

1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

General Motors LLC – Flint Assembly (State Registration No.: B1606) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance test program on the Prime Coating Operations (EU-ECOAT) at the General Motors LLC – Flint Assembly facility located in Flint, Michigan. Testing was performed on July 7, 2021, for the purpose of satisfying the emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) No. MI-ROP-B1606-2020.

The specific objectives were to:

- Verify the volatile organic compound (VOC) destruction efficiency (DE) of Regenerative Thermal Oxidizer 1 (RTO 1) serving ECOAT Oven Zones 1-3 (EU-ECOAT)
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

**TABLE 1-1
SUMMARY OF TEST PROGRAM**

Test Date(s)	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
7/7/2021	EU-ECOAT RTO 1 Inlet	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	6-8
7/7/2021	EU-ECOAT RTO 1 Inlet	O ₂ , CO ₂	EPA 3	3	10
7/7/2021	EU-ECOAT RTO 1 Inlet	Moisture	EPA 4 wb/db	3	1
7/7/2021	EU-ECOAT RTO 1 Inlet	THC	EPA 25A	3	60
7/7/2021	EU-ECOAT RTO 1 Exhaust	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	5-7
7/7/2021	EU-ECOAT RTO 1 Exhaust	O ₂ , CO ₂	EPA 3	3	10
7/7/2021	EU-ECOAT RTO 1 Exhaust	Moisture	EPA 4	3	30
7/7/2021	EU-ECOAT RTO 1 Exhaust	THC	EPA 25A	3	60

To simplify this report, a list of Units and Abbreviations is included in Appendix C.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized and compared to their respective permit limits in Table 1-2. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-3. The tests were conducted according to the test protocol dated March 15, 2021, that was submitted to the EGLE.

**TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS -
EU-ECOAT RTO 1
JULY 7, 2021**

Parameter/Units	Average Results	Emission Limits
Volatile Organic Compounds (VOC) Destruction Efficiency (DE) %	97.61	95

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location:	General Motors LLC - Flint Assembly Plant 3100 Van Slyke Road Flint, MI 48507	
Project Contact:	Scott Applegate	Jeff Hummel
Role:	Sr. Environmental Engineer	Sr. Environmental Engineer
Company:	General Motors LLC	General Motors LLC
Telephone:	248-494-6643	517-719-9053
Email:	scott.applegate@gm.com	jeffrey.hummel@gm.com

Agency Information

Regulatory Agency: EGLE
Agency Contact: Karen Kajiya-Mills
Telephone: 517-256-0880
Email: kajiya-millsk@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC	
Contact:	Matthew Young	Michael Nummer
Title:	District Manager	Field Technician
Telephone:	248-548-8070	248-548-8070
Email:	myoung@montrose-env.com	mnummer@montrose-env.com

Test personnel and observers are summarized in Table 1-3.

**TABLE 1-3
TEST PERSONNEL AND OBSERVERS**

Name	Affiliation	Role/Responsibility
Matthew Young	Montrose	District Manager, QI
Michael Nummer	Montrose	Field Technician
Benjamin Durham	Montrose	Field Technician
Scott Applegate	General Motors LLC – Flint Assembly	Observer/Client Liaison/Test Coordinator

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

General Motors LLC - Flint Assembly facility manufactures the Chevy Silverado and GMC Sierra crew cab 2500 and 3500 pickup trucks and operates a paint shop for the surface coating of light-duty automotive vehicles. Prime coating operations (EU-ECOAT) are performed in an electrodeposition tank followed by a curing oven, oven canopy, cooler zone, and a dry filter scuff booth. The ECOAT Oven consists of four oven zones. Emissions from ECOAT Oven Zones 1-3 are controlled by RTO 1, and emissions from ECOAT Oven Zone 4 are controlled by RTO 2. EU-ECOAT and RTO 1 were in operation for this test event.

2.2 FLUE GAS SAMPLING LOCATIONS

Information regarding the sampling locations is presented in Table 2-1.

**TABLE 2-1
SAMPLING LOCATIONS**

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EU-ECOAT RTO 1 Inlet	27.5	77 / 2.8	56 / 2.0	Flow: 16 (8/port); Moisture: 1; Gaseous: 1
EU-ECOAT RTO 1 Exhaust (SV-C7)	34.0	180 / 5.3	240 / 7.1	Flow: 16 (8/port); Moisture: 1; Gaseous: 1

Sampling locations were verified in the field to conform to EPA Method 1. Acceptable cyclonic flow conditions were confirmed prior to testing using EPA Method 1, Section 11.4. See Appendix A.1 for more information.

2.3 OPERATING CONDITIONS AND PROCESS DATA

Emission tests were performed while EU-ECOAT and RTO 1 were operating normally.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B.

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TEST METHODS

The test methods for this test program were presented previously in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 1, Sample and Velocity Traverses for Stationary Sources

EPA Method 1 is used to assure that representative measurements of volumetric flow rate are obtained by dividing the cross-section of the stack or duct into equal areas, and then locating a traverse point within each of the equal areas. Acceptable sample locations must be located at least two stack or duct equivalent diameters downstream from a flow disturbance and one-half equivalent diameter upstream from a flow disturbance.

3.1.2 EPA Method 2, Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

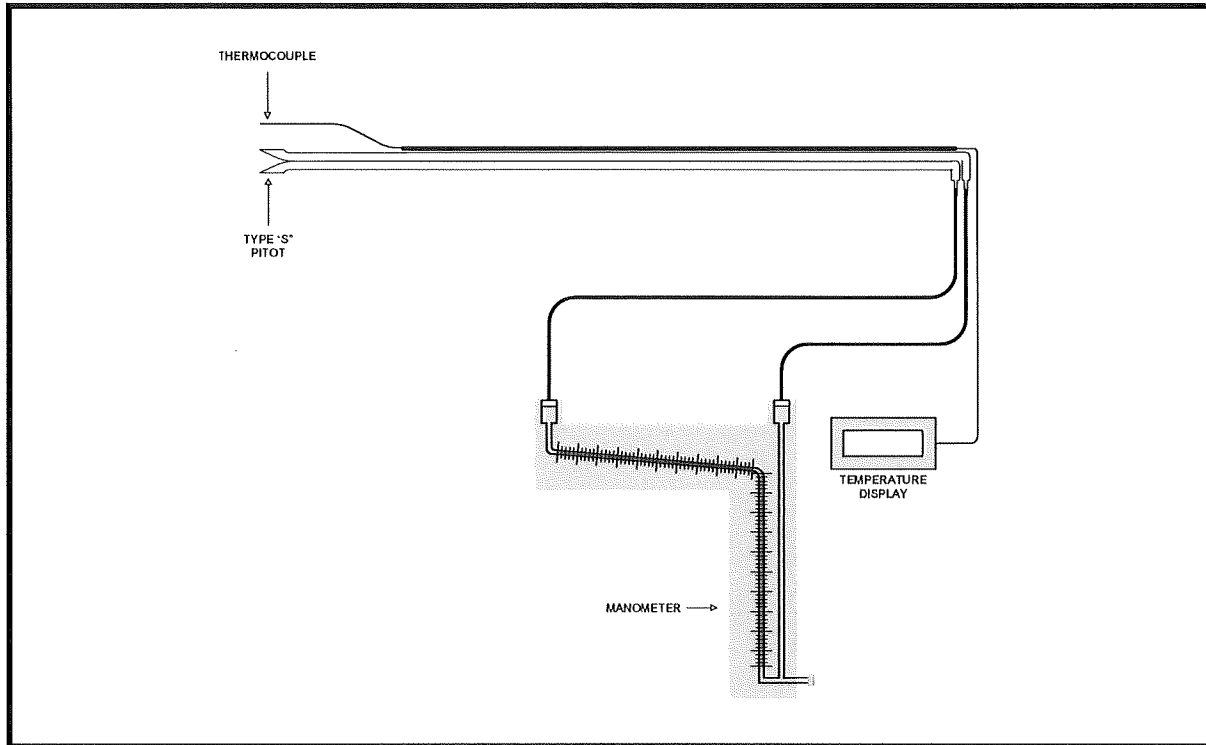
EPA Method 2 is used to measure the gas velocity using an S-type pitot tube connected to a pressure measurement device, and to measure the gas temperature using a calibrated thermocouple connected to a thermocouple indicator. Typically, Type S (Stausscheibe) pitot tubes conforming to the geometric specifications in the test method are used, along with an inclined manometer. The measurements are made at traverse points specified by EPA Method 1.

The sampling system is detailed in Figure 3-1.

3.1.3 EPA Method 3, Gas Analysis for the Determination of Dry Molecular Weight

EPA Method 3 is used to calculate the dry molecular weight of the stack gas using one of three methods. The first choice is to measure the percent O₂ and CO₂ in the gas stream. A gas sample is extracted from a stack by one of the following methods: (1) single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analyzed for percent CO₂ and percent O₂ using either an Orsat or a Fyrite analyzer. The second choice is to use stoichiometric calculations to calculate dry molecular weight. The third choice is to use an assigned value of 30.0, in lieu of actual measurements, for processes burning natural gas, coal, or oil.

**FIGURE 3-1
EPA METHOD 2 SAMPLING TRAIN**



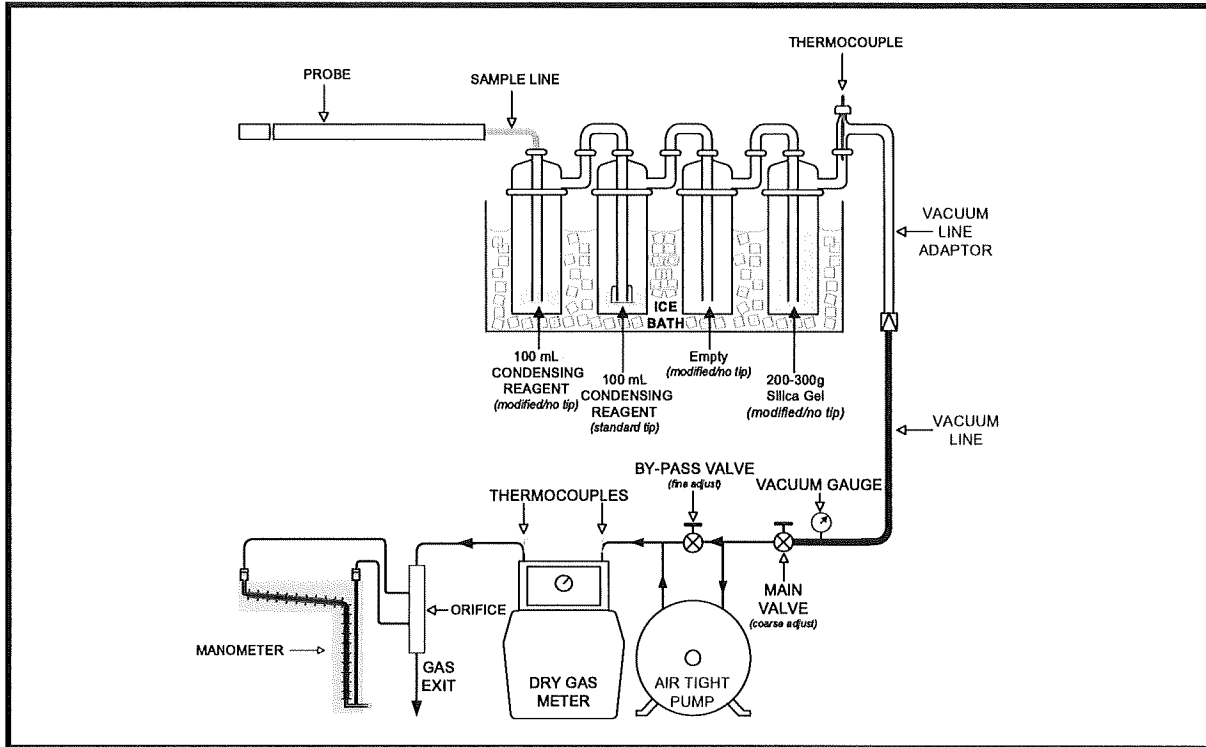
3.1.4 EPA Method 4, Determination of Moisture Content in Stack Gas

EPA Method 4 is a manual, non-isokinetic method used to measure the moisture content of gas streams. Gas is sampled at a constant sampling rate through a probe and impinger train. Moisture is removed using a series of pre-weighed impingers containing methodology-specific liquids and silica gel immersed in an ice water bath. The impingers are weighed after each run to determine the percent moisture.

For EU-COAT RTO 1 Inlet Duct sampling, the EPA Method 4 wb/db Approximation Method was used. The approximate moisture content and relative humidity of the gas stream is measured with a sling psychrometer.

For EU-COAT RTO 1 Exhaust Stack, the sampling system is detailed in Figure 3-2.

**FIGURE 3-2
EPA METHOD 4 (DETACHED) SAMPLING TRAIN**

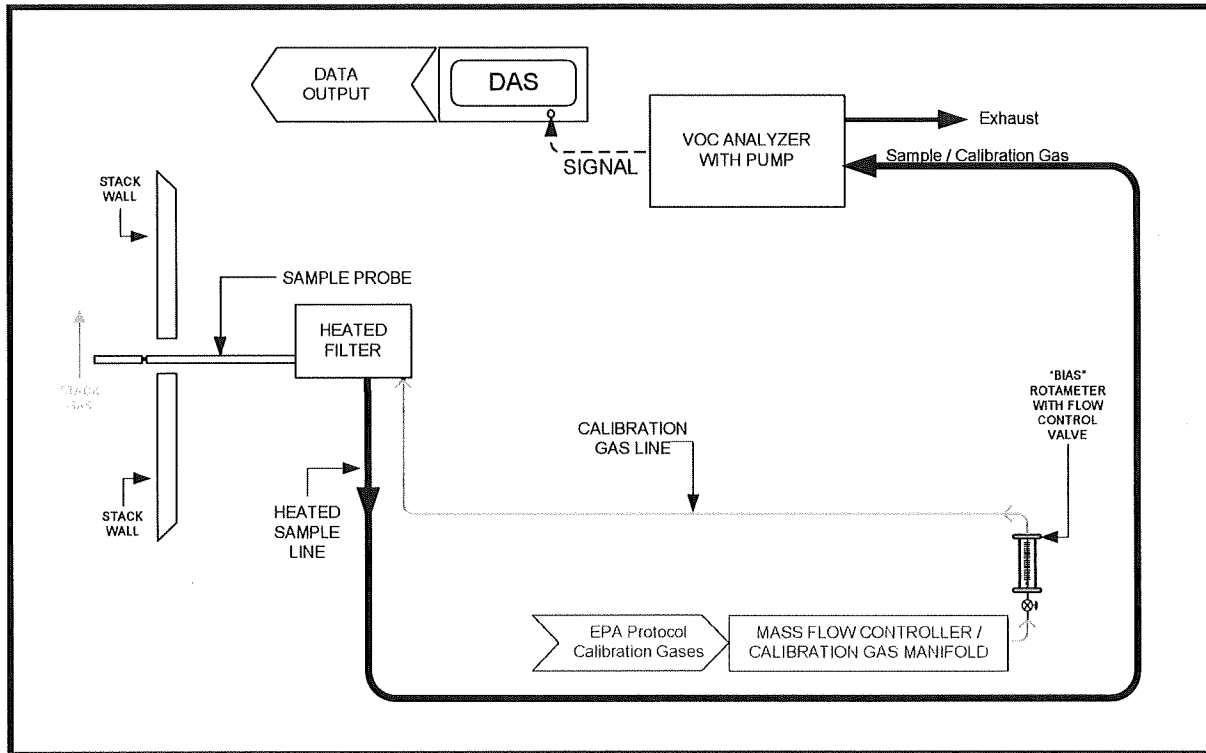


3.1.5 EPA Method 25A, Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer

EPA Method 25A is an instrumental test method used to measure the concentration of THC in stack gas. A gas sample is extracted from the source through a heated sample line and glass fiber filter to a flame ionization analyzer (FIA) equipped with a nonmethane cutter. Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

The sampling system is detailed in Figure 3-3.

**FIGURE 3-3
EPA METHOD 25A SAMPLING TRAIN**



3.2 PROCESS TEST METHODS

The test plan did not require that process samples be collected during this test program; therefore, no process sample data are presented in this test report.

4.0 TEST DISCUSSION AND RESULTS

4.1 FIELD TEST DEVIATIONS AND EXCEPTIONS

The Test Plan and EGLE approval letter for this test event called for EPA Method 3 and EPA Method 4 to be performed at all sampling locations. Instead, the wet-bulb/dry-bulb approximation technique as per EPA Method 4, Section 2.2.1, was utilized in estimating gas stream moisture content at all the inlet sampling locations in lieu of EPA Method 4. In addition, single pass EPA Method 3 determinations were performed during each run, and the average oxygen (O₂) and carbon dioxide (CO₂) concentrations were used to determine dry molecular weight.

4.2 PRESENTATION OF RESULTS

The average results are compared to the permit limits in Table 1-2. The results of individual compliance test runs performed are presented in Tables 4-1 and 4-2. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

**TABLE 4-1
 VOC EMISSIONS RESULTS -
 EU-ECOAT RTO 1 INLET DUCT**

Run Number	1	2	3	Average
Date	7/7/2021	7/7/2021	7/7/2021	--
Time	8:13-9:13	9:38-10:38	11:00-12:00	--
Flue Gas Parameters				
O ₂ , % volume dry	20.90	20.90	20.90	20.90
CO ₂ , % volume dry	0.00	0.00	0.00	0.00
flue gas temperature, °F	366.0	362.5	364.5	364.3
approximate moisture content, % volume*	3.04	4.08	3.82	3.65
volumetric flow rate, scfm	10,597	10,822	10,901	10,773
Volatile Organic Compounds (VOC), as propane				
ppmvw	157.3	221.6	223.7	200.9
lb/hr	11.45	16.47	16.75	14.89

* See Section 4.1 for details.

**TABLE 4-2
VOC EMISSIONS AND VOC DE RESULTS -
EU-ECOAT RTO 1 EXHAUST STACK**

Run Number	1	2	3	Average
Date	7/7/2021	7/7/2021	7/7/2021	--
Time	8:13-9:13	9:38-10:38	11:00-12:00	--
Process Data				
RTO Chamber Temperature, °F	1511.2	1514.6	1518.2	1514.7
Flue Gas Parameters				
O ₂ , % volume dry	20.90	20.90	20.90	20.90
CO ₂ , % volume dry	0.00	0.00	0.00	0.00
flue gas temperature, °F	428.2	427.1	424.4	426.6
moisture content, % volume	5.83	7.22	6.75	6.60
volumetric flow rate, scfm	11,335	11,329	11,415	11,360
Volatile Organic Compounds (VOC), as propane				
ppmvw	3.40	5.30	5.04	4.58
lb/hr	0.26	0.41	0.40	0.36
Volatile Organic Compounds (VOC) Destruction Efficiency (DE)				
%	97.69	97.50	97.64	97.61

* Process Data was provided by General Motors-Flint Assembly personnel.

5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA/QC AUDITS

The meter box and sampling train used during sampling performed within the requirements of their respective methods. All post-test leak checks, minimum metered volumes met the applicable QA/QC criteria.

Fyrite analyzer audits were performed during this test in accordance with EPA Method 3, Section 10.1 requirements. The results were within $\pm 0.5\%$ of the respective audit gas concentrations.

EPA Method 25A FIA calibration audits were within the measurement system performance specifications for the calibration drift checks and calibration error checks.

An EPA Method 205 field evaluation of the calibration gas dilution system was conducted. The dilution accuracy and precision QA specifications were met.

5.2 QA/QC DISCUSSION

All QA/QC criteria were met during this test program.

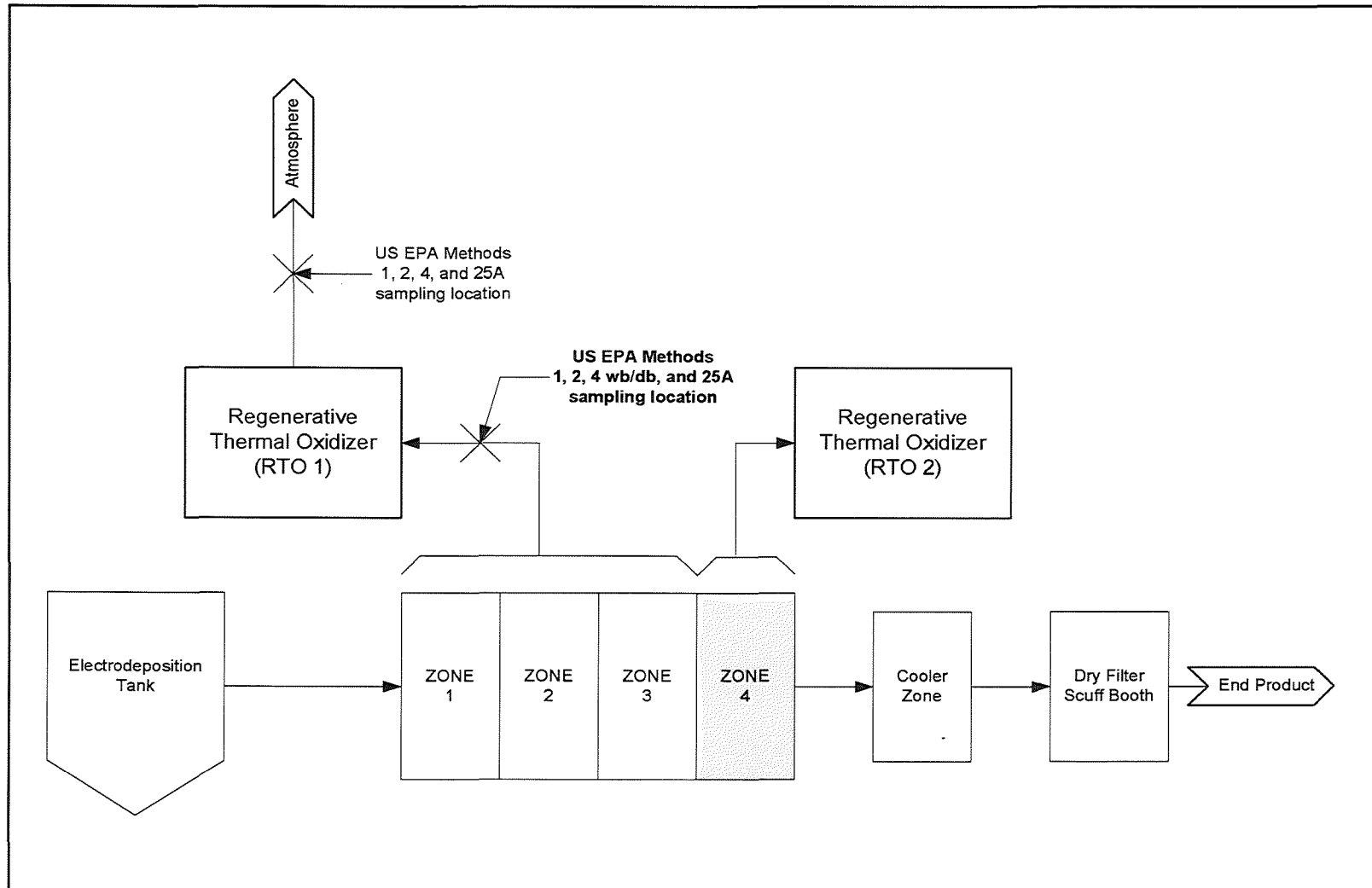
5.3 QUALITY STATEMENT

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D 7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).

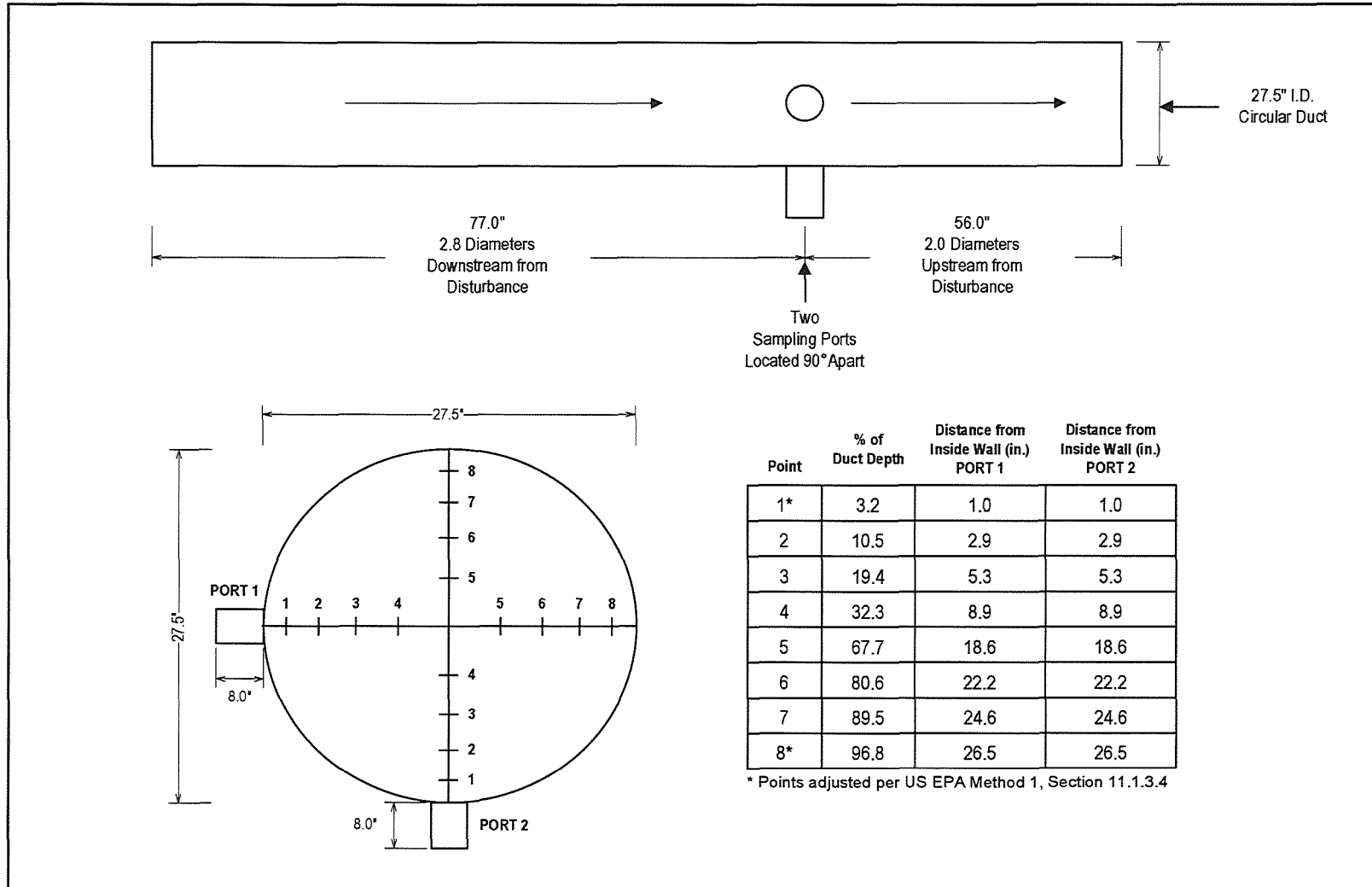
APPENDIX A FIELD DATA AND CALCULATIONS

Appendix A.1 Sampling Locations

EU-ECOAT SAMPLING LOCATION SCHEMATIC



EU-ECOAT RTO 1 INLET DUCT TRAVERSE POINT LOCATION DRAWING



EU-ECOAT RTO 1 EXHAUST STACK TRAVERSE POINT LOCATION DRAWING

