AP-42 Section Number: 1.3

Reference Number: 68

Title: Emissions Inventory Testing at Long Beach Auxiliary Boiler for Southern California Edison Company

May 1990

EMISSIONS INVENTORY TESTING AT LONG BEACH AUXILIARY BOILER

CARNOT

REPORT CERTIFICATION

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

Sheila M. Haythornthwaite
Field Engineer

Date 5/29/90

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

Arlene C. Bell
Director, Laboratory Services

Date 5/29/90

CONTENTS

Section			Page
	REPORT CERTIFICATION		ii
1.0	INTRODUCTION		1-1
2.0	UNIT DESCRIPTION AND OPERATION		2-1
	2.1	Unit Description	2-1
	2.2	Unit Operating Conditions	2-1
3.0	TEST DESCRIPTION		3-1
	3.1	Test Description and Schedule	3-1
	3.2	Sample Location	3-1
	3.3	Test Procedures	3-4
	3.4	Quality Assurance	3-8
4.0	TEST RESULTS		4-1
	4.1	Benzene	4-6
	4.2	Formaldehyde	4-8
	4.3	PAH	4-10
	4.4	Fuel Analysis	4-12
	4.5	Test Summary and Isokinetics	4-15

APPENDICES:

A.	Measurement Procedures		A-1
B.	Quality Assurance		B-1
	B.1	Quality Assurance Program Summary and ARB Certification	
	B.2	Calibration Data	
	B.3	CEM Performance Data	

CONTENTS

Section			Page
C.	Data Sheets, Calculations and Laboratory Reports		C-1
	C.1	Sample Location	
	C.2	Unit Operating Data	
	C.3	CEM Data	
	C.4	Benzene	
	C.5	Formaldehyde	
	C.6	PAH	
	C.7	Fuel Analysis	
D.	Calculations		D-1
	D.1	General Emission Calculations	
E.	Instrument Strip Charts		E-1
F.	Chain of Custody		F-1

EMISSIONS INVENTORY TESTING AT LONG BEACH AUXILIARY BOILER

Prepared for:

SOUTHERN CALIFORNIA EDISON COMPANY
Rosemead, California

For Inclusion in:

Air Toxics Hot Spots Inventory
required under
AB2588

Prepared by:

Sheila M. Haythornthwaite

CARNOT

formerly the California Division of
ENERGY SYSTEMS ASSOCIATES

Tustin, California

MAY, 1990

CR 53304-2051

SECTION 1.0

INTRODUCTION

Carnot, formerly the California Division of Energy Systems Associates, was contracted by the Southern California Edison Company (SCE) to provide emissions measurement services in support of their preparation of emission inventory reports as required by the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588). AB 2588 requires any facility which meets certain criteria to submit an emission inventory report to local air pollution regulatory agencies. Data is compiled by a combination of source test emission measurements and estimations. These reports are prepared according to inventory plans approved by the Ventura County Air Pollution Control District and by the California Air Resources Board (ARB).

This document is the source test report for the emissions tests that were conducted on SCE's Long Beach Generating Station Auxiliary Boiler. The results of the tests on this unit were used to generate emissions data for it and other similar sources in the SCE power generating system. These results satisfy the requirements for measurements of substances that must be quantified by a source test as set forth in Appendix D of the Emission Inventory Criteria and Guidelines Regulation (The Regulation) published by the ARB on June 2, 1989.

Triplicate emissions tests were conducted while firing gas fuel for:

- formaldehyde
- benzene

Triplicate emissions tests were conducted while firing distillate oil for:

- formaldehyde
- benzene
- polycyclic aromatic hydrocarbons (PAH)

Two distillate oil samples were also analyzed for:

- Btu/lb (HHV)
- carbon, hydrogen, oxygen, nitrogen
- sulfur
- ash content

- chloride
- full set of metals to include:
  arsenic, beryllium, cadmium, total and hexavalent chromium, copper, lead, manganese, mercury, nickel, selenium and zinc

Testing was conducted February 2 through 7, 1990. The Carnot test team members were Bob Finken, Arlene Bell, Sheila Haythornthwaite, Jim Mulligan, and Russell Pence. Mr. Michael D. Escarcega of SCE coordinated all test activities.

Table 1-1 summarizes the results of the emissions tests while firing natural gas. Tables 1-2 and 1-3 summarize the results of the emissions tests while firing distillate oil. Table 1-4 presents the results of the distillate oil analyses. Detailed results are included in Section 4.0.

TABLE 1-1
SUMMARY OF AB2588 EMISSIONS TEST RESULTS
SCE/LONG BEACH AUXILIARY BOILER
NATURAL GAS FUEL
February 2, 1990

Species	
Benzene:	
ppb	ND < 4
lb/hr	ND $<4.57 \times 10^{-4}$
lb/MMBtu	ND $< 1.03 \times 10^{-5}$
Formaldehyde	
ppb	<23
lb/hr	$<9.96 \times 10^{-4}$
lb/MMBtu	$<2.26 \times 10^{-5}$

TABLE 1-2
SUMMARY OF AB2588 EMISSIONS TEST RESULTS
SCE/LONG BEACH AUXILIARY BOILER
DISTILLATE OIL
February 5 to 7, 1990

Species	
Benzene:	
ppb	ND < 4
lb/hr	ND < 5.35×10^{-4}
lb/MMBtu	ND < 1.32×10^{-5}
Formaldehyde	
ppb	361
lb/hr	1.85×10^{-2}
lb/MMBtu	4.54×10^{-4}
Total PAH	
$\mu g/m^3$	ND < 0.147
lb/hr	ND < 5.9×10^{-6}
lb/MMBtu	ND < 1.15×10^{-6}

TABLE 1-3
SUMMARY OF PAH EMISSION RESULTS
SCE/LONG BEACH AUXILIARY BOILER
DISTILLATE OIL
February 5 to 7, 1990

Species	$\mu g/m^3$	lb/hr	lb/MMBtu
Acenaphthene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Acenaphthylene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Anthracene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Benz[a]anthracene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Benzo[b]fluoranthene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Benzo[k]fluoranthene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Benzo[a]pyrene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Benzo[g,h,i]perylene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Chrysene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Dibenz[a,h]anthracene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Fluoranthene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Fluorene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Indeno[1,2,3-cd]pyrene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Naphthalene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Phenanthrene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
Pyrene	ND < 0.10	ND < $3.93x10^{-7}$	ND < $1.00x10^{-8}$
TOTAL PAH	ND < 0.47	ND < $5.9x10^{-6}$	ND < $1.51x10^{-6}$

TABLE 1-4
FUEL ANALYSIS SUMMARY
SCE/LONG BEACH AUXILIARY BOILER
DISTILLATE OIL
February 5, 1990

Parameter	
Btu/lb (HHV)	19,100
Carbon, %	83.93
Hydrogen, %	15.55
Nitrogen, %	0.25
Oxygen, %	0.2
Sulfur, %	0.05
Ash, %	<0.01
F factor, dscf/MMBtu @ 0% O_2 and 60°F	9,541
Chlorine, mg/l	ND <30
Arsenic, mg/l	ND <0.25
Beryllium, mg/l	ND <0.05
Cadmium, mg/l	ND <0.05
Chromium, mg/l	ND <0.05
Hexavalent Chromium, mg/l	ND <0.08
Copper, mg/l	ND <0.10
Lead, mg/l	<0.28
Mercury, mg/l	ND <0.10
Manganese, mg/l	ND <0.10
Nickel, mg/l	ND <0.05
Selenium, mg/l	ND <0.25
Zinc, mg/l	0.06

ND - not detected

SECTION 2.0

UNIT DESCRIPTION AND OPERATION

2.1 UNIT DESCRIPTION

Long Beach Generating Station is a combined cycle facility. The facility consists of seven combustion turbine generators, seven heat recovery boilers and two steam turbine generators. Hot gases passing through the combustion turbine exhaust to atmosphere through the heat recovery boilers. The steam generated in the boilers is used for three purposes: (1) to drive the steam turbines, (2) to provide injection steam to the combustor for NOx control, and (3) to provide heating and deaeration of the feedwater in the deaerator.

The unit is a single burner boiler manufactured by the Trane Company. It is capable of burning either natural gas or distillate fuel. Maximum design steam flow rate is 40,000 lbs/hr at an operating pressure of 140 psig. During a recent test program, it was found that the maximum achievable steam flow rate was approximately 33,000 lbs/hr with the 140 psig operating pressure being the limiting factor.

2.2 UNIT OPERATION

The Long Beach Auxiliary Boiler was operated at nominal full load while firing natural gas or distillate oil. Table 2-1 summarizes unit operation during each test. Complete unit operation data is in Appendix C.2.

TABLE 2-1
SUMMARY OF UNIT OPERATION
SCE/LONG BEACH AUXILIARY BOILER
February 2 to 7, 1990

Test	Date	Fuel	Steam Load (klb/hr)	Fuel Flow
1	2/2/90	Natural Gas	33,000	20.23 KSCFH
2	2/2/90	Natural Gas	33,000	20.23 KSCFH
3	2/2/90	Natural Gas	33,000	20.23 KSCFH
4-PAH	2/5/90	Distillate Oil	33,600	9.43 gal/min
5-PAH	2/5/90	Distillate Oil	33,125	9.50 gal/min
6-PAH	2/7/90	Distillate Oil	35,300	9.57 gal/min 9.50

Fuel D.L (#2.)

SECTION 3.0

TEST DESCRIPTION

3.1 TEST DESCRIPTION AND SCHEDULE

The tests on the Long Beach Generating Station Auxiliary Boiler were conducted with the boiler firing at or near full normal load, at normal operating conditions. Testing was conducted with the boiler firing both distillate oil and natural gas fuels. Table 3-1 gives the tests that were conducted for each fuel type. Table 3-2 is a summary of the tests performed.

TABLE 3-1
TEST SUMMARY

Fuel	Species to be Measured by Source Test
Distillate Oil	Benzene, Formaldehyde, PAH Also fuel analysis for Metals, Chloride
Natural Gas	Benzene, Formaldehyde

3.2 SAMPLE LOCATIONS

Samples were collected from four ports installed in the exhaust duct. The ports location meets the acceptability criteria given in EPA Method 1. Sampling was performed using sampling points in a 3x4 matrix layout. Figure 3-1 is a diagram of the sample location.

TABLE 3-2
TEST SCHEDULE AB2588 EMISSIONS TESTING
SCE/LONG BEACH AUXILIARY BOILER
February 2 to 7, 1990

Test No.	Date	Time	Fuel	Type of Test
1-LBAX-Vel	2/2/90	1053-1123	Gas	Velocity Traverse
1-LBAX-H_2O	2/2/90	1053-1123	Gas	Moisture
1-LBAX-Form	2/2/90	1054-1126	Gas	Formaldehyde
1-LBAX-Benzene	2/2/90	1053-1113	Gas	Benzene
1-LBAX-CEM	2/2/90	1053-1123	Gas	CEM (O_2, CO_2)
2-LBAX-Form	2/2/90	1135-1205	Gas	Formaldehyde
2-LBAX-Benzene	2/2/90	1135-1155	Gas	Benzene
2-LBAX-CEM	2/2/90	1135-1205	Gas	CEM (O_2, CO_2)
3-LBAX-Vel	2/2/90	1210-1240	Gas	Velocity
3-LBAX-H_2O	2/2/90	1210-1240	Gas	Moisture
3-LBAX-Form	2/2/90	1210-1240	Gas	Formaldehyde
3-LBAX-Benzene	2/2/90	1210-1230	Gas	Benzene
3-LBAX-CEM	2/2/90	1210-1240	Gas	CEM (O_2, CO_2)
4-LBAX-PAH	2/5/90	0900-1210	Distillate Oil	PAH
4-LBAX-CEM	2/5/90	0900-1215	Distillate Oil	CEM (O_2, CO_2)
4A-LBAX-Benzene	2/5/90	0928-0948	Distillate Oil	Benzene
4B-LBAX-Benzene	2/5/90	0958-1040	Distillate Oil	Benzene
4C-LBAX-Benzene	2/5/90	1047-1107	Distillate Oil	Benzene
5-LBAX-PAH	2/5/90	1325-1634	Distillate Oil	PAH
5-LBAX-CEM	2/5/90	1325-1634	Distillate Oil	CEM (O_2, CO_2)
5A-LBAX-Form	2/5/90	1432-1502	Distillate Oil	Formaldehyde
5B-LBAX-Form	2/5/90	1506-1536	Distillate Oil	Formaldehyde
5C-LBAX-Form	2/5/90	1540-1610	Distillate Oil	Formaldehyde
6-LBAX-PAH	2/1/90	0811-1136	Distillate Oil	PAH
6-LBAX-CEM	2/1/90	0811-1136	Distillate Oil	CEM (O_2, CO_2)

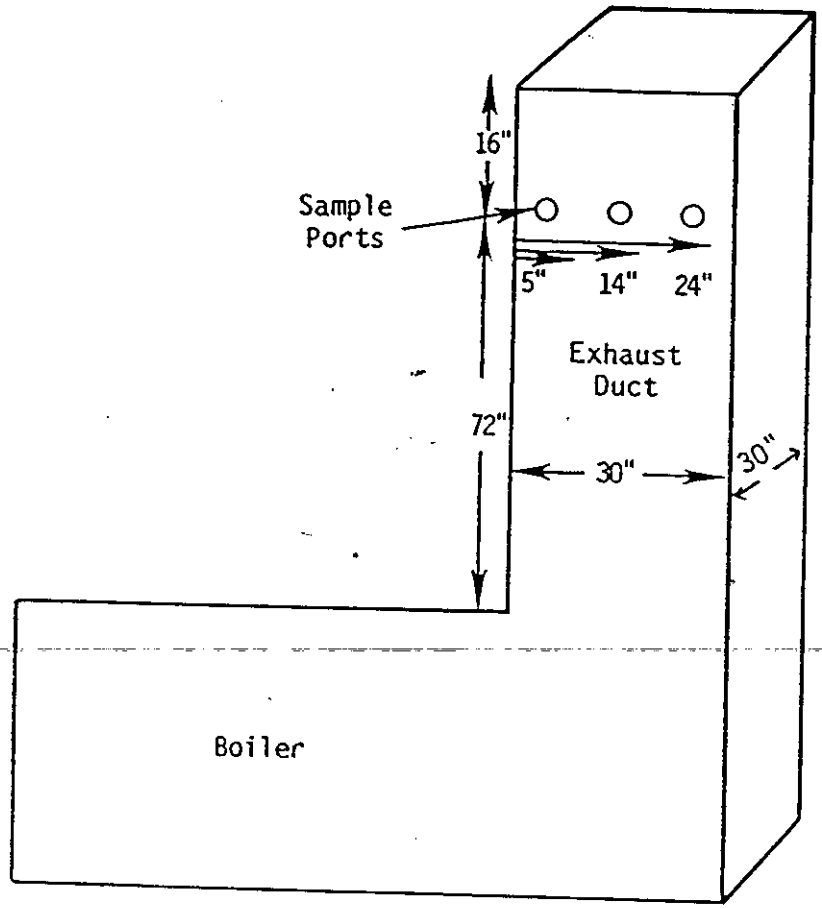


Figure 3-1. Long Beach Generating Station Auxiliary Boiler Sample Port Location.

3.3 TEST PROCEDURES

The test procedures for air emissions tests and related information that were used at the Long Beach Auxiliary Boiler are listed in Table 3-3. Descriptions of standard procedures are included in Appendix A. Additional information and modifications to standard procedures are presented below.

3.3.1 Benzene

Triplicate samples for benzene analysis were collected in Tedlar bags and analyzed by gas chromatography according to CARB Method 410A by Truesdail Laboratories in Tustin, California.

3.3.2 Formaldehyde

Triplicate formaldehyde samples were collected non-isokinetically using midget impingers in acidic 2,4-dinitrophenylhydrazine solution. The analysis for formaldehyde was performed by reverse phase HPLC by Radian Laboratories, in Research Triangle Park, North Carolina.

3.3.3 Polycyclic Aromatic Hydrocarbons (PAH)

Triplicate PAH samples were collected according to the sampling procedures of CARB Method 429. This method is known as semi-VOST or "Modified Method 5". Table 3-4 summarizes the pertinent information for these tests. In this procedure, a sample is collected isokinetically and passed through a heated Method 5 filter followed by an XAD-2 sorbent module in a water-cooled jacket. The sorbent module is followed by an impinger train to collect moisture and any PAH species that might pass through the resin.

Sample analysis was performed by Zenon Environmental in Burlington, Ontario. Zenon also prepared the resin, loaded the modules, and extracted the modules and other fractions according to CARB procedures. Appropriate pre- and post-test laboratory spikes were introduced to the samples by Zenon and the percent recovery is reported along with the results.

TABLE 3-3
TEST PROCEDURES FOR LONG BEACH COMBUSTION TURBINE
AIR EMISSIONS TESTS

Parameter	No. Replicates	Duration of Test (min.)	Sample Rate	Measurement Principle	Reference Method	Method Detection Limit
Benzene	3	20	0.5 l/min	GC/PID	CARB 410A	4 ppb
Formaldehyde	3	30	1 l/min	HPLC	CARB 430	0.1 $\mu g/m^3$
PAH	3	180	1 m^3/hr	GC/MS	CARB 429	10 ng/m^3 per species*
Metals, Chloride	2	--	--	Fuel Analysis	--	--

* assumes $3m^3$ samples

TABLE 3-4
PAH TEST INFORMATION

Sampling Method	CARB 429
Analytical Method	GC/MS
Analytical Laboratory	Zenon Environmental
Expected Levels	Less than 10 ng/m^3 per species
Analytical Lower Detection Limit	10-100 ng per species
Sample Volumes	3 m^3 (3-hour sample)
Internal Standards	Added to post-test samples
Surrogate Standards	Added to resin prior to sampling
Blank	Full field blank train used
Fractions to be Analyzed	Probe wash, filter, sorbent module, connecting glassware rinse, and first impinger combined
Chain of Custody	Maintained by Carnot and Zenon on all samples
Sample Train Assembly and Recovery	Performed in on-site clean room to minimize chance of contamination. All sample portions recovered with water, acetone, and hexane rinses.
Glassware Cleaning	Acid cleaning followed by DI H_2O, acetone, and hexane rinses and high temperature bake

PAH species were analyzed using GC/MS with selective ion monitoring. This procedure provides the lowest detection limits possible for these samples. PAH species to be quantitated are listed in Appendix C-1 of "Emission Inventory Criteria and Guidelines". These compounds are listed below:

Acenaphthene
Acenaphthylene
Anthracene
Benz[a]anthracene
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[a]pyrene
Benzo[g,h,i]perylene
Chrysene
Dibenz[a,h]anthracene
Fluoranthene
Fluorene
Indeno[1,2,3,-cd]pyrene
Naphthalene
Phenanthrene
Pyrene

In addition to the samples, a full field blank was collected and analyzed for PAH. For a field blank, a separate sample train was assembled, transported, leak checked, rinsed, and recovered in the same way as the sample train. This provides a blank value not only for the analytical procedures but also for the reagents, filter, and any possible contamination introduced by sample handling.

3.3.4 Distillate Oil Samples

Two distillate oil samples were collected by SCE and analyzed for:

- Btu/lb
- carbon, hydrogen, oxygen, nitrogen
- sulfur
- ash content
- chloride
- full set of metals to include:
  arsenic, beryllium, cadmium, total and hexavalent chromium, copper, lead, manganese, mercury, nickel, selenium, and zinc.

These analyses were performed by Curtis and Tompkins in Los Angeles.

3.3.5 Natural Gas Analysis

An analysis for the natural gas used during this test series was provided by Southern California Gas Company. Their analysis includes Btu/lb and composition. No suitable location was available at the Long Beach facility to take a gas sample.

3.3.6 Gaseous Emissions

Gaseous emissions (O_2 and CO_2) were measured using Carnot's Continuous Emissions Monitor (CEM) described in Appendix A. This system meets EPA and CARB requirements for gaseous species. A preliminary traverse indicated that there was no significant stratification. Therefore, O_2 and CO_2 concentrations were determined at a single point.

O_2 and CO_2 were measured in conjunction with all tests according to EPA Method 3A to provide data for molecular weight and dilution calculations.

3.3.7 Velocity and Moisture

Velocity and moisture were determined in conjunction with all isokinetic tests according to EPA Methods 1, 2, and 4. For non-isokinetic single point tests, either separate velocity and moisture determinations were performed or the velocity measured during a simultaneous isokinetic test is used for emission calculations.

3.4 QUALITY ASSURANCE

Carnot has a rigorous ongoing QA program to ensure that high-quality data is obtained and to ensure full documentation of test details. The QA program includes:

1. Appointment of a Quality Assurance Officer for Carnot's Source Test Division
2. Preparation of a QA manual for internal use
3. Standardization of reporting and review procedures
4. Implementation of chain of custody procedures on all samples and data sheets
5. Scheduling of internal QA and training meetings
6. Complete documentation of instrument calibration and CEM performance data

7. Adherence to method-specific QA procedures for all testing

8. Personnel training

9. Monitoring of new and emerging methods and technologies.

Specific QA data which will be included in the final report are:

1. Equipment calibration data

2. CEM calibration data

3. CEM performance data

4. Chain of custody on all samples (see example form in Appendix B)

Carnot participates in EPA's audit programs for Methods 5, 6, and 7, and is certified by the California Air Resources Board under its Independent Source Tester's Approval program. Additional QA information is presented in Appendix B.

SECTION 4.0

RESULTS

This section presents the results of the air emissions tests performed on SCE's Long Beach Auxiliary Boiler. Air emissions are presented on a concentration, mass emissions and lb/MMBtu basis. All data sheets, calculations, laboratory reports and quality assurance information are included in the Appendices.

The results of the tests are summarized in Tables 4-1 through 4-4. Detailed results of the tests are presented in the following subsections.

4.1 Benzene
4.2 Formaldehyde
4.3 Polycyclic Aromatic Hydrocarbons (PAH)
4.4 Fuel Analysis
4.5 Test Summary and Isokinetics

TABLE 4-1
SUMMARY OF AB2588 EMISSIONS TEST RESULTS
SCE/LONG BEACH AUXILIARY BOILER
NATURAL GAS FUEL
February 2, 1990

Species	
Benzene:	
ppb	ND < 4
lb/hr	ND <4.57 x 10^{-4}
lb/MMBtu	ND < 1.03 x 10^{-5}
Formaldehyde	
ppb	<23
lb/hr	<9.96 x 10^{-4}
lb/MMBtu	<2.26 x 10^{-5}

TABLE 4-2
SUMMARY OF AB2588 EMISSIONS TEST RESULTS
SCE/LONG BEACH AUXILIARY BOILER
DISTILLATE OIL
February 5 to 7, 1990

Species	
Benzene:	
ppb	ND < 4
lb/hr	ND < 5.35×10^{-4}
lb/MMBtu	ND < 1.32×10^{-5}
Formaldehyde	
ppb	361
lb/hr	1.85×10^{-2}
lb/MMBtu	4.54×10^{-4}
Total PAH	
$\mu g/m^3$	ND < 0.147
lb/hr	ND < 5.9×10^{-6}
lb/MMBtu	ND < 1.15×10^{-6}

TABLE 4-3
SUMMARY OF PAH EMISSION RESULTS
SCE/LONG BEACH AUXILIARY BOILER
DISTILLATE OIL
February 5 to 7, 1990

Species	$\mu g/m^3$	lb/hr	lb/MMBtu
Acenaphthene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Acenaphthylene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Anthracene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Benz[a]anthracene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Benzo[b]fluoranthene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Benzo[k]fluoranthene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Benzo[a]pyrene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Benzo[g,h,i]perylene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Chrysene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Dibenz[a,h]anthracene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Fluoranthene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Fluorene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Indeno[1,2,3-cd]pyrene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Naphthalene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Phenanthrene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
Pyrene	ND < 0.10	ND < 3.93×10^{-7}	ND < 1.00×10^{-8}
TOTAL PAH	ND < 0.47	ND < 5.9×10^{-6}	ND < 1.51×10^{-6}

TABLE 4-4
FUEL ANALYSIS SUMMARY
SCE/LONG BEACH AUXILIARY BOILER
DISTILLATE OIL
February 5, 1990

Parameter	
Btu/lb (HHV)	19,100
Carbon, %	83.93
Hydrogen, %	15.55
Nitrogen, %	0.25
Oxygen, %	0.2
Sulfur, %	0.05
Ash, %	<0.01
F factor, dscf/MMBtu @ 0% O_2 and 60°F	9,541
Chlorine, mg/l	ND <30
Arsenic, mg/l	ND <0.25
Beryllium, mg/l	ND <0.05
Cadmium, mg/l	ND <0.05
Chromium, mg/l	ND <0.05
Hexavalent Chromium, mg/l	ND <0.08
Copper, mg/l	ND <0.10
Lead, mg/l	<0.28
Mercury, mg/l	ND <0.10
Manganese, mg/l	ND <0.10
Nickel, mg/l	ND <0.05
Selenium, mg/l	ND <0.25
Zinc, mg/l	0.06

ND - not detected

4.1 BENZENE

The results of the benzene sampling are presented in Table 4-5. No benzene was detected in any of the samples. Appendix C.4 contains additional information.

TABLE 4-5
BENZENE EMISSIONS
SCE/LONG BEACH AUXILIARY BOILER

GAS FUEL

Test No.	1-LBAX-Benzene	2-LBAX-Benzene	3-LBAX-Benzene	Average
Date:	2/2/90	2/2/90	2/2/90	
[+] Flow rate, dscfm	9,250	9,250	9,250	9,250
O_2, %	6.8	6.8	6.8	6.8
ppb	ND < 4	ND < 4	ND < 4	ND < 4
lb/hr	ND < 4.57×10^{-4}	ND < 4.57×10^{-4}	ND < 4.57×10^{-4}	ND < 4.57×10^{-4}
lb/MMBtu	ND < 1.03×10^{-5}	ND < 1.03×10^{-5}	ND < 1.03×10^{-5}	ND < 1.03×10^{-5}

[+] Flow rate is the average of two velocity determinations
O_2 concentration is the average O_2 concentration during these three tests

DISTILLATE OIL

Test No.	4A-LBAX-Benzene	4B-LBAX-Benzene	4C-LBAX-Benzene	Average
Date	2/5/90	2/5/90	2/5/90	
[*] Flow rate, dscfm	10,832	10,832	10,832	10,832
O_2, %	8.44	8.44	8.44	8.44
ppb	ND < 4	ND < 4	ND < 4	ND < 4
lb/hr	ND < 5.35×10^{-4}	ND < 5.35×10^{-4}	ND < 5.35×10^{-4}	ND < 5.35×10^{-4}
lb/MMBtu	ND < 1.32×10^{-5}	ND < 1.32×10^{-5}	ND < 1.32×10^{-5}	ND < 1.32×10^{-5}

[*] Flow rate and O_2 from Test 4-SV

4.2 FORMALDEHYDE

Formaldehyde results are presented in Table 4-6. Appendix C.5 presents additional data and Radian's Laboratory report. The field blank was subtracted from each sample. The formaldehyde emission rate while firing natural gas is less than 9.96×10^{-4} lb/hr. The formaldehyde emission rate while firing distillate oil is 1.85×10^{-2} lb/hr.

TABLE 4-6
FORMALDEHYDE EMISSIONS
SCE/LONG BEACH AUXILIARY BOILER

GAS FUEL

Test No.	1-LBAX-Form	2-LBAX-Form	3-LBAX-Form	Average
Date:	2/2/90	2/2/90	2/2/90	
+ Flow rate, dscfm	9,251	9,251	9,251	9,251
O_2, %	6.6	6.8	7.0	6.8
ppb	<13	40	<15	<23.
lb/hr	$<5.91 \times 10^{-4}$	1.75×10^{-3}	$<6.52 \times 10^{-4}$	$<9.96 \times 10^{-4}$
lb/MMBtu	$<1.32 \times 10^{-5}$	3.95×10^{-5}	$<1.50 \times 10^{-5}$	$<2.26 \times 10^{-5}$

• Flow rate is the average of two velocity determinations

DISTILLATE OIL

Test No.	5A-LBAX-Form	5B-LBAX-Form	5C-LBAX-Form	Average
Date	2/5/90	2/5/90	2/5/90	
+ Flow rate, dscfm	10,832	10,832	10,832	10,832
O_2, %	8.8	8.3	8.2	8.4
ppb	192	881	<9	361
lb/hr	9.87×10^{-3}	4.53×10^{-2}	$<4.70 \times 10^{-4}$	1.85×10^{-2}
lb/MMBtu	2.51×10^{-4}	1.1×10^{-3}	$<1.14 \times 10^{-5}$	4.54×10^{-4}

+ Flow rate and O_2 from Test 5-SV

4.3 POLYCYCLIC AROMATIC HYDROCARBONS (PAH)

PAH results are presented in Table 4-7. The analysis for the fifteen target PAH compounds indicated that these species were not present at detectable levels. Test number 5-LBAX-5V was lost by Zenon Environmental Laboratory in a lab accident.[1] No results are reported for this test. Complete results are available in Appendix C.6.

[1] The laboratory accident involved the condenser backflushing, adding water to the sample. The water was not noticed, so the sample evaporated with the water.

TABLE 4-7
POLYCYCLIC AROMATIC HYDROCARBON EMISSIONS
SCE/LONG BEACH AUXILIARY BOILER
DISTILLATE OIL

Test No.	4-LBAX-SV	6-LBAX-SV	Average	
Date	2/5/90	2/5/90		
Flow Rate, dscfm	10,614	10,870		
O_2, %	9.5	7.9		
Species	**$\mu g/m^3$**	**$\mu g/m^3$**	**$\mu g/m^3$**	**lb/hr**	**lb/MMBtu**
Naphthalene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Acenaphthylene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Acenaphthene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Fluorene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Phenanthrene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Anthracene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Fluoranthene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Pyrene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Benz(a)anthracene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Chrysene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Benzo(b+k)fluoranthene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Benzo(a)pyrene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Indeno(1,2,3-cd)pyrene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Dibenzo(a,h)anthracene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Benzo(g,h,i)perylene	ND < 0.10	ND < 0.10	0.10	3.93×10^{-7}	1.00×10^{-8}
Total PAH	4-LBAX-SV	6-LBAX-SV		Average	
$\mu g/m^3$	ND < 0.144	ND < 0.149		0.147	
lb/hr	ND < 5.74×10^{-6}	ND < 6.06×10^{-6}		5.9×10^{-6}	
lb/MMBtu	ND < 1.58×10^{-7}	ND < 1.43×10^{-7}		1.51×10^{-6}	

4.4 FUEL ANALYSIS

Distillate oil analyses are presented in Table 4-8. Natural gas analysis is presented in Table 4-9. The natural gas analysis was supplied by Southern California Gas Company and is used to calculate emissions in lb/MMBtu.

Due to the high volatility of the distillate fuel, the laboratory had difficulty in performing the elemental analysis. A large portion of the fuel evaporated during analysis, and was erroneously counted as oxygen (which is not measured but determined by difference). It was assumed that the oxygen content was 0.2% (a typical value for distillate fuels), and the analyses were adjusted. This adjustment was not made for heating value or the trace metals analyses, which are not impacted.

TABLE 4-8
DISTILLATE OIL ANALYSIS
SCE/LONG BEACH AUXILIARY BOILER

Parameter	Sample No. 4A-LBAX-Fuel	Sample No. 4B-LBAX-Fuel	Average
Btu/lb (HHV)	18,800	19,400	19,100
Carbon, %	83.95	83.91	83.93
Hydrogen, %	15.56	15.54	15.55
Nitrogen, %	0.21	0.28	0.25
Oxygen, %	0.2	0.2	0.2
Sulfur, %	0.05	0.05	0.05
Ash, %	<0.01	<0.01	<0.01
F factor, dscf/MMBtu @ 0% O_2 and 60°F			9,541
Chlorine, mg/l	ND <30	ND <30	ND <30
Arsenic, mg/l	ND <0.05	ND <0.05	ND <0.05
Beryllium, mg/l	ND <0.05	ND <0.05	ND <0.05
Cadmium, mg/l	ND <0.05	ND <0.05	ND <0.05
Chromium, mg/l	ND <0.05	ND <0.05	ND <0.05
Hexavalent Chromium, mg/l	ND <0.05	ND <0.10	ND <0.08
Copper, mg/l	ND <0.10	ND <0.10	ND <0.10
Lead, mg/l	ND <0.25	0.3	<0.28
Mercury, mg/l	ND <0.10	ND <0.10	ND <0.10
Manganese, mg/l	ND <0.10	ND <0.10	ND <0.10
Nickel, mg/l	ND <0.05	ND <0.05	ND <0.05
Selenium, mg/l	ND <0.25	ND <0.25	ND <0.25
Zinc, mg/l	0.06	0.06	0.06

TABLE 4-9
NATURAL GAS ANALYSIS
SCE/LONG BEACH AUXILIARY BOILER

Parameter	Sample Date 1/30/90
Methane, %	92.1
Ethane, %	3.75
Propane, %	1.00
Butane, %	0.23
Iso-butane, %	0.13
Pentane, %	0.06
Iso-pentane, %	0.07
C_6^+, %	0.10
Carbon dioxide, %	1.00
Nitrogen, %	1.51
Btu/scf	1049.7
Specific Gravity	0.6098
F factor, dscf/MMBtu @ 0% O_2 and 60°F	8,476

4.5 TEST SUMMARY AND ISOKINETIC

A summary of the isokinetic and velocity tests performed is presented in Table 4-10. All tests were within the required range of 90-110% isokinetic.

TABLE 4-10
SUMMARY OF TEST CONDITIONS
SCE/LONG BEACH AUXILIARY BOILER
February 2 to 7, 1990

Test No.	Flow Rate (dscfm)	Moisture, %	O_2, %	CO_2, %	% Isokinetic	Comments
1-LBAX-Vel/ H_2O	9,054	15.1	6.6	8.0	N/A	Tests 1-3 performed while firing gas fuel
3-LBAX-Vel/ H_2O	9,444	13.2	7.0	7.8	N/A	Benzene and Formaldehyde Tests #1, 2, and 3 calculated using average flow rate and O_2 from velocity traverses 1 and 3
4-LBAX-PAH	10,614	10.3	9.5	9.3	105.8	Tests 4-6 performed while firing distillate oil
5-LBAX-PAH	10,832	9.8	8.6	9.4	100.4	Flow rate for isokinetic tests used for non-isokinetic tests run during the same time period.
6-LBAX-PAH	10,870	9.6	7.9	9.7	100.1	

APPENDIX A

MEASUREMENT PROCEDURES

Benzene by Gas Chromatography

Semi-Volatile Organic Sampling Train Procedures

Formaldehyde by HPLC

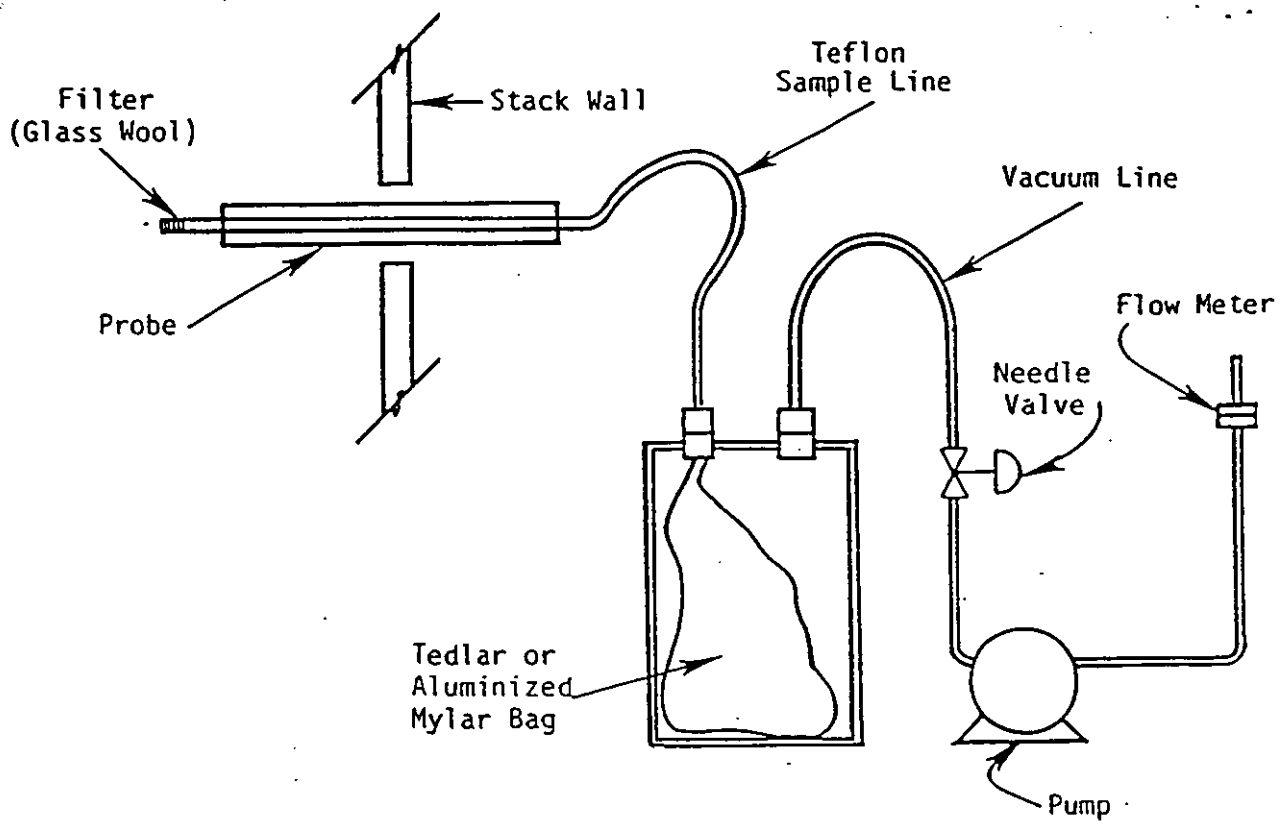
Continuous Emissions Monitoring System

Oxygen (O_2) by Continuous Analyzer

Carbon Dioxide (CO_2) by Continuous Analyzer

Determination of Moisture in Stack Gases

Method:	Benzene by Gas Chromatography
Reference:	CARB Method 410, Modified EPA Method 601/602.
Principle:	A Tedlar bag is filled with flue gas at a constant rate. The bag contents are analyzed by gas chromatography/photo ionization detection for volatile organic compounds.
Sample Procedure:	Samples are collected using a lung-type sampling system shown in the attached figure. In this system, a bag is placed in a sealed container and the container is evacuated. Flue gas enters the bag as it expands to fill the container. Sampling rate is monitored by a rotameter on the container exhaust. This system allows sample collection without exposing the sample to pumps, flowmeters, oils, etc.
Analytical Procedure:	In the analytical phase, the contents of the Tedlar bags are injected directly on a capillary chromatographic column. Column type, instrument conditions and sample volume are optimized to obtain complete separation of all compounds of interest and detection limits of no more than 10 ppb. Carnot subcontracts these analyses to qualified local laboratories experienced in these analytical procedures.



Sample Train for Determination of Volatile Organic Compounds (VOC) by EPA 601/602

Method: Semi-volatile Organic Sampling Train (Semi-VOST)

References: CARB Method 429 (for PAH)
ASME Modified Method 5

Principle: A metered flue gas sample is collected isokinetically, and semi-volatile organic compounds are collected on a heated filter, on water-cooled XAD-2 resin module, and in an iced impinger bath. Depending upon the specific test requirements, the samples are then analyzed for polycyclic aromatic hydrocarbons (PAH) species. This section discusses the sampling and sample handling techniques for the semi-VOST method.

Sample Train Preparation: Because of the very low detection limits of the analytical techniques, thorough cleaning of sample train components prior to testing is vital. Prior to testing, all glassware is cleaned in Carnot's laboratory with high purity water, acetone, and hexane rinses, and then baked at high temperature. Resin modules are cleaned and loaded with purified resin by the contract laboratory within one week of the scheduled test date. Batches of Whatman 934AH fiberglass filters are toluene-rinsed and proofed by the contract laboratory. Individual filters are then tared and stored in petri dishes lined with hexane rinsed aluminum foil.

Sample train assembly is performed in an on-site clean room by experienced personnel.

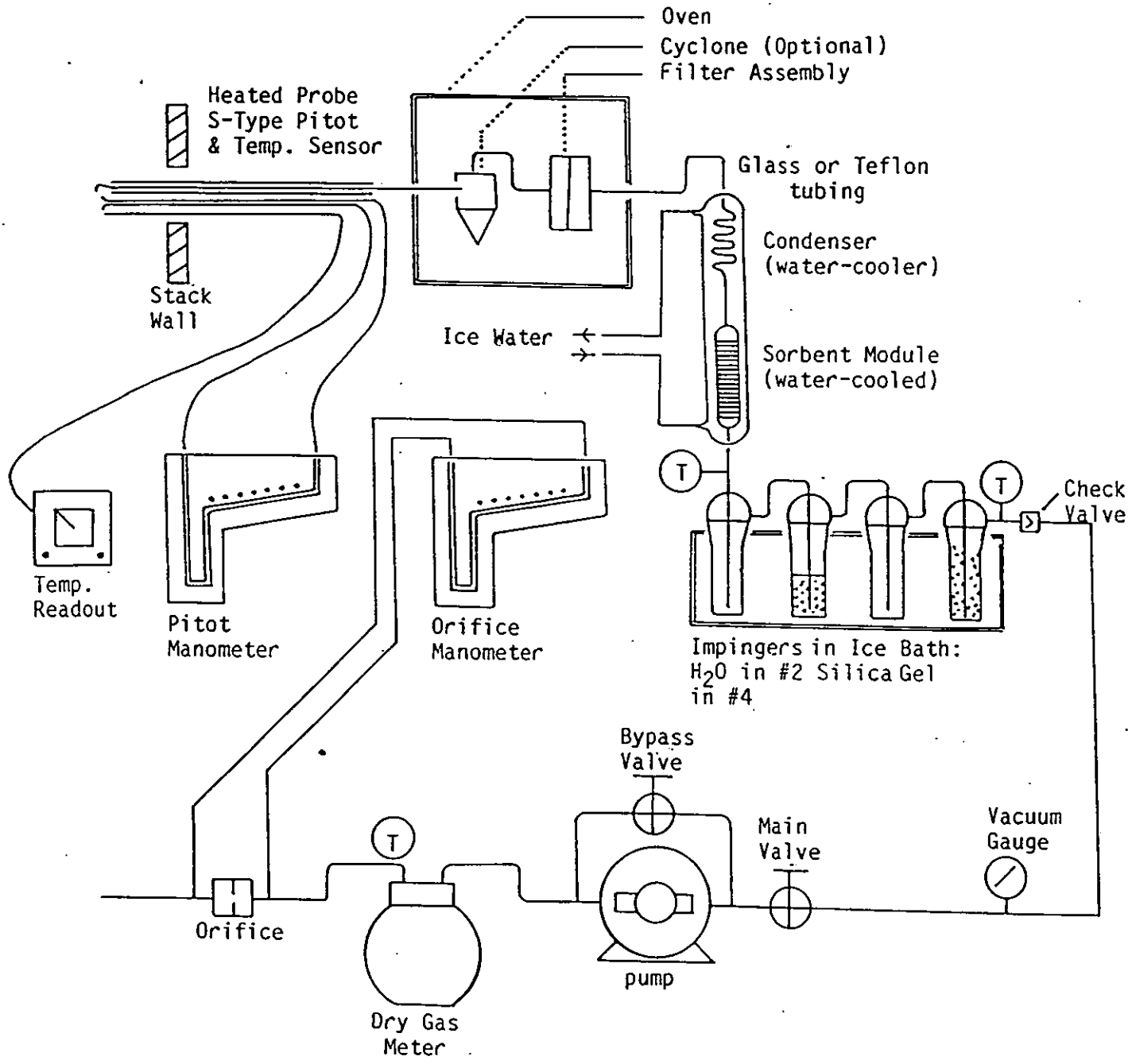
Sampling: The sample train is shown in the attached figure. Sample is pulled through the following components:

1. Glass or nickel-coated stainless steel nozzle
2. Heated glass probe (250 $\pm$ 15 F)
3. Optional cyclone in heated oven (250 $\pm$ 15 F)
4. Filter in heated oven
5. Glass or teflon tubing
6. Condenser/sorbent module cooled with circulating ice water from impinger bath
7. Dry impinger with stub stem
8. Smith-Greenburg impinger with 100 ml DI H_2O
9. Dry impinger as a knockout
10. Impinger containing silica gel
11. Leak-free vacuum pump
12. Calibrated dry gas meter

The pump, meter, manometers, and heater controllers are all contained in a single control box (Andersen Universal or equivalent).

During final sample train assembly and leak check procedures on the stack or duct, special precautions are taken to minimize the chance of contamination. Sample train components are open to the air for as short a time as possible; and during transport to and from the stack, all components are sealed with hexane rinsed aluminum foil.

Semi-VOST Sampling Train



Sample Recovery: All sample recovery is performed in Carnot's laboratory or an on-site clean room. Following sampling the resin module is sealed with glass caps and stored in a refrigerator or ice chest, the filter is placed in a light-proofed petri dish, and all glassware components are rinsed. The rinse consists of three rinses each of distilled water, acetone, hexane, and methylene chloride. All solvents are high purity GS/MC grade, the squirt bottles are teflon, and the sample bottles are amber glass with teflon-lined caps. Water fractions are placed in separate bottles from the solvent rinses to simplify extraction procedures for the contract laboratory.

Field Blank: At least once during each test series, a field blank sample is collected. This consists of assembling a sample train transporting it to and from the stack, leak checking it, and recovering it. This sample is analyzed using the same procedures as for the test samples.

Sample Custody: Full chain of custody is maintained on all reagents, sample trains, and samples by Carnot and by contract laboratories. In addition to formal documentation by the sample custodians, sample data sheets are initialed by the individuals who assemble and recover each sample train component.

Method:	Formaldehyde by HPLC
Reference:	CARB Method 430
Principle:	A metered gas sample is collected non-isokinetically in acidic 2,4-dinitrophenylhydrazine (DNPH) solution. Formaldehyde reacts with DNPH to form the 2,4-dinitrophenylhydrazone derivative. The concentration of this formaldehyde derivative is determined by reverse phase HPLC with an ultraviolet absorption detector.
Sampling Procedure:	A dry metered gas sample is collected through teflon tubing into an iced midget impinger train containing 20 ml of aqueous acidic DNPH solution. Samples are recovered with DNPH solution into precleaned glass bottles, refrigerated and analyzed within 7 days.
Analytical Procedure:	The concentration of the resulting formaldehyde derivative is quantitated after organic solvent extraction using reverse phase HPLC with an ultraviolet absorption detector. Formaldehyde in the sample is identified and quantitated by comparison of peak retention times and peak areas with those of standard solutions.

Continuous Emissions Monitoring System

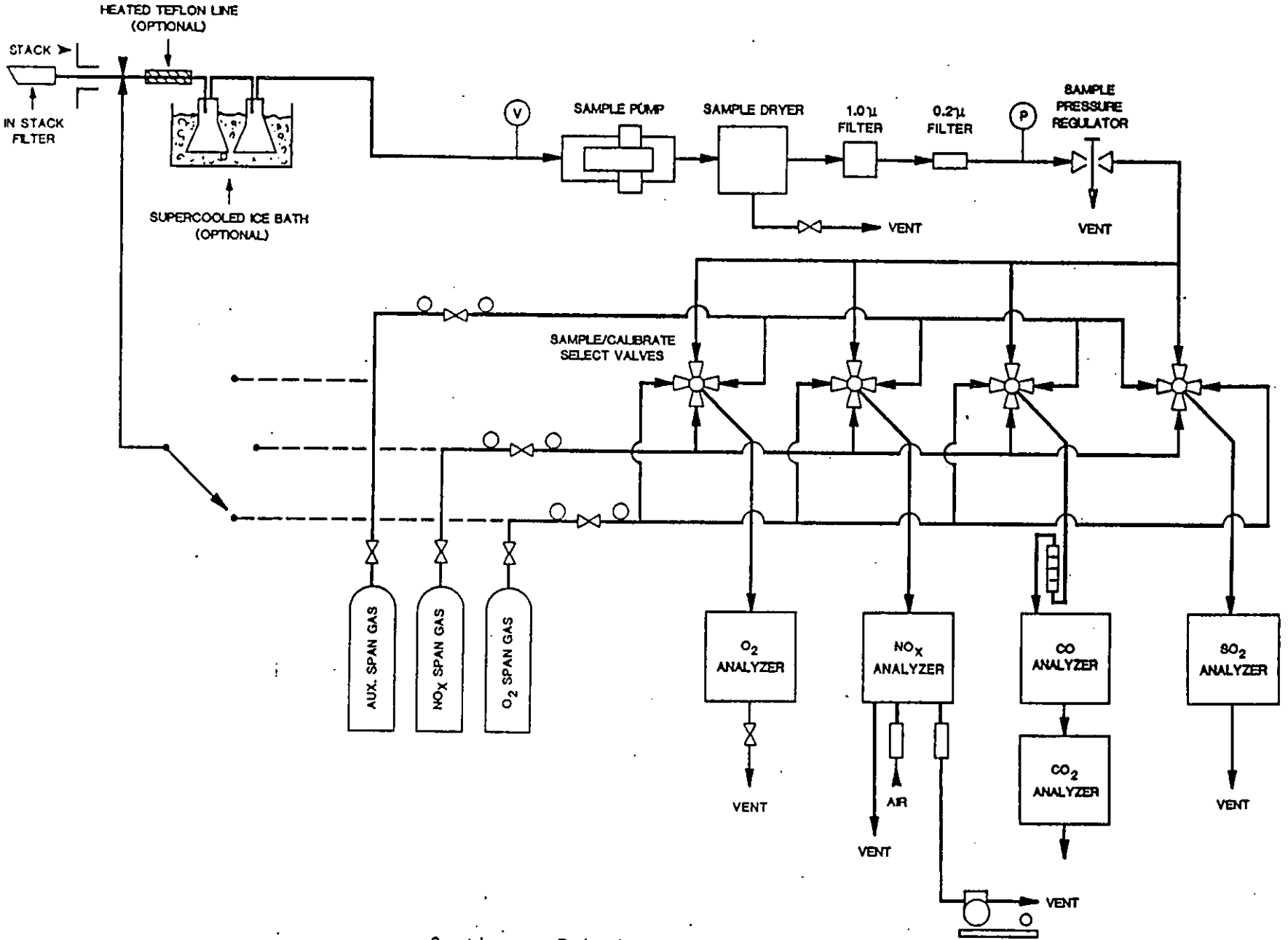
O_2, CO, CO_2, NO, NOx, and SO_2 are measured using an extractive continuous emissions monitoring (CEM) package, shown in the following figure. This package is comprised of three basic subsystems. They are: (1) the sample acquisition and conditioning system, (2) the calibration gas system, and (3) the analyzers themselves. This section presents a description of the sampling and calibration systems. Descriptions of the analyzers used in this program and the corresponding reference test methods follow. Information regarding quality assurance information on the system, including calibration routines and system performance data follows.

The sample acquisition and conditioning system contains components to extract a representative sample from the stack or flue, transport the sample to the analyzers, and remove moisture and particulate material from the sample. In addition to performing the tasks above, the system must preserve the measured species and deliver the sample for analysis intact. The sample acquisition system extracts the sample through a stainless steel probe. The probe is insulated or heated as necessary to avoid condensation. If the particulate loading in the stack is high, a sintered stainless steel filter is used on the end of the probe.

Where water soluble NO_2 and/or SO_2 are to be measured, the sample is drawn from the probe through a heated Teflon sample line into a supercooled (approximately -20 C) water removal trap. The trap consists of stainless steel flasks in a bath of dry ice and antifreeze. If dry ice is not locally available, ice and rock salt are used. This design removes the water vapor by condensation and freezes the liquid quickly. The contact between the sample and liquid water is minimized. Since the solubility of the NO_2 and SO_2 in ice is negligible, these species are conserved. This system meets the requirements of EPA Method 20. The sample is then drawn through a Teflon transport line and particulate filter, into the sample pump. The pump is a dual head, diaphragm pump. All sample-wetted components of the pump are stainless steel or Teflon. The pressurized sample leaving the pump flows through a stainless steel refrigerated (38 F) compressed air dryer for final moisture removal. A drain line and valve are provided to constantly expel any condensed moisture from the dryer. After the dryer, the sample is directed into a distribution manifold. Excess sample is vented through a back-pressure regulator, maintaining a constant pressure of 5-6 psig to the analyzers.

The calibration system is comprised of two parts: the analyzer calibration, and the system bias check (dynamic calibration). The analyzer calibration equipment includes pressurized cylinders of certified span gas. The gases used are, as a minimum, certified to 1% by the manufacturer where necessary, to comply with reference method requirements. EPA Protocol 1 gases are used. The cylinders are equipped with pressure regulators which supply the calibration gas to the analyzers at the same pressure and flow rate as the sample. The selection of zero, span, or sample gas directed to each analyzer is accomplished by operation of the sample/calibration selector valves.

The system bias check is accomplished by transporting the same gases used to zero and span the analyzers to the sample conditioner inlet (probe exit). The span gas is exposed to the same elements as the sample and the system response is documented. Where the supercooled moisture removal system is used, water is added to the knockout flasks before the pre-test check. The analyzer indications for the system calibration check must agree within 5% of the analyzer calibration. Values are adjusted and changes/repairs are made to the system to compensate for any difference in analyzer readings. Specific information on the analytical equipment and test methods used is provided in the following pages.

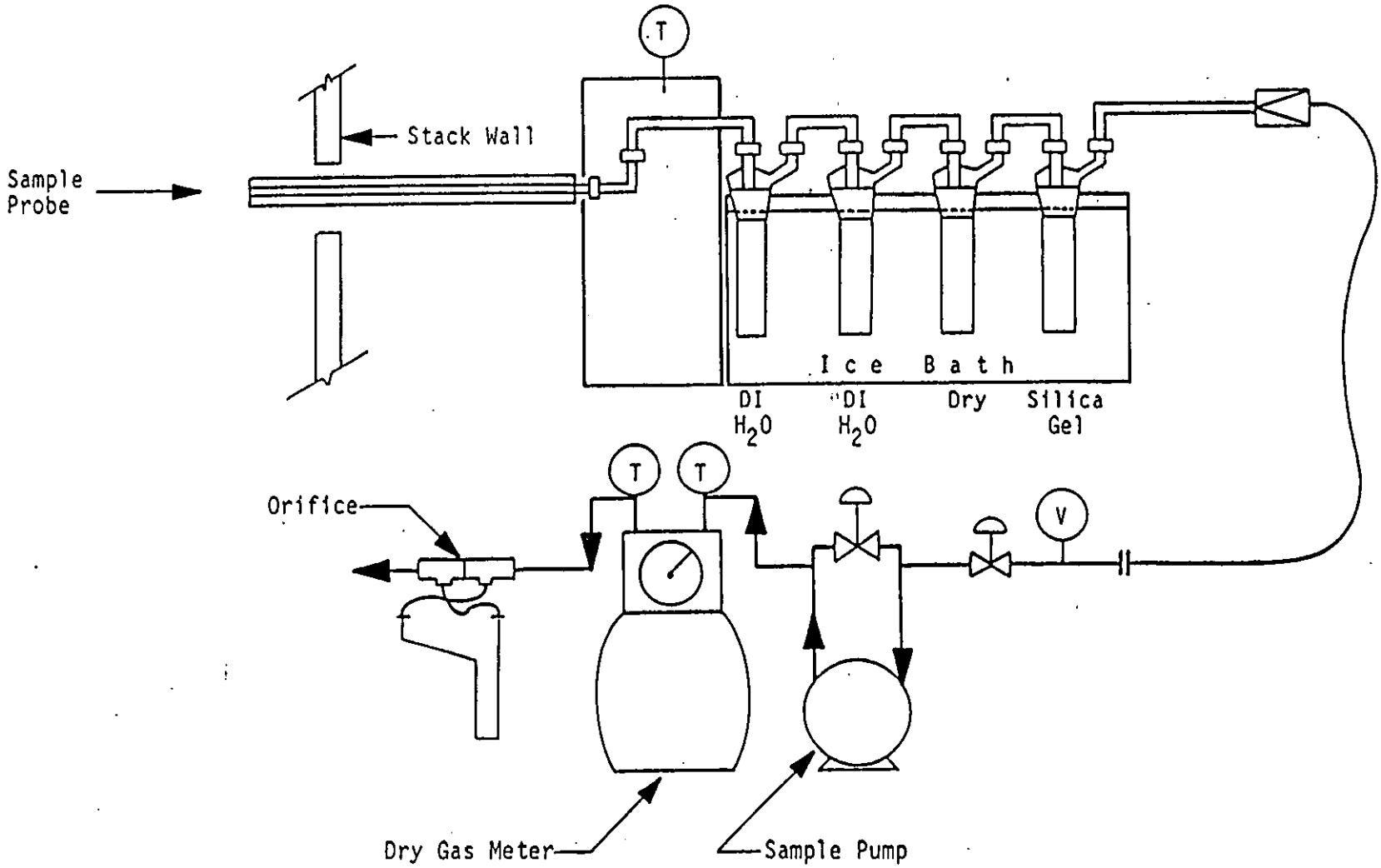


Continuous Emissions Monitoring System

Method:	Oxygen (O_2) by Continuous Analyzer
Applicable Ref. Methods:	EPA 3A, EPA 20, ARB 100, BA ST-14
Principle:	A sample is continuously drawn from the flue gas stream, conditioned, and conveyed to the instrument for direct readout of O_2 concentration.
Analyzer:	Teledyne Model 326A
Measurement Principle:	Electrochemical cell
Ranges:	0-5, 0-10, 0-25% O_2
Accuracy:	1% of full scale
Output:	0-100 mV, linear
Interferences:	Halogens and halogenated compounds will cause a positive interference. Acid gases will consume the fuel cell and cause a slow calibration drift.
Response Time:	90% <7 seconds
Sampling Procedure:	A representative flue gas sample is collected and conditioned using the CEM system described previously. If Method 20 is used, that method's specific procedures for selecting sample points are used. Otherwise, stratification checks are performed at the start of a test program to select single or multiple-point sample locations.
Analytical Procedure:	An electrochemical cell is used to measure O_2 concentration. Oxygen in the flue gas diffuses through a Teflon membrane and is reduced on the surface of the cathode. A corresponding oxidation occurs at the anode internally, and an electric current is produced that is proportional to the concentration of oxygen. This current is measured and conditioned by the instrument's electronic circuitry to give an output in percent O_2 by volume.
Special Calibration Procedure:	The measurement cells used with the O_2 instrument have to be replaced on a regular basis. After extended use, the cell tend to produce a nonlinear response. Therefore, a three-point calibration is performed at the start of each test day to check for linearity. If the response is not linear ($\pm$ 2% of scale), the cell is replaced.

Method:	Carbon Dioxide (CO_2) by Continuous Analyzer
Applicable Ref. Methods:	EPA 3A, ARB 100, BA ST-5
Principle:	A sample is continuously drawn from the flue gas stream, conditioned, and conveyed to the instrument for direct readout of CO_2 concentration.
Analyzer:	Horiba PIR 2000
Measurement Principle:	Nondispersive infrared (NDIR)
Accuracy:	1% of full scale
Ranges:	0-5, 0-10, 0-25%
Output:	0-10 mV
Interferences:	A possible interference includes water. Since the instrument receives dried sample gas, this interference is not significant.
Response Time:	1.2 seconds
Sampling Procedure:	A representative flue gas sample is collected and conditioned using the CEM system described previously.
Analytical Procedure:	Carbon dioxide concentrations are measured by short pathlength nondispersive infrared analyzers. These instruments measure the differential in infrared energy absorbed from energy beams passed through a reference cell (containing a gas selected to have minimal absorption of infrared energy in the wavelength absorbed by the gas component of interest) and a sample cell through which the sample gas flows continuously. The differential absorption appears as a reading on a scale of 0 to 100%.

Method:	Determination of Moisture in Stack Gases
Applicable Ref. Methods:	EPA 4, ARB 1-4
Principle:	A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined volumetrically or gravimetrically.
Sampling Procedure:	The sample train used in the tests is shown in the following figure. The sample is drawn at a constant rate through a stainless steel probe. The probe is connected to an impinger train by Teflon tubing. The train consists of two Smith-Greenburg impingers which contain 100 ml water, an empty impinger as a knockout, and an impinger containing silica gel to protect the pump from moisture.
Sample Recovery and Analysis:	Following testing, moisture content is determined gravimetrically from initial and final impinger weights.



Sample Train for Determination of Moisture by EPA Method 4.

APPENDIX B

QUALITY ASSURANCE

Appendix B.1

Quality Assurance Program Summary and ARB Certification

QUALITY ASSURANCE PROGRAM SUMMARY AND ARB CERTIFICATION

Carnot ensures the quality and validity of its emission measurement and reporting procedures through a rigorous quality assurance (QA) program. The program is developed and administered by an internal QA Officer, and encompasses seven major areas:

1. Development and use of an internal QA manual.
2. QA reviews of reports, laboratory work, and field testing.
3. Equipment calibration and maintenance.
4. Chain of custody.
5. Training.
6. Knowledge of current test methods.
7. Agency certification.

Each of these areas is discussed individually below.

Quality Assurance Manual. Carnot has prepared a QA Manual according to EPA guidelines. The manual serves to document and formalize all of Carnot's QA efforts. The manual is constantly updated, and each member of the Source Test Division is required to read and understand its contents. The manual includes details on the other six QA areas discussed below.

QA Reviews. Carnot's review procedure includes review of each source test report by the QA Officer, and spot check reviews of laboratory and field work.

The most important review is the one that takes place before a test program begins. The QA Officer works closely with Source Test Division personnel to prepare and review test protocols. Test protocol review includes selection of appropriate test procedures, evaluation of any interferences or other restrictions that might preclude use of standard test procedures, and evaluation and/or development of alternate procedures.

Equipment Calibration and Maintenance. The equipment used to conduct the emissions measurements is maintained according to the manufacturer's instructions to ensure proper operation. In addition to the maintenance program, calibrations are carried out on each measurement device according to the schedule outlined by the California Air Resources Board (CARB). The schedule for maintenance and calibrations are given in Tables B-1 and B-2. Quality control checks are also conducted in the field for each test program. The following is a partial list of checks made as part of each CEM system test series.

Sample acquisition and conditioning system leak check.

2-point analyzer calibrations (all analyzers)

3-point analyzer calibrations (analyzers with potential for linearity errors).

Complete system calibration check ("dynamic calibration" through entire sample system).

Periodic analyzer calibration checks (once per hour) are conducted at the start and end of each test run. Any change between pre- and post-test readings are recorded.

TABLE B-1.
SAMPLING INSTRUMENTS AND EQUIPMENT CALIBRATION SCHEDULE
As Specified by the CARB

Instrument Type	Frequency of Calibration	Standard of Comparison or Method of Calibration	Acceptance Limits
Orifice Meter (large)	12 months	Calibrated dry test meter	±2% of volume measured
Dry Gas Meter	12 months or when repaired	Calibrated dry test meter	±2% of volume measured
S-Type Pitot (for use with EPA type sampling train)	6 months	EPA Method 2	Cp constant (+5%) over working range. Difference between the average Cp for each leg must be less than 2%
Vacuum Gauges Pressure Gauges	6 months	Manometer	±3%
Field Barometer	6 months	Mercury barometer	± 0.2" Hg
Temperature Measurement	6 months	NBS mercury thermometer or NBS calibrated platinum RTD	± 4 F for <400°F ± 1.5% for >400°F
Temperature Readout Devices	6 months	Precision potentiometer	± 2% full scale reading
Analytical Balance	12 months (checked prior to each use)	Should be performed by manufacturer or qualified laboratory	± 0.3 mg of stated weight
Probe Nozzles	12 months	Nozzle diameter check micrometer	Range < ± 0.10 mm for three measurements
Continuous Analyzers	Depends on use, frequency, and performance	As specified by manufacturers operating manuals, EPA NBS gases, and/ or ref. methods	Satisfy all limits specified in operating specifications

TABLE B-2.
EQUIPMENT MAINTENANCE SCHEDULE
Based on Manufacturer's Specifications
and Carnot Experience

Equipment	Performance Requirement	Maintenance Interval	Corrective Action
Pumps	1. Absence of leaks 2. Ability to draw mfr required vacuum and flow	Every 500 hrs of operation or 6 months whichever is less	1. Visual insp. 2. Clean 3. Replace worn parts 4. Leak check
Flow Measuring Device	1. Free mechanical movement 2. Absence of malfunction	Every 500 hrs of operation or 6 months whichever is less After each test, if used in H_2S sampling or other corrosive atmospheres	1. Visual insp. 2. Clean 3. Calibrate
Sampling Instruments	1. Absence of malfunction 2. Proper response to zero, span gas	As required by manufacturer	As recommended by manufacturer
Integrated Sampling Tanks	Absence of leaks	Depends on nature of use	1. Steam clean 2. Leak check
Mobile Van Sampling Systems	Absence of leaks	Depends on nature of use	1. Change filters 2. Change gas dryer 3. Leak check 4. Check for system contamination
Sampling Lines	Sample degradation less than two percent	After each test or test series	Blow filtered air thru line until dry

All calibrations are conducted using gases certified by the manufacturer to be + 1% of label value (NBS traceable).

Calibration and CEM performance data are fully documented, and are included in each source test report.

Chain of Custody. Carnot maintains full chain of custody documentation on all samples and data sheets. In addition to normal documentation of changes between field sample custodians, laboratory personnel, and field test personnel, Carnot documents every individual who handles any test component in the field (e.g., probe wash, impinger loading and recovery, filter loading and recovery, etc.).

Samples are stored in a locked area to which only Source Test Division personnel have access. Neither other Carnot employees nor cleaning crews have keys to this area.

Data sheets are copied immediately upon return from the field, and this first generation copy is placed in locked storage. Any notes made on original sheets are initialed and dated.

Training. Personnel training is essential to ensure quality testing. Carnot has formal and informal training programs which include:

1. Attendance at EPA-sponsored training courses.
2. Enrollment in EPA correspondence courses.
3. A requirement for all technicians to read and understand Carnot's QA Manual.
4. In-house training and QA meetings on a regular basis.
5. Maintenance of training records.

Knowledge of Current Test Methods. With the constant updating of standard test methods and the wide variety of emerging test methods, it is essential that any qualified source tester keep abreast of new developments. Carnot subscribes to services which provide updates on EPA and CARB reference methods, and on EPA, CARB, and SCAQMD rules and regulations. Additionally, source test personnel regularly attend and present papers at testing and emission-related seminars and conferences. Carnot personnel maintain membership in the Air Pollution Control Association, the Source Evaluation Society, and the ASME Environmental Control Division.

AGENCY CERTIFICATION

Carnot is certified by the CARB as an independent source test contractor for gaseous and particulate measurements. Carnot also participates in EPA QA audit programs for Methods 5, 6, and 7.

Additionally, Carnot's QA Officer is actively participating on a Source Evaluation Society committee to develop a nationwide accreditation program for source testers.

STATE OF CALIFORNIA
George Deukmejian, Governor

AIR RESOURCES BOARD
1102 Q STREET
P.O. BOX 2815
SACRAMENTO, CA 95812

June 21, 1989

Robert A. Finken
Director, Testing Services
Energy Systems Associates
15991 Red Hill Ave., Suite 110
Tustin, CA 92680

Dear Mr. Finken:

Testing Approval

We are pleased to inform you that we have renewed your approval to conduct the types of testing listed in the enclosed Executive Order. This approval is valid until June 30, 1990 during which time a field audit of your company's testing ability may be conducted.

If you have any questions regarding the approvals or other tests, please contact Ms. Kathryn Gugeler at (916) 327-1521 or Mr. Raak Veblen at (916) 327-1519. All correspondance should be addressed to me at the post office box above.

Sincerely,

James J. Morgester, Chief
Compliance Division

State of California
AIR RESOURCES BOARD

Executive Order G-482

WHEREAS, the Air Resources Board ("Board"), pursuant to Section 41512 of the California Health and Safety Code, has established the procedures contained in Section 91200-91220, Title 17, California Code of Regulations, to allow the use of independent testers for compliance tests required by the Board; and

WHEREAS, pursuant to Sections 91200-91220, Title 17, California Code of Regulations, the Executive Officer has determined that Energy Systems Associates meets the requirements of the Board for conducting ARB Test Methods 1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 1-8, 1-10, and 1-100 (NOx, and 02).

NOW, THEREFORE, BE IT ORDERED that Energy Systems Associates is granted an approval, from the date of execution of this order, until June 30, 1990 to conduct the tests listed above, subject to compliance with Section 91200-91220, Title 17, California Code of Regulations.

BE IT FURTHER ORDERED that during the approved period the Executive Officer or his or her authorized representative may field audit one or more tests conducted pursuant to this order for each type of testing listed above.

Executed at Sacramento, California, this 19TH day of JUNE 1989.

James J. Morgester, Chief
Compliance Division

Appendix B.2

Calibration Data

ANALYTICAL REPORT – cont'd

ENERGY SYSTEMS

ATTN: BOB FINKEN

Date: 12-9-88

Our Project No.: 415080

Your P.O. No.: 4560

Cyl. No. AAL 4678 Analytical Accuracy ±1%

Component	Concentration
Oxygen	12.50%
Carbon Monoxide	275.5 PPM
Carbon Dioxide	14.97%
Nitrogen	Balance

*Gravimetric Master

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

*Certified to have been blended against NBS certified weights and verified correct by independent analysis.

Analyst _____

Approved By _____

AUG 2 3 1989

TELEX: 510-100-8831 (ScotGas)
FAX: 714-887-0549
PHONE: 714-887-2571

Scott Specialty Gases

a division of

Scott Environmental Technology Inc. 2600 CAJON BLVD., SAN BERNARDINO, CA 92405

Date: 8-9-89

Our Project No.: 01858

Your P.O. No.: 5264

ENERGY SYSTEMS ASSOCIATES
15991 RED HILL AVE., SUITE 110
TUSTIN, CA 92680
ATTN: JIM MULLIGAN

Gentlemen:

Thank you for choosing Scott for your Specialty Gas needs. The analyses for the gases ordered, as reported by our laboratory, are listed below. Results are in volume percent, unless otherwise indicated.

ANALYTICAL REPORT

Cyl. No. ALM 5688 — Analytical Accuracy ±2% *

Component	Concentration
CARBON DIOXIDE	22.50%
CARBON MONOXIDE	422.6 PPM
OXYGEN	8.001%
*GRAVIMETRIC MASTER	
NITROGEN	BALANCE

Cyl. No. ALM 5692 — Analytical Accuracy ±2%*

Component	Concentration
CARBON DIOXIDE	22.50%
CARBON MONOXIDE	422.2 PPM
OXYGEN	8.000%
*GRAVIMETRIC MASTER	
NITROGEN	BALANCE

Cyl. No. ALM 5675 — Analytical Accuracy ±2%*

Component	Concentration
CARBON DIOXIDE	15.00%
CARBON MONOXIDE	54.56 PPM
OXYGEN	5.001%
*GRAVIMETRIC MASTER	
NITROGEN	BALANCE

Cyl. No. ALM 5598 — Analytical Accuracy ±2%*

Component	Concentration
CARBON DIOXIDE	15.00%
CARBON MONOXIDE	54.46 PPM
OXYGEN	5.000%
*GRAVIMETRIC MASTER	
NITROGEN	BALANCE

*Certified to have been blended against NBS certified weights and verified correct by independent analysis.

Analyst _____

Approved By _____

Scott Specialty Gases

a division of

TELEX: 510-100-8831 (ScotGas)
FAX: 714-887-0549
PHONE: 714-887-2571

Scott Environmental Technology Inc. 2600 CAJON BLVD., SAN BERNARDINO, CA 92405

Shipped From Scott: SAN BERNARDINO
Date Shipped: 7-26-89
Our Project No: 01864
Your P.O. No: 5364
Page 1 of 1
Expiration Date: 1-26-91

ENERGY SYSTEMS
ATTN: JIM MULLIGAN

CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*

Certified Pr. Traceability Protocol No. 1 Procedure No. G1 Cylinder No. ALM-6064 Cylinder Pressure 1900 psig Certified Accuracy ±1 % NBS Traceable

REFERENCE STD

COMPONENTS	CERTIFIED CONC	SRM/CRM NO.	CYL. NO.	CONC.
Nitric Oxide	50.64 PPM	SRM 1684 B	CAL-12787	94.80 PPM
NOX	50.69 PPM			

GAS ANALYZER

MAKE/MODEL/SERIAL NO.	LAST CAL. DATE	ANALYTICAL PRINCIPLE
Thermo-Electron 10 AR S/N 14853-150	5-2-89	Chemi-Luminenscent

BALANCE GAS Nitrogen

ANALYZER READINGS: Z = Zero Gas T = Test Gas R = Reference Gas

Component Nitric Oxide
First Analysis Date 6-13-89 Units PPM

Z 0.03	R 94.68	T 50.38
R 94.65	Z 0.04	T 50.35
Z 0.03	T 50.40	R 94.63

Mean Test Assay 50.44 PPM

Second Analysis Date 7-25-89 Units PPM

Z 0.00	R 95.17	T 50.85
R 95.13	Z 0.08	T 50.83
Z 0.07	T 50.82	R 95.08

Mean Test Assay 50.64 PPM

Component ____ Date ____ Units ____

Z ____	R ____	T ____
R ____	Z ____	T ____
Z ____	T ____	R ____

Mean Test Assay ____

Date ____ Units ____

Z ____	R ____	T ____
R ____	Z ____	T ____
Z ____	T ____	R ____

Mean Test Assay ____

Component ____ Date ____ Units ____

Z ____	R ____	T ____
R ____	Z ____	T ____
Z ____	T ____	R ____

Mean Test Assay ____

Date ____ Units ____

Z ____	R ____	T ____
R ____	Z ____	T ____
Z ____	T ____	R ____

Mean Test Assay ____

Chronology: Date ____
Assay ____

Analyst Doug Hagberg

Approved By: R. Sleaty

ANDERSEN
SAMPLERS INCORPORATED

4215 WENDELL DRIVE ◻ ATLANTA, GEORGIA 30336

CONTROL UNIT CALIBRATION

Date 1-20-84 Box No. 184-209 (ES-8)

Barometric pressure, P_b = 30.30 in. Hg Dry Gas Meter No. _____

Orifice manometer setting, ΔH in. H_2O	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °R	Temperature: Dry gas meter Inlet t_{di}, °R	Temperature: Dry gas meter Outlet t_{do}, °R	Temperature: Dry gas meter Average t_d, °R	Time θ, min	Y	ΔH@
1.0	5	5.43	71/531	120	92	106/566	9.5	.982	1.88
2.0	5	5.42	71/531	127	93	110/570	6.8	.990	1.91
4.0	5	5.41	71/531	134	94	114/574	4.9	.991	1.97
								.990	1.92

Calculations

H	$\frac{\Delta H}{13.6}$	Y: $\frac{V_w P_b \left(\quad t_d \quad \right)}{V_d \left(P_b + \frac{\Delta H}{13.6} \right) \left(\quad t_w \quad \right)}$	ΔH@: $\frac{0.0317\ \Delta H}{P_b \left(t_d \quad \right)} \left[\frac{\left(t_w \quad \right) \theta}{V_w} \right]^2$
.0	0.0735		
.0	0.147		
.0	0.294		

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ± 0.01

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ± 0.15

MAP

ENERGY SYSTEMS ASSOCIATES

DRY GAS METER CALIBRATION

'IELD GAS METER I.D. ES-8 TEST METER ES-13

)ATE 1/22/90 TEST METER LAST CAL. 1.000 = Yt

BAROMETRIC PRESSURE 30.17

FIELD METER			TEST METER				RESULTS				
/OLUME :u.ft.	TEMP. 'F	DELTA H "H2O	TIME min.	VOLUME cu.ft.	TEMP. 'F	PRESS. "H2O	Q cfm	Y	H@	AVE.Y	AVG. H@
4.55	90.5	0.4	13	4.55	64	0	0.35	1.050	1.71	1.0069	1.68
4.94	91.5	0.4	13	4.63	64	0	0.38	0.985	1.64		
4.91	93	0.4	13	4.59	64	0	0.38	0.986	1.67		
5.01	94	0.72	10	4.69	64.5	0	0.50	0.987	1.70	1.0046	1.63
4.98	96	0.72	10	4.87	64.5	0	0.50	1.035	1.57		
5.14	97	0.72	10	4.81	64.5	0	0.51	0.992	1.61		
4.66	97	1	8	4.37	65.5	0	0.58	0.992	1.74	0.9915	1.75
4.65	99	1	8	4.35	66.5	0	0.58	0.991	1.76		
4.68	100	1	8	4.38	67	0	0.59	0.992	1.73		
5.79	102	2	7	5.456	68	0	0.83	0.998	1.71	0.9981	1.71
5.85	102.	2	7	5.511	68	0	0.84	0.999	1.68		
5.77	102.	2	7	5.426	68	0	0.82	0.997	1.73		
6.77	103	4	6	6.414	68	0	1.13	1.000	1.82	1.0026	1.80
6.82	104.	4	6	6.459	68	0	1.14	1.003	1.79		
6.82	104.	4	6	6.468	68	0	1.14	1.004	1.78		
								AVERAGE		1.0007	1.71
										*******	*********

ENERGY SYSTEMS ASSOCIATES POST TEST DRY GAS METER CALIBRATION CHECK

CALIBRATED BY JJM
DATE 03/11/90
FIELD GAS METER I.D. ES-8
INITIAL Yd 0.990
INITIAL H@ 1.920

DATA ENTRY BY JJM
BAROMETRIC PRESSURE 30
TEST METER ES-13
TEST METER Y (Yt) 1.000
TEST METER LAST CAL. 12/89

FIELD METER				TEST METER			RESULTS		
VOLUME cu.ft.	TEMP. IN	TEMP OUT	DELTA "H2O	TIME min.	VOLUM cu.ft	TEMP. 'F	Q cfm	Y	H@
5.67	77	62.5	1.00	10	5.46	58	0.57	0.984	1.81
5.70	86	67.5	1.00	10	5.44	58	0.57	0.988	1.81
5.72	88	71.5	1.00	10	5.42	58	0.57	0.985	1.81
						AVERAGES		0.986	1.81

PASS - INDIVIDUAL Yd VALUES ACCEPTABLE
PASS - INDIVIDUAL DELTA H@ VALUES ACCEPTABLE
PASS - POST TEST Yd WITHIN LIMITS

E/A

POST TEST DRY GAS METER CALIBRATION DATA

Calibrated By J. Mulligan

Date 3/11/90

Field Meter ID ES-8

Barometric Press 30.00

Test Meter ID ES-13

Test Meter Y (Y_t) 1.00

Test Meter Last Cal 12/14/89

Test Program Preceding Calibration Check _____

Average ΔH from Test Runs _____

Maximum Vacuum from Test Runs _____

Field Meter								Test Meter				
				Temperature							Temperature	
ΔH	Final Volume	Initial Volume	Volume (V_{dg})	Inlet (t_i)	Outlet (t_o)	Vacuum	Time (0)	Final Volume	Initial Volume	Volume (V_{tm})	Inlet	Outlet
1.0	140.153	134.485	5.668	75	61	2	10:00	284.357	278.791	5.466	58	58
				83	64						58	58
1.0	145.851	140.153	5.698	84	66	2	10:00	289.703	284.257	5.446	58	58
				88	65						58	58
1.0	151.574	145.851	5.723	84	70	2	10:00	295.127	288.703	5.424	58	58
				92	73				288.703		58	58

ANDERSEN SAMPLERS INCORPORATED

4215 WENDELL DRIVE ☐ ATLANTA, GEORGIA 30336

CONTROL UNIT CALIBRATION

Date 1-28-87 Unit Number 187-342 (ES-1)

Barometric pressure, P_b = 29.98 in Hg. Model Number 90-800

Orifice manometer setting, ΔH, in. H_2O	Gas volume, wet test meter V_w, ft^3	Gas volume, dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °R	Temperature: Dry gas meter Inlet t_{di}, °R	Temperature: Dry gas meter Outlet t_{do}, °R	Temperature: Dry gas meter Average t_d, °R	Time θ, min	γ	$\Delta H_@$
1.0	5	5.42	76/536	132	102/562	117/577	9.18	.99	1.82
2.0	5	5.40	76/536	136	104/564	120/580	6.52	1.00	1.83
4.0	5	5.38	76/536	141	105/565	123/583	4.64	1.00	1.85
								1.00	1.83

Calculations:

ΔH	$\frac{\Delta H}{13.6}$	γ: $\frac{V_w P_b \left(\frac{t_d}{} \right)}{V_d \left(P_b + \frac{\Delta H}{13.6} \right) \left(\frac{t_w}{} \right)}$	$\Delta H_@$: $\frac{0.0317\ \Delta H}{P_b \left(\frac{t_{do}}{} \right)} \left[\frac{\left(\frac{t_w}{} \right) \theta}{V_w} \right]^2$
1.0	0.0735		
2.0	0.147		
4.0	0.294		

γ = Ratio of accuracy of wet test meter to dry test meter. Tolerance : ± 0.01

$\Delta H_@$ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance : ± 0.15

Calibrated by: RJP

ENERGY SYSTEMS ASSOCIATES

DRY GAS METER CALIBRATION

FIELD GAS METER I.D. ES-19 TEST METER ES-13

DATE 1/19/90 TEST METER LAST CAL. ---------- 1.000 = Yt

BAROMETRIC PRESSURE 30.15

FIELD METER			TEST METER				RESULTS				
VOLUME cu.ft.	TEMP. 'F	DELTA H "H2O	TIME min.	VOLUME cu.ft.	TEMP. 'F	PRESS. "H2O	Q cfm	Y	H@	AVE.Y	AVG. H@
6.01	84.5	0.4	15.5	5.759	65	0	0.39	0.993	1.54	0.9941	1.49
5.21	88	0.4	13	4.965	65	0	0.40	0.994	1.45		
5.18	91.5	0.4	13	4.907	65	0	0.40	0.995	1.47		
6.10	102	0.7	12	5.886	66	0	0.51	1.029	1.50	1.0306	1.49
5.12	106	0.7	10	4.898	66	0	0.51	1.029	1.49		
9.80	110	0.7	19	9.364	66	0	0.52	1.034	1.47		
5.44	99.5	1	9	5.198	66	0	0.60	1.014	1.55	0.9961	1.57
6.01	100	1	10	5.747	66	0	0.60	1.016	1.57		
5.71	100	1	9	5.153	66	0	0.63	0.958	1.58		
5.50	101	2	7	5.543	66	0	0.79	1.070	1.65	1.0276	1.68
4.97	101	2	6	4.73	66	0	0.83	1.010	1.66		
7.39	99.5	2	9	7.005	66	0	0.82	1.003	1.71		
6.83	102	4	6	6.467	65.5	0	1.14	1.003	1.77	1.0042	1.74
6.97	102	4	6	6.594	65.5	0	1.16	1.002	1.71		
8.05	102	4	7	7.66	65.5	0	1.15	1.008	1.72		
								AVERAGE		1.0105	1.59
										*******	*********

E/A

POST TEST DRY GAS METER CALIBRATION DATA

Calibrated By GWB

Date 2/16/90

Field Meter ID ES-19

Barometric Press 30.17

Test Meter ID ES-13

Test Meter Y (Y_t) 1.000

Test Meter Last Cal 12/14/89

Test Program Preceding Calibration Check OBrien

Average ΔH from Test Runs _____

Maximum Vacuum from Test Runs _____

Field Meter								Test Meter				
				Temperature							Temperature	
ΔH	Final Volume	Initial Volume	Volume (V_{dg})	Inlet (t_i)	Outlet (t_o)	Vacuum	Time (θ)	Final Volume	Initial Volume	Volume (V_{tm})	Inlet	Outlet
1.0	1000.256	993.905	6.345	94	70	5	10	101.978	95.830	6.148	62	64
				94	70						62	64
1.0	6.623	0.050	6.573	95	72	5	10	108.911	101.978	6.133	62	64
				96	73						62	64
1.0	13.070	6.623	6.447	96	74	5	10	114.285	108.111	6.174	62	64
				97	75						62	64

Appendix B.3

CEM Performance Data

SPAN GAS RECORD

Date 1/29/90

Client/Location SCE/Long Beach By SMH

Gas	Span Cylinder		Aux. Span Cylinder	
	Cylinder No.	Concentration	Cylinder No.	Concentration
Zero	ALM-6093		ALM-6093	
NOx	—	—	—	—
O2	AAL-4678	12.5	ALM-5692	8.000
CO	↓	275.5 289 ppm	↓	422.2 442 ppm
CO2	↓	14.97	↓	22.5
SO2	—	—	—	—

INSTRUMENT LINEARITY 1/30/90

SMH

	Analyzer				
	O2	CO2	CO	NOx	SO2
Analyzer Range	25%	25%	500	—	—
Set to High STD (80-90% of Range)	20.9	22.5	442 422.2	—	—
As-Found Low STD (50-60% of Range)	12.75	14.9	290	—	—
Actual Value of Low STD	12.5	14.97	289	—	—
Difference in % of Full Scale	1%	0.3%	0.2%	—	—

Allowable deviation is 2% of full scale (2 squares on strip chart).

APPENDIX C

DATA SHEETS, CALCULATIONS AND LABORATORY REPORTS

Appendix C.1

Sample Location

E/A

SAMPLING POINT LOCATION DATA
EPA Method 1

Plant LONG BEACH AUX BOILER Data by SNH

Date 2/90

Test Location EXHAUST DUCT

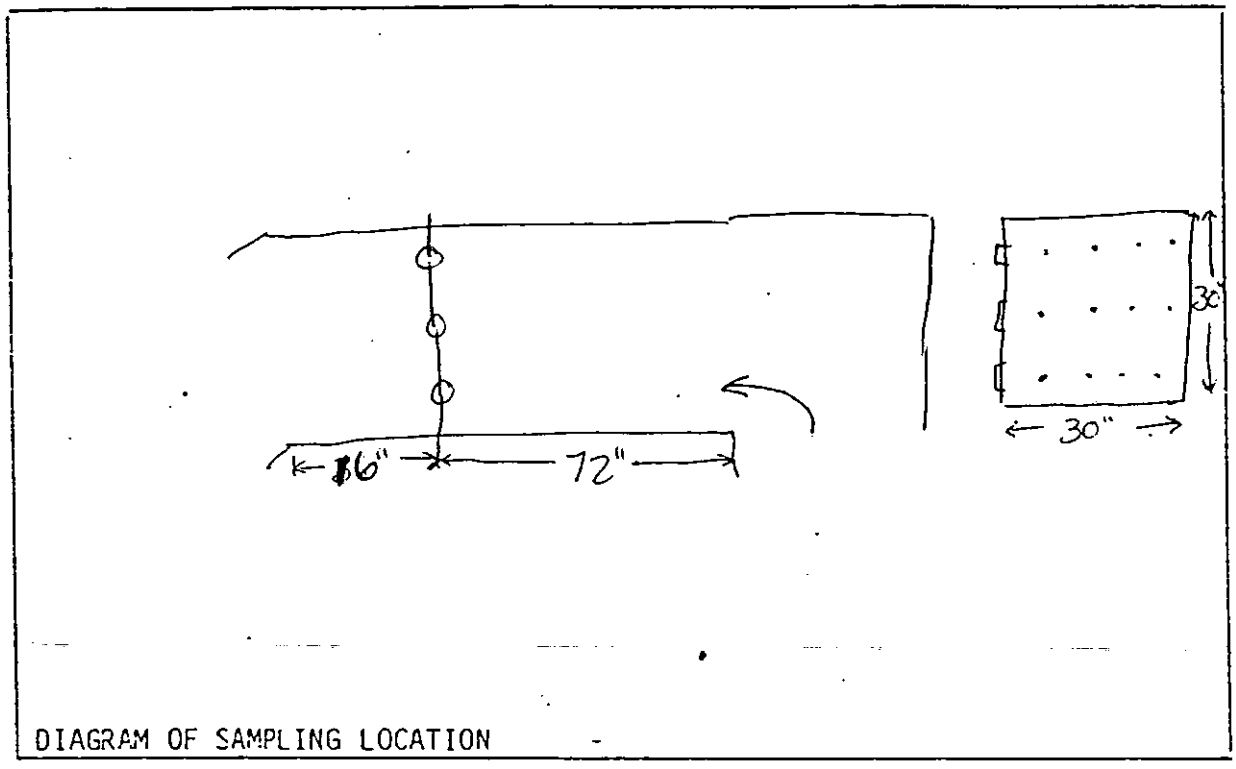


DIAGRAM OF SAMPLING LOCATION

Upstream Dist./Dia. _____

Downstream Dist./Dia. _____

Coupling Length _____

No. of Sampling Pts. 12

Stack Dimension 30" x 30"

Stack Area, ft^2 6.25 ft^2

*Inches from wall plus coupling length

Sample Point	% of Diameter	In. from near Wall	In. from Nozzle*

Appendix C.2

Unit Operating Data

LONG BEACH AUXILIARY BOILER

CONTROL ROOM DATA

Client/Location SCE Data by M. ESCARCEGA

Test No.		1	2	B			
Date		2/2/90	→	→			
Time		1100	1145	1245			
FUEL		GAS	GAS	GAS			
BOILER FRONT DATA:							
STEAM PRESS.	PSIG	137	137	136			
WINDBOX PRESS.	"H_2O	5.5	5.5	5.6			
FURNACE PRESS.	"H_2O	2.5	2.5	2.4			
OIL SUPPLY PRESS.	PSIG	35	35	36			
BURNER OIL PRESS.	PSIG	0	0	0			
ATOMIZING STEAM PRES	PSIG	53	53	53			
GAS SUPPLY PRESS.	PSIG	10.4	10.5	10.5			
BURNER GAS PRESS.	PSIG	2.0	1.9	1.9			
STEAM FLOW	KLB/HR	33	33	33			
AIR REGISTERS U/L	%OPEN	65/55	65/55	65/55			
MAIN CONTROL RM. DATA							
STEAM FLOW	KLB/HR	34	33	33			
GAS FLOW	KSCFH	20.4	20.1	20.2			
FUEL OIL FLOW		0	0	0			
DRUM LEVEL		11.0	10.9	10.9			
STEAM PRESS.	PSIG	139	139.7	139.2			
FEEDWATER PRESS.	PSIG	240.9	239.5	240.7			

Comments/Notes

EA

LONG BEACH AUXILIARY BOILER

CONTROL ROOM DATA

Client/Location SCE Data by BJR

Test No.		4	4	4	4	5	5
Date		2/5/90	2/5/90	2/5/90	2/5/90	2/5/90	2/5/90
Time		0902	0937	1101	1151	1332	1440
FUEL		OIL	OIL	OIL	OIL	OIL	OIL
BOILER FRONT DATA:							
STEAM PRESS.	PSIG	134	134	134	135	133	134
WINDBOX PRESS.	"H_2O	6.5	6.5	6.2	6.3	6.0	6.4
FURNACE PRESS.	"H_2O	1.9/3.1	1.9/3.0	1.9/2.9	1.9/2.8	1.9/2.6	1.9/2.5
X OIL SUPPLY PRESS.	PSIG	138	142	137	135	136	135
Y BURNER OIL PRESS.	PSIG	66.2	70.0	65.0	69.0	68.0	66.0
Y ATOMIZING STEAM PRES	PSIG	72.2	70.0	72.0	71.0	73.0	73
GAS SUPPLY PRESS.	PSIG	12.2	12.2	12.2	12.2	12.2	12.2
BURNER GAS PRESS.	PSIG	0	0	0	0	0	0
STEAM FLOW	KLB/HR	34	33.5	33.5	33.5	33.0	33.5
AIR REGISTERS U/L	%OPEN	80/75	80/75	80/75	80/75	80/75	80/75
MAIN CONTROL RM. DATA							
STEAM FLOW	KLB/HR	3.3	3.4	3.5	3.5	3.3	3.5
GAS FLOW	SCFH	0.1	0.1	0.1	0.1	0.1	0.1
FUEL OIL FLOW		9.4	9.0	9.5	9.8	9.4	9.6
DRUM LEVEL		11.1	11.2	11.3	11.2	11.1	11.1
STEAM PRESS.	PSIG	135.0	135.3	136.3	135.5	136.2	138.5
FEEDWATER PRESS.	PSIG	240	240	240	241	240	241

Comments/Notes

LONG BEACH AUXILIARY BOILER

CONTROL ROOM DATA

Client/Location SCE Data by BJR/MDE

Test No.		5	5	6	6	6
Date		2/5/90	2/5/90	2/7/90	2/7/90	2/7/90
Time		1537	1622	0812	0945	1115
FUEL		DISTILLATE		DISTILLATE		
BOILER FRONT DATA:						
STEAM PRESS.	PSIG	134	134	135	127	134
WINDBOX PRESS.	"H_2O	6.0	6.2	6.2	6.2	6.2
FURNACE PRESS.	"H_2O	1.9/2.5	1.9/2.5	2.0/2.6	2.0/2.4	2.0/2.5
OIL SUPPLY PRESS.	PSIG	137	136	138	136	135
BURNER OIL PRESS.	PSIG	66	64	66	68	67
ATOMIZING STEAM PRES	PSIG	72	71	72	72	73
GAS SUPPLY PRESS.	PSIG	12.2	12.2	12.2	12.2	12.2
BURNER GAS PRESS.	PSIG	0	0	0	0	0
STEAM FLOW	KLB/HR	33	33	34	36	36
AIR REGISTERS U/L	%OPEN	80/75	80/75	80/70	80/75	80/75
MAIN CONTROL RM. DATA						
STEAM FLOW	KLB/HR	34	34	35	37	36
GAS FLOW	SCFH	0.1	0.1	0	0	0
FUEL OIL FLOW		9.6	9.4	9.1	9.8	9.8
DRUM LEVEL		10.9	11.0	11.0	11.5	11.1
STEAM PRESS.	PSIG	136.7	136.7	135.4	127.5	137.8
FEEDWATER PRESS.	PSIG	240	240	239	238	239

Comments/Notes

Appendix C.3

CEM Data

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE/LBAX
Date 2/2/90
Test Location EXHAUST DUCT
Ambient Temperature, DB/WB
Operator SMH

Test No(s) 1-LBAX-CEM
Barometric Pressure
Duct Static Pressure
Fuel GAS

Test No.	Sample Time	Point	Dry, Uncorrected							Corrected to ___% ___, Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
	1053		6.5	8.0								
	1059		6.5	8.0								
	1105		6.6	7.9								
	1141		6.6	8.0								
	1117		6.6	7.9								
	1123		6.7	7.9								
		AVG	6.6	8.0								
Span Gas Concentration												

Comments:

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE, 1 RAX
Date 8/2/90
Test Location EXH. DUCT
Ambient Temperature, DB/WB
Operator ATM

Test No(s) 2-UBAX-CEM
Barometric Pressure
Duct Static Pressure
Fuel GAS

Test No.	Sample Time	Point	Dry, Uncorrected							Corrected to ___% ___, Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
	1135		6.8	7.9								
	1141		6.8	7.9								
	1147		6.8	7.9								
	1153		6.8	7.9								
	1159		6.9	7.8								
	1205		6.9	7.8								
		AVGS	6.8	7.9								
Span Gas Concentration												

Comments: _____

_____

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE/LBAX
Date 2/2/90
Test Location EXHAUST DUCT
Ambient Temperature, DB/WB
Operator

Test No(s) 3-LBAX-COM
Barometric Pressure
Duct Static Pressure
Fuel GAS

Test No.	Sample Time	Point	Dry, Uncorrected							Corrected to ___ % ___, Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
	1210		7.0	7.8								
	1216		7.0	7.8								
	1222		7.0	7.8								
	1228		7.0	7.8								
	1234		↓	↓								
	1240											
		AVG	7.0	7.8								
Span Gas Concentration												

Comments:

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE / LONG BEACH
Date 2/5/90
Test Location AUX BOILER Exh.
Ambient Temperature, DB/WB ~58°F
Operator SMM

Test No(s) 4-LBAX-CEM
Barometric Pressure 30.15
Duct Static Pressure
Fuel DISTILLATE OIL

Test No.	Sample Time	Point	Dry, Uncorrected							Corrected to ___% ___, Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
	0900			9.0	15				6.9			
	0915			9.4	15				6.5			
	0930			9.4	15				6.5			
	0945			9.5	16				7.5			
	1000			8.8	17				9.1			
	1015			9.5	18				9.5			
	1030			9.5	19				10.5			
	1045			9.4	19				10.5			
	1100			9.3	20				11.6			
	1115			9.3	21				12.6			
	1130			9.5	22				13.5			
	1145			9.5	22				13.5			
	1200			9.0	19				10.9			
	1215			9.4	22				13.5			
Span Gas Concentration				15.0	289							
	AVG			9.32					10.2			

Comments:

ESA DS-001

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE/LONG BEACH
Date 2/15/90
Test Location AUX Boiler
Ambient Temperature, DB/WB ~58°F
Operator SWH

Test No(s) 5-LBAX-CEM
Barometric Pressure 30.15
Duct Static Pressure
Fuel DISTILLATE OIL

Test No.	Sample Time	Point	Dry, Uncorrected						CO-CO_2	Corrected to ___% ___, Dry		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
	1325			9.3	15				6.6			
	1340			9.3	15				6.6			
	1355			9.5	15				6.5			
	1410			9.1	15				6.8			
	1425			9.5	15				6.5			
	1440			9.5	15				6.5			
	1455			9.3	15				6.6			
	1510			9.3	14				5.6			
	1525			9.3	15				6.6			
	1540			9.6	15				6.4			
	1555			9.6	15				6.4			
	1610			9.3	15				6.6			
	1625			9.3	15				6.6			
	1639			9.3	15				6.6			
Span Gas Concentration				15.0	289							
	AVG			9.4					6.5			

Comments:

E/A

CONTINUOUS EMISSIONS MEASUREMENTS

Client SCE/LBAX
Date 2/7/90
Test Location Aux. Boiler Exhaust Duct
Ambient Temperature, DB/WB ~60°F
Operator SMH

Test No(s) 6-LBAX-CEM
Barometric Pressure 29.98
Duct Static Pressure -.55
Fuel Distillate oil

Test No.	Sample Time	Point	Dry, Uncorrected O_2	CO_2	CO	NOx	NO	NO_2	CO-(A)CO_2 ~~SO_2~~	Corrected to % ___, Dry CO	NOx	SO_2
	0811			9.6	14				5.4			
	0826			9.6	15				6.4			
	0841			9.3	15				6.6			
	0913			9.5	15				6.5			
	0928			9.7	15				6.3			
	0943			9.9	16				7.1			
	0958			9.8	17				8.2			
	1014			9.8	19				10.2			
	1029			9.8	19				10.2			
	1044			9.8	20				11.2			
	1059			9.8	20				11.2			
	1114			9.9	20				11.1			
	1129			9.9	23				14.1			
Span Gas Concentration				15.0	289							
	AVG			9.7					8.8			

Comments:

Appendix C.4

Benzene

CARNOT
Benzene Emissions

Client/Location: SCE / Long Beach Auxiliary Boiler

Reference Temp (F)	60		
F Factor,Gas	8476	F Factor, Oil	9541
02,% Gas	6.8	02,% Oil	8.44
Flow rate, Gas Fuel(dscfm)	9250	Flow rate, Oil (dscfm)	10832

Fuel	Gas	Oil
Test No. 1A-LBAX-BEN		Test No. 4A-LBAX-BEN
ppb	ND< 4	ppb ND< 4
lb/hr	ND< 4.57E-04	lb/hr ND< 5.35E-04
lb/MMbtu	ND< 1.03E-05	lb/MMbtu ND< 1.32E-05
Test No. 1B-LBAX-BEN		Test No. 4B-LBAX-BEN
ppb	ND< 4	ppb ND< 4
lb/hr	ND< 4.57E-04	lb/hr ND< 5.35E-04
lb/MMbtu	ND< 1.03E-05	lb/MMbtu ND< 1.32E-05
Test No. 1C-LBAX-BEN		Test No. 4C-LBAX-BEN
ppb	ND< 4	ppb ND< 4
lb/hr	ND< 4.57E-04	lb/hr ND< 5.35E-04
lb/MMbtu	ND< 1.03E-05	lb/MMbtu ND< 1.32E-05
Average		Average
ppb	ND< 4	ppb ND< 4
lb/hr	ND< 4.57E-04	lb/hr ND< 5.35E-04
lb/MMbtu	ND< 1.03E-05	lb/MMbtu ND< 1.32E-05

CARNOT 05/03/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/2/90
Test Number	1-LBAX-H2	Data By	SMH
Test Method	4	Sample Location	EXH DUCT
Fuel	GAS	Reference Temp (F)	60
Control Box #	ES-19	Unit	AUX
Pitot Factor	0.840	Meter Cal Factor	1.0000
Stack Area (sq ft)	6.25	Sample Time (Min)	30
Bar Press (in Hg)	30.39	Nozzle Diam (in)	N/A
Meter Vol (acf)	21.352	Meter Temp (F)	108.8
Stack Press (iwg)	-0.67	Stack Temp (F)	634.6
Vel Head (iwg)	0.5227	O2 (%): from CEM	6.60
		from portable	6.80
Liquid Vol (ml)	76.1	CO2 (%): from CEM	8.00
		calculated	7.89
Meter Press (iwg)	1.50	Start/Stop Time	1053/1123

Std Sample Vol (SCF)	19.89
Metric Sample Vol (cubic meters)	0.56
Moisture Fraction	0.151
Stack Gas Mol Wt	27.79
Stack Gas Velocity (ft/sec)	59.06
Stack Flow Rate (wacfm)	22,148
Stack Flow Rate (dscfm)	9,056

PARTICULATE TEST DATA

Client/Location SCE/Long Beach Unit Box Cooler Test No. L-LBBX-H2O Method 4 Page 1
Sample Location duct Fuel Gas Ambient Temp., °F ____ of 1
Operators JM/RP Meter Vol. (Start/End) 552.576/573.528 Date 2/2/90

Pre Test Data:
- Barometric Press, in. Hg 30.39
- Stack Area, sq. ft. 6.25
- Sample Time/ Pt, min. 5 min/pt
- Assumed Stack Press -.07
- Assumed Moisture 9
- Assumed Molecular Wt 28.8

Equipment Info:
- Meter No. ES-15
- Meter, Yd 1.00
- Pitot, Cp .84
- CFM @ΔH = 1.0 .575
- Probe I.D. Quartz
- Nozzle No./Dia n/a
- Filter No. n/a

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	H2O	667.0	- 613.6	= 53.4
#2	H2O	595.8	- 584.7	= 11.1
#3	-	461.1	- 458.8	= 2.3
#4	SG	627.7	- 618.4	= 9.3
Total		____	- ____	= 76.1

Impinger Box I.D. ____
Integrated Bag I.D. ____

Leak Check:

Sample Train

	CFM	Vac.	Init. Pitot	IBS
Pre-Test	0.00	8	4	____ ____
Post-Test	0.02	8	12	____ ____

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.	____	____	____	____	____
Final	____	____	____	____	____

read leak test / read

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press., iwg
START	1052		1.5	552.576			102	94		62		2	
Point 2	1058		1.5	556.098	632		122	98		58		2	
	1103		1.5	560.	636		122	99		52		2	
	1108		1.5	563.150	634		122	100		53		2	
	1113		1.5	566.638	636		122	101		57		2	
	1118		1.5	570.183	634		122	102		60		2	
STOP	1123		1.5	573.528									
Total/Average													

Test Summary
- Initial BWH
- Sample Vol., c.f. 21.352
- Stack Press, iwg —
- ΔP — iwg ΔH 1.5 iwg
- Meter Temp., °F 108.8
- Stack Temp., °F —
- Water Collected, g 76.1
- O_2/CO_2 Method ____
- Chain of Cust. Info (init.):
  - Impingers Loaded ACB
  - Impingers Recovered ACB
  - Filter Loaded —
  - Filter Recovered —
  - Probe Wash —
- Comments: In Conjunction w/ I-wel.

EST DS-022

E/A

VELOCITY TRAVERSE DATA

Plant SCE/Long Beach Date 2/2/90

Boiler No. AP Data Taken By R.P & In

Fuel Type Gas Test Description AB2588 Tests

Test No. 1 - LB AX - Velocity

Baro. Press (in.Hg) 30.39 Pitot Tube Coefficient .84 Cp

Abs. Static Press in Stack (in.Hg) -.67 P_s

$$V_s = 2.90\ Cp \sqrt{\Delta P\ T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

Time	Traverse Point Port	Depth	Velocity Head, in.H_2O, ΔP	Gas Temp °F	Gas Temp °R, T_s	Velocity, ft/sec	N41 ~~Comments~~	O_2,%
1101	3	A	0.29	632			L 20%	
		B	0.41	635			L 15%	
		C	0.36	635			L 5%	
1103		D	0.59	636			L 15%	
1109	2	A	0.41	634			L 5%	
		B	0.53	636			L 5%	
		C	0.67	636			L 5%	
1110		D	0.69	634			L 5%	
	1	A	0.51	632			L 5%	
		B	0.56	635			L 5%	
		C	0.66	635			L 5%	
		D	0.70	635			L 5%	

P_s, corrected _____ in.Hg Q _____ WACFM

MW _____ lb/lb·mole Q_s _____ WSCFM

A_s _____ ft^2 Q_{sd} _____ DSCFM

$\Delta P = .5227$ ✓ $T_s = 634.6$ ✓

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Rev. 9/86

E/A

VELOCITY TRAVERSE DATA

Plant SCC/Long Beach — Date 2/2/90

Boiler No. AB — Data Taken By RSP & JM

Fuel Type Gas — Test Description AB2588 Tests

Test No. 30 - Velocity

Baro. Press (in.Hg) 30.37 — Pitot Tube Coefficient .84 Cp

Abs. Static Press in Stack (in.Hg) −0.66 P_s

$$V_s = 2.90\ Cp \sqrt{\Delta P\ T_s} \sqrt{\frac{29.92}{P_s} \times \frac{28.95}{MW}}$$

Time	Traverse Point Port	Traverse Point Depth	Velocity Head, in.H_2O, ΔP	Gas Temp °F	Gas Temp °R, T_s	Velocity, ft/sec	Comments	O_2,%
1213	3	A	0.33	628			6	
		B	0.44	629				
		C	0.38	628				
1214	4	D	0.59	630				
1216	2	A	0.43	629				
	1	B	0.59	632				
		C	0.69	633				
1218		D	0.62	631				
1219	3	A	0.40	628				
	1	B	0.70	632				
		C	0.76	632				
12	4	D	0.75	633				

P_s, corrected _____ in.Hg — Q _____ WACFM

MW _____ lb/lb-mole — Q_s _____ WSCFM

A_s _____ ft^2 — Q_{sd} _____ DSCFM

$\Delta P = .5465$ $T_s = 630.2$

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Rev. 9/86

E∫A

TEDLAR BAG DATA

Client/Project SCE/Long Beach

Date 2/2/90 Unit AX By [illegible]

	Bag ID No.	Bag ID No.	Bag ID No.
Test No.	1-LBAX-BGN	2-LBAX-BGN	3/LBAX/BGN
Sample Rate	.5 L/M	.5 L/M	.5 L/M
Start Time	1053	1135	1210
Stop Time	1113	1155	1230
Sample Location	port 1	port 1	port 1

Date _____ Unit _____ By _____

	Bag ID No.	Bag ID No.	Bag ID No.
Test No.			
Sample Rate			
Start Time			
Stop Time			
Sample Location			

Notes: GAS

Flow Rate from Average of 1-LBAX-H_2O + 2-LBAX-H_2O

ESA OS-070

P_{bar} = 30.15

E∫A

TEDLAR BAG DATA

Client/Project SCE / Long Beach

Date 2/5/90 Unit Aux Boiler By J. Mulligan

	Bag ID No.	Bag ID No.	Bag ID No.
Test No.	4A-LBAX-BAM	4B-LBAX-BAM	4C/LBAX-BOX
Sample Rate	.5 L/m	.5 L/m	.5 L/m
Start Time	9 28	9:58	10:47
Stop Time	9 48	10 40	11:07
Sample Location	Port 2	Port 2	Port 2

Date _____ Unit _____ By _____

	Bag ID No.	Bag ID No.	Bag ID No.
Test No.			
Sample Rate			
Start Time			
Stop Time			
Sample Location			

Notes: 4B-LBAX-BEN . Leak discovered in lung sampler. repaired & testing resumed (OIL)

Flow Rate from 4-LBAX-BN

REPORT

TRUESDAIL LABORATORIES, INC.

CHEMISTS - MICROBIOLOGISTS - ENGINEERS
RESEARCH – DEVELOPMENT – TESTING

14201 FRANKLIN AVENUE
TUSTIN, CALIFORNIA 92680
AREA CODE 714 • 730-6239
AREA CODE 213 • 225-1564
CABLE: TRUELABS

CLIENT: Energy Systems Associates
15991 Red Hill Avenue, Suite 110
Tustin, California 92680-7388
Attention: Arlene Bell/Robert A. Finken

DATE: February 22, 1990

RECEIVED: February 6, 1990

SAMPLE: Three (3) Tedlar bags labelled 4A-LBAX, 4B-LBAX and 4C-LBAX
P.O. No.: ESA PO# 53304-LBAX & -LBCT/Edison PO# C0138903

LABORATORY NO.: 37977

INVESTIGATION: Analyze for trace benzene by modified EPA Method 602

RESULTS

MODIFIED EPA 602 (Benzene)

Received: 2/3/90
Analyzed: 2/7/90

	Nanoliters per Liter (ppb)
	Benzene
4A-LBAX	ND<4
4B-LBAX	ND<4
4C-LBAX	ND<4

ND - Not Detected.

Respectfully submitted,
TRUESDAIL LABORATORIES, INC.

Joe Bramlett, Manager
Instrumental Methods

UESDAIL LABORATORIES, INC.

EMISTS - MICROBIOLOGISTS - ENGINEERS
EARCH – DEVELOPMENT – TESTING

14201 FRANKLIN AVENUE
TUSTIN, CALIFORNIA 92680
AREA CODE 714 • 730-6239
AREA CODE 213 • 225-1564
CABLE: TRUELABS

ENT Energy Systems Associates
15991 Red Hill Avenue, Suite 110
Tustin, California 92680-7388
Attention: Arlene Bell/Robert A. Finken

DATE February 22, 1990

RECEIVED February 2, 1990

LABORATORY NO. 37975

PLE Six (6) Tedlar bags labelled 1A-LBAX, 1B-LBAX, 1C-LBAX, 5A-LBCT, 5B-LBCT, & 5C-LBCT
P.O. No.: ESA PO# 53304-LBAX & -LBCT/Edison PO# C0138903

ESTIGATION Analyze for trace benzene by modified EPA Method 602

RESULTS

MODIFIED EPA 602 (Benzene)

Received: 2/2/90
Analyzed: 2/2/90

Nanoliters per Liter (ppb)

	Benzene
1A-LBAX	ND<4
1B-LBAX	ND<4
1C-LBAX	ND<4
5A-LBCT	ND<4
5B-LBCT	ND<4
5C-LBCT	ND<4

ND - Not Detected.

Respectfully submitted,
TRUESDAIL LABORATORIES, INC.

Joe Bramlett, Manager
Instrumental Methods

Appendix C.5

Formaldehyde

FORMALDEHYDE EMISSION CALCULATIONS

CLIENT/LOCATION: SCE / Long Beach Auxiliary Boiler
FUEL: OIL
F Factor: 9541
Reference Temp (F) 60

Test	ug/train	Vmstd	%O2	Qsd	ug/dscf	ug/m3	ppb	lb/hr	lb/MMbtu
5A-LBAX-FOR	16.2	2.35	8.82	10832	6.9	243.4	192	9.87E-03	2.51E-04
5B-LBAX-FOR	46.5	1.47	8.27	10832	31.6	1117.1	881	4.53E-02	1.10E-03
5C-LBAX-FOR	< 0.89	2.71	8.23	10832	0.3	11.6	9	4.70E-04	1.14E-05

Average ug/m3

457.4

Average ppb

361

Average lb/hr

1.85E-02

Average lb/MMbtu

4.54E-04

FORMALDEHYDE EMISSION CALCULATIONS

CLIENT/LOCATION: SCE / Long Beach Auxiliary Boiler
FUEL: gas
F Factor: 8476
Reference Temp (F) 60

Test	ug/train	Vmstd	%O2	Qsd	ug/dscf	ug/m3	ppb	lb/hr	lb/MMbtu
1-LBAX-FORM	< 0.89	1.84	6.6	9251	0.5	17.1	13	5.91E-04	1.32E-05
2-LBAX-FORM	2.7	1.89	6.8	9251	1.4	50.5	40	1.75E-03	3.95E-05
3-LBAX-FORM	< 0.89	1.67	7	9251	0.5	18.8	15	6.52E-04	1.50E-05

Average ug/m3

28.8

Average ppb

< 23

Average lb/hr

< 9.96E-04

Average lb/MMbtu

< 2.26E-05

CARNOT 05/04/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/2/90
Test Number	1-LBAX-FO	Data By	SMH
Test Method	430	Sample Location	EXH DUCT
Fuel	GAS	Reference Temp (F)	60
Control Box #	ES-8	Unit	AUX
Pitot Factor	NA	Meter Cal Factor	0.9900
Stack Area (sq ft)	6.25	Sample Time (Min)	32
Bar Press (in Hg)	30.39	Nozzle Diam (in)	N/A
Meter Vol (acf)	1.926	Meter Temp (F)	88.0
Stack Press (iwg)	NA	Stack Temp (F)	634.4
Vel Head (iwg)	NA	O2 (%): from CEM	6.60
		from portable	6.60
Liquid Vol (ml)	N/A	CO2 (%): from CEM	8.00
		calculated	8.00
Meter Press (iwg)	0.01	Start/Stop Time	1054/1126

Std Sample Vol (SCF)	1.84
Metric Sample Vol (cubic meters)	0.05

PARTICULATE TEST DATA

Client/Location SCE / Long Beach Unit AX Test No. L-LOAX - FORM Method FORM Page 1
Sample Location Pulk Fuel GAS Ambient Temp., °F ____ of 1
Operators RJP & J. M. Meter Vol. (Start/End) 083.041 / ~~084.308~~ 084.967 Date 2/2/90

Pre Test Data:
- Barometric Press, in. Hg 30.35
- Stack Area, sq. ft. 6.25
- Sample Time/ Pt. min. ~~2½~~ 3
- Assumed Stack Press -.55
- Assumed Moisture 4%
- Assumed Molecular Wt 28.8

Equipment Info:
- Meter No. ES-8
- Meter, Yd ~~1.000~~ .99
- Pitot, Cp .84
- CFM @ΔH = 1.0 .598
- Probe I.D. glass / quartz
- Nozzle No./Dia 14/10
- Filter No. N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DNPH	____	- 10mL	= ____
#2	"	____	- 10mL	= ____
#3	—	____	- —	= ____
#4	N/A	____	- ____	= ____
Total		____	- ____	= ____

Impinger Box I.D. ____
Integrated Bag I.D. ____

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	____	____	____	____	____
Post-Test	____	____	____	____	____

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.	____	____	____	____	____
Final	____	____	____	____	____

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Meter Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
~~start~~	1054		.010	083.048			83	82		Ice		0	
	1059		.010	083.398	636		85	83				6	
	1104		.010	083.621	630		87	85				8	
	1109		.010	083.948	635		85	86				6	
~~stop~~	1114		.010	084.308	65								
	1116		.010	084.308	636		54	51				0	
	1121		.010	084.641	635		97	54				0	
	1126			084.967									
	~~1134~~												
	~~11~~												
Total/Average													

Test Summary
- Initial SNH
- Sample Vol., c.f. 1.926
- Stack Press, iwg -.55
- ΔP .5346 iwg ΔH .010 iwg
- Meter Temp., °F 58
- Stack Temp., °F 634.4
- Water Collected, g ____
- O_2/CO_2 Method ____
- Chain of Cust. Info (init.):
  - Impingers Loaded SNH
  - Impingers Recovered JM
  - Filter Loaded —
  - Filter Recovered —
  - Probe Wash —
- Comments: Also:
  - 1 blank: 15 mL DNPH
  - 1 spike: 15 mL DNPH
  - 0.1/1 mL 50,000 x Dil. F

EST DS-022

CARNOT 05/04/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/2/90
Test Number	2-LBAX-FO*	Data By	SMH
Test Method	430	Sample Location	EXH DUCT
Fuel	GAS	Reference Temp (F)	60
Control Box #	ES-8	Unit	AUX
Pitot Factor	NA	Meter Cal Factor	0.9900
Stack Area (sq ft)	6.25	Sample Time (Min)	30
Bar Press (in Hg)	30.39	Nozzle Diam (in)	N/A
Meter Vol (acf)	2.049	Meter Temp (F)	106.7
Stack Press (iwg)	NA	Stack Temp (F)	633.8
Vel Head (iwg)	NA	O2 (%): from CEM	6.80
		from portable	6.80
Liquid Vol (ml)	N/A	CO2 (%): from CEM	7.90
		calculated	7.90
Meter Press (iwg)	0.01	Start/Stop Time	1135/1205

Std Sample Vol (SCF)	1.89
Metric Sample Vol (cubic meters)	0.05

Client/Location SCE / LB | Unit BX | Test No. ~~2~~ 2-LOAY-FORM Method FORM | Page 1
Sample Location Plant | Fuel Gas | Ambient Temp., °F | of 1
Operators RJP & DK | Meter Vol. (Start/End) 084.967 / 087.016 | Date 2/2/90

Pre Test Data:

Barometric Press, in. Hg	30.35
Stack Area, sq. ft.	6.25
Sample Time/ Pt, min.	30 min
Assumed Stack Press	-.67
Assumed Moisture	5 %
Assumed Molecular Wt	28.8

Equipment Info:

Meter No.	ES-8
Meter, Yd	~~1.00~~ .99
Pitot, Cp	.84
CFM @ΔH = 1.0	.598
Probe I.D.	Glass/Quartz
Nozzle No./Dia	N/A
Filter No.	N/A

Imp.	Matl	Wt(End)		Weight (Start)		Weight (g)
#1	DNPH		-	10mL	=	
#2	"		-	10mL	=	
#3	—		-	—	=	
#4	N/A		-		=	
Total			-		=	

Impinger Box I.D.
Integrated Bag I.D.

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
Start	1135		.010	084.967	630		102	102		Ice		0	
pt 1	1140		.010	085.[illegible]	635		106	103				0	
	1145		.010	085.[illegible]	635		107	105		Ice		0	
	1150		.010	086.100	630		109	107				0	
↓	1155		.010	086.357	634		110	108				0	
	1200		.010	086.677	634		111	110		Ice		0	
Stop	1205			087.016									
Total/Average													

Test Summary

Initial RJH
Sample Vol., c.f. 2.049
Stack Press, iwg -.67
ΔP .5346 iwg ΔH .010 iwg
Meter Temp., °F 106.7
Stack Temp., °F 633.8
Water Collected, g
O_2/CO_2 Method
Chain of Cust. Info (init.):
Impingers Loaded RJH
Impingers Recovered JM
Filter Loaded —
Filter Recovered —
Probe Wash —
Comments:

EST DS-022

CARNOT 05/04/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/2/90
Test Number	3-LBAX-FO*	Data By	SMH
Test Method	430	Sample Location	EXH DUCT
Fuel	GAS	Reference Temp (F)	60
Control Box #	ES-8	Unit	AUX
Pitot Factor	NA	Meter Cal Factor	0.9900
Stack Area (sq ft)	6.25	Sample Time (Min)	30
Bar Press (in Hg)	30.37	Nozzle Diam (in)	N/A
Meter Vol (acf)	1.836	Meter Temp (F)	113.6
Stack Press (iwg)	NA	Stack Temp (F)	630.7
Vel Head (iwg)	NA	O2 (%): from CEM	7.00
		from portable	7.00
Liquid Vol (ml)	N/A	CO2 (%): from CEM	7.80
		calculated	7.80
Meter Press (iwg)	0.04	Start/Stop Time	1210/1240

Std Sample Vol (SCF)	1.67
Metric Sample Vol (cubic meters)	0.05

PARTICU TEST DATA.

Client/Location: SCE / Long Beach | Unit: 4Y | Test No.: 3-40M-Form | Method: FORM | Page: 1 of 1
Sample Location: Duct | Fuel: GAS | Ambient Temp., °F: | Date: 2/2/90
Operators: S. McWhorter & D. Pearce | Meter Vol. (Start/End): 087.018 / 088.854

Pre Test Data:

Barometric Press, in. Hg	30.37
Stack Area, sq. ft.	6.25
Sample Time/ Pt, min.	20 min
Assumed Stack Press	-.67
Assumed Moisture	9 %
Assumed Molecular Wt	28.8

Equipment Info:

Meter No.	ES-8
Meter, Yd	0.9979
Pitot, Cp	.84
CFM @ΔH = 1.0	.598
Probe I.D.	Quartz
Nozzle No./Dia	N/A
Filter No.	N/A

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DNPH		10mL	
#2	"		10mL	
#3	—		—	
#4	N/A			
Total				

Impinger Box I.D.:
Integrated Bag I.D.:

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test					
Post-Test					

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Meter Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
Start	1210		.040	087.018	634		112	112		Ice		0	
	1215		.040	087.291	630		113	113				0	
	1220		.040	087.615	632		113	114		Ice		0	
	1225		.040	087.868	628		114	114				0	
	1230		.040	088.237	631		114	114		Ice		0	
	1235		.040	088.541	629		115	115		Ice		0	
	1240			088.854									
Total/Average													

Test Summary

Initial	SMH
Sample Vol., c.f.	1.836
Stack Press, iwg	-.67
ΔP .5346 iwg	ΔH .040 iwg
Meter Temp., °F	113.6
Stack Temp., °F	630.7
Water Collected, g	
O_2/CO_2 Method	
Chain of Cust. Info (init.):	
Impingers Loaded	SMH
Impingers Recovered	MM
Filter Loaded	—
Filter Recovered	—
Probe Wash	—
Comments:	

EST DS.022

CARNOT 05/04/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/5/90
Test Number	5A-LBAX-F	Data By	RBB
Test Method	430	Sample Location	EXH DUCT
Fuel	OIL	Reference Temp (F)	60
Control Box #	ES-8	Unit	AUX
Pitot Factor	NA	Meter Cal Factor	0.9900
Stack Area (sq ft)	6.25	Sample Time (Min)	30
Bar Press (in Hg)	30.15	Nozzle Diam (in)	N/A
Meter Vol (acf)	2.555	Meter Temp (F)	104.4
Stack Press (iwg)	NA	Stack Temp (F)	670.0
Vel Head (iwg)	NA	O2 (%): from CEM	8.80
		from portable	8.82
Liquid Vol (ml)	NA	CO2 (%): from CEM	9.36
		calculated	9.34
Meter Press (iwg)	0.03	Start/Stop Time	1432/1502

Std Sample Vol (SCF)	2.35
Metric Sample Vol (cubic meters)	0.07

Client/Location SCE/LB AX
Sample Location Exhaust Duct
Operators J. Mulligan

Unit Aux Boiler Test No. SA-LBAX-FORM
Fuel Dist. OIL
Method FORM
Ambient Temp., °F 68
Meter Vol. (Start/End) 088.857 091.405

Page 1 of 1
Date 2/5/80

Pre Test Data:
- Barometric Press, in. Hg 30.15
- Stack Area, sq. ft. 6.25
- Sample Time/ Pt, min. Single/30
- Assumed Stack Press -.7
- Assumed Moisture 7%
- Assumed Molecular Wt 28.

Equipment Info:
- Meter No. E5-8
- Meter, Yd .99
- Pitot, Cp .84
- CFM @ΔH = 1.0 .598
- Probe I.D. GLASS
- Nozzle No./Dia —
- Filter No. —

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DNPH	____	- 10ml	= ____
#2	DNPH	____	- 10ml	= ____
#3	____	____	- —	= ____
#4	N/A	____	- ____	= ____
Total		____	- ____	= ____

Impinger Box I.D. ____
Integrated Bag I.D. ____

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	___	___	___	___	___
Post-Test	___	___	___	___	___

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.	___	___	___	___	___
Final	___	___	___	___	___

Sample Point	Time	Meter Conditions ΔP	Meter Conditions ΔH	Meter Conditions Meter Reading	Temperatures, °F Stack	Probe	Meter In	Meter Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
Start	1432		.020	~~085.54~~	674		100	99		Ice	9.0	4	
	1437		.030	089.281	668		104	101		Ice	9.1	4	
	1442		.030	089.731	674		105	102		Ice	8.5	4	
	1447		.030	090.147	670		107	104		Ice	8.7	4	
	1452		.030	090.562	665		108	106		Ice	8.7	4	
	1457		.030	091.009	665		110	107			8.7	4	
✓	1502			091.405									
											8.82		
Total/Average													

Test Summary
- Initial DNH
- Sample Vol., c.f. 2.559
- Stack Press, iwg -.7
- ΔP ____ iwg ΔH .030 iwg
- Meter Temp., °F 104.4
- Stack Temp., °F 670
- Water Collected, g ____
- O_2/CO_2 Method ____
- Chain of Cust. Info (init.):
  - Impingers Loaded DNH
  - Impingers Recovered JM
  - Filter Loaded —
  - Filter Recovered —
  - Probe Wash —
- Comments: ____

Checked L. PR

EST DS-022
Rev. 9/80

CARNOT 05/04/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/5/90
Test Number	5B-LBAX-F	Data By	RBB
Test Method	430	Sample Location	EXH DUCT
Fuel	OIL	Reference Temp (F)	60
Control Box #	ES-8	Unit	AUX
Pitot Factor	NA	Meter Cal Factor	0.9900
Stack Area (sq ft)	6.25	Sample Time (Min)	30
Bar Press (in Hg)	30.15	Nozzle Diam (in)	N/A
Meter Vol (acf)	1.620	Meter Temp (F)	110.5
Stack Press (iwg)	NA	Stack Temp (F)	671.5
Vel Head (iwg)	NA	O2 (%): from CEM	8.60
		from portable	8.27
Liquid Vol (ml)	N/A	CO2 (%): from CEM	9.54
		calculated	9.80
Meter Press (iwg)	0.03	Start/Stop Time	1506/1536

Std Sample Vol (SCF) 1.47

Metric Sample Vol (cubic meters) 0.04

Client/Location: SCE/LBAX
Sample Location: Exhaust Duct
Operators: J. McGilligan

Unit: Aux. Boiler Test No: SB-LBAX-FORM Method: FORM
Fuel: Dist. Oil Ambient Temp., °F: 70
Meter Vol. (Start/End): 051.405 / 693.025

Page: 1 of 1
Date: 2/5/90

Pre Test Data:

Barometric Press, in. Hg	30.15
Stack Area, sq. ft.	6.25
Sample Time/ Pt, min.	Single/30
Assumed Stack Press	-.7
Assumed Moisture	7%
Assumed Molecular Wt	28.

Equipment Info:

Meter No.	ES-8
Meter, Yd	.99
Pitot, Cp	.84
CFM @ΔH = 1.0	.578
Probe I.D.	GLASS
Nozzle No./Dia	—
Filter No.	—

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DNPH	____	10mL	____
#2	DNPH	____	10mL	____
#3	—	____	—	____
#4	N/A	____	____	____
Total		____	____	____

Impinger Box I.D.: N/A
Integrated Bag I.D.: N/A

Leak Check:

Sample Train

	CFM	Vac.	Init. Pitot	IBS
Pre-Test	____	____	____	____
Post-Test	____	____	____	____

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.	____	____	____	____	____
Final	____	____	____	____	____

Sample Point	Time	Meter Conditions ΔP	Meter Conditions ΔH	Meter Conditions Meter Reading	Temperatures, °F Stack	Probe	Meter In	Meter Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
Start	1506		.020	091.409	668		109	109		Ice	8.5	2	
port 3	1511		.020	091.545	667		109	110		Ice	8.5	2	
	1516		.030	091.768	672		110	110		Ice	8.2	4	
	1521		.030	092.084	671		111	111		Ice	8.2	4	
	1526		.030	092.398	677		112	111		Ice	8.0	4	
	1531		.030	092.708	674		112	112		Ice	8.2	4	
Stop	1536			693.029									
											8.27		
Total/Average													

Test Summary

Initial: SH
Sample Vol., c.f.: 1.620
Stack Press, iwg: -.7
ΔP ____ iwg ΔH .027 iwg
Meter Temp., °F: 110.5
Stack Temp., °F: 671.5
Water Collected, g: ____
O_2/CO_2 Method: ____
Chain of Cust. Info (init.):
Impingers Loaded: SWH
Impingers Recovered: JM
Filter Loaded: —
Filter Recovered: —
Probe Wash: —
Comments: ____

checked by RB

EST DS-022
Rev. 9/89

CARNOT 05/04/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/5/90
Test Number	5C-LBAX-F	Data By	RBB
Test Method	430	Sample Location	EXH DUCT
Fuel	OIL	Reference Temp (F)	60
Control Box #	ES-8	Unit	AUX
Pitot Factor	NA	Meter Cal Factor	0.9900
Stack Area (sq ft)	6.25	Sample Time (Min)	30
Bar Press (in Hg)	30.15	Nozzle Diam (in)	N/A
Meter Vol (acf)	2.995	Meter Temp (F)	112.4
Stack Press (iwg)	NA	Stack Temp (F)	674.8
Vel Head (iwg)	NA	O2 (%): from CEM	8.60
		from portable	8.23
Liquid Vol (ml)	N/A	CO2 (%): from CEM	9.51
		calculated	9.80
Meter Press (iwg)	0.03	Start/Stop Time	1540/1610

Std Sample Vol (SCF)	2.71
Metric Sample Vol (cubic meters)	0.08

Client/Location: SCE/LBAX | Unit: Aux. Boiler | Test No.: SC-LBAX-FORM | Method: FORM | Page: 1 of 1

Sample Location: Exhaust Duct | Fuel: DIST. OIL | Ambient Temp., °F: 70 | Date: 2/5/90

Operators: d Mulligan | Meter Vol. (Start/End): 093.025 / 1096.024

Pre Test Data:

Barometric Press, in. Hg	30.15
Stack Area, sq. ft.	16.25
Sample Time/ Pt, min.	single/30
Assumed Stack Press	-.7
Assumed Moisture	7%
Assumed Molecular Wt	28.

Equipment Info:

Meter No.	ES-8
Meter, Yd	.99
Pitot, Cp	.84
CFM @ΔH = 1.0	.598
Probe I.D.	glass
Nozzle No./Dia	—
Filter No.	—

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	DNPH	____	10mL	____
#2	DNPH	____	10mL	____
#3	—	____	—	____
#4	N/A	____	—	____
Total		____	____	____

Impinger Box I.D.: N/A

Integrated Bag I.D.: N/A

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	___	___	___	___	___
Post-Test	___	___	___	___	___

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.	___	___	___	___	___
Final	___	___	___	___	___

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg
Start	1540		.030	093.025	676		112	112		Ice	8.1	5	
	1545		.030	093.591	674		113	112		Ice	8.3	5	
	1550		.030	094.040	675		113	112		Ice	8.3	5	
	1555		.030	094.529	674		113	112		Ice	8.3	5	
	1600		.030	095.027	675		113	112		Ice	8.2	5	
	1605		.030	095.529	675		113	112		Ice	8.2	5	
Stop	1610			096.024							8.23		
Total/Average													

Test Summary

Initial	SNH
Sample Vol., c.f.	2.995
Stack Press, iwg	-.7
ΔP ____ iwg ΔH	.030 iwg
Meter Temp., °F	112.4
Stack Temp., °F	674.8
Water Collected, g	____
O_2/CO_2 Method	____

Chain of Cust. Info (init.):

Impingers Loaded	SNH
Impingers Recovered	JM
Filter Loaded	—
Filter Recovered	—
Probe Wash	—

Comments: ____

EST DS-022

RADIAN
CORPORATION

Radian Work Order P0-02-057

Analytical Report
03/08/90

Energy Systems Associates

Energy Systems Associates
15991 Red Hill Ave, Suite 110
Tustin, CA 92680-7388

Arlene Bell

Customer Work Identification Energy Systems Associates
Purchase Order Number 5738

Contents:

1 Analytical Data Summary
2 Sample History
3 Comments Summary
4 Notes and Definitions

Radian Analytical Services
900 Perimeter Park
Morrisville, NC 27560

919-481-0212

Client Services Coordinator: JFMCGAUGHEY

Certified by:

Previously Reported on 03/07/90.

RADIAN CORPORATION

Analytical Data Summary

Energy Systems Associates
Radian Work Order: P0-02-057

Method:Aldehydes by HPLC (1)				
List:ESA Analyte List				
Sample ID:	1-LBAX-FORM (A&B)	2-LBAX-FORM (A&B)	3-LBAX-FORM (A&B)	5A-LBAX-FORM (A&B)
Factor:	1	1	1	1
Results in:	total ug	total ug	total ug	total ug
	01A	02A	03A	04A
Matrix:	Water	Water	Water	Water

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	19.8	0.89	25.0	0.89	16.8	0.89	38.5	0.89

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

RADIAN CORPORATION

Analytical Data Summary

Energy Systems Associates
Radian Work Order: P0-02-057

Method:Aldehydes by HPLC (1) List:ESA Analyte List				
Sample ID:	5B-LBAX-FORM (A&B)	5C-LBAX-FORM (A&B)	FIELD SPIKE VIAL A	FIELD BLANK VIAL A
Factor:	1	1	1	1
Results in:	total ug	total ug	total ug	total ug
	05A	06A	07A	08A
Matrix:	Water	Water	Water	Water

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	68.8	0.89	16.5	0.89	19.5	0.89	22.3	0.89

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

Energy Systems Associates
Radian Work Order: P0-02-057

Method:Aldehydes by HPLC (1)
List:ESA Analyte List

Sample ID:	METHOD BLANK	MATRIX SPIKE	MATRIX SPIKE DUP
Factor:	1		
Results in:	total ug		
	09A	10A	11A
Matrix:	Water		

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Formaldehyde	2.80 *	0.89						

* Est. result less than 5 times detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

Energy Systems Associates
Radian Work Order: P0-02-057

Method:Aldehydes by HPLC (1)
List:Aldehyde Matrix Spike List

Sample ID:	MATRIX SPIKE	MATRIX SPIKE DUP		
Factor:	0.0	0.0		
Results in:	%	%		
	10A	11A		
Matrix:	Water	Water		
	Result Det. Limit	Result Det. Limit		
Formaldehyde	110	108		

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

Energy Systems Associates
Radian Work Order: P0-02-057

Sample Identifications and Dates

Sample ID	1-LBAX-FORM (A&B)	2-LBAX-FORM (A&B)	3-LBAX-FORM (A&B)	5A-LBAX-FORM (A&B)	5B-LBAX-FORM (A&B)	5C-LBAX-FORM (A&B)
Date Sampled						
Date Received	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90
Matrix	Water	Water	Water	Water	Water	Water
	01	02	03	04	05	06
Aldehydes by HPLC						
Prepared	02/16/90	02/16/90	02/16/90	02/16/90	02/17/90	02/17/90
Analyzed	02/28/90	02/28/90	02/28/90	02/28/90	02/28/90	02/28/90
Analyst	LK	LK	LK	LK	LK	LK
File ID	PAPE245	PAPE246	PAPE247	PAPE249	PAPE250	PAPE251
Blank ID						
Instrument	V5000	V5000	V5000	V5000	V5000	V5000
Report as	received	received	received	received	received	received

RADIAN CORPORATION

Sample History

Energy Systems Associates
Radian Work Order: PO-02-057

Sample Identifications and Dates

Sample ID	FIELD SPIKE VIAL A	FIELD BLANK VIAL A	METHOD BLANK	MATRIX SPIKE	MATRIX SPIKE DUP
Date Sampled					
Date Received	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90
Matrix	Water	Water	Water	Water	Water
	07	08	09	10	11
Aldehydes by HPLC					
Prepared	02/17/90	02/17/90	02/18/90		
Analyzed	02/28/90	02/28/90	02/28/90	02/28/90	02/28/90
Analyst	LK	LK	LK		
File ID	PAPE252	PAPE253	PAPE274		
Blank ID					
Instrument	V5000	V5000	V5000		
Report as	received	received	received		
Aldehydes by HPLC					
Prepared				02/18/90	02/18/90
Analyzed				03/01/90	02/28/90
Analyst				LK	LK
File ID				PAPE285	PAPE286
Blank ID					
Instrument				V5000	V5000
Report as				received	received

RADIAN
CORPORATION

Appendix A

Comments, Notes and Definitions

- The asterisk(*) is used to flag results which are less than five times the method specified detection limit. Studies have shown that the uncertainty of the analysis will increase exponentially as the method detection limit is approached. These results should be considered approximate.

TERMS USED IN THIS REPORT:

Analyte - A chemical for which a sample is to be analyzed. The analysis will meet EPA method and QC specifications.

Compound - See Analyte.

Detection Limit - The method specified detection limit, which is the lower limit of quantitation specified by EPA for a method. Radian staff regularly assess their laboratories' method detection limits to verify that they meet or are lower than those specified by EPA. Detection limits which are higher than method limits are based on experimental values at the 99% confidence level. Note, the detection limit may vary from that specified by EPA based on sample size, dilution or cleanup. (Refer to Factor, below)

EPA Method - The EPA specified method used to perform an analysis. EPA has specified standard methods for analysis of environmental samples. Radian will perform its analyses and accompanying QC tests in conformance with EPA methods unless otherwise specified.

Factor - Default method detection limits are based on analysis of clean water samples. A factor is required to calculate sample specific detection limits based on alternate matrices (soil or water), use of cleanup procedures, or dilution of extracts/ digestates. For example, extraction or digestion of 10 grams of soil in contrast to 1 liter of water will result in a factor of 100.

Matrix - The sample material. Generally, it will be soil, water, air, oil, or solid waste.

Radian Work Order - The unique Radian identification code assigned to the samples reported in the analytical summary.

Units -	ug/L	micrograms per liter (parts per billion);liquids/water
	ug/Kg	micrograms per kilogram (parts per billion); soils/solids
	ug/M3	micrograms per cubic meter; air samples
	mg/L	milligrams per liter (parts per million);liquids/water
	mg/Kg	milligrams per kilogram (parts per million);soils/solids
	%	percent; usually used for percent recovery of QC standards
	uS/cm	conductance unit; microSiemans/centimeter
	mL/hr	milliliters per hour; rate of settlement of matter in water
	NTU	turbidity unit; nephelometric turbidity unit
	CU	color unit; equal to 1 mg/L of chloroplatinate salt

Appendix C.6

PAH

PAH CALCULATIONS

CLIENT:	SCE / LBAX	INITIALS:	SMH
		VMSTD(DSCF):	91.71
PROJECT NO:		QSD(DSCF/MIN):	10614
TEST DATE:	2/5/90	CO2,%:	9.3
TEST NUMBER:	4-LBAX-SV	O2,%:	9.5
T REF (F)	60	F Factor	9541
Fuel: Distillate			

SPECIES	ug/train	ug/dscm	lb/hr	lb/MMbtu
Naphthalene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Acenaphthylene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Acenaphthene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Fluorene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Phenanthrene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Anthracene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Fluoranthene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Pyrene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Benz(a)anthracene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Chrysene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Benzo(b+k)fluoranthene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Benzo(a)pyrene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Indeno(1,2,3-cd)pyrene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Dibenzo(a,h)anthracene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
Benzo(g,h,i)perylene	ND < 0.025	ND < 0.010	ND < 3.82E-07	ND < 1.05E-08
TOTAL PAH	< 0.375	< 0.144	< 5.74E-06	1.58E-07

PAH CALCULATIONS

CLIENT:	SCE / LBAX	INITIALS:	SMH
		VMSTD(DSCF):	88.88
PROJECT NO:		QSD(DSCF/MIN):	10870
TEST DATE:	2/5/90	CO2,%:	9.7
TEST NUMBER:	6-LBAX-SV	O2,%:	7.9
T REF (F)	60	F Factor	9541
Fuel: Distillate			

SPECIES	ug/train	ug/dscm	lb/hr	lb/MMbtu
Naphthalene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Acenaphthylene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Acenaphthene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Fluorene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Phenanthrene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Anthracene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Fluoranthene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Pyrene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Benz(a)anthracene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Chrysene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Benzo(b+k)fluoranthene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Benzo(a)pyrene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Indeno(1,2,3-cd)pyrene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Dibenzo(a,h)anthracene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
Benzo(g,h,i)perylene	ND < 0.025	ND < 0.010	ND < 4.04E-07	ND < 9.50E-09
TOTAL PAH	< 0.375	< 0.149	< 6.06E-06	1.43E-07

?E5.647C66F2S

CARNOT 01/29/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/5/90
Test Number	4-LBAX-SV	Data By	SMH
Test Method	429	Sample Location	EXH DUCT
Fuel	Dist. Oil	Reference Temp (F)	60
Control Box #	ES-19	Unit	AUX
Pitot Factor	0.840	Meter Cal Factor	1.0000
Stack Area (sq ft)	6.25	Sample Time (Min)	180
Bar Press (in Hg)	30.15	Nozzle Diam (in)	0.228
Meter Vol (acf)	99.063	Meter Temp (F)	106.8
Stack Press (iwg)	-0.55	Stack Temp (F)	676.0
Vel Head (iwg)	0.6928	O2 (%): from CEM	9.50
		from portable	9.50
Liquid Vol (ml)	225.7	CO2 (%): from CEM	9.30
		calculated	9.30
Meter Press (iwg)	0.87	Start/Stop Time	900/1210

Std Sample Vol (SCF)	91.71
Metric Sample Vol (cubic meters)	2.60
Moisture Fraction	0.103
Stack Gas Mol Wt	28.65
Stack Gas Velocity (ft/sec)	68.49
Stack Flow Rate (wacfm)	25,683
Stack Flow Rate (dscfm)	10,614
Isokinetic Ratio (%)	105.78

PARTICUL TEST DATA

Client/Location SCE / Long Beach
Sample Location Aux
Operators JM

Unit Aux Boiler Test No. 4-LOAX-SV Method 429 Page 1
Fuel Distillate Ambient Temp., °F 68 of 1
Meter Vol. (Start/End) 555.724/694.825 Date 2/5/20

Pre Test Data:
Barometric Press, in. Hg 30.15 SMH
Stack Area, sq. ft. 6.25
Sample Time/ Pt, min. 15 min
Assumed Stack Press 12 E-7
Assumed Moisture 7%
Assumed Molecular Wt 28.8

Equipment Info:
Meter No. ES-1
Meter, Yd 1.00
Pitot, Cp .84
CFM @ΔH = 1.0 .585
Probe I.D. 3/8"
Nozzle No./Dia .228
Filter No. 110-236

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	—	673.8	- 474.6	= 199.2 ✓
#2	1G	618.4	- 620.2	= -1.8 ✓
#3	—	485.3	- 485.9	= -.6 ✓
#4	SG	787.3	- 558.4	= 228.9 ✓
Total				= 225.7 ✓

Impinger Box I.D. N/A
Integrated Bag I.D. N/A

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.014	16	SMH	OK	—
Post-Test	.004	17	SMH	—	—

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.	—	—	—	—	—
Final	—	—	—	—	—

1.25

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Temperatures, °F Stack	See Probe Sheet	Meter In	Meter Out	Oven	Imp. Out (Coil)	O_2	Vacuum	Static Press. iwg
Start	900	.54	.67	555.724	645		98	90	241	68		7	
Port 1	915	.84	1.05	568.678	678		116	92	249	43	11.2	11	
2	930	.89	1.11	610.515	680		119	94	225	46	10.8	11	
3	945	.84	1.1	620.378	682		123	96	247	35	11.5	12	
Strip 4	1000			630.196									
Start	1005	.71	.64	630.196	681		112	97	237	44	9.4	9	
Port 2-1	1020	.61	.76	638.354	676		122	98	236	45	9.6	5	
2	1035	.70	.87	646.482	670		120	98	225	48	9.8	10	
3	1050	.76	.95	654.587	677		121	99	235	49	9.4	11	
Strip 4	1105			663.219									
Start	1110	.61	.76	663.215	674		105	98	238	64	8.1	5	
Port 1	1125	.55	.73	670.776	674		123	95	248	54	8.2	5	
2	1140	.54	.72	678.468	676		123	100	247	59	8.5	9	
3	1155	.66	.82	686.477	679		123	100	245	61	8.4	10	
Strip 4	1210			694.825									
											9.54		
Total/Average													

Test Summary

Initial SMH
Sample Vol., c.f. 99.063
Stack Press, iwg 22
ΔP .6928 iwg ΔH .868 iwg
Meter Temp., °F 106.8
Stack Temp., °F 676
Water Collected, g 225.7
O_2/CO_2 Method 9.5/9.3
Chain of Cust. Info (init.):
Impingers Loaded ACB
Impingers Recovered SMH
Filter Loaded SMH
Filter Recovered SMH
Probe Wash SMH/ACB
Comments: —

SST DS-022

2E5.647C66F2S

CARNOT 01/29/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/5/90
Test Number	5-LBAX-SV	Data By	SMH
Test Method	429	Sample Location	EXH DUCT
Fuel	Dist. Oil	Reference Temp (F)	60
Control Box #	ES-19	Unit	AUX
Pitot Factor	0.840	Meter Cal Factor	1.0000
Stack Area (sq ft)	6.25	Sample Time (Min)	180
Bar Press (in Hg)	30.15	Nozzle Diam (in)	0.228
Meter Vol (acf)	96.086	Meter Temp (F)	107.3
Stack Press (iwg)	-0.55	Stack Temp (F)	672.6
Vel Head (iwg)	0.7127	O2 (%): from CEM	8.60
		from portable	8.60
Liquid Vol (ml)	207.2	CO2 (%): from CEM	9.40
		calculated	9.40
Meter Press (iwg)	0.79	Start/Stop Time	1325/1634

Std Sample Vol (SCF)	88.86
Metric Sample Vol (cubic meters)	2.52
Moisture Fraction	0.098
Stack Gas Mol Wt	28.69
Stack Gas Velocity (ft/sec)	69.31
Stack Flow Rate (wacfm)	25,992
Stack Flow Rate (dscfm)	10,832
Isokinetic Ratio (%)	100.43

2E5.647C66F2S

CARNOT 01/29/90

SAMPLE TRAIN TEST SUMMARY

Client/Location	SCE/LBAX	Date	2/7/90
Test Number	6-LBAX-SV	Data By	SMH
Test Method	429	Sample Location	EXH DUCT
Fuel	Dist. Oil	Reference Temp (F)	60
Control Box #	ES-19	Unit	AUX
Pitot Factor	0.840	Meter Cal Factor	1.0000
Stack Area (sq ft)	6.25	Sample Time (Min)	180
Bar Press (in Hg)	29.98	Nozzle Diam (in)	0.228
Meter Vol (acf)	97.164	Meter Temp (F)	110.4
Stack Press (iwg)	-0.55	Stack Temp (F)	673.9
Vel Head (iwg)	0.7206	O2 (%): from CEM	7.90
		from portable	7.90
Liquid Vol (ml)	202.9	CO2 (%): from CEM	9.70
		calculated	9.70
Meter Press (iwg)	0.84	Start/Stop Time	811/1136

Std Sample Vol (SCF)	88.88
Metric Sample Vol (cubic meters)	2.52
Moisture Fraction	0.096
Stack Gas Mol Wt	28.73
Stack Gas Velocity (ft/sec)	69.88
Stack Flow Rate (wacfm)	26,207
Stack Flow Rate (dscfm)	10,870
Isokinetic Ratio (%)	100.10

Client/Location: SCE/Long Beach | Unit: Aux Boiler | Test No.: 5-LBAX-SV | Method: 5V | Page: 1
Sample Location: Exhaust Duct | Fuel: DISTILLATE OIL | Ambient Temp., °F: 68 | of: 1
Operators: J. McLigan | Meter Vol. (Start/End): 695.512 / 791.598 | Date: 2/5/90

Pre Test Data:
- Barometric Press, in. Hg: 30.15
- Stack Area, sq. ft.: 6.25
- Sample Time/ Pt, min.: 180 / 15
- Assumed Stack Press: -.7
- Assumed Moisture: 7%
- Assumed Molecular Wt: 28.

Equipment Info:
- Meter No.: E5-19
- Meter, Yd: 1.00
- Pitot, Cp: .84
- CFM @ΔH = 1.0: .595
- Probe I.D.: glass
- Nozzle No./Dia: .228
- Filter No.: 110-571

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	—	711.0	525.0	186
#2	BNJ_{H_2O}	581.4	585.1	-3.8
#3	—	500.0	500.0	0
#4	SG	815.5	790.5	25.0
Total		—	—	207.2

Impinger Box I.D.: N/A
Integrated Bag I.D.: N/A

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.018	17	4.9	OK	
Post-Test	.012	16	4.9		

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.					
Final					

ΔH 1.1

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Stack Temp.	Stack Probe Temp.	Meter In	Meter Out	Oven	Imp. Out (exit resin column)	O_2	Vacuum	Static Press. iwg	Test Summary
Start	1325	.50	.53	695.512	679		88	91	225	57	9.1	6		
port 3-1	1340	.58	.63	701.758	677		113	88	270	61		7		Initial BNH
2	1355	.53	.59	708.94	673		113	96	263	57	9.0	7		Sample Vol., c.f. 96.086
3	1410	.58	.63	715.930	670		113	97	259	60	9.1	7		Stack Press, iwg
Stop 4	1425			723.319						60				ΔP .727 iwg ΔH .787 iwg
Start	1430	.61	.67	723.319	674		105	97	240	62	8.0	8		Meter Temp., °F 107.3
port 2-1	1445	.74	.81	730.572	674		117	98	246	58	8.7	10		Stack Temp., °F 672.6
2	1500	.82	.89	738.785	668		121	100	246	55	8.5	10		Water Collected, g 207.2
3	1515	.82	.89	747.095	667		123	101	230	55	8.2	10		O_2/CO_2 Method 8.6 / 9.4
Stop 4	1530			755.572										Chain of Cust. Info (init.):
Start	1534	.86	.94	755.572	676		114	101	235	64	8.1	12		Impingers Loaded BNH
port 1-1	1549	.89	.97	764.551	675		125	102	235	58	8.3	12		Impingers Recovered BNH
2	1604	.87	.95	773.498	675		125	102	266	60	8.2	11		Filter Loaded ACB
3	1619	.84	.92	782.398	663		125	102	230	60		11		Filter Recovered BNH
Stop 4	1634			791.598										Probe Wash ACB/BNH
											8.5			Comments:
Total/Average														

Checked by: RB

EST DS-022

PARTICULATE TEST DATA

Client/Location: SCE / Long Beach - Dexiban Boiler: AUX Test No.: 6-LBAX-SV Method: PAR Page: 1
Sample Location: Duct AUX Fuel: DISTILLATE Ambient Temp., °F: 77 of: 1
Operators: L. MULLIGAN Meter Vol. (Start/End): 792.584 / 809.748 Date: 2/7/90

Pre Test Data:
- Barometric Press, in. Hg: 28.98
- Stack Area, sq. ft.: 6.25
- Sample Time/ Pt, min.: 15/150
- Assumed Stack Press: -.55
- Assumed Moisture: 7%
- Assumed Molecular Wt: 28.8

Equipment Info:
- Meter No.: ES 19
- Meter, Yd: 1.00
- Pitot, Cp: .84
- CFM @ΔH = 1.0: .598
- Probe I.D.: glass
- Nozzle No./Dia: .228
- Filter No.: 10-569

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	—	645.0	- 474.1	= 170.9 ✓
#2	H2O	584.5	- 592.4	= -7.9 ✓
#3	—	487.2	- 484.6	= 2.6 ✓
#4	SG	787.3	- 450.0	= 337.3 ✓
Total				202.9 ✓

Impinger Box I.D.: N/A
Integrated Bag I.D.: N/A

Leak Check:

Sample Train

	CFM	Vac.	Init. Pitot	IBS
Pre-Test	.014	16 in	OK	
Post-Test	.017	22 in		

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Out
Init.					
Final					

1.13

Sample Point	Time	Meter Conditions ΔP	ΔH	Meter Reading	Stack	Temperatures, °F see Probe Stack	Meter In	Out	Oven	Impinger Out	O_2	Vacuum	Static Press. iwg	Test Summary
START	811	.74	.96	792.584	677		107	85	225	56	9.6	16	-.55	
port-1-1	826	.82	1.06	801.032	663		123	103	264	41	8.4	20		Initial BNH
1-2	841/848	.93	1.09	801.325	671		117	97	251	51	8.1	22		Sample Vol., c.f. 97.164
↓ 1-3	~~848~~ TIB	.90	.99	819.063	668		117	97	264	65		22		Stack Press, iwg -.55
stop 4	928			827.608										ΔP .7206 iwg ΔH 0.836 iwg
START	931	.60	.67	827.608	667		118	100	272	57	7.6	18		Meter Temp., °F 110.4
port-1	946	.83	.93	835.028	681		127	101	265	55	7.5	22		Stack Temp., °F 673.9
2-2	1001	.83	.93	843.448	678		120	102	285	56	7.6	22		Water Collected, g 202.9
2-3	1016	.88	.95	851.958	676		121	102	262	54	7.6	22		O_2/CO_2 Method 7.9 / 9.7
stop 4	1031			860.455										Chain of Cust. Info (init.):
START	1036	.55	.62	860.455	673		114	102	263	63	7.6	18		Impingers Loaded ACB
port-1	1051	.57	.64	867.954	677		128	103	263	53	7.6	18		Impingers Recovered ACB
3-2	1106	.52	.58	875.332	675		126	108	260	51	7.5	12		Filter Loaded ACB/JW
3-3	1121	.57	.64	882.278	681		125	103	241	54		18		Filter Recovered ACB
stop 4	1136			889.748										Probe Wash JW/ACB
											7.91			Comments: - 0.023 fan
														total
Total/Average														

FST DS-022

PARTICUL TEST DATA

Client/Location SCE / Long Beach Unit Aux. boiler ~~Test No.~~ CARB 429 ~~Test~~ Method SW-LBAK Page 1
Sample Location exhaust duct Fuel Distillate Oil Ambient Temp., °F _____ of 1
Operators JM Meter Vol. (Start/End) 1 Date _____

Pre Test Data:
- Barometric Press, in. Hg _____
- Stack Area, sq. ft. _____
- Sample Time/ Pt, min. _____
- Assumed Stack Press _____
- Assumed Moisture _____
- Assumed Molecular Wt _____

Equipment Info:
- Meter No. _____
- Meter, Yd _____
- Pitot, Cp _____
- CFM @ΔH = 1.0 _____
- Probe I.D. _____
- Nozzle No./Dia _____
- Filter No. _____

Imp.	Matl	Wt(End)	Weight (Start)	Weight (g)
#1	—	488.2	489.0	=
#2	BNJ H_2O	590.4	590.5	=
#3	—	481.0	480.2	=
#4	Si	756.0	753.0	=
Total		_____	_____	=

Impinger Box I.D. _____
Integrated Bag I.D. _____

Leak Check:

Sample Train

	CFM	Vac.	Init.	Pitot	IBS
Pre-Test	.018	8	J	___	___
Post-Test	___	___	___	___	___

Pre-Test Calibration

	Time	ΔH	Meter Reading	Meter Temp. In	Meter Temp. Out
Init.	___	___	___	___	___
Final	___	___	___	___	___

Sample Point	Time	Meter Conditions ΔP	Meter Conditions ΔH	Meter Conditions Meter Reading	Temperatures, °F Stack	Probe	Meter In	Out	Oven	Imp. Out	O_2	Vacuum	Static Press. iwg	Test Summary
														Initial _____
														Sample Vol., c.f. _____
														Stack Press, iwg _____
														ΔP ____ iwg ΔH ____ iwg
														Meter Temp., °F _____
														Stack Temp., °F _____
														Water Collected, g _____
														O_2/CO_2 Method _____
														Chain of Cust. Info (init.):
														Impingers Loaded JS
														Impingers Recovered JS
														Filter Loaded JS
														Filter Recovered JS
														Probe Wash JS/SH
														Comments: _____
Total/Average														

EST DS-022

ANALYTICAL RESULTS REPORT

CLIENT INFORMATION
Name: ENERGY SYSTEMS ASSOCIATES
Project: PAH ANALYSIS OF MM5 TRAINS

LAB INFORMATION
Contact: HH
Project: AN898506
Date: Apr.03 1990

Note: "-" = Not Analysed
"<" = Less than MDL
"*" = Lab Accident

			Client ID:	4-LBCT-SV MM5 TRAIN	5-LBCT-SV MM5 TRAIN	6-LBCT-SV MM5 TRAIN	LBCT-BLK MM5 TRAIN	4-LBAX-SV MM5 TRAIN	5-LBAX-SV MM5 TRAIN	6-LBAX-SV MM5 TRAIN	LBAX-BLK MM5 TRAIN
			Lab ID:	004056 90	004057 90	004058 90	004059 90	004060 90	004061 90	004062 90	004063 90
Component	MDL	Units									
Naphthalene	0.025	ug		<	<	<	<	<		<	<
Acenaphthylene	0.025			<	<	<	<	<		<	<
Acenaphthene	0.025			<	<	<	<	<		<	<
Fluorene	0.025			<	<	<	<	<		<	<
Phenanthrene	0.025			0.032	<	0.04	<	<		<	<
Anthracene	0.025			<	<	<	<	<		<	<
Fluoranthene	0.025			<	<	<	<	<		<	<
Pyrene	0.025			<	<	<	<	<		<	<
Chrysene	0.025			<	<	<	<	<		<	<
Benz(a)anthracene	0.025			<	<	<	<	<		<	<
Benzo(b+k)fluoranthene	0.025			<	<	<	<	<		<	<
Benzo(a)pyrene	0.025			<	<	<	<	<		<	<
Indeno(1,2,3-cd)pyrene	0.025			<	<	<	<	<		<	<
Dibenzo(ah)anthracene	0.025			<	<	<	<	<		<	<
Benzo(ghi)perylene	0.025			<	<	<	<	<		<	<
Surrogate Recoveries %											
d10 Acenaphthene				33	30	35	40	45		27	38
d10 Anthracene				44	37	33	50	95		36	60
d12 Chysene				38	32	45	44	120		41	49
d12 Benzo(a)pyrene				44	69	32	77	230		40	120

Appendix C.7

Fuel Analysis

LBAX : Natural Gas

EPA Fuel "F" factor calculations

Reference temp, F:	60
Composition by wt, %:	
Carbon	72.58
Hydrogen	23.21
Nitrogen	2.39
Sulfur	0
Oxygen	1.82
Ash	0
Heating value, btu/lb:	22,660
F factor, dscf/mmbtu @ 0% O2:	8,476
Ash content, lb/mmbtu:	0.000

Energy Systems Associates A CORPORATION
15991 RED HILL AVE., SUITE 110, TUSTIN, CALIFORNIA 92680

SUBJECT SCE/Long Beach CT #3 JOB NO. 53304
Calculation of F factor for natural gas.

SHEET NO. ___ of ___

COMPUTED BY D. Bell DATE 4/18/90 CHECKED BY ___ DATE ___

Compound	Composition by volume Mole %	wt % C	wt % H	wt % N	wt % O
CH_4	92.1	11.06	3.71		
C_2H_6	3.75	0.90	0.23		
C_3H_8	1.00	0.36	0.08		
$n\text{-}C_4H_{10}$	0.23	0.11	0.02		
$i\text{-}C_4H_{10}$	0.13	0.06	0.01		
$n\text{-}C_5H_{12}$	0.06	0.04	0.01		
$i\text{-}C_5H_{12}$	0.07	0.04	0.01		
$C_6H_{14}+$	0.10	0.07	0.01		
CO_2	1.00	0.12			0.32
N_2	1.51				
				0.42	

MW = 17.58 = Total 12.76 + 4.08 + 0.42 + 0.32

% by weight 72.58 23.21 2.39 1.82

$$Btu/lb = 1049.7\ Btu/ft^3 \times \frac{385.3\ ft^3}{mole} \times \frac{mole}{17.58\ lb}$$

$$= 23{,}006$$

$$F_{68} = \frac{10^6 [3.64(23.21) + 1.53(72.58) + .14(2.39) - .46(1.82)]}{23{,}006}$$

$$= 8477\ dscf/10^6\ Btu$$

126087

LBAX: Distillate

EPA Fuel "F" factor calculations

Reference temp, F:	60
Composition by wt, %:	
Carbon	83.95
Hydrogen	15.56
Nitrogen	0.21
Sulfur	0.05
Oxygen	0.2
Ash	0
Heating value, btu/lb:	18,800
F factor, dscf/mmbtu @ 0% O2:	9,694

LBAX : Distillate

EPA Fuel "F" factor calculations

Reference temp, F:	60
Composition by wt, %:	
Carbon	83.91
Hydrogen	15.54
Nitrogen	0.28
Sulfur	0.05
Oxygen	0.2
Ash	0
Heating value, btu/lb:	19,400
F factor, dscf/mmbtu @ 0% O2:	9,388

Curtis & Tompkins, Ltd

LABORATORY NUMBER: 25430-1
CLIENT: ENERGY SYSTEMS ASSOCIATES
PROJECT #: SUBMITTED BY CLIENT
LOCATION: SUBMITTED BY CLIENT
SAMPLE ID: 4A-LBAX-Fuel

DATE RECEIVED: 02/09/90
DATE ANALYZED: 02/15/90
DATE REPORTED: 03/15/90

METHODS: EPA 6010/7000
CAC TITLE 22 METALS IN AQUEOUS SOLUTIONS

METAL	RESULT	REGULATORY LIMITS STLC
	--mg/L--	
Arsenic	ND (0.25)	5
Beryllium	ND (0.05)	0.75
Cadmium	ND (0.05)	1
Chromium (total)	ND (0.05)	560
Chromium (VI)	ND (0.05)	--
Copper	ND (0.10)	25
Lead	ND (0.25)	5
Mercury	ND (0.10)	0.2
Manganese	ND (0.10)	350
Nickel	ND (0.05)	20
Selenium	ND (0.25)	1
Zinc	0.06	250

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES.

QA/QC DATA SUMMARY:

	RPD	SPIKE		RPD	SPIKE
Arsenic	21	101	Mercury	9	95
Beryllium	3	90	Manganese	2	98
Cadmium	19	84	Nickel	11	100
Chromium	1	101	Selenium	14	105
Copper	3	102	Zinc	3	99
Lead	13	97			

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 25430-2
CLIENT: ENERGY SYSTEMS ASSOCIATES
PROJECT #: SUBMITTED BY CLIENT
PROJECT #: SUBMITTED BY CLIENT
SAMPLE ID: 4B-LBAX-Fuel

DATE RECEIVED: 02/09/90
DATE ANALYZED: 02/15/90
DATE REPORTED: 03/15/90

METHODS: EPA 6010/7000
CAC TITLE 22 METALS IN AQUEOUS SOLUTIONS

METAL	RESULT	REGULATORY LIMITS STLC
	--mg/L--	
Arsenic	ND (0.25)	5
Beryllium	ND (0.05)	0.75
Cadmium	ND (0.05)	1
Chromium (total)	ND (0.05)	560
Chromium (VI)	ND (0.05)	--
Copper	ND (0.10)	25
Lead	0.3	5
Mercury	ND (0.10)	0.2
Manganese	ND (0.10)	350
Nickel	ND (0.05)	20
Selenium	ND (0.25)	1
Zinc	0.06	250

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES.

QA/QC DATA SUMMARY:

	RPD	SPIKE		RPD	SPIKE
Arsenic	21	101	Mercury	9	95
Beryllium	3	90	Manganese	2	98
Cadmium	19	84	Nickel	11	100
Chromium	1	101	Selenium	14	105
Copper	3	102	Zinc	3	99
Lead	13	97			

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 25430-1
CLIENT: ENERGY SYSTEMS ASSOCIATES
PROJECT #: SUBMITTED BY CLIENT
LOCATION: SUBMITTED BY CLIENT
SAMPLE ID: 4A-LBAX-Fuel

DATE RECEIVED: 02/09/90
DATE ANALYZED: 03/07/90
DATE REPORTED: 03/14/90

ULTIMATE AND PROXIMATE ANALYSIS

PARAMETER	AS RECEIVED BASIS (% by Weight)
ASH CONTENT	<0.01
CARBON	72.55
CHLORINE	<0.01
HYDROGEN	13.45
NITROGEN	0.18
OXYGEN	13.78
SULFUR	0.04
CHLORINE BY X-RAY DIFF. (mg/L)	ND (30)
BTU/LB.	18,800

by difference but an artifact of evaporation. correct to 0.2 % O_2 and reapportion rest of analysis

C: 83.95
H: 15.56
N: 0.21
O: 0.2
S: 0.05

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES

Curtis & Tompkins, Ltd

LABORATORY NUMBER: 25430-2
CLIENT: ENERGY SYSTEMS ASSOCIATES
PROJECT #: SUBMITTED BY CLIENT
LOCATION: SUBMITTED BY CLIENT
SAMPLE ID: 4B-LBAX-Fuel

DATE RECEIVED: 02/09/90
DATE ANALYZED: 03/07/90
DATE REPORTED: 03/14/90

ULTIMATE AND PROXIMATE ANALYSIS

PARAMETER	AS RECEIVED BASIS (% by Weight)
ASH CONTENT	<0.01
CARBON	74.83
CHLORINE	<0.01
HYDROGEN	13.86
NITROGEN	0.25
OXYGEN	11.02
SULFUR	0.04
CHLORINE BY X-RAY DIFF. (mg/L)	ND (30)
BTU/LB.	19,400

see previous page:

C	83.91
H	15.54
N	0.28
O	0.2
S	0.05

ND = NOT DETECTED; LIMIT OF DETECTION IN PARENTHESES

APPENDIX D

CALCULATIONS

Appendix D.1

General Emission Calculations

E∫A

EMISSION CALCULATIONS

1. Sample Volume and Isokinetics

a. Sample gas volume, dscf

$$V_{m\ std} = 0.03342 V_m [P_{bar} + (H/13.6)](T_{ref}/T_m)(Y)$$

b. Water vapor volume, scf

$$V_{w\ std} = 0.0472\ V_{lc}\ (T_{ref}/528°R)$$

c. Moisture content, nondimensional

$$Bwo = V_{w\ std}/(V_{m\ std} + V_{w\ std})$$

d. Stack gas molecular weight, lb/lb mole

$$MW_{dry} = 0.44(\%\ CO_2) + 0.32(\%\ O_2) + 0.28(\%\ N_2)$$

$$MW_{wet} = MW_{dry}\ (1 - B_{wo}) + 18\ (B_{wo})$$

e. Absolute stack pressure, iwg

$$Ps = P_{bar} + P_{sg}/13.6$$

f. Stack velocity, ft/sec

$$V_s = 2.90\ C_p \sqrt{\Delta PTs}\ \sqrt{\frac{29.92}{Ps} x \frac{28.95}{MW_{wet}}}$$

g. Actual stack gas flow rate, wacfm

$$Q = (V_s)(A_s)(60)$$

h. Standard stack gas flow rate, dscfm

$$Q_{sd} = Q\ (1 - Bwo)(T_{ref}/Ts)(Ps/29.92)$$

i. Percent isokinetic

$$I = \frac{17.32 \times T_s\ (V_{m\ std})}{(1-Bwo)\theta \times V_s \times Ps \times Dn^2} \times \frac{528\ °R}{T_{ref}}$$

2. Particulate Emissions

a. Grain loading, gr/dscf

$$C = 0.01543\ (M_n/V_{m\ std})$$

b. Grain loading at 12% CO_2, gr/dscf

$$C_{12\%\ CO_2} = C\ (12/\%\ CO_2)$$

c. Mass emissions, lb/hr

$$M = C \times Qsd \times (60 \text{ min/hr})/(7000 \text{ gr/lb})$$

3. Gaseous Emissions, lb/hr

$$M = ppm \times 10\text{-}6 \frac{MW_i \text{ lb/lb mole}}{SV} \times Qsd \times 60 \text{ min/hr}$$

where SV = specific molar volume of an ideal gas:

385.3 ft^3/lb mole for T_{ref} = 528 °R
379.5 ft^3/lb mole for T_{ref} = 520 °R

4. Emissions Rates, lb/10^6 Btu

a. Fuel factor at 68 °F, dscf/10^6 Btu at 0% O_2

$$F_{68} = \frac{10^6[3.64(\%H) + 1.53(\%C) + 0.14(\%N) + 0.57(\%S) - 0.46(\%O_2, \text{ fuel})]}{HHV, \text{ Btu/lb}}$$

b. Fuel factor at 60 °F

$$F_{60} = F_{68} (520 \text{ °R}/528 \text{ °R})$$

c. Gaseous emission factor

$$\text{lb/}10^6 \text{ Btu}_i = ppm_i \times 10^{-6} \times \frac{MW_i \text{ lb}}{\text{lb mole}} \times \frac{1}{SV} \times F \times \frac{20.9}{20.9-\%O_2}$$

d. Particulate emission factor

$$\text{lb/}10^6 \text{ Btu} = C \times \frac{1 \text{ lb}}{7000 \text{ gr}} \times F \times \frac{20.9}{20.9-\%O_2}$$

These calculations are routinely performed on ESA's computer.

Nomenclature:

A_s = stack area, ft^2

Bwo = flue gas moisture content

$C_{12\%\ CO_2}$ = particulate grain loading, gr/dscf corrected to 12% CO_2

C = particulate grain loading, gr/dscf

C_p = pitot calibration factor, dimensionless

Dn = nozzle diameter, in.

F = fuel F factor, dscf/10^6 Btu at 0% O_2

H = orifice pressure differential, iwg

I = % isokinetics

M_n = mass of collected particulate, mg

M_i = mass emissions of species i, lb/hr

MW = molecular weight of flue gas

MW_i = molecular weight of species i:

NOx: 46

CO: 28

SO_2: 64

HC: 16

θ = sample time, min.

ΔP = average velocity head, iwg $= \left(\overline{\sqrt{\Delta P}}\right)^2$

P_{bar} = barometric pressure, in.Hg

Ps = stack absolute pressure, in.Hg.

Psg = stack static pressure, iwg

Q = wet stack gas flow rate at actual conditions, wacfm

Qsd = dry stack gas flow rate at standard conditions, dscfm

SV = specific molar volume of an ideal gas at std conditions, ft^3/lb mole

Tm = meter temperature, °R

T_{ref} = reference temperature, °R

Ts = stack temperature, °R

V_s = stack velocity, ft/sec

V_{lc} = volume of liquid collected in impingers, ml

Vm = dry meter volume uncorrected, dcf

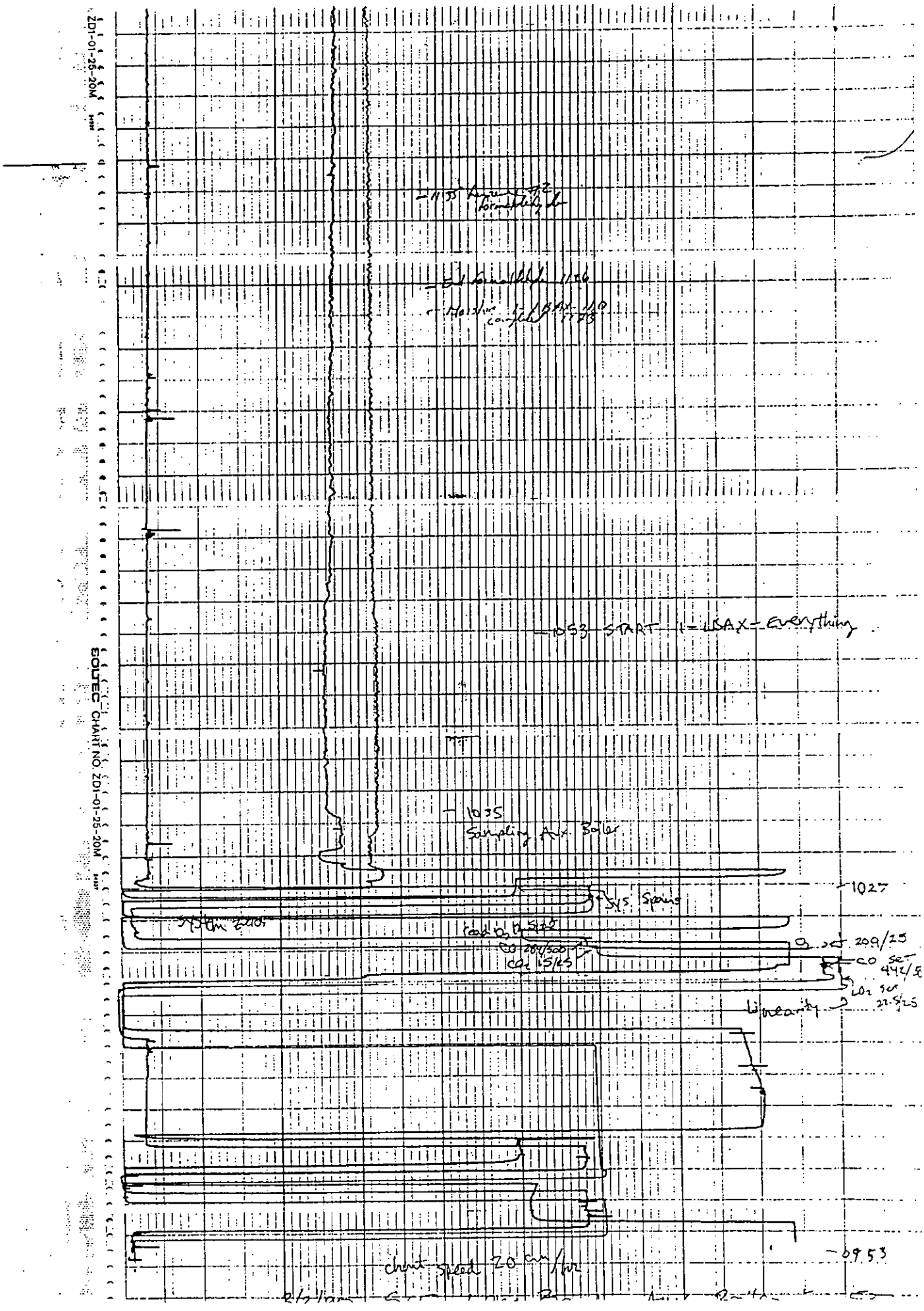
$V_{m\ std}$ = dry meter volume at standard conditions, dscf

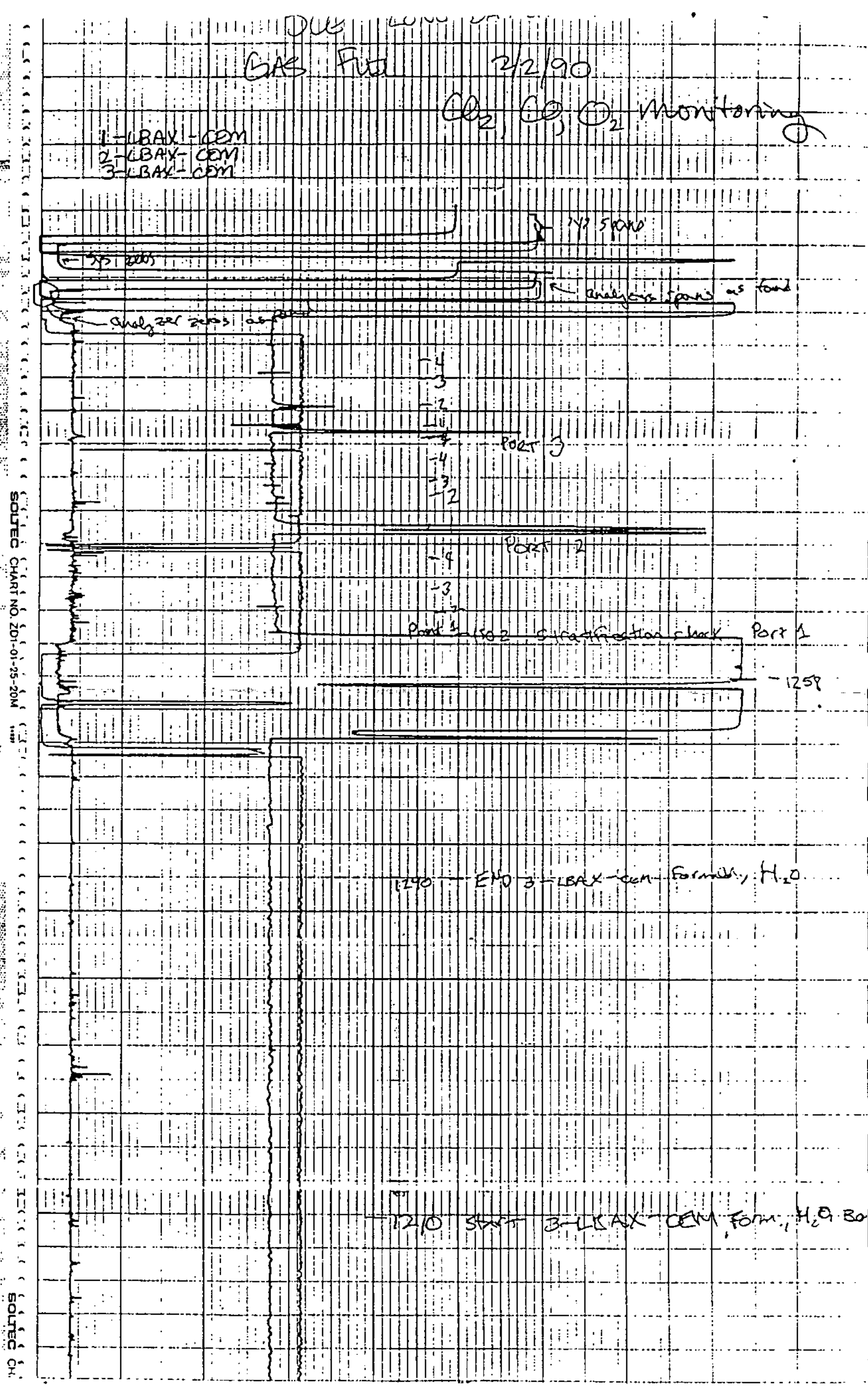
$V_{w\ std}$ = volume of water vapor at standard conditons, scf

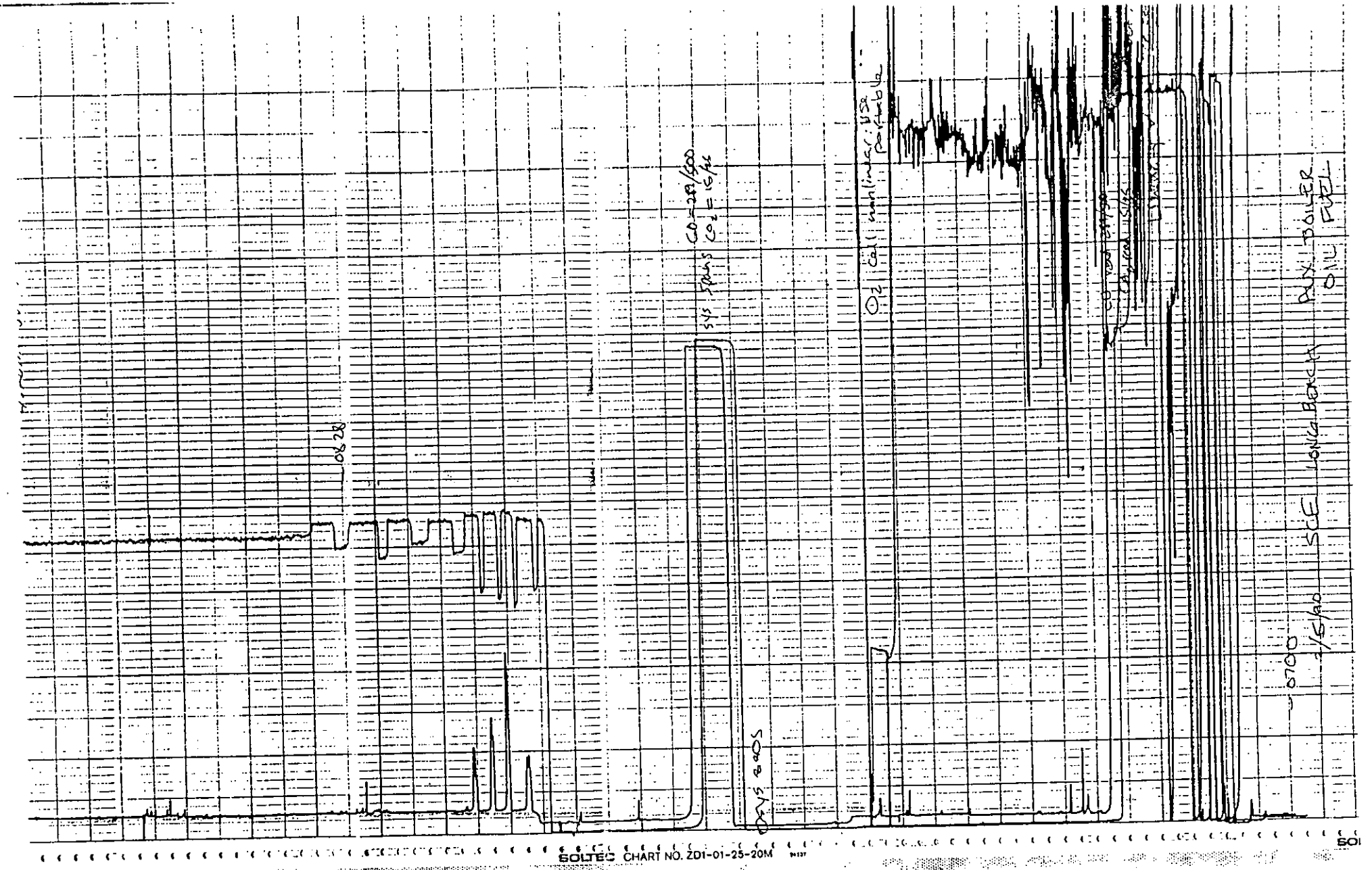
Y = meter calibration coefficient

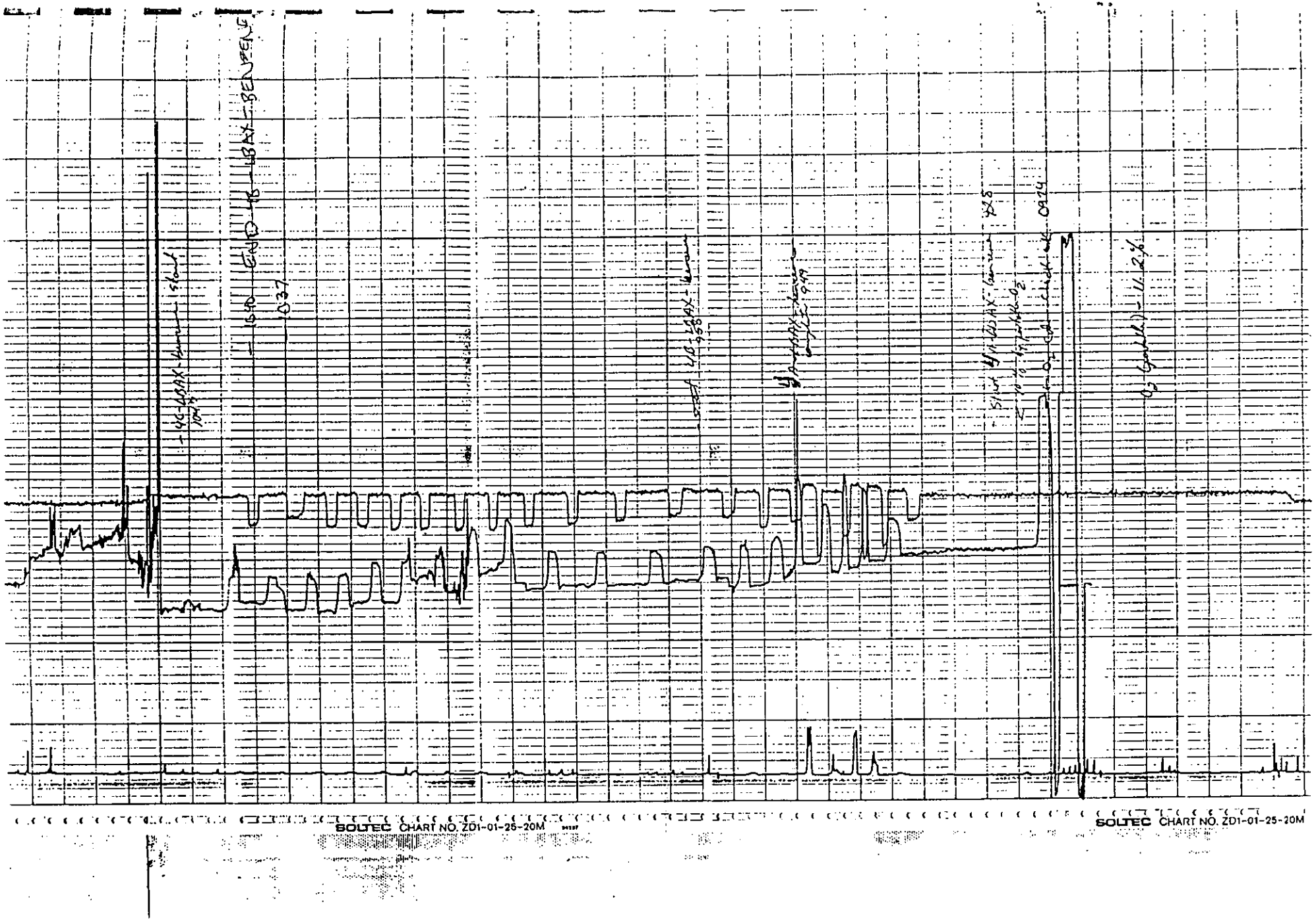
APPENDIX E

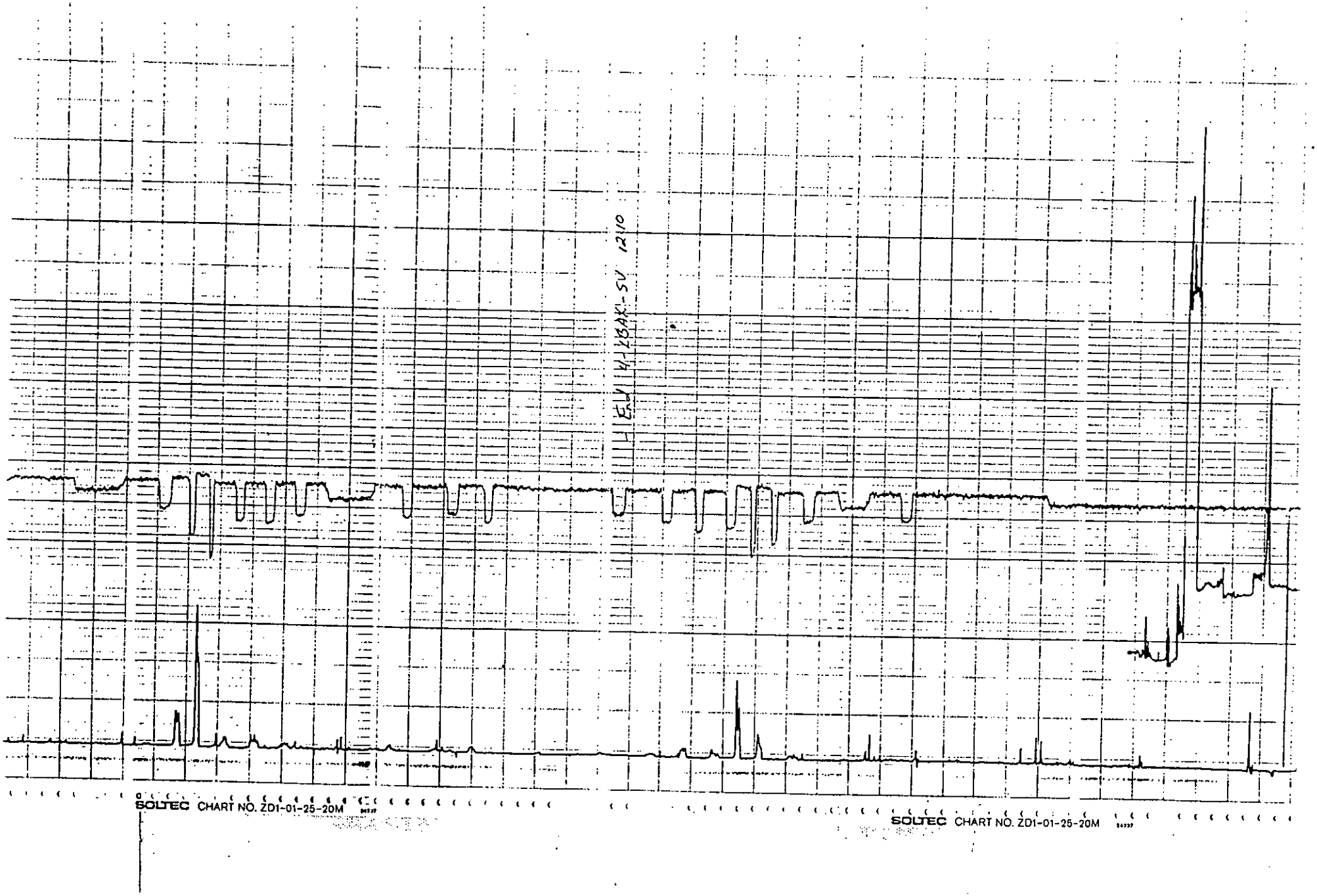
INSTRUMENT STRIP CHARTS

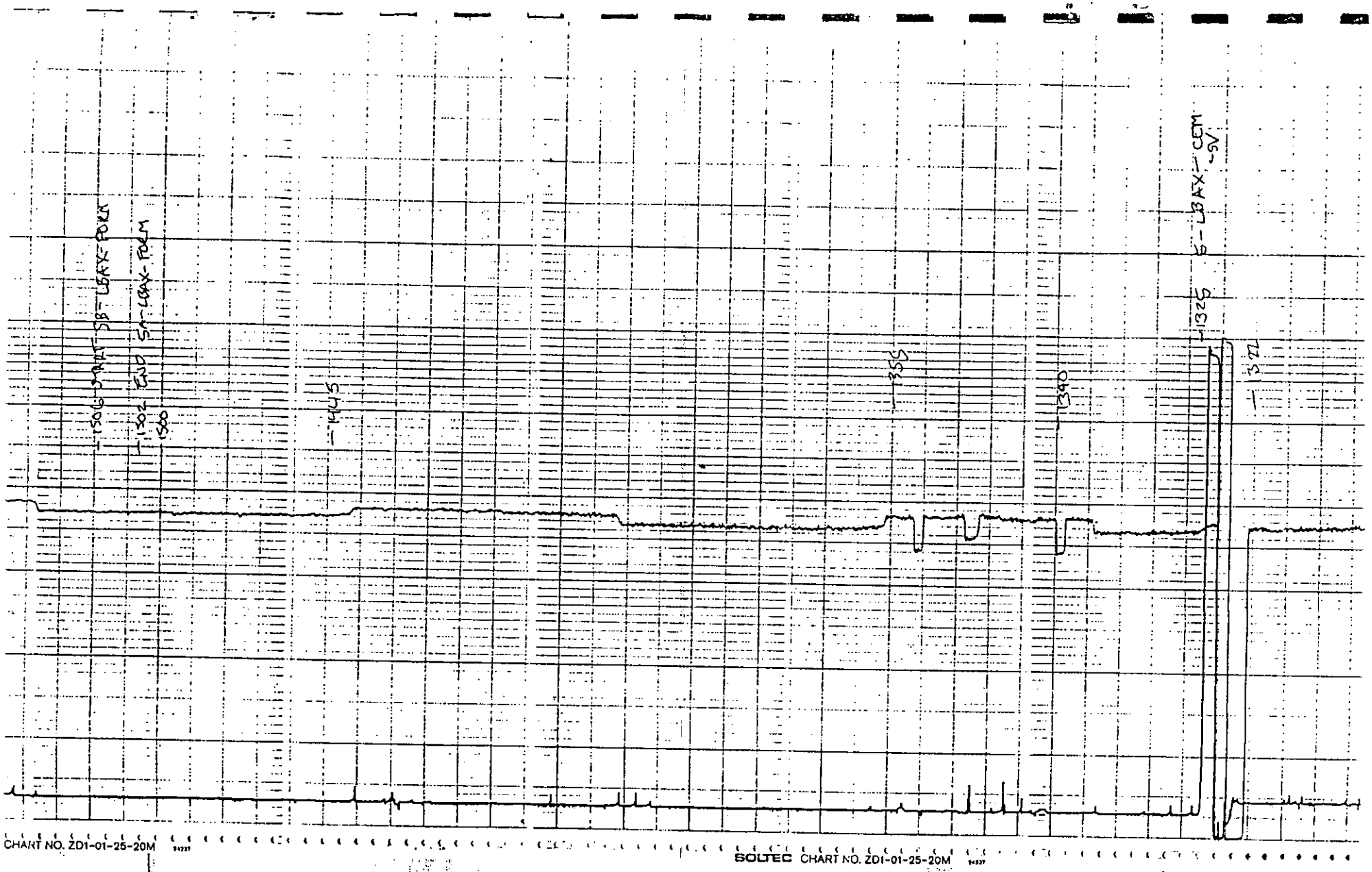

ZD1-01-25-20M
SOLTEC CHART NO. ZD1-01-25-20M
1135
1136
1053 START 1 = USAX = Everything
1035
Sampling Aux. Boiler
1027
Sys. Spans
System Zero
Load
CO 200/500
CO2 15/25
209/25
CO set 44/8
CO2 set 22.5/25
linearity
0953
chart speed 20 mm/hr

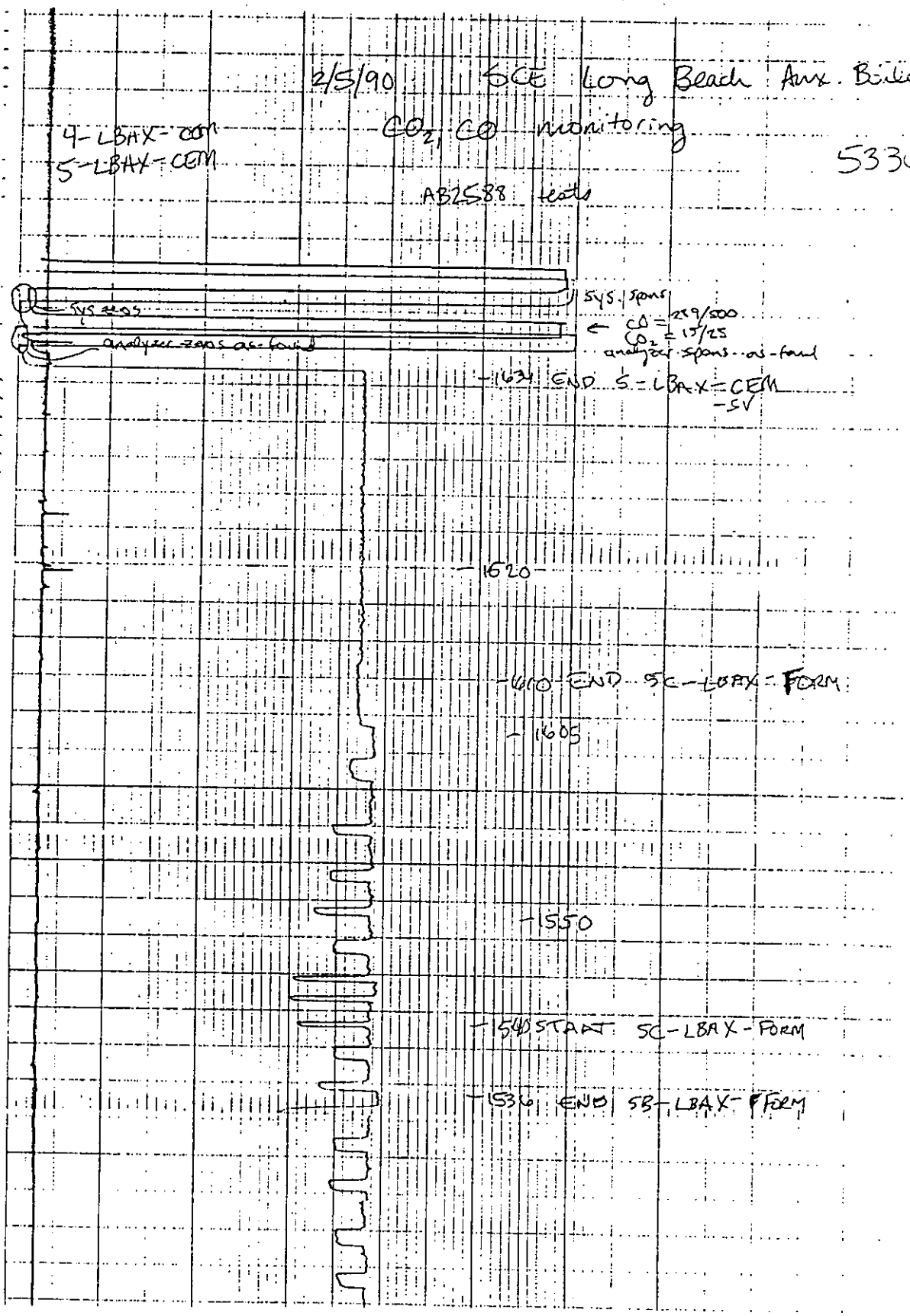

GAS FIRE 2/2/90
CO2, CO, O2 Monitoring
1-LBAX-CEM
2-LBAX-CEM
3-LBAX-CEM
sys span
sys zeros
analyzers spans as found
analyzer zeros as found
Port 3
Port 2
Port 1 1502 Stratification check Port 1
1258
1240 END 3-LBAX-CEM Formald., H2O
1210 Start 3-LBAX-CEM, Form., H2O
SOLTEC CHART NO. Z01-01-25-20M

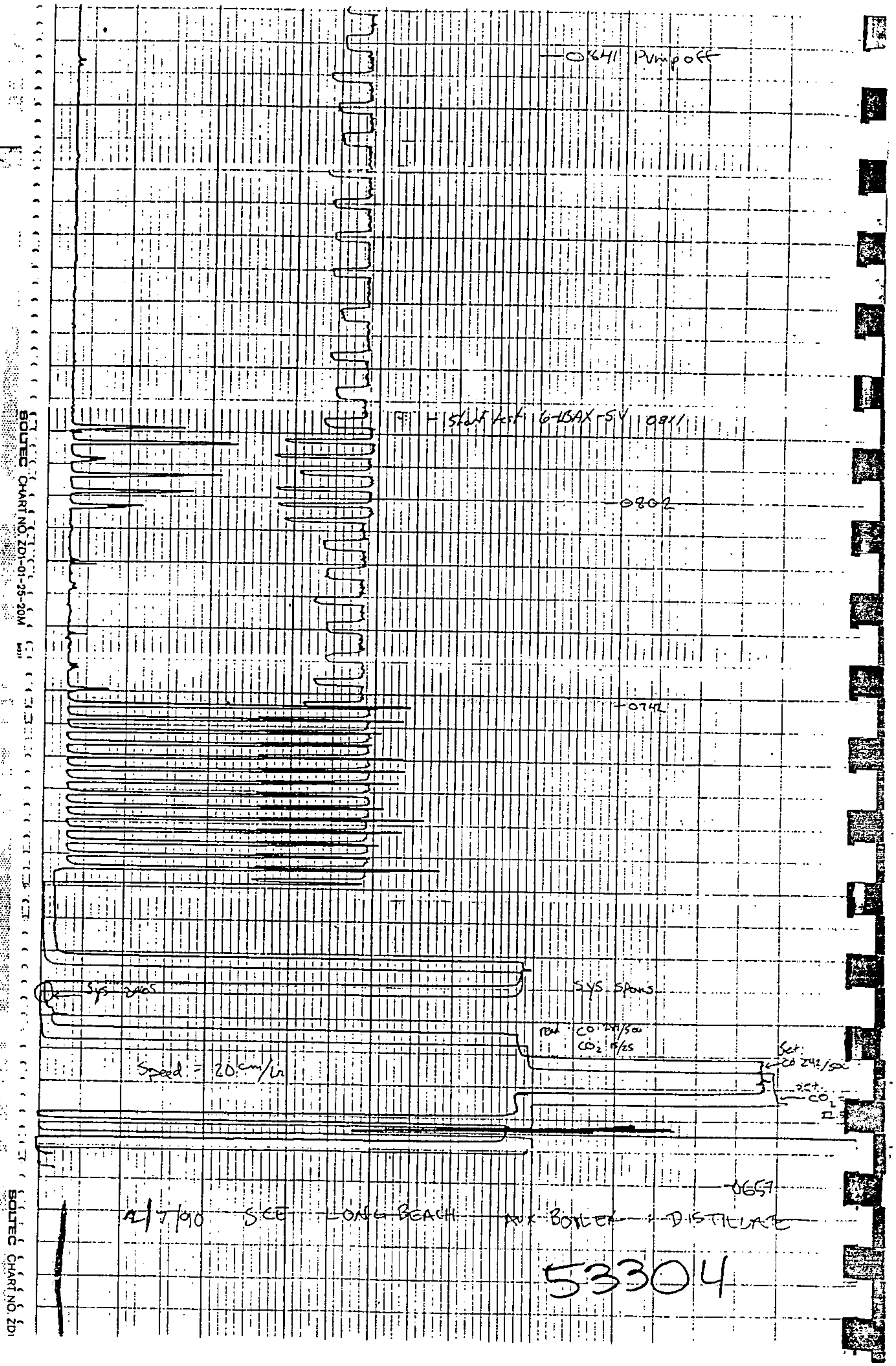

O2 Cal manifold, USA portable
SYS spans CO=29/500 CO2 = 6/12
SYS zeros
6700
1/5/90 SCE LONG BEACH DUX BOILER OIL FUEL
GOLTEC CHART NO. ZD1-01-25-20M

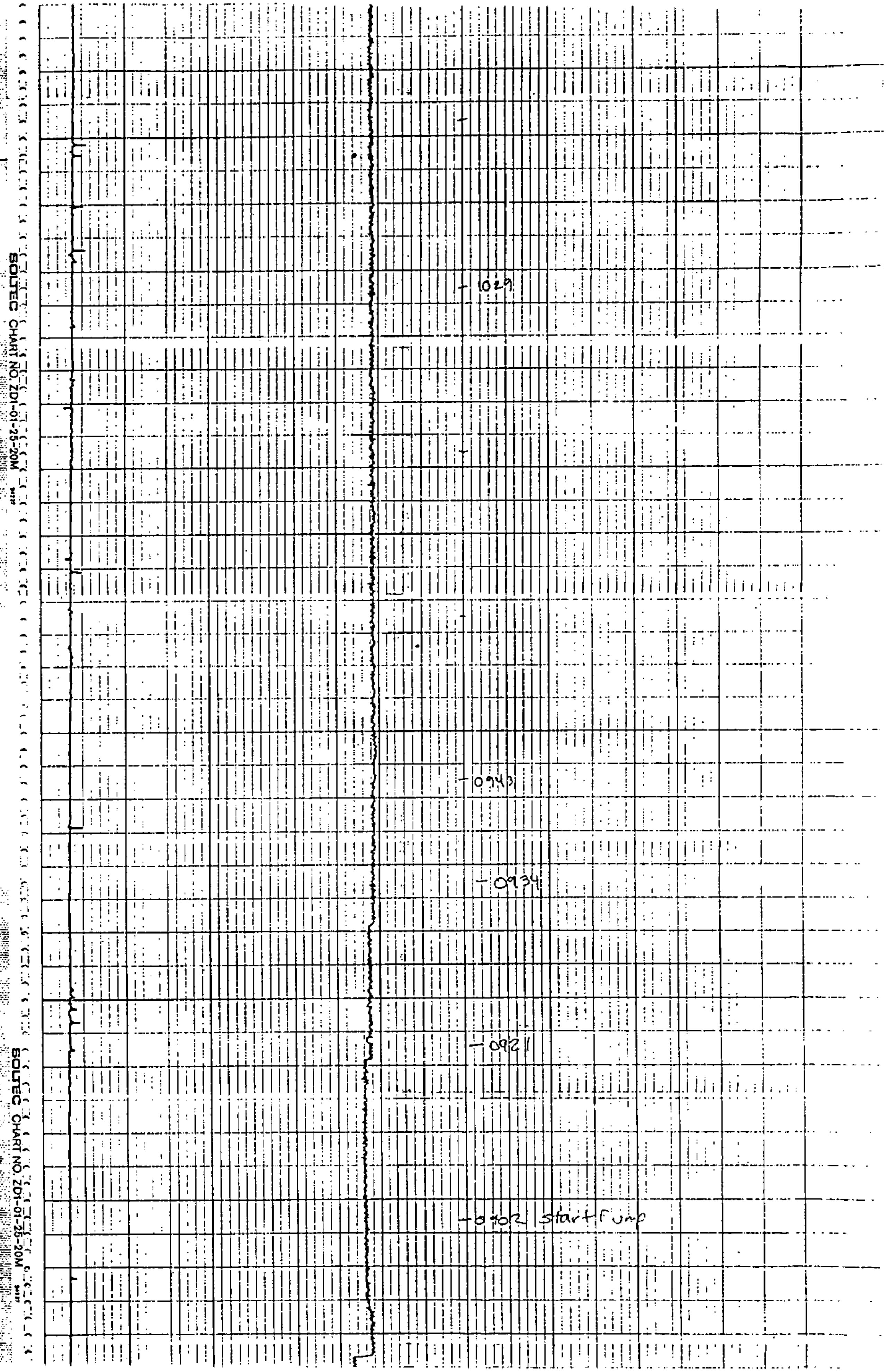

SOLTEC CHART NO. ZD1-01-25-20M
SOLTEC CHART NO. ZD1-01-25-20M


HELIUM LEAK-SV 1210
SOLTEC CHART NO. ZD1-01-25-20M
SOLTEC CHART NO. ZD1-01-25-20M

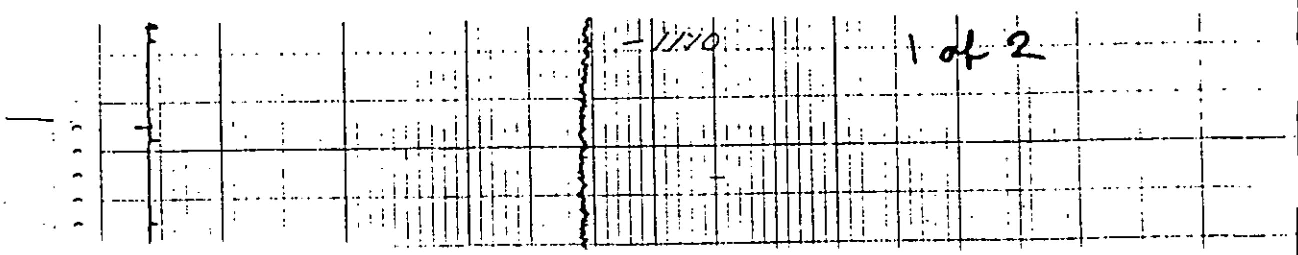

1506 JOINT DB-LBAX-POLM
1502 END SA-LBAX-POLM
1500
1445
1355
1340
1325
LB AX-CCM
-5V
1315
CHART NO. ZD1-01-25-20M
SOLTEC CHART NO. ZD1-01-25-20M

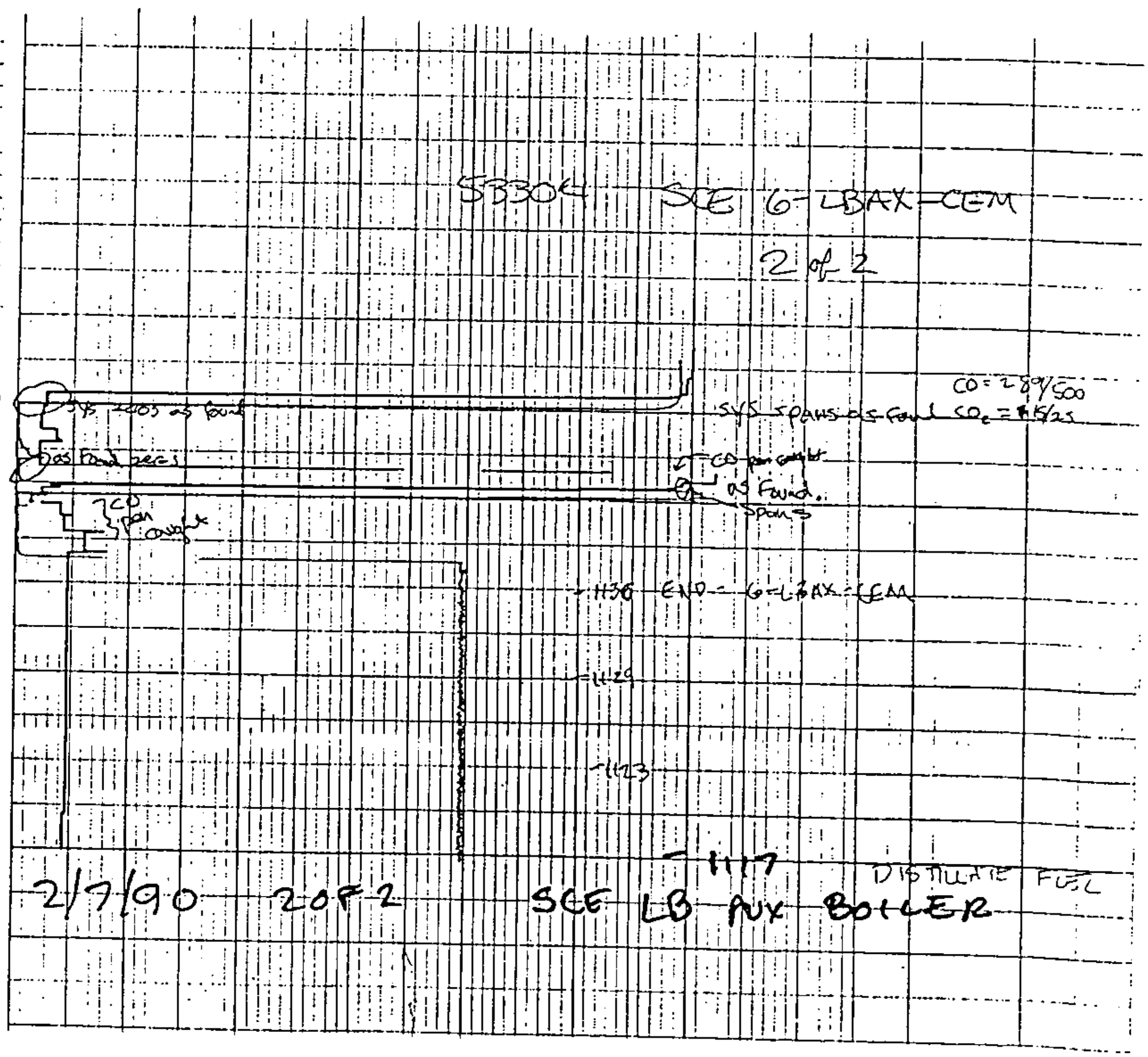

2/5/90
SCE Long Beach Aux. Boiler
CO_2, CO monitoring
4-LBAX-CEM
5-LBAX-CEM
AB2588 tests
5533
SYS zeros
analyzer zeros as-found
SYS. spans
CO = 259/500
CO_2 = 15/25
analyzer spans - as-found
1634 END 5-LBAX-CEM -SV
1620
1610 END SC-LBAX-FORM
1605
1550
1540 START SC-LBAX-FORM
1536 END SB-LBAX-FORM
SOLTEC CHART NO. ZD1-01-25-20M


0641 Pump off
Start Act 6-BAX-SV 0811
0802
0742
Sys zero
SYS. Spans
CO 241/500
CO_2 5/25
Set: CO 241/500
Set CO_2
Speed = 20 cm/hr
0657
4/7/90 SCE LONG BEACH AUX BOILER DISTILLATE
53304
SOLTEC CHART NO. ZD1-01-25-20M
SOLTEC CHART NO. ZD1



SOLTEC CHART NO. ZD1-01-25-20M
1029
0943
0934
0921
0902 start Pump
SOLTEC CHART NO. ZD1-01-25-20M


1 of 2



SOLTEC CHART NO. ZD1-01-25-20M

APPENDIX F

CHAIN OF CUSTODY

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Analyze for:
Formaldehyde
Acetaldehyde
Benzaldehyde

Samples:

Sample No. (Project No. Test No.	Complete Description
1-LBAX-FORM	Vials A and B
2-LBAX-FORM	" "
3-LBAX-FORM	" "
5A-LBAX-FORM	" "
5B-LBAX-FORM	" "
5C-LBAX-FORM	" "
FIELD SPIKE	Vial A
FIELD BLANK	Vial A

combine report in total µg

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
[illegible]			

Samples shipped to: Radian

Samples shipped from ESA by: _____ Date _____

Carrier: _____ Air Bill No. _____

Samples received by: _____ Date _____

Company: _____

15991 RED HILL AVENUE, SUITE 110, TUSTIN, CA 92680-7388 / (714) 259-9520 / Telecopy: (714) 259-0372

Truesdail
Lab # 37977

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples:

Sample No. (Project No. Test No.	Complete Description
4A-LBAX-BENZENE	1 Tedlar bag for benzene by GC/PID
4B-LBAX-BENZENE	" " "
4C-LBAX-BENZENE	

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
[signature]			

Samples shipped to: Truesdail Laboratories
14201 Franklin
Tustin, CA 92680

Samples shipped from ESA by: Car Date 2/6/90
Carrier: [signature] Air Bill No.
Samples received by: [signature] Date 2/6/90
Company: Truesdail Labs

15991 RED HILL AVENUE, SUITE 110, TUSTIN, CA 92680-7388 / (714) 259-9520 / Telecopy: (714) 259-0372

Truesdail Lab # 3795

Energy Systems Associates A CORPORATION

CERTIFICATION OF SAMPLE RECEIPT

Samples: Project # 55304/LBAX / Gas

Sample No. (Project No. Test No.	Complete Description
1A-LBAX-Benzene	Tedlar bags LBAX - Gas
1B-LBAX-Benzene	
1C-LBAX-Benzene	
~~5A-LBCT-Ben~~	
5A-LBCT-Benzene	Tedlar bags LBCT - Distillate by Bob, 2/2/90
5B-LBCT-Benzene	
5C-LBCT-Benzene	

Chain of Custody Prior to Shipment:

Released by	Time and Date	Received by	Time and Date
[illegible]	1300 2/2/90		

Samples shipped to: Truesdail Laboratories
Tustin, CA 92680

Samples shipped from ESA by: Hand carried Date 2/2/90

Carrier: Air Bill No.

Samples received by: [signature] Date 2/2/90

Company: Truesdail Labs.

15991 RED HILL AVENUE, SUITE 110, TUSTIN, CA 92680-7388 / (714) 259-9520 / Telecopy: (714) 259-0372

ESA DS-057

CHAIN OF CUSTODY RECORD

RECORD NO. _____

PROJECT NO. _____ PROJECT LOCATION _____

FIELD SAMPLER
Name _____ Affiliation _____
Signature _____
Sample Storage _____
Comments _____

ANALYSES REQUESTED

PAH-MM5

ZENON Environmental Inc.
845 Harrington Court
Burlington, Ontario
L7N 3P3
(416)-639-6320

Sample Code	Date Collected	Sample Description	Container Seq. No.	Container Size	Container Type	Sample Size	PAH-MM5	Field Procedures pH	Elect. Cond.	Preservatives
004060		4-LBAX-SV	3	3×500A	XAD TRAP		X			
					FILTER					
004061		5-LBAX-SV		3×500A	XAD TRAP		X			
					FILTER					
004062		6-LBAX-SV		3×500A	XAD TRAP		X			
					FILTER					
004063		LBAX-FIELD BLANK		2×500A	XAD TRAP		X			
					FILTER					

Custody Relinquished by _____ Date/Time _____
Received by _____ Affiliation _____
Sample Storage _____

Custody Relinquished by _____ Date/Time _____
Received by _____ Affiliation _____
Sample Storage _____

Client's Name: ESA

Address: _____