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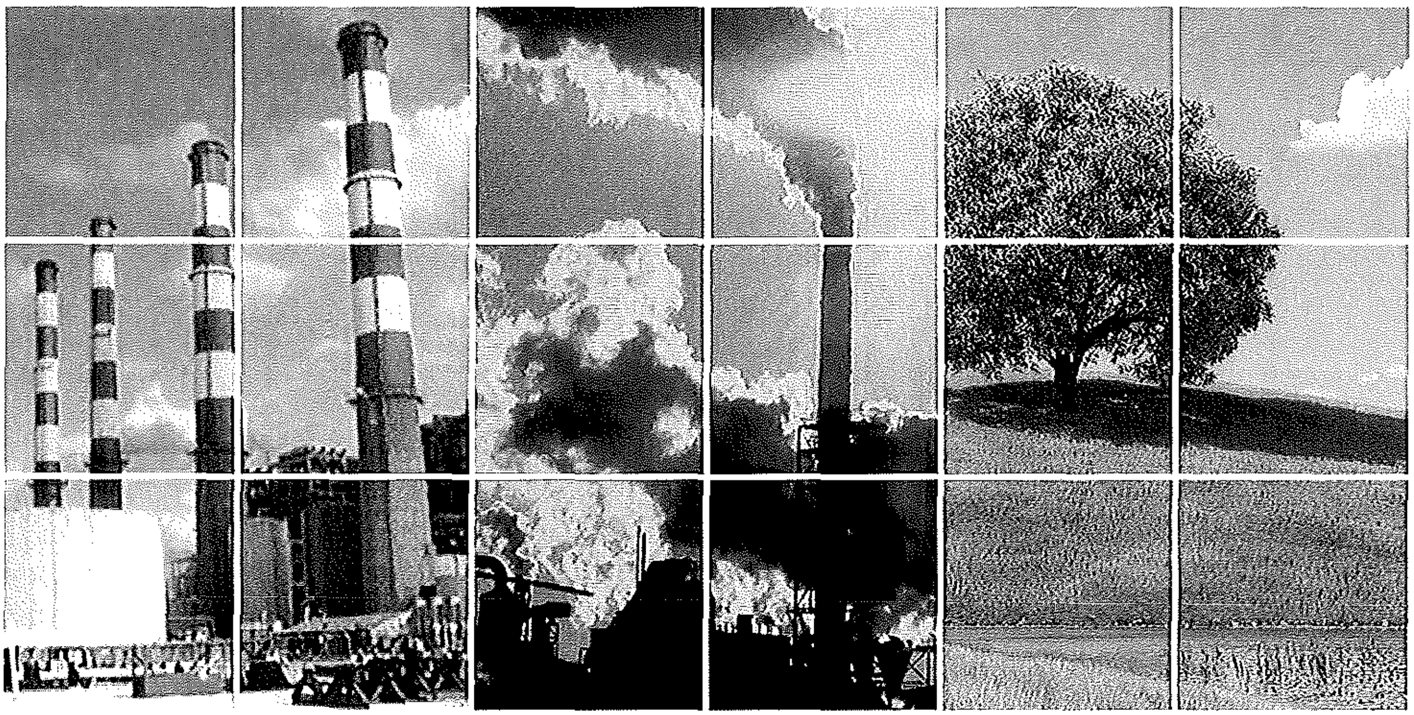

REGENERATIVE THERMAL OXIDIZER DESTRUCTION EFFICIENCY EMISSION TEST REPORT

AAR MOBILITY SYSTEMS
CADILLAC, MICHIGAN

Prepared for: AAR Mobility Systems

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2055 Niagara Falls Boulevard, Suite #3
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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 by Mr. Steven Culmo, Mr. Stephen Zimmerman, 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.

2.0 SAMPLING AND ANALYTICAL PROCEDURES

This section provides a brief overview of the specific test methods that will be 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 (RM 2)

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 form 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 (12.9 duct diameters) downstream and 140 inches (5.0 duct diameters) upstream form 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 CO_2, AND O_2 (RM 3)

The concentrations of oxygen and carbon dioxide were measured on a dry basis according to the procedures provided in RM 3. O_2 and CO_2 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 O_2 and CO_2 with a Fyrite gas analyzer. The gas concentrations were entered directly into the flow calculation spreadsheets.

2.3 MOISTURE DETERMINATION (RM 4)

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).

Calibration ranges were initially selected based on supplied data from previous testing. When the EUSKINORRAIL process was brought on line at test conditions it was discovered that the calibration range was not adequate for the concentrations. A higher calibration gas was obtained and the range of the analyzer was increased to 0-2000 ppm. The combined inlet was calibrated on the range of 0-1000 ppm, and the RTO was

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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.

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 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 are 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 CHECK

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 by placing flexible tubing over one side of the pitot tube tip. The tubing was pinched off when the pitot is

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 (CE) 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% 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.

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.

3.5 DATA REDUCTION

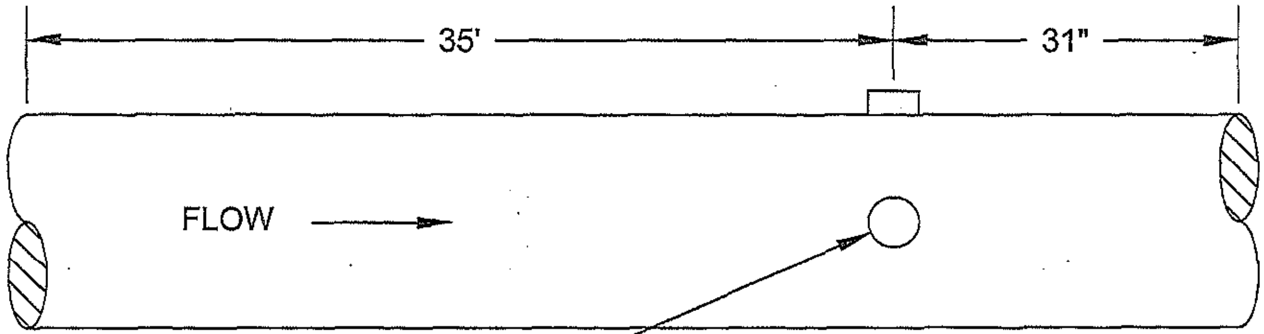
The QA/QC procedure for data reduction includes using computer spreadsheet programs to generate tables of results. Data input files and equations are double-checked by a second person, and tables are checked for transposition errors with spot calculations being performed by hand.

4.0 TEST RESULTS

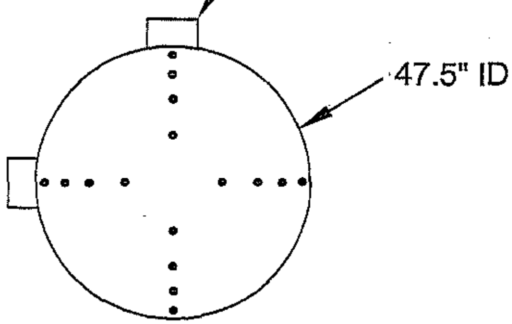
CRA conducted destruction efficiency testing on AAR's RTO in Cadillac, Michigan. Testing was performed August 21-22, 2013. Table 4.1 is a summary of the test results. The average destruction efficiency for the RTO was 89.6 percent.

Table 4.2 is a summary of each sources VOC usage as a percent of the total during the test, each sources capture efficiency, and each sources contribution to the system capture efficiency.

Field data sheets and calculation spreadsheets are provided in Appendix A. Appendix B contains the calibration data and calibration gas certification data sheets. Plant process data is provided in Appendix C.



TEST
PORTS



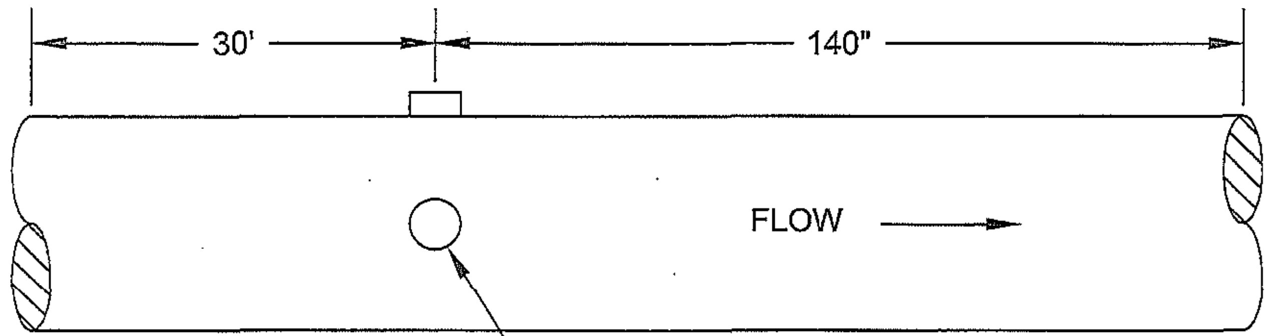
STACK TEST PORT
CROSS SECTION

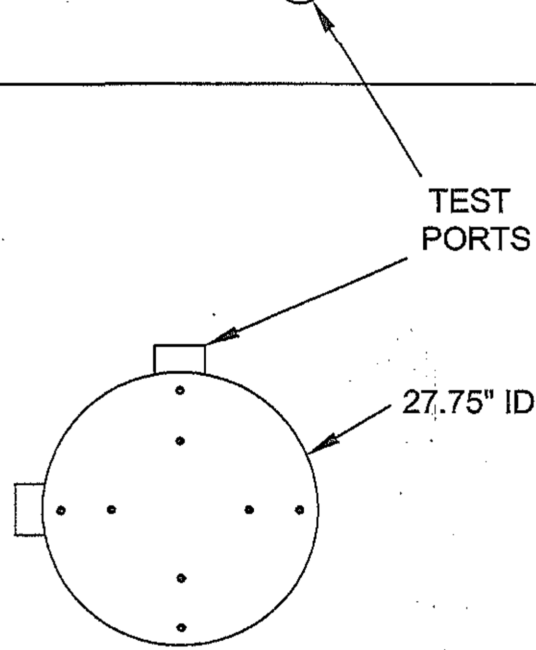
TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	1.52
2	4.99
3	9.22
4	15.34
5	32.16
6	38.29
7	42.51
8	45.98

figure 2.1

COMBINED EXHAUST
SAMPLING LOCATION
AAR
Cadillac, Michigan

81370-02(001)GN-NI001 SEP 18/2013





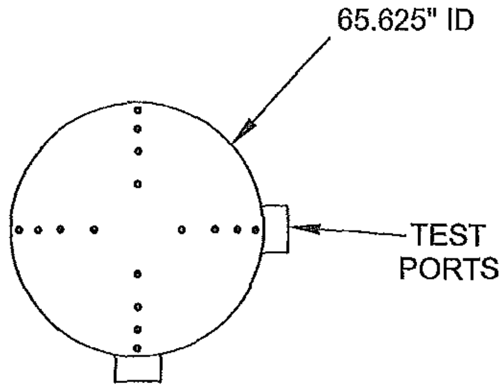
STACK TEST PORT
CROSS SECTION

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

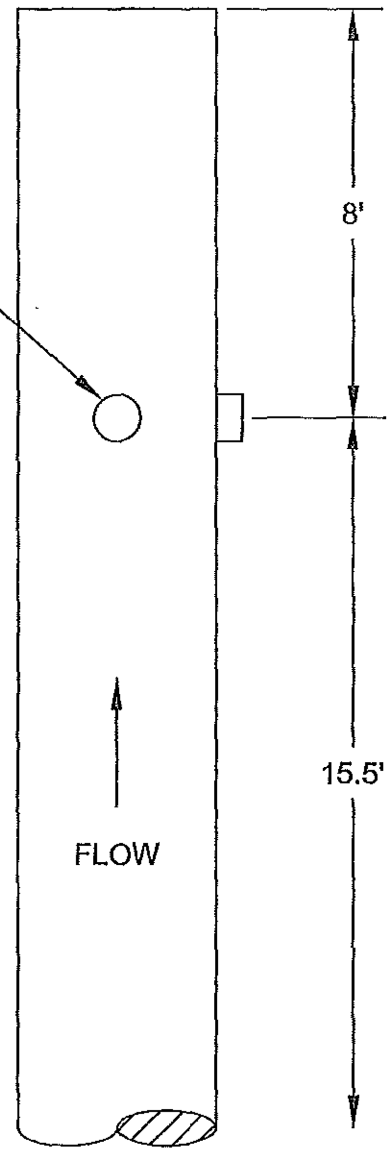
figure 2.2

EUSKINORRAIL EXHAUST
SAMPLING LOCATION
AAR
Cadillac, Michigan

81370-02(001)GN-NI002 SEP 18/2013



STACK TEST PORT CROSS SECTION



TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	2.13
2	6.88
3	12.75
4	21.25
5	44.38
6	52.88
7	58.75
8	63.50

figure 2.3

RTO EXHAUST
SAMPLING LOCATION
AAR
Cadillac, Michigan

TABLE 1.1

DESTRUCTION EFFICIENCY TEST SUMMARY
AAR SYSTEMS MOBILITY
CADILLAC, MICHIGAN

Parameter	*Test Method*	*Location*	*No. of Test Runs*	*Run Duration*	*Comments*
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
CADILLAC, MICHIGAN
AUGUST 21-22, 2013

Equipment	*Reference*	*Calibrated With*	*Limit*	*Equipment ID*	*Calibration Date*	*Calibration Within Limit?*
Meter Box post -test	Method 5 Section 5	Standard Dry Gas meter	Y: avg. within 5% of meter box value	BE04905	10/10/2012	yes
Meter Box post -test	USEPA ALT 009	Y_{qa} Check	Y_{qa}: avg. within 5% of meter box value	BE04905	8/22/2013	yes
Pitot Assembly	Method 2	Reference Thermocouple	(b)	BE04193D	9/4/2013	yes
Pitot Assembly	Method 2	Reference Thermocouple	(b)	BE04196A	9/4/2013	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
CADILLAC, MICHIGAN

Location	*Parameter*	*Units* *Date*	*Run 1* *8/21/2013*	*Run 2* *8/22/2013*	*Run 3* *8/22/2013*	*Average*
Outlet	THC	ppm as C_3H_8	73.6	65.5	64.9	68.0
	CH4	ppm as CH_4	0.00	0.26	0.18	0.14
	RRF THC/CH4		2.38	2.37	2.37	
	CH4	ppm as C_3H_8	0.43	0.11	0.07	0.20
	TNMHC	ppm as C_3H_8	73.2	65.4	64.8	67.8
	Flow Rate	WSCFM	17980	18190	18900	18360
	Emission Rate	lb/hr	9.01	8.14	8.39	8.52
Combined	THC	ppm as C_3H_8	526.5	378.4	383.7	429.6
	Flow Rate	WSCFM	10410	12620	12580	11870
	Emission Rate	lb/hr	37.55	32.71	33.06	34.44
Skin	THC	ppm as C_3H_8	1613.6	2139.0	1904.0	1885.5
	Flow Rate	WSCFM	3900	3650	3630	3730
	Emission Rate	lb/hr	43.1	53.5	47.4	48.0
		Total lbs - IN	**80.7**	**86.3**	**80.5**	**82.5**
		D/E%	**88.8**	**90.6**	**89.6**	**89.7**

TABLE 4.2

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

Location	*% of total VOC Applied*	*Source Capture Efficiency %*	*Contribution to Total Capture Efficiency*
EU 197 Line	10.2%	85.0%	8.6%
EU Balsacore	63.2%	100.0%	63.2%
EU Skinorrail	26.6%	100.0%	26.6%
		Total	98.5%