RAMCON

ENVIRONMENTAL CORPORATION

RAMCON BUILDING □ 223 SCOTT ST. □ MEMPHIS, TN. 38112 □ 901/458-7000

RAMCON

ENVIRONMENTAL CORPORATION

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
ASPHALT PAVING COMPANY
Hickory, North Carolina
September 21, 1988

Charles Luckadoo
Asphalt Paving Company

G. Sumner Buck, III
President

Allen Turner
Team Leader

RAMCON BUILDING, 223 SCOTT STREET, MEMPHIS, TENNESSEE 38112
TELEPHONE 800/458-4567 IN TENNESSEE 901/458-7000 FAX 901-458-3868

RAMCON
ENVIRONMENTAL CORPORATION

October 4, 1988

Mr. Charles Luckadoo
Asphalt Paving Company
P. O Box 5340
Statesville, NC 28677

Re: Particulate Emissions Tests- Hickory, North Carolina

Dear Mr. Luckadoo:

Enclosed you will find four copies of our report on the particulate emissions tests we conducted at Asphalt Paving in Hickory, North Carolina. Based on our test results, your plant does pass both EPA New Source Performance Standards and those set by the State of North Carolina. The average grain loading of the three test runs was below the allowable emissions standard set by EPA and the State of North Carolina. Therefore, your plant is operating in compliance with State and Federal Standards.

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

Mr. Bernie Pittman
North Carolina DNR
919 North Main Street
Mooresville, NC 28115

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,

Sumner

G. Sumner Buck, III
President

GSBIII:mew

Enclosures

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I. INTRODUCTION

On September 21, 1988, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Asphalt Paving Company's Astec drum mix asphalt plant located in Hickory, North Carolina. RAMCON personnel conducting the test were Allen Turner and Murphy O'Neal. John Biggs was responsible for the particulate laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples was limited to Mr. Turner and Mr. Biggs.

The purpose of the test was to determine if the rate of particulate emissions from the plant's baghouse and the total contaminants by weight (grain loading) is below the allowable N.S.P.S. limits set by the State of North Carolina.

II. TEST RESULTS

Table I summarizes the test results. The grain loading limitation for EPA is specified in 39 FR 9314, March 8, 1974, 60.92 Standards for Particulate Matter (1), as amended. The allowable N.S.P.S. particulate emissions for EPA and the State of North Carolina is .04 gr/dscf.

Mr. Bernie Pittman of the North Carolina Department of Natural Resources observed the testing conducted by RAMCON. Murphy O'Neal conducted the visible emissions (Reference Method 9). The opacity on all three test runs was 0%, therefore meeting N.S.P.S. requirements.

TABLE I

SUMMARY OF TEST RESULTS
September 21, 1988

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	10:57 to 12:00	0.0084 gr/DSCF	99.3%	1.92 lbs/hr
2	14:09 to 15:12	0.0066 gr/DSCF	99.3%	1.50 lbs/hr
3	15:29 to 16:32	0.0081 gr/DSCF	101.7%	1.83 lbs/hr
	Average:	0.0077 gr/DSCF		1.75 lbs/hr

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

III. TEST PROCEDURES

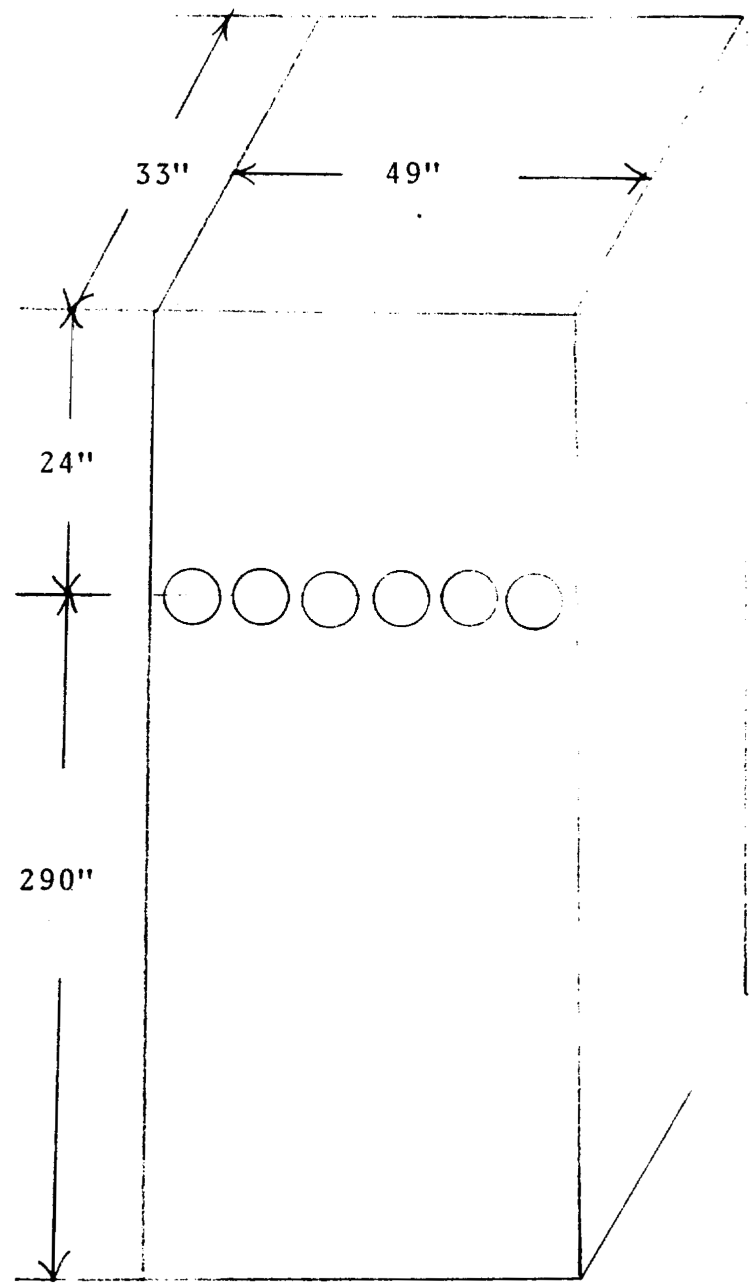
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

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

C. Sampling Site: The emissions test was conducted after a baghouse on a rectangular stack measuring 33" x 49" with an equivalent diameter of 39.4". Six sampling ports were placed 24" down (0.6 diameters upstream) from the top of the stack and 290" up (7.4 diameters downstream) from the last flow disturbance. Thirty points were sampled, five through each port for two minutes each for a total test time of 60 minutes per test run.

Points on a Diameter	Probe Mark
1	* 8.3"
2	14.9"
3	21.5"
4	28.1"
5	34.7"

*Measurements include a 5" standoff.



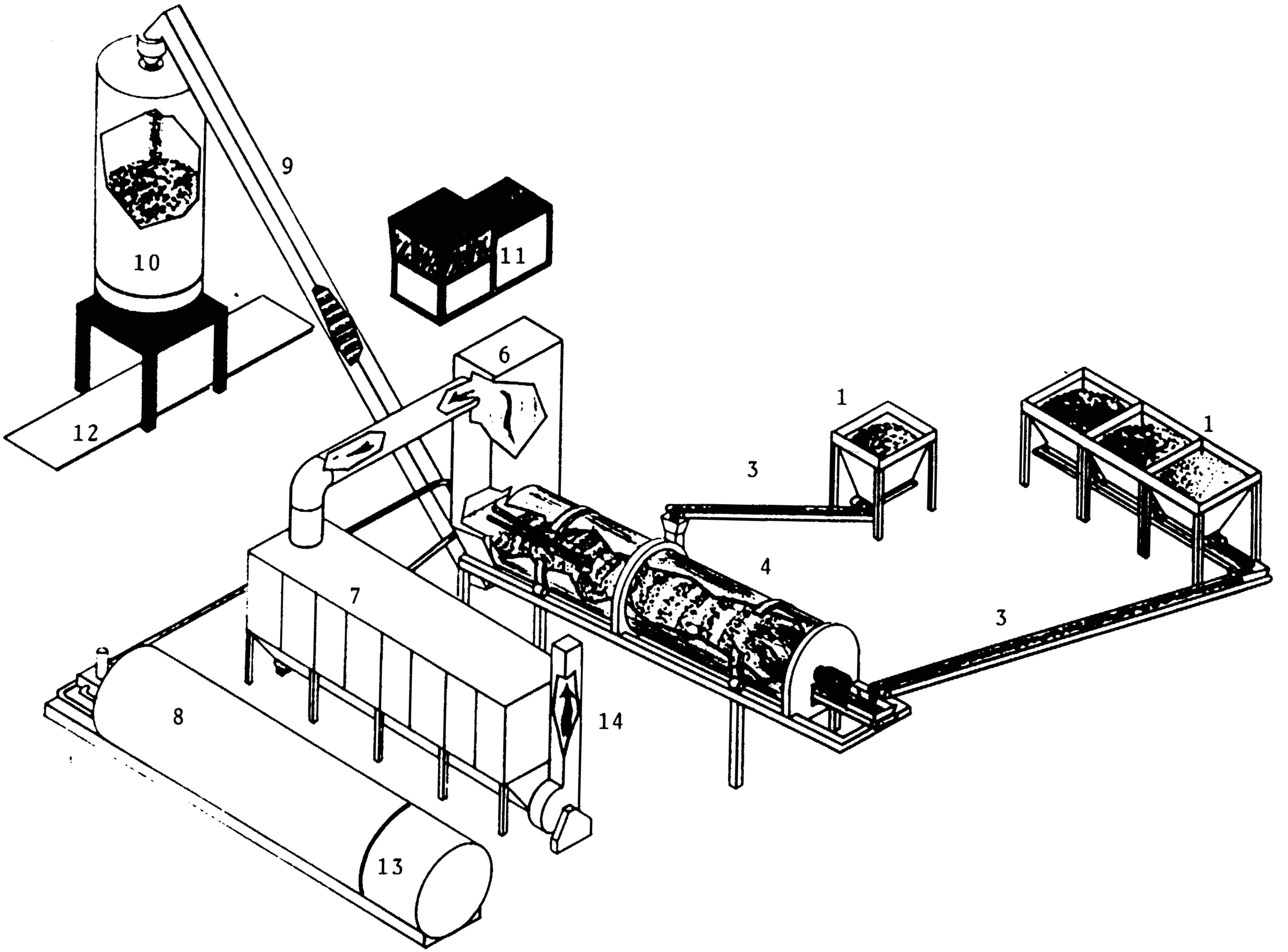
IV. THE SOURCE

IV. THE SOURCE

Asphalt Paving Company employs an Astec 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 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% moisture removal.

The drum dryer uses a burner fired with #2 fuel to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate and hot asphalt oil thoroughly. The air is drawn into the system via an exhaust fan. After passing through the burner and the mixing drum, the air passes through a baghouse. The baghouse was manufactured by Astec. The exhaust gas is drawn through the baghouse and discharged to the atmosphere through the 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.



ASTEC - DRUM MIX BAGHOUSE

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

14. Stack

PLANT DATA

COMPANY NAME ASPHALT PAVING CO INC.

COMPANY REP. LEE REESE DATE SEPT 21 1988 PHONE # 704-322 3805

DATA SOURCE ____

PLANT LOCATION HICKORY, N.C.

PLANT MFG. ASTEC PLANT MODEL # 87-225 PLANT TYPE DOUBLE BAR

MIX SPECIFICATION # 86-250-801 OIL SPECIFICATION # ____

	Time 24 Hour	__ Fuel Oil __ Nat. Gas __ Propane __ Coal __ #2 FUEL		Burner Setting ____	Aggregate TPH	Recycle TPH		Liquid Asphalt TPH	Mix Temp. °F	__ Venturi __ Baghouse Pressure Drop Inches Water
	10:35			69	272			17.3	320	6
	10:50			57	273			17.4	332	6
	11:05			55	277			17.6	315	6
1	11:20			57	275			17.4	320	6
	11:35			57	276			17.7	310	6
	11:50			73	277			17.8	315	6
	14:40			71	269			17.2	337	6
2	14:55			70	270			17.2	329	6
	15:10			67	270			17.4	326	6
	15:25			65	273			17.4	324	6
	15:40			64	269			17.1	326	6
3	15:55			69	271			17.4	330	6
	16:10			63	275			17.5	330	6
	16:25			67	271			17.2	340	6

PLANT DATA

COMPANY NAME ASPHALT PAVING CO INC.

COMPANY REP. LEE REESE DATE SEPT. 21 1988 PHONE # 704·322 3805

DATA SOURCE ______

PLANT LOCATION HICKORY NC

PLANT MFG. ASTEC PLANT MODEL # 87-225 PLANT TYPE DOUBLE-BA

MIX SPECIFICATION # ______ OIL SPECIFICATION # ______

Time 24 Hour	___ Fuel Oil ___ Nat. Gas ___ Propane ___ Coal ___ #2 FUELOIL	Burner Setting ______	Aggregate TPH	Recycle TPH	Liquid Asphalt TPH	Mix Temp. °F	___ Venturi ___ Baghouse Pressure Drop Inches Water

DATA SUMMARY

Plant

1. Manufacturer of plant ASTEC.
2. Designed maximum operating capacity 400 TPH @ 4 % moisture.
3. Actual operation rate 300 TPH @ 8 % moisture.
4. Startup date MARCH 18 1988.
5. Type of fuel used in dryer #2 FUEL OIL.
6. Quanity of fuel consumption ________.

Aggregate

7. Name/type of mix I-1.
8. Percent asphalt in mix 6.0 %.
9. Temperature of asphalt 300.
10. Sieve/Screening analysis: % Passing;

1"	100	3/8"	—	#40	23
3/4"	100	# 4	67	#80	13
1/2"	98	# 8	49	#200	4.3

Baghouse

11. Manufacturer ASTEC.
12. No. of bags 896. Type of bags NOMEX.
13. Air to cloth ratio ________. Designed ACFM 60,000.
14. Square feet of bags ________.
15. Type of cleaning; pulse jet ✓, reverse air ____, plenum pulse ________, other ________.
16. Cleaning cycle time .75 SEC.
17. Interval between cleaning cycle 20 SEC.
18. Pressure drop across baghouse 6 psi.
19. Pulse pressure on cleaning cycle 125 psi.

COMPANY NAME ASPHALT PAVING CO. DATE SEPT 21 1988

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 Asphalt Paving Relative humidity in lab 45 %

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

Blank volume (V_a) 200 ml

Date/Time wt. blank 9/27/88 Gross wt. 139.3944 mg

Date/Time wt. blank 9/28/88 Gross wt. 139.3944 mg

Ave. Gross wt. 139.3944 mg

Tare wt. 139.3941 mg

Weight of blank (m_{ab}) 0.0003 mg

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

Weight of residue in acetone wash: $W_a = C_a V_{aw} P_a$ = (.0000019)(200)(.7853) = (0.0003)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt 9/27/88 9:00 am Gross wt	g	94.4915	146.3261	94.4787
Date/Time of wt 9/28/88 9:00 am Gross wt	g	94.4913	146.3262	94.4782
Average Gross wt	g	94.4914	146.3262	94.4785
Tare wt	g	94.4779	146.3135	94.4574
Less acetone blank wt (W_a)	g	0.0003	0.0003	0.0003
Wt of particulate in acetone rinse (m_a)	g	0.0132	0.0124	0.0208

Filter Numbers	#	ST-2997	ST-2998	ST-2996
Date/Time of wt 9/27/88 9:30 am Gross wt	g	0.5376	0.5330	0.5330
Date/Time of wt 9/28/88 9:30 am Gross wt	g	0.5374	0.5328	0.5331
Average Gross wt	g	0.5375	0.5329	0.5331
Tare wt	g	0.5283	0.5279	0.5320

Weight of particulate on filters(s) (m_f)	g	0.0092	0.0050	0.0011
Weight of particulate in acetone rinse	g	0.0132	0.0124	0.0208
Total weight of particulate (m_n)	g	0.0224	0.0174	0.0219

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] Signature of reviewer [signature]

VII. CALCULATIONS

SUMMARY OF TEST DATA

		9-21-88 RUN #1	9-21-88 RUN #2	9-21-88 RUN #3
SAMPLING TRAIN DATA				
	start	10:57	14:09	15:29
	finish	12:00	15:12	16:32
1. Sampling time, minutes	θ	60.0	60.0	60.0
2. Sampling nozzle diameter, in.	D_n	.2300	.2300	.2300
3. Sampling nozzle cross-sect. area, ft^2	A_n	.000289	.000289	.000289
4. Isokinetic variation	I	99.3	99.3	101.7
5. Sample gas volume - meter cond., cf.	V_m	43.799	44.021	44.972
6. Average meter temperature, ^oR	T_m	544	548	550
7. Avg. oriface pressure drop, in. H_2O	dH	1.68	1.68	1.68
8. Total particulate collected, mg.	M_n	22.40	17.40	21.90
VELOCITY TRAVERSE DATA				
9. Stack area, ft^2.	A	11.20	11.20	11.20
10. Absolute stack gas pressure, in. Hg.	P_s	28.84	28.84	28.84
11. Barometric pressure, in. Hg.	P_{bar}	28.84	28.84	28.84
12. Avg. absolute stack temperature, R^o	T_s	760	761	762
13. Average $-\sqrt{\text{vel. head}}$, (C_p= .81)	$-\sqrt{dP}$	1.18	1.18	1.18
14. Average stack gas velocity, ft./sec.	V_s	82.01	82.08	82.23
STACK MOISTURE CONTENT				
15. Total water collected by train, ml.	V_{ic}	336.00	337.00	352.00
16. Moisture in stack gas, %	B_{ws}	27.87	27.92	28.44
EMISSIONS DATA				
17. Stack gas flow rate, dscf/hr.(000's)	Q_{sd}	1597	1595	1584
18. Stack gas flow rate, cfm	acfm	55111	55158	55259
19. Particulate concentration, gr/dscf	C_s	0.0084	0.0066	0.0081
20. Particulate concentration, lb/hr	E	1.92	1.50	1.83
21. Particulate concentration, lb/mBtu	E'	0.00000	0.00000	0.00000
ORSAT DATA				
22. Percent CO_2 by volume	CO_2	4.50	4.50	4.50
23. Percent O_2 by volume	O_2	14.80	14.80	14.80
24. Percent CO by volume	CO	.00	.00	.00
25. Percent N_2 by volume	N_2	80.70	80.70	80.70

Format: summryR3

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

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 ^{o}R.

T_{std} = Standard absolute temperature ($528^{o}R$).

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:

$$V_{m(std)} = (17.64)(.994)(43.799) \left[\frac{(28.84) + \frac{1.68}{13.6}}{544} \right] = 40.889 \text{ dscf}$$

RUN 2:

$$V_{m(std)} = (17.64)(.994)(44.021) \left[\frac{(28.84) + \frac{1.68}{13.6}}{548} \right] = 40.796 \text{ dscf}$$

RUN 3:

$$V_{m(std)} = (17.64)(.994)(44.972) \left[\frac{(28.84) + \frac{1.68}{13.6}}{550} \right] = 41.526 \text{ dscf}$$

Total Contaminants by Weight: GRAIN LOADING

Particulate concentration c_s' gr./dscf.

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

Where:

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

M_n = Total amount of particulate matter collected, mg.

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

Run 1:

$$c_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{22.40}{40.889} \right] = 0.0084 \text{ gr./dscf.}$$

Run 2:

$$c_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{17.40}{40.796} \right] = 0.0066 \text{ gr./dscf.}$$

Run 3:

$$c_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{21.90}{41.526} \right] = 0.0081 \text{ gr./dscf.}$$

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

Where:

M_d = Dry molecular weight, lb./lb.-mole.

$\%CO_2$ = Percent carbon dioxide by volume (dry basis).

$\%O_2$ = Percent oxygen by volume (dry basis).

$\%N_2$ = Percent nitrogen by volume (dry basis).

$\%CO$ = Percent carbon monoxide by volume (dry basis).

0.264 = Ratio of O_2 to N_2 in air, v/v.

0.28 = Molecular weight of N_2 or CO, divided by 100.

0.32 = Molecular weight of O_2 divided by 100.

0.44 = Molecular weight of CO_2 divided by 100.

Run 1:

$$M_d = 0.44(\ 4.50\%) + 0.32(14.80\%) + 0.28(\ .00\% + 80.70\%) = 29.31\ \frac{lb}{lb\text{-}mole}$$

Run 2:

$$M_d = 0.44(\ 4.50\%) + 0.32(14.80\%) + 0.28(\ .00\% + 80.70\%) = 29.31\ \frac{lb}{lb\text{-}mole}$$

Run 3:

$$M_d = 0.44(\ 4.50\%) + 0.32(14.80\%) + 0.28(\ .00\% + 80.70\%) = 29.31\ \frac{lb}{lb\text{-}mole}$$

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

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

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)(^{o}R).

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

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

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

Run 1:

$V_{wc(std)}$ = (0.04707) (330.0) = 15.5 cu.ft
$V_{wsg(std)}$ = (0.04715) (6.0) = 0.3 cu.ft

Run 2:

$V_{wc(std)}$ = (0.04707) (330.0) = 15.5 cu.ft
$V_{wsg(std)}$ = (0.04715) (7.0) = 0.3 cu.ft

Run 3:

$V_{wc(std)}$ = (0.04707) (345.0) = 16.2 cu.ft
$V_{wsg(std)}$ = (0.04715) (7.0) = 0.3 cu.ft

Moisture Content of Stack Gases

$$B_{ws} = \frac{V_{wc_{std}} + V_{wsg_{std}}}{V_{wc_{std}} + V_{wsg_{std}} + V_{m_{std}}} \times 100$$

Where:

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

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

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

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

Run 1:

$$B_{ws} = \frac{15.5 + 0.3}{15.5 + 0.3 + 40.889} \text{ X } 100 = 27.87\ \%$$

Run 2:

$$B_{ws} = \frac{15.5 + 0.3}{15.5 + 0.3 + 40.796} \text{ X } 100 = 27.92\ \%$$

Run 3:

$$B_{ws} = \frac{16.2 + 0.3}{16.2 + 0.3 + 41.526} \text{ X } 100 = 28.44\ \%$$

$$M_s = M_d \; (1 - B_{ws}) + 18 \; (B_{ws})$$

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 = 29.31 (1 - 27.87) + 18 (27.87) = 26.16 (lb./lb.-mole)

Run 2:

M_s = 29.31 (1 - 27.92) + 18 (27.92) = 26.15 (lb./lb.-mole)

Run 3:

M_s = 29.31 (1 - 28.44) + 18 (28.44) = 26.09 (lb./lb.-mole)

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

Where:

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

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

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:

$$V = (85.49)\ (\ .81)\ (\ 1.18) \sqrt{\frac{760}{(28.84)(26.16)}} = 82.01 \text{ ft/sec.}$$

Run 2:

$$V = (85.49)\ (\ .81)\ (\ 1.18) \sqrt{\frac{761}{(28.84)(26.15)}} = 82.08 \text{ ft/sec.}$$

Run 3:

$$V = (85.49)\ (\ .81)\ (\ 1.18) \sqrt{\frac{762}{(28.84)(26.09)}} = 82.23 \text{ ft/sec.}$$

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

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:

$$Q_{sd}=3600(1- .2787)(82.01)(11.20)\left[\frac{528}{760}\right]\left[\frac{28.84}{29.92}\right] = 1597192.5 \frac{dscf}{hr}$$

Run 2:

$$Q_{sd}=3600(1- .2792)(82.08)(11.20)\left[\frac{528}{761}\right]\left[\frac{28.84}{29.92}\right] = 1595348.6 \frac{dscf}{hr}$$

Run 3:

$$Q_{sd}=3600(1- .2844)(82.23)(11.20)\left[\frac{528}{762}\right]\left[\frac{28.84}{29.92}\right] = 1584651.5 \frac{dscf}{hr}$$

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

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:

$$E = \frac{(0.0084)\ (1597192.5)}{7000} = 1.92\ \text{lb. / hr.}$$

Run 2:

$$E = \frac{(0.0066)\ (1595348.6)}{7000} = 1.50\ \text{lb. / hr.}$$

Run 3:

$$E = \frac{(0.0081)\ (1584651.5)}{7000} = 1.83\ \text{lb. / hr.}$$

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

Where:

I	=	Percent isokinetic sampling.
100	=	Conversion to percent.
T_s	=	Absolute average stack gas temperature, ^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:

$$I = (100)(\ 760\ ) \left[\frac{(0.002669)(336.00) + \frac{43.799}{544} \left[28.84 + \frac{1.68}{13.6} \right]}{60\ (\ 60.0\ )\ (\ 82.01\ )\ (\ 28.84\ )\ (\ .000289\ )} \right] = 99.3\%$$

Run 2:

$$I = (100)(\ 761\ ) \left[\frac{(0.002669)(337.00) + \frac{44.021}{548} \left[28.84 + \frac{1.68}{13.6} \right]}{60\ (\ 60.0\ )\ (\ 82.08\ )\ (\ 28.84\ )\ (\ .000289\ )} \right] = 99.3\%$$

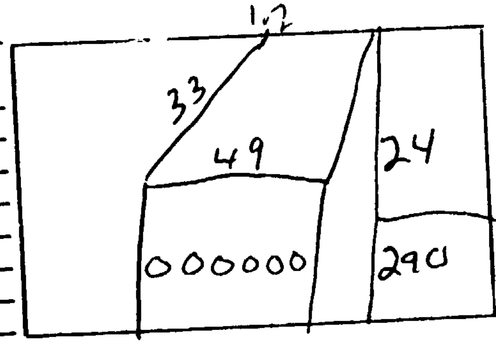
Run 3:

$$I = (100)(\ 762\ ) \left[\frac{(0.002669)(352.00) + \frac{44.972}{550} \left[28.84 + \frac{1.68}{13.6} \right]}{60\ (\ 60.0\ )\ (\ 82.23\ )\ (\ 28.84\ )\ (\ .000289\ )} \right] = 101.7\%$$

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant: Asphalt Paving Co.
Location: Hickory N.C.
Operator: Allen Turner
Date: 9-21-88
Run No.: 1
Sample Box No.: 1
Meter Box No.: C-185
Meter H @: 1.82
C Factor: .994
Pitot Tube Coefficient Cp: .810



Schematic of Stack Cross Section

Ambient Temperature: 10
Barometric Pressure: 28.84
Assumed Moisture, %: 25
Probe Length, m(ft): 4
Nozzle Identification No.: 0002885
Avg. Calibrated Nozzle Dia., (in.): .23/.23/.23
Probe Heater Setting: 6
Leak Rate, m^3/min. (cfm): .002 at 3 inHg
Probe Liner Material: stainless steel
Static Pressure, mm Hg (in. Hg): .05
Filter No.: ST-2997

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	530	532
INITIAL	200	526
DIFFERENCE	330	6

Observer: Bernie Pittman

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 ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A 1	10:52 / 10:59	1	300	1.3	1.5 3	247.2 / 248.5	70	70	250	55
2	11:01	1	300	1.3	1.5	250.0	80	70	250	55
3	11:03	1	300	1.4	1.7	251.4	80	70	250	55
4	11:05	1	300	1.4	1.7 5.1	253.2	85	70	250	55
5	11:07	1	300	1.4	1.7	254.2	90	70	250	55
B 1	11:07-30 / 11:09-30	1	300	1.5	1.8	255.5	90	70	250	55
2	11:11-30	1	300	1.5	1.8 10.8	257.0	90	70	250	55
3	11:13-30	1	300	1.5	1.8	258.7	90	70	250	55
4	11:15-30	1	300	1.5	1.8	260.0	90	70	250	55
5	11:17-30	1	300	1.5	1.8	261.8	90	70	250	55
C 1	11:18 / 11:20	1	300	1.5	1.8	263.1	100	70	250	55
2	11:22	2	300	1.6	1.9 3.8	264.7	100	70	250	55
3	11:24	2	300	1.6	1.9	266.2	100	70	250	55

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 9-21-88 LOCATION Hickory N.C. TEST NO. 1

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
4	11:26	1	300	.1.1	1.3	267.6	100	70	250	60
5	11:28	1	300	.1.2	1.4	269.1	100	70	250	60
6 1	11:28-30 / 11:30-30	1	300	1.5	1.8 3.6	270.5	100	70	250	60
2	11:32-30	1	300	1.5	1.8	271.9	100	70 490	250	60
3	11:34-30	1	300	1.6	1.9 3.8	273.5	100	70	250	60
4	11:36-30	1	300	1.5	1.9	275.1	100	70	250	60
5	11:38-30	1	300	.1.2	1.4	276.7	100	70	250	60
8 1	11:39-30 / 11:41-30	1	300	.1.5	.1.8	278.1	100 1700	75	250	60
2	11:43-30	1	300	1.4	.1.7	279.6	100	75	250	60
3	11:45-30	2	300	.1.7	.2.0 4	281.2	100	75 0	250	60
4	11:47-30	2	300	.1.7	2.0 1	282.7	100	75 45	250	60
5	11:49-30	2	300	.1.3	.1.6	284.4	100	75	250	60
7 1	11:50 / 11:52	2	300	.1.1	1.3	285.8	100	75	250	60
2	11:54	2	300	.95	1.1	287.1	100	80	250	80
3	11:56	2	300	.1.3	1.6	288.2	100	80 320	250	60
4	11:58	2	300	1.3	1.6	289.7	100	80	250	60
5	12:00	2	300	1.3	1.6	291.499	100	80	250	60

RAMCON ENVIRONMENTAL CORPORATION

1.2

Plant Asphalt Paving

Location [illegible] N.C.

Operator [illegible]

Date 9-21-88

Run No. 2

Sample Box No. 1

Meter Box No. C-185

Meter H @ 1.82

C Factor .994

Pitot Tube Coefficient Cp .810

Ambient Temperature 90

Barometric Pressure 28.80

Assumed Moisture, % 25

Probe Length, m(ft) 4

Nozzle Identification No. 0002884

Avg. Calibrated Nozzle Dia., (in.) .23/.23/.230

Probe Heater Setting 6

Leak Rate, m^3/min. (cfm) .006 at 6 [illegible]

Probe Liner Material Stainless steel

Static Pressure, mm Hg (in. Hg) .02

Filter No. ST-2998

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	530	521
INITIAL	200	514
DIFFERENCE	330	7

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in 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
						291.4 / 292.5	90 90	80	240	55
1	2:09-30 / 2:11-30	1	300	1.3	1.5 3	293.9	90	80	240	55
2	2:13-30	1	300	1.3	1.5	295.4	90	80	240	55
3	2:15-30	1	300	1.4	1.7	296.9	90	80	240	55
4	2:17-30	1	300	1.4	1.7 5.1	298.5	90	80	240	55
5	2:19-30	1	300	1.4	1.7	299.9	90	80	240	55
1	2:20 / 2:22	1	300	1.5	1.8	301.4	90	80	240	60
2	2:24	1	300	1.5	1.8	302.9	90	80	240	60
3	2:26	1	300	1.5	1.8 10.8	304.6	90	80	240	60
4	2:28	1	300	1.5	1.8	306.1	90	80	240	60
5	2:30	1	300	1.5	1.8	307.5	90	80	240	60
1	2:30-30 / 2:32-30	1	300	1.5	1.6	309.0	90	80	240	60
2	2:34-30	1	300	1.6	1.9 3.8	310.6	90	80	240	60
3	2:36-30	1	300	1.6	1.9					

CO_2 = 4.5 %   [illegible] 14.8 %

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 9-21-88 LOCATION [illegible] W.C. 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 800	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
4	2:38-30	1	300	1.1	1.3	312.3	100	80	250	60
5	2:40-30	1	300	1.2	1.4	313.5	100	80	250	60
1	2:41-30 / 2:43-30	1	300	1.5	1.8	314.8	100	80	250	60
2	2:45-30	1	300	1.5	1.8	316.4	100	80	250	60
3	2:47-30	1	300	1.6	~~1.8~~ 1.9	318.0	100	80	250	60
4	2:49-30	1	300	1.5	1.8	319.6	100	80	250	60
5	2:51-30	1	300	1.2	1.4	321.1	100	80	250	60
1	2:52 / 2:54	1	300	1.5	1.8	322.4	100	80	250	60
2	2:56	1	300	1.4	1.7	323.9	100	80	250	60
3	2:58	1	300	1.7	2.0	325.4	100	80	250	60
4	3:00	1	302	1.7	2.0	327.2	100	85	250	60
5	3:02	1	302	1.3	1.6	328.7	100	85	250	60
1	3:02-30 / 3:04-30	1	305	1.1	1.3	330.3	100	85	250	60
2	3:06-30	1	305	.95	1.1	331.3	100	85	250	60
3	3:08-30	1	305	1.3	1.6	332.6	100	85	250	60
4	3:10-30	1	305	1.3	1.6	333.9	100	85	250	60
5	3:12-30	1	305	1.3	1.6	335.421	100	85	250	60
							1700	595		

RAMCON ENVIRONMENTAL CORPORATION

Plant: Asphalt Paving

Location: [illegible] N.C.

Operator: [illegible]

Date: 9-21-86

Run No.: 3

Sample Box No.: 1

Meter Box No.: C-185

Meter H @: 1.82

C Factor: .994

Pitot Tube Coefficient Cp: .810

1.2

Schematic of Stack Cross Section

Ambient Temperature: 80

Barometric Pressure: 28.84

Assumed Moisture, %: 25

Probe Length, m(ft): 4

Nozzle Identification No.: .000 2885

Avg. Calibrated Nozzle Dia., (in.): .230/.230/.230

Probe Heater Setting: 6

Leak Rate, m^3/min. (cfm): .005 at [illegible]

Probe Liner Material: [illegible]

Static Pressure, mm Hg (in. Hg): .03

Filter No.: ST-2996

	IMPINGER VOLUME ml	SILICA GEL WEIGHT, g
FINAL	545	518
INITIAL	200	511
DIFFERENCE	345	7

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	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
1	3:29 / 3:31	1	298	1.3	1.5	335.5 / 337.1	90	80	225	60
2	3:33	1	300	1.3	1.5	338.5	90	80	225	60
3	3:35	1	300	1.4	1.7	339.9	100	80	225	60
4	3:37	1	300	1.4	1.7	341.1	100	80	230	60
5	3:39	1	300	1.4	1.7	342.7	100	80	230	60
1	3:40 / 3:42	1	300	1.5	1.8	344.2	100	80	230	60
2	3:44	1	305	1.5	1.8	345.6	100	80	230	60
3	3:46	1	310	1.5	1.8	347.2	100	80	230	60
4	3:48	1	310	1.5	1.8	348.7	100	80	230	60
5	3:50	1	310	1.5	1.8	350.4	100	80	240	60
1	3:51 / 3:53	1	310	1.5	1.8	351.8	100	80	240	60
2	3:55	1	305	1.6	1.9	353.5	100	80	240	60
3	3:57	1	305	1.6	1.9	355.4	100	80	240	60

CO_2 = 4.5%　　O_2 = 14.8%

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 9-21-88 LOCATION Hickory N.C. TEST NO. 3

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
4	3:59	1	302	1.1	1.3	356.4	100	80	250	60
5	4:01	1	305	1.2	1.4	357.9	100	80	250	60
1	4:01-30 / 4:03-30	1	300	1.5	1.8	359.1	100	80	250	60
2	4:05-30	1	300	1.5	1.8	360.6	100	80	250	60
3	4:07-30	1	300	1.6	1.9	362.3	100	80	250	60
4	4:09-30	1	295	1.5	1.8	364.1	100	80	250	60
5	4:11-30	1	295	1.2	1.4	365.6	100	80	250	60
1	4:11½ / 4:14	1	295	1.5	1.8	367.0	100	80	250	60
2	4:16	1	295	1.0	1.7	368.7	100	70	250	60
3	4:18	1	295	1.7	2.0	370.1	100	80	250	60
4	4:20	1	300	1.7	2.0	371.6	100	80	250	60
5	4:22	1	300	1.3	1.6	373.3	100	80	250	60
1	4:22-30 / 4:24-30	1	301	1.1	1.3	374.3	100	80	250	60
2	4:26-30	1	300	.95	1.1	375.6	100	80	260	60
3	4:28-30	1	302	1.3	1.6	377.2	100	80	260	60
4	4:30-30	1	305	1.3	1.6	378.6	100	80	260	60
5	4:32-30	1	301	1.3	1.6	380.472	100	80	260	60

-31-

Run # 1

Collection Method Continuous/Grab GAS	1 Actual Reading	1 Net	2 Actual Reading	2 Net	3 Actual Reading	3 Net	Average Net Volume
CO_2		4.5		4.5			4.5
O_2 (Net is actual O_2 reading minus actual CO_2 reading)		14.8		14.8			14.8
CO (Net is actual CO reading minus actual O_2 reading)		0		0			0
N_2 (Net is 100 minus actual CO reading)		80.7		80.7			80.7

Run # 2

Collection Method Continuous/Grab GAS	1 Actual Reading	1 Net	2 Actual Reading	2 Net	3 Actual Reading	3 Net	Average Net Volume
CO_2		4.5		4.5			4.5
O_2 (Net is actual O_2 reading minus actual CO_2 reading)		14.8		14.8			14.8
CO (Net is actual CO reading minus actual O_2 reading)		0		0			0
N_2 (Net is 100 minus actual CO reading)		80.7		80.7			80.7

Run # 3

Collection Method Continuous/Grab GAS	1 Actual Reading	1 Net	2 Actual Reading	2 Net	3 Actual Reading	3 Net	Average Net Volume
CO_2		4.5		4.5			4.5
O_2 (Net is actual O_2 reading minus actual CO_2 reading)		14.8		14.8			14.8
CO (Net is actual CO reading minus actual O_2 reading)		0		0			0
N_2 (Net is 100 minus actual CO reading)		80.7		80.7			80.7

IX. CALIBRATIONS

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number ________ Date 10-1-88 Meter box number C-185 Plant Mega

Barometric pressure, P_b = 30.02 in. Hg Dry gas meter number 670775 Pretest Y .994

Orifice manometer setting, (ΔH), in. H_2O	Gas volume		Temperature				Time (θ), min	Vacuum setting, in. Hg	Y_i	Y_i
	Wet test meter (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), °F	Dry gas meter						$\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
				Inlet (t_{d_i}), °F	Outlet (t_{d_o}), °F	Average[a] (t_d), °F				
1.5	10	10.30	74	98	77	87.5	15.01	5	.992	1.86
1.5	10	10.35	74	104	77	90.5	14.47	5	.992	1.72
1.5	10	10.42	74	106	77	91.5	14.88	5	.988	1.81
									Y = .991	

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

where

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

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

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

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

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

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

ΔH = Pressure differential across orifice, in. H_2O.

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

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ± 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 8-26-88 Meter box number C-185 Plant —

Barometric pressure, P_b = 29.96 in. Hg Dry gas meter number 670775 Pretest Y .987

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: Average[a] (t_d), °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	Y_i = $\dfrac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
1.5	10	10.32	74	100	77	88.5	15.00	5	.992	1.86
1.5	10	10.30	74	102	77	89.5	14.84	5	.995	1.82
1.5	10	10.32	74	104	77	90.5	14.75	5	.995	1.79
									Y = .994	1.82

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

where

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

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

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

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

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

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

ΔH = Pressure differential across orifice, in. H_2O.

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

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

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

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%
	9-21-88	60°F	60°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%
	9-21-88	60°F	60°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

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. 44 Date 2-5-88

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	1.05	1.6	.810	<.01
2	.87	1.35	.803	<.01
3	.58	.88	.812	<.01
		$\bar{C}_p$ (SIDE A)	.808	

"B" SIDE CALIBRATION

Run No.	Δp std cm H_2O (in. H_2O)	Δp(s) cm H_2O in. H_2O)	$C_p(s)$	DEVIATION $C_p(s)-\bar{C}_p(B)$
1	1.05	1.60	.810	<.01
2	.87	1.30	.818	<.01
3	.58	0.90	.802	<.01
		$\bar{C}_p$ (SIDE B)	.810	

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

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

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

Form No. EED-17-1

RAMCON

Lear Siegler Stack Sampler

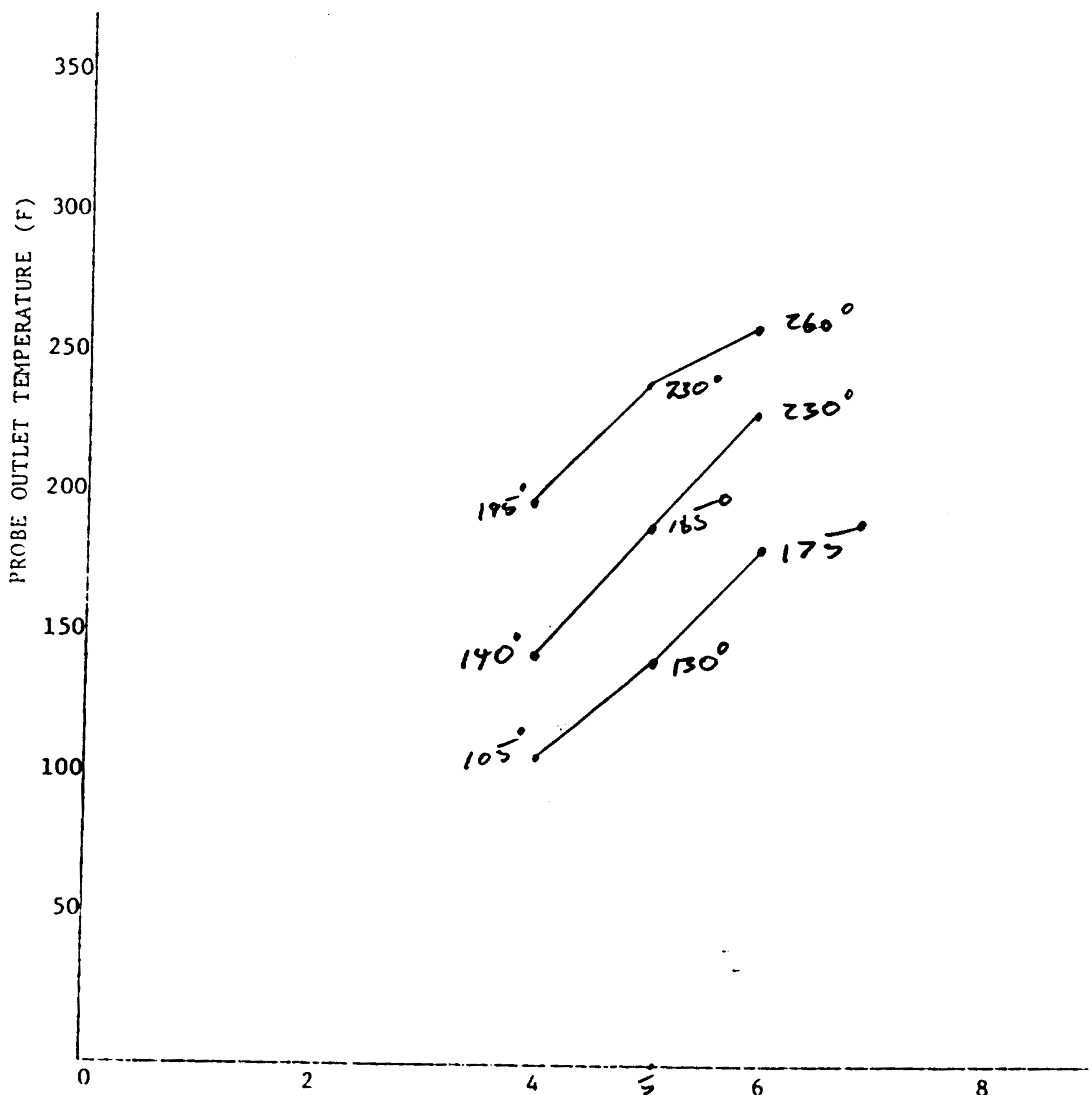
Heating Probe Calibration

Probe No. 44 Probe Length 4 ft

Date of Calibration 2/21/68 Signature ______

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 2-9-88 Thermocouple number 44

Ambient temperature 55 °F Barometric pressure 29.95 in. Hg

Calibrator S Bock Reference: mercury-in-glass ✓

other ______

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	ice water	32°F	32°F	0 %
B	Boiling water	212°F	212°F	0 %
C	Boiling oil	381°F	379°F	.005 %
D	Ambient 9-21-88	60°F	60°F	0%

[a]Type of calibration system used.

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

X. RAMCON PERSONNEL

RAMCON Environmental Stack Test Team

Sumner Buck - President

Sumner Buck is the President of RAMCON Environmental. He is a graduate of the EPA 450 "Source Sampling for Particulate Pollutants" course and the 474 "Continuous Emissions Monitoring" course all given at RTP. Mr. Buck is a qualified V.E. reader with current certification. Mr. Buck has personally sampled over 300 stacks including over 200 asphalt plants. He is 43 years old and a graduate of the University of Mississippi with graduate studies at Memphis State University and State Technical Institute of Memphis.

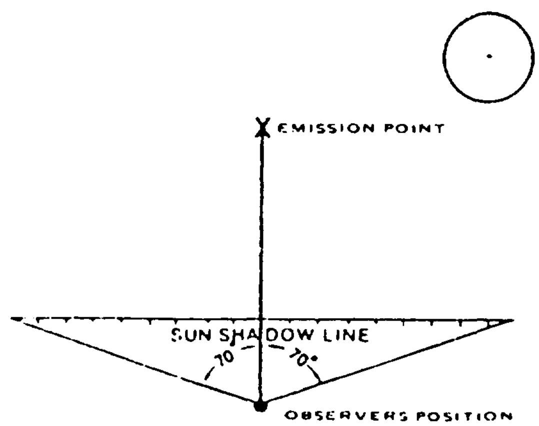
Allen Turner - Team Leader

Allen Turner has been employed by RAMCON for three years. He has undergone extensive training in Methods 1 through 9. He is qualified as a team leader and is currently certified as a V.E. reader.

XI. VISIBLE EMISSIONS

SOURCE NAME	Asphalt Paving Co.	OBSERVATION DATE	
START TIME		STOP TIME	
ADDRESS			
CITY		STATE	-
ZIP			
PHONE		SOURCE ID NUMBER	
PROCESS EQUIPMENT		OPERATING MODE	
CONTROL EQUIPMENT	Baghouse	OPERATING MODE	
DESCRIBE EMISSION POINT			
HEIGHT ABOVE GROUND LEVEL		HEIGHT RELATIVE TO OBSERVER	
DISTANCE FROM OBSERVER	40 Ft	DIRECTION FROM OBSERVER	
DESCRIBE EMISSIONS	NA		
EMISSION COLOR	NA	PLUME TYPE: CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐	
WATER DROPLETS PRESENT	NO ☒ YES ☐	IS WATER DROPLET PLUME ATTACHED ☐ DETACHED ☐	
AT WHAT POINT IN THE PLUME WAS OPACITY DETERMINED			
DESCRIBE BACKGROUND	Clear Sky		
BACKGROUND COLOR	Blue	SKY CONDITIONS	Clear
WIND SPEED	0-5	WIND DIRECTION	NW
AMBIENT TEMPERATURE	80	RELATIVE HUMIDITY	

SOURCE LAYOUT SKETCH — DRAW NORTH ARROW



M \ SEC	0	15	30	45	M \ SEC	0	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
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17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
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22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
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25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

AVERAGE OPACITY FOR HIGHEST PERIOD	0	NUMBER OF READINGS ABOVE % WERE	
RANGE OF OPACITY READINGS: MINIMUM		MAXIMUM	
OBSERVER'S NAME (PRINT)	Murphy ONeal		
OBSERVER'S SIGNATURE	Murphy R. Oneal	DATE	
ORGANIZATION			
CERTIFIED BY		DATE	
VERIFIED BY		DATE	

COMMENTS

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS

SIGNATURE

TITLE | DATE

SOURCE NAME Asphalt Paving Co. Inc.

ADDRESS

CITY | STATE | ZIP

PHONE | SOURCE ID NUMBER

PROCESS EQUIPMENT | OPERATING MODE

CONTROL EQUIPMENT Baghouse | OPERATING MODE

DESCRIBE EMISSION POINT NA

HEIGHT ABOVE GROUND LEVEL | HEIGHT RELATIVE TO OBSERVER 10 Ft

DISTANCE FROM OBSERVER 40 Ft | DIRECTION FROM OBSERVER

DESCRIBE EMISSIONS NA

EMISSION COLOR NA | PLUME TYPE CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐

WATER DROPLETS PRESENT NO ✓ YES ☐ | IS WATER DROPLET PLUME ATTACHED ☐ DETACHED ☐

AT WHAT POINT IN THE PLUME WAS OPACITY DETERMINED

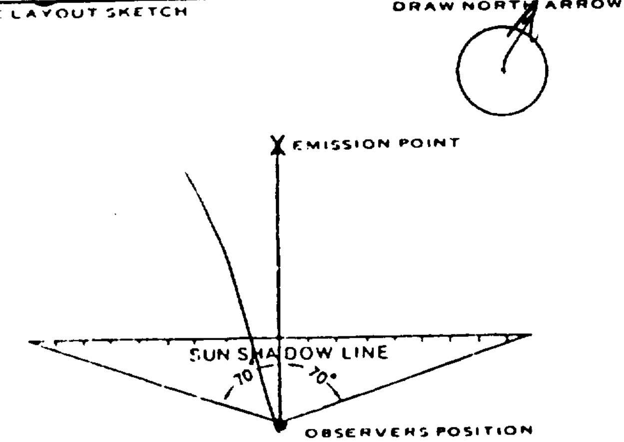
DESCRIBE BACKGROUND Sky

BACKGROUND COLOR Blue | SKY CONDITIONS Clear

WIND SPEED 0-5 | WIND DIRECTION NW

AMBIENT TEMPERATURE 80 | RELATIVE HUMIDITY

SOURCE LAYOUT SKETCH



COMMENTS NO Visable Emissions

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS

SIGNATURE

TITLE | DATE

OBSERVATION DATE | START TIME | STOP TIME

M \ SEC	0	15	30	45	M \ SEC	0	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
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9	0	0	0	0	39	0	0	0	0
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11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
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20	0	0	0	0	50	0	0	0	0
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22	0	0	0	0	52	0	0	0	0
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24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

AVERAGE OPACITY FOR HIGHEST PERIOD 0 | NUMBER OF READINGS ABOVE % WERE

RANGE OF OPACITY READINGS MINIMUM MAXIMUM

OBSERVER'S NAME (PRINT) Murphy ONeal

OBSERVER'S SIGNATURE Murphy R. ONeal | DATE

ORGANIZATION

CERTIFIED BY | DATE

VERIFIED BY | DATE

SOURCE NAME: Asphalt Paving Co

ADDRESS:

CITY: | STATE: | ZIP:

PHONE: | SOURCE ID NUMBER:

PROCESS EQUIPMENT: Baghouse | OPERATING MODE:

CONTROL EQUIPMENT: | OPERATING MODE:

DESCRIBE EMISSION POINT:

HEIGHT ABOVE GROUND LEVEL: | HEIGHT RELATIVE TO OBSERVER:

DISTANCE FROM OBSERVER: 40 Ft | DIRECTION FROM OBSERVER:

DESCRIBE EMISSIONS: NA

EMISSION COLOR: NA | PLUME TYPE: CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐

WATER DROPLETS PRESENT: NO ✓ YES ☐ | IS WATER DROPLET PLUME ATTACHED ☐ DETACHED ☐

AT WHAT POINT IN THE PLUME WAS OPACITY DETERMINED: NA

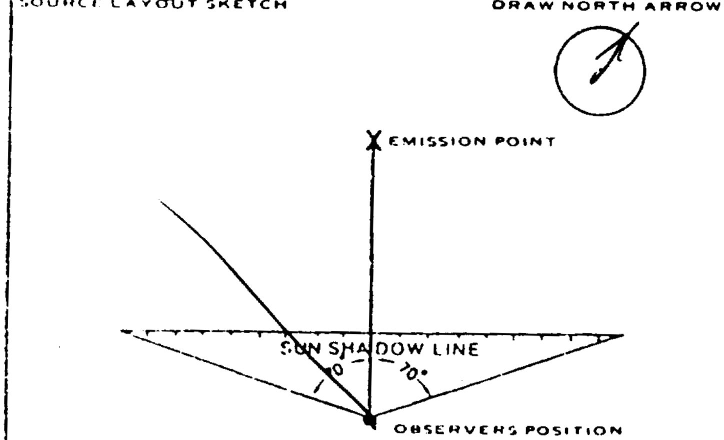
DESCRIBE BACKGROUND: Blue Sky

BACKGROUND COLOR: Blue | SKY CONDITIONS: Clear

WIND SPEED: 0-5 | WIND DIRECTION: NW

AMBIENT TEMPERATURE: 80 | RELATIVE HUMIDITY:

SOURCE LAYOUT SKETCH | DRAW NORTH ARROW



OBSERVATION DATE: | START TIME: | STOP TIME:

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30	0	0	0	0

M \ sec	0	15	30	45
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53	0	0	0	0
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55	0	0	0	0
56	0	0	0	0
57	0	0	0	0
58	0	0	0	0
59	0	0	0	0
60	0	0	0	0

AVERAGE OPACITY FOR HIGHEST PERIOD: 0 | NUMBER OF READINGS ABOVE % WERE

RANGE OF OPACITY READINGS: MINIMUM | MAXIMUM

COMMENTS: No Emissions

OBSERVER'S NAME (PRINT): Murphy O'Neal

OBSERVER'S SIGNATURE: Murphy O'Neal | DATE:

ORGANIZATION:

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS

SIGNATURE:

TITLE: | DATE:

CERTIFIED BY: | DATE:

VERIFIED BY: | DATE:

TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT
CUSTOMS HOUSE
701 BROADWAY
NASHVILLE, TENNESSEE 37219-5403

JUN 21 1988

Murphy O'Neal
RAMCON
223 Scott Street
Memphis, TN 38108

RE: Certificate Number 1146

Dear Mr. O'Neal:

Enclosed you will find your certification card for successfully completing the June 7-9, 1988 Visible Emissions Evaluation School held in Memphis, Tennessee. In order to be certified as a qualified Visible Emissions Evaluator for all the methods approved by the Tennessee Air Pollution Control Board, one must meet an intensive array of criteria.

The individual reading criteria is as follows:

1. EPA Method 9 (6 Minute Average) requires a deviation of less than 7.5 on white and black smoke, and that the reader miss no reading by more than 15% opacity.

2. Tennessee Visible Emissions Evaluation Method 1 (Roads and Parking Areas) requires a worst-two-minute deviation of 8.8 or less.

3. TVEE Method 2 (Aggregate or Time Count) has the same criteria requirements as EPA Method 9.

4. TVEE Method 3 (Zero Percent Opacity) requires that the value assigned to a zero reading during a certification run shall not exceed 10% opacity, nor shall the combination of other zero readings exceed 10% opacity (i.e. two readings of five percent opacity).

5. TVEE Method 4 (Fugitive Dust Emissions from Non-Stack Emission Points) has the same criteria requirements as EPA Method 9.

Based on these criteria you are certified by the State of Tennessee to read EPA Method 9, and TVEE Methods 1, 2, 3, and 4 with sunglasses.

This certification is valid until December 08, 1988.

You must complete the requirements for recertification prior to this expiration date to retain your status as a qualified Visible Emissions Evaluator.

It was a pleasure having your participation in our Visible Emissions School. The Tennessee Division of Air Pollution Control would welcome any comments, or suggestions you may have concerning the operation of the school. Please forward any comments to the Division at (615)741-3931 or at the above address.

Sincerely yours,

Carl Koontz

Carl Koontz, Instructor
Visible Emissions Evaluation School
Division of Air Pollution Control

Enclosure