RAMCON **ENVIRONMENTAL CORPORATION**

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

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
WINFORD COMPANY
BOSSIER CITY, LOUISIANA
July 1, 1986

Jim Winford
Winford Company

Sumner Buck
G. Sumner Buck, III
President

Cameron Mitchell
J. Cameron Mitchell
Team Leader

RAMCON ENVIRONMENTAL CORPORATION

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July 10, 1986

Mr. Jim Winford
Winford Company
P.O. Box 599
Minden, LA 71058-0599

Subject: Particulate Emissions Test - Bossier City, LA

Dear Mr. Winford:

Enclosed are four copies of our report on particulate emissions. 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 was in compliance with State and Federal Standards.

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

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

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 July 1, 1986, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Winford Company's Stansteel batch mix asphalt plant located in Bossier City, Louisiana. RAMCON personnel conducting the test were Cameron Mitchell, Team Leader and Shawn Greenwood. 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. Mitchell 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 EPA N.S.P.S. limits and those set by 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 maximum allowable particulate emissions for the State of Louisiana is .04 gr/DSCF.

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

TABLE I

SUMMARY OF TEST RESULTS
July 1, 1986

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	08:53 to 09:57	0.0043 gr/DSCF	90%	1.0 lbs/hr
2	10:29 to 12:06	0.0114 gr/DSCF	88%	2.5 lbs/hr
3	12:50 to 14:18	0.0063 gr/DSCF	92%	1.3 lbs/hr
	Average:	0.0073 gr/DSCF		1.6 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

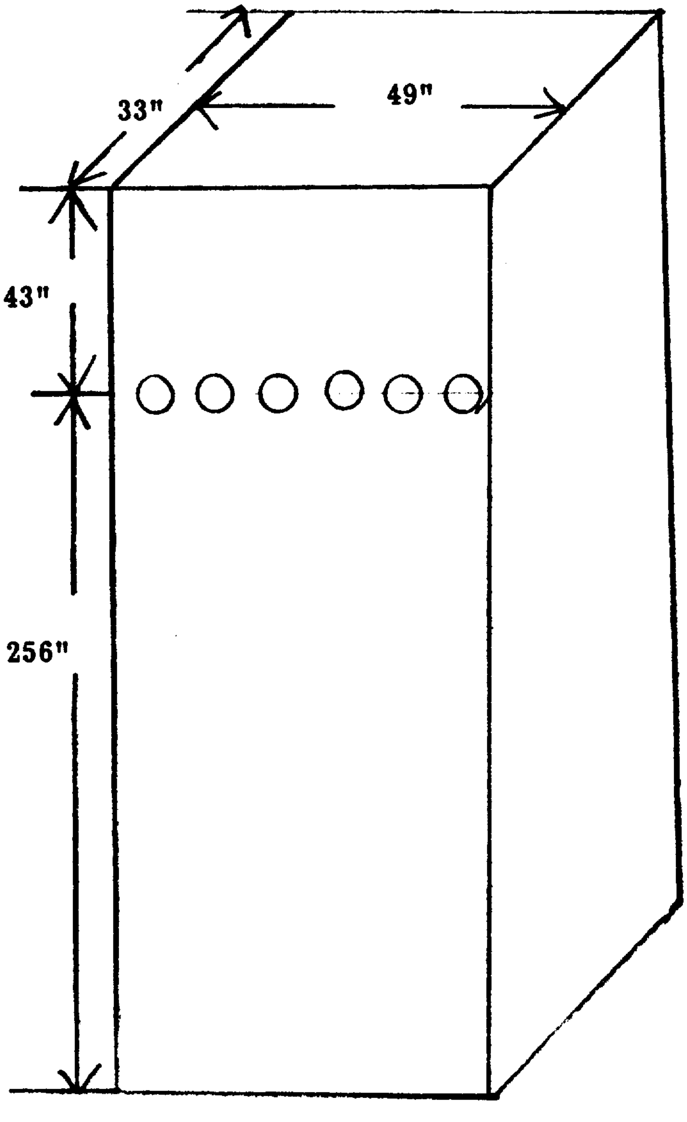
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

B. Problems Encountered: Test run two was sampled at an isokinetic rate slightly below the 90% limitation set by EPA. Since a low isokinetic rate tends to bias the test results against the source, and since all three test runs were well below the .04 gr/dscf emissions standard allowed, RAMCON Environmental recommends acceptance of all three test runs as demonstration of compliance with N.S.P.S. and the State of Louisiana.

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 43" down (1.1 diameters upstream) from the top of the stack and 256" up (6.5 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	*5.3"
2	11.9"
3	18.5"
4	25.1"
5	31.7"

* Measurements include a 2.0" standoff.



IV. THE SOURCE

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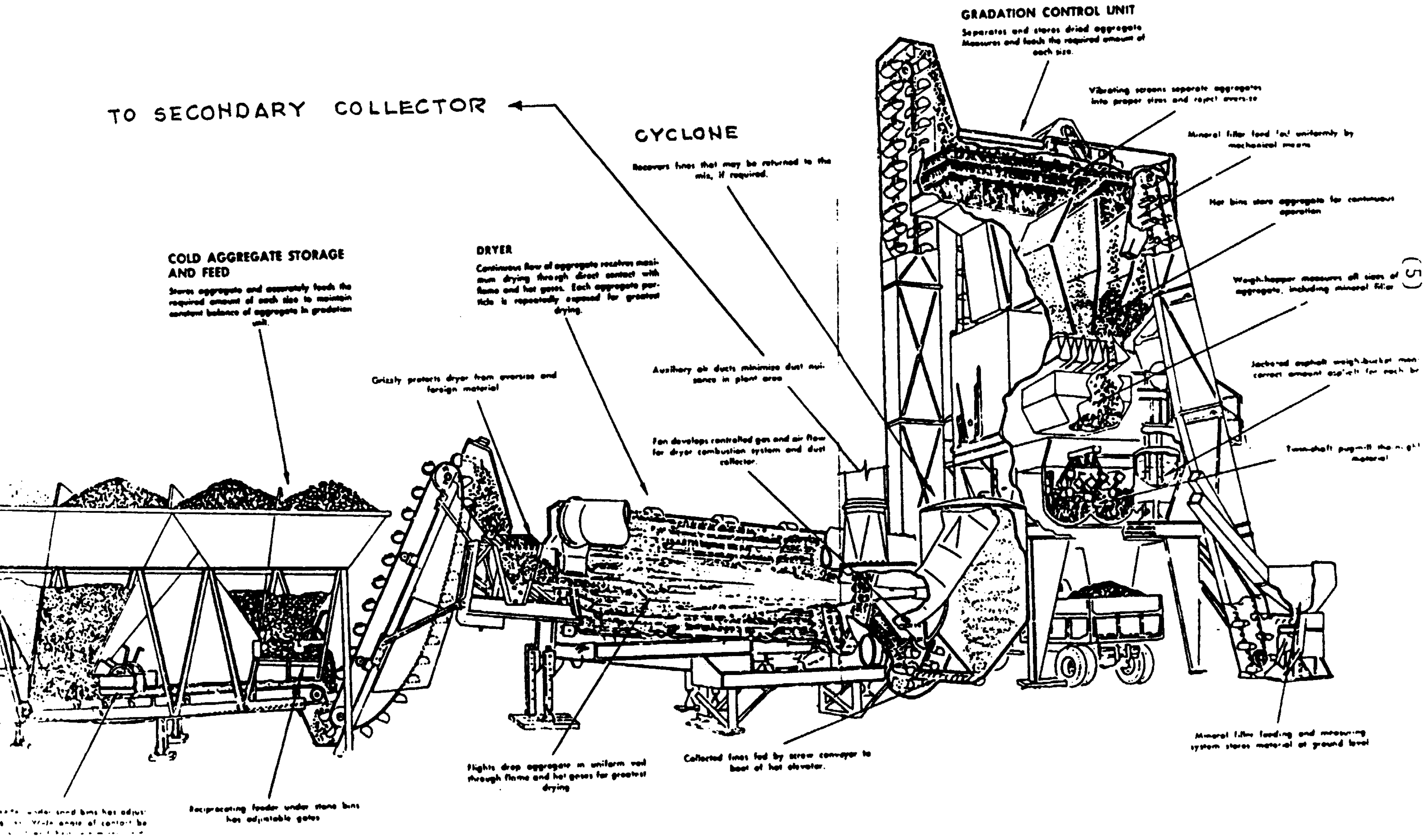
Winford Company employs a Stansteel batch mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind the mixture 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 dried aggregate is pulled by a bucket elevator to the top of a gradation control unit which separates and stores the aggregate by size. The required amount of each aggregate is dispensed into a weigh-hopper and from there, into a pugmill where the hot liquid asphalt is mixed thoroughly with the gregate. 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 dryer uses a burner fired with coal and gas to heat air to dry the aggregate. 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 baghouse. The baghouse is manufactured by Astec. 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 1 - 4 inches of water. The particulate matter, which is removed by the baghouse is reinjected into the pugmill. The following sketch shows a typical batch mix asphalt plant.

Figure 4-1

ASPHALT BATCH MIX PLANT - AN EXPLODED VIEW



DATA SUMMARY

Plant

1. Manufacturer of plant Stansteel.
2. Designed maximum operating capacity 300 TPH @ 0 % moisture.
3. Actual operation rate 200 TPH @ 5 % moisture.
4. Startup date 7-1-86.
5. Type of fuel used in dryer Coal + Gas.
6. Quanity of fuel consumption 3000 lbs P.H..

Aggregate

7. Name/type of mix 1-W.C..
8. Percent asphalt in mix 4.5 %.
9. Temperature of asphalt 350.
10. Sieve/Screening analysis: % Passing; Private N-A

1"		3/8"		#	
3/4"		#		#	
1/2"		#		#200	

Baghouse

11. Manufacturer Astec.
12. No. of bags 900. Type of bags Nomex.
13. Air to cloth ratio 6-1. Designed ACFM 70,000.
14. Square feet of bags 11,616 sq ft.
15. Type of cleaning; pulse jet ✓, reverse air _____,
plenum pulse _____, other _____.
16. Cleaning cycle time 5/10 [illegible] sec..
17. Interval between cleaning cycle 8 sec.
18. Pressure drop across baghouse 3 psi.
19. Pulse pressure on cleaning cycle 80-90 psi.

COMPANY NAME Winford DATE 7-1-86

COMPANY REPRESENTATIVE Steve Roton

(7)

PLANT DATA

COMPANY NAME Winford

COMPANY REP. Steve Rotar DATE 7-1-86 PHONE # 746-2467

DATA SOURCE Computer

PLANT LOCATION Bossier City La

PLANT MFG. Stansteel PLANT MODEL # R.M.-60A PLANT TYPE Batch

MIX SPECIFICATION # 1-W.C. OIL SPECIFICATION # 1-A

Time 24 Hour	__ Fuel Oil __ Nat. Gas __ Propane __ Coal ↙ lbs P.M	Burner Setting %	Liquid Asph Included Aggregate TPH	Recycle TPH	Liquid Asphalt TPH	Mix Temp. °F	__ Venturi __ Baghouse Pressure Drop Inches Water
8:45	60.216	50	200	0		340	3
9:00	51.6	40	200	0		350	3
9:15	55.9	45	200	0		326	4
9:30	51.6	40	200	0		338	4
9:45	51.6	40	200	0		330	3
10:30	51.6	40	200	0		300	3
10:45	43.0	50	200	0		250	4
11:00	47.3	25	200	0		250	3
11:15	47.3	15	200	0		275	3
11:30	45.15	22	200	0		290	4
12:45	47.3	25	200	0		250	3
1:00	43.0	20	200	0		270	3
1:15	47.0	25	200	0		290	4
1:30	45.15	22	200	0		291	3
1:45	48.2	26	200	0		240	3
2:00	47.0	25	200	0		250	3
2:15	47.0	25	200	0		250	3

tart #1
:58

End
51

tart #2
29

End
2:06

art #3
2:50

End #2
:18

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.

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 Winford Company

Relative humidity in lab 49 %

Sample Location asphalt plant stack

Density of Acetone (pa) .7853 mg/ml

Blank volume (V_a) 200 ml

Date/Time wt. blank 7-2-86

Gross wt. 95.8603 mg

Date/Time wt. blank 7-3-86

Gross wt. 95.8602 mg

Ave. Gross wt. 95.8603 mg

Tare wt. 95.8600 mg

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

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (p_a) = (.000002 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} P_a$ = (.000002)(200)(.7853) = (.0003)

			Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})		ml	200	200	200
Date/Time of wt 7-2-86	Gross wt	g	129.1916	136.4379	143.4353
Date/Time of wt 7-3-86	Gross wt	g	129.1913	136.4374	143.4350
	Average Gross wt	g	129.1915	136.4377	143.4352
	Tare wt	g	129.1800	136.4084	143.4223
	Less acetone blank wt (W_a)	g	.0003	.0003	.0003
Wt of particulate in acetone rinse (m_a)		g	.0112	.0290	.0126

	Filter Numbers	#	SG-1485	SG-1486	SG-1484
Date/Time of wt 7-2-86	Gross wt	g	.6647	.6679	.6652
Date/Time of wt 7-3-86	Gross wt	g	.6645	.6677	.6651
	Average Gross wt	g	.6646	.6678	.6652
	Tare wt	g	.6628	.6668	.6618

Weight of particulate on filters(s) (m_f)	g	.0018	.0010	.0034
Weight of particulate in acetone rinse	g	.0112	.0290	.0126
Total weight of particulate (m_n)	g	.0130	.0300	.0160

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 T Fuck

VII. CALCULATIONS

NAME: WINFORD COMPANY

	LOCATION: BOSSIER CITY, LOUISIANA	date	7/01/86	7/01/86	7/01/8
	SUMMARY OF TEST DATA		RUN # 1	RUN # 2	RUN #
	SAMPLING TRAIN DATA	start	08:53	10:29	12:5
		finish	09:57	12:06	14:1
1	Sampling time, minutes	θ	60	60	60
2	Sampling nozzle diameter, in.	Dn	.250	.250	.250
3	Sampling nozzle cross-sectional area, ft^2.	An	.000342	.000342	.000342
4	Isokinetic variation	I	90	88	92
5	Sample gas volume - meter conditions, cf.	Vm	48.51	43.19	41.99
6	Average meter temperature, °R	Tm	559	566	568
7	Average oriface pressure drop, in.H_2O	ΔH	1.82	1.52	1.43
8	Total particulate collected mg.	Mn	13.0	30.0	16.0
	VELOCITY TRAVERSE DATA				
9	Stack area, ft^2.	A	11.2	11.2	11.2
10	Absolute stack gas pressure, in. Hg.	Ps	30.12	30.12	30.12
11	Barometric pressure, in. Hg.	Pbar	30.12	30.12	30.12
12	Average absolute stack temperature, °R	Ts	685	661	666
13	Average $\sqrt{\text{velocity head}}$, (Cp= .82)	$\sqrt{\Delta P}$	.97	.87	.83
14	Average stack gas velocity ft. / sec.	Vs	61	54	52
	STACK MOISTURE CONTENT				
15	Total water collected by train, ml.	Vlc	136.0	137.0	157.0
16	Moisture in stack gas, %	Bws	12.1	13.8	15.8
	EMISSIONS DATA:				
17	Stack gas flow rate, dscf/hr. (000's)	Qsd	1,684	1,513	1,409
18	Total particulate concentration, gr/dscf	Cs	.0043	.0114	.0063
19	Total particulate concentration, lbs/hr	E	1.0	2.5	1.3
20	Total particulate concentration, lbs/mbtu	E'	.0000	.0000	.0000
	ORSAT DATA				
21	Percent CO2 by volume	CO2	2.3	2.3	2.8
22	Percent O2 by volume	O2	18.3	18.3	17.7
23	Percent CO by volume	CO	.0	.0	.0
24	Percent N2 by volume	N2	79.4	79.4	79.5

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 °R

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

ΔH = Average pressure drop across oriface meter,in.H_20

Y = Dry gas meter calibration factor

13.6 = Inches water per inches Hg.

Run # 1 $$V_{m(std)} = 17.64 \quad (1.00)(48.51) \left[\frac{(30.12) + \frac{1.82}{13.6}}{559} \right] = 46.31 \text{ dsc}$$

Run # 2 $$V_{m(std)} = 17.64 \quad (1.00)(43.19) \left[\frac{(30.12) + \frac{1.52}{13.6}}{566} \right] = 40.70 \text{ dsc}$$

Run # 3 $$V_{m(std)} = 17.64 \quad (1.00)(41.99) \left[\frac{(30.12) + \frac{1.43}{13.6}}{568} \right] = 39.42 \text{ dsc}$$

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: $C_s' = \left[0.0154 \ \frac{gr}{mg} \right] \left[\frac{13.0}{46.31} \right] = .0043$ gr./dscf.

Run # 2: $C_s' = \left[0.0154 \ \frac{gr}{mg} \right] \left[\frac{30.0}{40.70} \right] = .0114$ gr./dscf.

Run # 3: $C_s' = \left[0.0154 \ \frac{gr}{mg} \right] \left[\frac{16.0}{39.42} \right] = .0063$ 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: $M_d = 0.44(\ 2.3\%\ ) + 0.32(18.3\%\ ) + 0.28(\ \ .0\% + 79.4\%\ ) =$ 29.1 lb./lb.-mole

Run # 2: $M_d = 0.44(\ 2.3\%\ ) + 0.32(18.3\%\ ) + 0.28(\ \ .0\% + 79.4\%\ ) =$ 29.1 lb./lb.-mole

Run # 3: $M_d = 0.44(\ 2.8\%\ ) + 0.32(17.7\%\ ) + 0.28(\ \ .0\% + 79.5\%\ ) =$ 29.2 lb./lb.-mole

Water vapor condensed :

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

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

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

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

R = Ideal gas constant, 21.85 (in.Hg.)(cu.ft./lb.-mole)(°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) (122.0) = 5.7 cu.ft
$V_{wsg(std)}$ = (0.04715) (14.0) = .7 cu.ft

Run # 2: $V_{wc(std)}$ = (0.04707) (116.0) = 5.5 cu.ft
$V_{wsg(std)}$ = (0.04715) (21.0) = 1.0 cu.ft

Run # 3: $V_{wc(std)}$ = (0.04707) (140.0) = 6.6 cu.ft
$V_{wsg(std)}$ = (0.04715) (17.0) = .8 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: $$B_{ws} = \frac{5.7 + .7}{5.7 + .7 + 46.31} \times 100 = 12.1\ \%$$

Run # 2: $$B_{ws} = \frac{5.5 + 1.0}{5.5 + 1.0 + 40.70} \times 100 = 13.8\ \%$$

Run # 3: $$B_{ws} = \frac{6.6 + .8}{6.6 + .8 + 39.42} \times 100 = 15.8\ \%$$

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 = 29.1 (1- .121) + 18 (.121) = 27.8 (lb./lb.-mole).

Run # 2: M_s = 29.1 (1- .138) + 18 (.138) = 27.6 (lb./lb.-mole).

Run # 3: M_s = 29.2 (1- .158) + 18 (.158) = 27.4 (lb./lb.-mole).

Stack gas velocity:

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

Where:

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

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

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, (°f).

T_s = Absolute stack temperature, (°R). = 460 + t_s.

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

Run # 1: $V = (85.49)(\ .82)(\ .97) \sqrt{\frac{685}{(30.12)(27.76)}} = 61.25$ ft/se

Run # 2: $V = (85.49)(\ .82)(\ .87) \sqrt{\frac{661}{(30.12)(27.57)}} = 54.15$ ft/se

Run # 3: $V = (85.49)(\ .82)(\ .83) \sqrt{\frac{666}{(30.12)(27.43)}} = 51.99$ 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 $(\text{ft.})^2$.

3600 = Conversion factor, sec./hr.

t_s = Stack temperature (°f).

T_s = Absolute stack temperature, (°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:

$$Q_{sd} = 3600\ (1-.121)\ (61.25)\ (11.2) \left[\frac{528}{685} \right] \left[\frac{30.12}{29.92} \right] = 1684427 \text{ dscf/}$$

Run # 2:

$$Q_{sd} = 3600\ (1-.138)\ (54.15)\ (11.2) \left[\frac{528}{661} \right] \left[\frac{30.12}{29.92} \right] = 1513394 \text{ dscf/h}$$

Run # 3:

$$Q_{sd} = 3600\ (1-.158)\ (51.99)\ (11.2) \left[\frac{528}{666} \right] \left[\frac{30.12}{29.92} \right] = 1408658 \text{ dscf/h}$$

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: $$E = \frac{(.0043)(1684427)}{7000} = 1.0 \text{ lb. / hr.}$$

Run # 2: $$E = \frac{(.0114)(1513394)}{7000} = 2.5 \text{ lb. / hr.}$$

Run # 3: $$E = \frac{(.0063)(1408658)}{7000} = 1.3 \text{ lb. / hr.}$$

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

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

O = 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:

$$I = 100 \times 685 \left[\frac{(0.002669)(136.0) + \frac{48.5}{559} \left[30.12 + \frac{1.82}{13.6} \right]}{60\ (\ 60\ )\ (\ 61.25\ )\ (30.12\ )\ (\ .000342\ )} \right] = 90\ \%$$

Run # 2:

$$I = 100 \times 661 \left[\frac{(0.002669)(137.0) + \frac{43.2}{566} \left[30.12 + \frac{1.52}{13.6} \right]}{60\ (\ 60\ )\ (\ 54.15\ )\ (30.12\ )\ (\ .000342\ )} \right] = 88\ \%$$

Run # 3:

$$I = 100 \times 666 \left[\frac{(0.002669)(157.0) + \frac{42.0}{568} \left[30.12 + \frac{1.43}{13.6} \right]}{60\ (\ 60\ )\ (\ 51.99\ )\ (30.12\ )\ (\ .000342\ )} \right] = 92\ \%$$

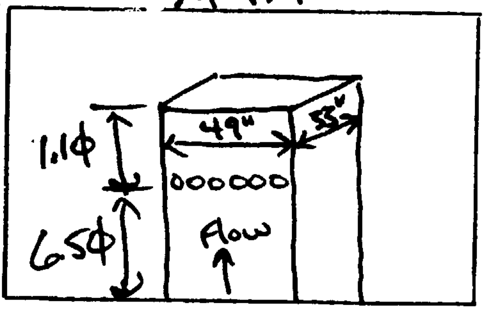
VIII. FIELD DATA

P. of 2

RAMCON ENVIRONMENTAL CORPORATION

Plant Winford Co.
Location Bossier City, La.
Operator C. Mitchell
Date 7-1-86
Run No. 1
Sample Box No. 1
Meter Box No. C282
Meter H @ 1.47
C Factor 1.0004
Pitot Tube Coefficient Cp 0.816

M=1.9



Schematic of Stack Cross Section

Ambient Temperature 84°F
Barometric Pressure 30.12
Assumed Moisture, % 20
Probe Length, m(ft) 5 ft.
Nozzle Identification No. 0.0003412
Avg. Calibrated Nozzle Dia., (in.) 0.250/0.251/0.25
Probe Heater Setting 4
Leak Rate, m³/min. (cfm) <0.02
Probe Liner Material 316 Stainless
Static Pressure, mm Hg (in.Hg) +0.02/13.6
Filter No. SG-1485

	IMPINGER VOLUME ml	SILICA GEL WEIGHT g
FINAL	322	512
INITIAL	200	498
DIFFERENCE	122	14

TRAV. PT NO.	SAMPLING TIME (θ)min 8:53	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H20	PRESSURE DIFF. ORF. MTR in H20	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	CM ~~8:32~~ / 8:55	6	CM 205 ~~120~~	CM ~~2.0~~ 0.18	1.3	589.45 / 591.35	85	80	260	45
2	8:57	6	205	0.62	1.2	592.60	95	80	260	45
3	8:59	4	230	0.37	0.70	593.51	95	80	265	45
4	9:01	4	230	0.45	0.86	595.22	100	80	265	45
5	9:03	7	235	0.87	1.7	595.83	105	80	265	45
B) 1	9:04 / 9:06	4	205	0.50	0.95	597.34	100	85	270	45
2	9:08	5	225	0.70	1.3	600.05	105	85	240	45
3	9:10	7	240	1.1	2.1	600.85	105	85	235	45
4	9:12	7	240	1.0	1.9	601.94	110	85	255	50
5	9:14	7	240	1.0	1.9	603.43	110	85	255	50
C) 1	9:15 / 9:17	7	205	1.1	2.1	605.65	110	85	265	50
2	9:19	6	230	0.95	1.8	607.25	110	90	265	50
3	9:21	7	235	1.1	2.1	609.30	110	90	265	50

CO_2 = 2.5%
%

Form #REC-05

Form #REC-U6

P2 of

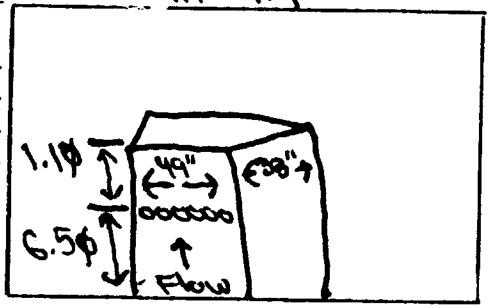
RAMCON emissions test log sheet, cont. DATE 7-1-86 LOCATION Bossier City La. TEST NO. 1

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) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
4	9:23	8	235	1.3	2.5	611.50	115	90	265	55
5	9:25	7	235	1.3	2.5	612.65	115	90	265	55
D) 1	9:26 / 9:28	4	215	0.65	1.2	614.40	115	90	270	55
2	9:30	5	225	0.90	1.7	615.95	115	90	270	55
3	9:32	6	235	1.2	2.3	617.61	115	90	270	55
4	9:34	7	235	1.2	2.3	619.52	115	90	250	50
5	9:36	7	235	1.2	2.3	621.00	120	90	240	50
E) 1	9:37 / 9:39	4	200	0.70	1.3	622.90	110	90	270	50
2	9:41	6	225	1.1	2.1	624.61	115	90	270	50
3	9:43	6	230	1.0	1.9	626.00	120	90	245	50
4	9:45	6	230	1.0	1.9	628.40	120	90	240	50
5	9:47	7	230	1.3	2.5	630.00	120	90	255	55
F) 1	9:47^{30} / 9:49^{30}	6	195	1.0	1.9	631.70	120	90	255	55
2	9:51^{30}	6	220	1.1	2.1	633.30	120	90	255	55
3	9:53^{30}	6	225	1.1	2.1	634.90	120	90	255	55
4	9:55^{30}	6	225	1.0	1.9	636.63	120	90	240	60
5	9:57^{30}	6	225	1.1	2.1	637.94	120	90	240	60

RAMCON ENVIRONMENTAL CORPORATION

Plant Winford Co.
Location Bossier City, LA
Operator S. Greenwood
Date 7/1/86
Run No. 2
Sample Box No. 2
Meter Box No. C282
Meter H @ 1.47
C Factor 1.0004
Pitot Tube Coefficient Cp 0.816

M > 1.9



Schematic of Stack Cross Section

Ambient Temperature 88 °F
Barometric Pressure 30.12
Assumed Moisture, % 20
Probe Length, m(ft) 3ft.
Nozzle Identification No. 0.0003418
Avg. Calibrated Nozzle Dia., (in.) 0.250/0.25/0.25
Probe Heater Setting 4
Leak Rate, m3/min. (cfm) 0.02
Probe Liner Material 316 Stainless
Static Pressure, mm Hg (in. Hg) +0.02/13.6
Filter No. SG-1486

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	316	522
INITIAL	200	501
DIFFERENCE	116	21

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	10:29 / 10:31	4	195	0.75	1.4	638.24 / 640.42	100	95	265	45
2	10:33	5	190	1.0	1.9	641.90	110	95	265	45
3	10:35	6	190	1.1	2.1	643.38	110	95	255	45
4	10:37	6	200	1.1	2.1	645.27	110	95	260	45
5	10:39	6	205	1.0	1.9	646.44	110	95	265	45
B) 1	10:40 / 10:42	5	200	0.8	1.5	648.65	110	95	255	50
2	10:44	5	205	0.95	1.8	650.23	115	95	260	50
3	10:46	6	205	1.1	2.1	652.30	115	95	265	50
4	10:48	6	205	1.1	2.1	653.90	115	95	265	55
5	10:50	7	205	1.2	2.3	654.95	120	95	265	55
C) 1	10:51 / 10:53	6	205	1.0	1.9	656.90	115	95	250	55
2	10:55 ~~10:54~~	6	210	1.0	1.9	658.97	120	95	250	55
3	10:57 ~~10:56~~	6	210	1.2	2.3	661.23	120	95	265	55

O_2 =
=

CO_2 = 2.5%
= 0

Form #REC-05

RAMCON emissions test log sheet, cont. DATE 7/1/96 LOCATION Bossier City, LA TEST NO. 2

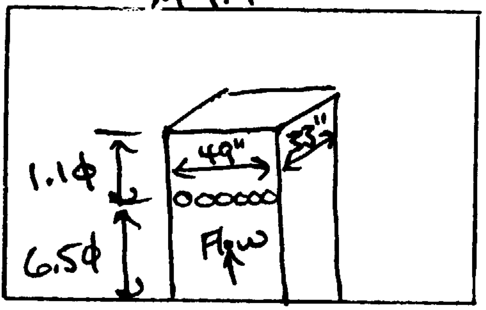
TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME Vm (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
4	10:59	7	210	1.2	2.3	662.42	120	95	255	50
5	11:01	7	210	1.2	2.3	663.82	120	95	260	50
D) 1	11:02 11:04	3	195	0.4	0.76	665.27	120	95	250	50
2	11:06	4	200	0.7	1.3	666.66	120	95	255	50
3	11:08	5	210	1.0	1.9	668.28	120	95	250	55
4	11:10	6	210	1.1	2.1	670.18	120	95	255	55
5	11:12	5	210	1.0	1.9	671.26	120	95	260	55
E) 1	11:13 11:15	3	200	0.4	0.76	672.68	120	95	250	55
2	11:17	3	200	0.4	0.76	673.90	120	95	255	50
3	11:19	3	200	0.5	0.95	674.96	120	95	250	50
4	11:21	4	200	0.6	1.1	676.31	120	95	265	55
5	11:23	4	200	0.75	1.4	677.285	120	95	265	55
F) 1	11:24 11:26	2	190	0.25	0.48	678.58	120	95	260	55
2	11:28	3	195	0.3	0.57	679.11	120	95	260	55
*3	11:30	3	195	0.25	0.48	679.585	120	95	260	55
4	~~[illegible]~~ 12:04	2	190	0.3	0.57	680.75	105	100	240	60
5	12:06	2	190	0.3	0.57	681.435	110	100	245	60

1 of 2

RAMCON ENVIRONMENTAL CORPORATION

Plant Winford Co.
Location Bossier City, La
Operator C. Mitchell Jr
Date 7-1-86
Run No. 3
Sample Box No. 3
Meter Box No. C282
Meter H @ 1.47
C Factor 1.0004
Pitot Tube Coefficient Cp 0.816

M=1.9



Schematic of Stack Cross Section

Ambient Temperature 92°F
Barometric Pressure 30.12
Assumed Moisture, % 20
Probe Length, m(ft) 3 ft.

	IMPINGER VOLUME ml	SILICA GEL WEIGHT, g
FINAL	340	512
INITIAL	200	495
DIFFERENCE	140	17

Nozzle Identification No. 0.0003418
Avg. Calibrated Nozzle Dia., (in.) 0.250/0.250/0.250
Probe Heater Setting 4
Leak Rate, m³/min. (cfm) <0.02
Probe Liner Material 316 Stainless
Static Pressure, mm Hg (in. Hg) +0.02/13.6
Filter No. SG-1484

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft³	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A) 1	12:50 / 12:52	0	155	0.12	0.23	681.73 / 682.56	100	100	220	45
2	12:54	0	155	0.15	0.28	683.15	110	100	270	45
3	12:56	2	175	0.25	0.48	684.15	110	100	200	45
4	12:58	2	185	0.35	0.66	685.10	115	95	200	45
5	13:00	3	185	0.38	0.72	685.85	115	95	200	45
B) 1	13:01 / 13:03	2	150	0.25	0.48	687.10	115	95	200	45
2	13:05	2	165	0.27	0.51	687.90	115	95	240	45
3	13:07	2	190	0.35	0.66	689.02	115	95	240	45
* 4	13:09	3	195	0.47	0.89	689.78	115	95	240	45
5	13:32³⁰ / 13:34³⁰	5	200	1.0	1.9	691.45	105	100	245	55
C) 1	13:35³⁰ / 13:37³⁰	3	195	0.50	CM 0.95 ~~0.50~~	692.90 ~~0.95~~ CM	110	100	245	55
2	13:39³⁰	3	195	0.50	0.95	694.20	115	100	265	45
3	13:41³⁰	4	225	0.60	1.1	695.65	120	100	265	45

Form #REC-05

* Plant down

CO_2 = 1.5%
4.0%

(27)

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 7-1-86 LOCATION Bossier City 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 V_m (ft.^{3})	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
4	13:43^{30}	5	230	0.72	1.4	697.10	120	100	270	45
5	13:45^{30}	6	230	0.95	1.8	698.19	120	100	270	45
D) 1	13:46^{30}/13:48^{30}	4	215	0.67	1.3	699.82	120	100	250	45
2	13:50^{30}	4	210	0.67	1.3	701.70	120	100	250	45
3	13:52^{30}	5	230	0.95	1.8	702.91	120	100	240	55
4	13:54^{30}	6	235	1.0	1.9	704.85	120	100	240	55
5	13:56^{30}	7	235	1.2	2.3	706.11	120	100	250	50
E) 1	13:57/13:59	6	225	1.0	1.9	708.20	120	95	250	45
2	14:01	6	230	1.1	2.1	709.75	120	95	240	45
3	14:03	6	230	1.1	2.1	711.61	120	95	240	55
4	14:05	7	235	1.3	2.5	713.55	125	100	240	55
5	14:07	6	235	1.1	2.1	715.01	125	100	240	55
F) 1	14:08/14:10	6	200	1.0	1.9	716.86	120	100	240	55
2	14:12	6	190	1.0	1.9	718.80	125	100	240	55
3	14:14	7	220	1.2	2.3	720.53	125	100	240	55
4	14:16	7	225	1.2	2.3	722.85	125	100	240	55
5	14:18	6	225	1.1	2.1	723.72	125	100	240	55

IX. CALIBRATIONS

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number ________ Date 7-3-86 Meter box number C282 Plant ________

Barometric pressure, P_b = 30.10 in. Hg Dry gas meter number 700205 Pretest Y 1.47

Orifice manometer setting, (ΔH), in. H_2O	Gas volume		Temperature				Time (θ), min	Vacuum setting, in. Hg	Y_i	Y_i
	Wet test meter (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), °F	Dry gas meter						$\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
				Inlet (t_{d_i}), °F	Outlet (t_{d_o}), °F	Average[a] (t_d), °F				
1.0	10	10.32	79	108	84	96	16.42	5	0.997	1.48
1.0	10	10.31	79	108	84	96	16.44	4	0.998	1.49
1.0	10	10.33	79	108	84	96	16.45	4	0.996	1.49
									Y =	1.49

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

where

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in. H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y $\pm 0.05Y$.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

Quality Assurance Handbook M4-2.4A

Form #REC-01

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 6/29/86 Meter box number 700205

Barometric pressure, P_b = 30.04 in. Hg Calibrated by John R. Biggs

Orifice manometer setting (ΔH), in. H_2O	Gas volume		Temperature				Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
	Wet test meter (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), °F	Dry gas meter Inlet (t_{d_i}), °F	Dry gas meter Outlet (t_{d_o}), °F	Dry gas meter Avg[a] (t_d), °F			
0.5	5	562.825 568.010	77 77	105 106	84 84	94.75	11.580	0.9950	1.4732
1.0	5	572.400 577.558	78 78	107 109	84 84	96.0	8.158	0.9994	1.4624
1.5	10	578.800 589.040	78 78	108 110	84 85	96.75	13.340	1.0069	1.4644
2.0	10								
3.0	10								
4.0	10								
							Avg	1.0004	1.4667

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

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

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-20-86 Thermocouple number 32

Ambient temperature 23 9 °C Barometric pressure 30.12 in. Hg

Calibrator Reference: mercury-in-glass ✓

other

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	ice water	32	32	0.0%
B	Boiling water	212	212	0.0%
C	Boiling oil	410 5	412 8	<.5%
D	Ambient 7-1-86	84°F	84°F	0%

[a] Type of calibration system used.

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

Quality Assurance Handbook M5-2.5

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. 32 (3ft) Date 5-13-86

Calibrated by: C. Mitchell

"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	1.00	1.50	0.816	0
2	0.80	1.20	0.816	0
3	0.60	0.90	0.816	0
		$\bar{C}_p$ (SIDE A)	0.816	

"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	1.0	1.50	0.816	0
2	0.80	1.20	0.816	0
3	0.60	0.90	0.816	0
		$\bar{C}_p$ (SIDE B)	0.816	

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

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

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

Form No. EED-17-1

RAMCON

Lear Siegler Stack Sampler

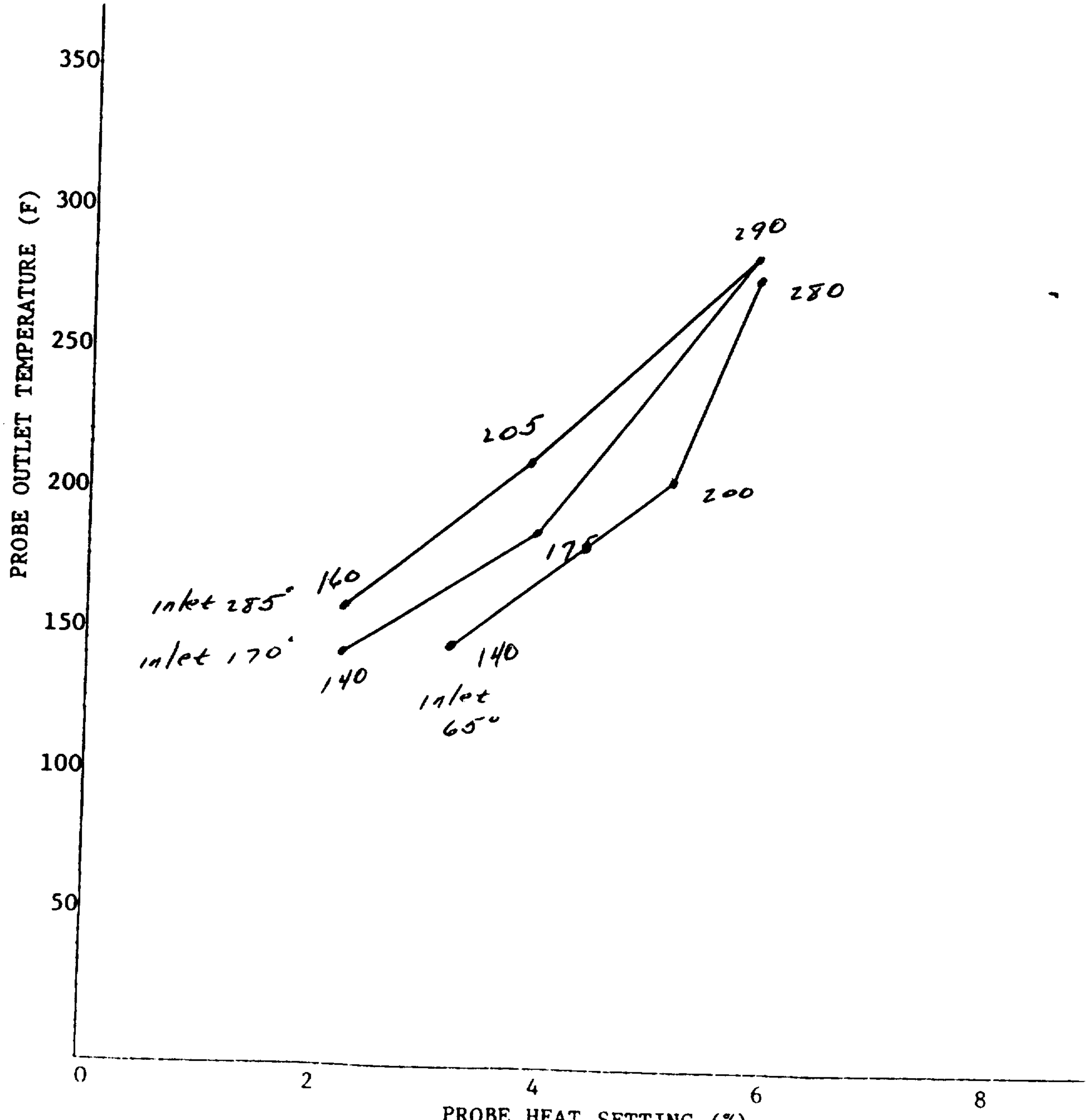
Heating Probe Calibration

Probe No. 32 Probe Length 3'

Date of Calibration 5-20-86 Signature K. B. Allmendinger

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



STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-20-86 Thermocouple number inlet/outlet

Ambient temperature 23.9 °C Barometric pressure 30.12 in. Hg

Calibrator ______ 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 7-1-86	84°F	84°F	0%

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[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 5-20-86 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%
	7-1-86	84°F	84°F	0%

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[a] Type of calibration system used.

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

X. RAMCON PERSONNEL

RAMCON Environmental Stack Test Team

Sumner Buck - President

Sumner Buck is the President of RAMCON Environmental. He is a graduate of the EPA 450 "Source Sampling for Particulate Pollutants" course and the 474 "Continuous Emissions Monitoring" course all given at RTP. Mr. Buck is a qualified V.E. reader with current certification. Mr. Buck has personally sampled over 300 stacks including over 100 asphalt plants. He is 43 years old and a graduate of the University of Mississippi with graduate studies at Memphis State University and State Technical Institute of Memphis.

J. Cameron Mitchell - Team Leader

Cameron Mitchell has been employed by RAMCON for several years. He has undergone extensive training in Methods 1 through 9. He is qualified as a team leader and has personally sampled over 150 stacks including over 100 asphalt plants. He is currently certified as a V.E. reader. He is enrolled in Memphis State University with a major in Civil Engineering and a minor in Mathematics.