Commonwealth of Pennsylvania
Environmental Resources
October 12, 1990

Subject: Source Test Review

To: Data File
Commercial Stone Company, Inc.
Sand Manufacturing Plant - Springfield Pike
Connellsville Township, Fayette County

From: John S. Pitulski
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PARTICULATE EMISSION TESTING
SAND PLANT BAGHOUSE
SPRINGFIELD PIKE QUARRY
COMMERCIAL STONE
CONNELLSVILLE, PA

Report to:

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TABLE OF CONTENTS

APPENDIX

1.0 INTRODUCTION

On August 27, 1990, particulate emission testing and opacity observations were performed on the Sand Plant Baghouse at Commercial Stone Company's Springfield Pike plant in Connellsville, PA.

The test program was authorized by Ms. Leah Trielle of Commercial Stone Company. Testing was performed by Mr. Richard Campbell, Mr. Darren Midberry and visible emission readings by Mr. Kevin Kennedy of Comprehensive Safety Compliance, Inc. (CSC). Testing was observed by Mr. Tim Kunz of the Pennsylvania Department of Environmental Resources Air Pollution Control Bureau.

2.0 SUMMARY OF RESULTS

Table No. 1 below is a summary of Particulate Emission Data and Opacity Data from tests on the Sand Plant Baghouse.

Table No. 2 is a summary of flue gas parameters.

TABLE NO. 1

Particulate Emissions and Opacity Data

Test Data 1990	Test No.	Test Location	Particulate Emission Data: Conc.[a] Gr/dscf	Emission Rate[b] lb/hr.	Allowable lb/hr	Opacity Data[c]: Min. %	Max. %	Highest 6 min. Avg. %
8/27	SPS-1	Baghouse Outlet	0.009	1.3	18.2	0	0	0
8/27	SPS-2	Baghouse Outlet	0.010	1.5	18.3	0	0	0
8/27	SPS-3	Baghouse Outlet	0.008	1.2	18.4	0	0	0

(a) Grains per dry standard cubic foot
(b) Pounds per hour
(c) Opacity data from EPA Method 9 observations

TABLE NO. 2

Summary of Flue Gas Parameters

Test Date 1990	Test No.	Test Location	Percent Moisture	Stack Temp. °F	Percent		Flow Rates	
					CO_2 [a]	O_2 [b]	ACFM[c]	DSCFM[d]
8/27	SPS-1	Baghouse Outlet	1.3	74	0.0	21.0	18,600	17,300
8/27	SPS-2	Baghouse Outlet	1.3	78	0.0	21.0	18,900	17,500
8/27	SPS-3	Baghouse Outlet	2.0	78	0.0	21.0	18,900	17,400

a percent carbon dioxide by volume
b percent oxygen by volume
c actual cubic feet per minute
d dry standard cubic feet per minute

3.0 PROCESS AND TEST PROGRAM DESCRIPTION

Process Description

Commercial Stone operates a sand plant at the Springfield Pike location which uses a Buell size classifier (Model GI75) manufactured by Envirotech Corporation. The Buell Gravitational-Inertial Classifier utilizes classifying principles combining, gravitational, inertial centrifugal, and aerodynamic forces. Air or gas entrained feed material enters the classifier primary air inlet at the top of the unit. The primary air inlet velocity is between 3500 and 6000 feet per minute, depending on the classification required. The curtain of feed material drops in front of the air outlet provided with widely spaced vanes to almost reverse the gas flow introduced through the primary air inlet. Prior to passing through the vanes, the relatively high velocity of the entering gas stream sets up, by friction, a counter clockwise eddy current in the chamber. The eddy current is reinforced by gas entering through the secondary air inlet located just above the coarse discharge outlet. Each particle entering the classifier has a gravitational force (Fg) proportional to its mass which, in turn, is proportional to the cube of its diameter. As the particle is introduced in the classifier at the velocity of the primary gas stream, it is also subjected to an inertial force (Fi) also proportional to its mass. Since the gas stream flows in a downward direction, the inertial and gravitational forces (Fi and Fg) complement each other. The gas stream changes direction as it passed through the vanes, thus exerting a drag force (Fd) proportional to the diameter of the particle, and almost opposite in direction to the gravitational and inertial forces. As the particle is influenced by the drag force (Fd) and changes direction, it is subjected to a small centrifugal force (Fc) proportional to its mass, directly opposing drag force (Fd). Under set conditions, the resultant force (R) acting on a particular particle diameter (K) referred to as the cut point, will be of a magnitude and direction to give the particle a 50-50 chance of being swept by the gas stream through the vanes or to impinge on the vanes and to be thrown back into the feed curtain. The resultant force (R) on larger particles than (K) is in a direction at small variance with the gravitational-inertial forces and the particles will either impinge on the vanes and be knocked out, or if large enough, they will not even come in contact with the vanes but fall directly into the coarse discharge. Smaller particles will have a resultant force (R) almost perpendicular to the gravitational-inertial forces which will permit them to be swept through the vanes by the gas stream. The eddy current flowing in a downward parallel direction to the plane formed by the vanes, provides a moving wall containing the curtain of feed material in the classifying zone without detrimental frictional drag effects of a solid wall. The particles not swept through the vanes fall on an inclined baffle plate located at the bottom of the gas outlet directly underneath the primary gas inlet. The coarse product is scrubbed by the secondary air as it slides off into the coarse discharge outlet. Any fines adhering to coarser particles are picked up by the secondary air flow to join the stray fine particles entrained by the eddy current and are returned to the classifier inlet at point, where they are reintroduced in the classifying zone. The buell gravitational-inertial classifier separates at any desired cut point between 200 to 50 mesh (74 to 297) microns). The cut point is controlled by the air velocity through the vanes, determining the magnitude of the drag force (Fd), and the primary air inlet velocity determining inertial force, (Fi). Regulating the inlet velocity by increasing the flow through the secondary air inlet while keeping the total sir volume, i.e., vane velocity constant, is usually all that is required to meet varying cut point requirements. There are two units which each have a capacity of 50-70 tons per hour. A process schematic is shown in Figure No. 1. Process data is provided in Table No. 3.

Emission Control Equipment

The particulate emissions from the two classifiers are collected by a common baghouse. The baghouse is an Eastern Control System (ECS) reverse pulse collector. The unit is a Model 270 which contains 270 ten foot length bags. This provides a surface area of 3645 square feet for collection. Test Data from the baghouse during testing is provided in Appendix D.

Test Program Description

Testing was conducted on the Particulate Emissions from the Sand Plant Baghouse exit stack.

The sampling location is shown in Figure No. 2 Sample duration was 84 minutes for Test No. 1 and 72 minutes for Tests 2 and 3.

BUELL GRAVITATIONAL-INERTIAL CLASSIFIER

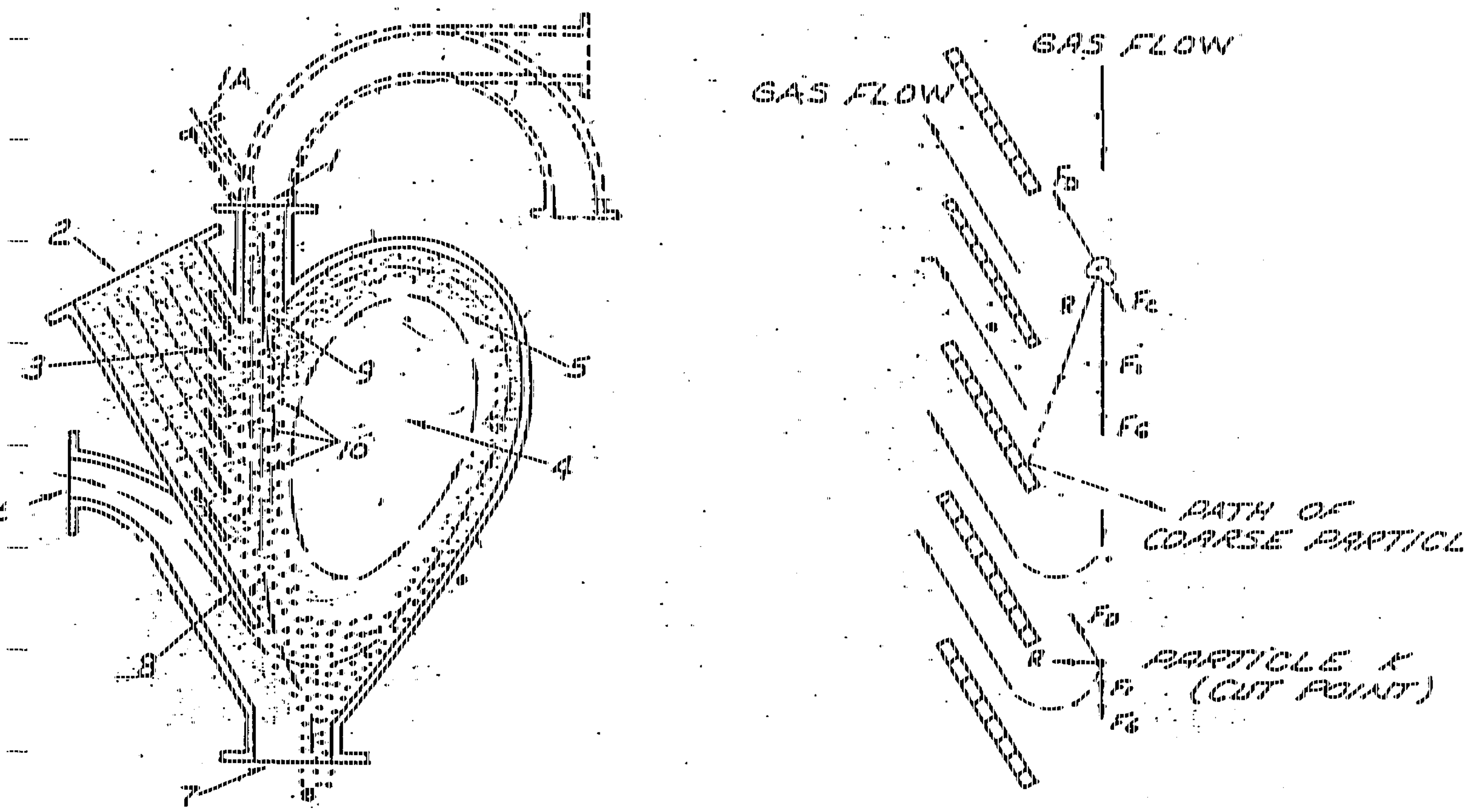


Figure No. 1

Process Schematic Springfield Pike Plant

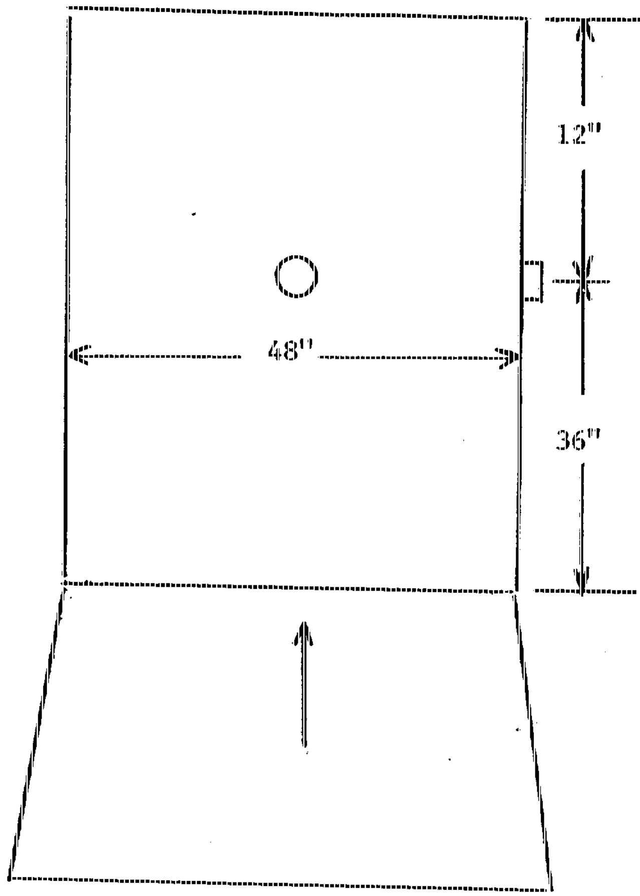
TABEL NO. 3

Process Production

Springfield Pike Sand Plant

DATE 1990	TEST NO	PRODUCTION RATE TONS/HR
8/27	SPS-1	96.0
8/27	SPS-2	97.5
8/27	SPS-3	98.3

Additional process data is provided in Appendix D.



Sample Point Location

Point No.	Percent of Diameter	Point Location (inches)
1	2.1	1.0
2	6.7	3.2
3	11.8	5.7
4	17.7	8.5
5	25.0	12.0
6	35.6	17.1
7	64.4	30.9
8	75.0	36.0
9	82.3	39.5
10	88.2	42.3
11	93.3	44.8
12	97.9	47.0

2 sample ports
90° apart
12 points per port
24 total points

FIGURE NO. 2

Commercial Stone Sand Plant
Sample Location

Method 5 Sampling Procedures

After selecting the sampling site and the minimum number of traverse points, the stack pressure, temperature, moisture and range of velocity head were measured according to the procedures described in the Federal Register*.

Approximately 200 grams of silica gel was weighed in a sealed impinger prior to each test. Glass fiber filters** (4 inch diameter) desiccated for at least 24 hours, dried at 105°C for 2 hours and weighed to the nearest 0.1mg. on an analytical balance. One hundred ml of distilled water was placed in each of the first two impingers; the third impinger was initially empty; and the impinger containing the silica gel was placed next in series. The sampling train was leak-checked at the sampling site prior to each test run by plugging the inlet to the nozzle and pulling 15-inch Hg vacuum, at the conclusion of the test by plugging the inlet to the nozzle and pulling a vacuum equal to the highest vacuum reached during the test run. A more detailed description of the sampling and analytical procedures is provided in Appendix B.

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*Federial Register, CFR 40, Part 60, July 1, 1989

A. FORMULAS AND CALCULATIONS

NOMENCLATURE AND DIMENSIONS

A_s = cross-sectional area of stack, ft^2

A_n = area of sampling nozzle, ft^2

B_{ws} = proportional by volume of water vapor in the gas stream, dimensionless

C_p = pitot tube coefficient, diamensionless = .84

C_s = concentration of particulate matter in stack gas, gr/scf,dry basis

%CO = percent of carbon monoxide by volume, dry basis

$\%CO^2$ = percent of carbon dioxide by volume, dry basis

H = average pressure drop across the orifice meter, inches of H_2O

I = percent of isokinetic sampling

M_d = dry molecular weight, lb/lb-mole

M_n = total amount of particulate matter collected, mg.

M_s = molecular weight of stack gas (wet basis), lb/lb-mole

$\%N_2$ = percent of nitrogen by volume, dry basis

$\%O_2$ = percent of oxygen by volume, dry basis

p = velocity head of stack gas, inches of H_2O

P_{bar} = barometric pressure, inches of Hg

P_s = absolute stack gas pressure, inches of Hg

pmr = particulate matter emission rate, lbs/hr

Q_s = volumetric flow rate, wet basis, standard conditions

$Q_{s\,std}$ = volumetric flow rate, dry basis, standard

T_m = average temperature of dry gas meter, $^{\circ}R$

T_s = average temperature of stack gas, $^{\circ}R$

V_{1_c} = total volume of liquid collected in impingers and silica gel, ml.

V_m = volume of sample through the dry gas meter at meter conditions, ft^3

$V_{m_{std}}$ = volume of gas sample through the dry gas meter at standard conditions, ft^3

V_s = stack gas velocity at stack conditions, fps

$V_{w_{std}}$ = volume of water in the gas sample at standard conditions, ft^3

Θ = total sampling time, minutes

Note: Standard conditions = $70^{\circ}F$ and 29.92 inches of Hg.

Example Calculations for Particulate Emissions

Test No. SPS-1

1. Volume of dry gas sampled corrected to standard conditions. Note: V_m must be corrected for leakage if any leakage rates exceed L_a.)

$$V_{m_{std}} = 17.65 \times V_m \times Y \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right] =$$

$$V_{m_{std}} = 17.65 \times 87.500 \times (.995) \left[\frac{28.6 + \frac{3.9}{13.6}}{567} \right] = 78.287$$

2. Volume of water vapor at standard conditions, ft^3.

$$V_{w_{std}} = 0.04707 V_{l_c} =$$

$$V_{w_{std}} = 0.04707 \times 21.4 = 1.01$$

3. Moisture content in stack gas.

$$B_{ws} = \frac{V_{wc_{std}}}{V_{m_{std}} + V_{wc_{std}}} = B_{ws} = \frac{1.01}{78.287 + 1.01} = .013$$

4. Dry molecular weight of stack gas.

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

$$M_d = 0.440\ (0.0) + 0.32\ (21) + 0.280\ (79) = 28.84$$

5. Molecular weight of stack gas

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

$$M_s = 28.84\ (1-.013) + 18(.013) = 28.70$$

6. Stack velocity at stack conditions, fps

$$V_s = 85.49 \times C_p \times \sqrt{\Delta p \text{ avg.}} \times \sqrt{\frac{T_s}{P_s\ M_s}} =$$

$$V_s = 85.49 \times .84 \times (.425) \times \sqrt{\frac{534}{28.61 \times 28.70}} = 24.61$$

7. Stack gas volumetric flow rate at stack conditions, cfh

$$Q_s = 3600 \times V_s \times A_s$$

$$Q_s = 60 \times 24.61 \times 12.57 = 18{,}561 \text{ ACFM}$$

8. Dry stack gas volumetric flow rate at standard conditions, cfh.

$$Q_{s_{std}} = 17.65\, Q_s \frac{P_s}{T_s} (1 - B_{ws}) = \text{SCFM} \times 60 = \text{SCFH}$$

$$Q_{std} = 17.65 \times 18{,}561 \frac{28.61}{534} \times (1 - .013) = 17{,}324 \times 60 = 1{,}039{,}440$$

9. Concentration in g/scf

$$C'_s = 0.001 \text{ g/mg} \frac{M_n}{V_{m_{std}}} = 0.001 \times \frac{43.9}{78.287} = 0.00056$$

$$0.00056 \times 15.43 = 0.009 \text{ gr/dscf}$$

10. Particulate mass emission rate, lbs/hr.

$$\text{pmr} = \frac{C_s \times Q_{s_{std}}}{454} = \frac{.00056 \times 1{,}039{,}440}{454} = 1.3 \text{ lb/hr}$$

11. Isokinetic variation

$$I = \frac{100\, T_s \left[0.002669\, V_{1_C} + \frac{V_m}{T_m}\, Y \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right]}{60\, \theta\, V_s\, P_s\, A_n} =$$

$$I = \frac{100\,(534)\left[0.002669(21.4) + \frac{87.500}{567}(.995)\left(28.6 + \frac{3.9}{13.6}\right)\right]}{60 \times 84 \times 24.61 \times 28.61 \times .000707} = 95.6$$

Example Calculations for Particulate Emissions

Test No. SPS-2

1. Volume of dry gas sampled corrected to standard conditions. Note: V_m must be corrected for leakage if any leakage rates exceed L_a.)

$$V_{m_{std}} = 17.65 \times V_m \times Y \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] =$$

$$V_{m_{std}} = 17.65 \times 36.887 \times (.995) \left[\frac{28.6 + \frac{3.9}{13.6}}{569}\right] = 32.887$$

$$V_{m_{std}} = 17.65 \times V_m \times Y \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] =$$

$$V_{m_{std}} = 17.65 \times 40.405 \times (.99) \quad \frac{28.6 + \frac{4.0}{13.6}}{561} = 36.363$$

$$\text{Total } V_{m_{std}} = 32.887 + 36.363 = 69.250$$

2. Volume of water vapor at standard conditions, ft^3.

$$V_{w_{std}} = 0.04707 V_{l_c} =$$

$$V_{w_{std}} = 0.04707 \times 19.6 = .922$$

3. Moisture content in stack gas.

$$B_{ws} = \frac{V_{wc\ std}}{V_{m_{std}} + V_{wc_{std}}} = B_{ws} = \frac{.922}{69.250 + .922} = .013$$

4. Dry molecular weight of stack gas.

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

$$M_d = 0.440\ (0.0) + 0.32\ (21.0) + 0.280\ (79) = 28.84$$

5. Molecular weight of stack gas

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

$$M_s = 28.84\ (1-.013) + 18(.013) = 28.70$$

6. Stack velocity at stack conditions, fps

$$V_s = 85.49 \times C_p \times \sqrt{\Delta p \text{ avg.}} \times \sqrt{\frac{T_s}{P_s\ M_s}} =$$

$$V_s = 85.49 \times .84 \times (.432) \times \sqrt{\frac{538}{28.61 \times 28.70}} = 25.11$$

7. Stack gas volumetric flow rate at stack conditions, cfh

$$Q_s = 3600 \times V_s \times A_s$$

$$Q_s = 60 \times 25.11 \times 12.57 = 18{,}938 \text{ ACFM}$$

8. Dry stack gas volumetric flow rate at standard conditions, cfh.

$$Q_{s_{std}} = 17.65\ Q_s\ \frac{P_s}{T_s}\ (1-B_{ws}) = \text{SCFM} \times 60 = \text{SCFH}$$

$$Q_{std} = 17.65 \times 18{,}938\ \frac{28.61}{538} \times (1-.013) = 17{,}544 \times 60 = 1{,}052{,}640$$

9. Concentration in g/scf

$$C'_s = 0.001 \text{ g/mg}\ \frac{M_n}{V_{m_{std}}} = 0.001 \times \frac{46.4}{69.250} = 0.00067$$

$$.00067 \times 15.43 = 0.010 \text{ gr/dscf}$$

10. Particulate mass emission rate, lbs/hr.

$$\text{pmr} = \frac{C_s \times Q_{s_{std}}}{454} = \frac{.00067 \times 1{,}052{,}640}{454} = 1.5 \text{ lb/hr}$$

11. Isokinetic variation

$$I = \frac{100\, T_s \left[0.002669\, V_{1_c} + \frac{V_m}{T_m}\, Y \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right]}{60\, \theta\, V_s\, P_s\, A_n} =$$

$$I = \frac{100\ (538)\ \left[0.002669(19.6) + \frac{77.292}{565} \times (.99)\ \left(28.6 + \frac{4}{13.6}\right) \right]}{60 \times 72 \times 25.11 \times 28.61 \times .000707} = 97.2$$

Example Calculations for Particulate Emissions

Test No. SPS-3

1. Volume of dry gas sampled corrected to standard conditions. Note: V_m must be corrected for leakage if any leakage rates exceed L_a.)

$$V_{m_{std}} = 17.65 \times V_m \times Y \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right] =$$

$$V_{m_{std}} = 17.65 \times 77.275 \times (.99) \left[\frac{28.6 + \frac{3.8}{13.6}}{571} \right] = 68.292$$

2. Volume of water vapor at standard conditions, ft^3.

$$V_{w_{std}} = 0.04707 V_{l_c} =$$

$$V_{w_{std}} = 0.04707 \times 29.2 = 1.37$$

3. Moisture content in stack gas.

$$B_{ws} = \frac{V_{wc_{std}}}{V_{m_{std}} + V_{wc_{std}}} = B_{ws} = \frac{1.37}{68.292 + 1.37} = .020$$

4. Dry molecular weight of stack gas.

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

$$M_d = 0.440\ (0.0) + 0.320\ (21) + 0.280\ (79) = 28.84$$

5. Molecular weight of stack gas

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

$$M_s = 28.84\ (1-.02) + 18(.02) = 28.62$$

6. Stack velocity at stack conditions, fps

$$V_s = 85.49 \times C_p \times \sqrt{\Delta p\ avg.} \times \sqrt{\frac{T_s}{P_s\ M_s}} =$$

$$V_s = 85.49 \times .84 \times (.430) \times \frac{538}{28.61 \times 28.62} = 25.03$$

7. Stack gas volumetric flow rate at stack conditions, cfh

$$Q_s = 3600 \times V_s \times A_s$$

$$Q_s = 60 \times 25.03 \times 12.57 = 18{,}878 \text{ ACFM}$$

8. Dry stack gas volumetric flow rate at standard conditions, cfh.

$$Q_{s_{std}} = 17.65\ Q_s \frac{P_s}{T_s} (1-B_{ws}) = \text{SCFM} \times 60 = \text{SCFH}$$

$$Q_{std} = 17.65 \times 18{,}878\ \frac{28.61}{538} \times (1-.02) = 17{,}364 \times 60 = 1{,}041{,}840$$

9. Concentration in g/scf

$$C'_s = 0.001 \text{ g/mg} \frac{M_n}{V_{m_{std}}} = 0.001 \times \frac{35.8}{68.292} = .00052$$

$$.00052 \times 15.43 = .008 \text{ gr/dscf}$$

10. Particulate mass emission rate, lbs/hr.

$$pmr = \frac{C_s \times Q_{s_{std}}}{454} = \frac{.00052 \times 1{,}041{,}840}{454} = 1.2 \text{ lb/hr}$$

11. Isokinetic variation

$$I = \frac{100\ T_s \left[0.002669\ V_{1_c} + \frac{V_m}{T_m}\ Y \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right]}{60\ \theta\ V_s\ P_s\ A_n} =$$

$$I = \frac{100\ (538)\ [0.002669(29.2) + \frac{77.275}{571} \times (.99)\ (28.6 + \frac{3.8}{13.6})]}{60 \times 72 \times 25.03 \times 28.61 \times .000707} = 97.1$$

Formula,

$A = 0.76E^{0.42}$, where:
A = Allowable emissions in pounds per hour
E = Emission index = F x W pounds per hour
E = Process factor in pounds per unit, and
W = Production or charging rate in units per hour
F = 20 lbs/ton
W = Tons/hr

Test No.1

$A = 0.76\ (20 \times 96.0)^{0.42} = 18.2$ lbs/hr

Test No. 2

$A = 0.76\ (20 \times 97.5)^{0.42} = 18.3$ lbs/hr

Test No. 3

$A = 0.76\ (20 \times 98.3)^{0.42} = 18.4$ lbs/hr

B. SAMPLING METHODOLOGY & EQUIPMENT CALIBRATION

SAMPLE AND VELOCITY TRAVERSES FOR STATIONARY SOURCES
EPA METHOD 1

The following method was used in this test program. Sampling procedures follow those described in EPA Method 1 of the Federal Register*.

SELECTION OF THE MEASUREMENT SITE

The velocity measurement were taken at (**) stack (or duct) diameters downstream and (**) diameters upstream from any flow disturbances.

CHOOSING THE NUMBER OF TRAVERSE POINTS (non-Cyclonic flow)

Particulate Traverse Sampling

At least twelve (12) traverse points were sampled for circular (or rectangular) stack diameters greater than .61 meters. At least eight (8) traverse points were sampled for circular stacks and nine (9) points for rectangular stacks for equivalent diameters for .30 to .61 meters. For other stack diameters, Figure 1-1 was referred to.

Non-Particulate Traverse Sampling

The above procedure was used except that Figure 1-2 is substituted for Figure 1-1.

CROSS SECTIONAL TRAVERSE POINT LOCATIONS

The traverse points were located on two (2) perpendicular diameters. For particulate traverse samples, on of the above diameters was positioned in the plane containing the greatest concentration variation.

Circular Stacks

EPA Method 1, Figure 1-3 and Table 1-2 was referred to.

Rectangular Stacks

Using Figure 1-4 and Table 1-1 a rectangular grid, sectioned into as many equal areas as there are traverse points, was constructed. A sample was taken at the center of each elemental area in the grid.

No traverse points were located within 2.5 centimeters of the stack wall for stack diameters greater than .61 meters. For stack diameters equal to or less than .61 meters, no traverse points were located within 1.3 centimeters. For both of the above cases, where the sample nozzle inside diameter was greater than the adjusted distances, the larger distance was used.

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*Federal Register, CFR 40, Part 60, July 1, 1989
** Check sampling location schematic included.

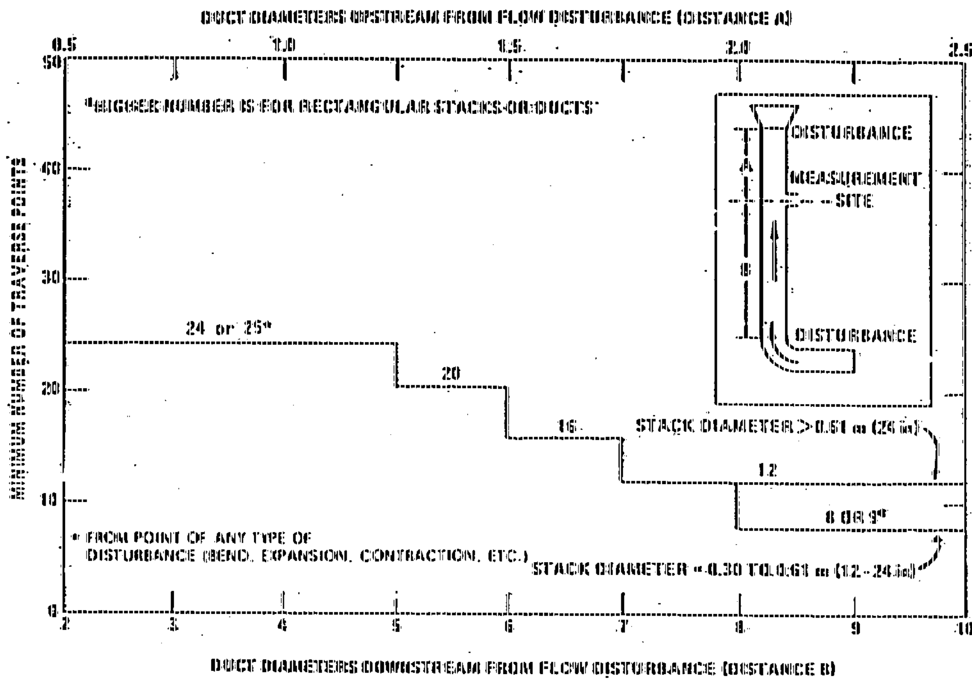


Figure 1-2. Minimum number of traverse points for particulate traverses.

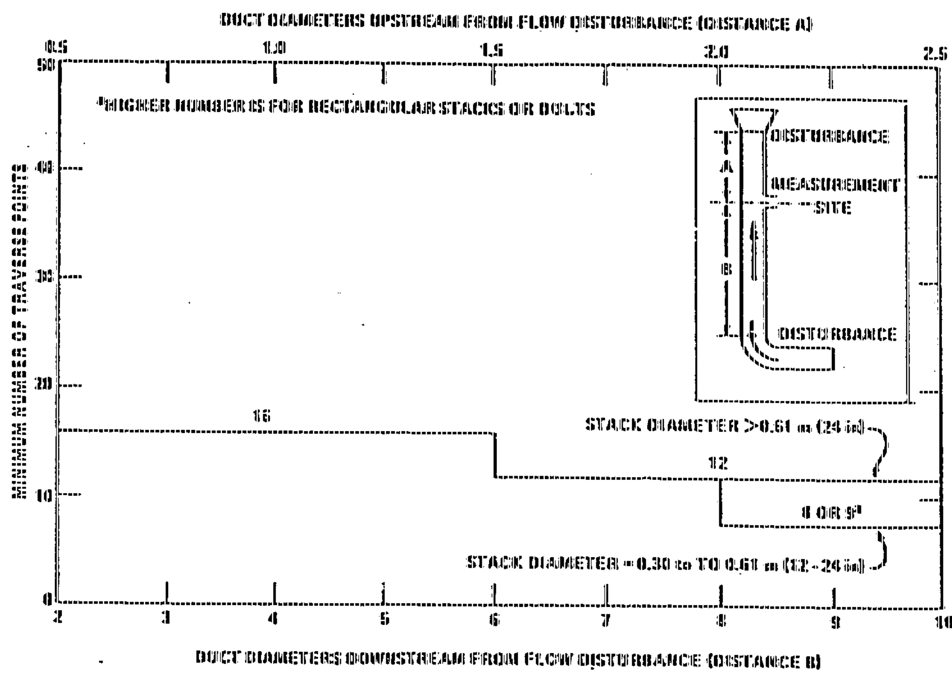


Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

Table 1-2. Location of Traverse Points in Circular Stacks

[Percent of stack diameter from inside wall to traverse point]

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

TRAVERSE POINT	DISTANCE, % of diameter
1	4.4
2	14.6
3	29.6
4	70.4
5	85.4
6	95.6

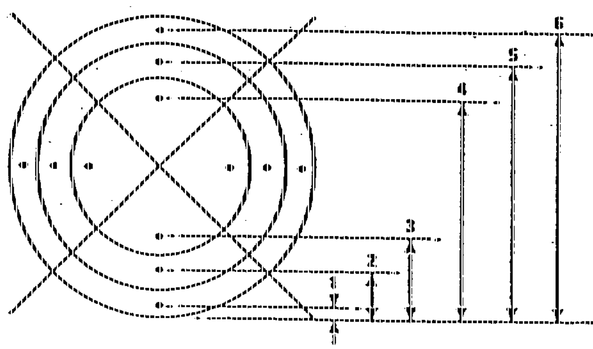


Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

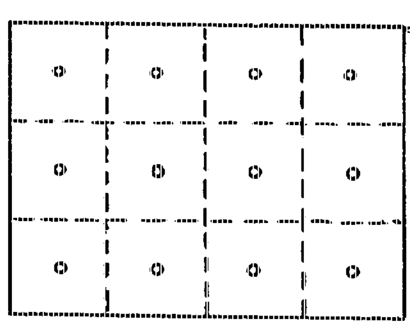


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

Verification of the Absence of Cyclonic Flow through Stacks

For any stack where there existed a possibility of cyclonic flow, a test for the presence of cyclonic flow was performed using a manometer and Type S pitot tube.

The manometer was leveled and zeroed before the pitot tube was connected to the probe and positioned at each traverse point. The pitot tube was rotated (if necessary) until a null reading was obtained. All rotation angles were assigned absolute values. When no rotation was necessary, a value of 0 degrees was assigned. The values were summed, and the resultant angle called alpha ( ). Twenty (20 degrees was the limit of acceptability of the measurement locations for the average value of alpha with a Standard Deviation of ten (10) degrees or less.

A minimum of 24 traverse points for circular ducts and 42 points for rectangular ducts were used in the determination of gas flow angles. When the absence of cyclonic gas flow was verified, these same points were used to obtain velocity measurements.

EPA METHOD 2

DETERMINE OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE
EPA METHOD 2

The average velocity in a stack (or duct) was determined from the gas' density and average velocity head with a Type S pitot tube and stack gas flow was quantified.

SAMPLING APPARATUS

The apparatus consisted of the following equipment:

Pitot Tube - Type S pitot tube that meet all geometry standards was used to monitor stack gas velocity.

Draft Gauge - An inclined manometer made by Dwyer with readability of 0.01 inches H_2O in the 0-1 inch range was used.

Temperature Gauge - Included a thermocouple and digital readout capable of measuring temperatures to within 1.5% of the minimum stack temperatures.

Barometer - A barometer capable of measuring atmospheric pressure to within 2.5 mm Hg.

Gas Density Determination Equipment - Fyrite analyzer.

SAMPLING PROCEDURE

The apparatus was set up as illustrated in Figure 1.

The pretest leak-check was conducted for both the impact and static openings of the Pitot tube.

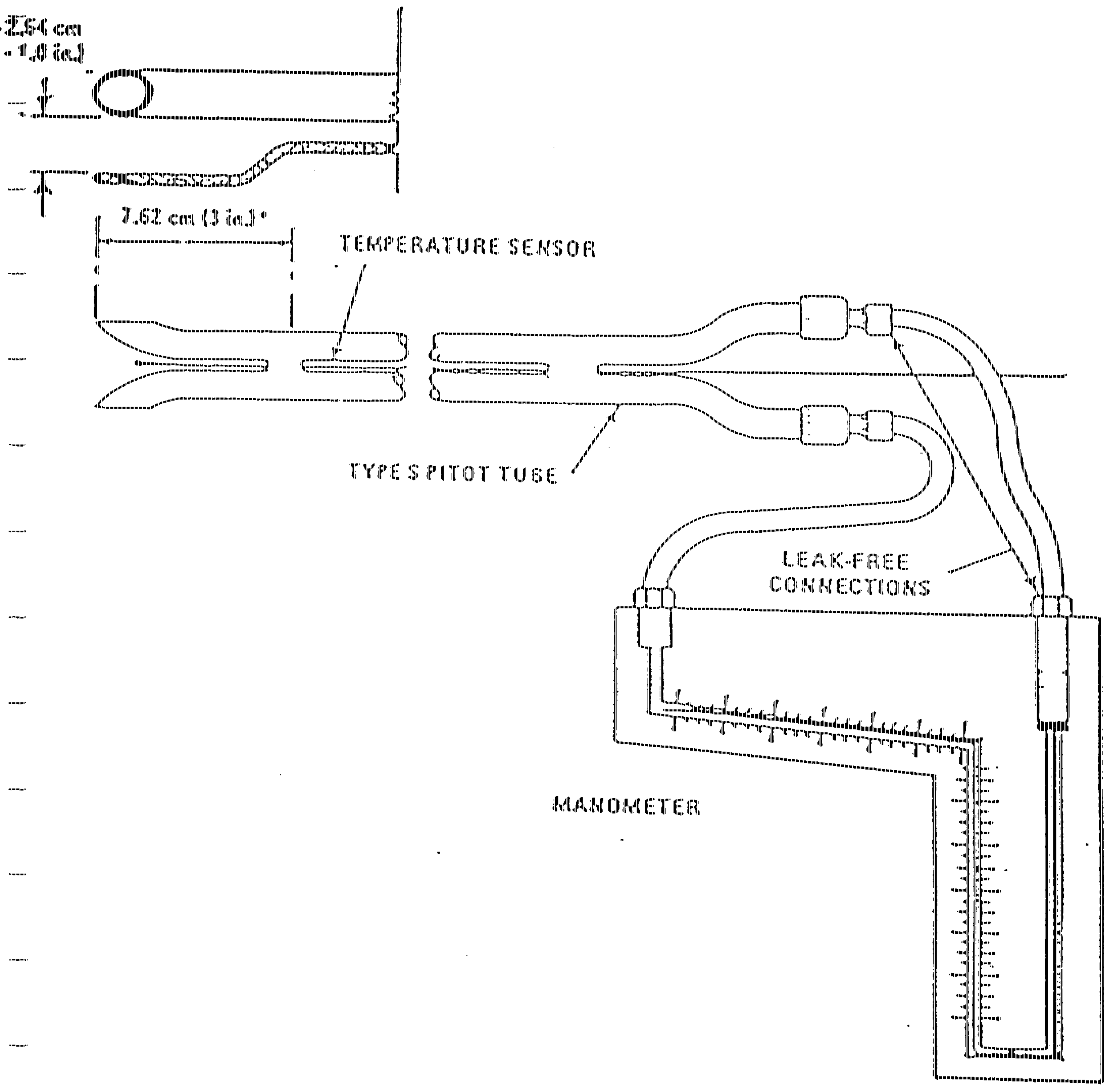
After adjusting the manometer level and zero, the velocity head and temperature were measured for each traverse point and recorded on the data sheet.

In addition, the static pressure in the stack was measured and the atmospheric pressure recorded.

The stack gas dry molecular weight was determined using EPA Method 3.

The moisture content was obtained using either EPA Method 4 or EPA Method 5.

The cross sectional area of the stack (or duct) at the sampling location was measured and recorded.



EPA Method 2

Flow Measurement System

EPA METHOD 3

GAS ANALYSIS FOR CARBON DIOXIDE, OXYGEN, EXCESS AIR & DRY

GAS ANALYSIS FOR CARBON DIOXIDE, OXYGEN, EXCESS AIR AND DRY MOLECULAR WEIGHT

EPA METHOD 3

The following method was used in this test program. Sampling procedures followed those described in EPA Method 3 of the Federal Register*.

SAMPLING APPARATUS

The gas analysis sampling train used in these tests at the exit stack meet the design specifications established by the Federal EPA and was assembled by Comprehensive Safety Compliance, Inc. (CSC) personnel.

The apparatus consisted of the following:

INTEGRATE SAMPLING: APPARATUS

PROBE - A stainless steel probe equipped with an in-stack or out-stack glass wool filter to remove particulate matter.

PUMP - A leak-free, diaphragm-type pump to transport sample gas to the flexible bag.

CONDENSER - A water-cooled condenser to remove excess moisture.

VALVE - A needle valve to adjust the sample flow rate.

SURGE TANK - A surge tank installed between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rate meter.

RATE METER - A rotameter capable of measuring flow rates to within ± 2% of a flow range of 500 to 1000 cubic centimeters per minute.

ORSAT ANALYZER - This combustible gas analyzer was used to determine dry molecular weight (DMW) for O_2, CO_2 and CO.

*Federal Register, CFR 40, Part 60, July 1, 1989

INTEGRATED SAMPLING

The sample train was set up as shown in Figure No. 1.

For single point sampling the sample point location was at the center of the cross-section or at least 1 meter away from the stack wall. The analyzer leak test was performed, and the flexible bag as well as the sample train was also leak tested.

For multi-point sampling at least eight traverse points were sampled in circular stacks with diameters less than .61 meters (9 points for rectangular stacks of .61 meter equivalent diameter). At least twelve points were sampled for all other cases.

Traverse point location was performed; with respect to EPA Method 1. All points were traversed and sampled for an equal length of time.

After positioning the probe and purging the sample line, the sample bag was connected to the train.

The sample was taken at a constant rate. The run was simultaneous will the lasted the total duration of the pollutant emission rate determination.

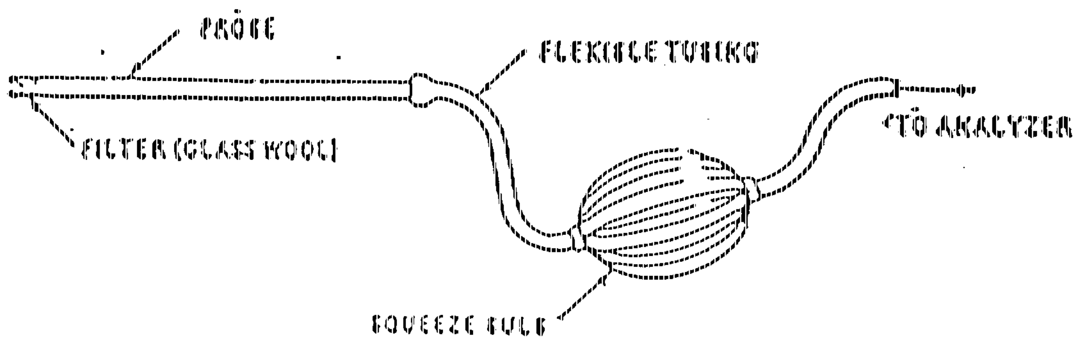
One flue gas sample was taken for each pollutant emission rate determination. Within eight hours the samples were analyzed for % CO_2 and O_2. The % N_2 and CO were determined and the dry molecular weight was calculated.

SAMPLE ANALYSIS

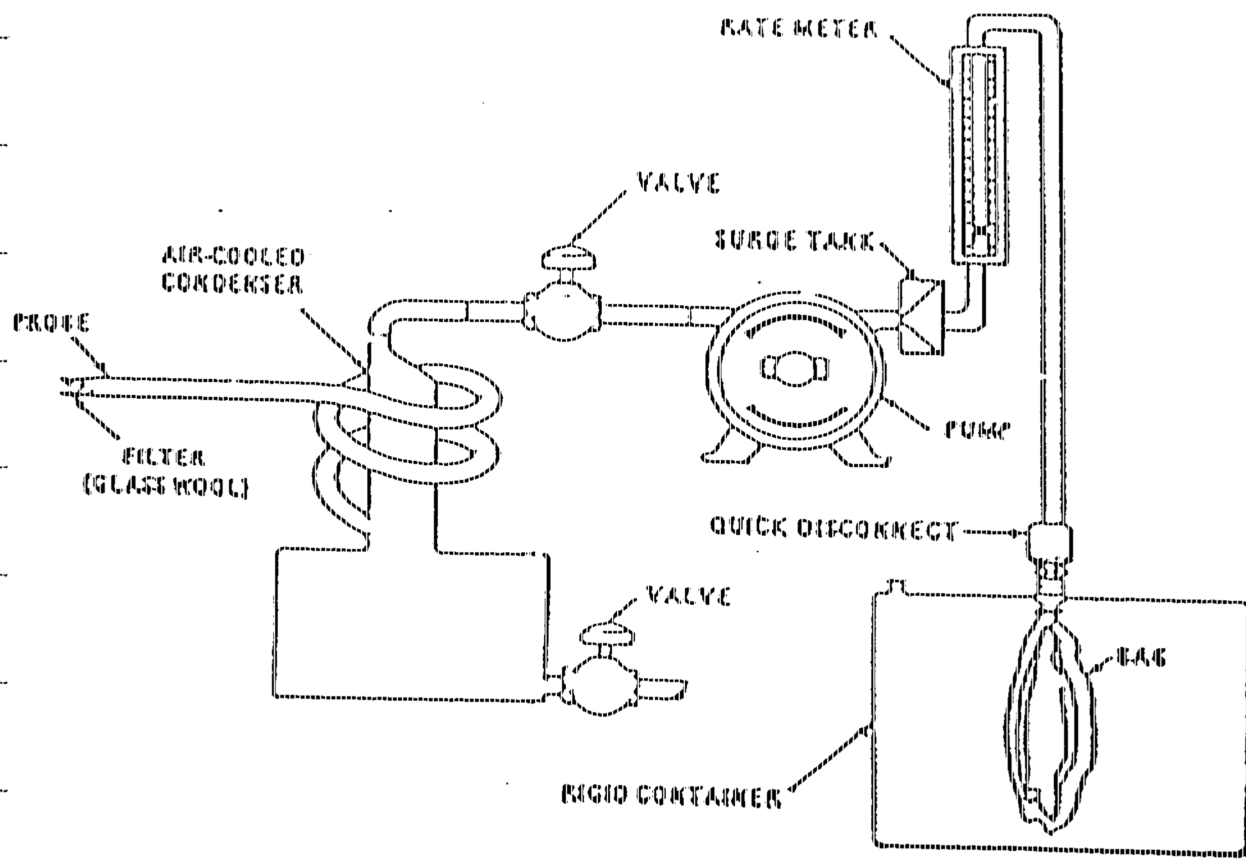
After a sample was drawn into a combustible gas analyzer, it was immediately analyzed for percent CO_2 and O_2. The percentage of the gas that is N_2 and Co was determined by subtracting the sum of the percents CO_2 and O_2 from 100 percent.

During sample analysis for a given gas, consecutive passes through the analyzer absorbing solutions were made until two consecutive readings were obtained. All values were averaged and recorded to the nearest 0.1%.

The analyzer was leak-tested before and after the analyses was performed.



Grab-sampling train.



EPA Method 3

Gas Composition Sampling Train

CO_2 ANALYSIS

The results of three analyses differ by no more than:

a) .3% volume when the CO_2 was greater than 4% of the total gas volume.

b) .2% volume when CO_2 was less than or equal to 4% of the total gas volume.

O_2 ANALYSIS

The analytical procedure was repeated until the results of three analyses differ by no more than:

a) .3% volume when O_2 was less than or equal to 15% of total gas volume.

b) .2% by volume when O_2 was greater than or equal to 15% of total gas volume.

CO AND N_2 ANALYSIS

For percent CO and N_2, the analytical procedure was repeated until three analyses differ by no more than .3%.

DETERMINATION OF THE DRY MOLECULAR WEIGHT

The DMW of each sample was determined using the following formula:

$$DMW = 0.440\ (\%\ CO_2) + .322\ (\%\ O_2) + .280\ (\%\ N_2 + \%\ CO)$$

EMISSION RATE CORRECTION FACTOR OR EXCESS AIR DETERMINATION

An EPA approved combustible gas analyzer was used to determine the excess air content in the stack emissions.

For single point and grab samples, the values obtained for % O_2, CO and N_2 were substituted in the following equation to determine the % excess air:

$$\%\ EA = \frac{\%\ O_2 - .5\%\ CO}{.264\%\ N_2 - (\%\ O_2 - .5\%\ CO)} \times 100\%$$

The fuel factor, F, calculated as follows:

$$F = \frac{20.9 - \%O_2}{\%CO_2}$$

*20.9 = The percent of O_2 by volume in ambient air.

SAMPLING PROCEDURE

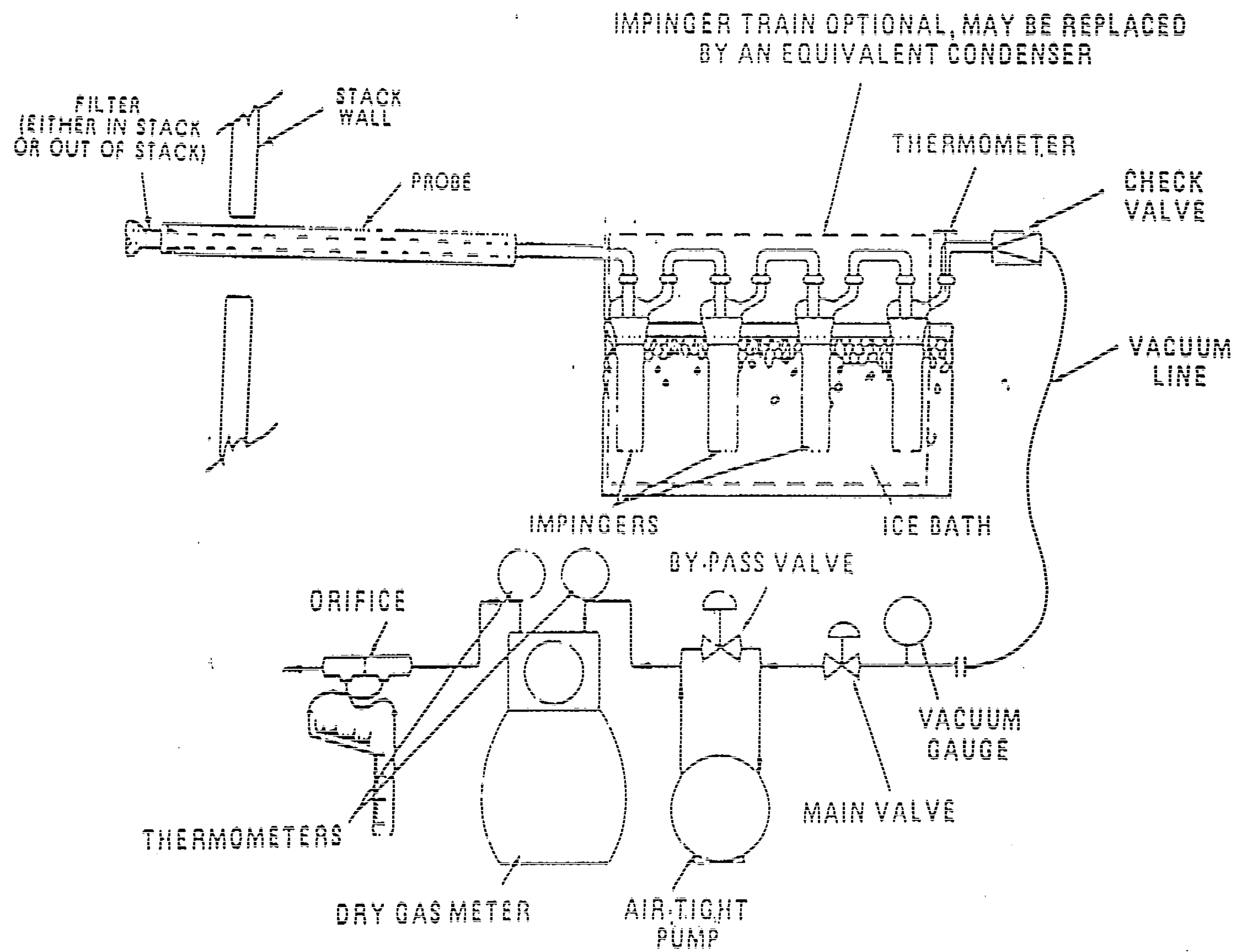
After selecting the sampling site and the minimum number of traverse points, the stack pressure and temperature was measured according to the procedures described in the Federal Register*.

Approximately 200 grams of silica gel were weighed in a sealed impinger prior to each test. One-hundred m.l of distilled water was placed in each of the first two impingers; the third impinger was initially empty; and the impinger containing the silica gel was placed next in series. The train was set up with the probe as shown in Figure A-1. The sampling train was leak-checked at the sampling site prior to each test run by plugging the inlet to the nozzle and pulling a 15 inch Hg vacuum, and at the conclusion of the test by plugging the inlet to the nozzle and pulling a vacuum equal to the highest vacuum reached during the test run.

Crushed ice was placed around the impingers to keep the temperature of the gases leaving the last impinger at 68 F or less.

During sampling, stack gas and sampling train data were recorded at each sampling point and when significant changes in stack flow conditions occur. All sampling data were recorded on the Field Data Sheet.

*Federal Register, CFR 40, Part 60, July 1, 1989



Moisture sampling train-reference method.

SAMPLE RECOVERY PROCEDURE

The sampling train was moved carefully from the test site to the cleanup area. Sample fractions were recovered as follows:

1. The volume of water from the first three impingers was measured and recorded on the Recovery Data Sheet.

2. The silica gel from the fourth impinger was weighed and the gain recorded on the Sample Recovery Data Sheet with other pertinent data.

EPA METHOD 5

DETERMINATION OF PARTICULATE EMISSIONS

DETERMINATION OF PARTICULATE EMISSIONS
EPA METHOD 5

The following method was used in this test program. Sampling procedures followed those described in Method 5 of the Federal Register*.

SAMPLING APPARATUS

The particulate sampling train used in these tests at the exit stack met design specifications established by the Federal EPA and was assembled by Comprehensive Safety Compliance, Inc. (CSC) personnel. It consisted of:

Nozzle - Stainless steel (316) with sharp, tapered leading edge and accurately measured round opening.

Probe - Glass lined with a heating system capable of maintaining a minimum gas temperature of 250 F at the exit end during sampling.

Filter Holder - Pyrex glass with heating system capable of maintaining a filter temperature of approximately 250 F.

Draft Gauge - An inclined manometer made by Dwyer with readability of 0.01 inches H_2O in the 0-1 inch range was used.

Impingers - Four impingers connected in series with glass ball joints. The first, third and fourth impingers were of the Greensburg-Smith design, modified by replacing the tip with a 1/2 inch I.D. glass tube extending to 1/2 inch from the bottom of the flask.

Metering System - Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5 , calibrated dry gas meter, and related equipment, to maintain an isokinetic sampling rate and to determine sample volume. The dry gas meter is made by Rockwell and the fiber vane pump is made by Gast.

Barometer - Aneroid type to measure atmospheric pressures to ±0.1 inch Hg.

*Federal Register, CFR 40, Part 60, July 1, 1989

SAMPLING PROCEDURE

After selecting the sampling site and the minimum number of traverse points, the sack pressure, temperature, moisture and range of velocity head were measured according to the procedures described in the Federal Register*.

Approximately 200 grams of silica gel was weighed in a sealed impinger prior to each test. Glass fiber filters** (4 inch diameter) were desiccated for at least 24 hours, dried at 105 C for 2 hours and weighed to the nearest 0.1 mg on an analytical balance. One hundred ml of distilled water was placed in each of the first two impingers; the third impinger was initially empty; and the impinger containing the silica gel was placed next in series. The train was set up with the probe as shown in Figure A-1. The sampling train was leak-checked at the sampling site prior to each test run by plugging the inlet to the nozzle and pulling 15 inch Hg vacuum, and at the conclusion of the test by plugging the inlet to the nozzle and pulling a vacuum equal to the highest vacuum reached during the test run.

The pitot tube and line were leak-checked at the test site prior to an following the initial velocity traverse. The check was made by blowing into the impact opening of the pitot tube* until 3 or more inches of water were recorded on the manometer and then capping the impact opening and holding it for 15 seconds to assure it was leak free. The static pressure side of the pitot tube was leak checked using the same procedure, except suction was used to obtain the 3 inch H_2O manometer reading. Crushed ice was placed around the impingers to keep the temperature of the gases leaving the last impinger at 68 F or less.

During sampling, stack gas and sampling train data were recorded at each sampling point and when significant changes in stack flow conditions occurred. Isokinetic sampling rates were set throughout the sampling period with the said of a nomograph or calculator. All sampling were recorded on the Particulate Field Data Sheet.

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* Federal Register, CFR 40, Part 60, July 1, 1989
**934 AH type

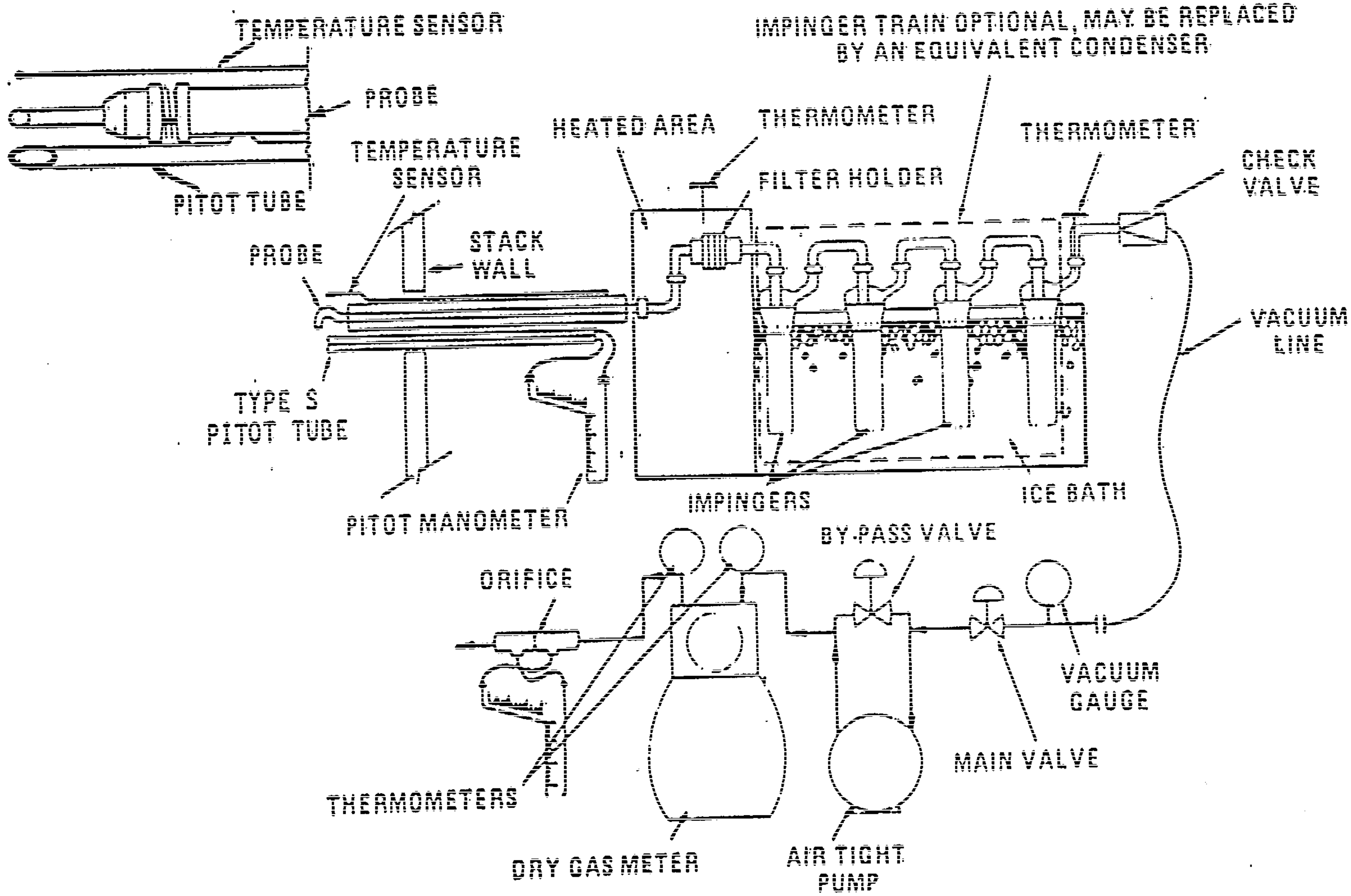


Figure 1. Schematic of Method 5 sampling train.

SAMPLE RECOVERY PROCEDURE

The sampling train was moved carefully from the test site to the cleanup area. Samples of the acetone and distilled water used in the sample recovery were taken for use as blanks. The volume of water from the first three impingers was measured. Sample fractions were recovered as follows:

Container No. 1 - The filter was removed from its holder and placed in a petri dish and sealed.

Container No. 2 - Loose particulate and H_2O washings from all sample-exposure surface prior to the filter were placed in a sample container, sealed and labelled. Particulate was removed from the probe with the aid of a brush and H_2O rinsing. The liquid level was marked after the container was sealed.

Container No. 3 - Loose particulate and acetone washings from all sample-exposure surface prior to the filter were placed in a sample container, sealed and labeled. Particulate was removed from the probe with the aid of a brush and acetone rinsing. The liquid level was marked after the container was sealed.

Container No. 4 - A minimum of 200 ml of acetone was taken for the blank analysis. The blank was obtained and treated in a similar manner as the acetone washing.

Container No. 5 - Distilled water in the impinger section of the sampling train was measured and placed in a sample container. The impingers and connecting glassware were rinsed with distilled H_2O and this rinse was added to the container for shipment to the laboratory.

Container No. 6 - The impinger section of the sampling train of the connecting glassware was rinsed with acetone and this rinse was put in a container for shipment to the laboratory.

Container No. 7 - A minimum of 200 ml of distilled water was taken for the blank analysis. The blank was obtained and treated in a similar manner as the water rinse.

The silica gel from the fourth impinger was weighed and the gain recorded on the Sample Recovery Data Sheet with other pertinent data.

ANALYTICAL PROCEDURES

The following procedures were used and follow the methods described in the DER Source Testing Manual*.

Container No. 1 - The filter and any loosed particulate matter from this sample container were placed into a tared glass weighing dish, baked at 105 C for 2 hours, desiccated for 24 hours to a constant weight and weighed to the nearest 0.1 mg.

Container No. 2 - The H_2O washings were transferred to a tared beaker and evaporated to dryness at 105 C temperature and pressure, desiccated for 24 hours to a constant weight, and weighed to the nearest 0.1 mg.

Container No. 3 - the acetone washings were transferred to a tared beaker and evaporated to dryness at ambient temperature and pressure, desiccated for 24 hours to a constant weight, and weighed to the nearest 0.1 mg.

Container No. 4 - The acetone blank was transferred to a tared breaker and evaporated to dryness at ambient temperature and pressure. The blank was then desiccated for 24 hours to a constant weight and weighed to the nearest 0.1 mg.

Container No. 5 - The contents of this container were filtered through 0.8-.22 micron tared filters to remove insoluble particulate. The filters and filtrates in tared breakers were evaporated to dryness at 105 C, then desiccated to a constant weight and weighed on an analytical balance to the nearest 0.1 mg.

Container No. 6 - The acetone was transferred to a tared beaker and evaporated to dryness at ambient temperature and pressure. The sample was then desiccated for 24 hours to a constant weight and weighed to the nearest 0.1 mg.

Container No. 7 - The distilled water blank was transferred to a tared beaker and evaporated to dryness at 105 C. The blank was desiccated to a constant weight and weighed on analytical balance to the nearest 0.1 mg.

The term "constant weight" means a difference of no more than 0.5 mg or 1% of total weight less tare weight, whichever is greater between two consecutive readings, with no less than 6 hours of desiccation between weighings.

EPA Method 9

Visual Determination of the

Opacity of Emissions from Stationary Sources

Determination of Opacity of Emissions from
Stationary Sources

EPA Method 9

The following method was used in this test program. Observation procedures follow those described in EPA Method 9 of the Federal Register *.

Observation Procedures

The opacity of emissions from stationary sources was determined visually by a qualified observer. The qualified observer stood at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140 sector to his back. Consistent with maintaining the above requirement, the observer made his observations from a position such that his line of vision was approximately perpendicular to the plume direction, and approximately perpendicular to the longer axis of the outlet. The observer recorded the name of the plant, emissions location, type facility, observer's name and affiliation, a sketch of the observer's position relative to the source, and the date on a field data sheet (Figure 1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background were recorded on a field data sheet at the time opacity readings were taken.

Opacity observations were made at the point of greatest opacity in the portion of the plume where condensed water vapor was not present. The observer did no look continuously at the plume, but momentarily at 15-seconds intervals.

SOURCE NAME

ADDRESS

CITY | STATE | ZIP

PHONE | SOURCE ID NUMBER

PROCESS EQUIPMENT | OPERATING MODE

CONTROL EQUIPMENT | OPERATING MODE

DESCRIBE EMISSION POINT
START STOP

HEIGHT ABOVE GROUND LEVEL
START STOP

HEIGHT RELATIVE TO OBSERVER
START STOP

DISTANCE FROM OBSERVER
START STOP

DIRECTION FROM OBSERVER
START STOP

DESCRIBE EMISSIONS
START STOP

EMISSION COLOR
START STOP

PLUME TYPE: CONTINUOUS ☐
FUGITIVE ☐ INTERMITTENT ☐

WATER DROPLETS PRESENT:
NO ☐ YES ☐

IF WATER DROPLET PLUME
ATTACHED ☐ DETACHED ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
START STOP

DESCRIBE BACKGROUND
START STOP

BACKGROUND COLOR
START STOP

SKY CONDITIONS
START STOP

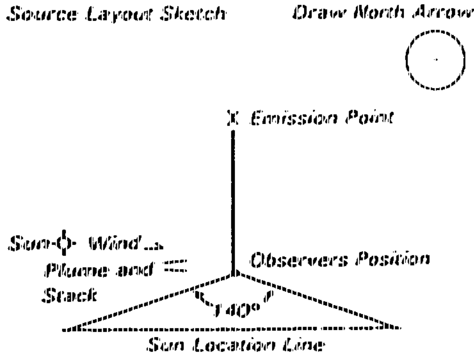
WIND SPEED
START STOP

WIND DIRECTION
START STOP

AMBIENT TEMP.
START STOP

WET BULB TEMP. | RH,percent

Source Layout Sketch Draw North Arrow



COMMENTS

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS
SIGNATURE

TITLE | DATE

OBSERVATION DATE | START TIME | STOP TIME

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
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20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

AVERAGE OPACITY FOR HIGHEST PERIOD | NUMBER OF READINGS ABOVE % WERE

RANGE OF OPACITY READINGS
MINIMUM MAXIMUM

OBSERVER'S NAME (PRINT)

OBSERVER'S SIGNATURE | DATE

ORGANIZATION

CERTIFIED BY | DATE

VERIFIED BY | DATE

If condensed water vapor was present within the plume as it emerged from the emission outlet, opacity observations were made beyond the point in the plume at which condensed water vapor was no longer visible. The observer recorded the approximate distance from the emission outlet to the point in the plume at which the observations were made.

If water vapor in the plume condensed and became visible at a distinct distance from the emission outlet, the opacity of emissions were evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.

Opacity observations were recorded to the nearest 5 percent at 15-second intervals on an observational record sheet (Figure 1). A minimum of 24 observations were recorded. Each momentary observation recorded was deemed to represent the average opacity of emissions for a 15-second period.

Opacity was determined as an average of 24 consecutive observations recorded at 15-second intervals. The observations recorded on the record sheet were divided into sets of 24 consecutive observations. A set was composed of any 24 consecutive observations. For each set of 24 observations, the average was calculated by summing the opacity of the 24 observations and dividing this sum by 24.

To receive certification as a qualified observer, a candidate was tested and demonstrated the ability to assign opacity readings in 5 percent increments to 25 different black plumes and 25 different white plumes, with an error not to exceed 15 percent opacity on any one reading and an average error not exceed 7.5 percent opacity in each category.

The certification is valid for a period of 6 months, at which time the qualification procedure must be repeated by any observer in order to retain certification. The certification test consists of showing the candidate a complete run of 50 plumes-25 black plumes and 25 white plumes-generated by a smoke generator. Plumes within each set of 25 black and 25 white runs were presented in random order. The candidate assigned an opacity value to each plume and recorded his observation on a suitable form. At the completion of each run of 50 readings, the score of the candidate was determined. If a candidate failed to qualify, the complete run of 50 readings was repeated in any retest. The smoke test was administered as part of a smoke school and was preceded by training of familiarization runs of the smoke generator during which candidates were shown black and white plumes of known opacity.

METER BOX CALIBRATION DATA AND CALCULATION FORM

Date 8/9/90 Meter box number 999

Barometric pressure, P_b = 29.05 in. Hg Calibrated by Kevin Kennedy

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperatures: Wet test meter (t_w), °F	Temperatures: Dry gas meter: Inlet (t_{d_i}), °F	Temperatures: Dry gas meter: Outlet (t_{d_o}), °F	Temperatures: Dry gas meter: Avg[a] (t_d), °F	Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	348.589 353.836	73 °F	101 105	82 85	93	12:00	.987	1.61
1.0	5	357.515 362.291	73 °F	105 120	88 89	100	9:30	.993	
1.5	10	363.123 373.703	73 °F	108 110	87 87	98	13:00	.986	1.41
2.0	10	374.035 384.653	73 °F	111 121	88 91	103	11:40	.990	
3.0	10	385.132 395.755	73 °F	119 125	88 90	106	10:00	.992	1.64
4.0	10	401.271 411.882	73 °F	119 125	88 92	106	8:50	.991	
							Avg	.990	1.55

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460) \Theta}{V_w}\right]^2$
0.5	0.0368	5(29.05) (553) 5.247(29.09) (533)	
1.0	0.0737	5(29.05) (560) 5.276(29.12) (533)	
1.5	0.110	10(29.05) (558) 10.58 (29.16) (533)	
2.0	0.147	10(29.05) (563) 10.618 (29.20) (533)	
3.0	0.221	10(29.05) (566) 10.623 (29.27) (533)	
4.0	0.294	10(29.05) (566) 10.611 (29.34) (533)	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

METER BOX CALIBRATION DATA AND CALCULATION FORM

Date 8/6/90 Meter box number 443

Barometric pressure, P_b = 28.9 in. Hg Calibrated by [signature]

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperatures: Wet test meter (t_w), °F	Dry gas meter: Inlet (t_{d_i}), °F	Dry gas meter: Outlet (t_{d_o}), °F	Dry gas meter: Avg[a] (t_d), °F	Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	5	920.900 926.150	72 °F	108 120	79 83	97	12:10	.996	
1.0	5	926.260 931.560	73 °F	122 103	88 91	101	8:14	.990	1.47
1.5	10	935.000 945.327	73 °F	133 105	92 79	102	13:00	1.017	
2.0	10	945.992 956.395	73 °F	111 115	80 89	97	8:30 [50]	.994	
3.0	10	956.939 967.498	73 °F	111 140	85 90	106	10:00	.998	1.65
4.0	10	968.026 978.629	73 °F	112 140	86 90	107	8:39 [45]	.993	1.64
							Avg	.998	

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460) \Theta}{V_w}\right]^2$
0.5	0.0368	5(28.9) (557) / 5.25(28.94)(532) = .996	
1.0	0.0737	5(28.9) (561) / 5.30 (28.97)(533) = .990	
1.5	0.110	10(28.9) (562) / 10.327(29.01)(533) 1.017	
2.0	0.147	10(28.9) (557) / 10.453(29.05)(533) = .994	
3.0	0.221	10(28.9) (560) / 10.559(29.12)(533) .998	
4.0	0.294	10(28.9) (562) / 10.603(29.19)(533) .993	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

Darren S. Mulberry 9-10-90

POSTTEST DRY GAS METER CALIBRATION DATA FORM

Test numbers ________ Date 9-10-90 Meter box number 444 Plant ________

Barometric pressure, P_b = 29.40 in. Hg Dry gas meter number 806 Pretest Y .990

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter Inlet (t_{d_i}), °F	Temperature: Dry gas meter Outlet (t_{d_o}), °F	Temperature: Dry gas meter Average[a] (t_d), °F	Time (Θ), min	Vacuum setting, in. Hg	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	$\Delta H_@$
2"	10	10.456	72	104/110	86/90	97	12.29	2"	.996	10 (29.4) (557) / 10.456 (29.4 + 2/13.6) (532)	1.66 / 1.65
2"	10	10.498	72	104/117	88/91	100	12.30	2"	.998	10 (29.4) (560) / 10.498 (29.4 + 2/13.6) (532)	1.6
2"	10	10.532	72	109/120	88/94	103	12.32	2"	.999	10 (29.4) (563) / 10.532 (29.4 + 2/13.6) (532)	
									Y = .998		

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y $\pm$0.05Y

P_b = Barometric pressure, in. Hg.

Θ = Time of calibration run, min.

[illegible signature] 9-10-90

POSTTEST DRY GAS METER CALIBRATION DATA FORM

Test numbers ________ Date 9-10-90 Meter box number 443 Plant ________

Barometric pressure, P_b = 29.40 in. Hg Dry gas meter number 806 Pretest Y .995

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °F	Time (Θ), min	Vacuum setting, in. Hg	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
2"	10	10.667	72	113/136	86/96	108	12.52	2"	.996	10 (29.4) 568 / 10.667(29.4 + 2/13.6)532
2"	10	10.704	72	116/138	89/93	109	12.54	2"	.994	10 (29.4) 569 / 10.704 (29.4 + 2/13.6)532
2"	10	10.757	72	124/139	90/94	112	12.56	2"	.994	10 (29.4) 572 / 10.757(29.4 + 2/13.6)(532)
									Y = .995	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y $\pm$0.05Y

P_b = Barometric pressure, in. Hg.

Θ = Time of calibration run, min.

PITOT TUBE INSPECTION DATA SHEET

Pitot Tube Identification Number: #7 Date: 2/23/90

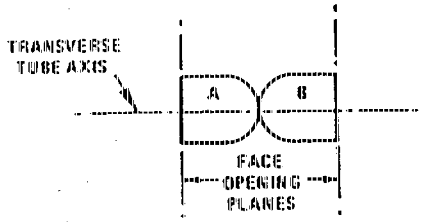
1. What is the external diameter of the tubing in inches? 3/8"

2. Are the face opening planes perpendicular to the transverse axis as in Figure A (end view)? yes

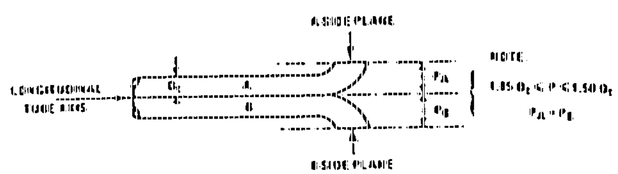
3. Are the face opening planes parallel to the longitudinal axis as in Figure B (top view)? yes

4. Are both legs of equal length and center lines coincident, when viewed from both sides as in Figure (C)? yes

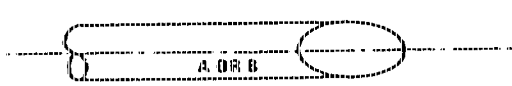
5. Does the tube meet all the geometric specifications to be assigned a .84 coefficient? yes



(a)



(b)



(c)

CALIBRATED BY: Kevin Kennedy

NOZZLE CALIBRATION DATA FORM

Date 8/23/90 Calibrated by R. Campbell

Nozzle identification number	D_1, (in.)	D_2, (in.)	D_3, (in.)	ΔD, (in.)	D_{avg}
#4	.360	.360	.360	0.0	.360

where:

$D_{1,2,3,}$ = Three different nozzles diameters, in.; each diameter measure within 0.001 in.

ΔD = Maximum difference between any two diameters, in., $\Delta D \leq 0.004$ in.

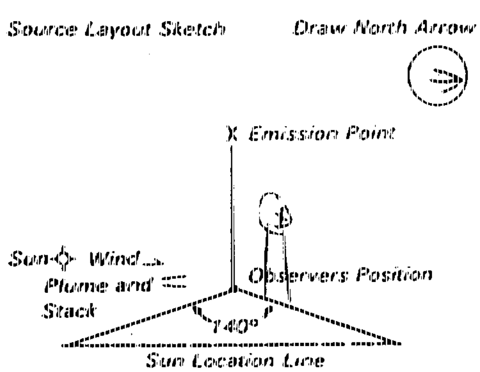
D_{avg} = Average of D_1, D_2, and D_3.

Visible Emission Observation Form

SOURCE NAME	Coram Stone
ADDRESS	Springfield Pike
CITY	
STATE	PA
ZIP	
PHONE	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	
OPERATING MODE	
CONTROL EQUIPMENT	
OPERATING MODE	
DESCRIBE EMISSION POINT	START STOP
HEIGHT ABOVE GROUND LEVEL	START STOP
HEIGHT RELATIVE TO OBSERVER	START STOP
DISTANCE FROM OBSERVER	START 40' STOP
DIRECTION FROM OBSERVER	START SW STOP
DESCRIBE EMISSIONS	START STOP
EMISSION COLOR	START STOP
PLUME TYPE	CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☐ YES ☐
IF WATER DROPLET PLUME	ATTACHED ☐ DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	START STOP
DESCRIBE BACKGROUND	START HAZY SKY STOP
BACKGROUND COLOR	START Blue STOP
SKY CONDITIONS	START HAZY STOP
WIND SPEED	START 0 STOP
WIND DIRECTION	START EAST STOP
AMBIENT TEMP.	START 60 STOP
WET BULB TEMP.	
RH, percent	

OBSERVATION DATE: 8/27/90 START TIME: 8:50 STOP TIME: 10:40

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0



AVERAGE OPACITY FOR HIGHEST PERIOD	
NUMBER OF READINGS ABOVE % WERE	
RANGE OF OPACITY READINGS	MINIMUM MAXIMUM
OBSERVER'S NAME (PRINT)	Kevin Kennedy
OBSERVER'S SIGNATURE	Kevin Kennedy
DATE	8/27/90
ORGANIZATION	CSC Inc
CERTIFIED BY	ETB
DATE	March 1990
VERIFIED BY	
DATE	

COMMENTS: TEST 4

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS
SIGNATURE
TITLE
DATE

VISIBLE EMISSION OBSERVATION FORM

No.

COMPANY NAME: Comm. Stone

STREET ADDRESS: Springfield Pike

CITY: Connellsville | **STATE:** PA | **ZIP:**

PHONE (KEY CONTACT): | **SOURCE ID NUMBER:**

PROCESS EQUIPMENT: | **OPERATING MODE:**

CONTROL EQUIPMENT: | **OPERATING MODE:**

DESCRIBE EMISSION POINT:

HEIGHT ABOVE GROUND LEVEL: | **HEIGHT RELATIVE TO OBSERVER:** Start End

DISTANCE FROM OBSERVER: Start 40 End | **DIRECTION FROM OBSERVER:** Start SW End

DESCRIBE EMISSIONS: Start End

EMISSION COLOR: Start End | **IF WATER DROPLET PLUME:** Attached ☐ Detached ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start End

DESCRIBE PLUME BACKGROUND: Start HAZY SKY End

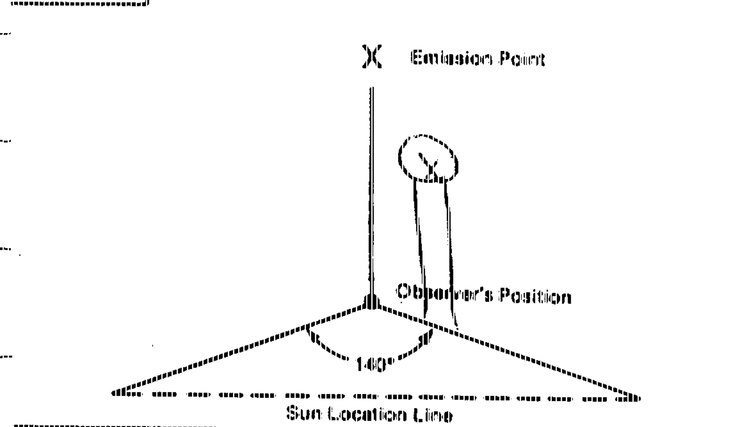
BACKGROUND COLOR: Start Blue End | **SKY CONDITIONS:** Start HAZY End

WIND SPEED: Start 0 End | **WIND DIRECTION:** Start EAST End

AMBIENT TEMP: Start 60 End | **WET BULB TEMP:** | **RH, percent:**

Stack with Plume | Sun | Wind

SOURCE LAYOUT SKETCH — Draw North Arrow



ADDITIONAL INFORMATION: TEST-1

OBSERVATION DATE: 8/27/90 | **START TIME:** 8:50 | **END TIME:** 10:46

MIN \ SEC	0	15	30	45	COMMENTS
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2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25					
26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT): Kevin Kennedy

OBSERVER'S SIGNATURE: Kevin Kennedy | **DATE:** 8/27/90

ORGANIZATION: CSC Inc

CERTIFIED BY: ETA | **DATE:** March 1990

CONTINUED ON VEO FORM NUMBER:

Visible Emission Observation Form

SOURCE NAME: Comm Stone

ADDRESS: SPRingField Pike

CITY: | STATE: PA | ZIP:

PHONE: | SOURCE ID NUMBER:

PROCESS EQUIPMENT: | OPERATING MODE:

CONTROL EQUIPMENT: | OPERATING MODE:

DESCRIBE EMISSION POINT
START STOP

HEIGHT ABOVE GROUND LEVEL: START STOP | HEIGHT RELATIVE TO OBSERVER: START STOP

DISTANCE FROM OBSERVER: START 4/5 STOP | DIRECTION FROM OBSERVER: START SW STOP

DESCRIBE EMISSIONS
START STOP

EMISSION COLOR: START STOP | PLUME TYPE: CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐

WATER DROPLETS PRESENT: NO ☑ YES ☐ | IF WATER DROPLET PLUME: ATTACHED ☐ DETACHED ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
START STOP

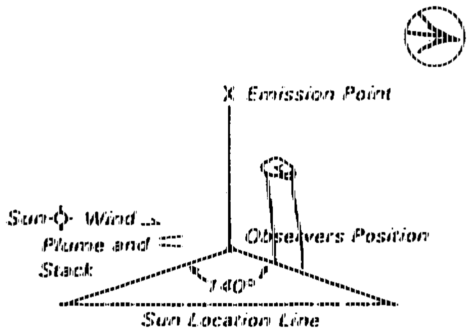
DESCRIBE BACKGROUND
START HAZY SKY STOP

BACKGROUND COLOR: START Blue STOP | SKY CONDITIONS: START HAZY STOP

WIND SPEED: START 0-2 STOP | WIND DIRECTION: START EAST STOP

AMBIENT TEMP.: START 80°F STOP | WET BULB TEMP. | RH, percent

Source Layout Sketch — Draw North Arrow



COMMENTS: TEST-2

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS
SIGNATURE
TITLE | DATE

OBSERVATION DATE: 8/27/90 | START TIME: 11:10 | STOP TIME:

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

AVERAGE OPACITY FOR HIGHEST PERIOD | NUMBER OF READINGS ABOVE % WERE

RANGE OF OPACITY READINGS
MINIMUM MAXIMUM

OBSERVER'S NAME (PRINT): Kevin Kennedy

OBSERVER'S SIGNATURE: [signature] | DATE: 8/27/90

ORGANIZATION: CSC INC.

CERTIFIED BY: ETA | DATE: MARch 1990

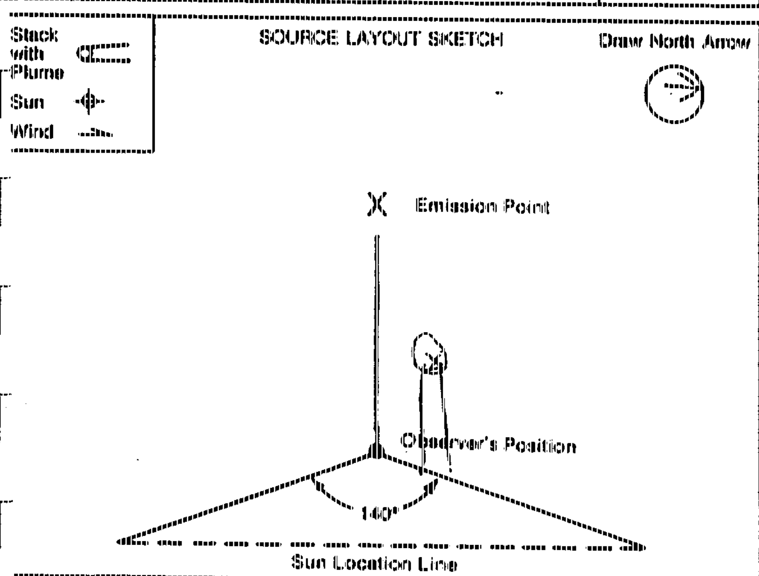
VERIFIED BY: | DATE:

VISIBLE EMISSION OBSERVATION FORM

No.

COMPANY NAME	Comm. Stone
STREET ADDRESS	SpringField Pike
CITY	
STATE	PA
ZIP	
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	
OPERATING MODE	
CONTROL EQUIPMENT	
OPERATING MODE	
DESCRIBE EMISSION POINT	
HEIGHT ABOVE GROUND LEVEL	
HEIGHT RELATIVE TO OBSERVER	Start End
DISTANCE FROM OBSERVER	Start 40 End
DIRECTION FROM OBSERVER	Start SW End
DESCRIBE EMISSIONS	Start End
EMISSION COLOR	Start End
IF WATER DROPLET PLUME	Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start End
DESCRIBE PLUME BACKGROUND	Start HAZY SKY End
BACKGROUND COLOR	Start Blue End
SKY CONDITIONS	Start HAZY End
WIND SPEED	Start 0 - 2 End
WIND DIRECTION	Start East End
AMBIENT TEMP	Start 80° F End
WET BULB TEMP	
RH, percent	

SOURCE LAYOUT SKETCH



ADDITIONAL INFORMATION

TEST-2

OBSERVATION DATE	START TIME	END TIME
8/27/90	11:10	12:45

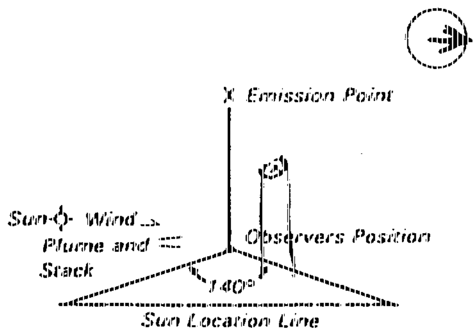
MIN \ SEC	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT)	Kevin Kennedy
OBSERVER'S SIGNATURE	Kevin Kennedy
DATE	8/27/90
ORGANIZATION	CSC Inc.
CERTIFIED BY	ETA
DATE	March 199[illegible]
CONTINUED ON VEO FORM NUMBER	

Visible Emission Observation Form

SOURCE NAME	Camo Stone
ADDRESS	Springfield Pike
CITY	
STATE	PA
ZIP	
PHONE	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	
OPERATING MODE	
CONTROL EQUIPMENT	
OPERATING MODE	
DESCRIBE EMISSION POINT	START STOP
HEIGHT ABOVE GROUND LEVEL	START 45 STOP
HEIGHT RELATIVE TO OBSERVER	START 0 STOP
DISTANCE FROM OBSERVER	START 40 STOP
DIRECTION FROM OBSERVER	START SW STOP
DESCRIBE EMISSIONS	START STOP
EMISSION COLOR	START STOP
PLUME TYPE	CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☑ YES ☐
IF WATER DROPLET PLUME	ATTACHED ☐ DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	START STOP
DESCRIBE BACKGROUND	START HAZY SKY STOP
BACKGROUND COLOR	START Blue STOP
SKY CONDITIONS	START HAZY STOP
WIND SPEED	START 0-2 mph STOP
WIND DIRECTION	START EAST STOP
AMBIENT TEMP	START 80°F STOP
WET BULB TEMP	
RH, percent	

Source Layout Sketch   Draw North Arrow



OBSERVATION DATE	3/27/90
START TIME	1:33
STOP TIME	2:56

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0
30	0	0	0	0	60	0	0	0	0

AVERAGE OPACITY FOR HIGHEST PERIOD	
NUMBER OF READINGS ABOVE % WERE	
RANGE OF OPACITY READINGS	MINIMUM MAXIMUM
OBSERVER'S NAME (PRINT)	Kevin Kennedy
OBSERVER'S SIGNATURE	Kevin Kennedy
DATE	3/27/90
ORGANIZATION	CSC Inc.
CERTIFIED BY	ETA
DATE	March 1990
VERIFIED BY	
DATE	

COMMENTS: TEST-3

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS

SIGNATURE

TITLE   DATE

VISIBLE EMISSION OBSERVATION FORM

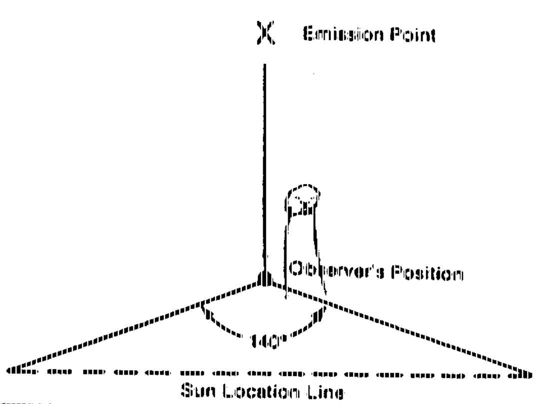
No.

COMPANY NAME	Commstone
STREET ADDRESS	SpringField Pike
CITY	
STATE	PA
ZIP	
PHONE (KEY CONTACT)	
SOURCE ID NUMBER	
PROCESS EQUIPMENT	
OPERATING MODE	
CONTROL EQUIPMENT	
OPERATING MODE	
DESCRIBE EMISSION POINT	
HEIGHT ABOVE GROUND LEVEL	45'
HEIGHT RELATIVE TO OBSERVER	Start 10' End
DISTANCE FROM OBSERVER	Start 40' End
DIRECTION FROM OBSERVER	Start SW End
DESCRIBE EMISSIONS	Start End
EMISSION COLOR	Start End
IF WATER DROPLET PLUME	Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	Start End
DESCRIBE PLUME BACKGROUND	Start HAZY SKY End
BACKGROUND COLOR	Start Blue End
SKY CONDITIONS	Start HAZY End
WIND SPEED	Start 0-2mph End
WIND DIRECTION	Start EAST End
AMBIENT TEMP	Start End
WET BULB TEMP	
RH, percent	

SOURCE LAYOUT SKETCH

Draw North Arrow

Stack with Plume
Sun
Wind



ADDITIONAL INFORMATION: TEST-3

OBSERVATION DATE	START TIME	END TIME
8/27/90	1:33	2:56

MIN \ SEC	0	15	30	45	COMMENTS
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT)	Kevin Kennedy
OBSERVER'S SIGNATURE	Kevin Kennedy
DATE	8/27/90
ORGANIZATION	CSCENC
CERTIFIED BY	ETA
DATE	MARCH 1990
CONTINUED ON VEO FORM NUMBER	

PLANT [illegible]
LOCAL [illegible]
OPERATOR R. Campbell
DATE 8/27/76
RUN NO. SPS-1
SAMPLE BOX NO.
METER BOX NO. # 443
METER ΔHφ
C FACTOR KF = 18
PITOT TUBE COEFFICIENT, C_p .84

SCHEMATIC OF STACK CROSS-SECTION
Location
Stack dimen. 48"

AMBIENT TEMPERATURE 74
BAROMETRIC PRESSURE [illegible]
ASSUMED MOISTURE, % 1A
PROBE LENGTH, (ft)
NOZZLE IDENTIFICATION NO. #4
AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .360
PROBE HEATER SETTING 250
LEAK RATE, (cfm) 0.006 at 15"
PROBE LINER MATERIAL Glass
STATIC PRESSURE, (in. Hg) +.20
FILTER NO. 100032

TRAVERSE POINT NUMBER	TIME	SAMPLING TIME (θ), min.	VACUUM (in. Hg)	STACK TEMPERATURE (T_S) (°F)	VELOCITY HEAD (ΔP_S), (in. H_2O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H_2O)	GAS SAMPLE VOLUME (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (°F)	GAS SAMPLE TEMPERATURE AT DRY GAS METER OUTLET (°F)	FILTER HOLDER TEMPERATURE, (°F)	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, (°F)
	8:50	0					6.600				
A-1		3.5	10.0	73	.45	8.0	12.370	74	76	248	47
2		7.0	8.0	73	.37	6.6	17.545	123	78	250	47
3		10.5	5.5	73	.28	5.0	20.210	124	82	250	47
4		14.0	5.0	73	.24	4.2	26.170	124	84	255	47
5		17.5	5.0	73	.20	3.6	29.890	125	84	256	48
6		21	3.5	74	.16	2.8	33.570	123	86	257	48
7		24.5	4.5	75	.19	3.4	37.110	124	86	260	48
8		28	3.0	74	.14	2.5	40.285	125	86	261	48
9		31.5	4.5	75	.20	3.6	44.110	126	89	260	49
10		35	5.6	75	.24	4.2	48.370	127	89	259	49
11		38.5	5.0	74	.22	4.1	52.510	132	91	260	49
12		42	5.0	74	.20	3.6	56.321	133	91	258	49
B-1	9:45	45.5	14.0	73	.57	10.0	62.360	127	90	256	51
2		49	13.0	73	.50	9.0	68.360	128	91	255	51
3		52.5	11.0	73	.44	7.8	73.975	133	94	254	51
4		56	9.0	73	.38	6.8	79.360	139	94	256	51
5		59.5	5.5	74	.25	4.5	83.600	141	95	258	52
6		63	2.0	74	.05	0.9	85.400	129	97	257	52
TOTAL								Avg.	Avg.		
AVERAGE				74	.425	3.9	87.500	Avg.	107		

C-076

IMPINGER WATER
Final 202 ml
Init. 200 ml
Cond. 2 ml

DESICCANT
Final 244.9 gms
Init. 225.5 gms
Gain 19.4 gms

ORSAT ANALYSES

Time			
CO_2	0.0	0.0	0.0
O_2	21.0	21.0	21.0
CO			

PLANT [illegible]
LOCATION [illegible]
OPERATOR RJ Campbell
DATE 8/27/90
RUN NO. SPS-1
SAMPLE BOX NO.
METER BOX NO. #443
METER ΔH@
G FACTOR
PITOT TUBE COEFFICIENT, C_p .84

SCHEMATIC OF STACK CROSS-SECTION
Location
Stack dimen. 46"

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 29.6
ASSUMED MOISTURE, %
PROBE LENGTH, (ft)
NOZZLE IDENTIFICATION NO.
AVERAGE CALIBRATED NOZZLE DIAMETER, (in.)
PROBE HEATER SETTING
LEAK RATE, (cfm) 0.005 at 15"
PROBE LINER MATERIAL Glass
STATIC PRESSURE, (in. Hg)
FILTER NO. 100032

TRAVERSE POINT NUMBER	TIME	SAMPLING TIME (θ), min.	VACUUM (in. Hg)	STACK TEMPERATURE (T_S) (°F)	VELOCITY HEAD (ΔP_S), (in. H_2O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H_2O)	GAS SAMPLE VOLUME (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER: INLET (°F)	GAS SAMPLE TEMPERATURE AT DRY GAS METER: OUTLET (°F)	FILTER HOLDER TEMPERATURE, (°F)	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, (°F)
B-7	66.5		1.0	74	.04	0.70	87.120	120	95	259	51
8	70		1.0	74	.02	0.36	88.600	120	96	260	51
9	73.5		1.0	74	.02	0.36	90.010	120	93	261	50
10	77		1.0	74	.02	0.36	91.400	119	95	260	50
11	80.5		1.0	74	.02	0.36	92.905	119	93	257	50
12	84	10:27	1.0	74	.02	0.36	94300	119	92	256	51
TOTAL								Avg.	Avg.		
AVERAGE								Avg.			

IMPINGER WATER
Final ______ ml
Init. ______ ml
Cond. ______ ml

DESICCANT
Final ______ gms
Init. ______ gms
Gain ______ gms

ORSAT ANALYSES

Time			
CO_2			
O_2			
CO			

PLANT Comm. Stone
LOCATION Sol... Field Sand
OPERATOR R. Campbell
DATE 8/27/96
RUN NO. SPS-2
SAMPLE BOX NO.
METER BOX NO. #447 ✱#444
METER ΔH@
C FACTOR KF+
PITOT TUBE COEFFICIENT, C_p .84

SCHEMATIC OF STACK CROSS SECTION
Location
Stack dimen: 48"

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 28.6
ASSUMED MOISTURE, %
PROBE LENGTH, (ft)
NOZZLE IDENTIFICATION NO. #4
AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .360
PROBE HEATER SETTING 250
LEAK RATE, (cfm) 0.00 at 15"
PROBE LINER MATERIAL Glass
STATIC PRESSURE, (in. Hg) +.20
FILTER NO. 1000 21

TRAVERSE POINT NUMBER	TIME	SAMPLING TIME (θ), min.	VACUUM (in. Hg)	STACK TEMPERATURE (T_S) (°F)	VELOCITY HEAD (ΔP_S) (in. H_2O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H_2O)	GAS SAMPLE VOLUME (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (°F)	GAS SAMPLE TEMPERATURE AT DRY GAS METER OUTLET (°F)	FILTER HOLDER TEMPERATURE, (°F)	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, (°F)
	11:10	0					96.150				
B-1		3	13.0	80	.55	9.8	101.410	91	91	262	41
2		6	13.0	80	.55	9.8	106.790	128	97	263	41
3		9	12.0	80	.46	8.2	111.760	139	99	260	41
4		12	9.0	79	.37	6.6	116.910	147	99	261	42
5		15	8.0	79	.30	5.4	120.480	154	104	264	42
6		18	5.0	79	.17	3.0	123.570	152	106	269	42
7		21	2.0	79	.10	1.8	125.860	139	106	272	42
8		24	1.0	78	.06	1.1	127.550	136	105	268	42
9		27	1.0	78	.04	0.70	129.025	130	103	269	42
10		30	1.0	79	.02	0.36	130.340	127	105	264	42
11		33	1.0	79	.02	0.36	131.690	123	103	260	43
12	Stop/	36	1.0	78	.02	0.36	133.037	120	102	258	42
A-1	[illegible]/	39	10.0	75	.45	8.0	~~[illegible]~~ ✱	95	87	260	44
2		42	11.0	75	.45	8.0	690.740	98	87	259	44
3		45	8.0	76	.35	6.2	695.000	111	87	256	44
4		48	7.0	76	.32	5.6	698.530	115	86	253	44
5		51	5.0	76	.24	4.3	702.180	117	87	254	45
6		54	4.0	76	.15	2.7	705.770	117	88	255	45
TOTAL						½ (3.9)	½(36.887)	Avg. ½(109)	Avg.		
AVERAGE				78	.432	(4.0)	(40.405)	Avg. (101)			

IMPINGER WATER
Final 209 ml
Init. 200 ml
Cond. 9 ml

DESICCANT
Final 214.7 gms
Init. 199.1 gms
Gain 15.6 gms

ORSAT ANALYSES

Time			
CO_2	0.0	0.0	0.0
O_2	21.0	21.0	21.0
CO			

✱ Changed Meterboxes
Pump stopped
681.400 new reading

PLANT "Om - Sign"
LOCATION SAND Plant
OPERATOR P. Campbell
DATE 8/27/90
RUN NO. SPS-2
SAMPLE BOX NO.
METER BOX NO. #444
METER ΔH@
C FACTOR
PITOT TUBE COEFFICIENT, C_p .84

SCHEMATIC OF STACK CROSS SECTION
Location
Stack dimen. 484

BIENR ERAT
BAROMETRIC PRESSURE 28.6
ASSUMED MOISTURE, %
PROBE LENGTH, (ft)
NOZZLE IDENTIFICATION NO.
AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .360
PROBE HEATER SETTING 250
LEAK RATE, (cfm) .000 at 15"
PROBE LINER MATERIAL Glass
STATIC PRESSURE, (in. Hg)
FILTER NO. 100021

TRAVERSE POINT NUMBER	TIME	SAMPLING TIME (θ), min.	VACUUM (in. Hg)	STACK TEMPERATURE (T_S) (°F)	VELOCITY HEAD (ΔP_S), (in. H_2O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H_2O)	GAS SAMPLE VOLUME (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (°F)	GAS SAMPLE TEMPERATURE AT DRY GAS METER OUTLET (°F)	FILTER HOLDER TEMPERATURE, (°F)	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, (°F)
7		57	2.0	77	.10	1.8	708.080	117	88	254	45
8		60	1.0	77	.07	1.2	710.000	118	88	256	45
9		63	4.0	77	.12	2.1	712.686	114	92	258	45
10		66	4.0	77	.15	2.7	715.690	120	94	261	45
11		69	4.0	77	.15	2.7	718.810	121	94	263	46
12	1:11	72	4.0	77	.15	2.7	721.865	122	94	261	46
TOTAL								Avg.	Avg.		
AVERAGE								Avg.			

IMPINGER WATER
Final 204 ml
Init. 200 ml
Cond. 4 ml

DESICCANT
Final ______ gms
Init. ______ gms
Gain ______ gms

ORSAT ANALYSES

Time			
CO_2			
O_2			
CO			

PLANT Conn Stone
LOCATION Springfield SAND
OPERATOR D. Campbell
DATE 8/5/86
RUN NO. SPS-3
SAMPLE BOX NO.
METER BOX NO. #441
METER ΔH@
C FACTOR KF=18
PITOT TUBE COEFFICIENT, C_p .84

SCHEMATIC OF STACK CROSS SECTION
Location
Stack dimen. 48"

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 28.6
ASSUMED MOISTURE, %
PROBE LENGTH, (ft)
NOZZLE IDENTIFICATION NO. #4
AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .365
PROBE HEATER SETTING 250
LEAK RATE, (cfm)
PROBE LINER MATERIAL Glass
STATIC PRESSURE, (in. Hg) +.20
FILTER NO. 1080 30

TRAVERSE POINT NUMBER	TIME	SAMPLING TIME (θ), min.	VACUUM (in. Hg)	STACK TEMPERATURE (T_S) (°F)	VELOCITY HEAD (ΔP_S), (in.) H_2O	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H_2O)	GAS SAMPLE VOLUME (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (°F)	GAS SAMPLE TEMPERATURE AT DRY GAS METER OUTLET (°F)	FILTER HOLDER TEMPERATURE, (°F)	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, (°F)
	1230	0					721.940				
A-1		3	10.0	81	.45	8.0	726.670	93	93	262	50
2		6	10.0	81	.45	8.0	731.510	127	93	266	50
3		9	7.0	80	.32	5.8	735.690	129	94	268	50
4		12	6.0	80	.25	4.4	737.330	134	92	270	50
5		15	5.0	80	.20	3.6	740.790	134	92	264	50
6		18	5.0	79	.14	2.5	745.540	133	90	260	51
7		21	3.5	79	.10	1.8	748.065	130	93	260	51
8		24	4.0	79	.15	2.7	751.130	131	94	259	51
9		27	5.0	79	.20	3.6	754.590	130	98	261	52
10		30	5.5	78	.25	4.4	758.390	136	97	264	53
11		33	5.5	78	.25	4.4	762.220	138	96	264	52
12	stop	36	5.0	78	.20	3.6	765.580	137	96	261	52
B-1	1317	39	13.0	76	.55	9.8	770.870	119	89	259	54
2		42	13.0	77	.48	8.5	775.370	136	88	259	54
3		45	13.0	77	.46	8.2	780.295	138	89	261	54
4		48	5.0	77	.15	2.7	783.640	133	88	259	54
5		51	5.0	77	.15	2.7	786.590	134	88	260	54
6		54	5.0	78	.10	1.8	789.005	136	88	258	55
TOTAL								Avg.	Avg.		
AVERAGE				78	.430	3.8	77.275	Avg.	111		

C-089

IMPINGER WATER
Final 208 ml
Init. 200 ml
Cond. 8 ml

DESICCANT
Final 247.6 gms
Init. 226.4 gms
Gain 21.2 gms

ORSAT ANALYSES

Time			
CO_2	0.0	0.0	0.0
O_2	21.0	21.0	21.0
CO			

PLANT Commercial Stove[illegible]

LOCATION Springfield Pike (SKND)

OPERATOR R. Campbell

DATE 8-27-90

RUN NO. SPS-3

SAMPLE BOX NO.

METER BOX NO. # 444

METER ΔHφ

Y FACTOR

PITOT TUBE COEFFICIENT, C_p .84

SCHEMATIC OF STACK CROSS SECTION

Location

Stack dimen.

AMBIENT TEMPERATURE

BAROMETRIC PRESSURE 28.6

ASSUMED MOISTURE, %

PROBE LENGTH, (ft)

NOZZLE IDENTIFICATION NO. #4

AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .360

PROBE HEATER SETTING

LEAK RATE, (cfm) 0.005 at 15"

PROBE LINER MATERIAL Glass

STATIC PRESSURE, (in. Hg) +.20

FILTER NO. 100030

TRAVERSE POINT NUMBER	TIME	SAMPLING TIME (θ), min.	VACUUM (in. Hg)	STACK TEMPERATURE (T_S) (°F)	VELOCITY HEAD (ΔP_S), (in. H₂O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H₂O)	GAS SAMPLE VOLUME (ft³)	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (°F)	GAS SAMPLE TEMPERATURE AT DRY GAS METER OUTLET (°F)	FILTER HOLDER TEMPERATURE, (°F)	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, (°F)
B-7		57	2.0	77	.05	0.90	790.995	128	91	260	54
8		60	2.0	77	.05	0.90	792.530	129	92	264	54
9		63	2.0	77	.04	0.70	794.001	121	96	261	55
10		66	2.0	77	.04	0.70	795.490	121	96	258	56
11		69	2.0	78	.05	0.90	797.280	121	97	261	56
12	2:53	72	2.0	78	.05	0.90	799.215	121	98	264	56
TOTAL								Avg.	Avg.		
AVERAGE						3.8/3ave		Avg.			

IMPINGER WATER
Final ______ ml
Init. ______ ml
Cond. ______ ml

DESICCANT
Final ______ gms
Init. ______ gms
Gain ______ gms

ORSAT ANALYSES

Time			
CO_2			
O_2			
CO			

D. PROCESS DATA

(3)

Springfield Pike

Sand Plant 8-27-90

Time	IA (Total Production)	Mfg. Sand	Dust (Baghouse)
:50 - 10:00 Am	96 tons/hr	72 tons/hr	24 tons/hr
11 Am - 1:11 Pm	97.5 tons/hr	73.13 ton/hr	24.37 tons/hr
3 - 2:53 Pm	98.3 tons/hr	73.73 tons/hr	24.57 tons/hr

(α)

Sp

Mfg. Sand

Sieve	WT. Passing	% Passing
3/8	626.5	100
4	624.4	99.7
8	447	71.3
16	311.4	49.7
30	235.4	37.6
50	166.4	26.7
100	99.3	15.8
200	49.5	7.9

Dust (Baghouse)

Sieve	WT. Passing	% Passing
3/8	565.4	100
4	565.4	100
8	564.8	99.9
16	563.5	99.6
30	561	99.2
50	550.2	97.3
100	474.9	84
200	300.4	53.1

1A (#10)

Sieve	WT. Passing	% Passing
3/8	620	100
4	615	99.2
8	454.7	73.4
16	331.1	53.4
30	259	41.8
50	199.6	32.2
100	135.4	21.8
200	73.6	11.9

FABRIC FILTER DATA SHEET — PARAMETERS OF DESIGN AND OPERATION AFFECTING PERFORMANCE

Facility: Springfield Pike Sandpit Boiler No. ______

Monitor Name: Baghouse Test No. 1-3

Design Efficiency: ______ Test Date: 8/27/90

	Recording Interval: Sampling Time (minutes)	Recording Interval: Clock Time (24 hr. clock)	Pressure Drop Across Baghouse (in. H_2O)	Pressure Drop Across Compartment (in. H_2O): 1	2	3	4	5
TEST 1	8:50 am		3.3"					
	9:05 am		3.3"					
	9:20 am		3.4"					
	9:35 Am		3.5"					
	9:50 Am		3.5"					
	10:05 Am		3.4"					
	10:20 Am		3.5"					
	10:35 Am		3.5"					
TEST 2	11:10 Am		3.0"					
	11:25 Am		3.0"					
	11:40 Am		3.1"					
	11:55 Am		3.1"					
	12:10 pm		3.1"					
	12:25 pm		3.2"					
	12:40 pm		3.2"					
	12:55 pm		3.3"					
	1:10 pm		3.3"					
	1:15 pm		3.3"					
TEST 3	1:30 pm		3.5"					
	1:45 pm		3.5"					
	2:00 pm		3.5"					
	2:15 pm		3.4"					
	2:30 pm		3.5"					
	2:45 pm		3.5"					
	3:00 pm		3.5"					
		Representative						
		Design						

E. LABORATORY DATA

ANALYTICAL DATA

Test No.	SPS-1	SPS-2	SPS-3
Test Date	8/27/90	8/27/90	8/27/90
Filter No.	100031	100021	100030
Filter Tare, mg	620.2	627.3	617.3
Filter Final, mg	628.0	633.7	623.3
Filter Net, mg	7.8	6.4 ✓	6.0
Probe Acetone, mg	20.5	5.1 ✓	13.7
Probe Water	2.4	24.7 ✓	7.1
Impinger Sol. mg.	19.4	1.4	11.1
Impinger Insol., mg	9.0	3.6 ✓	6.0
Impinger Acetone, mg	4.2	6.6	3.0
Acetone Blank (mg)*	0.2	-	-
Water Blank (mg)*	0.4	-	-
Total particulate, mg	43.9	46.4	35.8

*Data not corrected for blank values.

Analyst: Kevin Kennedy

Reviewer: Richard S. Campbell

F. V. E. CERTIFICATION

VISIBLE EMISSIONS EVALUATOR

This is to certify that

Kevin Kennedy

met the specifications of Federal Reference Method 9 and qualified as a visible emissions evaluator. Maximum deviation on white and black smoke did not exceed 7.5% opacity and no single error exceeding 15% opacity was incurred during the certification test conducted by Eastern Technical Associates of Raleigh, North Carolina. This certificate is valid for six months from date of issue.

Thomas Hose
President

225654
Certificate Number

Vice President

Pittsburgh
Location

David Savage
Program Manager

March 21, 1990
Date of Issue