BTEC Inc.

# Aluminum Reverberatory Melt Furnaces Particulate Matter Emissions Test Report



*Prepared for:*

**Michigan Automotive Compressor, Inc.**

2400 North Dearing Road
Jackson, Michigan

Project No. 13-4351.00
May 21, 2014



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 Michigan Automotive Compressor, Inc. (MACI) to provide air emissions testing services for compliance evaluation purposes. Sampling consisted of testing for filterable and condensable particulate matter concentrations and emission rates from a single exhaust stack serving four aluminum reverberatory melt furnaces (designated EUFurnace-01, EUFurnace-3A, EUFurnace-04, and EUFurnace-05). The purpose of the test program was to evaluate particulate matter emission rates from the baghouse exhaust stack to compare to Permit No. 117-11B emission limitations.

The emissions test program was conducted on April 17, 2014. The test program utilized U.S. EPA Methods 1, 2, 3, 4, 5, and 202 and consisted of triplicate 120-minute emission test runs.

The average total particulate matter emission rate during the emissions test program was 0.4 pounds per hour. The average total particulate matter concentration during the emissions test program was 0.0005 grains per dry standard cubic foot.

# 1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Michigan Automotive Compressor, Inc. (MACI) to provide air emissions testing services for compliance evaluation purposes. Sampling consisted of testing for filterable and condensable particulate matter concentrations and emission rates from a single exhaust stack serving four aluminum reverberatory melt furnaces (designated EUFurnace-01, EUFurnace-3A, EUFurnace-04, and EUFurnace-05). The purpose of the test program was to evaluate particulate matter emission rates from the baghouse exhaust stack to compare to Permit No. 117-11B emission limitations.

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 suggested by the aforementioned document.

## 1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on April 17, 2014 at the Michigan Automotive Compressor facility in Jackson, Michigan. The test program included evaluation of filterable and condensable particulate matter from a single aluminum melt furnace exhaust stack.

## 1.b Purpose of Testing

The purpose of the test program was to evaluate particulate matter emission rates from the baghouse exhaust stack to compare to Permit No. 117-11B emission limitations.

## 1.c Source Description

Four aluminum reverberatory melt furnaces (designated EUFurnace-01, EUFurnace-3A, EUFurnace-04, and EUFurnace-05) melt virgin aluminum ingots with particulate emissions controlled by two baghouse dust collectors. Exhaust from the two baghouse dust collectors is routed to a single exhaust stack. All four furnaces are natural gas-fired. EUFurnace-01 has a maximum melt capacity of 2,200 pounds per hour, EUFurnace-3A has a maximum melt capacity of 2,200 pounds per hour, EUFurnace-04 has a maximum melt capacity of 6,600 pounds per hour, and EUFurnace-05 has a maximum melt capacity of 3,300 pounds per hour.

Each furnace is equipped with a continuous feed flux addition system with a maximum flux feed rate of thirteen pounds per hour. The injection fluxing system (model FIM5 manufactured by Pyrotek) utilizes a wand to deliver flux in the furnace below the molten metal line. The flux reacts with the molten metal, removing impurities, thereby reducing metal oxide build up on the interior of the oven.

### 1.d Test Program Contact

Mr. Donald McCulla
Michigan Automotive Compressor, Inc.
2400 North Dearing Road
Jackson, Michigan 48755
(586) 201-6056

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

### 1.e Testing Personnel

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

## 2. Summary of Results

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

### 2.a Operating Data

Operating data is included in Appendix E.

### 2.b Applicable Permit

The aluminum melt furnaces and baghouses are included in AQD Permit to Install No. 170-11B.

### 2.c Results

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

### 2.d Emission Regulation Comparison

AQD Permit No. 170-11B limits (1) the PM emission rate to 0.006 gr/dscf; (2) the $PM_{2.5}$ emission rate to 2 lbs/hr; and, (3) the $PM_{10}$ emission rate to 3 lbs/hr. The emissions test program measured total particulate matter. It is then conservative to compare these results to the PM, $PM_{10}$, and $PM_{2.5}$ limits included in the permit.

## 3. Source Description

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

### 3.a Process Description

Four aluminum reverberatory melt furnaces (designated EUFurnace-01, EUFurnace-3A, EUFurnace-04, and EUFurnace-05) melt virgin aluminum ingots with particulate emissions controlled by two baghouse dust collectors. Exhaust from the two baghouse dust collectors is routed to a single exhaust stack. All four furnaces are natural gas-fired. EUFurnace-01 has a maximum melt capacity of 2,200 pounds per hour, EUFurnace-3A has a maximum melt capacity of 2,200 pounds per hour, EUFurnace-04 has a maximum melt capacity of 6,600 pounds per hour, and EUFurnace-05 has a maximum melt capacity of 3,300 pounds per hour.

Each furnace is equipped with a continuous feed flux addition system with a maximum flux feed rate of thirteen pounds per hour. The injection fluxing system (model FIM5 manufactured by Pyrotek) utilizes a wand to deliver flux in the furnace below the molten metal line. The flux reacts with the molten metal, removing impurities, thereby reducing metal oxide build up on the interior of the oven.

### 3.b Raw and Finished Materials

Furnace melt rates, furnace flux rates, and baghouse pressure drop data for the emissions test period are included in Appendix E.

### 3.c Process Capacity

EUFurnace-01 has a maximum melt capacity of 2,200 pounds per hour, EUFurnace-3A has a maximum melt capacity of 2,200 pounds per hour, EUFurnace-04 has a maximum melt capacity of 6,600 pounds per hour, and EUFurnace-05 has a maximum melt capacity of 3,300 pounds per hour.

### 3.d Process Instrumentation

The process is regulated by the temperature of the furnace as well as the aluminum charge and withdrawal rates. The furnaces are controlled by two baghouses rated at a combined total 90,000 scfm. The control devices are baghouse dust collectors. Proper operation of the baghouse dust collector is verified by baghouse pressure drop monitoring.

## 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

PM concentrations and emission rates were measured using the procedures of 40 CFR 60, Appendix A, Methods 5/202. BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a glass nozzle, (2) a steel probe with borosilicate glass liner, (3) a heated filter holder, (4) a vertical condenser, (5) an empty pot bellied impinger, (6) an empty modified Greenburg-Smith (GS) impinger, (7) unheated filter holder with a teflon filter, (8) a second modified GS impinger with 100 ml of deionized water, and a third modified GS impinger containing approximately 300 g of silica gel desiccant, (9) a length of sample line, and (10) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice. A schematic drawing of the sampling train is provided as Figure 1.

A sampling train leak test was conducted before and after each test run. After completion of the final leak test for each test run, the filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. The impinger train was then purged with nitrogen for one hour at a flow rate of 18 liters per minute. The CPM filter was recovered and placed in a petri dish. The back half of the filter housing, the condenser, the pot bellied impinger, the moisture drop out impinger, and the front half of the CPM filter housing and all connecting glassware were triple rinsed with deionized water which was collected in a pre-cleaned sample container. The same glassware was then rinsed with acetone which was collected in a pre-cleaned sample container labeled as the organic fraction. The glassware was then double rinsed with hexane which was added to the same organic fraction sample bottle. A train blank was set up and recovered after the first test run.

BTEC labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. In addition, blank samples of the acetone, DI water, hexane, and filter were collected. BTEC personnel carried all samples to BTEC's laboratory (for filter and acetone gravimetric analysis) in Royal Oak, Michigan. DI water and organic samples were hand delivered to Bureau Veritas North America for analysis.

Sampling and analysis procedures followed the methodologies specified by the following methods codified at 40 CFR 60, Appendix A:

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"* was used to determine the velocity traverse points
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"* was used to determine exhaust gas velocity
- Method 3 - *"Gas Analysis for the Determination of Dry Molecular Weight" (Fyrite Procedure)* was used to determine exhaust gas molecular weight

- Method 4 - *"Determination of Moisture Content in Stack Gases"* was used to determine exhaust gas moisture content

- Method 5 - *"Determination of Particulate Matter Emissions from Stationary Sources"* was used to determine particulate matter concentrations and emission rates

- Method 202 - *"Dry Impinger Method for Determining Condensable Particulate Matter Emissions from Stationary Sources"* was used to determine condensable particulate matter emissions.

### 4.b Recovery and Analytical Procedures

Recovery and analytical procedures were described in Section 4.a.

### 4.c Sampling Ports

Sampling ports are located in the baghouse exhaust stack. The exhaust stack is 65.5 inches in diameter and exhausts a minimum of 60 feet above ground level.

### 4.d Traverse Points

Sampling traverse points are illustrated by Figure 2.

## 5. Test Results and Discussion

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

### 5.a Results Tabulation

The average total particulate matter emission rate during the emissions test program was 0.4 pounds per hour. The average total particulate matter concentration during the emissions test program was 0.0005 grains per dry standard cubic foot. Detailed emissions test results are summarized by Table 2.

### 5.b Discussion of Results

AQD Permit No. 170-11B limits (1) the PM emission rate to 0.006 gr/dscf; (2) the $PM_{2.5}$ emission rate to 2 lbs/hr; and, (3) the $PM_{10}$ emission rate to 3 lbs/hr. Total particulate matter concentrations and emission rates are far less than the emission limitations for PM, $PM_{2.5}$, and the $PM_{10}$.

### 5.c Sampling Procedure Variations

No sampling procedure variations were included in the emissions test program.

### 5.d Process or Control Device Upsets

No upset conditions occurred during testing.

### 5.e Control Device Maintenance

No control device maintenance was performed prior to the test program.

### 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

Laboratory data is presented in Appendix D.

# TABLES

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

| Name and Title | Affiliation | Telephone |
|---|---|---|
| Mr. Donald McCulla<br>Environmental Specialist | Michigan Automotive Compressior, Inc.<br>Safety, Hygiene, and Environment<br>2400 North Dearing Road<br>Parma, MI 49269 | (586) 201-6056 |
| Mr. Matthew Young<br>Project Manager | BTEC<br>4949 Fernlee Avenue<br>Royal Oak, MI 48073 | (248) 548-8070 |
| Mr. Ken Felder<br>Environmental Technician | BTEC<br>4949 Fernlee Avenue<br>Royal Oak, MI 48073 | (248) 548-8070 |

Table 2
Particulate Matter Emission Rates

| | | | | |
|---|---|---|---|---|
| Company | MACI | | | |
| Source Designation | Baghouse | | | |
| Test Date | 4/17/2014 | 4/17/2014 | 4/17/2014 | |
| **Meter/Nozzle Information** | **P-1** | **P-2** | **P-3** | **Average** |
| Meter Temperature Tm (F) | 67.6 | 81.5 | 90.5 | 79.9 |
| Meter Pressure - Pm (in. Hg) | 29.5 | 29.5 | 29.5 | 29.5 |
| Measured Sample Volume (Vm) | 119.5 | 121.9 | 124.9 | 122.1 |
| Sample Volume (Vm-Std ft3) | 116.8 | 116.0 | 117.0 | 116.6 |
| Sample Volume (Vm-Std m3) | 3.31 | 3.28 | 3.31 | 3.30 |
| Condensate Volume (Vw-std) | 1.174 | 0.943 | 1.089 | 1.069 |
| Gas Density (Ps(std) lbs/ft3) (wet) | 0.0743 | 0.0743 | 0.0743 | 0.0743 |
| Gas Density (Ps(std) lbs/ft3) (dry) | 0.0745 | 0.0745 | 0.0745 | 0.0745 |
| Total weight of sampled gas (m g lbs) (wet) | 8.76 | 8.69 | 8.77 | 8.74 |
| Total weight of sampled gas (m g lbs) (dry) | 8.70 | 8.65 | 8.72 | 8.69 |
| Nozzle Size - An (sq. ft.) | 0.000250 | 0.000250 | 0.000250 | 0.000250 |
| Isokinetic Variation - I | 101.7 | 100.3 | 100.3 | 100.8 |
| **Stack Data** | | | | |
| Average Stack Temperature - Ts (F) | 134.0 | 131.0 | 138.0 | 134.3 |
| Molecular Weight Stack Gas- dry (Md) | 28.8 | 28.8 | 28.8 | 28.8 |
| Molecular Weight Stack Gas-wet (Ms) | 28.7 | 28.7 | 28.7 | 28.7 |
| Stack Gas Specific Gravity (Gs) | 0.992 | 0.993 | 0.992 | 0.992 |
| Percent Moisture (Bws) | 1.00 | 0.81 | 0.92 | 0.91 |
| Water Vapor Volume (fraction) | 0.0100 | 0.0081 | 0.0092 | 0.0091 |
| Pressure - Ps ("Hg) | 29.2 | 29.2 | 29.2 | 29.2 |
| Average Stack Velocity -Vs (ft/sec) | 74.3 | 74.3 | 76.0 | 74.9 |
| Area of Stack (ft2) | 26.0 | 26.0 | 26.0 | 26.0 |
| **Exhaust Gas Flowrate** | | | | |
| Flowrate $ft^3$(Actual) | 115,691 | 115,712 | 118,328 | 116,577 |
| Flowrate $ft^3$ (Standard Wet) | 100,396 | 100,938 | 101,998 | 101,111 |
| Flowrate $ft^3$ (Standard Dry) | 99,397 | 100,124 | 101,057 | 100,193 |
| Flowrate $m^3$ (standard dry) | 2,815 | 2,835 | 2,862 | 2,837 |
| **Total Particulate Weights (mg)** | | | | |
| Total Nozzle/Probe/Filter | 0.5 | 0.5 | 0.5 | 0.5 |
| Organic Condensible Particulate | 2.1 | 1.6 | 1.9 | 1.9 |
| Inorganic Condensible Particulate | 2.4 | 4.5 | 2.9 | 3.3 |
| Condensible Blank Correction | 2.0 | 2.0 | 2.0 | 2.0 |
| Total Condensible Particulate | 2.5 | 4.1 | 2.8 | 3.1 |
| Total Filterable and Condensible Particulate | 3.0 | 4.6 | 3.3 | 3.6 |
| **Filterable Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.000 | 0.000 | 0.000 | 0.000 |
| lb/1000 lb (dry) | 0.000 | 0.000 | 0.000 | 0.000 |
| mg/dscm (dry) | 0.2 | 0.2 | 0.2 | 0.2 |
| gr/dscf | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| **Filterable Particulate Emission Rate** | | | | |
| lb/ hr | 0.057 | 0.057 | 0.057 | 0.057 |
| **Condensible Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.001 | 0.001 | 0.001 | 0.001 |
| lb/1000 lb (dry) | 0.001 | 0.001 | 0.001 | 0.001 |
| mg/dscm (dry) | 0.8 | 1.2 | 0.8 | 0.9 |
| gr/dscf | 0.0003 | 0.0005 | 0.0004 | 0.0004 |
| **Condensible Particulate Emission Rate** | | | | |
| lb/ hr | 0.3 | 0.5 | 0.3 | 0.4 |
| **Total Particulate Concentration** | | | | |
| lb/1000 lb (wet) | 0.001 | 0.001 | 0.001 | 0.001 |
| lb/1000 lb (dry) | 0.001 | 0.001 | 0.001 | 0.001 |
| mg/dscm (dry) | 0.9 | 1.4 | 1.0 | 1.1 |
| gr/dscf | 0.0004 | 0.0006 | 0.0004 | 0.0005 |
| **Total Particulate Emission Rate** | | | | |
| lb/ hr | 0.339 | 0.527 | 0.378 | 0.415 |

# FIGURES

BTEC Inc.

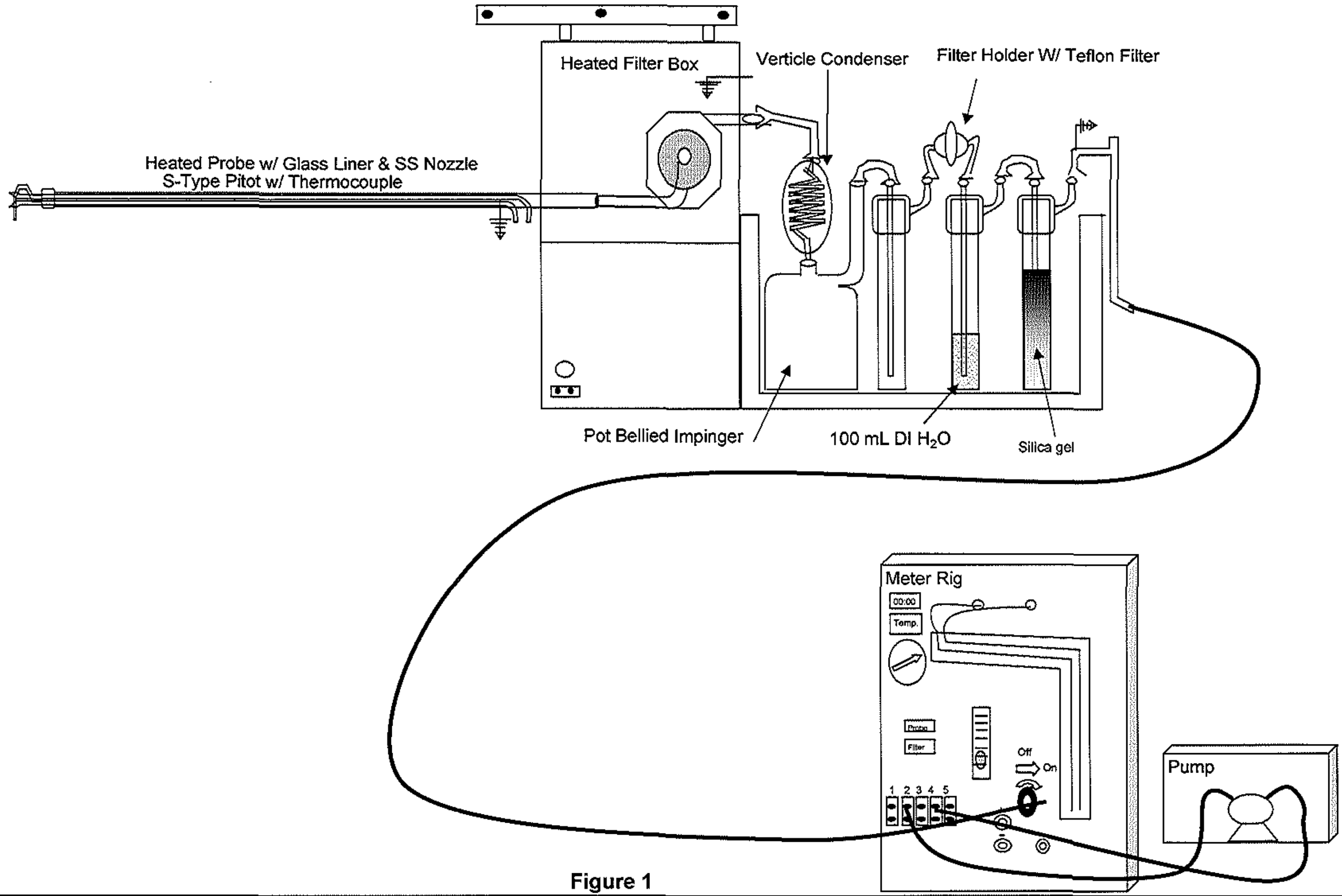
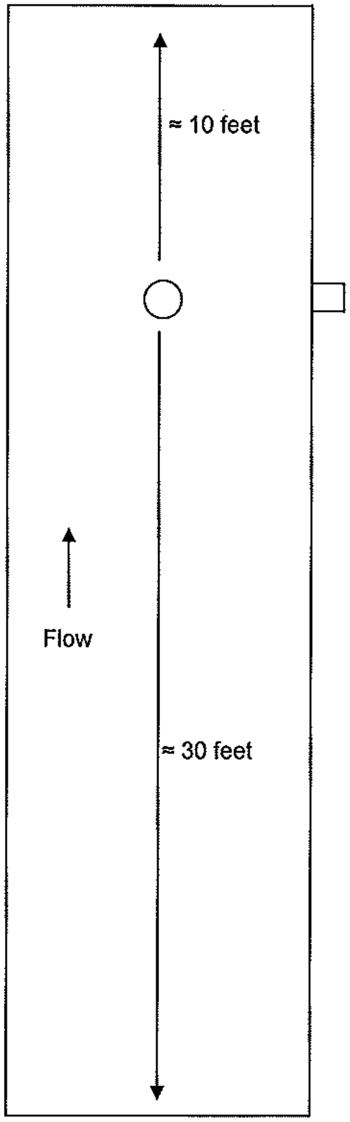


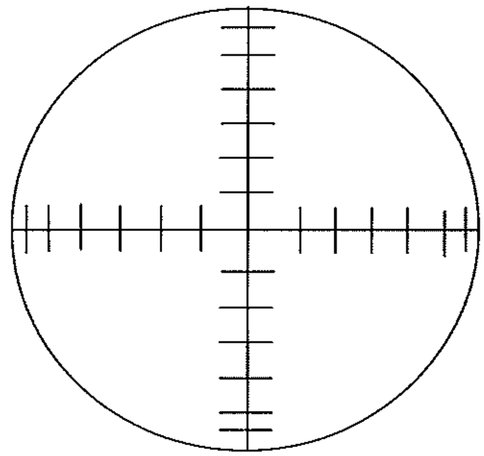

Figure 1

| | | |
|---|---|---|
| **Site:**<br>**USEPA Method 5/202**<br>**Michigan Automotive Compressor**<br>**Jackson, Michigan** | **Sampling Date:**<br>**April 17, 2014** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee Avenue**<br>**Royal Oak, Michigan 48073** |

**BTEC Inc.**

diameter = 69 inches



Not to Scale

| Points | Distance " |
|---|---|
| 1 | 1.4 |
| 2 | 4.6 |
| 3 | 8.1 |
| 4 | 12.2 |
| 5 | 17.3 |
| 6 | 24.6 |
| 7 | 44.4 |
| 8 | 51.8 |
| 9 | 56.8 |
| 10 | 60.9 |
| 11 | 64.4 |
| 12 | 67.6 |

**Figure 2**

| | | |
|---|---|---|
| **Site:**<br>**A1 Baghouse**<br>**Michigan Automotive Compressor**<br>**Jackson, Michigan** | **Sampling Date:**<br>**April 17, 2014** | **BT Environmental Consulting, Inc.**<br>**4949 Fernlee Avenue**<br>**Royal Oak, Michigan 48073** |