

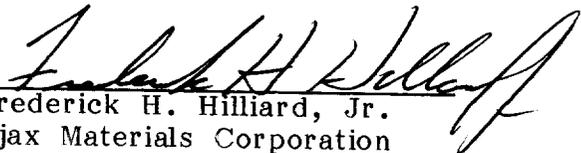
# RAMCON

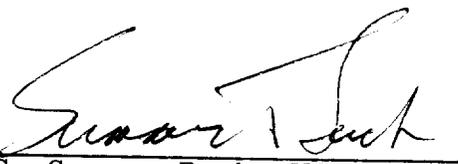
ENVIRONMENTAL CORPORATION

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/](http://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.

SOURCE SAMPLING  
for  
PARTICULATE EMISSIONS  
**AJAX MATERIALS CORPORATION**  
DETROIT, MICHIGAN  
July 13, 1988

  
Frederick H. Hilliard, Jr.  
Ajax Materials Corporation

  
G. Sumner Buck, III  
President

  
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Team Leader

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## I. INTRODUCTION

On July 13, 1988, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Ajax Materials' Gencor-Bituma drum mix asphalt plant located in Detroit, Michigan. RAMCON personnel conducting the test were Allen Turner, Team Leader, and Murphy O'Neal. 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. Turner 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. Robert Zabick of the Wayne County Air Pollution Control Division observed the testing conducted by RAMCON. Murphy O'Neal conducted the visible emissions test (Reference Method 9). The opacity on the two test runs was 0-5%; therefore, this plant meets N.S.P.S. requirements.

TABLE I  
SUMMARY OF TEST RESULTS  
July 13, 1988

<u>Test Run</u>	<u>Time</u>	<u>Grain Loading</u>	<u>Isokinetic Variation</u>	<u>Actual Emissions</u>
1	07:20 to 08:23	0.0153 gr/DSCF	112.8%	4.0 lbs/hr
2	11:08 to 12:15	0.0202 gr/DSCF	102.2%	5.1 lbs/hr
3	13:44 to 14:51	0.0094 gr/DSCF	101.7%	2.4 lbs/hr
Average:		0.0150 gr/DSCF		3.8 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.

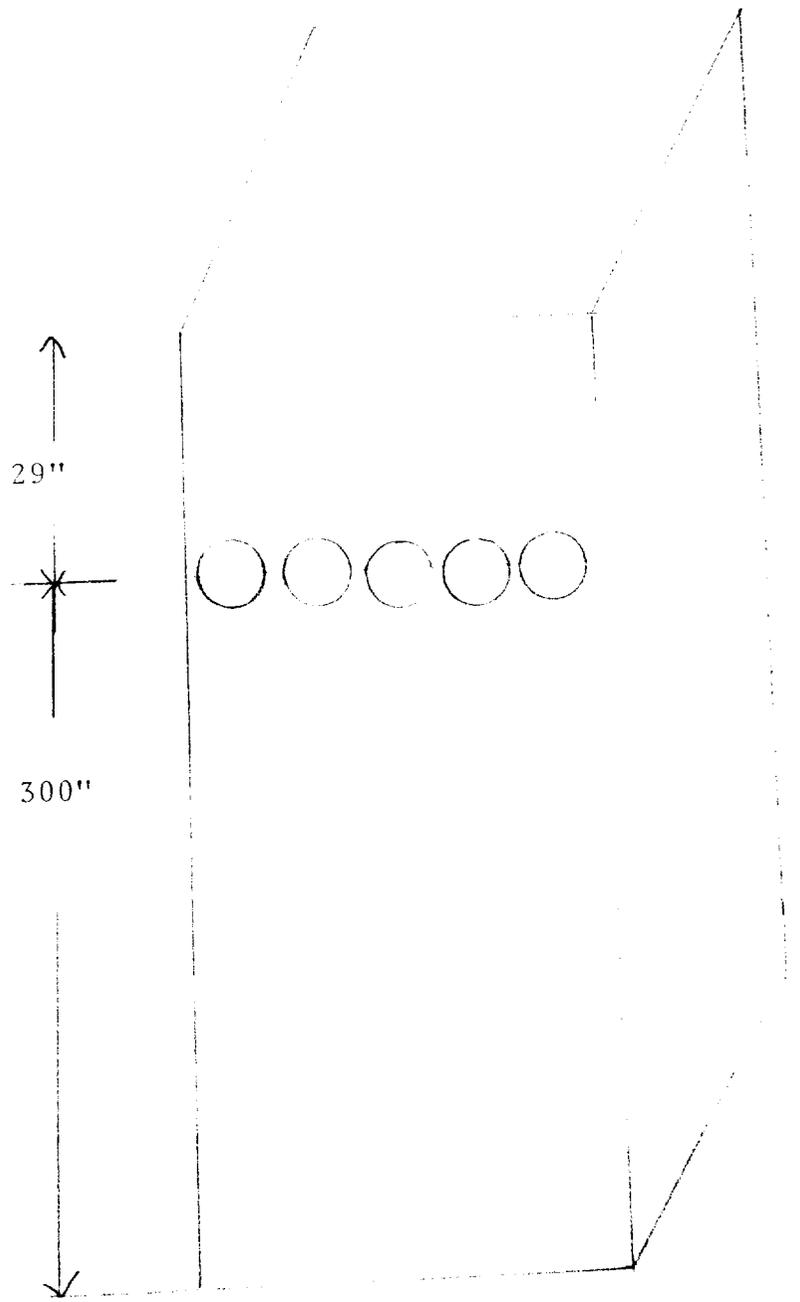
B. Problems Encountered: No problems were encountered that affected testing.

C. Sampling Site: The emissions test was conducted after a baghouse on a rectangular stack with an equivalent diameter of 48". Five sampling ports were placed 29" down (.60 diameters upstream) from the top of the stack and 300" up (6.3 diameters downstream) from the last flow disturbance. Thirty points were sampled, six through each port for 2 minutes each for a total test time of sixty minutes per test run.

Points on a <u>Diameter</u>	<u>Probe Mark</u>
-----------------------------------	-----------------------

1	* 9.0"
2	17.0"
3	25.0"
4	33.0"
5	41.0"
6	49.0"

\*Measurements include a 5.0" standoff.



#### **IV. THE SOURCE**

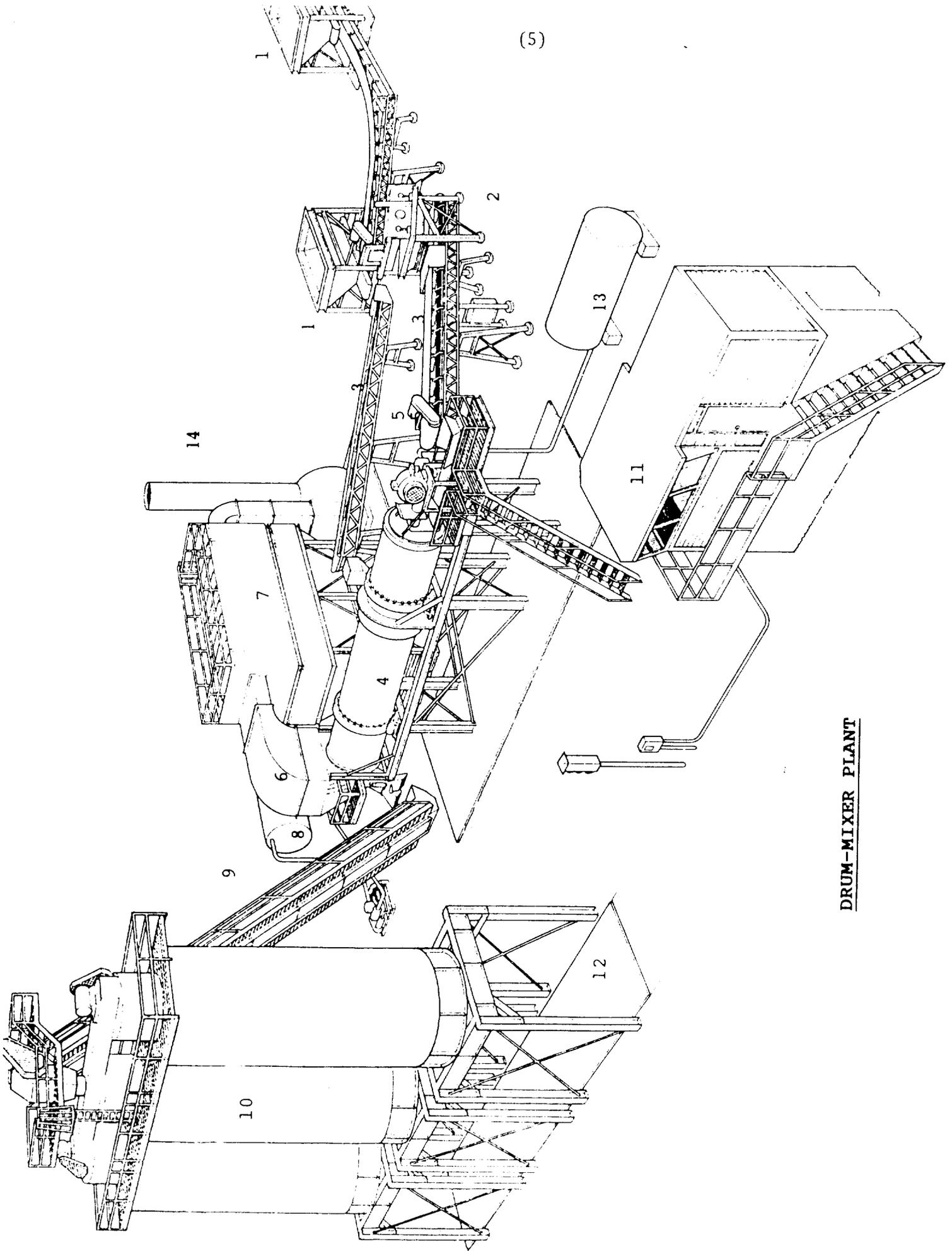
#### IV. THE SOURCE

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

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

The drum dryer uses a burner fired with 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 is manufactured by Gencor-Bituma. 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.

(5)



DRUM-MIXER PLANT

(6)

1. Aggregate bins: Virgin aggregate is fed individually into each of four bins by type. It is metered onto a conveyor belt running under the bins to a shaker screen. The proportion of each aggregate type is determined by the job mix formula and pre-set to be metered out to meet these specifications.
2. Preliminary oversize screen: The aggregate is fed through a shaker screen where oversize rocks and foreign material is screened out of the mix.
3. Weigh conveyor belt: The aggregate is conveyed to the rotary drum dryer on a conveyor belt which weighs the material. The production rate is determined by this weight reading.
4. Rotary drum dryer/mixer: The aggregate is fed into the rotary drum dryer where it is tumbled by flinging into a veil in front of a flame which drives off the moisture. Further mixing is also accomplished in this drum. Hot liquid asphalt is injected into the drum where it is blended with the aggregate. Mixing continues in a coater located at the end of the drum.
5. Burner: The fuel fired burner is used to provide the flame which dries the aggregate.
6. Knock off baffling: A baffling plate is inserted in the "dirty" side plenum as a knock out for heavy particles in the air stream. These particles fall to the bottom of the baghouse.
7. Baghouse: The hot gases are pulled through the bags into the clean air plenum. The solid particulate matter is trapped on the dust coat buildup on the bags. A bag cleaning cycle consisting of jet burst of air from the inside (or clean air side) of the bags sends a large bubble of air down the inside of the bags shaking loose buildup on the bag surface. This particulate matter is collected at the bottom of the baghouse and reinjected into the drum mixer where it is used as part of the finished project.
8. Liquid asphalt storage: The liquid asphalt is stored in this heated tank until it is needed in the mixer. The amount of asphalt content and its temperature are pre-set for each different type job.
9. Conveyor to surge/storage bin: The finished product of aggregate mixed with liquid asphalt is conveyed to a surge bin.
10. Surge/Storage bin: The asphaltic cement is dumped into this surge bin and metered out to dump trucks which pull underneath a slide gate at the bottom of the bin.
11. Control/operators house: The entire plant operation is controlled from this operator's house.
12. Truck loading scale: As the trucks receive the asphalt from the storage/surge bin they are weighed on the loading scale which tells the plant operator the amount of asphalt that is being trucked on each individual load.
13. Fuel Storage



(8)  
DATA SUMMARY

Plant

1. Manufacturer of plant Bituma.
2. Designed maximum operating capacity 400 TPH @ 5.0% moisture.
3. Actual operation rate \_\_\_\_\_ TPH @ \_\_\_\_\_ % moisture.
4. Startup date \_\_\_\_\_.
5. Type of fuel used in dryer NATURAL GAS.
6. Quantity of fuel consumption \_\_\_\_\_.

Aggregate

7. Name/type of mix WEARING COURSE.
8. Percent asphalt in mix 5.9 %.
9. Temperature of asphalt 300.
10. Sieve/Screening analysis:                    % Passing;  
1" 100                    3/8" \_\_\_\_\_ # \_\_\_\_\_  
3/4" 100                    # \_\_\_\_\_ # \_\_\_\_\_  
1/2" 100                    # \_\_\_\_\_ #200 \_\_\_\_\_

Baghouse

11. Manufacturer Bituma.
12. No. of bags ~~546~~ 546. Type of bags NOMAX.
13. Air to cloth ratio 5.59 To 1. Designed ACFM 70,000.
14. Square feet of bags 12,507.
15. Type of cleaning; pulse jet , reverse air ,  
plenum pulse \_\_\_\_\_, other \_\_\_\_\_.
16. Cleaning cycle time \_\_\_\_\_.
17. Interval between cleaning cycle \_\_\_\_\_.
18. Pressure drop across baghouse \_\_\_\_\_ psi.
19. Pulse pressure on cleaning cycle \_\_\_\_\_ psi.

COMPANY NAME ASAX MATERIALS                    DATE 7-13-88

COMPANY REPRESENTATIVE DANNI WALKER

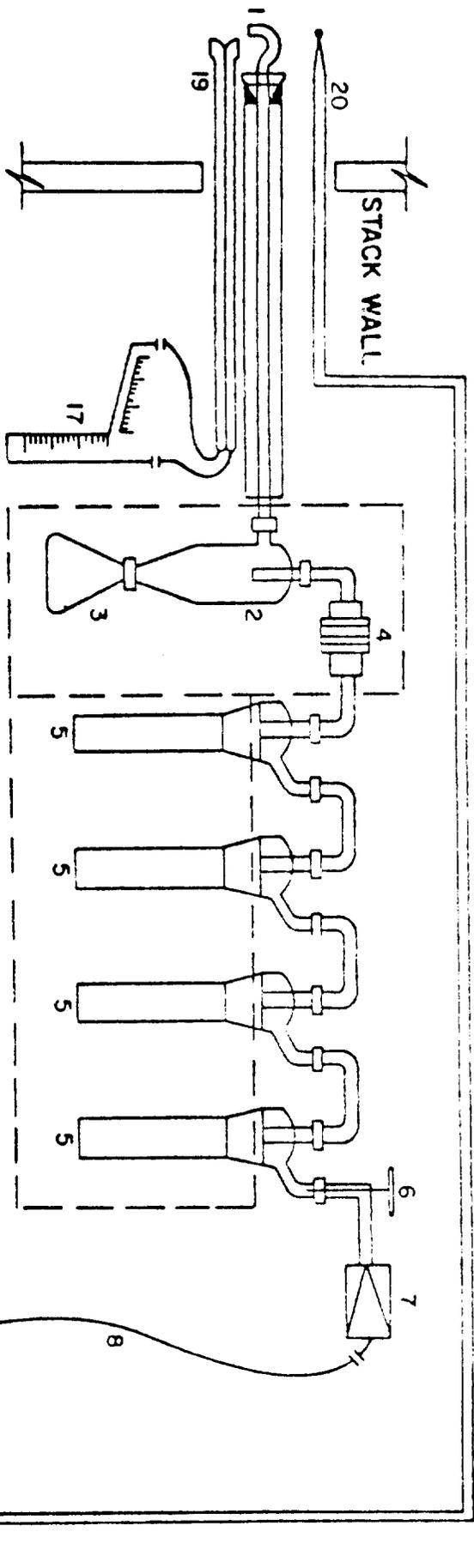
## **V. EQUIPMENT USED**

## **VI. LABORATORY PROCEDURES & RESULTS**

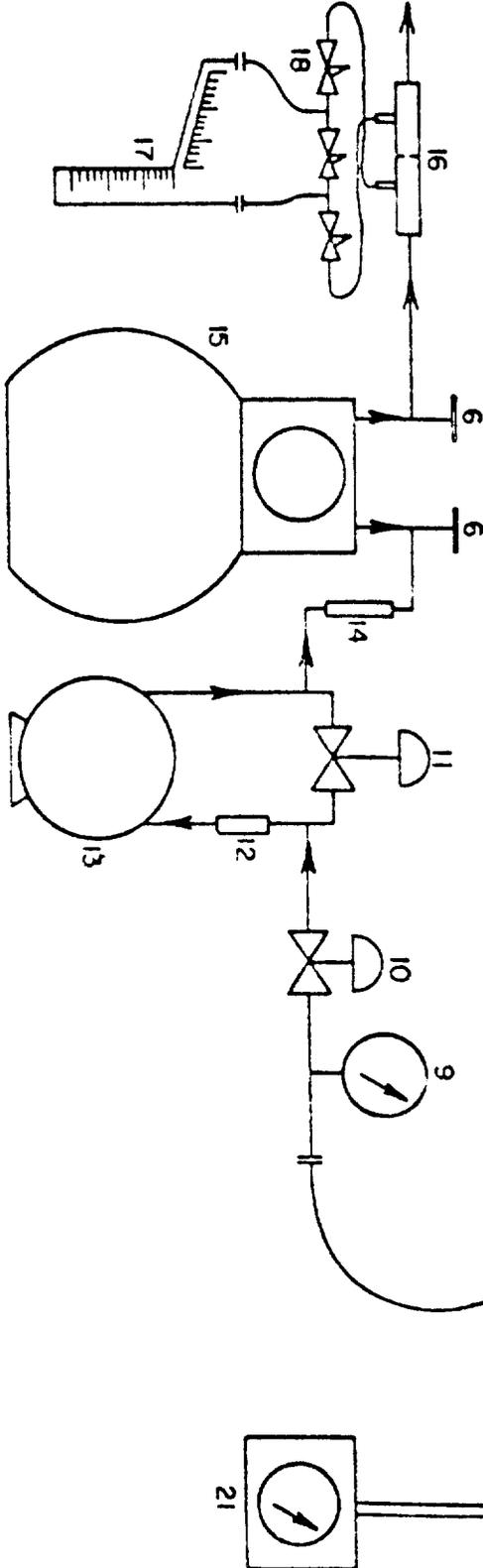
V. EQUIPMENT USED

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) Orler
- 13) Vacuum Pump
- 14) Filter
- 15) Dry Gas Meter
- 16) Office Tube
- 17) Incline Monometer
- 18) Solenoid Valves
- 19) Pilot
- 20) Thermocouple
- 21) Pyrometer



**SAMPLING TRAIN  
USED FOR ISOKINETIC SAMPLING**

LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

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

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

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

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

II. Post-Testing Lab Analysis

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

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

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

- C. PROBE RINSINGS: In all tests, where a probe washout analysis is necessary, this is accomplished in accordance with procedures specified in "EPA Reference Method 5". These samples are returned in sealed mason jars to the laboratory for analysis. The front half of the filter holder is washed in accordance with the same procedures and included with the probe wash. Reagent or ACS grade acetone is used as the solvent. The backhalf of the filter holder is washed with deionized water into the impinger catch for appropriate analysis.
- D. IMPINGER CATCH: In some testing cases, the liquid collected in the impingers must be analyzed for solid content. This involves a similar procedure to the probe wash solids determination, except that the liquid is deionized water.
- E. ACETONE: Conduct a blank analysis of acetone from the one gallon glass container. This acetone will be used in the field for rinsing the probe, nozzle, and top half of the filter holder. Performing such a blank analysis prior to testing will insure that the quality of the acetone to be used will not exceed the .001% residual purity standard.

#### SPECIAL NOTE

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

## WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

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

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

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

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

SAMPLE ANALYTICAL DATA FORM

Plant Location Le... Relative humidity in lab 45 %

Sample Location Natural asphalt plant Density of Acetone ( $\rho_a$ ) .7853 mg/ml

Blank volume ( $V_a$ ) 200 ml

Date/Time wt. blank 7-19-88

Gross wt. 96.8375 mg

Date/Time wt. blank 7-20-88

Gross wt. 96.8375 mg

Ave. Gross wt. 96.8375 mg

Tare wt. 96.8371 mg

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

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

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

Run # 1	Run # 2	Run # 3
200	200	200
94.8429	98.9875	97.6792
94.8431	98.9874	97.6794
Average Gross wt	94.8430	98.9875
Tare wt	94.8144	97.9480
Less acetone blank wt ( $W_a$ )	.0004	.0004
Wt of particulate in acetone rinse ( $m_a$ )	.0282	.0391

Filter Numbers	#
1A-2708	BT-2727
5G-2697	
Date/Time of wt <u>7-19-88</u>	Gross wt <u>0.6927</u>
Date/Time of wt <u>7-20-88</u>	Gross wt <u>0.6927</u>
Average Gross wt	<u>0.6927</u>
Tare wt	<u>0.6778</u>

Weight of particulate on filters(s) ( $m_f$ )	<u>0.0149</u>
Weight of particulate in acetone rinse	<u>0.0282</u>
Total weight of particulate ( $m_p$ )	<u>0.0431</u>

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 ST

## VII. CALCULATIONS

**SUMMARY OF TEST DATA**

		RUN #1	RUN #2	RUN #3
<b>SAMPLING TRAIN DATA</b>				
	start	07:20	11:08	13:44
	finish	08:23	12:15	14:51
1. Sampling time, minutes	$\theta$	60.0	60.0	60.0
2. Sampling nozzle diameter, in.	$D_n$	.2500	.2500	.2500
3. Sampling nozzle cross-sect. area, ft <sup>2</sup>	$A_n$	.000341	.000341	.000341
4. Isokinetic variation	I	112.8	102.2	101.7
5. Sample gas volume - meter cond., cf.	$V_m$	44.087	40.894	40.325
6. Average meter temperature, °R	$T_m$	546	573	570
7. Avg. oriface pressure drop, in. H <sub>2</sub> O	dH	1.89	1.59	1.53
8. Total particulate collected, mg.	$M_n$	43.10	50.40	23.10
<b>VELOCITY TRAVERSE DATA</b>				
9. Stack area, ft <sup>2</sup>	A	16.00	16.00	16.00
10. Absolute stack gas pressure, in. Hg.	$P_s$	30.65	30.65	30.65
11. Barometric pressure, in. Hg.	$P_{bar}$	30.65	30.65	30.65
12. Avg. absolute stack temperature, R <sup>o</sup>	$T_s$	680	685	674
13. Average $-\sqrt{\text{vel. head}}$ , ( $C_p = .80$ )	$-\sqrt{dP}$	0.87	0.85	0.84
14. Average stack gas velocity, ft./sec.	$V_s$	54.93	53.82	52.77
<b>STACK MOISTURE CONTENT</b>				
15. Total water collected by train, ml.	$V_{ic}$	362.00	318.00	315.00
16. Moisture in stack gas, %	$B_{ws}$	28.26	27.98	28.03
<b>EMISSIONS DATA</b>				
17. Stack gas flow rate, dscf/hr. (000's)	$Q_{sd}$	1805	1762	1755
18. Stack gas flow rate, cfm	acfm	52733	51667	50659
19. Particulate concentration, gr/dscf	$C_s$	0.0153	0.0202	0.0094
20. Particulate concentration, lb/hr	E	3.95	5.09	2.36
21. Particulate concentration, lb/mBtu	E'	0.00000	0.00000	0.00000
<b>ORSAT DATA</b>				
22. Percent CO <sub>2</sub> by volume	CO <sub>2</sub>	4.00	4.00	4.00
23. Percent O <sub>2</sub> by volume	O <sub>2</sub>	14.00	14.00	14.00
24. Percent CO by volume	CO	.00	.00	.00
25. Percent N <sub>2</sub> by volume	N <sub>2</sub>	82.00	82.00	82.00

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

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  $^{\circ}R$ .
- $T_{std}$  = Standard absolute temperature ( 528 $^{\circ}R$ ).
- dH = Average pressure drop across oriface meter, in. H<sub>2</sub>O.
- Y = Dry gas meter calibration factor.
- 13.6 = Inches water per inches Hg.

RUN 1:

$$V_{m(std)} = (17.64) (.990) (44.087) \left[ \frac{(30.65) + \frac{1.89}{13.6}}{546} \right] = 43.416 \text{ dscf}$$

RUN 2:

$$V_{m(std)} = (17.64) (.990) (40.894) \left[ \frac{(30.65) + \frac{1.59}{13.6}}{573} \right] = 38.346 \text{ dscf}$$

RUN 3:

$$V_{m(std)} = (17.64) (.990) (40.325) \left[ \frac{(30.65) + \frac{1.53}{13.6}}{570} \right] = 38.006 \text{ dscf}$$

Total Contaminants by Weight: GRAIN LOADING

Particulate concentration  $C'_S$  gr./dscf.

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

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.

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

Run 1:

$$C'_S = \left[ 0.0154 \frac{\text{gr}}{\text{mg}} \right] \left[ \frac{43.10}{43.416} \right] = 0.0153 \text{ gr./dscf.}$$

Run 2:

$$C'_S = \left[ 0.0154 \frac{\text{gr}}{\text{mg}} \right] \left[ \frac{50.40}{38.346} \right] = 0.0202 \text{ gr./dscf.}$$

Run 3:

$$C'_S = \left[ 0.0154 \frac{\text{gr}}{\text{mg}} \right] \left[ \frac{23.10}{38.006} \right] = 0.0094 \text{ gr./dscf.}$$

Dry Molecular Weight

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

Where:

- $M_d$  = Dry molecular weight, lb./lb.-mole.  
 $\%CO_2$  = Percent carbon dioxide by volume (dry basis).  
 $\%O_2$  = Percent oxygen by volume (dry basis).  
 $\%N_2$  = Percent nitrogen by volume (dry basis).  
 $\%CO$  = Percent carbon monoxide by volume (dry basis).  
0.264 = Ratio of  $O_2$  to  $N_2$  in air, v/v.  
0.28 = Molecular weight of  $N_2$  or CO, divided by 100.  
0.32 = Molecular weight of  $O_2$  divided by 100.  
0.44 = Molecular weight of  $CO_2$  divided by 100.

Run 1:

$$M_d = 0.44(4.00\%) + 0.32(14.00\%) + 0.28(.00\% + 82.00\%) = 29.20 \frac{\text{lb}}{\text{lb-mole}}$$

Run 2:

$$M_d = 0.44(4.00\%) + 0.32(14.00\%) + 0.28(.00\% + 82.00\%) = 29.20 \frac{\text{lb}}{\text{lb-mole}}$$

Run 3:

$$M_d = 0.44(4.00\%) + 0.32(14.00\%) + 0.28(.00\% + 82.00\%) = 29.20 \frac{\text{lb}}{\text{lb-mole}}$$

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

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

Where:

0.04707 = Conversion factor, ft.<sup>3</sup>/ml.

0.04715 = Conversion factor, ft.<sup>3</sup>/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)(°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:

$$\begin{aligned} V_{wc_{std}} &= (0.04707) ( 350.0 ) = 16.5 \text{ cu.ft} \\ V_{wsg_{std}} &= (0.04715) ( 12.0 ) = 0.6 \text{ cu.ft} \end{aligned}$$

Run 2:

$$\begin{aligned} V_{wc_{std}} &= (0.04707) ( 300.0 ) = 14.1 \text{ cu.ft} \\ V_{wsg_{std}} &= (0.04715) ( 18.0 ) = 0.8 \text{ cu.ft} \end{aligned}$$

Run 3:

$$\begin{aligned} V_{wc_{std}} &= (0.04707) ( 300.0 ) = 14.1 \text{ cu.ft} \\ V_{wsg_{std}} &= (0.04715) ( 15.0 ) = 0.7 \text{ cu.ft} \end{aligned}$$

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

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:

$$B_{ws} = \frac{16.5 + 0.6}{16.5 + 0.6 + 43.416} \times 100 = 28.26 \%$$

Run 2:

$$B_{ws} = \frac{14.1 + 0.8}{14.1 + 0.8 + 38.346} \times 100 = 27.98 \%$$

Run 3:

$$B_{ws} = \frac{14.1 + 0.7}{14.1 + 0.7 + 38.006} \times 100 = 28.03 \%$$

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

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:

$$M_s = 29.20 ( 1 - 28.26 ) + 18 ( 28.26 ) = 26.03 \text{ (lb./lb.-mole)}$$

Run 2:

$$M_s = 29.20 ( 1 - 27.98 ) + 18 ( 27.98 ) = 26.07 \text{ (lb./lb.-mole)}$$

Run 3:

$$M_s = 29.20 ( 1 - 28.03 ) + 18 ( 28.03 ) = 26.06 \text{ (lb./lb.-mole)}$$

Stack Gas Velocity

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

Where:

- $V_s$  = Average velocity of gas stream in stack, ft./sec.
- $K_p$  = 85.49 ft/sec  $\left[ \frac{(\text{g/g-mole}) - (\text{mm Hg})}{(^{\circ}\text{K}) (\text{mm H}_2\text{O})} \right]^{1/2}$
- $C_p$  = Pitot tube coefficient, (dimensionless).
- $dP$  = Velocity head of stack gas, in.  $\text{H}_2\text{O}$ .
- $P_{\text{bar}}$  = Barometric pressure at measurement site, (in. Hg).
- $P_g$  = Stack static pressure, (in. Hg).
- $P_s$  = Absolute stack gas pressure, (in. Hg) =  $P_{\text{bar}} + P_g$
- $P_{\text{std}}$  = Standard absolute pressure, ( 29.92 in. Hg ).
- $t_s$  = Stack temperature, ( $^{\circ}\text{f}$ ).
- $T_s$  = Absolute stack temperature, ( $^{\circ}\text{R}$ ). =  $460 + t_s$ .
- $M_s$  = Molecular weight of stack gas, wet basis, (lb/lb-mole).

Run 1:

$$V = (85.49) ( .80 ) ( 0.87 ) \sqrt{\frac{680}{(30.65)(26.03)}} = 54.93 \text{ ft/sec.}$$

Run 2:

$$V = (85.49) ( .80 ) ( 0.85 ) \sqrt{\frac{685}{(30.65)(26.07)}} = 53.82 \text{ ft/sec.}$$

Run 3:

$$V = (85.49) ( .80 ) ( 0.84 ) \sqrt{\frac{674}{(30.65)(26.06)}} = 52.77 \text{ ft/sec.}$$

Stack Gas Flow Rate

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

Where:

- $Q_{sd}$  = Dry volumetric stack gas flow rate corrected to standard conditions, (dscf/hr).
- $A$  = Cross sectional area of stack, (ft.<sup>2</sup>).
- 3600 = Conversion factor, (sec./hr.).
- $t_s$  = Stack temperature, (°f).
- $T_s$  = Absolute stack temperature, (°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:

$$Q_{sd} = 3600(1 - .2826)(54.93)(16.00) \left[ \frac{528}{680} \right] \left[ \frac{30.65}{29.92} \right] = 1805457.9 \frac{\text{dscf}}{\text{hr}}$$

Run 2:

$$Q_{sd} = 3600(1 - .2798)(53.82)(16.00) \left[ \frac{528}{685} \right] \left[ \frac{30.65}{29.92} \right] = 1762915.7 \frac{\text{dscf}}{\text{hr}}$$

Run 3:

$$Q_{sd} = 3600(1 - .2803)(52.77)(16.00) \left[ \frac{528}{674} \right] \left[ \frac{30.65}{29.92} \right] = 1755512.8 \frac{\text{dscf}}{\text{hr}}$$

Emissions Rate from Stack

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

Where:

E = Emissions rate, lb/hr.

C<sub>s</sub> = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, gr/dscf.

Q<sub>sd</sub> = Dry volumetric stack gas flow rate corrected to standard conditions, dscf/hr.

Run 1:

$$E = \frac{(0.0153) (1805457.9)}{7000} = 3.95 \text{ lb. / hr.}$$

Run 2:

$$E = \frac{(0.0202) (1762915.7)}{7000} = 5.09 \text{ lb. / hr.}$$

Run 3:

$$E = \frac{(0.0094) (1755512.8)}{7000} = 2.36 \text{ lb. / hr.}$$

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

Where:

- I = Percent isokinetic sampling.
- 100 = Conversion to percent.
- $T_s$  = Absolute average stack gas temperature, °R.
- 0.002669 = Conversion factor, Hg - ft<sup>3</sup>/ml - °R.
- $V_{ic}$  = Ttl vol of liquid collected in impingers and silica gel, ml.
- $T_m$  = Absolute average dry gas meter temperature, °R.
- $P_{bar}$  = Barometric pressure at sampling site, (in. Hg).
- dH = Av pressure differential across the oriface meter, (in.H<sub>2</sub>O).
- 13.6 = Specific gravity of mercury.
- 60 = Conversion seconds to minutes.
- $\theta$  = 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<sup>2</sup>.

Run 1:

$$I = (100)(680) \left[ \frac{(0.002669)(362.00) + \frac{44.087}{546} \left[ 30.65 + \frac{1.89}{13.6} \right]}{60 (60.0) (54.93) (30.65) (.000341)} \right] = 112.8\%$$

Run 2:

$$I = (100)(685) \left[ \frac{(0.002669)(318.00) + \frac{40.894}{573} \left[ 30.65 + \frac{1.59}{13.6} \right]}{60 (60.0) (53.82) (30.65) (.000341)} \right] = 102.2\%$$

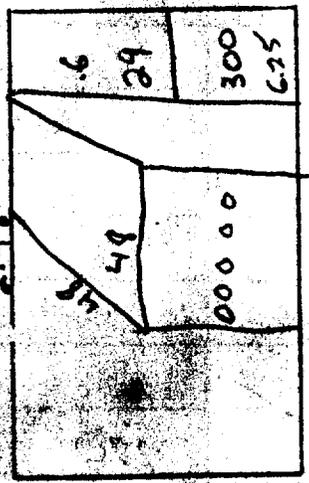
Run 3:

$$I = (100)(674) \left[ \frac{(0.002669)(315.00) + \frac{40.325}{570} \left[ 30.65 + \frac{1.53}{13.6} \right]}{60 (60.0) (52.77) (30.65) (.000341)} \right] = 101.7\%$$

## VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Ambient Temperature 70  
 Barometric Pressure 30.65  
 Assumed Moisture, % 18  
 Probe Length, m(ft) 6  
 Nozzle Identification No. 0003409  
 Avg. Calibrated Nozzle Dia., (in.) 3.50/3.50/3.50  
 Probe Heater Setting 4  
 Leak Rate, m<sup>3</sup>/min. (cfm) 0.00147 2.1x10<sup>-3</sup>  
 Probe Liner Material PTFE  
 Static Pressure, mm Hg (in. Hg) 40.5  
 Filter No. BT-2708



Schematic of Stack Cross Section

Station 2-135 RT  
 Operator ...  
 Date 7-13-80  
 Run No. ...  
 Sample Box No. ...  
 Meter Box No. ...  
 Meter H @ ...  
 C Factor ...  
 Pitot Tube Coefficient ...

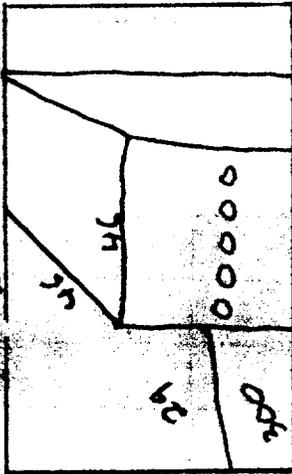
TRAV. PT NO.	SAMPLING TIME (6) min.	VACUUM in. Hg	STACK TEMP (T <sub>s</sub> ) °F	VELOCITY HEAD (P <sub>s</sub> ) in H <sub>2</sub> O	PRESSURE DIFF. ORF. MTR in H <sub>2</sub> O	GAS SAMPLE VOLUME ft <sup>3</sup>	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP AVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
1	<del>7:27</del>	4	220	.70	1.7	<del>697.2</del> 699.2	70	70	225	60
2	7:29	4	220	.70	1.7	700.5	70	70	225	60
3	7:26	5	220	1.0	2.5	702.1	70	70	225	60
4	7:28	5	220	1.0	2.5	703.7	70	70	230	60
5	7:30	4	220	.60	1.5	705.1	72	72	230	60
6	7:32	4	215	.70	1.7	706.4	72	72	230	60
1	<del>7:33</del>	4	220	.60	1.5	707.7	72	72	230	60
2	7:36:30	5	220	.80	2.0	709.2	72	72	230	60
3	7:38:30	5	220	1.1	2.7	710.9	72	72	240	60
4	7:40:30	5	220	.90	2.2	712.5	72	72	240	60
5	7:42:30	5	220	.90	2.2	714.1	72	72	240	60
6	7:44:30	5	220	.90	2.2	715.9	72	72	240	60
1	<del>7:45</del>	5	215	1.0	2.5	717.3	74	74	240	60

RAMCON emissions test log sheet, cont. DATE 7-13-88 LOCATION 2003 TEST NO. 1

TRAVERSE POINT	SAMPLING TIME (min)	VACUUM (in. Hg)	STACK TEMP (°F)	VELOCITY HEAD ΔPs (in. H <sub>2</sub> O)	ORIFICE DIFF. PRESSURE ΔH (in. H <sub>2</sub> O)	GAS VOLUME V <sub>m</sub> (ft. <sup>3</sup> )	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGING TEMP (°F)
							in	out		
2	7:49	3	220	.60	1.5	718.8	100	80	240	60
3	7:51	3.5	220	.80	2.0	720.3	100	80	240	60
4	7:53	3.5	220	.80	2.0	721.8	100	80	240	60
5	7:55	5	220	.90	2.2	723.3	100	80	240	60
6	7:57	5	220	.90	2.2	725.1	100	80	240	60
1	<del>7:58</del>	5	<del>220</del>	.90	2.2	726.6	100	80	240	60
2	8:02	5	225	.90	2.2	728.1	100	80	240	60
3	8:04	5	225	.90	2.2	729.7	100	80	240	60 (26)
4	8:06	3	220	.50	1.2	730.9	100	80	240	60
5	8:08	3	220	.50	1.2	732.2	100	80	240	60
6	8:10	3	220	.50	1.2	733.6	100	80	240	60
1	<del>8:11</del>	4	220	.80	2.0	735.0	100	80	240	60
2	8:15	4	220	.80	2.0	736.3	100	80	240	60
3	8:17	4	220	.80	2.0	737.7	100	80	240	60
4	8:19	4	220	.50	1.2	739.1	100	80	240	60
5	8:21	4	220	.50	1.2	740.1	100	80	240	60
6	8:23	4	220	.50	1.2	741.787	100	80	240	60

RAMCON ENVIRONMENTAL CORPORATION

Plant Ogden Ambient Temperature 87 STACK BR. NO. 532  
 Location Point 13 Barometric Pressure 30.65 FINAL INITIAL 500 532  
 Operator 0000-0000 Assumed Moisture, % 27 INITIAL 200 DIFFERENCE 300 18  
 Date 7-13-55 Probe Length, m(ft) 6 NOZZLE IDENTIFICATION NO. 0003409  
 Run No. 2 Nozzle Identification No. (in.) 3/8/35/250  
 Sample Box No. 204 Avg. Calibrated Nozzle Dia., (in.) 3/8  
 Filter Box No. 200 Probe Heater Setting 0107  
 Filter H e 495 Leak Rate, m<sup>3</sup>/min. (cfm) 0107  
 Factor 1.495 Probe Liner Material 0107  
 Pilot Tube Coefficient Cp 1.05 Static Pressure, mm Hg (in. Hg) 0.05  
 Filter No. BT-2727



Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (t) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft <sup>3</sup>	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LAG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
1	<del>11:10</del> 11:10	3	210	0.30	0.63	<del>741.9</del> 743.1	110	110	240	60
2	11:12	3	210	0.40	0.84	744.1	110	108	240	60
3	11:14	3	210	0.50	1.1	745.2	112	108	240	60
4	11:16	3	222	0.60	1.3	746.3	116	108	240	60
5	11:18	3	224	0.60	1.3	747.5	116	108	240	60
6	11:20	4	220	0.80	1.7	748.9	120	102	240	60
1	<del>11:21</del> 11:23	4	221	0.60	1.3	750.2	120	102	240	60
2	11:25	4	221	0.60	1.3	751.4	120	102	240	60
3	11:27	4	222	0.70	1.5	752.8	120	104	240	60
4	11:29	4	224	1.0	2.1	754.4	120	104	240	60
5	11:31	4	225	1.1	2.3	756.0	120	104	240	60
6	11:33	4	225	1.1	2.3	757.8	122	104	240	60
1	<del>11:35</del> 11:35-30	4	225	0.60	1.3	759.0	122	104	240	60

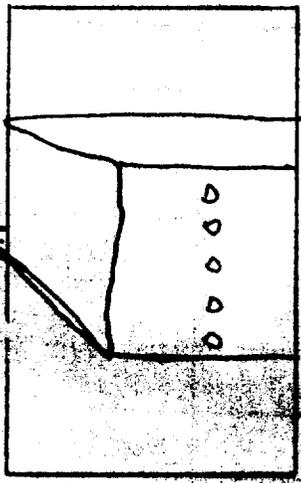
Ugly

RAMCON emissions test log sheet, cont. DATE 7-13-88 LOCATION Substation TEST NO. 2

TRAVERSE POINT	SAMPLING TIME (min)	VACUUM (in. Hg)	STACK TEMP (°F)	VELOCITY HEAD (in. H <sub>2</sub> O)	ORIFICE DIFF. PRESSURE (in. H <sub>2</sub> O)	GAS VOLUME V <sub>m</sub> (ft. <sup>3</sup> )	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
2	11:32:30	3	224	.70	1.5	760.3	124	104	250	60
3	11:33:30	3	224	.70	1.5	761.2	124	104	250	60
4	11:34:30	3	229	.80	1.7	763.2	124	106	250	60
5	11:35:30	4	227	1.1	2.3	764.7	124	106	250	60
6	11:36:30	4	227	1.0	2.1	766.4	124	106	250	60
1	11:37:30	4	228	1.1	2.3	767.8	124	106	250	60
2	11:38:30	4	230	.80	1.7	769.3	124	106	250	60
3	11:39:30	4	230	.80	1.7	770.8	124	106	250	60
4	11:40:30	4	230	.90	1.9	772.4	124	106	250	60
5	11:41:30	4	234	1.1	2.3	774.0	124	106	250	60
6	11:42:30	4	234	1.1	2.3	775.8	124	106	250	60
1	11:43:30	4	234	.50	1.1	776.7	124	106	250	60
2	11:44:30	4	234	.50	1.1	777.8	124	106	250	60
3	11:45:30	4	230	.60	1.3	779.0	124	106	250	60
4	11:46:30	4	230	.60	1.3	780.2	124	106	250	60
5	11:47:30	4	230	.60	1.3	781.3	124	106	250	60
6	11:48:30	4	230	.60	1.3	782.44	124	106	250	60

RAMCON ENVIRONMENTAL CORPORATION

Plant Aldrich  
 Location Booth  
 Operator James  
 Date 2-12-85  
 Run No. 3  
 Sample Box No. 1  
 Meter Box No. 004  
 Meter H<sub>e</sub> 2.1  
 C Factor 985  
 Pilot Tube Coefficient Cp .803



Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T <sub>s</sub> ) °F	VELOCITY HEAD (P <sub>0</sub> ) in H <sub>2</sub> O	PRESSURE DIFF. ORF. MTR in H <sub>2</sub> O	GAS SAMPLE VOLUME ft <sup>3</sup>	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
1	<del>1:44-30</del> 1:45-30	2	215	.30	.63	<del>782.8</del> 783.8	115	108	250	60
2	1:48-30	3	215	.50	1.1	785.0	115	108	250	60
3	1:50-30	3	215	.70	1.5	786.2	115	104	250	60
4	1:52-30	3	215	.70	1.5	787.4	115	104	250	60
5	1:54-30	3	215	.80	1.7	788.8	120	100	250	60
6	1:56-30	3	220	1.1	2.3	790.6	120	100	250	60
1	<del>1:57</del> 1:59	3	215	.50	1.1	791.9	120	100	250	60
2	2:01	3	220	.70	1.5	793.2	120	100	245	60
3	2:03	3	220	.70	1.5	794.4	120	100	245	60
4	2:05	3	220	.90	1.9	796.0	120	100	245	60
5	2:07	3	220	1.0	2.1	797.4	120	100	245	60
6	2:09	3	220	.90	1.9	799.1	120	100	245	60
1	<del>2:10</del> 2:12	3	220	.40	.87	800.2	120	100	245	60

Unger

RAMCON emissions test log sheet, cont. DATE 7-13-87 LOCATION 200-63 TEST NO. 3

TRAVERSE POINT	SAMPLING TIME (min)	VACUUM (in. Hg)	STACK TEMP (°F)	VELOCITY HEAD (in. H <sub>2</sub> O)	ORFICE DIFF. PRESSURE (in. H <sub>2</sub> O)	GAS VOLUME V <sub>m</sub> (ft. <sup>3</sup> )	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
2	2:19	3	220	.70	1.5	801.5	120	100	250	60
3	2:16	3	220	.90	1.9	802.2	120	100	250	60
4	2:18	3	220	1.0	2.1	804.5	120	100	250	60
5	<del>2:21-30</del> 2:22-30	4	215	1.0	2.1	805.8	120	100	250	60
6	2:25-30	4	220	1.0	2.1	807.4	120	100	250	60
1	<del>2:28-30</del> 2:29-30	4	220	.50	1.1	808.2	120	100	250	60
2	2:30-30	4	220	.50	1.1	810.0	120	100	250	60
3	2:32-30	4	220	.70	1.5	811.3	120	100	250	60
4	2:34-30	4	225	.90	1.9	812.7	120	100	250	60
5	2:36-30	4	225	1.0	2.1	814.4	120	100	250	60
6	2:38-30	4	225	.90	1.9	815.9	120	100	250	60
1	<del>2:41-30</del> 2:41-30	2	220	.40	.84	817.0	120	100	250	60
2	2:43-30	2	220	.40	.84	818.2	120	100	250	60
3	2:45-30	2	227	.50	1.1	819.2	120	100	250	60
4	2:47-30	2	227	.60	1.3	820.3	120	100	250	60
5	2:49-30	2	227	.40	.84	821.4	120	100	250	60
6	2:51-30	4	226	1.0	2.1	823.125	120	100	250	60

## **IX. CALIBRATIONS**

RAMCON ENVIRONMENTAL CORPORATION

EPA QA MANUAL VOL. III  
 Section No. 3.4.2  
 Revision No. 0  
 Date January 15, 1980  
 Page 17 of 22

Date 2-10-88 Thermocouple number Outlet  
 Ambient temperature 55°F °C Barometric pressure 29.96 in. Hg  
 Calibrator J. Greenwood Reference: mercury-in-glass   
 other \_\_\_\_\_

Reference point number <sup>a</sup>	Source <sup>b</sup> (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference, % <sup>c</sup>
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%
	7-13-88	70°F	70°F	0%

<sup>a</sup>Every 30°C (50°F) for each reference point.

<sup>b</sup>Type of calibration system used.

<sup>c</sup>
$$\left[ \frac{(\text{ref temp, } ^\circ\text{C} + 273) - (\text{test thermom temp, } ^\circ\text{C} + 273)}{\text{ref temp, } ^\circ\text{C} + 273} \right] 100 \leq 1.5\%$$

Figure 2.5 stack temperature sensor calibration data form.

RAMCON ENVIRONMENTAL CORPORATION

EPA QA MANUAL VOL. III  
 Section No. 3.4.2  
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Date 2-10-88 Thermocouple number dnlet  
 Ambient temperature 55°F °C Barometric pressure 29.96 in. Hg  
 Calibrator S. Greenwood Reference: mercury-in-glass   
 other \_\_\_\_\_

Reference point number <sup>a</sup>	Source <sup>b</sup> (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference, % <sup>c</sup>
A	ICE BATH	33°F	33°F	0%
B	OVEN	150°F	151°F	.007%
C	OVEN	175°F	173°F	.01%
D	AMBIENT 7-13-88	55°F 70°F	54°F 70°F	.02% 0%

<sup>a</sup>Every 30°C (50°F) for each reference point.

<sup>b</sup>Type of calibration system used.

<sup>c</sup>
$$\left[ \frac{(\text{ref temp, } ^\circ\text{C} + 273) - (\text{test thermom temp, } ^\circ\text{C} + 273)}{\text{ref temp, } ^\circ\text{C} + 273} \right] 100 \leq 1.5\%$$

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. 61 Date 2-3-88

Calibrated by: Sam T. Turner

"A" SIDE CALIBRATION

Run No.	$\Delta p$ std cm H <sub>2</sub> O (in. H <sub>2</sub> O)	$\Delta p$ (s) cm H <sub>2</sub> O (in. H <sub>2</sub> O)	$C_p$ (s)	DEVIATION $C_p(s) - \bar{C}_p(A)$
1	0.90	1.4	.802	
2	0.60	.93	.803	
3	0.41	.64	.800	
$\bar{C}_p$ (SIDE A)			.802	

"B" SIDE CALIBRATION

Run No.	$\Delta p$ std cm H <sub>2</sub> O (in. H <sub>2</sub> O)	$\Delta p$ (s) cm H <sub>2</sub> O (in. H <sub>2</sub> O)	$C_p$ (s)	DEVIATION $C_p(s) - \bar{C}_p(B)$
1	0.90	1.39	.805	
2	0.60	.94	.799	
3	0.41	.63	.807	
$\bar{C}_p$ (SIDE B)			.804	

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

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

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

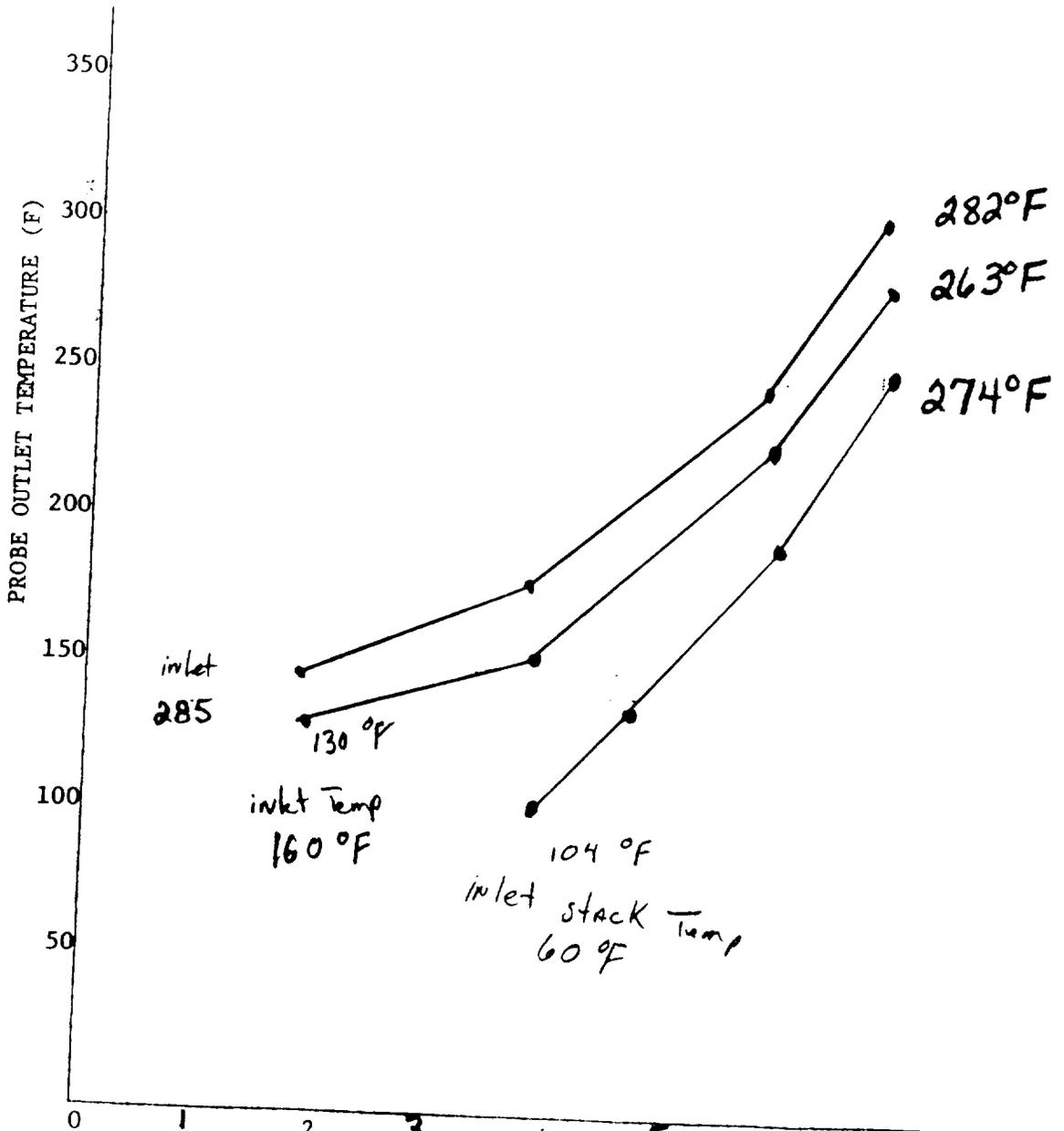
RAMCON

Lear Siegler Stack Sampler

Heating Probe Calibration

Probe No. 61 Probe Length 6'  
Date of Calibration 2-9-88 Signature Sam T Turner  
Name of Company to be tested \_\_\_\_\_

Note: 3 ft. probe - 5 min. warmup  
6 ft. probe - 15 min. warmup  
10 ft. probe - 30 min. warmup  
Calibration flow rate = .75 CFM



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Date 2/9/88 Thermocouple number 61  
 Ambient temperature 53°F Barometric pressure 29.95 in. Hg  
 Calibrator S. Greenwood Reference: mercury-in-glass   
 other

Reference point number <sup>a</sup>	Source <sup>b</sup> (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference, % <sup>c</sup>
A	ICE WATER	32°F	32°F	0%
B	Boiling Water	213°F	211°F	.9%
C	Oil	380°F	379°F	.2%
D	Ambient	53°F	53°F	0%
	7-13-88	70°F	70°F	0%

<sup>a</sup>Every 30°C (50°F) for each reference point.

<sup>b</sup>Type of calibration system used.

<sup>c</sup>
$$\left[ \frac{(\text{ref temp, } ^\circ\text{C} + 273) - (\text{test thermom temp, } ^\circ\text{C} + 273)}{\text{ref temp, } ^\circ\text{C} + 273} \right] 100 < 1.5\%$$

Figure 2.5 stack temperature sensor calibration data form.

## METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 7-19-89Meter box number 004-639809Barometric pressure,  $P_b = 30.01$  in. Hg Calibrated by Allen Turner

Orifice manometer setting ( $\Delta H$ ), in. H <sub>2</sub> O	Gas volume		Temperature			Time ( $\theta$ ), min	$Y_i$	$\Delta H @_i$ in. H <sub>2</sub> O <sup>10</sup>	
	Wet test meter ( $V_w$ ), ft <sup>3</sup>	Dry gas meter ( $V_d$ ), ft <sup>3</sup>	Wet test meter ( $t_w$ ), °F	Dry gas meter					
				Inlet ( $t_{d_i}$ ), °F	Outlet ( $t_{d_o}$ ), °F				Avg <sup>a</sup> ( $t_d$ ), °F
0.5	5								
1.0	5	<del>68.987</del> 74.2005	72	<del>100</del> 101	<del>82</del> 82	91.25	9.56	.991	1.98
1.5	10								
2.0	10	<del>58.158</del> 69.883	72	<del>102</del> 104	<del>82</del> 82	92.5	13.70	.934	2.0
3.0	10	<del>47.425</del> 58.006	72	<del>102</del> 104	<del>82</del> 82	92.5	11.37	.975	2.1
4.0	10								
Avg							.927		2.0

$\Delta H$ , in. H <sub>2</sub> O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t + 460)}$	$\Delta H @_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[ \frac{(t_w + 460) \theta}{V_w} \right]^2$
0.5	0.0368	$\frac{165805.25}{171753.89}$	10.58
1.0	0.0737		
1.5	0.110	$\frac{165805.25}{172662.13}$	<u>10.725</u>
2.0	0.147		
3.0	0.221	$\frac{82715.083}{83434.136}$	5.2135
4.0	0.294		

<sup>a</sup> 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 7-1-88Meter box number 004-638809Barometric pressure,  $P_b = 29.99$  in. Hg Calibrated by Allen Turner

Orifice manometer setting ( $\Delta H$ ), in. H <sub>2</sub> O	Gas volume		Temperature			Time ( $\theta$ ), min	$Y_i$	$\Delta H \theta_i$ in. H <sub>2</sub> O	
	Wet test meter ( $V_w$ ), ft <sup>3</sup>	Dry gas meter ( $V_d$ ), ft <sup>3</sup>	Wet test meter ( $t_w$ ), °F	Dry gas meter					
				Inlet ( $t_{d_i}$ ), °F	Outlet ( $t_{d_o}$ ), °F				Avg <sup>a</sup> ( $t_d$ ), °F
0.5	5								
1.0	5	<del>492023</del> 49789	>>	<del>102</del> 100	<del>86</del> 86	95	9.20	.998	1.86
1.5	10								
2.0	10	<del>691452</del> 692029	>>	<del>104</del> 110	<del>86</del> 86	96.5	1376	.975	2.1
3.0	10	<del>470725</del> 691252	>>	<del>102</del> 110	<del>86</del> 86	96	1144	.981	2.15
4.0	10								
		10.477	10.577	5167			Avg	.985	2.0

$\Delta H$ , in. H <sub>2</sub> O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t + 460)}$	$\Delta H \theta_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[ \frac{(t_w + 460) \theta}{V_w} \right]^2$
0.5	0.0368		
1.0	0.0737	<del>168</del> $\frac{16674.95}{83416.644}$	$\frac{83222.25}{63416.644}$
1.5	0.110		
2.0	0.147	$\frac{16674.35}{17122.94}$	
3.0	0.221	<del>168</del> $\frac{16674.4}{16969.27}$	
4.0	0.294		

<sup>a</sup> If there is only one thermometer on the dry gas meter, record the temperature under  $t_d$ .

**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.

**Allen Turner - Team Leader**

Allen Turner has been employed by RAMCON for three years. He has undergone extensive training in Methods 1 through 9. He is qualified as a team leader and is currently certified as a V.E. reader.

**XI. VISIBLE EMISSIONS**

SOURCE NAME <i>AT&amp;T</i> <i>Adwall</i>			OBSERVATION DATE				START TIME <i>11:08</i>		STOP TIME			
ADDRESS			SEC		M		SEC		M		SEC	
			M	0	15	30	45	M	0	15	30	45
			1	0	0	5	0	31	0	10	0	0
			2	0	0	0	0	32	0	0	0	0
			3	0	0	0	0	33	0	0	0	0
			4	0	0	0	5	34	0	0	5	0
			5	0	0	0	0	35	0	0	0	0
			6	0	0	0	5	36	0	0	0	0
			7	0	0	0	0	37	0	0	0	0
			8	0	0	0	0	38	0	0	0	0
			9	0	0	0	5	39	0	0	0	5
			10	0	0	0	0	40	0	10	0	0
			11	0	0	0	0	41	0	0	0	0
			12	0	5	0	5	42	0	0	0	0
			13	0	0	0	0	43	0	0	0	5
			14	0	0	0	0	44	0	0	0	0
			15	0	0	0	0	45	0	0	0	0
			16	0	0	5	0	46	0	0	0	0
			17	0	0	0	0	47	0	0	0	0
			18	0	0	0	5	48	0	5	0	0
			19	0	0	0	0	49	0	0	0	0
			20	0	5	0	0	50	0	0	0	0
			21	0	0	0	0	51	0	0	0	0
			22	0	0	0	0	52	0	5	0	0
			23	0	0	5	0	53	0	0	0	0
			24	0	0	0	0	54	0	0	5	0
			25	0	0	0	0	55	0	0	0	0
			26	0	0	5	0	56	0	0	0	0
			27	0	0	0	0	57	0	0	0	0
			28	0	0	0	0	58	0	0	0	5
			29	0	5	0	0	59	0	0	0	0
			30	0	0	0	0	60	0	0	0	0

CITY <i>Robert</i>	STATE	ZIP
PHONE	SOURCE ID NUMBER	
PROCESS EQUIPMENT		OPERATING MODE
CONTROL EQUIPMENT <i>Boothhouse</i>		OPERATING MODE
DESCRIBE EMISSION POINT <i>Stack Exit</i>		
HEIGHT ABOVE GROUND LEVEL	HEIGHT RELATIVE TO OBSERVER	
DISTANCE FROM OBSERVER <i>75 yds</i>	DIRECTION FROM OBSERVER	
DESCRIBE EMISSIONS <i>None visible except when purged</i>		
EMISSION COLOR <i>N.A.</i>	PLUME TYPE: CONTINUOUS <input type="checkbox"/> FUGITIVE <input type="checkbox"/> INTERMITTENT <input checked="" type="checkbox"/>	
WATER DROPLETS PRESENT NO <input checked="" type="checkbox"/> YES <input type="checkbox"/>	IS WATER DROPLET PLUME ATTACHED <input type="checkbox"/> DETACHED <input type="checkbox"/>	
AT WHAT POINT IN THE PLUME WAS OPACITY DETERMINED <i>stack exit</i>		
DESCRIBE BACKGROUND <i>Clear sky</i>		
BACKGROUND COLOR <i>Blue</i>	SKY CONDITIONS <i>Clear</i>	
WIND SPEED <i>0-5</i>	WIND DIRECTION <i>NW</i>	
AMBIENT TEMPERATURE <i>62</i>	RELATIVE HUMIDITY	
SOURCE LAYOUT SKETCH		DRAW NORTH ARROW

COMMENTS	AVERAGE OPACITY FOR HIGHEST PERIOD		NUMBER OF READINGS ABOVE % WERE	
	RANGE OF OPACITY READINGS			
	MINIMUM	MAXIMUM		
	OBSERVER'S NAME (PRINT) <i>Murphy O'Neal</i>			DATE
	OBSERVER'S SIGNATURE <i>Murphy O'Neal</i>			
	ORIGINAL LETTER <i>Horton</i>			
I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS		CERTIFIED BY <i>State of Tenn</i>		DATE
SIGNATURE	VERIFIED BY			DATE
TITLE				DATE

SOURCE NAME			OBSERVATION DATE				START TIME				STOP TIME			
AJAX (Virgin)			7-13-88											
ADDRESS														
CITY			STATE		ZIP									
PHONE			SOURCE/ID NUMBER											
PROCESS EQUIPMENT			OPERATING MODE											
CONTROL EQUIPMENT			OPERATING MODE											
DESCRIBE EMISSION POINT														
HEIGHT ABOVE GROUND LEVEL			HEIGHT RELATIVE TO OBSERVER											
DISTANCE FROM OBSERVER			DIRECTION FROM OBSERVER											
DESCRIBE EMISSIONS														
EMISSION COLOR			PLUME TYPE: CONTINUOUS <input type="checkbox"/>		FUGITIVE <input type="checkbox"/> INTERMITTENT <input checked="" type="checkbox"/>									
WATER DROPLETS PRESENT			IS WATER DROPLET PLUME ATTACHED <input type="checkbox"/> DETACHED <input type="checkbox"/>											
AT WHAT POINT IN THE PLUME WAS OPACITY DETERMINED														
DESCRIBE BACKGROUND														
BACKGROUND COLOR			SKY CONDITIONS											
WIND SPEED			WIND DIRECTION											
AMBIENT TEMPERATURE			RELATIVE HUMIDITY											
SOURCE LAYOUT SKETCH			DRAW NORTH ARROW											
			AVERAGE OPACITY FOR HIGHEST PERIOD				NUMBER OF READINGS ABOVE % WERE							
COMMENTS			RANGE OF OPACITY READINGS											
			MINIMUM		MAXIMUM									
			OBSERVER'S NAME (PRINT)											
			OBSERVER'S SIGNATURE								DATE			
			ORGANIZATION											
I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS			CERTIFIED BY								DATE			
SIGNATURE			State of Tenn											
TITLE			DATE											
			VERIFIED BY								DATE			



TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT  
CUSTOMS HOUSE

701 BROADWAY  
NASHVILLE, TENNESSEE 37219-5403

JUN 21 1988

Murphy O'Neal  
RAMCON  
223 Scott Street  
Memphis, TN 38108

RE: Certificate Number 1146

Dear Mr. O'Neal:

Enclosed you will find your certification card for successfully completing the June 7-9, 1988 Visible Emissions Evaluation School held in Memphis, Tennessee. In order to be certified as a qualified Visible Emissions Evaluator for all the methods approved by the Tennessee Air Pollution Control Board, one must meet an intensive array of criteria.

The individual reading criteria is as follows:

1. EPA Method 9 (6 Minute Average) requires a deviation of less than 7.5 on white and black smoke, and that the reader miss no reading by more than 15% opacity.
2. Tennessee Visible Emissions Evaluation Method 1 (Roads and Parking Areas) requires a worst-two-minute deviation of 8.8 or less.
3. TVEE Method 2 (Aggregate or Time Count) has the same criteria requirements as EPA Method 9.
4. TVEE Method 3 (Zero Percent Opacity) requires that the value assigned to a zero reading during a certification run shall not exceed 10% opacity, nor shall the combination of other zero readings exceed 10% opacity (i.e. two readings of five percent opacity).
5. TVEE Method 4 (Fugitive Dust Emissions from Non-Stack Emission Points) has the same criteria requirements as EPA Method 9.

Based on these criteria you are certified by the State of Tennessee to read EPA Method 9, and TVEE Methods 1, 2, 3, and 4 with sunglasses.

This certification is valid until December 08, 1988.

You must complete the requirements for recertification prior to this expiration date to retain your status as a qualified Visible Emissions Evaluator.

It was a pleasure having your participation in our Visible Emissions School. The Tennessee Division of Air Pollution Control would welcome any comments, or suggestions you may have concerning the operation of the school. Please forward any comments to the Division at (615)741-3931 or at the above address.

Sincerely yours,

*Carl Koontz*

Carl Koontz, Instructor  
Visible Emissions Evaluation School  
Division of Air Pollution Control

Enclosure