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/

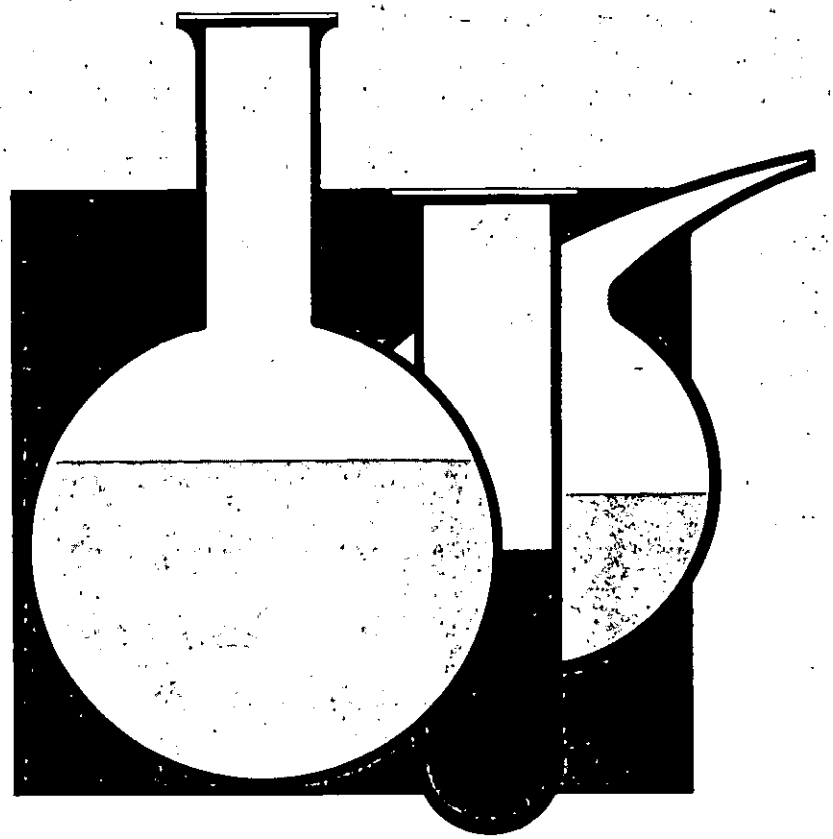
The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP42 Section:	11.3
Reference:	13
Title:	Mass Emission Tests Conducted On The Tunnel Kiln #6B And #28 In Marion, VA, For General Shale Products Corporation, Guardian Systems, Inc., Leeds, AL, October 1990.

AP-42 Section 11.3
Reference 13

GUARDIAN SYSTEMS INC.

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



Test Report

MASS EMISSION TESTS

CONDUCTED ON THE

TUNNEL KILN #6B, and #28

IN

MARION, VIRGINIA

FOR

GENERAL SHALE PRODUCTS CORPORATION

ON

OCTOBER 17-19, 1990

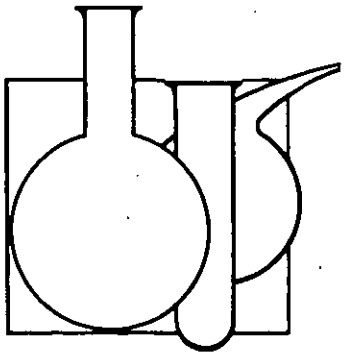
APPROVED BY _____

Tom Lotz
Director, Field Services

TABLE OF CONTENTS

Chapter		Page
I	**Introduction and Process Description**	1
II	**Discussion of Test Results**	2
	Tables	
	1 Summarized Results TK 6B	3
	2 Summarized Results TK 28	5
	Graph	
	1 Mass Emissions TK 6B	4
	2 Mass Emissions TK 28	6
	Computer Input & Complete Results TK 6B	7
	Computer Input & Complete Results TK 28 .	10
III	**Sampling and Analytical Procedures**	13
	Figures	
	1 Stack Breeching Diagram and Sample Point Location TK 6B . . .	16
	2 Stack Breeching Diagram and Sample Point Location TK 28	17
	3 Particulate Sampling Train	18
IV	**Field Data**	
	Nomenclature	19
	Equations	23
	Hand Calculations	26
	Data Sheets	27
	Particulate Analysis	36
V	**Plant Operational Data**	
	Process Information	50
	Coal Analysis	52
V	**Calibrations**	53

Introduction



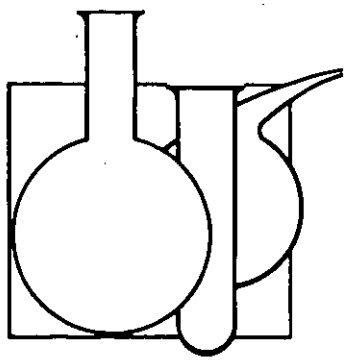
I. INTRODUCTION AND TEST DESCRIPTION

On October 17-19, 1990, Guardian Systems, Inc., performed a series of particulate emissions test on the General Shale Products Tunnel Kilns #6B and #28 located near Marion, 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 4'0" x 7'6" - 6B and 10'2"-28). 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 kiln at a slow, methodical pace requiring several days for the complete travel. By means of a coal and natural gas firing process, heat is increased in each chamber 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 are responsible for all production data. Mr. Mike Stacy, the Plant Manager, was responsible for the operation of the plant. Mr. Daryl Addison, Department of Air Pollution Control, Commonwealth of Virginia observed the tests, while Mr. John Charles Dickson of the same office, read the visual emissions during the tests. Mr. Tom Lotz and Mr. Emmanuel Isong of Guardian Systems, Incorporated, performed these test.

Test Results



II. SUMMARY OF TEST RESULTS

Tables 1 and 2 are summaries of the test results for the Tunnel Kilns #6B and #28. The allowable emission rate (see Operational Data) was determined using the following equation:

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

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

Tunnel Kiln	#6B	#28
Allowable Emission lbs per hour	8.50	21.64
Permit limit, lbs per hour	7.125	19.86
Actual Emissions lbs per hour	4.79	7.02
% of Allowables	56	32
% of Permit Limit	67	35

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

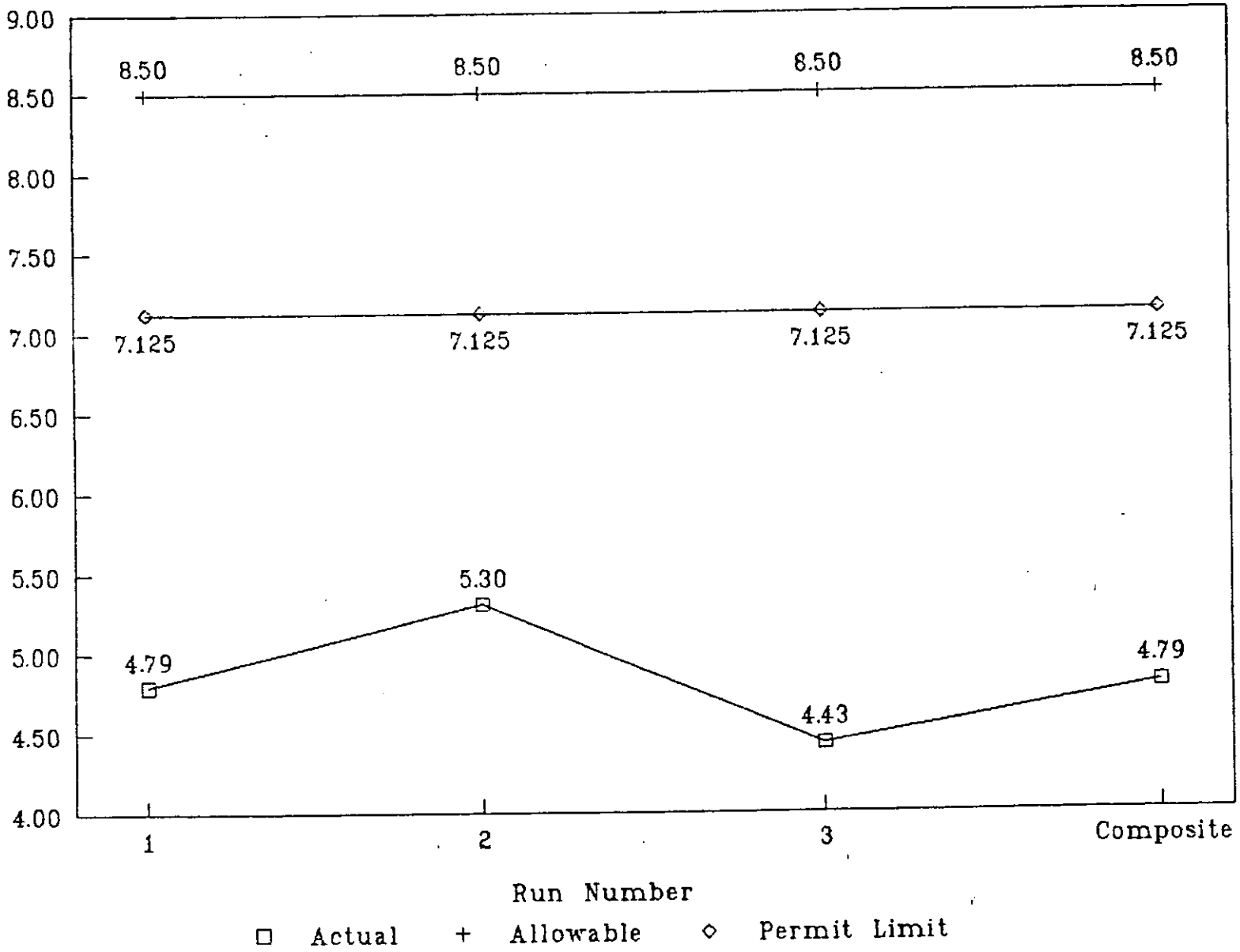
Summarized Air Test Results for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/17/90	10/17/90	10/17/90	10/17/90
Location	TK 6B	TK 6B	TK 6B	TK 6B
Time	1028-1146	1239-1349	1443-1552	1028-1552
Stack Gas Temperature, F	417	409	406	411
Moisture Content, % v/v	5.80	5.37	6.98	6.05
Oxygen Content, % v/v	16.00	16.00	16.50	16.17
Carbon Dioxide Content, % v/v	4.75	5.00	5.50	5.08
Carbon Monoxide Content, % v/v	0.00	0.00	0.00	0.00
Excess Air, %	325.07	329.49	403.23	349.68
Stack Gas Velocity Feet per Second	13.41	13.04	13.03	13.04
Volumetric Flow Actual Cubic Feet per Minute	5,205	5,058	5,058	5,059
Volumetric Flow Dry Std Cubic Feet per Minute	2,908	2,866	2,827	2,840
Concentration Grains per Dry Std Cubic Ft	0.192	0.216	0.183	0.197
Concentration Grains per Actual Cubic Foot	0.107	0.122	0.102	0.111
Particulate Mass Rate, #/hr	4.79	5.30	4.43	4.79
Allowable Emission Rate, #/hr	8.50	8.50	8.50	8.50
Permit Limit, #/hr	7.125	7.125	7.125	7.125
% Isokinetic	104.11	105.06	106.36	106.17

Table 1

GENERAL SHALE PRODUCTS TK6B

On October 17, 1990



Graph 1

GUARDIAN SYSTEMS inc

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

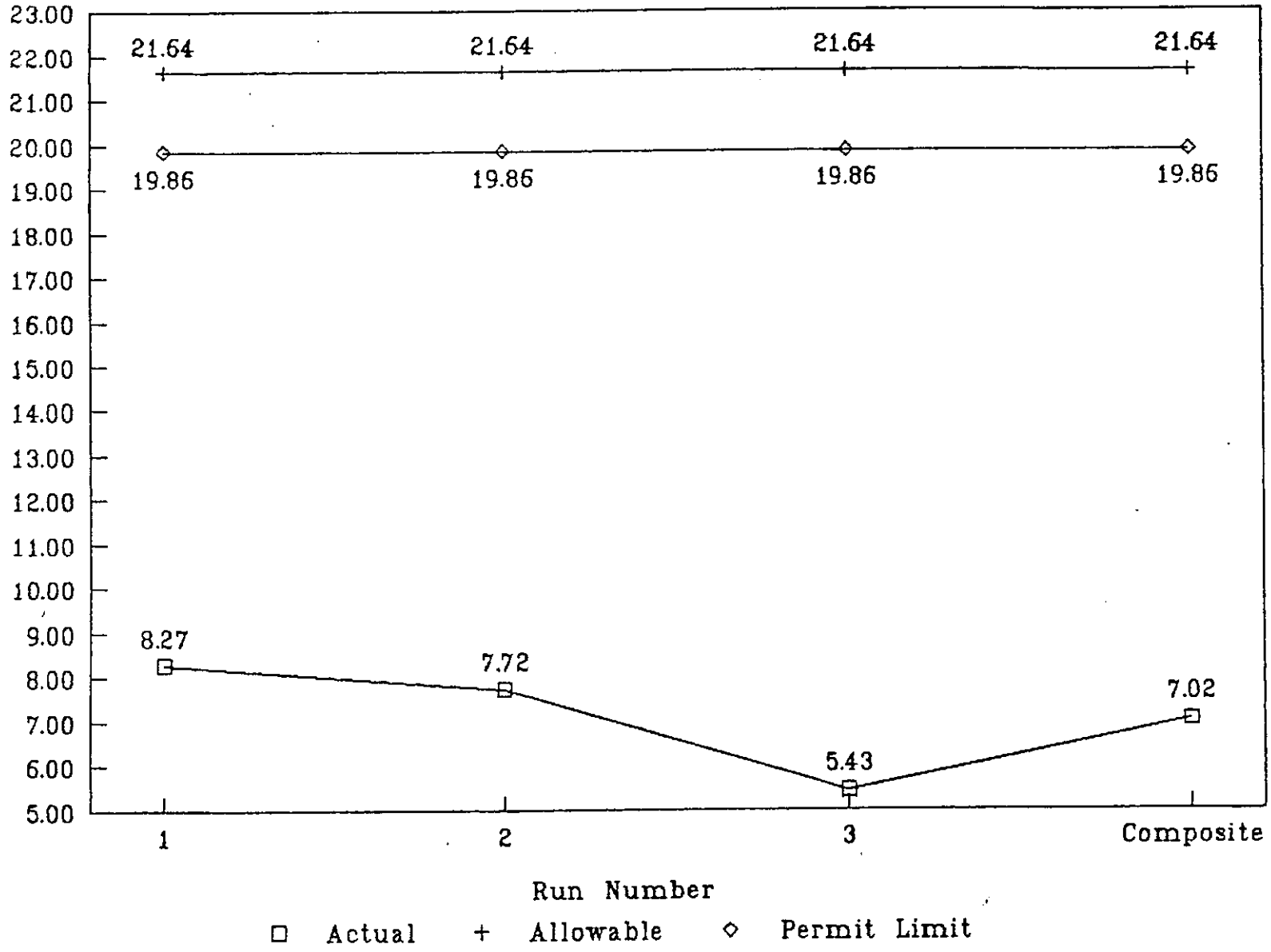
Summarized Air Test Results for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/18/90	10/19/90	10/19/90	10/18-19/9
Location	TK 28	TK 28	TK 28	TK 28
Time	1531-1648	0815-0930	1000-1110	1531-1110
Stack Gas Temperature, F	364	351	353	356
Moisture Content, % v/v	3.76	3.88	4.13	3.92
Oxygen Content, % v/v	18.00	16.00	16.00	16.67
Carbon Dioxide Content, % v/v	2.50	4.00	4.00	3.50
Carbon Monoxide Content, % v/v	0.00	0.00	0.00	0.00
Excess Air, %	602.41	312.50	312.50	377.99
Stack Gas Velocity Feet per Second	22.56	21.16	19.76	20.81
Volumetric Flow Actual Cubic Feet per Minute	11,585	10,862	10,145	10,684
Volumetric Flow Dry Std Cubic Feet per Minute	7,052	6,728	6,253	6,569
Concentration Grains per Dry Std Cubic Ft	0.137	0.134	0.101	0.125
Concentration Grains per Actual Cubic Foot	0.083	0.083	0.062	0.077
Particulate Mass Rate, #/hr	8.27	7.72	5.43	7.02
Allowable Emission Rate, #/hr	21.64	21.64	21.64	21.64
Permit Limit, #/hr	19.86	19.86	19.86	19.86
% Isokinetic	105.51	104.67	105.61	107.01

Table 2

GENERAL SHALE PRODUCTS TK28

On October 18-19, 1990



Particulate Emissions, #/hr

Graph 2

CHARLES INDUSTRIAL SYSTEMS INC

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

Computer Input Parameters for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/17/90	10/17/90	10/17/90	10/17/90
Location	TK 6B	TK 6B	TK 6B	TK 6B
Time	1028-1146	1239-1349	1443-1552	1028-1552
Barometric Pressure, in Hg	29.48	29.48	29.48	29.48
Static Pressure, in H2O	-0.050	0.050	0.020	0.007
Run Time, minutes	64.00	64.00	64.00	192.00
Meter Volume, CF	41.132	40.836	40.923	122.891
Meter Correction factor, MCF	1.0498	1.0498	1.0498	
Meter Volume (Corrected)	43.180	42.870	42.961	129.011
Stack Temperature, F	417	409	406	411
Meter Temperature, F	83	82	84	83
Meter Pressure, in H2O	1.36	1.31	1.31	1.33
Sqr Velocity Pressure	0.181	0.177	0.177	0.178
Mass of Particulate, mg	518.2	578.9	489.0	1586.1
Ml of Water Collected	54.3	49.8	65.7	169.8
% Oxygen	16.00	16.00	16.50	16.17
% Carbon Dioxide	4.75	5.00	5.50	5.08
% Carbon Monoxide	0.00	0.00	0.00	0.00
Stack Area, Sq ft	6.467	6.467	6.467	6.467
Pitot Correction Factor	0.852	0.852	0.852	0.844
Nozzle Diameter, in	0.504	0.504	0.504	0.504
Feed Rate, Tons/hr	2.97	2.97	2.97	2.97

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

Computed Air Test Results for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/17/90	10/17/90	10/17/90	10/17/90
Location	TK 6B	TK 6B	TK 6B	TK 6B
Time	1028-1146	1239-1349	1443-1552	1028-1552
1. Stack Pressure				
Inches Hg	29.48	29.48	29.48	29.48
Millimeters Hg	748.70	748.89	748.83	748.80
2. Meter Pressure				
Inches Hg	29.58	29.58	29.58	29.58
Millimeters Hg	751.33	751.24	751.24	751.27
3. Meter Volume				
Dry Std Cubic Feet	41.510	41.283	41.218	124.011
Dry Std Cubic Meters	1.176	1.169	1.167	3.512
4. Water Volume				
Std Cubic Feet	2.556	2.344	3.092	7.992
Std Cubic Meters	0.072	0.066	0.088	0.226
5. Moisture Content, %	5.80	5.37	6.98	6.05
6. Molecular Weight Dry	29.40	29.44	29.54	29.46
7. Molecular Weight Wet	28.74	28.83	28.73	28.77
8. Stack Velocity				
Feet per Second	13.41	13.04	13.03	13.04
Meters per Second	4.09	3.97	3.97	3.97
9. Volumetric Flow				
Actual Cubic Ft per minute	5,205	5,058	5,058	5,059
Actual Cubic M per second	2.46	2.39	2.39	2.39
10. Volumetric Flow				
Dry Std Cubic Ft per minute	2,908	2,866	2,827	2,840
Dry Std Cubic M per second	1.37	1.35	1.33	1.34
11. Concentration				
Grains per Dry Std Cubic Ft	0.1922	0.2160	0.1827	0.1970
Grams per Dry Std Cubic M	0.4399	0.4942	0.4181	0.4507
12. Excess Air, %	325.07	329.49	403.23	349.68

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

Computed Air Test Results for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/17/90	10/17/90	10/17/90	10/17/90
Location	TK 6B	TK 6B	TK 6B	TK 6B
Time	1028-1146	1239-1349	1443-1552	1028-1552
15. Particulate Mass Rate				
Pounds per Hour, #/hr	4.79	5.30	4.43	4.79
16. Volume at Nozzle				
Actual Cubic Feet	74.298	72.867	73.761	220.927
Actual Cubic Meters	2.104	2.064	2.089	6.257
17. Concentration				
Grains per Actual Cubic Ft	0.1074	0.1223	0.1021	0.1106
Grams per Actual Cubic M	0.2458	0.2800	0.2336	0.2530
18. Isokinetic, %	104.11	105.06	106.36	106.17

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

Computer Input Parameters for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/18/90	10/19/90	10/19/90	10/18-19/9
Location	TK 28	TK 28	TK 28	TK 28
Time	1531-1648	0815-0930	1000-1110	1531-1110
Barometric Pressure, in Hg	29.54	29.62	29.62	29.59
Static Pressure, in H2O	-0.060	-0.050	-0.040	-0.050
Run Time, minutes	63.00	63.00	63.00	189.00
Meter Volume, CF	40.170	37.208	35.375	112.753
Meter Correction factor, MCF	1.0501	1.0501	1.0501	
Meter Volume (Corrected)	42.183	39.072	37.147	118.402
Stack Temperature, F	364	351	353	356
Meter Temperature, F	65	55	62	61
Meter Pressure, in H2O	1.25	1.13	0.99	1.12
Sqr Velocity Pressure	0.312	0.296	0.276	0.295
Mass of Particulate, mg	373.4	345.8	245.2	964.4
Ml of Water Collected	34.9	34.1	34.1	103.1
% Oxygen	18.00	16.00	16.00	16.67
% Carbon Dioxide	2.50	4.00	4.00	3.50
% Carbon Monoxide	0.00	0.00	0.00	0.00
Stack Area, Sq ft	8.557	8.557	8.557	8.557
Pitot Correction Factor	0.858	0.858	0.858	0.844
Nozzle Diameter, in	0.375	0.375	0.375	0.375
Feed Rate, Tons/hr	11.98	11.98	11.98	11.98

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

Computed Air Test Results for General Shale Products Corporation

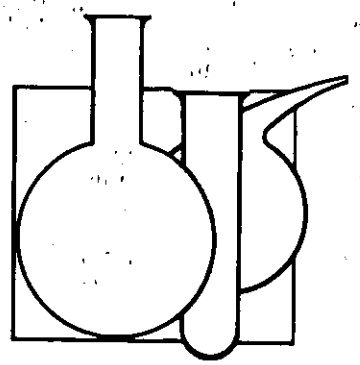
Run Number	1	2	3	Composite
Date	10/18/90	10/19/90	10/19/90	10/18-19/9
Location	TK 28	TK 28	TK 28	TK 28
Time	1531-1648	0815-0930	1000-1110	1531-1110
1. Stack Pressure				
Inches Hg	29.54	29.62	29.62	29.59
Millimeters Hg	750.20	752.25	752.27	751.58
2. Meter Pressure				
Inches Hg	29.63	29.70	29.69	29.68
Millimeters Hg	752.65	754.46	754.20	753.77
3. Meter Volume				
Dry Std Cubic Feet	42.015	39.768	37.289	119.090
Dry Std Cubic Meters	1.190	1.126	1.056	3.373
4. Water Volume				
Std Cubic Feet	1.643	1.605	1.605	4.853
Std Cubic Meters	0.047	0.045	0.045	0.137
5. Moisture Content, %	3.76	3.88	4.13	3.92
6. Molecular Weight Dry	29.12	29.28	29.28	29.23
7. Molecular Weight Wet	28.70	28.84	28.81	28.79
8. Stack Velocity				
Feet per Second	22.56	21.16	19.76	20.81
Meters per Second	6.88	6.45	6.02	6.34
9. Volumetric Flow				
Actual Cubic Ft per minute	11,585	10,862	10,145	10,684
Actual Cubic M per second	5.47	5.13	4.79	5.04
10. Volumetric Flow				
Dry Std Cubic Ft per minute	7,052	6,728	6,253	6,569
Dry Std Cubic M per second	3.33	3.18	2.95	3.10
11. Concentration				
Grains per Dry Std Cubic Ft	0.1369	0.1339	0.1013	0.1247
Grams per Dry Std Cubic M	0.3132	0.3064	0.2317	0.2854
12. Excess Air, %	602.41	312.50	312.50	377.99

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

Computed Air Test Results for General Shale Products Corporation

Run Number	1	2	3	Composite
Date	10/18/90	10/19/90	10/19/90	10/18-19/9
Location	TK 28	TK 28	TK 28	TK 28
Time	1531-1648	0815-0930	1000-1110	1531-1110
15. Particulate Mass Rate Pounds per Hour, #/hr	8.27	7.72	5.43	7.02
16. Volume at Nozzle Actual Cubic Feet	69.021	64.202	60.502	193.692
Actual Cubic Meters	1.955	1.818	1.713	5.485
17. Concentration Grains per Actual Cubic Ft	0.0833	0.0829	0.0624	0.0767
Grams per Actual Cubic M	0.1907	0.1898	0.1428	0.1755
18. Isokinetic, %	105.51	104.67	105.61	107.01

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 matrix for each stack. The dimension of the stack and #6B (see **Figure 1**) indicated that 24 points would be required to sample these sources. The dimensions of the stack #28 (see **Figure 2**) indicated 20 points would be required to sample this source. We sampled 21 points (3 x 7 matrix) for three minutes at each point.

METHOD 2

Velocity measurements 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 1 to 10 inch vertical scale was used on stack #28. A micromanometer (0-0.25 inch scale), having 0.001 inch H_2O divisions on the 0 to 0.25 inch inclined scale was used on stack 6B 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 (2) separate gas 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.

METHOD 5

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 3.** 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.

SAMPLE POINT LOCATION

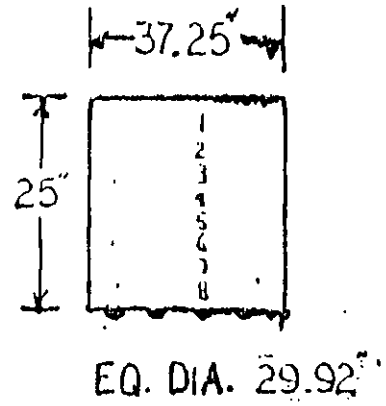
AND

STACK BREECHING DIAGRAM

Plant No. 6b

GENERAL SHALE PRODUCT CORPORATION

MARION, VIRGINIA



Point Number	Distance from Inside Wall Inches
1	1.6
2	4.7
3	7.8
4	10.9
5	14.1
6	17.2
7	20.3
8	23.4

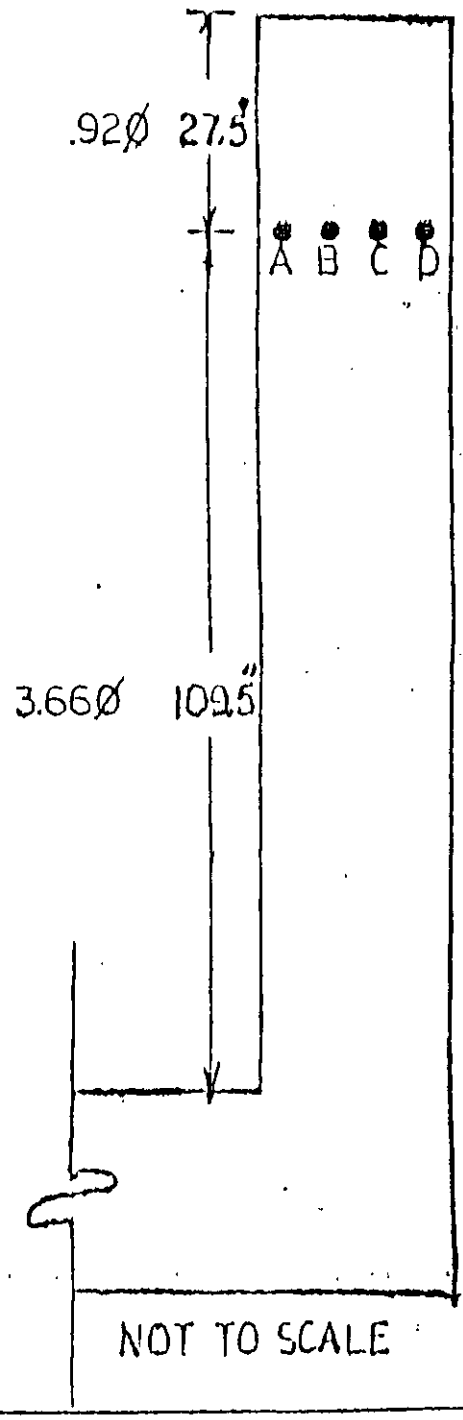


Figure 1

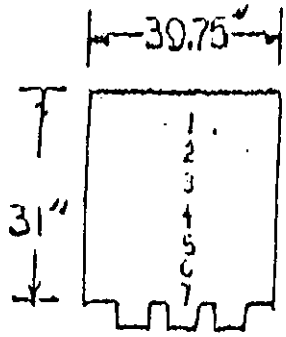
SAMPLE POINT LOCATION

AND

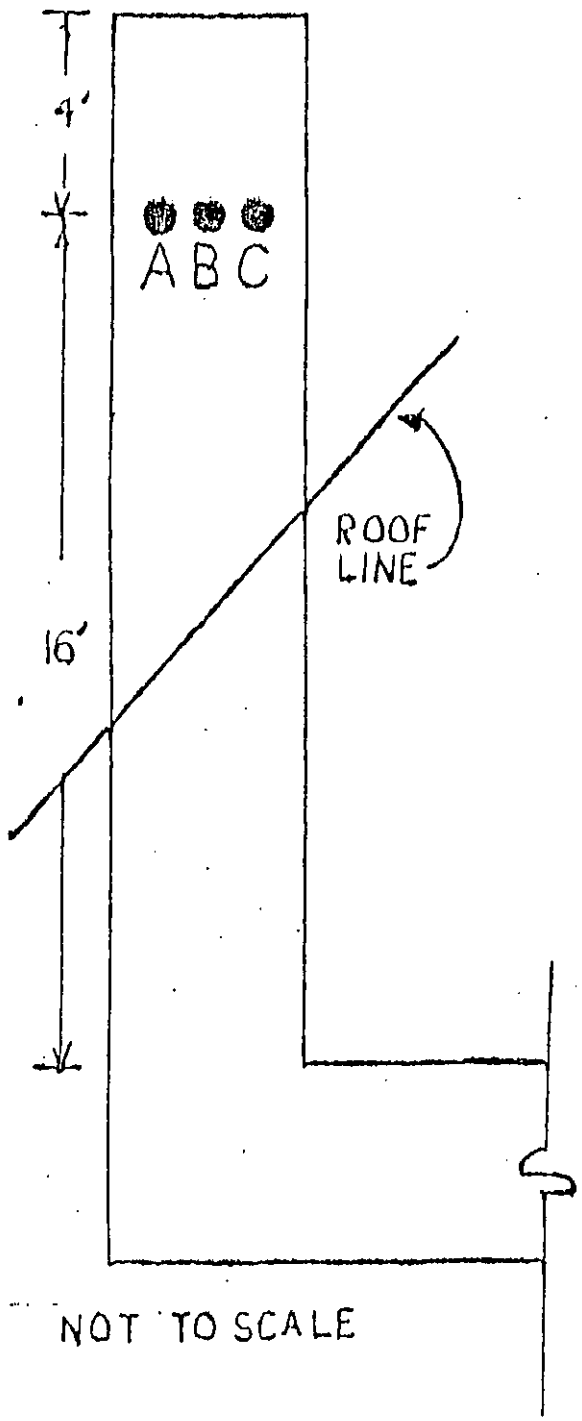
STACK BREECHING DIAGRAM

PLANT NO. 28

GENERAL SHALE PRODUCT CORPORATION
MARION, VIRGINIA



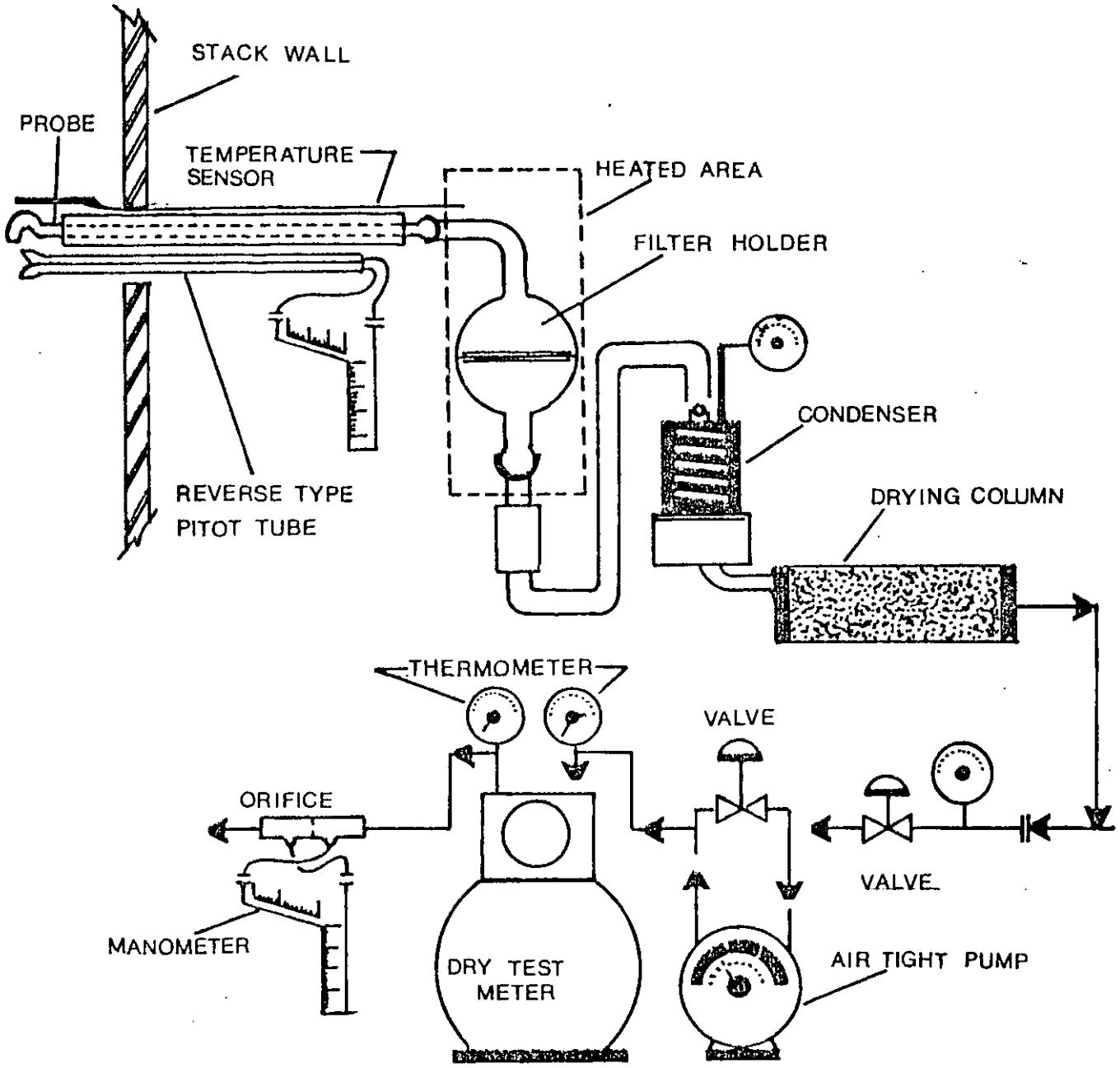
EQ. DIA. 34.83"



Point No.	Distance from Inside Wall Inches
1	2.2
2	6.6
3	11.1
4	15.5
5	19.9
6	24.4
7	28.8

Figure 2

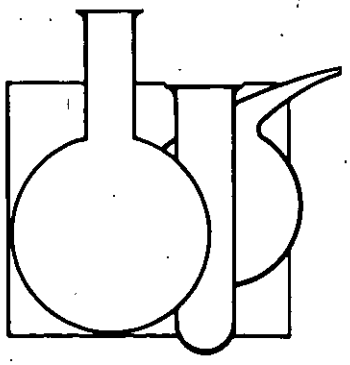
GUARDIAN SYSTEMS inc



PARTICULATE SAMPLING TRAIN.. METHOD 5

Figure 3

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.

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

2.

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

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.

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$$

7.

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

8.

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

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 6

1. $P_s = P_{bar} + (P_g/13.6) = (29.48) + (-.05)/13.6 = 29.48$

2. $P_m = P_{bar} + (\Delta H/13.6) = (29.48) + (1.36)/13.6 = 29.58$

3. $V_{m(std)} = V_m Y (T_{std}/T_m)(P_m/P_{std})$
   $= (41.112)(1.0498)(528/543)(29.58/29.92) = 41.510$

4. $V_{w(std)} = 0.04707 V_{lc} = 0.04707(54.3) = 2.556$

5. $B_{ws} = V_{w(std)}/(V_{m(std)} + V_{w(std)}) = (2.556)/(2.556 + 41.510) = .0580$

6. $M_d = 0.44\ \%CO_2 + 0.32\ \%O_2 + 0.28(\%N_2 + \%CO) =$
   $.44(4.75) + .32(16) + .28(29.25) = 29.40$

7. $M_s = M_d (1-B_{ws}) + 18(B_{ws}) = (29.40)(1-.0580) + 18(.0580) = 28.74$
   .9420

8. $v_s = K_p C_p (\sqrt{\Delta p}\ \cancel{\cos\theta}) \sqrt{(T_s/(M_s P_s))}$
   $= 85.49(.854)(.101)\sqrt{(877/(28.74)(29.48))} = 13.41$

9. $Q_a = v_s A_s (60) = (13.41)(6.467)(60) = 5203$
   $25 \times 32.25/144 = 6.467$

10. $Q_s = Q_a(1-B_{ws})(528/T_s)(P_s/29.92)$
    $= (5203)(1-.058)(528/877)(29.48/29.92) = 2907$
    .942

11. $c_s = 0.0154(M_n/V_{m(std)}) = 0.0154(518.2/41.510) = .1922$

15. $PMR = c_s Q_s (60/7000) = (.1922)(2907)(60/7000) = 4.79$

16. $V_n = T_s/P_s \times ((0.002669)V_{lc} + V_m P_m/T_m)$
    $= (577/29.48)((0.002669)(54.3) + (1.0498)(29.58)/(543))$
    $= 74.29$

18. $I = V_n(100)/((60)\Theta v_s A_n) = 100(74.29)/(60(.94)(13.41)(.0013859))$
    $= 101.13$

$.001 \times 1.38 = .0013859$

FIELD DATA SHEET

PLANT Gerald Stl RUN # 1
LOCATION TL63 DATE 10/17/90
BARO. PRES. 29.48 TIME 1038 - 1146

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

	TIME MIN	TIME DUR	METER VOL FT 3	STACK TEMP °F	METER TEMP °F IN	OUT	AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2O	VELOCITY PRESSURE "H2O	VACUUM PRESSURE "Hg
Pt A			467.037 ~~466.892~~	(1)	(2)	(3)		(4)	(5)			
1	2	2	467.9	393	70	70	70	35	248	.63	.016	—
2		4	468.8	406	72	69	70	33	259	.62	.016	—
3		6	469.6	404	71	68	70	33	255	.54	.014	—
4		8	470.3	394	72	68	70	33	256	.27	.007	—
5		10	471.1	402	72	68	70	33	257	.39	.010	—
6		12	471.9	412	72	68	70	33	257	.50	.013	—
7		14	472.7	418	72	68	70	33	254	.65	.017	—
8		16	473.778	416	75	69	72	36	258	.61	.016	—
Pt B												
1	2	18	474.9	418	78	71	74	37	259	1.05	.027	1.0
2		20	476.1	418	78	72	75	37	258	1.04	.027	1.0
3		22	477.4	420	82	75	78	39	262	1.24	.032	1.1
4		24	478.7	412	84	75	80	40	263	1.37	.035	2.5
5		26	480.1	417	86	76	81	41	255	~~1.40~~ 1.60	~~.036~~ .041	3.5
6		28	481.5	422	86	76	81	42	261	1.36	.035	3.2
7		30	482.8	422	87	77	82	37	261	1.32	.034	3.2
8		32	484.028	424	88	77	82	38	263	1.16	.030	3.0
Pt C												
1	2	34	485.5	422	90	79	84	37	260	1.64	.042	4.0
2		36	486.9	432	90	80	85	40	262	1.74	.045	4.5
3		38	488.4	434	93	81	87	42	264	1.89	.049	5.0
4		40	490.0	434	94	81	88	44	263	2.02	.052	6.0
5		42	491.7	434	95	82	90	44	266	2.22	.057	7.8
6		44	492.2	435	100	83	92	46	268	2.22	.057	7.8
7		46	494.1	430	102	86	94	47	261	2.56	.065	9.1
8		48	496.750	432	101	87	95	48	259	2.05	.052	8.5

STATIC PRESSURE "H2O: -.05

PROBE TIP SIZE

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

WATER
#12
ml. 46
gram 8.3
Total 54.3

OPERATOR
Lotz / Isom

Sample Box No. 1
Meter Box No. 200
Meter ΔH@ 1.74
Pitot, CP .532
Temp. Device ΩII
Probe No. ~~4~~ 13-3
Probe Liner GLASS
Probe Htr. Set 65
Ambient Temp. 45
% O_2 15 / 17
% CO_2 6 / 3.5

NOTES
05 = 1.70 67%
Orifice —
Pitot —
Meter Q25
K = 63.125

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

PLANT: General Shale
LOCATION: TEGB
BARO. PRES.: 29.48
RUN #: 1
DATE: 10/17/90
TIME: 1025 - 1146

	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	STATIC PRESSURE "H2O -.03 PROBE TIP SIZE BEFORE	PROBE TIP SIZE AFTER
Pre-Test				(1)	(2)	(3)		(4)	(5)					
1	2	50	499.2	412	99	86	92	43	262	1.45	.037	5.0	.504	.504
2		52	499.6	422	87	81	84	39	264	1.48	.038	5.1	.504	.504
3		54	500.9	404	91	82	86	41	254	1.25	.032	4.8	.504	.504
4		52	501.9	387	93	83	88	42	261	0.94	.023	3.5		
5		54	503.2	390	93	83	88	41	263	1.23	.030	4.5		
6		60	504.8	411	93	83	88	41	259	1.99	.050	8.0		
7		62	506.7	424	94	82	88	42	267	2.58	.066	10.2		
8		64	508.169	423	95	82	88	44	264	1.96	.050	9.3		
32		64	4.132	416			82			1.36	.181	10.2		
				417 ADJ			83 ADJ.							
				505.2										
				508.250										
							@ 12 "Hg / hr							
				Pre - .12										
				Static - .11										
				505.376										
				508.959										
					.015	@ 12 Hg/hr								

WATER
ml. 46
gram 8.3
Total 54.3

OPERATOR
L.T.2 / Doug

Sample Box No. 1
Meter Box No. 2.2
Meter ΔH@ 1.74
Pitot, CP .82
Temp. Device 24
Probe No. 31
Probe Liner SS
Probe Htr. Set 65
Ambient Temp. 45
% O_2 15 / 12
% CO_2 6 / 3.5

NOTES
Orifice
Pitot
Meter

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

PLANT: Gerdau Steel
LOCATION: TK 6B
BARO. PRES.: 29.45
RUN #: 2
DATE: 10/17/90
TIME: 1239 - 1349

	TIME MIN	TIME DUR	METER VOL FT 3	STACK TEMP °F	METER TEMP. °F IN	OUT	AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2O	VELOCITY PRESSURE "H2O	VACUUM PRESSURE "Hg	STATIC PRESSURE "H2O +.05	PROBE TIP SIZE BEFORE	AFTER
Point			509.038	(1)	(2)	(3)		(4)	(5)						
1	2	2	510.2	410	76	75	76	33	223	1.05	.027	—		.504	.504
2		4	511.5	411	77	77	77	34	225	1.28	.033	—		.504	.504
3		6	512.4	409	78	77	77	34	243	0.78	.020	—		.504	.504
4		8	513.6	394	80	77	78	34	245	0.68	.017	—			
5		10	514.6	393	81	77	79	35	249	0.80	.020	—			
6		12	516.0	402	83	78	80	35	235	2.00	.050	1.0			
7		14	517.8	404	83	78	80	37	253	2.31	.060	2.0			
8		16	519.390	412	84	78	82	38	244	1.88	.048	1.9			
Point															
1	2	18	520.8	418	85	78	82	38	242	1.75	.045	1.5			
2		20	522.4	420	81	77	79	35	244	1.82	.047	1.8			
3		22	523.9	422	83	77	80	37	246	1.70	.044	1.8			
4		24	525.3	425	84	78	82	35	261	1.97	.057	2.0			
5		26	526.9	422	84	78	82	35	267	2.10	.054	2.5			
6		28	528.6	424	85	78	82	36	264	2.17	.056	2.9			
7		30	530.4	418	85	78	82	35	257	2.44	.063	3.5			
8		32	531.973	419	86	79	82	35	256	1.78	.046	2.5			
Point															
1	2	34	533.1	394	86	79	82	36	257	1.16	.029	1.0			
2		36	534.4	405	81	77	79	33	236	1.22	.031	2.0			
3		38	535.7	402	82	77	80	33	245	1.30	.033	2.0			
4		40	536.9	420	83	77	80	33	254	1.34	.034	2.1			
5		42	538.4	401	84	77	80	33	256	1.46	.037	2.6			
6		44	539.8	405	86	79	82	35	253	1.39	.035	2.5			
7		46	541.3	406	87	79	83	36	265	1.47	.037	2.9			
8		48	542.35	404	87	79	83	36	265	.79	.020	1.0			

WATER
#7 ml. 42
gram 7.8
Total 49.8

OPERATOR
Lotz/Isom

Sample Box No. 7
Meter Box No. 250
Meter ΔH@ 1.74
Pitot, CP .852
Temp. Device RTI
Probe No. 3-3
Probe Liner SS
Probe Htr. Set 6.5
Ambient Temp. 88
% O_2 16.0 / 16.0
% CO_2 5.0 / 5.0

NOTES
Orifice
Pitot ✓
Meter 1.025

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

PLANT Gulf States RUN # 2
LOCATION TKGB DATE 10/17/9-
BARO. PRES. 29.48 TIME 1235 - 1349

	TIME MIN	TIME DUR	METER VOL FT 3	STACK TEMP °F	METER TEMP. °F IN	OUT	AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2o	VELOCITY PRESSURE "H2o	VACUUM PRESSURE "Hg
PrtA				(1)	(2)	(3)		(4)	(5)			
1	2	50	543.3	400	85	80	82	33	249	.80 ~~.020~~	.020	1.0
2		52	544.4	400	85	80	82	34	265	0.75	.019	1.0
3		54	545.4	401	85	80	82	34	267	0.60	.015	1.0
4		56	546.1	394	85	80	82	34	246	0.40	.010	—
5		58	547.0	400	85	80	82	34	254	0.52	.013	—
6		60	547.5	411	85	81	83	34	247	0.71	.018	1.0
7		62	549.0	410	86	81	83	34	262	0.87	.022	1.9
8		64	549.874	411	85	81	83	34	263	0.47	.012	—
25		25	40.836	[illegible]			81			1.51	.177	
				409 ADJ			82 ADJ					

549.9103
549.904
.009 @4 11 of 10

STATIC PRESSURE "H2o +.05

PROBE TIP SIZE

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

WATER

#7
ml. 42
gram 7.8
Total 49.8

OPERATOR
CO72/SW

Sample Box No. 1
Meter Box No. 2R
Meter ΔH@ 1.74
Pitot, CP .52
Temp. Device RT
Probe No. 3-3
Probe Liner SS
Probe Htr. Set 65
Ambient Temp. 71
% O_2 16.0 / 16.2
% CO_2 5.0 / 5.0

NOTES

Orifice
Pitot
Meter

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

PLANT Gerdau Steel
LOCATION TK6B
BARO. PRES. 29.48
RUN # 3
DATE 10/17/90
TIME 1443 – 1552

	TIME MIN	TIME DUR	METER VOL FT 3	STACK TEMP °F	METER TEMP. °F IN	OUT	AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2O	VELOCITY PRESSURE "H2O	VACUUM PRESSURE "Hg
Port			550.070	(1)	(2)	(3)		(4)	(5)			
Port 1	2	2	551.1	401	75	75	75	34	254	.079	.020	—
2		4	551.9	402	76	76	76	37	262	.63	.016	—
3		6	553.0	404	76	76	76	37	260	.59	.015	—
4		8	553.8	400	77	76	76	36	260	.59	.015	—
5		10	554.6	402	78	76	77	36	255	.51	.013	—
6		12	555.7	404	79	76	78	34	254	.71	.018	—
7		14	556.7	408	80	76	78	34	253	.78	.020	—
8		16	557.550	407	81	77	79	35	251	.43	.011	—
Port B												
1	2	18	558.4	400	82	77	80	34	259	.59	.015	—
2		20	559.7	404	81	78	80	34	262	0.98	.021	—
3		22	560.8	410	83	78	80	35	264	1.06	.027	—
4		24	561.9	410	84	79	82	36	261	1.18	.030	—
5		26	563.3	411	85	79	82	36	260	1.22	.031	—
6		28	564.7	405	86	80	83	37	262	1.30	.033	1.0
7		30	565.9	414	86	80	83	37	260	1.14	.029	—
8		32	567.095	412	88	80	84	37	261	1.02	.026	—
Port C												
1	2	34	568.4	412	89	81	85	36	263	1.58	.040	1.0
2		36	569.9	409	88	82	85	36	261	1.60	.042	1.5
3		38	571.4	419	89	82	86	36	254	1.61	.041	1.5
4		40	572.9	417	90	87	86	37	260	2.05	.052	2.3
5		42	574.6	418	91	83	82	37	263	2.09	.053	2.5
6		44	576.2	418	91	83	86	38	263	2.17	.055	3.0
7		46	577.9	415	92	83	88	39	266	2.41	.061	3.5
		48	579.400	416	92	83	88	40	259	1.46	.037	2.3

STATIC PRESSURE "H2O: +0.20

PROBE TIP SIZE

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

WATER

#5
ml. 57
gram 8.7
Total 65.7

OPERATOR
LTY/Doug

Sample Box No. 1
Meter Box No. 280
Meter ΔH@ 1.74
Pitot, CP .852
Temp. Device SII
Probe No. 3-3
Probe Liner SS
Probe Htr. Set 65
Ambient Temp. 70
% O_2 11.0 / 12.0
% CO_2 5.0 / 4.0

NOTES

Orifice
Pitot ✓
Meter E25

FIELD DATA SHEET

GUARDIAN SYSTEMS INC
BOX 300
LEEDS, ALABAMA 35094

PLANT Carl Stokes
LOCATION TK6B
BARO. PRES. 25.48
RUN # 3
DATE 10/17/90
TIME 1443 - 1552

	TIME MIN	TIME DUR	METER VOL FT 3	STACK TEMP °F	METER TEMP. °F IN	OUT	AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2O	VELOCITY PRESSURE "H2O	VACUUM PRESSURE "Hg
Pitot				(1)	(2)	(3)	-	(4)	(5)			
1	7	50	580.9	402	89	83	86	36	264	1.60	.040	2.0
2		52	582.2	394	89	83	86	37	252	1.53	.035	2.0
3		54	583.6	391	89	83	86	38	268	1.21	.030	2.0
4		56	584.5	356	89	85	86	38	262	0.61	.015	—
5		58	585.8	354	89	83	86	37	262	1.63	.040	2.0
6		60	587.6	387	88	83	86	36	261	1.20	.054	3.8
7		62	589.4	391	88	83	86	37	265	2.75	.068	5.0
8		64	590.996	355	89	82	84	39	263	1.81	.041	3.0
2			40.[illegible]									
				406.005			84.005					

591.052
591.045
.007

Pr .10
St. .10

STATIC PRESSURE "H2O +.020

PROBE TIP SIZE

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

WATER

ml. 57
gram 8.7
Total 65.7

OPERATOR

LCT2
/Isaac

Sample Box No. 1
Meter Box No. 200
Meter ΔH@ 1.74
Pitot, CP .852
Temp. Device RTI
Probe No. 3-3
Probe Liner SS
Probe Htr. Set 65
Ambient Temp. 71
% O_2 16 - 17.0
% CO_2 5.0 / 4.0

NOTES

Orifice
Pitot
Meter

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

PLANT Gulf States RUN # 1
LOCATION TL28 DATE 10/18/90
BARO. PRES. 29.94 TIME 1531-1648

	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			591.550	(1)	(2)	(3)		(4)	(5)			
1	3	3	595.4	361	57	57	57	34	246	1.14	.09	1.0
2		6	555.3	361	61	59	60	33	252	1.39	.11	1.5
3		9	597.2	364	62	60	61	33	249	1.52	.12	2.5
4		12	599.0	365	64	60	62	34	253	1.40	.11	2.0
5		15	601.0	365	65	61	63	33	250	1.40	.11	2.1
6		18	603.0	366	66	62	64	33	253	1.52	.12	3.0
7		21	604.857	365	66	62	64	33	251	1.52	.12	3.4
Port B												
1	3	24	606.8	350	64	62	63	33	257	1.17	.09	1.5
2		27	608.7	359	65	63	64	33	239	1.15	.09	1.5
3		30	610.6	363	65	63	64	33	245	0.89	.07	1.0
4		33	612.5	367	66	64	65	33	237	1.15	.09	2.0
5		36	614.4	366	66	65	66	33	244	1.15	.09	2.0
6		39	616.3	366	67	65	66	33	248	1.28	.10	2.5
7		42	618.244	366	67	65	66	33	238	1.41	.11	3.0
Port C												
1	3	45	620.2	359	65	65	65	33	257	1.16	.09	2.5
2		48	622.1	361	66	65	66	33	241	1.15	.09	2.5
3		51	623.9	362	67	65	66	33	239	1.03	.08	2.0
4		54	625.9	365	67	65	66	33	240	1.02	.08	2.0
5		57	627.8	366	67	66	66	33	249	1.02	.08	2.0
6		60	629.7	365	68	66	67	33	249	1.28	.10	4.0
7		63	631.667	365	68	66	67	33	241	1.41	.11	4.5
2"		63"	[illegible]	[illegible]			[illegible]			[illegible]	[illegible]	
				[illegible]		631.283		631.11				
						631.771					Pre 4.5	
											Post 3.7	
						.008	[illegible]					

STATIC PRESSURE "H2O: -.06

PROBE TIP SIZE

BEFORE	AFTER
.375	.375
.375	.375
.375	.375

WATER
#12
ml. 30
gram 4.9
Total 34.9

OPERATOR
LOTZ / Jones

Sample Box No. 1
Meter Box No. 250
Meter ΔH@ 1.74
Pitot, CP .858
Temp. Device ΩII
Probe No. 41-1
Probe Liner Glass
Probe Htr. Set 65
Ambient Temp. 56
% O_2 18.0 / 18.0
% CO_2 2.5 / 2.5

NOTES
K = 20.066
Orifice ✓
Pitot ✓
Meter 0.25

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

PLANT Carl Schlo RUN # 2
LOCATION Z28 DATE 10/19/86
BARO. PRES. 29.62 TIME 815 - 930

	TIME MIN	TIME DUR	METER VOL FT 3	STACK TEMP °F	METER TEMP. °F IN	OUT	AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2O	VELOCITY PRESSURE "H2O	VACUUM PRESSURE "Hg
PMA			632.040	(1)	(2)	(3)		(4)	(5)			
1	3	3	633.7	342	41	58	40	35	229	1.40	.05	—
2		6	635.6	345	43	40	42	33	225	1.38	.11	—
3		9	637.6	347	47	42	44	33	226	1.51	.12	—
4		12	639.8	350	50	43	46	33	238	1.63	.13	—
5		15	641.8	350	53	45	49	33	242	1.64	.13	—
6		18	643.9	350	56	46	51	33	241	1.52 ~~1.46~~	.12 ~~.14~~	—
7		21	645.840	351	58	47	52	34	244	1.52	.12	—
Port 1												
1	2	24	647.5	350	57	49	53	33	248	1.02	.08	—
2		27	649.2	343	58	50	54	33	247	0.98	.07	—
3		30	650.8	349	59	51	55	33	247	0.96	.075	—
4		33	652.5	352	61	53	57	33	247	1.02	.08	—
5		36	654.3	353	62	53	58	33	250	1.15	.09	—
6		39	656.1	355	64	54	59	33	253	1.15	.09	—
7		42	658.03	355	66	56	61	33	249	1.22	.095	—
Port 2												
1	3	45	659.7	350	61	54	58	33	248	1.03	.08	—
2		48	661.4	347	62	56	59	33	240	0.77	.06	—
3		51	662.8	352	62	58	60	33	252	0.77	.06	—
4		54	664.4	353	63	57	60	33	243	.90	.07	—
5		57	666.2	355	63	57	60	33	250	.90	.07	—
6		60	667.7	355	63	57	60	33	251	1.03	.08	—
7		63	669.248	354	64	58	61	33	248	.77	.06	—
							59					
21		63	32.200	350		669.288		SCALPT.		1.03	.08	
				SCALPT.		669.272						
						.016						

STATIC PRESSURE "H2O: -.03

PROBE TIP SIZE

BEFORE	AFTER
.375	.375
.375	.375
.375	.375

WATER

#9

ml. 30

grain 4.1

Total 34.1

OPERATOR

LOTZ / Isaac

Sample Box No. 1
Meter Box No. 20
Meter ΔH@ 1.74
Pitot, CP .858
Temp. Device ATI
Probe No. 4-1
Probe Liner Glass
Probe Htr. Set 65
Ambient Temp. 30
% O_2 16.0 / 16.0
% CO_2 4.0 / 4.0

NOTES

Orifice
Pitot ✓
Meter @ 25"

Leak rate
R 2.6
Static 65

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

PLANT: Gulf States RUN #: 3
LOCATION: TL 28 DATE: 10/15/90
BARO. PRES.: 29.62 TIME: 0900-1000-1110

	TIME MIN	TIME DUR	METER VOL FT 3	STACK TEMP °F	METER TEMP °F IN	OUT	AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2O	VELOCITY PRESSURE "H2O	VACUUM PRESSURE "Hg
Port			669.775	(1)	(2)	(3)		(4)	(5)			
1	5	3	671.1	343	51	51	51	33	247	.63	.05	—
2		6	672.6	350	50	51	50	33	254	.76	.06	—
3		9	674.1	353	50	51	50	33	252	.76	.06	—
4		12	675.7	352	56	52	54	33	253	.89	.07	—
5		15	677.3	354	56	53	54	33	255	.89	.07	—
6		18	678.9	353	55	53	56	33	254	1.02	.08	—
7		21	680.64	350	59	54	56	33	253	1.02	.08	—
Port												
1	3	24	682.2	350	58	53	56	33	257	.77	.06	—
2		27	683.6	349	60	55	58	33	256	.64	.05	—
3		30	684.9	351	63	56	60	33	253	.77	.06	—
4		33	686.7	355	64	57	60	33	252	.90	.07	—
5		36	688.3	356	67	58	62	33	254	.90	.07	—
6		39	690.0	352	69	59	64	34	254	1.03	.08	—
7		42	691.814	352	71	61	66	33	258	1.03	.08	—
Port												
1	3	45	693.4	349	68	62	65	33	250	.91	.07	—
2		48	695.1	350	70	62	66	33	249	1.04	.08	—
3		51	697.1	350	72	63	68	33	249	1.31	.10	1.0
4		54	698.9	352	74	64	69	33	257	1.30	.10	1.0
5		57	701.0	355	76	65	70	33	252	1.44	.11	1.5
6		60	703.0	355	77	66	72	33	255	1.44	.11	1.5
7		63	705.150	354	77	67	72	33	257	1.44	.11	1.5
			35.375	352			61			.99	.076	
21		63		35.005	705.19	26.005						
					705.185							
					.017							

STATIC PRESSURE "H2O: -.04

PROBE TIP SIZE

BEFORE	AFTER
.375	.375
.375	.375
.375	.375

WATER

#5
ml. 32
gram 2.1
Total 34.1

OPERATOR: [illegible]

Sample Box No. 1
Meter Box No. 20
Meter ΔH@ 1.74
Pitot, CP FST
Temp. Device ΔT
Probe No. 4-1
Probe Liner glass
Probe Htr. Set 65
Ambient Temp. 52
% O_2 15.0 / 16.0
% CO_2 4.0 / 4.0

NOTES

Orifice
Pitot ✓
Meter [illegible]

R - 7.5
S - 6.5

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 6B

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.:	10/25/90	1600	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: Coal Stack Sample date: 10/17/93

Sample location: TK 6B Run no.: 1

Sample recovery person: CDR Recovery date: 10/17/93

Filter(s) no.: E-1

MOISTURE

Impingers			Silica gel #12		
Final volume (wt)	46	ml(gm)	Final wt.	990.0 g	g
Initial volume (wt)	0	ml(gm)	Initial wt.	951.7 g	g
Net volume (wt)	46	ml(gm)	Net wt.	8.3 g	g

Total moisture 54.3 g

Color of silica gel Micro

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. R #1 sealed ✓

Description of particulate on filter Dark Brown

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

Acetone blank container no. Blk Liquid level marked ✓

Samples stored and locked ✓

Remarks:

Date of laboratory custody NA

Laboratory personnel taking custody LDR

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 6B

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 250 ml
Acetone blank residue concentration: 0.0046 mg/g
Acetone blank weight 0.9 mg

ACETONE RINSE WEIGHT

Date & time of wt.:	10/25/90	0900	Gross wt.	104470.1 mg
Date & time of wt.:	11/1/90	0800	Gross wt.	104469.8 mg
			Average Gross wt.	104470.0 mg
			Tare wt.	104277.4 mg
			Less weight of acetone blank	0.9 mg
			Weight of particulate in acetone rinse	191.7 mg

PARTICULATE WEIGHT

Filter(s) container number: 1

Date & time of wt.:	10/25/90	0900	Gross wt.	500.6 mg
Date & time of wt.:	10/25/90	1600	Gross wt.	500.1 mg
			Average Gross wt.	500.4 mg
			Tare wt.	173.8 mg
			Weight of particulate on filter (s)	326.6 mg
			Weight of particulate in acetone rinse	191.7 mg
			TOTAL WEIGHT OF PARTICULATE	518.2 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: Coal Stack Sample date: 10/17/90
Sample location: TK 60 Run no.: 2
Sample recovery person: LDT2 Recovery date: 10/17/90
Filter(s) no.: E-5

MOISTURE

Impingers Silica gel #7
Final volume (wt) 42 ml(gm) Final wt. 923.9 g ____ g
Initial volume (wt) 0 ml(gm) Initial wt. 916.1 g ____ g
Net volume (wt) 42 ml(gm) Net wt. 7.8 g ____ g
Total moisture 49.8 g
Color of silica gel mixed
Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. R #2 sealed ✓
Description of particulate on filter DARK BROWN

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

Date of laboratory custody ✓
Laboratory personnel taking custody LDT2
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 6B

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 250 ml
Acetone blank residue concentration: 0.0046 mg/g
Acetone blank weight 0.9 mg

ACETONE RINSE WEIGHT

Date & time of wt.:	10/25/90	0900 Gross wt.	99884.8 mg
Date & time of wt.:	11/1/90	0800 Gross wt.	99884.4 mg
		Average Gross wt.	99884.6 mg
		Tare wt.	99655.7 mg
		Less weight of acetone blank	0.9 mg
		Weight of particulate in acetone rinse	228.0 mg

PARTICULATE WEIGHT

Filter(s) container number: 2

Date & time of wt.:	10/25/90	0900 Gross wt.	520.6 mg
Date & time of wt.:	10/25/90	1600 Gross wt.	520.2 mg
		Average Gross wt.	520.4 mg
		Tare wt.	169.5 mg
		Weight of particulate on filter (s)	350.9 mg
		Weight of particulate in acetone rinse	228.0 mg
		TOTAL WEIGHT OF PARTICULATE	578.9 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: Coal Shed Sample date: 10/17/90

Sample location: 6B Run no.: 3

Sample recovery person: LOR Recovery date: 10/17/90

Filter(s) no.: E-3

MOISTURE

Impingers			Silica gel #5		
Final volume (wt)	57	ml(gm)	Final wt.	977.7 g	g
Initial volume (wt)	0	ml(gm)	Initial wt.	965.0 g	g
Net volume (wt)	57	ml(gm)	Net wt.	8.7 g	g

Total moisture 65.7 g

Color of silica gel Brown

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. R #3 sealed ✓

Description of particulate on filter DARK BROWN

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

Acetone blank container no. Liquid level marked

Samples stored and locked ✓

Remarks:

Date of laboratory custody ✓

Laboratory personnel taking custody LOR

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: 3

Sample location: TK 6B

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 150 ml
Acetone blank residue concentration: 0.0046 mg/g
Acetone blank weight 0.5 mg

ACETONE RINSE WEIGHT

Date & time of wt.:	10/25/90	0900	Gross wt.	101036.3 mg
Date & time of wt.:	11/1/90	0800	Gross wt.	101036.5 mg
			Average Gross wt.	101036.4 mg
			Tare wt.	100860.6 mg
			Less weight of acetone blank	0.5 mg
			Weight of particulate in acetone rinse	175.3 mg

PARTICULATE WEIGHT

Filter(s) container number: 3

Date & time of wt.:	10/25/90	0900	Gross wt.	485.2 mg
Date & time of wt.:	10/25/90	1600	Gross wt.	484.8 mg
			Average Gross wt.	485.0 mg
			Tare wt.	171.3 mg
			Weight of particulate on filter (s)	313.7 mg
			Weight of particulate in acetone rinse	175.3 mg
			TOTAL WEIGHT OF PARTICULATE	489.0 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: _____

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 28

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.:	10/25/90	1600	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: Cool Stoke Sample date: 10-15-50

Sample location: TK28 Run no.: 1

Sample recovery person: LOTZ Recovery date: 10-15-50

Filter(s) no.: _____

MOISTURE

Impingers			Silica gel #12		
Final volume (wt)	30	ml(gm)	Final wt.	994.9 g	____ g
Initial volume (wt)	0	ml(gm)	Initial wt.	990.0 g	____ g
Net volume (wt)	30	ml(gm)	Net wt.	4.9 g	____ g

Total moisture 34.9 g

Color of silica gel Milky

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. Pt 1 sealed ✓

Description of particulate on filter Gray

Acetone rinse container no. Pt 1 Liquid level marked ✓

Acetone blank container no. B16 Liquid level marked ✓

Samples stored and locked ✓

Remarks: _____

Date of laboratory custody 10/2

Laboratory personnel taking custody LOTZ

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 28

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 200 ml
Acetone blank residue concentration: 0.0046 mg/g
Acetone blank weight 0.7 mg

ACETONE RINSE WEIGHT

Date & time of wt.:	10/25/90	0900	Gross wt.	105633.2 mg
Date & time of wt.:	10/25/90	1600	Gross wt.	105633.3 mg
		Average	Gross wt.	105633.3 mg
			Tare wt.	105449.7 mg
	Less weight of acetone blank			0.7 mg
	Weight of particulate in acetone rinse			182.8 mg

PARTICULATE WEIGHT

Filter(s) container number: 1

Date & time of wt.:	10/25/90	0900	Gross wt.	362.5 mg
Date & time of wt.:	10/25/90	1600	Gross wt.	362.7 mg
		Average	Gross wt.	362.6 mg
			Tare wt.	172.0 mg
	Weight of particulate on filter (s)			190.6 mg
	Weight of particulate in acetone rinse			182.8 mg
	TOTAL WEIGHT OF PARTICULATE			373.4 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: Cool Stack Sample date: 10-15-90

Sample location: TK 25 Run no.: 2

Sample recovery person: GOZ Recovery date: 10-19-90

Filter(s) no.: _____

MOISTURE

Impingers			Silica gel #7		
Final volume (wt)	30	ml(gm)	Final wt.	924.1 g	____ g
Initial volume (wt)	0	ml(gm)	Initial wt.	900 g	____ g
Net volume (wt)	30	ml(gm)	Net wt.	24.1 g	____ g

Total moisture 34.1 g

Color of silica gel Navy

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. R #2 sealed ✓

Description of particulate on filter Grey

Acetone rinse container no. R #2 Liquid level marked ✓

Acetone blank container no. _____ Liquid level marked _____

Samples stored and locked ✓

Remarks: _____

Date of laboratory custody NA

Laboratory personnel taking custody GOZ

Remarks: _____

GUARDIAN SYSTEMS INC

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 28

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 145 ml
Acetone blank residue concentration: 0.0046 mg/g
Acetone blank weight 0.5 mg

ACETONE RINSE WEIGHT

Date & time of wt.:	10/25/90	0900	Gross wt.	102674.9 mg
Date & time of wt.:	10/25/90	1600	Gross wt.	102675.4 mg
		Average	Gross wt.	102675.2 mg
			Tare wt.	102480.8 mg
	Less weight of acetone blank			0.5 mg
	Weight of particulate in acetone rinse			193.8 mg

PARTICULATE WEIGHT

Filter(s) container number: 2

Date & time of wt.:	10/25/90	0900	Gross wt.	326.4 mg
Date & time of wt.:	10/25/90	1600	Gross wt.	326.5 mg
		Average	Gross wt.	326.5 mg
			Tare wt.	174.5 mg
	Weight of particulate on filter (s)			152.0 mg
	Weight of particulate in acetone rinse			193.8 mg
	TOTAL WEIGHT OF PARTICULATE			345.8 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: Canal 5/6 Sample date: 10-19-90

Sample location: FR 2.5 Run no.: 3

Sample recovery person: LTR Recovery date: 10-19-90

Filter(s) no.: _____

MOISTURE

Impingers			Silica gel #5		
Final volume (wt)	32	ml(gm)	Final wt.	992.2 g	_____ g
Initial volume (wt)	0	ml(gm)	Initial wt.	990.1 g	_____ g
Net volume (wt)	32	ml(gm)	Net wt.	2.1 g	_____ g

Total moisture 34.1 g

Color of silica gel Mixed

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. R #3 sealed ✓

Description of particulate on filter Capsule Brown

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

Acetone blank container no. _____ Liquid level marked _____

Samples stored and locked ✓

Remarks: _____

Date of laboratory custody Nov

Laboratory personnel taking custody LTR

Remarks: _____

GUARDIAN SYSTEMS inc

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 28

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 130 ml
Acetone blank residue concentration: 0.0046 mg/g
Acetone blank weight 0.5 mg

ACETONE RINSE WEIGHT

Date & time of wt.:	10/25/90	0900	Gross wt.	102822.7 mg
Date & time of wt.:	10/25/90	1600	Gross wt.	102822.9 mg
		Average	Gross wt.	102822.8 mg
			Tare wt.	102718.0 mg
	Less weight of acetone blank			0.5 mg
	Weight of particulate in acetone rinse			104.3 mg

PARTICULATE WEIGHT

Filter(s) container number: 3

Date & time of wt.:	10/25/90	0900	Gross wt.	310.9 mg
Date & time of wt.:	10/25/90	1600	Gross wt.	310.8 mg
		Average	Gross wt.	310.9 mg
			Tare wt.	170.0 mg
	Weight of particulate on filter (s)			140.9 mg
	Weight of particulate in acetone rinse			104.3 mg
	TOTAL WEIGHT OF PARTICULATE			245.2 mg

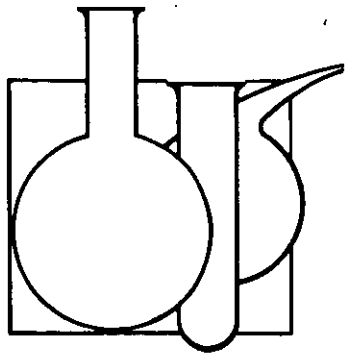
Note: In no case shall a blank residue greater than (0.01mg/g) of 0.001% of the weight of blank used be subtracted from the sample weight.

Remarks: _____

Signature of analyst: _____

Signature of reviewer: _____

Plant Operation Data



PROCESS INFORMATION

PLANT: Marion, VA - 6B DATE: October 17, 1990

Brick Rate:

Car Schedule	=	70	Minutes	=	0.857	Cars/Hour
Car Count	=	1,828	S/S Patio Brick/Car			
Hourly Rate	=	1,567	S/S Brick/Hour			
Brick Weight	=	3.6	Lbs.			
Brick Rate	=	5,641	Lbs./Hour			

Fuel Rate:

Total	=	33.3	Therms/M Brick			
Coal	=	3.62	Tons/Day			
		302	Lbs./Hour	=	84	% of Btu's
Natural Gas	=	19.0	MCF/Day			
		792	Cu. Ft./Hour	=	16	% of Btu's

Total Process Weight:

	5,641	Lbs. Brick/Hour
+	302	Lbs. Coal/Hour
	5,943	Total Lbs./Hour
	2.97	Tons/Hour

Coal Analysis:

See Attached	Btu/Lb.	
	Sulfur	
	Ash	

Allowable Emissions:

New Source Process Weight Formula: 8.5 Lbs./Hour

(Permit: 7.125 Lbs./Hour)

PROCESS INFORMATION

PLANT: Marion, VA - 28 DATE: October 18 & 19, 1990

Brick Rate:

Car Schedule	=	72	Minutes	=	0.83	Cars/Hour
Car Count	=	5,760	S/S Brick/Car			
Hourly Rate	=	4,800	S/S Brick/Hour			
Brick Weight	=	4.8	Lbs.			
Brick Rate	=	23,040	Lbs./Hour			

Fuel Rate:

Total	=	29.0	Therms/M Brick			
Coal	=	10.95	Tons/Day			
		912.5	Lbs./Hour	=	92.5	% of Btu's
Natural Gas	=	25.3	MCF/Day			
		1,054	Cu. Ft./Hour	=	7.5	% of Btu's

Total Process Weight:

	23,040	Lbs. Brick/Hour
+	912	Lbs. Coal/Hour
	23,952	Total Lbs./Hour
	11.98	Tons/Hour

Coal Analysis:

See Attached	Btu/Lb.	
	Sulfur	
	Ash	

Allowable Emissions:

New Source Process Weight Formula: 21.64 Lbs./Hour

(Permit: 19.86 Lbs./Hour)

GUARDIAN SYSTEMS, INC.
P.O. BOX 190
LEEDS, ALABAMA 35094

October 19, 1990

General Shale Products Corporation Control No: 16363
P.O. Box 3547, C.R.S.
Johnson City, TN 37601 Sample Date:

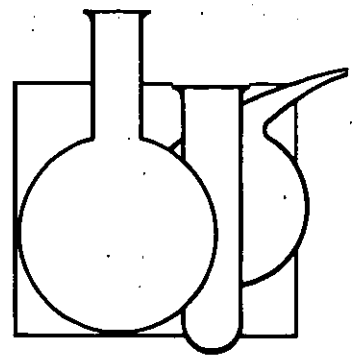
Report to: Mr. David McNees

Sample Mark: Marion
Sample Number:

	As Received	Dry Basis
Moisture, %	3.00	
Ash, %	2.77	2.86
Volatile Matter	37.83	39.00
Fixed Carbon	56.40	58.14
Sulfur, %	.81	.83
BTU	14,341	14,784
MAF, BTU	15,219	

Approved by: Charles M Johnson

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 1.33 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 observed. 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.

The equipment used during these tests was as follows:

Location:

	#6B	#28
Probe	3'	4-1'
Meter Box:	#200	#200
Stack Temperature:	Omega II	Omega II
Sample Box	#1	#1
Condenser:	#1	#1
Average Stack Temperature	411	356
Recalibration Temperature	420	360

The Omega II was recalibrated at the recalibration temperature for each stack and agreed within 1.5% of an ASTM mercury-in-glass reference thermometer. 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:

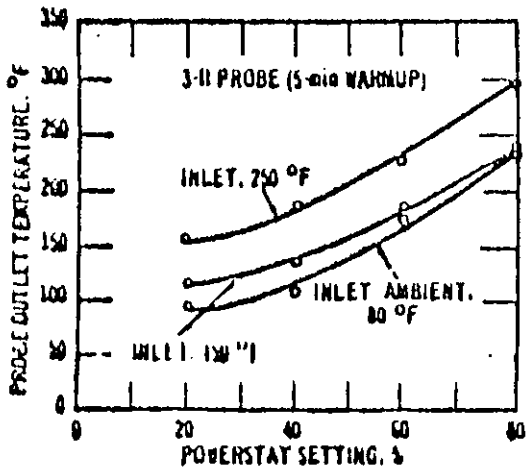
BSO	522	Flow Resistance (Max.) @ 320 cm/min.	80 mm
*pH	9.0	Flow Rate (air) lpm/cm² @ 70 cm Hg	60
DOP @320/cm/min ASTM Methods 2986)	99.9%	Max. Use Temp.	400°C
Tensile Strength (Fed. Spec. UUP31B)	600 gr.	Static Properties	Medium
Weight 8"x10"sheet	4.0±.3 gr.	Ability to Fold	Good

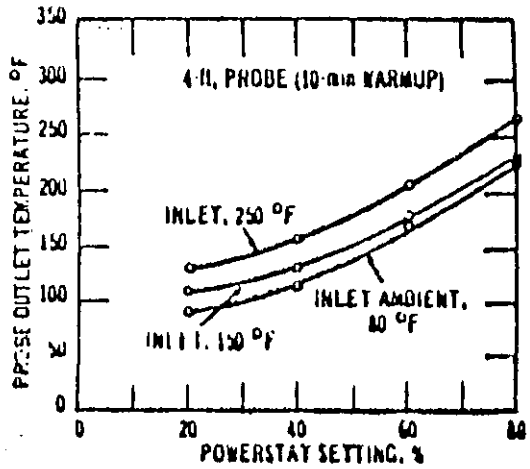
WATER EXTRACTABLE IONS:

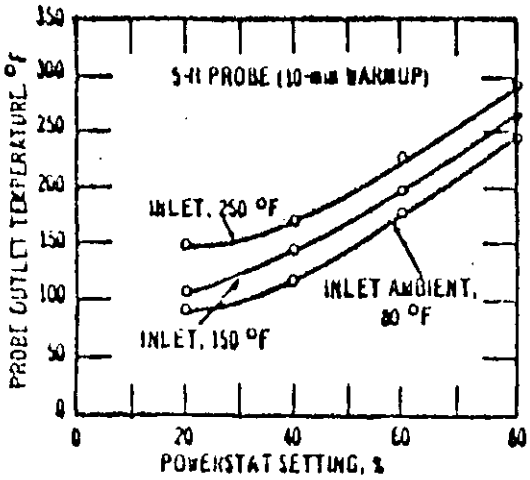
Sulfate	600	Chloride	1500
Nitrate	115	Fluoride	87
Ammonia	13		

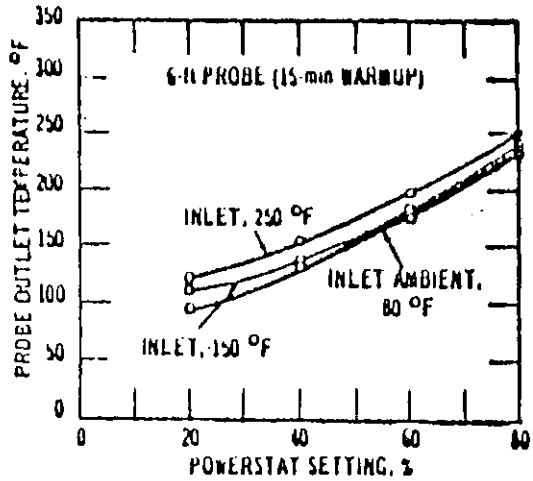
*pH—Gelman Procedure:

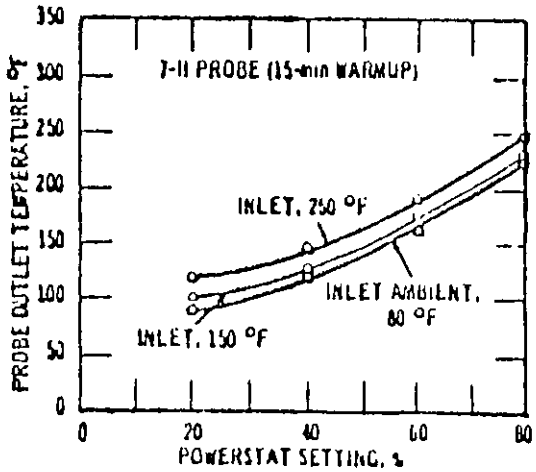
A. 500 ml distilled water.
B. Add 15 drops saturated KCl solution.
C. Shred one 8"x10" sheet and soak in prepared water for one hour.
D. Run pH at ambient temperature.











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				

SIGNATURE

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 Paul Shore Stack 6B

SIGNATURE

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	1.0	1.0	1.0	1.00
0				
Pres Wet Test Meter, in H20	-0.70	-0.70	-0.70	-0.70
Gas Volume Wet Init, CF	0.000	8.500	16.989	25.489
Gas Volume Wet Final, CF	8.500	16.989	25.484	50.973
Gas Volume Dry Init, CF	725.255	733.811	742.496	2201.562
Gas Volume Dry Final, CF	733.811	742.496	751.219	2227.526
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	95	102	105	101
Dry Gas Temp Final In, F	102	105	109	105
Dry Gas Temp Init Out, F	90	92	95	92
Dry Gas Temp Final Out, F	92	95	96	94
Run Time, sec	900	900	900	2700
Meter Calibration Factor, Y	1.0483	1.0384	1.0397	1.0421
Qm	0.5939	0.5959	0.5984	0.5961
Km	0.7431	0.7438	0.7457	0.7442
Delta H@	1.67	1.66	1.66	1.66

Previous Y 1.0501 % Difference 0.76%
Previous H@ 1.67 % Difference 0.43%

Project Grand Shore Stack TK 28

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. Growlin

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 Grandlin

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. Grad

GUARDIAN SYSTEMS INC
Pitot Calibration Form

Date: 5/15/90 Probe #: 3-3

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

Side A

Run #	Pstd	Ptype s	Cp(s)	Deviation
1	0.53	0.72	0.849	0.000
2	0.53	0.72	0.849	0.000
3	0.53	0.72	0.849	0.000

Avg Cp = 0.849 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	0.71	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

Is average PCF equal to or less than 0.01 YES

Average PCF = 0.852

SIGNATURE Tom E. Gravlee

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 Tom E. Gravlee