Pauline 12/3/97 39500205

PM $\frac{5.5\ lb/hr}{85\ ton/hr} = (0.10\ lb/ton)$ [A]

control - no eff. given - front/back total

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

JUN 12 1989

SUBJECT: Stack Test Review of Paolino & Sons Asphalt Plant, Philadelphia, Pa.
CDS# 39-7160-92187
42-101-

FROM: Jim Gouvas 3ES-11
POS

TO: Sue Insetta, Chief 3AM-21
EP&SCS

THRU: Vic Guide, Chief 3ES-11
POS

A review of the stationary source stack sampling report titled "Source Sampling for Formaldehyde & Particulate Emissions Paolino & Sons, Inc. Philadelphia, Pa. September 1-2, 1988" submitted by Ramco Environmental Corp (REC), Memphis, Tenn. has been completed.

The tests (EPA Method 5, EPA MM5 and EPA Method 9) were conducted on the Asphalt Plant Stack during the period of September 1-2, 1988.

The Asphalt Plant Stack emission's are regulated by 40 CFR Subpart I (NSPS) and PaDER 123.13 (c)(i) The emission standard for this source is [redacted] cubic foot (gr/dscf) NSPS and PaDER. The Asphalt Plant's three test run emission rate average was [redacted] (EPA calculated). The Asphalt Plant emission's are in compliance with this emission standard. (See the attachments for the emission rate compliance determination calculations)

EPA Modified Method 5 was the test used on run number 3. The test was used for Particulate and Formaldehyde emission rates. The results from of the Formaldehyde test run is contained in the report.

EPA Method 9 (Visible Emissions) was conducted by Bob Scott, Philadelphia AMS during the test runs. The visible emissions observed were in compliance with the NSPS emission standard.

I have reviewed the test report's field testing procedures, calculation, and quality assurance procedures. I have found them in agreement with procedures required by EPA Method 5. The calculations, as presented, appear to be correct and the test report acceptable in content.

The attachments are comparisons of emission rate calculations made by the writer using the raw data from the report's field testing data sheets.

Attachments: 1. Emission Rate Calculation Comparisons (EPA vs REC),
2. EPA Emission Rate Compliance Determination Calculations

EMISSION RATE CALCULATION COMPARISONS

FACILITY	PAOLINO & SONS
PLACE	PHILADELPHIA, PA
CDS#	39-7160-92167
DATE OF TEST	5-1-2-88
PSD	NO
NSPS	YES
SIP SOURCE	NO
NESHAP	NO
AUDIT SAMPLE	NO
PASS/FAIL	N/A
TESTING LAB	RAMCO ENVIRONMETAL CORP (REC)
ADDRESS	223 SCOTT ST MEMPHIS, TENN
PHONE #	800-458-4567
PROJECT #	NONE
UNIT	ASPHALT PLANT
TEST METHOD	EPA METHOD 5 & PaDER BACK HALF
TESTING PARAMETER	PARTICULATE

TEST DATA UNITS: gr/dscf

RUN NUMBER	1	2	3	AVERAGE
EPA	0.0168	0.0256	0.0510	0.[illegible]
REC	0.0168	0.0266	0.0505	0.[illegible]

TESTING PARAMETER FORMALDEHYDE
TEST DATA UNITS: gr/dscf

RUN NUMBER			3
EPA			0.0004
REC			0.0004

EMISSION RATE CALCULATION COMPARISONS

TESTING PARAMETER	ISOKINETICS			
TEST DATA UNITS:	%			
RUN NUMBER		1	2	3
EFA		106.0	99.0	110.9
REC		106.0	99.8	109.4
IN ACCEPTABLE RANGE (90-110%)	YES			

EMISSION REGULATIONS	40 CFR SUBPART I (NSPS) PaDER 123.13 (c)(1)
EMISSION STANDARD	
PARTICUATES	.04 gr/dscf (NSPS & PaDER)
FORMALDEHYDE	NONE
IN COMPLIANCE	YES-PARTICULATE

EPA EMISSION RATE CALCULATIONS

FACILITY		PAOLINO & SONS ASPHALT PLANT	
LOCATION		PHILADELPHIA, PA	
CDS#		39-7160-92157	
REGULATION		40 CFR SUBPART I (NSPS) PaDER 123.12 (c)(i)	
TEST METHOD		EPA METHOD 5 & PaDER BACK HALF NOTE:RUN #3-EPA MM5 (FORMALDEH & PARTICULATES)	
DATE OF TEST		9-1-2-88	
RUN #		1	2	3
NET SAMPLING TIME, Theta	min.	60	60	90
NOZZLE DIAMETER	in.	0.3	0.332	0.2
PITOT TUBE COEFFICIENT, Cp		0.81	0.81	0.8
DGM CAL. FACTOR, Y		0.99	0.99	0.99
BAROMETRIC PRESSURE	in.Hg.	30.32	30.32	30.4
METERED VOLUME, Vm	cu.ft.	45.569	57.913	28.499
METERED VOLUME, Vm(std)	dscf	43.533	54.215	27.936
METER TEMPERATURE	degF	97	110	82
WATER IN IMPINGERS, Vlc	ml.	364	412	262
PARTICULATE COLLECTED, Mn	mg.	47.4	93.5	92.3
FORMALDEHYDE COLLECTED	mg.			6.6
STACK TEMPERATURE	degF	295	293	291
STACK DIAMETER	ft.	4.13	4.13	4.13
STATIC PRESSURE	in.Hg.	0	0	0
STACK AREA	sq.ft.	13.40	13.40	13.40
% OXYGEN	%	11.3	12.5	12.3
% CARBON DIOXIDE	%	8	7.5	7.5
% MOISTURE	%	28.24	28.23	30.52
MWd	lb/mol	29.73	29.70	29.66
MWs	lb/mol	26.42	26.62	25.79
MEASURED btu INPUT	Mbtu/hr	ERR	ERR	ERR
AVERAGE dH	in.Hg	2.04	3.20	0.71
AVERAGE SQRT dP		0.680	0.644	0.649
F-FACTOR	dscf/Mbtu	ERR	ERR	ERR
% EXCESS AIR	%			
% ISOKINETIC	%	106.0	99.0	110.9
FLOW RATES -DRY, STD CONDITIONS	dscfm	18690	18111	17196
	lb/hr	87974	85153	80742
-WET, ACTUAL CONDITIONS	acfm	36753	34604	34699
	lb/hr	107499	102247	100757
	fpm	2743	2583	2590
PARTICULATE EMISSION	gr/dscf	0.0166	0.0266	0.0510
	@12% CO2	0.0252	0.0426	0.0832
	@ 7% O2	0.0242	0.0438	0.0820
	lb/hr	2.6915	4.1309	7.8141
FORMALDEHYDE EMISSIONS	gr/dscf	0.0000	0.0000	0.0004
	lb/hr			0.0651

Steve
Rose

RAMCON

ENVIRONMENTAL CORPORATION

This is the only copy. 2nd Test Plan must SIP

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

RAMCON
ENVIRONMENTAL CORPORATION

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
PAOLINO PAVING & SUPPLY, INC.
PHILADELPHIA, PENNSYLVANIA
December 3, 1987

Joe Marchionne
Paolino Paving & Supply

G. Sumner Buck, III
President

Cameron Mitchell
Team Leader

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

RAMCON
ENVIRONMENTAL CORPORATION

January 12, 1988

Mr. Joe Marchionne
Paolino Paving & Supply
3201 South 61st Street
Philadelphia, PA 19153

Re: Particulate Emissions Test - Philadelphia, PA

Dear Mr. Marchionne:

Enclosed you will find four copies of our report on the particulate emissions test we conducted at your plant. Based on our test results, your plant does meet emissions standards set by the City of Philadelphia. Therefore, the plant is operating in compliance with City Standards.

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

Mr. Robert Scott
City of Philadelphia
Department of Public Health
500 S. Broad Street
Philadelphia, PA 19146

You will need to keep one copy of the report at the plant. We certainly have enjoyed working with you and look forward to serving you again in the future.

Sincerely,

G. Sumner Buck, III
President

GSBIII:kr

Enclosures

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

TABLE OF CONTENTS

I. INTRODUCTION

On December 3, 1987, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Paolino Paving & Supply's Stansteel batch mix asphalt plant located in Philadelphia, Pennsylvania. RAMCON personnel conducting the test were Cameron Mitchell, Team Leader and Shawn Greenwood. Kim Rea 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. Mitchell and Ms. Rea.

The purpose of the test was to determine if the rate of particulate emissions from the plant's baghouse are below the allowable limits set by the City of Philadelphia.

II. TEST RESULTS

Table I summarizes the test results. The allowable emissions are found in Pennsylvania Air Regulations 25 PA 123.1, .13 and .41 and Philadelphia Air Management Regulation 2, sections 4, 7 & 8. The visible emissions limit is 20%. The mass emissions limit is .04 gr/dscf and 10.2 lbs/hr from the process weight and the formula in 25 PA 123.13.

TABLE I

SUMMARY OF TEST RESULTS
December 3, 1987

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
*1		0.0383 gr/DSCF	STATIC → RUN RATE	10.2 lbs/hr
1	09:02 to 13:32	0.0261 gr/DSCF	93%	8.3 lbs/hr
2	14:24 to 15:29	0.0331 gr/DSCF	99%	9.8 lbs/hr
3	16:12 to 17:17	0.0241 gr/DSCF	93%	7.3 lbs/hr
	Average:	0.0278 gr/DSCF		8.5 lbs/hr

NO BACK HALF

* Includes backhalf analysis

10.2
12.2 -

On the basis of these test results, the average grain loading on the three test runs does meet the .04 gr/DSCF limitation set by the City of Philadelphia. The actual emissions also meets the 10.2 lbs/hr limitation. Therefore, the plant is operating in compliance with City standards.

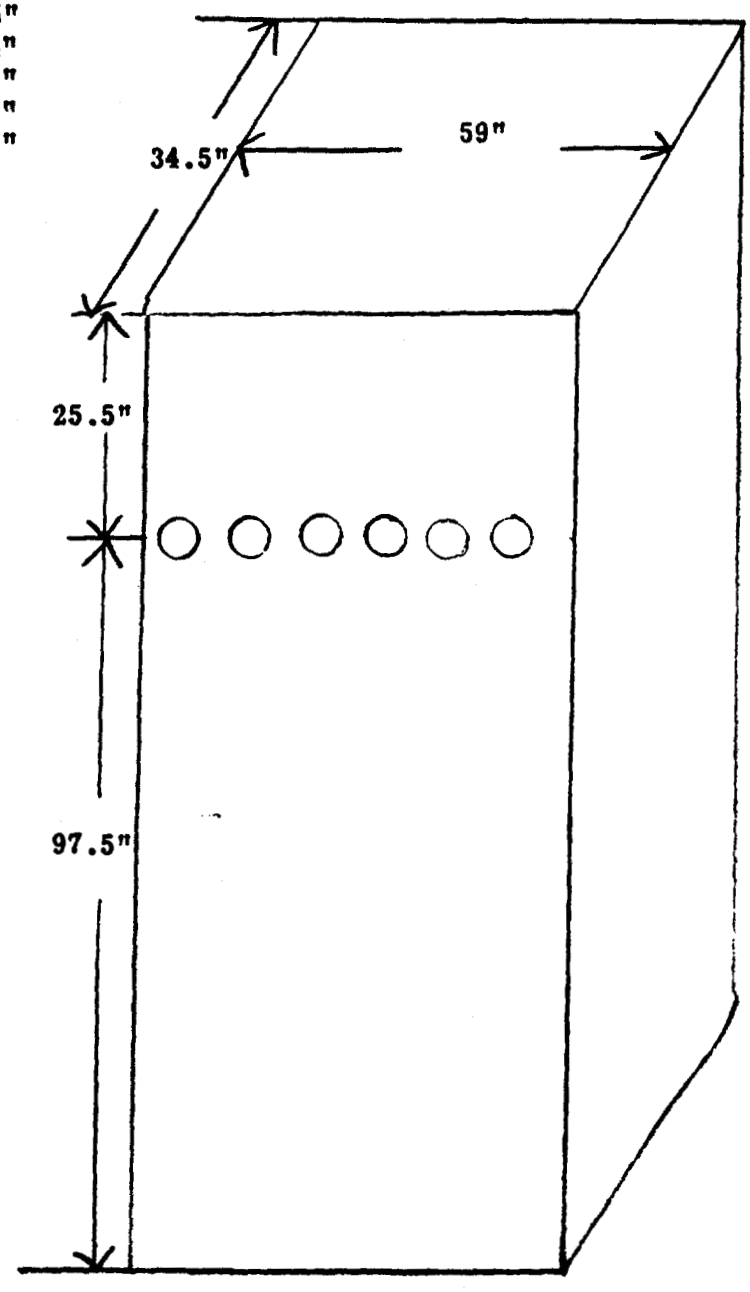
III. TEST PROCEDURES

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 59" x 34.5" with an equivalent diameter of 43.5". Six sampling ports were placed 25.5" down (0.6 diameters upstream) from the top of the stack and 97.5" up (2.2 diameters downstream) from the last flow disturbance. Thirty points were sampled. Run one at 2.5 minutes each, runs two and three at two minutes each.

Points on a Diameter	Probe Mark
1	3.5"
2	10.4"
3	17.3"
4	24.2"
5	31.1"



IV. THE SOURCE

IV. THE SOURCE

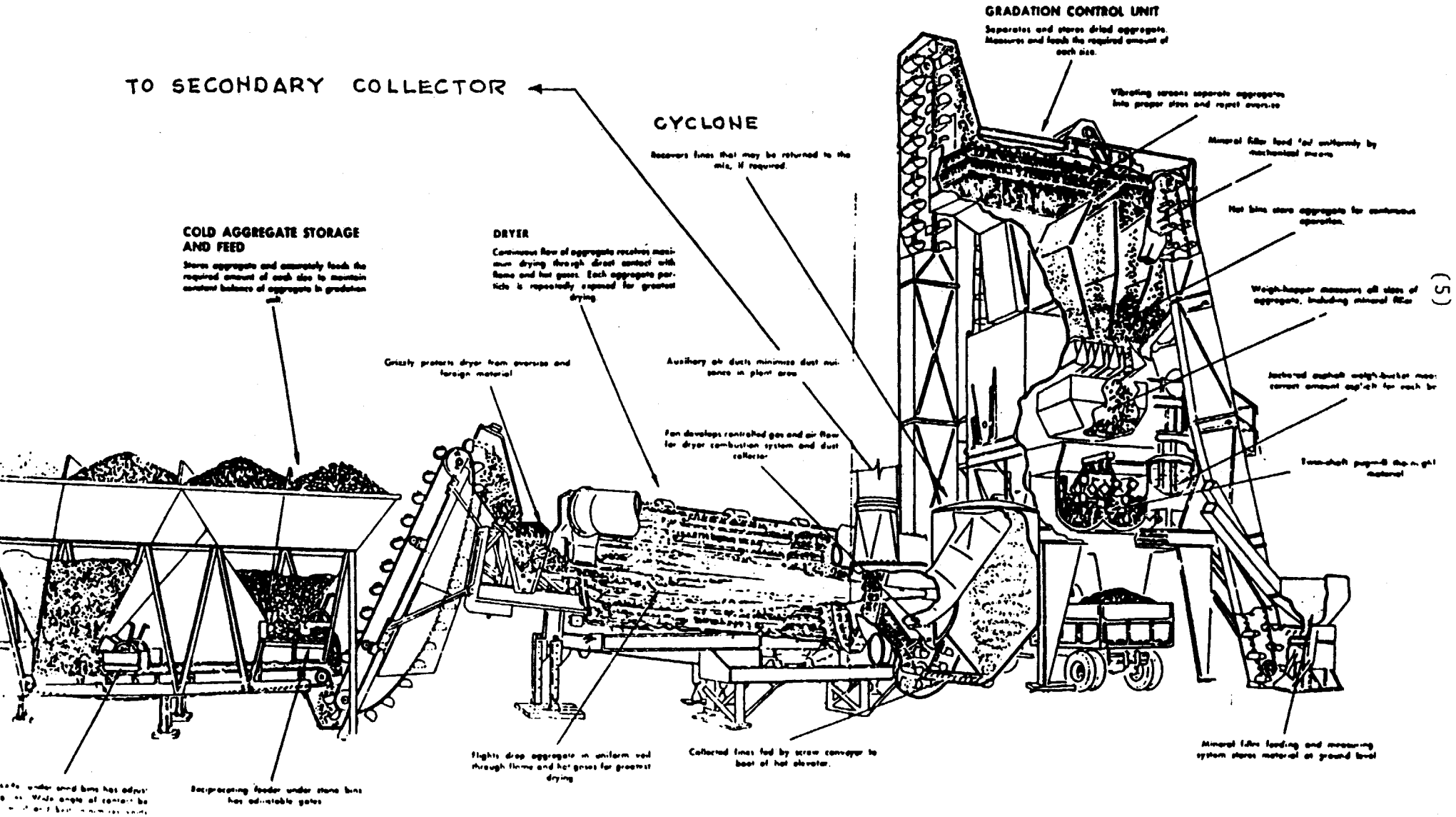
Paolino Paving & Supply employs a Stansteel batch mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind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

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

The drum dryer uses a burner fired with #2 fuel oil to heat air to dry the aggregate. The air is drawn into the system via an exhaust fan. After passing through the burner and the mixing drum, the air passes through a baghouse. The baghouse is manufactured by Stansteel. The exhaust gas is drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube sheet is 1 - 6 inches of water. The particulate matter, which is removed by the baghouse is reinjected into the pugmill. The following sketch shows a typical batch mix asphalt plant.

Figure 4-1

ASPHALT BATCH MIX PLANT - AN EXPLODED VIEW



DATA SUMMARY

Plant

1. Manufacturer of plant Stan-Steel.
2. Designed maximum operating capacity 120 TPH @ 5 % moisture.
3. Actual operation rate 85 TPH @ 5 % moisture.
4. Startup date 4-87.
5. Type of fuel used in dryer #2 Fuel Oil.
6. Quanity of fuel consumption N/A.

Aggregate

7. Name/type of mix ID-2.
8. Percent asphalt in mix 4.4 %.
9. Temperature of asphalt 310.
10. Sieve/Screening analysis: % Passing; Private work N/A

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

Baghouse

11. Manufacturer Stan-Steel.
12. No. of bags 812. Type of bags Nomex.
13. Air to cloth ratio N/A. Designed ACFM N/A.
14. Square feet of bags 0.5" dia x 10' long
15. Type of cleaning; pulse jet ____, reverse air X, plenum pulse ____, other ____.
16. Cleaning cycle time 6 sec.
17. Interval between cleaning cycle 6 sec.
18. Pressure drop across baghouse 12.8 in H_2O clean.
19. Pulse pressure on cleaning cycle N/A psi.

COMPANY NAME Paulino Paving & Supply DATE 12-3-87

COMPANY REPRESENTATIVE Joe Marchionne

PLANT DATA

COMPANY NAME Padino Paving Supply Inc.

COMPANY REP. _____ DATE 12-3-87 PHONE # (215) 465-3560

DATA SOURCE Control Room Guages

PLANT LOCATION Philadelphia Pa.

PLANT MFG. Stand Still PLANT MODEL # N/A PLANT TYPE Batch Mix

MIX SPECIFICATION # ID-2 OIL SPECIFICATION # AC-20

Time 24 Hour	✓ Fuel Oil #2 / Nat. Gas / Propane / Coal — N/A	Burner Setting % Open	Mix ~~Aggregate~~ ~~TPH~~ Tons	N/A Recycle TPH	Liquid Asphalt ~~TPH~~ %	Agg. ~~Mix~~ Temp. °F	✓ Venturi Baghouse Pressure Drop Inches Water
12:18		3.0	200		4.4	370	12.5
12:25		3.25	40		4.4	-	12.5
12:40		3.0	60		4.4	370	12.5
12:57		3.0	80		4.4	370	12.5
1:07		3.0	120		4.4	370	12.5
1:20		3.0	117.5		4.4	370	12.5
14:32		2.0	20		4.4	370	12.5
14:50		2.0	40		4.4	390	12.5
15:00		2.5	60		4.4	-	12.5
15:12		2.5	80		4.4	370	12.5
15:33		1.0	120		4.4	400	13.0
16:33		2.5			4.4	370	12.5
16:46		2.0			4.4	370	12.5
16:55		3.0			—	370	12.5
	¼" [illegible] Through [illegible]				[illegible]	[illegible]	
17:00	Recommend [illegible]			[illegible]			
17:10		2.5	-		4.4	370	12.5
17:20		2.5			4.4	370	12.5

REC #04

V. EQUIPMENT USED

V. EQUIPMENT USED

Equipment used on conducting the particulate emissions test was:

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

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

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

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

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

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

VI. LABORATORY PROCEDURES & RESULTS

LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

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

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

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

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

II. Post-Testing Lab Analysis

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

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

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

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

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

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

SPECIAL NOTE

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

WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

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

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

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

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

Form REC#8

SAMPLE ANALYTICAL DATA FORM

Plant Location Philadelphia, Pa — Relative humidity in lab 45 %

Sample Location _____ — Density of Acetone (pa) .7853 mg/ml

Blank volume (V_a) 200 ml

Date/Time wt. blank 12-8-87 — Gross wt. 142.4778 mg

Date/Time wt. blank 12-9-87 — Gross wt. 142.4770 mg

Ave. Gross wt. 142.4774 mg

Tare wt. 142.4774 mg

Weight of blank (m_{ab}) 0 mg

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (P_a) = (0 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} P_a$ = (0)(200)(.7853) = (0)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	230	305	285
Date/Time of wt 12-4-87/9:00 Gross wt	g	142.7487	153.1148	148.2114
Date/Time of wt 12-8-87/11:00 Gross wt	g	142.7490	153.1145	148.2104
Average Gross wt	g	142.7489	153.1146	148.2109
Tare wt	g	142.6841	153.0514	148.1695
Less acetone blank wt (W_a)	g	0.0	0.0	0.0
Wt of particulate in acetone rinse (m_a)	g	0.0648	0.0632	0.0414

Filter Numbers	#	KA-2432	KA-2433	KA-2434
Date/Time of wt 12-4-87/9:00 Gross wt	g	0.5507	0.5507	0.5469
Date/Time of wt 12-8-87/11:00 Gross wt	g	0.5507	0.5509	0.5430
Average Gross wt	g	0.5507	0.5508	0.5450
Tare wt	g	0.5257	0.5239	0.5238

Weight of particulate on filters(s) (m_f)	g	0.0250	0.0269	0.0212
Weight of particulate in acetone rinse	g	0.0648	0.0632	0.0414
Total weight of particulate (m_n)	g	0.0898	0.0901	0.0626
Total weight of filters in backhalf	g	0.0422 / 0.1320 (Total)	= .0383 gr/dscf	

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 J. Cameron Mitchell — Signature of reviewer _____

Poolino (13) (Bank left)

Filter Weights: Run 1

.8m Tare
.0836
.0774
.0062

.8m Tare
.0915
.0768
.0147

.45m Tare
.0715
.0692
.0023

.45m Tare
.0752
.0695
.0057

.2m Tare
.0377
.0305
.0072

.2m Tare
.0403
.0322
.0081

.0062
.0147
.0023
.0057
.0072
.0081
.0422 g. Total on filters

Water Evaporation: Run 1

Beaker Tare
146.3927
146.3307
.0620 g. in beaker

VII. CALCULATIONS

NAME: PAOLINO PAVING & SUPPLY, INC.

LOCATION: PHILADELPHIA, PENNSYLVANIA

39-7160-02187

			date	12/03/87	12/03/87	12/03/
	SUMMARY OF TEST DATA			RUN # 1	RUN # 2	RUN #
	SAMPLING TRAIN DATA		start	09:02	14:24	16:1
			finish	13:32	15:29	17:1
1	Sampling time, minutes		θ	75	60	60
2	Sampling nozzle diameter, in.		Dn	.230	.230	.230
3	Sampling nozzle cross-sectional area, ft^2		An	.000289	.000289	.000289
4	Isokinetic variation		I	93	99	93
5	Sample gas volume - meter conditions, cf.		Vm	50.38	39.94	38.42
6	Average meter temperature, °R		Tm	523	524	528
7	Average oriface pressure drop, in.H_2O		ΔH	.94	.90	.88
8	Total particulate collected mg.		Mn	89.8	90.1	62.6
	VELOCITY TRAVERSE DATA					
9	Stack area, ft^2		A	14.1	14.1	14.1
10	Absolute stack gas pressure, in. Hg.		Ps	30.54	30.54	30.54
11	Barometric pressure, in. Hg.		Pbar	30.54	30.54	30.54
12	Average absolute stack temperature, °R		Ts	589	591	602
13	Average $\bar{\sqrt{\text{velocity head}}}$, (Cp= .80)		$\bar{\sqrt{\Delta P}}$	.98	.96	.95
14	Average stack gas velocity ft. / sec.		Vs	56	55	55
	STACK MOISTURE CONTENT					
15	Total water collected by train, ml.		Vic	185.0	209.0	160.0
16	Moisture in stack gas, %		Bws	14.1	18.9	15.8
	EMISSIONS DATA:					
17	Stack gas flow rate, dscf/hr. (000's)		Qsd	2,237	2,080	2,113
18	Total particulate concentration, gr/dscf		Cs	.0261	.0331	.0241
19	Total particulate concentration, lbs/hr		E	8.3	9.8	7.3
20	Total particulate concentration, lbs/mbtu		E'	.0000	.0000	.0000
	ORSAT DATA					
21	Percent CO2 by volume		CO2	3.0	4.0	2.5
22	Percent O2 by volume		O2	17.8	18.0	17.5
23	Percent CO by volume		CO	.0	.0	.0
24	Percent N2 by volume		N2	79.2	78.0	80.0

Buzzycalc

Dry Gas Volume :

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

Where:

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

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

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

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

T_m = Absolute temperature at meter $^\circ R$

T_{std} = Standard absolute temperature ($528^\circ R$)

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

Y = Dry gas meter calibration factor

13.6 = Inches water per inches Hg.

Run # 1 $V_{m(std)} = 17.64 \quad (1.02)(50.38) \left[\frac{(30.54) + \frac{.94}{13.6}}{523} \right] = 53.05$ ds

Run # 2 $V_{m(std)} = 17.64 \quad (1.02)(39.94) \left[\frac{(30.54) + \frac{.90}{13.6}}{524} \right] = 41.97$ ds

Run # 3 $V_{m(std)} = 17.64 \quad (1.02)(38.42) \left[\frac{(30.54) + \frac{.88}{13.6}}{528} \right] = 40.07$ ds

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: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{89.8}{53.05} \right] = .0261 \text{ gr./dscf.}$$

Run # 2: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{90.1}{41.97} \right] = .0331 \text{ gr./dscf.}$$

Run # 3: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{62.6}{40.07} \right] = .0241 \text{ gr./dscf.}$$

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: $M_d = 0.44(\ 3.0\%\ ) + 0.32(17.8\%\ ) + 0.28(\ \ .0\% + 79.2\%\ ) =$ 29.2 lb./lb.-mole

Run # 2: $M_d = 0.44(\ 4.0\%\ ) + 0.32(18.0\%\ ) + 0.28(\ \ .0\% + 78.0\%\ ) =$ 29.4 lb./lb.-mole

Run # 3: $M_d = 0.44(\ 2.5\%\ ) + 0.32(17.5\%\ ) + 0.28(\ \ .0\% + 80.0\%\ ) =$ 29.1 lb./lb.-mole

Water vapor condensed :

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

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

Where:

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

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

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

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

V_f = Final volume of impinger contents, ml.

V_i = Initial volume of impinger contents

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

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

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

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

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

Run # 1:	$V_{wc(std)}$	= (0.04707) (170.0) =	8.0	cu.ft
	$V_{wsg(std)}$	= (0.04715) (15.0) =	.7	cu.ft
Run # 2:	$V_{wc(std)}$	= (0.04707) (194.0) =	9.1	cu.ft
	$V_{wsg(std)}$	= (0.04715) (15.0) =	.7	cu.ft
Run # 3:	$V_{wc(std)}$	= (0.04707) (151.0) =	7.1	cu.ft
	$V_{wsg(std)}$	= (0.04715) (9.0) =	.4	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: $$B_{ws} = \frac{8.0 + .7}{8.0 + .7 + 53.05} \times 100 = 14.1\ \%$$

Run # 2: $$B_{ws} = \frac{9.1 + .7}{9.1 + .7 + 41.97} \times 100 = 18.9\ \%$$

Run # 3: $$B_{ws} = \frac{7.1 + .4}{7.1 + .4 + 40.07} \times 100 = 15.8\ \%$$

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: $M_s = 29.2\ (1-\ .141\ ) + 18\ (\ .141\ ) = 27.6$ (lb./lb.-mole).

Run # 2: $M_s = 29.4\ (1-\ .189\ ) + 18\ (\ .189\ ) = 27.3$ (lb./lb.-mole).

Run # 3: $M_s = 29.1\ (1-\ .158\ ) + 18\ (\ .158\ ) = 27.3$ (lb./lb.-mole).

Stack gas velocity:

$$V_s = K_p\, C_p \left| \sqrt{\Delta P} \right|_{avg.} \sqrt{\frac{T_{s(avg.)}}{P_s\ M_s}}$$

Where:

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

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

C_p = Pitot tube coefficient,(dimensionless).

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

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

P_g = Stack static pressure (in.Hg).

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

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

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

T_s = Absolute stack temperature, ($^\circ$R). = 460 + t_s.

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

Run # 1: $V = (85.49)\,(.80)\,(.98)\sqrt{\frac{589}{(30.54)(27.62)}} = 56.08$ ft/s

Run # 2: $V = (85.49)\,(.80)\,(.96)\sqrt{\frac{591}{(30.54)(27.25)}} = 55.40$ ft/s

Run # 3: $V = (85.49)\,(.80)\,(.95)\sqrt{\frac{602}{(30.54)(27.35)}} = 55.23$ ft/s

Stack gas flow rate:

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

Where:

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

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

3600 = Conversion factor, sec./hr.

t_s = Stack temperature ($^\circ$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:

$$Q_{sd} = 3600\ (1-.141)\ (\ 56.08)\ (\ \ 14.1) \left[\frac{528}{589}\right] \left[\frac{30.54}{29.92}\right] = 2237427 \text{ dscf}$$

Run # 2:

$$Q_{sd} = 3600\ (1-.189)\ (\ 55.40)\ (\ \ 14.1) \left[\frac{528}{591}\right] \left[\frac{30.54}{29.92}\right] = 2079726 \text{ dscf}$$

Run # 3:

$$Q_{sd} = 3600\ (1-.158)\ (\ 55.23)\ (\ \ 14.1) \left[\frac{528}{602}\right] \left[\frac{30.54}{29.92}\right] = 2113263 \text{ dscf}$$

Emissions rate from stack:

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

Where:

E = Emissions rate, lb./hr.

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

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

Run # 1: $E = \frac{(.0261)(2237427)}{7000} = 8.3$ lb. / hr.

Run # 2: $E = \frac{(.0331)(2079726)}{7000} = 9.8$ lb. / hr.

Run # 3: $E = \frac{(.0241)(2113263)}{7000} = 7.3$ lb. / hr.

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

Where:

I	=	Percent isokinetic sampling.
100	=	Conversion to percent.
T_s	=	Absolute average stack gas temperature, °R.
0.002669	=	Conversion factor, Hg - ft^3/ml - °R.
V_{ic}	=	Total volume of liquid collected in impingers and silica gel,
T_m	=	Absolute average dry gas meter temperature, °R.
P_{bar}	=	Barometric pressure at sampling site, (in.Hg).
ΔH	=	Average pressure differential across the oriface meter, (in.H_2
13.6	=	Specific gravity of mercury.
60	=	Conversion seconds to minutes
Q	=	Total sampling time, minutes.
V_s	=	Stack gas velocity, ft./sec.
P_s	=	Absolute stack gas pressure, in.Hg.
A_n	=	Cross sectional area of nozzle, ft^2.

Run # 1:

$$I = 100 \times 589 \left[\frac{(0.002669)(185.0) + \frac{50.4}{523}\left[30.54 + \frac{.94}{13.6}\right]}{60\ (\ 75\ )\ (\ 56.08\ )\ (30.54\ )\ (\ .000289\ )} \right] = 93\ \%$$

Run # 2:

$$I = 100 \times 591 \left[\frac{(0.002669)(209.0) + \frac{39.9}{524}\left[30.54 + \frac{.90}{13.6}\right]}{60\ (\ 60\ )\ (\ 55.40\ )\ (30.54\ )\ (\ .000289\ )} \right] = 99\ \%$$

Run # 3:

$$I = 100 \times 602 \left[\frac{(0.002669)(160.0) + \frac{38.4}{528}\left[30.54 + \frac{.88}{13.6}\right]}{60\ (\ 60\ )\ (\ 55.23\ )\ (30.54\ )\ (\ .000289\ )} \right] = 93\ \%$$

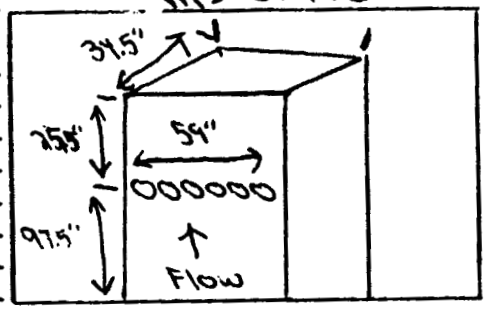
VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant Paolino & Sons

Location Philadelphia, Pennsylvania
Operator Steven Sherwood
Date 12/3/87
Run No. 1
Sample Box No. 1
Meter Box No. C38 7053053
Meter H @ 1.07
C Factor 1.02
Pitot Tube Coefficient Cp 0.801

$\eta = 0.940$



Schematic of Stack Cross Section

		IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
Ambient Temperature 41°			
Barometric Pressure 30.54	FINAL	370	528
Assumed Moisture, % 5%	INITIAL	200	513
Probe Length, m(ft) 3M	DIFFERENCE	170	15
Nozzle Identification No. 0.000 3185			
Avg. Calibrated Nozzle Dia., (in.) .330 .330 .330			
Probe Heater Setting 5			
Leak Rate, m^3/min. (cfm) .0018 @ 15 in.			
Probe Liner Material 316 Stainless Steel			
Static Pressure, mm Hg (in. Hg) -0.03 13.6			
Filter No. AA-2432			

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		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A) 1	9:02 / 9:04 30	3	119	0.53	0.50	187.26 / 188.51	40	40	180	35
2	9:07	5	125	0.70	0.66	189.86	50	40	190	35
3 *	12:15 / 12:17 30	9	141	1.20	1.15	191.95	60	60	210	45
4	12:20	11	144	1.70	1.60	194.16	65	60	220	45
5	12:23 30		143	1.80	1.70	196.45	65	60	230	45
B) 1	12:24 / 12:26 30	4	129	0.88	0.47	197.64	65	60	240	45
2	12:29	8	124	0.85	0.80	199.11	65	60	245	45
3	12:31 30	10	125	1.20	1.15	201.01	70	60	245	45
4	12:34	12	131	1.10	1.05	202.94	70	60	245	45
5	12:36 30	12	134	1.10	1.05	204.81	70	60	250	45
C) 1	12:37 30 / 12:40	7	135	0.65	0.61	206.13	70	60	245	45
2	12:42 30	9	133	0.95	0.89	207.81	70	60	240	45
3	12:45	10	128	1.0	0.94	209.51	70	60	240	45

* Plant Down.

$O_2 = 18\%$ $CO_2 = 3\%$

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 12/3/87 LOCATION Phil., Pa. TEST NO. 1

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME Vm (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
4	12:47 30	12	131	1.30	1.20	211.47	70	60	245	45
5	12:50	10	132	0.90	0.85	213.04	70	60	250	45
1	12:53 / 13:32	8	127	0.75	0.71	214.65	65	60	250	45
2	12:57	10	125	0.95	0.89	216.27	70	60	245	45
3	12:59 30	12	123	1.20	1.15	218.23	70	60	240	45
4	13:02	11	124	1.00	0.94	219.88	70	60	235	45
5	13:04 30	9	126	0.80	0.75	221.38	70	60	235	45
1	13:08 / 13:36 30	4	121	0.45	0.42	222.45	70	60	230	45
2	13:11	7	123	0.75	0.71	223.86	70	60	230	45
3	13:13 30	11	126	1.10	1.05	225.74	70	60	230	45
4	13:16	12	128	1.20	1.15	227.63	70	60	225	45
5	13:18 30	13	127	1.20	1.15	229.51	70	60	225	45
1	13:19 30 / 13:44	6	126	0.45	0.42	230.68	65	60	230	50
2	13:21 30	7	128	0.75	0.71	231.80	70	60	225	50
3	13:27	13	129	1.40	1.30	233.83	70	60	225	50
4	13:29 30	13	131	1.20	1.15	235.72	70	60	220	50
5	13:32	12	128	1.10	1.05	237.58	70	60	220	50

-SE-

RAMCON ENVIRONMENTAL CORPORATION

Plant Rodline & Sons

Location Philadelphia, Pennsylvania

Operator Shawn Desmond

Date 12/3/87

Run No. 2

Sample Box No. 2

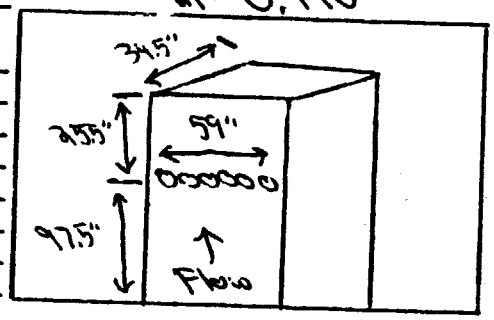
Meter Box No. Case 100205

Meter H @ 1.07

C Factor 1.32

Pitot Tube Coefficient Cp 0.801

$n = 0.940$



Ambient Temperature 46°

Barometric Pressure 30.51

Assumed Moisture, 8.5% 8.0%

Probe Length, m(ft) 3M

Nozzle Identification No. 0.800 0.805

Avg. Calibrated Nozzle Dia., (in.) .330 .330 .330

Probe Heater Setting 5

Leak Rate, m^3/min. (cfm) ≤0.015 @ 9"

Probe Liner Material S.S. Swagelok S.S.

Static Pressure, mm Hg (in. Hg) +0.03 1.35"

Filter No. HA-2433

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	394	496
INITIAL	200	481
DIFFERENCE	194	15

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H_2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A) 1	14:24 / 14:26	2	121	0.45	0.42	238.03 / 238.43	60	60	220	45
2	14:28	3	127	0.70	0.66	240.05	65	60	225	45
3	14:30	6	128	1.20	1.15	241.68	65	60	225	45
4	14:32	7	130	1.80	1.70	243.67	70	60	230	45
5	14:34	7	129	1.70	1.60	245.33	70	60	230	45
B) 1	14:35 / 14:37	2	127	0.50	0.47	246.23	70	55	235	45
2	14:39	3	130	0.75	0.71	247.39	70	55	240	45
3	14:41	6	128	1.20	1.15	249.00	70	55	240	45
4	14:43	6	126	1.30	1.20	250.71	75	55	240	45
5	14:45	5	124	1.05	0.99	252.12	75	55	245	45
C) 1	14:46 / 14:48	3	126	0.55	0.52	253.11	70	55	245	45
2	14:50	3	128	0.80	0.75	254.39	70	55	245	45
3	14:52	5	127	1.10	1.05	255.92	75	55	250	45

O_2 = 18.0% CO_2 = 4.0%

" = 18.0% " = 4.0%

Form #REG-05

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 12/3/87 LOCATION Ph. 1, Pa. TEST NO. 2

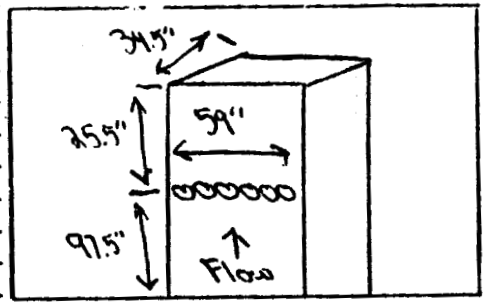
TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME Vm (ft^3)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
4	14:54	5	125	1.10	1.05	257.44	75	55	250	45
5	14:56	4	124	0.90	0.85	258.77	75	55	250	45
1	14:57 / 14:59	3	128	0.50	0.47	259.70	70	55	245	45
2	15:01	4	131	0.85	0.80	260.98	75	55	245	45
3	15:03	4	134	1.0	0.94	262.31	75	55	240	45
4	15:05	4	138	1.05	0.99	263.68	75	55	240	45
5	15:07	3	141	0.80	0.75	264.86	75	55	240	45
1	15:09 / 15:10	2	134	0.40	0.38	265.74	70	55	245	45
2	15:12	3	136	0.70	0.66	266.99	75	55	245	45
3	15:14	5	137	1.10	1.05	268.37	75	55	245	45
4	15:16	4	135	1.00	0.94	269.71	75	55	250	45
5	15:18	4	132	0.90	0.85	270.94	75	55	250	45
1	15:19 / 15:21	3	133	0.55	0.52	271.98	70	55	245	45
2	15:23	4	138	0.95	0.89	273.39	75	55	240	45
3	15:25	6	135	1.20	1.15	274.84	75	55	235	45
4	15:27	6	133	1.30	1.20	276.46	75	55	230	45
5	15:29	5	131	1.10	1.05	277.97	75	55	225	45

RAMCON ENVIRONMENTAL CORPORATION

Plant Radino & Sons

Location Philadelphia, Pennsylvania
Operator Shawn Sherwood
Date 12/3/87
Run No. 3
Sample Box No. 1
Meter Box No. Cal 7002857
Meter H @ 1.07
C Factor 1.02
Pitot Tube Coefficient Cp 0.801

A_n = .940



Ambient Temperature 46°
Barometric Pressure 30.54
Assumed Moisture, % 8.5% 9.2%
Probe Length, m(ft) 3.4

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	351	486
INITIAL	200	477
DIFFERENCE	151	9

Nozzle Identification No. 0.500 3995
Avg. Calibrated Nozzle Dia., (in.) .330 .331 .330
Probe Heater Setting 5
Leak Rate, m^3/min. (cfm) +0.019 @ 14 in.
Probe Liner Material 316 Stainless Steel
Static Pressure, mm Hg (in. Hg) +0.03 1.36
Filter No. AA-2434

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 H_2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A) 1	16:12 / 16:14	4	148	0.45	0.42	278.50 / 279.40	55	55	210	40
2	16:16	7	165	0.85	0.80	280.89	60	55	215	40
3	16:18	9	160	1.20	1.15	282.36	70	55	210	40
4	16:20	11	154	1.80	1.70	284.23	75	60	210	40
5	16:22	12	151	1.70	1.60	285.97	75	60	215	40
B) 1	16:23 / 16:25	4	144	0.50	0.47	287.01	75	60	220	45
2	16:27	5	144	0.70	0.66	288.07	75	65	220	45
3	16:29	8	143	1.05	0.99	289.43	80	65	225	45
4	16:31	8	145	1.10	1.05	290.80	80	65	225	45
5	16:33	7	141	0.95	0.89	292.16	80	65	230	45
C) 1	16:34 / 16:36	5	137	0.50	0.47	293.20	75	65	225	45
2	16:38	7	138	0.95	0.89	294.48	80	65	220	45
3	16:40	8	140	1.05	0.99	295.73	80	65	220	45

O_2 = 17.5% CO_2 = 2.5%

Form #REC-06

Page 2 of 2

RAMCON emissions test log sheet, cont. DATE 10/3/97 LOCATION Phil. Pa. TEST NO. 3

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
4	16:42	9	141	1.20	1.15	297.21	80	65	225	45
5	16:44	7	139	0.90	0.85	298.57	80	65	230	45
A1	16:39 / 16:47	4	138	0.55	0.52	299.70	75	60	230	45
2	16:49	7	141	0.90	0.85	300.89	75	60	230	45
3	16:51	8	140	1.10	1.05	302.39	75	60	230	45
4	16:53	9	139	1.20	1.15	303.72	75	60	235	45
5	16:55	6	136	0.80	0.75	304.98	75	60	240	45
B1	16:52 / 16:58	4	135	0.40	0.38	305.83	75	60	240	45
2	17:00	5	141	0.70	0.68	307.07	75	60	240	45
3	17:02	8	147	1.05	0.99	308.22	75	60	245	45
4	17:04	8	143	1.00	0.94	309.46	75	60	245	45
5	17:06	6	140	0.75	0.71	310.64	75	60	250	45
C1	17:07 / 17:09	4	134	0.45	0.42	311.49	75	60	250	45
2	17:11	6	139	0.85	0.80	312.85	75	60	245	45
3	17:13	9	136	1.20	1.15	314.22	75	60	240	45
4	17:15	8	133	1.05	0.99	315.64	75	60	240	45
5	17:17	7	131	0.90	0.85	316.92	75	60	239	45
									230	45

IX. CALIBRATIONS

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number _____ Date 12/7/07 Meter box number C283 Plant Perdue & Sons

Barometric pressure, P_b = 30.26 in. Hg Dry gas meter number 700305 Pretest Y 1.02

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter Inlet (t_{d_i}), °F	Temperature: Dry gas meter Outlet (t_{d_o}), °F	Temperature: Dry gas meter Average[a] (t_d), °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	$\frac{Y_i V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
0.50	10	345.00 / 349.89	72°	85° / 86°	68° / 70°	78°	4:58	2	1.03	1.10
1.00	10	350.00 / 354.415	72°	86° / 90°	70° / 72°	80°	6:57	4	1.02	1.06
1.50	10	355.00 / 359.57	72°	88° / 91°	74° / 75°	82°	11:11	6	1.02	1.03
									Y = 1.02	1.07

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

where

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

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

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

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

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

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

ΔH = Pressure differential across orifice, in. H_2O.

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

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

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number 1 Date 11-30-87 Meter box number C-242 Plant _____

Barometric pressure, P_b = 30.01 in. Hg Dry gas meter number 700205 Pretest Y 1.01

Orifice manometer setting, (ΔH), in. H_2O	Gas volume		Temperature				Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
	Wet test meter (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), °F	Dry gas meter Inlet (t_{d_i}), °F	Dry gas meter Outlet (t_{d_o}), °F	Dry gas meter Average[a] (t_d), °F				
1	10	9.85	78	78	82	80	14.10	5	1.017	1.11
1	10	10.06	76	93	88	85.5	14.11	5	1.006	1.12
1	10	10.09	77	85	92	88.5	14.13	5	1.009	1.11
									Y = 1.011	

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

where

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

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

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

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

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

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

ΔH = Pressure differential across orifice, in. H_2O.

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

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

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

POSTTEST DRY GAS METER CALIBRATION DATA FORM
EPA CALIBRATED ORIFICE

Calibration Date 12-14-87
Device Number 4
Device K' 2.480 x 10^{-4}
Meter Box No. C-282
D.G.M. No. 700205
P_{bar} 759.97 mmHg
T ambient 69.8 °F

$V_{mstd} = V_s$

$V_s = \frac{K' P_o \Theta}{V T_o}$

Where;

Sampling Time (Θ) min.	Vacuum (in. Hg)	Pressure Diff. Orf. Mtr (H_2O)	Gas Sample Volume (ft^3)	Gas Sample Tem At Dry Gas Met (°F)	
				Inlet	Outle
		ΔH avg.	V_m / V_{mstd}	°F / °R	
15.0	19"	0.28	459.878 / 465.338	74 / 75	71 / 71
RUN 1	19"	0.28	5.66 / 5.61	74.5 / 534.5	21.67 / 294
15.0	19"	0.28	465.338 / 471.226	74 / 76	72 / 71
RUN 2	19"	0.28	5.68 / 5.63	75 / 535.0	21.94 / 294
15.0	19"	0.28	471.226 / 476.904	75 / 75	72 / 71
RUN 3	19"	0.28	5.678 / 5.62	75 / 535	21.94 / 294

V_{mstd} = Dry gas volume through meter at standard conditions, cu.ft. (Determine using Method 5 formulas and procedures.)
V_s = Dry gas volume through calibrated orifice at standard conditions.
K' = Calibrated orifice constant (Determined by EPA).
P_o = Pressure at entry to orifice mm Hg.
T_o = Temperature at entry to orifice °K.

$$V_s = \frac{(2.480\times10^{-4})(759.97)(15)}{(17.15)}(35.3145) = 5.82\ ft^3$$

$$V_{mstd} = 17.64\,(5.61)\left[\frac{(29.97) + \frac{(0.28)}{13.6}}{(532.75)}\right] = 5.61\ ft^3$$

$$Y = \frac{V_s}{V_{mstd}} = \frac{5.82}{5.61} = 1.04$$

$$V_s = \frac{(2.480\times10^{-4})(759.97)(15)}{(17.15)}(35.3145) = 5.82\ ft^3$$

$$V_{mstd} = 17.64\,(5.63)\left[\frac{(29.92) + \frac{(0.28)}{13.6}}{(533.75)}\right] = 5.63\ ft^3$$

$$Y = \frac{V_s}{V_{mstd}} = \frac{5.82}{5.63} = 1.03$$

$$V_s = \frac{(2.480\times10^{-4})(759.97)(15)}{(17.15)}(35.3145) = 5.82\ ft^3$$

$$V_{mstd} = 17.64\,(5.62)\left[\frac{(29.92) + \frac{(0.28)}{13.6}}{(533.75)}\right] = 5.62\ ft^3$$

$$Y = \frac{V_s}{V_{mstd}} = \frac{5.82}{5.62} = 1.03$$

RAMCON ENVIRONMENTAL CORPORATION

Date 9-5-87 Thermocouple number Inlet

Ambient temperature 83 °F Barometric pressure 30.52 in. Hg

Calibrator C. Mitchell Reference: mercury-in-glass ✓

other _____

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °F	Thermocouple Potentiometer Temperature, °F	Temperature Difference,[c] %
A	Ice bath	33	33	0
B	oven	150	150	0
C	oven	175	175	0
D	Ambient	83	83	0
	12-3-87	41°F	41°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 9-5-87 Thermocouple number Hotbox #2

Ambient temperature 84 °F Barometric pressure 30.52 in. Hg

Calibrator C. Mitchell Reference: mercury-in-glass ✓

other _____

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °F	Thermocouple Potentiometer Temperature, °F	Temperature Difference,[c] %
A	Ice bath	33	33	0
B	Oven	150	150	0
C	Oven	175	175	0
D	Ambient	84	84	0
	12-3-87	41	41	0

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON

Lear Siegler Stack Sampler

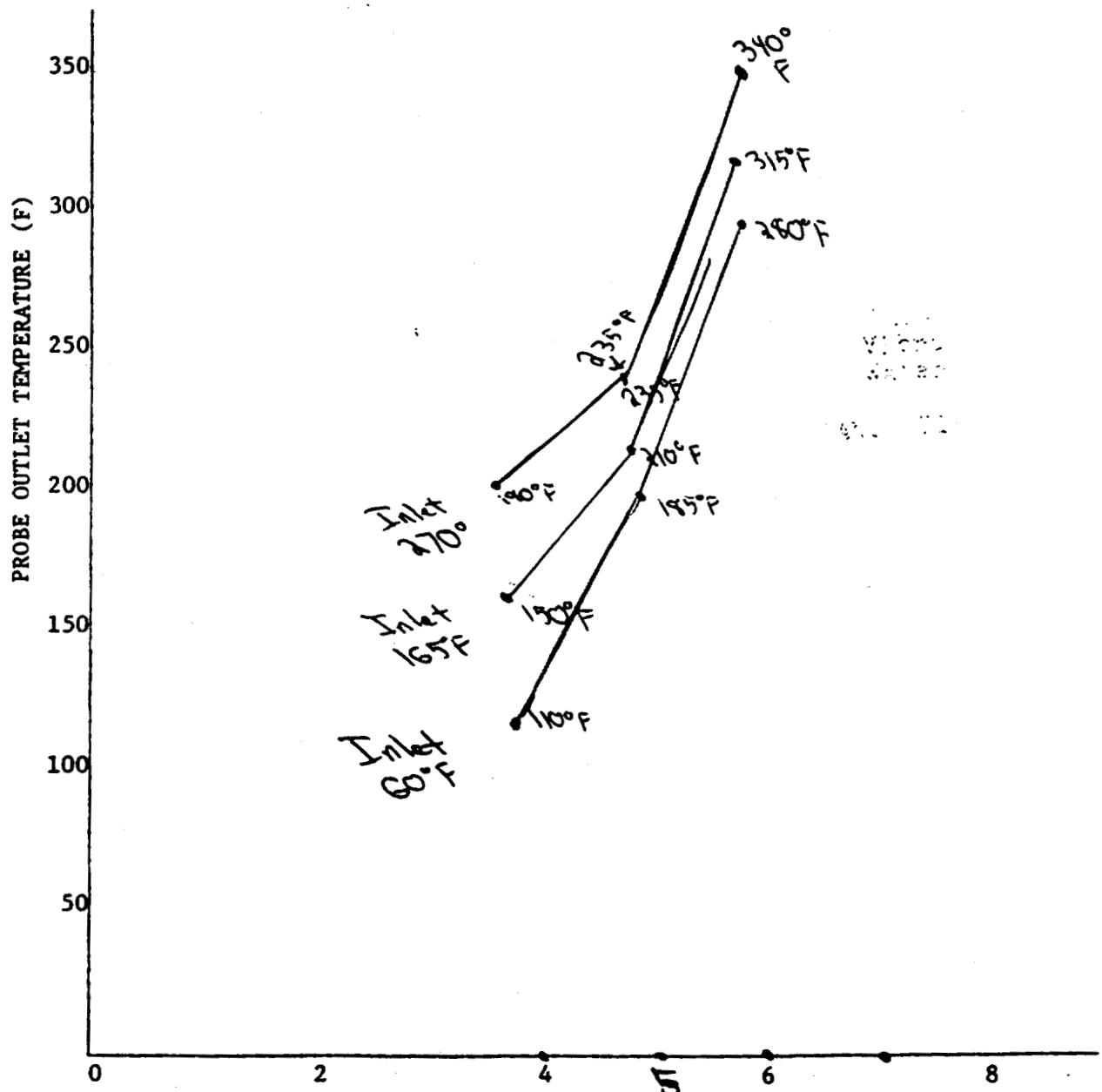
Heating Probe Calibration

Probe No. 33 Probe Length 3ft.

Date of Calibration 1/09/87 Signature Shawn Heerwood

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 9-5-87 Thermocouple number 33

Ambient temperature 85 °F Barometric pressure 30.52 in. Hg

Calibrator C. Mitchell Reference: mercury-in-glass ✓

other _____

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C °F	Thermocouple Potentiometer Temperature, °C °F	Temperature Difference,[c] %
A	Ice bath	33	33	0
B	oven	150	150	0
C	oven	175	175	0
D	Ambient	85	85	0
	12-3-87	41	41	0

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON ENVIRONMENTAL CORPORATION

Lear Siegler Stack Sampler

Nozzle Diameter Calibration

Date _____ Signature _____

Nozzle No.	Average Diameter	Nozzle No.	Average Diameter
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	

Pitot Tube Calibration (S Type)

Pitot Tube Identification No. 33 Date 9-5-87

Calibrated by: C. Mitchell

"A" SIDE CALIBRATION Impact

Run No.	Δp std cm H_2O (in. H_2O)	Δp (s) cm H_2O (in. H_2O)	$C_p(s)$	DEVIATION $C_{p(s)}-\bar{C}_p(A)$
1	1.10	1.70	0.804	+0.009
2	0.56	0.88	0.798	+0.003
3	0.33	0.54	0.782	-0.01
		$\bar{C}_p$ (SIDE A)	0.795	

"B" SIDE CALIBRATION

Run No.	Δp std cm H_2O (in. H_2O)	Δp(s) cm H_2O in. H_2O)	$C_p(s)$	DEVIATION $C_{p(s)}-\bar{C}_p(B)$
1	1.10	1.70	0.804	+0.003
2	0.56	0.87	0.802	+0.001
3	0.33	0.52	0.797	-0.004
		$\bar{C}_p$ (SIDE B)	0.801	

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

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

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

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 100 asphalt plants. He is 44 years old and a graduate of the University of Mississippi with graduate studies at Memphis State University and State Technical Institute of Memphis.

J. Cameron Mitchell - Team Leader

Cameron Mitchell has been employed by RAMCON for several years. He has undergone extensive training in Methods 1 through 9. He is qualified as a team leader and has personally sampled over 250 stacks including over 200 asphalt plants. He is currently certified as a V.E. reader. He recently graduated from Memphis State University with a Bachelors Degree in Civil Engineering and a minor in Mathematics.