COMMONWEALTH of VIRGINIA

State Air Pollution Control Board

INTRA-AGENCY MEMORANDUM

TO : Director, Division of Source Evaluation

FROM : Director, Region I

SUBJECT : Stack Test: Barb & Shumaker, Inc.

DATE : August 18, 1987

Attached for your information is a summary of the results of the stack test that was conducted on the drum mix asphalt plant operated by Barb & Shumaker, Inc. near Abingdon, Virginia. The results show that the plant is capable of operating in compliance with State Board Regulations.

Michael D. Overstreet

MDO/JDK/fp

Attachment

MEMORANDUM TO: Director, Region I

FROM : Engineer B, Region I JDK

SUBJECT : Stack Test Results:

Barb & Shumaker, Inc.
319 Island Road
Bristol, VA 24201
Ref: Drum Mix Asphalt Plant
Registration Number: 10190

DATE : August 7, 1987

INTRODUCTION

On April 29, 1986 Ramcon Environmental Corporation (Ramcon) from Memphis, Tennessee conducted a series of quantitative particulate emissions tests on the exhaust from the fabric filter serving the drum mix asphalt plant in Abingdon, Virginia.

The purpose of the test was to determine compliance with the rate of emissions set in the state permit dated February 11, 1986 and to fulfill requirements contained in the Consent Agreement and Order with Barb & Shumaker, Inc. which was effective December 12, 1986.

BACKGROUND

The Barb & Shumaker, Inc. drum mix asphalt plant is located just off Route 794 near Abingdon, Virginia. The facility consists of a 185 TPH Astec drum mix asphalt plant with an Esstee MS12-270 fabric filter for air pollution control.

The source was tested in accordance with EPA Method 5 for particulate emissions. At time of testing, the source operated at approximately 122 TPH.

Cleaned gas is emitted to the atmosphere by a round, 32" diameter exhaust stack with 12 traverse points sampled in each of two ports. Each point was sampled for 2.5 minutes for a total test time of 60 minutes for each of three runs.

Some of the results reported by Ramcon are as follows:

	Run 1	Run 2	Run 3
Volume of gas sampled, DSCF	44.36	47.27	48.42
Isokintic Variation, %	102.	97.	103.
Stack Flow Rate, SCFH	602,000	676,000	656,000
Particulate Emission Rate, lb/hr	1.9	2.3	1.7
Part. Emission Conc., gr/DSCF	0.0217	0.0237	0.0181
Allowed Emissions, gr/DSCF	0.04	0.04	0.04

ENGINEERING EVALUATION

Test results indicate that particulate emissions were being discharged from the fabric filter at an average rate 0.0212 gr/DSCF, which is in compliance with the allowed rate of 0.04 gr/DSCF.

Mr. Charles B. Dickson and Christopher D. Cary observed and evaluated the visible emissions from the fabric filter exhaust. Visible emissions evaluated by Mr. Cary during Run 1 ranged from 0-**10% opacity**, with most readings being 0-5%. Mr. Dickson's evaluation of visible emissions during Run 2 showed opacities ranging from 0 to 25%, with six minute averages ranging from 2.9-8.5% opacity. There was a detached steam plume visible during both Runs 1 and 2. During the third run, Mr. Dickson's evaluation showed opacity readings from 0-30%, without evidence of a moisture plume. **Six-minute averages of the readings ranged 9.2-27.1%.**

RECOMMENDATION

It is recommended that the test results submitted by Ramcon Environmental Corp.be accepted as verification that the drum mix asphalt plant operated by Barb & Shumaker, Inc. near Abingdon, Virginia, was operating on April 29, 1987 in compliance with applicable State Board Regulations.

Visible emissions during the test were **sometimes above the limit of 20% opacity.** Test results indicate that the visible plume is not particulate matter, but could possibly be a condensed organic vapor plume. Such visible plumes are characteristic of this brand of drum mix asphalt plants. **It is recommended that further investigations be conducted into the cause and remedy of this situation.**

MEMORANDUM TO: Director, Region I

FROM : Engineer B, Region I JDK

SUBJECT : Stack Test

Barb and Shumaker, Inc.
319 Island Road
Bristol, VA 24201
Ref: Drum Mix Asphalt Plant - Abingdon, VA
Registration Number: 10190

DATE : April 30, 1987

INTRODUCTION

On April 29, 1987, Ramcon Environmental Corporation from Memphis, Tennessee conducted a series of quantitative particulate emissions tests on the exhaust gases from the fabric filter that serves the drum mix asphalt plant operated by Barb and Shumaker, Inc. in Abingdon, VA.

The purpose of the test was to fulfill requirements specified in Specific Condition 10 of the February 11, 1986 permit and to verify compliance with the NSPS particulate emission limit of 0.04 grains per dry standard cubic foot of flue gas.

One run of a stack test was conducted on October 20, 1986. Due to unsatisfactory operating conditions the remaining two runs were cancelled and stack testing postponed until the 1987 season.

Persons present during testing were:

Ramcon Environmental Corp.
Ken Almendinger
Bill Turner

Barb and Shumaker, Inc.
Don W. Shumaker, Sr.
Don W. Shumaker, Jr.
Ralph Perrigan

State Air Pollution Control Board
Christopher D. Cary
Charles B. Dickson
J. Denise Kimbell

DISCUSSION

Particulate emissions from the 1985 model 185 TPH Astec drum mix asphalt plant are controlled by an Esstee Mfg. Co. MS12-270 fabric filter. Cleaned gas is emitted to the atmosphere by a 3-foot diameter exhaust stack, approximately 28 feet high.

Three test runs were made in accordance with EPA Methods 1-5. All three runs were observed by SAPCB staff.

The test conditions were good and the plant operated at a steady rate throughout the testing. The production rate ranged about 120-125 ton per hour. The plant could not be operated at full capacity due to the high moisture content of the rock fed to the dryer.

Visible emissions were observed and evaluated during the testing by Mr. Christopher D. Cary and Mr. Charles B, Dickson. During the first two runs, the exhaust from the fabric filter was evaluated to have 0-5% opacity most of the time. During the third run, opacity of emissions ranged from 0-30%. No cause could be linked with this increase in opacity of emissions.

CONCLUSION

The testing was conducted in an acceptable manner as outlined in EPA Methods 1-5. The results should reflect an accurate assessment of particulate emissions being discharged from the fabric filter during the time of the test.

SOURCE: Barb and Shumaker, Inc.
LOCATION: Abingdon, VA
DATE: 4-29-87 OBSERVER'S NAME: J. Denise Kimbell
Chris Cary

PURPOSE OF TEST: Determine NSPS Compliance
TESTING DONE BY: Ramcon Environmental Corporation
LAB ANALYSIS DONE BY: Kim Rea - Ramcon Environmental Corp.

COMPANY CONTACT: Don W. Shumaker, Sr. TELEPHONE (703) 628-6020
CONTROL EQUIPMENT OPERATING: YES ESTEE Mfg Co., Inc. Fabric Filter
OPACITY READING MADE: YES ✓ C. B DICKSON / C. O. CARY NO

UNIT/PROCESS NAME: Astec Drum Mix Asphalt Plant
RATED CAPACITY: 185 TPH
TYPE FUEL USED: #2 oil for dryer

APPROX. PROCESS RATE: 124 TPH
METHOD OF DETERMINING PROCESS RATE: COMPUTER CONTROLS
STACK HEIGHT: 28 FEET (EST)
INDIVIDUAL STACK: ✓ COMMON STACK
DIAMETER: (IF ROUND) 32" (IF RECTANGULAR) WIDTH LENGTH

I. SAMPLING POINT LOCATION

A. DISTANCE DOWNSTREAM FROM ANY FLOW DISTURBANCE: 75"
NATURE OF DISTURBANCE FAN
(BEND, CONTRACTION, EXPANSION, FAN, BAFFLES, ETC.)
B. DISTANCE UPSTREAM FROM ANY FLOW DISTURBANCE: 144"
NATURE OF DISTURBANCE STACK EXIT
(BEND, STACK EXIT, CONTRACTION, FAN, BAFFLES, EXPANSION, ETC.)
C. NUMBER OF PORTS IN STACK: 2
D. NUMBER OF POINTS SAMPLED PER PORT: 12

II. STACK GAS

A. STACK TEMPERATURE: 202 °F
B. ~~ORSAT~~ ANALYSIS: FYRITE
GRAB CONTINUOUS NUMBER OF INTEGRATED SAMPLES
C. PRELIMINARY ΔP: MIN. .26 MAX. .58

III. PARTICULATE TEST

A. SAMPLING TRAIN: DGM # 646 882
1. MANUFACTURER LEAR SIEGLER, INC. MODEL Ser No. C124
2. TEST METHOD: EPA METHOD 5 ✓ ASME PTC 21/27
OTHER (DESCRIBE)
3. TYPE FILTERS GLASS
4. PROBE: LENGTH 4 FT MATERIAL 316 Stainless Steel
5. PROBE HEATER SETTING 4½
6. HEATER BOX SETTING 250°F
7. METER CALIBRATION FACTOR (Y) 1.0186
8. METER ΔH FACTOR 1.69
9. DATE OF LAST CALIBRATION CHECK 4/28/87
a. ORIFICE METER ✓ b. DRY GAS METER ✓
c. TEMPERATURE DEVICES d. PITOT TUBE 1-8-87
e. NOZZLE DIAMETER 4/29 f. OTHER

Virginia State Air Pollution Control Board
Visible Emission Evaluation Record

DATE April 29, 1987

COMPANY Burb + Schumaker REGISTRATION NO. 10190

LOCATION

EMISSION POINT NAME Baghouse Exhaust Stack HEIGHT TO DISCHARGE POINT 25 ft

OBSERVER Christopher D Cary CERTIFICATION EXPIRATION DATE 10/87

CLOCK TIME: INITIAL 9 : 10 A.M./P.M. (A.M. circled) FINAL 10 : 10 A.M./P.M. (A.M. circled)

VISIBLE EMISSION READINGS

HR.	MIN.	SECONDS 0	15	30	45	STEAM PLUME CHECK IF APPLICABLE DET.	ATT.	COMMENT
10	0	5	0	5	5	–		
	1	0	0	0	0	–		
	2	0	0	5	5	–		
	3	5	0	0	5	–		
	4	5	5	5	5	–		
	5	5	5	5	0	–		
	6	0	0	0	0	–		
	7	0	0	5	0	✓		
	8	5	0	0	5	✓		
	9	5	0	0	0	✓		
9	10	5	5	5	5	✓		3-4 FT
	11	5	5	5	5	✓		
	12	0	5	0	5	✓		
	13	5	5	0	5	✓		
	14	5	0	5	0	✓		
	15	0	5	0	0	✓		
	16	0	5	5	5	✓		
	17	0	5	5	5	✓		
	18	5	5	0	5	✓		
	19	5	5	0	5	✓		
	20	5	5	5	0	✓		
	21	5	5	0	0	✓		
	22	5	5	5	0	✓		
	23	5	5	10	10	✓		
	24	0	5	5	5	✓		
	25	5	5	5	5	✓		
	26	10	5	5	0	✓		
	27	5	5	5	0	✓		
	28	0	5	0	5	✓		
	29	5	5	10	5			

HR.	MIN.	SECONDS 0	15	30	45	STEAM PLUME CHECK IF APPLICABLE DET.	ATT.	COMMENT
9	30	5	0	0	5	–		
	31	5	5	5	5	–		
	32	5	10	5	5	✓		
	33	0	5	5	5	✓		
	34	5	5	0	5	✓		
	35	5	0	0	5	–		
	36	10	5	5	5	✓		
	37	5	5	5	5	✓		
	38	0	5	0	0	✓		
	39	5	5	0	0	✓		
	40	0	5	5	5	–		
	41	10	5	5	5	–		
	42	0	0	0	5	✓		
	43	5	5	0	0	–		
	44	0	5	5	0	–		
	45	5	5	5	5	–		
	46	0	5	0	0	✓		
	47	0	0	5	0	✓		
	48	5	5	0	0	✓		5-6 FT
	49	0	0	5	5	–		
	50	0	5	5	0	✓		
	51	0	5	5	0	–		
	52	0	0	0	0	–		
	53	0	0	0	5	–		
	54	0	0	0	0	–		
	55	0	0	0	0	–		
	56	0	0	0	0	–		
	57	0	0	0	5	–		
	58	5	5	5	5	–		
9	59	5	0	5	5	–		

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(5/1/75)

#1 PAGE

RUN #2

VIRGINIA STATE AIR POLLUTION CONTROL BOARD
VISIBLE EMISSION EVALUATION RECORD

DATE 4-29-87

COMPANY Barb & Shumaker, Inc. REGISTRATION NO. 10190

LOCATION Abingdon, Va. (Acme Stone Quarry site) Washington County

EMISSION POINT NAME Asphalt Plant Stack HEIGHT TO DISCHARGE POINT EST 30'

OBSERVER C. B. DICKSON CERTIFICATION EXPIRATION DATE 10-30-87

CLOCK TIME: INITIAL 11 : 53 A.M./~~P.M.~~ FINAL 12 : 53 ~~A.M.~~/P.M.

VISIBLE EMISSION READINGS

HR.	MIN.	SECONDS 0	15	30	45	STEAM PLUME CHECK IF APPLICABLE DET.	ATT.	COMMENT
12	0	10	20	20	20	✓		
	1	20	0	20	20	✓		
	2	0	0	0	0	✓		
	3	0	0	0	10	✓		
	4	0	0	5	0	✓		
	5	5	5	0	0	✓		
	6	0	5	20	10	✓		
	7	10	10	0	20	✓		
	8	0	0	5	0	✓		
	9	10	5	0	5	✓		
	10	5	5	0	10	✓		
	11	5	20	0	25	✓		
	12	5	10	10	20	✓		
	13	5	20	0	0	✓		
	14	10	5	5	10	✓		
	15	0	5	10	5	✓		
	16	0	10	10	10	✓		
	17	5	5	0	0	✓		
	18	0	5	5	5	✓		
	19	5	5	5	5	✓		
	20	10	5	0	0	✓		
	21	0	0	0	10	✓		
	22	0	10	5	5	✓		
	23	5	5	0	5	✓		
	24	5	5	10	20	✓		
	25	5	5	5	0	✓		
	26	5	0	10	5	✓		
	27	10	0	0	10	✓		
	28		10	10	10	✓		
	29	5	10	0	5	✓		
	30	5	10	10	5	✓		
	31	10	0	5	5	✓		
	32	5	10	0	0	✓		
	33	10	5	5	5	✓		
	34	0	5	5	5	✓		
	35	10	5	10	5	✓		
	36	0	10	10	5	✓		
	37	5	5	5	10	✓		
	38	0	10	5	10	✓		
	39	5	5	5	5	✓		
	40	0	5	0	0	✓		
	41	5	10	10	10	✓		
	42	10	0	0	10	✓		
	43	10	0	10	10	✓		
	44	10	5	5	5	✓		
	45	5	10	10	0	✓		
	46	0	0	0	0	✓		
	47	5	0	0	5	✓		
	48	5	10	5	5	✓		
	49	5	5	10	0	✓		
	50	10	5	0	5	✓		
	51	0	10	10	10	✓		
	52	10	0	0	5	✓		
	53	0	0	5	5	✓		
	54	[illegible]	5	5	5	✓		
	55	[illegible]	5	0	5	✓		
	56	5	5	5	5	✓		
	57	5	0	0	0	✓		
	58	0	0	0	0	✓		
	59	10	10	20	20	✓		

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#2 PAGE

RUN #2

VIRGINIA STATE AIR POLLUTION CONTROL BOARD
VISIBLE EMISSION EVALUATION RECORD

DATE 4-29-87

COMPANY BARB & SHUMAKER, & INC. REGISTRATION NO. 10190

LOCATION ABINGDON - (ACME STONE QUARRY SITE) WASHINGTON CO.

EMISSION POINT NAME ASPHALT PLANT STACK HEIGHT TO DISCHARGE POINT EST 30'

OBSERVER C. B. DICKSON CERTIFICATION EXPIRATION DATE 10-30-87

CLOCK TIME: INITIAL 12 : 53 ~~A.M.~~/P.M. FINAL 1 : 02 A.M./P.M.

VISIBLE EMISSION READINGS

HR.	MIN.	SECONDS 0	15	30	45	STEAM PLUME CHECK IF APPLICABLE DET.	ATT.	COMMENT
1	0	0	0	0	0	✓		
	1	0	0	5	0	✓		
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
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	25							
	26							
	27							
	28							
	29							

HR.	MIN.	SECONDS 0	15	30	45	STEAM PLUME CHECK IF APPLICABLE DET.	ATT.	COMMENT
	30							
	31							
	32							
	33							
	34							
	35							
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	43							
	44							
	45							
	46							
	47							
	48							
	49							
	50							
	51							
	52							
12	53	0	0	5	5	✓		
	54	5	5	5	5	✓		
	55	0	10	5	5	✓		
	56	5	5	0	0	✓		
	57	0	0	5	0	✓		
	58	0	0	0	5	✓		
	59	0	0	0	0	✓		

SAPCB Form 13
(5/1/75)

010 RUN #3

Virginia State Air Pollution Control Board
Visible Emission Evaluation Record

DATE 4-29-87

COMPANY BARB & SHUMAKER, INC. REGISTRATION NO. 10190

LOCATION ABINGDON, VA. (ACME STONE QUARRY SITE) WASHINGTON COUNTY

EMISSION POINT NAME ASPHALT PLANT STACK HEIGHT TO DISCHARGE POINT EST 30'

OBSERVER C. B. DICKSON CERTIFICATION EXPIRATION DATE 10-30-87

CLOCK TIME: INITIAL 2 : 23 ~~A.M.~~/P.M. FINAL 3 : 23 ~~A.M.~~/P.M.

VISIBLE EMISSION READINGS

HR.	MIN.	SECONDS 0	15	30	45	STEAM PLUME CHECK IF APPLICABLE DET.	ATT.	COMMENT
3	0	30	30	10	30			
	1	10	20	20	20			
	2	30	10	10	20			21.3%
	3	20	20	20	20			
	4	20	20	30	20			
	5	20	10	5	5			
	6	10	10	20	20			
	7	10	30	30	20			18.3%
	8	30	20	20	20			
	9	10	20	20	30			
	10	20	20	20	20			
	11	20	20	30	30			
	12	30	10	10	30			16.5%
	13	10	10	20	20			
	14	10	20	20	30			
	15	5	5	10	10			
	16	20	10	10	5			
	17	10	20	20	10			
	18	10	10	10	5			
	19	5	5	10	10			9.2%
	20	10	10	10	10			
	21	10	10	10	5			
	22	10	5	5	0			
2	23	10	10	10	10			
	24	10	20	20	20			
	25	20	20	20	20			
	26	20	20	20	20			[illegible]%
	27	20	20	30	30			
	28	30	30	30	30			
	29	30	30	30	30			

HR.	MIN.	SECONDS 0	15	30	45	STEAM PLUME CHECK IF APPLICABLE DET.	ATT.	COMMENT
	30	30	30	30	30			
	31	30	30	30	30			
	32	10	10	20	20			27.1%
	33	20	30	30	30			
	34	30	30	30	30			
	35	20	20	20	30			
	36	20	20	30	30			
	37	30	30	30	20			26.7%
	38	30	30	30	30			
	39	30	30	30	30			
	40	30	20	20	30			
	41	20	20	20	30			
	42	20	30	30	30			
	43	20	20	30	20			20.4%
	44	10	10	10	10			
	45	10	20	20	20			
	46	30	20	20	20			
	47	20	20	20	20			
	48	20	20	30	30			
	49	30	30	20	20			21.7%
	50	10	10	20	20			
	51	30	20	20	20			
	52	30	30	30	30			
	53	30	20	20	5			
	54	[illegible]	30	30	30			
	55	[illegible]	10	10	5			
	56	20	20	20	30			19.8%
	57	30	30	30	20			
	58	30	20	5	10			
	59	10	30	30	30			

RAMCON ENVIRONMENTAL CORPORATION

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

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
BARB & SHUMAKER, INC.
ABINGDON, VIRGINIA
April 29, 1987

Don W. Shumaker, Sr.
Barb & Shumaker, Inc.

G. Sumner Buck, III
President

Ken Allmendinger
Team Leader

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REGION 1 OFFICE

RAMCON ENVIRONMENTAL CORPORATION

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

May 6, 1987

Mr. Don Shumaker, Sr.
Barb & Shumaker, Inc.
319 Island Road
Bristol, VA 24201

Re: Particulate Emissions Test - Abingdon, Virginia

Dear Mr. Shumaker:

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

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

Ms. J. Denise Kimbell
State A.P.C. Board
Region 1
121 Russell Road
Abingdon, VA 24210

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

On April 29, 1987, personnel from RAMCON Environmental Corporation (REC) conducted a source emissions test for particulate emissions compliance at Barb & Shumaker Inc.'s Astec drum mix asphalt plant located in Abingdon, Virginia. RAMCON personnel conducting the test were Ken Allmendinger, Team Leader and Bill Turner. Kim Rea was responsible for the final particulate laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples was limited to Mr. Allmendinger and Ms. Rea.

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

Ms. Denise Kimbell and Mr. Christopher Cary of Virginia's Air Pollution Control Board observed the testing conducted by RAMCON.

TABLE I

SUMMARY OF TEST RESULTS
April 29, 1987

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	09:04 to 10:09	0.0217 gr/SCF	102%	1.9 lbs/hr
2	11:56 to 12:55	0.0237 gr/SCF	97%	2.3 lbs/hr
3	14:21 to 15:20	0.0181 gr/SCF	103%	1.7 lbs/hr
	Average:	0.0212 gr/SCF		2.0 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 Virginia. Therefore, the plant is operating in compliance with State and Federal Standards.

III. TEST PROCEDURES

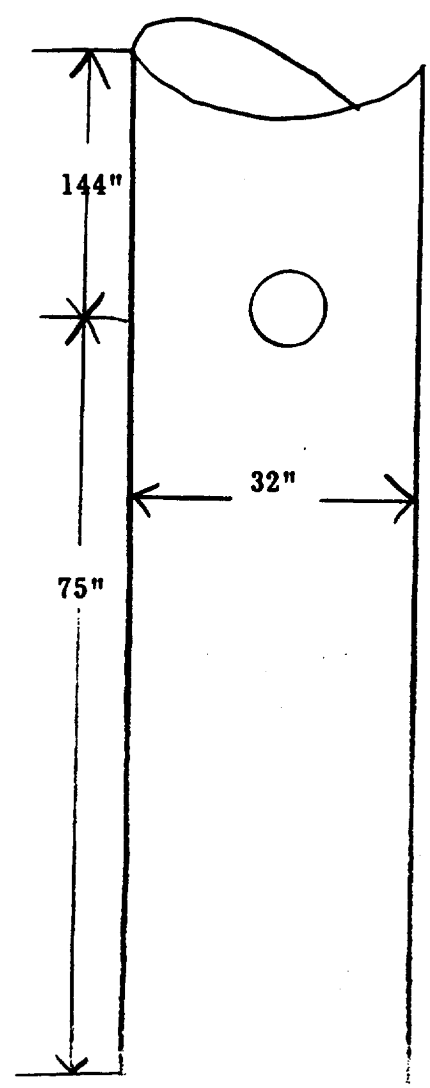
A. Method Used: The source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

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 32". The sampling ports were placed 144" down (4.5 diameters upstream) from the top of the stack and 75" up (2.3 diameters downstream) from the last flow disturbance. Twenty four points were sampled, twelve through each traverse for 2.5 minutes each.

Points on a Diameter	Probe Mark
1	*8.0"
2	9.1"
3	10.8"
4	12.7"
5	15.0"
6	18.4"
7	27.6"
8	31.0"
9	33.3"
10	35.2"
11	36.9"
12	38.0"

*Measurements include a 7.0" standoff.



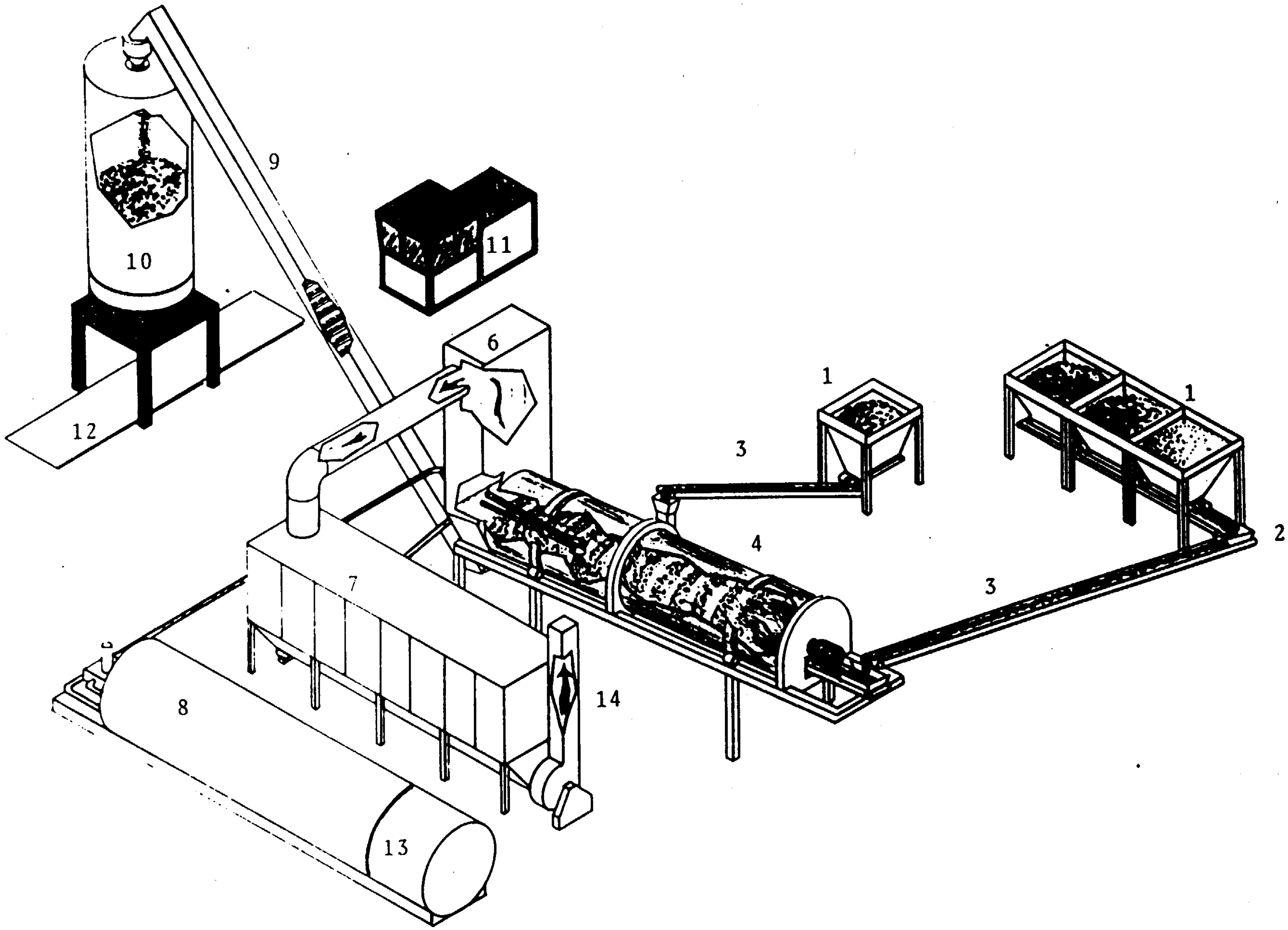
IV. THE SOURCE

IV. THE SOURCE

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

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

The drum mixer uses a burner fired with #2 fuel oil 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 Estee. The exhaust gasses are drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube-sheet is 1 - 6 inches of water. The particulate matter, which is removed by the baghouse, is reinjected into the drum mixer.



ASTEC - DRUM MIX BAGHOUSE

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 Astec.
2. Designed maximum operating capacity 186 TPH @ 5 % moisture.
3. Actual operation rate 122 TPH @ 4.5 % moisture.
4. Startup date ________.
5. Type of fuel used in dryer #2.
6. Quanity of fuel consumption ________.

Aggregate

7. Name/type of mix 5-5 Limestone.
8. Percent asphalt in mix 5.6 %.
9. Temperature of asphalt 204.
10. Sieve/Screening analysis: % Passing;

1"		3/8"	100	#30	32
3/4"		#4	95	#50	18
1/2"		#8	70	#200	8

Baghouse

11. Manufacturer Estee.
12. No. of bags 360. Type of bags Nomex.
13. Air to cloth ratio 5.67-1. Designed ACFM 28,000.
14. Square feet of bags 5640.
15. Type of cleaning; pulse jet ✓, reverse air ____, plenum pulse ________, other ________.
16. Cleaning cycle time .1.
17. Interval between cleaning cycle 30 sec.
18. Pressure drop across baghouse ________ psi.
19. Pulse pressure on cleaning cycle 90 psi.

COMPANY NAME Baeo & Shumaker DATE 4-29-87

COMPANY REPRESENTATIVE Doris Shumaker Form #REC-03

PLANT DATA

COMPANY NAME Barb and Shumaker, Inc.
COMPANY REP. Don W. Shumaker, Sr. DATE 4-29-87 Phone # (703)628-6020
DATA SOURCE Estee Mfg. Co., Inc Fabric Filter
PLANT LOCATION Abingdon, VA
PLANT MANUFACTURER Astec PLANT MODEL NO. 85-183 PLANT TYPE Drum Mix
MIX SPECIFICATION NO. S-5 Limestone OIL SPECIFICATION NO. 2

TIME: START 9.00 STOP 10.05 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
9 A.M.		68	117	X	5.6	303	
9:15		67	117	X	5.6	300	
9:45		61	117	X	5.6	305	
10.04		63	117	X	5.6	295	
2.10		60	124	X	5.6	299	
2.35		61	121.2	X	5.6	299	
2.58		61	121.5	X	5.6	302	
3.10		60	122.3		5.6	300	

REMARKS:

PLANT DATA

COMPANY NAME Barb and Shumaker, Inc.
COMPANY REP. Don W. Shumaker, Sr DATE 4-29-87 Phone # (703)628-6020
DATA SOURCE EsTee Mfg Co. Fabric Filter
PLANT LOCATION Abingdon, VA
PLANT MANUFACTURER Astec PLANT MODEL NO. 85-183 PLANT TYPE Drum Mix
MIX SPECIFICATION NO. S-5 Limestone OIL SPECIFICATION NO. 2

TIME: START 11:35 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
11:35		53	123.0		5.6	295	
12:15		49	124.6		5.6	300	
12:40		60	122.3		5.6	298	
12:55		60	124.0		5.6	299	
1:05		60	124.0		56	299	

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.

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.

WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

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

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

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

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

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

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

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

SPECIAL NOTE

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

Form REC#8

SAMPLE ANALYTICAL DATA FORM (14)

Plant Location Barb & Shumaker

Sample Location hot mix asphalt

Blank volume (V_a) 200 ml

Date/Time wt. blank 5-4-87

Date/Time wt. blank 5-5-87

Relative humidity in lab 45 %

Density of Acetone (pa) .7853 mg/ml

Gross wt. 97.9597 mg

Gross wt. 97.9587 mg

Ave. Gross wt. 97.9592 mg

Tare wt. 97.9500 mg

Weight of blank (m_{ab}) .0002 mg

Acetone blank residue concentration (C_a) $(C_a) = (M_{ab}) / (V_a)(p_a)$ = (.0000013 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} P_a$ = (.0000013)(200)(.7853) = (.0002)

		Run # 1	Run # 2	Run # 2
Acetone rinse volume (V_{aw})	ml	200	200	200
Date/Time of wt 5-4-87 Gross wt	g	100.0822	94.8495	100.4809
Date/Time of wt 5-5-87 Gross wt	g	100.0820	94.8493	100.4806
Average Gross wt	g	100.0821	94.8494	100.4808
Tare wt	g	100.0463	94.8057	100.4542
Less acetone blank wt (W_a)	g	.0002	.0002	.0002
Wt of particulate in acetone rinse (m_a)	g	.0356	.0435	.0264

Filter Numbers	#	SG-1934	SG-1935	SG-1936
Date/Time of wt 5-4-87 Gross wt	g	.5312	.5319	.5362
Date/Time of wt 5-5-87 Gross wt	g	.5310	.5316	.5360
Average Gross wt	g	.5311	.5318	.5361
Tare wt	g	.5041	.5027	.5057

Weight of particulate on filters(s) (m_f)	g	.0270	.0291	.0304
Weight of particulate in acetone rinse	g	.0356	.0435	.0264
Total weight of particulate (m_n)	g	.0626	.0726	.0568

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

Remarks

Signature of analyst Kim Rea Signature of reviewer S Ford

VII. CALCULATIONS

NAME: BARB & SHUMAKER, INC.

LOCATION: ABINGDON, VIRGINIA

SUMMARY OF TEST DATA

			RUN # 1	RUN # 2	RUN #
		date	4/29/87	4/29/87	4/29/
	SAMPLING TRAIN DATA	start	09:04	11:56	14:2
		finish	10:09	12:55	15:2
1	Sampling time, minutes	θ	60	60	60
2	Sampling nozzle diameter, in.	Dn	.270	.270	.270
3	Sampling nozzle cross-sectional area, ft^2.	An	.000398	.000398	.000398
4	Isokinetic variation	I	102	97	103
5	Sample gas volume - meter conditions, cf.	Vm	43.72	47.78	49.30
6	Average meter temperature, °R	Tm	535	549	553
7	Average oriface pressure drop, in.H_2O	ΔH	1.61	1.89	1.89
8	Total particulate collected mg.	Mn	62.6	72.6	56.8
	VELOCITY TRAVERSE DATA				
9	Stack area, ft^2.	A	5.6	5.6	5.6
10	Absolute stack gas pressure, in. Hg.	Ps	30.09	30.09	30.09
11	Barometric pressure, in. Hg.	Pbar	30.09	30.09	30.09
12	Average absolute stack temperature, °R	Ts	662	658	668
13	Average $\sqrt{\text{velocity head}}$, (Cp= .79)	$\sqrt{\Delta P}$	.81	.88	.87
14	Average stack gas velocity ft. / sec.	Vs	50	54	54
	STACK MOISTURE CONTENT				
15	Total water collected by train, ml.	Vic	320.0	297.0	324.0
16	Moisture in stack gas, %	Bws	25.4	22.8	23.9
	EMISSIONS DATA:				
17	Stack gas flow rate, dscf/hr. (000's)	Qsd	602	676	656
18	Total particulate concentration, gr/dscf	Cs	.0217	.0237	.0181
19	Total particulate concentration, lbs/hr	E	1.9	2.3	1.7
20	Total particulate concentration, lbs/mbtu	E'	.0000	.0000	.0000
	ORSAT DATA				
21	Percent CO2 by volume	CO2	5.0	4.0	4.0
22	Percent O2 by volume	O2	12.5	14.5	13.5
23	Percent CO by volume	CO	.0	.0	.0
24	Percent N2 by volume	N2	82.5	81.5	82.5

Buzzycalc

Dry Gas Volume :

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

Where:

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

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

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

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

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

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

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

Y = Dry gas meter calibration factor

13.6 = Inches water per inches Hg.

Run # 1 $V_{m(std)} = 17.64 \; (1.02)(43.72) \left[\frac{(30.09) + \frac{1.61}{13.6}}{535} \right] = 44.36$ ds

Run # 2 $V_{m(std)} = 17.64 \; (1.02)(47.76) \left[\frac{(30.09) + \frac{1.89}{13.6}}{549} \right] = 47.27$ ds

Run # 3 $V_{m(std)} = 17.64 \; (1.02)(49.30) \left[\frac{(30.09) + \frac{1.89}{13.6}}{553} \right] = 48.42$ ds

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: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{62.6}{44.36} \right] = .0217 \text{ gr./dscf.}$$

Run # 2: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{72.6}{47.27} \right] = .0237 \text{ gr./dscf.}$$

Run # 3: $$C_s' = \left[0.0154 \frac{gr}{mg} \right] \left[\frac{56.8}{48.42} \right] = .0181 \text{ gr./dscf.}$$

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: $M_d = 0.44(5.0\%) + 0.32(12.5\%) + 0.28(.0\% + 82.5\%) = 29.3$ lb./lb.-mol

Run # 2: $M_d = 0.44(4.0\%) + 0.32(14.5\%) + 0.28(.0\% + 81.5\%) = 29.2$ lb./lb.-mol

Run # 3: $M_d = 0.44(4.0\%) + 0.32(13.5\%) + 0.28(.0\% + 82.5\%) = 29.2$ lb./lb.-mol

Water vapor condensed :

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

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

Where:

0.04707 = Conversion factor ft^3/ml.

0.04715 = Conversion factor ft^3/g.

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

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

V_f = Final volume of impinger contents, ml.

V_i = Initial volume of impinger contents

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

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

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

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

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

Run # 1: $V_{wc(std)}$ = (0.04707) (310.0) = 14.6 cu.ft
$V_{wsg(std)}$ = (0.04715) (10.0) = .5 cu.ft

Run # 2: $V_{wc(std)}$ = (0.04707) (285.0) = 13.4 cu.ft
$V_{wsg(std)}$ = (0.04715) (12.0) = .6 cu.ft

Run # 3: $V_{wc(std)}$ = (0.04707) (315.0) = 14.8 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: $B_{ws} = \frac{14.6 + .5}{14.6 + .5 + 44.36} \times 100 = 25.4\ \%$

Run # 2: $B_{ws} = \frac{13.4 + .6}{13.4 + .6 + 47.27} \times 100 = 22.8\ \%$

Run # 3: $B_{ws} = \frac{14.8 + .4}{14.8 + .4 + 48.42} \times 100 = 23.9\ \%$

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- .254) + 18 (.254) = 26.4 (lb./lb.-mole).

Run # 2: M_s = 29.2 (1- .228) + 18 (.228) = 26.7 (lb./lb.-mole).

Run # 3: M_s = 29.2 (1- .239) + 18 (.239) = 26.5 (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 $\left[(g/g\text{-mole})\text{-}(mm\ Hg)\ /\ (^\circ K)(\ mm\ H_2O\right]^{1/2}$

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: $V = (85.49)\ (\ .79)\ (\ .81) \sqrt{\frac{662}{(30.09)(26.43)}} = 49.91$ ft/s

Run # 2: $V = (85.49)\ (\ .79)\ (\ .88) \sqrt{\frac{658}{(30.09)(26.65)}} = 53.84$ ft/s

Run # 3: $V = (85.49)\ (\ .79)\ (\ .87) \sqrt{\frac{668}{(30.09)(26.52)}} = 53.76$ ft/s

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:

$$Q_{sd} = 3600\ (1-.254)\ (\ 49.91)\ (\ \ 5.6) \left[\frac{528}{662}\right] \left[\frac{30.09}{29.92}\right] = \quad 602079 \text{ dscf}$$

Run # 2:

$$Q_{sd} = 3600\ (1-.228)\ (\ 53.84)\ (\ \ 5.6) \left[\frac{528}{658}\right] \left[\frac{30.09}{29.92}\right] = \quad 676210 \text{ dscf}$$

Run # 3:

$$Q_{sd} = 3600\ (1-.239)\ (\ 53.76)\ (\ \ 5.6) \left[\frac{528}{668}\right] \left[\frac{30.09}{29.92}\right] = \quad 655620 \text{ dscf}$$

Emissions rate from stack:

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

Where:

E = Emissions rate, lb./hr.

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

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

Run # 1: $$E = \frac{(.0217)(602079)}{7000} = 1.9 \text{ lb. / hr.}$$

Run # 2: $$E = \frac{(.0237)(676210)}{7000} = 2.3 \text{ lb. / hr.}$$

Run # 3: $$E = \frac{(.0181)(655620)}{7000} = 1.7 \text{ lb. / hr.}$$

Isokinetic variation :

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

Where:

I	=	Percent isokinetic sampling.
100	=	Conversion to percent.
T_s	=	Absolute average stack gas temperature, °R.
0.002669	=	Conversion factor, Hg − ft^3/ml − °R.
V_{ic}	=	Total volume of liquid collected in impingers and silica gel, m
T_m	=	Absolute average dry gas meter temperature, °R.
P_{bar}	=	Barometric pressure at sampling site, (in.Hg).
ΔH	=	Average pressure differential across the oriface meter, (in.H_2[
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:

$$I = 100 \times 662 \left[\frac{(0.002669)(320.0) + \frac{43.7}{535}\left[30.09 + \frac{1.61}{13.6}\right]}{60\ (\ 60\ )\ (\ 49.91\ )\ (30.09\ )\ (\ .000398\ )} \right] = 102\ \%$$

Run # 2:

$$I = 100 \times 658 \left[\frac{(0.002669)(297.0) + \frac{47.8}{549}\left[30.09 + \frac{1.89}{13.6}\right]}{60\ (\ 60\ )\ (\ 53.84\ )\ (30.09\ )\ (\ .000398\ )} \right] = 97\ \%$$

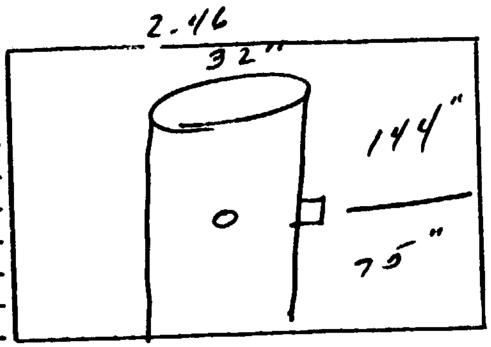
Run # 3:

$$I = 100 \times 668 \left[\frac{(0.002669)(324.0) + \frac{49.3}{553}\left[30.09 + \frac{1.89}{13.6}\right]}{60\ (\ 60\ )\ (\ 53.76\ )\ (30.09\ )\ (\ .000398\ )} \right] = 103\ \%$$

VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant Barb & Shumaker
Location Abington Va.
Operator K. Allmendinger
Date 4-29-87
Run No. 1
Sample Box No. 1
Meter Box No. 646882
Meter H @ 1.69
C Factor 1.0186
Pitot Tube Coefficient Cp .75



Schematic of Stack Cross Section

Ambient Temperature 50
Barometric Pressure 30.09
Assumed Moisture, % 25
Probe Length, m(ft) 4'
Nozzle Identification No. .0003976
Avg. Calibrated Nozzle Dia., (in.) .270/.270/.270
Probe Heater Setting 4.5
Leak Rate, m^3/min. (cfm) +.01
Probe Liner Material 316 stainless
Static Pressure, mm Hg (in. Hg) .01
Filter No. 56-1934

	IMPINGER VOLUME ml	SILICA GEL WEIGHT, g
FINAL	510	310
INITIAL	200	301
DIFFERENCE	310	10

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	9:04:10 / 9:06:40	2	165	.55	1.4	73.876 / 75.47	65	45	240	40
2	9:09:10	2	175	.47	1.2	76.99	70	55	230	40
3	9:11:40	2	195	.47	1.2	78.52	70	55	230	40
4	9:14:10	2	200	.55	1.4	80.16	75	55	230	40
5	9:16:40	2	205	.53	1.3	81.83	75	55	235	40
6	9:19:10	2	210	.57	1.4	83.55	80	60	240	40
7	9:21:40	3	215	.70	1.7	85.39	80	60	250	40
8	9:24:10	3	215	.70	1.7	87.32	80	60	250	40
9	9:26:40	4	210	.73	1.8	89.33	90	60	250	40
10	9:29:10	4	205	.73	1.8	91.25	90	60	250	40
11	9:31:40	4	210	.73	1.8	93.15	90	60	245	40
12	9:34:10	4	215	.73	1.8	95.125	95	60	245	40
B) 1	9:39:10 / 9:41:30	2	100	.50	1.2	96.72	80	65	240	40

CO_2 = 5.0

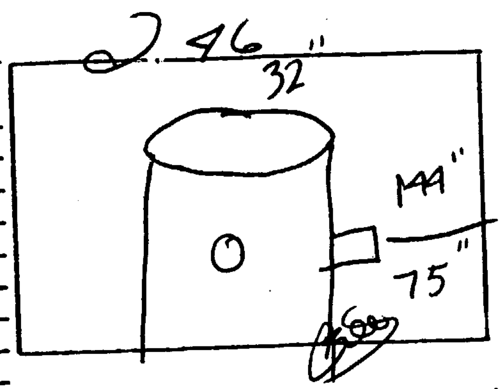
- Form #REC-06

RAMCON emissions test log sheet, cont. DATE 4-25-87 LOCATION Abingdon Va. TEST NO. 1

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
2	9:44:10	2	155	.55	1.4	98.42	90	65	240	40
3	9:46:40	2	200	.57	1.4	100.15	90	65	240	40
4	9:49:10	3	215	.63	1.5	101.91	95	65	255	40
5	9:51:40	3	215	.67	1.6	103.75	95	65	255	40
6	9:54:10	3	215	.70	1.7	105.68	95	65	255	40
7	9:56:40	3	220	.73	1.8	107.63	100	65	250	40
8	9:59:10	3	220	.75	1.8	109.55	100	65	250	40
9	10:01:40	3	220	.75	1.8	111.50	100	70	250	40
10	10:04:10	4	220	.80	2.0	113.58	100	70	250	40
11	10:06:40	4	220	.80	2.0	115.61	100	70	250	40
12	10:09:10	4	220	.77	1.9	117.596	100	70	250	40

RAMCON ENVIRONMENTAL CORPORATION

Plant: Barb & Shumaker
Location: Abingdon VA
Operator: Bill Turner
Date: 4-29-87
Run No.: 2
Sample Box No.: 2
Meter Box No.: 646882
Meter H @: 1.69
C Factor: 1.0186
Pitot Tube Coefficient Cp: .79



Schematic of Stack Cross Section

Ambient Temperature:
Barometric Pressure: 30.09
Assumed Moisture, %: 25
Probe Length, m(ft): 4'
Nozzle Identification No.: 0003976
Avg. Calibrated Nozzle Dia., (in.): .270/.270/.270
Probe Heater Setting: 45
Leak Rate, m^3/min. (cfm): .019 @ 6"
Probe Liner Material: 316 Stainless Steel
Static Pressure, mm Hg (in. Hg): .01
Filter No.: 56-1935

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	483	311
INITIAL	200	299
DIFFERENCE	285	12

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	11:56 / 11:58:30	4	70	.55	1.4	118.563 / 120.42	70	70	230	40
2	12:01	4	70	.63	1.6	122.23	88	70	265	40
3	12:03:30	4	105	.67	1.7	124.14	90	70	265	40
4	12:06	4	160	.73	1.8	126.12	94	70	250	40
5	12:08:30	4	225	.79	~~2.0~~ 1.9	128.15	99	70	250	40
6	12:11	5	225	.86	2.1	130.25	98	72	260	40
7	12:13:30	5	235	.89	2.2	132.90	100	74	260	40
8	12:16	5	240	.85	2.1	134.92	100	74	250	40
9	12:18:30	5	240	.85	2.1	136.40	102	74	250	40
10	12:21	5	240	.85	2.1	138.38	102	76	260	40
11	12:23:30	5	240	.83	2.0	140.43	104	76	260	40
12	12:26	5	225	.83	2.0	142.975	106	76	260	40
B) 1	12:28	5	230	.56	1.4	144.25	96	76	255	40

CO_2 = 4%

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Form #REC-06

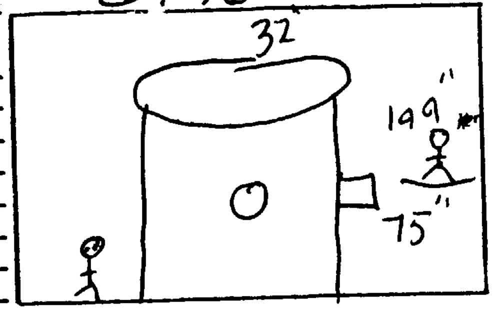
RAMCON emissions test log sheet, cont. DATE 4-29-87 LOCATION Abingdon Va BBS TEST NO. 2

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 Vm (ft³)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
2	12:30:30	~~2~~ 4	~~59~~ 100	.59 ~~.50~~	1.5	146.03	104	78	250	40
3	12:33	5	125	.65	1.6	147.88	106	78	255	40
4	12:35:30	5	170	.70	1.7	149.77	108	78	255	40
5	12:38	5	230	.73	1.8	151.72	108	78	255	40
6	12:40:30	5	230	.80	2.0	153.75	110	78	260	40
7	12:43	5	235	.87	2.1	155.89	110	80	260	40
8	12:45:30	5	235	.90	2.2	158.01	110	80	240	48
9	12:48	5	235	.90	2.2	160.18	110	80	240	45
10	12:50:30	5	235	.87	2.1	162.27	110	80	245	48
11	12:53	5	230	.79	1.9	164.31	110	80	245	48
12	12:55	5	230	.79	1.9	166.34	110	80	250	48

RAMCON ENVIRONMENTAL CORPORATION

Plant Barb & Shumaker
Location Abingdon, VA.
Operator BJP Turner
Date 4-29-87
Run No. 3
Sample Box No. 3
Meter Box No. 646882
Meter H @ 1.69
C Factor 1.0186
Pitot Tube Coefficient Cp .79

2.46



Schematic of Stack Cross Section

Ambient Temperature
Barometric Pressure 30.09
Assumed Moisture, % 25
Probe Length, m(ft) 4'
Nozzle Identification No. .0003976
Avg. Calibrated Nozzle Dia., (in.) .270/.270/.270
Probe Heater Setting
Leak Rate, m^3/min. (cfm) .003 @ 6"
Probe Liner Material 316 Stainless Steel
Static Pressure, mm Hg (in. Hg) .01
Filter No. 56-1936

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL	513	306
INITIAL	200	297
DIFFERENCE	313	9

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (T_s) °F	VELOCITY HEAD (P_s) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	~~2:21~~ 2:23:30	5	90	.57	1.4	~~166.524~~ 168.42	82	80	245	40
2	2:26	6	100	.65	1.6	170.29	84	80	245	40
3	2:28:30	6	150	.65	1.6	172.29	100	80	248	40
4	2:31	6	206	.75	1.9	174.13	102	80	250	40
5	2:33:30	6	225	.82	2.0	176.19	102	80	250	40
6	2:36	6	230	.85	2.1	178.39	100	80	250	40
7	2:38:30	6	235	.85	2.1	180.43	98	80	250	40
8	2:41	6	238	.80	2.0	182.67	98	82	255	40
9	2:43:30	6	240	.80	2.0	184.87	100	82	255	40
10	2:46	6	240	.92	2.0	186.99	102	82	255	40
11	2:48:30	6	240	.85	2.1	188.09	102	84	255	40
12	2:51	6	240	.81	2.0	191.15	102	84	255	40
B) 1	2:53	6	~~152~~ 155	.52	1.3	193.27	98	86	240	40

CO_2 : 4%

Form #REC-06

RAMCON emissions test log sheet, cont. DATE 4-29-87 LOCATION B&3 Abingdon Va 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 V_m (ft.^{3})	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
2	2:55:30	6	100	.55	1.4	195.17	102	89	245	45
3	2:58	6	150	.60	1.5	196.98	110	89	250	45
4	3:00:30	6	200	.68	1.7	198.88	110	86	250	45
5	3:03	6	248	.74	1.8	200.83	112	86	255	45
6	3:05:30	6	245	.85	2.1	202.89	112	86	258	45
7	3:08	6	245	.85	2.1	204.97	110	86	255	45
8	3:10:30	6	245	.87	2.1	207.08	110	86	260	45
9	3:13	6	245	.85	2.1	209.27	108	86	260	45
10	3:15:30	6	243	.87	2.1	211.96	108	86	255	45
11	3:18	6	245	.89	2.2	213.92	108	86	255	45
12	3:20:30	6	245	.89	2.2	215.825	108	88	255	45

IX. CALIBRATIONS

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 5-4-87 Meter box number 646882

Barometric pressure, P_b = 30.07 in. Hg Calibrated by [illegible]

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Avg[a] (t_d), °F	Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	415.32 / 420.431	73	108 / 110	84 / 84	96.5	12:21	1.0202	1.64
1.0	5	421.84 / 426.98	72	110 / 110	85 / 86	97.75	8:49	1.0155	1.67
1.5	10	428.39 / 438.685	73	114 / 114	86 / 86	100	14:24	1.0168	1.66
2.0	10								
3.0	10								
4.0	10								
							Avg	1.0175	1.66

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\Theta}{V_w}\right]^2$
0.5	0.0368		
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 4-28-87 Meter box number 64688 2

Barometric pressure, P_b = 30.24 in. Hg Calibrated by MAA

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperatures: Wet test meter (t_w), °F	Temperatures: Dry gas meter: Inlet (t_{d_i}), °F	Temperatures: Dry gas meter: Outlet (t_{d_o}), °F	Temperatures: Dry gas meter: Avg[a] (t_d), °F	Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	99.003 / 104.088	72	98 / 102	80 / 78	89.5	12:24	1.0144	1.66
1.0	5	106.55 / 111.437	72	102 / 105	80 / 80	91.75	8:18	1.0169	1.67
1.5	10	113.84 / 123.473	72	108 / 109	80 / 80	94.25	14:11	1.0244	1.73
2.0	10								
3.0	10								
4.0	10								
							Avg	1.0186	1.69

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\Theta}{V_w}\right]^2$
0.5	0.0368		
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 5-19-86 Thermocouple number inlet/outlet

Ambient temperature 23.9 °C Barometric pressure 30.12 in. Hg

Calibrator [illegible] 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	75°F	75°F	0 0%
B	outlet Ambient	75°F	75°F	0 0%
C	Ambient 4-29-87	50°F	50°F	0%

[a] Type of calibration system used.

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

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-19-86 Thermocouple number Hot box

Ambient temperature 23 °C Barometric pressure 30.12 in. Hg

Calibrator LA Reference: mercury-in-glass ✓

other ______

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] %
A	boiling water	100 °C	100 °C	0%
B	Ambient	23 °C	22.8 °C	< 1%
	4-29-87	50 °F	50 °F	0%

[a]Type of calibration system used.

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

RAMCON

Lear Siegler Stack Sampler

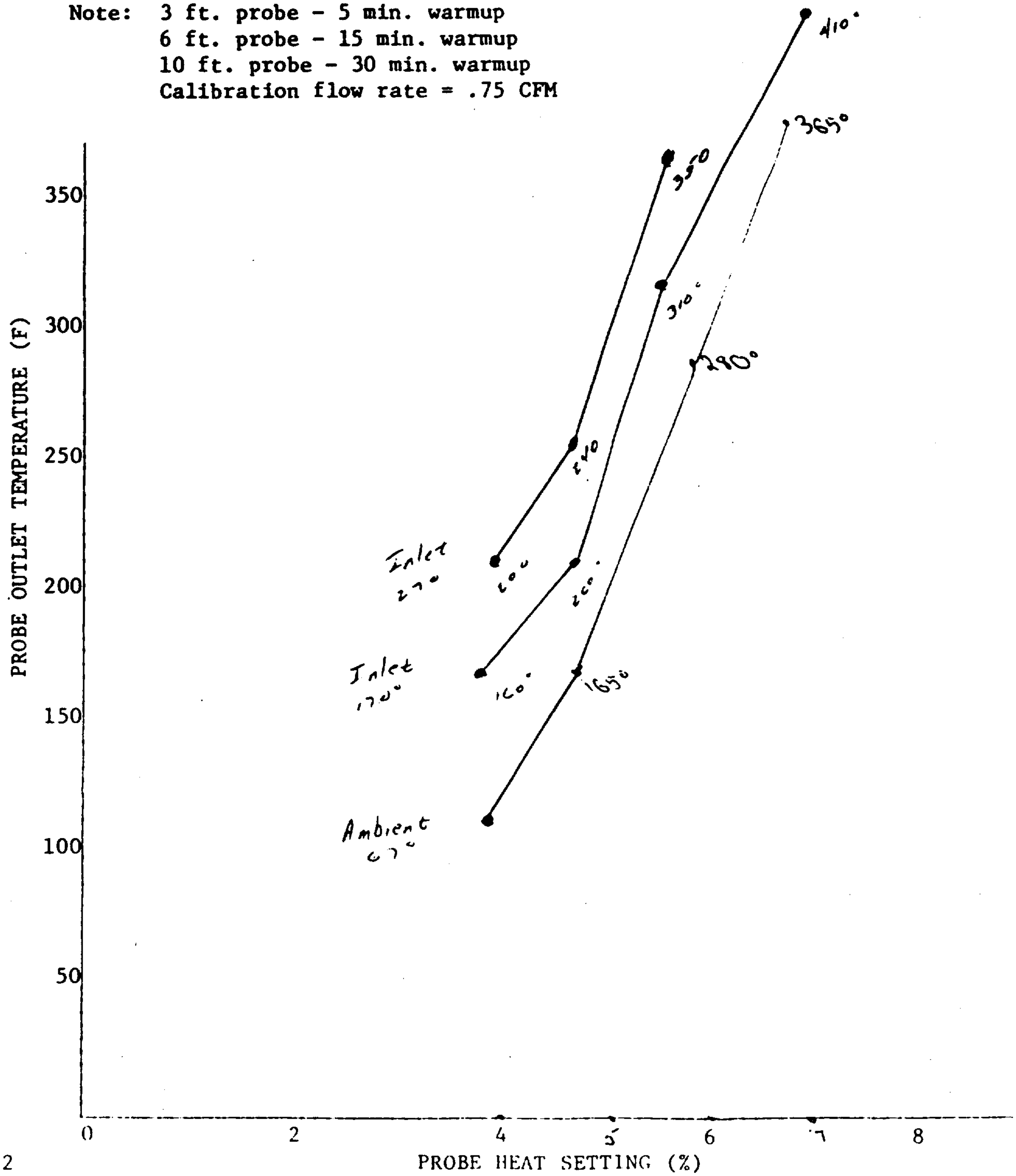
Heating Probe Calibration

Probe No. 44 Probe Length 4'

Date of Calibration 12-18-86 Signature K. B. Allenbach

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



PITOT TUBE CALIBRATION DATA

Calibration pitot tube: type S size (OD) 3/8 ID number 44

Type S pitot tube ID number 44 $C_{p(std)}$ = 1

Calibration: date 1-8-87 performed by K. C. [illegible]

A-Side Calibration

Δp_{std}, cm (in.) H_2O	Δp_s, cm (in.) H_2O	$C_{p(S)}$ [a]	DEV. [b]
.92	1.5	.78	.01
.74	1.15	.80	.01
.82	1.3	.79	.00
Average		.79	

B-Side Calibration

Δp_{std}, cm (in.) H_2O	Δp_s, cm (in.) H_2O	$C_{p(S)}$ [a]	DEV. [b]
.92	1.5	.78	.01
.74	1.15	.80	.01
.82	1.3	.79	.00
Average		.79	

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

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

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

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 12-17-86 Thermocouple number 44 (4')

Ambient temperature 21.1 °C °C Barometric pressure 25.76 in. Hg

Calibrator [signature] Reference: mercury-in-glass ✓

other ______

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] %
A	Ambient	70°F 21.1°C	70°F 21.1°C	.00
B	Ice water	2°C	35°F 1.7°C	.001
C	Boiling water	212°F 100°C	219°F 103.9°C	-.01
D	Boiling oil	244°F 117.8°C	254°F 123.3°C	-.01
E	Ambient 4-29-87	50°F	50°F	0%

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

[b]Type of calibration system used.

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

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.