FINAL REPORT

FCA US LLC

DETROIT, MICHIGAN

DETROIT ASSEMBLY COMPLEX MACK (DACM): RTO2 SOURCE TESTING PROGRAM

RWDI #2305818

December 7, 2023

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by FCA US LLC (FCA) to complete the emission sampling program at their Detroit Assembly Complex - Mack (DACM) located at 4000 Saint Jean Street, Detroit, Michigan. DACM operates an automobile assembly plant that produces the Jeep Grand Cherokee L.

A source test for the regenerative thermal oxidizer installed for the control of odors ("RTO2") is required in the Air Quality Division (AQD) Administrative Consent Order No. 2022-16 ("ACO"). A copy of the pertinent portions of the ACO is provided in **Appendix G**. While Section 12.D of the ACO requires that "*the Company shall conduct performance testing for RTO2 as specified in the PTI as amended*", FCA agreed to the EGLE Air Quality Division's request to conduct performance testing on RTO2 prior to issuance of the updated PTI. This Source Testing Report provides the results of the tests that measured the exhaust VOC concentration and destruction efficiency (DE) of RTO2.

Executive Table i: Average Emission Data

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	**Test 2**	**Test 3**	**Average**
NMOC Inlet	26.23 ppmv 8.16 lb/hr	20.48 ppmv 6.40 lb/hr	14.87 ppmv 4.63 lb/hr	20.53 ppmv 6.40 lb/hr
NMOC Outlet	3.10 ppmv 1.24 lb/hr	2.74 ppmv 1.11 lb/hr	2.67 ppmv 1.05 lb/hr	2.84 ppmv 1.13 lb/hr
RTO Temperature (°F)	1449	1450	1450	1450
Clearcoat 1 & 2 Observation Zone Production Rates	52 vehicles per hour	43 vehicles per hour	32 vehicles per hour	42 vehicles per hour
Destruction Efficiency	84.8 %	82.7 %	77.3 %	82.3 %

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1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by FCA US LLC (FCA) to complete the emission sampling program at their Detroit Assembly Complex - Mack (DACM) located at 4000 Saint Jean Street, Detroit, Michigan. DACM operates an automobile assembly plant that produces the Jeep Grand Cherokee L.

A source test for RTO2 is required in the Air Quality Division (AQD) Administrative Consent Order No. 2022-16 (ACO). A copy of the pertinent portions of the ACO is provided in **Appendix G**. While Section 12.D of the ACO requires that "*the Company shall conduct performance testing for RTO2 as specified in the PTI as amended*", FCA agreed to the EGLE Air Quality Division's request to conduct performance testing on RTO2 prior to issuance of the updated PTI.

This Source Testing Report provides the results of the tests that measured the exhaust VOC concentration and destruction efficiency (DE) of RTO2.

1.1 Location and Dates of Testing

The test program was completed on October 12th of 2023 at the FCA DACM facility.

1.2 Purpose of Testing

The source test for RTO2 is required in the Air Quality Division (AQD) Administrative Consent Order No. 2022-16. The facility SRN number is N2155.

1.3 Description of Source

DACM currently operates an automobile assembly plant that produces the Jeep Grand Cherokee L model for FCA US LLC under PTI 14-19A, Emission Units and Flexible Group: EUECOAT, EUPRIMER, and EUTOPCOAT and FG-AUTOASSEMBLY. The regenerative thermal oxidizer (RTO2) serves the clearcoat observation zone and operates in accordance with Administration Consent Order No. 2022-16. The facility SRN number is N2155.

1.4 Personnel Involved in Testing

Details with respect to the key individuals involved with the stack sampling survey are provided below:

Table 1.4.1: Testing Personnel

Thomas Caltrider Corporate Environmental Programs Thomas.Caltrider@stellantis.com	**FCA US LLC** CIMS 450-09-00 38111 Van Dyke Ave. Sterling Heights, 48312	(248) 882-7169
Paul Diven Environmental Specialist Paul.Diven@stellantis.com	**FCA US LLC** Detroit Assembly Complex Mack (DACM) 4000 Saint Jean Street Detroit, MI USA 48214	(313) 212-2588
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April Wendling District Manager Wendlinga@michigan.gov	**EGLE AQD** Detroit District Office	N/A
Robert Brynes AQD Detroit District byrnesr@michigan.gov	**EGLE AQD** Detroit District Office	(517) 275-0439
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Steve Smith Project Manager Steve.Smith@rwdi.com		(734) 751-9701
Mike Nummer Senior Field Technician Michael.Nummer@rwdi.com		(248) 841-8442
Hunter Griggs Field Technician Hunter.Griggs@rwdi.com		
Cade Smith Field Technician Cade.Smith@rwdi.com		

2 SUMMARY OF RESULTS

2.1 Operating Data

Operational data collected during the testing includes the number of vehicles produced and the combustion chamber temperatures from RTO2 during each test. This information can be found in **Appendix A**.

2.2 Applicable Permit Number

EGLE Permit To Install (PTI) No. 14-19A and the Administration Consent Order No. 2022-16. The facility SRN number is N2155.

3 SOURCE DESCRIPTION

3.1 Description of Process and Emission Control Equipment

DACM operates an automobile assembly plant that produces the Jeep Grand Cherokee L model for FCA US LLC under PTI 14-19A, Emission Units and Flexible Group: EUECOAT, EUPRIMER, and EUTOPCOAT and FG-AUTOASSEMBLY. This Source Testing Report addresses the testing of RTO2 only, which controls the potential odor emissions from the clearcoat observation zones from Clearcoat 1 and Clearcoat 2.

Booth overspray is controlled by a waterwash particulate control system. A portion of the clearcoat exhaust is filtered and recirculated to the booth air make up system. The line purge/cleaning material used in the clearcoat process is captured and recovered in the purge pot collection system. The exhausts from the observation zones for Clearcoat Booth 1 and Clearcoat Booth 2 are routed to RTO2.

3.2 Process Flow Sheet or Diagram

RTO2 has one inlet and one outlet. Figures can be found in the **Figure Section**.

3.3 Type and Quantity of Raw and Finished Materials

Various raw materials are used for the assembly of vehicles. For the clearcoat operations, the vehicles are sprayed (by robot) with a clear topcoat material to complete the coating process of the vehicles.

3.4 Normal Rated Capacity of Process

DACM was operating under normal representative production rates. Process data is provided in **Appendix A**.

3.5 Process Instrumentation Monitored During the Test

Vehicle counts and RTO combustion chamber temperatures were recorded and monitored during the testing event.

4 SAMPLING AND ANALYTICAL PROCEDURES

The emission 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 3** – Determination of Molecular Weight of Dry Stack Gases
- **Method 4** – Determination of Moisture Content
- **Method 25A** – Determination of Total Gaseous Organic Concentrations using a Flame Ionization Analyzer

4.1 Stack Velocity, Temperature, and Volumetric Flow Rate

The exhaust velocities and flow rates were determined following U.S. EPA Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)". Velocity measurements were taken with a pre-calibrated S-Type pitot tube and incline manometer or digital manometer. Volumetric flow rates were determined following the equal area method as outlined in U.S. EPA Method 2. Temperature measurements were made simultaneously with the velocity measurements and were conducted using a chromel-alumel type "k" thermocouple in conjunction with a calibrated digital temperature indicator.

The dry molecular weight of the stack gas from RTO2 inlet and outlet was determined following calculations outlined in U.S. EPA Method 3/3A, "Gas Analysis for the Determination of Dry Molecular Weight (Instrumental). RWDI collected integrated sample bags for each of RTO2 inlet and outlet using the orsat pump from the sampling consoles or manual pump. The integrated bag samples were collected over the duration of each test period. The bag samples were delivered to a continuous monitoring system for CO_2 and O_2 measurements. The CO_2 and O_2 analyzers were operated according to USEPA Method 3A. Prior to testing, a 3-point analyzer calibration error check was conducted using USEPA protocol gases. The calibration error check was performed by introducing zero, mid and high-level calibration gases directly into the analyzer. The calibration error check was performed to confirm that the analyzer response is within ±2% of the certified calibration gas introduced. Prior to each test run, a system-bias test was performed where known concentrations of calibration gases were introduced at the probe tip to measure if the analyzers response was within ±5% of the introduced calibration gas concentrations. At the conclusion of each set of bag samples a system-bias check was performed to evaluate the percent drift from pre and post-test system bias checks. The system bias checks were used to confirm that the analyzer did not drift greater than ±3% throughout a test run.

Zero and upscale calibration checks were conducted both before and after each set of bag samples in order to quantify measurement system calibration drift and sampling system bias. Upscale is either the mid- or high-range gas, whichever most closely approximates the flue gas level. During these checks, the calibration gases were introduced into the sampling system at a conjunction where the sample bag would be introduced to ensure that system was working properly. The analyzers were calibrated on-site using EPA Protocol No. 1 certified calibration mixtures.

Stack moisture content was determined through wet-bulb dry-bulb testing and according to U.S. EPA Method 4, "Determination of Moisture Content of Stack Gases". A schematic of the Method 2 and 4 sampling train are provided in **Figure Section**.

4.2 Total Hydrocarbon, Methane and Non-Methane Organic Compounds (NMOC)

THC and CH_4 concentrations were recorded simultaneously at the inlet and outlet of RTO2 during each test. The measurements were taken continuously following USEPA Method 25A on the inlet and outlet using a Flame Ionization Detector (FID) analyzer with a dual FID for concurrent measurements of THC and CH_4. As outlined in Method 25A, the measurement location was taken at the centroid of each source.

Each test consisted of three (3) 60-minute tests, with the exception of Test 3 with was completed over 83 minutes due to varying production rates. Regular performance checks on the CEMS were conducted by zero and span calibration checks using USEPA Protocol calibration gases. The response of the monitor to pollutant-free air and the corresponding sensitivity to the span gases was reviewed frequently as an ongoing indication of analyzer performance.

Prior to testing, a 4-point analyzer calibration error check was conducted using USEPA protocol gases. The calibration error check was performed by introducing zero, low, mid, and high-level calibration gases up the heated line to the probe tip. The calibration error check was performed to confirm that the analyzer response is within ±5% of the certified calibration gas introduced. At the conclusion of each test run a system-bias check was performed to evaluate the percent drift from pre- and post-test system bias checks. The system bias check was used to confirm that the analyzer did not drift greater than ±3% throughout a test run.

Zero and mid gas calibration checks were conducted both before and after each test run to quantify measurement system calibration drift and sampling system bias. During these checks, the calibration gases were introduced into the sampling system at the probe tip so that the calibration gases were analyzed in the same manner as the flue gas samples.

A gas sample was continuously extracted from the stack and delivered to the gas analyzer, which measures the pollutant or diluent concentrations in the gas. The probe tip was equipped with a sintered stainless-steel filter for particulate removal. The end of the probe was connected to a heated Teflon sample line, which delivered the sample gases from the stack to the CEM system. The heated sample line was designed to maintain the gas temperature above 250°F to prevent condensation of stack gas moisture within the line.

To determine the non-methane organic compound (NMOC) concentrations, the methane concentration was subtracted from THC. The methane must be converted from methane as methane to methane as propane and then subtracted from the THC concentration. The methane response factor (RF) was determined each test by introducing a known methane concentration to the analyzer and dividing the methane channel response by the THC channel response. Dividing methane by the RF gives methane as propane and was then subtracted from the THC concentration. Results were reported as Non-Methane Organic Compounds (NMOC). A schematic of the USEPA Method 25A is provided in **Figures Section**.

4.3 Gas Dilution System

Calibration gases were mixed using an Environics 4040 Gas Dilution System. 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. The calibration is done yearly, and the records are included in the Source Testing Report. A multi-point EPA Method 205 check was executed in the field prior to testing.

The gas dilution system consists of calibrated orifices or mass flow controllers and dilutes a high-level calibration gas to within ±2% of predicted values. The gas divider is capable of diluting gases at set increments and were evaluated for accuracy in the field in accordance with US EPA Method 205 "*Verification of Gas Dilution Systems for Field Instrument Calibrations*". The gas divider dilutions were measured to evaluate that the responses are within ±2% of predicted values. In addition, a certified mid-level calibration gas within ±10% of one of the tested dilution gases was introduced into an analyzer to ensure the response of the gas calibration is within ±2% of gas divider dilution concentration.

4.4 Description of Recovery and Analytical Procedures

There were no samples to recover during this test program. All testing used real time data from the analyzers.

4.5 Sampling Port Description

All sampling ports meet USEPA Method 1 locations and can be found in the **Figure Section**.

5 TEST RESULTS AND DISCUSSION

5.1 Detailed Results

Table 5.1.1: Average Emission Data

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	Test 2	Test 3	Average
NMOC Inlet	26.23 ppmv 8.16 lb/hr	20.48 ppmv 6.40 lb/hr	14.87 ppmv 4.63 lb/hr	20.53 ppmv 6.40 lb/hr
NMOC Outlet	3.10 ppmv 1.24 lb/hr	2.74 ppmv 1.11 lb/hr	2.67 ppmv 1.05 lb/hr	2.84 ppmv 1.13 lb/hr
RTO Temperature (°F)	1449	1450	1450	1450
Clearcoat 1 & 2 Observation Zone Production Rates	52 vehicles per hour	43 vehicles per hour	32 vehicles per hour	42 vehicles per hour
Destruction Efficiency	84.8 %	82.7 %	77.3 %	82.3 %

5.2 Discussion of Results

Detailed testing results can be found in **Appendix B**.

5.3 Variations in Testing Procedures

There were no sampling variations to the method. Due to lower production volumes on Test 3, the test was extended beyond 60 minutes to 83 minutes.

5.4 Process Upset Conditions During Testing

There were normal process breaks during production.

5.5 Maintenance Performed in Last Three Months

Only routine maintenance was performed on the machinery in the last three months. RTO2 was a new installation and prior to testing, was in the commissioning and verification stages of the project.

5.6 Re-Test

This was not a retest.

5.7 Audit Samples

This test did not require any audit samples.

5.8 Process Data

Process data can be found in **Appendix A**.

5.9 Measurement Results

Data from the testing can be in **Appendix B**.

5.10 Flows and Moisture

Flow and moisture determination results can be found in **Appendix C**.

5.11 Calibration Data

Calibration data can be found in **Appendix D**.

5.12 Field Notes

Field notes can be found in **Appendix E**.

5.13 Example Calculations

Example calculations can be found in **Appendix F**.

5.14 Laboratory Data

There was no laboratory data from this testing program.

6 CONCLUSION

Testing for overall outlet concentrations and destruction efficiency associated with the RTO2 System was completed on October 12, 2023. Testing followed the methodology outlined in the Source Testing Plan approved by EGLE. Testing demonstrated that the overall outlet concentration as non-methane organic compounds (NMOC) was less than 5 ppmvd (as propane).

TABLES

Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
RTO2 Inlet	3	Velocity, Temperature, and Flow Rate	U.S. EPA [1] Methods 1,2, and 4
	3	Oxygen / Carbon Dioxide	U.S. EPA [1] Method 3/3A
	3	THC/Methane/NMOC	U.S. EPA [1] Method 25A
RTO2 Outlet	3	Velocity, Temperature, and Flow Rate	U.S. EPA [1] Methods 1,2, and 4
	3	Oxygen / Carbon Dioxide	U.S. EPA [1] Method 3/3A
	3	THC/Methane/NMOC	U.S. EPA [1] Method 25A

Notes:

[1] U.S. EPA - United States Environmental Protection Agency

Table 2: Sampling Summary and Sample Log

Source and Test #	Sampling Date	Start Time	End Time
RTO2 Inlet			
Test #1	12-Oct-23	7:03 AM	8:02 AM
Test #2	12-Oct-23	9:05 AM	10:04 AM
Test #3	12-Oct-23	11:33 AM	12:56 PM
RTO2 Outlet			
Test #1	12-Oct-23	7:03 AM	8:02 AM
Test #2	12-Oct-23	9:05 AM	10:04 AM
Test #3	12-Oct-23	11:33 AM	12:56 PM

Table 3A: Sampling Summary - Flow Characteristics - RTO2 Inlet

Stack Gas Parameter	Unit	Test No. 1	Test No. 2	Test No. 3	Average
Testing Date		12-Oct-23	12-Oct-23	12-Oct-23	
Stack Temperature	°F	82	81	82	82
Moisture	%	1.65%	1.59%	1.71%	1.65%
Velocity	ft/s	51.8	51.8	51.9	51.8
Referenced Flow Rate	CFM	45,311	45,510	45,392	45,404

Notes:

[1] Referenced flow rate expressed as dry at 101.3 kPa, 68 °F, and Actual Oxygen

Table 3B: Sampling Summary - Flow Characteristics - RTO2 Outlet

Stack Gas Parameter	Unit	Test No. 1	Test No. 2	Test No. 3	Average
Testing Date		12-Oct-23	12-Oct-23	12-Oct-23	
Stack Temperature	°F	185	182	180	182
Moisture	%	2.74%	2.44%	2.18%	2.45%
Velocity	ft/s	34.4	34.4	33.4	34.1
Referenced Flow Rate	CFM	58,214	58,682	57,368	58,088

Notes:

[1] Referenced flow rate expressed as dry at 101.3 kPa, 68 °F, and Actual Oxygen

Table 4: THC, Methane, and NMOC EMISSIONS TABLE

Source: FCA DACM RTO 2 Inlet

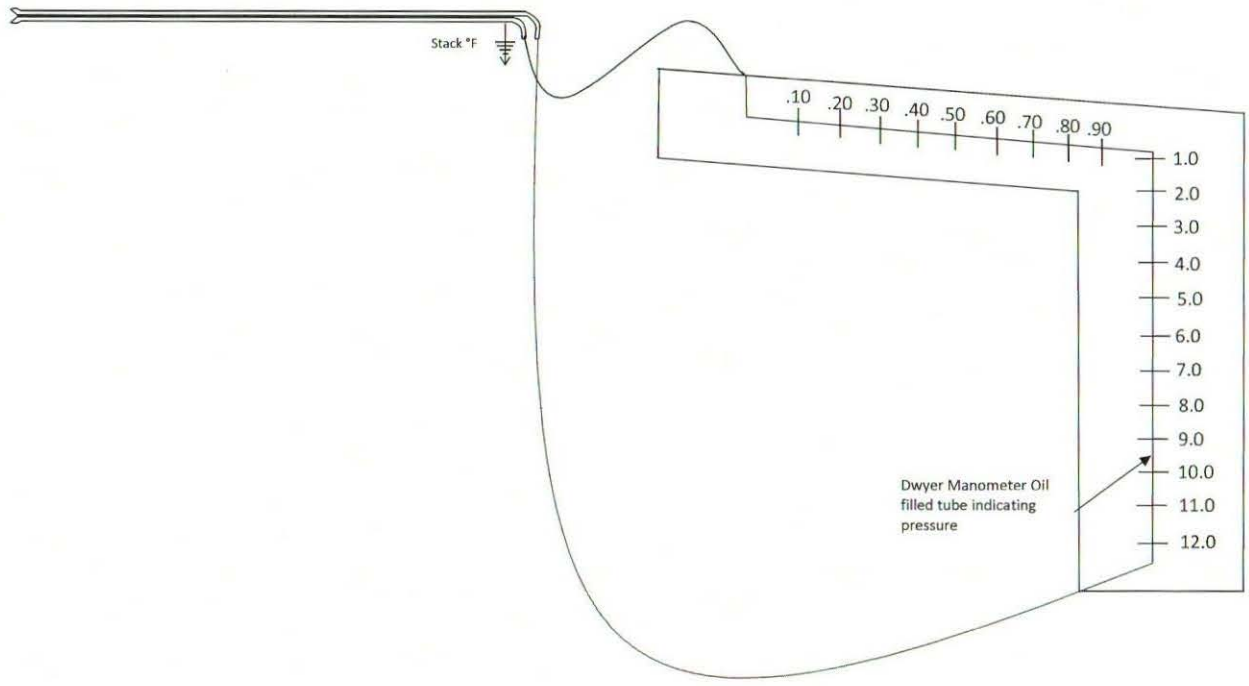
RWDI Project # 2305818

Parameter	Test 1	Test 2	Test 3	Average
Date	12-Oct-23	12-Oct-23	12-Oct-23	--
Start Time:	7:03	9:05	11:33	--
Stop Time:	8:02	10:04	12:56	--
Duration (mins):	60	60	82	--
RTO 2 Inlet THC Concentration (as propane) (ppm_w):	27.05	21.75	16.18	21.66
RTO 2 Inlet THC Concentration (as propane) (ppm_d):	27.50	22.10	16.46	22.02
RTO 2 Inlet THC Concentration (as propane) (mg/m^3_d):	50.41	40.51	30.17	40.36
RTO 2 Inlet THC Concentration (as propane) (lb/hr_d):	8.56	6.90	5.13	6.86
RTO 2 Inlet Methane Correction Factor	2.47	2.48	2.47	2.47
RTO 2 Inlet CH4 Concentration (as methane) (ppm_w):	3.09	3.96	3.87	3.64
RTO 2 Inlet CH4 Concentration (as Methane) (ppm_d):	3.14	4.02	3.94	3.70
RTO 2 Inlet CH4 Concentration (as Propane) (ppm_d):	1.27	1.62	1.59	1.50
RTO 2 Inlet CH4 Concentration (as propane) (mg/m^3_d):	2.33	2.97	2.92	2.74
RTO 2 Inlet CH4 Concentration (as propane) (lb/hr_d):	0.40	0.51	0.50	0.47
RTO 2 Inlet NMOC Concentration (as Propane) (ppm_d):	26.23	20.48	14.87	20.53
RTO 2 Inlet NMOC Concentration (as propane) (mg/m^3_d):	48.08	37.53	27.25	37.62
RTO 2 Inlet NMOC Concentration (as propane) (lb/hr_d):	8.16	6.40	4.63	6.40
RTO 2 Inlet Flow Rate (dscfm):	45,311	45,510	45,392	45,404
RTO 2 Inlet Flow Rate (dm^3/s):	21.38	21.47	21.41	21.42
Moisture:	1.65%	1.59%	1.71%	1.65%
RTO 2 Outlet THC Concentration (as propane) (ppm_w):	3.66	3.20	3.02	3.29
RTO 2 Outlet THC Concentration (as propane) (ppm_d):	3.76	3.28	3.09	3.38
RTO 2 Outlet THC Concentration (as propane) (mg/m^3_d):	6.90	6.02	5.66	6.19
RTO 2 Outlet THC Concentration (as propane) (lb/hr_d):	1.50	1.32	1.22	1.35
RTO 2 Outlet Methane Correction Factor	2.17	2.23	2.16	2.18
RTO 2 Outlet CH4 Concentration (as methane) (ppm_w):	1.40	1.18	0.88	1.15
RTO 2 Outlet CH4 Concentration (as Methane) (ppm_d):	1.44	1.21	0.90	1.18
RTO 2 Outlet CH4 Concentration (as Propane) (ppm_d):	0.66	0.54	0.42	0.54
RTO 2 Outlet CH4 Concentration (as propane) (mg/m^3_d):	1.21	0.99	0.76	0.99
RTO 2 Outlet CH4 Concentration (as propane) (lb/hrd):	0.26	0.22	0.16	0.22
RTO 2 Outlet NMOC Concentration (as Propane) (ppm_d):	3.10	2.74	2.67	2.84
RTO 2 Outlet NMOC Concentration (as propane) (mg/m^3_d):	5.69	5.03	4.89	5.20
RTO 2 Outlet NMOC Concentration (as propane) (lb/hr_d):	1.24	1.11	1.05	1.13
RTO 2 Outlet Flow Rate (dscfm):	58,214	58,682	57,368	58,088
RTO 2 Outlet Flow Rate (dm^3/s):	27.46	27.68	27.06	27.40
Moisture:	2.74%	2.44%	2.18%	2.45%
Destruction Efficiency NMOC (%)	84.81%	82.73%	77.31%	82.30%
NMOC RTO2 Outlet Concentration (ppmvd) as Propane	3.10	2.74	2.67	2.84

Note: "d" indicated based on dry conditions

FIGURES

Figure No. #1: Schematic of USEPA Method 2



USEPA Method 2

FCA US, LLC

Detroit Assembly Complex - Mack (DACM)

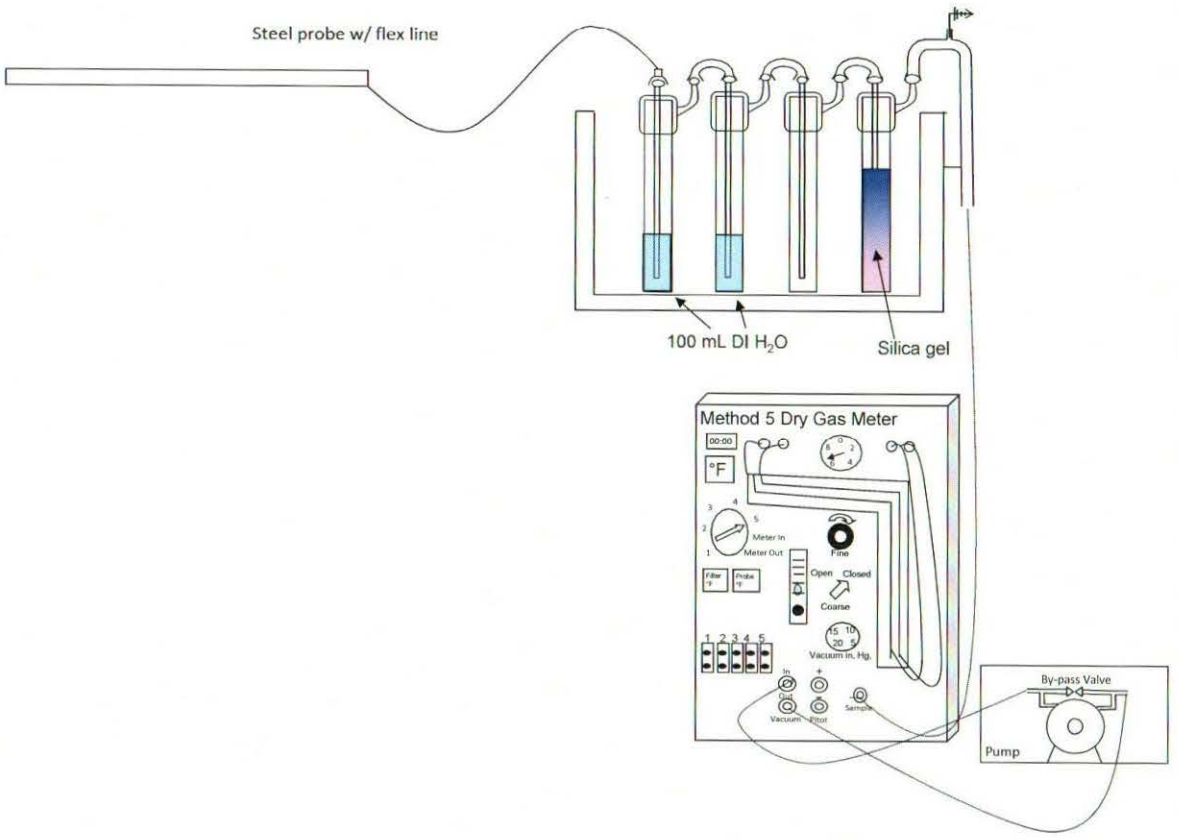
RTO 2

Detroit, Michigan

Project #2305818

Date: October 12, 2023

Figure No. #2: Schematic of US EPA Method 4



USEPA Method 4

FCA US LLC

Detroit Assembly Complex - Mack (DACM)

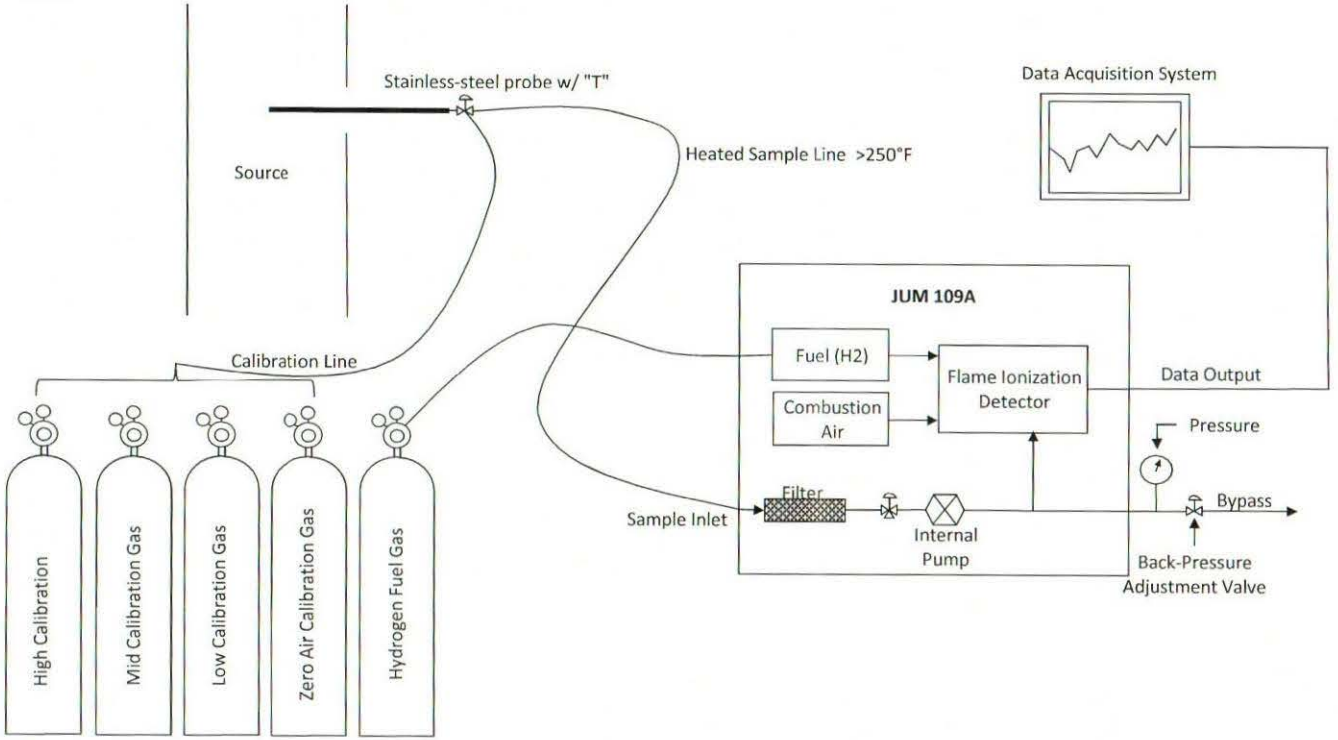
RTO 2

Detroit, Michigan

Project 2305818

Date: October 12, 2023

Figure No. 3: USEPA Method 25A Schematic



USEPA Method 25A

FCA US LLC

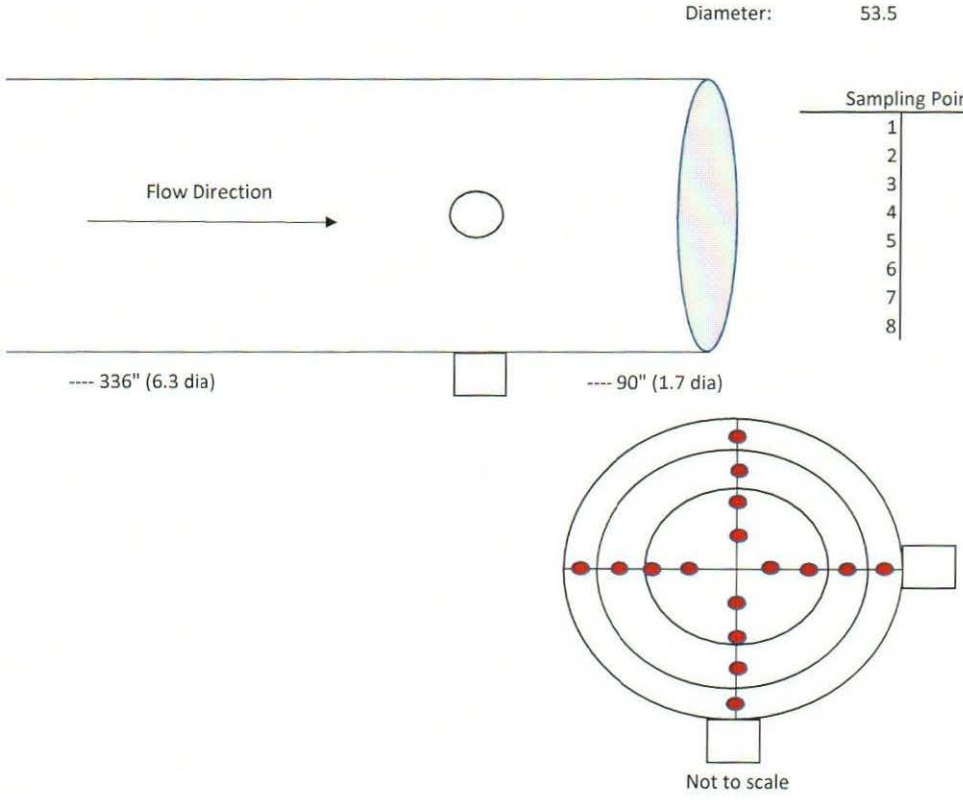
Detroit Assembly Complex - Mack (DACM)

Detroit, Michigan

Project# 2305818

Date: October 12, 2023

Figure 4: RTO 2 Inlet

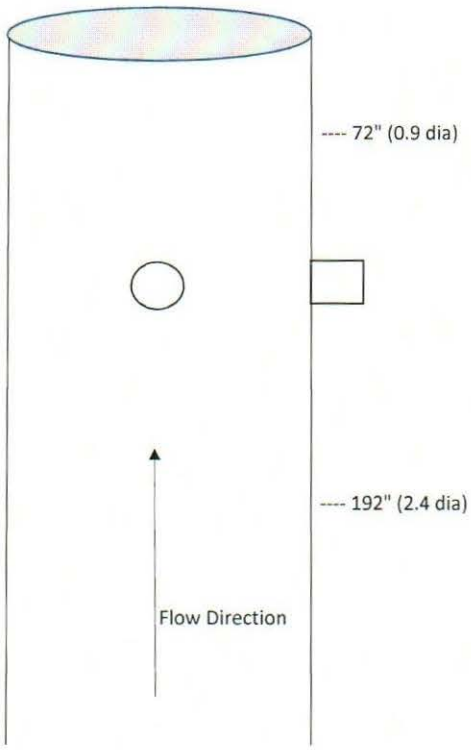


Sampling Points (in.)	
1	1.7
2	5.6
3	10.4
4	17.3
5	36.2
6	43.1
7	47.9
8	51.8

RTO 2 Inlet
FCA
Detroit Assembly Complex Mack
Detroit, Michigan

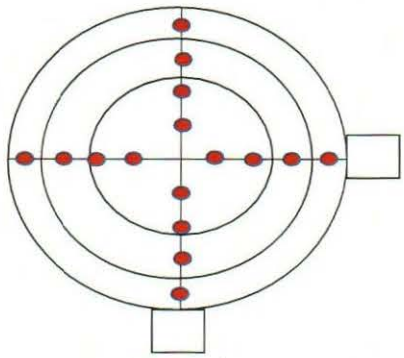
RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309

Figure 5: RTO 2 Outlet



Diameter: 81.5

Sampling Points (in.)	
1	2.6
2	8.6
3	15.8
4	26.3
5	55.2
6	65.7
7	72.9
8	78.9



Not to scale

RTO 2 Outlet
FCA
Detroit Assembly Complex Mack
Detroit, Michigan

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309