BTEC Inc.

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Ford Motor Company (Ford) to evaluate volatile organic compounds (VOC) Removal Efficiency (RE) of the Carbon Wheels Systems No. 1 & 2 and Destruction Efficiency (DE) of the four Regenerative Thermal Oxidizers (RTOs) associated with the carbon wheel systems and ovens at the Michigan Assembly Plant located in Wayne, Michigan. The emissions test program was conducted from March 7th, 2017 to March 14th, 2017. The purpose of this report is to document the results of the test program.

Testing consisted of triplicate 60-minute test runs. The results of the emission test program are summarized by Table I.

Table I
Overall Results Summary
Test Dates: March 7-14, 2017

Source	Test Dates	Destruction Efficiency (%)	Removal Efficiency (%)	Temperature °F
Ecoat RTO	March 8, 2017	98.9		1,502
3-Wet Oven RTO	March 7, 2017	97.8		1,400
Carbon Wheel System 1 RTO	March 9, 2017	98.2		1,425
Carbon Wheel System 2 RTO	March 14, 2017	95.5		1,508
Carbon Wheel System 2	March 14, 2017		95.3	268

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1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Ford Motor Company (Ford) to evaluate volatile organic compounds (VOC) Removal Efficiency (RE) of the Carbon Wheels Systems No. 1 & 2 and Destruction Efficiency (DE) of the four Regenerative Thermal Oxidizers (RTOs) associated with the carbon wheel systems and ovens at the Michigan Assembly Plant located in Wayne, Michigan. The emissions test program was conducted on March 7th to March 14th, 2017. The purpose of this report is to document the results of the test program.

The Air Quality Division (AQD) of Michigan's Department of Environmental Quality has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013, see Appendix A). The following is a summary of the emissions test program and results in the format outlined by the AQD document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emissions test program was conducted on March 7-14, 2017. Sampling was conducted at the ECoat RTO (March 8th), 3-Wet Oven RTO (March 7th), Carbon Wheel System 1 RTO (March 9th , Carbon Wheel System 1 RTO (March 13th), and Carbon Wheel & RTO System 2 (March 14th). The test program included evaluation of VOC emission rates at the inlet(s) and outlet(s) and corresponding VOC RE, and DE.

1.b Purpose of Testing

The purpose of the emissions test program was to verify VOC RE, DE, and demonstrate overall control efficiency to comply with the requirements of Michigan Department of Environmental Quality Air Quality Division Permit No. MI-ROP-A8650-2016 for the Michigan Assembly Plant.

1.c Source Description

The sources tested control VOC emissions from the ECoat and 3-Wet painting operations process. The system consists of two carbon concentration wheel systems and four RTOs.

BTEC Inc.

1.d Testing Personnel

Names and affiliations for personnel involved in the emissions test program are summarized by Table 1.

Table 1
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Barry Boulianne Senior Project Manager	BTEC 4949 Fernlee Ave. Royal Oak, MI	(248) 548-8072
Mr. Steve Smith Project Manager	BTEC 4949 Fernlee Ave. Royal Oak, MI	(248) 548-8070
Mr. Mason Sakshaug Environmental Technician	BTEC 4949 Fernlee Ave. Royal Oak, MI	(248) 548-8070
Mr. Shane Rabideau Environmental Technician	BTEC 4949 Fernlee Ave. Royal Oak, MI	(248) 548-8070
Mr. Paul Molenda Environmental Technician	BTEC 4949 Fernlee Ave. Royal Oak, MI	(248) 548-8070
Mr. David Trahan Environmental Technician	BTEC 4949 Fernlee Ave. Royal Oak, MI	(248) 548-8070
Ms. Susan Hicks Principal Environmental Engineer	Ford Motor Company Fairlane Plaza North 290 Town Center Drive, Suite 800 Dearborn, Michigan 48126	(313)594-3185
Mr. Mark Dziadosz MDEQ Air Quality Division	Michigan Department of Environmental Quality SE Michigan District 27700 Donald Ct Warren, MI 48092	(586)753-3745

2. Summary of Results

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

2.a Operating Data

Process operating data for this emissions test program is provided in Appendix E.

2.b Applicable Permit

The applicable permit for this emissions test program is Permit No. MI-ROP-A8650-2016.

2.c Results

The results of the emissions test program are summarized by Table 2. Detailed data for each test run can be found in Tables 3-7.

Table 2
Overall Results Summary
Test Dates: March 7th-14th, 2017

Source	Test Dates	Destruction Efficiency (%)	Removal Efficiency (%)	Temperature °F
Ecoat RTO	March 8, 2017	98.9		1,502
3-Wet Oven RTO	March 7, 2017	97.8		1,400
Carbon Wheel System 1 RTO	March 9, 2017	98.2		1,425
Carbon Wheel System 2 RTO	March 14, 2017	95.5		1,508
Carbon Wheel System 2	March 14, 2017		95.3	268

2.d Emission Regulation Comparison

NA

3. Source Description

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

3.a Process Flow Diagram

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

3.b Process Description

Michigan Assembly is an automotive assembly plant located in Wayne, Michigan. Vehicle body panels are stamped and assembled on site from sheet metal components. The bodies are cleaned, treated, and prepared for painting in the phosphate system. Drawing compounds, mill oils, and dirt are removed from the vehicle bodies utilizing both high pressure spray and immersion cleaning/rinsing techniques. Vehicle bodies then are dip coated in electro deposition corrosion primer paint for protection. The electro primer (E-coat) is heat-cured to the vehicle body in a high-temperature bake oven. After completing the E-coat operation, vehicle bodies are conveyed to the sealer area for application of various sealants to body seams and joints. Vehicle bodies are then conveyed to an oven to cure the sealers.

After the sealer oven, the vehicles are routed to the 3-Wet paint system. The 3-Wet system consists of dual spray booths and oven; the bodies receive a solvent borne surface primer, basecoat and clearcoat that is applied to interior and exterior surface areas. All three materials are applied using robotic bell applicators. The surfaces are then dried in the oven. After exiting the 3-Wet oven, the vehicles are routed to inspection and blackout/cavity wax booth.

3.c Raw and Finished Materials

NA.

3.d Process Capacity

NA.

3.e Process Instrumentation

The rotary concentrator desorb temperature was recorded every 15-minutes during each test run. The regenerative thermal oxidizer temperature was recorded every 15-minutes during the test run. Process data was collected by Ford personnel and can be found in Appendix E.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used to verify emission rates and removal efficiency.

4.a Sampling Train and Field Procedures

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 at each traverse location. 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 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. Both sampling locations were evaluated for cyclonic flow and deemed acceptable for flowrate measurement.

Exhaust gas molecular weight was determined according to Method 3. The equipment used for the Method 3 evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. CO_2 and O_2 content was analyzed using the Fyrite® procedure.

Exhaust gas moisture content was evaluated using Method 4 with triplicate test runs conducted at the outlet. Exhaust gas was extracted 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 was then determined volumetrically (liquid impingers) and gravimetrically (silica gel impinger). A schematic drawing of the Method 4 sampling train is provided as Figure 15.

VOC concentrations were measured at the inlet and outlet of the carbon concentrators according to USEPA Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer." The samples were collected through a probe and heated sample line, and into the analyzers, in accordance with Method 25A procedures. BTEC used a VIG THC hydrocarbon analyzer to determine the VOC concentration at the inlet. A J.U.M. Model 109A methane/non-methane hydrocarbon analyzer was used at the outlet to determine the methane/non-methane concentrations.

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 will be ionized into carbon. The carbon concentration is then determined by the detector in parts per million (ppm). This concentration is sent 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).

The J.U.M. Model 109A utilizes two FIDs to determine the average ppm for THC (as propane), as well as the average ppm for methane (as methane). Upon entry, the gas stream is split by the analyzer. 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 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 ppm 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.

The analyzer's response factor is obtained by introducing a methane calibration gas to the calibrated J.U.M. 109A. The response of the analyzer's THC FID to the methane calibration gas, in ppm as propane, is divided by the Methane analyzer's response to the methane calibration gas, in ppm as methane.

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 drawing of the continuous emission system is provided as Figure 16.

4.b Recovery and Analytical Procedures

Molecular weight and moisture content and samples were recovered and analyzed consistent with the specification of Methods 3 and 4.

4.c Sampling Ports

The inlet and outlet sampling locations satisfy the minimum criteria for Method 1.

4.d Traverse Points

Stack traverse point diagrams are appended as Figures 1-14.

5. Test Results and Discussion

The final results for Carbon Wheel System #1 have not been included as the outlet airflow taken during the test does not appear to be representative. The airflow on the outlet stack may have been affected by the extreme high wind conditions and weather conditions.

The Ford team has worked with an outside supplier to verify that the system airflows are operating as designed. The BTEC team was contracted to perform an additional airflow study.

The Ford team would like to schedule a test as soon as possible for Carbon Wheel System #1 removal efficiency.

5.a Results Tabulation

The results of the emission test program are summarized by Table 2 (see section 2c). Detailed data for each test run can be found in Tables 3-7.

5.b Sampling Procedure Variations

The emissions test program did not include sampling procedure variations.

5.c Process or Control Device Upsets

No upset conditions occurred during testing.

5.d Control Device Maintenance

There has been no major maintenance performed during the past three months.

5.e Retest

This test program was not a re-test.

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 C.

5.h Sample Calculations

Sample calculations are provided in Appendix D.

5.i Field Data Sheets

Field documents are presented as well as raw analyzer test data (provided electronically on CD) are provided in Appendix B.

5.j Laboratory Data

Since all analysis was performed on site through the use of online analyzers there are no laboratory results for this test program.

Table 3
Ecoat RTO VOC Destruction Efficiency Summary
Ford MAP
Wayne, MI

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	3/8/2017	3/8/2017	3/8/2017	
Sampling Time	8:15-9:15	9:48-10:48	13:05-14:05	
Tank Inlet Flowrate (scfm)	13,600	13,691	13,293	13,528
Oven Inlet Flowrate (scfm)	14,849	14,469	14,628	14,649
Outlet Flowrate (scfm)	28,488	29,157	29,524	29,056
Tank Inlet VOC Concentration (ppmv propane)	15.3	18.9	12.6	15.6
Tank Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	14.9	17.8	11.0	14.6
Tank Inlet VOC Mass Flowrate (standard lb/hr)	1.4	1.7	1.0	1.4
Oven Inlet VOC Concentration (ppmv propane)	186.9	187.5	186.3	186.9
Oven Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	186.8	184.8	183.3	184.9
Oven Inlet VOC Mass Flowrate (standard lb/hr)	19.0	18.3	18.3	18.5
Outlet VOC Concentration (ppmv propane)	1.0	1.1	1.5	1.2
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	1.0	1.1	1.2	1.1
Outlet CH4 Concentration (ppmv methane)	0.0	0.2	0.1	0.1
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)*	0.0	0.0	0.0	0.0
Outlet VOC Concentration (- methane)	1.0	1.1	1.2	1.1
Outlet VOC Mass Emission Rate (standard lb/hr)	0.2	0.2	0.2	0.2
VOC Destruction Efficiency (%)	**99.1**	**98.9**	**98.8**	**98.9**

*: Run 2 and 3 oulet methane concentration was negative after drift correction and has been reset to zero.

Tank Inlet 1 VOC Correction			
Co	0.80	1.78	2.27
Cma	29.8	29.8	29.8
Cm	29.86	30.49	30.24

Oven Inlet 2 VOC Correction			
Co	3.69	6.46	7.55
Cma	149	149	149
Cm	149.85	152.39	152.88

Outlet VOC Correction			
Co	-0.05	-0.01	0.36
Cma	29.8	29.8	29.8
Cm	29.67	29.94	29.57

Outlet CH4 Correction			
Co	0.03	0.30	0.34
Cma	29.8	29.8	29.8
Cm	29.91	29.89	29.67

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
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 * scfm* 60

Table 4
3-Wet Oven RTO (Topcoat) VOC Destruction Efficiency Summary
Ford MAP
Wayne, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	3/7/2017	3/7/2017	3/17/2017	
Sampling Time	8:00-9:00	9:15-10:15	10:32-11:32	
Inlet Flowrate (scfm)	23,885	23,906	23,077	23,623
Outlet Flowrate (scfm)	22,015	23,511	21,898	22,475
Inlet VOC Concentration (ppmv propane)	247.1	343.1	289.6	293.3
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	244.9	338.6	286.4	290.0
Inlet VOC Mass Flowrate (lb/hr)	40.0	55.4	45.2	46.9
Outlet VOC Concentration (ppmv propane)	5.9	7.9	6.7	6.9
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	5.9	8.0	6.8	6.9
Outlet CH4 Concentration (ppmv methane)	0.2	0.0	0.2	0.1
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	0.2	0.0	0.3	0.2
Outlet VOC Concentration (- methane)	5.8	8.0	6.7	6.8
Outlet VOC Mass Emission Rate (lb/hr)	0.9	1.3	1.0	1.1
VOC Destruction Efficiency (%)	**97.8**	**97.7**	**97.8**	**97.8**

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
453600: mg per lb
Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

Inlet VOC Correction			
Co	2.21	4.66	4.27
Cma	249	249	249
Cm	251.24	253.57	252.35

Outlet VOC Correction			
Co	0.20	0.37	0.33
Cma	29.8	29.8	29.8
Cm	29.01	28.57	28.42

Outlet CH4 Correction			
Co	0.05	-0.04	-0.05
Cma	29.8	29.8	29.8
Cm	29.67	29.28	29.26

RF= 2.13

Table 5
Carbon Wheel System 1 RTO VOC Destruction Efficiency Summary
Ford MAP
Wayne, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	3/9/2017	3/9/2017	3/9/2017	
Sampling Time	8:00-9:00	9:15-10:15	10:30-11:30	
Inlet Flowrate (scfm)	9,387	9,667	9,218	9,424
Outlet Flowrate (scfm)	11,490	11,245	10,831	11,189
Inlet VOC Concentration (ppmv propane)	250.0	259.6	274.0	261.2
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	249.6	259.0	273.7	260.8
Inlet VOC Mass Flowrate (lb/hr)	16.0	17.1	17.3	16.8
Outlet VOC Concentration (ppmv propane)	3.6	3.6	3.7	3.6
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	3.9	3.9	4.0	3.9
Outlet CH4 Concentration (ppmv methane)	0.3	0.0	0.0	0.1
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	0.3	0.0	0.0	0.1
Outlet VOC Concentration (- methane)	3.7	3.9	4.0	3.9
Outlet VOC Mass Emission Rate (lb/hr)	0.3	0.3	0.3	0.3
VOC Destruction Efficiency (%)	**98.2**	**98.2**	**98.3**	**98.2**

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
453600: mg per lb
Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

Inlet VOC Correction			
Co	2.08	3.88	3.67
Cma	299	299	299
Cm	299.00	299.10	298.94

Outlet VOC Correction			
Co	-0.10	-0.09	0.01
Cma	29.8	29.8	29.8
Cm	28.81	27.83	27.33

Outlet CH4 Correction			
Co	0.05	-0.07	-0.23
Cma	29.8	29.8	29.8
Cm	29.84	29.52	29.25

RF= 2.17

Table 6
Carbon Wheel System 2 RTO VOC Destruction Efficiency Summary
Ford MAP
Wayne, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	3/14/2017	3/14/2017	3/14/2017	
Sampling Time	8:20-9:20	9:34-10:34	10:55-11:55	
Inlet Flowrate (scfm)	16,921	16,524	17,348	16,931
Outlet Flowrate (scfm)	19,718	22,067	20,744	20,843
Inlet VOC Concentration (ppmv propane)	361.1	210.8	396.7	322.9
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	360.7	210.4	400.2	323.8
Inlet VOC Mass Flowrate (lb/hr)	41.8	23.8	47.5	37.7
Outlet VOC Concentration (ppmv propane)	12.5	11.9	11.6	12.0
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	12.4	11.8	11.4	11.9
Outlet CH4 Concentration (ppmv methane)	3.1	3.0	2.4	2.8
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	2.8	2.8	2.3	2.6
Outlet VOC Concentration (- methane)	11.1	10.5	10.4	10.7
Outlet VOC Mass Emission Rate (lb/hr)	1.5	1.6	1.5	1.5
VOC Destruction Efficiency (%)	**96.4**	**93.3**	**96.9**	**95.5**

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
453600: mg per lb

Equations

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

Inlet VOC Correction			
Co	2.97	4.17	3.97
Cma	498	498	498
Cm	497.48	493.22	492.74

Outlet VOC Correction			
Co	0.37	0.75	0.84
Cma	29.8	29.8	29.8
Cm	29.49	29.08	28.79

Outlet CH4 Correction			
Co	0.28	0.23	0.09
Cma	29.8	29.8	29.8
Cm	29.95	29.71	29.36

RF= 2.2

Table 7
Carbon Wheel System 2 VOC Removal Efficiency Summary
Ford MAP
Wayne, MI

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	3/14/2017	3/14/2017	3/14/2017	
Sampling Time				
Basecoat 1 Flowrate (scfm)	57,043	58,316	59,165	**58,175**
Basecoat 2 Flowrate (scfm)	22,900	22,660	22,979	**22,846**
Primecoat Flowrate (scfm)	35,027	35,478	35,170	**35,225**
Clearcoat Flowrate (scfm)	48,767	48,887	48,356	**48,670**
Combined Outlet Flowrate (scfm)	157,385	156,340	157,392	**157,039**
RTO Outlet (scfm)	20,584	21,289	21,528	**21,134**
Basecoat 1 VOC Concentration (ppmv propane)	59.6	51.0	37.2	**49.3**
Basecoat 1 VOC Concentration (ppmv, corrected as per USEPA 7E)	60.0	51.4	37.4	**49.6**
Basecoat 1 VOC Mass Flowrate (standard lb/hr)	23.4	20.5	15.1	**19.7**
Basecoat 2 VOC Concentration (ppmv propane)	87.4	76.5	62.5	**75.5**
Basecoat 2 VOC Concentration (ppmv, corrected as per USEPA 7E)	87.5	77.1	63.1	**75.9**
Basecoat 2 VOC Mass Flowrate (standard lb/hr)	13.7	11.9	9.9	**11.9**
Primecoat VOC Concentration (ppmv propane)	73.7	74.5	52.1	**66.8**
Primecoat VOC Concentration (ppmv, corrected as per USEPA 7E)	73.1	74.4	51.7	**66.4**
Primecoat VOC Mass Flowrate (standard lb/hr)	17.5	18.1	12.4	**16.0**
Clearcoat VOC Concentration (ppmv propane)	107.4	121.2	88.1	**105.6**
Clearcoat VOC Concentration (ppmv, corrected as per USEPA 7E)	107.3	121.5	88.0	**105.6**
Clearcoat VOC Mass Flowrate (standard lb/hr)	35.8	40.6	29.1	**35.2**
Combined Inlets Mass Flowrate (standard lb/hr)	**90.5**	**91.2**	**66.6**	**82.7**
Combined Outlet VOC Concentration (ppmv propane)	5.9	6.7	5.4	**6.0**
Combined Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	5.6	6.6	5.5	**5.9**
Combined Outlet CH4 Concentration (ppmv methane)	2.3	2.3	2.4	**2.3**
Combined Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	2.1	2.2	2.3	**2.2**
Combined Outlet (-methane)	4.6	5.6	4.5	**4.9**
Combined Outlet Mass Flowrate (standard lb/hr)	5.0	6.0	4.8	**5.3**
RTO Outlet VOC Concentration (ppmv propane)	11.0	12.1	10.1	**11.1**
RTO Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	10.9	12.1	10.1	**11.0**
RTO CH4 Concentration (ppmv methane)	2.9	1.8	2.5	**2.4**
RTO Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	2.6	1.1	1.7	**1.8**
RTO Outlet (-methane)	9.7	11.6	9.3	**10.2**
RTO Outlet Mass Flowrate (standard lb/hr)	1.4	1.7	1.4	**1.5**
CC Clean Air Exhaust Mass Flowrate (lb/hr)	**3.6**	**4.3**	**3.5**	**3.8**
VOC Removal Efficiency %	**96.0**	**95.2**	**94.8**	**95.3**

Basecoat 1 VOC Correction			
Co	-0.12	-0.06	0.18
Cma	90.29	90.29	90.29
Cm	89.72	89.70	89.64

Basecoat 2 VOC Correction			
Co	0.11	0.60	0.52
Cma	90.29	90.29	90.29
Cm	90.12	89.54	89.32

Primecoat VOC Correction			
Co	0.21	0.59	0.64
Cma	90.29	90.29	90.29
Cm	90.93	90.25	90.59

Clearcoat VOC Correction			
Co	0.05	0.56	0.12
Cma	90.29	90.29	90.29
Cm	90.34	90.16	90.44

Combined Outlet VOC Correction			
Co	0.42	0.33	0.16
Cma	29.8	29.8	29.8
Cm	29.32	28.80	28.60

Combined Outlet CH4 Correction			
Co	0.28	0.21	0.17
Cma	29.8	29.8	29.8
Cm	29.50	29.11	29.25

RTO Outlet VOC Correction			
Co	0.75	0.36	-0.04
Cma	29.8	29.8	29.8
Cm	28.81	29.36	29.83

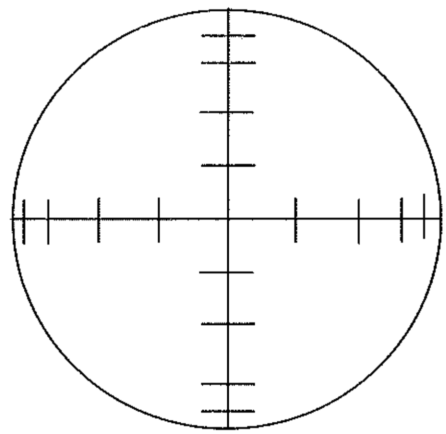
RTO Outlet CH4 Correction			
Co	0.37	0.80	0.83
Cma	29.8	29.8	29.8
Cm	29.07	29.25	29.68

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
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 * scfm * 60

BTEC Inc.

diameter = 33.5 inches

Points	Distance "
1	1.07
2	3.52
3	6.50
4	10.82
5	22.68
6	27.00
7	29.98
8	32.43



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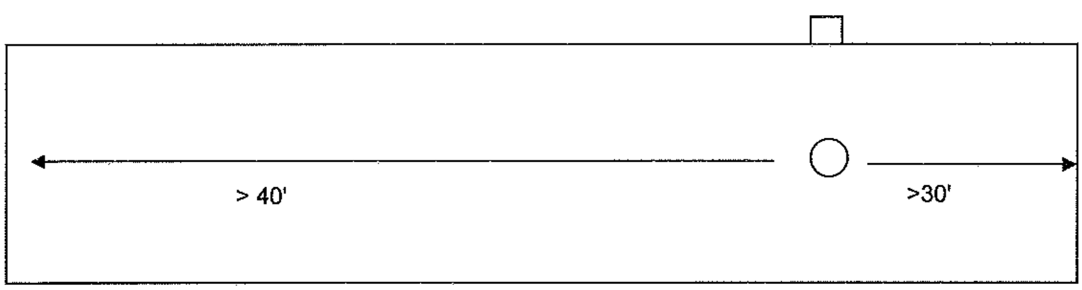


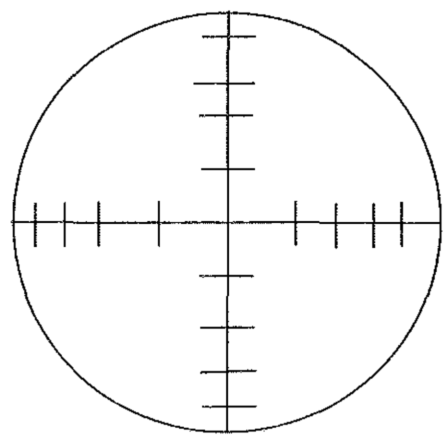
Figure No. 1

Site:	Sampling Date:	BT Environmental Consulting, Inc.
Ecoat RTO Inlet Tank Ford MAP Wayne, MI	March 8, 2017	4949 Fernlee Ave Royal Oak, MI

BTEC Inc.

diameter = 49.75 inches

Points	Distance "
1	1.59
2	5.22
3	9.65
4	16.07
5	33.68
6	40.10
7	44.53
8	48.16



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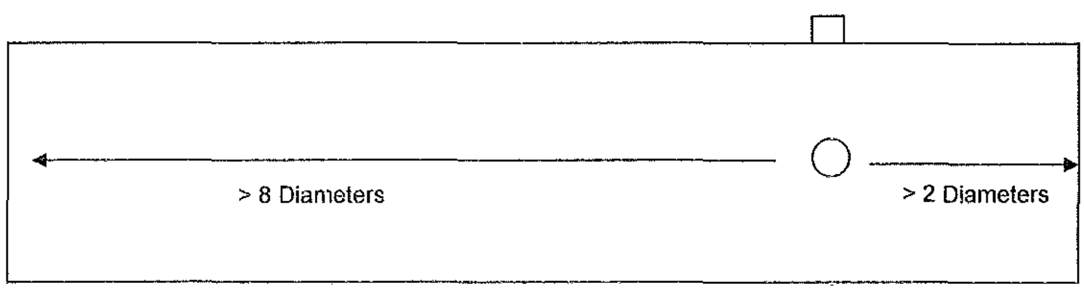
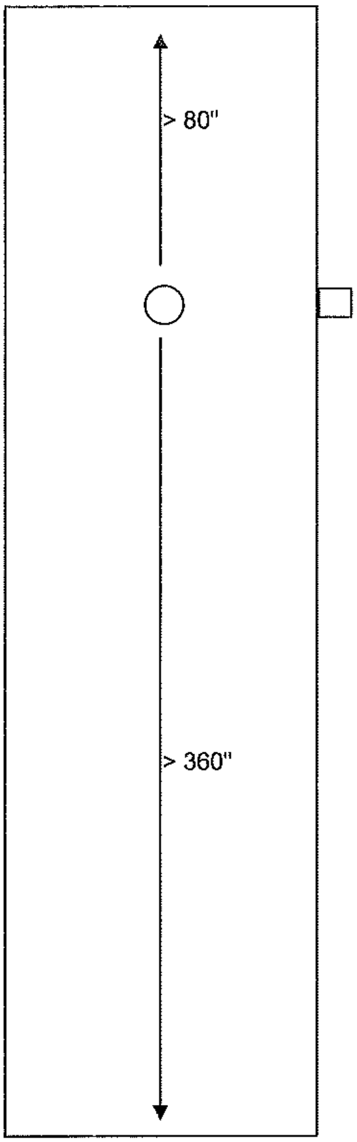
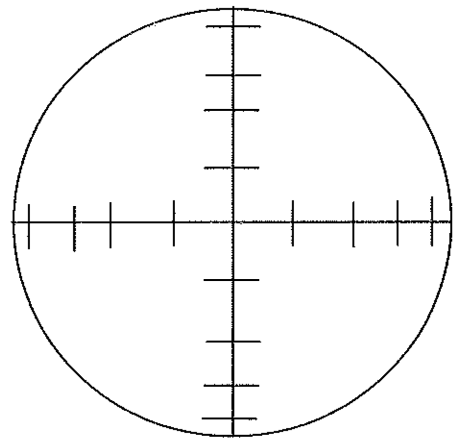


Figure No. 2

Site:	Sampling Date:	
Ecoat RTO Inlet Oven Ford MAP Wayne, MI	March 8, 2017	<u>BT Environmental Consulting, Inc.</u> 4949 Fernlee Ave Royal Oak, MI

diameter = 48.25 inches





Not to Scale

Points	Distance "
1	1.54
2	5.07
3	9.36
4	15.58
5	32.67
6	38.89
7	43.18
8	46.71

Figure No. 3

Site:
Ecoat RTO Outlet
Ford MAP
Wayne, MI

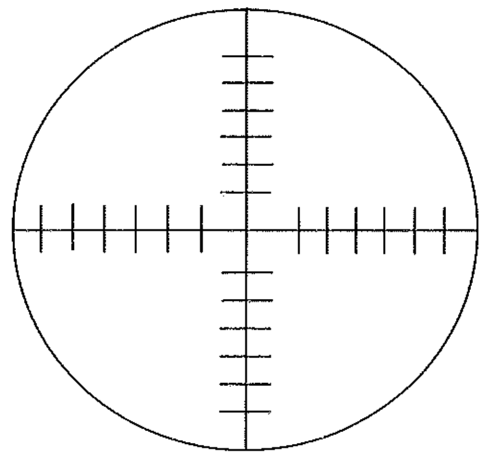
Sampling Date:
March 8, 2017

BT Environmental Consulting, Inc.
2615 Wolcott Street
Ferndale, Michigan

BTEC Inc.

diameter = 55.5 inches

Points	Distance "
1	1.78
2	5.83
3	10.77
4	17.93
5	37.57
6	44.73
7	49.67
8	53.72



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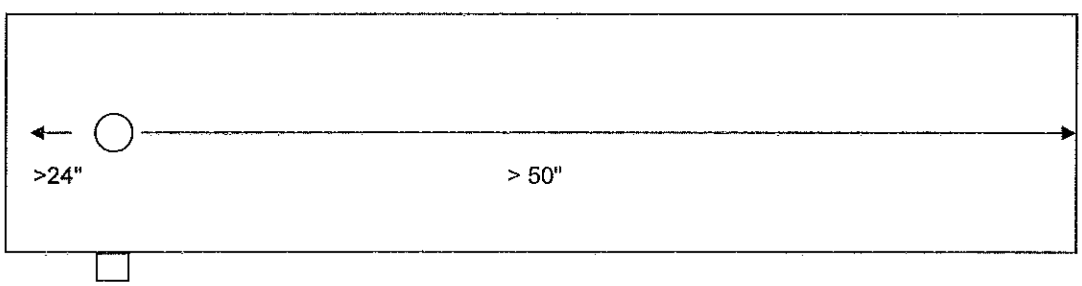
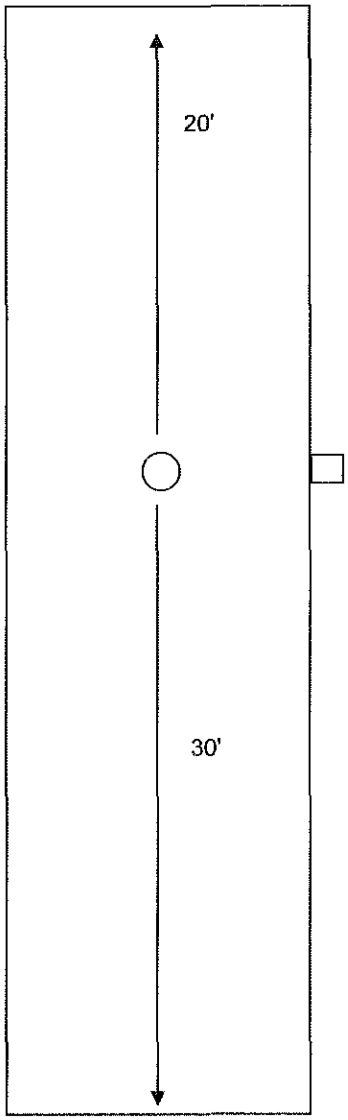


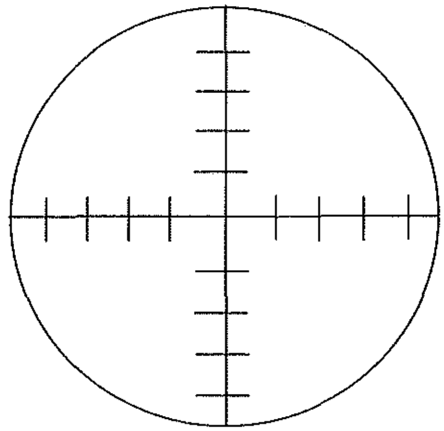
Figure No. 4

Site:	Sampling Date:	
3-Wet Oven RTO Inlet Ford MAP Wayne, MI	March 7, 2017	<u>BT Environmental Consulting, Inc.</u> 4949 Fernlee Ave Royal Oak, MI

BTEC Inc.

diameter = 59 inches





Not to Scale

Points	Distance "
1	1.89
2	6.20
3	11.45
4	19.06
5	39.94
6	47.55
7	52.81
8	57.11

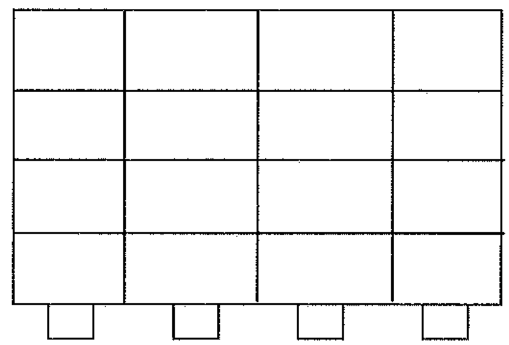
Figure No. 5

Site:	Sampling Date:	
3-Wet Oven RTO Outlet Ford MAP Wayne, MI	March 7, 2017	BT Environmental Consulting, Inc. 4949 Fernlee Ave Royal Oak, MI

BTEC Inc.

Stack Dimensions: 48" X 48"

Points	Distance "
1	6
2	18
3	30
4	42



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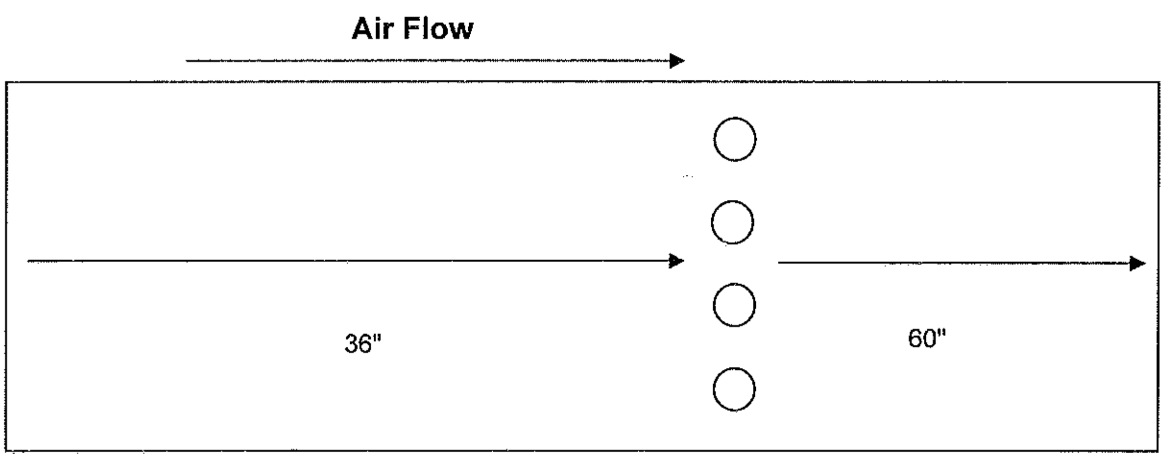

Figure No. 6

Site: **Carbon Wheel System 1 RTO Inlet** **Ford MAP** **Wayne, MI**	**Sampling Date:** **March 9, 2017**	**<u>BT Environmental Consulting, Inc.</u>** **4949 Fernlee Ave** **Royal Oak, MI**

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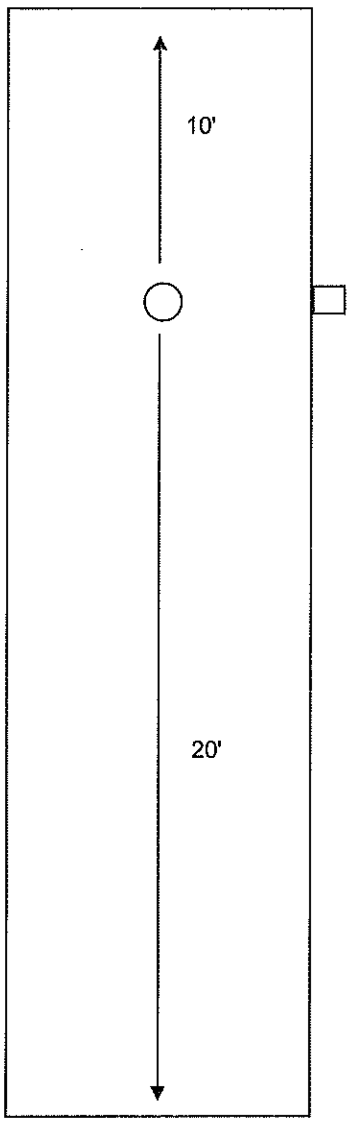
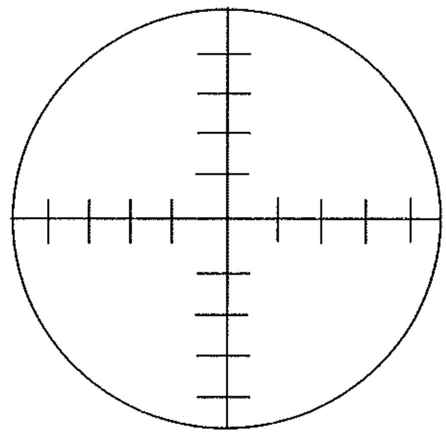
BTEC Inc.

diameter = 47.25 inches





Not to Scale

Points	Distance "
1	1.51
2	4.96
3	9.17
4	15.26
5	31.99
6	38.08
7	42.29
8	45.74

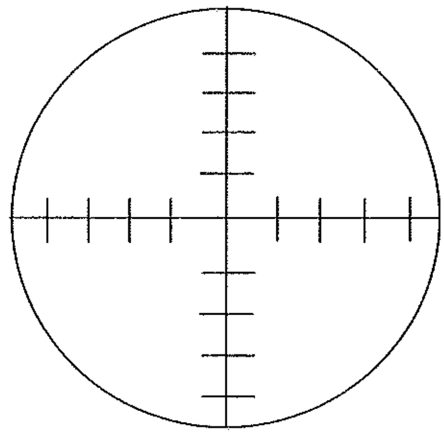
Figure No. 7

Site:	**Sampling Date:**	
Carbon Wheel System 1 RTO Outlet **Ford MAP** **Wayne, MI**	**March 9, 2017**	**BT Environmental Consulting, Inc.** **4949 Fernlee Ave** **Royal Oak, MI**

BTEC Inc.

diameter = 46 inches

Points	Distance "
1	1.47
2	4.83
3	8.92
4	14.86
5	31.14
6	37.08
7	41.17
8	44.53



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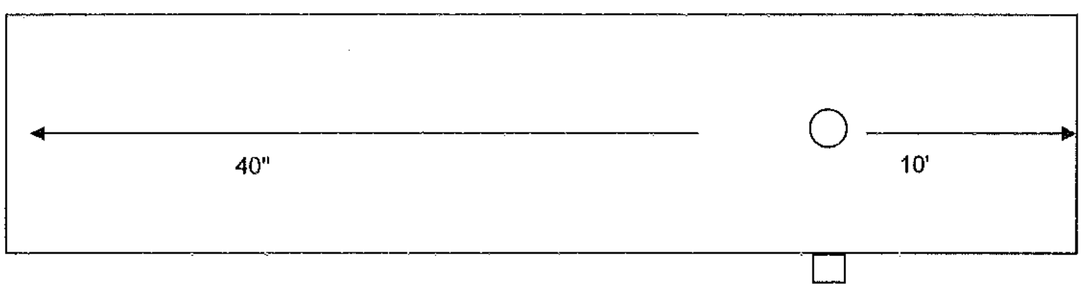


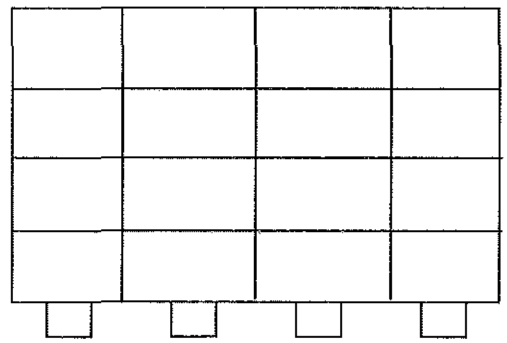
Figure No. 8

Site: Carbon Wheel System 2 RTO Inlet Ford MAP Wayne, MI	Sampling Date: March 14, 2017	BT Environmental Consulting, Inc. 4949 Fernlee Ave Royal Oak, MI

BTEC Inc.

Stack Dimensions: 48" X 66"

Points	Distance "
1	6
2	18
3	30
4	42



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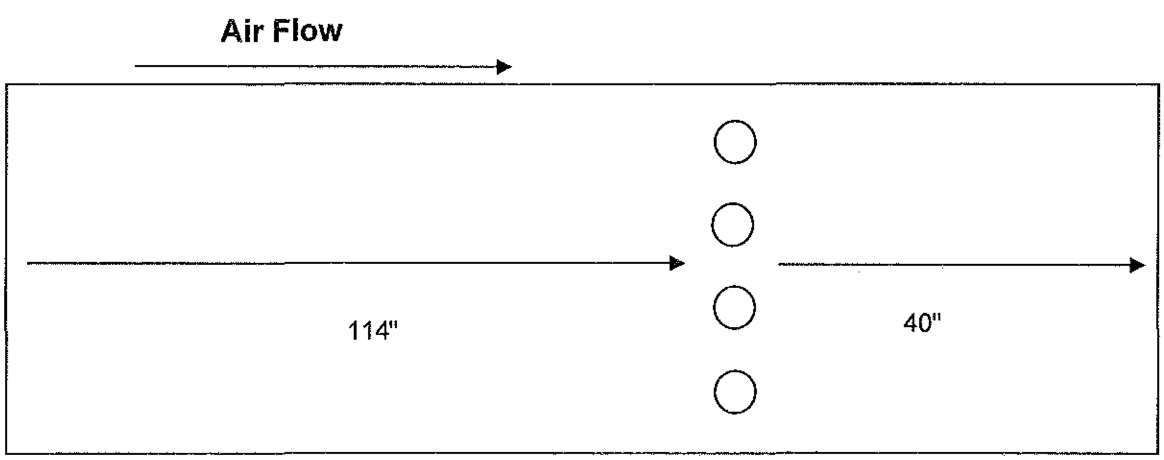


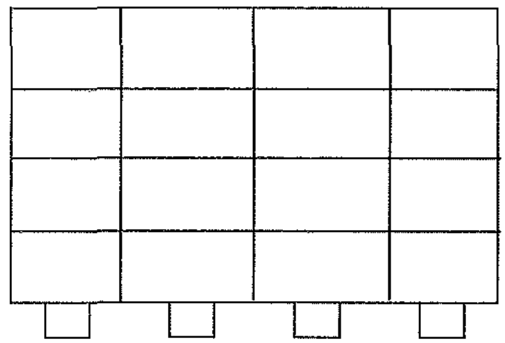
Figure No. 9

Site:	Sampling Date:	BT Environmental Consulting, Inc.
Carbon Wheel System 2 RTO Outlet Ford MAP Wayne, MI	March 14, 2017	4949 Fernlee Ave Royal Oak, MI

BTEC Inc.

Stack Dimensions: 60" X 70"

Points	Distance "
1	7.5
2	22.5
3	37.5
4	52.5



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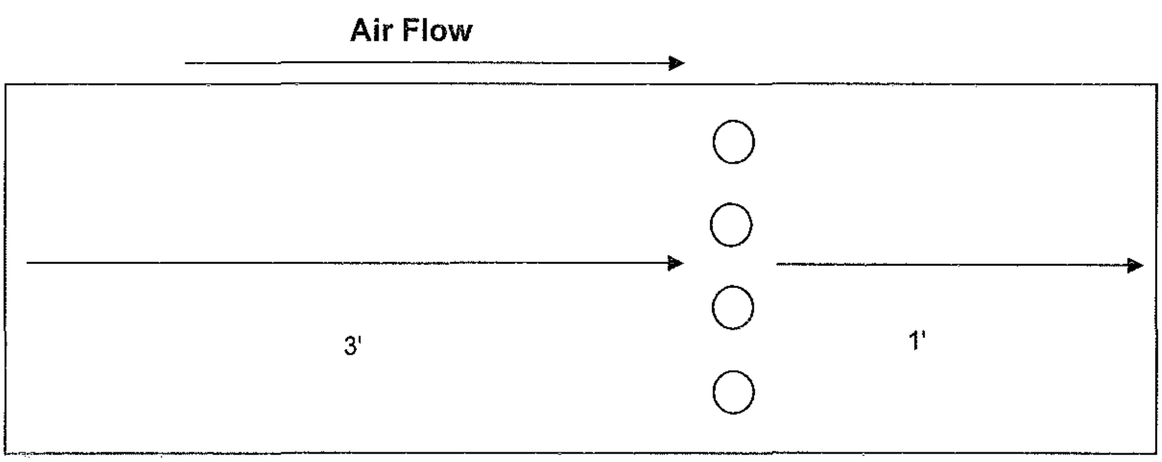


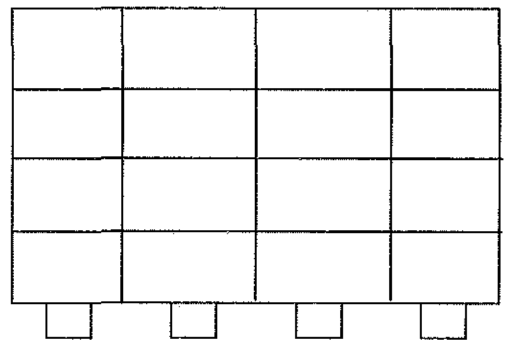
Figure No. 10

Site:	Sampling Date:	
Carbon Wheel System 2 Inlet Basecoat 1 Ford MAP Wayne, MI	March 14, 2017	<u>BT Environmental Consulting, Inc.</u> 4949 Fernlee Ave Royal Oak, MI

BTEC Inc.

Stack Dimensions: 48" X 60"

Points	Distance "
1	6
2	18
3	30
4	42



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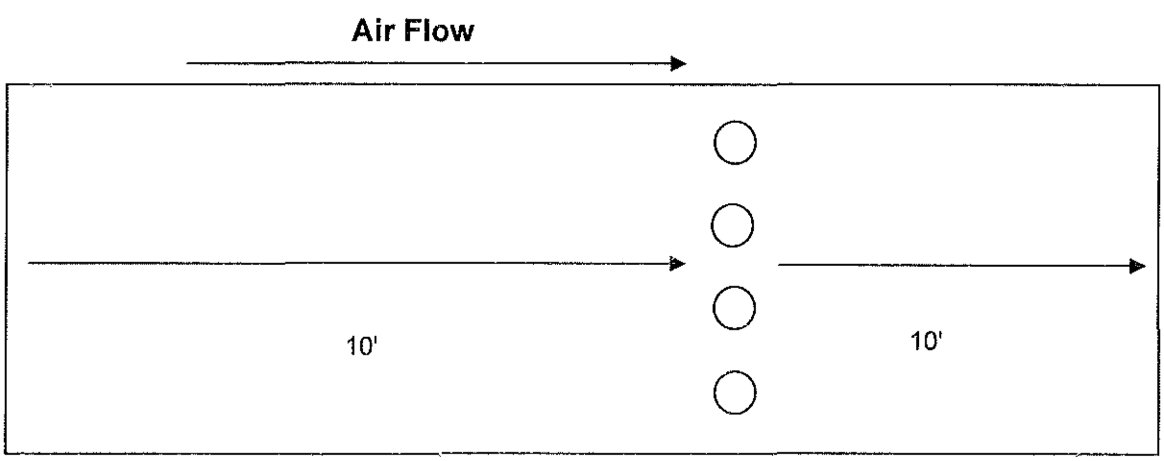


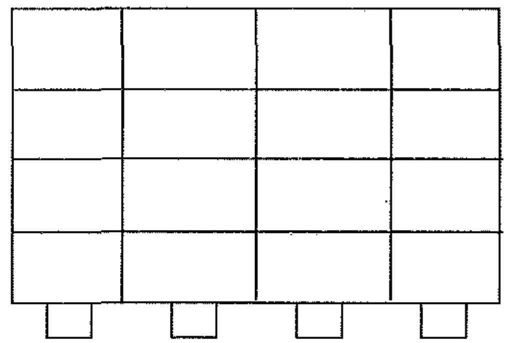
Figure No. 11

Site: **Carbon Wheel System 2 Inlet Basecoat 2** **Ford MAP** **Wayne, MI**	**Sampling Date:** **March 14, 2017**	<u>**BT Environmental Consulting, Inc.**</u> **4949 Fernlee Ave** **Royal Oak, MI**

BTEC Inc.

Stack Dimensions: 60" X 50"

Points	Distance "
1	6.3
2	18.8
3	31.3
4	43.8



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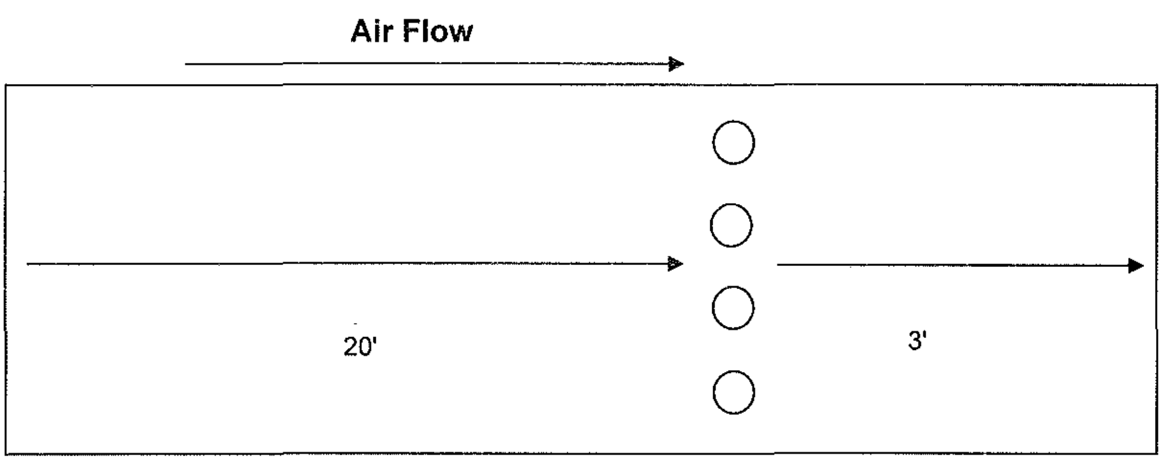


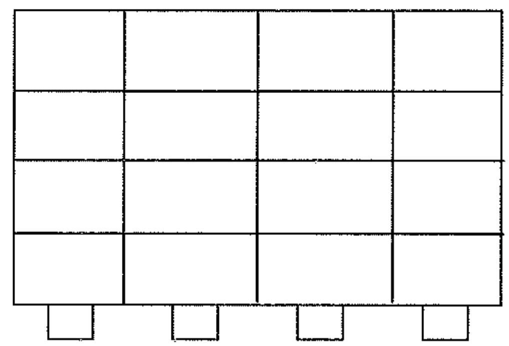
Figure No. 12

Site: **Carbon Wheel System 2 Inlet Clearcoat** **Ford MAP** **Wayne, MI**	**Sampling Date:** **March 14, 2017**	**<u>BT Environmental Consulting, Inc.</u>** **4949 Fernlee Ave** **Royal Oak, MI**

BTEC Inc.

Stack Dimensions: 60" X 36"

Points	Distance "
1	4.5
2	13.5
3	22.5
4	31.5



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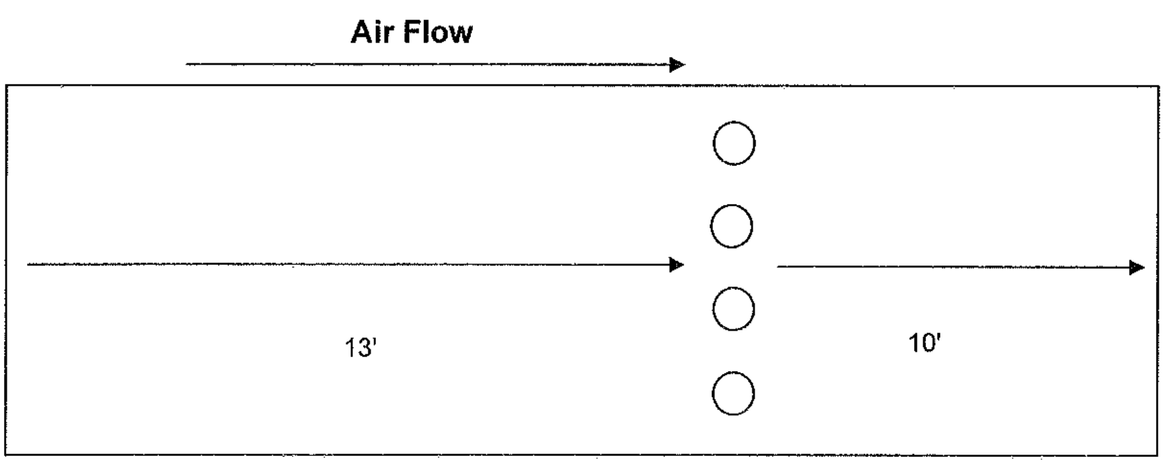
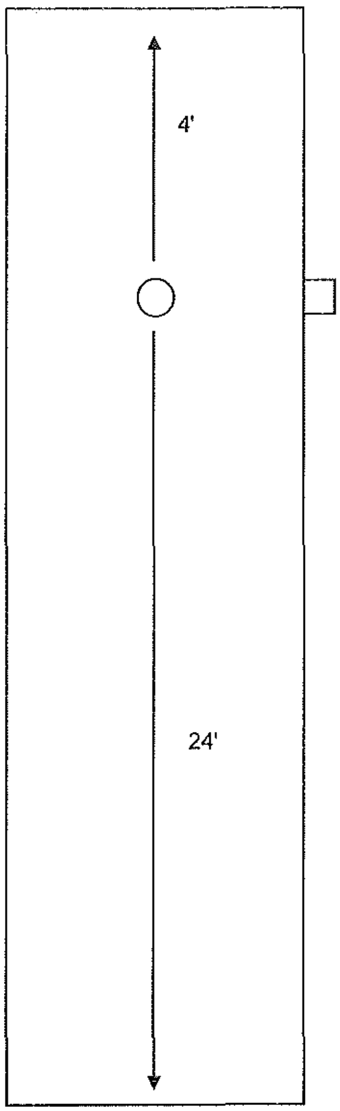


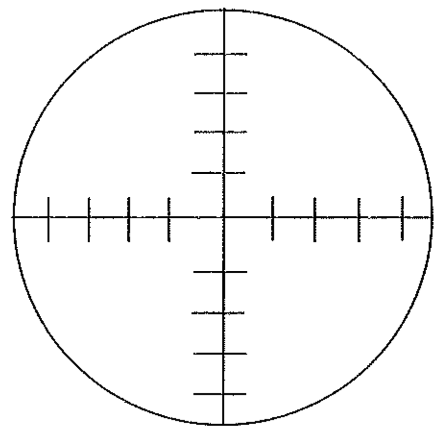
Figure No. 13

Site:	Sampling Date:	
Carbon Wheel System 2 Inlet Primecoat Ford MAP Wayne, MI	March 14, 2017	BT Environmental Consulting, Inc. 4949 Fernlee Ave Royal Oak, MI

BTEC Inc.

diameter = 120 inches





Not to Scale

Points	Distance "
1	3.84
2	12.60
3	23.28
4	38.76
5	81.24
6	96.72
7	107.40
8	116.16

Figure No. 14

Site:	Sampling Date:	
System 2 RTO & Carbon Wheel Outlet **Ford MAP** **Wayne, MI**	**March 14, 2017**	**BT Environmental Consulting, Inc.** **4949 Fernlee Ave** **Royal Oak, MI**

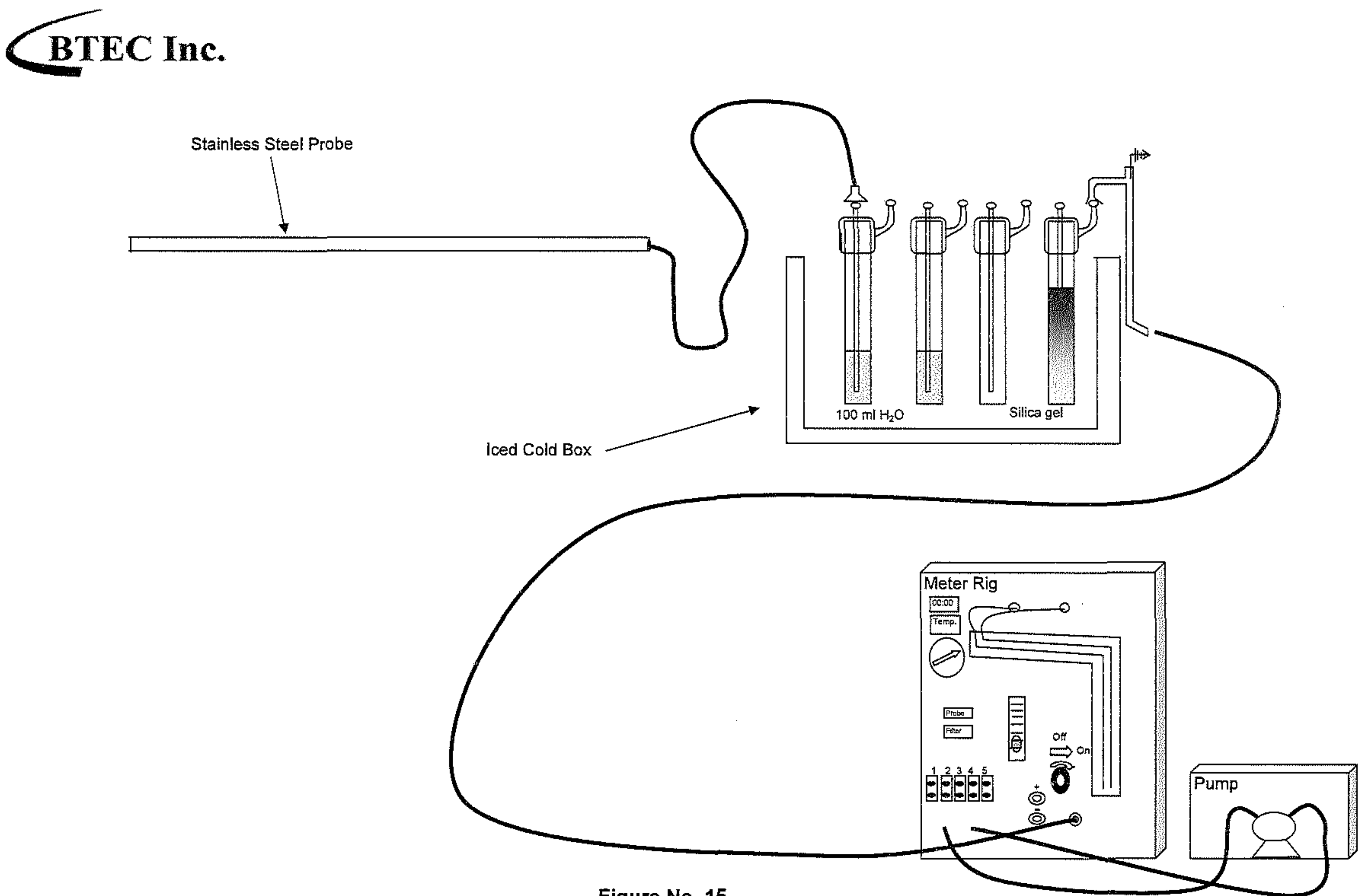


Figure No. 15

Site: **USEPA Method 4** **Ford Motor Company** **Wayne, Michigan**	**Sampling Date:** **March 7-14, 2017**	**BT Environmental Consulting, Inc.** **4949 Fernlee Ave** **Royal Oak, MI**

BTEC Inc.

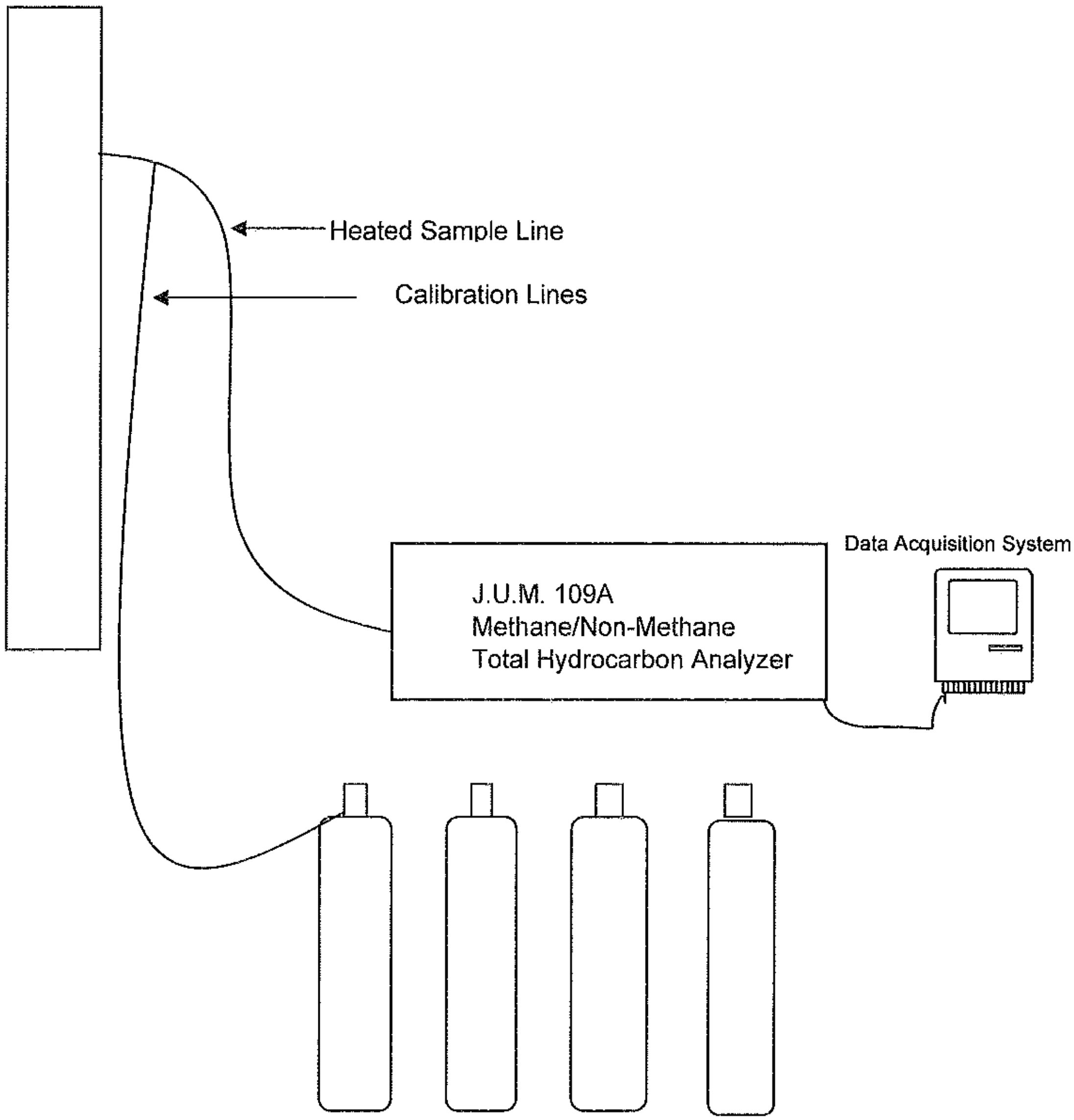


Figure No. 16

Site: **USEPA Method 25A** **Ford Motor Company** **Wayne, Michigan**	**Sampling Date:** **March 7-14, 2017**	**BT Environmental Consulting, Inc.** **4949 Fernlee Ave** **Royal Oak, MI**