Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

1989

ENTROPY
ENVIRONMENTALISTS INC.

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

STATIONARY SOURCE SAMPLING REPORT

REFERENCE NO. 6476

S. T. WOOTEN COMPANY

DRUGSTORE, NORTH CAROLINA

PARTICULATE EMISSIONS AND PLUME OPACITY TESTING

ROTARY DRYER STACK

OCTOBER 12, 1989

REPORT CERTIFICATION

DATE October 31, 1989

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

Signature _____

Leslie C. Murray

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

Signature _____

Bruce G. Hawks

The preparation of this report was carried out under my direction and supervision.

Signature _____

John T. Nash

I have reviewed the contents of this report and hereby certify that it is authentic and accurate.

Signature _____

D. James Grove, P.E.

ENTROPY

TABLE OF CONTENTS

		PAGE
INTRODUCTION		
1.1	Outline of Test Program	1-1
1.2	Test Participants	1-1
SUMMARY OF RESULTS		2-1
PROCESS DESCRIPTION AND OPERATION		
3.1	General	3-1
3.2	Source Air Flow	3-1
3.3	Operation During Testing	3-1
SAMPLING AND ANALYTICAL PROCEDURES		
4.1	General	4-1
4.2	Sampling Points	4-1
4.3	Volumetric Air Flow Rates	4-1
4.3.1	Flue Gas Velocity	4-1
4.3.2	Flue Gas Composition	4-1
4.3.3	Flue Gas Moisture Content	4-1
4.4	Particulate Emissions	4-1
4.5	Plume Opacity	4-3
4.6	Equipment Calibration	4-3
APPENDICES		
A.	Test Results	
	1. Particulate	1
	2. Plume Opacity	4
	3. Example Calculations	8
B.	Field and Analytical Data	
	1. Particulate	11
	2. Plume Opacity	24
C.	Calibration Data	29
D.	Sampling and Analytical Procedures	44

INTRODUCTION

1.1 Outline of Test Program. Stationary source sampling was performed for S. T. Wooten Company in Drugstore, North Carolina, on October 12, 1989. Three test sets were conducted at the rotary dryer stack with each test set consisting of EPA Method 5 testing for filterable and condensable particulate emissions, and EPA Method 9 testing for plume opacity.

1.2 Test Participants. Table 1-1 lists the personnel involved in the test program.

TABLE 1-1

TEST PARTICIPANTS

S. T. Wooten Company	Tim Mooney Test Coordinator
	Greg Martin Plant Manager
North Carolina Department of Environment, Health, and Natural Resources	Mark Feltner Test Observer
Entropy Environmentalists Inc.	Barry F. Rudd Project Manager
	Leslie C. Murray Sampling Team Leader
	Patrick F. Daley Engineering Technician
	James B. Winegar Visible Emissions Observer

SUMMARY OF RESULTS

Table 2-1 presents the run-by-run particulate tests summary. Due to the absence of a visible plume during runs M9-2 and M9-3, only the plume opacity observations for run M9-1 are summarized in this section; refer to Table 2-2.

Detailed results of all the testing can be found in Appendix A; field and analytical data are provided in Appendix B.

TABLE 2-1

PARTICULATE TESTS SUMMARY

Rotary Dryer Stack

	M5-1	M5-2	M5-3	Average
Run Date	10/12/89	10/12/89	10/12/89	
Run Start Time	847	1010	1259	
Run Finish Time	956	1118	1406	
Test Train Parameters:				
Volume Of Dry Gas Sample, SCF *	46.804	43.156	46.107	
Percent Isokinetic	108.9	108.1	110.2	
Flue Gas Parameters:				
Temperature, °F	275	273	279	276
Air Flow Rate, Dry SCFM *	25,784	23,941	25,099	24,941
Air Flow Rate, Wet ACFM	48,179	47,454	50,478	48,704
Filterable Particulate:				
Concentration, grains/DSCF *	0.00963	0.00558	0.00288	0.00603
Emission Rate, lb/hr	2.13	1.14	0.619	1.30
Filterable & Condensable Particulate:				
Concentration, grains/DSCF *	0.0337	0.0275	0.0254	0.0289
Emission Rate, lb/hr	7.44	5.64	5.47	6.18

* 68° F -- 29.92 Inches of Mercury (Hg).

TABLE 2-2

SIX-MINUTE AVERAGE PLUME OPACITY OBSERVATIONS SUMMARY

Rotary Dryer Stack

Run Number	M9-1
Highest 6-minute Average Opacity, %	5
Highest Single Opacity Reading, %	20

Run M9-1			
Set	Time		Avg. %
No.	Start	End	Opacity
1	850	856	2
2	856	902	5
3	902	908	3
4	908	914	3
5	914	920	3
6	920	926	1
7	926	932	2
8	932	938	3
9	938	944	5
10	944	950	1

PROCESS DESCRIPTION AND OPERATION

3.1 General. The S. T. Wooten Company operates an Aztec double drum asphalt plant in Drugstore, North Carolina. The facility consists of a mixing chamber and rotary dryer, baghouse, ID fan, and stack. The testing covered in this report was performed at the rotary dryer stack.

3.2 Source Air Flow. Figure 3-1 is an air flow schematic which shows the passage of flue gases exhausted from the rotary dryer.

3.3 Operation During Testing. The facility was producing 300 to 310 tons per hour asphalt during the testing.

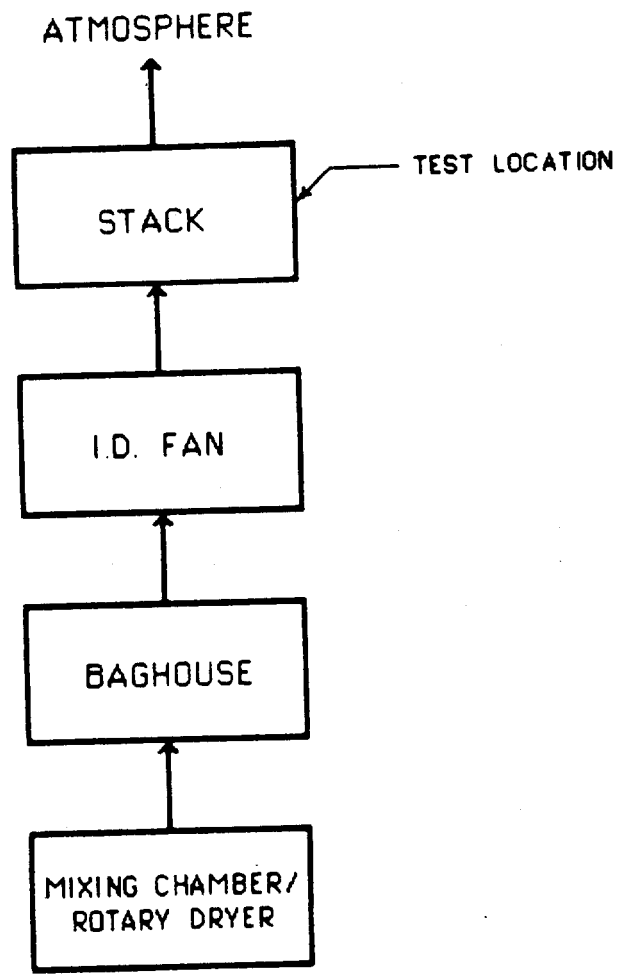


FIGURE 3-1. ROTARY DRYER AIR FLOW SCHEMATIC.

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 Environment, Health, and Natural Resources. This section provides brief descriptions of the sampling and analytical procedures. Detailed descriptions of the procedures 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 30 equal areas with five sampling points on each of six traverse axes, 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 M5-3, a multipoint, integrated flue gas sample was collected and analyzed according to the procedures outlined in 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 Content. Moisture content was determined by analyzing the sampling train impinger reagents according to the procedures outlined in EPA Method 5.

4.4 Particulate Emissions. Sampling was conducted using an EPA Method 5 sampling train. Each of the 30 points was sampled for two minutes, resulting in net run times of 60 minutes.

EPA Method 5 analytical procedures were used to determine the filterable particulate emissions. The sampling train distilled water reagent and acetone rinses were analyzed to determine the condensable particulate emissions. For each run, the impingers' water was extracted three times with chloroform and then extracted three times with ether. The acetone rinses and the pooled chloroform and ether phases were evaporated to dryness at room temperature and desiccated.

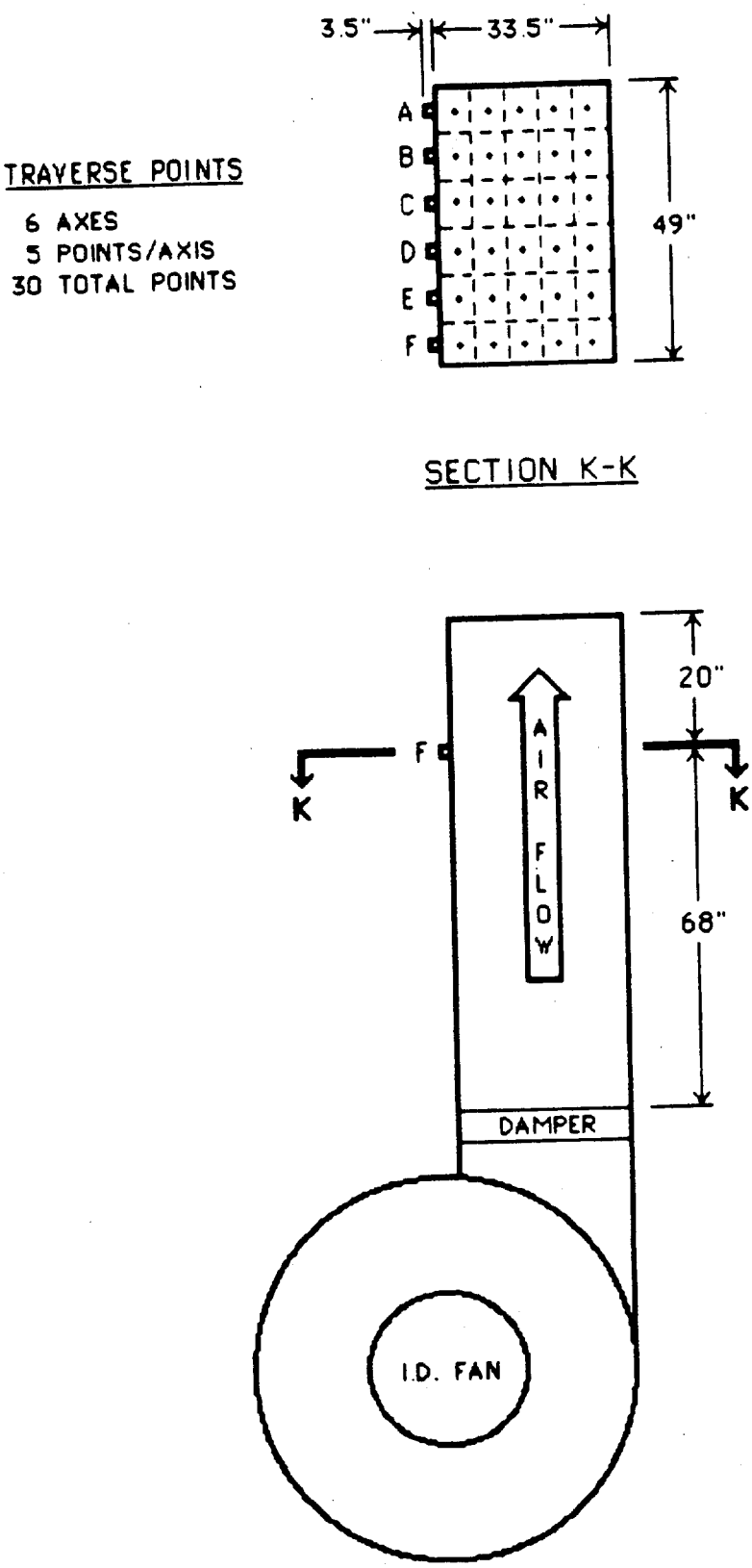


FIGURE 4-1. ROTARY DRYER STACK TEST LOCATION.

After extraction, the water phase was evaporated to dryness on a steam bath and desiccated. Following desiccation, a gravimetric analysis was performed on each phase to determine the weight of the residue.

4.5 Plume Opacity. EPA Method 9 procedures were used to determine the plume opacity.

4.6 Equipment Calibration. Pertinent calibration data are provided in Appendix C.

A. TEST RESULTS

1. Particulate

FIELD DATA AND RESULTS TABULATION

PLANT: S. T. Wooten Company, Drugstore, North Carolina

RUN #	DATE	SAMPLING LOCATION	OPERATOR
M5-1	10/12/89	Rotary Dryer Stack	Leslie C. Murray
M5-2	10/12/89	Rotary Dryer Stack	Leslie C. Murray
M5-3	10/12/89	Rotary Dryer Stack	Leslie C. Murray

		M5-1	M5-2	M5-3
	Run Start Time	847	1010	1259
	Run Finish Time	956	1118	1406
	Net Traversing Points	30	30	30
Theta	Net Run Time, Minutes	60.00	60.00	60.00
Dia	Nozzle Diameter, Inches	0.241	0.241	0.241
Cp	Pitot Tube Coefficient	0.840	0.840	0.840
Y	Dry Gas Meter Calibration Factor	1.0202	1.0202	1.0202
Pbar	Barometric Pressure, Inches Hg	30.00	30.00	30.00
Delta-H	Avg. Pressure Differential of Orifice Meter, Inches H_2O	2.00	1.84	2.14
Vm	Volume Of Metered Gas Sample, Dry ACF	48.397	44.801	48.679
tm	Dry Gas Meter Temperature, Degrees F	101	103	113
Vmstd	Volume Of Metered Gas Sample, Dry SCF*	46.804	43.156	46.107
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, ml	341.5	395.0	430.0
Vwstd	Volume of Water Vapor, SCF*	16.074	18.593	20.240
$\%H_2O$	Moisture Content, Percent by Volume	25.6	30.1	30.5
Mfd	Dry Mole Fraction	0.744	0.699	0.695
$\%CO_2$	Carbon Dioxide, Percent By Volume, Dry	6.1	6.1	6.1
$\%O_2$	Oxygen, Percent By Volume, Dry	12.0	12.0	12.0
Md	Gas Molecular Weight, lb/lb-Mole, Dry	29.46	29.46	29.46
Ms	Gas Molecular Weight, lb/lb-Mole, Wet	26.53	26.01	25.96
Pg	Flue Gas Static Pressure, Inches H_2O	-0.51	-0.29	-0.48
Ps	Absolute Flue Gas Pressure, Inches Hg	29.96	29.98	29.96
ts	Flue Gas Temperature, Degrees F	275	273	279
Delta-p	Average Velocity Head, Inches H_2O	1.0400	0.9925	1.1110
vs	Flue Gas Velocity, Feet/Second	70.42	69.36	73.78
A	Stack/Duct Area, Square Inches	1,642	1,642	1,642
Qsd	Volumetric Air Flow Rate, Dry SCFM*	25,784	23,941	25,099
Qaw	Volumetric Air Flow Rate, Wet ACFM	48,179	47,454	50,478
%I	Isokinetic Sampling Rate, Percent	108.9	108.1	110.2

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

(Continued next page)

FIELD DATA AND RESULTS TABULATION

(Continued)

PLANT: S. T. Wooten Company, Drugstore, North Carolina

		M5-1	M5-2	M5-3
		---	---	---
	Filterable Particulate			
mg	Catch Weight, Milligrams	29.2	15.6	8.6
gr/DSCF	Concentration, grains/DSCF *	0.00963	0.00558	0.00288
lb/hr	Emission Rate, lb/hr	2.13	1.14	0.619
	Filterable & Condensable Particulate			
mg	Catch Weight, Milligrams	102.1	76.9	75.9
gr/DSCF	Concentration, grains/DSCF *	0.0337	0.0275	0.0254
lb/hr	Emission Rate, lb/hr	7.44	5.64	5.47

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

APPENDIX A.2

A. TEST RESULTS

2. Plume Opacity

Name of Source: S. T. WOOTEN - CLAYTON

Observer: JAMES B. WINEGAR

File Name: STW-1 Slant Angle: 22.0

Start Time: 0850 Stop Time: 0950 Date of Test: 10-12-1989

- O R I G I N A L D A T A -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	0	0	0	5	31	0	0	0	0
2	0	5	0	0	32	0	0	0	0
3	0	0	5	0	33	0	5	0	0
4	5	0	0	0	34	0	0	0	0
5	5	5	5	5	35	0	0	0	0
6	0	0	0	0	36	5	5	0	0
7	5	5	5	0	37	5	0	0	0
8	5	5	0	5	38	0	0	0	0
9	5	5	0	0	39	0	0	0	0
10	10	0	5	10	40	0	0	5	0
11	10	10	0	0	41	0	5	0	5
12	5	0	10	15	42	10	5	10	0
13	5	0	0	5	43	5	5	0	0
14	10	5	20	0	44	0	0	5	5
15	0	0	10	0	45	5	5	10	0
16	0	5	0	0	46	5	5	5	0
17	0	0	0	5	47	0	0	0	5
18	5	0	0	10	48	5	0	0	0
19	0	10	0	5	49	5	0	10	5
20	5	0	0	0	50	5	5	0	0
21	0	5	5	0	51	0	5	10	10
22	0	5	10	0	52	15	10	0	0
23	0	0	0	0	53	0	0	15	15
24	0	10	0	5	54	15	0	0	5
25	10	5	5	5	55	10	0	0	0
26	0	0	15	5	56	0	0	0	0
27	15	0	0	0	57	0	0	0	5
28	5	5	10	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	5
30	0	0	0	0	60	5	0	0	5

NOTE: _____

DATE PRINT: 10-19-1989 TIME PRINT: 14:49:13

Name of Source: S. T. WOOTEN - CLAYTON

Observer: JAMES B. WINEGAR

File Name: STW-1 Slant Angle: 22.0

Start Time: 0850 Stop Time: 0950 Date of Test: 10-12-1989

- R O L L I N G A V E R A G E S -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	-	-	-	-	31	3	3	2	2
2	-	-	-	-	32	2	2	2	1
3	-	-	-	-	33	1	1	1	1
4	-	-	-	-	34	1	1	0	0
5	-	-	-	-	35	0	0	0	0
6	-	-	-	2	36	0	1	1	1
7	2	2	2	2	37	1	1	1	1
8	2	2	2	3	38	1	1	1	1
9	3	3	3	3	39	1	1	1	1
10	3	3	3	4	40	1	1	1	1
11	4	4	4	4	41	1	1	1	1
12	4	4	4	5	42	1	1	2	2
13	5	5	4	5	43	2	2	2	2
14	5	5	6	5	44	2	2	2	2
15	5	5	5	5	45	3	3	3	3
16	5	5	5	5	46	4	4	4	4
17	4	4	4	4	47	4	4	4	4
18	4	4	4	3	48	3	3	3	3
19	3	4	4	4	49	3	2	3	3
20	3	3	2	2	50	3	4	3	3
21	2	2	2	2	51	3	3	3	3
22	2	2	3	3	52	4	4	4	4
23	3	3	3	2	53	4	4	4	5
24	2	3	3	2	54	5	5	5	5
25	3	3	3	3	55	6	6	5	5
26	3	3	3	4	56	5	5	5	5
27	4	4	4	4	57	5	4	4	4
28	4	4	4	4	58	3	3	3	3
29	4	4	4	4	59	3	3	2	2
30	4	4	4	3	60	1	1	1	1

BLOCK SIZE (for Rolling Averages) = 24 READINGS

*The highest BLOCK in this ROLLING AVERAGE is at 14 Min and 30 Sec

>> OPERATION WAS PERFORMED ON THE: original DATA. <<

NOTE: _____

DATE PRINT: 10-19-1989 TIME PRINT: 14:49:34

Name of Source: S. T. WOOTEN - CLAYTON

Observer: JAMES B. WINEGAR

File Name: STW-1 Slant Angle: 22.0

Start Time: 0850 Stop Time: 0950 Date of Test: 10-12-1989

- B L O C K A V E R A G E S -

Sec>> Min	00	15	30	45	Sec>> Min	00	15	30	45
1	-	-	-	-	31	-	-	-	-
2	-	-	-	-	32	-	-	-	-
3	-	-	-	-	33	-	-	-	-
4	-	-	-	-	34	-	-	-	-
5	-	-	-	-	35	-	-	-	-
6	-	-	-	2	36	-	-	-	1
7	-	-	-	-	37	-	-	-	-
8	-	-	-	-	38	-	-	-	-
9	-	-	-	-	39	-	-	-	-
10	-	-	-	-	40	-	-	-	-
11	-	-	-	-	41	-	-	-	-
12	-	-	-	5	42	-	-	-	2
13	-	-	-	-	43	-	-	-	-
14	-	-	-	-	44	-	-	-	-
15	-	-	-	-	45	-	-	-	-
16	-	-	-	-	46	-	-	-	-
17	-	-	-	-	47	-	-	-	-
18	-	-	-	3	48	-	-	-	3
19	-	-	-	-	49	-	-	-	-
20	-	-	-	-	50	-	-	-	-
21	-	-	-	-	51	-	-	-	-
22	-	-	-	-	52	-	-	-	-
23	-	-	-	-	53	-	-	-	-
24	-	-	-	3	54	-	-	-	5
25	-	-	-	-	55	-	-	-	-
26	-	-	-	-	56	-	-	-	-
27	-	-	-	-	57	-	-	-	-
28	-	-	-	-	58	-	-	-	-
29	-	-	-	-	59	-	-	-	-
30	-	-	-	3	60	-	-	-	1

BLOCK SIZE = 24 READINGS

>> OPERATION WAS PERFORMED ON THE: original DATA. <<

NOTE: _____

DATE PRINT: 10-19-1989 TIME PRINT: 14:49:48

APPENDIX A.3

A. TEST RESULTS

3. Example Calculations

EXAMPLE TEST CALCULATIONS RUN M5-1

Rotary Dryer Stack

VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS

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

$$Vmstd = 17.64 * 1.0202 * 48.397 * \frac{30.00 + (2.000/13.6)}{(460 + 101)} = 46.804\ DSCF$$

VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

$$Vwstd = 0.04707 * Vlc$$

$$Vwstd = 0.04707 * 341.5 = 16.074\ SCF$$

PERCENT MOISTURE, BY VOLUME, AS MEASURED IN FLUE GAS

$$\%H_2O = 100 * Vwstd / (Vwstd + Vmstd)$$

$$\%H_2O = \frac{16.074}{16.074 + 46.804} * 100 = 25.6\ \%$$

ABSOLUTE FLUE GAS PRESSURE

$$Ps = Pbar + (Pg / 13.6)$$

$$Ps = 30.00 + (-0.51/13.6) = 29.96\ \text{inches Hg}$$

DRY MOLE FRACTION OF FLUE GAS

$$Mfd = 1 - \%H_2O / 100$$

$$Mfd = 1 - 25.6/100 = 0.744$$

DRY MOLECULAR WEIGHT OF FLUE GAS

$$Md = (\%CO_2/100 * 44) + (\%O_2/100 * 32) + ((100 - \%CO_2 - \%O_2)/100 * 28)$$

$$Md = (6.1/100 * 44) + (12.0/100 * 32) + ((100 - 6.1 - 12.0)/100 * 28)$$

$$Md = 29.46\ \text{lb/lb-Mole}$$

WET MOLECULAR WEIGHT OF FLUE GAS

$$Ms = (Md * Mfd) + (0.18 * \%H_2O)$$

$$Ms = (29.46 * 0.744) + (0.18 * 25.6) = 26.53\ \text{lb/lb-Mole}$$

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

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

$$vs = 85.49 * 0.840 * \text{SQUARE ROOT}\left[\frac{1.0400 * (460 + 275)}{29.96 * 26.53}\right] = 70.42 \text{ ft/sec}$$

DRY VOLUMETRIC FLUE GAS FLOW RATE AT STANDARD CONDITIONS

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

$$Qsd = \frac{60}{144} * 0.744 * 70.42 * 1,642.0 * \frac{528}{460 + 275} * \frac{29.96}{29.92}$$

Qsd = 25,784 SCFM

WET VOLUMETRIC FLUE GAS FLOW RATE AT STANDARD CONDITIONS

Qaw = 60 / 144 * vs * A

Qaw = 60 / 144 * 70.42 * 1,642.0 = 48,179 ACFM

PERCENT ISOKINETIC OF SAMPLING RATE

$$\%I = \frac{Pstd}{Tstd} * \frac{100}{60} * \frac{(ts + 460) * Vmstd}{Ps * vs * Mfd * Theta * (\pi * (NozzleDia/2)^2/144)}$$

$$\%I = \frac{29.92}{528} * \frac{100}{60} * \frac{(275 + 460) * 46.804}{29.96 * 70.42 * 0.744 * 60.00 * (\pi * (0.241/2)^2/144)}$$

%I = 108.9 %

CONCENTRATION, GRAINS PER DRY STANDARD CUBIC FOOT, FILTERABLE PARTICULATE

$$gr/DSCF = \frac{7,000}{453.592} * \frac{(mg / 10^3)}{Vmstd}$$

$$gr/DSCF = \frac{7,000}{453.592} * \frac{(29.2/10^3)}{46.804} = 0.00963 \text{ gr/DSCF}$$

EMISSION RATE, POUNDS PER HOUR, FILTERABLE PARTICULATE

$$lb/hr = \frac{60}{453.592} * \frac{(mg / 10^3)}{Vmstd} * Qsd$$

$$lb/hr = \frac{60}{453.592} * \frac{(29.2/10^3)}{46.804} * 25,784 = 2.13 \text{ lb/hr}$$

APPENDIX B.1

B. FIELD AND ANALYTICAL DATA

1. Particulate

Preliminary Field Data

PLANT NAME S.T. Wooten

LOCATION Drugstore, NC

SAMPLING LOCATION Rotary Dryer Stack

NO. OF PORTS 6

PORT INSIDE DIAMETER 3"

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 37"

NIPPLE LENGTH 3 1/2"

DEPTH OF DUCT 33 1/2"

WIDTH (RECTANGULAR DUCT) 49"

EQUIVALENT DIAMETER:

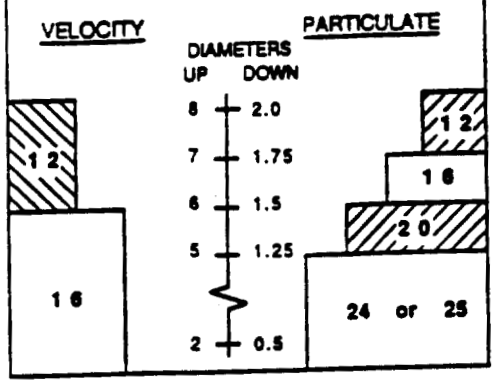
$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(33.5)(49)}{(33.5 + 49)} = 39.79$

DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE	UPSTREAM	DOWNSTREAM
	68"	20"
DIAMETERS	1.7	.50

STACK AREA = 33 1/2 * 49 = 1641.5 IN²

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.



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

POINT	% OF DUCT DEPTH	DISTANCE FROM INSIDE WALL	DISTANCE FROM OUTSIDE OF PORT
1	10	3 3/8	7 1/2
2	30	10	13 1/2
3	50	16 3/4	20 1/4
4	70	23 1/2	27
5	90	30 1/8	33 5/8
6			
7			
8			
9			
10			
11			
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19			
20			
21			
22			
23			
24			

ORSAT FIELD DATA

Plant Name S T Wooten Co.

Sampling Location Rotary Dryer Stack Fuel Type

Run and/or Sample No. M3-3 Leak Test? Date 10-12-89 Operator LCM

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
1259	1645	6.1	18.1	—	12.0	—	
1406	1655	6.1	18.1		12.0		
	1705	6.1	18.1		12.0		
	Avg.	6.1		Avg.	12.0	—	81.9

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.			

ISOKINETIC TYPE FIELD DATA SHEET

14

COMPANY NAME S.T. Wooten Co
ADDRESS Drugstore NC
SAMPLING LOCATION ~~Asphalt plant~~ E.D. Fan IN CA Stack
DATE 10-12-89 TEAM LEADER LCM
BAROMETRIC PRESSURE. IN. HG 30.0
TRAIN LEAK CHECK VACUUM IN. HG 15.0 04
TRAIN LEAK RATE, CU.FT/MIN .0010 0.005

RUN NUMBER MS-1
TIME START 0847
TIME FINISH 0956
TECHNICIANS PFD
STATIC PRESSURE IN. H_2O -.51

EQUIPMENT CHECKS

- ✓ PITOTS, PRETEST
- ✓ PITOTS, POSTTEST
- NA M3 SAMPLING SYS/TED BAG
- ✓ THERMOCOUPLE @ 350 PRE
- ✓ THERMOCOUPLE @ 280 POST

IDENTIFICATION NUMBERS

REAGENT BOX ~~N~~ 0565 NOZZLE 506 DIAMETER .241
METER BOX N-4 T/C READOUT F-5
UMBILICAL U-9 T/C PROBE 5-10
SAMPLE BOX 33 ORSAT PUMP NA
PROBE 4-1 PITOT 4-1 TEDLAR BAG NA

LEAK CHECK READINGS

BEFORE 1 / AFTER 1 / BEFORE 2 / AFTER 2 / BEFORE 3 / AFTER 3 / BEFORE 4 / AFTER 4 / BEFORE 5 / AFTER 5 / BEFORE 6 / AFTER 6

FILTER #	TARE
E9260	.5061

DELTA H@	1.655	
METER TEMP	100	
EST. %H_2O	20	29
C FACTOR	.73	.70
STACK TEMP	280	280
REF DELTA P	.95	1.00
K-FACTOR	~~1.9368~~ K1	1.84 K2

FYRITE

C_p

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
1	A1	0	999.641	2.17	4.20	4.20	92	2	255	60	270	K-
2	2	2	1001.54	1.45	2.80	2.80	98	2	257	64	280	
3	3	4	003.87	1.51	2.92	2.92	99	2	257	64	280	
4	4	6	005.84	1.60	3.09	3.09	99	2	257	64	276	
5	5	8	007.82	1.08	1.99	1.99	101	2	250	63	277	K-
6	B1	10/0	009.648	.99	1.82	1.82	100	2	250	63	275	
7	2	2	011.41	1.45	2.67	2.67	101	2	250	62	272	
8	3	4	013.24	1.92	3.53	3.53	102	2	250	62	272	
9	4	6	015.33	1.25	2.30	2.30	103	2	253	62	273	
10	5	8	017.09	.56	1.03	1.03	103	2	253	61	273	
11	C1	10/0	018.310	1.27	2.34	2.34	103	2	255	64	265	
12	2	2	020.05	1.23	2.26	2.26	103	2	260	65	272	
13	3	4	021.55	1.22	2.24	2.24	103	2	261	65	274	
14	4	6	023.54	1.12	2.06	2.06	103	2	264	63	277	
15	5	8	025.23	.56	1.03	1.03	103	2	264	60	275	
16	D1	10/0	1026.447	1.17	2.15	2.15	101	2	265	60	269	
17	2	2	028.16	1.03	1.90	1.90	102	2	265	60	275	
18	3	4	029.76	1.05	1.93	1.93	102	2	264	59	276	
19	4	6	031.32	.90	1.66	1.66	102	2	260	59	277	
20	5	8	032.80	.69	1.27	1.27	102	2	260	59	278	
21	E1	10/0	034.133	1.27	2.34	2.34	101	2	260	62	273	
22	2	2	035.85	.81	1.49	1.49	102	2	260	60	276	
23	3	4	037.29	.80	1.47	1.47	102	2	261	59	277	
24	4	6	638.70	.75	1.38	1.38	102	2	259	59	277	
25	5	8	040.05	.84	1.55	1.55	102	2	259	59	277	

F1010
9/89
p1

minutes Vm $(\sqrt{\Delta p})^2$ ΔH tm ts

ENTROPY

PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME S.T. Wooten Co RUN # MS-1

SAMPLING LOCATION ~~Asphalt plant I.D. Fan~~ Dryer Stack DATE 10-12-75

15

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H_2O IDEAL	ACTUAL	GAS METER TEMP. °F	PUMP VACUUM IN. HG GAUGE	FILTER BOX TEMP. °F	IMP. EXIT TEMP. °F	STACK TEMP. °F	LEAK TEST READINGS
F 1	10/0	041.454	1.20	2.21	2.21	101	2	263	60	275	
2	2	043.17	0.59	1.09	1.09	101	2	260	60	277	
3	4	044.43	.42	.77	.77	102	2	260	60	278	
4	6	045.49	.55	1.01	1.01	101	2	260	60	277	
5	8	046.65	.86	1.58	1.58	101	2	260	60	276	
	60/55	048.038									

V_M	$(\sqrt{\Delta P})^2$	$\overline{\Delta H}$	$\overline{T_M}$	$\overline{T_S}$
48.397	1.040	2.00	101	275

ENTROPY

ISOKINETIC TYPE FIELD DATA SHEET

16

COMPANY NAME S.T. Wooten Co
ADDRESS Drugstore NC
SAMPLING LOCATION ~~Asphalt plant BD Fan~~ Dryer Stack
DATE 10-12-89 TEAM LEADER LCM
BAROMETRIC PRESSURE. IN. HG 30.0
TRAIN LEAK CHECK VACUUM IN. HG 15 6.5
TRAIN LEAK RATE, CU.FT/MIN 0.000 0.000

RUN NUMBER MS-2
TIME START 1010
TIME FINISH 1118
TECHNICIANS PFD
STATIC PRESSURE IN. H_2O -.29

EQUIPMENT CHECKS

- ✓ PITOTS, PRETEST
- ✓ PITOTS, POSTTEST
- NA M3 SAMPLING SYS/TED BAG
- ✓ THERMOCOUPLE @ 300 PRE
- ✓ THERMOCOUPLE @ 275 POST

IDENTIFICATION NUMBERS

REAGENT BOX 0566 NOZZLE 506 DIAMETER .241
METER BOX N-4 T/C READOUT FS
UMBILICAL UB T/C PROBE S-7
SAMPLE BOX 19 ORSAT PUMP NA
PROBE 4-4 PITOT 4-4 TEDLAR BAG NA

LEAK CHECK READINGS

B1 E2 B2 E3 B3 E4 B4 E5 B5 E6 B6 E

FILTER #	TARE
E9255	0.5022

DELTA H@	1.655					FYRITE
METER TEMP	100					
EST. %H_2O	24	26				
C FACTOR	.70	.69				
STACK TEMP	286	280				
REF DELTA P	1.00	1.07				
K-FACTOR	1.84 K1	1.7196 K2				C_p

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
K-1 1	F1	0	048.604	1.19	2.19	2.19	97	2	240	65	270	K-
2	2	2	050.33	.44	.81	.81	97	2	245	63	271	
3	3	4	051.43	.28	.52	.52	98	2	250	62	271	
4	4	6	052.32	.63	1.14	1.14	98	2	250	62	270	
5	5	8	053.57	1.20	2.20	2.20	98	2	250	62	271	
6	E1	10/0	054.974	1.09	2.01	2.01	98	2	257	64	269	
7	2	2	056.56	.54	.97	.97	100	2	257	60	271	
8	3	4	057.81	.34	.62	.62	100	2	257	60	271	
9	4	6	058.76	.49	.90	.90	100	2	257	60	272	
10	5	8	059.80	.83	1.53	1.53	100	2	259	60	270	K-
11	D1	10/0	061.113	1.49	2.56	2.56	100	2	260	64	270	
12	2	2	062.90	.78	1.34	1.34	102	2	260	64	270	
13	3	4	064.29	.75	1.29	1.29	102	2	253	64	274	
14	4	6	065.60	1.00	1.72	1.72	102	2	250	64	277	
15	5	8	067.07	.69	1.19	1.19	103	2	250	62	279	
16	C1	10/0	068.354	1.30	2.24	2.24	102	2	250	62	272	
17	2	2	069.99	1.05	1.81	1.81	103	2	254	62	277	
18	3	4	071.58	.80	1.35	1.35	103	2	254	62	278	
19	4	6	072.95	.89	1.53	1.53	104	2	255	62	279	
20	5	8	074.36	1.14	1.96	1.96	104	2	255	62	280	
21	D1	10/0	075.875	1.75	3.01	3.01	103	3	255	64	275	
22	2	2	077.86	1.58	2.72	2.72	105	3	260	64	275	
23	3	4	079.76	1.37	2.36	2.36	106	3	260	62	273	
24	4	6	081.53	.85	1.46	1.46	106	3	260	60	274	
25	5	8	082.97	.80	1.38	1.38	107	3	260	60	275	

F1010
9/89
p1

minutes Vm $(\sqrt{\Delta p})^2$ ΔH tm ts

ENTROPY

PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME S.T. Wooten Co RUN # MS-2

SAMPLING LOCATION ~~Asphalt stack ID Fan~~ Dryer Stack DATE 10-12-85

17

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H2O IDEAL	ORIFICE SETTING (ΔH), IN. H2O ACTUAL	GAS METER TEMP. °F	PUMP VACUUM IN. HG GAUGE	FILTER BOX TEMP. °F	IMP. EXIT TEMP. °F	STACK TEMP. °F	LEAK TEST READINGS
A 1	10/0	084.305	2.35	4.01	4.01	105	3	258	60	275	
2	2	086.28	2.55	4.38	4.38	107	3	258	60	274	
3	4	088.61	1.93	3.32	3.32	109	3	259	60	273	
4	6	090.71	.85	1.46	1.46	109	2	255	60	272	
5	8	092.14	.69	1.19	1.19	110	2	255	60	272	
	60/60	093.405									

V_M	$(\sqrt{\Delta P})^2$	$\overline{\Delta H}$	$\overline{T_M}$	$\overline{T_S}$
44.801	.9925	1.84	103	273

ENTROPY

ISOKINETIC TYPE FIELD DATA SHEET

18

COMPANY NAME S.T. Wooten Co
ADDRESS Drugstore NC.
SAMPLING LOCATION ~~Asphalt plant~~ Fan DP/STACK
DATE 10-12-89 TEAM LEADER LCM
BAROMETRIC PRESSURE. IN. HG 30.0
TRAIN LEAK CHECK VACUUM IN. HG 15 03
TRAIN LEAK RATE, CU.FT/MIN 0.002 0.000

RUN NUMBER MS-3
TIME START 1255
TIME FINISH 1406
TECHNICIANS PFD ~~LCM~~
STATIC PRESSURE IN. H_2O -.48

EQUIPMENT CHECKS

- ✓ PITOTS, PRETEST
- ✓ PITOTS, POSTTEST
- ✓ M3 SAMPLING SYS/TED BAG
- ✓ THERMOCOUPLE @ 300 PRE
- ✓ THERMOCOUPLE @ 300 POST

IDENTIFICATION NUMBERS

REAGENT BOX 0586 NOZZLE 506 DIAMETER .241
METER BOX N-4 T/C READOUT F-5
UMBILICAL U-10 T/C PROBE S-10
SAMPLE BOX ~~FT~~ 33 ORSAT PUMP 10
PROBE 4-1 PITOT 41 TEDLAR BAG 25

LEAK CHECK READINGS

B1	
B2	
B3	
B4	
B5	
B6	

FILTER #	TARE
E9256	.5038

DELTA H@	1.655				FYRITE
METER TEMP	100	110	120		4/5.6
EST. %H_2O	26	26	26		5.2
C FACTOR	.64	.68	.66		
STACK TEMP	280	280	280		
REF DELTA P	1.07	1.00	1.04		
K-FACTOR	1.7196 K1	1.84 K2			C_p

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
1	A1	0	093.514	2.68	~~4.83~~	4.53	99	2	270	65	265	K2
2	2	2	096.13	2.70	4.97	4.97	100	3	268	64	270	
3	3	4	098.42	1.57	3.62	3.62	101	2	270	64	272	
4	4	6	100.55	.82	1.51	1.51	102	2	270	64	274	
5	5	8	102.02	.28	.52	.52	103	1	270	65	275	
6	B1	10/0	102.909	1.28	2.36	2.36	104	2	265	64	277	
7	2	2	104.65	1.57	2.83	2.83	108	2	265	63	280	
8	3	4	106.50	1.28	3.28	3.28	109	2	265	60	284	
9	4	6	108.65	.97	1.78	1.78	110	2	265	60	284	
10	5	8	110.13	.43	.79	.79	114	2	263	60	284	
11	C1	10/0	111.259	1.20	2.21	2.21	114	2	265	62	271	
12	2	2	112.96	1.15	2.12	2.12	114	2	265	61	280	
13	3	4	114.65	.95	1.75	1.75	115	2	264	60	282	
14	4	6	115.17	1.00	1.84	1.84	115	2	260	61	282	
15	5	8	117.70	.81	1.49	1.49	116	2	258	61	282	
16	D1	10/0	119.096	.70	1.29	1.29	1.28	2	255	61	279	
17	2	2	120.48	1.14	2.10	2.10	116	2	254	60	281	
18	3	4	122.00	.99	1.82	1.82	116	2	255	60	281	
19	4	6	123.54	1.21	2.23	2.23	117	2	258	60	283	
20	5	8	125.21	1.55	2.85	2.85	117	2	259	60	283	
21	E1	10/0	127.140	.52	.96	.96	116	2	258	60	278	
22	2	2	128.29	.98	1.80	1.80	116	2	257	61	284	
23	3	4	129.77	1.08	1.99	1.99	117	2	257	61	284	
24	4	6	131.36	1.17	2.15	2.15	117	2	255	61	284	
25	5	8	133.05	1.37	2.52	2.52	117	2	260	62	283	

F1010
9/89
p1

minutes Vm $(\sqrt{\Delta p})^2$ ΔH tm ts

ENTROPY

PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME S.T. Wooten Co. RUN # MS-3

SAMPLING LOCATION ~~Drugstore · I.D. Fan Stack~~ ~~Asphalt plant~~ Dry Stack DATE 10-12-89

SAMPLE POINT	CLOCK TIME, MIN.	DRY GAS METER READING, CU. FT.	PITOT READING (ΔP), IN. H_2O	ORIFICE SETTING (ΔH), IN. H2O IDEAL	ORIFICE SETTING (ΔH), IN. H2O ACTUAL	GAS METER TEMP. °F	PUMP VACUUM IN. HG GAUGE	FILTER BOX TEMP. °F	IMP. EXIT TEMP. °F	STACK TEMP. °F	LEAK TEST READINGS
F 1	10/0	134.845	.75	1.38	1.38	117	2	270	60	280	
2	2	136.17	1.26	1.89	1.89	117	2	270	60	286	
3	4	137.72	1.21	2.23	2.23	117	2	270	60	282	
4	6	139.43	.80	1.47	1.47	118	2	260	60	282	
5	8	140.86	.75	1.38	1.38	118	2	255	60	282	
	60/off	142.193									

V_M	$(\sqrt{\Delta P})^2$	$\overline{\Delta H}$	$\overline{T_M}$	$\overline{T_S}$
49.679	1.111	2.14	113	279

ENTROPY

MOISTURE SAMPLING LABORATORY RESULTS

Plant Name: S T WOOTEN EEI Ref# 6476

Sampling Location: Rotary Dryer Stack

Date Received: 10/16 Date Analyzed: 10/16 Reagent Box(es): 0566

Run Number	M5-1	M5-2	M5-3
Run Date	10/12	10/12	10/12
ANALYSIS OF MOISTURE CATCH			
Reagent 1 (H20)			
Final Weight, g.	906.0	954.0	992.5
Tared Weight, g.	577.5	572.0	578.5
Water Catch,g.	328.5	382.0	414.0
Reagent 2 ( )			
Final Weight, g.			
Tared Weight, g.			
Water Catch,g.	0.0	0.0	0.0
Reagent 3 ( )			
Final Weight, g.			
Tared Weight, g.			
Water Catch,g.	0.0	0.0	0.0
CONDENSED WATER, g.	328.5	382.0	414.0
Silica Gel:			
Final Weight, g.	213.0	213.0	216.0
Tared Weight, g.	200.0	200.0	200.0
ADSORBED WATER, g.	13.0	13.0	16.0
TOTAL WATER COLLECTED, g.	341.5	395.0	430.0

PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name: S T WOOTEN EEI Ref# 6476

Sampling Location: Rotary Dryer Stack

Date Received: 10/16 Date Analyzed: 10/19 Reagent Box(es): 0566

Run Number	M5-1	M5-2	M5-3
Run Date	10/12	10/12	10/12
Sample ID/Container #	F / 1072	F / 1073	F / 1074
	76.9085	✓76.6568	✓77.1584
	✓76.9083	76.6570	77.1586
Tare Weight., g.	76.3937	76.1512	76.6573
SAMPLE WT., g.	0.5146	0.5056	0.5011
Sample ID/Container #	R / 2479	R / 2480	R / 2481
		99.6485	
	✓102.6708	✓99.6484	99.6889
	102.6709	99.6493	✓99.6888
Tare Wt., g.	102.6497	99.6358	99.6772
SAMPLE WT., g.	0.0211	0.0126	0.0116
Sum of Particulate, mg.	535.7	518.2	512.7
Total Filter Tare, mg.	506.1	502.2	503.8
Blank Residue, mg.	(175 ml) 0.4	(175 ml) 0.4	(125 ml) 0.3
TOTAL PARTICULATE CATCH, mg.	29.2	15.6	8.6

Blank Beaker # 2003
Final wt., mg. 99546.3
Tare wt., mg. 99545.9
Residue, mg. 0.4
Volume, ml. 200

Concentration, mg/ml 0.002

---Legend---
✓ = Final Weight
L = Loose Particulate
F = Filter D = Dish
R = Rinse P = Pan

Notes and Comments

Run 1 filter darker & rinse visibly higher

ENTROPY

SUMMARY OF IMPINGERS' WATER ANALYSIS

Plant Name: S T WOOTEN EEI Ref# 6476

Run Number	M5-1	M5-2	M5-3
Run Date	10/12	10/12	10/12
Sample ID/Container #	1 / 2044	1 / 2047	1 / 2059
	96.9190		
	96.9186	97.0770	112.0385
	96.9193	97.0773	112.0382
Tare Weight., g.	96.9093	97.0750	112.0345
SAMPLE WT., g.	0.0093	0.0020	0.0037
Sample ID/Container #	2 / 332	2 / 325	2 / 329
	127.2223	129.4696	129.3942
	127.2219	129.4693	129.3939
	127.2438	129.4750	129.3992
Tare Wt., g.	127.1685	129.4156	129.3398
SAMPLE WT., g.	0.0534	0.0537	0.0541
Sample ID/Container #	4 / 2046	4 / 2052	4 / 2064
	96.5710	102.5486	105.4908
	96.5712	102.5489	105.4907
Tare Wt., g.	96.5603	102.5425	105.4807
SAMPLE WT., g.	0.0107	0.0061	0.0100

1	Organic Fraction Catch, mg.	9.3		2.0		3.7
2	Inorganic Fraction Catch,mg	53.4		53.7		54.1
4	Acetone Soluble Catch, mg.	10.7		6.1		10.0
	Acetone Residue, mg. (250 ml)	0.5	(250 ml)	0.5	(250 ml)	0.5
	Water Residue, mg. (200 ml)	0.0	(200 ml)	0.0	(200 ml)	0.0
	TOTAL IMPINGERS' CATCH, mg.	72.9		61.3		67.3
	TOTAL TRAIN CATCH, mg.	102.1		76.9		75.9

Proceoure Explanation

1 - Extractable with freon (trichloro-trifluoro-ethane)
2 - Water catch after extraction and heating to 210 F
3 - Water catch after heating to _____ F
4 - Acetone rinsings of impingers and connecting glassware

Blank Beaker #
Final wt.,mg. 89234.6
Tare wt., mg. 89234.6
Residue, mg. 0.0
Volume, ml. 200
Conc., mg/ml 0.0

CUSTODY SHEET FOR REAGENT BOX # 0566

Date of Makeup 5 Oct 1985 Initials BJ16 Locked? ✓

Individual Tare of Reagent: 200 mls. of DI H_2O

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME S.T. WOOTEN

SAMPLING LOCATION ~~E.D. FAN STACK~~ Rotary Dryer Stack
~~Asphalt plant Stack~~

Run Number	Date Used	Initials	Locked?	Date Cleanup	% S. Gel Spent	Initials	Locked?
M5-1	10-12-89	PFD	✓	10-12-89	40	PFD	✓
M5-2	10-12-89	PFD	✓	10-12-89	40	PFD	✓
M5-3	10-12-89	PFD	✓	10-12-89	40	PFD	✓

Received in Lab Date 10/13 Initials JFJ Locked? ✓

Zero & Span Balance Initials JFJ

Sampling Method: M5

Remarks:

Filter #	Tare Weight (grams)	Used on Test
E9260	0.5061	M5-1
E9255	0.5022	M5-2
E9256	0.5038	M5-3

ENTROPY ENVIRONMENTALISTS, INC.

APPENDIX B.2

B. FIELD AND ANALYTICAL DATA

2. Plume Opacity

VISIBLE EMISSIONS EVALUATOR

This [illegible] that

James [illegible] Winegar

met the specifications of Fe[illegible] 9 and qualified as a visible emissions evaluator. Maximum deviati[illegible] black smoke did not exceed 7.5% opacity and no single [illegible] opacity was incurred during the certification test conduc[illegible] Associates of Raleigh, North Carolina. This certificat[illegible] issue.

Thomas [illegible] Rose
Pres[illegible]

[illegible] 1057
Number

Willa [illegible]
Vice President

[illegible]
Location

David Savage
Program Manager

September 20, 1989
Date of Issue

© GOES 448

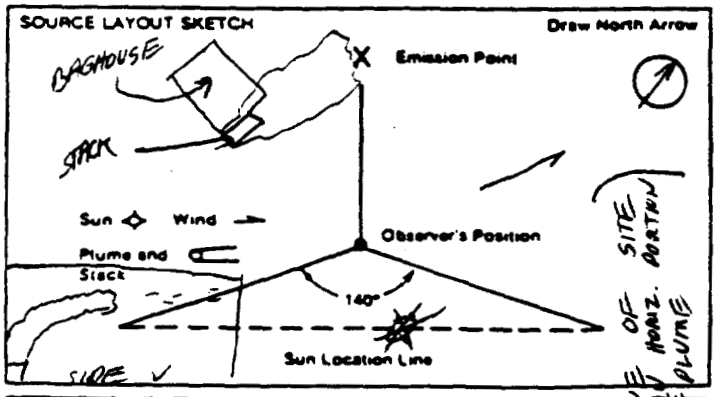
LITHO IN U.S.A.

VISIBLE EMISSION OBSERVATION FORM 2

M9-1

SOURCE NAME	S. T. WOOTEN
ADDRESS	ASPHALT PLANT
	SR 1010
CITY	CLAYTON
STATE	NC
ZIP	—
PHONE	—
SOURCE ID NUMBER	—
PROCESS EQUIPMENT	ROTARY DRYER
OPERATING MODE	≈ 300 TPH
CONTROL EQUIPMENT	BAGHOUSE
OPERATING MODE	CONT
DESCRIBE EMISSION POINT START	≈ 5' x 3' RECT. DUCT
STOP	SAME
HEIGHT ABOVE GROUND LEVEL START	SLANT X
HEIGHT RELATIVE TO OBSERVER START	BELOW
STOP	
DISTANCE FROM OBSERVER START	*
STOP	*
DIRECTION FROM OBSERVER START	NW
STOP	NW
DESCRIBE EMISSIONS START	CONING STEAM PLUME
STOP	W/ PUFFS OF PART
EMISSION COLOR START	PEP WHITE
STOP	SAME
PLUME TYPE	CONTINUOUS ☑ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☐ YES ☑
IS WATER DROPLET PLUME	ATTACHED ☑ DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED START	≈ 1000' FROM STACK
STOP	SAME
DESCRIBE BACKGROUND START	SKY
STOP	SKY
BACKGROUND COLOR START	BL
STOP	BL
SKY CONDITIONS START	0% cl
STOP	0% cl
WIND SPEED START	2-4
STOP	2-4
WIND DIRECTION START	SW
STOP	SW
AMBIENT TEMP START	59°F
STOP	65°F
WET BULB TEMP	57°F
RH, percent	89%

SOURCE LAYOUT SKETCH — Draw North Arrow



COMMENTS

X SLANT & MEASURED 22°

STACK GAS COND = 156 °F WB 280 °F DB

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SIGNATURE

TITLE

DATE

OBSERVATION DATE	START TIME	STOP TIME
10/12/89	0850	0950

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	0	5	31	0	0	0	0
2	0	5	0	0	32	0	0	0	0
3	0	0	5	0	33	0	5	0	0
4	5	0	0	0	34	0	0	0	0
5	5	5	5	5	35	0	0	0	0
6	0	0	0	0	36	5	5	0	0
7	5	5	5	0	37	5	0	0	0
8	5	5	0	5	38	0	0	0	0
9	5	5	0	0	39	0	0	0	0
10	10	0	5	10	40	0	0	5	0
11	10	10	0	0	41	0	5	0	5
12	5	0	10	15	42	10	5	10	0
13	5	0	0	5	43	5	5	0	0
14	10	5	20	0	44	0	0	5	5
15	0	0	10	0	45	5	5	10	0
16	0	5	0	0	46	5	5	5	0
17	0	0	0	5	47	0	0	0	5
18	5	0	0	10	48	5	0	0	0
19	0	10	0	5	49	5	0	10	5
20	5	0	0	0	50	5	5	0	0
21	0	5	5	0	51	0	5	10	0
22	0	5	10	0	52	15	10	0	0
23	0	0	0	0	53	0	0	15	1
24	0	10	0	5	54	15	0	0	5
25	10	5	5	5	55	10	0	0	0
26	0	0	15	5	56	0	0	0	0
27	15	0	0	0	57	0	0	0	5
28	5	5	10	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	5	0	0	0

RANGE OF OPACITY READINGS MIN 0 MAX 20	HIGHEST AVERAGE OPACITY AND AVERAGING PERIOD —
NUMBER OF READINGS ≥ 20 %	MINUTES OPACITY ≥ 20 = 0.25 = 0.25

OBSERVER'S NAME (PRINT)	JAMES B. WINEGAR
OBSERVER'S SIGNATURE	James B. Winegar
DATE	10/12/89
ORGANIZATION	—
CERTIFIED BY	ETA
DATE	9/20/89
VERIFIED BY	
DATE	

M9-2

VISIBLE EMISSION OBSERVATION FORM 2

SOURCE NAME	S.T. WOOTEN
ADDRESS	ASPHALT PLANT
	SR 1010
CITY	CLAYTON
STATE	NC
ZIP	—
PHONE	—
SOURCE ID NUMBER	—

PROCESS EQUIPMENT	ROTARY DRYER
OPERATING MODE	≈ 300 TPH/HR
CONTROL EQUIPMENT	BAGHOUSE
OPERATING MODE	CONT

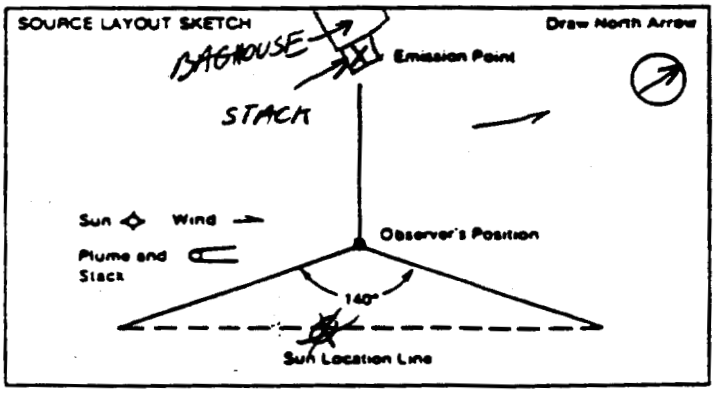
DESCRIBE EMISSION POINT	START ≈ 5' x 3' RECT DUCT STOP SAME
HEIGHT ABOVE GROUND LEVEL	START ≈ 30' STOP ≈ 30'
HEIGHT RELATIVE TO OBSERVER	START ≈ 30' STOP ≈ 30'
DISTANCE FROM OBSERVER	START ≈ 250' STOP ≈ 250'
DIRECTION FROM OBSERVER	START ~~NE~~ NW STOP NW

JBW 4/12/89

DESCRIBE EMISSIONS	START NO VE DETECTED STOP
EMISSION COLOR	START NA STOP
PLUME TYPE	CONTINUOUS ☑ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☐ YES ☑
IS WATER DROPLET PLUME	ATTACHED ☐ DETACHED ☑
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	START ≈ 5' ABOVE STACK STOP SAME

DESCRIBE BACKGROUND	START SKY STOP SKY
BACKGROUND COLOR	START BL STOP BL
SKY CONDITIONS	START 0% cl STOP 0% cl
WIND SPEED	START 2-4 STOP 3-7
WIND DIRECTION	START SW STOP SW
AMBIENT TEMP	START 67°F STOP 70°F
WET BULB TEMP	62°F
RH, percent	74%

SOURCE LAYOUT SKETCH — Draw North Arrow



OBSERVATION DATE	START TIME	STOP TIME
10/12/89	1011	1111

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

RANGE OF OPACITY READINGS	MIN 0 MAX 0
HIGHEST AVERAGE OPACITY AND AVERAGING PERIOD	—
NUMBER OF READINGS ≥ 20 %	0
MINUTES OPACITY ≥ 20	0 = 0.25 = 0

COMMENTS

OBSERVER'S NAME (PRINT)	JAMES B. WINEGAR
OBSERVER'S SIGNATURE	J. B. Winegar
DATE	10/12/89
ORGANIZATION	—
CERTIFIED BY	ETA
DATE	9/20/89
VERIFIED BY	
DATE	

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SIGNATURE

TITLE

DATE

VISIBLE EMISSION OBSERVATION FORM 2

M9-3

SOURCE NAME	S.T. WOOTEN
ADDRESS	ASPHALT PLANT SR 1010
CITY	CLAYTON
STATE	NC
ZIP	—
PHONE	—
SOURCE ID NUMBER	—

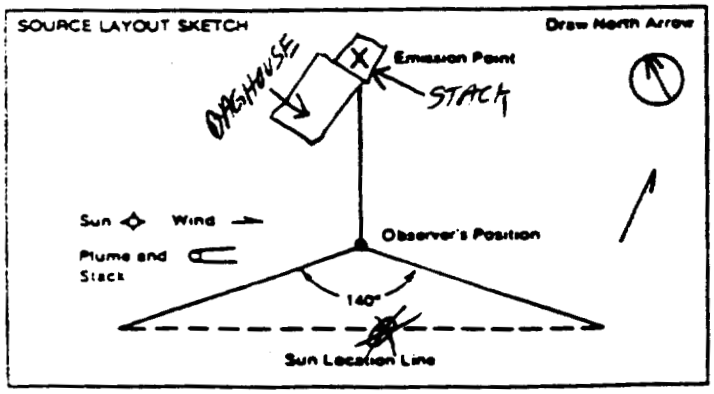
PROCESS EQUIPMENT	ROTARY DRYER
OPERATING MODE	≈ 300 TONS/HR
CONTROL EQUIPMENT	BAGHOUSE
OPERATING MODE	CONT

DESCRIBE EMISSION POINT	START ≈ 3' x 5' RECT DUCT STOP SAME
HEIGHT ABOVE GROUND LEVEL	START ≈ 30' STOP ≈ 30'
HEIGHT RELATIVE TO OBSERVER	START ≈ 30' STOP ≈ 30'
DISTANCE FROM OBSERVER	START ≈ 200' STOP ≈ 200'
DIRECTION FROM OBSERVER	START NE STOP NE

DESCRIBE EMISSIONS	START ONE PUFF* STOP NO VE DETECTED
EMISSION COLOR	START LT BRN STOP NA
PLUME TYPE	CONTINUOUS ☑ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☑ YES ☐
IS WATER DROPLET PLUME	ATTACHED ☐ N/A DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	START ≈ 5' ABOVE STACK STOP SAME

DESCRIBE BACKGROUND	START SKY STOP SKY
BACKGROUND COLOR	START BL STOP BL
SKY CONDITIONS	START 0% cl STOP 0% cl
WIND SPEED	START 4-8 STOP 4-8
WIND DIRECTION	START SW STOP SW
AMBIENT TEMP	START 78°F STOP 75°F
WET BULB TEMP	70°F
RH, percent	68%

SOURCE LAYOUT SKETCH — Draw North Arrow



COMMENTS

I = INTERFER FRM FUGITIVE DUST

* MAY BE FRM FRONT-END LOADER

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SIGNATURE

TITLE

DATE

OBSERVATION DATE	START TIME	STOP TIME
10/12/89	1304	1404

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	I	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	I	0
10	0	0	5	0	40	0	0	0	I
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	I	0	46	0	0	0	0
17	0	I	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	I	I	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

RANGE OF OPACITY READINGS	MIN 0 MAX 5
HIGHEST AVERAGE OPACITY AND AVERAGING PERIOD	—
NUMBER OF READINGS ≥ 20 %	0
MINUTES OPACITY ≥ 20 %	0 × 0.25 = 0

OBSERVER'S NAME (PRINT)	JAMES B. WINEGAR
OBSERVER'S SIGNATURE	J. B. Winegar
DATE	10/12/89
ORGANIZATION	
CERTIFIED BY	ETA
DATE	9/20/89
VERIFIED BY	
DATE	

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 with the possibility of the calibration status changing 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 Environmentalists Inc. (EEI) 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, EEI 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 EEI'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 when necessary.

Each item of equipment used for this test program was inspected again before being packed and transported to the job site. The majority of the equipment needs a visual inspection only. In the case of the meter consoles, a 10-minute quick calibration check is conducted. EEI performs these quality assurance activities prior to departure to detect equipment problems which may originate during periods of storage. This minimizes on-site delays due to equipment failure.

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

Calibration. Equipment that require calibration include the nozzle, pitot tube, pressure gauges, thermometers, flow meters, dry gas meters, and barometers. The following sections elaborate on the calibration procedures followed by EEI 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, calibrated before initial field use, and visually inspected on-site prior to testing. Each time a nozzle is calibrated, 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 EEI, 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 and again on-site prior to testing. If either of these visual inspections indicate damage or raise 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 EEI 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 EEI'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 ± 5 %, 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. If necessary, the impinger thermometer is adjusted 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. Prior to each field use, the thermometer used to measure the temperature of the metered gas sample is checked against an ASTM mercury-in-glass thermometer. The dry gas meter thermometer is acceptable if the values agree within ± 5.4°F. Thermometers not meeting this requirement are adjusted or labeled with a correction factor.

Flue Gas Temperature Sensor. All thermocouples employed by EEI for the measurement of flue gas temperatures are calibrated upon receipt. Each receives an initial, 3-point calibration (ice bath, boiling water, and hot oil) using an ASTM mercury-in-glass thermometer as a reference. The thermocouple is acceptable if the agreement is within ± 1.5 % (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 % (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 again compared with an ASTM mercury-in-glass reference. If the absolute temperatures agree within ± 1.5 %, the temperature data are considered valid.

Dry Gas Meter and Orifice

General. The dry gas meter and orifice are typically installed in a common console and are calibrated simultaneously. As a transfer standard, EEI uses a dry gas meter that is calibrated annually against a spirometer. During the annual transfer standard calibration, three calibration runs are performed at each of seven flow rates ranging from approximately 0.2 to 1.25 cfm.

EEI uses three calibration procedures: 1) full calibration, 2) 10-minute quick calibration, and 3) posttest calibration.

Full Calibration. The full calibration is a complete calibration procedure used to obtain the calibration factor of the dry gas meter and orifice before their first use and, at a minimum, every six months thereafter. Two calibrations are performed at each of three different orifice settings (flow rates): 0.5, 2.1, and 4.8 in. H_2O, and at zero vacuum.

EPA Reference Method 5 calls for another full calibration anytime a posttest meter calibration indicates that the average meter coefficient (Y_d) has changed by more than 5 %. Standard practice at EEI is to recalibrate the meter anytime Y_d is found to be outside the range $0.97 \leq Y_d \leq 1.03$, or deviates more than the 5 %.

An orifice calibration factor (delta-H@) is calculated for each of the six flow settings during the full calibration. If the range of values does not vary by more than 0.15 in. H_2O, the arithemtic average of the six values obtained during the calibration is used. Standard practice at EEI is to recalibrate if the average delta-H@ is found to be outside the range 1.6 to 2.0 in. H_2O.

Ten-Minute Quick Calibration. The 10-minute quick calibration is conducted prior to reporting to the test site and again prior to each day of testing. The meter console is not used if Y_d is not within ± 3 % of that of the full test.

Posttest Calibration. The posttest calibration is designed to check whether the calibration factors have changed. Posttest calibrations are performed after each field test series. Each posttest calibration is performed at an average orifice setting (based on the test data) and at the maximum vacuum reached during the testing. Three calibrations are performed at these settings.

If the post test Y_d deviates by less than 5 % from that of the full test calibration, the test data are acceptable. If Y_d deviates by more than 5 %, the meter is recalibrated prior to reuse, and the Y_d (initial or posttest) that yields the lowest sample volume is used for all calculations.

If the posttest delta-H@ deviates by more than 10 % from that of the full test, the orifice is recalibrated prior to reuse. No adjustments are made for calculation purposes.

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 International Airport, approximately 2.5 miles from EEI's location.

SAMPLING EQUIPMENT CALIBRATION CHECKLIST

JOB NAME/NUMBER ST Wooten TEAM LEADER LCM

SAMPLING LOCATION Rotary Dryer Stack

BAROMETER CHECK

DATE	ENTROPY IN-HOUSE REFERENCE BAROMETER	FIELD BAROMETER
10-11-89	29.83	29.8

THERMOMETERS AND THERMOCOUPLE CHECK

DATE 10-12-89 REFERENCE THERMOMETER AMBIENT TEMPERATURE 100 °F

	AMBIENT TEMPERATURE °F	MUST BE WITHIN ACCEPTANCE RANGE °F
THERMOMETERS		
Impinger Exit	100/100	±2°F
Filter Compartment	102 101	±5.4°F
Dry Gas Meter	101	±5.4°F
Other		
THERMOCOUPLE	*5-7 *5-10 / 99 100	±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

PITOTS	I.D. #	VISUAL INSPECTION CHECK
	4-4	✓
	4-1	✓
NOZZLES	506	✓

F-1039
8/86

ENTROPY

Dry Gas Meter Identification: 6838323 Calibration by: W.L. SHERRILL

Date: 10-3-89 Barometric Pressure (P_b): 29.73 in. Hg

*Date: 10-4-89 *Barometric Pressure (P_b): 29.82 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft^3	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft^3	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. ($\bar{Y}_{ds}$)
	2.62	86	2.572	75	-.48	10	.2544		1.0104
	2.55		2.543	75	-.48		.2472		.9946
	2.614		2.559	75	-.48		.2539		1.0132
*	4.153		4.214	76	-.90		.4046		.9804
*	4.2987		4.204	76	-.90		.4187		1.0172
*	4.3169		4.214	76	-.90		.4205		1.0191
	4.9826		4.943	75	-1.20		.4801		.9937
	5.045		4.945	75	-1.20		.4900		1.0138
	4.973		4.963	75	-1.20		.4830		.9957
	7.96		7.807	75	-2.38		.7231		1.0161
	7.805		7.808	75	-2.38		.7580		.9962
	7.942		7.806	75	-2.38		.7713		1.0140
*	10.255		10.296	76	-3.80		.9990		.9980
*	10.264		10.293	76	-3.80		.9998		.9992
*	10.3826		10.381	76	-3.80		1.0114		1.0021

$$\frac{(V_s)\ (t_{ds} + 460)\ (P_b)}{\theta \cdot (17.64)\ (P_b)\ (V_s)}$$

Dry Gas Meter Identification: 6838323 Calibration by: W.L. SHERRILL

Date: 10-3-89 Barometric Pressure (P_b): 29.73 in. Hg

PAGE 2 OF 2

ENTROPY ENVIRONMENTALISTS, INC.

*Date: 10-4-89 *Barometric Pressure (P_b): 29.82 in. Hg

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft^3	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft^3	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. ($\bar{Y}_{ds}$)
*	12.1403	86	12.032	76	-5.20	10	1.1826		1.0145
*	12.031		12.053	76	-5.20		1.1720		1.0036
*	12.0037		12.059	76	-5.20		1.1693		1.0009
	13.588		13.515	75	-6.40		1.3196		1.0121
	13.397		13.472	75	-6.40		1.3011		1.0011
	13.333		13.428	75	-6.40		1.2949		.9996

Y_{ds} = 1.0045

$$Q = (17.64)\frac{(P_b)(V_s)}{(V_s)(t_{ds} + 460)(P_b)}$$

37

Dry Gas Meter Identification: 1017057 Calibration by: W.L. SHERRILL

PAGE 1 OF 2

Date: 10-3-89 Barometric Pressure (P_b): 29.73 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

*Date: 10-4-89 *Barometric Pressure (P_b): 29.82 in. Hg

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft^3	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft^3	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. ($\bar{Y}_{ds}$)
	2.62	80	2.541	78	-.28	10	.2544		1.0280
	2.55	80	2.533	79	-.28		.2477		1.0055
	2.614	80	2.529	79	-.28		.2539		1.0324
*	4.153		4.188	79	-.60		.4046		.9913
*	4.2987		4.193	79	-.60		.4187		1.0248
*	4.3169		4.186	79	-.60		.4205		1.0309
	4.9826		4.923	80	-.84		.4839		1.0142
	4.973		4.936	80	-.84		.4830		1.0096
	5.045		4.926	80	-.84		.4900		1.0263
	7.960		7.809	80	-1.68		.7731		1.0236
	7.805		7.8016	80	-1.68		.7580		1.0040
	7.942		7.818	80	-1.68		.7713		1.0201
*	10.255		10.144	79	-2.80		.9990		1.0161
*	10.264		10.266	79	-2.80		.9998		1.0049
*	10.3826		10.348	79	-2.80		1.0114		1.0084

$$Q = \frac{(V_s)\ (t_{ds} + 460)\ (P_b)}{(17.64)\ (P_b)\ (V_s)}$$

Dry Gas Meter Identification: 1017657 Calibration by: W.L. SHERRILL

PAGE 2 OF 2

Date: 10-3-89 Barometric Pressure (P_b): 29.73 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

*Date: 10-4-89 *Barometric Pressure (P_b): 29.82 in. Hg

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft^3	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft^3	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. ($\bar{Y}_{ds}$)
*	12.1403	80	11.962	78	-3.72	10	1.1826		1.0205
*	12.031		11.969	79	-3.72		1.1720		1.0126
*	12.0037		11.970	79	-3.72		1.1693		1.0102
	13.588		13.377	80	-4.60		1.3196		1.0275
	13.397		13.318	80	-4.60		1.3011		1.0175
	13.333		13.271	80	-4.60		1.2949		1.0162

Y_{ds} = 1.016*

$$(V_s)\ (t_{ds} + 460)\ (P_b)$$

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

39

Meter Box Number: N4

Calibration by: MBC

Standard Meter Number: 6838323 Standard Meter Gamma: 1.0045

Date: 10-5-89 Barometric Pressure (P_b): 29.66 in. Hg

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

METERBOX 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
4.132	68	10	0.5	4.155	78	1.0166	1.607
4.110	68	↓	0.5	4.161	82	1.0172	1.613
8.276	68	↓	2.1	8.371	87	1.0228	1.658
8.294	70	↓	2.1	8.453	89	1.0176	1.645
12.292	69	↓	4.8	12.380	92	1.0285	1.706
12.288	69	↓	4.8	12.418	90	1.0287	1.701
					Average	1.0202	1.655

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

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

ON-SITE DRY GAS METER AUDIT

Date 10-11-89

Time 1430

Auditor LCM

Meter Box Identification Number N-4

Pretest Gamma (Y) 1.0202 ΔH_a 1.655

Barometric Pressure (P_{bar}) 29.9 in.Hg

Dry Gas Meter Readings, ft^3	Meter Temperatures, ^oF	Upper and Lower Limits for Audit Gamma
Initial 959.600	Initial 102	0.97 * Y = .989594
Final 967.023	Final 103	1.03 * Y = 1.050806

Dry Gas Volume Metered, ft^3	Average Meter Temperature, ^oF	Run Time, min.	Calculated Audit Gamma
Vm = 7.423	Tm = 102.5	10	Y_c = 1.04361

$$Y_c = \frac{10}{Vm} * \sqrt{\frac{0.0319\ (Tm + 460)}{P_{bar}}}$$

$$Y_c = \frac{10}{7.423} * \sqrt{\frac{0.0319\ (102.5 + 460)}{29.9}} = 1.043617974$$

Audit Gamma Within Acceptable Limits? Yes ✓ No ___

F-1040
9/86

ENTROPY

LCS

Meter Box Number N4 Calibration by: MBC

Meter Box Vacuum: 3 (in. Hg) Job No. 6436

Standard Meter Number 1013057 Standard Meter Gama: 1.0164

Date: 10-17-89 Barometric Pressure (P_b) 29.62 (in Hg)

POST TEST 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
7.980	77	10	2.0	7.904	85	1.0363	1.713
8.108	77	10	2.0	8.106	92	1.0399	1.638
8.010	77	10	2.0	8.056	94	1.0375	1.637
					Average	1.0379	1.675

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

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

ΔP (Magnehelic®)	ΔP (Manometer)	% Difference
.28	.28	0
1.5	1.5	0
2.7	2.75	1.8

F-1038
7/89

ENTROPY

NOZZLE NUMBER: 506

Date	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average
12-2-82	ST	.254	.251	.250	.252	.251	0.252
2-3-84	PLO	.252	.252	.254	.251	.250	0.252
3-12-84	MAH	.252	.249	.250	.252	.253	0.251
2-15-85	NMH	.247	.250	.246	.250	.249	0.248
3-25-85	JDE	.247	.245	.247	.249	.248	0.247"
2-19-86	JE	.252	.254	.255	.253	.255	0.254
9-17-86	BB	.253	.253	.256	.255	.256	.255
4/15/88	JE	.239	.238	.241	.242	.239	0.240
6/27/88	JE	.247	.249	.247	.246	.249	.248
8/16/88	BKG	.244	.242	.245	.242	.244	.243
10/31/88	BKG	.262	.260	.259	.260	.261	.260
2/13/89	BKG	.258	.258	.259	.258	.259	.258
7-25-89	MISSING						
8-21-89	JRW	0.239	0.240	0.243	0.241	0.240	0.241

NOTE: All diameters measured in inches.

APPENDIX D

SAMPLING AND ANALYTICAL PROCEDURES