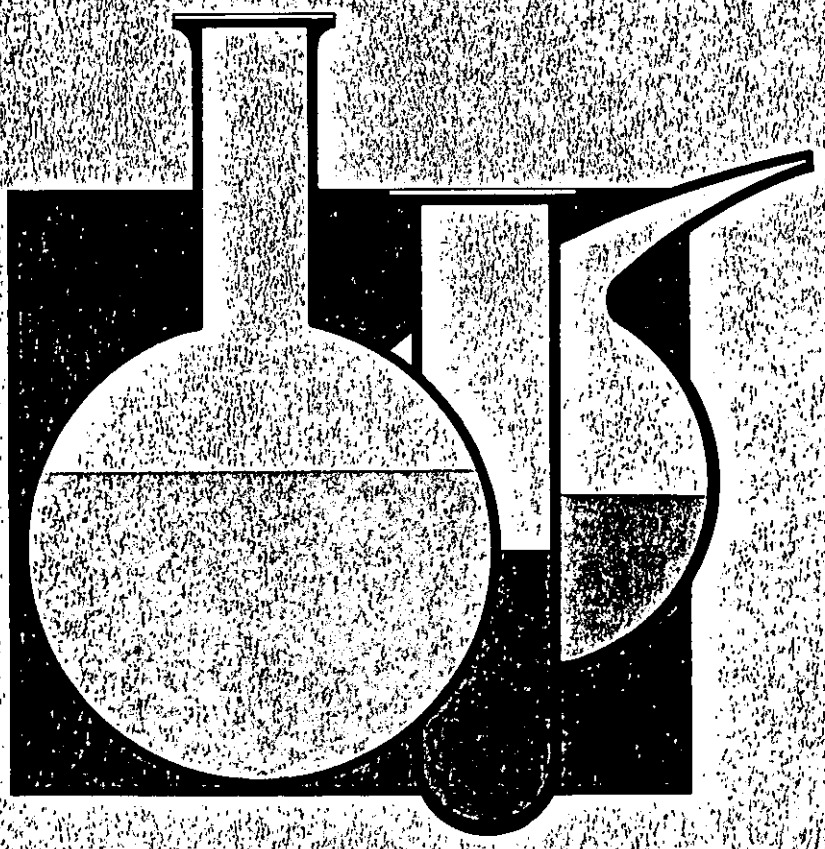
AP42 Section:	11.3
Background Chapter	4
Reference:	11
Title:	*Exhaust Gas Characterization Studies Conducted on the Plant 10B for General Shale Corporation in Johnson City, TN, Guardian Systems, Inc., Leeds, AL, February 1984.*

Background Report
Reference II (Section 4)

GUARDIAN SYSTEMS INC.

2809 Central Avenue
Birmingham, Alabama 35209
205/879-1850



Test Report

EXHAUST GAS CHARACTERIZATION STUDY

CONDUCTED ON PLANT 10B

FOR

GENERAL SHALE PRODUCTS CORPORATION

IN

JOHNSON CITY, TENNESSEE

ON

FEBRUARY 7-9, 1984

Approved by: _____

Tom Lotz
Director
Field Services Division

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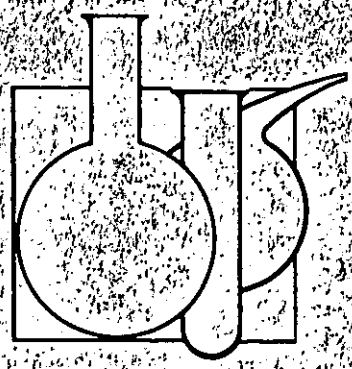
Introduction



I. INTRODUCTION

On February 7-9, 1984, Guardian Systems, Inc. performed a series of particulate emissions and particle size tests on General Shale Products Brick Plant Kiln No. 10B located in Johnson City, Tennessee. This unit has been modified from a dryer stack and an exhaust to only one stack. The purpose of this research project was to determine the results of recent modifications to the system and further characterize the particulate emissions during the two different modes of the kiln cycle which are "flashing" (referred to as OFF) and normal operation (referred to as ON).

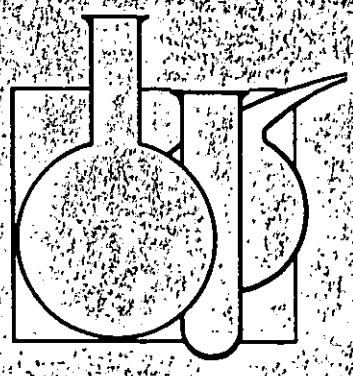
Individual bricks are formed and stacked onto kiln cars. The cars are inserted on a regular basis into a long, continuous-fired tunnel kiln. As one car is discharged another is inserted. This provides a constant moving mass inside the kiln. Cars are pushed through the long kiln at a slow, methodical pace. By means of a coal firing process, heat is increased in each chamber until the total firing is complete. During this process the brick are subjected to "flashing" or the process of imparting color to the brick. To accomplish the "flashing" of the brick, the fan damper is partialy closed and more coal is added to the kiln to produce a reducing atmosphere. The damper is then opened and the kiln returns to its normal mode. During the testing the OFF mode was approximately 1 minute and 30 seconds and the ON mode was approximately 3 minutes. To determine the emissions during each mode of the cycle two sampling trains were utilized.

Mr. Dave McNees, Corporate Representative, and Mr. Dick Green Plant Superintendent represented General Shale Products Corporation and Mr. Tom Lotz and Mr. Ashley Riley represented Guardian Systems, Inc.

Thee following personnel were present during the actual field sampling and performed the duties indicated:

Mr. Dave McNees	Provided production data
Mr. Dick Green	Stable operation of plant
Mr. Tom Lotz	Field sampling
Mr. Ashley Riley	Field sampling

Test Results



II. SUMMARY OF TEST RESULTS

Tables 1,2, & 3 are summaries of the mass test results for plant #10B during each mode. Table 4 is a breakdown of the particle size. The allowable emission rate was determined using the following equation:

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

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

The allowable emission rate, based on a process weight of 10.415 tons per hour, is 15.35 pounds per hour (See **Plant Operational Data**). The average actual emission rate is shown below. Since the ON test was for 40 minutes and the OFF test was for 20 minutes each hour these rates have been combined to produce a weighted average for a one hour test.

Test type	ON [1]	OFF [1]	Total Emissions [2]
Test 1 & 3 Emissions, Single point, lbs/hr	9.16	7.98	8.77
Test 2 Emissions, Single point, lbs/hr	15.14	10.92	13.75
Test 5 & 6 Emissions, Multi-point, lbs/hr	14.32	7.50	12.07

[1] These values represent true emissions even though the sample time was less than one hour.

[2] These values represent time weighted emissions which can be compared directly with the allowable emission rate.

II. SUMMARY OF TEST RESULTS CONTINUED

As the results indicate the single point mass emissions were reduced from the last test series approximately 58 %, from 21.32 pounds per hour to 8.92 pounds per hour with the coal crusher off (**Tables 1 & 2**). The coal crusher seems to add an additional 60 % in emissions, which if left in the system would cause problems with your compliance status.

When we initally decided to sample a single point, I indicated that this type of sampling would provide relative numbers to be used in evaluating operational changes to the system. The modifications to this process seems to have been very effective in reducing flow and concentration of particulate emissions. Once the changes had been made, the next step was to determine the total emissions (multi-point) and compare to the allowable emission rate. Tests 5 & 6 were taken at 16 different points to obtain an overall sample. The results of these tests showed a total emission rate of 12.96 pounds per hour which is approximately 84 % of the allowable emission rate.

Two single point particle size distribution tests were conducted to obtain relative mass and particle size relationships. These results are presented in Table 4 and the results of the total mass presented in Tables 1 & 2 tests 4. As the total emissions indicated, one impactor test is not sufficient to characterize the total emissions, but should supply relative mass and particle size relationships. These tests indicate that approximately 80% of your particles are smaller than approximately 10.5 microns. This would only give, at best, a 20 % reduction of particulate emissions with the installation of some type of cyclonic collection device.

GUARDIAN ** SYSTEMS ** INCORPORATED
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BIRMINGHAM, AL 35209
205-879-1850

SUMMARIZED AIR TEST RESULTS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43071

RUN NUMBER	1	2	3	4
DATE OF TEST	02/08/84	02/08/84	02/08/84	02/08/84
TIME OF TEST	1008-1050	1129-1214	1535-1617	1650-1726
LOCATION OF TEST	ON	ON	ON	IMP ON
STACK GAS TEMPERATURE DEGREES F	139	141	140	140
MOISTURE CONTENT, % V/V	5.20	5.20	5.19	5.19
OXYGEN CONTENT, % V/V	17.00	17.00	19.00	19.00
CARBON DIOXIDE CONTENT, % V/V	3.00	3.00	1.00	1.00
STACK GAS VELOCITY FEET PER SECOND	46.99	48.04	55.57	53.86
VOLUMETRIC FLOW ACTUAL CUBIC FEET PER MINUTE	23,400	23,924	27,674	26,823
VOLUMETRIC FLOW DRY STANDARD CUBIC FEET PER MINUTE	19,162	19,525	22,627	21,932
CONCENTRATION GRAINS PER DRY STANCARD CUBIC FOOT	0.046	0.090	0.055	0.035
CONCENTRATION GRAINS PER ACTUAL CUBIC FOOT	0.038	0.074	0.045	0.029
PARTICULATE MASS RATE (#/HR.)	7.63	15.14	10.68	6.59
% ISOKINETIC	102.08	102.93	101.03	106.86

Table I

GUARDIAN ** SYSTEMS ** INCORPORATED
2610 19TH. STREET, SOUTH
BIRMINGHAM, AL. 35209
205-879-1850

SUMMARIZED AIR TEST RESULTS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43070

RUN NUMBER	1	2	3	4
DATE OF TEST	02/08/84	02/08/84	02/08/84	02/08/84
TIME OF TEST	1008-1050	1129-1214	1535-1620	1650-1750
LOCATION OF TEST	OFF	OFF	OFF	IMPOFF
STACK GAS TEMPERATURE DEGREES F	140	149	138	139
MOISTURE CONTENT, % V/V	5.68	5.69	5.69	5.68
OXYGEN CONTENT, % V/V	17.00	17.00	19.00	19.00
CARBON DIOXIDE CONTENT, % V/V	3.00	3.00	1.00	1.00
STACK GAS VELOCITY FEET PER SECOND	43.68	33.95	46.09	47.48
VOLUMETRIC FLOW ACTUAL CUBIC FEET PER MINUTE	21,752	16,905	22,953	23,647
VOLUMETRIC FLOW DRY STANDARD CUBIC FEET PER MINUTE	17,699	13,551	18,749	19,287
CONCENTRATION GRAINS PER DRY STANCARD CUBIC FOOT	0.047	0.094	0.055	0.028
CONCENTRATION GRAINS PER ACTUAL CUBIC FOOT	0.038	0.075	0.045	0.023
PARTICULATE MASS RATE (#/HR.)	7.14	10.92	8.82	4.67
% ISOKINETIC	102.66	98.49	98.26	96.13

Table 2

TABLE 3

IMPACTOR RESULTS

Test #	4	4
Location	Port A	Port B
	Point 5	Point 6
Type	ON	OFF
Date	2-08-84	2-08-84
Oxygen, %	19.0	19.0
Carbon Dioxide, %	1.0	1.0
Moisture, %	5.19	5.68
Flow thru impactor,cfm	0.513	0.465
Barometric Pressure,in. of mercury	29.36	29.36
Static Pressure, in. of water	-0.52	-0.12
Temperature of Impactor, ^{o}F	140	139
Pre impactor D_{50} (microns)	13.67	14.36
Cum.% of mass smaller than D_{50}	100.00	100.00
Stage 1 D_{50} (microns)	11.02	11.58
Cum % of mass small than D_{50}	88.98	90.14
Stage 2 D_{50} (microns)	10.21	10.73
Cum % of mass small than D_{50}	78.46	81.95
Stage 3 D_{50} (microns)	6.63	6.97
Cum % of mass small than D_{50}	55.31	58.13
Stage 4 D_{50} (microns)	4.27	4.49
Cum % of mass small than D_{50}	37.51	41.49
Stage 5 D_{50} (microns)	2.47	2.61
Cum % of mass small than D_{50}	23.36	25.62
Stage 6 D_{50} (microns)	1.20	1.27
Cum % of mass small than D_{50}	11.93	14.08
Stage 7 D_{50} (microns)	0.75	0.79
Cum % of mass small than D_{50}	3.34	9.48
Stage 8 D_{50} (microns)	0.37	0.40
Cum % of mass small than D_{50}	0.00	8.71

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
2610 19TH. STREET, SOUTH
BIRMINGHAM, AL 35209
205-879-1850

SUMMARIZED AIR TEST RESULTS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43072

RUN NUMBER	5	6	7	8
DATE OF TEST	02/09/84	02/09/84	02/09/84	02/07/84
TIME OF TEST	0922-0947	1010-1102	0835-0845	1630-1645
LOCATION OF TEST	ON	OFF	VEL ON	VEL ON
STACK GAS TEMPERATURE DEGREES F	141	145	140	136
MOISTURE CONTENT, % V/V	7.07	7.13	7.07	5.20
OXYGEN CONTENT, % V/V	19.00	19.00	19.00	18.00
CARBON DIOXIDE CONTENT, % V/V	1.00	1.00	1.00	2.00
STACK GAS VELOCITY FEET PER SECOND	59.75	41.61	60.44	59.26
VOLUMETRIC FLOW ACTUAL CUBIC FEET PER MINUTE	29,756	20,723	30,097	29,512
VOLUMETRIC FLOW DRY STANDARD CUBIC FEET PER MINUTE	23,750	16,421	24,063	24,299
CONCENTRATION GRAINS PER DRY STANCARD CUBIC FOOT	0.070	0.053		
CONCENTRATION GRAINS PER ACTUAL CUBIC FOOT	0.056	0.042		
PARTICULATE MASS RATE (#/HR.)	14.32	7.50		
% ISOKINETIC	105.50	107.32		

Table 4

GUARDIAN ** SYSTEMS ** INCORPORATED
2610 19TH. STREET, SOUTH
BIRMINGHAM, AL 35209
205-879-1850

COMPUTER INPUT PARAMETERS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43071

RUN NUMBER	1	2	3	4
DATE	02/08/84	02/08/84	02/08/84	02/08/84
LOCATION	ON	ON	ON	IMP ON
TIME	1008-1050	1129-1214	1535-1617	1650-1726
BAROMETRIC PRESSURE (IN. HG)	29.36	29.36	29.36	29.36
STATIC PRESSURE (IN. H2O)	- 0.540	- 0.540	- 0.520	- 0.520
RUN TIME (MINUTES)	27	30	30	18
METER VOLUME (CORRECTED)	20.330	23.992	27.302	9.238
STACK TEMPERATURE (*F)	139	141	140	140
METER TEMPERATURE (*F)	69	87	88	92
METER PRESSURE (IN.H2O)	1.54	1.64	2.20	0.62
SQR VELOCITY PRESSURE	0.774	0.790	0.911	0.883
MASS OF PARTICULATE (MG.)	60.3	134.0	92.8	19.8
ML. OF WATER COLLECTED	23.3	26.6	30.2	10.1
% OXYGEN	17.0	17.0	19.0	19.0
% CARBON DIOXIDE	3.0	3.0	1.0	1.0
% CARBON MONOXIDE	0.0	0.0	0.0	0.0
STACK AREA (SQ. FT.)	8.30	8.30	8.30	8.30
PITOT CORRECTION FACTOR	0.84	0.84	0.84	0.84
NOZZLE DIAMETER (IN.)	0.240	0.240	0.240	0.177

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
2610 19TH. STREET, SOUTH
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205-879-1850

COMPUTER INPUT PARAMETERS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43070

RUN NUMBER	1	2	3	4
DATE	02/08/84	02/08/84	02/08/84	02/08/84
LOCATION	OFF	OFF	OFF	IMPOFF
TIME	1008-1050	1129-1214	1535-1620	1650-1750
BAROMETRIC PRESSURE (IN. HG)	29.36	29.36	29.36	29.36
STATIC PRESSURE (IN. H2O)	- 0.370	- 0.370	- 0.140	- 0.120
RUN TIME (MINUTES)	14	15	15	20
METER VOLUME (CORRECTED)	10.841	8.836	12.172	9.065
STACK TEMPERATURE (•F)	140	149	138	139
METER TEMPERATURE (•F)	67	85	85	92
METER PRESSURE (IN.H2O)	1.54	0.92	1.76	0.56
SQR VELOCITY PRESSURE	0.678	0.523	0.710	0.735
MASS OF PARTICULATE (MG.)	32.7	51.4	41.4	15.6
ML. OF WATER COLLECTED	13.7	10.8	14.9	10.9
% OXYGEN	17.0	17.0	19.0	19.0
% CARBON DIOXIDE	3.0	3.0	1.0	1.0
% CARBON MONOXIDE	0.0	0.0	0.0	0.0
STACK AREA (SQ. FT.)	8.30	8.30	8.30	8.30
PITOT CORRECTION FACTOR	0.89	0.89	0.89	0.89
NOZZLE DIAMETER (IN.)	0.253	0.253	0.253	0.187

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COMPUTER INPUT PARAMETERS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43072

RUN NUMBER	5	6	7	8
DATE	02/09/84	02/09/84	02/09/84	02/07/84
LOCATION	ON	OFF	VEL ON	VEL ON
TIME	0922-0947	1010-1102	0835-0845	1630-1645
BAROMETRIC PRESSURE (IN. HG)	29.26	29.26	29.26	29.38
STATIC PRESSURE (IN. H2O)	- 0.130	- 0.130	- 0.120	- 0.640
RUN TIME (MINUTES)	16	16	16	27
METER VOLUME (CORRECTED)	10.887	7.902	10.887	20.330
STACK TEMPERATURE (•F)	141	145	140	136
METER TEMPERATURE (•F)	70	86	70	69
METER PRESSURE (IN.H2O)	1.34	0.66	1.34	1.54
SQR VELOCITY PRESSURE	0.974	0.676	0.986	0.922
MASS OF PARTICULATE (MG.)	48.6	25.9	0.0	0.0
ML. OF WATER COLLECTED	17.2	12.2	17.2	23.3
% OXYGEN	19.0	19.0	19.0	18.0
% CARBON DIOXIDE	1.0	1.0	1.0	2.0
% CARBON MONOXIDE	0.0	0.0	0.0	0.0
STACK AREA (SQ. FT.)	8.30	8.30	8.30	8.30
PITOT CORRECTION FACTOR	0.84	0.84	0.84	0.89
NOZZLE DIAMETER (IN.)	0.201	0.201		

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
2610 19TH. STREET, SOUTH
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COMPUTED AIR TEST RESULTS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43071

RUN NUMBER	1	2	3	4
DATE OF TEST	02/08/84	02/08/84	02/08/84	02/08/84
LOCATION OF TEST	ON	ON	ON	IMP ON
1. STACK PRESSURE				
INCHES HG	29.32	29.32	29.32	29.32
MILLIMETERS HG	744.74	744.74	744.77	744.77
2 METER PRESSURE				
INCHES HG	29.47	29.48	29.52	29.41
MILLIMETERS HG	748.62	748.81	749.85	746.90
3. METER VOLUME				
DRY STANDARD CUBIC FEET	19.989	22.819	25.955	8.684
DRY STANDARD CUBIC METERS	0.566	0.646	0.735	0.246
4. WATER VOLUME				
STANDARD CUBIC FEET	1.097	1.252	1.422	0.475
STANDARD CUBIC METERS	0.031	0.035	0.040	0.013
5. MOISTURE CONTENT (%)	5.20	5.20	5.19	5.19
6. MOLECULAR WEIGHT DRY	29.16	29.16	28.92	28.92
7. MOLECULAR WEIGHT WET	28.58	28.58	28.35	28.35
8. STACK VELOCITY				
FEET PER SECOND	46.99	48.04	55.57	53.86
METERS PER SECOND	14.32	14.64	16.94	16.42
9. VOLUMETRIC FLOW				
ACTUAL CUBIC FEET PER MINUTE	23,400	23,924	27,674	26,823
ACTUAL CUBIC METERS PER SECOND	11.04	11.29	13.06	12.66
10. VOLUMETRIC FLOW				
DRY STANDARD CUBIC FEET PER MINUTE	19,162	19,525	22,627	21,932
DRY STANDARD CUBIC METER PER SECOND	9.04	9.21	10.68	10.35

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COMPUTED AIR TEST RESULTS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43071

RUN NUMBER	1	2	3	4
DATE OF TEST	02/08/84	02/08/84	02/08/84	02/08/84
LOCATION OF TEST	ON	ON	ON	IMP ON
11. CONCENTRATION				
GRAINS PER DRY STANCARD CUBIC FOOT	0.0465	0.0904	0.0551	0.0351
GRAMS PER DRY STANDARD CUBIC METER	0.1063	0.2069	0.1260	0.0803
15. PARTICULATE MASS RATE (#/HR.)	7.63	15.14	10.68	6.59
16. VOLUME AT NOZZLE				
ACTUAL CUBIC FEET	24.411	27.960	31.747	10.622
ACTUAL CUBIC METERS	0.691	0.792	0.899	0.301
17. CONCENTRATION				
GRAINS PER ACTUAL CUBIC FOOT	0.0380	0.0738	0.0450	0.0287
GRAMS PER ACTUAL CUBIC METER	0.0870	0.1689	0.1030	0.0656
18. % ISOKINETIC	102.08	102.93	101.03	106.86

GUARDIAN ** SYSTEMS ** INCORPORATED
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COMPUTED AIR TEST RESULTS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43070

RUN NUMBER	1	2	3	4
DATE OF TEST	02/08/84	02/08/84	02/08/84	02/08/84
LOCATION OF TEST	OFF	OFF	OFF	IMPOFF
1. STACK PRESSURE				
INCHES HG	29.33	29.33	29.35	29.35
MILLIMETERS HG	745.05	745.05	745.48	745.52
2. METER PRESSURE				
INCHES HG	29.47	29.43	29.49	29.40
MILLIMETERS HG	748.62	747.46	749.03	746.79
3. METER VOLUME				
DRY STANDARD CUBIC FEET	10.699	8.420	11.623	8.521
DRY STANDARD CUBIC METERS	0.303	0.238	0.329	0.241
4. WATER VOLUME				
STANDARD CUBIC FEET	0.645	0.508	0.701	0.513
STANDARD CUBIC METERS	0.018	0.014	0.020	0.015
5. MOISTURE CONTENT (%)	5.68	5.69	5.69	5.68
6. MOLECULAR WEIGHT DRY	29.16	29.16	28.92	28.92.
7. MOLECULAR WEIGHT WET	28.53	28.52	28.30	28.30
8. STACK VELOCITY				
FEET PER SECOND	43.68	33.95	46.09	47.48
METERS PER SECOND	13.31	10.35	14.05	14.47
9. VOLUMETRIC FLOW				
ACTUAL CUBIC FEET PER MINUTE	21,752	16,905	22,953	23,647
ACTUAL CUBIC METERS PER SECOND	10.27	7.98	10.83	11.16
10. VOLUMETRIC FLOW				
DRY STANDARD CUBIC FEET PER MINUTE	17,699	13,551	18,749	19,287
DRY STANDARD CUBIC METER PER SECOND	8.35	6.40	8.85	9.10

GUARDIAN ** SYSTEMS ** INCORPORATED
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COMPUTED AIR TEST RESULTS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43070

RUN NUMBER	1	2	3	4
DATE OF TEST	02/08/84	02/08/84	02/08/84	02/08/84
LOCATION OF TEST	OFF	OFF	OFF	IMPOFF
11. CONCENTRATION				
GRAINS PER DRY STANCARD CUBIC FOOT	0.0471	0.0940	0.0549	0.0282
GRAMS PER DRY STANDARD CUBIC METER	0.1077	0.2151	0.1255	0.0646
15. PARTICULATE MASS RATE (#/HR.)	7.14	10.92	8.82	4.67
16. VOLUME AT NOZZLE				
ACTUAL CUBIC FEET	13.150	10.504	14.230	10.448
ACTUAL CUBIC METERS	0.372	0.297	0.403	0.296
17. CONCENTRATION				
GRAINS PER ACTUAL CUBIC FOOT	0.0383	0.0754	0.0448	0.0230
GRAMS PER ACTUAL CUBIC METER	0.0876	0.1724	0.1025	0.0527
18. % ISOKINETIC	102.66	98.49	98.26	96.13

GUARDIAN ** SYSTEMS ** INCORPORATED
2610 19TH. STREET, SOUTH
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COMPUTED AIR TEST RESULTS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43072

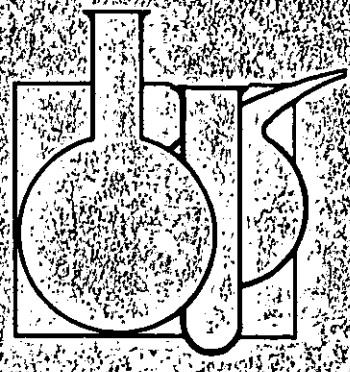
RUN NUMBER	5	6	7	8
DATE OF TEST	02/09/84	02/09/84	02/09/84	02/07/84
LOCATION OF TEST	ON	OFF	VEL ON	VEL ON
1. STACK PRESSURE				
INCHES HG	29.25	29.25	29.25	29.33
MILLIMETERS HG	742.96	742.96	742.98	745.06
2. METER PRESSURE				
INCHES HG	29.36	29.31	29.36	29.49
MILLIMETERS HG	745.71	744.44	745.71	749.13
3. METER VOLUME				
DRY STANDARD CUBIC FEET	10.642	7.485	10.642	20.002
DRY STANDARD CUBIC METERS	0.301	0.212	0.301	0.566
4. WATER VOLUME				
STANDARD CUBIC FEET	0.810	0.574	0.810	1.097
STANDARD CUBIC METERS	0.023	0.016	0.023	0.031
5. MOISTURE CONTENT (%)	7.07	7.13	7.07	5.20
6. MOLECULAR WEIGHT DRY	28.92	28.92	28.92	29.04
7. MOLECULAR WEIGHT WET	28.15	28.14	28.15	28.47
8. STACK VELOCITY				
FEET PER SECOND	59.75	41.61	60.44	59.26
METERS PER SECOND	18.21	12.68	18.42	18.06
9. VOLUMETRIC FLOW				
ACTUAL CUBIC FEET PER MINUTE	29,756	20,723	30,097	29,512
ACTUAL CUBIC METERS PER SECOND	14.04	9.78	14.20	13.93
10. VOLUMETRIC FLOW				
DRY STANDARD CUBIC FEET PER MINUTE	23,750	16,421	24,063	24,299
DRY STANDARD CUBIC METER PER SECOND	11.21	7.75	11.36	11.47

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
2610 19TH. STREET, SOUTH
BIRMINGHAM, AL 35209
205-879-1850

COMPUTED AIR TEST RESULTS FOR GENERAL SHALE PRODUCTS CO
JOB NUMBER 43072

RUN NUMBER	5	6	7	8
DATE OF TEST	02/09/84	02/09/84	02/09/84	02/07/84
LOCATION OF TEST	ON	OFF	VEL ON	VEL ON
11. CONCENTRATION				
GRAINS PER DRY STANCARD CUBIC FOOT	0.0703	0.0533		
GRAMS PER DRY STANDARD CUBIC METER	0.1609	0.1219		
15. PARTICULATE MASS RATE (#/HR.)	14.32	7.50		
16. VOLUME AT NOZZLE				
ACTUAL CUBIC FEET	13.335	9.447		
ACTUAL CUBIC METERS	0.378	0.268		
17. CONCENTRATION				
GRAINS PER ACTUAL CUBIC FOOT	0.0561	0.0422		
GRAMS PER ACTUAL CUBIC METER	0.1284	0.0966		
18. % ISOKINETIC	105.50	107.32		

Sampling & Analytical Procedures



III. SAMPLING AND ANALYTICAL PROCEDURES

General

All sampling and analytical procedures for determination of the particulate emissions from this source were conducted in accordance with the Code of Federal Regulations, Title 40, Part 60, Appendix A, Methods 1-5 and 17 as amended, except where noted below. All impactor data reduction was based on EPA-600/7-78-042, March 1978, "A Computer - Based Cascade Impactor Data Reduction Systems".

The dimensions of the stack (see **Figures 1 & 2**) indicated that 16 points (8 per diameter) would be required for the velocity traverses and 32 points should be used for the Method 5 test. A complete velocity traverse (32 points) was taken prior to the Method 5 test and it was determined from that traverse that 16 points should provide accurate information. The Method 17 tests were taken at a single point to compare the results with the previous test. The OFF train sampled side B, Point 6 for tests 1,2,3 & the impactor test #4, while the ON train sampled side A, Point 5 for the same test sequence.

A TI-55 was used to calculate the sampling rates for the mass and particle sizing determinations. The sampling equipment used in these tests was manufactured by Research Appliance Corporation and was properly calibrated before these tests (See **Calibrations**). The impactor was a Mark III High Temperature Sampler with Pre separator (**Figures 5 & 6**) made of stainless steel with Inconel O-rings and glass fiber collection media with a backup filter. Gas analysis for CO_2 and O_2 were determined during each test by a Fyrite Gas Analyser.

Sampling Techniques Method 17

The particulate determinations were made by utilizing the sample train in Figure 3. Initial and final leak checks of the sampling system and pitot lines were performed as outlined in Method 17 and were recorded on the data sheets. The nozzle was calibrated before and after each test using a micrometer and was also recorded on the data sheets.

The gases were drawn through a stainless steel nozzle attached to a Gelman 47mm Filter Holder. 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 the stack temperature.

The gases then pass through a condenser placed in an ice bath to maintain a maximum exit temperature of 68 °F. This temperature was also recorded on the data sheets. The gases then pass through a pre-weighed drying column filled with indicating silica gel to remove any remaining moisture. The clean and cool gases then entered the meter box where the gas flow and temperature were measured. Particulate catches were placed in sealed petri dishes. Each acetone wash from the nozzle 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 transported to the laboratory for analysis.

Sampling Techniques Method 5

The particulate determinations were made by utilizing the sample train in Figure 4 . 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 was calibrated before and after each test using a micrometer and was also recorded on the data sheets.

The gases were drawn through a stainless steel nozzle attached to a heated glass lined probe. The probe heater was maintained at the proper setting to obtain an exit temperature of 248 ± 25 °F. (See **Calibrations**) The gases then passed through a glass fiber filter (Gelman) of 0.3 micron retention to remove particulate matter. The filter was maintained at a temperature of 248 ± 25 °F. The sample box temperatures were recorded at each point on the data sheets. The gases then pass through a condenser placed in an ice bath to maintain a maximum exit temperature of 68 °F. This temperature was also recorded on the data sheets.

The gases then pass through a pre-weighed drying column filled with indicating silica gel to remove any remaining moisture. The clean and cool gases then entered the meter box where the gas flow and temperature were measured. At the end of each test, the particulate catch was placed in sealed petri dish. Each acetone wash 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 kept in a locked box and then transported to the Birmingham laboratory for analysis.

Sampling Techniques Particle size

The gases were drawn through a stainless steel nozzle attached to a preseparator and an Anderson impactor. By maintaining a constant flow through the filtering system the particules were aerodynamically separated and deposited on pre-weighed collection substrates. The filtering system was maintained at the stack temperature which was 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 ^{o}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. At the end of each test, the particulate catch was placed in sealed petri dish and then transported to the Birmingham laboratory for analysis.

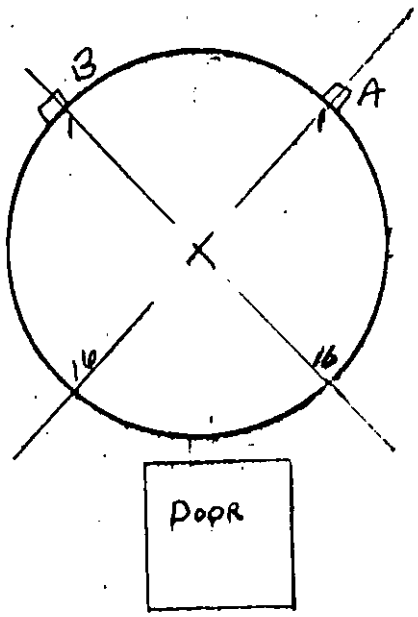
Analysis Particulates

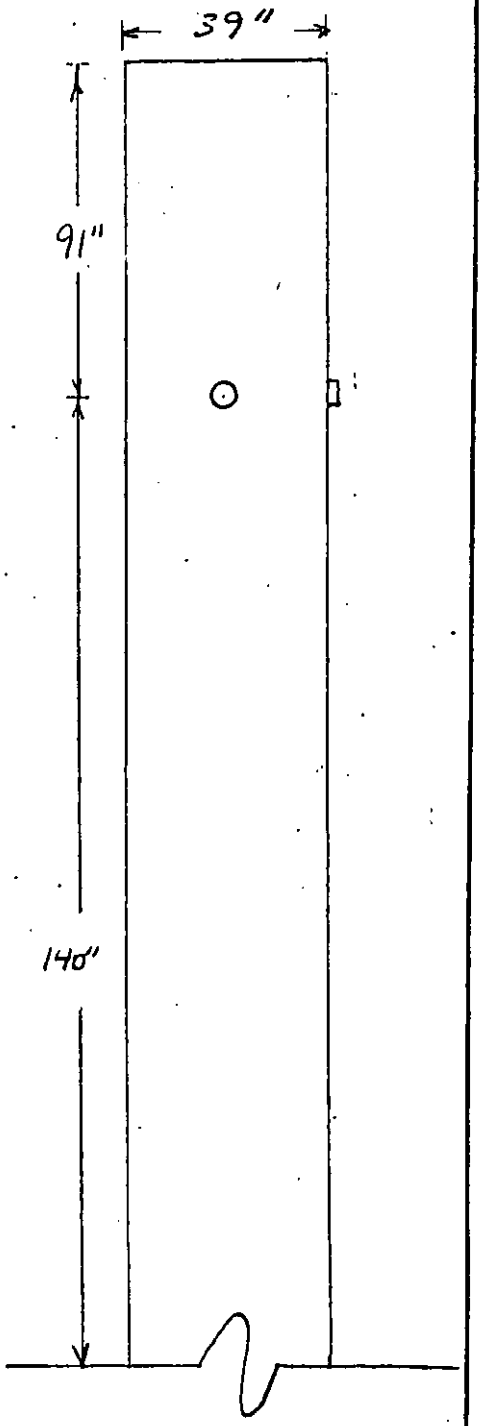
The Filters (Gelman, Class A, without organic binder, minimum 99.9% retention for particules of 0.3 microns as determined by DOP tests) were prepared for the field test by desiccating at 68 $\pm$ 10 ^{o}F at ambient pressure for twenty four (24) hours and weighed at intervals of at least six (6) hours to a constant weight (less than 0.5 milligrams change from previous reading). Impactor substrates were weighed to a constant weight of 0.05 milligrams change from the previous reading. Upon return to the laboratory, the filters were again subjected to the same procedures as outlined above. The weights were recorded in a bound laboratory book and transferred to the sheets laboratory 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 washes and the acetone blank for the group of tests were evaporated to dryness in tared glass beakers. They were then desiccated for twenty-four (24) hour and weighed to a constant weight, utilizing the weight procedure previously mention for the filters.

STACK BREECHING AND SAMPLE POINT LOCATION DIAGRAM

32 Points

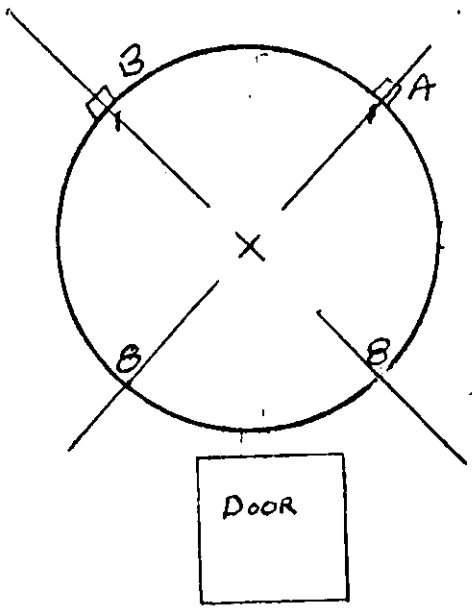




POINT #	Distance From Wall (inches)
16	38.0
15	37.1
14	35.7
13	34.1
12	32.4
11	30.4
10	27.9
9	24.4
8	14.6
7	11.1
6	8.6
5	6.6
4	4.9
3	3.3
2	1.9
1	1.0

Figure 1

STACK BREECHING AND SAMPLE POINT LOCATION DIAGRAM
16 Points



POINT #	Distance From Wall (inches)
8	37.7
7	34.9
6	31.4
5	26.4
4	12.6
3	7.6
2	4.1
1	1.3

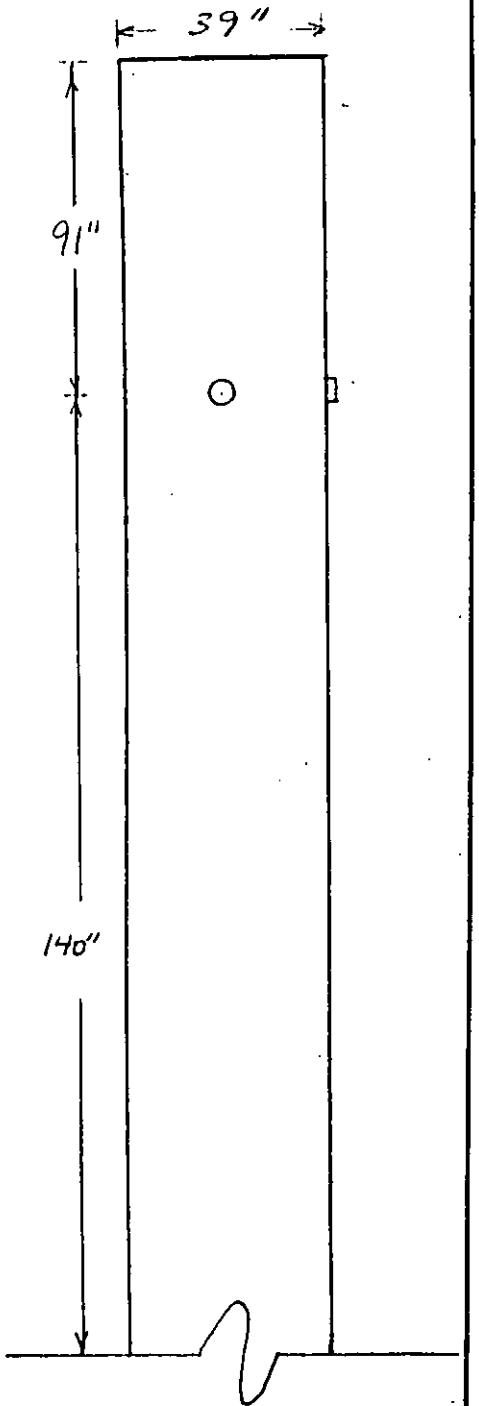


Figure 2

METHOD 17

PARTICULATE SAMPLING TRAIN

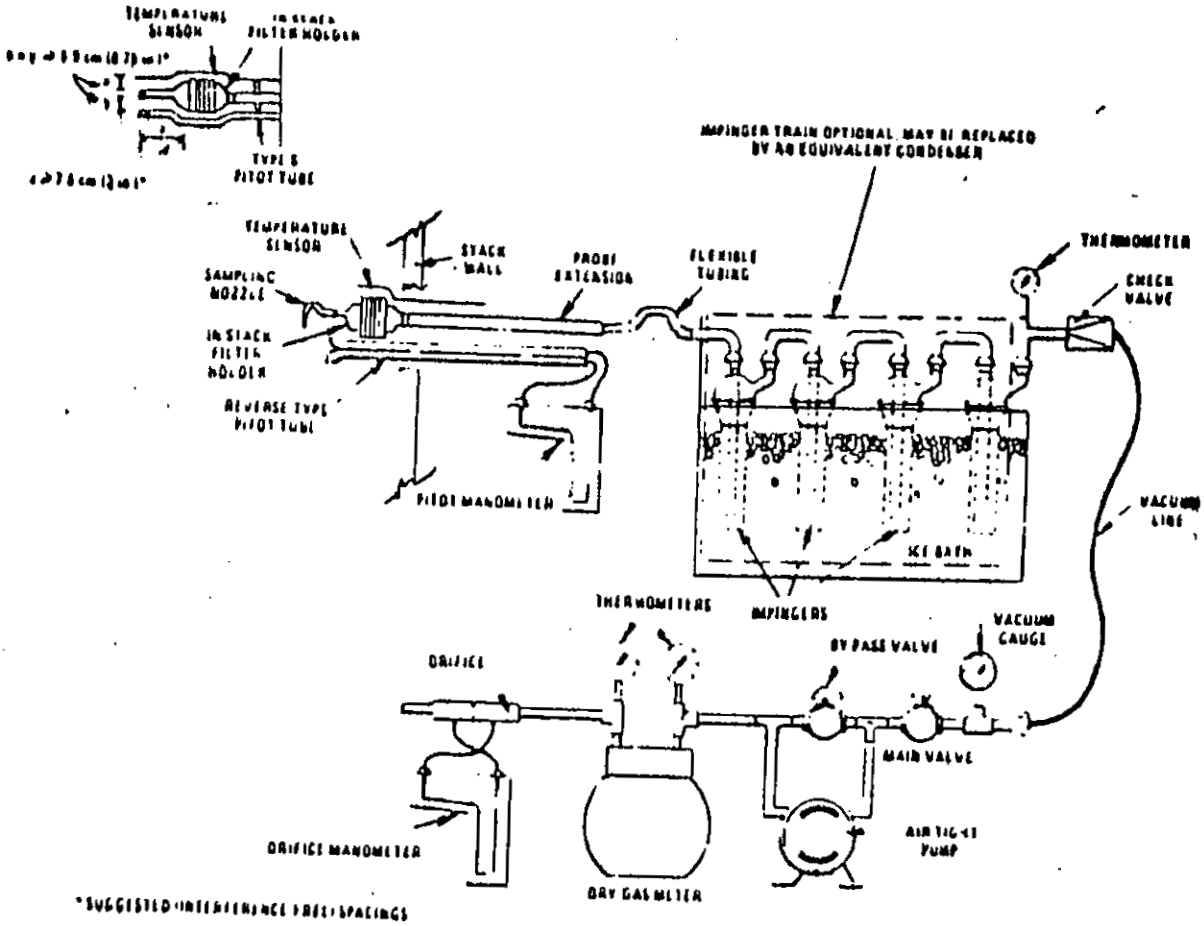


Figure 3

PARTICULATE SAMPLING TRAIN METHOD 5

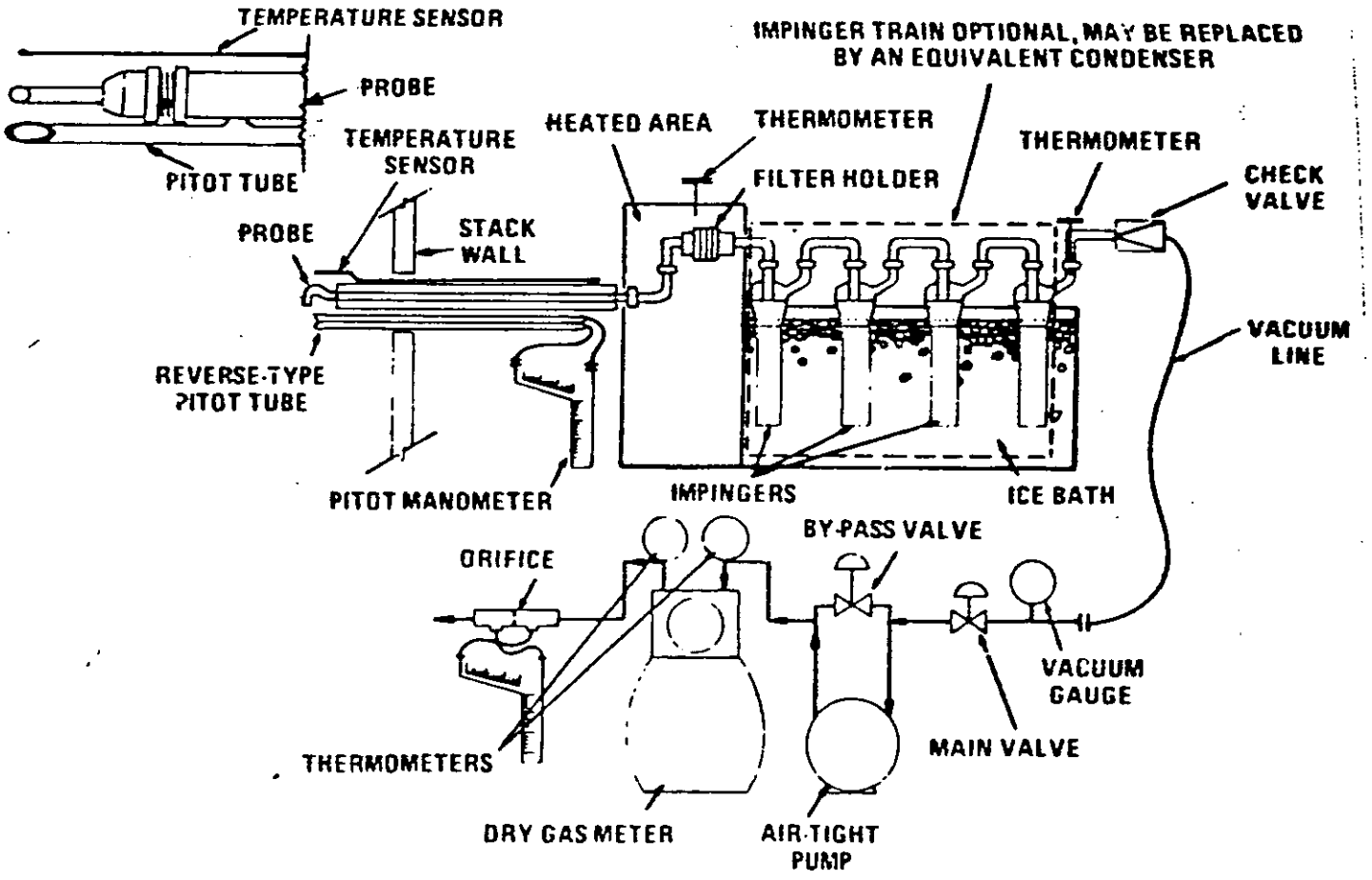
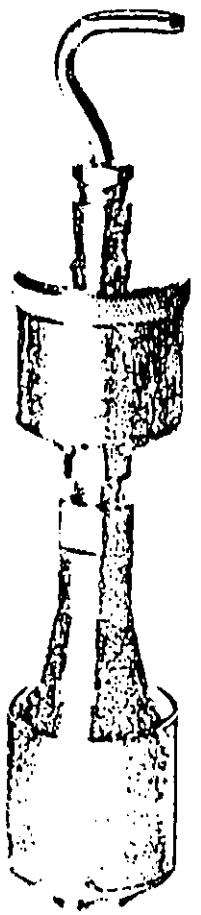


Figure 4



ANDERSEN Samplers INC

4215-C WENDELL DRIVE
ATLANTA, GEORGIA 30336

404-691-1910

TOLL FREE: 800-241-6898

IMPACTOR PRESEPARATOR

FOR

ANDERSEN PARTICLE SIZING STACK SAMPLER

Goes through 3" sampling port

The Andersen Preimpactor is used upstream from the particle sizing sampler when measuring particle size distributions in stacks with high grain loadings or with large particle size fractions (> 10μm). This stainless steel (temperature limitation, 1500°F), high capacity, instrument removes large particles in situ and attaches directly to the Andersen particle sizing stack sampler, permitting insertion through standard 3" sampling ports. It can also be adapted to other particle sizing instruments. Eliminates inherent bounce-off and reintrainment problems associated with aerodynamic fractionating of large particles (> 10μm). In addition, this new circular orifice design permits more efficient impaction and less reintrainment than is possible with cyclonic designs.

Figure 5

Mark III Hi-Temp Sampler

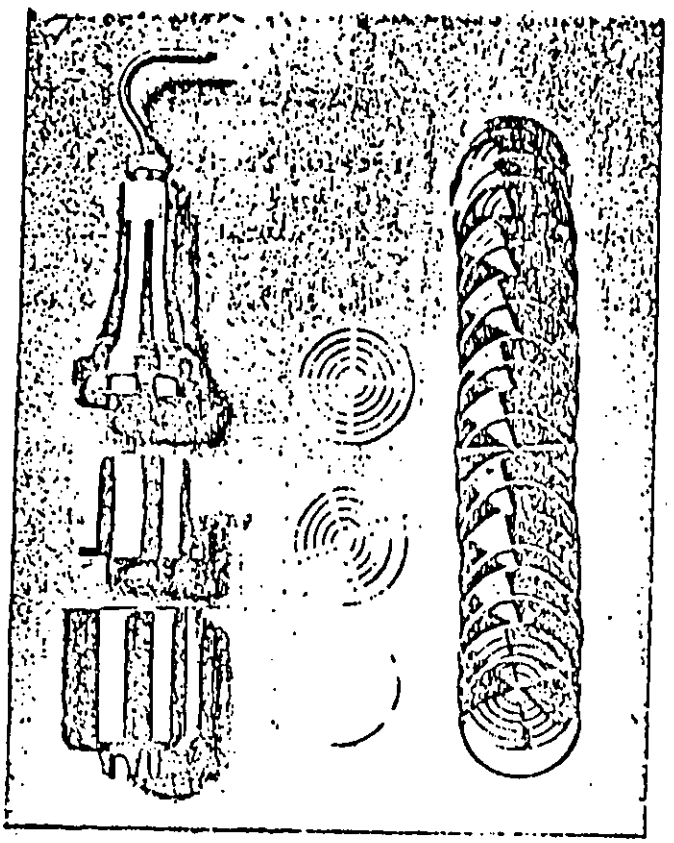
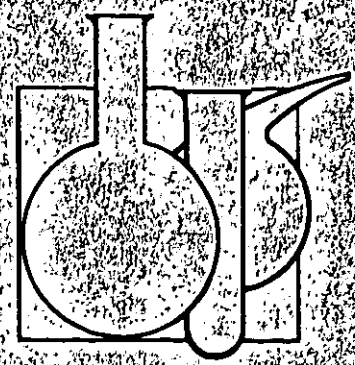


Figure 6

Field Data



NOMENCLATURE

ACF - Actual Cubic Feet

ACFM - Actual Cubic Feet per minute

ACM - Actual Cubic Meters

ACMS - Actual Cubic Meters per second

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

As - Area of Stack, (ft^2)

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

Ca - Acetone blank residue concentration, mg/g

c_a - Particulate Concentration, ACF

CFM - Cubic feet per minute

Cp - Pitot tube coefficient, (dimensionless)

c_s - Particulate Concentration, grains/DSCF

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

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

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

DSCF - Dry Standard Cubic Feet

DSCFM - Dry Standard Cubic Feet per minute

DSCM - Dry Standard Cubic Meters

DSCMS - Dry Standard Cubic Meters per second

EA - Excess Air, %

I - Isokinetic Sampling, %

Km - Orifice Correction Factor, (dimensionless)

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

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

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

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

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

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

Mn - Total amount of particulate matter collected, mg.

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

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

ΔP - Velocity head of stack gas, in. H_2O

Pa - Density of acetone, mg/ml

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

Pg - Stack static pressure, in. H_2O

Pm - Meter pressure, in. Hg

PMR - Particulate Mass Rate, lbs per hour

Ps - Absolute stack pressure, in. Hg

Pstd - Standard absolute pressure, 29.92 in. Hg

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

Qa - Volumetric flow rate, ACFM

Qs - Volumetric flow rate, DSCFM

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

SCF - Standard Cubic Foot

ta - Ambient Temperature, ^oF

tm - Average Temperature of meter, ^oF

t_s - Average Temperature of stack, ^oF

tstd - Standard Temperature, 68°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.

EQUATIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

BLANK ANALYTICAL DATA

Plant Ground Shop

Sample location 103

Relative humidity 20%

Type of blank Acetone

Liquid level at mark and container sealed ✓

Density of blank (ρa) .7847 g/ml

Blank volume (Va) 300 ml

Date and time of wt. 2/13/84 500 Gross wt. 112104.3 mg

Date and time of wt. 2/13/84 500 Gross wt. 112104.3 mg

Average gross wt. 112104.3 mg

Tare wt. 112104.2 mg

Weight of blank (ma) 0.1 mg

$$Ca = \frac{ma}{Va\ \rho a} = \frac{(0.1)}{(300)(.7847)} = 0.0004 \text{ mg/g}$$

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

Remarks: _____

Signature of analyst _____

Signature of reviewer _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: General STACE Sample date: 2/8/84

Sample location: 10B Run no.: 1 ON

Sample recovery person: C.T.Z./Riley Recovery date: 2/8/84

Filter(s) no.: 5-16

MOISTURE

Impingers See #4 Silica gel

Final volume (wt) _____ ml(gm) Final wt. _____g _____g

Initial volume (wt) _____ ml(gm) Initial wt. _____g _____g

Net volume (wt) _____ ml(gm) Net wt. _____g _____g

Total moisture _____g

Color of silica gel _____

Description of impinger water _____

RECOVERED SAMPLE

Filter container no. #1 ON sealed ✓

Description of particulate on filter BLACK

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

Acetone blank container no. _____ Liquid level marked _____

Samples stored and locked _____

Remarks: _____

Date of laboratory custody _____

Laboratory personnel taking custody C.T.Z.

Remarks: _____

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant General Shale Run No. 1 ON

Sample location 1 OB

Relative humidity 20%

Density of acetone (ρa) .7847 g/ml

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

Acetone rinse container no. ~~35~~ 1 ON

Acetone rinse volume (Vaw) 35 ml

Acetone blank residue concentration (Ca) 0.0004 mg/g

Wa = Ca Vaw ρa = (.0004)(35)(.7847) = — mg

Date and time of wt 2/13/84 0800 Gross wt 115487.0 mg

Date and time of wt 2/14/84 0800 Gross wt 115487.0 mg

Average gross wt 115487.0 mg

Tare wt 115471.4 mg

Less acetone blank wt (Wa) 0 mg

Weight of particulate in acetone rinse 15.6 mg

Filter(s) container no. 1 ON

Date and time of wt 0800 2/13/84 Gross wt 155.4 mg

Date and time of wt 0800 2/14/84 Gross wt 155.4 mg

Average gross wt 155.4 mg

Tare wt 110.7 mg

Weight of particulate on filter(s) 44.7 mg

Weight of particulate in acetone rinse 15.6 mg

Total weight of particulate 60.3 mg

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

Remarks: _____

Signature of analyst _____

Signature of reviewer _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: General Shale Sample date: 2-8-84

Sample location: 10 B Run no.: 2 ON

Sample recovery person: Lotz/Rue Recovery date: 2-8-84

Filter(s) no.: J-18

MOISTURE

Sec #4

Impingers		Silica gel	
Final volume (wt)	ml(gm)	Final wt.	g g
Initial volume (wt)	ml(gm)	Initial wt.	g g
Net volume (wt)	ml(gm)	Net wt.	g g

Total moisture g

Color of silica gel

Description of impinger water

RECOVERED SAMPLE

Filter container no. Run # 2 ON sealed ✓

Description of particulate on filter Burt

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

Acetone blank container no. Liquid level marked

Samples stored and locked

Remarks:

Date of laboratory custody

Laboratory personnel taking custody Lotz

Remarks:

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant Carol Shale Run No. 2ON

Sample location 10B

Relative humidity 20 %

Density of acetone (ρa) .7847 g/ml

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

Acetone rinse container no. 2 ON

Acetone rinse volume (Vaw) 25 ml

Acetone blank residue concentration (Ca) .0004 mg/g

Wa = Ca Vaw ρa = (.0004)(25)(.7847) = -0- mg

Date and time of wt 2/13/84 800 Gross wt 113/57.5 mg

Date and time of wt 2/14/84 800 Gross wt 113/57.5 mg

Average gross wt 113/57.5 mg

Tare wt 113/22.5 mg

Less acetone blank wt (Wa) -0- mg

Weight of particulate in acetone rinse 31.0 mg

Filter(s) container no. 2 ON

Date and time of wt 2/13/84 800 Gross wt 215.5 mg

Date and time of wt 2/14/84 800 Gross wt 215.5 mg

Average gross wt 215.5 mg

Tare wt 112.5 mg

Weight of particulate on filter(s) 103.0 mg

Weight of particulate in acetone rinse 31.0 mg

Total weight of particulate 134.0 mg

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

Remarks: _____

Signature of analyst [signature]

Signature of reviewer [signature]

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Green River Shale Sample date: 2-8-84

Sample location: 103 Run no.: 3 ON

Sample recovery person: [illegible] Recovery date: 2-8-84

Filter(s) no.: J-21

MOISTURE

see #4

Impingers		Silica gel	
Final volume (wt)	ml(gm)	Final wt.	g g
Initial volume (wt)	ml(gm)	Initial wt.	g g
Net volume (wt)	ml(gm)	Net wt.	g g

Total moisture g

Color of silica gel

Description of impinger water

RECOVERED SAMPLE

Filter container no. Rn #3 ON sealed ✓

Description of particulate on filter BLACK

Acetone rinse container no. Rn #3 ON Liquid level marked ✓

Acetone blank container no. Liquid level marked

Samples stored and locked

Remarks:

Date of laboratory custody

Laboratory personnel taking custody [illegible]

Remarks:

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant Green Shale Run No. 3 ON

Sample location 10 B

Relative humidity 20 %

Density of acetone (ρa) .7847 g/ml

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

Acetone rinse container no. 3 ON

Acetone rinse volume (Vaw) 25 ml

Acetone blank residue concentration (Ca) .0007 mg/g

Wa = Ca Vaw ρa = (.0007)(25)(.7847) = -0- mg

Date and time of wt 2/13/84 0500 Gross wt 111236.6 mg

Date and time of wt 2/14/84 0500 Gross wt 111236.6 mg

Average gross wt 111236.6 mg

Tare wt 111221.1 mg

Less acetone blank wt (Wa) -0- mg

Weight of particulate in acetone rinse 15.5 mg

Filter(s) container no. 3 ON

Date and time of wt 2/12/84 0500 Gross wt 188.1 mg

Date and time of wt 2/14/84 0500 Gross wt 188.1 mg

Average gross wt 188.1 mg

Tare wt 110.8 mg

Weight of particulate on filter(s) 77.3 mg

Weight of particulate in acetone rinse 15.5 mg

Total weight of particulate 92.8 mg

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

Remarks: _____

Signature of analyst [signature]

Signature of reviewer [signature]

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Gerald Shaw Sample date: 2-8-84

Sample location: 103 Run no.: 4 ON inf

Sample recovery person: CTT/R.C.'s Recovery date: 2-8-84

Filter(s) no.: AB-1

MOISTURE

Impingers			Silica gel #6		
Final volume (wt)	73	ml (gm)	Final wt.	1001.2 g	____ g
Initial volume (wt)	0	ml (gm)	Initial wt.	984.7 g	____ g
Net volume (wt)	73	ml (gm)	Net wt.	17.2 g	____ g

Total moisture 90.2 g

Color of silica gel Mixed

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. 4-ON-inf sealed ✓

Description of particulate on filter Black

Acetone rinse container no. NA Liquid level marked —

Acetone blank container no. ____ Liquid level marked ____

Samples stored and locked ____

Remarks: ____

Date of laboratory custody ____

Laboratory personnel taking custody LOT

Remarks: ____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Crystal Shale Sample date: 2-8-84

Sample location: 103 Run no.: 1 OFF

Sample recovery person: [illegible] Recovery date: 2-8-84

Filter(s) no.: 5-17

MOISTURE

Impingers			Silica gel	
Final volume (wt)	ml(gm)	Final wt.	g	g
Initial volume (wt)	ml(gm)	Initial wt.	g	g
Net volume (wt)	ml(gm)	Net wt.	g	g

Total moisture _____g

Color of silica gel _____

Description of impinger water _____

RECOVERED SAMPLE

Filter container no. 1-OFF sealed ✓

Description of particulate on filter Brick

Acetone rinse container no. 1-OFF Liquid level marked ✓

Acetone blank container no. _____ Liquid level marked _____

Samples stored and locked ✓

Remarks: _____

Date of laboratory custody _____

Laboratory personnel taking custody _____

Remarks: _____

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant Gen Shale Run No. 1 OFF

Sample location 10 B

Relative humidity 20%

Density of acetone (ρa) .7847 g/ml

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

Acetone rinse container no. 1-OFF

Acetone rinse volume (Vaw) 30 ml

Acetone blank residue concentration (Ca) 0.0004 mg/g

Wa = Ca Vaw ρa = (.0001)(30)(.7847) = -0- mg

Date and time of wt 2/13/84 800 Gross wt 111245.1 mg

Date and time of wt 2/14/84 800 Gross wt 111245.3 mg

Average gross wt 111245.3 mg

Tare wt 111236.6 mg

Less acetone blank wt (Wa) — mg

Weight of particulate in acetone rinse 8.7 mg

Filter(s) container no. 1-OFF

Date and time of wt 2/13/84 800 Gross wt 134.8 mg

Date and time of wt 2/14/84 800 Gross wt 134.8 mg

Average gross wt 134.8 mg

Tare wt 110.8 mg

Weight of particulate on filter(s) 24.0 mg

Weight of particulate in acetone rinse 8.7 mg

Total weight of particulate 32.7 mg

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

Remarks: _____

Signature of analyst L.F.

Signature of reviewer L.F.

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Coal Shale Sample date: 2-8-84

Sample location: 10B Run no.: 2 OFF

Sample recovery person: [illegible] Recovery date: 2-8-84

Filter(s) no.: J-19

MOISTURE

Impingers		Silica gel		
Final volume (wt)	ml(gm)	Final wt.	g	g
Initial volume (wt)	ml(gm)	Initial wt.	g	g
Net volume (wt)	ml(gm)	Net wt.	g	g

Total moisture _____g

Color of silica gel _____

Description of impinger water _____

RECOVERED SAMPLE

Filter container no. 2-OFF sealed ✓

Description of particulate on filter Black

Acetone rinse container no. 2-OFF Liquid level marked ✓

Acetone blank container no. _____ Liquid level marked _____

Samples stored and locked ✓

Remarks: _____

Date of laboratory custody _____

Laboratory personnel taking custody _____

Remarks: _____

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant General Shale Run No. 2 OFF

Sample location 10.3

Relative humidity 20%

Density of acetone (ρa) .7847 g/ml

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

Acetone rinse container no. 2-OFF

Acetone rinse volume (Vaw) 25 ml

Acetone blank residue concentration (Ca) 0.0004 mg/g

Wa = Ca Vaw ρa = (.0004)(25)(.7847) = 0 mg

Date and time of wt 2/13/84 500 Gross wt 110154.2 mg

Date and time of wt 2/14/84 500 Gross wt 110154.2 mg

Average gross wt 110154.2 mg

Tare wt 110139.8 mg

Less acetone blank wt (Wa) -0- mg

Weight of particulate in acetone rinse 14.3 mg

Filter(s) container no. 2-OFF

Date and time of wt 2/13/84 500 Gross wt 146.0 mg

Date and time of wt 2/14/84 500 Gross wt 146.0 mg

Average gross wt 146.0 mg

Tare wt 112.9 mg

Weight of particulate on filter(s) 33.1 mg

Weight of particulate in acetone rinse 18.3 mg

Total weight of particulate 51.4 mg

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

Remarks: _____

Signature of analyst _____

Signature of reviewer _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Gulf State Sample date: 2-8-84

Sample location: 103 Run no.: 3 OFF

Sample recovery person: Lopez/Riley Recovery date: 2-8-84

Filter(s) no.: 5-20

MOISTURE

Impingers			Silica gel	
Final volume (wt)	ml(gm)	Final wt.	g	g
Initial volume (wt)	ml(gm)	Initial wt.	g	g
Net volume (wt)	ml(gm)	Net wt.	g	g

Total moisture g

Color of silica gel

Description of impinger water

RECOVERED SAMPLE

Filter container no. 3-OFF sealed ✓

Description of particulate on filter BLANK

Acetone rinse container no. 3-OFF Liquid level marked

Acetone blank container no. Liquid level marked

Samples stored and locked

Remarks:

Date of laboratory custody

Laboratory personnel taking custody

Remarks:

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant Coal Shale Run No. 3 OFF

Sample location 10 E

Relative humidity 20 %

Density of acetone (ρa) .7847 g/ml

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

Acetone rinse container no. 3-OFF

Acetone rinse volume (Vaw) _____ ml

Acetone blank residue concentration (Ca) 0.0004 mg/g

Wa = Ca Vaw ρa = (.0004)(25)(.7847) = 0 mg

Date and time of wt 2/12/84 500 Gross wt 115.4828 mg

Date and time of wt 2/14/84 500 Gross wt 115.496.9 mg

Average gross wt 115.496.9 mg

Tare wt 115.4870 mg

Less acetone blank wt (Wa) -0- mg

Weight of particulate in acetone rinse 9.9 mg

Filter(s) container no. R-#3 OFF

Date and time of wt 2/10/84 500 Gross wt 142.6 mg

Date and time of wt 4/4/84 500 Gross wt 142.6 mg

Average gross wt 142.6 mg

Tare wt 111.1 mg

Weight of particulate on filter(s) 31.5 mg

Weight of particulate in acetone rinse 9.9 mg

Total weight of particulate 41.4 mg

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

Remarks: _____

Signature of analyst _____

Signature of reviewer _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Gurl Shelb Sample date: 2-8-84

Sample location: 16B Run no.: 4-OFF

Sample recovery person: Cottrell Recovery date: 2-8-84

Filter(s) no.: 21

MOISTURE

Impingers			Silica gel		
Final volume (wt)	45 (TOTAL)	ml(gm)	Final wt.	985.2 g	g
Initial volume (wt)	0	ml(gm)	Initial wt.	982.9 g	g
Net volume (wt)	45	ml(gm)	Net wt.	5.3 g	g

Total moisture 50.3 g - for all 4 runs.

Color of silica gel unused

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. _____ sealed _____

Description of particulate on filter _____

Acetone rinse container no. _____ Liquid level marked _____

Acetone blank container no. _____ Liquid level marked _____

Samples stored and locked _____

Remarks: _____

Date of laboratory custody _____

Laboratory personnel taking custody _____

Remarks: _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: General Shale Sample date: 2-9-84

Sample location: 10B Run no.: 5 ON

Sample recovery person: CST/Mig Recovery date: 2-9-84

Filter(s) no.: 2-3

MOISTURE

Impingers			Silica gel #5	
Final volume (wt)	15 ml(gm)	Final wt.	730.4 g	____ g
Initial volume (wt)	0 ml(gm)	Initial wt.	688.2 g	____ g
Net volume (wt)	15 ml(gm)	Net wt.	2.2 g	____ g

Total moisture 17.1 g

Color of silica gel mixed

Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. 2 5 ON sealed ✓

Description of particulate on filter Brick

Acetone rinse container no.	5 ON	Liquid level marked	✓
Acetone blank container no.	____	Liquid level marked	____

Samples stored and locked ✓

Remarks: ____

Date of laboratory custody ____

Laboratory personnel taking custody ____

Remarks: ____

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant General Shale. Run No. 5ON

Sample location 108

Relative humidity 20%

Density of acetone (ρa) .7847 g/ml

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

Acetone rinse container no. 5ON

Acetone rinse volume (Vaw) 100 ml

Acetone blank residue concentration (Ca) 0.00% mg/g

Wa = Ca Vaw ρa = (.00)(100)(.7847) = -0- mg

Date and time of wt 2/13/84 500 Gross wt 110135.9 mg

Date and time of wt 2/14/84 800 Gross wt 110135.9 mg

Average gross wt 110135.9 mg

Tare wt 110110.4 mg

Less acetone blank wt (Wa) -0- mg

Weight of particulate in acetone rinse 25.5 mg

Filter(s) container no. Rm 5ON

Date and time of wt 2/13/84 500 Gross wt 260.4 mg

Date and time of wt 2/14/84 800 Gross wt 260.4 mg

Average gross wt 260.4 mg

Tare wt 237.3 mg

Weight of particulate on filter(s) 23.1 mg

Weight of particulate in acetone rinse 25.5 mg

Total weight of particulate 48.6 mg

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

Remarks: _____

Signature of analyst _____

Signature of reviewer _____

METHOD 5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant: Gulf Shale Sample date: 2-9-84
Sample location: 102 Run no.: 6 OFF
Sample recovery person: [illegible] Recovery date: 2-9-84
Filter(s) no.: 8

MOISTURE

Impingers			Silica gel #5		
Final volume (wt)	10	ml (gm)	Final wt.	992.6 g	____ g
Initial volume (wt)	0	ml (gm)	Initial wt.	990.4 g	____ g
Net volume (wt)	10	ml (gm)	Net wt.	2.2 g	____ g

Total moisture 12.2 g
Color of silica gel Mixed
Description of impinger water Clear

RECOVERED SAMPLE

Filter container no. 6-OFF sealed ✓
Description of particulate on filter Black

Acetone rinse container no. 6-OFF Liquid level marked ✓
Acetone blank container no. ____ Liquid level marked ____
Samples stored and locked ✓
Remarks: ____

Date of laboratory custody N/A
Laboratory personnel taking custody ____
Remarks: ____

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant Gerald Shutt Run No. 6 OFF

Sample location 10 3

Relative humidity 20 %

Density of acetone (ρa) .7847 g/ml

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

Acetone rinse container no. 6 OFF

Acetone blank residue concentration (Ca) 0.00004 mg/g

Wa = Ca Vaw ρa = (.00004)(105)(.7847) = — mg

Date and time of wt 2/12/84 500 Gross wt 113164.9 mg

Date and time of wt 2/14/84 500 Gross wt 113164.9 mg

Average gross wt 113164.9 mg

Tare wt 113153.5 mg

Less acetone blank wt (Wa) -0- mg

Weight of particulate in acetone rinse 11.4 mg

Filter(s) container no. 6 OFF

Date and time of wt 2/12/84 500 Gross wt 257.3 mg

Date and time of wt 2/14/84 500 Gross wt 257.3 mg

Average gross wt 257.3 mg

Tare wt 236.8 mg

Weight of particulate on filter(s) 14.5 mg

Weight of particulate in acetone rinse 11.4 mg

Total weight of particulate 25.9 mg

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

Remarks: _____

Signature of analyst _____

Signature of reviewer _____

9N

FIELD DATA SHEET

A5

PLANT Gerald Shed RUN # 1

LOCATION 10B DATE 2-8-84

BARO. PRES. 29.36 TIME 1008-1057

Coal system OFF

GUARDIAN SYSTEMS INC.
2810 18th Street South
Birmingham, Alabama 35209
205/879-1850

	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
Port A5			937.254	1	2	3		4	—				-.54
				~~140~~	~~53~~	~~54~~	~~54~~	~~34~~	—				
	3	3	939.6	140	53	54	54	34	—	1.53	.61	4.0	
	6	3	941.6	139	60	60	60	33	—	1.55	.61	4.5	
	9	3	944.2	137	65	60	63	34	—	1.56	.61	4.5	
	12	3	946.4	138	72	60	66	34	—	1.57	.61	4.5	
	15	3	948.7	138	78	62	70	35	—	1.51	.55	4.5	
	18	3	951.0	139	82	64	73	35	—	1.52	.55	5.0	
	21	3	953.3	140	85	66	76	34	—	1.53	.55	5.0	
	24	3	955.7	141	90	69	80	34	—	1.53	.55	5.5	
	27	3	958.065	142	91	72	82	34	—	1.53	.55 (.426)	6.0	
	~~30~~	3											
	27 ✓		20 811 ✓	135 ✓			65 ✓			1.54 ✓	.774 ✓	6.0	
			.9069								(.570) ✓		
			20.520										
						95 & 1/2							
						958.170							
						.005 @ 64							
							6.5 ✓						
						STAC	7.2 ✓						

PROBE TIP SIZE

BEFORE	AFTER
.240	.240
.240	.240
.240	.240

WATER

ml. 23.3

gram

Total 23.3

OPERATOR

R. Ly

2.517

Sample Box No. NA

Meter Box No. 70

Meter ΔH@ 1.54

Pitot, CP .84

Temp. Device DT

Probe No.

Probe Liner L

Probe Htr. Set NA

Ambient Temp. 30°C

% O_2 17.0

% CO_2 3.0

NOTES

Orifice @7.5

Pitot 8.3-8.2 ✓

Meter

937.248
937.254
.006 @ 25" Hg

FIELD DATA SHEET

PLANT Gen State RUN 2

LOCATION 10B DATE 2-8-84

BARO. PRES. 29.34 TIME 1129-1214

GUARDIAN SYSTEMS INC.
2810 18th Street South
Birmingham, Alabama 35209
205/879-1850

Coal System out

	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 5			961.621	1	2	3		4				
	3	3	964.0	143	80	77	79	33	—	1.66	.64 [23]	5.0
	6	3	966.4	144	77	77	77	33	—	1.60	.62 [24]	5.0
	9	3	968.8	144	82	77	80	33	—	1.61	.62 [24]	6.0
	12	3	971.2	149	87	77	82	34	—	1.60	.62 [23]	7.5
	15	3	973.6	149	93	78	86	34	—	1.62	.62 [23]	8.5
	18	3	976.1	137	95	80	88	34	—	1.65	.62 [24]	9.5
	21	3	978.6	136	99	81	90	34	—	1.66	.62 [24]	10.5
	24	3	981.0	136	102	83	93	35	—	1.61	.62 [23]	12.0
	27	3	983.5	137	106	85	96	36	—	1.68	.62 [23]	13.5
	30	3	986.180	139	108	87	98	38	—	1.68	.62 [21]	16.0
	30 ✓		24.555 ✓	141 ✓			87 ✓			1.64 ✓	.790 ✓	16 ✓
			.9767								(.482) ✓	
			23.992 ✓									
			986.168									
			986.160									
			.008 @ 16" Hg									

STATIC PRESSURE "H2O -.54

PROBE TIP SIZE

BEFORE	AFTER
.240	.240
.240	.240
.240	.240

WATER

ml. 26.6

#6 gram

Total

OPERATOR

R.L.
2.907

Sample Box No. N/A
Meter Box No. 700
Meter ΔH@ 1.54
Pitot, CP .84
Temp. Device RI
Probe No. N/A 2
Probe Liner N/A
Probe Htr. Set N/A
Ambient Temp. 35
% O_2 17.80
% CO_2 3.090

NOTES

Orifice
Pitot
Meter

G-1

FIELD DATA SHEET

PLANT Green Station RUN # 3

LOCATION 10 B DATE 2-8-84

BARO. PRES. 29.32 TIME 1536 – 1617

GUARDIAN SYSTEMS INC.
2810 18th Street South
Birmingham, Alabama 35209
205/879-1850

coal system off

	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
Start			986.245	i	2	3		4					-.52
	3	3	989.1	135	96	74	85	36	–	2.21	.83 .39	6.5	
	6	3	991.4	137	74	74	74	32	–	2.16	.83 .39	6.8	
	9	3	994.5	136	86	76	81	40	–	2.19	.83 .39	7.0	
	12	3	997.3	138	88	76	82	37	–	2.19	.83 .40	7.5	
	15	3	000.1	139	93	78	86	37	–	2.20	.83 .40	8.0	
	18	3	003.0	140	98	80	89	38	–	2.21	.83 .41	9.0	
	21	3	005.8	138	103	82	91	39	–	2.21	.83 .41	9.5	
	24	3	008.6	143	106	84	95	37	–	2.22	.83 .41	10.0	
	27	3	011.5	144	109	87	98	37	–	2.23	.83 .41	10.5	
	30	3	014.386	145	112	89	101	38	–	2.23	.83 .41	11.0	
10	30		28.141	140			88			2.20	.911	11	
			.9702								(1634)		
			27.302										

14.515
14.510
.005@ 1" H2O

Run 6.5 –

Static 7.3 –

PROBE TIP SIZE

BEFORE	AFTER
.240	.240
.240	.240
.240	.240

WATER

ml. 30.2

gram

Total

OPERATOR

R.K.Y

2.907

Sample Box No. N/A

Meter Box No. 200

Meter ΔH@ 1.54

Pitot, CP .84

Temp. Device RI

Probe No. N/A 7

Probe Liner N/A

Probe Htr. Set N/A

Ambient Temp. 35

% O_2 19%

% CO_2 1%

NOTES

Orifice

Pitot

Meter

986.245 –
986.240
.005@ 25" H2O

Run –

Static –

FIELD DATA SHEET

PLANT Gen Stack RUN # 4 system off ON

LOCATION 10-B DATE 2-8-84

BARO. PRES. 29.36 TIME 16.50 17.26

GUARDIAN SYSTEMS INC.
2810 18th Street South
Birmingham, Alabama 35209
205/879-1880

	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
			14.600	1	2	3		4	—			
Port SA	3	3	016.1	136	91	89	90	41	—	.62	.78 .38	2.0
	6	3	017.7	138	89	89	89	36	—	.62	.78 .38	2.2
	9	3	019.2	141	94	89	92	37	—	.62	.78 .38	2.2
	12	3	020.7	144	97	89	93	38	—	.62	.78 .38	2.2
	15	3	022.4	146	101	90	96	38	—	.62	.78 .38	2.2
	18	3	023.961	136	100	90	95	38	—	.62	.78 .38	2.2
	21	3	—	—	—	—	—	—	—	—	—	—
6"	24 (RV)	3	9.361	140			92		—	.62	.883	2.2
	27	3	.9669						—		(.616)	
	30	3	9.238						—			

24.125
24.120
.005 @ 30"Hg

7.2 ft

8.2 STATE

STATIC PRESSURE "H2O -.52

PROBE TIP SIZE

BEFORE	AFTER
.177	.177
.177	.177
.177	.177

WATER

#6
ml. 73
AC gram 17.2
Total (10.1)

OPERATOR
R.W.
2.909

Sample Box No. 4A
Meter Box No. 700
Meter ΔH@ 1.54
Pitot, CP .84
Temp. Device KZ
Probe No. 4A L
Probe Liner 4A
Probe Htr. Set 4A
Ambient Temp. 35
% O_2 19.0
% CO_2 -1.0

NOTES

Orifice
Pitot
Meter

14.600
14.574
.006 @ 25"Hg

86.95

FIELD DATA SHEET OFF

PLANT GS.S.C RUN # 1

LOCATION 108 DATE 2-8-84

BARO. PRES. 29.36 TIME 1008-1050

GUARDIAN SYSTEMS INC.
2810 19th Street South
Birmingham, Alabama 35209
205/879-1850

	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: -.37
Port Bb			457.835										PROBE TIP SIZE BEFORE / AFTER
				(11	U	(1)							.253 / .253
1005 45 1005 45	130	130	458.522	134	50	50	50	33	—	1.51	.46 (.45)	7.8	.253 / .253
1012 45 1018 45	3		460.003	136	61	58	60	34	—	1.52	.46 (.45)	7.8	.253 / .25
1017 45 1023 45	4.5		461.1	137	64	59	62	35	—	1.53	.46 (.45)	8.1	
1021 45 1027 15	6		462.2	137	67	60	64	34	—	1.53	.46 (.45)	8.2	
1026 15 1027 45	7.5		463.3	138	70	62	66	34	—	1.54	.46 (.45)	8.6	
1030 45 1032 15	9		464.46	140	74	64	69	35	—	1.54	.46 (.45)	8.9	
1035 15 1037 45	10.5		465.6	143	77	66	72	36	—	1.54	.46 (.45)	9.1	
1040 1042	12		466.70	144	79	68	74	35	—	1.54	.46 (.44)	9.2	
1045 1047	13.5		467.816	145	83	70	76	36	—	1.55	.46 (.44)	9.5	
1050 1052	15		468.935	146	86	72	79	36	—	1.56	.46 (.44)	9.7	
Leak 3.45 cu ft @ 5.1													
											(.973)		
	14.433		10.620	140			67			1.54	.678		
			10.708		468.524					Pm 8.2			
			10.841		465.520					Stack 9.1			
					.004 @ 10°								

WATER
ml. 13.7
#s gain
Total

OPERATOR
JDL
3.78550

Sample Box No. NA
Meter Box No. 4W
Meter ΔH@ 1.74
Pitot, CP .85
Temp. Device RTE
Probe No. ST-2
Probe Liner —
Probe Htr. Set —
Ambient Temp. 70
% O_2 12.0
% CO_2 5.0

NOTES
Orifice @ 7.5
Pitot 8.2 7.2
Meter @ 25

457.835
457.527
.008 @ 25

8.2958 Sg H
39 4 Diameter

FIELD DATA SHEET

PLANT GS SC RUN # 2

LOCATION 10B DATE 2-8-84

BARO. PRES. 29.7" TIME 1129 - 1214

GUARDIAN SYSTEMS INC.
2810 18th Street South
Birmingham, Alabama 35209
205/879-1850

OFF Cool System ON

	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
Pit	86		468.785										-.37
	130	130	469.672	160	78	78	78	35	—	0.95	.29 (.53)	7.6	
200 450		3	470.543	157	76	77	76	36	—	.92	.28 (.91)	7.6	
730 900		4.5	471.414	159	79	77	78	36	—	.92	.28 (.94)	7.9	
1260 1550		6.0	472.262	154	83	78	80	36	—	.90	.27 (.98)	8.0	
1800		7.5	473.113	142 154	85	78	82	35	—	.92	.27 (.58)	8.5	
2050		9.0	473.978	144	87	80	84	35	—	.92	.28 (.91)	8.8	
2330 2700		10.5	474.845	143	90	83	86	36	—	.93	.27 (.95)	9.1	
2820 3420		12.0	475.710	142	92	83	88	36	—	.93	.27 (.95)	9.3	
3600		13.5	476.550	144	94	85	90	36	—	.93	.27 (.56)	9.6	
3960 4050		15	477.412	145	95	86	90	36	—	.93	.27 (.91)	10.0	
		15	8.627	149			85			.925	.523	10	
			1.024								(.991)		
			8.836		477.452				Run 8.5				
					477.450								
					.002 @ 10 "Hg				Static 7.6				

PROBE TIP SIZE

BEFORE	AFTER
.253	.253
.253	.253
.253	.253

WATER
ml. 10.8
gram
Total

OPERATOR
LGTZ
78150

Sample Box No.
Meter Box No. 460
Meter ΔH@ 1.74
Pitot, CP .89
Temp. Device S II
Probe No. S-2
Probe Liner —
Probe Htr. Set —
Ambient Temp. 35
% O_2 17.8
% CO_2 3.0

NOTES
Orifice
Pitot
Meter
Run 4 Start

468.785
477.750
.965 @ 25 "Hg

FIELD DATA SHEET

PLANT G.S. SC RUN # 3

LOCATION 103 DATE 2-8-94

BARO. PRES. 29.36 TIME 1535 – 1620

GUARDIAN SYSTEMS INC.
2810 18th Street South
Birmingham, Alabama 35209
205/879-1850

OFF Cont Sys OFF

	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
Pit B	0		477.490									
				(1)	(2)	(3)						
300												
480	1[30]	1[30]	478.629	133	76	76	76	35	—	1.71	.50 (1.05)	9.5
730												
900		3	479.820	135	78	77	78	37	=	1.68	.49 (1.05)	9.6
1200												
1350		4.5	480.978	136	82	77	80	39	—	1.72	.50 (1.05)	10.0
1650												
1800		6.0	482.173	136	85	78	82	38	=	1.72	.50 (1.05)	10.3
2100												
2230		7.5	483.358	138	88	79	84	39	—	1.72	.50 (1.05)	10.5
2530												
2700		9.0	484.570	139	90	81	86	39	—	1.79	.52 (1.07)	10.9
1000												
130		10.5	485.787	139	93	82	88	39	—	1.80	.52 (1.05)	11.2
3430												
600		12.0	487.01	140	95	84	90	35	—	1.80	.52 (1.05)	11.6
900												
030		13.5	488.231	141	97	85	91	40	—	1.84	.53 (1.05)	11.9
4370												
500		15.0	489.462	142	98	87	92	40	—	1.81	.52 (1.05)	12.0
0 ✓		15 ✓	11.972 ✓	138 ✓			85 ✓			1.76 ✓	.714 ✓	
			1.0167								(1.025) ✓	
			12.172 ✓		489.540							
					489.538							
					.002 @ 12" Hg							
						Run 7.3 ✓						
						Stat 8.2 ✓						

PROBE TIP SIZE

BEFORE	AFTER
.253	.253
.253	.253
.253	.253

STATIC PRESSURE "H2o -.14

WATER

ml. 14.9

@ 5 gram

Total

OPERATOR

3.7888

Sample Box No. NA

Meter Box No. 4D

Meter ΔH@ 1.74

Pitot, CP .89

Temp. Device 1 II

Probe No. S-2

Probe Liner —

Probe Htr. Set —

Ambient Temp.

% O_2 19%

% CO_2 1%

NOTES

Orifice

Pitot

Meter

477.490
477.488
.010 @ 25" Hg

Run ✓
Static ✓

FIELD DATA SHEET

PLANT J.C. RUN # 4 IMP

LOCATION 103 DATE 2-8-84

BARO. PRES. 29.36 TIME 1650 - 1750

GUARDIAN SYSTEMS INC.
2610 18th Street South
Birmingham, Alabama 35209
205/879-1850

OFF

	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 −.12
			489.611										PROBE TIP SIZE BEFORE .187 AFTER .187 .187 .187 .187 .187
Port 86		Δ		(1)	(2)	(3)		14					
130		130	490.31	136	88	84	88	35	—	.56	.54 (1.05)	8.0	
430 600		300	491.00	138	87	88	88	35	—	.56	.54 (1.05)	8.0	
900 1050		430	491.70	141	90	88	89	38	—	.54	.54 (1.05)	8.1	
1330 1500		600	492.355	144	92	89	90	38	—	.56	.54 (1.05)	8.2	WATER
1800 1930	7	730	493.092	146	94	89	92	38	—	.55	.54 (1.05)	8.2	ml. 45 TOTAL
2230 2400	9	900	493.795	130 ~~150~~	93	90	92	38	—	.57	.54 (1.05)	8.4	#5 gram 5.3 TOTAL
2700 2830	9	1030	494.494	134	94	90	92	38	—	.57	.54 (1.05)	8.5	Total 50.3
3130 3300	7	1200	495.21	138	95	90	92	38	—	.57	.54 (1.05)	8.5	10.9
3600 3780	7	1330	495.905	138	95	90	92	38	—	.57	.54 (1.05)	8.5	OPERATOR
4030 4200	7	1500	496.600	138	96	91	93	37	—	.56	.54 (1.05)	8.5	CLT2
4500 4630	7	1630	497.305	138	97	91	94	37	—	.57	.54 (1.05)	8.6	1.13385
4930 5100	7	1800	498.015	140	97	91	94	37	—	.57	.54 (1.05)	8.6	Sample Box No. —
5400 5530	7	1930	498.710	142	98	93	96	38		.50	.54 (1.05)	8.9	Meter Box No. 400
5830 6000	13	1950	9.099	139			92			.56	.735		Meter ΔH@ 1.74
			.9963								(1.025)		Pitot, CP .83
			9.065										Temp. Device 211
			498.734										Probe No. 5-2
			498.730										Probe Liner —
			.004 @ 94										Probe Htr. Set —
													Ambient Temp. 55
					Rn 8.2								% O_2 19
					57	5.1							% CO_2 1

NOTES

Orifice —

Pitot —

Meter —

489.611
489.608
.003 @ 50

Rn —
Start —

FIELD DATA SHEET

PLANT GS J.C RUN # 5

LOCATION 103 DATE 2-9-84

BARO. PRES. 29.26 TIME 922-947

GUARDIAN SYSTEMS INC.
2810 18th Street South
Birmingham, Alabama 35209
205/879-1850

ON

	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: -.3
Port A			499.660	(1)	(2)	(3)		(4)	(5)				PROBE TIP SIZE BEFORE / AFTER
6	1	1	500.3	136	62	62	62	33	235	1.13	.82 .57	6.6	.201 / .201
14		2	500.8	136	64	64	64	34	270	1.13	.82	6.6	.201 / .201
12		3	501.4	139	65	64	64	35	265	.84	.68	6.6	.201 / .201
12		4	502.0	140	66	64	65	35	260	~~.86~~ .91	~~.70~~	6.0	
8		5	502.6	139	68	64	66	34	240	1.04	.78	6.3	
10		6	503.2	140	68	64	66	34	245	1.52	1.1	7.5	
4		7	503.9	141	70	66	69	36	252	(.40)	1.0 .42	7.2	
12		8	504.568	141	73	66	70	36	250	1.12	.80	6.5	
Port B													
6	1	9	505.2	140	75	67	71	35	248	1.40	.98 .36	7.7	
14		10	506.0	142	75	68	71	35	249	1.56	1.1	8.0	
12		11	506.730	143	77	68	74	36	255	1.7	1.2	8.4	
10		12	507.5	144	80	68	74	36	270	1.7	1.2 .60	8.6	
8		13	508.2	143	80	70	75	35	271	1.63	1.15	8.4	
10		14	508.950	145	82	70	76	36	273	1.56	1.1	8.4	
4		15	509.6	146	84	70	77	36	263	1.5	1.05 .59	8.4	
12		16	510.325	146	84	70	77	36	254	1.22	.86	7.8	
16		16	10.665	141			70			1.34	.974	8.6	
			1.0208								(.681)		
			10.887		Run 6.0								
					Static 7.0				510.430				
									510.420				
									.010		94 Hz/in		

WATER
ml. 15
gram 45 2.2
Total 17.2

OPERATOR
Rib 1.57

Sample Box No. 1
Meter Box No. 400
Meter ΔH@ 1.74
Pitot, CP .84
Temp. Device 2 4
Probe No. 5'-N
Probe Liner GLASS
Probe Htr. Set 20
Ambient Temp. 24
% O_2 19.0
% CO_2 1.0

NOTES
Orifice ✓
Pitot RVS ✓
Meter

455.660
455.650
.010 @ 25

FIELD DATA SHEET

PLANT Gen Shaw Sub City RUN # 006

LOCATION 108 (OFF) DATE 2-9-84

BARO. PRES. 29.26 TIME 1010 - 1102

GUARDIAN SYSTEMS INC.
2810 18th Street South
Birmingham, Alabama 35209
205/879-1850

OFF

	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
				(1)	(2)	(3)		(4)	(5)			
Port	B		510.605									
16	1	1	511.1	149	78	76	77	34	227	.75	.53	7.5
14		2	511.6	134	78	76	77	35	256	.82	.58	7.8
12		3	512.225	135	80	78	79	35	270	.86	.62	8.2
10		4	512.7	138	82	78	80	35	264	.86	.60	8.5
8		5	513.2	140	85	81	83	35	265	.68	.47	8.0
6		6	513.760	141	87	80	84	35	270	.63	.44	8.0
4	1X	7	514.2	142	87	81	84	35	271	.60	.42	8.1
2	2330	8	514.640	143	88	82	86	35	272	.43	.30	7.5
Port A												
16	1	9	515.1	145	88	84	86	34	265	.58	.40	8.5
14		10	515.6	147	90	86	88	35	263	.58	.40	8.6
12		11	516.045	148	91	86	88	34	263	.61	.42	8.5
10	9	12	516.5	150	94	89	90	36	263	.57	.40	8.6
8	1730	13	517.1	150	93	87	90	36	259	.70	.49	9.0
6		14	517.570	150	94	88	91	35	252	.72	.50	9.1
4	1800 1900	15	518.1	151	97	85	93	35	253	.65	.45	9.0
2	1930 2000	16	518.536	154	95	90	93	35	270	.50	.35	8.7
16		16	7.931	145			86			.66	.676	
			.9963								(.971)	
			7.902		Run 6.3							
							94					
			518.544		STACK 69							
			518.544									
			.000 @ 10									

STATIC PRESSURE "H2O -.33

PROBE TIP SIZE

BEFORE	AFTER
.201	.201
.201	.231
.201	.201

WATER

ml. 10

#5 gram 2.2

Total 12.2

OPERATOR

Sample Box No. 1

Meter Box No. 400

Meter ΔH@ 1.74

Pitot, CP .84

Temp. Device RTD

Probe No. S-N

Probe Liner GLASS

Probe Htr. Set 70

Ambient Temp. 90

% O_2 15.0

% CO_2 1.0

NOTES

Orifice

Pitot

Meter

Run

Static

510.605
510.600
.005 @ 25 g

GUARDIAN SYSTEMS INC.

2810 18th Street South
Birmingham, Alabama 35209
205/879-1950

ON

PRELIMINARY VELOCITY TRAVERSE

PLANT Johnson City, TN 10B

DATE 2-7-84

LOCATION 10B

STACK I.D. ~~SS~~ SS.0

BAROMETRIC PRESSURE, in. Hg 29.38

STACK PRESSURE, in. H_2O -.64

PERCENT O_2 18.0

PERCENT CO_2 2.0

PITOT CORRECTION FACTOR .89

OPERATORS Lotz / Riley

#8

1630
1625

3-ON 1½ OFF

SCHEMATIC OF TRAVERSE POINT LAYOUT

P.64

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), F
	# A	
1		
2	.89	134
3	1.02	131
4	.99	130
5	.58	134
6	.58	135
7	.71	135
8	.85	134
.882	.8?1 ✓	
	#B Post	
1		
2	.87	148
3	.90	129
4	.88	126
5	.91	136
6	.95	143
7	.93	143
8	.91	141
	.952 ✓	
		(139)
AVERAGE	.922	136 ✓

.85

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
	#B	
1		
2	.92	137
3	1.00	137
4	1.05	134
5	1.05	133
6	1.10	135
7	1.02	137
8	.94	137
	1.005 ✓	
	(.84)	
AVERAGE		

GUARDIAN SYSTEMS INC.

2810 18th Street South
Birmingham, Alabama 35209
205/879-1850

#7

PLANT Gerald Stack Johnson City

DATE 2-8-84

LOCATION STACK 10B

STACK I.D. 39"

BAROMETRIC PRESSURE, in. Hg 29.26

STACK PRESSURE, in. H_2O -.12

PERCENT O_2 19

PERCENT CO_2 1

PITOT CORRECTION FACTOR .84

OPERATORS LOTZ/Rich

PRELIMINARY VELOCITY TRAVERSE

8:35-8:45

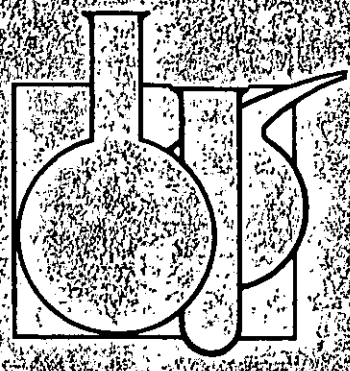
ON

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), F
B 1	.92	140
2	.83	138
3	.83	138
4	.96	138
5	1.05	140
6	1.1	140
7	1.1	140
8	1.15	140
9	1.15	135
10	1.15	135
11	1.2	135
12	1.2	135
13	1.1	135
14	1.05	138
15	1.05	138
16	1.00	138
AVERAGE	1.024	

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
A 1	.70	140
2	.75	142
3	.99	142
4	1.05	142
5	1.10	142
6	1.15	142
7	1.15	142
8	1.00	142
9	.78	142
10	.73	142
11	.75	142
12	.75	142
13	85	141
14	.89	141
15	.92	141
16	.92	141
AVERAGE	.986 ✓	140 ✓

Plant Operation Data



PROCESS INFORMATION

PLANT: Johnson City 105 DATE: February 8, 1984

Brick Rate:

Car Schedule = 56 Minutes = 1.07 Cars/Hour

Car Count = 3,883 S/S Brick/Car

Hourly Rate = 4,160 S/S Brick/Hour

Brick Weight = 4.8 Lbs.

Brick Rate = 19,968 Lbs./Hour

Fuel Rate:

Total = 28.7 Therms/M Brick

Coal = 10.22 Tons/Day

852 Lbs./Hour = 100 % of Btu's

Natural Gas = -0- MCF/Day

_____ Cu. Ft./Hour = -0- % of Btu's

Total Process Weight:

19,968 Lbs. Brick/Hour

\+ 852 Lbs. Coal/Hour

20,820 Total Lbs./Hour

10.41 Tons/Hour

Coal Analysis:

14,029 Btu/Lb.

_____ Sulfur

3.5 % Ash

Allowable Emissions:

$3.59 P^{0.62}$

$3.59 (10.41)^{0.62}$ = 15.34 Lbs./Hr.

SUPERVISOR Saylor/McElroy | DATE 2-9-84 | GREEN BRICK AT 8:00 A.M.

KILN SCHEDULE 56 min. | GREEN BRICK WEIGHT | STANDARD

PRODUCTION 99,840 | BURNED BRICK WEIGHT | SPECIAL

TYPE BRICK | CARS BURNED 26 | SOLID

TOTAL KILN HOURS | TOTAL BRICK BURNED | PAVER

KEY CHEK AVERAGE | TOTAL BRICK WEIGHT | OTHER

44 cars

	1	2	3
PUSHER PRESSURE			
TURBO PRESSURE			
GAS PRESSURE			
PREDRYER SUPPLY TEMP.			
DRYER EXHAUST DRAFT			
DRYER EXHAUST TEMP.			
COLD AIR SUPPLY TEMP.			
KILN EXHAUST DRAFT			
UNDER CAR TEMP.	340°		
COAL SCREENING			
COAL DRYER TEMP.			
FLASHING SYSTEM			
TURBO BLOWER (amps)			
DRYER SUPPLY (amps)			
DRYER EXHAUST (amps)			
COLD AIR SUPPLY (amps)			
KILN EXHAUST (amps)			
IMP MILL (amps)			
IMP MILL BLOWER (amps)			

	1	2	3
PREDRYER			
WET BULB			
DRY BULB			
HUMIDITY			
DEW POINT			
BRICK BODY			
FANS			
DRYER			
WET BULB			
DRY BULB			
HUMIDITY			
DEW POINT			
BRICK BODY			
FANS			

DRYER RECIRCULATING FANS

NO. 1

NO. 2

NO. 3

NO. 4

48 | 47

ENERGY METERS

	GAS	COAL	FLASHING	ELECTRIC
END		11401		
BEGIN		10288		
TOTAL		1113		

% Ash
3.5%

CONTROL VALVE PRESSURE

NO. 1 11%

NO. 2 10%

NO. 3 20%

NO. 4 05 96%

	BTU	THERMS	COST	THERM % OF TOTAL	COST PER M	THERMS PER M
GAS: _____ c.f. @ 1,040 =	____ / 100,000	= ____ @ ____/therm	= $			
COAL: 20,446 lb. @ 14029 =	286.8% / 100,000	= 2868 @ .186/therm	= $533.45	100%	5.34	28.7
FLASHING: _____ lb. @ ____ =	____ / 100,000	= ____ @ ____/therm	= $			

GAS: $ _____ per MCF, _____ ¢ per therm

TOTAL THERMS 2868

TOTAL THERMS PER M BRICK 28.68

KWHR PER M BRICK

KWHR COST PER M BRICK

COAL: $ _____ per ton, _____ ¢ per therm

BTU PER POUND OF BRICK 820

AVERAGE COST PER THERM .186

TOTAL COST 533.45

COST PER M BRICK 5.34

PROCESS INFORMATION

PLANT: Johnson City 108 DATE: February 9, 1984

Brick Rate:

Car Schedule = 56 Minutes = 1.07 Cars/Hour

Car Count = 3,883 S/S Brick/Car

Hourly Rate = 4,160 S/S Brick/Hour

Brick Weight = 4.8 Lbs.

Brick Rate = 19,968 Lbs./Hour

Fuel Rate:

Total = 29.3 Therms/M Brick

Coal = 10.44 Tons/Day

870 Lbs./Hour = 100 % of Btu's

Natural Gas = -0- MCF/Day

_____ Cu. Ft./Hour = -0- % of Btu's

Total Process Weight:

19,968 Lbs. Brick/Hour

\+ 870 Lbs. Coal/Hour

20,838 Total Lbs./Hour

10.42 Tons/Hour

Coal Analysis:

14,029 Btu/Lb.

_____ Sulfur

3.5% Ash

Allowable Emissions:

$3.59 P^{0.62}$

$3.59(10.42)^{0.62} = 15.35$ LBS./HR.

SUPERVISOR Saylor/DeSilvey | DATE 2-10-84 | GREEN BRICK AT 8:00 A.M.

KILN SCHEDULE 56min. | GREEN BRICK WEIGHT | STANDARD ✓ 19

PRODUCTION 99,840 | BURNED BRICK WEIGHT | SPECIAL 29

TYPE BRICK | CARS BURNED 26 | SOLID 39

TOTAL KILN HOURS | TOTAL BRICK BURNED 99,840 | PAVER 49

KEY CHEK AVERAGE | TOTAL BRICK WEIGHT | OTHER 59

L10

55

	1	2	3
PUSHER PRESSURE	250		
TURBO PRESSURE	35		
GAS PRESSURE	—		
PREDRYER SUPPLY TEMP.	105		
DRYER EXHAUST DRAFT	25		
DRYER EXHAUST TEMP.	125		
COLD AIR SUPPLY TEMP.	—		
KILN EXHAUST DRAFT	50		
UNDER CAR TEMP.	330°		
COAL SCREENING	ok		
COAL DRYER TEMP.	300		
FLASHING SYSTEM	ok		
TURBO BLOWER (amps)	33		
DRYER SUPPLY (amps)	19		
DRYER EXHAUST (amps)	—		
COLD AIR SUPPLY (amps)	9		
KILN EXHAUST (amps)	—		
IMP MILL (amps)	20		
IMP MILL BLOWER (amps)	40		

	1	2	3
PREDRYER			
WET BULB			
DRY BULB			
HUMIDITY			
DEW POINT			
BRICK BODY			
FANS			
DRYER			
WET BULB			
DRY BULB			
HUMIDITY			
DEW POINT			
BRICK BODY			
FANS			

DRYER RECIRCULATING FANS

NO. 1 125

NO. 2 190

NO. 3 300

NO. 4 300

48 | 47

ENERGY METERS

	GAS	COAL	FLASHING	ELECTRIC
END		12538		
BEGIN		11401		
TOTAL		1137		

% Ash
3.5%

CONTROL VALVE PRESSURE

NO. 1 14%

NO. 2 11%

NO. 3 17%

NO. 4 05 90%

GAS:	BTU	THERMS	COST	THERM % OF TOTAL	COST PER M	THERMS PER M
_____ c.f. @ 1,040 =	_____ / 100,000	= _____ @ _____/therm =	$ _____			
COAL:						
20,887 lb. @ 14029 =	293023 / 100,000	= 2930 @ .186 /therm =	$ 544.98	100%	5.46	29.3
FLASHING:						
_____ lb. @ _____ =	_____ / 100,000	= _____ @ _____/therm =	$ _____			

GAS: $ _____ per MCF, _____ ¢ per therm

TOTAL THERMS 2930

TOTAL THERMS PER M BRICK 29.3

KWHR PER M BRICK

KWHR COST PER M BRICK

COAL: $ _____ per ton, _____ ¢ per therm

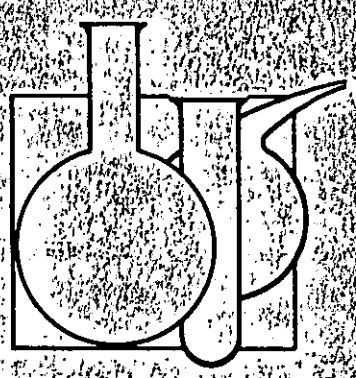
BTU PER POUND OF BRICK 837

AVERAGE COST PER THERM .186

TOTAL COST 544.98

COST PER M BRICK 5.46

Calibrations



VI. CALIBRATIONS

General

For each test the meter volume was adjusted using the average meter pressure during the test. For example, with an average meter pressure of 1.54 for box # 400 a 1.50 "H_2O was used to compare to the orginal calibration point, and a meter calibration factor of 1.0208 was multiplied by the sample volume to obtain the correct volume.

The equipment used during these tests was as follows:

Test Condition: OFF	Test Condition: ON
Meter Box: #400	Meter Box: #700
Stack Temeperature: OMEGA II	Stack Temperature: OMEGA I
Condenser: #1	Condenser: #2

The average temperature of the stack was 141 ^{o}F. Both the OMEGA II and OMEGA I were recalibrated at 140 ^{o}F and agreed exactly with an ASTM mercury-in-glass reference thermometer. The intercomponent spacings and the face opening alignment of each Pitot Tube assembly was rechecked and no changes were noticed; therefore, it was assumed that the cofficient of the assembly had not changed.

Set #1

Gauge	Average Test Condition Temperature	Gauge Reading	Reference Reading	Difference
Impinger 2/3/84 (Pre) #1		60	Room Temp 60	—
Meter In 410 (Pre) 2/3/84		60	Room Temp 60	—
Meter Out 2/3/84 (Pre) 410		60	Room Temp 60	—
Filter Heated Area 2/3/84 (Pre) #1		240	248 ± 25°F 240	—
Stack 2/10/84 (Post) 141 Omega II	141	140	Stack Temp °F 140	—

Post Test	Run 1	Run 2	Run 3
Train Leak Rate	____CFM	____CFM	____CFM
Pitot Leak Check	____	____	____
Pre Test (Answer Yes or No)			
Orsat Leak Check	____	____	____
Metering System Leak Check	____		
Barometer Calibrated	____		
Sample Bag Leak Check (if used)	____		

Signature [signature] Title [illegible] Date 2/10/84

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.

METER CALIBRATION FORM

Date 9/12/83 Box No. 400

P_{bar} = 30.00 in. Hg Calibrated by Joe Lot

Orifice Manometer Setting ΔH (in. H_2O)	Δ wtm (in. H_2O)	Gas Volume Wet Test Meter		Gas Volume Dry Gas Meter		Temperature Wet Test Meter		Avg. Temp. Dry Gas Meter	
		Initial	Final	Initial	Final	Initial	Final	Inlet	Outlet
2.5 @ 21"	-1.3	0.002	14.371	404.517	418.753	26.4	26.2	105/123	90/98
2.0 @ 23"	-1.05	14.371	26.558	418.753	431.022	26.2	26.0	120/124	98/103
1.5 @ 23"	-0.80	26.558	37.175	431.022	441.607	26.0	26.0	120/123	102/101
1.0 @ 24"	-0.60	37.175	46.224	441.607	450.680	26.0	26.0	121/125	105/107
0.5 @ 25"	-0.38	46.224	52.483	450.680	457.054	26.0	26.0	123/122	107/107

Pump must be operated for at least 15 minutes at each ΔH setting (.5, 1, 1.5, 2 and 3).

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

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

$P_{wtm} = P_{bar} - \frac{\Delta wtm}{13.6}$ 1.0075

$P_{dgm} = P_{bar} + \frac{\Delta H}{13.6}$ 1.0167 1.0208 1.0242

Δwtm = pressure on wet test meter in inches of H_2O 0.9963

Y = meter calibration factor 1.0131 = 1.01

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

Calculations

$$Y = \frac{(\text{wet final} - \text{wet initial})(T_{dgm})(P_{wtm})}{(\text{dry final} - \text{dry initial})(28.316)(T_{wtm})(P_{dgm})} \quad \text{or (1)}$$

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

Meter Tolerance = 1.00 ± 0.01

If the meter calibration factor is not within the allowable tolerance, the calibration factory Y may be used to mathematically correct the gas meter dial readings to the proper values instead of physically adjusting the dry gas meter dials to correspond to the wet test meter readings.

ORIFICE CALIBRATION FORM

Date 9/12/83 Meter Box No. 400

P_{bar} 30.00 Calibrated By [illegible]

ΔH	V_1	V_2	θ	t_1	t_2	$V_2 - V_1$	Q_m	K_m	
in. H_2O	CF	CF	Sec.	°F	°F	CF			
2.5	404.517	418.793	930	114	94	14.276	.9115	.7247	1.75
2.0	418.793	431.022	900	122	100.5	12.229	.8133	.7182	1.79
1.5	431.022	441.607	900	121.5	103.5	10.585	.7090	.7206	1.77
1.0	441.607	450.680	930	123.0	106.0	9.073	.5906	.7332	1.71
0.5	450.680	457.094	900	102.5	107.0	6.414	.4203	.7367	1.70
							Average K_m	.7267	

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

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

1.74

t_1 = Dry gas meter inlet temperature

t_2 = Dry gas meter outlet temperature

Calculations

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

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

$M_m = 29$

$T_m = t_2 + 460$

$P_m = P_{bar} + \dfrac{\Delta H}{13.6}$

Y = meter calibration factor

3. Calculate the average K_m as follows:

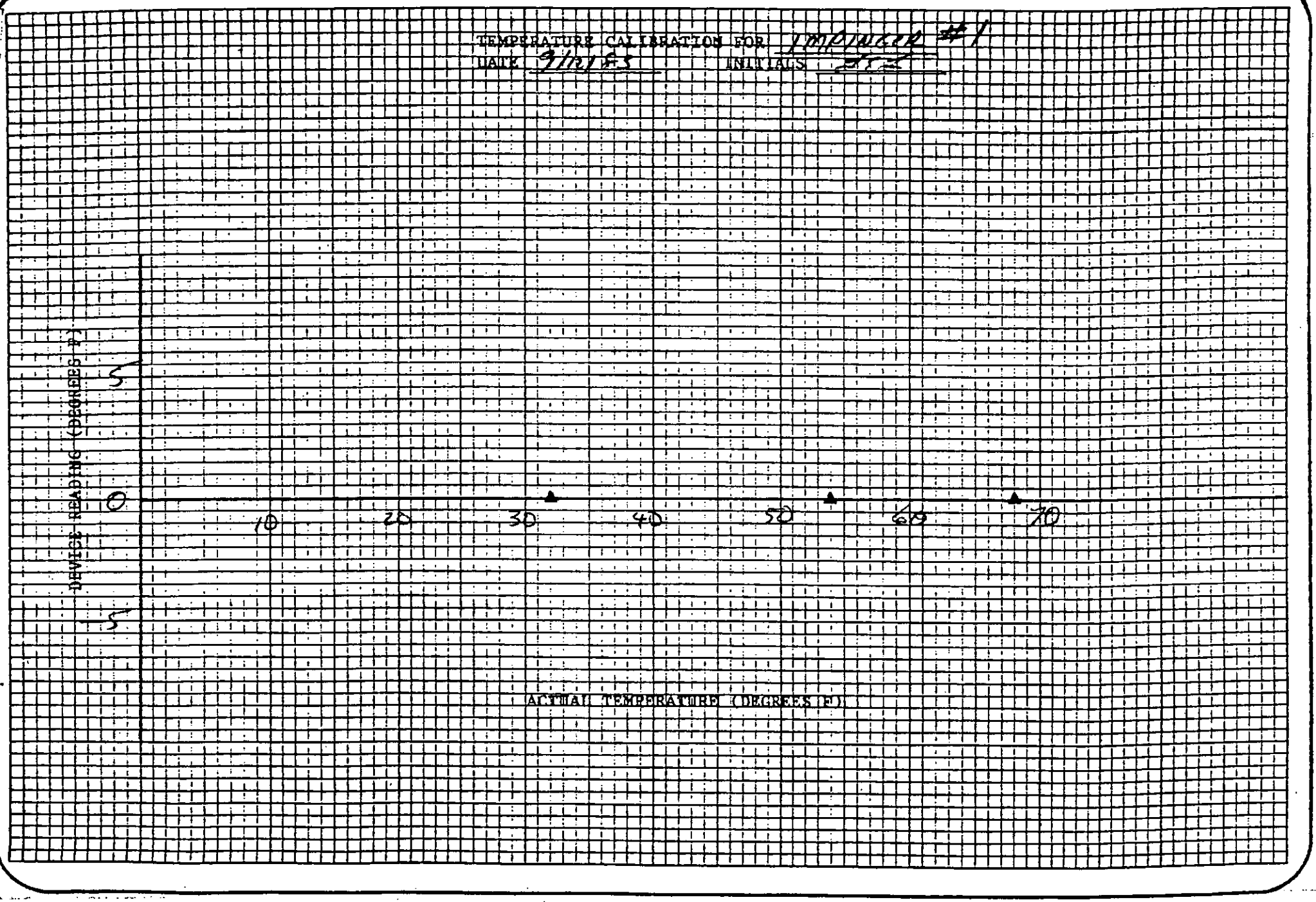
$$\bar{K}_m = \frac{\Sigma K_m}{5}$$

4. Calculate ΔH_a as follows:

$$\Delta H_a = \frac{Q@^2\ P@\ M@}{T@}\left[\frac{1}{\bar{K}_m^2}\right] = \frac{0.921}{\bar{K}_m^2}$$

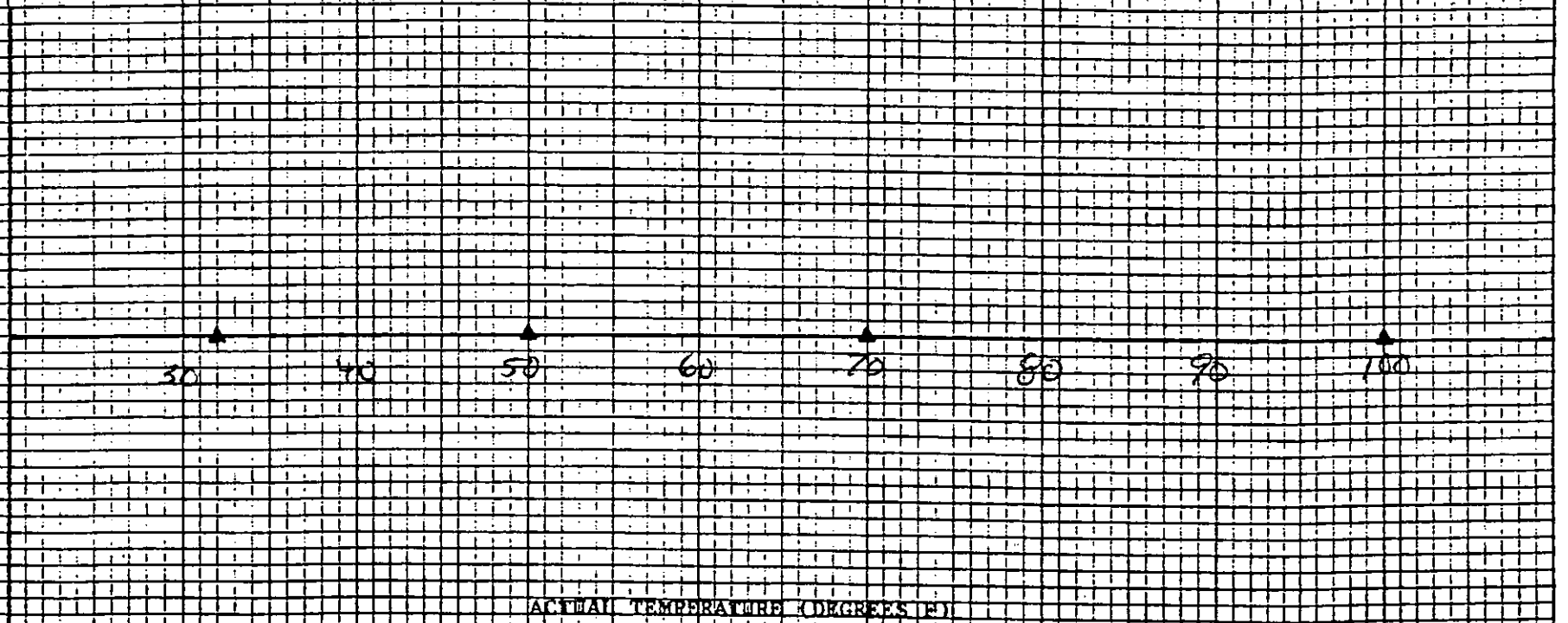
Q@ = 0.75 cfm
T@ = 528°R
P@ = 29.92 in.Hg
M@ = 29

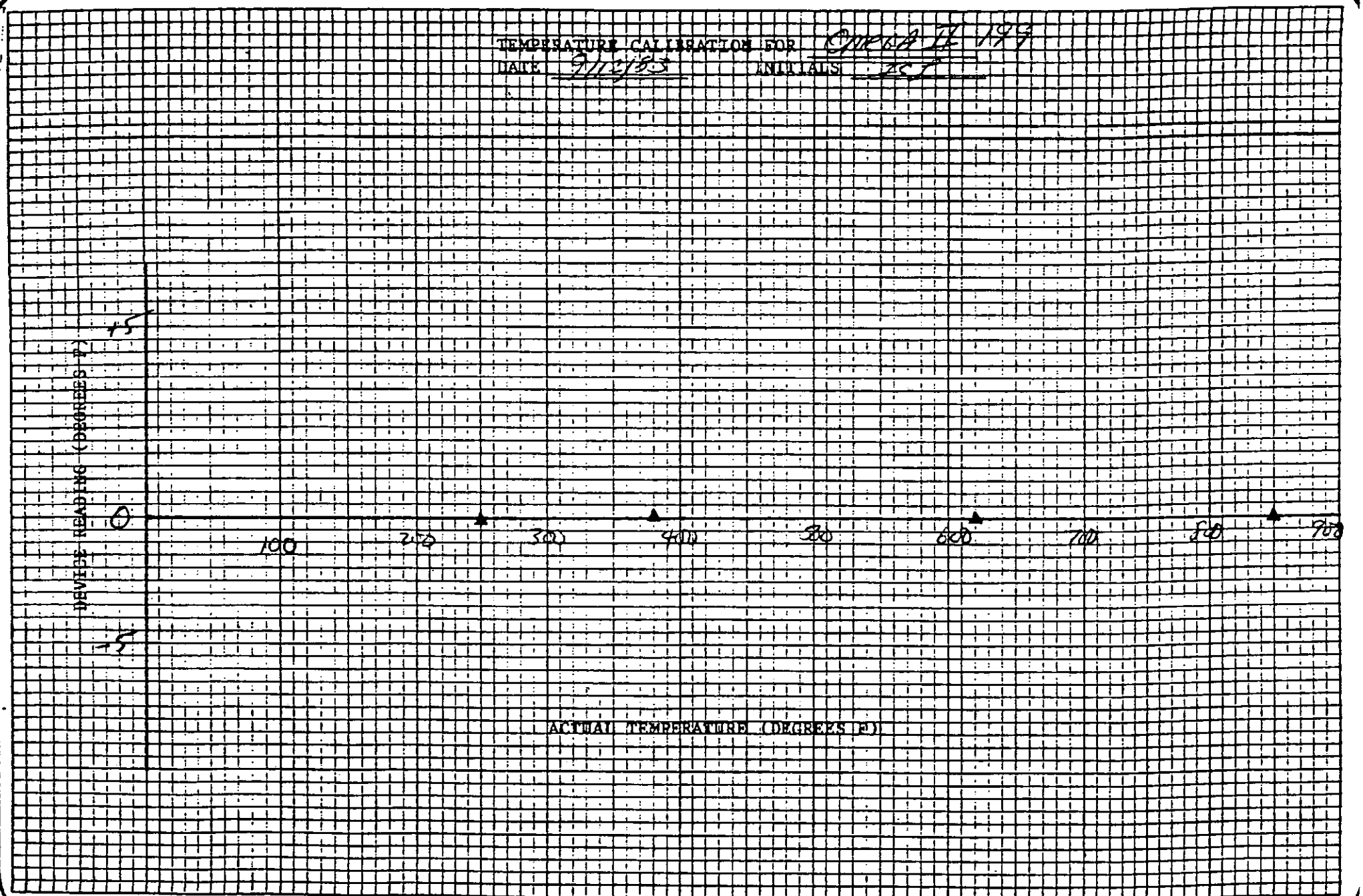
5. Orifice Tolerance = 1.84 ± .25


TEMPERATURE CALIBRATION FOR Impeller #1
DATE 9/12/85
INITIALS
DEVIATE READING (DEGREES F)
5
0
-5
10
20
30
40
50
60
70
ACTUAL TEMPERATURE (DEGREES F)

TEMPERATURE CALIBRATION FOR Omega HH 12 B

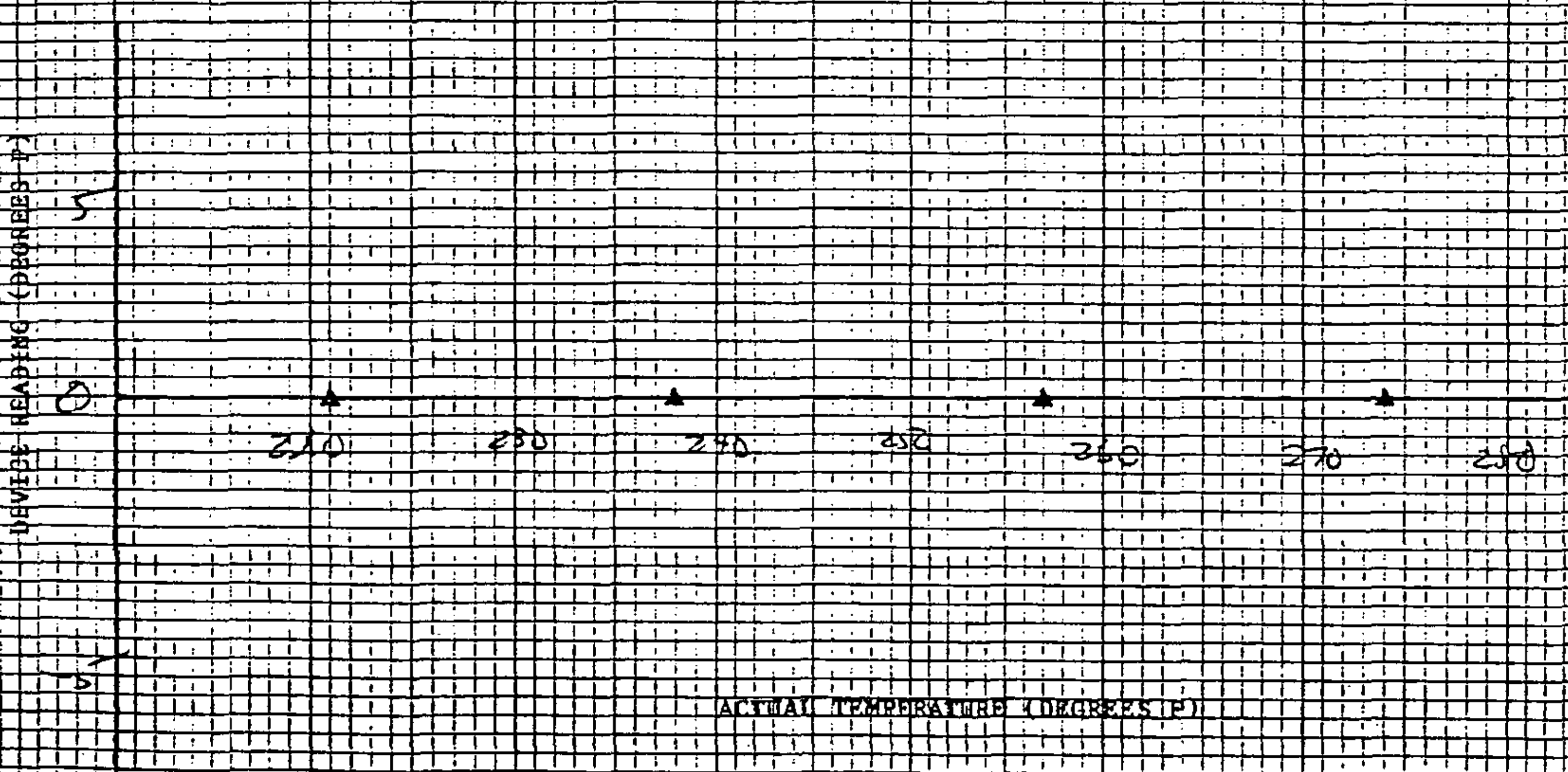
DATE 9/16/85 INITIALS AL




TEMPERATURE CALIBRATION FOR Orion II 199
DATE 9/12/83 INITIALS JST
+5
0
-5
100
200
300
400
500
600
700
800
900
DEVICE READING (DEGREES F)
ACTUAL TEMPERATURE (DEGREES F)

TEMPERATURE CALIBRATION FOR HZ50 #1

DATE 9/12/83 INITIALS [illegible]



PITOT CALIBRATION FORM

Date 9/12/83 Probe # 5'-N

Calibrated By Tom Lotz

Nozzle Size None Used

SIDE A

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(A)$
1	0.60	0.84	0.845	+.003
2	0.60	0.85	0.840	-.002
3	0.60	0.85	0.840	-.002
		$\bar{C}_p(A)$	0.842	

SIDE B

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(B)$
1	0.59	0.835	0.841	+.001
2	0.59	0.835	0.841	+.001
3	0.59	0.84	0.838	-.002
		$\bar{C}_p(B)$	0.840	

CALCULATIONS

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

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

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

PITOT CALIBRATION FORM

Date 2/2/84 Probe # 5'-M172

Calibrated By LOTZ

Nozzle Size None —

SIDE A

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(A)$
1	.53	0.655	0.891	
2	.53	0.615	0.891	
3	.53	0.655	0.891	
		$\bar{C}_p(A)$	0.891	

.87

SIDE B

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(B)$
1	.53	0.655	.891	+.002
2	.52	0.65	.885	-.004
3	.53	0.655	.891	+.002
		$\bar{C}_p(B)$	.889	

.89

CALCULATIONS

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

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

← Must be ≤ 0.01

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

Set #2

Gauge	Average Test Condition Temperature	Gauge Reading	Reference Reading	Difference
Impinger (Pre) 2/3/84 #2		60	Room Temp 60	—
Meter In (Pre) #700 2/3/84		60	Room Temp 60	—
Meter Out (Pre) #700 2/3/84		60	Room Temp 60	—
Filter Heated Area (Pre) NA #		242	248 ± 25°F 242	—
Stack (Post) 2/10/84 omega I	141	140	Stack Temp °F 140	—

Post Test	Run 1	Run 2	Run 3
Train Leak Rate	____CFM	____CFM	____CFM
Pitot Leak Check	____	____	____
Pre Test (Answer Yes or No)			
Orsat Leak Check	____	____	____
Metering System Leak Check	____		
Barometer Calibrated	____		
Sample Bag Leak Check (if used)	____		

Signature [signature] Title Director Date 2/10/84

METER CALIBRATION FORM

Date 9/23/83 Box No. 700

P_{bar} = 30.39 in. Hg Calibrated by Jon Lt

Orifice Manometer Setting ΔH (in. H_2O)	Δ wtm (in. H_2O)	Gas Volume Wet Test Meter Initial	Gas Volume Wet Test Meter Final	Gas Volume Dry Gas Meter Initial	Gas Volume Dry Gas Meter Final	Temperature Wet Test Meter Initial	Temperature Wet Test Meter Final	Avg. Temp. Dry Gas Meter Inlet	Avg. Temp. Dry Gas Meter Outlet
2.5	-1.3	84.173	90.650	233.457	251397	19.6	19.6	107/115	88/91
2.0	-1.1	90.650	95.042	251.397	266.521	19.5	19.5	111/113	90/92
1.5	-0.84	95.163	99.022	259410	291.878	19.5	19.5	107/110	90/90
1.0	-0.61	99.022	99.416	291.878	302.132	19.5	19.5	107/107	90/88
0.5	-0.37	99.216	105.903	302.582	309.538	19.5	19.5	102/101	88/87

Pump must be operated for at least 15 minutes at each ΔH setting (.5, 1, 1.5, 2 and 3)

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

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

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

$P_{dgm} = P_{bar} + \frac{\Delta H}{13.6}$

Δwtm = pressure on wet test meter in inches of H_2O

Y = meter calibration factor

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

.9669
.9702
.9769
.9831
.9569
.9768 = .98

Calculations

$$Y = \frac{(\text{wet final} - \text{wet initial})(T_{dgm})(P_{wtm})}{(\text{dry final} - \text{dry initial})(28.316)(T_{wtm})(P_{dgm})} \quad \text{or (1)}$$

$$\bar{Y} = \frac{\Sigma Y}{5}$$

Meter Tolerance = 1.00 ± 0.01

If the meter calibration factor is not within the allowable tolerance, the calibration factory Y may be used to mathematically correct the gas meter dial readings to the proper values instead of physically adjusting the dry gas meter dials to correspond to the wet test meter readings.

ORIFICE CALIBRATION FORM

Date 9/23/82 Meter Box No. 700

P_{bar} 30.39 Calibrated By [signature]

ΔH	V_1	V_2	θ	t_1	t_2	$V_2 - V_1$	Q_m	K_m	
in. H_2O	CF	CF	Sec.	°F	°F	CF			
2.5	233.657	251.397	1080	111	89.5	17.740	.9346	.7508	1.63
2.0	251.397	266.521	1025	112	91	15.124	.8428	.7556	1.61
1.5	250.440	291.578	900	108.5	90	11.468	.7345	.7606	1.59
1.0	291.578	302.582	1020	107.0	89.5	10.704	.6093	.7726	1.54
0.5	302.582	305.538	940	101.5	87.5	6.956	.4327	.7745	1.53
							Average K_m	.7633	

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

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

t_1 = Dry gas meter inlet temperature

t_2 = Dry gas meter outlet temperature

1.58

Calculations

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

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

$M_m = 29$

$T_m = t_2 + 460$

$P_m = P_{bar} + \dfrac{\Delta H}{13.6}$

Y = meter calibration factor

3. Calculate the average K_m as follows:

$$\bar{K}_m = \frac{\Sigma K_m}{5}$$

4. Calculate ΔH_a as follows:

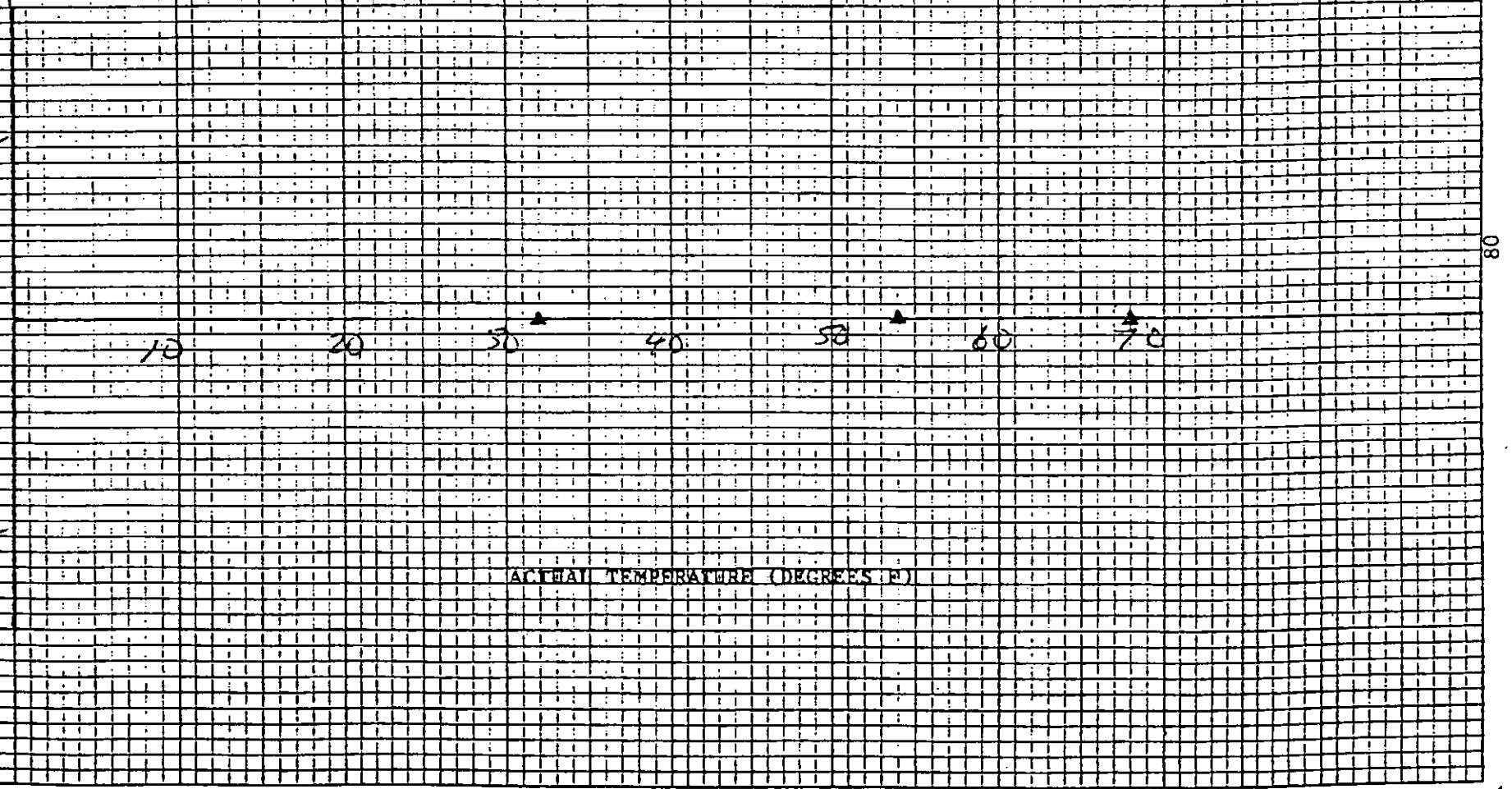
$$\Delta H_a = \frac{Q@^2\ P@\ M@}{T@}\left[\frac{1}{\bar{K}_m^2}\right] = \frac{0.921}{\bar{K}_m^2}$$

Q@ = 0.75 cfm
T@ = 528°R
P@ = 29.92 in.Hg
M@ = 29

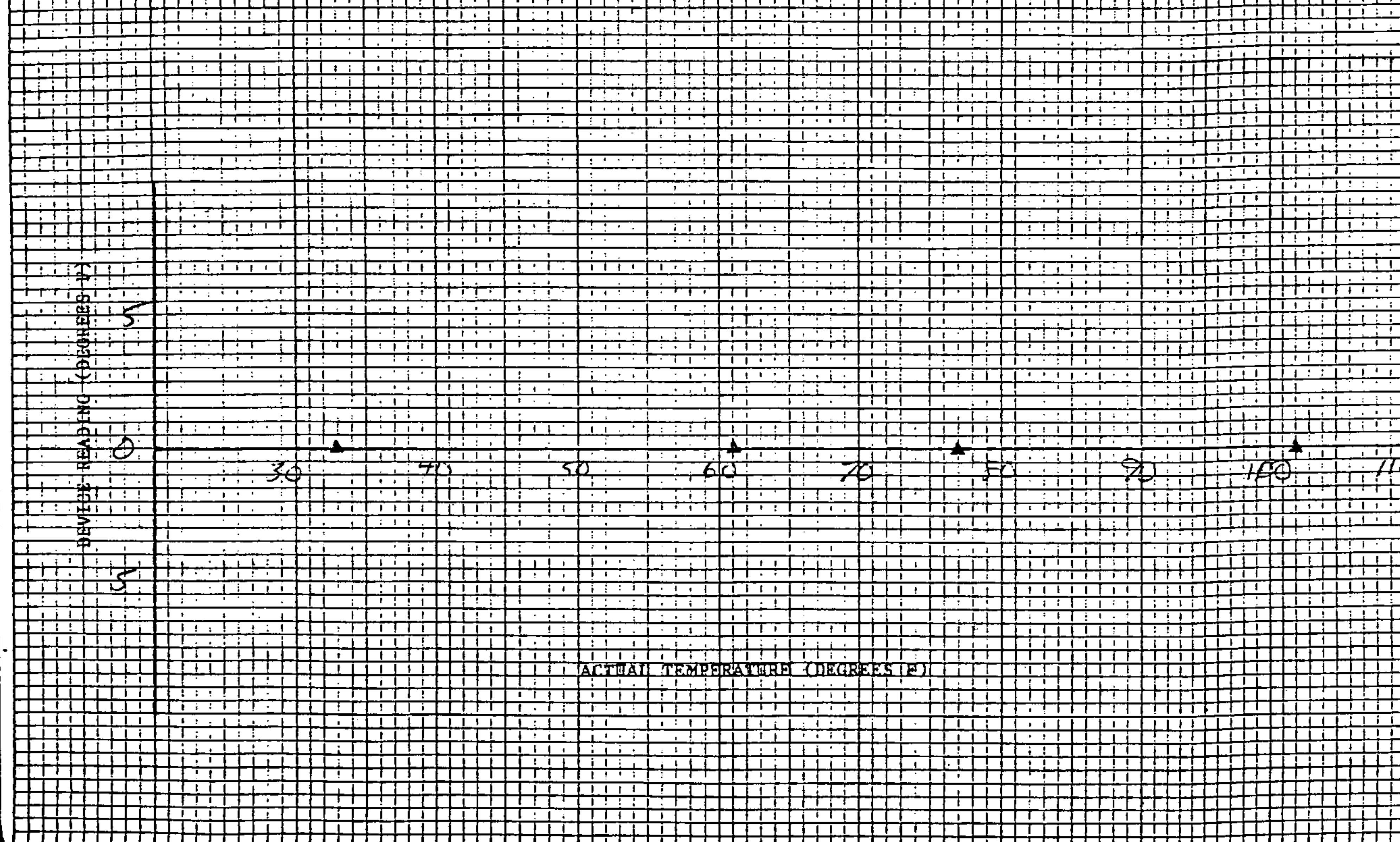
5. Orifice Tolerance = 1.84 ± .25

TEMPERATURE CALIBRATION FOR: Impinger #2

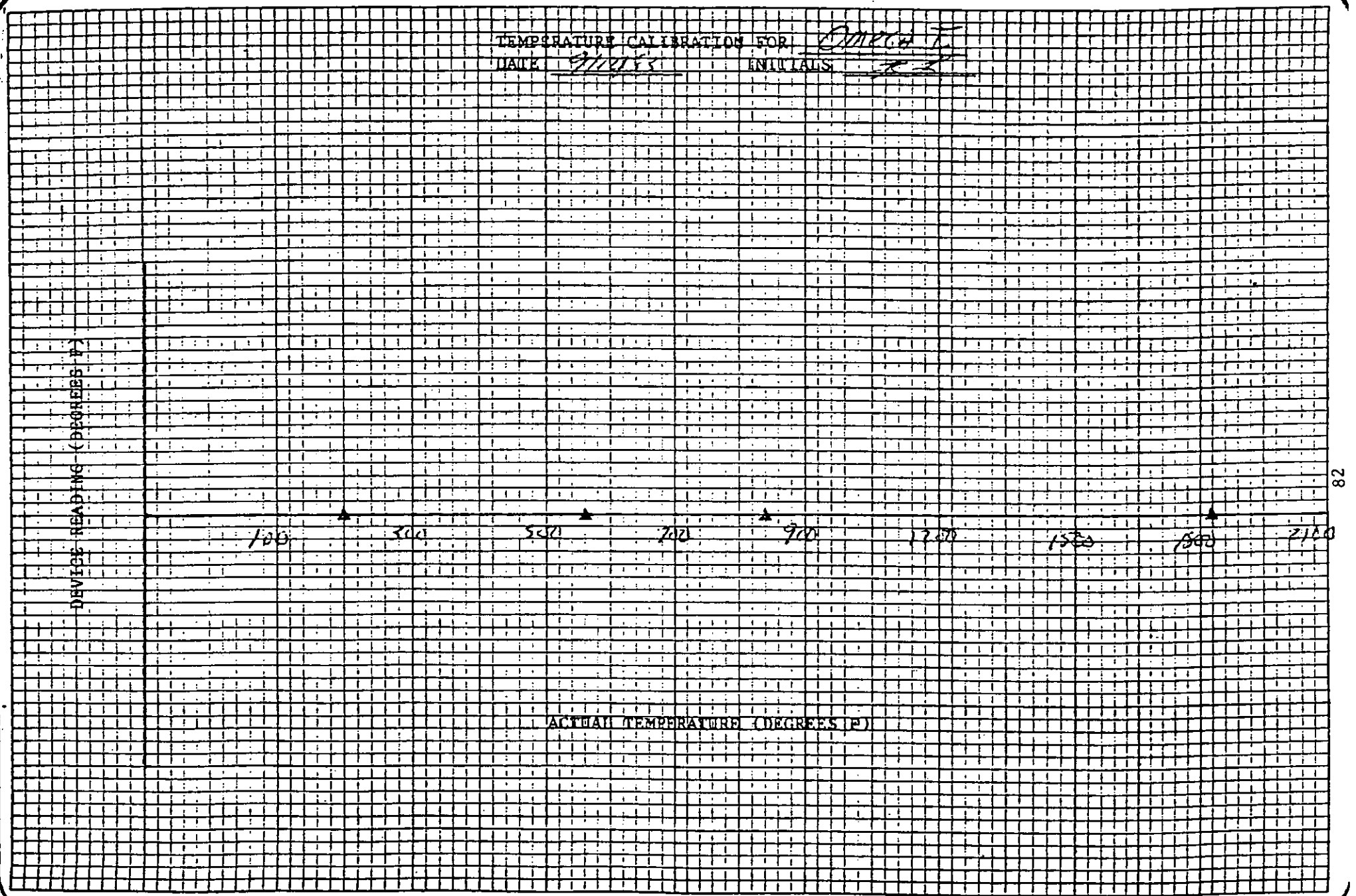
DATE: 7/12/93 INITIALS: JE



TEMPERATURE CALIBRATION FOR Omega I
DATE [illegible] INITIALS [illegible]



TEMPERATURE CALIBRATION FOR: Omega T
DATE: 9/10/15 INITIALS: [illegible]



PITOT CALIBRATION FORM

Date 2/2/84 Probe # 6-M171

Calibrated By LOTZ

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	0.53	0.74	0.838	
2	0.53	0.74	0.838	
3	0.53	0.74	0.838	
		$\overline{C}_{p(A)}$	0.838	

.84

SIDE B

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \overline{C}_p(B)$
1	0.53	.74	.838	
2	0.53	.74	.838	
3	0.53	.74	.838	
		$\overline{C}_{p(B)}$	.838	

.84

CALCULATIONS

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

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

← Must be ≤ 0.01

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