BTEC Inc.

# FGQUENCH
# 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. 16-4876.00
January 25, 2017

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

BTEC Inc.

## EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Ford Motor Company (Ford) to evaluate volatile organic compound (VOC) outlet concentrations on the FGQUENCH at the Sterling Axle Plant (Ford Sterling) located in Sterling Heights, Michigan. Sampling and analysis for this emission test program was conducted from December 6-8, 2016.

Testing consisted of triplicate 60-minute test runs for VOC. Due to the process, only one test was conducted per day. The emissions test program is required by Michigan Department of Environmental Quality Air Quality Division permit to install No. 135-11C.

The results of the emission test program are summarized by Table 2. Detailed emissions test results are summarized by Table 3.

**Table E-1**
**FGQUENCH VOC Emissions Summary**

| Test Parameter | Results (lb/hr) | Results (lb/ton metal processed) |
|---|---|---|
| **VOC** | **0.4 lb/hr** | **0.27 lb/ton metal processed** |

## 1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Ford Motor Company (Ford) to evaluate volatile organic compound (VOC) outlet concentrations on the FGQUENCH at the Sterling Axle Plant (Ford Sterling) located in Sterling Heights, Michigan. Sampling and analysis for this emission test program was conducted from December 6-8, 2016.

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). 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 December 6-8, 2016 at the Ford Sterling Axle Plant facility located in Sterling Heights, Michigan.

### 1.b Purpose of Testing

The emissions test program is required by Michigan Department of Environmental Quality Air Quality Division Permit to install No. 135-11C.

### 1.c Source Description

The Sterling Axle Plant operates numerous heat treat processes consisting of natural gas-fired pusher furnaces with oil quench, shared natural gas-fired post-washers, and shared natural gas-fired tempering furnaces. The process included in this emissions test program is identified as EUDEPT10-HT40A-D in Permit to Install Number 135-11C.

### 1.d Test Program Contact

The contact for the source and test program is:

Ms. Susan Hicks
Senior Environmental Engineer
Ford Motor Company
290 Town Center Drive, Suite 800
Dearborn, Michigan 48126
(313) 594-3185
email: shicks3@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. Susan Hicks<br>Senior Environmental Engineer | Ford Motor Company<br>Fairlane Plaza North, Suite 800<br>290 Town Center Drive<br>Dearborn, MI 48126 | (313) 594-3185 |
| Mr. Steve Smith<br>Project Manager | BTEC<br>4949 Fernlee Avenue<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. David Trahan<br>Environmental Technician | | |
| Mr. Mark Dziadosz<br>Air Quality Division | MDEQ | (586) 753-3745 |

## 2. Summary of Results

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

### 2.a Operating Data

The number of parts processed through the furnace was monitored during the test program.

### 2.b Applicable Permit

The applicable permit for this emissions test program is Permit to Install Number 135-11C.

### 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 numerous heat treat processes consisting of natural gas-fired pusher furnaces with oil quench, shared natural gas-fired post-washers, and shared natural gas-fired tempering furnaces.

### 3.b Process Flow Sheet or Diagram

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

### 3.c Raw and Finished Materials

The raw materials include various pinions and ring gear parts.

### 3.d Process Capacity

During the test, the furnace was processing Pinions & RDU rings steel at a rate of approximately 384 Pinions with a 11 hour cycle time or 792 RDU rings with a 7 hour cycle time.

### 3.e Process Instrumentation

The processes are regulated based on furnace temperatures and number of parts processed per load.

## 4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used to verify the VOC concentration.

### 4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content was conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *"Location of the Sampling Site and Sampling Points"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Determination of Molecular Weight of Dry Stack Gas"(Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*

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 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. The average of the absolute values of the flow angles was less than 20 degrees at each sampling location.

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 consisted 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. Moisture evaluations consisted of a 60-minute sample collection for each run.

Measurement of exhaust gas VOC and methane concentrations was conducted using the following reference test methods codified at 40 CFR 60, Appendix A:

- Method 25A- *"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"*

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 FGQUENCH outlet VOC concentrations were measured using a JUM 109A Methane/Non-Methane 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 J.U.M. Model 109A utilizes two flame ionization detectors (FID) to determine the average concentration (ppm) for THC (as propane) and the other for methane concentrations. 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 a data acquisition system (DAS), where 4-second interval data points are recorded to produce an average based on the overall duration of the test. This average is then used to determine the average concentration for THC reported as the calibration gas, propane, in equivalent units.

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 States 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 field quality assurance check of the system was performed pursuant to Method 205 by setting the diluted concentration to a value identical to a Protocol 1 calibration gas and then verifying that the analyzer response is the same with the diluted gas as with the Protocol 1 gas.

A drawing of the Method 25A sampling train used for the testing program is presented as Figure 2. 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 stacks showing sampling ports in relation to upstream and downstream disturbances are included as Figure 1.

### 4.d Traverse Points

A diagram of the stacks showing sampling ports in relation to upstream and downstream disturbances are 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 emission test program are summarized by Table 2. Detailed emissions test results are summarized by Table 3.

**Table 2**
**FGQUENCH VOC Emissions Summary**

| Test Parameter | Results (lb/hr) | Results (lb/ton metal processed) |
|---|---|---|
| VOC | 0.4 lb/hr | 0.27 lb/ton metal processed |



### 5.b Sampling Procedure Variations

There were no sampling procedure variations.

### 5.c Process or Control Device Upsets

During Run 1 the exhaust fan was not operating correctly for a large portion of the test. The resulting emission rate was 0.9 compared to 0.2 for the corresponding runs 2 and 3. The emission rate for run 1 appears to be biased high; however it is still used in the overall average emission rate.

### 5.d Control Device Maintenance

There was no control device maintenance performed during the test program.

### 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 C.

### 5.i Field Data Sheets

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

### 5.j Laboratory Data

There are no laboratory results for this test program.

**Table 3**
**FGQUENCH VOC Emission Rates**
**Ford Motor Company**
**Sterling Heights, Michigan**
**BTEC Project No. 16-4876.00**
**Sampling Dates: 12/6/2016-12/8/2016**

| Parameter | Run 1 | Run 2 | Run 3 | Average |
|---|---|---|---|---|
| Test Run Date | 12/6/2016 | 12/7/2016 | 12/8/2016 | |
| Test Run Time | 11:21-12:21 | 9:09-10:09 | 9:04-10:04 | |
| Outlet Flowrate (scfm) | 6,567 | 6,467 | 6,653 | **6,562** |
| Metal Processed (Tons) | 1.6032 | 1.6032 | 1.6032 | **1.6032** |
| Outlet VOC Concentration (ppmv as propane) | 19.8 | 3.8 | 5.1 | **9.6** |
| Outlet VOC Concentration (ppmv, corrected as per USEPA 7E) | 19.7 | 3.9 | 5.2 | **9.6** |
| **VOC Emission Rate as Propane(lb/hr) (corrected as per USEPA 7E)** | **0.9** | **0.2** | **0.2** | **0.4** |
| **VOC Emission Rate as Propane (lb/ton metal processed)** | **0.55** | **0.11** | **0.15** | **0.27** |

| | |
|---|---|
| **Run 1** | |
| **Zero** | 0.26 |
| **Cal Gas** | 29.80 |
| **Mid Cal** | 29.83 |
| **Run 2** | |
| **Zero** | -0.10 |
| **Cal Gas** | 29.8 |
| **Mid Cal** | 29.33 |
| **Run 3** | |
| Zero | 0 |
| **Cal Gas** | 29.80 |
| **Mid Cal** | 29.51 |

scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (CO = 28.01, NOx = 46.01, $SO_2$ = 64.05, $C_3H_8$ = 44.10, carbon = 12.01)
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 *for* VOC

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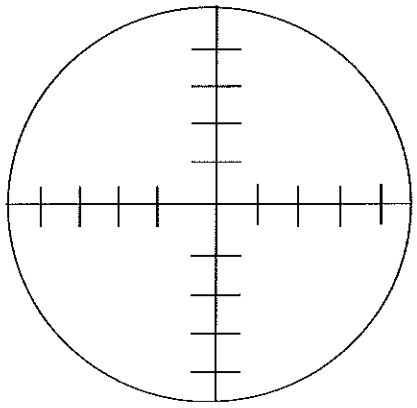
diameter = 23.5"

| Points | Distance " |
|---|---|
| 1 | 0.8 |
| 2 | 2.5 |
| 3 | 4.6 |
| 4 | 7.6 |
| 5 | 15.9 |
| 6 | 18.9 |
| 7 | 21.0 |
| 8 | 22.7 |



Not to Scale

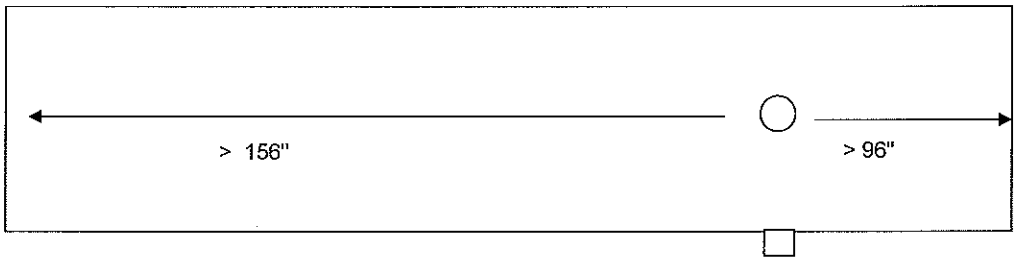



**Figure No. 1**

| | | |
|---|---|---|
| **Site:**<br>**Quench Furnace**<br>**Ford Sterling**<br>**Sterling Heights, Michigan** | **Sampling Date:**<br>**December 6-8, 2016** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee**<br>**Royal Oak, Michigan** |

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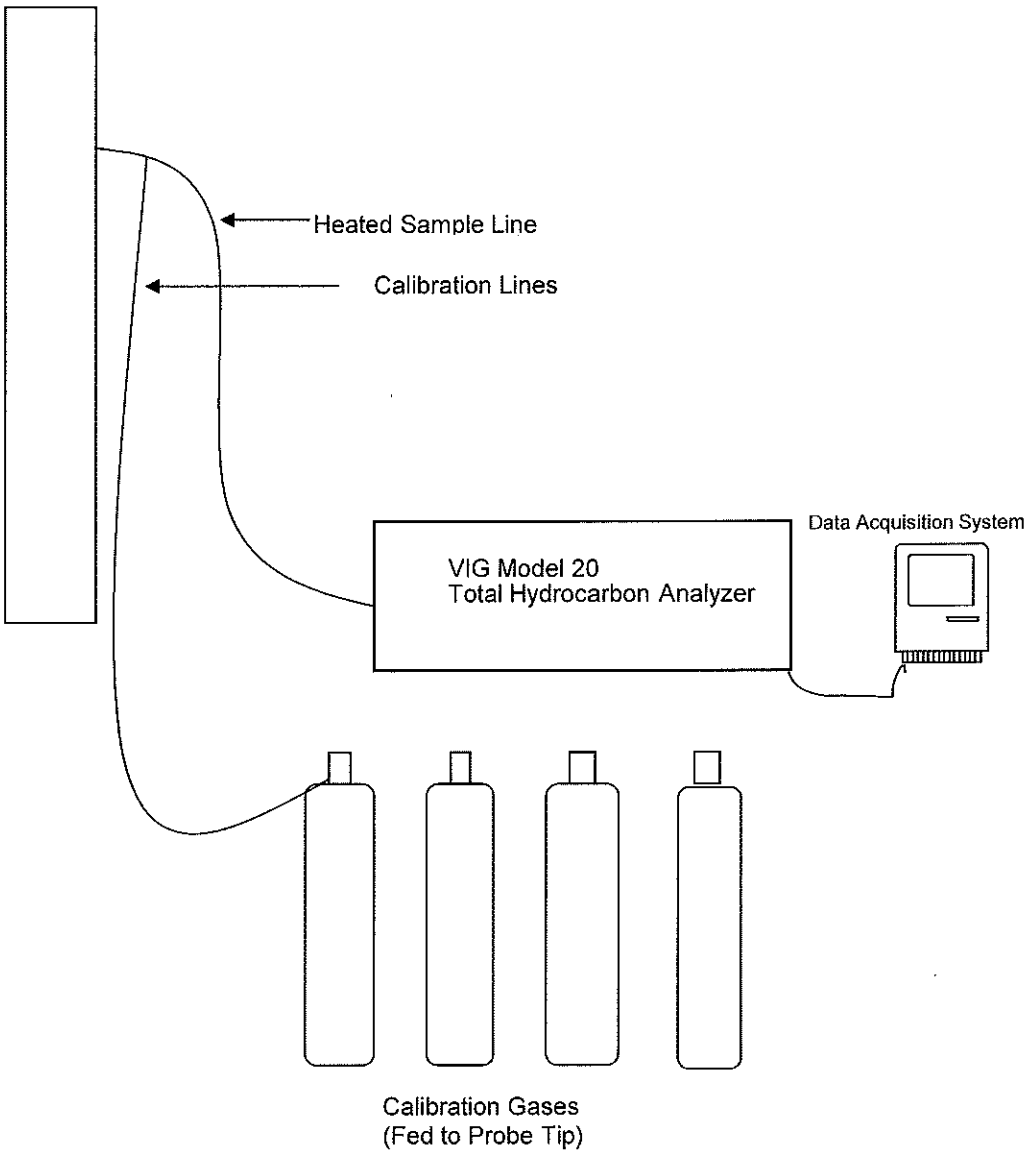


**Figure 2**

| | |
|---|---|
| **Site:**<br>**USEPA Method 25A**<br>**Ford Motor Company**<br>**Sterling Heights, Michigan** | **Sampling Date:**<br>**December 6-8, 2016** |
| | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee Avenue**<br>**Royal Oak, Michigan 48073** |

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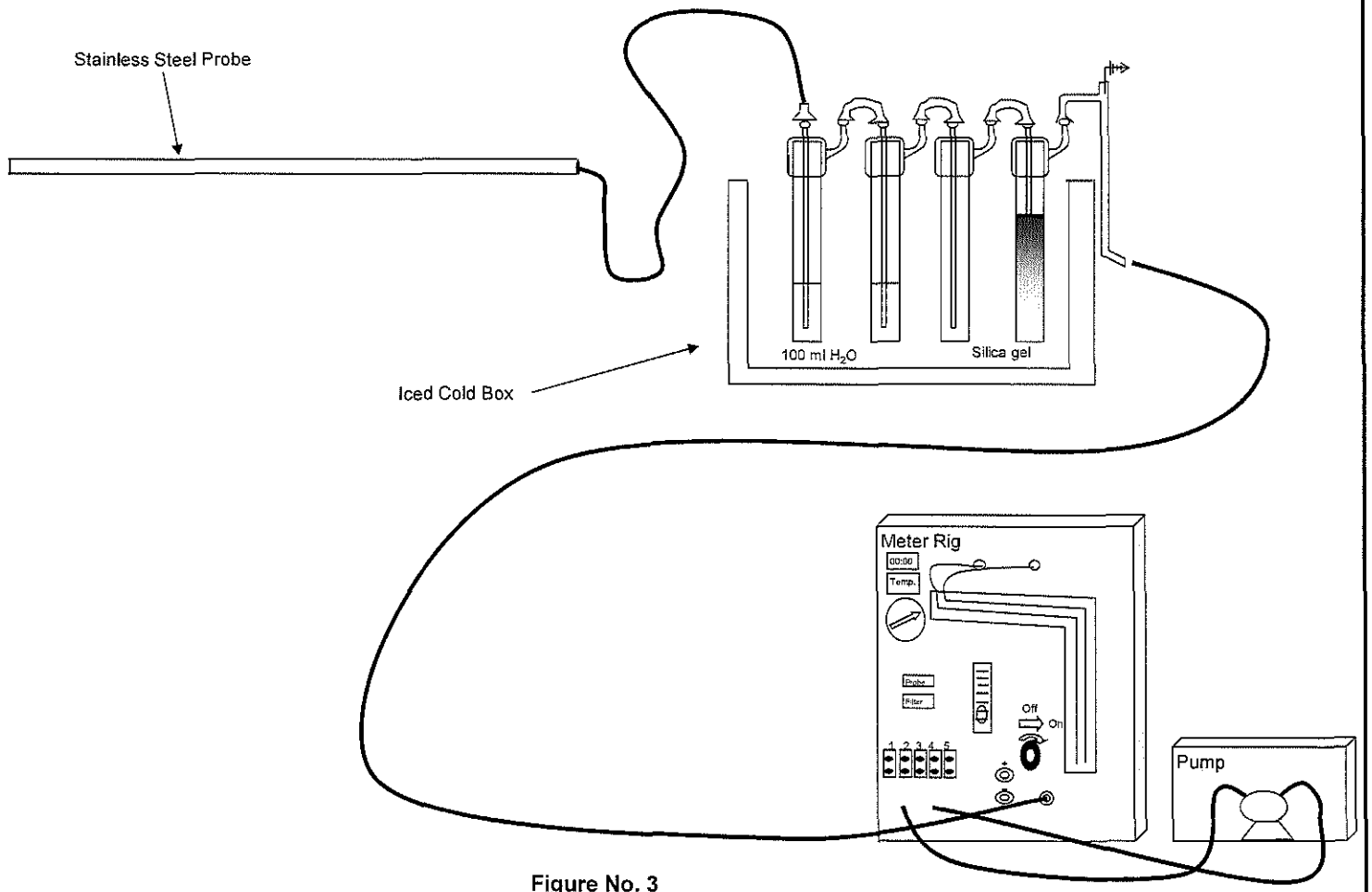


Figure No. 3

| | | |
|---|---|---|
| **Site:**<br>**USEPA Method 4**<br>**Ford Sterling**<br>**Sterling Heights, Michigan** | **Sampling Date:**<br>**December 6-8, 2016** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee Avenue**<br>**Royal Oak, Michigan** |