Executive Summary

Fiat Chrysler Automobiles (FCA) US LLC retained Apex Companies, LLC to conduct air emissions testing at the Sterling Heights Assembly Plant (SHAP) North facility in Sterling Heights, Michigan. The purpose of the air emission testing was to evaluate compliance with certain emission limits in Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit MI-ROP-B7248-2014a, effective November 18, 2014. The emission units tested were:

- EU-TOPCOAT3 – applies coating to vehicles in booths. Vehicles pass through associated curing ovens. There are two exhaust stacks from the EU-TOPCOAT3 line. Basecoat zone and clearcoat observation deck. Particulate matter (PM) was measured at each exhaust.
- Regenerative Thermal Oxidizer (RTO) – controls volatile organic compound (VOC) emissions from the E-coat tank, the basecoat heated flash zones, two powder ovens, the clearcoat automatic sections of the paint spray booths, and the coating ovens associated with E-coat and topcoat. PM emissions and VOC destruction efficiency (DE) of the RTO were measured.

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1 through 5, 25A, 202, and 205. Since only total PM was measured using USEPA Method 5, the PM_{10} and $PM_{2.5}$ fractions were assumed to be equivalent to the PM measured, as agreed upon with EGLE.

Detailed results are presented in Tables 1 through 4 after the Tables Tab of this report. The following tables summarize the results of testing conducted on July 30 and 31, 2019.

EU-TOPCOAT3 and RTO Emission Results

Parameter	Unit	Average Result		
		EU-TOPCOAT3 Basecoat Zone	EU-TOPCOAT3 Clearcoat Observation Deck	RTO Outlet
PM	lb/hr	0.27	0.25	1.4

PM: Particulate matter less than or equal to 2.5 and/or 10 microns were measured as total particulate matter.
lb/hr: pound per hour

RTO VOC Destruction Efficiency Results

Parameter	Average Result	Permit Limit
RTO VOC DE	95.4%	≥95%

VOC: volatile organic compound
DE: destruction efficiency

1.0 Introduction

1.1 Summary of Test Program

Fiat Chrysler Automobiles (FCA) US LLC retained Apex Companies, LLC (Apex) to conduct air emissions testing at the Sterling Heights Assembly Plant (SHAP) North facility in Sterling Heights, Michigan. The purpose of the air emission testing was to evaluate compliance with certain emission limits in Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) MI-ROP-B7248-2014a, effective November 18, 2014.

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1 through 5, 25A, 202, and 205.

Table 1-1 lists the emission sources tested, parameters, and test dates.

Table 1-1
Sources Tested, Parameters, and Test Dates

Source		Test Parameter	Test Dates
EU-TOPCOAT3	Basecoat Zone	PM	July 30, 2019
	Clearcoat Observation Deck	PM	July 30, 2019
Regenerative Thermal Oxidizer (RTO)		PM VOC DE	July 31, 2019

PM: particulate matter
VOC: volatile organic compound
DE: destruction efficiency

1.2 Key Personnel

The key personnel involved in this test program are listed in Table 1-2. Mr. David Kawasaki, Staff Consultant with Apex, led the emission testing program. Mr. Adekunle Sanni, Environmental Specialist, and Mr. Brad Bergeron, Air Compliance Testing, both with FCA, provided process coordination and recorded operating parameters. Mr. Mark Dziadosz with EGLE witnessed the testing and verified production parameters were recorded.

Table 1-2
Key Contact Information

FCA	
Brad Bergeron Air Compliance Testing **Fiat Chrysler Automobiles (FCA) US LLC - SHAP** 38111 Van Dyke Avenue Sterling Heights, Michigan 48312 Phone: 519.817.9888 brad.bergeron@external.fcagroup.com	Adekunle Sanni Environmental Specialist **Fiat Chrysler Automobiles (FCA) US LLC - SHAP** 38111 Van Dyke Avenue Sterling Heights, Michigan 48312 Phone: 586.978.6279 adekunle.sanni@fcagroup.com
Apex	
David Kawasaki, QSTI Staff Consultant **Apex Companies, LLC** 22345 Roethel Drive Novi, Michigan 48375 Phone: 248.344.3081 david.kawasaki@apexcos.com	
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Karen Kajiya-Mills Technical Programs Unit Supervisor **EGLE Air Quality Division** **Technical Programs Unit** Constitution Hall, 2nd Floor, South 525 West Allegan Street Lansing, Michigan 48909 Phone: 517.256.0880 kajiya-millsk@michigan.gov Mark Dziadosz Environmental Quality Analyst **EGLE Air Quality Division** **Warren District Office** 27700 Donald Court Warren, Michigan 48092 Phone: 586.753.3745 dziadoszm@michigan.gov	Joyce Zhu District Supervisor **EGLE Air Quality Division** **Warren District Office** 27700 Donald Court Warren, Michigan 48092 Phone: 586.753.3748 zhuj@michigan.gov

2.0 Source and Sampling Locations

2.1 Process Description

SHAP North paints and assembles the New RAM 1500 truck cabs. The painting process consists of conveying a sheet metal body that has been prepared for application through the coating process and the associated curing ovens. The emissions from the E-coat tank, basecoat heated flash zones, two powder ovens, the clear coat automatic sections of the paint spray booths, and the coating ovens associated with the E-coat and the topcoat are controlled by the RTO. In the EU-TOPCOAT3 coating line, topcoat is applied to vehicles that are then passed through the curing oven. The EU-TOPCOAT3 line is equipped with water wash systems to control particulate matter. VOC emissions from the topcoat line are controlled by the RTO.

Operating parameters were measured and recorded by FCA personnel during testing. Table 2-1 summarizes the RTO combustion chamber temperatures during testing. Additional operating parameter data are included in Appendix F.

Table 2-1
RTO Combustion Chamber Temperatures

Source	RTO Combustion Chamber Temperature (°F)			
	Run 1	Run 2	Run 3	Average
RTO	1,450	1,450	1,451	1,450

2.2 Control Equipment Description

2.2.1 EU-TOPCOAT3

EU-TOPCOAT3 uses a downdraft ventilation and water wash scrubber system below the booth grating to control paint overspray. Approximately 90% of the booth air is recycled. Emissions from the topcoat heated flash zones, clearcoat, and bake ovens are directed to a seven-chamber RTO for pollution control prior to exhausting to the atmosphere.

2.2.2 Regenerative Thermal Oxidizer

An RTO controls emissions from the paint application and curing operations. The RTO consists of the following main components: the regenerator columns, the combustion chamber with burner system, and the required air-directing system with valves and fan. The regenerator columns are filled with a ceramic packing material for heat absorption and recovery. The combustion chamber is lined with an insulation layer to maintain the high reaction temperatures. The natural gas burner is located at the side of the combustion chamber to allow easy access. A separate duct introduces combustion air within the combustion chamber.

The exhaust air stream flows through the regenerator columns and is directed through the combustion chamber by alternating valves operated on a timer system. The exhaust air flows through the hot packed beds and is pre-heated in the process. The majority of the hydrocarbons are oxidized within the pre-heated packed bed zone.

The combustion burner heats the emissions to the final combustion and/or final reaction temperature. Contaminants are oxidized in this process. The hot exhaust air flows through the heat exchanger in the exit column and heats the packed bed. Due to the regenerative heat exchange, the direction of flow through the columns alternates with valve position.

2.3 Flue Gas Sampling Locations

2.3.1 EU-TOPCOAT3 Basecoat Zone and Clearcoat Observation Deck Exhausts

The basecoat zone and clearcoat observation deck exhaust to atmosphere through two 50-inch-internal-diameter exhaust stacks with similar configuration. Two 4-inch-internal-diameter sampling ports oriented at 90° to one another are located in a straight section of the exhaust stacks accessed via the roof. The sampling ports extend 4 inches from the stack interior wall. The ports are located at the following locations relative to the nearest flow disturbances:

- Approximately 18 feet downstream (4.3 duct diameters) of duct confluences beneath the roof for the basecoat zone exhaust.
- Approximately 14 feet downstream (3.4 duct diameters) of duct confluences beneath the roof for the clearcoat observation deck.
- Approximately 14.2 feet upstream (3.4 duct diameters) of the stack exit to the atmosphere for both exhaust stacks.

Figure 1 in the Appendix depicts the sampling ports and traverse point locations for the basecoat zone and clearcoat observation deck exhaust stack sampling locations. A photograph of the EU-TOPCOAT3 sampling locations is provided in Figure 2-1.

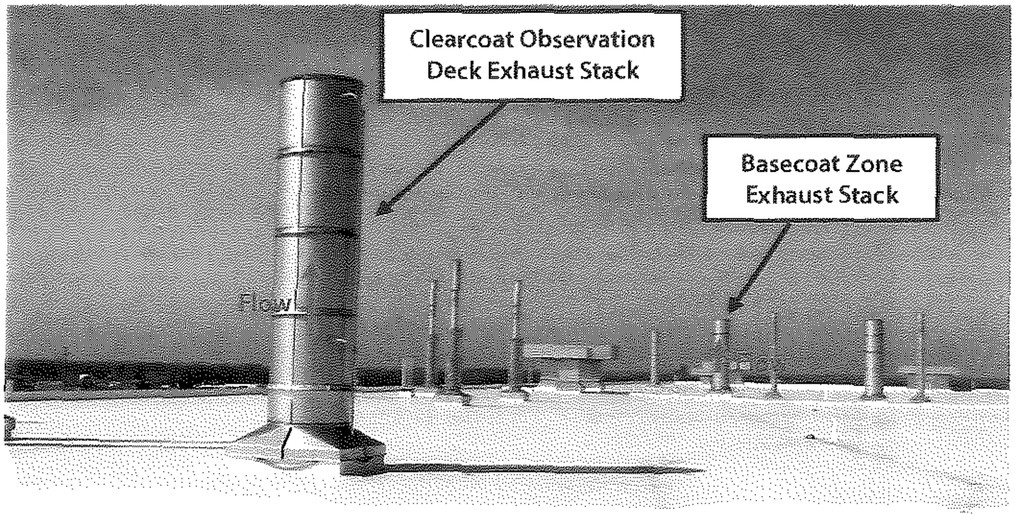


Figure 2-1. EU-TOPCOAT3 Outlet Sampling Locations

2.3.2 RTO Inlet

The RTO inlet has a 105-inch-internal-diameter exhaust stack with two 4-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 6 inches outward from the stack interior wall. The ports are located:

- Approximately 228 inches (2.2 duct diameters) from the nearest upstream disturbance.
- Approximately 60 inches (0.6 duct diameters) from the nearest downstream disturbance.

Figure 2 in the Appendix depicts the RTO inlet sampling ports and traverse point locations. A photograph of the RTO inlet sampling location is presented in Figure 2-2.

Figure 2-2. RTO Inlet Sampling Location

2.3.3 RTO Outlet

The RTO exhausts to atmosphere through a 110-inch-internal-diameter exhaust stack with four 4-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 8.25 inches outward from the stack interior wall. The ports are located:

- Approximately 61.5 feet (6.6 duct diameters) from the nearest upstream disturbance.
- Approximately 16.8 feet (1.8 duct diameters) from the nearest downstream disturbance.

Figure 3 in the Appendix depicts the RTO outlet sampling ports and traverse point locations. A photograph of the RTO outlet sampling location is presented in Figure 2-3.

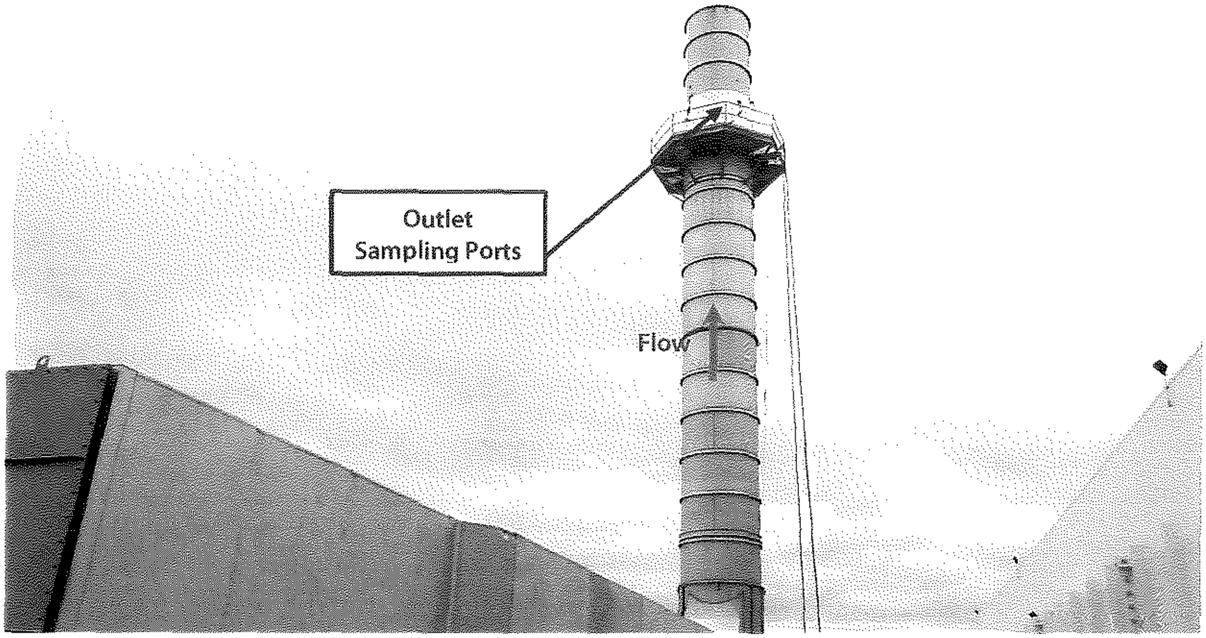


Figure 2-3. RTO Outlet Sampling Location

3.0 Summary and Discussion of Results

3.1 Objectives and Test Matrix

The objective of the air emission testing was to evaluate compliance with certain emission limits in EGLE ROP MI-ROP-B7248-2014a, effective November 18, 2014.

Table 3-1 summarizes the sampling and analytical matrix.

Table 3-1
Sampling and Analytical Matrix

Sampling Location		Sample/Type of Pollutant	Sample Method	Date (2019)	Run	Start Time	End Time	Analytical Laboratory
EU-TOPCOAT3	Basecoat Zone	Flowrate, molecular weight, moisture content, particulate matter	USEPA 1-4, modified 5	July 30	1	7:22	9:33	Bureau Veritas Laboratories
					2	9:57	11:59	
					3	12:30	14:32	
	Clearcoat Observation Deck			July 30	2	9:57	12:02	Bureau Veritas Laboratories
					3	12:30	14:33	
					4	14:43	16:46	
Regenerative Thermal Oxidizer (RTO)	RTO Outlet	Flowrate, molecular weight, moisture content, particulate matter	USEPA 1-5, 202	July 31	1	9:15	11:29	Bureau Veritas Laboratories
					2	12:13	14:27	
					3	14:46	16:58	
	RTO Inlet and Outlet	Flowrate, molecular weight, moisture content, volatile organic compounds	USEPA 1-4, 25A, 205	July 31	1	10:00	11:00	Not applicable
					2	12:00	13:00	
					3	13:30	14:30	

3.2 Field Test Changes and Issues

Communication between FCA, Apex, and EGLE allowed the testing to be completed as proposed in the June 24, 2019, Intent-to-Test Plan, with the following exceptions:

- Test Run 1 for EU-TOPCOAT3 Clearcoat Observation Deck was voided due to a failed post-test leak check. Therefore, one additional test run was completed.
- Due to a mechanical issue with the engine, testing at the EU-ENG-NEW-PSHOP2 source was not completed during this testing event. The EU-ENG-NEW-PSHOP2 testing was completed on September 11, 2019, and the results will be included in a separate report.

3.3 Summary of Results

The results of testing are presented in Tables 3-2 and 3-3. Detailed results are presented in the Appendix Tables 1 through 4 after the Tables Tab of this report. Graphs are presented after the Graphs Tab of this report. Sample calculations are presented in Appendix B.

Table 3-2
EU-TOPCOAT3 and RTO Emission Results

Parameter	Unit	Average Result		
		EU-TOPCOAT3 Basecoat Zone	EU-TOPCOAT3 Clearcoat Observation Deck	RTO Outlet
PM	lb/hr	0.27	0.25	1.4

PM: Particulate matter less than or equal to 2.5 and/or 10 microns were measured as total particulate matter.
lb/hr: pound per hour

Table 3-3
RTO VOC Destruction Efficiency Results

Parameter	Average Result	Permit Limit
RTO VOC DE	95.4%	≥95%

VOC: volatile organic compound
DE: destruction efficiency

4.0 Sampling and Analytical Procedures

Apex measured emissions in accordance with USEPA sampling methods. Table 4-1 presents the emissions test parameters and sampling methods.

Table 4-1
Emission Testing Methods

Parameter	EU-TOPCOAT3		RTO Inlet	RTO Outlet	USEPA Reference	
	Basecoat	Clearcoat			Method	Title
Sampling ports and traverse points	•	•	•	•	1	Sample and Velocity Traverses for Stationary Sources
Velocity and flowrate	•	•	•	•	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular weight	•	•	•	•	3	Gas Analysis for the Determination of Dry Molecular Weight
Moisture content	•	•	•	•	4	Determination of Moisture Content in Stack Gases
Particulate matter	• †	• †		•	5	Determination of Particulate Matter Emissions from Stationary Sources
Volatile organic compounds (VOCs)			•	•	25A	Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer
Particulate matter less than or equal to 2.5 and/or 10 microns ($PM_{2.5/10}$)				•	202	Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources
Gas dilution				•	205	Verification of Gas Dilution Systems for Field Instrument Calibrations

† Particulate matter at the EU-TOPCOAT3 Basecoat and Clearcoat exhausts was measured using a modified USEPA Method 5. The probe and filter were not heated since flue gas temperatures were below 85°F.

4.1 Emission Test Methods

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

USEPA Method 1, "Sample and Velocity Traverses for Stationary Sources," was used to evaluate the sampling locations and the number of traverse points for sampling and the measurement of velocity profiles. Figures 1 and 2 in the Appendix depict the source locations and traverse points.

USEPA Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to measure flue gas velocity and calculate volumetric flowrates. S-type Pitot tubes and thermocouple assemblies, calibrated in accordance with Method 2, Section 10.0, were used during testing. Because the dimensions of the Pitot tubes met the requirements outlined in Method 2, Section 10.1, and are within the specified limits, the baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned. **The digital manometer and thermometer are calibrated using calibration standards that are traceable to National Institute of Standards and Technology (NIST).** Pitot tube inspection sheets are included in Appendix A.

Cyclonic Flow Check. Apex evaluated whether cyclonic flow was present at the sampling locations. Cyclonic flow is defined as a flow condition with an average null angle greater than 20°. The direction of flow can be determined by aligning the Pitot tube to obtain zero (null) velocity head reading—the direction would be parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack walls when a null angle is obtained, the direction of flow is measured. If the absolute average of the flow direction angles is greater than 20°, the flue gas is considered to be cyclonic at that sampling location and an alternative location should be selected.

The average of the measured traverse point flue gas velocity null angles were less than 20° at the sampling locations. The measurements indicate the absence of cyclonic flow.

Field data sheets are included in Appendix C. Computer-generated field data sheets are included in Appendix D.

4.1.2 Molecular Weight (USEPA Method 3)

USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight," was used to determine the molecular weight of the flue gas. Flue gas was extracted from the stack through a probe positioned near the centroid of the duct and directed into a Fyrite® gas analyzer. The concentrations of carbon dioxide (CO_2) and oxygen (O_2) were measured by chemical absorption to within ±0.5%. The average CO_2 and O_2 results of the grab samples were used to calculate molecular weight.

4.1.3 Moisture Content (USEPA Method 4)

USEPA Method 4, "Determination of Moisture Content in Stack Gases" was used to determine the moisture content of the flue gas. Prior to testing, the moisture content was estimated using measurements from previous testing, psychrometric charts, and/or water saturation vapor pressure tables. These data were used in conjunction with preliminary velocity head pressure and temperature data to calculate flue gas velocity, nozzle size, and to establish the isokinetic sampling rate for the Method 5 and 202 sampling. For each sampling run, moisture content of the flue gases was measured using the reference method outlined in Section 2 of USEPA Method 4 in conjunction with the performance of USEPA Methods 5 and 202.

4.1.4 Particulate Matter (USEPA Methods 5 and 202)

USEPA Methods 5, "Determination of Particulate Emissions from Stationary Sources," and 202, "Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources," were used to measure particulate matter emissions. Figure 4-1 depicts the USEPA Methods 5 and 202 sampling train.

The USEPA Method 5 sampling train collects filterable particulate matter (FPM). The USEPA Method 202 sampling train collects condensable particulate matter (CPM), which is defined as material that is in vapor phase at stack conditions, but that which condenses and/or reacts upon cooling and dilution in the ambient air to form solid or liquid PM immediately after discharge from the stack. USEPA Method 202 collects the CPM using a water-dropout impinger, modified Greenburg-Smith impinger, and a Teflon filter. Because the temperature of the gas at the EU-TOPCOAT3 sample filtration is below 85°F, USEPA Method 202 was not required for particulate matter testing. Glassware was not baked, and therefore, the alternative method of Field Proof samples were collected as outlined in Method 202.

Apex's modular isokinetic stack sampling system consists of the following:

- A stainless steel button-hook nozzle.
- A heated (248±25°F) stainless steel-lined probe (heated for RTO and not-heated for Observation Zones).
- A desiccated and pre-weighed 83-millimeter-diameter glass fiber filter (manufactured to at least 99.95% efficiency (<0.05 % penetration) for 0.3-micron dioctyl phthalate smoke particles) in a heated (248±25°F) filter box.
- A Method 23-type stack gas condenser.
- A set of four pre-cleaned impingers with the configuration shown in Table 4-2.
- A second (back-half) CPM filter holder inserted between the second and third impingers and maintained at a temperature less than 85°F (for the RTO only).
- A sampling line.
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice.

Table 4-2
USEPA Methods 5 and 202 Impinger Configuration

Impinger Order (Upstream to Downstream)	Impinger Type	Impinger Contents	Contents
1	Modified - knockout	Empty	0 grams
2	Modified	Empty	0 grams
CPM filter (for RTO only)			
3	Modified	HPLC Water	~100 grams
4	Modified	Silica desiccant	~300 grams

Prior to testing, a preliminary velocity traverse was performed and a nozzle size was calculated that would allow isokinetic sampling at an average rate of approximately 0.75 cubic feet per minute (cfm). Apex selected a pre-cleaned nozzle that has an inner diameter that approximated the calculated ideal value. The nozzle was inspected and measured with calipers across three cross-sectional chords to evaluate the inside diameter; rinsed and brushed with acetone; and connected to the sample probe.

The impact and static pressure openings of the Pitot tube were leak-checked at or above a velocity head of 3.0 inches of water for more than 15 seconds. The sampling train was leak-checked by capping the nozzle tip and applying a vacuum of approximately 10 inches of mercury to the sampling train. The dry-gas meter was then monitored (for approximately 1 minute) to measure that the sample train leak rate was less than 0.02 cubic feet per minute (cfm). The probe and filter heaters were turned on, and the sample probe was inserted into the sampling port to begin sampling.

Ice was placed around the impingers, and the probe and filter temperatures were allowed to stabilize at 248±25 °F before each sample run. After the desired operating conditions were coordinated with the facility, testing was initiated.

Stack parameters (e.g., flue velocity, temperature) were monitored to establish the isokinetic sampling rate within 100±10 % for the duration of the test. Data was recorded at each of the traverse points.

At the conclusion of a test run and the post-test leak check, the sampling train was disassembled, and the impingers and filter were transported to the recovery area. The filter was recovered using tweezers and placed in a Petri dish. The Petri dish was immediately labeled and sealed with Teflon tape. The nozzle, probe, and the front half of the filter holder assembly were brushed and, at a minimum, triple-rinsed with acetone to recover particulate matter. The acetone rinses were collected in pre-cleaned sample containers.

At the end of a test run, the mass of liquid collected in each impinger was measured using a scale to within ±0.5 grams; these masses were used to calculate moisture content of the flue gas. For the RTO only, the impinger train was then purged with nitrogen, at a minimum flow rate of 14 liters per minute, for a minimum of one hour. The purpose of the nitrogen purge was to remove any dissolved sulfur dioxide gases from the impinger.

For the RTO only, the contents of the first two impingers were collected in a glass sample container labeled as CPM Container 1. The back of the filter-holder, condenser, Impingers 1 and 2, front-half of the CPM filter holder, and all connecting glassware were rinsed twice with HPLC water and the recovery rinsate was added to CPM Container 1.

For the RTO only, following the HPLC water rinse, the back of the filter-holder, condenser, Impingers 1 and 2, front-half of the CPM filter holder, and all connecting glassware were rinsed with acetone and then rinsed twice with hexane. The acetone and hexane rinses were collected in a glass sample container labeled as CPM Container 2.

For the RTO only, the CPM filter was recovered using Teflon-lined tweezers and placed in a Petri dish; the dish was sealed with Teflon tape, and labeled as CPM Container 3. The mass of condensate collected in Impingers 3 and 4 were measured to calculate the moisture content of the flue gas; these impingers were not recovered.

Apex labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. Immediately after recovery, the sample containers were stored. The sample containers were transported to Bureau Veritas Laboratories in Mississauga, Ontario, Canada for analysis. The laboratory analytical results are included in Appendix E.

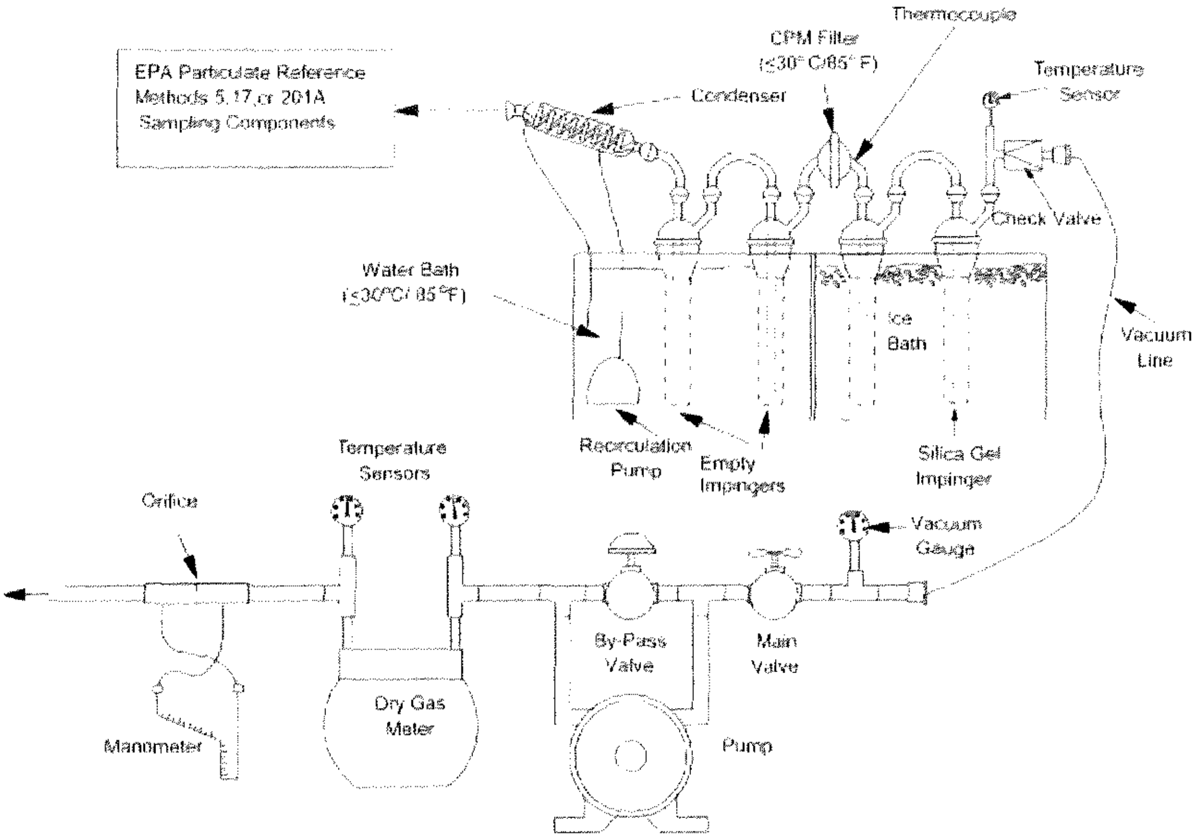
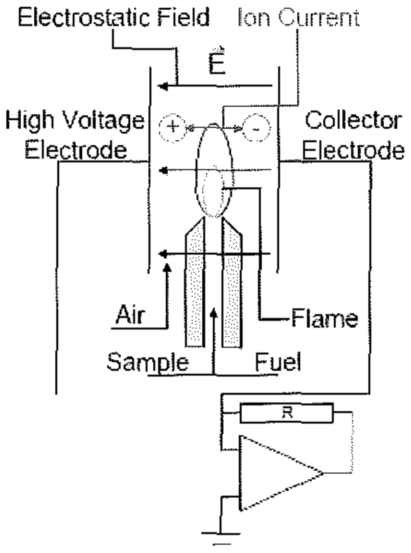


Figure 4-1. USEPA Methods 5 and 202 Sampling Train

4.1.5 Volatile Organic Compounds (USEPA Method 25A)

USEPA Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," was used to measure volatile organic compound concentrations in the flue gas. Samples were collected through a stainless steel probe and heated sample line into an analyzer.

A flame ionization detector (FID) determines the average hydrocarbon concentration in part per million by volume (ppmv) of VOC as the calibration gas (i.e., propane). The FID is fueled by 100% hydrogen, which generates a flame with a negligible number of ions. Flue gas is introduced into the FID and enters the flame chamber. The combustion of flue gas generates electrically charged ions. The analyzer applies a polarizing voltage between two electrodes around the flame, producing an electrostatic field. Negatively charged ions, anions, migrate to a collector electrode, while positive charged ions, cations, migrate to a high-voltage electrode. The current between the electrodes is directly proportional to the hydrocarbon concentration in the sample. The flame chamber is depicted at right.



Using the voltage analog signal, measured by the FID, the concentration of VOCs was recorded by a data acquisition system (DAS). The average concentration of VOCs is reported as the calibration gas (i.e., propane) in equivalent units.

Before testing, the analyzer was calibrated by introducing a zero-calibration range gas (<1% of span value) and high-calibration range gas (80-90% span value) to the tip of the sampling probe. The span value was set to 1.5 to 2.5 times the expected concentration (e.g., 0-100 ppmv). Next, a low-calibration range gas (25-35% of span value) and mid-calibration range gas (45-55% of span value) were introduced. The analyzers are considered to be calibrated when the analyzer response is ±5% of the calibration gas value.

At the conclusion of a test run, a calibration drift test was performed by introducing the zero- and mid-calibration gas to the tip of the sampling probe. The test run data was considered valid if the calibration drift test demonstrated the analyzers are responding within 3% of the calibration span from pre-test to post-test calibrations.

Figure 4-2 depicts the USEPA Method 25A sampling train.

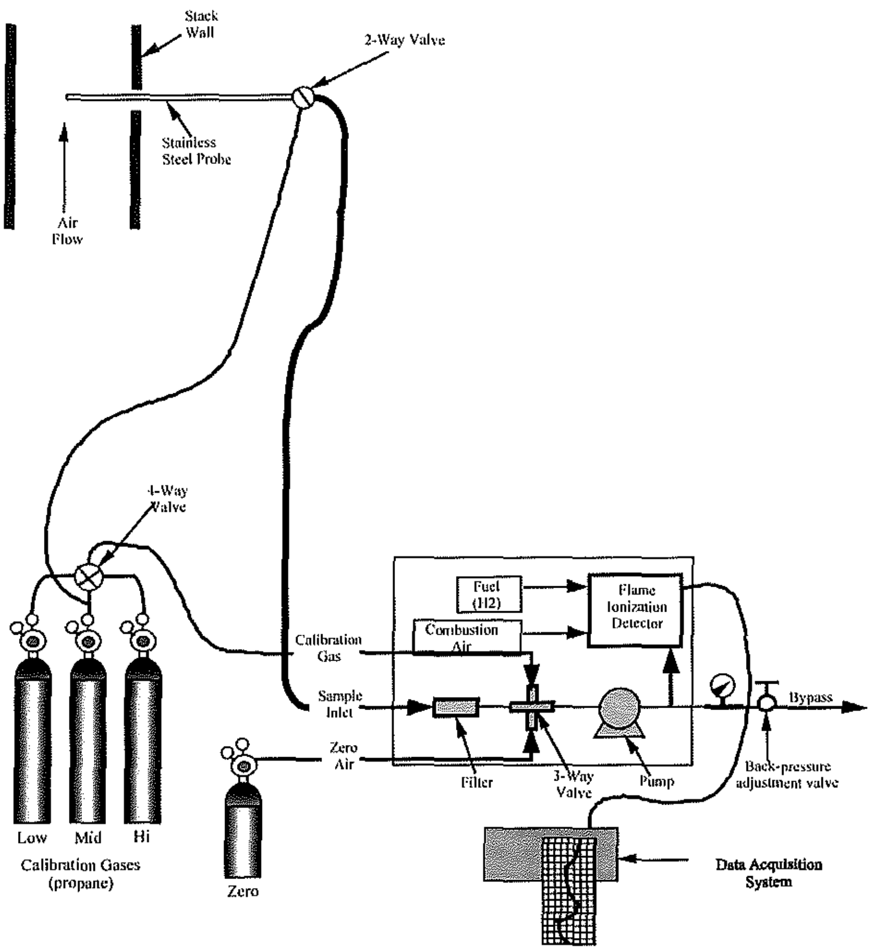


Figure 4-2. USEPA Method 25A Sampling Train

4.1.6 Gas Dilution (USEPA Method 205)

USEPA Method 205, "Verification of Gas Dilution Systems for Field Instrument Calibrations," was used to introduce known values of calibration gases into the analyzers. 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 was evaluated for accuracy in the field in accordance with USEPA Method 205.

The gas divider dilutions were measured to evaluate that they were within ±2% of predicted values. Two sets of three dilutions of the high-level calibration gas were performed. In addition, a certified mid-level calibration gas was introduced into an analyzer; this calibration gas concentration was within ± 10% of a gas divider dilution concentration.

4.2 Process Data

FCA recorded process data during testing. EGLE personnel verified the requested operating and process data were recorded. Process data are included in Appendix F.

5.0 **Quality Assurance and Quality Control**

5.1 QA/QC Procedures

Equipment used in this emissions test program passed Quality Assurance (QA) and Quality Control (QC) procedures. Refer to Appendix A for equipment calibrations. Before testing, the sampling equipment was cleaned, inspected, and calibrated according to procedures outlined in the applicable USEPA sampling method and USEPA's "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III, Stationary Source-Specific Methods."

5.2 QA/QC Audits

Onsite QA/QC procedures (i.e., Pitot tube inspections, nozzle size verifications, leak check, calculation of isokinetic sampling rates, calibrations) were performed in accordance with the respective USEPA sampling methods. Equipment inspection and calibration measurements are presented in Appendix A.

Offsite QA audits include dry-gas meter and thermocouple calibrations.

5.2.1 Audit Sample Results QA/QC

QA audit samples were not proposed during this test program. Currently, audit samples for the parameters to be measured are not available from the EPA Stationary Source Audit Program.

5.2.2 Sampling Train QA/QC

The sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. Table 5-1 summarizes the QA/QC audits conducted on each sampling train.

Table 5-1
USEPA Methods 5 and 202 Sampling Train QA/QC

Parameter	Run 1	Run 2	Run 3	Method Requirement	Comment
EU-TOPCOAT3 Basecoat Zone					
Average velocity pressure head (in H_2O)	0.67	0.67	0.70	>0.05 in H_2O	Valid
Sampling train post-test leak check	0 ft^3 for 1 min at 3 in Hg	0 ft^3 for 1 min at 3 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1 to 2		
EU-TOPCOAT3 Clearcoat Observation Deck (Run 2, Run 3, Run 4)					
Average velocity pressure head (in H_2O)	0.31	0.31	0.28	>0.05 in H_2O	Valid
Sampling train post-test leak check	0.002 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 6 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1		

Table 5-1
USEPA Methods 5 and 202 Sampling Train QA/QC

Parameter	Run 1	Run 2	Run 3	Method Requirement	Comment
Regenerative Thermal Oxidizer (RTO)					
Average velocity pressure head (in H_2O)	0.65	0.66	0.66	>0.05 in H_2O	Valid
Sampling train post-test leak check	0 ft^3 for 1 min at 7 in Hg	0 ft^3 for 1 min at 7 in Hg	0 ft^3 for 1 min at 7 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	5	5	5		

5.2.3 Instrument Analyzer QA/QC

The instrument analyzer sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. The analyzers passed the applicable calibration criteria. Table 5-2 summarizes the gas cylinders used during this test program. Analyzer calibration, bias, and drift data are included in Appendix A.

Table 5-2
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Air	Airgas	CC139694	--	4/5/2026
Propane	Airgas	CC56826	51.30 ppm	10/12/2023
Propane	Airgas	CC156708	109.6 ppm	12/3/2026
Propane	Airgas	CC18627	1,098 ppm	11/30/2026

5.2.4 Dry-Gas Meter QA/QC

Table 5-3 summarizes the dry-gas meter calibration checks in comparison to the acceptable USEPA tolerance. Complete dry-gas meter calibrations are included in Appendix A.

Table 5-3
Dry-Gas meter Calibration QA/QC

Dry-Gas Meter	Pre-test DGM Calibration Factor	Post-test DGM Calibration Factor	Difference Between Pre- and Post-test Calibrations	Acceptable Tolerance	Comment
3	0.999 (7/10/2019)	0.985 (9/13/2019)	0.014	±0.05	Valid
7	1.006 (6/24/2019)	0.996 (9/13/2019)	0.010	±0.05	Valid
8	0.967 (6/24/2019)	0.970 (9/13/2019)	0.003	±0.05	Valid

5.2.5 Thermocouple QA/QC

Temperature measurements using thermocouples and digital pyrometers were compared to a reference temperature prior to testing to evaluate accuracy of the equipment. The thermocouples and pyrometers measured temperature within ±1.5% of the reference temperatures and were within USEPA acceptance criteria. Thermocouple calibration sheets are included in Appendix A.

5.2.6 Laboratory Blanks QA/QC

QA/QC blanks were analyzed for the parameters of interest. The results are presented in Table 5-4. Blank corrections were not applied to the sample results. Blank and sample laboratory results are included in Appendix E.

Table 5-4
Laboratory Blanks QA/QC

Sample Identification	Result (mg)	Comment
Method 5 Filter Blank	1.20	Reporting limit is 0.30 milligrams.
Method 5 Acetone Blank	<0.5	Reporting limit is 0.5 milligrams. Sample volume was approximately 70 grams.
Method 202 Field Blank - Inorganic	1.4	Reporting limit is 0.5 milligrams. Sample volume was approximately 80 grams.
Method 202 Field Blank - Organic	<1.0	Reporting limit is 1.0 milligrams. Sample volume was approximately 69 grams.
Method 202 Proof Blank - Inorganic	1.3	Reporting limit is 0.5 milligrams. Sample volume was approximately 57 grams.
Method 202 Proof Blank - Organic	<1.0	Reporting limit is 1.0 milligrams. Sample volume was approximately 69 grams.

5.3 Data Reduction and Validation

The emissions testing Project Manager and/or the QA/QC Officer validated computer spreadsheets. The computer spreadsheets were used to ensure that field calculations were accurate. Random inspection of the field data sheets were conducted to verify data have been recorded appropriately. At the completion of a test, the raw field data were entered into computer spreadsheets to provide applicable onsite emissions calculations. The computer data were checked against the raw field sheets for accuracy during review of the report.

5.4 Sample Identification and Custody

The Apex project manager was responsible for the handling and procurement of the data collected in the field. The project manager ensured the data sheets are accounted for and completed in their entirety. Applicable Chain of Custody procedures followed guidelines outlined within ASTM D4840-99 (Reapproved 2010), "Standard Guide for Sample Chain-of-Custody Procedures." Detailed sampling and recovery procedures are described in Section 4.1. For each sample collected (i.e., impinger), sample identification and custody procedures were completed as follows:

- Containers were sealed to prevent contamination.
- Containers were labeled with test number, location, and test date.

- The level of fluid was marked on the outside of the sample containers to indicate if leakage occurred prior to receipt of the samples by the laboratory.
- Containers were placed in a cooler for storage, if necessary.
- Samples were logged using guidelines outlined in ASTM D4840-99(Reapproved 2010).
- Samples were transported to the laboratory under chain of custody.

Chains of custody and laboratory analytical results are included in Appendix E.

5.5 QA/QC Problems

Equipment audits and QA/QC procedures demonstrate sample collection accuracy and compliance for the test runs, with the following exception:

- Test Run 1 for EU-TOPCOAT3 Clearcoat Observation Deck was voided due to a failed post-test leak check. Therefore, one additional test run was completed.

6.0 Limitations

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