SOURCE TEST REPORT
2019 VOC DESTRUCTION EFFICIENCY
DENSO MANUFACTURING MICHIGAN, INC.
H451 TO
BATTLE CREEK, MI

Prepared For:

Denso Manufacturing Michigan, Inc.
One Denso Road
Battle Creek, MI 49037

For Submittal To:

Michigan Department of Environment, Great Lakes, and Energy
7953 Adobe Road
Kalamazoo, MI 49009

Prepared By:

Montrose Air Quality Services, LLC
4949 Fernlee Avenue
Royal Oak, MI 48073

Document Number: **M049AS-545724-RT-179**
Test Date: **October 9, 2019**
Submittal Date: **October 24, 2019**

ACCREDITED
TO ASTM D7036 ONLY
CERT #3925.01

EXECUTIVE SUMMARY

Montrose Air Quality Services (MAQS) was retained by Denso Manufacturing Michigan, Inc. (Denso) to conduct a volatile organic compound (VOC) Destruction Efficiency (DE) emissions test program on one Thermal Oxidizer (TO) at the Denso facility located in Battle Creek, Michigan. The emissions test program was conducted on October 8, 2019.

Testing of the H451 oven degreaser consisted of triplicate 60-minute test runs. The emissions test program was required by EGLE Air Quality Division MI-ROP-N1192-2017b. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: October 8, 2019

H451			
Pollutant	**Destruction Efficiency (%)**	**Average Emission Rate (pph)**	**Emission Limit**
VOC	85.7	0.28	95% DE -OR- 0.33 pph

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

SUMMARY TABLES

FIGURES

APPENDIX

1. Introduction

Montrose Air Quality Services (MAQS) was retained by Denso Manufacturing Michigan, Inc. (Denso) to conduct a volatile organic compound (VOC) Destruction Efficiency (DE) emissions test program on one Thermal Oxidizer (TO) at the Denso facility located in Battle Creek, Michigan. The emissions test program was conducted on October 8, 2019.

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 October 8, 2019 at the Denso facility located in Battle Creek, Michigan. The test program included evaluation of VOC DE emissions from H451 TO.

1.b Purpose of Testing

AQD issued MI-ROP-N1192-2017b to Denso. The permit limits emissions from the oxidizers as summarized by Table 1.

Table 1
VOC DE Emission Limitations
Denso Manufacturing Michigan, Inc.

Source	Pollutant	Emission Limit
H451	VOC	95% DE or 0.38 pph

1.c Source Description

The oven degreaser is used to remove machining oils containing VOCs from assembled heater cores. The cores consist of aluminum tubes, fins, and other small parts which have been assembled to make the core. The machining oils are used in the stamping of small aluminum pieces and to facilitate the formation of fins from strips of aluminum. Therefore, the main raw material used in making the cores is aluminum.

1.d Test Program Contacts

The contact for the source and test report is:

Ms. Jody Smith, P.E.
Advanced Environmental Engineering
Denso Manufacturing Michigan, Inc.
One Denso Road

Battle Creek, Michigan 49037
(269) 565-8562

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. Steve Smith Client Project Manage	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Dave Koponen Environmental Technician	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Mike Nummer Environmental Technician	MAQS 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

H451 TO

- Temperature- Minimum observed = 1,292 degrees F
- Minimum of 0.5 second gas retention time
- 95% DE or maximum VOC emission rate of 0.33 pph.

2.b Applicable Permit

The applicable permit for this emissions test program is MI-ROP-N1192-2017b.

2.c Results

H451 VOC DE test result is 85.7%, which is lower than the 95% emission limit, and the average emission rate is 0.28 pph, which is lower than the 0.33 pph emission limit.

3. Source Description

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

3.a Process Description

Oily cores are transported into the oven degreasers on a conveyor, which moves at a continuous speed through the degreaser. Therefore, the VOC load to the TOs from the degreasers will be constant as long as cores are loaded onto the entrance conveyor.

The oven degreasers are equipped with thermal oxidizers as pollution control. The operating parameter used to regulate the oven degreaser is the temperature of the thermal oxidizer.

3.b Process Flow Diagram

A flow diagram can be sent upon request.

3.c Raw and Finished Materials

The raw materials used by the process are aluminum and oil containing VOCs.

3.d Process Capacity

The maximum capacity of H451 oven degreaser is 947 cores/hour.

3.e Process Instrumentation

Section 3.d provides summary.

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 -"Sample and Velocity Traverses for Stationary Sources"
- 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 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 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 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)

Volatile Organic compound (VOC) concentrations 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 before it enters the analyzer. Data was recorded at 4-second intervals on a PC equipped with data acquisition software. MAQS used a CAI 700 THC hydrocarbon analyzer to determine the VOC concentrations at the inlet, and a JUM 109A Methane/Non-Methane THC hydrocarbon analyzer to determine the VOC concentrations at the outlet.

The CAI 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 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 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 JUM analyzer was calibrated for a range of 0 to 100 ppm on each channel and the CAI analyzer was calibrated for a range of 0 to 1,000 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.

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.

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 and 4.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figure 3 and 4.

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 4.

Table 3
Overall Emission Summary
Test Date: October 8, 2019

H451			
Pollutant	**Destruction Efficiency (%)**	**Average Emission Rate (pph)**	**Emission Limit**
VOC	85.7%	0.28	95% DE -OR- 0.33 pph

5.b Discussion of Results

H451 VOC DE test result is 85.7%, which is lower than the 95% emission limit, and the average emission rate is 0.28 pph, which is lower than the 0.33 pph emission limit.

5.c Sampling Procedure Variations

There were no sapling procedure variations.

5.d Process or Control Device Upsets

There were no process upsets during this test.

5.e Control Device Maintenance

Preventative maintenance activities are performed on a continual basis and include inspecting conveyors, emergency stops, safety circuits, electrical system, gas and pressure gauges, conduit and wiring, cabinet coolers, and alarms.
In the last 6 months, other specific maintenance activities for H451 degreaser include correcting the burner blower air pressure, restarting a burner flame that misfired, and adjusting the air flow valve for gas pressure.

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.

Limitations

The information and opinions rendered in this report are exclusively for use by Denso Manufacturing. MAQS will not distribute or publish this report without Denso Manufacturing's consent except as required by law or court order. MAQS accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by:_____
Steven Smith
Client Project Manager

This report was reviewed by:_____
Jacob Young
Staff Environmental Engineer

Tables

Table 4
H-451 TO Destruction Efficiency Summary
Denso
Battle Creek, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	10/8/2019	10/8/2019	10/8/2019	
Sampling Time	8:10-9:10	9:57-10:57	12:02-13:02	
Inlet Flowrate (scfm)	1,516	1,492	1,504	1,504
Outlet Flowrate (scfm)	1,682	1,720	1,632	1,678
Inlet VOC Concentration (ppmv propane)	218.1	191.6	177.6	195.8
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	209.7	179.2	164.1	184.3
Inlet VOC Mass Flowrate (lb/hr)	2.2	1.8	1.7	1.9
Outlet VOC Concentration (ppmv propane)	35.1	19.0	21.2	25.1
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	35.1	18.5	21.1	24.9
Outlet CH4 Concentration (ppmv methane)	1.5	2.2	-1.1	0.9
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	1.9	3.2	0.7	1.9
Outlet VOC Concentration (- methane)	34.3	17.2	20.8	24.1
Outlet VOC Mass Emission Rate (lb/hr)	0.39	0.20	0.23	0.28
VOC Destruction Efficiency (%)	**81.9**	**89.0**	**86.2**	**85.7**

Inlet VOC Correction			
Co	5.75	12.50	13.25
Cma	500	500	500
Cm	512.11	512.19	514.12

Outlet VOC Correction			
Co	0.74	1.28	1.02
Cma	50	50	50
Cm	49.68	49.15	48.80

Outlet CH4 Correction			
Co	-0.31	-1.00	-1.71
Cma	50	50	50
Cm	49.25	48.32	48.20

RF= 2.47

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

Figures

MONTROSE
AIR QUALITY SERVICES

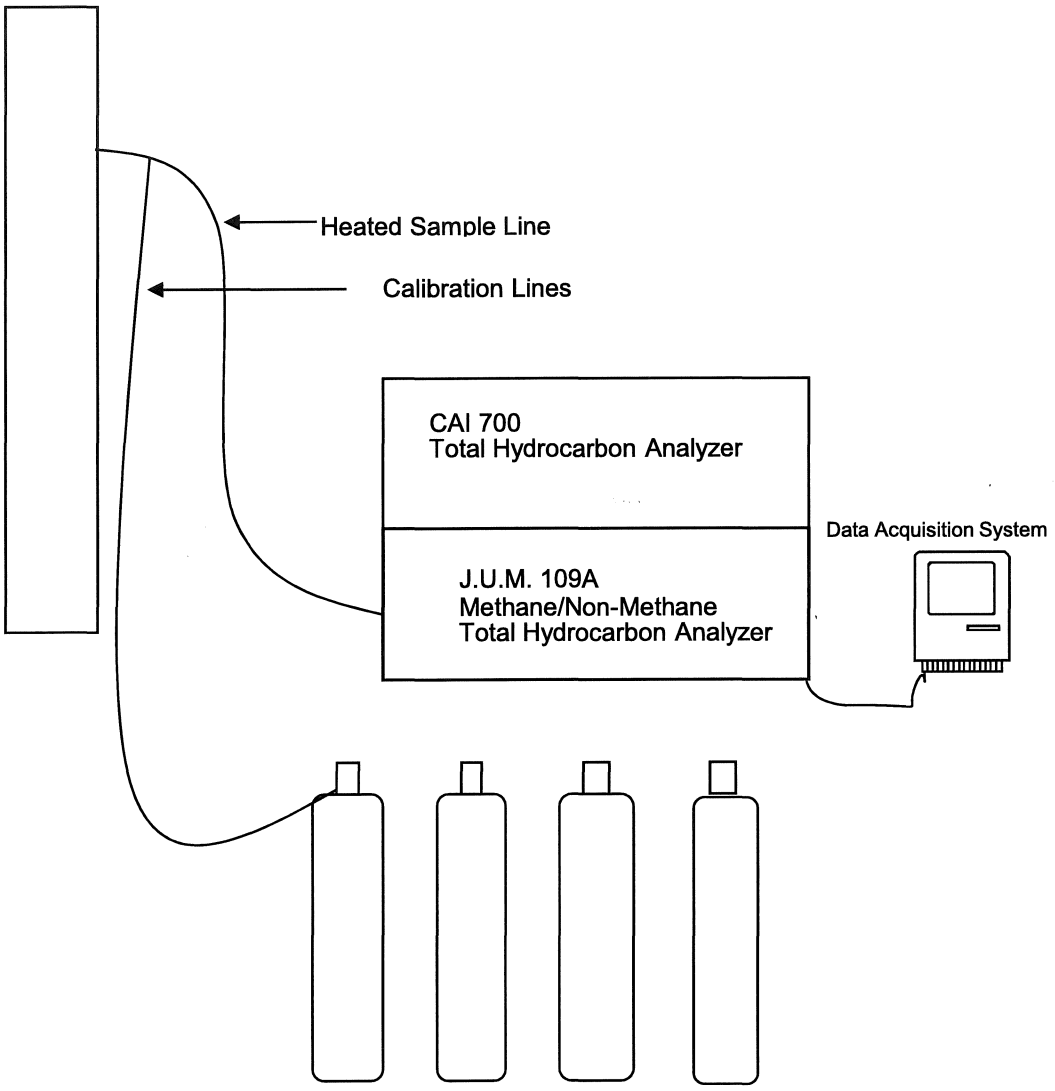


Figure No. 1

Site: **USEPA Method 25A** **Denso** **Battle Creek, Michigan**	**Sampling Date:** **October 8, 2019**
Montrose Air Quality Services **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**	

MONTROSE
AIR QUALITY SERVICES

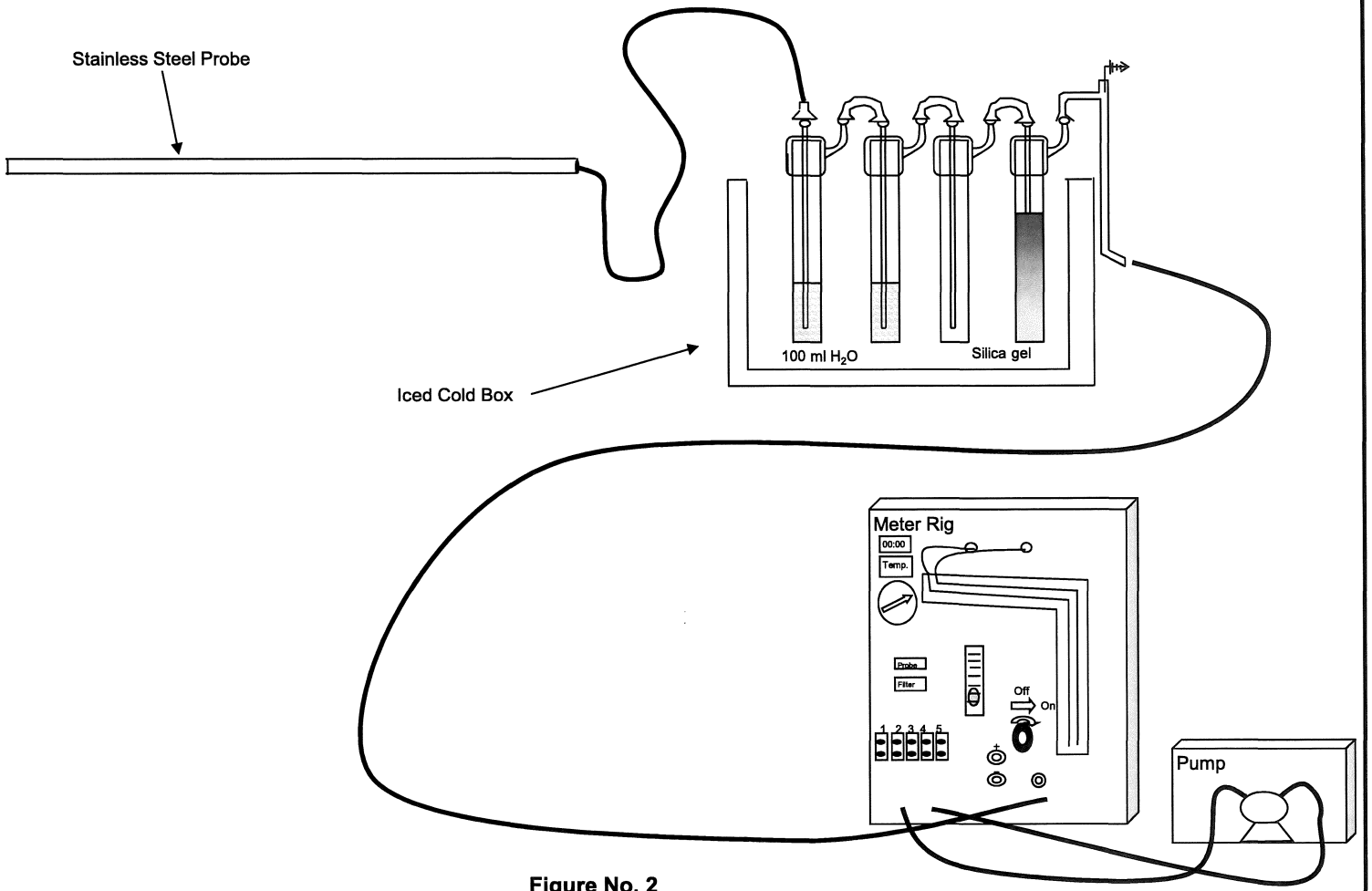
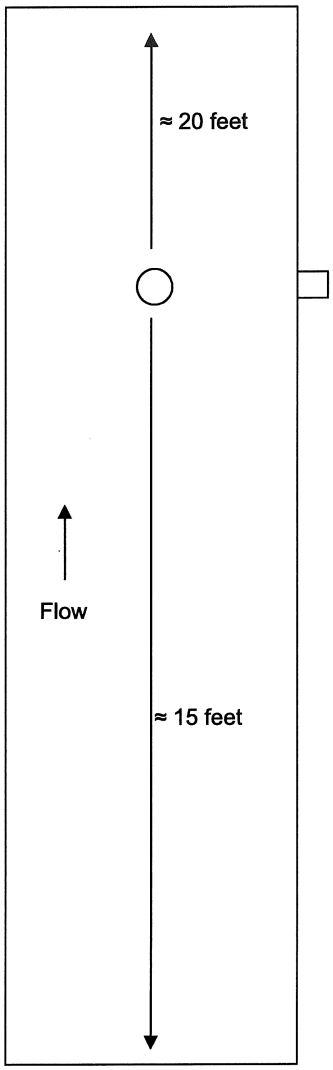


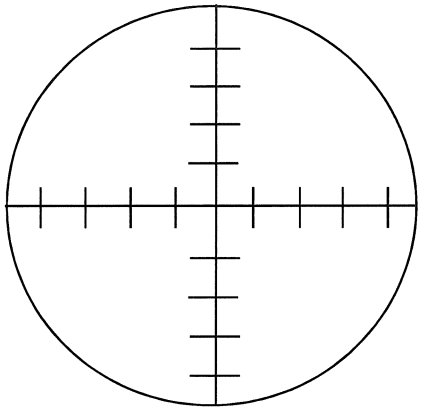
Figure No. 2

Site: **USEPA Method 4** **Denso** **Battle Creek, Michigan**	**Sampling Date:** **October 8, 2019**	**Montrose Air Quality Services** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

MONTROSE
AIR QUALITY SERVICES

diameter = 22 inches





Not to Scale

Points	Distance "
1	0.7
2	2.3
3	4.3
4	7.1
5	14.9
6	17.7
7	19.7
8	21.3

Figure No. 4

Site: **H451 Outlet** **Denso** **Battle Creek, Michigan**	**Sampling Date:** **October 8, 2019**	**Montrose Air Quality Services** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**