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.

ENTROPY
ENVIRONMENTALISTS INC.

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

STATIONARY SOURCE SAMPLING REPORT

EEI REF. NO. 5630

REA CONSTRUCTION COMPANY
CONTINUOUS MIX ASPHALT PLANT
RALEIGH, NORTH CAROLINA

PARTICULATE EMISSIONS AND PLUME OPACITY COMPLIANCE TESTING

ROTARY DRYER BAGHOUSE STACK

AUGUST 21, 1987

RECEIVED
NOV 16 198
RALEIGH REGIONAL OFFICE

REPORT CERTIFICATION

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

Date September 4, 1987 Signature

David W. Finley

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

Date September 4, 1987 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	Presentation	2-1
2.2	Discussion	2-1
2.2.1	Particulate Emissions	2-1
2.2.2	Plume Opacity	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	4-1
4.4	Particulate Emissions	4-1
4.5	Plume Opacity	4-1
4.6	Equipment Calibration	4-1
APPENDICES		
A.	Test Results and Example Calculations	1
B.	Field and Analytical Data	
	1. Particulate	7
	2. Plume Opacity	19
C.	Calibration Data	26
D.	Sampling and Analytical Procedures	37

INTRODUCTION

1.1 Outline of Test Program. Stationary source sampling was performed for Rea Construction Company, at the continuous mix asphalt plant in Raleigh, North Carolina on August 21, 1987 for compliance purposes. 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

Rea Construction Company	Don Schell Test Coordinator
Astec Industries, Inc.	Jeff Simpson Test Observer
Entropy Inc.	David W. Finley Project Supervisor
	A. Thomas McDonald Visible Emissions Observer
	Todd Langdon Engineering Technician

SUMMARY OF RESULTS

2.1 Presentation. Table 2-1 summarizes the results of the particulate emissions testing performed August 21, 1987, at the rotary dryer 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 0.0048 grains per dry standard cubic foot (gr/DSCF); the average emission rate was 1.04 pounds per hour. The maximum concentration of particulate allowed by the United States EPA New Source Performance Standards for Asphalt Plants is 0.04 gr/DSCF.

2.2.2 Plume Opacity. There were no visible emissions during the testing, with the exception of one 5% reading.

TABLE 2-1

PARTICULATE TESTS SUMMARY OF RESULTS

Rotary Dryer Baghouse Stack

	1	2	3
Run Date	8/21/87	8/21/87	8/21/87
Test Train Parameters:			
Volume of Dry Gas Sampled, SCF*	43.405	47.417	45.415
Percent Isokinetic	100.8	103.2	106.0
Flue Gas Parameters:			
Temperature, Degrees F	264	198	262
Volumetric Air Flow Rates SCFM*, Dry	24,986	26,662	24,870
ACFM, Wet	45,208	43,959	44,890
Method 5 Results:			
Catch, Milligrams	12.8	12.7	16.7
Concentration, Grains/DSCF*	0.004551	0.004133	0.005675
Emission Rate, Lbs/Hour	0.9747	0.9446	1.210

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

PROCESS DESCRIPTION AND OPERATION

3.1 General. Rea Construction Company, in Raleigh, North Carolina, operates a continuous mix process to produce asphalt. A gas-fired rotary dryer, rated at 300 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, in a coater, and the product is transferred to a holding silo.

3.2 Source Air Flow. Figure 3-1 is an air flow schematic which shows the test location.

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

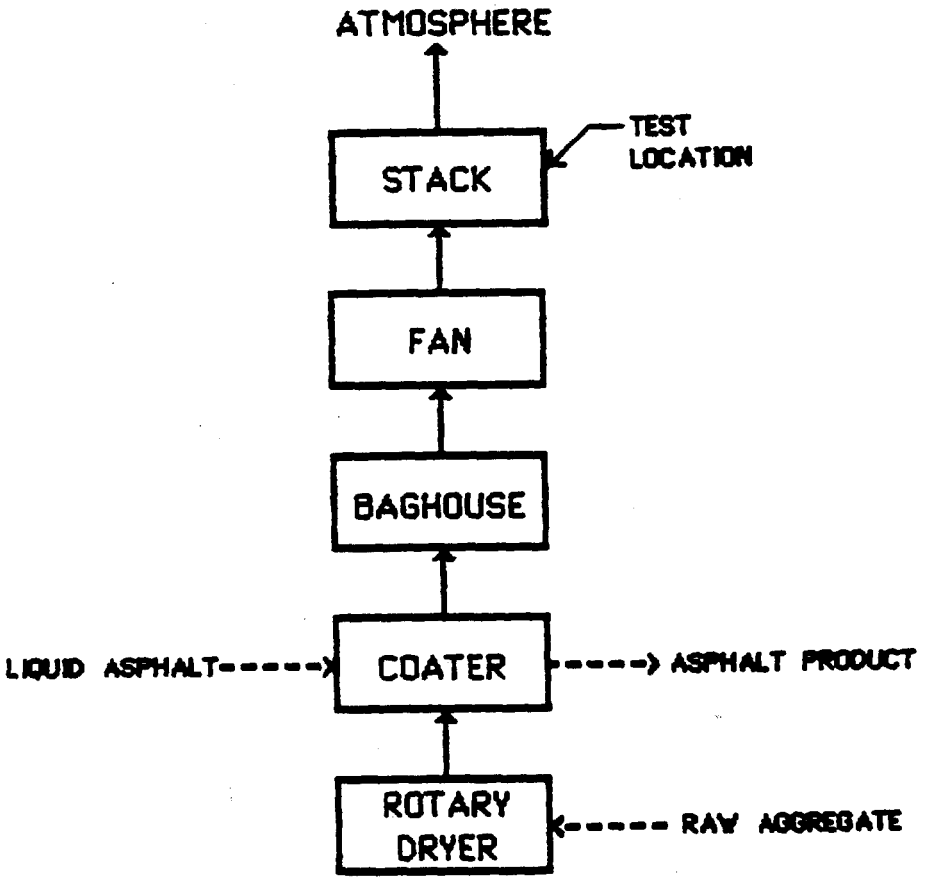


FIGURE 3-1. ROTARY DRYER PROCESS AIR FLOW SCHEMATIC SHOWING TEST LOCATION

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 - Part 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 30 equal areas, with five sampling points on each of six traverse axes, labeled A through E, 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 3, 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. Each of the 30 equal areas was sampled for two 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 Equipment Calibration. Pertinent calibration data are provided in Appendix C.

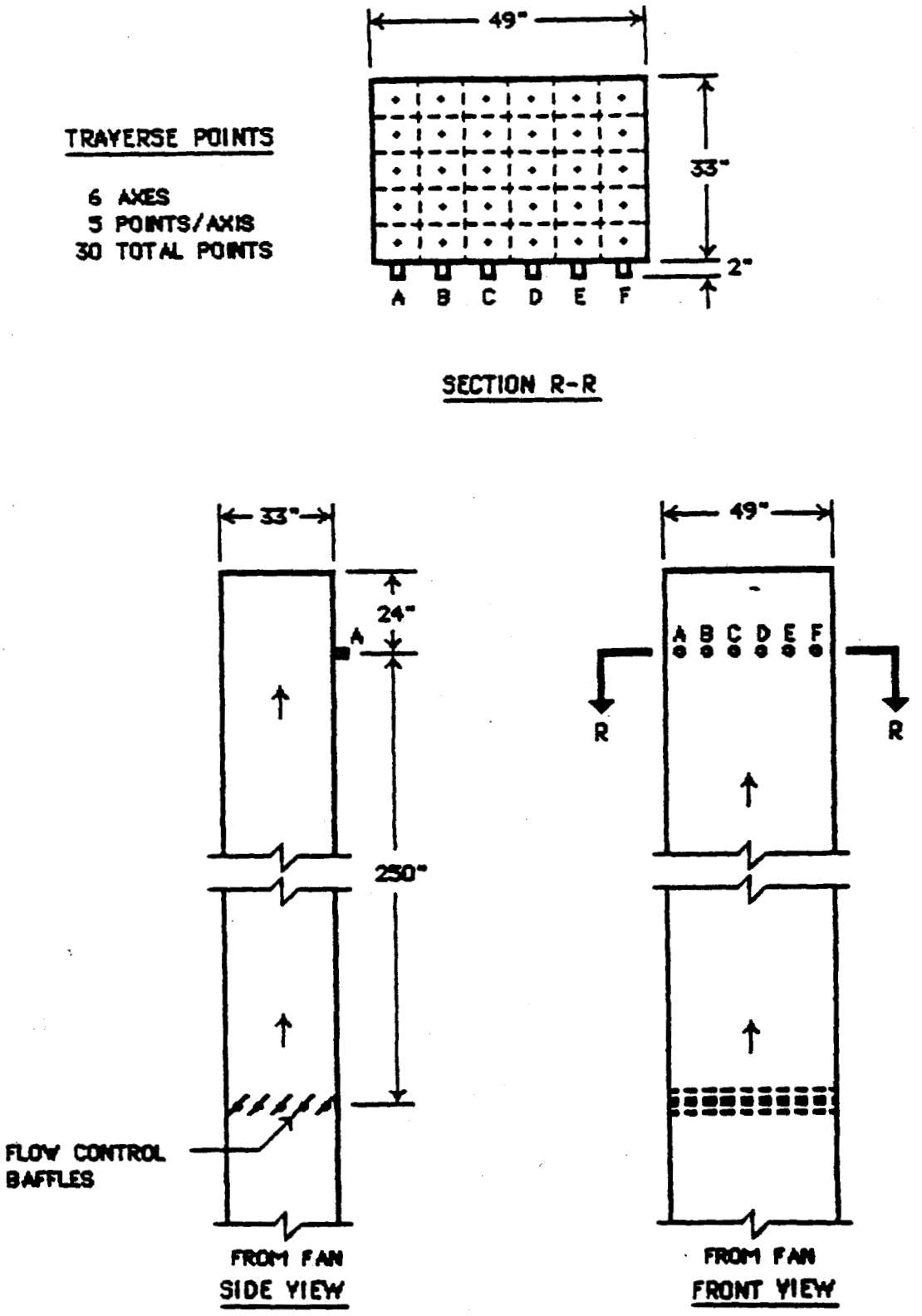


FIGURE 4-1. ROTARY DRYER BAGHOUSE STACK TEST LOCATION

APPENDIX A

TEST RESULTS AND EXAMPLE CALCULATIONS

ISOKINETIC SAMPLING TRAIN FIELD DATA & RESULTS TABULATION

PLANT: REA Construction Company, Raleigh, North Carolina

RUN #	DATE	SAMPLING LOCATION	OPERATOR
1	8/21/87	Rotary Dryer Baghouse Stack	David W. Finley
2	8/21/87	Rotary Dryer Baghouse Stack	David W. Finley
3	8/21/87	Rotary Dryer Baghouse Stack	David W. Finley

		1	2	3
	Run Start Time	812	1000	1300
	Run Finish Time	920	1104	1408
	Net Sampling Points	30	30	30
Theta	Net Run Time, Minutes	60.00	60.00	60.00
Dia	Nozzle Diameter, Inches	0.243	0.243	0.243
Cp	Pitot Tube Coefficient	0.840	0.840	0.840
Y	Dry Gas Meter Calibration Factor	0.991	0.991	0.991
Pbar	Barometric Pressure, Inches Hg	30.00	30.00	30.00
Delta H	Avg. Pressure Differential of Orifice Meter, Inches H2O	2.020	2.220	2.110
Vm	Volume of Metered Gas Sample, Dry ACF	46.120	50.988	48.590
tm	Dry Gas Meter Temperature, Degrees F	100	107	104
Vm(std)	Volume of Metered Gas Sample, Dry SCF*	43.405	47.417	45.415
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, mL	295.0	324.5	309.5
Vw(std)	Volume of Water Vapor, SCF*	13.886	15.274	14.568
%H2O	Moisture Content, Percent by Volume	24.2	24.4	24.3
Mfd	Dry Mole Fraction	0.758	0.756	0.757
%CO2	Carbon Dioxide, Percent by Volume, Dry	3.5	3.5	3.5
%O2	Oxygen, Percent by Volume, Dry	15.1	15.1	15.1
%CO+N2	CO + N2, Percent by Volume, Dry	81.4	81.4	81.4
Md	Dry Molecular Weight, Lb/Lb-Mole	29.16	29.16	29.16
Ms	Wet Molecular Weight, Lb/Lb-Mole	26.46	26.44	26.45
Pg	Flue Gas Static Pressure, Inches H2O	-0.80	-1.20	-0.68
Ps	Absolute Flue Gas Press., Inches HG	29.94	29.91	29.95
ts	Flue Gas Temperature, Degrees F	264	198	262
Delta p	Average Velocity Head, Inches H2O	0.9553	0.9923	0.9446
vs	Flue Gas Velocity, Feet/Second	67.10	65.24	66.63
A	Stack/Duct Area, Square Inches	1,617	1,617	1,617
Qsd	Volumetric Air Flow Rate, Dry SCFM*	24,986	26,662	24,870
Qaw	Volumetric Air Flow Rate, Wet ACFM	45,208	43,959	44,890
%I	Isokinetic Sampling Rate, Percent	100.8	103.2	106.0

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

(continued next page)

		1	2	3
	Method 5 Results:			
mg	Catch, Milligrams	12.8	12.7	16.7
gr/DSCF	Concentration, Grains per DSCF*	0.004551	0.004133	0.005675
Lb/Hr	Emission Rate, Lbs/Hour (PMRc)	0.9747	0.9446	1.210

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

EXAMPLE PARTICULATE TEST CALCULATIONS NO. 1

Rotary Dryer Baghouse Stack

VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS

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

$$Vm(std) = 17.64 * 0.991 * 46.120 * \frac{(30.00 + 2.020/13.6)}{(460 + 100)} = 43.405 \text{ DSCF}$$

VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

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

$$Vw(std) = 0.04707 * 295.0 = 13.886 \text{ SCF}$$

PERCENT MOISTURE, BY VOLUME, AS MEASURED IN FLUE GAS

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

$$\%H2O = \frac{13.886}{13.886 + 43.405} * 100 = 24.2\ \%$$

DRY MOLE FRACTION OF FLUE GAS

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

$$Mfd = 1 - 24.2/100 = 0.758$$

DRY MOLECULAR WEIGHT OF FLUE GAS

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

$$Md = 3.5*0.44 + 15.1*0.32 + 81.4*0.28 = 29.16 \text{ LB/LB-MOLE}$$

WET MOLECULAR WEIGHT OF FLUE GAS

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

$$Ms = 29.16 * 0.758 + (0.18 * 24.2) = 26.46 \text{ LB/LB-MOLE}$$

ABSOLUTE FLUE GAS PRESSURE

$$Ps = Pbar + Pg / 13.6$$

$$Ps = 30.00 + (-0.8 / 13.6) = 29.94 \text{ IN. HG.}$$

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

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

$$vs = 85.49 * 0.840 * SQRT\left[\frac{0.9553 * (460 + 264)}{29.94 * 26.46}\right] = 67.1 \text{ FT/SEC}$$

DRY VOLUMETRIC FLUE GAS FLOW RATE @ STANDARD CONDITIONS

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

$$Qsd = \frac{60}{144} * 0.758 * 67.1 * 1,617.0 * \frac{528}{264 + 460} * \frac{29.94}{29.92}$$

$$Qsd = 24,986 \text{ SCFM}$$

WET VOLUMETRIC STACK GAS FLOW RATE @ FLUE GAS CONDITIONS

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

$$Qaw = 60 / 144 * 67.1 * 1,617.0 = 45,208 \text{ ACFM}$$

PERCENT ISOKINETIC OF SAMPLING RATE

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

$$\%I = \frac{29.92}{528} * \frac{100}{60} * \frac{(264 + 460) * 43.405}{29.94 * 67.1 * 0.758 * 60.00 * 0.0003221}$$

$$\%I = 100.8 \ \%$$

GRAINS PER DRY STANDARD CUBIC FOOT

$$gr/DSCF = \frac{7000}{453.592} * \frac{mgs}{Vm(std)}$$

$$gr/DSCF = \frac{7000}{453.592} * \frac{12.8}{43.405} = 0.0046 \quad gr/DSCF$$

POUNDS PER HOUR

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

$$Lb/Hr = 60/7000 * 0.0046 * 24.986 = 0.97 \quad LB/HR$$

APPENDIX B.1

B. FIELD AND ANALYTICAL DATA

1. Particulate

Preliminary Field Data

PLANT NAME Bee Construction

LOCATION Raleigh, N.C.

SAMPLING LOCATION Baghouse Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 35"

NIPPLE LENGTH 2"

DEPTH OF DUCT 33"

WIDTH (RECTANGULAR DUCT) 49"

EQUIVALENT DIAMETER:

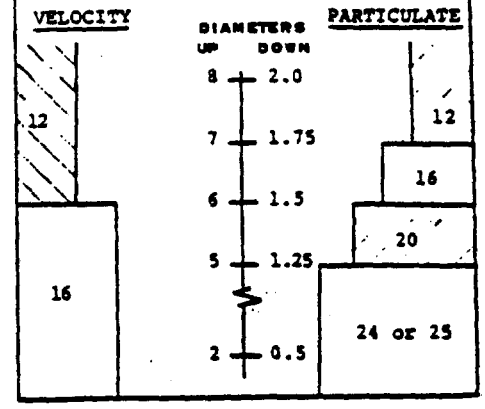
$$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(49)(33)}{(49 + 33)} = 39.4$$

DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE	UPSTREAM	DOWNSTREAM
	250	24"
DIAMETERS	6.3	0.61

STACK AREA= 33 X 49 = 1617 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	10	3 3/8	5 3/8
2	30	9 7/8	11 7/8
3	50	16 1/2	18 1/2
4	70	23 1/8	25 1/8
5	90	29 5/8	31 5/8
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

F-0003
8/86

ORSAT FIELD DATA

0 0 9

Plant Name REA

Sampling Location Bayside Street outlet Fuel Type N gas

Run and/or Sample No. 3 Leak Test? ✓ Date 8/21/87 Operator Oud

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
#		3.5	18.6	–	15.1	–	
#3	1500	3.5	18.6	–	15.1	–	
		3.6	18.6	–	15.0	–	
	Avg.	3.5		Avg.	15.1	–	81.4

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.			

ENTROPY ENVIRONMENTALISTS, INC.
SPECIALISTS IN SOURCE SAMPLING

PARTICULATE FIELD DATA

010

COMPANY NAME REA
ADDRESS Raleigh NC
SAMPLING LOCATION Bay Hawk Oakland Stack
DATE 8/28/87 TEAM LEADER DF TECHNICIANS [illegible]
BAROMETRIC PRESSURE, IN. HG 30.0 STATIC PRESSURE, IN. H_2O -.80
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 6
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .000 .000

RUN NUMBER 1
TIME START 0812
TIME FINISH 0920

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- — PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 270 °F

IDENTIFICATION NUMBERS

REAGENT BOX 503 NOZZLE 604 DIAMETER .243
METER BOX N-12 T/C READOUT F-4
UMBILICAL — T/C PROBE U-1
SAMPLE BOX — ORSAT PUMP —
PROBE — TEDLAR BAG —

FILTER #	TARE
E5826	.5074

NOMOGRAPH SET-UP NOMOGRAPH #

$\Delta H_@$ 1.71 C FACTOR .68
METER TEMP 100 STACK TEMP 270
% MOISTURE 25 REF. ΔP .95
1.9368421

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	399.568	2.10	4.06	4.06	92	4	252	60	263	
2	2	401.255	2.30	4.45	4.45	92	5	252	60	264	
3	4	403.525	2.00	3.87	3.87	92	5	252	60	264	
4	6	405.700	1.50	2.90	2.90	94	5	254	60	264	
5	8	407.600	1.30	2.51	2.51	94	5	254	60	264	
B/1	10/0	409.455	1.40	2.71	2.71	96	5	254	60	266	
2	2	411.350	1.90	3.68	3.68	96	5	254	60	266	CO_2
3	4	413.600	1.90	3.68	3.68	96	5	254	60	267	5%
4	6	415.555	1.80	3.48	3.48	96	5	254	60	268	
5	8	417.455	1.30	2.51	2.51	96	5	254	60	268	
C/1	20/0	419.362	.75	1.45	1.45	96	5	254	60	263	
2	2	420.700	1.10	2.13	2.13	96	6	253	60	264	
3	4	422.600	1.10	2.13	2.13	102	6	253	60	267	
4	6	424.500	1.30	2.51	2.51	104	6	254	60	267	
5	8	426.300	1.50	2.90	2.90	104	6	254	60	266	
D/1	30/0	428.090	.45	.87	.87	104	2	254	60	263	
2	2	429.250	.90	1.75	1.75	106	2	254	60	264	
3	4	430.600	.65	1.25	1.25	106	2	254	60	265	
4	6	432.050	.80	1.55	1.55	106	2	254	60	265	
5	8	433.330	.93	1.80	1.80	106	2	254	60	267	
E/1	40/0	434.880	.32	.62	.62	106	2	254	60	259	
2	2	435.865	.40	.77	.77	104	2	254	60	260	
3	4	436.820	.40	.77	.77	104	2	250	60	260	
4	6	437.900	.62	1.20	1.20	104	2	250	60	261	
5	8	439.155	.72	1.39	1.39	104	2	250	60	263	

V_M $(\sqrt{\Delta P})^2$ ΔH T_M T_S

ENTROPY

PARTICULATE FIELD DATA

PAGE 2

0 011

COMPANY NAME REA RUN # 1

MPLING LOCATION Bag House outlet duct DATE 8/28/87

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
F/1	0/0	440.532	.25	.48	.48	104	1	260	60	259
2	2	441.425	.50	.97	.97	104	1	260	60	259
3	4	442.600	.32	.62	.62	104	1	260	60	259
4	6	443.500	.40	.77	.77	104	1	260	60	259
5	8	444.600	.45	.87	.87	102	1	260	60	262
	10/OFF	445.688								

CO_2 5%

V_M	$(\sqrt{\Delta P})^2$	$\overline{\Delta H}$	$\overline{T_M}$	$\overline{T_S}$
46.12	.9553	2.02	100	264

F-1010
8/86

ENTROPY

PARTICULATE FIELD DATA

0 012

COMPANY NAME: REA
ADDRESS: Raleigh NC
SAMPLING LOCATION: Baghouse outlet duct
DATE: 8/21/87 TEAM LEADER: DE TECHNICIANS: TI
RUN NUMBER: 2
TIME START: 1000
TIME FINISH: 1104
BAROMETRIC PRESSURE, IN. HG: 30.0 STATIC PRESSURE, IN. H_2O: -1.20
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG: 15 6
SAMPLING TRAIN LEAK RATE, CU. FT./MIN.: .000 .000

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 270 °F

IDENTIFICATION NUMBERS

REAGENT BOX: 503 NOZZLE: 604 DIAMETER: .245
METER BOX: W-12 T/C READOUT: E-4
UMBILICAL: — T/C PROBE: —
SAMPLE BOX: — ORSAT PUMP: —
PROBE: 6.5 TEDLAR BAG: —

FILTER #	TARE
E5473	
.4722	

NOMOGRAPH SET-UP NOMOGRAPH #:

$\Delta H_@$: 1.71 C FACTOR: .68
METER TEMP: 100 STACK TEMP: 270
% MOISTURE: 25 REF. ΔP: .956.90 1936.94 21 2.044444

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	LK. CHECK READINGS
A/1	0/0	445.966	2.20	4.26	4.26	92	4	250	60	280	
2	2	448.400	2.20	4.26	4.26	92	4	250	60	233	
3	4	450.615	2.20	4.26	4.26	92	4	250	60	247	
4	6	453.100	1.90	3.68	3.68	94	4	250	60	193	
5	8	456.300	1.60	3.09	3.09	94	4	250	60	187	
B/1	0/0	457.584	1.60	3.09	3.09	104	3	250	60	199.	
2	2	459.525	1.90	3.80	3.80	104	3	250	60	205	CO_2 4%
3	4	461.955	2.10	4.30	4.30	104	3	250	60	201	
4	6	464.465	2.10	4.30	4.30	104	3	250	60	201	
5	8	466.800	1.50	3.10	3.10	104	3	250	60	193	
C/1	2/0	468.950	.90	1.84	1.94	114	2	252	60	195	
2	2	470.455	1.00	1.94	1.94	112	2	252	60	186	
3	4	472.400	1.40	2.88	2.88	112	2	252	60	187	
4	6	474.000	1.40	2.88	2.88	114	2	252	60	187	
5	8	476.100	1.40	2.88	2.88	114	2	252	60	189	
D/1	30/0	478.191	.55	1.15	1.15	112	2	252	60	195.	
2	2	479.400	.60	1.22	1.22	112	2	252	60	199	CO_2 4%
3	4	480.800	.60	1.22	1.22	112	2	252	60	195	
4	6	482.600	.70	1.48	1.48	112	2	250	60	195	
5	8	484.100	.70	1.48	1.48	112	2	250	60	195	
E/1	40/0	485.320	.35	.74	.74	110	2	250	60	197	
2	2	486.800	.40	.85	.85	110	2	250	60	196	
3	4	487.450	.60	1.25	1.25	110	2	250	60	195	
4	6	488.635	.80	1.69	1.69	110	2	251	60	196	
5	8	490.435	.80	1.69	1.69	110	2	250	60	200	

V_M $(\sqrt{\Delta P})^2$ ΔH T_M T_S

ENTROPY

PARTICULATE FIELD DATA

PAGE 2

0. 013

COMPANY NAME REA RUN # 2

MPLING LOCATION Bag House outlet Stack DATE 9/21/87

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
F/1	50/0	492.000	.25	.52	.52	110	1	255	60	193
2	2	492.900	.25	.52	.52	110	1	255	60	195
3	4	493.800	.35	.74	.74	110	1	255	60	190
4	6	494.900	.35	.74	.78	110	1	255	60	189
5	8	495.875	.35	.74	.74	110	1	255	60	192
	60/bFP	496.964								

V_M	$(\sqrt{\Delta P})^2$	$\overline{\Delta H}$	$\overline{T_M}$	$\overline{T_S}$
50.988	.9923	2.22	107	198

F-1010
8/86

ENTROPY

PARTICULATE FIELD DATA

0 014

COMPANY NAME REA
ADDRESS Raleigh NC
SAMPLING LOCATION Baghouse outlet stack
DATE 8/21/87 TEAM LEADER DR TECHNICIANS TL
BAROMETRIC PRESSURE, IN. HG 30.0 STATIC PRESSURE, IN. H_2O -.68
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 6
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .000 .000

RUN NUMBER 3
TIME START 1300
TIME FINISH 1408

EQUIPMENT CHECKS

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 270 °F

IDENTIFICATION NUMBERS

REAGENT BOX 503 NOZZLE 604 DIAMETER .243
METER BOX 10-12 T/C READOUT F-4
UMBILICAL — T/C PROBE —
SAMPLE BOX — ORSAT PUMP 7
PROBE — TEDLAR BAG 24

FILTER #	TARE
E 5714	
D.5013	

NOMOGRAPH SET-UP NOMOGRAPH #

$\Delta H_@$ 1.71 C FACTOR .68
METER TEMP 100 STACK TEMP 270
% MOISTURE 25 REF. ΔP .98 (.60)
1936842
2.044444

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	497.400	2.20	4.49	4.49	94	6	250	60	253	
2	2	498.500	2.50	5.11	5.11	94	6	250	60	253	
3	4	501.700	2.20	4.49	4.49	94	6	250	60	255	
4	6	504.400	1.60	3.27	3.27	94	6	250	60	257	
5	8	506.600	1.20	2.45	2.45	109	6	250	60	260	
B/1	10/0	508.522	1.50	3.06	3.06	109	6	250	60	263	
2	2	510.520	1.20	2.45	2.45	109	6	250	60	264	
3	4	512.400	1.30	2.66	2.66	110	6	250	60	267	
4	6	514.400	1.60	3.27	3.27	110	6	250	60	267	CO 4.[illegible]
5	8	516.400	1.60	3.27	3.27	110	6	250	60	267	
C/1	20/0	518.500	.80	1.63	1.63	110	6	250	60	264	
2	2	520.180	1.00	1.93	1.93	110	6	250	60	265	
3	4	521.765	1.20	2.45	2.45	110	6	250	60	263	
4	6	523.300	1.40	2.86	2.86	110	6	250	60	261	
5	8	525.100	1.60	3.27	3.27	110	6	250	60	261	
D/1	30/0	527.347	.45	.92	.92	110	6	250	60	259	
2	2	528.655	.63	1.28	1.28	110	6	250	60	261	
3	4	529.936	.80	1.63	1.63	110	6	252	60	265	
4	6	531.535	1.00	2.04	2.04	102	6	252	60	269	
5	8	533.200	1.10	2.25	2.25	102	6	252	60	266	
E/1	40/0	535.025	.35	.71	.71	102	2	252	60	261	
2	2	536.000	.40	.82	.82	102	2	252	60	262	
3	4	537.135	.45	.92	.92	102	2	254	60	264	
4	6	538.300	.60	1.22	1.22	100	2	254	60	262	
5	8	539.700	.78	1.60	1.60	100	2	256	60	262	

V_M $(\sqrt{\Delta P})^2$ ΔH T_M T_S

ENTROPY

PARTICULATE FIELD DATA

PAGE 2

0 015

COMPANY NAME REA RUN # 3

MPLING LOCATION Baghouse outlet stack DATE 8/21/87

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
1	50/0	541.226	.25	.51	.51	100	2	256	60	259
2	2	542.100	.30	.61	.61	100	2	256	60	261
3	4	543.100	.30	.61	.61	100	2	256	60	263
4	6	544.100	.40	.82	.82	100	2	256	60	262
5	8	545.100	.40	.82	.82	100	2	256	60	261
	60/60	545.990								

CO_2 4%

V_M	$(\sqrt{\Delta P})^2$	$\overline{\Delta H}$	$\overline{T_M}$	$\overline{T_S}$
48.59	.9446	2.11	104	262

F-1010
9/86

ENTROPY

PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name REA CONSTRUCTION EEI Ref. # 5630

Sampling Location ROTARY DRYER BAGHOUSE STACK

Date Received 8/21 Date Analyzed 8/26 Reagent Box(es) 0503

Run Number	1	2	3
Run Date	8/21	8/21	8/21

SUMMARY OF PARTICULATE ANALYSES

Sum of Particulate, mg.	520.5	485.2	518.2
Total Filter Tare mg.	507.4	472.2	501.3
Blank Residue, mg.	(125 mL) 0.3	(150 mL) 0.3	(100 mL) 0.2
TOTAL PARTICULATE CATCH, mg.	12.8	12.7	16.7

ANALYSIS OF MOISTURE CATCH

Reagent 1 (H_2O):			
Final Weight, g.	450.0	475.0	460.0
Tared Weight, g.	200.0	200.0	200.0
Water Catch, g.	250.0	275.0	260.0
Reagent 2 ( ):			
Final Weight, g.	–	–	–
Tared Weight, g.	–	–	–
Water Catch, g.	–	–	–
CONDENSED WATER, g.	250.0	275.0	260.0
Silica Gel:			
Final Weight, g.	245.0	249.5	249.5
Tared Weight, g.	200.0	200.0	200.0
ADSORBED WATER, g.	45.0	49.5	49.5
TOTAL WATER COLLECTED, g.	295.0	324.5	309.5

Blank Beaker # C110

Final wt. mg. 99358.7

Tare wt. mg. 99358.3

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

017

Plant Name REA CONSTRUCTION EEI Ref. # 5630

Run Number	1	2	3
Run Date	8/21	8/21	8/21
Sample ID/Container #	F&R 2139	F&R 2005	F&R 2008
Tare Wt., g.	98.4945 98.4941 98.4953 97.9736	97.8707 97.8704 97.8712 97.3852	98.2361 98.2365 98.2370 97.7179
SAMPLE WT., g.	0.5205	0.4852	0.5182
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.			

ENTROPY

CUSTODY SHEET FOR REAGENT BOX # 0503

Date of Makeup 8/4 Initials MAS Locked? ✓

Individual Tare of Reagent: 200 mls. of H_2O

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 800 gms.

PLANT NAME Rea Const. Co.

SAMPLING LOCATION Baghouse Stack

Run Number	Date Used	Initials	Locked?	Date Cleanup	% S. Gel Spent	Initials	Locked?
1	8-21-87	MS	✓	8-21-87	50	MS	✓
2	↓	↓	✓	↓	50	↓	✓
3	↓	↓	✓	↓	60		✓

Received in Lab Date 8/21 Initials J.F.J. Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: EPA M5

Filter #	Tare Weight (grams)	Used on Test
ES826	.5074	1
ES473	.4722	2
ES214	.5013	2

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

APPENDIX B.2

B. FIELD AND ANALYTICAL DATA

2. Plume Opacity

ENTROPY

VISIBLE EMISSIONS EVALUATOR

This is to certify that

Tom McDonald

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. Lee — President

218135 — Certificate Number

William S. Lee — Vice President

Raleigh — Location

David Savage — Program Manager

May 13, 1987 — Date of Issue

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LITHO IN U.S.A.

RUN 1, PASS 1

COMPANY NAME	STREET ADDRESS	CITY	STATE	ZIP
REA Const. Co.	Hy 54 West	Raleigh	NC	

PHONE (KEY CONTACT):
SOURCE ID NUMBER:

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

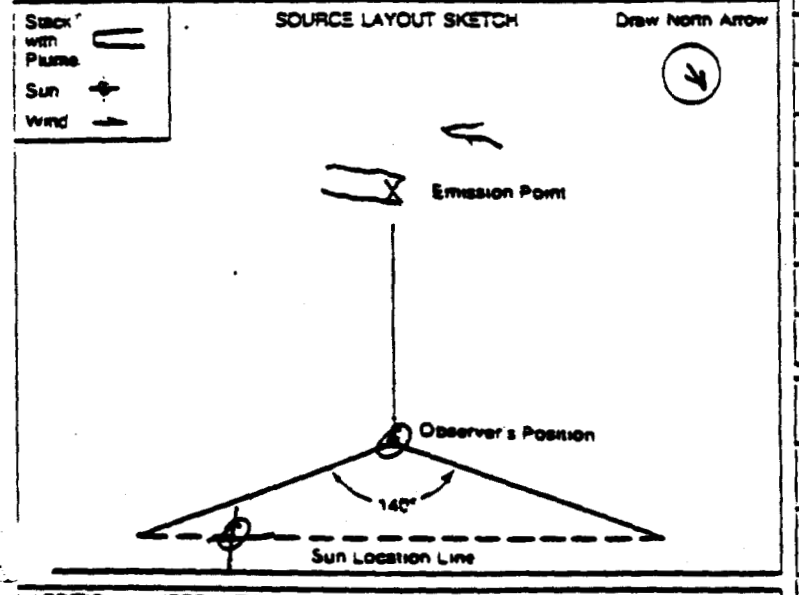
DESCRIBE EMISSION POINT: Rectangular Stack

HEIGHT ABOVE GROUND LEVEL: ~30'
HEIGHT RELATIVE TO OBSERVER: Start 30' End same
DISTANCE FROM OBSERVER: Start ~120' End same
DIRECTION FROM OBSERVER: Start SW End same

DESCRIBE EMISSIONS: Start: light brown particulate End
EMISSION COLOR: Start: light brown End
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 same
BACKGROUND COLOR: Start blue End same
SKY CONDITIONS: Start Clear End same
WIND SPEED: Start 0-5 mph End same
WIND DIRECTION: Start fm NW End same
AMBIENT TEMP: Start 78°F End 81°
WET BULB TEMP:
RH, percent:

SOURCE LAYOUT SKETCH



ADDITIONAL INFORMATION:

OBSERVATION DATE: 8-28-87
START TIME: 0806
END TIME: 0906

MIN \ SEC	0	15	30	45
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

COMMENTS: 020

OBSERVER'S NAME (PRINT): A. Thomas McDonald
OBSERVER'S SIGNATURE: A. Thomas McDonald
DATE: 8-21-87
ORGANIZATION: Entropy
CERTIFIED BY: Eastern Tech. Ass.
DATE: 5-87

CONTINUED ON VEO FORM NUMBER:

COMPANY NAME: Rea Const. Co.

STREET ADDRESS:

CITY: Raleigh | STATE: NC | ZIP:

PHONE (KEY CONTACT): | SOURCE ID NUMBER:

PROCESS EQUIPMENT: Asphalt plant | OPERATING MODE:

CONTROL EQUIPMENT: Baghouse | OPERATING MODE:

DESCRIBE EMISSION POINT: Rectangular 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

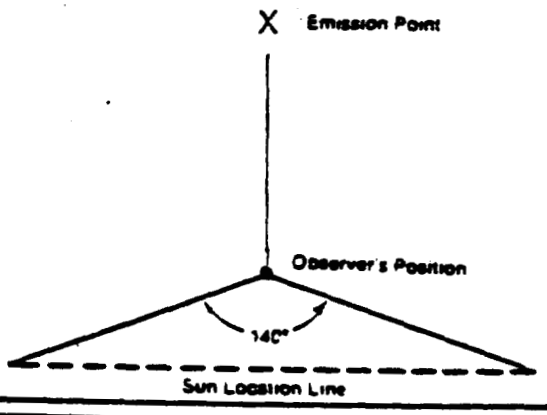
WIND SPEED: Start End | WIND DIRECTION: Start End

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

SOURCE LAYOUT SKETCH

Stack with Plume
Sun
Wind

Draw North Arrow



ADDITIONAL INFORMATION:

RUN 1 TRIAL

OBSERVATION DATE | 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	
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	5	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): A. Thomas McDonald

OBSERVER'S SIGNATURE: A. Thomas McDonald | DATE: 8-21-87

ORGANIZATION: Entropy

CERTIFIED BY: Eastern Tech. Ass. | DATE:

CONTINUED ON VEO FORM NUMBER:

021

RUN — PAGE 1

COMPANY NAME	STREET ADDRESS	CITY	STATE	ZIP
Reagonat. Co.	Hy. 54 west	Raliegh	NC	

PHONE (KEY CONTACT):
SOURCE ID NUMBER:

PROCESS EQUIPMENT	OPERATING MODE
Asphalt plant	
CONTROL EQUIPMENT	**OPERATING MODE**
Baghouse	

DESCRIBE EMISSION POINT: Rectangular stack

HEIGHT ABOVE GROUND LEVEL	HEIGHT RELATIVE TO OBSERVER
30'	Start 30' End same
DISTANCE FROM OBSERVER	**DIRECTION FROM OBSERVER**
Start ~120' End same	Start SW End same

DESCRIBE EMISSIONS: Start light brown particulate End same

EMISSION COLOR	IF WATER DROPLET PLUME
Start light brown End same	Attached ☐ Detached ☐

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

DESCRIBE PLUME BACKGROUND: Start Sky End same

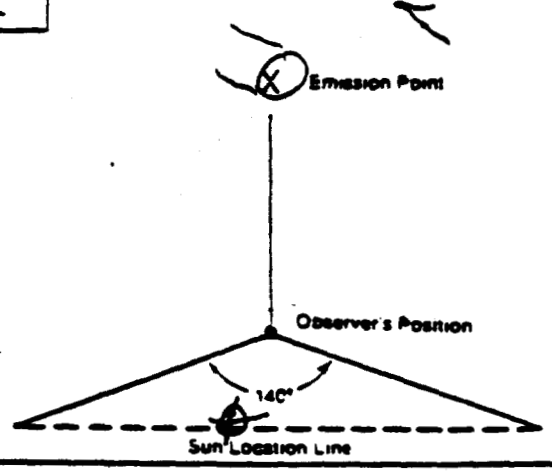
BACKGROUND COLOR	SKY CONDITIONS
Start Blue End same	Start clear End same
WIND SPEED	**WIND DIRECTION**
Start 0-5 mph End same	Start from N End same

AMBIENT TEMP	WET BULB TEMP	RH, percent
Start 83°F End same		

SOURCE LAYOUT SKETCH

Stack with Plume
Sun
Wind

Draw North Arrow



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
8-21-87	10:00	11:00

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	

022

OBSERVER'S NAME (PRINT): A. Thomas McDonald

OBSERVER'S SIGNATURE: A. Thomas McDonald — DATE: 8-21-87

ORGANIZATION: Entropy

CERTIFIED BY: Eastern Tech. Ass. — DATE:

CONTINUED ON VED FORM NUMBER

COMPANY NAME: REA Const. Co.

STREET ADDRESS:

CITY: Raleigh | STATE: NC | ZIP:

PHONE (KEY CONTACT): | SOURCE ID NUMBER:

PROCESS EQUIPMENT: Asphalt Plant | OPERATING MODE:

CONTROL EQUIPMENT: Baghouse | OPERATING MODE:

DESCRIBE EMISSION POINT: Rectangular 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

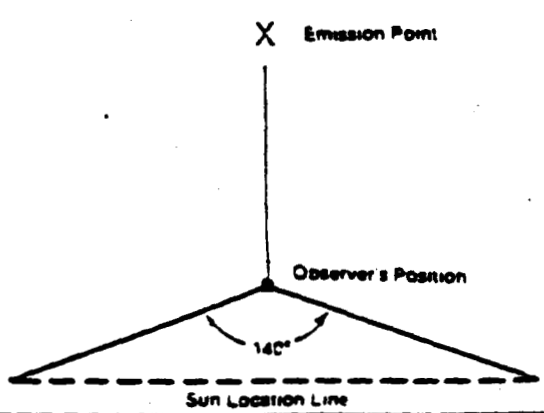
WIND SPEED: Start End | WIND DIRECTION: Start End

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

SOURCE LAYOUT SKETCH

Stack with Plume
Sun
Wind

Draw North Arrow



ADDITIONAL INFORMATION:

OBSERVATION DATE | START TIME | END TIME

SEC / MIN	0	15	30	45	COMMENTS
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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	
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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	

023

OBSERVER'S NAME (PRINT): A. Thomas McDonald

OBSERVER'S SIGNATURE: A Thomas McDonald | DATE: 8-21-87

ORGANIZATION: Entropy

CERTIFIED BY: Eastern Tech. Ass. | DATE:

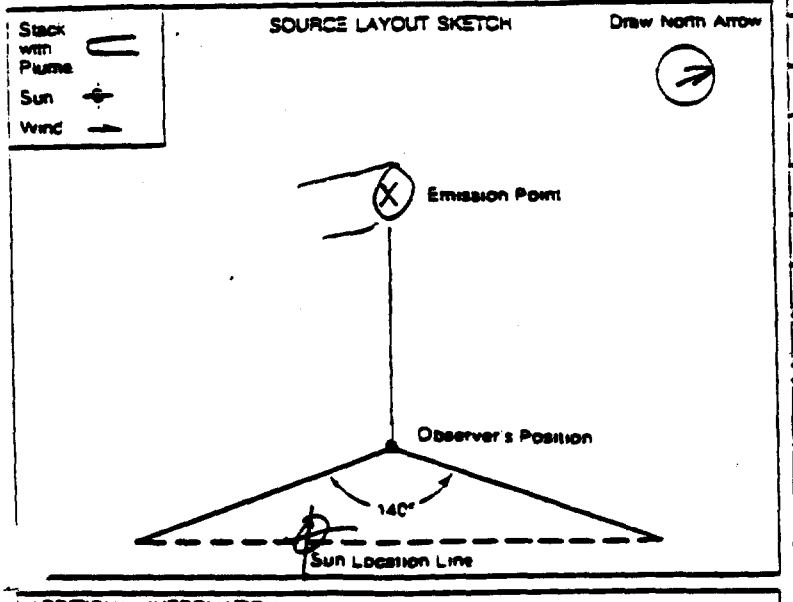
CONTINUED ON VEO FORM NUMBER:

Run 5 Page 1

COMPANY NAME	Rea Const. Co.
STREET ADDRESS	Hy. 54 West
CITY	Raliegh
STATE	NC
ZIP	
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Asphalt Plant
OPERATING MODE	
CONTROL EQUIPMENT	Baghouse
OPERATING MODE	
DESCRIBE EMISSION POINT	Rectangular stack
HEIGHT ABOVE GROUND LEVEL	~30'
HEIGHT RELATIVE TO OBSERVER	Start 30' End same
DISTANCE FROM OBSERVER	Start ~120' End
DIRECTION FROM OBSERVER	Start W End same
DESCRIBE EMISSIONS	Start light brown particulate End same
EMISSION COLOR	Start light Brown End Same
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 ~~overcast~~ sky
BACKGROUND COLOR	Start Blue End gray
SKY CONDITIONS	Start Clear End overcast
WIND SPEED	Start 0-5 mph End same
WIND DIRECTION	Start fm/N End same
AMBIENT TEMP	Start 90°F End 88°F
WET BULB TEMP	
RH, percent	

SOURCE LAYOUT SKETCH

Draw North Arrow



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
8-21-87	1300	1400

COMMENTS 024

MIN \ SEC	0	15	30	45
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28	0	0	0	0
29	0	0	0	0
30	0	0	0	0

OBSERVER'S NAME (PRINT)	A. Thomas McDonald
OBSERVER'S SIGNATURE	A. Thomas McDonald
DATE	8-21-87
ORGANIZATION	Entropy
CERTIFIED BY	Eastern Tech. Ass.
DATE	

CONTINUED ON VEO FORM NUMBER

COMPANY NAME		
Rea Const. Co.		
STREET ADDRESS		
Hy 54 West		
CITY	STATE	ZIP
Raleigh	NC	
PHONE (KEY CONTACT)	SOURCE ID NUMBER	

PROCESS EQUIPMENT	OPERATING MODE
Asphalt Plant	
CONTROL EQUIPMENT	OPERATING MODE
Baghouse	

DESCRIBE EMISSION POINT
Rectangular Stack

HEIGHT ABOVE GROUND LEVEL	HEIGHT RELATIVE TO OBSERVER
~30'	Start End
DISTANCE FROM OBSERVER	DIRECTION FROM OBSERVER
Start End	Start End

DESCRIBE EMISSIONS
Start End

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

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
Start End

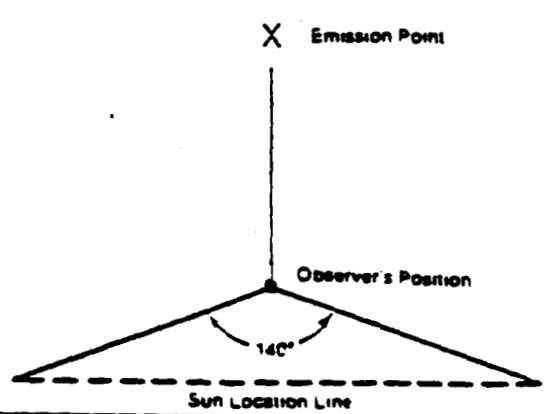
DESCRIBE PLUME BACKGROUND
Start End

BACKGROUND COLOR	SKY CONDITIONS
Start End	Start End
WIND SPEED	WIND DIRECTION
Start End	Start End
AMBIENT TEMP	WET BULB TEMP / RH, percent
Start End	

SOURCE LAYOUT SKETCH

Stack with Plume
Sun
Wind

Draw North Arrow



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME
8-21-87		

SEC / MIN	0	15	30	45	COMMENTS
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3	0	0	0	0	
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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)	
A. Thomas McDonald	
OBSERVER'S SIGNATURE	DATE
A. Thomas McDonald	8-21-87
ORGANIZATION	
Entropy	
CERTIFIED BY	DATE
Eastern Tech. Ass.	

CONTINUED ON VEO FORM NUMBER

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 ± 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.

Dry Gas Meter Identification: 6838323 Calibration by: MH

Date: 3-26-86 Barometric Pressure (P_b): 30.12 in. Hg

*Date: 3-27-86 *Barometric Pressure (P_b): 29.85 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. ($\bar{Y}_{ds}$)
0.30	2.924	82.4	2.906	81	0.40	10.00	0.2864	1.0026	
	2.969	82.8	2.869	81	.40	10.00	.2906	1.0304	
	3.652	83.3	3.501	81	.40	12.00	.3571	1.0377	
* 0.40	4.235	80.6	4.330	77	0.85	10.00	.4125	.9700	
	4.545	80.6	4.370	78	.85	10.00	.4427	1.0328	
	4.417	80.6	4.345	79	.85	10.00	.4302	1.0114	
0.50	5.328	78.8	5.206	75	1.10	10.00	.5271	1.0135	
	5.383	79.7	5.212	77	1.15	10.00	.5317	1.025	
	5.301	79.7	5.166	78	1.15	10.00	.5219	1.020	
* 0.80	8.288	81	8.216	79	2.65	10.00	.8067	.9985	
	8.397	82	8.214	80	2.65	10.00	.8058	1.0119	
	8.352	82.4	8.199	80	2.65	10.00	.8108	1.0075	
1.00	10.638	83.3	10.472	81	4.15	10.00	1.040	1.0014	
	10.656	83.3	10.534	81.5	4.15	10.00	1.042	.9981	
	10.528	83.3	10.450	81.5	4.15	10.00	1.0296	.9941	

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

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

0.032

Dry Gas Meter Identification: 6836323 Calibration by: MF

Date: 3-26-86 Barometric Pressure (P_b): 30.12 in. Hg

*Date: 3-27-86 *Barometric Pressure (P_b): 29.85 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. ($\bar{Y}_{ds}$)
* 1.20	12.304	82.4	12.168	80	5.50	10.00	1.1945	0.9932	
	12.177	82.4	12.065	80	5.50	10.00	1.1821	.9914	
	12.186	82.4	12.100	80	5.50	10.00	1.1830	.9892	
1.35	13.698	82.4	13.494	79.5	6.85	10.00	1.3418	.9931	
	13.552	82.4	13.505	80	6.85	10.00	1.33	.9826	
	13.752	81.5	13.712	80	7.00	10.00	1.35	.9833	

$\bar{Y}_{ds} = 1.0042$

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

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

0 ~033

Meter Box Number: N12

Calibration by: T. McDonald

Standard Meter Number: 6838323 Standard Meter Gamma: 1.0042

Date: 8-10-97 Barometric Pressure (P_b): 29.34 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
4.187	75	10.0	0.50	4.327	83	0.9850	1.61
4.208	75	10.0	0.50	4.336	86	0.9933	1.59
8.383	75	10.0	2.1	8.645	89	0.9940	1.67
8.394	75	10.0	2.1	8.718	92	0.9924	1.66
12.005	76	10.0	4.8	12.419	94	0.9914	1.85
11.933	76	10.0	4.8	12.397	96	0.9908	1.87
					Average	0.9912	1.71

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

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

Meter Box Number: N12 | Calibration by: T. McDonald

Meter Box Vacuum: 6 in. Hg

Standard Meter Number: 6838323 Standard Meter Gamma: 1.0042

Date: 8-25-87 Barometric Pressure (P_b): 29.77 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
8.147	73	10.0	2.12	8.219	86	1.0144	1.76
8.148	74	10.0	2.12	8.232	88	1.0147	1.76
8.137	74	10.0	2.12	8.220	89	1.0167	1.76
					Average	1.015	1.76

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

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

NOZZLE NUMBER: 604

Date	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average
12-2-82	ST	.244	.246	.243	.245	.244	0.244
04-07-83	HEC	0.241	0.244	0.243	0.244	0.245	0.243
01-10-84	PLO	.248	.245	.247	.245	.246	0.246
7-6-84	TTM	.242	.243	.243	.244	.243	0.243
10.24.85	GMC	.250	.252	.250	.251	.252	0.251
2.26.86	BB	.248	.245	.246	.247	.245	0.246
6-18-86	BTB	.237	.240	.237	.238	.237	0.238
9-17-86	BTB	.248	.250	.247	.250	.249	0.249
11-12-86	BTB	.250	.249	.251	.250	.250	0.250
1/12/87	JE.	.250	.249	.249	.248	.250	.249
5-12-87	J.E	.244	.247	.243	.245	—	0.245
7/31/87	JE	.243	.244	.242	.244	.242	0.243

NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC.