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

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

AP42 Section: 11.1

Reference Number: 302

Title: Source Sampling For Particulate Emissions, Thompson-McCully Co., Belleville, MI,

Ramcon Environmental Corp., Memphis, TN,

July 29, 1988.

AP-42 Section 11.1
Reference
Report Sect. 4
Reference ~~304~~ 302

RAMCON
ENVIRONMENTAL CORPORATION

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
THOMPSON MC CULLY
BELLEVILLE, MICHIGAN
July 29, 1988

Byron Thomas
Thompson McCully

G. Sumner Buck, III
President

Ken Allmendinger
Team Leader

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

RAMCON

ENVIRONMENTAL CORPORATION

August 25, 1988

Mr. Byron Thomas
Thompson-McCully
5905 Belleville Road
Belleville, MI 48111

Re: Particulate Emissions Tests - Belleville, Michigan

Dear Mr. Rolefson:

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

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

Mr. John Baguzis
Wayne County APC
1311 E. Jefferson
Detroit, MI 48207

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

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

Sincerely,

G. Sumner Buck, III
President

GSBIII:mew

Enclosures

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

TABLE OF CONTENTS

I. INTRODUCTION

On July 29, 1988, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Thompson-McCully's Barber-Greene drum mix asphalt plant located in Belleville, Michigan. RAMCON personnel conducting the test were Ken Allmendinger, Team Leader, and Kevin Powell. Bruce Shrader was responsible for the particulate laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples was limited to Mr. Allmendinger and Mr. Shrader.

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

II. TEST RESULTS

Table I summarizes the test results. The grain loading limitation for EPA is specified in 39 FR 9314, March 8, 1974, 60.92 Standards for Particulate Matter (1), as amended. The allowable N.S.P.S. particulate emissions for EPA and the State of Michigan is .04 gr/dscf.

Mr. John Baguzis of the Wayne County APC in Detroit, Michigan observed the testing conducted by RAMCON.

TABLE I

SUMMARY OF TEST RESULTS
July 29, 1988

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	08:02 to 10:00	0.0420 gr/DSCF	102.5%	11.3 lbs/hr
2	10:35 to 12:16	0.0296 gr/DSCF	102.7%	7.7 lbs/hr
3	13:05 to 14:07	0.0266 gr/DSCF	102.2%	7.1 lbs/hr
	Average:	0.0327 gr/DSCF		8.7 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 Michigan. Therefore, the plant is operating in compliance with State and Federal Standards.

III. TEST PROCEDURES

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

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

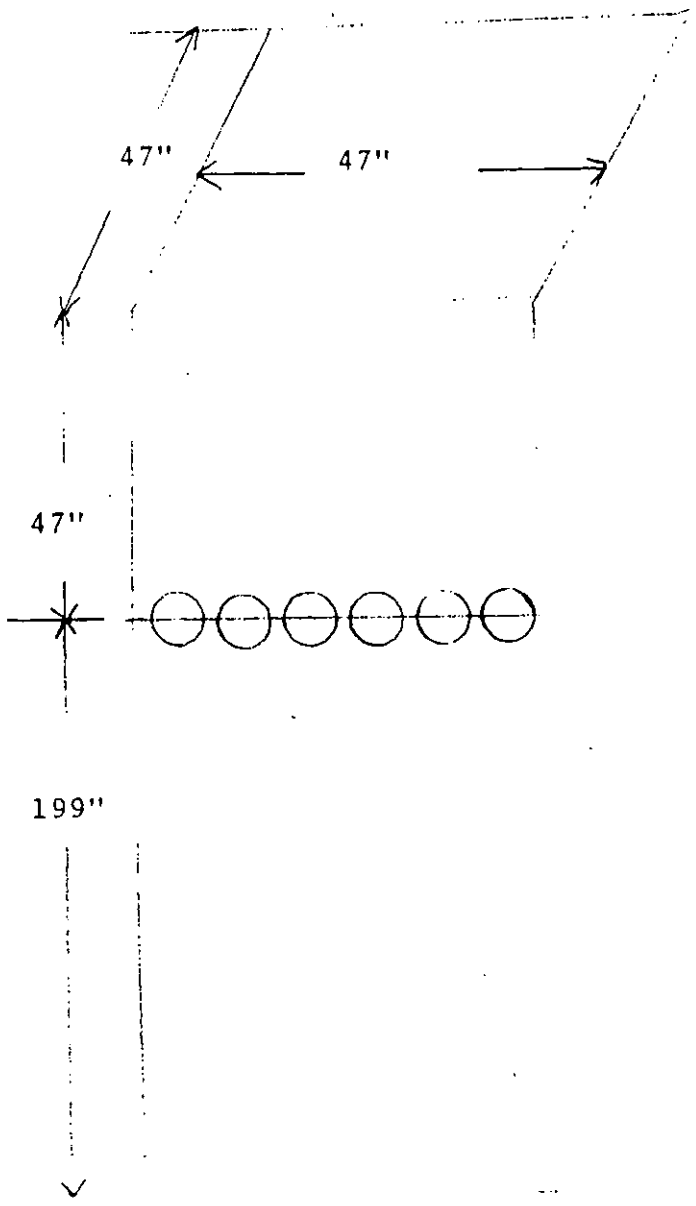
TABLE II

SUMMARY OF TEST RESULTS
July 29, 1988

Test Run	HCl Emissions	Cadmium Emissions	Chromium Emissions	Lead Emissions
1	.060 lbs/hour	0.00005 lbs/hr	0.0005 lbs/hr	0.0013 lbs/h
2	.009 lbs/hour	0.00005 lbs/hr	0.0005 lbs/hr	0.0013 lbs/h
3	.152 lbs/hour	0.00005 lbs/hr	0.0005 lbs/hr	0.0013 lbs/h

C. Sampling Site: The emissions test was conducted after a baghouse on a rectangular stack measuring 47" x 47" with an equivalent diameter of 47". Six sampling ports were placed 47" down (1.0 diameters upstream) from the top of the stack and 199" up (4.2 diameters downstream) from the last flow disturbance. Thirty points were sampled, five through each port for 2 minutes each for a total test time of sixty minutes per test run.

Points on a Diameter	Probe Mark
1	4.7"
2	14.1"
3	23.5"
4	32.9"
5	42.3"



IV. THE SOURCE

IV. THE SOURCE

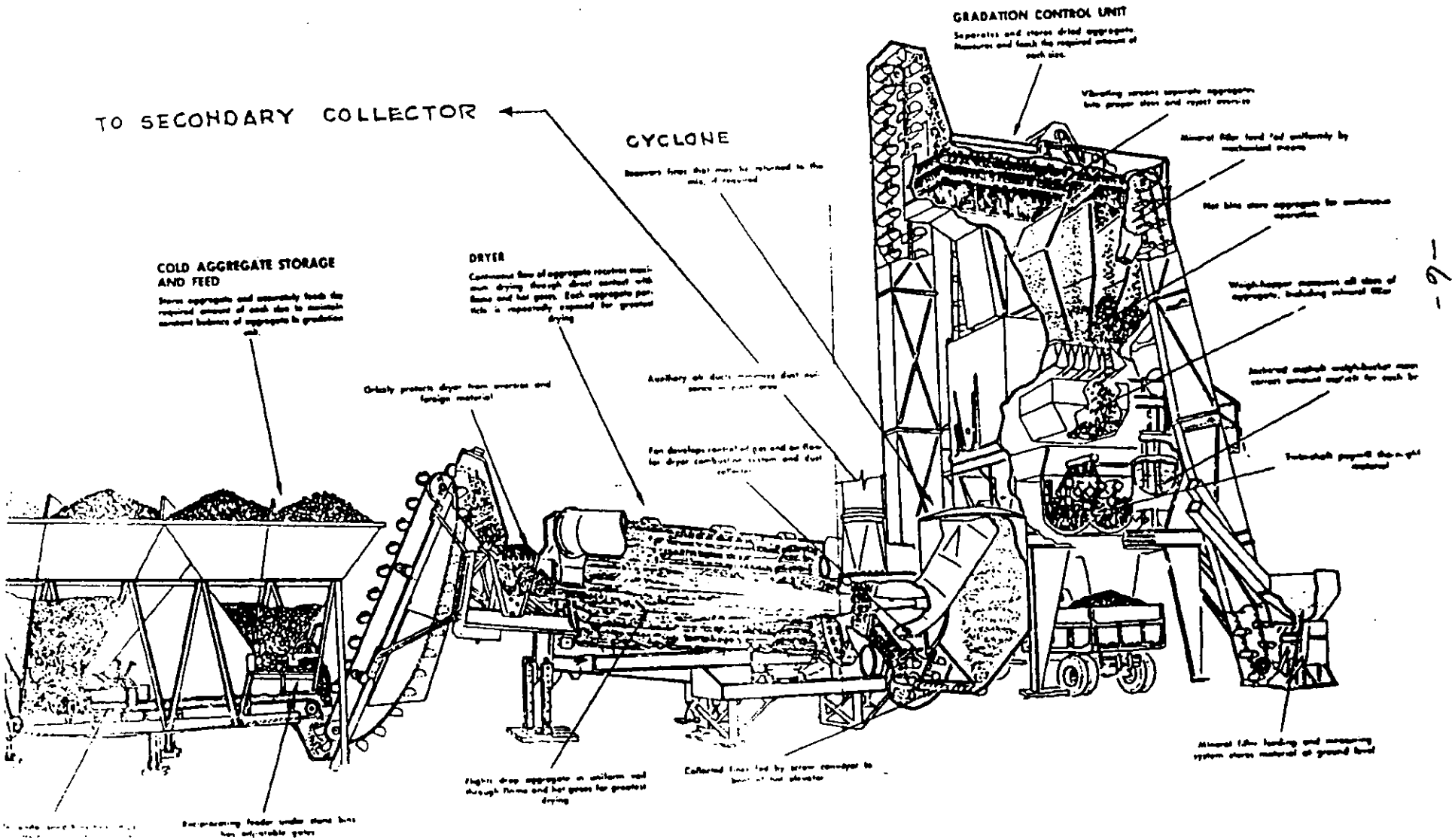
Thompson-McCully employs a Barber-Greene drum mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind the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

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

The drum dryer uses a burner fired with #4-#6 fuel oil and natural gas to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate and hot asphalt oil thoroughly. The air is drawn into the system via an exhaust fan. After passing through the burner and the mixing drum, the air passes through a baghouse. The baghouse was manufactured by Barber-Greene. The exhaust gas is drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube sheet is 1-6 inches of water. The particulate matter, which is removed by the baghouse, is reinjected into the drum mixer.

Figure 4-1

ASPHALT BATCH MIX PLANT - AN EXPLODED VIEW



PLANT DATA

COMPANY NAME THOMPSON MCNULLY

COMPANY REP. ALAN SANDELL DATE 7-29-88 PHONE # 485-1717

DATA SOURCE

PLANT LOCATION 1785 RAWSONVILLE ROAD - BELLEVILLE MICH

PLANT MFG. BARBER GREENE PLANT MODEL # DM-75 PLANT TYPE DRUM MIX

MIX SPECIFICATION # OIL SPECIFICATION #

	Time 24 Hour	___ Fuel Oil X Nat. Gas X Propane ___ Coal ___	Burner Setting	Aggregate TPH	Recycle TPH	Liquid Asphalt TPH	Mix Temp. °F	___ Venturi ___ Baghouse Pressure Drop Inches Water
	725-AM		60	243	82	14.3	300	5
	740-AM		—	—	—	—	—	—
	755-AM		—	—	—	—	—	—
	810-AM		—	—	—	—	—	—
DOWN	825-AM		—	—	—	—	—	—
	930-AM		—	—	—	—	—	—
	945-AM		—	—	—	—	—	—
	10-AM		—	—	—	—	—	—
	1015-AM		—	—	—	—	—	—
DOWN	1030-AM		—	—	—	—	—	—
	1110-AM		—	—	—	—	—	—
	1125-AM		—	—	—	—	—	—
DOWN	1200		60	350	NO	21.9	300	5
	1257		60	350	NO	21.9	300	5
	115		50	302	NO	19.2	300	6
	130		52	302	NO	19.2	300	5
	145		52	302	NO	19.2	300	5
	200		50	302	NO	19.2	300	5

DATA SUMMARY

Plant

1. Manufacturer of plant BARBER GREENE.
2. Designed maximum operating capacity 500 TPH @ 4 % moisture.
3. Actual operation rate 370 TPH @ 4 % moisture.
4. Startup date 1978.
5. Type of fuel used in dryer #4-6.
6. Quanity of fuel consumption 2GAL PER TON.

Aggregate

7. Name/type of mix 20-AAA-D.
8. Percent asphalt in mix 4.3 %.
9. Temperature of asphalt 300.
10. Sieve/Screening analysis: % Passing;

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

Baghouse

11. Manufacturer BARBER GREENE.
12. No. of bags 1200. Type of bags NOMEX.
13. Air to cloth ratio _____. Designed ACFM 82000.
14. Square feet of bags _____.
15. Type of cleaning; pulse jet X, reverse air _____, plenum pulse _____, other _____.
16. Cleaning cycle time NINE SECONDS.
17. Interval between cleaning cycle _____.
18. Pressure drop across baghouse 5 psi.
19. Pulse pressure on cleaning cycle _____ psi.

COMPANY NAME _____ DATE _____

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.

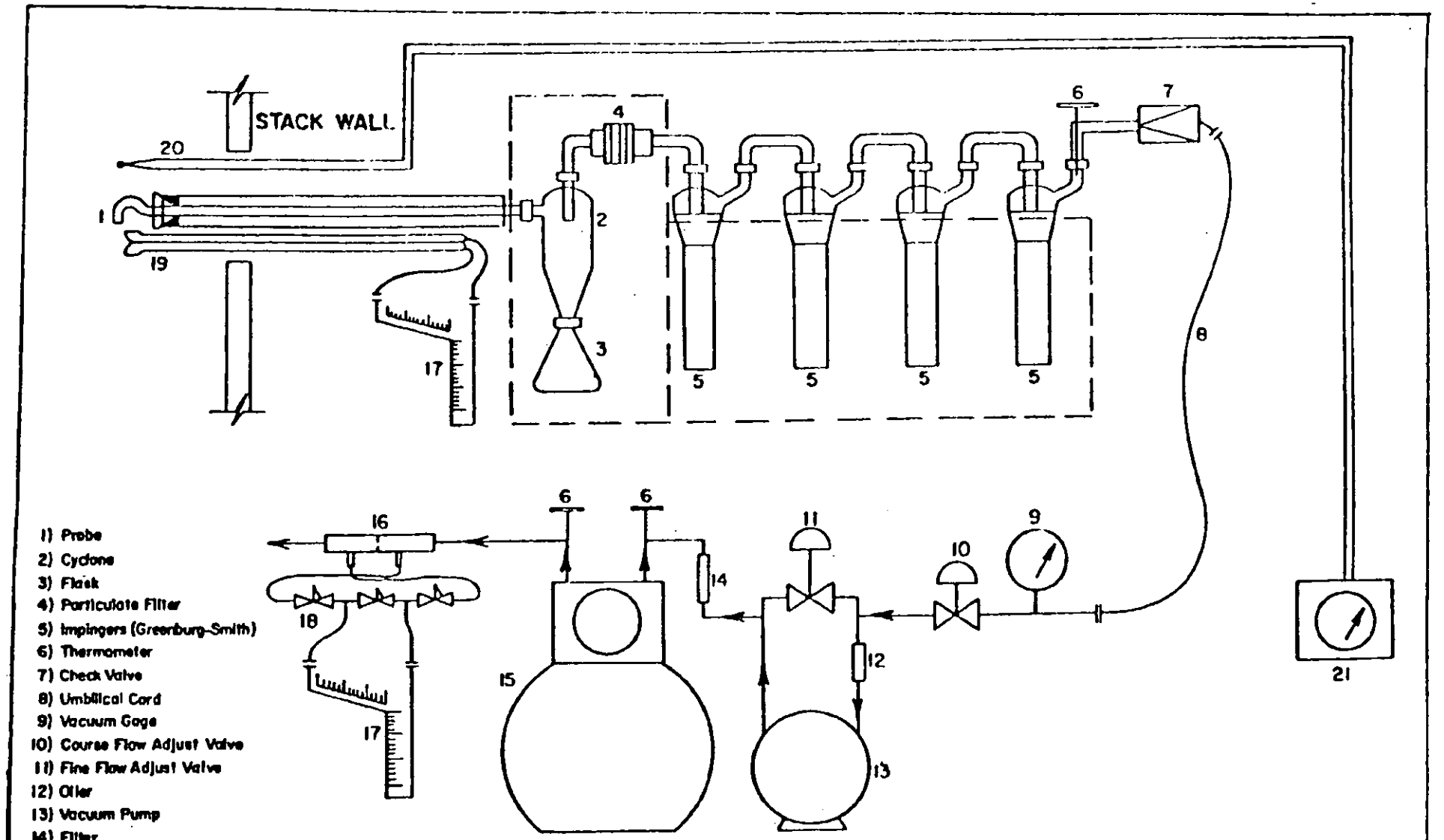
B. An Airguide Instruments Model 211-B (uncorrected) aneroid barometer was used to check the barometric pressure.

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.



1) Probe
2) Cyclone
3) Flask
4) Particulate Filter
5) Impingers (Greenburg-Smith)
6) Thermometer
7) Check Valve
8) Umbilical Cord
9) Vacuum Gage
10) Course Flow Adjust Valve
11) Fine Flow Adjust Valve
12) Oiler
13) Vacuum Pump
14) Filter
15) Dry Gas Meter
16) Orifice Tube
17) Incline Manometer
18) Solenoid Valves
19) Pitot
20) Thermocouple
21) Pyrometer

SAMPLING TRAIN
USED FOR ISOKINETIC SAMPLING

VI. LABORATORY PROCEDURES & RESULTS

LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

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

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

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

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

II. Post-Testing Lab Analysis

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

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

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

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

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

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

SPECIAL NOTE

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

Form REC#8

SAMPLE ANALYTICAL DATA FORM

Plant Location Thompson McCulley — Relative humidity in lab 60.5 %

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

Blank volume (V_a) 200 ml

Date/Time wt. blank 8-8-88 — Gross wt. 111.1043 mg

Date/Time wt. blank 8-9-88 — Gross wt. 111.1039 mg

Ave. Gross wt. 111.1041 mg

Tare wt. 111.1037 mg

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

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (p_a) = (.000025 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} p_a$ = (.000025)(200)(.7853) = (.0004)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	200	200	205
Date/Time of wt 8-8-88 Gross wt	g	167.2400	155.2235	164.9834
Date/Time of wt 8-9-88 Gross wt	g	167.2401	155.2233	164.9833
Average Gross wt	g	167.2401	155.2234	164.9834
Tare wt	g	167.1526	155.1725	164.9393
Less acetone blank wt (W_a)	g	.0004	.0004	.0004
Wt of particulate in acetone rinse (m_a)	g	.0871	.0505	.0437

Filter Numbers	#	BT2885	BT2851	BT2879
Date/Time of wt 8-8-88 Gross wt	g	0.5576	0.5561	0.5582
Date/Time of wt 8-9-88 Gross wt	g	0.5575	0.5562	0.5582
Average Gross wt	g	0.5576	0.5562	0.5582
Tare wt	g	0.5327	0.5298	0.5311

Weight of particulate on filters(s) (m_f)	g	.0249	.0264	.0271
Weight of particulate in acetone rinse	g	.0871	.0505	.0437
Total weight of particulate (m_n)	g	.1120	.0769	.0708

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 BS — Signature of reviewer

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.

HCl CONCENTRATION: BY MECURIC NITRATE

$$C_{HCl} = 2.204622 \times 10^{-6} \times \frac{36.45 \times M_{Cl}}{35.45 \times V_{m(std)}}$$

Where;

C_{HCl} = Concentration of HCl in lbs/dscf.

M_{Cl} = Mass of chloride collected determined by mecuric nitrate, mg.

$V_{m(std)}$ = Volume of stack gas sampled corrected to 29.92 in. Hg and 68°F, dscf.

2.204622×10^{-6} = Conversion factor for mg. to lb.

$\frac{36.45}{35.45}$ = Correction for molecular weight of Cl^- to HCl.

Run : $C_{HCl} = 2.204622 \times 10^{-6} \times \frac{36.45 \times 0.585}{35.45 \times 41.054} = 3.2301 \times 10^{-8}$ lbs/dscf

Run : $C_{HCl} = 2.204622 \times 10^{-6} \times \frac{36.45 \times 0.090}{35.45 \times 39.950} = < 5.1067 \times 10^{-9}$ lbs/dscf

Run : $C_{HCl} = 2.204622 \times 10^{-6} \times \frac{36.45 \times 1.46}{35.45 \times 41.007} = 8.0707 \times 10^{-8}$ lbs/dscf

HCl EMISSIONS: BY MECURIC NITRATE

$$E_{HCl} = C_{HCl} \times Q_{sd}$$

Where; E_{HCl} = Emissions of HCl in pounds per hour, lbs/hr.

C_{HCl} = Concentration of HCl in pounds per dry standard cubic foot, lbs/dscf.

Q_{sd} = Stack gas flow rate in dry standard cubic feet per hour, dscf/hr.

Run : $E_{HCl} = 3.2301 \times 10^{-8} \times 1,880,982.2 = .060$ lbs/hr

Run : $E_{HCl} = < 5.1067 \times 10^{-9} \times 1,824,579.6 = .009$ lbs/hr

Run : $E_{HCl} = 8,0707 \times 10^{-8} \times 1,880,087.0 = .152$ lbs/hr

CONCENTRATION OF LEAD

$$C_{pb} = \frac{\mu g\ Pb}{V_{m(std)}} \times (2.20462 \times 10^{-9}\ lbs/\mu g)$$

Where: C_{pb} = concentration of lead in sample.

μg Pb = weight of lead in sample.

$V_{m(std)}$ = dry gas volume at standard conditions.

2.20462×10^{-9} = conversion factor.

Run #1: $\frac{< 12.5}{41.054} \times (2.20462 \times 10^{-9}) = < 6.7126 \times 10^{-10}$ lbs/dscf

Run #2: $\frac{< 12.5}{39.950} \times (2.20462 \times 10^{-9}) = < 6.8981 \times 10^{-10}$ lbs/dscf

Run #3: $\frac{< 12.5}{41.007} \times (2.20462 \times 10^{-9}) = < 6.7202 \times 10^{-10}$ lbs/dscf

EMISSIONS OF LEAD:

$$E_{pb} = C_{pb} \times Q_{sd}$$

Where: E_{pb} = emissions of lead, lbs/hr.

C_{pb} = concentration of lead in sample, lbs/dscf.

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

Run #1: $(6.7126 \times 10^{-10}) \times 1{,}880{,}982.2 = < 0.0013$ lbs/hr

Run #2: $(6.8981 \times 10^{-10}) \times 1{,}824{,}579.6 = < 0.0013$ lbs/hr

Run #3: $(6.7202 \times 10^{-10}) \times 1{,}880{,}087.0 = < 0.0013$ lbs/hr

CONCENTRATION OF CHROMIUM

$$C_{pb} = \frac{\mu g\ Pb}{V_{m(std)}} \times (2.20462 \times 10^{-9}\ lbs/\mu g)$$

Where: C_{pb} = concentration of chromium in sample.

$\mu g\ Pb$ = weight of chromium in sample.

$V_{m(std)}$ = dry gas volume at standard conditions.

2.20462×10^{-9} = conversion factor.

Run #1: $\frac{< 5.0}{41.054} \times (2.20462 \times 10^{-9}) = < 2.6850 \times 10^{-10}$ lbs/dscf

Run #2: $\frac{< 5.0}{39.950} \times (2.20462 \times 10^{-9}) = < 2.7592 \times 10^{-10}$ lbs/dscf

Run #3: $\frac{< 5.0}{41.007} \times (2.20462 \times 10^{-9}) = < 2.6881 \times 10^{-10}$ lbs/dscf

Chromium **Emissions**

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

Where: **E** = **Emissions of** Chromium **, lbs/hr.**

Q_{sd} = **Stack gas flow rate, dscf/hr.**

C = Chromium **concentration, lbs/dscf.**

Run # 1:

$E = (< 2.6850 \times 10^{-10}$ lbs/dscf) (1,880,982.2 dscf/hr) $= < 0.0005$ lbs/hr

Run # 2:

$E = (< 2.7592 \times 10^{-10}$ lbs/dscf) (1,824,579.6 dscf/hr) $= < 0.0005$ lbs/hr

Run # 3:

$E = (< 2.6881 \times 10^{-10}$ lbs/dscf) (1,880,087.0 dscf/hr) $= < 0.0005$ lbs/hr

CONCENTRATION OF CADMIUM

$$C_{pb} = \frac{\mu g\ Pb}{V_{m(std)}} \times (2.20462 \times 10^{-9}\ lbs/\mu g)$$

Where: C_{pb} = concentration of cadmium in sample.

μg Pb = weight of cadmium in sample.

$V_{m(std)}$ = dry gas volume at standard conditions.

2.20462×10^{-9} = conversion factor.

Run #1: $\frac{< .5}{41.054} \times (2.20462 \times 10^{-9}) = < 2.6850 \times 10^{-11}$ lbs/dscf

Run #2: $\frac{< .5}{39.950} \times (2.20462 \times 10^{-9}) = < 2.7592 \times 10^{-11}$ lbs/dscf

Run #3: $\frac{< .5}{41.007} \times (2.20462 \times 10^{-9}) = < 2.6881 \times 10^{-11}$ lbs/dscf

CADMIUM **Emissions**

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

Where: E = Emissions of cadmium, lbs/hr.

Q_{sd} = Stack gas flow rate, dscf/hr.

C = Cadmium concentration, lbs/dscf.

Run # 1:

$E = (2.6850 \times 10^{-11}$ lbs/dscf)(1,880,982.2 dscf/hr) = < 0.00005 lbs/hr

Run # 2:

$E = (2.7592 \times 10^{-11}$ lbs/dscf)(1,824,579.6 dscf/hr) = < 0.00005 lbs/hr

Run # 3:

$E = (2.6881 \times 10^{-11}$ lbs/dscf)(1,880,087.0 dscf/hr) = < 0.00005 lbs/hr

ENVIRONMENTAL TESTING & CONSULTING INC.
2924 WALNUT GROVE RD. • MEMPHIS, TENN. 38111 • PHONE (901) 327-2750

August 11, 1988

Mr. Sumner Buck
Ramcon
223 Scott St.
Memphis, TN 38112

REF: ANALYTICAL TESTING
SAMPLE(S) DATE: 7/29/88
PLANT - THOMSON & McCULLY
#1, #2, #3 & BLANK

Dear Mr. Buck:

The above referenced samples have been analyzed per your instructions. The tests were performed in our laboratory (#00210) in accordance with Standard Methods, 16th Edition, and the results are shown below.

	Results (mg/l)				Standard Methods		
Tests	#1 585 ml	#2 600 ml	#3 730 ml	Blank 380 ml	Page #	By	Date
Chloride	1.0	<0.15	2.0	0.30	288	JF	8/2

If you have any questions please call me.

Very truly yours,

Michael J. Cimbalo
President

MJC/mg

ENVIRONMENTAL TESTING & CONSULTING INC.
2924 WALNUT GROVE RD. • MEMPHIS, TENN. 38111 • PHONE (901) 327-2750

August 29, 1988

Mr. Sumner Buck
Ramcon
223 Scott
Memphis, TN 38112

REF: ANALYTICAL TESTING
SAMPLE(S) DATE: 8/9/88
THOMPSON McCULLY - FILTERS

Dear Mr. Buck:

The above referenced samples have been analyzed per your instructions. The tests were performed in our laboratory (#00210) in accordance with Standard Methods, 16th Edition, and the results are shown below.

Tests	Results (mg) #1	#2	#3	Blank	Standard Methods Page #	By	Date
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	157	JF	8/9
Chromium Hex	<0.005	<0.005	<0.005	<0.005	201	JF	8/9
Lead	<0.0125	<0.0125	<0.0125	<0.0125	157	JF	8/9

If you have any questions please call me.

Very truly yours,

Michael J. Cimbalo RT
Michael J. Cimbalo
President

MJC/mg

VII. CALCULATIONS

THOMPSON-MCULLY
BELLEVILLE, MICHIGAN

SUMMARY OF TEST DATA

		7/29/88 RUN #1	7/29/88 RUN #2	7/29/88 RUN #3
SAMPLING TRAIN DATA				
	start	08:02	10:35	13:05
	finish	10:00	12:16	14:07
1. Sampling time, minutes	Θ	60.0	60.0	60.0
2. Sampling nozzle diameter, in.	D_n	.2450	.2450	.2450
3. Sampling nozzle cross-sect. area, ft^2	A_n	.000327	.000327	.000327
4. Isokinetic variation	I	102.5	102.7	102.2
5. Sample gas volume - meter cond., cf.	V_m	43.704	43.605	45.210
6. Average meter temperature, ^oR	T_m	559	573	579
7. Avg. oriface pressure drop, in. H_2O	dH	1.61	1.51	1.66
8. Total particulate collected, mg.	M_n	112.00	76.90	70.80
VELOCITY TRAVERSE DATA				
9. Stack area, ft^2	A	15.34	15.34	15.34
10. Absolute stack gas pressure, in. Hg.	P_s	29.95	29.95	29.95
11. Barometric pressure, in. Hg.	P_{bar}	29.95	29.95	29.95
12. Avg. absolute stack temperature, R^o	T_s	761	762	754
13. Average $-\sqrt{\text{vel. head}}$, (C_p= .81)	$-\sqrt{dP}$	1.00	0.99	1.01
14. Average stack gas velocity, ft./sec.	V_s	68.39	68.02	68.94
STACK MOISTURE CONTENT				
15. Total water collected by train, ml.	V_{ic}	345.00	362.00	364.00
16. Moisture in stack gas, %	B_{ws}	28.29	29.97	29.55
EMISSIONS DATA				
17. Stack gas flow rate, dscf/hr.(000's)	Q_{sd}	1880	1824	1880
18. Stack gas flow rate, cfm	acfm	62946	62606	63452
19. Particulate concentration, gr/dscf	C_s	0.0420	0.0296	0.0266
20. Particulate concentration, lb/hr	E	11.29	7.72	7.14
21. Particulate concentration, lb/mBtu	E'	0.00000	0.00000	0.00000
ORSAT DATA				
22. Percent CO_2 by volume	CO_2	3.80	3.50	3.80
23. Percent O_2 by volume	O_2	15.50	16.00	15.50
24. Percent CO by volume	CO	.00	.00	.00
25. Percent N_2 by volume	N_2	80.70	80.50	80.70

Format: summryR3

THOMPSON-MCULLY
BELLEVILLE, MICHIGAN

Dry Gas Volume

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

Where:

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

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

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

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

T_m = Absolute temperature at meter ^oR.

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

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

Y = Dry gas meter calibration factor.

13.6 = Inches water per inches Hg.

RUN 1:

$$V_{m(std)} = (17.64)(.990)(43.704)\left[\frac{(29.95) + \frac{1.61}{13.6}}{559}\right] = 41.054 \text{ dscf}$$

RUN 2:

$$V_{m(std)} = (17.64)(.990)(43.605)\left[\frac{(29.95) + \frac{1.51}{13.6}}{573}\right] = 39.950 \text{ dscf}$$

RUN 3:

$$V_{m(std)} = (17.64)(.990)(45.210)\left[\frac{(29.95) + \frac{1.66}{13.6}}{579}\right] = 41.007 \text{ dscf}$$

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:

$$M_d = 0.44(\ 3.80\%) + 0.32(15.50\%) + 0.28(\ .00\% + 80.70\%) = 29.23 \ \frac{lb}{lb\text{-mole}}$$

Run 2:

$$M_d = 0.44(\ 3.50\%) + 0.32(16.00\%) + 0.28(\ .00\% + 80.50\%) = 29.20 \ \frac{lb}{lb\text{-mole}}$$

Run 3:

$$M_d = 0.44(\ 3.80\%) + 0.32(15.50\%) + 0.28(\ .00\% + 80.70\%) = 29.23 \ \frac{lb}{lb\text{-mole}}$$

THOMPSON-MCULLY
BELLEVILLE, MICHIGAN

Water Vapor Condensed

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

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

Where:

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

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

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

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

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

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

p_w = Density of water, 0.002201 lb/ml.

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

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

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

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

Run 1:

$V_{wc(std)}$ = (0.04707) (330.0) = 15.5 cu.ft
$V_{wsg(std)}$ = (0.04715) (15.0) = 0.7 cu.ft

Run 2:

$V_{wc(std)}$ = (0.04707) (350.0) = 16.5 cu.ft
$V_{wsg(std)}$ = (0.04715) (12.0) = 0.6 cu.ft

Run 3:

$V_{wc(std)}$ = (0.04707) (350.0) = 16.5 cu.ft
$V_{wsg(std)}$ = (0.04715) (14.0) = 0.7 cu.ft

Moisture Content of Stack Gases

$$B_{ws} = \frac{V_{wc_{std}} + V_{wsg_{std}}}{V_{wc_{std}} + V_{wsg_{std}} + V_{m_{std}}} \times 100$$

Where:

B_{ws} = Proportion of water vapor, by volume, in the gas stream.

V_m = Dry gas volume measured by dry gas meter, (dcf).

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

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

Run 1:

$$B_{ws} = \frac{15.5 + 0.7}{15.5 + 0.7 + 41.054} \times 100 = 28.29\ \%$$

Run 2:

$$B_{ws} = \frac{16.5 + 0.6}{16.5 + 0.6 + 39.950} \times 100 = 29.97\ \%$$

Run 3:

$$B_{ws} = \frac{16.5 + 0.7}{16.5 + 0.7 + 41.007} \times 100 = 29.55\ \%$$

THOMPSON-MCULLY
BELLEVILLE, MICHIGAN

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 = 29.23 (1 - 28.29) + 18 (28.29) = 26.05 (lb./lb.-mole)

Run 2:

M_s = 29.20 (1 - 29.97) + 18 (29.97) = 25.84 (lb./lb.-mole)

Run 3:

M_s = 29.23 (1 - 29.55) + 18 (29.55) = 25.91 (lb./lb.-mole)

Format: msR3

Stack Gas Velocity

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

Where:

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

K_p = 85.49 ft/sec $\sqrt{(g/g\text{-mole})\text{-}(mm\ Hg) / (^oK)(\ mm\ H_2O)}$

C_p = Pitot tube coefficient, (dimensionless).

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

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

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

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

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

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

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

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

Run 1:

$$V = (85.49)\ (\ .81)\ (\ 1.00)\ -\sqrt{\frac{761}{(29.95)(26.05)}} = 68.39 \text{ ft/sec.}$$

Run 2:

$$V = (85.49)\ (\ .81)\ (\ 0.99)\ -\sqrt{\frac{762}{(29.95)(25.84)}} = 68.02 \text{ ft/sec.}$$

Run 3:

$$V = (85.49)\ (\ .81)\ (\ 1.01)\ -\sqrt{\frac{754}{(29.95)(25.91)}} = 68.94 \text{ ft/sec.}$$

Format: vsR3

THOMPSON-MCULLY
BELLEVILLE, MICHIGAN

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, (^{o}f).

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

T_{std} = Standard absolute temperature, ($528^{o}R$).

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:

$$Q_{sd}=3600(1-\ .2829\ )(\ 68.39)(\ 15.34)\left[\frac{528}{761}\right]\left[\frac{29.95}{29.92}\right]=\ 1880982.2\ \frac{dscf}{hr}$$

Run 2:

$$Q_{sd}=3600(1-\ .2997\ )(\ 68.02)(\ 15.34)\left[\frac{528}{762}\right]\left[\frac{29.95}{29.92}\right]=\ 1824579.6\ \frac{dscf}{hr}$$

Run 3:

$$Q_{sd}=3600(1-\ .2955\ )(\ 68.94)(\ 15.34)\left[\frac{528}{754}\right]\left[\frac{29.95}{29.92}\right]=\ 1880087.0\ \frac{dscf}{hr}$$

Format: qR3

Emissions Rate from Stack

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

Where:

E = Emissions rate, lb/hr.

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

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

Run 1:

$$E = \frac{(0.0420)\ (1880982.2)}{7000} = 11.29 \text{ lb. / hr.}$$

Run 2:

$$E = \frac{(0.0296)\ (1824579.6)}{7000} = 7.72 \text{ lb. / hr.}$$

Run 3:

$$E = \frac{(0.0266)\ (1880087.0)}{7000} = 7.14 \text{ lb. / hr.}$$

Isokinetic Variation

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

Where:

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

Run 1:

$$I = (100)(761)\left[\frac{(0.002669)(345.00) + \frac{43.704}{559}\left[29.95 + \frac{1.61}{13.6}\right]}{60\ (\ 60.0\ )\ (\ 68.39\ )\ (\ 29.95\ )\ (\ .000327\ )} \right] = 102.5\%$$

Run 2:

$$I = (100)(762)\left[\frac{(0.002669)(362.00) + \frac{43.605}{573}\left[29.95 + \frac{1.51}{13.6}\right]}{60\ (\ 60.0\ )\ (\ 68.02\ )\ (\ 29.95\ )\ (\ .000327\ )} \right] = 102.7\%$$

Run 3:

$$I = (100)(754)\left[\frac{(0.002669)(364.00) + \frac{45.210}{579}\left[29.95 + \frac{1.66}{13.6}\right]}{60\ (\ 60.0\ )\ (\ 68.94\ )\ (\ 29.95\ )\ (\ .000327\ )} \right] = 102.2\%$$

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant Thompson - McCully

Location Bellville, Ill.

Operator KAllen/Singer

Date 7-25-88

Run No. 1

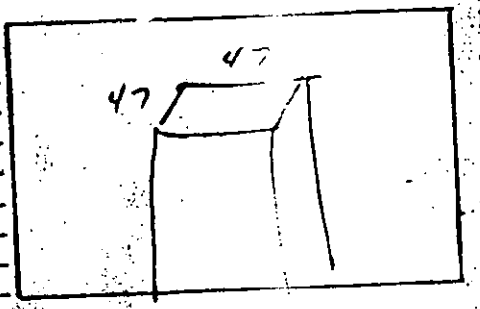
Sample Box No. 2

Meter Box No. C124 - 14781.0

Meter H @ 1.9

C Factor .882

Pitot Tube Coefficient, Cp .81



Schematic of Stack Cross Section

Ambient Temperature

Barometric Pressure

Assumed Moisture,

Probe Length, m(ft)

Nozzle Identification

Avg. Calibrated Nozz.

Probe Heater Setting

Leak Rate, m³/min. (cf

Probe Liner Material

Static Pressure,

Filter No. B7 -22

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (ΔPs) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft³	GAS SAMPLE TEMP AT DRY GAS METER °F Inlet	°F Outlet	
A) 1	8:02:30 / 8:04	3	300	.67	1.1	937.522 / 938.52	85	80	
2	8:05	4	305	.85	1.3	939.80	95	85	
3	8:08	5	305	1.1	1.7	941.29	100	90	
4	8:10	6	310	1.1	1.7	942.75	100	80	
5	8:12:20	6	310	1.0	1.6	944.17	100	85	
B) 1	8:13 / 8:15	4	305	.67	1.1	945.41	100	85	
2	8:17	6	310	1.0	1.6	946.87	105	85	
3	8:19	7	310	1.1	1.7	948.42	105	85	
4	8:21	8	310	1.2	1.9	950.00	105	85	
5	8:23	7	310	1.1	1.7	951.55	105	85	
C) 1	8:23:30 / 8:25	4	305	.70	1.1	952.82	105	90	
2	8:27	6	310	1.0	1.6	954.28	110	90	
3	8:29	8	310	1.2	1.9	955.89	110	90	

CO_2 = 4.0 , 3.5

* - Plant down

Form #RE[illegible]

RAMCON [illegible] test log sheet cont. DATE 7-23-58 LOCATION [illegible]

TRAVERSE POINT	SAMPLING TIME	VACUUM	STACK TEMP.	VELOCITY HEAD	ORIFICE DIFF. PRESSURE	GAS VOLUME	[illegible] TEMP. (°F)	TEMP. (°F)
4	[illegible]							
5	8:35							
D) 1	[illegible]				0			
2	[illegible]							
3	[illegible]							
4	9:3[illegible]							
5	9:39							
E) 1	9:40							
2	9:41							
3	9:42							
4	9:43							
5	9:45							
F) 1	9:47							
2	9:5[illegible]							
3	9:5[illegible]							
4	9:56							
5	10:00							

RAMCON ENVIRONMENTAL CORPORATION

Plant Thompson - McCully

Location Belluille Mi
Operator K. Allgendinger
Date 7-29-78
Run No. 2
Sample Box No. 3
Meter Box No. C124 147810
Meter H @ 1.70
C Factor .92
Pitot Tube Coefficient Cp .81

Ambient Temperature [illegible]
Barometric Pressure [illegible]
Assumed Moisture [illegible]
Probe Length [illegible]
Nozzle Identification [illegible]
Avg. Calibrated Nozzle Dia. [illegible]
Probe Heater Setting [illegible]
Leak Rate [illegible]
Probe Liner Material [illegible]
Static Pressure, in. Hg [illegible]
Filter No. 67 2251

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_S) °F	VELOCITY HEAD (P_s) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft³	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	[illegible]
A) 1	10:35:30 / 10:37:30	4	305	.77	1.2	981.183 / 982.46	100	100	230	
2	11:16:30 / 11:18	6	250	1.4	2.2	984.12	100	100	245	
3	11:20	6	275	1.2	1.9	985.76	110	100	245	
4	11:22	6	280	1.3	2.1	987.41	115	100	245	
5	11:24:30	6	285	1.3	2.1	989.08	120	100	240	
B) 1	11:35 / 11:27	4	285	.85	1.3	990.49	120	100	240	
2	11:29	5	290	1.0	1.6	991.44	120	100	240	
3	11:31	5	295	1.1	1.7	993.46	120	100	240	
4	11:33	6	300	1.2	1.9	995.03	125	100	240	
5	11:35	6	305	1.2	1.9	996.62	125	100	240	
C) 1	11:35:20 / 11:37	4	305	.78	1.2	997.99	125	100	245	
2	11:39	5	310	.95	1.5	999.40	125	100	245	
3	11:41	5	310	1.0	1.6	000.88	125	100	245	

CO_2 = 3.6 3.5

Form #REC-

RAMCON [illegible] sheet ___ cont. DATE [illegible] LOCATION [illegible]

TRAVERSE POINT	SAMPLING TIME, θ (min)	[illegible]	[illegible]	VELOCITY HEAD ΔP_s (in. H_2O)	[illegible] DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft.^{3})	[illegible] TEMP. (°F)		[illegible]
4	11:43	6	3[illegible]	1.2	1.9	2.5	125	105	[illegible]
5	11:45:30	6	[illegible]	1.2	1.9	4.01	130	105	[illegible]
D) 1	11:45:30 / 11:47	4	[illegible]	[illegible]	[illegible]	5.26	125	105	[illegible]
2	11:49	4	[illegible]	[illegible]	[illegible]	6.81	125	105	[illegible]
3	11:51	5	3.5	[illegible]	1.5	7.91	130	105	[illegible]
4	11:53	6	3.5	[illegible]	1.9	9.44	130	105	[illegible]
5	11:55:30	6	3.5	[illegible]	1.8	10.90	130	105	[illegible]
E) 1	11:58 / 11:58	4	3.0	[illegible]	1.2	12.56	125	105	[illegible]
2	12:00	4	3.5	[illegible]	1.2	13.68	130	105	[illegible]
3	12:02	4	3.5	.85	1.3	15.03	130	105	[illegible]
4	12:04	5	3.5	1.0	1.6	16.47	130	105	[illegible]
5	12:06:30	6	3.0	1.3	2.1	18.12	130	105	[illegible]
F) 1	12:08 / 12:08	3	3.0	[illegible]	[illegible]	14.27	130	105	[illegible]
2	12:10	4	3.0	.60	1.0	20.47	130	105	[illegible]
3	12:12	4	3.0	.75	1.2	21.76	130	105	[illegible]
4	12:14	5	3.0	.95	1.5	23.17	130	105	[illegible]
5	12:16:30	5	3.0	1.0	1.6	24.79	130	105	[illegible]

RAMCON ENVIRONMENTAL CORPORATION

Plant Thompson - McCully
Location Belleville [illegible]
Operator [illegible]
Date 7-25-[illegible]
Run No. 3
Sample Box No. 2
Meter Box No. C124 [illegible]
Meter H @ 1.7[illegible]
C Factor [illegible]
Pitot Tube Coefficient Cp .8[illegible]

Ambient Temperature [illegible]
Barometric Pressure [illegible]
Assumed Moisture [illegible]
Probe Length [illegible]
Nozzle Identification [illegible]
Avg. Calibrated Nozzle Dia. (in.) [illegible]
Probe Heater Setting [illegible]
Leak Rate, m^3/min [illegible]
Probe Liner Material [illegible]
Static Pressure [illegible]
Filter No. [illegible]

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD [illegible] in H_2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	[illegible]
A) 1	1:05:[illegible] / 1:07	[illegible]	255	[illegible]	2.1	24.89 / 26.52	115	[illegible]	[illegible]	[illegible]
2	1:09	11	270	[illegible]	2.4	28.23	120	[illegible]	[illegible]	[illegible]
3	1:11	11	275	1.8	2.1	29.97	120	[illegible]	[illegible]	[illegible]
4	1:13	11	285	1.8	2.1	31.70	120	105	240	[illegible]
5	1:15:[illegible]	8	250	1.6	1.7	33.37	125	105	240	[illegible]
B) 1	1:15:[illegible] / 1:17	6	240	.92	1.5	34.75	125	105	[illegible]	[illegible]
2	1:19	7	255	1.1	1.7	36.29	130	105	[illegible]	[illegible]
3	1:21	8	300	1.2	1.9	37.91	130	105	[illegible]	[illegible]
4	1:23	9	[illegible]	1.5	2.1	39.59	130	[illegible]	[illegible]	[illegible]
5	1:25:[illegible]	9	[illegible]	1.5	2.1	41.29	130	[illegible]	[illegible]	[illegible]
C) 1	1:26:[illegible] / 1:28	7	[illegible]	[illegible]	1.5	42.9[illegible]	125	[illegible]	[illegible]	[illegible]
2	1:30	7	265	[illegible]	1.6	44.30	130	110	[illegible]	[illegible]
3	1:32	8	255	1.1	1.7	45.85	130	110	250	[illegible]

CO_2 [illegible]

Form #REC-04

RAMCON emissions test [illegible] cont. DATE 7-25-88 LOCATION Bellville TEST NO. 2

TRAVERSE POINT	SAMPLING TIME θ (min)	[illegible] (in. Hg)	[illegible]	VELOCITY HEAD [illegible]	[illegible] DIFF. [illegible] (in. H2O)	GAS VOLUME Vm (ft³)	GAS SAMPLE TEMP. (°F)		
							[illegible]	[illegible]	
4	1:34	9	300	[illegible]	2.1	47.52	[illegible]	110	[illegible]
5	1:36:15	9	300	[illegible]	2.1	49.18	[illegible]	110	[illegible]
D) 1	1:36:40 / 1:38	6	295	[illegible]	1.3	50.82	[illegible]	110	250
2	1:40	8	300	[illegible]	1.3	51.96	135	110	250
3	1:42	7	300	.75	1.5	53.39	130	110	250
4	1:44	8	300	1.1	1.7	54.89	135	110	250
5	1:46:40	8	300	1.1	1.7	56.48	135	110	250
E) 1	1:47:05 / 1:49	4	290	.60	.95	57.68	130	110	250
2	1:51	6	295	.80	1.3	58.59	130	110	250
3	1:53	6	300	.80	1.3	60.35	135	110	250
4	1:55	7	300	1.0	1.6	61.80	135	110	255
5	1:57:05	9	300	1.3	2.1	63.43	135	110	255
F) 1	1:57:40 / 1:59	4	295	.48	.76	64.63	130	110	250
2	2:01	5	290	.60	.95	65.79	130	110	240
3	2:03	6	305	.80	1.3	67.13	135	110	240
4	2:05	7	310	.97	1.5	68.56	135	110	240
5	2:07:40	8	310	1.1	1.7	70.105	135	110	240

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 8-1-88 Meter box number 147810 C-124

Barometric pressure, P_b = 30.10 in. Hg Calibrated by [illegible]

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter Inlet (t_{d_i}), °F	Temperature: Dry gas meter Outlet (t_{d_o}), °F	Temperature: Dry gas meter Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	104.52 / 116.024	71.6	106 / 106	82 / 82	94	27:16	1.0007	1.65
1.0	5	49.30 / 104.499	71.6	108 / 108	82 / 82	95	8:52	1.0016	1.69
1.5	10	88.58 / 99.235	71.6	108 / 110	82 / 82	95.5	14:40	1.0054	1.73
2.0	10	15.56 / 88.572	71.6	110 / 110	80 / 82	95.5	12:38	1.0075	1.71
3.0	10								
[illegible]	10								
							Avg	1.0038	1.695

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.

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 7-25-88 Meter box number C124 1478-0

Barometric pressure, P_b = 30.05 in. Hg Calibrated by Mat

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	820.99 / 826.179	78.8	108 / 110	88 / 86	98	12:14	0.992	1.67
1.0	5	814.81 / 820.02	78.8	110 / 112	88 / 88	99.5	8:45	0.994	1.68
1.5	10	803.05 / 813.565	78.8	106 / 112	84 / 85	96.75	14:23	0.998	1.71
2.0	~~10~~ 9	793.28 / 802.494	78.8	110 / 110	80 / 82	95.5	11:19	1.004	1.74
3.0	10								
4.0	10								
							Avg	.992	1.70

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

RAMCON ENVIRONMENTAL CORPORATION

Date 2-10-88 Thermocouple number Inlet

Ambient temperature 55°F °C Barometric pressure 29.96 in. Hg

Calibrator S. Greenwood 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°F	33°F	0%
B	OVEN	150°F	151°F	.007%
C	OVEN	175°F	173°F	.01%
D	AMBIENT	55°F	54°F	.02%
	7-29-88	80°F	80°F	0%

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON ENVIRONMENTAL CORPORATION

Date 2-10-88 Thermocouple number Outlet

Ambient temperature 55°F °C Barometric pressure 29.96 in. Hg

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

other _____

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
A	ICE BATH	33°F	32°F	.03%
B	OVEN	152°F	150°F	.01%
C	OVEN	175°F	175°F	0%
D	AMBIENT	55°F	55°F	0%
	7-27-88	80°F	80°F	0%

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON ENVIRONMENTAL CORPORATION

Lear Siegler Stack Sampler

Nozzle Diameter Calibration

Date _____ Signature _____

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

Pitot Tube Calibration (S Type)

Pitot Tube Identification No. #4 Date 2-5-88

Calibrated by: Sam C. T. Chuang

"A" SIDE CALIBRATION

Run No.	Δp std cm H_2O (in. H_2O)	Δp (s) cm H_2O (in. H_2O)	$C_p(s)$	DEVIATION $C_{p(s)}-\bar{C}_p(A)$
1	1.05	1.6	.810	2.01
2	.87	1.35	.803	2.01
3	.58	.88	.812	2.01
		$\bar{C}_p$ (SIDE A)	.808	

"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	1.05	1.60	.810	2.01
2	.87	1.30	.818	2.01
3	.58	0.90	.802	2.01
		$\bar{C}_p$ (SIDE B)	.810	

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

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

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

Form No. EED-17-1

RAMCON

Lear Siegler Stack Sampler

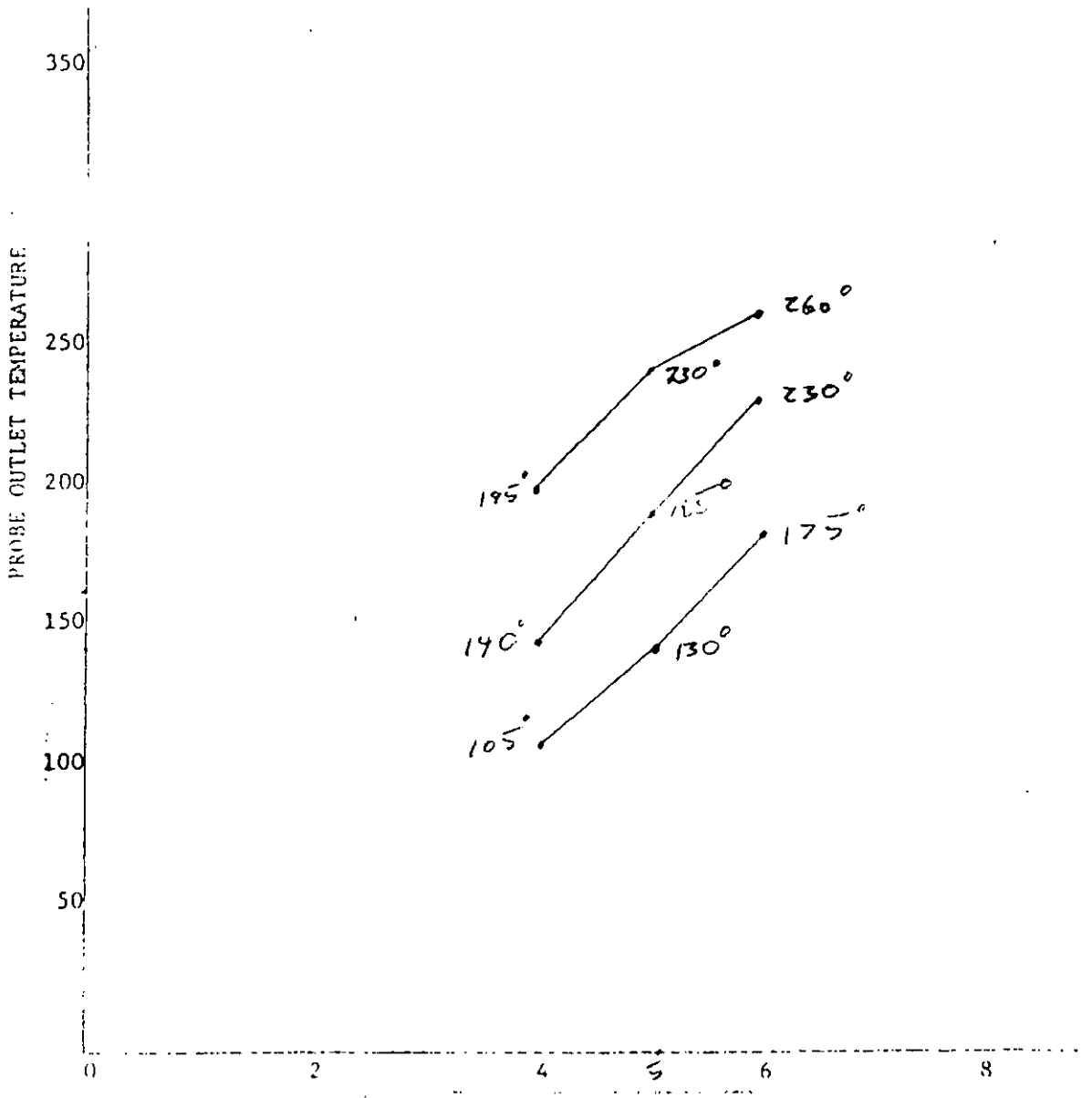
Heating Probe Calibration

Probe No. 44 Probe Length 4 5t

Date of Calibration 2/21/68 Signature _____

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 2-9-88 Thermocouple number 44

Ambient temperature 55 °F Barometric pressure 29.95 in. Hg

Calibrator S Buck Reference: mercury-in-glass ✓

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	ice water	32°F	32°F	0 %
B	Boiling water	212°F	212°F	0 %
C	Boiling oil	351°F	379°F	.005 %
D	Ambient 7-29-88	80°F	80°F	0 %

[a] Type of calibration system used.

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

X. RAMCON PERSONNEL

RAMCON Environmental Stack Test Team

Sumner Buck - President

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

Ken Allmendinger - Team Leader

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