BTEC Inc.

Heat Treat Furnace
VOC Emissions Test Report

Prepared for:

Ford Motor Company

Sterling Heights, Michigan

Ford Motor Company – Sterling Axle Plant
39000 Mound Road
Sterling Heights, Michigan 48310

Project No. 12-4318.00
December 3, 2013

BT Environmental Consulting, Inc.
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Royal Oak, Michigan 48073
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BTEC Inc.

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Ford Motor Company (Ford) to evaluate volatile organic compound (VOC) concentrations and emission rates from a single heat treat furnace exhaust at the Sterling Axle Plant located in Sterling Heights, Michigan. Sampling and analysis for this emission test program was conducted on October 9, 2013.

Testing consisted of triplicate 58-minute test runs (i.e., two process cycles per test run) for VOC at the exhaust of Furnace 18. The emissions test program was required by Permit to Install No. 135-11. The results of the emission test program are summarized by Table E-I.

Table E-I
Test Program Emission Summary

Exhaust Location	Average VOC Emission Rate (lb/hr)	Average VOC Emission Rate (lb/ton metal)
Department 6, Furnace 18 oil quench	0.38	0.52

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1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Ford Motor Company (Ford) to evaluate volatile organic compound (VOC) concentrations and emission rates from a single heat treat furnace exhaust at the Sterling Axle Plant located in Sterling Heights, Michigan. Sampling and analysis for this emission test program was conducted on October 9, 2013. 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" (February 2008, 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 emission test program was conducted on October 9, 2013 at the Sterling Axle Plant located in Sterling Heights, Michigan. The test program included monitoring VOC (as propane) concentration as well as measuring flowrates and moisture content at the outlet of one heat treat furnace, identified as Furnace 18.

1.b Purpose of Testing

The purpose of the testing was to quantify VOC emissions reported in pounds per ton of metal processed, as required by Permit to Install No. 135-11.

1.c Source Description

The Sterling Axle Plant operates a heat treat process (Department 6) consisting of three (3) natural gas-fired pusher furnaces with oil quench, two shared natural gas-fired post-washers, and two shared natural gas-fired tempering furnaces. This process is identified as EUDEPT6-HT16-18 in Permit to Install No. 135-11. Furnace 18 processes metal parts through a multi stage process, cycling every 29 minutes. This process includes the quenching of metal parts.

1.d Test Program Contact

The contact for the source and test program is:

Ms. Julia C. Guernsey, QSTI
Environmental Engineer
Environmental Quality Office
Ford Motor Company
Fairlane Plaza North, Suite 800
290 Town Center Drive
Dearborn, MI 48126
phone: (313) 845 0362
email: jguerns4@ford.com

1.e Testing Personnel

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. Julia Guernsey Environmental Engineer	Ford Motor Company Fairlane Plaza North, Suite 800 290 Town Center Drive Dearborn, MI 48126	(313) 845-0362
Mr. Ken Lievense Project Manager	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Mr. Andrew Lusk Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Thomas Maza Laboratory Scientist	MDEQ-AQD	(313) 456-4709
Remilando Pinga Senior Environmental Engineer	MDEQ-AQD	(586) 753-3744

2. Summary of Results

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

2.a Operating Data

Operational data collected during the testing included the type of part produced, the number of parts produced and the weight of the parts produced during each run. See Appendix E for this information.

2.b Applicable Permit

The applicable permit for this emissions test program is Permit to Install No. 135-11.

2.c Results

The overall results of the emission test program are summarized by Table 2 (see Section 5.a).

3. Source Description

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

3.a Process Description

The Sterling Axle Plant operates a heat treat process (Department 6) consisting of three (3) natural gas-fired pusher furnaces with oil quench, two shared natural gas-fired post-washers, and two shared natural gas-fired tempering furnaces This process is identified as EUDEPT6-HT16-18 in Permit to Install No. 135-11.

3.b Raw and Finished Materials

Pipeline quality natural gas is used to fire the pusher furnaces.

3.c Process Capacity

Maximum process rate is 92 tons of metal processed per year.

3.d Process Instrumentation

Operational data collected during the testing includes the type of part produced, the number of parts produced and the weight of the parts produced during each run. See Appendix E for this information.

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 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) was 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 null angle was determined to be less than 20 degrees.

Molecular weight determinations were assumed to be ambient.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the moisture sampling train 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. Duplicate moisture test runs were completed and the average moisture content used to calculate flowrates.

VOC concentrations were measured using the procedures found in 40 CFR 60, Appendix A, Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer."

The VOC concentrations were measured using a VIG Model 20 Total Hydrocarbon Analyzer. For each sampling location, 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 Laptop PC equipped with data acquisition software.

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). The analyzer was calibrated for a range of 0 to 50 ppm.

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

A drawing of the Method 25A sampling train used for the testing program is presented as Figure 3. Protocol 1 gas certification sheets for the calibration gases used for this testing program are presented in Appendix B.

4.b Recovery and Analytical Procedures

Because all measurements were conducted using on-line analyzers, no samples were recovered during the 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 1.

4.d Traverse Points

A diagram of the stack showing traverse points is included as Figure 1.

5. Test Results and Discussion

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

5.a Results Tabulation

The results of the emissions test program are summarized by Table 2.

Table 2
Test Program Emission Summary

Source	Average VOC Emission Rate (lb/hr)	Average VOC Emission Rate (lb/ton metal)
Department 6, Furnace 18 oil quench	0.38	0.52

Detailed emissions test results are summarized by Table 3.

5.b Sampling Procedure Variations

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

5.c Process or Control Device Upsets

No upset conditions occurred during testing.

5.d Control Device Maintenance

The heat treat furnace equipment is not equipped with add-on emissions control equipment.

5.e Re-test

This emissions 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 B.

5.h Sample Calculations

Sample calculations are provided in Appendix D.

5.i Field Data Sheets

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

5.j Laboratory Data

There are no laboratory results for this test program.

Table 3
Furnace 18 VOC Emission Rates
Ford
Sterling Heights, MI
BTEC Project No. 12-4318
Test Date: October 9th, 2013

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	10/9/2013	10/9/2013	10/9/2013	
Test Run Time	9:59-10:57	11:26-12:26	12:55-13:50	
Outlet Flowrate (scfm)	17,417	17,928	18,040	**17,795**
Outlet VOC Concentration (ppmv as propane)	3.57	2.89	2.59	**3.02**
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	3.48	2.87	2.90	**3.08**
VOC Emission Rate as Propane(lb/hr) (corrected as per USEPA 7E)	**0.41**	**0.35**	**0.36**	**0.38**
Weight of Processed Steel (lbs)[1]	1,434	1,434	1,434	1,434
Total cycle time (min)	58	58	58	
VOC Emission Factor (lbs of VOC/ton of metal)	**0.58**	**0.49**	**0.50**	**0.52**

VOC Correction			
Co	0.08	0.02	-0.30
Cma	8.99	8.99	8.99
Cm	9.10	9.03	8.64

scfm = standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
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
60 = min per hour
2000 = lbs per ton

Equations

$C_{gas} = (C_{avg} - C_o) * C_{ma} / (C_m - C_o)$, Eq. 7E-5b
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * *scfm* * 60 *for* VOC
ton of metal = lbs/2000
lbs of VOC/ton of metal = lb/hr / ton of metal

Figures

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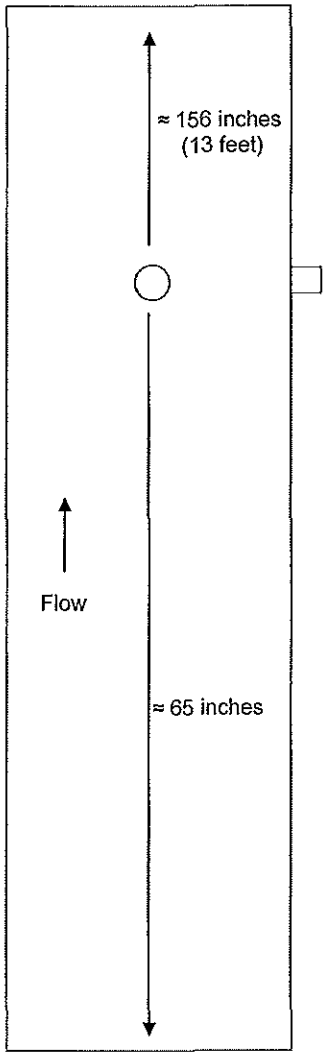
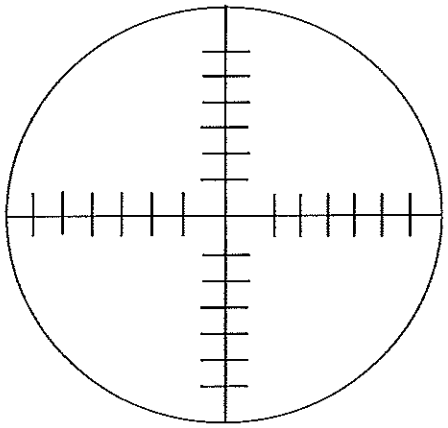
diameter = 31.5 inches





Not to Scale

Points	Distance "
1	0.7
2	2.1
3	3.7
4	5.6
5	7.9
6	11.2
7	20.3
8	23.6
9	25.9
10	27.8
11	29.4
12	30.8

Figure No. 1

Site: **Heat Treat Furnace** **Ford Motor Company** **Sterling Heights, Michigan**	**Sampling Date:** **October 9, 2013**

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Royal Oak, Michigan 48073

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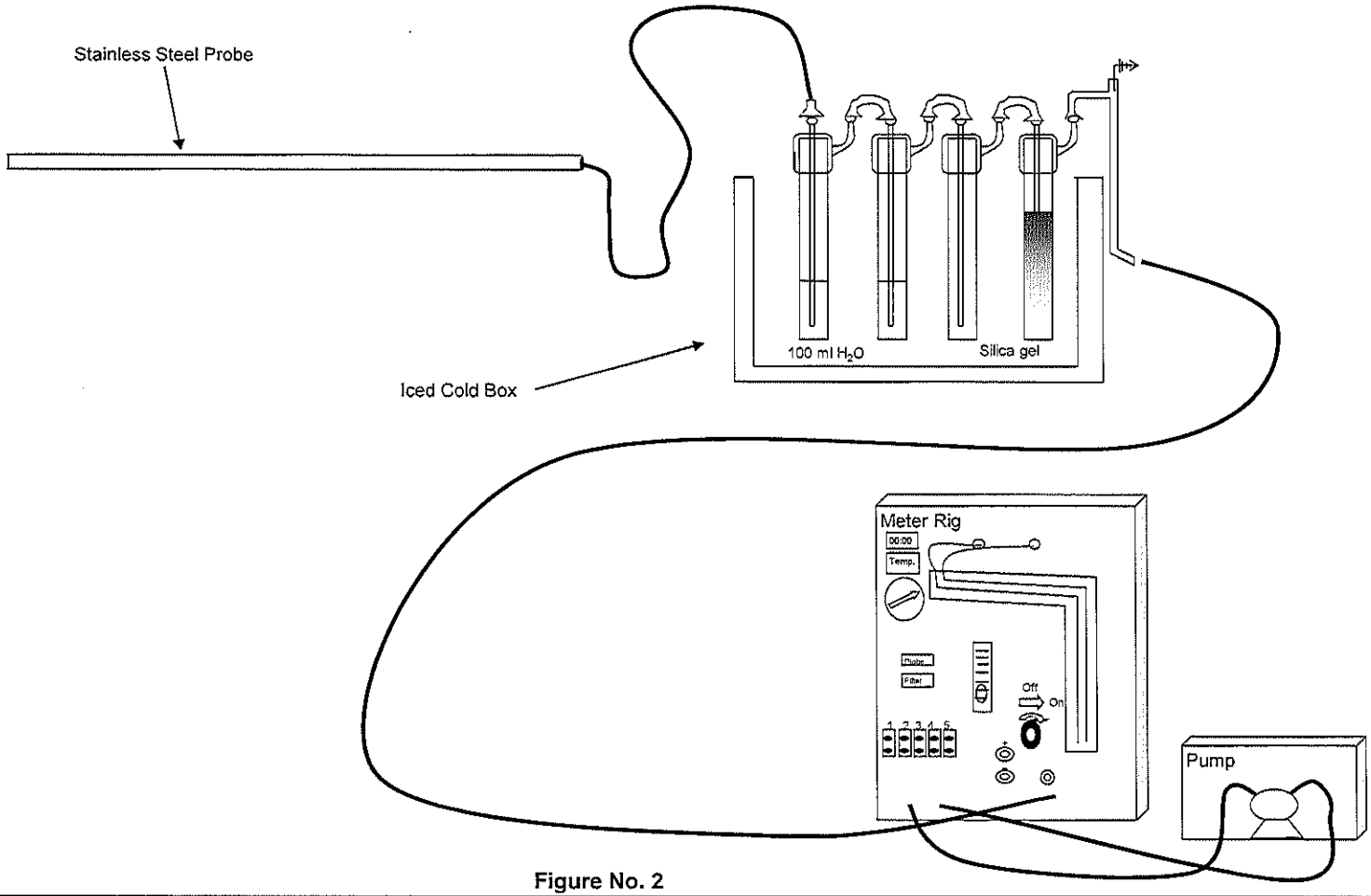

Figure No. 2

Site: USEPA Method 4 Ford Motor Company Sterling Heights, MI	Sampling Date: October 9, 2013	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073

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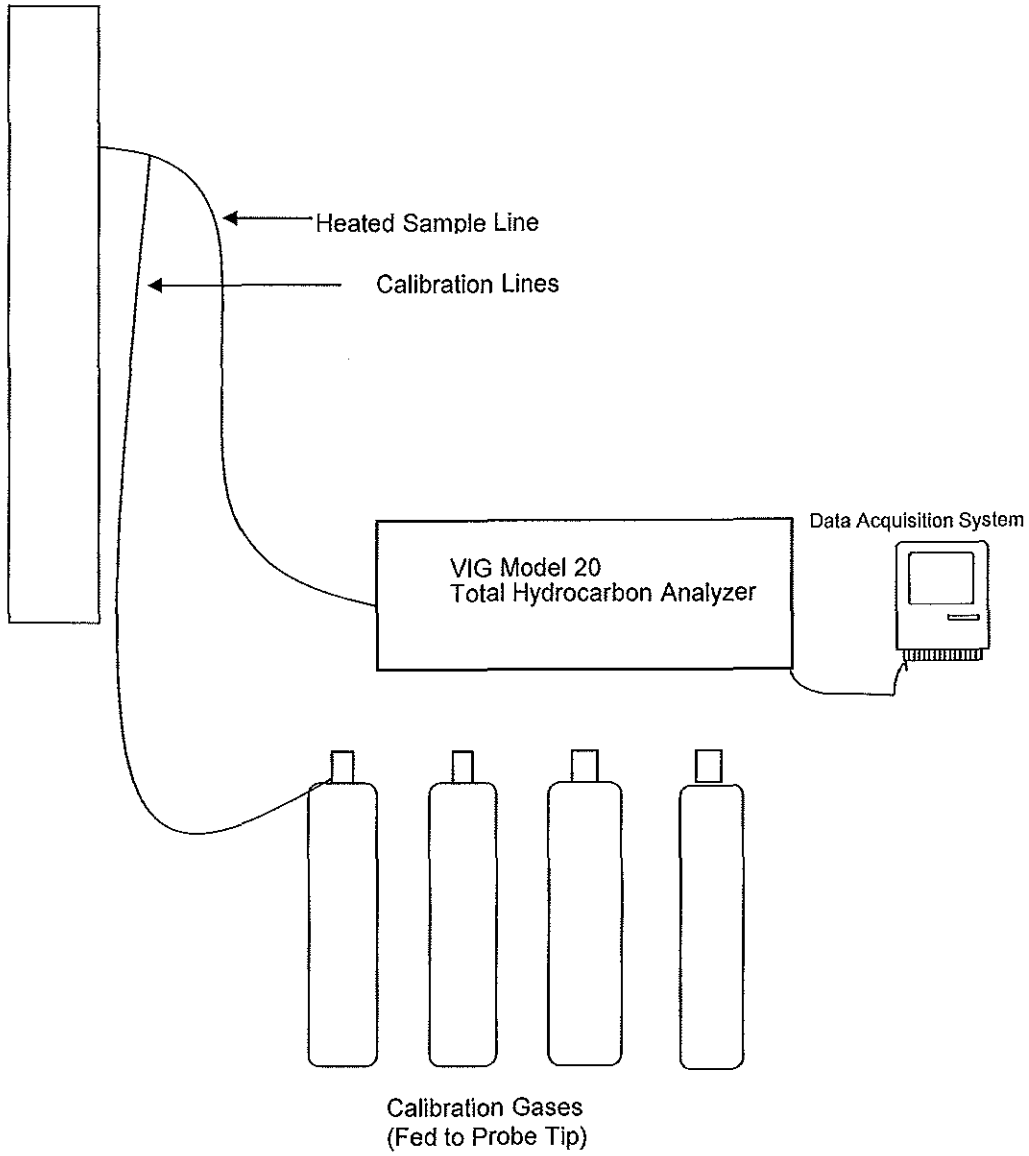

Figure No. 3

Site: **USEPA Method 25A** **Ford Motor Company** **Sterling Heights, Michigan**	**Sampling Date:** **October 9, 2013**
BT Environmental Consulting, Inc. **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**	