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:	11.3
Reference:	14
Title:	Mass Emission Tests Conducted On The Tunnel Kiln #21 In Glascow, VA, For General Shale Products Corporation, Guardian Systems, Inc., Leeds, AL, October 16, 1990.

AP-42 Section 11.3
Reference 14

GUARDIAN SYSTEMS INC.

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

Test Report

MASS EMISSION TESTS

CONDUCTED ON THE

TUNNEL KILN #21

IN

GLASCOW, VIRGINIA

FOR

GENERAL SHALE PRODUCTS CORPORATION

ON

OCTOBER 16, 1990

APPROVED BY_____

Tom Lotz
Director, Field Services

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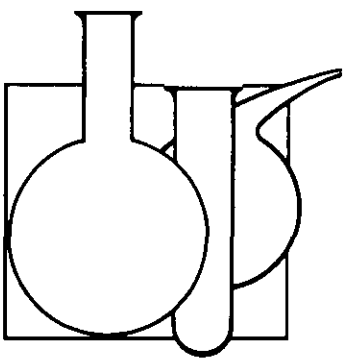
Introduction



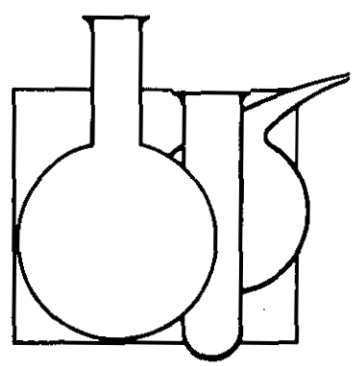
I. INTRODUCTION AND TEST DESCRIPTION

On October 16, 1990, Guardian Systems, Inc., performed a series of particulate emissions test on the General Shale Products Brick Plant Tunnel Kiln No. 21 located in Glascow, Virginia. These test were conducted in accordance to the rules and regulations expressed in the Code of Federal Regulations, Title 40, Section 60, Reference Method 1-5 as amended.

Individual bricks are formed and stacked onto kiln cars measuring approximately 5'9" x 9'2". Cars are inserted on a regular basis into a long, continuous-fired tunnel kiln. As one car is discharged another is inserted. This provides a constant moving mass inside the kiln. Cars are pushed through the 500 foot long kiln at a slow, methodical pace requiring almost 2 days for the complete travel. By means of a 100% coal firing process (See Coal analysis), heat is increased through the kiln until the total firing is complete. As the car continues through the kiln from the main firing zone the temperatures are reduced to provide necessary cooling.

Mr. Dave McNees and Mr. Mike Whitehead represented General Shale Products Corporation, and is responsible for all production data. Mr. Jeff Helbert, the Plant Manager, was responsible for the operation of the plant. Mr. Raymond Goetz, State Air Pollution Control Board, Commonwealth of Virginia observed the tests, while Ms. Robina Jordan read visual emissions. Mr. Tom Lotz and Mr. Emmanuel Isong of Guardian Systems, Incorporated, performed these test.

Test Results



II. SUMMARY OF TEST RESULTS

Table 1 is a summary of the test results on October 17-18, 1990 for the Tunnel Kiln #21.

$$E = 4.10\ p^{0.67}$$

Where E = Allowable emission rate, lbs/hour
P = process weight, tons/hour

The allowable emission rate, based on a process weight of 8.41 tons per hour, is 17.08 pounds per hour. The permit limit is 16.66 pounds per hour. The average actual emission rate is 4.36 pounds per hour which is 26 percent of the allowable emission rate, and 26 percent of the permit limit.

Run Number	1	2	3	Composite
Process Weight, Tons/hr	8.41	8.41	8.41	8.41
Particulate Emissions, #/hr	5.63	4.94	3.14	4.36
Allowables, #/hr	17.08	17.08	17.08	17.08
Permit Limit, #/hr	16.66	16.66	16.66	16.66

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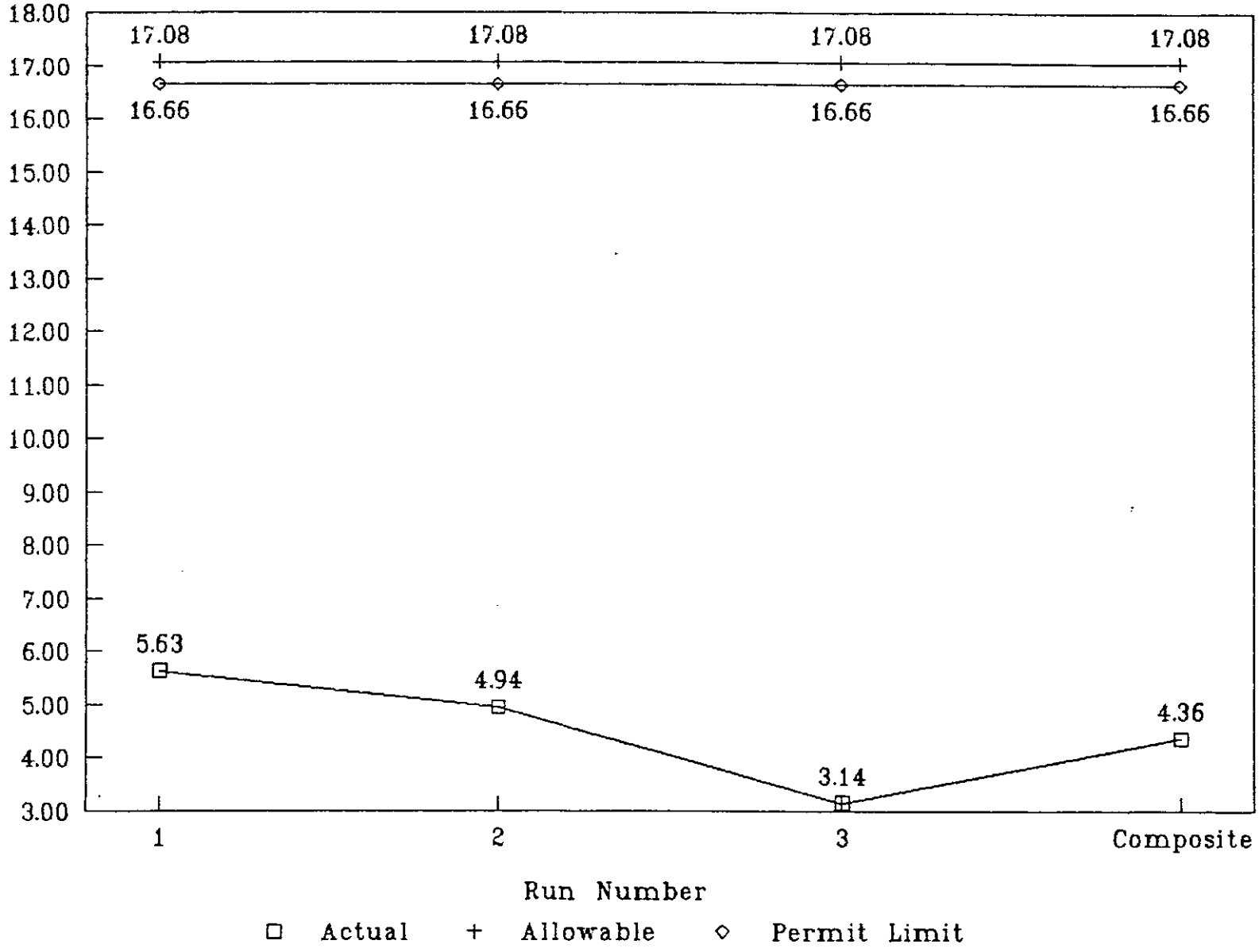
Summarized Air Test Results for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/16/90	10/16/90	10/16/90	10/16/90
Location	TK 21	TK 21	TK 21	TK 21
Time	1128-1231	1325-1428	1512-1614	1128-1614
Stack Gas Temperature, F	451	457	452	453
Moisture Content, % v/v	10.77	10.84	10.43	10.64
Oxygen Content, % v/v	11.50	14.00	15.25	13.58
Carbon Dioxide Content, % v/v	8.50	7.00	5.00	6.83
Carbon Monoxide Content, % v/v	0.00	0.00	0.00	0.00
Excess Air, %	119.54	204.20	262.75	182.90
Stack Gas Velocity Feet per Second	18.23	17.03	16.43	16.95
Volumetric Flow Actual Cubic Feet per Minute	5,546	5,180	4,997	5,156
Volumetric Flow Dry Std Cubic Feet per Minute	2,829	2,623	2,556	2,627
Concentration Grains per Dry Std Cubic Ft	0.232	0.220	0.143	0.194
Concentration Grains per Actual Cubic Foot	0.118	0.111	0.073	0.099
Particulate Mass Rate, #/hr	5.63	4.94	3.14	4.36
Allowable Emission Rate, #/hr	17.08	17.08	17.08	17.08
Permit Limit, #/hr	16.66	16.66	16.66	16.66
% Isokinetic	104.41	98.03	98.80	102.29

Table 1

GENERAL SHALE PRODUCTS TK21

On October 16, 1990



Particulate Emissions, #/hr

Graph 1

GUARDIAN SYSTEMS inc

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Computer Input Parameters for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/16/90	10/16/90	10/16/90	10/16/90
Location	TK 21	TK 21	TK 21	TK 21
Time	1128-1231	1325-1428	1512-1614	1128-1614
Barometric Pressure, in Hg	29.51	29.51	29.51	29.51
Static Pressure, in H2O	0.050	0.040	0.060	0.050
Run Time, minutes	62.50	62.50	62.50	187.50
Meter Volume, CF	27.808	44.064	42.969	114.841
Meter Correction factor, MCF	1.0498	1.0498	1.0498	
Meter Volume (Corrected)	29.193	46.258	45.109	120.560
Stack Temperature, F	451	457	452	453
Meter Temperature, F	71	91	87	83
Meter Pressure, in H2O	0.65	1.79	1.67	1.37
Sqr Velocity Pressure	0.239	0.222	0.214	0.225
Mass of Particulate, mg	432.3	626.3	401.5	1460.0
Ml of Water Collected	73.5	113.4	106.7	293.6
% Oxygen	11.50	14.00	15.25	13.58
% Carbon Dioxide	8.50	7.00	5.00	6.83
% Carbon Monoxide	0.00	0.00	0.00	0.00
Stack Area, Sq ft	5.070	5.070	5.070	5.070
Pitot Correction Factor	0.858	0.858	0.858	0.844
Nozzle Diameter, in	0.380	0.504	0.504	0.463
Feed Rate, Tons/hr	8.41	8.41	8.41	8.41

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Computed Air Test Results for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/16/90	10/16/90	10/16/90	10/16/90
Location	TK 21	TK 21	TK 21	TK 21
Time	1128-1231	1325-1428	1512-1614	1128-1614
1. Stack Pressure				
Inches Hg	29.51	29.51	29.51	29.51
Millimeters Hg	749.65	749.63	749.67	749.65
2. Meter Pressure				
Inches Hg	29.56	29.64	29.63	29.61
Millimeters Hg	750.77	752.90	752.67	752.11
3. Meter Volume				
Dry Std Cubic Feet	28.677	43.915	43.124	116.018
Dry Std Cubic Meters	0.812	1.244	1.221	3.286
4. Water Volume				
Std Cubic Feet	3.460	5.338	5.022	13.820
Std Cubic Meters	0.098	0.151	0.142	0.391
5. Moisture Content, %	10.77	10.84	10.43	10.64
6. Molecular Weight Dry	29.82	29.68	29.41	29.64
7. Molecular Weight Wet	28.55	28.41	28.22	28.40
8. Stack Velocity				
Feet per Second	18.23	17.03	16.43	16.95
Meters per Second	5.56	5.19	5.01	5.17
9. Volumetric Flow				
Actual Cubic Ft per minute	5,546	5,180	4,997	5,156
Actual Cubic M per second	2.62	2.45	2.36	2.43
10. Volumetric Flow				
Dry Std Cubic Ft per minute	2,829	2,623	2,556	2,627
Dry Std Cubic M per second	1.34	1.24	1.21	1.24
11. Concentration				
Grains per Dry Std Cubic Ft	0.2321	0.2196	0.1434	0.1938
Grams per Dry Std Cubic M	0.5312	0.5026	0.3281	0.4435
12. Excess Air, %	119.54	204.20	262.75	182.90

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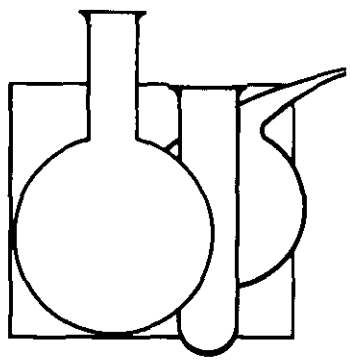
Computed Air Test Results for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/16/90	10/16/90	10/16/90	10/16/90
Location	TK 21	TK 21	TK 21	TK 21
Time	1128-1231	1325-1428	1512-1614	1128-1614
15. Particulate Mass Rate				
Pounds per Hour, #/hr	5.63	4.94	3.14	4.36
16. Volume at Nozzle				
Actual Cubic Feet	56.214	86.725	84.310	227.700
Actual Cubic Meters	1.592	2.456	2.388	6.448
17. Concentration				
Grains per Actual Cubic Ft	0.1184	0.1112	0.0733	0.0987
Grams per Actual Cubic M	0.2710	0.2545	0.1678	0.2260
18. Isokinetic, %	104.41	98.03	98.80	102.29

Sampling & Analytical Procedures



III. SAMPLING AND ANALYTICAL PROCEDURES

General

All sampling and analytical procedures for the determination of the particulate emissions from these sources were conducted in strict adherence with the Code of Federal Regulations, Title 40, Part 60, Appendix A, Methods 1-5 as amended. The sampling equipment used in these tests 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 sampling matrix. The dimension of the sample location (see **Figure 1**) indicated that 25 points would be required to sample this source. We sampled 25 points (5 x 5 matrix) for two and a half minutes at each point.

METHOD 2

Velocity measurements were taken using a properly calibrated S type pitot tube and a micro-manometer (0-0.25 inch scale) having 0.001 inch H_2O divisions on the 0 to 0.25 inch inclined scale was used due to the sufficient number of the low velocity pressures as specified in Method 2.

METHOD 3

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

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.

Sampling Techniques

From previous data about stack temperature, pressure, range of velocity heads, moisture content and stack gas dry molecular weight; 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. The nozzle (stainless steel 316 with an angle of taper of 30 degrees 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 place at each sampling point and 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 ^{0} 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 ^{0} 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 ^{0} 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 is lost. 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.

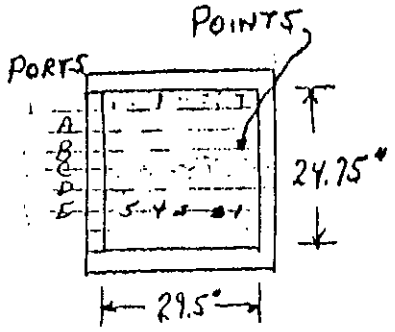
Analysis

The filters (Gelman, Class A, without organic binder, minimum 99.9% retention for particles of 0.3 microns as determined by DOP tests) were prepared for the field test by first heating for 2 hours 220 degrees F then desiccating at 68 $\pm$ 10 ^{0} 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. During each weighing the filter was not exposed to laboratory atmosphere for more than two (2) minutes and a relative humidity of less than fifty percent (50%).

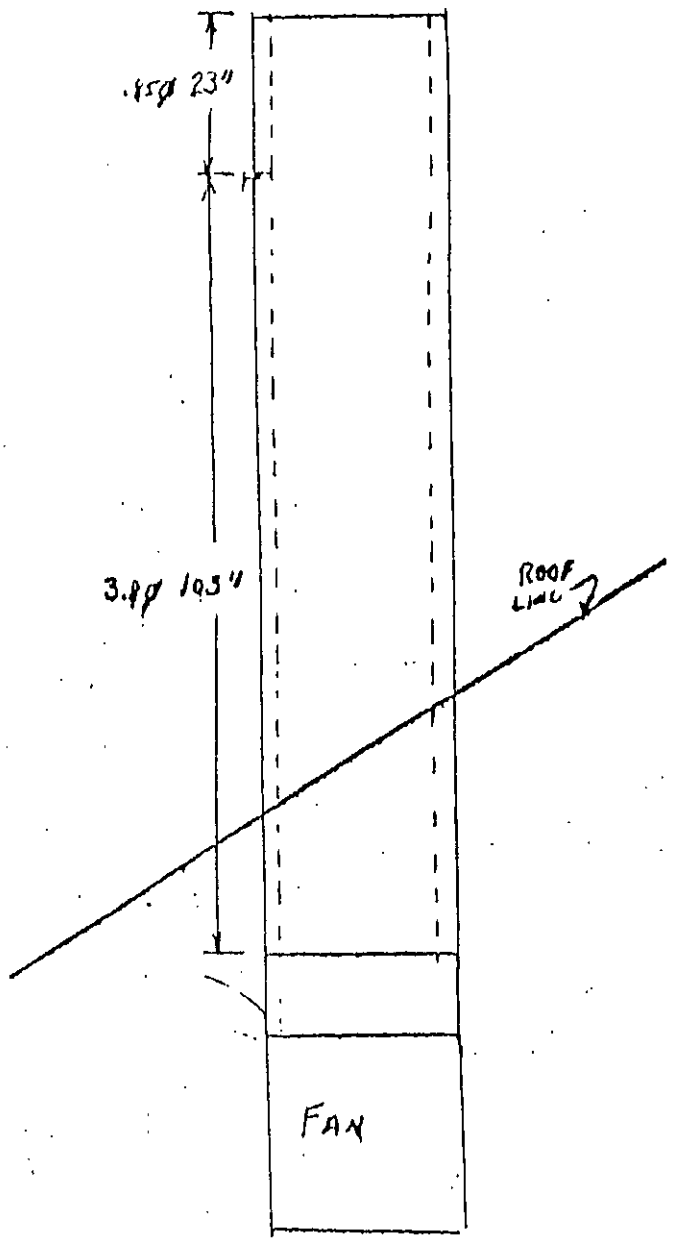
The acetone (reagent grade, 0.001% residue, in glass bottles) blank for the group of tests and the acetone rinses for each test were evaporated to dryness in tared glass beakers. They were then desiccated for twenty-four (24) hours and weighed to a constant weight as described above.

Stack Breeching Diagram
and
Sample Point Location

Point Number	Distance from wall (in.)
1	3.0
2	8.9
3	14.8
4	20.7
5	26.6

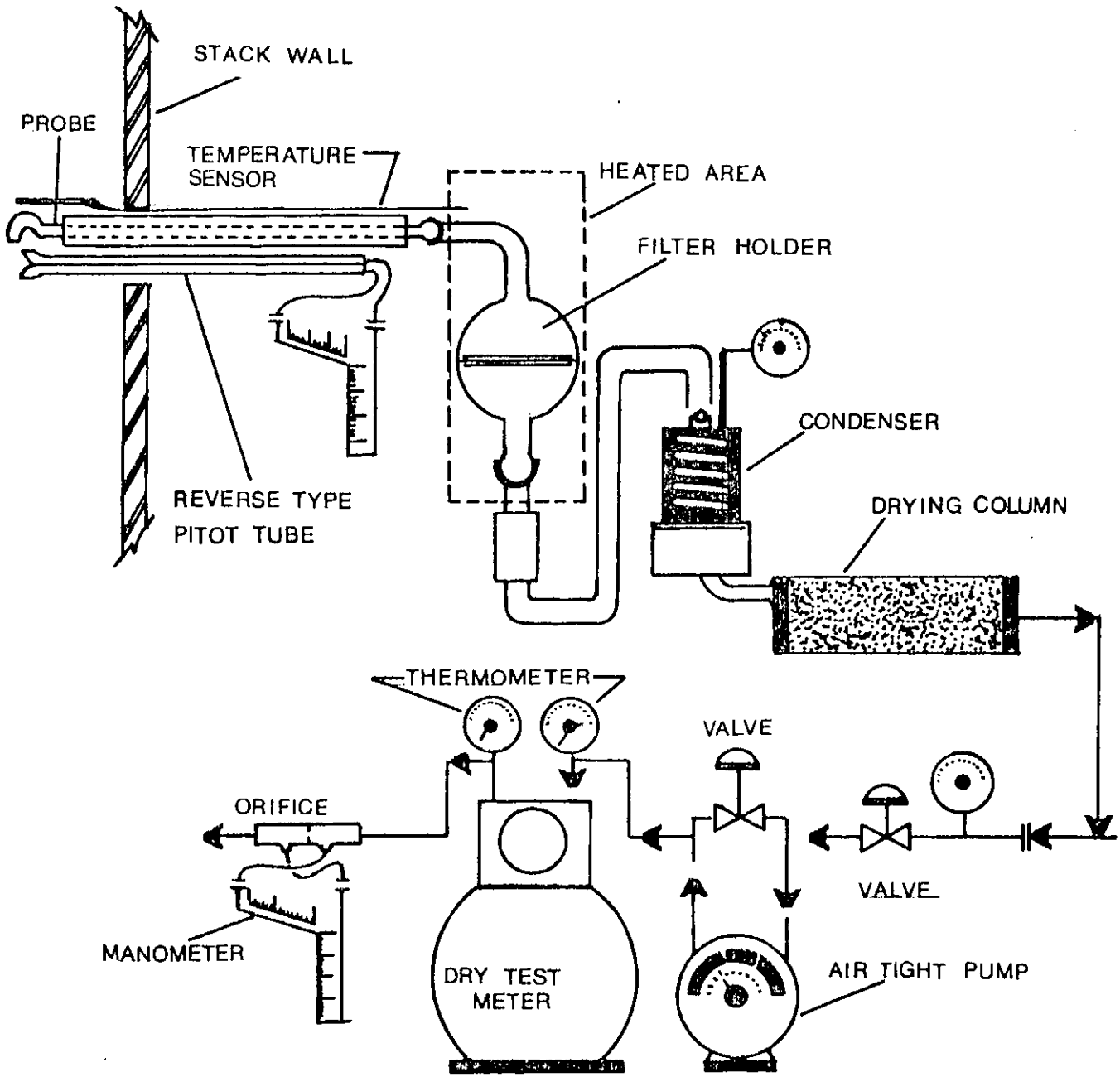


EQ. DIA. = 26.917"



NOT TO SCALE

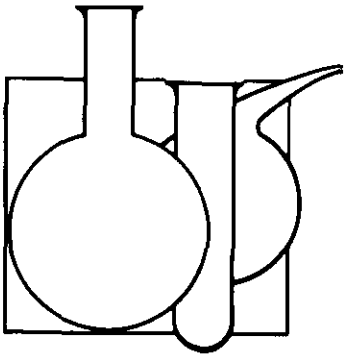
Figure 1



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)

C_a- Acetone blank residue concentration, mg/g

c_a - Particulate Concentration, ACF

CFM - Cubic feet per minute

C_p - Pitot tube coefficient, (dimensionless)

c_s- Particulate Concentration, grains/DSCF

Cso_2- Concentration of sulfur dioxide (dry basis) corrected at 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 $\frac{(lb/lb\text{-}mole)(in.Hg)}{(^0R)\ (in.\ H_2O)}$ 1/2

NOMENCLATURE - continued

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, 18.0g/g-mole(18.01lb/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 - $m^3/^0K$-g-mole (21.85 in. Hg-$ft^3/^0R$-lb-mole)

SCF - Standard Cubic Foot

ta - Ambient Temperature, ^0F

NOMENCLATURE - continued

tm - Average Temperature of meter, ^0F

t_s - Average Temperature of stack, ^0F

tstd - Standard Temperature, 68^0F

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 H measured for a specific orifice when operated under the following conditions: 0.75 cfm of dry air (M.W. = 29) at 68^0F, 29.92 in. Hg.

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

θ - Total Sampling time, min.

$\theta 1$ - Sampling time interval from the beginning of a run until the first component change, min.

θi - 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.

$$P_s = P_{b_{ar}} + \frac{P_g}{13.6}$$

2.

$$P_m = P_{b_{ar}} + \frac{\overline{\Delta H}}{13.6}$$

3.

$$V_m(std) = V_m Y \left(\frac{Tstd}{Tm}\right) \left(\frac{P_m}{Pstd}\right)$$

4.

$$V_w(std) = 0.04707 V_{1_c}$$

5.

$$B_{w_s} = \frac{V_w(std)}{V_m(std) + V_w(std)}$$

6.

$$M_d = 0.440(\%CO_2) + 0.320(\%0_2) + 0.280(\%N_2 + \%CO)$$

7.

$$M_s = M_d(1 - B_{w_s}) + 18(B_{w_s})$$

8.

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

EQUATIONS - Continued

9.

$$Q_a = (v_s)(A_s)(60)$$

10.

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

11.

$$c_s = [0.0154(Mn/Vmstd)]$$

12.

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

13.

$$c_{5_0} = c_s / 1 - \left[\frac{(1.5)(\%O_2) - 0.133(\%N_2) - 0.75(\%CO)}{21}\right]$$

14.

$$c_{1_2} = c_s \frac{12}{\%CO_2}$$

15.

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

16.

$$V_n = \frac{T_s}{P_s}\left[(0.002669)(V_{1_c}) + \frac{V_m}{T_m}(P_m)\right]$$

17.

$$C_a = (0.0154)(M_n)/V_n$$

18.

$$I = \frac{100 V_n}{60 v_s \theta A n}$$

19.

$$V_{m_c} = V_m - (L_p - L_a)\theta$$

20.

$$W_a = CaVawP_a$$

EQUATIONS

Run # 1

1. $P_s = P_{bar} + (P_g/13.6) = (29.51) + (.05)/13.6 = 29.51$

2. $P_m = P_{bar} + (\Delta H/13.6) = (29.51) + (0.65)/13.6 = 29.56$

3. $V_{m(std)} = V_m\ Y\ (T_{std}/T_m)(P_m/P_{std})$
$= (27.808)(1.0498)(528/531)(29.56/29.92) = 28.679$

4. $V_{w(std)} = 0.04707\ V_{lc} = 0.04707(73.5) = 3.460$

5. $B_{ws} = V_{w(std)}/(V_{m(std)} + V_{w(std)}) = (3.460)/(3.460 + 28.679) = .1077$

6. $M_d = 0.44\ \%CO_2 + 0.32\ \%O_2 + 0.28(\%N_2 + \%CO) =$
$.44(8.5) + .32(11.5) + .28(80) = 29.82$

7. $M_s = M_d\ (1-B_{ws}) + 18(B_{ws}) = (29.82)(1-.1077) + 18(.1077) = 28.55$
.8923

8. $v_s = K_pC_p\ (\sqrt{\Delta p}\ \sqrt{(T_s/(M_sP_s))}$
$= 85.49(.858)(.239)\sqrt{(910/(28.55)(29.51))} = 18.23$

9. $Q_a = v_s\ A_s\ (60) = (18.23)(5.070)(60) = 5546$

$\frac{24.75 \times 29.5}{.44} = 5.070$

10. $Q_s = Q_a(1-B_{ws})(528/T_s)(P_s/29.92)$
$= (5546)(1-.1077)(528/911)(29.51/29.92) = 2829$
.8923

11. $c_s = 0.0154(M_n/V_{m(std)}) = 0.0154(432.3/28.679) = .2321$

15. $PMR = c_sQ_s(60/7000) = (.2321)(2829)(60/7000) = 5.63$

16. $\dot{V}_n = T_s/P_s \times \{(0.002669)V_{lc} + V_mP_m/T_m\}$
$= (910/29.51)\{(0.002669)(73.5) + (27.808)(29.56)/(531)\}$ 1.0498
$= 56.163$

18. $I = V_n(100)/\{(60)\theta v_s A_n\} = 100(56.163)/\{60(62.5)(18.23)(.000787)\}$
$=$
104.39

$\left(\frac{.350}{24}\right)^2 \pi =$

FIELD DATA SHEET

PLANT Gil Shell RUN # 1

LOCATION TK 21 DATE 10-16-90

BARO. PRES. 29.51 TIME 1128 - 1231 Local Time

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
Port A			350.097	(1)	(2)	(3)		(4)	(5)			
1	2.5	2.5	351.1	450	60	60	60	32	253	.71	.065	—
2		5.0	352.6	452	63	61	62	34	254	1.04	.095	1.5
3		7.5	~~353.0~~ 353.7	451	63	61	62	34	252	0.85	.078	1.0
4		10.0	354.7	449	63	61	62	34	252	.36	.033	—
5		12.5	355.5	450	65	61	63	34	253	.33	.030	—
Port B 1		15.0	356.7	451	66	61	64	34	253	.77	.070	1.0
2		17.5	357.6	451	68	62	65	34	252	.38	.035	—
3		20.0	358.5	454	70	64	67	34	251	.41	.037	—
4		22.5	359.7	454	71	65	68	34	251	.62	.056	1.0
5		25.0	360.9	454	72	65	68	33	250	.61	.055	1.0
Port C 1		27.5	361.8	451	73	66	70	33	250	.77	.070	2.0
2		30.0	362.8	449	73	66	70	33	247	.44	.040	—
3		32.5	363.6	451	74	66	70	34	248	.39	.035	—
4		35.0	364.8	451	73	67	70	34	251	.69	.062	2.0
5		37.5	366.0	450	75	67	71	34	252	.67	.060	2.0
Port D 1		40.0	366.9	450	76	68	72	34	249	.44	.035	1.0
2		42.5	368.1	451	77	68	72	34	249	.78	.070	3.0
3		45.0	369.3	452	80	70	75	34	249	.73	.065	3.0
4		47.5	370.4	451	80	70	75	33	246	.69	.062	3.0
5		50.0	371.5	450	81	71	76	33	247	.58	.052	2.0
Port E		52.5	372.9	442	82	72	77	35	248	.84	.075	3.2
2		55.0	374.0	445	83	73	78	35	248	.76	.067	3.0
3		57.5	375.4	447	84	74	79	33	248	.85	.075	3.5
4		60.0	376.1	447	84	74	79	33	248	.91	.080	4.0
5		62.5	377.905	449	85	75	80	35	249	.68	.060	3.5
6		[illegible]	37.128 ✓	[illegible] ✓			70 ✓			.65 ✓	.239 ✓	4.0
				451 ADS			71 ADS.					

STATIC PRESSURE "H2o +.01

PROBE TIP SIZE

BEFORE	AFTER
.380	.380
.380	.380
.380	.380

WATER

#12

ml. 70

gram 3.5

Total 73.5

OPERATOR

LOT 2 / I Sort

Sample Box No. 1

Meter Box No. 200

Meter ΔH@ 1.74

Pitot, CP .858

Temp. Device SH

Probe No. 4-1

Probe Liner Glass

Probe Htr. Set 35

Ambient Temp. 45

% O_2 11.0 / 12.

% CO_2 9.0 / 8.0

NOTES

Orifice ✓

Pitot ✓

Meter ✓ .025

.05 .36

K = 19.080

micro manometer

377.980
377.970
.010 @ 5 [illegible]

R .06 ✓ S .04 ✓

G-1

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.

BOX 300
LEEDS, ALABAMA 35094

PLANT Gad Shale RUN # 2
LOCATION TK#21 DATE 10-16-90
BARO. PRES. 29.51 TIME 1326-1428

	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
Pre E			379.125	(1)	(2)	(3)		(4)	(5)			
1	2.5	2.5	380.9	452	85	82	84	33	228	2.28	.065	1.0
2		5.0	383.2	449	85	83	84	33	228	2.46	.070	2.5
3		7.5	385.3	455	87	83	85	35	242	2.81	.080	3.0
4		10.0	387.5	455	90	83	86	35	247	2.64	.075	3.0
5		12.5	389.3	452	92	84	88	36	252	1.95	.055	2.5
Pre B 1		15.0	390.4	457	93	84	88	35	258	2.64	.075	4.0
2		17.5	393.2	457	94	84	89	35	256	1.94	.055	3.0
3		20.0	394.8	458	95	85	90	35	256	1.24	.035	2.0
4		22.5	396.4	459	95	85	90	35	254	1.59	.045	2.5
5		25.0	398.5	459	95	85	90	36	254	1.66	.047	3.0
Pre 1		27.5	400.4	455	94	85	90	36	257	2.12	.060	4.0
2		30.0	401.7	456	94	85	90	37	257	1.24	.035	3.0
3		32.5	403.1	457	95	85	90	37	258	0.88	.025	2.4
4		35.0	404.8	460	95	85	90	37	255	1.76	.050	4.5
5		37.5	406.8	461	94	86	90	36	258	1.58	.045	4.0
Pre B 1		40.0	408.5	459	95	86	90	37	254	2.65	.075	8.0
2		42.5	410.4	459	97	87	92	38	254	2.29	.065	7.2
3		45.0	412.3	459	97	87	92	38	254	1.76	.050	6.0
4		47.5	414.2	461	98	87	92	37	255	1.95	.055	6.2
5		50.0	416.2	457	99	88	94	38	257	1.77	.050	6.4
Pre A 1		52.5	417.6	455	99	88	94	38	255	1.78	.050	6.4
2		55.0	419.2	454	100	90	95	38	257	1.25	.035	5.5
3		57.5	420.7	455	100	90	95	37	258	1.14	.032	5.0
4		60.0	421.9	452	99	89	94	37	258	0.64	.018	3.0
5		62.5	423.189	448	99	89	94	37	257	0.79	.022	3.5
15		62.5	44.064	456			95			1.79	.222	8.0
				457 ADT			91 ADS					

STATIC PRESSURE "H2o: +.04

PROBE TIP SIZE

BEFORE	AFTER
.504	.504
.504	.504
.504	.504

WATER
#7
ml. 105
gram 8.4
Total 113.4

OPERATOR
LOTZ/ISOM

Sample Box No. 1
Meter Box No. 200
Meter ΔH@ 1.74
Pitot, CP .858
Temp. Device SUT
Probe No. 4'-1
Probe Liner Glass
Probe Htr. Set 75
Ambient Temp. 69
% O_2 16 / 12
% CO_2 5 / 9

NOTES
.05 = 1.71
Orifice
Pitot ✓✓
Meter @25"
K = 58.915

423.256
423.250
.006 @9" Hg
1 min

R = .03
S = .10

FIELD DATA SHEET

PLANT Gulf Shore RUN # 3

LOCATION TK#21 DATE 10-16-90

BARO. PRES. 29.51 TIME 1512-1614

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
Port A			423.572	(1)	(2)	(3)		(4)	(5)			
1	2.5	2.5	425.0	449	79	79	79	33	238	1.29	.037	—
2		5.0	426.7	449	78	80	79	33	262	1.75	.055	—
3		7.5	428.5	451	80	80	80	34	263	1.71	.049	—
4		10.0	429.7	450	82	80	81	34	263	0.70	.020	—
5		12.5	430.8	441	84	80	82	33	265	0.60	.017	—
Port B 1		15.0	433.4	451	84	80	82	33	265	2.88	.082	3.2
2		17.5	434.9	452	86	80	83	36	264	1.75	.050	2.0
3		20.0	436.0	455	89	81	85	35	264	1.72	.049	2.0
4		22.5	438.8	455	90	82	86	35	261	1.90	.054	2.1
5		25.0	440.0	463	91	82	86	35	259	1.78	.051	2.0
Port C 1		27.5	442.2	456	92	83	88	35	261	2.04	.058	2.3
2		30.0	443.3	455	92	83	88	34	258	.67	.019	—
3		32.5	444.6	455	92	84	88	34	260	.85	.024	—
4		35.0	446.3	456	92	84	88	34	258	1.45	.041	1.5
5		37.5	448.5	455	92	84	88	36	259	1.73	.049	2.0
Port D 1		40.0	449.7	455	92	84	88	36	260	1.66	.047	2.0
2		42.5	451.6	452	93	86	90	39	259	1.63	.046	2.0
3		45.0	453.4	450	92	85	88	37	257	1.60	.045	2.0
4		47.5	455.0	447	92	85	88	37	262	1.53	.043	2.0
5		50.0	456.4	449	92	86	89	37	262	1.49	.042	2.0
Port E 1		52.5	458.6	456	93	86	90	36	259	1.84	.052	2.2
2		55.0	460.2	439	94	87	90	38	255	2.02	.056	2.5
3		57.5	462.4	443	95	87	91	38	255	2.35	.065	3.2
4		60.0	464.5	445	96	88	92	39	258	2.59	.072	3.5
5		62.5	466.541	444	97	89	93	40	257	2.20	.061	3.0
25		62.5	42.969 ✓	451 ✓			86 ✓			1.67 ✓	.214 ✓	3.5 ✓
				452 ADJ			87 ADJ					

STATIC PRESSURE "H2o: +.06

PROBE TIP SIZE

BEFORE	AFTER
.504	.504
.504	.504
.504	.504

WATER

#12

ml. 95

gram 11.7

Total 106.7

OPERATOR

LOTZ / ISONG

Sample Box No. 1

Meter Box No. 200

Meter ΔH@ 1.74

Pitot, CP .858

Temp. Device [illegible]

Probe No. 4'-1

Probe Liner GLASS

Probe Htr. Set 65

Ambient Temp. 67

% O_2 14.5 / 16

% CO_2 6 / 4

NOTES

Orifice

Pitot

Meter @25

466.588
466.580
.008 @ 4" Hg

R - .15 ✓

S - .21 ✓

G-1

G U A R D I A N * S Y S T E M S * I N C O R P O R A T E D
P.O. BOX 190
LEEDS, AL 35094
205-699-6647

Blank Analytical Data

Plant: General Shale Products Corporation

Sample location: TK 21

Relative humidity: 35%

Type of blank: Acetone

Liquid level at mark and container sealed: Yes

Density of blank: 0.7899 g/ml

Blank Volume 250 ml

Date & time of wt.:	10/25/90	0900	Gross wt.	106198.3 mg
Date & time of wt.:	11/1/90	0800	Gross wt.	106198.7 mg
			Average Gross wt.	106198.5 mg
			Tare wt.	106197.6 mg
			Weight of blank	0.90 mg
Concentration of Blank		0.0046 mg/g		0.0005% of weight

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

Remarks: _____

_____

Signature of analyst: _____

Signature of reviewer: _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Gen'l Shore Sample date: 10/16/90

Sample location: TK 21 Run no.: 1

Sample recovery person: LOTZ Recovery date: 10/16/90

Filter(s) no.: E-2

MOISTURE

Impingers			Silica gel #12		
Final volume (wt)	70	ml (gm)	Final wt.	1003.0 g	g
Initial volume (wt)	0	ml (gm)	Initial wt.	999.5 g	g
Net volume (wt)	70	ml (gm)	Net wt.	3.5 g	g

Total moisture 73.5 g

Color of silica gel mixed

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. R #1 sealed ✓

Description of particulate on filter ~~DRK~~ DARK BROWN

Acetone rinse container no. R #1 Liquid level marked ✓

Acetone blank container no. BLANK Liquid level marked ✓

Samples stored and locked ✓

Remarks:

Date of laboratory custody NA

Laboratory personnel taking custody COTR

Remarks:

G U A R D I A N * S Y S T E M S * I N C O R P O R A T E D
P.O. BOX 190
LEEDS, AL 35094
205-699-6647

Method 5 Analytical Particulate Data

Plant: General Shale Produc Run Number: 1

Sample location: TK 21

Relative humidity: 35%

Density of Acetone: 0.7899 g/ml

Liquid level at mark and container sealed: Yes
Filter marked and container sealed: Yes

Acetone rinse container number: 1
Acetone rinse volume 175 ml
Acetone blank residue concentration: 0.0046 mg/g
Acetone blank weight 0.6 mg

ACETONE RINSE WEIGHT

Date & time of wt.:	10/25/90	0900	Gross wt.	100649.1 mg
Date & time of wt.:	11/1/90	0800	Gross wt.	100649.4 mg
			Average Gross wt.	100649.3 mg
			Tare wt.	100508.4 mg
			Less weight of acetone blank	0.6 mg
			Weight of particulate in acetone rinse	140.2 mg

PARTICULATE WEIGHT

Filter(s) container number: 1

Date & time of wt.:	10/25/90	0900	Gross wt.	460.9 mg
Date & time of wt.:	10/25/90	0800	Gross wt.	460.6 mg
			Average Gross wt.	460.8 mg
			Tare wt.	168.7 mg
			Weight of particulate on filter (s)	292.1 mg
			Weight of particulate in acetone rinse	140.2 mg
			TOTAL WEIGHT OF PARTICULATE	432.3 mg

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

Remarks: _____

Signature of analyst: _____

Signature of reviewer: _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: General Shale Sample date: 10/16/90
Sample location: TE-21 Run no.: 2
Sample recovery person: LJ72 Recovery date: 10/16/90
Filter(s) no.: E-5

MOISTURE

Impingers			Silica gel #7		
Final volume (wt)	105	ml(gm)	Final wt.	975.0 g	g
Initial volume (wt)	0	ml(gm)	Initial wt.	967.2 g	g
Net volume (wt)	105	ml(gm)	Net wt.	8.4 g	g

Total moisture 113.4 g
Color of silica gel Mixed
Description of impinger water ~~[illegible]~~ Clear

RECOVERED SAMPLE

Filter container no. R#7 sealed ✓
Description of particulate on filter DARK BROWN

Acetone rinse container no. R#2 Liquid level marked ~~[illegible]~~ ✓
Acetone blank container no. Liquid level marked
Samples stored and locked ✓
Remarks:

Date of laboratory custody ✓
Laboratory personnel taking custody ✓
Remarks:

G U A R D I A N * S Y S T E M S * I N C O R P O R A T E D
P.O. BOX 190
LEEDS, AL 35094
205-699-6647

Method 5 Analytical Particulate Data

Plant: General Shale Produc Run Number: 2

Sample location: TK 21

Relative humidity: 35%

Density of Acetone: 0.7899 g/ml

Liquid level at mark and container sealed: Yes
Filter marked and container sealed: Yes

Acetone rinse container number: 2
Acetone rinse volume 175 ml
Acetone blank residue concentration: 0.0046 mg/g
Acetone blank weight 0.6 mg

ACETONE RINSE WEIGHT

Date & time of wt.:	10/25/90	0900 Gross wt.	102690.9 mg
Date & time of wt.:	11/1/90	0800 Gross wt.	102690.8 mg
		Average Gross wt.	102690.9 mg
		Tare wt.	102534.8 mg
		Less weight of acetone blank	0.6 mg
		Weight of particulate in acetone rinse	155.4 mg

PARTICULATE WEIGHT

Filter(s) container number: 2

Date & time of wt.:	10/25/90	0900 Gross wt.	640.6 mg
Date & time of wt.:	10/25/90	1600 Gross wt.	640.2 mg
		Average Gross wt.	640.4 mg
		Tare wt.	169.5 mg
		Weight of particulate on filter (s)	470.9 mg
		Weight of particulate in acetone rinse	155.4 mg
		TOTAL WEIGHT OF PARTICULATE	626.3 mg

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

Remarks: _____

Signature of analyst: _____

Signature of reviewer: _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Gaul Shale Sample date: 10/16/90

Sample location: TK21 Run no.: 3

Sample recovery person: CCT2 Recovery date: 10/16/90

Filter(s) no.: E-3

MOISTURE

Impingers			Silica gel #12		
Final volume (wt)	95	ml (gm)	Final wt.	981.7 g	g
Initial volume (wt)	0	ml (gm)	Initial wt.	970.0 g	g
Net volume (wt)	95	ml (gm)	Net wt.	11.7 g	g

Total moisture 106.7 g

Color of silica gel mixed

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. Run #3 sealed ✓

Description of particulate on filter DARK BROWN

Acetone rinse container no. Run #3 Liquid level marked ✓

Acetone blank container no. Liquid level marked

Samples stored and locked ✓

Remarks:

Date of laboratory custody ✓

Laboratory personnel taking custody CCT2

Remarks:

G-6

G U A R D I A N * S Y S T E M S * I N C O R P O R A T E D
P.O. BOX 190
LEEDS, AL 35094
205-699-6647

Method 5 Analytical Particulate Data

Plant: General Shale Produc Run Number: 3

Sample location: TK 21

Relative humidity: 35%

Density of Acetone: 0.7899 g/ml

Liquid level at mark and container sealed: Yes
Filter marked and container sealed: Yes

Acetone rinse container number: 3
Acetone rinse volume 125 ml
Acetone blank residue concentration: 0.0046 mg/g
Acetone blank weight 0.4 mg

ACETONE RINSE WEIGHT

Date & time of wt.:	10/25/90	0900	Gross wt.	96662.5 mg
Date & time of wt.:	11/1/90	0800	Gross wt.	96662.1 mg
			Average Gross wt.	96662.3 mg
			Tare wt.	96573.6 mg
			Less weight of acetone blank	0.4 mg
			Weight of particulate in acetone rinse	88.3 mg

PARTICULATE WEIGHT

Filter(s) container number: 3

Date & time of wt.:	10/25/90	0900	Gross wt.	485.1 mg
Date & time of wt.:	10/25/90	1600	Gross wt.	485.3 mg
			Average Gross wt.	485.2 mg
			Tare wt.	172.0 mg
			Weight of particulate on filter (s)	313.2 mg
			Weight of particulate in acetone rinse	88.3 mg
			TOTAL WEIGHT OF PARTICULATE	401.5 mg

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

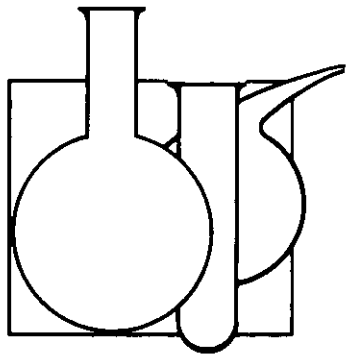
Remarks: _____

_____

Signature of analyst: _____

Signature of reviewer: _____

Plant Operation Data



PROCESS INFORMATION

PLANT: Glasgow, VA - 21 DATE: October 16, 1990

Brick Rate:

Car Schedule	=	48	Minutes	=	1.25	Cars/Hour
Car Count	=	2,380	S/S Brick/Car			
Hourly Rate	=	2,975	S/S Brick/Hour			
Brick Weight	=	5.40	Lbs.			
Brick Rate	=	16,065	Lbs./Hour			

Fuel Rate:

Total	=	30.9	Therms/M Brick			
Coal	=	8.94	Tons/Day			
		745	Lbs./Hour	=	92	% of Btu's
Natural Gas	=	22	MCF/Day			
		916	Cu. Ft./Hour	=	8	% of Btu's

Total Process Weight:

	16,065	Lbs. Brick/Hour
+	745	Lbs. Coal/Hour
	16,810	Total Lbs./Hour
	8.41	Tons/Hour

Coal Analysis:

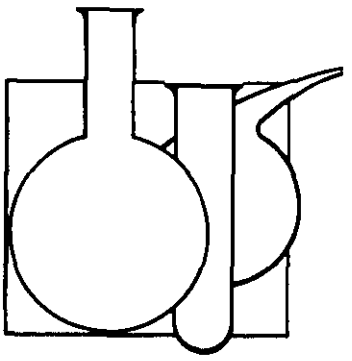
See Attached	Btu/Lb.	
	Sulfur	
	Ash	

Allowable Emissions:

New Source Process Weight Formula: 17.1 Lbs./Hour

(Permit: 16.66 Lbs./Hour)

Calibrations



VI. CALIBRATIONS

Meter Box

The meter box shall be initially calibrated every 6 months at the fixed settings of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, and 5.0 inches of H_2O. 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 shall be the closest point to the initial calibration (for an average meter pressure of 1.37 a 1.50 inches H_2O was used as the recalibration point). These recalibrations produced a single point MCF and a ^H@ which shall be compared to the original calibration to see if they are within the 5% allowed at the highest vacuum seen. These recalibration sheets are located behind the original calibration sheets.

Pitot Tubes

The S type pitot tubes are calibrated against a standard pitot tube (Cp=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 tube is measured as to its specifications and alignment. Upon return, the intercomponent spacings and the face opening alignment of the pitot tube assembly were rechecked and if no changes are noticed; it shall be assumed that the coefficient of the assembly had not changed.

Temperature Measurements

All temperature devices (impinger, meter box, hot box and stack) are 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.

Barometric Pressure

An aneroid barometer capable of measuring atmospheric pressure to within 0.1 inches Hg was 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	4-1
Meter Box:	#200
Stack Temperature:	Omega II
Sample Box	#1
Condenser	#1

The average stack temperature was 453 ^{0}F. The Omega II was recalibrated at 450 ^{0}F and agreed within 1.5% of the initial calibration value. The intercomponent spacing and the face opening alignment of the Pitot Tube assembly was rechecked and no changes were noticed; therefore, it was assumed that the coefficient of the assembly 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:

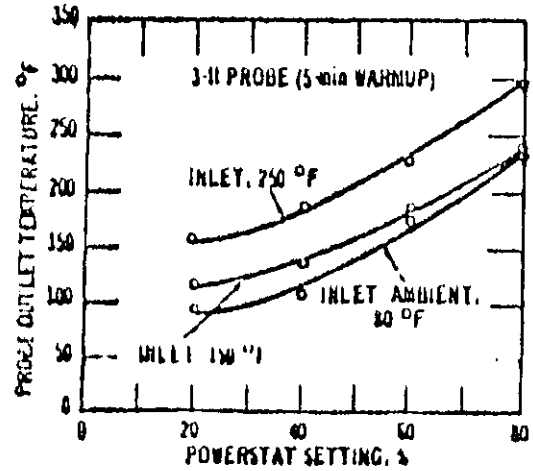
BSO	522	Flow Resistance (Max.) @ 320 cm/min.	80 mm
*pH	9.0	Flow Rate (air) lpm/cm² @ 70 cm Hg	60
DOP @320/cm/min ASTM Methods 2986)	99.9%	Max. Use Temp.	400°C
Tensile Strength (Fed. Spec. UUP31B)	600 gr.	Static Properties	Medium
Weight 8"x10"sheet	4.0±.3 gr.	Ability to Fold	Good

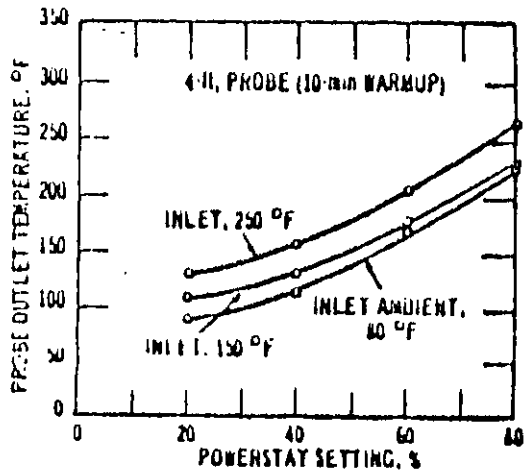
WATER EXTRACTABLE IONS:

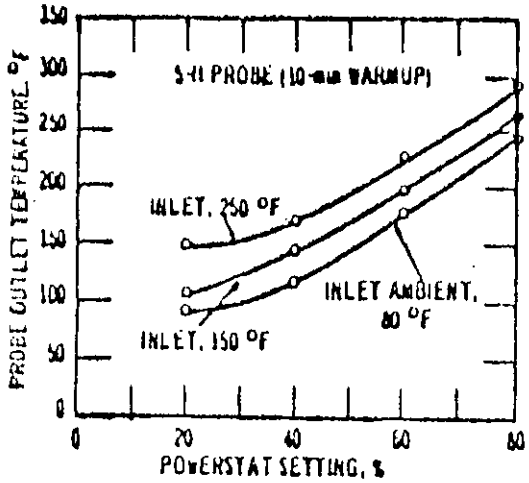
Sulfate	600	Chloride	1500
Nitrate	115	Fluoride	87
Ammonia	13		

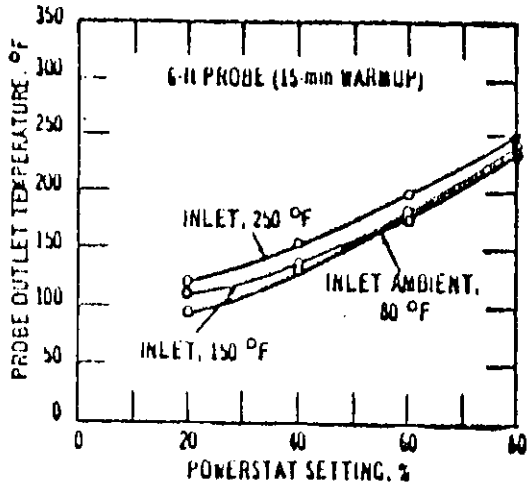
*pH—Gelman Procedure:

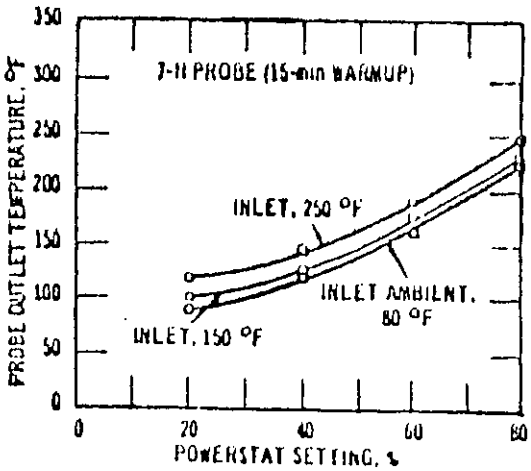
A. 500 ml distilled water.
B. Add 15 drops saturated KCl solution.
C. Shread one 8"x10" sheet and soak in prepared water for one hour.
D. Run pH at ambient temperature.











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 200
on 8/15/90

Run Number	1	2	3	4	5
Barometric Pres, in Hg	29.56	29.56	29.56	29.56	29.56
Orifice pres drop, in H20	0.5	1.0	1.5	2.0	2.5
Pres Wet Test Meter, in H20	-0.30	-0.50	-0.70	-0.90	-1.00
Gas Volume Wet Init, CF	0.000	6.792	15.543	25.925	37.737
Gas Volume Wet Final, CF	6.792	15.543	25.925	37.737	50.764
Gas Volume Dry Init, CF	144.933	151.457	159.965	170.154	181.843
Gas Volume Dry Final, CF	151.457	159.965	170.154	181.843	194.802
Temp Wet Init, C	24.4	24.2	24.1	24.0	23.7
Temp Wet Final, C	24.2	24.1	24.0	23.7	23.6
Dry Gas Temp Init In, F	81	87	96	100	102
Dry Gas Temp Final In, F	87	96	100	102	103
Dry Gas Temp Init Out, F	80	83	89	93	94
Dry Gas Temp Final Out, F	83	89	93	94	95
Run Time, sec	970	900	900	900	900
Meter Calibration Factor, Y	1.0526	1.0501	1.0498	1.0451	1.0412
Average Y	1.0478				
Qm	0.4238	0.5927	0.7086	0.8090	0.8931
Km	0.7546	0.7435	0.7230	0.7136	0.7045
Average Km	0.7278				
Delta H@	1.62	1.67	1.76	1.81	1.86
Average H@	1.74				

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GUARDIAN SYSTEMS INC
Recalibration of Meter Box 200
on 10/23/90

Run Number	1	2	3	Average
Barometric Pres, in Hg	29.67	29.67	29.67	29.67
Orifice pres drop, in H20	1.5	1.5	1.5	1.50
Pres Wet Test Meter, in H20	-0.70	-0.70	-0.70	-0.70
Gas Volume Wet Init, CF	0.000	9.960	19.943	29.903
Gas Volume Wet Final, CF	9.960	19.943	29.931	59.834
Gas Volume Dry Init, CF	751.219	761.431	771.743	2284.393
Gas Volume Dry Final, CF	761.431	771.743	782.166	2315.340
Temp Wet Init, C	17.5	17.5	17.5	17.5
Temp Wet Final, C	17.5	17.5	17.5	17.5
Dry Gas Temp Init In, F	105	109	110	108
Dry Gas Temp Final In, F	109	110	115	111
Dry Gas Temp Init Out, F	95	96	98	96
Dry Gas Temp Final Out, F	96	98	100	98
Run Time, sec	900	900	900	2700
Meter Calibration Factor, Y	1.0400	1.0359	1.0300	1.0353
Qm	0.7008	0.7043	0.7072	0.7041
Km	0.7134	0.7160	0.7177	0.7157
Delta H@	1.81	1.80	1.79	1.80

Previous Y	1.0498	% Difference	1.38%
Previous H@	1.76	% Difference	-2.16%

Project Gard State Stack TK 21

SIGNATURE [signature]

GUARDIAN SYSTEMS INC
Temperature Calibration for Omega II
on 5/18/90

Actual Temperature, F	Reading Temperature, F	Correction in Reading, F
-50	-52	2
0	-1	1
50	46	4
100	97	3
150	149	1
200	200	0
250	250	0
300	301	-1
350	348	2
400	400	0
450	448	2
500	500	0
550	549	1
600	598	2
650	648	2
700	698	2
750	748	2
800	798	2
850	848	2
900	899	1
950	949	1
1000	1000	0

SIGNATURE Tom E. Gramlin

GUARDIAN SYSTEMS INC
Temperature Calibration for Impingers
on 5/18/90

Device	Actual Temperature, F	Reading Temperature, F	Correction in Reading, F
Impinger 1	40	40	0
	50	50	0
	90	90	0
Impinger 2	40	40	0
	50	50	0
	90	90	0
Impinger 3	40	40	0
	50	50	0
	90	90	0
Impinger 4	40	40	0
	50	50	0
	90	90	0
Impinger 5	40	40	0
	50	50	0
	90	90	0
Impinger 6	40	40	0
	50	50	0
	90	90	0
Impinger 7	40	40	0
	50	50	0
	90	90	0
Impinger 8	40	40	0
	50	50	0
	90	90	0

SIGNATURE Tom E. Franklin

GUARDIAN SYSTEMS INC
Temperature Calibration for Hot Boxes
on 5/18/90

Device	Actual Temperature, F	Reading Temperature, F	Correction in Reading, F
Hot Box 1	225	225	0
	250	250	0
	275	275	0
Hot Box 2	225	225	0
	250	250	0
	275	275	0
Hot Box 3	225	225	0
	250	250	0
	275	275	0
Hot Box 4	225	225	0
	250	250	0
	275	275	0
Hot Box 5	225	225	0
	250	250	0
	275	275	0
Hot Box 6	225	225	0
	250	250	0
	275	275	0
Hot Box 7	225	225	0
	250	250	0
	275	275	0
Hot Box 8	225	225	0
	250	250	0
	275	275	0

SIGNATURE Tom E. Gaul

GUARDIAN SYSTEMS INC
Pitot Calibration Form

Date: 5/15/90 Probe #: 4-1

Calibrated By: Morris/Gravlee Average Velocity, f/m 2,901

Side A

Run #	Pstd	Ptype s	Cp(s)	Deviation
1	0.53	0.71	0.855	0.000
2	0.53	0.71	0.855	0.000
3	0.53	0.71	0.855	0.000

Avg Cp = 0.855 Avg = 0.000

Is average deviation less than or equal to 0.01? YES

Side B

Run #	Pstd	Ptype s	Cp(s)	Deviation
1	0.53	0.70	0.861	0.000
2	0.53	0.70	0.861	0.000
3	0.53	0.70	0.861	0.000

Avg Cp = 0.861 Avg = 0.000

Is average deviation less than or equal to 0.01? YES

Is average PCF equal to or less than 0.01 YES

Average PCF = 0.858

SIGNATURE Tony E. Gravlee