1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Ford Motor Company Flat Rock Assembly Plant (SRN N0929) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance emissions test program on the coating operations (EU-ECOAT, EU-GLIDECOAT, and EU-TOPCOAT) at the Ford Motor Company Flat Rock Assembly Plant facility located in Flat Rock, Michigan. The tests were conducted to satisfy the emissions testing requirements pursuant to Flat Rock Metro Air Pollution Control District (EGLE) Permit No. MI-ROP-N0929-2018.

The specific objectives were to:

- Verify the volatile organic compound (VOC) (total gaseous organic (TGO) / total gaseous nonmethane (TGNMO)) destruction efficiency (DE) of the regenerative catalytic oxidizers (RCOs) serving the EU-ECOAT and EU-GLIDECOAT
- Verify the VOC (TGO) DE of the RTO serving EU-TOPCOAT
- Determine the Overall VOC DE of the RCOs and RTO (FG-CONTROLS) serving EU-ECOAT, EU-GLIDECOAT, and EU-TOPCOAT
- 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
FG-CONTROLS SUMMARY OF TEST PROGRAM

Test Dates	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
09/23/2020	RCO A, B, C, Outlet Exhausts	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	~10
09/23/2020	RCO A, B, C, Outlet Exhausts	O_2, CO_2	EPA 3	3	~3
09/23/2020	RCO A, B, C, Outlet Exhausts	Moisture	EPA 4	1	30
09/23/2020	RCO A, B, C, Outlet Exhausts	VOC (TGO/Methane)	EPA 25A	3	60
09/23/2020	RCO A, B, C, Inlet	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	~10
09/23/2020	RCO A, B, C, Combined Inlet	Moisture (WB/DB)	EPA 4	3	~1
09/23/2020	RCO A, B, C, Combined Inlet	TGO	EPA 25A	3	60
09/23/2020	RTO Inlet and Outlet	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	~10
09/23/2020	RTO Inlet and Outlet	O_2, CO_2	EPA 3	3	~3
09/23/2020	RTO Inlet	Moisture (wb/db)	EPA 4	3	~1
09/23/2020	RTO Outlet	Moisture	EPA 4	1	30
09/23/2020	RTO Inlet and Outlet	TGO	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 5.0. 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 plan (protocol) that was received by the EGLE July 16, 2020 and approved on August 6, 2020.

The testing was conducted by the Montrose personnel listed in Table 1-2.

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location:	Ford Motor Company Ford Flat Rock Assembly Plant Flat Rock, MI 48134	
Project Contact:	Susan Hicks	John Lauch
Title	Senior Environmental Engineer	Environmental Engineer
Company:	Ford Motor Company	Ford Motor Company
Telephone:	313-594-3185	248-417-0211
Email:	shicks3@ford.com	jlauch@ford.com

Agency Information

Regulatory Agency:	Michigan Department of Environment, Great Lakes, and Energy (EGLE)	
Agency Contact:	Jeff Korniski	Regina Angellotti
Telephone:	313-456-4683	313-418-0895
Email:	korniskij@michigan.gov	angellottir1@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC	
Contact:	Matthew Young	Steve Smith
Title:	District Manager	Client Project Manager
Telephone:	586-744-9133	734-751-9701
Email:	myoung@montrose-env.com	ssmith@montrose-env.com

Test personnel and observers are summarized in Table 1-2.

TABLE 1-2
TEST PERSONNEL AND OBSERVERS

Name	Affiliation	Role/Responsibility
Steve Smith	Montrose	Client Project Manager, QI
David Trahan	Montrose	Senior Field Technician, QI
Mike Nummer	Montrose	Field Technician
Scott Dater	Montrose	Field Technician
Susan Hicks	Ford Motor Company-Dearborn	Observer/Client Liaison/Test Coordinator
John Lauch	Ford Flat Rock Assembly Plant	Observer

2.0 SUMMARY OF RESULTS

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 EGLE Permit No. MI-ROP-N0929-2018. Detailed results for individual test runs can be found in Section 5.0. All supporting data (including process data) can be found in the appendices.

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.

TABLE 2-1
SUMMARY OF AVERAGE COMPLIANCE RESULTS -
FG-CONTROLS
SEPTEMBER 23, 2020

Parameter/Units	Total Results	Emission Limits
RCO Outlet Exhaust Flow Weighted TGNMO Average, as propane		
ppmvw	4.6	≤ 5
RCO VOC (TGO/TGNMO) Destruction Efficiency (DE)		
%	93.1	--
RTO VOC (TGO) Destruction Efficiency (DE)		
%	94.8	--
Overall VOC (TGO/TGNMO) Destruction Efficiency (DE)		
%	93.4	--

3.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

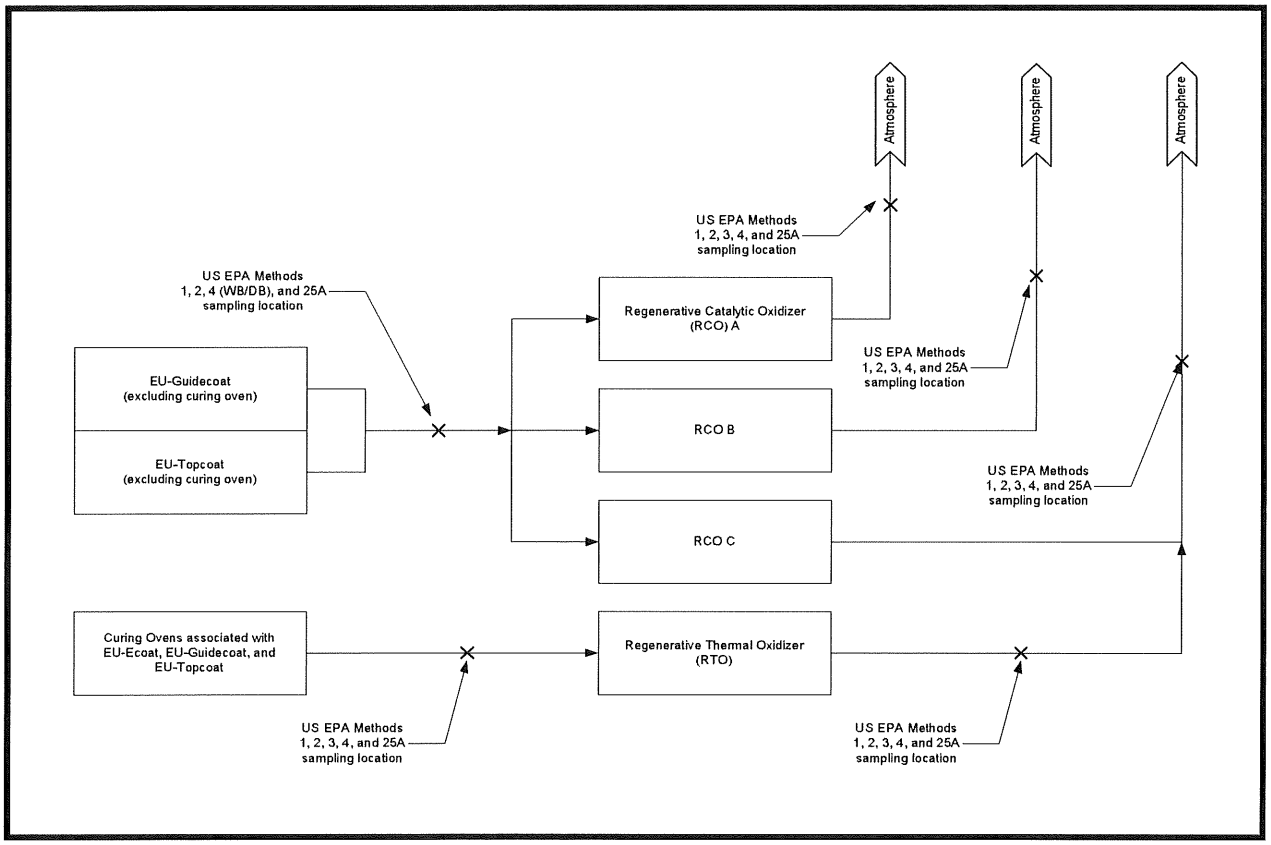
3.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

The Ford Motor Company Flat Rock Assembly Plant (SRN N0929) coating operations includes the electrocoating of vehicle bodies (EU-ECOAT), the application of guidecoat coating including anti-chip primer and black out, (EU-GLIDECOAT), and the application of topcoat coating including tutone/repair (EU-TOPCOAT). Emissions from EU-ECOAT and EU-GLIDECOAT were controlled by three regenerative catalytic oxidizers (RCOs), and emissions from EU-ECOAT were controlled by a regenerative thermal oxidizer (RTO).

The RCOs and RTO (FG-CONTROLS) and emission units EU-ECOAT, EU-GLIDECOAT, and EU-TOPCOAT were in operation during this test event.

The sampling location schematic is displayed in Figure 3-1.

FIGURE 3-1
FGCONTROLS SAMPLING LOCATION SCHEMATIC



3.2 OPERATING CONDITIONS AND PROCESS DATA

Emission tests were performed while the source/units and air pollution control devices were operating at the conditions required by the permit. The units were tested when 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.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 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.

4.1.1 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.

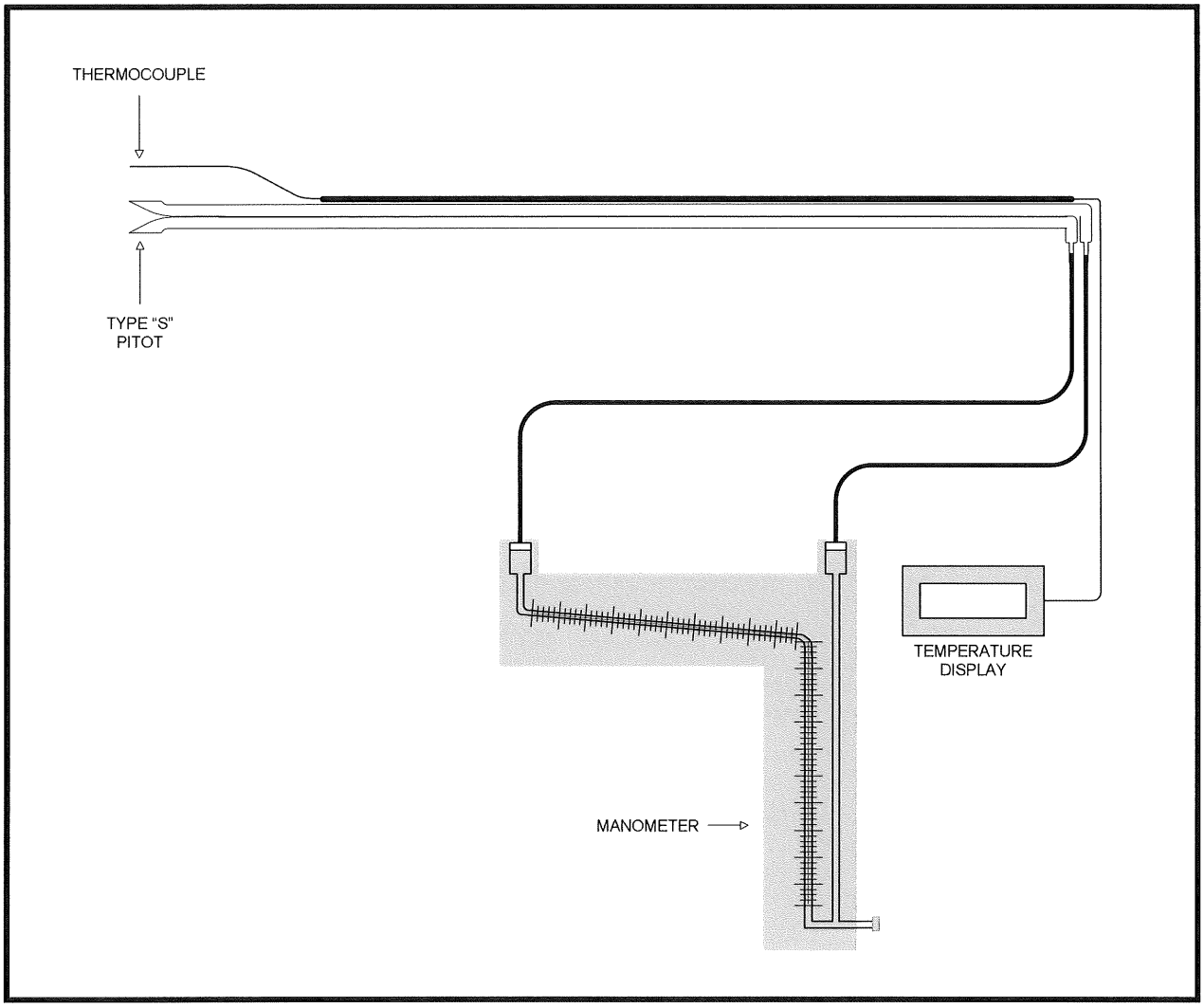
The sample port and traverse point locations are detailed in Appendix A.

4.1.2 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 4-1

FIGURE 4-1
US EPA METHOD 2 SAMPLING SYSTEM



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

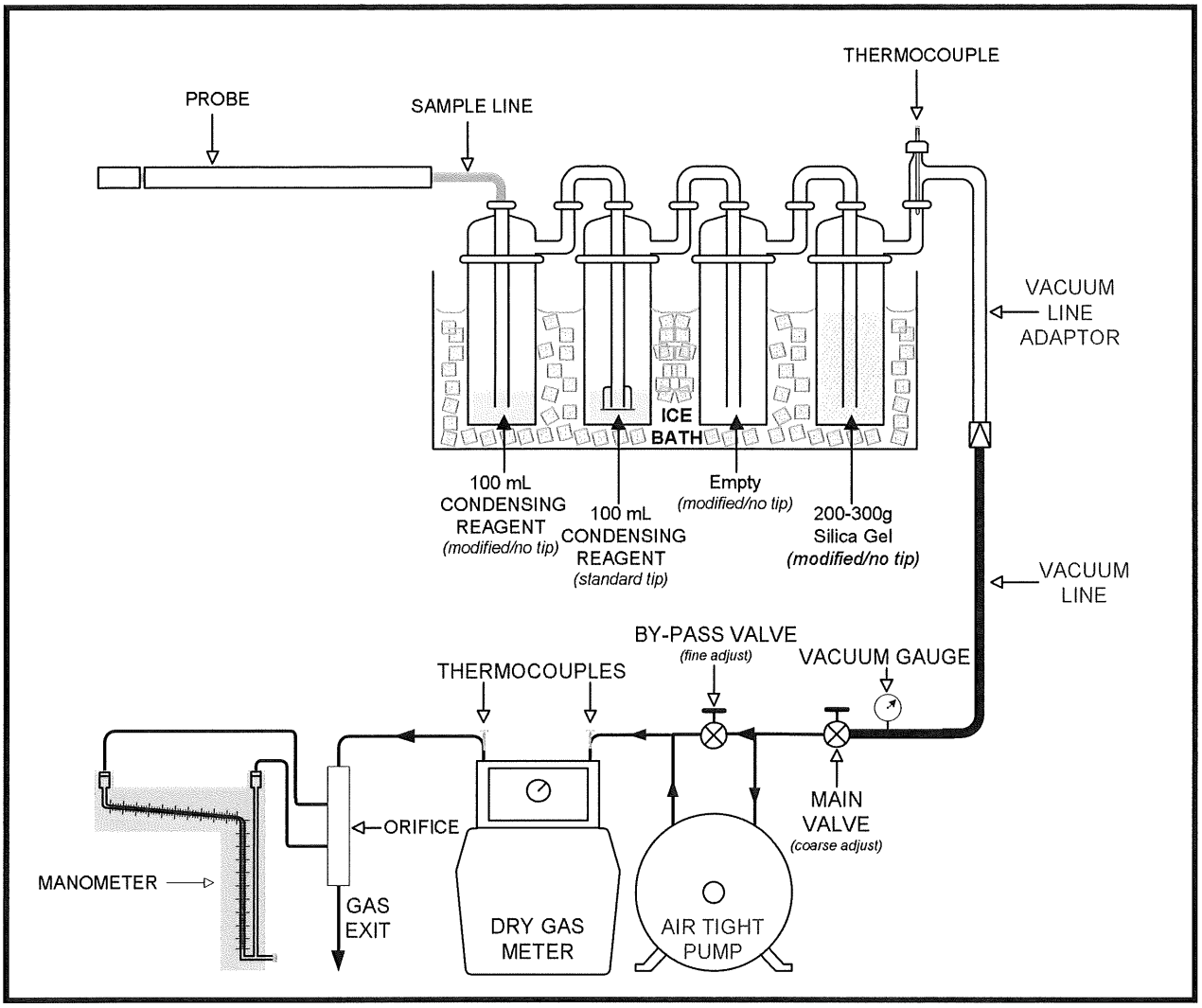
EPA Method 3 is used to calculate the dry molecular weight of the stack gas using one of three methods. The first choice is to measure the percent O_2 and CO_2 in the gas stream. A gas sample is extracted from a stack by one of the following methods: (1) single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analyzed for percent CO_2 and percent O_2 using either an Orsat or a Fyrite analyzer.

4.1.4 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.

The typical sampling system is detailed in Figure 4-2.

FIGURE 4-2
US EPA METHOD 4 (DETACHED) SAMPLING TRAIN



4.1.5 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). Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

The sampling system is detailed in Figures 4-3 (inlet sampling locations) and 4-4 (exhaust sampling locations).

FIGURE 4-3
EPA METHOD 25A SAMPLING TRAIN

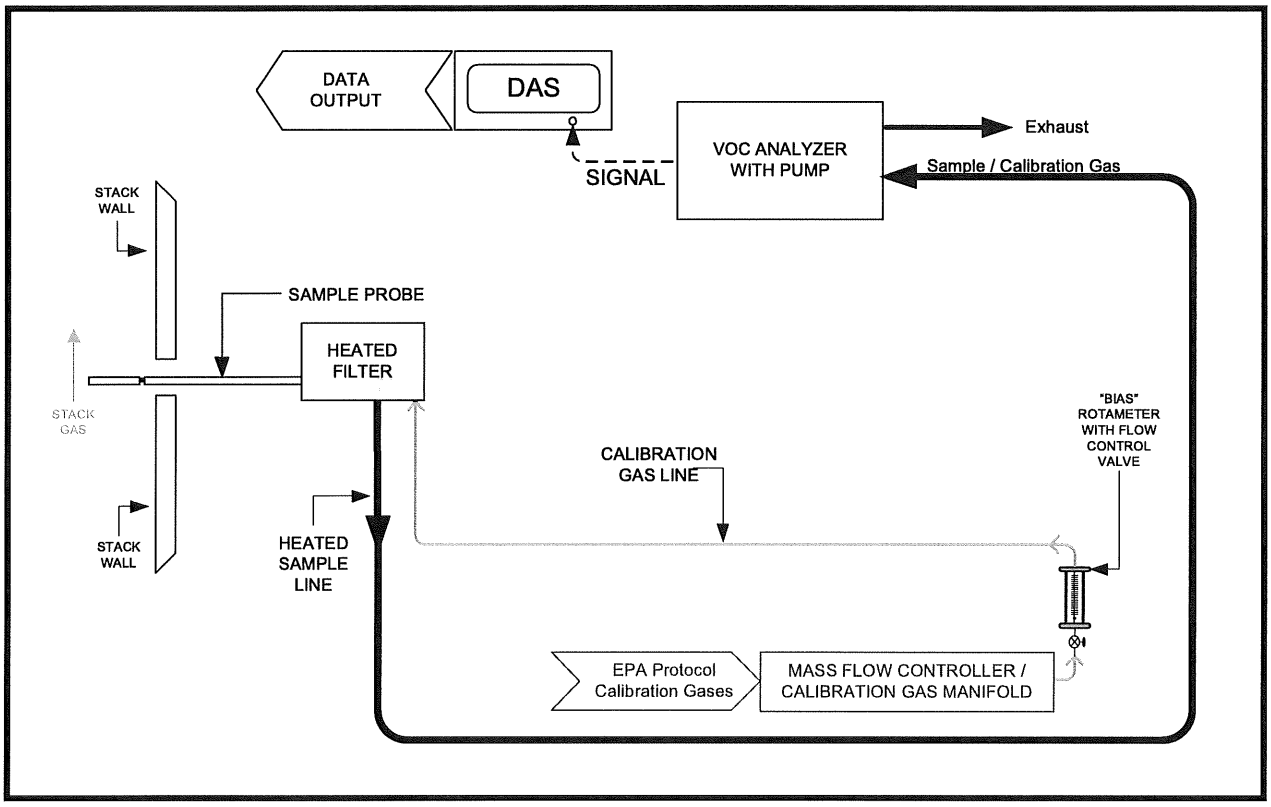
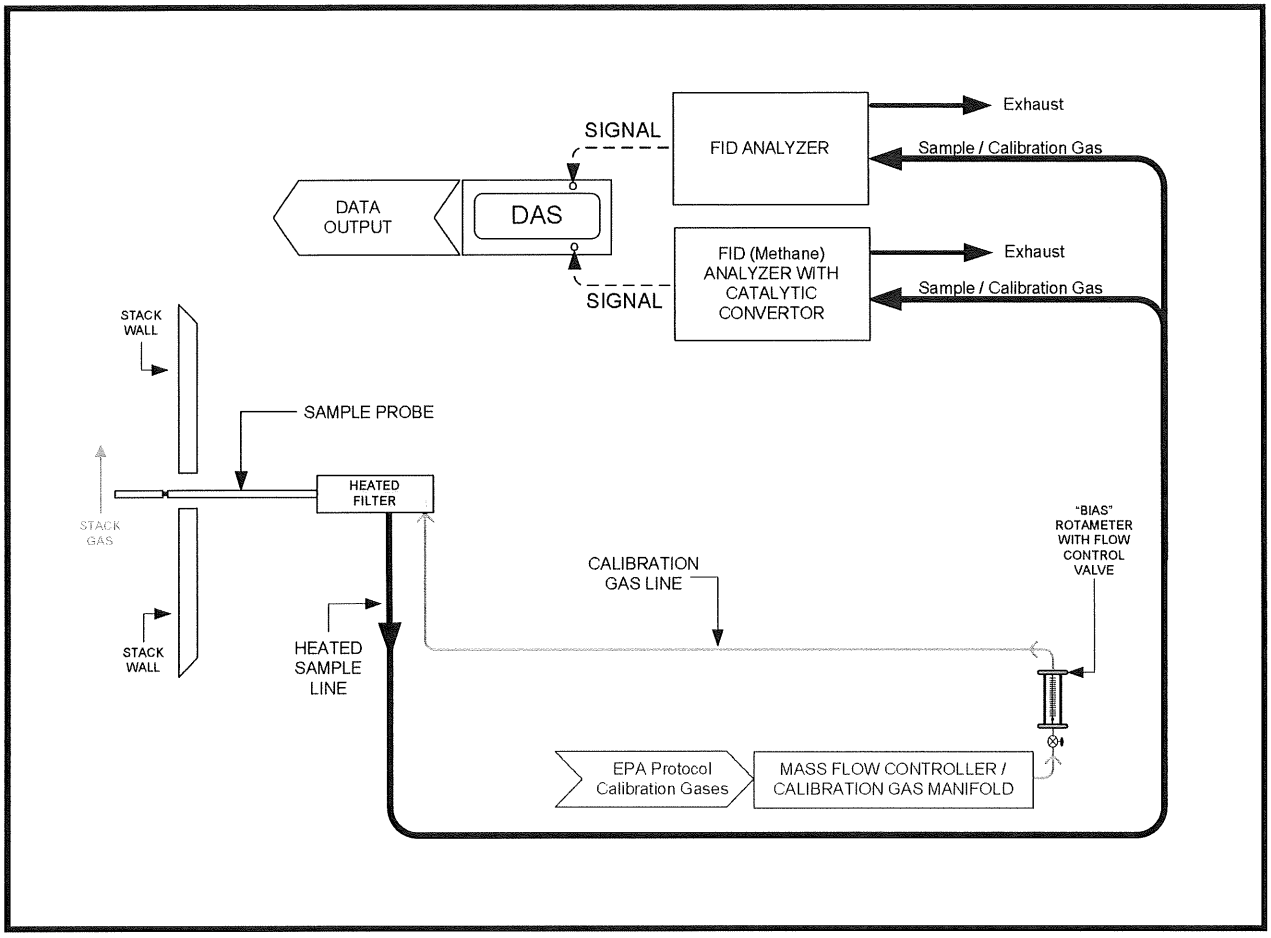


FIGURE 4-4
EPA METHOD 25A (TGO AND METHANE) SAMPLING TRAIN



4.2 FLUE GAS SAMPLING LOCATIONS

Information regarding the sampling locations is presented in Table 4-1.

TABLE 4-1
SAMPLING LOCATIONS

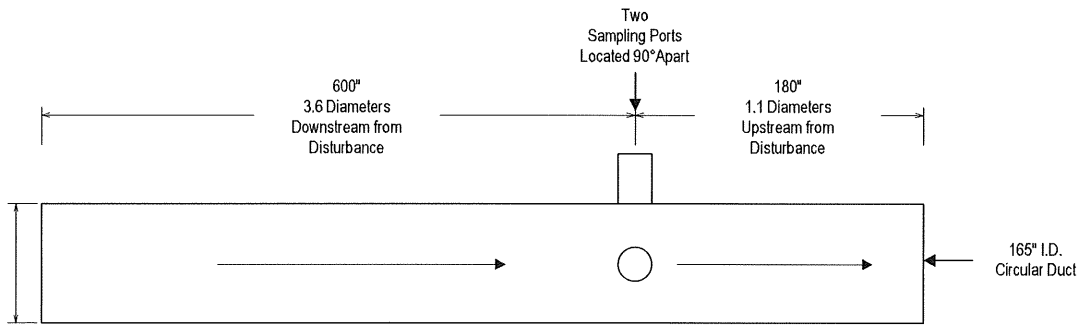
Sampling Location	Stack Inside Dimensions (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
RCO A Outlet Exhaust	107	360/3.4	960/9.0	Flow: 16 (8/port) Moisture and Gaseous: 1
RCO B Outlet Exhaust	107	360/3.4	960/9.0	Flow: 16 (8/port) Moisture and Gaseous: 1
RCO C Outlet Exhaust	107	360/3.4	960/9.0	Flow: 16 (8/port) Moisture and Gaseous: 1
RCO Inlet	168	600/4.6	180/1.1	Flow: 16 (8/port); Moisture and Gaseous: 1
RTO Inlet	49.5	228/4.6	240/4.8	Flow: 16 (8/port); Moisture and Gaseous: 1
RTO Outlet Exhaust	46x42 rectangular	174/4.0	84/1.9	Flow: 18 (6/port); Moisture and Gaseous: 1

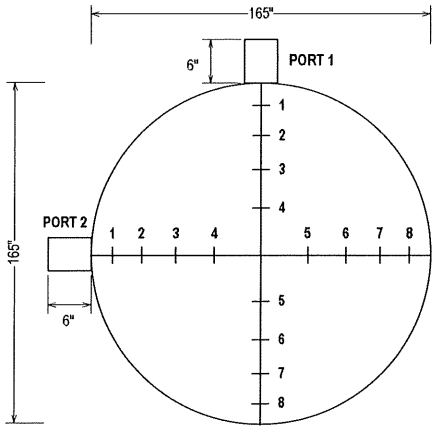
Sample locations were verified in the field to conform to EPA Method 1. Acceptable cyclonic flow conditions were confirmed prior to testing using EPA Method 1, Section 11.4. See Appendices A.1 and A. 2 for more information. The traverse point location drawings for each sampling location are located in Figures 4-5 through 4-10.

4.3 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.

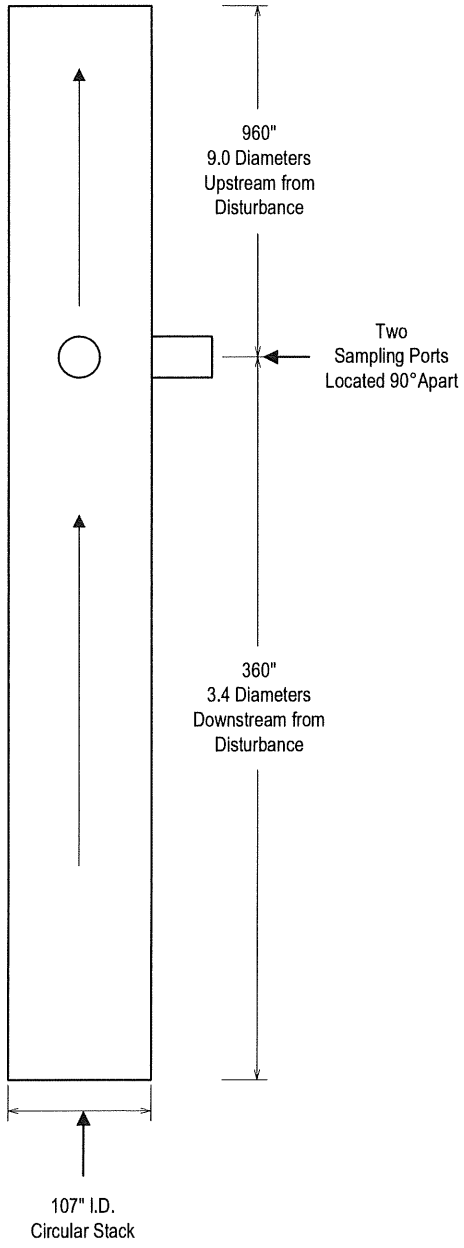
FIGURE 4-5
RCO A, B, AND C COMBINED INLET FLOW TRAVERSE

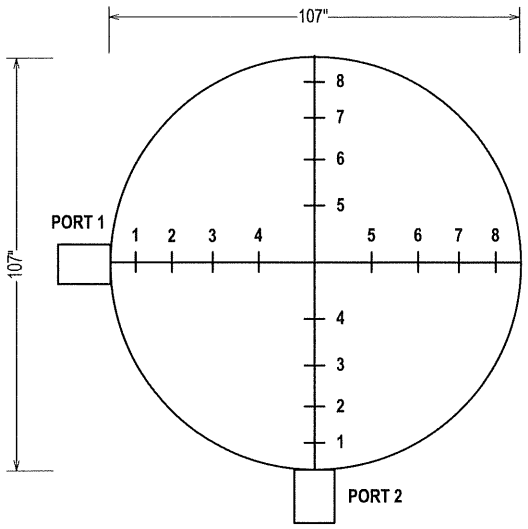




Point	% of Duct Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	3.2	5.4	5.4
2	10.5	17.6	17.6
3	19.4	32.6	32.6
4	32.3	54.3	54.3
5	67.7	113.7	113.7
6	80.6	135.4	135.4
7	89.5	150.4	150.4
8	96.8	162.6	162.6

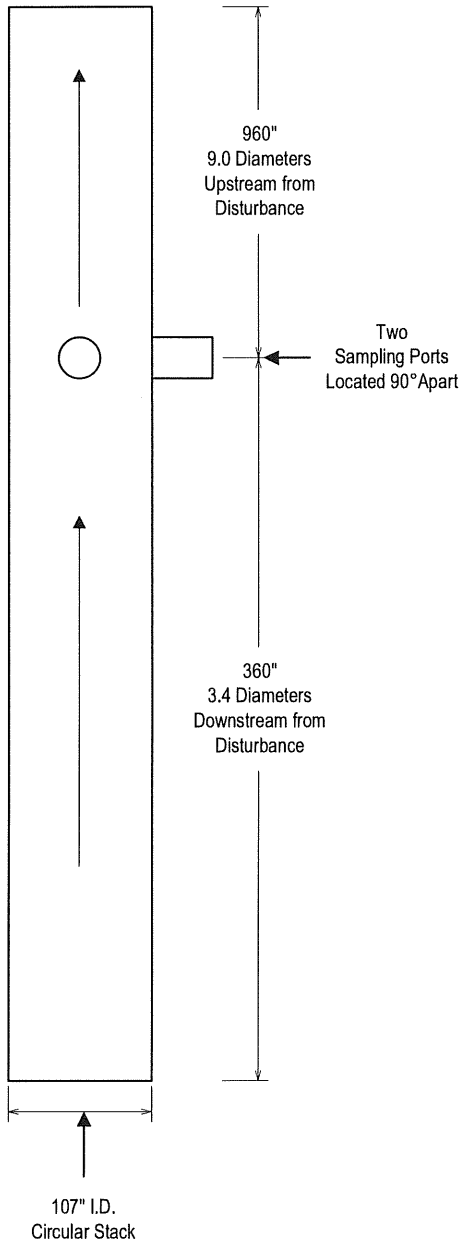
FIGURE 4-6
RCO A OUTLET EXHAUST FLOW TRAVERSE

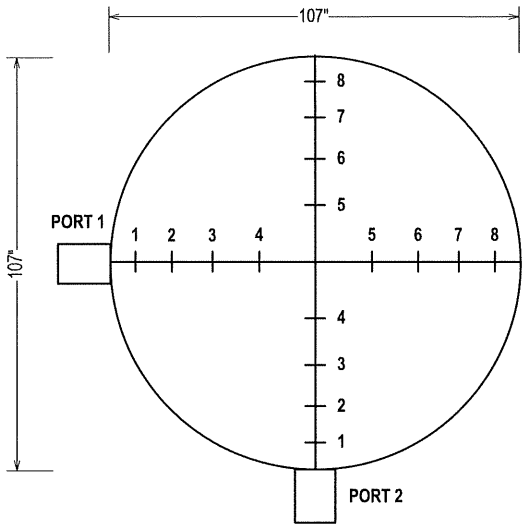




Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	3.2	3.4	3.4
2	10.5	11.2	11.2
3	19.4	20.8	20.8
4	32.3	34.6	34.6
5	67.7	72.4	72.4
6	80.6	86.2	86.2
7	89.5	95.8	95.8
8	96.8	103.6	103.6

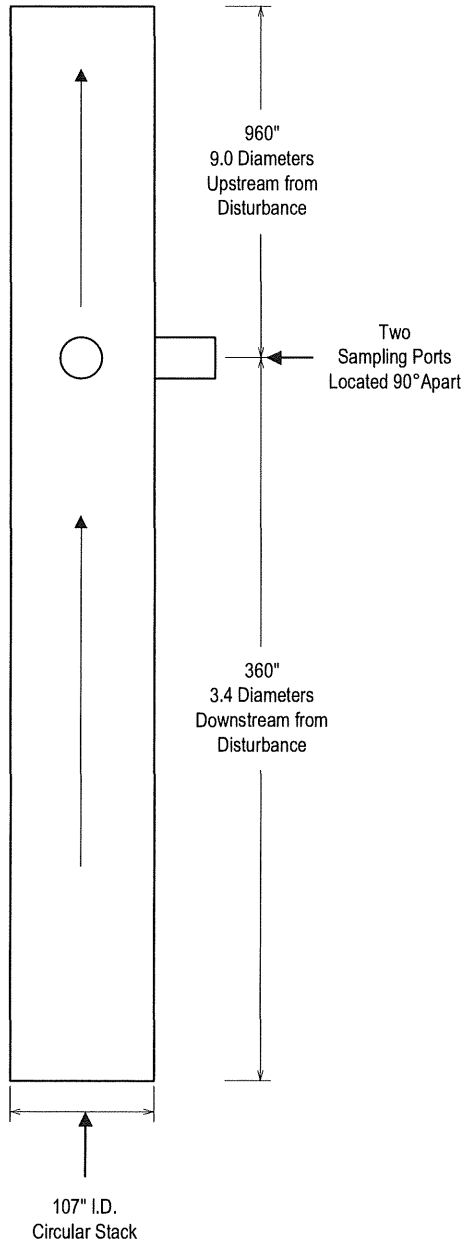
FIGURE 4-7
RCO B OUTLET EXHAUST FLOW TRAVERSE

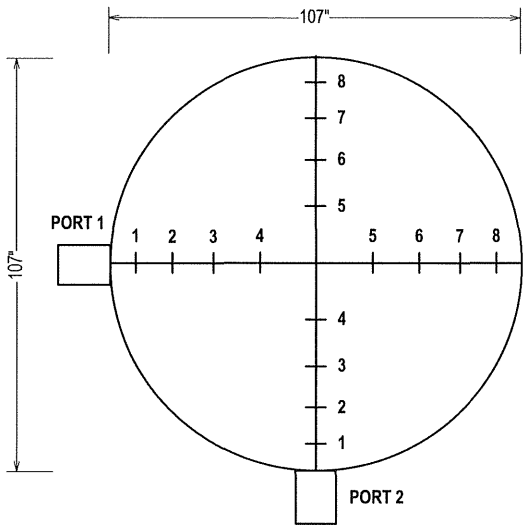




Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	3.2	3.4	3.4
2	10.5	11.2	11.2
3	19.4	20.8	20.8
4	32.3	34.6	34.6
5	67.7	72.4	72.4
6	80.6	86.2	86.2
7	89.5	95.8	95.8
8	96.8	103.6	103.6

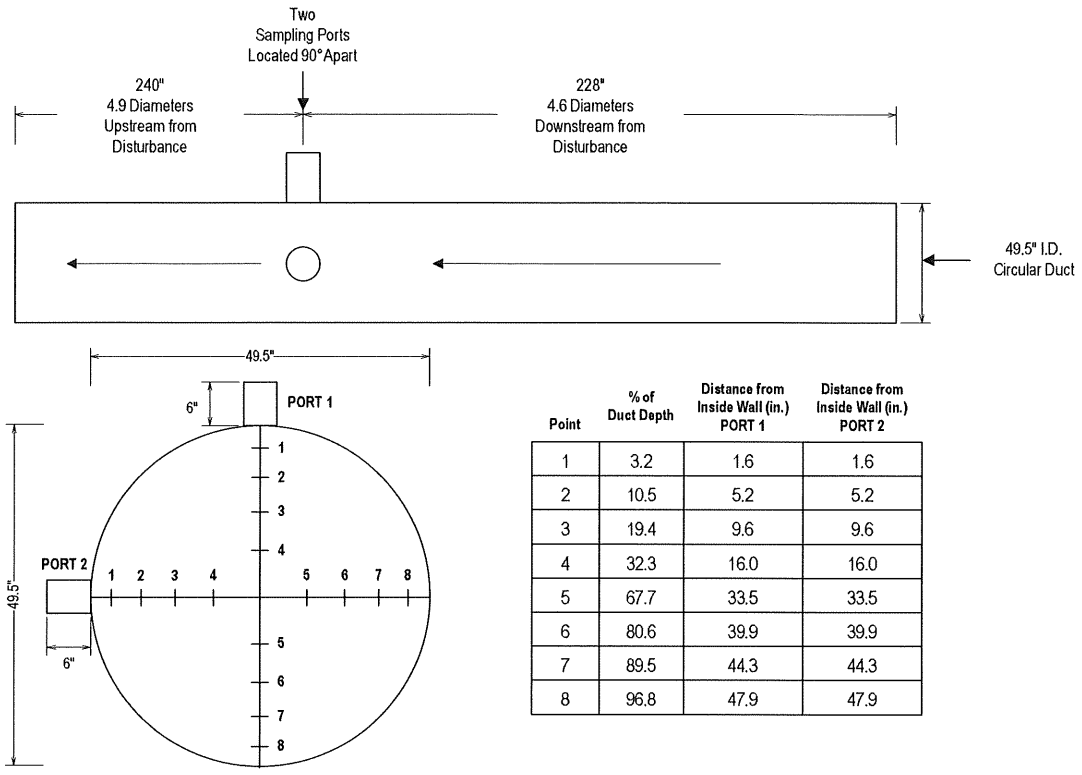
FIGURE 4-8
RCO C OUTLET EXHAUST FLOW TRAVERSE





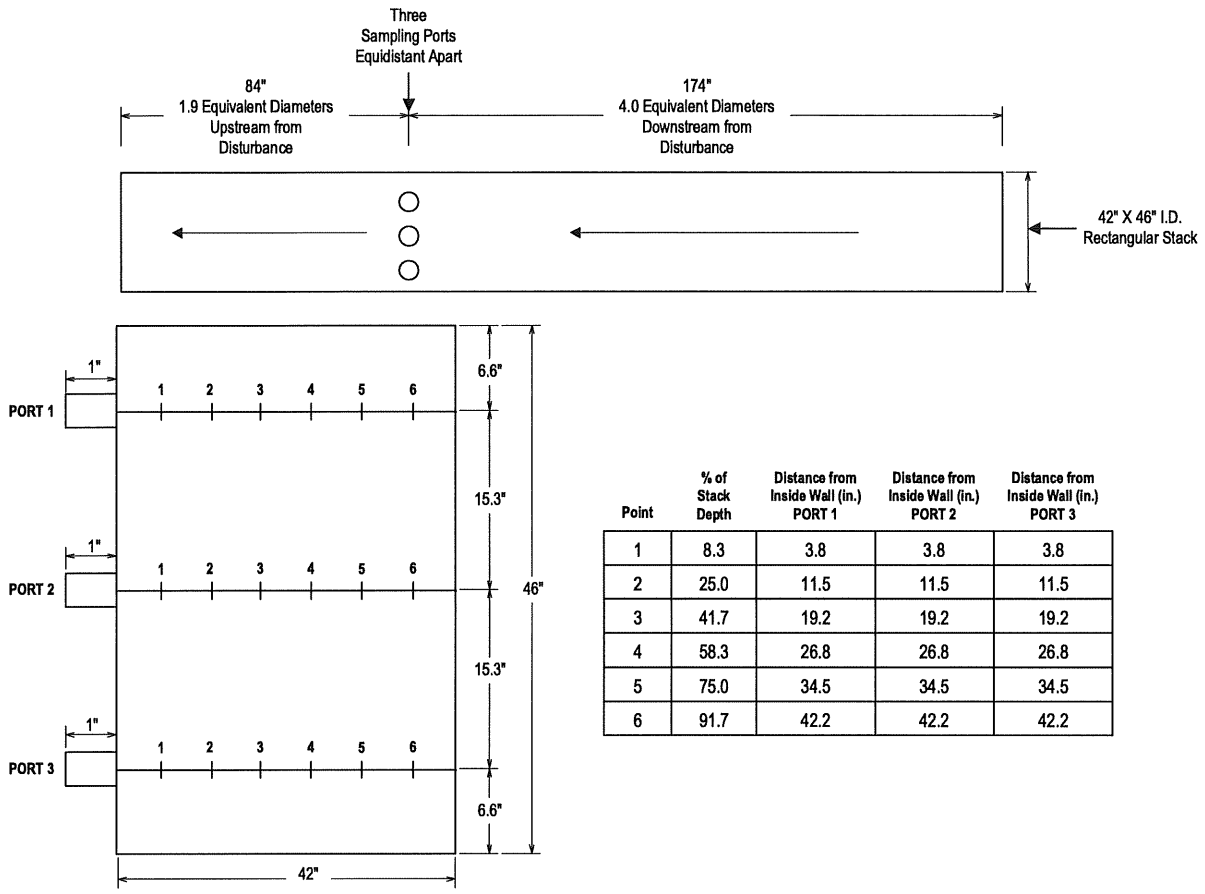
Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	3.2	3.4	3.4
2	10.5	11.2	11.2
3	19.4	20.8	20.8
4	32.3	34.6	34.6
5	67.7	72.4	72.4
6	80.6	86.2	86.2
7	89.5	95.8	95.8
8	96.8	103.6	103.6

FIGURE 4-9
RTO INLET FLOW TRAVERSE



Point	% of Duct Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	3.2	1.6	1.6
2	10.5	5.2	5.2
3	19.4	9.6	9.6
4	32.3	16.0	16.0
5	67.7	33.5	33.5
6	80.6	39.9	39.9
7	89.5	44.3	44.3
8	96.8	47.9	47.9

FIGURE 4-10
RTO OUTLET EXHAUST FLOW TRAVERSE



Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2	Distance from Inside Wall (in.) PORT 3
1	8.3	3.8	3.8	3.8
2	25.0	11.5	11.5	11.5
3	41.7	19.2	19.2	19.2
4	58.3	26.8	26.8	26.8
5	75.0	34.5	34.5	34.5
6	91.7	42.2	42.2	42.2

5.0 TEST DISCUSSION AND RESULTS

5.1 FIELD TEST DEVIATIONS AND EXCEPTIONS

No field deviations or exceptions from the test plan or test methods occurred during this test program.

5.2 PRESENTATION OF RESULTS

The average results are compared to the permit limits in Tables 2-1. The results of individual compliance test runs performed are presented in Tables 5-1 through 5-7. 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.

At the RCO Combined Inlet a dry molecular weight of 29.0 g/g-mole was applied each concentration run (EPA Method 2, Section 8.6) since the processes were considered to emit essentially air.

The moisture content of the gas stream at the RCO Combined Inlet was measured utilizing the wet-bulb/dry-bulb approximation method (EPA Method 4 Section 2.2.1) and applied to all concentration runs at this location.

A single, 30-minute, moisture run at the EU-Ecoat (excluding curing oven)/EU-Guidecoat (excluding curing oven) RCO A, B, and C Outlet Exhausts, RTO Inlet, and RTO Outlet Exhaust and was applied to all concentrations runs at these locations.

TABLE 5-1
RCO/RTO VOC EMISSIONS AND DE RESULTS

Run Number	1	2	3	Average
RCO COMBINED Inlet VOC (TGO), as propane				
lb/hr	162	146	135	148
RCO A Outlet Exhaust VOC (TGNMO), as propane				
lb/hr	3.90	2.02	2.43	2.79
RCO B Outlet Exhaust VOC (TGNMO), as propane				
lb/hr	2.33	1.52	2.40	2.08
RCO C Outlet Exhaust VOC (TGNMO), as propane*				
lb/hr	5.49	5.30	5.11	5.30
RCO VOC (TGO/TGNMO) Destruction Efficiency				
%	92.8	94.0	92.6	93.1
RCO A, B, and C Outlet Exhaust TGNMO Flow Weighted Average, as propane				
ppmvw	5.09	4.05	4.54	4.56
RTO Inlet VOC (TGO), as propane				
lb/hr	30.4	28.4	29.2	29.4
RTO Outlet Exhaust VOC (TGO), as propane				
lb/hr	1.42	1.63	1.49	1.52
RTO VOC (TGO) Destruction Efficiency				
%	95.3	94.3	94.9	94.8
Overall (TGO/TGNMO) Destruction Efficiency				
%	93.2	94.0	93.0	93.4

* Corrected for RTO Exhaust Emissions.

TABLE 5-2
VOC EMISSIONS RESULTS -
RCO A OUTLET EXHAUST

Run Number	1	2	3	Average
Date	09/23/2020	09/23/2020	09/23/2020	--
Time	08:12-09:12	09:40-10:40	12:05-13:05	--
Flue Gas Parameters				
O_2, % volume dry	21	21	21	21
CO_2, % volume dry	0	0	0	0
flue gas temperature, °F	156	160	167	161
moisture content, % volume	2.37	2.37	2.37	2.37
volumetric flow rate, scfm	117,543	115,203	106,730	113,159
TGO, as Propane				
ppmvw	34.8	35.1	34.3	34.7
Methane, as Propane				
ppmvw	30.0	32.5	31.0	31.2
VOC (TGNMO), as propane				
ppmvw	4.83	2.56	3.32	3.57
lb/hr	3.90	2.02	2.43	2.79

TABLE 5-3
VOC EMISSIONS RESULTS -
RCO B OUTLET EXHAUST

Run Number	1	2	3	Average
Date	09/23/2020	09/23/2020	09/23/2020	--
Time	08:12-09:12	09:40-10:40	12:05-13:05	--
Flue Gas Parameters				
O_2, % volume dry	21	21	21	21
CO_2, % volume dry	0	0	0	0
flue gas temperature, °F	160	164	170	165
moisture content, % volume	1.76	1.76	1.76	1.76
volumetric flow rate, scfm	113,124	116,511	114,014	114,550
TGO, as propane				
ppmvw	5.68	4.67	5.50	5.28
Methane, as Propane				
ppmvw	2.69	2.78	2.43	2.63
VOC (TGNMO), as propane				
ppmvw	3.00	1.89	3.06	2.65
lb/hr	2.33	1.52	2.40	2.08

TABLE 5-4
VOC EMISSIONS RESULTS -
RCO C OUTLET EXHAUST

Run Number	1	2	3	Average
Date	09/23/2020	09/23/2020	09/23/2020	--
Time	08:12-09:12	09:40-10:40	12:05-13:05	--
Flue Gas Parameters				
O_2, % volume dry	21	21	21	21
CO_2, % volume dry	0	0	0	0
flue gas temperature, °F	167	169	179	172
moisture content, % volume	3.21	3.21	3.21	3.21
volumetric flow rate, scfm	145,670	145,400	146,174	145,748
TGO, as propane				
ppmvw	9.07	8.95	8.63	8.88
Methane, as propane				
ppmvw	2.15	2.00	2.05	2.07
VOC (TGNMO), as propane				
ppmvw	6.917	6.947	6.578	6.814
lb/hr	6.919	6.936	6.603	6.819

TABLE 5-5
VOC EMISSIONS RESULTS -
RCO COMBINED INLET

Run Number	1	2	3	Average
Date	09/23/2020	09/23/2020	09/23/2020	--
Time	08:12-09:12	09:41-10:41	12:05-13:05	--
Flue Gas Parameters				
flue gas temperature, °F	72.3	73.9	81.9	76.0
moisture content, % volume	1.42	1.65	2.03	1.70
volumetric flow rate, scfm	338,140	330,133	329,704	332,659
VOC (TGO), as propane				
ppmvw	69.8	64.6	59.4	64.6
lb/hr	162	146	135	148

TABLE 5-6
VOC EMISSIONS RESULTS -
RTO INLET

Run Number	1	2	3	Average
Date	09/23/2020	09/23/2020	09/23/2020	--
Time	08:12-09:12	09:40-10:40	12:05-13:05	--
Flue Gas Parameters				
O_2, % volume dry	21	21	21	21
CO_2, % volume dry	0	0	0	0
flue gas temperature, °F	231	227	224	227
moisture content, % volume	2.98	2.99	2.99	2.99
volumetric flow rate, scfm	26,240	27,107	26,774	26,707
VOC (TGO), as propane				
ppmvw	169	153	159	160
lb/hr	30.4	28.4	29.2	29.4

TABLE 5-7
VOC EMISSIONS RESULTS -
RTO OUTLET EXHAUST

Run Number	1	2	3	Average
Date	09/23/2020	09/23/2020	09/23/2020	--
Time	08:12-09:12	09:40-10:40	12:05-13:05	--
Flue Gas Parameters				
O_2, % volume dry	20	20	20	20
CO_2, % volume dry	1	1	1	1
flue gas temperature, °F	333	330	341	335
moisture content, % volume	3.00	3.00	3.00	3.00
volumetric flow rate, scfm	29,279	29,385	28,953	29,206
VOC (TGO), as propane				
ppmvw	7.09	8.09	7.49	7.56
lb/hr	1.42	1.63	1.49	1.52

5.3 QA/QC AUDITS

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

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.

5.4 QA/QC DISCUSSION

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

5.5 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 D7036-04 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).