AECOM

Emissions Compliance Test Report Automotive Glass Adhesives & Bonding Processes (100 Building)

Carbon Bed 9156A
Carbon Bed 9158
Carbon Bed 9154A

40 CFR 63, Subpart HHHHH
National Emission Standards for Hazardous Air Pollutants (NESHAPs) Miscellaneous Coating Manufacturing (Coatings MACT)

Project number: 60720441

May 22, 2024

DuPont/DDP Michigan Operations
Midland, Michigan (SRN P1027)
Permit Number:
ROP No. MI-ROP-P1027-2020b

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Quality information

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1. Introduction

1.1 Summary of Test Program

AECOM Technical Services, Inc. (AECOM) was contracted by DuPont/DDP Specialty Electronic Materials US, LLC (DuPont) to conduct an emissions compliance test on the Automotive Glass Adhesives and Bonding Processes (100 Building) Urethanes/Prepolymer Carbon Adsorption System (Carbon Bed 9156A) and Primers Carbon Adsorption Systems, Polar (Carbon Bed 9158) and Non-Polar (Carbon Bed 9154A), within Dow's Michigan Operations Complex. DuPont operates a chemical manufacturing facility that produces automotive glass adhesives and bonding products in Midland, Michigan. The facility uses carbon beds to control emissions in its Urethanes/Prepolymer and Primers processes. The purpose of this compliance test was to demonstrate compliance with the emission standard to reduce emissions of total organic HAP by ≥95% for non-regenerative carbon adsorption systems subject to the Miscellaneous Coating Manufacturing (Coatings) MACT in 40 CFR 63, Subpart HHHHH.

The following table summarizes the pertinent data for this compliance test.

Table 1-1. General Summary Information

Responsible Groups	• DuPont/DDP Specialty Electronic Materials US, LLC • Michigan Department of Environment, Great Lakes, and Energy (EGLE) • U.S. Environmental Protection Agency (US EPA)
Applicable Regulations	• Michigan Renewable Operating Permit No. MI-ROP-P1027-2020b • 40 CFR Part 63, Subpart HHHHH
Industry / Plant	• Automotive Glass Adhesive & Bonding Products (100 Building)
Plant Location	• Dow Michigan Operations Complex (MiOps) Midland, Michigan 48640 (SRN: P1027)

Air Pollution Control Equipment	• Urethanes/Prepolymer Carbon Adsorption System:
	  • Carbon Bed 9156A
	• Primers Carbon Adsorption Systems:
	  • Carbon Bed 9158 (Polar)
	  • Carbon Bed 9154A (Non-Polar)

Emission Point(s)	• Urethanes/Prepolymer Process (EURULE290) • Primers Process (EUO4)
Pollutant(s) Measured	• ≥95% Reduction efficiency for total organic HAPs
Test Date(s)	• April 16-18, 2024

1.2 Key Personnel

Names and affiliations of personnel, including their roles in the test program, are summarized in the following table.

Table 1-2. Test Program Personnel Summary

Role	Role Description	Name	Affiliation
Process Focal Point	• Coordinate plant operation during the test. • Ensure the unit is operating at the agreed upon conditions in the test plan. • Collect any process data required. • Provide all technical support related to process operation.	Steven McNally (Production Engineer – Primers) Justin Houston (Production Engineer – Urethanes/Prepolymer)	DDP, Michigan Ops. 100 Bldg. Midland, MI
Environmental Focal Point	• Ensure all regulatory requirements and citations are reviewed and considered for the testing.	Randy Reinke (Environmental Specialist)	DDP, Michigan Ops. 1381 Bldg. Midland, MI
Technical Reviewer	• Completes technical review of the test data.	Rob Sava	AECOM
Field Team Leader	• Ensures field sampling meets the quality assurance objectives of the plan.	Pete Becker	AECOM
Sample Project Leader	• Ensures data generated meets the quality assurance objectives of the plan. • Leadership of the sampling program. • Develop the overall testing plan. • Determine the correct sample methods.	James Edmister	AECOM

2. Facility and Sampling Location Description

2.1 Process Description

2.1.1 Block Flow Diagrams

The following block flow diagrams give an overview of the processes and associated emissions control devices.

Figure 2-1. Urethanes/Prepolymer (EURULE290) Carbon Adsorption System Block Flow Diagram

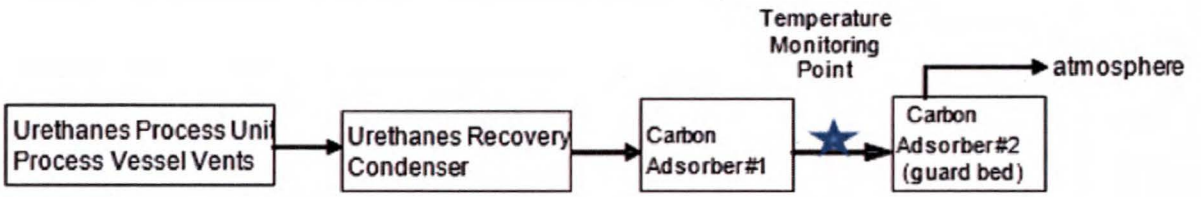
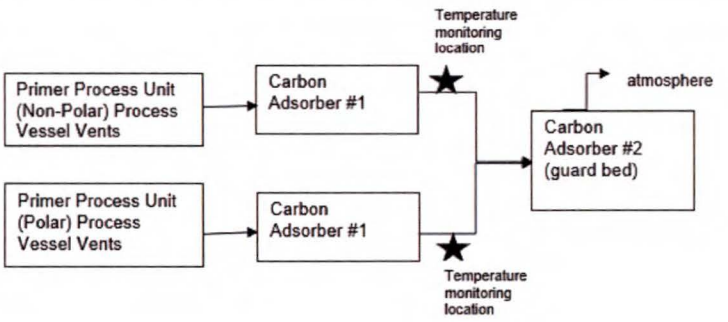


Figure 2-2. Primers (EU04 – Polar & Non-Polar) Carbon Adsorption System Block Flow Diagram



2.1.2 EURULE290 – Urethanes/Prepolymer Process (located in 100 Building)

This process produces polyurethane windshield adhesives for use in the automotive industry. The urethanes/prepolymer process consists of two areas: reactor and mixers. The reactor (R-2310) is used to produce the pre-polymer intermediates which are used as the raw material for urethane production. The pre-polymers are pumped to one of four mixers (i.e., MX-2510, MX-2520, MX-2530 & MX-2540) where they are mixed with various ratios of carbon black, clay, and small feed raw materials to produce a variety of urethane products. The urethane product is then pumped into 55-gallon drums. Hazardous air pollutant emissions from the process are sent to a vent treatment device (i.e., carbon adsorber) to meet the requirements of the Miscellaneous Coating Manufacturing MACT.

2.1.3 EU04 – Primers Process, Polar & Non-Polar (located in 100 Building)

The production of primers for use in automotive glass bonding involves blending/mixing of raw materials to create intermediates and final product. Primers process products are composed mainly of volatile organic solvents. Emissions are produced from filling, depressurization, and packaging operations. The Primers production process can be broken down into three sub process units: Suspended Solids Primer, Clear Primer, and Dissolved Solids Primer.

The first unit, Suspended Solids Primer, is used to produce primer that contains pigment. The pigments are "air-veyed" into a pigment handling system where they are dried and then conveyed to a mixing vessel (i.e., mix tank/reactor D-5500). Liquid raw materials are added to the mixing unit and then processed into final primer. Emissions are generated and vented through control devices (i.e., dust collectors and a carbon adsorption system) during the transfer of the pigments and liquid raw materials and the pressurization of the vessels to accommodate for various steps in the mixing process. The final product is transferred to a separate vessel where the primer is packed into various container sizes to meet market demand.

The second process, Clear Primer, is strictly a liquid mixing operation. Liquid raw materials are added to a mixing vessel (i.e., mix tank/reactor D-5580) according to specific recipes. Emissions are generated and vented through control devices (i.e., carbon adsorption system) during filling and depressurization operations. Once adequately mixed, the product is packaged into various container sizes to meet market demands.

The third process, Dissolved Solids Primer, utilizes a small solids resin handling system to add resin beads to liquid inside a mixing vessel (i.e., mix tank/reactor D-5590). Other raw materials are added to the mixing vessel and then the final product is packaged to meet market demand. Emissions are generated and vented through control devices (i.e., dust collectors and a carbon adsorption system) during filling and depressurization operations.

2.2 Basic Operating Parameters of Carbon Adsorption

The operating parameters in the following table are applicable to the carbon adsorption systems for both the Urethanes/Prepolymer (EURULE290) and Primers (EU04) process trains.

Parameter	Design Maximum Operating Rate	Expected Operating Rate	Normal Operating Range
Total quantity of carbon consumed - calculated per batch of product produced (Adsorber #1 of train).	≤ 1800 pounds	≤ 1700 pounds	≤ 1700 pounds
Outlet temperature of the first carbon canister.	≤ 120 degrees F	TT915602 (Urethanes/Prepolymer) 64 to 84 degrees F TT915403 (EU04 – Polar) 64 to 84 degrees F TT915402 (EU04 – Non-Polar) 64 to 84 degrees F	TT915602 (Urethanes/Prepolymer) -4 to 113 degrees F TT915403 (EU04 – Polar) -4 to 113 degrees F TT915402 (EU04 – Non-Polar) -4 to 113 degrees F

2.3 Control Equipment and Test Conditions

Testing will be conducted during worst-case conditions or during such time when the processes and equipment described in the tables below are manufacturing products with the highest organic HAP load vented to the non-regenerative carbon adsorption system.

2.3.1 Air Pollution Control Equipment Operation

Each process train emissions control system includes two carbon beds in series with the first used to control and the second to guard against breakthrough. The temperature is continuously monitored at the Adsorber #1 outlet of each train for proper operation. **Section 2.2** outlines the basic operating parameters. The following tables describe the process operations for the test program.

2.3.2 Urethanes/Prepolymer (EURULE290) Test Conditions

Vented Source	Run	Sampling Run Summary of Unit Operations
Urethanes/Prepolymer EURULE290 (4 mixers, 1 reactor & other ancillary equipment)	Run 1	Steps for 170724N (Reactor R-2310): • Load MDI, polyols, and catalyst to react to polymer. Add plasticizer and small additions, degas with vacuum, sample, and transfer to storage tanks. Steps for worst-case products described below (Mixers MX-2510, MX-2520, MX-2530 & MX-2540): • Final product formulation using intermediates from storage tanks, pigments, and small additions. Mix, vacuum degas, sample and package finished product. Note: For each of the products and mix tank/reactors above, the process will be in various steps of the batch during each test run. DDP anticipates that it will not produce more than one batch of each product during the performance test.
	Run 2	See detail above.
	Run 3	See detail above.
	Worst-Case Conditions	The Urethanes/Prepolymer Process includes four mixers and one reactor and other ancillary equipment (equipment list provided below). The worst-case VOC/HAP load to the carbon beds occurs when the mixers and reactor are producing the products listed below. During performance testing, the Urethanes/Prepolymer Process will be producing these products. A description of what will be occurring during the batch and test run is provided above. • Mixer MX-2510: Worst-Case VOC/HAP Product - 447 • Mixer MX-2520: Worst-Case VOC/HAP Product - 446 • Mixer MX-2530: Worst-Case VOC/HAP Product - 363 P2G • Mixer MX-2540: Worst-Case VOC/HAP Product - 583N • Reactor R-2310: Worst-Case VOC/HAP Product - 170724N

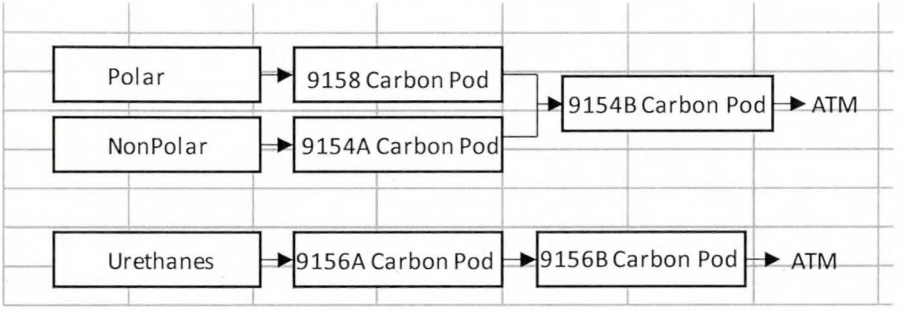
2.3.3 Primers Process, Polar & Non-Polar (EU04) Test Conditions

Vented Source	Run	Sampling Run Summary of Unit Operations
Primers Process EU04 (Polar & Non-Polar) (3 mix tanks/reactors & other ancillary equipment)	Run 1	Steps for 43533 (Mix tank/reactor D-5500): • Part #1 - Grind Process: Load polymer, solvent, catalyst and pigments, mix, mill, transfer to storage. • Part #2 - Letdown Process (follows Grind Process in mix/tank reactor D-5500): Load solvent, polymer and isocyanate, mix, transfer to storage. • Final product is a blend of part nos. 1 and 2 in the storage tank. Down packaging of the final product occurs from storage tank. Steps for 43518 (Mix tank/reactor D-5580): • Load solvent, silane and water, mix, package. Steps for 43555 (Mix tank/reactor D-5590): • Load solvent, polymer, UV indicator and silane, mix, package. (Note: Chemicals are added in a step wise manner followed by mixing.) Note: For each of the products and mix tank/reactors above, the process will be in various steps of the batch during each test run. DDP anticipates that it will not produce more than one batch of each product during the performance test.
	Run 2	See detail above.
	Run 3	See detail above.
	Worst-Case Conditions	The Primers Process includes three mix tanks/reactors and other ancillary equipment (equipment list provided below). The worst-case VOC/HAP load to the carbon beds occurs when the mix tanks/reactors are producing the products listed below. During performance testing, the Primers Process will be producing these products. A description of what will be occurring during the batch and test run is provided above. • Mix tank/reactor D-5500: Worst-Case VOC/HAP Product - 43533 • Mix tank/reactor D-5580: Worst-Case VOC/HAP Product - 43518 • Mix tank/reactor D-5590: Worst-Case VOC/HAP Product – 43555

2.4 Flue Gas Sampling Locations

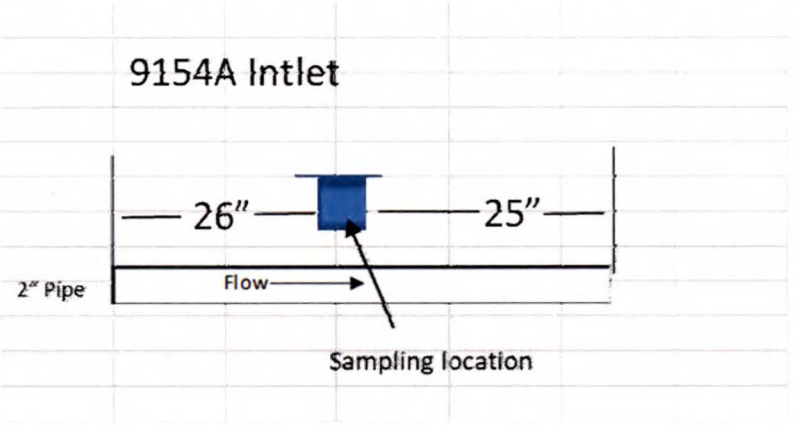
Sampling was completed on both the inlet and the outlet of the first carbon tote (Adsorber #1 position) for each carbon adsorption unit (CAU). All sampling ports were installed meeting the EPA Method 1A location requirements. The following block diagram shows the position and identification number for the tested carbon totes described in subsequent sections.

Figure 2-3. Carbon Tote Block Diagram



Following are dimensioned sketches showing all sampling ports in relation to breeching and to upstream and downstream disturbances or obstructions of gas flow.

Figure 2-4. Primers Process (EU04) Non-Polar CAU Test Locations



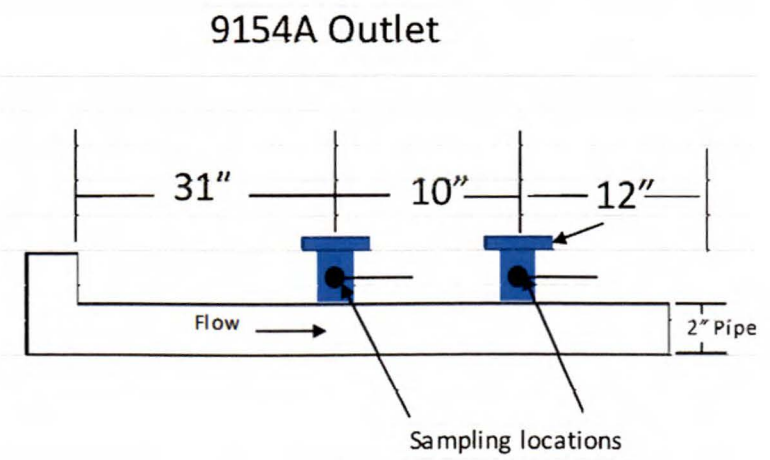


Figure 2-5. Primers Process (EU04) Polar CAU Test Locations

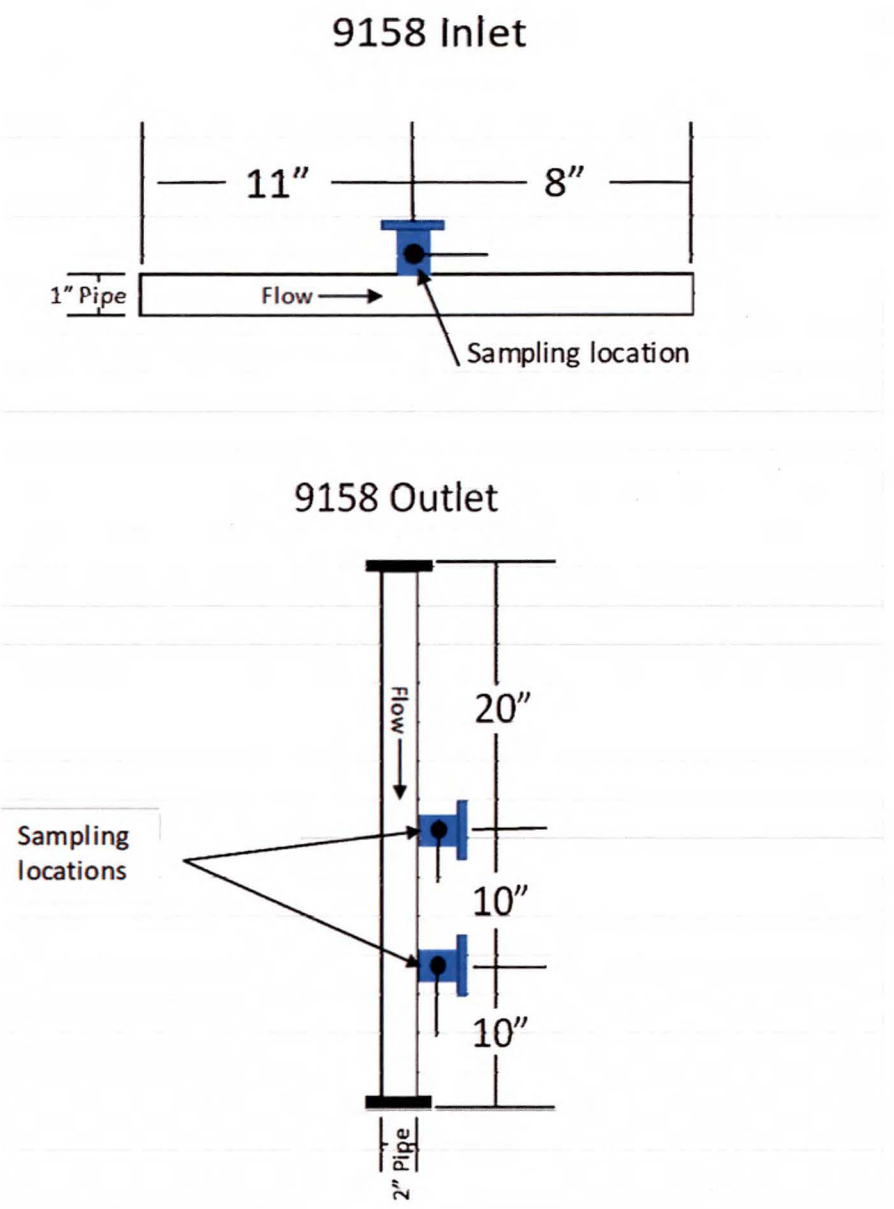
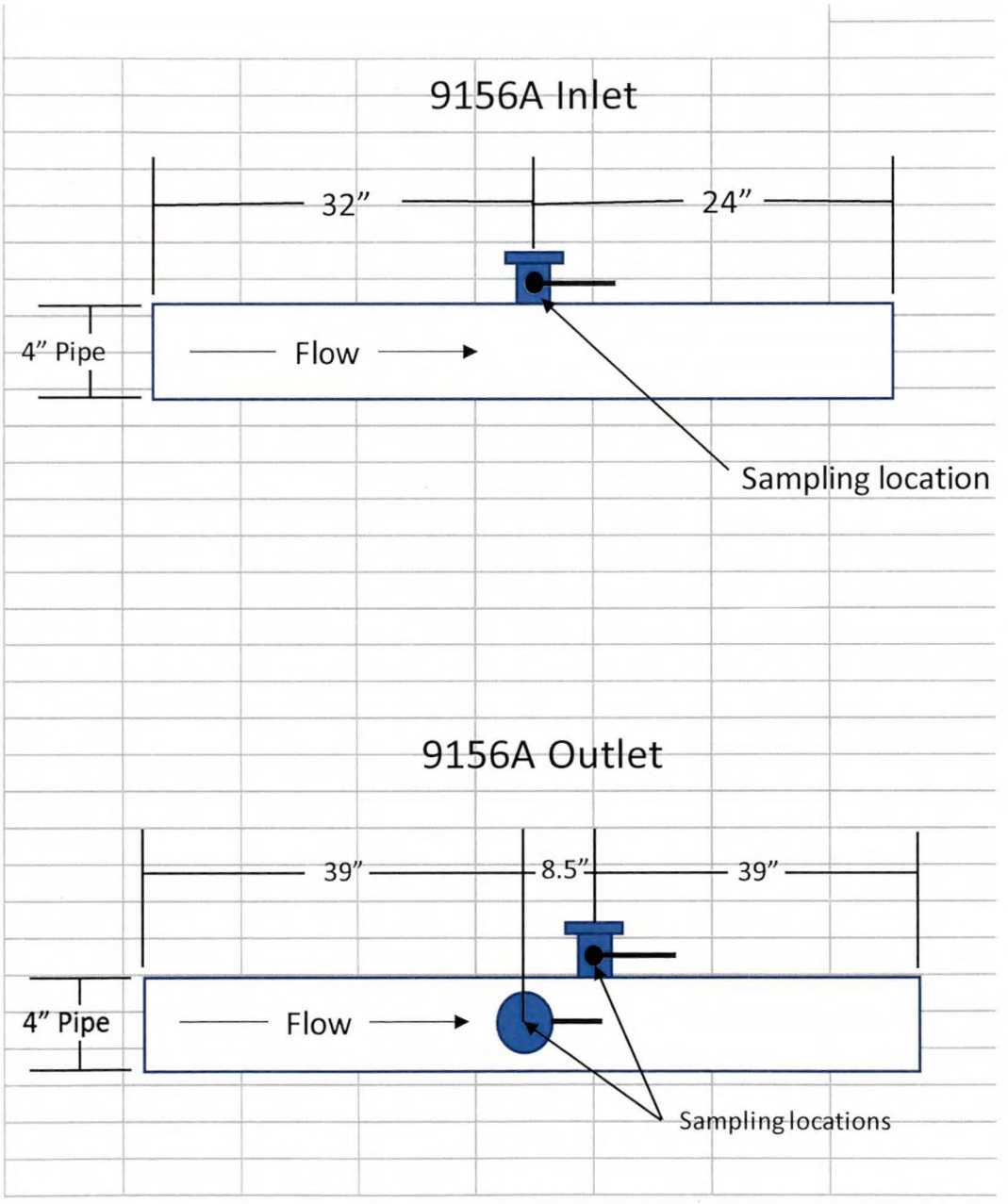


Figure 2-6. Urethanes/Prepolymer (EURULE290) CAU Test Locations



3. Summary and Discussion of Test Results

3.1 Objectives and Test Matrix

The purpose of this Performance Specification Test was to demonstrate compliance with the Miscellaneous Coating Manufacturing (Coatings) MACT in 40 CFR 63, Subpart HHHHH. Reference method test data are presented in **Appendix A**. The specific objectives were:

- Measure Total Organic HAP inlet mass input rate and control system outlet mass emissions rate after the first carbon tote identified as Adsorber #1 in each process train.
- Calculate Total Organic HAP removal efficiency using the mass rates of THC at the outlet compared to the inlet.

3.2 Process Operations

Sampling was conducted at the process operating conditions representing worst-case potential emissions as described previously in **Section 2.3**. Supporting process data is presented in **Appendix B**.

3.3 Comments / Exceptions

3.3.1 Gas Volumetric Flow Rate Determinations

Gas velocity was determined for each CAU at only the outlet test port location using a single sampling point near the centroid of the vent pipe. All of the exhaust vent pipes were ≤4 inches inside diameter. Method 2 differential pressure and gas temperature readings were measured near the centroid of the pipe as the expected highest velocity point to represent worst-case exhaust mass emission rate results. Inlet gas stream volumetric flow rates were assumed to be equal to outlet flow rates.

The justification for assuming inlet gas stream flow rates were equal to outlet exhaust gas flow rates are as follows:

- The control device includes a carbon adsorption tote, which only removes TOC without any chemical alterations to the compounds in the gas stream as would be the case for an oxidizer.
- Neither combustion air nor makeup gas is added to the gas stream as part of the removal process; therefore, only the components of the inlet gas stream comprise the outlet exhaust gas. The outlet provides a better location to measure gas flow rates due to concerns about the flammability of the gas stream at the inlet location.

3.3.2 Carbon Pod 9156 (Urethanes) operating conditions 4/16/24

Near the end of Run 2 of Carbon Pod 9156 (Urethanes), it was discovered not all the materials called out in the DDP test plan were running. All except one train was running the material that would have the worst-case emissions. Since Runs 1 and 2 removal efficiency was 99.99% it was agreed to continue the test with the condition that Run 3 must have all the trains running the material creating the worst-case emissions. Since Run 3's removal efficiency did not change with the additional loading from the final train running the correct material, all three runs are considered valid and acceptable (See EGLE approval email in Appendix E).

3.4 Emissions Test Data and Results Summaries

A summary of the emissions test results for Total Organic HAP removal efficiency are presented in **Table 3-1**, and the associated control device operating data is presented in **Table 3-2**. Supporting emissions test data are presented in **Tables 3-3** through **3-10**.

Table 3-1. Emissions Test Results

Control Device	Test Date	Inlet THC Mass Rate (lb/hr)	Outlet THC Emission Rate (lb/hr)	Percent Removal Efficiency (%RE)	Emission Standard (%RE)	Pass / Fail
CAU 9154A	04/18/2024	0.203	0.000072*	99.95%	≥95%	Pass
CAU 9158	04/17/2024	0.420	0.000036*	99.99%	≥95%	Pass
CAU 9156A	04/16/2024	2.169	0.000169	99.99%	≥95%	Pass

*Minimum Detection Limit used in Emission Rate Calculation

Table 3-2. Control Device Operating Data

Control Device	Test Date	Quantity of Carbon Consumed/Remaining per Run (lb)	Canister Outlet Temperature (°F) [1]
CAU 9154A – Non-Polar	04/18/2024	See Appendix B	92.45
CAU 9158 - Polar	04/17/2024	See Appendix B	95.67
CAU 9156A – Urethanes/Prepolymer	04/16/2024	See Appendix B	97.09

[1] The values shown are the average temperature at the outlet of the first canister (Adsorber #1).

Table 3-3. Emissions Test Data – CAU 9154A Inlet (Non-Polar)

Run Identification	Run 1	Run 2	Run 3	Average
Flow Run Number	Flow Run 1	Flow Run 2	Flow Run 3	
Run Date	4/18/24	4/18/24	4/18/24	
Run Time	09:50-10:50	11:08-12:08	12:30-13:30	
Exhaust Gas Conditions				
Oxygen (%, dry)	-0.02	-0.01	-0.01	
Carbon Dioxide (%, dry)	-0.01	0.00	-0.01	
Flue Gas Moisture (%)	0.23	0.33	0.43	0.27
Flue Gas Flow Rate (dscfm)	12.30	11.06	11.40	11.99
Total Hydrocarbons (as Propane)				
Concentration (ppmvd)	4430.26	1246.53	1785.39	2487.4
Conversion Factor (C_d) (lb/dscf/ppm)	1.145E-07	1.145E-07	1.145E-07	
Concentration (lb/dscf) (as propane)	5.073E-04	1.427E-04	2.044E-04	2.848E-04
Emission rate (lb/hr) (as propane)	0.374	0.095	0.140	0.203

Table 3-4. Emissions Test Data – CAU 9154A Exhaust (Non-Polar)

Run Identification	Run 1	Run 2	Run 3	Average
Flow Run Number	Flow Run 1	Flow Run 2	Flow Run 3	
Run Date	4/18/24	4/18/24	4/18/24	
Run Time	09:50-10:50	11:08-12:08	12:30-13:30	
Exhaust Gas Conditions				
Oxygen (%, dry)	-0.02	-0.01	-0.01	
Carbon Dioxide (%, dry)	-0.01	0.00	-0.01	
Flue Gas Moisture (%)	0.23	0.33	0.43	0.27
Flue Gas Flow Rate (dscfm)	12.30	11.06	11.40	11.99
Total Hydrocarbons (as Propane)				
Concentration (ppmvd)	0.90	0.90	0.90	0.90
Conversion Factor (C_d) (lb/dscf/ppm)	1.145E-07	1.145E-07	1.145E-07	
Concentration (lb/dscf) (as propane)	1.033E-07	1.034E-07	1.035E-07	1.034E-07
Emission rate (lb/hr) (as propane)	0.000076	0.000069	0.000071	0.000072

Table 3-5. Emissions Test Data – CAU 9158 Inlet (Polar)

Run Identification	Run 1	Run 2	Run 3	Average
Flow Run Number	Flow Run 1	Flow Run 2	Flow Run 3	
Run Date	4/17/24	4/17/24	4/17/24	
Run Time	08:45-09:45	10:12-11:12	11:42-12:42	
Exhaust Gas Conditions				
Oxygen (%, dry)	1.39	0.78	0.28	
Carbon Dioxide (%, dry)	0.10	0.13	0.14	
Flue Gas Moisture (%)	0.47	0.38	0.84	0.51
Flue Gas Flow Rate (dscfm)	2.91	2.45	1.68	2.67
Total Hydrocarbons (as Propane)				
Concentration (ppmvd)	15944.7	31200.8	35859.2	27668.2
Conversion Factor (C_d) (lb/dscf/ppm)	1.145E-07	1.145E-07	1.145E-07	
Concentration (lb/dscf) (as propane)	1.826E-03	3.572E-03	4.106E-03	3.168E-03
Emission rate (lb/hr) (as propane)	0.318	0.526	0.415	0.420

Table 3-6. Emissions Test Data – CAU 9158 Exhaust (Polar)

Run Identification	Run 1	Run 2	Run 3	Average
Flow Run Number	Flow Run 1	Flow Run 2	Flow Run 3	
Run Date	4/17/24	4/17/24	4/17/24	
Run Time	08:45-09:45	10:12-11:12	11:42-12:42	
Exhaust Gas Conditions				
Oxygen (%, dry)	1.40	0.79	0.28	
Carbon Dioxide (%, dry)	0.10	0.13	0.14	
Flue Gas Moisture (%)	0.47	0.38	0.84	0.51
Flue Gas Flow Rate (dscfm)	2.91	2.45	1.68	2.67
Total Hydrocarbons (as Propane)				
Concentration (ppmvd)	1.44	3.15	2.20	2.26
Conversion Factor (C_d) (lb/dscf/ppm)	1.145E-07	1.145E-07	1.145E-07	
Concentration (lb/dscf) (as propane)	1.644E-07	3.609E-07	2.520E-07	2.591E-07
Emission rate (lb/hr) (as propane)	0.000029	0.000053	0.000025	0.000036

Table 3-7. Emissions Test Data – CAU 9156A Inlet (Urethanes/Prepolymer)

Run Identification	Run 1	Run 2	Run 3	Average
Flow Run Number	Flow Run 1	Flow Run 2	Flow Run 3	
Run Date	4/16/24	4/16/24	4/16/24	
Run Time	09:15-10:15	11:18-12:18	13:38-14:38	
Exhaust Gas Conditions				
Oxygen (%, dry)	0.67	0.61	0.66	
Carbon Dioxide (%, dry)	0.34	0.75	0.52	
Flue Gas Moisture (%)	0.07	0.36	0.00	0.10
Flue Gas Flow Rate (dscfm)	37.32	22.29	22.15	33.00
Total Hydrocarbons (as Propane)				
Concentration (ppmvd)	11116.1	10360.2	13605.4	11693.9
Conversion Factor (C_d) (lb/dscf/ppm)	1.145E-07	1.145E-07	1.145E-07	
Concentration (lb/dscf) (as propane)	1.273E-03	1.186E-03	1.558E-03	1.339E-03
Emission rate (lb/hr) (as propane)	2.850	1.587	2.071	2.169

Table 3-8. Emissions Test Data – CAU 9156A Exhaust (Urethanes/Prepolymer)

Run Identification	Run 1	Run 2	Run 3	Average
Flow Run Number	Flow Run 1	Flow Run 2	Flow Run 3	
Run Date	4/16/24	4/16/24	4/16/24	
Run Time	09:15-10:15	11:18-12:18	13:38-14:38	
Exhaust Gas Conditions				
Oxygen (%, dry)	0.67	0.60	0.65	
Carbon Dioxide (%, dry)	0.34	0.74	0.52	
Flue Gas Moisture (%)	0.07	0.36	0.00	0.10
Flue Gas Flow Rate (dscfm)	37.32	22.29	22.15	33.00
Total Hydrocarbons (as Propane)				
Concentration (ppmvd)	0.90	0.90	0.90	0.90
Conversion Factor (C_d) (lb/dscf/ppm)	1.145E-07	1.145E-07	1.145E-07	
Concentration (lb/dscf) (as propane)	1.031E-07	1.034E-07	1.031E-07	1.032E-07
Emission rate (lb/hr) (as propane)	0.000231	0.000138	0.000137	0.000169

4. Sampling and Analytical Procedures

4.1 Test Methods

The total organic HAP emissions were determined using the following methods:

- Methods 1-4 of 40 CFR Part 60, Appendix A, as appropriate for selection of sampling sites, gas volumetric flow rate, gas molecular weight, and moisture content of the gas stream.
- Method 25A for THC, as propane.

4.2 Procedures

The above methods were performed using mobile continuous instrumental analyzers provided by AECOM from their internal testing team. Gas was withdrawn from the duct and transported to instrumental analyzers located in a mobile laboratory at ground level. A stainless-steel probe was inserted into the stack and used to collect sample gas. A Teflon sample line heated to 250°F was used to transport sample gas from the probe to the analyzers. The analyzers were kept at a constant temperature inside the mobile laboratory. Sample gas was collected continuously from the stack for a period of 60 minutes per test run.

EPA Method 1A (Sample Point Determination)

The number and location of traverse points in each vent pipe is determined according to the procedures outlined in EPA Method 1A. Since the ducts were less than or equal to four (4) inches inside diameter, flow readings were collected from a single point near the center of each pipe.

EPA Method 2 (Flue Gas Velocity and Volumetric Flow Rate)

The flue gas velocity and volumetric flow rate were determined according to the procedures outline in 40 CFR 60, Appendix A, EPA Method 2. Velocity measurements were made using Type-S pitot tubes conforming to the geometric specifications outlined in EPA Method 2. Differential pressures and temperatures were measured with a digital manometer and output to a data acquisition system (DAS) for continuous recording. Average differential pressures and temperatures were used to calculate the average volumetric flow rate for each test run.

EPA Method 3A (Flue Gas Composition and Molecular Weight)

EPA Method 3A (Instrumental Method) is utilized to determine the diluent (O_2 and CO_2) concentrations during each test run at the outlet of each CAU.

An analyzer measures O_2 concentrations based on the strong paramagnetic properties of O_2 relative to other compounds present in combustion gases. In the presence of a magnetic field, O_2 molecules become temporary magnets. The analyzer determines the sample gas O_2 concentration by detecting the displacement torque of the sample test body in the presence of a magnetic field.

An analyzer measures CO_2 concentrations based on the absorption of infrared radiation. The infrared unit uses a single beam, single wavelength technique, with wavelength selection being achieved by a carefully specified narrow band optical filter making it highly selective for CO_2 measurement in the presence of other infrared-absorbing gases.

Please note the gas stream make-up gas was nitrogen (N_2). Therefore, all O_2 and CO_2 concentrations were at or near zero (0.0%). The molecular weight of nitrogen was used for emission calculations.

EPA Method 4 (Moisture)

A calibrated Method 5 console withdrew vent gas samples through a sample probe to determine the percent moisture of the gas stream during each test run. Sample gas was bubbled through two impingers containing water, one empty impinger, and one impinger containing silica gel. All the sample train impingers were pre-weighed prior to sampling. The impinger train was kept on ice to knock out all

moisture in the sample gas. After the final leak check following each run, the exterior of the impingers were dried off and the impingers were weighed to determine percent moisture by the difference from pre-weights.

EPA Method 25A (Total Hydrocarbons Sampling and Analysis)

EPA Method 25A was utilized to determine THC as propane concentrations during each test run at the inlet and outlet of each CAU. Propane was selected as the calibration standard as specified by method standard procedures.

A gas sample was extracted from each vent pipe individually through a heated line to a flame ionization analyzer (FIA). Results are reported as volume concentration equivalent to propane.

4.3 List of Sampling Equipment

Table 4-1. Sampling Equipment

Reference Method	Equipment	ID #	Span
Method 3A (O_2/CO_2)	SERVOMEX 1440 Dual Analyzer	OXC-M1902	20.05% / 19.63%
Method 25A (THC)	VIG Industries Model 20/2 Heated Dual FID Analyzer	7730419	45.0 ppm
Method 25A (THC)		7730419	5.0 %

Figure 4-1. Sampling Train used for O_2 & CO_2 (M3A)

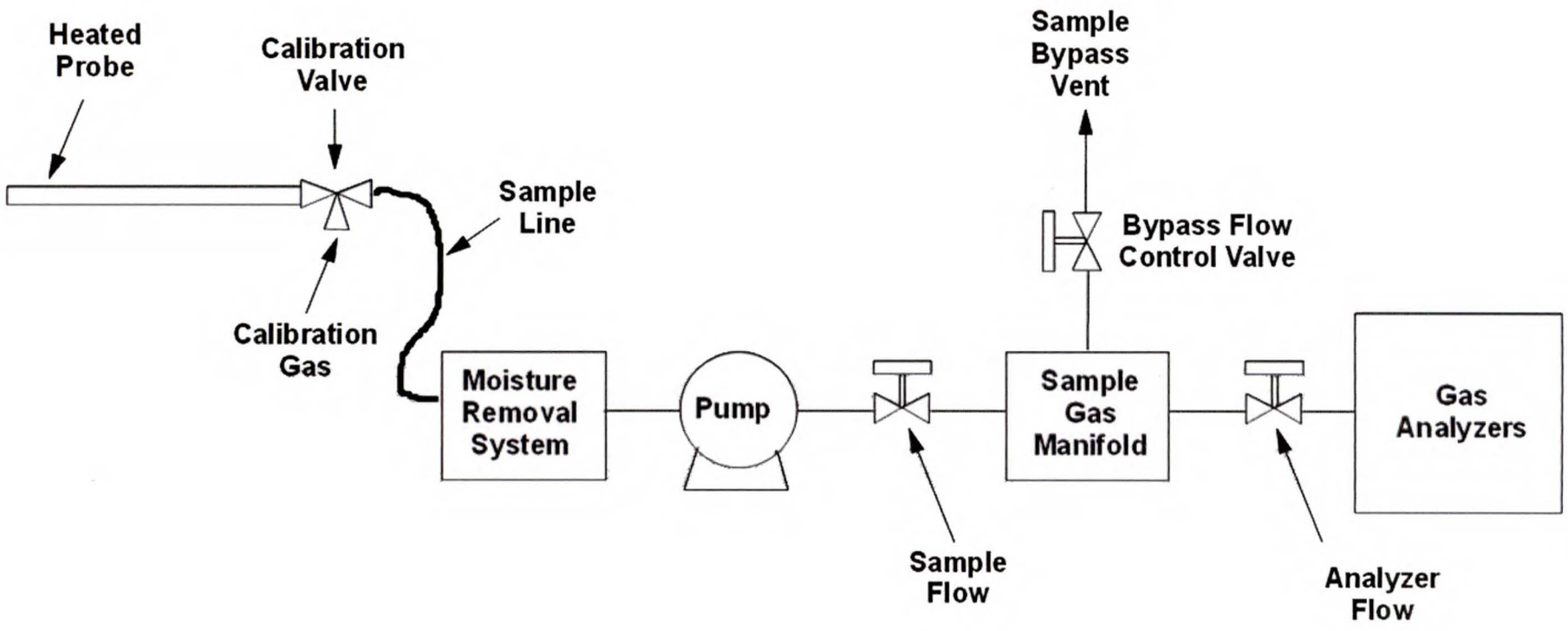


Figure 4-2. Sampling Train used for THC (25A)