Commonwealth of Pennsylvania
Environmental Resources
October 18, 1990

Subject: Stack Test Review

To: Data File
Rich Hill Quarry
Commercial Stone Company, Inc.
Connellsville, Fayette County

From: Rick Begley
Air Pollution Control Engineer
Division of Technical Services and Monitoring
Bureau of Air Quality Control

Through: Chief, Source Testing and Monitoring Section

Commercial Stone Company, Inc. operates a sand plant at the above location utilizing four Buell "Size Classifiers", each rated at 40 tons per hour. The plant processed an average of 140 tons of sand per hour during the testing period.

Effluent from the classifiers is collected and directed to a Tri Fab Inc. fabric collector, model 405-12, consisting of a single compartment containing 405 felted polyester bags for an air to cloth ratio of 7.3:1. The collector is rated at 48,400 ACFM with a pressure drop of 3.5 to 4.0 inches W.C.. A reverse jet pulse, actuated by a timer is used to periodically clean the bags. The effluent is drawn through the collector by a 200 HP I.D. Fan and directed to a 4 feet x 3 feet rectangular stack discharging to the atmosphere at a point 15 feet above grade.

On August 22, 1990, three particulate tests were performed on the exhaust stack of the fabric collector by personnel from Comprehensive Safety Compliance Inc. to demonstrate compliance with NSPS. The tests were conducted in accordance with a preapproved protocol and found to be acceptable to the Department with the following exception:

> The posttest meter calibration factor (Y) was used for the gas meter volumetric caculations instead of the pretest gas meter calibration factor. Although the effect of using the posttest Y in this case is negligible, future test reports may be rejected if the correct procedures are not followed.

The following test results were extracted from the test report:

Run	RHS-1	RHS-2	RHS-3
Volumetric Flow Rate (DSCF/min)	44,600	39,700	39,100
Rated capacity (T/hr)	160	160	160
Tested Rate (T/hr)	150	145	148
Actual Concentration (gr/DSCF)	0.011	0.011	0.009
Actual Emission Rate (lbs/hr)	4.2	3.9	3.1
Allowable Concentration (gr/DSCF)*	0.0218	0.0218	0.0218

*Per 40 CFR, Part 60, Subpart 000, Section 6.0672(1)

cc: Dick Murray - Greensburg District Office
File 26-310-016 through Doug Lesher, Abatement and Compliance Section
Reading File, Source Testing

RBsrjr

PARTICULATE EMISSION TESTING
SAND PLANT BAGHOUSE
RICH HILL QUARRY
COMMERCIAL STONE
CONNELLSVILLE, PA

Report to:

Mr. Ted Dinardo
Commercial Stone Inc.
2200 Springfield Pike
Connellsville, PA 15425

Report by:

Mr. Richard L. Campbell
Division Manager

Comprehensive Safety Compliance, Inc.
295 William Pitt Way
Pittsburgh, PA 15238

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APPENDIX

1.0 INTRODUCTION

On August 22, 1990, particulate emission testing and opacity observations were performed on the Sand Plant Baghouse at Commercial Stone Company's Rich Hill 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. Dick Murray 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			Opacity Data[c]		
			Conc.[a] Gr/dscf	Emission Rate[b] lb/hr.	Allowable lb/hr	Min. %	Max. %	Highest 6 min. Avg. %
8/22	RHS-1	Baghouse Outlet	0.011	4.2	21.9	0	5	1
8/22	RHS-2	Baghouse Outlet	0.011	3.9	21.6	0	0	0
8/22	RHS-3	Baghouse Outlet	0.009	3.1	21.8	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]
8/22	RHS-1	Baghouse Outlet	1.6	72	0	21.0	48,000	44,500
8/22	RHS-2	Baghouse Outlet	1.5	81	0	21.0	43,400	39,700
8/22	RHS-3	Baghouse Outlet	1.8	103	0	21.0	44,700	39,100

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 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 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 four 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 emissions from the four classifiers are collected by a common baghouse. The baghouse is a Tri Fab Inc. reverse pulse collector. The unit is a Model 405-12 which contains 108 ten foot length bags. The bag material is BHA Style NX01 NOMEX. Control System process data 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 87.5 minutes for Test No. 1 and 75 minutes for Tests 2 and 3.

BUELL GRAVITATIONAL-INERTIAL CLASSIFIER

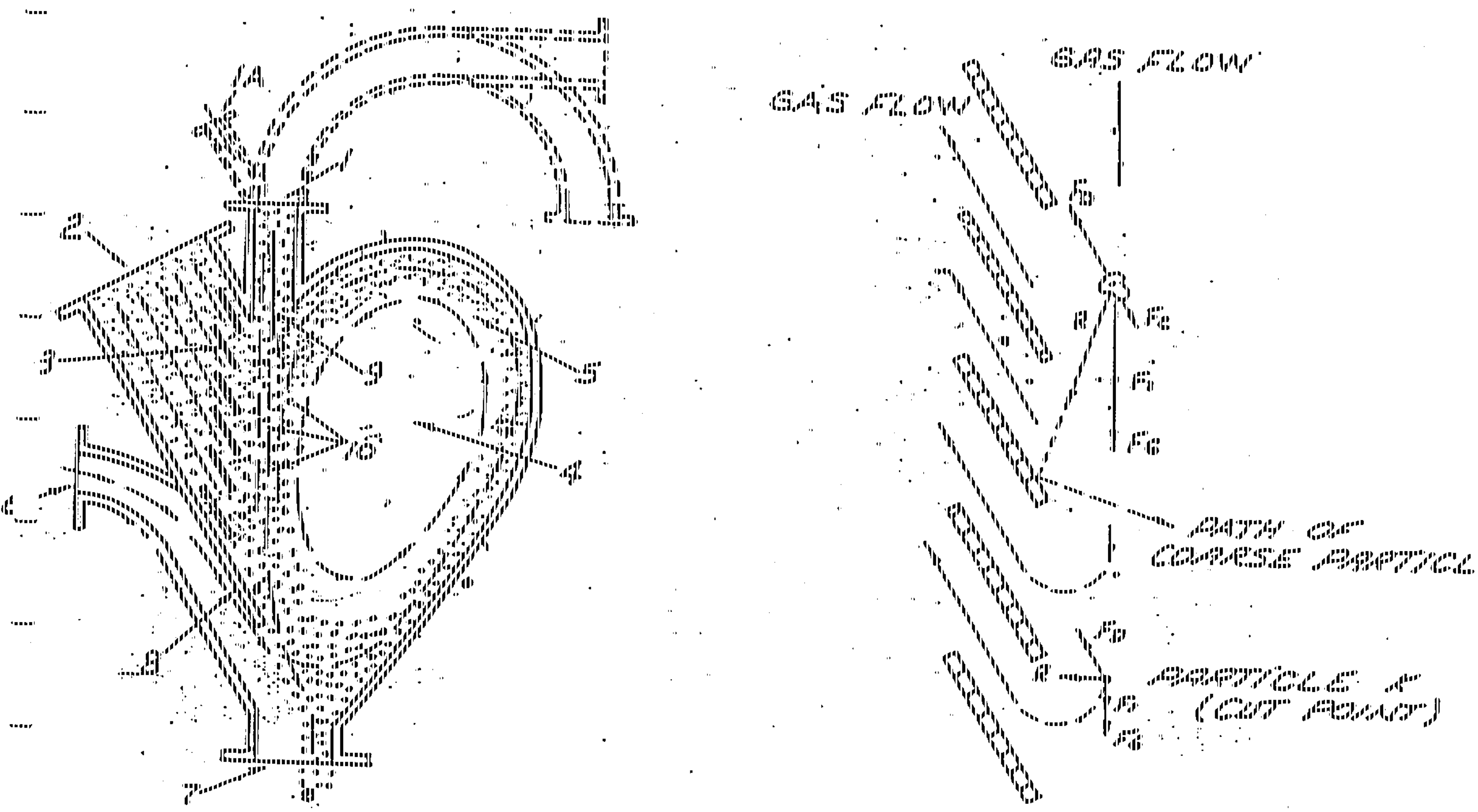


Figure No. 1

Process Schematic

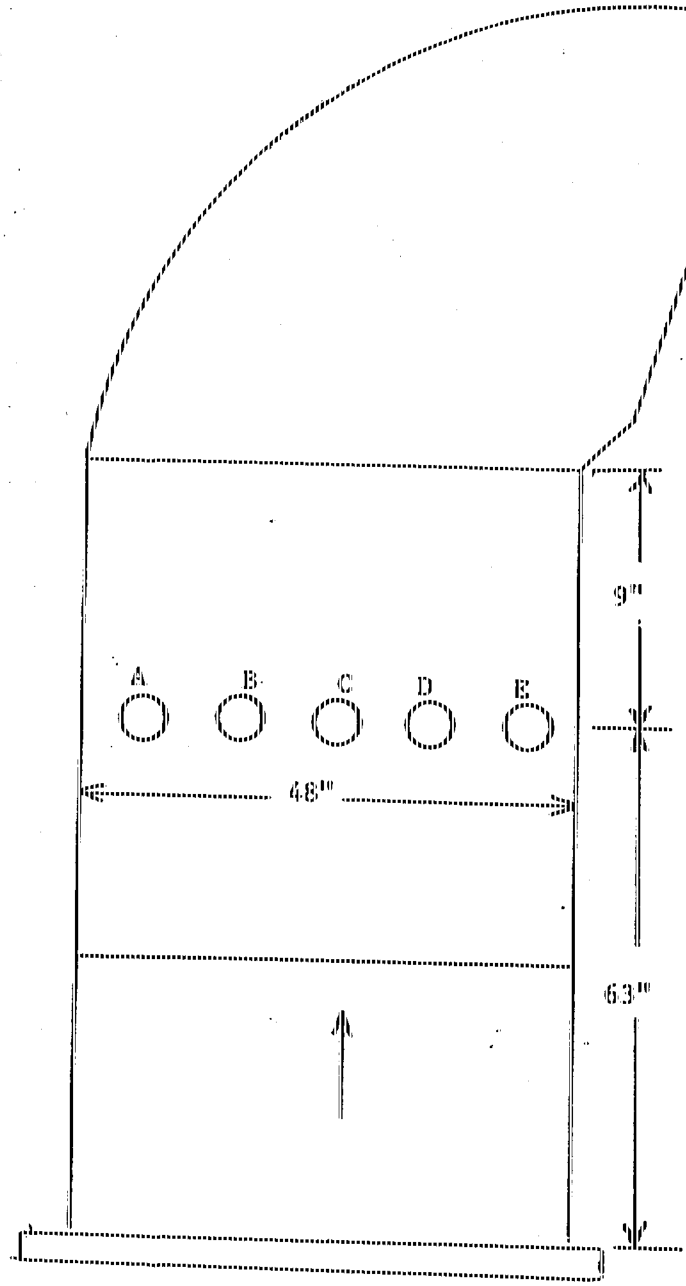
TABEL NO. 3

Process Production

Rich Hill Sand Plant

DATE 1990	TEST NO	PRODUCTION RATE TONS/HR
8/22	RHS-1	150
8/22	RHS-2	145
8/22	RHS-3	148

Additional process data is provided in Appendix D.



Sample Point Location

Point No.	Point Location (inches
1	3.6"
2	10.8"
3	18.0"
4	25.2"
5	32.4"

Retangular Duct 48" x 36"

5 sample ports
5 points per port
25 total sample points

FIGURE NO. 2

Commercial Stone Rich Hill Sandplant
Sampling 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.

*Federal 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_{lc} = 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. RHS-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.)

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

$$V_{m_{std}} = 17.65 \times 67.994 \times (.995) \left[\frac{28.4 + \frac{1.6}{13.6}}{548} \right] = 62.140$$

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

$$V_{w_{std}} = 0.04707 V_{1_c} =$$

$$V_{w_{std}} = 0.04707 \times 21.3 = 1.00$$

3. Moisture content in stack gas.

$$B_{ws} = \frac{V_{wc_{std}}}{V_{m_{std}} \times V_{wc_{std}}} = B_{ws} = \frac{1.00}{62.140 + 1.00} = .016$$

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

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

$$M_s = 28.84\ (1 - .016) + 18(.016) = 28.67$$

6. Stack velocity at stack conditions, fps

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

$$V_s = 85.49 \times .84 \times (1.15) \times \sqrt{\frac{532}{28.45 \times 28.67}} = 66.69$$

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

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

$$Q_s = 60 \times 66.69 \times 12.0 = 48,017 \text{ ACFM}$$

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

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

$$Q_{std} = 17.65 \times 48,017 \times \frac{28.45}{532} \times (1-.016) = 44,597 \times 60 = 2,675,820$$

9. Concentration in g/scf

$$C'_s = 0.001 \text{ g/mg} \frac{M_n}{V_{m_{std}}} = 0.001 \times \frac{44.7}{62.140} = 0.00072$$

$$00072 \times 15.43 = 0.011 \text{ gr/dscf}$$

10. Particulate mass emission rate, lbs/hr.

$$pmr = \frac{C_s \times Q_{s_{std}}}{454} = \frac{0.00072 \times 2,675,820}{454} = 4.2 \text{ lb/hr}$$

11. Isokinetic variation

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

$$I = \frac{100\ (532)\ [0.002669(21.3) + \frac{67.994}{548}\ (.995)\ (28.4 + \frac{1.6}{13.6})]}{60 \times 87.5 \times 66.69 \times 28.45 \times .000189} = 101.1$$

Example Calculations for Particulate Emissions

Test No. RHS-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.)

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

$$V_{m_{std}} = 17.65 \times 55.394 \times (.995) \left[\frac{28.4 + \frac{1.3}{13.6}}{554}\right] = 50.038$$

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

$$V_{w_{std}} = 0.04707 V_{1_c} =$$

$$V_{w_{std}} = 0.04707 \times 16.4 = 0.77$$

3. Moisture content in stack gas.

$$B_{ws} = \frac{V_{wc_{std}}}{V_{m_{std}} + V_{wc_{std}}} = B_{ws_{std}} = \frac{0.77}{50.038 + 0.77} = .015$$

4. Dry molecular weight of stack gas.

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

$$M_d = 0.440\ (0.0) + 0.32\ (21.0) + 0.280\ (79.0) = 28.84$$

5. Molecular weight of stack gas

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

$$M_s = 28.84\ (1 - .015) + 18(.015) = 28.68$$

6. Stack velocity at stack conditions, fps

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

$$V_s = 85.49 \times .84 \times (1.03) \times \sqrt{\frac{541}{28.45 \times 28.68}} = 60.23$$

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

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

$$Q_s = 60 \times 60.23 \times 12.0 = 43,366 \text{ ACFM}$$

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

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

$$Q_{std} = 17.65 \times 43,366\ \frac{28.45}{541} \times (1-.015) = 39,647 \times 60 = 2,378,820$$

9. Concentration in g/scf

$$C'_s = 0.001 \text{ g/mg} \frac{M_n}{V_{m\,std}} = 0.001 \times \frac{37.6}{50.038} = 0.00075$$

$$0.00075 \times 15.43 = 0.011 \text{ gr/dscf}$$

10. Particulate mass emission rate, lbs/hr.

$$pmr = \frac{C_s \times Q_{s_{std}}}{454} = \frac{0.00075 \times 2,378,820}{454} = 3.9 \text{ lb/hr}$$

11. Isokinetic variation

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

$$I = \frac{100\ (541)\ \left[0.002669(16.4) + \frac{55.394}{554}\ (.995)\ (28.4 + \frac{1.3}{13.6})\right]}{60 \times 75 \times 60.23 \times 28.45 \times .000189} = 106.9$$

Example Calculations for Particulate Emissions

Test No. RHS-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.)

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

$$V_{m_{std}} = 17.65 \times 55.203 \times .995 \left[\frac{28.4 + \frac{1.2}{13.6}}{551}\right] = 50.123$$

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

$$V_{w_{std}} = 0.04707 V_{1_c} =$$

$$V_{w_{std}} = 0.04707 \times 19.2 = 0.904$$

3. Moisture content in stack gas.

$$B_{ws} = \frac{V_{wc_{std}}}{V_{m_{std}} + V_{wc_{std}}} = B_{ws} = \frac{0.904}{50.123 + 0.904} = 0.018$$

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

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

$$M_s = 28.84\ (1-.018) + 18(.018) = 28.64$$

6. Stack velocity at stack conditions, fps

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

$$V_s = 85.49 \times .84 \times (1.04) \times \sqrt{\frac{563}{28.45 \times 28.64}} = 62.08$$

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

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

$$Q_s = 60 \times 62.08 \times 12 = 44,698 \text{ ACFM}$$

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

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

$$Q_{std} = 17.65 \times 44,698 \times \frac{28.45}{563} \times (1-.018) = 39,149 \times 60 = 2,348,940$$

2,2 99,778

2?10

9. Concentration in g/scf

29,008

$$C'_s = 0.001\ \text{g/mg}\ \frac{M_n}{V_{m_{std}}} = 0.001 \times \frac{30.2}{50.123} = 0.00060$$

$$0.00060 \times 15.43 = 0.009\ \text{gr/dscf}$$

.0091 gr/ dscf

4.77 lb/hr

10. Particulate mass emission rate, lbs/hr.

$$\text{pmr} = \frac{C_s \times Q_{s_{std}}}{454} = \frac{0.00060 \times 2,348,940}{454} = 3.1\ \text{lb/hr}$$

2.96 lbs/hr

11. Isokinetic variation

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

$$I = \frac{100\ (563)\ [0.002669(19.2) + \frac{55.203}{551}\ (.995)\ (28.4 + \frac{1.2}{13.6})]}{60 \times 75 \times 62.08 \times 28.45 \times .000189} = 108.3$$

96.11.98

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

$A = 0.76\ (20 \times 150)^{0.42} = 21.9$ lbs/hr

Test No. 2

$A = 0.76\ (20 \times 145)^{0.42} = 21.6$ lbs/hr

Test No. 3

$A = 0.76\ (20 \times 148)^{0.42} = 21.8$ 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.

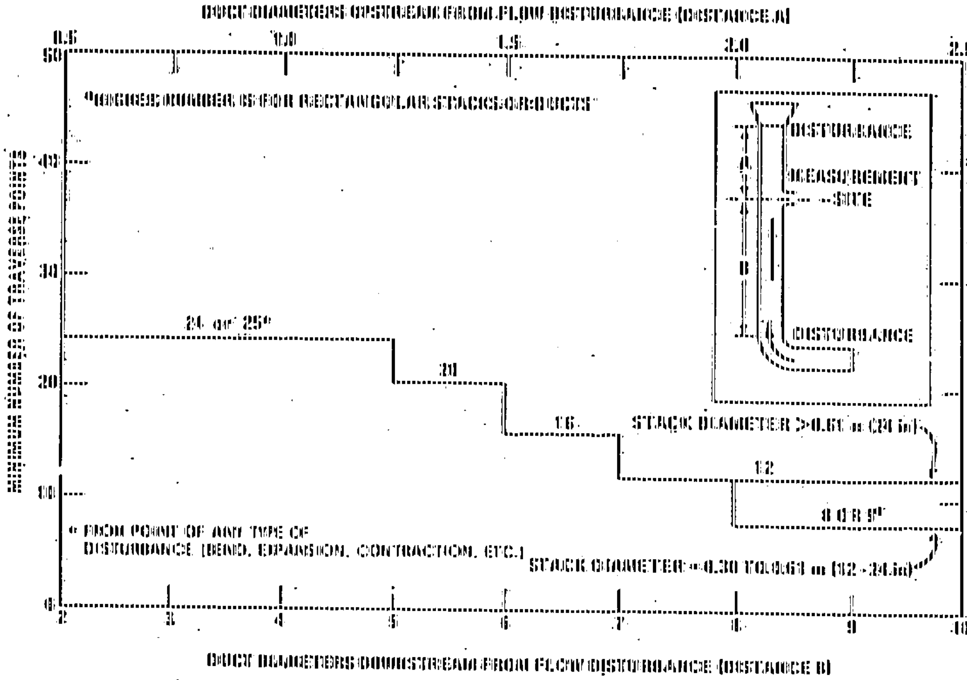


Figure 1-2. Minimum number of traverse points for particulate traverses.

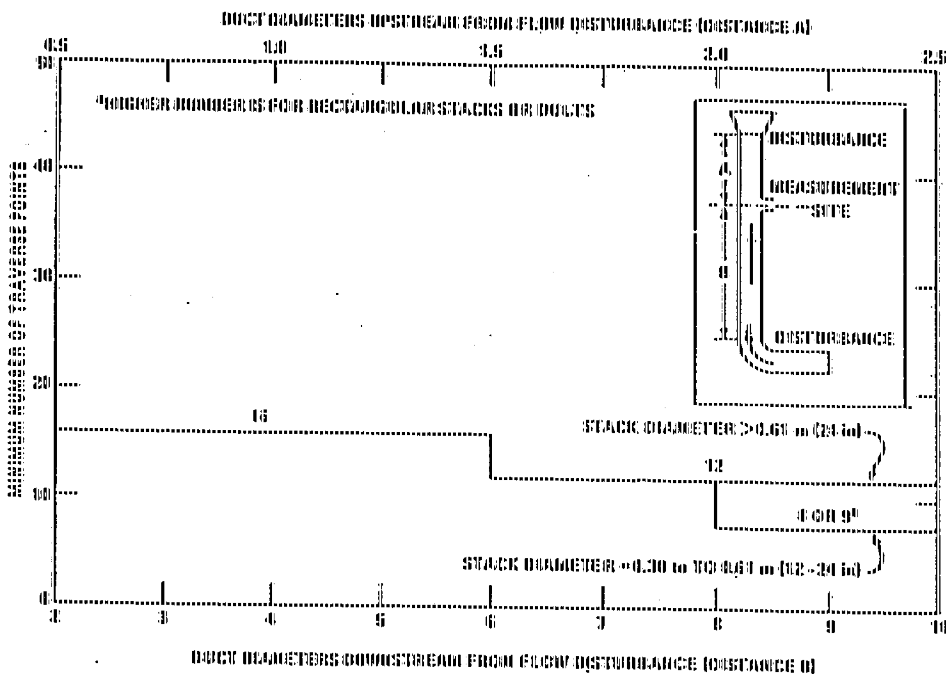


Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

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

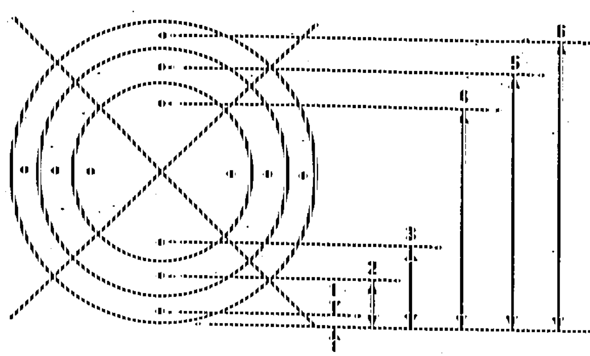


Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

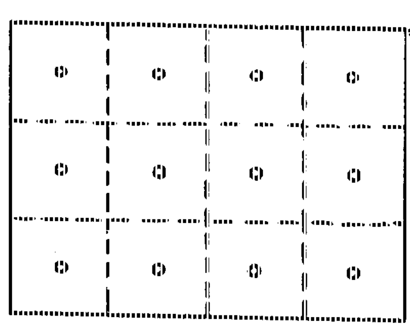


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

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:

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

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

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

<u>Barometer</u> - A barometer capable of measuring atmospheric pressure to within 2.5 mm Hg.

<u>Gas Density Determination Equipment</u> - 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.

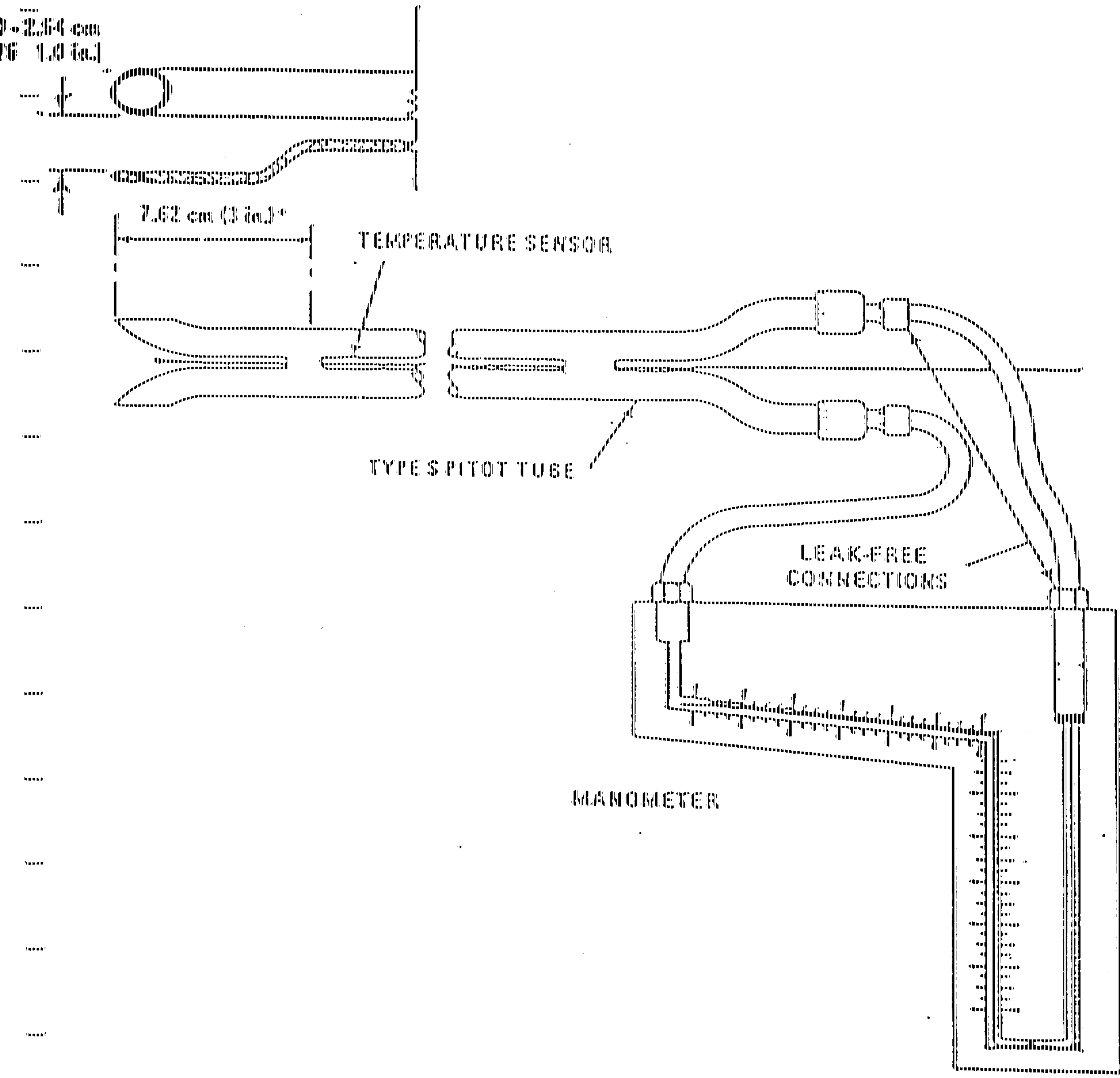
After adjusting the manometer level and zero, the velocity head and temperature were measured for each traverse point and recorded on the data sheet.

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.

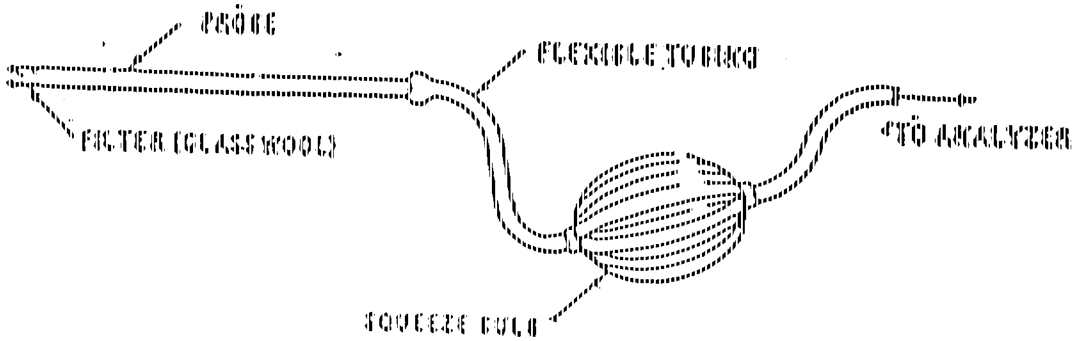
One flue gas sample was taken for each pollutant emission rate determination. Within eight hours the samples were analyzed for % CO_2 and O_2. The % N_2 and CO were determined and the dry molecular weight was calculated.

SAMPLE ANALYSIS

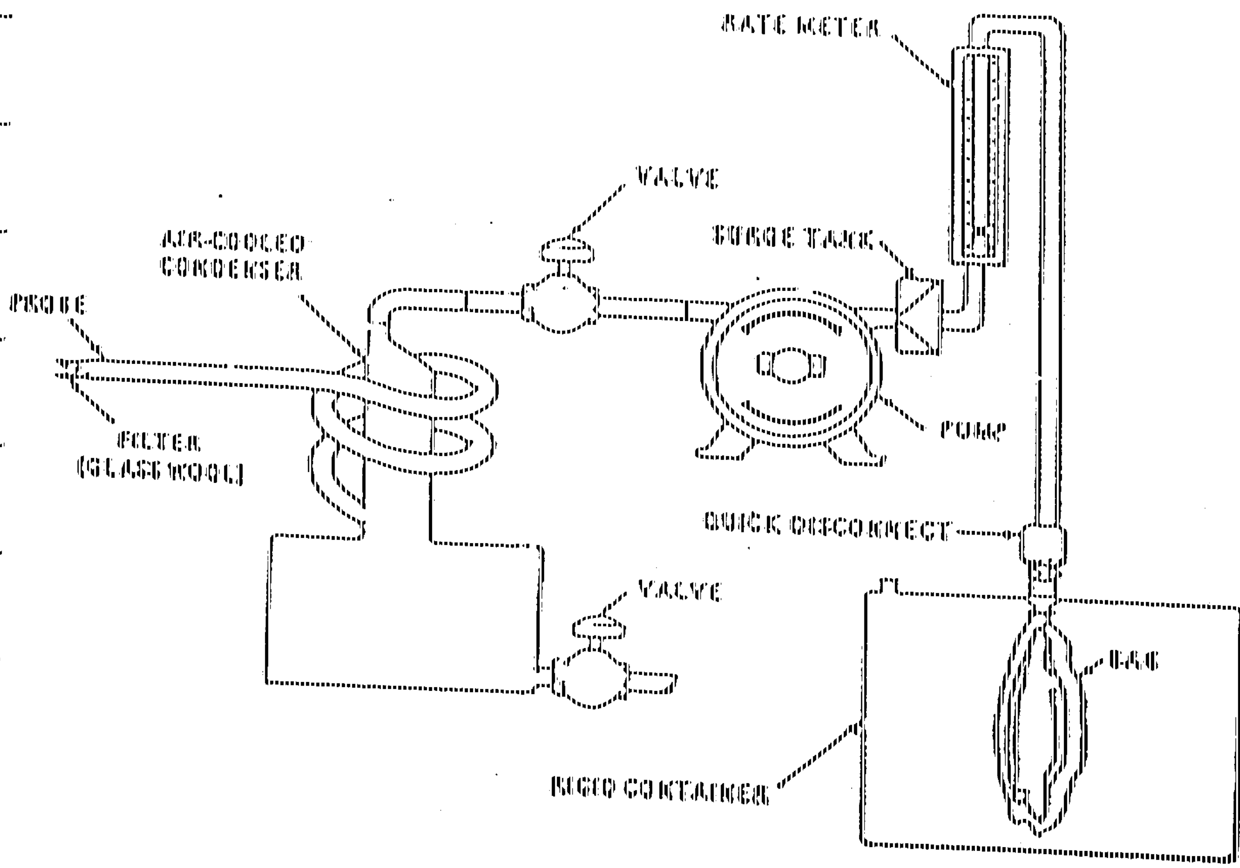
After a sample was drawn into a combustible gas analyzer, it was immediately analyzed for percent CO_2 and O_2. The percentage of the gas that is N_2 and Co was determined by subtracting the sum of the percents CO_2 and O_2 from 100 percent.

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

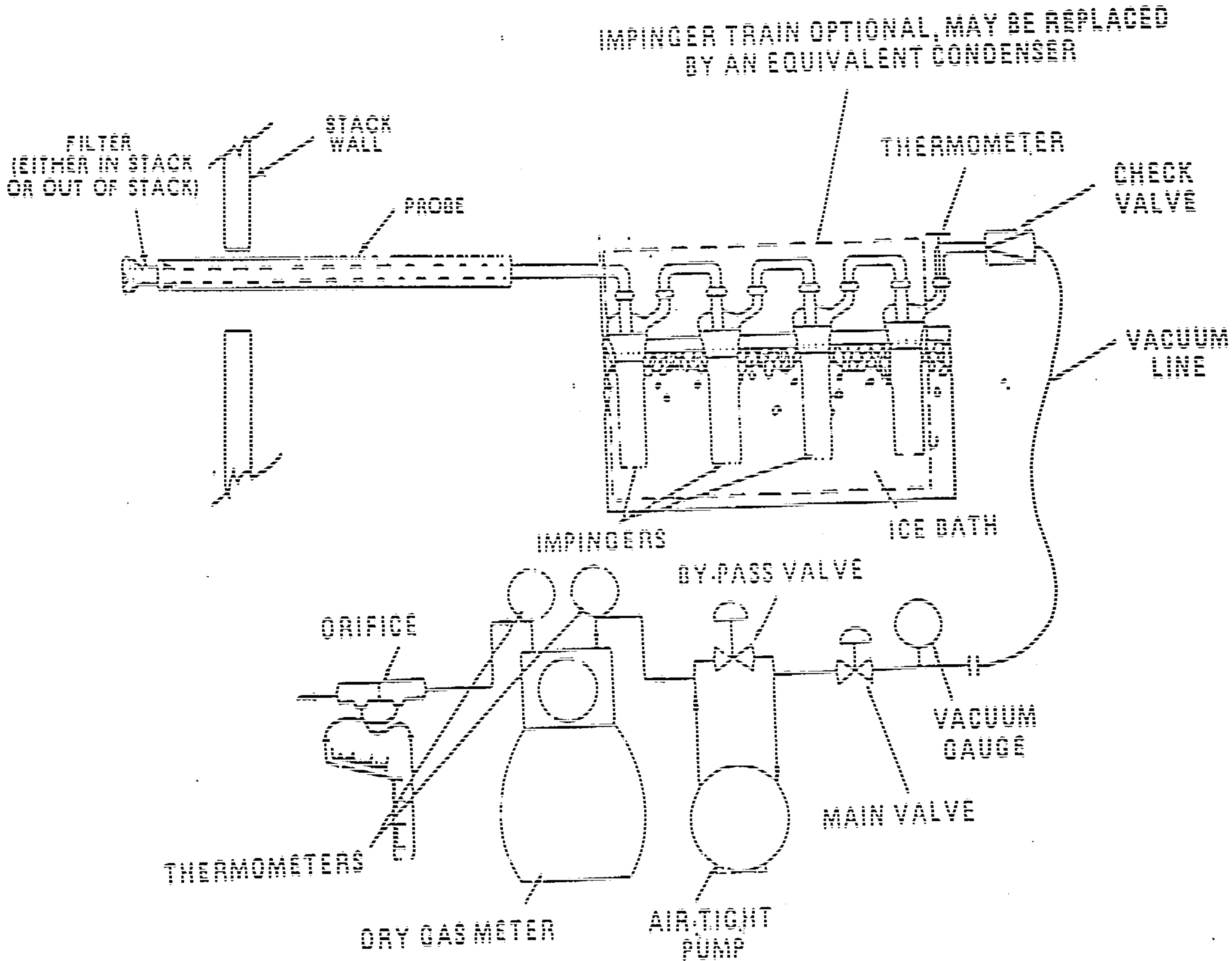
After selecting the sampling site and the minimum number of traverse points, the stack pressure and temperature was measured according to the procedures described in the Federal Register*.

Approximately 200 grams of silica gel were weighed in a sealed impinger prior to each test. One-hundred 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 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.

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

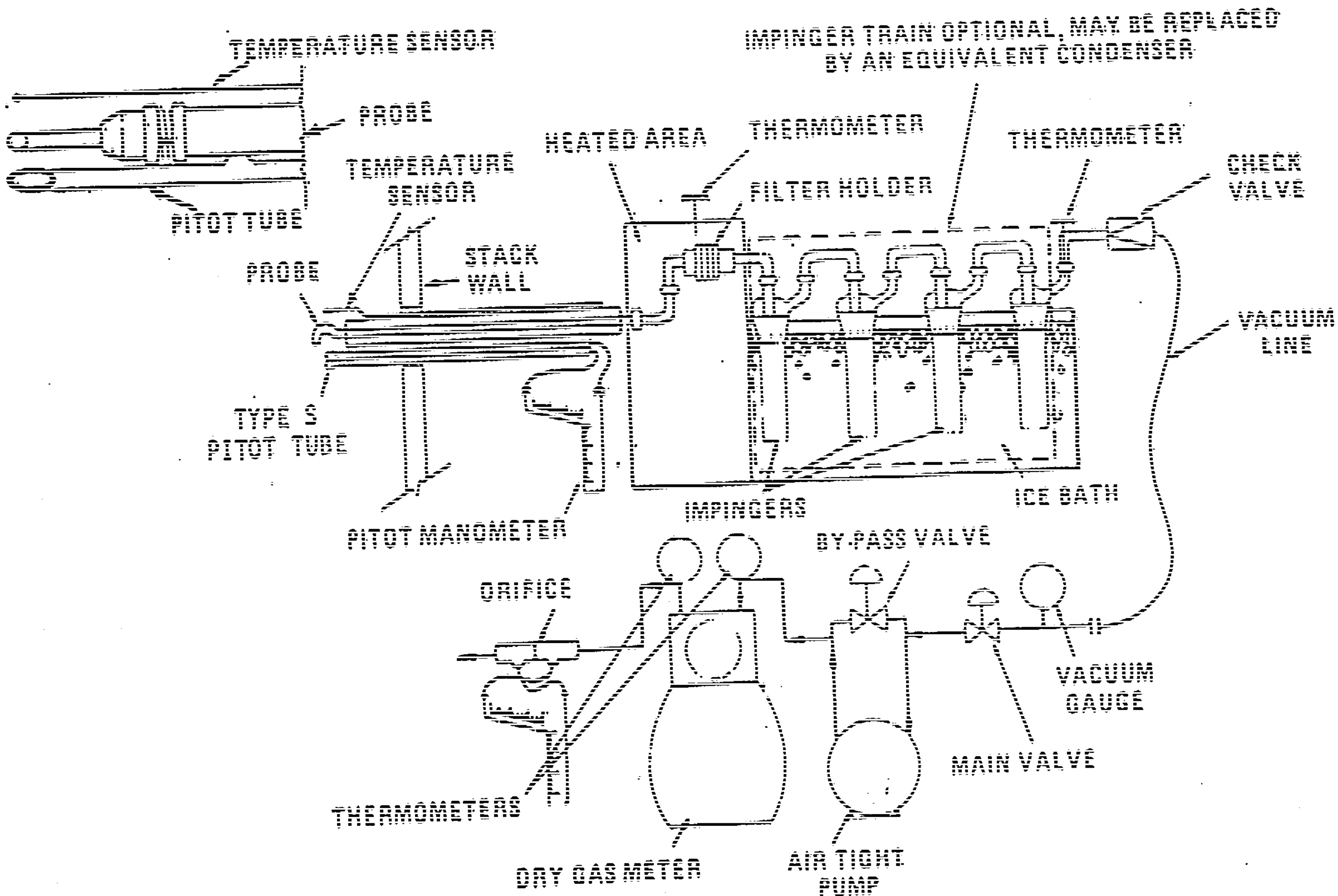


Figure 1. Schematic of Method 5 sampling train.

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

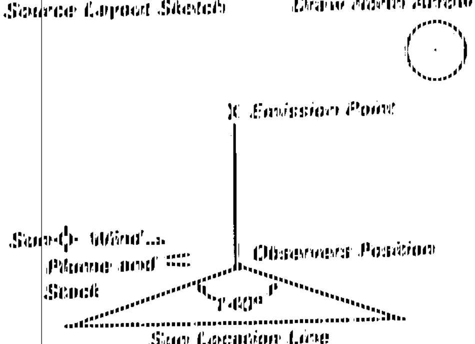
BACKGROUND COLOR: START STOP | SKY CONDITIONS: START STOP

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				
12					42				
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16					46				
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19					49				
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 8/6/90 Meter box number 943

Barometric pressure, P_b = 28.9 in. Hg Calibrated by [illegible 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	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	920.900 926.150	72 °F	108 120	77 83	97	12.10	.996	
1.0	5	926.260 931.560	73 °F	122 103	88 91	101	8:14	.990	
1.5	10	935.000 945.327	73 °F	133 105	92 79	102	13:00	1.017	
2.0	10	945.942 956.495	73 °F	111 115	80 84	97	8:30	.994	
3.0	10	956.939 967.488	73 °F	111 120	85 90	106	10:00	.998	
4.0	10	968.026 978.629	73 °F	112 120	86 90	107	8:39	.993	
							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) = .996 5.25 (28.94) (532)	
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) 10.553 (29.05)(533) = .994	
3.0	0.221	10(28.9) (566) 10.549(29.12)(533) .998	
4.0	0.294	10(28.9) (567) 10.603(29.19)(533) .993	

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

Darrin ___ 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	$Y_i = \dfrac{V_w\, P_b\, (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
2"	10	10.667	72	113/136	86/96	108	12.52	2"	.996	$\dfrac{10\,(29.4)\,568}{10.667\left(29.4 + \frac{2}{13.6}\right)532}$
2"	10	10.704	72	116/138	89/93	109	12.54	2"	.994	$\dfrac{10\,(29.4)\,569}{10.704\left(29.4 + \frac{2}{13.6}\right)532}$
2"	10	10.757	72	124/131	90/94	112	12.56	2"	.994	$\dfrac{10\,(29.4)\,572}{10.757\left(29.4 + \frac{2}{13.6}\right)(532)}$
									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: #6 Date: 2/22/93

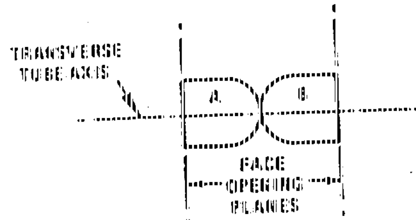
1. What is the external diameter of the tubing in inches?
3/8

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

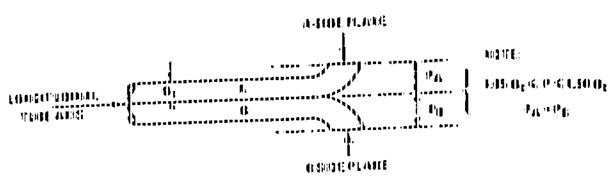
3. Are the face opening planes parallel to the longitudinal axis as in Figure B (top view)? yes

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

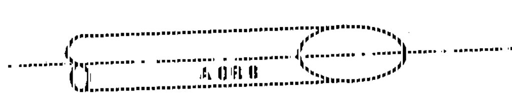
5. Does the tube meet all the geometric specifications to be assigned a .84 coefficient? yes



(a)



(b)



(c)

CALIBRATED BY:

NOZZLE CALIBRATION DATA FORM

Date 8/21/90 Calibrated by Rich Campbell

Nozzle identification number	D_1, (in.)	D_2, (in.)	D_3, (in.)	ΔD, (in.)	D_{avg}
#7	.186	.186	.186	0.0	.186

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.

C. FIELD DATA SHEETS

Visible Emission Observation Form

SOURCE NAME: Commercial Stone

ADDRESS: Richhill

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: 20' STOP: 20'

HEIGHT RELATIVE TO OBSERVER
START: 15' STOP: 15'

DISTANCE FROM OBSERVER
START: 30' STOP: 30'

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: Cloudy SKY STOP:

BACKGROUND COLOR
START: GRAY STOP:

SKY CONDITIONS
START: Cloudy STOP:

WIND SPEED
START: 0 - 5 mph STOP:

WIND DIRECTION
START: NW STOP:

AMBIENT TEMP
START: 65 F STOP:

WET BULB TEMP:
RH, percent:

Source Layout Sketch

Draw North Arrow

X Emission Point

Sun ☉ Wind → Plume and Stack

Observers Position

140°

Sun Location Line

OBSERVATION DATE: 8/22/90
START TIME: 945
STOP TIME:

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	5	5	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	5	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	5	5	5	5	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: 8/22/90

ORGANIZATION: CSC Inc.

CERTIFIED BY: ETA
DATE: March 1990

VERIFIED BY:
DATE:

COMMENTS: TEST-1

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

Visible Emission Observation Form

SOURCE NAME: Commercial Stone

ADDRESS: Rich Hill

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 20' STOP 20' | HEIGHT RELATIVE TO OBSERVER: START 15 STOP 15

DISTANCE FROM OBSERVER: START 30 STOP | DIRECTION FROM OBSERVER: START SW STOP

DESCRIBE EMISSIONS
START None STOP

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

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

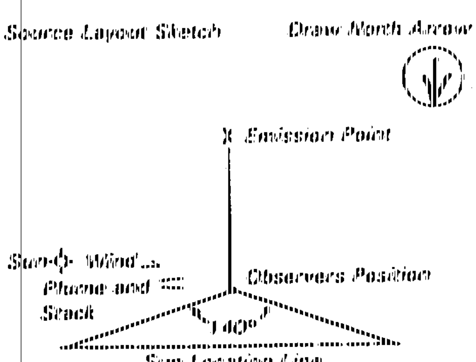
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
START STOP

DESCRIBE BACKGROUND
START Cloudy sky STOP

BACKGROUND COLOR: START Grey STOP | SKY CONDITIONS: START Cloudy STOP

WIND SPEED: START 0-5mph STOP | WIND DIRECTION: START NW STOP

AMBIENT TEMP: START 65°F STOP | WET BULB TEMP. | RH percent



COMMENTS: TEST-1

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

OBSERVATION DATE: 9/22/90 | START TIME: 9:25 | STOP TIME:

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	0	0	31				
2	0	0	0	0	32				
3	0	0	0	0	33				
4	0	0	0	0	34				
5	0	0	0	0	35				
6	0	0	0	0	36				
7	0	0	0	0	37				
8	0	0	0	0	38				
9	0	0	0	0	39				
10	0	0	0	0	40				
11	0	0	0	0	41				
12	0	0	0	0	42				
13	0	0	0	0	43				
14	0	0	0	0	44				
15	0	0	0	0	45				
16	0	0	0	0	46				
17	0	0	0	0	47				
18					48				
19					49				
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): Kevin Kennedy

OBSERVER'S SIGNATURE: Kevin Kennedy | DATE: 9/22/90

ORGANIZATION: ESC Inc.

CERTIFIED BY: ETA | DATE: March 1990

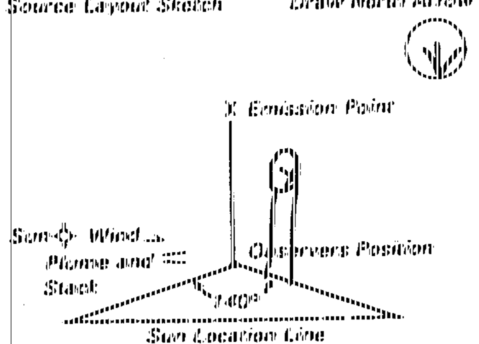
VERIFIED BY: | DATE:

Visible Emission Observation Form

Field	Entry
SOURCE NAME	Commercial Stone
ADDRESS	Rich Hill
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 20 STOP 20
HEIGHT RELATIVE TO OBSERVER	START 15 STOP
DISTANCE FROM OBSERVER	START 30 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 Cloudy Sky STOP
BACKGROUND COLOR	START Grey STOP
SKY CONDITIONS	START Cloudy STOP
WIND SPEED	START 0-5 mph STOP
WIND DIRECTION	START NW STOP
AMBIENT TEMP.	START 65 °F STOP
WET BULB TEMP.	
RH, percent	

Source Layout Sketch

Draw North Arrow



OBSERVATION DATE	START TIME	STOP TIME
9/22/90	12:00	

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
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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
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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
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16	0	0	0	0	46	0	0	0	0
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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

Field	Entry
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	9/22/90
ORGANIZATION	CSC Env.
CERTIFIED BY	ETA
DATE	March 1990
VERIFIED BY	
DATE	
COMMENTS	TEST-2
I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS SIGNATURE	
TITLE	
DATE	

Visible Emission Observation Form

SOURCE NAME Commercial Stone

ADDRESS Rich Hill

CITY | STATE MO | ZIP

PHONE | SOURCE ID NUMBER

PROCESS EQUIPMENT | OPERATING MODE

CONTROL EQUIPMENT | OPERATING MODE

DESCRIBE EMISSION POINT
START STOP

HEIGHT ABOVE GROUND LEVEL START 20' STOP 20' | HEIGHT RELATIVE TO OBSERVER START 15' STOP 15'

DISTANCE FROM OBSERVER START 70' STOP 70' | 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 ☐

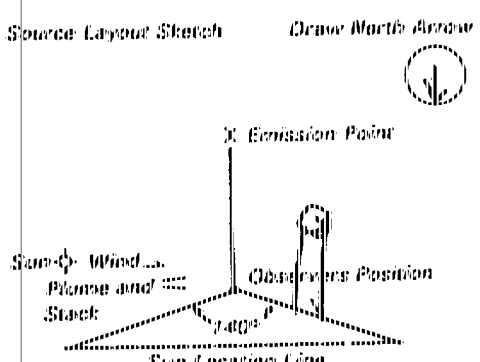
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
START STOP

DESCRIBE BACKGROUND
START Cloudy Sky STOP

BACKGROUND COLOR START Grey STOP | SKY CONDITIONS START Cloudy STOP

WIND SPEED START 0 - 5 mph STOP | WIND DIRECTION START NW STOP

AMBIENT TEMP. START 65 °F STOP | WET BULB TEMP. | RH, percent



COMMENTS TEST-2

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

OBSERVATION DATE 8/22/90 | START TIME 1:00 | STOP TIME 1:50

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	0	0	0	0	31				
2	0	0	0	0	32				
3	0	0	0	0	33				
4	0	0	0	0	34				
5	0	0	0	0	35				
6	0	0	0	0	36				
7	0	0	0	0	37				
8	0	0	0	0	38				
9	0	0	0	0	39				
10	0	0	0	0	40				
11	0	0	0	0	41				
12	0	0	0	0	42				
13	0	0	0	0	43				
14	0	0	0	0	44				
15	0	0	0	0	45				
16					46				
17					47				
18					48				
19					49				
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) Kevin Kennedy

OBSERVER'S SIGNATURE [illegible] | DATE 8/22/90

ORGANIZATION CSC Inc.

CERTIFIED BY ETA | DATE [illegible] 90

VERIFIED BY | DATE

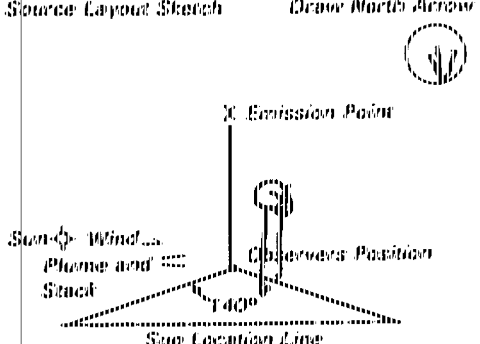
Visible Emission Observation Form

SOURCE NAME	Commercial Stone
ADDRESS	Rich Hill
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 20' STOP 20'	HEIGHT RELATIVE TO OBSERVER START 15' STOP
DISTANCE FROM OBSERVER START 30' STOP 30'	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 Cloudy sky	STOP
BACKGROUND COLOR START Grey STOP	SKY CONDITIONS START Cloudy STOP
WIND SPEED START 0-5mph STOP	WIND DIRECTION START NW STOP
AMBIENT TEMP. START 68 °F STOP	WET BULB TEMP. / RH, percent

OBSERVATION DATE 8/22/90 START TIME 2:05 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

Source Layout Sketch



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
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

SOURCE NAME: Commercial Stone

ADDRESS: Rich Hill

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 20' STOP 20' | HEIGHT RELATIVE TO OBSERVER: START 15' STOP 15'

DISTANCE FROM OBSERVER: START 30' STOP 30' | DIRECTION FROM OBSERVER: START SW STOP SW

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 Cloudy SKY STOP

BACKGROUND COLOR: START Grey STOP | SKY CONDITIONS: START Cloudy STOP

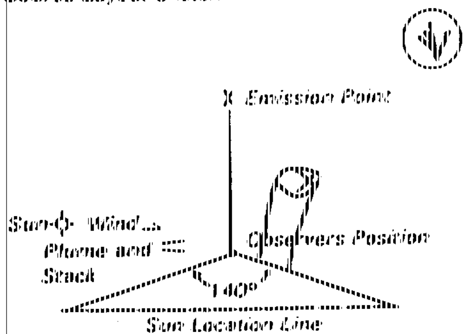
WIND SPEED: START 0-5mph STOP | WIND DIRECTION: START NW STOP

AMBIENT TEMP: START 65°F STOP | WET BULB TEMP: | RH, percent:

OBSERVATION DATE: 8/22/90 | START TIME: 205 | STOP TIME: 3:35

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

Source Layout Sketch Draw North Arrow



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: 8/22/90

ORGANIZATION: CSL 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

PLANT Rich Hill Comp. Sta. 3
LOCATION Sand Plant Stack
OPERATOR Rick Campbell
DATE 8/22/90
RUN NO. RHS-1
SAMPLE BOX NO. ______
METER BOX NO. #443
METER ΔHg ______
C FACTOR KF= 1.21
PITOT TUBE COEFFICIENT, C_p =.84

SCHEMATIC OF STACK CROSS SECTION
Location ______
Stack dimen: ______

AMBIENT TEMP. ______ 67
BAROMETRIC PRESSURE 28.4
ASSUMED MOISTURE, % 2%
PROBE LENGTH, (ft) ______
NOZZLE IDENTIFICATION NO. #7
AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .186
PROBE HEATER SETTING 250
LEAK RATE, (cfm) 0.0 at 8" Hg
PROBE LINER MATERIAL Glass
STATIC PRESSURE, (in. Hg) +.70
FILTER NO. 100051

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)
	9:25	0					614.667				
A-1		3.5	3.5	68	1.2	1.45	617.235	64	64	250	56
2		7.0	3.5	73	1.1	1.30	619.910	82	65	250	56
3		10.5	3.5	74	.95	1.10	622.190	86	64	258	57
4		14.0	3.0	71	.80	0.98	624.170	89	66	259	58
5		5/17.5	2.0	72	.75	0.90	625.955	93	66	251	58
B-1	9:47	21.0	3.5	72	1.7	2.10	629.060	94	69	256	58
2		24.5	3.0	72	1.4	1.70	631.130	100	69	258	59
3		28.0	3.0	72	1.3	1.60	634.255	104	71	256	59
4		31.5	3.5	73	1.7	2.10	637.260	107	72	258	60
5		5/35.0	4.0	74	1.8	2.20	640.465	108	73	256	60
C-1	10:09	38.5	4.5	72	1.8	2.20	643.830	93	75	250	61
2		42.0	5.0	72	1.9	2.30	647.040	109	76	257	59
3		45.5	5.0	71	1.8	2.20	650.260	111	77	259	56
4		49.0	4.0	71	1.5	1.80	653.040	112	77	261	54
5		5/52.5	4.0	71	1.5	1.80	655.829	113	77	260	54
D-1	10:30	56.0	4.0	71	1.4	1.70	658.700	97	79	264	50
2		59.5	4.0	71	1.5	1.80	661.775	109	78	265	50
3		63.0	3.5	71	1.2	1.40	664.280	112	79	266	50
TOTAL								Avg.	Avg.		
AVERAGE		87.5		72	1.15	1.6	67.994	Avg. 88			

G-053

IMPINGER WATER
Final 210 ml
Init. 200 ml
Cond. 10 ml

DESICCANT
Final 216.4 gms
Init. 205.1 gms
Gain 11.3 gms

ORSAT ANALYSES

Time			
CO_2	0.0	0.0	0.0
O_2	21.4	21.0	21.0
CO			

PLANT Campbell Shaw
LOCATION Rich Hill Sand plant
OPERATOR E. Campbell
DATE 8/22/90
RUN NO. 2HS-1
SAMPLE BOX NO.
METER BOX NO. # 443
METER ΔH@
C FACTOR KF= 1.21
PITOT TUBE COEFFICIENT, C_p

SCHEMATIC OF STACK CROSS SECTION
Location
Stack dimen.

BAROMETRIC PRESSURE
ASSUMED MOISTURE, % 2%
PROBE LENGTH, (ft)
NOZZLE IDENTIFICATION NO. #7
AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .186
PROBE HEATER SETTING
LEAK RATE, (cfm) 0.0 at 8"
PROBE LINER MATERIAL Glass
STATIC PRESSURE, (in. Hg)
FILTER NO. 10005 1

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)
D-4		66.5	3.0	72	1.0	1.20	666.570	111	79	248	50
5	/	70.6	3.6	72	1.1	1.30	668.050	111	79	269	50
E-1	1059 /	73.5	4.0	71	1.4	1.70	671.970	113	80	268	50
2		77.0	4.0	71	1.3	1.60	674.760	107	79	263	51
3		80.5	4.6	74	1.4	1.70	677.810	113	79	260	51
4		84.0	3.0	73	1.1	1.30	680.200	113	80	263	51
5	11:10	87.5	3.0	72	1.1	1.30	682.661	112	81	261	53
TOTAL								Avg.	Avg.		
AVERAGE								Avg.			

C-053

IMPINGER WATER
Final 210 ml
Init. 200 ml
Cond. 10 ml

DESICCANT
Final ______ gms
Init. ______ gms
Gain ______ gms

ORSAT ANALYSES

Time			
CO_2			
O_2			
CO			

PLANT	[illegible]
LOCATION	7kil ... SA Stack
OPERATOR	R. Campbell
DATE	8/22/90
RUN NO.	RHS-2
SAMPLE BOX NO.	
METER BOX NO.	# 443
METER ΔH@	
C FACTOR	
PITOT TUBE COEFFICIENT, C_p	.84

SCHEMATIC OF STACK CROSS SECTION
Location
Stack dimen.

AMBIENT TEMPERATURE	
BAROMETRIC PRESSURE	
ASSUMED MOISTURE, %	2%
PROBE LENGTH, (ft)	
NOZZLE IDENTIFICATION NO.	#7
AVERAGE CALIBRATED NOZZLE DIAMETER, (in.)	.196
PROBE HEATER SETTING	
LEAK RATE, (cfm)	0.01 @ 8"
PROBE LINER MATERIAL	Glass
STATIC PRESSURE, (in. Hg)	+.10
FILTER NO.	1000 52

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)
	12:00	0					682.871				
E-1		3	2.0	76	.40	1.1	684.870	106	77	246	58
2		6	2.0	77	.85	1.0	686.670	109	78	249	58
3		9	3.0	77	1.0	1.2	688.760	111	79	253	58
4		12	3.0	76	1.0	1.2	690.875	113	81	256	59
5		15	3.0	76	1.0	1.2	693.006	114	82	256	57
D-1	12:29	18	3.5	74	1.1	1.3	695.210	100	79	259	57
2		21	4.0	78	1.1	1.3	697.990	107	81	263	56
3		24	3.0	75	.70	.85	699.390	106	80	264	57
4		27	2.0	75	.50	.60	700.910	108	81	267	57
5		30	4.0	75	1.0	1.2	702.943	111	81	269	58
C-1	12:4[illegible]	33	4.0	77	1.4	1.7	705.400	94	80	260	59
2		36	4.0	80	1.5	1.8	708.000	106	79	258	59
3		39	4.0	83	1.4	1.7	710.401	109	79	257	59
4		42	4.0	83	1.1	1.3	712.440	109	80	260	59
5		45	4.0	81	1.3	1.6	714.810	112	80	261	60
B-1	1:00	48	4.0	82	1.2	1.45	717.220	96	80	257	51
2		51	4.0	85	1.1	1.3	719.410	106	80	254	50
3		54	4.0	88	1.1	1.3	721.640	109	80	254	51
TOTAL								Avg.	Avg.		
AVERAGE				81	1.03	1.3	55.394	Avg. 94			

IMPINGER WATER
Final 264 ml
Init. 260 ml
Cond. 4 ml

DESICCANT
Final 229.9 gms
Init. 217.5 gms
Gain 12.4 gms

C-055

ORSAT ANALYSES

Time			
CO_2	6.0	6.0	6.0
O_2	21.0	21.0	21.0
CO			

PLANT Camm Stone

LOCATION Rich Hill Sand plant

OPERATOR R. Crandall

DATE 8/23/90

RUN NO. RHS-2

SAMPLE BOX NO.

METER BOX NO. #443

METER ΔH@

C FACTOR

PITOT TUBE COEFFICIENT, C_p .84

SCHEMATIC OF STACK CROSS SECTION

Location

Stack dimen.

BARO. PERAL

BAROMETRIC PRESSURE

ASSUMED MOISTURE, %

PROBE LENGTH, (ft)

NOZZLE IDENTIFICATION NO. #7

AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .186

PROBE HEATER SETTING

LEAK RATE, (cfm) 0.01 at 8"

PROBE LINER MATERIAL Glass

STATIC PRESSURE, (in. Hg)

FILTER NO. 1900 52

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-4	"	57	4.0	84	1.3	1.55	724.080	111	80	250	51
5		60	4.0	83	1.3	1.55	726.546	112	80	251	51
A-1	1129	63	4.0	88	1.0	1.2	728.840	98	80	250	52
2		66	4.0	80	1.0	1.2	730.930	102	80	252	52
3		69	4.0	91	.80	0.98	732.910	107	80	254	53
4		72	4.0	95	1.0	1.2	735.895	109	80	253	53
5	1:34	75	4.0	97	1.0	1.2	738.475	111	80	254	53
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 Cam. [illegible]
LOCATION Rich Hill [illegible]
OPERATOR R.Cam[illegible] M&K.V.
DATE 8/22/90
RUN NO. DHS-3
SAMPLE BOX NO.
METER BOX NO. # 443
METER ΔHg
C FACTOR KC. 1.21
PITOT TUBE COEFFICIENT, C_p .84

SCHEMATIC OF STACK CROSS SECTION
Location
Stack dimen.

BAROMETRIC PRESSURE 28.4
ASSUMED MOISTURE, %
PROBE LENGTH, (ft)
NOZZLE IDENTIFICATION NO. #7
AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .186
PROBE HEATER SETTING
LEAK RATE, (cfm) 0.01 at 16"
PROBE LINER MATERIAL Glass
STATIC PRESSURE, (in. Hg) +.70
FILTER NO. 100053

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)
	2:05	0					738.600				
A-1		3	3.0	106	1.0	1.2	739.867	91	74	255	58
2		6	3.0	107	1.1	1.3	741.835	91	74	255	58
3		9	3.0	110	.85	1.05	743.450	98	74	256	60
4		12	3.0	95	.90	1.1	745.535	100	75	255	58
5		15	3.0	100	.80	.96	747.393	102	74	256	57
B-1	2:22	18	3.0	101	1.1	1.3	749.710	76	93	259	57
2		21	3.0	103	1.1	1.3	751.660	103	77	258	57
3		24	3.0	99	1.0	1.2	753.800	104	78	261	58
4		27	3.0	115	1.1	1.3	756.125	108	80	264	59
5		30	3.0	116	1.2	1.45	758.539	109	79	265	58
C-1	2:40	33	3.0	118	1.2	1.45	760.930	99	80	266	59
2		36	3.5	130	1.3	1.55	763.470	109	81	261	59
3		39	3.5	122	1.2	1.45	765.760	111	81	264	59
4		42	2.5	131	1.2	1.45	768.070	109	81	263	59
5		45	3.0	102	1.1	1.3	770.262	110	82	259	60
D-1	3:00	48	3.0	112	.80	0.96	772.295	98	82	253	60
2		51	3.0	108	1.0	1.2	774.399	106	81	251	60
3		54	3.0	102	.80	0.96	776.120	106	82	254	61
TOTAL								Avg.	Avg.		
AVERAGE				103	1.04	1.2	55.203	Avg.	91		

C-675

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

DESICCANT
Final 238.9 gms
Init. 226.7 gms
Gain 112 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 R. Campbell

DATE 8/22/90

RUN NO. RHS-3

SAMPLE BOX NO.

METER BOX NO. K443

METER ΔH@

C FACTOR KF = 1.21

PITOT TUBE COEFFICIENT, C_p .84

SCHEMATIC OF STACK CROSS-SECTION

Location

Stack dimen.

AMBIENT TEMPERATURE

BAROMETRIC PRESSURE

ASSUMED MOISTURE, %

PROBE LENGTH, (ft)

NOZZLE IDENTIFICATION NO. #7

AVERAGE CALIBRATED NOZZLE DIAMETER, (in.) .186

PROBE HEATER SETTING

LEAK RATE, (cfm) .001 at 10"

PROBE LINER MATERIAL

STATIC PRESSURE, (in. Hg)

FILTER NO. 100053

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)
D-4		57	3.0	96	0.70	0.84	777.981	104	81	252	60
5		60	3.0	93	1.0	1.2	780.135	111	82	252	61
E-1	3:17	63	3.0	94	1.1	1.3	783.030	101	82	257	60
2		66	3.0	90	1.1	1.3	785.815	108	82	260	59
3		69	3.0	82	1.0	1.2	788.610	109	82	261	59
4		72	3.0	80	1.0	1.2	791.195	110	80	260	61
5	3:32	75	3.0	78	1.0	1.2	793.803	111	82	259	62
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			

25.25

D. PROCESS DATA

8/22/90

Rich Hill Sand Plant

Time:	9:25–11:10	12–1:34	2:05–3:32
Going In	150 Ton/hr.	145 Ton/hr.	148 Ton/hr.
Coming Out Sand	120	116	119
Other (Dust)	30	29	29

Rich H.

	1A	Sand	Fine Dust out of Sand Plant @ Rich Hill
3/8	100	100	1
4	99	99	
8	74	72	
16	52	47	100
30	41	33	99
50	29	21	97
100	19	10	87
200	9	4	68
24			

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

Facility: Rich Hill Sand Plant [illegible] Boiler No.:

Monitor Name: Bergmann [illegible] Test No.: 1-3

Design Efficiency: Test Date: [illegible]

	Recording Interval		Pressure Drop Across Baghouse (in. H_2O)	Pressure Drop Across Compartment (in. H_2O)				
	Sampling Time (minutes)	Clock Time (24 hr. clock)		1	2	3	4	5
Test 1	9:25am		1.2"					
	9:40am		1.2"					
	9:55am		1.2"					
	10:10am		1.3"					
	10:25am		1.3"					
	10:40am		1.3"					
	10:55am		1.3"					
	11:10am		1.3"					
Test 2	12:00pm		1.2"					
	12:15pm		1.3"					
	12:30pm		1.2"					
	12:45pm		1.2"					
	1:00pm		1.3"					
	1:15pm		1.2"					
	1:30pm		1.3"					
	1:35pm		1.3"					
Test 3	2:00pm		1.2"					
	2:15pm		1.1"					
	2:30pm		1.2"					
	2:45pm		1.2"					
	3:00pm		1.2"					
	3:15pm		1.3"					
	3:30pm		1.3"					
	3:35pm		1.3"					
		Representative						
		Design						

E. LABORATORY DATA

ANALYTICAL DATA

Test No.	RHS-1	RHS-2	RHS-3
Test Date	8/22/90	8/22/90	8/22/90
Filter No.	100051	100052	100053
Filter Tare, mg	636.6	634.7	630.8
Filter Final, mg	646.4	642.7	638.9
Filter Net, mg	9.8	7.6	8.1
Probe Acetone, mg	23.8	18.5	15.5
Probe Water mg	7.2	2.0	0.3
Impinger Sol. mg	7.3	1.9	21.8
Impinger Insol., mg	1.5	4.7	5.7
Impinger Acetone, mg	2.4	4.8	0.6
Acetone Blank (mg)*	0.2		
Water Blank (mg)*	0.4		
Total particulate, mg	4[illegible].7	37.6	30.2

*Data not corrected for blank values.

Analyst Kevin Kennedy

Reviewer Richard L. 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