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.

AP42 Section:	11.18
Reference:	9
Title:	*Particulate Emission Tests On Batt Curing Oven For U. S. Gypsum, Birmingham, Alabama On October 31-November 1, 1977*, Guardian Systems, Inc., Birmingham, AL, Undated.

51

PM data for curing oven only. No process description but process rate as lb batt cured is included B.

Particulate Emission Tests

On

Batt Curing Oven

For

U.S. Gypsum

Birmingham, Alabama

October 31,-November 1, 1977

TABLE OF CONTENTS

I. INTRODUCTION

On October 31, 1977 a pretest discussion of sampling procedures was conducted with Mr. Jim Carroll of Jefferson County Department of Health, Air Pollution Control Program. These procedures were those outlined in the new revision to Reference Method 1-8, Standards of Performance for New Stationary Sources 40CFR60.

On October 31, 1977 the first test (Test #1) was completed on the batt curing oven stack. This test was disallowed by the Jefferson County Health Department due to a post test pitot leak check failure and subseqently is not included in this report.

On November 1, 1977 four (4) tests were conducted on the curing oven. The first test of this series (Test #2) was discontinued at midpoint due to a malfunction on the production line. It is not included in this report. The final three (3) tests (Tests #3, 4, 5) comprise this report.

The control device for the curing oven is a Veltran Electrostatic Precipitator exhausting through a two foot diameter stack.

Operational data for the curing oven was collected by U.S. Gypsum personnel. Mr. Lee Crawford of U.S. Gypsum was responsible for coordinating production line operation with the testing schedule. Mr. Jim Carroll of the Jefferson County Department of Health, Air Pollution Control Program observed the tests. Mr. David Daws and Mr. Paul Eddins of Guardian Systems performed the tests.

II. SAMPLING AND ANALYTICAL PROCEDURES

General

Preliminary measurements were made of the stack to determine the number of sampling points according to Method 1. The batt curing oven was sampled at 8 points on two (2) diameters for a total of 16 points. The Stack and Sample Point Locations for the stack can be found in Figure 1.

Stack temperature, stack pressure, the range of velocity heads, moisture content, and the stack gas dry molecular weight were determined to correctly set the nomographs for isokinetic sampling. The meter box was leaked checked from the pump to the orifice meter as outlined in Method 5. The equipment used in this test was manufactured by Research Appliance Corporation and was properly calibrated before and after the tests. (See calibrations.)

Sampling Techniques

The particulate determinations were made by utilizing the sampling train in Figure 2. Initial and final leak checks of the sampling systems and of the pitot lines were performed as outlined in Method 5 and these were recorded on the individual data sheets.

The gases were drawn through a stainless steel nozzle attached to a heated stainless steel lined probe. The probe heater was maintained at the proper setting to obtain an exit temperature of 248 $\pm$ 25°F. (See calibrations). The gases then passed through a glass cyclone for removing particulate matter approximately 10 microns and greater in size, then through a glass fiber filter (Gelman, Class A) of 0.3 microns retention to remove

Guardian

any remaining particulate matter. The cyclone and filter were maintained at temperature of 248 ± 25°F. The sample box temperature were recorded at each point on the data sheet.

The gases then passed through four (4) Greenburg-Smith impingers. The first and second impingers contained 150 milliliters of distilled water each, while the third was empty and the fourth contained approximately 220 grams of indicating silica gel. These impingers were placed in an ice bath during the tests to maintain a maximum exit temperature from the last impinger of 68°F. This temperature is also recorded on the data sheets. The clean and cool gases then entered the meter box where the gas flow and temperature were measured. (See data sheets.)

Gas analysis for CO_2 and O_2 were determined for each run by using Fyrite gas analyzers. Particulate catches were placed in sealed petri dishes. The acetone washes of the nozzle, probe and cyclone were combined and placed in sealed containers. These containers were transported to the laboratory for analysis.

Analysis

The filters (Gelman, Class A, without organic binder, minimum 99.9% retention for particules of 0.3 micrometer as determined by DOP tests) prepared for the field test were first desiccated at 68 ± 10°F at ambient pressure for 24 hours and weighed at intervals of atleast 6 hours to a constant weight (less then 0.5 milligrams change from previous reading.) Upon return to the laboratory the filters were again subjected to the same procedures as outlined above. The weights are recorded in a Bound Laboratory Book and were transferred to the laboratory report sheets.in this report. During each weighing the filter

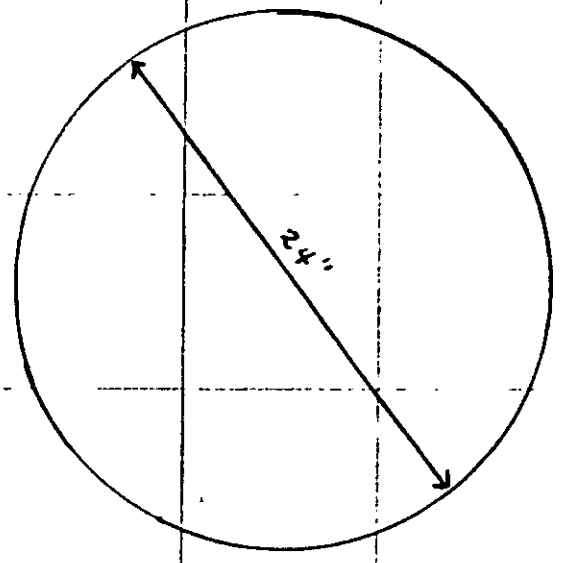
was not exposed to laboratory atmosphere for more than 2 minutes and the relative humidity of the laboratory was less than 50%.

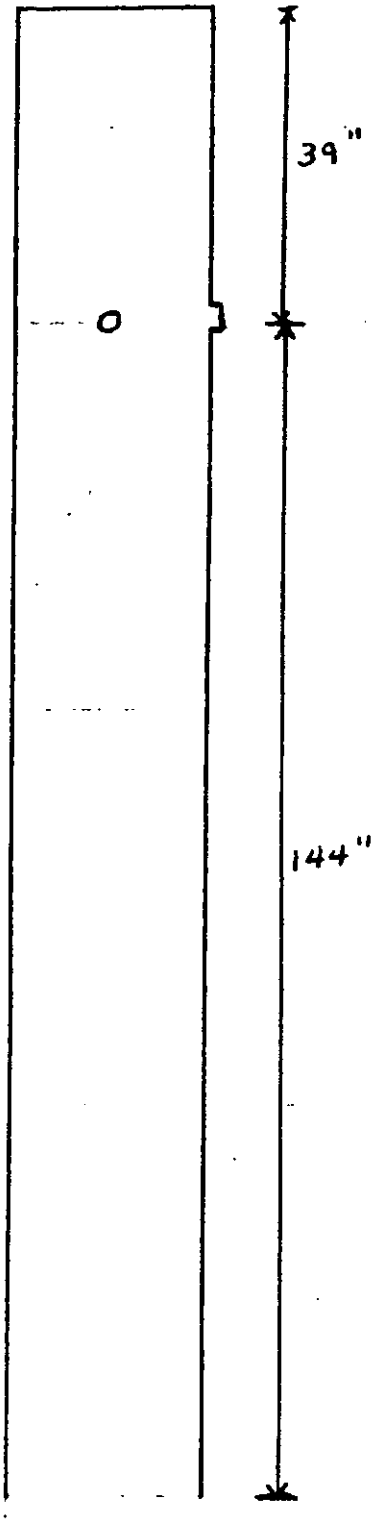
The acetone washings for each run and the blank were

to dryness in tared glass beakers at ambient pressure and temperature. They were then desiccated for 24 hours and weighed to constant weight.

The moisture content was determined for each run by measuring the amount of water collected in the impingers and the increase in weight of the silica gel. These weights were combined to give the total amount of water collected.

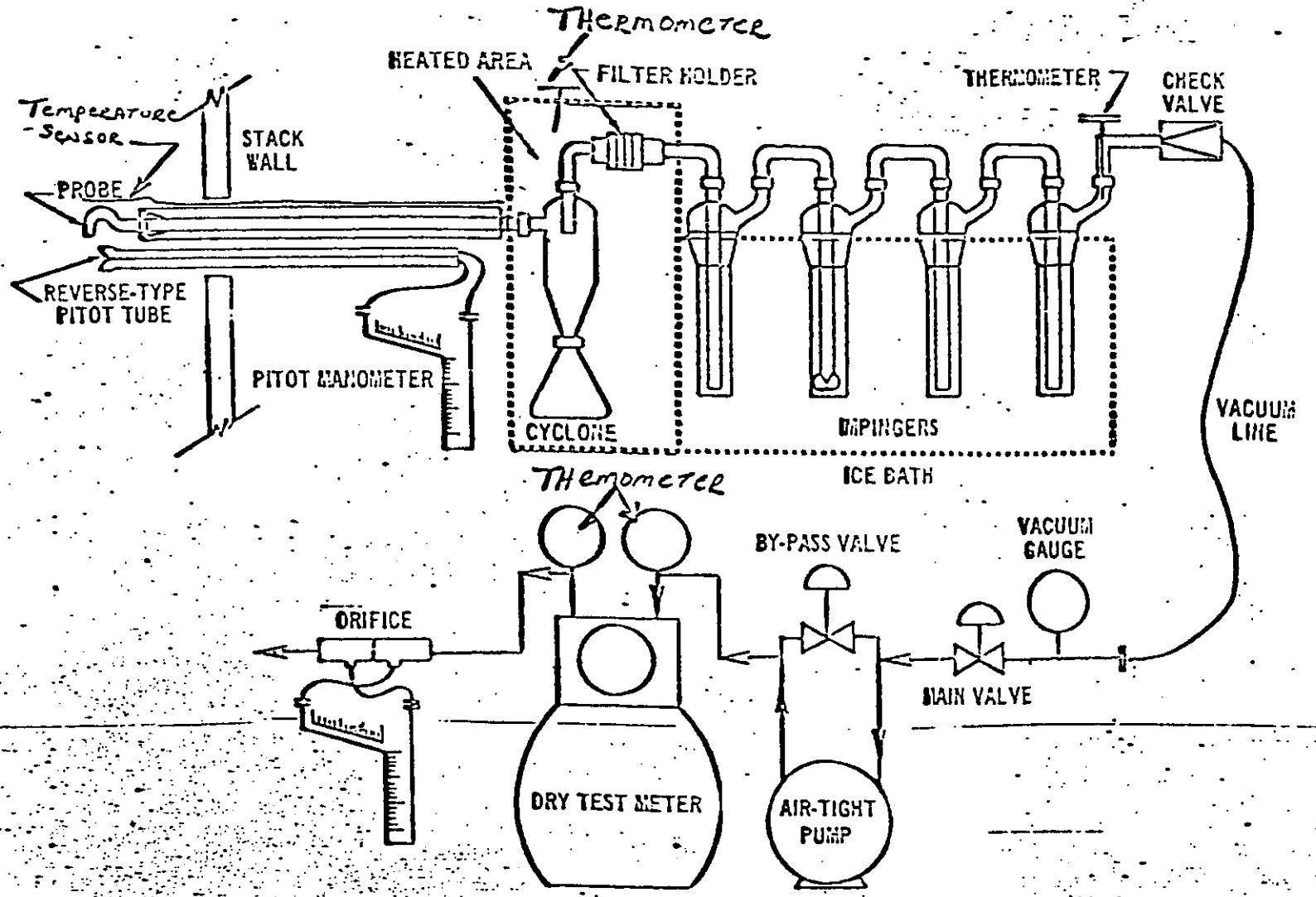
BATT CURING OVEN





POINT #	DISTANCE FROM WALL (IN.)
1.	1.0
2.	2.5
3.	4.7
4.	7.8
5.	16.2
6.	19.3
7	21.5
8.	23.0

FIGURE 1



Particulate Sampling Train

Figure 2

11/1/77

III. SUMMARY OF TEST RESULTS

The production rates (tons/hr) for the curing oven were based on production run times and weights supplied by U.S. Gypsum. The emission rates were computed according to the equation found in Section 6.4.1 of The Jefferson County Health Department, Air Pollution Control Rules and Regulations as follows:

$E = 3.59\ P^{0.62}$ $\qquad P \leq 30$ tons/hr

Run Number	Allowable Emission (lb/hr)	P	Emissions
3	5.52	2.0	0.93
4	4.46	1.4	1.71
5	6.78	2.8	1.34

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TABLE I

Summary of Test Results

Run Number	1	2	3
Date	11-1-77	11-1-77	11-1-77
Time	11:00-12:20	1:31-2:41	5:00-6:15
Temperature, °F	175	185	189
Moisture, %	4.95	4.87	5.07
Stack Velocity, f/s	59.57	60.60	60.03
Volumetric Flow, ACFM	11,228	11,423	11,315
Volumetric Flow, DSCFM	8,942	8,943	8,779
Concentration, Grains/ACF	0.0097	0.0175	0.0139
Concentration, Grains/DSCF	0.0122	0.0223	0.0179
Particulate Mass Rate, lb/hr	0.93	1.71	1.34
Process Weight, T/hr	2.00	1.42	2.79
Allowables, lb/hr	5.52	4.46	6.78

8800 DSCFM
0.02 gr DSCF
1.52 PPH

N=3
1.33 Avg

Avg
8800
.02gr/DSCF x 8779 DSCF/hour x 1 hour/hr x 1 lb/7000 = 1.52 PPH

Guardian

IV. OPERATIONAL DATA

1.6
12?

INDUSTRIAL FELT PRODUCTS

DAILY REPORT

B'HAM WOOL PLANT LOCATION: LEADER: SHIFT: DATE:

	1	2	3	4	5
CUSTOMER					
CODE & ITEMS	FELT	54			
FELT SIZE	4 X 24 x 48	2 x 16 x 48			
DENSITY & TYPE	4 = 4"	2.5 = 2"			
BLANKET THICKNESS	4"	4" spec			
PKGS. ORDERED & PCS. PER PKG	→ 4 PCS	8 PCS			
TYPE OF PACKAGE	carton	15 x 1			
WEIGHT TOLERANCE					
BINDER SETTING	7%	7%			
CUT OFF TIMER SETTING					
CHANGE TIME- START	9 00	130			
PROD. TIME-START	900	130			
PROD. TIME-STOP	12 45	500			
LOST TIME (REASON ON BACK)	10 min	25 min			
NET PRODUCT TIME	3 hr.	1 hr. 5 min			
INCAL FT. READING	1445	782			
ACTUAL LIN. FT.					
NO. GROSS PCS.	956	960			
PKGS. & PCS. PER PKG.	224 - 4 PCS	120 - 8 PCS			
NO. SALABLE PCS.	895	940			
PCS. REJECTS	60	20			
% REJECTS	6%	2%			
WIDTH OF TRIM	4"	4"			
PRODUCTION LABOR	10	10			

REMARKS:

[illegible]

[illegible]	[illegible]	[illegible]	35 mm [illegible]	[illegible]
Item # 1	1000 1015	Title, [illegible] Birds		10 min. LT
	1[illegible] 130	title [illegible]		
Item # 2	235 300	[illegible]		25 min. T

PRODUCTION REPORT – NO.

SIGNED [illegible] #2 DATE 7-1-77 SHIFT [illegible]

LINE NO.	#1 ↓ #1		#1		#1							
[illegible]	[illegible]		[illegible]		[illegible]							
ORDER NO.	15477		22967		[illegible]							
[illegible]	T-4587		T-454-1575		535							
PACKAGE	[illegible]		[illegible]		[illegible]							
SIZE	4x24x48		2x16x48		2x16x48							
TYPE	4" FELT		2" SA		2" SA							
BAG NO.	UNITS	WEIGHT	UNITS	WEIGHT	UNITS	WEIGHT	UNITS	WEIGHT	UNITS	WEIGHT	UNITS	WEIGHT
1	10	510	20	460	20	530						
2	10	520	20	450	20	520						
3	10	480	20	480	20	540						
4	10	550	20	530	20	530						
5	10	530	20	520	20	510						
6	10	550	20	520	20	500						
7	10	540	5	110								
8	10	510										
9	10	560										
10	10	[illegible]										
11	10	450										
12	10	490										
13	10	570										
14	10	530										
15	10	630										
16	10	590										
17	10	540										
18	10	570										
19	10	600										
20	10	570										
21	10	550										
22	10	510										
23	<1	180										
24												
25												
26												
27												
28												
TOTAL	[illegible]	11980	125	3070	120	3130	-12-					

[illegible] REV. [illegible] (PRINTED IN U.S.A.) 12

INDUSTRIAL FELT PRODUCTS

DAILY REPORT

B'HAM WOOL PLANT FOREMAN: LEADER: [illegible] SHIFT: 3-4 DATE: 11-[illegible]

	1	2	3	4	5
CUSTOMER	#3				
CODE & ITEMS	S.A.	S A			
FELT SIZE	2x16x48	1½x24x42			
DENSITY & TYPE	2.5 2"	2.5 1½"			
BLANKET THICKNESS	4 SPLIT	3" Split			
PKGS. ORDERED & PCS. PER PKG	8	8			
TYPE OF PACKAGE	Bags	Bags			
WEIGHT TOLERANCE	—	—			
BINDER SETTING	7 70	7 70			
CUT OFF TIMER SETTING					
CHANGE TIME- START	3:00	900			
PROD. TIME-START	4:30	900			
PROD. TIME-STOP	8:00	11 00			
LOST TIME (REASON ON BACK)	25 MIN	15 MIN			
NET PRODUCT TIME	3.05	1.75			
LINEAL FT. READING	2560	1400			
ACTUAL LIN. FT.		—			
NO. GROSS PCS.	5'49"	1592			
PKGS. & PCS. PER PKG.	6 [illegible]	2 [illegible]			
NO. SALABLE PCS.	[illegible] —	1512			
PCS. REJECTS	111	80			
% REJECTS					
WIDTH OF TRIM	4	4			
PRODUCTION LABOR	18	10			

REMARKS:

8-610-615 Sliter Saw Plug
.25-615-630 no giniles
.8-730-735 Sliter Saw Plug
ITEM #2-
.25 1045-1100 Change over

PRODUCTION REPORT - ____________ NO. ________

SIGNED [signature] DATE 11-1-73 SHIFT 3-11

LINE NO.	# 1		# 1		# 1		# 1		# 1			
CUST./BRAND	USG		USG		USG		USG		USG			
ORDER NO.	[illegible] 277		22449		94980		34103		2-51465			
CAR NO.	T-635		T-4561		T-45-491		T-65-601		T-667			
PACKAGE	IMP		IMP		IMP		IMP		IMP			
SIZE	2 X 16 X 48		2 X 16 X 48		2 X 16 X 48		2 X 16 X 48		1½ X 24 X 48			
TYPE	2 S.A.		2" S.A.		2" S.A.		2" S.A.		1½ S.A.			
LOAD NO.	UNITS	WEIGHT	UNITS	WEIGHT	UNITS	WEIGHT	UNITS	WEIGHT	UNITS	WEIGHT	UNITS	WEIGHT
1	20	530	20	450	20	520	20	470	20	440		
2	20	570	20	490	20	580	20	480	20	500		
3	20	610	20	440	20	500	20	580	20	520		
4	20	580	20	440	20	450	20	490	20	490		
5	20	460	20	510	20	450	20	500	20	630		
6	20	490	20	530	18	430	20	570	20	530		
7	20	430	2	50	=		20	510	20	490		
8	20	530	=				20	420	20	620		
9	20	570					20	460	20	660		
10	15	390					20	510	20	650		
11	=						11	260	20	680		
12							=	11	11	440		
13							over	Run	=	//		
14							20	580	over	Run		
15							7	190	8	270		
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
TOTAL	[illegible]	[illegible]	122	29[illegible]	118	2940	238	[illegible]	235	7030		
	/	/	/	/	/	/	/	/	/	/		

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V. TEST RESULTS

NOMENCLATURE

$\overline{\Delta h}$ - Avg. pressure diff. of orifice (in. H_2O)

$\overline{\sqrt{\Delta p}}$ Avg. of square roots of the velocity pressure (in. H_2O)

P_b - Barometric pressure (uncorrected, in. Hg)

P_m - Meter pressure

P_s/P_m - $\frac{\text{Stack pressure (in. Hg)}}{\text{Meter pressure (in. Hg)}}$

P_s - Stack pressure (in. Hg)

$\overline{t_m}$ - Avg. temp. of meter (^oF)

$\overline{t_s}$ - Avg. temp. of stack (^oF)

t_a - Ambient temperature

Note: Capital T denotes degrees Rankin

V_n - Volume collected at stack cond through nozzle

V_m - Actual bolume metered (ADCF) (Metered GAs Volume x MCF)

V_{mstd} - Vol. metered (SDCF)

V_{lc} - Tot. vol. of liquid collected in impinger & silica gel (ml)

V_{wstd} - Vol. of water vapor in gas sample (SCF)

B_{wo} - Proportion by volume of water vapor in the gas stream (dimensionless)

M_d - Molecular wt. of dry gas stream

M_w - Molecular wt. of wet gas stream

EA - Excess air

$\overline{v_s}$ - Avg. stack gas velocity (fps)

Q_a - Volumetric flow rate (ACFM)

Q_s - Volumetric flow rate (wet basis, SCFM)

Q_{std} - Volumetric flow rate (SDCFM)

M_n - Total amount of particulate collected (mg)

C_s - Particulate concentration (grains/SDCF)

C_a - Particulate concentration (grains/ACF)

C_{50} - Concentration (C_s) adjusted to 50% EA

PMR - Particulate mass rate (#/Hr.)

C_{12} - Concentration (C_s) adjusted to 12% CO_2

% CO_2, % N_2, % O_2, %CO - Number % by volume, dry basis from orsat analysis

ΔP_s - Differential pressure of the stack (in. H_2O)

A_n - Area of nozzle (ft^2) :(6 significant digits)

A_s - Area of stack (ft^2)

%I - Isokinetic (dimensionless)

K_p - Dimensional coefficient (85.48 $\frac{\text{ft.}}{\text{sec.}} \sqrt{\frac{\text{lb.}}{\text{lb. - mole } ^\circ R}}$)

Km - Orifice correction factor (dimensionless)

$\Delta H@$ - Value of h measured for a specific orifice whem operated under the following conditions: 0.75 cfm of dry air (M=29) at 70°F, 29.92 in. Hg.

mcf - Meter correction factor

θ - Total sampling time (minutes)

Standard conditions are 70°F, 29.92 in. Hg

CFM - Cubic feet per minute

SCFM - Standard cubic feet per minute

SDCFM - Standard dry cubic feet per minute

SCF - Standard cubic feet

C_{SO_2} - Concentration of sulfur dioxide at standard contitions, dry basis, lb/CF

EQUATIONS

1. $P_s = P_b + (\Delta P_s/13.6) = (\quad) + (\quad/13.6) =$

2. $P_m = P_b + (\overline{\Delta H}/13.6) = (\quad) + (\quad/13.6) =$

3. $\bar{v}_s = K_p C_p (\sqrt{\Delta p}) \sqrt{(T_s)/(M_w)(P_s)} =$

   $= (85.48)(\quad)(\quad) \sqrt{(\quad)/(\quad)(\quad)} =$

4. $V_{mstd} = 17.71 (V_m)(P_m)/(T_m) = 17.71(\quad)(\quad)/(\quad) =$

   $=$

5. $V_{wstd} = 0.0474(V_{lc}) = (0.0474)(\quad) =$

6. $B_{wo} = V_{wstd} / (V_{wstd} + V_{mstd}) = (\quad)/(\quad + \quad) =$

   $=$

7. $M_d = .44(\%CO_2) + .32(\%O_2) + .28(\%N_2 + \%CO) =$

   $= .44(\quad) + .32(\quad) + .28(\quad + \quad) =$

8. $M_w = M_d (1-B_{wo}) + 18(B_{wo}) = (\quad)(1-\quad) + (18)(\quad) =$

9. $\%EA = [[(\%O_2) - (0.5)(\%CO)] / [(.264)(\%N_2) - (\%O_2) + (.5)(\%CO)]](100)$

   $= [[(\quad) - (.5)(\quad)]/[.264)(\quad) - (\quad) + (.5)(\quad)]](100)$

   $=$

10. $C_{12} = (C_s)(12)/(\%CO_2) = (\quad)(12)/(\quad) =$

11. $C_{50} = \dfrac{C_s}{1 - \left[\dfrac{(1.5)(\%O_2) - (.133)(\%N_2) - (.75)(\%CO)}{21}\right]} =$

    $= \dfrac{(\quad)}{1 - \left[\dfrac{(1.5)(\quad) - (.133)(\quad) - (.75)(\quad)}{21}\right]} =$

    $=$

EQUATIONS CONTD

12. $Q_a = (v_s)(A_s)(60) = (\quad)(\quad)(60) =$

13. $Q_s = (Q_a)(530)(P_s)/(T_s)(29.92) = (\quad)(530)(\quad)/(\quad)(29.92)$

$=$

14. $Q_{std} = (Q_s)(1-B_{wo}) = (\quad)(1-\quad) =$

15. $C_s = (.0154)(M_n)/(V_{mstd}) = (.0154)(\quad)/(\quad) =$

$=$

16. $V_n = (T_s)/(P_s)\left[(.00267)(V_{lc}) + (V_m)(P_m)/(T_m)\right] =$

$= (\quad)/(\quad)\left[(.00267)(\quad) + (\quad)(\quad)/(\quad)\right]$

$=$

17. $PMR = C_s(Q_{std})(60)/(7000) = (\quad)(\quad)(60)/(7000) =$

$=$

18. $C_a = (.0154)(M_n)/(V_n) = (.0154)(\quad)/(\quad) =$

19. $\%I = \dfrac{(V_n)(1.667)}{(\rho)(v_s)(A_n)} = \dfrac{(\quad)(1.667)}{(\quad)(\quad)(\quad)} =$

SUPPLEMENTARY LABORATORY DATA

As requested by Mr. Jim Carroll of the Jefferson County Department of Health, Air Pollution Control, the impinger water for Runs 3, 4, and 5 were analyzed for solids content. Runs 3 and 4 were combined before it was decided to analyze the impinger catch.

Run Number	Weight Increase mg.	ml. water	ppm
3 & 4	201.0	800.0	251.3
5	74.1	350.0	211.7

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. . . .

3.

11-1-77	Run Number
30.03	Date
-.52	Barometric Pressure
64.00	Static Pressure (in. H_2O)
61.618	Run Time (min)
175.00	Volume of Meter (CF)
85.00	Stack Temp (°F)
2.96	Meter Temp (°F)
.953	Diff. Orifice Press (in. H_2O)
47.90	Sq. root Vel. Press.
66.50	Mg. of Particulate
20.50	Ml. of water condensed
.50	% O_2
3.1416	% CO_2
.847	Stack Area (Ft^2)
.000341	PCF
	Nozzle Area (Ft^2)

. . . .

1. Stack Pressure

30.04 Inches Hg.

763.02 Millimeters Hg.

2. Meter Pressure

30.30 Inches Hg.

769.62 Millimeters Hg.

3. Stack Velocity

59.57 Feet Per Second

18.16 Meters per Second

4. Meter Volume

60.554 SCF

1.715 SCM

5. Water Volume

3.152 SCF

.089 SCM

6. Moisture Content

[illegible]

7. Molecular Wt. Dry

[illegible]

8. Molecular Wt. Dry

[illegible]

12. Volumetric Flow

[illegible] ACFM

[illegible] ACMS

14. Volumetric Flow

[illegible] DSCFM

[illegible] DSCMS

15. Concentration

.0122 Gr/SDCF

[illegible] Gm/SDCM

16. Volume at Nozzle

[illegible] CF

[illegible] CM

17. Particulate Mass Rate

[illegible] lb/hr

18. Concentration

[illegible] Gr/ACF

[illegible] Gm/ACM

19. % Isokinetic

[illegible]

. . . .

3.		Run Number
11-1-77		Date
	30.08	Barometric Pressure
	-.52	Static Pressure (in. H_2O)
	64.00	Run Time (min)
	61.618	Volume of Meter (CF)
	175.00	Stack Temp (^oF)
	86.00	Meter Temp (^oF)
	2.96	Diff. Orifice Press (in. H_2O)
	.953	Sq. root Vel. Press.
	47.90	Mg. of Particulate
	66.50	Ml. of water condensed
	20.50	% O_2
	.50	% CO_2
	3.1416	Stack Area (Ft^2)
	.847	PCF
	.000341	Nozzle Area (Ft^2)
1.	Stack Pressure	
	30.04	Inches Hg.
	763.02	Millimeters Hg.
2.	Meter Pressure	
	30.30	Inches Hg.
	769.62	Millimeters Hg.
3.	Stack Velocity	
	59.57	Feet Per Second
	18.16	Meters per Second
4.	Meter Volume	
	60.554	SCF
	1.715	SCM
5.	Water Volume	
	3.152	SCF
	.089	SCM
6.	Moisture Content	
	.0495	
7.	Molecular Wt. Dry	
	28.90	
8.	Molecular Wt. Dry	
	28.56	
12.	Volumetric Flow	
	11,228.	ACFM
	5.2991	ACMS
14.	Volumetric Flow	
	8,942.	DSCFM
	4.2202	DSCMS
15.	Concentration	
	.0122	Gr/SDCF
	.0279	Gm/SDCM
16.	Volume at Nozzle	
	76.025	CF
	2.153	CM
17.		
	.93	
18.	Concentration	
	.0097	Gr/ACF
	.0222	Gm/ACM
19.	% Isokinetic	
	97.43	

Guardian Systems, Inc.
2809 Central Avenue
Birmingham, Alabama 35209

Run Number 3

Date 11/1/77

Location U.S. Gypsum

Amount liquid lost during transport none

Acetone blank volume, ml 200

Acetone wash volume, ml 420

Acetone blank concentration, mg/mg 6.39×10^{-7}

Acetone wash blank, mg .1

Filter Collections (mg)		Probe and Cyclone Wash (mg)	
Filter #	T-7	Dish #	3
Gross	276.7	Gross	78852.6
Tare	260.5	Tare	78820.9
Net	16.2	Acetone Blank	0.0
		Net	31.7

Total Particulate Capture 47.9 mg.

Water		Silica Gel	
Final	350	Final	236.5
Initial	300	Initial	220
Net	50	Net	16.5

Total Water 66.5

Approved By

. . . .

Value	Item
4.	Run Number
11-1-77	Date
30.03	Barometric Pressure
-.79	Static Pressure (in. H_2O)
64.00	Run Time (min)
61.656	Volume of Meter (CF)
185.00	Stack Temp (°F)
89.00	Meter Temp (°F)
3.02	Diff. Orifice Press (in. H_2O)
.961	Sq. root Vel. Press.
87.10	Mg. of Particulate
65.00	Ml. of water condensed
20.50	% O_2
.50	% CO_2
3.1416	Stack Area (Ft^2)
.847	PCF
.000341	Nozzle Area (Ft^2)

. . . .

1. Stack Pressure
   - 29.97 Inches Hg.
   - 761.24 Millimeters Hg.
2. Meter Pressure
   - 30.25 Inches Hg.
   - 768.35 Millimeters Hg.
3. Stack Velocity
   - 60.60 Feet Per Second
   - 18.47 Meters per Second
4. Meter Volume
   - 60.170 SCF
   - 1.704 SCM
5. Water Volume
   - 3.081 SCF
   - .087 SCM
6. Moisture Content
   - .0487
7. Molecular Wt. Dry
   - 28.90
8. Molecular Wt. Dry
   - 28.37
12. Volumetric Flow
   - 11,423. ACFM
   - 5.391 ACMS
14. Volumetric Flow
   - 9,943. DSCFM
   - [illegible] DSCMS
15. Concentration
   - .0223 Gr/SDCF
   - [illegible] Gm/SDCM
16. Volume at Nozzle
   - 76.847 CF
   - 2.176 CM
17. Particulate Mass Rate
   - [illegible] lb/hr
18. Concentration
   - [illegible] Gr ACF
   - [illegible] Gm ACM
19. % Isokinetic
   - 96.87

. . . .

Guardian SYSTEMS INCORPORATED
2809 CENTRAL AVENUE
BIRMINGHAM, ALABAMA 35209
PHONE (205) 879-1850

PLANT: U.S. Gypsum
LOCATION: Birmingham, AL
BARO. PRES.: 30.08
RUN #: 3
DATE: 11/1/77
TIME: 11:00 - 12:20

POINT NO.	TIME MIN	TIME DUR	METER VOL FT.3	STACK TEMP °F	METER TEMP °F IN	METER TEMP °F OUT	METER TEMP °F AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H_2O	VELOCITY PRESSURE "H_2O	Vacuum Pressure "Hg
Start A			451.902									
1	4	4	456.1	160	82	26	79	52	230	2.5	.77	3
2	8		459.1	170	84	76	81	54	230	2.8	.87	4
3	12		463.3	170	88	76	82	54	230	3.1	.96	4
4	16		467.3	170	90	76	83	58	230	3.3	1.05	5
	20		471.4	170	92	80	86	58	230	3.3	1.05	5
	24		475.5	175	94	80	87	60	250	3.3	1.05	5
	28		479.6	180	94	82	88	62	250	2.9	.90	5
	32		483.3	185	94	82	88	64	250	2.9	.90	5
Start B												
	36	4	486.3	160	86	80	83	64	230	1.6	.48	2
	40		489.3	160	88	82	85	64	240	1.8	.55	3
3	44		492.4	170	90	80	85	64	240	1.85	.56	3
	48		495.3	180	92	80	85	62	240	2.25	.69	3
5	52		500.4	185	96	82	89	62	260	3.8	1.2	6
	56		505.2	180	98	84	91	64	260	4.45	1.4	8
	60		509.8	190	100	86	93	62	260	4.2	1.3	7
	64		514.142	190	100	86	93	62	260	3.55	1.1	6
			62.240	175			86			2.93	.93?	

STATIC PRESSURE "H_2O: -.52

PROBE TIP SIZE: BEFORE .250 / AFTER .250

WATER: ml. 50; gram 16.5; Total 66.5

FILTER NO.: T-7

NOTES

SAMPLE BOX NO. 400
METER BOX NO. 400
METER ΔH@
PITOT, CP
TEMP. DEVICE

FINAL leak check @ 15" Hg
514.186
514.184
.002 cfm

pitot lk ck
impact @ 4" ✓
static @ 6" ✓

orifice check ✓

O_2 = 20.5 %
CO_2 = 0.5 %

INITIAL leak check @ 15" Hg
451.902
451.897
.005 cfm

pitot lk ck
impact @ 7" ✓
static @ 4.5" ✓

Nozzle # 7
.250 .250
.250 .250
.249 .250

4	Run Number
11-1-77	Date
30.03	Barometric Pressure
-.79	Static Pressure (in. H_2O)
64.00	Run Time (min)
61.656	Volume of Meter (CF)
185.00	Stack Temp (^oF)
89.00	Meter Temp (^oF)
3.02	Diff. Orifice Press (in. H_2O)
.961	Sq. root Vel. Press.
87.10	Mg. of Particulate
65.00	Ml. of water condonsed
20.50	% O_2
.50	% CO_2
3.1416	Stack Area (Ft^2)
.847	PCF
.000341	Nozzle Area (Ft^2)

1. Stack Pressure

29.97	Inches Hg.
761.24	Millimeters Hg.

2. Meter Pressure

30.25	Inches Hg.
768.35	Millimeters Hg.

3. Stack Velocity

60.60	Feet Per Second
18.47	Meters per Second

4. Meter Volume

60.170	SCF
1.704	SCM

5. Water Volume

3.081	SCF
.087	SCM

6. Moisture Content

.0487

7. Molecular Wt. Dry

28.90

8. Molecular Wt. Dry

28.37

12. Volumetric Flow

11,423.	ACFM
5.3911	ACMS

14. Volumetric Flow

8,943.	DSCFM
4.2206	DSCMS

15. Concentration

.0223	Gr/SDCF
.0510	Gm/SDCM

16. Volume at NSTP

76.849	CF
2.176	CM

17.

18. Concentration 1.71

.0175	Gr/ACF
.0400	GM/ACM

19. % Isokinetic

96.87

Guardian Systems, Inc.
2809 Central Avenue
Birmingham, Alabama 35209

Run Number 4

Date 11/1/77

Location U.S. Gypsum

Amount liquid lost during transport none

Acetone blank volume, ml 200

Acetone wash volume, ml 1470

Acetone blank concentration, mg/mg 6.39×10^{-7}

Acetone wash blank, mg .1

Filter Collections (mg)		Probe and Cyclone Wash (mg)	
Filter #	T-9	Dish #	4
Gross	274.8	Gross	77747.3
Tare	260.5	Tare	77673.8
Net	14.3	Acetone Blank	0.7
		Net	72.8

Total Particulate Capture 87.1 mg.

Water		Silica Gel	
Final	350	Final	235
Initial	300	Initial	220
Net	50	Net	15

Total Water 65.0

Reviewed by D Daws

PLANT U.S. Gypsum — RUN # 4

LOCATION B'ham — DATE 11/1/27

BARO. PRES. 30.03 — TIME 1:31 - 2:41

Guardian SYSTEMS INCORPORATED
2809 CENTRAL AVENUE
BIRMINGHAM, ALABAMA 35209
PHONE (205) 879-1850

POINT NO.	TIME MIN	TIME DUR	METER VOL FT.3	STACK TEMP °F	METER TEMP °F IN	METER TEMP °F OUT	METER TEMP °F AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2O	VELOCITY PRESSURE "H2O	Vacuum Pressure "Hg
Port B			514.274									
1	4	4	514.7	170°	80	80	80°	62°	240°	1.6	.49	1
2	8		517.4	170°	88	80	84°	64°	240°	1.6	.49	2
3	12		520.8	170°	90	80	85°	64°	240	1.9	.60	2
4	16		524.0	180°	94	92	88°	68°	240°	2.2	.68	2
5	20		528.7	190°	98	82	90°	64°	250°	4.1	1.3	5
6	24		531.7	195°	100	84	92°	64°	260°	4.1	1.3	5
7	28		535.9	190°	100	84	92°	64°	250°	4.1	1.3	5
8	32		540.3	190°	100	84	92°	64°	250°	4.1	1.3	6
Port A												
1	36	4	545.3	175°	90	84	87°	60°	230°	2.5	.75	2
2	40		548.7	180°	94	84	89°	58°	250°	2.7	.85	3
3	44		552.3	185°	96	84	90°	60°	260°	3.0	.94	4
4	48		556.4	190°	100	84	92°	60°	250°	3.5	1.1	5
5	52		562.2	195°	100	84	92°	60°	240°	3.5	1.1	5
	56		565.3	195°	100	84	92°	62°	230°	3.5	1.1	5
7	60		568.6	195°	102	84	93°	62°	250°	3.1	.96	5
8	64		573.2	195°	102	84	93°	62°	250°	2.9	.88	5
			576.553									
			62.274	185			89			3.025	.961	

STATIC PRESSURE "H2O -.75

PROBE TIP SIZE — BEFORE .250 — AFTER .250

WATER — ml. 50 — gram 150 — Total 65

FILTER NO. T-9

NOTES

SAMPLE BOX NO. 400
METER BOX NO. 400
METER ΔH@ 1.81
PITOT, CP
TEMP. DEVICE Pyrom.

Leak check @ 15" Hg
514.270
514.267
.003 cfm

pito lk. ck
impact @ 6.0 ✓
static @ 5.5 ✓
orifice ✓

O_2 = 20.5%
CO_2 0.5%

leak check @ "Hg
576.591
576.590
.001
6" Hg. 1/min
pitot lk ck
impact @ 5.0 ✓
static @ 4.8 ✓

Nozzle #7
.250 .250
.250 .250
.250 .250

Paul Eddins
Operator

5•	Run Number
11-1-77	Date
30.00	Barometric Pressure
-.62	Static Pressure (in. H_2O)
64.00	Run Time (min)
61.526	Volume of Meter (CF)
189.00	Stack Temp (^oF)
86.00	Meter Temp (^oF)
2.96	Diff. Orifice Press (in. H_2O)
.948	Sq. root Vel. Press.
69.90	Mg. of Particulate
68.00	Ml. of water condensed
20.00	% O_2
.50	% CO_2
3.1416	Stack Area (Ft^2)
.847	PCF
.000341	Nozzle Area (Ft^2)

1• Stack Pressure

29.95	Inches Hg.
760.73	Millimeters Hg.

2• Meter Pressure

30.22	Inches Hg.
767.59	Millimeters Hg.

3• Stack Velocity

60.03	Feet Per Second
18.30	Meters per Second

4• Meter Volume

60.304	SCF
1.708	SCM

5• Water Volume

3.223	SCF
.091	SCM

6• Moisture Content

.0507

7• Molecular Wt. Dry

28.88

8• Molecular Wt. Dry

28.33

12• Volumetric Flow

11,315.	ACFM
5.3401	ACMS

14• Volumetric Flow

8,779.	DSCFM
4.1452	DSCMS

15• Concentration

.0179	Gr/SDCF
.0410	Gm/SDCM

16• Volume at Nozzle

77.709	CF
2.200	CM

17•

1.34

18• Concentration

.0113	Gr/ACF
.0318	Gm/ACM

19• % Isokinetic

98.89

. . . .

5.	Run Number
11-1-77	Date
30.00	Barometric Pressure
-.62	Static Pressure (in. H_2O)
64.00	Run Time (min)
61.526	Volume of Meter (CF)
139.00	Stack Temp (^oF)
80.00	Meter Temp (^oF)
2.[illegible]	Diff. Orifice Press (in. H_2O)
.94[illegible]	Sq. root Vel. Press.
69.90	Mg. of Particulate
68.00	Ml. of water condensed
20.00	% O_2
.50	% CO_2
3.1416	Stack Area (Ft^2)
.847	PCF
.000[illegible]	Nozzle Area (Ft^2)

. . . .

1. Stack Pressure

29.95	Inches Hg.
760.73	Millimeters Hg.

2. Meter Pressure

30.22	Inches Hg.
767.59	Millimeters Hg.

3. Stack Velocity

60.03	Feet Per Second
18.30	Meters per Second

4. Meter Volume

60.304	SCF
1.70[illegible]	SCM

5. Water Volume

3.223	SCF
.091	SCM

6. Moisture Content

.0507

7. Molecular Wt. Dry

28.88

8. Molecular Wt. Dry

28.3[illegible]

12. Volumetric Flow

11,31[illegible].	ACFM
[illegible]	ACMS

14. Volumetric Flow

[illegible]	DSCFM
[illegible]	DSCMS

15. Concentration

.017[illegible]	Gr/SDCF
.04[illegible]	Gm/SDCM

16. Volume at Nozzle

77.7[illegible]	[illegible]
[illegible]	[illegible]

17. Particulate Mass Rate

1.[illegible]	lb/hr

18. Concentration

.01[illegible]	Gr/ACF
.0[illegible]	Gm/ACM

19. % Isokinetic

[illegible]

. . . .

Guardian Systems, Inc.
2809 Central Avenue
Birmingham, Alabama 35209

Run Number 5

Date 11/1/77

Location U.S. GYPSUM

Amount liquid lost during transport none

Acetone blank volume, ml 200

Acetone wash volume, ml 1280

Acetone blank concentration, mg/mg 6.39×10^{-7}

Acetone wash blank, mg .1

Filter Collections (mg)		Probe and Cyclone Wash (mg)	
Filter #	T-6	Dish #	5
Gross	274.4	Gross	77503.5
Tare	260.2	Tare	77447.2
Net	14.2	Acetone Blank	0.6
		Net	55.7

Total Particulate Capture 69.9 mg.

Water		Silica Gel	
Final	350	Final	238
Initial	300	Initial	220
Net	50	Net	18

Total Water 68.0

Approved By D Daws

PLANT U.S. Gypsum RUN # 3

LOCATION Birmingham, AL DATE 11/1/77

BARO. PRES. 30.00 TIME 5:00

Guardian SYSTEMS INCORPORATED
2809 CENTRAL AVENUE
BIRMINGHAM, ALABAMA 35209
PHONE (205) 879-1850

POINT NO.	TIME MIN	TIME HOUR	METER VOL FT.3	STACK TEMP °F	METER TEMP °F IN	METER TEMP °F OUT	METER TEMP °F AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2O	VELOCITY PRESSURE "H2O	Vacuum Pressure "Hg
Front A			576,681									
1	4	4	580.3	170	82	72	77	64	230	2.6	.80	4
2	8		584.0	180	86	76	81	56	230	2.6	.80	4
3	12		587.6	180	90	78	84	56	240	2.9	.90	5
4	16		591.8	190	92	80	86	56	250	3.2	1.0	5
5	20		595.9	195	94	80	87	58	250	3.3	1.05	5
6	24		600.0	195	96	80	88	60	250	3.15	.97	5
7	28		603.8	1.95	96	82	89	64	250	2.8	.88	4
8	32		607.5	195	98	82	90	64	260	2.5	.77	4
Rear + B												
1	36	4	609.0	170	90	80	85	62	260	1.6	.47	2
2	40		613.7	185	90	80	85	64	260	1.85	.56	3
3	44		617.2	190	92	80	86	66	250	2.4	.72	4
4	48		620.8	190	94	80	87	64	250	2.4	.72	4
5	52		625.3	195	96	80	88	64	250	4.2	1.38	7
6	56		629.8	195	98	80	89	62	240	4.25	1.3	7
7	60		634.6	200	98	82	90	62	240	4.25	1.3	7
8	64		638.825	200	98	82	90	62	250	3.5	1.1	
			62.147	189			86			2.96	.7476	

STATIC PRESSURE "H2O -.62

PROBE TIP SIZE: BEFORE .250 AFTER .250

WATER: ml. 50 gram 18 Total 68

FILTER NO. T-6

NOTES

SAMPLE BOX NO.

METER BOX NO. 100

METER ΔH@ 1.81

PITOT, CP

TEMP. DEVICE Blue M Pyr

leak check @15" Hg
576.681
576.677
.004 cfm

pitot lk. Clk
impact @ 2" ✓
static @ 4.5 ✓

O_2 = 20.0 %
CO_2 = 0.5 %

leak check @ 5" Hg.
638.887
638.886
.001 cfm

pitot lk ck
impact @ 3" ✓
static @ 7" ✓

Nozzle #7
.250 .250
.250 .249
.250 .250

VI. CALIBRATIONS

General

All meter boxes were recalibrated upon return to the laboratory from this test. Using the average meter pressure, each box was calibrated at the closest point (for an average meter pressure of 0.62 a 0.5 "H_2O was used as the calibration point). These three (3) calibrations produced a single point average $\Delta H@$ which was compared to the original calibration. All were within the 5% allowed at the highest vacuum seen. These calibration sheets are located behind the original calibration sheets.

Batt Oven

The equipment used at the Batt Oven Stack was as follows:

Probe: 5 ft SP

Box: 400

Stack Temperature: Pyrometer

Sample Box: 2

The average temperature of the stack was 183°F. The pyrometer was recalibrated at 185°F and agreed within 1.5% of the initial calibration value.

Guardian

Type A
Glass Fiber Filters

FEATURES

• High tensile strength. • Excellent handling characteristics. • Good wetting properties. • Minimum of 99.9% retention for particles of .3 μm as determined by DOP tests. • Binder free.

This is the original glass fiber filter pioneered by Gelman Instrument Company over 15 years ago. It continues to be widely used for high volume sampling. Since zinc is one of the raw materials incorporated in the glass fibers, Type A Filters have a variable zinc content. Another component of the filter, sulfuric acid, is used as a dispersion medium, making the sheets unsuitable for measurement of sulfates.

Type A Glass Fiber Filters are less likely to develop static charge or tear than other glass fiber media types. They are used extensively in applications where zinc and iron content is not important, or where sulfate content is not being determined.

Size	37 mm	47 mm	102 mm	8"x10"
Product No.	61715	61694	61696	61701
Filters/Pkg.	500	100	100	100

TYPE A GLASS FIBER FILTER SPECIFICATION REPORT

The following physical/chemical properties represent typical, average values obtained in accordance with accepted test methods. They are subject to normal manufacturing variations and are supplied as a technical service. *The analysis has been made in accordance with EPA procedures (micrograms/8" x 10" sheet).*

ELEMENTS:

Antimony	.30	Manganese	.200
Arsenic	.30	Mercury	.100
Beryllium	.1	Molybdenum	.10
Bismuth	.10	Nickel	.10
Cadmium	.5	Selenium	.5000
Chromium	.10	Tin	.10
Cobalt	.10	Titanium	.170
Copper	.2	Vanadium	.10
Iron	.2300	Zinc	.5000 to 25,000
Lead	.20		

OTHER PHYSICALS:

BSO	.522	Flow Resistance (Max.)	
*pH	.8.5	@ 320 cm/min.	.80 mm
DOP @320/cm/min		Flow Rate (air)	
(ASTM Method 2986	.99.9%	lpm/cm² @ 70 cm Hg	.50
Tensile Strength		Max. Use Temp.	.400°C
(Fed. Spec. UUP31B)	.750 gr	Static Properties	.Low
Weight,		Ability to	
8"x10" sheet	.4.0±.3 gr.	Fold	.Excellent

WATER EXTRACTABLE IONS:

Sulfate	.100	Chloride	.1500
Nitrate	.50	Fluoride	.15
Ammonia	.20		

*pH—Gelman Procedure

A. 500 ml distilled water
B. Add 15 drops saturated KCl solution
C. Shred one 8"x10" sheet and soak in prepared water for one hour.
D. Run pH at ambient temperature.

Type A/E
Glass Fiber Filters

FEATURES

• Low trace metals. • Medium Handling characteristics. • Available in all sizes. • Minimum of 99.9% retention for particles of .3 μm as determined by DOP tests. • Binder free.

Type A/E Glass Fiber Filters are composed of low acid soluble glass fiber. They contain low levels of both zinc and iron. The filters do react with atmospheric sulfur dioxide; and therefore, when high levels of sulfur are expected, corrections for this reaction should be accounted for.

Type A/E Glass Fiber Filters are binder free and ideal for gravimetric analysis of air pollutants. This pure, organic free filter is the basis for procedures widely used in determining municipal and industrial air polluting substances.

Size	25 mm	37 mm	47 mm	102 mm	8"x10"
Product No.	61630	61652	61631	61633	61638
Filters/Pkg.	500	500	100	100	100

TYPE A/E GLASS FIBER FILTER SPECIFICATION REPORT

The following physical/chemical properties represent typical, average values obtained in accordance with accepted test methods. They are subject to normal manufacturing variations and are supplied as a technical service. *The analysis has been made in accordance with EPA procedures (micrograms/8" x 10" sheet).*

ELEMENTS:

Antimony	.20	Manganese	.2
Arsenic	.20	Mercury	.60
Beryllium	.1	Molybdenum	.10
Bismuth	.10	Nickel	.10
Cadmium	.2	Selenium	.200
Chromium	.10	Tin	.10
Cobalt	.10	Titanium	.10
Copper	.2	Vanadium	.10
Iron	.100-1800	Zinc	.90
Lead	.10		

OTHER PHYSICALS:

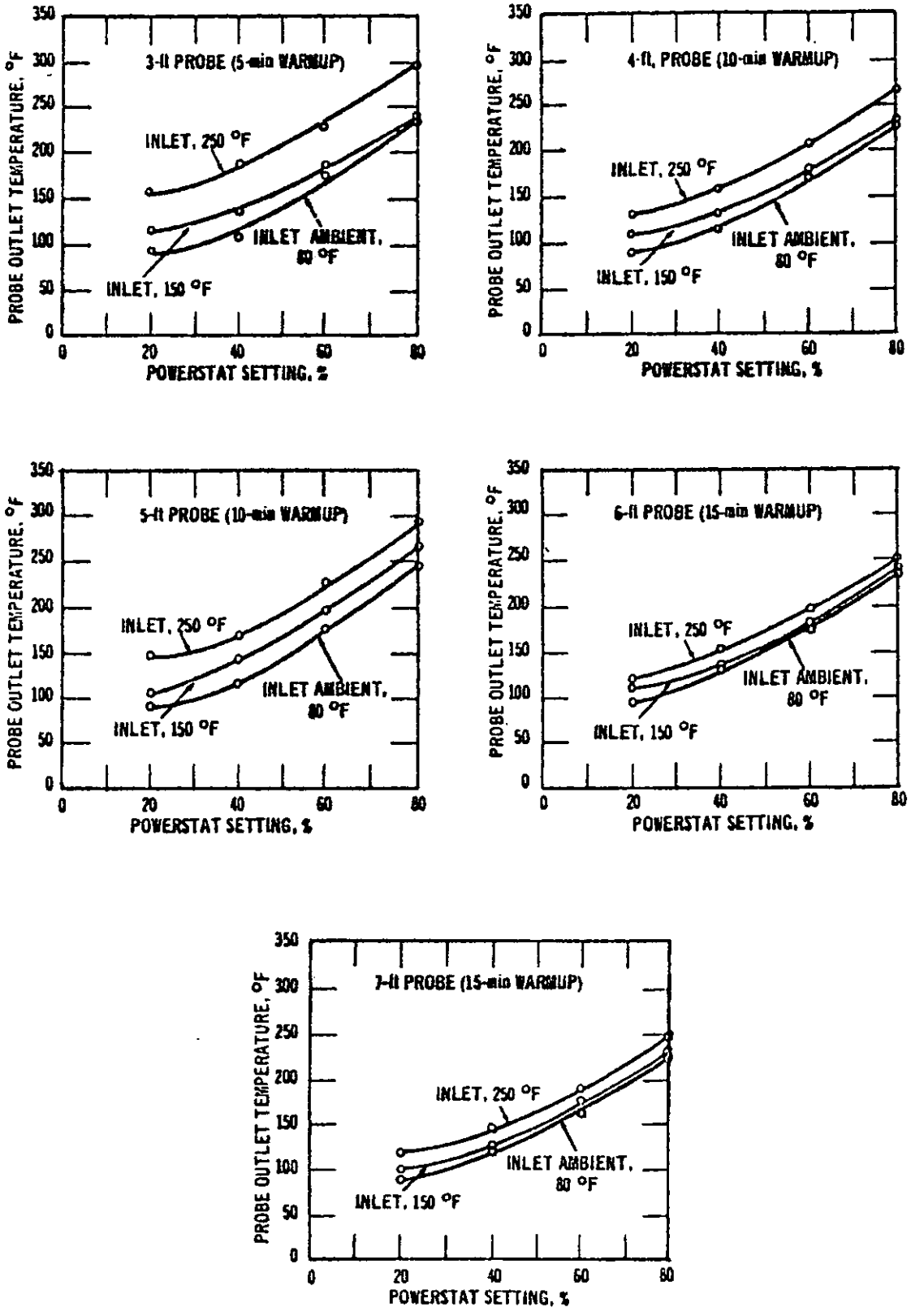
BSO	.522	Flow Resistance (Max.)	
*pH	.9.0	@ 320 cm/min.	.60 mm
DOP @320/cm/min		Flow Rate (air)	
ASTM Methods 2986)	.99.9%	lpm/cm² @ 70 cm Hg	.60
Tensile Strength		Max. Use Temp.	.400°C
(Fed. Spec. UUP31B)	.600 gr.	Static Properties	.Medium
Weight		Ability to	
8"x10"sheet	.4.0±.3 gr.	Fold	.Good

WATER EXTRACTABLE IONS:

Sulfate	.600	Chloride	.1500
Nitrate	.115	Fluoride	.87
Ammonia	.13		

*pH—Gelman Procedure:

A. 500 ml distilled water.
B. Add 15 drops saturated KCl solution.
C. Shread one 8"x10" sheet and soak in prepared water for one hour.
D. Run pH at ambient temperature.



NOTE: Flow rate held constant at 0.75; 50% change in flow rate has little effect on probe temperature.

Figure 16

Probe Temperatures

Date 9/28/77 Box No. 400

Barometric Pressure P_b = 30.02 in. Hg

Orifice Manometer Setting ΔH In. H_2O	Δ wtm in. H_2O	Gas Volume Wet Test Meter		Gas Volume Dry Gas Meter		Temperature Wet Test Meter		Temperature Dry Gas Meter	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final
.5	-.19	244.402	250.446	594.100	600.413	76	78	99	95
1.0	-.31	220,726	229.058	569.500	578.158	76	76	91	94
2.0	-.49	250,819	262.513	600.200	612.908	76	76	100	92
3.0	-.66	229.768	244.057	578,900	593,734	76	78	94	99
4.0									

[1]Pump must be operated for 15 minutes at each ΔH setting.

T_{dgm} = average temperature of dry gas meter (inlet and outlet) + 460°F

T_{wtm} = average temperature of wet test meter + 460°F

$$P_{wtm} = P_b - \frac{\Delta wtm}{13.6}$$

$$P_{dgm} = P_b + \frac{\Delta\ h}{13.6}$$

Δwtm = negative pressure on wet test meter in inches of H_2O

28.316 = conversion factor when using a wet test meter calibrated in liters

Calculations

$$\text{Meter Correction Factor (for each } \Delta H) = \frac{(\text{wet final} - \text{wet initial})\ (T_{dgm})\ (P_{wtm})}{(\text{dry final} - \text{dry initial})\ (28.316 \text{ or } 1)\ (T_{wtm})\ (P_{dgm})}$$

$$\text{Average MCF} = \frac{\Sigma MCF}{5}$$

.99
.99
.99
.99

Tolerances

Average MCF - 1.00 ± .01

.99

METER CALIBRATION FORM

Date 11/8/77 Box No. 400

Barometric Pressure P_b = 30.00 in. H_g 8" Hg

Orifice Manometer Setting ΔH In. H_2O	Δ wtm in. H_2O	Gas Volume Wet Test Meter Initial	Gas Volume Wet Test Meter Final	Gas Volume Dry Gas Meter Initial	Gas Volume Dry Gas Meter Final	Temperature Wet Test Meter Initial	Temperature Wet Test Meter Final	Temperature Dry Gas Meter Initial	Temperature Dry Gas Meter Final
1.0	-.87	845.452	859.824	649.700	664.470	72	72	81	90
2.0	-.85	860.822	875.064	665.500	680.403	72	74	90	100
3.0	-.84	876.007	890.157	681.400	696.407	74	74	101	109
3.0									
.0									

Pump must be operated for 15 minutes at each ΔH setting.

T_{dgm} = average temperature of dry gas meter (inlet and outlet) + 460°F

T_{wtm} = average temperature of wet test meter + 460°F

$P_{wtm} = P_b - \frac{\Delta wtm}{13.6}$

$P_{dgm} = P_b + \frac{\Delta h}{13.6}$

Δwtm = negative pressure on wet test meter in inches of H_2O

28.316 = conversion factor when using a wet test meter calibrated in liters

Calculations

Meter Correction Factor (for each ΔH) = $\frac{(\text{wet final} - \text{wet initial})\ (T_{dgm})\ (P_{wtm})}{(\text{dry final} - \text{dry initial})\ (28.316 \text{ or } 1)\ (T_{wtm})\ (P_{dgm})}$

Average MCF = $\frac{\Sigma MCF}{5}$

Tolerances

Average MCF = 1.00 ± .01

ORIFICE CALIBRATION FORM

Date 9/28/77 Meter Box No. 400

ΔH	V_1	V_2	θ	t_1	t_2	$V_2 - V_1$	Q_m	K_m
in. H_2O	CF	CF	Sec.	°F	°F	CF		
0.5	594.100	600.413	900	97	90	6.313	.4120	.7336
1.0	569.500	578.158	900	98	87	8.658	.5651	.7138
2.0	600.800	612.908	900	100	90	12.108	.7951	.7092
3.0	578.900	593.734	900	104	89	14.834	.9652	.7044
4.0								
							Average K_m	

V_1 = Dry gas meter reading at the start of each test

V_2 = Dry gas meter reading at the end of each test

t_1 = Dry gas meter inlet temperature

t_2 = Dry gas meter outlet temperature

Calculations

1. Q_m = (for each ΔH) $\frac{V_2 - V_1}{\theta} \left[\frac{t_2 + 460}{\frac{t_1 + t_2 + 460}{2}} \right] (60)\,(MCF)$

MCF: meter correction factor

2. K_m = (for each ΔH) $Q_m \sqrt{\frac{P_m M_m}{T_m \Delta H}}$

$P_m = P_{atm} + \frac{\Delta H}{13.6}$
$M_m = 29$
$T_m = t_2 + 460$

3. Calculate the average K_m as follows:

$\overline{K_m} = \frac{\Sigma K_m}{5}$

1.71
1.81
1.83
1.82

4. Calculate ΔH as follows:

$\Delta H@ = \frac{Q@^2\ P@\ M@}{T@} \quad \frac{1}{K_m^2}$

Q@ = 0.75 cfm
T@ = 530° A
P@ = 29.92 in. Hg
M@ = 29

Tolerances ΔH@ - 1.84 ± .25

1.80

APC - 062

ORIFICE CALIBRATION FORM

Date 11/8/22

Meter Box No. 400

8" Hg

ΔH	V_1	V_2	θ	t_1	t_2	$V_2 - V_1$	Q_m	K_m
in. H_2O	CF	CF	Sec.	°F	°F	CF		
3.0	649.700	664.470	900	96	96	14.770	.9816	.7154
3.0	665.500	680.403	1	110	86	14.903	.9882	.7138
3.0	681.406	696.407	1	116	84	15.007	.9923	.7122
3.0								
4.0								
						Average K_m		

V_1 = Dry gas meter reading at the start of each test

V_2 = Dry gas meter reading at the end of each test

t_1 = Dry gas meter inlet temperature

t_2 = Dry gas meter outlet temperature

Calculations

1. Q_m = (for each ΔH) $\frac{V_2 - V_1}{\theta} \left[\frac{t_2 + 460}{\frac{t_1 + t_2 + 460}{2}} \right] (60)\ (MCF)$

MCF: meter correction factor

2. K_m = (for each ΔH) $Q_m \sqrt{\frac{P_m\ M_m}{T_m\ \Delta H}}$

$P_m = P_{atm} + \frac{\Delta H}{13.6}$
$M_m = 29$
$T_m = t_2 + 460$

3. Calculate the average K_m as follows:

$\overline{K_m} = \frac{\Sigma K_m}{5}$

(1.80, 1.81, 1.82)

Tolerance

1.77 → 1.95

±5% of 1.86

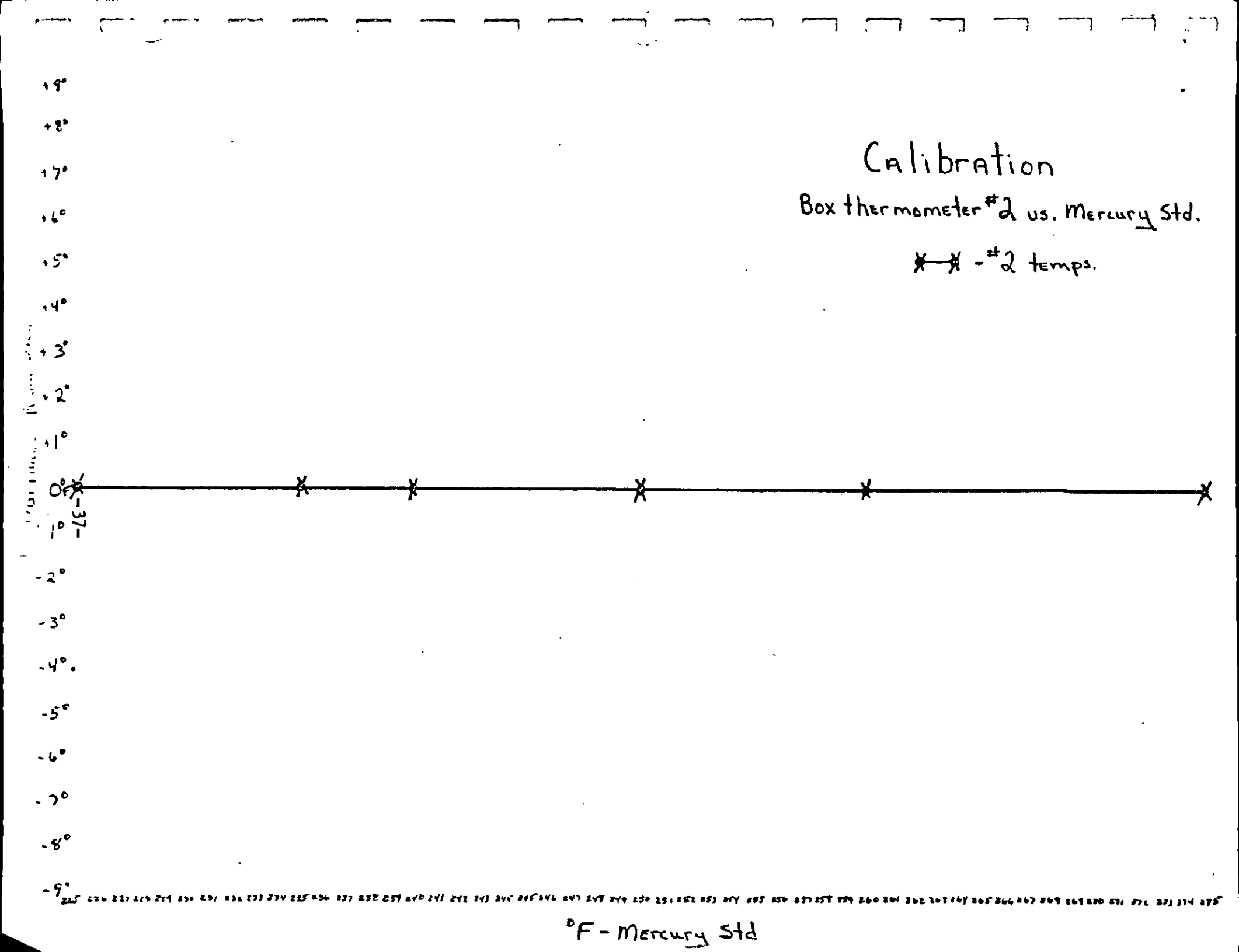
4. Calculate ΔH as follows:

$\Delta H@ = \frac{Q@^2\ P@\ M@}{T@} \quad \frac{1}{K_m^2}$

Q@ = 0.75 cfm
T@ = 530° A
P@ = 29.92 in. Hg
M@ = 29

~~Tolerances ΔH@ 1.84 ± .25~~

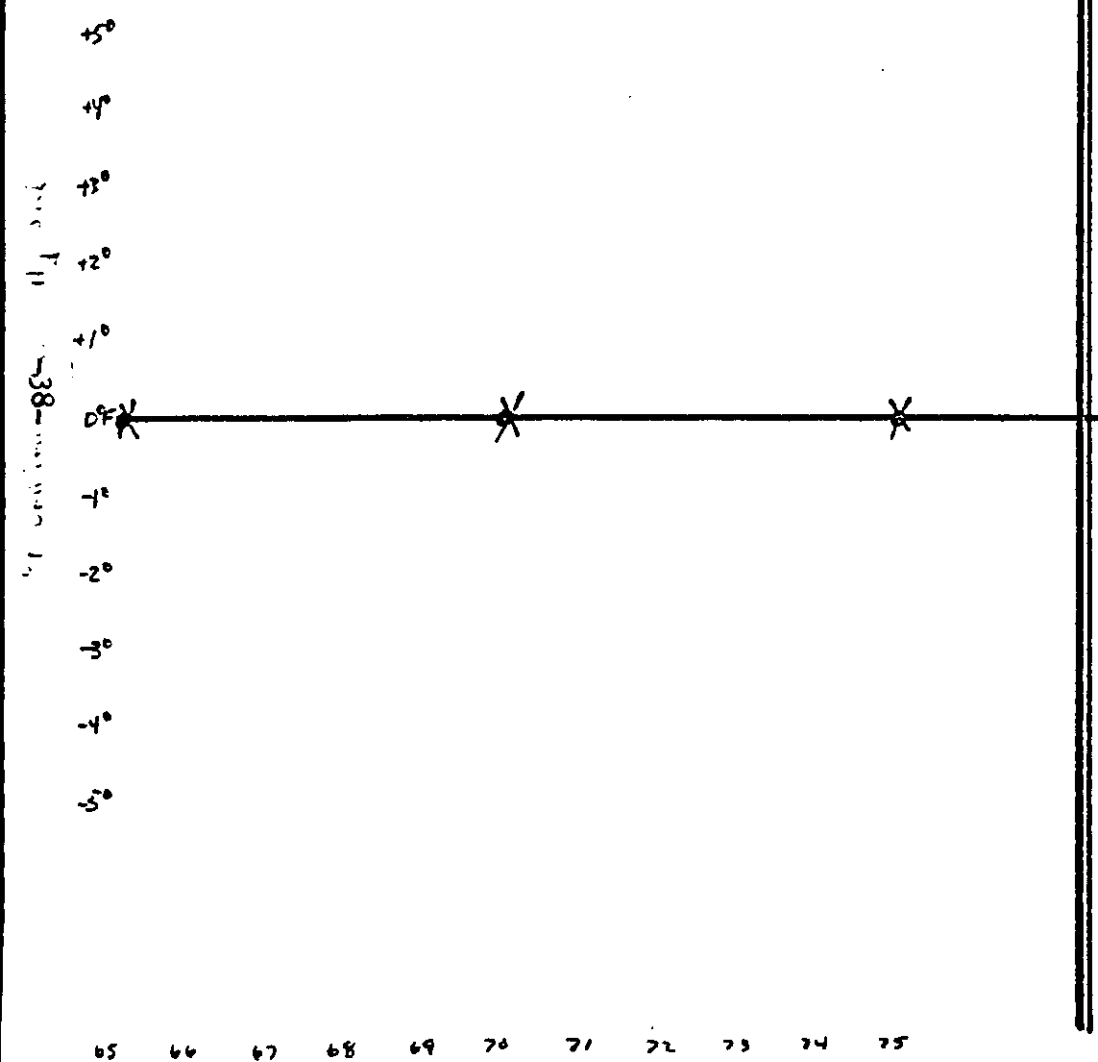
APC - 062


Calibration
Box thermometer #2 vs. Mercury Std.
- #2 temps.
+9°
+8°
+7°
+6°
+5°
+4°
+3°
+2°
+1°
0°
-1°
-2°
-3°
-4°
-5°
-6°
-7°
-8°
-9°
-37-
°F - Mercury Std

Calibration

$1\frac{3}{4}$" impinger vs. 70°F Hg Std.
therm.

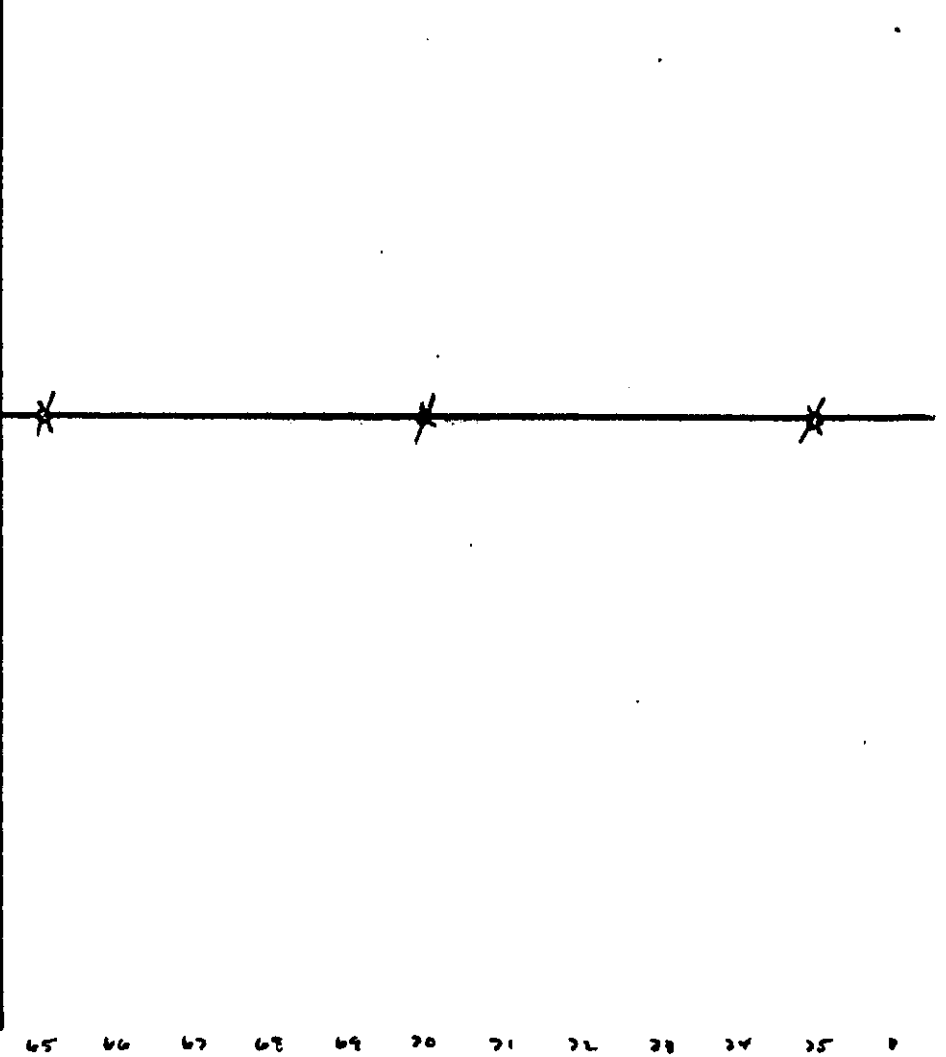
✕—✕ - $1\frac{3}{4}$" temp.

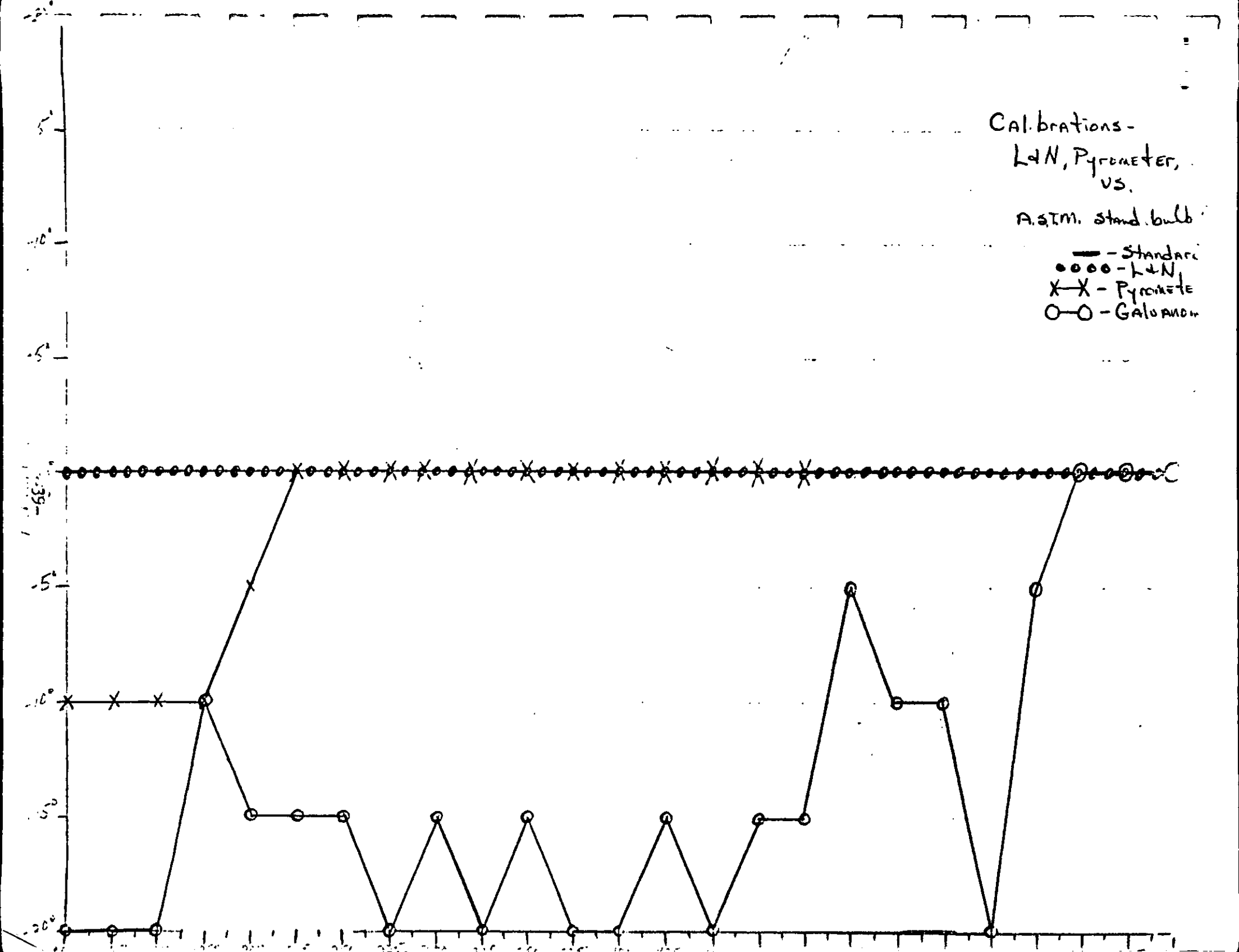


Calibration

1" (unmarked) impinger vs. 70°F Hg. Std.
therm.

✕—✕ - 1" temp.




Calibrations -
L&N, Pyrometer,
vs.
A.S.T.M. stand. bulb
- Standard
- L&N
- Pyrometer
- Galvanom
-5°
-10°
-5°
-10°

PITOT CALIBRATION FORM

PITOT NO. 5'SP DATE 9-20-77

STD READ	A	B	Cp A	Cp B
.52	.70	.70	.853	.853
.46	.63	.63	.846	.846
.35	.48	.49	.845	.837
.21	.29	.29	.842	.842
		AVERAGE Cp's	.847	.845

Measure the velocity pressure (ΔP) at the same point within a cross section of a straight run of duct work (8 diameters downstream and 2 diameters upstream from any point of disturbance) with a standard pitot tube and the S-type pitot tube for the desired range of gas velocities. The S-type pitot should be calibrated twice, reversing the direction of the legs during the second calibration. Make at least three determinations for each direction. Determine Cp for the minimum and maximum flow rates of the sampling train. Determine the pitot tube coefficient for each direction as:

Cp (std) = Coefficient of standard pitot tube (if unknown, use .99)

$$Cp(s) = Cp(std)\sqrt{\frac{\Delta P\ (Standard)}{\Delta P(s)}}$$

Use only those pitot tubes in which the average coefficient, Cp, equals 0.85 ± 0.02 in both directions, since the nomograph used with the sampling train is designed for this number. When other methods are employed where Cp is measured as an independent variable, this requirement will be waived.

This calibration must be done quarterly or at any time that a pitot tube is damaged. A record should be maintained showing dates and calibrations, and a copy included with each test report.

5/

DRAFT/WP
d3006-4/971130
03/30/92 .1

Emission Test Report
Review Checklist

Reviewer: Wallace
Review Date: 8/5/92

A. Background Information

1. Facility name: U. S. Gypsum
   Location: Birmingham, AL
2. Source category: Mineral Wool
3. Test date: 11/1/77
4. Test sponsor: Facility
5. Testing contractor: Guardian Systems Inc
6. Purpose of test: Compliance
7. Pollutants measured

   (PM) PM-10 CO SO_2 NO_x VOC Pb CO_2

   Others (list):

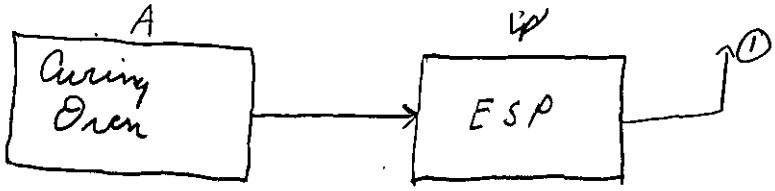
8. Process overview: On an attached page provide a block diagram of the unit operations and associated air pollution control systems at the facility. Identify process tested with letters from the beginning of the alphabet (A, B, C, etc.) and APC systems with letters from end of alphabet (V, W, X, etc.). Also identify test locations with Arabic numerals (1,2,3, ...). Using the ID symbols from that sketch complete the table below that identifies processes or unit operations tested.

No process description or flow diagram in report last effort on back of this page

Test ID	Process	Process ID	Emissions tested		APCD (controlled emissions only)
			Uncontrolled	Controlled	
1	Batt Curing Oven	A		X	ESP

B. Process Information

1. Provide a brief narrative description of the process. With as much detail as possible, (e.g., if a furnace or conveyor system is used, identify the type of unit) describe the equipment used for those operations tested. (Note: If process description provided in test report is adequate, attach copy or reproduce here.)



No process diagram or process description in report. Process data were provided. Process rate assumed to be based on tons of bath produced

2. For each process tested list feedstock materials and products. Indicate if activity factors are for feed (F) rate or product (P) rate.

Process ID	Feedstock materials	Products	Basis for activity factor	F/P
A	Batt mineral Wool	Cured mineral wool	Bolts produced	F

Basis for data: 1, 9-15
(Indicate page/table Nos. in test report)

3. For each process or operation tested and each test run note process capacity and operating rate during test.

Process ID	Capacity	Units	Test run	Process rate	Units
A	NA	NA	1	2.00	T/hr
			2	1.42	"
			3	2.79	"
			4		
			1		
			2		
			3		
			4		
			1		
			2		
			3		
			4		
			1		
			2		
			3		
			4		
			1		
			2		
			3		
			4		

Basis for data: 8

C. Air Pollution Control Systems Tested

1. For each air pollution control system pollution control system identified in A.8, note the following

ID	Type of APCD	Manufacturer	Model No.
W	ESP	Veltran	NA

Note: Be as specific as possible in identifying APCD. For example, indicate "pulse jet fabric filter" rather than simply "fabric filter."

2. For each system identified above, provide a narrative description. For fugitive systems describe capture techniques as well as the removal techniques (use a separate page if necessary)

No description available

3. Using the attached parameter list for guidance complete the table below. (Use additional pages as needed.)

APCD ID	Parameter	Units	Readings			
			Run 1	Run 2	Run 3	Run 4
Type of APCD:						
Type of APCD:						
Type of APCD:						

NA

D. Sampling and Analysis Methods

1. Complete the following table

Test location	Pollutant	S & A method	Reference/ conditional method	Deviations noted
A	PM	Methods 1-5	(Y)/N	(Y)/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N

2. If a method used was not a reference or conditional method, provide a narrative discussion including any data manipulation needed to make results correspond to reference or conditional method results.

NA

3. Describe any deviations identified above.

Used Fyrite for CO_2 and O_2 results. Does not affect PM levels

E. Emission Data Documentation

1. Tabulate the following stack gas data from the test report. (Use additional pages as needed.)

Test ID	Parameter	Units	Values reported			
			Run ~~1~~ 3	Run ~~2~~ 4	Run ~~3~~ 5	Run 4
	Stack temperature	°F	175	185	189	
	Moisture	%	4.95	~~5~~.87	5.07	
	Oxygen	%	20.5	20.5	20.4	
	Volumetric flow, actual	acfm	11,728	11,423	11,315	
	Volumetric flow, standard	dscfm	8942	8943	8779	
	Percent isokinetic	%	97	97	97	
	Pollutant concentration:					
	PM	gr/dscf	0.0122	0.0223	0.0179	
	Stack temperature					
	Moisture					
	Oxygen					
	Volumetric flow, actual					
	Volumetric flow, standard					
	Percent isokinetic					
	Pollutant concentration:					
	Stack temperature					
	Moisture					
	Oxygen					
	Volumetric flow, actual					
	Volumetric flow, standard					
	Percent isokinetic					
	Pollutant concentration:					

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2. Tabulate pollutant mass flux rates

p8

Test ID	Pollutant	Units	Mass flux rates			
			Run 1	Run 2	Run 3	Run 4
1	PM	lb/hr	0.93	1.21	1.34	

3. Present example emission factor calculations below.

4. Tabulate emission factors

Process	Pollutant	Units	Average emission factor	
			Uncontrolled	Controlled
A	PM	lb/Ton Batt		0.72

ATTACHMENT A
APCD PARAMETERS

Type of APCD	Parameters
Fabric filter	Cleaning mechanism Bag type Cleaning frequency Air to cloth ratio (A/C) Pressure drop Inlet temperature
ESP	Type (wet or dry) Number of fields Rapping cycle (if dry) Specific Collection Area (SCA) Particulate resistivity (if known) Spark rate Current and power levels
Venturi (or other high energy) scrubber	Pressure drop Liquid/gas (L/G) ratio Mist eliminator type
Packed-bed scrubber	Packing depth L/G ratio Caustic use (Y/N) pH Mist eliminator type
Carbon absorber	Bed depth Superficial gas velocity Bed temperature Desorption mechanism (media) Flue-gas moisture Cycle length Time-on-line after breakthrough