RAMCON
ENVIRONMENTAL CORPORATION

09-307-073

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
BETTER MATERIALS CORPORATION
Penns Park, Pennsylvania
August 31, 1988

Craig Cinalli
Better Materials Corporation

G. Sumner Buck, III
President

Ken Allmendinger
Team Leader

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

RAMCON

ENVIRONMENTAL CORPORATION

September 22, 1988

Mr. Craig Cinalli
Better Materials Corporation
P. O. Box 196
Penns Park, Pennsylvania 18943

Re: Particulate Emissions Tests- Penns Park, Pennsylvania

Dear Mr. Cinalli:

Enclosed you will find four copies of our report on the particulate emissions tests we conducted at Better Materials Corporation in Penns Park, 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. James Donnelly
Pennsylvania DER
1875 New Hope St.
Norristown, PA 19401

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

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I. INTRODUCTION

On August 31, 1988, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Better Materials Corporation's Standard-Havens drum mix asphalt plant located in Penns Park, Pennsylvania. RAMCON personnel conducting the test were Ken Allmendinger, Team Leader, and Bill Turner. John Biggs was responsible for the particulate laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples was limited to Mr. Allmendinger and Mr. Biggs.

The purpose of the test was to determine if the rate of particulate emissions from the plant's baghouse and the total contaminants by weight (grain loading) is below the allowable N.S.P.S. limits set by the State of 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
August 31, 1988

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	07:51 to 09:26	0.0192 gr/DSCF	109.7%	3.2 lbs/hr
2	09:59 to 11:34	0.0217 gr/DSCF	109.8%	3.5 lbs/hr
3	12:06 to 13:39	0.0286 gr/DSCF	100.6%	4.6 lbs/hr
	Average:	0.0232 gr/DSCF		3.9 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

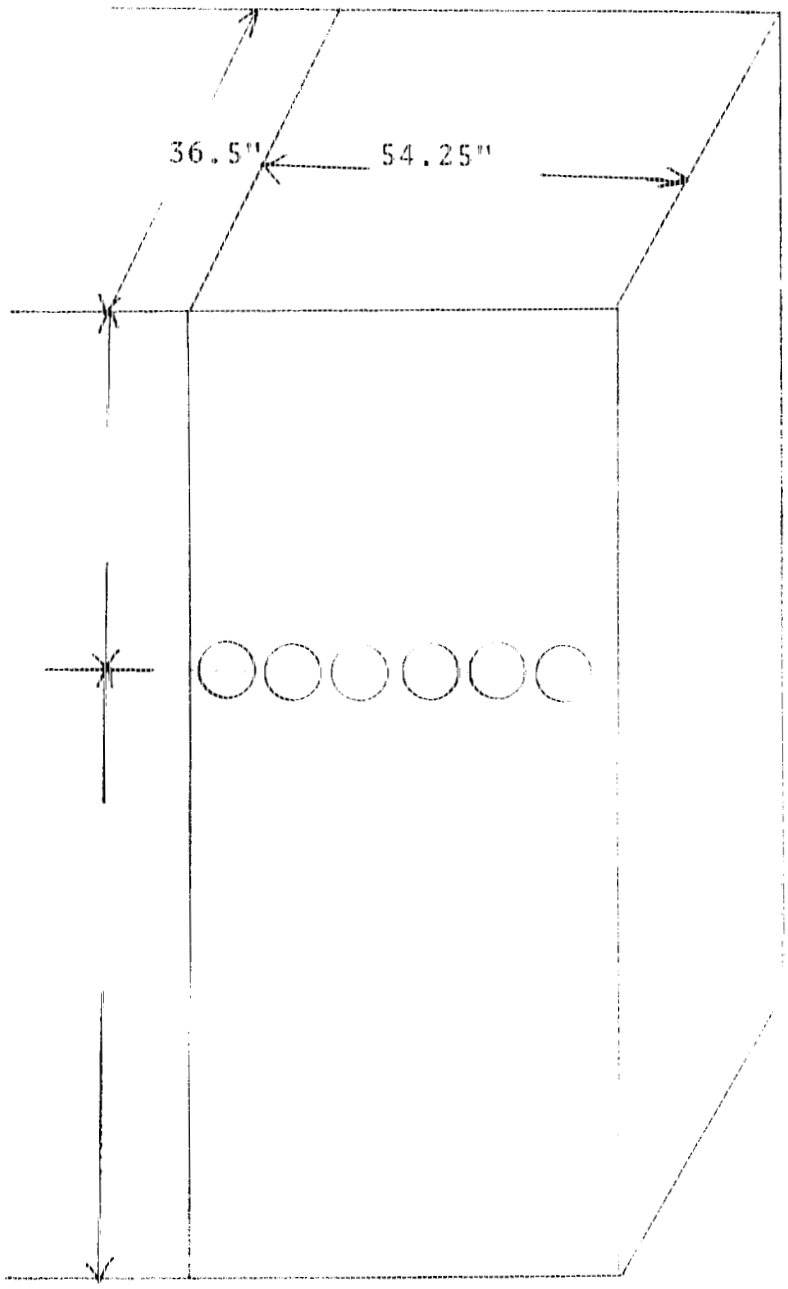
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

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

C. Sampling Site: The emissions test was conducted after a baghouse on a rectangular stack measuring 36.5" x 54.25" with an equivalent diameter of 43.6". Six sampling ports were placed at least 0.5 diameters upstream from the top of the stack and at least 2.0 diameters downstream from the last flow disturbance. Thirty points were sampled, five through each port for 3 minutes each for a total test time of 90 minutes per test run.

Points on a Diameter	Probe Mark
1	*11.7"
2	19.0"
3	26.3"
4	33.6"
5	40.9"

*Measurements include a 8" standoff.



IV. THE SOURCE

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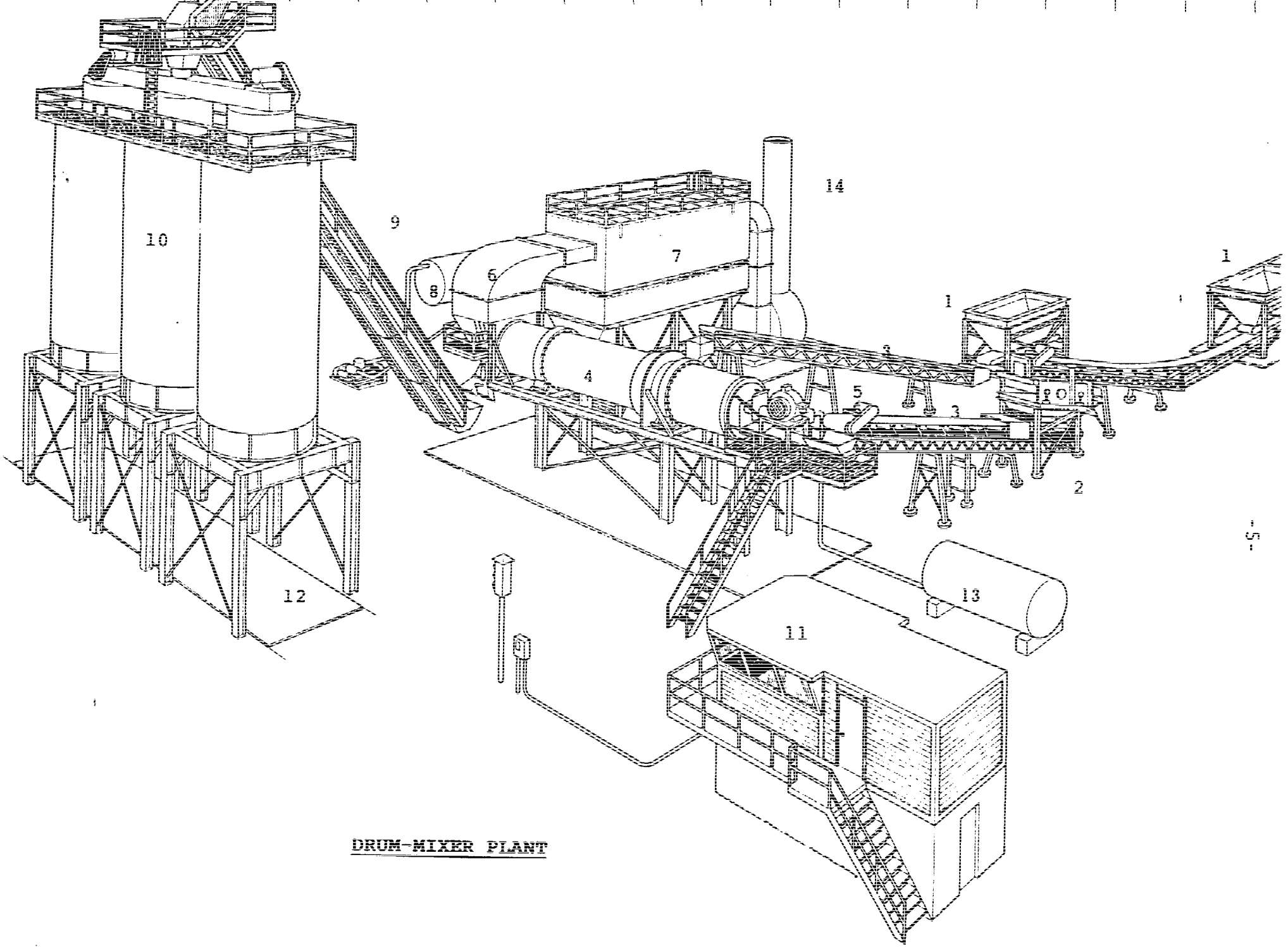
Better Materials Corporation employs a Standard Havens drum mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt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

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

The drum dryer uses a burner fired with fuel oil to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate and hot asphalt oil thoroughly. The air is drawn into the system via an exhaust fan. After passing through the burner and the mixing drum, the air passes through a baghouse.. The baghouse is manufactured by Standard Havens. The exhaust gas is drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube sheet is 1-6 inches of water. The particulate matter, which is removed by the baghouse, is reinjected into the drum mixer.



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

PLANT DATA

COMPANY NAME Better Materials Corp.

COMPANY REP. John Lang DATE 8-31-88 PHONE # 598-0729

DATA SOURCE

PLANT LOCATION Rt. 232 & Swamp Rd.

PLANT MFG. Standard Havens PLANT MODEL # Magnum PLANT TYPE 8'6" Drum

MIX SPECIFICATION # I-2 Base OIL SPECIFICATION # AC-20

Time 24 Hour	Fuel Oil #2 / Nat. Gas / Propane / Coal	Burner Setting 48 %	Aggregate TPH	Recycle TPH	Liquid Asphalt TPH	Mix Temp. °F	Venturi / Baghouse Pressure Drop Inches Water
7:45 AM	#2	48 %	220		10.8	306°	2.8
8:00	#2	49 %	233		10.5	302°	2.9
8:15	#2	50 %	230		10.7	300°	2.9
8:30	#2	47 %	227		11.0	310°	3.2
8:45	#2	48 %	225		10.6	312°	3.2
9:00	#2	43 %	230		10.7	308°	3.1
9:15	#2	48 %	231		10.8	305°	2.8
9:30	#2	45 %	224		10.7	303°	2.7
9:45	#2	46 %	218		10.7	304°	2.7
10:00	#2	47 %	2231		11.0	307°	2.8
10:15	#2	45 %	224		11.2	299°	2.6
10:30	#2	41 %	223		11.3	307°	2.7
10:45	#2	40 %	226		10.9	306°	2.6
11:00	#2	45 %	204		10.4	310°	2.6
11:15	#2	40 %	232		11.0	310°	2.7
11:30	#2	41 %	208		10.2	303°	2.8
11:45	#2	41 %	222		10.9	308°	2.5
12:00 PM	#2	44 %	227		10.6	307°	2.7
12:15	#2	49 %	236		11.8	290°	2.6
12:30	#2	32 %	225		11.3	318°	2.5
12:45	#2	36 %	227		11.5	304°	2.6
1:00 PM	#2	37 %	213		10.9	309°	2.5
1:15	#2	48 %	215		11.1	295°	2.9
1:30	#2	45 %	232		11.3	306°	2.8
1:45	#2						

DATA SUMMARY

Plant

1. Manufacturer of plant STANDARD HAVENS.
2. Designed maximum operating capacity 350 TPH @ 5 % moisture.
3. Actual operation rate 300 TPH @ 2.5 % moisture.
4. Startup date April 1988.
5. Type of fuel used in dryer #2 Fuel.
6. Quanity of fuel consumption 1.8 GALS PER TON.

Aggregate

7. Name/type of mix I-2 - BASE.
8. Percent asphalt in mix 4.6% %.
9. Temperature of asphalt 305°.
10. Sieve/Screening analysis: % Passing;

1"	100%	3/8"		#	
3/4"	93.7%	SAND #	6.3%	#	
1/2"	7.0%	#SAC	35.0%	#200	3.4% FILLER

Baghouse

11. Manufacturer STANDARD HAVENS Products.
12. No. of bags 384. Type of bags 100% 14oz NOMEX FELT.
13. Air to cloth ratio 12/1 @ 53,126. Designed ACFM 56,000.
14. Square feet of bags 10,380 FT2.
15. Type of cleaning; pulse jet ✓, reverse air ____, plenum pulse ____, other ____.
16. Cleaning cycle time 60 seconds.
17. Interval between cleaning cycle 30 seconds.
18. Pressure drop across baghouse 3-4" WG psi.
19. Pulse pressure on cleaning cycle 3.75 CFM @ 110 psi.

COMPANY NAME BETTER MATERIALS CORP DATE 8-31-88

COMPANY REPRESENTATIVE CRAIG S. CHATELAIN

Section C – Control Equipment, Continued

6. FABRIC COLLECTORS (IF APPLICABLE)

A. Manufacturer: Standard Havens Products

B. Model No.: Magnum No-5 Size 24

C. Air to cloth ratio (minimum, average, and maximum)
10,380 ft²-effective cloth area
5.12/1 @53,176

D. Type of Fabric
Material 100% Teflon Nomex
☒ Felted
☐ Woven
☐ Felted-Woven

E. Pressure Drop (Water gage)
3-4"WG-average

F. Volume of gases handled (ACFM)
56,000 max dscfm

G. Inlet gas temperature (°F)
320°F

H. Design inlet volume (ACFM)
56,000

I. Inlet concentration (lbs/hr or gr/SCF Dry)
76.19 #/hour

J. Outlet concentration (lbs/hr or gr/SCF Dry)
.3508 #/hour

K. Overall efficiency (%)
99.9

L. No. of compartments
ONE

M. No. of bags per compartment
352

N. Can each compartment be isolated for repair and/or bag replacement?
☐ Yes ☒ No

O. Bag dimensions
Length 40.5' Diameter 6.2

P. Method and frequency of bag cleaning (describe in detail). Give pneumatic flushing pressure if applicable.
Varies with production rate to maintain between 3-4"WG across baghouse. Average pulse interval 25-60seconds. pulse = 3.75 cartridges

Q. Are temperature controls provided? (Describe in detail)
Inlet temperature is monitored by a type 'J' thermocouple. Controls shut down the plant if temperatures exceed 400°F

R. Is baghouse insulated
NO

S. Maximum temperature bags can withstand (°F)
450°

T. Dew point at maximum Moisture (°F)
200°F

U. Describe method of dust removal from equipment
Sealed screw conveyors return the dust into the dust mixer. Closed loop process

V. EQUIPMENT USED

V. EQUIPMENT USED

Equipment used on conducting the particulate emissions test was:

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

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

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

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

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

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

VI. LABORATORY PROCEDURES & RESULTS

LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

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

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

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

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

II. Post-Testing Lab Analysis

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

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

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

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

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

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

SPECIAL NOTE

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

WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

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

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

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

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

COMPANY NAME Better Abrasives

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

Relative humidity in lab 45 %

			RUN 1	RUN 2	RUN 3
Impinger rinse volume (Filterable Extraction)		ml			
Date/Time of wt. 9/5/89	Gross wt.	g	0.1364	0.1276	0.1424
Date/Time of wt. 9/6/89	Gross wt.	g	0.1364	0.1276	0.1424
Filter Avg.	Gross wt.	g	0.1364	0.1276	0.1424
	Tare wt.	g	0.0843	0.0841	0.0849
Weight of insoluble particulate impinger rinse		g	0.0521	0.0435	0.0575
Water evaporation		#	1	2	3
Date/Time of wt. 9/5/89	Gross wt.	g	147.3720	149.3878	157.7737
Date/Time of wt. 9/6/89	Gross wt.	g	147.3720	149.3879	157.7737
Beaker Avg.	Gross wt.	g	147.3720	149.3878	157.7737
	Tare wt.	g	147.3219	149.3565	157.7212
Weight of soluble particulate from water		g	0.0501	0.0323	0.0525
Total weight of particulate (m_n)		g			

Remarks _____

Signature of Analyst _____

Signature of Reviewer _____

Form REC#8

SAMPLE ANALYTICAL DATA FORM

Plant Location Barber Materials — Relative humidity in lab 45 %

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

Blank volume (V_a) 200 ml

Date/Time wt. blank 9-6-88 — Gross wt. 139.5275 mg

Date/Time wt. blank 9-7-88 — Gross wt. 139.5268 mg

Ave. Gross wt. 139.5263 mg

Tare wt. 139.5260 mg

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

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (p_a) = (.000009 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} p_a$ = (.000009)(200)(.7853) = (.0003)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt 9-6-88 Gross wt	g	[illegible]	156.0419	[illegible]
Date/Time of wt 9-7-88 Gross wt	g	149.4755	156.0412	155.9836
Average Gross wt	g	149.4756	156.0416	155.9835
Tare wt	g	[illegible]	[illegible]	[illegible]
Less acetone blank wt (W_a)	g	.0003	.0003	.0003
Wt of particulate in acetone rinse (m_a)	g	.0218	.0359	.0405

Filter Numbers	#	[illegible]	[illegible]	[illegible]
Date/Time of wt 9-6-88 Gross wt	g	[illegible]	[illegible]	[illegible]
Date/Time of wt 9-7-88 Gross wt	g	[illegible]	[illegible]	[illegible]
Average Gross wt	g	[illegible]	[illegible]	[illegible]
Tare wt	g	.5298	[illegible]	.5301

Weight of particulate on filters(s) (m_f)	g	.0100	.0141	.0148
Weight of particulate in acetone rinse	g	.0218	.0359	.0405
Total weight of particulate (m_n)	g	.0318	.0500	.0553

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

Remarks

Signature of analyst Kim Rea — Signature of reviewer

VII. CALCULATIONS

BETTER MATERIALS CORPORATION
PENNS PARK, PENNSYLVANIA

SUMMARY OF TEST DATA

			8-31-88 RUN #1	8-31-88 RUN #2	8-31-88 RUN #3
SAMPLING TRAIN DATA					
		start	7:51	9:59	12:06
		finish	9:26	11:34	13:39
1.	Sampling time, minutes	Θ	90.0	90.0	90.0
2.	Sampling nozzle diameter, in.	D_n	.3000	.3000	.3000
3.	Sampling nozzle cross-sect. area, ft^2	A_n	.000491	.000491	.000491
4.	Isokinetic variation	I	109.7	109.8	100.6
5.	Sample gas volume - meter cond., cf.	V_m	69.114	70.478	65.855
6.	Average meter temperature, ^oR	T_m	545	564	575
7.	Avg. oriface pressure drop, in. H_2O	dH	1.75	1.78	1.58
8.	Total particulate collected, mg.	M_n	83.90	93.50	112.80
VELOCITY TRAVERSE DATA					
9.	Stack area, ft^2	A	13.80	13.80	13.80
10.	Absolute stack gas pressure, in. Hg.	P_s	30.24	30.24	30.24
11.	Barometric pressure, in. Hg.	P_{bar}	30.24	30.24	30.24
12.	Avg. absolute stack temperature, R^o	T_s	744	759	766
13.	Average $-\sqrt{\text{vel. head}}$, (C_p= .80)	$-\sqrt{dP}$	0.63	0.63	0.63
14.	Average stack gas velocity, ft./sec.	V_s	41.17	41.70	41.80
STACK MOISTURE CONTENT					
15.	Total water collected by train, ml.	V_{ic}	395.00	404.00	359.00
16.	Moisture in stack gas, %	B_{ws}	21.66	22.37	21.77
EMISSIONS DATA					
17.	Stack gas flow rate, dscf/hr.(000's)	Q_{sd}	1149	1130	1131
18.	Stack gas flow rate, cfm	acfm	34089	34528	34610
19.	Particulate concentration, gr/dscf	C_s	0.0192	0.0217	0.0286
20.	Particulate concentration, lb/hr	E	3.15	3.51	4.62
21.	Particulate concentration, lb/mBtu	E'	0.00000	0.00000	0.00000
ORSAT DATA					
22.	Percent CO_2 by volume	CO_2	5.50	4.80	5.30
23.	Percent O_2 by volume	O_2	13.50	14.40	13.80
24.	Percent CO by volume	CO	.00	.00	.00
25.	Percent N_2 by volume	N_2	81.00	80.80	80.90

Format: summryR3

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:

$$V_{m(std)} = (17.64)(.990)(69.114)\left[\frac{(30.24) + \frac{1.75}{13.6}}{545}\right] = 67.256 \text{ dscf}$$

RUN 2:

$$V_{m(std)} = (17.64)(.990)(70.478)\left[\frac{(30.24) + \frac{1.78}{13.6}}{564}\right] = 66.277 \text{ dscf}$$

RUN 3:

$$V_{m(std)} = (17.64)(.990)(65.855)\left[\frac{(30.24) + \frac{1.58}{13.6}}{575}\right] = 60.716 \text{ dscf}$$

Total Contaminants by Weight: GRAIN LOADING

Particulate concentration C_s' gr./dscf.

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

Where:

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

M_n = Total amount of particulate matter collected, mg.

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

Run 1:

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{83.90}{67.256}\right] = 0.0192 \text{ gr./dscf.}$$

Run 2:

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{93.50}{66.277}\right] = 0.0217 \text{ gr./dscf.}$$

Run 3:

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{112.80}{60.716}\right] = 0.0286 \text{ gr./dscf.}$$

Dry Molecular Weight

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

Where:

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

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

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

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

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

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

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

0.32 = Molecular weight of O_2 divided by 100.

0.44 = Molecular weight of CO_2 divided by 100.

Run 1:

$$M_d = 0.44(\ 5.50\%) + 0.32(13.50\%) + 0.28(\ .00\% + 81.00\%) = 29.42 \ \frac{lb}{lb\text{-}mole}$$

Run 2:

$$M_d = 0.44(\ 4.80\%) + 0.32(14.40\%) + 0.28(\ .00\% + 80.80\%) = 29.34 \ \frac{lb}{lb\text{-}mole}$$

Run 3:

$$M_d = 0.44(\ 5.30\%) + 0.32(13.80\%) + 0.28(\ .00\% + 80.90\%) = 29.40 \ \frac{lb}{lb\text{-}mole}$$

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) (380.0) = 17.9 cu.ft
$V_{wsg(std)}$ = (0.04715) (15.0) = 0.7 cu.ft

Run 2:

$V_{wc(std)}$ = (0.04707) (392.0) = 18.5 cu.ft
$V_{wsg(std)}$ = (0.04715) (12.0) = 0.6 cu.ft

Run 3:

$V_{wc(std)}$ = (0.04707) (345.0) = 16.2 cu.ft
$V_{wsg(std)}$ = (0.04715) (14.0) = 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:

$$B_{ws} = \frac{17.9 + 0.7}{17.9 + 0.7 + 67.256} \times 100 = 21.66\ \%$$

Run 2:

$$B_{ws} = \frac{18.5 + 0.6}{18.5 + 0.6 + 66.277} \times 100 = 22.37\ \%$$

Run 3:

$$B_{ws} = \frac{16.2 + 0.7}{16.2 + 0.7 + 60.716} \times 100 = 21.77\ \%$$

Molecular Weight of Stack Gases

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

Where:

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

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

Run 1:

$M_s = 29.42 (1 - 21.66) + 18 (21.66) = 26.95$ (lb./lb.-mole)

Run 2:

$M_s = 29.34 (1 - 22.37) + 18 (22.37) = 26.80$ (lb./lb.-mole)

Run 3:

$M_s = 29.40 (1 - 21.77) + 18 (21.77) = 26.92$ (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 $\left[\frac{(g/g\text{-mole})\text{-}(mm\ Hg)}{(^{o}K)(mm\ H_2O)}\right]^{1/2}$

C_p = Pitot tube coefficient, (dimensionless).

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

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

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

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

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

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

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

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

Run 1:

$$V = (85.49)\ (\ .80)\ (\ 0.63)\ \sqrt{\frac{744}{(30.24)(26.95)}} = 41.17\ ft/sec.$$

Run 2:

$$V = (85.49)\ (\ .80)\ (\ 0.63)\ \sqrt{\frac{759}{(30.24)(26.80)}} = 41.70\ ft/sec.$$

Run 3:

$$V = (85.49)\ (\ .80)\ (\ 0.63)\ \sqrt{\frac{766}{(30.24)(26.92)}} = 41.80\ ft/sec.$$

Stack Gas Flow Rate

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

Where:

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

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

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

t_s = Stack temperature, (^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:

$$Q_{sd} = 3600(1 - .2166)(41.17)(13.80)\left[\frac{528}{744}\right]\left[\frac{30.24}{29.92}\right] = 1149283.6 \frac{dscf}{hr}$$

Run 2:

$$Q_{sd} = 3600(1 - .2237)(41.70)(13.80)\left[\frac{528}{759}\right]\left[\frac{30.24}{29.92}\right] = 1130731.7 \frac{dscf}{hr}$$

Run 3:

$$Q_{sd} = 3600(1 - .2177)(41.80)(13.80)\left[\frac{528}{766}\right]\left[\frac{30.24}{29.92}\right] = 1131765.8 \frac{dscf}{hr}$$

Emissions Rate from Stack

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

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:

$$E = \frac{(0.0192)\ (1149283.6)}{7000} = 3.15\ lb.\ /\ hr.$$

Run 2:

$$E = \frac{(0.0217)\ (1130731.7)}{7000} = 3.51\ lb.\ /\ hr.$$

Run 3:

$$E = \frac{(0.0286)\ (1131765.8)}{7000} = 4.62\ lb.\ /\ hr.$$

Isokinetic Variation

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

Where:

I	=	Percent isokinetic sampling.
100	=	Conversion to percent.
T_s	=	Absolute average stack gas temperature, ^{o}R.
0.002669	=	Conversion factor, Hg - ft^3/ml - ^{o}R.
V_{ic}	=	Ttl vol of liquid collected in impingers and silica gel, ml.
T_m	=	Absolute average dry gas meter temperature, ^{o}R.
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:

$$I = (100)\left(\frac{744}{60} \right) \left[\frac{(0.002669)(395.00) + \frac{69.114}{545}\left[30.24 + \frac{1.75}{13.6}\right]}{(90.0)\ (41.17)\ (30.24)\ (.000491)} \right] = 109.7\%$$

Run 2:

$$I = (100)\left(\frac{759}{60} \right) \left[\frac{(0.002669)(404.00) + \frac{70.478}{564}\left[30.24 + \frac{1.78}{13.6}\right]}{(90.0)\ (41.70)\ (30.24)\ (.000491)} \right] = 109.8\%$$

Run 3:

$$I = (100)\left(\frac{766}{60} \right) \left[\frac{(0.002669)(359.00) + \frac{65.855}{575}\left[30.24 + \frac{1.58}{13.6}\right]}{(90.0)\ (41.80)\ (30.24)\ (.000491)} \right] = 100.6\%$$

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant: Better Matls.

Location: Penn. Park Pa.

Operator: K. Allmendinger

Date: ~~8-16-88~~ 8-31-88

Run No.: 1

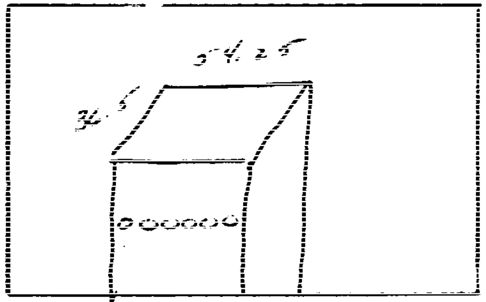
Sample Box No.: 2

Meter Box No.: 646882 0124

Meter H @: 1.68

C Factor: ~~.997~~ .990

Pitot Tube Coefficient Cp: .80



Schematic of Stack Cross Section

Ambient Temperature: 75? 60

Barometric Pressure: 29.94

Assumed Moisture, %: 20

Probe Length, m(ft): 4

Nozzle Identification No.: [illegible]

Avg. Calibrated Nozzle Dia., (in.): [illegible]

Probe Heater Setting: 7.0

Leak Rate, m^3/min. (cfm): 4.012 @10"

Probe Liner Material: 316 stainless

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

Filter No.: 83-2960 .3287

	IMPINGER VOLUME ml	SILICA GEL WEIGHT g
FINAL	400	530
INITIAL	200	515
DIFFERENCE	200	15

TRAV. PT NO.	SAMPLING TIME (θ)min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H_2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	~~7:51:50~~ 7:54	2	270	.18	.77	~~80.44163~~ 82.14	65	60	250	55
2	7:57	3	275	.20	.86	83.76	80	60	250	50
3	8:00	3	275	.20	.86	85.34	85	60	250	50
4	8:03	3	280	.22	.94	87.11	85	65	250	45
5	8:06:50	3	275	.22	.94	88.83	90	65	250	45
B) 1	~~8:08:30~~ 8:11	5	275	.33	1.4	91.03	85	65	255	45
2	8:14	6	280	.35	1.5	93.12	90	65	255	45
3	8:17	5	280	.30	1.3	95.19	95	65	255	45
4	8:20	4	280	.25	1.1	97.08	95	70	255	45
5	8:23.30	4	280	.23	.99	98.83	95	70	255	45
C) 1	~~8:24~~ 8:27	8	280	.55	2.4	101.44	95	70	250	45
2	8:30	7	285	.50	2.1	103.42	95	70	250	45
3	8:33	6	285	.38	1.6	106.30	100	70	250	45

CO_2 = 5.5, 6.5

Form #REC-08

RAMCON emissions test log sheet, cont. DATE 5-31-88 LOCATION Arena Park TEST NO. 1

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
4	8:36	6	285	.35	1.5	108.45	100	70	250	45
5	8:39	6	285	.33	1.4	110.54	100	70	250	45
D) 1	8:39:30 8:42	9	285	.38	2.0	113.27	100	75	250	45
2	8:45	9	290	.36	2.5	115.95	100	75	250	45
3	8:48	8	290	.30	2.1	118.49	100	75	250	45
4	8:51	8	285	.48	2.1	121.03	105	75	250	45
5	8:54:30	7	290	.43	1.8	123.42	105	75	250	45
E) 1	8:55 8:58	9	285	.35	2.4	126.07	105	75	250	45
2	9:02	9	290	.32	2.2	128.74	105	75	250	45
3	9:05	9	290	.32	2.2	131.44	105	80	245	45
4	9:08	8	290	.30	2.1	133.96	105	80	245	45
5	9:11	8	290	.28	2.1	136.47	105	80	245	45
F) 1	9:11:30 9:14	9	285	.35	2.4	139.18	105	80	245	45
2	9:17	9	290	.35	2.4	141.95	105	80	245	45
3	9:20	8	290	.30	2.1	144.53	110	80	245	45
4	9:23	8	290	.30	2.1	147.14	110	80	245	45
5	9:26:30	7	290	.45	1.9	149.62	110	80	240	45

RAMCON ENVIRONMENTAL CORPORATION

3165 4.29

Plant: Bobbs Mill
Location: [illegible] Park, Pa.
Operator: Bill [illegible] Liner
Date: 8-31-88
Run No.: 2
Sample Box No.: 3
Meter Box No.: 1.46882 C-124
Meter H @: 1.66
C Factor: .990
Pitot Tube Coefficient Cp: .80

Ambient Temperature: 75°
Barometric Pressure: 30.24
Assumed Moisture, %: 20
Probe Length, m(ft): 4
Nozzle Identification No.: .0004909
Avg. Calibrated Nozzle Dia., (in.): .300/.300/.300
Probe Heater Setting: 5.0
Leak Rate, m^3/min.(cfm): .005
Probe Liner Material: 316 Stainless Steel
Static Pressure, mm Hg(in.Hg):
Filter No.: 85-2561 .5282

	IMPINGER VOLUME ml	SILICA GEL WEIGHT g
FINAL	552	523
INITIAL	200	511
DIFFERENCE	352	12

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	~~9:59~~ 10:02	5	290	.77	3.3	~~149.931~~ 153.59	88	86	56	230
2	10:05	5	292	.73	3.1	156.00	104	84	56	235
3	10:08	5	294	.60	2.5	159.65	108	84	56	240
4	10:11	5	294	.55	2.4	161.93	110	84	56	245
5	10:14	5	294	.55	2.4	164.834	112	86	56	245
B) 1	~~10:15~~ 10:18	5	292	.83	3.6	168.09	110	86	58	250
2	10:21	5	295	~~.84~~ .73	3.1	171.23	112	86	58	250
3	10:24	5	295	.55	2.3	174.23	114	88	58	250
4	10:27	5	296	.47	2.0	176.56	116	88	58	250
5	10:30	5	296	.37	1.6	178.895	116	88	58	250
C) 1	~~10:31~~ 10:34	5	298	.55	2.4	181.61	112	90	58	255
2	10:37	5	300	.52	2.2	184.37	118	90	58	255
3	10:40	5	302	.51	2.2	186.95	120	90	58	255

CO_2: 4.5

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 8-31-88 LOCATION Evans Falls, PA 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)
4	10:43	4	300	.35	1.5	189.25	120	90	58	255
5	10:96	2	298	.24	1.0	191.26	120	92	58	255
D) 1	10:47 10:50	5	298	.53	2.3	193.81	119	92	60	255
2	10:53	5	302	.52	2.2	196.52	120	92	60	255
3	10:56	5	304	.45	1.9	199.05	122	94	60	250
4	10:59	3	302	.26	1.1	201.08	122	94	60	250
5	11:02	2	298	.17	.73	202.66	122	94	60	250
E) 1	11:03 11:06	4	296	.29	1.2	204.89	120	96	60	250
2	11:09	4	302	.31	1.3	206.88	120	96	60	250
3	11:12	3	304	.29	1.2	208.35	120	96	62	250
4	11:15	2	304	.20	.86	210.52	122	96	62	250
5	11:18	2	304	.17	.73	212.07	122	96	62	250
F) 1	11:19 11:22	2	300	.19	.81	213.92	120	98	62	250
2	11:25	2	304	.21	.90	215.52	120	98	62	250
3	11:28	2	305	.24	1.0	217.29	122	98	62	250
4	11:31	2	302	.19	.82	218.98	124	98	62	250
5	11:34	2	304	.14	.60	220.415	124	98	62	250

RAMCON ENVIRONMENTAL CORPORATION

Plant Bethlehem Steel

Location Penny Park Pa

Operator K. Allmendinger

Date 8-31-88

Run No. 3

Sample Box No. 2

Meter Box No. C124 694882

Meter H@ 1.66

C Factor .990

Pitot Tube Coefficient Cp .80

3.84

Ambient Temperature 84

Barometric Pressure 30.24

Assumed Moisture, % 20

Probe Length, m(ft) 4

Nozzle Identification No. .2004908

Avg. Calibrated Nozzle Dia., (in.) .300/.300/.300

Probe Heater Setting 4/5

Leak Rate, m^3/min. (cfm) .008 @ 12"

Probe Liner Material 3/4 Stainless

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

Filter No. B1-2915

	METERED VOLUME =	MOISTURE GM. WEIGHT =
FINAL	545	526
INITIAL	200	512
DIFFERENCE	345	14

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H_2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	12:06:50 / 12:09	4	250	.10	.86	220.52 / 222.27	110	110	250	65
2	12:12	4	310	.10	.86	224.00	120	105	250	65
3	12:15	4	310	.15	1.1	225.86	120	100	250	60
4	12:18	3	310	.23	.99	227.68	125	100	250	60
5	12:21:50	2	305	.16	.69	229.23	125	100	250	60
B) 1	12:22:46 / 12:25	3	305	.23	.89	230.93	120	100	250	60
2	12:28	4	310	.33	1.3	232.97	125	100	255	65
3	12:31	4	310	.35	1.3	234.58	125	100	255	55
4	12:34	5	305	.35	1.4	237.06	130	105	255	55
5	12:37:40	3	310	.19	.73	238.67	130	105	255	55
C) 1	12:38 / 12:41	6	305	.45	1.7	240.93	130	105	255	55
2	12:44	7	310	.48	1.9	243.48	130	105	255	55
3	12:47	6	310	.40	1.5	245.68	130	105	255	55

CO_2 = 5.0 , 5.5

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 5-31-88 LOCATION Pegasus Park 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)
4	12:50	9	310	.43	1.7	247.97	130	105	250	50
5	12:53	4	310	.22	.85	249.66	130	105	250	50
D) 1	12:53:30 12:54	5	310	.60	2.3	254.19	135	105	250	50
2	12:59	8	310	.56	2.2	254.80	130	110	250	50
3	1:02	8	310	.53	2.0	257.35	130	110	250	50
4	1:05	6	310	.35	1.4	259.55	130	110	250	50
5	1:08:30	5	310	.30	1.2	261.63	135	110	250	50
E) 1	1:09 1:12	9	305	.60	2.3	264.32	135	110	250	50
2	1:15	9	310	.40	2.3	266.86	125	105	250	50
3	1:18	9	310	.57	2.2	269.55	120	105	250	50
4	1:21	9	310	.55	2.1	271.97	120	105	250	50
5	1:24	9	310	.55	2.1	274.39	120	100	245	50
F) 1	1:24:40 1:27	9	300	.58	2.2	276.89	115	100	245	50
2	1:30	8	305	.53	2.0	279.32	115	100	245	50
3	1:33	8	305	.50	1.9	281.82	120	105	245	50
4	1:36	7	305	.47	1.8	284.14	120	105	245	50
5	1:39	6	305	.43	1.7	286.425	120	105	245	50

T-321

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 9-6-88 Meter box number C-14 69687

Barometric pressure, P_b = 30.09 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	6	945.13 / 951.199	78.8	109 / 114	85 / 85	98	14:37	1.006	1.63
1.0	6	952.18 / 958.079	78.8	110 / 110	85 / 85	97.5	10:25	1.006	1.65
1.5	10	966.44 / 976.44	78.8	115 / 112	85 / 85	98.75	14:06	1.013	1.63
2.0	10	978.07 / 988.16	78.8	110 / 112	85 / 85	98	12:21	1.021	1.68
3.0	10								
4.0	10								
							Avg	1.012	1.65

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

Quality Assurance Handbook M4-2.3A (front side)

Form #REC-02

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 5-22-85 Meter box number 6MC882 C-124

Barometric pressure, P_b = 30.03 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	$\Delta H@$ in. H_2O
0.5	5	707.07 / 712.07	75.2	109 / 110	86 / 86	97.75	12:45	0.9965	1.66
1.0	5	710.77 / 716.03	75.2	111 / 112	86 / 86	98.75	8:08	0.9900	1.65
1.5	10	698.63 / 709.698	75.2	110 / 112	85 / 85	98	14:17	0.9923	1.66
2.0	10	686.3 / 697.04	75.2	110 / 113	84 / 85	98	12:27	0.9909	1.64
3.0	10								
4.0	10								
							Avg	0.990	1.66

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.

Quality Assurance Handbook M4-2.3A (front side)

Form #REC-02

RAMCON ENVIRONMENTAL CORPORATION

Date 2-10-88 Thermocouple number Inlet/Outlet

Ambient temperature 24 °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	Inlet Ambient	24°C	24°C	0%
B	Outlet Ambient	24°C	24°C	0%
C	Ambient 5-31-88	60°F	60°F	0%

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON ENVIRONMENTAL CORPORATION

Date 2-10-88 Thermocouple number 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 8-31-88	60°F	60°F	0%

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

[b]Type of calibration system used.

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

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. 42 Date 2-4-88

Calibrated by: Sam T. Ramon

"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	4.01
2	0.85	1.35	.793	4.01
3	0.64	1.00	.800	4.01
		$\bar{C}_p$ (SIDE A)	.796	

"B" SIDE CALIBRATION

Run No.	Δp std cm H_2O (in. H_2O)	$\Delta p(s)$ cm H_2O in. H_2O)	$C_p(s)$	DEVIATION $C_p(s) - \bar{C}_p(B)$
1	0.98	1.55	.795	4.01
2	0.85	1.35	.793	4.01
3	0.64	1.00	.800	4.01
		$\bar{C}_p$ (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

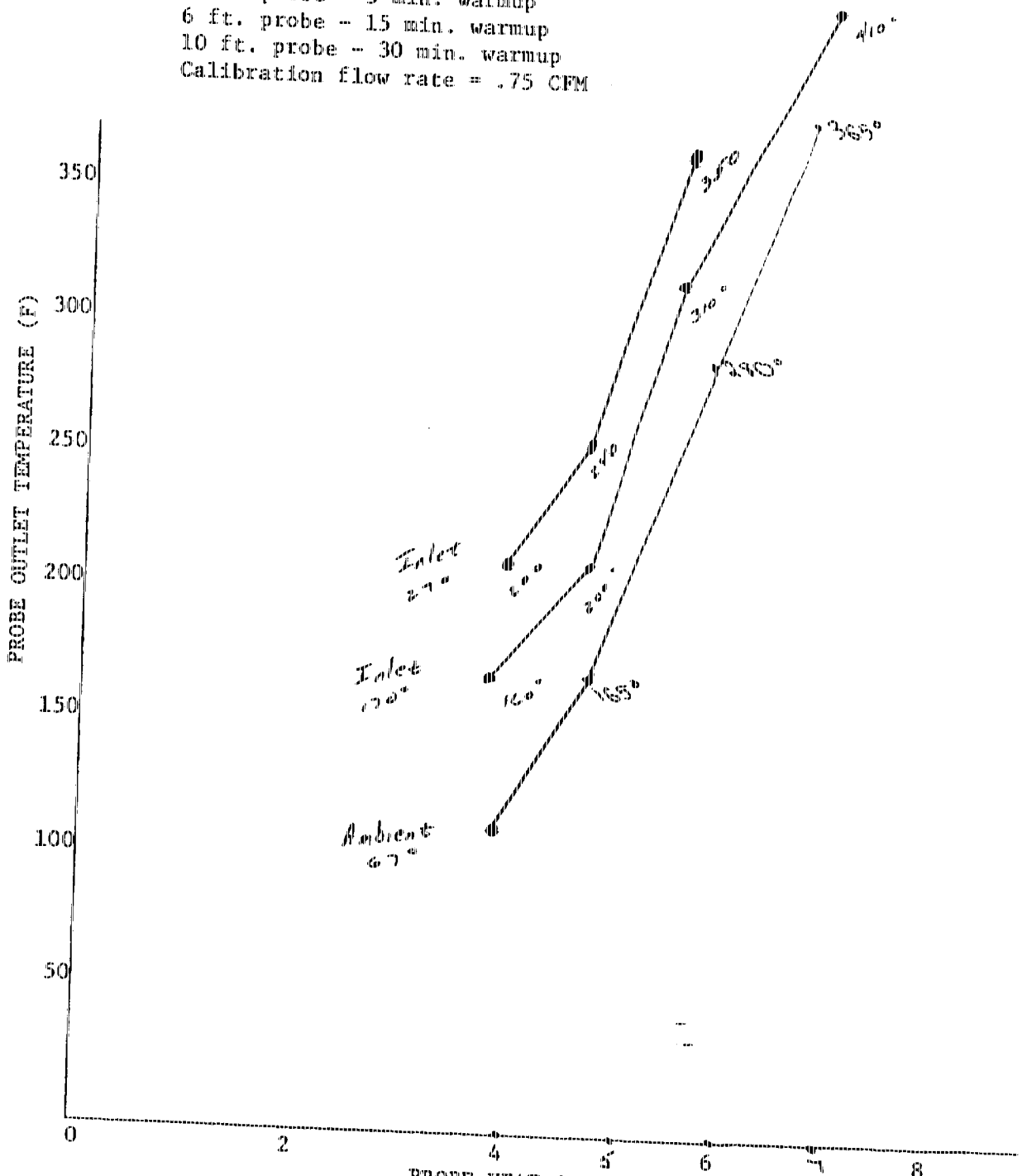
Heating Probe Calibration

Probe No. 42 Probe Length 4'

Date of Calibration 12-18-86 Signature K. B. Allen Jr.

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



RAMCON ENVIRONMENTAL CORPORATION

Date 2-10-88 Thermocouple number 42

Ambient temperature 55°F °C Barometric pressure 29.87 in. Hg

Calibrator K Allmarding Reference: mercury-in-glass ✓

other

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
A	ICE WATER	34°F	33°F	.03%
B	Boiling water	212°F	210°F	.009%
C	OIL	379°F	376°F	.008%
D	Ambient	55°F	54°F	.02%
	8-31-88	60°F	60°F	0%

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

X. RAMCON PERSONNEL

RAMCON Environmental Stack Test Team

Sumner Buck - President

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

Ken Allmendinger - Team Leader

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