Source Test for Measurement of Oxides of Nitrogen, Carbon Monoxide and VOC from Boiler Exhaust at

Candlewick Yarns
711 Cinnamon Drive
Lemoore, California 93245

Prepared for:

San Joaquin Valley Unified
Air Pollution Control District
1999 Tuolumne
Suite 200
Fresno, California 93721

Attention: Mr. Gary Martin

Prepared By:

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Reviewed by GAbe

PES Job Number: 4778.001
April 21, 1993

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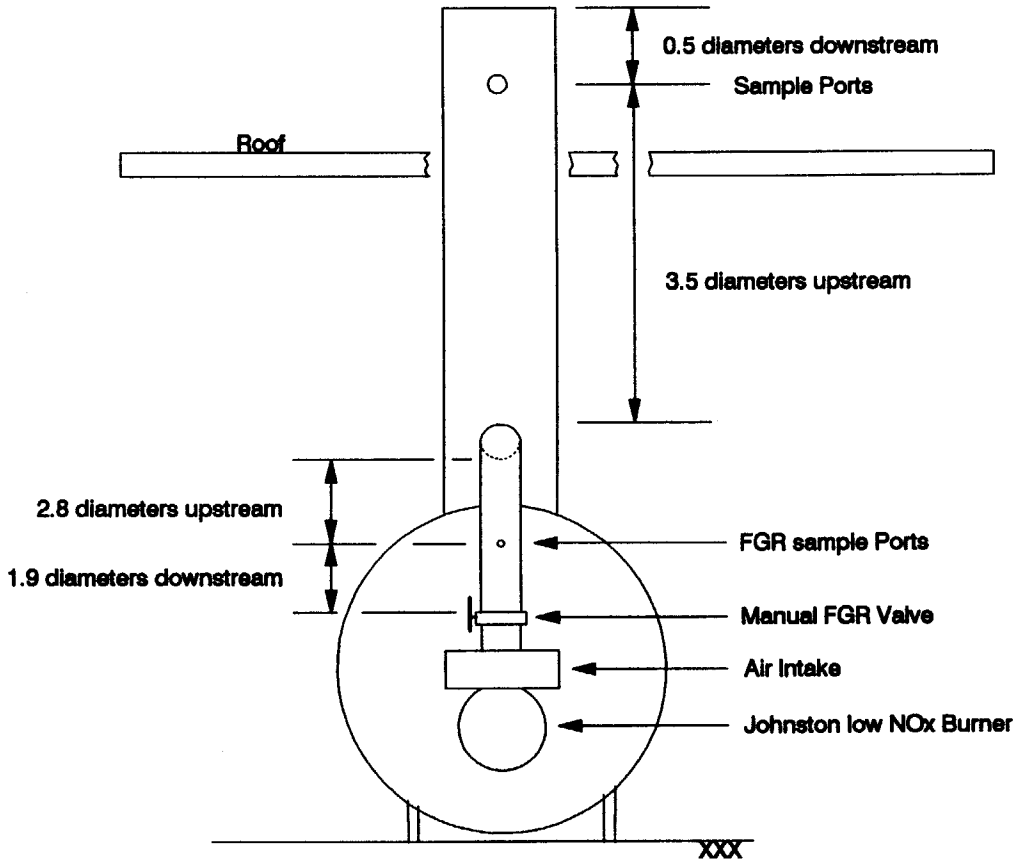
INTRODUCTION

Pacific Environmental Services, Inc (PES) was retained by Central Boiler Inc, to measure CO, and NOx emissions from a 21 MMBTU/HR boiler located at Candlewick Yarns, 711 Cinnamon Drive, Lemoore, California 93245. The tests were conducted to determine compliance with SJVUAPCD Authority to Construct No. C-233-1-0.

The object of the source test was to determine NO_x, CO and VOC emissions under maximum load conditions with the boiler operating on natural gas only. Instruments were used to determine the concentrations of oxides of nitrogen, oxygen, carbon monoxide and ROG on a continuous basis. PES conducted the test on April 21, 1993. The tests were performed by Steve Hernandez and Robert Nguyen of PES. Mr. M. Dean High, Senior Vice President provided guidance for planning and supervision purposes.

The unit tested was a Johnston Model PTFA-500 fire tube boiler with a Johnston Low NO_x burner assembly rated at 21.0 MMBTU/HR for natural gas. The boiler was equipped with a manual flue gas recirculation (FGR) system (see Figure 1). The Authority to Construct for this equipment can be found in Appendix A.



Candlewick Yarns 21.0 MMBTU/HR Fire Tube Boiler Layout

Figure 1

Process Description

Candlewick Yarns operated two mills which receive bailed nylon staple which is blended to produce the desired color and texture combinations. It is then directed to a cording process which evens the staple and brings it to a desired weight.

the staple is then spun into yarns and sent to ply twisting where the desired thickness is gained. it is then reeled into skeins and sent to heat setting where the yarn is heated to approximately 270°F to gain a perminant (controlled) twist.

The skeins are then wound onto cones and sent to packaging in preparation for shippment to customers.

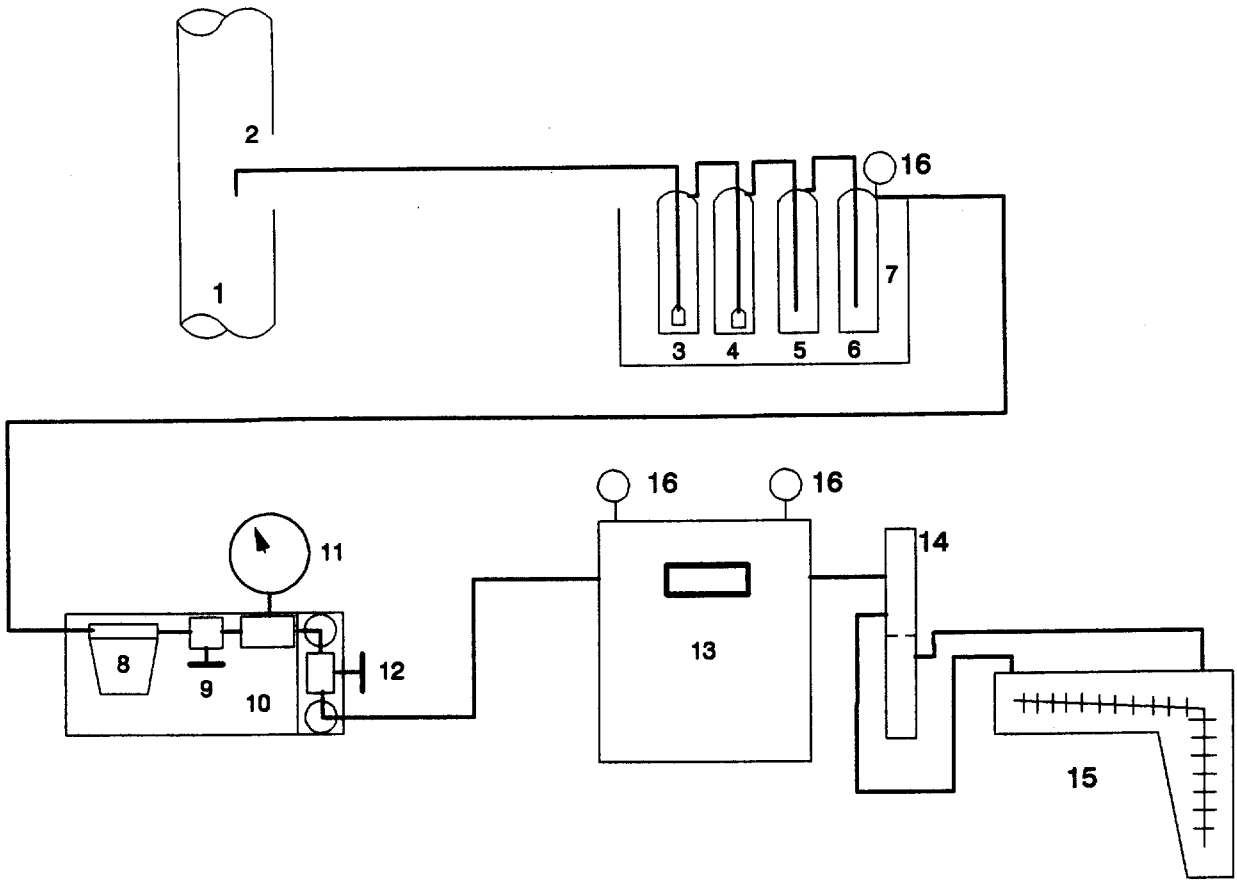
TEST METHODOLOGY

The sampling ports are shown in Figure 1. Since the test location was 0.5 diameters upstream and 0.5 diameters downstream of any disturbance, a total of 16 traverse points were measured (CARB Method 1). At each point the velocity head was measured using an S-type pitot tube attached to an inclined manometer. Temperature was measured with a chromel-alumel (type K) thermalcouple (CARB Method 2). Temperature was measured with a Fluke Model 52 Digital thermometer(DTM). Moisture was determined using CARB Method 4 at each load condition tested (Figure 2). A stratification test was performed using the oxygen analyzer prior to the start of testing and all points were found within 0.3% oxygen.

For each test condition, CARB Method 100 was used to determine the oxides of nitrogen (NOx), carbon monoxide (CO), carbon dioxide (CO_2), oxygen (O_2), and THC levels in the effluent gas from the boiler. The concentrations were measured by using a Continuous Emissions Monitoring System (CEMS) installed in a PES mobil monitoring van. A schematic of this system is shown in Figure 3.

A Rosemount Analytical (formerly Beckman Industrial) model 880 non-dispersive infrared analyzer was used to determine the carbon monoxide concentration. A Rosemount Analytical Model 880 non-dispersive Infrared Analyzer was used to determine the CO_2 concentration. A Rosemount Analytical Model 755R Paramagnetic Analyzer was used to determine the oxygen concentration. A Thermo Electron Model 10 Chemiluminescent Analyzer was used to determine the NOx concentration. A J.U.M. Engineering Model VE-7 Heated THC Analyzer was used to determine ROG. And CARB Method 25 using a Vacuum Bottle (Figure 4) was used for methane determination which was subtracted from the THC for VOC determination. Specifications for each analyzer are shown in Table 1. The output of the analyzers was linearized by the manufacturers.

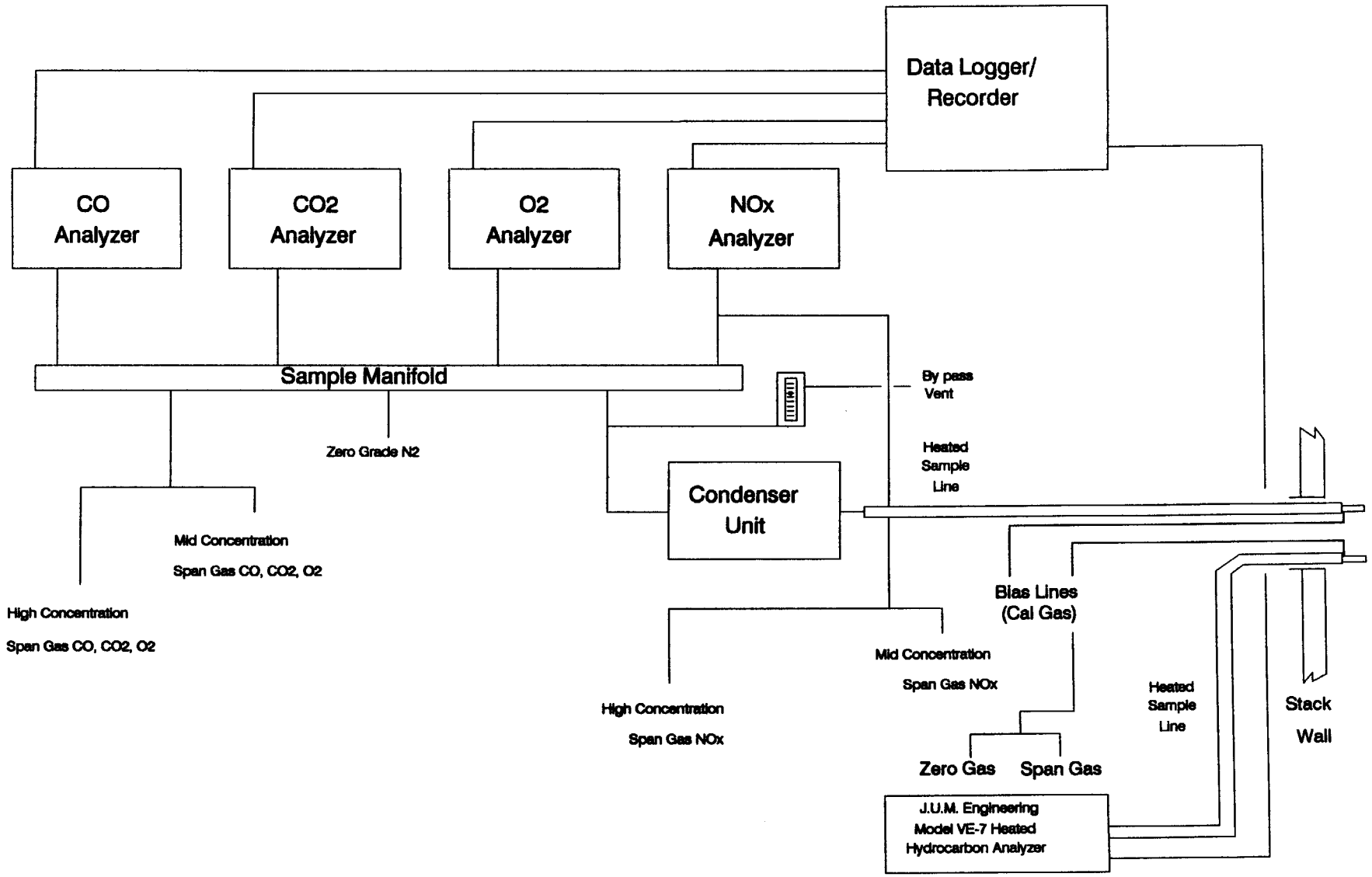
The monitoring train consisted of a 3/8-inch stainless steel sampling probe, a 3/8-inch heated teflon sampling line, a sample refrigeration system (operated at 40°F), a glass fiber filter in a 47 mm Teflon holder, a diaphragm vacuum pump, and a sample distribution manifold. The distribution manifold was equipped with a series of 5-way valves with flow meters (rotometer style). One flow meter acted as a bypass, and the others were connected to the individual analyzers. The output of each analyzer was logged 60 times per minute with a Yokogawa Model 2400 multi-channel strip chart recorder. The recorder monitored the output of the CO, CO_2, O_2, NOx and stack temperature on channels scaled specifically for each component.



1. Stack
2. Probe
3. Impinger with 100 mL DI water
4. Impinger with 100 mL DI water
5. Empty Impinger
6. Impinger With Silica Gel
7. Ice Bath
8. Filter for Pump
9. Metering Valve
10. Sealed Pump (Leak Free)
11. Vacuum Gage
12. Bypass Valve
13. Dry Gas Meter
14. Orifice Plate
15. Inclined Manometer
16. Temperature Indicator

CARB Method 4 Sampling train

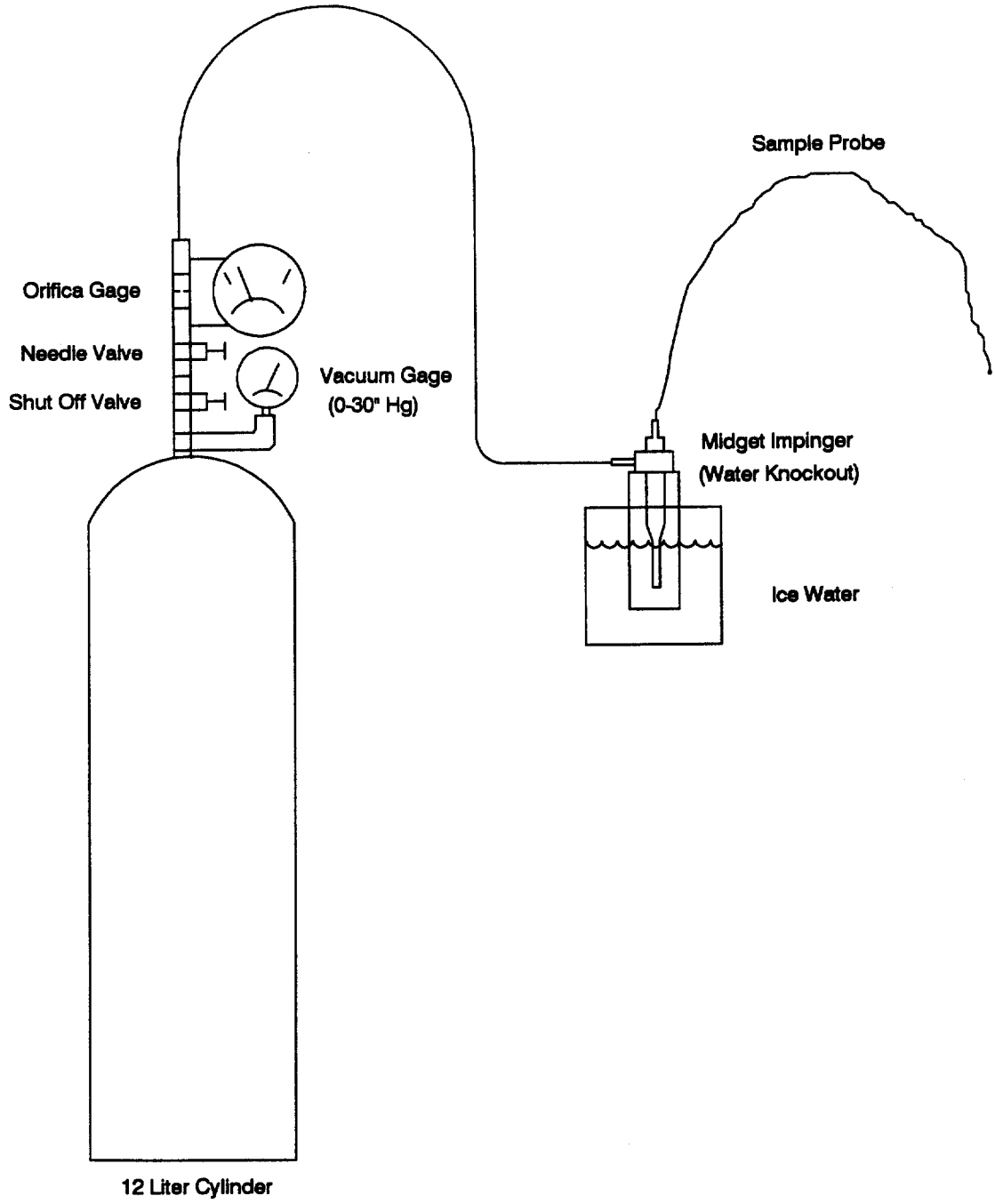
Figure 2



Continuous Monitoring System - CARB Method 100

Figure 3

PACIFIC ENVIRONMENTAL SERVICES, INC.



CARB Modified Method 25 Sample Train

Figure 4

Table No. 1 Continuous Monitor Specifications

NO_x Chemiluminescent Analyzer - Thermo-Electron Model 10A	
Response Time	1.5 sec - NO, 1.7 sec - NO_x
Zero Drift	± 0.5% after warm up (30 min)
Span Drift	± 1% of full scale
Linearity	± 1% of full scale
Accuracy	Derived from the calibration NO/NOx ± 1% gas was used.
Output	NO 0-5.0 Vdc (scaled 0-50 ppm) NOx 0-0.5 Vdc (scaled 0-50 ppm)
O2 Paramagnetic Analyzer - Beckman Model 755R	
Response Time	2 Sec
Zero Drift	± 1% of full scale
Span Drift	± 1% of full scale
Linearity	± 1% of full scale
Accuracy	Derived from the calibration O2 ± 1% gas was used.
Output	0-1.0 Vdc (scaled 0-25%)
CO/CO2 Infrared Analyzers - Beckman Model 880	
Response Time	2 sec.
Zero Drift	± 1% of full scale
Span Drift	± 1% of full scale
Linearity	± 1% of full scale
Accuracy	Derived from the calibration CO ± 1% gas was used.

Table 1 Continuous Monitor Specifications Cont'd

CO/CO2 Infrared Analyzers - Beckman Model 880 Cont'd

Output	0-1.0 Vdc (scaled 0-100 ppm CO) 0-1.0 Vdc (scaled 0-20 % CO_2)

ROG Heated Hydrocarbon Analyzer - J.U.M. Engineering Model VE-7 FID Analyzer

Response Time	0-95% in less than 1.2 Seconds
Zero Drift	± 1% of Full Scale in 24 Hrs
Span Drift	± 1% of Full scale in 24 Hrs
Linearity	± 1% of Full Scale
Accuracy	Derived from the Calibration Gas ± 1% gas was used
Sensitivity	1 ppb
Range Chanbe Consistency	Less than 1% Full Scale
Oxygen Synergism	Less than 2%
Output	0-10.0 Vdc Scaled:

R_1	0-10	ppm as C_1
R_2	0-100	ppm as C_1
R_3	0-1,000	ppm as C_1
R_4	0-10,000	ppm as C_1
R_5	0-100,000	ppm as C_1

Sample Flow Rate	3 Liters/Minute

Prior to the source tests, the suction side of the monitoring system was leak-checked at 20.5" Hg vacuum with no loss in 5 minutes, and the sampling bias of the system was determined by introducing CO, CO_2, O_2 and NOx span gas blends at the tip of the sampling line. A comparison of the analyzer responses was made between the span gas introduced at the sample line tip and the span gas introduced directly to the analyzers to ensure a differential of less than 5%. Since all analyzers were left on line during this procedure, a cross interference check was accomplished at the same time. The analyzers were spanned at a point between 20% and 90% of full scale before and after each test run NBS traceable calibration gases, and with a zero grade nitrogen. Table 2 lists all the gases used and Apendix C contains copies of the certifications.

Readings from the continuous monitors were permanently recorded on the multichannel recorder and a back up data logger (Rustrak Ranger II) was used. Average gas concentrations were obtained by numeric integration of the area under the curves on the stripchart using time intervals of two minutes. The average strip chart readings were then corrected using the averages of the initial and the final zero and span calibrations. The average zero and span calibrations were determined using the following equations:

$$Z_a = \frac{Z_f - Z_i}{2} + Z_i$$

$$S_a = \frac{S_f - S_i}{2} + S_i$$

Where:

Z_a, S_a = average zero or span strip chart divisions.

Z_f, S_f = final zero or span strip chart divisions.

Z_i, S_i = initial zero or span strip chart divisions.

Table No. 2 Calibration Gases

Gas Composition	Use:	Cylinder Serial No.	Certified Accuracy	Analysis Date
Nitrogen	Zero Gas	ALMO 27878	Zero Grade	N/A
11.0% O_2 50.0 ppm CO 11.0% CO_2 Bal N_2	Span Gas	IL 2572	± 1%	4-08-93
19.1% O_2 75.5 ppm CO 18.0% CO_2 Bal N_2	Span Gas	AAL 13428	± 1%	6-02-92 5-17-93*
22.5 ppm NO 22.8 ppm NOx Bal N_2	Span Gas	ALMO 27851	± 1% exp	3-19-93 3-94
40.1 ppm NO 40.7 ppm NOx Bal N_2	Span Gas	AAL 18076	± 1%	4-24-93
80.0 ppm CH_4 Bal Air	Span Gas	ALMO 14380	± 1%	2-14-92
7.99 ppm CH_4 Bal Air	Span Gas	AAL 7535	± 1%	9-11-92

* Recertified Gas

The following equation was then used to determine corrected gas concentrations:

$$C_{gas} = (C_m - Z_a) \times \frac{C_s}{S_a - Z_a}$$

Where:

C_m = measured gas concentration from strip chart.

C_{gas} = effluent gas concentration.

C_s = span concentration.

The following calculation was used to correct to 3% $_{O2}$:

$$C_{3\%O2} = \frac{20.95 - 3.0}{20.95 - C_{gasO2}}$$

Where:

$C_{3\%O2}$ = gas concentration corrected to 3% O_2.

C_{gasO2} = measured O_2 concentration.

TEST RESULTS

The 3 thirty minute tests were conducted with the boiler using natural gas and running at high fire.

The results of each test are presented with all relative data with the monitored and corrected concentrations. Table 3 details the results for natural gas.

Table No. 3 natural gas

FGR:	50% open	541 DSCFM (FGR)
FGR_{Return}:	16%	3,380 DSCFM (EXH.)
Condition:	95% of load capacity	19.8 MMBTU/HR
Fuel:	natural gas	18,334 cfh

RUN 1:

Pollutant	Units	Measured	Corrected (to 3% O_2)	Lbs/Hr	Allowed (lbs/hr)
NOx	ppm	27.5	25.9	0.66	0.92
CO	ppm	6.9	6.4	0.10	0.73
VOC	ppm	0.03	0.001	0.0002	0.06
O_2	%	1.8			

RUN 2:

Pollutant	Units	Measured	Corrected (to 3% O_2)	Lbs/Hr	Allowed (lbs/hr)
NOx	ppm	28.5	26.8	0.69	0.92
CO	ppm	11.8	11.1	0.17	0.73
VOC	ppm	0.4	0.4	0.0025	0.06
O_2	%	1.8			

RUN 3:

pollutant	Units	Measured	Corrected (to 3% O_2)	Lbs/Hr	Allowed (lbs/hr)
NOx	ppm	28.9	27.2	0.70	0.92
CO	ppm	4.1	3.9	0.06	0.73
VOC	ppm	1.5	1.4	0.0095	0.06
O_2	%	1.9			

Averages

pollutant	Units	Lbs/Hr	Allowed (lbs/hr)
NOx	ppm	0.68	0.92
CO	ppm	0.11	0.73
VOC	ppm	0.0041	0.06
O_2	%	1.9	

QUALITY ASSURANCE/QUALITY CONTROL

Source tests are performed to determine the types and amounts of pollutants emitted by a source. Information from this source test program may be used for obtaining permits, evaluating control equipment performance, updating emission inventories, and determining compliance with present and future emission regulations. For these purposes, reliable data are required. PES provides this reliability by using the following work practices:

Sample Handling and Conditioning

Quality control procedures used during this test included the use of non-reactive 316 stainless steel or teflon tubing and fittings throughout the system. Pre-test and post-test leak checks were made pulling a vacuum of 19.5" Hg at the beginning and 20" at the end of the testing day. Bias checks were made and found to be within tolerance. Zero and span drift errors were minimized by using average zero and span values to correct the data. A refrigeration unit was used with the pump down stream of the conditioned sample gas. All instrumentation was continuously monitored and checked to insure data reliability during all sample runs.

Calibration Gases

All calibration gases used were $\pm$ 1% accuracy and provided by Scott Specialty Gases in San Bernardino, Ca. All instruments were run for 4 hours prior to testing to insure proper operating order. Certifications for the gases are located in Appendix C.

Use Of Standard Test Procedures

CARB Methods 1 and 2 were utilized to determine the flow rate and CARB Method 100 was used to determine the NO_x, CO, O_2, and VOC emission rates. CARB Modified Method 25 was used for methane determination and subtracted from the THC concentration measured. And CARB Method 4 was used to determine moisture.

A procedure must be thoroughly studied under various conditions in order to be designated as a CARB Method. Results of many executions of the procedure are compared to demonstrate accuracy and repeatability before adoption of the procedure as a source testing method.

Use Of Trained Test Personnel

Because of the complexity of typical source testing methods, testers should be trained and experienced with the test procedures in order to assure reliable results. PES personnel have had professional training and routinely conduct source tests.

Knowledge Of Source's Operation

The source testing team should have sufficient knowledge of the process to be tested in order to properly document the process parameters during the tests. Without documentation of the process parameters used, results are much less meaningful. PES has experience with boiler operations and is familiar with the processes.

Equipment Maintenance and Calibration

Use of properly maintained and calibrated test equipment is essential for minimizing systematic errors in results. All sampling devices are constructed, maintained, and calibrated as suggested in the CARB Source Testing Manual.

Thorough Record Keeping

All data relating to the operation of the sampling train was immediately recorded to ensure that it was not lost or misinterpreted. Any unusual occurrences in the process operation, unusual test instrument readings, or any other items that could affect the test results were also noted.

Use Of Standardized Data Reduction Techniques

Data reduction was accomplished by the use of step by step calculation sheets which are included in Appendix B.

Appendix A

San Joaquin Valley
Unified Air Pollution Control District

AUTHORITY TO CONSTRUCT

PERMIT NO: C-233-1-0 **ISSUANCE DATE:** 10/29/92

LEGAL OWNER OR OPERATOR: CANDLEWICK YARNS
MAILING ADDRESS: P.O. BOX 70
LEMOORE, CA 93245

Part # 233-205X

LOCATION: 711 CINNAMON DRIVE, LEMOORE

EQUIPMENT DESCRIPTION:
JOHNSON MODEL PTFA-500 BOILER WITH ONE INDUSTRIAL COMBUSTION 21MMBTU MODEL LDNG-252P LOW NO
NATURAL GAS FIRED BURNER WITH FLUE GAS RECIRCULATION.

CONDITIONS

1 - No air contaminant shall be discharged into the atmosphere for a period or periods aggregating more than 3 minutes in any one hour which is as dark as or darker than Ringelmann 1 or equivalent 20% opacity.

2 - The boiler shall be fired on natural gas only.

3 - Natural Gas consumption shall not exceed 504,000 SCF per day.

4 - The flue gas recirculation system shall be operated in accordance with the manufacturer's directions whenever the boiler is operating.

5 The concentration of nitrogen oxides in the exhaust shall not exceed 30 ppmdv corrected to 3% oxygen averaged over any one hour period.

(CONDITIONS CONTINUE ON THE NEXT PAGE)

This is NOT a PERMIT TO OPERATE. Approval or denial of a PERMIT TO OPERATE will be made after an inspection to verify that the equipment has been constructed in accordance with the approved plans, specifications and conditions of this Authority to Construct, and to determine if the equipment can be operated in compliance with all Rules and Regulations of the San Joaquin Valley Unified Air Pollution Control District. PLEASE NOTIFY THE DISTRICT COMPLIANCE DIVISION at (209) 497-1040 WHEN CONSTRUCTION OF THE EQUIPMENT IS COMPLETED. Unless construction has commenced pursuant to Rule 2050, this Authority to Construct shall expire and application shall be cancelled two years from the date of issuance. The applicant is responsible for complying for all laws, ordinances and regulations of any other governmental agencies which may pertain to the above equipment.

DAVID L. CROW, EXECUTIVE DIRECTOR/APCO

DAVID WARDSEN, DIRECTOR OF PERMIT SERVICES

6 - A source test shall be performed to document actual emissions reductions and demonstrate compliance within 90 days of the startup of the boiler. 1-25-93 START-UP DATE

7 - The source test shall be performed by a qualified contractor according to a test plan submitted to the District for approval at least 30 days prior to the test date.

8 - Records of the fuel usage for the boiler shall be maintained for a period of at least two years and made available to the District upon request.

9 - Records of the monthly fuel usage shall be submitted to the District by March 1, of the following year. FEBRUARY 1993 To FEBRUARY 1994

10 - The emissions of Nitrogen Oxides from the boiler shall not exceed 0.92 lb/Hr or 22.2 lb/day.

11 - The emissons of PM10 from the boiler shall not exceed 0.03 lb/Hr. or 0.8 lb/day.

12 - The emissions of VOC from this boiler shall not exceed 0.06 lb/Hr or 1.4 lb/day.

13 - The emissions of carbon monoxide from the boiler shall not exceed 0.73 lb/Hr. or 17.6 lb/day.

} SOURCE TEST

14 - All air pollution control equipment shall be maintained in good operating condition.

15 - Permit No. 7954D and 7954E for the two boilers being replaced shall be surrendered prior to startup of the boiler.

State of California
Air Resources Board
Approved Independent Contractor

Pacific Environmental Services, Inc.

This is to certify that the [illegible] has been approved by the Air Resources Board to conduct compliance testing, pursuant to Section 91207, Title 17, California Code of Regulations, until June 30, 1994, for the test methods listed below:

ARB Source Test Methods:
10, [illegible] NMC, OR THC

James J. Morgester, Chief
Compliance Division

H. Roye Jackson, Manager
Field Evaluation Section

90 56105

Appendix B

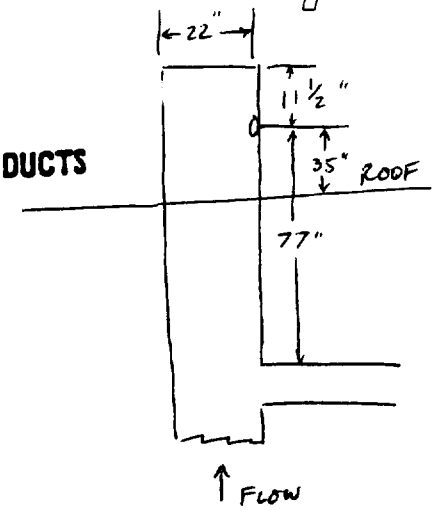
EMISSION TEST CALCULATIONS

Definiton of Symbols:

A	: cross-sectional area of stack, ft^2
A_n	: cross-sectional area of nozzle, ft^2
B_{W_s}	: water vapor in gas stream, proportional by volume
C_p	: pitot tube coeficient
I	: percent of isokinetic sampling
M_d	: dry molecular weight, lb/lb-mole
M_s	: molecular weight of stack gas, lb/lb-mole
P_{bar}	: barometric pressure at the sampling site, in. of Hg
P_s	: stack gas pressure, in. of Hg
Q_s	: stack volumetric flow rate , actual condition acfm
Q_{std}	: stack volumetric flow rate, standard conditions dscfm
T_m	: average dry gas meter temperature , R = 460 + °F
T_s	: average stack gas temperature, R = 460 + °F
V_{lc}	: total volume of liquid collected in impingers & silica gel, in ml
V_m	: Volume of gas sample as measured by dry gas meter, dscf
$V_{m_{std}}$	: Vm corrected to standard conditions, dscf
$V_{W_{std}}$	: volume of water vapor in gas sample corrected to standard conditions, scf
V_s	: stack gas velocity, ft/sec
γ	: dry gas meter calibration factor
ΔH	: average pressure differential across the orifice meter, in. of H_2O
θ	: total sampling time, in minutes
13.6	: specific gravity of mercury

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT CANDLEWICK YARNS
DATE 4-21-93
SAMPLING LOCATION BOILER EXHAUST
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE A) 27.5"
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE B) 5.5"
STACK I.D., (DISTANCE A - DISTANCE B) 22"
NEAREST UPSTREAM DISTURBANCE 0.5 Ø
NEAREST DOWNSTREAM DISTURBANCE 3.5 Ø
CALCULATOR NGUYEN

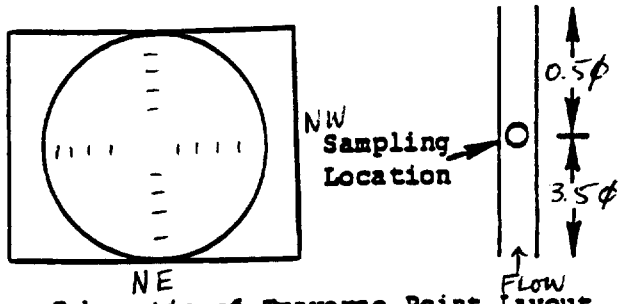


SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	0.032	22"	3/4	5.5"	6 1/4"
2	0.105	22"	2 1/4	5.5"	7 3/4"
3	0.194	22"	4 1/4	5.5"	9 3/4"
4	0.323	22"	7 1/8	5.5"	12 5/8"
5	0.677	22"	14 7/8	5.5"	20 3/8"
6	0.806	22"	17 3/4	5.5"	23 1/4"
7	0.895	22"	19 3/4	5.5"	25 1/4"
8	0.968	22"	21 1/4	5.5"	26 3/4"

PRELIMINARY VELOCITY TRAVERSE

Plant: CANDLEWICK YARNS
Date: 4-21-93
Location: BOILER EXHAUST
Stack I.D.: 22"
Barometric Pressure, in. Hg: 29.95
Stack Gauge Pressure, in. H_2O: _____
Operators: NGUYEN / HERNANDEZ
Pitot Tube I.D. Number: 1605-48
Temperature Readout I.D.: NUTECH 2A
Pitot Tube Leak Check: OK



Schematic of Traverse Point Layout

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
NE 1	0.35	286	
2	0.32	320	
3	0.28	341	
4	0.27	359	
5	0.28	361	
6	0.30	363	
7	0.31	364	
8	0.30	366	
			$\overline{\Delta P}$ =
			$\overline{T_s}$ =
Average			

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
1	0.37	331	
2	0.28	337	
3	0.25	346	
4	0.25	355	
5	0.27	358	
6	0.30	361	
7	0.31	362	
8	0.32	362	
0.30			
348 °F			
Average			

Plant CANDLEWICK YARNS
Date 4-21-93
Sampling Location BOILER EXHAUST
Sample Type SCAQMD 4.1
Run Number ONE - HIGH FIRE
Operator NGUYEN
Ambient Temperature 82 °F
Barometric Pressure 29.95 in Hg
Static Pressure (P_s) —
Filter Number(s) —
Pretest Leak Rate = 0.002 cfm @ 12.0 in. Hg
Pretest Pitot Leak Check OK
Pretest Orsat Leak Check —
Read and Record all Data Every 10 Minutes

FIELD DATA

Schematic of Traverse Point Layout

Probe Length and Type 3' TEFLON LINE W/SS PROBE
Pitot Tube I.D. No. 160 S-48
Nozzle I.D. No. & DIAMETER —
Assumed Moisture, % —

Meter Box Number 2A
Meter $\Delta H_@$ 1.984
C Factor —
Meter Gamma 0.988
Heater Box Setting —
Reference Δp —
Post Test Leak Rate = 0.005 cfm @ 12.0 in. Hg
Post Test Pitot Leak Check —
Post Test Orsat Leak Check —

Impinger Box No. 1B; Blank Box No: —

Traverse Point Number	Sampling Time, (min) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F
	0 / 13:12	144.120	—	1.5	1.5	377	82	81	4	—	65
	10 / 13:22	150.7	—	1.5	1.5	375	86	82	4	—	59
	20 / 13:32	157.2	—	1.5	1.5	370	91	84	4	—	64
	30 / 13:42	164.2	—	1.5	1.5	368	94	86	4	—	65
	40 / 13:52	170.4	—	1.5	1.5	365	97	89	4	—	58
	50 / 14:02	177.0	—	1.5	1.5	368	98	90	4	—	57
	60 / 14:12	183.521	—	—	—	—	—	—	—	—	—
	/										
	/										
	θ = 60 /	V_m = 39.401		ΔH =	1.5	T_s = 371 °F 831 R	T_m =	88 °F 548 R			≤ 68 °F
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PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: CANDLEWICK YARNS

Date: 4-21-93

Sampling Location: BOILER EXHAUST

Sample Type: SCAQMD 4.1

Run Number: ONE - HIGH FIRE

Sample Box Number: 1B

Clean-up Man: NGUYEN

Job Number:

Comments:

FRONT HALF

Filter Number:

Description of Filter:

MOISTURE

	#1		#2		#3	
Impingers						
Final Volume:	728.3	ml	585.8	ml	496.6	ml
Initial Volume:	580.2	ml	569.6	ml	494.5	ml
Net Volume:	148.1	ml	16.2	ml	2.1	ml
Total H_2O:						
	#4					
Silica Gel						
Final Volume:	757.4	g		g		g
Initial Volume	746.5	g		g		g
Net Volume	10.9	g		g		g
Total Moisture:					168.2 ml	

Description of Impinger Catch: CLEAR

Plant: CANDLEWICK YARNS

Date: 4-21-93

Source/Sample Number: ONE - HIGH FIRE

1. $Vm(std) = (17.64)(Vm)(Y)\left[\frac{P_{bar} + (\Delta H/13.6)}{Tm}\right]$

$Vm(std) = (17.64)(39.40)(0.988)\left[\frac{(29.95) + (1.5/13.6)}{(548)}\right]$

$Vm(std) =$ 37.67 dscf.

2. Volume water vapor collected (standard conditions).

$V(lo) =$ 188.2 condensate from impingers and selica gel.

$Vw(std) = (0.04707)\ V(lo) = (0.04707)(188.2)$

$Vw(std) =$ 8.86 scf.

3. Percent moisture, by volume.

$Bw_s = \frac{Vw(std)}{Vw(std) + Vm(std)} = \frac{(8.86)}{(8.86) + (37.67)} =$ 0.190

$Bw_s =$ 19.0% .

4. Molecular weight, stack gas.

Dry molecular weight.

$Md = 0.440(\%\ CO_2) + 0.320(\%\ O_2) + 0.280(\%\ N_2 + \%\ CO)$

$Md = 0.440\ (9.5) + 0.320(1.9) + 0.280(79)$

$Md =$ 26.91 lb/lb-mole.

$Ms = Md + Bw_s\ (18 - Md) = (26.91) + (0.190)(18 - 26.91)$

$Ms =$ 25.22 lb/lb-mole.

Plant: CANDLEWICK YARNS

Date: 4-21-93

Source/Sample Number: ONE - HIGH FIRE

5. Stack gas velocity average.

$$Vs(avg) = (85.49)(Cp)(\sqrt{\Delta P})\left[avg\sqrt{\frac{(Ts)}{(Ps)(Ms)}}\right]$$

$$Vs(avg) = (85.49)(0.84)(0.55)\left[\sqrt{\frac{(831)}{(29.95)(25.22)}}\right]$$

Vs(avg) = 41.43 ft/sec.

6. Stack volumetric flow rate, actual conditions (stack temperature and pressure).

Qs = (60)(Vs)(A) = (60)(41.43)(2.64)

Qs = 6,563 acfm.

7. Stack volumetric flow rate, standard conditions (68 degrees F, 29.92 Hg).

$$Q(std) = (17.64)(Qs)(1-Bw_s)\left[\frac{(Ps)}{(Ts)}\right]$$

$$Q(std) = (17.64)(6,563)(1 - 0.19)\left[\frac{(29.95)}{(831)}\right]$$

Q(std) = 3,380 dscfm.

8. Isokinetic variation.

$$\%I = (K)\left[\frac{(Ts)(Vm(std))}{(Ps)(Vs)(An)(\theta)(1 - Bw_s)}\right]$$

$$\%I = (0.0945)\left[\frac{(\quad)(\quad)}{(\quad)(\quad)(\quad)(\quad)(1 - \quad)}\right]$$

%I = N/A %

FGR Flow data

Operators: NGUYEN / HERNANDEZ Date: 4-21-93

Test Site: CANDLEWICK YARNS Client: CENTRAL BOILER

Pitot readings using CARB Method 1 (modified):

Run 1: Load Tested: HIGH FIRE Fuel: NAT. GAS $\%FGR_{open}$ 50

1.	0.06	Temp. 346	5.	0.17	Temp. 352
2.	0.05	Temp. 349	6.	0.20	Temp. 355
3.	0.07	Temp. 357	7.	0.21	Temp. 356
4.	0.12	Temp. 358	8.	0.22	Temp. 356

A_{SqRt} 0.358 DSCFM 540.7 $\%FGR_{Return}$ 16.0 T_{s+460} 814 R

Run 2: Load Tested: _____ Fuel: _____ $\%FGR_{open}$ _____

1.		Temp.	5.		Temp.
2.		Temp.	6.		Temp.
3.		Temp.	7.		Temp.
4.		Temp.	8.		Temp.

A_{SqRt} _____ DSCFM _____ $\%FGR_{Return}$ ____ T_{s+460} _____

Run 3: Load Tested: _____ Fuel: _____ $\%FGR_{open}$ _____

1.		Temp.	5.		Temp.
2.		Temp.	6.		Temp.
3.		Temp.	7.		Temp.
4.		Temp.	8.		Temp.

A_{SqRt} _____ DSCFM _____ $\%FGR_{Return}$ ____ T_{s+460} _____

FGR Pipe (I.D.) = 10" / 2 = radius/12 = rad'$^{(2)}$ X Pi = Area 0.545 ft^2

Diameters Upstream (A) 19" 1.9Ø Diameters Downstream (B) 28" 2.8Ø

Pitot Tube type and S/N STANDARD Temperature Readout NUTECH 2A

Where:

A_{SqRt} = Average square root of the "delta p"
FGR_{Return} = percentage of flue gas returned to burner.
$\%FGR_{Open}$ = FGR valve opening.
T_{s+460} = Average Stack Temperature in °F —> R
DSCFM = Volume of gas measured in FGR line corrected to dry gas standards.

Plant: CANDLEWICK YARNS

Date: 4-21-93

Source/Sample Number: ONE - HIGH FIRE (FGR)

5. Stack gas velocity average.

$$Vs(avg) = (85.49)(Cp)(\sqrt{\Delta P})\left[avg\sqrt{\frac{(Ts)}{(Ps)(Ms)}}\right]$$

$$Vs(avg) = (85.49)(0.99)(0.358)\left[\sqrt{\frac{(814)}{(29.95)(25.22)}}\right]$$

Vs(avg) = 31.5 ft/sec.

6. Stack volumetric flow rate, actual conditions (stack temperature and pressure).

$$Qs = (60)(Vs)(A) = (60)(31.5)(0.545)$$

Qs = 1028.5 acfm.

7. Stack volumetric flow rate, standard conditions (68 degrees F, 29.92 Hg).

$$Q(std) = (17.64)(Qs)(1-Bw_s)\left[\frac{(Ps)}{(Ts)}\right]$$

$$Q(std) = (17.64)(1028.5)(1 - 0.19)\left[\frac{(29.95)}{(814)}\right]$$

Q(std) = 540.7 dscfm.

8. Isokinetic variation.

$\frac{541}{3380} \times 100 =$

$$\%I = (K)\left[\frac{(Ts)(Vm(std))}{(Ps)(Vs)(An)(\theta)(1 - Bw_s)}\right]$$

$$\%I = (0.0945)\left[\frac{(\quad)(\quad)}{(\quad)(\quad)(\quad)(\quad)(1 - \quad)}\right]$$

%I = N/A %

HYDROCARBON SAMPLING FIELD DATA

Project No. _____

CLIENT: CANDLEWICK YARNS / CENTRAL BOILER **Date:** 4-21-93

Sampling Location: BOILER EXHAUST

Tank #		101		102		105	
Flowmeter #		MR19		GF79		MR19	
Time (min)		Sample A		Sample B		Sample C	
	24 HR CLOCK	" Hg	"H_2O	24 HR CLOCK	" Hg	"H_2O	24 HR CLOCK	" Hg	"H_2O
0	12:56	30.0	1.0	13:30	29.7	1.0	14:21	30.0	1.0
5	13:01	27.6	1.0	13:35	27.7	1.0	14:26	27.5	1.0
10	13:06	25.1	1.0	13:40	25.7	1.0	14:31	24.9	1.0
15	13:11	21.9	1.0	13:45	23.7	1.0	14:36	22.0	1.0
20	13:16	18.8	1.0	13:50	21.5	1.0	14:41	19.0	1.0
25	13:21	15.8	1.0	13:55	19.4	1.0	14:46	15.9	1.0
30	13:26	12.7	1.0	14:00	16.5	1.0	14:51	12.7	1.0
		TANK 101 HAS A STICKY VACUUM GAGE							
LEAK CHECK									
0	13:28	12.7	0.0	14:10	16.4	0.0	14:53	12.7	0.0
10	13:38	12.7	0.0	14:20	16.4	0.0	15:03	12.7	0.0

Pre Leak-check OK Post Leak-check _____

METHANE ANALYSES

Project No.: 4778.002

Client: Central Boiler / Candlewick Yarns

Cylinder#	Sample Id.	Total Area Of Sample	C_f	CH_4 (ppm)	$R_{1(v)}$	$P_{1(N2)}$	$D_{1(f)}$	$R_{2(v)}$	$P_{2(N2)}$	$D_{2(f)}$	CH_4(ppm) corrected
101	A	0	0.00109	0	-9.35	1.95	1.56	-	-	-	0
102	B	179	0.00109	0.195	-13.80	0.65	1.92	0.55	5.30	1.16	0.4
105	C	0	0.00109	0	-10.90	0.40	1.61	0.30	5.00	1.16	0

$$C_f = \frac{\text{concentration of calibration gas (ppm)}}{\text{average total area of calibration gas}}$$

$$D_{n(f)} = \frac{P_{bar} + P_{n(N2)}}{P_{bar} - R_{n(v)}}$$

CH_4 (ppm) = C_f x average total area of sample

Concentration of CH_4 corrected (ppm) = CH_4 x $D_{n(f)}$

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page of
4778.002	
Client: CENTRAL BOILER / CANDLEWICK YARNS	
Location: BOILER EXHAUST	

Prepared By	Date	Checked By	Date	Sheet Title
RTN	4-26-93			

4-26-93

BAROMETRIC PRESSURE: 29.46 in. Hg

TEMPERATURE: 74 °F

5-7-93

BAROMETRIC PRESSURE: 29.51 in

TEMPERATURE: 72 °F

Cylinder #	Sample Id.	$R_{1(V)}$ (in. Hg)	$P_{1(N_2)}$ (in. Hg)	$R_{2(V)}$ (in. Hg)	$P_{2(N_2)}$ (in. Hg)
101	A	−9.35	1.95		
102	B	−13.80	0.65	0.55	5.30
105	C	−10.90	0.40	0.30	5.00

CHANNEL A INJECT 05/10/93 12:16:25

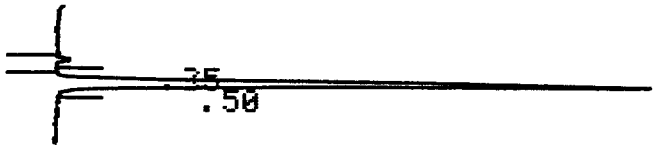
05/10/93 12:16:25 CH= "A" PS= 1.

FILE 1. METHOD 0. RUN 16 INDEX 16

PEAK#	AREA%	RT	AREA	BC
1	1.258	0.35	92	01
2	98.742	0.5	7221	01
TOTAL	100.		7313	

Calibrated w/ 8 ppm CH4

CHANNEL A INJECT 05/10/93 12:18:44



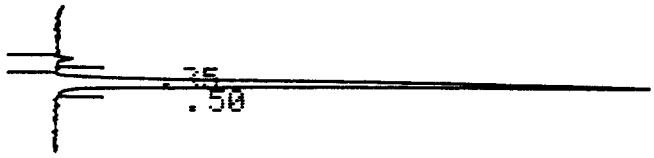
05/10/93 12:18:44 CH= "A" PS= 1.

FILE 1. METHOD 0. RUN 17 INDEX 17

PEAK#	AREA%	RT	AREA	BC
1	1.291	0.35	95	01
2	98.709	0.5	7261	01
TOTAL	100.		7356	

Calibrated w/ 8 ppm CH4

CHANNEL A INJECT 05/10/93 12:21:28



05/10/93 12:21:28 CH= "A" PS= 1.

FILE 1. METHOD 0. RUN 18 INDEX 18

PEAK#	AREA%	RT	AREA	BC
1	1.05	0.35	77	01
2	98.95	0.5	7259	01
TOTAL	100.		7336	

Calibrated w/ 8 ppm CH4

CHANNEL A INJECT 05/10/93 13:40:14

#101

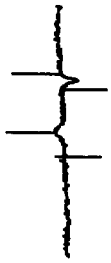
NO DATA, CHANNEL A

CHANNEL A INJECT 05/10/93 13:43:17

#101

NO DATA, CHANNEL A

CHANNEL A INJECT 05/10/93 12:58:02



#102

05/10/93 12:58:02 CH= "A" PS= 1.

FILE 1. METHOD 0. RUN 23 INDEX 23

PEAK#	AREA%	RT	AREA BC
1	100.	0.49	185 01
TOTAL	100.		185

CHANNEL A INJECT 05/10/93 13:01:43

#102

05/10/93 13:01:43 CH= "A" PS= 1.

FILE 1. METHOD 0. RUN 24 INDEX 24

PEAK#	AREA%	RT	AREA BC
1	100.	0.49	173 01
TOTAL	100.		173

EL A INJECT 05/10/93 13:47:13

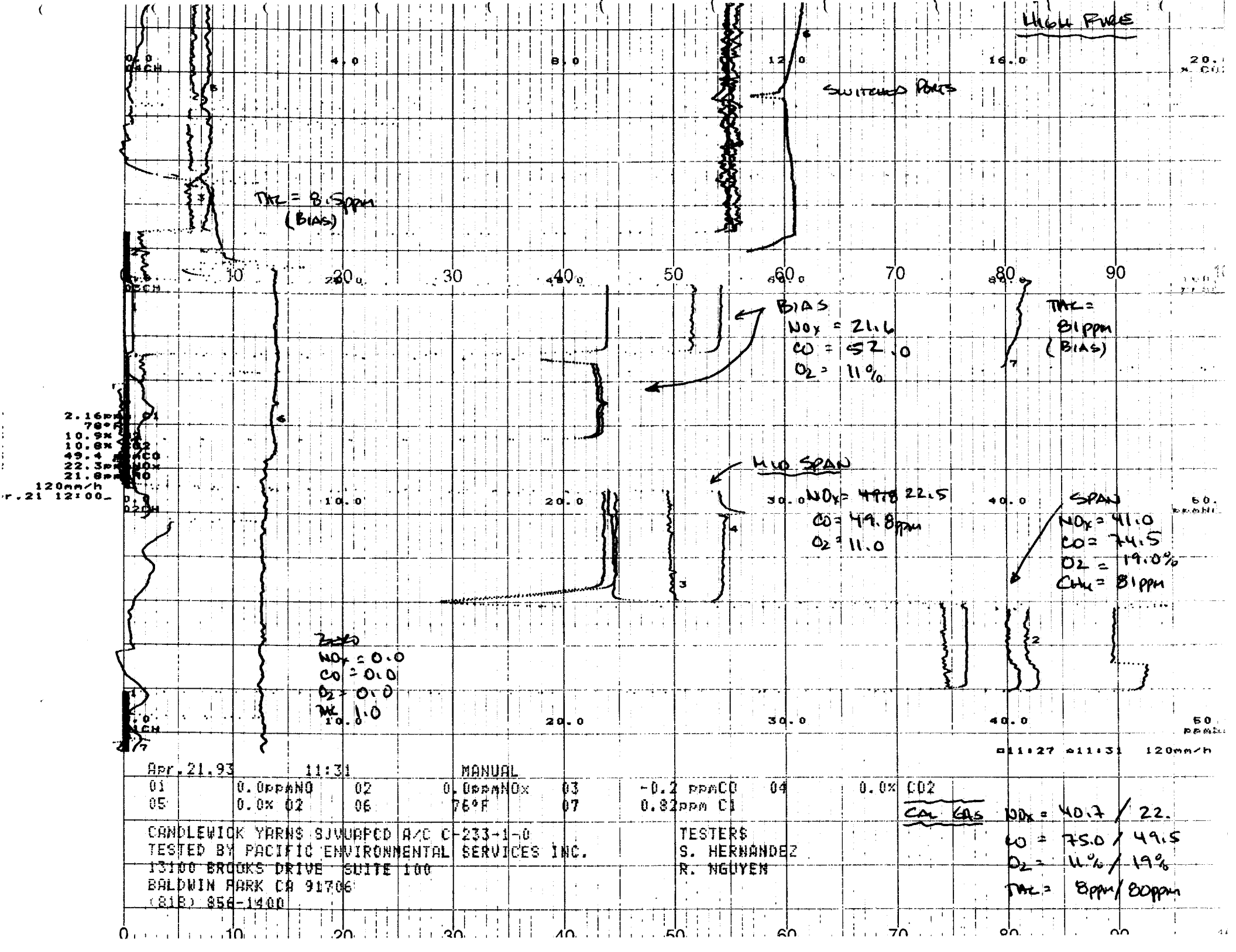
#105

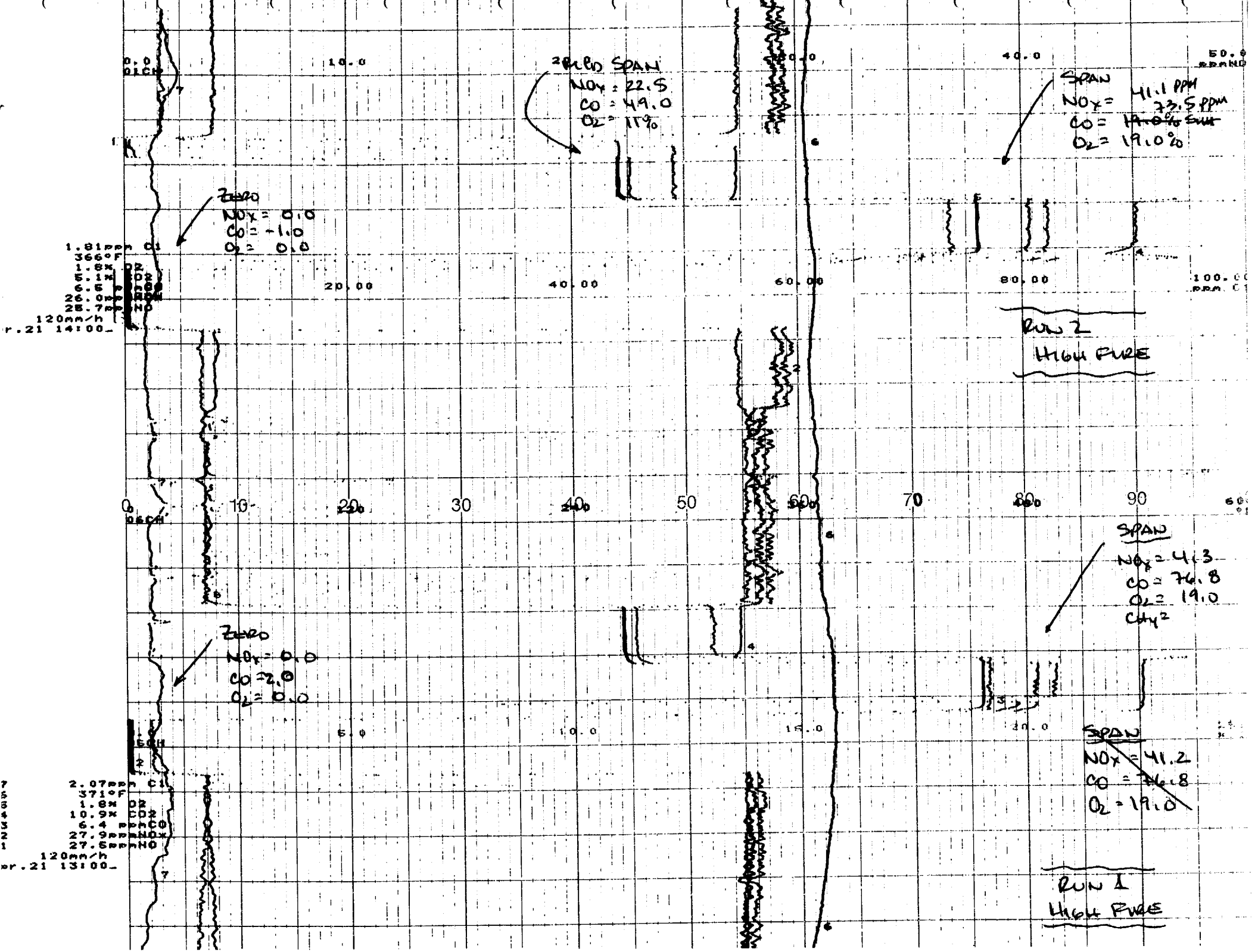
NO DATA, CHANNEL A

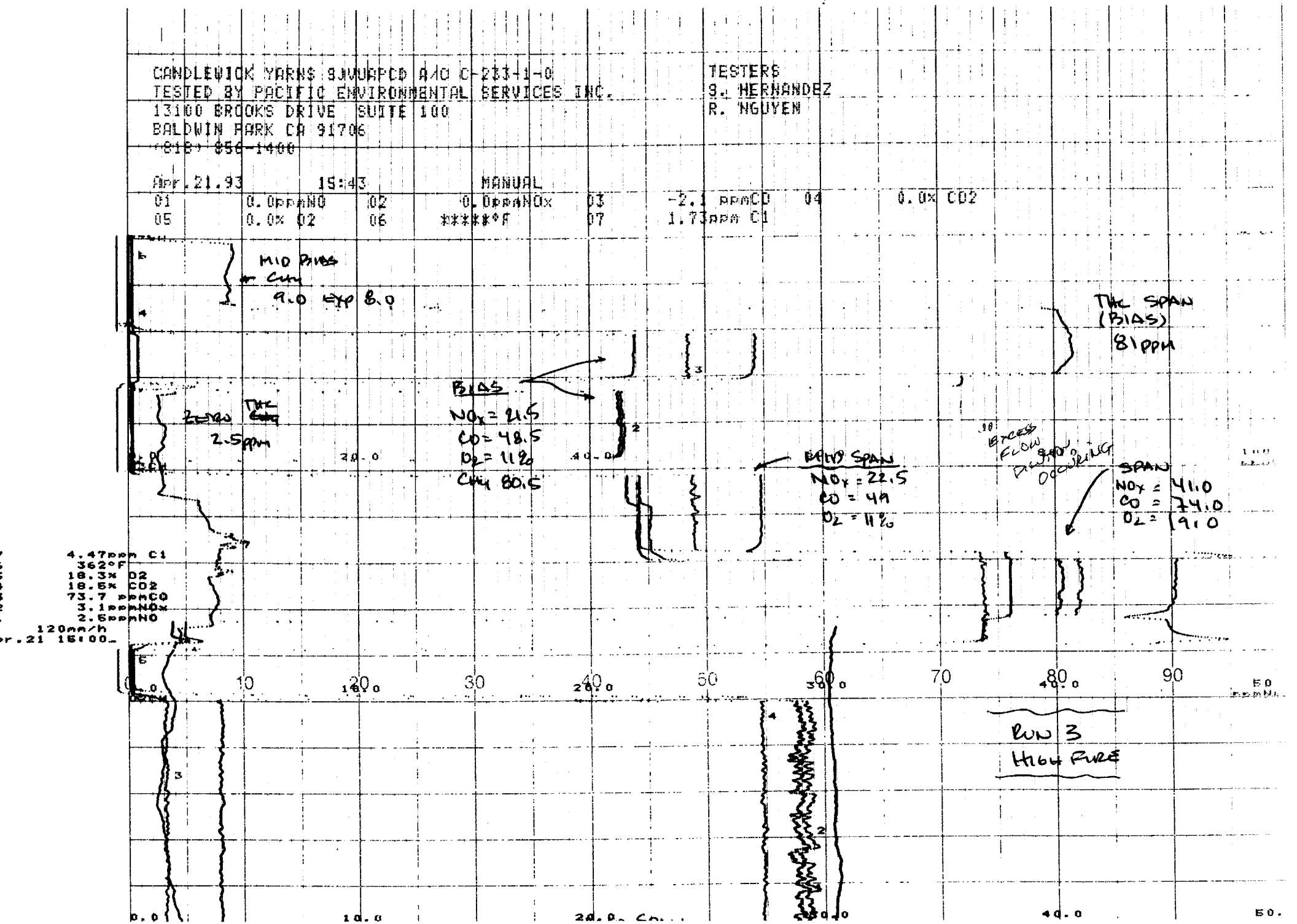
CHANNEL A INJECT 05/10/93 13:50:15

#105

NO DATA, CHANNEL A


HIGH FLOW
SWITCHED PORTS
THC = 8.5ppm
(BIAS)
BIAS
NOx = 21.6
CO = 52.0
O2 = 11%
THC = 81ppm
(BIAS)
HI SPAN
NOx = 41.8 22.5
CO = 49.8ppm
O2 = 11.0
SPAN
NOx = 41.0
CO = 74.5
O2 = 19.0%
CH4 = 81ppm
ZERO
NOx = 0.0
CO = 0.0
O2 = 0.0
THC 1.0
Apr.21.93 11:31 MANUAL
01 0.0ppmNO 02 0.0ppmNOx 03 -0.2 ppmCO 04 0.0% CO2
05 0.0% O2 06 76°F 07 0.82ppm C1
CANDLEWICK YARNS SJVUAPCD A/C C-233-1-0
TESTED BY PACIFIC ENVIRONMENTAL SERVICES INC.
13100 BROOKS DRIVE SUITE 100
BALDWIN PARK CA 91706
(818) 856-1400
TESTERS
S. HERNANDEZ
R. NGUYEN
Cal Gas NOx = 40.7 / 22.
CO = 75.0 / 49.5
O2 = 11% / 19%
THC = 8ppm / 80ppm


ZERO
NOx = 0.0
CO = -1.0
O2 = 0.0
SPAN
NOx = 22.5
CO = 49.0
O2 = 11%
SPAN
NOx = 41.1 PPM
73.5 PPM
CO = 19.0%
O2 = 19.0%
RUN 2
HIGH PURE
ZERO
NOx = 0.0
CO = 2.0
O2 = 0.0
SPAN
NOx = 41.3
CO = 76.8
O2 = 19.0
CO2
SPAN
NOx = 41.2
CO = 76.8
O2 = 19.0
RUN 1
HIGH PURE


CANDLEWICK YARNS SJVUAPCD A/O C-233-1-0
TESTED BY PACIFIC ENVIRONMENTAL SERVICES INC.
13100 BROOKS DRIVE SUITE 100
BALDWIN PARK CA 91706
(818) 856-1400
TESTERS
S. HERNANDEZ
R. NGUYEN
Apr.21.93 15:43 MANUAL
01 0.0ppmNO 02 0.0ppmNOx 03 -2.1 ppmCO 04 0.0% CO2
05 0.0% O2 06 *****°F 07 1.7ppm C1
MID BIAS
9.0 exp 8.0
THC SPAN
(BIAS)
81 PPM
ZERO THC
2.5ppm
BIAS
NOx = 21.5
CO = 48.5
O2 = 11%
CH4 80.5
HIGH SPAN
NOx = 22.5
CO = 49
O2 = 11%
EXCESS FLOW
SPAN
NOx = 41.0
CO = 74.0
O2 = 9.0
4.47ppm C1
362°F
18.3% O2
18.5% CO2
73.7 ppmCO
3.1ppmNOx
2.5ppmNO
120mm/h
Apr.21 15:00
RUN 3
HIGH FIRE

Location: CANDLEWICK YARNS Client: CENTRAL BOILER

Prepared By: SMM Checked By: — Date: 4-21-93

Run # 1 Load Tested: 100% Fuel: NAT GAS

One Minute Integration in % of Chart

	Time	NO_x	CO	THC	O_2	
1	12 :40	27.5	5.8	-0.1	1.9	361
2	12 :41	27.8	6.1	0.16	1.9	361
3	12 :42	27.6	6.3	0.65	1.9	360
4	12 :43	27.7	6.1	0.47	1.9	360
5	12 :44	27.7	5.8	0.54	1.9	360
6	12 :45	27.8	7.1	0.50	1.8	359
7	12 :46	27.4	6.2	0.15	1.8	356
8	12 :47	27.6	6.1	0.48	1.8	359
9	12 :48	27.7	6.0	0.61	1.9	361
10	12 :49	27.6	6.0	0.78	1.9	363
11	12 :50	27.5	6.2	0.90	1.8	363
12	12 :51	27.6	6.1	1.28	1.8	361
13	12 :52	27.7	6.2	1.51	1.8	365
14	12 :53	27.9	6.1	1.55	1.9	366
15	12 :54	27.6	6.1	1.47	1.9	367

OBSERVED JUMPS IN CO WHEN STACK VIBRATES. (OSCILLATION IN PGR)

Multiplication Factors:

NO_x 0 - 100% Full Scale = 0 - 50 ppm NO_x % Chart X 0.5

CO 0 - 100% Full Scale = 0 - 100 ppm CO % Chart X 1.0

O_2 0 - 100% Full Scale = 0 - 25% O_2 % Chart X 0.25

THC 0 - 100% Full Scale = 0 - 100 C_1 % Chart X 1.0

Location: CANDENCO YARNS Client: CANTRAL BOILER

Prepared By: SMH Checked By: — Date: 4-21-93

Run # 1 Load Tested: 100% Fuel: NAT GAS

One Minute Integration in % of Chart

	Time	NO_x	CO	THC	O_2	
1	12:55	27.7	6.2	1.57	1.8	368
2	12:56	28.0	6.1	2.29	1.8	369
3	12:57	27.8	6.5	2.3	1.8	369
4	12:58	27.8	6.6	2.26	1.8	370
5	12:59	27.9	6.4	2.14	1.8	371
6	13:00	27.9	6.4	2.12	1.8	371
7	13:01	28.2	6.3	2.92	1.8	372
8	13:02	28.0	6.8	3.34	1.7	373
9	13:03	28.0	6.6	3.68	1.7	373
10	13:04	28.0	6.7	3.62	1.7	374
11	13:05	27.9	6.7	3.46	1.8	374
12	13:06	28.0	6.8	3.43	1.7	375
13	13:07	28.2	6.8	3.77	1.7	375
14	13:08	27.9	6.7	3.72	1.8	374
15	13:09	28.1	29.0	3.25	1.7	375
		27.8 ppm NO_x	7.1 ppm CO	1.83 ppm C_1	1.8% O_2	

Multiplication Factors:

NO_x 0 - 100% Full Scale = 0 - 50 ppm NO_x % Chart X 0.5

CO 0 - 100% Full Scale = 0 - 100 ppm CO % Chart X 1.0

O_2 0 - 100% Full Scale = 0 - 25% O_2 % Chart X 0.25

THC 0 - 100% Full Scale = 0 - 100 ppm C_1 % Chart X 1.0

Location: Candelaria Yarns Client: Central Boiler

Prepared By: [illegible] Checked By: — Date: _____

Run # 2 Load Tested: 100% Fuel: Nat Gas

One Minute Integration ~~in % of Chart~~ Conc.

	Time	NO_x	CO	THC	O_2	
1	13 : 30	28.5	8.1	2.2	1.7	371
2	13 : 31	28.6	10.7	2.3	1.7	370
3	13 : 32	28.7	11.0	2.1	1.8	370
4	13 : 33	28.7	6.5	2.1	1.8	370
5	13 : 34	28.4	6.8	2.1	1.8	370
6	13 : 35	28.5	7.0	2.0	1.8	369
7	13 : 36	28.4	6.8	1.9	1.8	369
8	13 : 37	28.5	6.6	1.9	1.8	369
9	13 : 38	28.6	6.9	2.0	1.8	369
10	13 : 39	28.8	7.6	3.1	1.7	369
11	13 : 40	28.8	40.6	3.6	1.7	368
12	13 : 41	28.4	7.4	2.6	1.7	368
13	13 : 42	28.5	7.5	2.4	1.7	368
14	13 : 43	28.2	96.1	4.7	1.5	367
15	13 : 44	28.5	7.1	2.0	1.7	368

Multiplication Factors:

NO_x 0 - 100% Full Scale = 0 - 50 ppm NO_x % Chart X 0.5

CO 0 - 100% Full Scale = 0 - 100 ppm CO % Chart X 1.0

O_2 0 - 100% Full Scale = 0 - 25% O_2 % Chart X 0.25

THC 0 - 100% Full Scale = 0 - 100 ppm C_1 % Chart X 1.0

Location: Candlewick Yarns Client: Centra Boiler

Prepared By: ~~Sam~~ Checked By: — Date: 4-21-93

Run # 2 Load Tested: 100% Fuel: NAT GAS

One Minute Integration in ~~% of Chart~~ Recorder display

	Time	NO_x	CO	THC	O_2	
1	13 : 45	28.5	7.1	2.1	1.7	369
2	13 : 46	28.5	7.0	2.1	1.8	369
3	13 : 47	28.5	7.2	2.1	1.8	368
4	13 : 48	28.1	22.6	2.3	1.7	367
5	13 : 49	28.4	9.4	2.2	1.7	367
6	13 : 50	28.3	7.6	2.1	1.7	367
7	13 : 51	28.8	6.7	1.9	1.8	366
8	13 : 52	29.2	6.6	1.9	1.9	366
9	13 : 53	29.4	6.6	1.8	2.0	365
10	13 : 54	29.3	6.5	1.6	1.9	365
11	13 : 55	29.5	6.7	1.7	1.9	365
12	13 : 56	29.3	6.8	1.7	1.9	365
13	13 : 57	29.6	6.7	1.8	2.0	365
14	13 : 58	29.6	6.3	1.7	2.0	365
15	13 : 59	29.3	6.8	1.7	1.9	366
		28.8 ppm NO_x	11.9 ppm CO	2.2 ppm C_1	1.8% O_2	

13:52 FGR moved from 55 - 50% to stop oscillating NO_x moved up 0.5 ppm

Multiplication Factors:

NO_x 0 - 100% Full Scale = 0 - 50 ppm NO_x % Chart X 0.5

CO 0 - 100% Full Scale = 0 - 100 ppm CO % Chart X 1.0

O_2 0 - 100% Full Scale = 0 - 25% O_2 % Chart X 0.25

THC 0 - 100% Full Scale = 0 - 100 ppm C_1 % Chart X 1.0

Location: Cambrick Yarns Client: Cleaver Boiler

Prepared By: [illegible] Checked By: — Date: 4-21

Run # 3 Load Tested: 100% Fuel: Nat Gas

One Minute Integration in % of Chart

	Time	NO_x	CO	THC	O_2	
1	14:23	29.1	3.1	3.3	1.9	362
2	14:24	29.2	3.1	3.5	1.9	363
3	14:25	29.4	3.1	3.4	1.9	363
4	14:26	29.4	3.1	4.0	1.9	363
5	14:27	29.3	3.1	4.4	1.9	363
6	14:28	29.4	3.1	4.7	1.9	364
7	14:29	29.2	3.1	4.4	1.9	363
8	14:30	29.0	3.0	4.1	1.9	364
9	14:31	29.2	3.1	3.9	1.9	364
10	14:32	29.0	3.2	3.6	1.9	365
11	14:33	29.2	3.2	3.6	1.9	366
12	14:34	29.2	3.0	3.3	1.9	366
13	14:35	29.2	3.3	3.2	1.9	366
14	14:36	28.9	3.2	3.2	1.9	366
15	14:37	29.6	3.0	3.1	2.0	364

High water alarm at 14:34 →

Multiplication Factors:

NO_x 0 - 100% Full Scale = 0 - 50 ppm NO_x % Chart X 0.5

CO 0 - 100% Full Scale = 0 - 100 ppm CO % Chart X 1.0

O_2 0 - 100% Full Scale = 0 - 25% O_2 % Chart X 0.25

THC 0 - 100% Full Scale = 0 - 100 ppm C_1 % Chart X 1.0

Location: CANDLEWICK YARNS Client: CONTRA BOILER

Prepared By: SMH Checked By: — Date: 4-21-93

Run # 3 Load Tested: 100% Fuel: NAT GAS

One Minute Integration in % of Chart

	Time	NO_x	CO	THC	O_2	
1	14:38	29.1	3.2	2.9	2.0	366
2	14:39	29.0	3.2	2.8	1.9	363
3	14:40	28.8	3.1	2.6	1.9	364
4	14:41	28.9	3.1	2.5	2.0	364
5	14:42	29.4	3.2	2.3	2.0	364
6	14:43	29.5	3.1	2.3	2.0	364
7	14:44	29.2	3.1	2.5	1.9	363
8	14:45	29.1	3.2	2.8	1.9	363
9	14:46	29.3	3.1	2.9	1.9	363
10	14:47	29.0	3.1	2.9	1.9	363
11	14:48	29.1	3.0	2.8	2.0	363
12	14:49	29.4	3.1	2.7	2.0	362
13	14:50	29.3	3.1	3.1	2.0	362
14	14:51	29.2	3.0	3.6	2.0	362
15	14:52	29.1	3.1	3.8	1.9	362
		29.2 ppm NO_x	3.1 ppm CO	3.3 ppm C_1	1.9% O_2	

Multiplication Factors:

NO_x	0 - 100% Full Scale = 0 - 50 ppm NO_x	% Chart X	0.5
CO	0 - 100% Full Scale = 0 - 100 ppm CO	% Chart X	1.0
O_2	0 - 100% Full Scale = 0 - 25% O_2	% Chart X	0.25
THC	0 - 100% Full Scale = 0 - 100 C_1	% Chart X	1.0

PES

Calibration Summaries

Location: Candlewick Yarns **Client:** Central Boiler **Date:** 4-21-93

Prepared By: **Checked by:**

Run # 1	NO_x	CO	O_2	THC
Z_i =	0.0	0.0	0.0	1.0
Z_f =	0.0	2.0	0.0	2.5
S_i =	41.0	74.5	19.0	81.0
S_f =	41.3	76.8	19.0	81.0
Z_a/S_a	0.0/41.2	0.1/75.7	0.0/19.0	1.8/81.0

Run # 2	NO_x	CO	O_2	
Z_i =	0.0	2.0	0.0	
Z_f =	0.0	-1.0	0.0	
S_i =	41.3	76.8	19.0	
S_f =	41.1	73.5	19.0	
Z_a/S_a	0.0/41.2	0.1/75.2	0.0/19.0	

Run # 3	NO_x	CO	O_2	
Z_i =	0.0	-1.0	0.0	
Z_f =	0.0	-1.0	0.0	
S_i =	41.1	73.5	19.0	
S_f =	41.0	74.0	19.0	
Z_a/S_a	0.0/41.1	-1.0/73.8	0.0/19.0	

Run # —	NO_x	CO	O_2	
Z_i =				
Z_f =				
S_i =				
S_f =				
Z_a/S_a				

Run # —	NO_x	CO	O_2	
Z_i =				
Z_f =				
S_i =				
S_f =				
Z_a/S_a				

Run # —	NO_x	CO	O_2	
Z_i =				
Z_f =				
S_i =				
S_f =				
Z_a/S_a				

$$Z_a = \frac{Z_f - Z_i}{2} + Z_i$$

$$S_a = \frac{S_f - S_i}{2} + S_i$$

Where:

Z_a, S_a = Average zero or span strip chart divisions.

Z_f, S_f = Final zero or span strip chart divisions.

Z_i, S_i = Initial zero or span strip chart divisions.

Data Drift Correction Worksheet

$C_{gas\,(corr)} = (C_a - Z_a)\,(C_s + (S_a - Z_a)) \times C_{span2}$

Run 1 C_{span2} = (20.95 - 3.0) + (20.95 - 1.8) = 0.94

Start 12:40 NO_x (27.8-0.0) (40.7 + (41.2 - 0.0) = 25.9 (27.5)

End 13:09 CO (7.1 - 0.1) (75.0 + (75.7 - 0.1) = 6.4 (6.9)

O_2 (1.8-0.0) (19.0 + (19.0 - 0.0) = 1.8

THC (NOG) (1.83-1.8) (80.0+ (81.0 - 1.8) = 0.0 (0.03-0.4=-0.37)

Run 2 C_{span2} = (20.95 - 3.0) + (20.95 - 1.8) = 0.94

Start 13:30 NO_x (28.8-0.0) (40.7 + (41.2 - 0.0) = 26.8 (28.5)

End 13:59 CO (11.9-0.1) (75.0 + (75.2 - 0.1) = 11.1 (11.8)

O_2 (1.8 - 0.0) (19.0 + (19.0 - 0.0) = 1.8

THC (NOG) (2.2-1.8) (80.0 + (81.0 - 1.8) = 0.0 (0.4-0.4=0.0)

Run 3 C_{span2} = (20.95 - 3.0) + (20.95 - 1.9) = 0.94

Start 14:23 NO_x (29.2-0.0) (40.7 + (41.1 - 0.0) = 27.2 (28.9)

End 14:52 CO (3.1 - -1.0) (75.0 + (73.8 - -1.0) = 3.9 (4.1)

O_2 (1.9 - 0.0) (19.0 + (19.0 - 0.0) = 1.9

THC (NOG) (3.3-1.8) (80.0 + (81.0 - 1-8) = 1.03 (1.5-0.4=1.1)

Run ___ C_{span2} = (20.95 - 3.0) + (20.95 -) = ____

Start ___:___ NO_x (-) (+ (-) = ____

End ___:___ CO (-) (+ (-) = ____

O_2 (-) (+ (-) =

THC (NOG) (-) (+ (-) = ____

NO_x Emissions Calculated to lbs/hr

Calculation:

$$\frac{\text{ppm} \times 46 \text{ lb/lb-mole} \times 60 \times \text{min/hr} \times \text{DSCFM}}{385 \text{ SCF/lb-mole} \times 10^6 \text{ppm}}$$

= lbs/hr NOX (reported as NO_2)

Run 1 — $\frac{27.5 \times 46 \times 60 \times 3380 \text{ DSCFM}}{385 \times 10^6}$ = 0.66 lbs/hr as NO_2
Start 12 : 40
End 13 : 09

Run 2 — $\frac{28.5 \times 46 \times 60 \times 3,380 \text{ DSCFM}}{385 \times 10^6}$ = 0.69 lbs/hr as NO_2
Start 13 : 30
End 13 : 59

Run 3 — $\frac{28.9 \times 46 \times 60 \times 3,380 \text{ DSCFM}}{385 \times 10^6}$ = 0.70 lbs/hr as NO_2
Start 14 : 23
End 14 : 52

Run ___ — $\frac{\_\_\_\_ \times 46 \times 60 \times \_\_\_\_ \text{ DSCFM}}{385 \times 10^6}$ = _____ lbs/hr as NO_2
Start ___ : ___
End ___ : ___

Run ___ — $\frac{\_\_\_\_ \times 46 \times 60 \times \_\_\_\_ \text{ DSCFM}}{385 \times 10^6}$ = _____ lbs/hr as NO_2
Start ___ : ___
End ___ : ___

Run ___ — $\frac{\_\_\_\_ \times 46 \times 60 \times \_\_\_\_ \text{ DSCFM}}{385 \times 10^6}$ = _____ lbs/hr as NO_2
Start ___ : ___
End ___ : ___

Where:

ppm = Average of one minute integrations for NO_x corrected to $3\%O_2$

46 lb/lb-mole = Molecular Weight of NO_2.

DSCFM = Exhaust flow corected to dry gas standards.

385 SCF = Volume of 1 mole at 76°F

CO emissions calculated to lbs/hr

Calculation:

$$\frac{\text{ppmV} \times 28 \text{ lb/lb-mole} \times 60 \text{ min/hr} \times \text{DSCFM}}{385 \text{ SCF/lb-mole} \times 1{,}000{,}000} = \text{lbs/hr CO}$$

Run 1 $\frac{6.9 \times 28 \times 60 \times 3380 \text{ DSCFM}}{385 \times 10^6}$ = 0.10 lbs/hr CO

Run 2 $\frac{11.8 \times 28 \times 60 \times 3380 \text{ DSCFM}}{385 \times 10^6}$ = 0.17 lbs/hr CO

Run 3 $\frac{4.1 \times 28 \times 60 \times 3380 \text{ DSCFM}}{385 \times 10^6}$ = 0.06 lbs/hr CO

Run ____ $\frac{\_\_\_\_ \times 28 \times 60 \times \_\_\_\_ \text{ DSCFM}}{385 \times 10^6}$ = _____ lbs/hr CO

Run ____ $\frac{\_\_\_\_ \times 28 \times 60 \times \_\_\_\_ \text{ DSCFM}}{385 \times 10^6}$ = _____ lbs/hr CO

Run ____ $\frac{\_\_\_\_ \times 28 \times 60 \times \_\_\_\_ \text{ DSCFM}}{385 \times 10^6}$ = _____ lbs/hr CO

WHERE:

ppmV = ppm average of one minute integrations for NO_x corrected to 3% O_2.

28 lb/lb mole = Molecular weight of CO

DSCFM = Flows corrected to dry standards. Taken from calculations based on measured flow rates.

Appendix C

Scott Specialty Gases, Inc.

Shipped From: 2600 CAJON BLVD.
SAN BERNARDINO CA 92411
Phone: 714-887-2571 Fax: 714-887-0549

CERTIFICATE OF ANALYSIS

PACIFIC ENVIRONMENTAL SER
PO# 0640-102
13100 BROOKS DRIVE

BALDWIN PARK CA 91706

PROJECT #: 02-25048-002
PO#: PO # 0640-102
ITEM #: 02024520 2AL
DATE: 4/08/93

CYLINDER #: IL2572
FILL PRESSURE: 2000 PSIG
BLEND TYPE : ACUBLEND MASTER GAS

ANALYTICAL ACCURACY: +/-1%

COMPONENT	REQUESTED GAS CONC	MOLES	ANALYSIS (MOLES)	
CARBON DIOXIDE	11.	PCT	11.00	PCT
CARBON MONOXIDE	50.	PPM	50.00	PPM
OXYGEN	11.	PCT	11.00	PCT
NITROGEN		BAL		BAL

Post-it™ brand fax transmittal memo 7671 | # of pages ▸

To Steve	From Ognie
Co.	Co.
Dept.	Phone #
Fax #	Fax #

4/9 2000 PSIG BIN#1

ANALYST: RAYMOND JOHNSON

APPROVED BY: DR. ARMAND LANGE, PHD

Scott Specialty Gases, Inc.

Shipped From: 2600 CAJON BLVD.
SAN BERNARDINO CA 92411
Phone: 714-887-2571 Fax: 714-887-0549

CERTIFICATE OF ANALYSIS

PACIFIC ENVIRONMENTAL SER
ATTN: STEVE HERNANDEZ
13100 BROOKS DRIVE
BALDWIN PARK CA 91706

PROJECT #: 02-25328-002
PO#: 0640-102
ITEM #: 0202RC0C AL
DATE: 5/17/93

CYLINDER #: AAL13428
FILL PRESSURE: 700 PSIG

COMPONENT	ANALYSIS
CARBON DIOXIDE	17.99 PCT
CARBON MONOXIDE	75.21 PPM
OXYGEN	19.07 PCT
NITROGEN	BALANCE

5/17 700 PSIG

ANALYST: JOSEPH DE LA TORRE APPROVED BY: ROBERT SHEALY

Scott Specialty Gases, Inc.

2600 CAJON BOULEVARD, SAN BERNARDINO, CA 92411 (909) 887-2571 FAX: (909) 887-0549

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer:
Pacific Environmental Services
13100 Brooks Drive
Baldwin Park , CA 91706-0740

Assay Laboratory
Scott Specialty Gases
2600 Cajon Boulevard
San Bernardino, CA 92411

Purchase Order 0640-102
Scott Project # 24700

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number ALM027851
Cylinder Pressure 1950 psig
Certification Date 03-17-93
Previous Certification Dates NONE
Expiration Date 09-13-94

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
NItric Oxide	22.51 ppm	± 1 % NIST Traceable
NOX	22.82 ppm	

Balance Gas: Nitrogen

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
SRM 2629A	09-93	FF28519	19.3 ppm

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
TECO / 10AR / 14853-150	1-20-93	Chemi-Luminescent

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components: Nitric Oxide

First Triad Analysis

Date: 03-01-93 Response Units: mv

Z1=	0.000	R1=	78.33	T1=	90.95
R2=	78.30	Z2=	0.000	T2=	90.92
Z3=	0.000	T3=	90.94	R3=	78.28

Avg. Conc. of Cust Cyl. 22.41 ppm

Second Triad Analysis

Date: 03-17-93 Response Units: mv

Z1=	0.000	R1=	77.12	T1=	90.20
R2=	77.24	Z2=	0.000	T2=	90.54
Z3=	0.000	T3=	90.50	R3=	77.21

Avg. Conc. of Cust Cyl. 22.60 ppm

Calibration Curve

Concentration= Ax^2+Bx+C
A =-0.000504296
B =1.0489880
C =-0.292506

Date: Response Units: mv

Z1=		R1=		T1=	
R2=		Z2=		T2=	
Z3=		T3=		R3=	

Avg. Conc. of Cust Cyl.

Concentration=

Date: Response Units: mv

Z1=		R1=		T1=	
R2=		Z2=		T2=	
Z3=		T3=		R3=	

Avg. Conc. of Cust Cyl.

Concentration=

Date: Response Units:

Z1=		R1=		T1=	
R2=		Z2=		T2=	
Z3=		T3=		R3=	

Avg. Conc. of Cust Cyl.

Date: Response Units:

Z1=		R1=		T1=	
R2=		Z2=		T2=	
Z3=		T3=		R3=	

Avg. Conc. of Cust Cyl.

Concentration=

Special Notes

Analyst Joseph De La Torre

Scott Specialty Gases, Inc.

Shipped From: 2600 CAJON BLVD.
SAN BERNARDINO CA 92411
Phone: 714-887-2571 Fax: 714-887-0549

CERTIFICATE OF ANALYSIS

PACIFIC ENVIRONMENTAL SER
ATTN: STEVE HERNANDEZ
13100 BROOKS DRIVE

BALDWIN PARK CA 91706

PROJECT #: 02-19360
PO#: 0640-102
ITEM #: 02022914 4AL
DATE: 4/24/92

CYLINDER #: AAL18076

ANALYTICAL ACCURACY: +/-1%

COMPONENT	REQUESTED GAS CONC	MOLES	ANALYSIS (MOLES)	
NITRIC OXIDE	40.	PPM	40.01	PPM
NITROGEN - OXYGEN FREE		BAL		BAL

PACIFIC ENVIRONMENTAL

NIST TRACEABLE TO SRM1683B

NOX = 40.66 PPM

CYLINDER PRESSURE 2000 PSI

CYL#CAL12736 47.9 PPM NO

ANALYST: JOSEPH DE LA TORRE

APPROVED BY: DR ARMAND LAMOE PHD

Scott Specialty Gases, Inc.

Shipped From: 2600 CAJON BLVD.
SAN BERNARDINO CA 92411
Phone: 714-887-2571 Fax: 714-887-0549

CERTIFICATE OF ANALYSIS

PACIFIC ENVIRONMENTAL SER

13100 BROOKS DRIVE

BALDWIN PARK CA 91706

PROJECT #: 02-21555
PO#: 4450.039
ITEM #: 02022711 4AL
DATE: 9/11/92

CYLINDER #: AAL7535
FILL PRESSURE: 2000 PSIG

ANALYTICAL ACCURACY: +/-1%

COMPONENT	REQUESTED GAS CONC	MOLES	ANALYSIS (MOLES)	
METHANE	8.	PPM	7.998	PPM
AIR		BAL		BAL

PACIFIC ENVIRONMENTAL 9/11

ANALYST: MAYNARD JOHNSON

APPROVED BY: DR ARMAND LANGE PH D

Scott Specialty Gases, Inc.

Shipped From: 2600 CAJON BLVD. SAN BERNARDINO CA 92411-0000
Phone: 714-887-2571 Fax: 714-887-0549

CERTIFICATE OF ANALYSIS

PACIFIC ENVIRONMENTAL SER
ATTN: STEVE HERNANDEZ
13100 BROOKS DRIVE
BALDWIN PARK CA 91706

PROJECT #: 02-18169
PO#: 0640-102
ITEM #: 02022712 4AL
DATE: 2/14/92

CYLINDER #: ALM014380

ANALYTICAL ACCURACY: +/-1%

COMPONENT	REQUESTED GAS CONC	MOLES	ANALYSIS (MOLES)	
METHANE	80.	PPM	80.00	PPM
AIR		BAL		BAL

CYLINDER PRESSURE 2000 PSI

ANALYST: MAYNARD JOHNSON

APPROVED BY: DR ARMAND LANGE PHD

Appendix D

GRASEBY NUTECH-RTL

C A L I B R A T I O N S H E E T

Customer : PES Serial : 80669
Date : 3/27/93

CALCULATION DATA FOR RUN :	1	2	3
1. Barometric Pressure, P(B):	30.36	30.36	30.36
2. Orifice Setting, Delta H :	2.00	0.75	6.00
3. Finial Reading (Test) :	374.406	385.184	396.448
4. Initial Reading (Test) :	363.568	374.655	385.768
5. Volume, V(T) Cubic Feet :	10.838	10.529	10.680
6. Temp Initial T(T(I)) F :	70	70	69
7. Temp Finial T(T(F)) F :	70	69	69
8. Finial Reading (Box) :	102.946	113.914	125.252
9. Initial Reading (Box) :	92.000	103.200	114.500
10. Volume, V(B) Cubic Feet :	10.946	10.714	10.752
11. Temp Initial T(B(I)) F :	75	74	76
12. Temp Final T(B(F)) F :	76	75	81
13. Elapsed Time, Minutes :	14.0	22.0	8.0
Delta H(a) :	1.8278	1.7934	1.8267
Gamma :	0.9956	0.9902	0.9967

$\overline{\Delta H@} = 1.8160$
$\overline{\gamma} = 0.9942$

Calibration Performed By : Alejandro E. Pastrana

GRASEBY NUTECH-RTL
4022 STIRRUP CREEK DRIVE, SUITE 325, DURHAM, NC 27703-9000, USA
TEL: 919 544 5775 FAX: 919 544 3770

THERMOCOUPLE CALIBRATION

CALIBRATED BY: Jorge Mata

DATE: 12-31-92

Thermocouple number	Thermocouple reading (°C)	Thermometer reading (°C)
TC-1	0.0 23.0 98.0	0.0 24.0 99.0
TC-2	OUT OF SERVICE	
TC-3	0.0 23.0 97.0	0.0 24.0 98.0
TC-4	0.0 25.5 100.5	0.0 25.0 100.0
TC-5	NOT AVAILABLE	
TC-6	NOT AVAILABLE	
TC-7	NOT AVAILABLE	
TC-8	NOT AVAILABLE	

TC-9	NOT AVAILABLE	
TC-10	0.0 25.5 100.5	0.0 25.0 100.0
TC-11	NOT AVAILABLE	
C-1	NOT AVAILABLE	
C-2	NOT AVAILABLE	
S-1A	1.0 22.0 97.0	0.0 23.0 99.0
S-2A	0.0 25.0 98.5	0.0 25.0 100.0
S-16A	1.0 22.0 97.0	0.0 24.0 99.0
S-17A	1.0 22.0 98.0	0.0 24.0 99.0

Thermometer Standard Serial Number: 128239
Thermometer NIST I.D. Number: 88024

PES

PITOT TUBE CALIBRATION DATA SHEET

Calibrated By: Aziz Mahn

Date: 2-1-93

Pitot I.D. No.: D-3

Effective Length: 47"

Pitot Tube Assembly Level? Yes ✓ No ✓ *

Pitot Tube Openings Damaged? Yes (explain below) _____ No _____

α_1 = 0 ° (<10°). α_2 = 0 ° (<10°)

β_1 = 0 ° (<5°) β_2 = 0 ° (<5°)

γ = 0 ° θ = 0 ° A = 0.821 °

Z = A sin γ = _____ cm (in.) 0.32 cm (<1/8 in.)

W = A sin θ = _____ cm (in.) 0.08 cm (<1/32 in.)

P_A = 0.317 cm (in.)

P_B = 0.316 cm (in.)

D_t = 0.417 cm (in.)

Comments: * A LITTLE ROUGH AROUND THE EDGES.

Calibration Required? Yes _____ No ✓