environmental testing inc.

SOURCE SAMPLING REPORT

FOR

PIEDMONT ASPHALT PAVING COMPANY

Gold Hill, North Carolina

Performed by:
ENVIRONMENTAL TESTING, INC.
Charlotte, North Carolina

James S. McCormack, PE
October 1988

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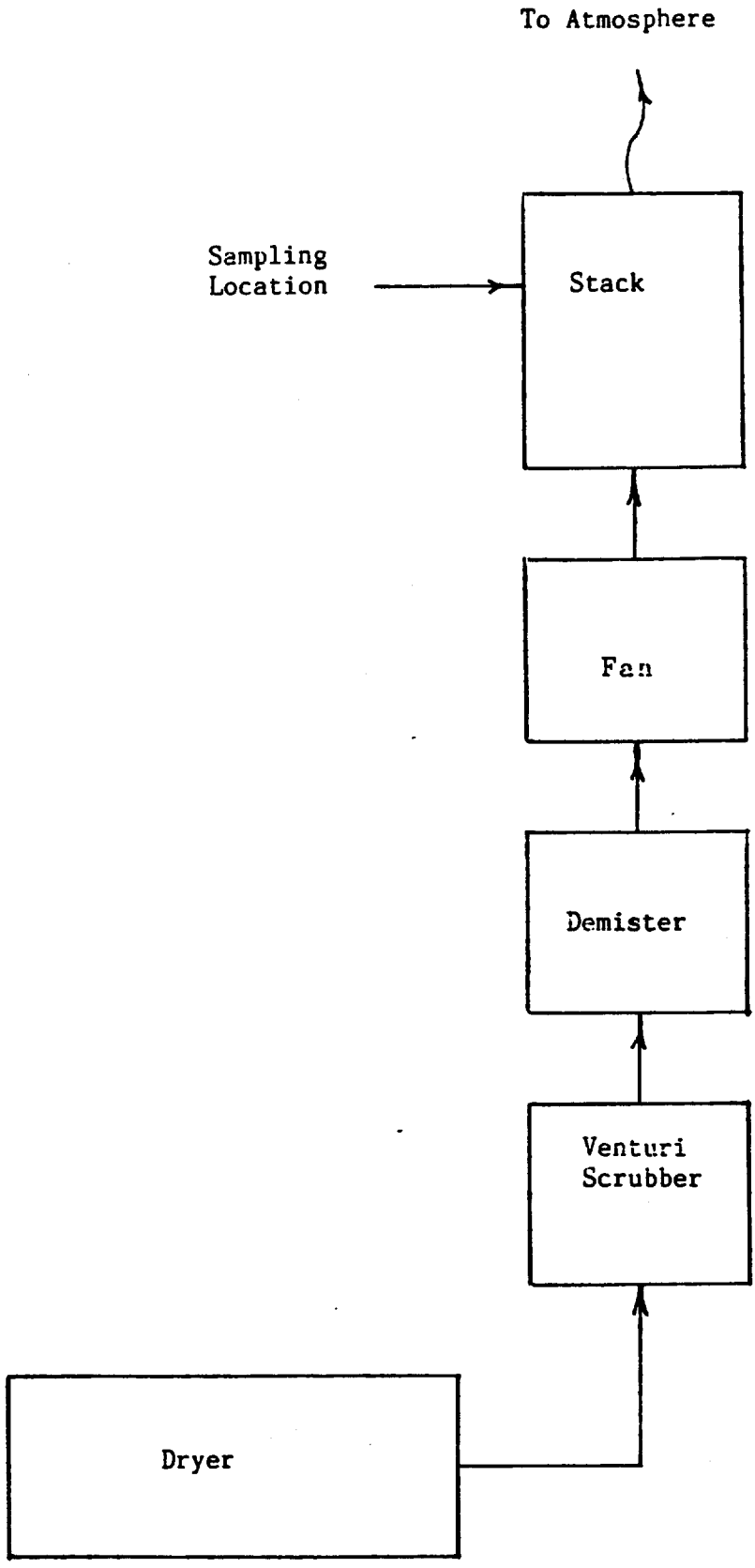
INTRODUCTION

Source sampling was performed for the Piedmont Asphalt Paving Company, Gold Hill, North Carolina, asphalt plant to determine particulate and visual emissions. Three sampling runs were made on October 24, 1988 at the sampling locations shown on Figure 1.

The measurements of stack gas flow rate, pollutant concentrations and visual emissions were made according to U.S. Environmental Protection Agency and the North Carolina Department of Natural Resources and Community Development (N.C. DNRCD) recommendations. Mr. Mike Landis, N.C. DNRCD, was present to observe the test.

The following sections of the report treat the summary of results, the process and its operation, the location of the sampling points and the sampling and analytical procedures used.



FLOW DIAGRAM

Figure 1

SUMMARY OF RESULTS

Table 1 presents the summary of results from the particulate sampling. The mean particulate concentration was 0.0258 grains per dry standard cubic foot. The mean particulate emission rate was 2.358 pounds per hour. The visual emissions observed did not exceed 5 percent during any of the sampling runs.

Based on the results of the particulate sampling, the Piedmont Asphalt Paving Company, Gold Hill, North Carolina plant was in compliance with the allowable particulate rate of 0.04 grains per dry standard cubic foot as permitted by N.C. DNRCD. The asphalt plant was in compliance with the allowable visual emission rate as permitted by N.C. DNRCD which allowed for a maximum opacity of 20 percent. Field Data sheets detailing the opacity readings can be found in Appendix B.

TABLE 1

SUMMARY OF RESULTS, PARTICULATE SAMPLING

Run Number	1	2	3
Date	10/24/88	10/24/88	10/24/88
% Isokinetic	101.99	96.12	103.71
Volume of Gas Sampled, SCF * Dry	51.899	48.091	43.244
Stack Gas Flow Rate, SCFM * Dry	11240.0	10964.1	9358.2
Stack Gas Flow Rate, ACFM	16897.7	16008.8	13903.4
Particulate:			
Catch, mgrams	119.00	67.41	57.62
Concentration, grains/ SCF * Dry	0.0353	0.0216	0.0205
Emission Rate, lbs/hr	3.401	2.028	1.646

*68°F, 29.92 in. Hg
**Nozzle, probe, filter

PROCESS DESCRIPTION AND OPERATION

The Piedmont Asphalt Paving Company plant in Gold Hill, North Carolina produced hot mix asphalt which was made from asphalt cement, sand, granite screenings and granite aggregates. The materials were dried in a rotary dryer which was fired with a single burner. The fuel was No. 2 fuel oil. The aggregates were then conveyed to a continuous drum mix where they were mixed with asphalt cement. The hot mix asphalt was then conveyed to a storage silo. Air was introduced at the burner and passed through the dryer, venturi scrubber, demister, fan and stack to the atmosphere.

The plant was a Barber & Greene continuous drum mix plant. The plant was rated at 160 tons per hour with materials at 5% moisture.

Process data - Appdx C.

LOCATION OF SAMPLING POINTS

The dimensions of the stack and the location of the sampling points are shown in Figure 2. The stack cross section was divided into 25 equal areas. The ports were labeled A, B, C, D and E. Each point was sampled for a period of 2.5 minutes per point which yielded a total test time of 62.5 minutes per run. The number of sampling points was determined by the distance from the last disturbance in the gas flow as outlined in Method 1, Federal Register, Volume 48, No. 191, 30 September 1983.

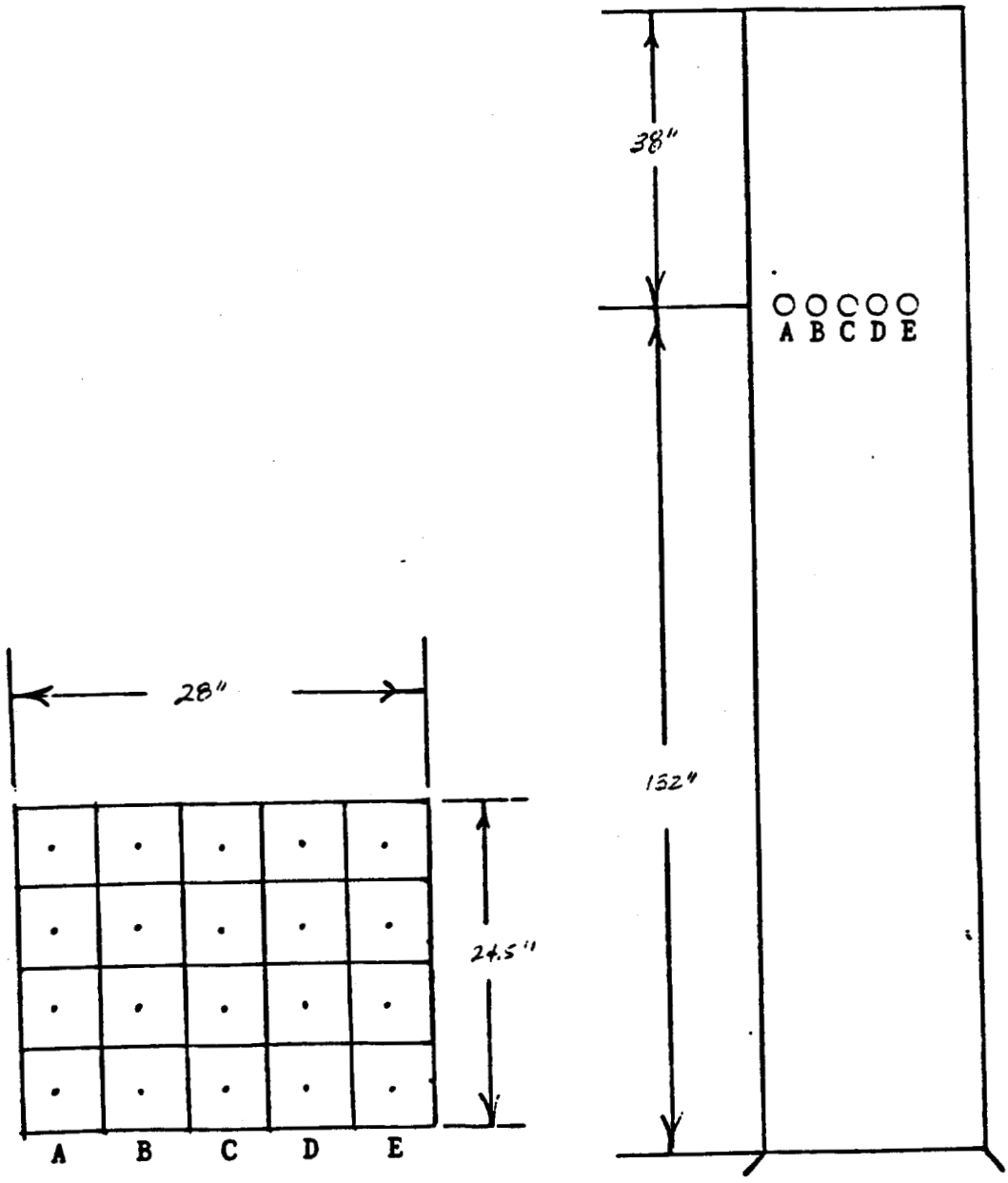


Figure 2

SAMPLING PORT AND POINT LOCATIONS

SAMPLING AND ANALYTICAL PROCEDURES

All sampling and analytical procedures used were those recommended by the U.S. Environmental Protection Agency and the N.C. DNRCD. Complete details are found in Appendix E which is a copy of the Federal Register, Volume 42, Number 160, dated 18 August 1977, the Federal Register, Volume 48, No. 191, 30 September 1983.

Sample point locations and velocity measurements were made by Methods 1 and 2. Gas composition was determined by Fyrite and Method 3 on continuous bag samples. Method 5 was used for the particulate determination. Method 9 was used for visual emissions.

APPENDICES

Summary of Method 5 Particulate Results

Piedmont Asphalt Paving Company Gold Hill NC

Run Number		1	2	3
Date		10/24/88	10/24/88	10/24/88
DN	Sample nozzle dia., in.	0.252	0.253	0.250
TT	Net time of test	62.5	62.5	62.5
PB	Barometric pressure, in. Hg.	28.94	28.94	28.94
PM	Average orifice pressure drop, in. H2O	2.762	2.498	1.990
VM	Volume of dry gas sampled, cu. ft. at meter conditions	55.02	52.61	47.99
TM	Average gas meter temp. in degrees F.	85.00	102.02	109.40
VMSTD	Volume of dry gas sampled at standard conditions*, SCF	51.899	48.091	43.244
VW	Total water collected in impingers + silica gel, ML.	287.9	244.8	239.3
VMV	Volume of water vapor at standard conditions*, SCF	13.557	11.528	11.269
PMV	Percent moisture by volume	20.712	19.336	20.672
MD	Mole fraction dry gas	0.7929	0.8066	0.7933
PCO2	Percent CO2 by volume, dry	6.40	6.43	6.50
PO2	Percent O2 by volume, dry	12.27	12.23	12.13
PCO	Percent CO by volume, dry	0.00	0.00	0.00
PN2	Percent N2 by volume, dry	81.33	81.33	81.37
MWD	Molecular weight-dry stack gas	29.515	29.515	29.525
MW	Molecular weight-stack gas	27.130	27.289	27.143
CP	Pitot tube coefficient	0.84	0.84	0.84
DPS	Average velocity head of stack gas, inches water	0.9313	0.8902	0.7708
TS	Average stack temperature, F	147.92	140.68	141.08

PSI	Static pressure of stack gas, inches Hg.	-0.028	-0.028	-0.028
PS	Stack pressure, absolute	28.912	28.912	28.912
VS	Average stack velocity, FPM	3532.6	3346.8	2906.6
AS	Stack area, inches sqrd.	686.0	686.0	686.0
QS	Stack flow rate, dry, standard conditions, DSCFM	11240.0	10964.1	9358.2
QSW	Stack flow rate, wet, standard conditions, WSCFM	14176.1	13592.3	11796.9
QA	Actual stack flow rate, ACFM	16897.7	16008.8	13903.4
PERI	Percent isokinetic	101.99	96.12	103.71
FMF	Particulate, Mg., front	119.00	67.41	57.62
CAN	Particulate, GR/DSCF front	0.0353	0.0216	0.0205
CAM	Particulate, GR/WSCF front	0.0445	0.0268	0.0259
CAT	Particulate, GR/ACF front	0.0235	0.0148	0.0138
CAW	Particulate, LB/HR front	3.401	2.028	1.646
FNP	Net sampling points	25	25	25

*68 Degrees F. 29.92 Inches Hg.

Method 5 Particulate Calculations Test Number 1

Piedmont Asphalt Paving Company Gold Hill NC

Volume of Dry Gas Sampled at Standard Conditions

$$VMSTD = \frac{17.64 * VM * (PB + PM / 13.6)}{TM + 460} = 51.899$$

Volume of Water Vapor at Standard Conditions

$$VMV = 0.04709 * VW = 13.557$$

Percent Moisture in Stack Gas

$$PMV = \frac{100 * VMV}{VMSTD + VMV} = 20.712$$

Mole Fraction of Dry Gas

$$MD = \frac{100 - PMV}{100} = 0.7929$$

Average Molecular Weight of Dry Stack Gas

$$MWD = 0.44 * PCO2 + 0.32 * PO2 + 0.28 * (PN2+PCO) = 29.515$$

Molecular Weight of Stack Gas

$$MW = MWD * MD + 18 * (1-MD) = 27.130$$

Stack Gas Velocity at Stack Conditions

$$VS = 5129.4 * CP * DPS * SQRT(TS + 460)/(PS * MW) = 3532.6$$

Stack Gas Volumetric Flow at Standard Conditions, Dry

$$QS = \frac{0.123 * VS * AS * PS * MD}{TS + 460} = 11240.0$$

Stack Gas Volumetric Flow at Stack Conditions

$$QA = \frac{QS * (TS + 460)}{17.64 * PS * MD} = 16897.7$$

Percent Isokinetic

$$PERI = \frac{1039 * (TS + 460) * VMSTD}{VS * TT * PS * MD * DN * DN} = 101.99$$

Particulate Loading -- Probe, Cyclone, Filter
(At Standard Conditions)

$$CAN = 0.0154 * FMF / VMSTD = 0.0353$$

Particulate Loading -- Probe, Cyclone, Filter
(At Stack Conditions)

$$CAT = \frac{17.64 * CAN * PS * MD}{TS + 460} = 0.0235$$

Particulate Lb/Hr -- Probe, Cyclone, Filter
(At Standard Conditions)

$$CAW = 0.00857 * CAN * QS = 3.401$$

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

APPENDIX B

Plant PIEDMONT ASPHALT PAVING CO, GOLD HILL NC

Date 10/24/88

Sampling location STK

Inside of far wall to outside of nipple (I) —

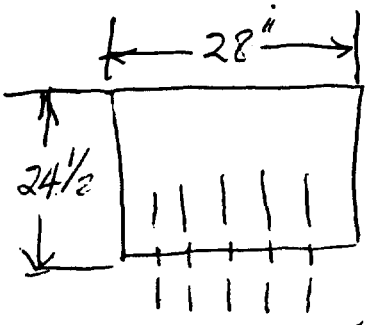
Inside of near wall to outside of nipple (nipple length) (I) —

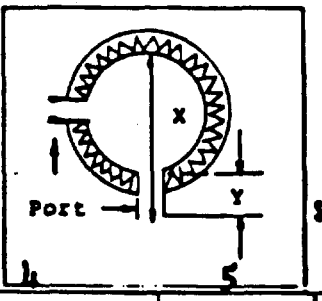
Stack I.D. (I-I) EQ DIA = 26.13

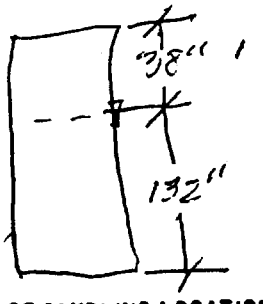
Nearest upstream disturbance ⊗ 1.5 dd

Nearest downstream disturbance 2.45 dd

Calculated by JSM







SCHEMATIC OF SAMPLING LOCATION

1	2	3	4	5
TRAVERSE POINT NUMBER	FRACTION OF STACK I D	STACK I D	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	NIPPLE LENGTH	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	~~2.45~~	24.5	2.45	1.75	4.20
2		↓	7.35	↓	9.10
3		↓	12.25	↓	14.00
4		↓	17.15	↓	18.90
5		↓	22.04	↓	23.79

METHOD 2 GAS VELOCITY AND CYCLONIC FLOW DETERMINATION

Plant and City PIEDMONT ASPHALT PAVING Co GARNER Run Date 10/24/88

Sampling Location Stk Clock Time 0800

Run Number 1 Operator JSM- RBM Amb. Temp., °F 64°F

Bar. Press., in. Hg 28.94 Static Press., in. H_2O -.38

Stack Press., in. Hg 28.912 Static Press., in. Hg -.0279

Stack Dimension, in. - Diam. or side 1 28.0 side 2 24.5

Pitot Tube (C_p) .84 Pitot Tube Leak Check <0.1 @ 8.7 in. H_2O

Field data

Traverse point number	Position, in.	Velocity head (Δp_s), in. H_2O		Stack temp., °F		Cyclonic flow determination: Δp_s at 0° reference		Cyclonic flow determination: Angle (α) which yields a null Δp	
1	4.2	1.45	.55	.20 145	145				
2	9.1	1.6	.60	.28	↓				
3	14.0	1.6	.58	.30	↓				
4	18.9	1.5	.57	.33	↓				
5	23.8	1.5	.60	.34 ↓	↓				

Average angle (α)[a] —

[a] Average of (α) must be < 10 degrees to be acceptable.

NOMAGRAPH DATA

$\Delta H_@$ 1.86 T_m 90 %M 18% P_s/P_m .999 C .84 D_b 145

$\overline{\Delta p}$ 0.8 T_s 145 DN_c .254 DN_a .250 .253 .252 Ref. Δp .6 W_b 138 7

METHOD 5 PARTICULATE FIELD DATA

Plant PIEDMONT ASPHALT PAVING CO, GOLDHILL N.C.
Run No. 1
Location Stack
Date 10/24/88
Operator JSM - LAM
Sample Box No. 1
Meter Box No. 1348
Filter No. 44
Probe No. 1
Pitot Tube Cp 0.84

Very Important — Fill In All Blanks
Leak Checks: Beg. @ 15" .015
End @ 10" .012
Pitot Tube: <0.1 @ 4.1 "H2O
<0.1 @ 4.1 "H2O
Static Pressure: -.38 "H2O
Start: 0830
Finish: 0935
Observer M. Landis Agency NCDNRCD

Bar. Press. "Hg 28.94
Meter Box ΔH@ 1.86 Y= 1.00
Assumed Tm, °F 90
Dry Bulb, °F 145
Wet Bulb, °F 138
Db - Wb, °F 7
Assumed Moisture % 18%
Ps/Pm .999
C Factor .84

Ambient Temp., °F 62°F
Heater Box Setting, °F 250°F
Probe Tip Dia., in. .252
Probe Length 4' glass
Probe Heater Setting 98%
Average Δp .8 Δp .6
Average ΔH 2.4 ΔH Rel
Process Weight —
Steam Load
Steam Pressure —

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in H_2O	Orifice Manometer (ΔH) in H_2O Desired	Orifice Manometer (ΔH) in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp °F	% CO_2	% O_2
A 1	0	24.12	1.6	4.8	4.8	65	62	7.0	240	53	149		
2	2.5	27.00	1.5	4.5	4.5	72	60	7.0	240	51	145		
3	5.0	29.82	1.5	4.5	4.5	79	61	7.0	245	54	150		
4	7.5	32.63	1.5	4.5	4.5	87	61	7.0	250	57	147		
5	10.0	35.47	1.4	4.2	4.2	94	62	6.0	250	60	145		
B 1	12.5/0	38.23	1.35	4.05	4.05	95	65	6.0	255	58	150		
2	2.5	40.78	1.2	3.6	3.6	98	65	6.0	250	58	149		
3	5.0	43.34	1.2	3.6	3.6	100	67	6.0	250	59	150		
4	7.5	46.02	1.2	3.6	3.6	102	68	6.0	245	55	149		
5	10.0	48.49	1.3	3.85	3.85	105	69	7.5	245	56	145		
C 1	0/12.5	50.96	.98	2.9	2.9	104	72	6.5	250	51	145		
2	2.5	53.36	.81	2.45	2.45	104	72	6.5	255	50	145		
3	5.0	55.55	.77	2.35	2.35	104	73	6.0	255	47	145		
4	7.5	57.67	.91	2.7	2.7	105	75	6.5	245	46	145		
5	10.0	59.87	.94	2.85	2.85	106	76	7.0	245	45	146		
D 1	12.5/0	62.19	.53	1.6	1.6	104	76	5.0	245	46	150		
2	2.5	63.95	.56	1.75	1.75	104	77	6.0	250	46	150		
3	5.0	65.81	.56	1.75	1.75	104	78	6.0	250	46	147		
4	7.5	67.79	.60	1.85	1.85	104	78	6.0	255	47	149		
5	10.0	69.58	.64	1.95	1.95	105	79	6.0	255	48	149		
E 1	0/12.5	71.54	.38	1.15	1.15	103	79	5.0	250	48	150		
2	2.5	73.06	.41	1.25	1.25	103	80	5.5	250	49	146		
3	5.0	74.67	.37	1.1	1.1	102	80	5.0	245	49	151		
4	7.5	76.15	.37	1.1	1.1	102	81	5.0	245	49	150		
5	10.0	77.64	.37	1.1	1.1	102	81	5.0	245	50	151		
	12.5	79.14											

METHOD 5 PARTICULATE FIELD DATA

Plant Piedmont Asphalt Paving Co, Coldhill NC
Run No. 2
Location Stack
Date 10/24/88
Operator JSM - RBM
Sample Box No. 2
Meter Box No. 1348
Filter No. 45
Probe No. 2
Pitot Tube Cp 0.84

Very Important — Fill In All Blanks
Leak Checks: Beg. @ 15" .014
End @ " .005
Pitot Tube: <0.1 @ 7.1 "H2O
<0.1 @ 7.1 "H2O
Static Pressure: -.38 "H2O
Start: 1033
Finish: 1139
Observer M. Landis Agency DNRCD

Bar. Press. "Hg 28.94
Meter Box ΔH@ 1.86 Y= 1.00
Assumed Tm, °F 90°F
Dry Bulb, °F 145
Wet Bulb, °F 138
Db - Wb, °F 7
Assumed Moisture % 18%
Ps/Pm .999
C Factor .84 .999

Ambient Temp., °F 66°F
Heater Box Setting, °F 250°F
Probe Tip Dia., in. .253
Probe Length 4' glass
Probe Heater Setting 90%
Average Δp .8 Δp .6
Average ΔH 2.4 ΔH Rel
Process Weight
Steam Load —
Steam Pressure —

Point	Clock Time	Dry Gas Meter, Cu. Ft	Pitot Manometer (Δp) in H_2O	Orifice Manometer (ΔH) in H_2O Desired	Orifice Manometer (ΔH) in H_2O Actual	Dry Gas Temp °F Inlet	Dry Gas Temp °F Outlet	Pump Vacuum in Hg Gauge	Box Temp °F	Impinger Temp °F	Stack Temp °F	% CO_2	% O_2
A 1	0	80.44	1.5	4.5	4.5	80	80	10.0	230	61	151		
2	2.5	82.96	1.6	4.8	4.8	93	78	11.0	230	56	146		
3	5.0	85.88	1.4	4.2	4.2	104	78	10.0	235	54	142		
4	7.5	88.63	1.3	3.85	3.85	108	78	10.0	230	56	148		
5	10.0	91.35	1.2	3.55	3.55	112	81	9.5	235	54	147		
B 1	12.5/0	93.87	1.1	3.30	3.30	114	84	9.0	235	54	146		
2	2½	96.20	1.05	3.15	3.15	116	84	9.0	240	55	142		
3	5	98.64	.98	3.0	3.0	117	84	8.0	240	54	141		
4	7½	101.02	1.0	3.0	3.0	117	87	8.0	240	55	140		
5	10	103.36	1.0	3.0	3.0	118	88	8.0	245	54	139		
C 1	0/12½	105.74	.71	2.15	2.15	117	88	7.0	245	56	139		
2	2½	107.77	.62	1.85	1.85	117	90	6.0	245	54	139		
3	5	109.67	.60	1.75	1.75	117	91	6.0	245	51	137		
4	7½	111.53	.96	2.85	2.85	119	92	8.0	245	51	138		
5	10	113.79	1.0	3.0	3.0	121	93	9.0	245	50	137		
D 1	12½/0	116.20	.58	1.75	1.75	120	95	6.0	245	50	136		
2	2½	118.06	.66	1.95	1.95	120	94	6.0	240	49	139		
3	5	120.00	.56	1.65	1.65	120	95	6.0	240	49	138		
4	7½	121.82	.68	2.05	2.05	120	96	6.0	240	51	138		
5	10	123.63	.60	1.75	1.75	121	97	6.0	240	50	138		
E 1	0/12½	125.51	.34	1.02	1.02	118	98	5.0	240	51	139		
2	2½	127.03	.35	1.08	1.08	117	98	5.0	240	51	139		
3	5	128.49	.37	1.1	1.1	117	98	5.0	240	51	140		
4	7½	130.02	.43	1.3	1.3	118	98	5.0	240	52	140		
5	10	131.66	.29	.89	.99	117	98	5.0	240	52	138		
	12½	133.05											

METHOD 5 PARTICULATE FIELD DATA

Plant PIEDMONT ASPHALT PAVING Co. (GOLD HILL, NC
Run No. 3
Location Stack
Date 10/24/88
Operator JSM - RBM
Sample Box No. 3
Meter Box No. 1348
Filter No. 46
Probe No. 3
Pitot Tube Cp 0.81

Very Important — Fill In All Blanks
Leak Checks: Beg. @ 15" .007
End @ 13" .008
Pitot Tube: <0.1 @ 7.5 "H2O
<0.1 @ 7.5 "H2O
Static Pressure: -.38 "H2O
Start: 1205
Finish: 1312
Observer M. Londis Agency NC DNRCD

Bar. Press. "Hg 28.94
Meter Box ΔH@ 1.86 Y= 1.00
Assumed Tm, °F 90
Dry Bulb, °F 145
Wet Bulb, °F 138
Db - Wb, °F 7
Assumed Moisture % 18 %
Ps/Pm .999
C Factor .84

Ambient Temp., °F 71° F
Heater Box Setting, °F 250
Probe Tip Dia., in. .250
Probe Length 4' glass
Probe Heater Setting 90%
Average Δp .8 Δp .6
Average ΔH 2.4 ΔH Ref
Process Weight
Steam Load
Steam Pressure

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in H_2O	Orifice Manometer (ΔH) in H_2O Desired	Orifice Manometer (ΔH) in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F	% CO_2	% O_2
A 1	0	133.30	1.3	3.85	3.85	98	95	10.0	225	59	137		
2	2½	136.05	1.1	3.25	3.25	100	95	8.0	230	56	137		
3	5	138.53	1.1	3.25	3.25	102	96	8.5	230	57	140		
4	7½	141.02	1.35	4.1	4.1	118	97	10.0	230	57	139		
5	10	143.75	1.2	~~3.55~~	3.55	122	98	9.0	235	58	139		
B 1	12½/0	146.38	1.2	3.6	3.6	123	98	9.0	235	54	140		
2	2½	148.97	1.05	3.2	3.2	123	98	8.5	245	59	139		
3	5	151.45	1.0	3.05	3.05	125	99	8.0	245	59	139		
4	7½	153.90	.85	2.6	2.6	126	99	7.5	250	58	140		
5	10	156.13	.78	2.4	2.4	127	100	7.5	250	58	139		
C 1	0/12½	158.35	.61	1.87	1.87	124	101	6.0	250	54	137		
2	2½	160.28	.55	1.7	1.7	124	101	6.0	245	50	138		
3	5	162.16	.54	1.65	1.65	123	101	5.5	245	50	140		
4	7½	164.01	.60	1.83	1.83	122	102	6.0	245	49	140		
5	10	165.91	.60	1.83	1.83	123	102	6.5	240	49	142		
D 1	12½/0	167.89	.28	.95	.95	122	102	6.0	245	50	143		
2	2½	169.65	.34	1.05	1.05	121	102	5.0	245	51	141		
3	5	171.18	.34	1.05	1.05	121	102	5.0	240	52	142		
4	7½	172.67	.39	1.2	1.2	120	103	5.0	240	52	143		
5	10	174.22	.34	1.05	1.05	120	103	5.0	240	53	146		
E 1	0/12½	175.69	.15	.45	.45	116	103	4.0	240	54	146		
2	2½	176.73	.18	.54	.54	116	103	4.0	240	52	145		
3	5	177.82	.20	.60	.60	116	103	5.0	240	53	144		
4	7½	179.01	.22	.64	.64	115	103	5.5	240	54	145		
5	10	180.20	.17	.50	.50	114	103	4.5	240	54	146		
	12½	181.29											

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METHOD 3 - ORSAT AND DRY MOLECULAR WEIGHT DETERMINATION

Plant PIEDMONT ASPHALT PAVING Co, GOLD HILL NC Sample Location STACK

Sample Type - Continuous ✓ Pump Leakfree @ 10" ? YES

Oxygen Check 20.9% ± 0.1% 20.9 Fuel Type No. 2 Fuel Oil

Orsat Leak Check @ 4 min.: Pipet Levels - Leakfree ? OK

Buret 20.1 - 20.1 = <0.2 ml ? OK

Run No. 1 Sample Date 10/24/88 Ambient Temp. °F 62°

Sampling Time (24 - hr clock) 0830-0935 Analysis By JSM

Gas \ Run	1 Actual	1 Net	2 Actual	2 Net	3 Actual	3 Net	Avg. %	Mult.	Molecular Wt. Dry lb/lb mole
CO_2	6.4	6.4	6.4	6.4	6.4	6.4	6.40	.44	2.816
O_2	18.7	12.3	18.6	12.2	18.7	12.3	12.27	.32	3.926
CO	18.7	0.0	18.6	0.0	18.7	0.0	0.00	.28	0.000
N_2	100	81.3	100	81.4	100	81.3	81.33	.28	22.772
								Total	29.514

$F_o = \frac{20.9 - \%O_2}{\%CO_2} = NA$

Run No. 2 Sample Date 10/24/88 Ambient Temp. °F 66°

Sampling Time (24 - hr clock) 1033-1139 Analysis By JSM

Gas \ Run	1 Actual	1 Net	2 Actual	2 Net	3 Actual	3 Net	Avg. %	Mult.	Molecular Wt. Dry lb/lb mole
CO_2	6.4	6.4	6.5	6.5	6.4	6.4	6.43	.44	2.831
O_2	18.7	12.3	18.6	12.1	18.7	12.3	12.23	.32	3.915
CO	18.7	0.0	18.6	0.0	18.7	0.0	0.00	.28	0.000
N_2	100	81.3	100	81.4	100	81.3	81.33	.28	22.772
								Total	29.518

$F_o = \frac{20.9 - \%O_2}{\%CO_2} = NA$

Run No. 3 Sample Date 10/24/88 Ambient Temp. °F 71

Sampling Time (24 - hr clock) 1205-1312 Analysis By JSM

Gas \ Run	1 Actual	1 Net	2 Actual	2 Net	3 Actual	3 Net	Avg. %	Mult.	Molecular Wt. Dry lb/lb mole
CO_2	6.4	6.4	6.6	6.6	6.5	6.5	6.50	.44	2.860
O_2	18.7	12.3	18.6	12.0	18.6	12.1	12.13	.32	3.822
CO	18.7	0.0	18.6	0.0	18.6	0.0	0.00	.28	0.000
N_2	100	81.3	100	81.4	100	81.4	81.37	.28	22.783
								Total	29.524

Fuel type	F_o range
Coal:	
Anthracite and lignite	1.016-1.130
Bituminous	1.083-1.230
Wood	1.000-1.120
Wood bark	1.003-1.130

$F_o = \frac{20.9 - \%O_2}{\%CO_2} = NA$

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METHOD 5 SAMPLE RECOVERY AND INTEGRITY SHEET

Plant PIEDMONT ASPHALT PAVING CO, GOLDHILL NC Recovered By RBM - JAF
Sample Location STACK Recovery Date 10/24/88

Run Number	1	2	3
Sample Date	10/24/88	10/24/88	10/24/88
Sample Box Number	1	2	3
Probe Number	1	2	3
Filter Number	44	45	46

MOISTURE RECOVERY

Impingers Cont. Number	1-1	1-2	1-3
Description of Water	Turb. d	Turb. d	Turb. d
Liquid Level Marked	✓	✓	✓
Final Volume (wt.), ml	466	426	422
Initial Volume (wt.), ml	200	200	200
Net Volume (wt.), ml (g)	266	226	222
Silica Gel Cont. Number	1-1	1-2	1-3
Silica Gel % Spent	60%	50%	40%
Final Weight, g	221.9	218.8	217.3
Initial Weight, g	200.0	200.0	200.0
Net Weight, g	21.9	18.8	17.3
Total Moisture, g	287.9	244.8	239.3

PARTICULATE RECOVERY

Filter Cont. Number	1-1	1-2	1-3
Particulate Description	light gray	medium gray	light gray
Filter Cont. Sealed	✓	✓	✓
Final Weight, mg	523.00	519.65	499.44
Final Weight Audit, mg	522.98	519.55	499.42
Initial Weight, mg	490.01	486.27	471.10
Initial Weight Audit, mg	489.96	486.30	471.11
Filter Catch, mg	33.00	33.31	28.32
Probe Rinse Cont. Number	1-1	1-2	1-3
Liquid Level Marked	✓	✓	✓
Final Weight, mg	98159.7	104743.4	100151.6
Final Weight Audit, mg	98159.3	104743.7	100151.1
Initial Weight, mg	98073.4	104729.5	100122.0
Initial Weight Audit, mg	98073.6	104729.4	100122.1
Less Acetone Blank, mg	0	0	0
Acetone Rinse Catch, mg	86.00	34.1	29.3
Total Particulate, mg	119.00	67.41	57.62
Acetone Blank Number	B		
Final Weight, mg	104199.1		
Final Weight Audit, mg	104199.3		
Initial Weight, mg	104199.3		
Initial Weight Audit, mg	104199.1		
Acetone Residue, mg	0.0		
Acetone Volume, ml	200		
Concentration, mg/mg	$< 5 \times 10^{-6}$		

LABORATORY CUSTODY

Received By: RBM
Date Received: 10/24/88
Stored & Locked: ✓
Remarks: N/A

Visible Emission Summary Data Sheet

Company Piedmont Asphalt Paving Co. Date 10-24-88 Location Gold Hill, NC

Start time 0830 Emission point Stack

Start no	Total opacity	Average opacity	Start no	Total opacity	Average opacity	Start no	Total opacity	Average opacity	Start no	Total opacity	Average opacity	Start no	Total opacity	Average opacity	Start no	Total opacity	Average opacity
1	70	2.9	37			73			109			145			181		
2	85	3.5	38			74			110			146			182		
3	90	3.8	39			75			111			147			183		
4	85	3.5	40			76			112			148			184		
5	75	3.1	41			77			113			149			185		
6	85	3.5	42			78			114			150			186		
7	90	3.8	43			79			115			151			187		
8	75	3.1	44			80			116			152			188		
9	110	4.6	45			81			117			153			189		
10	95	4.0	46			82			118			154			190		
11	65	2.7	47			83			119			155			191		
12	90	3.8	48			84			120			156			192		
13	70	2.9	49			85			121			157			193		
14	95	4.0	50			86			122			158			194		
15	85	3.5	51			87			123			159			195		
16	70	2.9	52			88			124			160			196		
17	75	3.1	53			89			125			161			197		
18	50	2.1	54			90			126			162			198		
19	35	1.4	55			91			127			163			199		
20	10	0.4	56			92			128			164			200		
21	30	1.2	57			93			129			165			201		
22	40	1.7	58			94			130			166			202		
23	55	2.3	59			95			131			167			203		
24	30	1.2	60			96			132			168			204		
25	45	1.9	61			97			133			169			205		
26	40	1.7	62			98			134			170			206		
27	20	0.8	63			99			135			171			207		
28	25	1.0	64			100			136			172			208		
29	20	0.8	65			101			137			173			209		
30	20	0.8	66			102			138			174			210		
31			67			103			139			175			211		
32			68			104			140			176			212		
33			69			105			141			177			213		
34			70			106			142			178			214		
35			71			107			143			179			215		
36			72			108			144			180			216		

Maximum average 4.6 % Start number of six minute average 1

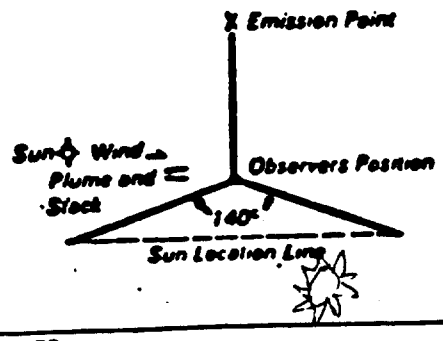
Number of nonoverlapping averages in excess of standard 0 Listing start number of these averages _____

Calculated by Jeff Francis Date 10-24-88 Reviewed by _____ Date _____

Visible Emission Observation Form

SOURCE NAME: Piedmont Asphalt Paving Co.	OBSERVATION DATE: 10-24-88
ADDRESS:	START TIME: 0850
CITY: Mt. Sanhmeir — STATE: NC — ZIP:	STOP TIME: 0930
PHONE:	SOURCE ID NUMBER:
PROCESS EQUIPMENT: Asphalt Plant — OPERATING MODE:	
CONTROL EQUIPMENT: Venturi-Scrubber — OPERATING MODE:	
DESCRIBE EMISSION POINT: Stack	
HEIGHT ABOVE GROUND LEVEL: 30' — HEIGHT RELATIVE TO OBSERVER: 30'	
DISTANCE FROM OBSERVER: 150' — DIRECTION FROM OBSERVER: NW	
DESCRIBE EMISSIONS: H2O Particulate	
EMISSION COLOR: Gray-White — PLUME TYPE: CONTINUOUS ☒ FUGITIVE ☐ INTERMITTENT ☐	
WATER DROPLETS PRESENT: NO ☐ YES ☒ — IF WATER DROPLET PLUME: ATTACHED ☐ DETACHED ☐	
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Immediately after steam dissipation	
DESCRIBE BACKGROUND: Sky	
BACKGROUND COLOR: Blue — SKY CONDITIONS: Clear	
WIND SPEED: 0-2 Calm — WIND DIRECTION: W	
AMBIENT TEMP START: 52 STOP: 55°F — Db: 50 Wb: 48 — RH,percent:	

Source Layout Sketch — Draw North Arrow



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

AVERAGE OPACITY FOR HIGHEST PERIOD: 4.6	NUMBER OF READINGS ABOVE: 20 % WERE: 0
RANGE OF OPACITY READINGS: MINIMUM 0	MAXIMUM 5
OBSERVER'S NAME (PRINT): Jeff Francis	
OBSERVER'S SIGNATURE: Jeff Francis	DATE: 10-24-88
ORGANIZATION: ETI	
CERTIFIED BY: ETA	DATE: 9-21-88
VERIFIED BY:	DATE:

COMMENTS:

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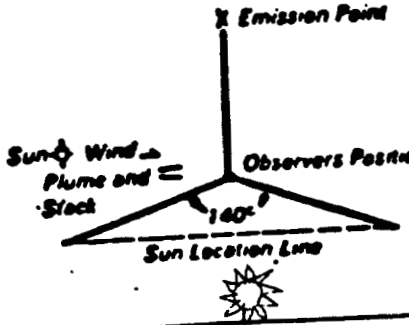
SIGNATURE: — TITLE: — DATE:

Visible Emission Observation Form

SOURCE NAME	Piedmont Asphalt Paving Co.
ADDRESS	
CITY	Misenheimer
STATE	NC
ZIP	
PHONE	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Asphalt Plant
OPERATING MODE	
CONTROL EQUIPMENT	Venturi Scrubber
OPERATING MODE	
DESCRIBE EMISSION POINT	Stack
HEIGHT ABOVE GROUND LEVEL	30'
HEIGHT RELATIVE TO OBSERVER	30'
DISTANCE FROM OBSERVER	150'
DIRECTION FROM OBSERVER	NW
DESCRIBE EMISSIONS	H_2O - Particulate
EMISSION COLOR	Gray-White
PLUME TYPE	CONTINUOUS ☒ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☐ YES ☒
IF WATER DROPLET PLUME	ATTACHED ☒ DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Immediately after Steam dissipation
DESCRIBE BACKGROUND	Sky
BACKGROUND COLOR	Blue White
SKY CONDITIONS	50% Cloudy
WIND SPEED	0-2
WIND DIRECTION	W
AMBIENT TEMP. START 57 / STOP	Db 64 Wb 55
RH, percent	

Source Layout Sketch — Draw North Arrow



OBSERVATION DATE	START TIME	STOP TIME
10-24-88	1020	1130

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

AVERAGE OPACITY FOR HIGHEST PERIOD	4.0
NUMBER OF READINGS ABOVE 20 % WERE	0
RANGE OF OPACITY READINGS MINIMUM	0
MAXIMUM	5
OBSERVER'S NAME (PRINT)	Jeff Francis
OBSERVER'S SIGNATURE	Jeff Francis
DATE	10-24-88
ORGANIZATION	ETI
CERTIFIED BY	ETA
DATE	9-21-88
VERIFIED BY	
DATE	

COMMENTS

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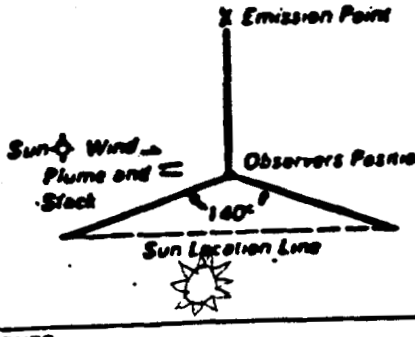
TITLE

DATE

Visible Emission Observation Form

SOURCE NAME	Piedmont Asphalt Paving Co.
ADDRESS	
CITY	Mocksville
STATE	N.C.
ZIP	
PHONE	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	Asphalt Plant
OPERATING MODE	
CONTROL EQUIPMENT	Venturi Scrubber
OPERATING MODE	
DESCRIBE EMISSION POINT	Stack
HEIGHT ABOVE GROUND LEVEL	120'
HEIGHT RELATIVE TO OBSERVER	120'
DISTANCE FROM OBSERVER	150'
DIRECTION FROM OBSERVER	N W
DESCRIBE EMISSIONS	H_2O - Particulate
EMISSION COLOR	Gray - White
PLUME TYPE	CONTINUOUS ☒ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☐ YES ☒
IF WATER DROPLET PLUME	ATTACHED ☐ DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Immediately after steam dissipation
DESCRIBE BACKGROUND	Sky
BACKGROUND COLOR	Blue
SKY CONDITIONS	Clear
WIND SPEED	0-2
WIND DIRECTION	W
AMBIENT TEMP START	64°
AMBIENT TEMP STOP	67°
Db	67
Wb	56
RH, percent	

Source Layout Sketch — Draw North Arrow



OBSERVATION DATE	START TIME	STOP TIME
10-24-88	1203	1503

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

AVERAGE OPACITY FOR HIGHEST PERIOD	NUMBER OF READINGS ABOVE % WERE
RANGE OF OPACITY READINGS	MINIMUM / MAXIMUM
OBSERVER'S NAME (PRINT)	Jeff Francis
OBSERVER'S SIGNATURE	Jeff Francis
DATE	10-24-88
ORGANIZATION	EPI
CERTIFIED BY	EPI
DATE	9-21-88
VERIFIED BY	
DATE	

COMMENTS

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SIGNATURE

TITLE

DATE

APPENDIX C

PROCESS DATA

The plant processed asphalt at 150 tons per hour using a continuous drum mix operation.

APPENDIX D

TEST PARTICIPANTS

James S. McCormack, PE	President Environmental Testing, Inc.
Richard B. McCain III	Environmental Scientist Environmental Testing, Inc.
Jeff A. Francis	Environmental Scientist Visible Emissions Specialist Environmental Testing, Inc.

APPENDIX E

CALIBRATION INFORMATION

NOZZLES

Each new set of nozzles purchased by ETI are first machined and calibrated before being put into field use. Thereafter, whenever it becomes apparent that a nozzle has been damaged, it is again machined and recalibrated. A set of three is matched to within 0.002 inches (Difference between high and low readings). Nozzles are checked prior to each source test.

PITOT TUBES

All pitot tubes used by ETI whether separate or attached to a sampling probe were made by ETI personnel. Prior to being put into field use, they are calibrated. In general, if a type "S" pitot tube is constructed properly, and not positioned too closely to the probe nozzle or any other obstruction, it will have a Cp of 0.83 - 0.87. As long as the pitot tube is not damaged its calibration should not change. All ETI pitot tubes are made to have a Cp of 0.84. If a pitot tube does not initially have a Cp of 0.84, it is altered until a reading of 0.84 is obtained. Pitot tubes are checked before each source test and receive a complete calibration once a year.

DRY GAS METER AND ORIFICE METER

Complete meter box calibrations are performed annually. One point calibrations at the average orifice meter and maximum vacuum readings encountered during the compliance test are performed after each source test. If the dry gas meter calibration factor differs from 1.00 by more than \0.02 then the dry gas meter is repaired and given an annual calibration.

THERMOMETERS, FYRITES, ORSAT AND ORSAT BAGS

Each new thermometer, pyrometer and thermocouple purchased or manufactured by ETI is checked and calibrated before being put into field use. After each source test each temperature sensing device used on the test receives a one point calibration check according to U.S. EPA guidelines.

Fyrites, orsat and orsat bags are checked before and after each source test. If they do not function according to U.S. EPA protocol that piece of equipment is either repaired or replaced.

LABORATORY EQUIPMENT

ETI has a written quality assurance document that covers calibration and maintenance of laboratory equipment. This includes calibration of the analytical balance against Class S weights, and service contracts to maintain traceability to N.B.S. Calibration of thermometers, barometers, stopwatches and wet test meters are traceable to N.B.S. A copy of our quality assurance document may be obtained by written request.

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METHOD 5 PRETEST - POSTEST CALIBRATION CHECKS

Plant Piedmont Asphalt Paving Co, Gold Hill NC Calibrated by RBM
Meter box number 1348 Date 10/21/88

Dry Gas Meter
Pretest meter calibration factor, Y = 1.00 (within ± 2%)
Postest meter calibration factor, Y = 1.008 (within ± 5% of pretest)
Recalibration required? Circle one: yes or (no) If yes new Y = ____
Lower cal. factor, Y = ____ for calculations (pretest or postest)

Dry Gas Meter Thermometers
Was a pretest temperature correction used? Circle one: yes or (no) If yes temperature correction ____ (within ± 5.4°F over range)
Postest comparison with mercury-in-glass thermometer? (within ±10.8°F at ambient temperature) Recalibration required? Circle one: yes or (no)
Recalibration temperature correction? ____ (within ±5.4°F over range
If yes, no correction necessary for calculations if meter thermometer temperature is higher; if calibration temperature is higher, add correction to average meter temperature for calculations

Stack Temperature Sensor
Was a pretest temperature correction used? Circle one: yes or (no) If yes temperature correction ____ °F (within ±1.5% in °R over range)
Average stack temperature of compliance test, 603 °R
Temperature of ref. thermometer for recalibration #1 600 #2 ____ °R (within ± 10% of the average stack temperature)
Temperature of stack thermometer for recalibration #1 598 #2 ____ °R
Diff. between ref. and stack thermometer temps. #1 2 #2 ____ °R
Do the ref. and stack values agree within ±1.5%? Circle one: (yes) or no
If yes, no correction is necessary for calculations
If no, calculations must be done twice--once with the recorded values and once with the average stack temperature corrected to correspond to the reference temperature differential; both final result values must be reported since there is no way to determine which is correct

Barometer
Was the pretest field barometer reading correct? Circle one: (yes) or no
Postest comparison? 0.006 in. Hg (±0.1 in. Hg) Recalibration required? Circle one: yes or (no) If yes, no correction necessary for calculations when the field barometer has a lower reading; if the mercury-in-glass reading is lower, subtract the difference from the field data readings for the calculations.

	Pretest	Postest
Hg in glass	29.389	29.164
Field	29.400	29.17
Difference	.011	.006

Nozzle
Was the nozzle calibrated to the nearest .001 in.? Circle one: (yes) or no

Nozzle #1:	0.252	0.252	0.252	0.252	0.252	: Average 0.252
Nozzle #2:	0.254	0.254	0.253	0.253	0.253	: Average 0.253
Nozzle #3:	0.251	0.250	0.250	0.249	0.249	: Average 0.250

Impinger Thermometer
Was a pretest temperature correction used? Circle one: yes or (no) If yes temperature correction ____ (within ±5.4°F over range)

POSTEST DRY GAS METER CALIBRATION DATA FORM (English Units)

Test Number 1 Date 11/25/88 Meter Box No. 1348 Plant Piedmont Agriculture Coating Co.

Barometric Pressure, P_b = 29.164 in. Hg Dry Gas Meter No. 1 Pretest Y 1.00

Orifice manometer setting, inches H_2O ΔH	Gas Volume: Wet test meter, ft³ V_w	Gas Volume: Dry gas meter, ft³ V_d	Temperature: Wet test meter, °F t_w	Temperature: Dry Gas Meter Inlet °F t_{d_i}	Temperature: Dry Gas Meter Outlet °F t_{d_o}	Temperature: Dry Gas Meter Average °F t_d	Time min. θ	Vacuum setting in. Hg	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$
2.42	10	10.79	67	130	103	116.5	12:07	11.0	1.008	$\frac{10 \times 29.164 (116.5 + 460)}{10.79 (29.164 + \frac{2.42}{13.6})(67 + 460)}$
2.42	10	10.80	67	130	103	116.5	12:17	11.0	1.007	$\frac{10 \times 29.164 (116.5 + 460)}{10.80 (29.164 + \frac{2.42}{13.6})(67 + 460)}$
2.42	10	10.78	67	130	103	116.5	12:11	11.0	1.009	$\frac{10 \times 29.164 (116.5 + 460)}{10.78 (29.164 + \frac{2.42}{13.6})(67 + 460)}$
										1.008

V_w = Gas volume passing through the wet test meter, ft.³

V_d = Gas volume passing throught the dry gas meter, ft.³

t_w = Temperature of the gas in the wet test meter, °F

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F

ΔH = Pressure differential across orifice, in. H_2O

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ± 0.05Y

P_b = Barometric pressure, in. Hg

θ = Time of calibration run, min.

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PRETEST - POSTEST THERMOMETER CALIBRATION

Client PIEDMONT ASPHALT PAVING CO CHILD HILL NC Date 10/21/88

Location STACK Ref. Thermometer #5

Thermometer	Pretest		Postest	
	Temp., °F	Ref. Temp., °F	Temp., °F	Ref. Temp., °F
DGM # 1346	70/70	70	68/68	68
DGM # 1264	69/70	70	—	—
DGM # —	—	—	—	—
DGM # —	—	—	—	—
Impinger #1	70	70	68	68
Impinger #2	69	70	67	68
Impinger #3	69	70	67	68
Impinger #4	70	70	68	68
Impinger #5	70	70	68	68
WB # 1	69	70	68	68
DB # 1	70	70	69	68
Box #1	70	70	68	68
Box #2	70	70	68	68
Box #3	71	70	68	68
Box #4	—	—	—	—
Box #5	—	—	—	—
Box #6	—	—	—	—
WB Omega 873	70	70	—	—
DB Omega 873	70	70	—	—
WB Omega #1	70	70	68	68
DB Omega #1	69	70	67	68
Probe 4' #1	70	70	67	68
Probe 4' #2	70	70	—	—
Probe ' #1	—	—	—	—
Probe ' #2	—	—	—	—
—	—	—	—	—

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RAC STAKSAMPLR CALIBRATION SHEET

Meter Box Serial Number: 1348 Barometric Pressure (P_b): 29.522

Leak Check @ 6.2 in. H_2O: OK Date: 09-16-88 Calibrated by: PRJ

Pump: OK Pump Oil: OK Clean Quick Connects: OK

Manometers: OK Dry Test Meter: OK Thermometers: OK

Lights: OK Electrical Check: OK Variac: OK

Vacuum Gauge: OK Leak Check @ 27" Hg.: <0.001 CFM

Man. Orifice	CF_w	CF_d	T_w	IT_d	OT_d	T_d avg.	Time t
0.5	5	5.31	71.0	111.0	97.0	104.00	12.74
1.0	5	5.30	71.0	113.0	97.0	105.00	9.24
1.5	10	10.62	71.0	116.5	98.5	107.50	15.31
2.0	10	10.68	71.0	122.0	101.0	111.50	13.28
3.0	10	10.68	71.0	124.0	102.0	113.00	10.93
4.0	10	10.68	71.0	127.0	103.0	115.00	9.61

Calculate Y and $\Delta H_@$ as follows:

$$Y = \frac{CF_w P_b (T_{d\ avg.} + 460)}{CF_d (P_b + \Delta H/13.6)(T_w + 460)} = 1.00 \qquad \Delta H_@ = \frac{0.0317\ \Delta H}{P_b (T_d + 460)} \left(\frac{(T_w + 460)\ t}{CF_w}\right)^2 = 1.86$$

Tolerances: $Y = 0.90 - \underline{1.00} - 1.10\ Y +/- 0.02Y$ $\Delta H_@ = 1.6 - \underline{1.84} - 2.1$ $\Delta H_@ +/- 0.15$ in.

CALIBRATION CALCULATIONS PUMP AND ORIFICE METER

Manometer Delta H 0.5 in. H_2O

$$Y = \frac{5 \times 29.522\ (104.00 + 460)}{5.31\ (29.522 + 0.0368)(71.0 + 460)} = 0.999 \qquad \Delta H_@ = \frac{0.01585}{29.522\ (104.00 + 460)} \left(\frac{(71.0 + 460)\ 12.74}{5}\right)^2 = 1.743$$

Manometer Delta H 1.0 in. H_2O

$$Y = \frac{5 \times 29.522\ (105.00 + 460)}{5.30\ (29.522 + 0.0737)(71.0 + 460)} = 1.001 \qquad \Delta H_@ = \frac{0.03170}{29.522\ (105.00 + 460)} \left(\frac{(71.0 + 460)\ 9.24}{5}\right)^2 = 1.830$$

Manometer Delta H 1.5 in. H_2O

$$Y = \frac{10 \times 29.522\ (107.50 + 460)}{10.62\ (29.522 + 0.1103)(71.0 + 460)} = 1.003 \qquad \Delta H_@ = \frac{0.04755}{29.522\ (107.50 + 460)} \left(\frac{(71.0 + 460)\ 15.31}{10}\right)^2 = 1.876$$

Manometer Delta H 2.0 in. H_2O

$$Y = \frac{10 \times 29.522\ (111.50 + 460)}{10.68\ (29.522 + 0.1471)(71.0 + 460)} = 1.003 \qquad \Delta H_@ = \frac{0.06340}{29.522\ (111.50 + 460)} \left(\frac{(71.0 + 460)\ 13.28}{10}\right)^2 = 1.869$$

Manometer Delta H 3.0 in. H_2O

$$Y = \frac{10 \times 29.522\ (113.00 + 460)}{10.68\ (29.522 + 0.2206)(71.0 + 460)} = 1.003 \qquad \Delta H_@ = \frac{0.09510}{29.522\ (113.00 + 460)} \left(\frac{(71.0 + 460)\ 10.93}{10}\right)^2 = 1.894$$

Manometer Delta H 4.0 in. H_2O

$$Y = \frac{10 \times 29.522\ (115.00 + 460)}{10.68\ (29.522 + 0.2941)(71.0 + 460)} = 1.004 \qquad \Delta H_@ = \frac{0.12680}{29.522\ (115.00 + 460)} \left(\frac{(71.0 + 460)\ 9.61}{10}\right)^2 = 1.945$$

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NOZZLE CALIBRATION

Date: 09-16-88
By: PRJ

Set Number 1 Orange Box

Nozzle I.D.	D_1, in.	D_2, in.	D_3, in.	D_4, in.	D_5, in.	D, in.	$D_{ave.}$
.187-1	0.186	0.188	0.188	0.187	0.187	0.002	0.187
.187-2	0.189	0.189	0.189	0.190	0.190	0.001	0.189
.187-3	0.185	0.186	0.186	0.186	0.186	0.001	0.186
.203-1	0.207	0.207	0.207	0.208	0.207	0.001	0.207
.250-1	0.252	0.252	0.252	0.252	0.252	0.000	0.252
.250-2	0.254	0.254	0.253	0.253	0.253	0.001	0.253
.250-3	0.251	0.250	0.250	0.249	0.249	0.002	0.250
.300-1	0.304	0.304	0.305	0.304	0.304	0.001	0.304
.300-2	0.303	0.303	0.304	0.303	0.303	0.001	0.303
.300-3	0.300	0.301	0.300	0.301	0.300	0.001	0.300
.335-1	0.336	0.336	0.336	0.335	0.336	0.001	0.336
.375-1	0.375	0.375	0.376	0.375	0.376	0.001	0.375
.375-2	0.375	0.374	0.375	0.375	0.375	0.001	0.375
.375-3	0.375	0.375	0.375	0.376	0.374	0.002	0.375
.400-1	0.404	0.405	0.405	0.405	0.405	0.001	0.405
.500-1	0.505	0.504	0.505	0.504	0.504	0.001	0.504
.500-2	0.504	0.502	0.503	0.503	0.503	0.002	0.503
.500-3	0.502	0.503	0.502	0.502	0.502	0.001	0.502
.625-1	0.619	0.618	0.618	0.619	0.619	0.001	0.619
.775-1	0.770	0.778	0.780	0.780	0.780	0.002	0.779
1.00-1	1.000	1.000	0.999	1.000	1.000	0.001	1.000

Set Number 2 Blue Box

Nozzle I.D.	D_1, in.	D_2, in.	D_3, in.	D_4, in.	D_5, in.	D, in.	$D_{ave.}$
.187-1	0.185	0.185	0.186	0.185	0.184	0.002	0.185
.187-2	0.184	0.185	0.184	0.185	0.185	0.001	0.185
.187-3	0.186	0.186	0.186	0.186	0.186	0.000	0.186
.203-2	0.207	0.207	0.206	0.206	0.207	0.001	0.207
.250-1	0.250	0.250	0.250	0.250	0.249	0.001	0.250
.250-2	0.251	0.251	0.252	0.252	0.252	0.001	0.252
.250-3	0.249	0.250	0.249	0.251	0.250	0.002	0.250
.300-1	0.301	0.302	0.302	0.302	0.301	0.001	0.302
.300-2	0.302	0.303	0.303	0.302	0.302	0.001	0.302
.300-3	0.301	0.300	0.302	0.302	0.302	0.002	0.302
.335-2	0.339	0.339	0.340	0.339	0.338	0.002	0.339
.375-1	0.378	0.378	0.377	0.378	0.378	0.001	0.378
.375-2	0.376	0.377	0.376	0.376	0.377	0.001	0.376
.375-3	0.376	0.376	0.376	0.375	0.375	0.001	0.376
.500-1	0.496	0.495	0.496	0.496	0.496	0.001	0.496
.500-2	0.497	0.499	0.499	0.499	0.499	0.002	0.499
.500-3	0.497	0.498	0.498	0.498	0.498	0.001	0.498

Where:

$D_{1,2,3,4,5}$ = nozzle diameter measured on a different diameter, in.
Tolerance = measure within 0.001 in.

D = maximum difference in any two measurements, in.
Tolerance = 0.004 in.

$D_{ave.}$ = average of D_1, D_2, D_3, D_4, and D_5.

TYPE S PITOT TUBE INSPECTION DATA FORM

Date: 09-15-88
Calibrator: PRJ

Specifications:
1.) Pitot tube assembly must be level.
2.) If pitot tube is damaged explain under comments section.
3.) $z = A \sin \tau$ (<0.125) and $w = A \sin \theta$ (<0.03125)
4.) α <10° and β <5°

I.D.	α_1°	α_2°	β_1°	β_2°	τ°	θ°	A, in.	z, in.	w, in.	P_A, in.	P_B, in.	D_t, i
36''- 1	2.0	2.0	1.0	1.0	1.5	0.5	0.778	0.020	0.00679	0.389	0.389	0.37
36''- 2	2.0	1.0	1.5	1.5	0.0	0.5	1.152	0.000	0.01005	0.576	0.576	0.37
40''- 1	1.0	2.0	1.0	1.0	0.0	0.5	1.098	0.000	0.00958	0.549	0.549	0.38
54''- 1	3.0	2.5	1.0	0.5	1.0	1.0	1.005	0.018	0.01754	0.502	0.503	0.37
66''- 1	1.0	0.5	3.5	0.0	0.0	1.5	1.042	0.000	0.02728	0.521	0.521	0.38
96''- 1	1.5	0.5	2.5	2.5	2.0	1.0	0.908	0.032	0.01585	0.454	0.454	0.37
4' - 1	1.0	2.5	1.0	3.5	0.5	0.5	0.967	0.008	0.00844	0.483	0.484	0.37
4' - 2	2.0	2.0	1.0	1.0	0.5	1.0	0.893	0.008	0.01558	0.446	0.447	0.37
4' - 3	4.0	2.0	1.5	3.0	1.0	1.0	0.877	0.015	0.01531	0.438	0.439	0.37
4' - 4	1.0	3.5	3.0	1.0	0.5	0.5	0.839	0.007	0.00732	0.419	0.420	0.37
4' - 5	1.0	1.0	2.0	2.0	0.5	0.5	0.865	0.007	0.00755	0.432	0.433	0.37
4' - 6	2.0	1.5	1.5	0.0	1.0	0.5	0.955	0.017	0.00833	0.477	0.478	0.37
5' - 1	2.5	1.0	1.0	0.5	1.0	1.0	1.000	0.017	0.01745	0.500	0.500	0.37
5' - 2	2.0	2.0	1.0	0.0	0.0	1.5	1.044	0.000	0.02733	0.522	0.522	0.37
5' - 3	1.0	1.0	1.0	1.0	1.0	0.5	1.049	0.018	0.00915	0.524	0.524	0.37
5' - 4	0.5	2.0	1.0	0.0	2.0	1.0	1.038	0.036	0.01812	0.519	0.519	0.38
6' - 1	0.0	0.0	1.5	0.5	0.5	1.0	0.996	0.009	0.01738	0.498	0.498	0.38
6' - 2	1.0	0.5	0.0	0.0	1.0	1.5	1.004	0.018	0.02628	0.502	0.502	0.37
6' - 3	1.0	1.0	1.0	1.0	0.5	0.5	1.006	0.009	0.00878	0.503	0.503	0.37
6' - 4	1.0	0.5	1.0	0.0	2.0	1.0	1.000	0.035	0.01745	0.500	0.500	0.37
8' - 1	1.0	1.5	3.0	2.0	3.0	1.0	0.845	0.044	0.01475	0.423	0.422	0.37
8' - 2	0.0	1.0	2.0	2.0	0.0	1.5	0.905	0.000	0.02369	0.452	0.453	0.38
8' - 3	4.0	6.0	3.0	0.0	0.0	1.5	0.932	0.000	0.02440	0.466	0.466	0.37
8' - 4	1.5	2.0	1.5	1.0	0.0	0.5	1.017	0.000	0.00887	0.509	0.508	0.37
8' - 5	2.0	1.0	0.0	0.0	1.0	1.0	0.985	0.017	0.01719	0.492	0.493	0.37
8' - 6	0.0	0.0	0.5	3.0	1.0	0.5	0.925	0.016	0.00807	0.462	0.463	0.3
8'9''	1.0	2.0	0.5	0.5	0.0	2.0	0.895	0.000	0.03124	0.447	0.448	0.3
9'7''-1	2.0	2.0	0.0	2.0	0.0	1.0	0.918	0.000	0.01602	0.459	0.459	0.3
9'7''-2	1.0	3.0	1.0	2.5	1.5	1.0	0.960	0.025	0.01675	0.480	0.480	0.3
12'6''	1.5	1.5	2.5	2.5	0.0	0.5	0.809	0.000	0.00705	0.404	0.404	0.3

Comments: Only minor filing and cleaning required.

Pitot tubes requiring further calibration: None.

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WET-BULB & DRY-BULB: OMEGA TEMP
TEMPERATURE SENSOR CALIBRATION DATA FORM
TOLERANCE: +/- 5.4 F

DATE: 09/15/88 BAROMETRIC PRESSURE: 29.34
AMBIENT TEMPERATURE, F : 70 REFERENCE THERMOMETER # 22
CALIBRATOR: PRJ

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE,F	THERMOCOUPLE POTENTIOMETER TEMPERATURE,F	TEMPERATURE DIFFERENCE, %
Omega Temp HH-2 #1					
Db1	A.	water bath	70	70	0.00
	B.	oil bath	120	120	0.00
	C.	oil bath	177	176	0.16
	D.	oil bath	220	221	-.15
	E.	oil bath	265	265	0.00
Wb1	A.	water bath	70	70	0.00
	B.	oil bath	120	121	-.17
	C.	oil bath	177	178	-.16
	D.	oil bath	220	221	-.15
	E.	oil bath	265	265	0.00
Omega Temp HH-2 #2					
Db2	A.	water bath	70	71	-.19
	B.	oil bath	120	121	-.17
	C.	oil bath	178	178	0.00
	D.	oil bath	221	222	-.15
	E.	oil bath	267	267	0.00
Wb2	A.	water bath	70	69	0.19
	B.	oil bath	120	121	-.17
	C.	oil bath	178	179	-.16
	D.	oil bath	221	222	-.15
	E.	oil bath	267	268	-.14
Omega Temp 873-F					
Db1	A.	water bath	71	71	0.00
	B.	oil bath	121	122	-.17
	C.	oil bath	178	179	-.16
	D.	oil bath	222	223	-.15
	E.	oil bath	268	270	-.27
Wb1	A.	water bath	71	71	0.00
	B.	oil bath	121	121	0.00
	C.	oil bath	178	178	0.00
	D.	oil bath	222	223	-.15
	E.	oil bath	268	269	-.14
Omega Temp 873-F High Temp					
	A.	oil bath	380	381	-.12
	B.	M. Furnace	435	437	-.22
	C.	M. Furnace	560	561	-.10
	D.	M. Furnace	812	814	-.16
	E.	M. Furnace	1130	1132	-.13

$$\text{TEMPERATURE DIFFERENCE} = \frac{(\text{REF TEMP, F} + 460) - (\text{TEST TEMP, F} + 460)}{\text{REF TEMP, F} + 460} \times 100 <= 1.5\%$$

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WET BULB - DRY BULB - NOx & HOT BOX: BIMETALLIC
TEMPERATURE SENSOR CALIBRATION DATA FORM
TOLERANCE: +/- 5.4 F

DATE: 09/15/88 BAROMETRIC PRESSURE: 29.34
AMBIENT TEMPERATURE, F : 70 REFERENCE THERMOMETER # 22
CALIBRATOR: PRJ

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE,F	THERMOCOUPLE POTENTIOMETER TEMPERATURE,F	TEMPERATURE DIFFERENCE, %
Bimetallic					
Wb1	A.	water bath	70	70	0.00
	B.	oil bath	120	120	0.00
	C.	oil bath	177	179	-.31
	D.	oil bath	221	222	-.15
	E.	oil bath	265	266	-.14
Db1	A.	water bath	70	71	-.19
	B.	oil bath	120	121	-.17
	C.	oil bath	177	178	-.16
	D.	oil bath	221	222	-.15
	E.	oil bath	265	266	-.14
Wb2	A.	water bath	70	70	0.00
	B.	oil bath	120	120	0.00
	C.	oil bath	177	176	0.16
	D.	oil bath	221	222	-.15
	E.	oil bath	265	265	0.00
Db2	A.	water bath	70	69	0.19
	B.	oil bath	120	119	0.17
	C.	oil bath	177	178	-.16
	D.	oil bath	221	221	0.00
	E.	oil bath	265	266	-.14
Nox	A.	water bath	71	71	0.00
	B.	oil bath	121	121	0.00
	C.	oil bath	179	178	0.16
	D.	oil bath	222	223	-.15
	E.	oil bath	267	267	0.00
Hot Box	A.	water bath	71	71	0.00
	B.	oil bath	122	123	-.17
	C.	oil bath	179	178	0.16
	D.	oil bath	223	223	0.00
	E.	oil bath	267	266	0.14

$$\text{TEMPERATURE DIFFERENCE} = \frac{(\text{REF TEMP, F} + 460) - (\text{TEST TEMP, F} + 460)}{\text{REF TEMP, F} + 460} \times 100 \leq 1.5\%$$

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PROBE THERMOCOUPLE
TEMPERATURE SENSOR CALIBRATION DATA FORM
TOLERANCE: +/- 5.4 F

DATE: 09/15/88
AMBIENT TEMPERATURE, F : 70
CALIBRATOR: PRJ

BAROMETRIC PRESSURE: 29.34
REFERENCE THERMOMETER # 22 & #5

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE,F	THERMOCOUPLE POTENTIOMETER TEMPERATURE,F	TEMPERATURE DIFFERENCE, %
Probe - #					
4'-1	A.	oil bath	97	97	0.00
	B.	oil bath	255	254	0.14
	C.	oil bath	376	377	-.12
4'-2	A.	oil bath	97	98	-.18
	B.	oil bath	255	255	0.00
	C.	oil bath	376	378	-.24
5'-1	A.	oil bath	97	97	0.00
	B.	oil bath	255	256	-.14
	C.	oil bath	376	377	-.12
5'-2	A.	oil bath	98	98	0.00
	B.	oil bath	257	258	-.14
	C.	oil bath	377	378	-.12
6'-1	A.	oil bath	98	98	0.00
	B.	oil bath	257	256	0.14
	C.	oil bath	377	377	0.00
6'-2	A.	oil bath	98	97	0.18
	B.	oil bath	257	257	0.00
	C.	oil bath	377	376	0.12
8'-1	A.	oil bath	99	99	0.00
	B.	oil bath	258	259	-.14
	C.	oil bath	378	377	0.12
8'-2	A.	oil bath	99	99	0.00
	B.	oil bath	258	259	-.14
	C.	oil bath	378	376	0.24
8'-3	A.	oil bath	100	100	0.00
	B.	oil bath	259	258	0.14
	C.	oil bath	379	380	-.12
8' 9"	A.	oil bath	100	101	-.18
	B.	oil bath	260	261	-.14
	C.	oil bath	379	380	-.12
9' 7"	A.	oil bath	100	99	0.18
	B.	oil bath	260	261	-.14
	C.	oil bath	380	379	0.12

$$\text{TEMPERATURE DIFFERENCE} = \frac{(\text{REF TEMP, F} + 460) - (\text{TEST TEMP, F} + 460)}{\text{REF TEMP, F} + 460} \times 100 <= 1.5\%$$

environmental testing inc.

METER BOX
TEMPERATURE SENSOR CALIBRATION DATA FORM
TOLERANCE: +/- 5.4 F

DATE: 09/15/88 BAROMETRIC PRESSURE: 29.34
AMBIENT TEMPERATURE, F : 70 REFERENCE THERMOMETER # 22
CALIBRATOR: PRJ

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE,F	THERMOCOUPLE POTENTIOMETER TEMPERATURE,F	TEMPERATURE DIFFERENCE, %
Meter Box					
1264A	A.	ice bath	34	34	0.00
	B.	water bath	70	70	0.00
	C.	oil bath	120	121	-.17
	D.	oil bath	177	178	-.16
1264B	A.	ice bath	34	35	-.20
	B.	water bath	70	71	-.19
	C.	oil bath	120	121	-.17
	D.	oil bath	177	178	-.16
1348A	A.	ice bath	34	35	-.20
	B.	water bath	70	71	-.19
	C.	oil bath	120	120	0.00
	D.	oil bath	177	178	-.16
1348B	A.	ice bath	34	34	0.00
	B.	water bath	70	71	-.19
	C.	oil bath	121	121	0.00
	D.	oil bath	177	177	0.00
1401A	A.	ice bath	35	35	0.00
	B.	water bath	71	71	0.00
	C.	oil bath	121	120	0.17
	D.	oil bath	178	178	0.00
1401B	A.	ice bath	35	34	0.20
	B.	water bath	71	70	0.19
	C.	oil bath	121	122	-.17
	D.	oil bath	178	179	-.16
1965A	A.	ice bath	35	35	0.00
	B.	water bath	71	72	-.19
	C.	oil bath	122	121	0.17
	D.	oil bath	178	177	0.16
1965B	A.	ice bath	35	35	0.00
	B.	water bath	71	72	-.19
	C.	oil bath	122	121	0.17
	D.	oil bath	178	179	-.16

$$\text{TEMPERATURE DIFFERENCE} = \frac{(\text{REF TEMP, F} + 460) - (\text{TEST TEMP, F} + 460)}{\text{REF TEMP, F} + 460} \times 100 \leq 1.5\%$$

environmental testing inc.

IMPINGER
TEMPERATURE SENSOR CALIBRATION DATA FORM
TOLERANCE: +/- 2.0 F

DATE: 09/15/88 BAROMETRIC PRESSURE: 29.34
AMBIENT TEMPERATURE, F : 70 REFERENCE THERMOMETER # 22
CALIBRATOR: PRJ

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE,F	THERMOCOUPLE POTENTIOMETER TEMPERATURE,F	TEMPERATURE DIFFERENCE, %
Impinger					
#1	A.	ice bath	34	34	0.00
	B.	water bath	70	70	0.00
	C.	oil bath	102	101	0.18
#2	A.	ice bath	34	34	0.00
	B.	water bath	70	71	-.19
	C.	oil bath	102	101	0.18
#3	A.	ice bath	34	33	0.20
	B.	water bath	70	70	0.00
	C.	oil bath	102	101	0.18
#4	A.	ice bath	34	34	0.00
	B.	water bath	70	71	-.19
	C.	oil bath	102	101	0.18
#5	A.	ice bath	34	33	0.20
	B.	water bath	71	70	0.19
	C.	oil bath	102	102	0.00

$$\text{TEMPERATURE DIFFERENCE} = \frac{(\text{REF TEMP, F} + 460) - (\text{TEST TEMP, F} + 460)}{\text{REF TEMP, F} + 460} \times 100 \leq 1.5\%$$

environmental testing inc.

SAMPLE BOX
TEMPERATURE SENSOR CALIBRATION DATA FORM
TOLERANCE: +/- 5.4 F

DATE: 09/15/88 BAROMETRIC PRESSURE: 29.34
AMBIENT TEMPERATURE, F : 70 REFERENCE THERMOMETER # 22
CALIBRATOR: PRJ

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE,F	THERMOCOUPLE POTENTIOMETER TEMPERATURE,F	TEMPERATURE DIFFERENCE, %
Sample Box					
#1	A.	water bath	70	70	0.00
	B.	oil bath	122	121	0.17
	C.	oil bath	178	177	0.16
	D.	oil bath	222	223	-.15
	E.	oil bath	266	265	0.14
#2	A.	water bath	70	69	0.19
	B.	oil bath	121	122	-.17
	C.	oil bath	177	178	-.16
	D.	oil bath	222	220	0.29
	E.	oil bath	266	265	0.14
#3	A.	water bath	71	71	0.00
	B.	oil bath	122	121	0.17
	C.	oil bath	178	177	0.16
	D.	oil bath	223	222	0.15
	E.	oil bath	266	263	0.41
#4	A.	water bath	71	70	0.19
	B.	oil bath	122	123	-.17
	C.	oil bath	178	177	0.16
	D.	oil bath	223	221	0.29
	E.	oil bath	267	266	0.14
#5	A.	water bath	71	70	0.19
	B.	oil bath	123	123	0.00
	C.	oil bath	178	176	0.31
	D.	oil bath	223	221	0.29
	E.	oil bath	267	266	0.14
#6	A.	water bath	72	71	0.19
	B.	oil bath	123	124	-.17
	C.	oil bath	178	177	0.16
	D.	oil bath	223	221	0.29
	E.	oil bath	267	265	0.28
#7	A.	water bath	72	72	0.00
	B.	oil bath	123	124	-.17
	C.	oil bath	179	178	0.16
	D.	oil bath	224	223	0.15
	E.	oil bath	268	267	0.14
#8	A.	water bath	72	71	0.19
	B.	oil bath	124	124	0.00
	C.	oil bath	179	178	0.16
	D.	oil bath	224	223	0.15
	E.	oil bath	268	267	0.14

$$\text{TEMPERATURE DIFFERENCE} = \frac{(\text{REF TEMP, F} + 460) - (\text{TEST TEMP, F} + 460)}{\text{REF TEMP, F} + 460} \times 100 <= 1.5\%$$

CORNING

Science Products
Corning Glass Works
Corning, New York 14831 USA
Tel: 607-974-9000

a CORNING Laboratory Sciences Company

November 18, 1986

Mr. Paul Jenkins
Environmental Testing Inc.
1700 University Commercial Place
Charlotte, NC 28213

Dear Mr. Jenkins:

Confirming our telephone conversation, our volumetric apparatus is calibrated in conformance with ASTM Standard E 542.

Very truly yours,

Allen R. Fuller

Allen R. Fuller
Product Engineering Supervisor

b10012

KIMBLE
Division of
Owens-Illinois

December 11, 1986

Mr. Paul R. Jenkins
Environmental Testing, Inc.
1700 University Commercial Place
Charlotte, North Carolina 28213

REF: Calibration of volumetric glassware
Mr. P. Jenkins letter 12-5-86

Dear Mr. Jenkins,

Volumetric standards, utilized by Kimble for calibration of class A and B laboratory glassware, are designed to meet applicable calibration requirements of ASTM Standard E 542.

Accuracy of balances, weights and thermometers employed for calibration of volumetric standards is traceable to National Bureau of Standards.

Sincerely,

Lew Horan
Standards Dept.

Mike Mollick
Quality Control

cc: Mr. N. DeBello - M.O.
Mr. E. Trasoras - Q.A.

WALTER H. KESSLER COMPANY, INC.

THERMOMETERS KESSLER HYDROMETERS

ONE-SIXTY HICKS STREET • WESTBURY, LONG ISLAND, NEW YORK • 516 EDGEWOOD 4-4064

MANUFACTURERS CERTIFICATE OF CALIBRATION

This is to certify that the instrument listed below has been tested in our temperature calibration laboratory in accordance with the latest procedures in the finest constant temperature equipment available, against National Bureau of Standards certified master standards.

Certified for: Fisher Scientific Company

Description: Thermometer #15-041D -1/201°C in 0.2° Div Total Immersion

Instrument Serial No. 811 007 Date Certified: January 30, 1981

Reading of This Instrument	Reading of N.B.S. Standard (True Temperature)
+0.02C	0.00C
20.00C	20.00C
40.00C	40.00C
59.96C	60.00C
79.98C	80.00C
100.02C	100.00C
119.92C	120.00C
139.98C	140.00C
160.00C	160.00C
180.00C	180.00C
199.86C	200.00C

The tabulated readings apply provided the ice-point reading taken after exposure for not less than 3 days to a temperature of about 25° C (77° F) is +0.02C . If the ice-point reading is found to be higher (or lower) than stated, all other readings will be higher (or lower) by the same amount.

Serial & Test numbers of National Bureau of Standards certified instruments referenced in certification of the thermometer listed above:

NBS Standard M44165,78A-227,M44451,78A-220,78A-601/602

NBS Test No 176240,219883,176240,219883,219606

WALTER H. KESSLER COMPANY, INC.

Irene Ciccilla

the OMEGA Group

DATE: 12-10-85

CERTIFICATE OF CALIBRATION

CUSTOMER: ENVIRONMENTAL TESTING INC
1700 UNIV COMMERICAL PL
CHARLOTTE NC 28213

Customer Purchase Order: 2861RO
OMEGA Work Order No: SO 511268760
MODEL: HH-2
SERIAL NO: 14403

OMEGA ENGINEERING certifies that the above instrumentation has been calibrated and tested to meet or exceed the published specifications. This calibration and testing was performed using instrumentation and standards that are traceable to the U.S. National Bureau of Standards.

Reference: NATIONAL BUREAU OF STANDARDS TEST NO(s): 36320

Tony D'Inverno
Supervisor, Instrumentation

CAL-3

WEIGHT TRACEABILITY CERTIFICATE

TO: Environmental Testing, Inc.
1700 Univ. Commercial Dr.
Charlotte, NC 28213

The balances listed below have been serviced by our representative on December 21, 1987

This is to certify that the test weights used are traceable to the National Bureau of Standards.

	Analytical	Precision
Mettler identification number of test weights used:	13	
Mettler calibration date of test weights used:	8-1-87	
National Bureau of Standards test number:	737/0670-49	

Model and serial number of balances serviced:

AE163- C57742	
H54AR- 677277	

Kevin Z. Bff
Mettler Service Representative

1-17-88
Date of Issue

Mettler

Mettler Instrument Corporation
Box 71, Hightstown, NJ 08520
(609) 448-3000

F-124 (1/88)

GCA CORPORATION
Precision Scientific Group

3737 West Cortland Street
Chicago, Illinois 60647
Telephone: 312-227-2660
Telex: 254028

February 2, 1984

Environmental Testing
1700 University Commercial Place
Charlotte, N.C. 28213

Attn: Mr. Paul Jenkins

Subj: Certification Wet Test Meter

Dear Mr. Jenskins:

In lieu of any printed certification from our company, we offer as follows our statement on the referenced subject.

> "The Wet Test Meter catalog number 63123, has been tested at our plant facilities using a Meter Prover Bottle NBS registration No. 4897. The Meter was found to perform to our advertised specifications of plus or minus 1/2% error in flow rate and conforms to specifications of ASTM D-1071."

Respectfully,

Bob Husberg
Supervisor, Customer Service

BH/mg

Whatman Inc.

Whatman Inc. • 9 Bridewell Place, Clifton, New Jersey 07014 • Telephone: (201) 777-4825
Telex: 133426 • Cable: REEVEPAP

February 1, 1979

Mr. Paul R. Jenkins, Jr.
Vice-President
Environmental Testing Inc.
1700 University Commercial Place
Charlotte, North Carolina 28213

Dear Mr. Jenkins:

Further to our telephone conversation on January 15, 1979 Reeve Angel Grade 900AF is tested with a Q128 DOP Penetrometer manufactured by the Air Technology Association to measure DOP. This is a more sophisticated unit than that listed in the Federal Register, Part II, Thursday, August 18, 1977, Environmental Protection Agency, Standards of Performance for New Stationary Sources.

Grade 900AF will meet the EPA DOP requirements of 0.05 ≤ percent penetration on a 0.3 micron dioctyl phthalate smoke particles as listed on page 41778 of the Federal Register, Vol. 42, No. 160, Thursday, August 18, 1977 under 3. Reagent, 3.1.1 Filters.

I hope this will satisfy your inquiry. If we can be of any further service, please contact us at your convenience.

Very truly yours,

John Zacharias
Vice President
Business Manager, Paper Division, N. A.

JZ/mpm