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.

RECEIVED
N.C. Dept. NRCD
SEP 26 1990
Winston-Salem
Regional Office

apac

THOMPSON-ARTHUR PAVING COMPANY

DIVISION OF APAC – CAROLINA, INC.

REPLY TO: P. O. Box 21088
Greensboro, NC 27420

September 25, 1990

Mr. Steve Moser
N. C. Dept of Nat. Resources
and Community Development
8025 North Point Blvd., Suite 100
Winston-Salem, NC 27106-3203

Re: Asphalt Plant 11
Stack Testing Report

Dear Mr. Moser:

Enclosed is a copy of the above referenced report. If you have any questions please let us know.

Sincerely,

Joyce Moretz

Joyce Moretz
Dir. of Safety/Environment

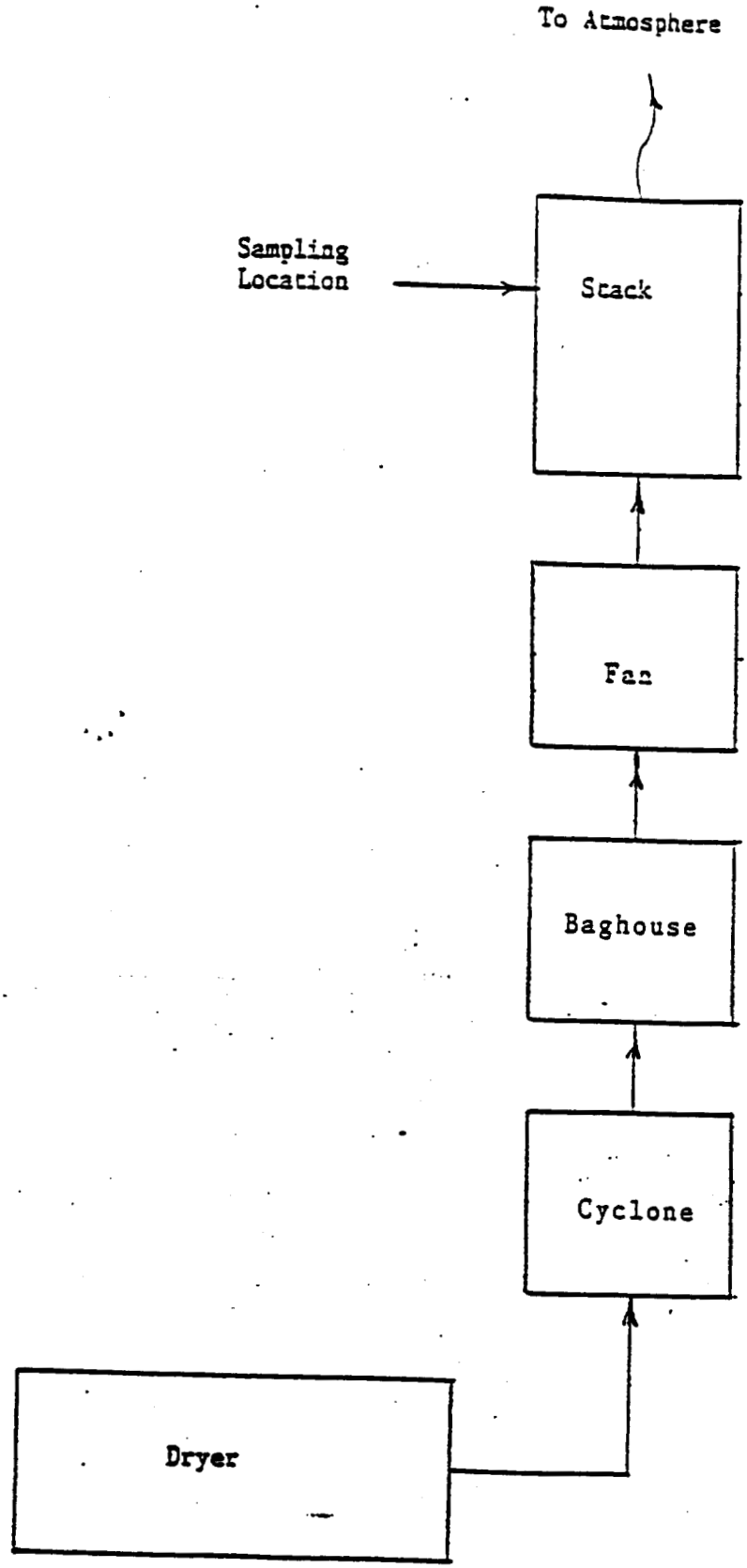
enclosure

INTRODUCTION

Source sampling was performed for Thompson - Arthur Paving Company, Greensboro, North Carolina. The purpose of the sampling was to determine compliance with the permit limitations of 0.04 grains per dry standard cubic foot as required by the State of North Carolina. Three sampling runs were made on September 18, 1990 at the sampling locations shown on Figure 1.

The measurements of stack gas flow rate and pollutant concentrations were made according to U.S. Environmental Protection Agency and the North Carolina Department of Natural Resources and Community Development (DNRCD) recommendations. Mr. Steve Moser, 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

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SUMMARY OF RESULTS

Table 1 presents the summary of results from the particulate sampling. The mean particulate concentration for the three runs was 0.0099 grains per dry standard cubic foot and the mean particulate emission rate was 1.834 pounds per hour. The average process weight was approximately 240 tons per hour.

Based on the results of the particulate sampling, the Thompson - Arthur Paving Company, Greensboro, North Carolina asphalt plant was in compliance with the regulations of the State of North Carolina which allowed for an emission rate of 0.04 grains per dry standard cubic foot.

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TABLE 1

SUMMARY OF RESULTS, PARTICULATE SAMPLING

Run Number	1	2	3
Date	09/18/90	09/18/90	09/18/90
% Isokinetic	104.63	100.73	98.16
Volume of Gas Sampled, SCF * Dry	43.433	41.151	38.881
Stack Gas Flow Rate, SCFM * Dry	22188.2	21981.5	21172.7
Stack Gas Flow Rate, ACFM	40212.4	40899.8	37477.4
Particulate:			
Catch, mgrams	20.20	30.45	27.75
Concentration, grains/ SCF * Dry	0.0072	0.0114	0.0110
Emission Rate, lbs/hr	1.362	2.147	1.994

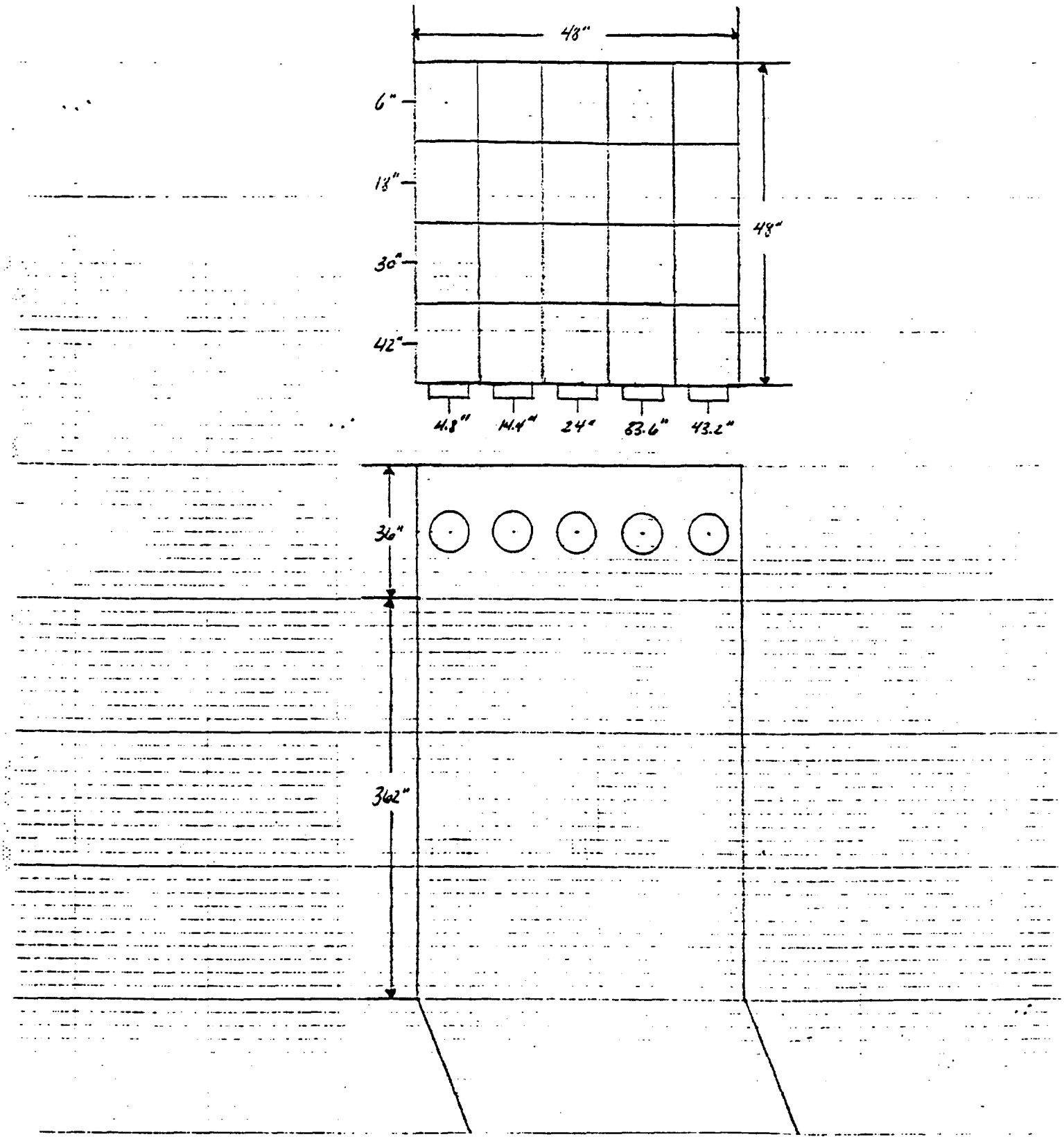
*68°F, 29.92 in. Hg
**Nozzle, probe, filter

PROCESS DESCRIPTION AND OPERATION

The Thompson - Arthur Paving Company asphalt plant in Greensboro, North Carolina is a batch type plant. It produces hot mix asphalt made from No. 2 fuel oil, cement, sand, granite screenings and granite aggregates. The materials are dried in a rotary dryer. The fuel was natural gas. The material mix was conveyed to one of three storage silos. Air was introduced at the burner and passed through the dryer, cyclone, baghouse, fan and stack to the atmosphere. The plant was rated at 400 tons per hour.

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 20 equal areas. The ports were labeled A, B, C, D and E. Each point was sampled for a period of 3.0 minutes per point which yielded a total test time of 60 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.



LOCATION OF SAMPLING POINTS

Figure 2

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.

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APPENDICES

APPENDIX A

SUMMARY OF RESULTS

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Appendix A

Summary of Method 5 Particulate Results

Thompson - Arthur Paving Greensboro N.C.

Run Number		1	2	3
Date		9/18/90	9/18/90	9/18/90
DN	Sample nozzle dia., in.	0.303	0.302	0.303
TT	Net time of test	60	60	60
PB	Barometric pressure, in. Hg.	29.37	29.37	29.37
PM	Average orifice pressure drop, in. H2O	1.914	1.832	1.579
VM	Volume of dry gas sampled, cu. ft. at meter conditions	44.95	43.31	41.10
TM	Average gas meter temp. in degrees F.	78.75	87.77	89.82
VMSTD	Volume of dry gas sampled at standard conditions*, SCF	43.433	41.151	38.881
VW	Total water collected in impingers + silica gel, ML.	377.4	401.5	335.3
VMV	Volume of water vapor at standard conditions*, SCF	17.772	18.907	15.789
PMV	Percent moisture by volume	29.037	31.481	28.881
MD	Mole fraction dry gas	0.7096	0.6852	0.7112
PCO2	Percent CO2 by volume, dry	4.90	5.30	5.00
PO2	Percent O2 by volume, dry	12.20	11.40	12.07
PCO	Percent CO by volume, dry	0.00	0.00	0.00
PN2	Percent N2 by volume, dry	83.00	83.40	82.93
MWD	Molecular weight-dry stack gas	29.300	29.332	29.283
MW	Molecular weight-stack gas	26.019	25.765	26.024
CP	Pitot tube coefficient	0.84	0.84	0.84
DPS	Average velocity head of stack gas, inches water	0.6221	0.6324	0.5861
TS	Average stack temperature, F	205.90	200.10	191.80

PSI	Static pressure of stack gas, inches Hg.	-0.018	-0.018	-0.018
PS	Stack pressure, absolute	29.352	29.352	29.352
VS	Average stack velocity, FPM	2503.1	2545.8	2332.8
AS	Stack area, inches sqrd.	2304.0	2304.0	2304.0
QS	Stack flow rate, dry, standard conditions, DSCFM	22188.2	21981.5	21172.7
QSW	Stack flow rate, wet, standard conditions, WSCFM	31267.0	32080.9	29770.8
QA	Actual stack flow rate, ACFM	40212.4	40899.8	37477.4
PERI	Percent isokinetic	104.63	100.73	98.16
FMF	Particulate, Mg., front	20.20	30.45	27.75
CAN	Particulate, GR/DSCF front	0.0072	0.0114	0.0110
CAM	Particulate, GR/WSCF front	0.0101	0.0166	0.0155
CAT	Particulate, GR/ACF front	0.0040	0.0061	0.0062
CAW	Particulate, LB/HR front	1.362	2.147	1.994
FNP	Net sampling points	20	20	20

*68 Degrees F. 29.92 Inches Hg.

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Method 5 Particulate Calculations Test Number 1

Thompson - Arthur Paving Greensboro N.C.

Volume of Dry Gas Sampled at Standard Conditions

$$VMSTD = \frac{17.64 * VM * (PB + PM / 13.6)}{TM + 460} = 43.433$$

Volume of Water Vapor at Standard Conditions

$$VMV = 0.04709 * VW = 17.772$$

Percent Moisture in Stack Gas

$$PMV = \frac{100 * VMV}{VMSTD + VMV} = 29.037$$

Mole Fraction of Dry Gas

$$MD = \frac{100 - PMV}{100} = 0.7096$$

Average Molecular Weight of Dry Stack Gas

$$MWD = 0.44 * PCO2 + 0.32 * PO2 + 0.28 * (PN2+PCO) = 29.300$$

Molecular Weight of Stack Gas

$$MW = MWD * MD + 18 * (1-MD) = 26.019$$

Stack Gas Velocity at Stack Conditions

$$VS = 5129.4 * CP * DPS * SQRT(TS + 460)/(PS * MW) = 2503.1$$

Stack Gas Volumetric Flow at Standard Conditions, Dry

$$QS = \frac{0.123 * VS * AS * PS * MD}{TS + 460} = 22188.2$$

Stack Gas Volumetric Flow at Stack Conditions

$$QA = \frac{QS * (TS + 460)}{17.64 * PS * MD} = 40212.4$$

Percent Isokinetic

$$PERI = \frac{1039 * (TS + 460) * VMSTD}{VS * TT * PS * MD * DN * DN} = 104.63$$

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

CAN = 0.0154 * FMF / VMSTD = 0.0072

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

$$CAT = \frac{17.64 * CAN * PS * MD}{TS + 460} = 0.0040$$

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

CAW = 0.00857 * CAN * QS = 1.362

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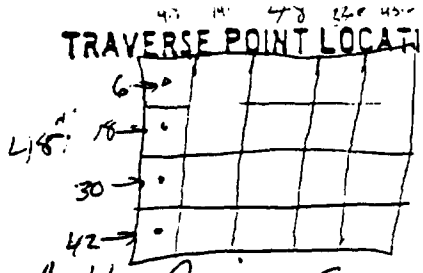
APPENDIX B

FIELD DATA SHEETS

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS



Plant Thompson Arthur Paving Greensboro

Date 9-18-90

Sampling location Asphalt baghouse stack

Inside of far wall to outside of nipple (I) 51

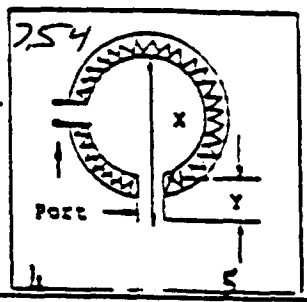
Inside of near wall to outside of nipple (nipple length) (I) 3"

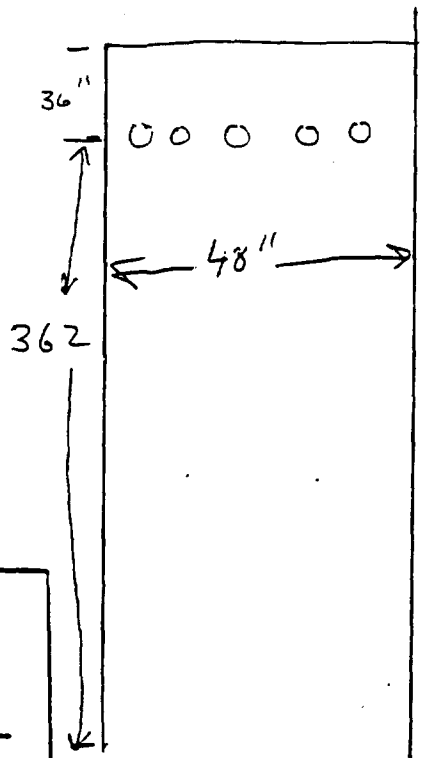
Stack I.D. (I-I) 48

Nearest upstream disturbance ~~.7254~~ dd .75

Nearest downstream disturbance ~~2.254~~ dd 2.54

Calculated by WDB





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		48"	6	3	9
2			18	3	21
3			30	3	33
4			42	3	45

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METHOD 2 GAS VELOCITY AND CYCLONIC FLOW DETERMINATION

Plant and City Thompson Arthur Paving Greensboro Run Date 9-18-90

Sampling Location Asphalt Baghouse Stack Clock Time 754

Run Number 1 Operator WQB/TEW Amb. Temp., °F 56

Bar. Press., in. Hg 29.37 Static Press., in. H_2O -.24

Stack Press., in. Hg 29.352 Static Press., in. Hg -0.01765

Stack Dimension, in. - Diam. or side 1 48" side 2 ——

Pitot Tube (C_p) 0.84 Pitot Tube Leak Check <0.1 @ 4.5 in. H_2O

Field data square stack

Traverse point number	Position, in.	Velocity head (Δp_s), in. H_2O A	B	Stack temp., °F C	D 26	E	Cyclonic flow determination: Δp_s at 0° reference	Angle (α) which yields a null Δp
1	9	.18	.20	.22	[illegible]	.26		
2	21	.21	.25	.26	[illegible]	.34		
3	33	.22	.26	.33	.36	.33		
4	45	.27	.33	.42	[illegible]	.36		
					.55			
1								
2								
3								
4								

$\Delta\bar{p}$ = .293

Average angle (α)[a]

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

NOMAGRAPH DATA

$\Delta H_@$ 1.84 T_m 85 %M 25% P_s/P_m 0.9994 C .69 D_b 158 166 175

$\overline{\Delta p}$ .293 T_s 200 DN_c .32 DN_a .303 .302 .306 Ref. Δp .38 .50 W_b 138 144 147 20 22 28

after 1st Run cal. %ssn .37 use .35 C .52 → 185 144

pace

METHOD 3 - ORSAT AND DRY MOLECULAR WEIGHT DETERMINATION

Plant THOMPSON - ARTHUR PLANT Sample Location BAGHOUSE STACK

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

Oxygen Check 20.9% ± 0.1% ✓ Fuel Type NATURAL GAS

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

Buret 14.0 - 14.0 = <0.2 ml ? ✓

Run No. 1 Sample Date 9/18/90 Ambient Temp. °F 57

Sampling Time (24 - hr clock) 1045 Analysis By TEW

Gas \ Run	1 Actual	1 Net	2 Actual	2 Net	3 Actual	3 Net	Avg. %	Mult.	Molecular Wt. Dry lb/lb mole
CO_2	4.9	4.9	4.9	4.9	4.8	4.8	4.87	.44	2.143
O_2	16.9	12.0	17.2	12.3	17.0	12.2	12.17	.32	3.894
CO	16.9	0.0	17.2	0.0	17.0	0.0	0.0	.28	0.000
N_2	100	83.1	100	82.8	100	83.0	82.96	.28	23.229
								Total	29.266

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

Run No. 2 Sample Date 9/18/90 Ambient Temp. °F 62

Sampling Time (24 - hr clock) 1415 Analysis By TEW

Gas \ Run	1 Actual	1 Net	2 Actual	2 Net	3 Actual	3 Net	Avg. %	Mult.	Molecular Wt. Dry lb/lb mole
CO_2	5.2	5.2	5.3	5.3	5.3	5.3	5.30	.44	2.319
O_2	16.6	11.4	16.8	11.5	16.7	11.4	11.43	.32	3.658
CO	16.6	0.0	16.8	0.0	16.7	0.0	0.0	.28	0.000
N_2	100	83.4	100	83.2	100	83.5	83.37	.28	23.344
								Total	29.321

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

Run No. 3 Sample Date 9/18/90 Ambient Temp. °F 73

Sampling Time (24 - hr clock) _____ Analysis By TEW

Gas \ Run	1 Actual	1 Net	2 Actual	2 Net	3 Actual	3 Net	Avg. %	Mult.	Molecular Wt. Dry lb/lb mole
CO_2	4.9	4.9	5.1	5.1	5.0	5.0	5.00	.44	2.200
O_2	17.0	12.1	17.2	12.1	17.0	12.0	12.07	.32	3.862
CO	17.0	0.0	17.2	0.0	17.0	0.0	0.00	.28	0.000
N_2	100	83.0	100	82.8	100	83.0	82.93	.28	23.220
								Total	29.282

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

pace

METHOD 5 PARTICULATE FIELD DATA

Plant: Thompson Arthur Paving Greensboro
Run No.: 1
Location: baghouse stack
Date: 9-18-90
Operator: WQB
Sample Box No.: 1
Meter Box No.: 1965
Filter No.: 17
Probe No.: 1
Pitot Tube Cp: 0.84

Very Important — Fill In All Blanks
Leak Checks. Beg. @ 15": 0.007
End @ " : 0.003
Pitot Tube: <0.1 @ 3.8 "H₂O
50.1 @ 4.0 "H₂O
Static Pressure: -.24 "H₂O
Start: 0929
Finish: 1036
Observer: Steve Moser
Agency:

Bar. Press. "Hg: 29.37
Meter Box ΔH@: 1.84 Y = 1.00
Assumed Tm, °F: 85
Dry Bulb, °F: 165
Wet Bulb, °F: 144
Db - Wb, °F: 41
Assumed Moisture %: 25
Ps/Pm: .9994
C Factor: .69

Ambient Temp., °F: 56
Heater Box Setting, °F: 250
Probe Tip Dia., in.: .303
Probe Length: 5' gauge
Probe Heater Setting: 85%
Average Δp: .293 Δp Rel: .38
Average ΔH: 1.40 ΔH Rel:
Process Weight:
Steam Load: NA
Steam Pressure: NA

Point	Clock Time	Dry Gas Meter, Cu Ft	Pitot Manometer (Δp) in H₂O	Orifice Manometer (ΔH) in H₂O Desired	Orifice Manometer (ΔH) in H₂O 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
A1	0	729.71	.16	.78	.78	61	61	2.8	250	60	180		
2	3	731.54	.28	1.38	1.38	65	61	4.0	250	60	196		
3	6	733.16	.36	1.75	1.75	70	62	5.0	250	50	200		
4	9	734.78	.36	1.25	1.25	72	62	5.0	250	50	204		
B1	12/0	737.52	.28	1.38	1.38	78	64	4.0	250	50	203		
2	3	739.48	.32	1.56	1.56	80	64	4.5	250	50	200		
3	6	741.60	.42	2.05	2.05	84	65	5.5	250	50	205		
4	9	743.98	.50	2.40	2.40	88	66	6.5	240	50	200		
C1	12/0	746.57	.35	1.70	1.70	90	68	5.0	250	50	200		
2	3	748.93	.50	2.40	2.40	94	70	6.0	250	50	205		
3	6	749.63	.45	2.20	2.20	94	70	6.0	250	50	214		
4	9	753.57	.56	2.70	2.70	96	71	7.0	245	52	215		
D1	12/0	756.27	.30	1.45	1.45	99	72	4.5	245	55	215		
2	3	758.29	.45	2.20	2.20	96	74	6.0	245	55	216		
3	6	760.49	.53	2.57	2.57	98	74	6.8	250	55	218		
4	9	763.26	.49	2.40	2.40	100	76	6.6	250	55	210		
E1	12/0	765.76	.30	1.45	1.45	99	77	4.8	245	55	213		
2	3	767.73	.40	1.92	1.92	100	78	5.5	245	55	208	- momentary shut down 1027	
3	6	770.38	.45	2.20	2.20	96	78	6.0	245	60	208	1031 shut	
4	9	771.96	.42	2.05	2.05	99	78	6.0	245	60	208		
	12/60	774.66											
		44.95		1.91									

pace

METHOD 5 PARTICULATE FIELD DATA

Plant: Thompson Arthur Poling
Run No.: 2
Location: Stack
Date: 09/18/90
Operator: WQB/TEW
Sample Box No.: ~~1~~ 2
Meter Box No.: 1965
Filter No.: 18
Probe No.: 2
Pilot Tube Cp: 0.84

Very Important — Fill In All Blanks
Leak Checks. Beg. @ 15": 0.002
End @ 10": 0.002
Pitot Tube: <0.1 @ 4.8 "H₂O
<0.1 @ 4.4 "H₂O
Static Pressure: -.24 "H₂O
Start: 1301
Finish: 1407
Observer: Steve Moser
Agency:

Bar. Press. "Hg: 29.37
Meter Box ΔH@: 1.84 Y = 1.00
Assumed Tm, °F: 85
Dry Bulb, °F: 210
Wet Bulb, °F: 155
Db - Wb, °F: 55
Assumed Moisture %: 28%
Ps/Pm: .9994
C Factor: .64

Ambient Temp., °F: 62
Heater Box Setting, °F: 250
Probe Tip Dia., in.: .303
Probe Length: 5' glass
Probe Heater Setting: 85%
Average Δp: .293 Δp Ref: .41
Average ΔH: 1.32 ΔH Ref:
Process Weight:
Steam Load: NA
Steam Pressure: NA

#4 Im

Point	Clock Time	Dry Gas Meter, Cu Ft	Pitot Manometer (Δp) in H₂O	Orifice Manometer (ΔH) in H₂O Desired	Orifice Manometer (ΔH) in H₂O 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	774.98	.17	.76	.76	70	70	3.9	245	60	152		
2	3	776.53	.28	1.26	1.26	72	70	5.0	250	60	151		
3	6	778.42	.45	2.00	2.00	77	71	7.0	255	60	180		
4	9	780.06	.39	1.78	1.78	84	72	7.0	250	59	195		
B 1	12/0	782.64	.28	1.26	1.26	86	72	5.5	250	60	190		
2	3	784.37	.36	1.62	1.26	90	73	6.1	250	60	190		
3	6	786.54	.40	1.80	1.80	92	74	6.8	250	58	199		
4	9	788.17	.45	2.00	2.00	96	74	7.1	250	58	196		
C 1	12/0	790.95	.29	1.31	1.31	100	76	5.5	245	60	205		
2	3	792.88	.53	2.39	2.39	100	77	7.8	245	58	210		
3	6	795.41	.62	2.80	2.80	104	78	8.0	245	58	216		
4	9	797.78	.42	1.90	1.90	106	80	7.0	245	58	210		
D 1	12/0	800.04	.40	1.80	1.80	106	80	6.8	250	60	210		
2	3	802.36	.59	2.62	2.62	108	82	8.3	250	60	215		
3	6	804.85	.47	2.13	2.13	110	82	7.5	250	54	216		
4	9	807.15	.40	1.80	1.80	111	84	7.0	250	54	210		
E 1	12/0	809.38	.36	1.62	1.62	110	84	6.5	250	60	215		
2	3	811.48	.40	1.80	1.80	110	86	7.0	250	60	218		
3	6	813.79	.46	2.08	2.08	110	86	7.2	250	60	215		
4	9	815.99	.42	1.90	1.90	112	86	7.2	250	60	215		
	12/60	818.29											
		43.31	1.83										

pace

METHOD 5 PARTICULATE FIELD DATA

Plant: Thompson Arthur Paving Greensboro
Run No.: 3
Location: Stack
Date: 09/18/90
Operator: WDB / TEW
Sample Box No.: B
Meter Box No.: 1965
Filter No.: 19
Probe No.: 3
Pitot Tube Cp: 0.84

Very Important — Fill In All Blanks
Leak Checks. Beg. @ 15": 0.005
End @ 8": 0.005
Pitot Tube: <0.1 @ 3.8 "H₂O
<0.1 @ 4.6 "H₂O
Static Pressure: -.24 "H₂O
Start: 1608
Finish: 1723
Observer: Steve Moser
Agency:

Bar. Press. "Hg: 29.37
Meter Box ΔH@: 1.84 Y = 1.00
Assumed Tm, °F: 85
Dry Bulb, °F: 210
Wet Bulb, °F: 155
Db - Wb, °F: 55
Assumed Moisture %: 28
Ps/Pm: 1954
C Factor: .64

Ambient Temp., °F: 73
Heater Box Setting, °F: 250
Probe Tip Dia., in.: .30 B
Probe Length: 5' glass
Probe Heater Setting: 85%
Average Δp: .273 Δp: .141
Average ΔH: 1.32 ΔH: Rel
Process Weight:
Steam Load: NA
Steam Pressure: NA

Point	Clock Time	Dry Gas Meter, Cu Ft	Pitot Manometer (Δp) in H₂O	Orifice Manometer (ΔH) in H₂O Desired	Orifice Manometer (ΔH) in H₂O 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
A1	0	818.65	.35	1.60	1.60	73	73	5.0	265	55	160		
2	3	820.76	.35	1.60	1.60	76	74	5.0	265	55	155		
3	6	822.82	.25	1.13	1.13	82	74	4.3	265	55	175		
4	9	824.60	.35	1.60	1.60	86	74	5.7	265	55	183		
B1	12/0	826.64	.35	1.60	1.60	92	75	5.5	250	55	195		
2	3	828.96	.20	.92	.92	94	76	4.0	250	54	193		
3	6	830.35	.47	2.12	2.12	96	76	6.5	245	54	194		
4	9	832.16	.48	2.20	2.20	100	78	6.0	240	54	194		
C1	12/0	835.11	.30	1.36	1.36	104	80	4.3	245	55	194		
2	3	837.10	.27	1.23	1.23	104	80	4.5	245	54	194		
3	6	839.08	.40	1.80	1.80	106	82	6.0	250	54	194		
4	9	841.16	.42	1.90	1.90	108	83	5.8	250	54	195		
D1	12/0	843.32	.25	1.13	1.13	110	84	4.3	250	55	200		
2	3	845.10	.38	1.72	1.72	108	85	5.7	250	54	205		
3	6	847.38	.30	1.36	1.36	110	86	5.0	250	54	205		
4	9	849.27	.44	1.99	1.99	110	88	6.3	250	56	205		
E1	12/0	851.54	.29	1.31	1.31	112	88	5.0	250	58	205	shut down	1702
2	3	853.14	.36	1.60	1.45	100	88	5.5	250	58	194		1703
3	6	855.36	.38	1.72	1.72	100	88	5.7	250	58	198		
4	9	857.23	.36	1.65	1.65	102	88	5.7	250	56	198		
	12/0	859.75											
				1.58									

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METHOD 5 SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Thompson Arthur Paving — Recovered By: WQB
Sample Location: Stack — Recovery Date: 09/18/90

Run Number	1	2	3
Sample Date	09/18/90	09/18/90	09/18/90
Sample Box Number	1	2	3
Probe Number	1	2	3
Filter Number	17	18	19

MOISTURE RECOVERY

Impingers Cont. Number	2-1	2-2	2-3
Description of Water	clear	white	clear
Liquid Level Marked	✓	✓	✓
Final Volume (wt.), ml	562	587	520
Initial Volume (wt.), ml	200	200	200
Net Volume (wt.), ml (g)	362	387	320
Silica Gel Cont. Number	2-1	2-2	2-3
Silica Gel % Spent	25%	30%	20%
Final Weight, g	315.4	319.5	315.3
Initial Weight, g	300	300	300
Net Weight, g	15.4	19.5	15.3
Total Moisture, g	377.4	401.5	335.3

PARTICULATE RECOVERY

Filter Cont. Number	2-1	2-2	2-3
Particulate Description	LIGHT TAN	LIGHT TAN	LIGHT TAN
Filter Cont. Sealed	✓	✓	✓
Final Weight, mg	502.6 .55	506.0 .2	510.5 .4
Final Weight Audit, mg	502.5	506.4	510.3
Initial Weight, mg	494.2 0	496.1 .25	500.8 .1
Initial Weight Audit, mg	494.2	496.4	500.6
Filter Catch, mg	8.35	9.95	9.70
Probe Rinse Cont. Number	2-1	2-2	2-3
Liquid Level Marked	✓	✓	✓
Final Weight, mg	98089.8 .15	104737.0 .55	100146.0 .15
Final Weight Audit, mg	98089.7	104736.9	100145.5
Initial Weight, mg	98076.0 0	104714.4 .55	100125.9 .8
Initial Weight Audit, mg	98076.0	104714.7	100125.1
Less Acetone Blank, mg	1.9	1.9	1.9
Acetone Rinse Catch, mg	11.85	20.5	18.05
Total Particulate, mg	20.2	30.45	27.15

Acetone Blank Number	C
Final Weight, mg	106799.5 .25
Final Weight Audit, mg	106799.0
Initial Weight, mg	106797.6 .35
Initial Weight Audit, mg	106797.1
Acetone Residue, mg	1.9
Acetone Volume, ml	250 ml
Concentration, mg/mg	9.6×10^{-6}

LABORATORY CUSTODY

Received By: WQB
Date Received: 09/18/90
Stored & Locked: ✓
Remarks: None

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APPENDIX C

PROCESS DATA

APPENDIX D

TEST PARTICIPANTS

W. Quentin BEST	Senior Source Sampling Technician Pace, Inc.
Tom E. Wynn	Source Sampling Technician Pace, Inc.

code of federal regulations

Protection of Environment

40

PARTS 53 TO 60

Revised as of July 1, 1989

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION
1985

APPENDIX E

Sampling and Analytical Procedures

APPENDIX F

Calibration Data

CALIBRATION INFORMATION

NOZZLES

Each new set of nozzles purchased by Pace 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 Pace whether separate or attached to a sampling probe were made by Pace 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 Pace 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 Pace 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

Pace 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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PRETEST - POSTEST CALIBRATION CHECKS

Plant Thompson - Arthur Paving Calibrated by WQB
Meter box number 1965 Date 9-20-90

Dry Gas Meter

Pretest meter calibration factor, Y = 1.00 (within ± 2%)
Postest meter calibration factor, Y = .98 (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, 659.27 °R
Temperature of ref. thermometer for recalibration #1 660 #2 — °R
(within ± 10% of the average stack temperature)
Temperature of stack thermometer for recalibration #1 660 #2 — °R
Diff. between ref. and stack thermometer temps. #1 0.0 #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? 0.0 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	29.45	29.35
Field	29.45	29.35
Difference	0.0	0.0

Nozzle

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

Nozzle #1:	.304	.303	.304	.302	.303	: Average .303
Nozzle #2:	.302	.302	.302	.302	.302	: Average .302
Nozzle #3:	.304	.303	.304	.302	.303	: Average .303

Impinger Thermometer

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

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POSTEST DRY GAS METER CALIBRATION DATA FORM (English Units)

Test Number 1 Date 9/19/90 Meter Box No. 1965 Plant THOMPSON-ARTHUR PAVING BAGHOUSE STACK

Barometric Pressure, P_b = 29.27 in. Hg Dry Gas Meter No. 899.82 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 $\frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$
1.77	10	10.66	74	119	92	105.5	13.89	7.7	.98	$\frac{10(29.27)(105.5+460)}{10.66(29.27+1.77/13.6)(74+460)}$
1.77	10	10.75	74	121	95.5	108.25	13.90	7.7	.99	$\frac{10(29.27)(108.25+460)}{10.75(29.27+1.77/13.6)(74+460)}$
1.77	10	10.80	74	122.5	97.5	110.00		7.7	.98	$\frac{10(29.27)(110+460)}{10.80(29.27+1.77/13.6)(74+460)}$

$\bar{Y}_i$ = .98

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 acturacy of wet test meter to dry gas meter for each run

$\bar{Y}$ = 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 THOMPSON ARTHUR PAVING Date 9-18-90

Location GREENSBORO, NC Ref. Thermometer 22

Thermometer	Pretest		Postest	
	Temp., °F	Ref. Temp., °F	Temp., °F	Ref. Temp., °F
DGM # 1965	66	68	72	72
DGM # 1965	66	68	72	72
DGM # 1401	66	68	72	72
DGM # 1401	66	68	72	72
Impinger #1	66	68	72	72
Impinger #2	66	68	72	72
Impinger #3	68	68	72	72
Impinger #4	66	68	72	72
Impinger #5	66	68	72	72
WB #	—	—	—	—
DB #	—	—	—	—
Box #1	70	68	73	72
Box #2	70	68	73	72
Box #3	70	68	73	72
Box #4	—	—	—	—
Box #5	—	—	—	—
Box #6	—	—	—	—
WB Omega 873	71	69	71	72
DB Omega 873	71	69	72	72
WB Omega #	71	69	72	72
DB Omega #	71	69	72	72
Probe ' #1	71	69	72	72
Probe ' #2	71	69	73	72
Probe ' #1	—	—	—	—
Probe ' #2	—	—	—	—
			—	

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RAC STAKSAMPLR CALIBRATION SHEET

Meter Box Serial Number: 1965 Barometric Pressure (P_b): 29.040

Leak Check @ 5.0 in. H_2O: OK Date: 12-26-89 Calibrated by: JAB

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_m	CF_d	T_m	IT_d	OT_d	T_d avg.	Time t
0.5	5	5.35	65.2	104.5	90.0	97.25	12.80
1.0	5	5.38	65.2	110.0	92.0	101.00	9.28
1.5	10	10.79	65.2	116.0	96.0	106.00	15.24
2.0	10	10.80	65.5	118.0	96.5	107.25	13.35
3.0	10	10.76	65.5	121.0	99.0	110.00	11.10
4.0	10	10.77	65.6	122.5	100.5	111.50	9.68

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

$$Y = \frac{CF_m P_b (T_{d\,avg.} + 460)}{CF_d (P_b + \Delta H/13.6)(T_m + 460)} = 1.00 \qquad \Delta H_@ = \frac{0.0317 \quad \Delta H}{P_b (T_d + 460)} \left(\frac{(T_m + 460)\, t}{CF_m}\right)^2 = 1.84$$

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

CALIBRATION CALCULATIONS PUMP AND ORIFICE METER

Manometer Delta H 0.5 in. H_2O

$$Y = \frac{5 \times 29.040\ (97.25 + 460)}{5.35\ (29.040 + 0.0368)(65.2 + 460)} = 0.990 \quad \Delta H_@ = \frac{0.01585}{29.040\ (97.25 + 460)} \left(\frac{(65.2 + 460)\ 12.80}{5}\right)^2 = 1.630$$

Manometer Delta H 1.0 in. H_2O

$$Y = \frac{5 \times 29.040\ (101.00 + 460)}{5.38\ (29.040 + 0.0737)(65.2 + 460)} = 0.990 \quad \Delta H_@ = \frac{0.03170}{29.040\ (101.00 + 460)} \left(\frac{(65.2 + 460)\ 9.28}{5}\right)^2 = 1.805$$

Manometer Delta H 1.5 in. H_2O

$$Y = \frac{10 \times 29.040\ (106.00 + 460)}{10.79\ (29.040 + 0.1103)(65.2 + 460)} = 0.995 \quad \Delta H_@ = \frac{0.04755}{29.040\ (106.00 + 460)} \left(\frac{(65.2 + 460)\ 15.24}{10}\right)^2 = 1.793$$

Manometer Delta H 2.0 in. H_2O

$$Y = \frac{10 \times 29.040\ (107.25 + 460)}{10.80\ (29.040 + 0.1471)(65.5 + 460)} = 0.994 \quad \Delta H_@ = \frac{0.06340}{29.040\ (107.25 + 460)} \left(\frac{(65.5 + 460)\ 13.35}{10}\right)^2 = 1.912$$

Manometer Delta H 3.0 in. H_2O

$$Y = \frac{10 \times 29.040\ (110.00 + 460)}{10.76\ (29.040 + 0.2206)(65.5 + 460)} = 1.000 \quad \Delta H_@ = \frac{0.09510}{29.040\ (110.00 + 460)} \left(\frac{(65.5 + 460)\ 11.10}{10}\right)^2 = 1.939$$

Manometer Delta H 4.0 in. H_2O

$$Y = \frac{10 \times 29.040\ (111.50 + 460)}{10.77\ (29.040 + 0.2941)(65.6 + 460)} = 0.999 \quad \Delta H_@ = \frac{0.12680}{29.040\ (111.50 + 460)} \left(\frac{(65.6 + 460)\ 9.68}{10}\right)^2 = 1.967$$

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TYPE S PITOT INSPECTION DATA FORM

Date: 05-02-90
By: WQB

Specifications:
1.) Pitot tube assembly must be level.
2.) If pitot tube is damaged explain under comments section.
3.) z = A sin Y (<0.125) and w = A sin θ (<0.03125)
4.) a <10° and B <5°

I.D.	a_1°	a_2°	B_1°	B_2°	Y°	θ°	A, in.	z, in.	w, in.	P_a, in.	P_b, in.	D_t, in.
36"- 1	0.5	2.5	1.0	3.0	2.5	1.0	0.730	0.032	0.01270	0.365	0.365	0.373
36"- 2	1.0	1.0	1.0	1.0	0.0	1.0	1.065	0.000	0.01860	0.532	0.533	0.380
40"- 1	2.5	1.0	2.5	1.0	0.0	1.0	1.112	0.000	0.01940	0.556	0.556	0.385
54"- 1	3.5	1.0	2.0	0.0	0.0	1.0	0.916	0.000	0.01600	0.458	0.458	0.385
66"- 1	0.0	0.0	0.5	0.0	1.0	1.0	1.071	0.019	0.01870	0.535	0.536	0.380
96"- 1	3.0	3.0	1.0	2.0	1.0	1.0	0.887	0.015	0.01548	0.443	0.444	0.378
3'- 1	0.0	0.0	0.0	0.5	1.0	1.0	1.057	0.018	0.01845	0.529	0.528	0.380
3'- 2	1.0	1.5	0.0	1.0	0.0	1.5	1.044	0.000	0.02733	0.522	0.522	0.377
3'- 3	0.5	0.5	1.0	0.5	0.5	1.0	1.044	0.009	0.01822	0.522	0.522	0.378
4'- 1	0.0	0.0	0.0	0.0	0.5	0.0	0.938	0.008	0.00000	0.469	0.469	0.378
4'- 2	0.0	0.0	1.5	0.0	0.0	1.0	0.908	0.000	0.01585	0.454	0.454	0.374
4'- 3	0.5	0.0	1.5	2.5	0.0	1.0	0.880	0.000	0.01536	0.440	0.440	0.376
4'- 4	1.0	2.0	1.0	3.0	0.0	1.5	0.838	0.000	0.02194	0.419	0.419	0.378
4'- 5	0.5	1.5	0.0	1.5	1.5	0.0	0.863	0.023	0.00000	0.432	0.431	0.373
4'- 6	0.0	0.0	0.0	0.0	0.0	0.0	0.959	0.000	0.00000	0.480	0.479	0.372
5'- 1	0.0	0.5	1.0	1.5	2.0	0.0	1.017	0.035	0.00000	0.508	0.509	0.376
5'- 2	0.0	0.0	0.5	1.0	1.0	1.0	1.058	0.018	0.01846	0.529	0.529	0.373
5'- 3	0.5	1.0	1.0	2.0	2.5	1.5	1.054	0.046	0.02759	0.527	0.527	0.375
5'- 4	0.5	0.0	0.5	1.0	1.5	1.0	1.052	0.027	0.01836	0.526	0.526	0.377
6'- 1	0.5	1.5	0.5	2.5	0.5	0.5	1.006	0.009	0.00878	0.503	0.503	0.376
6'- 2	0.0	0.5	0.0	0.5	2.0	0.0	1.008	0.035	0.00000	0.504	0.504	0.377
6'- 3	0.0	0.0	0.0	1.0	1.0	0.5	1.018	0.018	0.00888	0.509	0.509	0.376
6'- 4	1.0	0.0	0.5	0.0	1.5	1.5	1.008	0.026	0.02639	0.504	0.504	0.375
8'- 1	0.0	0.5	0.5	1.0	3.0	0.0	0.837	0.044	0.00000	0.419	0.418	0.376
8'- 2	1.0	0.0	1.0	4.0	2.0	0.0	0.908	0.032	0.00000	0.454	0.454	0.393
8'- 3	0.5	1.0	1.0	2.5	0.0	0.0	0.932	0.000	0.00000	0.466	0.466	0.375
8'- 4	1.0	2.5	0.0	3.0	0.0	1.0	1.015	0.000	0.01771	0.508	0.507	0.376
8'- 5	0.5	0.0	0.5	0.0	1.0	1.5	0.989	0.017	0.02589	0.494	0.495	0.376
8'- 6	0.5	2.0	0.5	2.0	1.0	0.0	0.917	0.016	0.00000	0.458	0.459	0.383
8'9"	1.0	2.0	1.5	1.5	1.0	2.0	0.895	0.016	0.03124	0.447	0.448	0.380
9'7"-1	0.5	1.0	0.5	0.5	0.5	1.0	0.914	0.008	0.01595	0.457	0.457	0.378
9'7"-2	0.5	0.0	2.0	3.0	1.0	1.0	0.983	0.017	0.01716	0.492	0.491	0.378
12'6"	1.5	1.5	2.5	2.5	0.0	0.5	0.809	0.000	0.00705	0.405	0.404	0.377

Comments: Only minor filing and cleaning required.

Pitot tubes requiring furthering calibration: None.

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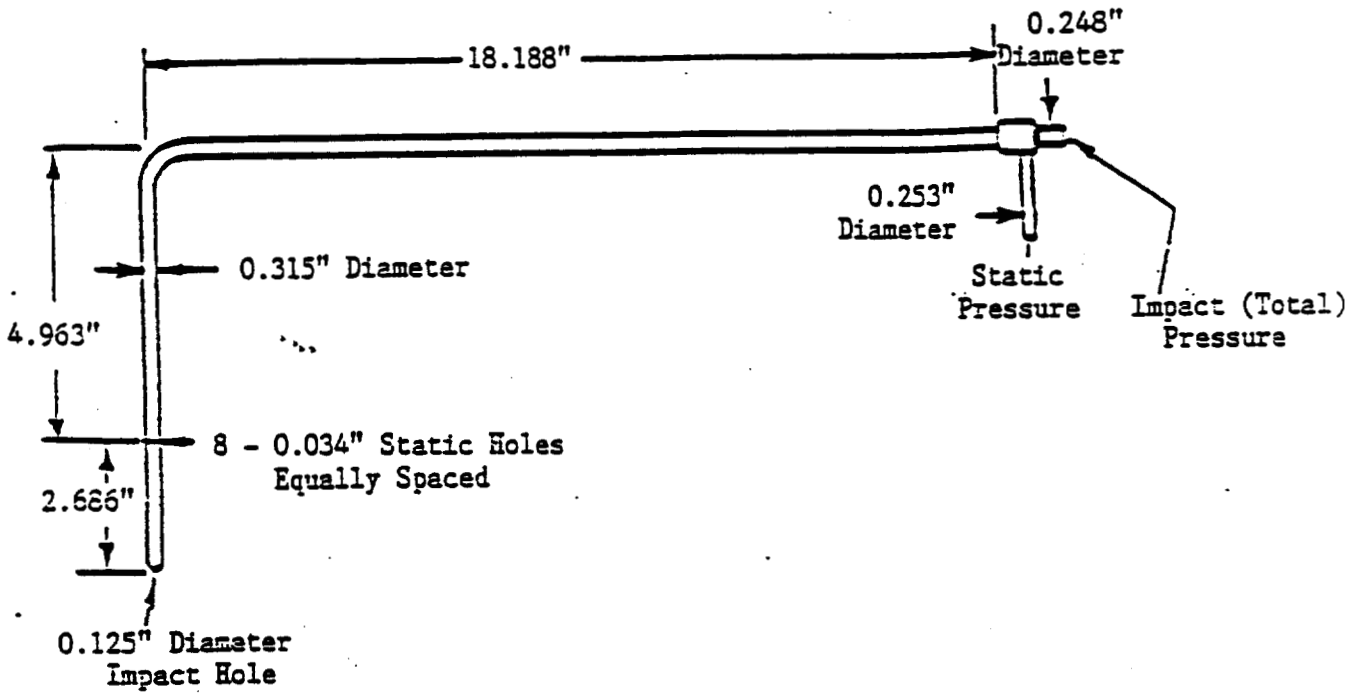
Standard Pitot Tube Calibration

Serial # 160 - 18 - 1



2.7.1	Hemispherical Tip
2.7.2	8.53 Diameters
2.7.3	15.76 Diameters
2.7.4	0.034"
2.7.5	90° curved bend

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

DATE: 06/05/90
AMBIENT TEMPERATURE, F : 74
CALIBRATOR: WQB

BAROMETRIC PRESSURE: 29.18
REFERENCE THERMOMETER # 5

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE, F	THERMOCOUPLE POTENTIOMETER TEMPERATURE, F	TEMPERATURE DIFFERENCE, %
Probe - #					
4'-1	A.	oil bath	110	110	0.00
	B.	oil bath	204	205	-.15
	C.	oil bath	350	351	-.12
4'-2	A.	oil bath	110	110	0.00
	B.	oil bath	204	204	0.00
	C.	oil bath	350	351	-.12
5'-1	A.	oil bath	115	110	0.87
	B.	oil bath	208	202	0.90
	C.	oil bath	350	353	-.37
5'-2	A.	oil bath	116	113	0.52
	B.	oil bath	209	208	0.15
	C.	oil bath	351	352	-.12
6'-1	A.	oil bath	118	115	0.52
	B.	oil bath	210	211	-.15
	C.	oil bath	351	353	-.25
6'-2	A.	oil bath	118	115	0.52
	B.	oil bath	210	211	-.15
	C.	oil bath	352	353	-.12
8'-1	A.	oil bath	119	114	0.86
	B.	oil bath	214	210	0.59
	C.	oil bath	352	351	0.12
8'-2	A.	oil bath	119	118	0.17
	B.	oil bath	215	215	0.00
	C.	oil bath	352	352	0.00
8'-3	A.	oil bath	119	116	0.52
	B.	oil bath	216	216	0.00
	C.	oil bath	352	353	-.12
8'-9"	A.	oil bath	124	121	0.51
	B.	oil bath	217	216	0.15
	C.	oil bath	352	354	-.25
9'-7"	A.	oil bath	124	120	0.68
	B.	oil bath	229	231	-.29
	C.	oil bath	352	355	-.37
12'-6"	A.	oil bath	124	123	0.17
	B.	oil bath	249	249	0.00
	C.	oil bath	352	353	-.12

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

pace. laboratories, inc.

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

DATE: 06/05/90
AMBIENT TEMPERATURE, F : 74
CALIBRATOR: WQB/TEW

BAROMETRIC PRESSURE: 29.18
REFERENCE THERMOMETER # 5

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE,F	THERMOCOUPLE POTENTIOMETER TEMPERATURE,F	TEMPERATURE DIFFERENCE, %
Impinger					
#1	A.	ice bath	36	36	0.00
	B.	water bath	78	76	0.37
	C.	water bath	116	115	0.17
	D.	water bath	107	106	0.18
#2	A.	ice bath	36	37	-.20
	B.	water bath	78	76	0.37
	C.	water bath	116	115	0.17
	D.	water bath	107	106	0.18
#3	A.	ice bath	36	38	-.40
	B.	water bath	78	78	0.00
	C.	water bath	116	115	0.17
	D.	water bath	107	108	-.18
#4	A.	ice bath	36	35	0.20
	B.	water bath	78	76	0.37
	C.	water bath	116	114	0.35
	D.	water bath	107	105	0.35
#5	A.	ice bath	36	36	0.00
	B.	water bath	78	77	0.19
	C.	water bath	116	115	0.17
	D.	water bath	107	106	0.18
#6	A.	ice bath	36	36	0.00
	B.	water bath	78	77	0.19
	C.	water bath	116	115	0.17
	D.	water bath	107	106	0.18

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

pace. laboratories, inc.

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

DATE: 06/05/90
AMBIENT TEMPERATURE, F : 74
CALIBRATOR: WOB/TEW

BAROMETRIC PRESSURE: 29.18
REFERENCE THERMOMETER # 5

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE,F	THERMOCOUPLE POTENTIOMETER TEMPERATURE,F	TEMPERATURE DIFFERENCE, %
Meter Box					
1264A	A.	ice bath	35	36	-.20
	B.	water bath	70	69	0.19
	C.	oil bath	122	120	0.34
	D.	oil bath	170	169	0.16
1264B	A.	ice bath	35	36	-.20
	B.	water bath	70	70	0.00
	C.	oil bath	123	124	-.17
	D.	oil bath	171	172	-.16
1348A	A.	ice bath	35	34	0.20
	B.	water bath	70	70	0.00
	C.	oil bath125	125	127	-.34
	D.	oil bath	171	171	0.00
1348B	A.	ice bath	35	36	-.20
	B.	water bath	70	70	0.00
	C.	oil bath	126	128	-.34
	D.	oil bath	171	170	0.16
1401A	A.	ice bath	35	36	-.20
	B.	water bath	70	70	0.00
	C.	oil bath	128	128	0.00
	D.	oil bath	172	173	-.16
1401B	A.	ice bath	35	34	0.20
	B.	water bath	70	71	-.19
	C.	oil bath	129	131	-.34
	D.	oil bath	172	172	0.00
1965A	A.	ice bath	35	34	0.20
	B.	water bath	70	69	0.19
	C.	oil bath	130	130	0.00
	D.	oil bath	172	174	-.32
1965B	A.	ice bath	35	35	0.00
	B.	water bath	70	70	0.00
	C.	oil bath	134	136	-.34
	D.	oil bath	172	173	-.16

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

pace. laboratories, inc.

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

DATE: 06/08/90
AMBIENT TEMPERATURE, F : 72
CALIBRATOR: TEW

BAROMETRIC PRESSURE: 29.18
REFERENCE THERMOMETER # 5

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE, F	THERMOCOUPLE POTENTIOMETER TEMPERATURE, F	TEMPERATURE DIFFERENCE, %
SAMPLE BOX					
#1	A.	oil bath	152	152	0.00
	B.	oil bath	200	195	0.76
	C.	oil bath	220	220	0.00
	D.	oil bath	260	255	0.69
	E.	oil bath	280	276	0.54
#2	A.	oil bath	152	152	0.00
	B.	oil bath	200	195	0.76
	C.	oil bath	220	220	0.00
	D.	oil bath	260	255	0.69
	E.	oil bath	280	276	0.54
#3	A.	oil bath	152	152	0.00
	B.	oil bath	200	200	0.00
	C.	oil bath	220	225	-.74
	D.	oil bath	262	260	0.28
	E.	oil bath	280	280	0.00
#4	A.	oil bath	152	152	0.00
	B.	oil bath	200	200	0.00
	C.	oil bath	222	225	-.44
	D.	oil bath	262	260	0.28
	E.	oil bath	280	280	0.00
#5	A.	oil bath	152	152	0.00
	B.	oil bath	200	200	0.00
	C.	oil bath	222	225	-.44
	D.	oil bath	264	265	-.14
	E.	oil bath	282	280	0.27
#6	A.	oil bath	152	152	0.00
	B.	oil bath	200	195	0.76
	C.	oil bath	222	220	0.29
	D.	oil bath	264	260	0.55
	E.	oil bath	282	277	0.67

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

pace. laboratories, inc.

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

DATE: 06/08/90
AMBIENT TEMPERATURE, F : 72
CALIBRATOR: TEW

BAROMETRIC PRESSURE: 29.18
REFERENCE THERMOMETER # 5

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE, F	THERMOCOUPLE POTENTIOMETER TEMPERATURE, F	TEMPERATURE DIFFERENCE, %
Omega Temp HH-2 #1					
Db1	A.	water bath	75	76	-.19
	B.	oil bath	150	151	-.16
	C.	oil bath	228	231	-.44
	D.	oil bath	286	286	0.00
Wb1	A.	water bath	75	75	0.00
	B.	oil bath	150	151	-.16
	C.	oil bath	228	229	-.15
	D.	oil bath	286	285	0.13
Omega Temp HH-2 #2					
Db2	A.	water bath	78	78	0.00
	B.	oil bath	150	151	-.16
	C.	oil bath	218	220	-.29
	D.	oil bath	284	284	0.00
Wb2	A.	water bath	78	77	0.19
	B.	oil bath	150	151	-.16
	C.	oil bath	218	217	0.15
	D.	oil bath	284	284	0.00
Omega Temp 873-F #1					
Db1	A.	water bath	76	76	0.00
	B.	oil bath	150	149	0.16
	C.	oil bath	226	226	0.00
	D.	oil bath	286	287	-.13
Wb1	A.	water bath	76	76	0.00
	B.	oil bath	150	149	0.16
	C.	oil bath	226	227	-.15
	D.	oil bath	286	286	0.00
Omega Temp 873-F #2					
Db2	A.	water bath	76	76	0.00
	B.	oil bath	150	152	-.33
	C.	oil bath	222	221	0.15
	D.	oil bath	286	288	-.27
Wb2	A.	water bath	76	76	0.00
	B.	oil bath	150	152	-.33
	C.	oil bath	222	221	0.15
	D.	oil bath	286	288	-.27

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

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

DATE: 06/25/90
AMBIENT TEMPERATURE, F : 72
CALIBRATOR: TEW

BAROMETRIC PRESSURE: 29.18
REFERENCE THERMOMETER # 5

REFERENCE POINT #		SOURCE	REFERENCE THERMOMETER TEMPERATURE, F	THERMOCOUPLE POTENTIOMETER TEMPERATURE, F	TEMPERATURE DIFFERENCE, %
Bimetallic					
Wb1	A.	water bath	72	72	0.00
	B.	oil bath	185	184	0.16
	C.	oil bath	225	225	0.00
	D.	oil bath	264	264	0.00
	E.	oil bath	282	281	0.13
Db1	A.	water bath	72	71	0.19
	B.	oil bath	185	185	0.00
	C.	oil bath	225	224	0.15
	D.	oil bath	264	263	0.14
	E.	oil bath	282	285	-.40
Wb2	A.	water bath	72	72	0.00
	B.	oil bath	185	184	0.16
	C.	oil bath	226	228	-.29
	D.	oil bath	266	265	0.14
	E.	oil bath	284	282	0.27
Db2	A.	water bath	72	70	0.38
	B.	oil bath	185	186	-.16
	C.	oil bath	226	230	-.58
	D.	oil bath	266	268	-.28
	E.	oil bath	284	285	-.13
NOx	A.	water bath	72	72	0.00
	B.	oil bath	90	91	-.18
	C.	oil bath	105	105	0.00
	D.	oil bath	115	116	-.17
	E.	oil bath	125	125	0.00
Hot Box	A.	water bath	72	70	0.38
	B.	oil bath	185	184	0.16
	C.	oil bath	225	225	0.00
	D.	oil bath	264	265	-.14
	E.	oil bath	281	281	0.00

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

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
Product Engineering Supervisor

b10012

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

METTLER

Weight Traceability Certificate

To: Pace Laboratory Inc
1700 Univ Commercial
Charlotte N.C. 28213

The balances listed below have been serviced by our representative on
Jan 24th 1990

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:	348	
METTLER calibration date of test weights used:	04/01/89	
National Bureau of Standards test number:	737/0670-Met49	

Model and serial number of balances serviced:

AE163 C57742
H54 677277
AK160 A44922

METTLER Service Representative

Jan 24th 1990
Date of issue

GCA

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

Bob Husberg
Supervisor, Customer Service

BH/mg

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.