BTEC Inc.

# VOC Destruction Efficiency Emissions Test Report



*Prepared for:*

**II Stanley Company, Inc.**

Battle Creek, Michigan

II Stanley Company, Inc.
1500 Hill Brady Road
Battle Creek, Michigan 49037

Project No. 14-4608.00
June 9, 2015



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

BTEC Inc.

## EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) has been retained by II Stanley Company, Inc. (II Stanley) to conduct volatile organic compound (VOC) destruction efficiency (DE) testing for compliance evaluation purposes on RTO No. 1 and RTO No. 2 at the II Stanley facility in Battle Creek, Michigan. The emissions test program was conducted on April 14, 2015. A capture efficiency test on the NDOs was also performed the week prior to the DE testing.

Testing of RTO No.1 and RTO No. 2 consisted of simultaneous triplicate 60-minute test runs at the inlet and outlet of each RTO. The emissions test program was required by MDEQ Air Quality Division Permit No. 113-03D. The results of the emission test program are summarized by Table I.

**Table I**
**Overall Emission Summary**
**Test Date: April 14th, 2015**

| Source | DE (%) | VOC Emission Rate (lb/hr) | VOC Emission Limit (lb/hr) |
|---|---|---|---|
| RTO No. 1 | 90.6% | 1.7 lb/hr | |
| RTO No. 2 | 87.3% | 1.8 lb/hr | |
| Combined | | 3.4 lb/hr | 5.4 lb/hr |

## 1. Introduction

BT Environmental Consulting, Inc. (BTEC) has been retained by II Stanley Company, Inc. (II Stanley) to conduct volatile organic compound (VOC) destruction efficiency (DE) testing for compliance evaluation purposes on RTO No. 1 and RTO No. 2 at the II Stanley facility in Battle Creek, Michigan. The emissions test program was conducted on April 14, 2015. A capture efficiency test on the NDOs was also performed the week prior to the DE testing. 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

The emissions test program was conducted on April 14, 2015 at the II Stanley facility in Battle Creek, Michigan. The test program included evaluation of VOC emissions and DE from RTO No. 1 and RTO No. 2. A capture efficiency test on the NDOs was also performed the week prior to the DE testing.

### 1.b Purpose of Testing

The facility operates under Permit No. 113-03D. Satisfactory operation of RTO No. 1 and No. 2 includes a minimum VOC capture efficiency of 100 percent (by weight), a minimum VOC destruction efficiency of 95 percent (by weight) or a combined maximum VOC emissions rate of 5.4 pph.

### 1.c Source Description

II Stanley operates RTO No. 1 and RTO No. 2 controlling VOC Emissions from associated emission units.

Each RTO is designed to handle a maximum of 172 pounds per hour (lb/hr) of VOCs uncontrolled to the inlet of the RTO, and has a maximum air flow volume of 50,000 standard cubic feet per minute (scfm).

The RTO burners are fired exclusively with natural gas, with an approximate heating value of 1,020 Btu per standard cubic feet (Btu/scf). The burners will consume about 6,471 standard cubic feet of natural gas per hour (scf/hr).

### 1.d Test Program Contacts

The contact for the source and test report is:

Ms. Debbie Oetting
Safety and Environmental Engineer
II Stanley Company, Inc.
1500 Hill Brady Road
Battle Creek, Michigan 49037
(260) 687-8613

Names and affiliations for personnel who were present during the testing program are summarized by Table 1.

**Table 1**
**Test Personnel**

| Name and Title | Affiliation | Telephone |
|---|---|---|
| Ms. Debbie Oetting<br>Safety and Environmental Engineer | II Stanley Company, Inc.<br>1500 Hill Brady Road<br>Battle Creek, Michigan 49037 | (260) 687-8613 |
| Mr. Ken Lievense<br>Project Manager | BTEC<br>4949 Fernlee Avenue<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Steve Smith<br>Environmental Technician | BTEC<br>4949 Fernlee Avenue<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Paul Draper<br>Environmental Technician | BTEC<br>4949 Fernlee Avenue<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Thomas Gasloli | MDEQ<br>Air Quality Division | (517) 335-3122 |

## 2. Summary of Results

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

### 2.a Operating Data

Process data monitored during the emissions test program included process throughput and RTO temperatures.

### 2.b Applicable Permit

The facility operates under Permit No. 113-03D. Satisfactory operation of RTO No. 1 and No. 2 includes a minimum VOC capture efficiency of 100 percent (by weight), a minimum VOC destruction efficiency of 95 percent (by weight) or a combined maximum VOC emissions rate of 5.4 pph.

### 2.c Results

The overall results of the emission test program are summarized by Table 2 (see Section 5.a). VOC emissions from the RTOs were below the corresponding limit of 5.4 lb/hr.

## 3. Source Description

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

### 3.a Process Description

As identified in FGCONTROLS of II Staley's operating permit, RTO No. 1 and No. 2 control VOC emissions with dry filter or water wash particulate control systems to control particulate matter.

Each RTO is designed to handle a maximum of 172 pounds per hour (lb/hr) of VOCs uncontrolled to the inlet of the RTO, and has a maximum air flow volume of 50,000 standard cubic feet per minute (scfm).

The RTO burners are fired exclusively with natural gas, with an approximate heating value of 1,020 Btu per standard cubic feet (Btu/scf). The burners will consume about 6,471 standard cubic feet of natural gas per hour (scf/hr).

### 3.b Process Flow Diagram

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

### 3.c Raw and Finished Materials

The raw material used by the process is natural gas.

### 3.d Process Capacity

The capacity of each RTO is 50,000 scfm, and the burners each have a maximum heat input capacity of 6.6 million BTU per hour (MMBtu/hr).

### 3.e Process Instrumentation

Process throughput and RTO temperatures.

## 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

The emissions test program utilized the following test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - "Sample and Velocity Traverses for Stationary Sources"
- Method 2 - "Determination of Stack Gas Velocity and Volumetric Flowrate"
- Method 3A - "Determination of Molecular Weight of Dry Stack Gas"(Fyrite)
- Method 4 - "Determination of Moisture Content in Stack Gases"
- Method 25A - "Determination of Total Gaseous Organic Concentration using a Flame Ionization Analyzer"

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) is assigned.

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. The average of the absolute values of the flow angle was less than 20 degrees for each source.

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 consists 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 moisture sampling and passed through (i) two impingers, each with 100 ml deionized water, (ii) an empty impinger, and (iii) an impinger filled with silica gel.

Exhaust gas moisture content is then determined gravimetrically. Inlet gas moisture content was evaluated using wet bulb/dry bulb temperatures and a moisture table.

Volatile Organic compound (VOC) concentrations were measured according to 40 CFR 60, Appendix A, Method 25A. A sample of the gas stream was drawn through a stainless steel probe with an in-line glass fiber filter to remove any particulate, and a heated Teflon® sample line to prevent the condensation of any moisture from the sample before it enters the analyzer. Data was recorded at 4-second intervals on a PC equipped with IOtech® data acquisition software. BTEC used a JUM Model 109A Methane/Non-Methane THC hydrocarbon analyzer and a VIG Model 20 THC hydrocarbon analyzer to determine the VOC concentration.

The JUM Model 109A analyzer utilizes two flame ionization detectors (FIDs) in order to report the average ppmv for total hydrocarbons (THC), as propane, as well as the average ppmv for methane (as methane). Upon entry, the analyzer splits the gas stream. One FID ionizes all of the hydrocarbons in the gas stream sample into carbon, which is then detected as a concentration of total hydrocarbons. Using an analog signal, specifically voltage, the concentration of THC is then sent to the data acquisition system (DAS), where recordings are taken at 4-second intervals to produce an average based on the overall duration of the test. This average is then used to determine the average ppmv for THC reported as the calibration gas, propane, in equivalent units.

The second FID reports methane only. The sample enters a chamber containing a catalyst that destroys all of the hydrocarbons present in the gas stream other than methane. As with the THC sample, the methane gas concentration is sent to the DAS and recorded. The methane concentration, reported as methane, can then be converted to methane, reported as propane, by dividing the measured methane concentration by the analyzer's response factor. Methane concentrations were not recorded for this emission test program.

The VIG THC hydrocarbon analyzer channels a fraction of the gas sample through a capillary tube that directs the sample to the flame ionization detector (FID), where the hydrocarbons present in the sample are ionized into carbon. The carbon concentration is then determined by the detector in parts per million (ppm). This concentration is transmitted to the data acquisition system (DAS) at 4-second intervals in the form of an analog signal, specifically voltage, to produce data that can be averaged over the duration of the testing program. This data is then used to determine the average ppm for total hydrocarbons (THC) using the equivalent units of propane (calibration gas).

In accordance with Method 25A, a 4-point (zero, low, mid, and high) calibration check will be performed on the THC analyzer. Calibration drift checks will be performed at the completion of each run.

For analyzer calibrations, calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System. The Series 4040 consists of a single chassis with four mass flow controllers. The mass flow controllers are factory-calibrated using a primary flow standard traceable to the United State's National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point

calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. A schematic of the sampling train is provided as Figure 5.

The accuracy of the gas dilution system was verified using the procedures detailed by Method 205.

### 4.b Recovery and Analytical Procedures

This test program did not include laboratory samples, consequently, sample recovery and analysis is not applicable to this test program.

### 4.c Sampling Ports

A diagram of the stacks showing sampling ports in relation to upstream and downstream disturbances is included as Figures 1-4.

### 4.d Traverse Points

A diagram of the stacks indicating traverse point locations and stack dimensions is included as Figures 1-4

## 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 2. Detailed results for the emissions test program are summarized by Tables 3 and 4.

**Table 2**
**Overall Emission Summary**
**Test Date: April 14th, 2015**

| Source | DE (%) | VOC Emission Rate (lb/hr) | VOC Emission Limit (lb/hr) |
|---|---|---|---|
| RTO No. 1 | 90.6% | 1.7 lb/hr | |
| RTO No. 2 | 87.3% | 1.8 lb/hr | |
| Combined | | 3.4 lb/hr | 5.4 lb/hr |

### 5.b Discussion of Results

VOC emissions from the RTOs were below the corresponding limit of 5.4 lb/hr.

### 5.c Sampling Procedure Variations

The analyzer at the RTO 1 outlet failed the post test calibration drift check after Run 2. The test data was considered valid and the analyzer was recalibrated before continuing on with Run 2, as allowed per Method 25A section 8.6.2. Calibration data is included in Appendix B.

### 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

There are no laboratory results for this test program. Raw CEM data is provided electronically in Appendix D.

**Table 3**
**RTO No. 1 VOC Emission Test Results Summary**
**II Stanley**
**Battle Creek, Michigan**

| Parameter | Run 1 | Run 2 | Run 3 | Average |
|---|---|---|---|---|
| Sampling Date | 4/14/2015 | 4/14/2015 | 4/14/2015 | |
| Sampling Time | 7:35-8:35 | 9:00-10:00 | 10:30-11:30 | |
| Inlet Flowrate (scfm) | 36,367 | 36,162 | 36,216 | 36,248 |
| Exhaust Flowrate (scfm) | 45,467 | 44,305 | 43,406 | 44,393 |
| Inlet VOC Concentration (ppmv propane) | 71.26 | 78.13 | 68.02 | 72.5 |
| Inlet VOC Concentration (ppmv propane) Corrected by 7E | 70.07 | 76.70 | 67.26 | 71.3 |
| **Inlet VOC Emission Rate (lbs/hr)** | **17.4** | **19.0** | **16.7** | **17.7** |
| Exhaust VOC Concentration (ppmv propane) | 6.07 | 5.20 | 4.65 | |
| Exhaust VOC Concentration (ppmv propane) Corrected by 7E | 5.77 | 5.50 | 4.92 | |
| **Exhaust VOC Emission Rate (lbs/hr)** | **1.8** | **1.7** | **1.5** | **1.6** |
| **VOC Destruction Efficiency (%)** | **89.7** | **91.2** | **91.2** | **90.7** |
| **RTO 2 Exhaust VOC Emission Rate (lbs/hr)** | **1.9** | **1.8** | **1.6** | **1.8** |
| **Combined Exhaust VOC Emission Rate (lbs/hr)** | **3.7** | **3.4** | **3.1** | **3.4** |

| Inlet VOC Correction | | | |
|---|---|---|---|
| **Co** | 0.20 | 0.12 | -0.09 |
| **Cma** | 99.6 | 99.6 | 99.6 |
| **Cm** | 101.22 | 101.42 | 100.78 |

| Outlet VOC Correction | | | |
|---|---|---|---|
| **Co** | 0.17 | -0.35 | -0.45 |
| **Cma** | 24.9 | 24.9 | 24.9 |
| **Cm** | 25.63 | 24.78 | 25.32 |

scfm: standard cubic feet per minute
ppmv: parts per million on a volume to volume basis
lb/hr: pounds per hour
VOC: volatile organic compound
MW = molecular weight ($C_3H_8$ = 44.10)
24.14: molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31: $ft^3$ per $m^3$
453,600: mg per lb

**Equations**

DE = (lbs/hr in - lbs/hr out)/(lbs/hr in) * 100
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

**Table 4**
**RTO No. 2 VOC Emission Test Results Summary**
**II Stanley**
**Battle Creek, Michigan**

| Parameter | Run 1 | Run 2 | Run 3 | Average |
|---|---|---|---|---|
| Sampling Date | 4/14/2015 | 4/14/2015 | 4/14/2015 | |
| Sampling Time | 7:35-8:35 | 9:00-10:00 | 10:30-11:30 | |
| Inlet Flowrate (scfm) | 33,285 | 34,490 | 34,542 | 34,106 |
| Exhaust Flowrate (scfm) | 49,078 | 47,890 | 48,174 | 48,380 |
| Inlet VOC Concentration (ppmv propane) | 55.94 | 67.91 | 60.69 | 61.5 |
| Inlet VOC Concentration (ppmv propane) Corrected by 7E | 54.88 | 66.01 | 59.14 | 60.0 |
| **Inlet VOC Emission Rate (lbs/hr)** | **12.5** | **15.6** | **14.0** | **14.0** |
| Exhaust VOC Concentration (ppmv propane) | 5.34 | 5.14 | 4.72 | |
| Exhaust VOC Concentration (ppmv propane) Corrected by 7E | 5.56 | 5.40 | 4.96 | |
| **Exhaust VOC Emission Rate (lbs/hr)** | **1.9** | **1.8** | **1.6** | **1.8** |
| **VOC Destruction Efficiency (%)** | **85.1** | **88.6** | **88.3** | **87.3** |
| **RTO 1 Exhaust VOC Emission Rate (lbs/hr)** | **1.8** | **1.7** | **1.5** | **1.6** |
| **Combined Exhaust VOC Emission Rate (lbs/hr)** | **3.7** | **3.4** | **3.1** | **3.4** |

| Inlet VOC Correction | | | |
|---|---|---|---|
| Co | 0.41 | 0.76 | 0.86 |
| Cma | 99.6 | 99.6 | 99.6 |
| Cm | 101.19 | 102.08 | 101.62 |

| Outlet VOC Correction | | | |
|---|---|---|---|
| Co | -0.21 | -0.42 | -0.42 |
| Cma | 24.9 | 24.9 | 24.9 |
| Cm | 24.64 | 25.22 | 25.40 |

scfm: standard cubic feet per minute
ppmv: parts per million on a volume to volume basis
lb/hr: pounds per hour
VOC: volatile organic compound
MW = molecular weight ($C_3H_8$ = 44.10)
24.14: molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31: $ft^3$ per $m^3$
453,600: mg per lb

**Equations**

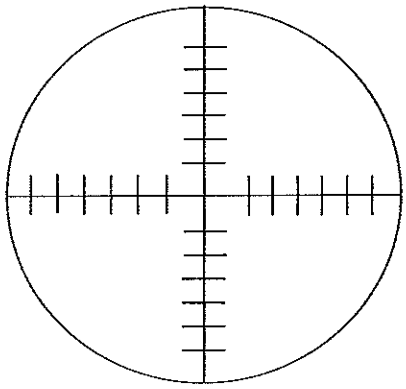
DE = (lbs/hr in - lbs/hr out)/(lbs/hr in) * 100
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

# Figures

**BTEC Inc.**

diameter = 59.75 inches

| Points | Distance " |
|---|---|
| 1 | 1.3 |
| 2 | 4.0 |
| 3 | 7.1 |
| 4 | 10.6 |
| 5 | 14.9 |
| 6 | 21.3 |
| 7 | 38.5 |
| 8 | 44.8 |
| 9 | 49.2 |
| 10 | 52.7 |
| 11 | 55.7 |
| 12 | 58.5 |



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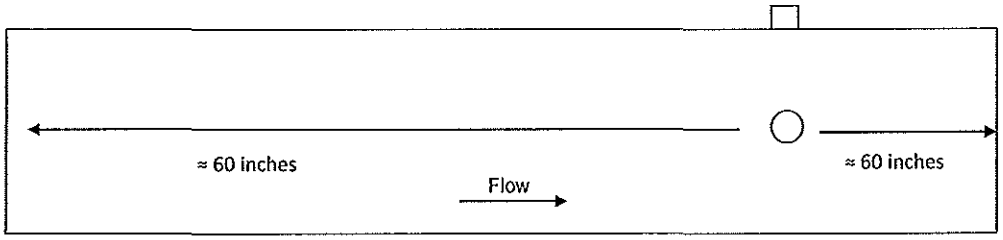
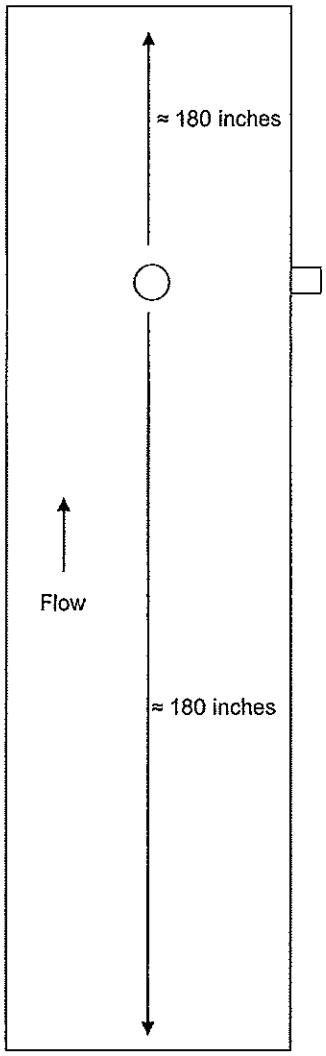


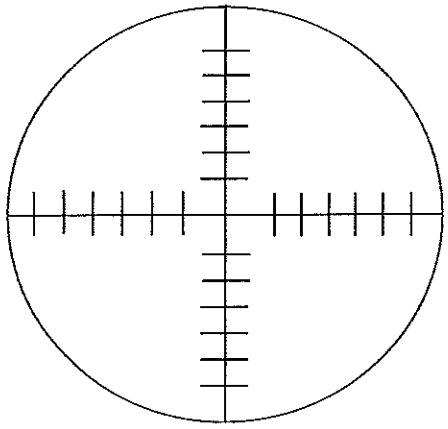

**Figure No. 1**

| Site: | Sampling Date: | |
|---|---|---|
| RTO #1 Inlet | April 14, 2015 | BT Environmental Consulting, Inc. |
| II Stanley Company, Inc. | | 4949 Fernlee Avenue |
| Battle Creek, Michigan | | Royal Oak, Michigan 48073 |

BTEC Inc.

diameter = 59.5 inches



Not to Scale

| Points | Distance " |
|---|---|
| 1 | 1.2 |
| 2 | 4.0 |
| 3 | 7.0 |
| 4 | 10.5 |
| 5 | 14.9 |
| 6 | 21.2 |
| 7 | 38.3 |
| 8 | 44.6 |
| 9 | 49.0 |
| 10 | 52.5 |
| 11 | 55.5 |
| 12 | 58.3 |

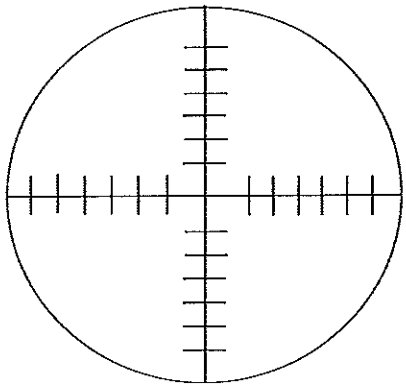
**Figure No. 2**

| Site: | Sampling Date: | |
|---|---|---|
| RTO #1 Exhaust | April 14, 2015 | BT Environmental Consulting, Inc. |
| II Stanley Company, Inc. | | 4949 Fernlee Avenue |
| Battle Creek, Michigan | | Royal Oak, Michigan 48073 |

BTEC Inc.

diameter = 59.75 inches

| Points | Distance " |
|---|---|
| 1 | 1.3 |
| 2 | 4.0 |
| 3 | 7.1 |
| 4 | 10.6 |
| 5 | 14.9 |
| 6 | 21.3 |
| 7 | 38.5 |
| 8 | 44.8 |
| 9 | 49.2 |
| 10 | 52.7 |
| 11 | 55.7 |
| 12 | 58.5 |



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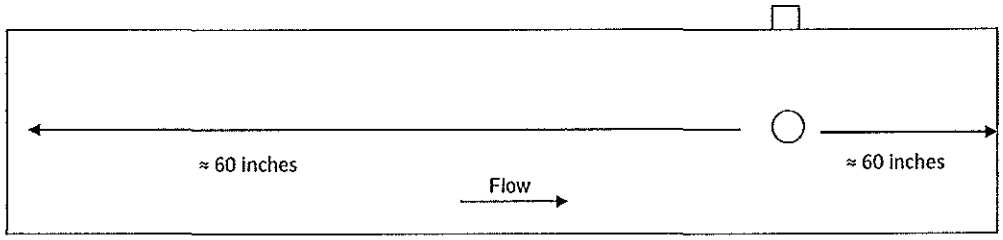
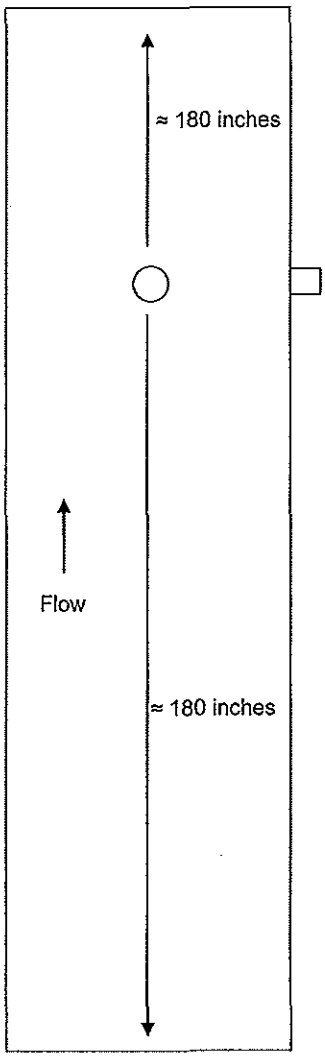


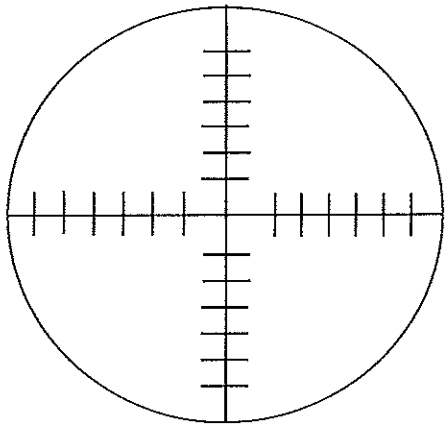

Figure No. 3

| Site: | Sampling Date: | |
|---|---|---|
| RTO #2 Inlet | April 14, 2015 | BT Environmental Consulting, Inc. |
| II Stanley Company, Inc. | | 4949 Fernlee Avenue |
| Battle Creek, Michigan | | Royal Oak, Michigan 48073 |

BTEC Inc.

diameter = 59.5 inches



Not to Scale

| Points | Distance " |
|---|---|
| 1 | 1.2 |
| 2 | 4.0 |
| 3 | 7.0 |
| 4 | 10.5 |
| 5 | 14.9 |
| 6 | 21.2 |
| 7 | 38.3 |
| 8 | 44.6 |
| 9 | 49.0 |
| 10 | 52.5 |
| 11 | 55.5 |
| 12 | 58.3 |

**Figure No. 4**

| | | |
|---|---|---|
| **Site:**<br>**RTO #2 Exhaust**<br>**II Stanley Company, Inc.**<br>**Battle Creek, Michigan** | **Sampling Date:**<br>**April 14, 2015** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee Avenue**<br>**Royal Oak, Michigan 48073** |

BTEC Inc.

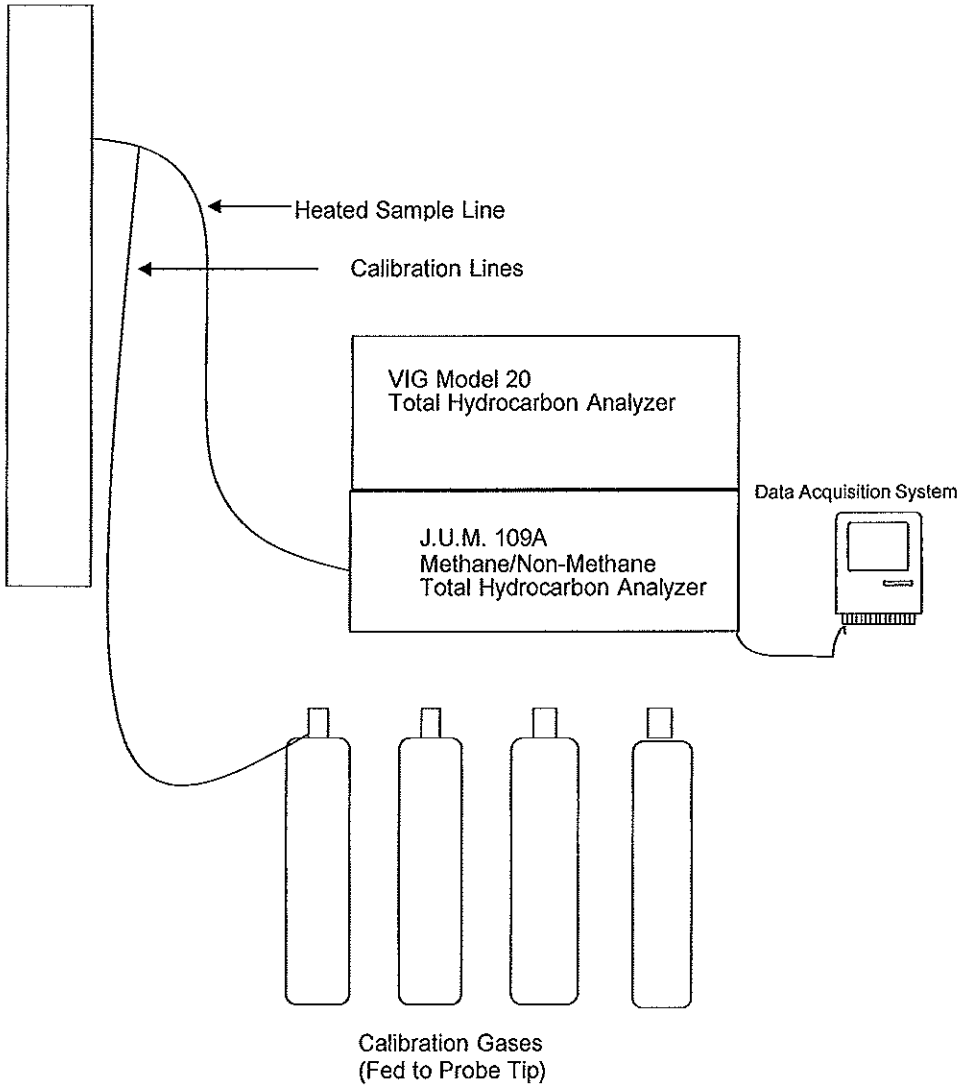



**Figure No. 5**

| | |
|---|---|
| **Site:** **Sampling Date:**<br>**USEPA Method 25A** **April 14, 2015**<br>**II Stanley Company, Inc.**<br>**Battle Creek, Michigan** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee Avenue**<br>**Royal Oak, Michigan 48073** |

BTEC Inc.

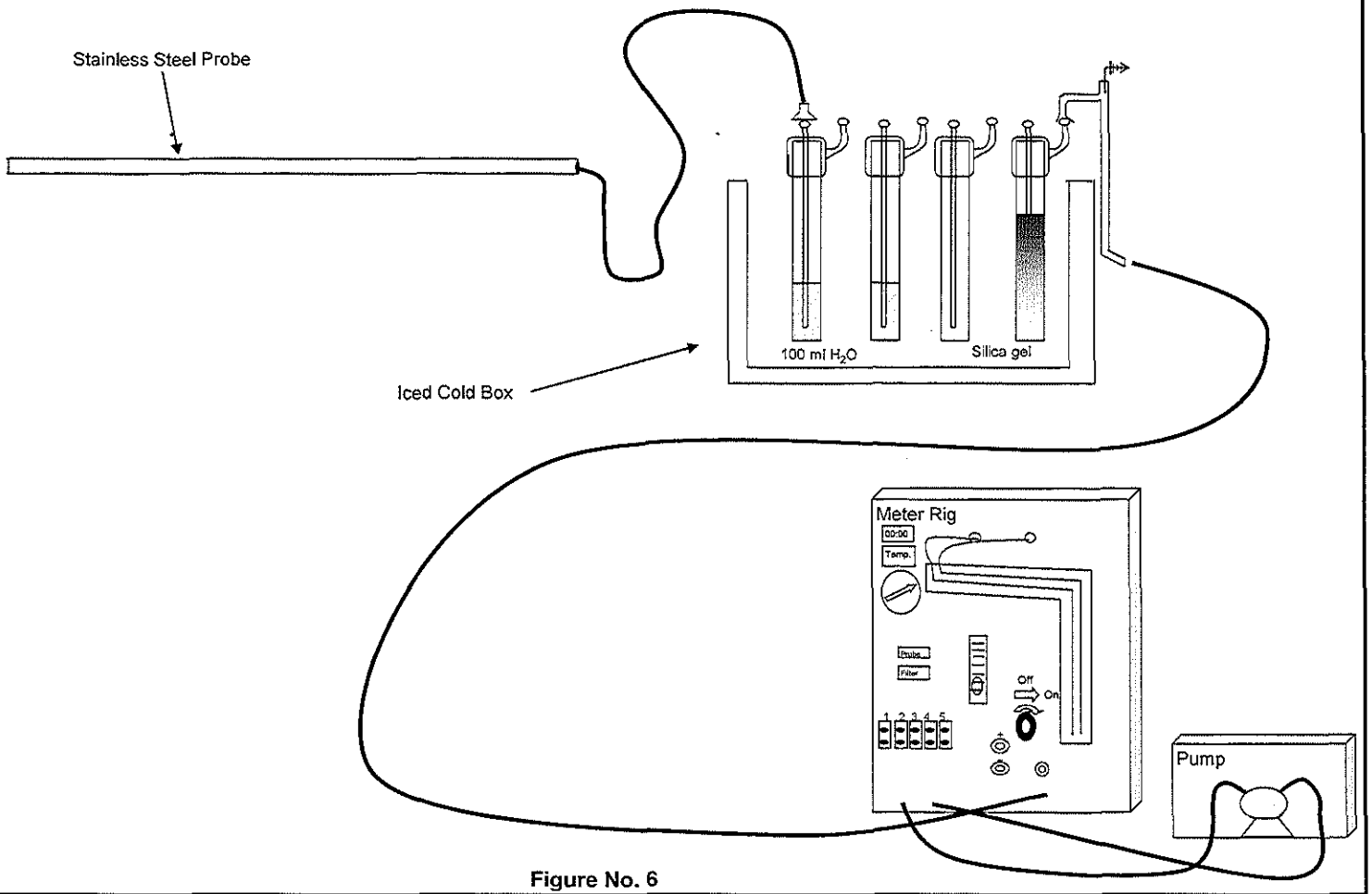



**Figure No. 6**

| | | |
|---|---|---|
| **Site:**<br>**USEPA Method 4**<br>**II Stanley Company, Inc.**<br>**Battle Creek, Michigan** | **Sampling Date:**<br>**April 14, 2015** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee Avenue**<br>**Royal Oak, Michigan 48073** |