MASS EMISSION TESTS
CONDUCTED ON THE
BAGHOUSE FOR THE #9 BATTERY
IN
BIRMINGHAM, ALABAMA
FOR
U.S. STEEL
ON
AUGUST 18-21, 1980

TABLE OF CONTENTS

INTRODUCTION

On August 18-21, 1980, Guardian Systems, Inc., conducted a series of mass emission measurements on the Wheelabrator-Frye Baghouse for the #9 Coke Battery located at Fairfield, Alabama. Measurements were made only during coke pushes. Each point tested represents one push.

The following personnel represented the companies listed below:

Pat Hester	U.S. Steel Corporation
Paul Thomas	U.S. Steel Corporation
Jerry Anderson	U.S. Steel Corporation
Clyde D. Kepple	Wheelabrator-Frye, Inc.
Jim Manning	Environmental Protection Agency
Tom Lotz	Guardian Systems, Inc.
Mark Wilson	Guardian Systems, Inc.
Don Lackey	Guardian Systems, Inc.

SAMPLING AND ANALYTICAL PROCEDURES

General

Stack temperature, pressure, range of velocity heads, and moisture content were determined to correctly set the nomograph and proper nozzle size for isokinetic sampling. The meter box was leak checked from the pump through the orifice as outlined in Method 5. The equipment used in this test was manufactured by Research Appliance Corporation and was properly calibrated before these tests (See Calibrations).

The stack was sampled at 24 points. The sample point location can be found in Figure 1.

Sampling Techniques

The particulate determinations were made by utilizing the sampling train in Figure 2. Initial and final leak checks of the sampling systems and pitot lines were performed as outlined in Method 5 and these were recorded on the individual data sheets. The nozzles were calibrated before and after each test using a micrometer and were also recorded on the individual data sheets.

The particulate samples were taken by sampling each point for 3 minutes. The gases were drawn through a heated glass lined probe. The probe heater was maintained at the proper setting to obtain an exit temperature of 248 $\pm$ 25°F. (See Calibrations) The gases then passed through a glass cyclone for removing particulate matter approximately 10 microns and greater in size, then through a glass fiber filter (Gelman, Class A) of 0.3 microns retention to remove any remaining particualte matter. The cyclone and filter were maintained at a temperature of 248 $\pm$ 25°F. The sample box temperatures were recorded at each point on the data sheets.

The gases then passed through four (4) Greenburg-Smith impingers. The first and second impingers contained 150 milliliters of distilled water each, while the third was empty and the fourth contained approximately 220 grams of indicating silica gel. These impingers were placed in an ice bath during the test to maintain a maximum exit temperature from the last impinger of 68°F. This temperature is also recorded on the data sheets. The clean and cool gases then entered the meter box where the gas flow and temperature was measured. (See data sheets)

Gas analysis for CO_2 and O_2 were determined for each run by using Fyrite Gas Analyzers. These samples were taken approximately five times during the testing sequence and were averaged. This was approved by Mr. Jim Manning. Particulate catches were placed in sealed petri dishes. The acetone washes of the nozzle, probe and cyclone were combined and placed in sealed containers also. For each run an acetone blank of approximately 300 milliliters was placed in a sealed container. These containers were transported to the laboratory for analysis. In our laboratory, the back-half train, (everything between and including the back-half of the filter holder to the third impinger) was prepared for analysis by first measuring the volume of liquid in the first three impingers and then transferring the liquid to a sample container. All parts of the back-half were rinsed with distilled water and the rinsings were added to the same sample container. The back half was again rinsed with acetone and these rinsings were placed in another container.

Analysis - Front-Half

The filters (Gelman, Class A, without organic binder, minimum 99.9% retention for particles of 0.3 microns as determined by DOP tests) were prepared for the field test by desiccating at 68 $\pm$ 10 ^{o}F at ambient pressure for 24 hours and weighing at intervals of at least six (6) hours to a constant weight (less than 0.5 milligrams change from previous reading). Upon return to the laboratory, the filters were again subjected to the same procedures as outlined above. The weights are recorded in a bound laboratory book and were transferred to the laboratory sheets in this report. During each weighing the filter was not exposed to laboratory atmosphere for more than two (2) minutes and the relative humidity of the laboratory was less than fifty percent (50%).

The acetone washings, along with the acetone blank for the group of tests, were evaporated to dryness in tared glass beakers. They were then desiccated for twenty four (24) hours and weighed to a constant weight.

The moisture content was determined for each run by measuring the increase in the amount of water collected in the impingers and the increase in weight of the silica gel. These weights were combined to give the total amount of water collected.

Analysis - Back-Half

The water and water rinsings were first filtered, then extracted with ether and Chloroform. The organic portion was evaporated and weighed. The aqueous portion was evaporated and a sulfate analysis was performed on the residue. The acetone rinsings were evaporated and weighed. These weights were combined to determine total back-half catch. A more thorough procedure follows.

2. In addition to the analytical procedure found in EPA Method 5, the condensible materials found in the back-half (everything between and including the back-half of the filter holder to the third impinger) will be included in the test results. The following procedures and calculations apply only to the back-half of the sampling train:

(a) Procedures for back-half particulate analysis.

(i) Identify and desiccate for 24 hours sufficient filters to filter all liquid collectors and washings.

(ii) Weigh and record the weights of the filters in addition to the identification number.

(iii) Before filtering, measure to the nearest milliliter the volume of liquid in each impinger and record.

(iv) Place the impinger solutions in a labeled container and wash any residue in the impinger into the container using distilled water and a policeman.

(v) Add the water washings from the back half of the filter holder and interconnecting glassware to the container in (iv).

(vi) Wash the impingers and the components in step (iii) with acetone and place in a labeled container.

(vii) Filter the solutions from steps (iv) and (iii) using preweighed and identified millipore filters. Use suction on all filtering.

(viii) Measure the filtrate from (vii) to the nearest milliliter and record the volume.

(ix) Air dry, then desiccate for 24 hours all filters used in the above steps. Weigh to the nearest .1 mg. and record the weight. As an alternative, the filters can be oven dried at 105 degrees C for 2 hours, cooled in a desiccator, and weighed to a constant weight.

(x) Identify and dry for 2 hours at 105 degrees C as many 350 milliliter evaporating dishes as are needed to evaporate the filtrates. Then desiccate until cool and weigh to the nearest .1 mg. Record each weight with its identification number.

(xi) Take the filtrate from step (viii) and extract organic particulate using three 25 milliliter portions of chloroform and three 25 milliliter portions of ethyl ether. Combine the ether and chloroform extracts, and transfer to a tared beaker.

(1) Organic Portion - evaporate at about 70 degrees F until no solvent remains. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest .1 mg. Place a measured quantity of unused ether into a preweighed evaporating dish. This is the ether blank. Do the same to obtain a chloroform blank. Record both weights to the nearest .1 mg.

(II) Water Portion - follow steps (xii) and (xiii) below.

(xii) Evaporate, using an evaporating dish prepared in (x), the filtrates from (xi)(II) and an equal amount of distilled water separately to constant weight at 105 degrees C. Desiccate the residue until cool and weigh to the nearest .1 mg. and record the weights.

(xiii). Perform a sulfate analysis (turbimeric) of the impinger residue from step (xii). Follow steps as given in Standard Methods For the Examination of Water and Wastewater, 14th Edition, published by the American Public Health Association, Washington, D. C. 20036, pages 496 - 498.

(xiv) Transfer the acetone washing from step (vi) into a preweighed evaporating dish after measuring and recording the volume of acetone.

(xv) Place a measured quantity of unused acetone into a preweighed evaporating dish. This is the acetone blank.

(xvi) Evaporate both the blank (xiv) and unknowns (xiii) at less than 60 degrees C in a vacuum.

(xvii) Desiccate to constant weight and reweigh. Then, record the weight to the nearest .1 mg.

(b) Addendum to procedures for back-half particulate analysis.

(i) After filtration, the filters are to be handled carefully to prevent loss of material.

(ii) Store used filters in separate petri dishes for transportation.

(iii) When filtering using the Millipore filters, it may be necessary to start with an .8μ filter, then a .45μ filter, and finally a .22μ filter.

Millipore .22μ Catalog #GSWP-047-00

.45μ Catalog #HAWP-047-00

.80μ Catalog #AAWP-047-00

(iv)

(I) Solvent/water blank concentration

$$Ca = \frac{m_a}{Va\ \rho a}$$

m_a = Mass of residue of solvent after evaporation

Va = Volume of solvent or water blank

ρa = Density of solvent/water

Ca = Solvent/water concentration

(II) Solvent/Water wash blank

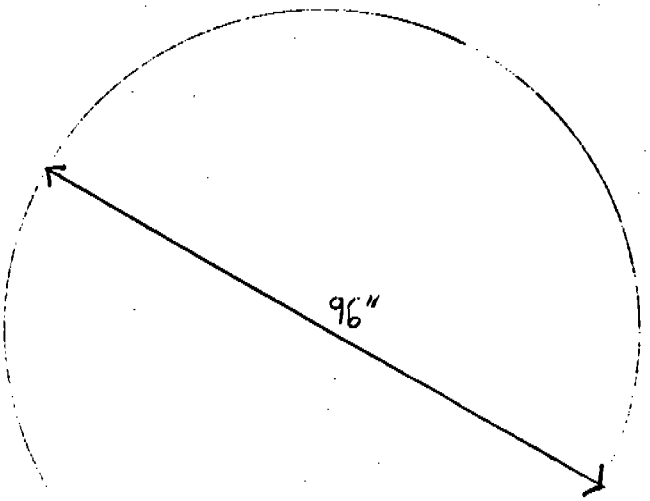
$Wa = Ca\ Vaw\ \rho a$

Wa = Weight of solvent/water residue in solvent/water wash

Vas = Volume of solvent/water wash blank

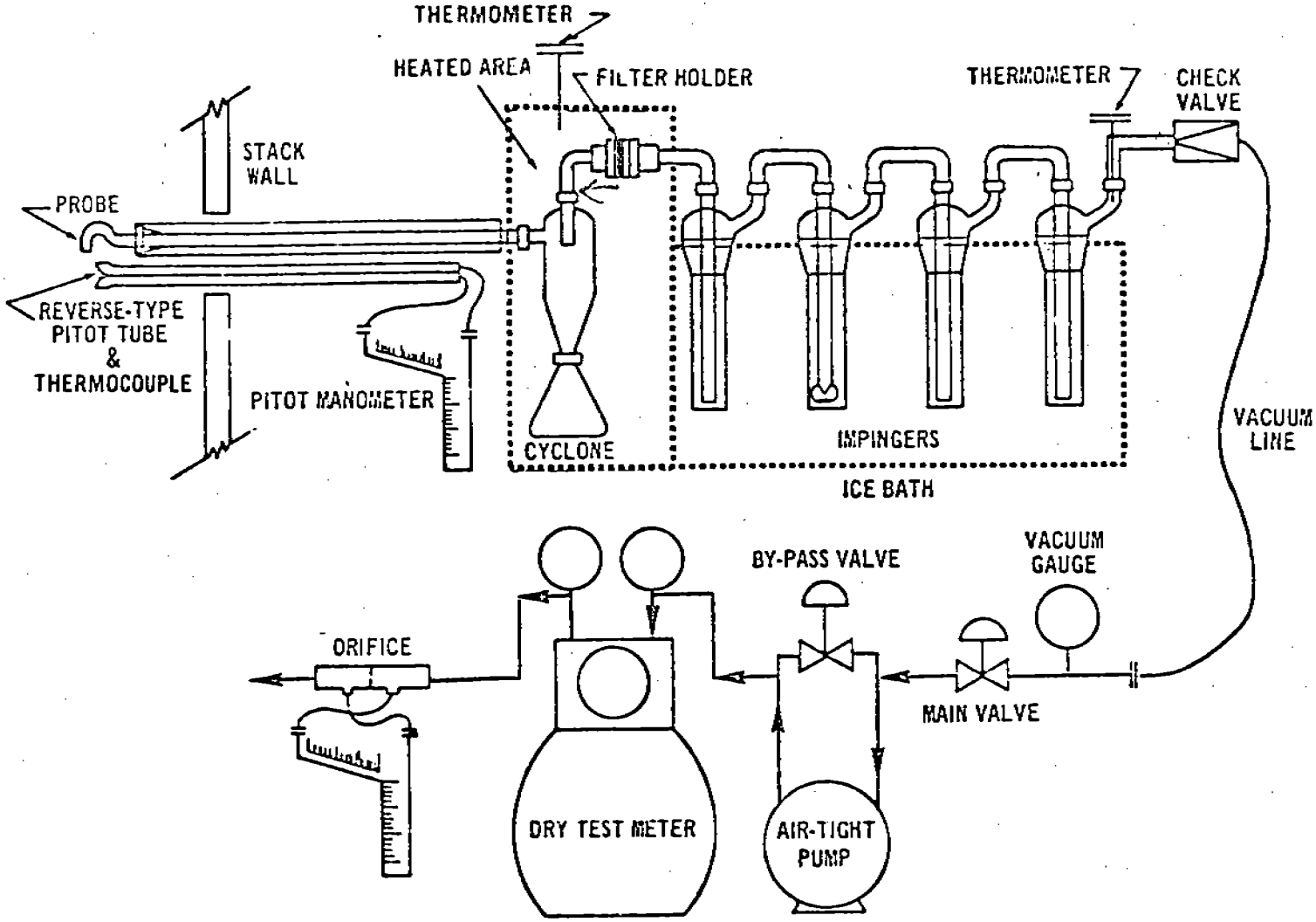
(c) Calculation of back-half particulate catch. Determine the total back-half particulate catch from the sum of the weights obtained from steps (xi)(I), (xii), and (xvii) less the acetone, ether and chloroform blanks, and the sulfate determined from (xiii).

SAMPLE POINT LOCATION



Point #	Distance from Wall (inches)
1.	2.0
2.	6.4
3.	11.3
4.	17.0
5.	24.0
6.	34.1
7.	61.9
8.	72.0
9.	79.0
10.	84.7
11.	89.6
12.	94.0

Figure 1



PARTICULATE SAMPLING TRAIN. . . METHOD 5

SUMMARY OF TEST RESULTS

The following table is a summary of the tests performed for U.S. Steel Corporation on August 18-21, 1980. Four complete tests were run during the testing period. The first test was performed using a condenser instead of the impingers. Guardian Systems, Inc., was then requested by U.S. Steel to use impingers on the back half of the train. Therefore, the next three tests were done using impingers.

Sampling was done at each of the 24 points for three minutes at each point. Each sampling point contains one coke push. A representative from U.S. Steel with a radio would tell Guardian Systems, Inc., when they were ready to push. The technicians from Guardian would turn on and set the meter box and then the representative from U.S. Steel would tell the coke battery to go ahead and push the coke. The meter box was turned off at the end of 3 minutes until the next push. Therefore, each test consists of 24 coke pushes.

TABLE 1

TABULAR TEST RESULTS

Test Number	1	2	3	4	Average (Runs 2-4)
Type	Condenser	Imp.	Imp.	Imp.	
Date	8-18-80	8-19-80	8-20-80	8-21-80	
Time	7:45-2:14	7:49-2:27	7:09-2:08	7:38-4:11	
Moisture, %	2.78	2.67	2.71	2.66	2.68
Gas Temperature, ^{o}F	129	132	132	133	132
Gas Velocity	62.63	61.31	59.15	57.73	59.40
Volumetric Flow, ACFM	188,877	184,919	178,405	174,118	
Volumetric Flow, DSCFM	166,313	161,877	155,291	151,315	156,161
Concentration, grains/ACF	0.004	0.008	0.007	0.008	
Concentration, grains/DSCF	0.005	0.010	0.008	0.009	0.009
Emissions, lbs/hr	6.62	13.33	9.94	11.85	11.71
Coke Pushed, tons/test	324.0	324.0	324.0	324.0	324.0
Emissions, lbs/ton of coke pushed		0.05	0.04	0.04	0.04
Allowable, lbs/ton of coke pushed					0.03
Isokinetic, %	91.33	90.20	94.54	93.62	

NOMENCLATURE

ACF - Actual Cubic Feet

ACFM - Actual Cubic Feet per minute

ACM - Actual Cubic Meters

ACMS - Actual Cubic Meters per second

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

As - Area of Stack, (ft^2)

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

Ca - Acetone blank residue concentration, mg/g

c_a - Particulate Concentration, ACF

CFM - Cubic feet per minute

Cp - Pitot tube coefficient, (dimensionless)

c_s - Particulate Concentration, grains/DSCF

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

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

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

DSCF - Dry Standard Cubic Feet

DSCFM - Dry Standard Cubic Feet per minute

DSCM - Dry Standard Cubic Meters

DSCMS - Dry Standard Cubic Meters per second

EA - Excess Air, %

I - Isokinetic Sampling, %

Km - Orifice Correction Factor, (dimensionless)

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

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

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

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

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

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

Mn - Total amount of particulate matter collected, mg.

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

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

ΔP - Velocity head of stack gas, in. H_2O

Pa - Density of acetone, mg/ml

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

Pg - Stack static pressure, in. H_2O

Pm - Meter pressure, in. Hg

PMR - Particulate Mass Rate, lbs per hour

Ps - Absolute stack pressure, in. Hg

Pstd - Standard absolute pressure, 29.92 in. Hg

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

Qa - Volumetric flow rate, ACFM

Qs - Volumetric flow rate, DSCFM

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

SCF - Standard Cubic Foot

ta - Ambient Temperature, ^oF

tm - Average Temperature of meter, ^oF

t_s - Average Temperature of stack, ^oF

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

NOTE: Capital "T" denotes degrees Rankin

Va - Volume of acetone blank, ml

Vaw - Volume of acetone used in wash, ml

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

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

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

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

Vn - Volume collected at stack conditions through nozzle, ACF

Vs - Average stack gas velocity, ft/sec.

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

Wa - Weight of residue in acetone wash, mg

Y - Dry gas meter calibration factor, (dimensionless)

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

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

$\overline{\sqrt{\Delta P}}$ - 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1 •	Run Number
6-18-80	Date
30•27	Barometric Pressure (in. Hg.)
-•38	Static Pressure (in. H_2O)
72•00	Time (minutes)
73•038	Meter Volume (corrected)
129•00	Stack Temperature (^oF)
116•00	Meter Temperature (^oF)
3•60	Meter Pressure (in. H_2O)
1•042	Sq. Root Velocity Pressure
20•60	Mg of Particulate
41•50	Ml of water condensed
19•25	% O_2
•00	% CO_2
50•2656	Stack Area (Ft^2)
•95	Pitot Correction Factor
•000314	Nozzle Area (Ft^2)

1 • Stack Pressure

30•24	Inches Hg
768•10	Millimeters Hg

2 • Meter Pressure

30•53	Inches Hg
775•46	Millimeters Hg

3 • Meter Volume

68•300	Dry Standard Cubic Feet
1•934	Dry Standard Cubic Meters

4 • Water Volume

1•953	Standard Cubic Feet
•055	Standard Cubic Meters

5 • Moisture Content

•0278	(Convert to % X 100)

6 • Molecular Weight Dry

28•77

7 • Molecular Weight Wet

28•47

8 • Stack Velocity

62•63	Feet per Second
19•09	Meters per Second

9 • Volumetric Flow

188,577•	Actual Cubic Feet per Minute
89•1405	Actual Cubic Meters per Second

10 • Volumetric Flow

166,313•	Dry Standard Cubic Feet per Minute
78•4914	Dry Standard Cubic Meters per Second

11 • Concentration

•0046	Grains per Dry Standard Cubic Foot
•0105	Grams per Dry Standard Cubic Meter

15 • Particulate Mass Rate

6•62	Pounds per Hour

16 • Volume at Nozzle

77•566	Actual Cubic Feet
2•196	Actual Cubic Meters

17 • Concentration

•0041	Grains per Actual Cubic Foot
•0094	Grams per Actual Cubic Meter

18 • % Isokinetic

91•33

TOTAL

2.	Run Number
8-19-80	Date
30.24	Barometric Pressure (in. Hg.)
-.75	Static Pressure (in. H_2O)
72.00	Time (minutes)
69.847	Meter Volume (corrected)
132.00	Stack Temperature (^oF)
112.00	Meter Temperature (^oF)
3.30	Meter Pressure (in. H_2O)
1.017	Sq. Root Velocity Pressure
40.95	Mg of Particulate
38.30	Ml of water condensed
19.50	% O_2
.00	% CO_2
50.2656	Stack Area (Ft^2)
.85	Pitot Correction Factor
.000314	Nozzle Area (Ft^2)

1. Stack Pressure

30.18	Inches Hg
766.57	Millimeters Hg

2. Meter Pressure

30.48	Inches Hg
774.19	Millimeters Hg

3. Meter Volume

65.660	Dry Standard Cubic Feet
1.859	Dry Standard Cubic Meters

4. Water Volume

1.803	Standard Cubic Feet
.051	Standard Cubic Meters

5. Moisture Content

.0267	(Convert to % X 100)

6. Molecular Weight Dry

28.78

7. Molecular Weight Wet

28.49

8. Stack Velocity

61.31	Feet per Second
18.69	Meters per Second

9. Volumetric Flow

184,919.	Actual Cubic Feet per Minute
87.2725	Actual Cubic Meters per Second

10. Volumetric Flow

161,877.	Dry Standard Cubic Feet per Minute
76.3979	Dry Standard Cubic Meters per Second

11. Concentration

.0096	Grains per Dry Standard Cubic Foot
.0220	Grams per Dry Standard Cubic Meter

15. Particulate Mass Rate

13.33	Pounds per Hour

16. Volume at Nozzle

75.007	Actual Cubic Feet
2.124	Actual Cubic Meters

17. Concentration

.0084	Grains per Actual Cubic Foot
.0192	Grams per Actual Cubic Meter

18. % Isokinetic

90.20

FRONT HALF ONLY

2. Run Number

8-19-80 Date

30.24 Barometric Pressure (in. Hg.)

-.75 Static Pressure (in. H_2O)

72.00 Time (minutes)

69.847 Meter Volume (corrected)

132.00 Stack Temperature (^oF)

112.00 Meter Temperature (^oF)

3.30 Meter Pressure (in. H_2O)

1.017 Sq. Root Velocity Pressure

14.10 Mg of Particulate

38.30 Ml of water condensed

19.50 % O_2

.00 % CO_2

50.2656 Stack Area (Ft^2)

.85 Pitot Correction Factor

.000314 Nozzle Area (Ft^2)

1. Stack Pressure

30.18 Inches Hg

766.57 Millimeters Hg

2. Meter Pressure

30.48 Inches Hg

774.19 Millimeters Hg

3. Meter Volume

65.660 Dry Standard Cubic Feet

1.859 Dry Standard Cubic Meters

4. Water Volume

1.803 Standard Cubic Feet

.051 Standard Cubic Meters

5. Moisture Content

.0267 (Convert to % X 100)

6. Molecular Weight Dry

28.78

7. Molecular Weight Wet

28.49

8. Stack Velocity

61.31 Feet per Second

18.69 Meters per Second

9. Volumetric Flow

184,919. Actual Cubic Feet per Minute

87.2725 Actual Cubic Meters per Second

10. Volumetric Flow

161,877. Dry Standard Cubic Feet per Minute

76.3979 Dry Standard Cubic Meters per Second

11. Concentration

.0033 Grains per Dry Standard Cubic Foot

.0076 Grams per Dry Standard Cubic Meter

15. Particulate Mass Rate

4.59 Pounds per Hour

16. Volume at Nozzle

75.007 Actual Cubic Feet

2.124 Actual Cubic Meters

17. Concentration

.0029 Grains per Actual Cubic Foot

.0066 Grams per Actual Cubic Meter

18. % Isokinetic

90.20

BACK HALF ONLY

2. Run Number

8-19-80 Date

30.24 Barometric Pressure (in. Hg.)

-.75 Static Pressure (in. H_2O)

72.00 Time (minutes)

69.847 Meter Volume (corrected)

132.00 Stack Temperature (^oF)

112.00 Meter Temperature (^oF)

3.30 Meter Pressure (in. H_2O)

1.017 Sq. Root Velocity Pressure

26.85 Mg of Particulate

38.30 Ml of water condensed

19.50% O_2

.00% CO_2

50.2656 Stack Area (Ft^2)

.85 Pitot Correction Factor

.000314 Nozzle Area (Ft^2)

1. Stack Pressure

30.18 Inches Hg

766.57 Millimeters Hg

2. Meter Pressure

30.48 Inches Hg

774.19 Millimeters Hg

3. Meter Volume

65.660 Dry Standard Cubic Feet

1.859 Dry Standard Cubic Meters

4. Water Volume

1.803 Standard Cubic Feet

.051 Standard Cubic Meters

5. Moisture Content

.0267 (Convert to % X 100)

6. Molecular Weight Dry

28.78

7. Molecular Weight Wet

28.49

8. Stack Velocity

61.31 Feet per Second

18.69 Meters per Second

9. Volumetric Flow

184,919. Actual Cubic Feet per Minute

87.2725 Actual Cubic Meters per Second

10. Volumetric Flow

161,877. Dry Standard Cubic Feet per Minute

76.3979 Dry Standard Cubic Meters per Second

11. Concentration

.0063 Grains per Dry Standard Cubic Foot

.0144 Grams per Dry Standard Cubic Meter

15. Particulate Mass Rate

8.74 Pounds per Hour

16. Volume at Nozzle

75.007 Actual Cubic Feet

2.124 Actual Cubic Meters

17. Concentration

.0055 Grains per Actual Cubic Foot

.0126 Grams per Actual Cubic Meter

18. % Isokinetic

90.20

3. TOTAL	Run Number
8-20-80	Date
30.07	Barometric Pressure (in. Hg.)
-.62	Static Pressure (in. H_2O)
72.00	Time (minutes)
70.619	Meter Volume (corrected)
132.00	Stack Temperature (^oF)
112.00	Meter Temperature (^oF)
3.30	Meter Pressure (in. H_2O)
.978	Sq. Root Velocity Pressure
32.00	Mg of Particulate
39.00	Ml of water condensed
18.75	% O_2
.00	% CO_2
50.2656	Stack Area (Ft^2)
.85	Pitot Correction Factor
.000314	Nozzle Area (Ft^2)

1. Stack Pressure

30.02	Inches Hg
762.51	Millimeters Hg

2. Meter Pressure

30.31	Inches Hg
769.88	Millimeters Hg

3. Meter Volume

66.016	Dry Standard Cubic Feet
1.869	Dry Standard Cubic Meters

4. Water Volume

1.836	Standard Cubic Feet
.052	Standard Cubic Meters

5. Moisture Content

.0271	(Convert to % X 100)

6. Molecular Weight Dry

28.75

7. Molecular Weight Wet

28.46

8. Stack Velocity

59.19	Feet per Second
18.03	Meters per Second

9. Volumetric Flow

178,405.	Actual Cubic Feet per Minute
84.1982	Actual Cubic Meters per Second

10. Volumetric Flow

153,291.	Dry Standard Cubic Feet per Minute
73.2396	Dry Standard Cubic Meters per Second

11. Concentration

.0075	Grains per Dry Standard Cubic Foot
.0172	Grams per Dry Standard Cubic Meter

15. Particulate Mass Rate

9.94	Pounds per Hour

16. Volume at Nozzle

75.842	Actual Cubic Feet
2.148	Actual Cubic Meters

17. Concentration

.0065	Grains per Actual Cubic Foot
.0149	Grams per Actual Cubic Meter

18. % Isokinetic

94.54

FRONT HALF ONLY

3.	Run Number
3-20-80	Date
30.078	Barometric Pressure (in. Hg.)
-.621	Static Pressure (in. H_2O)
72.00	Time (minutes)
70.619	Meter Volume (corrected)
132.00	Stack Temperature (^oF)
112.00	Meter Temperature (^oF)
3.30	Meter Pressure (in. H_2O)
.978	Sq. Root Velocity Pressure
7.00	Mg of Particulate
39.00	Ml of water condensed
18.75	% O_2
.00	% CO_2
50.2656	Stack Area (Ft^2)
.85	Pitot Correction Factor
.000314	Nozzle Area (Ft^2)

1. Stack Pressure
   - 30.02 Inches Hg
   - 762.51 Millimeters Hg
2. Meter Pressure
   - 30.31 Inches Hg
   - 769.88 Millimeters Hg
3. Meter Volume
   - 58.016 Dry Standard Cubic Feet
   - 1.869 Dry Standard Cubic Meters
4. Water Volume
   - 1.836 Standard Cubic Feet
   - .052 Standard Cubic Meters
5. Moisture Content
   - .0271 (Convert to % X 100)
6. Molecular Weight Dry
   - 28.75
7. Molecular Weight Wet
   - 28.46
8. Stack Velocity
   - 59.15 Feet per Second
   - 18.03 Meters per Second
9. Volumetric Flow
   - 170,405. Actual Cubic Feet per Minute
   - 84.1982 Actual Cubic Meters per Second
10. Volumetric Flow
    - 155,291. Dry Standard Cubic Feet per Minute
    - 73.2835 Dry Standard Cubic Meters per Second
11. Concentration
    - .0016 Grains per Dry Standard Cubic Foot
    - .0037 Grams per Dry Standard Cubic Meter
15. Particulate Mass Rate
    - 2.17 Pounds per Hour
16. Volume at Nozzle
    - 75.842 Actual Cubic Feet
    - 2.148 Actual Cubic Meters
17. Concentration
    - .0014 Grains per Actual Cubic Foot
    - .0032 Grams per Actual Cubic Meter
18. % Isokinetic
    - 94.54

3. BACK HALF ONLY — Run Number

8-20-80 — Date

30.07	Barometric Pressure (in. Hg.)
-.62	Static Pressure (in. H_2O)
72.00	Time (minutes)
70.619	Meter Volume (corrected)
132.00	Stack Temperature (^oF)
112.00	Meter Temperature (^oF)
3.30	Meter Pressure (in. H_2O)
.978	Sq. Root Velocity Pressure
25.00	Mg of Particulate
39.00	Ml of water condensed
13.75	% O_2
.00	% CO_2
50.2656	Stack Area (Ft^2)
.85	Pitot Correction Factor
.000314	Nozzle Area (Ft^2)

1. Stack Pressure

30.02	Inches Hg
762.51	Millimeters Hg

2. Meter Pressure

30.31	Inches Hg
769.88	Millimeters Hg

3. Meter Volume

66.016	Dry Standard Cubic Feet
1.869	Dry Standard Cubic Meters

4. Water Volume

1.836	Standard Cubic Feet
.052	Standard Cubic Meters

5. Moisture Content

.0271	(Convert to % X 100)

6. Molecular Weight Dry

28.75

7. Molecular Weight Wet

28.46

8. Stack Velocity

59.15	Feet per Second
18.03	Meters per Second

9. Volumetric Flow

178,405.	Actual Cubic Feet per Minute
84.1932	Actual Cubic Meters per Second

10. Volumetric Flow

155,291.	Dry Standard Cubic Feet per Minute
73.2895	Dry Standard Cubic Meters per Second

11. Concentration

.0058	Grains per Dry Standard Cubic Foot
.0133	Grams per Dry Standard Cubic Meter

15. Particulate Mass Rate

7.76 Pounds per Hour

16. Volume at Nozzle

75.342	Actual Cubic Feet
2.148	Actual Cubic Meters

17. Concentration

.0051	Grains per Actual Cubic Foot
.0117	Grams per Actual Cubic Meter

18. % Isokinetic

94.54

TOTAL

4.	Run Number
8-21-80	Date
30.06	Barometric Pressure (in. Hg.)
-.64	Static Pressure (in. H_2O)
72.00	Time (minutes)
67.973	Meter Volume (corrected)
133.00	Stack Temperature (^oF)
110.00	Meter Temperature (^oF)
3.03	Meter Pressure (in. H_2O)
.954	Sq. Root Velocity Pressure
37.80	Mg of Particulate
37.00	Ml of water condensed
19.375	% O_2
.00	% CO_2
50.2656	Stack Area (Ft^2)
.85	Pitot Correction Factor
.000314	Nozzle Area (Ft^2)

1. Stack Pressure
   - 30.01 Inches Hg
   - 762.26 Millimeters Hg
2. Meter Pressure
   - 30.28 Inches Hg
   - 769.11 Millimeters Hg
3. Meter Volume
   - 63.702 Dry Standard Cubic Feet
   - 1.804 Dry Standard Cubic Meters
4. Water Volume
   - 1.742 Standard Cubic Feet
   - .049 Standard Cubic Meters
5. Moisture Content
   - .0266 (Convert to % X 100)
6. Molecular Weight Dry
   - 28.78
7. Molecular Weight Wet
   - 28.49
8. Stack Velocity
   - 57.73 Feet per Second
   - 17.60 Meters per Second
9. Volumetric Flow
   - 174,118. Actual Cubic Feet per Minute
   - 82.1750 Actual Cubic Meters per Second
10. Volumetric Flow
    - 151,319. Dry Standard Cubic Feet per Minute
    - 71.4131 Dry Standard Cubic Meters per Second
11. Concentration
    - .0091 Grains per Dry Standard Cubic Foot
    - .0208 Grams per Dry Standard Cubic Meter
15. Particulate Mass Rate
    - 11.85 Pounds per Hour
16. Volume at Nozzle
    - 73.303 Actual Cubic Feet
    - 2.076 Actual Cubic Meters
17. Concentration
    - .0079 Grains per Actual Cubic Foot
    - .0181 Grams per Actual Cubic Meter
18. % Isokinetic
    - 93.62

FRONT HALF ONLY

4.	Run Number
8-21-80	Date
30.06	Barometric Pressure (in. Hg.)
-.64	Static Pressure (in. H_2O)
72.00	Time (minutes)
67.973	Meter Volume (corrected)
133.00	Stack Temperature (^oF)
110.00	Meter Temperature (^oF)
3.03	Meter Pressure (in. H_2O)
.954	Sq. Root Velocity Pressure
3.00	Mg of Particulate
37.00	Ml of water condensed
19.375	% O_2
.00	% CO_2
50.2656	Stack Area (Ft^2)
.85	Pitot Correction Factor
.000314	Nozzle Area (Ft^2)

1. Stack Pressure

30.01	Inches Hg
762.26	Millimeters Hg

2. Meter Pressure

30.28	Inches Hg
769.11	Millimeters Hg

3. Meter Volume

63.702	Dry Standard Cubic Feet
1.804	Dry Standard Cubic Meters

4. Water Volume

1.742	Standard Cubic Feet
.049	Standard Cubic Meters

5. Moisture Content

.0266	(Convert to % X 100)

6. Molecular Weight Dry

28.78	

7. Molecular Weight Wet

28.49	

8. Stack Velocity

57.73	Feet per Second
17.60	Meters per Second

9. Volumetric Flow

174,118.	Actual Cubic Feet per Minute
82.1750	Actual Cubic Meters per Second

10. Volumetric Flow

151,315.	Dry Standard Cubic Feet per Minute
71.4131	Dry Standard Cubic Meters per Second

11. Concentration

.0007	Grains per Dry Standard Cubic Foot
.0016	Grams per Dry Standard Cubic Meter

15. ~~Particulate~~ Mass Rate

.94	Pounds per Hour

16. Volume at Nozzle

73.303	Actual Cubic Feet
2.076	Actual Cubic Meters

17. Concentration

.0006	Grains per Actual Cubic Foot
.0014	Grams per Actual Cubic Meter

18. % Isokinetic

93.62	

Back Half Only

4	Run Number
8-21-80	Date
30.06	Barometric Pressure (in. Hg.)
-.64	Static Pressure (in. H_2O)
72.00	Time (minutes)
67.973	Meter Volume (corrected)
133.00	Stack Temperature (^oF)
110.00	Meter Temperature (^oF)
3.03	Meter Pressure (in. H_2O)
.954	Sq. Root Velocity Pressure
34.80	Mg of Particulate
37.00	Ml of water condensed
19.375	% O_2
.00	% CO_2
50.2656	Stack Area (Ft^2)
.85	Pitot Correction Factor
.000314	Nozzle Area (Ft^2)

1. Stack Pressure

30.01 Inches Hg
762.26 Millimeters Hg

2. Meter Pressure

30.28 Inches Hg
769.11 Millimeters Hg

3. Meter Volume

63.702 Dry Standard Cubic Feet
1.804 Dry Standard Cubic Meters

4. Water Volume

1.742 Standard Cubic Feet
.049 Standard Cubic Meters

5. Moisture Content

.0266 (Convert to % X 100)

6. Molecular Weight Dry

28.78

7. Molecular Weight Wet

28.49

8. Stack Velocity

57.73 Feet per Second
17.60 Meters per Second

9. Volumetric Flow

174,118. Actual Cubic Feet per Minute
82.1750 Actual Cubic Meters per Second

10. Volumetric Flow

151,319. Dry Standard Cubic Feet per Minute
71.4131 Dry Standard Cubic Meters per Second

11. Concentration

.0084 Grains per Dry Standard Cubic Foot
.0193 Grams per Dry Standard Cubic Meter

15. Particulate Mass Rate

10.21 Pounds per Hour

16. Volume at Nozzle

73.303 Actual Cubic Feet
2.076 Actual Cubic Meters

17. Concentration

.0073 Grains per Actual Cubic Foot
.0167 Grams per Actual Cubic Meter

18. % Isokinetic

93.62

BACK HALF ANALYSIS

Run #	#2	#3	#4
Initial filtering of water collected with .22 micron filter, mg	1.2	0.9	2.9
Organic Portion, mg	2.3	0.7	1.5
Chloroform Blank, mg	-.1	-.1	-.1
Ether Blank, mg	-.2	-.2	-.2
Evaporation of Water Portion, mg	53.7	43.0	53.0
blank Water, mg	-.1	-.1	-.1
Sulfate Analysis, mg	-32.25	-31.50	-35.50
Acetone Rinse, mg	2.3	12.4	13.4
Acetone Blank, mg	-0.0	-.1	-.1
Total Back Half Catch, mg	26.85	25.50	34.50

Filter # L-T-10

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
2809 Central Avenue
Birmingham, Alabama 35209
205/879 1850

PLANT U.S. Steel
LOCATION Fairfield Baghouse
BARO PRES. 30.27

RUN # 1
DATE August 18, 1980
TIME ~~7:45~~ 7:45 - 2:14

$\sqrt{\Delta P}$

POINT NO.	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 H_2O	VELOCITY PRESSURE H_2O	Vacuum Pressure Hg
~~0~~			~~929.028~~	~~+20~~				~~40~~	250	~~3.6~~	~~1.80~~	4
1	3	3	932.7	120	114	96	105	40	250	3.6	1.20	4
2	1	6	936.1	120	114	98	106	38	240	4.5	1.5	5
3		9	939.1	105	104	100	102	38	250	3.1	1.0 .85	3
4		12	942.3	110	108	102	105	38	250	3.6	1.2 .80	4
5		15	945.4	115	108	104	106	38	240	3.6	1.2	4
6		18	948.3	125	108	106	107	38	260	2.8	.9	3
7		21	950.7	135	110	108	109	38	240	2.0	.65	2
8		24	953.2	130	112	110	111	40	252	2.1	.70	2
9		27	955.4	135	114	112	113	39	258	1.5	0.50	1
10		30	958.3	135	114	114	114	40	250	3.1	1.0	3
11		33	961.3	135	116	116	116	38	262	3.1	1.0	3
12		36	964.026	135	118	118	118	39	256	2.4	.80	2
13		39	967.7	135	118	120	119	40	220	4.9	1.6	6
14		42	972.3	135	120	124	122	46	240	7.6	2.4	10
15		45	977.1	130	122	124	123	40	270	7.8	2.5	10
16		48	981.5	135	126	126	126	40	256	7.0	2.2	9
17		51	985.9	130	126	126	126	39	260	6.9	2.0	9
18		54	989.5	135	126	126	126	39	230	4.5	1.5	5
19		57	991.4	130	126	126	126	40	266	1.1	.35	1
20		60	993.3	135	126	124	125	40	260	1.1	.35	1
21		63	997.5	140	126	124	125	40	250	6.8	2.0	8
22		66	999.8	135	126	122	124	38	240	1.7	.55	2
23		69	2.0	135	124	120	122	38	240	1.7	.55	2
24	✓	72	4.157	135	122	112	117	40	230	1.6	.5	2
			74.53	129.17			115.96			3.66	1.042	
			X1.04 77.511						-28-			

STATIC PRESSURE "H_2O -.38

PROBE TIP SIZE

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

WATER
ml 30.0
gram 11.5
Total 41.5

OPERATOR
Mark Wilson

SAMPLE BOX NO. 3
METER BOX NO. 300
METER ΔH@ 1.80
PITOT, CP .85
TEMP. DEVICE I.N
PROBE LGTH. 8'
PROBE LINER Glass
PROBE HTR SET. 80%
AMBIENT TEMP.

NOTES
~~929.620~~
929.605
.015@ 25" Hg for 1 min

Orifice ✓ O.K.
Ram 7" O.K.
Stack 8" O.K.

CO_2 - 0.0%
O_2 - 19.25%

4.249
4.235
.014@ 15" Hg for 1 min

Ram - 7" O.K.
Stack - 7" O.K.
Orifice - 7" O.K.

GUARDIAN SYSTEMS INC.
2809 Central Avenue
Birmingham, Alabama 35209
205/879-1850

Run Number 1

Date 8-18-80

Location U.S. Steel Bughouse

Amount liquid lost during transport None

Acetone blank volume, ml 350

Acetone wash volume, ml 120

Acetone blank concentration, mg/mg 3.64×10^{-7}

Acetone wash blank, mg 0.1

Filter Collections (mg)		Probe and Cyclone Wash (mg)	
Filter #	LZ10	Dish #	1
Gross	256.7	Gross	99491.6
Tare	250.3	Tare	99477.4
Net	6.4	Acetone Blank	0
		Net	14.2

Total Particulate Capture 20.6 mg.

Water		Silica Gel	
Final	30	Final	
Initial		Initial	
Net	30	Net	11.5

Total Water 41.5

Approved By

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
2009 Central Avenue
Birmingham, Alabama 35209
205/879-1850

PLANT U.S Steel
LOCATION Bessemer
BARO PRES. 30.24

RUN # 2
DATE 8/19/80
TIME 7:49 - 2:27 ΔH $\sqrt{\Delta P}$

POINT NO	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
Start			006.577									
1	3	3	009.9	135	106	100	103	50	240	4.3	1.5	4
2	3	6	013.3	137	110	102	106	52	230	4.2	1.4	4
3	3	9	016.7	130	114	106	110	52	225	4.2	1.4	4
4	3	12	019.4	128	116	112	114	58	230	2.4	.82	3
5	3	15	022.6	130	116	114	116	58	240	3.4	1.1	3
6	3	18	025.7	130	118	116	117	59	235	3.4	1.1	3
7	3	21	028.0	136	118	118	118	60	265	1.8	.61	2
8	3	24	030.6	138	120	120	120	61	265	2.3	.78	2
9	3	27	033.4	144	120	120	120	59	250	2.8	.95	3
10	3	30	036.3	134	118	118	118	58	230	2.9	.98	3
11	3	33	039.4	136	120	120	120	59	265	3.4	1.1	3
12	3	36	042.5	140	120	120	120	62	230	3.4	1.1	3
Leak												
13	3	39	046.6	135	122	124	123	60	250	5.9	2.0	6
14	3	42	050.8	130	124	120	122	60	240	6.4	2.2	7
15	3	45	055.0	134	118	116	117	60	240	6.4	2.2	7
16	3	48	058.9	130	116	114	115	61	265	5.4	1.8	6
17	3	51	062.9	135	112	112	112	59	240	5.4	1.8	6
18	3	54	066.0	135	110	110	110	60	235	3.4	1.1	3
19	3	57	067.9	126	108	108	108	60	235	1.1	.38	1
20	3	60	069.9	130	104	104	103	58	230	1.4	.45	1
21	3	63	071.9	128	100	100	100	59	235	1.4	.45	1
22	3	66	073.9	130	102	100	101	60	235	1.3	.42	1
23	3	69	076.0	125	102	100	101	54	230	1.6	.55	2
24	3	72	077.847	125	102	100	101	58	230	1.1	.38	1
			077.890	132.54			112.29		-30-	3.304	1.0166	

STATIC PRESSURE "H2O -1.5-

PROBE TIP SIZE

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

WATER
ml 25
gram 13.3
Total 38.3

OPERATOR
Don Lackey

SAMPLE BOX NO.
METER BOX NO 352
METER ΔH@ 1.80
PITOT, CP .85
TEMP. DEVICE L&N
PROBE LGTH. 8'
PROBE LINER Glass
PROBE HTR SET 809
AMBIENT TEMP. 85-95°

NOTES
Rom -10" oc
Static 8" - OK
006.577
006.580
.01 ~.018" in 1 min
O2 - 19.5%
CO2 - 0%
077.890
077.905
Static -8"
Rom -8"

GUARDIAN SYSTEMS INC.
2909 Central Avenue
Birmingham, Alabama 35209
205/879-1850

Run Number 2

Date 8/19/80

Location U.S. Baghouse

Amount liquid lost during transport None

Acetone blank volume, ml 350

Acetone wash volume, ml 120

Acetone blank concentration, mg/mg 3.64×10^{-7}

Acetone-wash blank, mg 0.1

Filter Collections (mg)		Probe and Cyclone Wash (mg)	
Filter #	LX16	Dish #	2
Gross	268.8	Gross	9885.10
Tare	267.1	Tare	9873.6
Net	1.7	Acetone Blank	—
		Net	12.4

Total Particulate Capture 14.1 mg.

Water		Silica Gel	
Final	25	Final	
Initial	0	Initial	
Net	25	Net	13.5

Total Water 38.3

Approved By [signature]

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
2009 Central Avenue
Birmingham, Alabama 35209
205/879-1850

PLANT U.S. Steel — RUN # 3
LOCATION Bayliner — DATE 8/20/90
BARO PRES 30.07 — TIME 7:09 - 2:08 ΔH — √ΔP

POINT NO.	TIME MIN	TIME DUR	METER VOL FT 3	STACK TEMP °F	METER TEMP °F IN	METER TEMP °F OUT	METER TEMP °F AVG	IMP TEMP °F	BOX TEMP °F	METER PRESSURE "H2O	VELOCITY PRESSURE "H2O	Vacuum Pressure "Hg
A			078.414									
1	3	3	081.7	125	92	88	90	45	250	4.0	1.2	2
2	3	6	085.0	130	100	92	96	50	230	4.0	1.2	2
3	3	9	088.3	135	104	98	101	58	240	3.7	1.1	2
4	3	12	091.3	135	106	102	104	56	260	3.3	1.0	2
5	3	15	094.5	135	110	106	108	58	270	3.3	1.0	2
6	3	18	097.2	130	112	110	111	62	245	2.5	.78	1
7	3	21	099.5	130	110	110	110	55	245	1.8	.55	1
8	3	24	102.0	130	110	112	111	56	260	2.3	.72	1
9	3	27	104.7	130	110	114	112	58	270	2.3	.72	1
10	3	30	107.78	135	110	114	112	58	245	3.1	.95	2
11	3	33	111.0	132	110	114	112	57	250	3.7	1.1	2
12	3	36	114.3	135	116	116	116	59	250	3.7	1.1	2
B												
13	3	39	118.6	133	118	118	118	58	250	6.6	2.1	3
14	3	42	123.0	125	120	120	120	60	235	6.8	2.2	3
15	3	45	127.4	134	120	120	120	58	270	6.8	2.2	3
16	3	48	131.5	136	120	116	118	56	265	5.7	1.8	3
17	3	51	135.2	131	120	114	117	60	240	4.7	1.5	2
18	3	54	138.3	133	120	114	117	60	270	3.1	.95	2
19	3	57	140.5	136	120	116	118	60	230	1.5	.45	1
20	3	60	142.4	135	120	112	116	59	250	1.2	.38	1
21	3	63	144.4	130	110	112	111	60	240	1.3	.42	1
22	3	66	146.4	132	112	110	112	60	255	1.3	.42	1
23	3	69	148.3	130	114	114	114	60	250	1.2	.38	1
24	3	72	150.310	131	114	114	114	60	230	1.5	.45	1
							2673			1.3.4		
			72.060	132			111.54	-32-		3.308	.9775	

STATIC PRESSURE "H2O -.62

PROBE TIP SIZE

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

WATER
ml 20
gram 19.0
Total 39.0

OPERATOR
Don Lashley

SAMPLE BOX NO.
METER BOX NO. 300
METER ΔH@ 1.8
PITOT. CP .85
TEMP. DEVICE LAN
PROBE LGTH. 4'
PROBE LINER Quartz
PROBE HTR SET. 90%
AMBIENT TEMP.

NOTES
Static - 10" OK
Run - 9" OK
Leak check
078.278
078.267
.011
20" Hg for 1 min

CO_2 - 0%
O_2 - 18.75%

Final leak check
150.514
150.510
.004 cfm
Run - 9" OK
Static - 10" OK

GUARDIAN SYSTEMS INC.
2809 Central Avenue
Birmingham, Alabama 35209
205/879-1050

Run Number 3

Date 8/20/80

Location U.S.S. Bathouse

Amount liquid lost during transport None

Acetone blank volume, ml 350

Acetone wash volume, ml 150

Acetone blank concentration, mg/mg 3.64×10^{-7}

Acetone wash blank, mg 0.1

Filter Collections (mg)		Probe and Cyclone Wash (mg)	
Filter #	LX15	Dish #	3
Gross	269.4	Gross	99355.4
Tare	268.3	Tare	99349.5
Net	1.1	Acetone Blank	—
		Net	5.9

Total Particulate Capture 7.0 mg.

Water		Silica Gel	
Final	20	Final	
Initial	0	Initial	
Net	20	Net	19.0

Total Water 39.0

Approved By [signature]

FIELD DATA SHEET

GUARDIAN SYSTEMS INC.
2809 Central Avenue
Birmingham, Alabama 35209
205/879 1050

PLANT U.S. Steel
LOCATION Baghouse
RUN # 4
DATE 8/21/80
TIME 7:38 - 4:11
BARO PRES 30.06
ΔH
$\sqrt{\Delta P}$

POINT NO.	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
Start			154.112									
1	3		157.5	128	110	104	107	52	245	4.4	1.4	5
2	1		161.1	130	112	106	109	54	245	4.4	1.4	5
3			164.9	130	112	106	109	54	235	4.2	1.3	1
4			168.0	132	112	108	110	56	255	3.2	1.0	1
5			170.9	130	110	106	108	58	260	2.9	.92	1
6			173.6	135	108	106	107	60	265	2.4	.80	1
7			175.8	130	110	108	109	59	250	1.7	.55	1
8			178.3	135	108	106	107	60	270	1.8	.60	1
9			181.0	138	108	106	107	59	250	2.6	.85	1
10			183.9	140	110	106	108	54	265	3.2	1.0	1
11			186.8	140	110	108	109	58	250	2.9	.95	1
12	↓		189.9	138	110	108	109	54	250	3.4	1.1	1
~~Out~~			~~193.7~~	~~135~~	~~114~~	~~110~~	~~112~~	~~52~~	~~250~~	~~5.0~~	~~1.6~~	~~1~~
2	3		193.7	135	114	110	112	52	250	5.0	1.6	1
4			197.3	137	114	108	111	56	250	4.6	1.5	1
6			201.0	135	114	110	112	58	245	5.0	1.6	1
8			205.1	130	112	112	112	52	230	5.9	1.9	2
10			208.9	134	112	108	110	60	240	5.0	1.6	2
12			211.9	130	114	112	113	59	260	3.2	1.0	1
2			213.5	130	114	112	113	60	260	1.1	.35	1
4			215.7	132	114	114	114	60	245	1.1	.35	1
6			217.8	132	112	112	112	58	235	1.4	.45	1
8			219.8	130	106	106	106	60	250	1.2	.40	1
10			221.7	128	110	110	110	60	250	1.2	.40	1
12	↓		223.472	130	110	110	110		260	.91	.3	1
				131.1			111.34			72.71	1	
			69.360	133			110			3.03	.154	
			69.360	132.875			109.75			3.0296	.9536	

STATIC PRESSURE "H2O -.64

PROBE TIP SIZE

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

WATER
ml 90
gram 17.0
Total 37.0

OPERATOR
Mark Wilson

SAMPLE BOX NO. 2
METER BOX NO. 320
METER ΔH@ 1.80
PITOT, CP .85
TEMP. DEVICE L&N
PROBE LGTH. 8'
PROBE LINER Glass
PROBE HTR SET 502
AMBIENT TEMP. 95

NOTES
154.112
154.112
.000 @ 5" Hg for 1 min
Run 7" O.K
static 7" O.K.

CO_2 - 0.0%
O_2 - 19.375%

223.014
223.005
.009 @ 5" for
Run
Stati

GUARDIAN SYSTEMS INC.
2809 Central Avenue
Birmingham, Alabama 35209
205/879-1050

Run Number 4

Date 8/21/80

Location U.S.S. Bayhouse

Amount liquid lost during transport None

Acetone blank volume, ml 350

Acetone wash volume, ml 100

Acetone blank concentration, mg/mg 3.64×10^{-7}

Acetone wash blank, mg 0.1

Filter Collections (mg)		Probe and Cyclone Wash (mg)	
Filter #	LX14	Dish #	4
Gross	269.6	Gross	811364
Tare	268.9	Tare	81134.1
Net	0.7	Acetone Blank	—
		Net	2.3

Total Particulate Capture 3.0 mg.

Water		Silica Gel	
Final	20	Final	
Initial	0	Initial	
Net	20	Net	17.0

Total Water 37.0

Approved By [signature]

V. CALIBRATIONS

General

The meter box was recalibrated upon return to the laboratory from this test. The box was recalibrated at 2.5 "H_2O, the highest limit of our wet test meter. This calibration produced a single point MCF and Δ H@ ehich was compared to the original calibration. All were within the 5% allowed at the highest vacuum seen. This calibration sheet is located behind the original calibration sheets.

The equipment used on both ports was as follows:

Probe: 8' - 1

Box: 300

Stack Temperature: L&N 1

Sample Box: 2 & 3

The average temperature of the stack was 131.5 ^{o}F. The Pyro 1 was recalibrated at 135 ^{o}F and agreed within 1.5% of the initial calibration value.

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. A [illegible] 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	5.0
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 [illegible]
A [illegible]
B [illegible] KCl solution
C [illegible] 8" x 10" sheet and brew in prepared [illegible]
D [illegible] 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, correct [illegible] 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	61653	61633
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	60
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	100-1000	Zinc	50
Lead	10		

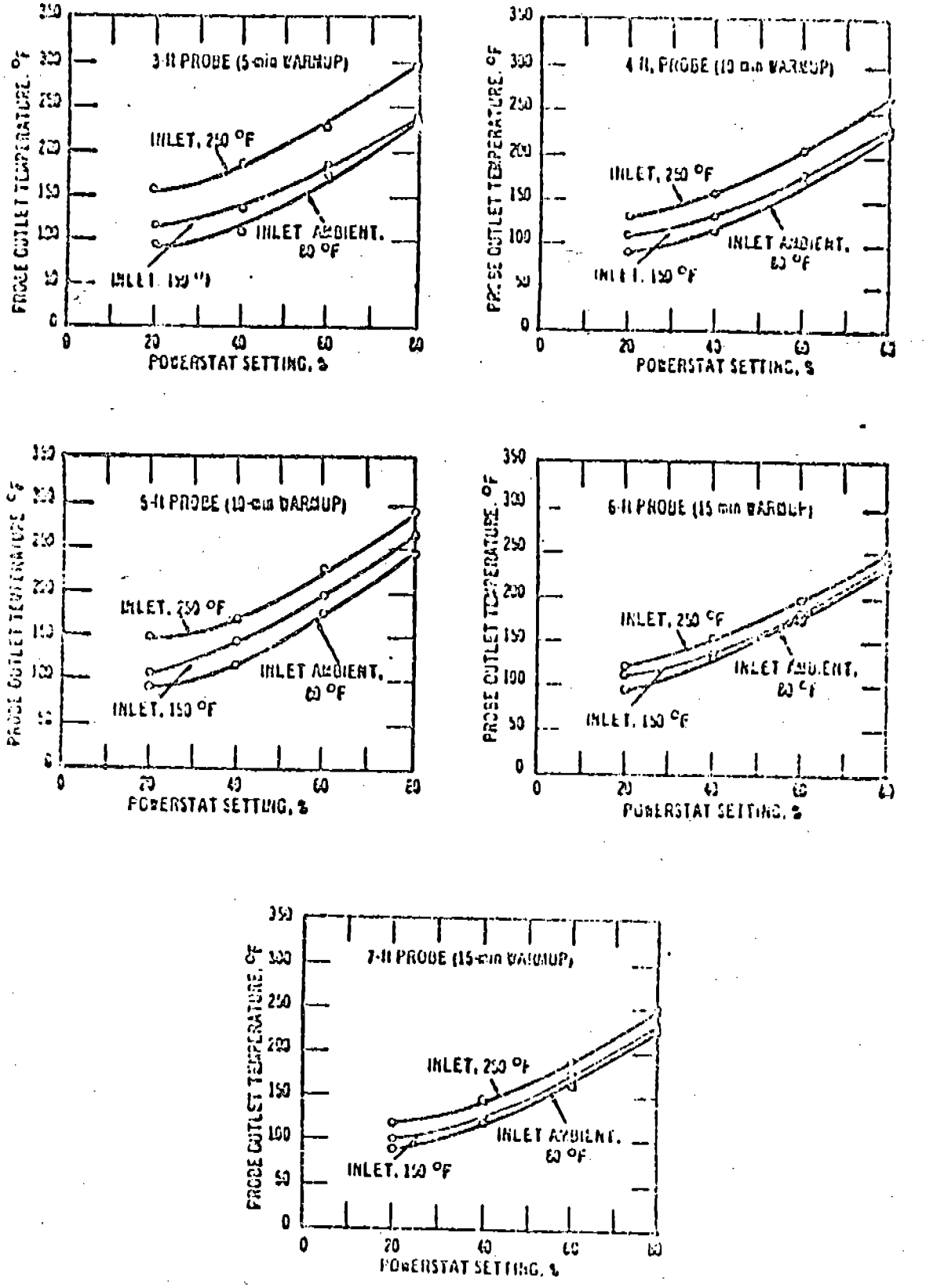
OTHER PHYSICALS:

BSO	522	Flow Resistance (Max.) @ 320 cm/min	60 mm
*pH	9.0	Flow Rate (air) lpm/cm² @ 70 cm Hg	[illegible]
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	67
Ammonia	13		

*pH: Gelman Procedure
A [illegible]
B [illegible] KCl solution
C [illegible] 8" x 10" sheet and [illegible]
D [illegible] ambient temperature



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

Figure 16

Probe Temperatures

METER CALIBRATION FORM

Date 8-1-80 Box No. 300

P_{bar} = 30.08 in. Hg Calibrated by Mark Wilson

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
.5	-.3	3109.317	3115.611	874.046	880.311	27.7	27.7	110/106	96/96
1.0	-.5	3115.611	3124.374	880.311	888.944	27.7	27.9	106/108	96/96
1.5	-.7	3124.374	3134.980	888.944	899.498	27.9	27.9	108/110	96/96
2.0	-.9	3134.980	3147.432	899.498	911.938	27.9	27.9	110/112	96/98
2.5	-1.1	3147.432	3161.082	911.938	925.391	27.9	27.9	113/112	98/98

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

1.0020
1.0092
0.9986
0.9956
1.0093
1.0029 = Y
1.04

Calculations

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

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.

Post

METER CALIBRATION FORM

Date August 26, 1980 Box No. 300

P_{bar} = 30.10 in. Hg Calibrated by Mark Wilson

	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	-1.1	4063.656	4078.392	588.762	604.334	28.5	28.5	126/126	118/118
	2.5	-1.1	4078.392	4092.578	604.334	619.126	28.5	28.1	126/126	118/118
*	2.5	-1.1	4092.578	4109.026	619.126	636.314	28.1	27.9	126/126	118/118

* + 60 sec

** + 150 sec 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

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

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

.9790
.9805
.9800
2.9395 ÷ 3 = .9798 ≈ .98 = Y

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

Calculations

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

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 8-1-80 Meter Box No. 300

P_{bar} 30.08 Calibrated By Mark Wilson

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		
.5	874.046	880.311	900	108	96	6.265	0.4140	0.7339
1.0	880.311	888.944	900	107	96	8.633	0.5751	0.7213
1.5	888.944	899.498	900	109	96	10.554	0.6945	0.7116
2.0	899.498	911.938	930	~~110~~ 111	98	12.440	0.7891	0.7000
2.5	911.938	925.391	900	112	98	13.453	0.8940	0.7091
							Average K_m	0.7152

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

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

$\Delta H_a = 1.80$

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

Post

ORIFICE CALIBRATION FORM

Date August 26, 1980 Meter Box No. 300

P_{bar} 30.10 Calibrated By Mark Wilson

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	588.982	604.334	960	126	118	15.372	.9341	.7282
2.5	604.334	619.126	900	126	118	14.792	.9602	.7486
2.5	619.126	636.314	1050	126	118	17.188	.9559	.7452
						Average K_m		.7407

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

1.74
1.64
1.66
5.04 ÷ 3 ≃ 1.68 = ΔH_a

Calculations

1. C_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:

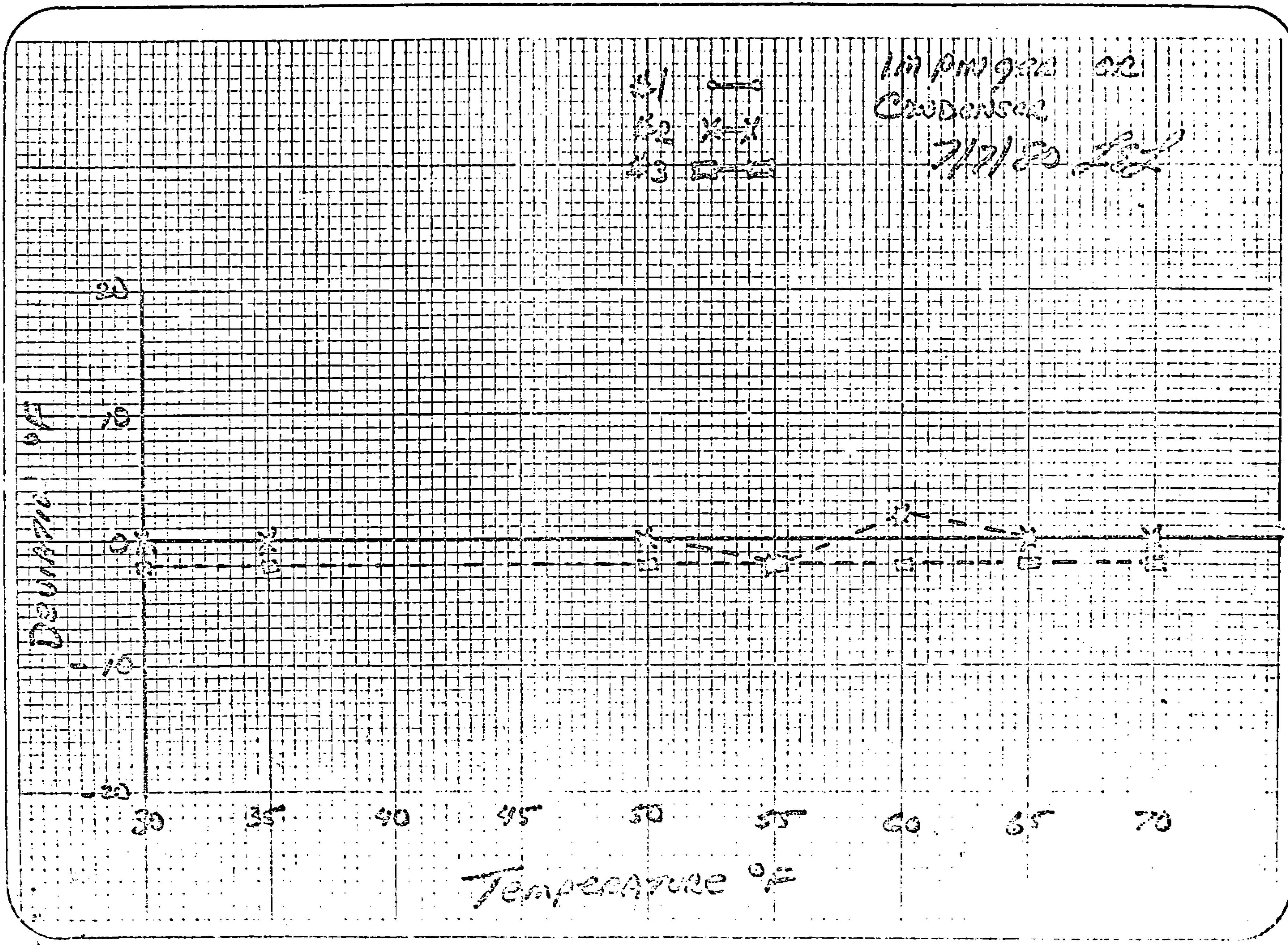
$$\bar{K}_m = \frac{\Sigma K_m}{5}$$

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


Deviation °F
20
10
0
-10
-20
30
35
40
45
50
55
60
65
70
Temperature °F
#1
#2
#3
Improved Condenser
7/7/80

PITOT CALIBRATION FORM

Date 6-25-80 Probe # 8-1

Calibrated By Tim Thornton

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	.55	.75	.848	-.002
2	.55	.75	.848	-.002
3	.55	.74	.853	+.003
		$\bar{C}_{p(A)}$	.850	.001

.85

SIDE B

Run #	ΔP_{std} (in. H_2O) Standard	$\Delta P(s)$ (in. H_2O) Type "s"	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(A)$
1	.55	.74	.853	+.003
2	.55	.75	.848	-.002
3	.55	.75	.848	-.002
		$\bar{C}_{p(B)}$	.850	.001

.85

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

METHOD 5 SOURCE TEST FOR PARTICULATE

Todays Date APRIL 2, 1981

Company US STEEL — Date of Test AUG 19, 1980

Location BIRMINGHAM, AL — Run No. 2 TOTAL

Test Performed on (stack, boiler, etc.) #9 COKE BATTERY BAGHOUSE

ENTER		PRESS	ALTERNATE PRESS
		A	A
1.017	AVG $\sqrt{P}$ Calculator prints entry.		
		R/S	SBR 008
3.30	ΔH Calculator prints entry.		
		R/S	SBR 012
112.3	Tm-meter temperature °F Calculator prints entry and absolute temperature.		
		R/S	SBR 022
132.5	Ts-stack temperature °F Calculator prints entry and absolute temperature.		
		R/S	SBR 032
.85	Cp-pitot tube co-efficient Calculator prints entry.		
		R/S	SBR 036
72	θ minutes in run Calculator prints entry.		
		R/S	SBR 040
.24	DIAM NOZZLE IN INCHES Calculator prints entry and nozzle area.		
	OR nozzle area in square feet Calculator prints entry.	SBR 052	SBR 052
		R/S	SBR 056
30.24	Pbar-barometric pressure in inches in mercury Calculator prints entry.		
		R/S	SBR 060
-.75	Ps-pressure of stack in inches of water. Calculator prints entry and absolute temperature.		
	OR absolute pressure of stack in inches of mercury Calculator prints entry.	SBR 070	SBR 070
		R/S	SBR 074
96	DIAM STACK IN INCHES Calculator prints entry and area in square feet		
	OR-area of stack in square feet Calculator prints entry.	SBR 086	SBR 086
		R/S	SBR 090
1	MM BTU/HR(enter best estimates available or enter 1 and disregard calculated result.) Calculator prints entry.		
		R/S	SBR 094
9500	F. FACTOR DSCF/MM BTU (Federal Register 60.45, laboratory factor, or enter 9500 and disregard calculated results). Calculator prints entry.		

ENTER		PRESS
		B
38.3	Total milliliters of water (water plus silica gel) Calculator prints entry and volume of water vapor at standard conditions.	
		C
.04095	Total grams particulate collected (Subtract blank weight) Calculator prints out entry.	
		D
73.603	Total volume gas metered (less allowed leaks and gas lost at filter changes) Calculator prints entry.	

ENTER		PRESS
		E
0	% CO_2 Calculator prints entry.	
		R/S
19.5	% O_2 Calculator prints entry.	
		R/S
0	% CO Calculator prints entry.	
		R/S
80.5	% N_2 Calculator prints entry and molecular weight dry.	

RUN 2

1.017	
3.3	
112.3	
572.3	
132.5	
592.5	
0.85	
72.	
4.24	
.0003141593	
30.24	
-0.75	
30.18485294	
96.7	
50.26548246	
1.	
9500.	
38.3	
1.802781	
0.04095	
73.603	
0.	
19.5	
0.	
80.5	
28.78	
69.15	V/M DSCF
2.54	% WATER
28.51	M/S
61.32	V/S
11097065.56	ACFH
9719210.49	DSCFH
1113.01	% EXCESS AIR
.0005921488	GM/CUFT
17.47	PPM
12.69	LB/HR
12.6878729	LB/MMBTU
.012401706	LB/MMBTU (F FAC)
3972.366478	/
41.8704115	=
94.87	% ISOKINETIC
.0091368565	

0.05 #/ton of coke pushed

METHOD 5 SOURCE TEST FOR PARTICULATE

Todays Date APRIL 2, 1981

Company US STEEL

Date of Test AUG 20, 1980

Location BIRMINGHAM, AL

Run No. 3 TOTAL

Test Performed on (stack, boiler, etc.) COKE BATTERY #9 BAGHOUSE

ENTER		PRESS	ALTERNATE PRESS
		A	A
.978	AVG $\sqrt{P}$ Calculator prints entry.		
		R/S	SBR 008
3.31	ΔH Calculator prints entry.		
		R/S	SBR 012
111.5	Tm-meter temperature °F Calculator prints entry and absolute temperature.		
		R/S	SBR 022
132	Ts-stack temperature °F Calculator prints entry and absolute temperature.		
		R/S	SBR 032
.85	Cp-pitot tube co-efficient Calculator prints entry.		
		R/S	SBR 036
72	θ minutes in run Calculator prints entry.		
		R/S	SBR 040
.24	DIAM NOZZLE IN INCHES Calculator prints entry and nozzle area.		
	OR nozzle area in square feet Calculator prints entry.	SBR 052	SBR 052
		R/S	SBR 056
30.07	Pbar-barometric pressure in inches in mercury Calculator prints entry.		
		R/S	SBR 060
-.62	Ps-pressure of stack in inches of water. Calculator prints entry and absolute temperature.		
	OR absolute pressure of stack in inches of mercury Calculator prints entry.	SBR 070	SBR 070
96	DIAM STACK IN INCHES Calculator prints entry and area in square feet	R/S	SBR 074
	OR-area of stack in square feet Calculator prints entry.	SBR 086	SBR 086
1	MM BTU/HR(enter best estimates available or enter 1 and disregard calculated result.) Calculator prints entry.	R/S	SBR 090
9500	F. FACTOR DSCF/MM BTU (Federal Register 60.45, Laboratory factor, or enter 9500 and disregard calculated results). Calculator prints entry.	R/S	SBR 094

ENTER		PRESS
39	Total milliliters of water (water plus silica gel) Calculator prints entry and volume of water vapor at standard conditions.	B
.032	Total grams particulate collected (Subtract blank weight) Calculator prints out entry.	C
74.942	Total volume gas metered (less allowed leaks and gas lost at filter changes) Calculator prints entry.	D

ENTER		PRESS
0	% CO_2 Calculator prints entry.	E
18.75	% O_2 Calculator prints entry.	R/S
0	% CO Calculator prints entry.	R/S
91.25	% N_2 Calculator prints entry and molecular weight dry.	R/S

RUN 3

0.978	
3.31	
111.5	
571.5	
132.	
592.	
0.85	
72.	
0.24	
.0003141595	
30.07	
-0.62	
30.02441176	
96.	
50.26548246	
1.	
9500.	
39.	
1.83573	
0.032	
74.942	
0.	
18.75	
0.	
91.25	
31.55	
70.12	V/M DSCF
2.55	% WATER
31.20	M/S
56.49	V/S
10222608.72	ACFH
8912296.91	DSCFH
351.12	% EXCESS AIR
.0004563604	GM/CUFT
12.28	PPM
8.97	LB/HR
8.966533107	LB/MMBTU
.0095578127	LB/MMBTU(F FAC)
4024.840589	/
38.36597669	=
104.91	% ISOKINETIC
0.00704164	

0.03 #/ton coke pushed

METHOD 5 SOURCE TEST FOR PARTICULATE

Today's Date APRIL 2, 1981

Company US STEEL — Date of Test AUG 21, 1980

Location BIRMINGHAM, AL — Run No. 4 TOTAL

Test Performed on (stack, boiler, etc.) COKE BATTERY #9 BAGHOUSE

ENTER		PRESS	ALTERNATE PRESS
		A	A
.954	AVG $\sqrt{P}$ Calculator prints entry.		
3.03	ΔH Calculator prints entry.	B/S	SBR 008
109.8	Tm-meter temperature °F Calculator prints entry and absolute temperature.	B/S	SBR 012
132.9	Ts-stack temperature °F Calculator prints entry and absolute temperature.	B/S	SBR 022
.85	Cp-pitot tube co-efficient Calculator prints entry.	B/S	SBR 032
72	θ minutes in run Calculator prints entry.	B/S	SBR 036
.240	DIAM NOZZLE IN INCHES Calculator prints entry and nozzle area.	B/S	SBR 040
	OR nozzle area in square feet Calculator prints entry.	SBR 052	SBR 052
30.06	Pbar-barometric pressure in inches in mercury Calculator prints entry.	B/S	SBR 056
-.64	Ps-pressure of stack in inches of water. Calculator prints entry and absolute temperature.	B/S	SBR 060
	OR absolute pressure of stack in inches of mercury Calculator prints entry.	SBR 070	SBR 070
96	DIAM STACK IN INCHES Calculator prints entry and area in square feet	B/S	SBR 074
	OR-area of stack in square feet Calculator prints entry.	SBR 086	SBR 086
1	MM BTU/HR(enter best estimates available or enter 1 and disregard calculated result.) Calculator prints entry.	B/S	SBR 090
9500	F. FACTOR DSCF/MM BTU (Federal Register 60.45, laboratory factor, or enter 9500 and disregard calculated results). Calculator prints entry.	B/S	SBR 094

ENTER		PRESS
37.0	Total milliliters of water (water plus silica gel) Calculator prints entry and volume of water vapor at standard conditions.	B
.0378	Total grams particulate collected (Subtract blank weight) Calculator prints out entry.	C
72.134	Total volume gas metered less allowed leaks and gas lost at filter changes) Calculator prints entry.	D

ENTER		PRESS
0	% CO_2 Calculator prints entry.	E
19.375	% O_2 Calculator prints entry.	B/S
0	% CO Calculator prints entry.	B/S
80.625	% N_2 Calculator prints entry and molecular weight dry.	B/S

RUN 4

0.954	
3.03	
109.8	
569.8	
132.9	
592.9	
0.85	
72.	
0.24	
.0003141593	
30.06	
-0.64	
30.01294118	
96.	
50.26548246	
1.	
9500.	
37.	
1.74159	
0.0378	
72.134	
0.	
19.375	
0.	
80.625	
28.775	
67.63	V/M DSCF
2.51	% WATER
28.50	M/S
57.71	V/S
10443231.39	ACFH
9091125.26	DSCFH
1014.40	% EXCESS AIR
.0005589587	GM/CUFT
16.49	PPM
11.20	LB/HR
11.20274112	LB/MMBTU
.0117065861	LB/MMBTU (F FAC)
3885.956475	
39.17901116	=
99.18	% ISOKINETIC
.0086247324	

0.04 #/ton coke pushed

Post-test DGM Calibration

$P_{wgm} = 30.18$

$P_{dgm} = 30.28$

$$Y = \frac{14.736 \cdot 30.18 \cdot 582}{15,372 \cdot 30.28 \cdot 543} = 1.02$$

$$= \frac{14.186}{14.792} = 1.02$$

$$= \frac{16.448}{17.188} = 1.02$$

Avg 1.02

$$PMR_c = \frac{m}{Q_m} \cdot \frac{Q_s}{\theta} = \frac{.032\ g}{0.2\ Hr} \times \frac{\#}{454 g} \times \frac{155,291(60)\ ft^3}{70.619\ ft^3} = 7.75\ \#/hr$$

$$PMR_a = \frac{0.032 g}{1.2\ hr} \times \frac{\#}{454 g} \times \frac{50,265 ft}{0.000314} = 9.4\ \#/hr$$

$$\%\ I = \frac{PMR_a}{PMR_c} \times 100 = \frac{9.4}{7.75} \times 100 = 121\ \%$$

$= K \quad 30.28$

$14.736 \quad 582 \times 30.18$

$15.372 \quad 28.316 \times 488.5 \times 30.28$

$P_{wtm} = 30.10 - \left(\frac{-1.1}{13.6}\right) = 30.18$

$P_{dgm} = 30.10 + \frac{2.5}{13.6} = 30.28$

$Y_1 = \frac{6.294\ (30.08)\ 562}{6.265\ (30.12)\ 487.7} \quad 30.10 \quad 542 \quad 1.16 \quad 1.16 \quad 1.04$

$= \frac{8.763}{8.633} \quad \frac{30.12 \cdot 562}{30.15 \cdot 542} = 1.05$

Pc test
Dgm calibration

$= \frac{10.606}{10.554} \cdot \frac{30.13 \cdot 563}{30.19 \cdot 542} = 1.04$

$= \frac{12.452 \cdot 30.15 \cdot 564}{12.44 \cdot 30.22 \cdot 542} = 1.04$

$= \frac{13.65 \cdot 30.16 \cdot 565}{13.453 \cdot 30.26 \cdot 542} = 1.05$

Avg = 1.04