RAMCON ENVIRONMENTAL CORPORATION

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

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
BITUMINOUS CONSTRUCTION, INC.
ODENTON, MARYLAND
June 10 & 11, 1987

John Sherwood

John Sherwood
Bituminous Construction

Sumner Buck

G. Sumner Buck, III
President

Ken Allmendinger

Ken Allmendinger
Team Leader

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June 17, 1987

Mr. John Sherwood
Bituminous Construction, Inc.
2313 Saint Paul Street
Baltimore, MD 21218

Re: Particulate Emissions Test - Odenton, Maryland

Dear Mr. Sherwood:

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

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

Mr. Craig Holdefer
Maryland Air Management
Div. of Environmental Affairs
P.O. Box 13387
Baltimore, MD 21203

We certainly have enjoyed working with you and look forward to serving you again in the future.

Sincerely,

G. Sumner Buck, III
President

GSBIII:kr

Enclosures

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I. INTRODUCTION

On June 10 & 11, 1987, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Bituminous Construction Inc.'s BMG drum mix asphalt plant located in Odenton, Maryland. RAMCON personnel conducting the test were Ken Allmendinger, Team Leader and Allen Turner. Kim Rea was responsible for the final 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. Allmendinger and Ms. Rea.

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

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 Maryland is .03 gr/DSCF and is specified in C.O.M.A.R. 101806.03.

TABLE I

SUMMARY OF TEST RESULTS
June 10 & 11, 1987

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	08:28 to 13:02	0.0213 gr/DSCF	96%	4.9 lbs/hr
2	07:43 to 09:50	0.0147 gr/DSCF	98%	3.6 lbs/hr
3	10:49 to 12:48	0.0194 gr/DSCF	92%	4.3 lbs/hr
	Average:	0.0185 gr/DSCF		4.3 lbs/hr

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

III. TEST PROCEDURES

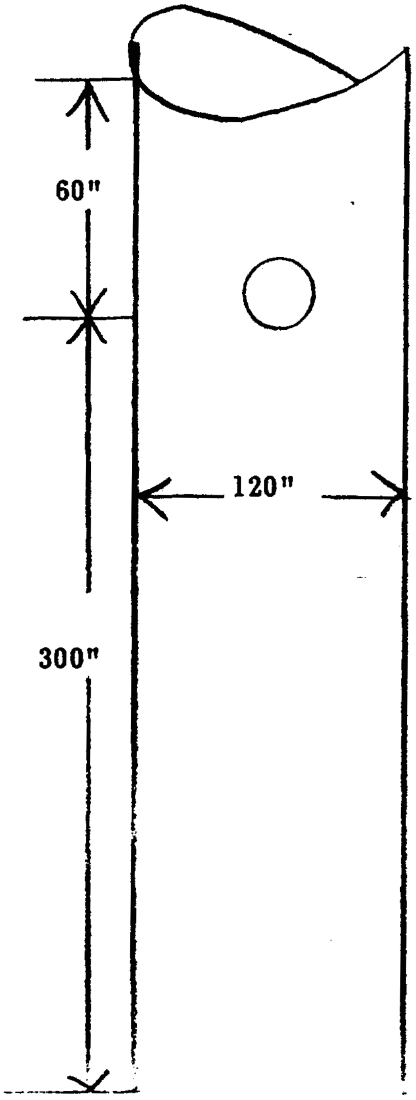
A. Method Used: The source sampling was conducted in accordance with Method 5 requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

B. Problems Encountered: The sample team had to test each run for 108 minutes in order to attain the 50 cubic feet of sample gas volume required by the State of Maryland. No other problems were encountered that affected testing.

C. Sampling Site: The emissions test was conducted after a scrubber on a round stack with a diameter of 120". The sampling ports were placed 60" down (0.5 diameters upstream) from the top of the stack and 300" up (2.5 diameters downstream) from the last flow disturbance. Twenty four points were sampled, twelve through each traverse for 4.5 minutes each.

Points on a Diameter	Probe Mark
1	*8.5"
2	14.0"
3	20.6"
4	27.2"
5	36.0"
6	48.6"
7	83.4"
8	96.0"
9	104.9"
10	111.8"
11	118.0"
12	123.5"

*Measurements include a 6.0" standoff.



IV. THE SOURCE

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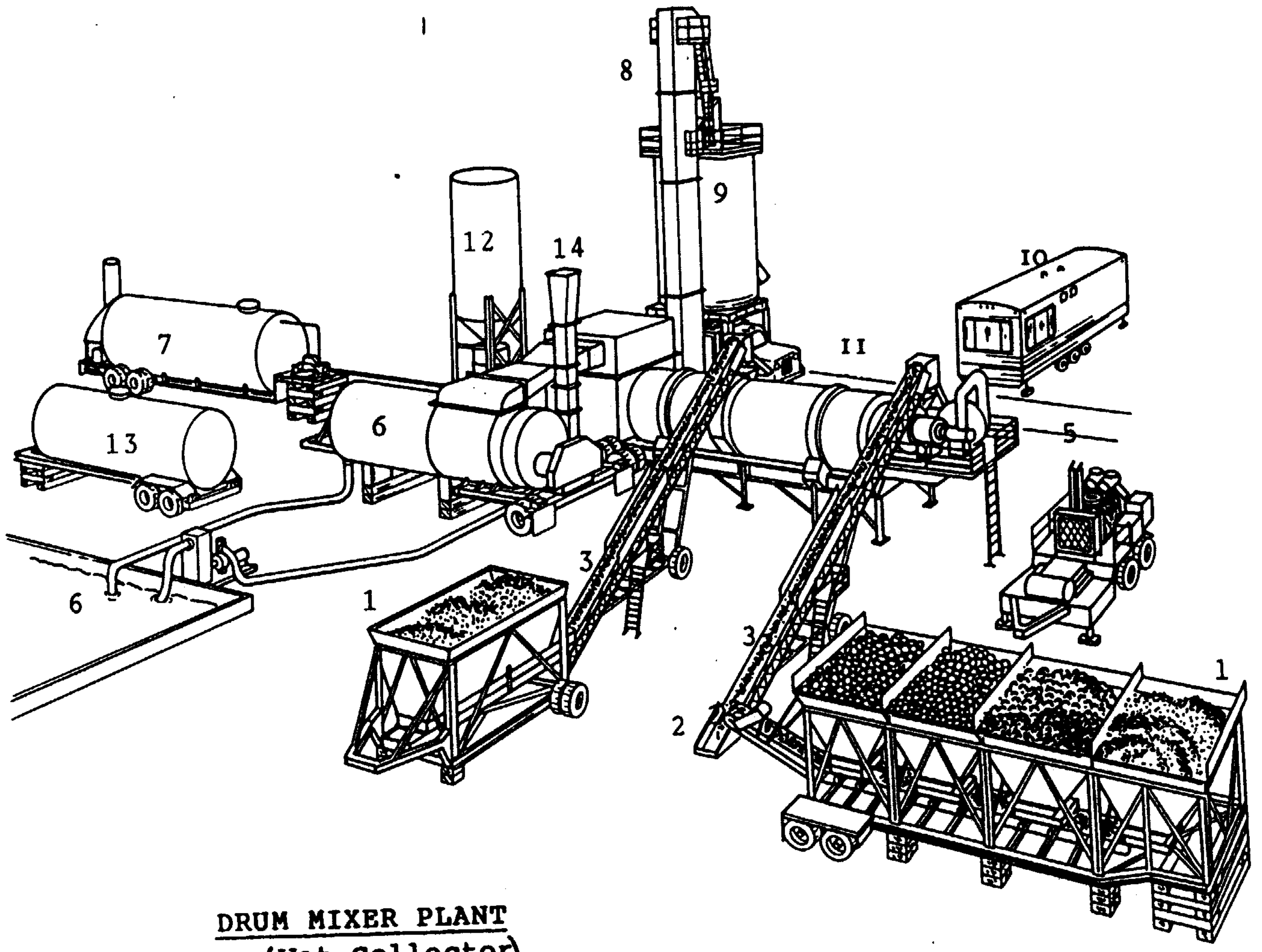
Bituminous Construction, Inc. employs a B.M.G. (Bata Machinery Group) drum mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind the mixture together. After the hot asphalt mix is manufactured at the plant, it is transported to the location where it is to be applied. The hot asphalt mix is spread evenly over the surface with a paver and then compacted with a heavy roller to produce the final product.

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

The drum mixer uses a burner fired with coal and natural gas to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate and hot asphalt oil thoroughly. The air is drawn into the system via an exhaust fan. After passing through the burner and the mixing drum, the air passes through a high efficiency scrubber. The scrubber was manufactured by B.M.G. The exhaust gasses are drawn through the scrubber and discharged to the atmosphere through the stack. The design pressure drop across the venturi is in excess of 8 inches of water. The particulate matter, which is removed by the scrubber is fed into the scrubber pond where it drops out of suspension.



DRUM MIXER PLANT
(Wet Collector)

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

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

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

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

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

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

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

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

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

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

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

12. Mineral filler system (when used).

13. Burner fuel storage (when used).

14. Stack.

DATA SUMMARY

Plant

1. Manufacturer of plant A.
2. Designed maximum operating capacity 500 TPH @ 5 % moisture.
3. Actual operation rate 340 TPH @ 4 to 5 % moisture.
4. Startup date MAY 1987.
5. Type of fuel used in dryer GAS/COAL.
6. Quanity of fuel consumption ——.

Aggregate

7. Name/type of mix BASE/TOP.
8. Percent asphalt in mix 5.7 6.2 %.
9. Temperature of asphalt 300°F.
10. Sieve/Screening analysis: % Passing;

1½	100	3/8"	74	#16	42
3/4"	90	#4	63	#50	14
1/2"		#8	52	#200	

Scrubber Control System

11. Manufacturer BMC CORP.
12. Type; Venturi X; Wet Washer ____;
    Spray Booth ____; Other ____.
13. Water line pressure 80 psi.
14. Pressure drop across system 20/22" psi.
15. Gallons per minute through system 350.
16. Water source POND (i.e., lagoon, pond, etc.)
17. Number of spray nozzles 96.

COMPANY NAME BMC. CORP

COMPANY REPRESENTATIVE E. HARRELL

DATE 6-11-87

(8)

PLANT DATA

COMPANY NAME RATTRIE (B.C.I)

COMPANY REP. E. HARRELL DATE JUNE 10, 1987 PHONE #

DATA SOURCE

PLANT LOCATION ODENTON MARYLAND

PLANT MFG. BMG PLANT MODEL # 55R90 PLANT TYPE DM

MIX SPECIFICATION # BASE OIL SPECIFICATION # A/C 20

Time 24 Hour	Fuel Oil ☐ Nat. Gas ☒ Propane ☐ Coal ☒	Burner Setting	Aggregate TPH	Recycle TPH	Liquid Asphalt TPH	Mix Temp. °F	☒ Venturi ☐ Baghouse Pressure Drop Inches Water
8:30		3.76	325	—	16.9	295°F	22"
8:15		3.80	325		16.9	290°F	22"
.10 9:00		3.75	325		16.9	296°F	22"
9:30		3.77	325		16.9	290°F	22"
12:20		4.0	325		16.9	285°F	22"
12:35		4.0	325		16.9	290°F	22"
13:50		4.0	325		16.9	290°F	22"
.11 ECOND ESI 8:00	–	3.6	325		16.9	290°F	20"
.12 IRD ESI 10:30		3.7	325		16.9	286°F	20"

V. EQUIPMENT USED

V. EQUIPMENT USED

Equipment used on conducting the particulate emissions test was:

A. The Lear Siegler PM-100 stack sampler with appropriate auxillary equipment and glassware. The train was set up according to the schematic on the nex page.

B. An Airguide Instruments Model 211-B (uncorrected) aneroid barometer was used to check the barometric pressure.

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

D. A Hays 621 Analyzer was used to measure the oxygen, carbon dioxide and carbon monoxide content of the stack gases. For non-combustion sources, A Bacharach Instrument Company Fyrite is used for the gas analysis.

E. Filters are mady by Schleicher and Schuell and are type 1-HV with a porosity of .03 microns.

F. The acetone is reagent grade or ACS grade with a residue of $\leq$ .001.

VI. LABORATORY PROCEDURES & RESULTS

LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

A. FILTERS: Fiberglass 4" sampling filters are prepared as follows:

Filters are removed from their box and numbered on the back side with a felt pen. The numbering system is continuous from job to job. The filters are placed in a dessicator to dry for at least 24 hours. Clean plastic petri dishes, also numbered, top and bottom, are placed in the dessicator with the filters. After dessication, the filters are removed one at a time and weighed on the Sartorius analytical balance, then placed in the correspondingly numbered petri dish. Weights are then recorded in the lab record book. Three filters are used for each complete particulate source emissions test and there should be several extra filters included as spares.

B. SILICA GEL: Silica Gel used for the test is prepared as follows:

Approximately 200 g of silica gel is placed in a wide mouth "Mason" type jar and dried in an oven (175°C for two hours). The open jars are removed and placed in a dessicator until cool (2 hours) and then tightly sealed. The jars are then numbered and weighed on the triple beam balance to the closest tenth of a gram, and this weight is recorded for each sealed jar. The number of silica gel jars used is the same as the number of filters. Silica gel should be indicating type, 6-16 mesh.

II. Post-Testing Lab Analysis

A. FILTERS: The filters are returned to the lab in their sealed glass filter holder which was used in field sampling. In the lab these holders are opened. The filter is placed in its petri dish with the lid off and returned to the dessicator for at least 24 hours. The top half of the filter holder is washed into the corresponding probe wash bottle and the bottom half of the filter holder is washed into the corresponding impinger catch bottle. (See II, C and D). After dessication, the filters are reweighed. The final weight is recorded in the lab record book. The filter pick up weight is calculated and recorded also. This procedure is repeated for all filters used in the field.

Alternately, the test team may opt to oven dry the filters at 220°F for two to three hours, weigh the sample, and use this weight as a final weight.

B. SILICA GEL: The sealed silica gel jars should be reweighed on the triple-beam balance and their weights recorded as shown on previous page.

C. PROBE RINSINGS: In all tests, a probe wash-out analysis will be necessary. These samples are returned in sealed Mason jars and consist of A.R. Acetone with an unknown solid content. Clean 250 ml beakers are used to make this analysis. These should be immaculately washed and rinsed with deionized water, then oven dried at 105°C for about one hour. The beakers should be moved to the dessicator to cool for ninety (90) minutes, then labeled with a pencil and weighed on the Sartorius analytical balance. Any variance from this procedure should be duplicated exactly when reweighing, as this procedure has been found to be quite sensitive. After preparing the necessary number of beakers (one for each probe wash and one blank) the Mason jars should be opened, poured into the beaker, and any material remaining on the jar walls rinsed with an acetone wash bottle into the beaker. The amount of liquid in the beaker should be noted on the analysis form. The acetone rinsings are evaporated on a warming plate. The liquid is kept swirled with an air sweep to prevent "bumping". When the acetone is evaporated the beakers are weighed as in Section II A.

D. IMPINGER CATCH: In some testing cases, the liquid collected in the impingers must be analyzed for solids content. This involves a similar procedure to the probe wash solids determination, except that the liquid is deionized water.

E. ACETONE: Conduct a blank analysis of acetone in the 1 gallon glass container. This acetone will be used in the field for rinsing the probe, nozzle, and top half of the filter holder. Performing such a blank analysis prior to testing will insure that the quality of the acetone to be used will not exceed the .001% residual purity standard.

SPECIAL NOTE

When sampling sources high in moisture content, (such as asphalt plants) the filter paper sometimes sticks to the filter holder. When removing the filter it may tear. In order to maintain control of any small pieces of filter paper which may be easily lost, they are washed with acetone into the probe washing. This makes the filter weight light (sometimes negative) and the probe wash correspondingly heavier. The net weight is the same and no particulate is lost. This laboratory procedure is taught by EPA in the Quality Assurance for Source Emissions Workshop at Research Triangle Park and is approved by EPA.

WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

The Sartorius balance is accurate to 0.1 mg and has a maximum capacity of 200 grams. The balance precision (standard deviation) is 0.05 mg. Before weighing an item, the balance should first be zeroed. This step should be taken before every series of weighings. To do this, the balance should have all weight adjustments at "zero" position. The beam arrest lever (on the lower left hand side toward the rear of the balance) is then slowly pressed downward to full release position. The lighted vernier scale on the front of the cabinet should align the "zero" with the mark on the cabinet. If it is not so aligned, the adjustment knob on the right hand side (near the rear of the cabinet) should be turned carefully until the marks align. Now return the beam arrest to horizontal arrest position. The balance is now "zeroed".

To weigh an item, it is first placed on the pan. And the sliding doors are closed to avoid air current disturbance. The weight adjustment knob on the right hand side must be at "zero". The beam arrest is then slowly turned upward. The lighted scale at the front of the cabinet will now indicate the weight of the item in grams. If the scale goes past the divided area, the item then exceeds 100 g weight (about 3-1/2 ounces) and it is necessary to arrest the balance (beam arrest lever) and move the lever for 100 g weight away from you. It is located on the left hand side of the cabinet near the front, and is the knob closest to the side of the cabinet. The balance will not weigh items greater than 200 grams in mass, and trying to do this might harm the balance. Remember -- this is a delicate precision instrument.

After the beam is arrested, in either weight range, the procedure is the same. When the weight of the item in grams is found, "dial in" that amount with the two knobs on the left hand side (near the 100 g lever) color coded yellow and green. As you dial the weight, the digits will appear on the front of the cabinet. When the proper amount is dialed, carefully move the arrest lever down with a slow, steady turn of the wrist. The lighted dial will appear, and the right hand side knob (front of cabinet) is turned to align the mark with the lower of the two lighted scale divisions which the mark appears between. When these marks are aligned, the two lighted digits along with the two indicated on the right hand window on the cabinet front are the fractional weight in grams (the decimal would appear before the lighted digits) and the whole number of grams weight is the amount "dialed in" on the left.

In general, be sure that the beam is in "arrest" position before placing weight on or taking weight off of the pan. Don't "dial in" weight unless the beam is arrested. The balance is sensitive to even a hand on the table near the balance, so be careful and painstaking in every movement while weighing.

Form REC#8

SAMPLE ANALYTICAL DATA FORM

Plant Location BCI

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 6-15-87 Gross wt. 147.4035 mg

Date/Time wt. blank 6-16-87 Gross wt. 147.4034 mg

Ave. Gross wt. 147.4035 mg

Tare wt. 147.4033 mg

Weight of blank (m_{ab}) .0002 mg

Acetone blank residue concentration (C_a) $(C_a) = (M_{ab}) / (V_a)(p_a)$ = (.0000013 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} P_a$ = (.0000013)(200)(.7853) = (.0002)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt 6-15-87 Gross wt	g	133.1891	95.1697	93.1843
Date/Time of wt 6-16-87 Gross wt	g	133.1890	95.1693	93.1840
Average Gross wt	g	133.1891	95.1695	93.1842
Tare wt	g	133.1245	95.1237	93.1397
Less acetone blank wt (W_a)	g	.0002	.0002	.0002
Wt of particulate in acetone rinse (m_a)	g	.0644	.0456	.0443

Filter Numbers	#	SG-2071	SG-2073	SG-2072
Date/Time of wt 6-15-87 Gross wt	g	.5520	.5520	.5600
Date/Time of wt 6-16-87 Gross wt	g	.5516	.5520	.5597
Average Gross wt	g	.5518	.5520	.5599
Tare wt	g	.5438	.5420	.5416

Weight of particulate on filters(s) (m_f)	g	.0080	.0100	.0183
Weight of particulate in acetone rinse	g	.0644	.0456	.0443
Total weight of particulate (m_n)	g	.0724	.0556	.0626

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

Remarks

Signature of analyst Kim Rea

Signature of reviewer

COMPANY NAME BCI

Chloroform and Ethyl Ether Extraction for EPA Method 5 (back half)

Relative humidity in lab 45%

Density of chloroform and ethyl ether 1.472 g/mL / .7074 g/mL

		RUN 1	RUN 2	RUN 3
Chloroform and ethyl ether rinse volume	ml	390	422	395
Date/time of wt 6/22 9:25 Am Gross wt.	g	95.1730	101.5346	98.4980
Date/time of wt 6/23 9:00 Gross wt.	g	95.1728	101.5343	98.4980
Avg. Gross wt.	g	95.1729	101.5345	98.4980
Tare wt.	g	95.1499	101.4946	98.4597
Wt. of particulate in chloroform ethyl ether rinse	g	.0230	.0399	.0383
Water evaporation	#	1	2	3
Date/time of wt. 6/22 9:30Am Gross wt.	g	140.5763	139.8074	133.0546
Date/time of wt. 6/23 9:00 Gross wt.	g	140.5761	139.8074	133.0543
Avg. Gross wt.	g	140.5762	139.8074	133.0545
Tare wt.	g	140.5499	139.7913	133.0456
Less chloroform & ehtyl either blank wt.	g	.0000	.0000	.0000
Weight of particulate from water (m_f)	g	.0263	.0161	.0089
Wt. of particulate in chloroform ethyl ether rinse	g	.0230	.0399	.0383
Total weight of particulate (m_n)	g	.0493	.0560	.0472

Note: In no case should a blank residue 0.02 mg/g or 0.001% of the weight of chloroform ethyl ether used be subtracted from the sample weight.

Remarks

Signature of Analyst Shaun Greenwood

Signature of Reviewer S Buck

VII. CALCULATIONS

NAME: BITUMINOUS CONSTRUCTION, INC.

LOCATION: ODENTON, MARYLAND		date	6/10/87	6/11/87	6/11/8
	SUMMARY OF TEST DATA		RUN # 1	RUN # 2	RUN #
	SAMPLING TRAIN DATA	start	08:28	07:43	10:49
		finish	13:02	09:50	12:48
1	Sampling time, minutes	θ	108	108	108
2	Sampling nozzle diameter, in.	Dn	.525	.525	.525
3	Sampling nozzle cross-sectional area, ft^2.	An	.001503	.001503	.001503
4	Isokinetic variation	I	96	98	92
5	Sample gas volume - meter conditions, cf.	Vm	53.85	60.24	52.64
6	Average meter temperature, °R	Tm	549	550	566
7	Average oriface pressure drop, in.H_2O	ΔH	.81	.98	.92
8	Total particulate collected mg.	Mn	72.4	55.6	62.6
	VELOCITY TRAVERSE DATA				
9	Stack area, ft^2.	A	78.5	78.5	78.5
10	Absolute stack gas pressure, in. Hg.	Ps	30.36	30.28	30.36
11	Barometric pressure, in. Hg.	Pbar	30.36	30.28	30.36
12	Average absolute stack temperature, °R	Ts	619	608	623
13	Average $\sqrt{\text{velocity head}}$, (Cp= .85)	$\sqrt{\Delta P}$	.14	.15	.14
14	Average stack gas velocity ft. / sec.	Vs	9	9	9
	STACK MOISTURE CONTENT				
15	Total water collected by train, ml.	Vlc	400.0	434.0	406.0
16	Moisture in stack gas, %	Bws	26.5	26.0	27.7
	EMISSIONS DATA:				
17	Stack gas flow rate, dscf/hr. (000's)	Qsd	1,595	1,731	1,567
18	Total particulate concentration, gr/dscf	Cs	.0213	.0147	.0194
19	Total particulate concentration, lbs/hr	E	4.9	3.6	4.3
20	Total particulate concentration, lbs/mbtu	E'	.0000	.0000	.0000
	ORSAT DATA				
21	Percent CO2 by volume	CO2	10.0	10.0	10.0
22	Percent O2 by volume	O2	11.0	11.0	11.0
23	Percent CO by volume	CO	.0	.0	.0
24	Percent N2 by volume	N2	79.0	79.0	79.0

Buzzycalc

Dry Gas Volume :

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

Where:

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

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

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

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

T_m = Absolute temperature at meter °R

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

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

Y = Dry gas meter calibration factor

13.6 = Inches water per inches Hg.

Run # 1 $V_{m(std)} = 17.64 \ (1.00)(53.85) \left[\frac{(30.36) + \frac{.81}{13.6}}{549} \right] = 52.45$ ds

Run # 2 $V_{m(std)} = 17.64 \ (1.00)(60.24) \left[\frac{(30.28) + \frac{.98}{13.6}}{550} \right] = 58.43$ dsc

Run # 3 $V_{m(std)} = 17.64 \ (1.00)(52.64) \left[\frac{(30.36) + \frac{.92}{13.6}}{566} \right] = 49.74$ dsc

Total contaminants by weight: 'GRAIN LOADING'

Particulate concentration C_s' gr./dscf.

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

Where:

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

M_n = Total amount of particulate matter collected, mg.

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

Run # 1: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{72.4}{52.45} \right] = .0213 \text{ gr./dscf.}$$

Run # 2: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{55.6}{58.43} \right] = .0147 \text{ gr./dscf.}$$

Run # 3: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{62.6}{49.74} \right] = .0194 \text{ gr./dscf.}$$

Dry molecular weight:

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

Where:

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

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

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

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

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

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

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

0.32 = Molecular weight of O_2 divided by 100.

0.44 = Molecular weight of CO_2 divided by 100.

Run # 1: $M_d = 0.44(10.0\%) + 0.32(11.0\%) + 0.28(\ .0\% + 79.0\%) =$ 30.0 lb./lb.-mol

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

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

Water vapor condensed :

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

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

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)

V_f = Final volume of impinger contents, ml.

V_i = Initial volume of impinger contents

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

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

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

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

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

Run # 1: $V_{wc(std)}$ = (0.04707) (390.0) = 18.4 cu.ft
$V_{wsg(std)}$ = (0.04715) (10.0) = .5 cu.ft

Run # 2: $V_{wc(std)}$ = (0.04707) (422.0) = 19.9 cu.ft
$V_{wsg(std)}$ = (0.04715) (12.0) = .6 cu.ft

Run # 3: $V_{wc(std)}$ = (0.04707) (395.0) = 18.6 cu.ft
$V_{wsg(std)}$ = (0.04715) (11.0) = .5 cu.ft

Moisture content of stack gases: $B_{ws} = \frac{V_{wc_{std}} + V_{wsg_{std}}}{V_{wc_{std}} + V_{wsg_{std}} + V_{m\,std}} \times 100$

Where:

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

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

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

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

Run # 1: $B_{ws} = \frac{18.4 + .5}{18.4 + .5 + 52.45} \times 100 = 26.5\ \%$

Run # 2: $B_{ws} = \frac{19.9 + .6}{19.9 + .6 + 58.43} \times 100 = 26.0\ \%$

Run # 3: $B_{ws} = \frac{18.6 + .5}{18.6 + .5 + 49.74} \times 100 = 27.7\ \%$

Molecular weight of stack gases: $M_s = M_d\ (1-B_{ws}) + 18\ (B_{ws})$.

Where:

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

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

Run # 1: $M_s = 30.0\ (1- .265) + 18\ (.265) = 26.8$ (lb./lb.-mole).

Run # 2: $M_s = 30.0\ (1- .260) + 18\ (.260) = 26.9$ (lb./lb.-mole).

Run # 3: $M_s = 30.0\ (1- .277) + 18\ (.277) = 26.7$ (lb./lb.-mole).

Stack gas velocity:

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

Where:

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

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

C_p = Pitot tube coefficient,(dimensionless).

ΔP = Velocity head of stack gas, in. H_2O.

P_{bar} = Barometric pressure at measurement site, (in.Hg).

P_g = Stack static pressure (in.Hg).

P_s = Absolute stack gas pressure, (in.Hg) = $P_{bar} + P_g$

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

t_s = Stack temperature, (°f).

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

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

Run # 1: $V = (85.49)\ (\ .85)\ (\ .14) \sqrt{\frac{619}{(30.36)(26.82)}}$ = 8.87 ft/s

Run # 2: $V = (85.49)\ (\ .85)\ (\ .15) \sqrt{\frac{608}{(30.28)(26.88)}}$ = 9.42 ft/s

Run # 3: $V = (85.49)\ (\ .85)\ (\ .14) \sqrt{\frac{623}{(30.36)(26.68)}}$ = 8.92 ft/s

Stack gas flow rate:

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

Where:

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

A = Cross sectional area of stack (ft.)^2.

3600 = Conversion factor, sec./hr.

t_s = Stack temperature (°f).

T_s = Absolute stack temperature, (°R).

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

P_{bar} = Barometric pressure at measurement site, (in.Hg.).

P_g = Stack static pressure, (in.Hg.).

P_s = Absolute stack gas pressure, (in.Hg.); = $P_{bar} + P_g$

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

Run # 1:

$$Q_{sd} = 3600\ (1-.265)\ (\ 8.87)\ (\ 78.5) \left[\frac{528}{619} \right] \left[\frac{30.36}{29.92} \right] = \quad 1594654 \text{ dscf/}$$

Run # 2:

$$Q_{sd} = 3600\ (1-.260)\ (\ 9.42)\ (\ 78.5) \left[\frac{528}{608} \right] \left[\frac{30.28}{29.92} \right] = \quad 1731328 \text{ dscf/}$$

Run # 3:

$$Q_{sd} = 3600\ (1-.277)\ (\ 8.92)\ (\ 78.5) \left[\frac{528}{623} \right] \left[\frac{30.36}{29.92} \right] = \quad 1567333 \text{ dscf/}$$

Emissions rate from stack:

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

Where:

E = Emissions rate, lb./hr.

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

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

Run # 1: $$E = \frac{(.0213)(1594654)}{7000} = 4.9 \text{ lb. / hr.}$$

Run # 2: $$E = \frac{(.0147)(1731328)}{7000} = 3.6 \text{ lb. / hr.}$$

Run # 3: $$E = \frac{(.0194)(1567333)}{7000} = 4.3 \text{ lb. / hr.}$$

Isokinetic variation : $$I = 100\ T_s \left[\frac{0.002669\ V_{ic} + (V_m/T_m)(P_{bar} + \Delta H/13.6)}{60\ \ 0\ \ V_s\ \ P_s\ \ A_n} \right]$$

Where:

I = Percent isokinetic sampling.

100 = Conversion to percent.

T_s = Absolute average stack gas temperature, °R.

0.002669 = Conversion factor, Hg - ft^3/ml - °R.

V_{ic} = Total volume of liquid collected in impingers and silica gel, m

T_m = Absolute average dry gas meter temperature, °R.

P_{bar} = Barometric pressure at sampling site, (in.Hg).

ΔH = Average pressure differential across the oriface meter, (in.H_2

13.6 = Specific gravity of mercury.

60 = Conversion seconds to minutes

0 = Total sampling time, minutes.

V_s = Stack gas velocity, ft./sec.

P_s = Absolute stack gas pressure, in.Hg.

A_n = Cross sectional area of nozzle, ft^2.

Run # 1:

$$I = 100 \times 619 \left[\frac{(0.002669)(400.0) + \frac{53.9}{549}\left[30.36 + \frac{.81}{13.6}\right]}{60\ (\ 108\ )\ (\ 8.87\ )\ (30.36\ )\ (\ .001503\ )} \right] = 96\ \%$$

Run # 2:

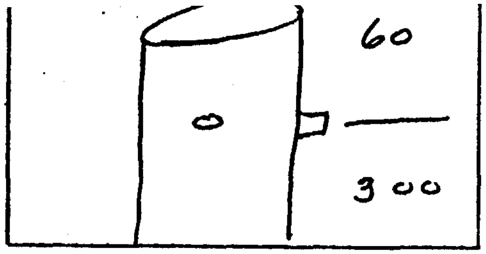
$$I = 100 \times 608 \left[\frac{(0.002669)(434.0) + \frac{60.2}{550}\left[30.28 + \frac{.98}{13.6}\right]}{60\ (\ 108\ )\ (\ 9.42\ )\ (30.28\ )\ (\ .001503\ )} \right] = 98\ \%$$

Run # 3:

$$I = 100 \times 623 \left[\frac{(0.002669)(406.0) + \frac{52.6}{566}\left[30.36 + \frac{.92}{13.6}\right]}{60\ (\ 108\ )\ (\ 8.92\ )\ (30.36\ )\ (\ .001503\ )} \right] = 92\ \%$$

VIII. FIELD DATA

Operator K. Allmendinger
Date 6-10-87
Run No. 1
Sample Box No. 1
Meter Box No. 646882
Meter H @ 1.691
C Factor .9964
Pitot Tube Coefficient Cp .85



Schematic of Stack Cross Section

Assumed Moisture, % 30
Probe Length, m(ft) 10'
Nozzle Identification No. 6015033
Avg. Calibrated Nozzle Dia., (in.) .525/.525/.5
Probe Heater Setting 9.5
Leak Rate, m³/min.(cfm) +.017
Probe Liner Material 1.316 Stainless
Static Pressure, mm Hg (in.Hg) .05
Filter No. SG-2071

INITIAL	2[illegible]	259
DIFFERENCE	390	10

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 ft³	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	8:28:30 8:33	2	155	.02	.76	393.095 395.27	75	65	250	.60
2	8:37:30	3	150	.03	1.1	397.87	90	65	250	60
3	8:42	3	155	.03	1.1	400.44	90	70	250	55
4	8:46:30	2	155	.02	.76	402.64	95	70	250	55
5	8:51	2	155	.02	.76	404.81	100	70	250	55
6	8:55:30	2	155	.02	.76	407.09	100	70	250	55
7	9:01	0	155	.01	.38	408.72	100	75	250	55
8	9:05:30	0	160	.01	.38	410.29	100	75	250	55
9	9:10	2	160	.02	.76	412.47	100	75	250	55
10	9:14:30	2	160	.02	.76	414.68	105	75	255	55
11	9:19	3	160	.03	1.1	417.32	110	80	255	55
12	9:23:30	3	160	.03	1.1	419.94	110	80	255	55
B) 1	9:30 9:34:30	2	160	.02	.76	422.23	90	80	250	55

Form #REC-05

RAMCON ENVIRONMENTAL CORPORATION

Plant BC1

Location Crofton, Md.

Operator K. Allmendinger

Date 6-10-87

Run No. 1

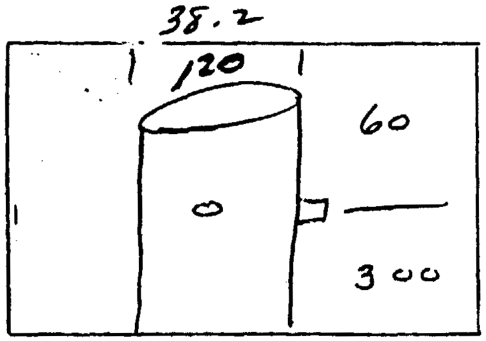
Sample Box No. 1

Meter Box No. 646882

Meter H @ 1.691

C Factor .9964

Pitot Tube Coefficient Cp .85



Schematic of Stack Cross Section

Ambient Temperature 65

		IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
Barometric Pressure 30.36	FINAL	550	309
Assumed Moisture, % 30	INITIAL	200	259
Probe Length, m(ft) 10'	DIFFERENCE	350	10

Nozzle Identification No. .60/5033

Avg. Calibrated Nozzle Dia., (in.) .585/.585/.5.

Probe Heater Setting 4.5

Leak Rate, m^3/min.(cfm) +.017

Probe Liner Material .316 Stainless

Static Pressure, mm Hg (in.Hg) .05

Filter No. SG-2071

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	8:28:30 8:33	2	155	.02	.76	393.095 395.27	75	65	250	.60
2	8:37:30	3	150	.03	1.1	397.87	90	65	250	60
3	8:42	3	155	.03	1.1	400.44	90	70	250	55
4	8:46:30	2	155	.02	.76	402.64	95	70	250	55
5	8:51	2	155	.02	.76	404.81	100	70	250	55
6	8:55:30	2	155	.02	.76	407.09	100	70	250	55
7	9:01	0	155	.01	.38	408.72	100	75	250	55
8	9:05:30	0	160	.01	.38	410.29	100	75	250	55
9	9:10	2	160	.02	.76	412.47	100	75	250	55
10	9:14:30	2	160	.02	.76	414.68	105	75	255	55
11	9:19	3	160	.03	1.1	417.32	110	80	255	55
12	9:23:30	3	160	.03	1.1	419.94	110	80	255	55
B) 1	9:30 9:34:30	2	160	.02	.76	422.23	90	80	250	55

Form #REC-05

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 6-10-87 LOCATION Crofton 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 Vm (ft^3)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
2	9:39	3	160	.03	1.1	424.813	105	80	250	55
3	~~12:18:30~~ 12:23	3	165	.03	1.1	427.4	85	80	260	60
4	12:27-30	3	165	.03	1.1	430.1	100	80	260	60
5	12:32	3	162	.03	1.1	432.7	100	80	260	60
6	12:36-30	2	160	.03	1.1	435.3	110	80	260	55
7	12:41	2	160	.02	.76	437.6	110	80	260	55
8	12:44-30	2	165	.02	.76	439.8	110	80	250	55
9	12:49	2	160	.02	.76	442.3	110	80	260	55
10	12:53-30	1	160	.01	.38	443.7	110	80	260	55
11	12:58	0	160	.01	.38	445.36	110	80	260	55
12	1:02:30	0	160	.01	.38	446.95	110	90	255	55

RAMCON ENVIRONMENTAL CORPORATION

Plant BCI

Location Crofton md.

Operator K. Allmendinger

Date 6-11-87

Run No. 2

Sample Box No. 2

Meter Box No. 646882

Meter H @ 1.69

C Factor .9~~9~~44

Pitot Tube Coefficient Cp .85

13.30

Ambient Temperature 60

Barometric Pressure 30.28

Assumed Moisture, % 25

Probe Length, m(ft) 10'

Nozzle Identification No. .00/5033

Avg. Calibrated Nozzle Dia., (in.) .525/.525/.525

Probe Heater Setting 4.5

Leak Rate, m³/min. (cfm) +.015

Probe Liner Material 316 Stainless

Static Pressure, mm Hg (in.Hg) .05

Filter No. 56-2073

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	622	318
INITIAL	200	306
DIFFERENCE	422	12

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft³	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A) 1	7:43 / 7:47:30	0	140	.01	.43	446.97 / 448.65	65	60	230	60
2	7:52	0	140	.01	.43	450.35	80	60	240	60
3	7:56:30	0	140	.01	.43	452.05	85	65	250	60
4	8:01	2	145	.02	.87	454.41	90	65	250	60
5	8:05:30	3	145	.03	1.3	457.28	95	70	250	60
6	8:10	3	145	.03	1.3	460.17	100	70	250	55
7	8:14:30	3	145	.03	1.3	463.06	100	70	255	55
8	8:19	3	145	.03	1.3	465.94	105	70	255	55
9	8:23:30	3	150	.03	1.3	468.83	105	75	250	55
10	8:28	2	150	.02	.87	471.27	105	75	250	55
11	8:32:30	2	150	.02	.87	473.67	105	75	250	55
12	8:37	0	150	.01	.43	475.615	105	75	250	55
B) 1	8:56 / 9:00:3	0	145	.01	.43	477.46	90	85	240	55

Form #REC 05

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 6-11-87 LOCATION Crofton TEST NO. 2

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME Vm (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
2	9:05	2	150	.02	.87	479.82	105	80	250	55
3	9:09:30	2	150	.02	.87	482.24	110	80	250	55
4	9:14	3	150	.03	1.3	485.16	110	80	250	55
5	9:18:30	3	150	.03	1.3	488.10	110	80	250	55
6	9:23	3	150	.03	1.3	491.08	115	85	250	55
7	9:27:30	3	150	.03	1.3	494.08	115	85	250	55
8	9:32	3	150	.03	1.3	496.99	115	85	250	55
9	9:36:30	3	150	.03	1.3	499.93	115	85	250	55
10	9:41	3	150	.02	.87	502.33	115	85	255	55
11	9:45:30	3	150	.02	.87	504.78	115	90	255	55
12	9:50	3	150	.02	.87	507.21	115	90	255	55

RAMCON ENVIRONMENTAL CORPORATION

Plant BCI
Location Crofter rd
Operator allen dumas
Date 6-18-87
Run No. 3
Sample Box No. 3
Meter Box No. 646 RBV
Meter H @ 1.69
C Factor .9964
Pitot Tube Coefficient Cp .85

Ambient Temperature 65
Barometric Pressure 30.36
Assumed Moisture, % 30
Probe Length, m(ft) 10'
Nozzle Identification No. .0615033
Avg. Calibrated Nozzle Dia., (in.) .525/.524/.525
Probe Heater Setting 4.5
Leak Rate, m^3/min. (cfm) .005
Probe Liner Material ~~+.017~~ ~~Plain~~ 316SS
Static Pressure, mm Hg (in. Hg) +.017
Filter No. SG-2072

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	595	313
INITIAL	200	302
DIFFERENCE	395	11

Schematic of Stack Cross Section

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	~~10:49:10~~ 10:53-40	0	160	.01	.43	~~507.315~~ 509.0	95	95	245	60
2	10:58-10	0	160	.01	.43	510.7	110	95	245	60
3	11:02-40	0	160	.01	.43	512.4	110	95	250	60
4	11:07-10	0	160	.01	.43	514.1	110	95	250	60
5	11:11-40	0	160	.01	.43	515.8	110	95	250	60
6	11:16-10	0	160	.02	.87	518.2	110	95	250	60
7	11:20-40	0	160	.02	.87	520.5	120	95	250	60
8	11:25-10	0	160	.02	.87	522.9	120	95	250	60
9	11:29-40	3	165	.03	1.3	525.9	120	95	250	60
10	11:34-10	3	165	.03	1.3	528.9	120	95	250	60
11	11:38-40	3	165	.03	1.3	531.8	120	95	245	60
12	11:43-10	3	165	.03	1.3	534.8	120	95	245	55
1(B)	~~11:47-40~~ 11:58-30	~~3~~ 1	165	.01	.43	536.2	120	95	250	60

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)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
2	12:03	1	165	.01	.43	538.4	120	95	260	60
3	12:07-30	1	165	.01	.43	539.9	120	95	260	60
4	12:12	1	165	.02	.87	542.4	120	95	260	60
5	12:16-30	1	165	.02	.87	544.9	120	95	260	60
6	12:21	1	165	.03	1.3	547.9	120	95	260	60
7	12:25-30	1	165	.03	1.3	550.9	120	95	260	60
8	12:30	1	165	.03	1.3	553.8	120	95	260	60
9	12:34-30	1	165	.03	1.3	556.9	120	95	260	60
10	12:39	1	165	.03	1.3	559.8	120	95	260	60
11	12:43-30	1	165	.03	1.3	562.7	120	95	260	60
12	12:48	1	165	.03	1.3	559.954	120	95	260	60

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 6-15-87 Meter box number 046882

Barometric pressure, P_b = 25.94 in. Hg Calibrated by

Orifice manometer setting (ΔH), in. H_2O	Gas volume		Temperature				Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O
	Wet test meter (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), °F	Dry gas meter					
				Inlet (t_{d_i}), °F	Outlet (t_{d_o}), °F	Avg[a] (t_d), °F			
0.5	5	570.67 575.76	78.8	100 105	80 85	92.5	12:25	1.008	1.72
1.0	5	577.29 582.357	78.8	110 110	85 85	97.5	8:46	1.009	1.695
1.5	10	582.57 592.214	78.8	115 115	85 90	101.25	14.25	1.0129	1.71
2.0	10								
3.0	10								
4.0	10								
							Avg	1.001	1.71

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 5-22-87 Meter box number 646882

Barometric pressure, P_b = 30.15 in. Hg Calibrated by

	Gas volume		Temperature						
				Dry gas meter					
Orifice manometer setting (ΔH), in. H_2O	Wet test meter (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), °F	Inlet (t_{d_i}), °F	Outlet (t_{d_o}), °F	Avg[a] (t_d), °F	Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	6	798.67 804.919	77	106 108	84 85	95.75	14:45	.9925	1.65
1.0	5	805.69 810.902	77	110 112	85 86	98.25	8:51	.9949	1.70
1.5	10	811.53 821.944	77	110 115	86 86	99.25	14:30	.9964	1.71
2.0	10								
3.0	10								
4.0	10								
							Avg	.9946	1.69

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.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-19-86 Thermocouple number inlet/outlet

Ambient temperature 23.9 °C Barometric pressure 30.12 in. Hg

Calibrator

Reference: mercury-in-glass ✓

other

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	inlet Ambient	75°F	75°F	0.0%
B	outlet Ambient	75°F	75°F	0.0%
C	Ambient 6-10-87	65°F	65°F	0%

[a] Type of calibration system used.

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

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-19-86 Thermocouple number Hot box

Ambient temperature 23 °C Barometric pressure 30.12 in. Hg

Calibrator LA Reference: mercury-in-glass ✓

other

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	boiling water	100°C	100 °C	0%
B	Ambient	23°C	22.8°C	< 1%
	6-10-87	65°F	65°F	0%

---

[a] Type of calibration system used.

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

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Date 2-26-87 Thermocouple number 10'

Ambient temperature 78 °F Barometric pressure 29.91 in. Hg

Calibrator ______ Reference: mercury-in-glass ✓

other ______

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
1	Ambient	76°F	76°F	%
2	Ice Bath	32°F	32°F	%
3	Boiling water	212°F	212°F	%
4	Ambient 8-10-87	65°F	65°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

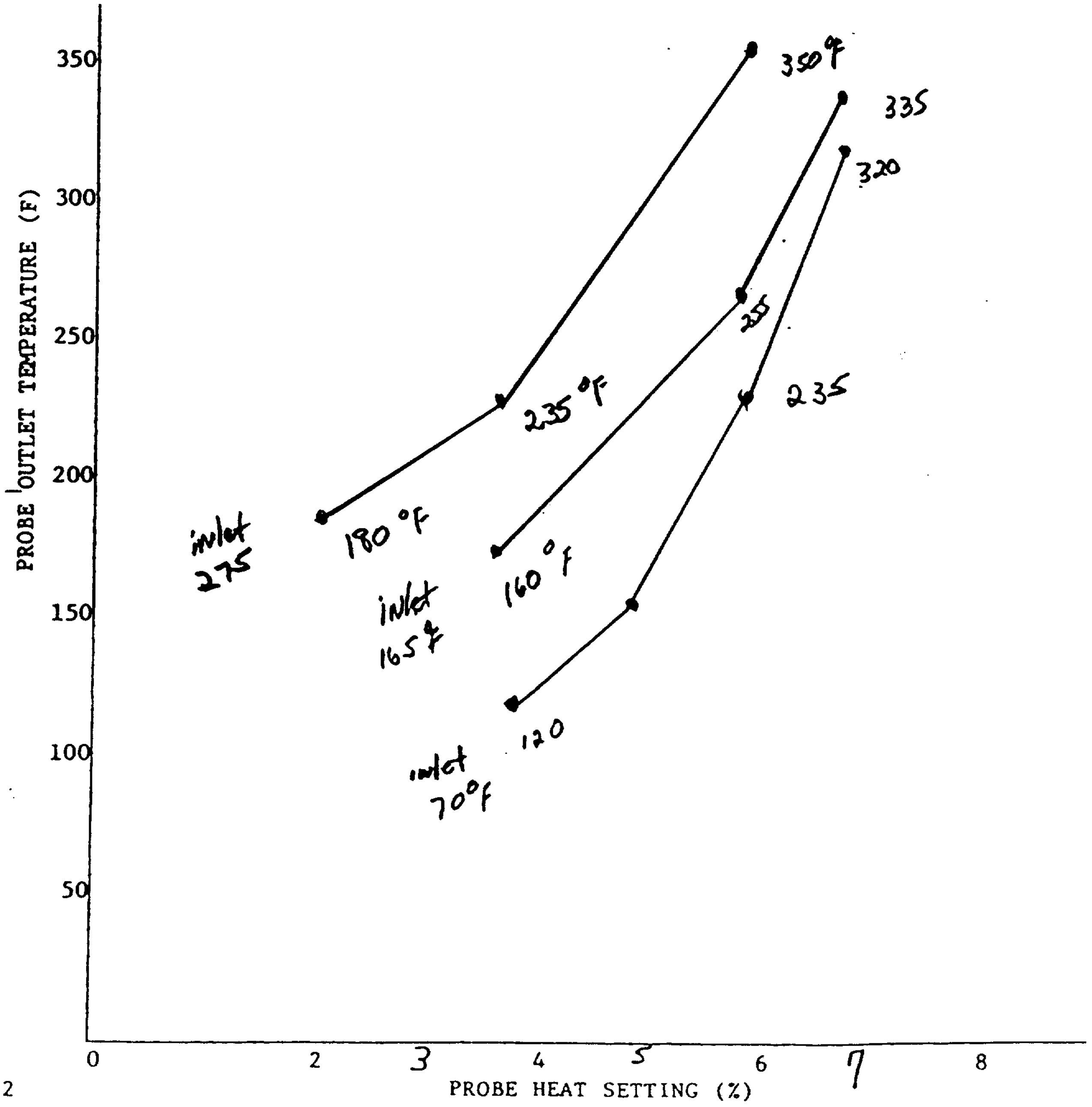
Heating Probe Calibration

Probe No. 10-1 Probe Length 10'

Date of Calibration 2-19-87 Signature Sam T. [illegible]

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. 10-1 Date 3-13-87

Calibrated by: ____________

"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	0.62	.86	.85	0
2	0.38	.53	.85	0
3	0.21	.29	.85	0
		$\bar{C}_p$ (SIDE A)	.85	

"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	0.62	.86	.85	0
2	0.38	.53	.85	0
3	0.20	.29	.85	0
		$\bar{C}_p$ (SIDE B)	.85	

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

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

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

Form No. EED-17-1

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.

Ken Allmendinger - Team Leader

Ken Allmendinger has been employed with RAMCON for three years. He has sampled over 100 asphalt plants with extensive training in Methods 1 through 5. He is qualified as a team leader and has current certification as a V.E. reader.