RAMCON ENVIRONMENTAL CORPORATION

RAMCON BUILDING 223 SCOTT STREET MEMPHIS, TENNESSEE 38112 TELEPHONE 901 / 458-7000 800 / 458-4567

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
L.J. EARNEST COMPANY
PLAIN DEALING, LOUISIANA
May 25, 1987

LaQuita Miller
L.J. Earnest Company

G. Sumner Buck, III
President

Ken Allmendinger
Team Leader

RAMCON ENVIRONMENTAL CORPORATION

RAMCON BUILDING 223 SCOTT STREET MEMPHIS, TENNESSEE 38112 TELEPHONE 901 / 458-7000 800 / 458-4567

June 5, 1987

Ms. LaQuita Miller
L.J. Earnest Company
P.O. Box 5339
Bossier City, LA 71171-5339

Re: Particulate Emissions Test - Plain Dealing, Louisiana

Dear Ms. Miller:

Enclosed are four copies of our report on the particulate emissions test we conducted at your plant. Based on our test results, your plant does pass emissions standards set by the State of Louisiana. The average grain loading of the three test runs was in compliance with State Standards.

You will want to sign the report covers and send two copies to:

Mr. Burns Doss
Department of Environmental Quality
Northwest Regional Office
1525 Fairfield Avenue
Room 11
Shreveport, LA 71101-4388

We certainly have enjoyed working with you and look forward to serving you again in the future.

Sincerely,

G. Sumner Buck, III
President

GSBIII:kr

Enclosures

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I. INTRODUCTION

On May 25, 1987, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at L.J. Earnest Company's Stansteel continuous hotmix asphalt plant located in Plain Dealing, Louisiana. RAMCON personnel conducting the test were Ken Allmendinger, Team Leader and Shawn Greenwood. Kim Rea was responsible for the final particulate laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples was limited to Mr. Allmendinger and Ms. Rea.

The purpose of the test was to determine if the rate of particulate emissions from the plant's baghouse and the total contaminants by weight (grain loading) are below the limits set by the State of Louisiana.

II. TEST RESULTS

Table I summarizes the test results. The grain loading limitation for EPA is .04 gr/DSCF and is specified in 39 FR 9314, March 8, 1974, 60.92 Standards for Particulate Matter (1), as amended. The allowable emissions for the State of Louisiana are the same as those set by EPA.

Mr. Burns Doss of Louisiana's Department of Environmental Quality observed the testing conducted by RAMCON.

TABLE I

SUMMARY OF TEST RESULTS
May 25, 1987

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	07:37 to 08:42	0.0187 gr/DSCF	94%	3.8 lbs/hr
2	09:13 to 10:18	0.0183 gr/DSCF	92%	3.9 lbs/hr
3	10:39 to 11:43	0.0229 gr/DSCF	90%	5.0 lbs/hr
	Average:	0.0200 gr/DSCF		4.2 lbs/hr

On the basis of these test results, the average grain loading of the three test runs was below the .04 gr/DSCF emissions limitation set by the State of Louisiana. Therefore, the plant is operating in compliance with State Standards.

III. TEST PROCEDURES

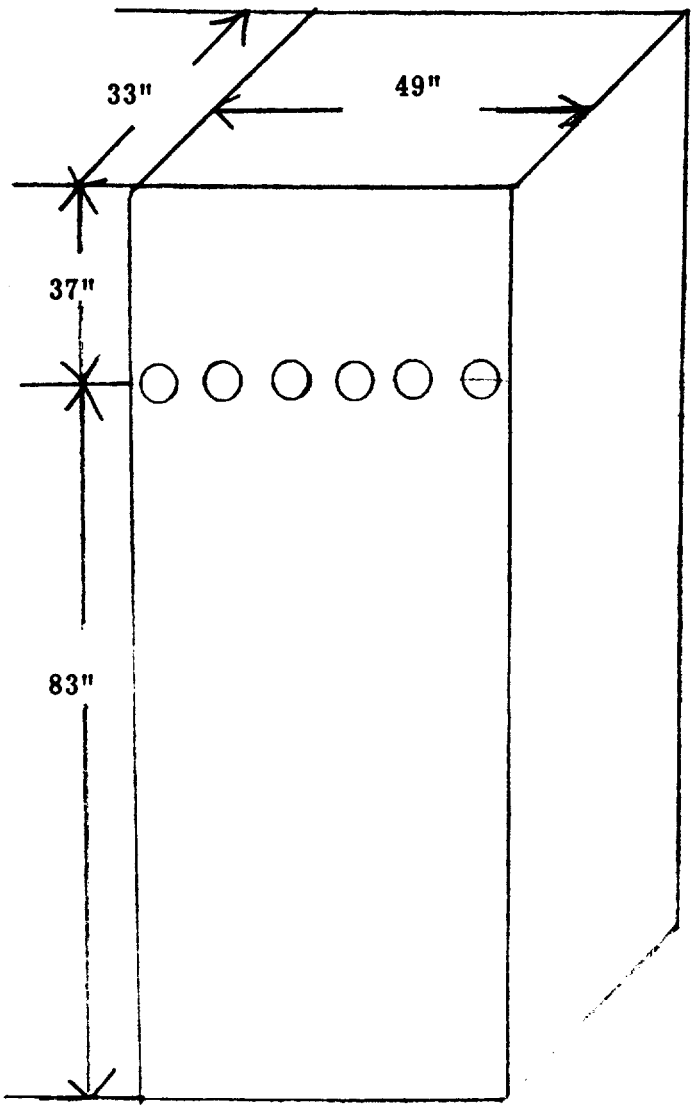
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

B. Problems Encountered: No problems were encountered that affected testing.

C. Sampling Site: The emissions test was conducted after a baghouse on a rectangular stack measuring 49" x 33" with an equivalent diameter of 39.4". Six sampling ports were placed 37" down (0.9 diameters upstream) from the top of the stack and 83" up (2.1 diameters downstream) from the last flow disturbance. Thirty points were sampled, five through each port for two minutes each.

Points on a Diameter	Probe Mark
1	*8.3"
2	14.9"
3	21.6"
4	28.1"
5	34.7"

*Measurements include a 5" standoff.



IV. THE SOURCE

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L.J. Earnest Company employs a Stansteel continuous mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind the mixture together. After the hot asphalt mix is manufactured at the plant, it is transported to the location where it is to be applied. The hot asphalt mix is spread evenly over the surface with a paver and then compacted with a heavy roller to produce the final product.

The following is a general description of the plant's manufacturing process: The cold feed materials (aggregate) are dumped into four separate bins which in turn feed a common continuous conveyor. The aggregate is dispensed from the bins in accordance with the desired formulation onto the cold feed system conveyor to an inclined conveyor then to a rotating drum for continuous mixing and drying at approximately 300°F. From the drum dryer the aggregate is dispensed into a mixing chamber called a coater where the required amount of hot asphalt oil is then injected onto and mixed into the dried aggregate in a "pugmill" located at the end of the drum. The now newly formed hot asphalt mix is then conveyed into a storage silo from which it is discharged through a slide gate into waiting dump trucks, which transport the material to a final destination for spreading. The rated capacity of the plant will vary with each aggregate mix and moisture content with a 5% surface moisture removal.

The drum mixer uses a burner fired with natural gas and fuel oil to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate and hot asphalt oil thoroughly. The air is drawn into the system via an exhaust fan. After passing through the gas burner and the mixing drum, the air passes through a baghouse. The baghouse is manufactured by Standard Havens. The exhaust gasses are drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube sheet is 2 - 6 inches of water. The particulate matter, which is removed by the baghouse is reinjected into the drum mixer.

DATA SUMMARY

Plant

1. Manufacturer of plant Astec.
2. Designed maximum operating capacity 370 TPH @ 5 % moisture.
3. Actual operation rate 370 TPH @ 5 % moisture.
4. Startup date May 1986.
5. Type of fuel used in dryer Natural Gas & Fuel.
6. Quanity of fuel consumption _____.

Aggregate

7. Name/type of mix ~~Gravel~~ Stone.
8. Percent asphalt in mix 5 %.
9. Temperature of asphalt 325.
10. Sieve/Screening analysis: % Passing;

1"	100	3/8"	97	#40	24
3/4"	100	# 4	61	#80	14
1/2"	100	#10	37	#200	9

Baghouse

11. Manufacturer Standard Havens.
12. No. of bags 594. Type of bags Nomex.
13. Air to cloth ratio 5.0. Designed ACFM 59000.
14. Square feet of bags _____.
15. Type of cleaning; pulse jet ✓, reverse air _____,
    plenum pulse _____, other _____.
16. Cleaning cycle time 2 Min.
17. Interval between cleaning cycle 5.
18. Pressure drop across baghouse 1 psi.
19. Pulse pressure on cleaning cycle 90 psi.

COMPANY NAME L.J. Earnest DATE 5-25-87

COMPANY REPRESENTATIVE Mike Accenac

PLANT DATA (6)

COMPANY NAME L. J. Earnest

COMPANY REP. Michael Earnest DATE 5-25-87 Phone # 326-7110

DATA SOURCE Computer

PLANT LOCATION Plant Dealing

PLANT MANUFACTURER Astec PLANT MODEL NO. _____ PLANT TYPE Counter

MIX SPECIFICATION NO. La. D.O.T.D. Type 8 OIL SPECIFICATION NO. AC-30

TIME: START _____ STOP _____ A.T. _____ °F R.H. _____ %

TIME 24 HOUR	FUEL OIL ☐ NATURAL GAS ☑ PROPANE ☐	BURNER SETTING	AGGREGATE TPH	RECYCLE TPH	ASPHALT	MIX TEMPERATURE °F	VENTURI ☐ Baghouse ☑ DIFFERENTIAL
7:00		7 1/2	238.0	—	12.4	325	1.0
7:15		7 1/2	236.0		12.5	325	1.1
7:30		7 1/2	231.8		13.5	350	1.1
7:45		6	220.2		11.6	315	1.0
8:00		7 1/2	226.2		11.9	360	1.0
8:15		7 1/2	256.5		13.4	370	1.1
8:30		7 1/2	253.1		13.3	365	1.1
8:45		7 1/2	256.0		13.5	360	1.1
9:00		7 1/2	254.3		13.3	350	1.2
9:15		7 1/2	254.7		13.4	375	1.2
9:30		7 1/2	234.6		12.6	375	1.2
9:45		6.0	253.0		13.3	345	1.2
10:00		5.5	253.1		13.3	340	1.2
10:15		5.5	253.4		13.3	320	1.1
10:30		6.0	251.2		13.4	340	1.2
10:45		6.0	253.1		13.2	335	1.2
11:00		6.5	259.5		13.7	320	1.2

REMARKS:

PLANT DATA

COMPANY NAME _____

COMPANY REP. _____ DATE _____ Phone # _____

DATA SOURCE _____

PLANT LOCATION _____

PLANT MANUFACTURER _____ PLANT MODEL NO. _____ PLANT TYPE _____

MIX SPECIFICATION NO. _____ OIL SPECIFICATION NO. _____

TIME: START _____ STOP _____ A.T. _____ °F R.H. _____ %

TIME 24 HOUR	FUEL OIL ☐ NATURAL GAS ☐ PROPANE ☐ ___	BURNER SETTING ___	AGGREGATE TPH	RECYCLE TPH	ASPHALT	MIX TEMPERATURE °F	VENTURI ☐ Baghouse ☐ DIFFERENTIAL ___
11:15		6.5	254.4		13.0	325	1.2
11:30		6.1	260.0		13.6	320	1.2
11:45		6.1	260.7		13.7	320	1.2
12:00							

REMARKS:

V. EQUIPMENT USED

V. EQUIPMENT USED

Equipment used on conducting the particulate emissions test was:

A. The Lear Siegler PM-100 stack sampler with appropriate auxillary equipment and glassware. The train was set up according to the schematic on the nex page.

B. An Airguide Instruments Model 211-B (uncorrected) aneroid barometer was used to check the barometric pressure.

C. Weston dial thermometers are used to check meter temperatures. An Analogic Model 2572 Digital Thermocouple is used for stack temperatures.

D. A Hays 621 Analyzer was used to measure the oxygen, carbon dioxide and carbon monoxide content of the stack gases. For non-combustion sources, A Bacharach Instrument Company Fyrite is used for the gas analysis.

E. Filters are mady by Schleicher and Schuell and are type 1-HV with a porosity of .03 microns.

F. The acetone is reagent grade or ACS grade with a residue of $\leq$ .001.

VI. LABORATORY PROCEDURES & RESULTS

LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

A. FILTERS: Fiberglass 4" sampling filters are prepared as follows:

Filters are removed from their box and numbered on the back side with a felt pen. The numbering system is continuous from job to job. The filters are placed in a dessicator to dry for at least 24 hours. Clean plastic petri dishes, also numbered, top and bottom, are placed in the dessicator with the filters. After dessication, the filters are removed one at a time and weighed on the Sartorius analytical balance, then placed in the correspondingly numbered petri dish. Weights are then recorded in the lab record book. Three filters are used for each complete particulate source emissions test and there should be several extra filters included as spares.

B. SILICA GEL: Silica Gel used for the test is prepared as follows:

Approximately 200 g of silica gel is placed in a wide mouth "Mason" type jar and dried in an oven (175°C for two hours). The open jars are removed and placed in a dessicator until cool (2 hours) and then tightly sealed. The jars are then numbered and weighed on the triple beam balance to the closest tenth of a gram, and this weight is recorded for each sealed jar. The number of silica gel jars used is the same as the number of filters. Silica gel should be indicating type, 6-16 mesh.

II. Post-Testing Lab Analysis

A. FILTERS: The filters are returned to the lab in their sealed glass filter holder which was used in field sampling. In the lab these holders are opened. The filter is placed in its petri dish with the lid off and returned to the dessicator for at least 24 hours. The top half of the filter holder is washed into the corresponding probe wash bottle and the bottom half of the filter holder is washed into the corresponding impinger catch bottle. (See II, C and D). After dessication, the filters are reweighed. The final weight is recorded in the lab record book. The filter pick up weight is calculated and recorded also. This procedure is repeated for all filters used in the field.

Alternately, the test team may opt to oven dry the filters at 220°F for two to three hours, weigh the sample, and use this weight as a final weight.

B. SILICA GEL: The sealed silica gel jars should be reweighed on the triple-beam balance and their weights recorded as shown on previous page.

WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

The Sartorius balance is accurate to 0.1 mg and has a maximum capacity of 200 grams. The balance precision (standard deviation) is 0.05 mg. Before weighing an item, the balance should first be zeroed. This step should be taken before every series of weighings. To do this, the balance should have all weight adjustments at "zero" position. The beam arrest lever (on the lower left hand side toward the rear of the balance) is then slowly pressed downward to full release position. The lighted vernier scale on the front of the cabinet should align the "zero" with the mark on the cabinet. If it is not so aligned, the adjustment knob on the right hand side (near the rear of the cabinet) should be turned carefully until the marks align. Now return the beam arrest to horizontal arrest position. The balance is now "zeroed".

To weigh an item, it is first placed on the pan. And the sliding doors are closed to avoid air current disturbance. The weight adjustment knob on the right hand side must be at "zero". The beam arrest is then slowly turned upward. The lighted scale at the front of the cabinet will now indicate the weight of the item in grams. If the scale goes past the divided area, the item then exceeds 100 g weight (about 3-1/2 ounces) and it is necessary to arrest the balance (beam arrest lever) and move the lever for 100 g weight away from you. It is located on the left hand side of the cabinet near the front, and is the knob closest to the side of the cabinet. The balance will not weigh items greater than 200 grams in mass, and trying to do this might harm the balance. Remember -- this is a delicate precision instrument.

After the beam is arrested, in either weight range, the procedure is the same. When the weight of the item in grams is found, "dial in" that amount with the two knobs on the left hand side (near the 100 g lever) color coded yellow and green. As you dial the weight, the digits will appear on the front of the cabinet. When the proper amount is dialed, carefully move the arrest lever down with a slow, steady turn of the wrist. The lighted dial will appear, and the right hand side knob (front of cabinet) is turned to align the mark with the lower of the two lighted scale divisions which the mark appears between. When these marks are aligned, the two lighted digits along with the two indicated on the right hand window on the cabinet front are the fractional weight in grams (the decimal would appear before the lighted digits) and the whole number of grams weight is the amount "dialed in" on the left.

In general, be sure that the beam is in "arrest" position before placing weight on or taking weight off of the pan. Don't "dial in" weight unless the beam is arrested. The balance is sensitive to even a hand on the table near the balance, so be careful and painstaking in every movement while weighing.

C. PROBE RINSINGS: In all tests, a probe wash-out analysis will be necessary. These samples are returned in sealed Mason jars and consist of A.R. Acetone with an unknown solid content. Clean 250 ml beakers are used to make this analysis. These should be immaculately washed and rinsed with deionized water, then oven dried at 105°C for about one hour. The beakers should be moved to the dessicator to cool for ninety (90) minutes, then labeled with a pencil and weighed on the Sartorius analytical balance. Any variance from this procedure should be duplicated exactly when reweighing, as this procedure has been found to be quite sensitive. After preparing the necessary number of beakers (one for each probe wash and one blank) the Mason jars should be opened, poured into the beaker, and any material remaining on the jar walls rinsed with an acetone wash bottle into the beaker. The amount of liquid in the beaker should be noted on the analysis form. The acetone rinsings are evaporated on a warming plate. The liquid is kept swirled with an air sweep to prevent "bumping". When the acetone is evaporated the beakers are weighed as in Section II A.

D. IMPINGER CATCH: In some testing cases, the liquid collected in the impingers must be analyzed for solids content. This involves a similar procedure to the probe wash solids determination, except that the liquid is deionized water.

E. ACETONE: Conduct a blank analysis of acetone in the 1 gallon glass container. This acetone will be used in the field for rinsing the probe, nozzle, and top half of the filter holder. Performing such a blank analysis prior to testing will insure that the quality of the acetone to be used will not exceed the .001% residual purity standard.

SPECIAL NOTE

When sampling sources high in moisture content, (such as asphalt plants) the filter paper sometimes sticks to the filter holder. When removing the filter it may tear. In order to maintain control of any small pieces of filter paper which may be easily lost, they are washed with acetone into the probe washing. This makes the filter weight light (sometimes negative) and the probe wash correspondingly heavier. The net weight is the same and no particulate is lost. This laboratory procedure is taught by EPA in the Quality Assurance for Source Emissions Workshop at Research Triangle Park and is approved by EPA.

Form REC#8

SAMPLE ANALYTICAL DATA FORM

Plant Location P.G. Earnest — Relative humidity in lab 45 %

Sample Location hot mix asphalt plant — Density of Acetone (pa) .7853 mg/ml

Blank volume (V_a) 200 ml

Date/Time wt. blank 5-26-87 — Gross wt. 104.1114 mg

Date/Time wt. blank 5-27-87 — Gross wt. 104.1102 mg

Ave. Gross wt. 104.1108 mg

Tare wt. 104.1106 mg

Weight of blank (m_{ab}) .0002 mg

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (p_a) = (.0000013 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} p_a$ = (.0000013)(200)(.7853) = (.0002)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt 5-26-87 Gross wt	g	100.4990	101.1713	111.2731
Date/Time of wt 5-27-87 Gross wt	g	100.4987	101.1772	111.2728
Average Gross wt	g	100.4989	101.1773	111.2730
Tare wt	g	100.4640	101.1445	111.2264
Less acetone blank wt (W_a)	g	.0002	.0002	.0002
Wt of particulate in acetone rinse (m_a)	g	.0347	.0326	.0464

Filter Numbers	#	SG-1977	SG-1978	SG-1960
Date/Time of wt 5-26-87 Gross wt	g	.5353	.5362	.5366
Date/Time of wt 5-27-87 Gross wt	g	.5350	.5360	.5362
Average Gross wt	g	.5352	.5361	.5364
Tare wt	g	.5296	.5289	.5322

Weight of particulate on filters(s) (m_f)	g	.0056	.0072	.0042
Weight of particulate in acetone rinse	g	.0347	.0326	.0464
Total weight of particulate (m_n)	g	.0403	.0398	.0506

Note: In no case should a blank residue greater than 0.01 mg/g (or 0.001% of the blank weight) be subtracted from the sample weight.

Remarks

Signature of analyst Kim Rice — Signature of reviewer

NAME: L.J. EARNEST COMPANY (13)

LOCATION: PLAIN DEALING, LOUISIANA

		date	5/25/87	5/25/87	5/25/8
	SUMMARY OF TEST DATA		RUN # 1	RUN # 2	RUN #
	SAMPLING TRAIN DATA	start	07:37	09:13	10:39
		finish	08:42	10:18	11:42
1	Sampling time, minutes	θ	60	60	60
2	Sampling nozzle diameter, in.	Dn	.225	.225	.225
3	Sampling nozzle cross-sectional area, ft^2	An	.000276	.000276	.000276
4	Isokinetic variation	I	94	92	90
5	Sample gas volume - meter conditions, cf.	Vm	34.83	35.69	36.58
6	Average meter temperature, °R	Tm	554	564	567
7	Average oriface pressure drop, in.H_2O	ΔH	1.15	1.26	1.34
8	Total particulate collected mg.	Mn	40.3	39.8	50.6
	VELOCITY TRAVERSE DATA				
9	Stack area, ft^2	A	11.2	11.2	11.2
10	Absolute stack gas pressure, in. Hg.	Ps	30.02	30.02	30.02
11	Barometric pressure, in. Hg.	Pbar	30.02	30.02	30.02
12	Average absolute stack temperature, °R	Ts	664	664	664
13	Average $\sqrt{\text{velocity head}}$, (Cp= .80)	$\sqrt{\Delta P}$	1.17	1.21	1.25
14	Average stack gas velocity ft. / sec.	Vs	76	79	81
	STACK MOISTURE CONTENT				
15	Total water collected by train, ml.	Vic	491.0	502.0	508.0
16	Moisture in stack gas, %	Bws	41.0	41.5	41.2
	EMISSIONS DATA:				
17	Stack gas flow rate, dscf/hr. (000's)	Qsd	1,438	1,478	1,536
18	Total particulate concentration, gr/dscf	Cs	.0187	.0183	.0229
19	Total particulate concentration, lbs/hr	E	3.8	3.9	5.0
20	Total particulate concentration, lbs/mbtu	E'	.0000	.0000	.0000
	ORSAT DATA				
21	Percent CO2 by volume	CO2	4.3	3.8	3.3
22	Percent O2 by volume	O2	14.8	13.8	14.0
23	Percent CO by volume	CO	.0	.0	.0
24	Percent N2 by volume	N2	80.9	82.4	82.7

Buzzycalc

Total contaminants by weight: 'GRAIN LOADING'

Particulate concentration C_s' gr./dscf.

$$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{M_n}{V_{m(std)}} \right]$$

Where:

C_s' = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, gr./dscf.

M_n = Total amount of particulate matter collected, mg.

$V_{m(std)}$ = Dry gas volume through meter at standard conditions, cu.ft.

Run # 1: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{40.3}{33.21} \right] = .0187 \text{ gr./dscf.}$$

Run # 2: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{39.8}{33.43} \right] = .0183 \text{ gr./dscf.}$$

Run # 3: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{50.6}{34.09} \right] = .0229 \text{ gr./dscf.}$$

Dry molecular weight:

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2).$$

Where:

M_d	= Dry molecular weight, lb./lb.-mole.
$\%CO_2$	= Percent carbon dioxide by volume (dry basis).
$\%O_2$	= Percent oxygen by volume (dry basis).
$\%N_2$	= Percent nitrogen by volume (dry basis).
%CO	= Percent carbon monoxide by volume (dry basis).
0.264	= Ratio of O_2 to N_2 in air, v/v.
0.28	= Molecular weight of N_2 or CO, divided by 100.
0.32	= Molecular weight of O_2 divided by 100.
0.44	= Molecular weight of CO_2 divided by 100.

Run # 1: $M_d = 0.44(4.3\%) + 0.32(14.8\%) + 0.28(\ \ .0\% + 80.9\%) =$ 29.3 lb./lb.-mole

Run # 2: $M_d = 0.44(3.8\%) + 0.32(13.8\%) + 0.28(\ \ .0\% + 82.4\%) =$ 29.2 lb./lb.-mole

Run # 3: $M_d = 0.44(3.3\%) + 0.32(14.0\%) + 0.28(\ \ .0\% + 82.7\%) =$ 29.1 lb./lb.-mole

Water vapor condensed : (17)

$$V_{wc_{std}} = \left[V_f - V_i \right] \left[\frac{\rho_w \, R \, T_{(std)}}{M_w \quad P_{(std)}} \right] = 0.04707 \left[V_f - V_i \right]$$

$$V_{wsg_{std}} = \left[W_f - W_i \right] \left[\frac{R \quad T_{(std)}}{M_w \quad P_{(std)}} \right] = 0.04715 \left[W_f - W_i \right]$$

Where:

0.04707 = Conversion factor ft^3/ml.

0.04715 = Conversion factor ft^3/g.

$V_{wc_{std}}$ = Volume of water vapor condensed (standard conditions) scf.

$V_{wsg_{std}}$ = Volume of water vapor collected in silica gel (standard conditions)

V_f = Final volume of impinger contents, ml.

V_i = Initial volume of impinger contents

ρ = Density of water, (0.002201 lb/ml).

R = Ideal gas constant, 21.85 (in.Hg.)(cu.ft./lb.-mole)($^\circ$R)

M_w = Molecular weight of water vapor (18.0 lb/lb-mole).

T_{std} = Absolute temperature at standard conditions, 528°R.

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

Run # 1: $V_{wc(std)}$ = (0.04707) (481.0) = 22.6 cu.ft
$V_{wsg(std)}$ = (0.04715) (10.0) = .5 cu.ft

Run # 2: $V_{wc(std)}$ = (0.04707) (490.0) = 23.1 cu.ft
$V_{wsg(std)}$ = (0.04715) (12.0) = .6 cu.ft

Run # 3: $V_{wc(std)}$ = (0.04707) (495.0) = 23.3 cu.ft
$V_{wsg(std)}$ = (0.04715) (13.0) = .6 cu.ft

Moisture content of stack gases: $$B_{ws} = \frac{V_{wc_{std}} + V_{wsg_{std}}}{V_{wc_{std}} + V_{wsg_{std}} + V_{m_{std}}} \times 100$$

Where:

B_{ws} = Proportion of water vapor, by volume, in the gas stream.

V_m = Dry gas volume measured by dry gas meter,(dcf).

$V_{wc_{std}}$ = Volume of water vapor condensed corrected to standard conditions (scf).

$V_{wsg_{std}}$ = Volume of water vapor collected in silica gel corrected to standard conditions (scf).

Run # 1: $$B_{ws} = \frac{22.6 + .5}{22.6 + .5 + 33.21} \times 100 = 41.0\ \%$$

Run # 2: $$B_{ws} = \frac{23.1 + .6}{23.1 + .6 + 33.43} \times 100 = 41.5\ \%$$

Run # 3: $$B_{ws} = \frac{23.3 + .6}{23.3 + .6 + 34.09} \times 100 = 41.2\ \%$$

Molecular weight of stack gases: $M_s = M_d\ (1-B_{ws}) + 18\ (B_{ws})$.

Where:

M_s = Molecular weight of stack gas, wet basis, (lb./lb.-mole).

M_d = Molecular weight of stack gas, dry basis, (lb./lb.-mole).

Run # 1: $M_s = 29.3\ (1-\ .410\ ) + 18\ (\ .410\ ) = 24.7$ (lb./lb.-mole).

Run # 2: $M_s = 29.2\ (1-\ .415\ ) + 18\ (\ .415\ ) = 24.5$ (lb./lb.-mole).

Run # 3: $M_s = 29.1\ (1-\ .412\ ) + 18\ (\ .412\ ) = 24.5$ (lb./lb.-mole).

Stack gas velocity:

$$V_s = K_p\, C_p \left[\sqrt{\Delta P}\right]_{avg.} \sqrt{\frac{T_{s(avg.)}}{P_s\, M_s}}$$

Where:

V_s = Average velocity of gas stream in stack, ft./sec.

K_p = 85.49 ft/sec $\left[\text{(g/g-mole)-(mm Hg) / ($^\circ$K)(mm } H_2O\right]^{1/2}$

C_p = Pitot tube coefficient,(dimensionless).

ΔP = Velocity head of stack gas, in. H_2O.

P_{bar} = Barometric pressure at measurement site, (in.Hg).

P_g = Stack static pressure (in.Hg).

P_s = Absolute stack gas pressure, (in.Hg) = $P_{bar} + P_g$

P_{std} = Standard absolute pressure, (29.92 in.Hg).

t_s = Stack temperature, ($^\circ$f).

T_s = Absolute stack temperature, ($^\circ$R). = 460 + t_s.

M_s = Molecular weight of stack gas, wet basis, (lb/lb-mole).

Run # 1: $V = (85.49)\,(.80)\,(1.17)\sqrt{\frac{664}{(30.02)(24.67)}} = 75.77$ ft/se

Run # 2: $V = (85.49)\,(.80)\,(1.21)\sqrt{\frac{664}{(30.02)(24.55)}} = 78.55$ ft/se

Run # 3: $V = (85.49)\,(.80)\,(1.25)\sqrt{\frac{664}{(30.02)(24.53)}} = 81.18$ ft/se

Stack gas flow rate:

$$Q_{sd} = 3600 \left[1-B_{wc} \right] V_s A \left[\frac{T_{std}}{T_{stk}} \right] \left[\frac{P_s}{P_{std}} \right]$$

Where:

Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, (dscf/hr).

A = Cross sectional area of stack $(ft.)^2$

3600 = Conversion factor, sec./hr.

t_s = Stack temperature ($^\circ$f).

T_s = Absolute stack temperature, ($^\circ$R).

T_{std} = Standard absolute temperature, (528°R).

P_{bar} = Barometric pressure at measurement site, (in.Hg.).

P_g = Stack static pressure, (in.Hg.).

P_s = Absolute stack gas pressure, (in.Hg.); = $P_{bar} + P_g$

P_{std} = Standard absolute pressure, (29.92 in.Hg.)

Run # 1:

$$Q_{sd} = 3600\ (1-.410)\ (\ 75.77)\ (\ \ 11.2) \left[\frac{528}{664} \right] \left[\frac{30.02}{29.92} \right] = 1438086 \text{ dscf/}$$

Run # 2:

$$Q_{sd} = 3600\ (1-.415)\ (\ 78.55)\ (\ \ 11.2) \left[\frac{528}{664} \right] \left[\frac{30.02}{29.92} \right] = 1478215 \text{ dscf/}$$

Run # 3:

$$Q_{sd} = 3600\ (1-.412)\ (\ 81.18)\ (\ \ 11.2) \left[\frac{528}{664} \right] \left[\frac{30.02}{29.92} \right] = 1535542 \text{ dscf/}$$

Emissions rate from stack:

$$E = \frac{(C_s)(Q_{sd})}{7000 \text{ gr./lb.}} = \text{lb. / hr.}$$

Where:

E = Emissions rate, lb./hr.

C = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions (gr/dscf).

Q = Dry volumetric stack gas flow rate corrected to standard conditions, (dscf/hr).

Run # 1: $E = \frac{(.0187)(1438086)}{7000} = 3.8$ lb. / hr.

Run # 2: $E = \frac{(.0183)(1478215)}{7000} = 3.9$ lb. / hr.

Run # 3: $E = \frac{(.0229)(1535542)}{7000} = 5.0$ lb. / hr.

$$\text{Isokinetic variation : } I = 100\ T_s \left[\frac{0.002669\ V_{ic} + (V_m/T_m)(P_{bar} + \Delta H/13.6)}{60\ \ \theta\ \ V_s\ \ P_s\ \ A_n} \right]$$

Where:

I	=	Percent isokinetic sampling.
100	=	Conversion to percent.
T_s	=	Absolute average stack gas temperature, °R.
0.002669	=	Conversion factor, Hg - ft^3/ml - °R.
V_{ic}	=	Total volume of liquid collected in impingers and silica gel, m
T_m	=	Absolute average dry gas meter temperature, °R.
P_{bar}	=	Barometric pressure at sampling site, (in.Hg).
ΔH	=	Average pressure differential across the oriface meter, (in.H_2O
13.6	=	Specific gravity of mercury.
60	=	Conversion seconds to minutes
θ	=	Total sampling time, minutes.
V_s	=	Stack gas velocity, ft./sec.
P_s	=	Absolute stack gas pressure, in.Hg.
A_n	=	Cross sectional area of nozzle, ft^2.

Run # 1:

$$I = 100 \times 664 \left[\frac{(0.002669)(491.0) + \frac{34.8}{554}\left[30.02 + \frac{1.15}{13.6}\right]}{60\ (\ 60\ )\ (\ 75.77\ )\ (30.02\ )\ (\ .000276\ )} \right] = 94\ \%$$

Run # 2:

$$I = 100 \times 664 \left[\frac{(0.002669)(502.0) + \frac{35.7}{564}\left[30.02 + \frac{1.26}{13.6}\right]}{60\ (\ 60\ )\ (\ 78.55\ )\ (30.02\ )\ (\ .000276\ )} \right] = 92\ \%$$

Run # 3:

$$I = 100 \times 664 \left[\frac{(0.002669)(508.0) + \frac{36.6}{567}\left[30.02 + \frac{1.34}{13.6}\right]}{60\ (\ 60\ )\ (\ 81.18\ )\ (30.02\ )\ (\ .000276\ )} \right] = 90\ \%$$

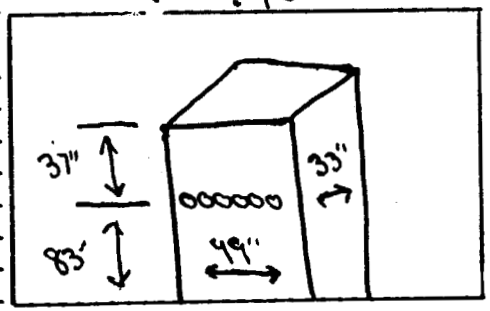
VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant L.J. Earnest

Location Plain Dealing, Louisiana
Operator Shawn Drummond
Date 5/25/87
Run No. 1
Sample Box No. 1
Meter Box No. 6469B2
Meter H @ 1.69
C Factor 0.9946
Pitot Tube Coefficient Cp .90

M = .70



Ambient Temperature 75°
Barometric Pressure 30.03
Assumed Moisture, % 30
Probe Length, m(ft) 4 ft.
Nozzle Identification No. D-0007761
Avg. Calibrated Nozzle Dia., (in.) 0.249 | 0.235 | 0.229
Probe Heater Setting 5
Leak Rate, m^3/min. (cfm) +0.004
Probe Liner Material 316 Stainless Steel
Static Pressure, mm Hg (in. Hg) 0.05 | 13.6
Filter No. 96-1977

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	681	300
INITIAL	300	279
DIFFERENCE	481	10

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft³	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	7:37 / 7:39	3	205	2.7	1.9	823.05 / 823.01	85	75	245	50
2	7:41	4	210	3.1	2.2	825.30	90	75	250	50
3	7:43	4	205	3.0	2.1	826.99	95	75	250	50
4	7:45	3	210	2.6	1.8	828.56	100	75	250	50
5	7:47	3	205	2.3	1.6	829.99	100	80	250	50
B) 1	7:48 / 7:50	4	200	2.8	2.0	831.76	100	80	255	50
2	7:52	4	205	3.0	2.1	833.26	105	80	250	50
3	7:54	5	205	3.4	2.4	834.98	105	80	250	50
4	7:56	3	205	2.7	1.9	836.64	110	80	255	50
5	7:58	3	205	2.4	1.7	838.07	110	80	255	55
C) 1	7:59 / 8:01	3	205	2.2	1.5	839.43	105	80	250	55
2	8:03	3	210	2.5	1.8	840.94	110	80	255	55
3	8:05	3	210	2.4	1.7	842.47	110	80	260	55

O_2 = 11.5% CO_2 = 4.0%

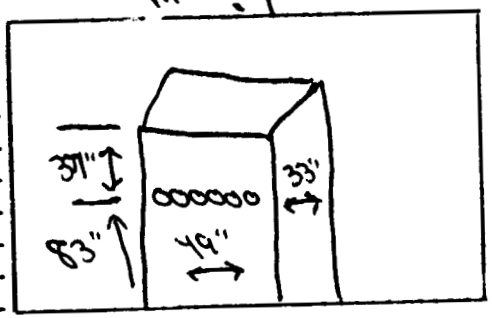
RAMCON emissions test log sheet, cont. DATE 5/25/87 LOCATION Plain Dealing, La. TEST NO. 1

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
4	8:07	3	215	2.1	1.5	843.88	110	80	255	55
5	8:09	3	215	1.8	1.3	845.17	110	80	260	55
B) 1	8:10 30 / 8:12 30	2	200	1.3	0.91	846.54	105	85	260	55
2	8:14 30	2	210	1.6	1.1	847.68	110	85	260	55
3	8:16 30	2	215	1.7	1.2	848.99	110	85	260	55
4	8:18 30	2	215	1.4	0.98	850.09	110	85	260	55
5	8:20 30	2	215	1.0	0.70	851.11	110	85	255	55
C) 1	8:21 / 8:23	1	190	0.40	0.28	851.78	110	85	255	55
2	8:25	1	200	0.55	0.39	852.57	110	85	260	55
3	8:27	1	210	0.65	0.46	853.42	110	85	260	60
4	8:29	1	215	0.60	0.42	854.20	110	85	255	60
5	8:31	1	215	0.45	0.32	854.89	110	85	250	60
D) 1	8:32 / 8:34	1	130	0.15	0.11	855.31	110	85	250	60
2	8:36	1	160	0.20	0.14	855.89	110	90	255	60
3	8:38	1	195	0.05	0.04	856.23	110	90	260	60
4	8:40	1	205	0.05	0.04	856.55	110	90	260	60
5	8:42	1	210	0.05	0.04	856.88	110	90	265	60

RAMCON ENVIRONMENTAL CORPORATION

Plant L.J. Earnest

Location Plain Dealing, Louisiana
Operator Shawn Sherwood
Date 5/25/87
Run No. 2
Sample Box No. 2
Meter Box No. 646882
Meter H @ 1.69
C Factor 0.9946
Pitot Tube Coefficient Cp .80



		IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
Ambient Temperature	78°		
Barometric Pressure	30.02 FINAL	690	317
Assumed Moisture, %	30 INITIAL	300	305
Probe Length, m(ft)	4 ft DIFFERENCE	490	12
Nozzle Identification No.	0.0002761		
Avg. Calibrated Nozzle Dia., (in.)	0.179 | 0.177 | 0.175		
Probe Heater Setting	5		
Leak Rate, m^3/min. (cfm)	+0.018		
Probe Liner Material	316 Stainless Steel		
Static Pressure, mm Hg (in. Hg)	0.05 | 13.6		
Filter No.	86-1978		

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H_2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	9:13 / 9:15	5	205	2.9	2.0	857.03 / 859.68	95	90	245	50
2	9:17	6	210	3.2	2.2	866.39	105	90	250	50
3	9:19	7	215	3.3	2.3	868.16	110	90	250	50
4	9:21	7	220	2.7	1.9	863.71	115	90	250	50
5	9:23	6	220	2.4	1.7	865.27	115	90	250	50
B) 1	9:24 / 9:26	7	220	3.2	2.2	866.81	110	90	255	50
2	9:28	8	215	3.3	2.3	868.77	115	90	255	55
3	9:30	8	215	3.5	2.5	870.60	120	90	255	55
4	9:32	8	215	3.3	2.2	872.45	120	90	259	55
5	9:34	7	220	3.0	2.1	874.08	120	90	260	55
C) 1	9:36 / 9:38	6	210	2.6	1.8	875.63	115	90	260	55
2	9:40	6	215	2.9	2.0	877.20	115	90	260	55
3	9:42	7	215	3.0	2.1	878.93	120	90	260	55

O_2 = 13.5% CO_2 = 4.0%

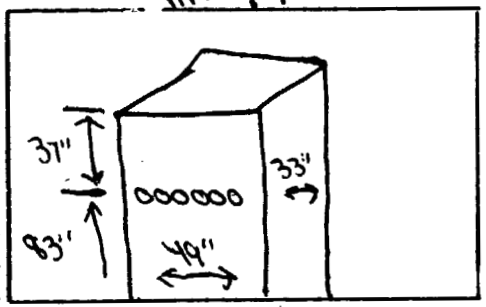
RAMCON emissions test log sheet, cont. DATE 5/25/87 LOCATION Plain Dealing, La TEST NO. 2

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME Vm (ft^3)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
4	9:44	6	215	2.7	1.9	880.52	120	90	260	55
5	9:46	5	210	2.3	1.6	882.05	120	90	260	55
D 1	~~9:46~~ 9:48	4	200	1.6	1.1	883.43	120	90	260	55
2	~~9:48~~ 9:50	4	205	1.7	1.2	884.73	120	90	260	55
3	9:52	4	205	1.7	1.2	886.03	120	90	265	55
4	9:54	3	200	1.4	0.98	887.19	120	90	265	60
5	9:56	3	200	1.2	0.84	888.26	120	90	265	60
E 1	~~9:57~~ 9:59	1	190	0.40	0.28	888.94	115	90	265	60
2	10:01	1	200	0.50	0.35	889.68	115	90	260	60
3	10:03	2	200	0.60	0.42	890.46	120	95	260	60
4	10:05	1	200	0.30	0.21	891.05	120	95	260	60
5	10:07	1	200	0.25	0.18	891.53	120	95	255	60
F 1	~~10:08~~ 10:10	1	165	0.05	0.04	891.85	110	95	250	60
2	10:12	1	170	0.05	0.04	892.07	115	95	255	60
3	10:14	1	185	0.05	0.04	892.28	115	95	260	60
4	10:16	1	190	0.05	0.04	892.49	115	95	265	60
5	10:18	1	190	0.05	0.04	892.72	115	95	270	60

RAMCON ENVIRONMENTAL CORPORATION

Plant L.J. Ernest

Location Plain Dealing, Louisiana
Operator Shawn Greenwood
Date 5/25/97
Run No. 3
Sample Box No. 3
Meter Box No. 946882
Meter H @ 1.69
C Factor 0.9940
Pitot Tube Coefficient Cp .80



		IMPINGER VOLUME ml	SILICA GEL WEIGHT g
Ambient Temperature 80°			
Barometric Pressure 30.05	FINAL	695	314
Assumed Moisture, % 30	INITIAL	200	301
Probe Length, m(ft) 4'	DIFFERENCE	495	13

Nozzle Identification No. 0.500x2761
Avg. Calibrated Nozzle Dia., (in.) 0.315 | 0.315 | 0.315
Probe Heater Setting 5
Leak Rate, m^3/min. (cfm) +0.019
Probe Liner Material 316 Stainless Steel
Static Pressure, mm Hg (in.Hg) 0.05 | 13.5
Filter No. 96-1960

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H20	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	10:39 / 10:41	7	205	3.2	2.2	892.90 / 894.59	100	95	245	50
2	10:43	8	200	3.4	2.4	896.36	110	95	245	50
3	10:45	9	205	3.5	2.5	898.13	115	95	250	50
4	10:47	8	205	3.0	2.1	899.83	115	95	250	50
5	10:49	7	205	2.8	2.0	901.51	110	95	255	50
B) 1	10:50 / 10:52	8	200	3.3	2.3	903.26	110	95	255	50
2	10:54	9	205	3.4	2.4	904.96	110	95	255	50
3	10:56	9	205	3.6	2.5	906.63	110	95	255	55
4	10:58	8	210	3.0	2.1	908.28	110	95	255	55
5	11:00	7	210	2.7	1.9	909.96	110	95	255	55
C) 1	11:00:30 / 11:02:30	7	210	2.6	1.8	911.49	115	95	255	55
2	11:04:30	8	210	2.8	2.0	913.04	120	95	260	55
3	11:06:30	8	210	2.9	2.0	914.64	120	95	260	55

O_2 = 14.5% CO_2 = 3.5%

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 5/25/87 LOCATION Plain Dealing, La TEST NO. 3

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME Vm (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
4	11:08 20	7	210	2.5	1.8	916.20	120	95	260	55
5	11:10 20	6	210	2.3	1.6	917.86	120	95	260	55
D 1	11:11 ~~11:13~~ 2	5	200	1.7	1.2	919.19	115	95	260	55
2	11:15 20	5	205	1.8	1.3	920.54	120	95	255	55
3	11:17 20	6	205	2.0	1.4	921.88	120	95	255	~~55~~ 60
4	11:19 20	5	210	1.7	1.2	923.24	125	95	250	60
5	11:21 20	5	215	1.5	1.1	924.55	125	95	250	60
E 1	11:21 ~~11:21~~ 2	3	200	0.55	0.39	925.33	120	95	250	60
2	11:26 20	3	200	0.65	0.46	926.18	120	95	250	60
3	11:28 20	4	200	0.75	0.53	927.04	120	100	255	60
4	11:30 20	3	205	0.60	0.42	927.78	120	100	255	65
5	11:32 20	2	210	0.45	0.32	928.50	120	100	260	65
F 1	11:33 ~~11:35~~ 2	1	185	0.05	0.04	928.89	120	100	260	65
2	11:37	1	190	0.05	0.04	929.04	120	100	265	65
3	11:39	1	195	0.05	0.04	929.21	120	100	265	65
4	11:41	1	200	0.05	0.04	929.39	120	100	270	65
5	11:43	1	205	0.05	0.04	929.48	120	100	270	65

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 5-25-87 Meter box number 646882

Barometric pressure, P_b = 30.13 in. Hg Calibrated by KSH

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), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Avg[a] (t_d), °F	Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	6	92.98 / 104.21	79	110 / 112	88 / 88	99.5	14:36	0.9985	1.617
1.0	5	91.87 / 97.055	79	113 / 114	88 / 88	100.75	8:53	1.0015	1.719
1.5	10	80.97 / 91.263	79	114 / 116	86 / 87	100.75	14:24	1.0071	1.695
2.0	10	70.15 / 80.38	79	112 / 115	84 / 86	99.25	12:30	1.0093	1.710
3.0	10								
4.0	10								
							Avg	1.0041	1.69

$$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t + 460)} \qquad \Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \Theta}{V_w} \right]^2$$

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	Y_i	$\Delta H@_i$
0.5	0.0368		
1.0	0.0737		
1.5	0.110		
2.0	0.147		
3.0	0.221		
4.0	0.294		

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

Quality Assurance Handbook M4-2.3A (front side)

Form #REC-02

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 5-22-87 Meter box number 646882

Barometric pressure, P_b = 30.15 in. Hg Calibrated by WX

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), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	6	198.6 / 804.919	77	106 / 108	84 / 85	95.75	14:45	.9925	1.65
1.0	5	805.69 / 810.902	77	110 / 112	85 / 86	98.25	8:51	.9949	1.70
1.5	10	811.53 / 821.944	77	110 / 115	86 / 86	99.25	14:30	.9964	1.71
2.0	10								
3.0	10								
4.0	10								
							Avg	.9944	1.69

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w} \right]^2$
0.5	0.0368		
1.0	0.0737		
1.5	0.110		
2.0	0.147		
3.0	0.221		
4.0	0.294		

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

RAMCON

Lear Siegler Stack Sampler

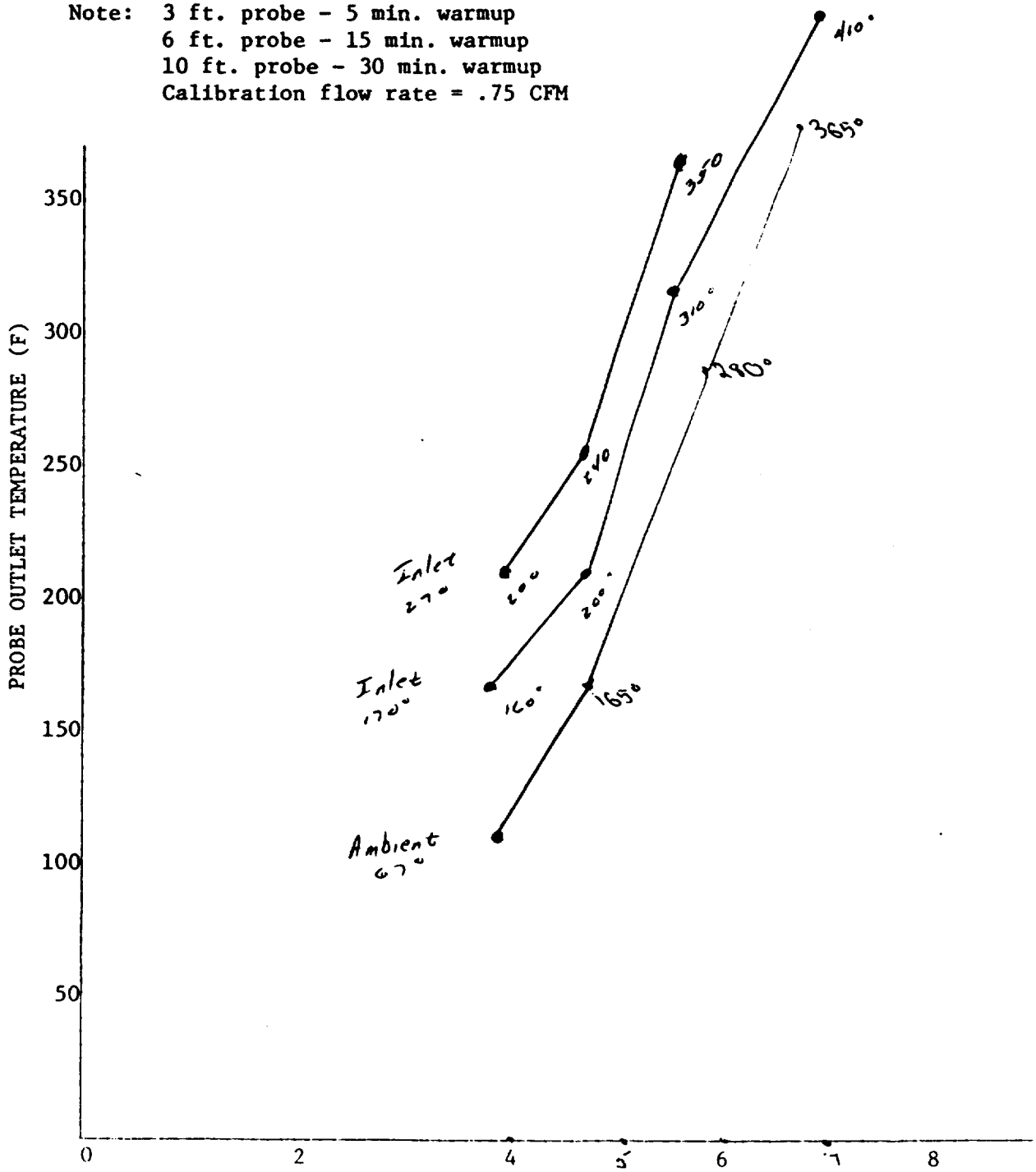
Heating Probe Calibration

Probe No. 44 Probe Length 4'

Date of Calibration 12-18-86 Signature K. B. Allen

Name of Company to be tested _____

Note: 3 ft. probe - 5 min. warmup
6 ft. probe - 15 min. warmup
10 ft. probe - 30 min. warmup
Calibration flow rate = .75 CFM



PITOT TUBE CALIBRATION DATA

Calibration pitot tube: type S size (OD) 3/8 ID number 44

Type S pitot tube ID number 44 $C_{p(std)}$ = 1

Calibration: date 1-8-87 performed by [illegible]

A-Side Calibration

Δp_{std}, cm (in.) H_2O	Δp_s, cm (in.) H_2O	$C_{p(S)}$ [a]	DEV. [b]
.92	1.5	.78	.01
.74	1.15	.80	.01
.82	1.3	.79	.00
Average		.79	

B-Side Calibration

Δp_{std}, cm (in.) H_2O	Δp_s, cm (in.) H_2O	$C_{p(S)}$ [a]	DEV. [b]
.92	1.5	.78	.01
.74	1.15	.80	.01
.82	1.3	.79	.00
Average		.79	

[a] $C_{p(S)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$ = _____

[b] $DEV = C_{p(S)} - \bar{C}_p$, (must be ≤ 0.01)

$\bar{C}_p(A) - \bar{C}_p(B)$ = _____ (must be ≤ 0.01).

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 12-17-86 Thermocouple number 44 (4')

Ambient temperature 21.1 °C °C Barometric pressure 25.76 in. Hg

Calibrator [illegible] Reference: mercury-in-glass ✓

other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] %
A	Ambient	70°F 21.1°C	70°F 21.1°C	.00
B	Ice water	2°C	35°F 1.7°C	.001
C	Boiling water	212°F 100°C	219°F 103.9°C	-.01
D	Boiling 0.1	244°F 117.8°C	254°F 123.3°C	-.01
E	Ambient 5-25-87	75°F	75°F	0%

[a] Every 30°C (50°F) for each reference point.

[b] Type of calibration system used.

[c] $\left[\frac{\text{(ref temp, °C + 273) - (test thermom temp, °C + 273)}}{\text{ref temp, °C + 273}}\right] 100 \leq 1.5\%$.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-19-86 Thermocouple number inlet/outlet

Ambient temperature 23.9 °C Barometric pressure 30.12 in. Hg

Calibrator [illegible] Reference: mercury-in-glass ✓

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	inlet Ambient	75°F	75°F	0.0%
B	outlet Ambient	75°F	75°F	0.0%
C	Ambient 5-25-87	75°F	75°F	0%

[a] Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%$.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-19-86 Thermocouple number Hot box

Ambient temperature 23 °C Barometric pressure 30.12 in. Hg

Calibrator LA Reference: mercury-in-glass ✓

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	Boiling water	100 °C	100 °C	0%
B	Ambient	23 °C	22.8 °C	< 1%
	5-25-87	75°F	75°F	0%

[a] Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%$.