BTEC Inc.

EUCOPELAND+DISTANK RTO Destruction Efficiency and Emissions Test Report
Test Date: February 18, 2015

Prepared for:

Packaging Corporation of America

Packaging Corporation of America
2246 Udell Street
Filer City, Michigan 49634

Project No. 15-4654.00
April 7, 2015

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
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DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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: Packaging Corporation of America County: Manistee

Source Address: 2246 Udell Street City: Filer City

AQD Source ID (SRN): B3692 RO Permit No.: MI-ROP-B3692-2009 RO Permit Section No.: ______

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 NA To NA

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

RTO Destruction Efficiency and Emissions Test Report, Test Date: Feb. 18, 2015

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.

Robert J. Peretin	Mill Manager	(231) 723-9951
Name of Responsible Official (print or type)	Title	Phone Number
[signature]	MILL MANAGER	4/13/15
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 Packaging Corporation of America (PCA) to evaluate volatile organic compounds (VOC) destruction efficiency (DE) of a regenerative thermal oxidizer (RTO) associated with EUCOPELAND+DISTANK at the PCA facility located in Filer City, Michigan. The emissions test program was conducted on February 18, 2015.

Testing of EUCOPELAND+DISTANK consisted of triplicate 60-minute test runs. The emissions test program was required by MDEQ Air Quality Division Renewable Operating Permit (ROP) No. MI-ROP-B3692-2009. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: February 18, 2015

Pollutant	Average Emission Rate	Emission Limit
VOC (DE)	97.0%	90%
Black Liquor Solids Fired	1.30 lb/ton	2.97 lb/ton

BTEC Inc.

TABLE OF CONTENTS

BTEC Inc.

TABLE OF CONTENTS (continued)

SUMMARY TABLES

FIGURES

APPENDIX

BTEC Inc.

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Packaging Corporation of America (PCA) to evaluate volatile organic compounds (VOC) destruction efficiency (DE) of a regenerative thermal oxidizer (RTO) associated with EUCOPELAND+DISTANK at the PCA facility located in Filer City, Michigan. The emissions test program was conducted on February 18, 2015. 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 February 18, 2015 at the PCA facility located in Filer City, Michigan. The test program included evaluating the DE of VOC, measuring at the inlet and outlet of the RTO.

1.b Purpose of Testing

AQD issued Renewable Operating Permit (ROP) No. MI-ROP-B3692-2009 to PCA. This permit limits emissions from the RTO summarized by Table 1.

Table 1
DE and Black Liquor Solids Fired Emission Limitations
PCA

Facility	Permit No.	VOC (DE)	Black Liquor Solids Fired
Filer City, MI	MI-ROP-B3692-2009	90%	≤2.97 lb/ton

1.c Source Description

The Copeland Reactor at the PCA facility is a fluidized bed design, which recovers sodium carbonate from the spent pulping liquor (black liquor). Black liquor is fired into the Copeland Reactor at approximately 50% solids. Organic material in the liquor burns and the resultant sodium forms sodium carbonate pellets. The pellets are drawn off to maintain the proper fluidized bed height.

Exhaust gases are conveyed to two (2) parallel cyclones, then to a venturi scrubber, and a separator vessel equipped with a demister section before being exhausted to a wet electrostatic precipitator (WESP) followed by an RTO to reduce gaseous organic HAP emissions.

1.d Test Program Contacts

The contact for the source and test report is:

Ms. Sara Kaltunas
Packaging Corporation of America
2246 Udell Street
Filer City, MI 49634
(231) 723-9951 ext 465

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. Ken Lievense Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Steve Smith Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Paul Molenda Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070

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 RTO temperature, black liquor solids firing rate, tons per hour, differential pressure across the venturi scrubber, natural gas usage of RTO.

2.b Applicable Permit

The applicable permit for this emissions test program is Renewable Operating Permit (ROP) No. MI-ROP-B3692-2009.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). DE emissions were above the corresponding limit of 90%. Black liquor solids emissions were also below the limit of 2.97 lb/ton.

3. Source Description

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

3.a Process Description

The Copeland Reactor at the PCA facility is a fluidized bed design, which recovers sodium carbonate from the spent pulping liquor (black liquor). Black liquor is fired into the Copeland Reactor at approximately 50% solids. Organic material in the liquor burns and the resultant sodium forms sodium carbonate pellets. The pellets are drawn off to maintain the proper fluidized bed height.

Exhaust gases are conveyed to two (2) parallel cyclones, then to a venturi scrubber, and a separator vessel equipped with a demister section before being exhausted to a wet electrostatic precipitator (WESP) followed by an RTO to reduce gaseous organic HAP emissions.

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

Spent black liquor at 50% solids (Copeland Reactor).

3.d Process Capacity

The Copeland Reactor process has a design capacity in excess of 70 gallons per minute (GPM) of black liquor. During the testing the Copeland Reactor will be operated at 50-65 GPM.

3.e Process Instrumentation

Exhaust gases from the Copeland Reactor pass through two cyclones, Venturi Scrubber, mist eliminator, wet electrostatic precipitator and a regenerative thermal oxidizer. During operation, the Venturi scrubber differential pressure and RTO combustion chamber temperature are monitored.

4. Sampling and Analytical Procedures

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

4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at 40 CFR 60, Appendix A:

- Method 1 - *"Location of the Sampling Site and Sampling Points"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flow rate"*
- Method 3 - *"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 Methods 1 and 2. An S-type pitot tube with a thermocouple assembly, calibrated in accordance with Method 2, Section 4.1.1, was used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

A cyclonic flow check was 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 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 3. The O_2 /CO_2 content of the gas stream was drawn into a tedlar bag and measured using an O_2 /CO_2 Fyrite gas analyzer.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the moisture sampling (see Section 3.2) and passed through (i) two impingers, each with 100 ml glycol diluted water, (ii) an empty impinger, and (iii) an impinger filled with silica gel. Exhaust gas moisture content is then determined gravimetrically.

Volatile Organic Compounds (USEPA Method 25A) with Dilution

Volatile Organic compound (VOC) concentrations for the Copeland + Distank RTO's inlet and outlet stacks 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 along with a heated dilution unit before it enters the analyzer. Data was recorded at 4-second intervals on a PC equipped with Labview® II data acquisition software. BTEC used two JUM 109A hydrocarbon analyzers with methane cutters along with M&C Gas-Dilution Units DIL-1/(H) to determine the VOC concentration.

An Environics gas dilution system was used to generate all non-zero calibration gases. A zero, low, mid, and high level gas (approximately 0, 30, 50, and 90) was introduced directly to the back of the analyzer (to bypass the dilution unit) to verify the "Calibration Error" requirement in section 8.4 of Method 25A. Each of these analyzer readings was within the ±5% of the Environics predicted value.

Following the calibration error check, the analyzer was connected to the full system including the dilution unit. A zero and low level gas (each approximately 10-12 times the concentrations used for the calibration error) was introduced to the full system. The recorded values were compared with the Environics predicted values to calculate a dilution factor (Dilution Factor = Environics predicted value / analyzer response during "initial system calibration"). These values were used as the "intial system calibrations". No adjustments to the dilution units were made for the remainder of the test (The instrument span value used for calculations is the highest calibration gas used during the "calibration error" step).

After each test, a zero and a low level gas was introduced to the system and the analyzers response recorded. The post calibration drift was calculated using the respective post test analyzer calibration and the "initial system calibration". The drift must was within ±3% of the system span·

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

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 stack showing sampling ports in relation to upstream and downstream disturbances is included as Figure 3.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figure 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 Table 5.

Table 3
Overall Emission Summary
Test Date: February 18, 2015

Pollutant	Average Emission Rate	Emission Limit
VOC (DE)	97.0%	90%
Black Liquor Solids Fired	1.2 lb/ton	≤2.97 lb/ton

5.b Discussion of Results

The DE was 97.0% which is higher than the limit of 90%. The black liquor solids fired was 1.30 lb/ton, which is also below the limit of ≤2.97 lb/ton.

5.c Sampling Procedure Variations

Run 1 was a spot check and less than one hour long, and did not show passing results. Raw CEM data for Run 1 is included on the enclosed compact disc.

Run 2 also did not have passing results, and so a temperature change to the RTO was made after the run. Run 3 had passing results but PCA decided to continue further runs at a lower RTO temperature to achieve the lowest average minimum operating temperature possible at steady operation.. The results of Run 2 and 3 are included as Table 5.

Freezing sampling apparatus issues occurred during Run 6 due to the high moisture and very cold temperatures. Run 6 was extended due to lost time during freezing. Run 3 was also extended due to a loss of dilution air but remedied with no loss in data quality.

5.d Process or Control Device Upsets

No upsets occurred in the process. However, in order to achieve a lower average RTO temperature, five test runs were done in addition to the first spot check. No adjustments to the RTO were made after the first three test runs.

5.e Control Device Maintenance

12-6-14 - RTO saddle replacement.

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 4
Detailed RTO Destruction Efficiency Summary
PCA
Filer City, Michigan

Parameter	Run 4	Run 5	Run 6	Average
Sampling Date	2/18/2015	2/18/2015	2/18/2015	
Sampling Time	13:15-14:15	14:47-15:47	17:20-18:27*	
RTO Temp	1716	1701	1693	
Black Liquor Solids (Tons/hr)	7.89	7.92	7.90	7.90
Exhaust Flowrate (scfm)	56,443	57,357	55,045	56,282
Measured Inlet VOC Concentration (ppmv propane)	67.73	95.09	72.29	
Measured Inlet CH4 Concentration (ppmv methane)	86.68	124.26	96.36	
Measured Inlet VOC Concentration (ppmv propane) Corrected by 7E	66.7	93.7	71.9	
Measured Inlet CH4 Concentration (ppmv methane) Corrected by 7E	86.1	124.2	96.5	
Inlet Dilution Factor	30.1	30.1	30.1	
Actual Inlet VOC Concentration (ppmv propane)	2006.38	2820.96	2163.50	2330.28
Actual Inlet CH4 Concentration (ppmv methane)	2592.38	3738.69	2905.10	3078.72
Inlet VOC Concentration (ppmv propane, - methane)	817.22	1105.97	830.89	918.02
Inlet VOC Emission Rate (lbs/hr, -methane)	**315.7**	**434.1**	**313.0**	**354.3**
Measured Outlet VOC Concentration (ppmv propane)	7.62	8.21	8.24	
Measured Outlet CH4 Concentration (ppmv methane)	12.15	13.58	13.37	
Measured Outlet VOC Concentration (ppmv propane) Corrected by 7E	7.5	8.1	8.1	
Measured Outlet CH4 Concentration (ppmv methane) Corrected by 7 E	11.2	12.5	12.4	
Outlet Dilution Factor	10.1	10.1	10.1	
Actual Outlet VOC Concentration (ppmv propane)	75.43	81.50	81.81	79.58
Actual Outlet CH4 Concentration (ppmv methane)	112.71	126.46	125.45	121.54
Outlet VOC Concentration (ppmv propane, - methane)	26.4	26.5	27.3	26.7
Outlet VOC Emission Rate (lbs/hr, -methane)	**10.2**	**10.4**	**10.3**	**10.3**
VOC Destruction Efficiency (%)	**96.8**	**97.6**	**96.7**	**97.0**
Outlet VOC Emission Rate (lb/ton BLS)	**1.29**	**1.32**	**1.30**	**1.30**

* run gap from 17:31-17:38 due to ice blockage in sample probe
Inlet Flowrate was not measured and is assumed to be the same as the Outlet
Dilution factor is averaged fom initial VOC and CH4 calibration results

Inlet VOC Correction			
Co	1.37	1.96	1.76
Cma	149.4	149.4	149.4
Cm	150.11	150.42	148.36
Cma pre dilution		4482	

Inlet CH4 Correction			
Co	1.14	1.25	1.18
Cma	149.3	149.3	149.3
Cm	149.43	149.11	148.42
Cma pre dilution		4480	

Outlet VOC Correction			
Co	0.30	0.30	0.30
Cma	49.6	49.6	49.6
Cm	48.95	48.95	48.95
Cma pre dilution		496	

Outlet CH4 Correction			
Co	0.91	0.99	1.04
Cma	49.8	49.8	49.8
Cm	51.07	51.07	50.49
Cma pre dilution		498	

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
BLS: Black Liquor Solids
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
453600: mg per lb

Inlet Response Factor	Outlet Response Factor
2.18	2.30

Equations
Actual Concentration = Measured Concentration * Dilution Factor
ppmv propane, -methane = ppmv propane - ppmv methane / RF
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

Table 5
RTO Non Compliance Test Runs
PCA
Filer City, Michigan

Parameter	Run 2	Run 3	Average
Sampling Date	2/18/2015	2/18/2015	
Sampling Time	9:45-10:45	11:36-12:41*	
RTO Temp	1662	1765	
Black Liquor Solids (Tons/hr)	7.78	7.87	7.82
Exhaust Flowrate (scfm)	56,443	56,443	56,443
Measured Inlet VOC Concentration (ppmv propane)	103.35	86.95	
Measured Inlet CH4 Concentration (ppmv methane)	125.17	103.13	
Measured Inlet VOC Concentration (ppmv propane) Corrected by 7E	103.1	86.2	
Measured Inlet CH4 Concentration (ppmv methane) Corrected by 7E	124.3	101.8	
Inlet Dilution Factor	30.1	30.1	
Actual Inlet VOC Concentration (ppmv propane)	3103.31	2595.17	2849.24
Actual Inlet CH4 Concentration (ppmv methane)	3741.51	3062.84	3402.17
Inlet VOC Concentration (ppmv propane, - methane)	1387.02	1190.20	1288.61
Inlet VOC Emission Rate (lbs/hr, -methane)	**535.8**	**459.7**	**497.75**
Measured Outlet VOC Concentration (ppmv propane)	62.51	11.05	
Measured Outlet CH4 Concentration (ppmv methane)	86.04	17.12	
Measured Outlet VOC Concentration (ppmv propane) Corrected by 7E	64.3	11.1	
Measured Outlet CH4 Concentration (ppmv methane) Corrected by 7 E	85.3	16.1	
Outlet Dilution Factor	10.1	10.1	
Actual Outlet VOC Concentration (ppmv propane)	649.85	111.87	380.86
Actual Outlet CH4 Concentration (ppmv methane)	861.10	162.55	511.82
Outlet VOC Concentration (ppmv propane, - methane)	275.5	41.2	158.33
Outlet VOC Emission Rate (lbs/hr, -methane)	**106.4**	**15.9**	**61.16**
VOC Destruction Efficiency (%)	**80.1**	**96.5**	**88.3**
Outlet VOC Emission Rate (lb/ton BLS)	**13.68**	**2.02**	**7.85**

*gap in run from 12:10-12:15 due to loss of dilution air
Inlet Flowrate was not measured and is assumed to be the same as the Outlet
Dilution factor is averaged fom initial VOC and CH4 calibration results

Inlet VOC Correction		
Co	1.43	1.21
Cma	149.4	149.4
Cm	149.12	149.79
Cma pre dilution		4482

Inlet CH4 Correction		
Co	0.68	0.94
Cma	149.3	149.3
Cm	150.21	150.88
Cma pre dilution		4480

Outlet VOC Correction		
Co	0.49	0.36
Cma	49.6	49.6
Cm	48.30	48.23
Cma pre dilution		496

Outlet CH4 Correction		
Co	0.83	0.91
Cma	49.8	49.8
Cm	50.60	51.07
Cma pre dilution		498

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
BLS: Black Liquor Solids
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
453600: mg per lb

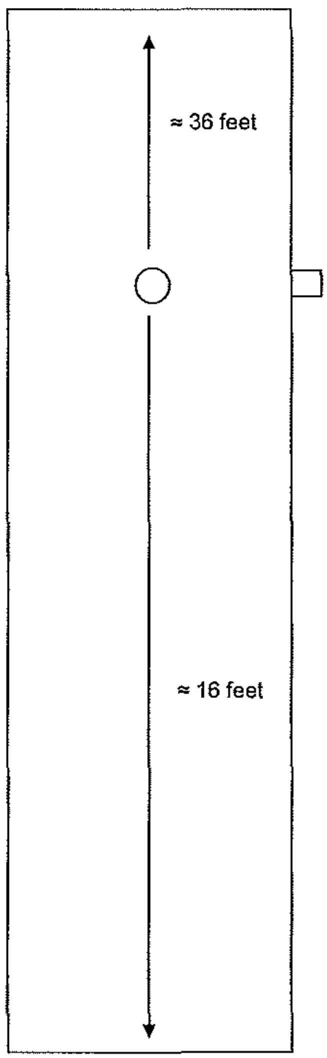
Inlet Response Factor	Outlet Response Factor
2.18	2.30

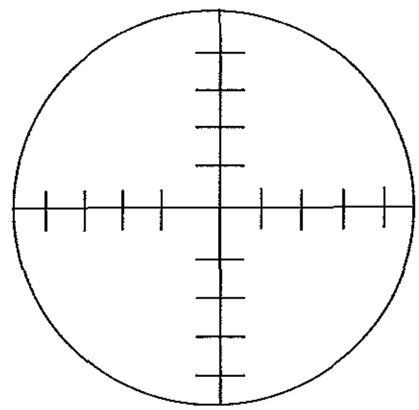
Equations
Actual Concentration = Measured Concentration * Dilution Factor
ppmv propane, -methane = ppmv propane - ppmv methane / RF
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

Figures

BTEC Inc.

diameter = 78.5





Not to Scale

Points	Distance "
1	2.5
2	8.2
3	15.2
4	25.4
5	53.1
6	63.3
7	70.3
8	76.0

Figure 1

Site: **RTO Exhaust** **PCA** **Filer City, Michigan**	**Sampling Date:** **February 18, 2015**	**<u>BT Environmental Consulting, Inc.</u>** **4949 Fernlee** **Royal Oak, Michigan**

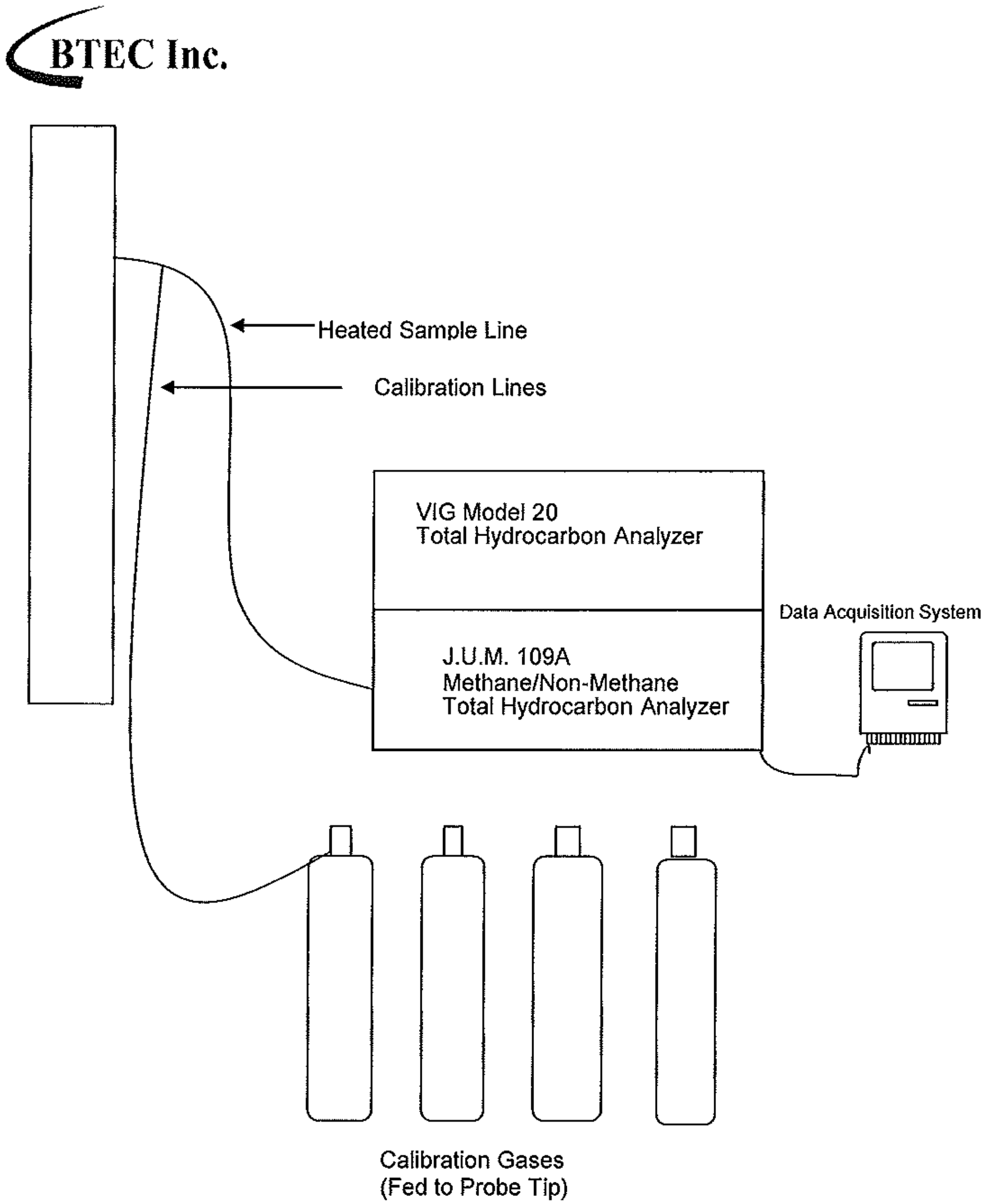


Figure 2

Site: **USEPA Method 25A** **PCA** **Filer City, Michigan**	**Sampling Date:** **February 18, 2015**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

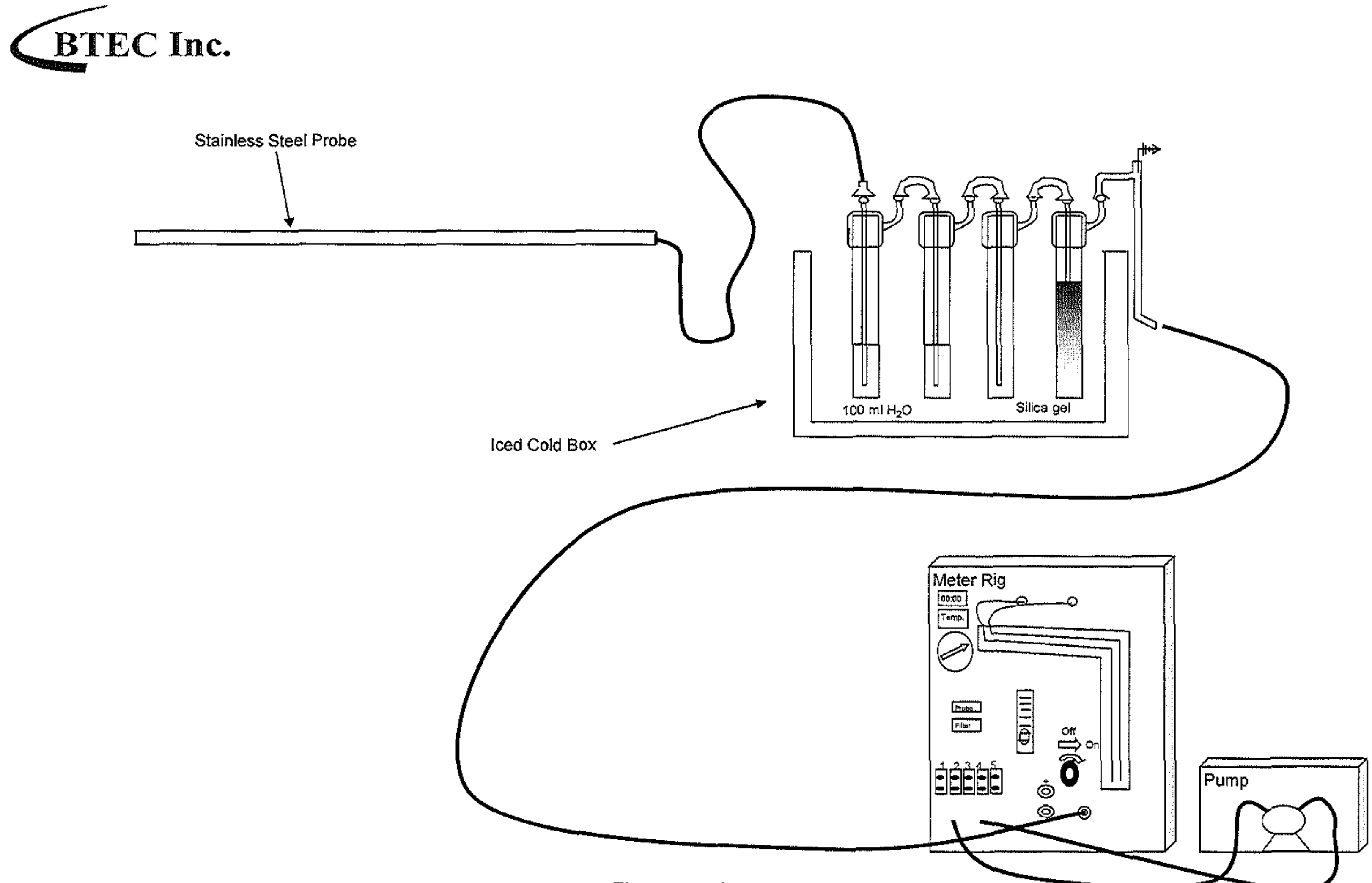


Figure No. 3

Site:	Sampling Date:	
USEPA Method 4	February 18, 2015	BT Environmental Consulting, Inc.
PCA		4949 Fernlee Avenue
Filer City, Michigan		Royal Oak, Michigan