EXECUTIVE SUMMARY

Montrose Air Quality Services (MAQS) was retained by Ford Motor Company (Ford) to evaluate volatile organic compound (VOC) concentrations at the outlet of three (3) regenerative catalytic oxidizers (RCOs) at the Flat Rock Assembly Plant (FRAP) located in Flat Rock, Michigan. Sampling and analysis for this emission test program was conducted on August 26, 2020.

Testing consisted of a triplicate test runs at the exhaust from RCO C, along with a single run at the exhaust of RCO A and B. The emissions test program is required by Michigan Department of Environmental Quality Air Quality Division Permit No. MI-ROP-N0929-2018. The results of the emission test program are summarized by Table E-I.

Table E-I
Test Program Emission Summary

Exhaust Location	RCO Temperature (F)	Average VOC Concentration (ppmv, minus methane)
RCO A	1100 / Set Point 1100	5.7
RCO B	1331 / Set Point 1300	3.4
RCO C	1012 / Set Point 1000	4.7
RCO C	1015 / Set Point 1000	6.6
RCO C	1047 / Set Point 1050	4.9

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1. Introduction

Montrose Air Quality Services (MAQS) was retained by Ford Motor Company (Ford) to evaluate volatile organic compound (VOC) concentrations at the outlet of three (3) regenerative catalytic oxidizers (RCOs) at the Flat Rock Assembly Plant (FRAP) located in Flat Rock, Michigan. Sampling and analysis for this emission test program was conducted on August 26, 2020. 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" (March 2018). 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 August 26, 2020 at the FRAP facility located in Flat Rock, Michigan. The test program included monitoring VOC (as propane) and methane concentrations at the outlet of three (3) RCO units.

1.b Purpose of Testing

The FRAP Outlet Concentration Monitoring Plan (required for FG-Controls by AQD Permit No. MI-ROP-N0929-2018) requires periodic monitoring of the VOC concentration of exhaust from each of the three (3) RCO units.

1.c Source Description

The FRAP coating operations are controlled by three (3) RCOs (identified as RCO A, RCO B, and RCO C) and one (1) regenerative thermal oxidizer (RTO) as pollution control equipment. All three (3) RCO units share a common inlet duct. The RTO exhaust combines with RCO C exhaust before it is exhausted from the RCO C stack.

1.d Test Program Contact

The contact for the source and test program is:

Mr. Jamie Hayward
Plant Environmental Control Engineer
Flat Rock Assembly Plant
1 International Dr.
Flat Rock, Michigan 48134
(313) 805-9166

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
Mr. Jamie Hayward Environmental Engineer	Flat Rock Assembly Plant 1 International Dr. Flat Rock, MI 48134	(313) 805-9166
Ms. Susan Hicks Environmental Engineer	Ford Motor Company Fairlane Plaza North, Suite 800 290 Town Center Drive Dearborn, MI 48126	(313) 594-3185
Mr. John Lauch Environmental Engineer	Ford Motor Company Fairlane Plaza North, Suite 800 290 Town Center Drive Dearborn, MI 48126	(313) 323-1276
Mr. Steve Smith Project Manager	MAQS 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 506-0107

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 includes the number of vehicles produced during each test run and RCO operating temperature for each test run. In addition, operating data collected includes the RTO temperature for the period during which RCO C was being tested. See Appendix D for this information.

2.b Applicable Permit

The applicable permit for this emissions test program is Permit No. MI-ROP-N0929-2018.

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

FRAP is an automotive assembly plant located in Flat Rock, 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 one of the two identical 3-Wet paint system. In the booth, the vehicle is painted with primer, a color basecoat and a protective clearcoat layer using automatic bells on robot spray applicators. The vehicle then passes through an oven to cure the 3-Wet applications. The 3-Wet booths allow for paint application of one layer after the other without an intermediate drying stage.

The vehicle paint process includes the e-coat priming (guidecoat) surface priming, base/clearcoat and vehicle sealing operations. The majority of the process emissions associated with these coating activities are oxidized at elevated temperatures by the RCO and RTO emission control equipment that is part of this test program.

3.b Process Flow Sheet or Diagram

Each RCO controls VOC emissions from the corresponding equipment by oxidizing organics present in the exhaust gas at elevated temperatures.

3.c Raw and Finished Materials

The raw materials include various automotive coatings that are used in the following emission units: EGECOAT, EGGUIDECOAT/EGTOPCOAT, and EGCOAT. They include body sealing agents, electro deposition primer, surface primers, top/base coat color paints, and a clear protective final coating.

3.d Process Capacity

The RCOs must average under 5 ppm VOC when combined.

3.e Process Instrumentation

The only process operating parameters relevant to the emissions test program are RCO and RTO operating temperatures.

4. Sampling and Analytical Procedures

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

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)*

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. A single flowrate was conducted at each source.

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.

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 RCO outlet VOC concentrations were measured using a JUM 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 JUM utilizes two flame ionization detectors (FID) to determine the average concentration (ppm) for THC (as propane) and the average concentration for 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 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.

The analyzer's response factor is obtained by introducing a methane calibration gas to the calibrated JUM. The response factor is then calculated by dividing the methane channel response by the THC channel response.

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 A.

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

The THC sampling probes for each RCO were placed at a single fixed position for the duration of each test run. The sampling points for flowrate can be found in Figure 1.

4.d Traverse Points

The sampling points for flowrate can be found in 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

Exhaust Location	RCO Temperature (F)	Average VOC Concentration (ppmv, minus methane)
RCO A	1100 / Set Point 1100	5.7
RCO B	1331 / Set Point 1300	3.4
RCO C	1012 / Set Point 1000	4.7
RCO C	1015 / Set Point 1000	6.6
RCO C	1047 / Set Point 1050	4.9

Detailed emissions test results are summarized by Table 3 and 4.

5.b Sampling Procedure Variations

There were three runs completed on RCO A.

5.c Process or Control Device Upsets

See section 5.b.

5.d Control Device Maintenance

No major maintenance was performed before testing.

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 A.

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 B.

5.j Laboratory Data

There are no laboratory results for this test program.

Tables

Table 3
OCM RCO Verification
Ford
FRAP

Parameter	Run 1	Run 2	Run 3
Sampling Date	8/26/2020	8/26/2020	8/26/2020
Sampling Time	7:54-8:24	8:55-9:25	9:45-10:15
RCO	C	B	A
Outlet Flowrate (scfm)	144,613	119,445	114,661
Outlet VOC Concentration (ppmv propane)	6.7	6.6	29.1
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	6.2	6.1	28.4
Outlet CH4 Concentration (ppmv methane)	3.7	6.2	50.9
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	3.5	6.0	51.0
Outlet VOC Concentration (- methane)	4.7	3.4	5.7
Outlet VOC Mass Emission Rate (lb/hr)	4.6	2.8	4.5

Outlet VOC Correction			
Co	0.43	0.47	0.43
Cma	49.62	49.62	49.62
Cm	50.42	50.42	50.56

Outlet CH4 Correction			
Co	0.23	0.20	0.24
Cma	50.38	50.38	50.38
Cm	50.28	49.98	50.23

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

RF= 2.25

Equations

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

Table 4
OCM RCO Verification
Ford
FRAP

Parameter	Run 2	Run 3
Sampling Date	8/26/2020	8/26/2020
Sampling Time	12:00-12:15	12:45-13:15
RCO	C	C
Outlet Flowrate (scfm)	114,661	114,661
Outlet VOC Concentration (ppmv propane)	8.5	7.1
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	8.0	6.6
Outlet CH4 Concentration (ppmv methane)	3.3	4.0
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	3.2	3.9
Outlet VOC Concentration (- methane)	6.6	4.9
Outlet VOC Mass Emission Rate (lb/hr)	5.2	3.9

Outlet VOC Correction		
Co	0.51	0.48
Cma	49.62	49.62
Cm	50.18	50.13

Outlet CH4 Correction		
Co	0.17	0.15
Cma	50.38	50.38
Cm	49.98	49.90

RF= 2.25

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

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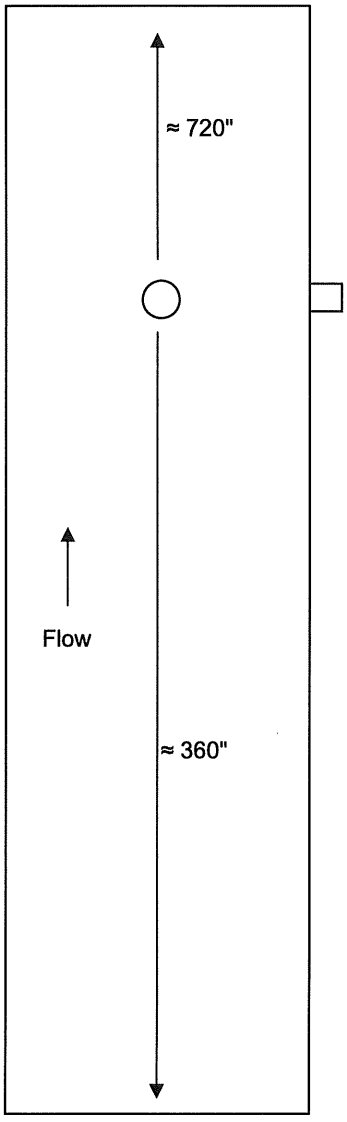
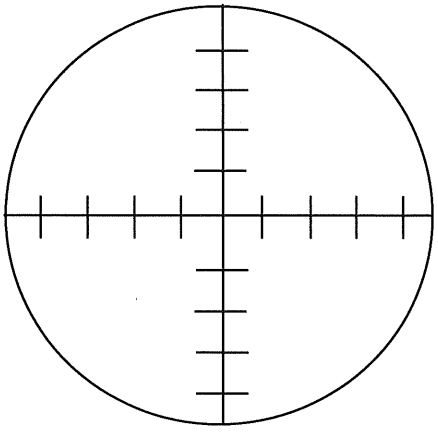
diameter = 107 inches





Not to Scale

Points	Distance "
1	3.4
2	11.2
3	20.8
4	34.6
5	72.4
6	86.2
7	95.8
8	103.6

Figure No. 1

Site: **RCO A,B,C** **Ford** **Flat Rock, MI**	**Sampling Date:** **August 26, 2020**	**Montrose Air Quality Services** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

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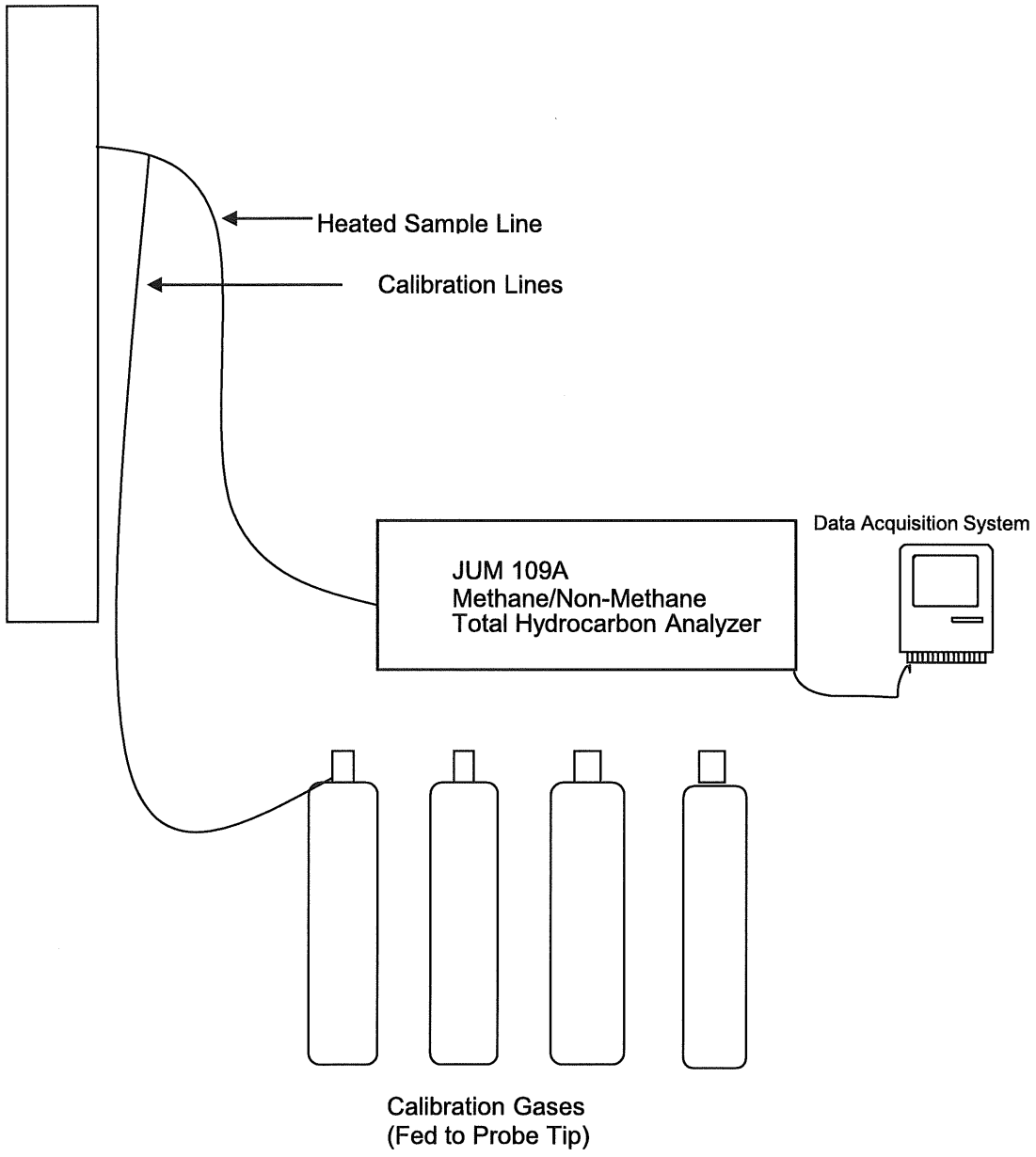

Figure 2

Site: **Sampling Date:** **USEPA Method 25A** **August 26, 2020** **Ford** **Flat Rock Assembly Plant** **Flat Rock, Michigan**	**Montrose Air Quality Services** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**