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

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

Commonwealth of Pennsylvania
Environmental Resources
September 21, 1988

Subject: Source Test Review

To: Data File
Wyoming Sand and Stone Company
Eaton Township, Wyoming County

From: John S. Pitulski
Air Quality Program Specialist
Division of Technical Services and Monitoring
Bureau of Air Quality Control

Through: Chief, Source Testing and Monitoring Section

Wyoming Sand and Stone Company operates a newly installed asphalt production plant at the aforementioned location. The unit is a batch-mix design with a maximum production capacity of 300 tons per hour. Emissions from the facility are controlled by a baghouse collector system manufactured by McCarter Corporation.

On July 14, 1988 particulate compliance testing was conducted at the plant by personnel from Ramcon Environmental Corporation. The three tests appear to have been conducted in accordance with the applicable test methods and are acceptable to the Department.

The following data was extracted from the test reports:

Test Run Number	1	2	3
Volumetric Flowrate (dscfm)	17400	17583	18050
Mass Emission Rate (lb/hr)	1.34	0.90	1.75
Particulate Concentration (gr/dscf)	0.0090	0.0060	0.0113
Allowable Concentration (gr/dscf)	0.04	0.04	0.04

AIR QUALITY

RAMCON

ENVIRONMENTAL CORPORATION

88 SEP -7 PM 1:36

DEPT. OF ENV. RESOURCES
BUREAU OF
ENVIRONMENTAL
WILKES-BARRE REGION

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
WYOMING SAND & STONE
WILKES-BARRE, PENNSYLVANIA
July 14, 1988

Tom Gozikowski
Wyoming Sand & Stone

G. Sumner Buck, III
President

Ken Allmendinger
Team Leader

RAMCON BUILDING, 2223 SCOTT STREET, MEMPHIS, TENNESSEE 38112
TELEPHONE 800/458-4567 IN TENNESSEE 901/458-7000 FAX 901-458-3868

RAMCON
ENVIRONMENTAL CORPORATION

August 26, 1988

Mr. Tom Gozikowski
Wyoming Sand & Stone
R. D. #2
Tunkhannock, PA 18657

Re: Particulate Emissions Tests - Tunkhannock, PA

Dear Mr. Barnes:

Enclosed you will find four copies of our report on the particulate emissions tests we conducted at Wyoming Sand & Stone in Tunkhannock, Pennsylvania. Based on our test results, your plant does pass both EPA New Source Performance Standards and those set by the State of Pennsylvania. The average grain loading of the three test runs was below the allowable emissions standard set by EPA and the State of Pennsylvania. 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. Jim Parette
Pennsylvania DER
90 E. Union St.
Wilkes-Barre, PA 18703

You will need to keep one copy of the report at the plant.

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

Sincerely,

G. Sumner Buck, III
President

GSBIII:mew

Enclosures

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

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	TEST RESULTS	1
III.	TEST PROCEDURES	2
IV.	THE SOURCE	4
V.	EQUIPMENT USED	8
VI.	LABORATORY PROCEDURES & RESULTS	9
VII.	CALCULATIONS	14
VIII.	FIELD DATA	25
IX.	CALIBRATIONS	31
X.	RAMCON PERSONNEL	38

I. INTRODUCTION

On July 14, 1988, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Wyoming Sand & Stone's McCarter batch mix asphalt plant located in Tunkhannock, Pennsylvania. RAMCON personnel conducting the test were Ken Allmendinger, Team Leader, and Kevin Powell. Bruce Shrader 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. Allmendinger and Mr. Shrader.

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 Pennsylvania.

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 Pennsylvania is .04 gr/dscf.

TABLE I

SUMMARY OF TEST RESULTS
July 14, 1988

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	07:10 to 08:39	0.0090 gr/DSCF	110.0%	1.34 lbs/hr
2	09:17 to 10:45	0.0060 gr/DSCF	97.3%	0.90 lbs/hr
3	13:51 to 15:18	0.0113 gr/DSCF	98.3%	1.75 lbs/hr
	Average:	0.0088 gr/DSCF		1.33 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 Pennsylvania. Therefore, the plant is operating in compliance with State and Federal Standards.

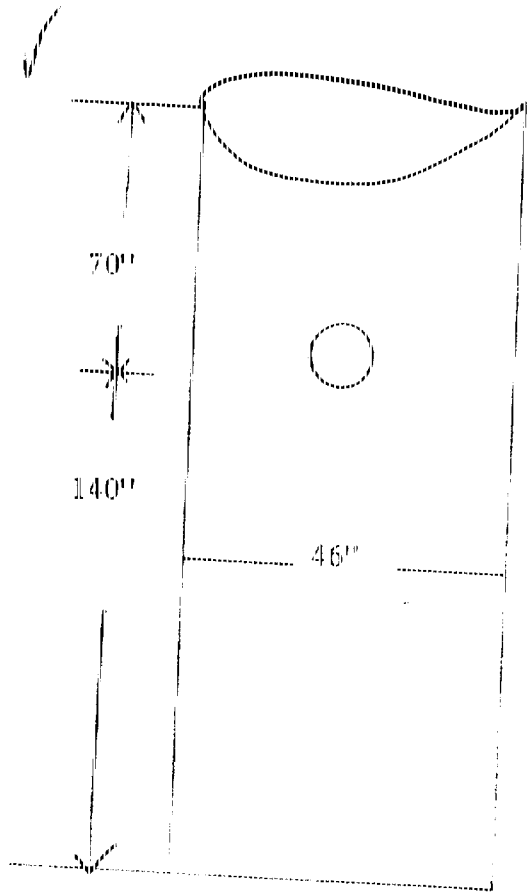
III. TEST PROCEDURES

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 particulate emissions test was conducted on a round stack with a diameter of 46". The sampling ports were placed at least 70" down (1.5 diameters upstream) from the top of the stack and 140" up (3.04 diameters downstream) from the last flow disturbance. Twenty-four points was sampled, twelve through each traverse for 3 1/2 minutes each for a total testing time of 84 minutes per test run.

Points on a Diameter	Probe Mark
1	1.0"
2	3.1"
3	5.4"
4	8.1"
5	11.5"
6	16.3"
7	29.7"
8	34.5"
9	37.9"
10	40.6"
11	42.9"
12	45.0"



IV. THE SOURCE

IV. THE SOURCE

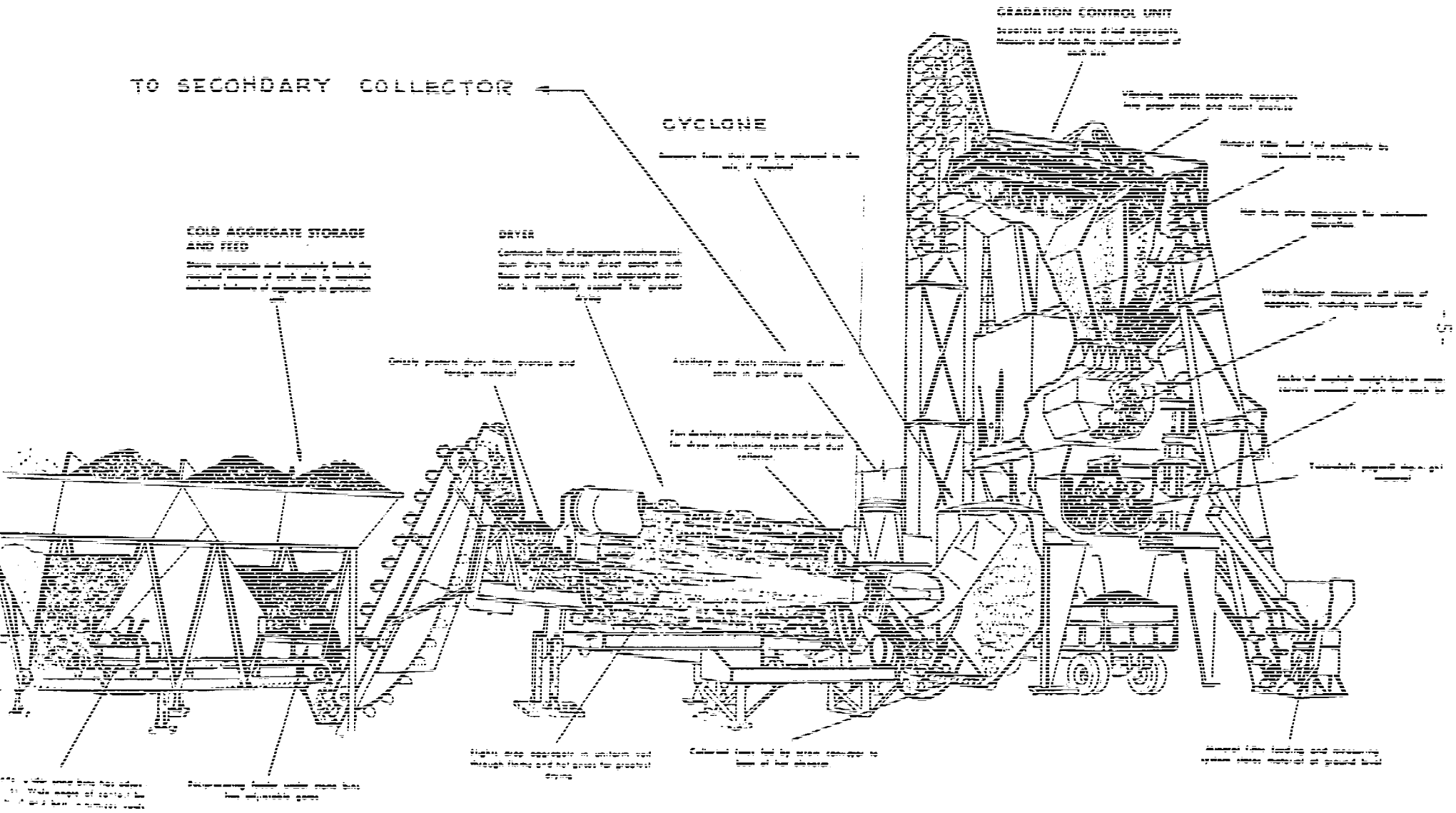
Wyoming Sand & Stone employs a McCarter batch mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind the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

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

The drum dryer uses a burner fired with fuel oil to heat air to dry the aggregate. The air is drawn into the system via an exhaust fan. After passing through the burner and the mixing drum, the air passes through a baghouse. The baghouse is manufactured by McCarter. 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 pugmill. The following sketch shows a typical batch mix asphalt plant.

Figure 4-1

ASPHALT BATCH MIX PLANT - AN EXPLODED VIEW



DATA SUMMARY

Plant

1. Manufacturer of plant MC CARTER.
2. Designed maximum operating capacity 300 TPH @ 5 % moisture.
3. Actual operation rate 270 TPH @ 7.5 % moisture.
4. Startup date 1 Jan 84
5. Type of fuel used in dryer #2 oil.
6. Quanity of fuel consumption _____.

Aggregate

7. Name/type of mix IDZ Top.
8. Percent asphalt in mix 6.6 %.
9. Temperature of asphalt 300°.
10. Sieve/Screening analysis: % Passing:

1"		3/8"	96	#16	32
3/4"		#4	83	#30	26
1/2"	100	#8	44	#50	14
				#100	6
				#200	2

Baghouse

11. Manufacturer MC CARTER.
12. No. of bags 756. Type of bags NOMEX.
13. Air to cloth ratio 5.1 to 1. Designed ACFM 55000 359°F
14. Square feet of bags 10690.
15. Type of cleaning: pulse jet ✓, reverse air _____, plenum pulse _____, other _____.
16. Cleaning cycle time 2-24 sec.
17. Interval between cleaning cycle 14 sec.
18. Pressure drop across baghouse 2.5 psi.
19. Pulse pressure on cleaning cycle 120 psi.

COMPANY NAME Tennessee Corp DATE 7-14-88

COMPANY REPRESENTATIVE Jack Dean

PLANT DATA

COMPANY NAME _____

COMPANY REP. _____ DATE _____ PHONE # _____

DATA SOURCE _____

PLANT LOCATION _____

PLANT MFG. _____ PLANT MODEL # _____ PLANT TYPE _____

MIX SPECIFICATION # _____ OIL SPECIFICATION # _____

Time 24 Hour	✓ Fuel Oil ___ Nat. Gas ___ Propane ___ Coal ___	Burner Setting	273 average Aggregate TPH	Recycle TPH	Liquid Asphalt TPH	Mix Temp. °F	___ Venturi ___ Baghouse Pressure Drop Inches Water
7:15		80	275		15 Ton	300	2
7:30		76	275		[illegible]	"	2.20
7:45		79	275		19	300	2.2
8:00		60	300		19	300	2.1
8:15		81	275		15	300	2
8:30		60	275		15	300	2.3
8:45		73	264		14	300	2
9:00		70	275		15	300	2.2
9:15		65	275		15	300	2.4
9:30		72	261		17	300	2.5
9:45		70	265		18	300	2.2
10:00		88	271		17.8	300	2
10:15		68	269		17.4	300	2.4
10:30		77	266.9		17.6	300	2.4

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 qn 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 REC48

SAMPLE ANALYTICAL DATA FORM

Plant Location Longwoing

Sample Location Last nozzle test

Relative humidity in lab 45 %

Density of Acetone (pa) .7853 mg/ml

Blank volume (V_a) 200 ml

Date/Time wt. blank 7-18-88

Date/Time wt. blank 7-19-88

Gross wt. 156.5686 mg

Gross wt. 156.5690 mg

Ave. Gross wt. 156.5683 mg

Tare wt. 156.5679 mg

Weight of blank (m_{ab}) .0004 mg

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (P_a) = (.0000025 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} P_a$ = (.00002)(200)(.7853) = (.0004)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt 7-18-88 Gross wt	g	159.7777	155.8440	156.4695
Date/Time of wt 7-19-88 Gross wt	g	159.7779	155.8443	156.4696
Average Gross wt	g	159.7778	155.8442	156.4696
Tare wt	g	159.6986	155.8348	156.4447
Less acetone blank wt (W_a)	g	0.0004	0.0004	0.0004
Wt of particulate in acetone rinse (m_a)	g	0.0788	0.0096	0.0205

Filter Numbers	#	592694	592695	592860
Date/Time of wt 7-18-88 Gross wt	g	0.5355	0.5319	0.5433
Date/Time of wt 7-19-88 Gross wt	g	0.5355	0.5319	0.5435
Average Gross wt	g	0.5355	0.5319	0.5434
Tare wt	g	0.5288	0.5261	0.5302

Plus back half

		.0081	.0045	.0055
Weight of particulate on filters(s) (m_f)	g	0.0067	0.0031	0.0032
Weight of particulate in acetone rinse	g	0.0788	0.0096	0.0205
Total weight of particulate (m_n)	g	0.0856	0.0200	0.0392

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]

COMPANY NAME Wyoming

Soluble and Insoluble Extraction for EPA Method 5 (back half)

Relative humidity in lab %

			RUN 1	RUN 2	RUN 3
Impinger rinse volume (Filterable Extraction)		ml			
Date/Time of wt. 7/28/88	Gross wt.	g	.0411	.0377	.0377
Date/Time of wt. 7/28/88	Gross wt.	g	.0411	.0377	.0377
Filter Avg.	Gross wt.	g	.0411	.0377	.0377
	Tare wt.	g	.0330	.0322	.0322
Weight of insoluble particulate impinger rinse		g	.0081	.0055	.0055
Water evaporation		#			
Date/Time of wt. 7/28/88	Gross wt.	g			132.7472
Date/Time of wt. 7/28/88	Gross wt.	g			132.7476
Beaker Avg.	Gross wt.	g			132.7476
	Tare wt.	g			132.7388
Weight of soluble particulate from water		g			0.0088
Total weight of particulate (m_n)		g			.0153

Remarks

Signature of Analyst

Signature of Reviewer

VII. CALCULATIONS

SUMMARY OF TEST DATA

		7/14/88 RUN #1	7/14/88 RUN #2	7/14/88 RUN #3
SAMPLING TRAIN DATA				
1. Sampling time, minutes	start	07:10	09:17	13:51
	finish	08:39	10:45	15:18
	θ	84.0	84.0	84.0
2. Sampling nozzle diameter, in.	D_n	.2750	.2750	.2750
3. Sampling nozzle cross-sect. area, ft^2	A_n	.000413	.000413	.000413
4. Isokinetic variation	I	110.0	97.3	98.3
5. Sample gas volume - meter cond., cf.	V_m	61.973	56.715	59.578
6. Average meter temperature, ^oR	T_m	560	573	581
7. Avg. orifice pressure drop, in. H_2O	dH	1.47	1.26	1.48
8. Total particulate collected, mg.	M_n	33.60	20.00	39.20
VELOCITY TRAVERSE DATA				
9. Stack area, ft^2	A	11.50	11.50	11.50
10. Absolute stack gas pressure, in. Hg.	P_s	29.50	29.50	29.50
11. Barometric pressure, in. Hg.	P_{bar}	29.50	29.50	29.50
12. Avg. absolute stack temperature, R^o	T_s	770	781	745
13. Average $\sqrt{\text{vel. head}}$, (C_p= .81)	$\sqrt{dP}$	0.75	0.79	0.79
14. Average stack gas velocity, ft./sec.	V_s	51.76	55.06	54.25
STACK MOISTURE CONTENT				
15. Total water collected by train, ml.	V_{lc}	474.00	481.00	510.00
16. Moisture in stack gas, %	B_{ws}	27.93	30.52	30.94
EMISSIONS DATA				
17. Stack gas flow rate, dscf/hr. (000's)	Q_{sd}	1044	1055	1083
18. Stack gas flow rate, cfm	acfm	35714	37991	37433
19. Particulate concentration, gr/dscf	C_s	0.0090	0.0060	0.0113
20. Particulate concentration, lb/hr	E	1.34	0.90	1.75
21. Particulate concentration, lb/mBtu	E'	0.00000	0.00000	0.00000
ORSAT DATA				
22. Percent CO_2 by volume	CO_2	6.30	8.30	2.80
23. Percent O_2 by volume	O_2	12.00	9.20	16.90
24. Percent CO by volume	CO	.00	.00	.00
25. Percent N_2 by volume	N_2	81.70	82.50	80.30

FOUNDING SAND & STONE
WILKES-BARRE, PENNSYLVANIA

"15"

Dry Gas Volume

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

Where:

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

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

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

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

T_m = Absolute temperature at meter ^oR.

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

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

Y = Dry gas meter calibration factor.

13.6 = Inches water per inches Hg.

RUN 1:

$$V_{m(std)} = (17.64)(1.000)(61.973)\left[\frac{(29.50) + \frac{1.47}{13.6}}{560}\right] = 57.799 \text{ dscf}$$

RUN 2:

$$V_{m(std)} = (17.64)(1.000)(56.715)\left[\frac{(29.50) + \frac{1.26}{13.6}}{573}\right] = 51.668 \text{ dscf}$$

RUN 3:

$$V_{m(std)} = (17.64)(1.000)(59.578)\left[\frac{(29.50) + \frac{1.48}{13.6}}{581}\right] = 53.559 \text{ dscf}$$

WYOMING SAND & STONE
WILKES-BARRE, PENNSYLVANIA
Total Contaminants by Weight: GRAIN LOADING

Particulate concentration C_s' gr./dscf.

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

Where:

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

M_n = Total amount of particulate matter collected, mg.

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

Run 1:

$$C_s' = \left[0.0154 \ \frac{gr}{mg} \right] \left[\frac{13.60}{57.799} \right] = 0.0090 \text{ gr./dscf.}$$

Run 2:

$$C_s' = \left[0.0154 \ \frac{gr}{mg} \right] \left[\frac{20.00}{51.668} \right] = 0.0060 \text{ gr./dscf.}$$

Run 3:

$$C_s' = \left[0.0154 \ \frac{gr}{mg} \right] \left[\frac{39.20}{53.559} \right] = 0.0113 \text{ gr./dscf.}$$

WYOMING SAND & STONE
WILKES-BARRE, PENNSYLVANIA

Dry Molecular Weight

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

Where:

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

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

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

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

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

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

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

0.32 = Molecular weight of O_2 divided by 100.

0.44 = Molecular weight of CO_2 divided by 100.

Run 1:

$$M_d = 0.44(6.30\%) + 0.32(12.00\%) + 0.28(.00\% + 81.70\%) = 29.49 \ \frac{lb}{lb\text{-}mole}$$

Run 2:

$$M_d = 0.44(8.30\%) + 0.32(9.20\%) + 0.28(.00\% + 82.50\%) = 29.70 \ \frac{lb}{lb\text{-}mole}$$

Run 3:

$$M_d = 0.44(2.80\%) + 0.32(16.90\%) + 0.28(.00\% + 80.30\%) = 29.12 \ \frac{lb}{lb\text{-}mole}$$

WYOMING SAND & STONE
WILKES-BARRE, PENNSYLVANIA

Water Vapor Condensed

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

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

Where:

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

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

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

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

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

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

P_w = Density of water, 0.002201 lb/ml.

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

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

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

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

Run 1:

$V_{wc(std)}$ = (0.04707) (460.0) = 21.7 cu.ft
$V_{wsg(std)}$ = (0.04715) (14.0) = 0.7 cu.ft

Run 2:

$V_{wc(std)}$ = (0.04707) (465.0) = 21.9 cu.ft
$V_{wsg(std)}$ = (0.04715) (16.0) = 0.8 cu.ft

Run 3:

$V_{wc(std)}$ = (0.04707) (495.0) = 23.3 cu.ft
$V_{wsg(std)}$ = (0.04715) (15.0) = 0.7 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:

$$B_{ws} = \frac{21.7 + 0.7}{21.7 + 0.7 + 57.799} \times 100 = 27.93\ \%$$

Run 2:

$$B_{ws} = \frac{21.9 + 0.8}{21.9 + 0.8 + 51.668} \times 100 = 30.52\ \%$$

Run 3:

$$B_{ws} = \frac{23.3 + 0.7}{23.3 + 0.7 + 53.559} \times 100 = 30.94\ \%$$

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

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:

$$M_s = 29.49 (1 - 27.93) + 18 (27.93) = 26.28 \text{ (lb./lb.-mole)}$$

Run 2:

$$M_s = 29.70 (1 - 30.52) + 18 (30.52) = 26.13 \text{ (lb./lb.-mole)}$$

Run 3:

$$M_s = 29.12 (1 - 30.94) + 18 (30.94) = 25.68 \text{ (lb./lb.-mole)}$$

Stack Gas Velocity

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

Where:

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

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

C_p = Pitot tube coefficient, (dimensionless).

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

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

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

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

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

t_s = Stack temperature, (^{o}F).

T_s = Absolute stack temperature, (^{o}R). = 460 + t_s.

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

Run 1:

$$V = (85.49)\ (\ .81)\ (\ 0.75) \sqrt{\frac{770}{(29.50)(26.28)}} = 51.76 \text{ ft/sec.}$$

Run 2:

$$V = (85.49)\ (\ .81)\ (\ 0.79) \sqrt{\frac{781}{(29.50)(26.13)}} = 55.06 \text{ ft/sec.}$$

Run 3:

$$V = (85.49)\ (\ .81)\ (\ 0.79) \sqrt{\frac{745}{(29.50)(25.68)}} = 54.25 \text{ ft/sec.}$$

WYOMING SAND & STONE
WILKES-BARRE, PENNSYLVANIA

Stack Gas Flow Rate

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

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, (^oF).

T_s = Absolute stack temperature, (^oR).

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

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:

$$Q_{sd} = 3600(1 - .2793)(51.76)(11.50)\left[\frac{528}{770}\right]\left[\frac{29.50}{29.92}\right] = 1044125.6 \; \frac{dscf}{hr}$$

Run 2:

$$Q_{sd} = 3600(1 - .3052)(55.06)(11.50)\left[\frac{528}{781}\right]\left[\frac{29.50}{29.92}\right] = 1055697.9 \; \frac{dscf}{hr}$$

Run 3:

$$Q_{sd} = 3600(1 - .3094)(54.25)(11.50)\left[\frac{528}{745}\right]\left[\frac{29.50}{29.92}\right] = 1083838.9 \; \frac{dscf}{hr}$$

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

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:

$$E = \frac{(0.0090)(1044125.6)}{7000} = 1.34 \text{ lb. / hr.}$$

Run 2:

$$E = \frac{(0.0060)(1055697.9)}{7000} = 0.90 \text{ lb. / hr.}$$

Run 3:

$$E = \frac{(0.0113)(1083838.9)}{7000} = 1.75 \text{ lb. / hr.}$$

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

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_{lc}	=	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 orifice 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:

$$I = (100)(770) \left[\frac{(0.002669)(474.00) + \frac{61.973}{560}\left[29.50 + \frac{1.47}{13.6}\right]}{60\ (84.0)\ (51.76)\ (29.50)\ (.000413)} \right] = 110.0\%$$

Run 2:

$$I = (100)(781) \left[\frac{(0.002669)(481.00) + \frac{56.715}{573}\left[29.50 + \frac{1.26}{13.6}\right]}{60\ (84.0)\ (55.06)\ (29.50)\ (.000413)} \right] = 97.3\%$$

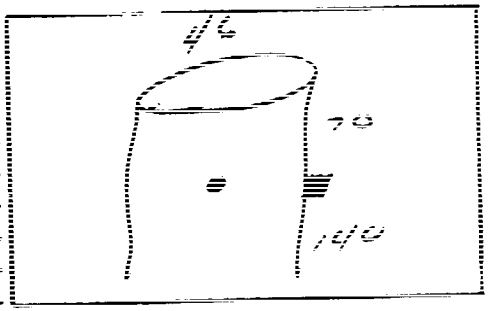
Run 3:

$$I = (100)(745) \left[\frac{(0.002669)(510.00) + \frac{59.578}{581}\left[29.50 + \frac{1.48}{13.6}\right]}{60\ (84.0)\ (54.25)\ (29.50)\ (.000413)} \right] = 98.3\%$$

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant Wyoming Sand & Gravel
Location Wilkes-Barre Pa.
Operator K Allmendinger
Date 9-14-88
Run No. 1
Sample Box No. 2
Meter Box No. 0114 1478-10
Meter H @ 1.72
C Factor .998
Pitot Tube Coefficient Cp .81



Schematic of Stack Cross Section

	VALUE	MAX. VAR.
Ambient Temperature 78		
Barometric Pressure 29.50 mm	660	528
Assumed Moisture, % 2.5 mm	200	544
Probe Length, m(ft) 5' mm	460	14

Nozzle Identification No. .0004 1.5
Avg. Calibrated Nozzle Dia., (in.) .197/.195/.195
Probe Heater Setting 60
Leak Rate, m³/min. (cfm) 0.006@20"
Probe Liner Material 316 stainless
Static Pressure, mm Hg(in.Hg) .05
Filter No. 56-2694

TRAV. PT NO.	SAMPLING TIME (θ)min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	7:10 7:13:30	0	265	.4796 .23	.57	470.36 470.51	85	80	240	60
2	7:17	0	260	.4796 .23	.57	475.00	90	80	230	60
3	7:20:30	1	295	.549 .28	.70	476.68	95	80	235	60
4	7:24	3	305	.6083 .37	.92	478.69	100	80	240	55
5	7:27:30	3	305	.649 .42	1.0	480.64	105	80	240	55
6	7:31	3	305	.671 .45	1.1	482.705	105	85	245	55
7	7:34:30	4	305	.748 .55	1.4	485.05	110	85	245	55
8	7:38	4	305	.748 .55	1.4	487.40	110	85	245	55
9	7:41:30	4	305	.7746 .60	1.5	488.84	110	85	245	55
10	7:45	6	305	.8944 .80	2.0	519.89	115	85	250	55
11	7:48:30	6	305	.8944 .80	2.0	522.70	115	90	250	55
12	7:52	6	305	.8938 .80	2.2	525.64	115	90	250	55
B) 1	7:57 8:00:30	6	305	.8964 .80	2.0	528.51	115	95	255	55

.002 2.0 65 O_2 = 12.0

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 7-14-88 LOCATION Wilkerson 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)
2	8:04	6	305	.846 .95	1.9	531.345	115	50	200	55
3	8:07:30	6	305	.846 .75	1.9	534.13	120	50	200	55
4	8:11	7	315	.9737 .99	2.4	537.19	120	50	200	55
5	8:14:30	7	320	.995 .97	2.4	540.28	120	50	200	55
6	8:18	7	320	.891 .83	2.1	534.24	120	55	200	55
7	8:21:30	5	320	.742 .5	1.4	536.71	120	55	200	55
8	8:25	4	320	.693 .48	1.2	538.97	120	55	200	55
9	8:28:30	4	320	.671 .45	1.1	541.19	120	55	200	55
10	8:32	4	325	.693 .48	1.2	543.42	120	55	200	55
11	8:35:30	4	320	.693 .48	1.2	545.66	120	55	255	55
12	8:39	4	320	.707 .50	1.2	534.883	120	55	255	55

RAMCON ENVIRONMENTAL CORPORATION

Plant Wyoming Sand & Gravel

Location Wilkes-Barre, Pa

Operator L Allmendinger

Date 7-14-88

Run No. 2

Sample Box No. 3

Meter Box No. C124 147810

Meter H @ 1.72

C Factor .958

Pitot Tube Coefficient Cp .81

Ambient Temperature 90

Barometric Pressure 29.50

Assumed Moisture, % 30

Probe Length, m(ft) 5'

Nozzle Identification No. .0004125

Avg. Calibrated Nozzle Dia., (in.) .275/.275/.275

Probe Heater Setting 5.0

Leak Rate, m^3/min. (cfm) +.005 @ 10"

Probe Liner Material 316 stainless

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

Filter No. 56-2695

Initial	2 00	510	16
Difference	405		

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H2O	PRESSURE DIFF. ORF. MTR in H2O	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
A) 1	9:17 / 9:20:30	1	290	.25	.49	535.046 / 536.43	105	105	240	65
2	9:24	1	290	.25	.49	537.86	105	100	240	60
3	9:27:30	3	305	.33	.64	539.46	115	100	240	60
4	9:31	3	320	.40	.78	541.29	120	100	245	55
5	9:33:30	4	320	.48	.94	543.27	120	100	250	55
6	9:37	4	325	.50	.98	545.28	120	100	255	55
7	9:40:30	4	325	.50	.98	547.30	120	100	255	55
8	9:44	5	320	.55	1.1	549.41	120	100	260	55
9	9:47:30	6	320	.60	1.2	551.62	125	100	260	55
10	9:51	6	325	.70	1.4	554.05	125	100	260	55
11	9:54:30	8	325	.90	1.8	556.76	125	100	260	55
12	9:58	8	320	.85	1.7	559.51	125	105	260	55
B) 1	10:03 / 10:06:30	8	315	.85	1.7	562.17	120	105	260	55

CO_2 = 10.0 6.5

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 7-14-88 LOCATION Wilkes-Barre 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)	ORIFICE 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)
2	10:10	9	325	1.1	2.1	565.00	125	105	265	55
3	10:13:30	9	325	1.1	2.1	567.59	125	105	265	55
4	10:17	9	330	1.1	2.1	570.77	125	105	265	55
5	10:20:30	8	330	.90	1.8	573.51	125	105	260	55
6	10:24	6	330	.78	1.5	576.03	125	105	260	55
7	10:27:30	5	330	.65	1.2	578.29	130	105	260	55
8	10:31	5	330	.60	1.2	580.26	130	100	260	55
9	10:34:30	5	330	.55	1.1	582.24	130	100	255	55
10	10:38	4	330	.50	.98	584.15	130	105	255	55
11	10:41:30	4	330	.50	.98	586.29	130	105	255	55
12	10:45	4	325	.48	.94	588.41	130	105	255	55

RAMCON ENVIRONMENTAL CORPORATION

Plant Wyoming Sand + Gravel

Location Wilkes-Barre Pa.
Operator K. Allmendinger
Date 7-14-88
Run No. 3
Sample Box No. 2
Meter Box No. C124 147810
Meter H @ 1.72
C Factor .998
Pitot Tube Coefficient Cp .81

Ambient Temperature 95
Barometric Pressure 29.5
Assumed Moisture, % 30
Probe Length, m(ft) 5
Nozzle Identification No. .0004125
Avg. Calibrated Nozzle Dia., (in.) .275/.275/.275
Probe Heater Setting 5.0
Leak Rate, m^3/min. (cfm) .005
Probe Liner Material 3/4 [illegible]
Static Pressure, mm Hg (in. Hg) .05
Filter No. BT-2660

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	695	524
INITIAL	200	509
DIFFERENCE	495	15

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H2O	PRESSURE DIFF. ORF. MTR in H2O	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
A) 1	1:51:15 / 1:54:45	0	230	.5745 / .33	.75	610.066 / 611.87	105	105	260	65
2	1:58:15	0	230	.5477 / .30	.68	613.53	110	105	260	60
3	2:01:45	2	260	.608 / .37	.84	615.42	120	100	260	60
4	2:05:15	3	270	.6557 / .43	.98	617.43	120	105	255	55
5	2:08:45	3	280	.693 / .48	1.1	619.56	125	105	255	55
6	2:12:15	3	285	.728 / .53	1.2	621.83	130	105	250	55
7	2:15:45	3	290	.768 / .59	1.3	624.13	130	105	250	55
8	2:19:15	4	295	.8185 / .67	1.5	626.65	130	105	250	55
9	2:22:45	4	295	.7937 / .63	1.4	629.12	130	105	250	55
10	2:26:15	4	300	.837 / .70	1.6	631.78	135	110	250	55
11	2:29:45	4	300	.837 / .70	1.6	634.39	135	110	240	55
12	2:33	5	300	.922 / .85	1.9	637.22	135	110	240	55
B) 1	2:36:45 / 2:40:15	4	275	.837 / .70	1.6	639.86	125	110	240	55

CO_2 = 3.0 2.5 O_2

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 9-14-88 LOCATION Wilkes-Barre 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)	ORIFICE 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)
2	1:43:45	4	295	.78 (.783)	1.8	642.62	135	110	240	55
3	2:43:15	5	295	.95 (.9747)	2.2	645.73	140	110	245	55
4	2:50:45	6	295	1.1 (1.949)	2.5	648.89	140	110	245	55
5	2:54:15	6	295	1.1 (1.949)	2.5	652.19	140	110	245	55
6	2:57:45	5	290	.90 (.9487)	2.4	655.24	140	115	245	55
7	3:01:15	5	295	.73 (.8544)	1.7	657.96	140	115	245	55
8	3:04:45	4	295	.60 (.7746)	1.4	660.43	140	115	250	55
9	3:08:15	3	295	.57 (.7416)	1.3	662.84	140	115	250	55
10	3:11:45	3	295	.53 (.728)	1.2	665.14	140	115	250	55
11	3:15:15	3	290	.53 (.728)	1.2	667.43	140	115	250	55
12	3:18:45	3	290	.50 (.707)	1.1	669.64	140	115	250	55

IX. CALIBRATIONS

RAMCON ENVIRONMENTAL CORPORATION

Date 2-10-88 Thermocouple number Inlet/Outlet

Ambient temperature 24 °C Barometric pressure 29.95 in. Hg

Calibrator S. Turner References: mercury-in-glass ✓

other

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
A	Inlet Ambient	24°C	24°C	0%
B	Outlet Ambient	24°C	24°C	0%
C	Ambient 7-14-88	76°F	75°F	2%

[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 Hotbox

Ambient temperature 24°C °C Barometric pressure 29.95 in. Hg

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

other

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
A	Boiling Water	100°C	100°C	0%
B	Ambient	24°C	24°C	0%
C	Ambient 7-14-88	78°F	78°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. 52 Date 2-4-88

Calibrated by: Sam O.T. Tuman

"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	0.98	1.5	.808	<.01
2	0.85	1.30	.809	<.01
3	0.64	.99	.804	<.01
		$\bar{C}_p$ (SIDE A)	.809	

"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	0.98	1.55	.795	<.01
2	0.85	1.30	.809	<.01
3	0.64	0.99	.804	<.01
		$\bar{C}_p$ (SIDE B)	.803	

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

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

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

Form No. EED-17-1

RAMCON ENVIRONMENTAL CORPORATION

Date 2-10-88 Thermocouple number 52

Ambient temperature 56°F °C Barometric pressure 29.95 in. Hg

Calibrator K. Allmerding 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	34°F	34°F	0%
B	BOILING WATER	213°F	212°F	.005%
C	OIL	382°F	381°F	.003%
D	AMBIENT	56°F	55°F	.02%
	7-14-88	78°F	78°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

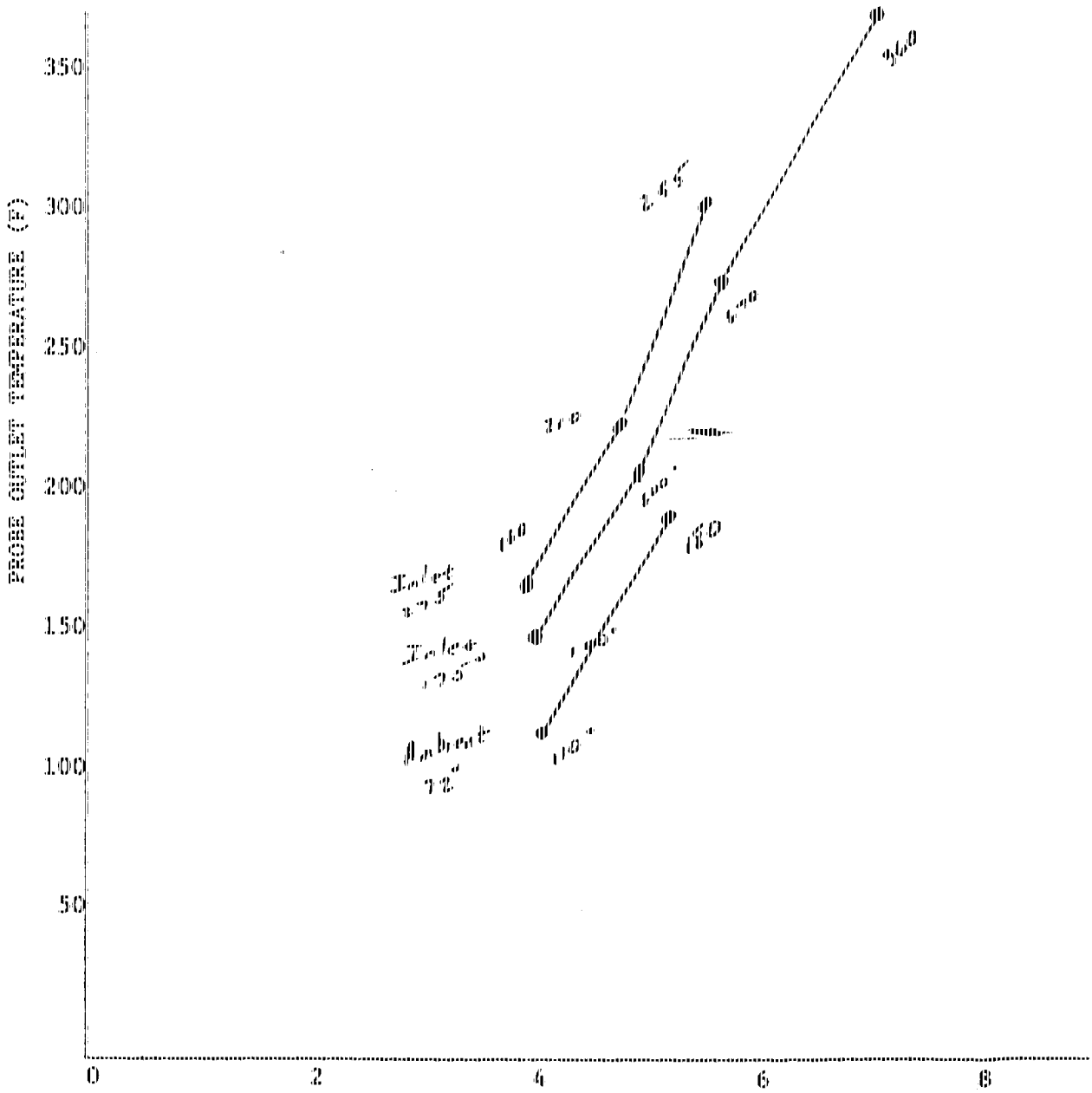
Heating Probe Calibration

Probe No. 45 Probe Length 5'

Date of Calibration 12-19-86 Signature K. B. Allen

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



METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 7-25-78 Meter box number 9/29 4285-0

Barometric pressure, P_b = 29.95 in. Hg Calibrated by [illegible]

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	82.01 / 86.06	78.8	68 / 70	85 / 86	78	12:14	0.992	1.67
1.0	5	94.41 / 100.00	78.8	70 / 72	88 / 88	79.5	8:45	0.994	1.68
1.5	10	103.01 / 113.50	78.8	69 / 71	84 / 85	76.75	11:13	0.998	1.71
2.0	10	113.11 / 125.04	78.8	69 / 70	80 / 82	75.5	11:14	1.004	1.74
3.0	10								
4.0	10								
							Avg	.992	1.70

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
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.

Form MRBC-08

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 2-8-88 Meter box number 029 / 9880

Barometric pressure, P_b = 29.88 in. Hg Calibrated by [illegible]

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	49.14 / 49.19	70.6	70 / 71	94 / 98	86.3	11.46	0.9996	1.71
1.0	5	47.03 / 47.33	70.6	72 / 74	97 / 98	90.3	8.48	0.9995	1.71
1.5	10	47.54 / 48.38	70.6	71 / 76	98 / 98	90.5	11.32	1.001	1.74
2.0	10	44.94 / 46.40	70.6	74 / 76	98 / 98	90.5	11.46	1.005	1.70
3.0	10								
4.0	10								
							Avg	0.9993	1.715

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460) \theta}{V_w} \right]^2$
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.

Form QRBC-03

K. 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.