SOURCE TEST REPORT

EPA TEST NO.: 71-CI-23

PLANT TESTED: Southeastern Kusan, Inc.
Gaffney, South Carolina

TESTOR: Environmental Engineering, Inc.
2324 Southwest 34 Street
Gainesville, Florida   32601
AC 904/372-3318

CONTRACT NO.: CPA 70-82, Modification No. 1 to
Task Order No. 2, Third of three plants.

TABLE OF CONTENTS

INTRODUCTION

Beryllium emission tests were performed at Southeastern Kusan, Incorporated, located in Gaffney, South Carolina. The tests were conducted on August 25 and 30, 1971.

The purpose of these tests was to determine beryllium emissions from a baghouse controlled beryllium smelting operation.

Southeastern Kusan performs the secondary smelting of beryllium - copper alloys. Emissions from the process are filtered through a bag collector. Emission tests were performed at the inlet and outlet of the central unit. Two separate sampling trains were used simultaneously at the inlet, and one train at the outlet. Two separate test runs were performed at the inlet and outlet.

SUMMARY OF TEST RESULTS

Summarized test results of stack parameters and beryllium emission rates for all three plants tested are included in Tables 1 and 2. Complete stack parameter and beryllium emission test results are included in the appendix. The tests indicate that Southeastern Kusan, Inc. emits 0.09 grams of Beryllium per 8-hour day.

The following code was used to characterize sample data:

SK - Southeastern - Kusan, Inc., Division of Beth. Steel, Gaffney, South Carolina

 0 - Outlet stack from baghouse

 1 - Run #1

 2 - Run #2

 3 - Run #3

MP - Millipore AA filter

 W - Whatman 41 filter

WB - Whatman 41 filter (when used as a backup)

Be - Beryllium sample

IGB - Impinger and back half acetone and water and rinses, and backup filter combined.

 I - Impinger and back half acetone and water rinses combined

 P - Probe particulate and probe acetone wash combined

 F - Filter

HI - Horizontal Inlet

VI - Vertical Inlet

TABLE I

SUMMARY OF BERYLLIUM EMISSION DATA

SOUTHEASTERN KUSAN, INC.
Gaffney, South Carolina
BAGHOUSE INLET AND OUTLET

	Inlet, Complete Test		
	0° Traverse	90° Traverse	Outlet Test
Run Number	VI-1-MP	HI-1-MP	0-1-MP
Date	8/25/71	8/25/71	8/25/71
Stack Flow Rate @ Stack Conditions, CFM	18,543	19,462	20,348
Stack Gas Moisture, % Volume	0.4	0.5	0.4
Stack Gas Temperature, ^{o}F	109.5	113	111
Test Time, Minutes	312	312	320
Beryllium Emissions, Total Catch $\mu g/m^3$ @ Stack Conditions grams/8-hr. day	8.12 2.03	14.67 3.84	0.38 0.10

TABLE 2

SUMMARY OF BERYLLIUM EMISSION DATA

SOUTHEASTERN KUSAN, INC.
Gaffney, South Carolina
BAGHOUSE INLET AND OUTLET

	Inlet, Complete Test		Outlet Test
	First Half of Test 0° Traverse	Second Half of Test 90° Traverse	
Run Number	VI-2-MP	HI-2-MP	O-2-MP
Date	8/30/71	8/30/71	8/30/71
Stack Flow Rate @ Stack Conditions, CFM	18,698	20,466	20,523
Stack Gas Moisture, % Volume	1.4	0.9	0.7
Stack Gas Temperature, $^{\circ}F$	152	100	125
Test Time, Minutes	168	168	320
Beryllium Emissions, Total Catch $\mu g/m^3$ @ Stack Conditions grams/8-hr. day	10.86 2.74	1.78 0.51	0.24 0.07

PROCESS DESCRIPTION AND OPERATION

Southeastern Kusan, Incorporated, is engaged in the production of beryllium-copper molds for plastic casting. Tests were conducted to determine the extent of beryllium emissions produced by melting and pouring beryllium-copper alloy. No tests were conducted for grinding and finishing operations, which are presently uncontrolled. A Wheelabrator baghouse, fed by numerous hoods, is employed in controlling Beryllium emissions at Southeastern Kusan.

The production of plastic casting molds begins with the melting of as much as 2,000 lbs. of beryllium-copper (approximately 2% Be) ingots in a crucible enclosed by a furnace. On 8/25/71, 1,000 pounds of alloy were melted. The crucible was heated with a natural gas flame to roughly 1,900°F. The process required approximately two hours, during which time a several foot high copper (green) hale was observed over the crucible. Air flow however, was sufficient to pull all visible green emissions into the crucible area hood.

Once the correct temperature was attained the molten alloy was poured into a transfer pot and dressed (i.e. skimmed to remove oxides and impurities). The transfer pot was then moved to the pouring cart where the molten material was screened through two-inch openings into molds. The pour hole and risers were covered to retain heat during the setting process, and a movable hood was installed over the molds during cooling to prevent beryllium emissions into work areas.

Beryllium emission control was obtained by hooding each work area except grinding, for which a hood is planned in the near future. The furnace area emissions were ducted to a cyclone and joined with the hood emissions from the transfer crucible area, two small open sided cooling areas, and the pouring table area. The combined emissions were routed to a three section Wheelabrator baghouse operated at 22,900 CFM. Air movement in the building was moderate during the test period and was provided by two three-foot exhaust fans and three open doors.

LOCATION OF SAMPLING POINTS

At Southeastern Kusan a square plywood stack extension was connected to the existing effluent stack from the baghouse so that the sampling location would be further downstream from the curved section of stack. The sampling location could not be located eight stack diameters downstream, therefore, more sampling points were used. Inlet sampling to the baghouse was accomplished by locating sampling ports in the existing horizontal duct. Two ports were located 90° apart from each other. Schematic diagrams of the inlet and outlet sampling locations are shown in Figures 1, 2, and 3 respectively.

LOCATION OF SAMPLING PORT AND POINTS
AT BAGHOUSE INLET (HORIZONTAL STACK)
SOUTHEASTERN KUSAN, INC.
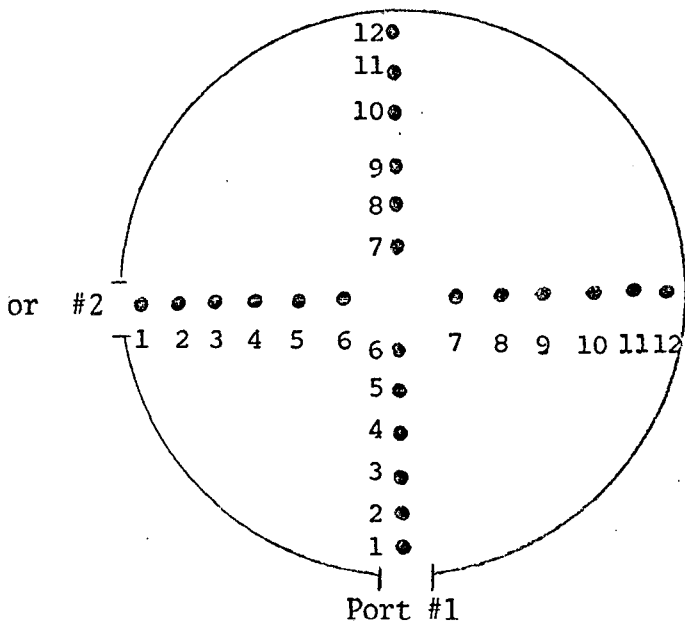
Point No.	Distance from Inside Wall, In.
1	0.75
2	2.41
3	4.25
4	6.36
5	9.00
6	12.8
7	23.2
8	27.0
9	29.8
10	31.8
11	33.6
12	35.25

FIGURE 1

LOCATION OF SAMPLING PORT AND POINTS
AT BAGHOUSE EXHAUST
SOUTHEASTERN KUSAN, INC.
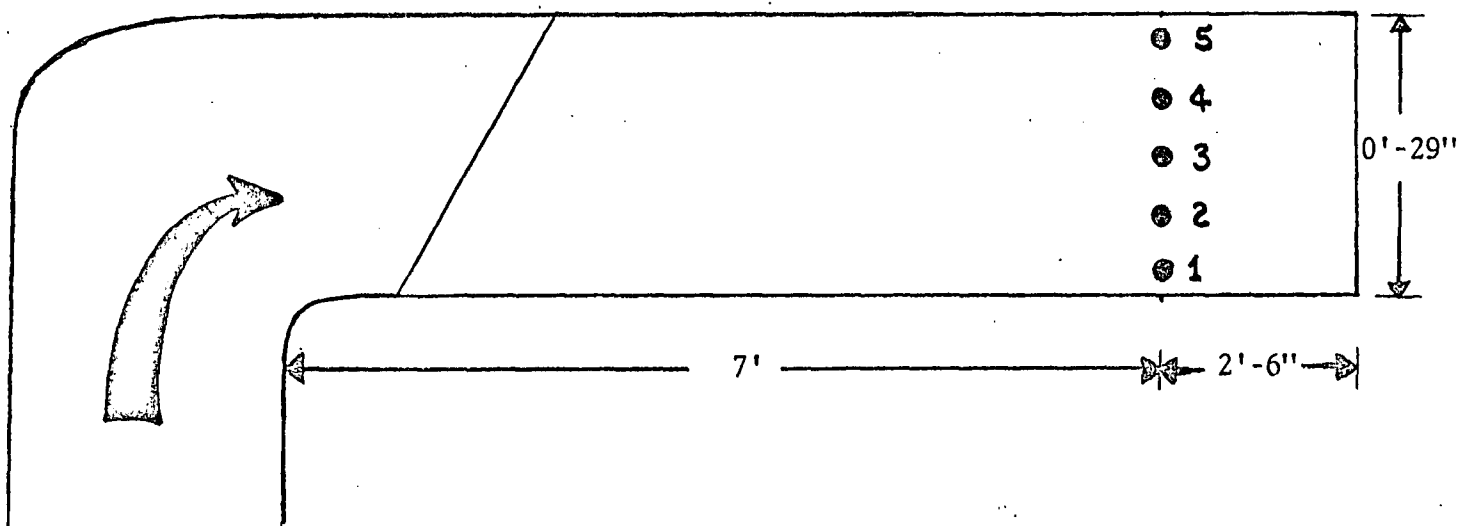
FIGURE 2
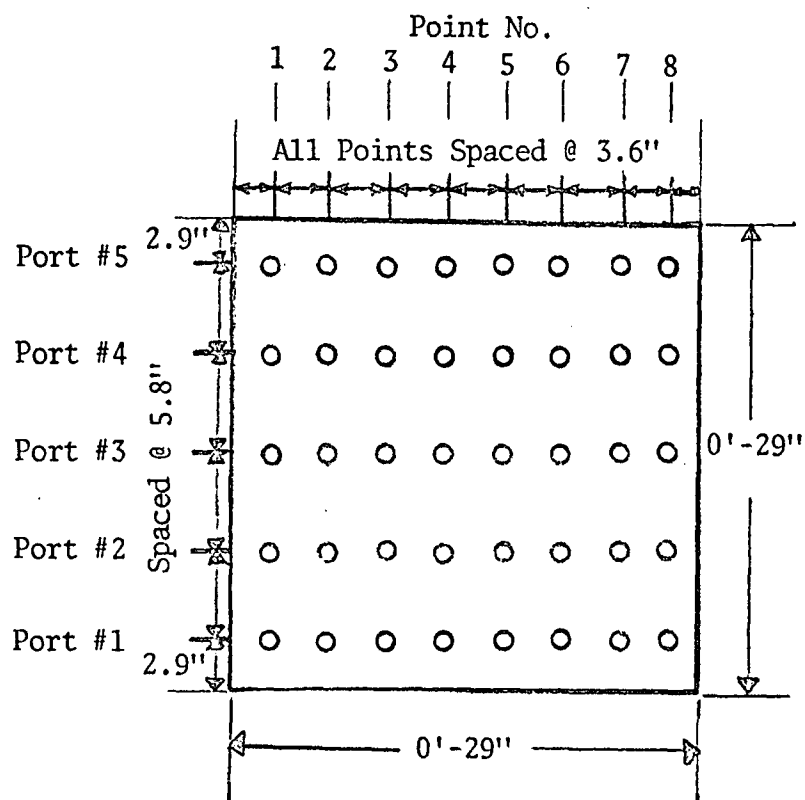
FIGURE 3

SAMPLING AND ANALYTICAL PROCEDURES

All sources were tested in such a manner as to comply
with the Environmental Protection Agency's (EPA) Proposed Reg-
ulations on National Emission Standards for Five Stationary Source
Categories, published in the Federal Register (36 F.R. 5931,
March 31, 1971). A copy of these procedures from the August 20,
1971 Environment Reporter is presented in the appendix.

Specific testing procedures and modifications of the
prescribed EPA method are also included in the appendix.

All samples collected were sent to EPA personnel in
North Carolina for Beryllium analysis. Laboratory results are
presented in the appendix following.

APPENDIX

CODE TO SAMPLE DESIGNATIONS

SK - Southeastern - Kusan, Inc., Division of Beth. Steel, Gaffney, South Carolina

O - Outlet stack from baghouse

1 - Run #1

2 - Run #2

3 - Run #3

MP - Millipore AA filter

W - Whatman 41 filter

WB - Whatman 41 filter (when used as a backup)

Be - Beryllium sample

IGB - Impinger and back half acetone and water and rinses, and backup filter combined.

I - Impinger and back half acetone and water rinses combined

P - Probe particulate and probe acetone wash combined

F - Filter

HI - Horizontal Inlet

VI - Vertical Inlet

SOURCE TEST DATA

E.P.A. Test No._____ No. of Runs_____2_____

Name of Firm_____Southeastern Kusan, Inc._____

Location of Plant_____Gaffney, South Carolina_____

Type of Plant_____Beryllium Smelting Operation_____

Control Equipment_____Baghouse_____

Sampling Point Location_____Baghouse inlet and outlet_____

Pollutants Sampled_____Beryllium_____

Run No.	VI-1-MP	HI-1-MP	O-1-MP
Date	8/25/71	8/25/71	8/25/71
Time Began	0745	0750	0752
Time End	1257	1302	1312
Barometric Pressure, "Hg. Absolute	29.9	29.9	29.9
Meter Orifice Pressure Drop, "H_2O	1.812	1.796	3.150
Volume of Dry Gas Meter @ Meter Cond., ft^3	260.477	265.329	338.730
Ave. Meter Temp., ^oF	83.9	122.6	83.8
Volume of Gas Sampled @ Stack Cond., ft^3	272.65	261.15	354.35
Volume of H_2O Collected in Impingers & Silica Gel, ml^2	22	24.7	28.3
Volume of Water Vapor Collected & Stack Cond., ft^3	1.12	1.27	1.44
Stack Gas Moisture, % Volume	0.41	0.49	0.41
Mole Fraction of Dry Stack Gas	0.9959	0.9951	0.9959

Run No.		(Same)	
Molecular Weight of Stack Gas, @ Stack Cond.	28.92	28.92	28.92
Molecular Weight of Stack Gas, Dry	28.97	28.97	28.97
Stack Gas Sp. Gravity, Ref. to Air	1.00	1.00	1.00
Ave. Sq. Root of Velocity Head, "H_2O	0.744	0.778	0.986
Ave. Stack Gas Temp., $^\circ$F	109.5	113.2	111.0
Pitot Corr. Factor	0.85	0.85	0.85
Stack Pressure, "Hg Absolute	29.9	29.9	29.9
Stack Gas Velocity @ Stack Cond., fpm	2625	2755	3484
Stack Area, ft^2	7.06	7.06	5.84
Stack Gas Flow Rate @ Stack Cond., cfm	17976	17613	19664
Net Time of Test, min.	312	312	320
Sampling Nozzle Diameter, in.	0.250	0.250	0.250
Percent Isokinetic	97.7	89.1	93.2
Beryllium Catch, Probe, µg	23.18	77.60	1.45
Beryllium Catch, Filter, µg	36.27	24.18	0.39
Beryllium Catch, Total, µg	62.70	108.50	3.83
Beryllium Concentration, Probe, Stack Cond., µg/m^3	3.00	10.49	0.14
Beryllium Concentration, Filter, Stack Cond., µg/m^3	4.70	3.27	0.04
Beryllium Concentration, Total, Stack Cond., µg/m^3	8.12	14.67	0.38

SOURCE TEST DATA

E.P.A. Test No._____No. of Runs_____2_____

Name of Firm_____Southeastern Kusan, Inc._____

Location of Plant_____Gaffney, South Carolina_____

Type of Plant_____Beryllium Smelting Operation_____

Control Equipment_____Baghouse_____

Sampling Point Location___Baghouse inlet and outlet_____

Pollutants Sampled_____Beryllium_____

Run No.	VI-2-MP	HI-2-MP	0-2-MP
Date	8/30/71	8/30/71	8/30/71
Time Began	0720	1015	0717
Time End	1008	1303	1237
Barometric Pressure, "Hg. Absolute	29.55	29.55	29.55
Meter Orifice Pressure Drop, "H_2O	1.636	2.215	3.716
Volume of Dry Gas Meter @ Meter Cond., ft^3	134.098	155.587	383.625
Ave. Meter Temp., ^oF	69.4	91.4	83.3
Volume of Gas Sampled @ Stack Cond., ft^3	156.95	158.89	412.45
Volume of H_2O Collected in Impingers & Silica Gel, ml^2	39.6	29.0	51.1
Volume of Water Vapor Collected & Stack Cond., ft^3	2.20	1.48	2.71
Stack Gas Moisture, % Volume	1.37	0.93	0.66
Mole Fraction of Dry Stack Gas	0.9863	0.9907	0.9934

Run No.		(Same)	
Molecular Weight of Stack Gas, @ Stack Cond.	28.76	28.81	28.84
Molecular Weight of Stack Gas, Dry	28.91	28.91	28.91
Stack Gas Sp. Gravity, Ref. to Air	0.99	0.99	1.00
Ave. Sq. Root of Velocity Head, "H_2O	0.723	0.828	0.982
Ave. Stack Gas Temp., ^oF	152.4	100.0	124.7
Pitot Corr. Factor	0.85	0.85	0.85
Stack Pressure, "Hg Absolute	29.5	29.5	29.5
Stack Gas Velocity @ Stack Cond., fpm	2647	2898	3514
Stack Area, ft^2	7.06	7.06	5.84
Stack Gas Flow Rate @ Stack Cond., cfm	18449	19354	19625
Net Time of Test, min.	168	168	320
Sampling Nozzle Diameter, in.	0.250	0.250	0.250
Percent Isokinetic	102.1	94.5	106.2
Beryllium Catch, Probe, µg	10.52	6.33	0.77
Beryllium Catch, Filter, µg	37.30	0.72	0.43
Beryllium Catch, Total, µg	48.29	7.99	2.79
Beryllium Concentration, Probe, Stack Cond., $µg/m^3$	2.37	1.41	0.07
Beryllium Concentration, Filter, Stack Cond., $µg/m^3$	8.39	0.16	0.04
Beryllium Concentration, Total, Stack Cond., $µg/m^3$	10.86	1.78	0.24

COMPLETE SAMPLING PROCEDURES USED FOR BERYLLIUM SAMPLING

Prior to performing the actual beryllium particulate runs, certain preliminary stack and stack gas parameters had to be determined for each source. This preliminary data included the average temperature, velocity head, moisture content, and the stack diameter at the point where the tests were being performed.

The stack gas temperature was determined by using bimetallic thermometers and mercury bulb thermometers.

Velocity head measurements were determined across the stack diameter by using a calibrated S-type pitot tube with an inclined mano-meter. This data was used to select the sampling nozzle diameter.

The approximate moisture content of the stack gas was determined by the wet-bulb and dry-bulb thermometer technique since the stack gas temperature was below $212^{O}F$.

The sampling traverse points were selected so that a representative sample could be extracted from the gas stream. The traverse points for circular stacks were located in the center of the annular equal area circles selected, which were dependent upon diameter and duct diameters downstream from flow disturbances.

The basic modification of the EPA particulate sampling train for beryllium sampling was the selection of filter media. Tests were performed with Millipore "AA" filters backed up by a Whatman #41 filter. A schematic diagram of the sampling train is shown in Figure A-1.

1. Nozzle (stainless steel)
2. Probe (Pyrex glass tubing inside stainless steel shaft)
3. Filter

4. Ice bath
5. Impinger with 100 ml distilled water (modified tip)
6. Impinger with 100 ml distilled water
7. Impinger, dry (modified tip)
8. Impinger with silica gel (modified tip)
9. Thermometer
10. Flexible sample line
11. Vacuum gauge
12. Main control valve
13. Air tight vacuum pump
14. By-pass control valve
15. Dry test meter
16. Calibrated orifice
17. Inclined manometer
18. "S" type pitot tube

FIGURE A-1 BERYLLIUM SAMPLING TRAIN

The gases sampled were collected through the following train: a stainless steel nozzle; a glass probe; a filter; two impingers with 100 ml of distilled water; one dry impinger; one impinger with 180 grams of silica gel (the second impinger had a standard tip, while the first, third, and fourth impingers had modified tips with 1/2-inch ID opening); a flexible sample line; an air-tight pump; a dry test meter; and finally, a calibrated orifice.

Duplicate tests were performed at both the inlet and outlet of the baghouse. Inlet sampling consisted of using a sampling train in a vertical position (port opening located at bottom of existing horizontal duct) and a sampling train in a horizontal position. Both inlet trains were run at the same time at the same inlet position during the first test. A test run for each train consisted of traversing through only one position -- vertical or horizontal. During the second test, the vertical sample traverse was performed with the first train and the horizontal traverse second with the second train. An orsat analysis of the stack gas was performed during the second test.

Outlet sampling was conducted with a third sampling train at the fabricated plywood stack in a horizontal position. Both outlet test runs occurred simultaneously with all inlet sampling runs.

Sample recovery for all beryllium tests was accomplished by the following procedure:

1. Each filter was removed from its holder and placed in Container No. 1 and sealed.

2. All sample-exposed surfaces prior to the filter were washed with acetone and placed into Container No. 2 and sealed.

-19-

3. The volume of water in the first three impingers was measured and then placed into Container No. 3. The water rinsings of all sample-exposed surfaces between the back half of the filter holder and fourth impinger were also placed into Container No. 3 prior to sealing.

4. The used silica gel from the fourth impinger was transferred to the original tared container and sealed.

5. All sample-exposed surfaces between the back half of the filter holder and the fourth impinger were rinsed with acetone and the rinsings were placed into Container No. 5 and sealed.

PARTICULATE TEST CALCULATIONS

Plant _Southeastern Kusan, Inc._, Stack _Inlet – Vertical Port_, Date _8-25-72_

Bar. Press. _29.90_ "Hg, Stack Press. _29.9_ "Hg, Stack Dia. _36_ in., Stack Area _7.06_ ft^2

Ave. Stack Temp. _109.5_ °F, Ave. Meter Temp. _83.9_ °F, Ave. $\sqrt{h}$ _0.744_ "H$_2$O, Nozzle Dia. _0.25_ in.

C _0.85_, Meter Vol. _260.477_ ft^3, Moisture plus Silica Gel _22_ ml, Sample Time _312_ min.

Orsat Analysis: CO$_2$ _—_ %, O$_2$ _—_ %, CO _—_ %, N$_2$ _—_ %   Ave. Orifice ΔH _1.81_ "H$_2$O

Nozzle Dia. and Area: 1/4 in.---0.000341 ft^2, 3/8 in.---0.000767 ft^2, 1/2 in.---0.0013 ft^2

1) $V_{wv} = (0.0474) \times$ (Moisture + Silica Gel)ml   = _1.04_ scf

2) $V_{stpd} = (17.71) \times (P_o + \frac{\overline{\Delta H}}{13.6}) \times (V_m) \times (\frac{1}{\overline{T_m} + 460})$ = _252.527_ scf

3) $V_t = (V_{wv}) + (V_{stpd})$ = _253.567_ scf

4) $W = \frac{V_{wv}}{V_t}$ = _0.004_

5) FDA = (1.0) − (W)   = _0.996_

6) $M_d = [(0.44) \times (\_\_\%CO_2)] + [(0.32) \times (\_\_\%O_2)] + [(0.28) \times (\_\_\%N_2 + \_\_\%CO)]$ = _28.97_

7) $M_s = [(M_d) \times (FDA)] + [(18) \times (W)]$ = _28.92_

8) $G_s = \frac{M_s}{28.99}$ = _1.0_

9) Excess Air, EA $= \frac{[(\_\_\%O_2) - (\_\_\%CO)]}{[(0.266) \times (\_\_\%N_2)] - [(\_\_\%O_2) - (\_\_\%CO)]} \times 100$ = _—_ %

10) $\bar{U} = (174) \times (C_p) \times (\sqrt{h}) \times (\sqrt{\frac{\overline{T_s} + 460}{G_s}}) \times (\sqrt{\frac{29.92}{P_s}})$ = _2625_ fpm

11) $Q_s = (\bar{U}) \times (A_s)$ = _18543_ cfm

12) $Q_d = (Q_s) \times (FDA)$ = _18466_ cfm

13) $Q_{stpd} = (Q_d) \times (\frac{70 + 460}{T_s + 460})$ = _17173_ cfm

14) $V_i = (\bar{U}) \times (A_n) \times (FDA) \times (Time) \times (\frac{70 + 460}{T_s + 460})$ = _258.558_ scf

15) Percent Isokinetic $= \frac{(V_{stpd})}{(V_i)} \times 100$ = _97.7_ %

16) Percent Isokinetic by the EPA Method $= \frac{(5.626) \times (T_s + 460) \times (V_m)}{(\bar{U}) \times (Time) \times (P_s) \times (FDA) \times (A_n)}$ = _100.3_ %

17) $E_{stp} = \frac{(15.43) \times (Y)}{V_{stpd}}$ 18) $E_{12} = \frac{(12) \times (E_{stp})}{(CO_2\%)}$ 19) $E_{50} = \frac{(E_{stp}) \times (100 + EA\%)}{150}$

20) $E_m = (E_{stp}) \times (Q_{stpd}) \times (0.00857)$

Particulate Lab Analysis (Y) μg	Particulate Concentrations, μg/m^3 (E_{stp})	(E_{12})	(E_{50})	Emission Rate, lbs/hr (E_m)
Be-SK-VI-1-MP-P 23.18	3.24			
Be-SK-VI-1-MP-F 36.27	5.07			
Be-SK-VI-1-MP-I 3.25	0.37			
Be-SK-VI-1-MP-WB 0.00	0.0			
Total 62.70	8.68			

-21-

Subpart E—Standards of Performance for Nitric Acid Plants

§ 466.50 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to nitric acid plants.

(b) For purposes of § 466.11(e), the entire plant is the affected facility.

§ 466.51 Definitions.

As used in this part, all terms not defined herein shall have the meaning given them in the Act:

(a) "Nitric acid plant" means any facility producing weak nitric acid by either the pressure or atmospheric pressure process.

(b) "Weak nitric acid" means acid which is 50 to 70 percent in strength.

§ 466.52 Standard for nitrogen oxides.

No person subject to the provisions of this subpart shall cause or allow the discharge into the atmosphere of nitrogen oxides in the effluent which are:

(a) In excess of 3 lbs. per ton of acid produced (1.5 Kgm. per metric ton), maximum 2-hour average, expressed as NO_2.

(b) A visible emission within the meaning of this part.

§ 466.53 Emission monitoring.

(a) There shall be installed, calibrated, maintained, and operated, in any nitric acid plant subject to the provisions of this subpart, an instrument for continuously monitoring and recording emissions of nitrogen oxides.

(b) The instrument installed and used pursuant to this section shall have a confidence level of at least 95 percent and be accurate within ±20 percent and shall be calibrated in accordance with the method(s) prescribed by the manufacturer(s) of such instrument; the instrument shall be calibrated at least once per year unless the manufacturer(s) specifies or recommends calibration at shorter intervals, in which case such specifications or recommendations shall be followed.

(c) The owner or operator of any nitric acid plant subject to the provisions of this subpart shall maintain a file of all measurements required by this subpart and shall retain the record of any such measurement for at least 1 year following the date of such measurement.

§ 466.54 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of nitrogen oxides from nitric acid plants.

(b) All performance tests shall be conducted while the affected facility is operating at or above the acid product rate for which such facility was designed.

(c) Test methods set forth in the appendix to this part shall be used as follows:

(1) For each repetition the NO_x concentration shall be determined by using Method 7. The sampling location shall be selected according to Method 1 and the sampling point shall be the centroid of the stack or duct. The sampling time shall be 2 hours and four samples shall be taken during each 2-hour period.

(2) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed by Method 3, and moisture content shall be determined by Method 4.

(d) Acid produced, expressed in tons per hour of 100 percent weak nitric acid, shall be determined during each 2-hour testing period by suitable flow meters and shall be confirmed by a material balance over the production system.

(e) For each repetition, nitrogen oxides emissions, expressed in lb./ton of weak nitric acid, shall be determined by dividing the emission rate in lb./hr. by the acid produced. The emission rate shall be determined by the equation, lb./hr.=Q×C, where Q=volumetric flow rate of the effluent in ft.³/hr. at standard conditions, dry basis, as determined in accordance with § 466.54(d)(2), and C=NO_x concentration in lb./ft.³, as determined in accordance with § 466.54(d)(1), corrected to standard conditions, dry basis.

Subpart F—Standards of Performance for Sulfuric Acid Plants

§ 466.60 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to sulfur acid plants.

(b) For purposes of § 466.11(e) the entire plant is the affected facility.

§ 466.61 Definitions.

As used in this part, all terms not defined herein shall have the meaning given them in the Act:

(a) "Sulfuric acid plant" means any facility producing sulfuric acid by the contact process by burning elemental sulfur, alkylation acid, hydrogen sulfide, organic sulfides and mercaptans, or acid sludge.

(b) "Acid mist" means sulfur acid mist, as measured by test methods set forth in this part.

§ 466.62 Standard for sulfur dioxide.

No person subject to the provisions of this subpart shall cause or allow the discharge into the atmosphere of sulfur dioxide in the effluent in excess of 4 lbs. per ton of acid produced (2 kgm. per metric ton), maximum 2-hour average.

§ 466.63 Standard for acid mist.

No person subject to the provisions of this subpart shall cause or allow the discharge into the atmosphere of acid mist in the effluent which is:

(a) In excess of 0.15 lb. per ton of acid produced (0.075 Kgm. per metric ton), maximum 2-hour average, expressed as H_2SO_4.

(b) A visible emission within the meaning of this part.

§ 466.64 Emission monitoring.

(a) There shall be installed, calibrated, maintained, and operated, in any sulfuric acid plant subject to the provisions of this subpart, an instrument for continuously monitoring and recording emissions of sulfur dioxide.

(b) The instrument installed and used pursuant to this section shall have a confidence level of at least 95 percent and be accurate within ±20 percent and shall be calibrated in accordance with the method(s) prescribed by the manufacturer(s) of such instrument, the instrument shall be calibrated at least once per year unless the manufacturer(s) specifies or recommends calibration at shorter intervals, in which case such specifications or recommendations shall be followed.

(c) The owner or operator of any sulfuric acid plant subject to the provisions of this subpart shall maintain a file of all measurements required by this subpart and shall retain the record of any such measurement for at least 1 year following the date of such measurement.

§ 466.65 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of acid mist and sulfur dioxide from sulfuric acid plants.

(b) All performance tests shall be conducted while the affected facility is operating at or above the acid production rate for which such facility was designed.

(c) Test methods set forth in the appendix to this part shall be used as follows:

(1) For each repetition the acid mist and SO_2 concentrations shall be determined by using Method 8 and traversing according to Method 1. The sampling time shall be 2 hours, and sampling volume shall be 40 ft.³ corrected to standard conditions.

(2) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed by Method 3. Moisture content can be considered to be zero.

(d) Acid produced, expressed in tons per hour of 100 percent sulfuric acid shall be determined during each 2-hour testing period by suitable flow meters and shall be confirmed by a material balance over the production system.

(e) For each repetition, acid mist and sulfur dioxide emissions, expressed in lb./ton of sulfuric acid shall be determined by dividing the emission rate in lb./hr. by the acid produced. The emission rate shall be determined by the equation, lb./hr.=Q×C, where Q=volumetric flow rate of the effluent in ft.³/hr. at standard conditions, dry basis, as determined in accordance with § 466.65(d)(2), and C=acid mist and SO_2 concentrations in lb./ft.³ as determined in accordance with § 466.65(d)(1), corrected to standard conditions, dry basis.

APPENDIX—TEST METHODS

METHOD 1—SAMPLE AND VELOCITY TRAVERSES FOR STATIONARY SOURCES

1. Principle and applicability.

1.1 Principle. A sampling site and the number of traverse points are selected to aid in the extraction of a representative sample.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with

New Source Performance Standards. This method is not intended to apply to gas streams other than those emitted directly to the atmosphere without further processing.

2. *Procedure.*

2.1 Selection of a sampling site and minimum number of traverse points.

2.1.1 Select a sampling site that is at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, contraction, or visible flame. For a rectangular cross section, determine an equivalent diameter from the following equation:

$$\text{equivalent diameter}=2\left[\frac{(\text{length})\,(\text{width})}{\text{length}+\text{width}}\right]$$

equation 1-1

2.1.2 When the above sampling site criteria can be met, the minimum number of traverse points is twelve (12).

2.1.3 Some sampling situations render the above sampling site criteria impractical. When this is the case, choose a convenient sampling location and use Figure 1-1 to determine the minimum number of traverse points.

2.1.4 To use Figure 1-1 first measure the distance from the chosen sampling location to the nearest upstream and downstream disturbances. Determine the corresponding number of traverse points for each distance from Figure 1-1. Select the higher of the two numbers of traverse points, or a greater value, such that for circular stacks the number is a multiple of four, and for rectangular stacks the number follows the criteria of section 2.2.2.

2.2 Cross sectional layout and location of traverse points.

2.2.1 For circular stacks locate the traverse points on two perpendicular diameters according to Figure 1-2 and Table 1-1.
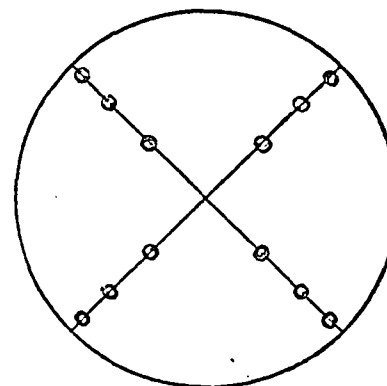
Figure 1-2. Cross section of circular stack showing location of traverse points on perpendicular diameters.

Figure 1-3. Cross section of rectangular stack divided into 12 equal areas, with traverse points at centroid of each area.

NUMBER OF DUCT DIAMETERS UPSTREAM*
(DISTANCE A)

*FROM POINT OF ANY TYPE OF DISTURBANCE (BEND, EXPANSION, CONTRACTION, ETC.)

NUMBER OF DUCT DIAMETERS DOWNSTREAM*
(DISTANCE B)

Figure 1-1. Minimum number of traverse points.

Table 1-1. 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									
	6	8	10	12	14	16	18	20	22	24
1	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5	85.3	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	35.5	26.9	22.0	18.8	16.5	14.6	13.2
7		89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1
8		96.7	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	26.1	23.0
10			97.5	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	73.9	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

2.2.2. For rectangular stacks divide the cross section into as many equal rectangular areas as traverse points, such that the ratio of the length to the width of the elemental areas is between one and two. Locate the traverse points at the centroid of each equal area according to Figure 1-3.

3. References. Determining Dust Concentration in a Gas Stream. ASME Performance Test Code #27. New York. 1957.

Devorkin, Howard, et al. Air Pollution Source Testing Manual. Air Pollution Control District. Los Angeles. November 1963.

Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases. Western Precipitation Division of Joy Manufacturing Co. Los Angeles. Bulletin WP-50. 1968.

Standard Method for Sampling Stacks for Particulate Matter. In: 1971 Book of ASTM Standards, Part 23. Philadelphia. 1971. ASTM Designation D-2928-71.

METHOD 2—DETERMINATION OF STACK GAS VELOCITY (TYPE S PITOT TUBE)

1. Principle and applicability.
1.1 Principle. Stack gas velocity is determined from the gas density and from measurement of the velocity head using a Type S (Stauscheibe or reverse type) pitot tube.
1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with New Source Performance Standards. Being a directional instrument, a pitot tube should not be used in the case of nondirectional flow.

2. Apparatus.
2.1 Pitot tube—Type S (Figure 2-1), or equivalent.
2.2 Differential pressure gauge—Inclined manometer, or equivalent, to measure velocity head to within 10 percent of the minimum value.
2.3. Temperature gauge—Thermocouples, bimetallic thermometers, liquid filled systems, or equivalent, to measure stack temperature to within 1.5 percent of the minimum absolute stack temperature.
2.4 Pressure gauge—Mercury-filled U-tube manometer, or equivalent, to measure stack pressure to within 0.1 in. Hg.
2.5 Barometer—To measure atmospheric pressure to within 0.1 in. Hg.

2.6 Gas analyzer—To analyze gas composition for determining molecular weight.
2.7 Pitot tube—Standard type, to calibrate Type S pitot tube.
3. Procedure.
3.1 Set up the apparatus as shown in Figure 2-1. Make sure all connections are tight and leak free. Measure the velocity head at the traverse points specified by Method 1.
3.2 Measure the temperature of the stack gas. If the total temperature variation with time is less than 50° F., a point measurement will suffice. Otherwise, conduct a temperature traverse.
3.3 Measure the static pressure in the stack.
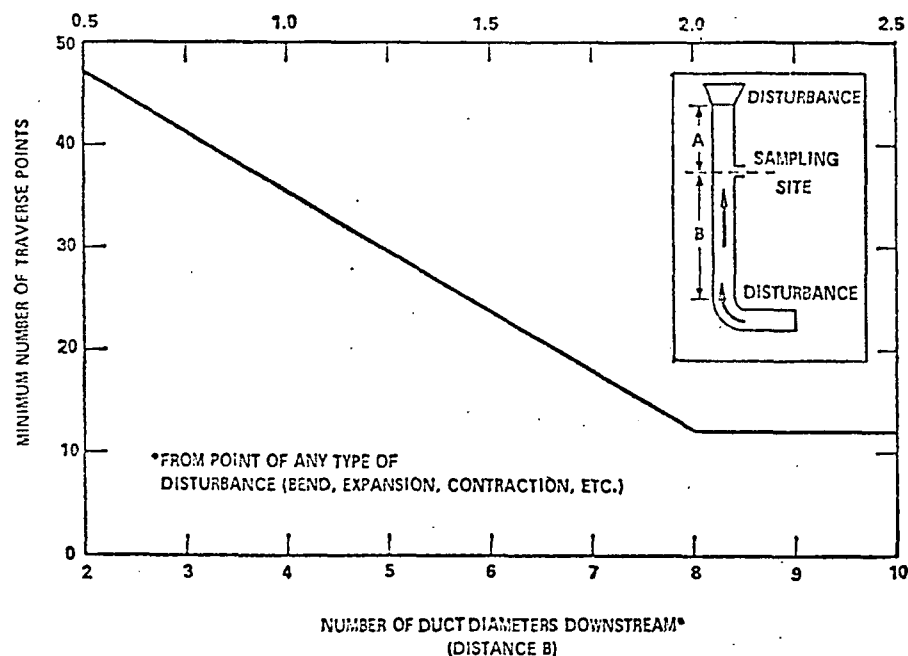3.4 Determine the stack gas molecular weight by gas analysis and appropriate calculation as indicated in Method 3.

PIPE COUPLING · TUBING ADAPTER

TYPE S PITOT TUBE

MANOMETER

Figure 2-1. Pitot tube - manometer assembly.

4. Calibration.
4.1 To calibrate the pitot tube, measure the velocity head at some point in a flowing gas stream with both a Type S pitot tube and a standard type pitot tube with known coefficient. The velocity of the flowing gas stream should be within the normal working range.

4.2 Calculate the pitot tube coefficient using Equation 2-1.

$$C_{p_{test}} = C_{p_{std}} \sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}} \quad \text{equation 2-1}$$

where:

$C_{p_{test}}$=Pitot tube coefficient of Type S pitot tube.

$C_{p_{std}}$=Pitot tube coefficient of standard type pitot tube (if unknown, use 0.99).

ΔP_{std}=Velocity head measured by standard type pitot tube.

ΔP_{test}=Velocity head measured by Type S pitot tube.

4.3 Compare the coefficients of the Type S pitot tube determined first with one leg and

PLANT_____

DATE_____

RUN NO._____

STACK DIAMETER, in._____

BAROMETRIC PRESSURE, in. Hg._____

STATIC PRESSURE IN STACK (P$_g$), in. Hg._____

OPERATORS_____

Traverse point number	Velocity head, in. H$_2$O	$\sqrt{\Delta_p}$	Stack Temperature (T$_s$), °F
	AVERAGE:		

Figure 2-2. Velocity traverse data.

then the other pointed downstream. Use the pitot tube only if the two coefficients differ by no more than 0.01.

5. *Calculations.*

Use Equation 2-2 to calculate the stack gas velocity.

$$V_s = K_p C_p \sqrt{\frac{T_s \Delta_p}{P_s M_s}} \quad \text{equation 2-2}$$

where:

V_s=Stack gas velocity, feet per second (f.p.s.).

$K_p = 85.48 \dfrac{\text{ft.}}{\text{sec.}} \left(\dfrac{\text{lb.}}{\text{lb. mole} = °R} \right)^{1/2}$ when these units are used.

C_p=Pitot tube coefficient, dimensionless.

T_s=Absolute stack gas temperature, °R.

Δ_p=Velocity head of stack gas, in H$_2$O (see fig. 2-2).

P_s=Absolute stack gas pressure, in Hg.

M_s=Molecular weight of stack gas, lb./lb.-mole.

SCHEMATIC OF STACK CROSS SECTION

Figure 2-2 shows a sample recording sheet for velocity traverse data. Use the averages in the last two columns of Figure 2-2 to determine the average stack gas velocity from Equation 2-2.

6. *References.*

Mark, L. S. Mechanical Engineers' Handbook. McGraw-Hill Book Co., Inc., New York, 1951.

Perry, J. H. Chemical Engineers' Handbook. McGraw-Hill Book Co., Inc., New York, 1960.

Shigehara, R. T., W. F. Todd, and W. S. Smith. Significance of Errors in Stack Sampling Measurements. Paper presented at the Annual Meeting of the Air Pollution Control Association, St. Louis, Mo., June 14-19, 1970.

Standard Method for Sampling Stacks for Particulate Matter. In: 1971 Book of ASTM standards, Part 23. Philadelphia, 1971. ASTM Designation D-2928-71.

Vennard, J. K. Elementary Fluid Mechanics. John Wiley and Sons, Inc., New York, 1947.

METHOD 3—GAS ANALYSIS FOR CARBON DIOXIDE, EXCESS AIR, AND DRY MOLECULAR WEIGHT

1. *Principle and applicability.*

1.1 Principle. An integrated or grab gas sample is extracted from a sampling point and analyzed for its components using an Orsat analyzer.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. *Apparatus.*

2.1 Grab sample (Figure 3-1).

2.1.1 Probe—Stainless steel or Pyrex [1] glass, equipped with a filter to remove particulate matter.

2.1.2 Pump—One-way squeeze bulb, or equivalent, to transport gas sample to analyzer.

2.2 Integrated sample (Figure 3-2).

2.2.1 Probe—Stainless steel or Pyrex [1] glass equipped with a filter to remove particulate matter.

2.2.2 Air-cooled condenser—To remove any excess moisture.

2.2.3 Needle valve—To adjust flow rate.

2.2.4 Pump—Leak-free, diaphragm type, or equivalent, to pull gas.

2.2.5 Rate meter—To measure a flow range from 0 to 0.035 c.f.m.

2.2.6 Flexible bag—Tedlar,[1] or equivalent, with a capacity of 2 to 3 cu. ft. Leak test the bag in the laboratory before using.

2.2.7 Pitot tube—Type S, or equivalent, attached to the probe so that the sampling flow rate can be regulated proportional to the stack gas velocity when velocity is varying with time or a sample traverse is conducted.

2.3 Analysis.

2.3.1 Orsat analyzer, or equivalent.

3. *Procedure.*

3.1 Grab sampling.

3.1.1 Set up the equipment as shown in Figure 3-1. Place the probe in the stack at a sampling point and purge the sampling line.

[1] Trade name.

Figure 3-1. Grab-sampling train.

Figure 3-2. Integrated gas - sampling train.

3.1.2 Draw sample into the analyzer.

3.2 Integrated sampling.

3.2.1 Evacuate the flexible bag. Set up the equipment as shown in Figure 3-2 with the bag disconnected. Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are tight and that there are no leaks.

3.2.2 Sample at a rate proportional to the stack gas velocity.
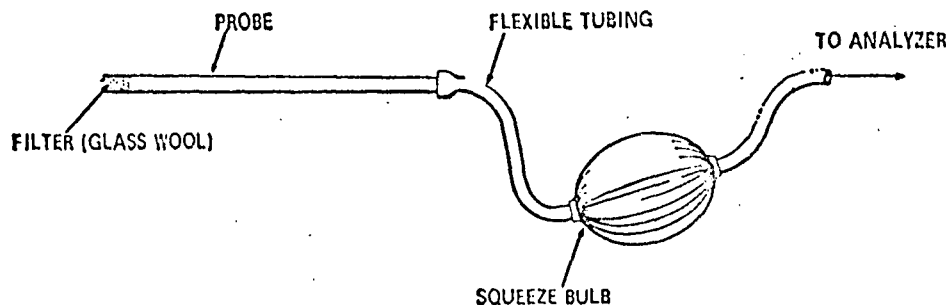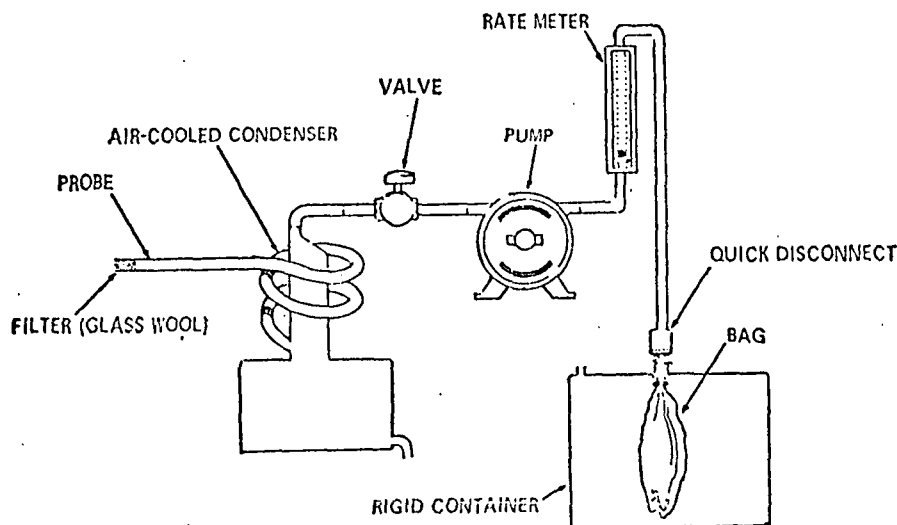
3.3 Analysis.

3.3.1 Determine the CO_2, O_2, and CO concentrations as soon as possible. Make as many passes as are necessary to give constant readings. If more than 10 passes are necessary, replace the absorbing solution.

3.3.2 For integrated sampling, repeat the analysis until three consecutive runs vary no more than 0.2 percent by volume for each component being analyzed.

4. *Calculations.*

4.1 Carbon dioxide. Average the three consecutive runs and report result to the nearest 0.1 percent CO_2.

4.2 Excess air. Use Equation 3-1 to calculate excess air, and average the runs. Report the result to the nearest 0.1 percent excess air.

$$\% EA = \frac{(\% \ O_2) - 0.5(\% \ CO)}{0.264(\% \ N_2) - (\% \ O_2) + 0.5(\% \ CO)} \times 100$$

equation 3-1

where:

$\% EA$ = Percent excess air.

$\% O_2$ = Percent oxygen by volume, dry basis.

$\% N_2$ = Percent nitrogen by volume, dry basis.

$\% CO$ = Percent carbon monoxide by volume, dry basis.

0.264 = Ratio of oxygen to nitrogen in air by volume.

4.3 Dry molecular weight. Use Equation 3-2 to calculate dry molecular weight and average the runs. Report the result to the nearest tenth.

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

Equation 3-2

where:

M_d = Dry molecular weight, lb./lb.-mole.

$\% CO_2$ = Percent carbon dioxide by volume, dry basis.

$\% O_2$ = Percent oxygen by volume, dry basis.

$\% N_2$ = Percent nitrogen by volume, dry basis.

0.44 = Molecular weight of carbon dioxide divided by 100.

0.32 = Molecular weight of oxygen divided by 100.

0.28 = Molecular weight of nitrogen divided by 100.

5. *References*

Altshuller, A. P., et al. Storage of Gases and Vapors in Plastic Bags. Int. J. Air & Water Pollution. *6*:75–81. 1963.

Conner, William D., and J. S. Nader. Air Sampling with Plastic Bags. Journal of the American Industrial Hygiene Association. *25*:291–297. May–June 1964.

Devorkin, Howard, et al. Air Pollution Source Testing Manual. Air Pollution Control District. Los Angeles. November 1963.

METHOD 4—DETERMINATION OF MOISTURE IN STACK GASES

1. *Principle and applicability.*

1.1 Principle. Moisture is removed from the gas stream, condensed, and determined gravimetrically.

1.2 Applicability. This method is applicable for the determination of moisture in stack gas only when specified by test procedures for determining compliance with New Source Performance Standards. This method does not apply when liquid droplets are present in the gas stream.[2]

Other methods such as drying tubes, wet bulb-dry bulb techniques, and volumetric condensation techniques may be used subject to the approval of the Administrator.

2. *Apparatus.*

2.1 Probe—Stainless steel or Pyrex[1] glass sufficiently heated to prevent condensation and equipped with a filter to remove particulate matter.

2.2 Impingers—Two midget impingers, each with 30 ml. capacity, or equivalent.

2.3 Ice bath container—To condense moisture in impingers.

2.4 Silica gel tube—To protect pump and dry gas meter.

2.5 Needle valve—To regulate gas flow rate.

2.6 Pump—Leak-free, diaphragm type, or equivalent, to pull gas through train.

2.7 Dry gas meter—To measure to within 1 percent of the total sample volume.

2.8 Rotameter—To measure a flow range from 0 to 0.1 c.f.m.

2.9 Balance—Capable of measuring to the nearest 0.1 g.

2.10 Barometer—Sufficient to read to within 0.1 in. Hg.

2.11 Pitot tube—Type S, or equivalent. attached to probe so that the sampling flow rate can be regulated proportional to the stack gas velocity when velocity is varying with time or a sample traverse is conducted.

3. *Procedure.*

3.1 Place about 5 ml. distilled water in each impinger and weigh the impinger and contents to the nearest 0.1 g. Assemble the apparatus without the probe as shown in Figure 4-1. Leak check by plugging the inlet to the first impinger and drawing a vacuum. Insure that flow through the dry gas meter is less than 1 percent of the sampling rate.

3.2 Connect the probe, and sample at a constant rate of 0.075 c.f.m. or at a rate proportional to the stack gas velocity not to exceed 0.075 c.f.m. Continue sampling until the dry gas meter registers 1 cu. ft. or until visible liquid droplets are carried over from the first impinger to the second. Record temperature, pressure, and dry gas meter reading as required by Figure 4-2.

3.3 After collecting the sample, weigh the impingers and their contents again to the nearest 0.1 g.

_____

[1] Trade name.

[2] If liquid droplets are present in the gas stream, assume the stream to be saturated, determine the average stack gas temperature (Method 1), and use a psychrometric chart to obtain an approximation of the moisture percentage.

4. Calculations.

4.1 Volume of water collected.

$$V_{wc} = \frac{(W_f - W_i)RT_{std}}{P_{std}M_w} =$$

$$\left(0.0474 \frac{ft.^3}{g.}\right)(w_f - W_i)$$

equation 4-1

where:

V_{wc} = Volume of water vapor collected (standard conditions), cu. ft.

W_f = Final weight of impingers and contents, g.

W_i = Initial weight of impingers and contents, g.

R = Ideal gas constant, 21.83-in. Hg—cu. ft./lb. mole-° R.

T_{std} = Absolute temperature at standard conditions, 530° R.

P_{std} = Pressure at standard conditions, 29.92 in. Hg.

M_w = Molecular weight of water, 18 lb./lb. mole.

4.2 Gas volume.

$$V_{mc} = V_m \left(\frac{P_m}{P_{std}}\right)\left(\frac{T_{std}}{T_m}\right) =$$

$$\left(17.71 \frac{°R}{in. Hg}\right)\frac{V_m P_m}{T_m}$$

equation 4-2

where:

V_{mc} = Dry gas volume through meter at standard conditions, cu. ft.

V_m = Dry gas volume measured by meter, cu. ft.

P_m = Barometric pressure at the dry gas meter, in. Hg.

P_{std} = Pressure at standard conditions, 29.92-in. Hg.

T_{std} = Absolute temperature at standard conditions, 530° R.

T_m = Absolute temperature at meter (°F.+460), °R.

4.3 Moisture content.

$$B_{wo} = \frac{V_{wo}}{V_{wo} + V_{mc}} + B_{wm} = \frac{V_{wo}}{V_{wo} + V_{mo}} + (0.025)$$

equation 4-3

where:

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

V_{wc} = Volume of water vapor collected (standard conditions), cu. ft.

V_{mc} = Dry gas volume through meter (standard conditions), cu. ft.

B_{wm} = Approximate volumetric proportion of water vapor in the gas stream leaving the impingers, 0.025.

Figure 4-1. Moisture-sampling train.

LOCATION _____ COMMENTS

TEST _____

DATE _____

OPERATOR _____

BAROMETRIC PRESSURE _____

CLOCK TIME	GAS VOLUME THROUGH METER, (Vm), ft^3	ROTAMETER SETTING, ft^3/min	METER TEMPERATURE, °F

Figure 4-2. Field moisture determination.

5. References.

Air Pollution Engineering Manual, Danielson, J. A. (ed.). U.S. DHEW, PHS, National Center for Air Pollution Control. Cincinnati, Ohio. PHS Publication No. 999-Ap-40. 1967.

Devorkin, Howard, et al. Air Pollution Source Testing Manual. Air Pollution Control District. Los Angeles, Calif. November 1963.

Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases. Western Precipitation Division of Joy Manufacturing Co., Los Angeles, Calif. Bulletin WP-50. 1968.

METHOD 5.—DETERMINATION OF PARTICULATE EMISSIONS FROM STATIONARY SOURCES

1. Principle and applicability.

1.1 Principle. Particulate matter is withdrawn isokinetically from the source and its weight is determined gravimetrically after removal of uncombined water.

1.2 Applicability. This method is applicable for the determination of particulate emissions from stationary sources only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. Apparatus.

2.1 Sampling train. The design specifications of the particulate sampling train used by EPA (Figure 5-1) are described in APTD-0581. Commercial models of this train are available.

2.1.1 Nozzle—Stainless steel (316) with sharp, tapered leading edge.

2.1.2 Probe—Pyrex [1] glass with a heating system capable of maintaining a gas temperature of 250° F. at the exit end during sampling. When temperature or length limitations are encountered, 316 stainless steel, or equivalent, may be used, as approved by the Administrator.
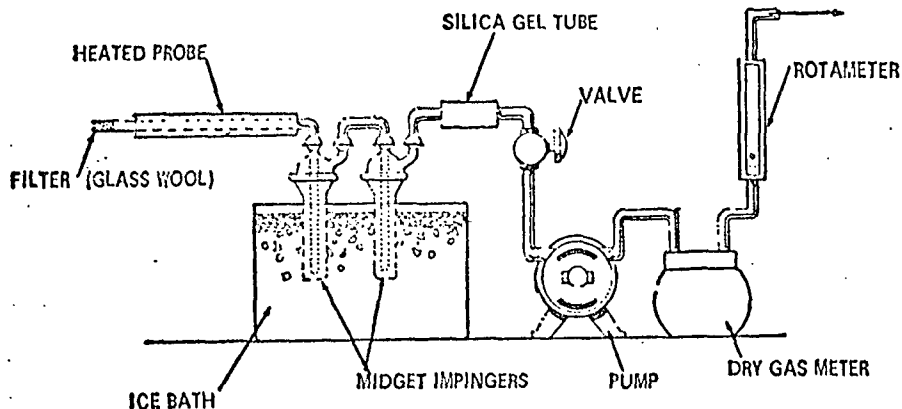
2.1.3 Pitot tube—Type S, or equivalent, attached to probe to monitor stack gas velocity.

2.1.4 Filter holder—Pyrex[1] glass with heating system capable of maintaining any temperature to a maximum of 225° F.

2.1.5 Impingers—Four impingers connected in series with glass ball joint fittings. The first, third, and fourth impingers are of the Greenburg-Smith design, modified by re-placing the tip with a ½-inch ID glass tube extending to ½-inch from the bottom of the flask. The second impinger is of the Greenburg-Smith design with the standard tip.

2.1.6 Metering system—Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5° F., dry gas meter with 2 percent accuracy, and related equipment, or equivalent, as required to maintain an isokinetic sampling rate and to determine sample volume.

HEATED AREA   FILTER HOLDER   THERMOMETER   CHECK VALVE

Figure 5-1. Particulate-sampling train.

3.2.2 Acetone—Reagent grade.
3.3 Analysis -   .
3.3.1 Water—Deionized, distilled.
3.3.2 Chloroform—Reagent grade.
3.3.3 Ethyl ether—Reagent grade.
3.3.4 Desiccant—Drierite,[1] indicating.
4. *Procedure.*
4.1 Sampling.

4.1.1 After selecting the sampling site and the minimum number of sampling points, determine the stack pressure, temperature, moisture, and range of velocity head.

4.1.2 Preparation of collection train. Weigh to the nearest gram approximately 200 g. of silica gel. Label a filter of proper diameter, desiccate[3] for at least 24 hours and weigh to the nearest 0.5 mg. In a room where the relative humidity is less than 50 percent. Place 100 ml. of water in each of the first two impingers, leave the third impinger empty, and place approximately 200 g. of preweighed silica gel in the fourth impinger. Save a portion of the water for use as a blank in the sample analysis. Set up the train without the probe as in Figure 5-1. Leak check the sampling train at the sampling site by plugging the inlet to the filter holder and pulling a 15-in. Hg vacuum. A leakage rate not in excess of 0.02 c.f.m. at a vacuum of 15-in. Hg is acceptable. Attach the probe and adjust the heater to provide a gas temperature of about 250° F. at the probe outlet. Turn on the filter heating system. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger at 70° F. or less.

4.1.3 Particulate train operation. For each run record the data required on the example sheet shown in Figure 5-2. Take readings at each sampling point at least every 5 minutes and when significant changes in stack conditions necessitate additional adjustments in flow rate. To begin sampling, position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Maintain isokinetic sampling throughout the sampling period. Nomographs are available which aid in the rapid adjustment of the sampling rate without other computations. APTD-0576 details the procedure for using these nomographs. Turn off the pump at the conclusion of each run and record the final readings. Remove the probe and nozzle from the stack and handle in accordance with the sample recovery process described in section 4.2.

2.1.7 Barometer—To measure atmospheric pressure to ±0.1 in. Hg.
2.2 Sample recovery.
2.2.1 Probe brush—At least as long as probe.
2.2.2 Glass wash bottles—Two.
2.2.3 Glass sample storage containers.
2.2.4 Graduated cylinder—250 ml.
2.3 Analysis.
2.3.1 Glass weighing dishes.
2.3.2 Desiccator.
2.3.3 Analytical balance—To measure to ±0.1 mg.
2.3.4 Beakers—250 ml.

2.3.5 Separatory funnels—500 ml. and 1,000 ml.
2.3.6 Trip balance—300 g. capacity, to measure to ±0.05 g.
2.3.7 Graduated cylinder—25 ml.
3. *Reagents.*
3.1 Sampling
3.1.1 Filters—Glass fiber, MSA 1106 BH, or equivalent, numbered for identification and preweighed.
3.1.2 Silica gel—Indicating type, 6 to 16 mesh, dried at 175° C. (350° F.) for 2 hours.
3.1.3 Water—Deionized, distilled.
3.1.4 Crushed ice.
3.2 Sample recovery
3.2.1 Water—Deionized, distilled.

[1] Trade name.

[3] Dry using Drierite[1] at 70° ±10° F.

PLANT_____
LOCATION_____
OPERATOR_____
DATE_____
RUN NO._____
SAMPLE BOX NO._____
METER BOX NO._____
METER Δ H$_G$_____
C FACTOR_____

AMBIENT TEMPERATURE_____
BAROMETRIC PRESSURE_____
ASSUMED MOISTURE, %_____
HEATER BOX SETTING_____
PROBE LENGTH, in._____
NOZZLE DIAMETER, in._____
PROBE HEATER SETTING_____

SCHEMATIC OF STACK CROSS SECTION

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (P$_S$), in. Hg.	STACK TEMPERATURE (T$_S$), °F	VELOCITY HEAD (Δ P$_S$),	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (Δ H), in. H$_2$O	GAS SAMPLE VOLUME (Vm), ft^3	GAS SAMPLE TEMPERATURE AT DRY GAS METER		SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
							INLET (Tm $_{in}$), °F	OUTLET (Tm $_{out}$), °F		
TOTAL							Avg.	Avg.		
AVERAGE							Avg.			

Figure 5-2. Particulate field data.

4.2 Sample recovery. Exercise care in moving the collection train from the test site to the sample recovery area to minimize the loss of collected sample or the gain of extraneous particulate matter. Set aside portions of the water and acetone used in the sample recovery as blanks for analysis. Place the samples in containers as follows:

Container No. 1. Remove the filter from its holder, place in this container, and seal.

Container No. 2. Place loose particulate matter and acetone washings from all sample-exposed surfaces prior to the filter in this container and seal. Use a razor blade, brush, or rubber policeman to loosen adhering particles.

Container No. 3. Measure the volume of water from the first three impingers and place the water in this container. Place water

rinsings of all sample-exposed surfaces between the filter and fourth impinger in this container prior to sealing.

Container No. 4. Transfer the silica gel from the fourth impinger to the original container and seal. Use a rubber policeman as an aid in removing silica gel from the impinger.

Container No. 5. Thoroughly rinse all sample-exposed surfaces between the filter and fourth impinger with acetone, place the washings in this container, and seal.

4.3 Analysis. Record the data required on the example sheet shown in Figure 5-3. Handle each sample container as follows:

Container No. 1. Transfer the filter and any loose particulate matter from the sample container to a tared glass weighing dish, des-

sicate, and dry to a constant weight. Report results to the nearest 0.5 mg.

Container No. 2. Transfer the acetone washings to a tared beaker and evaporate to dryness at ambient temperature and pressure. Dessicate and dry to a constant weight. Report results to the nearest 0.5 mg.

Container No 3. Extract organic particulate from the impinger solution with three 25 ml. portions of chloroform. Complete the extraction with three 25 ml. portions of ethyl ether. Combine the ether and chloroform extracts, transfer to a tared beaker and evaporate at 70° F. until no solvent remains. Dessicate, dry to a constant weight, and report the results to the nearest 0.5 mg. Evaporate the remaining water portion at 212°F. Dessicate the residue, dry to a constant weight, and report the results to the nearest 0.5 mg.

Container No. 4. Weigh the spent silica gel and report to the nearest gram.

PLANT_____

DATE_____

RUN NO._____

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, mg		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1			
2			
3a*			
3b**			
5			
TOTAL	✗	✗	

*3a - ORGANIC EXTRACT FRACTION.

**3b - RESIDUAL WATER FRACTION.

	VOLUME OF LIQUID WATER COLLECTED	
	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL		
INITIAL		
LIQUID COLLECTED		
TOTAL VOLUME COLLECTED		g* | ml

*CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER. (1 g/ml):

$$\frac{INCREASE, \ g}{(1 \ g/ml)} = VOLUME \ WATER, \ ml$$

Figure 5-3. Analytical data.

Container No. 5. Transfer the acetone washings to a tared beaker and evaporate to dryness at ambient temperature and pressure. Desiccate, dry to a constant weight, and report the results to the nearest 0.5 mg.

5. *Calibration.*

Use standard methods and equipment approved by the Administrator to calibrate the orifice meter, pitot tube, dry gas meter, and probe heater.

6. *Calculations.*

6.1 Sample concentration method.

6.1.1 Average dry gas meter temperature. See data sheet (Figure 5-2).

6.1.2 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (70° F., 29.92 in. Hg) by using Equation 5-1.

$$V_{m_{std}} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right) =$$

$$\left(17.71 \frac{°R}{in. \ Hg}\right)(V_m)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

equation 5-1

where:

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

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

T_{std} = Absolute temperature at standard conditions, 530 °R.

T_m = Average dry gas meter temperature, °R.

P_{bar} = Barometric pressure at the orifice meter, in. Hg.

ΔH = Pressure drop across the orifice meter, in. H_2O.

13.6 = Specific gravity of mercury.

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

6.1.3 Volume of Water vapor.

$$V_{w_{std}} = V_{l_c}\left(\frac{\rho_{H_2O}}{M_{H_2O}}\right)\left(\frac{RT_{std}}{P_{std}}\right) = \left(0.0474 \frac{cu. \ ft.}{ml.}\right)V_{l_c}$$

equation 5-2

where:

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

V_{l_c} = Total volume of liquid collected in impingers and silica gel (see Figure 5-3), ml.

ρ_{H_2O} = Density of water, 1 g./ml.

M_{H_2O} = Molecular weight of water, 18 lb./lb. mole.

R = Ideal gas constant, 21.83 in Hg-cu. ft./lb. mole-°R.

T_{std} = Absolute temperature at standard conditions, 530° R.

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

6.1.4 Total gas volume.

$$V_{total} = V_{m_{std}} + V_{w_{std}}$$

equation 5-3

where:

V_{total} = Total volume of gas sample (standard conditions), cu. ft.

$V_{m_{std}}$ = Volume of gas through dry gas meter (standard conditions), cu. ft

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

6.1.5 Total particulate weight. Determine the total particulate catch from the weights on the analysis data sheet (Figure 5-3).

6.1.6 Concentration.

$$c_s' = \left(0.0154 \frac{gr.}{mg.}\right)\left(\frac{M_n}{V_{total}}\right)$$

equation 5-4

where:

c_s' = Concentration of particulate matter in stack gas (Sample Concentration Method), gr./s.c.f.

M_n = Total amount of particulate matter collected, mg.

V_{total} = Total volume of gas sample (standard conditions), cu. ft.

6.2 Ratio of area method.

6.2.1 Stack gas velocity. Collect the necessary data as detailed in Method 2. Correct the

stack gas velocity to standard conditions (29.92 in. Hg, 530° R.) as follows:

$$V_{s\,std} = V_s \left(\frac{P_s}{P_{std}}\right)\left(\frac{T_{std}}{T_s}\right) = \left(17.71 \frac{°R}{in.\ Hg}\right)\left(\frac{V_s P_s}{T_s}\right)$$ equation 5-5

where:

$V_{s\,std}$ = Stack gas velocity at standard conditions, ft./sec.

$$c_s = \frac{M_s}{Q_s} = \frac{\frac{M_s}{\theta} \frac{A_s}{A_n}}{A_s V_{s\,std}} = \left(2.57 \times 10^{-4} \frac{gr.=min.}{mg.=sec.}\right)\left(\frac{M_n}{\theta V_{s\,std} A_n}\right)$$ equation 5-6

where:

c_s = Concentration of particulate matter in the stack gas (Ratio of Area Method), gr./s.c.f.

M_s = Particulate mass flow rate through the stack (standard conditions), mass/time.

Q_s = Volumetric flow rate of gas stream through the stack (standard conditions), volume/time.

$$I = \frac{c_s}{c_s'} \times 100 = \frac{T_s\left[\frac{V_{lc}\rho_{H_2O}R}{M_{H_2O}} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right]}{\theta V_s P_s A_n} \times 100 =$$

$$\frac{\left(1.667 \frac{min.}{sec.}\right)\left[\left(0.00267 \frac{in.\ Hg\text{-}cu.\ ft.}{ml.-°R}\right)V_{lc} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right]T_s}{\theta V_s P_s A_n}$$ equation 5-7

where:

I = Percent of isokinetic sampling.

C_s = Concentration of particulate matter in the stack gas (Ratio of Area Method), gr./s.c.f.

C_s' = Concentration of particulate matter in the stack gas (Sample Concentration Method), gr./s.c.f.

V_{lc} = Total volume of liquid collected in impingers and silica gel (see Figure 5-3), ml.

ρ_{H_2O} = Density of water, 1 g./ml.

R = Ideal gas constant, 21.83 in. Hg-cu. ft./lb. mole-°R.

M_{H_2O} = Molecular weight of water, 18 lb./lb. mole.

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

T_m = Absolute average dry gas meter temperature (see Figure 5-2), °R.

P_{bar} = Barometric pressure at sampling site, in. Hg.

ΔH = Average pressure drop across the orifice (see Figure 5-2), in. H₂O.

T_s = Absolute average stack gas temperature (see Figure 5-2), °R.

V_s = Stack gas velocity calculated by Method 2, Equation 2-2, ft./sec.

P_s = Absolute stack gas pressure, in. Hg.

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

T_{std} = Absolute temperature at standard conditions, 530° R.

T_s = Absolute stack gas temperature (average), °R.

6.2.2 Concentration.

M_n = Total amount of particulate matter collected by train, mg.

θ = Total sampling time, min.

A_s = Cross-sectional area of stack, sq. ft.

A_n = Cross-sectional area of nozzle, sq. ft.

$V_{s\,std}$ = Stack gas velocity at standard conditions, ft./sec.

6.3 Isokinetic variation.

θ = Total sampling time, min.

V_s = Stack gas velocity calculated by Method 2, Equation 2-2, ft./sec.

P_s = Absolute stack gas pressure, in. Hg.

A_n = Cross-sectional area of nozzle, sq. ft.

6.4 Acceptable results. The following range sets the limit on acceptable isokinetic sampling results:

If 82 percent <I<120 percent, the results are acceptable; otherwise, reject the results and repeat the test.

6.5 Average particulate concentration. If the criteria for acceptability are met, calculate the average concentration of particulate in the stack from the following equation:

$$\bar{c}_s = \frac{c_s + c_s'}{2}$$ Equation 5-8

where:

$\bar{c}_s$ = Average particulate concentration in the stack gas, gr./s.c.f.

c_s = Concentration of particulate matter in the stack gas (Ratio of Area Method), gr./s.c.f.

c_s' = Concentration of particulate matter in the stack gas (Sample Concentration Method), gr./s.c.f.

7. References.

Addendum to Specifications for Incinerator Testing at Federal Facilities. PHS, NCAPC. Dec. 6, 1967.

Martin, Robert M. Construction Details of Isokinetic Source Sampling Equipment. Environmental Protection Agency, APTD–0581.

Rom, Jerome J. Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment. Environmental Protection Agency, APTD–0576.

Smith, W. S.; R. T. Shigehara, and W. F. Todd. A Method of Interpreting Stack Sampling Data. Paper presented at the 63d Annual Meeting of the Air Pollution Control Association, St. Louis. June 14–19, 1970.

Smith, W. S., et al. Stack Gas Sampling Improved and Simplified with New Equipment. APCA Paper No. 67–119. 1967.

Specifications for Incinerator Testing at Federal Facilities. PHS, NCAPC. 1967.

METHOD 6—DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

1. Principle and applicability.

1.1 Principle. A gas sample is extracted from the sampling point in the stack, and the acid mist including sulfur trioxide is separated from the sulfur dioxide. The sulfur dioxide fraction is measured by the barium-thorin titration method.

1.2 Applicability. This method is applicable for the determination of sulfur dioxide emissions from stationary sources only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. Apparatus.

2.1 Sampling. See Figure 6-1

2.1.1 Probe—Pyrex [1] glass, approximately 5–6 mm. ID, with a heating system to prevent condensation and a filter to remove particulate matter including sulfuric acid mist.

2.1.2 Midget bubbler—One, with glass wool packed in top to prevent sulfuric acid mist carryover.

2.1.3 Glass wool.

2.1.4 Midget impingers—Three.

2.1.5 Drying tube—Packed with 6 to 16 mesh indicating-type silica gel or equivalent, to dry the sample.

2.1.6 Pump—Leak-free, vacuum type.

2.1.7 Rate meter—Rotameter, or equivalent, to measure a 0–10 s.c.f.h. flow range.

2.1.8 Dry gas meter—Sufficiently accurate to measure the sample volume within 1 percent.

2.1.9 Pitot tube—Type S, or equivalent, necessary only if a sample traverse is required or if stack gas velocity varies with time.

2.2 Sample recovery.

2.2.1 Glass wash bottles—Two.

2.2.2 Polyethylene storage bottles—To store impinger samples.

2.3 Analysis.

[1] Trade name.
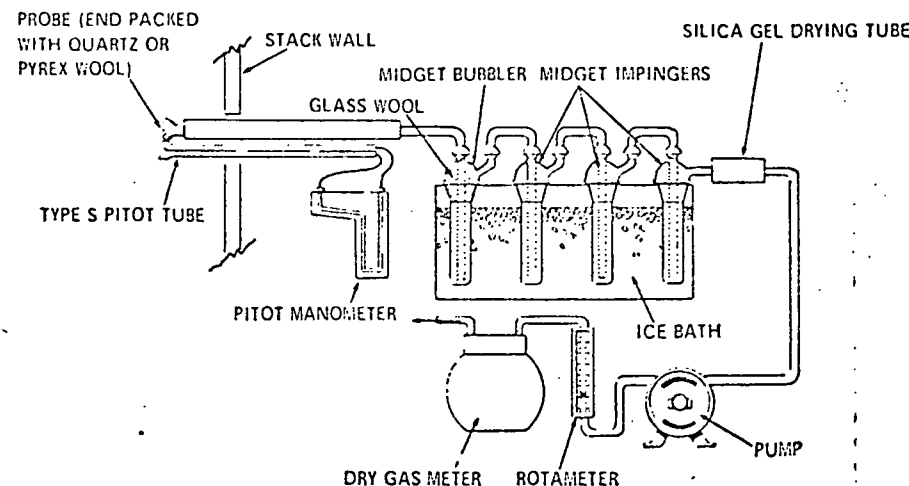
Figure 6-1. SO₂ sampling train.

(Labels: PROBE (END PACKED WITH QUARTZ OR PYREX WOOL), STACK WALL, SILICA GEL DRYING TUBE, MIDGET BUBBLER, MIDGET IMPINGERS, GLASS WOOL, TYPE S PITOT TUBE, PITOT MANOMETER, ICE BATH, DRY GAS METER, ROTAMETER, PUMP)

RESULTS OF LABORATORY ANALYSES FOR BERYLLIUM

Sample No.	Code	µg Be		*Total µg Be	
75	Be-SK-HI-1-MP-P	77.60			
73	Be-SK-HI-1-MP-F	24.18	*	108.50	
76	Be-SK-HI-1-MP-I	1.45			
74	Be-SK-HI-1-MP-WB	5.27			**
80	Be-SK-VI-1-MP-P	23.18			
78	Be-SK-VI-1-MP-F	36.27	*	62.70	
81	Be-SK-VI-1-MP-I	3.25			
79	Be-SK-VI-1-MP-WB	0.00			
85	Be-SK-0-1-MP-P	1.45			
83	Be-SK-0-1-MP-F	0.39	*	3.83	
86	Be-SK-0-1-MP-I	1.72			
84	Be-SK-0-1-MP-WB	0.27			
90	Be-SK-HI-2-MP-P	6.33			
88	Be-SK-HI-2-MP-F	0.72	*	7.99	
91	Be-SK-HI-2-MP-I	0.59			
89	Be-SK-HI-2-MP-WB	0.35			***
95	Be-SK-VI-2-MP-P	10.52			
93	Be-SK-VI-2-MP-F	37.30	*	48.29	
96	Be-SK-VI-2-MP-I	0.47			
94	Be-SK-VI-2-MP-WB	0.00			
100	Be-SK-0-2-MP-P	0.77			
98	Be-SK-0-2-MP-F	0.43	*	2.79	
101	Be-SK-0-2-MP-I	1.59			
99	Be-SK-0-2-MP-WB	0.00			
103	Be-SK-HiVol-1-W	22.67	*	25.38	
104	Be-SK-HiVol-Acetone	2.71			
105	Be-SK-HiVol-2-W	26.86			
106	Be-SK-HiVol-3-W	2.41			
107	Be-SK-HiVol-2 & 3 Acetone	2.54	*	31.81	
108	Be-SK-Sample 1-Baghouse Catch	93.73 $\frac{µg}{g}$			
109	Be-SK-MP-Blank	0.00			
110	Be-SK-W-Blank	0.00			

* Total µg Be per run

** Denotes that the two particulate runs were accomplished at the same time, in the same stack with a separate probe (two probes total) for each run.

*** Denotes that the vertical traverse was performed during the first half of the test and that the horizontal traverse was performed during the second half of the test.

PROJECT PARTICIPANTS

NAME	TITLE
John Koogler, P.E., Ph.D.	Project Director
John Dollar, E.I.T., M.S.	Project Manager
Ray Black, B.S.	Environmental Specialist
Robert Durgan, Technician	Environmental Specialist
George Allen, Technician	Environmental Specialist
Larry Wurts, Technician	Environmental Specialist
Mike Jackson, Technician	Environmental Specialist

SOURCE SAMPLING FIELD DATA SHEET

Plant _Southeastern Kusan, Inc Gaffney SC_

Sampling Location _"INLET"-(VERTICAL)_

Date _8-25-71_, Run No. _1_

Time Start _07:45_, Time End _12:57_

Sampling Time/Point _26min / point = 312 min total_

DB _130_°F, WB ___°F, DP ___°F, VF @ DP ___ "Hg

Moisture _3.0 *_, FDA _0.97_, Gas Density Factor ___

Barometric Press. _29.9_ "Hg, Stack Press. _<30_ "Hg

Weather _Clear & Warm_

Temp. _70_ °F, W/D ___, W/S ___

Sample Box No. _#5_, Meter Box No. _#5_

Meter ΔHg _1.72_, Pitot Corr. Factor _0.85_

Nozzle Dia. _1/4_ in., Probe Length _6_ ft

Probe Heater Setting _−_

Stack Dimensions: Inside Diameter _36_ in
Inside Area _7.069_ ft²
Height ___ ft

Sketch Of Stack:

HORIZONTAL STACK

Vertical Sample Here

* = assumed moisture
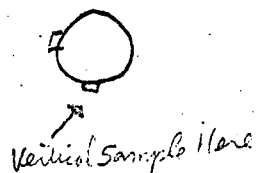
Mat'l Processing Rate ___

Final Gas Meter Reading _992.011_ ft³

Initial Gas Meter Reading _731.534_ ft³

Total Condensate In Impingers _−52_ ml

Moisture In Silica Gel _+ 74_ gm

Silica Gel Container No. _106_, Filter No. _−_

Orsat:

CO₂					
O₂					
CO					
N₂					
Excess Air					

Test Conducted By: _R. Durgan_

Remarks: _millipore filter with W Hatman # 41 Backup-filter_

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H₂O)	Meter Orifice Press.Diff. ("H₂O) Calc.	Meter Orifice Press.Diff. ("H₂O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
Port# 1												
		07:45	731.534	0.50	1.60	1.00	130	62	62			23"
Port# 12	35.25	07:55	738.9	0.50	1.60	1.60	130	62	62			23"
		08:05	746.3	0.50	1.60	1.60	130	70	65			5"
		08:11	750.0	0.45	1.48	1.48	150	70	67			5"
11	33.6	08:24	760.9	0.45	1.48	1.48	150	70	67			3"
		08:57	770.1	0.47	1.55	1.55	150	70	67			3"

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H₂O)	Meter Orifice Press.Diff. ("H₂O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Motor (°F) In	Out	Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
10	31.8	08:30	780.9	0.47	1.55	1.55	150	75	70			3.2"
		09:03	791.3	0.47	1.55	1.55	160	76	72			3.2
9	29.8	09:16	801.2	0.50	1.60	1.60	120	78	73			3.5
		09:29	812.1	0.60	1.85	1.85	120	80	74			3.6
8	27.0	09:42	824.0	0.65	2.00	2.00	104	82	76			3.8
(2 min) Orifice duration		09:55	—	0.65	2.00	2.00	104	83	78			4.0
7	23.2	10:08	848.9	0.90	2.95	2.95	92	84	79			5.0
		10:21	883.5	0.90	2.95	2.95	97	87	81			5.0
6	12.8	10:34	875.1	0.75	2.42	2.42	95	88	82			4.5
		10:47	887.7	0.75	2.42	2.42	95	88	83			4.3
5	9.00	11:00	898.3	0.55	1.75	1.75	94	89	84			3.5
		11:13	—	0.50	1.60	1.60	94	91	85			3.4
4	6.36	11:26	920.0	0.40	1.30	1.30	93	94	87			3.0
		11:39	929.1	0.40	1.30	1.30	93	96	88			3.0
3	4.25	11:52	939.2	0.45	1.48	1.48	93	97	90			3.2
		12:05	949.0	0.45	1.48	1.48	93	98	91	—	92	3.2
2	2.41	12:18	959.2	0.60	1.85	1.85	93	100	92			3.6
		12:31	971.5	0.70	2.25	2.25	93	101	93			4.0
1	0.75	12:44	982.2	0.45	1.48	1.48	93	103	94			3.0
		12:57	992.011	0.40	1.30	1.30	93	103	95	—	90	2.8
			260.477		30.9							
					265.							

SOURCE SAMPLING FIELD DATA SHEET

Plant _Southeastern Kosan, Inc. (Gaffney S.C.)_

Sampling Location _Intet (horizontal)_

Date _8-25-71_ , Run No. _1_

Time Start _7:50 A.M_ , Time End _____

Sampling Time/Point _26 min (312 min total)_

DB ___°F, WB ___°F, DP ___°F, VF @ DP _____ "Hg

Moisture _3.0_ %* FDA ____ , Gas Density Factor ____

Barometric Press. _29.9_ "Hg, Stack Press. _<30_ "Hg

Weather _____

Temp. _____°F, W/D _____ , W/S _____

Sample Box No. _____ , Meter Box No. _____

Meter Δ Hg _1.60_ , Pitot Corr. Factor _____

Nozzle Dia. _1/4_ in., Probe Length _4_ ft

Probe Heater Setting _____

Stack Dimensions: Inside Diameter _36_ in
Inside Area _7.069_ ft²
Height _____ ft

* Assumed moisture

Sketch Of Stack:

Mat'l Processing Rate _____

Final Gas Meter Reading _304.594_ ft³

Initial Gas Meter Reading _39.265_ ft³

Total Condensate In Impingers _-10_ ml

Moisture In Silica Gel _34.7_ gm

Silica Gel Container No. _103_ , Filter No. ____

Orsat: CO₂ | | | |

O₂ | | | |

CO | | | |

N₂ | | | |

Excess Air | | | |

Test Conducted By: _Ray Block_

Remarks: _Millipore filter with Whatman #41 Back up filter_

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H₂O)	Meter Orifice Press.Diff. ("H₂O)		Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F)		Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
					Calc.	Actual		In	Out			
E		0750	39.265									
12		0800	—	0.40	1.2	1.2	150	67	75	—	81	4.5
12					1.2	1.2		68	77		81	4.5
12		0816	55.5	0.40	1.2	1.2	150	74	88	—	86	5.0
11		0829	64.8	0.45	1.3	1.3	150	80	97	—	88	7.5
11		0842	74.5	0.45	1.3	1.3	156	92	114	—	92	8.5
1		0855	86.8	0.72	2.1	2.1	160	108	132	—	95	13.0
10		0908	99.1	0.70	2.0	2.0	160	120	147	—	72	16.0

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft3)	Stack Velocity Head ("H2O)	Meter Orifice Press.Diff. ("H2O)		Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F)		Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
					Calc.	Actual		In	Out			
9		0921	113.7	0.82	2.4	2.40	155	132	157	=	65	21.0
9		0934	125.7	0.80	2.3	2.30	120	140	160	=	65	22.0
8		0947	137.7	0.75	2.2	2.20	104	148	172	=	64	22.0
8		1000	149.5	0.65	1.9	1.90	102	154	176	=	64	22.5
7		1013	164.4	1.00	2.9	2.90	92	142	155	—	66	27.5
7		1026	178.1	0.98	2.8	2.80	97	130	148	=	70	27.0
6		1039	190.0	0.65	1.9	1.90	95	120	137	—	73	21.0
6		1052	200.6	0.65	1.9	1.90	94	118	130	—	75	21.0
5		1105	212.7	0.60	1.8	1.80	94	112	126	—	76	20.5
5		1118	222.9	0.55	1.6	1.60	93	110	122	—	82	18.5
4		1131	232.6	0.53	1.55	1.55	93	110	122	=	84	18.5
4		1144	242.3	0.53	1.55	1.55	93	110	122	=	88	18.5
3		1257	253.7	0.53	1.55	1.55	93	110	124	=	88	18.5
3		1210	164.4	0.53	1.55	1.55	93	110	124	=	90	18.5
2		1223	274.5	0.53	1.55	1.55	93	110	120	=	82	18.5
2		1236	284.6	0.50	1.50	1.50	93	106	118	=	84	17.5
1		1249	295.4	0.50	1.50	1.50	93	106	118	=	86	17.5
1		1302	304.5	0.50	1.50	1.50	93	106	118		88	17.5

Correction Factor: 1.0

Plant _SOUTHEASTERN KUSAN INC. GAFFNEY S.C._

Sampling Location _INLET (VERTICAL)._

Date _8-30-71_, Run No. _2-V_

Time Start _07:20_, Time End _10:08_

Sampling Time/Point _14 min/point_

@ _150_°F, WB _—_ °F, DP _—_ °F, VF @ DP _—_ "Hg

Moisture _2.0_%, FDA _0.98_, Gas Density Factor _—_

Barometric Press. _28.55_ "Hg, Stack Press. _28.55-0.23 = 28.74_ Hg

Weather _Clear & Warm_

Temp. _80_ °F, W/D _—_, W/S _—_

Sample Box No. _#5_, Meter Box No. _#5_

Meter Δ Hg _1.72_, Pitot Corr. Factor _0.85_

Nozzle Dia. _1/4_ in., Probe Length _6_ ft

Probe Heater Setting _—_

Stack Dimensions: Inside Diameter _36_ in

Inside Area _7.069_ ft²

Height _____ ft

Sketch Of Stack:

Mat'l Processing Rate _____

Final Gas Meter Reading _1126.113_ ft³

Initial Gas Meter Reading _992.015_ ft³

Total Condensate In Impingers _#11_ ml

Moisture In Silica Gel _(218.8)-190.2=28.6_ gm

Silica Gel Container No. _14_, Filter No. ___

Orsat: CO₂ _0.7 / 0.737_

O₂ _19.9_

CO _—_

N₂ _79.4_

Excess Air ___

Test Conducted By: _R. Duncan_

Remarks: _Millipore + Whatman 41 filters (Rubber gasketed holder)_
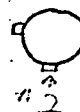
⊘ = assumed moisture

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H₂0)	Meter Orifice Press.Diff. ("H₂0) Calc.	Meter Orifice Press.Diff. ("H₂0) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
1		07:20	992.015	0.60				85		—	—	
12	35.25	07:27	992.015	0.60	1.88	1.88	105	61	61	—	—	3.2
		07:34	1003.8	0.50	1.62	1.62	105	61	61	—	—	3.2
11	33.6	07:41	1009.1	0.48	1.58	1.58	105	62	61	—	—	3.2
		07:48	1014.3	0.50	1.62	1.62	—	62	62	—	—	3.2
10	31.8	07:55	1020.5	0.52	1.68	1.68	—	63	62	—	—	3.2
		08:02	1025.9	0.52	1.68	1.68	148	64	62	—	—	3.2
9	29.8	08:09	1031.3	0.54	1.72	1.72	148	66	62	—	—	3.2
		08:16	1035.4	0.60	1.62	1.62	148	67	63	—	—	3.2

| Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft3)	Stack Velocity Head ("H2O)	Meter Orifice Press.Diff. ("H2O)		Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F)		Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
					Calc.	Actual		In	Out			
8	27.0	08:23	1042.5	0.55	1.75	1.75	150	68	64	—	—	3.4
		08:30	1048.5	0.58	1.84	1.84	154	69	64	—	82°	3.4
7	29.2	08:37	1055.0	0.75	2.40	2.40	154	71	65	—	—	4.2
		08:44	1061.5	0.72	2.35	2.35	154	71	65	—	—	4.0
6	12.8	08:51	1067.7	0.65	2.00	2.00	154	73	67	—	—	3.8
		08:58	1074.1	0.65	2.00	2.00	154	74	68	—	—	3.8
5	9.00	09:05	1089.1	0.50	1.62	1.62	177	75	69	—	—	3.5
		09:12	1085.0	0.45	1.48	1.48	177	75	69	—	—	3.5
4	6.36	09:19	1090.5	0.40	1.30	1.30	177	76	71	—	92°	3.2
		09:26	1095.4	0.40	1.30	1.30	177	76	71	—	—	3.2
3	4.25	09:33	100.0	0.30	0.93	0.93	177	77	72	—	—	2.8
		09:40	104.5	0.35	1.10	1.10	177	78	73	—	—	2.8
2	2.41	09:47	109.1	0.35	1.10	1.10	164	79	74	—	—	2.8
		09:54	114.2	0.35	1.10	1.10	164	79	75	—	—	2.8
1	0.75	10:01	119.9	0.55	1.75	1.75	168	80	76	—	—	3.6
		10:08	126.113	0.58	1.94	1.84	168	82	77	—	—	4.0

SOURCE SAMPLING FIELD DATA SHEET

Plant _Southeastern Kusan Inc. Gaffney S.C._

Sampling Location _INLET (HORIZONTAL)_

Date _8-30-71_ , Run No. _2-14_

Time Start _10:15_ , Time End _1:03 pm_

Sampling Time/Point _14 min/point_

DB _50_ °F, WB _—_ °F, DP ___ °F, VF @ DP _—_ "Hg

✷ Moisture _2.0_ %, FDA _0.98_ , Gas Density Factor _—_

Barometric Press _29.55_ "Hg, Stack Press. _30_ "Hg

Weather _Clear & Warm_

Temp. _80_ °F, W/D _—_ , W/S _—_

Sample Box No. _#5_ , Meter Box No. _#5_

Meter Δ Hg _1.72_ , Pitot Corr. Factor _0.85_

Nozzle Dia. _¼_ in., Probe Length _6_ ft

Probe Heater Setting _—_

Stack Dimensions: Inside Diameter _36_ in
Inside Area _7.069_ ft²
Height _____ ft

Sketch Of Stack:

#1 ⬭
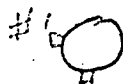
Mat'l Processing Rate _____

Final Gas Meter Reading _281.700_ ft³

Initial Gas Meter Reading _126.113_ ft³

Total Condensate In Impingers _−12_ ml

Moisture In Silica Gel _(238.3)−197.3 = 41.0_ gm

Silica Gel Container No. _112_ Filter No. ___

Orsat: CO₂ _____
O₂ _____
CO _____
N₂ _____
Excess Air _____

Test Conducted By: _R. Dergan_

Remarks: _Millipore + Whatman 41 filter (Nichrome wire retainer in holder)_

✷ = Assumed Moisture

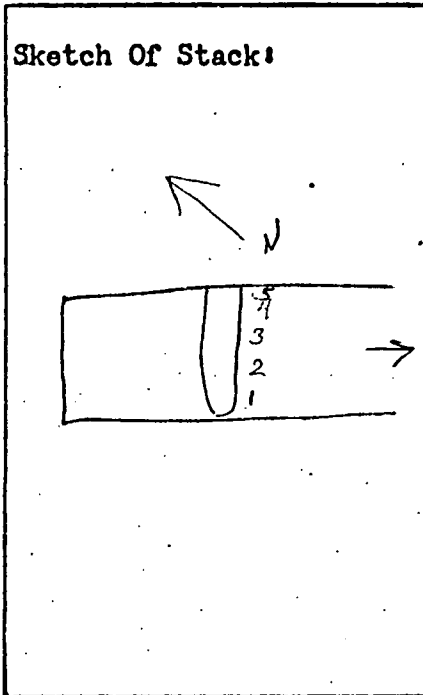| Port and Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H₂O)	Meter Orifice Press.Diff. ("H₂O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Out	Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
Port #2	Passing Operation	10:15	126.113									
1	0.75	10:22	130.8	0.30	0.93	0.93	102	82	79	—	—	8.0
		10:29	136.0	0.38	1.25	1.25	102	84	79	—	—	8.2
2	2.41	10:36	141.8	0.55	1.75	1.75	102	84	80	—	—	13.5
		10:43	148.1	0.55	1.75	1.75	102	85	81	—	—	6.5
3	4.25	10:50	154.2	0.65	2.00	2.00	102	86	81	—	—	5.0
		10:57	161.0	0.75	2.40	2.40	102	87	82	—	—	5.2
4	6.36	11:04	168.4	0.90	2.95	2.95	101	89	83	—	—	6.2
		11:11	175.3	0.95	3.10	3.10	101	91	84	—	—	6.4

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft3)	Stack Velocity Head ("H2O)	Meter Orifice Press.Diff. ("H2O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Out	Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
5	9.00	11:18	184.5	1.10	3.65	3.65	160.0	94	85	—	—	7.5
		11:25	192.8	1.10	3.65	3.65	100.0	95	86	—	—	7.8
6	12.9	11:32	200.3	1.10	3.65	3.65	100.0	97	87	—	—	7.4
		11:39	208.3	1.10	3.65	3.65	100.0	98	88	—	—	7.4
7	23.2	11:46	215.9	0.70	2.25	2.25	100.0	100	90	—	—	5.2
		11:53	223.1	0.70	2.25	2.25	100.0	100	91	—	—	5.2
8	27.0	12:00	228.0	0.60	1.88	1.88	99.0	100	91	—	—	4.5
		12:07	—	0.60	1.88	1.88	99.0	100	91	—	—	4.5
9	29.8	12:14	241.2	0.60	1.88	1.88	99.0	100	91	—	—	4.5
		12:21	246.5	0.60	1.88	1.88	99.0	100	92	—	—	4.5
10	31.8	12:28	252.8	0.60	1.88	1.88	99.0	99	93	—	—	4.2
		12:35	258.6	0.60	1.88	1.88	99.0	99	93	—	—	4.2
11	33.6	12:42	264.5	0.55	1.75	1.75	99.0	100	94	—	—	3.8
		12:49	270.5	0.55	1.75	1.25	99.0	100	94	—	—	3.8
12	35.25	12:56	276.2	0.50	1.62	1.62	99.0	100	95	—	—	3.8
		1:03	281.7	0.45	1.48	1.48	99.0	100	95	—	—	3.8

SOURCE SAMPLING FIELD DATA SHEET

Plant **S. E. Kusan, Inc, Gaffney, S.C.**

Sampling Location **outlet**

Date **8/25/71**, Run No. **1**

Time Start **7.52**, Time End _____

Sampling Time/Point **8min** **(320 min total)**

DB ____ °F, WB ____ °F, DP ____ °F, VF @ DP _____ "Hg

Moisture **3** %, FDA _____, Gas Density Factor _____

Barometric Press. **29.9** "Hg, Stack Press. **29.9** "Hg

Weather **clear**

Temp. **70** °F, W/D **East**, W/S **—**

Sample Box No. **EEI/L**, Meter Box No. **EEI#2**

Meter ΔHg **1.6**, Pitot Corr. Factor **0.849**

Nozzle Dia. **1/4** in., Probe Length **4** ft

Probe Heater Setting **—**

Stack Dimensions: Inside Diameter **29 X 29** in

Inside Area **5.88** ft²

Height **horiz** ft

Sketch Of Stack:

Mat'l Processing Rate _____

Final Gas Meter Reading **478.830** ft

Initial Gas Meter Reading **140.100** ft³

Total Condensate In Impingers **—5** ml

Moisture In Silica Gel **+33.3** gm

Silica Gel Container No **105**, Filter No. **millipo**

Orsat:

CO₂				
O₂				
CO				
N₂				
Excess Air				

Test Conducted By: **Moose** **BigRed**

Remarks: **Millipore filter with Whatman 41 back-up filter**

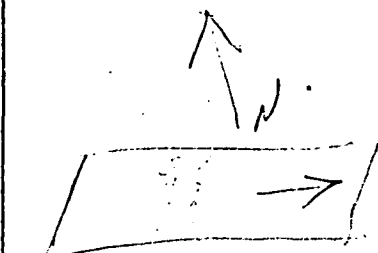| Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft3)	Stack Velocity Head ("H₂0)	Meter Orifice Press.Diff. ("H₂0) Calc.	Meter Orifice Press.Diff. ("H₂0) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
1			140.100									
1	3.6"	7.52	147.4	0.82	28	2.8	110	63	62	0	71	9.0
2	7.2"	8.00	155.7	0.86	2.9	2.9	130	64	63	8	80	9.3
3	10.8	8.08	163.1	0.76	2.5	2.5	135	66	63	1	85	8.9
4	14.0	8.16	168.0	0.3	0.93	0.93	135	68	64	9	85	9.1
5	17.6	8.24	172.6	0.28	0.87	0.87	137	69	65	2	85	8.2
6	21.2	8.32	176.8	0.26	0.80	0.80	140	70	67	10	87	7.3
7	24.8	8.40	181.1	0.26	0.80	0.80	139	71	68	3	88	7.0
8		8.48	188.3	0.66	1.9	1.9	140	72	69	11	88	10.7

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft3)	Stack Velocity Head ("H2O)	Meter Orifice Press.Diff. ("H2O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Out	Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Tra ("Hg)
2)												
8		8 56	194.8	0.76	2.5	2.5	140	74	71	4	88	12.0
7		9.04	202.2	0.76	2.5	2.5	140	76	71	12	90	12.0
6		9.12	209.2	0.74	2.2	2.2	140	78	72	5	80	10.9
5		9.20	216.1	0.7	1.95	1.95	122	79	73	13	79	8.2
4		9.28	223.4	0.65	2.05	2.05	112	80	74	6	78	8.2
3		9.36	230.5	0.7	2.4	2.4	108	80	75	14	78	7.9
2		9.44	239.3	0.85	2.85	2.85	108	81	76	7	78	9.0
1		9.52	247.0	0.94	3.1	3.1	104	82	77	6	78	7.9
3) 1		10.00	255.8	1.2	3.6	3.6	99	83	78	8	78	11.1
2		10.08	264.5	0.95	3.05	3.05	100	84	79	1	77	9.8
3		10.16	272.4	0.78	2.6	2.6	101	85	80	9	78	8.4
4		10.24	280.5	0.75	2.55	2.55	100	85	81	2	80	8.2
5		10.32	289.4	0.90	2.3	2.3	100	86	81	10	80	9.0
6		10.40	297.2	0.92	2.85	2.85	100	87	82	3	80	9.1
7		10 48	305.6	1.2	3.6	3.6	100	88	83	11	82	11.3
8		10.56	314.8	1.2	3.6	3.6	100	89	84	4	83	11.2
4) 8		11.04	235.8	1.7	5.0	5.0	100	92	85	12	82	18.0
7		11.12	3.37.0	1.5	4.6	4.6	100	94	86	5	83	14.8
6		11 20	346.4	1.3	3.7	3.7	100	95	87	13	83	10.6
5		11 28	355.4	1.1	3.5	3.5	100	96	87	6	85	10.3
4		11 36	364.2	0.95	3.05	3.05	100	97	89	14	85	9.7
3		11 44	372.8	0.95	3.05	3.05	100	97	90	7	85	9.4
2		11 52	381.7	1.3	3.7	3.7	100	98	91	15	86	10.3
1		12 00	392.6	1.5	4.6	4.6	100	99	91	8	87	14.8
5) 1		12.08	452.	1.5	4.6	4.6	100	101	93	1	86	14.4
2		12.16	413.9	1.5	4.45	4.45	100	103	93	9	87	13.8
3		12.24	424.5	1.5	4.6	4.6	100	104	94	2	87	14.0
4		12.32	435.0	1.5	4.6	4.6	100	105	95	10	87	14.0
5		12 40	446	1.5	4.6	4.6	100	106	96	3	89	14.0
6		12 48	459	1.5	4.6	4.6	100	108	97	11	89	14.0
7		12 56	467.5	1.5	4.6	4.6	100	109	98	4	90	14.0
8		1.04	478.830	1.6	4.9	4.9	100	110	99	12	91	15.2
Average					.75						5	

SOURCE SAMPLING FIELD DATA SHEET

Plant _S.E. Kusan_

Sampling Location _Outlet_

Date _8/30/31_, Run No. _2_

Time Start _____, Time End _____

Sampling Time/Point _8 min_

DB ___ °F, WB ___ °F, DP ___ °F, VF @ DP _____ "Hg

Moisture _2_ %, FDA _____, Gas Density Factor _____

Barometric Press _2955_ "Hg, Stack Press. _30_ "Hg

Weather _Cold_

Temp. _____ °F, W/D _____, W/S _____

Sample Box No. _L-1_, Meter Box No. _EEI 2_

Meter ΔHg _1.60_, Pitot Corr. Factor _0.849_

Nozzle Dia. _1/4_ in., Probe Length _4_ ft

Probe Heater Setting _____

Stack Dimensions: Inside Diameter _29 X 29_ in
Inside Area _____ ft²
Height _____ ft

Sketch Of Stack:

Mat'l Processing Rate _____

Final Gas Meter Reading _862.157_ ft³

Initial Gas Meter Reading _478.532_ ft³

Total Condensate In Impingers _+ 16_ ml

Moisture In Silica Gel _(221.2) - 186.1 = 35.1_ gm

Silica Gel Container No. _111_, Filter No. _Millipore_

Orsat: CO₂ _____
O₂ _____
CO _____
N₂ _____
Excess Air _____

Test Conducted By: _Moose_
Mike Jackoff

Remarks: _Millipore + Whatman 41 filters_
(Glass gasketed holder)

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H₂O)	Meter Orifice Press.Diff. ("H₂O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Out	Sample Box Temp. (F) TMR	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
57	1	7.17	478.532									
1		7.25	489.5	1.4	5.4	5.0	92	60	60	0	68	10.5
2		7.33	—	1.5	5.75	5.4	110	61	60	8	82	11.0
3		7.41	513.2	1.5	5.75	5.75	119	64	61	16	84	9.2
4		7.49	526.0	1.5	5.75	5.75	121	66	61	24	84	7.0
5		7.57	538.4	1.5	5.75	5.75	123	68	62	32	82	7.2
6		8.05	552.4	1.5	5.75	5.75	129	70	63	40	83	8.1
7		8.13	563.6	1.3	5.05	5.05	130	74	65	48	83	5.0
8		8.21	575.7	1.4	5.4	5.4	135	75	66	56	82	6.2

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft3)	Stack Velocity Head ("H2O)	Meter Orifice Press.Diff. ("H2O)		Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F)		Sample Box Temp. (F)	Last Impinger Temp. (F)	Vacuum On Sample Train ("Hg)
					Calc.	Actual		In	Out			
4) 8		8:29	586.5	1.2	4.6	4.6	140	77	67	04	85	5.2
7		8:37	597.7	1.2	4.6	4.6	155	78	68	12	85	5.5
6		8:45	605.2	0.95	3.7	3.7	155	80	70	20	80	4.2
5		8:53	615.1	0.85	3.3	3.3	159	80	70	28	78	3.8
4		9:01	623.5	0.75	2.95	2.95	157	81	72	36	77	3.8
3		9:09	632.7	0.78	3.05	3.05	158	81	72	44	78	3.9
2		9:17	641.7	0.92	3.65	3.65	157	82	74	52	77	4.4
1		9:25	—	1.2	4.6	4.6	156	84	75	60	80	6.1
3) 1		9:33	664.0	1.2	4.6	4.6	143	86	77	8	80	5.9
2		9:41	672.0	0.72	2.9	2.9	150	88	78	16	82	3.2
3		9:49	679.3	0.6	2.35	2.35	153	87	79	24	85	3.0
4		9:57	687.7	0.65	2.6	2.6	149	88	80	32	86	3.8
5		10:05	696.7	0.8	3.15	3.15	150	89	81	40	86	4.1
6		10:13	705.5	0.8	3.15	3.15	144	91	83	48	87	3.8
7		10:21	715.1	0.95	3.7	3.7	111	92	84	56	86	5.0
8		10:29	725.8	1.1	4.3	4.3	119	93	85	04	85	5.5
2) 8		10:37	735.5	0.92	3.65	3.65	108	94	87	12	84	5.0
7		10:45	741.3	0.85	3.30	3.30	106	95	87	20	86	4.5
6		10:53	752.9	0.78	3.10	3.10	106	95	89	28	85	4.0
5		11:01	761.4	0.72	2.90	2.90	106	95	90	36	88	3.8
4		11:09	769.3	0.6	2.35	2.35	106	96	91	44	88	3.0
3		11:17	777.7	0.68	2.7	2.7	106	96	91	52	89	3.2
2		11:25	786.3	0.85	3.3	3.3	105	97	92	60	90	3.9
1		11:33	795.6	1.0	3.9	3.9	104	98	93	8	89	4.8
1) 1		11:41	804.2	0.75	2.95	2.95	106	100	94	16	90	3.2
2		11:49	812.6	0.75	2.95	2.95	104	100	95	24	88	3.3
3		11:57	821.5	0.78	3.10	3.10	105	101	95	32	92	3.9
4		12:05	830.1	0.75	2.95	2.95	103	101	96	40	88	3.2
5		12:13	838.2	0.7	2.75	2.75	101	100	96	48	87	3.2
6		12:21	846.2	0.7	2.75	2.75	102	99	96	56	94	3.5
7		12:29	855.1	0.65	2.6	2.6	102	100	96	04	95	3.1
8		12:37	862.157	0.6	2.35	2.35	102	101	97	12	95	3.0