RAMCON

ENVIRONMENTAL CORPORATION

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AIR ENFORCEMENT BRANCH
EPA Region III

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
BASIC CONSTRUCTION COMPANY
NEWPORT NEWS, VIRGINIA
JULY 11 & 12, 1989

Chad Pritchard
Basic Construction Company

G. Sumner Buck, III
President

Ken Allmendinger
Field Supervisor

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

RAMCON
ENVIRONMENTAL CORPORATION

July 27, 1989

Mr. Chad Pritchard
Basic Construction Company
P.O. Box 2719
Newport News, VA 23602

Re: Particulate Emissions Test: Newport News, Virginia

Dear Mr. Pritchard:

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

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

Mr. Kenneth J. Pinzel
Department of Air Pollution Control
Commonwealth of Virginia
2010 Old Greenbrier Road #A
Chesapeake, VA 23320-2168

You will need to keep one copy of the report at the plant. We certainly have enjoyed working with you. Please let us know if we can be of further assistance.

Sincerely,

G. Sumner Buck, III
President

GSBIII:kr

Enclosures

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

TABLE OF CONTENTS

I. INTRODUCTION

On July 11 & 12, 1989 personnel from RAMCON Environmental Corporation conducted a source emissions test for particulate emissions compliance at Basic Construction Company's Cedarapids drum mix asphalt plant located in Newport News, Virginia. RAMCON personnel conducting the test were Ken Allmendinger, Field Supervisor and Joey Barrett. Bruce Shrader was responsible for the laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples was limited to Mr. Allmendinger and Mr. Shrader.

The purpose of the test was to determine if the rate of particulate emissions from this plant's baghouse is below or equal to the allowable emissions limit set by US the State of Virginia.

II. TEST RESULTS

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

Mr. Kenneth Pinzel of Virginia's Department of Air Pollution Control observed the testing conducted by RAMCON Environmental.

TABLE I

SUMMARY OF TEST RESULTS

July 11 & 12, 1989

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	11:45 to 14:54	0.0163 gr/DSCF	109.8%	2.9 lbs/hr
2	06:59 to 08:07	0.0050 gr/DSCF	103.4%	0.8 lbs/hr
3	09:30 to 10:37	0.0045 gr/DSCF	102.5%	0.7 lbs/hr
	Average:	0.0086 gr/DSCF		1.5 lbs/hr

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

III. TEST PROCEDURES

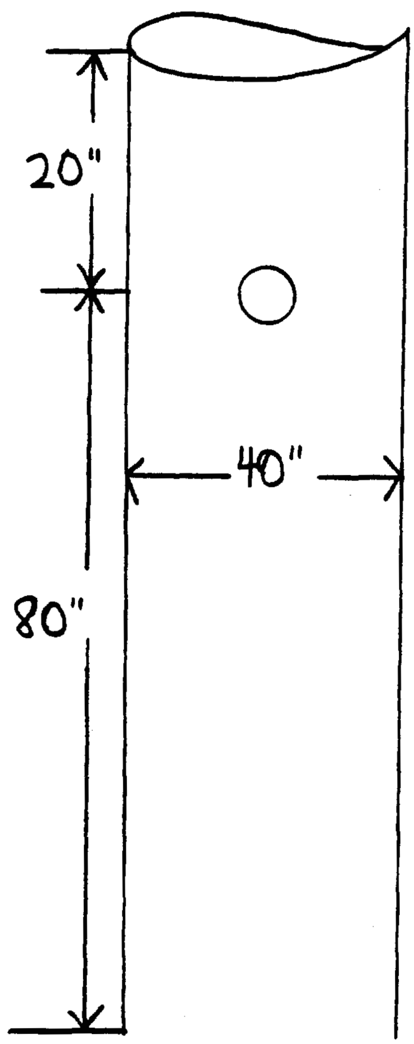
A. Method Used: Method 5 source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

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

C. Sampling Site: The emissions test was conducted after a baghouse on a round stack with a diameter of 40". The sampling port was placed 20" down (0.5 diameters upstream) from the top of the stack and 80" up (2.0 diameters downstream) from the last flow disturbance. Thirty two points were sampled for two minutes each for a total testing time of 64 minutes per test run.

Points on a Diameter	Probe Mark
1	*6.5"
2	7.5"
3	8.9"
4	10.5"
5	12.3"
6	14.3"
7	16.8"
8	20.5"
9	30.5"
10	34.2"
11	36.7"
12	38.7"
13	40.5"
14	42.1"
15	43.5"
16	44.9"

*Measurements include a 5.5" standoff.



IV. THE SOURCE

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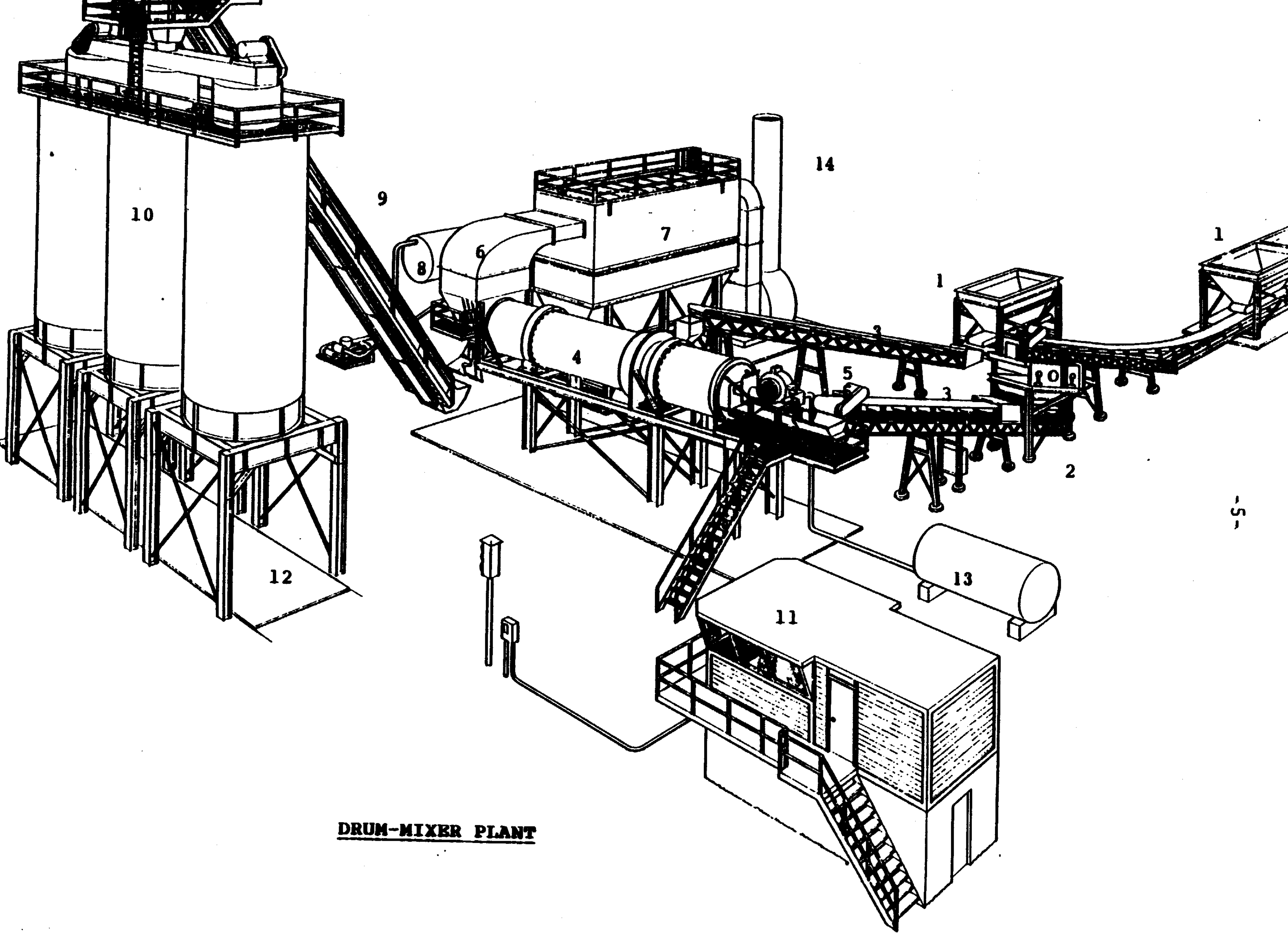
Basic Construction Company employs a Cedarapids drum mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to 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 then compacted with a heavy roller to produce the final product.

The following to 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. When recycled asphalt mix is used, it is added halfway down the drum by a separate weigh conveyor. The required amount of hot asphalt oil is then injected onto and mixed into the dried aggregate. The now newly formed hot asphalt mix is pulled to the top of a storage silo by a conveyor. The hot asphalt mix is then discharged from the storage silo through a slide gate into waiting dump trucks which transports 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 used a burner fired with natural gas to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate. The air is drawn into the system via an exhaust fan. After passing through the gas burner and the mixing drum, the air passes through a baghouse. The baghouse is manufactured by Cedarapids. The exhaust gasses are drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube sheet is 2-6 inches of water. The particulate matter, which is removed by the baghouse, is reinjected into the drum mixer.



DRUM-MIXER PLANT

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

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

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

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

5. Burner: The fuel fired burner is used to provide the flame which drys the aggregate.

6. Knock off baffleing: A baffeling plate is inserted in the "dirty" side plenum as a knock out for heavy particles in the air stream. These particles fall to the bottom of the baghouse.

7. Baghouse: The hot gases are pulled through the bags into the clean air plenum. The solid particulate matter is trapped on the dust coat buildup on the bags. A bag cleaning cycle consisting of jet burst of air from the inside (or clean air side) of the bags sends a large bubble of air down the inside of the bags shaking loose buildup on the bag surface. This particulate matter is collected at the bottom of the baghouse and reinjected into the drum mixer where it is used as part of the finished project.

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

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

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

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

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

13. Fuel Storage

14. Stack

DATA SUMMARY

Plant

1. Manufacturer of plant Cedarrapids, Inc.
2. Designed maximum operating capacity 319 TPH @ 5 % moisture.
3. Actual operation rate 316 TPH @ 2.65 % moisture.
4. Startup date 5-15-89.
5. Type of fuel used in dryer Natural Gas.
6. Quantity of fuel consumption 9400 cf.

Aggregate

7. Name/type of mix B-3 (Base Course) 1½" top size.
8. Percent asphalt in mix ______ %.
9. Temperature of asphalt Liquid: 285°F Mixture: 268°F
10. Sieve/Screening analysis: % Passing;

1"	______	3/8"	______	#	______
3/4"	______	#	______	#	______
1/2"	______	#	______	#200	______

Baghouse

11. Manufacturer Cedarrapids, Inc.
12. No. of bags 560. Type of bags Nomex.
13. Air to cloth ratio 5.34 : 1. Designed ACFM 47,000.
14. Square feet of bags 8,800.
15. Type of cleaning; pulse jet ✓, reverse air ______, plenum pulse ______, other ______.
16. Cleaning cycle time 100 msec.
17. Interval between cleaning cycle 41 seconds.
18. Pressure drop across baghouse 2.8 psi.
19. Pulse pressure on cleaning cycle 110 psi.

COMPANY NAME Basic Construction Co. DATE 7-11/7-12-89

PLANT DATA

COMPANY NAME Basic Construction Company

COMPANY REP. Chad Pritchard DATE 7-11-89 PHONE # 804-249-3789

DATA SOURCE 7-12-89 56000

PLANT LOCATION 538 Oyster Point Road, Newport News, VA 23602

PLANT MFG. Cedarapids PLANT MODEL # / PLANT TYPE Drum Dryer/Mixer

MIX SPECIFICATION # B-3 OIL SPECIFICATION # N/A

	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	
	7-11-89								
	11:50	629,000	30%	221	94	9.8	268	4.1	
	12:00		38	222	79	10.1	263	3.9	
	12:10	3200 CF	36	231	82	10.2	266	3.7	
	12:20		37	222	87	10.1	266	3.1	AVG 318.
	12:30		39	226	79	10.0	268	2.9	
ST ERRUPTED →	12:40		37	221	76	9.9	273	2.8	
	2:50	632200	37	230	82	10.3	264	4.3	
	—	END TEST	#1	AVG 225	AVG 83	AVG 10.1	AVG 267	AVG 3.5	
	7-12-89								
	7:00	632500	37	220	83	10.2	263	2.7	
	7:10		36	226	80	10.2	271	2.2	
	7:20		35	219	80	10.2	268	2.3	
	7:30	3100 CF	35	224	79	10.2	266	2.5	AVG 314
	7:40		32	224	77	10.6	274	2.4	
	7:50		32	230	84	10.1	269	2.6	
	8:00	635600	37	223	79	9.9	271	2.4	
	—	END TEST	#2	AVG 224	AVG 80	AVG 10.2	AVG 269	AVG 2.4	
	7-12-89								
	9:30	636100	35	238	78	10.2	262	2.9	
	9:40		35	228	76	10.1	273	2.7	
	9:50	3100 CF	39	224	83	10.5	263	2.4	
	10:00		35	220	80	10.1	274	2.7	AVG
	10:10		32	225	82	10.0	265	2.7	31[illegible]
	10:20		38	220	79	10.0	270	2.6	
	10:30	639200	34	225	78	10.0	269	2.4	
	—	END TEST	#3	AVG 226	AVG 79	AVG 10.1	AVG 268	AVG 2.6	

V. EQUIPMENT USED

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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 desiccator to dry for at least 24 hours. Clean plastic petri dishes, also numbered, top and bottom, are placed in the desiccator with the filters. After desiccation, 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 books. 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 at 175°C for two hours. The open jars are removed and placed in a desiccator until cool for two hours and then tightly sealed. The jars are then numbered and weighed on the triple beam balance to the closest tenth of a gram. 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 desiccator for at least 24 hours. Then the filters are weighed continuously every six hours until a constant weight is achieved. All data is recorded on the laboratory forms that will be bound in the test report.

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 to the lab in sealed mason jars 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: A blank analysis of acetone is conducted from the one gallon glass container used in the field preparation. This acetone was used in the field for rinsing the probe, nozzle, and top half of the filter holder. A blank analysis is performed prior to testing on all new containers of acetone received from the manufacturer to insure that the quality of the acetone used will be 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. 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 the "zero" position. The beam arrest lever (on the lower left hand side toward the rear of the balance) is then slowly pressed downward to the full release position. The lighted vernier scale on the front of the cabinet should align with 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 the 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 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 BASIC   Relative humidity in lab 50 %

Sample Location hot mix asphalt facility   Density of Acetone (pa) .7857 mg/ml

Blank volume (V_a) 200 ml

Date/Time wt. blank 7-21-89; 8:00am   Gross wt. 94.3865 mg

Date/Time wt. blank 7-21-89; 2:00pm   Gross wt. 94.3869 mg

Ave. Gross wt. 94.3867 mg

Tare wt. 94.3847 mg

Weight of blank (m_{ab}) 0.0020 mg

Acetone blank residue concentration (C_a) $(C_a) = (M_{ab}) / (V_a)(p_a)$ = (0.0000127 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} p_a$ = (0.0000127)(250)(0.7857) = (0.0025)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	250	250	250
Date/Time of wt 7-21-89; 8:00am Gross wt	g	123.1609	156.7868	158.7441
Date/Time of wt 7-21-89; 4:00pm Gross wt	g	123.1608	156.7870	158.7443
Average Gross wt	g	123.1608	156.7869	158.7442
Tare wt	g	123.1239	156.7749	158.7332
Less acetone blank wt (W_a)	g	0.0025	0.0025	0.0025
Wt of particulate in acetone rinse (m_a)	g	0.0344	0.0095	0.0085

Filter Numbers	#	FK-3314	BS-3317	FK-3313
Date/Time of wt 7-21-89; 8:00am Gross wt	g	0.5456	0.5307	0.5424
Date/Time of wt 7-21-89; 4:00pm Gross wt	g	0.5457	0.5307	0.5423
Average Gross wt	g	0.5456	0.5307	0.5423
Tare wt	g	0.5373	0.5272	0.5392

Weight of particulate on filters(s) (m_f)	g	0.0083	0.0035	0.0031
Weight of particulate in acetone rinse	g	0.0344	0.0095	0.0085
Total weight of particulate (m_n)	g	0.0427	0.0130	0.0116

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 RUN #1 APPEARS SLIGHTLY OILY

Signature of analyst Bruce Shrader   Signature of reviewer [signature]

Basic
Company Name

1-12-89
Date

REFERENCE METHOD 3: GAS ANALYSIS BY FYRITE

FUEL	F_o FACTORS
WOOD	1.0540
BARK	1.0830
ANTHRACITE	1.0699
BITUMINOUS	1.1398
LIGNITE	1.0761
OIL	1.3465
GAS	1.7489
PROPANE	1.5095
BUTANE	1.4791

$$O_2\% = 20.9 - [F_o \times CO_2\%]$$

RUN #1: ____ = 20.9 - [____ x ____]

RUN #2: ____ = 20.9 - [____ x ____]

RUN #3 ____ = 20.9 - [____ x ____]

RUN 1:	$CO_2\%$	1.5	$CO_2\%$		$CO_2\%$	1.5	AVG.	1.5
	$O_2\%$	13	$O_2\%$		$O_2\%$	13	AVG.	13.0
	$N_2\%$		$N_2\%$		$N_2\%$		AVG.	85.5
RUN 2:	$CO_2\%$	3.0	$CO_2\%$		$CO_2\%$	3.0	AVG.	3.0
	$O_2\%$	10.5	$O_2\%$		$O_2\%$	10.5	AVG.	10.5
	$N_2\%$		$N_2\%$		$N_2\%$		AVG.	86.5
RUN 3:	$CO_2\%$	3.0	$CO_2\%$		$CO_2\%$	3.0	AVG.	3.0
	$O_2\%$	10.0	$O_2\%$		$O_2\%$	10.0	AVG.	10.0
	$N_2\%$		$N_2\%$		$N_2\%$		AVG.	87.0

VII. CALCULATIONS

SUMMARY OF TEST DATA

		7-11-89 RUN #1	7-12-89 RUN #2	7-12-89 RUN #3
SAMPLING TRAIN DATA				
	start	11:45	06:59	09:30
	finish	14:54	08:07	10:37
1. Sampling time, minutes	Θ	64.0	64.0	64.0
2. Sampling nozzle diameter, in.	D_n	.2100	.2300	.2300
3. Sampling nozzle cross-sect. area, ft^2	A_n	.000241	.000289	.000289
4. Isokinetic variation	I	109.8	103.5	102.5
5. Sample gas volume - meter cond., cf.	V_m	43.490	42.175	42.498
6. Average meter temperature, ^oR	T_m	579	563	572
7. Avg. oriface pressure drop, in. H_2O	dH	1.42	1.41	1.45
8. Total particulate collected, mg.	M_n	42.70	13.00	11.60
VELOCITY TRAVERSE DATA				
9. Stack area, ft^2.	A	8.70	8.70	8.70
10. Absolute stack gas pressure, in. Hg.	P_s	30.00	29.96	29.96
11. Barometric pressure, in. Hg.	P_{bar}	30.00	29.96	29.96
12. Avg. absolute stack temperature, R^o	T_s	729	713	733
13. Average $-\sqrt{\text{vel. head}}$, (C_p= .80)	$-\sqrt{dP}$	1.12	1.05	1.06
14. Average stack gas velocity, ft./sec.	V_s	74.12	69.51	71.08
STACK MOISTURE CONTENT				
15. Total water collected by train, ml.	V_{ic}	303.00	402.00	390.00
16. Moisture in stack gas, %	B_{ws}	26.14	32.07	31.55
EMISSIONS DATA				
17. Stack gas flow rate, dscf/hr.(000's)	Q_{sd}	1245	1096	1099
18. Stack gas flow rate, cfm	acfm	38691	36284	37104
19. Particulate concentration, gr/dscf	C_s	0.0163	0.0050	0.0045
20. Particulate concentration, lb/hr	E	2.90	0.78	0.71
21. Particulate concentration, lb/mBtu	E'	0.00000	0.00000	0.00000
ORSAT DATA				
22. Percent CO_2 by volume	CO_2	1.50	3.00	3.00
23. Percent O_2 by volume	O_2	13.00	10.50	10.00
24. Percent CO by volume	CO	.00	.00	.00
25. Percent N_2 by volume	N_2	85.50	86.50	87.00

Format: summryR3

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

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:

$$V_{m(std)} = (17.64)(1.013)(\ 43.490)\left[\frac{(30.00) + \frac{1.42}{13.6}}{579}\right] = 40.406 \text{ dscf}$$

RUN 2:

$$V_{m(std)} = (17.64)(1.013)(\ 42.175)\left[\frac{(29.96) + \frac{1.41}{13.6}}{563}\right] = 40.244 \text{ dscf}$$

RUN 3:

$$V_{m(std)} = (17.64)(1.013)(\ 42.498)\left[\frac{(29.96) + \frac{1.45}{13.6}}{572}\right] = 39.918 \text{ dscf}$$

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:

$$c_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{42.70}{40.406}\right] = 0.0163 \text{ gr./dscf.}$$

Run 2:

$$c_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{13.00}{40.244}\right] = 0.0050 \text{ gr./dscf.}$$

Run 3:

$$c_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{11.60}{39.918}\right] = 0.0045 \text{ gr./dscf.}$$

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

Where:

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

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

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

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

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

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

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

0.32 = Molecular weight of O_2 divided by 100.

0.44 = Molecular weight of CO_2 divided by 100.

Run 1:

$$M_d = 0.44(\ 1.50\%) + 0.32(13.00\%) + 0.28(\ .00\% + 85.50\%) = 28.76\ \frac{lb}{lb\text{-}mole}$$

Run 2:

$$M_d = 0.44(\ 3.00\%) + 0.32(10.50\%) + 0.28(\ .00\% + 86.50\%) = 28.90\ \frac{lb}{lb\text{-}mole}$$

Run 3:

$$M_d = 0.44(\ 3.00\%) + 0.32(10.00\%) + 0.28(\ .00\% + 87.00\%) = 28.88\ \frac{lb}{lb\text{-}mole}$$

Water Vapor Condensed

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

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

Where:

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

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

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

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

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

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

p_w = Density of water, 0.002201 lb/ml.

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

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

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

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

Run 1:

$V_{wc(std)}$ = (0.04707) (290.0) = 13.7 cu.ft
$V_{wsg(std)}$ = (0.04715) (13.0) = 0.6 cu.ft

Run 2:

$V_{wc(std)}$ = (0.04707) (392.0) = 18.5 cu.ft
$V_{wsg(std)}$ = (0.04715) (10.0) = 0.5 cu.ft

Run 3:

$V_{wc(std)}$ = (0.04707) (380.0) = 17.9 cu.ft
$V_{wsg(std)}$ = (0.04715) (10.0) = 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:

$$B_{ws} = \frac{13.7 + 0.6}{13.7 + 0.6 + 40.406} \times 100 = 26.14\ \%$$

Run 2:

$$B_{ws} = \frac{18.5 + 0.5}{18.5 + 0.5 + 40.244} \times 100 = 32.07\ \%$$

Run 3:

$$B_{ws} = \frac{17.9 + 0.5}{17.9 + 0.5 + 39.918} \times 100 = 31.55\ \%$$

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

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 = 28.76 (1 - 26.14) + 18 (26.14) = 25.95 (lb./lb.-mole)

Run 2:

M_s = 28.90 (1 - 32.07) + 18 (32.07) = 25.40 (lb./lb.-mole)

Run 3:

M_s = 28.88 (1 - 31.55) + 18 (31.55) = 25.45 (lb./lb.-mole)

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

Where:

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

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

C_p = Pitot tube coefficient, (dimensionless).

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

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

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

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

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

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

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

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

Run 1:

$$V = (85.49)\,(\ .80)\,(\ 1.12) \sqrt{\frac{729}{(30.00)(25.95)}} = 74.12 \text{ ft/sec.}$$

Run 2:

$$V = (85.49)\,(\ .80)\,(\ 1.05) \sqrt{\frac{713}{(29.96)(25.40)}} = 69.51 \text{ ft/sec.}$$

Run 3:

$$V = (85.49)\,(\ .80)\,(\ 1.06) \sqrt{\frac{733}{(29.96)(25.45)}} = 71.08 \text{ ft/sec.}$$

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

Where:

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

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

3600 = Conversion factor, (sec./hr.).

t_s = Stack temperature, ($^\circ$f).

T_s = Absolute stack temperature, ($^\circ$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:

$$Q_{sd}=3600(1- .2614)(74.12)(8.70)\left[\frac{528}{729}\right]\left[\frac{30.00}{29.92}\right] = 1245181.1 \ \frac{dscf}{hr}$$

Run 2:

$$Q_{sd}=3600(1- .3207)(69.51)(8.70)\left[\frac{528}{713}\right]\left[\frac{29.96}{29.92}\right] = 1096617.7 \ \frac{dscf}{hr}$$

Run 3:

$$Q_{sd}=3600(1- .3155)(71.08)(8.70)\left[\frac{528}{733}\right]\left[\frac{29.96}{29.92}\right] = 1099139.4 \ \frac{dscf}{hr}$$

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

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:

$$E = \frac{(0.0163)\ (1245181.1)}{7000} = 2.90\ lb.\ /\ hr.$$

Run 2:

$$E = \frac{(0.0050)\ (1096617.7)}{7000} = 0.78\ lb.\ /\ hr.$$

Run 3:

$$E = \frac{(0.0045)\ (1099139.4)}{7000} = 0.71\ lb.\ /\ hr.$$

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

Where:

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

Run 1:

$$I = (100)(729) \left[\frac{(0.002669)(303.00) + \frac{43.490}{579} \left[30.00 + \frac{1.42}{13.6} \right]}{60\ (64.0)\ (74.12)\ (30.00)\ (.000241)} \right] = 109.8\%$$

Run 2:

$$I = (100)(713) \left[\frac{(0.002669)(402.00) + \frac{42.175}{563} \left[29.96 + \frac{1.41}{13.6} \right]}{60\ (64.0)\ (69.51)\ (29.96)\ (.000289)} \right] = 103.5\%$$

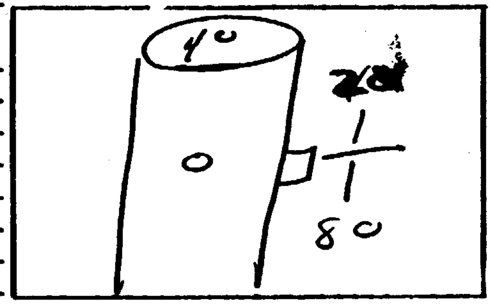
Run 3:

$$I = (100)(733) \left[\frac{(0.002669)(390.00) + \frac{42.498}{572} \left[29.96 + \frac{1.45}{13.6} \right]}{60\ (64.0)\ (71.08)\ (29.96)\ (.000289)} \right] = 102.5\%$$

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant: Basic
Location: Newport News Va.
Operator: K. Allmendinger
Date: 9-11-89
Run No.: 1
Sample Box No.: 1
Meter Box No.: 646882 C-124
Meter H @: 1.63
C Factor: 1.013
Pitot Tube Coefficient Cp: .786



Schematic of Stack Cross Section

Ambient Temperature: 83
Barometric Pressure: 30.00
Assumed Moisture, %: 18
Probe Length, m(ft): 12
Nozzle Identification No.: .0002405
Avg. Calibrated Nozzle Dia., (in.): .210/.210/.210
Probe Heater Setting: 4.5
Leak Rate, m^3/min. (cfm): .006 @ 17"
Probe Liner Material: SS Stainless
Static Pressure, mm Hg (in. Hg):
Filter No.: FK-5514 .5525

	IMPINGER VOLUME ml	SILICA GEL WEIGHT g
FINAL	450	311
INITIAL	200	298
DIFFERENCE	250	13

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	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	11:45:30 / 11:47	2	192	1.0	.98	135.29 / 136.47	105	105	265	70
2	11:49	2	192	.98	.96	137.67	110	100	225	65
3	11:51	2	[illegible]	.93	.91	138.84	115	100	225	65
4	11:53	2	260	.89	.87	139.98	115	100	225	65
5	11:55	2	2?5	.75	.74	141.05	120	100	235	60
6	11:57	1	2[illegible]	.65	.64	142.03	120	100	235	60
7	11:59	1	28[illegible]	.65	.64	143.02	120	100	235	60
8	12:01	2	2[illegible]	.75	.74	144.08	125	105	225	55
9	12:03	[illegible]	280	[illegible]3	1.3	145.46	125	105	225	55
10	12:05	3	285	1.5	1.5	146.92	130	105	225	55
11	12:07	3	285	1.8	1.8	148.51	130	105	230	55
12	12:09	4	285	2.2	2.2	150.36	130	105	230	55
13	12:11	5	285	2.5	2.5	152.29	130	105	230	50

* Plant down

Form #REC-05

5	11:5[illegible]	2	.2[illegible]	.1[illegible]	.4	41.	[illegible]	[illegible]	[illegible]	[illegible]
6	11:57	1	2[illegible]	.65	.64	142.03	120	100	235	60
7	11:59	1	28[illegible]	.65	.64	143.02	120	100	235	60
8	12:01	2	2[illegible]	.[illegible]	.74	144.08	125	105	225	55
9	12:03	[illegible]	280	[illegible]3	1.3	145.46	125	105	225	55
10	12:05	3	285	1.5	[illegible]5	146.92	130	105	225	55
11	12:07	3	285	1.8	1.8	148.51	130	105	230	55
12	12:09	4	285	2.2	2.2	150.36	130	105	230	55
13	12:11	5	285	2.5	2.5	152.29	130	105	230	50

* Plant down

Form #REC-05

3	12:28	1	240	~~.40~~ [illegible]	~~.39~~ .40	160.51	130	110	235	50
4	12:30	1	235	.40	.39	161.25	130	110	235	55
5	12:32	1	275	.35	.34	161.98	130	110	235	55
6	12:34	1	275	.35	.34	162.79	130	110	240	55
7	12:36	1	280	.30	.29	163.33	130	110	240	55
8	12:38	1	280	.30	.29	163.98	130	110	240	55
9	12:40	2	280	.88	.86	165.11	135	110	240	55
10	12:42	3	285	1.7	1.7	166.63	135	110	240	55
11	~~2:42~~ 2:44	4	270	2.2	2.2	168.44	130	130	250	70
12	2:46	5	280	2.6	2.6	170.44	135	125	250	70
13	2:48	6	285	3.0	2.9	172.58	140	125	250	60
14	2:50	6	285	3.0	2.9	174.78	140	120	250	60
15	2:52	6	285	2.9	2.8	176.87	140	120	250	60
16	2:54	6	285	2.8	2.7	178.78	140	120	250	65

RAMCON ENVIRONMENTAL CORPORATION

Plant Basic
Location Newport News Va
Operator K. [illegible]
Date 7-12-89
Run No. 2
Sample Box No. 2
Meter Box No. 601882 C-124
Meter H @ 1.63
C Factor 1.013
Pitot Tube Coefficient Cp .80

Ambient Temperature 85
Barometric Pressure 29.96
Assumed Moisture, % 30
Probe Length, m(ft) 12
Nozzle Identification No. .0002885
Avg. Calibrated Nozzle Dia., (in.) .230/.230/.230
Probe Heater Setting 4.5
Leak Rate, m^3/min. (cfm) +.006@10"
Probe Liner Material 316 stainless
Static Pressure, mm Hg (in. Hg)
Filter No. EK-5317 .5272

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	592	316
INITIAL	200	306
DIFFERENCE	392	10

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	6:59:30 / 7:01	1	120	.45	.49	178.982 / 179.53	90	85	235	65
2	7:03	2	160	.50	.54	180.83	95	85	235	65
3	7:05	2	220	.50	.54	181.72	100	85	240	60
4	7:07	2	255	.45	.49	182.59	105	85	240	60
5	7:09	2	255	.45	.49	183.43	105	85	245	55
6	7:11	1	255	.40	.43	184.26	105	90	245	55
7	7:13	1	260	.40	.43	185.08	110	90	245	55
8	7:15	2	260	.50	.54	185.97	110	90	245	55
9	7:17	4	260	1.4	1.5	187.44	110	85	245	55
10	7:19	5	260	1.9	2.1	189.12	115	90	250	50
11	7:21	6	265	2.2	2.4	190.96	115	90	250	50
12	7:23	7	265	2.5	2.7	193.03	115	90	250	50
13	7:25	7	265	2.7	2.9	194.98	115	90	250	50

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 9-12-89 LOCATION Newport ~~Newt~~ TEST NO. 2

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft.^{3})	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
14	7:27	7	265	2.5	2.7	196.98	115	90	255	50
15	7:29	6	265	2.2	2.4	198.98	115	90	255	50
16	7:31	5	265	2.0	2.2	200.76	115	90	255	50
B) 1	7:35 / 7:37	1	250	.30	.32	201.49	105	95	260	50
2	7:39	1	250	.30	.32	202.21	110	95	260	50
3	7:41	1	250	.30	.32	202.91	115	95	260	50
4	7:43	1	250	.32	.35	203.63	115	95	260	50
5	7:45	1	255	.30	.32	204.33	115	95	260	50
6	7:47	1	265	.30	.32	205.04	115	95	260	50
7	7:49	1	265	.28	.30	205.71	115	95	260	50
8	7:51	1	265	.28	.30	206.37	115	95	260	50
9	7:53	3	265	1.1	1.2	207.67	120	95	260	50
10	7:55	3	265	1.5	1.6	209.15	120	95	260	50
11	7:57	4	270	2.0	2.2	210.91	125	95	260	50
12	7:59	5	270	2.3	2.5	212.87	125	95	255	50
13	8:01	6	270	2.7	2.9	214.80	125	95	255	50
14	8:03	6	270	2.9	3.1	216.98	125	95	255	50
15	8:05	6	270	2.9	3.1	219.11	125	95	255	50
16	8:07	6	270	3.0	3.2	221.157	125	95	255	50

B 7-12-89

RAMCON ENVIRONMENTAL CORPORATION

Plant: Basin

Location: Newport News Va.
Operator: K. Allmendinger
Date: 7-12-89
Run No.: 3
Sample Box No.: 1
Meter Box No.: 646882 C-124
Meter H @: 1.63
C Factor: 1.013
Pitot Tube Coefficient Cp: .796

Ambient Temperature: 90
Barometric Pressure: 29.96
Assumed Moisture, %: 30
Probe Length, m(ft): 4/2
Nozzle Identification No.: 0002885
Avg. Calibrated Nozzle Dia., (in.): .280/.280/.280
Probe Heater Setting: 4.5
Leak Rate, m^3/min. (cfm): .011 @ 10"
Probe Liner Material: 316 Stainless
Static Pressure, mm Hg (in. Hg):
Filter No.: FK-3313 .5392

	IMPINGER VOLUME ml	SILICA GEL WEIGHT g
FINAL	580	303
INITIAL	200	293
DIFFERENCE	380	10

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_S) °F	VELOCITY HEAD (P_S) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	9:30:15 / 9:32	1	250	.50 ~~1.4~~	.54 ~~1.5~~	221.505 / 223.44	105	100	260	65
2	9:34	1	255	.50	.54	223.33	110	100	260	65
3	9:36	1	260	.52	.56	224.27	115	100	260	60
4	9:38	1	270	.48	.52	225.13	115	100	255	60
5	9:40	1	275	.40	.43	225.93	120	100	255	60
6	9:42	1	275	.43	.46	226.73	120	100	255	60
7	9:44	1	275	.43	.46	227.56	120	100	255	60
8	9:46	3	280	1.3	1.4	228.99	120	100	255	60
9	9:48	4	280	1.7	1.8	230.58	125	100	255	60
10	9:50	5	275	2.0	2.2	232.33	125	100	245	60
11	9:52	5	275	2.0	2.2	234.15	125	100	245	60
12	9:54	6	275	2.3	2.5	235.99	125	100	245	55
13	9:56	6	280	2.3	2.5	237.96	125	100	245	55

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 9-12-85 LOCATION Newport News TEST NO. 3

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM in. 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)
14	9:58	6	280	2.3	2.5	239.84	130	100	245	55
15	10:00	6	280	2.5	2.7	241.82	130	100	245	55
16	10:02:15	5	280	1.8	1.9	243.52	130	100	245	55
B) 1	10:05 / 10:07	1	250	.30	.32	244.24	115	100	240	50
2	10:09	1	255	.32	.35	244.96	120	100	240	50
3	10:11	1	260	.30	.32	245.66	120	100	240	50
4	10:13	1	260	.30	.32	246.39	125	100	240	50
5	10:15	1	270	.28	.30	247.03	125	100	240	50
6	10:17	1	270	.25	.27	247.64	125	100	240	50
7	10:19	1	275	.25	.27	248.28	125	100	240	50
8	10:21	1	275	.25	.27	248.92	125	100	240	50
9	10:23	2	280	.75	.81	250.11	125	100	240	50
10	10:25	4	285	1.6	1.7	251.53	130	100	245	50
11	10:27	6	285	2.1	2.3	253.57	130	105	245	50
12	10:29	6	285	2.4	2.5	255.35	130	105	245	50
13	10:31	7	285	2.8	3.0	257.62	130	105	245	50
14	10:33	8	285	3.3	3.6	259.68	130	105	245	50
15	10:35	8	280	3.2	3.5	261.83	130	105	245	50
16	10:37	8	285	3.2	3.5	264.003	130	105	245	50

IX. CALIBRATION

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 7-28-89 Meter box number 646882/C-124

Barometric pressure, P_b = 30.11 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								
1.0	~~5~~ 14	104.00 / 118.627	76.1	106 / 112	80 / 86	92.5	23.32	.993	1.51
1.5	~~10~~ 11	91.30 / 102.648	76.1	106 / 112	84 / 86	97	14.93	1.003	1.50
2.0	10	56.95 / 67.232	76.1	108 / 112	84 / 84	97	11.50	1.006	1.52
3.0	10								
4.0	10								
							Avg	1.001	1.51

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.

Form #REC-02

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number ________ Date 7-7-89 Meter box number C-124 Plant ________

Barometric pressure, P_b = 30.84 in. Hg Dry gas meter number 646882 Pretest Y 1.01

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average (t_d),[a] °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
1.0	~~10~~ 7	156.270 / 153.410	69.8	100 / 102	70 / 72	86	12.32	3	1.007	1.647
1.5	10 10	166.820 / 176.854	69.8	100 / 102	72 / 74	87	14.19	3	1.015	1.670
2.0	10 10	152.640 / 162.658	69.8	92 / 100	68 / 70	82.5	12.23	5	1.017	1.638
									Y = 1.013	1.63

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

where

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

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

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

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

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

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

ΔH = Pressure differential across orifice, in. H_2O.

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

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

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 4-5-89 Thermocouple number Inlet/Outlet

Ambient temperature 20 °C Barometric pressure 29.88 in. Hg

Calibrator Turner Reference: mercury-in-glass ✓

other ______

Reference point number	Source[a] (specify)	Reference thermometer temperature, °~~C~~ F	Thermocouple potentiometer temperature, °~~C~~ F	Temperature difference,[b] %
A	Ice Bath	32	32	0
B	Boiling oil	381	381	0
C	Boiling water	212	212	0
D	ambient 7-11-89	83°F	83°F	0

[a]Type of calibration system used.

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

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 4-5-89 Thermocouple number Hotbox

Ambient temperature 20 °C Barometric pressure 29.88 in. Hg

Calibrator Tum Reference: mercury-in-glass ✓

other ______

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	Ice Bath	32	32	0
B	Boiling water	212	212	0
C	Boiling oil	381	381	0
D	Ambient 7-11-89	83°F	83°F	0

[a]Type of calibration system used.

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

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. 42 Date 5-7-89

Calibrated by: Sam T. Thomas

"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	1.55	.795	<.01
2	0.85	1.35	.793	<.01
3	0.64	1.00	.800	<.01
		$\bar{C}_p$ (SIDE A)	.796	

"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	1.35	.793	<.01
3	0.64	1.00	.800	<.01
		$\bar{C}_p$ (SIDE B)	.796	

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

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

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

Form No. EED-17-1

RAMCON

Lear Siegler Stack Sampler

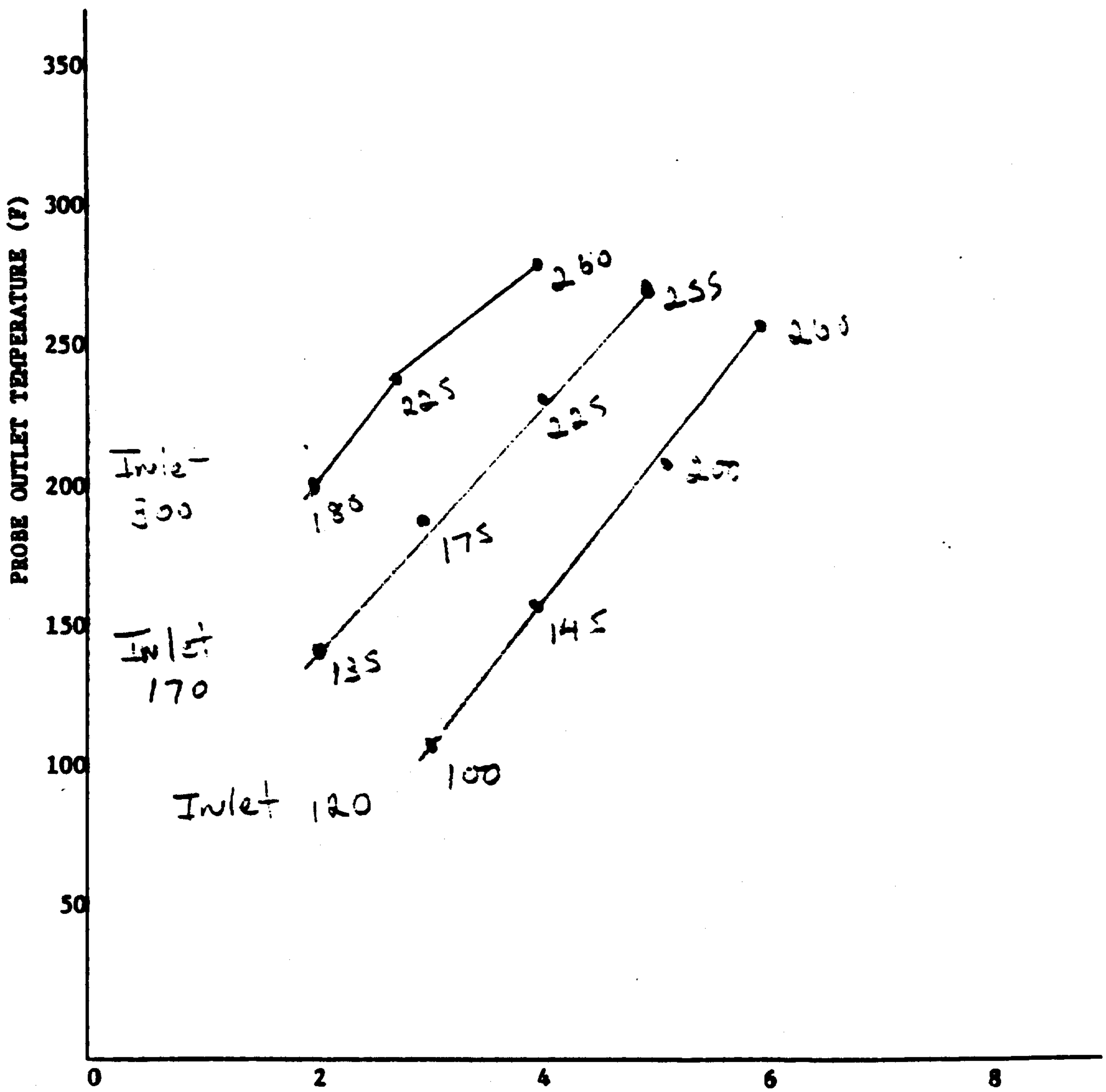
Heating Probe Calibration

Probe No. 42 **Probe Length** 4'

Date of Calibration 5-7-89 **Signature** Sam Turner

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

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-5-89 Thermocouple number 42

Ambient temperature 20 °C Barometric pressure 29.88 in. Hg

Calibrator Turner Reference: mercury-in-glass ✓

other ______

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	Ice Bath	32	32	0
B	Boiling H2O	212	212	0
C	Boiling oil	381	381	0
D	Ambient ~~83~~ 7-11-89	83°F	83°F	0

[a]Type of calibration system used.

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

X. RAMCON PERSONNEL

RAMCON Environmental Stack Test Team

Sumner Buck - President

Sumner Buck is the President of RAMCON Environmental Corporation. He is a graduate of the EPA 450 "Source Sampling for Particulate Pollutant's" course and the 474 "Continuous Emissions Monitoring" course all given at RTP. Mr. Buck is a certified V.E. reader with current certification. Mr. Buck has personally sampled over 400 stacks including over 300 asphalt plants. He is 47 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 - Field Supervisor

Ken Allmendinger has been employed with RAMCON Environmental for four years. He has personally sampled over 300 asphalt plants and 100 incinerators and boilers. He has extensive training in Methods 1 through 9. He has a current certification as a V.E. reader and has attended several plant manufacturers' schools to understand the stacks he is testing. He has recently been promoted to Field Supervisor and has responsibility for three other stack sampling teams.