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RAMCON

ENVIRONMENTAL CORPORATION

RAMCON BUILDING

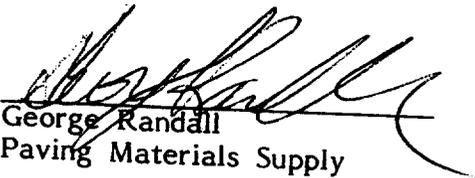
223 SCOTT STREET

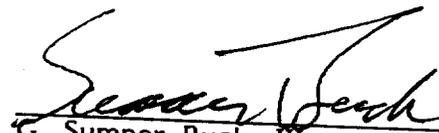
MEMPHIS, TENNESSEE 38112

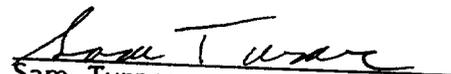
TELEPHONE 901 / 458-7000

TELEX 53-806

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
PAVING MATERIALS SUPPLY
BALTIMORE COUNTY, MARYLAND
June 18 & 19, 1984


George Randall
Paving Materials Supply


G. Sumner Buck, III
President


Sam Turner
Team Leader

RAMCON

ENVIRONMENTAL CORPORATION

RAMCON BUILDING

223 SCOTT STREET

MEMPHIS, TENNESSEE 38112

TELEPHONE 901 / 458-7000

TELEX 53-806

July 2, 1984

Mr. George Randall
Paving Materials Supply
7000 Greenspring Avenue
Baltimore County, MD 21209

Subject: Particulate Emissions Test - Baltimore County, Maryland Plant

Dear Mr. Randall:

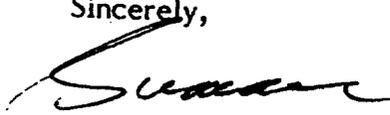
Enclosed are four copies of our report on particulate emissions. Based on our test results, your plant does pass both EPA new source performance standards and those set by the State of Maryland. The average of the three test runs was in compliance with State and Federal standards.

You will want to sign the report cover and send one copy to:

Mr. Don Andrew
Office of Environmental Programs
P.O. Box 13387
Baltimore, MD 21203

We certainly have enjoyed working with you and hope to serve you again in the future.

Sincerely,


G. Sumner Buck, III
President

GSBIII:kr

Enclosures

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I. INTRODUCTION

On June 18 & 19, 1984, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Paving Materials Supply H & B drum mix asphalt plant located in Baltimore County, Maryland. RAMCON personnel conducting the test were Sam Turner, Team Leader and Miles Mason. Sam Turner was responsible for the laboratory analysis, including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples were limited to Mr. Turner and and Mr. Mason.

The purpose of the test was to determine if the rate of emissions from the plant's baghouse and the total contaminants by weight (grain loading) are below limits set by the State of Maryland and by the U.S. Environmental Protection Agency.

II. TEST RESULTS

Table I summarizes the test results. The grain loading limitation is specified in 39 FR 9314, March 8, 1974, 60.92 Standards for Particulate Matter (1) as amended. The allowable emissions for the State of Maryland are found in C.O.M.A.R. 101806.03. Ms. Kathy Gunkel of the Maryland Office of Environmental Programs observed the testing conducted by RAMCON.

TABLE I
SUMMARY OF TEST RESULTS
June 18 & 19, 1984

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	08:38 to 09:45	0.0143 gr/SCF	92%	3.1 lbs/hr
2	12:33 to 13:40	0.0167 gr/SCF	91%	3.4 lbs/hr
3	08:27 to 09:33	0.0092 gr/SCF	99%	1.7 lbs/hr
Average		0.0134 gr/SCF		2.7 lbs/hr

On the basis of these test results, the average grain loading of the three test runs was below the .04 gr/SCF limit set by EPA and the .03 gr/SCF limit set by the State of Maryland. Therefore, the plant is operating in compliance with the State of Maryland and Federal standards.

III. TEST PROCEDURES

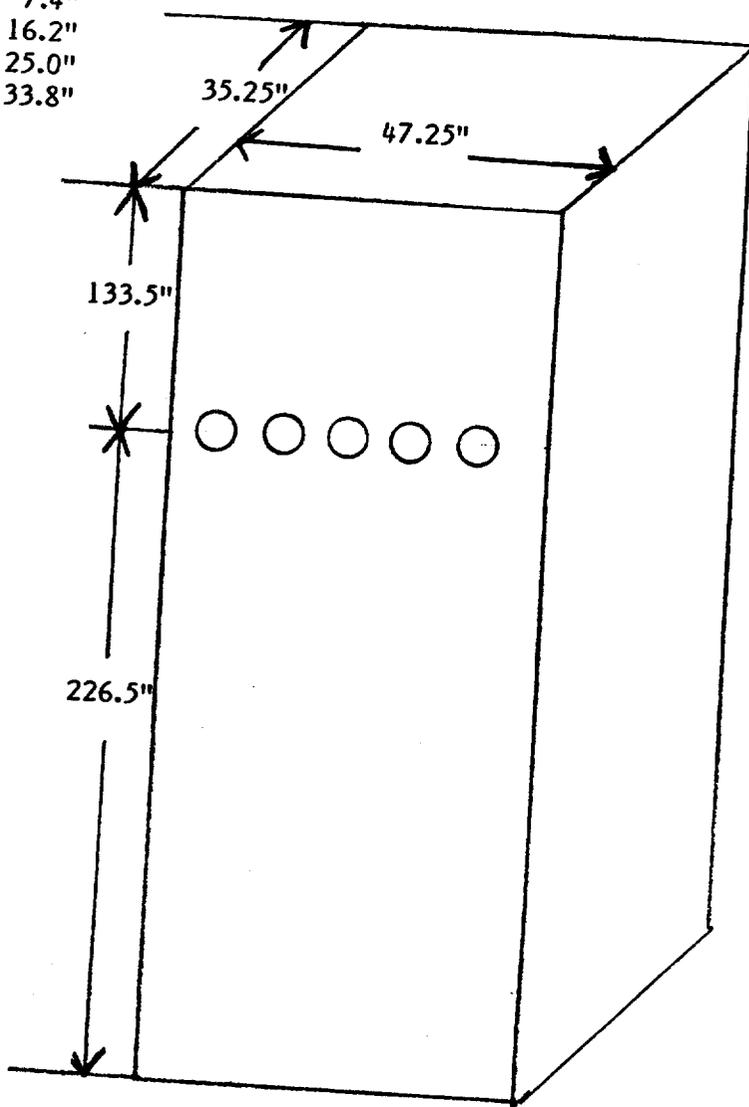
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended. All three test runs were sampled at three minutes each.

B. Problems Encountered: No problems were encountered.

(3)

C. Sampling Site: The emissions test was conducted after a baghouse on a rectangular stack with an equivalent diameter of 40.4". Five sampling ports were placed 133.5" down (3.3 diameters upstream) from the top of the stack and 226.5" up (5.6 diameters downstream) from the last flow disturbance. Twenty points were sampled, four through each port for three minutes each.

<u>Points on a Diameter</u>	<u>Plus 3" Standoff</u>	<u>Probe Mark</u>
1		7.4"
2		16.2"
3		25.0"
4		33.8"



IV. THE SOURCE

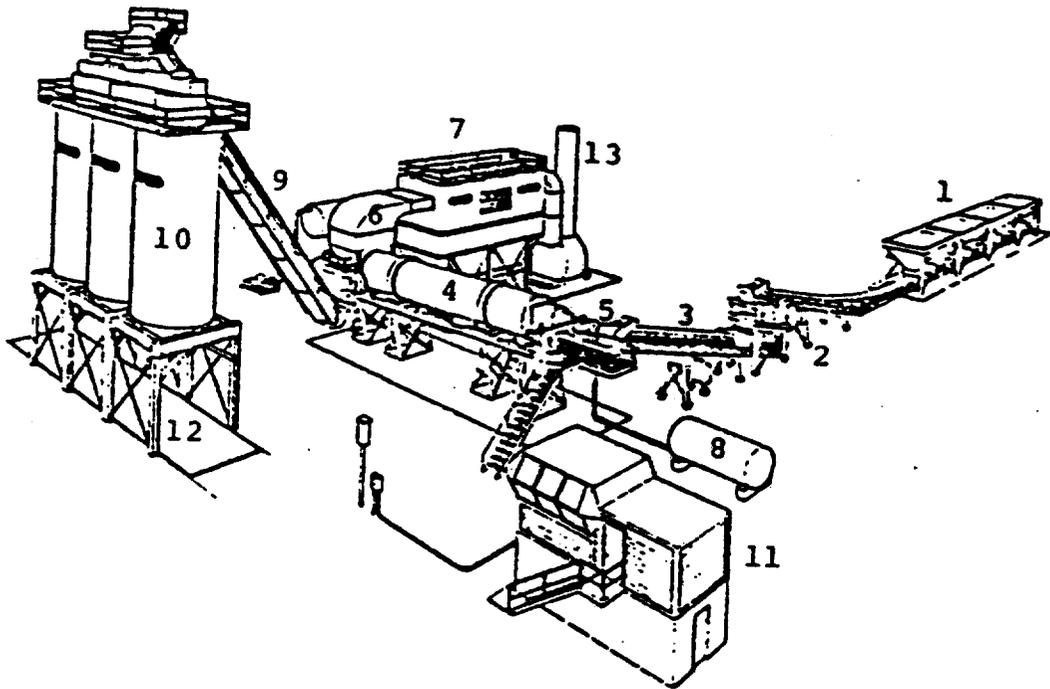
IV. THE SOURCE

Paving Materials Supply Co. employs an H & B drum mix asphalt plant which is used to manufacture asphalt concrete 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 belt 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. When recycle asphalt mix is used, it is added approximately halfway down the drum through a separate weigh conveyor. 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 a 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 to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate and hot asphalt oil thoroughly. The air is drawn into the system via an exhaust fan. After passing through the gas burner, the air is pulled through the front end of the mixing drum. The air is pulled through a center outlet in the dryer and through a knockout box prior to going through a baghouse. The baghouse is manufactured by H & B. 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 drum mixer.

1. Aggregate Feed Bins
2. Preliminary Oversize Screen
3. Weigh Conveyor Belt
4. Rotary Drum Dryer/Mixer
5. Burner
6. Knock Out Baffleing
7. Baghouse
8. Liquid Asphalt Storage
9. Conveyor to Surge/Storage Bin(s)
10. Surge/Storage Bin
11. Control/Operators' House
12. Truck Loading Scale
13. Stack



DRUM-MIXER PLANT

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. Knock off baffling: A baffling plate is inserted in the "dirty" side plenum as a knock out for heavy particles in the air stream. These particles fall to the bottom of the baghouse.
7. Baghouse: The hot gasses are pulled through the bags into the clean air plenum. The solid particulate matter is trapped on the dust coat buildup on the bags. A bag cleaning cycle consisting of jet burst of air from the inside (or clean air side) of the bags sends a large bubble of air down the inside of the bags shaking loose buildup on the bag surface. This particulate matter is collected at the bottom of the baghouse and reinjected into the drum mixer where it is used as part of the finished product.
8. 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.
9. Conveyor to surge/storage bin: The finished product of aggregate mixed with liquid asphalt is conveyed to a surge bin.
10. Surge/storage bin: The asphaltic cement is dumped into this surge bin and metered out to dump trucks which pull underneath slide gate at the bottom of the bin.
11. Control/operators house: The entire plant operation is controlled from this operator's house.
12. 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.
13. Stack

DATA SUMMARY

Plant

1. Manufacturer of plant A+B
2. Designed maximum operating capacity 300 TPH @ 5% moisture.
3. Actual operation rate 225 TPH @ 4.6 % moisture.
4. Startup date _____.
5. Type of fuel used in dryer Nat. GAS.
6. Quantity of fuel consumption _____.

Aggregate

7. Name/type of mix _____.
 8. Percent asphalt in mix _____ %.
 9. Temperature of asphalt _____.
 10. Sieve/Screening analysis: % Passing;
- | | | | |
|------------|------------|------------|--|
| 1" _____ | 3/8" _____ | #40 _____ | |
| 3/4" _____ | #4 _____ | #80 _____ | |
| 1/2" _____ | #10 _____ | #200 _____ | |

Baghouse

11. Manufacturer A+B
12. No. of bags 616. Type of bags 14 oz long.
13. Air to cloth ratio 6-1. Designed ACFM 50,000.
14. Square feet of bags 9856.
15. Type of cleaning; pulse jet , reverse air _____, plenum pulse _____, other _____.
16. Cleaning cycle time 10 SEC.
17. Interval between cleaning cycle 150 SEC.
18. Pressure drop across baghouse 4.5 - 5.0 psi.
19. Pulse pressure on cleaning cycle 100 PSI psi.

COMPANY NAME _____

DATE _____

PLANT DATA

(8)

COMPANY NAME PAVING Materials Supply
 COMPANY REP. George Randall DATE 6/18/84 Phone # 301-484-8133
 DATA SOURCE _____
 PLANT LOCATION GREENSPRING AVE
 PLANT MANUFACTURER A+B PLANT MODEL NO. DM 100 PLANT TYPE Drum
 MIX SPECIFICATION NO. _____ OIL SPECIFICATION NO. _____
 SIEVE/SCREENING ANALYSIS _____

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

TIME 24 HOUR	FUEL OIL <input type="checkbox"/> NATURAL GAS <input checked="" type="checkbox"/> PROPANE <input type="checkbox"/>	BURNER SETTING	AGGREGATE TPH	RECYCLE TPH	ASPHALT	MIX TEMPERATURE °F	VENTURI <input type="checkbox"/> Baghouse <input checked="" type="checkbox"/> DIFFERENTIAL
0815		53	225		4.5	305	
0830		67	225		5.6	300	
0845		68	225		5.6	305	
0900		68	225		5.6	305	
0915		54	225		4.5	315	
0930		53	225		4.5	300	
0945		55	225		4.5	305	
0949	Shut Down						
12:27	Started up						
12:30		69	225		5.6	305	
12:45		66	225		5.6	305	
13:00		68	225		5.6	305	
1315		54	225		4.5	300	
1330		55	225		4.5	305	
1345		56	225		4.5	305	
1400	Shut Down						

REMARKS: _____

BAND SN

SIEVE SIZE

% PASSING

 $\frac{3}{4}$ "

100

 $\frac{3}{8}$ "

98

4

69

8

52

16

41

30

31

50

19

100

8

200

4

BAND B1

 $1\frac{1}{2}$ "

100

 $\frac{3}{4}$ "

91

 $\frac{3}{8}$ "

69

4

50

8

41

16

34

50

14

200

35

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 next page.
- B. A Fisher Scientific 211-B airguide (uncorrected) aneroid barometer was used to check the barometric pressure.
- C. Weston dial thermometers were used to check both stack and meter temperatures.
- D. A Hays 621 Analyzer was used to measure the oxygen, carbon dioxide and carbon monoxide content of the stack gases.

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.

WEIGHING PROCEDURE — SARTORIUS ANALYTICAL BALANCE

The Sartorius balance is accurate to approximately $+0.2$ mg and has a maximum capacity of 200 g. It is equipped with "pre-weighing" which enables an unknown mass to be quickly weighed to a $+1$ g level with no adjustment. It also has a tare weighing feature which is for quick net gain measurement without subtraction. 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 $3\frac{1}{2}$ 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 is now set to weigh items between 100 and 200 grams. 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 now 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, either. The balance is sensitive to even a hand on the table near the balance, so be careful and painstaking in every movement while weighing.

SAMPLE ANALYTICAL DATA FORM

Plant Location PAVING MATERIALS SUPPLY
 Sample Location BALTIMORE COUNTY, MARYLAND
 Relative humidity in lab 45%
 Density of acetone (ρ_a) .7899 g/ml

	RUN 1	RUN 2	RUN 3
Acetone rinse container number	PW 1	PW 2	PW 3
Acetone rinse volume (V_{aw}) ml	150	200	200
Acetone blank residue concentration (C_a) mg/g	0	0	0
$W_a = C_a V_{aw} \rho_a = (0)(200)(.7899) =$	0	0	0
Date/time of wt <u>6/19/83</u> <u>6/20/83</u> <u>9:30</u> Gross wt g	140.4211	153.5256	148.3113
Date/time of wt <u>6/22/83</u> <u>6/22/83</u> <u>11:00</u> Gross wt g	140.4224	153.5267	148.3120
Average Gross wt g	140.4218	153.5262	148.3119
Tare wt g	140.8438	153.4454	148.2842
Less acetone blank wt (W_a) g	0	0	0
Wt of particulate in acetone rinse (m_a) g	0.0780	0.0808	0.0275
Filter numbers	RV 30	RV 44	RV 34
Date/time of wt <u>6/19/83</u> <u>6/20/83</u> <u>9:30 AM</u> Gross wt g	0.6532	0.6536	0.6848
Date/time of wt <u>6/22/83</u> <u>11:00 AM</u> Gross wt g	0.6523	0.6519	0.6849
Average Gross wt g	0.6528	0.6528	0.6849
Tare wt g	0.6775	0.6776	0.6808
Weight of particulate on filters (s) (m_f) g	0.0252	0.0248	0.0041
Weight of particulate in acetone rinse g	0.0780	0.0808	0.0275
Total weight of particulate (m_n) g	0.0528	0.0560	0.0316
	.0141	.0166	.0091

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

Remarks _____

Signature of analyst Don Turner
 Signature of reviewer Steve Berk

VII. CALCULATIONS

NAME: PAVING MATERIALS SUPPLY

LOCATION: BALTIMORE COUNTY, MARYLAND

SUMMARY OF TEST DATA

SAMPLING TRAIN DATA

date 6/18/84 6/18/84 6/19/84

RUN # 1 RUN # 2 RUN # 3

start 08:38 12:33 08:27

finish 09:45 13:40 09:33

1	Sampling time, minutes	θ	60	60	60
2	Sampling nozzle diameter, in.	Dn	.293	.293	.293
3	Sampling nozzle cross-sectional area, ft ²	An	.000468	.000468	.000468
4	Isokinetit variation	I	92	91	99
5	Sample gas volume - meter conditions, cf.	Vm	61.20	56.10	57.69
6	Average meter temperature, °R	Tm	551	556	558
7	Average oriface pressure drop, in.H ₂ O	ΔH	2.09	1.75	1.94
8	Total particulate collected mg.	Mn	52.8	56.0	31.6

VELOCITY TRAVERSE DATA

9	Stack area, ft. ²	A	11.6	11.6	11.6
10	Absolute stack gas pressure, in Hg.	Ps	29.22	29.22	29.14
11	Barometric pressure, in. Hg.	Pbar	29.18	29.18	29.10
12	Average absolute stack temperature, °R	Ts	769	751	769
13	Average $\sqrt{\text{velocity head}}$, (Cp= .81)	$\sqrt{\Delta P}$.96	.91	.94
14	Average stack gas velocity ft./ sec.	Vs	65	61	65

STACK MOISTURE CONTENT

15	Total water collected by train, ml.	Vic	205.0	260.0	402.0
16	Moisture in stack gas, %	Bws	14.6	19.2	26.5

EMISSIONS DATA:

17	Stack gas flow rate, dscf/hr. (000's)	Qsd	1,540	1,411	1,329
18	Total particulate concentration, gr/dscf	Cs	.0143	.0167	.0092
19	Total particulate concentration, lbs/hr	E	3.1	3.4	1.7
20	Total particulate concentration, lbs/mbtu	E ^l	.0	.0	.0

ORSAT DATA

21	Percent CO ₂ by volume	CO ₂	6.0	6.0	6.0
22	Percent O ₂ by volume	O ₂	15.0	15.0	15.0
23	Percent CO by volume	CO	.0	.0	.0
24	Percent N ₂ by volume	N ₂	79.0	79.0	79.0

Dry Gas Volume :

$$V_{m(\text{std})} = V_m \left[\frac{T_{(\text{std})}}{T_m} \right] \left[\frac{P_{\text{bar}} + \Delta H}{13.6} \right] = 17.64 \frac{^{\circ}\text{R}}{\text{in. Hg.}} Y V_m \left[\frac{P_{\text{bar}} + \Delta H}{13.6} \right] \left[\frac{1}{T_m} \right]$$

Where:

- $V_{m(\text{std})}$ = 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 orifice meter, in. Hg.
 P_{std} = Standard absolute pressure, (29.92 in. Hg.)
 T_m = Absolute temperature at meter $^{\circ}\text{R}$
 T_{std} = Standard absolute temperature (528 $^{\circ}\text{R}$)
 ΔH = Average pressure drop across orifice meter, in. H₂O
 Y = Dry gas meter calibration factor
 13.6 = inches water per inches Hg.

Run # 1 $V_{m(\text{std})} = 17.64 (.99)(61.20) \left[\frac{(29.18) + \frac{2.09}{13.6}}{551} \right] = 56.90 \text{ dscf}$

Run # 2 $V_{m(\text{std})} = 17.64 (.99)(56.10) \left[\frac{(29.18) + \frac{1.75}{13.6}}{556} \right] = 51.64 \text{ dscf}$

Run # 3 $V_{m(\text{std})} = 17.64 (.99)(57.69) \left[\frac{(29.10) + \frac{1.94}{13.6}}{558} \right] = 52.79 \text{ dscf}$

Total contaminants by weight: 'GRAIN LOADING'

Particulate concentration C_s gr./dscf.

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

Where:

C_s = concentration of particulate mater in stack gas, dry basis, corrected to standard conditions, g/dsf

M_n = Total amount of particulate mater colected, mg.

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

Run # 1: $C_s = \left[0.0154 \frac{\text{gr}}{\text{mg}} \right] \left[\frac{52.8}{56.90} \right] = .0143 \text{ gr./dscf.}$

Run # 2: $C_s = \left[0.0154 \frac{\text{gr}}{\text{mg}} \right] \left[\frac{56.0}{51.64} \right] = .0167 \text{ gr./dscf.}$

Run # 3: $C_s = \left[0.0154 \frac{\text{gr}}{\text{mg}} \right] \left[\frac{31.6}{52.79} \right] = .0092 \text{ gr./dscf.}$

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: $M_d = 0.44(6.0\%) + 0.32(15.0\%) + 0.28(.0\% + 79.0\%) = 29.6$
 lb./lb.-mole

Run # 2: $M_d = 0.44(6.0\%) + 0.32(15.0\%) + 0.28(.0\% + 79.0\%) = 29.6$
 lb./lb.-mole

Run # 3: $M_d = 0.44(6.0\%) + 0.32(15.0\%) + 0.28(.0\% + 79.0\%) = 29.6$
 lb./lb.-mole

Water vapor condensed :

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

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

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

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:

$$V_{wc(std)} = (0.04707) (195.0) = 9.2 \text{ cu.ft}$$

$$V_{wsg(std)} = (0.04715) (10.0) = .5 \text{ cu.ft}$$

Run # 2:

$$V_{wc(std)} = (0.04707) (250.0) = 11.8 \text{ cu.ft}$$

$$V_{wsg(std)} = (0.04715) (10.0) = .5 \text{ cu.ft}$$

Run # 3:

$$V_{wsg(std)} = (0.04707) (390.0) = 18.4 \text{ cu.ft}$$

$$V_{wc(std)} = (0.04715) (12.0) = .6 \text{ cu.ft}$$

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 ream.
 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).

$$\text{Run \# 1: } B_{ws} = \frac{9.2 + .5}{9.2 + .5 + 56.90} \times 100 = 14.6 \%$$

$$\text{Run \# 2: } B_{ws} = \frac{11.8 + .5}{11.8 + .5 + 51.64} \times 100 = 19.2 \%$$

$$\text{Run \# 3: } B_{ws} = \frac{18.4 + .6}{18.4 + .6 + 52.79} \times 100 = 26.5 \%$$

Molecular weight of stack gases:

$$M_s = M_d (1 - B_{ws}) + (B_{ws})$$

Where:

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

$$\text{Run \# 1: } M_s = 29.6 (1 - .146) + 18 (.146) = 27.9 \text{ (lb./lb.-mole).}$$

$$\text{Run \# 2: } M_s = 29.6 (1 - .192) + 18 (.192) = 27.4 \text{ (lb./lb.-mole).}$$

$$\text{Run \# 3: } M_s = 29.6 (1 - .265) + 18 (.265) = 26.5 \text{ (lb./lb.-mole).}$$

Stack gas velocity:

$$V_s = K_p C_p \left[\Delta P \right]^{1/2} \text{ avg. } \left[\frac{T_s(\text{avg.})}{P_s M_s} \right]^{1/2}$$

Where:

- V_s = Average velocity of gas stream in stack, ft./sec.
 K_p = 85.49 ft/sec $\left[\frac{(\text{g/g-mole}) - (\text{mm Hg})}{(^{\circ}\text{K})(\text{mm H}_2\text{O})} \right]^{1/2}$
 C_p = Pitot tube coefficient, (dimensionless).
 ΔP = Velocity head of stack gas, in. H₂O.
 P_{bar} = Barometric pressure at measurement site, (in.Hg).
 P_g = Stack static pressure (in.Hg).
 P_s = Absolute stack gas pressure, (in.Hg) = $P_{\text{bar}} + P_g$
 P_{std} = Standard absolute pressure, (29.92 in.Hg).
 t_s = Stack temperature, ($^{\circ}\text{f}$).
 T_s = Absolute stack temperature, ($^{\circ}\text{R}$). = 460 + t_s .
 M_s = Molecular weight of stack gas, wet basis, (lb/lb-mole).

$$\text{Run \# 1: } V = (85.48) (.81) (.96) \left[\frac{769}{(29.22)(27.91)} \right]^{1/2} = 64.55 \text{ ft/s}$$

$$\text{Run \# 2: } V = (85.48) (.81) (.91) \left[\frac{751}{(29.22)(27.37)} \right]^{1/2} = 61.06 \text{ ft/s}$$

$$\text{Run \# 3: } V = (85.48) (.81) (.94) \left[\frac{769}{(29.14)(26.53)} \right]^{1/2} = 64.91 \text{ ft/s}$$

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 (°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:

$$Q_{sd} = 3600 (1 - .146) (64.55) (11.6) \left[\frac{528}{769} \right] \left[\frac{29.22}{29.92} \right] = 1539629 \text{ dscf/}$$

Run # 2:

$$Q_{sd} = 3600 (1 - .192) (61.06) (11.6) \left[\frac{528}{751} \right] \left[\frac{29.22}{29.92} \right] = 1410966 \text{ dscf/}$$

Run # 3:

$$Q_{sd} = 3600 (1 - .265) (64.91) (11.6) \left[\frac{528}{769} \right] \left[\frac{29.14}{29.92} \right] = 1328833 \text{ dscf/}$$

Emissions rate from stack:

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

Where:

E = Emissions rate, lb./hr.

C = concentration of particulate mater in stack gas, dry basis, corrected to standard conditions (g/dsf).

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

Run # 1:
$$E = \frac{(.0143) (1539629)}{7000} = 3.1 \text{ lb. / hr.}$$

Run # 2:
$$E = \frac{(.0167) (1410966)}{7000} = 3.4 \text{ lb. / hr.}$$

Run # 3:
$$E = \frac{(.0092) (1328833)}{7000} = 1.7 \text{ lb. / hr.}$$

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

Where:

- I = Percent isokinetic sampling.
 100 = conversion to percent.
 T_s = Absolute average stack gas temperature, °R.
 0.002669 = conversion factor, Hg - ft³/ml - °R.
 V_{ic} = Total volume of liquid collected in impingers and silica gel, ml.
 T_m = Absolute average dry gas meter temperature, °R.
 P_{bar} = Barometric pressure at sampling site, (in.Hg).
 ΔH = Average pressure differential across the orifice meter, (in.H₂O).
 13.6 = Specific gravity of mercury.
 60 = conversion seconds to minutes
 D = 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, ft².

Run # 1:

$$I = 100 \times 769$$

$$\frac{(0.002669)(205.0) + \frac{61.2}{551} \left(29.18 + \frac{2.09}{13.6} \right)}{60 (60) (64.55) (29.22) (.000468)} = 92 \%$$

Run # 2:

$$I = 100 \times 751$$

$$\frac{(0.002669)(260.0) + \frac{56.1}{556} \left(29.18 + \frac{1.75}{13.6} \right)}{60 (60) (61.06) (29.22) (.000468)} = 91 \%$$

Run # 3:

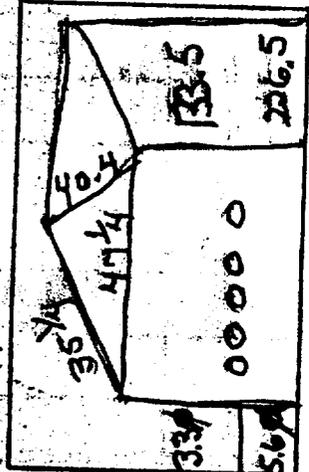
$$I = 100 \times 769$$

$$\frac{(0.002669)(402.0) + \frac{57.7}{558} \left(29.10 + \frac{1.94}{13.6} \right)}{60 (60) (64.91) (29.14) (.000468)} = 99 \%$$

VIII. FIELD DATA

Plant Paving Materials Supply pp 78

Location Baltimore County, MD
 Operator Sam T. Tucker
 Date 6-18-84
 Run No. One
 Sample Box No. One
 Meter Box No. 700205
 Meter H @ 1.26
 C Factor .99
 Pitot Tube Coefficient Cp .81



Ambient Temperature 75
 Barometric Pressure 29.18
 Assumed Moisture, % 75
 Probe Length, m(ft) 3
 Nozzle Identification No. 0004682
 Avg. Calibrated Nozzle Dia., (in.) .293/295/297
 Probe Heater Setting 5.0
 Leak Rate, m³/min. (cfm) 5.02
 Probe Liner Material Stainless Steel
 Static Pressure, mm Hg (in. Hg) 1.04
 Filter No. RU 30

INITIAL	FINAL	DIFFERENCE	SCALE OR UNIT
200	395	195	
515	525	10	

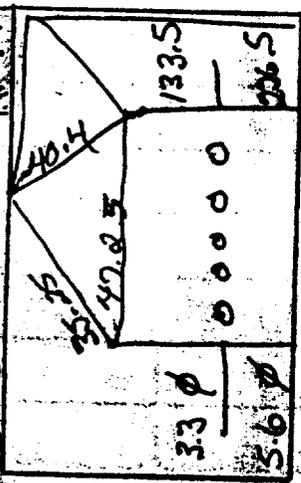
Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM (in. Hg)	STACK TEMP (T _s) (°F)	VELOCITY HEAD (Ps) (in)H2O	PRESSURE DIFF. ORF. MTR (in H2O)	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	8:38 8:41	2	290	1.1	2.6	174.95 178.30	80	80	265	60
2	8:44	2	315	1.0	2.3	182.30	80	80	265	60
3	8:47	3	320	.85	2.0	184.30	100	80	265	60
4	8:50	3	315	.75	1.8	187.07	100	80	240	50
(B) 1	8:58 8:55	3	295	1.1	2.6	190.30	95	80	240	50
2	8:58	2	315	.95	2.2	193.40	100	80	245	50
3	9:01	2	320	.76 x	1.8	196.30	105	80	245	50
4	9:04	2	320	.76	1.8	199.40	105	80	245	50
(C) 1	9:05 9:08	3	300	1.1	2.6	502.50	100	80	245	50
2	9:11	2	315	.85	2.0	505.20	105	80	245	50
3	9:14	2	315	.80	1.9	508.40	105	80	245	50
4	9:17	2	310	.80	1.9	511.80	105	80	240	50
(D) 1	9:18 9:21	2	295	1.1	2.6	514.30	105	80	240	50

RAMCON ENVIRONMENTAL CORPORATION

Plant Rawing Materials Supply

Location Baltimore County, MD
 Operator Sam L. Hoover
 Date 6-18-84
 Run No. TWO
 Sample Box No. TWO
 Meter Box No. 700205
 Meter H # 126
 C Factor 99
 Pitot Tube Coefficient Cp 0.8



AMBIENT TEMPERATURE	80
BAROMETRIC PRESSURE	29.78
ASSUMED MOISTURE, %	2.5
PROBE LENGTH, m(ft)	3
NOZZLE IDENTIFICATION NO.	000383

AVG. CALIBRATED NOZZLE DIA., (in.) 0.265/0.266
 PROBE HEATER SETTING 1.02
 LEAK RATE, m³/min. (cfm) 0.02
 PROBE LINER MATERIAL Stainless Steel
 STATIC PRESSURE, mm Hg (in. Hg) 1.05
 FILTER NO. AV 44

Schematic of Stack Cross Section 536.55 (57)

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM (in. Hg)	STACK TEMP (T _s) (°F)	VELOCITY HEAD (P _s) (in) H ₂ O	PRESSURE DIFF. ORF. MTR (in H ₂ O)	GAS SAMPLE VOLUME (ft ³)	GAS SAMPLE TEMP. AT DRY GAS METER (°F)		FILTER HOLDER TEMP (°F)	GAS TEMP AVG CONDENSER OR LAST IMPINGER (°F)
							Inlet	Outlet		
(A) 1	12:33 12:36	6	280	1.0	2.0	536.55 540.50	85	85	240	60
2	12:39	6	280	1.0	2.0	542.40	100	85	240	60
3	12:42	6	290	.95	1.85	544.92	105	85	240	60
4	12:45	6	300	.85	1.70	547.59	100	85	245	55
(B) 1	12:46 12:49	6	300	1.1	2.2	550.70	100	85	245	55
2	12:52	6	310	1.0	2.0	553.50	110	85	255	55
3	12:55	6	310	.95	1.85	556.52	110	90	260	55
4	12:58	5	310	.85	1.70	559.10	110	90	260	55
(C) 1	13:01 13:02	6	300	1.1	2.20	562.20	110	90	270	55
2	13:05	6	310	.85	1.70	564.70	115	90	270	55
3	13:08	6	310	.80	1.60	567.70	115	90	270	55
4	13:11	5	310	.80	1.60	570.38	120	95	270	55
(D) 1	13:12 13:15	6	310	1.1	2.2	573.50	115	95	270	55

RAMCON ENVIRONMENTAL CORPORATION

Plant Paving Materials Supply

Location Baltimore County, MD

Operator SAB I TURNER

Date 6-19-84

Run No. 84

Sample Box No. Three

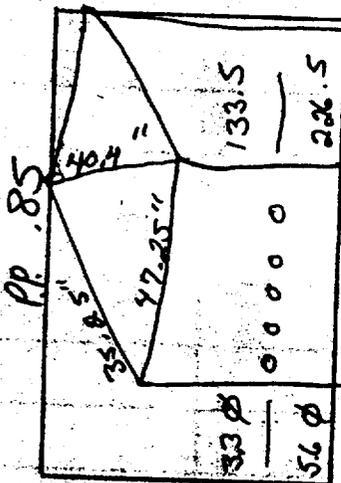
Meter Box No. Three

Meter H # 700205

C Factor 1.26

Pitot Tube Coefficient Cp .99

Filter No. 34



Ambient Temperature 80
 Barometric Pressure 29.10
 Assumed Moisture, % 38%
 Probe Length, m(ft) 37
 Nozzle Identification No. 0004
 Avg. Calibrated Nozzle Dia., (in.) .293 / .293
 Probe Heater Setting 5.0
 Leak Rate, m³/min. (cfm) -.02
 Probe Linear Material Stainless Steel
 Static Pressure, mm Hg (in. Hg) 1.04
 Filter No. 34

INFORM VOLUME
 FINAL 590
 INITIAL 300
 DIFFERENCE 290
 SLACK OR WEIGHT 57
 505
 12

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM (in. Hg)	STACK TEMP (Ts) (°F)	VELOCITY HEAD (Fs) (in)H2O	PRESSURE DIFF. ORF. MTR (in H2O)	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	8:27 8:30	5	300	1.0	2.2	595.142 596.10	80	80	250	60
2	8:33	5	310	.95	2.0	599.00	100	80	250	60
3	8:36	5	310	.90	1.95	602.10	105	80	250	50
4	8:39	5	310	.85	1.85	604.80	105	80	260	50
(B) 1	8:40 8:43	5	300	1.0	2.2	608.00	105	85	260	50
2	8:46	5	310	1.0	2.2	611.0	110	85	260	50
3	8:49	5	310	.90	1.85	613.90	110	85	255	60
4	8:52	5	310	.90	1.85	616.70	110	85	255	60
(C) 1	8:53:30 8:56	5	300	1.0	2.2	619.70	110	90	255	60
2	8:59	5	300	.85	1.85	622.60	110	90	250	60
3	9:02	5	315	.80	1.75	625.40	115	90	250	60
4	9:05:30	5	315	.80	1.75	628.05	115	90	260	60
(D) 1	9:07:30 9:10	5	300	1.0	2.2	631.30	110	90	255	60

IX. CALIBRATIONS

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number 1 Date 5-25-59 Meter box number C-282 Plant Douglas
 Barometric pressure, $P_b = 30.3$ in. Hg Dry gas meter number 700205 Pretest Y 1.00

Orifice manometer setting, (ΔH) , in. H ₂ O	Gas volume		Temperature			Time (θ) , min	Vacuum setting, in. Hg	Y_i	$V_w P_b (t_d + 460)$	$V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)$
	Wet test meter (V_w) , ft ³	Dry gas meter (V_d) , ft ³	Wet test meter (t_w) , °F	Inlet (t_{d_i}) , °F	Outlet (t_{d_o}) , °F					
1	10	10.68	76	132	101	18.40	5	1.00	1.64	
1	10	10.70	74	134	102	18.81	5	1.00	1.64	
1	10	10.72	76	135	103	18.82	5	1.00	1.64	
								Y = 1.00		

* 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, ft³
- V_d = Gas volume passing through the dry gas meter, ft³
- 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. H₂O
- 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

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number _____ Date 6-29-84 Meter box number 7282 Plant Laving Materials Supp
 Barometric pressure, $P_b = 29.85$ in. Hg Dry gas meter number 70005 Pretest Y _____

Orifice manometer setting, (ΔH), in. H_2O	Gas volume		Temperature				Time (θ), min	Vacuum setting, in. Hg	Y_i	$V_w P_b (t_d + 460)$ $V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)$
	Wet test meter (V_w), ft ³	Dry gas meter (V_d), ft ³	Wet test meter (t_w), of	Dry gas meter		Average (t_d), of				
				Inlet (t_{d_i}), of	Outlet (t_{d_o}), of					
2	10	44.95 55.23	78	108	82	94	10.75	5	1.27	0.99
2	10	55.25	78	108	83	95.5	10.65	5	1.26	0.99
2	10	65.60 59.75	78	107	84	95.5	10.71	5	1.27	0.99
									Y =	

* 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, ft³.
- V_d = Gas volume passing through the dry gas meter, ft³.
- 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.

RAMCON ENVIRONMENTAL CORPORATION

Lear Siegler Stack Sampler

Nozzle Diameter Calibration

Date _____

Signature _____

Nozzle No.	Average Diameter
1	_____
2	_____
3	_____
4	_____
5	_____
6	_____

Nozzle No.	Average Diameter
7	_____
8	_____
9	_____
10	_____
11	_____
12	_____

Pitot Tube Calibration (S Type)

Pitot Tube Identification No. 3 #2 Date 3-10-80

Calibrated by: [Signature]

"A" SIDE CALIBRATION

Run No.	Δp std cm H ₂ O (in. H ₂ O)	Δp (s) cm H ₂ O (in. H ₂ O)	C_p (s)	DEVIATION $C_p(s) - \bar{C}_p(A)$
1	.60	.92	.81	.006
2	.43	.63	.82	.004
3	.30	.44	.82	.004
\bar{C}_p (SIDE A)			.816	

"B" SIDE CALIBRATION

Run No.	Δp std cm H ₂ O (in. H ₂ O)	Δp (s) cm H ₂ O (in. H ₂ O)	C_p (s)	DEVIATION $C_p(s) - \bar{C}_p(B)$
1	.60	.92	.81	.006
2	.43	.64	.82	.004
3	.30	.44	.82	.004
\bar{C}_p (SIDE B)			.816	

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

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

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

RAMCON ENVIRONMENTAL CORPORATION

EPA QA MANUAL VOL. III
Section No. 3.4.2
Revision No. 0
Date January 15, 1980
Page 17 of 22

Date 8/20/81 Thermocouple number Hellor
Ambient temperature 76 °C Barometric pressure _____ in. Hg
Calibrator hee Reference: mercury-in-glass
other _____

Reference point number ^a	Source ^b (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference, °C
100°C	boiling H ₂ O	100°C	100°C	100%
76°F	ambient	meas 75.5°F	75°C	993%

^aEvery 30°C (50°F) for each reference point.

^btype of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

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Date 2/30/81 Thermocouple number 34
Ambient temperature 75 °C Barometric pressure _____ in. Hg
Calibrator J. Kee Reference: mercury-in-glass
other _____

Reference point number ^a	Source ^b (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference, % ^c
75° F	Ambient Temp.	MERC. -75.5	76° F	99.3 accuracy 0.7 diff
87 32° F 0° C	ice bath	32° F 0° C	32° F 0° C	100 acc. 0 diff
100° C	boiling H ₂ O	100° C	100° C	0 diff.
	AMBIENT 6-18-84	75° F	75° F	0%

^aEvery 30°C (50°F) for each reference point.

^bType of calibration system used.

^c
$$\frac{[(\text{ref temp, } ^\circ\text{C} + 273) - (\text{test thermom temp, } ^\circ\text{C} + 273)]}{\text{ref temp, } ^\circ\text{C} + 273} \times 100 < 1.5\%$$

Figure 2.5 stack temperature sensor calibration data form.

RAMCON

Lear Siegler Stack Sampler

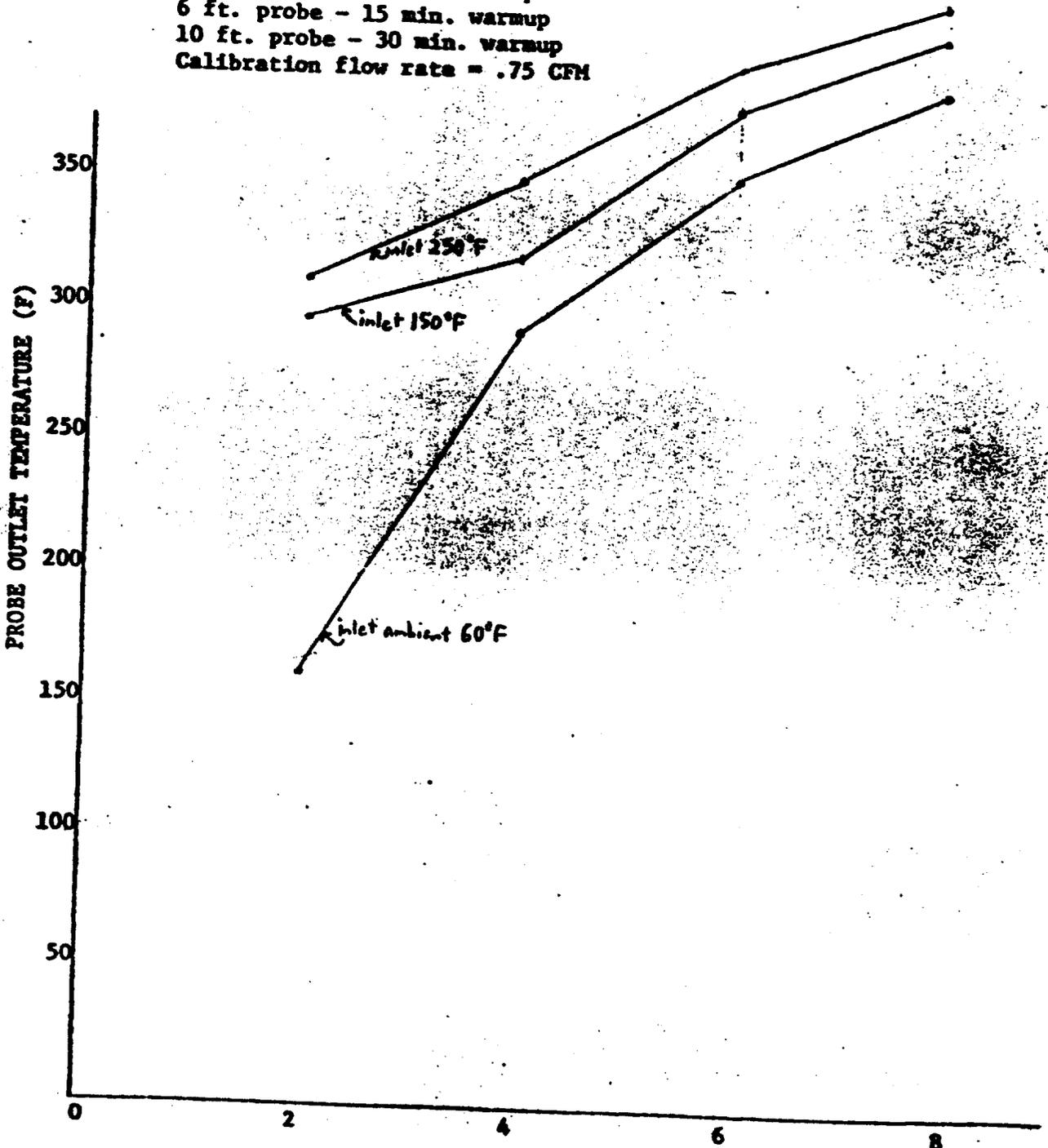
Heating Probe Calibration

Probe No. 1 Probe Length 3'

Date of Calibration 2/7/77 Signature W.C. Ludwig

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 8-25-83 Thermocouple number INLET/OUTLET
 Ambient temperature 99 °F Barometric pressure 29.92 in. Hg
 Calibrator S. Buck Reference: mercury-in-glass 100 °F
 other _____

Reference point number	Source ^a (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Temperature difference, % ^b
100	INLET AMBIENT	100 °F	100 °F	0%
100	OUTLET AMBIENT	100 °F	100 °F	0%
75 °F	6-1884	75 °F	75 °F	0%

^a Type of calibration system used.

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

X. RAMCON PERSONNEL

RAMCON Environmental Stack Test Team

Sumner Buck - President & Field Supervisor

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 40 years old and a graduate of the University of Mississippi with graduate studies at Memphis State University and State Technical Institute of Memphis.

Sam Turner - Team Leader

Sam Turner has three years experience in the Air Division and is qualified as a team leader. He has sampled over twenty large boiler stacks and approximately 75 asphalt plants. He is a graduate of State Technical Institute of Memphis, and holds an Associate Degree in Environmental Engineering. He also has another year's experience in the wet chemistry lab.