AP42 Section: 11.1

Reference Number: 304

Title: Source Sampling For Particulate Emissions, Tri-State Asphalt, Weirton, WV,

Ramcon Environmental Corp., Memphis, TN,

April 24, 1986.

AP-42 Section 11.1
Reference
Report Sect. 4
Reference ~~303~~ 304

RAMCON ENVIRONMENTAL CORPORATION

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

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
TRI-STATE ASPHALT
WEIRTON, WEST VIRGINIA
April 24, 1986

Frank Kline
Tri-State Asphalt

G. Sumner Buck, III
President

Ken Allmendinger
Team Leader

RAMCON ENVIRONMENTAL CORPORATION

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

May 6, 1986

Mr. Frank Kline
Tri-State Asphalt
R.D. 1, Box 427A
Rayland, OH 43943

Subject: Particulate Emissions Test - Weirton, WV

Dear Mr Kline:

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

You will want to sign the report covers and send one copy to:

Mr. Bruce Morgan
West Virginia A.P.C.
Northern Panhandle Regional Office
1911 Warwood AVenue
Wheeling, WV 26003

You will also need to send a copy to:

Mr. Richard W. Eaton
Field Investigator
US EPA Region III
Wheeling Field Office
303 Methodist Building
Wheeling, WV 26003

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

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I. INTRODUCTION

On April 24, 1986, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Tri-State Asphalt's Barber-Greene drum mix asphalt plant located in Weirton, West Virginia. RAMCON personnel conducting the test were Ken Allmendinger, Team Leader and Shawn Greenwood. Kim Rea was responsible for the laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples were limited to Mr. Allmendinger 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 N.S.P.S. limits set by US EPA and the State of West Virginia.

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 West Virginia are the same as those set by EPA.

Mr. Bruce Morgan of West Virginia's Air Pollution Control Commission and Mr. Richard Eaton of US EPA Region III observed the testing conducted by RAMCON.

TABLE I

SUMMARY OF TEST RESULTS
April 24, 1986

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	10:03 to 11:18	0.0201 gr/DSCF	91%	5.5 lbs/hr
2	13:25 to 15:03	0.0121 gr/DSCF	90%	3.4 lbs/hr
4	16:28 to 17:36	0.0089 gr/DSCF	97%	2.3 lbs/hr
	Average:	0.0137 gr/DSCF		3.7 lbs/hr

On the basis of these test results, the average grain loading of the three test runs was below the .04 gr/DSCF emissions limitation set by US EPA and the State of West Virginia. Therefore, the plant is operating in compliance with State and Federal Standards.

III. TEST PROCEDURES

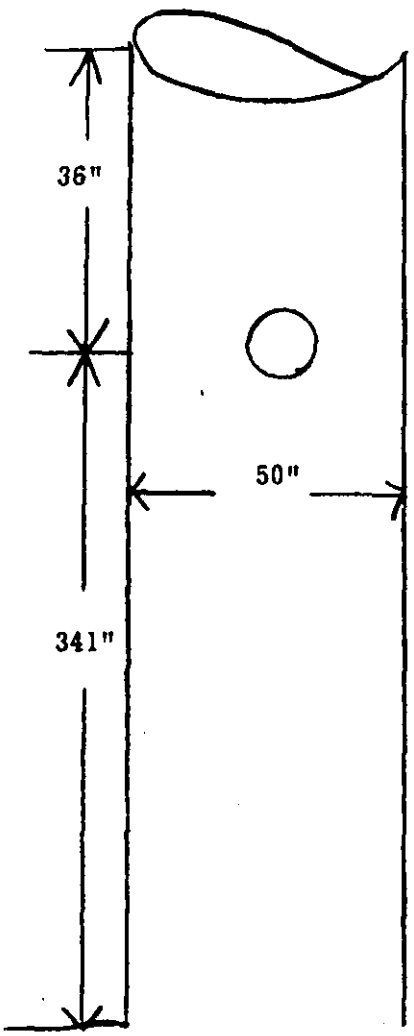
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

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

C. Sampling Site: The emissions test was conducted after a baghouse on a round stack with a diameter of 50". The sampling ports were placed 36" down (0.7 diameters upstream) from the top of the stack and 341" up (6.8 diameters downstream) from the last flow disturbance. Thirty six points were sampled, sixteen through each traverse for two minutes each.

Points on a Diameter	Probe Mark
1	*8.0"
2	9.4"
3	11.2"
4	13.2"
5	15.4"
6	18.0"
7	21.1"
8	25.7"
9	38.2"
10	42.8"
11	46.0"
12	48.5"
13	50.7"
14	52.7"
15	54.5"
16	56.2"

* Measurements include a 7" standoff.



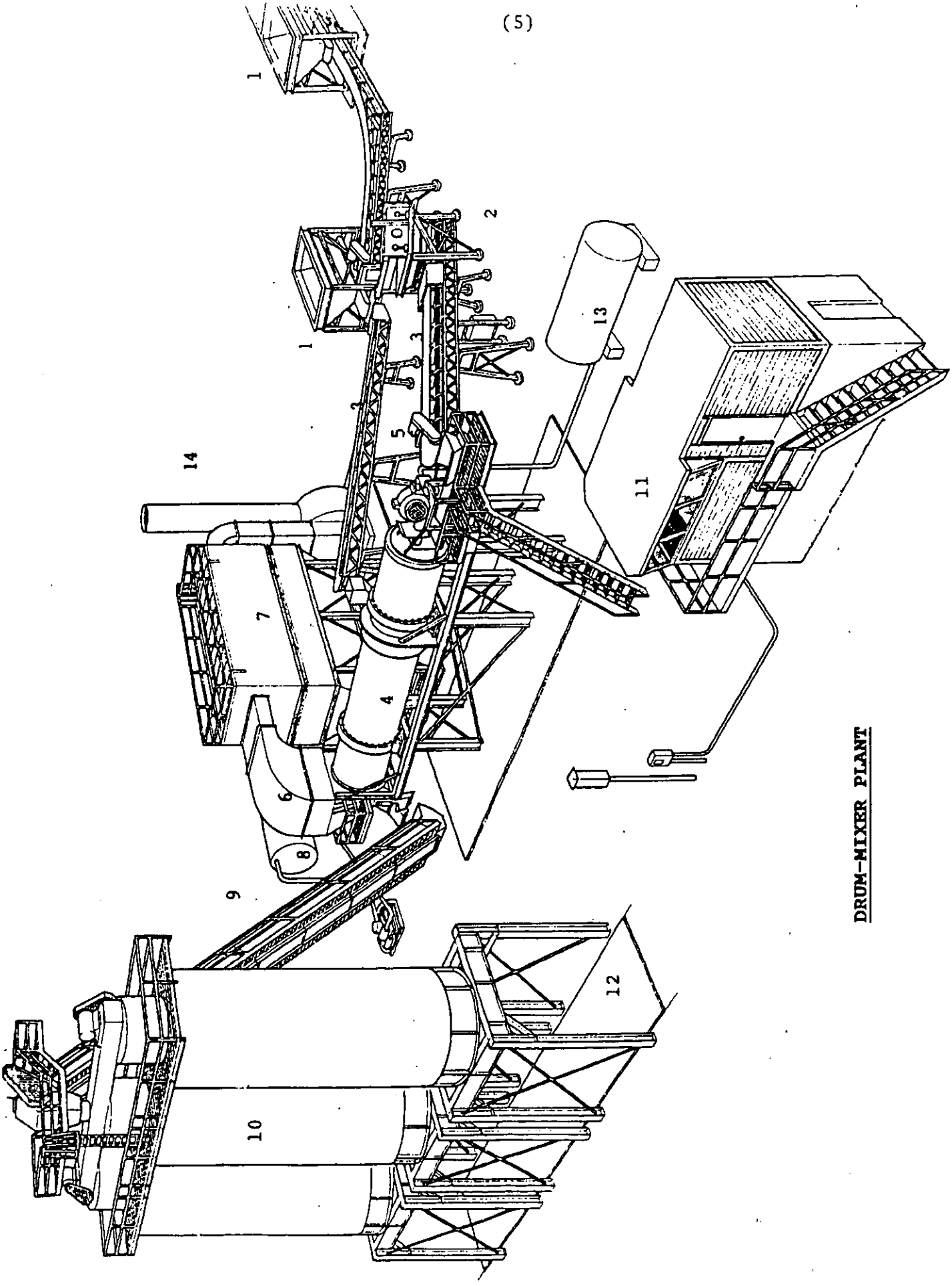
IV. THE SOURCE

IV. THE SOURCE

Tri State Asphalt Company employs a Barber-Greene 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. 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 burner fired with diesel fuel 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 Eastern Controls. The exhaust gasses are drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube sheet is 1 - 4 inches of water. The particulate matter, which is removed by the baghouse is reinjected into the drum mixer.



DRUM-MIXER PLANT

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 proporation 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 drys the aggregate.

6. Knock off baffleing: A baffeling 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

DATA SUMMARY

Plant

1. Manufacturer of plant Barber-Greene (DM-665)
2. Designed maximum operating capacity 300 TPH @ 4 % moisture.
3. Actual operation rate 240 TPH @ 5 % moisture.
4. Startup date 7-84; ECS Baghouse 7-85
5. Type of fuel used in dryer #2 Heat Oil
6. Quanity of fuel consumption 336 gal/hr.

Aggregate

7. Name/type of mix Wrg I.
8. Percent asphalt in mix 6.0 %.
9. Temperature of asphalt 310.
10. Sieve/Screening analysis: % Passing;

1"		3/8"	95 %	# 16	30 %
3/4"		# 4	62 %	# 100	4 %
1/2"	100 %	# 8	44 %	#200	2.5 %

Baghouse

11. Manufacturer Eastern Control Systems.
12. No. of bags 540. Type of bags 100% Nomex.
13. Air to cloth ratio 7.4/1. Designed ACFM 54,000.
14. Square feet of bags 17,290.
15. Type of cleaning; pulse jet ____, reverse air X, plenum pulse ____, other ____.
16. Cleaning cycle time .12 sec.
17. Interval between cleaning cycle 60 second.
18. Pressure drop across baghouse 4.5 inches water column psi.
19. Pulse pressure on cleaning cycle 100 psi.

COMPANY NAME Tri-State Asphalt DATE 4-24-86

COMPANY REPRESENTATIVE Kevin F Stem D

PLANT DATA (8)

COMPANY NAME Tri State Asphalt

COMPANY REP. K Schamp DATE 8-29-86 Phone # _____

DATA SOURCE _____

PLANT LOCATION Weiston

PLANT MANUFACTURER Bar.-Gruening PLANT MODEL NO. DM 66S PLANT TYPE D.M

MIX SPECIFICATION NO. _____ OIL SPECIFICATION NO. _____

TIME: START 8:50 Am STOP _____ A.T. _____ °F R.H. _____ %

TIME 24 HOUR	FUEL OIL ☑ NATURAL GAS ☐ PROPANE ☐	BURNER SETTING	AGGREGATE TPH	RECYCLE TPH	% ASPHALT	MIX TEMPERATURE °F	VENTURI ☐ Baghouse ☑ DIFFERENTIAL
8:50 Am		27	130		6.0%	315°	3.3
9:05		34	177		6.0%	300	3.3
9:12	DOWN - For Test - (LAB)						
9:40	START	34	177		6.0%	305	3.5
9:55		37	200		"	310	4.0
10:10		45	215		"	310	4.1
10:25		55	220		"	300	4.6
10:40		56	220		"	305	4.5
10:55		45	220			315	4.1
11:10		43	220			314	3.6
11:25		39	220			310	3.4
11:30	DOWN - Check Bag House						
1:45	START	40	175			285	3.5
2:00		40	200			295	3.75
2:15		34	200			305	4.4
2:30		34	225			310	4.5
2:45			225				

REMARKS:

PLANT DATA (9)

COMPANY NAME _____

COMPANY REP. _____ DATE _____ Phone # _____

DATA SOURCE _____

PLANT LOCATION _____

PLANT MANUFACTURER _____ PLANT MODEL NO. _____ PLANT TYPE _____

MIX SPECIFICATION NO. _____ OIL SPECIFICATION NO. _____

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

TIME 24 HOUR	FUEL OIL ☑ NATURAL GAS ☐ PROPANE ☐	BURNER SETTING	AGGREGATE TPH	RECYCLE TPH	ASPHALT	MIX TEMPERATURE °F	VENTURI ☐ Baghouse ☐ DIFFERENTIAL
3:00 Pm		41	225		6.0%	313	4.5
3:15		40	225		"	310	4.4
3:16	Down For Test						
4:30	Start	21	150		"	317	3.2
4:45		35	200		"	304	4.0
5:00		39	225		"	295	4.1
5:15		39	225		"	305	4.1
5:30		39	225		"	310	4.6
5:33	Down. Test Completed						

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.

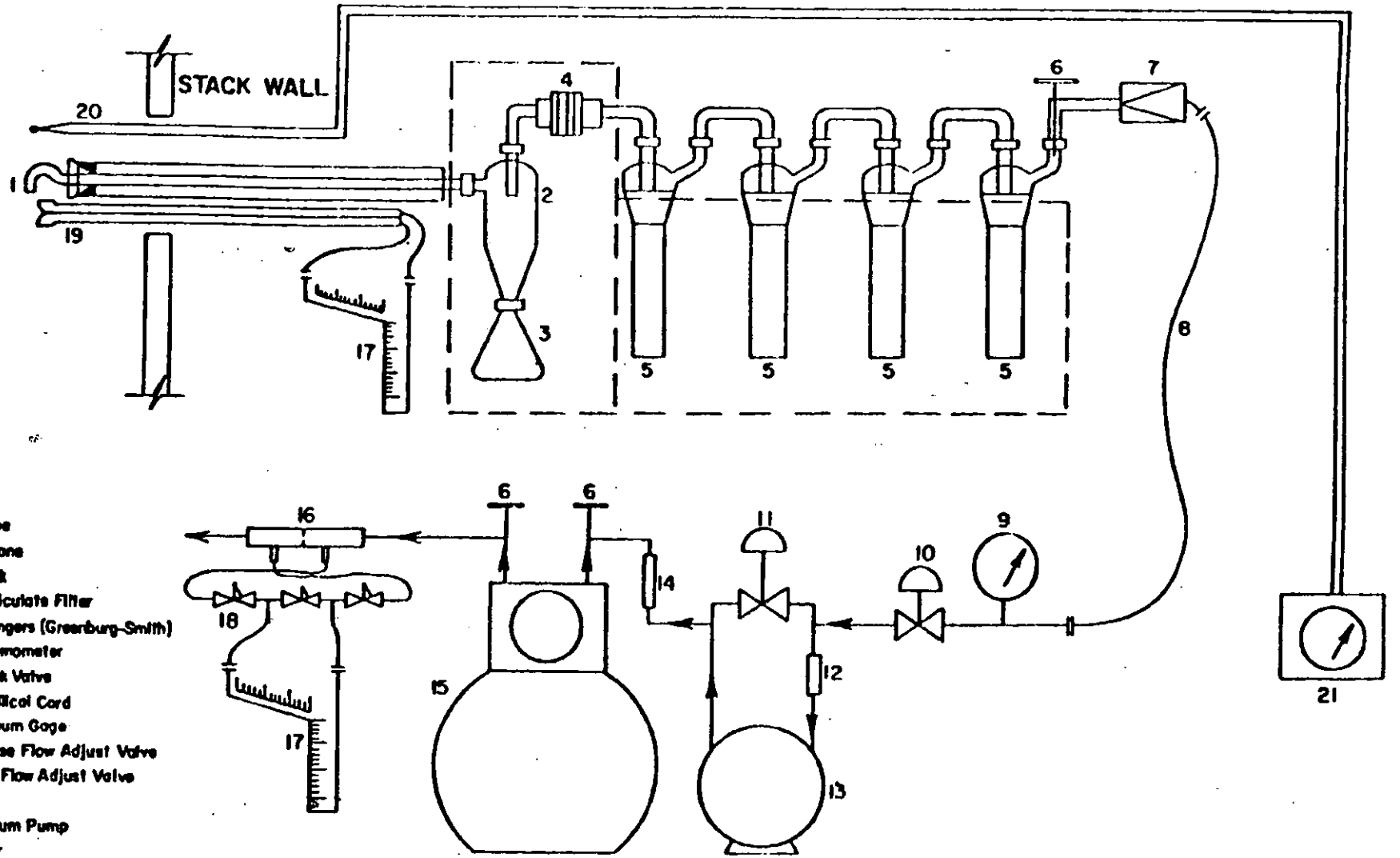
B. An Airguide Instruments Model 211-B (uncorrected) aneroid barometer was used to check the barometric pressure.

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 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) Orifice
13) Vacuum Pump
14) Filter
15) Dry Gas Meter
16) Orifice Tube
17) Incline Manometer
18) Solenoid Valves
19) Pitot
20) Thermocouple
21) Pyrometer

SAMPLING TRAIN
USED FOR ISOKINETIC SAMPLING

VI. LABORATORY PROCEDURES & RESULTS

LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

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

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

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

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

II. Post-Testing Lab Analysis

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

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

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

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

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

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

SPECIAL NOTE

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

WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

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

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

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

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

Form REC#8

(14)

SAMPLE ANALYTICAL DATA FORM

Plant Location Tri-State - Weirton WV Relative humidity in lab 45 %

Sample Location Asphalt plant stack Density of Acetone (pa) .7857 mg/ml

Blank volume (V_a) 200 ml

Date/Time wt. blank 5-6-86 Gross wt. 94.6217 mg

Date/Time wt. blank 5-7-86 Gross wt. 94.6215 mg

Ave. Gross wt. 94.6216 mg

Tare wt. 94.6177 mg

Weight of blank (m_{ab}) .0039 mg

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (P_a) = (.0000248 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} P_a$ = (.0000248)(200)(.7857) = (.0039)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt 5-7-86 Gross wt	g	136.8757	93.1604	98.5713
Date/Time of wt 5-6-86 Gross wt	g	136.8755	93.1600	98.5710
Average Gross wt	g	136.8756	93.1602	98.5712
Tare wt	g	136.8320	93.1360	98.5574
Less acetone blank wt (W_a)	g	.0015	.0015	.0015
Wt of particulate in acetone rinse (m_a)	g	.0421	.0227	.0123

Filter Numbers	#	SG-1310	SG-1311	SG-1312
Date/Time of wt 5-7-86 Gross wt	g	.6971	.6932	.7086
Date/Time of wt 5-6-86 Gross wt	g	.6970	.6930	.7084
Average Gross wt	g	.6971	.6931	.7085
Tare wt	g	.6880	.6845	.6976

Weight of particulate on filters(s) (m_f)	g	.0091	.0086	.0109
Weight of particulate in acetone rinse	g	.0421	.0227	.0123
Total weight of particulate (m_n)	g	.0512	.0313	.0232

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 Acetone Blank too high

Signature of analyst Kim Rea Signature of reviewer S Tuck

VII. CALCULATIONS

NAME: TRI-STATE ASPHALT, INC.

LOCATION: WEIRTON, WEST VIRGINIA

		date	4/24/86	4/24/86	4/24/86
	SUMMARY OF TEST DATA		RUN # 1	RUN # 2	RUN # 3
	SAMPLING TRAIN DATA	start	10:03	13:25	16:28
		finish	11:18	15:03	17:36
1	Sampling time, minutes	θ	64	64	64
2	Sampling nozzle diameter, in.	Dn	.230	.230	.230
3	Sampling nozzle cross-sectional area, ft^2	An	.000289	.000289	.000289
4	Isokinetic variation	I	91	90	97
5	Sample gas volume - meter conditions, cf.	Vm	40.26	41.67	42.31
6	Average meter temperature, °R	Tm	542	553	555
7	Average oriface pressure drop, in.H_2O	ΔH	1.33	1.34	1.34
8	Total particulate collected mg.	Mn	51.2	31.3	23.2
	VELOCITY TRAVERSE DATA				
9	Stack area, ft^2	A	13.6	13.6	13.6
10	Absolute stack gas pressure, in. Hg.	Ps	29.76	29.76	29.76
11	Barometric pressure, in. Hg.	Pbar	29.76	29.76	29.76
12	Average absolute stack temperature, °R	Ts	626	586	655
13	Average $\sqrt{\text{velocity head}}$, (Cp= .84)	$\sqrt{\Delta P}$	.99	.97	.97
14	Average stack gas velocity ft. / sec.	Vs	64	60	64
	STACK MOISTURE CONTENT				
15	Total water collected by train, ml.	Vlc	311.0	307.0	311.0
16	Moisture in stack gas, %	Bws	27.2	26.6	26.6
	EMISSIONS DATA:				
17	Stack gas flow rate, dscf/hr. (000's)	Qsd	1,904	1,944	1,841
18	Total particulate concentration, gr/dscf	Cs	.0201	.0121	.0089
19	Total particulate concentration, lbs/hr	E	5.5	3.4	2.3
20	Total particulate concentration, lbs/mbtu	E'	.0000	.0000	.0000
	ORSAT DATA				
21	Percent CO2 by volume	CO2	3.8	3.3	2.5
22	Percent O2 by volume	O2	16.5	16.0	16.6
23	Percent CO by volume	CO	.0	.0	.0
24	Percent N2 by volume	N2	79.7	80.7	80.9

Buzzycalc

Dry Gas Volume :

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

Where:

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

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

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

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

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

T_{std} = Standard absolute temperature (528°R)

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

Y = Dry gas meter calibration factor

13.6 = Inches water per inches Hg.

Run # 1 $V_{m(std)} = 17.64 \quad (1.00)(40.26) \left[\frac{(29.76) + \frac{1.33}{13.6}}{542} \right] = 39.16$ dsc

Run # 2 $V_{m(std)} = 17.64 \quad (1.00)(41.67) \left[\frac{(29.76) + \frac{1.34}{13.6}}{553} \right] = 39.73$ dsc

Run # 3 $V_{m(std)} = 17.64 \quad (1.00)(42.31) \left[\frac{(29.76) + \frac{1.34}{13.6}}{555} \right] = 40.19$ dsc

Total contaminants by weight: 'GRAIN LOADING'

Particulate concentration C_s' gr./dscf.

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

Where:

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

M_n = Total amount of particulate matter collected, mg.

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

Run # 1: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{51.2}{39.16} \right] = .0201 \text{ gr./dscf.}$$

Run # 2: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{31.3}{39.73} \right] = .0121 \text{ gr./dscf.}$$

Run # 3: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{23.2}{40.19} \right] = .0089 \text{ gr./dscf.}$$

Dry molecular weight:

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

Where:

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

Run # 1: $M_d = 0.44(3.8\%) + 0.32(16.5\%) + 0.28(.0\% + 79.7\%) = 29.3$ lb./lb.-mole

Run # 2: $M_d = 0.44(3.3\%) + 0.32(16.0\%) + 0.28(.0\% + 80.7\%) = 29.2$ lb./lb.-mole

Run # 3: $M_d = 0.44(2.5\%) + 0.32(16.6\%) + 0.28(.0\% + 80.9\%) = 29.1$ lb./lb.-mole

Water vapor condensed :

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

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

Where:

0.04707 = Conversion factor ft^3/ml.

0.04715 = Conversion factor ft^3/g.

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

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

V_f = Final volume of impinger contents, ml.

V_i = Initial volume of impinger contents

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

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

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

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

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

Run # 1:	$V_{wc(std)}$	= (0.04707) (300.0) =	14.1	cu.ft
	$V_{wsg(std)}$	= (0.04715) (11.0) =	.5	cu.ft
Run # 2:	$V_{wc(std)}$	= (0.04707) (298.0) =	14.0	cu.ft
	$V_{wsg(std)}$	= (0.04715) (9.0) =	.4	cu.ft
Run # 3:	$V_{wc(std)}$	= (0.04707) (302.0) =	14.2	cu.ft
	$V_{wsg(std)}$	= (0.04715) (9.0) =	.4	cu.ft

Moisture content of stack gases:

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

Where:

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

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

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

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

Run # 1: $B_{ws} = \frac{14.1 + .5}{14.1 + .5 + 39.16} \times 100 = 27.2\ \%$

Run # 2: $B_{ws} = \frac{14.0 + .4}{14.0 + .4 + 39.73} \times 100 = 26.6\ \%$

Run # 3: $B_{ws} = \frac{14.2 + .4}{14.2 + .4 + 40.19} \times 100 = 26.6\ \%$

Molecular weight of stack gases: $M_s = M_d\ (1-B_{ws}) + 18\ (B_{ws})$.

Where:

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

M_d = Molecular weight of stack gas, dry basis, (lb./lb.-mole).

Run # 1: $M_s = 29.3\ (1-\ .272\ ) + 18\ (\ .272\ ) = 26.2$ (lb./lb.-mole).

Run # 2: $M_s = 29.2\ (1-\ .266\ ) + 18\ (\ .266\ ) = 26.2$ (lb./lb.-mole).

Run # 3: $M_s = 29.1\ (1-\ .266\ ) + 18\ (\ .266\ ) = 26.2$ (lb./lb.-mole).

Stack gas velocity:

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

Where:

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

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

C_p = Pitot tube coefficient,(dimensionless).

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

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

P_g = Stack static pressure (in.Hg).

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

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

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

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

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

Run # 1: $V = (85.49)(.84)(.99)\sqrt{\frac{.626}{(29.76)(26.23)}} = 63.67$ ft/sec

Run # 2: $V = (85.49)(.84)(.97)\sqrt{\frac{586}{(29.76)(26.22)}} = 60.36$ ft/sec

Run # 3: $V = (85.49)(.84)(.97)\sqrt{\frac{655}{(29.76)(26.15)}} = 63.90$ 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 ($^\circ$f).

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

T_{std} = Standard absolute temperature, (528°R).

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

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

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

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

Run # 1:

$$Q_{sd} = 3600\ (1-.272)\ (\ 63.67)\ (\ \ 13.6) \left[\frac{528}{626} \right] \left[\frac{29.76}{29.92} \right] = 1903876 \text{ dscf/h}$$

Run # 2:

$$Q_{sd} = 3600\ (1-.266)\ (\ 60.36)\ (\ \ 13.6) \left[\frac{528}{586} \right] \left[\frac{29.76}{29.92} \right] = 1943991 \text{ dscf/h}$$

Run # 3:

$$Q_{sd} = 3600\ (1-.266)\ (\ 63.90)\ (\ \ 13.6) \left[\frac{528}{655} \right] \left[\frac{29.76}{29.92} \right] = 1841206 \text{ dscf/h}$$

AVG= 1896358 dscf/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 = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions (gr/dscf).

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

Run # 1: $E = \frac{(.0201)(1903876)}{7000} = 5.5$ lb. / hr.

Run # 2: $E = \frac{(.0121)(1943991)}{7000} = 3.4$ lb. / hr.

Run # 3: $E = \frac{(.0089)(1841206)}{7000} = 2.3$ lb. / hr.

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

Where:

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

Run # 1:

$$I = 100 \times 626 \left| \frac{(0.002669)(311.0) + \frac{40.3}{542}\left| 29.76 + \frac{1.33}{13.6} \right|}{60\ (\ 64\ )\ (\ 63.67\ )\ (29.76\ )\ (\ .000289\ )} \right| = 91\ \%$$

Run # 2:

$$I = 100 \times 586 \left| \frac{(0.002669)(307.0) + \frac{41.7}{553}\left| 29.76 + \frac{1.34}{13.6} \right|}{60\ (\ 64\ )\ (\ 60.36\ )\ (29.76\ )\ (\ .000289\ )} \right| = 90\ \%$$

Run # 3:

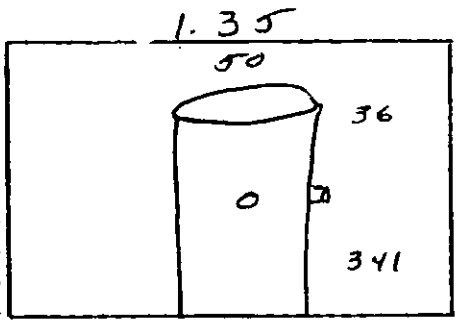
$$I = 100 \times 655 \left| \frac{(0.002669)(311.0) + \frac{42.3}{555}\left| 29.76 + \frac{1.34}{13.6} \right|}{60\ (\ 64\ )\ (\ 63.90\ )\ (29.76\ )\ (\ .000289\ )} \right| = 97\ \%$$

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant TRI-STATE

Location WEIRTON W.V.
Operator K Allmendinger
Date 4-24-86
Run No. 1
Sample Box No. 1
Meter Box No. 6468822
Meter H @ 1.78
C Factor 1.001
Pitot Tube Coefficient Cp .84



		IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
Ambient Temperature 60			
Barometric Pressure 29.76	FINAL	500	509
Assumed Moisture, % 30	INITIAL	200	295
Probe Length, m(ft) 5'	DIFFERENCE	300	11

Nozzle Identification No. .0002885
Avg. Calibrated Nozzle Dia., (in.) .230/.230/.230
Probe Heater Setting 35
Leak Rate, m^3/min. (cfm) .002
Probe Liner Material 316 stainless steel
Static Pressure, mm Hg (in. Hg) .05
Filter No. SG-1310

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H_2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A) 1	10:03:10 / 10:05	4	150	1.0	1.4	494.713 / 495.89	65	60	270	45
2	10:07	4	155	1.1	1.5	479.22	75	60	265	45
3	10:09	4	160	1.1	1.5	498.46	80	60	260	45
4	10:11	4	165	1.1	1.5	499.81	80	60	255	45
5	10:13	4	170	1.1	1.5	501.05	85	60	250	45
6	10:15	4	170	1.1	1.5	502.31	85	65	250	45
7	10:17	4	170	1.1	1.5	503.54	90	65	245	45
8	10:19	5	165	1.2	1.6	504.93	90	65	240	45
9	10:21	5	170	1.2	1.6	506.27	90	65	250	45
10	10:23	4	165	1.0	1.4	507.58	90	65	255	45
11	10:25	4	165	.96	1.3	508.86	90	70	260	45
12	10:27	4	165	.94	1.3	510.15	95	70	250	45
13	10:29	4	170	.94	1.3	511.45	95	70	255	45

CO_2 = 3.5
N_2 = 11

4.0

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 4-24-86 LOCATION Wharton W.U. TEST NO. 1

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP.(°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
14	10:31	4	170	.84	1.3	512.71	95	70	260	45
15	10:33	4	165	.92	1.3	513.96	95	70	250	45
16	10:35:10	4	165	.90	1.2	515.18	95	70	230	45
B) 1	10:43:10 / 10:44	4	160	.80	1.1	516.36	85	75	230	45
2	10:46	4	170	.95	1.3	517.60	90	75	240	45
3	10:48	4	165	.95	1.3	518.81	95	75	240	45
4	10:50	4	165	.90	1.2	520.03	95	75	250	45
5	10:52	4	165	.90	1.2	521.23	100	75	250	45
6	10:54	4	160	.90	1.2	522.44	100	75	260	45
7	10:56	5	165	1.0	1.4	523.73	100	75	265	45
8	10:58	5	165	.96	1.3	525.00	100	75	260	45
9	11:00	5	170	.95	1.3	526.27	100	75	260	45
* 10	11:01:40	5	170	.93	1.3	526.92	100	75	255	45
11	11:05 / 11:06	5	160	.93	1.3	528.75	90	80	260	45
12	11:10	4	165	.90	1.2	530.00	100	80	265	45
13	11:12	4	165	.90	1.2	531.24	100	80	250	45
14	11:14	4	170	.92	1.2	532.49	100	80	250	45
15	11:16	5	165	.95	1.3	533.74	100	80	245	45
16	11:18	5	200	.92	1.2	534.97	100	80	240	45

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RAMCON ENVIRONMENTAL CORPORATION

Plant TRI-STATE PPG #2

Location Weirton W.V.
Operator K Allmendinger
Date 4-24-86
Run No. 2
Sample Box No. 2
Meter Box No. 646882
Meter H @ 1.78
C Factor 1.001
Pitot Tube Coefficient Cp .84

		IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
Ambient Temperature	73		
Barometric Pressure	29.76 FINAL	498	310
Assumed Moisture, %	30 INITIAL	200	304
Probe Length, m(ft)	5' DIFFERENCE	298	6

Nozzle Identification No. 000285
Avg. Calibrated Nozzle Dia., (in.) .234/.234/.234
Probe Heater Setting 3.5
Leak Rate, m^3/min. (cfm) .018
Probe Liner Material 316 stainless steel
Static Pressure, mm Hg (in. Hg) .05
Filter No. SG-1311

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H_2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A) 1	1:25:45 / 1:27	3	150	.80	1.1	535.11 / 536.28	85	80	225	45
2	1:29	3	165	.88	1.2	537.50	90	80	230	45
3	1:30:45	4	165	.90	1.3	538.191	95	80	235	45
4	1:59 / 2:02	5	175	1.1	1.6	540.25	85	80	260	45
5	2.04	5	195	1.1	1.6	541.58	95	80	265	45
6	2:06	6	205	1.1	1.6	542.94	100	80	260	45
7	2:08	6	200	1.1	1.6	544.31	100	80	250	45
8	2:10	6	200	1.1	1.6	545.67	100	80	245	45
9	2:12	6	105	1.2	1.7	547.15	100	80	240	45
10	2:14	5	100	.96	1.4	548.53	105	80	250	45
11	2:16	4	100	.53	1.3	549.84	105	80	235	45
12	2:18	4	100	.90	1.3	551.14	105	85	250	45
13	2:20	4	105	.88	1.2	552.39	105	85	260	45

CO_2 = 3.0 3.5

Form RECO-00

RAMCON emissions test log sheet, cont. DATE 4-24-86 LOCATION Weirton W.V. TEST NO. 2

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
14	2:22	4	100	.83	1.2	553.65	105	85	250	45
15	2:24	4	100	.80	1.1	554.85	105	85	245	45
16	2:26	4	105	.78	1.1	556.053	105	85	240	45
1) 1	2:31 / 2:33	5	105	1.0	1.4	557.40	85	85	245	45
2	2:35	5	105	1.1	1.6	558.80	105	85	250	45
3	2:37	5	105	1.2	1.7	560.24	105	85	260	45
4	2:39	5	110	1.2	1.7	561.68	110	85	265	45
5	2:41	5	110	1.2	1.7	563.15	110	85	255	45
6	2:43	5	110	1.2	1.7	564.56	110	85	250	45
7	2:45	5	110	1.2	1.7	565.98	110	85	245	45
8	2:47	5	110	1.1	1.6	567.42	110	85	240	45
9	2:49	4	110	.80	1.1	568.79	110	85	245	45
10	2:51	4	110	.78	1.1	569.96	110	85	250	45
11	2:53	4	110	.75	1.1	571.18	110	85	255	45
12	2:55	4	110	.73	1.0	572.33	110	85	260	45
13	2:57	4	110	.70	.99	573.48	110	85	255	45
14	2:59	4	110	.68	.97	574.62	110	85	250	45
15	3:01	4	115	.65	.92	575.73	110	85	245	45
16	3:03	3	115	.60	.85	576.785	110	85	240	45

RAMCON ENVIRONMENTAL CORPORATION

Plant TRI-STATE

Location Weirton, W.V.
Operator K. Allmendinger
Date 4-24-86
Run No. 3
Sample Box No. 3
Meter Box No. 646882
Meter H @ 1.78
C Factor 1.001
Pitot Tube Coefficient Cp .84

PP = 1.42

Ambient Temperature 73
Barometric Pressure 29.76
Assumed Moisture, % 30
Probe Length, m(ft) 5'

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	502	312
INITIAL	200	303
DIFFERENCE	302	9

Nozzle Identification No. .000285
Avg. Calibrated Nozzle Dia., (in.) .234/.230/.230
Probe Heater Setting 3.5
Leak Rate, m^3/min. (cfm) .014
Probe Liner Material 3/8 stainless steel
Static Pressure, mm Hg (in. Hg) .05
Filter No. SG-1312

Schematic of Stack Cross Section

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H20	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A) 1	4:28:10 / 4:30	2	160	.80	1.1	577.302 / 578.19	90	85	250	45
2	4:32	2	170	.85	1.2	579.73	95	85	250	45
3	4:34	2	180	.87	1.2	580.98	100	85	255	45
4	4:36	2	180	.90	1.3	582.27	100	85	255	45
5	4:38	2	175	.90	1.3	583.56	100	85	250	45
6	4:40	2	180	.87	1.2	584.83	105	85	250	45
7	4:42	2	200	.87	1.2	586.07	105	85	250	45
8	4:44	3	200	.95	1.3	587.40	105	85	245	45
9	4:46	3	200	1.2	1.7	588.85	105	85	250	45
10	4:48	3	175	1.2	1.7	590.31	105	85	250	45
11	4:50	3	175	1.2	1.7	591.77	105	85	255	45
12	4:52	2	195	.87	1.2	593.05	105	85	250	45
13	4:54	2	190	.85	1.2	594.32	105	85	250	45
		CO_2 =	2.5		2.5					

OL-1

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 4-24-86 LOCATION Weirton W.V. TEST NO. 3

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME Vm (ft^3)	GAS SAMPLE TEMP. (°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
14	4:56	2	200	.80	1.1	555.53	105	85	250	45
15	4:58	2	190	.75	1.1	556.74	105	85	255	45
16	5:00:10	2	190	.70	.99	557.874	105	85	255	45
B) 1	~~5:04~~ 5:06	2	190	.87	1.2	559.13	95	85	250	45
2	5:08	3	175	1.0	1.4	600.46	105	85	250	45
3	5:10	3	175	1.1	1.6	601.88	105	85	250	45
4	5:12	3	175	1.2	1.7	603.35	110	85	245	45
5	5.14	3	~~175~~ 175 HA	1.2	1.7	604.82	110	85	245	45
6	5:16	3	170	1.2	1.7	606.31	110	85	250	45
7	5:18	3	170	1.2	1.7	607.82	110	85	250	45
8	5:20	3	270	1.2	1.7	609.31	110	85	250	45
9	5:22	3	270	1.0	1.4	610.65	110	85	255	45
10	5:24	3	265	.90	1.3	611.97	110	85	255	45
11	5:26	3	265	.87	1.2	613.25	110	85	255	45
12	5:28	3	240	.85	1.2	614.54	110	85	250	45
13	5:30	3	200	.85	1.2	615.82	110	85	250	45
14	5:32	3	175	.85	1.2	617.10	110	85	250	45
15	5:34	3	175	.85	1.2	618.37	110	85	250	45
16	5:36	3	175	.75	1.1	619.613	110	85	250	45

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date ~~7-6-87~~ 5-8-86 Meter box number 646882

Barometric pressure, P_b = 21.91 in. Hg Calibrated by LKS

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter Inlet (t_{d_i}), °F	Temperature: Dry gas meter Outlet (t_{d_o}), °F	Temperature: Dry gas meter Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$, in. H_2O
0.5	5	223.45 / 228.52	78	102 / 110	80 / 80	93	12:40	1.006	1.78
1.0	5	217.52 / 222.614	78	106 / 109	80 / 80	93.75	9:01	1.009	1.80
1.5	10	205.63 / 215.521	78	114 / 116	82 / 82	99.5	14:54	1.017	1.83
2.0	10								
3.0	10								
4.0	10								
							Avg	1.010	1.80

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368		
1.0	0.0737		
1.5	0.110		
2.0	0.147		
3.0	0.221		
4.0	0.294		

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

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 4-21-86 Meter box number 646882

Barometric pressure, P_b = 19.80 in. Hg Calibrated by Kent

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	455.15 / 460.35	70	100 / 102	78 / 78	89.5	12:25	.9991	1.72
1.0	5	460.46 / 465.69	70	102 / 104	78 / 78	90.5	9:06	1.0003	1.795
1.5	10	467.16 / 477.507	70	104 / 106	78 / 78	91.5	14:51	1.0019	1.79
2.0	10	483.15 / 493.465	70	106 / 106	78 / 78	92	12:57	1.0028	1.82
3.0	10								
4.0	10								
							Avg	1.0010	1.78

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368		
1.0	0.0737		
1.5	0.110		
2.0	0.147		
3.0	0.221		
4.0	0.294		

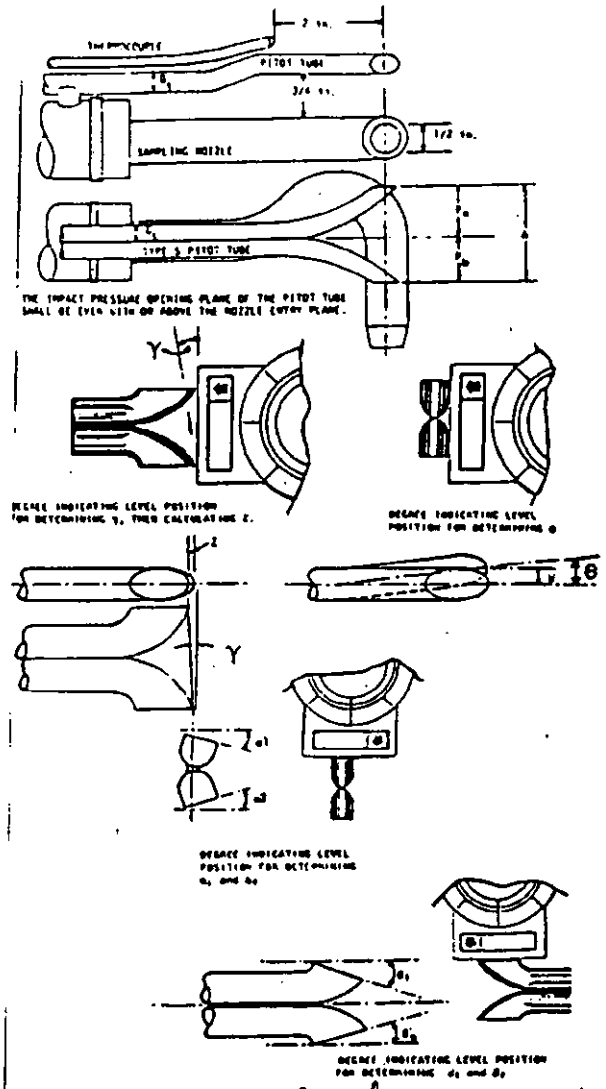
[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

PITOT TUBE INSPECTION DATA SHEET

Company Name: Tri-State

Pre-sample Date 5-5-86

Post Sample Date 5-5-86



Y	level?	Y
N	obstructions?	N
N	damaged?	N
Y	$-10° < \alpha_1 < +10°$	Y
Y	$-10° < \alpha_2 < +10°$	Y
Y	$-5° < \beta_1 < +5°$	Y
Y	$-5° < \beta_2 < +5°$	Y
O	γ	O
O	θ	O
O	A	O
Y	$1.05\ D_t < P_a < 1.5\ D_t$	Y
Y	$1.05\ D_t < P_b < 1.5\ D_t$	Y
Y	$3/16" \leq D_t \leq 3/8"$	Y
O	$A \tan \gamma < 0.125"$	O
O	$A \tan \theta < 0.03125"$	O
Y	$P_a = P_b \pm 0.063"$	Y

Comments: Probes manufactured in April 1986

Pitot tube/probe number 54 meets or exceeds all specifications criteria and/or applicable design features* and is hereby assigned a pitot tube calibration factor of 0.84.

Signature Ken Allenbaugh

Date 5-5-86

*See 40 CFR 60, Vol. 42, No. 160, Method 2. Verify the minimum 2 inch setback of the thermocouple and the minimum 3/4 inch separation between the pitot tube and the nozzle as shown at the top of this page.

RAMCON ENVIRONMENTAL CORPORATION

Date 1-3-85 Thermocouple number 5

Ambient temperature ~~31.20~~ 80 °C Barometric pressure 31.20 in. Hg

Calibrator KM Reference: mercury-in-glass ✓

other _____

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
0	Ice water	0	32	0
100	Boiling water	99	210 = 98.9	.10
—	Boiling 0,1	380	378	.53
	Ambient 4-24-86	60°F	60°F	0%

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

RAMCON ENVIRONMENTAL CORPORATION

Date 7-12-84 Thermocouple number Hotbox

Ambient temperature 25 °C Barometric pressure 29.34 in. Hg

Calibrator Turner Reference: mercury-in-glass ✓

other _____

Reference point number[a]	Source[b] (specify)	Reference Thermometer Temperature, °C	Thermocouple Potentiometer Temperature, °C	Temperature Difference,[c] %
100°C	boiling H2O	100 °C	100 °C	0 %
76°F	Ambient	Mercury 75.8 F	75°C	.1 %
	4-24-86	60°F	60°F	0 %

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

[b]Type of calibration system used.

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

Figure 2.5 stack temperature sensor calibration data form.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 7-13-84 Thermocouple number INLET/OUTLET

Ambient temperature 77 °C Barometric pressure 29.34 in. Hg

Calibrator S Turner Reference: mercury-in-glass ✓

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	INLET AMBIENT	77°F	77°F	0.0%
B	OUTLET AMBIENT	77°F	77°F	0.0%
C	AMBIENT 4-24-86	60°F	60°F	0%

[a] Type of calibration system used.

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

X. RAMCON PERSONNEL

RAMCON Environmental Stack Test Team

Sumner Buck - President

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

Ken Allmendinger - Team Leader

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