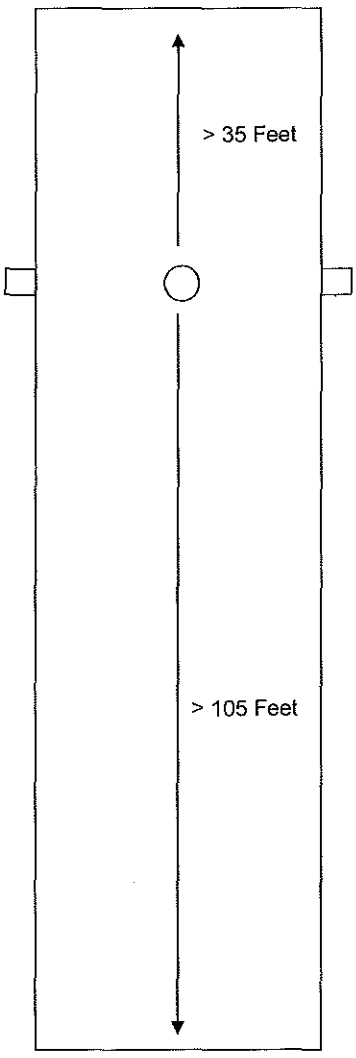
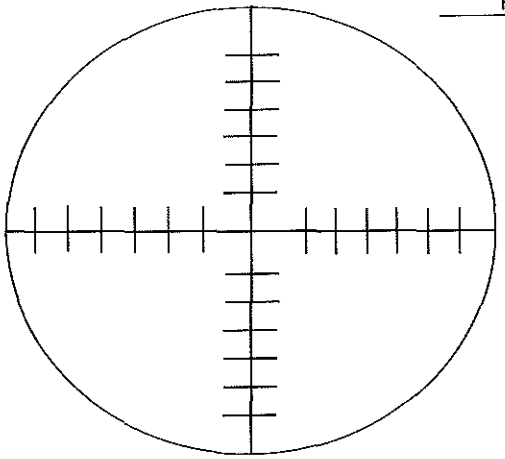
Diameter = 210 inches

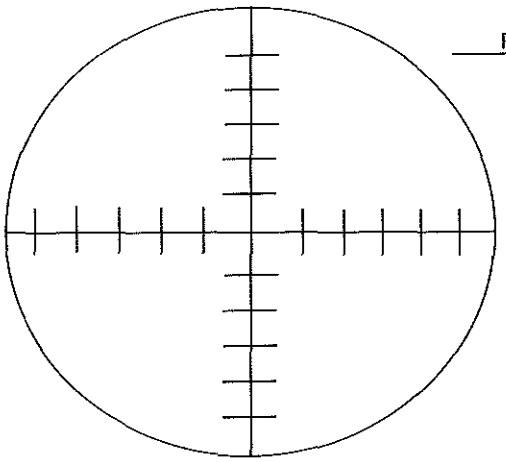



Particulate test traverse



| Points | Distance " |
|---|---|
| 1 | 4.4 |
| 2 | 14.1 |
| 3 | 24.8 |
| 4 | 37.2 |
| 5 | 52.5 |
| 6 | 74.8 |
| 7 | 135.2 |
| 8 | 157.5 |
| 9 | 172.8 |
| 10 | 185.2 |
| 11 | 195.9 |
| 12 | 205.6 |

Preflow traverse



| Points | Distance " |
|---|---|
| 1 | 5.5 |
| 2 | 17.2 |
| 3 | 30.7 |
| 4 | 47.5 |
| 5 | 71.8 |
| 6 | 138.2 |
| 7 | 162.5 |
| 8 | 179.3 |
| 9 | 192.8 |
| 10 | 204.5 |

Not to Scale

**Figure 1**

| | | |
|---|---|---|
| **Site:**<br>**No.2 BOP**<br>**Ecorse, Michigan** | **Sampling Dates:**<br>**December 15, 2016** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee**<br>**Royal Oak, Michigan** |

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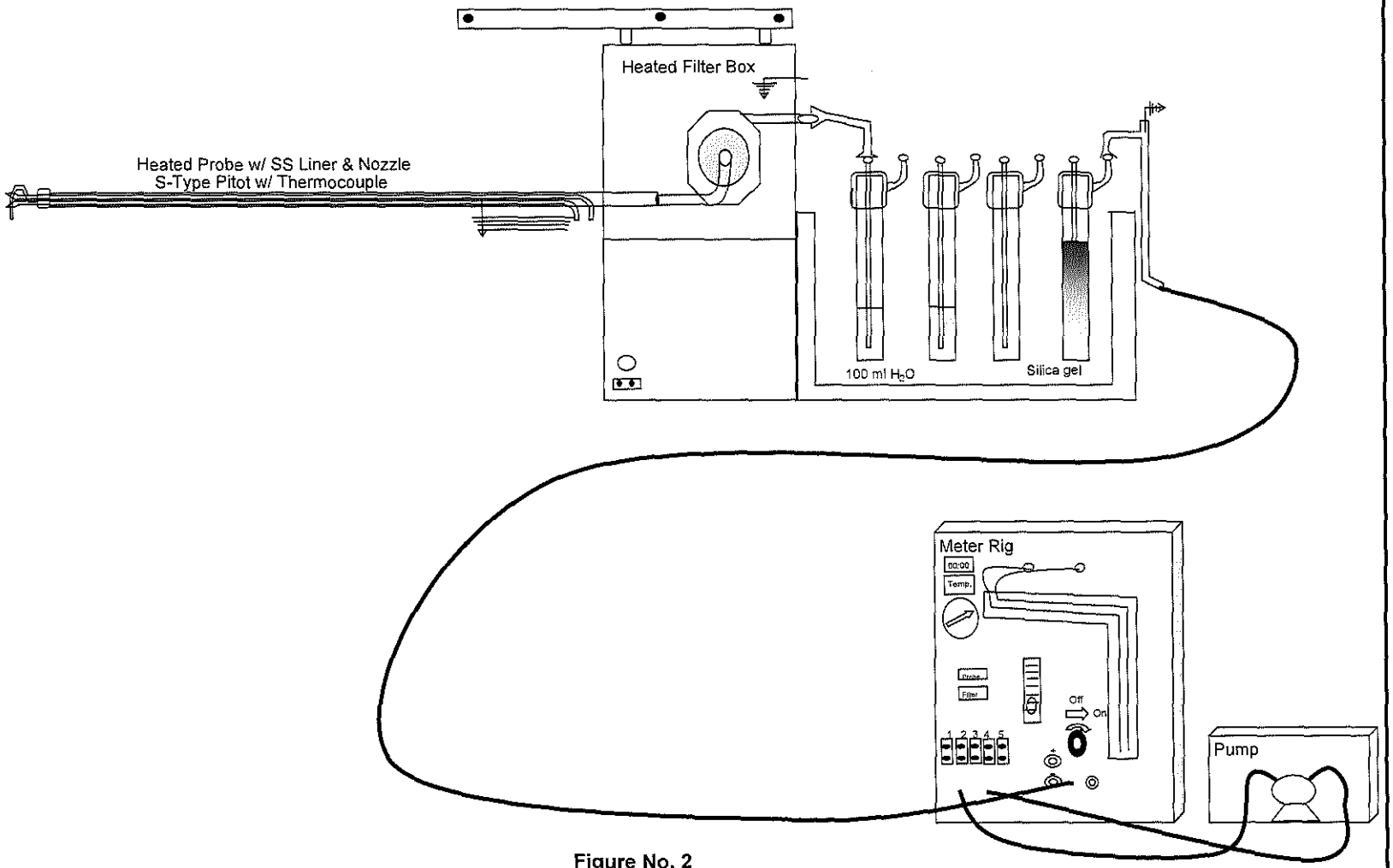


Figure No. 2

| | | |
|---|---|---|
| **Site:**<br>**USEPA Method 5**<br>**US Steel Corporation**<br>**Ecorse, Michigan** | **Sampling Date:**<br>**December 15, 2016** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee Avenue**<br>**Royal Oak, Michigan 48073** |