

RECEIVED

DEC 1 1985

AIR MANAGEMENT
ADMINISTRATION

RAMCON

ENVIRONMENTAL CORPORATION

RAMCON BUILDING

223 SCOTT STREET

MEMPHIS, TENNESSEE 38112

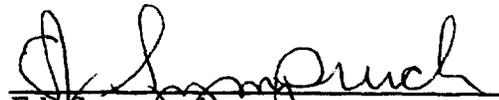
TELEPHONE 901 / 458-7000

TELEX 53-806

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.

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
GENSTAR STONE PRODUCTS
COCKEYSVILLE, MARYLAND
November 23 & 25, 1985


Ed Sympruch
Genstar Stone Products


G. Sumner Buck, III
President


Sam Turner
Field Supervisor

RAMCON

ENVIRONMENTAL CORPORATION

RAMCON BUILDING

223 SCOTT STREET

MEMPHIS, TENNESSEE 38112

TELEPHONE 901 / 458-7000

TELEX 53-806

December 3, 1985

Mr. Ed Sympruch
Genstar Stone Products
11350 McCormick Road
Hunt Valley, MD 21031

Subject: Particulate Emissions Test - Cockeysville, MD

Dear Mr. Sympruch:

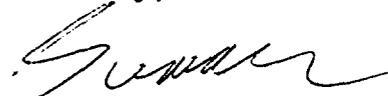
Enclosed are four copies of our report on particulate emissions. Based on our test results, your plant does pass both EPA New Source Performance Standards and those set by the State of Maryland. The average grain loading of the three test runs was in compliance with Federal and State Standards.

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

Mr. Craig Holdefer
Maryland Air Management
Div. of Environmental Affairs
P.O. Box 13387
Baltimore, MD 21203

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

Sincerely,



G. Sumner Buck, III
President

GSBIII:kr

Enclosures

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	TEST RESULTS	1
III.	TEST PROCEDURES	2
IV.	THE SOURCE	4
V.	EQUIPMENT USED	9
VI.	LABORATORY PROCEDURES & RESULTS	10
VII.	CALCULATIONS	15
VIII.	FIELD DATA	25
IX.	CALIBRATION	31
X.	RAMCON PERSONNEL	36

I. INTRODUCTION

On November 23 & 25, 1985, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Genstar Stone Products Astec drum mix asphalt plant located in Cockeysville, Maryland. RAMCON personnel conducting the test were Sam Turner, Field Supervisor and Billy Turner. Kim Rea was responsible for the laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples were limited to Mr. Turner and Ms. Rea.

The purpose of the test was to determine if the rate of emissions from the plant's baghouse and the total contaminants by weight (grain loading) are below the limits set by EPA and the State of Maryland.

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 emissions for the State of Maryland are the same as those set by EPA. Mr. Craig Holdefer of Maryland's Department of Environmental Affairs observed the testing conducted by RAMCON.

TABLE I
SUMMARY OF TEST RESULTS
November 23 & 25, 1985

<u>Test Run</u>	<u>Time</u>	<u>Grain Loading</u>	<u>Isokinetic Variation</u>	<u>Actual Emissions</u>
1	08:04 to 10:03	0.0222 gr/SCF	93%	7.1 lbs/hr
2	11:06 to 12:55	0.0313 gr/SCF	91%	9.7 lbs/hr
3	08:38 to 10:56	0.0314 gr/SCF	96%	9.2 lbs/hr
Average:		0.0283 gr/SCF		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/SCF emissions limitation set by US EPA and the State of Maryland. Therefore, the plant is operating in compliance with State and Federal Standards.

III. TEST PROCEDURES

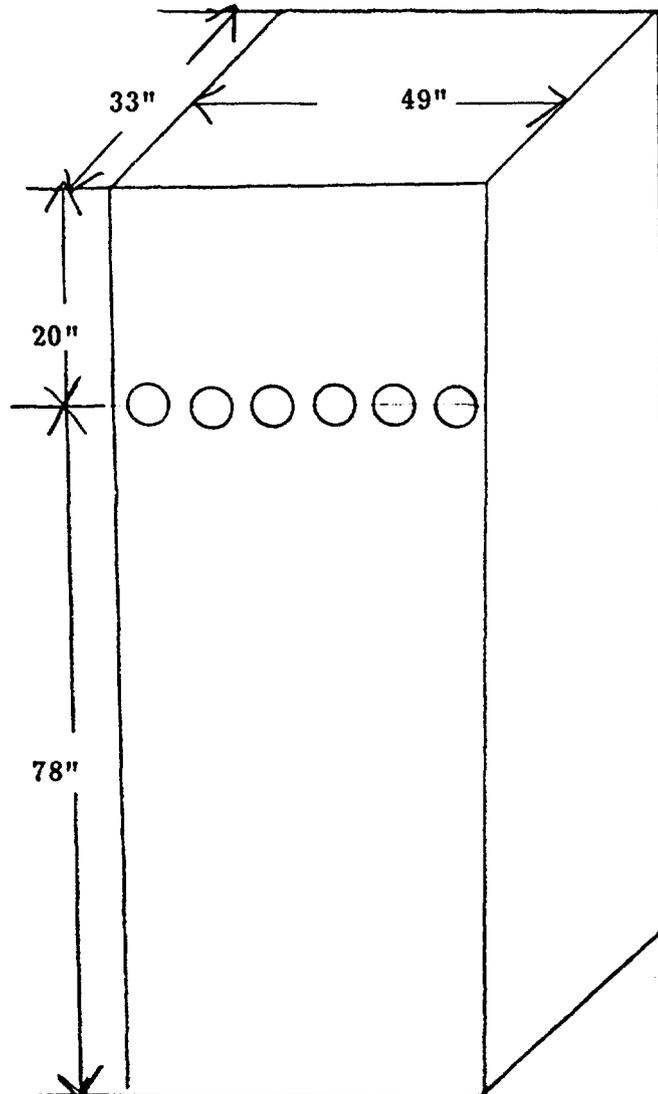
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

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

(3)

C. Sampling Site: The emissions test was conducted after a baghouse on a rectangular stack measuring 33" x 49" with an equivalent diameter of 39.4". Six sampling ports were placed approximately 20" down (0.5 diameters upstream) from the top of the stack and 78" up (2.0 diameters downstream) from the last flow disturbance. Twenty four points were sampled, four through each port for three minutes each.

<u>Points on a Diameter</u>	<u>Probe Mark</u>
1	4.1"
2	12.4"
3	20.6"
4	28.9"



IV. THE SOURCE

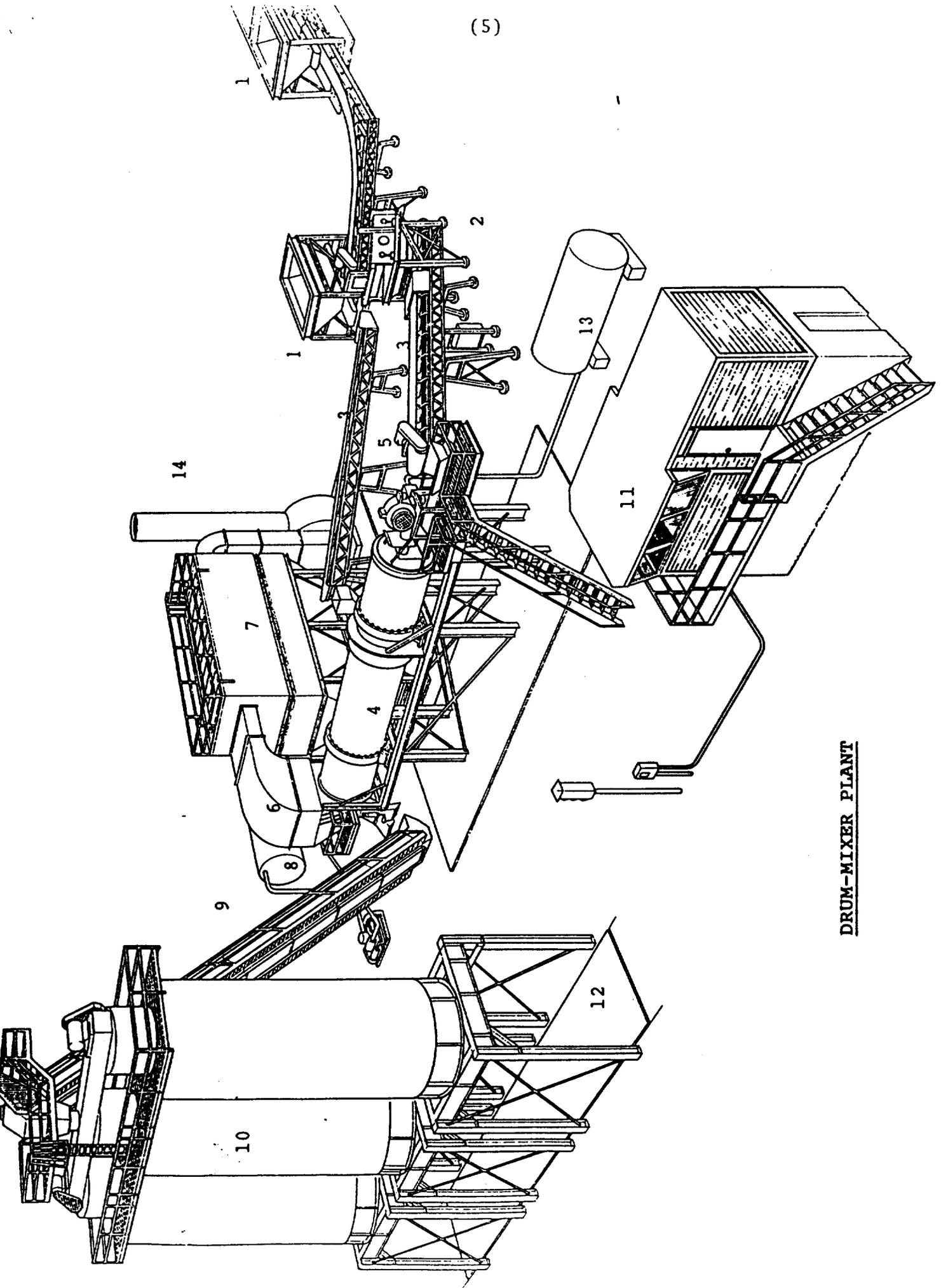
IV. THE SOURCE

Genstar Stone Products employs an Astec drum mix asphalt plant which is used to manufacture asphalt concrete 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. When recycled asphalt mix is used, it is added approximately halfway down the drum through a separate weigh conveyor. The required amount of hot asphalt oil is then injected onto and mixed into the dried aggregate in a separate container called a coater situated at the end of the drum dryer. 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% surface moisture removal.

The drum mixer uses a coal burner to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate. The hot asphalt oil is blended into the aggregate in the coater. The air is drawn into the system via an exhaust fan. After passing through the gas burner and the mixing drum, the air passes through a baghouse. The baghouse is manufactured by Astec. The exhaust gasses are drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube sheet is 2 - 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 flighting into a veil in front of a flame which drives off the moisture. Further mixing is also accomplished in this drum. Hot liquid asphalt is injected approximately one-third of the way down the inclined drum where it is mixed with the aggregate.
5. **Burner:** The fuel fired burner is used to provide the flame which 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**
14. **Stack**

(7)

DATA SUMMARY

Plant

- 1. Manufacturer of plant ASTEC INDUSTRIES INC.
- 2. Designed maximum operating capacity 400 TPH @ 5.0 % moisture.
- 3. Actual operation rate 300 TPH @ 3.8 % moisture.
- 4. Startup date ≈ OCT 15, 1985.
- 5. Type of fuel used in dryer 5% GAS, 95% COAL.
- 6. Quantity of fuel consumption ≈ 10 LBS COAL per 1.00 of mix

Aggregate

- 7. Name/type of mix BI BASE MIX.
 - 8. Percent asphalt in mix 4.6 %.
 - 9. Temperature of asphalt ≈ 310 °F.
 - 10. Sieve/Screening analysis: % Passing;
- | | | |
|-----------------|----------------|------------------|
| 1" <u>100</u> | 3/8" <u>97</u> | # 20 <u>34</u> |
| 3/4" <u>100</u> | # 4 <u>69</u> | # 100 <u>9</u> |
| 1/2" <u>99</u> | # 8 <u>55</u> | # 200 <u>4.2</u> |

Baghouse

- 11. Manufacturer ASTEC.
- 12. No. of bags 960. Type of bags NOMEX 1402.
- 13. Air to cloth ratio _____ . Designed ACFM _____.
- 14. Square feet of bags 12697.27.
- 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 ≈ 7.5" WATER psi.
- 19. Pulse pressure on cleaning cycle 100 psi.

COMPANY NAME _____ DATE _____

COMPANY REPRESENTATIVE [Signature]

PLANT DATA

(8)

COMPANY NAME GENSTAR STONE PRODUCTS INC
 COMPANY REP. Geo. ConCannon DATE NOV 23, 1985 Phone # (301) 628-4031
 DATA SOURCE _____
 PLANT LOCATION COCKEYSVILLE, Md
 PLANT MANUFACTURER ASTECC PLANT MODEL NO. 85017 PLANT TYPE DRYER J&M
 MIX SPECIFICATION NO. BI (EASE) ^{Serial} OIL SPECIFICATION NO. _____

TIME: START 7:30 STOP _____ A.T. _____ °F R.H. _____ %

TIME 24 HOUR	FUEL OIL <input type="checkbox"/> NATURAL GAS <input type="checkbox"/> PROPANE <input type="checkbox"/> GAS, COAL <input checked="" type="checkbox"/>	BURNER SETTING	AGGREGATE TPH	RECYCLE TPH	ASPHALT	MIX TEMPERATURE °F	VENTURI <input type="checkbox"/> Baghouse <input checked="" type="checkbox"/> DIFFERENTIAL
7:45		32.1	241		11.5	309	5.5
8:00		39.5	267		12.7	317	7.5
8:15		41	291		13.9	302	7.5
8:30	Run 1	41.6	289		14.0	310	8.0
8:45		41.6	287		13.9	302	8.0
9:15		32.6	267		12.7	340	7.0
9:30		40.1	295		14.1	312	7.5
11:00		41.6	287		13.6	284	6.0
11:15		36.4	257		12.6	295	6.0
11:30	Run 2	36.9	268		12.8	308	6.0
12:15	11:25						
8:45		30.5	340		16.5	301	7.0
9:00		38.0	325		15.6	293	6.0
9:45	Run 3	27.8	320		15.6	307	6.5
10:00		26.2	316		15.0	315	6.0
10:15		23.6	317		15.3	303	6.0
10:45		29.4	330		15.9	294	7.0

REMARKS:

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 I-HV with a porosity of .03 microns.
- F. The acetone is reagent grade or ACS grade with a residue of \leq .001.

VI. LABORATORY PROCEDURES & RESULTS

LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

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

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

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

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

II. Post-Testing Lab Analysis

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

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

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

- C. PROBE RINSINGS: In all tests, a probe wash-out analysis will be necessary. These samples are returned in sealed Mason jars and consist of A.R. Acetone with an unknown solid content. Clean 250 ml beakers are used to make this analysis. These should be immaculately washed and rinsed with deionized water, then oven dried at 105°C for about one hour. The beakers should be moved to the dessicator to cool for ninety (90) minutes, then labeled with a pencil and weighed on the Sartorius analytical balance. Any variance from this procedure should be duplicated exactly when reweighing, as this procedure has been found to be quite sensitive. After preparing the necessary number of beakers (one for each probe wash and one blank) the Mason jars should be opened, poured into the beaker, and any material remaining on the jar walls rinsed with an acetone wash bottle into the beaker. The amount of liquid in the beaker should be noted on the analysis form. The acetone rinsings are evaporated on a warming plate. The liquid is kept swirled with an air sweep to prevent "bumping". When the acetone is evaporated the beakers are weighed as in Section II A.
- D. IMPINGER CATCH: In some testing cases, the liquid collected in the impingers must be analyzed for solids content. This involves a similar procedure to the probe wash solids determination, except that the liquid is deionized water.
- E. ACETONE: Conduct a blank analysis of acetone in the 1 gallon glass container. This acetone will be used in the field for rinsing the probe, nozzle, and top half of the filter holder. Performing such a blank analysis prior to testing will insure that the quality of the acetone to be used will not exceed the .001% residual purity standard.

SPECIAL NOTE

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

WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

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

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

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

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

SAMPLE ANALYTICAL DATA FORM

Plant Location Treat Hill

Sample Location Henstar

Relative humidity in lab <u>45</u> %	Run #	Run #	Run #
Density of acetone (ρ_a) <u>.7853</u> mg/ml	<u>1</u>	<u>2</u>	<u>3</u>
Acetone rinse container number #	<u>PW1</u>	<u>PW2</u>	<u>PW3</u>
Acetone rinse volume (V_{aw}) ml	<u>250</u>	<u>250</u>	<u>250</u>
	Gross	Tare	Net
Acetone blank (M_a) g	<u>131.1315</u>	<u>131.1315</u>	<u>0</u>

Acetone blank residue concentration (C_a)

$(C_a) = (M_a) / (V_{aw}) (\rho_a) = (0 \text{ mg/g})$

Weight of residue in acetone wash

$W_a = C_a V_{aw} \rho_a = (0) (250) (.7853) = (0)$

Date/Time of wt <u>11-23-85</u>	Gross wt	g	<u>130.7604</u>	<u>131.9324</u>	<u>163.0933</u>
Date/Time of wt <u>11-27-85</u>	Gross wt	g	<u>130.7602</u>	<u>131.9322</u>	<u>163.0930</u>
Average Gross wt	g		<u>130.7603</u>	<u>131.9323</u>	<u>163.0932</u>
Tare wt	g		<u>130.6922</u>	<u>131.8344</u>	<u>163.0018</u>
Less acetone blank wt (W_a)	g		<u>0</u>	<u>0</u>	<u>0</u>
Wt of particulate in acetone rinse (m_a)	g		<u>.0681</u>	<u>.0979</u>	<u>.0914</u>

Filter Numbers	#	<u>ST-1192</u>	<u>ST-1193</u>	<u>ST-1185</u>	
Date/Time of wt <u>11-23-85</u>	Gross wt	g	<u>.6655</u>	<u>.6674</u>	<u>.6720</u>
Date/Time of wt <u>11-27-85</u>	Gross wt	g	<u>.6653</u>	<u>.6672</u>	<u>.6720</u>
Average Gross wt	g		<u>.6654</u>	<u>.6673</u>	<u>.6720</u>
Tare wt	g		<u>.6522</u>	<u>.6579</u>	<u>.6560</u>

Weight of particulate on filters(s) (m_f)	g	<u>.0132</u>	<u>.0094</u>	<u>.0160</u>
Weight of particulate in acetone rinse	g	<u>.0681</u>	<u>.0979</u>	<u>.0914</u>
Total weight of particulate (m_T)	g	<u>.0813</u>	<u>.1073</u>	<u>.1074</u>

Remarks _____

Signature of analyst Don Turner Signature of reviewer S. Black

COMPANY NAME GEOSTAR

Chloroform and Ethyl Ether Extraction for EPA Method 5 (back half)

Relative humidity in lab 42%

Density of chloroform and ethyl ether _____

	RUN 1	RUN 2	RUN 3
Chloroform and ethyl ether rinse volume	ml 260	215	280
Date/time of wt <u>11-27-85</u> Gross wt.	g 150.9816	149.4950	154.1726
Date/time of wt <u>11-28-85</u> Gross wt.	g 150.9810	149.4940	154.1716
Avg. Gross wt.	g 150.9844	149.4945	154.1722
Tare wt.	g 150.9593	149.4755	154.1572
Wt. of particulate in chloroform ethyl ether rinse	g .0221	.0190	.0150
Water evaporation	# 46	56	66
Date/time of wt <u>11-27-85</u> Gross wt.	g 140.9119	136.8391	141.2143
Date/time of wt <u>11-28-85</u> Gross wt.	g 140.9110	136.8366	141.2145
Avg. Gross wt.	g 140.9115	136.8389	141.2144
Tare wt.	g 140.8505	136.7799	141.1700
Less chloroform & ethyl ether blank wt.	g 0	0	0
Weight of particulate from water (m _f)	g .0610	.0590	.0444
Wt. of particulate in chloroform ethyl ether rinse	g .0221	.0190	.0150
Total weight of particulate (m _T)	g .0831	.0780	.0594

Note: In no case should a blank residue 0.02 mg/g or 0.001% of the weight of chloroform ethyl ether used be subtracted from the sample weight.

Remarks _____

Signature of Analyst [Signature]

Signature of Reviewer [Signature]

VII. CALCULATIONS

NAME: GENSTAR STONE PRODUCTS

LOCATION: COCKEYSVILLE, MARYLAND

date 11/23/85 11/23/85 11/25/85

SUMMARY OF TEST DATA

RUN # 1 RUN # 2 RUN # 3

SAMPLING TRAIN DATA

start 08:04 11:06 08:38
finish 10:03 12:55 10:56

Table with 5 columns: Parameter, Unit, Run 1, Run 2, Run 3. Rows 1-8 include: Sampling time, nozzle diameter, nozzle area, isokinetic variation, sample gas volume, average meter temperature, average orifice pressure drop, total particulate collected.

VELOCITY TRAVERSE DATA

Table with 5 columns: Parameter, Unit, Run 1, Run 2, Run 3. Rows 9-14 include: Stack area, absolute stack gas pressure, barometric pressure, average absolute stack temperature, average velocity head, average stack gas velocity.

STACK MOISTURE CONTENT

Table with 5 columns: Parameter, Unit, Run 1, Run 2, Run 3. Rows 15-16 include: Total water collected by train, moisture in stack gas.

EMISSIONS DATA:

Table with 5 columns: Parameter, Unit, Run 1, Run 2, Run 3. Rows 17-20 include: Stack gas flow rate, total particulate concentration (gr/dscf, lbs/hr, lbs/mbtu).

ORSAT DATA

Table with 5 columns: Parameter, Unit, Run 1, Run 2, Run 3. Rows 21-24 include: Percent CO2, O2, CO, N2 by volume. Includes handwritten '4.8' and '14.0' next to CO2 and O2 rows.

Handwritten note: 200% [unclear]

(16)

Dry Gas Volume :

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

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 orifice meter, in. Hg.

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

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

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

ΔH = Average pressure drop across orifice meter, in. H₂O

Y = Dry gas meter calibration factor

13.6 = Inches water per inches Hg.

$$\text{Run \# 1 } V_{m(std)} = 17.64 (1.01)(54.12) \left[\frac{(30.45) + \frac{1.99}{13.6}}{524} \right] = 56.30 \text{ dsc}$$

$$\text{Run \# 2 } V_{m(std)} = 17.64 (1.01)(51.95) \left[\frac{(30.45) + \frac{1.80}{13.6}}{536} \right] = 52.81 \text{ dsc}$$

$$\text{Run \# 3 } V_{m(std)} = 17.64 (1.01)(50.53) \left[\frac{(30.53) + \frac{1.73}{13.6}}{524} \right] = 52.67 \text{ dsc}$$

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.

$$\text{Run \# 1: } C_s = \left[0.0154 \frac{\text{gr}}{\text{mg}} \right] \left[\frac{81.3}{56.30} \right] = .0222 \text{ gr./dscf.}$$

$$\text{Run \# 2: } C_s = \left[0.0154 \frac{\text{gr}}{\text{mg}} \right] \left[\frac{107.3}{52.81} \right] = .0313 \text{ gr./dscf.}$$

$$\text{Run \# 3: } C_s = \left[0.0154 \frac{\text{gr}}{\text{mg}} \right] \left[\frac{107.4}{52.67} \right] = .0314 \text{ gr./dscf.}$$

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: $M_d = 0.44(4.8\%) + 0.32(15.0\%) + 0.28(.0\% + 80.2\%) = 29.4$
lb./lb.-mole

Run # 2: $M_d = 0.44(4.0\%) + 0.32(14.0\%) + 0.28(.0\% + 82.0\%) = 29.2$
lb./lb.-mole

Run # 3: $M_d = 0.44(4.8\%) + 0.32(14.0\%) + 0.28(.0\% + 81.2\%) = 29.3$
lb./lb.-mole

(19)

Water vapor condensed :

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

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

Where:

0.04707 = Conversion factor ft^3/ml .0.04715 = Conversion factor ft^3/g . $V_{wc_{std}}$ = Volume of water vapor condensed (standard conditions) scf. $V_{wsg_{std}}$ = Volume of water vapor collected in silica gel (standard conditions) V_f = Final volume of impinger contents, ml. V_i = Initial volume of impinger contents P = Density of water, (0.002201 lb/ml). R = Ideal gas constant, 21.85 (in.Hg.)(cu.ft./lb.-mole)($^{\circ}$ R) M_w = Molecular weight of water vapor (18.0 lb/lb-mole). T_{std} = Absolute temperature at standard conditions, 528 $^{\circ}$ R. P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

Run # 1:	$V_{wc(std)}$	= (0.04707) (260.0) =	12.2 cu.ft
	$V_{wsg(std)}$	= (0.04715) (10.0) =	.5 cu.ft

Run # 2:	$V_{wc(std)}$	= (0.04707) (215.0) =	10.1 cu.ft
	$V_{wsg(std)}$	= (0.04715) (9.0) =	.4 cu.ft

Run # 3:	$V_{wc(std)}$	= (0.04707) (280.0) =	13.2 cu.ft
	$V_{wsg(std)}$	= (0.04715) (11.0) =	.5 cu.ft

(20)

$$\text{Moisture content of stack gases: } B_{ws} = \frac{V_{wc_{std}} + V_{ws_{g_{std}}}}{V_{wc_{std}} + V_{ws_{g_{std}} + V_m_{std}} \times 100$$

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).

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

$$\text{Run \# 1: } B_{ws} = \frac{12.2 + .5}{12.2 + .5 + 56.30} \times 100 = 18.4 \%$$

$$\text{Run \# 2: } B_{ws} = \frac{10.1 + .4}{10.1 + .4 + 52.81} \times 100 = 16.6 \%$$

$$\text{Run \# 3: } B_{ws} = \frac{13.2 + .5}{13.2 + .5 + 52.67} \times 100 = 20.6 \%$$

$$\text{Molecular weight of stack gases: } M_s = M_d (1 - B_{ws}) + (B_{ws}).$$

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).

$$\text{Run \# 1: } M_s = 29.4 (1 - .184) + 18 (.184) = 27.3 \text{ (lb./lb.-mole).}$$

$$\text{Run \# 2: } M_s = 29.2 (1 - .166) + 18 (.166) = 27.3 \text{ (lb./lb.-mole).}$$

$$\text{Run \# 3: } M_s = 29.3 (1 - .206) + 18 (.206) = 27.0 \text{ (lb./lb.-mole).}$$

Stack gas velocity:

$$V_s = K_p C_p \left[\Delta P \right]^{1/2} \text{ avg.} \left[\frac{T_s(\text{avg.})}{P_s M_s} \right]^{1/2}$$

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).
 ΔP = Velocity head of stack gas, in. H₂O.
 P_{bar} = Barometric pressure at measurement site, (in.Hg).
 P_g = Stack static pressure (in.Hg).
 P_s = Absolute stack gas pressure, (in.Hg) = $P_{\text{bar}} + P_g$
 P_{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).

$$\text{Run \# 1: } V = (85.49) (.81) (1.41) \left[\frac{714}{(30.45)(27.30)} \right]^{1/2} = 90.49 \text{ ft/sec}$$

$$\text{Run \# 2: } V = (85.49) (.81) (1.33) \left[\frac{717}{(30.45)(27.34)} \right]^{1/2} = 85.47 \text{ ft/sec}$$

$$\text{Run \# 3: } V = (85.49) (.81) (1.31) \left[\frac{716}{(30.53)(26.97)} \right]^{1/2} = 84.59 \text{ ft/sec}$$

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.)².
 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:

$$Q_{sd} = 3600 (1 - .184) (90.49) (11.2) \left[\frac{528}{714} \right] \left[\frac{30.45}{29.92} \right] = 2246645 \text{ dscf/l}$$

Run # 2:

$$Q_{sd} = 3600 (1 - .166) (85.47) (11.2) \left[\frac{528}{717} \right] \left[\frac{30.45}{29.92} \right] = 2159745 \text{ dscf/l}$$

Run # 3:

$$Q_{sd} = 3600 (1 - .206) (84.59) (11.2) \left[\frac{528}{716} \right] \left[\frac{30.53}{29.92} \right] = 2043186 \text{ dscf/l}$$

Emissions rate from stack:

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

Where:

E = Emissions rate, lb./hr.

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

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

$$\text{Run \# 1: } E = \frac{(.0222) (2246645)}{7000} = 7.1 \text{ lb. / hr.}$$

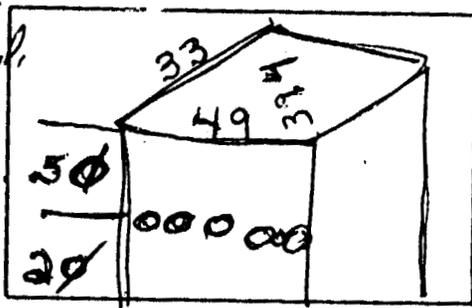
$$\text{Run \# 2: } E = \frac{(.0313) (2159745)}{7000} = 9.7 \text{ lb. / hr.}$$

$$\text{Run \# 3: } E = \frac{(.0314) (2043186)}{7000} = 9.2 \text{ lb. / hr.}$$

VII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant Genstar
 Location Hwy 83 N Exit 17 Salt Mar.
 Operator Sam T. Turner
 Date 11-23-85
 Run No. _____
 Sample Box No. _____
 Meter Box No. 670775
 Meter H @ 18 179
 C Factor 1.01
 Pitot Tube Coefficient Cp .81



Ambient Temperature 40
 Barometric Pressure 30.45 FINAL
 Assumed Moisture, % 25 INITIAL
 Probe Length, m(ft) 4 DIFFERENCE
 Nozzle Identification No. 0002498
 Avg. Calibrated Nozzle Dia., (in.) 2.14/2.41/2.4
 Probe Heater Setting 4
 Leak Rate, m³/min. (cfm) .007 at 9" vacuum
 Probe Liner Material Stainless Steel
 Static Pressure, mm Hg (in. Hg) +0.15
 Filter No. ST-1192 (0.6522)

IMPINGER VOLUME ml	SILICA GEL WEIGHT g
260	310
200	300
260	10

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ)min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft ³	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A 1	8:07 8:07	3	255	2.0	2.0	953.385 955.70	50	40	250	40
2	8:10	4	255	2.3	2.3	958.00	60	40	240	40
3	8:13	4	255	2.4	2.4	960.40	65	40	260	40
4	8:16	4	255	2.4	2.4	962.96	65	44	260	40
B 1	8:17 8:20	4	240	2.2	2.2	965.38	62	44	245	40
2	8:23	4	250	2.3	2.3	967.70	72	46	245	40
3	8:26	4	255	2.2	2.2	970.10	75	48	250	40
4	8:29	4	255	2.2	2.2	972.15	78	50	250	40
C 1	8:30 8:33	3	255	1.7	1.7	974.60	72	50	240	40
2	8:36	4	260	2.2	2.2	976.85	82	52	245	40
3	8:39	4	260	2.2	2.2	979.20	82	52	245	40
4	8:42	4	260	2.2	2.2	981.70	82	54	240	40
D 1	8:43 8:46	3	255	1.8	1.8	983.80	76	54	245	40

CO₂ = 5.0 %
 O₂ = 15.5 %

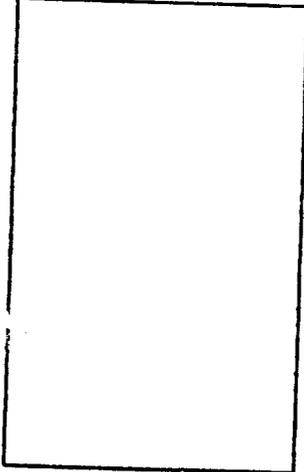
CO₂ = 4.5 %
 O₂ = 15.0 %

CO₂ = 5.0 %
 O₂ = 14.5 %

RAMCON ENVIRONMENTAL CORPORATION

Plant Gen Star

Location Hwy 83N Exit 17 B BATH MD.
 Operator Billy Turner
 Date 11-23-85
 Run No. 2
 Sample Box No. 2
 Meter Box No. 670775
 Meter H @ 1.75
 C Factor 1.01
 Pitot Tube Coefficient Cp .81



Ambient Temperature 40
 Barometric Pressure 30.45 FINAL 465 309
 Assumed Moisture, % 25 INITIAL 200 300
 Probe Length, m(ft) 4 DIFFERENCE 213 9
 Nozzle Identification No. 10002498
 Avg. Calibrated Nozzle Dia., (in.) 2.14/2.14
 Probe Heater Setting 4
 Leak Rate, m³/min. (cfm) .01 at 8" WAs
 Probe Liner Material Stainless Steel
 Static Pressure, mm Hg (in. Hg) +0.15
 Filter No. ST 1193

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft ³	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A 1	11:06 11:09	3	248	2.0	2.0	1.79 9.70	65	60	230	40
2	11:12	5	253	2.2	2.2	12.10	80	60	240	40
3	11:15	5	252	2.3	2.3	14.50	85	60	265	40
4	11:18	5	252	2.0	2.0	16.30	60	60	260	40
B 1	11:19 11:22	5	251	2.2	2.2	19.60	80	60	245	40
2	11:25	5	252	2.0	2.0	21.30	85	60	250	40
3	11:28	5	257	2.0	2.0	23.80	85	60	255	40
4	11:31	5	259	2.0	2.0	26.40	90	60	255	40
C 1	11:32 11:35	4	257	1.8	1.8	28.40	83	62	250	40
2	11:38	5	263	2.0	2.0	30.70	91	62	250	40
3	11:41	5	268	1.8	1.8	32.40	93	62	245	40
4	11:44	5	256	1.8	1.8	34.80	100	62	250	40
D 1	11:44 11:49	3	251	1.2	1.2	37.30	85	60	245	40

CO₂ = 4.0%
 O₂ = 16.6%
 CO₂ = 3.3%
 O₂ = 15.2%

RAMCON

emissions test log sheet, cont. DATE

LOCATION

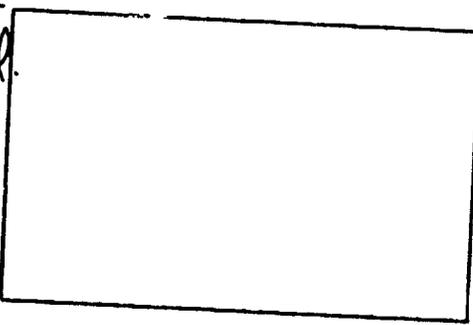
TEST NO.

TRAVERSE POINT	SAMPLING TIME (min)	VACUUM (In. Hg)	STACK TEMP (°F)	VELOCITY (ft/min)	HEAD (in. H ₂ O)	ORIFICE DIFF. PRESSURE (in. H ₂ O)	GAS VOLUME (l ₃)		BOX TEMP. (°F)	IMPINGER TEMP. (°F)
							in	out		
2	12:22	3	255	1.2	39.20	80	60	245	40	
3	12:56	5	213	2.2	41.10	95	60	216	40	
4	12:29	5	234	2.2	43.70	90	63	260	40	
E-1	12:30	3	251	1.2	45.40	90	63	255	40	
2	12:36	4	268	1.8	47.50	98	65	250	40	
3	12:39	5	273	1.8	49.70	100	70	255	40	
4	12:42	6	274	2.2	52.10	100	70	250	40	
F-1	12:43	3	269	1.2	54.10	100	70	245	40	
2	12:49	4	271	1.6	56.10	100	70	245	40	
3	12:52	3	272	1.2	57.90	100	71	250	40	
4	12:55	3	267	1.2	59.752	100	72	250	45	

105

Plant Crewstar

Location Hwy 93N Exit 17 Baltimore Md.
 Operator Sam Turner
 Date 11-25-85
 Run No. 3
 Sample Box No. 3
 Meter Box No. 670 775
 Meter H @ 1.79
 C Factor 1.01
 Pitot Tube Coefficient Cp .81



Ambient Temperature 40
 Barometric Pressure 30.53 FINAL 480 SILICA GEL WEIGHT. 311
 Assumed Moisture, % 2.5 INITIAL 200
 Probe Length, m(ft) 4 DIFFERENCE 280 300
 Nozzle Identification No. 0002490
 Avg. Calibrated Nozzle Dia., (in.) .214 .214 .214
 Probe Heater Setting 4
 Leak Rate, m³/min. (cfm) .005 at 7" Vacuum
 Probe Liner Material Stainless Steel
 Static Pressure, mm Hg (in. Hg) .015
 Filter No. ST-1185 (16560)

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ)min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (P _s) in H ₂ O	PRESSURE DIFF. ORF. MTR in H ₂ O	GAS SAMPLE VOLUME ft ³	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A 1	8:38 8:41	4	250	1.8	1.8	59.857 62.10	40	38	230	40
2	8:44	5	255	2.0	2.0	64.20	56	38	230	40
3	8:47	5	255	2.2	2.2	66.50	60	38	235	40
4	8:50	5	250	2.0	2.0	69.70	66	40	255	40
B 1	9:39 9:42	5	250	2.2	2.2	71.00	54	48	250	40
2	9:45	5	255	2.2	2.2	73.40	65	48	250	40
3	9:48	5	268	2.0	2.0	75.60	72	48	265	40
4	9:51	5	262	1.8	1.8	77.96	76	50	265	40
C 1	9:51:15 9:54:15	4	258	1.8	1.8	79.99	76	50	230	40
2	9:57:15	4	258	1.6	1.6	82.00	80	50	235	40
3	10:00:15	4	258	1.6	1.6	84.10	80	50	235	50
4	10:03:15	4	260	1.6	1.6	86.24	84	52	250	50
D 1	10:03:30 10:06:30	4	260	1.6	1.6	88.20	82	54	240	50

CO₂ = 5.0 %
 O₂ = 14.0 %
 C₂ = 0 %

CO₂ = 5.0 %
 O₂ = 14.0 %
 C₂ = 0 %

CO₂ = 4.5 %
 O₂ = 14.0 %
 C₂ = 0 %

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 11-27-85Meter box number 670775Barometric pressure, $P_b = 30.13$ in. Hg Calibrated by SAN TURNER

Orifice manometer setting (ΔH), in. H ₂ O	Gas volume		Temperature				Time (θ), min	Y_i	$\Delta H @_i$ in. H ₂ O
	Wet test meter (V_w), ft ³	Dry gas meter (V_d), ft ³	Wet test meter (t_w), °F	Dry gas meter					
				Inlet (t_{d_i}), °F	Outlet (t_{d_o}), °F	Avg ^a (t_d), °F			
0.5	5 5.165	137.30 137.15	72	100 108	78 78	91.25	13.13	1.002	1.86
1.0	5 5.15	134.00 137.15	72	92 108	76 78	88.5	9.27	.999	1.87
1.5	10								
2.0	10								
3.0	10 10.18	123.60 137.78	72	98 102	74 76	89.5	10.72	1.007	1.87
4.0	10								
Avg								1.003	1.87

$\frac{\Delta H, \text{in. H}_2\text{O}}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H @_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460) \theta}{V_w} \right]^2$
0.5	0.0368	
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 .

2 9.16
#1 10.43

3 13.08
Quality Assurance Handbook M4-2.3A (front side)

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. 41 Date 6/10/85

Calibrated by: John P. Biggs

"A" SIDE CALIBRATION

Run No.	Δp std cm H ₂ O (in. H ₂ O)	Δp (s) cm H ₂ O (in. H ₂ O)	C_p (s)	DEVIATION $C_p(s) - \bar{C}_p(A)$
1	0.91	1.4	0.806	+0.003
2	0.355	0.55	0.803	0.00
3	0.205	0.32	0.800	-0.003
		\bar{C}_p (SIDE A)	0.803	

"B" SIDE CALIBRATION

Run No.	Δp std cm H ₂ O (in. H ₂ O)	Δp (s) cm H ₂ O (in. H ₂ O)	C_p (s)	DEVIATION $C_p(s) - \bar{C}_p(B)$
1	0.91	1.4	0.806	+0.001
2	0.355	0.55	0.803	-0.002
3	0.205	0.315	0.807	+0.002
		\bar{C}_p (SIDE B)	0.805	

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

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

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

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 10-25-85Meter box number 670775Barometric pressure, $P_b =$ 30.53 in. Hg Calibrated by SAM T. TURNER

Orifice manometer setting (ΔH), in. H ₂ O	Gas volume		Temperature			Time (θ), min	Y_i	$\Delta H \theta_i$ in. H ₂ O	
	Wet test meter (V_w), ft ³	Dry gas meter (V_d), ft ³	Wet test meter (t_w), °F	Dry gas meter					
				Inlet (t_{d_i}), °F	Outlet (t_{d_o}), °F				Avg ^a (t_d), °F
0.5	5	41.649 46.636	76	80 98	66 72	79	12.53	1.01	1.74
1.0	5	46.802 57.843	76	92 101	72 75	85	9.07	1.01	1.80
1.5	10								
2.0	10								
3.0	10	52.502 62.612	76	99 116	76 80	97.75	10.62	1.01	1.83
4.0	10								
Avg							1.01	1.83	1.79

ΔH , in. H ₂ 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		
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 .

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 6-28-85 Thermocouple number 41
 Ambient temperature 78 °C Barometric pressure 30.33 in. Hg
 Calibrator SAM TURNER Reference: mercury-in-glass
 other _____

Reference point number	Source ^a (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference, ^b %
1.	Ice water	32°F	32°F	0%
2.	Boiling	212°F	212	0%
3	Boiling oil	379.4°F	380°F	.2%
4	Ambient 11-23-85	40°F	40°F	0%

^aType of calibration system used.

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

RAMCON

Lear Siegler Stack Sampler

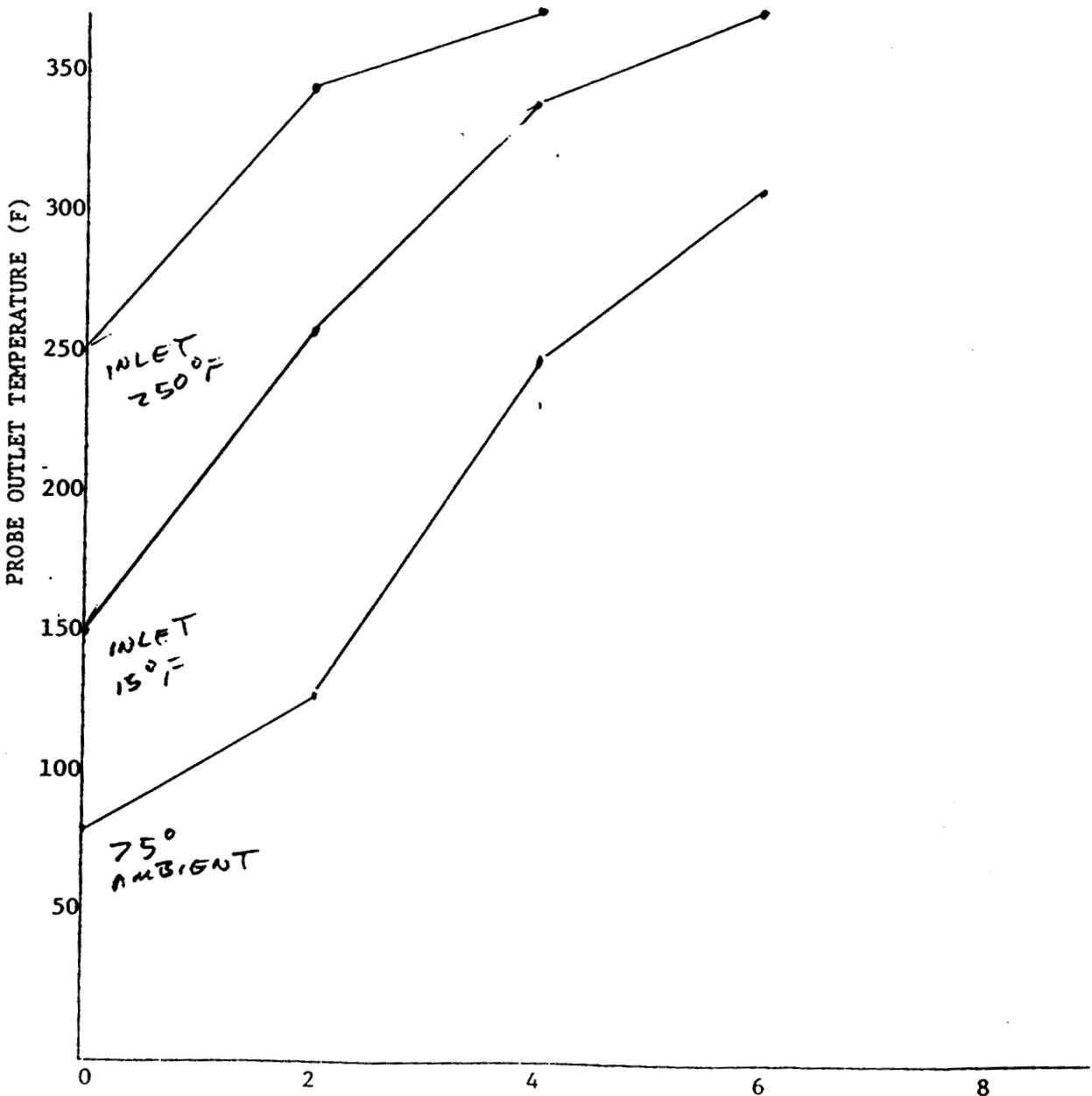
Heating Probe Calibration

Probe No. 4 Probe Length 4'

Date of Calibration 4-1-65 Signature [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



X. RAMCON PERSONNEL

RAMCON Environmental Stack Test Team

Sumner Buck - President

Sumner Buck is the President of RAMCON Environmental. He is a graduate of the EPA 450 "Source Sampling for Particulate Pollutants" course and the 474 "Continuous Emissions Monitoring" course all given at RTP. Mr. Buck is a qualified V.E. reader with current certification. Mr. Buck has personally sampled over 300 stacks including over 100 asphalt plants. He is 40 years old and a graduate of the University of Mississippi with graduate studies at Memphis State University and State Technical Institute of Memphis.

Sam Turner - Field Supervisor

Sam Turner has three years experience in the Air Division and is qualified as a team leader. He has sampled over twenty large boiler stacks and approximately 150 asphalt plants. Mr. Turner is a qualified V.E. reader with current certification. He is a graduate of State Technical Institute of Memphis, and holds an Associate Degree in Environmental Engineering. He also has another year's experience in the wet chemistry lab.