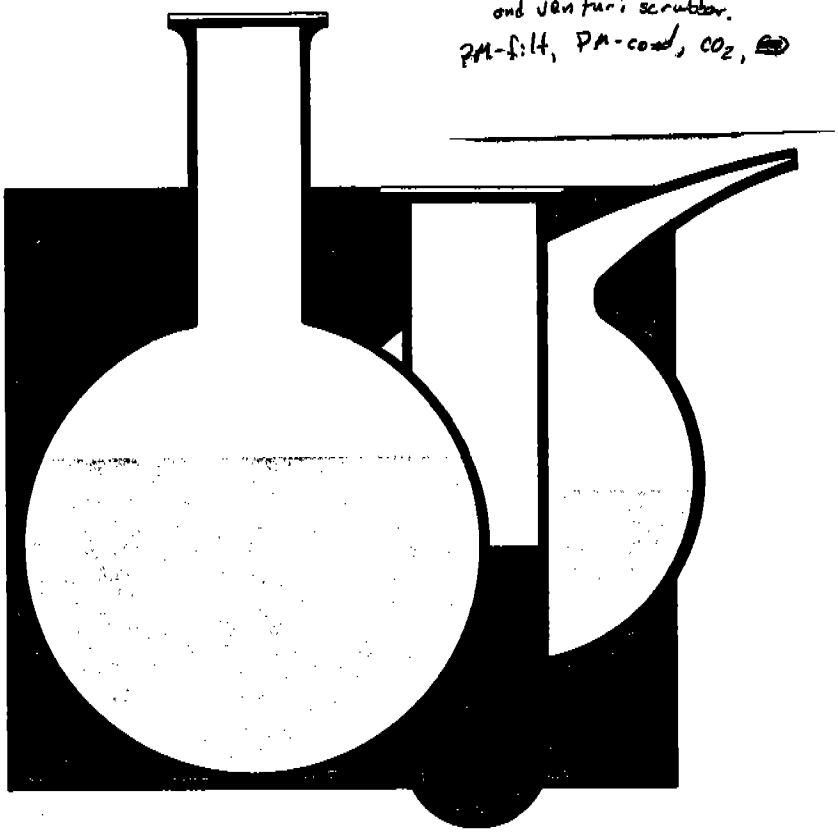
L 11

GUARDIAN SYSTEMS INC.

P.O. Box 300
Leeds, Alabama 35094
205/699-6647

3 runs on a coal-fired kiln controlled by settling chamber, multicyclone, and venturi scrubber.
PM-filt, PM-cond, CO_2, [illegible]



Test Report

SI Lime Co. (Now called Dravo Lime)
Kiln #2
Saginaw, Alabama
10/28/86

EPA Methods 1-5

T-13-1d

MASS EMISSION TESTS

CONDUCTED ON THE

#2 ROTARY LIME KILN

IN

SAGINAW, ALABAMA

FOR

SI LIME COMPANY

ON

OCTOBER 28, 1986

Approved by: Tom Lotz

Tom Lotz
Director
Field Services Division

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SOURCE TEST REPORT SUBMITTAL FORM

COMPANY Dravo Lime Co

FACILITY NO. 411-0002 LOCATION Saginaw

Test report on sampling of: No. 2 Lime Kiln

Particulate - Method 5	(✓)
Sulfur dioxide - Method 6	( )
Oxides of Nitrogen - Method 7	( )
Other ( ) - Method ____	( )

This source is (✓) not an NSPS Source.
( ) an NSPS Source.

Note any special considerations (Expiration of Permit, litigation, etc.):

None

Allowable emissions (with units)

Run 1	Run 2	Run 3
29.16 lbs/hr	→	

Submitted by: H Craig Date Nov 7 '86

Emissions

Run 1	Run 2	Run 3	AVG
20.9	20.4	21.6	21.0

Comments:

Evaluated by: Date 11-19-86

T-13-1d

411-0002

ADEM Form 175 4/84

COMPANY NAME Drano Lime Co FACILITY NO. 411-0002

TEST ON No 2 Lime Kiln DATE 10-28-80 TEST BY Guardian

Parameter	Run I	Run II	Run III
Units of Allowable	#/hr		
Allowable Rate	29.16		
Production Rate	1		
$\overline{\Delta H}$ (0.XX in. H_2)	1.73	1.70	1.73
$\sqrt{\Delta P}$ (0.XX in. H_2)	.720	.713	.717
$\overline{t_m}$ (X°F)	99	100	105
$\overline{t_s}$ (X°F)	178	179	179
P_b (0.XX in. Hg) +.41	30.12	—	—
P_s (0.XX in. Hg) -.41	30.09	—	—
V_m (0.XXX ACF) .9165 1.005	38.446	37.800	40348
$\%CO_2$	9	9	9.5
$\%O_2$	14	14	14
$\%N_2$	77	77	76.5
%CO	0	—	—
V_{lc} (0.X ml)	144.4	158.1	144.7
M_n (0.X mg)	93.3	91.8	100.3
C_p	.84	—	—
A_s (0.X ft^2)	32.76	—	—
A_n x 1000 (0.XXX ft^2) .248 Δ	.248 / .335	—	—
θ (X min.)	60	—	—

STACK TEST EVALUATION FOR COMPLIANCE

DRAVO LIME 411-0002 10-28-86
CONDUCTED BY GUARDIAN SYSTEMS NO. 2 LIME KILN

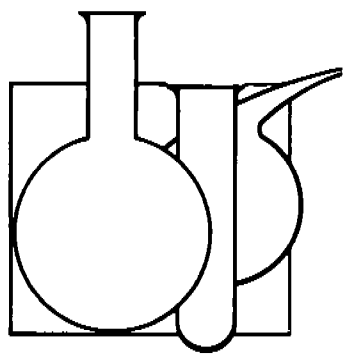
INPUT PARAMETERS	1	2	3
DELTA H	1.730	1.700	1.730
AVE SQRT DELTA P	.720	.713	.717
METER TEMP	99.000	100.000	105.000
STACK TEMP	178.000	179.000	179.000
BAROMETRIC PRESS	30.120	30.120	30.120
STACK PRESS	30.090	30.090	30.090
VOLUME METERED	38.446	37.900	40.348
METER CORR. FACTOR	1.000	1.000	1.000
%CO2	9.000	9.000	9.500
%O2	14.000	14.000	14.000
%N2	77.000	77.000	76.500
%CO	0.000	0.000	0.000
TOTAL VOLUME H2O	144.400	158.100	144.700
PART WT	93.300	91.800	100.300
PITOT COEF	.840	.340	.840
STACK AREA	32.760	32.760	32.760
NOZZLE DIAMETER	.2480	.2480	.2480
TIME	60.000	60.000	60.000

CALCULATED PARAMETERS	1	REPORT	2	REPORT	3	REPORT
NOZZLE AREA X 1000	.3354		.3354		.3354	
VOLUME MTR STD (SDCF)	36.696		36.012		38.102	
VOLUME H2O VAPOR	6.796		7.441		6.811	
% MOISTURE	15.6	(15.9)	17.1	(17.4)	15.2	(15.4)
MOL WT DRY	30.00		30.00		30.08	
MOL WT WET	28.12		27.94		28.25	
AVG STACK VEL (FPS)	44.9	(45.0)	44.6	(44.7)	44.6	(44.8)
FLOW RATE ACTUAL (ACFM)	88300		87700		87700	
FLOW RATE STD (SDCFM)	62200	(62900)	60600	(60400)	62100	(61800)
CONCENTRATION (GR/SDCF)	.0391	(.040)	.0392	(.040)	.0405	(.041)
PART MASS RATE (#/HR)	20.87	(21.17)	20.39	(20.69)	21.58	(21.88)
% ISOKINETIC	96	(95)	97	(95)	100	(99)
POUNDS PER HOUR	20.870	(21.17)	20.390	(20.69)	21.580	(21.88)

AVERAGE EMISSION RATE = 20.95 (2125) POUNDS PER HOUR
ALLOWABLE EMISSION RATE = 29.16 POUNDS PER HOUR

EVALUATED BY TSO 11-14-86

Introduction



I. INTRODUCTION AND PROCESS DESCRIPTION

On October 28, 1986, Guardian Systems, Inc. performed a series of particulate emission tests on the #2 Rotary Lime Kiln Stack of SI Lime Company located in Saginaw, Alabama. These tests were conducted in accordance to the rules and regulations expressed in the Code of Federal Regulations, Title 40, Section 60, Reference Methods 1-5 as amended.

Raw carbonate material is charged on a weight basis to the elevated end of a sloped revolving kiln. As the kiln is slowly rotated a coal fuel system supplies extremely hot gases countercurrent to the gravitational flow of the stone to drive off CO_2 and form the lime product. The emissions from the kiln are exhausted through a Ducon scrubber to the atmosphere.

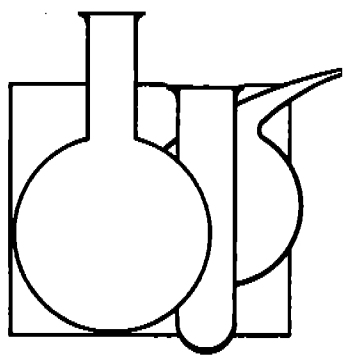
Mr. Bill Schoof, represented SI Lime Company, and is responsible for all production data. Mr. Greg Karstens and Mr. Chuck Turner of Guardian Systems, Incorporated, performed these tests.

Exhaust gas through settling chamber, multicyclone, and then Ducon Venturi scrubber w/ 14" ΔP.

Combination of petroleum coke (70%) and coal (30%). Petroleum coke has about 3x more sulfur than coal.

Ed Kerr now in place of Bill Schoof. (205)664-7100

Test Results



II. SUMMARY OF TEST RESULTS

Table I is a summary of the test results for the #2 Rotary Lime Kiln. All production data was supplied by SI Lime Company personnel (See **Plant Operational Data**). The ~~actual~~ allowable emission rates for the #2 Rotary Lime Kiln were calculated from the following equation:

For P less than 30 tons/hr

$$E = 3.59\ P^{0.62}$$

Where:

E = Emissions in pounds per hour

P = Process weight in tons per hour

Test #	1	2	3	Avg
Feed Process weight, ton/hr (w/out coal)	25.5	25.5	25.5	25.5
Allowable emission rate lbs/hr	26.74	26.74	26.74	26.74
Actual Emission rate, lbs/hr	21.17	20.69	21.88	21.25
% of Allowables	79	77	82	79

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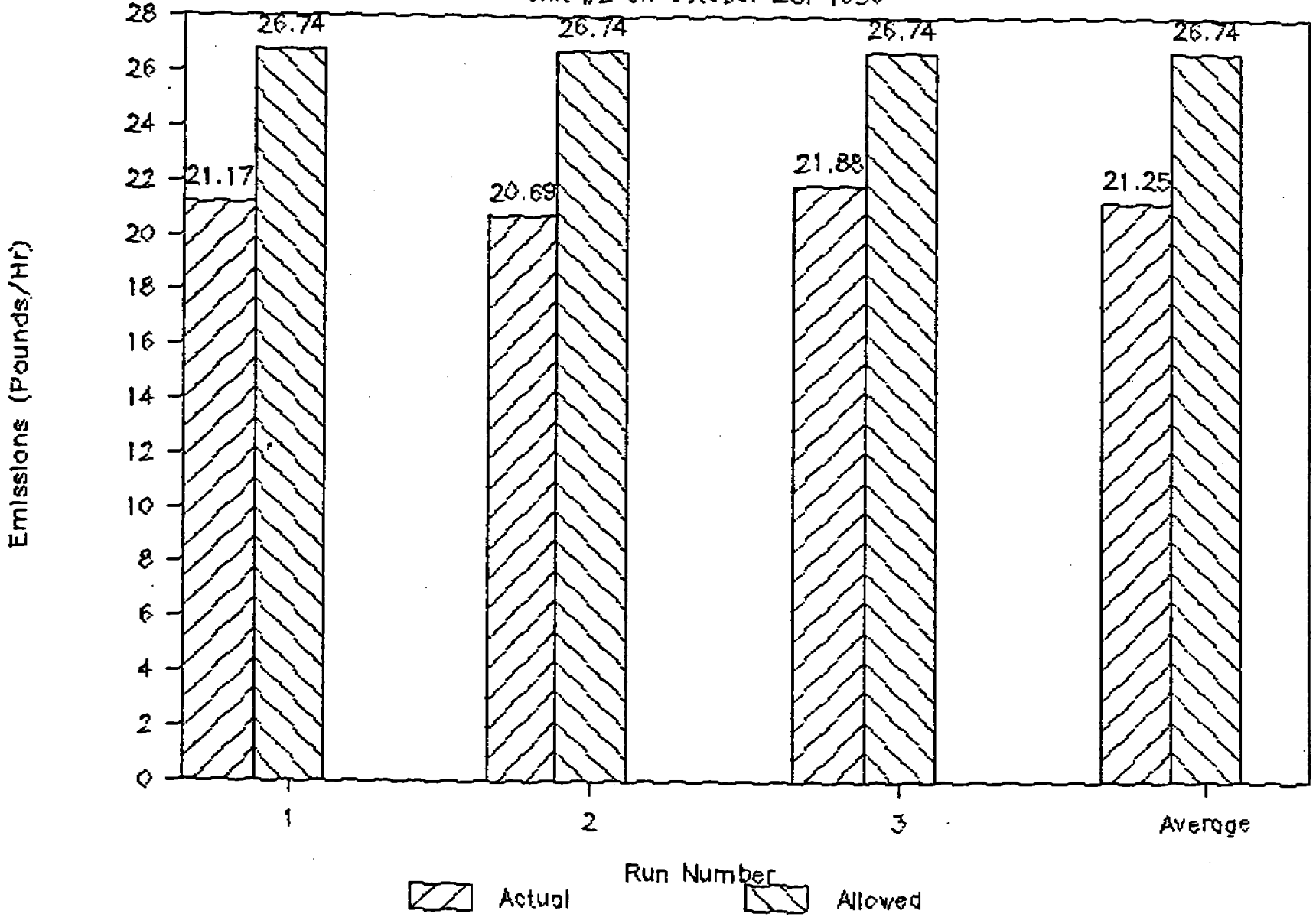
Summarized Air Test Results for SI Lime Company

Run Number	1	2	3	Average
Date	10-28-86	10-28-86	10-28-86	10-28-86
Location	Unit #2	Unit #2	Unit #2	Unit #2
Time	0907-1015	1030-1136	1152-1259	0907-1259
Stack Gas Temperature, F	178	179	179	179
Moisture Content, % v/v	15.87	17.38	15.40	16.21
Oxygen Content, % v/v	14.00	14.00	14.00	14.00
Carbon Dioxide Content, % v/v	9.00	9.00	9.50	9.17
Carbon Monoxide Content, % v/v	0.00	0.00	0.00	0.00
Excess Air, %	221.24	221.24	225.95	222.79
Stack Gas Velocity Feet per Second	45.00	44.74	44.75	44.83
Volumetric Flow Actual Cubic Feet per Minute	88,443	87,937	87,952	88,109
Volumetric Flow Dry Std Cubic Feet per Minute	61,929	60,370	61,828	61,382
Concentration Grains per Dry Std Cubic Ft	0.040	0.040	0.041	0.040
Concentration Grains per Actual Cubic Foot	0.028	0.027	0.029	0.028
Particulate Mass Rate, #/hr	21.17	20.69	21.88	21.25
Allowable Mass Rate, #/MBTU	26.74	26.74	26.74	26.74
Process weight, tons/hr	25.5	25.5	25.5	25.5
% Isokinetic	94.72	95.35	98.51	96.20

Figure 1

SI LIME COMPANY PARTICULATE EMISSIONS

Unit #2 on October 28, 1986



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Computer Input Paramters for SI Lime Company

Run Number	1	2	3	Average
Date	10-28-86	10-28-86	10-28-86	10-28-86
Location	Unit #2	Unit #2	Unit #2	Unit #2
Time	1430-1536	1545-1648	1656-1759	1430-1759
Barometric Pressure, in Hg	30.12	30.12	30.12	30.12
Static Pressure, in H2O	-0.410	-0.410	-0.430	-0.417
Run Time, minutes	60.00	60.00	60.00	60.00
Meter Volume, CF	38.255	37.612	40.147	38.671
Meter Correction Factor, MCF	0.9865	0.9865	0.9865	
Meter Volume (Corrected)	37.739	37.104	39.605	38.149
Stack Temperature, F	178	179	179	179
Meter Temperature, F	99	100	105	101
Meter Pressure, in H2O	1.73	1.70	1.73	1.72
Sqr Velocity Pressure	0.720	0.713	0.717	0.717
Mass of Particulate, mg	93.3	91.8	100.3	95.1
Ml of Water Collected	144.4	158.1	144.7	149.1
% Oxygen	14.00	14.00	14.00	14.00
% Carbon Dioxide	9.00	9.00	9.50	9.17
% Carbon Monoxide	0.00	0.00	0.00	0.00
Stack Area, Sq ft	32.759	32.759	32.759	32.759
Pitot Correction Factor	0.842	0.842	0.842	0.842
Nozzle Diameter, in	0.248	0.248	0.248	0.248
Process weight, tons/hr	25.5	25.5	25.5	25.5

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Computed Air Test Results for SI Lime Company

Run Number	1	2	3	Average
Date	10-28-86	10-28-86	10-28-86	10-28-86
Location	Unit #2	Unit #2	Unit #2	Unit #2
Time	0907-1015	1030-1136	1152-1259	0907-1259
1. Stack Pressure				
Inches Hg	30.09	30.09	30.09	30.09
Millimeters Hg	764.28	764.28	764.24	764.27
2. Meter Pressure				
Inches Hg	30.25	30.25	30.25	30.25
Millimeters Hg	768.28	768.22	768.28	768.26
3. Meter Volume				
Dry Std Cubic Feet	36.036	35.364	37.416	36.275
Dry Std Cubic Meters	1.021	1.002	1.060	1.027
4. Water Volume				
Std Cubic Feet	6.797	7.442	6.811	7.017
Std Cubic Meters	0.192	0.211	0.193	0.199
5. Moisture Content, %	15.87	17.38	15.40	16.21
6. Molecular Weight Dry	30.00	30.00	30.08	30.03
7. Molecular Weight Wet	28.10	27.91	28.22	28.08
8. Stack Velocity				
Feet per Second	45.00	44.74	44.75	44.83
Meters per Second	13.72	13.64	13.64	13.66
9. Volumetric Flow				
Actual Cubic Ft per minute	88,443	87,937	87,952	88,109
Actual Cubic M per second	41.75	41.51	41.51	41.59
10. Volumetric Flow				
Dry Std Cubic Ft per minute	→ 61,929	60,370	61,828	61,382
Dry Std Cubic M per minute	29.23	28.49	29.18	28.97
11. Concentration				
Grains per Dry Std Cubic Ft	0.0399	0.0400	0.0413	0.0404
Grams per Dry Std Cubic M	0.0912	0.0915	0.0945	0.0924
12. Excess Air, %	221.24	221.24	225.95	222.79

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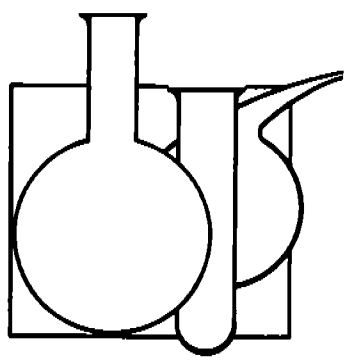
Computed Air Test Results for SI Lime Company

Run Number	1	2	3	Average
Date	10-28-86	10-28-86	10-28-86	10-28-86
Location	Unit #2	Unit #2	Unit #2	Unit #2
Time	0907-1015	1030-1136	1152-1259	0907-1259
15. Particulate Mass Rate Pounds per Hour, #/hr	21.17	20.69	21.88	21.25
16. Volume at Nozzle				
Actual Cubic Feet	51.469	51.518	53.231	52.076
Actual Cubic Meters	1.458	1.459	1.507	1.475
17. Concentration				
Grains per Actual Cubic Ft	0.0279	0.0274	0.0290	0.0281
Grams per Actual Cubic M	0.0639	0.0628	0.0664	0.0644
18. Isokinetic, %	94.72	95.35	98.51	96.20

Sampling & Analytical Procedures



III. SAMPLING AND ANALYTICAL PROCEDURES

General

All sampling and analytical procedures for determination of the particulate emissions from this source were conducted in strict adherence with the Code of Federal Regulations, Title 40, Part 60, Appendix A, Methods 1-5 as amended. The equipment used in this test was manufactured by Research Appliance Corporation and was properly calibrated before these tests (See **Calibrations**). The particulate mass was determined gravimetrically after removal of uncombined water.

METHOD 1

This method was used to determine the number of sampling points and the required matrix. The dimensions of the stack (see **Figure 1**) indicated that 24 points would be required to sample this source. We sampled 24 points (12 per diameter) for two and a half minutes at each point. Verification of absence of cyclonic flow was not determined because cyclonic flow did not seem to exist from the stack exhaust.

METHOD 2

Velocity meaurements were taken using a properly calibrated S type pitot tube and a 0-10.0 inch inclined vertical manometer, having 0.01 inch H_2O divisions on the 0 to 1 inch inclined scale, and 0.1 inch H_2O divisions on the 1 to 10 inch vertical scale.

METHOD 3

Gas analysis for CO_2, O_2, and N_2 by difference was performed by using the grab sample technique twice during each test and analyzed with a Fyrite Gas Analyzer (0-20% scale with 0.5% divisions).

METHOD 4

Moisture content of the stack gases was determined in conjunction with Method 5 for each test by measuring the amount of water collected in the condenser and the increase in weight of the silica gel. These weights were combined to give the total amount of water collected.

METHOD 5

Sampling Techniques

Preliminary data was used to determine stack temperature, pressure, range of velocity heads, moisture content and stack gas dry molecular weight prior to sampling. A Radio Shack PC-4 computer and a TI55 was used to calculate the sampling rate for isokinetic sampling. The particulate determinations were made by utilizing the sample train in **Figure 2.** The meter box was leak checked from the pump to the orifice and initial and final leak checks of the sampling system and pitot lines were performed as outlined in Method 5 and were recorded on the data sheets (**See Field Data**). The nozzle (stainless steel 316 with an angle of taper of 30° and of button hook design) was calibrated before and after each test using a micrometer and was also recorded on the data sheets.

The sampling probe was placed at each sampling point for two and a half minutes to provide a total sampling time of 60 minutes. The gases were drawn through a stainless steel nozzle attached to a heated glass lined probe. The probe was maintained at the proper setting to obtain an exit temperature of 248 $\pm$ 25 °F (See **Calibrations**). The gases then pass through a glass fiber filter (Gelman, Class A) of 0.3 micron retention to remove particulate matter. The filter was maintained at a temperature of 248 $\pm$ 25 °F. These temperatures were recorded at each point on the data sheets.

The gases then pass through a condenser placed in an ice bath to maintain a maximum exit temperature of 68 °F. This temperature was also recorded on the data sheets. The gases then pass through a pre-weighed drying column filled with indicating silica gel to remove any remaining moisture. The clean and cool gases then entered the meter box where the gas flow and temperature were measured and recorded.

Upon completion of the sampling and the final leak checks the gel column and the probe nozzle-filter holder assembly was transferred to the cleanup area making sure no particulate was lost. The cleanup data was recorded on **Particulate Sample Recovery and Intergrity Sheet** located in the Field Data Section. Particulate catches were placed in sealed petri dishes.

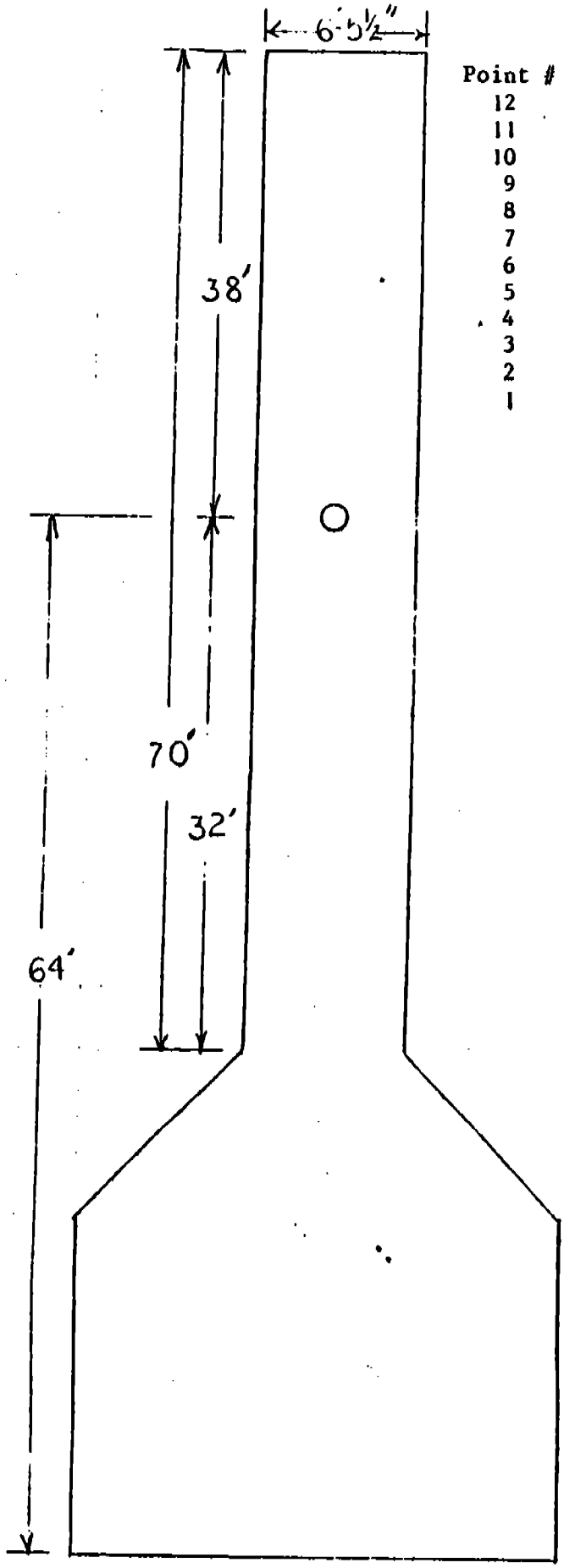
Each acetone rinse from the nozzle, probe, and filter holder was combined and placed in a sealed container. For the group of tests an acetone blank of approximately 200 milliliters was placed in a sealed container. These containers were clearly marked and transported to our laboratory for analysis.

Analysis

The filters (Gelman, Class A, without organic binder, minimum 99.9% retention for particules of 0.3 microns as determined by DOP tests) were prepared for the field test by first heating for 2 hours at 220 °F then desiccating at 68 ± 10 °F at ambient pressure for 24 hours and weighing at intervals of at least six (6) hours to a constant weight to the nearest 0.1 milligrams (less than 0.5 milligrams change from previous reading). Upon return to the laboratory, the filters were subjected to the same procedures as outlined above. The weights were recorded in a bound laboratory book and transferred to the sheets in this report (**Method 5 Train Analytical Particulate Data**). During each weighing the filter was not exposed to the laboratory atmosphere for more than two (2) minutes and the relative humidity of the laboratory was less than fifty percent (50%).

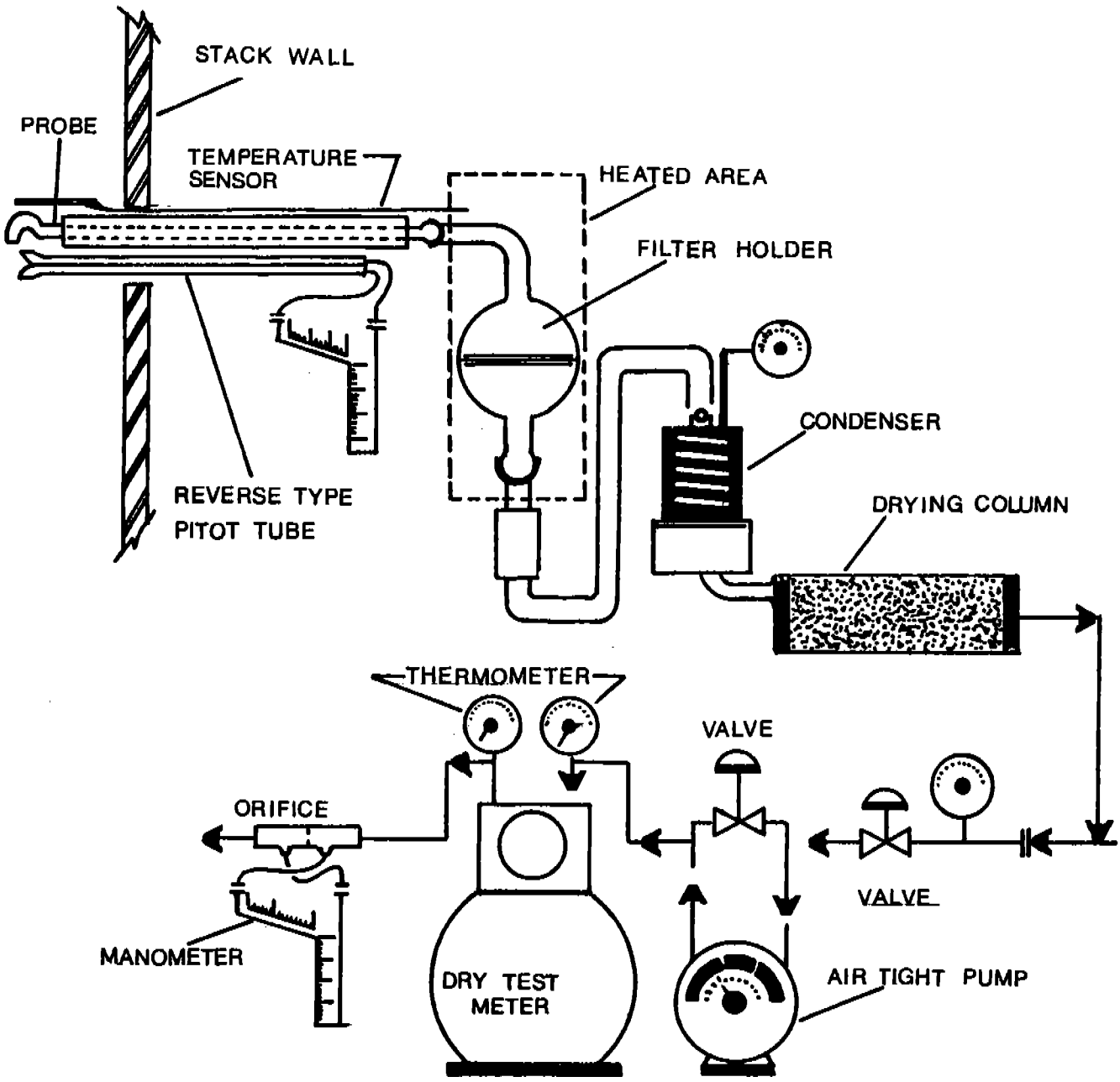
The acetone (reagent grade, 0.001 % residue, in glass bottles) blank (**Blank Analytical Data**) for the group of tests and the acetone rinses for each test were evaporated to dryness in tared glass beakers. They were then desiccated for twenty-four (24) hours and weighed to a constant weight as describe above.

Stack Breeching and Sample Point Location for Unit #1



Point #	Distance
12	1.6
11	5.2
10	9.2
9	13.7
8	19.4
7	27.6
6	49.9
5	58.1
4	63.8
3	68.3
2	72.3
1	75.9

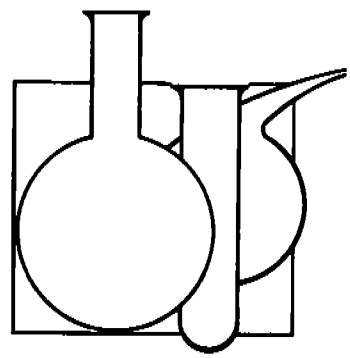
Figure 1



PARTICULATE SAMPLING TRAIN.. METHOD 5

Figure 2

Field Data



NOMENCLATURE

ACF - Actual Cubic Feet

ACFM - Actual Cubic Feet per minute

ACM - Actual Cubic Meters

ACMS - Actual Cubic Meters per second

An - Cross sectional area of nozzle, (ft^2)

As - Area of Stack, (ft^2)

Bws - Water vapor in the gas stream, proportion by volume (dimensionless)

Ca - Acetone blank residue concentration, mg/g

c_a - Particulate Concentration, ACF

CFM - Cubic feet per minute

Cp - Pitot tube coefficient, (dimensionless)

c_s - Particulate Concentration, grains/DSCF

Cso_2 - Concentration of sulfur dioxide (dry basis) corrected to standard conditions, lb/DSCF

C_{12} - Particulate concentration (c_s adjusted to 12% excess air), grains/DSCF

C_{50} - Particulate concentration (c_s adjusted to 50% excess air), grains/DSCF

DSCF - Dry Standard Cubic Feet

DSCFM - Dry Standard Cubic Feet per minute

DSCM - Dry Standard Cubic Meters

DSCMS - Dry Standard Cubic Meters per second

EA - Excess Air, %

I - Isokinetic Sampling, %

Km - Orifice Correction Factor, (dimensionless)

Kp - Pitot tube constant, 85.49 $\left[\frac{(lb/lb\text{-}mole)(in.\ Hg)}{(^{\circ}R)\ (in.\ H_2O)}\right]^{1/2}$

La - Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.02 CFM or 4 percent of the average sampling rate, whichever is less.

Li - Individual leakage rate observed during the leak check conducted prior to the "i^{th}" component change ($i = 1,2,3,...n$), CFM.

Lp - Leakage rate observed during the post test leak check, $ft^3/min.$ (cfm).

Ma - Mass of residue of acetone after evaporation, mg.

Md - Molecular weight of stack gas; dry basis, lb/lb-mole.

Mn - Total amount of particulate matter collected, mg.

Ms - Molecular weight of stack gas; wet basis, lb/lb-mole.

Mw - Molecular weight of water, 18.0 g/g-mole (18.01 lb/lb-mole)

ΔP - Velocity head of stack gas, in. H_2O

Pa - Density of acetone, mg/ml

Pbar - Barometric pressure at the sampling site, in. Hg

Pg - Stack static pressure, in. H_2O

Pm - Meter pressure, in. Hg

PMR - Particulate Mass Rate, lbs per hour

Ps - Absolute stack pressure, in. Hg

Pstd - Standard absolute pressure, 29.92 in. Hg

Pw - Density of water, 0.9982 g/ml (0.002201 lb/ml)

Qa - Volumetric flow rate, ACFM

Qs - Volumetric flow rate, DSCFM

R - Ideal gas constant, 0.06236 mm Hg - $m^3/^oK$-g-mole (21.85 in. Hg-$ft^3/^oR$-lb-mole)

SCF - Standard Cubic Foot

ta - Ambient Temperature, ^oF

tm - Average Temperature of meter, ^oF

t_s - Average Temperature of stack, ^oF

tstd - Standard Temperature, $68^{\circ}F$

NOTE: Capital "T" denotes degrees Rankin

Va - Volume of acetone blank, ml

Vaw - Volume of acetone used in wash, ml

Vlc - Total volume of liquid collected in condenser and silica gel, ml

Vm - Volume of gas sample, as measured by the dry gas meter, ACF

Vmc - Volume of gas sample, corrected for leak, ACF

Vm(std) - Volume of gas sample measured by the dry gas meter, corrected to standard conditions, DSCF

Vn - Volume collected at stack conditions through nozzle, ACF

Vs - Average stack gas velocity, ft/sec.

Vw(std) - Volume of water in the gas sample, corrected to standard conditions, SCF

Wa - Weight of residue in acetone wash, mg

Y - Dry gas meter calibration factor, (dimensionless)

ΔH - Average pressure differential across the calibrated orifice, in. H_2O

ΔH_a - Value of ΔH measured for a specific orifice when operated under the following conditions: 0.75 cfm of dry air (M.W. = 29) at $68^{\circ}F$, 29.92 in. Hg.

$\sqrt{\Delta P}$ - Average of the square roots of the velocity pressure, in. H_2O

Θ - Total sampling time, min.

Θ_1 - Sampling time interval from the beginning of a run until the first component change, min.

Θ_i - Sampling time interval between two successive component changes, beginning with the interval between the first and second changes, min.

Θp - Sampling time interval from the final (n^{th}) component change until the end of the sampling run, min.

$\%CO_2$, $\%O_2$, $\%N_2$, %CO - Number percent (%) by volume (dry basis) of each compound in the stack gas.

EQUATIONS

1. $$P_s = P_{bar} + \frac{P_g}{13.6}$$

2. $$P_m = P_{bar} + \frac{\overline{\Delta H}}{13.6}$$

3. $$V_{m(std)} = V_m Y \left(\frac{Tstd}{Tm}\right) \left[\frac{Pbar + \frac{\overline{\Delta H}}{13.6}}{Pstd}\right]$$

4. $$V_{w(std)} = 0.04707\ V_{lc}$$

5. $$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

6. $$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

7. $$M_s = M_d\ (1 - B_{ws}) + 18(B_{ws})$$

8. $$v_s = K_p C_p\ (\sqrt{\Delta p})\ \text{avg.} \sqrt{\frac{T_s}{M_s P_s}}$$

9. $$Q_a = (v_s)\ (A_s)\ (60)$$

10. $$Q_s = Q_a\ (1 - B_{ws})\ \left(\frac{528}{T_s}\right)\ \left(\frac{P_s}{29.92}\right)$$

11. $$c_s = \left[0.0154\ (Mn/Vmstd)\right]$$

12. $$EA = \left[\frac{\%O_2 - 0.5\ \%CO}{0.264\ \%N_2\ (\%O_2 - 0.5\ \%CO)}\right] 100$$

13. $$c_{50} = \frac{c_s}{1 - \left[\frac{(1.5)(\%O_2) - 0.133(\%N_2) - 0.75\ (\%CO)}{21}\right]}$$

14. $$c_{12} = c_s\ \frac{12}{\%\ CO_2}$$

15. $$PMR = (c_s)(Q_s)\left(\frac{60}{7000}\right)$$

16. $$V_n = \frac{T_s}{P_s}\left[(0.002669)(V_{1c}) + \frac{V_m}{T_m}\left(P_{bar} + \frac{\overline{\Delta H}}{13.6}\right)\right]$$

17. $$C_a = (0.0154)(M_n)\ /V_n$$

18. $$I = \frac{100\ V_n}{60\ \Theta\ v_s\ An}$$

19. $$V_{mc} = V_m - (L_p - L_a)\ \Theta$$

20. $$W_a = Ca\ Vaw\ p_a$$

FIELD DATA SHEET

PLANT SI LIME RUN # 1

LOCATION #2 STACK DATE 10-28-86

BARO. PRES. 30.12 TIME 1430-1536

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

	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
			892.939									
A				(1)	(2)	(3)		(4)	(5)			
1	2.5	2.5	894.8	174	83	82	82	36	250	2.16	.67	2.1
2		5	896.6	176	90	88	89	38	250	2.10	.64	2.2
3		7.5	898.2	177	96	89	93	39	251	1.90	.58	2.2
4		10	899.8	179	100	90	95	39	251	1.60	.49	2.1
5		12.5	901.2	179	103	92	97	39	252	1.31	.40	2.1
6		15	902.6	179	105	93	99	39	254	1.38	.42	2.3
7		17.5	904.4	179	105	94	99	41	249	1.94	.59	2.5
8		20	906.2	178	107	95	101	41	251	2.22	.67	2.7
9		22.5	908.3	178	106	96	101	41	252	2.38	.72	2.8
10		25	909.9	177	105	96	101	41	253	2.49	.75	3.1
11		27.5	912.0	175	104	96	100	43	255	2.46	.74	3.3
12		30	913.5	170	103	96	100	43	256	2.17	.65	3.3
B												
1	2.5	32.5	915.1	178	101	95	98	43	256	1.68	.51	2.8
2		35	916.7	179	102	96	99	43	257	1.38	.42	2.8
3		37.5	918.0	181	105	97	101	43	258	1.15	.35	2.6
4		40	919.2	180	106	97	101	38	259	.96	.29	2.5
5		42.5	920.7	180	106	97	101	39	260	1.12	.34	2.6
6		45	922.4	180	108	98	103	39	261	1.79	.54	2.7
7		47.5	924.4	181	110	98	104	39	261	1.59	.48	2.7
8		50	925.6	180	109	99	104	40	262	1.56	.47	2.8
9		52.5	926.9	179	108	99	104	42	263	1.59	.48	3.1
10		55	928.2	179	106	99	103	43	261	1.56	.47	3.6
11		57.5	929.5	179	106	100	103	43	261	1.59	.48	4.1
12		60	931.194	174	106	100	103	43	261	1.57	.47	4.4
		60	38.255	178			99			1.73	.720	4.4

STATIC PRESSURE "H2O -.41

PROBE TIP SIZE

BEFORE	AFTER
.248	.248
.247	.248
.248	.248

WATER

#4

ml. 135

gram 9.4

Total 144.4

OPERATOR

KARSTENS / TURNER

Sample Box No. 4

Meter Box No. 700

Meter ΔH@ 2.07

Pitot, CP .84

Temp. Device SLIII

Probe No. 81

Probe Liner SS

Probe Htr. Set 600

Ambient Temp. 85°

% O_2	14	14
% CO_2	9	9

NOTES

Orifice Y cal 18"

Pitot S6.2 R80

Meter at 20"

Final leak ✓ at 4.5" Hg .010

R-6.1 ✓

S-6.4 ✓

3-1

FIELD DATA SHEET

PLANT SI Lime RUN # 2

LOCATION #2 STACK DATE 10/28/86

BARO. PRES. 30.12 TIME 1545-1648

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

	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
			931.427									
B				(1)	(2)	(3)		(4)	(5)			
1	2.5	2.5	932.8	179	99	96	98	39	228	1.64	.50	1.6
2	|	5	934.3	179	102	98	100	46	241	1.48	.45	1.4
3	|	7.5	935.7	179	103	98	100	46	256	1.22	.37	1.6
4	|	10	937.2	179	102	98	100	47	268	1.09	.33	1.6
5	|	12.5	938.8	180	102	98	100	46	271	.99	.30	1.8
6	|	15	940.3	180	102	98	100	42	267	.99	.30	2.0
7	|	17.5	941.8	180	102	98	100	44	251	1.88	.57	3.8
8	|	20	942.9	179	102	98	100	46	260	1.58	.48	3.7
9	|	22.5	944.0	179	102	98	100	46	248	1.58	.48	3.7
10	|	25	945.7	177	102	98	100	46	251	1.69	.51	3.9
11	|	27.5	947.3	177	102	98	100	47	257	1.72	.52	4.1
12	|	30	948.8	175	101	97	99	47	264	1.76	.53	4.3
A	2.5											
1	|	32.5	950.7	178	99	95	97	36	270	2.33	.71	3.9
2	|	35	952.6	179	102	96	99	40	252	2.17	.66	4.2
3	|	37.5	954.3	179	103	96	99	38	261	1.88	.57	4.2
4	|	40	955.7	179	104	96	100	39	257	1.62	.49	4.1
5	|	42.5	957.3	179	103	96	100	39	240	1.42	.43	4.1
6	|	45	958.7	180	102	96	99	38	244	1.45	.44	4.2
7	|	47.5	960.3	181	103	96	100	38	248	1.78	.54	4.5
8	|	50	962.0	180	103	96	100	40	246	2.01	.61	4.7
9	|	52.5	964.1	180	104	96	100	41	252	2.17	.66	4.8
10	|	55	966.7	179	105	97	101	43	268	2.15	.65	4.8
11	|	57.5	967.7	180	107	97	102	46	271	2.08	.63	4.9
12	|	60	969.039	177	108	97	102	45	258	2.16	.65	5.1
		60	37.612	179			100			1.70	.713	5.1

STATIC PRESSURE "H2O -.41

PROBE TIP SIZE

BEFORE	AFTER
.248	.248
.248	.248
.248	.248

WATER

10

ml. 148

gram 10.1

Total 158.1

OPERATOR

Turner / Karstens

Sample Box No. 400

Meter Box No. 400

Meter ΔH@ 2.07

Pitot, CP .84

Temp. Device ΔTC

Probe No. 8'

Probe Liner SS

Probe Htr. Set 609

Ambient Temp. 84°

% O_2	14	14
% CO_2	9	9

NOTES

Orifice ✓

Pitot ✓ RS.2S6.6

Meter ✓ at 18" Hg

R 5.5 ✓

S 5.8 ✓

FINAL LEAK CHECK AT 6# .011

FIELD DATA SHEET

PLANT SILMET RUN # 3

LOCATION #2 STACK DATE 10-29-86

BARO. PRES. 30.12 TIME 1656-1759

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

	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
			969.274									
A				(1)	(2)	(3)		(4)	(10)			
1	2.5	2.5	971.8	181	102	97	100	37	229	2.27	.69	2.1
2		5	973.5	182	106	99	103	42	230	2.15	.65	2.1
3		7.5	974.8	182	109	99	94	42	243	1.85	.57	2.2
4		10	977.3	182	110	100	105	42	253	1.66	.50	2.3
5		12.5	978.5	182	111	100	105	42	253	1.42	.43	2.3
6		15	979.9	183	112	100	106	41	265	1.42	.43	2.3
7		17.5	981.5	182	112	100	106	41	248	1.69	.51	2.4
8		20	983.1	180	113	100	106	41	250	2.16	.65	2.8
9		22.5	985.1	179	114	101	108	44	251	2.34	.70	3.1
10		25	987.2	179	114	100	107	45	253	2.37	.71	3.4
11		27.5	9890	175	115	101	108	46	254	2.19	.65	3.5
12	↓	30	990.8	168	115	101	108	43	255	2.18	.64	3.4
B												
1	2.5	32.5	993.0	173	110	100	105	43	257	1.85	.55	3.1
2		35	994.6	181	112	101	106	45	258	1.50	.45	3.2
3		37.5	995.6	180	112	101	106	45	259	1.23	.37	3.1
4		40	996.4	180	112	101	106	45	260	1.10	.33	3.2
5		42.5	998.2	180	111	101	106	43	272	.97	.29	3.1
6		45	999.8	180	110	101	105	43	269	1.26	.38	3.4
7		47.5	1001.3	180	110	100	105	42	259	1.69	.51	3.9
8		50	1003.1	181	111	101	106	46	263	1.50	.45	3.9
9		52.5	1004.7	180	112	101	106	47	254	1.66	.50	4.2
10		55	1006.2	180	112	100	106	48	247	1.66	.50	4.3
11		57.5	1008.8	180	113	100	106	49	236	1.70	.51	4.5
12	↓	60	1009.42	175	113	100	106	51	227	1.74	.52	4.8
24		60	40.147	179			105			1.73	.717	

STATIC PRESSURE "H2o -.43

PROBE TIP SIZE

BEFORE	AFTER
.248	.248
.248	.248
.248	.248

#7 WATER

ml.

gram

Total

OPERATOR

KBUTTS
TURNER

Sample Box No. 4

Meter Box No. 400

Meter ΔH@ 2.07

Pitot, CP .84

Temp. Device

Probe No. 8'

Probe Liner SS

Probe Htr. Set 600

Ambient Temp. 75°

% O_2	14	14
% CO_2	9.5	9.5

NOTES

Orifice

Pitot ✓

Meter ✓

S 6.2 ✓

R 4.8 ✓

FINAL LEAK CHECK AT 5" Hg

.009

BLANK ANALYTICAL DATA

Plant SI Lime

Sample location UNIT #1 & UNIT #2

Relative humidity 20%

Type of blank ACETONE

Liquid level at mark and container sealed ✓

Density of blank (ρa) .7847 g/ml

Blank volume (Va) 200 ml

Date and time of wt. 10/30/86 700 Gross wt. 98487.5 mg

Date and time of wt. 10/30/86 1800 Gross wt. 98487.5 mg

Average gross wt. 98487.5 mg

Tare wt. 98487.4 mg

Weight of blank (ma) 0.1 mg

$$Ca = \frac{ma}{Va\ \rho a} = \frac{(0.1)}{(200)(.7847)} = .0006 \text{ mg/g}$$

Note: In no case shall a blank residue greater than (0.01 mg/g) or 0.001% of the weight of blank used be subtracted from the sample weight.

Remarks: _____

Signature of analyst [signature]

Signature of reviewer [signature]

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant SI Lime Run No. 1

Sample location Unit #2

Relative humidity 20%

Density of acetone (ρa) .7847 g/ml

Sample type	Sample identifiable	Liquid level marked and/or container sealed
Acetone rinse	✓	✓
filter(s)	✓	✓

Acetone rinse container no. R#1 STK 2

Acetone rinse volume (Vaw) 100 ml

Acetone blank residue concentration (Ca) .0006 mg/g

Wa = Ca Vaw ρa = (.0006)(100)(.7847) = — mg

Date and time of wt 10/30/86 700 Gross wt 104546.3 mg

Date and time of wt 10/30/86 1800 Gross wt 104546.0 mg

Average gross wt 104546.2 mg

Tare wt 104540.3 mg

Less acetone blank wt (Wa) — mg

Weight of particulate in acetone rinse 5.9 mg

Filter(s) container no. R#1 STK 2

Date and time of wt 10/30/86 700 Gross wt 252.8 mg

Date and time of wt 10/30/86 1800 Gross wt 252.6 mg

Average gross wt 252.7 mg

Tare wt 165.3 mg

Weight of particulate on filter(s) 87.4 mg

Weight of particulate in acetone rinse 5.9 mg

Total weight of particulate 93.3 mg

Note: In no case shall a blank residue greater than (.01 mg/g) or .001% of the weight of acetone used be subtracted from the sample weight.

Remarks: _____

Signature of analyst _____

Signature of reviewer _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: SI Lime Sample date: 10/28/86
Sample location: UNIT #2 Run no.: 2
Sample recovery person: KAMSTENS Recovery date: 10/28/86
Filter(s) no.: 91

MOISTURE

Impingers			Silica gel #10		
Final volume (wt)	148	ml(gm)	Final wt.	945.9 g	g
Initial volume (wt)	0	ml(gm)	Initial wt.	935.8 g	g
Net volume (wt)	148	ml(gm)	Net wt.	10.1 g	g

Total moisture 158.1 g
Color of silica gel MIXED
Description of impinger water CLEAR

RECOVERED SAMPLE

Filter container no. RUN#2 STK 2 sealed ✓
Description of particulate on filter GREY

Acetone rinse container no. R #2 STK #2 Liquid level marked ✓
Acetone blank container no. _____ Liquid level marked _____
Samples stored and locked ✓
Remarks: _____

Date of laboratory custody 10/29/86
Laboratory personnel taking custody LOTZ
Remarks: _____

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant SI Line Run No. 2

Sample location Unit #2

Relative humidity 20%

Density of acetone (ρa) .7847 g/ml

Sample type	Sample identifiable	Liquid level marked and/or container sealed
Acetone rinse	✓	✓
filter(s)	✓	✓

Acetone rinse container no. R #2 Stk 2

Acetone rinse volume (Vaw) 100 ml

Acetone blank residue concentration (Ca) .0006 mg/g

Wa = Ca Vaw ρa = (.0006)(100)(.7847) = 0 mg

Date and time of wt 10/30/86 700 Gross wt 105473.6 mg

Date and time of wt 10/30/86 1800 Gross wt 105473.4 mg

Average gross wt 105473.6 mg

Tare wt 105470.9 mg

Less acetone blank wt (Wa) — mg

Weight of particulate in acetone rinse 2.7 mg

Filter(s) container no. R #2 Stk 2

Date and time of wt 10/30/86 700 Gross wt 256.5 mg

Date and time of wt 10/30/86 1800 Gross wt 256.5 mg

Average gross wt 256.5 mg

Tare wt 167.4 mg

Weight of particulate on filter(s) 89.1 mg

Weight of particulate in acetone rinse 2.7 mg

Total weight of particulate 91.8 mg

Note: In no case shall a blank residue greater than (.01 mg/g) or .001% of the weight of acetone used be subtracted from the sample weight.

Remarks: _____

Signature of analyst _____

Signature of reviewer _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: ST Lime Sample date: 10/28/86
Sample location: UNIT #2 Run no.: 3
Sample recovery person: KAMSTEWS Recovery date: 10/28/86
Filter(s) no.: 92

MOISTURE

Impingers Silica gel # 7
Final volume (wt) 133 ml(gm) Final wt. 972.8 g ____ g
Initial volume (wt) 0 ml(gm) Initial wt. 961.1 g ____ g
Net volume (wt) 133 ml(gm) Net wt. 11.7 g ____ g
Total moisture 144.7 g
Color of silica gel Mixed
Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. R-#3 STK 2 sealed ✓
Description of particulate on filter Grey

Acetone rinse container no. R#3 STK 2 Liquid level marked ✓
Acetone blank container no. ____ Liquid level marked ____
Samples stored and locked ✓
Remarks: ____

Date of laboratory custody 10/29/86
Laboratory personnel taking custody LOTZ
Remarks: ____

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant SI Lime Run No. 3

Sample location UNIT #2

Relative humidity 20%

Density of acetone (ρa) .7847 g/ml

Sample type	Sample identifiable	Liquid level marked and/or container sealed
Acetone rinse	✓	✓
filter(s)	✓	✓

Acetone rinse container no. 12 #3 Stk #2

Acetone rinse volume (Vaw) 100 ml

Acetone blank residue concentration (Ca) .0006 mg/g

Wa = Ca Vaw ρa = (.0006)(100)(.7847) = 0 mg

Date and time of wt 10/30/86 700 Gross wt 105797.3 mg

Date and time of wt 10/30/86 1800 Gross wt 105797.1 mg

Average gross wt 105797.2 mg

Tare wt 105785.0 mg

Less acetone blank wt (Wa) — mg

Weight of particulate in acetone rinse 12.2 mg

Filter(s) container no. 12 #3 Stk #2

Date and time of wt 10/30/86 700 Gross wt 255.1 mg

Date and time of wt 10/30/86 1800 Gross wt 255.0 mg

Average gross wt 255.1 mg

Tare wt 167.0 mg

Weight of particulate on filter(s) 88.1 mg

Weight of particulate in acetone rinse 12.2 mg

Total weight of particulate 100.3 mg

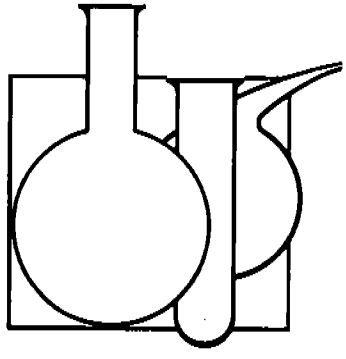
Note: In no case shall a blank residue greater than (.01 mg/g) or .001% of the weight of acetone used be subtracted from the sample weight.

Remarks: _____

Signature of analyst _____

Signature of reviewer _____

Plant Operation Data

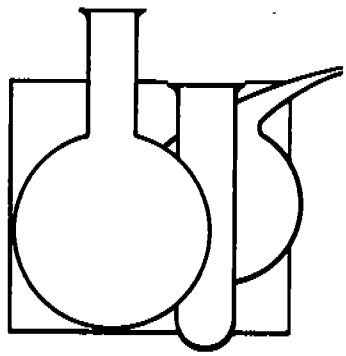


V. PLANT OPERATIONAL DATA

The following data was provided by Mr. Bill Schoof of SI Lime Company for the compliance test on Unit #2 on October 28, 1986.

Test Number	1	2	3	Average
Process rate, tons/hr	25.5	25.5	25.5	25.5

Calibrations



VI. METHOD 5 CALIBRATIONS

Meter Boxes

The meter box shall be initially calibrated every 6 months at the fixed settings of 0.5, 1.0, 1.5, 2.0, and 2.5 inches of water. Upon return to the laboratory from this test the meter box was recalibrated using the average meter pressure for the test series. The recalibration point was the closest point to the initial calibration (for an average meter pressure of 1.72 a 1.50 "H_2O was used as the recalibration point). These recalibrations produced a single point MCF and a H@ which were compared to the original calibration to see if they are within the 5% allowed at the highest vacuum observed. These recalibration sheets are located behind the original calibration sheets.

Pitot Tubes

The S type pitot tubes were calibrated against a standard pitot tube (C_p = 0.99) in a wind tunnel with a capacity to generate a test section velocity of approximately 3000 feet/ minute every 6 months. Additionally the pitot tubes were measured as to their specifications and alignment. Upon return, the intercomponent spacings and the face opening alignment of the pitot tube assembly was rechecked and if no changes are noticed; it shall be assumed that the coefficient of the assembly has not changed.

Temperature measurements

All temperature devices (impinger, meter box, hot box and stack) were calibrated every 6 months against an ASTM mercury-in-glass reference thermometer or a reference thermocouple and potentiometer calibrated by fixed points, e.g., ice bath and boiling water (corrected to barometric pressure). Upon return the stack temperature device was recalibrated within 10% of the average absolute stack temperature. If the device being tested agrees within 1.5% of the reference device, the temperature data taken in the field shall be considered valid.

V. METHOD 5 CALIBRATIONS CONTINUED

Barometric Pressure

An aneroid barometer capable of measuring atmospheric pressure to within 0.1 inches Hg shall be used. If this device is defective the following alternate method shall be used. The barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 0.1 inches Hg per 100 feet elevation increase or vice versa for elevation decrease.

Specific Test equipment and measurements

The equipment used during these tests was as follows:

Probe: 8'-1
Meter Box: #400
Stack Temperature: OMEGA III
Sample Box: #4
Condenser: #2

The average temperature of the stack was 149°F. The OMEGA III was recalibrated at 150°F and agreed exactly with an ASTM mercury-in-glass reference thermometer. The intercomponent spacings and the face opening alignment of the Pitot Tube assemblies were rechecked and no changes were noticed; therefore, it was assumed that the coefficient of the assemblies had not changed.

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

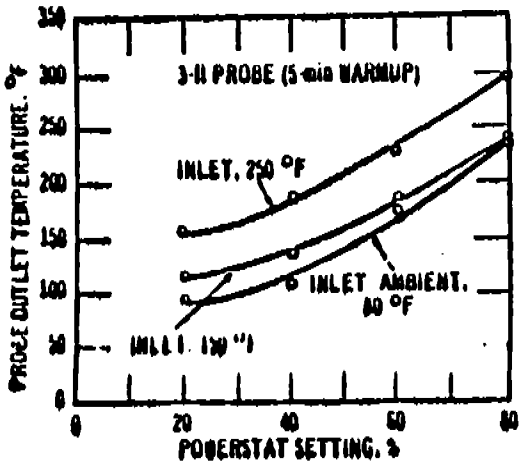
OTHER PHYSICALS:

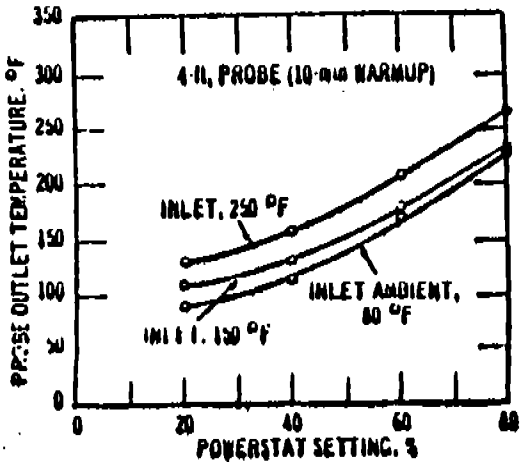
BSO	.522	Flow Resistance (Max.) @ 320 cm/min.	.80 mm
*pH	.9.0	Flow Rate (air) lpm/cm² @ 70 cm Hg	.60
DOP @320/cm/min ASTM Methods 2986)	.99.9%	Max. Use Temp.	.400°C
Tensile Strength (Fed. Spec. UUP31B)	.600 gr.	Static Properties	.Medium
Weight 8"x10"sheet	.4.0±.3 gr.	Ability to Fold	.Good

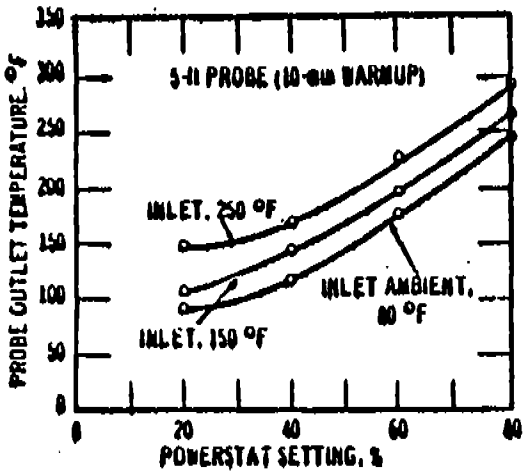
WATER EXTRACTABLE IONS:

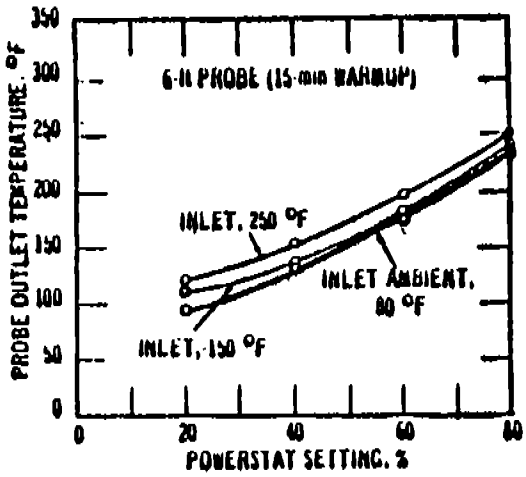
Sulfate	.600	Chloride	.1500
Nitrate	.115	Fluoride	.87
Ammonia	.13		

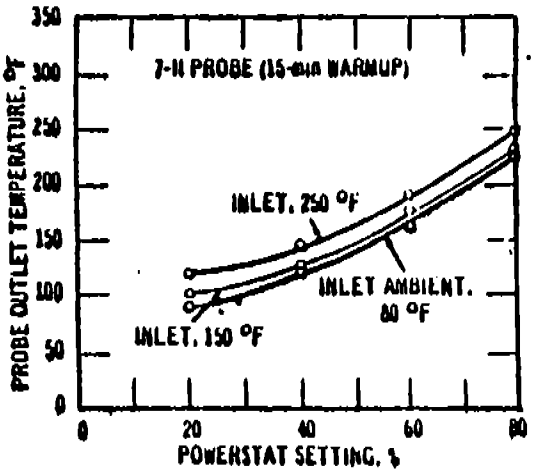
*pH—Gelman Procedure:
A. 500 ml distilled water.
B. Add 15 drops saturated KCl solution.
C. Shread one 8"x10" sheet and soak in prepared water for one hour.
D. Run pH at ambient temperature.











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

GUARDIAN SYSTEMS INC
Initial Meter Calibration Box 400
on 9/23/86

Run Number	1	2	3	4	5
Barometric Pres, in Hg	30.03	30.03	30.03	30.03	30.03
Orifice pres drop, in H20	0.5	1.0	1.5	2.0	2.5
Pres Wet Test Meter, in H20	-0.41	-0.62	-0.81	-1.05	-1.22
Gas Volume Wet Init, CF	0.000	0.000	0.000	0.000	0.000
Gas Volume Wet Final, CF	5.863	9.440	9.780	11.263	12.655
Gas Volume Dry Init, CF	188.917	194.545	203.937	213.711	225.004
Gas Volume Dry Final, CF	194.545	203.937	213.711	225.004	237.809
Temp Wet Init, C	23.0	23.0	23.0	23.0	23.0
Temp Wet Final, C	23.0	23.0	23.0	23.0	22.8
Vapor Pressure, mm Hg	21.068	21.068	21.068	21.068	20.941
Dry Gas Temp Init In, F	82	84	91	97	102
Dry Gas Temp Final In, F	84	91	97	102	106
Dry Gas Temp Init Out, F	78	83	87	91	93
Dry Gas Temp Final Out, F	83	87	91	93	95
Run Time, sec	900	1080	900	900	900
Meter Calibration Factor, Y	1.0265	0.9969	1.0002	1.0028	0.9984
Average Y	1.0050				
Qm	0.3843	0.5190	0.6488	0.7499	0.8447
Km	0.6902	0.6568	0.6684	0.6677	0.6718
Average Km	0.6710				
Delta H@	1.93	2.13	2.06	2.07	2.04
Average H@	2.05				

SIGNATURE G Karsten

GUARDIAN SYSTEMS INC
Meter Recalibration Box 400
on 10/29/86

Run Number	1	2	3	Average
Barometric Pres, in Hg	30.07	30.07	30.07	30.07
Orifice pres drop, in H20	1.5	1.5	1.5	1.50
Pres Wet Test Meter, in H20	-0.81	-0.81	-0.81	-0.81
Gas Volume Wet Init, CF	0.000	0.000	0.000	0.000
Gas Volume Wet Final, CF	9.482	9.473	9.465	28.420
Gas Volume Dry Init, CF	26.237	36.145	46.082	108.464
Gas Volume Dry Final, CF	36.145	46.082	56.179	138.406
Temp Wet Init, C	14.5	14.5	14.5	14.5
Temp Wet Final, C	14.5	14.5	14.7	14.6
Vapor Pressure, mm Hg	12.382	12.382	12.463	12.409
Dry Gas Temp Init In, F	93	98	102	98
Dry Gas Temp Final In, F	98	102	105	102
Dry Gas Temp Init Out, F	73	79	85	79
Dry Gas Temp Final Out, F	79	85	88	84
Run Time, sec	900	900	900	2700
Meter Calibration Factor, Y	0.9861	0.9917	0.9818	0.9865
Qm	0.6397	0.6463	0.6508	0.6456
Km	0.6675	0.6705	0.6724	0.6702
Delta H@	2.07	2.05	2.04	2.05

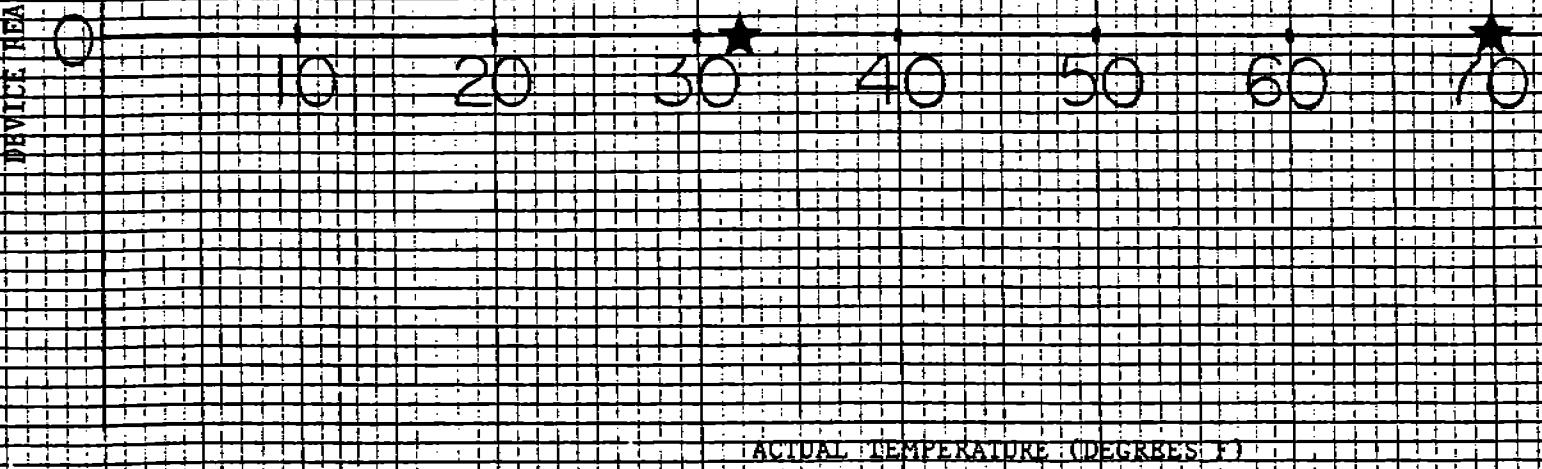
Previous Y 1.0002 % Difference 1.36%
Previous H@ 2.06 % Difference 0.45%

Project S1 LIME Stack #2

SIGNATURE L Karstens

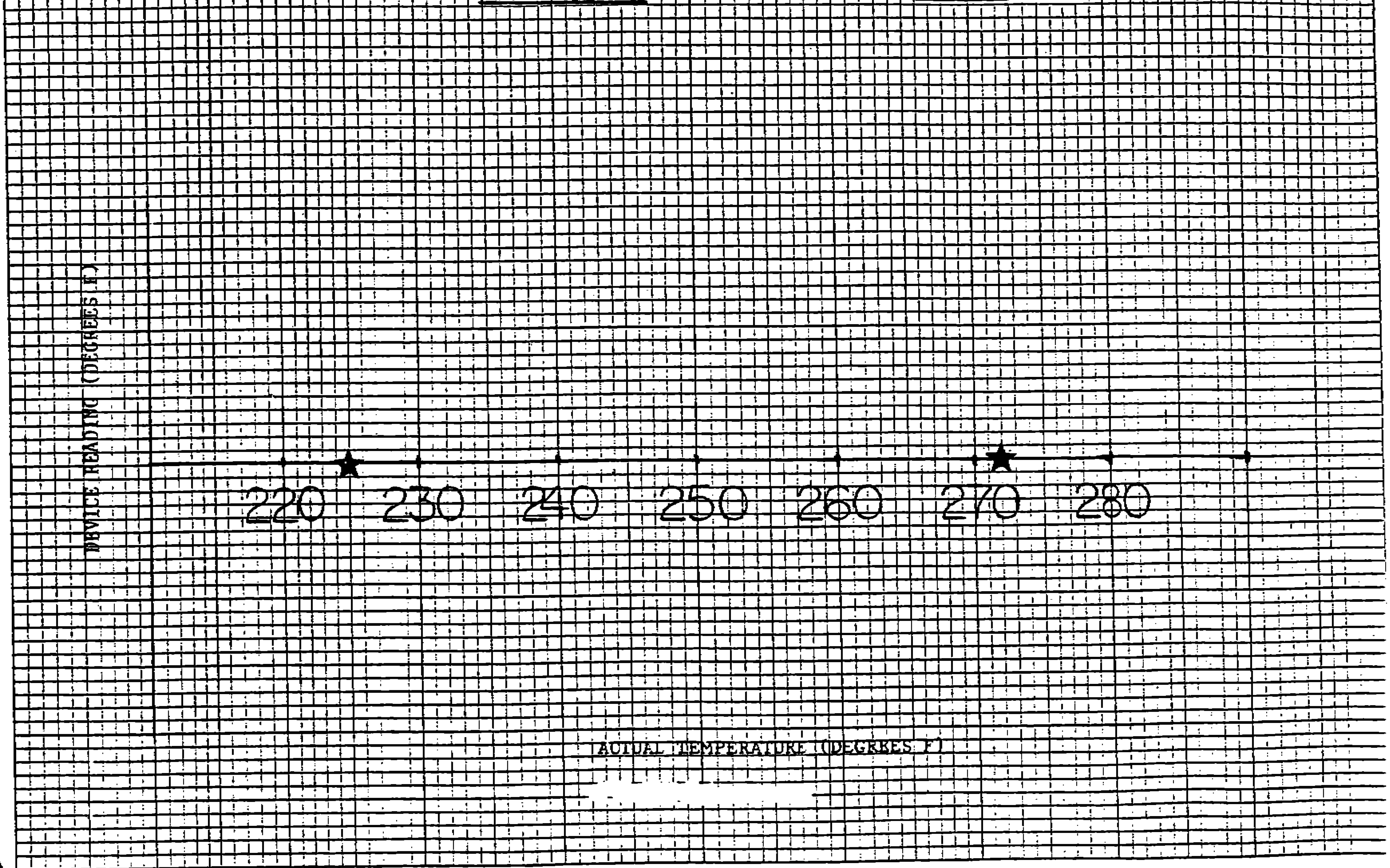
TEMPERATURE CALIBRATION
FOR IMPINGER II

DATE INITIAL 10-11-86 DATE FINAL



TEMPERATURE CALIBRATION
FOR HOT BOX 4

DATE INITIAL 10-1-86 DATE FINAL ______



PITOT CALIBRATION FORM

Date 10-1-86 Probe # 8'-1

Calibrated By G KARSTENS

Nozzle Size NA

SIDE A

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(A)$
1	.31	.42	.851	+.006
2	.29	.40	.842	-.003
3	.29	.40	.842	-.003
		$\bar{C}_{p(A)}$	.845	

.84

SIDE B

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(A)$
1	.25	.36	.825	-.013
2	.28	.39	.849	+.011
3	.28	.39	.839	+.001
		$\bar{C}_{p(B)}$	.838	

CALCULATIONS

.84

$$C_p(s) = C_{P(std)} \text{ (or 0.99)} \sqrt{\frac{\Delta P_{std}}{\Delta P(s)}}$$

$$\text{Average Deviation} = \frac{\Sigma \left| C_p(s) - \bar{C}_p(A \text{ or } B) \right|}{3}$$

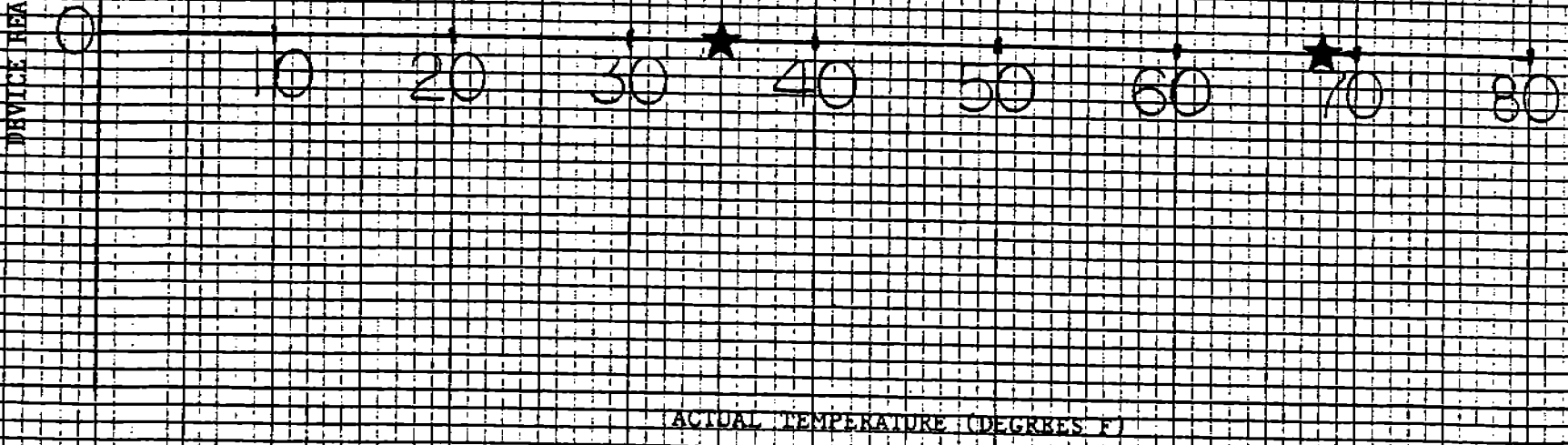
← Must be ≤ 0.01

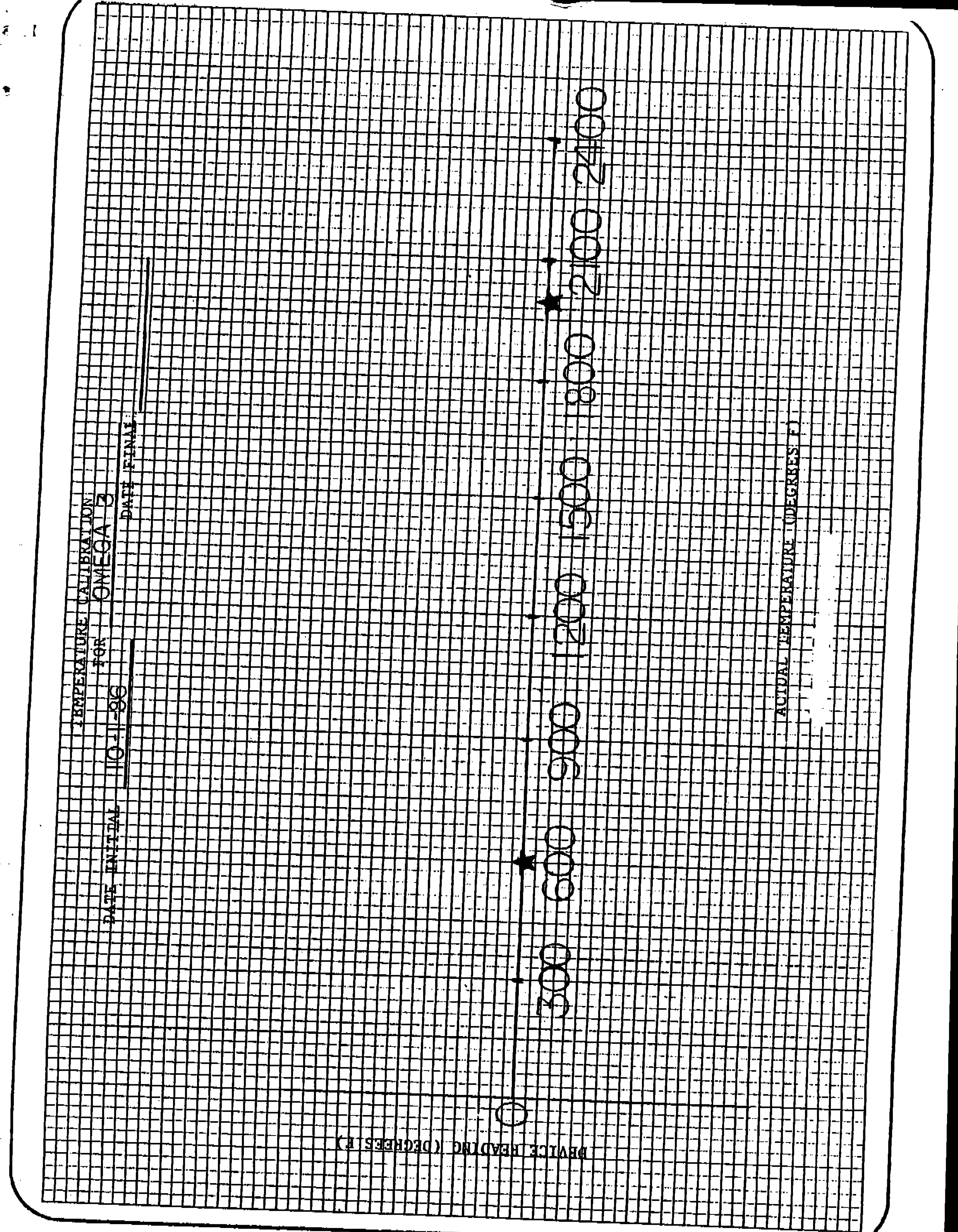
$$\left| \bar{C}_p(A) - \bar{C}_p(B) \right|$$ ← Must be ≤ 0.01

TEMPERATURE CALIBRATION

FOR OMEGA 3

DATE INITIAL 10-1-86 DATE FINAL




TEMPERATURE CALIBRATION
FOR OMEGA 3
DATE INITIAL 10-1-96
DATE FINAL
ACTUAL TEMPERATURE (DEGREES F)
DEVICE READING (DEGREES F)
0
300
600
900
1200
1500
1800
2100
2400