RAMCON ENVIRONMENTAL CORPORATION

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

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
LINCOLN ASPHALT PAVING, INC.
RUSTON, LOUISIANA
October 8, 1986

Mike Haddox
Lincoln Asphalt Paving

G. Sumner Buck, III
President

Sam Turner
Field Supervisor

RAMCON ENVIRONMENTAL CORPORATION

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October 15, 1986

Mr. Mike Haddox
Lincoln Asphalt Paving
P.O. Box 1510
Ruston, LA 71270

Subject: Particulate Emissions Test - Ruston, Louisiana

Dear Mr. Haddox:

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 both EPA New Source Performance Standards and those set by the State of Louisiana. The average grain loading of the three test runs is in compliance with State and Federal Standards.

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

Mr. Robert McMullen
Louisiana Air Quality Division
P.O. Box 739
Shreveport, LA 71162

You will need to keep one copy of the report at the plant. 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 October 8, 1986, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Lincoln Asphalt Paving's A.D.M. drum mix asphalt plant located in Ruston, Louisiana. RAMCON personnel conducting the test were Sam Turner, Field Supervisor and Allen Turner. Kim Rea was responsible for the final 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. Turner and Ms. Rea.

The purpose of the test was to determine if the rate of emissions from the plant's scrubber and the total contaminants by weight (grain loading) are below the limits set by US EPA N.S.P.S. and the State of Louisiana.

II. TEST RESULTS

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

TABLE I

SUMMARY OF TEST RESULTS
October 8, 1986

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	07:38 to 08:41	0.0186 gr/DSCF	99%	1.1 lbs/hr
2	09:12 to 10:16	0.0208 gr/DSCF	108%	1.3 lbs/hr
3	10:45 to 11:48	0.0340 gr/DSCF	82%	2.8 lbs/hr
	Average:	0.0245 gr/DSCF		1.7 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 EPA and the State of Louisiana. Therefore, the plant is operating in compliance with Federal and State Standards.

III. TEST PROCEDURES

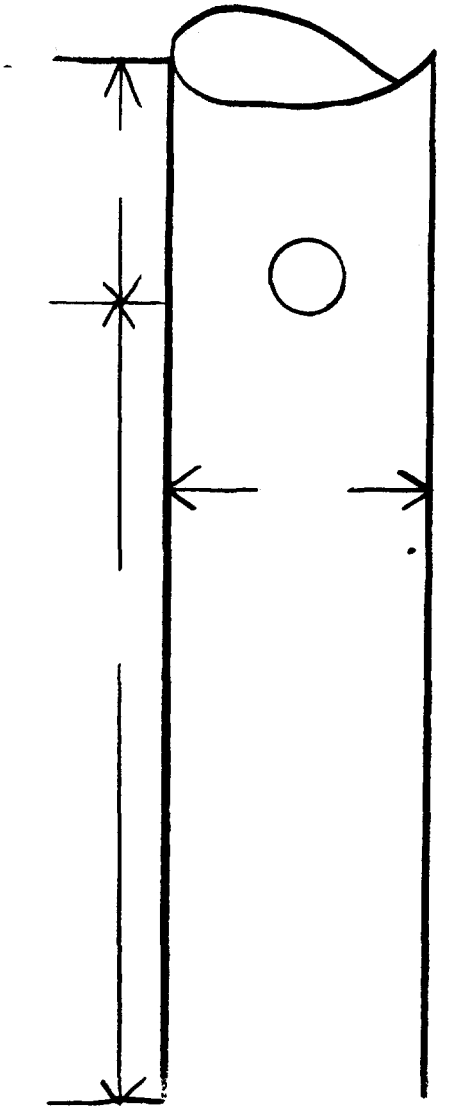
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

B. Problems Encountered: Test run three was sampled at an isokinetic sampling rate slightly below the 90% limit set by EPA. Since a low isokinetic rate tends to bias against the source and since all three runs are well below the allowable .04 gr/DSCF, RAMCON Environmental recommends acceptance of all three test runs as demonstration of compliance with N.S.P.S.

C. Sampling Site: The emissions test was conducted after a scrubber on a round stack with a diameter of 46.5". The sampling ports were placed 48" down (1.0 diameters upstream) from the top of the stack and 180" up (3.9 diameters downstream) from the last flow disturbance. Twenty four points were sampled, twelve through each traverse for 2.5 minutes each.

Points on a Diameter	Probe Mark
1	*6.0"
2	8.1"
3	10.5"
4	13.2"
5	16.6"
6	21.5"
7	35.0"
8	39.9"
9	43.3"
10	46.0"
11	48.4"
12	50.5"

* Measurements include a 5" standoff.



IV. THE SOURCE

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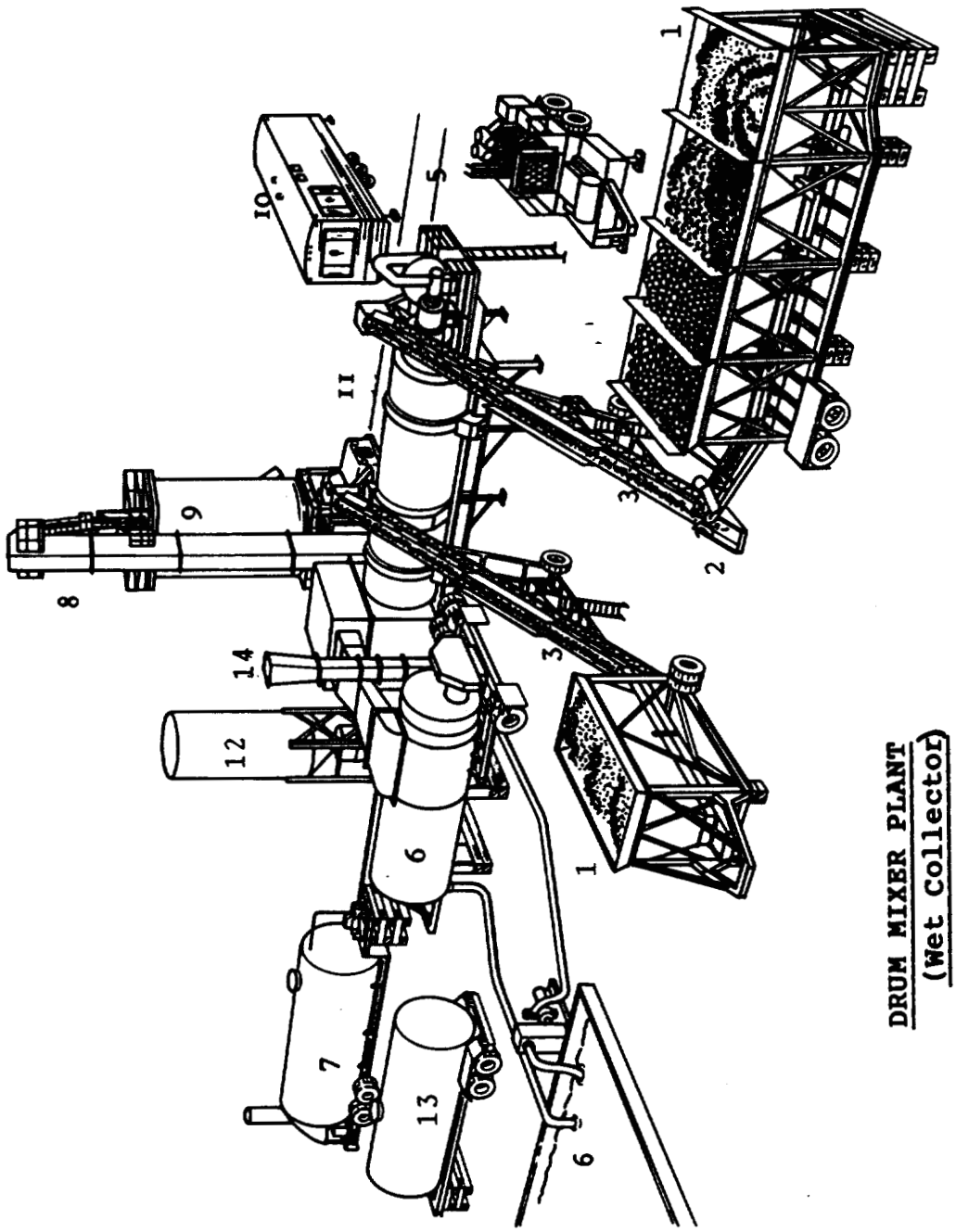
Lincoln Asphalt Paving employs an A.D.M. drum mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind the 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 weigh conveyor then to a rotating drum for continuous mixing and drying at approximately 300°F. The required amount of hot asphalt oil is then injected onto and mixed into the dried aggregate. The now newly formed hot asphalt mix is pulled to the top of a storage silo by conveyor. The hot asphalt mix is then discharged from the storage silo 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 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 burner and the mixing drum, the air passes through a high efficiency scrubber. The scrubber is manufactured by A.D.M. The exhaust gasses are drawn through the scrubber and discharged to the atmosphere through the stack. The design pressure drop across the venturi is in excess of 8 inches of water. The particulate matter, which is removed by the scrubber is fed into the scrubber pond where it drops out of suspension.



DRUM MIXER PLANT
(Wet Collector)

1. Aggregate bins: Virgin and recycled aggregate is fed individually into each of the bins by type. It is metered onto a conveyor belt running under the bins to a shaker screen. The proportion of each aggregate type is determined by the job mix formula and pre-set to be metered out to meet these specifications.

2. Preliminary oversize screen: The aggregate is fed through a shaker screen where oversize rocks and foreign material is screened out of the mix.

3. Weigh conveyor belt: The aggregate is conveyed to the rotary drum dryer on a conveyor belt which weighs the material. The production rate is determined by this weight reading.

4. Rotary drum dryer/mixer: The aggregate is fed into the rotary drum dryer where it is tumbled by flighting into a veil in front of a gas flame which drives off the moisture. Further mixing is also accomplished in this drum. Hot liquid asphalt is injected approximately one-third of the way down the inclined drum where it is mixed with the aggregate.

5. Burner: The fuel fired burner is used to dry the rough aggregate and sand in the rotating drum as well as reheat recycled asphalt when it is part of the mix.

6. Wet scrubbing system: A system of cyclonic action, spray nozzles and a venturi removes 99% of particulates in the gas stream.

7. Liquid asphalt storage: The liquid asphalt is stored in this heated tank until it is needed in the mixer. The amount of asphalt content and its temperature are pre-set for each different type job.

8. Conveyor to surge/storage bin: The finished product of aggregate mixed with liquid asphalt is conveyed to a surge bin.

9. Surge/storage bin: The asphaltic cement is dumped into this surge bin and metered out to dump trucks which pull underneath the slide gate at the bottom of the bin.

10. Control/operators house: The entire plant operation is controlled from this operator's house.

11. Truck loading scale: As the trucks receive the asphalt from the storage/surge bin they are weighed on the loading scale which tells the plant operator the amount of asphalt that is being trucked on each individual load.

12. Mineral filler system (when used).

13. Burner fuel storage (when used).

14. Stack.

DATA SUMMARY

Plant

1. Manufacturer of plant Asphalt Drum Mixers, Inc
2. Designed maximum operating capacity 100 TPH @ 5 % moisture.
3. Actual operation rate ? TPH @ 3.5 % moisture.
4. Startup date 7-29-86.
5. Type of fuel used in dryer Nat Gas.
6. Quanity of fuel consumption 400 CFM.

Aggregate

7. Name/type of mix DotD Type I wearing Course
8. Percent asphalt in mix 5.0 %.
9. Temperature of asphalt 310.
10. Sieve/Screening analysis: % Passing;

1"	100%	3/8"	~~100%~~	#N.4	28%
3/4"	100%	# N4	61%	# N8	17%
1/2"	91%	# N0	46%	#200	5%

Scrubber Control System

11. Manufacturer ADM, Inc.
12. Type; Venturi X; Wet Washer ____;
    Spray Booth ____; Other ____.
13. Water line pressure 24 psi.
14. Pressure drop across system 14" W.C 6.1 psi.
15. Gallons per minute through system 40.
16. Water source pond (i.e., lagoon, pond, etc.)
17. Number of spray nozzles 16.

COMPANY NAME Asphalt Drum Mixers, Inc

COMPANY REPRESENTATIVE [signature]

DATE 10-6-86

PLANT DATA (8)

COMPANY NAME Lincoln Asphalt Paving Inc.
COMPANY REP. J.W. Clemons DATE Oct. 2, 1986 PHONE # (318) 255-9282
DATA SOURCE
PLANT LOCATION Parish Rd #455 Ruston LA, 71273
PLANT MFG. ADM PLANT MODEL # DM6028P PLANT TYPE Drum
MIX SPECIFICATION # Type I OIL SPECIFICATION # ———

Time 24 Hour	___ Fuel Oil ___ Nat. Gas___ Propane___ Coal ___ _____	Burner Setting _____	Aggregate TPH	Recycle TPH	Liquid Asphalt TPH	Mix Temp. °F	___ Venturi ___Baghouse Pressure Drop Inches Water
0950	Nat Gas	50	72	—	3.6	320	14
10.10	"	55	77	—	3.9	300	14
10.22	"	58	80	—	4.1	315	14
10.35	"	57	79	—	4.0	310	14
	"			—			
	"			—			
	"			—			
	"			—			
	"			—			
	"			—			

REC #04

PLANT DATA

COMPANY NAME Lick asphalt & Paving Inc

COMPANY REP. J.W. Cummings DATE Oct 8, 1986 Phone # 257-2412

DATA SOURCE

PLANT LOCATION Pit Road 405 Rock Inc - 7127

PLANT MANUFACTURER A.D. Mac PLANT MODEL NO. PLANT TYPE

MIX SPECIFICATION NO. Type I 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
7.30	Not Gas	90	78	—	3.8	315	
7.50	—	96	82	—	4.2	300	
8.10	—	93	81	—	4.1	307	
8.25	—	91	81	—	4.1	305	
8.40	—	90	80	—	4.0	310	
9.15	—	88	78	—	3.8	305	
9.30	—	89	80		4.1	300	
9.50	—	85	80	—	4.1	305	
10.10	—	92	78	—	3.8	300	
10.30	—	89	78	—	3.7	310	
10.50	—	90	80	—	4.1	300	
11.05	—	95	77	—	3.7	300	
11.25	—	82	81	—	4.2	310	
11.45		79	80	—	4.1	305	

REMARKS:

V. EQUIPMENT USED

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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.

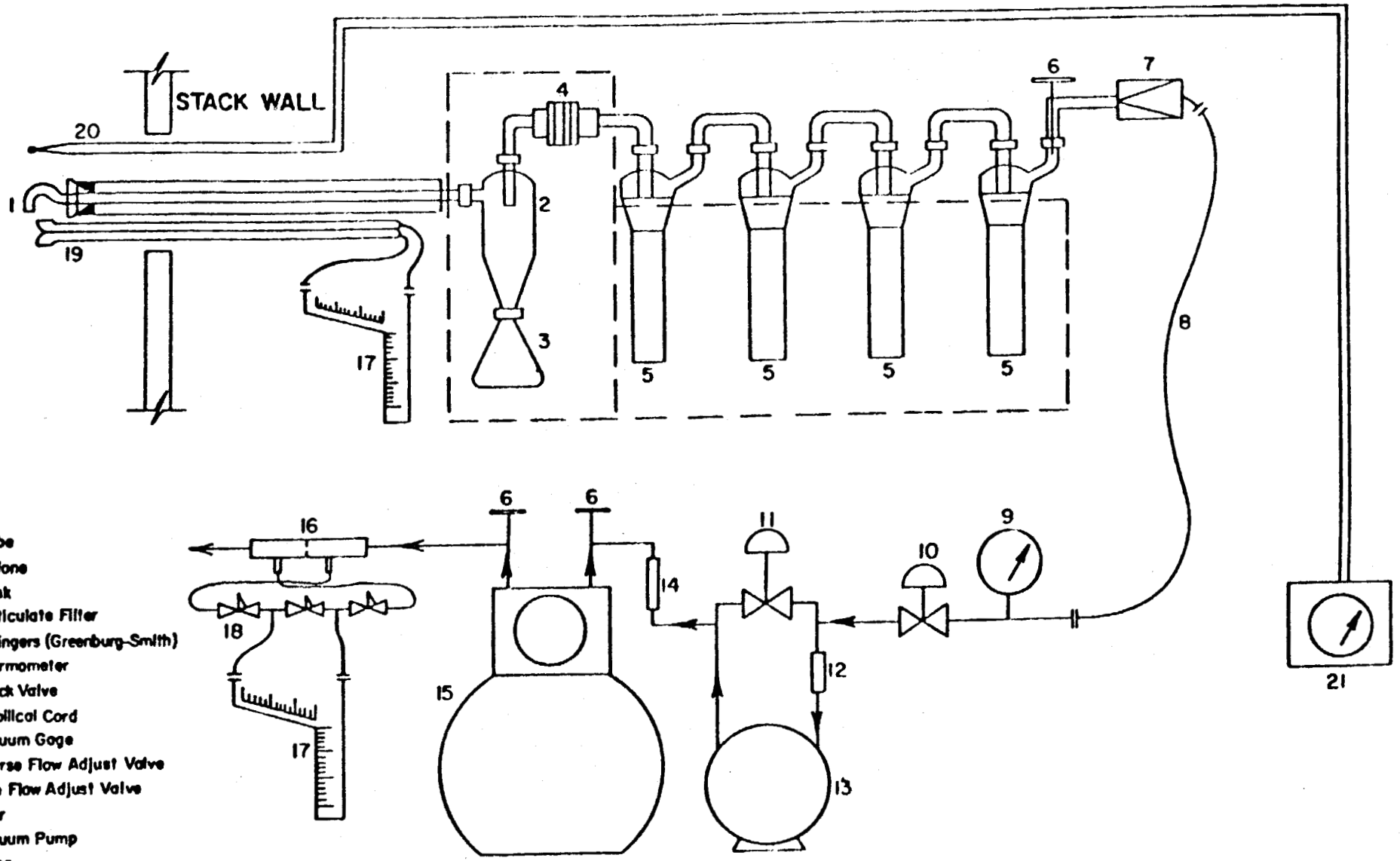
C. Weston dial thermometers are used to check meter temperatures. An Analogic Model 2572 Digital Thermocouple is used for stack temperatures.

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



1) Probe
2) Cyclone
3) Flask
4) Particulate Filter
5) Impingers (Greenburg-Smith)
6) Thermometer
7) Check Valve
8) Umbilical Cord
9) Vacuum Gage
10) Course Flow Adjust Valve
11) Fine Flow Adjust Valve
12) Oiler
13) Vacuum Pump
14) Filter
15) Dry Gas Meter
16) Orifice Tube
17) Incline Manometer
18) Solenoid Valves
19) Pitot
20) Thermocouple
21) Pyrometer

SAMPLING TRAIN
USED FOR ISOKINETIC SAMPLING

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.

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.

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.

Form REC#8

SAMPLE ANALYTICAL DATA FORM

Plant Location Lincoln Asphalt — Relative humidity in lab 45 %

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

Blank volume (V_a) 200 ml

Date/Time wt. blank 10-10-86 — Gross wt. 98.6754 mg

Date/Time wt. blank 10-13-86 — Gross wt. 98.6753 mg

Ave. Gross wt. 98.6754 mg

Tare wt. 98.6751 mg

Weight of blank (m_{ab}) .0003 mg

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (p_a) = (.0000019 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} p_a$ = (.0000019)(200)(.7853) = (.0003)

		Run #2	Run #3	Run #4
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt 10-10-86	Gross wt g	99.8112	98.4812	95.7714
Date/Time of wt 10-13-86	Gross wt g	99.8109	98.4810	95.7711
	Average Gross wt g	99.8111	98.4811	95.7713
	Tare wt g	99.7967	98.4613	95.7133
	Less acetone blank wt (W_a) g	.0003	.0003	.0003
Wt of particulate in acetone rinse (m_a)	g	.0141	.0195	.0577

Filter Numbers	#	RC-1690	RC-1689	RC-1691
Date/Time of wt 10-10-86	Gross wt g	.5449	.5450	.5436
Date/Time of wt 10-13-86	Gross wt g	.5446	.5450	.5434
	Average Gross wt g	.5448	.5450	.5435
	Tare wt g	.5181	.5151	.5170

Weight of particulate on filters(s) (m_f)	g	.0267	.0299	.0265
Weight of particulate in acetone rinse	g	.0141	.0195	.0577
Total weight of particulate (m_n)	g	.0409	.0494	.0842

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 Rea — Signature of reviewer S Tsai

VII. CALCULATIONS

NAME: LINCOLN ASPHALT PAVING, INC.

LOCATION: RUSTON, LOUISIANA

			date	10/08/86	10/08/86	10/08/8
	SUMMARY OF TEST DATA			RUN # 1	RUN # 2	RUN #
	SAMPLING TRAIN DATA		start	07:38	09:12	10:45
			finish	08:41	10:16	11:48
1	Sampling time, minutes		θ	60	60	60
2	Sampling nozzle diameter, in.		Dn	.415	.415	.415
3	Sampling nozzle cross-sectional area, ft^2		An	.000939	.000939	.000939
4	Isokinetic variation		I	99	108	82
5	Sample gas volume - meter conditions, cf.		Vm	34.56	37.75	39.39
6	Average meter temperature, °R		Tm	547	554	552
7	Average oriface pressure drop, in.H_2O		ΔH	1.17	1.37	1.28
8	Total particulate collected mg.		Mn	40.9	49.4	84.2
	VELOCITY TRAVERSE DATA					
9	Stack area, ft^2		A	11.8	11.8	11.8
10	Absolute stack gas pressure, in. Hg.		Ps	30.16	30.25	30.16
11	Barometric pressure, in. Hg.		Pbar	30.16	30.25	30.16
12	Average absolute stack temperature, °R		Ts	623	625	628
13	Average $\bar{\sqrt{\text{velocity head}}}$, (Cp= .80)		$\bar{\sqrt{\Delta P}}$	.29	.30	.40
14	Average stack gas velocity ft. / sec.		Vs	18	18	25
	STACK MOISTURE CONTENT					
15	Total water collected by train, ml.		Vic	361.0	447.0	415.0
16	Moisture in stack gas, %		Bws	33.5	36.5	33.9
	EMISSIONS DATA:					
17	Stack gas flow rate, dscf/hr. (000's)		Qsd	427	425	584
18	Total particulate concentration, gr/dscf		Cs	.0186	.0208	.0340
19	Total particulate concentration, lbs/hr		E	1.1	1.3	2.8
20	Total particulate concentration, lbs/mbtu		E^1	.0000	.0000	.0000
	ORSAT DATA					
21	Percent CO2 by volume		CO2	10.0	10.0	10.0
22	Percent O2 by volume		O2	11.0	11.0	11.0
23	Percent CO by volume		CO	.0	.0	.0
24	Percent N2 by volume		N2	79.0	79.0	79.0

Buzzycalc

Dry Gas Volume :

$$V_{m(std)} = V_m \left[\frac{T_{(std)}}{T_m} \right] \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{(std)}} \right] = 17.64 \frac{^\circ R}{in.Hg.} \; Y \; V_m \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right]$$

Where:

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

V_m = Dry Gas Volume measured by meter, cu.ft.

P_{bar} = Barometric pressure at oriface meter, in. Hg.

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

T_m = Absolute temperature at meter $^\circ R$

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

ΔH = Average pressure drop across oriface meter, in.H_2O

Y = Dry gas meter calibration factor

13.6 = Inches water per inches Hg.

Run # 1 $V_{m(std)} = 17.64 \quad (1.00)(\ 34.56) \left[\frac{(30.16) + \frac{1.17}{13.6}}{547} \right] = 33.78$ dsc

Run # 2 $V_{m(std)} = 17.64 \quad (1.00)(\ 37.75) \left[\frac{(30.25) + \frac{1.37}{13.6}}{554} \right] = 36.56$ dsc

Run # 3 $V_{m(std)} = 17.64 \quad (1.00)(\ 39.39) \left[\frac{(30.16) + \frac{1.28}{13.6}}{552} \right] = 38.16$ dsc

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: $$C_s^{'} = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{40.9}{33.78} \right] = .0186 \text{ gr./dscf.}$$

Run # 2: $$C_s^{'} = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{49.4}{36.56} \right] = .0208 \text{ gr./dscf.}$$

Run # 3: $$C_s^{'} = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{84.2}{38.16} \right] = .0340 \text{ gr./dscf.}$$

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: $M_d = 0.44(10.0\%) + 0.32(11.0\%) + 0.28(\ .0\% + 79.0\%) =$ 30.0 lb./lb.-mole

Run # 2: $M_d = 0.44(10.0\%) + 0.32(11.0\%) + 0.28(\ .0\% + 79.0\%) =$ 30.0 lb./lb.-mole

Run # 3: $M_d = 0.44(10.0\%) + 0.32(11.0\%) + 0.28(\ .0\% + 79.0\%) =$ 30.0 lb./lb.-mole

Water vapor condensed :

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

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

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) (350.0) = 16.5 cu.ft
$V_{wsg(std)}$ = (0.04715) (11.0) = .5 cu.ft

Run # 2: $V_{wc(std)}$ = (0.04707) (440.0) = 20.7 cu.ft
$V_{wsg(std)}$ = (0.04715) (7.0) = .3 cu.ft

Run # 3: $V_{wc(std)}$ = (0.04707) (405.0) = 19.1 cu.ft
$V_{wsg(std)}$ = (0.04715) (10.0) = .5 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: $$B_{ws} = \frac{16.5 + .5}{16.5 + .5 + 33.78} \times 100 = 33.5\ \%$$

Run # 2: $$B_{ws} = \frac{20.7 + .3}{20.7 + .3 + 36.56} \times 100 = 36.5\ \%$$

Run # 3: $$B_{ws} = \frac{19.1 + .5}{19.1 + .5 + 38.16} \times 100 = 33.9\ \%$$

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: $M_s = 30.0\ (1-\ .335\ ) + 18\ (\ .335\ ) = 26.0$ (lb./lb.-mole).

Run # 2: $M_s = 30.0\ (1-\ .365\ ) + 18\ (\ .365\ ) = 25.6$ (lb./lb.-mole).

Run # 3: $M_s = 30.0\ (1-\ .339\ ) + 18\ (\ .339\ ) = 25.9$ (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: $V = (85.49)\,(.80)\,(.29)\sqrt{\frac{623}{(30.16)(25.98)}} = 17.71$ ft/se

Run # 2: $V = (85.49)\,(.80)\,(.30)\sqrt{\frac{625}{(30.25)(25.62)}} = 18.45$ ft/se

Run # 3: $V = (85.49)\,(.80)\,(.40)\sqrt{\frac{628}{(30.16)(25.93)}} = 24.55$ 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:

$$Q_{sd} = 3600\ (1-.335)\ (\ 17.71)\ (\ \ 11.8) \left[\frac{528}{623}\right] \left[\frac{30.16}{29.92}\right] = \quad 427406 \text{ dscf/h}$$

Run # 2:

$$Q_{sd} = 3600\ (1-.365)\ (\ 18.45)\ (\ \ 11.8) \left[\frac{528}{625}\right] \left[\frac{30.25}{29.92}\right] = \quad 425082 \text{ dscf/h}$$

Run # 3:

$$Q_{sd} = 3600\ (1-.339)\ (\ 24.55)\ (\ \ 11.8) \left[\frac{528}{628}\right] \left[\frac{30.16}{29.92}\right] = \quad 584227 \text{ dscf/h}$$

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: $E = \frac{(.0186)(427406)}{7000} = 1.1$ lb. / hr.

Run # 2: $E = \frac{(.0208)(425082)}{7000} = 1.3$ lb. / hr.

Run # 3: $E = \frac{(.0340)(584227)}{7000} = 2.8$ 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:

$$I = 100 \times 623 \left[\frac{(0.002669)(361.0) + \frac{34.6}{547}\left(30.16 + \frac{1.17}{13.6}\right)}{60\ (\ 60\ )\ (\ 17.71\ )\ (30.16\ )\ (\ .000939\ )} \right] = 99\ \%$$

Run # 2:

$$I = 100 \times 625 \left[\frac{(0.002669)(447.0) + \frac{37.8}{554}\left(30.25 + \frac{1.37}{13.6}\right)}{60\ (\ 60\ )\ (\ 18.45\ )\ (30.25\ )\ (\ .000939\ )} \right] = 108\ \%$$

Run # 3:

$$I = 100 \times 628 \left[\frac{(0.002669)(415.0) + \frac{39.4}{552}\left(30.16 + \frac{1.28}{13.6}\right)}{60\ (\ 60\ )\ (\ 24.55\ )\ (30.16\ )\ (\ .000939\ )} \right] = 82\ \%$$

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant Lincoln Paving

Location Ruston La
Operator Sam Turner
Date 10-8-86
Run No. 2
Sample Box No. 2
Meter Box No. 670775
Meter H @ 1.84
C Factor 1.02
Pitot Tube Coefficient Cp .801

.135
1" 1/4

Ambient Temperature 67
Barometric Pressure 30.16
Assumed Moisture, % 3.4
Probe Length, m(ft) 5'
Nozzle Identification No. .009893
Avg. Calibrated Nozzle Dia., (in.) .415 | .415 | .415
Probe Heater Setting 4.5
Leak Rate, m^3/min. (cfm) .008 @ 7" Vac
Probe Liner Material Stainless Steel
Static Pressure, mm Hg (in.Hg) .06 | 13.6
Filter No. RG - 1690

	FINAL	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
	FINAL	550	498
	INITIAL	200	489
	DIFFERENCE	350	11

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		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A 1	7:38 / 7:40:30	1	160	.05	.68	000.30 / 1.40	66	66	245	60
2	7:43	1	160	.05	.68	2.40	80	66	245	60
3	7:45:30	1	161	.05	.68	3.5	86	66	250	60
4	7:48	1	161	.05	.68	4.70	90	66	255	60
5	7:50:30	2	162	.09	1.2	6.20	94	67	255	60
6	7:53	3	162	.12	1.6	7.70	96	68	255	60
7	7:55:30	2	162	.08	1.1	9.30	100	70	250	55
8	7:58	2	164	.08	1.1	10.70	100	70	250	55
9	8:00:30	2	165	.08	1.1	12.10	100	72	255	55
10	8:03	3	164	.10	1.4	13.70	102	72	250	55
11	8:05:30	3	164	.10	1.4	15.30	104	73	250	55
12	8:08	3	163	.10	1.4	16.90	104	74	250	55

Form #REC-05

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 10-8-86 LOCATION Ruston 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 V_m (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
1	~~8:11:30~~ 8:14	1	160	.06	.82	18.20	92	75	255	55
2	8:16:30	1	162	.06	.82	19.60	102	76	255	55
3	8:19	2	163	.08	1.1	20.90	106	76	250	55
4	8:21:30	3	163	.10	1.4	22.40	106	76	(6) 245 ~~250~~	55
5	8:24	3	164	.10	1.4	24.10	108	77	245	55
6	8:26:30	3	164	.08	1.4	25.50	108	78	250	55
7	8:29	3	164	.08	1.4	27.00	108	78	255	55
8	8:31:30	3	165	.09	1.2	28.50	110	79	255	55
9	8:34	3.5	165	.10	1.4	30.10	110	79	250	55
10	8:36:30	4	165	.10	1.4	31.60	110	80	250	55
11	8:39	4	165	.10	1,4	33.20	110	80	250	55
12	8:41:30	4	165	.10	1.4	34.86	112	80	255	55

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RAMCON ENVIRONMENTAL CORPORATION

Plant Sinclair Caphell

Location Rustan Sal
Operator Allen Turner
Date 10-8-86
Run No. 3
Sample Box No. 1
Meter Box No. 670775
Meter H @ 1.84
C Factor 1.02
Pitot Tube Coefficient Cp .80)

Ambient Temperature 65
Barometric Pressure 30.25
Assumed Moisture, % 30
Probe Length, m(ft) 5
Nozzle Identification No. .009393
Avg. Calibrated Nozzle Dia., (in.) .415/.415/.415
Probe Heater Setting 4.5
Leak Rate, m^3/min. (cfm) .019 at 5 inches
Probe Liner Material stainless steel
Static Pressure, mm Hg (in. Hg) +.05 / 13.6
Filter No. 12C-1629

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	640	503
INITIAL	200	496
DIFFERENCE	440	7

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		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
(a) 1	9:12 / 9:14-30	0	160	.03	.47	35.1 / 36.1	90	80	250	55
2	9:17	0	165	.08	1.2	37.5	100	80	250	55
3	9:19-30	1	165	.08	1.2	38.8	100	80	250	55
4	9:22	2	166	.09	1.4	40.3	110	90	250	55
5	9:24-30	2	165	.09	1.4	42.0	110	80	250	55
6	9:27	2	165	.09	1.4	43.6	110	80	250	55
7	9:29-30	2	165	.11	1.7	45.3	110	80	250	55
8	9:32	3	165	.11	1.7	47.3	110	80	250	55
9	9:34-30	3	165	.12	1.9	49.1	110	80	250	55
10	9:37	3	165	.11	1.7	50.8	110	80	250	55
11	9:39-30	3	165	.11	1.7	52.6	110	80	250	55
12	9:42	3	165	.11	1.7	54.3	110	80	250	55

Form #REC-05

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 10/8/86 LOCATION Lincoln 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 V_m (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
(B) 1	~~9:46~~ 9:48-30	3	165	.06	.87	56.0	100	80	260	55
2	9:51	3	165	.06	.82	57.7	100	80	260	55
3	9:53-30	3	165	.08	1.1	58.7	100	80	260	55
4	9:56	3	165	.10	1.4	60.8	110	80	260	55
5	9:58-30	2	165	.10	1.4	61.6	110	80	260	55
6	10:01	3	165	.10	1.4	63.2	110	80	260	55
7	10:03-30	3	165	.10	1.4	64.9	110	80	260	55
8	10:06	3	165	.10	1.4	66.5	110	80	260	55
9	10:08-30	3	165	.10	1.4	68.1	110	80	260	55
10	10:11	3	165	.10	1.4	69.7	110	80	260	60
11	10:13-30	3	165	.16	1.4	71.2	110	80	260	60
12	10:16	3	165	.10	14	72.852	110	80	260	60

RAMCON ENVIRONMENTAL CORPORATION

Plant Sivalon Paving

Location Ruston La.
Operator Adam Turner
Date 10-8-85
Run No. 4
Sample Box No. 3
Meter Box No. 670225
Meter H @ 1.84
C Factor 1.002
Pitot Tube Coefficient Cp .801

Ambient Temperature 67
Barometric Pressure 30.16
Assumed Moisture, % 34
Probe Length, m(ft) 5
Nozzle Identification No. 0009393
Avg. Calibrated Nozzle Dia., (in.) .415/.415/.415
Probe Heater Setting 4.5
Leak Rate, m^3/min. (cfm) .014 at 8" Vac
Probe Liner Material Stainless Steel
Static Pressure, mm Hg (in. Hg) .06 / 13.6
Filter No. RC-1691

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	605	503
INITIAL	200	513
DIFFERENCE	405	10

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		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
(B) 1	10:45 / 10:47:30	0	171	.06	.82	72.9 / 74.3	90	80	250	60
2	10:50	0	170	.06	.82	75.7	100	80	250	60
3	10:52-30	0	170	.66	.82	76.5	100	80	250	60
4	10:55	0	170	.06	.82	77.7	100	80	250	60
5	10:57-30	0	170	.06	.82	78.7	110	80	250	60
6	11:00	0	170	.03	.47	79.5	110	80	250	60
7	11:02-30	0	170	.03	.47	80.4	110	80	250	60
8	11:05	0	170	.03	.47	81.4	110	80	250	60
9	11:07-30	4	170	1.0	1.4	83.0	110	80	250	60
10	11:10	4	170	1.0	1.4	85.1	110	80	250	60
11	10:12-30	4	170	1.0	1.4	87.2	110	80	250	60
12	10:15	4	170	1.0	1.4	89.4	110	80	250	60

Form #REC-05

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 10-8-86 LOCATION Lincoln 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 V_m (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
(G) 1	~~11:18-30~~ 11:30-30	6	165	.08	1.2	91.2	90	80	260	55
2	11:23	6	165	.08	1.2	93.6	100	80	260	60
3	11:25-30	4	165	.08	1.2	95.8	100	80	260	60
4	11:28	4	165	.08	1.2	97.6	100	80	260	60
5	11:30-30	4	168	.11	1.7	99.3	100	80	260	60
6	11:33	4	165	.11	1.7	101.0	100	80	260	60
7	11:35-30	4	165	.12	1.9	102.8	100	80	260	60
8	11:38	4	165	.12	1.9	104.8	100	80	260	60
9	11:40-30	4	165	.12	1.9	106.5	110	80	260	60
10	11:43	4	170	.12	1.9	108.4	110	80	260	60
11	11:45-30	4	170	.12	1.9	110.4	110	80	260	60
12	11:48	4	170	.12	1.9	~~112.3~~ 112.388 (GF)	110	80	260	60

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 10-9-86 Meter box number 670775

Barometric pressure, P_b = 30.20 in. Hg Calibrated by Sam Turay

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	5	149.70 / 154.75	76	100 / 109	79 / 80	92	12.93	1.019	1.83
1.0	5	144.50 / 149.54	76	98 / 109	78 / 79	91	9.17	1.017	1.84
1.5	10								
2.0	10								
3.0	10	134.9 / 144.30	76	100 / 108	74 / 77	89.25	10.52	1.029	1.82
4.0	10								
							Avg	1.022	1.83

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.

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 9-29-86 Meter box number 670775

Barometric pressure, P_b = 30.20 in. Hg Calibrated by Sam Turner

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	5.5	787.50 / 793.11	76	104 / 113	84 / 86	96.25	14.45	1.017	1.87
1.0	5	782.20 / 787.284	76	106 / 114	84 / 84	97	9.2	1.02	1.83
1.5	10								
2.0	10								
3.0	10	771.90 / 781.937	76	100 / 114	82 / 84	95	10.6	1.024	1.83
4.0	10								
							Avg	1.02	1.84

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 ENVIRONMENTAL CORPORATION

Date 5-16-86 Thermocouple number 51

Ambient temperature 23 °C Barometric pressure 30.03 in. Hg

Calibrator Sam Turner Reference: mercury-in-glass ✓

other _____

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
A	Ice water	32°	32°F	0.0%
B	Boiling H2O	512°F	212°F	0.0%
C	Boiling oil	410.5°F	413.2°F	<0.3%
D	Ambient 10-8-86	67°F	67°F	0%

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON

Lear Siegler Stack Sampler

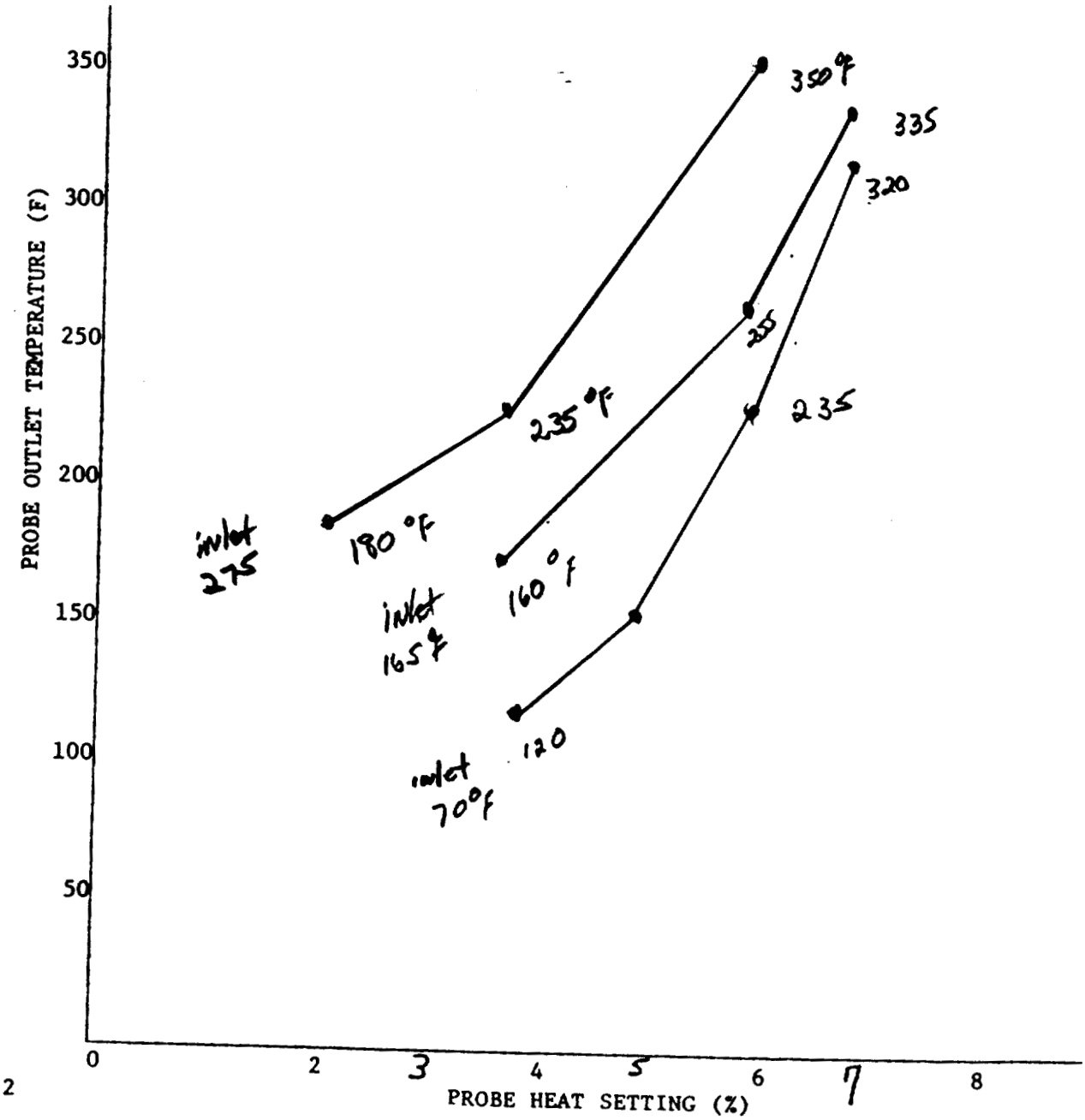
Heating Probe Calibration

Probe No. 51 Probe Length 5'

Date of Calibration 4-3-86 Signature Sam T. Tenny

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



RAMCON ENVIRONMENTAL CORPORATION

Lear Siegler Stack Sampler

Nozzle Diameter Calibration

Date _____ Signature _____

Nozzle No.	Average Diameter	Nozzle No.	Average Diameter
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	

Pitot Tube Calibration (S Type)

Pitot Tube Identification No. 51 Date 5-14-86

Calibrated by: Sam T. Turner

"A" SIDE CALIBRATION

Run No.	Δp std cm H_2O (in. H_2O)	Δp (s) cm H_2O (in. H_2O)	$C_p(s)$	DEVIATION $C_{p(s)}-\bar{C}_p(A)$
1	.58	.90	.803	-.002
2	.90	1.4	.802	-.001
3	.70	1.1	.798	.003
		$\bar{C}_p$ (SIDE A)	.801	

"B" SIDE CALIBRATION

Run No.	Δp std cm H_2O (in. H_2O)	Δp(s) cm H_2O in. H_2O)	$C_p(s)$	DEVIATION $C_p(s)-\bar{C}_p(B)$
1	.58	.90	.803	-.002
2	.90	1.4	.802	-.001
3	.70	1.1	.798	.003
		$\bar{C}_p$ (SIDE B)	.801	

$$\text{AVERAGE DEVIATION} = \sigma(\text{A OR B}) = \frac{\sum_{1}^{3} |C_p(s)-\bar{C}_p(\text{A OR B})|}{3} \leftarrow \text{MUST BE} \leq 0.01$$

$$|\bar{C}_p(\text{SIDE A})-\bar{C}_p(\text{SIDE B})| \leftarrow \text{MUST BE} \leq 0.01$$

$$C_{p(s)} = C_{p(std)}\sqrt{\frac{\Delta p\ std}{\Delta p_s}}$$

RAMCON ENVIRONMENTAL CORPORATION

Date 5-16-86 Thermocouple number Hot Box

Ambient temperature 23 °C Barometric pressure 30.03 in. Hg

Calibrator Sam Turner Reference: mercury-in-glass ✓

other _____

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
A	boiling H_2O	100 °C	100 °C	0 %
B	Ambient	23 °C	22.8°C	< .1 %
	10.8.86	67°F	67°F	0 %

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON ENVIRONMENTAL CORPORATION

Date 5-16-86 Thermocouple number inlet/outlet

Ambient temperature 23 °C Barometric pressure 30.03 in. Hg

Calibrator Sam T. Turner Reference: mercury-in-glass ✓

other _____

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
A	inlet Ambient	73 °F	73 °F	0.0 %
B	outlet Ambient	73 °F	73 °F	0.0 %
C	Ambient 10-8-86	67 °F	67 °F	0 %

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.