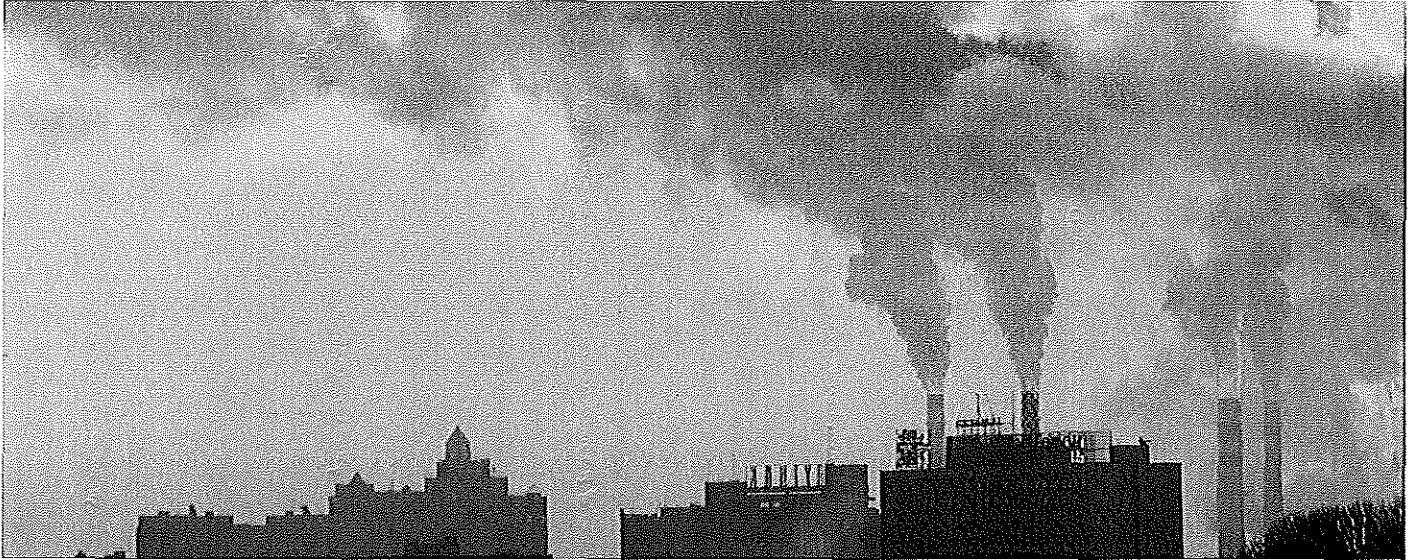




**CONESTOGA-ROVERS
& ASSOCIATES**

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**REGENERATIVE THERMAL OXIDIZER DESTRUCTION
EFFICIENCY RE-TEST REPORT**

AAR Mobility Systems
Cadillac, Michigan

RECEIVED

JUN 09 2014

AIR QUALITY DIV.

Conestoga-Rovers & Associates
2055 Niagara Falls Boulevard, Suite 3
Niagara Falls, New York 14304

April 1, 2014 • 081370-04 • Report No. 4



Executive Summary

CRA performed an emission test program at AAR Mobility Systems (AAR) on the regenerative thermal oxidizer (RTO) that controls volatile organic compound (VOC) emissions from various sources at their facility. The first test program was performed on August 21 and 22, 2013. The results showed that the RTO did not meet their permit limit of 95.0 percent destruction efficiency (DE). The average DE for the August 2013 testing resulted in a DE of 89.7 percent. After repairs performed by AAR and RTO vendors, the test program was repeated the week of February 10, 2014. While the results still did not meet the permit limit of 95 percent DE the improvement was good, and additional minor adjustments were made to improve the operation of the RTO. The testing was then repeated on February 18, 2014 and the results showed that the DE of the RTO was now above the permit limit. The results are summarized and compared to the permit limit in the table below.

<i>Parameter</i>	<i>Average Result</i>	<i>Permit Limit</i>
<i>DE</i>	<i>96.3%</i>	<i>95.0%</i>

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Section 1.0 Introduction

1.1 Project Overview

AAR Mobility Systems (AAR) contracted with Conestoga-Rovers & Associates, Inc. (CRA) to conduct a destruction efficiency test program at their Cadillac, Michigan facility. The purpose of this test program was to verify the destruction efficiency (DE) of the Regenerative Thermal Oxidizer (RTO) used to control emissions from the FGCOATINGS. The FGCOATINGS flexible group encompasses multiple process lines. These processes include: EU197LINE, EUCONTAINERLINE, EUBALSACORE, and EUSKINORRAIL. The exhausts of these processes are directed to the RTO. This test is being conducted to satisfy requirements of the facility's renewable operating permit (ROP) # MI-ROP-B4197-2011. Capture efficiency (CE) determinations were made prior to the emissions test to verify that the processes meet the requirements of RM 204 as permanent total enclosures (PTE). These data are presented under a separate cover.

1.2 Test Program Organization

The primary contacts for this project are as follows:

AAR's contact is:

Mr. Greg Shay
Environmental Specialist
AAR Mobility Systems
201 Haynes Street
Cadillac, MI 49601
Phone: (231) 779-6372

CRA's Project Manager is:

Mr. Peter Romzick
Conestoga-Rovers & Associates, Inc.
14496 N. Sheldon Road, Suite 200
Plymouth, MI 48170
Phone: (734) 453-5123

CRA's Project Coordinator is:

Mr. Steven Culmo
Conestoga-Rovers & Associates, Inc.
2055 Niagara Falls Boulevard
Niagara Falls, NY 14304
Office Phone: (716) 297-6150
Cell Phone: (716) 583-9625

AAR staff coordinated the plant's operations, collected process information and provided CRA with process data. CRA was responsible for all field measurements related to the determination of the mass of VOC in the gas stream and the destruction efficiency of the RTO. The testing was performed on February 18, 2014 by Mr. Steven Culmo, and Mr. James Balmer of CRA. The testing was witnessed by Mr. Robert Dickman of the Michigan Department of Environmental Quality (MDEQ).

1.3 Test Plan

The objective of this test program was to determine the volatile organic compound (VOC) DE of the RTO associated with FGCOATINGS flexible group.

DE is the difference between the mass of VOC entering the RTO and the mass of VOC in the RTO exhaust. VOC emission rates were determined from the VOC concentration measurements and the gas volumetric flow rates. Measurements were made at the two RTO inlets and one RTO exhaust. The VOC mass is expressed as propane for each of three 1-hour test runs.

Testing was conducted according to United States Environmental Protection Agency (USEPA) Methods (RM) outlined in Title 40 of the Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A and 40 CFR 51 Appendix M. A summary of the test program is presented in Table 1.1.

Section 2.0 Sampling and Analytical Procedures

This section provides a brief overview of the specific test methods that were used to determine the mass of VOC destructed. Details of each method are given in the following sections.

2.1 Stack Gas Velocity and Volumetric Flow Rate (RM2)

The gas velocity in each duct was determined according to the procedures provided in RM 2. The average velocity head was determined using an inclined manometer and a type-S pitot tube

with a pitot coefficient of 0.84. Exhaust gas temperature was measured at each traverse point using a type-K thermocouple. Static pressure was determined using a straight tap and an inclined manometer. One complete velocity traverse was conducted at each test location during each test run. Cyclonic flow checks were performed at each location. The results were all found to be acceptable and are presented in Appendix A.

The combined inlet from the EU197LINE, EUCONTAINERLINE, EUBALSACORE processes is a horizontal round duct with an inside diameter of 47.5 inches. There are two sample ports installed 90 degrees to each other. The test ports are located 420 inches (8.8 duct diameters) downstream and 31 inches (0.65 duct diameters) upstream from a flow disturbance. Eight traverse points per port were measured for a total of 16 traverse points. Figure 2.1 is a diagram of the sampling location and traverse point layout.

The inlet from the EUSKINORRAIL process is a horizontal round duct with an inside diameter of 27.75 inches. There are two sample ports installed 90 degrees to each other. The test ports are located 360 inches (13.0 duct diameters) downstream and 140 inches (5.0 duct diameters) upstream from a flow disturbance. Four traverse points per port were measured for a total of eight traverse points. Figure 2.2 is a diagram of the sampling location and traverse point layout.

The RTO outlet is a vertical round duct with an inside diameter of 65.63 inches. There are two sample ports installed 90 degrees to each other. The test ports are located 186 inches (2.8 duct diameters) downstream and 96 inches (1.5 duct diameters) upstream from a flow disturbance. Eight traverse points per port were measured for a total of 16 traverse points. Figure 2.3 is a diagram of the sampling location and traverse point layout.

One flow rate determination was made at each location during each sample run. Field data sheets are included in Appendix A.

2.2 Gas Analysis for CO₂ and O₂ (RM3)

The concentrations of oxygen and carbon dioxide were measured on a dry basis according to the procedures provided in RM 3. O₂ and CO₂ concentrations were used to determine the molecular weight of each gas stream in the volumetric flow rate calculations. Grab samples were analyzed periodically throughout each test run for O₂ and CO₂ with a Fyrite gas analyzer. The gas concentrations were entered directly into the flow calculation spreadsheets.

2.3 Moisture Determination (RM4)

The moisture content of each gas stream was determined according to a modified RM 4 procedure. Single-point sampling of the gas stream through an impinger sampling train was

used to collect moisture from a measured volume of exhaust gas. One RM 4 run was completed at each test location. Field data sheets are included in Appendix A.

2.4 VOC Concentration (RM 25A Modified)

The VOC concentrations were measured at both inlet test sites using JUM Model VE-7 Flame Ionization Analyzers. The concentration was measured at the outlet site using a JUM Model 109A Total Non-Methane Hydrocarbon Analyzer. The Method 25A sampling train consisted of a probe, a heated filter with calibration gas port and several lengths of heated Teflon® sample line. The sample line was heated to >275° F. One-minute average concentration data was collected using a PC-based data acquisition system (DAS).

The EUSKINORRAIL was calibrated on the 0 – 2,500 ppm range. The combined inlet was calibrated on the range of 0-1000 ppm, and the RTO outlet was calibrated on the range of 0-100 ppm. Calibration of the analyzers was performed using EPA Protocol No. 1 gas mixtures of propane in air and methane in air according to RM 25A. Calibration points were at 0, 25 to 35 percent, 45 to 55 percent, and 80 to 90 percent of span. Individual gas concentrations were produced with an Environics Model 4040 gas dilution system. The operation of the Environics was verified in the field following procedures in RM 205 and the results are included in Appendix B.

Section 3.0 Quality Assurance and Quality Control

The test program was designed and implemented with emphasis on completeness and data quality. Comprehensive QA/QC is built into CRA's program to ensure data collection is of known precision and accuracy and is complete, representative, and comparable. Data comparability is achieved by the use of standard units of measure as specified by the test methods.

3.1 Equipment and Sampling Preparation

Sampling equipment is cleaned and functions are checked and calibrated prior to use in the field. Each parameter sampling method requires specific cleaning methods of the glassware, train components, and recovery containers. These materials are then sealed prior to shipment to the field.

The QA/QC procedures for sampling operations include performing leak checks before and after each sample run. These are performed on all train components including vacuum sample

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trains, pitot lines, and gas sample bag systems. If pre-test leak checks do not meet the criteria, the trains are adjusted to do so. Post-test leak checks are mandatory, performed, and recorded on field data sheets.

3.2 Leak Checks

3.2.1 Moisture Trains

Both pre- and post-run leak checks were conducted. A pre-test leak check was performed to verify integrity of the vacuum system. The leak check was conducted in accordance with the procedures outlined in RM 5, Section 8.4. If the leakage rate is found to be no greater than 0.02 cubic feet per minute (cfm), the results are acceptable and no correction is applied to the total volume of dry gas metered. All leak checks were acceptable.

3.2.2 Pitot Leak Checks

The pitot tubes used during the test program are leak checked prior to the test series and following each traverse set. The leak check was performed according to RM 2 Section 8.1 by placing flexible tubing over one side of the pitot tube tip. The tubing was pinched off when the pitot is pressurized to greater than 3 inches of water. No loss of pressure for 15 seconds indicates a successful leak check. This procedure is repeated for the other side of the pitot tube as well. All pitot leak checks were acceptable.

3.3 Calibrations

All Field and post-test calibrations are summarized in Table 3.1 and are included in Appendix B.

3.3.1 Meter Box Calibration

Following the procedures outlined in EPA Method 5, Section 10.3.2, a standard dry gas meter is substituted for a wet test meter per EPA Method 5, Section 16.1. Primarily, the meter calibration factors (Y and $\Delta H@$) are determined at multipoint calibration runs at a variety of flow rates. Factors calculated at the individual runs must agree within 2 percent of each other. The factors are then averaged and that average is posted on the meter box.

After each sampling run calculations from Alternative Method 5 Post-Test Calibration (ALT-009) are performed. If the average Y_{qa} is within 5 percent of the posted Y the post-test calibration is acceptable.

3.3.2 Pitot Calibration

Pitot tubes are calibrated following the procedures outlined in EPA Method 2, Section 10.1. Pitot tubes were given a baseline coefficient when they meet certain geometrically measured angles and dimensions as set forth in the method.

3.3.3 Thermocouple Calibration

Thermocouples are calibrated according to the *Approved Alternative Method (ALT-011), Alternative Method 2 Thermocouple Calibration Procedure*. This alternative method utilizes single-point calibration procedure at room temperature.

3.3.4 Barometer Calibration

Prior to field use, CRA's barometer is compared to the National Weather Service's (NWS) barometer located at the Niagara Falls International Airport. If the CRA barometer disagrees by more than ± 2.3 mm (0.1 in.) of Hg from the barometer located at the airport, the CRA barometer is adjusted until it agrees with the NWS barometer. CRA and the NWS elevations are within ten feet of each other, thus eliminating the need for any elevation correction.

When in the field, barometer readings are taken from the CRA barometer. At the conclusion of fieldwork, the barometer is brought back, checked against the NWS barometer, and corrected if necessary. Readings taken in the field are corrected based on the degree of error between the CRA barometer and the NWS barometer.

3.4 CEMS Sampling Performance Specifications

3.4.1 Calibration Error Test

The CE tests were accomplished following the procedures outlined in RM 25A, by first introducing the zero calibration gas and adjusting the instrument to read zero. Next, the high span gas was introduced, and the analyzer's response was adjusted to match this calibration gas certified concentration. Next, the mid and low calibration gases were introduced, and the analyzer's response must be within +/-5 percent of the target gas.

3.4.2 System Response Time

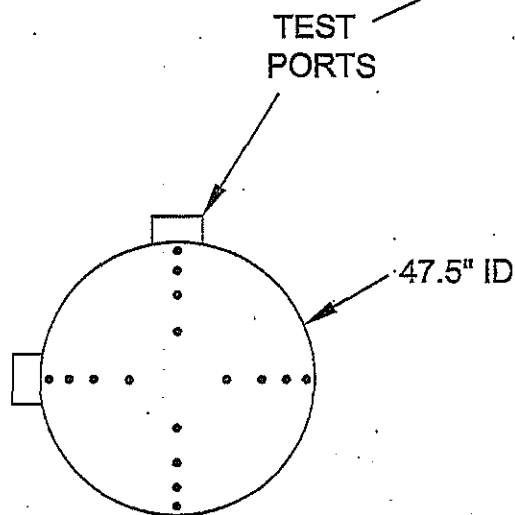
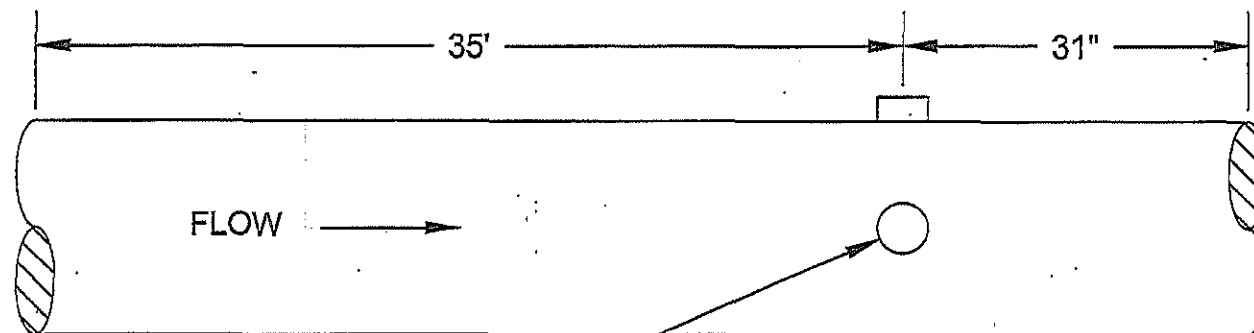
The system response time was initially checked during the site set-up activities according to RM 25A. These data are included in Appendix A with the field data sheets.

3.4.3 Post Test Calibration and Drift Check

A drift check was performed following the procedures outlined in RM 204B, Section 7.2. Immediately following the test period and hourly during the test, the zero gas was introduced into the system and the monitor's response recorded. The response did not vary (drift from) from the previous hourly calibration value by more than 3 percent of span. This procedure was repeated for the calibration gas that most closely approximates the concentration of the captured emissions.

Section 4.0 Results

The results of the testing are presented in Tables 4.1 and 4.2.

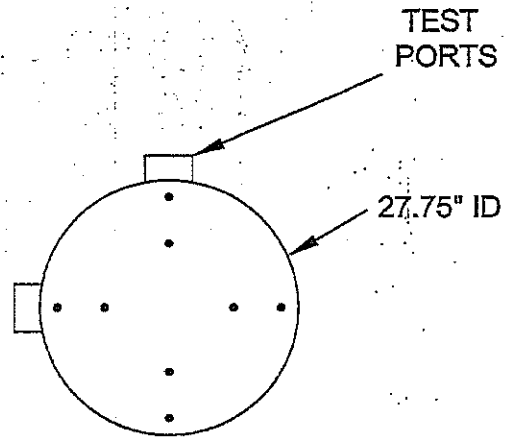
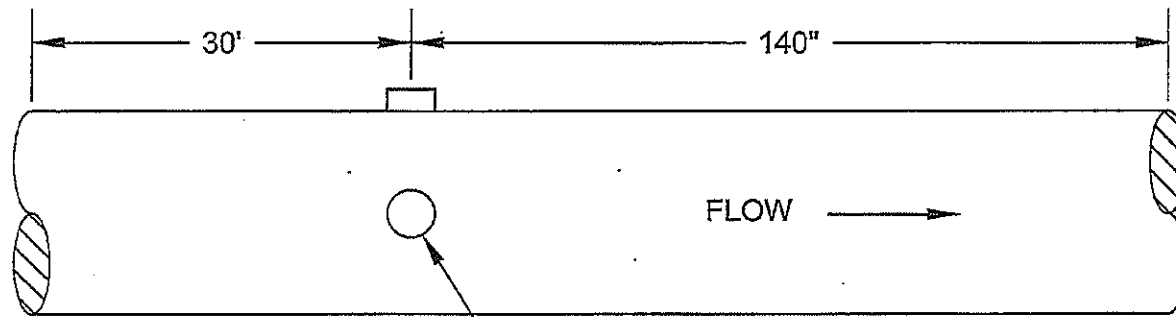


STACK TEST PORT
CROSS SECTION

TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	1.52
2	4.99
3	9.22
4	15.34
5	32.16
6	38.29
7	42.51
8	45.98

figure 2.1
COMBINED EXHAUST
SAMPLING LOCATION
AAR
Cadillac, Michigan





TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	1.88
2	7.00
3	20.88
4	25.88

STACK TEST PORT CROSS SECTION

figure 2.2
 EUSKINORRAIL EXHAUST
 SAMPLING LOCATION
 AAR
 Cadillac, Michigan



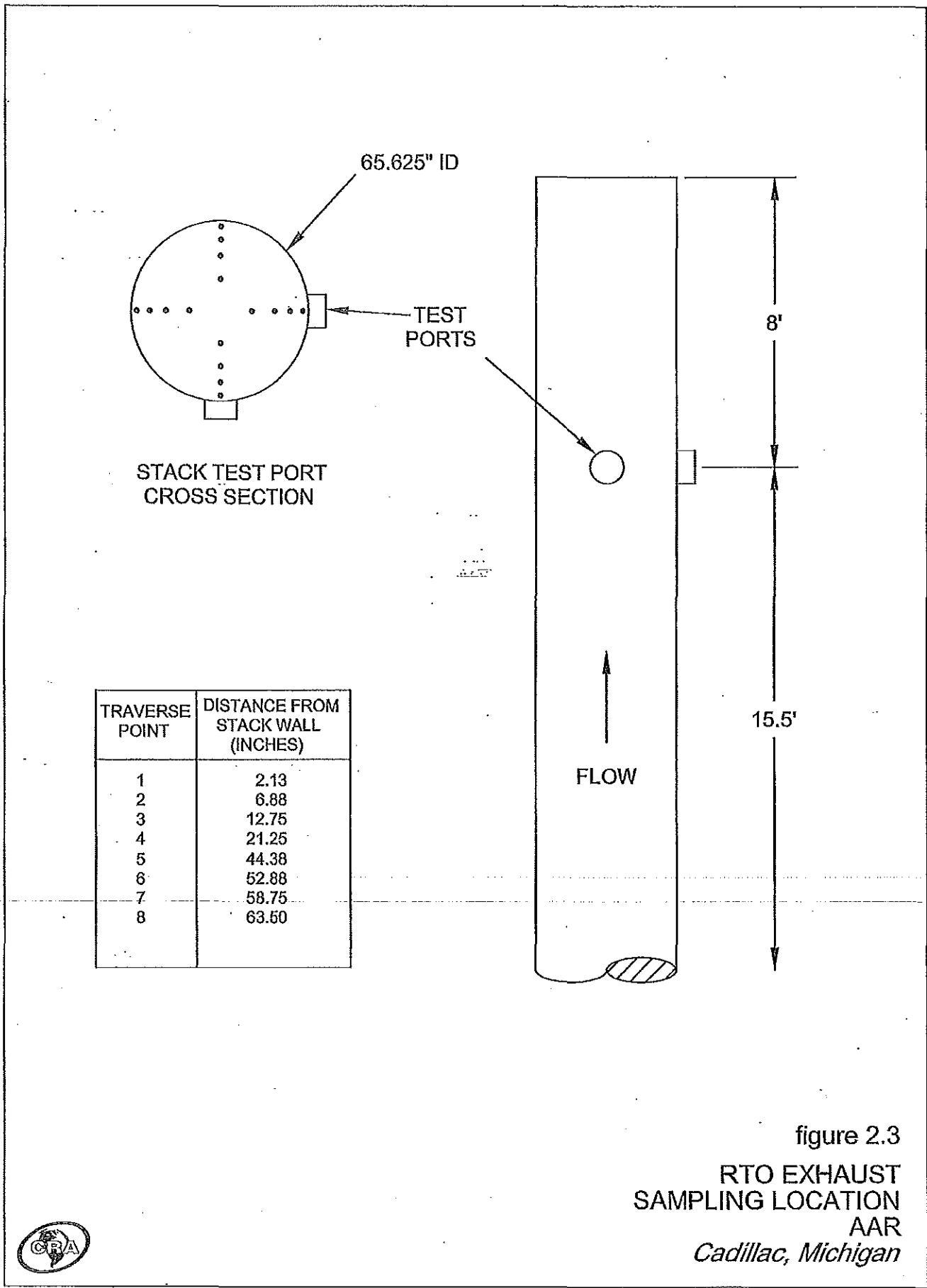


TABLE 1.1

**DESTRUCTION EFFICIENCY TEST SUMMARY
AAR MOBILITY SYSTEMS
CADILLAC, MICHIGAN**

<i>Parameter</i>	<i>Test Method</i>	<i>Location</i>	<i>No. of Test Runs</i>	<i>Run Duration</i>	<i>Comments</i>
Gas Flow Rate	RM 1&2	Inlets/Outlet	3	N/A	One determination per test run
Gas Molecular Weight	RM 3	Inlets/Outlet	N/A	Grab	One determination per test run
Moisture	RM 4	Inlets/Outlet	1	35 minutes	Minimum sample 21scf, one determination at each location
Destruction Efficiency	RM 25A	Inlets/Outlet	3	60 minutes	
Calibration Gas	RM 205	N/A	N/A	N/A	Calibration gas dilution

TABLE 3.1
EQUIPMENT CALIBRATION SUMMARY
DESTRUCTION EFFICIENCY TEST
AAR MOBILITY SYSTEMS
CADILLAC, MICHIGAN
FEBRUARY 18, 2014

<i>Equipment</i>	<i>Reference</i>	<i>Calibrated With</i>	<i>Limit</i>	<i>Equipment ID</i>	<i>Calibration Date</i>	<i>Calibration Within Limit?</i>
Meter Box pre -test	Method 5 Section 5	Standard Dry Gas meter	Y: avg. within 5% of meter box value	BE04901	3/18/2013	yes
Meter Box pre -test	Method 5 Section 5	Standard Dry Gas meter	Y: avg. within 5% of meter box value	BE04902	3/18/2013	yes
Meter Box post -test	USEPA ALT 009	Y _{qa} Check	Y _{qa} : avg. within 5% of meter box value	BE04901	N/A	yes
Meter Box post -test	USEPA ALT 009	Y _{qa} Check	Y _{qa} : avg. within 5% of meter box value	BE04902	N/A	yes
Pitot Assembly	Method 2	Reference Thermocouple	(b)	BE04193D	2/20/2014	yes
Pitot Assembly	Method 2	Reference Thermocouple	(b)	NFA4191A	2/20/2014	yes
Pitot Assembly	Method 2	Reference Thermocouple	(b)	NFA4196A	2/20/2014	yes
Barometer	Method 2	NWS	± 0.1 in. Hg	BE04921	2/7/2014	Yes
	Section 4.4	Barometer (a)			2/20/2014	Yes

Pitot calibration checks include the measurement of geometric specifications, equipment is inspected for damage or misalignment following each field test.

TABLE 4.1

**SUMMARY OF RESULTS
AAR MOBILITY SYSTEMS
CADILLAC, MICHIGAN**

<i>Location</i>	<i>Parameter</i>	<i>Units Date</i>	<i>Run 1 02/18/2014</i>	<i>Run 2 02/18/2014</i>	<i>Run 3 02/18/2014</i>	<i>Average</i>
Outlet	THC	ppm as C ₃ H ₈	12.3	12.9	12.0	12.4
	CH ₄	ppm as CH ₄	0.00	0.00	0.00	0.00
	RRF THC/CH ₄		2.35	2.35	2.35	
	CH ₄	ppm as C ₃ H ₈	0.00	0.00	0.00	0.00
	TNMHC	ppm as C ₃ H ₈	12.3	12.9	12.0	12.4
	Flow Rate	WSCFM	22150	21280	21410	21610
	Emission Rate	lb/hr	1.86	1.88	1.76	1.84
Combined	THC	ppm as C ₃ H ₈	96.4	109.9	142.4	116.2
	Flow Rate	WSCFM	15170	15270	14850	15100
	Emission Rate	lb/hr	10.02	11.50	14.49	12.00
Skin	THC	ppm as C ₃ H ₈	1226.6	1214.5	1031.8	1157.6
	Flow Rate	WSCFM	4860	4700	4770	4780
	Emission Rate	lb/hr	40.8	39.1	33.7	37.9
	Total lbs - IN		50.9	50.6	48.2	49.9
	DE%		96.3	96.3	96.3	96.3

TABLE 4.2

SUMMARY OF VOC CAPTURE EFFICIENCY
OVERALL EMISSIONS CONTROL SYSTEM
AAR MOBILITY SYSTEMS
CADILLAC, MICHIGAN

<i>Location</i>	<i>% of total VOC Applied</i>	<i>Source Capture Efficiency %</i>	<i>Contribution to Total Capture Efficiency</i>
EU 197 Line	12.1%	85.0%	10.3%
EU Balsacore	1.7%	100.0%	1.7%
EU Skinorrail	86.2%	100.0%	86.2%
		Total	98.2%