

FINAL REPORT



FCA US LLC

DETROIT, MICHIGAN

DETROIT ASSEMBLY COMPLEX MACK (DACM): RTOI DESTRUCTION EFFICIENCY & CONCENTRATORS 1 & 2 REMOVAL EFFICIENCY

RWDI #2302773

April 19, 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. This source test is required under Permit to Install (PTI) 14-19A, as referenced in the Air Quality Division (AQD) Administrative Consent Order No. 2022-16 (ACO). This testing program covered the required testing for re-validation of destruction efficiency (DE) for the regenerative thermal oxidizer (RTO) serving the E-Coat Tank and curing oven (EUECOAT), Primer Curing Oven (EUPRIMER), basecoat/clearcoat curing ovens (EUTOPCOAT), and the desorb portion from the two (2) Concentrators. The testing also included the re-validation of the removal efficiency for two (2) Zeolite Concentrators servicing the primer booths and primer ambient flash (EUPRIMER) and the basecoat/clearcoat booths and basecoat heated flash (EUTOPCOAT).

Executive Table i: Average Emission Data – Destruction Efficiency at 1450°F (RTO)

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	Test 2	Test 3	Average
NMOC Combined Oven & Booth Inlets	1164.9 ppmv (Booth) 98.3 (Oven) 145.2 lb/hr (combined)	1227.6 ppmv (Booth) 100.5 (Oven) 152.7 lb/hr (Combined)	989.0 ppmv (Booth) 94.9 (Oven) 123.6 lb/hr (Combined)	1127.2 ppmv (Booth) 97.9 (Oven) 140.5 lb/hr (Combined)
NMOC Outlet	7.0 ppmv 3.6 lb/hr	7.8 ppmv 4.0 lb/hr	5.4 ppmv 2.8 lb/hr	6.73 ppmv 3.5 lb/hr
Destruction Efficiency	97.5%	97.4%	97.7%	97.5 %

Executive Table ii: Average Emission Data – Destruction Efficiency at 1375°F (RTO)

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	Test 2	Test 3	Average
NMOC Combined Oven & Booth Inlets	831.4 ppmv (Booth) 82.7 ppmv (Oven) 109.1 lb/hr (Combined)	699.2 ppmv (Booth) 69.1 ppmv (Oven) 90.9 lb/hr (Combined)	847.3 ppmv (Booth) 65.5 ppmv (Oven) 105.8 lb/hr (Combined)	792.6 ppmv (Booth) 72.4 ppmv (Oven) 101.9 lb/hr
NMOC Outlet	7.5 ppmv 3.9 lb/hr	6.9 ppmv 3.5 lb/hr	7.4 ppmv 3.8 lb/hr	7.3 ppmv 3.7 lb/hr
Destruction Efficiency	96.4%	96.1%	96.4%	96.3 %

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**DETROIT ASSEMBLY COMPLEX MACK (DACM):
RTO1 DESTRUCTION EFFICIENCY & CONCENTRATORS 1 & 2 REMOVAL EFFICIENCY
FCA US LLC**



RWDI#2302773
April 19, 2023

Executive Table iii: Average Emission Data – Removal Efficiency (Combined 2 Concentrators)

Parameter	Concentration & Emission Rate (ppmv, lb/hr & % Removal)			
	Test 1	Test 2	Test 3	Average
NMOC Desorb Outlet	1164.9 ppmv 115.4 lb/hr	1227.6 ppm 120.8 lb/hr	989.0 ppm 94.3 lb/hr	1127.2 ppmv 110.2 lb/hr
NMOC Outlet	8.7 ppmv 6.8 lb/hr	10.8 ppmv 8.1 lb/hr	8.5 ppmv 6.6 lb/hr	9.3 ppmv 7.2 lb/hr
Removal Efficiency	94.1%	93.3%	93.0%	93.5%



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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. This source test is required under Permit to Install (PTI) 14-19A, as referenced in the Air Quality Division (AQD) Administrative Consent Order No. 2022-16 (ACO).

This testing program covered the required testing for re-validation of destruction efficiency (DE) for the regenerative thermal oxidizer (RTO) serving the E-Coat Tank and curing oven (EUECOAT), Primer Curing Oven (EUPRIMER), basecoat/clearcoat curing ovens (EUTOPCOAT), and the desorb portion from the two (2) Concentrators. The testing also included the re-validation of the removal efficiency for two (2) Zeolite Concentrators servicing the primer booths and primer ambient flash (EUPRIMER) and the basecoat/clearcoat booths and basecoat heated flash (EUTOPCOAT).

The test program was completed on February 21 to 22, 2023.

The testing was performed in accordance with the testing requirements identified in the following condition under FGAUTOASSEMBLY:

V(5): Destruction efficiency of the RTO and removal efficiency of the concentrators.

DACM recorded the production rate of vehicles processed during each destruction efficiency test from the RTO and each removal efficiency test from the concentrators. The two (2) concentrators have a combined inlet and a combined clean air exhaust from the units. Therefore, the two (2) concentrators were tested as a single unit. DACM recorded the RTO combustion chamber temperature during each of the destruction efficiency tests and the desorption gas inlet temperatures for each of the Zeolite Concentrators during each removal efficiency test.

1.1 Location and Dates of Testing

The test program was completed on February 21st and 22nd, of 2023 at the FCA DACM facility.

1.2 Purpose of Testing

The emissions test program was required by EGLE Permit To Install (PTI) No. 14-19A and the Administration Consent Order No. 2022-19. The facility SRN number is N2155.



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2 SUMMARY OF RESULTS

2.1 Operating Data

Operational data collected during the testing includes the number of vehicles produced during each test, the combustion chamber temperatures from RTO1 and the desorb temperatures from Concentrators 1 & 2. 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. 2022-19. The facility SRN number is N2155.



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 was determined following calculations outlined in U.S. EPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight" using a Fyrite.

Stack moisture content was determined through direct condensation 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**. The following moisture tests were completed:

- RTO1 Outlet @ 1450°F - three (3) moisture tests
- RTO1 Outlet @ 1375°F - three (3) moisture tests
- Desorb Line (Inlet 1) of RTO1 @ 1450°F - three (3) moisture tests. Note that this was also the inlet location used for Concentrator 1 & 2 as per EGLE request.
- Desorb Line (Inlet 1) of RTO1 @ 1375°F -three (3) moisture tests.
- Oven Line (Inlet 2) of RTO1 @ 1450°F - three (3) moisture tests.
- Oven Line (Inlet 2) of RTO1 @ 1375°F - three (3) moisture tests.
- Combined Clean Air Exhaust of Concentrator 1 & 2 - three (3) moisture tests.



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 to ensure accurate gas-mixtures.

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 – Destruction Efficiency at 1450°F (RTO)

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	Test 2	Test 3	Average
NMOC Combined Oven & Booth Inlets	1164.9 ppmv (Booth) 98.3 (Oven) 145.2 lb/hr (combined)	1227.6 ppmv (Booth) 100.5 (Oven) 152.7 lb/hr (Combined)	989.0 ppmv (Booth) 94.9 (Oven) 123.6 lb/hr (Combined)	1127.2 ppmv (Booth) 97.9 (Oven) 140.5 lb/hr (Combined)
NMOC Outlet	7.0 ppmv 3.6 lb/hr	7.8 ppmv 4.0 lb/hr	5.4 ppmv 2.8 lb/hr	6.73 ppmv 3.5 lb/hr
Destruction Efficiency	97.5%	97.4%	97.7%	97.5 %



5.5 Maintenance Performed in Last Three Months

FCA completed inspections and maintenance on RTO 1 that included adjustments of valve timing, positioning, and overall inspection of RTO 1.

5.6 Re-Test

This was not a retest.

5.7 Audit Samples

This test did not require any audit samples.

5.8 Flows and Moisture

Flow and moisture determination results can be found in **Appendix B for RTO and C for Concentrators**.

5.9 Calibration Data

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

5.10 Process Data

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

5.11 Example Calculations

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

5.12 Field Notes

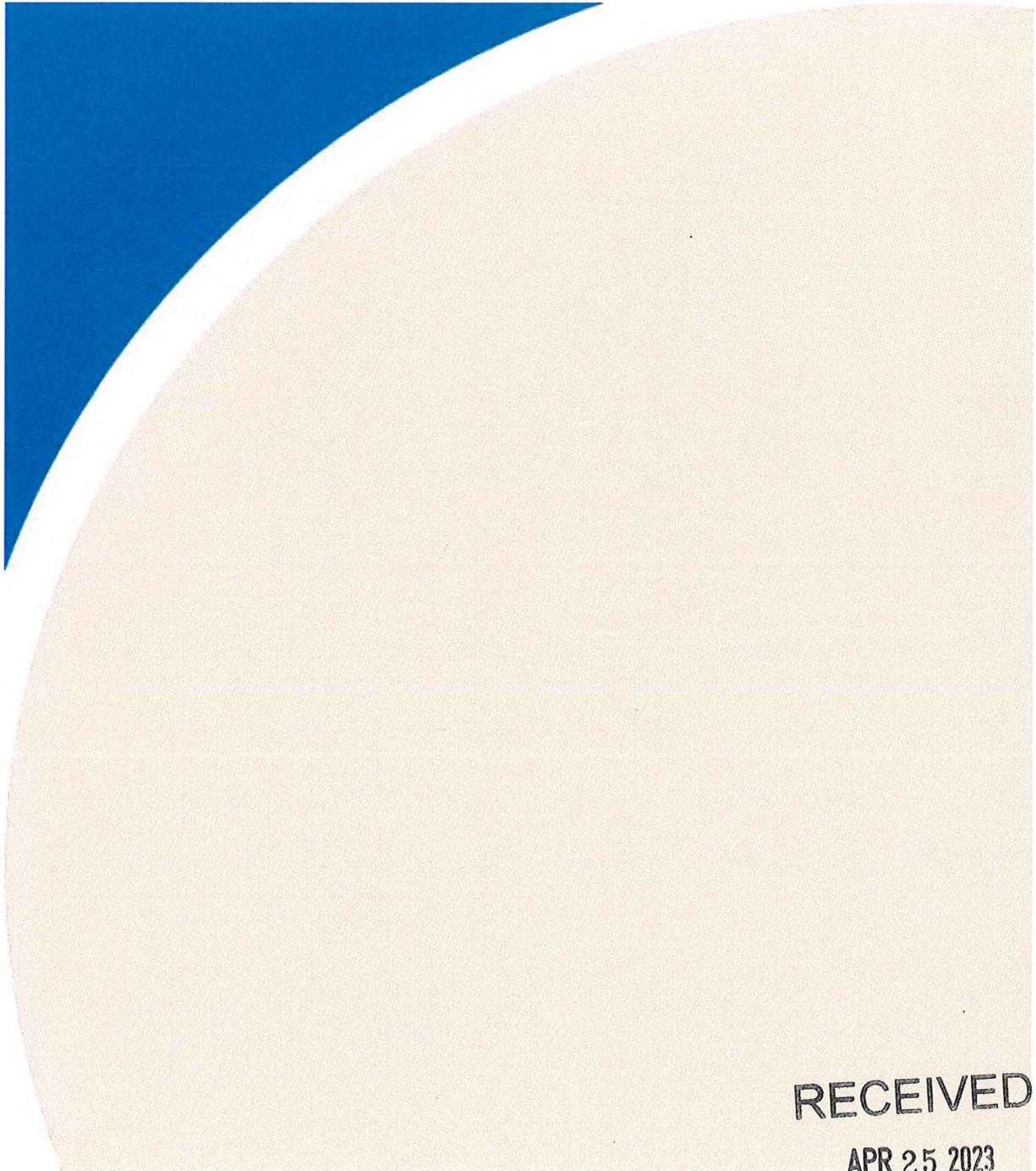
Field notes can be found in **Appendix F**.

5.13 Laboratory Data

There was no laboratory data from this testing program.



TABLES



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Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
DACM RTO (Oven Inlet, Booth Inlet, Outlet)	6	Velocity, Temperature and Flow Rate	U.S. EPA ^[1] Methods 1-2
	6	Oxygen, Carbon Dioxide	U.S. EPA [1] Method 3
	6	Moisture Content	U.S. EPA [1] Method 4
	6	THC, CH ₄ , NMOC	U.S. EPA [1] Method 25A
DACM Concentrator (Desorb Outlet, Outlet)	3	Velocity, Temperature and Flow Rate	U.S. EPA ^[1] Methods 1-2
	3	Oxygen, Carbon Dioxide	U.S. EPA [1] Method 3
	3	Moisture Content	U.S. EPA [1] Method 4 (Desorb)/WB-DB Outlet
	3	THC, CH ₄ , NMOC	U.S. EPA [1] Method 25A

Notes:

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

Table 3: Sampling Summary - Concentrator

Source and Test #	Sampling Date	Start Time	End Time	Desorption Gas Inlet Temperature °F	
				Concentrator 1	Concentrator 2
Concentrator - Reduction Efficiency					
Test #1	21-Feb-23	7:35 AM	8:34 AM	369.6	369.2
Test #2	21-Feb-23	9:20 AM	10:19 AM	368.9	368.8
Test #3	21-Feb-23	11:18 AM	12:17 PM	368.5	369.7

FIGURES

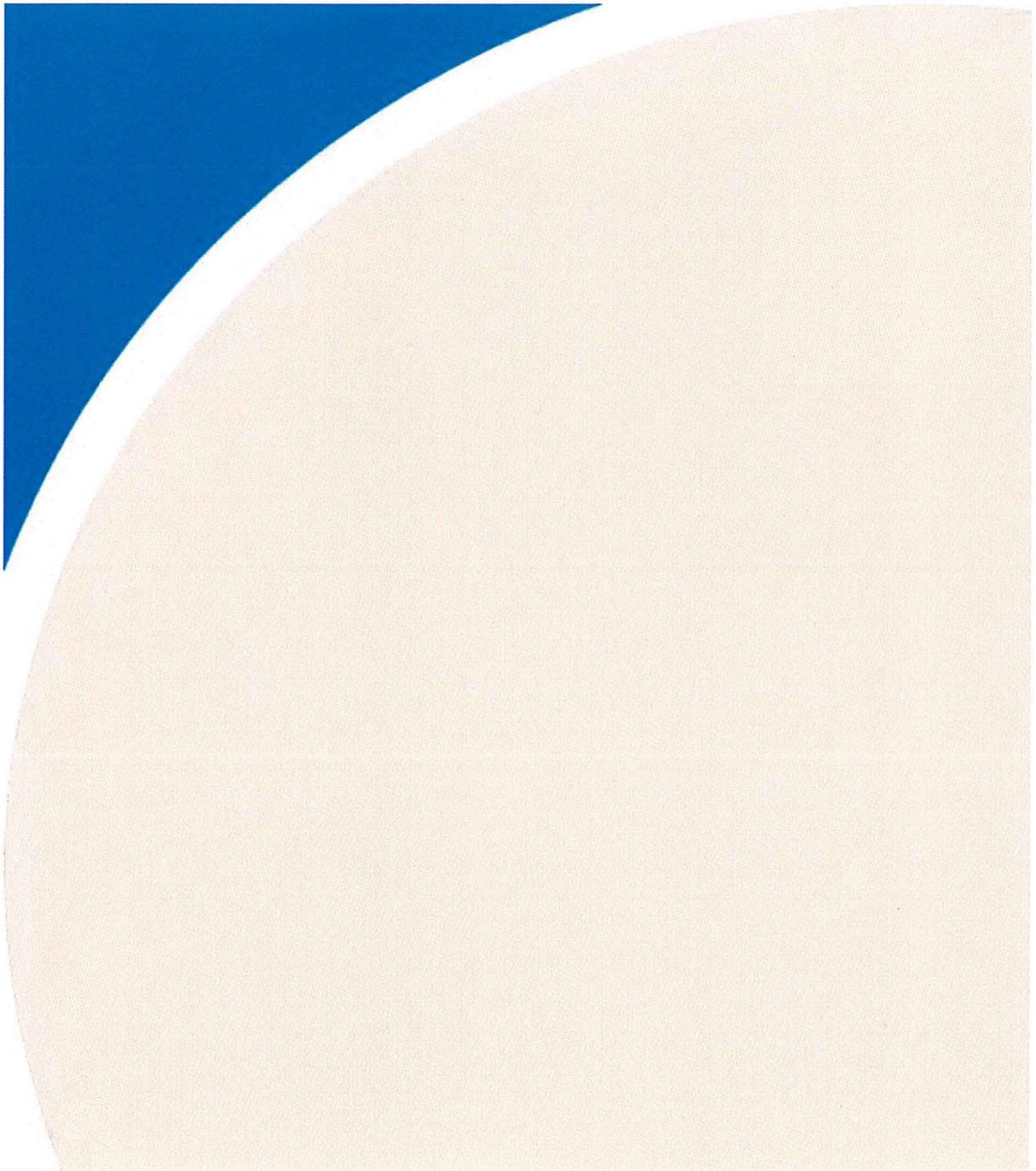
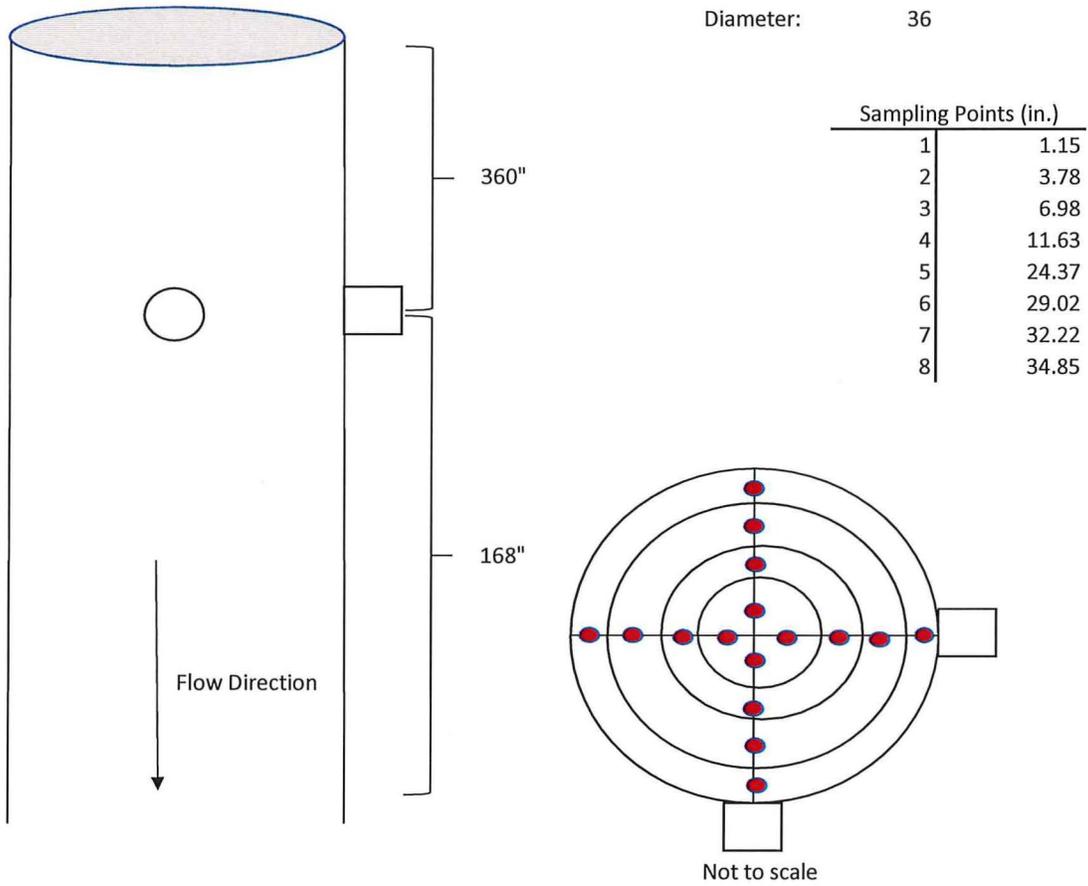




Figure No. 1: Booth Inlet/Desorb Outlet



Source: Booth Inlet/Desorb Outlet
 FCA US, LLC
 DACM
 Detroit, Michigan

Date:
 February 21-22, 203

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 2239 Star Court
 Rochester Hills, MI 48309

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NMOC Outlet	7.0 ppmv 3.6 lb/hr	7.8 ppmv 4.0 lb/hr	5.4 ppmv 2.8 lb/hr	6.73 ppmv 3.5 lb/hr
Destruction Efficiency	97.5%	97.4%	97.7%	97.5 %

Executive Table ii: Average Emission Data – Destruction Efficiency at 1375°F (RTO)

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	Test 2	Test 3	Average
NMOC Combined Oven & Booth Inlets	831.4 ppmv (Booth) 82.7 ppmv (Oven) 109.1 lb/hr (Combined)	699.2 ppmv (Booth) 69.1 ppmv (Oven) 90.9 lb/hr (Combined)	847.3 ppmv (Booth) 65.5 ppmv (Oven) 105.8 lb/hr (Combined)	792.6 ppmv (Booth) 72.4 ppmv (Oven) 101.9 lb/hr
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RTO1 DESTRUCTION EFFICIENCY & CONCENTRATORS 1 & 2 REMOVAL EFFICIENCY
FCA US LLC**



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Executive Table iii: Average Emission Data – Removal Efficiency (Combined 2 Concentrators)

Parameter	Concentration & Emission Rate (ppmv, lb/hr & % Removal)			
	Test 1	Test 2	Test 3	Average
NMOC Desorb Outlet	1164.9 ppmv 115.4 lb/hr	1227.6 ppm 120.8 lb/hr	989.0 ppm 94.3 lb/hr	1127.2 ppmv 110.2 lb/hr
NMOC Outlet	8.7 ppmv 6.8 lb/hr	10.8 ppmv 8.1 lb/hr	8.5 ppmv 6.6 lb/hr	9.3 ppmv 7.2 lb/hr
Removal Efficiency	94.1%	93.3%	93.0%	93.5%



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- Appendix G:** Approval Letter and Source Testing Plan



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. This source test is required under Permit to Install (PTI) 14-19A, as referenced in the Air Quality Division (AQD) Administrative Consent Order No. 2022-16 (ACO).

This testing program covered the required testing for re-validation of destruction efficiency (DE) for the regenerative thermal oxidizer (RTO) serving the E-Coat Tank and curing oven (EUECOAT), Primer Curing Oven (EUPRIMER), basecoat/clearcoat curing ovens (EUTOPCOAT), and the desorb portion from the two (2) Concentrators. The testing also included the re-validation of the removal efficiency for two (2) Zeolite Concentrators servicing the primer booths and primer ambient flash (EUPRIMER) and the basecoat/clearcoat booths and basecoat heated flash (EUTOPCOAT).

The test program was completed on February 21 to 22, 2023.

The testing was performed in accordance with the testing requirements identified in the following condition under FGAUTOASSEMBLY:

V(5): Destruction efficiency of the RTO and removal efficiency of the concentrators.

DACM recorded the production rate of vehicles processed during each destruction efficiency test from the RTO and each removal efficiency test from the concentrators. The two (2) concentrators have a combined inlet and a combined clean air exhaust from the units. Therefore, the two (2) concentrators were tested as a single unit. DACM recorded the RTO combustion chamber temperature during each of the destruction efficiency tests and the desorption gas inlet temperatures for each of the Zeolite Concentrators during each removal efficiency test.

1.1 Location and Dates of Testing

The test program was completed on February 21st and 22nd, of 2023 at the FCA DACM facility.

1.2 Purpose of Testing

The emissions test program was required by EGLE Permit To Install (PTI) No. 14-19A and the Administration Consent Order No. 2022-19. The facility SRN number is N2155.



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2 SUMMARY OF RESULTS

2.1 Operating Data

Operational data collected during the testing includes the number of vehicles produced during each test, the combustion chamber temperatures from RTO1 and the desorb temperatures from Concentrators 1 & 2. 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. 2022-19. The facility SRN number is N2155.



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 was determined following calculations outlined in U.S. EPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight" using a Fyrite.

Stack moisture content was determined through direct condensation 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**. The following moisture tests were completed:

- RTO1 Outlet @ 1450°F - three (3) moisture tests
- RTO1 Outlet @ 1375°F - three (3) moisture tests
- Desorb Line (Inlet 1) of RTO1 @ 1450°F - three (3) moisture tests. Note that this was also the inlet location used for Concentrator 1 & 2 as per EGLE request.
- Desorb Line (Inlet 1) of RTO1 @ 1375°F - three (3) moisture tests.
- Oven Line (Inlet 2) of RTO1 @ 1450°F - three (3) moisture tests.
- Oven Line (Inlet 2) of RTO1 @ 1375°F - three (3) moisture tests.
- Combined Clean Air Exhaust of Concentrator 1 & 2 - three (3) moisture tests.



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 to ensure accurate gas-mixtures.

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 – Destruction Efficiency at 1450°F (RTO)

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	Test 2	Test 3	Average
NMOC Combined Oven & Booth Inlets	1164.9 ppmv (Booth) 98.3 (Oven) 145.2 lb/hr (combined)	1227.6 ppmv (Booth) 100.5 (Oven) 152.7 lb/hr (Combined)	989.0 ppmv (Booth) 94.9 (Oven) 123.6 lb/hr (Combined)	1127.2 ppmv (Booth) 97.9 (Oven) 140.5 lb/hr (Combined)
NMOC Outlet	7.0 ppmv 3.6 lb/hr	7.8 ppmv 4.0 lb/hr	5.4 ppmv 2.8 lb/hr	6.73 ppmv 3.5 lb/hr
Destruction Efficiency	97.5%	97.4%	97.7%	97.5 %



5.5 Maintenance Performed in Last Three Months

FCA completed inspections and maintenance on RTO 1 that included adjustments of valve timing, positioning, and overall inspection of RTO 1.

5.6 Re-Test

This was not a retest.

5.7 Audit Samples

This test did not require any audit samples.

5.8 Flows and Moisture

Flow and moisture determination results can be found in **Appendix B for RTO and C for Concentrators**.

5.9 Calibration Data

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

5.10 Process Data

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

5.11 Example Calculations

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

5.12 Field Notes

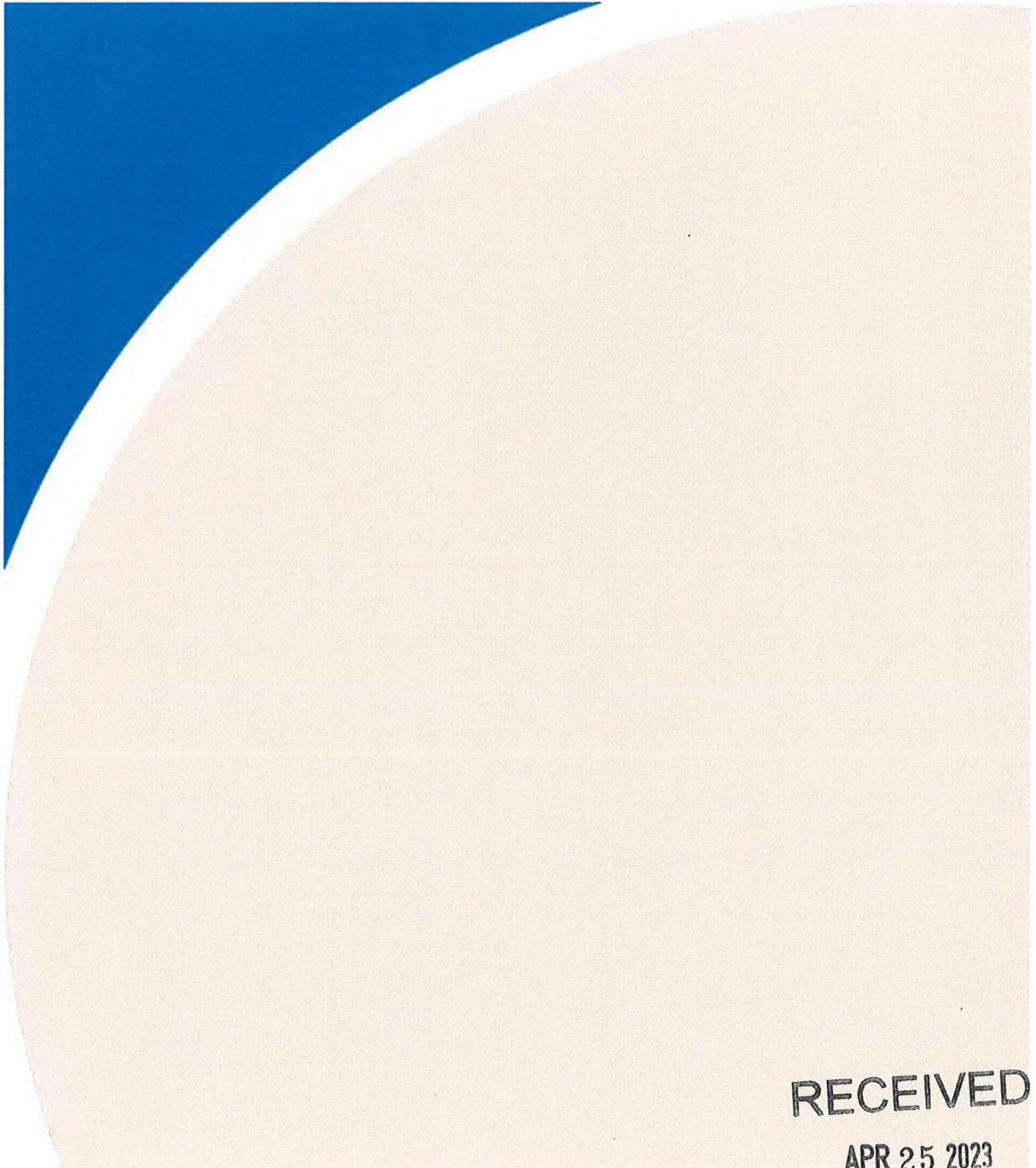
Field notes can be found in **Appendix F**.

5.13 Laboratory Data

There was no laboratory data from this testing program.



TABLES



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Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
DACM RTO (Oven Inlet, Booth Inlet, Outlet)	6	Velocity, Temperature and Flow Rate	U.S. EPA ^[1] Methods 1-2
	6	Oxygen, Carbon Dioxide	U.S. EPA [1] Method 3
	6	Moisture Content	U.S. EPA [1] Method 4
	6	THC, CH4, NMOC	U.S. EPA [1] Method 25A
DACM Concentrator (Desorb Outlet, Outlet)	3	Velocity, Temperature and Flow Rate	U.S. EPA ^[1] Methods 1-2
	3	Oxygen, Carbon Dioxide	U.S. EPA [1] Method 3
	3	Moisture Content	U.S. EPA [1] Method 4 (Desorb)/WB-DB Outlet
	3	THC, CH4, NMOC	U.S. EPA [1] Method 25A

Notes:

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

Table 3: Sampling Summary - Concentrator

Source and Test #	Sampling Date	Start Time	End Time	Desorption Gas Inlet Temperature °F	
				Concentrator 1	Concentrator 2
Concentrator - Reduction Efficiency					
Test #1	21-Feb-23	7:35 AM	8:34 AM	369.6	369.2
Test #2	21-Feb-23	9:20 AM	10:19 AM	368.9	368.8
Test #3	21-Feb-23	11:18 AM	12:17 PM	368.5	369.7

FIGURES

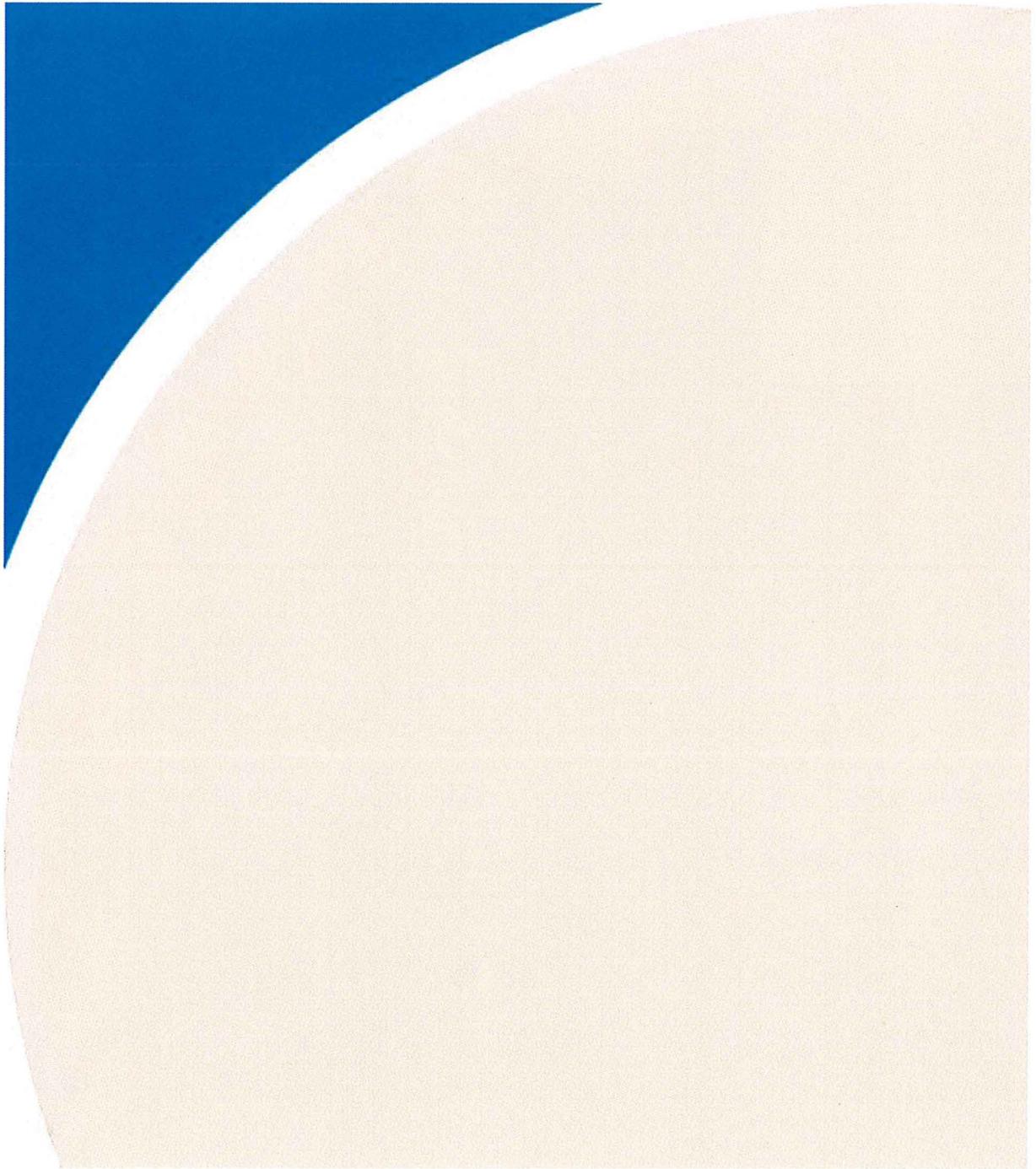
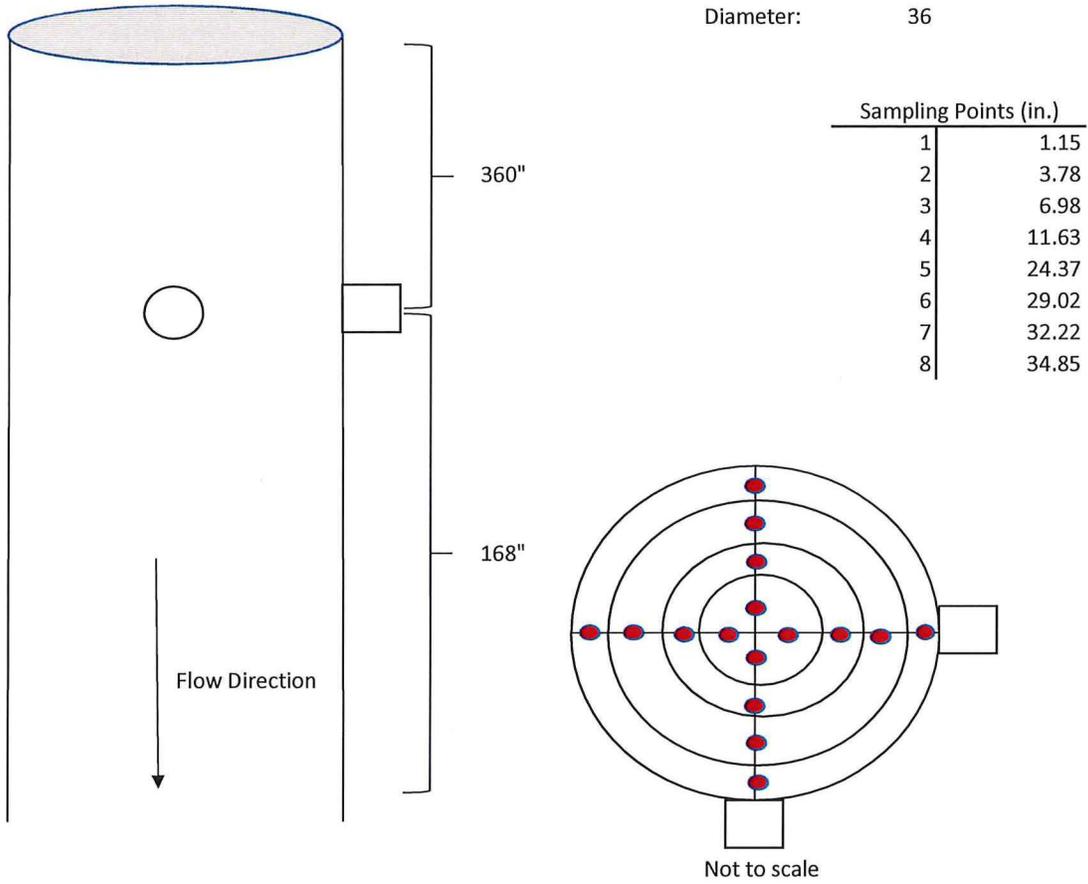




Figure No. 1: Booth Inlet/Desorb Outlet



Source: Booth Inlet/Desorb Outlet
FCA US, LLC
DACM
Detroit, Michigan

Date:
February 21-22, 203

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309

FINAL REPORT



FCA US LLC

DETROIT, MICHIGAN

DETROIT ASSEMBLY COMPLEX MACK (DACM): RTOI DESTRUCTION EFFICIENCY & CONCENTRATORS 1 & 2 REMOVAL EFFICIENCY

RWDI #2302773

April 19, 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. This source test is required under Permit to Install (PTI) 14-19A, as referenced in the Air Quality Division (AQD) Administrative Consent Order No. 2022-16 (ACO). This testing program covered the required testing for re-validation of destruction efficiency (DE) for the regenerative thermal oxidizer (RTO) serving the E-Coat Tank and curing oven (EUECOAT), Primer Curing Oven (EUPRIMER), basecoat/clearcoat curing ovens (EUTOPCOAT), and the desorb portion from the two (2) Concentrators. The testing also included the re-validation of the removal efficiency for two (2) Zeolite Concentrators servicing the primer booths and primer ambient flash (EUPRIMER) and the basecoat/clearcoat booths and basecoat heated flash (EUTOPCOAT).

Executive Table i: Average Emission Data – Destruction Efficiency at 1450°F (RTO)

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	Test 2	Test 3	Average
NMOC Combined Oven & Booth Inlets	1164.9 ppmv (Booth) 98.3 (Oven) 145.2 lb/hr (combined)	1227.6 ppmv (Booth) 100.5 (Oven) 152.7 lb/hr (Combined)	989.0 ppmv (Booth) 94.9 (Oven) 123.6 lb/hr (Combined)	1127.2 ppmv (Booth) 97.9 (Oven) 140.5 lb/hr (Combined)
NMOC Outlet	7.0 ppmv 3.6 lb/hr	7.8 ppmv 4.0 lb/hr	5.4 ppmv 2.8 lb/hr	6.73 ppmv 3.5 lb/hr
Destruction Efficiency	97.5%	97.4%	97.7%	97.5 %

Executive Table ii: Average Emission Data – Destruction Efficiency at 1375°F (RTO)

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	Test 2	Test 3	Average
NMOC Combined Oven & Booth Inlets	831.4 ppmv (Booth) 82.7 ppmv (Oven) 109.1 lb/hr (Combined)	699.2 ppmv (Booth) 69.1 ppmv (Oven) 90.9 lb/hr (Combined)	847.3 ppmv (Booth) 65.5 ppmv (Oven) 105.8 lb/hr (Combined)	792.6 ppmv (Booth) 72.4 ppmv (Oven) 101.9 lb/hr
NMOC Outlet	7.5 ppmv 3.9 lb/hr	6.9 ppmv 3.5 lb/hr	7.4 ppmv 3.8 lb/hr	7.3 ppmv 3.7 lb/hr
Destruction Efficiency	96.4%	96.1%	96.4%	96.3 %

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**DETROIT ASSEMBLY COMPLEX MACK (DACM):
RTO1 DESTRUCTION EFFICIENCY & CONCENTRATORS 1 & 2 REMOVAL EFFICIENCY
FCA US LLC**



RWDI#2302773
April 19, 2023

Executive Table iii: Average Emission Data – Removal Efficiency (Combined 2 Concentrators)

Parameter	Concentration & Emission Rate (ppmv, lb/hr & % Removal)			
	Test 1	Test 2	Test 3	Average
NMOC Desorb Outlet	1164.9 ppmv 115.4 lb/hr	1227.6 ppm 120.8 lb/hr	989.0 ppm 94.3 lb/hr	1127.2 ppmv 110.2 lb/hr
NMOC Outlet	8.7 ppmv 6.8 lb/hr	10.8 ppmv 8.1 lb/hr	8.5 ppmv 6.6 lb/hr	9.3 ppmv 7.2 lb/hr
Removal Efficiency	94.1%	93.3%	93.0%	93.5%



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**DETROIT ASSEMBLY COMPLEX MACK (DACM):
RTO1 DESTRUCTION EFFICIENCY & CONCENTRATORS 1 & 2 REMOVAL EFFICIENCY
FCA US LLC**

RWDI#2302773
April 19, 2023



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- Appendix F:** Field Notes
- Appendix G:** Approval Letter and Source Testing Plan



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. This source test is required under Permit to Install (PTI) 14-19A, as referenced in the Air Quality Division (AQD) Administrative Consent Order No. 2022-16 (ACO).

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The test program was completed on February 21 to 22, 2023.

The testing was performed in accordance with the testing requirements identified in the following condition under FGAUTOASSEMBLY:

V(5): Destruction efficiency of the RTO and removal efficiency of the concentrators.

DACM recorded the production rate of vehicles processed during each destruction efficiency test from the RTO and each removal efficiency test from the concentrators. The two (2) concentrators have a combined inlet and a combined clean air exhaust from the units. Therefore, the two (2) concentrators were tested as a single unit. DACM recorded the RTO combustion chamber temperature during each of the destruction efficiency tests and the desorption gas inlet temperatures for each of the Zeolite Concentrators during each removal efficiency test.

1.1 Location and Dates of Testing

The test program was completed on February 21st and 22nd, of 2023 at the FCA DACM facility.

1.2 Purpose of Testing

The emissions test program was required by EGLE Permit To Install (PTI) No. 14-19A and the Administration Consent Order No. 2022-19. The facility SRN number is N2155.



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2 SUMMARY OF RESULTS

2.1 Operating Data

Operational data collected during the testing includes the number of vehicles produced during each test, the combustion chamber temperatures from RTO1 and the desorb temperatures from Concentrators 1 & 2. 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. 2022-19. The facility SRN number is N2155.



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)

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- 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 was determined following calculations outlined in U.S. EPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight" using a Fyrite.

Stack moisture content was determined through direct condensation 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**. The following moisture tests were completed:

- RTO1 Outlet @ 1450°F - three (3) moisture tests
- RTO1 Outlet @ 1375°F - three (3) moisture tests
- Desorb Line (Inlet 1) of RTO1 @ 1450°F - three (3) moisture tests. Note that this was also the inlet location used for Concentrator 1 & 2 as per EGLE request.
- Desorb Line (Inlet 1) of RTO1 @ 1375°F -three (3) moisture tests.
- Oven Line (Inlet 2) of RTO1 @ 1450°F - three (3) moisture tests.
- Oven Line (Inlet 2) of RTO1 @ 1375°F - three (3) moisture tests.
- Combined Clean Air Exhaust of Concentrator 1 & 2 - three (3) moisture tests.



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 to ensure accurate gas-mixtures.

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 – Destruction Efficiency at 1450°F (RTO)

Parameter	Concentration & Emission Rate (ppmv, lb/hr, & % Destruction)			
	Test 1	Test 2	Test 3	Average
NMOC Combined Oven & Booth Inlets	1164.9 ppmv (Booth) 98.3 (Oven) 145.2 lb/hr (combined)	1227.6 ppmv (Booth) 100.5 (Oven) 152.7 lb/hr (Combined)	989.0 ppmv (Booth) 94.9 (Oven) 123.6 lb/hr (Combined)	1127.2 ppmv (Booth) 97.9 (Oven) 140.5 lb/hr (Combined)
NMOC Outlet	7.0 ppmv 3.6 lb/hr	7.8 ppmv 4.0 lb/hr	5.4 ppmv 2.8 lb/hr	6.73 ppmv 3.5 lb/hr
Destruction Efficiency	97.5%	97.4%	97.7%	97.5 %



5.5 Maintenance Performed in Last Three Months

FCA completed inspections and maintenance on RTO 1 that included adjustments of valve timing, positioning, and overall inspection of RTO 1.

5.6 Re-Test

This was not a retest.

5.7 Audit Samples

This test did not require any audit samples.

5.8 Flows and Moisture

Flow and moisture determination results can be found in **Appendix B for RTO and C for Concentrators**.

5.9 Calibration Data

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

5.10 Process Data

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

5.11 Example Calculations

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

5.12 Field Notes

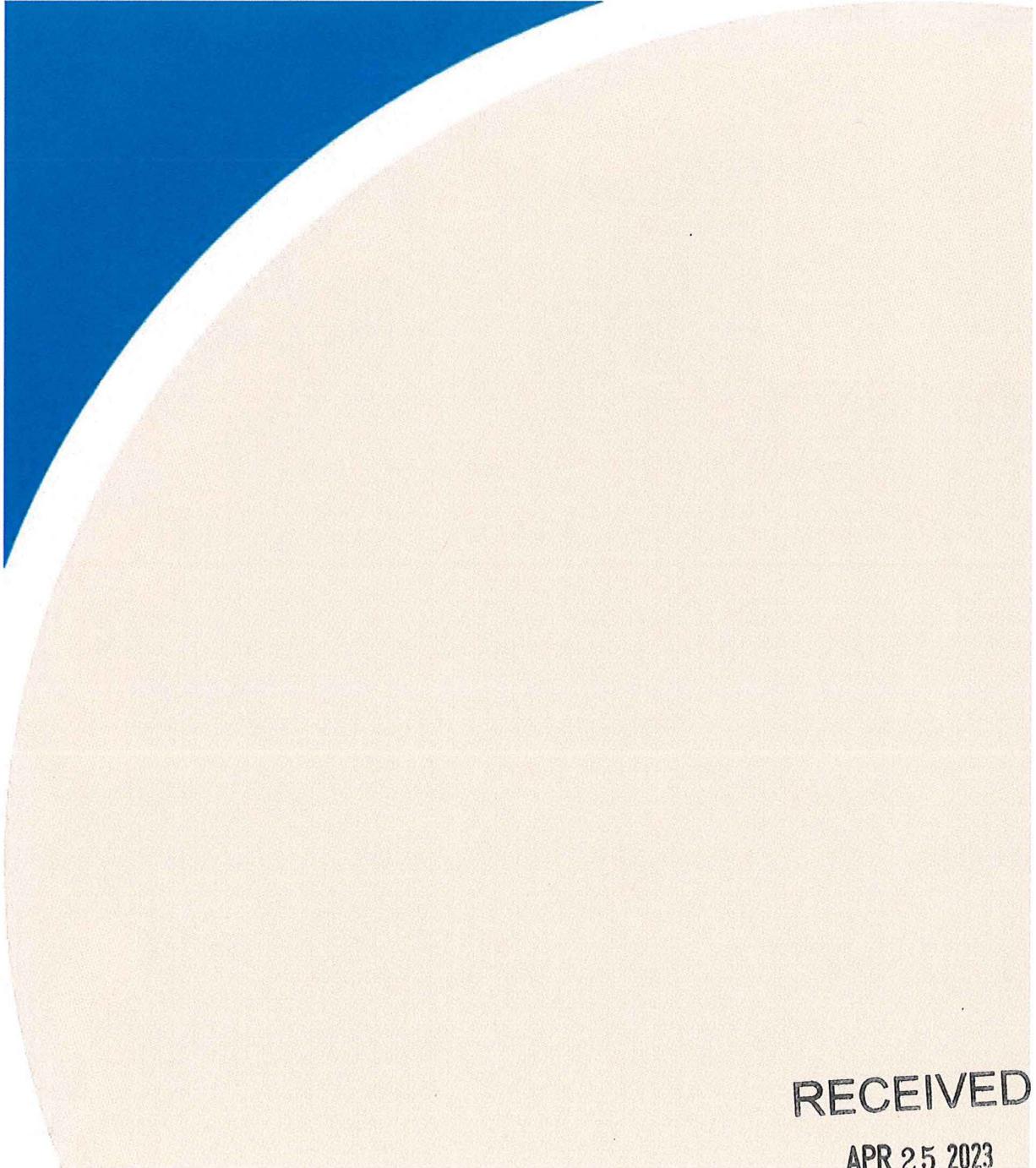
Field notes can be found in **Appendix F**.

5.13 Laboratory Data

There was no laboratory data from this testing program.



TABLES



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Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
DACM RTO (Oven Inlet, Booth Inlet, Outlet)	6	Velocity, Temperature and Flow Rate	U.S. EPA ^[1] Methods 1-2
	6	Oxygen, Carbon Dioxide	U.S. EPA [1] Method 3
	6	Moisture Content	U.S. EPA [1] Method 4
	6	THC, CH ₄ , NMOC	U.S. EPA [1] Method 25A
DACM Concentrator (Desorb Outlet, Outlet)	3	Velocity, Temperature and Flow Rate	U.S. EPA ^[1] Methods 1-2
	3	Oxygen, Carbon Dioxide	U.S. EPA [1] Method 3
	3	Moisture Content	U.S. EPA [1] Method 4 (Desorb)/WB-DB Outlet
	3	THC, CH ₄ , NMOC	U.S. EPA [1] Method 25A

Notes:

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

Table 3: Sampling Summary - Concentrator

Source and Test #	Sampling Date	Start Time	End Time	Desorption Gas Inlet Temperature °F	
				Concentrator 1	Concentrator 2
Concentrator - Reduction Efficiency					
Test #1	21-Feb-23	7:35 AM	8:34 AM	369.6	369.2
Test #2	21-Feb-23	9:20 AM	10:19 AM	368.9	368.8
Test #3	21-Feb-23	11:18 AM	12:17 PM	368.5	369.7

FIGURES

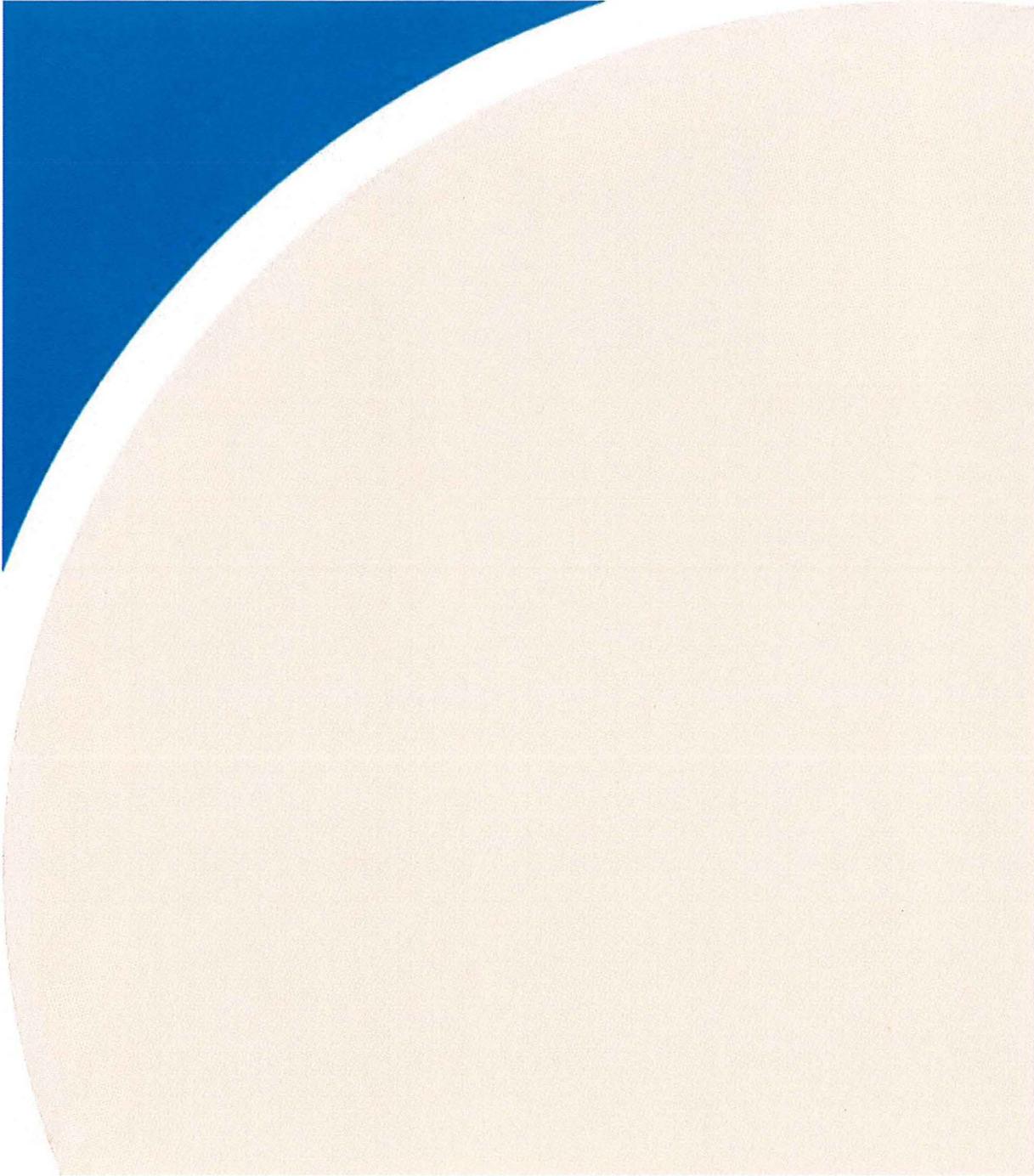
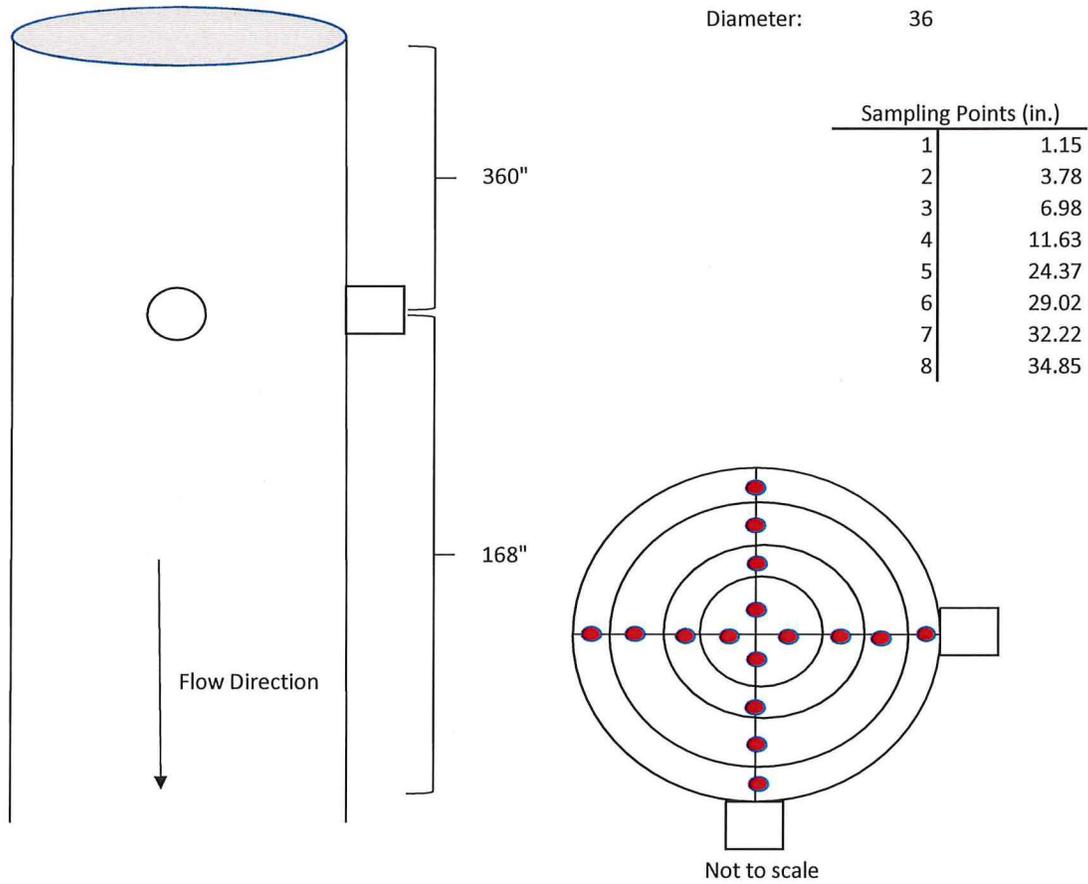




Figure No. 1: Booth Inlet/Desorb Outlet



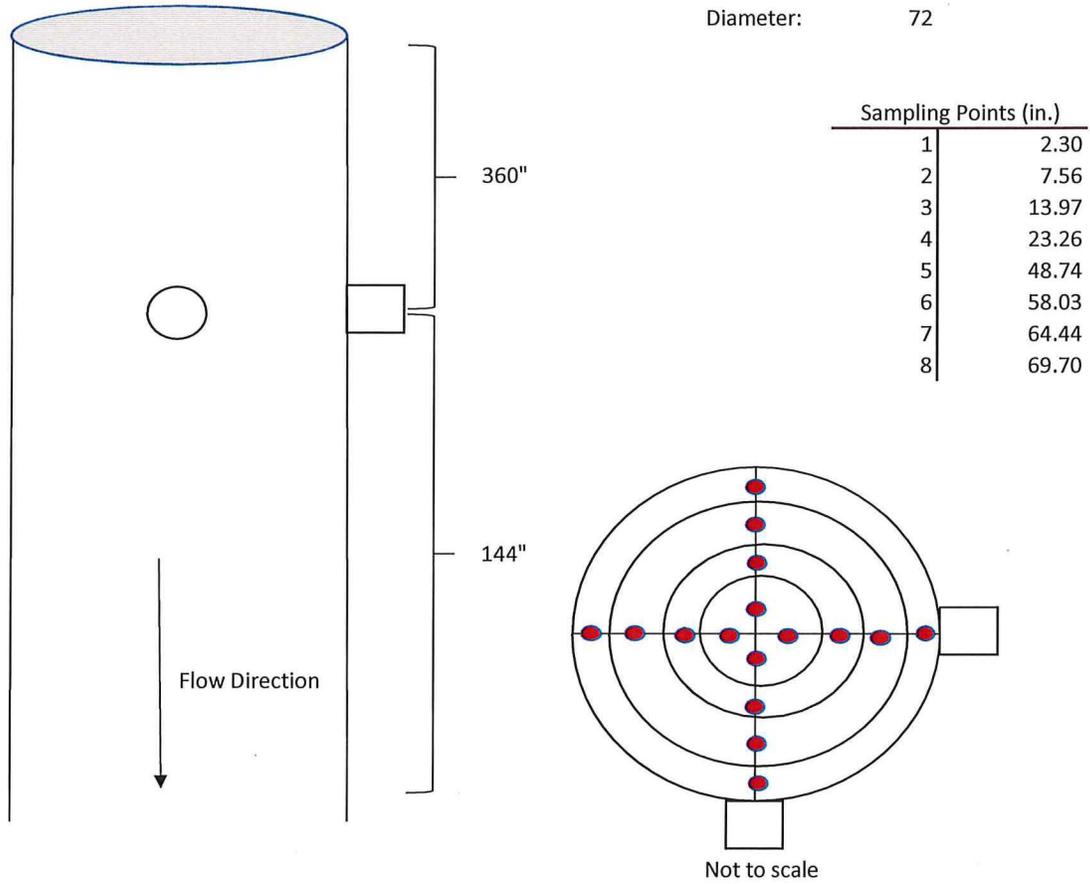
Source: Booth Inlet/Desorb Outlet
FCA US, LLC
DACM
Detroit, Michigan

Date:
February 21-22, 203

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309



Figure No. 2: Oven Inlet



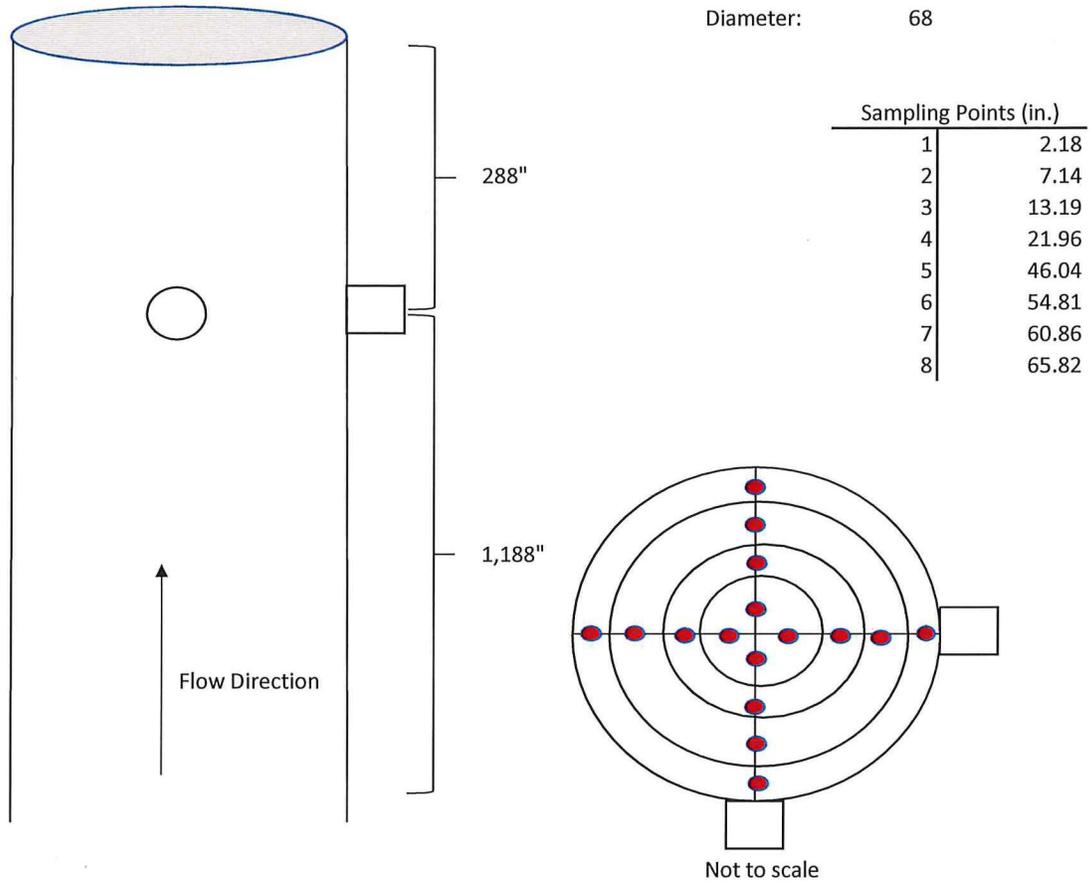
Source: Oven Inlet
FCA US, LLC
DACM
Detroit, Michigan

Date:
February 21-22, 2023

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309



Figure No. 3: RTO Outlet



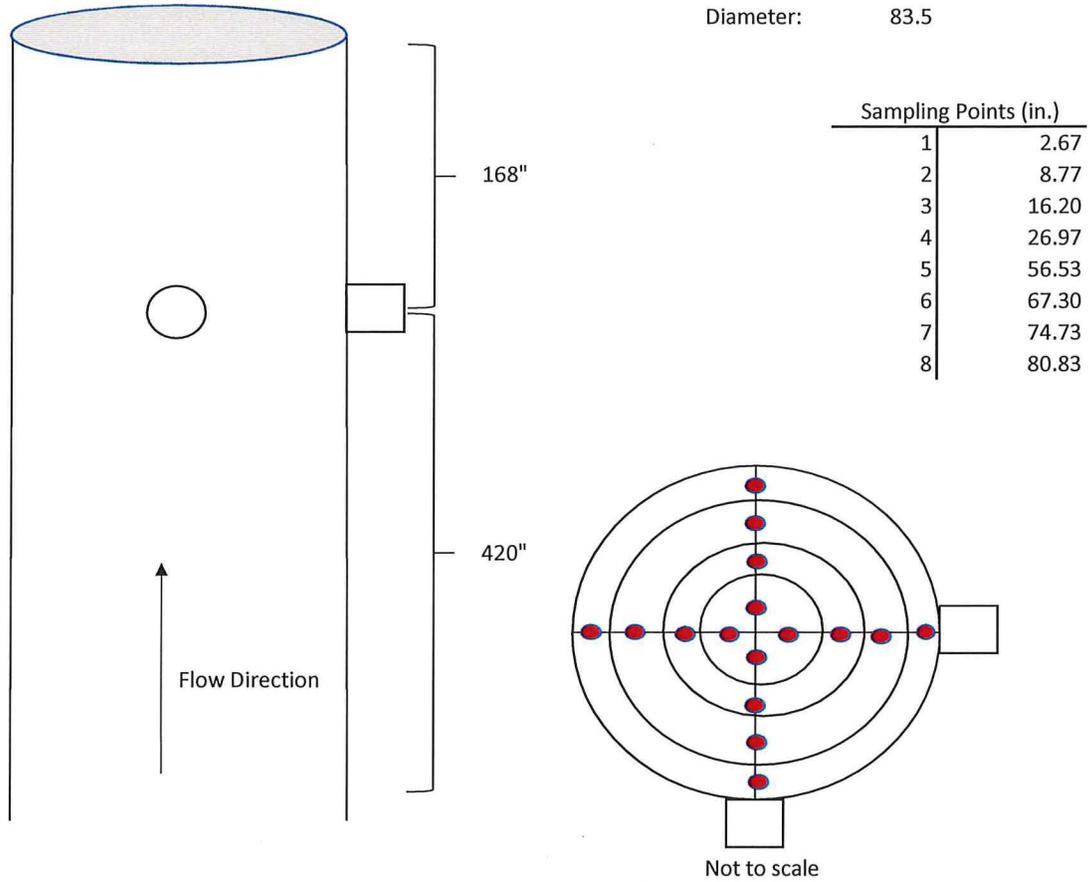
Source: RTO Outlet
FCA US, LLC
DACM
Detroit, Michigan

Date:
February 21-22, 2023

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309



Figure No. 4: Concentrator Outlet



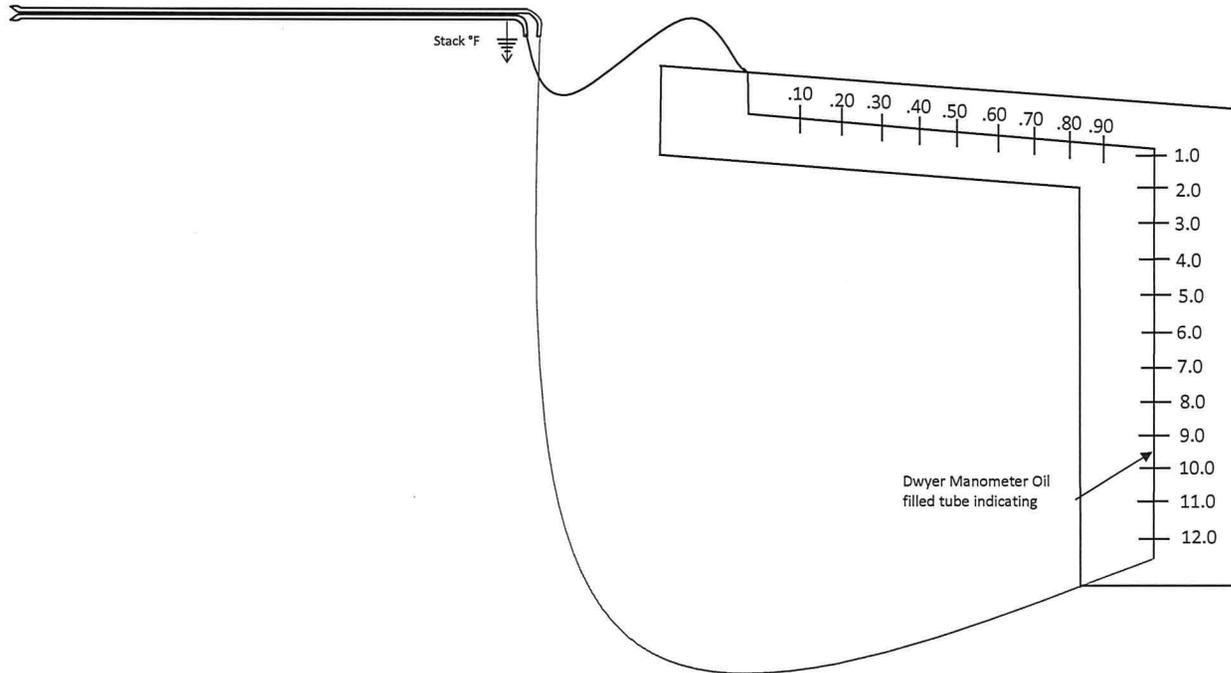
Source: Concentrator Outlet
FCA US, LLC
DACM
Detroit, Michigan

Date:
February 21, 2023

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309



Figure No. 5



USEPA Method 2

FCA US, LLC

DACM

Booth Inlet, Oven Inlet, RTO Outlet, and Concentrator Outlet
Detroit, Michigan

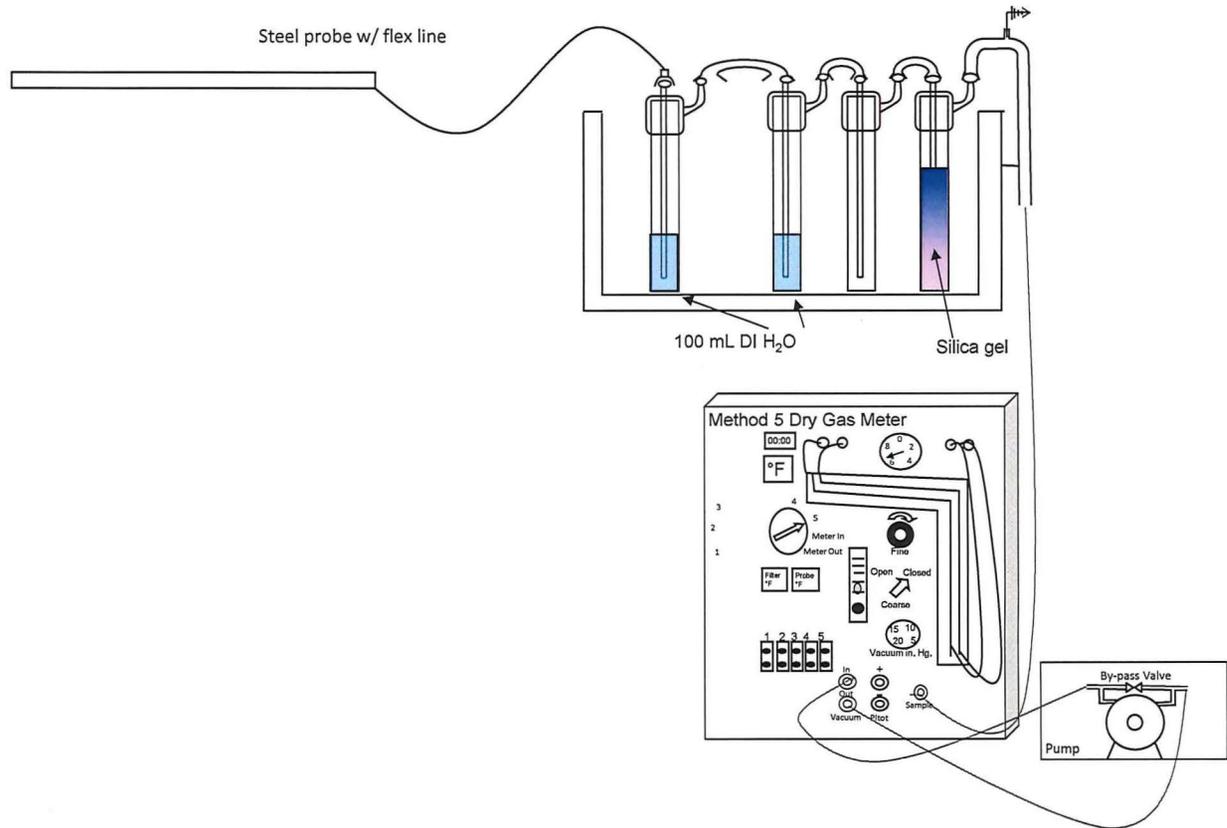
Project #2302773

Date: February 21-22, 2023





Figure No. 6



USEPA Method 4

FCA US, LLC

DACM

Booth Inlet, Oven Inlet, and RTO Outlet

Detroit, Michigan

Project #2302773

February 21-22, 2023



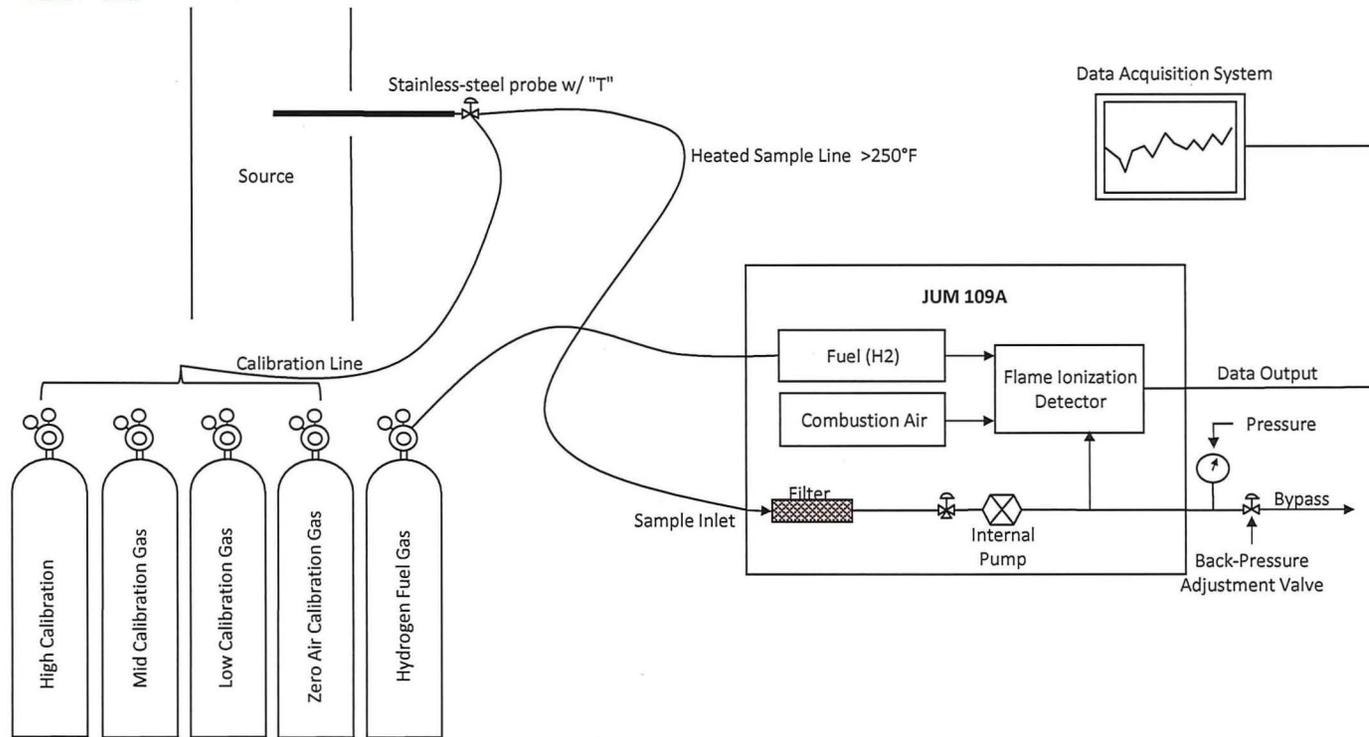
AIR QUALITY DIVISION

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Figure No. 7



USEPA Method 25A

FCA US, LLC

DACM

Booth Inlet, Oven Inlet, RTO Outlet, and Concentrator Outlet

Detroit, Michigan

Project #2302773

February 21-22, 2023

