Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

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I. INTRODUCTION

On April 20, 1988, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at B.P. Short & Sons Paving's Bituma-Stor [redacted] located in Lawrenceville, Virginia. RAMCON personnel conducting the test were Sam Turner, Field Supervisor and Allen Turner. Shawn Greenwood 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 was limited to Mr. Turner and Mr. Greenwood.

The purpose of the test was to determine if the rate of [redacted] from the plant's [redacted] and the total contaminants by weight (grain loading) is below the allowable N.S.P.S. limits set by EPA and the State of Virginia.

II. TEST RESULTS

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

Ms. Lillian Alexander of Virginia's Air Quality Control observed the testing conducted by RAMCON.

TABLE I

SUMMARY OF TEST RESULTS
April 20, 1988

Test Run	Time	Grain Loading	[redacted] Variation	Actual Emissions
1	08:48 to 10:52	0.0130 gr/DSCF	103.2%	1.9 lbs/hr
2	12:10 to 13:20	0.0173 gr/DSCF	100.8%	2.7 lbs/hr
3	14:28 to 16:47	0.0226 gr/DSCF	97.5%	3.9 lbs/hr
	[redacted]	[redacted]		[redacted]

On the basis of these test results, the average grain loading of the three test runs was below the [redacted] set by US EPA and the State of Virginia. Therefore, the plant is operating in compliance with State and Federal Standards.

III. TEST PROCEDURES

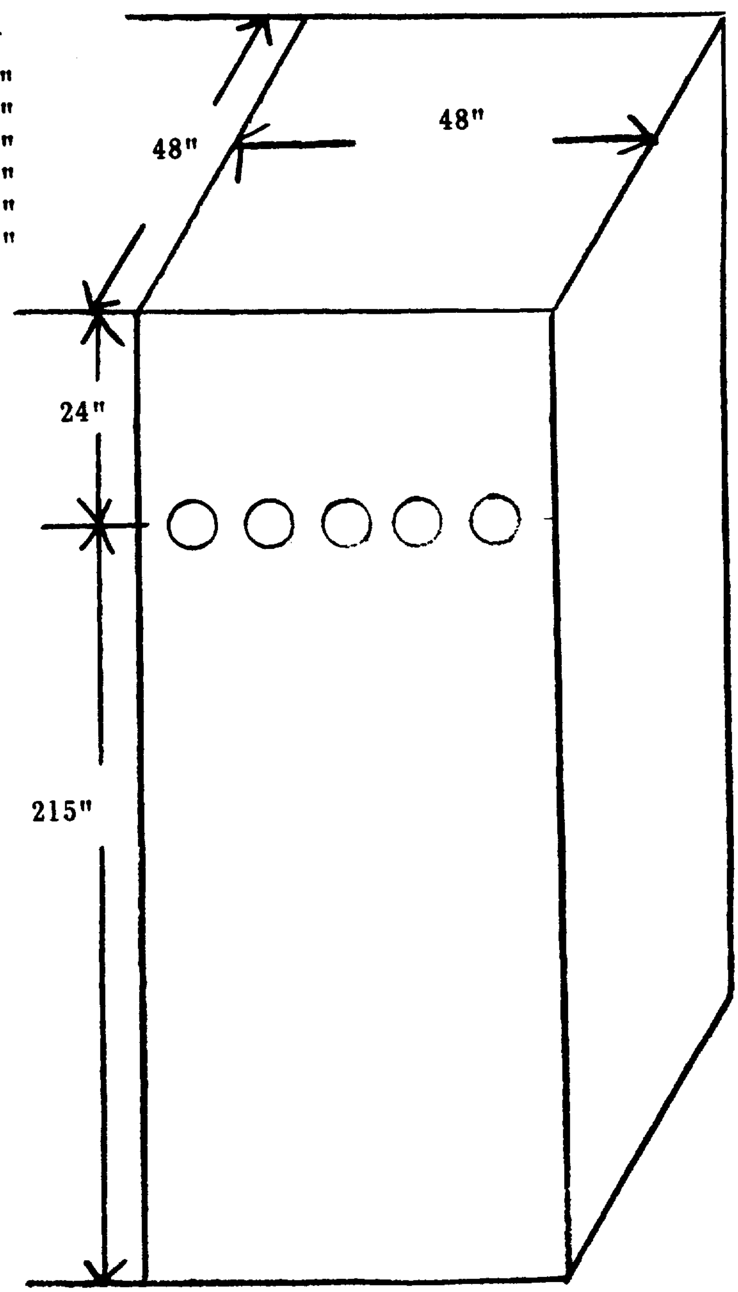
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

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

C. Sampling Site: The emissions test was conducted after a baghouse on a square stack measuring 48" x 48" with an equivalent diameter of 48". Five sampling ports were placed 24" down (0.5 diameters upstream) from the top of the stack and 215" up (4.5 diameters downstream) from the last flow disturbance. Thirty points were sampled, six through each port for two minutes each.

Points on a Diameter	Probe Mark
1	*9.0"
2	17.0"
3	25.0"
4	33.0"
5	41.0"
6	49.0"

*Measurements include a 5.0" standoff.



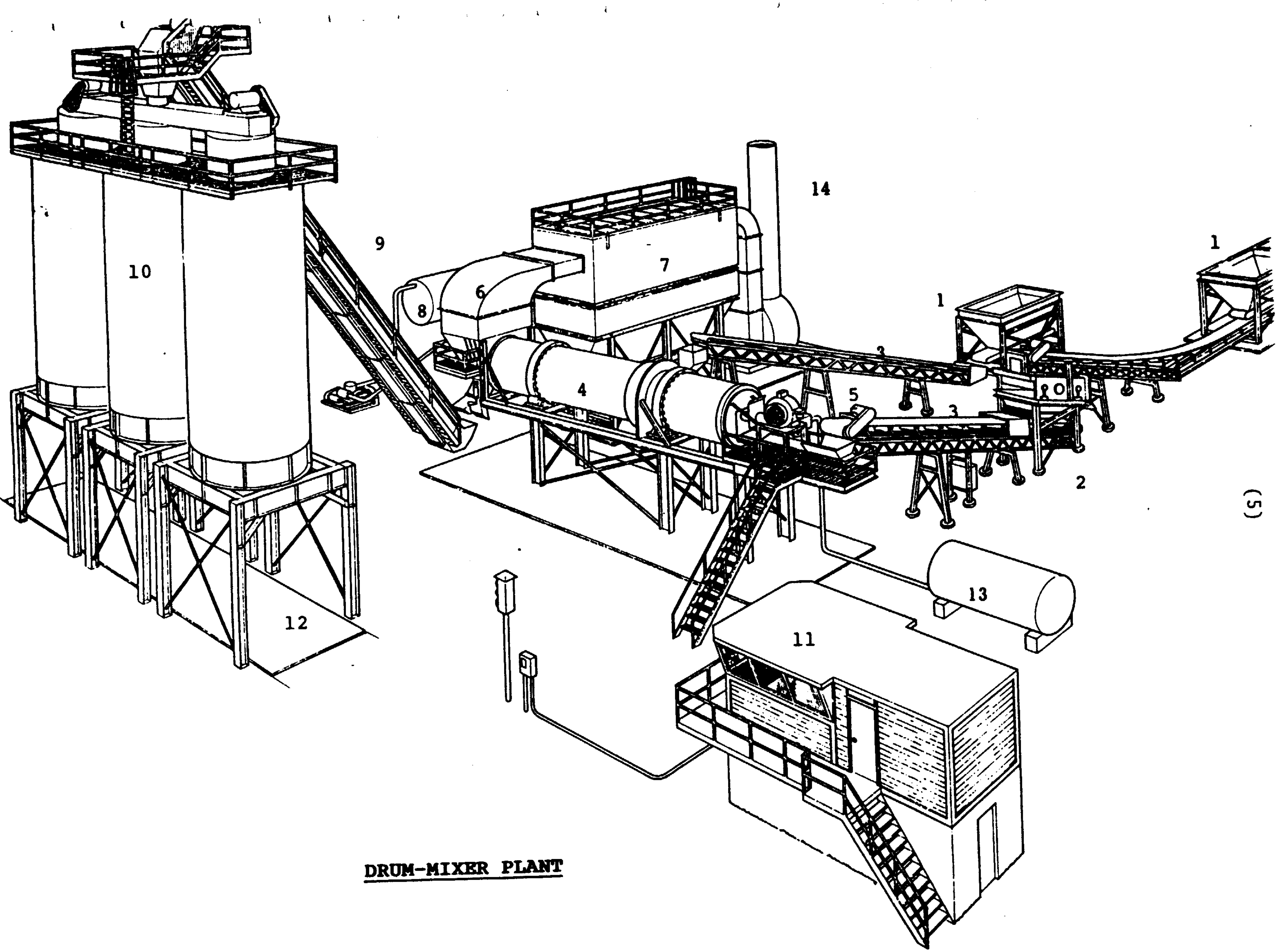
IV. THE SOURCE

IV. THE SOURCE

B.P. Short & Sons Paving employs a Genco/Bituma Stor drum mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind the mixture together. After the hot asphalt mix is manufactured at the plant, it is transported to the location where it is to be applied. The hot asphalt mix is spread evenly over the surface with a paver and then compacted with a heavy roller to produce the final product.

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

The drum mixer uses a [redacted] to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate and hot asphalt oil thoroughly. The air is drawn into the system via an exhaust fan. After passing through the burner and the mixing drum, the exhaust gasses pass through a baghouse. The baghouse is manufactured by Genco/Bituma Stor. The exhaust gasses are drawn through the baghouse and discharged to the atmosphere through a stack. The design pressure drop across the tube-sheet is 1 - 6 inches of water. The particulate matter, which is removed by the baghouse, is reinjected into the drum mixer.



DRUM-MIXER PLANT

1. Aggregate bins: Virgin aggregate is fed individually into each of four bins by type. It is metered onto a conveyor belt running under the bins to a shaker screen. The proporation 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 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 provide the flame which drys the aggregate.

6. Knock off baffleing: A baffeling 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 gases 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 project.

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 a 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. Fuel Storage

DATA SUMMARY

Plant

1. Manufacturer of plant Cenco Butumz stor corporation.
2. Designed maximum operating capacity 200 TPH @ 2 % moisture.
3. Actual operation rate 160 TPH @ 4.5 % moisture.
4. Startup date ______.
5. Type of fuel used in dryer #2 oil.
6. Quanity of fuel consumption ______.

Aggregate

7. Name/type of mix 1 : 5-5.
8. Percent asphalt in mix 5.5 %.
9. Temperature of asphalt 295.
10. Sieve/Screening analysis: % Passing;

1"		3/8"	50 %	#	
3/4"		#scr	30 %	#	
1/2"		#sand	20 %	#200	

Baghouse

11. Manufacturer Cenco Butumz corp.
12. No. of bags 612. Type of bags Nomex.
13. Air to cloth ratio 5.52/1. Designed ACFM 42,000.
14. Square feet of bags 7612.
15. Type of cleaning; pulse jet ______, reverse air ✓,
    plenum pulse ______, other ______.
16. Cleaning cycle time .3.
17. Interval between cleaning cycle 20 Sec.
18. Pressure drop across baghouse 1.5 psi.
19. Pulse pressure on cleaning cycle 80 lbs psi.

COMPANY NAME X B.P. Short and Son Paving Co DATE X 4/20/88

PLANT DATA (8)

COMPANY NAME B.P. Short and Son Paving Co.

COMPANY REP. ______ DATE April 20, 1988 PHONE # (804) 732-8412

DATA SOURCE ______

PLANT LOCATION Edgerton, Virginia

PLANT MFG. Bituma PLANT MODEL # ______ PLANT TYPE Drum

MIX SPECIFICATION # S-5 OIL SPECIFICATION # ______

Time 24 Hour	# Fuel Oil 2 / Nat. Gas __ / Propane __ / Coal __	Burner Setting	Aggregate TPH	Recycle TPH	Liquid Asphalt TPH	Mix Temp. °F	__ Venturi / __ Baghouse Pressure Drop Inches Water
8:45 AM		6.1	163	[illegible]	9.1	292 °F	.1
9:00 AM		5.9	160		9.0	299	.1
9:15 AM		6.0	163		9.1	298	.1
9:30 AM		5.8	167		9.2	285	.1
10:40		5.7	159		8.9	298	.1
12:10 PM		6.6	163		9.1	287	.15
12:25 PM		5.9	163		9.1	288	.1
12:40 PM		5.9	162		9.1	286	.11
12:55 PM		6.0	161		9.1	294	.1
1:10 PM		6.1	170		9.5	281	.12
2:30 PM		6.25	165		8.9	282	.13
2:45 PM		5.7	165		8.9	288	.15
3:00 PM		5.7	167		9.1	287	.15
3:15 PM		5.8	165		8.9	293	.18
3:30 PM							

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 petri dishes. In the lab, the dishes are opened and placed into a dessicator for at least 24 hours. Then, the filters are weighed continuously every 6 hours until a constant weight is achieved. All data is recorded on the laboratory forms that will be bound in the test report.

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 silica gel used in the stack test is returned to the appropriate mason jar and sealed for transport to the laboratory where it is reweighed to a constant weight on a triple-beam balance to the nearest tenth of a gram.

C. PROBE RINSINGS: In all tests, where a probe washout analysis is necessary, this is accomplished in accordance with procedures specified in "EPA Reference Method 5". These samples are returned in sealed mason jars to the laboratory for analysis. The front half of the filter holder is washed in accordance with the same procedures and included with the probe wash. Reagent or ACS grade acetone is used as the solvent. The backhalf of the filter holder is washed with deionized water into the impinger catch for appropriate analysis.

D. IMPINGER CATCH: In some testing cases, the liquid collected in the impingers must be analyzed for solid 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 from the one 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 B. P. Short & Sons Paving   Relative humidity in lab 51 %

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

Blank volume (V_a) 200 ml

Date/Time wt. blank 4/25/88   Gross wt. 100.2053 mg

Date/Time wt. blank 4/26/88   Gross wt. 100.2052 mg

Ave. Gross wt. 100.2053 mg

Tare wt. 100.2050 mg

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

Acetone blank residue concentration (C_a) $(C_a) = (M_{ab}) / (V_a)(p_a)$ = (.000019 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} P_a$ = (.0000019)(200)(.7653) = (.0003)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt 4/27/88 1:30Pm Gross wt	g	126.0540	149.4716	156.0428
Date/Time of wt 4/28/88 9:30Am Gross wt	g	126.0535	149.4714	156.0423
Average Gross wt	g	126.0538	149.4715	156.0426
Tare wt	g	126.0312	149.4540	156.0064
Less acetone blank wt (W_a)	g	.0003	.0003	.0003
Wt of particulate in acetone rinse (m_a)	g	.0223	.0172	.0531

Filter Numbers	#	SG-2545	SG-2544	SG-2588
Date/Time of wt 4/27/88 11Am Gross wt	g	0.5385	0.5530	0.5232
Date/Time of wt 4/28/88 9:30Am Gross wt	g	.5382	.5529	.5228
Average Gross wt	g	.5384	.5530	.5230
Tare wt	g	0.5309	0.5298	0.5187

Weight of particulate on filters(s) (m_f)	g	.0075	.0232	.0043
Weight of particulate in acetone rinse	g	.0223	.0172	.0531
Total weight of particulate (m_n)	g	.0298	.0404	.0574

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   Signature of reviewer

VII. CALCULATIONS

NAME: B.P. SHORT & SONS PAVING COMPANY
LOCATION: LAWRENCEVILLE, VIRGINIA
TEST DATE: 4/20/88

SUMMARY OF TEST DATA

		RUN #1	RUN #2	RUN #3
SAMPLING TRAIN DATA				
1. Start time		08:48	12:10	14:28
2. Finish time		10:52	13:20	16:47
3. Sampling time, minutes	Θ	60.0	60.0	60.0
4. Sampling nozzle diameter, in.	D_n	.3110	.3110	.3110
5. Sampling nozzle cross-sect. area, ft^2	A_n	.000528	.000528	.000528
6. Isokinetic variation	I	103.2	100.8	97.5
7. Sample gas volume - meter cond., cf.	V_m	34.460	36.140	39.819
8. Average meter temperature, ^oR	T_m	518	534	540
9. Avg. oriface pressure drop, in. H_2O	dH	1.25	1.32	1.62
10. Total particulate collected, mg.	M_n	29.80	40.40	57.40
VELOCITY TRAVERSE DATA				
11. Stack area, ft^2.	A	16.00	16.00	16.00
12. Absolute stack gas pressure, in. Hg.	P_s	29.80	29.80	29.80
13. Barometric pressure, in. Hg.	P_{bar}	29.80	29.80	29.80
14. Avg. absolute stack temperature, R^o	T_s	693	700	698
15. Average $-\sqrt{\text{vel. head}}$, (C_p= .80)	$-\sqrt{dP}$	0.52	0.53	0.59
16. Average stack gas velocity, ft./sec.	V_s	33.53	34.19	38.09
STACK MOISTURE CONTENT				
17. Total water collected by train, ml.	V_{ic}	311.00	283.00	298.00
18. Moisture in stack gas, %	B_{ws}	29.29	27.05	26.36
EMISSIONS DATA				
19. Stack gas flow rate, dscf/hr.(000's)	Q_{sd}	1036	1079	1217
20. Stack gas flow rate, cfm	acfm	32189	32822	36566
21. Particulate concentration, gr/dscf	C_s	0.0130	0.0173	0.0226
22. Particulate concentration, lb/hr	E	1.92	2.67	3.93
23. Particulate concentration, lb/mBtu	E'	0.00000	0.00000	0.00000
ORSAT DATA				
24. Percent CO_2 by volume	CO_2	6.00	6.00	4.50
25. Percent O_2 by volume	O_2	14.50	14.00	13.50
26. Percent CO by volume	CO	.00	.00	.00
27. Percent N_2 by volume	N_2	79.50	80.00	82.00

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

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:

$$M_d = 0.44(6.00\%) + 0.32(14.50\%) + 0.28(.00\% + 79.50\%) = 29.54 \frac{lb}{lb\text{-}mole}$$

Run 2:

$$M_d = 0.44(6.00\%) + 0.32(14.00\%) + 0.28(.00\% + 80.00\%) = 29.52 \frac{lb}{lb\text{-}mole}$$

Run 3:

$$M_d = 0.44(4.50\%) + 0.32(13.50\%) + 0.28(.00\% + 82.00\%) = 29.26 \frac{lb}{lb\text{-}mole}$$

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

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 ^oR.

T_{std} = Standard absolute temperature (528^oR).

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

Y = Dry gas meter calibration factor.

13.6 = Inches water per inches Hg.

RUN 1:

$$V_{m(std)} = (17.64)(1.005)(\ 34.460) \left[\frac{(29.80) + \frac{1.25}{13.6}}{518} \right] = 35.254 \text{ dscf}$$

RUN 2:

$$V_{m(std)} = (17.64)(1.005)(\ 36.140) \left[\frac{(29.80) + \frac{1.32}{13.6}}{534} \right] = 35.871 \text{ dscf}$$

RUN 3:

$$V_{m(std)} = (17.64)(1.005)(\ 39.819) \left[\frac{(29.80) + \frac{1.62}{13.6}}{540} \right] = 39.112 \text{ dscf}$$

Format: dsmP3

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:

$$c_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{29.80}{35.254} \right] = 0.0130 \text{ gr./dscf.}$$

Run 2:

$$c_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{40.40}{35.871} \right] = 0.0173 \text{ gr./dscf.}$$

Run 3:

$$c_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{57.40}{39.112} \right] = 0.0226 \text{ gr./dscf.}$$

NAME: B.P. SHORT & SONS PAVING COMPANY (18)
LOCATION: LAWRENCEVILLE, VIRGINIA
TEST DATE: 4/20/88

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 = 29.54 (1 - 29.29) + 18 (29.29) = 26.16 (lb./lb.-mole)

Run 2:

M_s = 29.52 (1 - 27.05) + 18 (27.05) = 26.40 (lb./lb.-mole)

Run 3:

M_s = 29.26 (1 - 26.36) + 18 (26.36) = 26.29 (lb./lb.-mole)

Format: mgB3

Water Vapor Condensed

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

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

Where:

0.04707 = Conversion factor, $ft.^3/ml.$

0.04715 = Conversion factor, $ft.^3/g.$

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

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

$V_f - V_i$ = Final volume of impinger contents less initial volume, ml.

$W_f - W_i$ = Final weight of silica gel less initial weight, g.

p_w = Density of water, 0.002201 lb/ml.

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

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

T_{std} = Absolute temperature at standard conditions, 528^oR.

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

Run 1:

$V_{wc(std)}$ = (0.04707) (300.0) = 14.1 cu.ft

$V_{wsg(std)}$ = (0.04715) (11.0) = 0.5 cu.ft

Run 2:

$V_{wc(std)}$ = (0.04707) (270.0) = 12.7 cu.ft

$V_{wsg(std)}$ = (0.04715) (13.0) = 0.6 cu.ft

Run 3:

$V_{wc(std)}$ = (0.04707) (285.0) = 13.4 cu.ft

$V_{wsg(std)}$ = (0.04715) (13.0) = 0.6 cu.ft

NAME: B.P. SHORT & SONS PAVING COMPANY
LOCATION: LAWRENCEVILLE, VIRGINIA
TEST DATE: 4/20/88

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

Where:

V_s	=	Average velocity of gas stream in stack, ft./sec.
K_p	=	85.49 ft/sec $\left[(g/g\text{-mole})\text{-}(mm\ Hg) / (^{o}K)(mm\ H_2O)\right]^{1/2}$
C_p	=	Pitot tube coefficient, (dimensionless).
dP	=	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, (^{o}f).
T_s	=	Absolute stack temperature, (^{o}R). = 460 + t_s.
M_s	=	Molecular weight of stack gas, wet basis, (lb/lb-mole).

Run 1:

$$V = (85.49)\ (\ .80)\ (\ 0.52) \sqrt{\frac{693}{(29.80)(26.16)}} = 33.53 \text{ ft/sec.}$$

Run 2:

$$V = (85.49)\ (\ .80)\ (\ 0.53) \sqrt{\frac{700}{(29.80)(26.40)}} = 34.19 \text{ ft/sec.}$$

Run 3:

$$V = (85.49)\ (\ .80)\ (\ 0.59) \sqrt{\frac{698}{(29.80)(26.29)}} = 38.09 \text{ ft/sec.}$$

NAME: B.P. SHORT & SONS PAVING COMPANY
LOCATION: LAWRENCEVILLE, VIRGINIA
TEST DATE: 4/20/88

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:

$$B_{ws} = \frac{14.1 + 0.5}{14.1 + 0.5 + 35.254} \text{ X } 100 = 29.29\ \%$$

Run 2:

$$B_{ws} = \frac{12.7 + 0.6}{12.7 + 0.6 + 35.871} \text{ X } 100 = 27.05\ \%$$

Run 3:

$$B_{ws} = \frac{13.4 + 0.6}{13.4 + 0.6 + 39.112} \text{ X } 100 = 26.36\ \%$$

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

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, (^{o}f).
- T_s = Absolute stack temperature, (^{o}R).
- T_{std} = Standard absolute temperature, (528^{o}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:

$$Q_{sd}=3600(1- .2929)(33.53)(16.00)\left[\frac{528}{693}\right]\left[\frac{29.80}{29.92}\right] = 1036316.1 \frac{dscf}{hr}$$

Run 2:

$$Q_{sd}=3600(1- .2705)(34.19)(16.00)\left[\frac{528}{700}\right]\left[\frac{29.80}{29.92}\right] = 1079288.2 \frac{dscf}{hr}$$

Run 3:

$$Q_{sd}=3600(1- .2636)(38.09)(16.00)\left[\frac{528}{698}\right]\left[\frac{29.80}{29.92}\right] = 1217251.8 \frac{dscf}{hr}$$

NAME: B.P. SHORT & SONS PAVING COMPANY
LOCATION: LAWRENCEVILLE, VIRGINIA
TEST DATE: 4/20/88

Emissions Rate from Stack

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

Where:

E = Emissions rate, lb./hr.

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

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

Run 1:

$$E = \frac{(0.0130)\ (1036316.1)}{7000} = 1.92 \text{ lb. / hr.}$$

Run 2:

$$E = \frac{(0.0173)\ (1079288.2)}{7000} = 2.67 \text{ lb. / hr.}$$

Run 3:

$$E = \frac{(0.0226)\ (1217251.8)}{7000} = 3.93 \text{ lb. / hr.}$$

$$I = 100 \; T_s \left[\frac{0.002669 \; V_{ic} + (V_m / T_m) \; (P_{bar} + dH / 13.6)}{60 \quad \theta \quad V_s \quad P_s \quad A_n} \right]$$

Where:

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

Run 1:

$$I = (100)(\;693\;) \left[\frac{(0.002669)(311.00) + \frac{34.460}{518} \left[29.80 + \frac{1.25}{13.6} \right]}{60 \; (\;60.0\;) \; (\;33.53\;) \; (\;29.80\;) \; (\;.000528\;)} \right] = 103.2\%$$

Run 2:

$$I = (100)(\;700\;) \left[\frac{(0.002669)(283.00) + \frac{36.140}{534} \left[29.80 + \frac{1.32}{13.6} \right]}{60 \; (\;60.0\;) \; (\;34.19\;) \; (\;29.80\;) \; (\;.000528\;)} \right] = 100.8\%$$

Run 3:

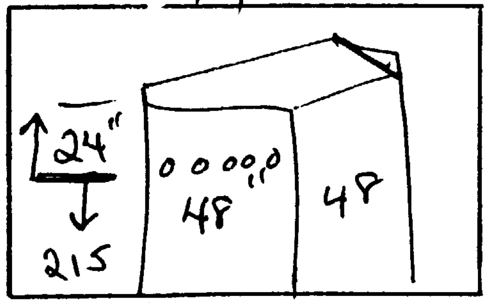
$$I = (100)(\;698\;) \left[\frac{(0.002669)(298.00) + \frac{39.819}{540} \left[29.80 + \frac{1.62}{13.6} \right]}{60 \; (\;60.0\;) \; (\;38.09\;) \; (\;29.80\;) \; (\;.000528\;)} \right] = 97.5\%$$

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant B. P. Short & Sons
Location Lawrenceville Va.
Operator Sam Turner
Date 4-20-88
Run No. 1
Sample Box No. 1
Meter Box No. C-185
Meter H @ 1.85
Y Factor 1.005
Pitot Tube Coefficient Cp .799
Pitot Tube leak ck OK

4.4



Schematic of Stack Cross Section

Ambient Temperature 45
Barometric Pressure 29.80
Assumed Moisture, % 25
Probe Length, m(ft) 5'
Nozzle Identification No. 0.000 5275
Avg. Calibrated Nozzle Dia., (in.) .311 | .311 | .311
Probe Heater Setting 4
Leak Rate, m^3/min. (cfm) .001 at 7" Vac
Probe Liner Material 316 SS
Static Pressure, mm Hg (in. Hg) .13 / .136
Filter No. SG-2545

	IMPINGER VOLUME ml	SILICA GEL WEIGHT g
FINAL	500	211
INITIAL	200	200
DIFFERENCE	300	11

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A 1	8:48 / 8:50	1	230	.15	.66	791.09 / 791.10	50	46	250	60
2	8:52	1	230	.15	.66	792.80	54	47	250	60
3	8:54	1	232	.20	.88	793.70	58	44	245	35
4	8:56	1	230	.10	.44	794.40	60	44	245	35
5	8:58	1	230	.10	.44	795.10	61	44	245	35
6	9:00	1	230	.10	.44	795.80	62	44	250	35
B 1	9:01 / 9:03	2	230	.30	1.3	797.10	62	44	250	35
2	9:05	2	236	.30	1.3	798.40	62	44	250	35
3	9:07	1	238	.13	~~.52~~ .57	799.10	67	44	250	35
4	9:09	1	~~239~~ 239	.15	.66	799.90	68	44	245	35
5	9:11	1	239	.15	.66	800.90	68	44	245	35
6	9:13	2	234	.25	1.1	801.85	69	44	245	35

CO_2 = 6.0 %, O_2 = 14.0 % CO_2 = 6.0 % O_2 = 14.5 CO_2 = 6.0 O_2 = 14.5

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 4-20-88 LOCATION Lawrenceville GA 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)
C 1	9:14 / 9:16	3.0	234	.50	2.2	803.70	68	46	230	40
2	9:18	2.5	236	.35	1.5	804.70	70	46	230	40
3	9:20	2.0	235	.25	1.1	806.00	72	47	230	40
4	9:22	2.0	236	.22	.97	806.90	(SD) ~~7~~ 72	47	225	40
5	9:24	2.0	238	.28	1.2	808.00	72	48	225	40
6	9:26	2.0	239	.28	1.2	809.22	74	48	250	40
D 1	9:27 / 9:29	3.0	238	.55	2.40	810.90	70	50	250	40
2	9:31	2.5	239	.35	1.5	812.30	72	50	245	40
3	9:33	2.0	239	.25	1.1	813.40	74	50	245	40
4	9:35	2.0	240	.25	1.1	814.40	74	50	250	40
5	9:37	2.0	238	.30	1.3	815.6	74	50	250	40
6	10:36 / 10:38	2.0	220	(SD) ~~.30~~ .35	(SD) ~~1.3~~ 1.5	817.00	60	56	240	50
E 1	10:40 / 10:42	6.0	220	(SD) ~~.55~~ .70	(SD) ~~2.4~~ 3.1	818.90	66	56	240	50
2	10:44	5.0	220	.50	2.2	820.60	68	56	240	50
3	10:46	2.5	226	.30	1.3	821.80	72	56	240	50
4	10:48	3.0	228	.35	1.5	823.10	72	56	240	50
5	10:50	2.5	230	.25	1.1	824.20	76	56	240	50
6	10:52	3.5	231	.45	1.98	825.55	76	55	240	50

RAMCON ENVIRONMENTAL CORPORATION

4.4

Plant B.P. Short & Sons
Location Lawrenceville Va
Operator Sam [illegible]
Date 4-20-88
Run No. 2
Sample Box No. 2
Meter Box No. ~~1.85~~ C-185
Meter H @ 1.85
C Factor 1.005
Pitot Tube Coefficient Cp .799
Pitot Tube leak ck OK

Schematic of Stack Cross Section

Ambient Temperature 58
Barometric Pressure 29.80
Assumed Moisture, % 2.5
Probe Length, m(ft) 5
Nozzle Identification No. .00 527 5
Avg. Calibrated Nozzle Dia., (in.) .311/.311/.311
Probe Heater Setting ~~X~~ (ST) 4.0
Leak Rate, m^3/min. (cfm) .01 at 5" Vac
Probe Liner Material 316 SS
Static Pressure, mm Hg (in. Hg) .12/13.6
Filter No. SG-2544

	IMPINGER VOLUME ml	SILICA GEL WEIGHT, g
FINAL	470	213
INITIAL	200	200
DIFFERENCE	270	13

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 Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A 1	12:19 / 12:18	2	227	.75	3.3	825.71 / 828.00	62	60	250	60
2	12:20	2	235	.50	2.2	829.20	72	60	245	60
3	12:22	4	237	.45	2.0	830.70	76	59	245	50
4	12:24	7	237	.30	1.32	832.00	78	59	245	50
5	12:26	7	238	.30	1.32	833.30	78	59	250	55
6	12:28	7	239	.30	1.32	834.35	80	60	250	55
B 1	12:29 / 12:31	7	242	.65	2.86	836.10	80	60	250	55
2	12:33	7	242	.60	2.6	837.70	76	60	250	55
3	12:35	6	242	.28	1.2	839.00	78	60	245	55
4	12:37	6	243	.28	1.2	840.50	80	60	245	55
5	12:39	3	244	.40	1.76	841.80	85	60	245	55
6	12:41	2	242	.38	1.67	843.10	86	60	245	55

CO_2 = 6.0 O_2 = 14.5 % CO_2 = 6.0 O_2 = 14.0 CO_2 = 6.0 O_2 = 14.0

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 4-20-88 LOCATION Lawrenceville TEST NO. 2

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft.^{3})	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
C 1	~~1242~~ 1244	2	240	.38	1.67	844.50	83	62	245	55
2	1246	2	241	.35	1.54	845.80	86	62	245	55
3	12:48	1	241	.23	1.0	846.80	88	62	255	55
4	1250	1	238	.20	0.88	848.00	88	62	255	55
5	1252	1	241	.30	1.30	849.10	89	64	255	55
6	1254	1	242	.25	1.1	850.30	90	64	255	55
D 1	~~1255~~ 1259	1	232	.30	1.3	851.70	86	64	245	55
2	1259	1	240	.35	1.54	852.80	90	64	245	55
3	13:01	1	241	.15	.66	853.90	91	65	245	55
4	1303	1	242	.15	.66	854.60	91	65	240	55
5	1305	1	244	.20	.88	855.70	91	65	225	55
6	1307	1	242	.20	.88	856.70	91	65	225	55
E 1	~~1308~~ 1310	1	234	.18	.79	857.60	89	65	225	55
2	1312	1	237	.20	.88	858.70	90	66	250	55
3	1314	1	242	.13	.57	859.60	92	66	250	55
4	1316	1	243	.10	.44	860.48	92	66	250	55
5	1318	1	243	.10	.44	861.10	92	66	250	55
6	1320	1	241	.09	.40	861.85	92	66	250	55

RAMCON ENVIRONMENTAL CORPORATION

Plant B.P. Short & [illegible]
Location Saunersville Va.
Operator [illegible]
Date 4-20-88
Run No. 3
Sample Box No. 1
Meter Box No. C-185
Meter H @ 1.85
C Factor 1.005
Pitot Tube Coefficient Cp .799

Ambient Temperature 45
Barometric Pressure 29.80
Assumed Moisture, % 25
Probe Length, m(ft) 5'
Nozzle Identification No. .311
Avg. Calibrated Nozzle Dia., (in.) .311/.311/.311
Probe Heater Setting 7
Leak Rate, m^3/min. (cfm) .001 @ 5 in Hg
Probe Liner Material Stainless Steel
Static Pressure, mm Hg (in. Hg)
Filter No. SG-2588

	IMPINGER VOLUME ml	SILICA GEL WEIGHT, g
FINAL	485	265
INITIAL	200	200
DIFFERENCE	285	13

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ)min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
1	2:28 / 2:30	4	230	.81	3.6	862.0 / 860.0 / 863.8	70	70	230	60
2	2:32	4	230	.25	3.3	865.8	80	70	230	60
3	2:34	4	240	.50	2.2	867.3	84	70	230	60
4	2:36	2	240	.35	1.5	868.7	90	70	240	60
5	2:38	2	240	.32	1.4	870.0	90	70	240	60
6	2:40	3	240	.50	2.2	871.7	90	70	240	60
1	2:41 / 2:43	4	240	.75	3.3	873.5	85	70	240	60
2	2:45	7	240	.80	3.5	875.4	90	70	245	55
3	2:47	3	240	.50	2.2	877.2	90	70	245	55
4	2:49	3	245	.30	1.3	878.6	90	70	240	55
5	2:51	3	245	.30	1.3	879.7	90	70	240	55
6	2:53	2	240	.35	1.5	881.1	95	70	235	55

O_2 = 13.5, O_2 = CO_2 = 4.0% O_2 = 13.5% CO_2 = 4.5%

Form #REC-06

RAMCON emissions test log sheet, cont. DATE______ LOCATION______ TEST NO.______

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)
1	2:54 / 2:56	4	230	.65	2.9	882.6	90	70	235	55
2	2:58	3	230	.45	2.0	884.2	95	70	235	55
3	3:00	3	235	.25	1.1	885.4	95	70	235	55
4	3:02	1	240	.21	.92	886.4	95	70	235	55
5	3:04	1	240	.25	1.1	887.6	95	70	235	55
6	3:06	1	245	.32	1.4	888.9	95	70	235	55
1	3:07 / 3:09	2	230	.35	1.5	890.2	90	70	240	55
2	3:11	3	234	.43	1.9	891.6	95	70	230	45
3	3:13	3	240	.34	1.5	893.0	95	70	230	45
4	3:15	3	244	.15	.66	894.0	95	70	230	45
5	3:17	3	244	.15	.66	894.9	95	70	230	45
6	3:19	3	246	.19	.84	895.9	95	70	235	45
1	3:20 / 3:22	2	230	.25	1.1	896.9	90	70	235	45
2	3:24	1	235	.25	1.1	898.1	95	70	235	45
3	3:26	1	235	.20	.88	899.1	95	70	235	45
4	3:28	1	245	.15	.66	900.0	95	70	235	45
5	3:30	1	245	.15	.66	901.1	95	70	235	45
6	4:47 / 4:49	1	210	.10	.44	901.519	80	70	225	45

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 5-4-88 Meter box number C-185

Barometric pressure, P_b = 29.88 in. Hg Calibrated by Sam Turner

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter Inlet (t_{d_i}), °F	Temperature: Dry gas meter Outlet (t_{d_o}), °F	Temperature: Dry gas meter Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5								
1.0	6	452.30 / 458.465	74	80 / 98	68 / 68	78.5	10.95	.979	1.87
1.5	10								
2.0	10	458.465 / 468.716	74	95 / 101	68 / 68	83	13.00	.987	1.88
3.0	10	468.716 / 478.952	74	90 / 102	68 / 69	82.25	10.69	.985	1.91
4.0	10								
							Avg	.984	1.89

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		

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

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 4-11-88 Meter box number C-185

Barometric pressure, P_b = 29.68 in. Hg Calibrated by Sam Turner

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter Inlet (t_{d_i}), °F	Temperature: Dry gas meter Outlet (t_{d_o}), °F	Temperature: Dry gas meter Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5								
1.0	5	670.90 / 675.977	72	87 / 93	68 / 68	79	8.95	0.995	1.80
1.5	10								
2.0	10	650.32 / 660.46	72	82 / 93	64 / 66	76.25	12.92	1.007	1.88
3.0	10	660.10 / 670.64	72	90 / 96	66 / 67	79.75	10:59	1.013	1.88
4.0	10								
							Avg	1.005	1.85

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		

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

RAMCON ENVIRONMENTAL CORPORATION

Date 2/9/88 Thermocouple number 51

Ambient temperature 54°F ~~°C~~ Barometric pressure 29.95 in. Hg

Calibrator S. Greenwood Reference: mercury-in-glass ✓

other ________

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, ~~°C~~	Thermocouple Potentiometer Temperature, ~~°C~~	Temperature Difference,[c] %
A	ICE WATER	32°F	32°F	0%
B	BOILING WATER	212°F	211°F	.005%
C	OiL	380°F	382°F	.005%
D	Ambient	54°F	55°F	.01%
	4-20-88	45°F	45°F	0%

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON

Lear Siegler Stack Sampler

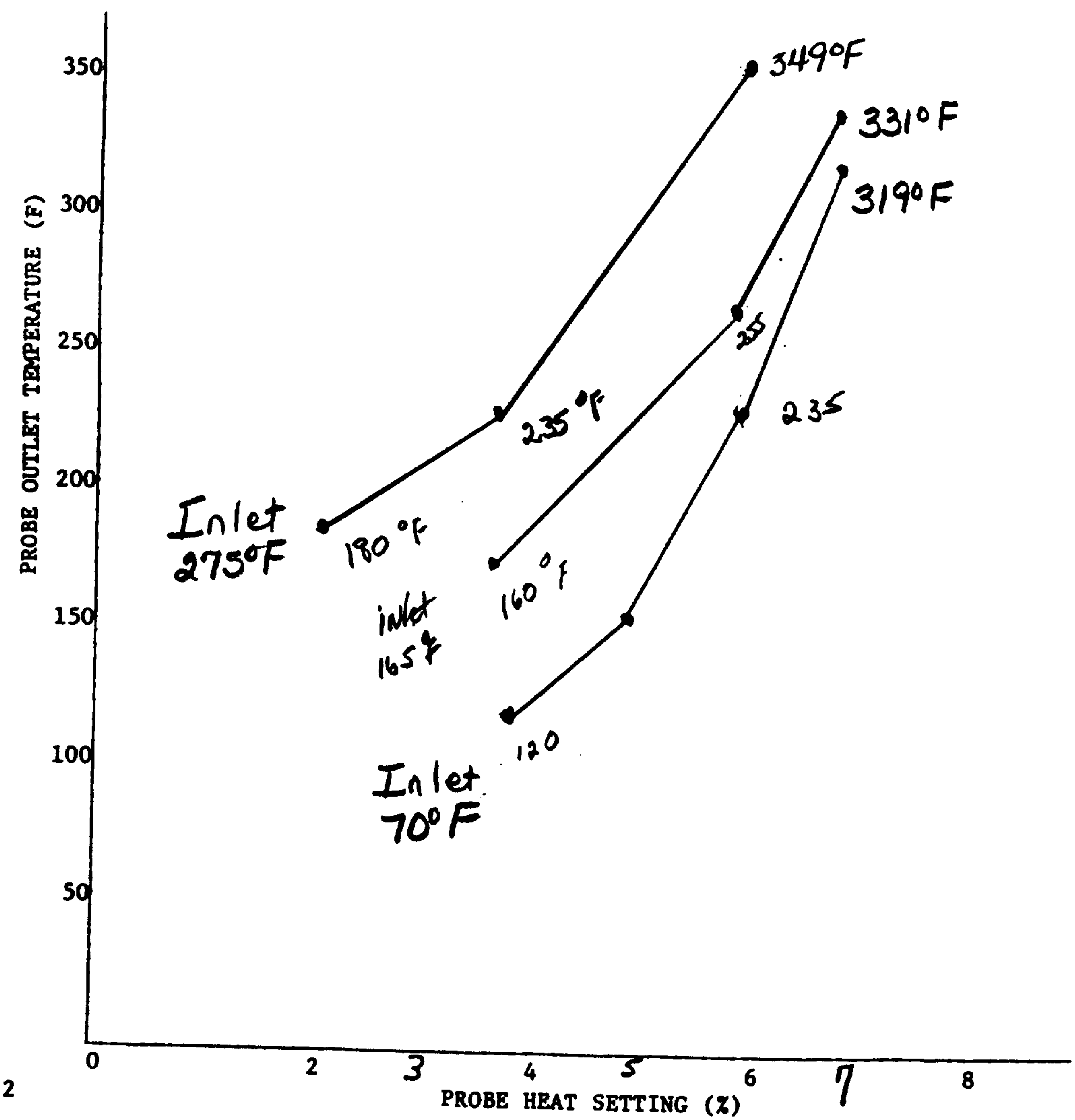
Heating Probe Calibration

Probe No. 51 Probe Length 5'

Date of Calibration 2-10-88 Signature Sam T. Tenney

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



Form No. EED-17-2

RAMCON ENVIRONMENTAL CORPORATION

Lear Siegler Stack Sampler

Nozzle Diameter Calibration

Date ________________ Signature ____________________

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

Pitot Tube Calibration (S Type)

Pitot Tube Identification No. 51 Date 2-3-88

Calibrated by: Sam T. Turner

"A" SIDE CALIBRATION

Run No.	Δp std cm H_2O (in. H_2O)	Δp (s) cm H_2O (in. H_2O)	$C_p(s)$	DEVIATION $C_p(s)-\bar{C}_p(A)$
1	0.90	1.41	.799	< .01
2	0.60	.94	.799	< .01
3	0.41	.65	.794	< .01
		$\bar{C}_p$ (SIDE A)	.797	

"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	0.90	1.4	.802	< .01
2	0.60	.95	.795	< .01
3	0.41	.64	.800	< .01
		$\bar{C}_p$ (SIDE B)	.799	

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

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

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

RAMCON ENVIRONMENTAL CORPORATION

Date 2-10-88 Thermocouple number Inlet

Ambient temperature 55°F ~~°C~~ Barometric pressure 29.96 in. Hg

Calibrator S. Greenwood Reference: mercury-in-glass ✓

other ______

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, ~~°C~~	Thermocouple Potentiometer Temperature, ~~°C~~	Temperature Difference,[c] %
A	ICE BATH	33°F	33°F	0%
B	OVEN	150°F	151°F	.007%
C	OVEN	175°F	173°F	.01%
D	AMBIENT	55°F	54°F	.02%
	4-20-86	45°F	45°F	0%

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON ENVIRONMENTAL CORPORATION

Date 2-10-88 Thermocouple number Outlet

Ambient temperature 55°F °C Barometric pressure 29.96 in. Hg

Calibrator S. Greenwood Reference: mercury-in-glass ✓

other ______

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
A	ICE BATH	33° F	32° F	.03%
B	OVEN	152° F	150° F	.01%
C	OVEN	175° F	175° F	0%
D	Ambient	55° F	55° F	0%
	4-20-86	45°F	45°F	0%

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

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 400 stacks including over 300 asphalt plants. He is 42 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 - Field Supervisor

Sam Turner has five years experience in the Air Division and is our field supervisor. He has sampled over 30 large boiler stacks and approximately 200 asphalt plants. He is a graduate of State Technical Institute of Memphis, and holds an Associate Degree in Environmental Engineering. He also has current certification as a V.E. reader.

RAMCON

ENVIRONMENTAL CORPORATION

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
B.P. SHORT & SONS PAVING COMPANY
LAWRENCEVILLE, VIRGINIA
April 20, 1988

Skip Parks
B.P. Short & Sons

G. Sumner Buck, III
President

Sam Turner
Field Supervisor

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

RAMCON

ENVIRONMENTAL CORPORATION

May 3, 1988

Mr. Skip Parks
B.P. Short & Sons Paving Company
P.O. Box 2007
Petersburg, VA 23803

Re: Particulate Emissions Test - Lawrenceville, Virginia

Dear Mr. Parks:

Enclosed you will find four copies of our report on the particulate emissions test we conducted at your plant. Based on our test results, your plant does pass both EPA New Source Performance Standards and those set by the State of Virginia. The average grain loading of the three test runs is in compliance with State and Federal Standards.

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

Ms. Lillian Alexander
Virginia Air Quality Control
7701-03 Timberlake Road
Lynchburg, VA 24502

You will need to keep one copy of the report at the plant. We certainly have enjoyed working with you and we look forward to serving you again in the future.

Sincerely,

G. Sumner Buck, III
President

GSBIII:kr

Enclosures