DIVISION OF ENVIRONMENTAL MANAGEMENT
AIR QUALITY SECTION

November 4, 1987

MEMORANDUM

TO: Ken Schuster

FROM: Robert Wooten

SUBJECT: Review of Report of Particulate and Visible Emissions Testing Performed on the Rotary Dryer Baghouse Stack at Cumberland Paving Company, Princeton, Johnston County, North Carolina.

The tests were performed June 29, 1987 by personnel of Entropy Environmentalists. The report was received July 21, 1987 at the Raleigh Regional Office and some time later at the central office.

This asphalt plant is regulated under NSPS Subpart I.

EPA Method 9 was used to perform the visible emissions test. The observer was properly certified at the time of the test. It appears that correct procedures were followed. No visible emissions were recorded. Subpart I permits emissions of less than 20% opacity.

EPA Method 5 was used to determine particulate emissions. The only problem noted was that Run 1 was 84.8% isokinetic whereas 90% is the acceptable lower limit. The likely result of this is that the reported emissions of Run 1 are somewhat greater than the actual emissions. The average emission concentration of the three runs was .0108 grains per DSCF whereas Subpart I allows up to .04 grains per DSCF. Compliance is well demonstrated.

/lhb

cc: Mike Aldridge
Central File

NORTH CAROLINA DIVISION OF ENVIRONMENTAL MANAGEMENT

Air Quality Action Request

Computer _____

Name	Location	Reg/Co./Prem. No.
CUMBERLAND PAVING	SR 1002, Princeton	5/51(Johnston)/0013

Contact: Bobby Narron, Hugh Smith-foreman

Telephone: 936-4411

Type Action: CI ___ EE XX SR ___ PC ___ VE ___ PI ___ Other NSPS stack test

Air Program Status 03 92 _____ _____ _____ Class AIP Chg _____

Action Requested By: _____ Address/Phone _____ Rec'd Date _____

Last Insp. Date 00-00-00 Action Date 6/29/87 Next Insp. Date 6/30/88

Permit # 5447 Issued 5/22/84 Expires 4/1/89 Stip. # _____ Met Y/N Y

Recommendations:

Signature: David Daniel

Date: 7/6/87

Dist: Yellow (Central File) - Blue (Region) - White (Opt.) Specify _____

This plant is a drum mix asphalt plant. Emission points are controlled by a baghouse-6532 sq.ft. of filter area; Astec Super Six Pack.

At the time of the inspection, a stack test was being conducted. Attached is my AQ-92, for your convenience.

NSPS information:

The plant was operating at 300 tph (black base) while burning #2 fuel oil in the rotary dryer. No VEs were seen during the test.

1. first batch was produced 6/8/87
2. maximum production was reached 6/22/87
3. the plant stack tested for particulate and VE 6/29/87.

Await stack test results.

DYD/jf

SOURCE TEST
OBSERVERS CHECKLIST

N. C. Division of Environmental Management / Air Quality Section

Source Name: Cumberland Paving	Testing Firm: Entropy Envir.
Address: Princeton	Address: RTP
Johnston Co.	
Plant Location: S.R. 1002	Phone:
Source Contact: Bobby Narron	Test Engineer: Tom McDonald
Phone: 936 4411	Assistant: Mark Owen

Other Personnel Involved	Affiliation
Hugh Smith - Foreman - Plt op.	C.P.C.
Michael Kirkman	Entropy VEE
Wesley Weston	D.O.T.

Process Description: Drum Mix 300 TPH Asphalt Plant
Process Rate During Test: 300 TPH Base
Maximum Process Rate: 300 TPH
Burner Sizes (Incin.) Pri: NA Sec: NA

Soot Blowing Parameters:
A = NA Hr B = _____ Hr
R = _____ Hr S = _____ Hr
A = Hours of soot blowing during sample(s)
B = Hours not soot blowing during sample(s) containing soot blowing
R = Average hours of operation per 24 hours
S = Average hours of soot blowing per 24 hours

TEST PARAMETERS

Duct Size: 29 1/2" x 45"
Distance Before Ports: 87"
Distance After Ports: 19"
Number of Test Points: 24
Number of Runs: 3
Sampling Time Per Run (min.): 60

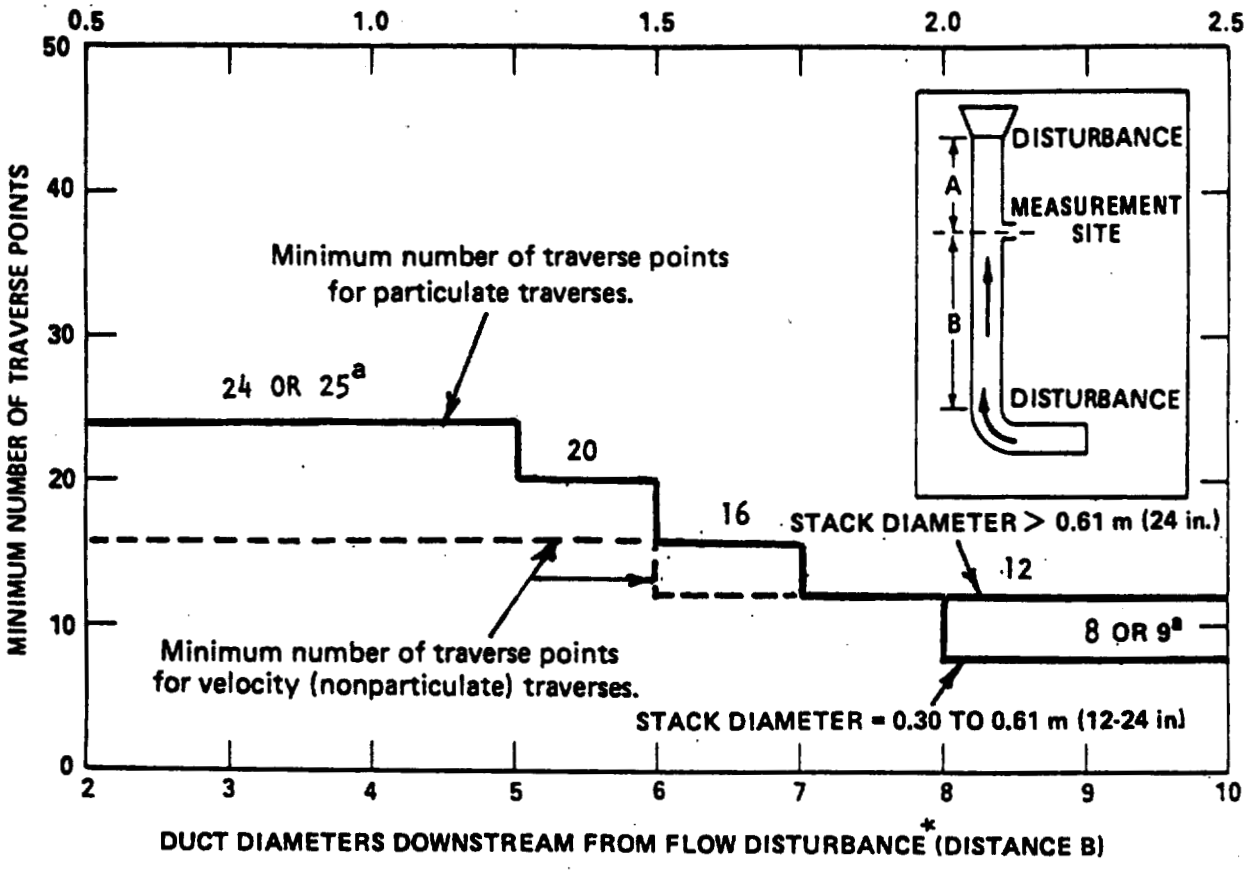
Pollutant Sampled: Particulate & VE
E. P. A. Method No.: 5 & 9
If method differs from E. P. A. method, explain:

For Method 5 sampling train record ΔH@ 1.95
Y. 99%

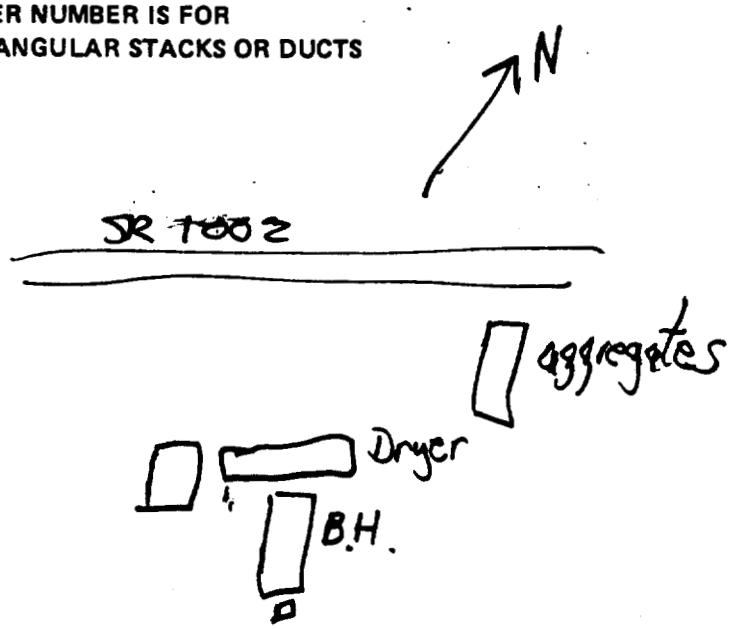
	Run #1	Run #2	Run #3
Leakage Rate (ft^3/min.) (0.02 ft^3/min. or less)	.002/.000	.001	not observed
Time Started (24 hr. Clock)	9:49 am	1:08 pm	
Time Ended	12:33 pm		
Test Date(s)	6-28-87	6-29-87	/ /

See Graph on Reverse Side For Number of Test Points.
Use Reverse Side for Comments.

Request 2 Copies of Report
D Daniel 6-29-87
OBSERVERS SIGNATURE



COMMENTS;



paving lot. - next week.
collapsing curb.
O Sun

CUMBERLAND PAVING
PRINCETON
ROTARY DRYER BAGHOUSE
29 JUNE 1987

	RUN NUMBER	1	2	3
Ms	WET MOLECULAR WT., #/#-MOLE	27.74	ERR	ERR
Pstatic	GAS STATIC PRESS,. IN. H2O	-0.95		
Ps	ABSOLUTE GAS PRESS, IN. HG.	29.83	0.00	0.00
TsF	STACK GAS TEMP., DEG. F	279		
SSR DP	SUM OF SQUARE ROOTS OF VELOCITY PRESS. VALUES	30.1001		
vs	FLUE GAS VELOCITY, FT/SEC	85.1	ERR	ERR
Ds	DUCT DIAMETER, INCHES	29.5X45		
As	DUCT AREA, SQUARE INCHES	1327.5	0.0	0.0
AsF	DUCT AREA, SQUARE FEET	9.219	0.000	0.000
Qs	GAS FLOW RATE, WET ACFM	47071	ERR	ERR
Qstd	GAS FLOW RATE, DRY SCFM	29048	ERR	ERR
mn	SAMPLE WEIGHT, GRAMS	0.0277		
cs	PART. CONCENTRATION GR/DSCF	0.0138	ERR	ERR
pmrc	POLLUTANT MASS RATE CALC. FROM CONCENTRATION, #/HR	3.43	ERR	ERR
pmra	POLLUTANT MASS RATE CALC. FROM AREA RATIO, #/HR	2.92	ERR	ERR
%I	% ISOKINETIC	85.2	ERR	ERR
pmr avg	AVERAGE OF pmra & pmrc	3.17	ERR	ERR
%EA	% EXCESS AIR	235.0	ERR	ERR
F	"F" FACTOR, CU FT/MIL BTU			
q	HEAT INPUT RATE, MIL BTU/HR	ERR	ERR	ERR
e	EMISSION RATE, #/MIL BTU	ERR	ERR	ERR

CUMBERLAND PAVING
PRINCETON
ROTARY DRYER BAGHOUSE
29 JUNE 1987

	RUN NUMBER	1	2	3
	RUN DATE	29JUNE 87		
	RUN START TIME	9:49 AM		
	RUN FINISH TIME	12:33 PM		
N	NUMBER OF SAMPLE POINTS	24		
Theta	TEST RUN TIME, MINUTES	60		
Dn	NOZZLE DIAMETER, INCHES	0.188		
An	NOZZLE AREA, SQ. IN.	0.0278	0.0000	0.0000
Cp	PITOT TUBE COEFFICIENT	0.840		
Y	GAS METER CAL. FACTOR	0.997		
Pbar	BAROMETRIC PRESSURE, IN. HG	29.90		
Delta H	AVG. PRESS. DIFFERENTIAL OF ORIFICE METER, IN. H2O	0.983		
Vm	ACTUAL METERED GAS VOL. CF	32.757		
TmF	GAS METER TEMP,. DEG. F	96		
Vm(std)	METERED GAS VOLUME AT DRY STANDARD CONDITIONS, DSCF	31.056	0.000	0.000
Vwc	VOLUME OF WATER COLLECTED IN IMPINGERS & DESICCANT, ML	101.5		
Vwc(std)	VOLUME OF WATER VAPOR, SCF	4.778	0.000	0.000
%M	MOISTURE, % BY VOLUME	13.3	ERR	ERR
fm	MOLE FRACTION OF DRY GAS	0.867	ERR	ERR
%CO2	CO2, % BY VOLUME, DRY	4.0		
%O2	O2, % BY VOLUME, DRY	15.0		
%CO	CO, % BY VOLUME, DRY	0.0		
%N2	N2, % BY VOLUME, DRY	81.0		
Md	DRY MOLECULAR WT., #/#-MOLE	29.24	0.00	0.00

SOURCE

STATION/UNIT

		1	2	3
	RUN DATE			
	RUN START TIME			
	RUN FINISH TIME			
N	NUMBER OF SAMPLE POINTS	24		
Theta	TEST RUN TIME, MINUTES			
Dn	NOZZLE DIAMETER, INCHES			
Cp	PITOT TUBE COEFFICIENT			
Y	GAS METER CAL. FACTOR			
Pbar	BAROMETRIC PRESSURE, IN. HG	29.9		
Delta H	AVG. PRESS. DIFFERENTIAL OF ORIFICE METER, IN. H2O			
Vm	ACTUAL METERED GAS VOL. CF			
TmF	GAS METER TEMP,. DEG. F			
Vwc	VOLUME OF WATER COLLECTED IN IMPINGERS & DESICCANT, ML			
%CO2	CO2, % BY VOLUME, DRY			
%O2	O2, % BY VOLUME, DRY			
%CO	CO, % BY VOLUME, DRY			
%N2	N2, % BY VOLUME, DRY			
Pstatic	GAS STATIC PRESS,. IN. H2O			
TsF	STACK GAS TEMP., DEG. F	279		
SSR DP	SUM OF SQUARE ROOTS OF VELOCITY PRESS. VALUES			
Ds	DUCT DIAMETER, INCHES			
As	DUCT AREA, SQUARE INCHES	1327.5		
AsF	DUCT AREA, SQUARE FEET			
mn	SAMPLE WEIGHT, GRAMS			
F	"F" FACTOR, CU FT/MIL BTU			

DIVISION OF ENVIRONMENTAL MANAGEMENT
RALEIGH REGIONAL OFFICE

Date: Aug 17, 1987

M E M O R A N D U M

TO: Mike Aldridge

FROM: Kenneth Schuster/D. Daniel

SUBJECT: Request for Source Test Review
Company: Cumberland Paving, Princeton
County: Johnston

It is requested that the attached subject source test dated June 29, 1987 be reviewed. It is 1 of 1 copy(s).

Additional Comment:

Org Q - accept as is - 8-13-87

The org. emission (part.) rate of 0.011 gr/dscf appears to show compliance with the allowable rate of 0.04 gr/dscf Opacity appears to meet compliance also.

KS:

Attachment

ENTROPY
ENVIRONMENTALISTS INC.

POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919-781-3550

STATIONARY SOURCE SAMPLING REPORT
EEI REF. NO. 5569

CUMBERLAND PAVING COMPANY
CONTINUOUS MIX ASPHALT PLANT
PRINCETON, NORTH CAROLINA

PARTICULATE EMISSIONS AND PLUME OPACITY COMPLIANCE TESTING

ROTARY DRYER BAGHOUSE STACK

JUNE 29, 1987

REPORT CERTIFICATION

The sampling and analysis performed for this report was carried out under my direction and supervision.

Date July 14, 1987 Signature _____

Arthur T. McDonald

I have reviewed all testing details and results in this test report and hereby certify that the test report is authentic and accurate.

Date July 14, 1987 Signature _____

D. James Grove, P.E.

TABLE OF CONTENTS

INTRODUCTION

1.1 Outline of Test Program. Stationary source sampling was performed for Cumberland Paving Company at the continuous mix asphalt plant in Princeton, North Carolina on June 29, 1987. Three EPA Method 5 runs were performed at the rotary dryer baghouse stack to determine the particulate emissions. EPA Method 9 plume opacity determinations were conducted concurrently with the particulate emissions testing.

1.2 Test Participants. Table 1-1 lists the personnel present during the test program.

TABLE 1-1
TEST PARTICIPANTS

Cumberland Paving Company	Bobby Narron Test Coordinator
North Carolina Department of Natural Resources and Community Development	David Daniel Test Observer
Entropy Inc.	Arthur T. McDonald Project Supervisor
	Michael L. Kirkman Sampling Team Leader & Visible Emissions Observer
	Mark K. Owens Engineering Technician

SUMMARY OF RESULTS

2.1 Presentation. Table 2-1 summarizes the results of the particulate emissions testing performed June 30, 1987, at the baghouse stack. Detailed test results are given in Appendix A; field and analytical data are presented in Appendix B.

2.2 Discussion

2.2.1 Particulate Emissions. The average particulate concentration was 0.011 grains per dry standard cubic foot (gr/DSCF). The maximum concentration of particulate allowed by the United States EPA New Source Performance Standards for Asphalt Concrete Plants is 0.04 gr/DSCF.

2.2.2 Plume Opacity. All stack plume opacity readings were zero. Field data and observer certification documentation are given in Appendix B.2.

2.2.3 Run 1 Sampling Rate. Run 1 was performed at an isokinetic sampling rate which is slightly lower than the EPA minimum limit of 90%. Due to an overestimate of the moisture content while setting the sampling parameters, run 1 was performed with a sampling rate at 85% isokinetic.

Assuming worst case condition (all particles being greater than 50 microns in diameter), the maximum error would result in the measured concentration for run 1 being 15% higher than real. If the reported concentration for run 1 of 0.014 grains per dry standard cubic foot (gr/DSCF) is reduced for the worst case error, the adjusted concentration would be 0.012 gr/DSCF. The average concentration would decrease from 0.011 gr/DSCF to 0.010 gr/DSCF, a decrease of 10%.

TABLE 2-1

PARTICULATE TESTS SUMMARY OF RESULTS

Dryer Baghouse Stack

	1	2	3
Run Date	6/29/87	6/29/87	6/29/87
Test Train Parameters:			
Volume of Dry Gas Sampled, SCF*	31.056	37.057	35.974
Percent Isokinetic	84.8	102.0	99.4
Flue Gas Parameters:			
Temperature, Degrees F	275	270	259
Volumetric Air Flow Rates SCFM*, Dry	29,162	28,920	28,818
ACFM, Wet	46,900	46,502	45,113
Excess Air, Percent	235.0	235.0	235.0
Method 5 Results:			
Catch, Milligrams	27.7	25.8	18.3
Concentration, Grains/DSCF*	0.01376	0.01074	0.007850
Emission Rate, Lbs/Hour	3.441	2.663	1.939

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

PROCESS DESCRIPTION AND OPERATION

3.1 General. Cumberland Paving Company, in Princeton, North Carolina, operates a continuous mix process to produce asphalt. An ASTEC rotary dryer, rated at 325 tons per hour, is used in the production process. The aggregate is dropped into the rotary dryer, where it is mixed, dried, and heated; liquid asphalt is then added to the aggregate and the product is transferred to a holding silo. The rotary dryer is fired with natural gas.

3.2 Process Emissions. Particulates are emitted from the process during drying and mixing due to the release of dust from the surface of the aggregate mix. The exhaust gases from the rotary dryer pass through a coater, baghouse, and a fan before exiting the stack to the atmosphere, as shown schematically in Figure 3-1.

3.3 Operation During Testing. Approximately 300 tons per hour of asphalt were produced during testing.

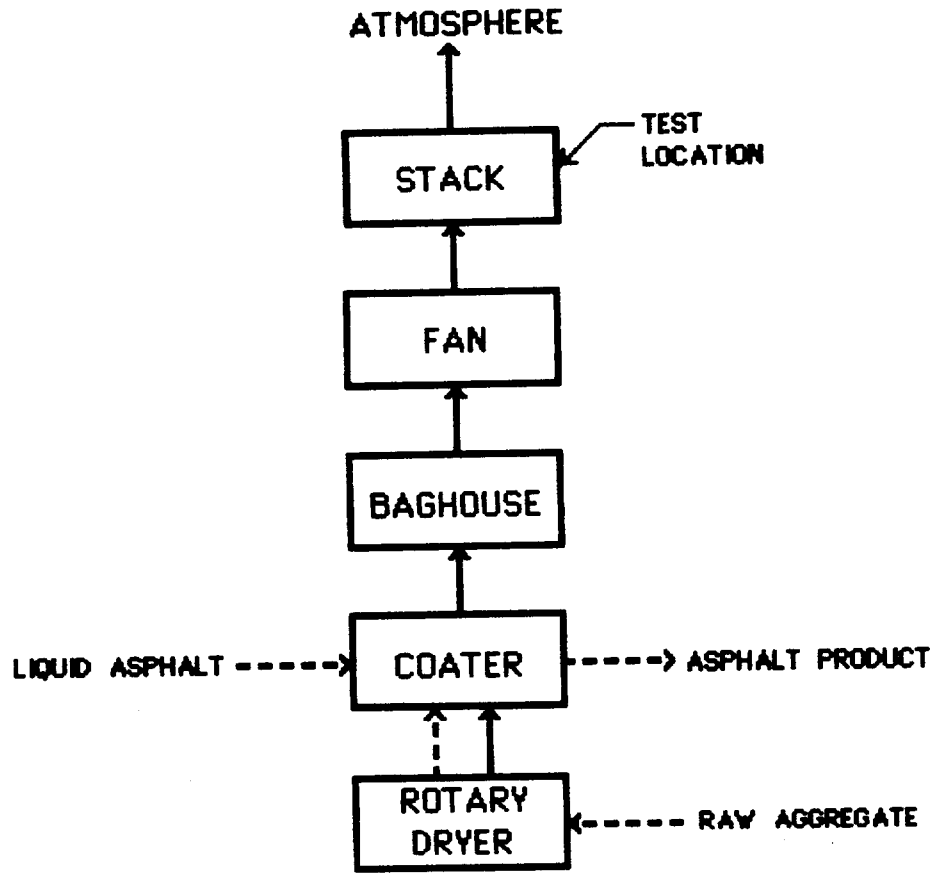


FIGURE 3-1. ROTARY DRYER AIR FLOW SCHEMATIC SHOWING TEST LOCATION

SAMPLING AND ANALYTICAL PROCEDURES

4.1 General. All sampling and analytical procedures were those recommended by the United States Environmental Protection Agency and the North Carolina Department of Natural Resources and Community Development. Descriptions of the sampling equipment and procedures (extracted from 40 CFR 60) are provided in Appendix D.

4.2 Sampling Points. The number and location of the sampling points were determined according to EPA Method 1. The stack cross section was divided into 24 equal areas, i.e., four sample points on each of the six traverse axes labeled A through F, as shown in Figure 4-1.

4.3 Volumetric Air Flow Rates

4.3.1 Flue Gas Velocity. EPA Method 2 was used to take the velocity measurements during the traverses of the stack cross section.

4.3.2 Flue Gas Composition. During run 2, a multipoint, integrated flue gas sample was collected and analyzed using EPA Method 3; the analytical results were used to determine the flue gas composition and molecular weight for each run.

4.3.3 Flue Gas Moisture. Moisture content was determined by analyzing the sampling train impinger reagents according to the procedures outlined in EPA Method 5.

4.4 Particulate Emissions. EPA Method 5 sampling and analytical procedures were used to determine the particulate emissions. The centroid of each of the 24 equal areas was sampled for 2.5 minutes, resulting in a net run time of 60 minutes.

4.5 Plume Opacity. The procedures outlined in EPA Method 9 were followed in determining the plume opacity.

4.6 Sampling Equipment. All sampling equipment was manufactured by Nutech Corporation or Entropy. Pertinent calibration data are provided in Appendix C.

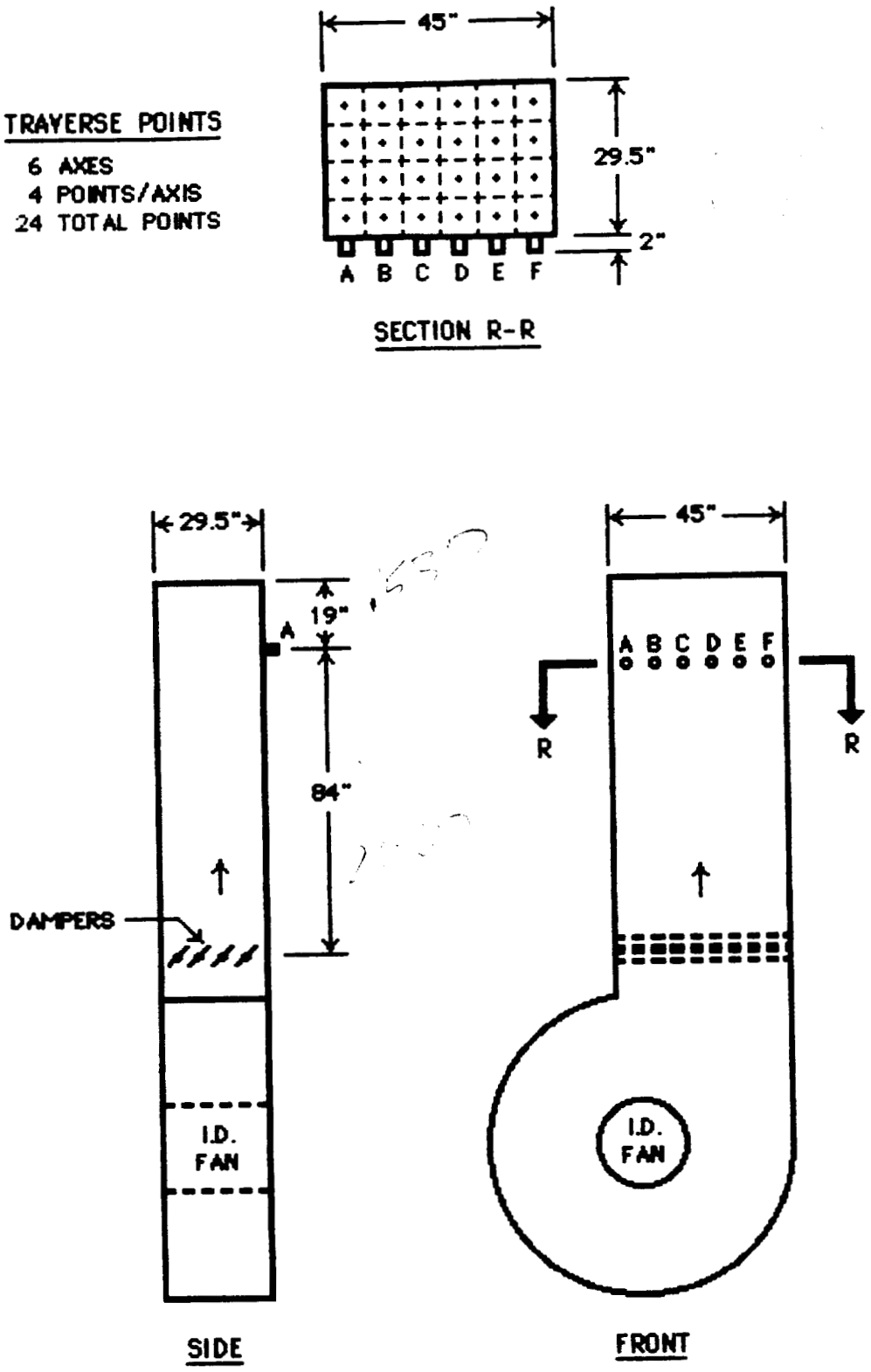


FIGURE 4-1. ROTARY DRYER BAGHOUSE STACK TEST LOCATION

APPENDIX A

TEST RESULTS AND EXAMPLE CALCULATIONS

ISOKINETIC SAMPLING TRAIN FIELD DATA & RESULTS TABULATION

PLANT: Cumberland Paving Princeton, NC

RUN #	DATE	SAMPLING LOCATION	OPERATOR
1	6/29/87	Dryer Baghouse Stack	Arthur T. McDonald
2	6/29/87	Dryer Baghouse Stack	Arthur T. McDonald
3	6/29/87	Dryer Baghouse Stack	Arthur T. McDonald

		1	2	3
	Run Start Time	949	1308	1612
	Run Finish Time	1233	1528	1806
	Net Sampling Points	24	24	24
Theta	Net Run Time, Minutes	60.00	60.00	60.00
Dia	Nozzle Diameter, Inches	0.188	0.188	0.188
Cp	Pitot Tube Coefficient	0.840	0.840	0.840
Y	Dry Gas Meter Calibration Factor	0.997	0.997	0.997
Pbar	Barometric Pressure, Inches Hg	29.90	29.90	29.90
Delta H	Avg. Pressure Differential of Orifice Meter, Inches H2O	0.983	1.450	1.340
Vm	Volume of Metered Gas Sample, Dry ACF	32.757	39.604	38.934
tm	Dry Gas Meter Temperature, Degrees F	96	104	111
Vm(std)	Volume of Metered Gas Sample, Dry SCF*	31.056	37.057	35.974
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, mL	101.5	125.0	111.0
Vw(std)	Volume of Water Vapor, SCF*	4.778	5.884	5.225
%H2O	Moisture Content, Percent by Volume	13.3	13.7	12.7
Mfd	Dry Mole Fraction	0.867	0.863	0.873
%CO2	Carbon Dioxide, Percent by Volume, Dry	4.0	4.0	4.0
%O2	Oxygen, Percent by Volume, Dry	15.0	15.0	15.0
%CO+N2	CO + N2, Percent by Volume, Dry	81.0	81.0	81.0
Md	Dry Molecular Weight, Lb/Lb-Mole	29.24	29.24	29.24
Ms	Wet Molecular Weight, Lb/Lb-Mole	27.74	27.70	27.81
Pg	Flue Gas Static Pressure, Inches H2O	-0.10	-1.05	-1.10
Ps	Absolute Flue Gas Press., Inches HG	29.89	29.82	29.82
ts	Flue Gas Temperature, Degrees F	275	270	259
Delta p	Average Velocity Head, Inches H2O	1.5730	1.5510	1.4880
vs	Flue Gas Velocity, Feet/Second	84.79	84.07	81.56
A	Stack/Duct Area, Square Inches	1,328	1,328	1,328
Qsd	Volumetric Air Flow Rate, Dry SCFM*	29,162	28,920	28,818
Qaw	Volumetric Air Flow Rate, Wet ACFM	46,900	46,502	45,113
%I	Isokinetic Sampling Rate, Percent	84.8	102.0	99.4
%EA	Excess Air, Percent	235.0	235.0	235.0

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

		1	2	3
	Method 5 Results:			
mg	Catch, Milligrams	27.7	25.8	18.3
gr/DSCF	Concentration, Grains per DSCF*	0.01376	0.01074	0.007850
Lb/Hr	Emission Rate, Lbs/Hour (PMRc)	3.441	2.663	1.939

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

EXAMPLE PARTICULATE TEST CALCULATIONS NO. 1

Dryer Baghouse Stack

VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS

$$Vm(std) = 17.64 * Y * Vm * \frac{(Pbar + Delta\ H/13.6)}{(460 + tm)}$$

$$Vm(std) = 17.64 * 0.997 * 32.757 * \frac{(29.90 + 0.983/13.6)}{(460 + 96)} = 31.056 \text{ DSCF}$$

VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

$$Vw(std) = 0.04707 * Vlc$$

$$Vw(std) = 0.04707 * 101.5 = 4.778 \text{ SCF}$$

PERCENT MOISTURE, BY VOLUME, AS MEASURED IN FLUE GAS

$$\%H2O = 100 * Vw(std) / (Vw(std) + Vm(std))$$

$$\%H2O = \frac{4.778}{4.778 + 31.056} * 100 = 13.3\ \%$$

DRY MOLE FRACTION OF FLUE GAS

$$Mfd = 1 - \%H2O/100$$

$$Mfd = 1 - 13.3/100 = 0.867$$

DRY MOLECULAR WEIGHT OF FLUE GAS

$$Md = \%CO2 * 0.44 + \%O2 * 0.32 + \%CO+N2 * 0.28$$

$$Md = 4.0*0.44 + 15.0*0.32 + 81.0*0.28 = 29.24 \text{ LB/LB-MOLE}$$

WET MOLECULAR WEIGHT OF FLUE GAS

$$Ms = (Md * Mfd) + (0.18 * \%H2O)$$

$$Ms = 29.24 * 0.867 + (0.18 * 13.3) = 27.74 \text{ LB/LB-MOLE}$$

ABSOLUTE FLUE GAS PRESSURE

$$Ps = Pbar + Pg / 13.6$$

$$Ps = 29.90 + (-0.0 / 13.6) = 29.89 \text{ IN. HG.}$$

AVERAGE FLUE GAS VELOCITY [Note: (Delta p)avg is square of avg sq. root]

$$vs = 85.49 * Cp * SQRT\left[\frac{(\text{Delta p})avg * (460 + ts)}{Ps * Ms}\right]$$

$$vs = 85.49 * 0.840 * SQRT\left[\frac{1.5730 * (460 + 275)}{29.89 * 27.74}\right] = 84.8 \text{ FT/SEC}$$

DRY VOLUMETRIC FLUE GAS FLOW RATE @ STANDARD CONDITIONS

$$Qsd = \frac{60}{144} * Mfd * vs * A * \frac{Tstd}{ts + 460} * \frac{Ps}{Pstd}$$

$$Qsd = \frac{60}{144} * 0.867 * 84.8 * 1,327.5 * \frac{528}{275 + 460} * \frac{29.89}{29.92}$$

$$Qsd = 29,162 \text{ SCFM}$$

WET VOLUMETRIC STACK GAS FLOW RATE @ FLUE GAS CONDITIONS

$$Qaw = 60 / 144 * vs * A$$

$$Qaw = 60 / 144 * 84.8 * 1,327.5 = 46,900 \text{ ACFM}$$

PERCENT ISOKINETIC OF SAMPLING RATE

$$\%I = \frac{Pstd}{Tstd} * \frac{100}{60} * \frac{(ts + 460) * Vm(std)}{Ps * vs * Mfd * Theta * \text{Area-nozzle, sq.ft.}}$$

$$\%I = \frac{29.92}{528} * \frac{100}{60} * \frac{(275 + 460) * 31.056}{29.89 * 84.8 * 0.867 * 60.00 * 0.0001928}$$

$$\%I = 84.8 \ \%$$

GRAINS PER DRY STANDARD CUBIC FOOT

$$gr/DSCF = \frac{7000}{453{,}592} * \frac{mgs}{Vm(std)}$$

$$gr/DSCF = \frac{7000}{453{,}592} * \frac{27.7}{31.056} = 0.0138 \text{ gr/DSCF}$$

POUNDS PER HOUR

$$Lb/Hr = 60 / 7000 * gr/DSCF * Qsd$$

$$Lb/Hr = 60/7000 * 0.0138 * 29{,}162 = 3.44 \text{ LB/HR}$$

PERCENT EXCESS AIR

$$\%EA = \frac{\%O2 - (0.5 * \%CO)}{(0.264 * \%N2) - (\%O2 - (0.5*\%CO))} * 100$$

$$\%EA = \frac{15.0 - (0.5 * 0.0)}{0.264 * 81.0 - (15.0 - (0.5 * 0.0))} * 100 = 235.0 \%$$

APPENDIX B

FIELD AND ANALYTICAL DATA

APPENDIX B

1. PARTICULATE

Preliminary Field Data

PLANT NAME Cumberland Paving Co.

LOCATION Princeton NC.

SAMPLING LOCATION Baghouse stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 31 1/2"

NIPPLE LENGTH 2"

DEPTH OF DUCT 29 1/2"

WIDTH (RECTANGULAR DUCT) 45"

EQUIVALENT DIAMETER:

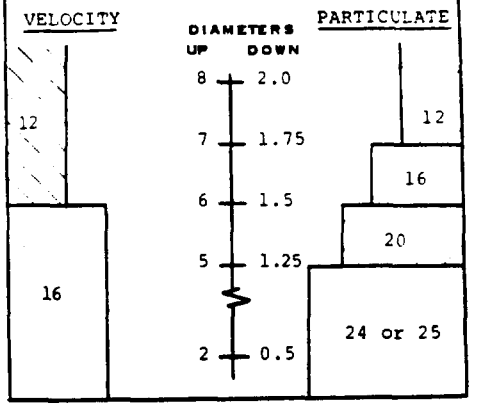
$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(29\frac{1}{2})(45)}{(29\frac{1}{2} + 45)} = 35\frac{5}{8}$"

DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE	UPSTREAM	DOWNSTREAM
	87"	19"
DIAMETERS	2 1/2	1/2

STACK AREA = 29 1/2" x 45" = 1327.5 IN^2

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.



Point	% OF DUCT DEPTH	DISTANCE FROM INSIDE WALL	DISTANCE FROM OUTSIDE OF PORT
1	12.5	3 5/8"	5 5/8"
2	37.5	11"	13"
3	62.5	18 3/8	20 3/8
4	87.5	25 7/8	27 7/8
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

	4	6	8	10	12	14	16	18	20	22	24
1	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3	75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4	93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5		85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6		95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7			89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8			96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9				91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10				97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11					93.3	85.4	78.0	70.4	61.2	39.3	32.3
12					97.9	90.1	83.1	76.4	69.4	60.7	39.8
13						94.3	87.5	81.2	75.0	68.5	60.2
14						98.2	91.5	85.4	79.6	73.8	67.7
15							95.1	89.1	83.5	78.2	72.8
16							98.4	92.5	87.1	82.0	77.0
17								95.6	90.3	85.4	80.6
18								98.6	93.3	88.4	83.9
19									96.1	91.3	86.8
20									98.7	94.0	89.5
21										96.5	92.1
22										98.9	94.5
23											96.8
24											98.9

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

	2	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.0	59.1	54.2
8							93.8	83.3	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	86.4	79.2
11										95.5	87.5
12											95.8

ENTROPY ENVIRONMENTALISTS, INC

ORSAT FIELD DATA

Plant Name Cumberland Paving - Princeton, NC

Sampling Location Rotary Dryer Exhaust Fuel Type #2 Oil

Run and/or Sample No. 2 Leak Test? ✓ Date 6/29/87 Operator [illegible]

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
1308	1540	4.1	19.1	—	15.0		
to	to	4.0	19.0	—	15.0		
1528	1600	4.0	19.9	—	14.9		
	Avg.	4.0		Avg.	15.0		81.0

Run and/or Sample No. _____ Leak Test? _____ Date _____ Operator _____

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.			Avg.			

Run and/or Sample No. _____ Leak Test? _____ Date _____ Operator _____

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.			Avg.			

F-1009
8/86

PARTICULATE FIELD DATA

COMPANY NAME Cumberland Paving Co. — RUN NUMBER 1
ADDRESS ~~Smithfield NC~~ Princeton, NC — TIME START 0949
SAMPLING LOCATION Baghouse Stack — TIME FINISH 1233
DATE 6-29-87 — TEAM LEADER (TMC) — TECHNICIANS MD
BAROMETRIC PRESSURE, IN. HG 29.9 — STATIC PRESSURE, IN. H_2O -0.95
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 4
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.002 0.000

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ORSAT SAMPLING SYSTEM
- TEDLAR BAG
- ✓ THERMOCOUPLE @ 300 °F

IDENTIFICATION NUMBERS

REAGENT BOX 0232 NOZZLE 501 DIAMETER .188
METER BOX N4 T/C READOUT Extech
UMBILICAL V2 T/C PROBE 4-3
SAMPLE BOX 3 ORSAT PUMP —
PROBE 4-3 TEDLAR BAG —

FILTER #	TARE
E5728	.5146

NOMOGRAPH SET-UP — NOMOGRAPH # (TMC)

$\Delta H_@$ 1.75 — C FACTOR ~~0.59~~ 0.61
METER TEMP ~~60~~ 100 — STACK TEMP 300
% MOISTURE 30 — REF. ΔP ~~3.10~~ 3.20

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H_2O IDEAL	ORIFICE SETTING (ΔH), IN. H_2O ACTUAL	GAS METER TEMP. °F	PUMP VACUUM IN. HG GAUGE	FILTER BOX TEMP. °F	IMP. EXIT TEMP. °F	STACK TEMP. °F	LK. CHECK READINGS
A 1	0/0	943.707	3.60	2.07	2.07	86	4	245	62	282	
2	2½	946.017	3.55	2.04	2.04	88	4	248	60	284	
3	5	947.80	3.20	1.84	1.84	89	4	250	60	287	
4	7½	949.58	1.50	0.86	0.86	90	4	250	61	288	
B 1	10/0	950.96	2.65	1.52	1.52	91	3	251	61	281	
2	2½	952.72	2.55	1.47	1.47	92	3	251	62	283	
3	5	954.42	2.60	1.50	1.50	93	3	250	63	286	
4	7½	956.18	2.00	1.15	1.15	94	3	[illegible]	63	287	
C 1	20/0	957.708	2.40	1.38	1.38	95	3	[illegible]	62	291	
2	2½	959.39	1.75	1.01	1.01	95	3	251	62	291	
3	5	960.85	1.50	0.86	0.86	96	2	250	63	289	
4	7½	962.22	2.00	1.15	1.15	96	3	252	64	274	
D 1	30/0	963.76	2.50	1.44	1.44	97	3	252	63	279	
2	2½	965.45	1.05	0.60	0.60	97	3	255	63	285	
3	5	966.67	1.00	0.58	0.58	96	3	254	64	286	Fyrite 4%
4	2½	968.80	0.83	0.48	0.48	97	3	252	63	281	
E 1	40/0	968.74	1.20	0.69	0.69	97	3	250	64	260	
2	2½	969.95	0.75	0.43	0.43	99	2	248	65	261	
3	5	970.92	0.90	0.52	0.52	101	2	248	68	233	
4	7½	972.02	0.95	0.55	0.55	100	2	251	67	258	
F 1	50/0	972.99	0.83	0.48	0.48	100	2	252	67	263	
2	2½	974.05	0.39	0.22	0.22	101	2	253	66	260	
3	5	974.72	0.60	0.35	0.35	101	2	253	66	253	Fyrite 3%
4	7½	975.58	0.69	0.40	0.40	101	2	251	65	245	
	60/off	976.464									

32.757 — 1.573 — .9929 — 96 — 279

F-1010
8/86

V_M — $(\sqrt{\Delta P})^2$ — ΔH — T_M — T_S

ENTROPY

PARTICULATE FIELD DATA

COMPANY NAME Cumberland Paving Co — RUN NUMBER 2
ADDRESS Smithfield NC Pinadow NC — TIME START 1302
SAMPLING LOCATION Baghouse stack — TIME FINISH 1528
DATE 6-29-87 — TEAM LEADER [redacted] — TECHNICIANS MO
BAROMETRIC PRESSURE, IN. HG 29.9 — STATIC PRESSURE, IN. H_2O -1.05
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 6
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.001 0.000

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 250 °F

IDENTIFICATION NUMBERS

REAGENT BOX 0232 NOZZLE 501 DIAMETER .188
METER BOX N4 T/C READOUT ETTech
UMBILICAL J2 T/C PROBE L-3
SAMPLE BOX 5 ORSAT PUMP [redacted] 581
PROBE 4-5 TEDLAR BAG [redacted] 6

FILTER #	TARE
E5739	.5082

NOMOGRAPH SET-UP — NOMOGRAPH # (VAS)

$\Delta H_@$ 1.75 — C FACTOR 0.86
METER TEMP [redacted] 105 — STACK TEMP 280
% MOISTURE 14 — REF. ΔP 2.18

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H_2O IDEAL	ORIFICE SETTING (ΔH), IN. H_2O ACTUAL	GAS METER TEMP. °F	PUMP VACUUM IN. HG GAUGE	FILTER BOX TEMP. °F	IMP. EXIT TEMP. °F	STACK TEMP. °F	LK. CHECK READINGS
A 1	0/0	976.591	3.80	3.28	3.21	100	6	255	61	276	
2	2½	979.20	4.00	3.38	3.38	101	6	255	63	278	
3	5	981.68	2.90	2.45	2.45	102	5	254	63	279	Sprite 4p
4	7½	983.96	1.55	1.31	1.31	102	3	254	61	280	
B 1	10/0	985.69	2.10	1.77	1.77	102	4	255	61	283	
2	2½	987.60	2.80	2.36	2.36	102	5	254	63	278	
3	5	989.74	2.60	2.19	2.19	102	5	254	63	276	
4	7½	991.80	1.85	1.56	1.56	104	4	252	64	275	
C 1	20/0	993.61	2.45	2.07	2.07	105	5	252	65	271	
2	2½	995.83	1.95	1.65	1.65	105	4	250	65	268	
3	5	997.61	1.98	1.67	1.67	102	4	253	68	252	
4	7½	999.46	1.75	1.48	1.48	102	4	255	64	234	
D 1	30/0	1001.15	1.45	1.22	1.22	103	3	256	62	270	
2	2½	2.76	1.05	0.89	0.89	103	2	254	62	266	
3	5	4.14	1.20	1.01	1.01	103	2	254	63	269	
4	7½	5.60	1.00	0.84	0.84	103	2	255	61	271	
E 1	40/0	6.95	1.60	1.35	1.35	103	3	257	63	272	
2	2½	8.63	0.55	0.46	0.46	104	2	257	64	272	
3	5	9.69	1.08	0.91	0.91	104	2	256	64	274	
4	7½	11.06	0.65	0.55	0.55	105	2	256	66	275	
F 1	50/0	12.15	0.74	0.62	0.62	105	2	257	66	273	
2	2½	13.28	0.33	0.28	0.28	109	1	259	67	258	
3	5	14.08	0.66	0.56	0.56	109	2	258	65	261	
4	7½	15.16	0.61	0.51	0.51	109	2	256	67	262	
	end/off	1016.195									

39.604	1.551	1.446	164	270
V_M	$(\sqrt{\Delta P})^2$	ΔH	T_M	T_S

F-1010
8/86

ENTROPY

PARTICULATE FIELD DATA

COMPANY NAME Cumberland Paving Co — RUN NUMBER 3
ADDRESS Princeton NC — TIME START 1612
SAMPLING LOCATION Bag House Stack — TIME FINISH 1806
DATE 6-29-87 — TEAM LEADER [illegible] — TECHNICIANS MO
BAROMETRIC PRESSURE, IN. HG 25.9 — STATIC PRESSURE, IN. H_2O -1.10
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 6
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.001 0.001

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- PITOTS, POST-TEST
- ORSAT SAMPLING SYSTEM
- TEDLAR BAG
- ✓ THERMOCOUPLE @ 280 °F

IDENTIFICATION NUMBERS

REAGENT BOX 0232 — NOZZLE 501 — DIAMETER .188
METER BOX N4 — T/C READOUT Extech
UMBILICAL U2 — T/C PROBE 6-3
SAMPLE BOX 3 — ORSAT PUMP —
PROBE 4-3 — TEDLAR BAG —

FILTER #	TARE
E 5730	.5015

NOMOGRAPH SET-UP

NOMOGRAPH # (YAS)
$\Delta H_@$ 1.75 — C FACTOR 0.86
METER TEMP 105 — STACK TEMP 180
% MOISTURE 14 — REF. ΔP 2.18

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H_2O IDEAL	ORIFICE SETTING (ΔH), IN. H_2O ACTUAL	GAS METER TEMP. °F	PUMP VACUUM IN. HG GAUGE	FILTER BOX TEMP. °F	IMP. EXIT TEMP. °F	STACK TEMP. °F	LK. CHECK READINGS
A 1	0/0	16.300	3.10	2.62	2.62	106	6	263	68	258	
2	2½	18.67	2.95	2.49	2.49	107	6	262	64	255	
3	5	20.91	1.90	1.60	1.60	108	5	260	63	261	
4	7½	22.81	1.55	1.31	1.31	109	4	260	63	249	
B 1	10/0	24.45	2.10	1.77	1.77	109	5	257	64	249	
2	2½	26.37	1.85	1.56	1.56	110	5	258	64	254	
3	5	28.18	2.65	2.24	2.24	110	6	257	65	255	
4	7½	30.29	1.85	1.56	1.56	112	5	257	65	256	
C 1	20/0	32.12	2.90	2.45	2.45	111	4	255	67	260	
2	2½	34.24	1.30	1.10	1.10	112	3	253	69	247	
3	5	35.79	1.68	1.42	1.42	111	3	253	68	249	
4	7½	37.53	1.89	1.60	1.60	111	3	254	68	247	
D 1	30/0	39.35	1.47	1.24	1.24	112	3	255	67	258	
2	2½	40.97	1.00	0.84	0.84	112	2	254	63	258	
3	5	42.41	1.38	1.16	1.16	112	2	254	63	260	
4	7½	43.93	1.85	1.56	1.56	112	3	253	64	262	
E 1	40/0	45.72	0.97	0.82	0.82	112	2	254	64	261	
2	2½	47.06	0.56	0.47	0.47	112	2	253	66	263	
3	5	48.06	0.99	0.84	0.84	112	2	253	66	268	
4	7½	49.38	1.38	1.16	1.16	111	2	254	67	270	freite 4%
F 1	50/0	50.95	1.07	0.90	0.90	111	2	254	67	272	
2	2½	52.34	0.34	0.29	0.29	111	2	253	65	269	
3	5	53.14	0.48	0.41	0.41	111	2	253	65	262	
4	7½	54.05	0.82	0.69	0.69	111	2	255	69	271	
	60/off	55.234									

38.934 — 1.488 — 1,338 — 111 — 259

V_M — $(\sqrt{\Delta P})^2$ — ΔH — T_M — T_S

F-1010
8/86

ENTROPY

PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name CUMBERLAND PAVING EEI Ref. # 5569

Sampling Location BAGHOUSE STACK

Date Received 6/30 Date Analyzed 7/2 Reagent Box(es) 0232

	1	2	3
Run Number			
Run Date	6/29	6/29	6/29

SUMMARY OF PARTICULATE ANALYSES

Sum of Particulate, mg.	542.6	534.2	519.9
Total Filter Tare mg.	514.6	508.2	501.5
Blank Residue, mg.	(125 mL) 0.3	(100 mL) 0.2	(50 mL) 0.1
TOTAL PARTICULATE CATCH, mg.	27.7	25.8	18.3

ANALYSIS OF MOISTURE CATCH

Reagent 1 (H_2O):			
Final Weight, g.	280.0	310.0	290.0
Tared Weight, g.	200.0	200.0	200.0
Water Catch, g.	80.0	110.0	90.0
Reagent 2 ( ):			
Final Weight, g.	–	–	–
Tared Weight, g.	–	–	–
Water Catch, g.	–	–	–
CONDENSED WATER, g.	80.0	110.0	90.0
Silica Gel:			
Final Weight, g.	221.5	215.0	221.0
Tared Weight, g.	200.0	200.0	200.0
ADSORBED WATER, g.	21.5	15.0	21.0
TOTAL WATER COLLECTED, g.	101.5	125.0	111.0

Blank Beaker # 2015

Final wt. mg. 94782.1

Tare wt. mg. 94781.7

Residue, mg. 0.4

Volume, mL. 200.0

Concen., mg/mL .002

--- Legend ---

= Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

ENTROPY

LABORATORY SAMPLE WEIGHT CALCULATIONS

Plant Name CUMBERLAND PAVING EEI Ref. # 5569

Run Number	1	2	3
Run Date	6/29	6/29	6/29
Sample ID/Container #	F&R 384	F&R 398	F&R 463
Tare Wt., g.	133.8589 ✓133.8586 133.8600 133.8160	✓124.5930 124.5930 124.0588	✓134.7335 134.7335 134.2136
SAMPLE WT., g.	.5426	.5342	.5199
Sample ID/Container #			
Tare Wt., g.			
SAMPLE WT., g.			
Sample ID/Container #			
Tare Wt., g.			
SAMPLE WT., g.			
Sample ID/Container #			
Tare Wt., g.			
SAMPLE WT., g.			

CUSTODY SHEET FOR REAGENT BOX # 0232

Date of Makeup 6/26 Initials MS Locked? ✓

Individual Tare of Reagent: 200 mls. of H_2O

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Cumberland Paving Co.

SAMPLING LOCATION Baghouse Stack

Run Number	Date Used	Initials	Locked?	Date Cleanup	% S. Gel Spent	Initials	Locked
1	6-29-87		✓	6-29-87	40		✓
2	6-29-87	↓	✓	6-29-87	40	↓	✓
3	6-29-87	↓	✓	6-29-87	40	↓	✓

Received in Lab Date 10/30 Initials J.F.J. Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: M5

Filter #	Tare Weight (grams)	Used on Test
E5725	.5146	1
E5729	.5052	2
E5730	.5015	3

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

APPENDIX B

2. PLUME OPACITY

VISIBLE EMISSION OBSERVATION FORM

No. 1-1

COMPANY NAME: Cumberland Paving Co.
STREET ADDRESS:
CITY: Princeton | STATE: NC | ZIP:
PHONE (KEY CONTACT): | SOURCE ID NUMBER:

PROCESS EQUIPMENT: Asphalt Plant | OPERATING MODE:
CONTROL EQUIPMENT: Baghouse | OPERATING MODE:

DESCRIBE EMISSION POINT: Rectangle Stack
Baghouse Stack
HEIGHT ABOVE GROUND LEVEL: 20'
HEIGHT RELATIVE TO OBSERVER: Start 20' End 20'
DISTANCE FROM OBSERVER: Start 40' End 30'
DIRECTION FROM OBSERVER: Start SW End SW

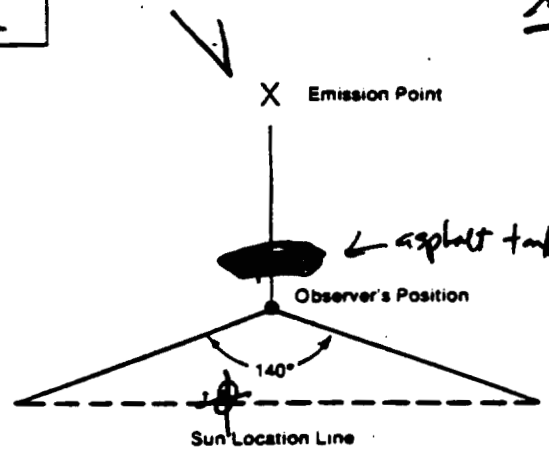
DESCRIBE EMISSIONS: Start 0 End 0
EMISSION COLOR: Start 0 End 0
IF WATER DROPLET PLUME: Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start Stack Exit End Same

DESCRIBE PLUME BACKGROUND: Start Blue Sky End Same
BACKGROUND COLOR: Start Blue End
SKY CONDITIONS: Start Clear End
WIND SPEED: Start 0-5 mph End
WIND DIRECTION: Start SW End
AMBIENT TEMP: Start 85 End
WET BULB TEMP:
RH, percent:

SOURCE LAYOUT SKETCH

Stack with Plume
Sun
Wind

Draw North Arrow



OBSERVATION DATE: 6/29/87 | START TIME: 9[illegible]9 | END TIME: 1135

SEC / MIN	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	

OBSERVER'S NAME (PRINT): Michael Kinkman
OBSERVER'S SIGNATURE: Michael Kinkman | DATE: 6/29/87
ORGANIZATION: Entropy
CERTIFIED BY: Eastern Tech. Assoc | DATE: 5/13/87

ADDITIONAL INFORMATION:

CONTINUED ON VEO FORM NUMBER: 1-2

VISIBLE EMISSION OBSERVATION FORM

No. 1-2

COMPANY NAME: Cumberland Paving Co.

STREET ADDRESS:

CITY: Princeton | STATE: NC | ZIP:

PHONE (KEY CONTACT): | SOURCE ID NUMBER:

PROCESS EQUIPMENT: | OPERATING MODE:

CONTROL EQUIPMENT: | OPERATING MODE:

DESCRIBE EMISSION POINT: Baghouse Stack

HEIGHT ABOVE GROUND LEVEL: | HEIGHT RELATIVE TO OBSERVER: Start End

DISTANCE FROM OBSERVER: Start End | DIRECTION FROM OBSERVER: Start End

DESCRIBE EMISSIONS: Start End

EMISSION COLOR: Start End | IF WATER DROPLET PLUME: Attached ☐ Detached ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start End

DESCRIBE PLUME BACKGROUND: Start End

BACKGROUND COLOR: Start End | SKY CONDITIONS: Start End

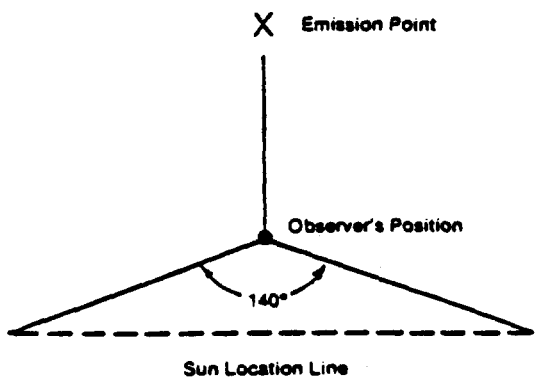
WIND SPEED: Start End | WIND DIRECTION: Start End

AMBIENT TEMP: Start End | WET BULB TEMP: | RH, percent:

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH

Draw North Arrow



ADDITIONAL INFORMATION:

OBSERVATION DATE: 6/29/87 | START TIME: | END TIME:

SEC / MIN	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	stopped 1025
7	0	0	0	0	started 1059
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	stopped 1118
25	0	0	0	0	started 1130
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	

OBSERVER'S NAME (PRINT):

OBSERVER'S SIGNATURE: Michael Anderson | DATE: 6/29/87

ORGANIZATION:

CERTIFIED BY: | DATE:

CONTINUED ON VEO FORM NUMBER: E WJD

VISIBLE EMISSION OBSERVATION FORM

No. 2-1

COMPANY NAME: Cumberland Paving Co.
STREET ADDRESS:
CITY: Princeton | STATE: NC | ZIP:
PHONE (KEY CONTACT): | SOURCE ID NUMBER:

PROCESS EQUIPMENT: Asphalt Plant | OPERATING MODE:
CONTROL EQUIPMENT: Baghouse | OPERATING MODE:

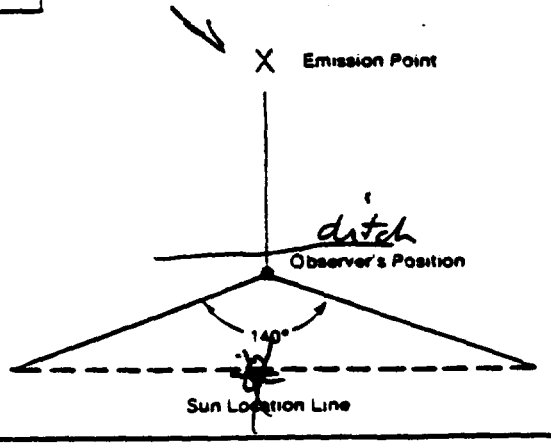
DESCRIBE EMISSION POINT: Rectangle Stack
Baghouse Stack
HEIGHT ABOVE GROUND LEVEL: 20' | HEIGHT RELATIVE TO OBSERVER: Start 17' End
DISTANCE FROM OBSERVER: Start 35' End | DIRECTION FROM OBSERVER: Start NW End

DESCRIBE EMISSIONS: Start 0 End 0
EMISSION COLOR: Start 0 End 0 | IF WATER DROPLET PLUME: Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start Stack Exit End Same

DESCRIBE PLUME BACKGROUND: Start Sky End Sky
BACKGROUND COLOR: Start Blue End Blue | SKY CONDITIONS: Start Clear End Clear
WIND SPEED: Start 0-5mph End 0-5 | WIND DIRECTION: Start W End W
AMBIENT TEMP: Start 88 End 88 | WET BULB TEMP: | RH, percent:

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH — Draw North Arrow



ADDITIONAL INFORMATION:

SEC / MIN	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	stopped 1340
26	0	0	0	0	
27	0	0	0	0	stopped 1430
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	

OBSERVATION DATE: 6/29/87 | START TIME: 1313 | END TIME: 1506

OBSERVER'S NAME (PRINT): Michael Kirkman
OBSERVER'S SIGNATURE: Michael Kirkman | DATE: 6/29/87
ORGANIZATION: Entropy
CERTIFIED BY: Eastern Tech Assoc. | DATE: 5/13/87

CONTINUED ON VEO FORM NUMBER: 2-2

VISIBLE EMISSION OBSERVATION FORM

No. 2-2

COMPANY NAME: Cumberland Paving Co.
STREET ADDRESS:
CITY: Princeton | STATE: NC | ZIP:
PHONE (KEY CONTACT): | SOURCE ID NUMBER:

PROCESS EQUIPMENT: | OPERATING MODE:
CONTROL EQUIPMENT: | OPERATING MODE:

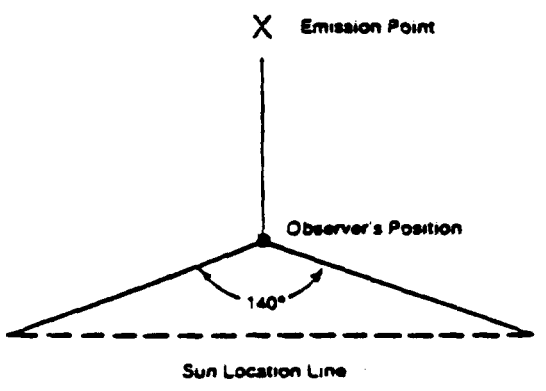
DESCRIBE EMISSION POINT: Stack
HEIGHT ABOVE GROUND LEVEL: | HEIGHT RELATIVE TO OBSERVER: Start End
DISTANCE FROM OBSERVER: Start End | DIRECTION FROM OBSERVER: Start End

DESCRIBE EMISSIONS: Start End
EMISSION COLOR: Start End | IF WATER DROPLET PLUME: Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: End

DESCRIBE PLUME BACKGROUND: Start End
BACKGROUND COLOR: Start End | SKY CONDITIONS: Start End
WIND SPEED: Start End | WIND DIRECTION: Start End
AMBIENT TEMP: Start End | WET BULB TEMP: | RH, percent:

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH — Draw North Arrow



OBSERVATION DATE: 6/29/87 | START TIME: | END TIME:

SEC / MIN	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	stopped HSS
19	0	0	0	0	started HSS
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	

OBSERVER'S NAME (PRINT):
OBSERVER'S SIGNATURE: Mark L Kelsey | DATE: 6/29/87
ORGANIZATION:
CERTIFIED BY: | DATE:

ADDITIONAL INFORMATION:

CONTINUED ON VEO FORM NUMBER: | END

VISIBLE EMISSION OBSERVATION FORM

No. 3-1

COMPANY NAME: Cumberland Paving Co
STREET ADDRESS:
CITY: Princeton | STATE: NC | ZIP:
PHONE (KEY CONTACT): | SOURCE ID NUMBER:

PROCESS EQUIPMENT: Asphalt Plant | OPERATING MODE:
CONTROL EQUIPMENT: Baghouse | OPERATING MODE:

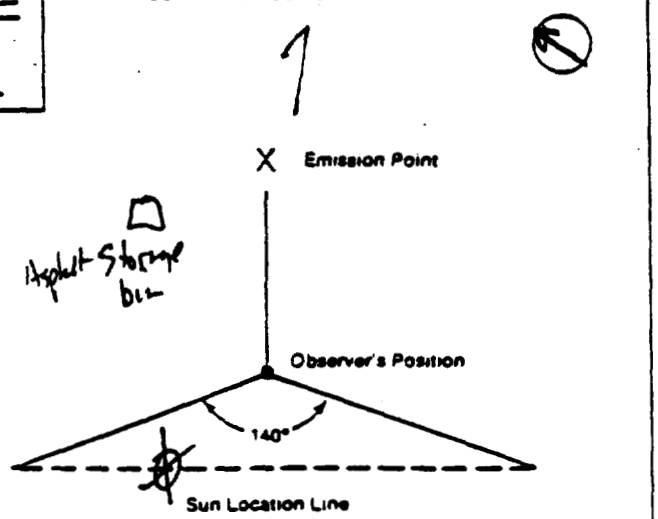
DESCRIBE EMISSION POINT: Rectang. Stack / Baghouse Stack
HEIGHT ABOVE GROUND LEVEL: 20' | HEIGHT RELATIVE TO OBSERVER: Start 20 End 20'
DISTANCE FROM OBSERVER: Start 70' End | DIRECTION FROM OBSERVER: Start SE End SE

DESCRIBE EMISSIONS: Start 0 End 0
EMISSION COLOR: Start 0 End 0 | IF WATER DROPLET PLUME: Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start Stack Exit End Same

DESCRIBE PLUME BACKGROUND: Start Sky End Sky
BACKGROUND COLOR: Start Blue End Blue | SKY CONDITIONS: Start Clear End Partly Cloudy
WIND SPEED: Start 0-5 mph End Same | WIND DIRECTION: Start SW End
AMBIENT TEMP: Start 88 End 87 | WET BULB TEMP: | RH, percent:

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH — Draw North Arrow



OBSERVATION DATE	START TIME	END TIME
6/29/87	1615	1755

SEC / MIN	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
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5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	stopped 1645

OBSERVER'S NAME (PRINT): Michael Kirkman
OBSERVER'S SIGNATURE: Michael Kirkman | DATE: 6/29/87
ORGANIZATION: Entropy
CERTIFIED BY: Eastern Tech Assoc. | DATE: 5/13/87

ADDITIONAL INFORMATION:

CONTINUED ON VEO FORM NUMBER: 3-2

VISIBLE EMISSION OBSERVATION FORM

No. 3-2

COMPANY NAME: Cumberland Paving Co.

STREET ADDRESS:

CITY: Fremont | STATE: NC | ZIP:

PHONE (KEY CONTACT): | SOURCE ID NUMBER:

PROCESS EQUIPMENT: | OPERATING MODE:

CONTROL EQUIPMENT: | OPERATING MODE:

DESCRIBE EMISSION POINT: Baghouse Stack

HEIGHT ABOVE GROUND LEVEL: | HEIGHT RELATIVE TO OBSERVER: Start End

DISTANCE FROM OBSERVER: Start End | DIRECTION FROM OBSERVER: Start End

DESCRIBE EMISSIONS: Start End

EMISSION COLOR: Start End | IF WATER DROPLET PLUME: Attached ☐ Detached ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start End

DESCRIBE PLUME BACKGROUND: Start End

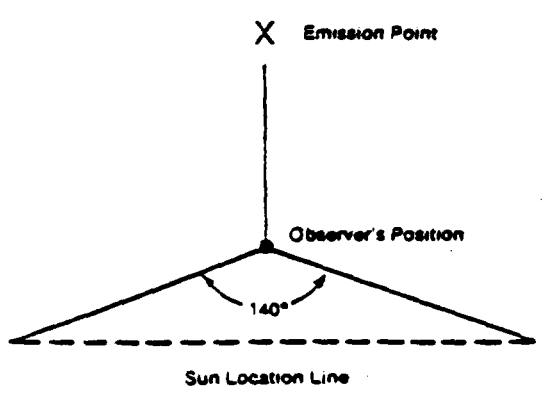
BACKGROUND COLOR: Start End | SKY CONDITIONS: Start End

WIND SPEED: Start End | WIND DIRECTION: Start End

AMBIENT TEMP: Start End | WET BULB TEMP: | RH, percent:

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH — Draw North Arrow



OBSERVATION DATE: 6/29/87 | START TIME: | END TIME:

SEC / MIN	0	15	30	45	COMMENTS
1	0	0	0	0	Start 1725
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	

OBSERVER'S NAME (PRINT): Michael Kirkman

OBSERVER'S SIGNATURE: Michael Kirkman | DATE: 6/29/87

ORGANIZATION: Entropy

CERTIFIED BY: | DATE:

ADDITIONAL INFORMATION:

CONTINUED ON VEO FORM NUMBER: | END

VISIBLE EMISSIONS EVALUATOR

This is to certify that

Michael K. Blatnyan

met the specifications of Federal Reference Method 9 and qualified as a visible emissions evaluator. Maximum deviation on white and black smoke did not exceed 7.5% opacity and no single error exceeding 15% opacity was incurred during the certification test conducted by Eastern Technical Associates of Raleigh, North Carolina. This certificate is valid for six months from date of issue.

Thomas H Rose
President

118134
Certificate Number

Willie S Lee
Vice President

Raleigh
Location

David Savage
Program Manager

May 13, 1981
Date of Issue

APPENDIX C

CALIBRATION DATA

QUALITY ASSURANCE PROCEDURES

General. Each item of field test equipment purchased or constructed by Entropy is assigned a unique, permanent identification number. New items for which calibration is required are calibrated before initial field use. Equipment whose calibration status may change with use or with time is inspected in the field before testing begins, and again upon return from each field use. When an item of equipment is found to be out of calibration, it is adjusted and recalibrated or retired from service. All equipment is periodically recalibrated in full, regardless of the outcome of these regular inspections.

Calibrations are conducted in a manner and at a frequency which meet or exceed U. S. EPA specifications. Entropy follows the calibration procedures outlined in EPA Reference Methods, and those recommended within the Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III (EPA-600/4-77-027b, August, 1977). When the Reference Methods are inapplicable, Entropy uses methods such as those prescribed by the American Society for Testing and Materials (ASTM).

Data obtained during calibrations are recorded on standardized forms, which are checked for completeness and accuracy by the Quality Assurance Manager or the Quality Assurance Director. Data reduction and subsequent calculations are performed using Entropy's in-house computer facilities. Calculations are generally performed at least twice as a check for accuracy. Copies of calibration data are included in the test or project reports.

Inspection and Maintenance. An effective preventive maintenance program is necessary to ensure data quality. Each item of equipment returning from the field is inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated where necessary.

Each item of equipment transported to the field for this test program was inspected again before being packed. Entropy performs these quality assurance activities prior to departure for the job site to detect equipment problems which may originate during periods of storage. This minimizes lost time on site due to equipment failure.

Occasional equipment failure in the field is unavoidable despite the most rigorous inspection and maintenance procedures. For this reason, Entropy routinely transports sufficient backup equipment to the job site to have complete redundancy of all critical sampling train components.

Calibration. Emissions sampling equipment that requires calibration includes the nozzle, pitot tube, pressure gauges, thermometers, flow meters, dry gas meters, and barometers. The following sections elaborate on the calibration procedures followed by Entropy for these items of equipment. Calibration data for the specific items of equipment used for this test program follow the text.

Nozzles. Each probe nozzle is uniquely and permanently identified at the time of purchase, and calibrated before initial field use. The inside diameter of the nozzle is measured to the nearest 0.001 in. using a micrometer. Five measurements are made using different diameters each time. If the difference between the high and the low numbers does not exceed 0.004 inch, the average of the five measurements is used. If the difference exceeds this amount, or when the nozzle becomes nicked, dented, or corroded, the nozzle is reshaped, sharpened, and recalibrated.

Pitot Tubes. All Type S pitot tubes used by Entropy, whether separate or attached to a sampling probe, are constructed in-house or by Nutech Corporation. Each pitot is calibrated when new in accordance with the geometry standards contained in EPA Reference Method 2. A Type S pitot tube, constructed and positioned according to these standards, will have a coefficient of 0.84 $\pm$ 0.02. This coefficient should not change as long as the pitot tube is not damaged.

Each pitot tube is inspected visually before it is transported to the field. If this inspection indicates damage or raises doubt that the pitot remains in accordance with the EPA geometry standards, the pitot tube is not used until it has been refurbished and recalibrated.

Differential Pressure Gauges. Some meter consoles used by Entropy are equipped with 10 in. W.C. inclined-vertical manometers. Fluid manometers

do not require calibration other than leak checks. Manometers are leak-checked in the field prior to each test series, and again upon return from the field.

Most of Entropy's meter consoles are equipped with Magnehelic differential pressure gauges. Each set of gauges is calibrated initially over its full range, 0-10 inches W.C. After each field use, the calibration of the gauge set is checked against an inclined manometer at the average delta p encountered during the test. If the agreement is within $\pm$ 5 percent, the calibration is acceptable.

Thermometers

Impinger Thermometer. On site, prior to the start of testing, the thermometer used to monitor the temperature of the gas leaving the last impinger is compared with a mercury-in-glass thermometer which meets ASTM E-1 specifications. The impinger thermometer is adjusted if necessary until it agrees within 2°F of the reference thermometer. (If the thermometer is not adjustable, it is labeled with a correction factor).

Dry Gas Meter Thermometer. The thermometer used to measure the temperature of the metered gas sample is checked prior to each field trip against an ASTM mercury-in-glass thermometer. The dry gas meter thermometer is acceptable if the values agree with 5.4°F. Thermometers not meeting this requirement are adjusted or labeled with a correction factor.

Flue Gas Temperature Sensor. All thermocouples employed by Entropy for the measurement of flue gas temperatures are calibrated upon receipt. Initial calibrations are performed at three points (ice bath, boiling water, and hot oil). An ASTM mercury-in-glass thermometer is used as a reference. The thermocouple is acceptable if the agreement is within 1.5 percent (absolute) at each of the three calibration points.

On site, prior to the start of testing, the reading from the stack gas thermocouple-potentiometer combination is compared with a mercury-in-glass reference thermometer. If the two agree within 1.5 percent (absolute), the thermocouple and potentiometer are considered to be in proper working order for the test series.

After each field use, the thermocouple-potentiometer system is compared with an ASTM mercury-in-glass reference thermometer at a temperature within 10 percent of the average absolute flue gas temperature. If the absolute temperatures agree within 1.5 percent, the temperature data are considered valid.

Dry Gas Meter and Orifice. The dry gas meter and orifice are calibrated simultaneously. There are two calibration procedures. The full calibration is a complete laboratory procedure used to obtain the calibration factor of the dry gas meter before its first use and periodically thereafter. Full calibrations are performed at three different orifice settings (flow rates). A simpler procedure, the posttest calibration, is designed to check whether the calibration factor has changed. Posttest calibrations are performed after each field test series at an intermediate orifice setting (based on the test data) and at the maximum vacuum reached during the test.

Entropy uses as a transfer standard a dry gas meter that is calibrated annually against a spirometer. During the annual calibration, triplicate calibration runs are performed at seven flow rates ranging from 0.25 to 1.40 cfm.

Dry Gas Meter. Each metering system receives a full calibration at the time of purchase, and a posttest calibration after each field use. If the calibration factor, Y, deviates by less than five percent from the initial value, the test data are acceptable. If Y deviates by more than five percent, the meter is recalibrated and the meter coefficient (initial or recalibrated) that yields the lowest sample volume for the test runs is used.

EPA Reference Method 5 calls for another full calibration anytime the posttest calibration check indicates that Y has changed by more than five percent. Standard practice at Entropy is to recalibrate the dry gas meter anytime Y is found to be outside the range $0.98 \leq Y \leq 1.02$.

Orifice. An orifice calibration factor is calculated for each flow setting during a full calibration. If the range of values does not vary by more than 0.15 in. H_2O over the range of 0.4 to 4.0 in. H_2O, the arithmetic average of the values obtained during the calibration is used.

Barometer. Each field barometer is adjusted before each test series to agree within ± 0.1 inches of a reference aneroid barometer. The reference barometer is checked weekly against the station pressure value (corrected for elevation difference) reported by the National Weather Service station at the Raleigh-Durham airport, approximately 2.5 miles from Entropy's location.

SAMPLING EQUIPMENT CALIBRATION CHECKLIST

JOB NAME/NUMBER Cumberland Paving Co. 5356 TEAM LEADER JMS

SAMPLING LOCATION Baghouse Stack

BAROMETER CHECK

DATE	ENTROPY IN-HOUSE REFERENCE BAROMETER	FIELD BAROMETER
6-29-87	29.9	29.9

THERMOMETERS AND THERMOCOUPLE CHECK

DATE ~~6-29-87~~ 6-29-87 REFERENCE THERMOMETER AMBIENT TEMPERATURE 69 °F

	AMBIENT TEMPERATURE °F	MUST BE WITHIN ACCEPTANCE RANGE °F
THERMOMETERS		
Impinger Exit	70	±2°F
Filter Compartment	67	±5.4°F
Dry Gas Meter	69	±5.4°F
Other		
THERMOCOUPLE	69	±8°F

NOTE: Adjust thermometer until acceptable. If thermometer can't be adjusted, use a backup. If no back up, then record the ambient temperature indicated by the unadjusted thermometer.

PITOT AND NOZZLE CHECK

	I.D. #	VISUAL INSPECTION CHECK
PITOTS	4-3	✓
NOZZLES	501	✓

ENTROPY

Dry Gas Meter Identification: 1017057 Calibration by: N. Hawkins

Date: 4-1-96 Barometric Pressure (P_b): 27.96 In. Hg

ENTROPY ENVIRONMENTAL LTD, INC. PAGE 1 of 2

*Date: _____ *Barometric Pressure (P_b): _____ In. Hg

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft³	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft³	Dry Gas Meter Temp. (t_{ds}) °F	Pressure (Δp) in. H_2O	Time (θ) min.	Flow Rate (Q) cfm	Meter Meter Coeff. (Y_{ds})	Avg. Meter Coeff. ($\bar{Y}_{ds}$)
0.40	4.062	78.8	4.062	80	0.85	10.0	0.3971	1.0001	
	4.117	79.3	4.061	80	0.85	10.0	0.4021	1.0130	
	4.154	79.7	4.065	80	0.85	10.0	0.4088	1.0289	
0.60	6.084	79.7	6.035	80	1.3	10.0	0.5938	1.0055	
	6.166	79.7	6.016	80	1.275	10.0	0.6018	1.0223	
	6.102	79.7	6.015	80	1.25	10.0	0.5955	1.0119	
0.80	8.057	79.7	7.956	80	2.35	10.0	0.7902	1.0074	
	8.132	79.7	8.003	80	2.40	10.0	0.7937	1.0107	
	8.114	79.3	7.976	80	2.45	10.0	0.7925	1.0100	
1.0	10.129	78.8	10.141	80	3.875	10.0	0.9901	0.9936	
	10.164	78.8	10.081	80	3.80	10.0	0.9936	1.0011	
	10.173	78.8	10.092	80	3.80	10.0	0.9945	1.0009	
1.2	12.359	78.8	12.305	80	5.5	10.0	1.2012	0.9932	
	12.368	78.8	12.316	80	5.3	10.0	1.2051	0.9935	
	12.313	78.8	12.274	80	5.3	10.0	1.2031	0.9925	

$$Y_{ds} = \frac{(V_s)\,(t_{ds} + 460)\,(P_b)}{(V_{ds})\,(t_s + 460)\,(P_b + (\Delta p / 13.6))}$$

$$Q = (17.64)\,\frac{(P_b)\,(V_s)}{(\quad)\,(\quad)\,(\quad)}$$

Dry Gas Meter Identification: 1017057 Calibration by: _____

Date: 4-1-86 Barometric Pressure (P_b): 25.86 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

*Date: _____ *Barometric Pressure (P_b): _____ in. Hg

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft³	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft³	Dry Gas Meter Temp. (t_{ds}) °F	Pressure (Δp) in. H_2O	Time (θ) min.	Flow Rate (Q) cfm	Meter Meter Coeff. (Y_{ds})	Avg. Meter Coeff. ($\bar{Y}_{ds}$)
1.4	14.454	77.7	14.462	81	7.625	10.0	1.4107	0.9834	
	14.444	78.8	14.446	80.5	7.55	10.0	1.4120	0.9847	
	14.391	78.8	14.406	80	7.575	10.0	1.4076	0.9834	

$\bar{Y}_{ds} = 1.002$

$$Y_{ds} = \frac{(V_s)\,(t_{ds} + 460)\,(P_b)}{(V_{ds})\,(t_s + 460)\,(P_b + (p / 13.6))}$$

$$Q = (17.64)\,\frac{(P_b)\,(V_s)}{(t_s + 460)\,(\theta)}$$

Meter Box Number: N4

Calibration by: T. McDonald

Standard Meter Number: 1017057 Standard Meter Gamma: 1.002

Date: 3/27/87 Barometric Pressure (P_b): 29.42 in. Hg

*Date: _____ *Barometric Pressure (P_b): _____ in. Hg

PRETEST CALIBRATION

Standard Meter			Meter Box Metering System				
Gas Volume (V_{ds}) ft^3	Temp. (t_{ds}) °F	Time (θ) min.	Orifice Setting (ΔH) in. H_2O	Gas Volume (V_d) ft^3	Temp. (t_d) °F	Coeff. (Y_d)	$\Delta H_@$ in. H_2O
4.002	69	10.0	0.50	4.082	73	0.9886	1.759
4.114	69	10.0	0.50	4.211	75	0.9881	1.661
8.182	69	10.0	2.1	8.323	79	0.9984	1.748
8.177	69	10.0	2.1	8.350	~~8~~ 82	1.0001	1.74
12.168	69	10.0	4.8	12.355	84	1.0028	1.79
12.127	69	10.0	4.8	12.341	87	1.0061	1.79
					Average	0.9974	1.75

≈ .997

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

Meter Box Number: N4

Calibration by: T. McDonald

Meter Box Vacuum: 6 in. Hg

Standard Meter Number: 1017057 Standard Meter Gamma: 1.002

Date: 7/1/87 Barometric Pressure (P_b): 29.57 in. Hg

POSTTEST CALIBRATION

Standard Meter			Meter Box Metering System				
Gas Volume (V_{ds}) ft^3	Temp. (t_{ds}) °F	Time (θ) min.	Orifice Setting (ΔH) in. H_2O	Gas Volume (V_d) ft^3	Temp. (t_d) °F	Coeff. (Y_d)	$\Delta H_@$ in. H_2O
6.468	74	10.0	1.25	6.509	78	1.000	1.69
6.432	74	10.0	1.25	6.499	81	1.0016	1.70
6.392	74	10.0	1.25	6.503	84	1.0002	1.71
					Average	1.0006	1.70

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + \Delta H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

ENTROPY

NOZZLE NUMBER: 501

Date	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average
12-2-82	ST	.175	.172	.176	.175	.172	0.174
4-14-83	JJM	.174	.175	.176	.175	.175	0.175
6-7-83	NML	.180	.180	.177	.177	.178	0.178
11-14-83	DLO	.186	.186	.185	.186	.187	0.186
3-12-84	MAH	.186	.188	.186	.185	.185	0186
3-25-85	JDE	.181	.180	.178	.180	.182	0.180"
6-13-85	NMH	.176	.179	.179	.176	.179	0.179
2-19-86	JE	.185	.186	.182	.184	.183	0.184
9-11-86	BTB	.192	.192	.190	.191	.193	.192
10-13-86	NH.	.193	.190	.189	.191	.190	.191
1/13/87	JE	.189	.192	.193	.191	.190	.191
3/11/87	ST	.188	.189	.187	.185	.188	0.187
3/20/87	SLH	.188	.187	.186	.184	.187	0.186
4/21/87	JE	.189	.190	.187	.188	.187	0.188

NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC.

APPENDIX D

SAMPLING AND ANALYTICAL PROCEDURES