Commonwealth of Pennsylvania
Environmental Resources
June 25, 1987

Subject: Source Test Review

To: Data File
Haines and Kibblehouse
Hilltown Township, Bucks County

From: John N. Mitchell
Air Pollution Control Engineer
Division of Technical Services and Monitoring
Bureau of Air Quality Control

Through: Chief, Source Testing and Monitoring Section

On April 14, 1987 RAMCON Environmental Corporation conducted particulate and SO_2 testing on Haines and Kibblehouse's Simplicity/Barber Greene batch mix asphalt plant in Hilltown Township, Bucks County. The asphalt plant is used to manufacture hot asphalt for road pavement. The source is subject to N.S.P.S. requirements and all applicable rules and regulations of the Department of Environmental Resources.

The following is a brief description of the Simplicity batch mix asphalt plant: The cold aggregate is stored in four bins which feed a common continuous conveyor. The conveyor feeds a rotating drum dryer which mixes and dries the aggregate. The drum dryer is heated by hot air from a Genco coal burner fired by coal and liquid propane used as a supplemental fuel. The heated air from the burner is drawn into the dryer by an exhaust fan. After passing through the coal burner and the dryer, the air is passed through a McCarter baghouse and discharged to the atmosphere through a 34 x 32.5 rectangular duct. The dried aggregate is sent to a gradation control unit which separates and stores the aggregate by size. From the gradation unit the aggregate is dispensed into a weigh hopper and then into a pug mill, where hot liquid asphalt is mixed thoroughly with the aggregate. The hot asphalt mix is then discharged to a storage silo where the mix is transferred through a slide gate into awaiting dump trucks. The particulate collected by the baghouse is recycled back to the pug mill.

The testing program was conducted without a pretest protocol submitted to the Department for approval. As a consequence, there are several inconsistencies that invoke questions as to the accuracy of the test results. They include:

1. The first test run was a simultaneous test for SO_2 and particulate. The Department does not accept a combination pollutant test, accept under very special circumstances and with prior approval of the Department.

2. Coal samples were not taken during sampling to verify the sulfur dioxide concentration obtained by testing.

3. A SO_2 audit sample was not analyzed with the SO_2 compliance sample to verify the analytical technique for SO_2.

4. The use of a water rinse in addition to a acetone rinse during cleanup, both required by the Department was questioned. Although the use of a water rinse was confirmed by G. Sumner Buck, President of RAMCON, by phone conversation, there is no laboratory data to verify the use of a water rinse.

5. The laboratory analysis of the backhalf showed no insoluble particulate. It has been the Department's experience that even on very clean sources, some particulate is found in the back half. It is suspected that RAMCON may not have used a 0.22 micropore filter as required by Chapter 139 §139.12(5).

With all the inconsistencies and irregularities encountered in report, the Department recommends that the Regional Office request the Department to retest this source to verify the results obtained by RAMCON.

The following information was extracted from the report:

	Run 1	Run 2	Run 3
Maximum Operating Capacity, Ton/hr	200	200	200
Actual Operating Rate, ton/hr	185	185	185
Volumetric Flow Rate, DSCFM	16,380	17,470	16,250
Particulate Concentration, grains/DSCF	0.0206*	0.0225	0.0221
Allowable Particulate Concentration, grains/DSCF	0.04	0.04	0.04
Emission Rate, lbs/hr	2.9*	3.4	3.1
SO_2 Concentration, ppm	90.6*	-	-
Allowable SO_2 Concentration, ppm	500	-	-

*Results obtained by an unapproved testing procedure.

RAMCON ENVIRONMENTAL CORPORATION

RAMCON BUILDING 223 SCOTT STREET MEMPHIS, TENNESSEE 38112 TELEPHONE 901 / 458-7000 800 / 458-4867

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
HAINES & KIBBLEHOUSE
BLOOMING GLEN, PENNSYLVANIA
April 14, 1987

Harry Budenz
Haines & Kibblehouse

G. Sumner Buck, III
President

Sam Turner
Field Supervisor

RAMCON ENVIRONMENTAL CORPORATION

RAMCON BUILDING 223 SCOTT STREET MEMPHIS, TENNESSEE 38112 TELEPHONE 901/458-7000 800/458-4667

April 23, 1987

Mr. Harry Budenz
Haines & Kibblehouse
P.O. Box 196
Skippack, PA 19474

Re: Particulate Emissions Test - Blooming Glen, Pennsylvania

Dear Mr. Budenz:

Enclosed are four copies of our report on the particulate emissions test we conducted at your hot mix asphalt plant. 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 in compliance with State and Federal Standards.

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

Mr. Phillip Bedein, P.E.
Department of Environmental Resources
Bureau of Air Quality Control
1875 New Hope Street
Norristown, PA 19401

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

Sincerely,

G. Summer Buck, III
President

GSBIII:kr

Enclosures

TABLE OF CONTENTS

I. INTRODUCTION

On April 14, 1987, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate & SO_2 emissions compliance at Haines & Kibblehouse's Simplelty batch mix asphalt plant located in Blooming Glen, Pennsylvania. RAMCON personnel conducting the test were Sam Turner, Field Supervisor and Bill Turner. 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 were limited to Mr. Turner and Ms. Rea.

The purpose of the test was to determine if the rate of particulate and SO_2 emissions from the plant's baghouse and the total contaminants by weight (grain loading) are below the N.S.P.S. limits set by EPA and 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 particulate emissions for the State of Pennsylvania are the same as those set by EPA. The allowable SO_2 emissions for the State of Pennsylvania is specified in Pennsylvania's Regulation Manual, Section 123.21 with an emissions limitation not to exceed 500 parts per million.

Mr. Ronald Drake and Mr. Phillip Bedein of Pennsylvania's Department of Environmental Resources observed the testing conducted by RAMCON.

TABLE I

SUMMARY OF TEST RESULTS
April 14, 1987

Test Run	Time	Grain Loading	SO_2 Emissions	Actual Emissions
1	07:11 to 08:13	0.0206 gr/DSCF	90.619 ppm	2.9 lbs/hr
2	08:56 to 09:58	0.0225 gr/DSCF		3.4 lbs/hr
3	10:30 to 11:32	0.0221 gr/DSCF		3.1 lbs/hr
	Averages:	0.0217 gr/DSCF		3.1 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. The SO_2 emissions is also below the allowable emissions limitation set by Pennsylvania. Therefore, the plant is operating in compliance with State and Federal Standards.

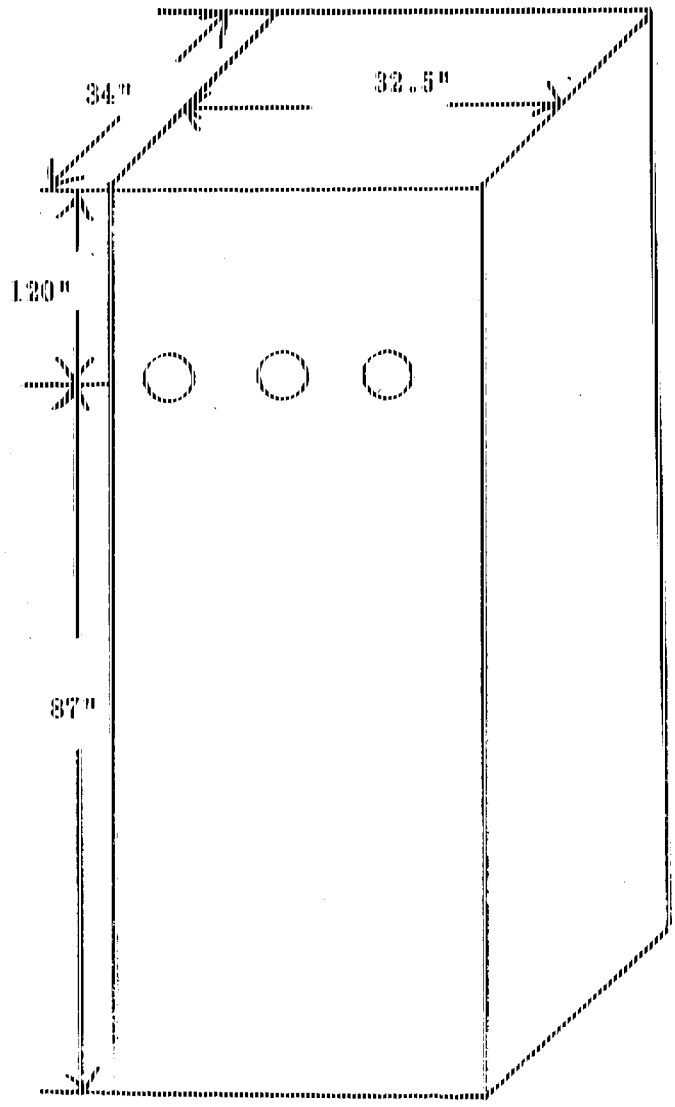
III. TEST PROCEDURES

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

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

C. Sampling Sites The emissions test was conducted after a baghouse on a rectangular stack measuring 34" x 32.5" with an equivalent diameter of 33.2". Three sampling ports were placed 120" down (3.6 diameters upstream) from the top of the stack and 87" up (2.6 diameters downstream) from the last flow disturbance. Twenty four points were sampled, eight through each port for 2.5 minutes each.

Points on a Diameter	Probe Mark
1	2.1"
2	6.4"
3	10.7"
4	15.0"
5	19.3"
6	23.6"
7	27.9"
8	32.2"



IV. THE SOURCE

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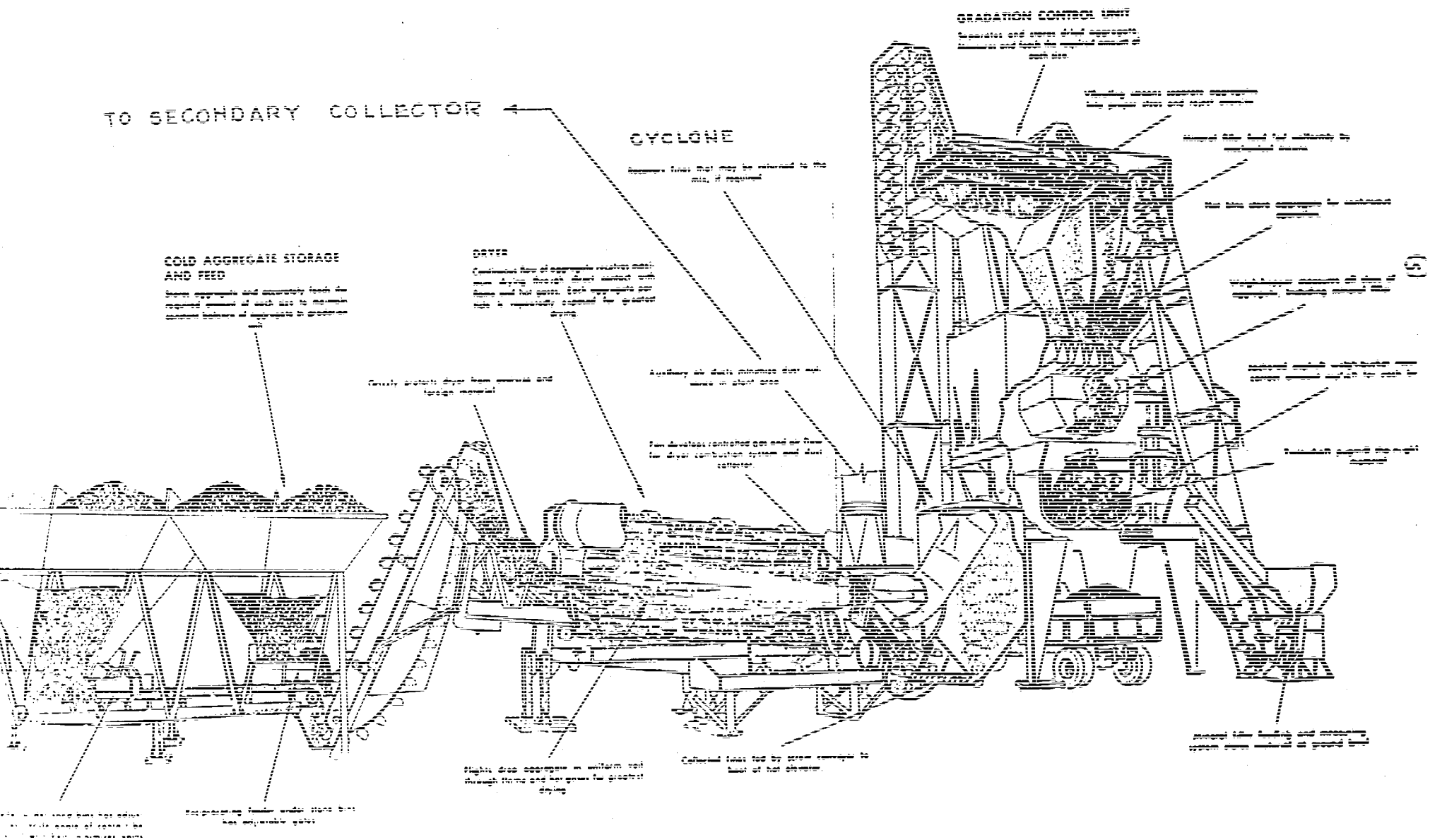
Haines & Kibblehouse employs a Simplicity batch mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind 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 Genco coal burner fired with propane and coal to heat air to dry the aggregate. The air is drawn into the system via an exhaust fan. After passing through the burner and the mixing drum, the air passes through a baghouse. The baghouse is manufactured by McCarter. The exhaust gasses are 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 Lampblack.
2. Designed maximum operating capacity 200 TPH @ 5 % moisture.
3. Actual operation rate 125 TPH @ 5 % moisture.
4. Startup date March, 1986 (Recaptured)
5. Type of fuel used in dryer Digital Blackhead Coal
6. Quality of fuel consumption Digital 10,000 Btu/lb.

Aggregate

7. Name/type of mix 1/2 Asphalt.
8. Percent asphalt in mix 5.9 %.
9. Temperature of asphalt 320°F.
10. Sieve/Screening analysis: % Passing:

1" 100	#4 45.0	#50 14.5
3/4" 95.0	#16 33.1	#100 8.8
1/2" 650	#30 23.3	#200 5.5

Baghouse

11. Manufacturer Wheelabrator.
12. No. of bags 540. Type of bags Dynel 16#.
13. Air to cloth ratio 4:1. Designed ACFM 20,000.
14. Square feet of bags 6925.
15. Type of cleaning: pulse jet /, reverse air ____, plenum pulse ____, other ____.
16. Cleaning cycle time 1 Sec.
17. Interval between cleaning cycle 540 sec.
18. Pressure drop across baghouse 5-7 inches psi.
19. Pulse pressure on cleaning cycle 85-90 psi.

COMPANY NAME Lemley Hot Mix DATE ____

COMPANY REPRESENTATIVE Gary Lemley

PLANT DATA (7)

COMPANY NAME [illegible]

COMPANY REP. [illegible] DATE [illegible] Phone [illegible]

DATA SOURCE [illegible]

PLANT LOCATION [illegible]

PLANT MANUFACTURER [illegible] PLANT MODEL NO. [illegible] PLANT TYPE [illegible]

MIX SPECIFICATION NO. [illegible] OIL SPECIFICATION NO. [illegible]

TIME: START _____ STOP _____ A.T. _____ °F R.H. _____ %

	TIME 24 HOUR	FUEL OIL ☐ NATURAL GAS ☐ PROPANE ☐	BURNER SETTING	AGGREGATE TPH	RECYCLE TPH	ASPHALT	MIX TEMPERATURE °F	VENTURI ☐ Baghouse ☐ DIFFERENTIAL
	0715	Propane Oil	60%	185		5.9%	320°F	6 1/2 inches
	0730	"	50%	"		"	"	"
#1	0745	"	25%	"		"	"	"
	0800	"	35%	"		5.9%	320°F	6 1/2 inches
	0815	Propane Oil	30%	"	X	"	320°F	"
	0830	"	30%	"	"	5.9%	320°F	6" inches
	0845	"	20%	"	"	5.9%	325°	5 1/2"
	0900	"	35%	"	V	5.9%	320°	5 1/2
	0915	"	45%	"	X	5.9%	320	5 1/2
	0930	"	30	"	"	5.9%	320	5 1/2
#2	0945	"	35%	"	X	5.9%	320	5 1/2
	1000	"	30%	"	X	5.9%	320	5 1/2
	1015	"	30%	"	X	5.9%	320	5 1/2
	1030		30%		X	5.9%	320°	5 1/2
	1045		30%		X	5.9%	320°	5 1/2
	1100		30%			5.9	320	5 1/2
	1115		35%			5.9	320	5 1/2

REMARKS:

Form #REC-04

PLANT AREA (8)

COMPANY NAME

COMPANY REP. DATE Phone #

DATA SOURCE

PLANT LOCATION

PLANT MANUFACTURER PLANT MODEL NO. PLANT TYPE

MIX SPECIFICATION NO. OIL SPECIFICATION NO.

TIME: START STOP A.T. °F R.H. %

TIME 24 HOUR	FUEL OIL [ ] NATURAL GAS [ ] PROPANE [ ]	BURNER SETTING	AGGREGATE TPH	RECYCLE TPH	ASPHALT	MIX TEMPERATURE °F	VENTURI [ ] Baghouse [ ] DIFFERENTIAL
1130	Propane Oil	35	185	X	5.9%	380°	5 1/2
1145							
1200							
1215							

REMARKS:

Form #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.

VII. 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.

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.

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.

Form RBC#8

SAMPLE ANALYTICAL DATA FORM

(rg)

Plant Location Plains — Relative humidity in lab 35 %

Sample Location Lake Mac Road Site — Density of Acetone (pa) .7853 mg/ml

Blank volume (V_a) 200 ml

Date/Time wt. blank 4-20-97 — Gross wt. 101.6882 mg

Date/Time wt. blank 4-21-97 — Gross wt. 101.6872 mg

Ave. Gross wt. 101.6877 mg

Tare wt. 101.6874 mg

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

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (pa) = (.00001 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} P_a$ = (.00001)(200)(.7853) = (.0003)

		Run # 1	Run # 2	Run #3
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt. 4-20-97 Gross wt.	g	100.4871	98.2111	96.4413
Date/Time of wt. 4-21-97 Gross wt.	g	100.4868	98.2109	96.4410
Average Gross wt.	g	100.4870	98.2110	96.4412
Tare wt.	g	100.4834	98.1778	96.4154
Less acetone blank wt. (W_a)	g	.0003	.0003	.0003
Wt of particulate in acetone rinse (m_a)	g	.0033	.0329	.0255

Filter Numbers	#	SG-1909	SG-1913	SG-1910
Date/Time of wt. 4-20-97 Gross wt.	g	.5800	.5693	.5519
Date/Time of wt. 4-21-97 Gross wt.	g	.5800	.5690	.5518
Average Gross wt.	g	.5800	.5692	.5519
Tare wt.	g	.5319	.5236	.5035

Weight of particulate on filters(s) (m_f)	g	.0481	.0456	.0484
Weight of particulate in acetone rinse	g	.0033	.0329	.0255
Total weight of particulate (m_n)	g	.0714	.0785	.0739

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

Remarks

Signature of analyst [signature] Signature of reviewer [signature]

COMPANY NAME (cq) Glass & Cobblehouse

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	243	224	246
Date/Time of wt. 4-20-87	Gross wt.	g	.0317	.0324	.0322
Date/Time of wt. 4-21-87	Gross wt.	g	.0316	.0320	.0321
Filter Avg.	Gross wt.	g	.0316	.0320	.0321
	Tare wt.	g	.0316	.0320	.0321
Weight of insoluble particulate impinger rinse		g	0	0	0
Water evaporation		#	1	2	3
Date/Time of wt. 4-20-87	Gross wt.	g	95.1033	92.0764	96.1855
Date/Time of wt. 4-21-87	Gross wt.	g	95.1029	92.0760	96.1842
Beaker Avg.	Gross wt.	g	95.1030	92.0764	96.1851
	Tare wt.	g	95.0689	97.0320	98.1340
Weight of soluble particulate from water		g	.0341	.0444	.0511
Total weight of particulate (m_n)		g	.0341	.0444	.0511

Remarks _____

Signature of Analyst Kim Ray

Signature of Reviewer _____

(cs)

SO_2 ANALYSES
(Method 6)

Plant Haines #1 Date 4-27-87

Audit Samples

Audit Number		A	B	A	B	A	B	A	B
V_{soln}	(ml)								
V_a	(ml)								
N	(N)								
V_t	(ml)								
$V_{m(std)}$	(dscm)								
C_{SO_2}	(mg/dscm)								

K_2 = 32.03 mg/meq

SO_2 Analysis for Impinger 2 & 3 Combined.

Run Number		1		2		3		Blank	
		A	B	A	B	A	B	A	B
V_{soln}	(ml)	1000	1000						
V_a	(ml)	10	10						
N	(N)	.0097	.0097						
V_t	(ml)	11.4	11.6						
$V_{m(std)}$	(dscf)								
C_{SO_2}	(lb/dscf)								

K_3 = 7.061×10^{-5} lb/meq

Analysis performed by: Sam Edwards Approved by: _____

VII. CALCULATIONS

NAME: HAINES & KIBBLEHOUSE

LOCATION: BLOOMING GLEN QUARRY

			date	4/14/87	4/14/87	4/14/87
	SUMMARY OF TEST DATA			RUN # 1	RUN # 2	RUN # 3
	SAMPLING TRAIN DATA		start	07:11	08:56	10:30
			finish	08:13	09:58	11:32
1	Sampling time, minutes		θ	60	60	60
2	Sampling nozzle diameter, in.		Dn	.280	.280	.280
3	Sampling nozzle cross-sectional area, ft^2		An	.000428	.000428	.000428
4	Isokinetic variation		I	97	92	94
5	Sample gas volume - meter conditions, cf.		Vm	51.00	52.37	51.09
6	Average meter temperature, °R		Tm	514	525	535
7	Average orifice pressure drop, in.H_2O		ΔH	2.63	2.82	2.63
8	Total particulate collected mg.		Mn	71.4	78.5	73.9
	VELOCITY TRAVERSE DATA					
9	Stack area, ft^2		A	7.7	7.7	7.7
10	Absolute stack gas pressure, in. Hg.		Ps	30.15	30.15	30.15
11	Barometric pressure, in. Hg.		Pbar	30.15	30.15	30.15
12	Average absolute stack temperature, °R		Ts	695	689	700
13	Average $\sqrt{\text{velocity head}}$, (Cp= .82)		$\sqrt{\Delta P}$	.88	.92	.88
14	Average stack gas velocity ft. / sec.		Vs	57	59	57
	STACK MOISTURE CONTENT					
15	Total water collected by train, ml.		Vlc	253.0	233.0	252.0
16	Moisture in stack gas, %		Bws	18.2	16.9	18.8
	EMISSIONS DATA:					
17	Stack gas flow rate, dscf/hr. (000's)		Qsd	983	1,048	975
18	Total particulate concentration, gr/dscf		Cs	.0206	.0225	.0221
19	Total particulate concentration, lbs/hr		E	2.9	3.4	3.1
20	Total particulate concentration, lbs/mbtu		E	.0000	.0000	.0000
	ORSAT DATA					
21	Percent CO2 by volume		CO2	3.0	2.0	2.0
22	Percent O2 by volume		O2	15.0	16.0	16.0
23	Percent CO by volume		CO	.0	.0	.0
24	Percent N2 by volume		N2	82.0	82.0	82.0

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 $V_{m(std)} = 17.64 \quad (1.01)(51.00) \left[\frac{(30.15) + \frac{2.63}{13.6}}{514} \right] = 53.37$ dscf

Run # 2 $V_{m(std)} = 17.64 \quad (1.01)(52.37) \left[\frac{(30.15) + \frac{2.82}{13.6}}{528} \right] = 53.69$ dscf

Run # 3 $V_{m(std)} = 17.64 \quad (1.01)(51.09) \left[\frac{(30.15) + \frac{2.63}{13.6}}{535} \right] = 51.38$ 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: $C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{71.4}{53.37}\right] = .0206$ gr./dscf.

Run # 2: $C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{78.5}{53.69}\right] = .0225$ gr./dscf.

Run # 3: $C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{73.2}{51.38}\right] = .0221$ 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($15.0% $) + 0.28($ .0% + 82.0% $) =$ 29.1 lb./lb.-mole

Run # 2: $M_d = 0.44($ 2.0% $) + 0.32($16.0% $) + 0.28($ .0% + 82.0% $) =$ 29.0 lb./lb.-mole

Run # 3: $M_d = 0.44($ 2.0% $) + 0.32($16.0% $) + 0.28($ .0% + 82.0% $) =$ 29.0 lb./lb.-mole

Water vapor condensed :

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

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

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) (243.0) =	11.4 cu.ft
	$V_{wsg(std)}$	= (0.04715) (10.0) =	.5 cu.ft
Run # 2:	$V_{wc(std)}$	= (0.04707) (224.0) =	10.5 cu.ft
	$V_{wsg(std)}$	= (0.04715) (9.0) =	.4 cu.ft
Run # 3:	$V_{wc(std)}$	= (0.04707) (246.0) =	11.6 cu.ft
	$V_{wsg(std)}$	= (0.04715) (6.0) =	.3 cu.ft

(ar)

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: $$B_{ws} = \frac{11.4 + .5}{11.4 + .5 + 53.37} \times 100 = 18.2\ \%$$

Run # 2: $$B_{ws} = \frac{10.5 + .4}{10.5 + .4 + 53.69} \times 100 = 16.9\ \%$$

Run # 3: $$B_{ws} = \frac{11.6 + .3}{11.6 + .3 + 51.38} \times 100 = 18.8\ \%$$

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: $M_s = 29.1 (1- .182) + 18 (.182) = 27.1$ (lb./lb.-mole).

Run # 2: $M_s = 29.0 (1- .169) + 18 (.169) = 27.1$ (lb./lb.-mole).

Run # 3: $M_s = 29.0 (1- .188) + 18 (.188) = 26.9$ (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: $V = (85.49)(.82)(.88)\sqrt{\frac{695}{(30.15)(27.08)}} = 56.64$ ft/se

Run # 2: $V = (85.49)(.82)(.92)\sqrt{\frac{699}{(30.15)(27.14)}} = 58.89$ ft/se

Run # 3: $V = (85.49)(.82)(.88)\sqrt{\frac{700}{(30.15)(26.93)}} = 57.00$ ft/se

Stack gas flow rate:

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

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-.182) (56.64) (7.7) $\left[\frac{528}{695}\right] \left[\frac{30.15}{29.92}\right]$ = 983206 dscf/

Run # 2:

Q_{sd} = 3600 (1-.169) (58.89) (7.7) $\left[\frac{528}{689}\right] \left[\frac{30.15}{29.92}\right]$ = 1047554 dscf/

Run # 3:

Q_{sd} = 3600 (1-.188) (57.00) (7.7) $\left[\frac{528}{700}\right] \left[\frac{30.15}{29.92}\right]$ = 975182 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: $E = \frac{(.0206)(983206)}{7000} = 2.9$ lb./hr.

Run # 2: $E = \frac{(.0225)(1047554)}{7000} = 3.4$ lb./hr.

Run # 3: $E = \frac{(.0221)(975182)}{7000} = 3.1$ lb./hr.

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

Where:

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

Run # 1:

$$I = 100 \times 695 \left[\frac{(0.002669)(253.0) + \frac{51.0}{514}\left[30.15 + \frac{2.63}{13.6}\right]}{60\ (60)\ (56.64)\ (30.15)\ (.000428)} \right] = 97\ \%$$

Run # 2:

$$I = 100 \times 689 \left[\frac{(0.002669)(233.0) + \frac{52.4}{525}\left[30.15 + \frac{2.82}{13.6}\right]}{60\ (60)\ (58.89)\ (30.15)\ (.000428)} \right] = 92\ \%$$

Run # 3:

$$I = 100 \times 700 \left[\frac{(0.002669)(252.0) + \frac{51.1}{535}\left[30.15 + \frac{2.63}{13.6}\right]}{60\ (60)\ (57.00)\ (30.15)\ (.000428)} \right] = 94\ \%$$

Sulfur Dioxide Concentration

$$CSO_2 = \frac{K_3 N (V_t - V_{tb}) \left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Where; CSO_2 = Sulfur dioxide concentration, (lbs/dscf)

K_3 = 7.061×10^{-5} Lb/meq

N = Normality of barium perchlorate titrant, g equivalents/liter

V_t = Volume of barium perchlorate titrant used for the sample, ml.

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.

V_{soln} = Total volume of solution in which the sulfuric acid or sulfur dioxide sample is contained, 250 ml or 1,000 ml respectively

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter corrected to standard conditions, dscf.

V_a = Volume of sample aliquot titrated (10 ml for SO_2)

Run # 1: $CSO_2 = 7.061 \times 10^{-5} \left[\frac{.0099000 \ (\ 11.50 - \ .00) \ \left(\frac{1000}{10}\right)}{(\ \ 53.370 \ \ )} \right] = .0000150600$ lbs./dscf

Run # 2: $CSO_2 = 7.061 \times 10^{-5} \left[\frac{.0000000 \ (\ \ .00 - \ .00) \ \left(\frac{\ \ 0}{0}\right)}{(\ \ 53.690 \ \ )} \right] = .0000000000$ lbs./dscf

Run # 3: $CSO_2 = 7.061 \times 10^{-5} \left[\frac{.0000000 \ (\ \ .00 - \ .00) \ \left(\frac{\ \ 0}{0}\right)}{(\ \ 51.380 \ \ )} \right] = .0000000000$ lbs./dscf

Sulfur Dioxide Emissions

$$E = CSO_2 \times Q_{sd}$$

Where; E = Emissions of sulfur dioxide in pounds per hour

Q_{sd} = Stack gas flow rate (dscf/hr)

CSO_2 = Sulfur dioxide concentration (lbs/dscf)

Run # 1: E = (.000015060 lbs/dscf) (783206 dscf/hr) = 14.81 lbs/hr

Run # 2: E = (.000000000 lbs/dscf) (1047554 dscf/hr) = .00 lbs/hr

Run # 3: E = (.000000000 lbs/dscf) (775182 dscf/hr) = .00 lbs/hr

Emissions of SO_2 PPM (Parts Per Million)

$$E = CSO_2 \left| \frac{453.593g}{1\ lb} \right| \frac{MOL\ SO_2}{64g\ SO_2} \left| \frac{22.4\ l}{MOL} \right| \frac{293^\circ K}{273^\circ K} \left| \frac{ft^3}{28.317\ l} \right| 1,000,000$$

Where: CSO_2 = Concentration of SO_2 in lbs/dscf

453.593 = Conversion to grams

MOL SO_2 = Molar conversion for SO_2

22.4 l/MOL = Volumetric molar conversion @ $273^\circ K$

$293^\circ K/273^\circ K$ = Temperature correction to std conditions

28.317 l = Conversion of liters to cubic feet

1,000,000 = Conversion to parts per million

Run # 1:

$$E = \frac{.0000150600\ lbs}{dscf} \left| \frac{453.593g}{1\ lb} \right| \frac{MOL\ SO_2}{64g\ SO_2} \left| \frac{22.4\ l}{MOL} \right| \frac{293^\circ K}{273^\circ K} \left| \frac{ft^3}{28.317\ l} \right| 1,000,000 =$$

90.619 ppm

Run # 2:

$$E = \frac{.0000000000\ lbs}{dscf} \left| \frac{453.593g}{1\ lb} \right| \frac{MOL\ SO_2}{64g\ SO_2} \left| \frac{22.4\ l}{MOL} \right| \frac{293^\circ K}{273^\circ K} \left| \frac{ft^3}{28.317\ l} \right| 1,000,000 =$$

.000 ppm

Run # 3:

$$E = \frac{.0000000000\ lbs}{dscf} \left| \frac{453.593g}{1\ lb} \right| \frac{MOL\ SO_2}{64g\ SO_2} \left| \frac{22.4\ l}{MOL} \right| \frac{293^\circ K}{273^\circ K} \left| \frac{ft^3}{28.317\ l} \right| 1,000,000 =$$

.000 ppm

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant Haines & Kibblehouse

Location Hamburg Glen Rd

Operator Sam Turner

Date 4-14-97

Run No. 1 (3a)(5a)

Sample Box No. 2

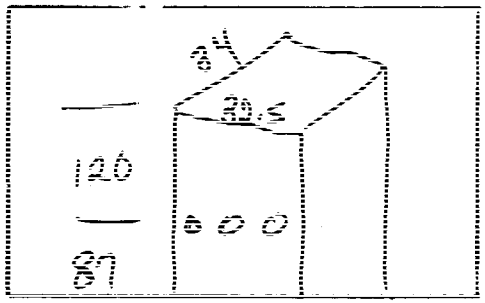
Meter Box No. 670775

Meter H @ 1.84

C Factor .998 1.005

Pitot Tube Coefficient Cp .96

.55



	Value	Temp.
Ambient Temperature	48	
Barometric Pressure	30.15 mm Hg	760	964
Assumed Moisture, %	21 mm H2O	533	677
Probe Length, m(ft)	4' mm H2O	25	10
Nozzle Identification No.	.0994276		
Avg. Calibrated Nozzle Dia., (in.)	.238/.238/.239		
Probe Heater Setting	4		
Leak Rate, m³/min. (cfm)	.01 @ 7" Vac		
Probe Liner Material	Stainless Steel		
Static Pressure, mm Hg(in. Hg)	-3/-0.6		
Filter No.	96-1909		

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft³	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	°F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A 1	7:11:30 / 7:14	4	203	.70	2.3	143.70	40	40	235	35
2	7:16:30	5	204	.80	2.7	149.60	54	46	235	35
3	7:19	5	207	.80	2.7	150.50	56	41	235	35
4	7:21:30	5	235	.70	2.3	151.60	58	42	230	35
5	7:24	5	230	.70	2.3	154.60	60	42	230	35
6	7:26:30	6	230	.80	2.7	156.40	62	43	250	40
7	7:29	6	232	.80	2.7	159.00	63	44	250	46
8	7:31:30	6	230	.90	2.7	160.90	64	44	250	40
B 1	7:33:30 / 7:35	6	227	.80	2.7	162.90	46	44	245	40
2	7:37:30	6	228	.80	2.7	165.10	62	44	245	40
3	7:40	6	221	.80	2.7	167.80	64	44	245	47
4	7:42:30	6	229	.80	2.7	169.50	64	44	240	40
5	7:45	6	237	.80	2.7	171.60	64	44	240	45

3.0 CO2 [illegible] % 6.2 [illegible]

15.0 O2 [illegible] % O2 15.9

Form #REC-06

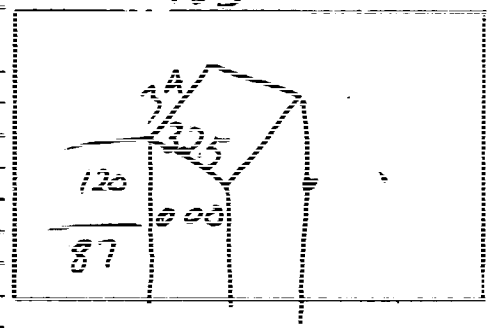
RAMCON emissions test log sheet, cont. DATE 11-14-87 LOCATION Planning Glew TEST NO. 1

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)
6	7:47:30	6	245	.80	2.7	173.90	66	46	240	40
7	7:50	6	245	.80	2.7	176.00	66	46	240	40
8	7:52:30	6	234	.80	2.7	178.11	69	47	240	40
C) 1	~~7:55:30~~ 7:56	5	240	.70	2.3	180.30	62	48	240	45
2	7:58:30	6	240	.80	2.7	182.30	68	48	240	45
3	8:01	6	243	.80	2.7	184.60	69	48	245	45
4	8:03:30	6	248	.80	2.7	186.60	70	48	245	45
5	8:06	6	250	.80	2.7	188.70	70	48	245	45
6	8:08:30	6	253	.80	2.7	190.90	70	49	240	45
7	8:11	6	257	.80	2.7	193.00	70	49	240	45
8	8:13:30	6	260	.80	2.7	195.21	70	49	240	45

RADIAN ENVIRONMENTAL CORPORATION

Plant Leaders Refractories .55

Location Bloomsburg Pa.
Operator Bill Feltner
Date 4-24-92
Run No. 2
Sample Box No. 3
Meter Box No. 670775
Meter H @ 1.84
C Factor 1.005
Pitot Tube Coefficient Cp .86



Schematic of Stack Cross Section

Ambient Temperature	58		
Barometric Pressure	30.15 mm	424	493
Assumed Moisture, %	21 mm	320	474
Probe Length, m(ft)	4' mm	224	7
Nozzle Identification No.	.0004-376		
Avg. Calibrated Nozzle Dia., (in.)	.238/.238		
Probe Heater Setting	4		
Leak Rate, m³/min.(cfm)	.000 @ 7" dec.		
Probe Liner Material	316 Mes 316		
Static Pressure, mm Hg(in.Hg)	-1/13.6		
Filter No.	56-1/13		

TRAV. PT NO.	SAMPLING TIME (θ)min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft³	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	8:58:58	2	220	.60	2.0	197.42	54	52	250	40
2	9:01	4	230	.80	2.7	199.58	64	52	250	40
3	9:03:30	4	230	.80	2.7	201.68	69	52	255	40
4	9:06	5	230	.80	2.7	203.71	70	52	240	35
5	9:08:30	5	230	.80	2.7	205.86	70	52	240	35
6	9:11	5	235	.80	2.7	208.07	72	54	240	35
7	9:13:30	6	230	.90	3.0	210.36	74	54	250	40
8	9:16	6	225	1.0	3.3	212.58	74	54	250	50
B) 1	9:17:24	6	200	.9	3.0	214.82	70	56	250	50
2	9:22	6	230	.9	3.0	217.19	70	56	255	50
3	9:24:30	6	240	.8	2.7	219.22	76	58	255	56
4	9:27	6	235	.8	2.7	221.49	76	58	260	60
5	9:29:30	5	230	.8	2.7	223.56	78	58	260	55

$CO_2 = 2.0$ $O_2 = 16$ CO_2 2.0 O_2 16.0

Form #REC-05

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 4-4-87 LOCATION Blooming Glen Pa Haines & Kibblehouse 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 (ft³)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
6	9:32	6	230	.9	3.0	225.32	78	58	260	55
7	9:34:30	6	230	.9	3.0	228.05	79	58	260	55
8	9:37	6	230	.9	3.0	230.375	78	60	250	50
C) 1	9:40:30	6	200	.7	2.3	232.27	64	60	250	50
2	9:43	6	210	.8	2.7	234.32	80	60	250	50
3	9:45:30	6	240	.8	2.7	236.55	80	60	250	50
4	9:48	6	240	.9	3.0	238.86	80	60	255	50
5	9:50:30	6	230	.9	3.0	240.11	80	60	255	50
6	9:53	6	235	.9	3.0	243.45	80	60	255	50
7	9:55:30	6	240	.9	3.0	245.63	80	60	255	50
8	9:58	6	245	.9	3.0	247.91	80	60	260	50

KAMCON ENVIRONMENTAL CORPORATION

Plant Hawes & Kilgore

Location Bowling Glen Pa
Operator Sam Lumen
Date 9-14-91
Run No. 3
Sample Box No. 2
Meter Box No. 670775
Meter H @ 1.94
C Factor 1.005
Pitot Tube Coefficient Cp .816

		Value	Metric
Ambient Temperature	58		
Barometric Pressure	30.15 mm	446	746
Assumed Moisture, %	21 mm	260	460
Probe Length, m(ft)	4' mm	254	6

Nozzle Identification No. .6/0427C
Avg. Calibrated Nozzle Dia., (in.) .29/.291.28
Probe Heater Setting 4
Leak Rate, m³/min.(cfm) .015 at 9" Hg.
Probe Liner Material Stainless Steel
Static Pressure, mm Hg(in.Hg) .1/134
Filter No. SG-1/0

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ)min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_g) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft³	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A 1	10:30 10:40:30	4	227	.70	2.3	348.0 350.60	65	61	235	50
2	10:35	4	230	.70	2.3	352.40	75	61	245	40
3	10:30:30	4	240	.70	2.3	353.90	80	62	245	40
4	10:40	4	242	.70	2.3	356.10	80	62	245	40
5	10:42:30	6	242	.80	2.7	359.20	82	62	245	40
6	10:45	6	230	.80	2.7	360.40	82	62	245	40
7	10:47:30	6	234	.80	2.7	362.50	83	62	240	40
8	10:50	6	233	.80	2.7	364.69	84	63	240	40
B 1	10:51 10:53:30	6	226	.80	2.7	366.90	90	64	245	46
2	10:56	6	227	.90	2.7	369.90	82	64	245	45
3	10:59:30	6	229	.80	2.7	372.99	83	64	245	45
4	11:01	6	230	.80	2.7	373.20	85	65	245	45
5	11:03:30	6	233	.80	2.7	375.30	85	63	245	45

C_{O_2} = 2.0
O_2 = 16.0
CO = 0

C_{O_2} = 2.0
O_2 = 16.0
CO = 0

Form #REC-05

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 4-14-87 LOCATION [illegible] 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)
6	11:06	6	238	.80	2.7	267.30	87	66	245	40
7	11:08:30	6	241	.80	2.7	269.70	88	67	240	40
8	11:11	6	243	.80	2.7	271.85	88	67	240	40
9	11:13:30	6	232	.80	2.7	273.90	94	69	240	40
10	11:16	6	242	.80	2.7	276.10	89	70	240	40
1	11:18:30	6	254	.80	2.7	278.40	90	70	235	40
2	11:22	6	256	.80	2.7	280.80	90	70	235	40
3	11:24:30	6	257	.80	2.7	283.60	90	70	240	40
4	11:27	6	251	.80	2.7	286.70	90	70	240	40
5	11:29:30	6	255	.80	2.7	289.10	90	70	240	40
6	11:32	6	243	.80	2.7	291.145	91	70	245	40

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 4-20-89 Meter box number 67075

Barometric pressure, P_b = 30.14 in. Hg Calibrated by Sam Luang

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	Temperatures: Wet test meter (t_w), °F	Temperatures: Dry gas meter Inlet (t_{d_i}), °F	Temperatures: Dry gas meter Outlet (t_{d_o}), °F	Temperatures: Dry gas meter Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	6	558.5 / 564.70	72	78 / 77	74 / 74		6.28	0.998	1.79
1.0	5	564.58 / 569.50	72	80 / 82	72 / 73		9.28	0.991	1.89
1.5	10								
2.0	10								
3.0	10	609.75 / 619.265	72	80 / 85	70 / 72		11.25	1.008	1.90
4.0	10								
							Avg	.999	1.86

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460) \theta}{V_w}\right]^2$
0.5	0.0368	6 (30.14)(535.25) / 6.05 (30.1768)(532)	
1.0	0.0737	5 (30.14)(536.25) / 5.08 (30.2137)(532)	
1.5	0.110		
2.0	0.147		
3.0	0.221	10 (30.14)(536) / 9.91 (30.361)(532)	
4.0	0.294		

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

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 4-3-87 Meter box number 670775

Barometric pressure, P_b = 30.05 in. Hg Calibrated by Sean Cleary

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	27.48 / 32.80	72	93 / 97	76 / 76	87.50	6:52	1.001	1.90
1.0	5	13[illegible] / 32.60	72	94 / 95	75 / 76	85.25	4:45	1.003	1.90
1.5	10								
2.0	10								
3.0	10	32.[illegible] / 42.36	72	93 / 92	77 / 76	84.75	6:43	1.010	1.85
4.0	10								
							Avg	1.005	1.88

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.

PITOT TUBE CALIBRATION DATA

Calibration pitot tube: type S size (OD) 3/8 ID number 41

Type S pitot tube ID number 41 $C_{p(std)}$ = 1

Calibration: date 1-9-97 performed by _____

A-Side Calibration

Δp_{std}, cm (in.) H_2O	Δp_s, cm (in.) H_2O	$C_{p(S)}$ [a]	DEV. [b]
.95	1.95	.81	.01
.99	1.1-	.29	.01
.92	1.3	.24	.01
Average		.80	

B-Side Calibration

Δp_{std}, cm (in.) H_2O	Δp_s, cm (in.) H_2O	$C_{p(S)}$ [a]	DEV. [b]
.95	1.45	.81	.01
.99	1.2c	.2e	.01
.92	1.3	.2c	.01
Average		.8c	

[a] $C_{p(S)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$ = _____

[b] DEV = $C_{p(S)} - \bar{C}_p$, (must be ≤ 0.01)

$\bar{C}_p(A) - \bar{C}_p(B)$ = _____ (must be ≤ 0.01).

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date [illegible] Thermocouple number [illegible]

Ambient temperature [illegible] °C Barometric pressure [illegible] in. Hg

Calibrator [illegible] Reference: mercury-in-glass [illegible]

other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference[c], %
A	[illegible]	32°F	31°F	.03 %
B	[illegible]	30°F	31°F	.005 %
C	Oil	360°F	357°F	.006 %
D	[illegible]	51°F	53°F	.02 %
	4-19-87	78°	78°	0 %

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

[b] Type of calibration system used.

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

RAMCON

Lear Siegler Stack Sampler

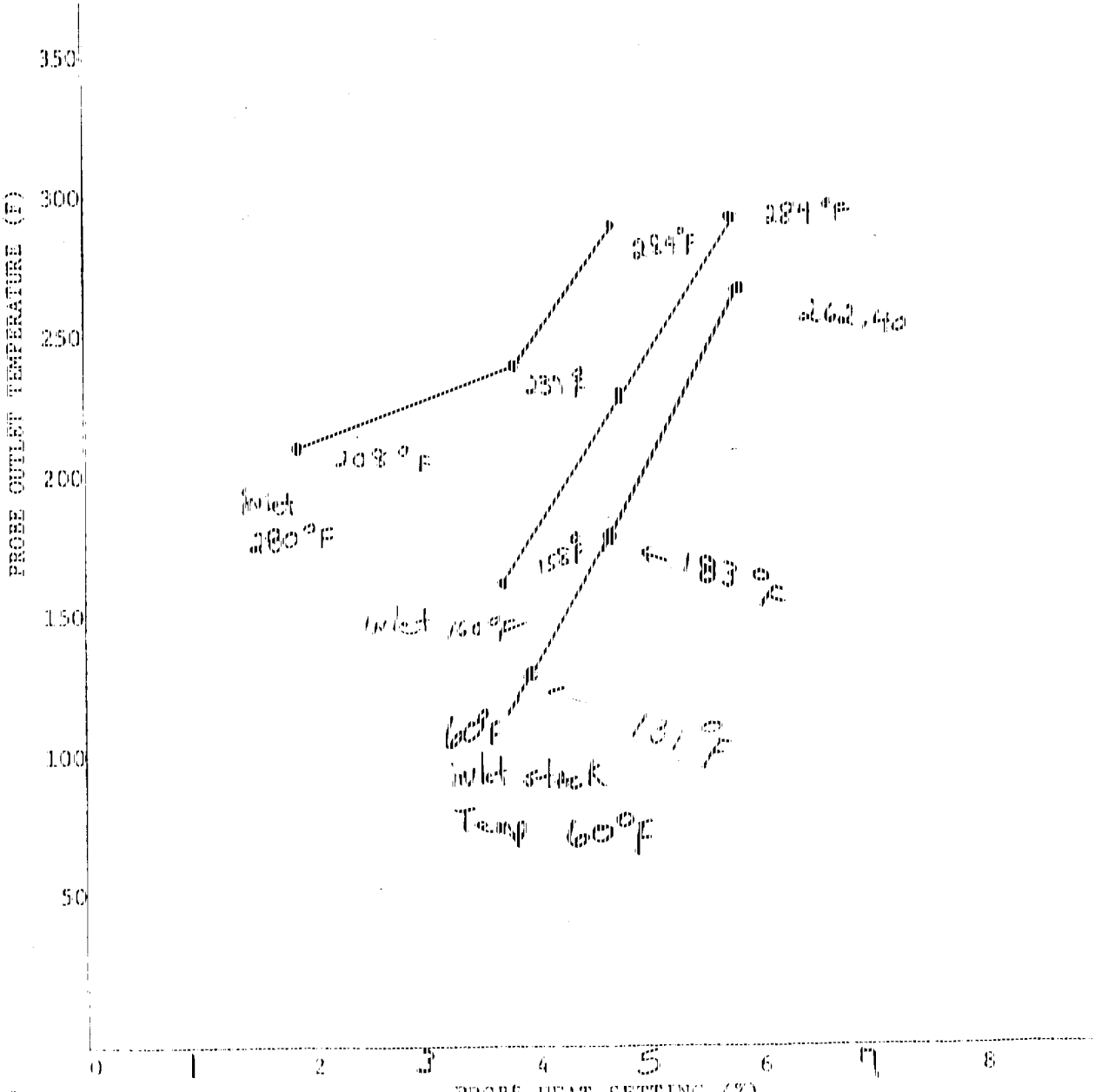
Heating Probe Calibration

Probe No. 41 Probe Length 4'

Date of Calibration 3-31-86 Signature Scott Cooper

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



STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 6-10-85 Thermocouple number [illegible]

Ambient temperature 24 °C Barometric pressure 29.9 in. Hg

Calibrator [illegible] Reference: mercury-in-glass [illegible]

other

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	[illegible]	84 °C	24 °C	0
B	[illegible]	91 °C	21 °C	0
C	[illegible] 4-14-85	95 °C	98 °C	0 %

[a] Type of calibration system used.

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

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 6-19-86 Thermocouple number Method

Ambient temperature 24 °C Barometric pressure 29.95 in. Hg

Calibrator Sam Tharp Reference: mercury-in-glass ✓

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	boiling water	100 °C	100 °C	0
B	ambient 6-19-86	24 °C	23.9	4.1 %
C	ambient 6-19-86	24 °C	24 °C	0 %

[a] Type of calibration system used.

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

X. RAMCON PERSONNEL

RAMCON Environmental Stack Test Team

Summer Buck - President

Summer 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 400 stacks including over 300 asphalt plants. He is 42 years old and a graduate of the University of Mississippi with graduate studies at Memphis State University and State Technical Institute of Memphis.

Sam Turner - Field Supervisor

Sam Turner has five years experience in the Air Division and is our field supervisor. He has sampled over 30 large boiler stacks and approximately 200 asphalt plants. He is a graduate of State Technical Institute of Memphis, and holds an Associate Degree in Environmental Engineering. He also has current certification as a V.E. reader.