Title: Stack Test - Battery No. 3

(2)

Plant and Location: US Steel Fairfield, Ala

AP-42 Section 12.2
Reference
Report Sect. 4
Reference 114

SCC: 30300306

Test Date: 8/75

By Whom: Company

Battery 3

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

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

Encoded By:

Date Encoded:

Completed By:

Form No.:

SOTDAT/STEEL LIBRARY SYSTEM

Report Title: —

Plant and Location: USSC, Fairfield, AL

SCC: 30300306

Testing Date(s): 8/75

By Whom: Co.

Stack Test Review Attached:

Reviewed by:

Problems Seen by Reviewer:

Confidentiality Status: Clear

If status is confidential, list confidential pages or sections:

Source of Determination of the Confidentiality Status: Memo entitled: "Steel Technical Support Materials", From: Edward Reich, Director DSSE, To: Tom Voltaggio

Report Encoded by:

Date Encoded:

Form Numbers:

Comments:

Baltimore County

1700.D.3.1.52. Port.

Bethlehem Steel File Larry F. Kertcher 4/12/76

Coke Oven Combustion Stack Emission

In a telephone conversation with Joe Kunz, I learned that the U.S. Steel coke oven plant, Fairfield, Alabama, tested its No. 3 battery stack on August 19, 20, and 21, 1975. Prior to these tests, rehabilitative work had started resulting in a reduced number of ovens in operation. The company used an in-stack thimble followed by impingers. All tests lasted a total of 160 minutes. The coke oven production for all ovens was 11.0 tons per push. The coal charge was 15.17 tons. Sixteen ovens were charged during the first two tests, while 15 were charged during the third test. The test reports were as follows:

	Filter	Condensibles	Probe Wash	Volume	Emission	Flow
1.	0.3955 gms.	0.2305 gms.	0.0183 gms.	53.09 scfd	0.115 gr/scfd	37500 scfd
2.	0.3405 gms.	0.2140 gms.	0.0146 gms.	49.55 scfd	0.106 gr/scfd	37700 scfd
3.	0.3370 gms.	0.0945 gms.	0.0256 gms.	46.99 scfd	0.110 gr/scfd	36600 scfd

000731

	Underfire Gas	Opacity 58 mins.	Opacity 0 mins.	Opacity Average
1.	5210 mcf #1	20	60	35 to 45
2.	5140 mcf #2	20	60	30 to 40
3.	5020 mcf #3	First 0.5 hr. as above but last half hour was 60% op.		

Total emission = 0.64 lbs/ton coal charge w/condensibles
= 0.40 lbs/ton coal charge w/o condensibles

Additionally, information was received on the performance of the Lone Star Steel coke oven stack which was equipped with a dry ESp in December, 1972. The precipatator was purchased from Precipitair and resulted in emissions as follows:

Stack temperature - 530°F
Air Volume - 38139 scfm, 36988 scfm, 38263 scfm
Outlet Grain Loading (Front half only) - 0.0249 gr/acf, 0.0172 gr/acf, 0.0222 gr/acf
Outlet Grain Loading (Full train) - 0.038 gr/acf, 0.23 gr/acf, 0.0292 gr/acf
Opacity - NVE

This battery was fired with coke oven gas. Ninety eight percent (98%) of the particulates was less than one micron in diameter.

1700.D.3.1.53

1700.0.3.1.52.part.

United States Steel Corporation

USS

1975 SEP 22 AM 7:43

ENV. HEALTH

L. J. WRIGHT
GENERAL SUPERINTENDENT

SOUTHERN STEEL DIVISION
FAIRFIELD WORKS
P. O. BOX 599
FAIRFIELD, ALABAMA 35064

September 17, 1975

AIR PROGRAMS OFFICE
RECEIVED
NOV 12 1975
EPA-REGION IV
ATLANTA, GA.

Mr. Don Ellis
Public Health Engineer
Air Pollution Control Program
Jefferson County Department of Health
P. O. Box 2646
Birmingham, Alabama 35202

Dear Mr. Ellis:

Stack Test - Battery No. 3
Fairfield Works - U. S. Steel Corporation

Attached is one copy of results of stack testing performed on August 19, 20 and 21, 1975, on Battery No. 3. These tests were conducted pursuant to Condition No. 8 of the Jefferson County Department of Health resolution passed May 21, 1975, and in accordance with provisions mutually agreed upon in a meeting held on June 19, 1975.

000731

Tests were performed using WP-50 equipment described in the attached sampling procedure. Thirty-two sampling points were isokinetically sampled for five minutes. Condenser water and sample tube rinsings were collected and evaporated using a steam bath.

Routine analyses were run on the underfiring coke oven gas and the stack gas, and coke oven charges and pushes were recorded during the tests. A description of the coal is included along with back pressure on the battery and pressure charts.

Attachments

1700.0.3.1.53

Analysis of Coke-Oven Fuel Gas and No. 3 Battery Flue Gas*

Date Time	Under-Firing Coke-Oven Gas 8-19-75 1:00 p.m.	No. 3 Stack Gas 8-19-75 4:30 p.m.	Under-Firing Coke-Oven Gas 8-20-75 1:30 p.m.	No. 3 Stack Gas 8-20-75 3:35 p.m.	Under-Firing Coke-Oven Gas 8-21-75 1:00 p.m.	No. 3 Stack Gas 8-21-75 3:55 p.m.
CO_2	1.8	2.8	2.2	3.3	2.5	3.3
Illuminants	2.5	0.2	2.0	0.0	2.3	0.1
O_2	0.2	14.4	0.2	13.8	0.3	13.3
CO	7.8	0.3	4.0	0.6	5.4	.7
CH_4	52.8	0.3	48.3	1.1	28.4	0.0
H_2	27.4	0.9	28.2	0.0	48.9	0.7
N_2	7.0	81.1	14.6	81.2	11.8	81.9
Btu, gross	524	14	496	13	508	10

* Note: Samples of flue gas from No. 3 battery stack collected at a point near the stack where gas from both sides would be represented.

Confidential
For use within United States Steel
by authorized personnel only

Fairfield No. 3 Coke-Battery Pushing and Charging Data

Oven No. Pushed	8-19-75 Pushed p.m.	8-19-75 Charged p.m.	8-20-75 Pushed p.m.	8-20-75 Charged p.m.	8-21-75 Pushed p.m.	8-21-75 Charged p.m.
77	3:10	3:45	3:13	3:35	3:10	3:22
79	4:00	4:23	3:32	3:50	3:26	3:48
59	4:19	4:36	3:47	4:42	3:45	4:03
17	4:33	4:53	4:44	4:58	4:00	4:55
9	4:50	5:04	4:55	5:09	4:19	4:35
19	5:06	5:23	5:07	5:29	4:32	5:05
12	5:30	5:30	5:26	5:40	7:00	7:28
14	5:35	5:50	5:37	6:43	-	-
27	5:45	6:05	5:45	6:54	7:25	7:58
37	6:34	6:40	6:40	7:00	5:25	5:41
47	6:45	6:58	6:51	7:16	5:38	5:57
57	6:55	7:18	7:11	7:38	5:54	6:00
29	7:15	7:35	7:35	7:50	7:32	7:35
39	7:52	8:00	7:47	8:09	7:45	7:48
49	7:45	8:16	8:06	8:23	7:55	8:22
32	8:19	8:40	8:20	8:36	8:19	8:36

	8-19-75	8-20-75	8-21-75
11-Ton Ovens Pushed per 8-Hr Shift	23	23	22
Coal Mix	50% Concord 45% Black Creek 5% Pond	50% Concord 45% Black Creek 5% Pond	50% Concord 45% Black Creek 5% Pond
Back Pressure on Battery	6 mm	6 mm	6 mm
Under-Firing Gas Volume	5210 mcf	5140 mcf	5020 mcf

Coal Charge/Oven = 15.17 tons theoretical

Confidential
For use within United States Steel by authorized personnel only

Fairfield Coke Plant
No. 3 Battery Stack

Test No.	Date, 1975	Test Time	Length of Test, min	Stack Temp, F	% H_2O by Vol	Vol Sampled, scf (dry)	Gas Flow, scfm (dry)	Weight of Dust Filter, grams	Dust Conc, gr/scfd	Dust Loading, lb/hr	Btu Input, MM Btu/hr	Dust, lb/MM Btu
1	8-19	1715-2020	160	460	11.0	53.09	37,600	0.3955	0.115	37.0	114	0.325
2	8-20	1605-1930	160	510	12.9	49.55	37,700	0.3405	0.106	34.1	106	0.321
3	8-21	1600-1900	160	478	11.4	46.99	36,600	0.3370	0.11	34.6	106	0.326
Avg.				483	11.8		37,300		0.11	35.2	109	0.324

Data on Evaporation Residue

Test No.	Evaporation Residue Weight, gm	
	In Condensate	In Probe Washings
1	0.2305	0.0183
2	0.2140	0.0146
3	0.0945	0.0256

Confidential
For use within United States Steel
by authorized personnel only

Sample Calculations from Test 2

Gas Velocity in Flue

$$V_g = 2.9\ F_h \left[\frac{29.92}{P_s} \times \frac{1.00}{S_{pg}} \times T_g \times H\right]^{1/2}$$

$$V_g = (2.9)(0.82)\left[\frac{29.92}{30.04} \times \frac{1.00}{0.93} \times 970 \times 0.038\right]^{1/2} = 14.94 \text{ ft/sec}$$

$$V_{std} = V_g \times A \times 60 \times \frac{P_s}{29.92} \times \frac{520}{T_g}$$

$$V_{std} = (14.94)(87.9)(60)\left(\frac{30.04}{29.92}\right)\left(\frac{530}{970}\right) = 43{,}225 \text{ scfm}$$

Point - East 3

$$R_m = 0.33 \times \frac{T_m}{T_g} \times V_g \times d^2 \times \frac{P_s}{P_b - P_m}$$

$$R_m = (0.33)\ \frac{(540)}{(970)}\ (14.94)(0.1406)\ \frac{(29.92)}{(24.12)} = 0.48 \text{ cfm}$$

$$V_v = 0.00267 \times \frac{V_w \times T_m}{P_b - P_m}$$

$$V_v = (0.00267)\ \frac{(125)(545)}{24.58} = 7.4 \text{ ft}^3$$

Moisture Correction

$$M_c = \frac{V_m}{V_m + V_v}$$

$$M_c = \frac{65.24}{65.24 = 7.4} = \frac{65.24}{72.64} = 0.90$$

Corrected Meter Rate

$$R_{mc} = R_m \times M_c$$

$$R_{mc} = (0.48)(0.90) = 0.43 \text{ cfm}$$

Corrected Volume of Gas Sampled

$$V_{std} = V_m\ \frac{P_b - P_m - P_w}{29.92}\ \frac{520}{T_m}$$

$$V_{std} = (65.24)\left[\frac{29.92 - 5.34 - 1.21}{29.92}\right]\left[\frac{530}{545}\right] = 49.55$$

Confidential
For use within United States Steel
by authorized personnel only

Sample Calculations from Test 2 (continued)

Dust Loading

$$\frac{W \times 15.4}{V_{std}}$$

$$\frac{(0.3405)(15.4)}{49.55} = 0.1058 \text{ gr/scfd}$$

Moisture Content of Gas

Moisture remaining in gas.

$$G_m = \frac{P_s \times V_m}{P_b - P_m}$$

$$G_m = \frac{(0.738)(65.24)}{24.58} = 1.96$$

Moisture Content

$$M = \frac{V_v + G_m}{V_v + V_m}$$

$$M = \frac{7.4 + 1.96}{7.4 + 65.24} = \frac{9.36}{72.64} \times 100 = 12.9\%$$

Confidential
For use within United States Steel
by authorized personnel only

Nomenclature

Symbols Used in Calculations

A = Cross-sectional area of stack, ft^2

A_n = Cross-sectional area of nozzle, ft^2

B_{wo} = Proportion by volume of water vapor in the gas stream, dimensionless

C_p = Pitot tube coefficient, dimensionless

C_s = Concentration of particulate matter in stack gas, lb/scf, dry basis

C'_s = Concentration of particulate matter in stack gas, gr/scf, dry basis

G_d = Specific gravity of gas in stack, dimensionless

ΔH = Average pressure drop across the orifice meter, inches H_2O

I = Percent of isokinetic sampling

M_n = Total amount of particulate matter collected, mg

P_{bar} = Barometric pressure, inches Hg

P_m = Absolute pressure at meter, inches Hg

P_s = Absolute pressure in stack, inches Hg

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg

ΔP = Velocity head measured by pitot tube, inches H_2O

$\left(\sqrt{\Delta P}\right)_{avg}$ = Average of the square roots of the velocity heads measured in the stack, (inches $H_2O)^{1/2}$

Q_s = Volumetric flow rate, dry basis, standard conditions, ft^3/hr

R_m = Meter rate at meter conditions, ft^3/min

T_m = Absolute dry gas-meter temperature, ^oR

Confidential
For use within United States Steel
by authorized personnel only

Nomenclature (continued)

Symbols Used in Calculations

T_s = Absolute stack-gas temperature, ^oR

$T_{s(avg)}$ = Absolute average stack-gas temperature, ^oR

$T_{(std)}$ = Absolute temperature at standard conditions, 530 ^oR

V_g = Volumetric flow rate, wet basis, stack conditions, acfm

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of gas sample through the dry gas meter (meter conditions), cu ft

$V_{m(std)}$ = Volume of gas sample through the dry gas meter (standard conditions), cu ft

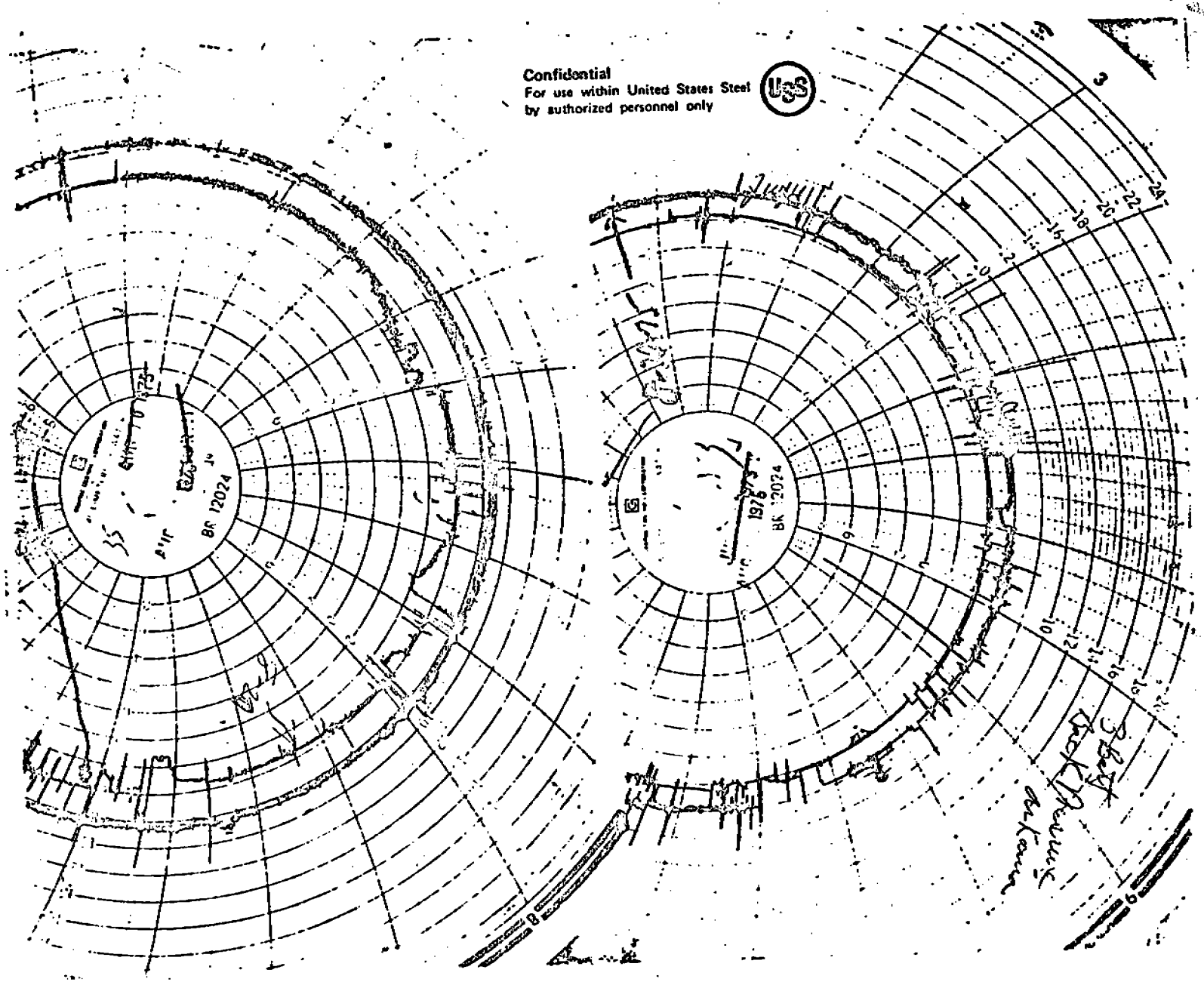
$V_{s(avg)}$ = Average stack-gas velocity, ft/sec

$V_{w(std)}$ = Volume of water in the gas sample (standard conditions), cu ft

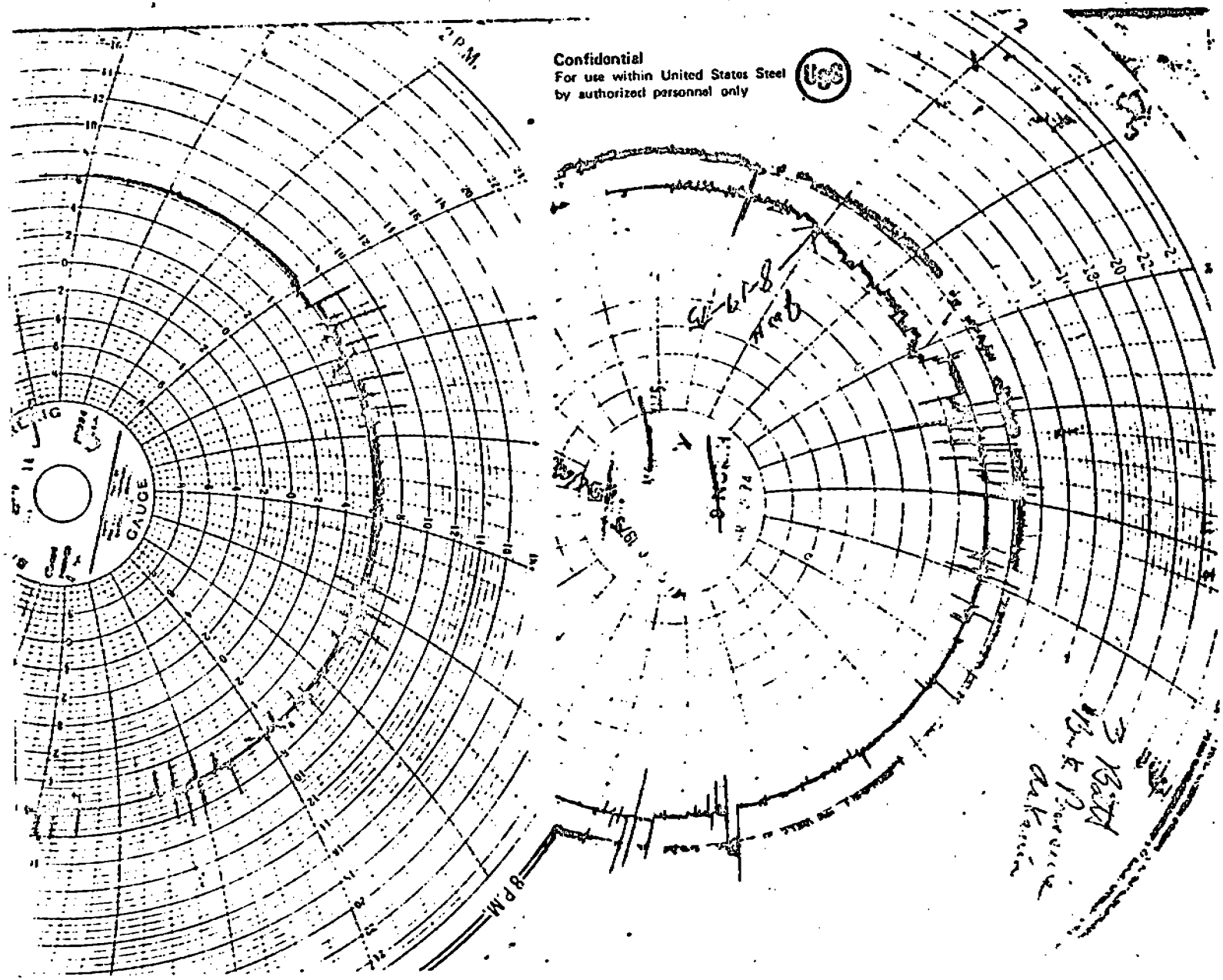
θ = Total sampling time, min

Confidential
For use within United States Steel
by authorized personnel only

Confidential
For use within United States Steel
by authorized personnel only



Confidential
For use within United States Steel
by authorized personnel only



Id-VE-2-1/.4

VISIBLE EMISSIONS OBSERVATION REPORT

Confidential
For use within United States Steel by authorized personnel only

USS

Air Pollution Control Program
[redacted]
Jefferson County Department of Health

Name of Company U. S. Steel Fairfield

Address Pleasant Grove Road Fairfield, Alabama

Location 09

Permit Number

Type of Source #3 Underfeeding Stoker

Type of Fuel

Sky Condition Partly Cloudy

Observation Point South of Stack

Stack Height 250 ft.

Distance from Stack 600 ft.

Wind Speed 4-12 mph

Wind Direction Easterly

Color of Smoke Black

Observation Began 1540

Observation Ended 1640

Violation Observed X (If YES, X)

Notice Issued Number

Minutes Exceeding 20% Opacity 58

Minutes Exceeding 60% Opacity 00

Observer J. M. Cox 27

Time Analysis (1/4 hr. increments) 04

Date 3/8/1975 Id VE

(See Special Remarks or Comments on back)

Hood blocked my VIEW

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

Id-VE-2/1/74

VISIBLE EMISSIONS OBSERVATION REPORT

Confidential
For use within United States Steel by authorized personnel only

USS

Air Pollution Control Program
Bureau of Environmental Health
Jefferson County Department of Health

Name of Company U. S. Steel Fairfield Coke Plant

Address Pleasant Grove Road · Fairfield, Alabama

Location 09

Permit Number

Type of Source #3 Underfiring Stack

Type of Fuel

Sky Condition Partly Cloudy

Observation Point South of Stack

Stack Height 250 ft.

Distance from Stack 600 ft.

Wind Speed 4-12 mph

Wind Direction Easterly

Color of Smoke Black

Observation Began 1642

Observation Ended 1742

Violation Observed X (If YES, X)

Notice Issued Number

Minutes Exceeding 20% Opacity 58

Minutes Exceeding 60% Opacity 00

Observer L. M. Cain 27

Time Analysis (1 4 hr. increments) 04

Date 08/19/75 Id VE

(Comments on back)

A puff blocked my VIEW

Min.	Seconds 00	15	30	45	Min.	Seconds 00	15	30	45
0	45	45	40	35		40	40	35	45
1	35	30	35	40		45	45	40	35
2	35	40	40	35		40	35	45	45
3	30	30	30	30		45	40	45	45
4	35	30	30	30		45	45	45	45
5	30	30	35	35		45	40	40	45
6	35	40	40	40		40	40	40	40
7	40	40	45	45		35	35	35	35
8	40	40	35	35		35	35	35	35
9	35	/	35	40		40	40	40	40
10	40	40	35	30		40	30	30	35
11	30	30	40	40		40	40	40	40
12	35	30	30	35		40	40	40	40
13	35	35	35	40		40	40	40	40
14	20	25	30	35		40	40	40	40
15	35	35	40	40		35	35	35	35
16	40	40	40	40		35	35	35	35
17	40	35	35	40		35	35	35	35
18	40	40	45	40		35	35	35	35
19	40	40	40	45		30	30	30	30
20	45	40	40	40		30	30	40	40
21	35	35	30	30		30	40	40	40
22	35	35	40	40		30	40	40	40
23	40	40	45	40		30	40	40	40
24	35	30	30	30		30	40	45	45
25	30	30	/	30		30	40	40	40
26	30	30	30	30		30	45	50	50
27	30	30	30	40		30	20	40	50
28	30	40	40	40		35	35	35	35
29	40	35	35	45		35	35	35	35

Confidential
For use within United States Steel by authorized personnel only

USS

VISIBLE EMISSIONS OBSERVATION REPORT

Air Pollution Control Program
Bureau of Environmental Health
Jefferson County Department of Health

Name of Company: U S Steel - Fairfield Coke Works
Address: Pleasant Grove Road Fairfield, Alabama

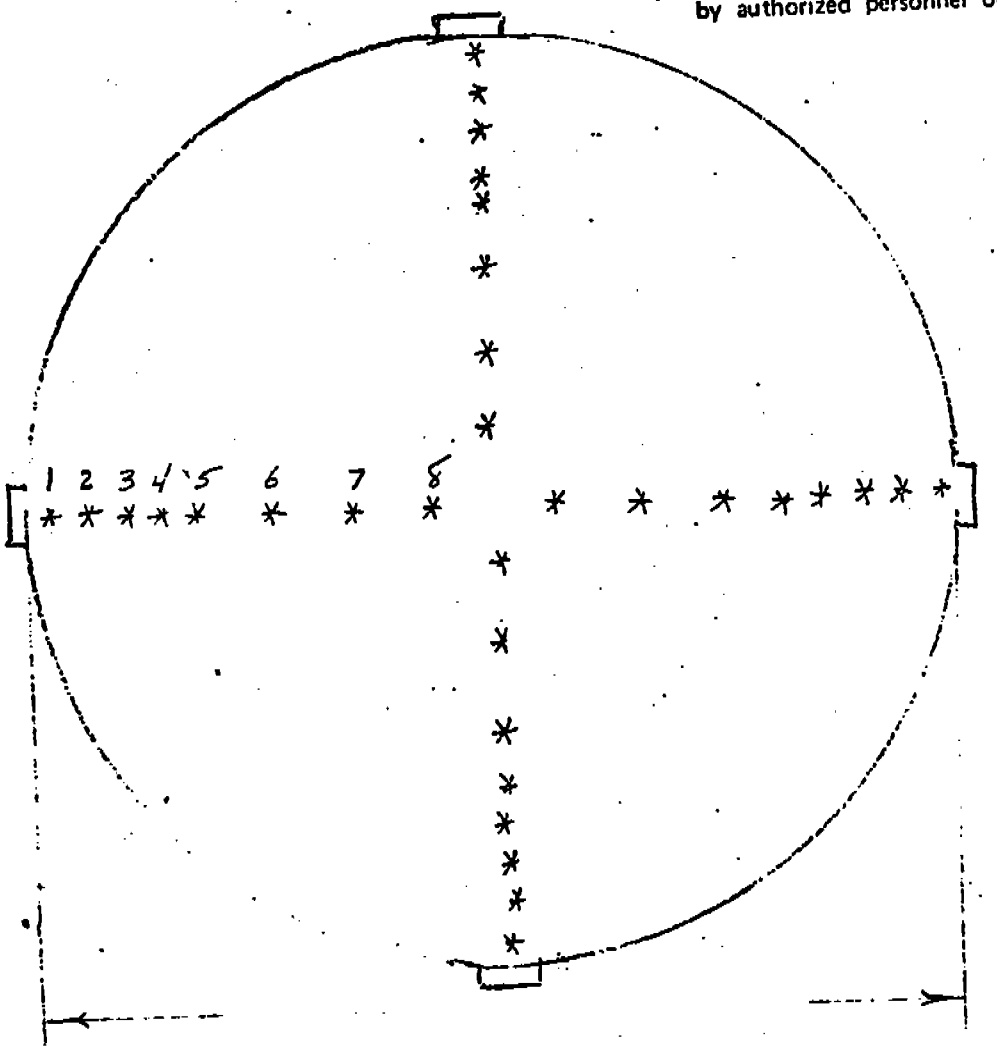
Location: 09
Permit Number:
Type of Source: Underfire Stack #3
Type of Fuel:
Sky Condition: Partly Cloudy
Observation Point: North of Stack
Stack Height: 270 ft.
Distance From Stack: 500 ft.
Wind Speed: 5-13 mph
Wind Direction: Northerly
Color of Smoke: Clear
Observation Began: 1500
Observation Ended: 1620
Violation Observed: X (If Yes, X)
Notice Issued: Number:
Minutes Exceeding 20% Opacity:
Minutes Exceeding 60% Opacity:
Observer: L M Cue
Time Analysis (1/4 hr. Increments): 04
Date: 5 5 2 0 7 5
EA: S E

(Signature of Observer or Persons on Back)

Min.	Seconds 0	15	30	45	Seconds 0	15	30	45
0	50	55	55	55	55	60	60	60
1	50	50	50	50	60	60	60	60
2	50	50	40	45	65	65	55	55
3	45	45	40	45	60	60	55	55
4	30	35	50	55	60	60	60	50
5	30	35	35	40	55	50	60	55
6	35	45	40	40	60	60	60	65
7	45	45	40	40	65	70	70	70
8	40	40	35	35	70	70	70	70
9	40	40	30	30	70	60	65	50
10	40	40	35	35	55	55	65	65
11	35	30	35	30	70	70	65	65
12	40	35	40	35	65	70	70	70
13	40	45	45	45	70	70	70	70
14	45	45	45	45	70	70	70	70
15	45	45	40	50	75	70	70	75
16	40	40	40	40	75	75	65	70
17	40	40	50	50	70	70	65	70
18	50	55	60	60	70	70	70	70
19	60	60	60	50	70	65	70	70
20	60	60	60	60	75	75	75	75
21	60	60	50	50	70	70	75	70
22	50	50	50	50	65	70	70	70
23	50	60	60	50	70	70	75	75
24	75	50	50	50	75	60	70	70
25	55	50	60	60	70	70	65	70
26	60	60	50	50	65	70	70	70
27	50	70	50	50	60	65	65	50
28	55	55	50	50	55	65	65	60
29	75	55	50	50	65	60	50	50

18242 REV. 1063

Confidential
For use within United States Steel
by authorized personnel only



DISTANCE FROM INSIDE WALL TO SAMPLING POINTS

POINT NO.	1	2	3	4	5	6	7	8
DISTANCE (INCHES)	2.0	6.2	10.8	15.9	21.5	27.9	35.9	47.6

DUST [illegible] FIELD NO. 3 COKE BATTERY STACK

DRAWN BY	CHK'D BY	APPROVED BY	UNITED STATES STEEL CORPORATION	FIGURE NO.
DRAWING NO		PROJECT NO.	RESEARCH	
		DATE		

DUST SAMPLING DATA SHEET

Sampled FAIRFIELD WORKS
Sampling Station No 3 COKE BATTERY STACK
Project No. 18E-001-488-(003)
Ambient Temp., F
Barometer, in. Hg 30.07
Nozzle Diameter, inches 3/8
Wt. of Condensate, gms.
Thimble No. C-382
Gross Wt. 47.6375 grams
Tare Wt. 42.2420 grams
Dust Wt. 5.3955 grams

Test No. 1
Date 8-19-1975
Operators(1) JM-JEN
Time: From 1715 to 2020
Remarks:

Confidential
For use within United States Steel
by authorized personnel only

Elapsed Time of Test, Minutes	Meter Reading, cu.ft.	Differential Meter Reading, cu.ft.	Average Rate, cfm	Meter Suction inches of Hg	Meter Exit Temp., F	Saturation Temp., F	POSITION	[illegible]	
5	1.83		.36	3.0	87	80	N-1	.37	
10	4.12	2.29	.46	4.8	82	72	2	.53	
15	7.30	3.18	.63	6.6	82	70	3	.64	
20	10.48	3.18	.63	7.0	82	70	4	.64	
25	13.64	3.16	.63	7.0	82	73	5	.64	
30	16.76	3.12	.62	7.0	82	72	6	.64	
35	19.76	3.00	.60	7.2	82	64	7	.64	
40	22.92	3.16	.63	7.8	82	62	8	.64	
45	24.44	1.52	.31	3.3	81	71	E-1	.32	
50	26.04	1.60	.32	3.8	81	70	2	.32	
55	[illegible]	[illegible]	.46	[illegible]	80	[illegible]	3	.45	
60	30.46	[illegible]	.45	[illegible]	80	70	4	.45	
65	32.78	2.12	.43	5.[illegible]	80	70	5	.45	
70	35.00	2.22	.44	5.6	80	70	6	.45	
75	36.66	1.66	.33	4.1	80	70	7	.32	
80	39.06	2.40	.48	5.8	80	67	8	.45	
85	40.72	1.66	.33	4.1	80	72	S-1	.32	
90	42.34	1.62	.32	4.0	80	70	2	.32	
95	43.92	1.58	.31	4.0	80	68	3	.32	
100	[illegible]	1.62	.33	4.2	80	68	4	.32	
105	48.02	[illegible]	.19	[illegible]	[illegible]	[illegible]	5	.50	
110	[illegible]			5.5	80	70	6	.39	

DUST SAMPLING DATA SHEET

as Sampled FAIRFIELD WORKS
ampling Station No 3 COKE BATTERY STACK
roject No. 18F-001-488 (003)
mbient Temp., F
arometer, in. Hg
ozzle Diameter, inches
t. of Condensate, gms. 107 ml
Thimble No.
Gross Wt. grams
Tare Wt. grams
Dust Wt. grams

Test No. 1
Date 8-19 1975
Operators(1) DM . JN
Time: From to
Remarks:

Confidential
For use within United States Steel
by authorized personnel only

USS

Elapsed Time of Test, minutes	Meter Reading, cu.ft.	Differential Meter Reading, cu.ft.	Average Rate, cfm	Meter Suction inches of Hg	Meter Exit Temp., F	Saturation Temp., F	Position	K	
115	51.58	1.54	.31	4.0	80	70	S-7	.32	
120	53.96	1.38	.27	4.0	80	70	8	.32	
125	54.52	1.56	.31	4.0	80	70	W-1	.32	
130	56.08	1.46	.30	4.0	80	70	2	.32	
135	57.63	1.60	.32	4.4	78	67	3	.32	
140	59.96	2.29	.45	6.1	78	66	4	.45	
145	62.19	2.22	.44	6.1	79	66	5	.45	
150	64.94	2.76	.55	7.7	78	64	6	.55	
155	67.10	2.16	.43	6.2	78	65	7	.45	
160	69.28	2.18	.43	6.2	78	66	8	.45	
				5.33	80	69			
					1.03	.714			

DUST SAMPLING DATA SHEET

s Sampled FAIRFIELD WORKS
mpling Station No 3 COKE BATTERY STACK
oject No. 19E-001-488-(003)
bient Temp., F 90
rometer, in. Hg 30.12
ozzle Diameter, inches 3/8
t. of Condensate, gms. 125 ml
nimble No. C-397
Gross Wt. 45.9807 grams
Tare Wt. 45.6402 grams
Dust Wt. 0.3405 grams

Test No. 2
Date 8-20 1975
Operators(1) JEM-PAH
Time: From 1605 to 1930
Remarks:

Confidential
For use within United States Steel
by authorized personnel only

USS

LEAK CHECK OK

Elapsed Time of Test, minutes	Meter Reading, cu.ft.	Differential Meter Reading, cu.ft.	Average Rate, cfm	Meter Suction inches of Hg	Meter Exit Temp., F	Saturation Temp., F	POSITION	[illegible]	
5	2.08		.41	4.5	84	77	N-1	0.43	
10	4.28	2.20	.44	4.9	86	73	2	.43	
15	6.44	2.16	.43	4.5	86	72	3	.43	
20	9.96	2.52	.51	5.4	86	70	4	.52	
25	11.52	2.56	.51	5.4	86	68	5	.52	
30	14.18	2.56	.51	5.4	86	68	6	.52	
35	16.68	2.50	.50	5.4	86	70	7	.52	
40	19.20	2.52	.50	5.4	86	68	8	.52	
45	20.78	1.58	.31	3.5	85	76	E-1	.30	
50	22.30	1.52	.30	3.5	85	76	2	.30	
55	24.48	2.18	.43	5.7	85	76	3	.43	
60	26.56	2.08	.41	5.7	85	70	4	.43	
65	28.60	2.04	.40	5.7	85	70	5	.43	
70	30.76	2.16	.43	5.9	85	70	6	.43	
75	32.94	2.18	.43	5.9	85	70	7	.43	
80	34.96	2.02	.40	5.9	85	70	8	.43	
85	36.44	1.48	.30	3.7	85	70	S-1	.30	
90	37.94	1.50	.30	3.9	85	70	2	.30	
95	39.[illegible]	1.52	.30	3.9	84	70	3	.30	
100	[illegible]	[illegible]	[illegible]	4.1	84	70	4	.30	
105	43.04	2.05	.41	5.9	84	70	5	.43	
110	[illegible]	1.97	.40	6.1	84	68	6	.43	

DUST SAMPLING DATA SHEET

as Sampled FAIRFIELD WORKS
ampling Station No 3 COKE BATTERY STACK
roject No. 18E-001-488 (00 3)
mbient Temp., F 90
arometer, in. Hg 30.12
ozzle Diameter, inches 3/8
t. of Condensate, gms.
himble No.
Gross Wt. grams
Tare Wt. grams
Dust Wt. grams

Test No. 2
Date 8-20 - 19 75
Operators(1) [illegible]
Time: From to
Remarks:

Confidential
For use within United States Steel
by authorized personnel only

USS

Elapsed Time of Test, minutes	Meter Reading, cu.ft.	Differential Meter Reading, cu.ft.	Average Rate, cfm	Meter Suction inches of Hg	Meter Exit Temp., F	Saturation Temp., F	Position	K	
115	47.06	2.05	.41	6.1	84	70	S-7	0.43	
120	49.04	1.98	.40	6.0	84	68	8	.43	
125	50.54	1.50	.30	4.2	84	68	W-1	.30	
130	52.04	1.50	.30	4.2	84	68	2	.30	
135	54.16	2.12	.42	6.3	84	68	3	.43	
140	56.34	2.18	.43	6.3	84	68	4	.43	
145	58.50	2.16	.42	6.3	84	68	5	.43	
150	60.60	2.10	.42	6.3	84	68	6	.43	
155	62.90	2.20	.44	6.5	84	68	7	.57	
160	65.24			8.5	84	68	8	.52	
				5.34	85	70			
					1.21	.738			

DUST SAMPLING DATA SHEET

s Sampled FAIRFIELD WORKS
mpling Station No 3 Gas Rotary Stack
oject No. 18E-001-488-(003)
bient Temp., F 95
rometer, in. Hg 30.18
ozzle Diameter, inches 3/8
t. of Condensate, gms. 98 mls.
nimble No. C.230
Gross Wt. 58.4781 grams
Tare Wt. 58.1411 grams
Dust Wt. 0.3370 grams

Test No. 3
Date 8-21 1975
Operators(1) [illegible]
Time: From 1600 to 1900
Remarks:

Confidential
For use within United States Steel
by authorized personnel only

USS

Test Check - OK

Elapsed Time of Test, minutes	Meter Reading, cu.ft.	Differential Meter Reading, cu.ft.	Average Rate, cfm	Meter Suction inches of Hg	Meter Exit Temp., F	Saturation Temp., F	Position	[illegible]	
5	1.54		.31	3.0	88	80	N-1	0.30	
10	3.06	1.52	.30	3.0	86	79	2	.30	
15	5.28	2.22	.44	4.8	86	79	3	.42	
20	7.36	2.08	.41	4.2	86	79	4	.42	
25	9.36	2.00	.40	4.8	86	80	5	.42	
30	11.18	1.96	.40	4.8	86	80	6	.42	
35	13.56	2.38	.48	6.0	86	76	7	.42	
40	15.62	2.06	.41	4.8	86	76	8	.42	
45	17.10	1.48	.30	4.0	86	76	E-1	.30	
50	18.62	1.52	.30	4.0	86	76	2	.30	
55	20.12	1.50	.30	4.0	86	76	3	.30	
60	22.16	2.04	.41	5.3	86	74	4	.42	
65	24.16	2.00	.40	5.3	86	74	5	.42	
70	26.16	2.00	.40	5.7	86	74	6	.42	
75	28.22	2.06	.41	5.7	86	74	7	.42	
80	30.26	2.04	.41	5.7	86	74	8	.42	
85	31.78	1.52	.30	3.9	86	74	S-1	.30	
90	33.30	1.52	.30	3.9	86	74	2	.30	
95	34.83	1.52	.30	3.9	86	74	3	.30	
100	36.92	2.09	.42	5.0	86	74	4	.42	
105	39.04	2.12	.42	5.1	86	74	5	.42	
110	41.18	2.14	.43	5.8	86	73	6	.42	

DUST SAMPLING DATA SHEET

Test No. 3

Date 8-21 1975

Operators(1) [illegible]

Time: From _____ to _____

Remarks: _____

Sampled FAIRFIELD WORKS

pling Station No 3 COKE BATTERY STACK

oject No. 18E-001-488 (008)

bient Temp., F _____

rometer, in. Hg _____

zzle Diameter, inches _____

. of Condensate, gms. _____

imble No. _____

Gross Wt. _____ grams

Tare Wt. _____ grams

Dust Wt. _____ grams

Confidential
For use within United States Steel
by authorized personnel only

USS

lapsed Time of Test, minutes	Meter Reading, cu.ft.	Differential Meter Reading, cu.ft.	Average Rate, cfm	Meter Suction inches of Hg	Meter Exit Temp., F	Saturation Temp., F	Position	[illegible]	
115	43.26	2.0[illegible]	.42	5.7	86	74	5-7	0.42	
120	45.40	2.14	.43	5.9	86	74	8	.42	
125	46.92	1.52	.30	3.3	86	72	10-1	.30	
130	49.18	2.26	.45	6.3	86	70	2	.42	
135	51.34	2.16	.43	6.1	86	70	3	.42	
140	53.52	2.18	.43	6.1	86	70	4	.42	
145	55.74	2.22	.44	6.2	86	70	5	.42	
150	57.80	2.06	.41	6.[illegible]	86	70	6	.42	
155	59.86	2.06	.41	6.[illegible]	86	70	7	.42	
160	61.98	2.12	.42	6.1	86	70	8	.42	
				5.03	86	72			
					1.25	.791			

PITOT TRAVERSE DATA SHEET

Gas Traversed FAIRFIELD WORKS Date 8-19-75

Traverse Point NO 3 COKE BATTERY STACK Operator(s) PAM, JN

Project No. RE-001-UST (003) Remarks

Size of Flue 10.55 Ft

Area of Flue 87.9

Pitot Tube Correction Factor 0.82

Pb 30.07

Confidential
For use within United States Steel by authorized personnel only

Station	NORTH In H	NORTH In √H	EAST Out H	EAST Out √H	SOUTH In H	SOUTH In √H	WEST Out H	WEST Out √H	In H	In √H	Out H	Out √H
2.03	.02	.141	.02	.141	.02	.141	.02	.141				
6.22	.04	.200	.02	.141	.02	.141	.02	.141				
10.79	.06	.245	.04	.200	.02	.141	.02	.141				
15.87	.06	.245	.04	.200	.02	.141	.04	.200				
21.46	.06	.245	.04	.200	.05	.224	.04	.200				
27.94	.06	.245	.04	.200	.03	.173	.06	.245				
35.94	.06	.245	.02	.141	.02	.141	.04	.200				
47.62	.06	.245	.04	.200	.02	.141	.04	.200				
Average	450°F		462		464		464		460			
AVG √H 0.186	Time 1535 Flue Temp. Flue Press. - 1.0 A.C				Time Flue Temp. Flue Press.				Time Flue Temp. Flue Press.			

Calculations:

$$V_S = (2.9)(.82)\sqrt{\frac{29.92}{30.07} \times \frac{1.0}{0.93} \times 920} = (31.37)(2.9)(.82)$$

$$= 74.59\ (\sqrt{H})$$

$$= 13.87\ Ft/SEC.$$

$$V_{CFM} = (13.87)(60)(87.9) = 73,150\ ACFM$$

$$V_{SCFM}\ (73,150)\ \frac{(530)}{920}\ \frac{(29.99)}{29.92} = 42,740\ SCFM$$

$$R_{m} = (0.33)\frac{(530)}{920}(71.96)\frac{(29.99)}{17.92}(.86)(.1406) = 2.77\ (\sqrt{H})$$

CORR $= 2.26\ (\sqrt{H})$

78 S 8011
FAIRFIELD [illegible]

4236

PITOT TRAVERSE DATA SHEET

Gas Traversed FAIRFIELD WORKS Date 8-20-75

Traverse Point NO 2 COKE BATTERY STACK Operator(s) TAM, JTN

Project No. AE-001-[illegible] (003) Remarks

Size of Flue 10.58 Ft

Area of Flue 87.9

Pitot Tube Correction Factor 0.82

Pb - 30.12

Confidential
For use within United States Steel by authorized personnel only

Station	NORTH In H	NORTH In √H	EAST Out H	EAST Out √H	SOUTH In H	SOUTH In √H	WEST Out H	WEST Out √H	In H	In √H	Out H	Out √H
2.03	.04	.200	.02	.141	.02	.141	.02	.141				
6.22	.04	.200	.02	.141	.02	.141	.02	.141				
10.79	.04	.200	.04	.200	.02	.141	.04	.200				
15.87	.06	.245	.04	.200	.02	.141	.04	.200				
21.46	.06	.245	.04	.200	.04	.200	.04	.200				
27.94	.06	.245	.04	.200	.04	.200	.04	.200				
35.94	.06	.245	.04	.200	.04	.200	.06	.245				
47.62	.06	.245	.04	.200	.04	.200	.06	.245				
Average	520°F		516		522		480		510			

AVG. √H = 0.195

Time 1530
Flue Temp.
Flue Press. -1.0 H2O

Time
Flue Temp.
Flue Press.

Time
Flue Temp.
Flue Press.

Calculations:

$$V_S = (2.9)(.82)\sqrt{\frac{29.92}{30.04} \times \frac{1.0}{0.93} \times .970} = (32.23)(2.9)(.82) = 76.64(\sqrt{H}) = 14.94 \text{ Ft/SEC.}$$

$$V_{CFM} = (14.94)(60)(87.9) = 78{,}793 \text{ ACFM}$$

$$V_{SCFM} = (78{,}793)\frac{(530)}{970}\frac{(30.04)}{29.92} = 43{,}225 \text{ SCFM}$$

$$P_{[illegible]} = (0.33)\frac{(540)}{970}(73.9)\frac{(29.92)}{23.92}(.89)(.1406) = 2.13(\sqrt{H})$$

PITOT TRAVERSE DATA SHEET

Gas Traversed: FAIRFIELD WORKS — Date: 6-21-75

Traverse Point: No 3 COKE BATTERY STACK — Operator(s): PAM, JN

Project No.: RE-001-USS (003) — Remarks:

Size of Flue: 10.58 Ft

Area of Flue: 87.9

Pitot Tube Correction Factor: 0.82

Confidential
For use within United States Steel by authorized personnel only

Pb - 30.18

Station	NORTH In H	NORTH In √H	EAST Out H	EAST Out √H	SOUTH In H	SOUTH In √H	WEST Out H	WEST Out √H	In H	In √H	Out H	Out √H
2.03	.02	.141	.02	.141	.02	.141	.02	.141				
6.22	.02	.141	.02	.141	.02	.141	.04	.200				
10.79	.04	.200	.02	.141	.02	.141	.04	.200				
15.37	.04	.200	.04	.200	.04	.200	.04	.200				
21.46	.04	.200	.04	.200	.04	.200	.04	.200				
27.94	.04	.200	.04	.200	.04	.200	.04	.200				
35.94	.04	.200	.04	.200	.04	.200	.04	.200				
47.62	.04	.200	.04	.200	.04	.200	.04	.200				
Average	.044		.040		.044		.054		.048			

AVG = 0.183

Time 1520	Time	Time
Flue Temp.	Flue Temp.	Flue Temp.
Flue Press. -1.0 H2O	Flue Press.	Flue Press.

Calculations:

$$V_s = (2.9)(.82)\sqrt{\frac{2992}{30.10} \times \frac{1.0}{0.93} \times 938} = (21.66)(2.9)(.82)$$

$$= 75.28(.\overline{41})$$

$$= 13.77 \text{ Ft/SEC}$$

$$V_{CFM} = (13.77)(60)(87.9) = 72{,}622 \text{ ACFM}$$

$$V_{SCFM} = (72{,}622)\frac{(530)}{938}\frac{(30.10)}{2992} = 41{,}280 \text{ SCFM}$$

$$P_{m1} = (0.33 - \frac{2.4(5)}{23})(72.6)\frac{(2992)}{21.1}(.87)(.146) = 21.1$$

SAMPLING PROCEDURE

I. Determination of Flow Conditions

A. Use a pitot tube similar to that shown in Figure 3.

B. Mark the pitot tube to indicate the distance to the center of each area.

1. For round flues (Table I and Figure 4), the radius of the flue plus the length of the sleeve and collar through which the pitot tube will be inserted should be measured from the end of the tube and marked. The distances (R_1, R_2, R_3..., as shown in Table I) should then be measured in both directions from the above reference mark and marked on the pitot tube.

2. For rectangular flues (Figure 2), the distance from the wall of the flue to each station or area, plus the length of the sleeve and collar through which the pitot tube will be inserted, should be measured from the end of the tube and marked.

C. Connect the pitot tube to an inclined draft gage.

D. Insert the pitot tube into the flue and record the differential pressure indicated for each point of the traverse on a data sheet (Figure 8).

E. Measure the temperature of the gas in the flue with a thermocouple or metal thermometer.

F. Measure the static pressure of the gas in the flue with a manometer.

G. Calculate the individual-point velocities of the gas by using Equations 1 or 2.

H. Calculate the average velocity for the entire cross section of the flue by taking the average of the individual velocities obtained during the traverse.

II. Determination of the Probes Gas-Sampling Conditions

Calculate the meter-sampling rates for each station used in the pitot-tube traverse by using Equation 4.

III. Collection of the Dust Sample

A. Set up the gas-sampling equipment as shown in Figure 5.

Confidential
For use within United States Steel
by authorized personnel only

B. Insert the alundum extraction thimble into the holder.

C. Attach a sampling nozzle to the thimble holder. The size of the sampling nozzle depends upon the gas velocity and the sampling rate to be maintained. Sampling nozzle size to give an isokinetic sampling rate between 0.5 to 1.5 cubic feet per minute should be selected.

D. Connect with tubing the gas-outlet side of the thimble holder to the condenser.

E. Test the equipment for leaks.

F. Mark sampler in same manner as pitot tube described under Section I-B.

G. Insert the sampler through the hole provided in the flue and spot the nozzle at the first point as quickly as possible with the nozzle turned down stream.

H. Turn on the exhauster and set the control valve to the meter rate computed for the first point and face the nozzle directly into the gas stream.

I. Observe and record meter rate, meter volume, temperature, and vacuum on a data sheet similar to the one shown in Figure 7.

J. At the proper time, move the sampler quickly to the next position and correct the meter rate.

K. Continue until at least one complete round of all sampling points have been made.

L. At the end of the run, remove the sampler without changing the flow rate through it.

M. Hold the sampler in a verticle position, nozzle up, and tap on the tube to cause any dust sticking to the inside of the sampler to enter the filters.

N. Turn off the exhauster and open the sampler.

O. Brush the dust or filter fibers that may have collected on the inside of the nozzle into the filter.

Confidential
For use within United States Steel
by authorized personnel only

P. Remove the filter and place it in a dust-tight container for transport to the laboratory.

Q. Measure and record the amount of water collected in the condensate receiver.

IV. Calculation of the Dust Loading and Moisture Content of the Gas

A. Calculate dust loading by using Equations 8 and 9.

B. Calculate the percent moisture by using Equations 10, 11, and 12, and Table I.

V. Weighing Thimbles and Dust

A sufficient number of clean thimbles to conduct the test should be marked for identification. They are then placed into a drying oven at 103 C for a minimum of four hours; following which the thimbles are removed from the oven and placed into a desiccator for cooling. After the sample run, the thimbles are transported back to the laboratory for weighing. The thimbles are again placed into the oven for drying and desiccator for cooling. The drying time, drying temperature, and desiccator cooling time must be uniform both before and after sampling. Weighing shall be done to the nearest 0.1 of a milligram. The weight of the dust collected in the filter is then determined by differences.

Confidential
For use within United States Steel
by authorized personnel only

Equations

Gas Velocity in Flue

(1) $$V_G = 2.9\ F_H \left[\frac{29.92}{P_s} \times \frac{1.00}{S_{pg}} \times T_G \times H\right]^{1/2}$$

(2) $$V_G = 2.9\ F_H \left[H\ T_G\right]^{1/2}$$

(3) $$V_{std} = V_{avg} \times A \times 60 \times \frac{P_s}{29.92} \times \frac{520}{T_G}$$

(4) $$R_m = 0.33 \times \frac{T_m}{T_G} \times V_G \times d^2 \times \frac{P_s}{P_b - P_m}$$

(5) $$V_v = 0.00267\ \frac{V_w \times T_m}{P_b - P_m}$$

Moisture Correction

(6) $$M_c = \frac{V_m}{V_m + V_v}$$

Corrected Meter Rate

(7) $$R_{mc} = R_m \times M_c$$

Corrected Volume of Gas Sampled

(8) $$V_{std} = V_m \left[\frac{P_b - P_m - P_w}{29.92}\right]\left[\frac{520}{T_m}\right]$$

Dust Loading

(9) $$\frac{W \times 15.4}{V_{std}}$$

Moisture Content of Gas

Moisture remaining in gas

(10) $$G_m = \frac{P_s \times V_m}{P_b - P}$$

Confidential
For use within United States Steel
by authorized personnel only

(11) <u>Moisture Content</u>

$$M = \frac{V_v + G_m}{V_v + V_m}$$

Confidential
For use within United States Steel
by authorized personnel only

Nomenclature

A = Cross-sectional area of flue, sq ft

d = Diameter of sampling nozzle, inches

F_H = Pitot-tube correction factor

G_m = Moisture remaining in metered gas, cu ft at meter conditions

H = Gage reading, equivalent inches of water

M_c = Moisture correction

P_b = Barometric pressure, inches Hg

P_m = Suction at meters, inches Hg

P_s = Absolute pressure of gas in the flue, inches of Hg

p_w = Vapor pressure of water at the meter temperature, inches Hg

p_s = Vapor pressure of water at the temperature in the condensate flash, inches Hg

R_m = Meter rate, cfm

R_{mc} = Corrected meter rate, cfm

S_{pg} = Specific gravity of gas referred to air

T_G = Absolute temperature of gas, Rankine

T_m = Temperature of gas at meter, Rankine

v_g = Velocity of gas, feet per second

V_m = Volume of gas sampled through meter, cubic feet

v_v = Volume of water vapor condensed at meter conditions, cu ft

v_w = Volume of water condensed, cubic centimeters of liquid.

V_{avg} = Average gas velocity, feet per second

V_{std} = Volume of flue gas sampled at standard conditions, scfm

W = Weight of collected dust, grams

Confidential
For use within United States Steel
by authorized personnel only

Table I

Equal-Area Zones for Velocity Traverse*
Round Flues

Diameter, inches	Area, square feet	Number of Equal Zones	Area of Each Zone, square feet	Radius to Stations in Zone A(R_1), inches	Radius to Stations in Zone B(R_2), inches	Radius to Stations in Zone C(R_3), inches	Radius to Stations in Zone D(R_4), inches	Radius to Stations in Zone E(R_5), inches	Radius to Stations in Zone F(R_6), inches
8	0.3491	2	0.1745	2	3-1/2				
10	0.5454	2	0.2725	2-1/2	4-3/8				
12	0.7854	2	0.3925	3	5-1/4				
14	1.069	3	0.356	2-7/8	5	6-3/8			
15	1.227	3	0.409	3	5-3/8	6-7/8			
16	1.396	3	0.465	3-1/4	5-5/8	7-1/4			
18	1.767	3	0.589	3-3/4	6-3/8	8-1/4			
20	2.182	3	0.727	4-1/8	7-1/8	9-1/4			
22	2.640	3	0.880	4-1/2	7-3/4	10			
24	3.142	4	0.785	4-1/4	7-3/8	9-1/2	10-1/4		
26	3.687	4	0.922	4-5/8	8	10-1/4	12-1/8		
28	4.276	4	1.07	5	8-5/8	11	13-1/8		
30	4.909	4	1.227	5-3/8	9-1/4	11-7/8	14		
32	5.585	4	1.396	5-5/8	9-3/4	12-5/8	14-7/8		
36	7.069	5	1.416	5-5/8	9-7/8	12-3/4	15	17-1/8	
42	9.621	5	1.924	6-1/2	11-1/2	14-7/8	17-1/2	19-7/8	
48	12.51	5	2.50	7-1/2	13-1/8	17	20	22-7/8	
48	12.51	6	2.085	7	12	15-1/2	18-3/8	20-3/4	23
54	15.9	6	2.65	7-1/2	13-1/2	17-1/2	20-5/8	23-1/4	25-7/8
60	19.63	6	3.27	8-3/8	15	19-3/8	22-7/8	25-7/8	28-3/4
66	23.76	6	3.96	9-5/8	16-1/2	21-3/8	25-1/4	28-1/2	31-5/8
72	28.27	6	4.71	10-1/2	18	23-1/4	27-1/2	31-1/4	34-1/2

Confidential
For use within United States Steel
by authorized personnel only

Table II

Pressure of Saturated Water Vapor

TEMP °F	"Hg
0	0.0375
2	.0417
4	.0462
6	.0512
8	.0567
10	.0628
12	.0694
14	.0766
16	.0846
18	.0932
20	.1027
22	.1130
24	.1242
26	.1365
28	.1499
30	.1646
32	.1806
33	.1880
34	.1957
35	.2036
36	.2119
37	.2204
38	.2292
39	.2384
40	.2478
41	.2576
42	.2678
43	.2783
44	.2891
45	.3003
46	.3120

TEMP °F	"Hg
47	0.3240
48	.3364
49	.3492
50	.3624
51	.3761
52	.3903
53	.4049
54	.4200
55	.4356
56	.4517
57	.4687
58	.4865
59	.5032
60	.5214
61	.5403
62	.5597
63	.5798
64	.6005
65	.6218
66	.6438
67	.6664
68	.6898
69	.7139
70	.7386
71	.7642
72	.7906
73	.8177
74	.8456
75	.8744
76	.9040
77	.9345

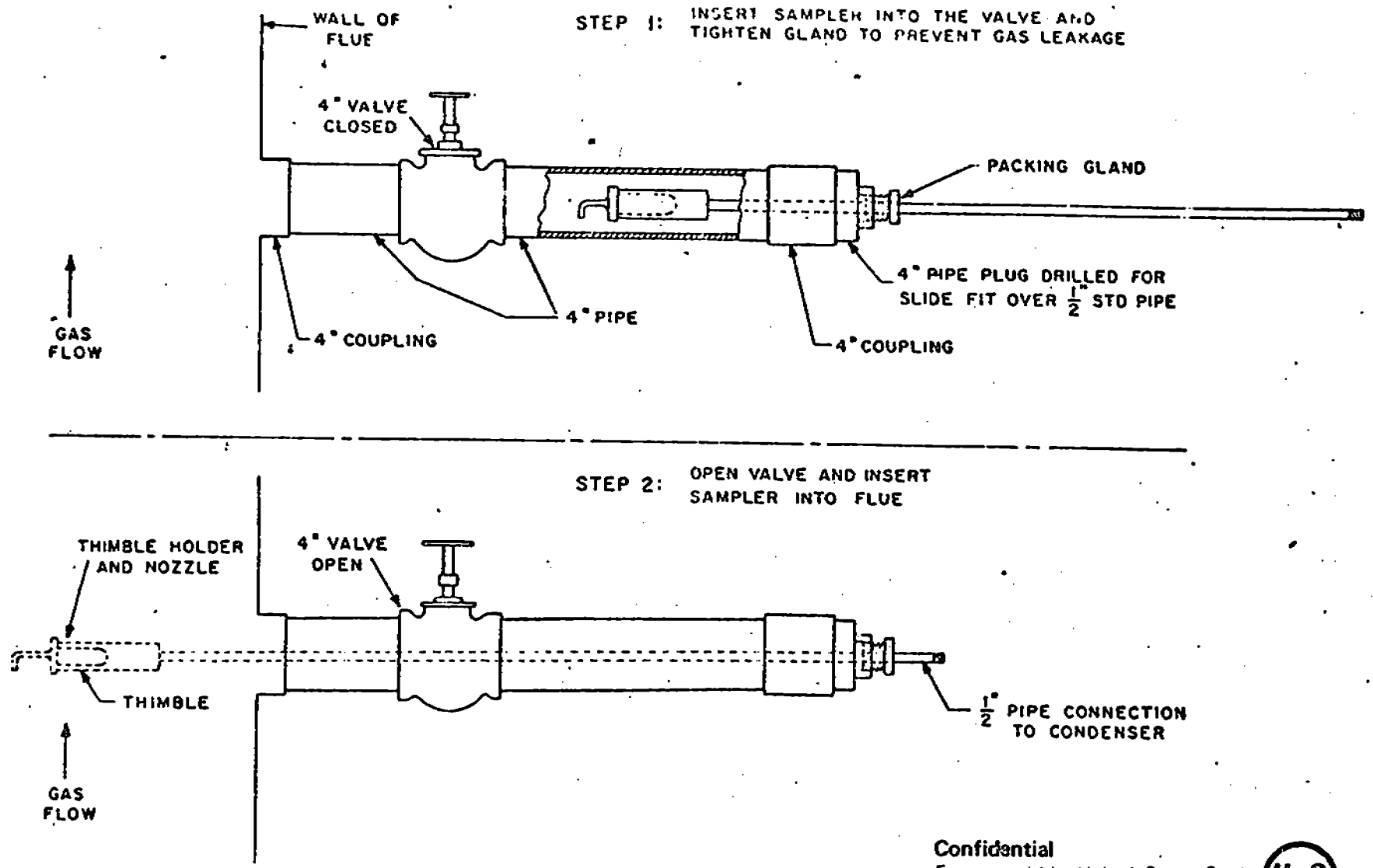
TEMP °F	"Hg
78	.9658
79	.9981
80	1.0314
81	1.0656
82	1.1003
83	1.1370
84	1.174
85	1.212
86	1.251
87	1.292
88	1.334
89	1.377
90	1.421
91	1.466
92	1.512
93	1.560
94	1.609
95	1.659
96	1.710
97	1.763
98	1.818
99	1.874
100	1.931
101	1.990
102	2.051
103	2.113
104	2.176
105	2.241
106	2.308
107	2.377
108	2.448

TEMP °F	"Hg
109	2.520
110	2.594
111	2.670
112	2.748
113	2.827
114	2.909
115	2.993
116	3.079
117	3.167
118	3.257
119	3.349
120	3.444
121	3.541
122	3.640
123	3.741
124	3.845
125	3.952
126	4.061
127	4.172
128	4.286
129	4.403
130	4.523
131	4.645
132	4.770
133	4.898
134	5.029
135	5.163
136	5.30
137	5.44
138	5.58
139	5.73

TEMP °F	"Hg.
140	5.876
141	6.03
142	6.19
143	6.35
144	6.51
145	6.677
146	6.85
147	7.022
148	7.20
149	7.38
150	7.566
151	7.755
152	7.948
153	8.145
154	8.347
155	8.554
156	8.764
157	8.979
158	9.198
159	9.421
160	9.649
161	9.881
162	10.12
163	10.36
164	10.61
165	10.860
166	11.12
167	11.38
168	11.65
169	11.92
170	12.20

TEMP °F	"Hg.
171	12.48
172	12.77
173	13.06
174	13.36
175	13.6[illegible]
176	13.9[illegible]
177	14.3[illegible]
178	14.[illegible]
179	14.9[illegible]
180	15.2[illegible]
181	15.5[illegible]
182	15.98
183	16.3[illegible]
184	16.70
185	17.0[illegible]
186	17.4[illegible]
187	17.8[illegible]
188	18.21
189	18.61
190	19.0[illegible]
191	19.4[illegible]
192	19.8[illegible]
193	20.2[illegible]
194	20.7[illegible]
195	21.1[illegible]
196	21.5[illegible]
197	22.0[illegible]
198	22.5[illegible]
199	22.9[illegible]
200	23.4
212	29.9

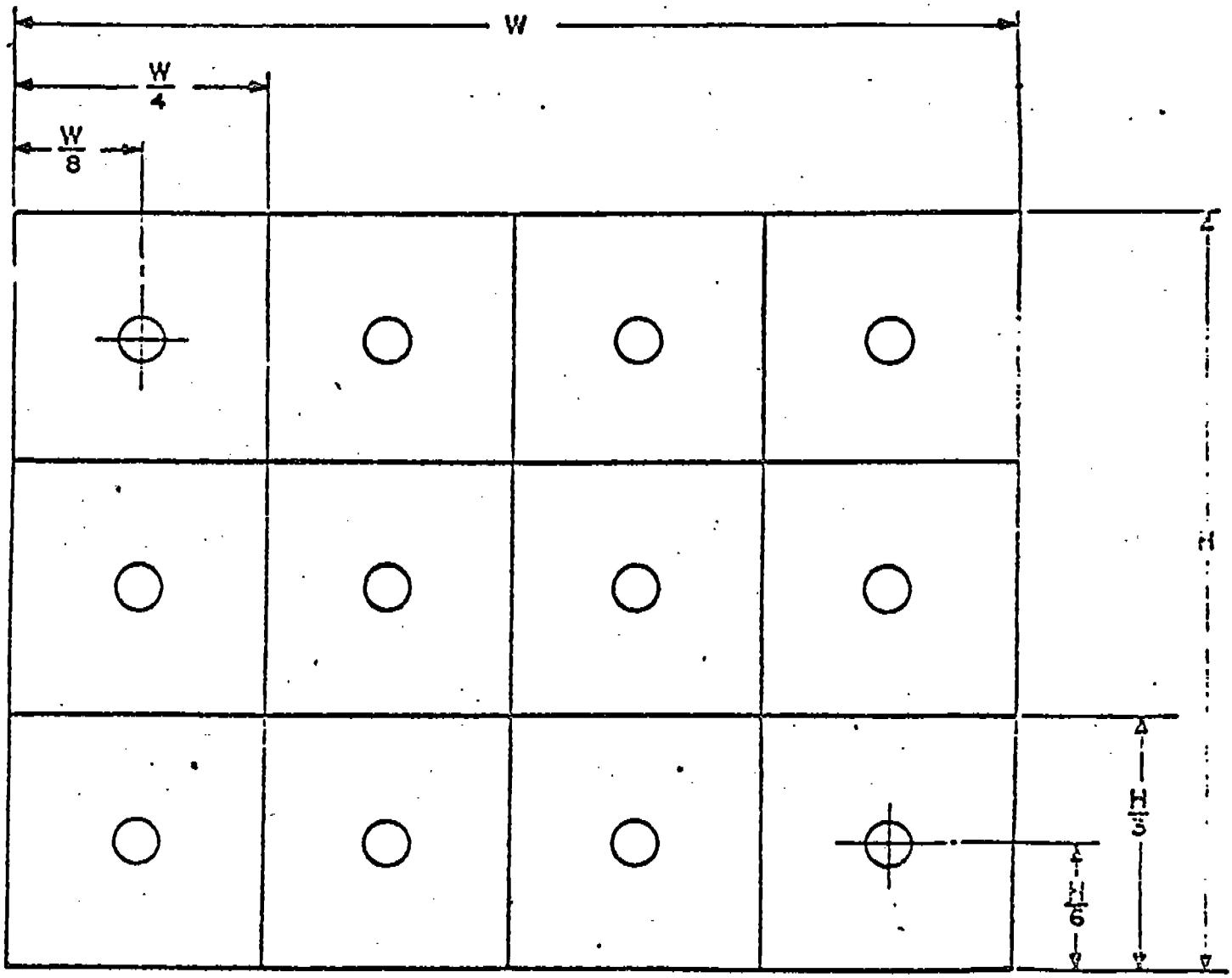
Confidential
For use within United States Steel
by authorized personnel only



Confidential
For use within United States Steel by authorized personnel only

PROCEDURE FOR INSERTING SAMPLER INTO THE FLUE

DRAWN BY	CHK'D BY	APPROVED BY	UNITED STATES STEEL CORPORATION	FIGURE NO.
	A.A.S.		RESEARCH	1
DRAWING No	PROJECT No. 18-L-001 (003)			



IF THE FLOW IS UNIFORM THE NUMBER OF TEST POINTS MAY BE CHOSEN AS FOLLOWS:

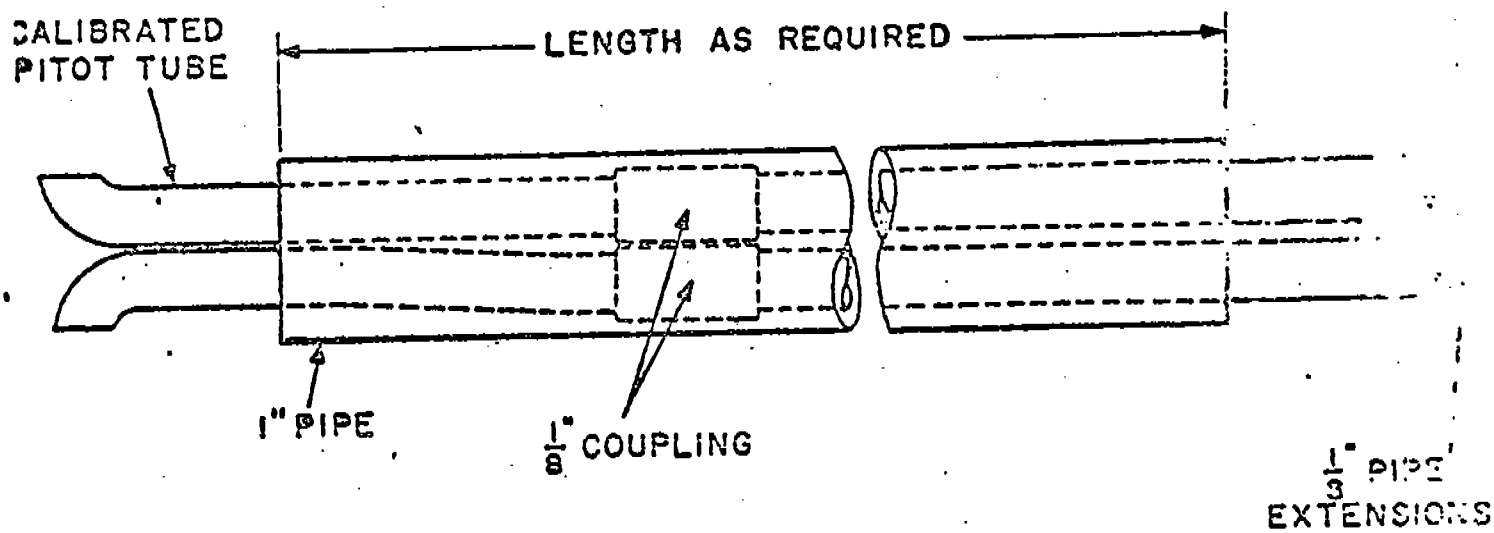
CROSS SECTIONAL AREA, SQUARE FEET	NUMBER OF TEST POINTS
LESS THAN 2	4
2 TO 25	12
OVER 25	20

Confidential
For use within United States Steel
by authorized personnel only

TRAVERSE LAYOUT FOR RECTANGULAR FLUE

DRAWN BY	CHK'D BY	APPROVED BY	UNITED STATES STEEL CORPORATION	FIGURE NO.
DRAWING No.		PROJECT No. 18-[illegible] DATE	RESEARCH PITTSBURGH, PA.	2

G-18292 REV. 1063



Confidential
For use within United States Steel
by authorized personnel only

PITOT - TUBE ASSEMBLY

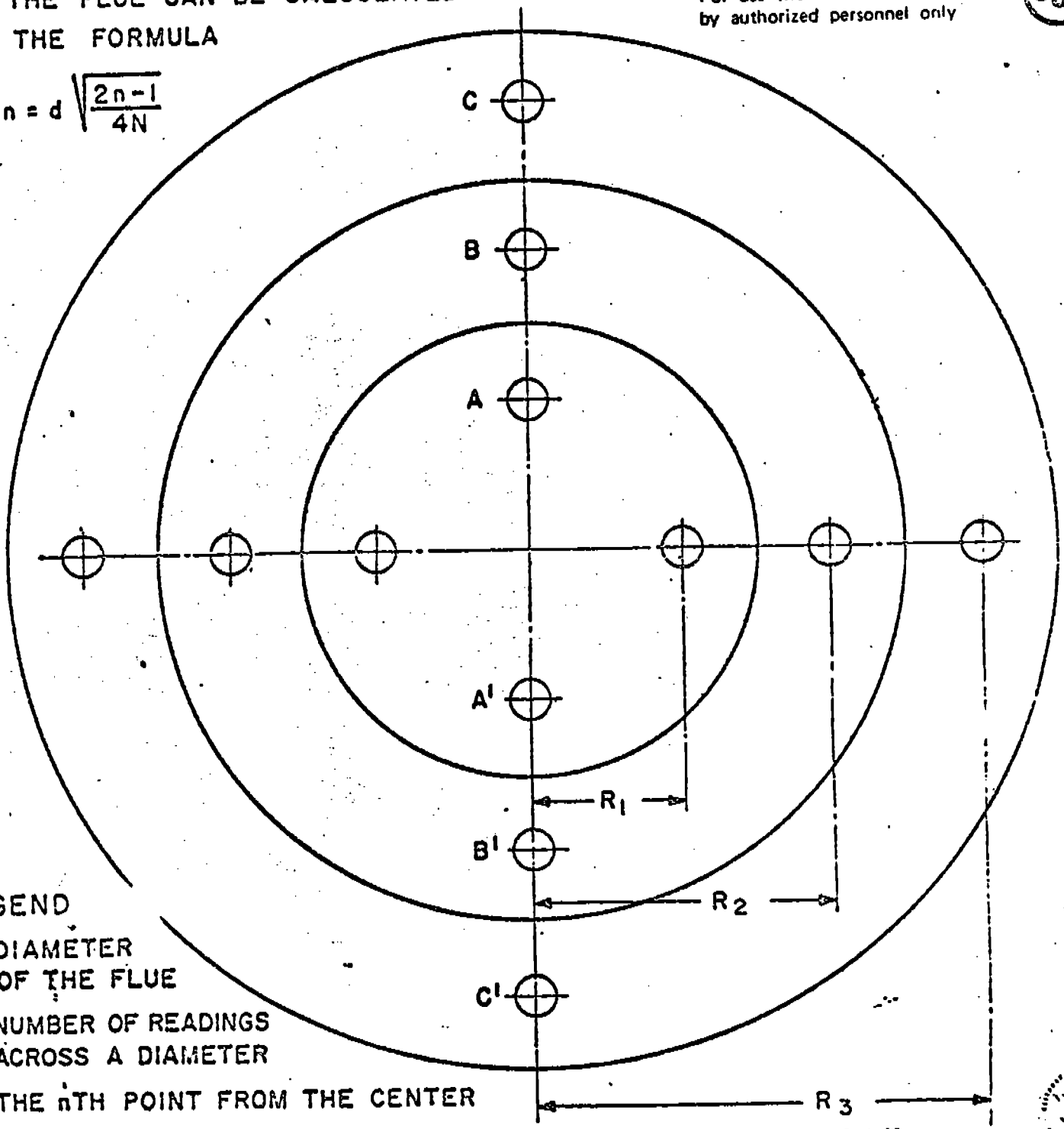
DRAWN BY	CHK'D BY	APPROVED BY	UNITED STATES STEEL CORPORATION	FIGURE NO.
	RAS		RESEARCH	3
DRAWING NO.		PROJECT No. 18-1-001/003		

G-16242 REV. 1063

THE DISTANCE "R" FROM THE CENTER OF THE FLUE CAN BE CALCULATED BY THE FORMULA

$$R_n = d\sqrt{\frac{2n-1}{4N}}$$

Confidential
For use within United States Steel
by authorized personnel only



LEGEND

d = DIAMETER OF THE FLUE

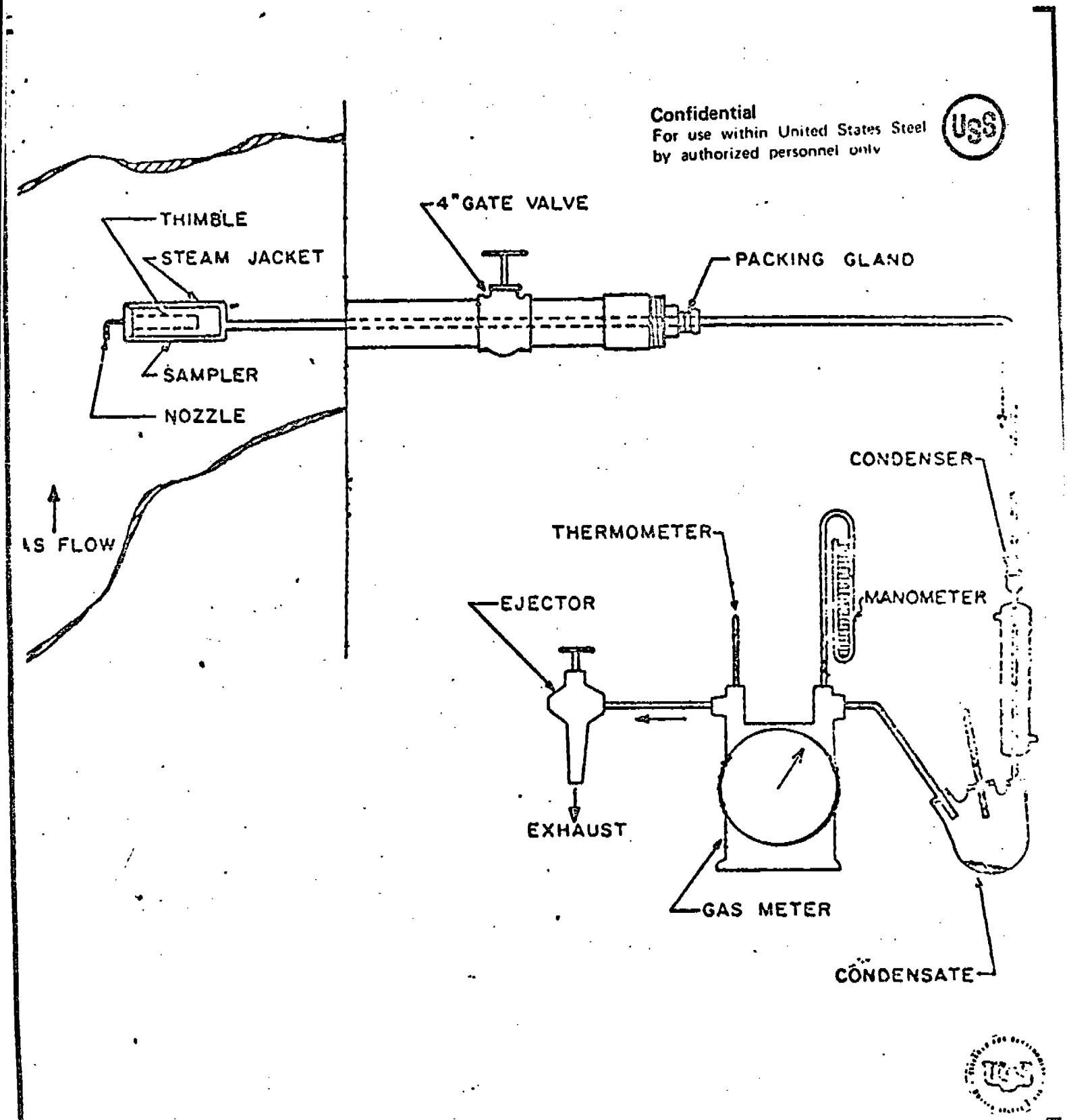
N = NUMBER OF READINGS ACROSS A DIAMETER

n = THE nTH POINT FROM THE CENTER

Rn = DISTANCE FROM THE CENTER OF THE FLUE TO THE nTH POINT

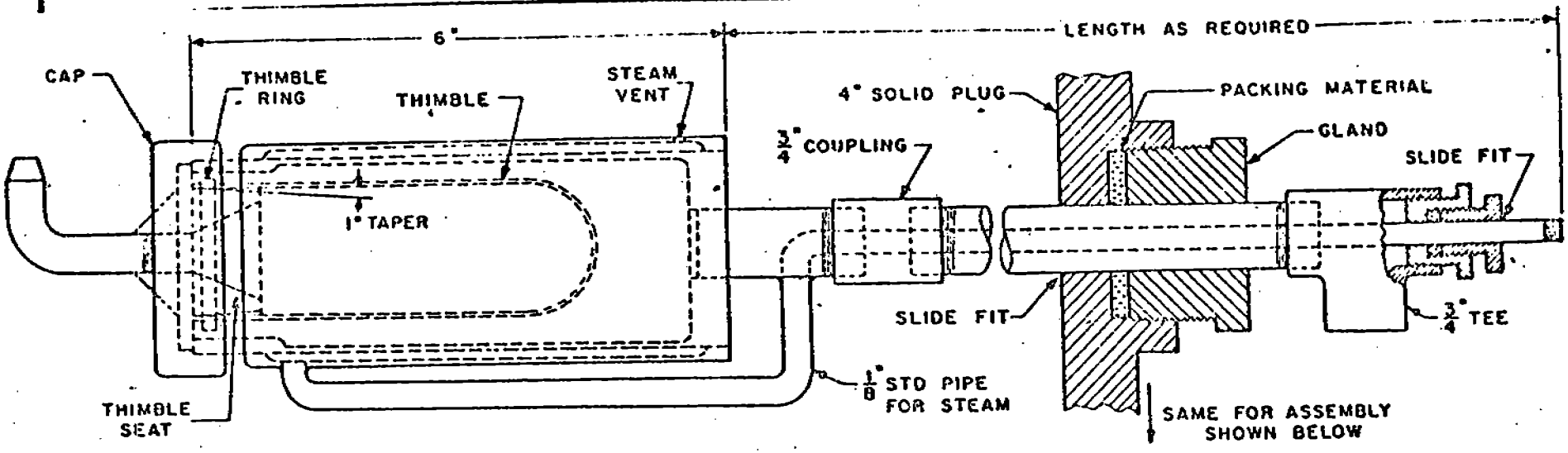
EQUAL-AREA ZONE FOR VELOCITY TRAVERSE

DRAWN BY	CHKD BY	APPROVED BY	UNITED STATES STEEL CORPORATION	PAGE NO.
DRAWING NO.		DATE	RESEARCH PITTSBURGH, PA.	4

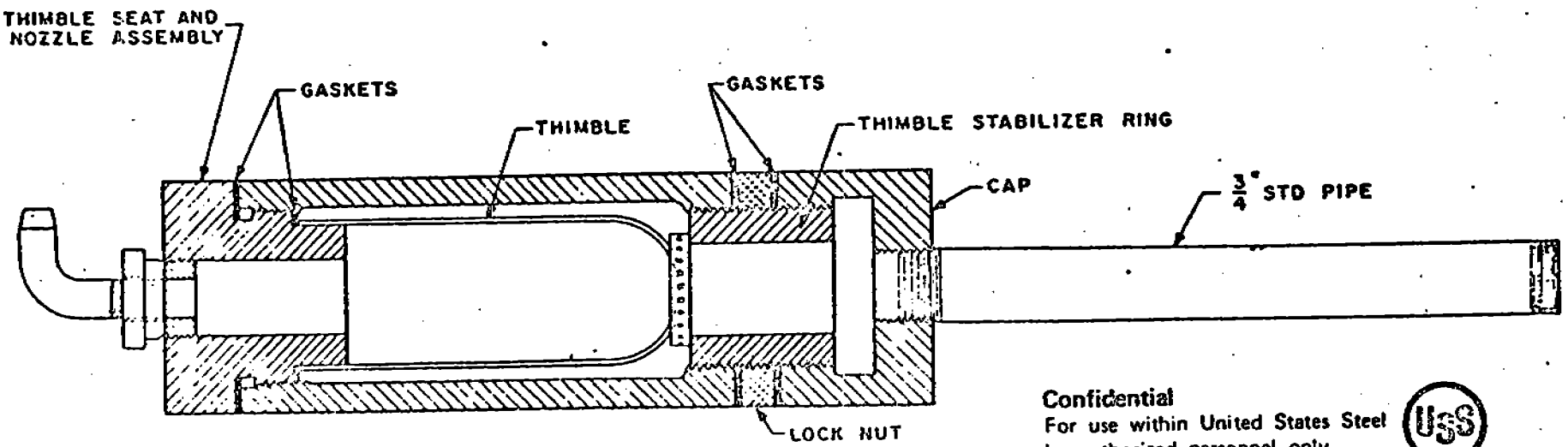


EQUIPMENT FOR MEASURING DUST AND MOISTURE CONTENT

DRAWN BY	CHKD BY	APPROVED BY	UNITED STATES STEEL CORPORATION	FIGURE NO.
DRAWING No		PROJECT No 18-E-001/003	RESEARCH PITTSBURGH, PA.	5



PAPER - THIMBLE HOLDER



ALUNDUM - THIMBLE HOLDER

Confidential
For use within United States Steel by authorized personnel only

PAPER - AND ALUNDUM - THIMBLE HOLDERS WITH PACKING - GLAND ASSEMBLY

DRAWN BY	CHK'D BY	APPROVED BY
DRAWING NO.		PROJECT NO. 18-E-001(003) DATE

UNITED STATES STEEL CORPORATION
RESEARCH
PITTSBURGH, PA.

FIGURE NO. 6

DUST SAMPLING DATA SHEET

Gas Sampled _____

Sampling Station _____

Project No. _____

Ambient Temp., F _____

Barometer, in. Hg _____

Nozzle Diameter, inches _____

Wt. of Condensate, gms. _____

Thimble No. _____

Gross Wt. _____ grams

Tare Wt. _____ grams

Dust Wt. _____ grams

Test No. _____

Date _____ 19 _____

Operators(1) _____

Time: From _____ to _____

Remarks: _____

STATION	Elapsed Time of Test, minutes	Meter Reading, cu.ft.	Differential Meter Reading, cu.ft.	Average Rate, cfm	Meter Suction inches of Hg	Meter Exit Temp., F	Saturation Temp., F	Required Meter Rate cfm

Confidential
For use within United States Steel
by authorized personnel only

USS

DRAWN BY	CHK'D BY	APPROVED BY	UNITED STATES STEEL CORPORATION	FIGURE NO.
	RAS		Research	7
DRAWING No		PROJECT No 18-F-001(003)	PITTSBURGH, PA	

PITOT TRAVERSE DATA SHEET

Traversed _____ Date _____

Traverse Point _____ Operator(s) _____

Duct No. _____ Remarks _____

Type of Flue _____

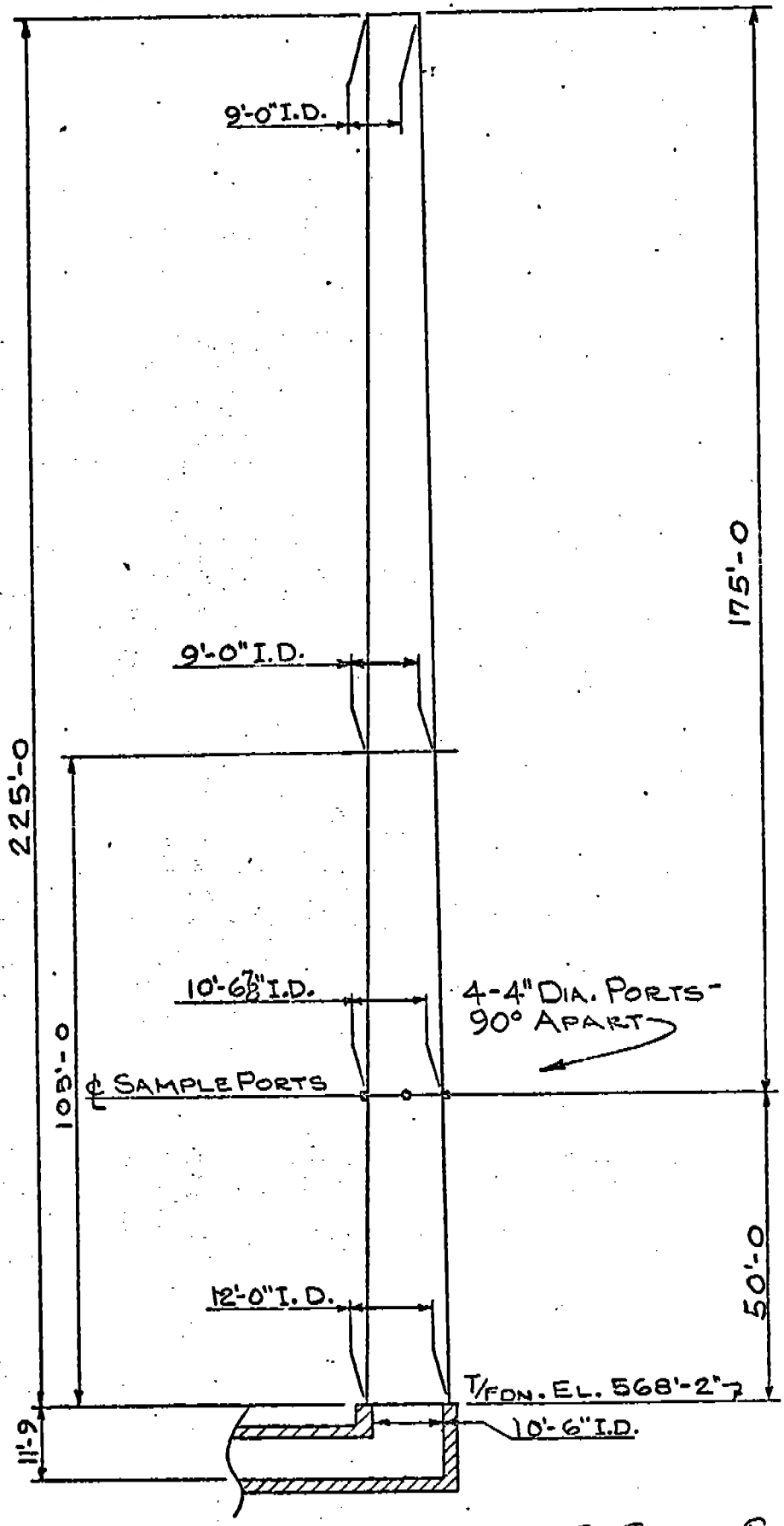
Size of Flue _____

Pitot Tube Correction Factor _____

Station	In		Out		In		Out		In		Out	
	H	$\sqrt{H}$	H	$\sqrt{H}$	H	$\sqrt{H}$	H	$\sqrt{H}$	H	$\sqrt{H}$	H	$\sqrt{H}$
Average												
	Time _____ Flue Temp. _____ Flue Press.				Time _____ Flue Temp. _____ Flue Press.				Time _____ Flue Temp. _____ Flue Press.			

Calculations:

Confidential
For use within United States Steel
by authorized personnel only



U.S. STEEL CORP.
FAIRFIELD WORKS
COKE BATTERY Nº 3
LOCATION OF STACK SAMPLING PORTS
G.W.E. 7-18-75