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STATIONARY SOURCE SAMPLING REPORT

EEI REF. NO. 5448

GENERAL REFINERY PLANT

GARDEN CITY, GEORGIA

BENZENE, MERCURY, TOLUENE, TRIETHYLAMINE,
AND XYLENE EMISSIONS TESTING

CONDENSER EXHAUST AND OIL POLISHER OUTLET

Performed For: RESOURCES CONSERVATION CO.

FEBRUARY 26-28, 1987

REPORT CERTIFICATION

The sampling and analysis performed for this report was carried out under my direction and supervision.

Date March 31, 1987 Signature B. Dwain Ritchie

B. Dwain Ritchie

I have reviewed all testing details and results in this test report and hereby certify that the test report is authentic and accurate.

Date March 31, 1987 Signature Walter S. Smith

Walter S. Smith, P.E.

TABLE OF CONTENTS

INTRODUCTION

1.1 Background. Resources Conservation Co. was contracted by the United States Environmental Protection Agency to conduct cleanup operations at the defunct General Refinery Plant in Garden City, Georgia. Cleanup operations include the treatment and removal of industrial waste abandoned on the plant site.

To prepare a sludge waste product for removal from the site, the oil, moisture, and solids components are separated using a series of solvent, heating, and condensing processes. Resource Conservation Co. employed Entropy Inc. to measure emissions of benzene, mercury, toluene, triethylamine, and xylene at two of the process exhausts.

1.2 Process Test Locations

1.2.1 Condenser Exhaust. The combined effluent from several condensers was diverted from the normal exhaust path through a tee extension, as shown in Figure 1-1. The test equipment installed in the tee extension allowed the concurrent measurement of velocity and collection of emission samples. During each of four tests, three different pollutant-specific sampling trains were operated sequentially. Testing at the condenser exhaust was conducted on February 26, 27, and 28, 1987.

1.2.2 Oil Polisher Outlet. The oil polisher effluent, primarily steam, was sampled on February 27, 1987, during one test which was made possible by a process alteration arranged by Resource Conservation Co. Equipment inserted in the outlet pipe through two access ports allowed the concurrent collection of samples and measurement of velocity. The sampling arrangement is depicted in Figure 1-2.

1.3 Test Participants. Table 1-1 lists the personnel present during the test program.

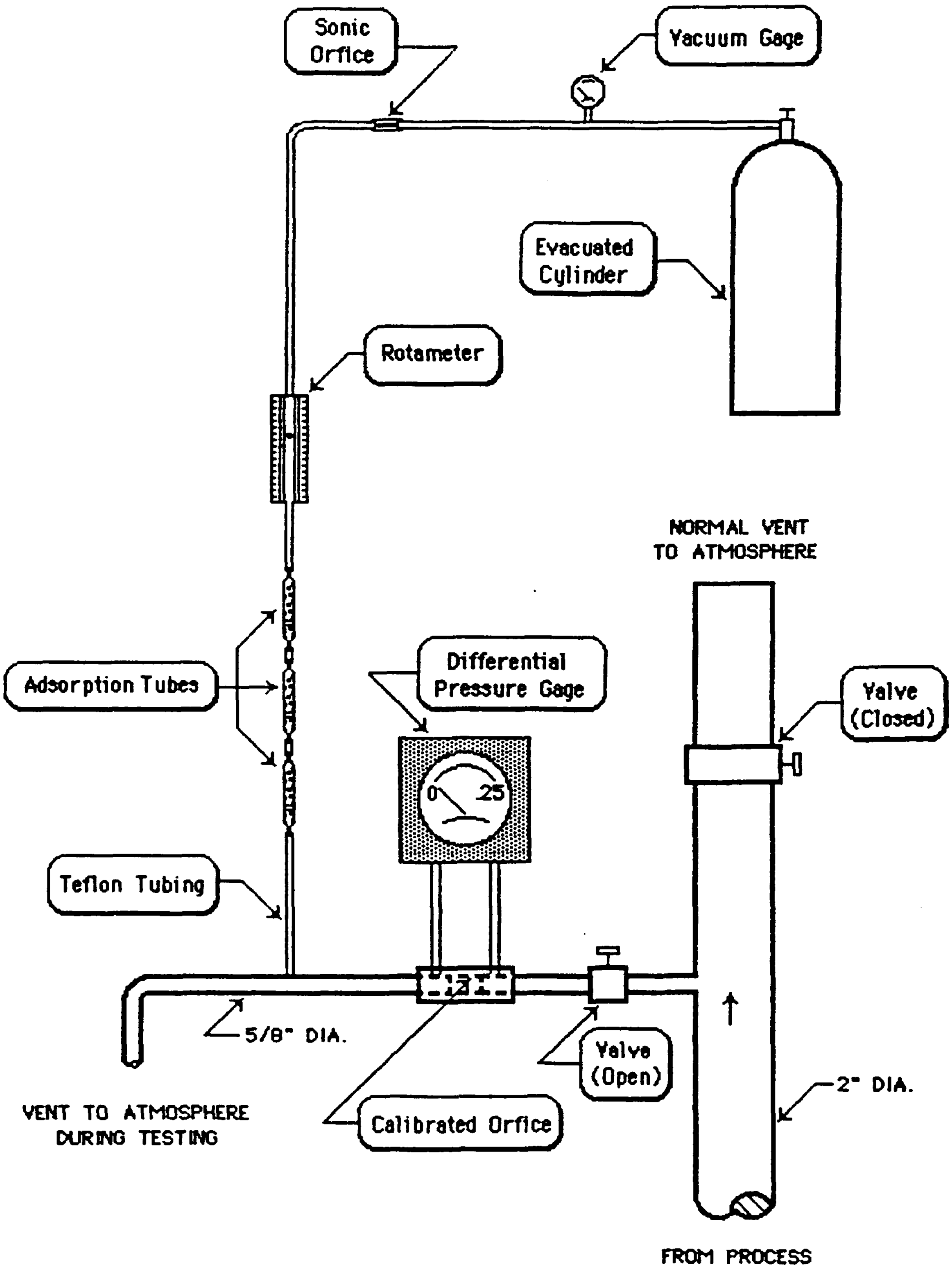

FIGURE 1-1. CONDENSER EXHAUST TEST LOCATION AND SAMPLING TRAIN SCHEMATIC

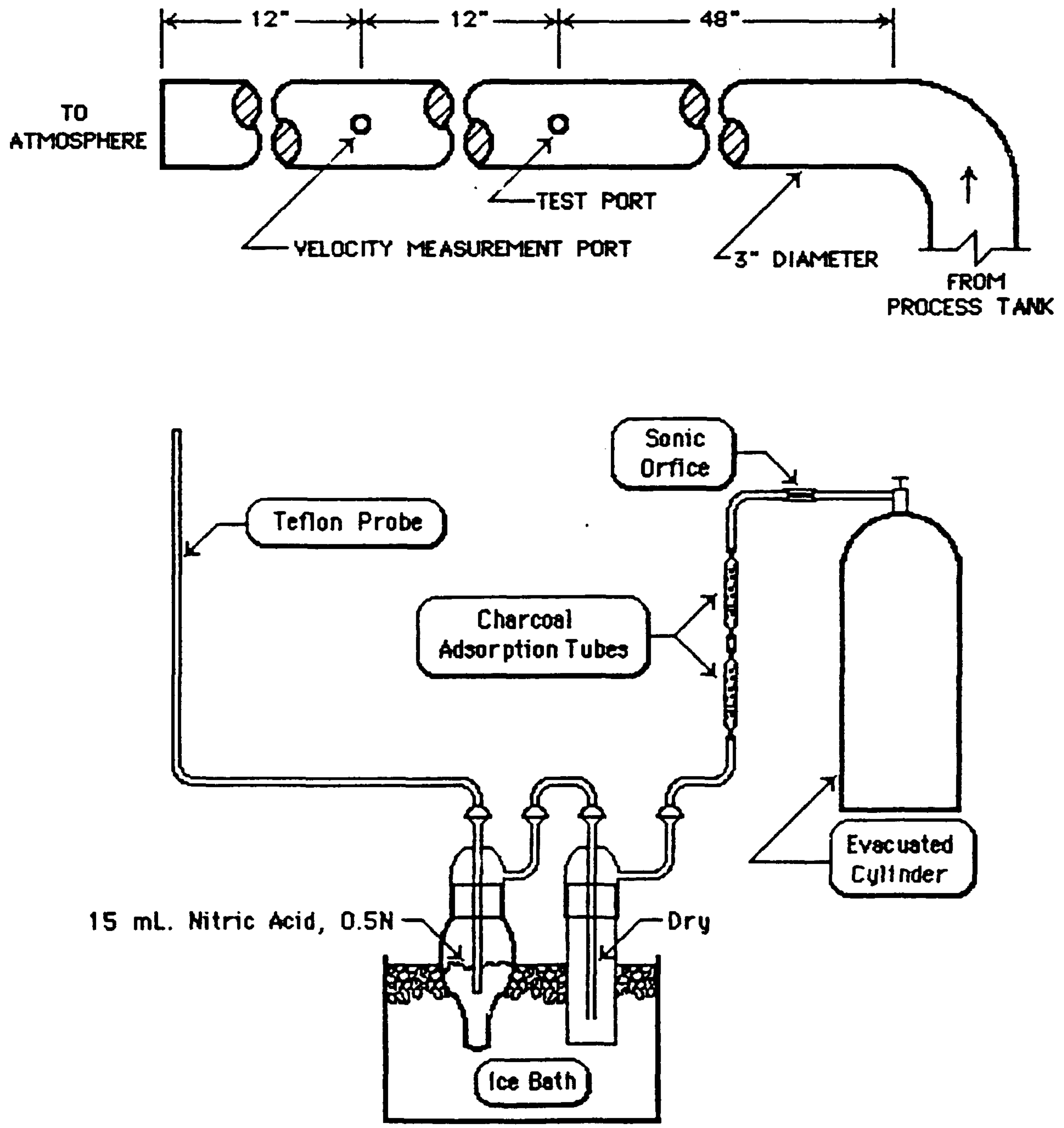

FIGURE 1-2. OIL POLISHER OUTLET TEST LOCATION AND SAMPLING TRAIN SCHEMATIC

TABLE 1-1

TEST PARTICIPANTS

Resources Conservation Co.	Test Coordinators Mark Tose R. Reams Goodloe, Jr.
Entropy Inc.	Project Supervisor B. Dwain Ritchie
	Sampling Team Leaders Anthony L. Mastrianni Brent W. Hall Robert W. Metz

SUMMARY OF RESULTS

Table 2-1 summarizes the results of emission measurements performed at the condenser exhaust and the oil polisher outlet on February 27, 1987. Detailed test results are tabulated in Appendix A; field and analytical data are provided in Appendix B.

TABLE 2-1

SUMMARY OF EMISSIONS

	Run 1	Run 2	Run 3	Run 4	Average
Condenser Exhaust					
Concentration, ppmvd					
Benzene	321	321	339	311	323
Mercury	< 0.00496	< 0.00496	< 0.00496	< 0.00496	< 0.00496
Toluene	164	144	145	132	146
Triethylamine	22,560	13,235	29,928	29,003	23,682
Xylene	200	182	191	161	184
Emission Rate, Lb/Hr					
Benzene	0.00127	0.00127	0.000926	0.00108	0.00114
Mercury	< 0.000000052	< 0.000000041	< 0.000000042	< 0.000000037	< 0.000000043
Toluene	0.000769	0.000676	0.000469	0.000540	0.000614
Triethylamine	0.0985	0.0492	0.131	0.103	0.0954
Xylene	0.00108	0.000983	0.000710	0.000763	0.000884
Oil Polisher Outlet					
Concentration, ppmvd					
Benzene	39.3				
Mercury	< 0.0677				
Toluene	1,502				
Triethylamine	20,130				
Xylene	8,271				
Emission Rate, Lb/Hr					
Benzene	0.000473				
Mercury	< 0.00000210				
Toluene	0.0214				
Triethylamine	0.314				
Xylene	0.135				

SAMPLING AND ANALYTICAL PROCEDURES

3.1 Sampling Equipment. The arrangements of sampling equipment at the condenser exhaust and the oil polisher outlet were shown in Figures 1-1 and 1-2. All equipment was manufactured by Nutech Corp. or Entropy Inc. Pertinent calibration data are presented in Appendix D.

3.2 Volumetric Gas Flow Rates.

3.2.1 Condenser Exhaust. As illustrated in Figure 1-1, gas flow rate was measured using a calibrated orifice; orifice pressure drop readings were recorded at two-minute intervals throughout each test run. The molecular weight of the sample gas was calculated using the molecular weights and concentrations of the significant constituents of the gas (ambient air and triethylamine). The gas moisture content was calculated assuming saturation. The volumetric gas flow rate was determined using these values in the following equation:

Equation 1
$$Q = Km \sqrt{\frac{T_{abs} * \text{delta p}}{P_{abs} * \text{Mol. Wt.}}}$$

Where:

Q	=	flow rate, cfm
K_m	=	orifice calibration coefficient
T_{abs}	=	absolute temperature, ^oR
P_{abs}	=	absolute pressure, inches Hg
delta p	=	orifice pressure drop, inches H_2O
Mol. Wt.	=	molecular weight of gas, lb/lb mole, wet

3.2.2 Oil Polisher Outlet. Gas flow rate was measured by taking readings at one-minute intervals throughout the single test run using an S-type pitot tube inserted into the oil polisher outlet duct through a drilled port 12 inches downstream of the sampling port (see Figure 1-2). The molecular weight of the sample gas was that of ambient air. The gas moisture content was calculated assuming saturation. The following equations were used to calculate the volumetric gas flow rate:

Equation 2

$$vs = 85.49 * Cp * \frac{\text{avg. delta p} * T_{abs}}{P_{abs} * \text{Mol. Wt.}}$$

Where:	vs	= average velocity, fps
	85.49	= pitot calibration coefficient
	avg. delta p	= differential pressure, inches H_2O
	T_{abs}	= absolute temperature, ^oR
	P_{abs}	= absolute pressure, inches Hg
	Mol. Wt.	= molecular weight of gas, lb/lb mole, wet

Equation 3

$$Qsd = \frac{60}{144} * Mfd * vs * A * \frac{528}{Ts} * \frac{Ps}{29.92}$$

Where:	Qsd	= dry volumetric flow rate at standard conditions, cfm
	60/144	= seconds per minute/cubic inches per cubic foot
	Mfd	= dry mole fraction of the flue gas
	vs	= average gas velocity, fps
	A	= duct cross sectional area, square feet
	528	= standard absolute temperature, ^oR
	29.92	= standard absolute pressure, inches Hg

3.3 Sample Acquisition.

3.3.1 Condenser Exhaust. The condenser exhaust gas was sampled using the arrangement shown in Figure 1-1. The sample gas was diverted from the normal exhaust path by closing the exhaust valve and opening the ball valve in the tee extension in which the sample line was installed. Extracted by the negative pressure of an evacuated cylinder, the sample gas flowed through three adsorption tubes in series, a rotameter, a sonic orifice, a vacuum gauge, and into the cylinder.

Three pollutant-specific sampling trains were operated sequentially to collect the samples. Although duplicate samples (sample lines A and B) were taken during the operation of each train, only the samples from line A were analyzed; the duplicates were retained as backups. Table 3-1 summarizes the arrangements of the various adsorbent media for each sampling train (also documented on field data records, Appendix B) and states the capture objectives of each medium.

TABLE 3-1

CONDENSER EXHAUST ADSORBENT SAMPLING MEDIA AND CAPTURE OBJECTIVES

	Sample Collection Medium	Capture Objective
Train A		toluene, benzene, xylene
Position 1	charcoal	
Position 2	charcoal	
Position 3	charcoal	
Train B		triethylamine
Position 1	silica gel	
Position 2	silica gel	
Position 3	silica gel	
Train C		mercury
Position 1	silvered Chromosorb P	
Position 2	silvered Chromosorb P	
Position 3	silica gel	

3.3.2 Oil Polisher Outlet. The oil polisher outlet gas was sampled by the insertion of a sampling probe into the test port, as shown in Figure 1-2. Extracted by the negative pressure of an evacuated cylinder, the sample gas passed through a Mae West impinger charged with 15 mL of 0.5N nitric acid and a dry impinger (both submerged in ice), two adsorption tubes charged with activated charcoal, a sonic orifice, and into the cylinder. Table 3-2 identifies the capture objectives for each of the sampling train components and capture media.

TABLE 3-2

OIL POLISHER OUTLET SAMPLING TRAIN COMPONENTS AND CAPTURE OBJECTIVES

Train Component	Sample Collection Medium	Capture Objective
Mae West impinger	0.5N Nitric Acid Reagent	benzene toluene xylene triethylamine gaseous mercury
adsorbent tubes	charcoal	benzene toluene xylene

3.4 Sample Recovery. The samples were transferred from the test site to the laboratory on ice in a cooler. The adsorbent tubes were transferred to a freezer for storage. The impinger reagent from the oil polisher outlet (OP) test was stored in a refrigerator after recovery. The reagent from the OP sample was bilayered with 47 mL in the aqueous layer and 3 mL in the organic phase. Blue ice packs were used to keep the samples cool during shipment to Oxford Laboratories. After receipt at Oxford Laboratories, the samples were stored in a freezer or refrigerator until analysis. Chain-of-custody records for the transfer of the samples to Oxford Laboratories are presented in Appendix C.

3.5 Sample Analysis. The silica gel adsorbent tubes and the aqueous portion of the OP reagent were analyzed for triethylamine according to the protocol in NIOSH Method 221. The silvered Chomosorb P tubes were desorbed with acid and analyzed for mercury by cold vapor atomic absorption. The aqueous portion of the OP reagent was also analyzed by cold vapor atomic absorption for mercury. Charcoal adsorbent tubes were analyzed for benzene, toluene, and xylenes by the protocol of NIOSH Method 1501. An aliquot of the OP reagent organic phase was diluted in methanol. A 50 uL aliquot of the methanol sample was placed in distilled water and analyzed by purge trap GC/PID. For all the adsorbent train analyses, the second "b" tube was analyzed separately from the primary "a" tube. The analytes were not detected on any of the "b" tubes, thus demonstrating that the pollutants were effectively captured on the "a" tubes.

APPENDIX A.1

A. TEST RESULTS

1. Condenser Exhaust

GAS FLOW RATE TABULATIONS

Condenser Exhaust

Water %: 1.1 Mfd = 0.989

Sample	Orifice Delta P	Gas Temp F	Baro. Press. in. Hg	Static Press. in. H2O	Molecular Weight lb/lb-mole Dry	Wet	- Air Flows -- ACFM Wet	SCFM Dry
CE-1A	0.307	50	30.4	-4.2	30.50	30.36	0.317	0.327
CE-1B	0.220	50	30.4	-4.0			0.268	0.277
CE-1C	0.330	50	30.4	-4.3			0.329	0.339
CE-2A	0.301	50	30.4	-4.1	29.78	29.65	0.318	0.327
CE-2B	0.157	50	30.4	-4.3			0.230	0.236
CE-2C	0.196	50	30.4	-4.2			0.257	0.264
CE-3A	0.148	50	30.4	-3.0	31.01	30.87	0.218	0.225
CE-3B	0.226	50	30.4	-5.0			0.270	0.278
CE-3C	0.211	50	30.4	-4.4			0.261	0.269
CE-4A	0.237	46	30.4	-4.2	30.94	30.80	0.276	0.286
CE-4B	0.147	48	30.4	-4.5			0.218	0.225
CE-4C	0.164	46	30.4	-4.6			0.229	0.238

FIELD DATA & RESULTS TABULATION

General Refinery Plant

Garden City, Georgia

Run	Sampling Location	Operator
CE-1Aa	Condenser Exhaust	B. Dwain Ritchie
CE-2Aa	Condenser Exhaust	Brent W. Hall
CE-3Aa	Condenser Exhaust	Brent W. Hall
CE-4Aa	Condenser Exhaust	Brent W. Hall

		CE-1Aa	CE-2Aa	CE-3Aa	CE-4Aa
	Run Date	2/26/87	2/26/87	2/27/87	2/28/87
	Run Start Time	1614	2233	315	1115
	Run Finish Time	1644	2303	345	1145
Theta	Net Run Time, Minutes	30	30	30	30
Qsd	Flue Gas Flow Rate, Dry SCFM*	0.327	0.327	0.225	0.286
Vc	Avg. Calibration Vol., Milliliters	39	39	39	39
Y	Calibration Meter Factor, Gamma	1.034	1.034	1.034	1.034
Vsc	Volume Of Gas Sampled, DSL*	1.21	1.21	1.21	1.21
	Benzene				
ForWt	Formula Weight, Lb/Lb-Mole	78.0	78.0	78.00	78.00
mg	Catch, Milligrams	1.26	1.26	1.33	1.22
ppmvd	Concentration, ppmv, Dry	321	321	339	311
Lb/Hr	Emission Rate, Lb/Hour	0.00127	0.00127	0.000926	0.00108
	Toluene				
	Formula Weight, Lb/Lb-Mole	92.13	92.13	92.13	92.13
	Catch, Milligrams	0.76	0.668	0.673	0.610
	Concentration, ppmv, Dry	164	144	145	132
	Emission Rate, Lb/Hour	0.000769	0.000676	0.000469	0.000540
	Xylene				
	Formula Weight, Lb/Lb-Mole	106.16	106.16	106.16	106.16
	Catch, Milligrams	1.07	0.971	1.02	0.862
	Concentration, ppmv, Dry	200	182	191	161
	Emission Rate, Lb/Hour	0.00108	0.000983	0.000710	0.000763

* 68 Deg. F - 29.92 Inches of Mercury (Hg)

FIELD DATA & RESULTS TABULATION

General Refinery Plant

Garden City, Georgia

Run	Sampling Location	Operator
CE-1Ba	Condenser Exhaust	B. Dwain Ritchie
CE-2Ba	Condenser Exhaust	B. Dwain Ritchie
CE-3Ba	Condenser Exhaust	Brent W. Hall
CE-4Ba	Condenser Exhaust	Brent W. Hall

		CE-1Ba	CE-2Ba	CE-3Ba	CE-4Ba
	Run Date	2/26/87	2/26/87	2/27/87	2/28/87
	Run Start Time	1717	2328	420	1200
	Run Finish Time	1733	2348	450	1230
Theta	Net Run Time, Minutes	20	20	30	30
Qsd	Flue Gas Flow Rate, Dry SCFM*	0.277	0.236	0.278	0.225
Vc	Avg. Calibration Vol., Milliliters	39	39	39	39
Y	Calibration Meter Factor, Gamma	1.034	1.034	1.034	1.034
Vsc	Volume Of Gas Sampled, DSL*	0.825	0.817	1.25	1.25
	Triethylamine				
ForWt	Formula Weight, Lb/Lb-Mole	101.19	101.19	101.19	101.19
mg	Catch, Milligrams	78.3	45.5	157	152
ppmvd	Concentration, ppmv, Dry	22,560	13,235	29,928	29,003
Lb/Hr	Emission Rate, Lb/Hour	0.0985	0.0492	0.131	0.103

* 68 Deg. F - 29.92 Inches of Mercury (Hg)

FIELD DATA & RESULTS TABULATION

General Refinery Plant

Garden City, Georgia

Run	Sampling Location	Operator
CE-1Ca	Condenser Exhaust	B. Dwain Ritchie
CE-2Ca	Condenser Exhaust	B. Dwain Ritchie
CE-3Ca	Condenser Exhaust	Brent W. Hall
CE-4Ca	Condenser Exhaust	Brent W. Hall

		CE-1Ca	CE-2Ca	CE-3Ca	CE-4Ca
	Run Date	2/26/87	2/27/87	2/27/87	2/28/87
	Run Start Time	1815	19	520	1250
	Run Finish Time	1845	49	550	1320
Theta	Net Run Time, Minutes	30	30	30	30
Qsd	Flue Gas Flow Rate, Dry SCFM*	0.339	0.264	0.269	0.238
Vc	Avg. Calibration Vol., Milliliters	39	39	39	39
Y	Calibration Meter Factor, Gamma	1.034	1.034	1.034	1.034
Vsc	Volume Of Gas Sampled, DSL*	1.21	1.21	1.21	1.21
	Mercury				
ForWt	Formula Weight, Lb/Lb-Mole	200.59	200.59	200.59	200.59
mg	Catch, Milligrams	< 0.00005	< 0.00005	< 0.00005	< 0.00005
ppmvd	Concentration, ppmv, Dry	< 0.00496	< 0.00496	< 0.00496	< 0.00496
Lb/Hr	Emission Rate, Lb/Hour	< 0.000000052	< 0.000000041	< 0.000000042	< 0.000000037

* 68 Deg. F - 29.92 Inches of Mercury (Hg)

APPENDIX A.2

A. TEST RESULTS

2. Oil Polisher Outlet

FIELD DATA & RESULTS TABULATION

PLANT: General Refinery Plant, Garden City, Georgia

RUN	DATE	SAMPLING LOCATION	OPERATOR
OP-1	2/27/87	Oil Polisher Outlet	Robert W. Metz

		OP-1
	Run Start Time	1114
	Run Finish Time	1117
Theta	Net Run Time, Minutes	2.5
Cp	Pitot Tube Coefficient	0.84
Pbar	Barometric Pressure, Inches Hg	30.4
	Tank Sampling Parameters	
V(tank)	Volume of Tank, liters	7.071
t(pre)	Pretest Temperature, deg. F	48
Pa(pre)	Pretest Absolute Pressure, mmHg	772.2
t(post)	Posttest Temperature, deg. F	48
Pa(post)	Posttest Absolute Pressure, mmHg	772.2
Vstd	" lume Sampled, Dry SCF*	0.0294
Vlc	Volume of Water Collected in Impingers, mL	32.0
V	Volume of Water Vapor, SCF*	1.506
%H2O	Moisture Content, Percent By Volume	98.1
Mfd	Dry Mole Fraction	0.019
Md	Dry Molecular Weight, Lb/Lb-Mole	28.84
Ms	Wet Molecular Weight, Lb/Lb-Mole	18.21
Pg	Flue Gas Static Pressure, Inches H2O	0.0
Ps	Absolute Flue Gas Pressure, Inches Hg	30.4
ts	Flue Gas Temperature, Degrees F	212
Delta p	Average Velocity Head, Inches H2O	0.0786
vs	Flue Gas Velocity, Feet/Second	22.18
A	Stack/Duct Area, Square Inches	7.07
Qsd	Volumetric Air Flow Rate, Dry SCFM*	0.991
Qaw	Volumetric Air Flow Rate, Wet ACFM	65.34
	<u>Benzene</u>	
ForWt	Formula Weight, Lb/Lb Mole	78.0
mg	Catch, Milligrams	0.106
ppmvd	Concentration, ppmvd	39.3
Lb/Hr	Emission Rate, Lb/Hr	0.000473
	<u>Mercury</u>	
	Formula Weight, Lb/Lb Mole	200.59
	Catch, Milligrams	< 0.00047
	Concentration, ppmvd	< 0.0677
	Emission Rate, Lb/Hr	< 0.00000210
	<u>Toluene</u>	
	Formula Weight, Lb/Lb Mole	92.13
	Catch, Milligrams	4.791
	Concentration, ppmvd	1,502
	Emission Rate, Lb/Hr	0.0214

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

	OP-1
Triethylamine	
Formula Weight, Lb/Lb Mole	101.19
Catch, Milligrams	70.5
Concentration, ppmvd	20,130
Emission Rate, Lb/Hr	0.314
Xylenes	
Formula Weight, Lb/Lb Mole	106.16
Catch, Milligrams	30.389
Concentration, ppmvd	8,271
Emission Rate, Lb/Hr	0.135

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

APPENDIX B.1

B. FIELD DATA

1. Condenser Exhaust

AIR FLOW RATE FIELD DATA

CE-1A

COMPANY NAME Resource Conservation

ADDRESS Garden City, Ga.

SAMPLING LOCATION Condenser Exhaust PERSONNEL DR

DATE 2-26-97 DUCT DIMENSIONS ______ DUCT AREA (A) ______ $in.^2$

BAROMETRIC PRESSURE (P_{bar}) 30.40 IN. Hg STATIC PRESSURE (P_g) -4.2 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	△P IN. H_2O Orifice	TEMP. °F
CE 1A	1613	0	.22	50
		2	.35	50
		4	.35	50
		6	.37	50
		8	.47	50
		10	.35	50
		12	.50	50
		14	.45	50
		16	0.0	50
		18	.35	50
		20	.35	50
		22	.26	50
		24	.25	50
		26	0	50
		28	.33	50
	1643	30		~~50~~
		Avg.	0.30667	50

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	△P IN. H_2O	TEMP. °F

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AIR FLOW RATE FIELD DATA CE-1B

COMPANY NAME Resourse Conservation

ADDRESS Garden City, GA.

SAMPLING LOCATION Condenser Exhaust PERSONNEL TM

DATE 2-26-87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ $IN.^2$

BAROMETRIC PRESSURE (P_{bar}) 30.40 IN. Hg STATIC PRESSURE (P_g) -4.0 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
CE1B	1717	start	.30	50
		2	0.00	50
		4	0.45	50
		6	0.35	50
		8	0.00	50
		10	0.00	50
		12	.35	50
		14	.60	50
		16	.60	50
		18	.55	50
	1793	20	~~0.0~~	~~50~~
		Avg.	0.2202	50

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F

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ENTROPY

CE-1C

AIR FLOW RATE FIELD DATA

COMPANY NAME Resourse

ADDRESS Garden City, GA.

SAMPLING LOCATION Condenser Exhaust PERSONNEL TM

DATE 2-26-87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ $IN.^2$

BAROMETRIC PRESSURE (P_{bar}) 30.40 IN. Hg STATIC PRESSURE (P_g) -4.3 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F	RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
CE1C	1815	0	.40	50					
	/	2	.50	50					
		4	.35	50					
		6	.25	50					
		8	.70	50					
		10	.15	50					
		12	.20	50					
		14	.40	50					
		16	.25	50					
		18	.40	50					
		20	.25	50					
		22	.20	50					
		24	.30	50					
		26	.30	50					
		28	.50	50					
	1845	30	~~.25~~	~~50~~					
		Avg.	0.33001	50					

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ENTROPY

CE-2A

AIR FLOW RATE FIELD DATA

COMPANY NAME Resourse Conservation

ADDRESS Garden City, Ga.

SAMPLING LOCATION Condenser Exhaust PERSONNEL TM

DATE 2-26-87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ $IN.^2$

BAROMETRIC PRESSURE (P_{bar}) 30.40 IN. Hg STATIC PRESSURE (P_g) -4.1 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL.

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	△P IN. H_2O	TEMP. °F
CE2A	2233	0	0.50	50
		2	0.50	50
		4	0.60	50
		6	0.55	50
		8	0.35	50
		10	0.13	50
		12	0.40	50
		14	0.12	50
		16	0.40	50
		18	0.25	50
		20	0.20	50
		22	0.13	50
		24	0.30	50
		26	0.35	50
		28	0.08	50
	2303	30	~~0.35~~	~~50~~
		Avg.	0.30059	50

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	△P IN. H_2O	TEMP. °F

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AIR FLOW RATE FIELD DATA

CE-2B

COMPANY NAME RESOORSE CONSERVATION

ADDRESS GARDEN CITY, GA.

SAMPLING LOCATION CONDENSER EXHAUST PERSONNEL TM

DATE 2-26-87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ $IN.^2$

BAROMETRIC PRESSURE (P_{bar}) 30.40 IN. Hg STATIC PRESSURE (P_g) -4.3 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
CE-2B	2328	0	0.00	50
		2	0.20	50
		4	0.15	50
		6	0.25	50
		8	0.13	50
		10	0.20	50
		12	0.25	50
		14	0.25	50
		16	0.06	50
		18	0.14	50
	2348	20	~~0.25~~	~~50~~
		Avg.	0.1571	50

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F

F-1024
8-86

ENTROPY

AIR FLOW RATE FIELD DATA

CE-2C

COMPANY NAME Resourse Conservation

ADDRESS Garden City, Ga.

SAMPLING LOCATION Condenser Exhaust PERSONNEL TM

DATE 2-27-87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ IN^2

BAROMETRIC PRESSURE (P_{bar}) 30.4 IN. Hg STATIC PRESSURE (P_g) -4.2 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
CE-2C	019	0	0.12	50
		2	0.10	50
		4	0.15	50
		6	0.13	50
		8	0.10	50
		10	0.10	50
		12	0.25	50
		14	0.30	50
		16	0.23	50
		18	0.24	50
		20	0.29	50
		22	0.25	50
		24	0.28	50
		26	0.25	50
		28	0.27	50
	049	30	~~0.17~~	~~50~~
		Avg.	0.19639	50

F-1026
8-86

ENTROPY

AIR FLOW RATE FIELD DATA CE-3A

COMPANY NAME RESOURCE CONSERVATIONS

ADDRESS GARDEN CITY, GA

SAMPLING LOCATION Condensers EX 4 Rust PERSONNEL Bull

DATE 2/28/87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ $IN.^2$

BAROMETRIC PRESSURE (P_{bar}) 30.4 IN. Hg STATIC PRESSURE (P_g) -3.0 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
CE-3A	3:15	0	0.17	50
		2	0.15	50
		4	0.12	50
		6	0.18	50
		8	0.14	50
		10	0.15	50
		12	0.14	50
		14	[illegible].15	50
		16	0.07	50
		18	0.11	50
		20	0.22	50
		22	0.16	50
		24	0.16	50
		26	0.20	50
		28	0.13	50
	3:45	30		50
		Avg.	0.14778	50

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F

F-1026
8-86

ENTROPY

AIR FLOW RATE FIELD DATA

CE-3B

COMPANY NAME Resource Conservations

ADDRESS Garden City, Ga

SAMPLING LOCATION Condensor Exhaust PERSONNEL BWH

DATE 2/27/87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ IN^2

BAROMETRIC PRESSURE (P_{bar}) 30.4 IN. Hg STATIC PRESSURE (P_g) -5.0 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	△P IN. H_2O	TEMP. °F
CE-3B	0420	0	0.19	50
	22	2	0.17	50
	24	4	0.28	50
	26	6	0.28	50
	28	8	0.27	50
	30	10	0.24	50
	32	12	0.24	50
	34	14	0.24	50
	36	16	0.17	50
	38	18	0.19	50
	40	20	0.30	50
	42	22	0.19	50
	44	24	0.24	50
	46	26	0.22	50
	48	28	0.20	50
	0450	30		50
		Avg.	0.22618	50

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	△P IN. H_2O	TEMP. °F

F-1024
8-86

ENTROPY

AIR FLOW RATE FIELD DATA

CE-3C

COMPANY NAME Resource Conservation

ADDRESS Garden City, Ga

SAMPLING LOCATION Condensor Exhaust PERSONNEL BWH

DATE 2/27/87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ $IN.^2$

BAROMETRIC PRESSURE (P_{bar}) 30.4 IN. Hg STATIC PRESSURE (P_g) -4.4 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
CE-3C	520	0	0.19	50
		2	0.33	50
		4	0.23	50
		6	0.24	50
		8	0.24	50
		10	0.32	50
		12	0.08	50
		14	0.17	50
		16	0.14	50
		18	0.23	50
		20	0.11	50
		22	0.21	50
		24	0.24	50
		26	0.26	50
		28	0.27	50
	550	30	~~0.28~~	~~50~~
		Avg.	0.21121	50

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F

F-1026
8-86

ENTROPY

AIR FLOW RATE FIELD DATA

CE-4A

COMPANY NAME Resources Conservation Co.

ADDRESS Garden City, GA.

SAMPLING LOCATION Condenser Exhaust PERSONNEL BWH

DATE 2/28/87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ $IN.^2$

BAROMETRIC PRESSURE (P_{bar}) 30.4 IN. Hg STATIC PRESSURE (P_g) -4.2 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
CE-4A	11:15	0	0.25	46
		2	0.24	46
		4	0.29	46
		6	0.12	46
		8	0.17	46
		10	0.23	46
		12	0.13	46
		14	0.28	46
		16	0.36	46
		18	0.33	46
		20	0.36	46
		22	0.08	46
		24	0.32	46
		26	0.32	46
		28	0.21	46
	11:45	30	~~0.31~~	~~46~~
		Avg.	0.23706	46

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F

F-1024
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ENTROPY

AIR FLOW RATE FIELD DATA

CE-4B

COMPANY NAME: RESOURCES CONSERVATION

ADDRESS: GARDEN CITY, GA.

SAMPLING LOCATION: CONDENSER EXHAUST PERSONNEL: BRW

DATE: 7/28/87 DUCT DIMENSIONS: ______ DUCT AREA (A): ______ $IN.^2$

BAROMETRIC PRESSURE (P_{bar}): 30.4 IN. Hg STATIC PRESSURE (P_g): -4.5 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
CE-4B	12:00	0	0.20	48
		2	0.22	
		4	0.22	
		6	0.06	
		8	0.20	
		10	0.15	
		12	0.10	
		14	0.17	
		16	0.11	
		18	0.13	
		20	0.17	
		22	0.05	
		24	0.15	
		26	0.17	
		28	0.19	
	12:30	30	0.20	
		Avg.	0.1473	48

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F

ENTROPY

AIR FLOW RATE FIELD DATA

CE-4C

COMPANY NAME RESOURCES CONSERVATION

ADDRESS GARDEN CITY, GA.

SAMPLING LOCATION CONDENSER EXHAUST PERSONNEL Bush

DATE 2/28/87 DUCT DIMENSIONS ______ DUCT AREA (A) ______ $IN.^2$

BAROMETRIC PRESSURE (P_{bar}) 30.4 IN. Hg STATIC PRESSURE (P_g) -4.6 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) ______

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL.

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
CE-4C	1250	0	0.20	46
		2	0.21	46
		4	0.21	46
		6	0.18	
		8	0.12	
		10	0.10	
		12	0.13	
		14	0.19	
		16	0.10	
		18	0.11	
		20	0.17	
		22	0.22	
		24	0.13	
		26	0.17	
		28	0.28	
	1320	30	~~0.13~~	
		Avg.	0.16421	46

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F

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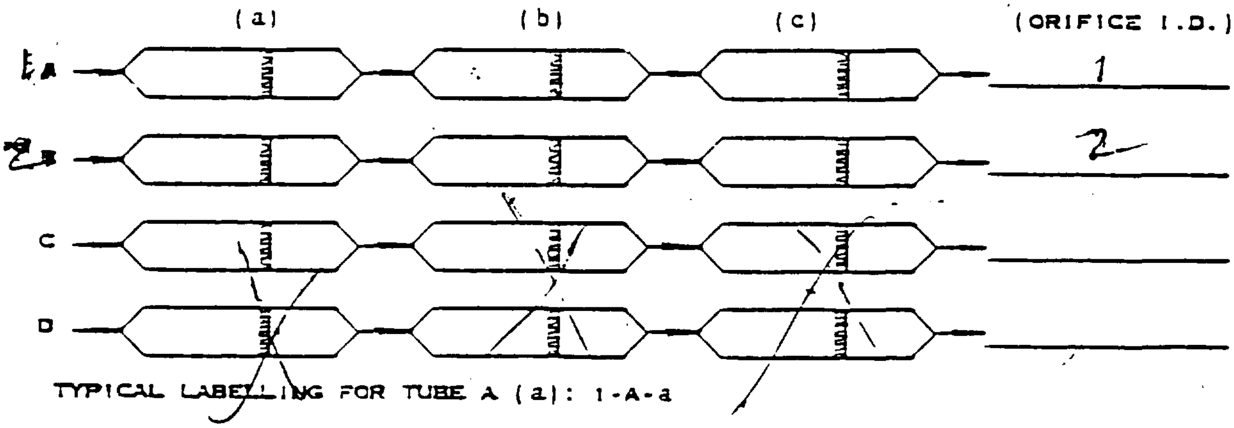
ENTROPY

CE-1A

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME: Resource Conservation
ADDRESS: Garden City, GA.
SAMPLING LOCATION: Condenser Exhaust
DATE: 2-26-87 TEAM LEADER: TK TECHNICIANS: TM
BAROMETRIC PRESSURE, IN. HG. (P_{BAR}): 30.4 PUMP #: Tank

RUN: CE-[redacted]
TIME START: 1614
TIME FIN.: 1644



TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS	ROTAMETER READINGS 1- SAMPLES	2- SAMPLES	C- SAMPLES	D- SAMPLES
[illegible]	47 (MIN)	~~8~~ 34		
5	46	34		
10	42	43		
15	42	45		
20	44	43		
25	44	43		
30 OFF				

30 (MIN) NET TIME, MINUTES

CALIBRATION	AMB. TEMP. (ta)	-1- ~~TIME SECONDS (SEC)~~	-1- VOLUME MILS (VC)	-2- TIME SECONDS	-2- VOLUME MILS	-C- TIME SECONDS	-C- VOLUME MILS	-D- TIME SECONDS	-D- VOLUME MILS
INITIAL	52°F	BYRON	38	NA	38				
FINAL	47	MODEL 90	40		38				
AVERAGE	50	60	39	60	38				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

$V_a = \text{MIN.} * \frac{60}{1000} * V_c/\text{SEC}$ $V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

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8-86

ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME Resourse Conservation

ADDRESS Garden City, GA.

SAMPLING LOCATION Condenser Exhaust

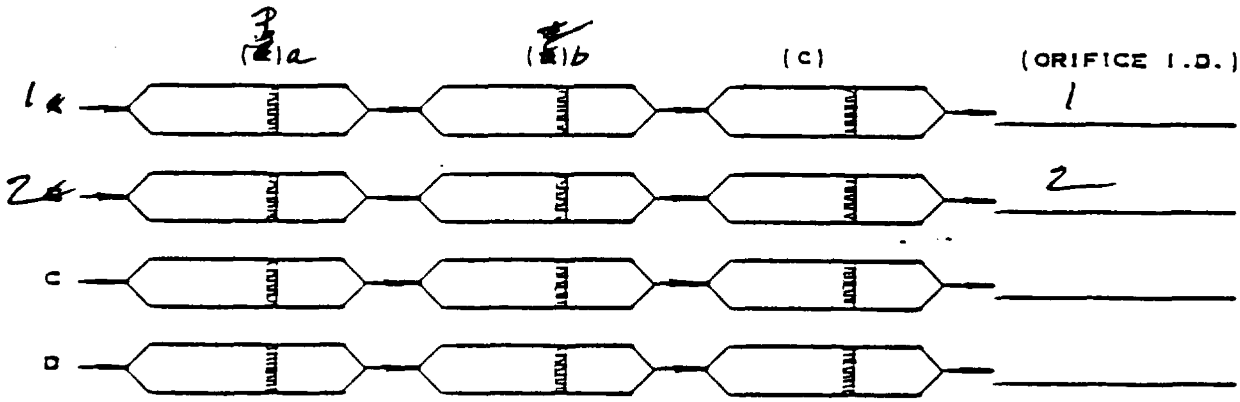
DATE 2-26-87 TEAM LEADER DR TECHNICIANS TM

BAROMETRIC PRESSURE, IN. HG. (P_{BAR}) 30.4 PUMP # M-25 TANK

RUN CE-1B

TIME START 1713

TIME FIN. 1733



TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS	ROTAMETER READINGS 1- SAMPLES	2- SAMPLES	C- SAMPLES	D- SAMPLES
0	46	43		
5	46	43		
10	46	43		
15	46	43		
20/OFF				

20 (MIN) NET TIME, MINUTES

Model 940

CALIBRATION	AMB. TEMP. (ta)	1 TIME SECONDS (SEC)	1 VOLUME MILS (VC)	2 TIME SECONDS	2 VOLUME MILS	C TIME SECONDS	C VOLUME MILS	D TIME SECONDS	D VOLUME MILS
INITIAL	46	40 l/min		39 l/min					
FINAL	44	38		39					
AVERAGE	45	60	39	60	39				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

V_a = MIN. * $\frac{60}{1000}$ * V_c/SEC $\quad V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

EA 5.81

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ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME: RESOURSE CONSERVATION

ADDRESS: GARDEN CITY GA.

SAMPLING LOCATION: CONDENSER EXHAUST

DATE: 2-26-87 TEAM LEADER: JDR TECHNICIANS: ____

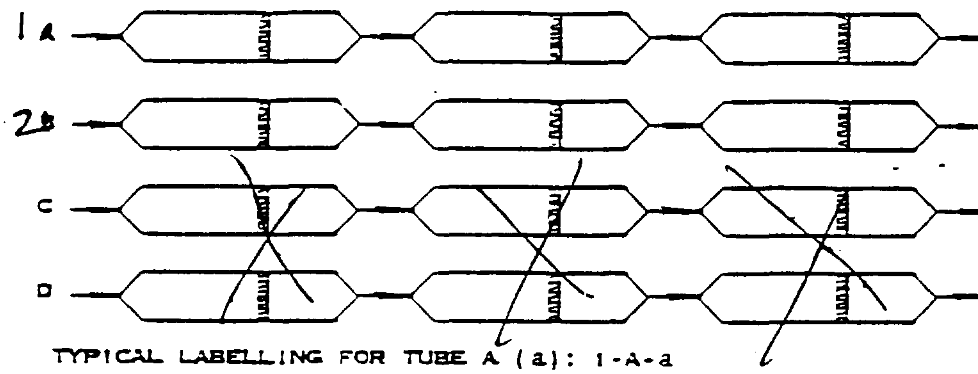
BAROMETRIC PRESSURE, IN. HG. (P_{BAR}): 30.40 PUMP #: M-25 TANK

RUN: CE-1C

TIME START: 1815

TIME FIN.: 1845

(a) (b) (c) (ORIFICE I.D.)



ORIFICE I.D.: 1A – 1; 2B – 2; C – ____; D – ____

TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME	ROTAMETER READINGS			
HOURS	A- SAMPLES	B- SAMPLES	C- SAMPLES	D- SAMPLES
0	48	45		
5	48	45		
10	48	45		
15	48	45		
20	48	45		
25	48	45		
30				

30 (MIN) NET TIME, MINUTES

		1 (-A-)		2 (-B-)		-C-		-D-	
CALIBRATION	AMB. TEMP. (ta)	TIME SECONDS (SEC)	VOLUME MILS (VC)	TIME SECONDS	VOLUME MILS	TIME SECONDS	VOLUME MILS	TIME SECONDS	VOLUME MILS
INITIAL	44	39		36 →					
FINAL	43	39		38 →					
AVERAGE	44	60	39	60	38				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

$V_a = \text{MIN.} * \frac{60}{1000} * V_c/\text{SEC}$ $V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

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ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME Resourse

ADDRESS Garden City, GA.

SAMPLING LOCATION Condenser Exhaust

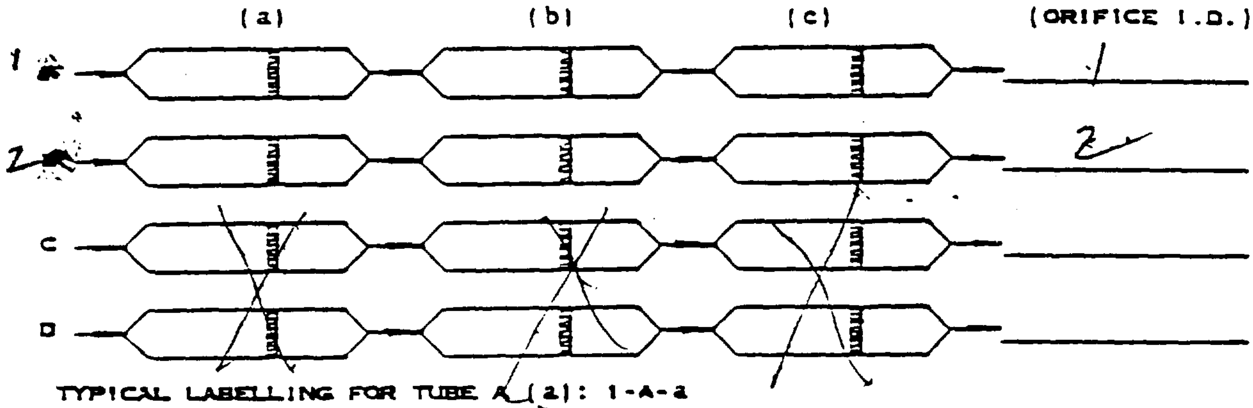
DATE 2-26-87 TEAM LEADER DC TECHNICIANS TM

BAROMETRIC PRESSURE, IN. HG. (P_{BAR}) 30.4 PUMP # M-25 TANK

RUN CE-2A

TIME START 2233

TIME FIN. ~~2235~~ 2303



TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS	ROTAMETER READINGS 1- SAMPLES	2- SAMPLES	C- SAMPLES	D- SAMPLES
0	46	43		
5	46	43		
10	46	43		
15	46	43		
20	46	43		
25	46	43		
30	46	43		

30 (MIN) NET TIME, MINUTES

CALIBRATION	AMB. TEMP. (ta)	-1- TIME SECONDS (SEC)	-1- VOLUME MILS (VC)	-2- TIME SECONDS	-2- VOLUME MILS	-C- TIME SECONDS	-C- VOLUME MILS	-D- TIME SECONDS	-D- VOLUME MILS
INITIAL	44		39		38				
FINAL	44		39		38				
AVERAGE	44	60	39	60	38				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

$V_a = \text{MIN.} * \frac{60}{1000} * V_c/\text{SEC}$ $V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

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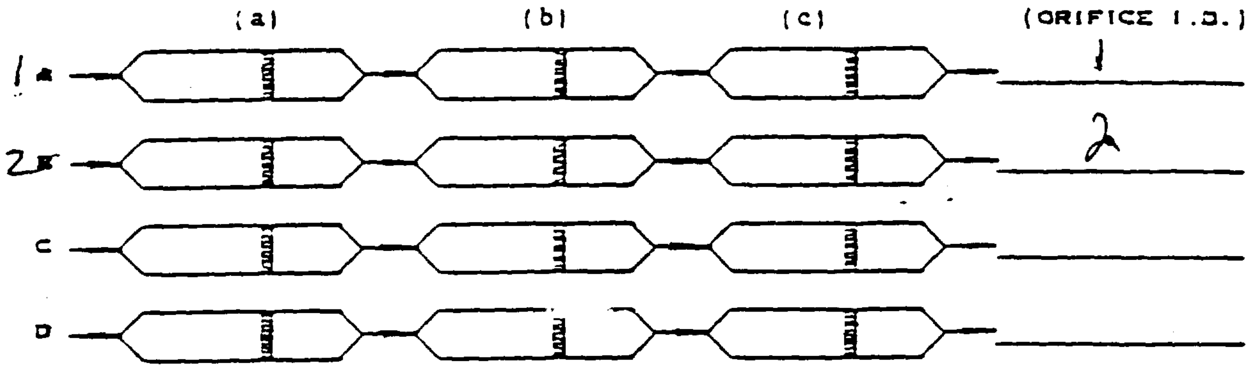
ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME Resourse Conservation	RUN CG-2Br
ADDRESS Garden City GA.	TIME START 2328
SAMPLING LOCATION Condenser Exhaust	TIME FIN. 2348
DATE 2-26-87 TEAM LEADER DK	TECHNICIANS TM
BAROMETRIC PRESSURE, IN. HG. (P_{BAR}) 30.4	PUMP # M-25 T...



TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS		ROTAMETER READINGS			
		1 A- SAMPLES	2 B- SAMPLES	C- SAMPLES	D- SAMPLES
2328	0	46	43		
	5	46	43		
	10	46	43		
	15	46	43		
	20	46	43		

20 NET TIME, MINUTES
(MIN)

BYRON MODEL 490

CALIBRATION	AMB. TEMP. (ta)	-A- 1 ~~TIME SECONDS (SEC)~~	-A- 1 VOLUME MILS (VC)	-B- 2 ~~TIME SECONDS~~	-B- 2 VOLUME MILS	-C- TIME SECONDS	-C- VOLUME MILS	-D- TIME SECONDS	-D- VOLUME MILS
INITIAL	44		39		38				
FINAL	44		39		38				
AVERAGE	44	60	39	60	38				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

V_a = MIN.* $\frac{60}{1000}$ * V_c/SEC $\qquad V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

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ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME RESOURSE CONSERVATION

ADDRESS GARDEN CITY, GA.

SAMPLING LOCATION CONDENSER EXHAUST

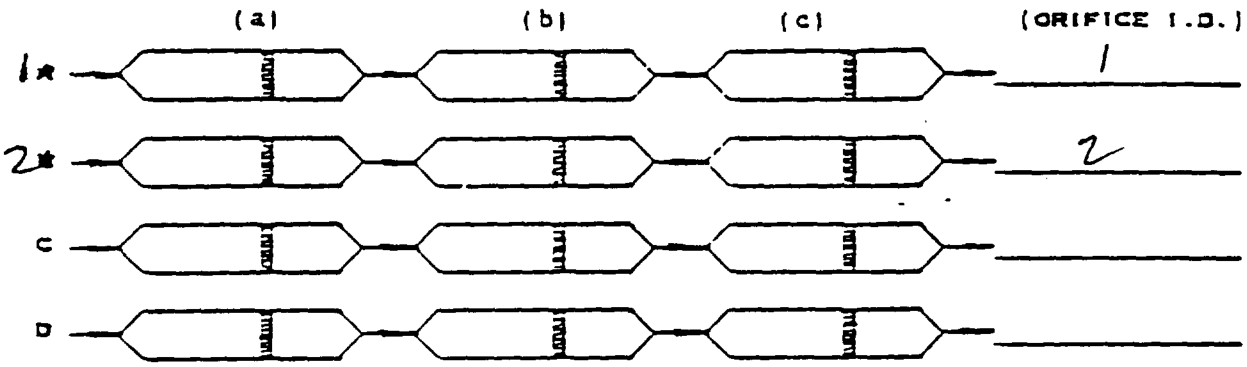
DATE 2-27-87 TEAM LEADER DC TECHNICIANS TM

BAROMETRIC PRESSURE, IN. HG. (P_{BAR}) 30.4 PUMP # H-2S TANK

RUN CE-2C

TIME START 019

TIME FIN. 049



TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS		ROTAMETER READINGS 1 SAMPLES	2 SAMPLES	C- SAMPLES	D- SAMPLES
019	0	46	43		
	5	46	43		
	7	46	43		
	15	46	43		
	20	46	43		
	25	46	43		
	30	46	43		

30 NET TIME, MINUTES
(MIN)

BYRON - MODEL 90

CALI-BRATION	AMB. TEMP. (ta)	1 ~~TIME SECONDS~~ (SEC)	1 VOLUME MILS (VC)	2 ~~TIME SECONDS~~	2 VOLUME MILS	C TIME SECONDS	C VOLUME MILS	D TIME SECONDS	D VOLUME MILS
INITIAL	44		39		38				
FINAL	44		38		39				
AVERAGE	44	60	39	60	39				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

$V_a = \text{MIN.} * \frac{60}{1000} * V_c/\text{SEC}$ $V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

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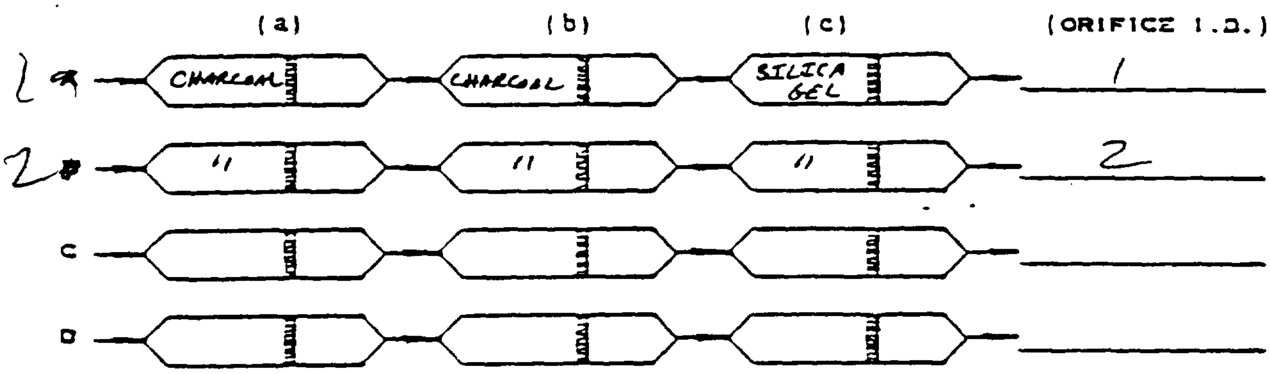
ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME RESOURCE CONSERVATION
ADDRESS GARDEN CITY, GA.
SAMPLING LOCATION CONDENSOR EXHAUST
DATE 2/27/87 TEAM LEADER Bwo TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG. (P_{BAR}) 30.4 PUMP # —

RUN CE-3A
TIME START 03:15
TIME FIN. 03:45



TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS	ROTAMETER READINGS 1 - SAMPLES	2 - SAMPLES	C - SAMPLES	D - SAMPLES
0315/ 0	~~43~~ 45	42		
5	4~~6~~	43		
10	46	43		
15	46	43		
20	46	43		
25	46	43		
0345/ 30				

30 NET TIME, MINUTES
(MIN)

CALIBRATION	AMB. TEMP. (ta)	1 TIME SECONDS (SEC)	1 VOLUME MILS (VC)	2 TIME SECONDS	2 VOLUME MILS	C TIME SECONDS	C VOLUME MILS	D TIME SECONDS	D VOLUME MILS
INITIAL	48	NA	39	NA	38				
FINAL	50	NA	39	NA					
AVERAGE	49	60	39	60	38				
VOLUME LITERS (Va)			l		l		l		l
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

V_a = MIN. * $\frac{60}{1000}$ * V_c/SEC $\qquad V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

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ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME Resource Conservation

ADDRESS Garden City, Ga.

SAMPLING LOCATION Condensor Exhaust

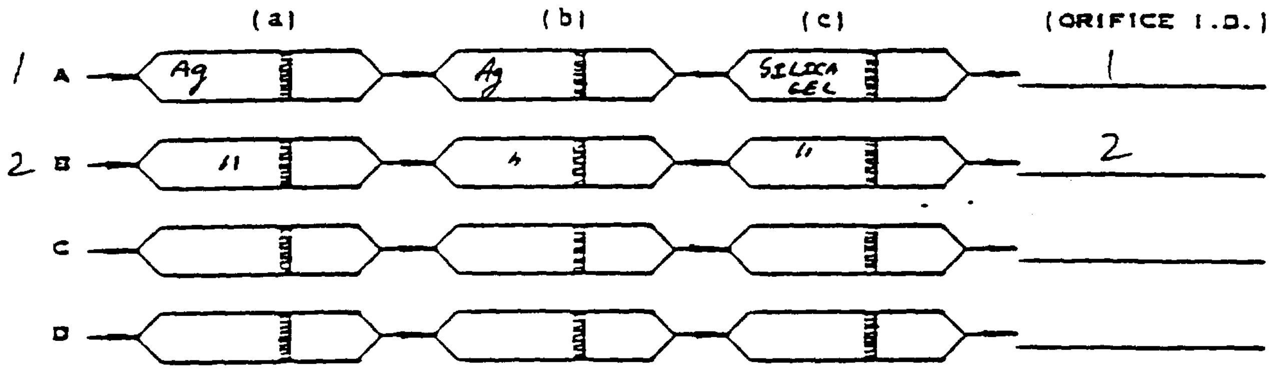
DATE 2/27/87 TEAM LEADER BWH TECHNICIANS —

BAROMETRIC PRESSURE, IN. HG. (P_{BAR}) 30.4 PUMP # ____

RUN CE-3B

TIME START 0420

TIME FIN. 0450



TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS	ROTAMETER READINGS 1 SAMPLES	2 SAMPLES	C- SAMPLES	D- SAMPLES
0420 / 0	46	43		
5	46	43		
10	46	43		
15	46	43		
20	46	43		
25	46	43		
0450 / 30	46	43		

30 (MIN) NET TIME, MINUTES

CALIBRATION	AMB. TEMP. (ta)	1 TIME SECONDS (SEC)	1 VOLUME MILS (VC)	2 TIME SECONDS	2 VOLUME MILS	-C- TIME SECONDS	-C- VOLUME MILS	-D- TIME SECONDS	-D- VOLUME MILS
INITIAL	50	NA	39	N/A	38				
FINAL	50		39		38				
AVERAGE	50	60	39	60	38				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

$V_a = \text{MIN.} * \frac{60}{1000} * V_c/\text{SEC}$ $\quad V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

6/86

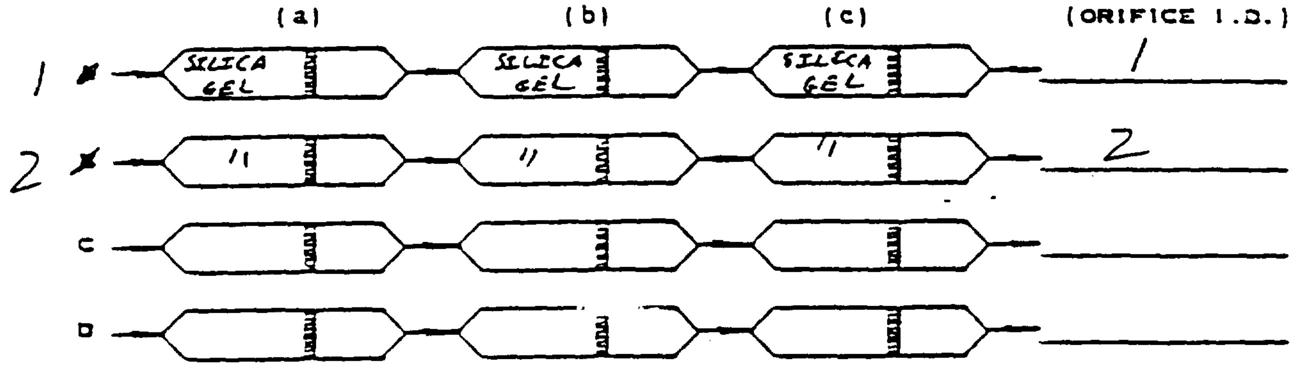
F-102

ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME Resource Conservation
ADDRESS Garden City, Ga
SAMPLING LOCATION Condenser Exhaust
DATE 2/27/87 TEAM LEADER BWH TECHNICIANS
BAROMETRIC PRESSURE, IN. HG. (P_{BAR}) 30.4 PUMP #

RUN CE-3C
TIME START 520
TIME FIN. 550



TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS	ROTAMETER READINGS			
	1 A- SAMPLES	2 B- SAMPLES	C- SAMPLES	D- SAMPLES
520/ 0	46	43		
5	46	43		
10	46	43		
15	46	43		
20	46	43		
25	46	43		
550/ 30	46	43		

30 NET TIME, MINUTES
(MIN)

CALIBRATION	AMB. TEMP. (ta)	1 -A- TIME SECONDS (SEC)	1 -A- VOLUME MILS (VC)	B 2 TIME SECONDS	B 2 VOLUME MILS	-C- TIME SECONDS	-C- VOLUME MILS	-D- TIME SECONDS	-D- VOLUME MILS
INITIAL	50	NA	39	NA	38				
FINAL	50	NA	39	NA	38				
AVERAGE	50	60	39	60	38				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

V_a = MIN.* $\frac{60}{1000}$ * V_c/SEC

$V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

6/86
F-102

ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME: RESOURCES CONSERVATION CO.
ADDRESS: GARDEN CITY, GA.
SAMPLING LOCATION: CONDENSER EXHAUST
DATE: 2/28/87 TEAM LEADER: BWH TECHNICIANS: —
BAROMETRIC PRESSURE, IN. HG. (P_{BAR}): 30.4 PUMP #: —

RUN: CE-4A
TIME START: 11:15
TIME FIN.: 11:45

	(a)	(b)	(c)	(ORIFICE I.D.)
1	CHARCOAL	CHARCOAL	SILICA	1
2	"	"	"	2
C				
D				

TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS	ROTAMETER READINGS 1 SAMPLES	2 SAMPLES	C- SAMPLES	D- SAMPLES
11:15 / 0	46	43		
5	46	43		
10	46	43		
15	46	43		
20	46	43		
25	46	43		
30	46	43		

30 (MIN) NET TIME, MINUTES

CALI-BRATION	AMB. TEMP. (ta)	1 TIME SECONDS (SEC)	1 VOLUME MILS (VC)	2 TIME SECONDS	2 VOLUME MILS	C TIME SECONDS	C VOLUME MILS	D TIME SECONDS	D VOLUME MILS
INITIAL	46	NA	39	NA	38				
FINAL	46	NA	39	NA.	38				
AVERAGE	46	60	39	100	38				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

$V_a = \text{MIN.} * \frac{60}{1000} * V_c/\text{SEC}$ $V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

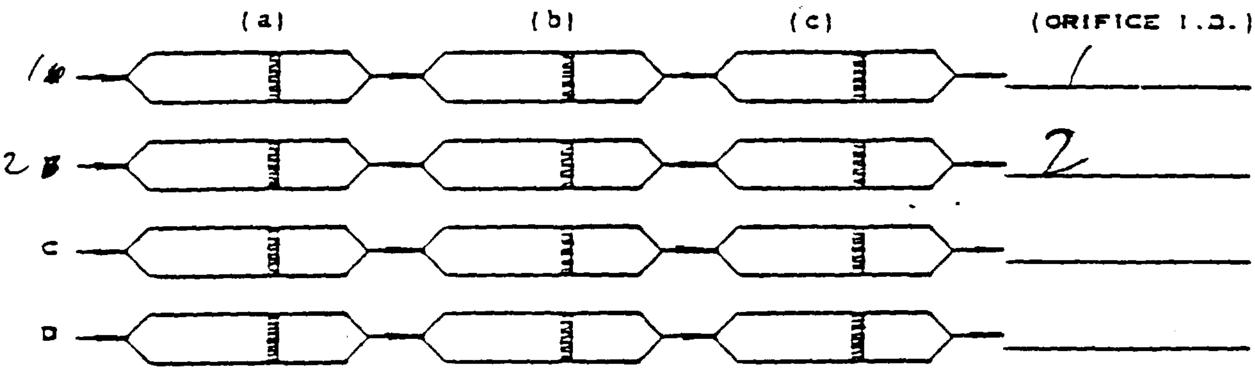
6/86
F-1021

ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME: RESOURCES CONSERVATION
ADDRESS: GARDEN CITY, GA.
SAMPLING LOCATION: CONDENSER EXHAUST
DATE: 1/28/87   TEAM LEADER: Bull   TECHNICIANS: —
BAROMETRIC PRESSURE, IN. HG. (P_{BAR}): 30.4   PUMP #: —

RUN: CE-4B
TIME START: 12:00
TIME FIN.: 12:30



TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS	ROTAMETER READINGS 1 - SAMPLES	2 - SAMPLES	C - SAMPLES	D - SAMPLES
0	46	43		
5	46	43		
10	46	43		
15	46	43		
20	46	43		
25	46	43		
30				

30 (MIN) NET TIME, MINUTES

		-A-		-B-		-C-		-D-	
CALIBRATION	AMB. TEMP. (ta)	TIME SECONDS (SEC)	VOLUME MILS (VC)	TIME SECONDS	VOLUME MILS	TIME SECONDS	VOLUME MILS	TIME SECONDS	VOLUME MILS
INITIAL	48	NA	39	NA	38				
FINAL	48	—	39	—	38				
AVERAGE	48	60	39	60	38				
VOLUME LITERS (Va)			1		1		1		1
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

V_a = MIN. * $\frac{60}{1000}$ * V_c/SEC $V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

0/86

F-102

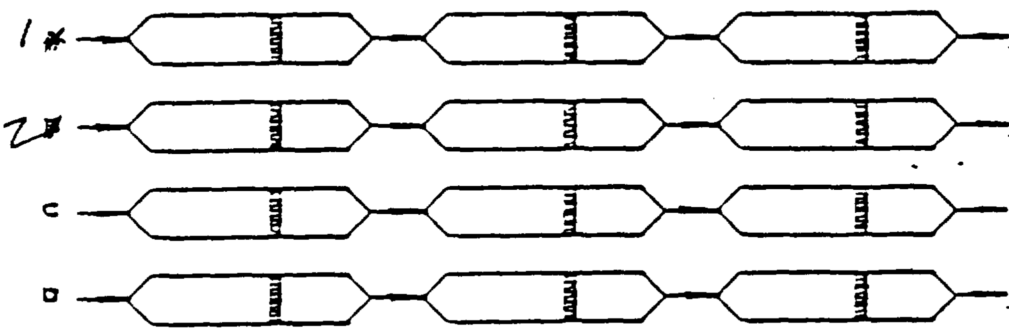
ENTROPY

ADSORBENT SAMPLING TRAIN FIELD DATA

COMPANY NAME: RESOURCES CONSERVATION
ADDRESS: GARDEN CITY, GA.
SAMPLING LOCATION: CONDENSER EXHAUST
DATE: 2/28/87 TEAM LEADER: BWG TECHNICIANS: —
BAROMETRIC PRESSURE, IN. HG. (P_{BAR}): 30.4 PUMP #: —

RUN: CE-4C
TIME START: 1250
TIME FIN.: 1320

(a) (b) (c) (ORIFICE I.D.)



	ORIFICE I.D.
1#	1
2#	2
C	
D	

TYPICAL LABELLING FOR TUBE A (a): 1-A-a

CLOCK TIME HOURS	ROTAMETER READINGS 1 R- SAMPLES	2#- SAMPLES	C- SAMPLES	D- SAMPLES
1250/ 0	46	43		
5	46	43		
10	46	43		
15	46	43		
20	46	43		
25	46	43		
1320/ 30				

30 NET TIME, MINUTES
(MIN)

CALIBRATION	AMB. TEMP. (ta)	1 TIME SECONDS (SEC)	1 VOLUME MILS (VC)	2 TIME SECONDS	2 VOLUME MILS	C TIME SECONDS	C VOLUME MILS	D TIME SECONDS	D VOLUME MILS
INITIAL	46	NA	39	NA	38				
FINAL	46	"	39	"	38				
AVERAGE	46	60	39	60	38				
VOLUME LITERS (Va)			l		l		l		l
VOLUME STANDARD (V_{sc})			dsl		dsl		dsl		dsl

$V_a = \text{MIN.} * \frac{60}{1000} * V_c/\text{SEC}$ $V_{sc} = 17.64 * \frac{P_{bar}}{(t_a + 460)} * V_a$

6/86
F-1024

ENTROPY

APPENDIX B.2

B. FIELD DATA

2. Oil Polisher Outlet

OP-1 Calculations

VELOCITY TRAVERSE DATA AND CALCULATIONS

Company name ______ Date 2/27/87

Address ______ Time start ______

Measurement location ______ Time finish ______

Duct dimensions 3" ∅ Duct area (A) 7.07 $in.^2$ Personnel ______

Barometric pressure (p_{bar}) 30.4 in.Hg Static pressure (P_g) 0 in. H_2O

Percent moisture (% H_2O) 98.1 % Pitot Tube Coefficient (C_p) 0.84

~~Point~~ TIME	Δp in.H_2O	Temp. °F	Point #	Δp in.H_2O	Temp. °F	Point #	Δp in.H_2O	Temp. °F	Point #	Δp in.H_2O	Temp. °F
~~[illegible]~~	~~0.05~~										
~~1114~~	~~0.055~~		1114	0.05	212						
~~1115~~	~~0.105~~		1115	0.055							
~~1116~~	·		1116	0.105							
~~1116:30~~			1116:30	0.115							
			avg = 0.0786								

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$\Delta p_{avg} = (\overline{\sqrt{\Delta p}})^2 = \boxed{0.0786}$ Δp_{avg}

AVERAGE STACK TEMPERATURE, °F

$t_s = \boxed{212}$ t_s

ABSOLUTE STACK GAS PRESSURE, in. Hg

$P_s = (\underset{P_{bar}}{30.4}) + (\underset{P_g}{0}) / 13.6 = \boxed{30.4}$ P_s

DRY MOLE FRACTION OF STACK GAS

$M_{fd} = 1 - (\underset{\%H_2O}{98.1} / 100) = \boxed{0.019}$ M_{fd}

DRY MOLECULAR WEIGHT OF STACK GAS, lb/lb-mole

$M_d = 0.44\ (\underset{\%CO_2}{0}) + 0.32\ (\underset{\%O_2}{20.9}) + 0.28\ (\underset{\%N_2}{79.1} + \underset{\%CO}{\quad}) = \boxed{28.84}$ M_d

WET MOLECULAR WEIGHT OF STACK GAS, lb/lb-mole

$M_s = (\underset{M_d}{28.84})(\underset{M_{fd}}{0.019}) + 0.18\ (\underset{\%H_2O}{98.1}) = \boxed{18.21}$ M_s

AVERAGE STACK GAS VELOCITY, ft/sec

$v_s = 85.49\ (\underset{C_p}{0.84})\ \sqrt{(\underset{\Delta p_{avg}}{0.0786})(\underset{t_s}{212} + 460) / (\underset{P_s}{30.4})(\underset{M_s}{18.21})} = \boxed{22.18}$ v_s

DRY VOLUMETRIC STACK GAS FLOW RATE, scfm

$Q_{sd} = 7.353\ (\underset{M_{fd}}{0.019})(\underset{v_s}{22.18})(\underset{A}{7.07})(\underset{P_s}{30.4}) / (\underset{t_s}{212} + 460) = \boxed{0.991}$ Q_{sd}

WET VOLUMETRIC STACK GAS FLOW RATE, acfm

$Q_{aw} = (60 / 144)(\underset{v_s}{22.18})(\underset{A}{7.07}) = \boxed{65.34}$ Q_{aw}

OP-1

AIR FLOW RATE FIELD DATA

COMPANY NAME Resources Conservation

ADDRESS Garden City GA

SAMPLING LOCATION 0.1 Polisher Outlet PERSONNEL RWM

DATE 2/27/87 DUCT DIMENSIONS 3" Dia DUCT AREA (A) 7.07 IN^2

BAROMETRIC PRESSURE (P_{bar}) 30.4 IN. Hg STATIC PRESSURE (P_g) 0 IN. H_2O

PITOT PROBE I.D. ______ PITOT TUBE COEFFICIENT (C_p) 0.84

ASSUMED FLUE GAS MOLECULAR WT;
MOISTURE CONTENT ASSUMED TO BE AT SATURATION LEVEL.

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F
OP-1	1114		0.05	212
	1115	1 min	0.055	212
	1116	1 min	0.105	212
	1116.5	.5 min	0.115	212
		Avg.	0.07858	212

RUN #	24 HR. CLOCK TIME	ELAPSED TIME	ΔP IN. H_2O	TEMP. °F

F-1024
8-86

ENTROPY

EVACUATED TANK FIELD DATA

Column 96

Company Name RESOURCES CONSERVATION Run # OP-1

Address Garden City, Ga Date 2/27/87

Sampling Location Oil Polisher Outlet Start 1114

Tank Number GT24 Tank Volume 7.071 liters Finish 1116.30

Operator RWM

SONIC ORIFICE ID - ~~[illegible]~~ 191 cc

TANK PARAMETERS

Parameter	Barometric Pressure, in.Hg	Barometric Pressure, mmHg	Tank Temp., F	Tank Temp., C	Tank Pressure (mm Hg) Gauge	Tank Pressure (mm Hg) Absolute	Leak Check (cm Hg change) Tank	Leak Check (cm Hg change) System
Pretest	30.4	~~786~~	48	9	-756	16.2		
Post Test	30.4	772.2	48	9	-670	102.		
at lab → Final Pressure	~~30.4~~ 29.12		~~48~~ 66	9	+406			

$V_{sample} = 0.833$ dsl

SAMPLE DATA

Clock Time	Gauge Pressure, Inches Hg	Flow Meter Setting, cc/min	TEMP
1114	0.05		
1115	.055		
1116	.105		
	.115		
1114	0.05		
1115	0.055		
1116	0.105		
1116.34	0.115		

F-1043, 9/86

APPENDIX C

ANALYTICAL DATA

Report Number: 5448
Date Samples Received: 03/02/86
Date Samples Analyzed: 03/20/86
Analyst: Bruce Hawks
Report Date: 03/23/86

Subject: Analysis of a charcoal tubes for toluene, benzene, and xylenes.

Analytical Methodology: The entire contents of the charcoal tube was desorbed with 4.0 mL of carbon disulfide. Standards were prepared by spiking charcoal tubes with the analytes; the standard tubes were desorbed in the same manner as the sample tube thus inherently correcting for desorption efficiency. Analysis was performed on a Perkin-Elmer Model 8310 gas chromatograph with flame ionization detection. The chromatographic conditions were:

Analytical column	10% SP-1000 on 80/100 Supelcoport 20' x 1/8" S.S.
Column Temperature	$100^{\circ}C$, hold 6 min, $20^{\circ}C$/min to $140^{\circ}C$, hold 4 min
Flow rate	40 mL/min, N_2
Injector Temperature	$250^{\circ}C$
Detector Temperature	$300^{\circ}C$

RESULTS: All results reported in micrograms per sample

Run ID	Benzene	Toluene	Xylenes
CE-1A-1a	1,260	760	1,070
CE-1A-1b	< 0.03	< 0.03	< 0.03
CE-2A-1a	1,260	668	971
CE-2A-1b	< 0.03	< 0.03	< 0.03
CE-3A-1a	1,330	673	1,020
CE-3A-1b	< 0.03	< 0.03	< 0.03
CE-4A-1a	1,220	610	862
CE-4A-1b	< 0.03	< 0.03	< 0.03
OP-1	106	111	389
OP-1	< 0.03	< 0.03	< 0.03

Bruce Hawks

Bruce Hawks

ENTROPY

Oxford Laboratories, Inc.
Analytical and Consulting Chemists
1316 South Fifth Street
Wilmington, N.C. 28401
(919) 763-9793

DATE RECEIVED 3-13-87
DATE REPORTED 3-24-87
87W6114

ENTROPY ENVIROMENTALIST INC
P.O. BOX 12291
RESEARCH TRIANGLE PK. , N.C. 27709-2291

P.O. # 5448A-3

ATTENTION: Bruce Hawks

SAMPLE DESCRIPTION: Bilayered .5N HNO3

1. OP-1 Reagent Upper Layer 1.5ml
2. OP-1 Reagent Lower Layer 46.5ml

RESULTS

	1	2
Mercury, ug/ml	X	<.01
riethylamine, ug/ml	X	1500
Xylene, ug/ml	10,000	X
Toluene, ug/ml	1560	X
Benzene, ug/ml	<400	X

Bruce A. Babson

BRUCE A. BABSON , CHEMIST

Oxford Laboratories, Inc.
Analytical and Consulting Chemists
1316 South Fifth Street
Wilmington, N.C. 28401
(919) 763-9793

DATE RECEIVED 3-13-87
DATE REPORTED 3-12-87
87W6113

ENTROPY ENVIROMENTALIST INC
P.O. BOX 12291
RESEARCH TRIANGLE PK. , N.C. 27709-2291

P.O. # 5448A-2

ATTENTION: Bruce Hawks

SAMPLE DESCRIPTION: 8 Silica Gel Tubes

1. CE-1B-1a
2. CE-1B-1b
3. CE-2B-1a
4. CE-2B-1b
5. CE-3B-1a
6. CE-3B-1b

RESULTS

	1	2	3	4	5	6
Triethylamine,mg/tube	78.3	<0.03	45.5	<0.03	157	<0.03

Oxford Laboratories, Inc.
Analytical and Consulting Chemists
1316 South Fifth Street
Wilmington, N.C. 28401
(919) 763-9793

DATE RECEIVED 3-13-87
DATE REPORTED 3-12-87
87W6113

ENTROPY ENVIROMENTALIST INC
P.O. BOX 12291
RESEARCH TRIANGLE PK. , N.C. 27709-2291

P.O. # 5448A-2

ATTENTION: Bruce Hawks

SAMPLE DESCRIPTION: 8 Silica Gel Tubes

7. CE-4B-1a
8. CE-4B-1b

RESULTS

	7	8
Triethylamine,mg/tube	152	<0.03

NOTE: See Discussion.

Bruce A. Babson
BRUCE A. BABSON , CHEMIST

Oxford Laboratories, Inc.

Analytical and Consulting Chemists
1316 South Fifth Street
Wilmington, N.C. 28401
(919) 763-9793

DATE RECEIVED 3-13-87
DATE REPORTED 3-12-87
87W6115

ENTROPY ENVIROMENTALIST INC
P.O. BOX 12291
RESEARCH TRIANGLE PK. , N.C. 27709-2291

P.O. # 5448A-1

ATTENTION: Bruce Hawks

SAMPLE DESCRIPTION: 8 tubes for Mercury

1. CE-1C-1a
2. CE-1C-1b
3. CE-2C-1a
4. CE-2C-1b
5. CE-3C-1a
6. CE-3C-1b

RESULTS

	1	2	3	4	5	6
Mercury as Hg, ug	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Oxford Laboratories, Inc.

Analytical and Consulting Chemists
1316 South Fifth Street
Wilmington, N.C. 28401
(919) 763-9793

DATE RECEIVED 3-13-87
DATE REPORTED 3-12-87
87W6115

ENTROPY ENVIROMENTALIST INC
P.O. BOX 12291
RESEARCH TRIANGLE PK. , N.C. 27709-2291

P.O. # 5448A-1

ATTENTION: Bruce Hawks

SAMPLE DESCRIPTION: 8 tubes for Mercury

7. CE-4C-1a
8. CE-4C-1b

RESULTS

	7	8
Mercury as Hg, ug	<0.05	<0.05

Bruce A. Babson

BRUCE A. BABSON , CHEMIST

Oxford Laboratories, Inc.
Analytical and Consulting Chemists
1316 South Fifth Street
Wilmington, N.C. 28401
(919) 763-9793

March 19, 1987

Entropy Environmentalists Inc.
P.O. Box 12291
Research Triangle Park, N.C. 27709-2291

Attention: Bruce Hawks

Sample Description: 8 Silica Gel Tubes

DISCUSSION

"A" tubes were desorbed with 15ml of 1.0 NH_2SO_4. Two desorption efficiency trials were performed using this ratio of solvent to adsorbent. The data for recovery was as follows:

Loading, mg	Recovery, %
36.3	67.4
217.8	86.4

Since these loading rates bracketed the amounts found on the "A" tubes, an average % recovery (76.9) was calculated and data for the "A" was adjusted using this recovery.

Recovery from the "B" tubes was not as efficient, probably due to the fact that only 5ml of acid was used. Recovery at 2.9mg was 25.8%. Detection limits for the "B" tubes were adjusted accordingly.

Bruce A. Babson

Bruce A. Babson, Chemist

BAB/lo

ENTROPY
ENVIRONMENTALISTS INC.

POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919-781-3550

INTERLABORATORY SAMPLE TRANSFER CHAIN-OF-CUSTODY FORM

Please return this form along with the analytical results.

The samples referenced on EEI Purchase Order Number: 5448A-2 were shipped via Pony Express on 3/9/87 by BH to Oxford Labs

Samples received at Oxford Labs on 3-13-87 by Roger Oxford

Note any broken seals, leakage, spillage, and/or damage to the samples.

"OK"

ENTROPY
ENVIRONMENTALISTS INC.

POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919-781-3550

INTERLABORATORY SAMPLE TRANSFER CHAIN-OF-CUSTODY FORM

Please return this form along with the analytical results.

The samples referenced on EEI Purchase Order Number: 5448A-3 were shipped via Pony Express on 3/10/87 by BH to Oxford Lab

Samples received at Oxford Labs on 3-13-87 by Roger Offord

Note any broken seals, leakage, spillage, and/or damage to the samples.

ENTROPY
ENVIRONMENTALISTS INC.

POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919-781-3550

INTERLABORATORY SAMPLE TRANSFER CHAIN-OF-CUSTODY FORM

Please return this form along with the analytical results.

The samples referenced on EEI Purchase Order Number: 5448A-1 were shipped via Pony Express on 3/9/87 by BH to Oxford Lab

Samples received at Oxford Labs on 3-13-87 by Roger Oxford

Note any broken seals, leakage, spillage, and/or damage to the samples.

APPENDIX D

CALIBRATION DATA

ORIFICE CALIBRATIONS

Condenser Exhaust

By: ODR on 3-5-87

Orifice # 1
Box N-5 Y = 1.0237 @ Dh<=0.5
MolWt, wet = 28.68

Orifice Delta P	Meter Delta H	Volume acf	Time min	Meter Tmp-F	Orif Tmp-F	Orif Flow acfm	Bar P. In. Hg	Coeffnt Km	
0.05	0.07	0.664	5	75	69	0.1344	30.05	0.763	
0.10	0.13	0.982	5	78	69	0.1977	30.05	0.791	
0.15	0.18	1.19	5	80	70	0.2391	30.05	0.780	
0.20	0.25	1.359	5	82	70	0.2721	30.05	0.768	
0.25	0.32	1.518	5	84	70	0.3028	30.05	0.763	0.7663
0.30	0.37	1.655	5	86	70	0.3290	30.05	0.755	
0.40	0.48	1.894	5	79	69	0.3807	30.04	0.761	
0.50	0.6	2.124	5	80	69	0.4261	30.04	0.762	
0.60	0.72	2.324	5	82	69	0.4645	30.04	0.757	
							Average	0.7666	

Resourse Conservation

MASS FLOW METER CALIBRATION

BYRON Model 90

BAROMETRIC PRESSURE (MM HG) 758.0 P_B AMBIENT TEMPERATURE (°C) 10 (T_A)	METER IDENTIFICATION Leather Case CALIBRATION DATE 2/26/87 CALIBRATION TIME 1109
--- BUBBLE METER DATA --- RUN TIME (MINUTES) 0.96 (θ) MEASURED VOLUME. (LITERS) 0.10 (V_B)	FLOW RATE SETTING (MLPM) 100.0 METERED VOLUME. V_M (DRY STD. LITERS) 0.10 V_M
VOLUME STD., V_{SB} = (.386)(P_B/(T_A +273))(V_B) = .1034 FLOW RATE. STD = (0.1034 V_{SB})/(0.96 θ) = .10.77	CALIBRATION FACTOR (Y) Y = (.1034 V_{SB})/(0.10 V_M) = 1.034

BAROMETRIC PRESSURE (MM HG) 758.0 P_B AMBIENT TEMPERATURE (°C) 10 (T_A)	METER IDENTIFICATION Leather Case CALIBRATION DATE 2/26/87 CALIBRATION TIME 1109
--- BUBBLE METER DATA --- RUN TIME (MINUTES) 0.95 (θ) MEASURED VOLUME. (LITERS) 0.10 (V_B)	FLOW RATE SETTING (MLPM) 100 METERED VOLUME. V_M (DRY STD. LITERS) 0.10 V_M
VOLUME STD., V_{SB} = (.386)(P_B/(T_A + 273))(V_B) = 0.1034 FLOW RATE. STD = (0.1034 V_{SB})/(0.95 θ) = 0.1088	CALIBRATION FACTOR (Y) Y = (0.1034 V_{SB})/(0.10 V_M) = 1.034

BAROMETRIC PRESSURE (MM HG) 758.0 P_B AMBIENT TEMPERATURE (°C) 10 (T_A)	METER IDENTIFICATION Leather Case CALIBRATION DATE 2/26/87 CALIBRATION TIME 1109
--- BUBBLE METER DATA --- RUN TIME (MINUTES) 0.95 (θ) MEASURED VOLUME. (LITERS) 0.10 (V_B)	FLOW RATE SETTING (MLPM) 100 METERED VOLUME. V_M (DRY STD. LITERS) 0.10 V_M
VOLUME STD., V_{SB} = (.386)(P_B/(T_A +273))(V_B) = 0.1034 FLOW RATE. STD = (0.1034 V_{SB})/(0.95 θ) = 0.1088	CALIBRATION FACTOR (Y) Y = (0.1034 V_{SB})/(0.10 V_M) = 1.034

F-1033
8-86

ENTROPY

APPENDIX E

SAMPLING AND ANALYTICAL PROCEDURES

ALIPHATIC AMINES IN AIR

Physical and Chemical Analysis Branch

Analytical Method

Analyte: Aliphatic Amines	**Method No.:** P&CAM 221
Matrix: Air	**Range:** 1 to 2400 mg/m³ in a 10-liter sample of air
Procedure: Adsorption on silica gel; elution with acid; GC analysis	**Precision** (CV_T): 0.03 for methylamine at 300 mg/m³
Date Issued: 1/29/76	**Classification:** E (Proposed)
Date Revised:	

1. **Principle of the Method**

1.1 A known volume of air is drawn through a tube containing silica gel to trap the aliphatic amines. The silica gel is transferred to glass-stoppered tubes and treated with sulfuric acid. A portion of the resulting acid solution is made alkaline with an excess of sodium hydroxide and an aliquot of the alkaline solution is analyzed by gas chromatography with a flame ionization detector.

1.2 The method may be used to determine a single aliphatic amine or to determine two or more amines in a single sample. The method has been applied to the following individual compounds:

Methylamine
Ethylamine
Dimethylamine
Isopropylamine
Butylamine
Diethylamine
Diisopropylamine
Triethylamine
Cyclohexylamine

2. **Range and Sensitivity**

2.1 The limit of detection of the method is 0.01 mg of amine (0.02 mg of methylamine) per sample when the analyte is desorbed from 150 mg of silica gel with 2 mℓ of sulfuric acid and a 3-μℓ aliquot of the alkaline mixture is analyzed. This limit corresponds approximately to 1 mg/m³ (2 mg/m³ for methylamine) in a 10-liter sample of air.

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4.6 A coefficient of variation of 0.03 has been determined for the analysis of 10 samples of 1.2 mg of methylamine collected from 4 liters of air (300 mg/m^3) with a personal sampling pump. The recovery was 99%.

5. **Advantages and Disadvantages**

5.1 The sampling method uses a small, portable device involving no liquids. The sorbent tube can be used for at least 8 hr to measure an average workday concentration, or for only 15 min to measure an excursion concentration. Desorption of the sample and preparation for analysis are simple. The analysis is accomplished by a rapid instrumental method.

5.2 Most analytical interferences can be eliminated by altering the GC conditions.

5.3 Several aliphatic amines can be collected and determined simultaneously. This is especially useful when the identity and composition of the amine vapors are not known.

5.4 The major disadvantage of the method is the necessity for measuring desorption efficiencies. When the desorption is less than complete, as for higher molecular weight amines, the effect of the amount of compound absorbed must also be determined.

6. **Apparatus**

6.1 **Air Sampling Equipment**

6.1.1 Sorbent tubes. The sorbent tubes consist of Pyrex glass tubes 125 mm long and 8 mm i.d., packed with three separate sections of 45/60-mesh activated silica gel. The weights of the three sections of silica gel are, in order, 600, 150, and 150 mg; these tubes are designed for sample flow in either direction. Plugs of 100-mesh stainless steel screen are used to contain the silica gel sections. These plugs of negligible pressure drop are prepared from 7-mm discs of screen held in place by Teflon rings. Pieces of Pyrex tubing 12 mm long and 7 mm in o.d. are located between the sorbent sections to inhibit migration of the amines. The ends of the tubes are flamesealed after packing to prevent contamination before use for sampling. The pressure drop across the tubes does not exceed 6 cm of water at a flow rate of 200 mℓ/min. The silica gel should be the equivalent of Silica Gel D-08, Chromatographic Grade, Activated and Fines Free, 45/60-mesh, as supplied by Applied Science Laboratories, Inc., State College, Pa. Polyethylene caps should be provided to seal the tubes after sampling has been completed.

8.2 Collection and Shipping of Samples

8.2.1 Immediately before beginning the collection of a sample, break each end of the sorbent tube so as to provide openings at least half the inside diameter of the tube.

8.2.2 Choose the direction desired for sample flow, mark the inlet end of the tube with a permanent marker, and attach the other end to the sampling pump. For low concentrations of amines, low humidity conditions, or short sampling periods, pump the sample air through the 150-mg sorbent section first; for high concentrations, high humidity, or long sampling periods, pump the sample air through the 600-mg sorbent section first. Sample air must not pass through any hose or tubing before entering the sorbent tube.

8.2.3 With the sorbent tube in a vertical position, sample the air at 200 mℓ/min for the desired period of time (0.25 to 8 hr). The flow rate and sampling time, or the volume, must be measured as accurately as possible. The temperature and pressure of the air being sampled should be measured and recorded.

8.2.4 Immediately after sampling is completed, cap the sorbent tubes with the polyethylene caps provided. Rubber caps must not be used.

8.2.5 One tube should be handled in the same manner as the sample tubes (break, seal, and ship) except that no air is pumped through it. Label this tube as a blank.

8.2.6 Pack the tubes tightly before shipping to minimize breakage in transit.

8.2.7 After the sample is collected the tubes should not be subjected to extremes of high temperature or low pressure. Refrigeration will reduce sample loss.

8.3 Analysis of Samples

8.3.1 Preparation of Samples. Remove and discard the stainless steel plugs and glass spacers and transfer each section of silica gel to a separate glass-stoppered test tube or flask. Label the samples and analyze each section separately.

8.3.2 Desorption. Desorb the amines from the silica gel by adding 2 mℓ of 1.0 *N* sulfuric acid to the 150-mg sections and 8 mℓ to the 600-mg section. Shake the sample mixtures occasionally over a period of 1 hr. Tests have indicated that desorption reaches a maximum in an hour.

8.4.1 Importance of Determination. Desorption efficiency for a particular compound can vary from one lot of silica gel to another, and also from one laboratory to another. Therefore, it is necessary to determine at least once the desorption efficiency for each amine with each lot of silica gel used. Among the aliphatic amines listed in Section 1.2 desorption efficiency decreases with increasing molecular weight. Desorption efficiency increases with increasing ratio of sulfuric acid to silica gel; however, an increase in this ratio results in a reduction in analytical sensitivity. A compromise ratio of 75 mg of silica gel per milliliter of sulfuric acid is recommended. Desorption efficiency may also vary with the amount of amine present on the silica gel. Measurements of efficiency should, therefore, be made for at least two amounts within the normal range of sample size.

8.4.2 Procedure for Determination of Desorption Efficiency. Place 150 mg of silica gel in a 2-mℓ glass-stoppered tube. The silica gel must be from the same lot as that used in collecting the sample; it can be obtained from unused sorbent tubes. With a microliter syringe, inject a known amount of the amine, either pure or in water solution, directly onto the silica gel. Close the tube with the glass stopper and allow it to stand at least overnight to insure complete adsorption of the amine. Prepare at least three tubes for each of at least two different amounts of amine. These tubes are referred to as samples. Prepare a blank in the same manner, omitting the amine. Analyze the samples and blank as described in Section 8.3. Also analyze three standards prepared by adding identical amounts of the amine to 2.0 mℓ of 0.1 *N* sulfuric acid. Determine the concentrations of the amine in the blank, samples, and standards using calibration curves prepared as described in Section 9. The desorption efficiency is calculated by dividing the concentration of amine found in the sample by the concentration obtained for the corresponding standard.

9. Standards and Calibration

9.1 For accuracy in the preparation of standards, it is recommended that an initial standard be prepared in a relatively large volume and at a high concentration. Aliquots of this standard can then be diluted to prepare other standards. Prepare the initial standard by pipetting an appropriate volume of amine into a 100-mℓ volumetric flask and adding distilled water to the mark. Check the concentration of this solution by titrating with standard sulfuric acid. Make the first dilution by adding an equal volume of 2.0 *N* sulfuric acid to an aliquot of the initial standard. Make additional dilutions with 1.0 *N* sulfuric acid so that the final concentration of sulfuric acid will be the same in standards and samples.

10.3 The concentration may also be expressed in terms of parts per million (ppm) by volume:

$$ppm = mg/m^3 \times \frac{24.45}{M.W.} \times \frac{760}{P} \times \frac{T+273}{298}$$

where: 24.45 = molar volume (ℓ/mole) at 25° C and 760 mmHg.

M.W. = molecular weight.

P = pressure (mmHg) of air sampled.

T = temperature (°C) of air sampled.

11. References

11.1 Campbell, Evan E., G.O. Wood, and R.G. Anderson, "Development of Air Sampling Techniques," Los Alamos Scientific Laboratory, Progress Reports LA-5634-PR (June 1974), LA-5973-PR (J ıy 1975), and LA-6057-PR (September 1975).

11.2 Andre, C.E., and A.R. Mosier, "Precolumn Inlet System for the Gas Chromatographic Analysis of Trace Quantities of Short-Chain Aliphatic Amines," Anal. Chem., 45, 1971 (1973).

11.3 Wood, G. O., and R. G. Anderson, "Development of Air Monitoring Techniques Using Solid Sorbents," Los Alamos Scientific Laboratory, Progress Reports LA-6216-PR (February 1976) and LA-6513-PR (September 1976).

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FORMULA: Table 1

HYDROCARBONS, AROMATIC

METHOD: 1501
ISSUED: 2/15/84

M.W.: Table 1

OSHA, NIOSH, ACGIH: Table 2

PROPERTIES: Table 1

COMPOUNDS: (Synonyms in Table 1)				
benzene	cumeme	α-methylstyrene	styrene	vinyltoluene
p-tert-butyltoluene	ethylbenzene	naphthalene	toluene	xylene

SAMPLING

SAMPLER: SOLID SORBENT TUBE (coconut shell charcoal, 100 mg/50 mg)

FLOW RATE, VOLUME: Table 3

SHIPMENT: no special precautions

SAMPLE STABILITY: not determined

BLANKS: 2 to 10 field blanks per set

BULK SAMPLE: desirable, 1 to 10 mL; ship in separate containers from samples

ACCURACY

RANGE STUDIED,
BIAS and OVERALL PRECISION (s_r): Table 3

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, FID

ANALYTES: hydrocarbons listed above

DESORPTION: 1 mL CS_2; stand 30 min

INJECTION VOLUME: 5 µL

TEMPERATURE-INJECTION: 225 °C
-DETECTOR: 225 °C
-COLUMN: see step 11

CARRIER GAS: N_2 or He, 25 mL/min

COLUMN: glass, 3.0 m x 2 mm, 10% OV-275 on 100/120 mesh Chromosorb W-AW or equivalent

CALIBRATION: analytes in CS_2

RANGE AND PRECISION (s_r): Table 4

ESTIMATED LOD: 0.001 to 0.01 mg per sample with capillary column [1]

APPLICABILITY: This method is for peak, ceiling and TWA determinations of aromatic hydrocarbons It may be used for simultaneous measurements, though there is the possibility that interactions between analytes may reduce the breakthrough volumes and change desorption efficiencies.

INTERFERENCES: Use of the recommended column will prevent interference by alkanes ($\leq C_{10}$). Under conditions of high humidity, the breakthrough volumes may be reduced by as much as 50%. Other volatile organic solvents, e.g., alcohols, ketones, ethers and halogenated hydrocarbons, are possible interferences. If interference is suspected, use a less polar column or change column temperature.

OTHER METHODS: This method is based on and supercedes Methods P&CAM 127, benzene, styrene, toluene and xylene [2]; S311, benzene [4]; S22, p-tert-butyltoluene [3]; S23, cumene [3]; S29, ethylbenzene [3]; S26, α-methylstyrene [3]; S292, naphthalene [4]; S30, styrene [3]; S343, toluene [4]; S25, vinyltoluene [3]; S318, xylene [4].

9. Determine desorption efficiency (DE) at least once for each batch of charcoal used for sampling in the calibration range (step 8). Prepare three tubes at each of five levels plus three media blanks.
   a. Remove and discard back sorbent section of a media blank sampler.
   b. Inject a known amount of analyte (calibration stock solution for naphthalene) directly onto front sorbent section with a microliter syringe.
   c. Cap the tube. Allow to stand overnight.
   d. Desorb (steps 5 through 7) and analyze together with working standards (steps 11, 12 and 13).
   e. Prepare a graph of DE vs. mg analyte recovered.
10. Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1501-1. Select appropriate column temperature:

	Approximate Retention Time (min), at Indicated Column Temperature			
Substance[a]	50 °C	100 °C	150 °C	Programmed[b]
benzene	2.5			2.5
toluene	4.3	1.1		4.2
xylene (para)	7.0	1.4		5.2
ethylbenzene	7.0	1.4		5.5
xylene (meta)	7.2	1.5		5.6
cumene	8.3	1.6		6.0
xylene (ortho)	10	1.9		6.5
styrene	16	2.6		7.6
α-methylstyrene		3.2	1.0	8.1
vinyltoluene (meta)		3.8	1.2	8.5
naphthalene		25	4.3	12

[a]Data not available for p-tert-butyltoluene and p-vinyltoluene.
[b]Temperature program: 50 °C for 3 min, then 15 °C/min to 200 °C.

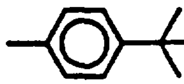
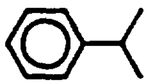
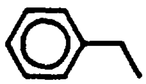
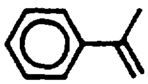
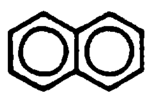
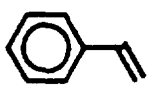
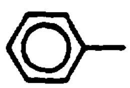
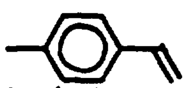
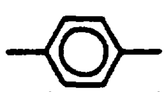
NOTE: Alternatively, column and temperature may be taken from Table 4.

12. Inject sample aliquot manually using solvent flush technique or with autosampler.
    NOTE: If peak area is above the linear range of the working standards, dilute with eluent, reanalyze and apply the appropriate dilution factor in calculations.
13. Measure peak area.

CALCULATIONS:

14. Determine the mass, mg (corrected for DE) of analyte found in the sample front (W_f) and back (W_b) sorbent sections, and in the average media blank front (B_f) and back (B_b) sorbent sections.
    NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.

Table 1. Synonyms, formula, molecular weight, properties [5].

Name/Synonyms	Structure	Empirical Formula	Molecular Weight	Boiling Point (°C)	Vapor Pressure @ 25 °C (mm Hg)	Vapor Pressure @ 25 °C (kPa)	Density @ 20 °C (g/mL)
benzene CAS #71-43-2		C_6H_6	78.11	80.1	95.2	12.7	0.879
p-*tert*-butyltoluene CAS #98-51-1 1-*tert*-butyl-4-methylbenzene		$C_{11}H_{16}$	148.25	192.8	0.7	0.09	0.861
cumene CAS #98-82-8 isopropylbenzene		C_9H_{12}	120.20	152.4	4.7	0.62	0.862
ethylbenzene CAS #100-41-4		C_8H_{10}	106.17	136.2	9.6	1.28	0.867
α-methylstyrene CAS #98-83-9 isopropenylbenzene (1-methylethenyl)-benzene		C_9H_{10}	118.18	165.4	2.5	0.33	0.911
naphthalene CAS #91-20-3		$C_{10}H_8$	128.18	80.2[a]	0.2	0.03	1.025
styrene CAS #100-42-5 vinylbenzene		C_8H_8	104.15	145.2	6.1	0.81	0.906
toluene CAS #108-88-3 methylbenzene		C_7H_8	92.14	110.6	28.4	3.79	0.867
vinyltoluene[b]		C_9H_{10}	118.18	167.7	1.6	0.22	0.898
CAS #25013-15-4			(meta)	171.6	1.9	0.26	0.911
methylstyrene	(p-vinyltoluene)		(para)	172.8	1.8	0.24	0.911
methylvinylbenzene			(ortho)	169.8	1.8	0.24	0.904
xylene[c]		C_8H_{10}	106.17				
CAS #1330-20-7			(ortho)	144.4	6.7	0.89	0.880
dimethylbenzene	(p-xylene)		(meta)	139.1	8.4	1.12	0.864
			(para)	138.4	8.8	1.19	0.861

[a]Melting point.
[b]Commercial mixture of meta and para isomers.
[c]Mixture of isomers.

Table 4. Measurement range, precision and conditions[a] [3,4,12].

Substance	Desorption Volume (mL)	Measurement Range (mg)	Measurement Precision (s_r)	Carrier Flow (mL/min)	Column Parameters[b] t (°C)	Column Parameters[b] Length (m)	Column Parameters[b] Packing[c]
benzene	1.0	0.09- 0.35	0.036	50	115	0.9	A
p-*tert*-butyltoluene	0.5	0.27- 1.09	0.021[d]	50	115	3.0	B
cumene	0.5	0.86- 3.46	0.010	50	99	3.0	B
ethylbenzene	0.5	2.17- 8.67	0.010	50	85	3.0	B
α-methylstyrene	0.5	0.69- 3.57	0.011	50	115	3.0	B
naphthalene	1.0	4.96-19.7	0.019	30	125	3.0	C
styrene	0.5	2.17- 8.49	0.013[d]	50	109	3.0	B
toluene	1.0	1.13- 4.51	0.011	50	155	0.9	D
vinyltoluene	0.5	2.41- 9.64	0.008	50	120	3.0	B
xylene	1.0	2.[illegible]-[illegible]0.4	0.010	50	180	0.9	D

[a]Injection volume, 5.0 µL; nitrogen carrier gas.
[b]All columns stainless steel, 3.2 mm outside diameter.
[c]A, 50/80 mesh Porapak P; B, 10% FFAP on 80/100 mesh Chromosorb W AW-DMCS;
C, 10% OV-101 on 100/120 mesh Supelcoport; D, 50/80 mesh Porapak Q.
[d]Corrected value, calculated from data in [12].

FORMULA: Hg

MERCURY

METHOD: 6000
ISSUED: 2/15/84

M.W.: 200.59

OSHA: 0.1 mg/m^3
NIOSH: 0.05 mg/m^3 [1]
ACGIH: 0.05 mg/m^3

PROPERTIES: liquid; d 13.55 g/mL @ 20 °C; BP 356 °C; MP -39 °C; VP 0.16 Pa (0.0012 mm Hg; 13.2 mg/m^3) @ 20 °C

SYNONYMS: quicksilver; CAS# 7439-97-6.

SAMPLING

SAMPLER: SOLID SORBENT TUBE (30 mg silvered Chromosorb P, with glass fiber prefilter)

FLOW RATE: 0.01 to 0.2 L/min

VOL-MIN: 0.5 L
-MAX: 7 L @ 0.1 mg/m^3

SHIPMENT: routine

SAMPLE STABILITY: at least 7 days @ 25 °C [2]

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: 0.0456 to 0.18 mg/m^3 [2,4] (3-L samples)

BIAS: not significant [2,4]

OVERALL PRECISION (s_r): 0.061 [2]

MEASUREMENT

TECHNIQUE: ATOMIC ABSORPTION, FLAMELESS

ANALYTE: elemental mercury

DESORPTION: thermal (650 to 700 °C)

CARRIER GAS: air, 1.0 L/min

WAVELENGTH: 253.7 nm

CALIBRATION: aqueous Hg^{2+} spikes onto sampler

RANGE: 0.01 to 1 µg per sample [2,4]

ESTIMATED LOD: 0.001 µg per sample

PRECISION (s_r): 0.051 [2,3]

APPLICABILITY: The working range is 0.003 to 0.3 mg/m^3 for a 3-L air sample. If a glass fiber (13-mm) filter is used to prevent potential interference from mercury compounds, this filter may be analyzed for particulate Hg species [4]. This method is not affected by high humidity environments (breakthrough determined at 85% R.H.) [2].

INTERFERENCES: Chlorine and other strong oxidizing gases which attack silver (the sampling substrate), reduce the efficiency of the sampling tube but do not interfere in the measurement. Methyl mercuric chloride is partially retained on the sampler and is, therefore, a potential interferent [5].

OTHER METHODS: This method combines and replaces P&CAM 175 [4] and S199 [3].

MEASUREMENT:

8. Set up the measurement system as described in the APPENDIX.
9. Purge the system before analyzing samples and standards by heating the first desorption section 60 sec, allowing to cool 60 sec and heating second section 30 sec.
10. Allow system to cool 1 min before analyzing samples.
11. Measure samples and standards by inserting the tube, thermally desorbing first section 60 sec, waiting 60 sec and desorbing second section for 30 sec.
    NOTE: Handle the tube only with lint-free gloves or tissues to prevent contamination.
12. Allow the system to cool at least 30 sec before removing tube and inserting the next sample.
    CAUTION: Tubes are hot when removed. Catch them in a dry beaker as they come out of the desorption unit.

CALCULATIONS:

13. Read the absorbance of the sample and calculate the mass of Hg on the samples, W (µg), and blanks from the calibration graph. Obtain an average value for the media blanks, B (µg).
14. Calculate the concentration, C (mg/m³), of mercury in air volume sampled, V (L):

$$C = \frac{W - B}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Method S199 [2] was issued on July 8, 1977, and validated over the range 0.046 to 0.18 mg/m³ at 760 mm Hg and 18.0 °C using a 3-L sample [6]. Overall precision, s_r, was 0.061 with average recovery of 100.7%. The mercury concentration was independently determined by theoretical calculations based on mercury vapor pressure data and flow rate. Breakthrough did not occur after sampling 3.5 hrs at 0.184 L/min (39 L) in a Hg concentration of 0.244 mg/m³ and 85% relative humidity. Six samples stored at room temperature for seven days gave results not significantly different from samples that were analyzed immediately after exposure.

REFERENCES:

[1] Criteria for a Recommended Standard...Occupational Exposure to Inorganic Mercury, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 73-11024 (1973).
[2] Backup Data Report No. S199, prepared under NIOSH Contract 210-76-0123, available as "Ten NIOSH Analytical Methods, Set 5," available as Order No. PB 287-499 from NTIS, Springfield, VA 22161 (1977).
[3] NIOSH Manual of Analytical Methods, 2nd. ed., V. 4, S199, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-175 (1978).
[4] Ibid, V. 5, P&CAM 175, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 79-141 (1979).
[5] Trujillo, P. E. and E. E. Campbell. Development of a Multistage Air Sampler for Mercury, Anal. Chem., 47, 1629-1634 (1975).
[6] NIOSH Research Report-Development and Validation of Methods for Sampling and Analysis of Workplace Toxic Substances, U.S. Department of Health and Human Services, Publ. (NIOSH) 80-133 (1980).

METHOD REVISED BY: R. DeLon Hull, NIOSH/DPSE; S199 originally validated under NIOSH Contract CDC-99-76-123.

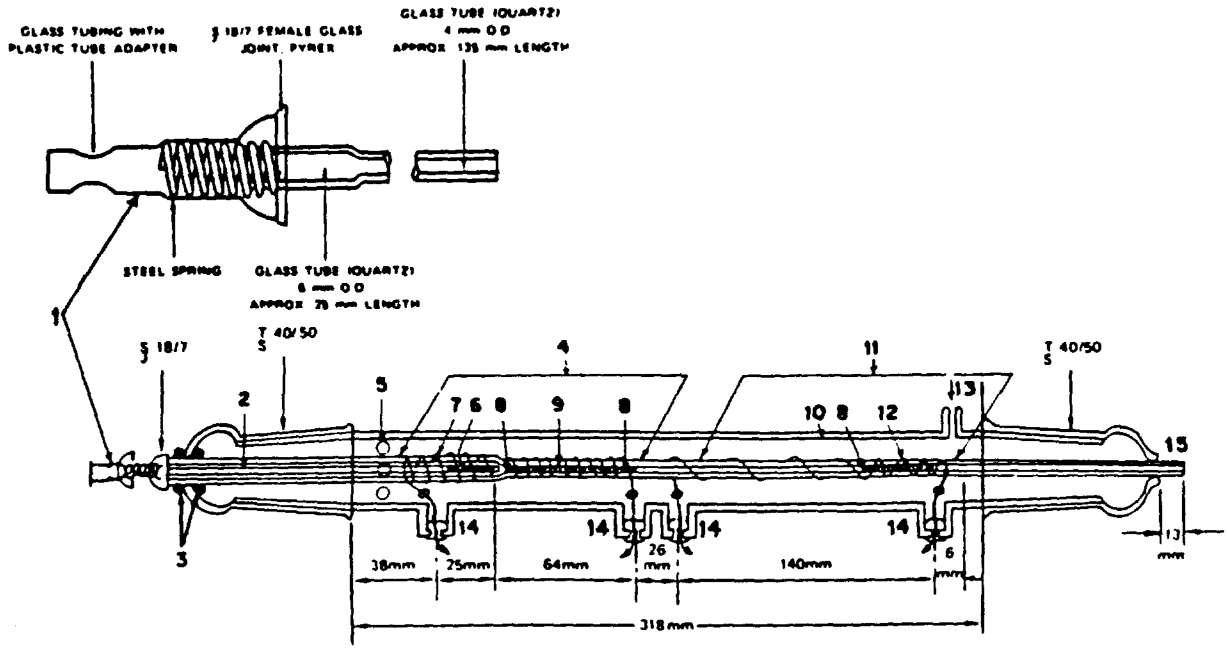
C. Carrier Air Supply. Room air is drawn by vacuum pump, attached to a ballast tank to prevent fluctuations in airflow.

Before entering the desorption unit, the air passes through a drying tube containing anhydrous $Mg(ClO_4)_2$ or other suitable drying agent. The dimensions of the drying tube and subsequent filters are not critical but should not impede airflow. Change the drying agent periodically, depending on the humidity of the air. The dried air passes through a filter containing activated charcoal and 30/60 mesh silvered Chromosorb P or Mersorb charcoal to remove organic vapors and metallic mercury before entering the thermal desorption unit.

Carrier air passes through, in order, the thermal desorption unit, the detection system, a second filter containing Mersorb charcoal which collects the mercury, a 0 to 5 L/min flowmeter, critical orifice, and into the ballast tank of the vacuum pump.

D. Cooling air. Supplied by an air compressor at a flow rate of 20 L/min. The air enters the desorption unit near the second desorption section.

E. Detection system. Mercury from the outlet of the thermal desorption unit enters the optical cell of a flameless atomic absorption spectrophotometer through a glass tube maintained at 70 °C using a heating tape. Power for the heating tape is supplied by a 120 V ac, 8 A variable transformer.



1. LOADING MECHANISM
2. QUARTZ GLASS PLUNGER TUBE
3. RUBBER "O" RINGS
4. SAMPLE DESORPTION SECTION
5. COOLING AIR VENT HOLES
6. SAMPLING TUBE
7. NICHROME WIRE COILS
8. QUARTZ GLASS WOOL PLUGS
9. CUPRIC OXIDE (CuO)
10. COOLING JACKET
11. SECOND DESORPTION SECTION
12. GOLD SECTION
13. COOLING AIR INTAKE
14. WIRE HOLES AND SOLDERLESS CONNECTORS
15. OUTLET

Figure 6000-2 THERMAL DESORPTION UNIT