Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

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

AP42 Section:	11.18
Reference:	6
Title:	*Sulfur Oxide Emission Tests Conducted On The #1 And #2 Cupola Stacks In Leeds, Alabama For Rock Wool Company, November 8 & 9, 1988*, Guardian Systems, Inc., Leeds, AL, Undated.

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d3006-4/971130
03/30/92 1

Emission Test Report
Review Checklist

Reviewer: Wallace
Review Date: 7/31/92

A. Background Information

1. Facility name: Rockwool Company
   Location: Leeds, Alabama
2. Source category: Mineral Wool Production
3. Test date: November 8-9, 1988
4. Test sponsor: Rockwool Company
5. Testing contractor: Guardian Systems, Inc.
6. Purpose of test: Compliance test - state regulations
7. Pollutants measured

   PM PM-10 CO SO_2 NO_x VOC Pb CO_2

   Others (list): Sulfates (SO_3)

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

Attached diagram, Not in Test report but provided by State agency

Test ID	Process	Process ID	Emissions tested		APCD (controlled emissions only)
			Uncontrolled	Controlled	
1	Cupola No 1	A		X	Baghouse
2	Cupola No 2	B		X	Baghouse

B. Process Information

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

No process description was provided in the test report. However, the attached process flow diagram was provided by the State agency (and it included on p 69 of test report). The process data provided in the appendix indicates that the cupola is charged at a rate of about 5 tons per hour with approximately equal charges occurring at about 10 minute. The charge burden comprises a mixture of coke (~15%) and slage (~85%) in Unit A and a mixture of coke (~15%), slag (~80%), and ore (~5%) in unit B.

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

Process ID	Feedstock materials	Products	Basis for activity factor	F/P
A	Coke and Slag	Raw Mineral Wool	Total Feed	F
B	Coke, Slag, Ore	"	Total Feed	F

Basis for data: p65, 66
(Indicate page/table Nos. in test report)

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

Process ID	Capacity	Units	Test run	Process rate	Units
A	NA	—	1	4.725	T/hr
			2	4.725	T/hr
			3	4.725	T/hr
			4		
B	NA	—	1	5.01	T/hr
			2	5.01	T/hr
			3	5.01	T/hr
			4		
			1		
			2		
			3		
			4		
			1		
			2		
			3		
			4		

Basis for data: page 7, 10, 65, 66

C. Air Pollution Control Systems Tested

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

ID	Type of APCD	Manufacturer	Model No.
W	Fabric Filter	NA	NA
X	"	NA	NA

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

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

None available

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

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

No APCD data available

D. Sampling and Analysis Methods

1. Complete the following table

Test location	Pollutant	S & A method	Reference/ conditional method	Deviations noted
1 and 2	SO_2	Method 8	Y/N	Y/N
	Sulfates	Method 8	Y/N	Y/N
	CO	Method 3 (Orsat)	Y/N	Y/N
	CO_2	Method 3 (Orsat)	Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N

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

3. Describe any deviations identified above.

E. Emission Data Documentation

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

Test ID	Parameter	Units	Values reported			
			Run 1	Run 2	Run 3	~~Run 4~~ Avg
1	Stack temperature	°F	146	153	161	153
	Moisture	% V	7.00	6.50	7.11	6.68
	Oxygen	% V	6.53	6.00	5.63	6.06
	Volumetric flow, actual	acfm	4273	4369	4092	4413
	Volumetric flow, standard	dscfm	3873	3524	3236	3544
	Percent isokinetic		104	103	105	
	Pollutant concentration:					
	SO_2	lb/dscf	1.23×10^{-4}	1.70×10^{-4}	1.24×10^{-4}	
	CO	%	7.78	8.00	8.00	
	CO_2	%	9.73	10.00	10.00	
	SO_3 (No conc available)	lb/hr	0.08	0.08	0.09	
	Stack temperature	°F	130	131	121	127
	Moisture	%	7.34	6.35	5.05	6.22
	Oxygen	%	12.00	11.93	11.77	11.90
	Volumetric flow, actual	acfm	9509	8847	10,191	
	Volumetric flow, standard	dscfm	7904	7420	8806	
	Percent isokinetic		109	108	106	
	Pollutant concentration:					
	SO_2	lb/dscf	6.82×10^{-5}	7.37×10^{-5}	7.24×10^{-5}	
	CO	%	3.53	3.63	3.40	
	CO_2	%	4.80	4.83	5.17	
	SO_3	lb/hr	0.05	0.03	0.03	
	Stack temperature					
	Moisture					
	Oxygen					
	Volumetric flow, actual					
	Volumetric flow, standard					
	Percent isokinetic					
	Pollutant concentration:					

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2. Tabulate pollutant mass flux rates 9/

Test ID	Pollutant	Units	Mass flux rates			
			Run 1	Run 2	Run 3	Run 4
1	SO_2	lb/hr	26.62	35.90	24.05	
	CO	lb/hr	13.12	12.30	12.14	
	CO_2	lb/hr	2584	2417	2219	
	SO_3	lb/hr	4.08	0.08	0.14	
2	SO_2	lb/hr	32.58	32.79	36.26	
	CO	lb/hr	1218	1176	1306	
	CO_2	lb/hr	2602	2458	3122	
	SO_3	lb/hr	0.05	0.03	0.02	

9/ All taken directly from Table except CO_2 which was calculated as

$$CO_2(lb/hr) = Q\left(\frac{dscf}{min}\right) * 60\frac{min}{hr} * C_{CO_2}(90/100) * \frac{1\,lb\,mole}{385\,scf} * \frac{44\,lb\,CO_2}{lb\text{-}mole\,CO_2}$$

3. Present example emission factor calculations below.

$$E.F = \frac{ER\ (lb/hr)}{Process\ rate\ (T/hr)}$$

Data Taken Tables B. 3 and E. 2

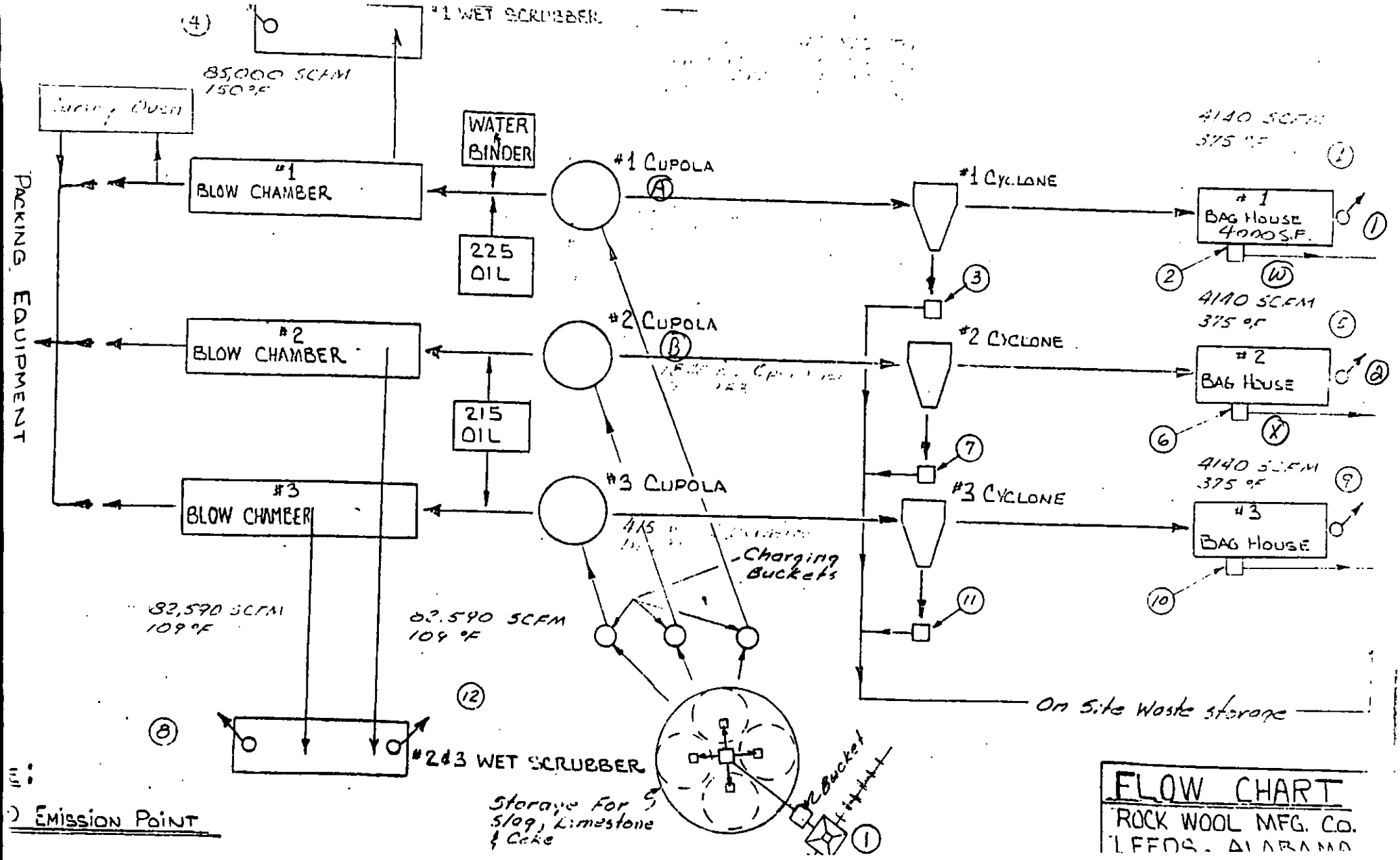
4. Tabulate emission factors

Process	Pollutant	Units	Average emission factor	
			Uncontrolled	Controlled
A	SO_2	lb/Ton		6.25
	CO	lb/ton	265	
	CO_2	lb/ton	509	
	SO_3	lb/ton		0.30 a/
B	SO_2			6.89
	CO		246	
	CO_2		544	
	SO_3			0.0067

a/ Contained 1 very high value

ATTACHMENT A
APCD PARAMETERS

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



) Emission Point

Wallace
7/28/92

Notes re existing emission factors

① All emission factors cite Reference 2; which is AP-40

② Pollutants are PM and SO_2 units are total weight of Charge

③ Processes for which EF available
- Cupola
- Reverberatory furnace
- Blow chamber
- Curing oven
- Cooler

Note that results for Cupola and Blow Chamber are based on a straight arithmetic average of results for 3 Cupolas (Table 98) and 4 blow chambers (Table 100), respectively. The Cupola numbers are fairly tight and hence OK. At least 1 of the blow chamber values is out of line as shown below

Plant	EF (lb/ton product)
1	5.2
13	3.9
14	55.7 - ?
25	4.0

~~Also units for Cupola probably be lb/ton of mineral wool produced, not per ton charge.~~

21

SULFUR OXIDE EMISSION TESTS

CONDUCTED ON THE

#1 AND #2 CUPOLA STACKS

IN

LEEDS, ALABAMA

FOR

ROCK WOOL COMPANY

ON

NOVEMBER 8 & 9 1988

Contains sufficient data to calculate cupola emission factors for SO_2, sulfates, CO, and CO_2

Note that process rate is based on slag, coal and ore (Unit 2) or slag and coal.

Approved by: Tom Lotz
Director
Field Services Division

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I. INTRODUCTION

On November 8 & 9 1988, Guardian Systems, Inc. performed a series of sulfur oxide emission tests on the #1 and #2 Cupola Stacks at Rock Wool Company in Leeds, Alabama. These tests were conducted in accordance to the rules and regulations expressed in the Code of Federal Regulations, Title 40, Section 60, Reference Methods 1-4 , and modified Method 8 as amended and approved by the Jefferson County Department of Health, Air Pollution Control (JCHD). The purpose of these tests were to determine the SO_2, SO_3, and particulate sulfur(expressed as SO_2) emissions from these stacks.

The following personnel were present during the actual field sampling and represented the companies indicated:

Mr. Bill Haag	Rock Wool Company
Mr. Ralph Fulton	JCHD
Mr. Brian Debrow	JCHD
Mr. Tom Lotz	Guardian Systems, Inc.
Mr. John Hamrick	Guardian Systems, Inc.
Mr. Tom Gravlee	Guardian Systems, Inc.

0.120

1 Cupola g/sec = 30.30 lb/hr × 453.6 g/lb × 1 hr/3600 sec = 3.88 g/sec

2 Cupolas " = 66.14 lb/hr × 0.120 = 8.33

II. SUMMARY OF TEST RESULTS

The following is a listing of the composite emissions from each source. For complete information by source see the following pages.

Test Location	Stack #1	Phone	Sack #2	Phone
Date	11/9/88	11/21/88	11/8/88	11/21/88
Process weight, Tons/hr	4.725		5.01	
Emissions, #/hr				
as Sulfur Dioxide	29.51	30.65	34.52	35.09
as Sulfur Trioxide	0.19	0.19	0.03	0.03
as SO_2 on Filter	0.06	0.06	0.21	0.22
Total Emissions, #/hr				
Sulfur Oxides	29.75	30.80	34.77	35.34
Total Emissions, #/hr				
Carbon Monoxide	1255	1256	1236	1304

E.F. $\frac{lbs}{Ton}$ = Run 1: $\frac{30.80\ lb/hr}{4.725\ TPH}$ = 6.52 lb/Ton Run 2: $\frac{35.34\ lb/hr}{5.01\ TPH}$ = 7.05 lb/Ton

Avg. 6.785 lb/Ton

30.80
35.34
66.14

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 300
LEEDS, AL 35094
205-699-6647

Summarized Air Test Results for Rock Wool Company

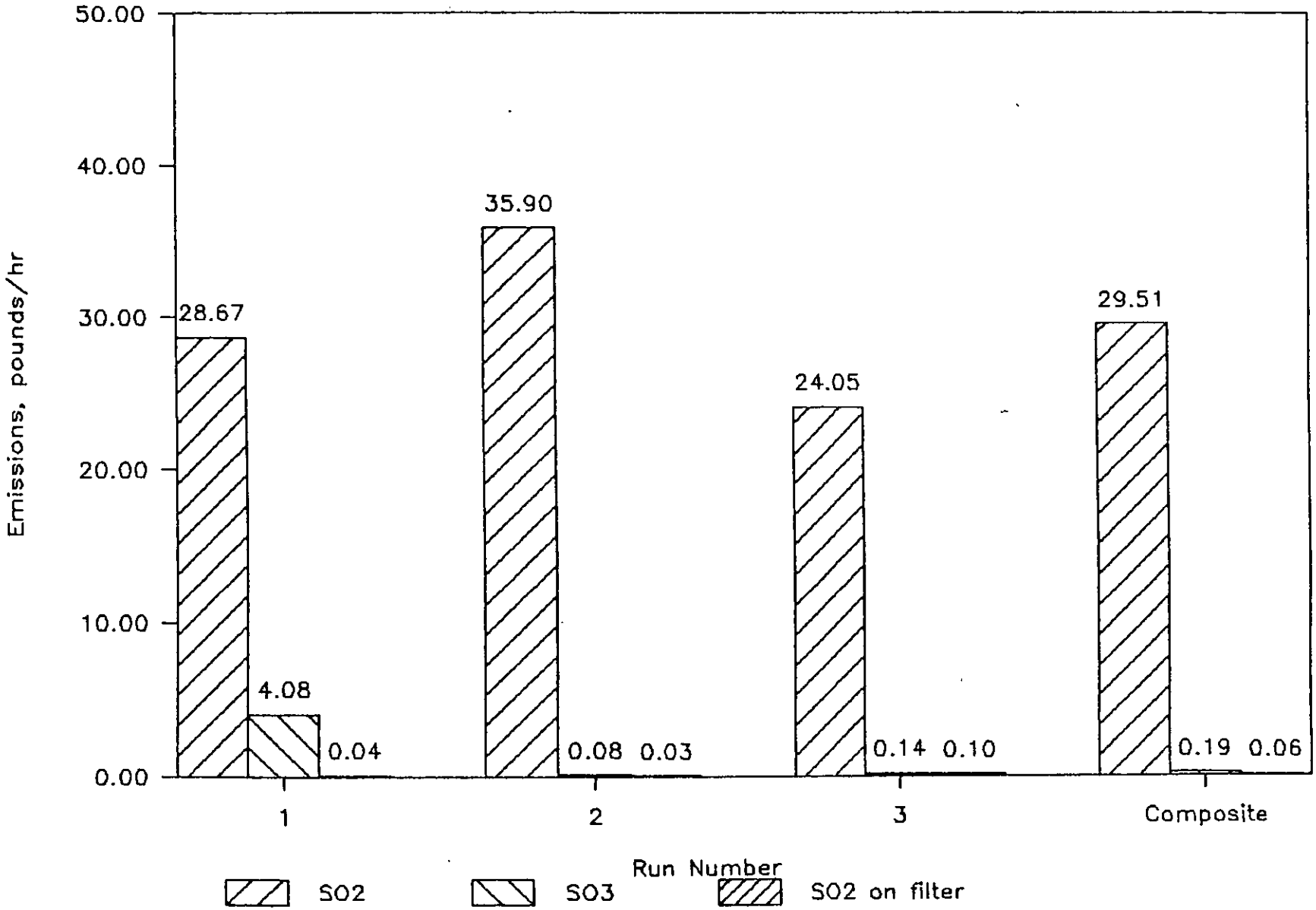
Run Number	1	2	3	Composite
Date	11-09-88	11-09-88	11-09-88	11-09-88
Location	Unit #1	Unit #1	Unit #1	Unit #1
Time	0940-1043	1130-1233	1347-1450	0940-1450
Stack Gas Temperature, F	146	153	161	153
Moisture Content, % v/v	7.00	6.50	7.11	6.88
Oxygen Content, % v/v	6.53	6.00	5.63	6.06
Carbon Dioxide Content, % v/v	9.73	10.00	10.00	9.91
Carbon Monoxide Content, % v/v	7.77	8.00	8.60	8.12
Excess Air, %	15.23	11.07	7.14	11.05
Stack Gas Velocity Feet per Second	21.82	19.97	18.71	20.17
Volumetric Flow Actual Cubic Feet per Minute	4,773	4,369	4,092	4,413
Volumetric Flow Dry Std Cubic Feet per Minute	3,873	3,524	3,236	3,543
Emissions, pounds/hr				
Sulfur Dioxide	28.67	35.90	24.05	29.51
Sulfur Trioxide	4.08	0.08	0.14	0.19
Sulfur on filter as SO2	0.04	0.03	0.10	0.06
Total Sulfur Oxides (SOx)	32.79	36.01	24.30	29.75
		Max		Avg
Carbon Monoxide Emission Rate pounds/hr	1312	1230	1214	1255
Cupola Charging Process Weight, Tons/hr	4.725	4.725	4.725	4.725
% Isokinetic	104.41	102.71	105.26	104.08

$\frac{4.30}{3} = 1.433$ .35

Table 1

ROCK WOOL COMPANY EMISSIONS UNIT # 1

On November 9, 1988



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 300
LEEDS, AL 35094
205-699-6647

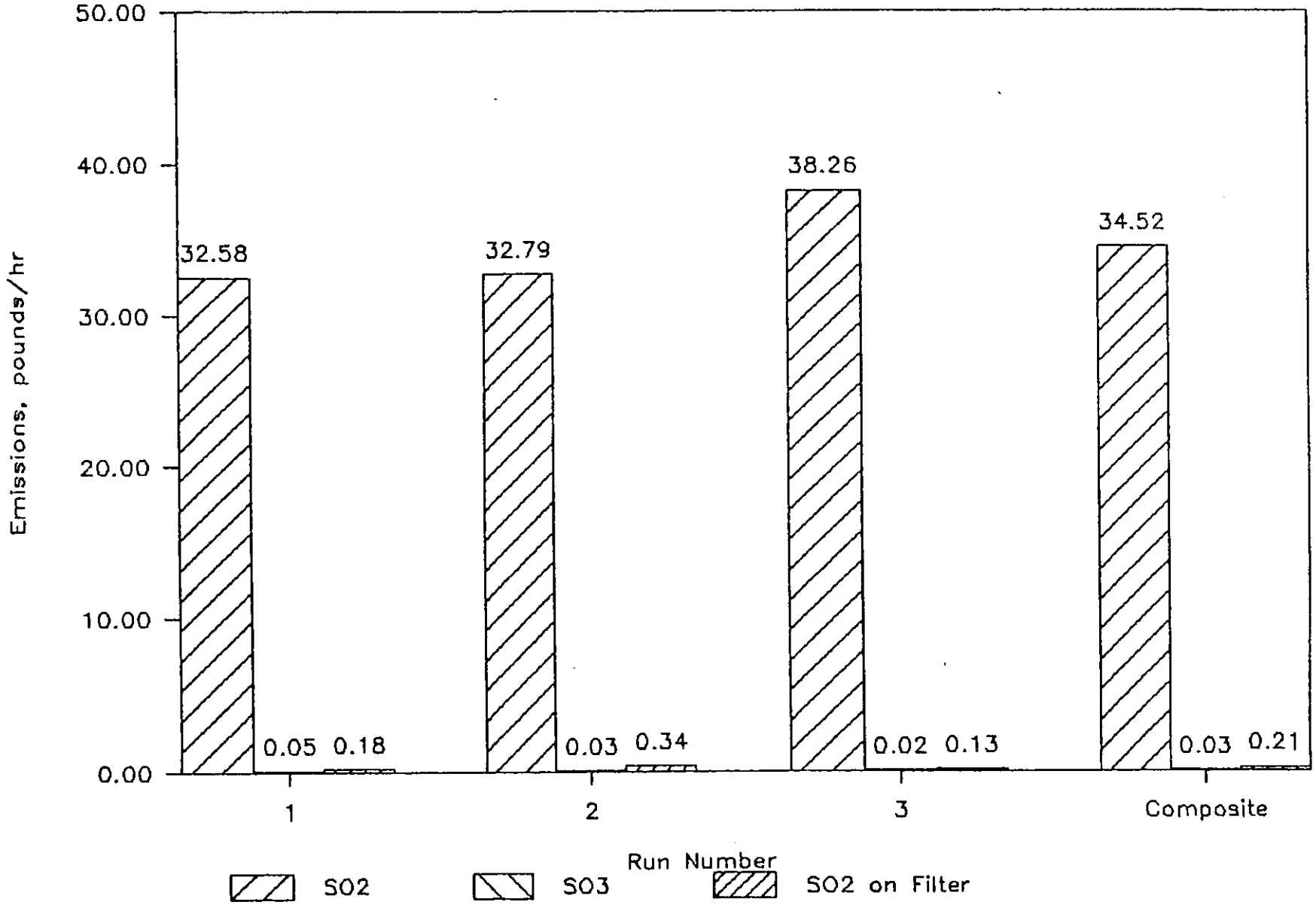
Summarized Air Test Results for Rock Wool Company

Run Number	1	2	3	Composite
Date	11-08-88	11-08-88	11-08-88	11-08-88
Location	Unit #2	Unit #2	Unit #2	Unit #2
Time	0940-1045	1139-1243	1320-1423	0940-1423
Stack Gas Temperature, F	130	131	121	127
Moisture Content, % v/v	7.34	6.35	5.05	6.22
Oxygen Content, % v/v	12.00	11.93	11.77	11.90
Carbon Dioxide Content, % v/v	4.80	4.83	5.17	4.93
Carbon Monoxide Content, % v/v	3.53	3.63	3.40	3.52
Excess Air, %	94.76	92.83	91.80	93.13
Stack Gas Velocity Feet per Second	43.47	40.44	46.54	43.50
Volumetric Flow Actual Cubic Feet per Minute	9,509	8,847	10,181	9,515
Volumetric Flow Dry Std Cubic Feet per Minute	7,904	7,420	8,806	8,041
Emissions, pounds/hr				
Sulfur Dioxide	32.58	32.79	38.26	34.52
Sulfur Trioxide	0.05	0.03	0.02	0.03
Sulfur on filter as SO2	0.18	0.34	0.13	0.21
Total Sulfur Oxides (SOx)	32.81	33.16	38.41	34.77
			Max.	Avg
Carbon Monoxide Emission Rate pounds/hr	1218	1176	1306	1236
Cupola Charging Process Weight, Tons/hr includes slag & coke	5.01	5.01	5.01	5.01
% Isokinetic	109.06	107.75	105.99	107.59

Table 2

ROCK WOOL COMPANY EMISSIONS UNIT # 2

On November 8, 1988



Graph 2

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 300
LEEDS, AL. 35094
205-699-6647

Computer Input Paramters for Rock Wool Company

Run Number	1	2	3	Composite
Date	11-09-88	11-09-88	11-09-88	11-09-88
Location	Unit #1	Unit #1	Unit #1	Unit #1
Time	0940-1043	1130-1233	1347-1450	0940-1450
Barometric Pressure, in Hg	29.97	29.97	29.97	29.97
Static Pressure, in H20	-0.110	-0.120	-0.110	-0.113
Run Time, minutes	62.50	62.50	62.50	187.50
Meter Volume, CF	37.288	33.568	32.296	103.152
Meter Correction factor, MCF	1.0049	1.0049	1.0049	
Meter Volume (Corrected)	37.471	33.732	32.454	103.657
Stack Temperature, F	146	153	161	153
Meter Temperature, F	87	90	102	93
Meter Pressure, in H20	1.22	1.01	0.90	1.04
Sqr Velocity Pressure	0.372	0.339	0.315	0.342
Ml of Water Collected	58.1	48.0	49.8	155.9
% Oxygen	6.53	6.00	5.63	6.06
% Carbon Dioxide	9.73	10.00	10.00	9.91
% Carbon Monoxide	7.77	8.00	8.60	8.12
Stack Area, Sq ft $\frac{21'' \times 25''}{144} = 3.6458$	3.646	3.646	3.646	3.646
Pitot Correction Factor	0.822	0.822	0.822	0.822
Nozzle Diameter, in	0.310	0.310	0.310	0.310
Cupola Charging Process Weight, Tons/hr	4.725	4.725	4.725	4.725

G-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 300
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Computed Air Test Results for Rock Wool Company

Run Number	1	2	3	Composite
Date	11-09-88	11-09-88	11-09-88	11-09-88
Location	Unit #1	Unit #1	Unit #1	Unit #1
Time	0940-1043	1130-1233	1347-1450	0940-1450
1. Stack Pressure				
Inches Hg	29.96	29.96	29.96	29.96
Millimeters Hg	761.03	761.01	761.03	761.03
2. Meter Pressure				
Inches Hg	30.06	30.04	30.04	30.05
Millimeters Hg	763.52	763.12	762.92	763.19
3. Meter Volume				
Dry Std Cubic Feet	36.338	32.518	30.609	99.390
Dry Std Cubic Meters	1.029	0.921	0.867	2.815
4. Water Volume				
Std Cubic Feet	2.735	2.259	2.344	7.338
Std Cubic Meters	0.077	0.064	0.066	0.208
5. Moisture Content, %	7.00	6.50	7.11	6.88
6. Molecular Weight Dry	29.82	29.84	29.83	29.83
7. Molecular Weight Wet	28.99	29.07	28.98	29.01
8. Stack Velocity				
Feet per Second	21.82	19.97	18.71	20.17
Meters per Second	6.65	6.09	5.70	6.15
9. Volumetric Flow				
Actual Cubic Ft per minute	4,773	4,369	4,092	4,413
Actual Cubic M per second	2.25	2.06	1.93	2.08
10. Volumetric Flow				
Dry Std Cubic Ft per minute	3,873	3,524	3,236	3,543
Dry Std Cubic M per second	1.83	1.66	1.53	1.67
Sulfur Dioxide Concentrations				
Pounds/DSCF	1.23E-04	1.70E-04	1.24E-04	1.39E-04
Gms/DSCM	1.98	2.72	1.98	2.22
PPM	742	1021	744	834

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 300
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205-699-6647

Computed Air Test Results for Rock Wool Company

Run Number	1	2	3	Composite
Date	11-09-88	11-09-88	11-09-88	11-09-88
Location	Unit #1	Unit #1	Unit #1	Unit #1
Time	0940-1043	1130-1233	1347-1450	0940-1450
Sulfur Trioxide Concentrations				
Pounds/DSCF	1.75E-05	3.55E-07	7.39E-07	8.82E-07
Gms/DSCM	2.81E-01	5.69E-03	1.18E-02	1.41E-02
PPM	84.3	1.7	3.6	4.2
Sulfur Oxide Concentrations				
as SO2 Pounds/DSCF	1.91E-07	1.54E-07	5.41E-07	2.87E-07
as SO2 Gms/DSCM	3.05E-03	2.46E-03	8.66E-03	4.59E-03
as SO2 PPM	1.1	0.9	3.2	1.7
Carbon Monoxide Concentrations				
Pounds/DSCF	5.65E-03	5.82E-03	6.25E-03	5.91E-03
Gms/DSCM	90.46	93.18	100.17	94.60
PPM	77,667	80,000	86,000	81,222
12. Excess Air, %	15.23	11.07	7.14	11.05
15a. SO2 Mass Rate Pounds per Hour, #/hr	28.67	35.90	24.05	29.51
15a. SO3 Mass Rate Pounds per Hour, #/hr	4.08	0.08	0.14	0.19
15a. SOX Mass Rate Pounds per Hour, #/hr	0.04	0.03	0.10	0.06
15a. CO Mass Rate Pounds per Hour, #/hr	1312.45	1229.82	1214.30	1255.44
16. Volume at Nozzle				
Actual Cubic Feet	44.784	40.322	38.705	123.811
Actual Cubic Meters	1.268	1.142	1.096	3.506
18. Isokinetic, %	104.41	102.71	105.26	104.08

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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 300
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Computer Input Paramters for Rock Wool Company

Run Number	1	2	3	Composite
Date	11-08-88	11-08-88	11-08-88	11-08-88
Location	Unit #2	Unit #2	Unit #2	Unit #2
Time	0940-1045	1139-1243	1320-1423	0940-1423
Barometric Pressure, in Hg	30.00	30.00	30.00	30.00
Static Pressure, in H2O	-0.130	-0.130	-0.130	-0.130
Run Time, minutes	62.50	62.50	62.50	187.50
Meter Volume, CF	51.230	47.549	55.804	154.583
Meter Correction factor, MCF	1.0067	1.0067	1.0067	
Meter Volume (Corrected)	51.573	47.868	56.178	155.619
Stack Temperature, F	130	131	121	127
Meter Temperature, F	94	94	98	95
Meter Pressure, in H2O	2.37	2.07	2.82	2.42
Sqr Velocity Pressure	0.744	0.693	0.807	0.748
Ml of Water Collected	83.4	66.2	60.7	210.3
% Oxygen	12.00	11.93	11.77	11.90
% Carbon Dioxide	4.80	4.83	5.17	4.93
% Carbon Monoxide	3.53	3.63	3.40	3.52
Stack Area, Sq ft	3.646	3.646	3.646	3.646
Pitot Correction Factor	0.822	0.822	0.822	0.822
Nozzle Diameter, in	0.248	0.248	0.248	0.248
Cupola Charging Process Weight, Tons/hr	5.01	5.01	5.01	5.01

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 300
LEEDS, AL 35094
205-699-6647

Computed Air Test Results for Rock Wool Company

Run Number	1	2	3	Composite
Date	11-08-88	11-08-88	11-08-88	11-08-88
Location	Unit #2	Unit #2	Unit #2	Unit #2
Time	0940-1045	1139-1243	1320-1423	0940-1423
1. Stack Pressure				
Inches Hg	29.99	29.99	29.99	29.99
Millimeters Hg	761.76	761.76	761.76	761.76
2. Meter Pressure				
Inches Hg	30.17	30.15	30.21	30.18
Millimeters Hg	766.43	765.87	767.27	766.52
3. Meter Volume				
Dry Std Cubic Feet	49.571	45.975	53.668	149.235
Dry Std Cubic Meters	1.404	1.302	1.520	4.226
4. Water Volume				
Std Cubic Feet	3.926	3.116	2.857	9.899
Std Cubic Meters	0.111	0.088	0.081	0.280
5. Moisture Content, %	7.34	6.35	5.05	6.22
6. Molecular Weight Dry	29.25	29.25	29.30	29.27
7. Molecular Weight Wet	28.42	28.54	28.73	28.56
8. Stack Velocity				
Feet per Second	43.47	40.44	46.54	43.50
Meters per Second	13.25	12.33	14.19	13.26
9. Volumetric Flow				
Actual Cubic Ft per minute	9,509	8,847	10,181	9,515
Actual Cubic M per second	4.49	4.18	4.81	4.49
10. Volumetric Flow				
Dry Std Cubic Ft per minute	7,904	7,420	8,806	8,041
Dry Std Cubic M per second	3.73	3.50	4.16	3.80
Sulfur Dioxide Concentrations				
Pounds/DSCF	6.87E-05	7.37E-05	7.24E-05	7.16E-05
Gms/DSCM	1.10	1.18	1.16	1.15
PPM	413	443	435	430

Sample Calculations Unit #1
Run #1

1. Stack Pressure $= 29.97 + \frac{-.11}{13.6} = 29.96$

2. Meter Pressure $= 29.97 + \frac{1.22}{13.6} = 30.06$

3. Meter Volume $= (37.471)(30.06)(460+68) / (29.92)(27+460) = 36.339$

   DSCM $= 36.339 \times .02832 = 1.029$

4. Water vol $= .04707\ (58.1) = 2.735$

5. Moisture $= \frac{2.735}{(2.735\ 36.339)} = .0700 = 7.00\%$

6. Mole wt. $= .44(9.73) + .32(6.53) + .28(83.74) = 29.82$

7. mole wt $= 29.82\ (1 - .0700) + (7.00)(.18) = 28.99$

8. Velocity $= (85.49)(.822)(.372)\sqrt{\frac{(146+460)}{(29.96)(28.99)}} = 21.84$

9. $Q_a = (21.84)(60)\left(\frac{21 \times 25}{144}\right) = 4778$

10. $Q_{std} = (4778)\left(\frac{29.96}{29.92}\right)\left(\frac{528}{(146+460)}\right)(1 - .07) = 3877$

#/hr SO_2 $= (.00007061)(.0109)(11.65-0)\left(\frac{500}{1}\right) / 36.339 = .0001233$

Gms/dscm SO_2 $= (.03203)(.0109)(11.65-0)\left(\frac{500}{1}\right) / 1.029 = 1.98$

ppm SO_2 $= \frac{(24.45)(\cancel{760})}{298} = \frac{X\ (\cancel{760})}{293} = 24.0398$ $\qquad \frac{24.0398}{64.064} = .375$

$.375 \times 1.98 \times 1000 = 743$ ppm

SULFUR TRIOXIDE

$\#/DSCF = (.00008825)(.0109)(2.65-0)\left(\frac{250}{1}\right) / 36.339 = 1.75 \times 10^{-5}$

$GMS/DSCM = (.04003)(.0109)(2.65-0)\left(\frac{250}{1}\right) / 1.029 = 2.81 \times 10^{-1}$

$ppm = \frac{24.0398}{80.064} = .300$

$.300 \times .281 \times 1000 = 84.3$

SULFUR OXIDES

$\#/DSCF = (.00007061)(.0109)(.9-0)\left(\frac{250}{25}\right) / 36.339 = 1.91 \times 10^{-7}$

$GMS/DSCF = (.03203)(.0109)(.9-0)\left(\frac{250}{25}\right) / 1.029 = 3.05 \times 10^{-3}$

$= .375 \times 1000 \times .00305 = 1.15$

CO

$ppm = 7.7667 \times 10{,}000 = 77{,}667\ ppm$

$\frac{28}{24.0388} = 1.16$

$GMS/DSCM = \frac{77{,}667}{1000} \times 1.16 = 90.46$

$\#/DSCF = 90.46 \frac{GMS}{DSCM} \cdot \frac{.00220462\ \#}{GMS} \cdot \frac{CM}{35.314445\ CF}$

$= 5.65 \times 10^{-5}$

12. Excess Air = $(6.53 - (.5)(2.77)) / ((.264)(75.52) - ((6.53 - (.5)(2.77))))$

$= 2.645 / 17.411 = .1519 \times 100 = 15.19\%$

15 a. SO_2 #/hr = $.0001233 \times 3877 \times 60 = 28.68$

SO_3 = $1.75 \times 10^{-5} \times 3877 \times 60 = 4.07$

SO_4 - part = 1.91×10^{-7} 3877×60 = .04

CO = $5.65 \times 10^{-3} \times 3877 \times 60 = 1314$

16 Vol of Nozzle = $\frac{(460+146)}{29.96}\left[(.002662)(58.1) + (37.471)(34.06)/(460+87)\right]$

$= 44.785$

Area of Nozzle = $\left((.310)/24\right)^2 \times 3.1416 = .000524$

18 % I = $(100)(44.785) / (62.5)(60)(21.84)(.000524) = 104.36$

III. METHOD 8 SAMPLING AND ANALYTICAL PROCEDURES

General

All sampling and analytical procedures for determination of the sulfur dioxide, sulfur trioxide, and particulate sulfur (as sulfur dioxide) emissions from this source were conducted in strict adherence with the Code of Federal Regulations, Title 40, Part 60, Appendix A, Methods 1-4, & 8 as amended and described below. The equipment used in this test was manufactured by Research Appliance Corporation and was properly calibrated before these tests (See **Calibrations**). These gas fractions were extracted isokinetically from the stack and separated. Each fraction was measured separately by the barium-thorin titratin method.

METHOD 1

This method was used to determine the number of sampling points and the required matrix. The dimensions of both stacks (see **Figures 1 & 2**) indicated that 25 points would be required to sample these stacks. We sampled 25 points (5 x 5 matrix) for two and a half minutes at each point on both stacks. Verification of absence of cyclonic flow was not determined because cyclonic flow did not seem to exist from the stack exhaust.

METHOD 2

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

METHOD 3

Gas analysis for CO_2, O_2, CO, and N_2 by difference was performed using the multi-point integrated sample technique during each test. The individual gas bags (aluminized Mylar) were leak checked the previous night by pressuring each bag to 4 in. H_2O and allowed to stand overnight. All gas bags used in this test were leak free. The integrated gas samples were taken utilizing the sampling train shown in **Figure 3**. Just prior to sampling, a 10 inch Hg vacuum was placed across the system and the vacuum remained stable for 0.5 minutes. The samples were taken at a constant rate (see **Data Sheets**) at each point used in the particulate traverse.

After completion of sampling, the sampling train was again leak checked at 10 in. Hg and no leaks were noted for 0.5 minutes. Each gas sample was analyzed with a Hayes Orsat Gas Analyzer (0-50% scale with 0.1% divisions) within eight (8) hours after it was taken. Each analysis was repeated until the results of any three analyses differed by no more than (1) 0.3% by volume when the CO_2 was greater than 4.0% by volume or 0.2% by volume when the CO_2 was less than 4.0% by volume; (2) 0.3% by volume when the O_2 is less than 15.0% by volume or 0.2% by volume when the O_2 is less than 15.0%; (3) and 0.3% by volume for CO. The orsat was leak checked before and after each sample was analyzed for 4 minutes and the meniscus in the burette did not change by more than 0.2 ml or the liquid level in each pipette did not fall below the bottom of the capillary tubing (see **Data Sheets**). The data was validated by calculating a fuel factor, F_0 and comparing the calculated value to the expected value. All values where within the expected range of F_0 = 1.016 to 1.130 for anthracite and 1.083 to 1.230 for bituminous.

METHOD 4

Moisture content of the stack gases was determined in conjunction with Method 8 for each test by weighing the amount of water collected in the impingers and the increase in weight of the silica gel. These weights were combined to give the total amount of water collected.

METHOD 8

Sampling Techniques

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

The sampling probe was placed at each sampling point for two and a half minutes to provide a total sampling time of 62.5 minutes. The gases were drawn through a stainless steel nozzle attached to a heated glass lined probe. The probe was maintained at the minimum setting to prevent condensation. 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 ambient temperature.

The gases were then scrubbed through a series of four impingers to capture SO_3 and SO_2. The first impinger contained approximately 100ml of 80% isopropanol solution, the second and second third contained approximately 100 ml of a 3% hydrogen peroxide solution each, and the fourth contained approximately 200 grams of silica gel. These impingers were placed in an ice bath to maintain a maxium exit temperature of 68 °F. This temperature was also recorded on the data sheets. 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, the sampling probe was removed from the stack and the post-test meter and pitot leakage rates were determined and recorded on the Data Sheets. The system was purged by drawing ambient air through the system for fifteen minutes at the average flow rate used for sampling.

The clean-up data was recorded on **Method 8 & Method 5 Sample Recovery and Intergrity Sheet.** These sheets are located in the Field Data Section. Particulate catches were placed in sealed petri dishes. Each isopropanol rinse from the nozzle, probe, cyclone, dropout bottle and filter holder was combined and placed in a sealed container. The contents of the four impingers were transferred to their respective tared bottles and reweighed. Then the rinsings from the connecting pieces and the impingers were added to the respective bottles, labeled and sealed. Field blanks of the isopropanol and hydrogen peroxide was also taken and place in a bottle, labeled and sealed. These containers were clearly marked and transported to our laboratory for analysis.

Analysis

The Filter (Gelman, Class A, without organic binder, minimum 99.9% retention for particules of 0.3 microns as determined by DOP tests) were added to

the probe rinse bottle.

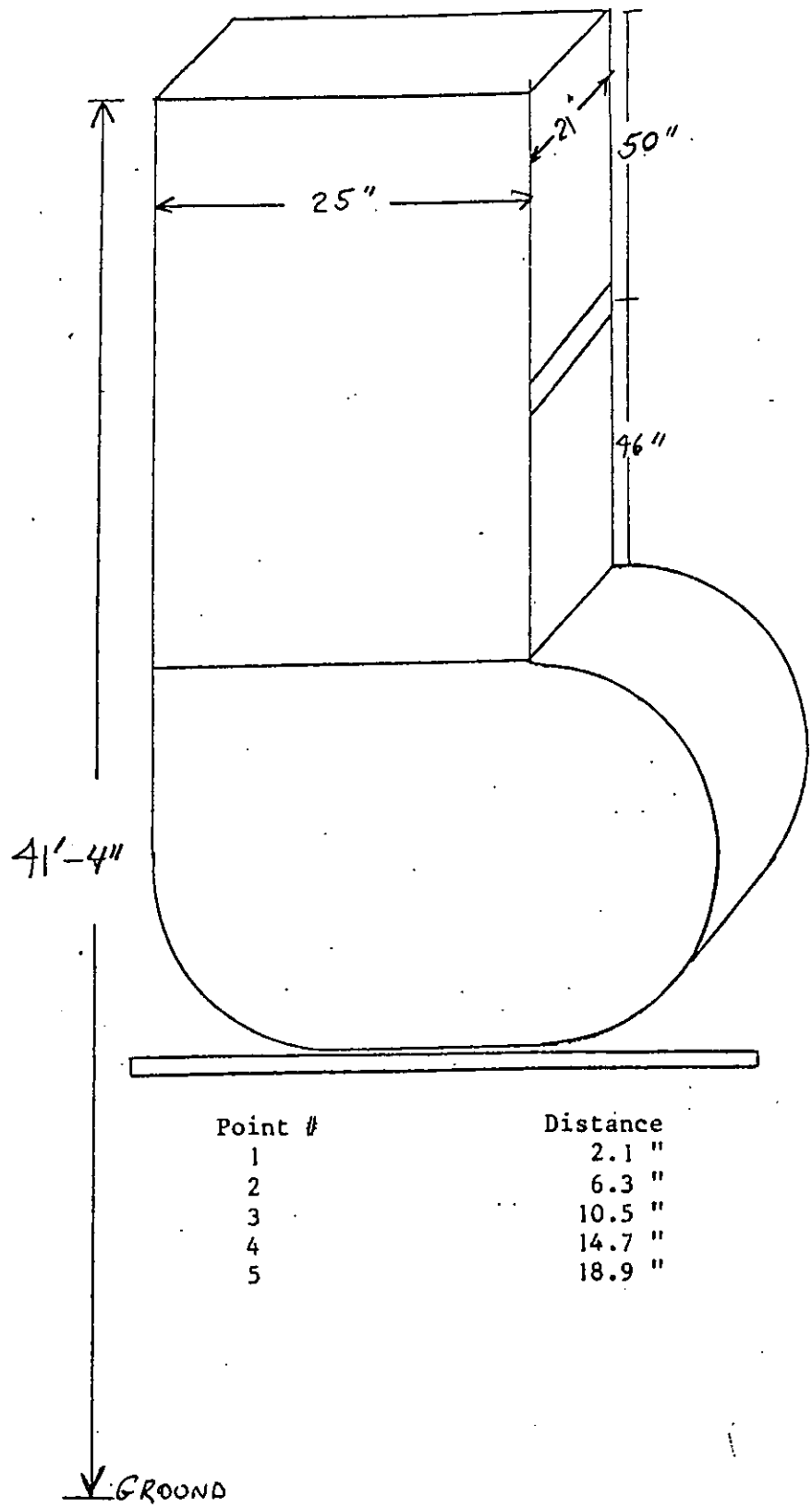
All titrations were performed at our laboratory in Leeds, Alabama. The titer used for this test was again standarized against 0.0200N Sulfuric Acid and the normality was determined to be 0.0109N. A blank was determined for the hydrogen peroxide.

Each container was brought to a known volume and titrated for SO_2 or SO_3 content using the Barium Perchlorate titrant until duplicate titrations agreed within 0.1 ml. This data is recorded on the **Sulfur Analysis Analytical Data.** Additionally one EPA known standard from Lot # 585 was prepared and titrated with the following results:

Sample Number	Measured Concentration	Actual Concentration	Relative Error	Type
9408	224.4 mg/DSCM	221.2 mg/DSCM	1.46%	Known

Stack Breeching and Sample Point Diagram

Cupola #1

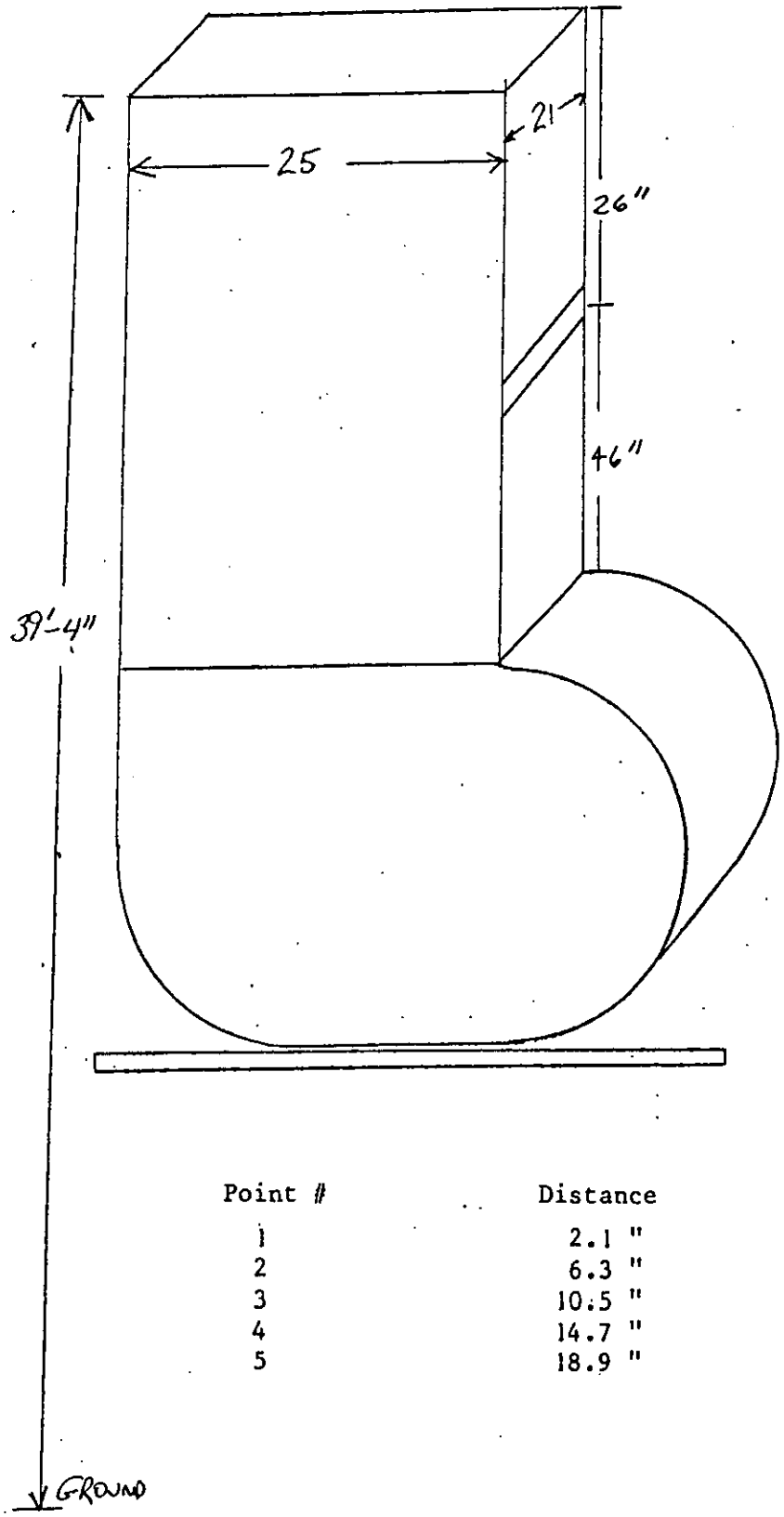


Point #	Distance
1	2.1 "
2	6.3 "
3	10.5 "
4	14.7 "
5	18.9 "

Figure 1

Stack Breeching and Sample Point Diagram

Cupola #2



Point #	Distance
1	2.1 "
2	6.3 "
3	10.5 "
4	14.7 "
5	18.9 "

Figure 2

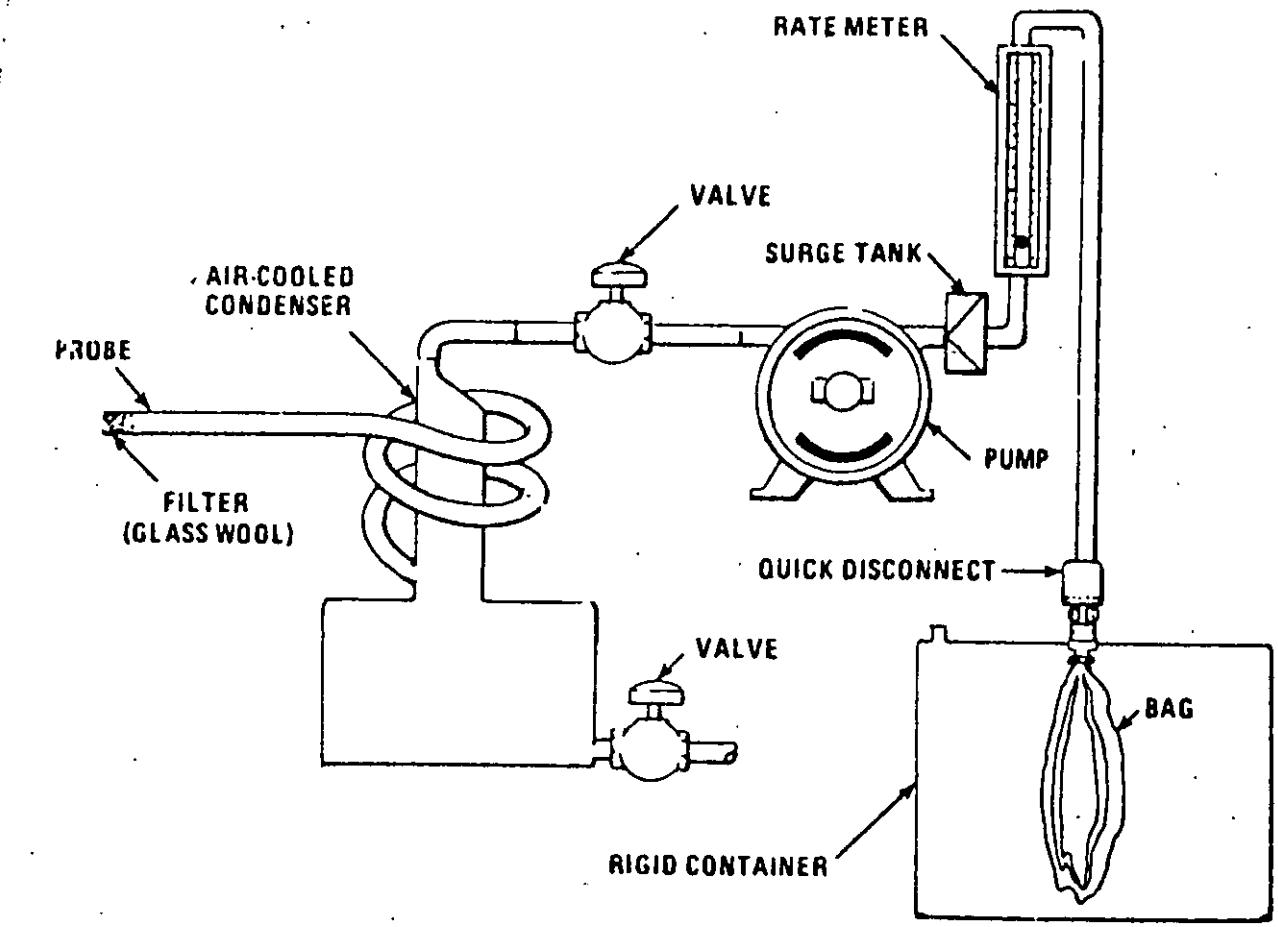
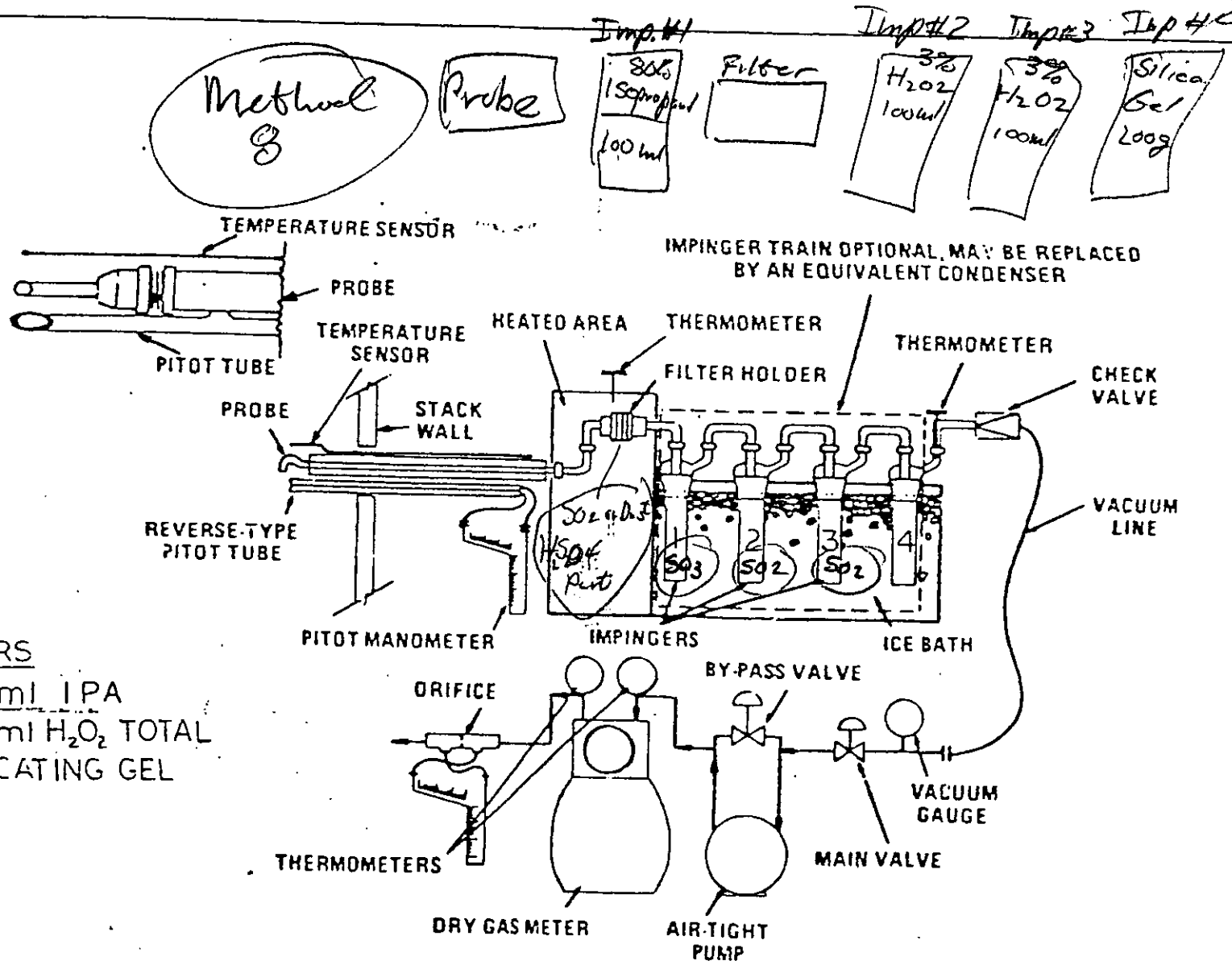

RATE METER
VALVE
SURGE TANK
AIR-COOLED
CONDENSER
PROBE
PUMP
FILTER
(GLASS WOOL)
QUICK DISCONNECT
VALVE
BAG
RIGID CONTAINER

Figure 3



METHOD 8 PARTICULATE SAMPLING TRAIN

Figure 4

GUARDIAN EXCTEMS INC

NOMENCLATURE

ACF - Actual Cubic Feet

ACFM - Actual Cubic Feet per minute

ACM - Actual Cubic Meters

ACMS - Actual Cubic Meters per second

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

As - Area of Stack, (ft^2)

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

Ca - Acetone blank residue concentration, mg/g

c_a - Particulate Concentration, ACF

CFM - Cubic feet per minute

Cp - Pitot tube coefficient, (dimensionless)

c_s - Particulate Concentration, grains/DSCF

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

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

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

DSCF - Dry Standard Cubic Feet

DSCFM - Dry Standard Cubic Feet per minute

DSCM - Dry Standard Cubic Meters

DSCMS - Dry Standard Cubic Meters per second

EA - Excess Air, %

I - Isokinetic Sampling, %

Km - Orifice Correction Factor, (dimensionless)

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

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

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

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

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

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

Mn - Total amount of particulate matter collected, mg.

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

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

ΔP - Velocity head of stack gas, in. H_2O

Pa - Density of acetone, mg/ml

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

Pg - Stack static pressure, in. H_2O

Pm - Meter pressure, in. Hg

PMR - Particulate Mass Rate, lbs per hour

Ps - Absolute stack pressure, in. Hg

Pstd - Standard absolute pressure, 29.92 in. Hg

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

Qa - Volumetric flow rate, ACFM

Qs - Volumetric flow rate, DSCFM

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

SCF - Standard Cubic Foot

ta - Ambient Temperature, ^oF

tm - Average Temperature of meter, ^oF

t_s - Average Temperature of stack, ^oF

tstd - Standard Temperature, 68°F

NOTE: Capital "T" denotes degrees Rankin

Va - Volume of acetone blank, ml

Vaw - Volume of acetone used in wash, ml

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

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

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

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

Vn - Volume collected at stack conditions through nozzle, ACF

Vs - Average stack gas velocity, ft/sec.

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

Wa - Weight of residue in acetone wash, mg

Y - Dry gas meter calibration factor, (dimensionless)

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

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

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

Θ - Total sampling time, min.

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

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

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

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

NOMENCLATURE FOR SO_2

C_{so2}	=	Concentration of sulfur dioxide, dry basis corrected to standard conditions, mg/dscm (lb/dscf)
C_{ppm}	=	Concentration of sulfur dioxide, dry std. conditions, ppm
N	=	Normality of barium perchlorate titrant, milliequivalents/ml
P_{bar}	=	Barometric pressure at the exit orifice of the dry gas meter, mm Hg (in. Hg).
P_{std}	=	Standard absolute pressure, 760 mm Hg (29.92 in Hg)
T_m	=	Average dry gas meter absolute temperature, °K (°R).
T_{std}	=	Standard absolute temperature, 293 °K (528 °R)
V_a	=	Volume of sample aliquot titrated, ml.
V_m	=	Dry gas volume measured by the dry gas meter, dcm (dcf)
$V_{m(std)}$	=	Sample volume at standard conditions (dry basis), ml.
V_{soln}	=	Total volume in which the sulfur dioxide sample is contained, 100ml.
V_t	=	Volume of barium perchlorate titrant used for the sample, ml. (average or replicate titrations)
V_{tb}	=	Volume of barium perchlorate titrant used for the blank, ml.
Y	=	Dry gas meter calibration factor
32.03	=	Equivalent weight of sulfur dioxide

EQUATIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

20. $W_a = Ca\ Vaw\ p_a$

EQUATIONS FOR SO_2

$$V_{m(std)} = V_m \times Y \times (T_{std}/T_m) \times (P_{bar}/P_{std})$$
$$= K_1 \times Y \times (V_m) \times (P_{bar}/T_m)$$

$$C_{so2} = K_2 \times (V_t - V_{tb}) \times (N) \times (V_{soln}/V_a) / (V_{m(std)})$$

If C_{so2} is in Metric units then:

$$C_{ppm} = C_{so2} \times 0.375$$

Where: $K_1 = 17.64 \dfrac{°R}{\text{in Hg}}$ for English units

$K_2 = 7.061 \times 10^{-5}$ lb/meq. for English units

FIELD DATA SHEET

PLANT Rockwood RUN # 1

LOCATION UMZ #1 DATE 11-9-88

BARO. PRES. 29.97 TIME 940 - 1043

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	STATIC PRESSURE "H2O .11	PROBE TIP SIZE BEFORE	AFTER
A			763.562	(1)	(2)	(3)		(4)	(5)						
1	2.5	2.5	764.7	144	82	79	80	36	64	.68	.08	1.0		.310	.310
2		5.0	765.9	146	86	82	84	38	65	.83	.10	1.5		.310	.310
3		7.5	767.3	147	88	83	86	38	66	1.08	.13	2.0		.310	.310
4		10.0	768.8	147	91	83	87	37	68	1.50	.18	2.6			
5		12.5	770.6	146	94	84	89	37	70	2.05	.25	4.5			
D 1		15.0	771.7	145	96	84	90	37	71	0.50	.06	1.0			
2		17.5	772.8	145	95	84	90	37	71	0.67	.08	1.2			
3		20.0	774.3	145	94	84	89	38	72	1.17	.14	2.1			
4		22.5	775.8	145	94	84	89	38	72	1.34	.16	2.2			
5		25.0	777.9	146	94	84	89	37	73	1.92	.23	2.7			
C 1		27.5	779.0	146	94	84	89	38	73	.59	.07	1.0			
2		30.0	780.1	147	92	83	88	37	74	.75	.09	5.9			
3		32.5	781.4	148	91	83	87	37	74	1.00	.12	7.0			
4		35.0	782.9	148	91	82	86	37	74	1.33	.16	8.0			
5		37.5	785.4	148	91	82	86	37	74	1.91	.23	8.5			
D 1		40.0	786.8	147	93	82	88	38	74	.74	.08	1.0			
2		42.5	788.2	145	93	82	88	37	75	1.00	.12	2.0			
3		45.0	789.7	145	91	81	86	38	75	1.33	.16	2.5			
4		47.5	791.7	145	92	81	86	38	75	1.54	.185	2.7			
5		50.0	793.2	146	93	81	87	38	75	1.54	.185	2.7			
E 1		52.5	794.2	144	92	81	86	38	76	.33	.04	—			
2		55.0	795.3	146	90	81	86	38	76	.83	.10	1.5			
3		57.5	796.9	146	88	81	84	38	76	1.33	.16	2.5			
4		60.0	798.8	146	89	81	85	38	77	2.16	.26	4.7			
5		62.5	800.850	146	89	81	85	38	78	2.40	.29	5.2			
							800.932				R-2.3				
							800.915				S-6.5				
							.017 @ 9.5" Hg								
G-25		62.5	37.288	146			86.8	-31-		1.22	.372				

WATER
#8
ml. 28.0
gram 30.1
Total 58.1

OPERATOR
LOTZ / GUNLEE

Sample Box No. 8
Meter Box No. 100
Meter ΔH@ 2.16
Pitot, CP .82
Temp. Device 52 ft
Probe No. 3-3
Probe Liner GLASS
Probe Htr. Set 65
Ambient Temp. 65
% O_2
% CO_2 3.0 / 3.5

NOTES
Orifice @ 4.79
Pitot @ 4.14 3.8
Meter @ 25 Tr 1
2 MUSHFLOW
Mould Hold

FIELD DATA SHEET

GUARDIAN SYSTEMS

BOX 300
LEEDS, ALABAMA 35094

PLANT Rockwood RUN # 2
LOCATION UNIT #1 DATE 11-9-88
BARO. PRES. 28.57 TIME ~~1150~~ 1130-1233

	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
A	811.975		~~811.347~~ ~~810.865~~	(1)	(2)	(3)		(4)	(5)			
1	2.5	2.5	813.1	143	80	77	78	36	67	.58	.07	—
2		5.0	814.5	152	89	83	86	37	70	.88	.09	—
3		7.5	816.1	152	93	84	88	37	72	~~1.00~~ 1.00	.12	0.5
4		10.0	817.5	151	96	85	90	37	74	~~1.33~~ 1.33	.16	1.0
5		12.5	819.2	150	96	86	91	38	75	1.75	.21	2.0
B1		15.0	820.2	149	98	86	92	38	77	.50	.06	—
2		17.5	821.3	148	97	86	91	37	77	.59	.07	—
3		20.0	822.5	149	94	82	91	38	78	.75	.09	1.0
4		22.5	823.5	151	96	86	91	38	78	~~1.08~~ 1.08	.13	2.0
5		25.0	825.4	154	97	86	92	38	78	1.57	.19	5.0
C1		27.5	826.5	154	97	86	92	38	78	.50	.06	2.9
2		30.0	827.5	150	93	86	89	38	78	.50	.06	2.9
3		32.5	828.6	151	93	86	89	38	78	.58	.07	3.2
4		35.0	829.9	154	93	86	89	38	78	1.07	.13	5.2
5		37.5	831.3	150	94	86	90	38	77	1.65	.20	8.8
D1		40.0	832.7	153	95	86	91	38	77	.50	.06	3.0
2		42.5	834.0	151	94	85	90	38	78	.66	.08	4.0
3		45.0	835.3	152	94	85	90	38	78	.99	.12	5.5
4		47.5	836.7	154	95	85	90	38	78	1.16	.14	5.9
5		50.0	838.4	156	96	86	91	38	77	1.65	.20	7.8
E1		52.5	839.3	156	96	86	91	38	78	.49	.06	3.0
2		55.0	840.4	158	95	85	90	38	78	.57	.07	3.5
3		57.5	841.9	157	94	85	90	38	78	1.15	.14	6.4
4		60.0	843.5	156	95	85	90	38	78	1.73	.21	9.0
5		62.5	845.543	157	97	86	92	38	78	2.06	.25	10.4
						845.610						
						845.605						
2.5		62.5	33.564	153		90	.002	-32	@ 11.5	1.012	780	

STATIC PRESSURE "H -.12

PROBE TIP SIZE BEFORE	AFTER
.310	.310
.310	.310
.310	.310

WATER
#9
ml. 20.3
gram 27.7
Total 48.0

OPERATOR
CDR/Gulee

Sample Box No. 7
Meter Box No. 100
Meter ΔH@ 2.16
Pitot, CP .82
Temp. Device NT
Probe No. 3-3
Probe Liner Glass
Probe Htr. Set 65
Ambient Temp. 65
% O_2 /
% CO_2 /

NOTES
Orifice —
Pitot A-205-U
Meter Q254 —

R - 3.4
S - 4.2

FIELD DATA SHEET

PLANT Rockwood RUN # 3
LOCATION Unit #1 DATE 11-9-88
BARO. PRES. 29.57 TIME 1347-1450

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
A			849.996	(1)	(2)	(3)		(4)	(5)			
1	2.5	2.5	850.9	152	111	109	110	37	69	.43	.05	—
2		5.0	852.2	157	110	108	109	38	70	.60	.07	—
3		7.5	853.6	157	109	107	108	38	70	1.02	.12	—
4		10.0	855.1	158	110	106	108	38	70	1.27	.15	—
5		12.5	856.6	158	110	105	108	39	73	1.69	.20	—
D1		15.0	857.7	158	110	105	108	39	72	.34	.04	—
2		17.5	858.7	157	109	103	106	40	75	.42	.05	—
3		20.0	859.8	163	106	102	104	40	76	.67	.08	—
4		22.5	861.3	165	105	101	103	39	76	1.00	.12	.9
5		25.0	862.9	164	102	100	101	36	76	1.57	.19	1.5
C1		27.5	863.9	163	104	100	102	35	77	0.33	.04	—
2		30.	865.1	161	104	100	102	35	78	.50	.06	—
3		32.5	866.1	160	102	98	100	35	78	.67	.08	—
4		35	867.4	161	102	97	100	36	78	1.00	.12	.9
5		37.5	868.9	161	102	97	100	36	78	1.44	.17	1.2
D1		40	869.7	162	101	96	98	36	78	.25	.03	3.0
—		42.5	870.8	161	100	96	98	35	78	.50	.06	5.5
3		45	871.9	164	100	94	97	35	78	.66	.08	6.5
4		47.5	873.3	165	100	94	97	35	78	1.07	.13	8.0
5		50	874.9	165	100	94	97	35	78	1.40	.17	8.5
E1		52.5	875.9	165	102	94	98	35	78	0.33	.04	4.0
2		55	877.0	162	102	94	98	35	78	.58	.07	6.0
3		57.5	878.4	162	100	94	97	35	78	1.16	.14	7.8
4		60	880.2	162	100	94	97	36	78	1.40	.17	9.0
5		62.5	882.292	162	100	92	96	36	78	2.14	.26	10.4
					882.373							
					882.370							
		62.5	32.296	161	.003					.876	.315	

STATIC PRESSURE "H2O: -.11

PROBE TIP SIZE

BEFORE	AFTER
.310	.310
.310	.310
.310	.310

WATER
#3 ml. 9.9
gram 39.9
Total 49.8

OPERATOR
Lutz/Clarke

Sample Box No. 8
Meter Box No. 100
Meter ΔH@ 2.16
Pitot, CP .82
Temp. Device Salt
Probe No. 3-3
Probe Liner Glass
Probe Htr. Set 65
Ambient Temp. 65
% O_2 /
% CO_2 /

NOTES
Orifice
Pitot ✓✓
Meter @25

R-2.7
S-5.3

@ 12.5 ft/min

JEFFERSON COUNTY DEPARTMENT OF HEALTH
BUREAU OF ENVIRONMENTAL HEALTH
AIR POLLUTION CONTROL PROGRAM

VISIBLE EMISSIONS OBSERVATION REPORT

Company Name Rockwool Manufacturing Company V.E.E. No. ____

Source Mineral Wool Cupola #1 with baghouse Permit No. 0 0 0 2 5 1 2 1 0 1

Start/Stop Time 9:47/10:47 Sky Condition Overcast (Mist on occasion) Date 1 1 0 9 8 8

Observation Point East of the source Distance from Source 550 feet

Stack Height ____ Background Sky & trees Plume Color ____

Method of Evaluation 1 Wind Direction ____

Total Minutes Observed 6 0

Highest 6 Minute Average 0 0

Violation Observed N

Notice Number ____

Minutes Exceeding:

10% Opacity = ____

20% Opacity = ____

60% Opacity = ____

____ % Opacity = ____

Min.	Seconds 0	15	30	45
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0

Min.	Seconds 0	15	30	45
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
24	0	0	0	0
25	0	0	0	0
26	0	0	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0

Min.	Seconds 0	15	30	45
30	0	0	0	0
31	0	0	0	0
32	0	0	0	0
33	0	0	0	0
34	0	0	0	0
35	0	0	0	0
36	0	0	0	0
37	0	0	0	0
38	0	0	0	0
39	0	0	0	0
40	0	0	0	0
41	0	0	0	0
42	0	0	0	0
43	0	0	0	0
44	0	0	0	0

Min.	Seconds 0	15	30	45
45	0	0	0	0
46	0	0	0	0
47	0	0	0	0
48	0	0	0	0
49	0	0	0	0
50	0	0	0	0
51	0	0	0	0
52	0	0	0	0
53	0	0	0	0
54	0	0	0	0
55	0	0	0	0
56	0	0	0	0
57	0	0	0	0
58	0	0	0	0
59	0	0	0	0

Results and Recommendations:

Observer [illegible] 4 7

Time Analysis 0 4

ENV-AP-008-12/84 Revised

JEFFERSON COUNTY DEPARTMENT OF HEALTH
BUREAU OF ENVIRONMENTAL HEALTH
AIR POLLUTION CONTROL PROGRAM

VISIBLE EMISSIONS OBSERVATION REPORT

V.E.E. No. _____

Company Name: Rockwool Manufacturing Co.

Permit No.: 0 0 0 2 5 1 2 1 0 1

Source: Cupola #1 with baghouse

Start/Stop Time: 11:00/12:00 Sky Condition: Overcast Date: 1 1 0 9 8 8

Observation Point: East of Source Distance from Source: 550 feet

Stack Height: _____ Background: Sky + Trees Plume Color: _____

Method of Evaluation: 1 Wind Direction: _____

Total Minutes Observed: 60

Highest 6 Minute Average: 0 0

Violation Observed: N

Notice Number: _____

Minutes Exceeding:

10% Opacity = _____

20% Opacity = _____

60% Opacity = _____

_____ % Opacity = _____

Min.	Seconds 0	15	30	45
1				
2				
5				
8				
10				
11				
13				
14				

Min.	Seconds 0	15	30	45
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				

Min.	Seconds 0	15	30	45
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				

Min.	Seconds 0	15	30	45
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				

Results and Recommendations:

Observer: Brian Kilbrow 4 7

Time Analysis: 0 4

ENV-AP-008-12/84 Revised

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Rock Wood Sample date: 11-9-88
Sample location: UNIT #1 Run no.: 1
Sample recovery person: LDR Recovery date: 11-9-88
Filter(s) no.: _____

MOISTURE

Impingers			Silica gel #8		
Final volume (wt)	642.4	ml(gm)	Final wt.	1019.7 g	240.8 g
Initial volume (wt)	614.4	ml(gm)	Initial wt.	1012.8 g	217.6 g
Net volume (wt)	28.0	ml(gm)	Net wt.	6.9 g	23.2 g

Total moisture 58.1 g

Color of silica gel mixed

Description of impinger water light cloudy not clear

RECOVERED SAMPLE

Filter container no. R#1 sealed ✓

Description of particulate on filter Speckled

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

Acetone blank container no. _____ Liquid level marked _____

Samples stored and locked ✓

Remarks: _____

Date of laboratory custody 11-9-88

Laboratory personnel taking custody Charles M Johnson

Remarks: _____

GUARDIAN SYSTEMS inc

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Rockwell Sample date: 11-9-88

Sample location: Unit #1 Run no.: 2

Sample recovery person: LTR Recovery date: 11-9-88

Filter(s) no.: _____

MOISTURE

Impingers Silica gel #7

Final volume (wt) 633.7 ml (gm) Final wt. 984.1 g 255.5 g

Initial volume (wt) 613.4 ml (gm) Initial wt. 978.6 g 233.2 g

Net volume (wt) 20.3 ml (gm) Net wt. 5.5 g 22.2 g

Total moisture 48.0 g

Color of silica gel mixed

Description of impinger water clear

RECOVERED SAMPLE

Filter container no. Jr #2 sealed ✓

Description of particulate on filter Specks

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

Acetone blank container no. _____ Liquid level marked _____

Samples stored and locked ✓

Remarks: _____

Date of laboratory custody 11-9-88

Laboratory personnel taking custody Charles M. Johnson

Remarks: _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Rock Wool Sample date: 11-9-88

Sample location: Stack Vent #1 Run no.: 3

Sample recovery person: LJT2 Recovery date: 11-9-88

Filter(s) no.: _____

MOISTURE

Impingers			Silica gel #3		
Final volume (wt)	659.5	ml(gm)	Final wt.	992.0 g	275.6 g
Initial volume (wt)	649.6	ml(gm)	Initial wt.	984.3 g	243.4 g
Net volume (wt)	9.9	ml(gm)	Net wt.	7.7 g	32.2 g

Total moisture 49.8 g

Color of silica gel Mixed

Description of impinger water 1st Clear Red Clear

RECOVERED SAMPLE

Filter container no. R #3 sealed ✓

Description of particulate on filter Speckled

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 11-9-88

Laboratory personnel taking custody Charles M. Johnson

Remarks: _____

PLANT Rockwood SAMPLE LOCATION UNIT #1

FIELD DATA CHECKS

SAMPLE RECOVERY PERSONNEL Lotz / Henrich

PERSON WITH DIRECT RESPONSIBILITY FOR RECOVERED SAMPLES

Sample no.	Sample identification no.		Date of recovery	Liquid level marked	Stored in locked container
	H_2SO_4	SO_2			
1	✓	✓	11-9-88	✓	✓
2	✓	✓	"	✓	✓
3	✓	✓	"	✓	✓
BLANKS					

REMARKS

SIGNATURE OF FIELD SAMPLE

LABORATORY DATA CHECK

LAB PERSON WITH DIRECT RESPONSIBILITY FOR RECOVERED SAMPLES

DATE RECOVERED SAMPLES RECEIVED 9-8

ANALYST Charles M. Johnson

Sample no.	Sample identification no.		Date of analysis	Liquid at marked level	Sample identified
	H_2SO_4	SO_2			
1	✓	✓	11-15-88	✓	✓
2	✓	✓	"	✓	✓
3	✓	✓	"	✓	✓
BLANKS					

REMARKS

SIGNATURE OF LAB SAMPLE TRUSTEE Charles M. Johnson

METHOD 8 Sample recovery and integrity data.

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 300
LEEDS, AL 35094
205-699-6647

Plant: Rock Wool Date: 11-15-88

Sample location: Unit #1 Analyst: Johnson

Normality of Barium Perchlorate: 0.0109

FRONT HALF SULFUR ANALYSIS

				Total
Run Number	1	2	3	
Vol of solution, ml	250	250	250	750
Vol of sample aliquot, ml	25	25	25	75
Vol of titrant, ml 1st	0.9	0.7	2.1	
Vol of titrant, ml 2nd	0.9	0.6	2.2	
Average titration, ml	0.90	0.65	2.15	3.7
BLANK				
Vol of titrant, ml 1st	0.0			
Vol of titrant, ml 2nd	0.0			
Average titration, ml	0.00			

SULFUR TRIOXIDE ANALYSIS

Run Number	1	2	3	
Vol of solution, ml	250	250	250	750
Vol of sample aliquot, ml	1	25	25	51
Vol of titrant, ml 1st	2.7	1.2	2.4	
Vol of titrant, ml 2nd	2.6	1.2	2.3	
Average titration, ml	2.65	1.20	2.35	6.2
BLANK				
Vol of titrant, ml 1st	0.0			
Vol of titrant, ml 2nd	0.0			
Average titration, ml	0.00			

SULFUR DIOXIDE ANALYSIS

Run Number	1	2	3	EPA 9408
Vol of solution, ml	500	500	500	100
Vol of sample aliquot, ml	1	1	1	10
Vol of titrant, ml 1st	11.7	14.4	9.9	1.35
Vol of titrant, ml 2nd	11.6	14.3	9.8	1.35
Average titration, ml	11.65	14.35	9.85	1.35
BLANK				
Vol of titrant, ml 1st	0.0			
Vol of titrant, ml 2nd	0.0			
Average titration, ml	0.00			

EPA Lot # 0585	True Value	Cal Value	Error
Sample # 9408, mg/DSCM	221.2	224.4	1.46%

Signature of analyst: Charles M. Johnson

Signature of reviewer: [illegible]

Integrated Bag Sampling Field Data

Run No. 1

Date 11-9-88 Plant Rock Wool

Sampling location Unit #1

Barometric pressure 29.57 " Hg.

Ambient temp. °F 60 Stack temp. °F 146

Operator Curtice

Sample bag leak checked ✓ Sample train leak checked ✓

	Time	Traverse point	Rate meter flow rate, Q cm^3/min.	% Dev.[a]	Fyrite, O_2	Fyrite, CO_2
940	A 1		1.5	—		
	2		1.1	—		
	3		1.1	—		
	4		1.1	—		
	5		1.1	—		
	B 1		1.1	—		
	2		1.1	—		
	3		1.1	—		
	4		1.1	—		
	5		1.1	—		
	C 1		1.1	—		
	2		1.1	—		
	3		1.1	—		
	4		1.1	—		
	5		1.1	—		
	D 1		1.1	—		
	2		1.1	—		
	3		1.1	—		
	4		1.1	—		
	5		1.1	—		
	E 1		1.1	—		
	2		1.1	—		
	3		1.1	—		
	4		1.1	—		
	5		1.1	—		
1013						
			Average	—		

[a] % Dev. = $\left(\frac{Q - Q_{avg.}}{Q_{avg.}}\right)100$ (Must be ≤10%)

II-4

GUARDIAN SYSTEMS inc

Integrated Bag Sampling Field Data

Run No. 2

Date 11-9-88 Plant Rock Wool

Sampling location UNIT #1

Barometric pressure 29.97 " Hg.

Ambient temp. °F 65 Stack temp. °F 153

Operator Gamec

Sample bag leak checked ✓ Sample train leak checked ✓

Time	Traverse point	Rate meter flow rate, Q cm^3/min.	% Dev.[a]	Fyrite, O_2	Fyrite, CO_2
1130	A1	1.5 l/m	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	B1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	C1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	D1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	E1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
		Average			

[a] % Dev. = $\left(\frac{Q - Q_{avg.}}{Q_{avg.}}\right)100$ (Must be $\leq$10%)

Integrated Bag Sampling Field Data

Run No. 3

Date 11-9-88 Plant Rock Island

Sampling location Unit #1

Barometric pressure 28.97 " Hg.

Ambient temp. °F 65 Stack temp. °F 161

Operator GANice

Sample bag leak checked ✓ Sample train leak checked ✓

Time	Traverse point	Rate meter flow rate, Q cm^3/min.	% Dev.[a]	Fyrite, O_2	Fyrite, CO_2
1347	A1	1.5 l/m	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	B1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	C1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	D1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	E1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
1450	5	"	—		
		Average	—		

[a] % Dev. = $\left(\frac{Q - Q_{avg.}}{Q_{avg.}}\right)100$ (Must be ≤10%)

II-4

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 300
LEEDS, AL 35094
205-699-6647

Dry Molecular Weight Determination

Test No: 1

Plant: Rock Wool Date: 11-09-88

Sample Location: Unit #1 Sampling Time: 0940-1043

Type: Integrated Method: Orsat Ambient Temp: 60

Run Number	1	1	2	2	3	3		
Gas	Actual	Net	Actual	Net	Actual	Net	Avg	Mol Wt
CO2	9.7	9.7	9.8	9.8	9.7	9.7	9.73	4.28
O2	16.2	6.5	16.3	6.5	16.3	6.6	6.53	2.09
CO	24.0	7.8	24.1	7.8	24.0	7.7	7.77	2.17
N2		76.0		75.9		76.0	75.97	21.27
Fo =	1.043					TOTAL		29.82

OPERATOR: _____

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 300
LEEDS, AL 35094
205-699-6647

Dry Molecular Weight Determination

Test No: 2

Plant: Rock Wool Date: 11-09-88

Sample Location: Unit #1 Sampling Time: 1130-1233

Type: Integrated Method: Orsat Ambient Temp: 65

Run Number	1	1	2	2	3	3		
Gas	Actual	Net	Actual	Net	Actual	Net	Avg	Mol Wt
CO2	10.0	10.0	10.0	10.0	10.0	10.0	10.00	4.40
O2	16.0	6.0	16.0	6.0	16.0	6.0	6.00	1.92
CO	24.0	8.0	24.0	8.0	24	8.0	8.00	2.24
N2		76.0		76.0		76.0	76.00	21.28
Fo =	1.050					TOTAL		29.84

OPERATOR: _____

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 300
LEEDS, AL 35094
205-699-6647

Dry Molecular Weight Determination

Test No: 3

Plant: Rock Wool Date: 11-09-88

Sample Location: Unit #1 Sampling Time: 1347-1450

Type: Integrated Method: Orsat Ambient Temp: 62

Run Number	1	1	2	2	3	3		
Gas	Actual	Net	Actual	Net	Actual	Net	Avg	Mol Wt
CO2	10.0	10.0	10.0	10.0	10.0	10.0	10.00	4.40
O2	15.6	5.6	15.6	5.6	15.7	5.7	5.63	1.80
CO	24.2	8.6	24.2	8.6	24.3	8.6	8.60	2.41
N2		75.8		75.8		75.7	75.77	21.21
Fo =	1.052					TOTAL		29.83

OPERATOR: _____

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

PLANT Rockwool RUN # 1
LOCATION #2 Stack DATE 11-8-88
BARO. PRES. 30.00 TIME 940-1045

	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
			571.923	(1)	(2)	(3)		(4)				
A 1	2.5	2.5	573.7	123	83	81	82	55	64	1.23	.30	1.5
2		5.0	575.8	127	87	83	85	39	60	1.92	.47	2.5
3		7.5	577.8	127	91	84	88	39	64	2.15	.52	3.0
4		10.0	580.0	128	96	85	91	39	65	2.69	.65	4.0
5		12.5	581.6	128	99	85	92	40	65	3.16	.76	4.5
B 1		15.0	583.2	126	99	85	92	40	66	1.17	.28	1.5
2		17.5	585.2	126	98	86	92	40	66	1.92	.46	2.5
3		20.0	587.8	126	98	86	92	40	67	3.13	.75	5.0
4		22.5	589.9	127	100	86	93	40	70	2.71	.65	4.5
5		25.0	592.7	128	101	86	94	40	70	3.54	.85	5.8
C 1		27.5	593.9	129	103	87	95	40	69	.96	.23	1.0
2		30.0	595.9	130	101	87	94	40	70	2.28	.55	3.5
3		32.5	598.0	131	100	87	94	40	71	2.99	.72	5.4
4		35.0	600.2	131	101	87	94	40	73	2.82	.68	8.0
5		37.5	603.5	131	101	87	94	40	73	3.48	.84	8.5
D 1		40.0	604.7	130	101	87	94	40	74	1.25	.30	3.5
2		42.5	606.6	130	102	87	95	40	75	2.00	.48	8.5
3		45.0	608.8	130	102	87	95	39	73	2.58	.62	7.5
4		47.5	611.0	130	102	87	95	39	74	2.50	.60	7.0
5		50.0	613.3	130	102	87	95	39	74	2.71	.65	5.5
E 1		52.5	614.2	131	103	87	95	39	71	1.16	.28	1.5
2		55.0	616.3	131	103	87	95	39	71	1.91	.46	3.0
3		57.5	618.9	132	101	87	94	39	71	2.36	.57	5.0
4		60.0	621.0	134	101	87	94	39	72	3.22	.78	6.5
5		62.5	623.203	134	102	87	95	39	72	3.43	.83	8.0
25		62.5	51.230	130			94			2.37	~~.708~~ .744	

STATIC PRESSURE "H2O -.13

PROBE TIP SIZE

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

WATER

ml. 47.9
gram 35.5
Total 83.4

OPERATOR Hamrick Graebe

Sample Box No. 1
Meter Box No. 100
Meter ΔH@ 2.16
Pitot, CP .82
Temp. Device NII
Probe No. 3'3"
Probe Liner Glass
Probe Htr. Set 65%
Ambient Temp. 60°
% O_2
% CO_2

NOTES

Orifice @4.0"/1.0
Pitot R4.1 - S5.6
Meter @26"Hg
Final Leak ✓ @ 13"Hg
623.270
623.268
.002
Filter # J-14

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
BOX 300
LEEDS, ALABAMA 35094

PLANT Rockwell RUN # 2
LOCATION #2 Stack DATE 11-8-88
BARO. PRES. 30.00 TIME 1139 - 1243

	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
			637.031	(1)	81	83		81				
A1	2.5	2.5	638.9	129	83	82	83	40	72	1.14 ~~.448~~	.28	1.0
2		5.0	640.1	133	87	85	86	38	72	1.59	.39	1.0
3		7.5	643.0	133	90	85	88	38	72	2.29	.56	1.5
4		10.0	644.8	134	95	86	91	38	69	2.83	.69	2.0
5		12.5	647.2	134	98	86	92	38	69	3.17	.77	2.0
B1		15.0	648.9	131	101	86	93	38	69	1.20	.29	1.0
2		17.5	651.1	133	101	87	94	38	70	1.94	.47	2.0
3		20.0	652.9	132	100	87	94	39	71	2.53	.61	2.5
4		22.5	655.0	132	101	87	94	39	69	2.44	.59	2.0
5		25.0	657.7	131	101	87	94	39	69	2.70	.65	2.5
C1		27.5	658.0	131	102	87	95	39	69	.83	.20	1.0
2		30.0	660.5	131	102	87	95	39	70	.62	.15	1.0
3		32.5	662.9	131	98	87	93	39	70	2.32	.56	2.0
4		35.0	663.3	131	97	87	92	39	70	2.77	.67	3.0
5		37.5	666.6	131	97	87	92	38	69	3.10	.75	3.5
D1		40.0	667.5	131	98	87	93	38	69	.870	.21	3.0
2		42.5	669.2	131	98	87	93	38	69	1.86	.45	7.0
3		45.0	671.6	131	98	87	93	38	69	2.98	.72	11.0
4		47.5	674.1	128	102	87	95	38	69	2.46	.59	10.0
5		50.0	676.4	128	102	87	95	38	70	2.80	.67	11.0
E1		52.5	677.1	128	105	88	96	38	70	1.00	.24	5.0
2		55.0	679.1	128	105	88	96	39	69	1.38	.33	5.4
3		57.5	680.5	127	102	88	95	39	69	1.97	.48	7.0
4		60.0	682.4	126	102	88	95	39	69	2.35	.57	7.5
5		62.5	684.580	129	103	88	96	37	68	2.67	.64	10.0
			47.549									
25		62.5	~~684.765~~	131			94			2.07	.693	

STATIC PRESSURE "H2O -.13

PROBE TIP SIZE

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

WATER

ml. 21.4
gram 44.8
Total 66.2

OPERATOR
HAMRICK
GRACE

Sample Box No. 1
Meter Box No. 100
Meter ΔH@ 2.16
Pitot, CP .82
Temp. Device 1 II
Probe No. 3' 3"
Probe Liner Glass
Probe Htr. Set 65%
Ambient Temp. 65°
% O_2
% CO_2

NOTES

Orifice
Pitot R48 - S45
Meter
Final Leak @ 15" Hg
684.768
684.765
.003

Filter #520

G-1

FIELD DATA SHEET

PLANT Rockwool
LOCATION #2 Stack
BARO. PRES. 30.00

RUN 3
DATE 11-8-88
TIME 1320-1423

GUARDIAN SYSTEMS
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
			692.933	(1)	(2)	(3)		(4)				
A1	25	2.5	694.8	119	87	85	86	37	69	1.84	.44	1.0
2		5.0	696.8	121	91	87	89	36	69	2.51	.60	2.0
3		7.5	699.2	121	95	88	92	36	68	2.90	.69	2.5
4		10.0	701.7	121	99	88	94	36	69	3.12	.74	3.0
5		12.5	704.7	122	102	88	95	36	69	3.84	.91	3.5
B1		15.0	706.3	121	105	89	97	36	69	1.78	.42	2.5
2		17.5	708.8	120	104	89	97	36	69	2.76	.65	2.5
3		20.0	711.1	120	103	89	96	36	69	3.48	.82	3.0
4		22.5	713.0	119	104	90	97	36	68	3.36	.79	2.5
5		25.0	715.7	122	104	90	97	37	70	3.18	.75	3.0
C1		27.5	717.6	120	104	89	97	37	70	1.95	.46	4.0
2		30.0	719.6	120	103	89	96	37	70	2.63	.62	8.0
3		32.5	722.6	121	104	90	97	37	69	3.48	.82	10.0
4		35.0	725.6	121	106	89	97	38	70	3.35	.79	10.0
5		37.5	728.1	121	107	90	98	38	70	4.20	.99	12.5
D1		40.0	729.7	121	107	90	98	38	70	1.78	.42	6.5
2		42.5	733.5	120	107	90	98	38	70	2.25	.53	8.0
3		45.0	736.6	120	107	90	98	38	70	2.85	.67	10.5
4		47.5	737.3	120	107	90	98	38	69	3.14	.74	11.0
5		50.0	738.8	121	107	90	98	38	70	3.70	.87	12.0
E1		52.5	740.4	121	109	90	100	38	70	1.07	.25	5.0
2		55.0	741.7	121	106	90	98	38	70	2.12	.50	9.8
3		57.5	744.0	121	106	90	98	38	70	2.72	.64	11.8
4		60.0	746.2	123	107	90	98	38	71	2.79	.66	12.0
5		62.5	748.757	124	108	90	99	38	71	3.68	.87	14.0
25		62.5	55.804	121			98			2.82	.807	

G-1

STATIC PRESSURE "
-.13

PROBE TIP SIZE

BEFORE	AFTER
.248	.24
.248	.24
.248	.242

#6 WATER

ml. 21.6
gram 39.1
Total 60.7

OPERATOR
Hamrick
Faulee

Sample Box No. 1
Meter Box No. 100
Meter ΔH@ 2.16
Pitot, CP .82
Temp. Device 211
Probe No. 3'3"
Probe Liner Glass
Probe Htr. Set 65%
Ambient Temp. 62.0
% O_2
% CO_2

NOTES

Orifice ✓
Pitot R4.5 S41 ✓
Meter ✓

Final Leak ✓
@ 15" Hg
748.774
748.770
.004 ✓

JEFFERSON COUNTY DEPARTMENT OF HEALTH
BUREAU OF ENVIRONMENTAL HEALTH
AIR POLLUTION CONTROL PROGRAM

VISIBLE EMISSIONS OBSERVATION REPORT

Company Name Rock Wool Manufacturing Co. V.E.E. No. [ ]

Source Cupola #2 with cyclone and baghouse Permit No. 0 0 0 2 5 1 2 5 9 2

Start/Stop Time 10:10AM/11:10 Sky Condition Overcast Date 1 1 0 8 8 8

Observation Point North East of the Source Distance from Source 550 feet

Stack Height _____ Background Trees Plume Color _____

Method of Evaluation 1 Wind Direction West

Minutes Exceeding:

Total Minutes Observed 6 0 — 10% Opacity = [ ]

Highest 6 Minute Average 0 0 — 20% Opacity = [ ]

Violation Observed N — 60% Opacity = [ ]

Notice Number [ ] — [ ] % Opacity = [ ]

Min	Seconds 0	15	30	45	Min.	Seconds 0	15	30	45	Min	Seconds 0	15	30	45	Min	Seconds 0	15	30	45
0	0	0	0	0	15	0	0	0	0	30	0	0	0	0	45	0	0	0	0
1	0	0	0	0	16	0	0	0	0	31	0	0	0	0	46	0	0	0	0
2	0	0	0	0	17	0	0	0	0	32	0	0	0	0	47	0	0	0	0
3	0	0	0	0	18	0	0	0	0	33	0	0	0	0	48	0	0	0	0
4	0	0	0	0	19	0	0	0	0	34	0	0	0	0	49	0	0	0	0
5	0	0	0	0	20	0	0	0	0	35	0	0	0	0	50	0	0	0	0
6	0	0	0	0	21	0	0	0	0	36	0	0	0	0	51	0	0	0	0
7	0	0	0	0	22	0	0	0	0	37	0	0	0	0	52	0	0	0	0
8	0	0	0	0	23	0	0	0	0	38	0	0	0	0	53	0	0	0	0
9	0	0	0	0	24	0	0	0	0	39	0	0	0	0	54	0	0	0	0
10	0	0	0	0	25	0	0	0	0	40	0	0	0	0	55	0	0	0	0
11	0	0	0	0	26	0	0	0	0	41	0	0	0	0	56	0	0	0	0
12	0	0	0	0	27	0	0	0	0	42	0	0	0	0	57	0	0	0	0
13	0	0	0	0	28	0	0	0	0	43	0	0	0	0	58	0	0	0	0
14	0	0	0	0	29	0	0	0	0	44	0	0	0	0	59	0	0	0	0

Results and Recommendations:

Observer Brian Delson 4 7 — Time Analysis 0 4

ENV-AP-008-12/84 Revised

JEFFERSON COUNTY DEPARTMENT OF HEALTH
BUREAU OF ENVIRONMENTAL HEALTH
AIR POLLUTION CONTROL PROGRAM

VISIBLE EMISSIONS OBSERVATION REPORT

Company Name: RockWool Manufacturing Co. V.E.E. No.

Source: Cupola #2 with cyclone baghouse. Permit No. 0 0 0 2 5 1 2 5 0 2

Start/Stop Time: 11:40 / 12:00 Sky Condition: Overcast Date: 1 1 0 8 8 8

Observation Point: East of the Source Distance from Source: 550 feet

Stack Height: Background: Plume Color:

Method of Evaluation: 1 Wind Direction: West

Total Minutes Observed:

Highest 6 Minute Average: 0 0

Violation Observed: N

Notice Number:

Minutes Exceeding:

10% Opacity =

20% Opacity =

60% Opacity =

% Opacity =

Min.	Seconds 0	15	30	45	Min.	Seconds 0	15	30	45	Min.	Seconds 0	15	30	45	Min.	Seconds 0	15	30	45
0					15					30					45				
1					16					31					46				
2					17					32					47				
3					18					33					48				
4					19					34					49				
5					20					35					50				
6					21					36					51				
7					22					37					52				
8					23					38					53				
9					24					39					54				
10					25					40					55				
11					26					41					56				
12					27					42					57				
13					28					43					58				
14					29					44					59				

Results and Recommendations:

Observer: Brian Lubrow 4 7

Time Analysis: 0 4

ENV-AP-008-12/84 Revised

#

JEFFERSON COUNTY DEPARTMENT OF HEALTH
BUREAU OF ENVIRONMENTAL HEALTH
AIR POLLUTION CONTROL PROGRAM

VISIBLE EMISSIONS OBSERVATION REPORT

Company Name: Rock Wool Manufacturing Co. V.E.E. No.:

Source: Cupola #2 with Cyclone and baghouse Permit No.: 0 0 0 2 5 1 2 5 0 2

Start/Stop Time: 1:20/2:20 Sky Condition: Overcast Date: 1 1 0 8 8 8

Observation Point: North East of the Source Distance from Source: 550 feet

Stack Height: Background: Trees Plume Color:

Method of Evaluation: 1 Wind Direction: West

Total Minutes Observed: 6 0

Highest 6 Minute Average: 0 0

Violation Observed: N

Notice Number:

Minutes Exceeding:

10% Opacity =

20% Opacity =

60% Opacity =

% Opacity =

Min.	Seconds 0	15	30	45	Min.	Seconds 0	15	30	45	Min.	Seconds 0	15	30	45	Min.	Seconds 0	15	30	45
0	0	0	0	0	15	0	0	0	0	30	0	0	0	0	45	0	0	0	0
1	0	0	0	0	16	0	0	0	0	31	0	0	0	0	46	0	0	0	0
2	0	0	0	0	17	0	0	0	0	32	0	0	0	0	47	0	0	0	0
3	0	0	0	0	18	0	0	0	0	33	0	0	0	0	48	0	0	0	0
4	0	0	0	0	19	0	0	0	0	34	0	0	0	0	49	0	0	0	0
5	0	0	0	0	20	0	0	0	0	35	0	0	0	0	50	0	0	0	0
6	0	0	0	0	21	0	0	0	0	36	0	0	0	0	51	0	0	0	0
7	0	0	0	0	22	0	0	0	0	37	0	0	0	0	52	0	0	0	0
8	0	0	0	0	23	0	0	0	0	38	0	0	0	0	53	0	0	0	0
9	0	0	0	0	24	0	0	0	0	39	0	0	0	0	54	0	0	0	0
10	0	0	0	0	25	0	0	0	0	40	0	0	0	0	55	0	0	0	0
11	0	0	0	0	26	0	0	0	0	41	0	0	0	0	56	0	0	0	0
12	0	0	0	0	27	0	0	0	0	42	0	0	0	0	57	0	0	0	0
13	0	0	0	0	28	0	0	0	0	43	0	0	0	0	58	0	0	0	0
14	0	0	0	0	29	0	0	0	0	44	0	0	0	0	59	0	0	0	0

Results and Recommendations:

Observer: Brian Lidrow 4 7

Time Analysis: 0 4

ENV-AP-008-12/84 Revised

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Rock Wool Sample date: 11-8-88

Sample location: Unit #2 Run no.: 2

Sample recovery person: [illegible] Recovery date: 11-8-88

Filter(s) no.: J-20

MOISTURE

Impingers			Silica gel #1		
Final volume (wt)	876.9	ml(gm)	Final wt.	1020.5 g	268.0 g
Initial volume (wt)	855.5	ml(gm)	Initial wt.	1007.0 g	236.7 g
Net volume (wt)	21.4	ml(gm)	Net wt.	13.5 g	31.3 g

Total moisture 66.2 g

Color of silica gel mixed

Description of impinger water 15% Cloudy 85% Clear

RECOVERED SAMPLE

Filter container no. R #2 sealed ✓

Description of particulate on filter PART

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 11-8-88

Laboratory personnel taking custody Charles Johnson

Remarks:

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Rich Wood Sample date: 11-8-88

Sample location: Unit #2 Run no.: 3

Sample recovery person: [illegible] Recovery date: 11-8-88

Filter(s) no.: J-

MOISTURE

Impingers			Silica gel #6	
Final volume (wt)	886.6	ml(gm)	Final wt. 1019.1 g	259.4 g
Initial volume (wt)	865.0	ml(gm)	Initial wt. 1011.0 g	228.4 g
Net volume (wt)	21.6	ml(gm)	Net wt. 8.1 g	31.0 g

Total moisture 60.7 g

Color of silica gel [illegible]

Description of impinger water [illegible] Clear

RECOVERED SAMPLE

Filter container no. R#3 sealed ✓

Description of particulate on filter [illegible]

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 11-8-88

Laboratory personnel taking custody Charles [illegible]

Remarks:

PLANT Rockwell SAMPLE LOCATION UNIT #2

FIELD DATA CHECKS

SAMPLE RECOVERY PERSONNEL Hamack/Kotz

PERSON WITH DIRECT RESPONSIBILITY FOR RECOVERED SAMPLES

Sample no.	Sample identification no.		Date of recovery	Liquid level marked	Stored in locked container
	H_2SO_4	SO_2			
1	✓	✓	11-8-88	✓	✓
2	✓	✓	"	✓	✓
3	✓	✓	"	✓	✓
BLANKS	✓	✓	"	✓	✓

REMARKS

SIGNATURE OF FIELD SAMPLE TRUSTEE [signature]

LABORATORY DATA CHECKS

LAE PERSON WITH DIRECT RESPONSIBILITY FOR RECOVERED SAMPLES Charles Johnson

DATE RECOVERED SAMPLES RECEIVED 11-8-88

ANALYST Charles M. Johnson

Sample no.	Sample identification no.		Date of analysis	Liquid at marked level	Sample identified
	H_2SO_4	SO_2			
1	✓	✓	11-15-88	✓	✓
2	✓	✓	"	✓	✓
3	✓	✓	"	✓	✓
BLANKS	✓	✓	"	✓	✓

REMARKS

SIGNATURE OF LAB SAMPLE TRUSTEE Charles M. Johnson

METHOD 8 Sample recovery and integrity data.

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 300
LEEDS, AL 35094
205-699-6647

Plant: Rock Wool Date: 11-15-88

Sample location: Unit #2 Analyst: Johnson

Normality of Barium Perchlorate: 0.0109

FRONT HALF SULFUR ANALYSIS

Run Number	1	2	3	
Vol of solution, ml	250	250	250	750
Vol of sample aliquot, ml	25	25	25	75
Vol of titrant, ml 1st	2.4	4.5	1.6	
Vol of titrant, ml 2nd	2.4	4.6	1.7	
Average titration, ml	2.40	4.55	1.65	8.6
BLANK				Total
Vol of titrant, ml 1st	0.0			
Vol of titrant, ml 2nd	0.0			
Average titration, ml	0.00			

SULFUR TRIOXIDE ANALYSIS

Run Number	1	2	3	
Vol of solution, ml	250	250	250	750
Vol of sample aliquot, ml	100	100	100	300
Vol of titrant, ml 1st	2.0	1.1	1.0	
Vol of titrant, ml 2nd	2.0	1.2	1.0	
Average titration, ml	2.00	1.15	1.00	4.15
BLANK				Total
Vol of titrant, ml 1st	0.0			
Vol of titrant, ml 2nd	0.0			
Average titration, ml	0.00			

SULFUR DIOXIDE ANALYSIS

Run Number	1	2	3	EPA 9408
Vol of solution, ml	500	500	500	100
Vol of sample aliquot, ml	1	1	1	10
Vol of titrant, ml 1st	8.9	8.8	10.1	1.35
Vol of titrant, ml 2nd	8.8	8.8	10.1	1.35
Average titration, ml	8.85	8.80	10.10	1.35
BLANK				
Vol of titrant, ml 1st	0.0			
Vol of titrant, ml 2nd	0.0			
Average titration, ml	0.00			

EPA Lot # 0585	True Value	Cal Value	Error
Sample # 9408, mg/DSCM	221.2	224.4	1.46%

Signature of analyst: Charles M. Johnson

Signature of reviewer: [illegible]

Integrated Bag Sampling Field Data

Run No. 2

Date 11-8-85 Plant Rockwell

Sampling location UNIT A L

Barometric pressure 30.09 " Hg.

Ambient temp. °F 65 Stack temp. °F 131

Operator Gerwee

Sample bag leak checked ✓ Sample train leak checked ✓

Time	Traverse point	Rate meter flow rate, Q cm^3/min.	% Dev.[a]	Fyrite, O_2	Fyrite, CO_2
1139	A1	1.5	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	B1 C1	"	—		
	B2 2	"	—		
	3 3	"	—		
	4 4	"	—		
	5 5	"	—		
	6 C1	"	—		
	6 2	"	—		
	C4 3	"	—		
	2 4	"	—		
	3 5	"	—		
	4 D1	"	—		
	5 2	"	—		
	6 3	"	—		
	D4 4	"	—		
	2 5	"	—		
	3 E1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
1243					
		Average	—		

[a] % Dev. = $\left(\frac{Q - Q_{avg.}}{Q_{avg.}}\right)100$ (Must be ≤10%)

II-4

GUARDIAN SYSTEMS inc

Integrated Bag Sampling Field Data

Run No. 1

Date 11-9-88 Plant Rockwell

Sampling location UNIT #2

Barometric pressure 30.00 " Hg.

Ambient temp. °F 60 Stack temp. °F 130

Operator Bruce

Sample bag leak checked ✓ Sample train leak checked ✓

Time	Traverse point	Rate meter flow rate, Q cm^3/min.	% Dev.[a]	Fyrite, O_2	Fyrite, CO_2
940	A1	1.5	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	B1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	C1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	D1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	E1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
1045					
		Average	—		

[a] % Dev. = $\left(\frac{Q - Q_{avg.}}{Q_{avg.}}\right)100$ (Must be ≤10%)

II-4

GUARDIAN SYSTEMS INC

Integrated Bag Sampling Field Data

Run No. 3

Date 11-8-88 Plant Rockwell

Sampling location UNIT #2

Barometric pressure 30.00 " Hg.

Ambient temp. °F 62 Stack temp. °F 121

Operator Gamboa

Sample bag leak checked ✓ Sample train leak checked ✓

Time	Traverse point	Rate meter flow rate, Q cm^3/min.	% Dev.[a]	Fyrite, O_2	Fyrite, CO_2
1320	A1	1.5	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	B1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	C1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	D1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
	E1	"	—		
	2	"	—		
	3	"	—		
	4	"	—		
	5	"	—		
		Average	—		

[a] % Dev. = $\left(\frac{Q - Q_{avg.}}{Q_{avg.}}\right)100$ (Must be ≤10%)

II-4

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 300
LEEDS, AL 35094
205-699-6647

Dry Molecular Weight Determination

Test No: 1

Plant: Rock Wool Date: 11-08-88

Sample Location: Unit #2 Sampling Time: 0940-1045

Type: Integrated Method: Orsat Ambient Temp: 60

Run Number	1	1	2	2	3	3		
Gas	Actual	Net	Actual	Net	Actual	Net	Avg	Mol Wt
CO2	4.8	4.8	4.8	4.8	4.8	4.8	4.80	2.11
O2	16.8	12.0	16.8	12.0	16.8	12.0	12.00	3.84
CO	20.3	3.5	20.4	3.6	20.3	3.5	3.53	0.99
N2		79.7		79.6		79.7	79.67	22.31
Fo =	1.280					TOTAL		29.25

OPERATOR: _____

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 300
LEEDS, AL 35094
205-699-6647

Dry Molecular Weight Determination

Test No: 2

Plant: Rock Wool Date: 11-08-88

Sample Location: Unit #2 Sampling Time: 1139-1243

Type: Integrated Method: Orsat Ambient Temp: 65

Run Number	1	1	2	2	3	3		
Gas	Actual	Net	Actual	Net	Actual	Net	Avg	Mol Wt
CO2	4.8	4.8	4.9	4.9	4.8	4.8	4.83	2.13
O2	16.7	11.9	16.8	11.9	16.8	12.0	11.93	3.82
CO	20.4	3.7	20.4	3.6	20.4	3.6	3.63	1.02
N2		79.6		79.6		79.6	79.60	22.29
Fo =	1.274					TOTAL		29.25

OPERATOR: _____

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 300
LEEDS, AL 35094
205-699-6647

Dry Molecular Weight Determination

Test No: 3

Plant: Rock Wool Date: 11-08-88

Sample Location: Unit #2 Sampling Time: 1320-1423

Type: Integrated Method: Orsat Ambient Temp: 62

Run Number	1	1	2	2	3	3		
Gas	Actual	Net	Actual	Net	Actual	Net		Avg Mol Wt
CO2	5.2	5.2	5.1	5.1	5.2	5.2	5.17	2.27
O2	16.9	11.7	17.0	11.9	16.9	11.7	11.77	3.77
CO	20.3	3.4	20.4	3.4	20.3	3.4	3.40	0.95
N2		79.7		79.6		79.7	79.67	22.31
Fo =	1.265					TOTAL		29.30

OPERATOR: _____

V. PRODUCTION DATA

The following information pertain to the cupola operation on the test days was provided by Mr. Bill Haag of Rock Wool Company.

Charging Report

Shift 1 From 2 To 3 Date 11-8-88

Furnace No. 2

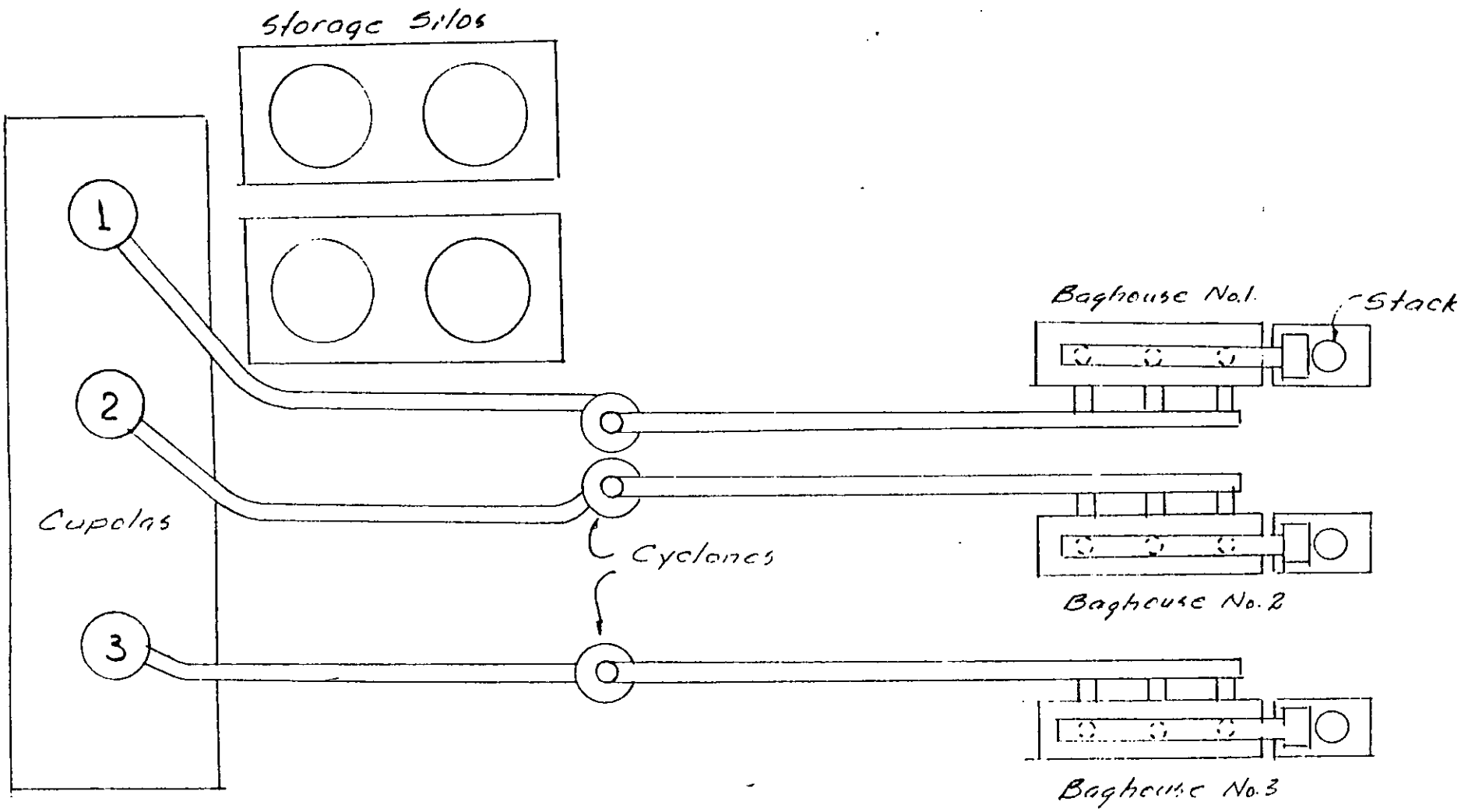
TIME	COKE	45 SLAG	A SLAG	SG [redacted]	ORE	TIME	COKE	45 SLAG	A SLAG	SG [redacted]	ORE
7:04	625					11:32	25	750	750	200	100
7:12		750	750	200	100	11:44		750	750	200	100
7:22	TAP	750	750	200	100	11:51	600				
7:42	625					11:58	26	750	750	200	100
7:48	23	750	750	200	100	12:06		750	750	200	100
7:58		750	750	200	100	12:17	600				
8:05	625					12:23	23	750	750	200	100
8:12	24	750	750	200	100	12:33		750	750	200	100
8:22		750	750	200	100	12:40	625				
8:29	625					12:47	24	750	750	200	100
8:37	25	600	900	200	100	12:57		750	750	200	100
8:47		600	900	200	100	1:04	625				
8:54	625					1:10	22	750	750	200	100
9:01	24	600	900	200	100	1:20		750	750	200	100
9:10		600	900	200	100	1:26	625				
9:18	625					1:33	25	750	750	200	100
9:26	26	600	900	200	100	1:44		750	750	200	100
9:36		600	900	200	100	1:51	625				
9:44	625					1:59		750	750	200	100
9:51	26	600	900	200	100	2:09		750	750	200	100
10:01		600	900	200	100	2:17	625				
10:10	625					2:23		750	750	200	100
10:17	26	600	900	200	100	2:33	(19)	750	750	200	100
10:27		600	900	200	100	2:42	625				
10:36	625					2:48		750	750	200	100
10:43	25	600	900	200	100	2:57		750	750	200	100
10:55		600 (1)	900	200	100					(19)	
11:01	600					Tons	5.89	13.35	15.15	3.80	1.90
11:07	25	750	750	200	100						
11:17		750	750	200	100			Slag	34.20		
11:26	600								5.8		

Charging Report

Shift 1 From 7 To 3 Date 11-9-79

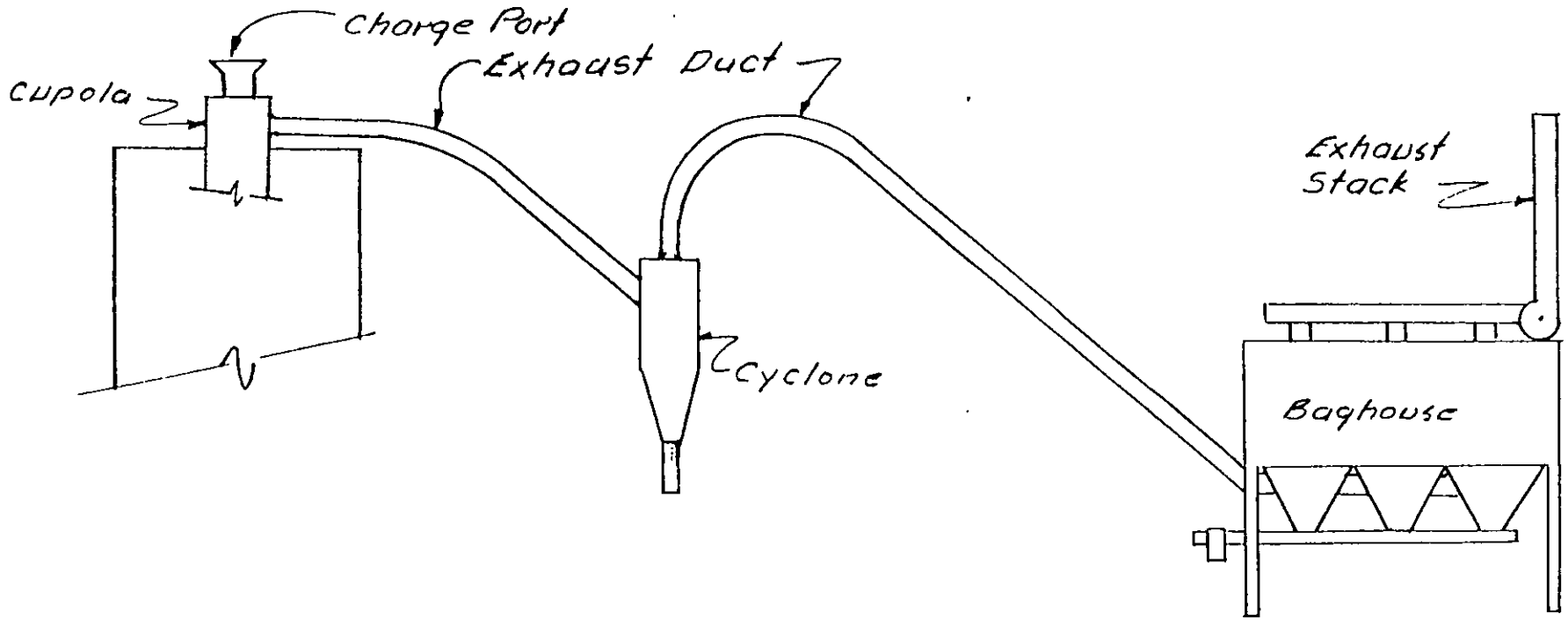
Furnace No. 1

TIME	COKE	45 SLAG	A SLAG	SG [redacted]	ORE	TIME	COKE	45 SLAG	A SLAG	SG [redacted]	ORE
7:09		900	600	300		11:49		900	600	300	
7:19		900	600	300		11:57	600				
7:26	600	/				12:05	26	900	600	300	
7:34	/	900	600	300		12:15		900	600	300	
7:44	TAP	900	600	300		12:23	600				
7:58	600	/				12:30	27	900	600	300	
8:05	27	900	600	300		12:41		900	600	300	
8:17		900	600	300		12:50	600				
8:25	600					12:57	24	900	600	300	
8:34	27	900	600	300		1:08		900	600	300	
8:44		900	600	300		1:14	600				
8:52	600					1:22	25	900	600	300	
9:00	26	900	600	300		1:32		900	600	300	
9:11		900	600	300		1:39	600				
9:18	600					1:48	/	900	600	300	
9:25	26	900	600	300		1:59		900	600	300	
9:36		900	600	300		2:05	600				
9:44	600					2:13	/	900	600	300	
9:53	28	900	600	300		2:24		900	600	300	
10:04		900	600	300		2:31	600				
10:12	600					2:37		900	600	300	
10:19	23	900	600	300		2:49		900	600	300	
10:28		900	600	300		2:57	600 (18)	(18)			
10:35	600										
10:45	28	900	600	300		Ton	5.40	16.20	10.80	5.40	
10:56		900	600	300							
11:03	600							Slag	32.40		
11:13	27	900	600	300					6.0		
11:21		900	600	300							
11:30	6[illegible]	/									
11:38	27	900	600	300							

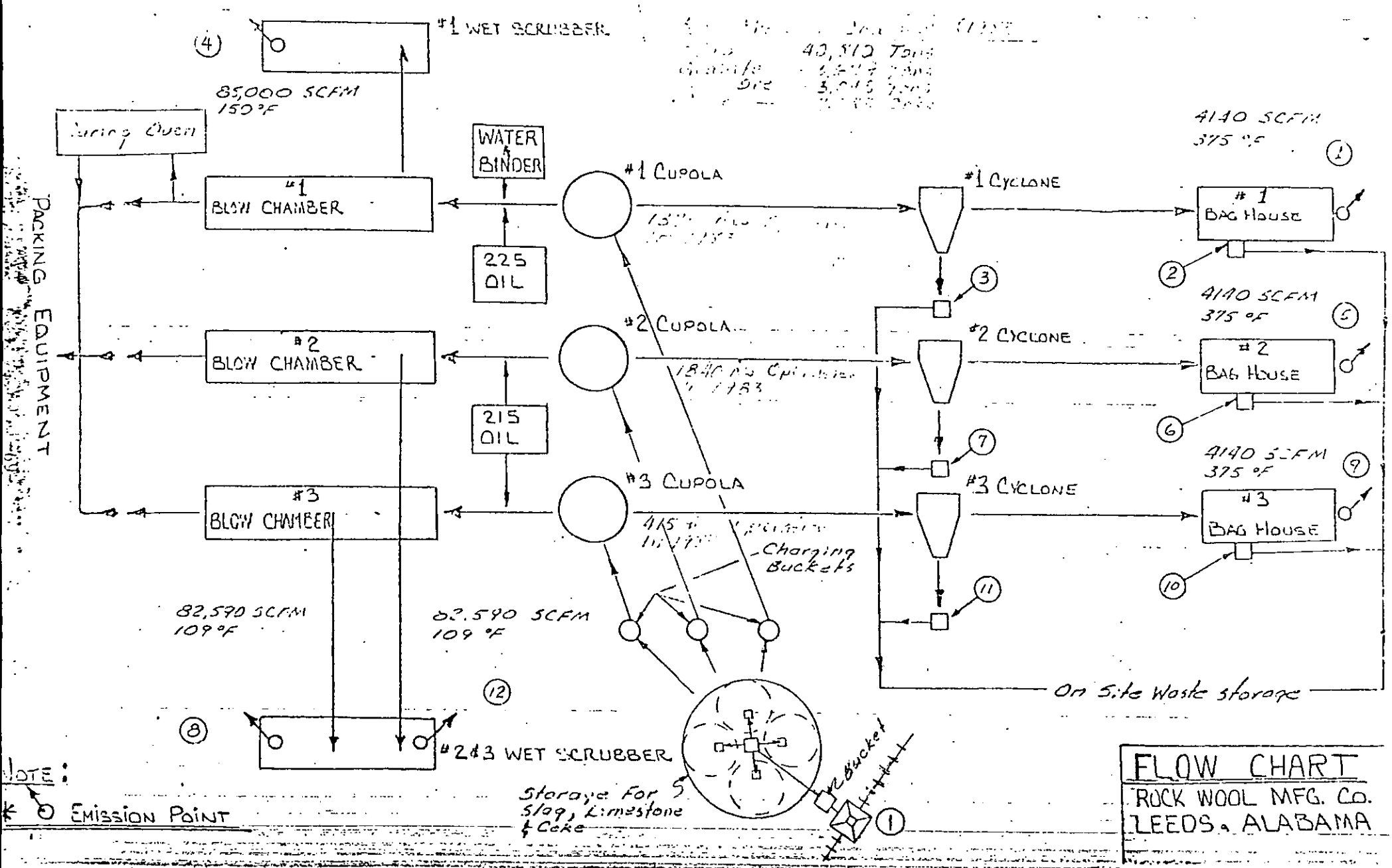


PLAN VIEW
OF
CUPOLA EXHALIST

ROCK WOOL



Typical Elevation
Units 1, 2 & 3



NOTE:
* O Emission Point

FLOW CHART
ROCK WOOL MFG. CO.
LEEDS, ALABAMA

VI. METHOD 8 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, and 2.5 inches of water. Upon return to the laboratory from this test the meter box was recalibrated using the average meter pressure for the test series. The recalibration point was the closest point to the initial calibration. These recalibrations produced a single point MCF and a H@ which was 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 tubes shall be calibrated against a standard pitot tube (C_p = 0.99) in a wind tunnel with a capacity to generate a test section velocity of approximately 3000 feet/ minute every 6 months. Additionally, the pitot tube shall be measured as to its specifications and alignment. Upon return, the intercomponent spacings and the face opening alignment of the pitot tube assembly was rechecked and if no changes are noticed, it was assumed that the coefficient of the assembly had not changed.

Temperature measurments

All temperature devices (impinger, meter box, hot box and stack) shall be 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 was considered valid.

VI. METHOD 8 CALIBRATIONS CONTINUED

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 was 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) was requested and an adjustment for elevation differences between the weather station and sampling point was 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

These calibration sheets are located behind the original calibration sheets.

The equipment used was as follows:

Location:	#2 Stack	#1 Stack
Probe #:	3-3	3-3
Meter Box #:	100	100
Hot Box #:	7 & 8	7 & 8
Impinger #:	7 & 8	7 & 8
Temperature:	Omega II	Omega II
Avg. Stk Temp:	127	153
Recal. Temp:	130	155
% Diff	0	0

The intercomponent spacings and the face opening alignment of the pitot tube assemblies were rechecked and no changes were noticed; therefore, it was asumed 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:

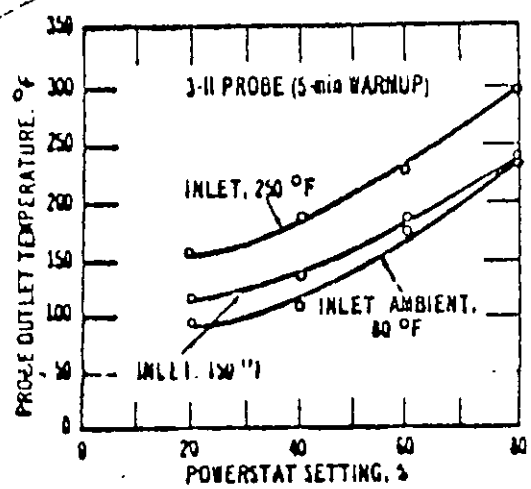
BSO	522	Flow Resistance (Max.) @ 320 cm/min.	80 mm
*pH	9.0	Flow Rate (air) lpm/cm² @ 70 cm Hg	60
DOP @320/cm/min ASTM Methods 2986)	99.9%	Max. Use Temp.	400°C
Tensile Strength (Fed. Spec. UUP31B)	600 gr.	Static Properties	Medium
Weight 8"x10"sheet	4.0±.3 gr.	Ability to Fold	Good

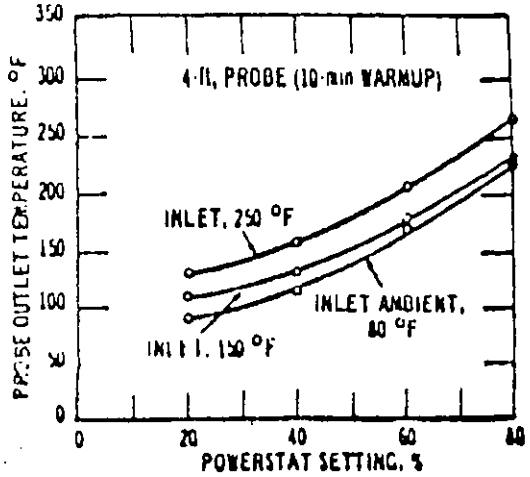
WATER EXTRACTABLE IONS:

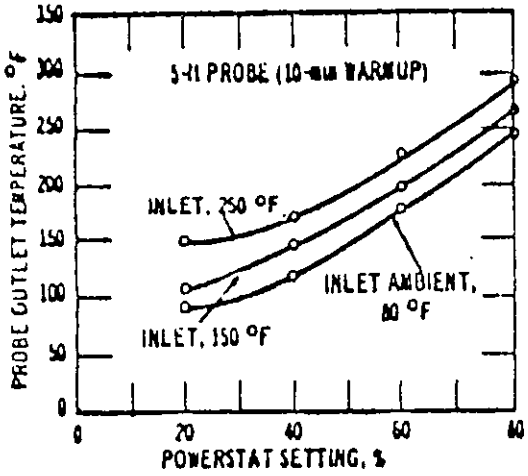
Sulfate	600	Chloride	1500
Nitrate	115	Fluoride	87
Ammonia	13		

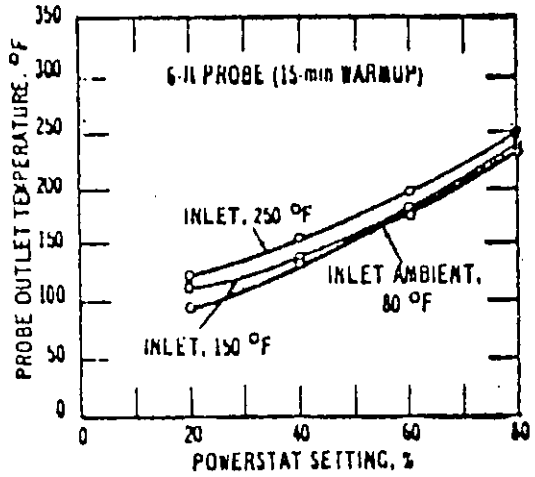
*pH—Gelman Procedure:

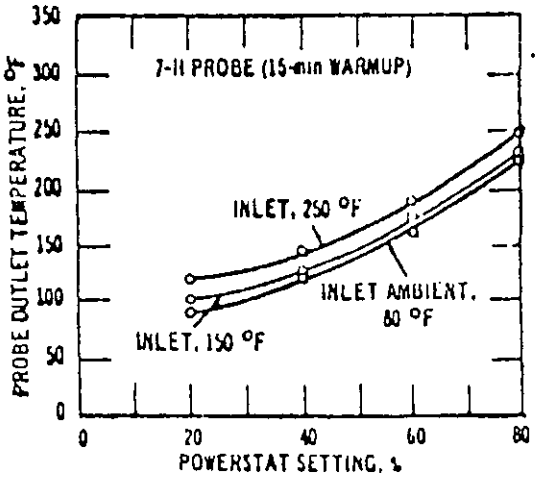
A. 500 ml distilled water.
B. Add 15 drops saturated KCl solution.
C. Shread one 8"x10" sheet and soak in prepared water for one hour.
D. Run pH at ambient temperature.











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 100
on 10/20/88

Run Number	1	2	3	4	5
Barometric Pres, in Hg	30.10	30.10	30.10	30.10	30.10
Orifice pres drop, in H20	0.5	1.0	1.5	2.0	2.5
Pres Wet Test Meter, in H20	-0.29	-0.47	-0.60	-0.80	-0.97
Gas Volume Wet Init, CF	0.000	5.493	13.044	22.099	32.671
Gas Volume Wet Final, CF	5.493	13.044	22.099	32.671	44.493
Wet Test MCF	1.0443	1.0443	1.0443	1.0443	1.0443
Gas Volume Dry Init, CF	868.731	874.735	883.004	893.104	904.950
Gas Volume Dry Final, CF	874.735	883.004	893.104	904.950	918.229
Temp Wet Init, C	16.5	16.5	16.5	17.0	17.2
Temp Wet Final, C	16.5	16.5	17.0	17.2	17.4
Dry Gas Temp Init In, F	93	88	107	115	118
Dry Gas Temp Final In, F	100	107	115	118	121
Dry Gas Temp Init Out, F	75	78	94	99	102
Dry Gas Temp Final Out, F	88	94	99	102	104
Run Time, sec	900	900	900	900	900
Meter Calibration Factor, Y	1.0035	1.0049	1.0057	1.0066	1.0067
Average Y	1.0055				
Qm	0.3962	0.5482	0.6684	0.7838	0.8783
Km	0.7118	0.6940	0.6848	0.6933	0.6938
Average Km	0.6955				
Delta H@	1.82	1.91	1.96	1.92	1.91
Average H@	1.90				

SIGNATURE_____

GUARDIAN SYSTEMS INC
Recalibration of Meter Box 100
on 11/10/88

Run Number	1	2	3	Average
Barometric Pres, in Hg	30.17	30.17	30.17	30.17
Orifice pres drop, in H20	1.0	1.0	1.0	1.00
Pres Wet Test Meter, in H20	-0.48	-0.48	-0.48	-0.48
Gas Volume Wet Init, CF	8.338	15.890	23.473	47.701
Gas Volume Wet Final, CF	15.890	23.473	31.038	70.401
Wet Test MCF	1.0443	1.0443	1.0443	1.0443
Gas Volume Dry Init, CF	911.936	920.372	928.912	2761.220
Gas Volume Dry Final, CF	920.372	928.912	937.456	2786.740
Temp Wet Init, C	13.8	14.0	14.2	14.0
Temp Wet Final, C	14.0	14.2	14.4	14.2
Dry Gas Temp Init In, F	86	102	105	98
Dry Gas Temp Final In, F	102	105	107	105
Dry Gas Temp Init Out, F	81	87	91	86
Dry Gas Temp Final Out, F	87	91	94	91
Run Time, sec	900	900	900	2700
Meter Calibration Factor, Y	0.9891	0.9934	0.9952	0.9926
Qm	0.5512	0.5582	0.5600	0.5565
Km	0.6999	0.7055	0.7056	0.7037
Delta H@	1.88	1.85	1.85	1.86

Previous Y 1.0049 % Difference 1.23%
Previous H@ 1.91 % Difference 2.61%

Project Rich Wenf Stack UNIT #1

SIGNATURE

GUARDIAN SYSTEMS INC
Recalibration of Meter Box 100
on 11/10/88

Run Number	1	2	3	Average
Barometric Pres, in Hg	30.17	30.17	30.17	30.17
Orifice pres drop, in H20	2.5	2.5	2.5	2.50
Pres Wet Test Meter, in H20	-0.98	-1.00	-0.97	-0.98
Gas Volume Wet Init, CF	31.039	43.259	55.426	129.724
Gas Volume Wet Final, CF	43.259	55.426	67.572	166.257
Wet Test MCF	1.0443	1.0443	1.0443	1.0443
Gas Volume Dry Init, CF	937.456	950.713	964.154	2852.323
Gas Volume Dry Final, CF	950.713	964.154	977.677	2892.544
Temp Wet Init, C	16.8	16.6	16.7	16.7
Temp Wet Final, C	16.6	16.7	16.8	16.7
Dry Gas Temp Init In, F	83	109	115	102
Dry Gas Temp Final In, F	109	115	119	114
Dry Gas Temp Init Out, F	82	89	95	89
Dry Gas Temp Final Out, F	89	95	100	95
Run Time, sec	900	900	900	2700
Meter Calibration Factor, Y	1.0070	1.0092	1.0104	1.0089
Qm	0.8815	0.8882	0.8953	0.8883
Km	0.7082	0.7094	0.7115	0.7097
Delta H@	1.84	1.83	1.82	1.83

Previous Y 1.0067 % Difference -0.22%
Previous H@ 1.91 % Difference 4.26%

Project Rahwal Stack UNIT# 2

SIGNATURE

GUARDIAN SYSTEMS INC
Temperature Calibration for Omega II
on 10/20/88

Actual Temperature, F	Reading Temperature, F	Correction in Reading, F
0	0	0
50	50	0
100	100	0
150	150	0
200	200	0
250	250	0
300	300	0
350	350	0
400	400	0
450	450	0
500	500	0
550	550	0
600	600	0
650	650	0
700	700	0
750	750	0
800	800	0
850	850	0
900	900	0
950	950	0
1000	1000	0
1200	1200	0
1400	1400	0
1600	1600	0
1800	1800	0

SIGNATURE _____

GUARDIAN SYSTEMS INC
Temperature Calibration for Impingers
on 10/20/88

Device	Actual Temperature, F	Reading Temperature, F	Correction in Reading, F
Impinger 1	32	32	0
	50	50	0
	65	65	0
Impinger 2	32	32	0
	50	50	0
	65	65	0
Impinger 3	32	32	0
	50	50	0
	65	65	0
Impinger 4	32	32	0
	50	50	0
	65	65	0
Impinger 5	32	32	0
	50	50	0
	65	65	0
Impinger 6	32	32	0
	50	50	0
	65	65	0
Impinger 7	32	32	0
	50	50	0
	65	65	0
Impinger 8	32	32	0
	50	50	0
	65	65	0

SIGNATURE

PITOT CALIBRATION FORM

Date 8/4/88 Probe # 3-3

Calibrated By Hamrick/Gradlee

Nozzle Size

SIDE A

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \overline{C}_p(A)$
1	.51	.74	.822	+0.002
2	.51	.75	.816	-0.004
3	.51	.75	.816	-0.004
		$\overline{C}_p(A)$	.820	

SIDE B

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \overline{C}_p(B)$
1	.51	.74	.822	-0.001
2	.52	.74	.830	+0.007
3	.51	.75	.816	-0.007
		$\overline{C}_p(B)$	.823	

CALCULATIONS

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

$$\text{Average Deviation} = \frac{\Sigma \left| C_p(s) - \overline{C}_p(A \text{ or } B) \right|}{3} \longleftarrow \text{Must be} \leq 0.01$$

$$\left| \overline{C}_p(A) - \overline{C}_p(B) \right| \longleftarrow \text{Must be} \leq 0.01$$