SOURCE TEST REPORT

EPA TEST NO.: 71-CI-21

PLANT TESTED: American Beryllium Company
Sarasota, Florida

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, First of Three Plants

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INTRODUCTION

Emission tests were performed on three sources located at the American Beryllium Company in Sarasota, Florida, on August 4, 5 and 6, 1971.

The purpose of these tests was to determine beryllium emissions from a baghouse controlled beryllium machine shop.

American Beryllium is a beryllium metal machining plant which utilizes bag collectors for controlling beryllium dust emissions. For all three sources only the baghouse outlets were tested. No collection efficiencies were determined. Two separate sampling trains, operated simultaneously, were used in testing each source. Duplicate tests runs were conducted for all three sources.

SUMMARY OF TEST RESULTS

Summarized test conditions and beryllium emission rates for all three sources tested are included in Tables 1 through 3. Complete stack parameter and beryllium emission test results are included in the Appendix. The tests indicate that American Beryllium Company emits 11.67 grams of beryllium per 8-hour day.

The following code was used to characterize sample data:

A - American Beryllium Company, Sarasota, Florida

N - North Stack

MN - Middle North Stack

S - South Stack

1 - Run #1

2 - Run #2

G - Gelman type A filter

MP - Millipore AA filter

GB - Gelman type A 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

TABLE 1

SUMMARY OF BERYLLIUM EMISSION DATA

AMERICAN BERYLLIUM COMPANY
Sarasota, Florida
MIDDLE NORTH STACK

Run Number	MN-1-MP	MN-2-MP	MN-1-G	MN-2-G
Date	8/4/71	8/4/71	8/4/71	8/4/71
Stack Flow Rate @ Stack Conditions, CFM	4985	4922	4668	4617
Stack Gas Moisture, % Volume	0.7	0.1	0.02	0.01
Stack Gas Temperature, ^{o}F	140	140	140	140
Test Time, Minutes	120	120	120	120
Beryllium Emissions, Total Catch μg/m^3 @ Stack Conditions grams/8-hour day	 107.05 7.20	 187.87 12.48	 180.61 11.40	 224.71 14.02

TABLE 2

SUMMARY OF BERYLLIUM EMISSION DATA

AMERICAN BERYLLIUM COMPANY
SARASOTA, FLORIDA
NORTH STACK

Run Number	N-1-MP	N-2-MP	N-1-G	N-2-G
Date	8/5/71	8/5/71	8/5/71	8/5/71
Stack Flow Rate @ Stack Conditions, CFM	1957	1898	1983	1810
Stack Gas Moisture, % Volume	0.2	0.2	0.1	0.5
Stack Gas Temperature, ^oF	146.5	150	146.5	150
Test Time, Minutes	120	72	120	72
Beryllium Emissions, Total Catch				
$\mu g/m^3$ @ Stack Conditions	25.79	6.67	6.89	10.10
grams/8-hour day	0.46	0.12	0.18	0.24

TABLE 3

SUMMARY OF BERYLLIUM EMISSION DATA

AMERICAN BERYLLIUM COMPANY
SARASOTA, FLORIDA
SOUTH STACK

Run Number	S-1-MP	S-2-MP	S-1-G	S-2-G
Date	8/6/71	8/6/71	8/6/71	8/6/71
Stack Flow Rate @ Stack Conditions, CFM	1108	1074	1049	1074
Stack Gas Moisture, % Volume	0.4	0.4	0.2	0.1
Stack Gas Temperature, ^{o}F	139	142.5	138	140
Test Time, Minutes	96	96	96	96
Beryllium Emissions, Total Catch $\mu g/m^3$ @ Stack Conditions grams/8-hour day	 4.47 0.07	 1.73 0.02	 18.02 0.26	 16.38 0.24

PROCESS DESCRIPTION AND OPERATION

The American Beryllium Company is a machining facility engaged in the production of high tolerance components manufactured from beryllium and other specialty metals. Their products include components for inertial guidance, optical mirrors, space structural assemblies, nuclear devices, digital encoders, x-ray telescopes, space instruments, and memory devices. The operations performed are turning, milling, grinding, lapping, honing, electrical discharge machining, drilling, and deburring. All of the operations with the exception of grinding are performed dry. In addition, small scale plating and thermal cycling operations are carried out in a separate building not connected to the main structure.

The vacuum collection line for dry machining operations consists of one or more high velocity exhaust pickups positioned at the tool point which are fed to central baghouses. Prior to entry to the baghouse the exhaust gases are passed through a chip removal device located approximately ten feet down the line from the pickup point. All of the exhaust gases exit through ducts onto the roof of the building approximately two feet above the roof line. The three exit ducts sampled were designated North, Middle North, and South.

There are seven Spencer Turbine Co. baghouses servicing the various beryllium machining devices. The exhaust from four baghouses exits from the middle north duct at 140°F and 4800 cfm. Two exhaust from the north duct at 150^{o}F and 1600 cfm and one from the south duct at 140^{o}F and 1070 cfm. In order to determine the amount of beryllium being collected during the day of the emission test, the baghouses were emptied and shaken down prior to the shift beginning the day of the test. At the end of the shifts for that specific day, the baghouses were emptied in the same way and the collected dust weighed. This procedure was also performed on the day preceeding the emission test to verify the weight range. A list of the baghouses and pertinent information is included in Table 4. The four baghouses with the common exhaust point were treated as one for the weight check. It should be noted that it is American Beryllium Company's common practice to empty baghouses as often as once a day depending on the dust collected. The baghouse sight glasses are checked every day during lunch break and emptied if more than half full.

Each baghouse is serviced by a turbine ranging from twenty to fifty horsepower. The baghouses and turbines are housed in three separate rooms located within the main structure. American Beryllium Company personnel were unable to supply any information on bag material or permeability. However, two different types of bags were in use. A sample of the two bag types from the north and south baghouses was obtained by EPA personnel.

Examination of the middle-north baghouses resulted in the discovery of considerable deposits of beryllium dust located on top of the shaker plate in baghouse number three. The deposited dust was over one-half inch thick in some areas. A further check was conducted in order to determine if any beryllium dust was located in the duct work

TABLE 4

BAGHOUSE OPERATIONS AT THE AMERICAN BERYLLIUM COMPANY

Baghouse	Turbine H.P.	Exhaust Duct	Exhaust Flow Rate ACFM	Temp. °F	No. Bags	Dimensions Dia.(in.) x Length (in.)	First Wt. Check lbs. Be	Day of Emission Test Second Wt. Check lbs. Be
1	25				45	4 x 48		
2	20	Middle North	4900	140	45	4 x 48	9.9	10.0
3	50				61	6 x 48		
4	50				61	6 x 48		
5	50	South Duct	1000	150	61	6 x 48	6.4	8.0
6	50	North Duct	2000	140	61	6 x 48	7.8	2.2
7	50				61	6 x 48		

leading to the exhaust point. Holes were cut in the probable hang-up areas. No accumulation was present in any area checked, although there was a film of beryllium dust throughout the observed areas.

The roof area surrounding the middle-north exhaust duct (up to seventy-five feet from the duct,) also had considerable deposits of beryllium dust present. A sample was taken by EPA personnel for chemical analysis, and it was determined that the sample was 89.9% Be. No other exhaust points appeared to have any deposits of beryllium dust in their vicinity.

Upon discussion with company personnel, it was determined that the subject beryllium deposits occurred during a bag break. Approximately three months prior to the source test, one or more torn bags were discovered in baghouse number three. The total time this condition existed is in question. Company estimates ranged from one to thirty days. Upon discovery of the condition, the baghouse was cleaned and new bags were installed. Apparently the dust deposits located on the shaker plate were overlooked. Therefore, emission data obtained from the middle-north exhaust duct may not be representative of normal plant operation.

LOCATION OF SAMPLING POINTS

Stack extensions were connected to the existing effluent stacks from the baghouses so that the sampling locations would be approximately eight stack diameters downstream from any disturbance.

Circular metal stack extensions were used on all sources tested at American Beryllium Company. In all cases, the sampling location was eight stack diameters downstream and two stack diameters upstream from any disturbance. Figure 1 is a typical diagram of the stack extension used. Figure 2 shows the selected sampling points for all sampling performed.

LOCATION OF SAMPLING POINTS
AT AMERICAN BERYLLIUM COMPANY

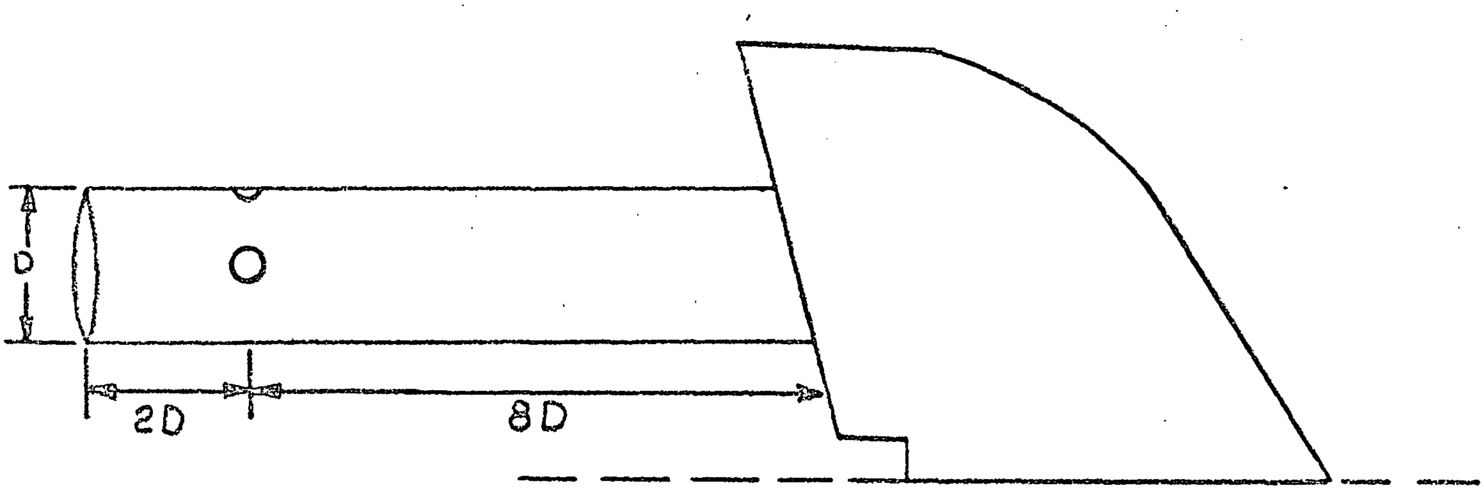


FIGURE NO. 1

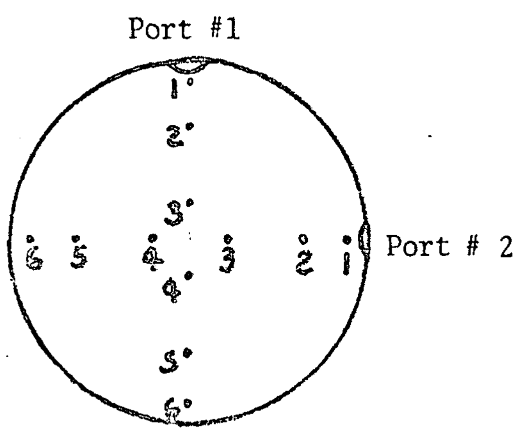


FIGURE NO. 2

SAMPLE POINT DISTANCE FROM INSIDE STACK WALL

Point No.	12" I.D.	18" I.D.
1	1/2"	3/4"
2	1 3/4"	2 5/8"
3	3 1/2"	5 3/8"
4	8 1/2"	12 5/8"
5	10 1/4"	15 3/8"
6	11 1/2"	17 1/4"

SAMPLING AND ANALYTICAL PROCEDURES

All sources were tested in such a manner as to comply with the Environmental Protection Agency's (EPA) Proposed Regulations 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

A - American Beryllium Company, Sarasota, Florida

N - North Stack

MN - Middle North Stack

S - South Stack

1 - Run #1

2 - Run #2

G - Gelman Type A filter

MP - Millipore AA filter

GB - Gelman type A 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

SOURCE TEST DATA

E.P.A. Test No. ______ No. of Runs 2

Name of Firm American Beryllium Company

Location of Plant Sarasota, Florida

Type of Plant Beryllium Machining

Control Equipment Bag House

Sampling Point Location Middle North Stack

Pollutants Sampled Beryllium Dust

Run No.	MN-1-MP	MN-1-G	MN-2-MP	MN-2-G
Date	8/4/71	8/4/71	8/4/71	8/4/71
Time Began	0815	0810	1220	1118
Time End	1025	1020	1430	1328
Barometric Pressure, "Hg. Absolute	30.00	30.05	30.00	30.05
Meter Orifice Pressure Drop, "H_2O	1.950	2.07	1.937	2.07
Volume of Dry Gas Meter @ Meter Cond., ft^3	101.904	101.592	101.627	105.86
Ave. Meter Temp., ^oF	81.8	84.0	89.0	90.7
Volume of Gas Sampled @ Stack Cond., ft^3	113.14	111.70	110.67	115.05
Volume of H_2O Collected in Impingers & Silica Gel, ml^2	15.6	0.5	2.5	1.8
Volume of Water Vapor Collected & Stack Cond., ft^3	0.83	0.03	0.13	0.10
Stack Gas Moisture, % Volume	0.74	0.02	0.12	0.08
Mole Fraction of Dry Stack Gas	0.9926	.9998	0.9988	.9992

Run No.		Same as Previous Page		
Molecular Weight of Stack Gas, @ Stack Cond.	28.89	28.97	28.97	28.95
Molecular Weight of Stack Gas, Dry	28.97	28.97	28.97	28.97
Stack Gas Sp. Gravity, Ref. to Air	1.00	1.00	1.00	1.00
Ave. Sq. Root of Velocity Head, "H_2O	0.779	0.729	0.769	0.722
Ave. Stack Gas Temp., ^oF	140.0	140.0	140.0	140.0
Pitot Corr. Factor	0.85	0.85	0.85	0.85
Stack Pressure, "Hg Absolute	30.0	30.0	30.0	30.0
Stack Gas Velocity @ Stack Cond., fpm	2823	2644	2787	2615
Stack Area, ft^2	1.77	1.77	1.77	1.77
Stack Gas Flow Rate @ Stack Cond., cfm	4866	4552	4741	4448
Net Time of Test, min.	120.0	120.0	120.0	120.0
Sampling Nozzle Diameter, in.	0.250	0.250	0.250	0.250
Percent Isokinetic	98.3	103.7	97.4	107.9
Beryllium Catch, Probe, μg	172.25	457.2	321.7	528.3
Beryllium Catch, Filter, μg	82.8	0.65	15.25	26.25
Beryllium Catch, Total, μg	343.00	571.35	588.85	732.15
Beryllium Concentration, Probe, Stack Cond., $\mu g/m^3$	53.69	144.52	99.77	162.14
Beryllium Concentration, Filter, Stack Cond., $\mu g/m^3$	25.84	0.21	4.87	8.06
Beryllium Concentration, Total, Stack Cond., $\mu g/m^3$	107.05	180.61	187.87	224.71

SOURCE TEST DATA

E.P.A. Test No.____ No. of Runs 2

Name of Firm American Beryllium Company

Location of Plant Sarasota, Florida

Type of Plant Beryllium Machining

Control Equipment Baghouse

Sampling Point Location North Stack

Pollutants Sampled Beryllium Dust

Run No.	N-1-MP	N-1-G	N-2-MP	N-2-G
Date	8/5/71	8/5/71	8/5/71	8/5/71
Time Began	0815	0819	1312	1123
Time End	1025	1020	1434	1245
Barometric Pressure, "Hg. Absolute	30.00	30.05	30.00	30.05
Meter Orifice Pressure Drop, "H_2O	1.471	1.605	1.402	1.354
Volume of Dry Gas Meter @ Meter Cond., ft^3	90.023	95.080	53.590	51.968
Ave. Meter Temp., ^oF	80.8	81.5	90.5	91.0
Volume of Gas Sampled @ Stack Cond., ft^3	100.76	106.38	59.27	55.42
Volume of H_2O Collected in Impingers & Silica Gel, ml^2	3.0	2.5	1.7	4.8
Volume of Water Vapor Collected & Stack Cond., ft^3	0.16	0.14	0.09	0.26
Stack Gas Moisture, % Volume	0.16	0.13	0.16	0.47
Mole Fraction of Dry Stack Gas	0.9984	0.9987	0.9984	0.9953

Run No.		(Same)		
Molecular Weight of Stack Gas, @ Stack Cond.	28.95	28.96	28.95	28.92
Molecular Weight of Stack Gas, Dry	28.97	28.97	28.97	28.97
Stack Gas Sp. Gravity, Ref. to Air	1.00	1.00	1.00	1.00
Ave. Sq. Root of Velocity Head, "H_2O	0.685	0.694	0.662	0.630
Ave. Stack Gas Temp., ^oF	146.5	146.5	150.0	152.0
Pitot Corr. Factor	0.85	0.85	0.85	0.85
Stack Pressure, "Hg Absolute	30.00	30.00	30.00	30.00
Stack Gas Velocity @ Stack Cond., fpm	2494	2526	2418	2306
Stack Area, ft^2	0.78	0.78	0.78	0.78
Stack Gas Flow Rate @ Stack Cond., cfm	1916	1945	1826	1671
Net Time of Test, min.	120	120	72	72
Sampling Nozzle Diameter, in.	0.250	0.250	0.250	0.250
Percent Isokinetic	99.1	103.3	100.2	98.3
Beryllium Catch, Probe, μg	32.10	1.25	1.65	1.70
Beryllium Catch, Filter, μg	1.40	1.00	0.00	0.00
Beryllium Catch, Total, μg	73.60	20.75	11.20	15.85
Beryllium Concentration, Probe, Stack Cond., $\mu g/m^3$	11.25	0.42	0.98	1.08
Beryllium Concentration, Filter, Stack Cond., $\mu g/m^3$	0.49	0.33	0.00	0.00
Beryllium Concentration, Total, Stack Cond., $\mu g/m^3$	25.79	6.89	6.67	10.10

SOURCE TEST DATA

E.P.A. Test No. ____________ No. of Runs 2

Name of Firm American Beryllium Company

Location of Plant Sarasota, Florida

Type of Plant Beryllium Machining

Control Equipment Baghouse

Sampling Point Location South Stack

Pollutants Sampled Beryllium Dust

Run No.	S-1-MP	S-1-G	S-2-MP	S-2-G
Date	8/6/71	8/6/71	8/6/71	8/6/71
Time Began	0730	0725	1005	1014
Time End	0916	0911	1151	1200
Barometric Pressure, "Hg. Absolute	30.00	30.05	30.00	30.05
Meter Orifice Pressure Drop, "H_2O	0.400	0.410	2.402	2.380
Volume of Dry Gas Meter @ Meter Cond., ft^3	37.755	37.153	93.340	89.031
Ave. Meter Temp., ^oF	76.3	73.9	91.0	89.0
Volume of Gas Sampled @ Stack Cond., ft^3	42.28	41.73	101.89	97.00
Volume of H_2O Collected in Impingers & Silica Gel, ml[2]	2.8	1.6	8.0	2.0
Volume of Water Vapor Collected & Stack Cond., ft^3	0.15	0.09	0.43	0.11
Stack Gas Moisture, % Volume	0.35	0.20	0.42	0.11
Mole Fraction of Dry Stack Gas	0.9965	0.9980	0.9958	0.9989

Run No.		(same)		
Molecular Weight of Stack Gas, @ Stack Cond.	28.93	28.95	28.92	28.96
Molecular Weight of Stack Gas, Dry	28.97	28.97	28.97	28.97
Stack Gas Sp. Gravity, Ref. to Air	1.00	1.00	1.00	1.00
Ave. Sq. Root of Velocity Head, "H_2O	0.390	0.372	0.377	0.380
Ave. Stack Gas Temp., ^oF	139.0	138.0	142.5	140.0
Pitot Corr. Factor	0.85	0.85	0.85	0.85
Stack Pressure, "Hg Absolute	30.0	30.0	30.0	30.0
Stack Gas Velocity @ Stack Cond., fpm	1412	1345	1369	1377
Stack Area, ft^2	0.78	0.78	0.78	0.78
Stack Gas Flow Rate @ Stack Cond., cfm	1097	1053	1030	1044
Net Time of Test, min.	96	96	96	96
Sampling Nozzle Diameter, in.	0.250	0.250	0.375	0.375
Percent Isokinetic	91.8	95.1	101.4	96.0
Beryllium Catch, Probe, μg	2.35	12.5	1.65	39.2
Beryllium Catch, Filter, μg	0.35	1.25	0.35	2.60
Beryllium Catch, Total, μg	5.35	21.30	5.00	45.00
Beryllium Concentration, Probe, Stack Cond., $\mu g/m^3$	1.96	10.58	0.57	14.27
Beryllium Concentration, Filter, Stack Cond., $\mu g/m^3$	0.29	1.06	0.12	0.95
Beryllium Concentration, Total, Stack Cond., $\mu g/m^3$	4.47	18.02	1.73	16.38

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 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.

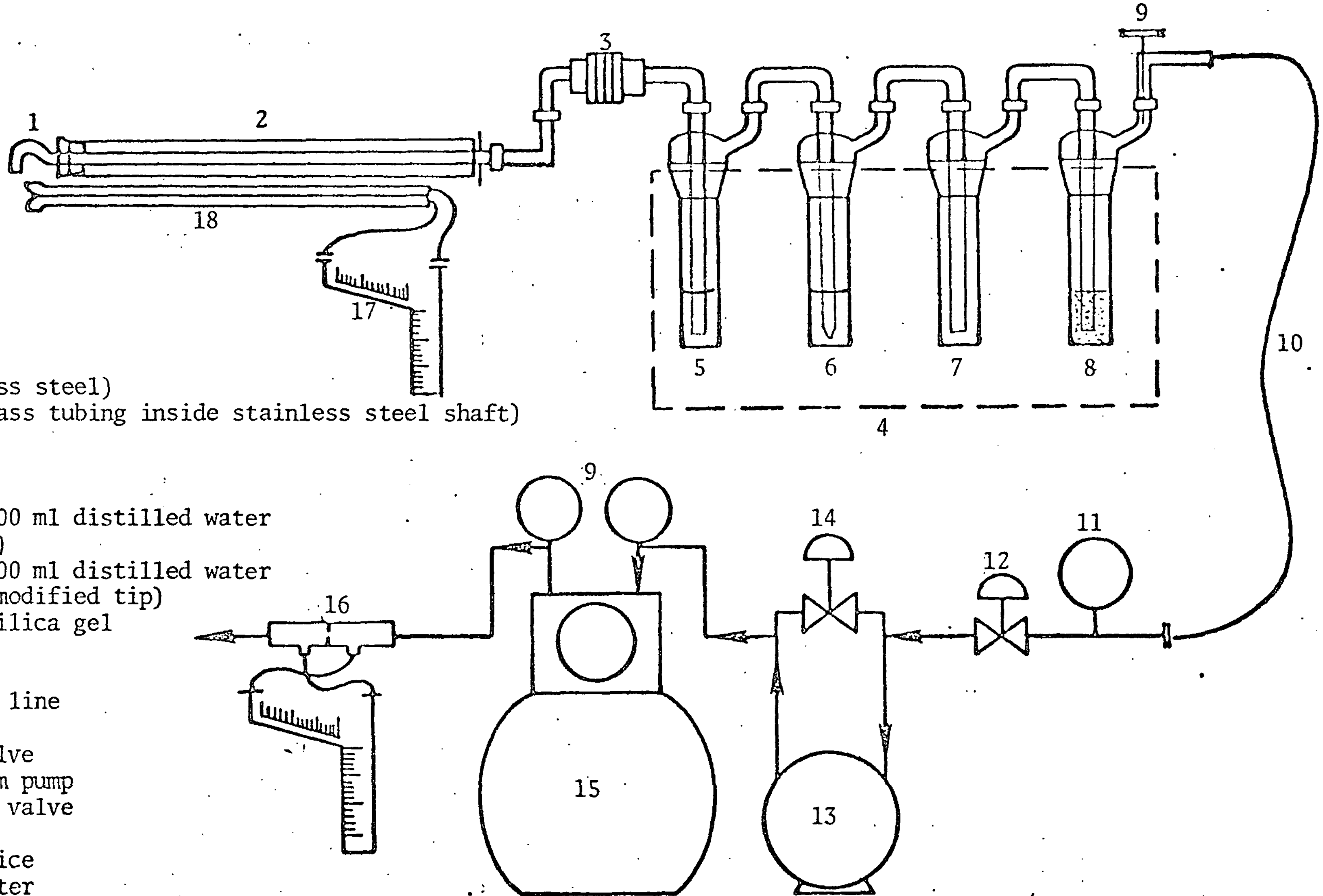
Velocity head measurements were determined across the stack diameter by using a calibrated S-type pitot tube with an inclined manometer.

The approximate moisture content of the stack gas was determined by the wet-bulb and dry-bulb thermometer technique.

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 according to Method 1.

The basis modification of the EPA particulate sampling train for beryllium sampling was the selection of filter media. Tests were performed with the Gelman Type A glass fiber filter and also with a type AA Millipore filter. A schematic diagram of the sampling train used is shown in Figure A-1.

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



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

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.

At the American Beryllium Company, two sampling trains were used simultaneously. One train contained only a glass fiber filter and the other contained a millipore filter backed up by a Gelman Type A glass fiber filter.

Each test run consisted of sampling for a specified time at each traverse point through either a vertical or a horizontal sampling position for the first half of the test run, and then switching to the other sampling position for the second half of the run. Duplicate samples were taken from all sources. In all cases, the train using a millipore filter was placed in the vertical position (port opening located at top of horizontal duct), starting with the sampling point nearest the bottom of the duct. The sampling train containing the glass fiber filter always started in the horizontal position at the traverse point nearest the port opening. After gases were withdrawn at the selected six points, the probes (still attached to their respective trains) were switched from vertical to horizontal positions and vice versa. Both trains were used simultaneously.

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.

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 (EXAMPLE)

Plant *American Beryllium Co.*, Stack *Middle North (Be-A-MN-1-MP)*, Date *8-4-71*

Bar. Press. *30.0* "Hg, Stack Press. *30.0* "Hg, Stack Dia. *18* in., Stack Area *1.77* ft^2

Ave. Stack Temp. *140* °F, Ave. Meter Temp. *82* °F, Ave. $\sqrt{h}$ *0.78* "H_2O, Nozzle Dia. *0.25* in.

C_p *0.85*, Meter Vol. *101.904* ft^3, Moisture plus Silica Gel *15.6* ml, Sample Time *120* min.

Orsat Analysis: CO_2 *—* %, O_2 *—* %, CO *—* %, N_2 *—* % Ave. Orifice ΔH *1.95* "H_2O

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) $V_{wv} = (0.0474) \times (\text{Moisture + Silica Gel})\text{ml}$ = *0.739* scf

2) $V_{stpd} = (17.71) \times (P_o + \frac{\overline{\Delta H}}{13.6}) \times (V_m) \times (\frac{1}{\overline{T}_m + 460})$ = *99.466* scf

3) $V_t = (V_{wv}) + (V_{stpd})$ = *100.205* scf

4) $W = \frac{V_{wv}}{V_t}$ = *0.0074*

5) $FDA = (1.0) - (W)$ = *0.9926*

6) $M_d = [(0.44)\times(\_\_\_\%CO_2)] + [(0.32)\times(\_\_\_\%O_2)] + [(0.28)\times(\_\_\_\%N_2 + \_\_\_\%CO)]$ = *28.97*

7) $M_s = [(M_d) \times (FDA)] + [(18) \times (W)]$ = *28.89*

8) $G_s = \frac{M_s}{28.99}$ = *1.0*

9) Excess Air, $EA = \dfrac{[(-\%O_2) - (\frac{-\%CO}{2})]}{[(0.266)\times(-\%N_2)] - [(-\%O_2) - (\frac{-\%CO}{2})]} \times 100$ = *—* %

10) $\bar{U} = (174) \times (C_p) \times (\sqrt{h}) \times (\sqrt{\frac{\bar{T}_s + 460}{G_s}}) \times (\sqrt{\frac{29.92}{P_s}})$ = *2823* fpm

11) $Q_s = (\bar{U}) \times (A_s)$ = *4986* cfm

12) $Q_d = (Q_s) \times (FDA)$ = *4949* cfm

13) $Q_{stpd} = (Q_d) \times (\frac{70 + 460}{T_s + 460})$ = *4383* cfm

14) $V_i = (\bar{U}) \times (A_n) \times (FDA) \times (\text{Time}) \times (\frac{70 + 460}{T_s + 460})$ = *101.186* scf

15) **Percent Isokinetic** $= \frac{(V_{stpd})}{(V_i)} \times 100$ = *98.3* %

16) Percent Isokinetic by the EPA Method $= \dfrac{(5.626) \times (T_s + 460) \times (V_m)}{(\bar{U}) \times (\text{Time}) \times (P_s) \times (FDA) \times (A_n)}$ = *97.6* %

17) $E_{stp} = \frac{(35.31) \times (Y)}{V_{stpd}}$ 18) $E_{12} = \frac{(12) \times (E_{stp})}{(CO_2\%)}$ 19) $E_{50} = \frac{(E_{stp}) \times (100 + EA\%)}{150}$

20) $E_m = (E_{stp}) \times (Q_{stpd}) \times (0.00857) \times (0.436 \times 10^{-6})$

	Particulate Lab Analysis (Y) μgm	Particulate Concentrations, μgm/m³ (E_{stp})	(E_{12})	(E_{50})	Emission Rate, lbs/hr (E_m)
Be-A-MN-1-MP-P	172.25	61.15	—	—	1001.6×10^{-6}
Be-A-MN-1-MP-F	82.80	29.39	—	—	481.4×10^{-6}
Be-A-MN-1-MP-IGB	87.95	31.22	—	—	511.4×10^{-6}
TOTAL	343.00	121.76	—	—	1994.4×10^{-6}

Subpart E—Standards of Perfo.m-ance 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 u.ed 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 .o 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.

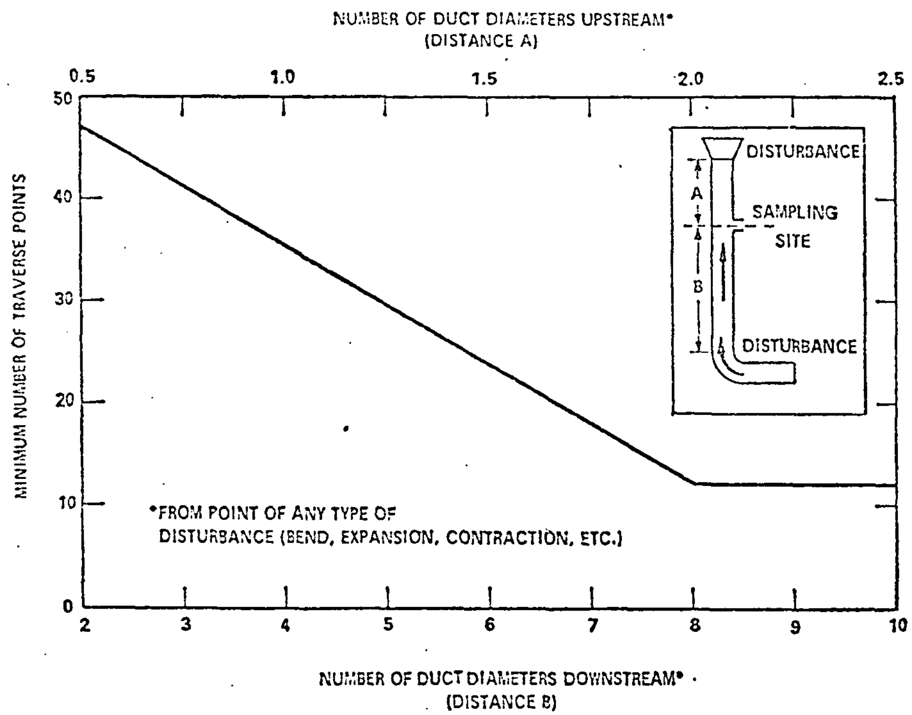


Figure 1-1. Minimum number of traverse points.

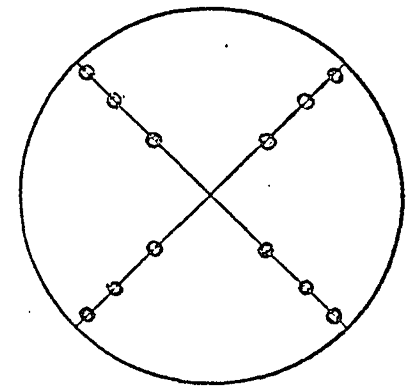


Figure 1-2. Cross section of circular stack showing location of traverse points on perpendicular diameters.

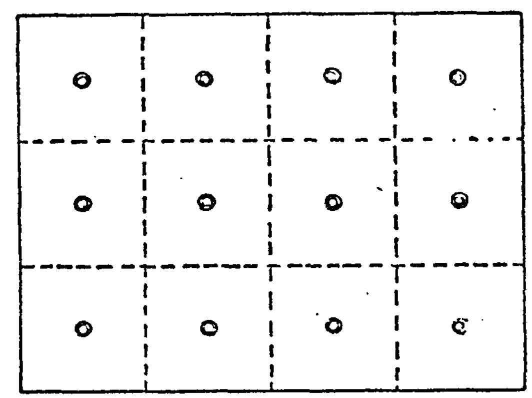


Figure 1-3. Cross section of rectangular stack divided into 12 equal areas, with traverse points at centroid of each area.

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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 (Stauschelbe 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.

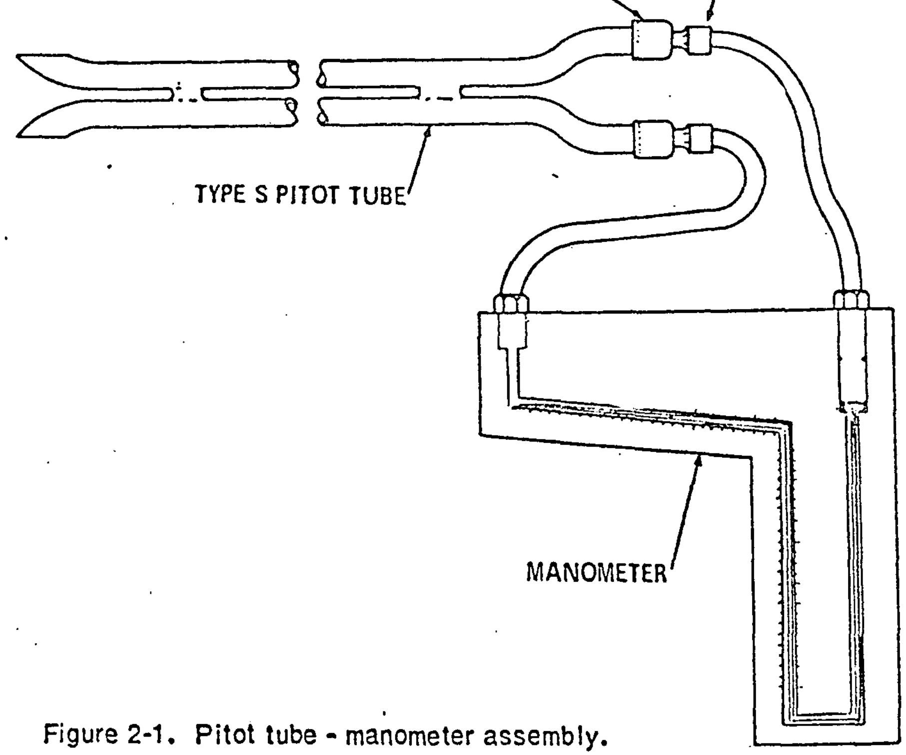


Figure 2-1. Pitot tube - manometer assembly.

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.

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

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 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.

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

where:

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

$K_p = 85.48 \frac{\text{ft.}}{\text{sec.}} \left(\frac{\text{lb.}}{\text{lb. mole} = {}^\circ\text{R}}\right)^{1/2}$ 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_2O (see fig. 2-2).
P_s = Absolute stack gas pressure, in Hg.
M_s = Molecular weight of stack gas, lb./lb.-mole.

PLANT__________

DATE__________

RUN NO.__________

STACK DIAMETER, in.__________

BAROMETRIC PRESSURE, in. Hg.__________

STATIC PRESSURE IN STACK (P_g), in. Hg.__________

OPERATORS__________

SCHEMATIC OF STACK CROSS SECTION

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta p}$	Stack Temperature (T_S), °F
	AVERAGE:		

Figure 2-2. Velocity traverse data.

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.

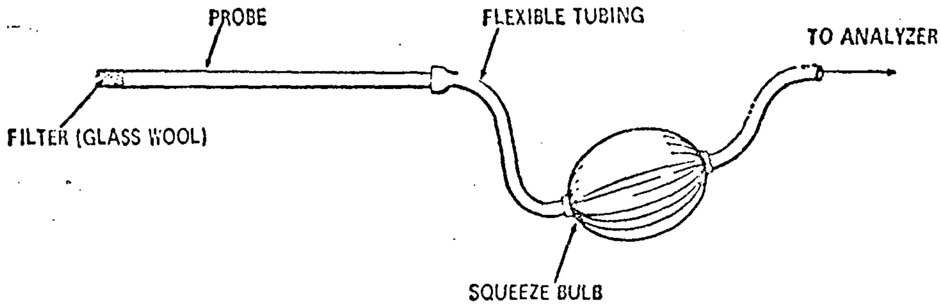


Figure 3-1. Grab-sampling train.

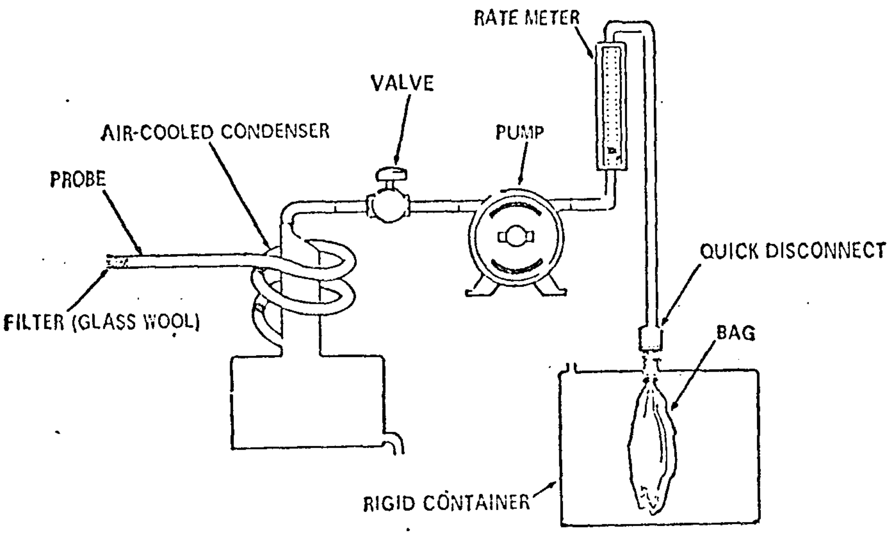


Figure 3-2. Integrated gas - sampling train.

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.

$$V_{wc} = \frac{(W_f - W_i) R T_{std}}{P_{std} M_w} = \left(0.0474 \frac{ft.^3}{g.}\right)(W_f - W_i)$$

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.

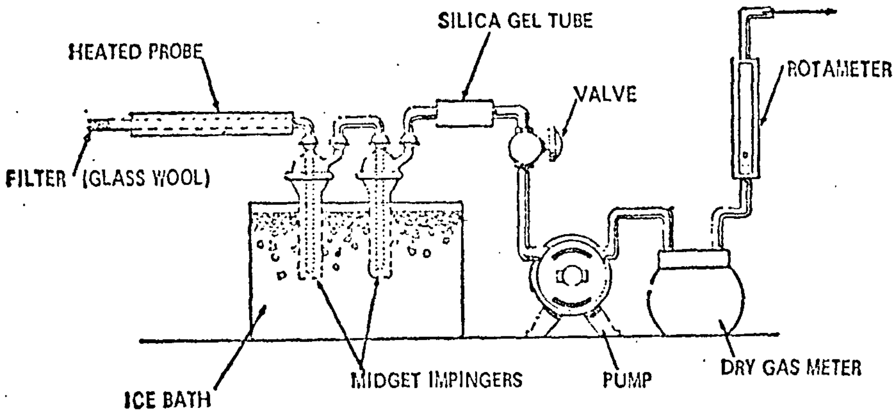


Figure 4-1. Moisture-sampling train.

LOCATION ______________________ COMMENTS

TEST ______________________

DATE ______________________

OPERATOR ______________________

BAROMETRIC PRESSURE ______________________

CLOCK TIME	GAS VOLUME THROUGH METER, (Vm), ft³	ROTAMETER SETTING, ft³/min	METER TEMPERATURE, °F

Figure 4-2. Field moisture determination.

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.

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

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.

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 replacing 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.

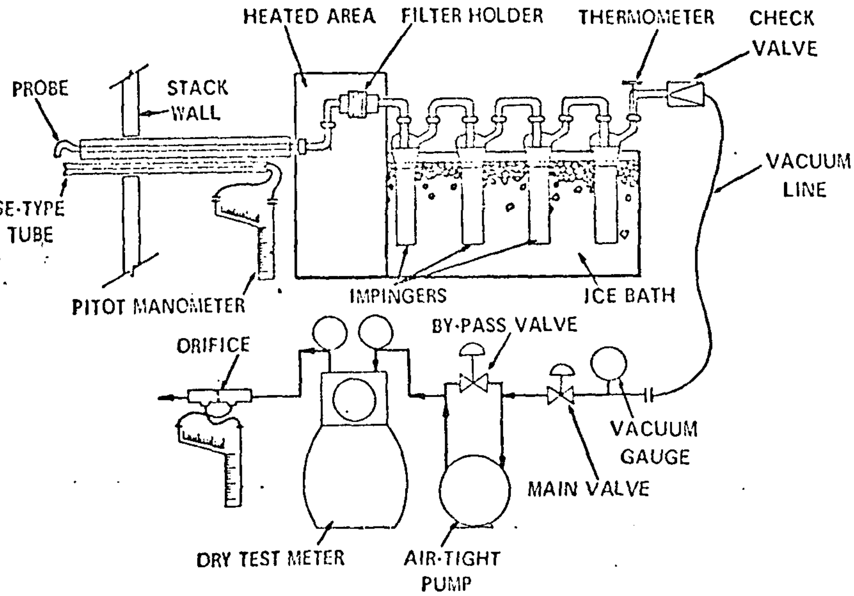


Figure 5-1. Particulate-sampling train.

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.

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.

[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 $\Delta H_@$ ____________
C FACTOR ____________

SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE ____________
BAROMETRIC PRESSURE ____________
ASSUMED MOISTURE, % ____________
HEATER BOX SETTING ____________
PROBE LENGTH, in. ____________
NOZZLE DIAMETER, in. ____________
PROBE HEATER SETTING ____________

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (P_S), in. Hg.	STACK TEMPERATURE (T_S), °F	VELOCITY HEAD (ΔP_S),	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH), in. H_2O	GAS SAMPLE VOLUME (Vm), ft^3	GAS SAMPLE TEMPERATURE AT DRY GAS METER: INLET (Tm_{in}), °F	OUTLET (Tm_{out}), °F	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °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, dessicate, 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	X	X	

*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):

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

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.

$$V_{m_{std}} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}+\frac{\Delta H}{13.6}}{P_{std}}\right) = \left(17.71\ \frac{°R}{\text{in. Hg}}\right)(V_m)\left(\frac{P_{bar}+\frac{\Delta H}{13.6}}{T_m}\right)$$

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.

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

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 sum of the weights on the analysis data sheet (Figure 5-3).

6.1.6 Concentration.

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

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:

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

where:

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

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.

$$c_s=\frac{M_s}{Q_s}=\frac{\frac{M_n}{\theta}\frac{A_s}{A_n}}{A_sV_{s_{std}}}=\left(2.57\times10^{-4}\frac{gr.-min.}{mg.-sec.}\right)\left(\frac{M_n}{\theta V_{s_{std}}A_n}\right)\qquad \text{equation 5-6}$$

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.

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.

$$I=\frac{c_s}{c_s'}\times100=\frac{T_s\left[\frac{V_{l_c}\rho_{H_2O}R}{M_{H_2O}}+\frac{V_m}{T_m}\left(P_{bar}+\frac{\Delta H}{13.6}\right)\right]}{\theta V_sP_sA_n}\times100=$$

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

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_{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.

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 H_2O.

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

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:

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

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.

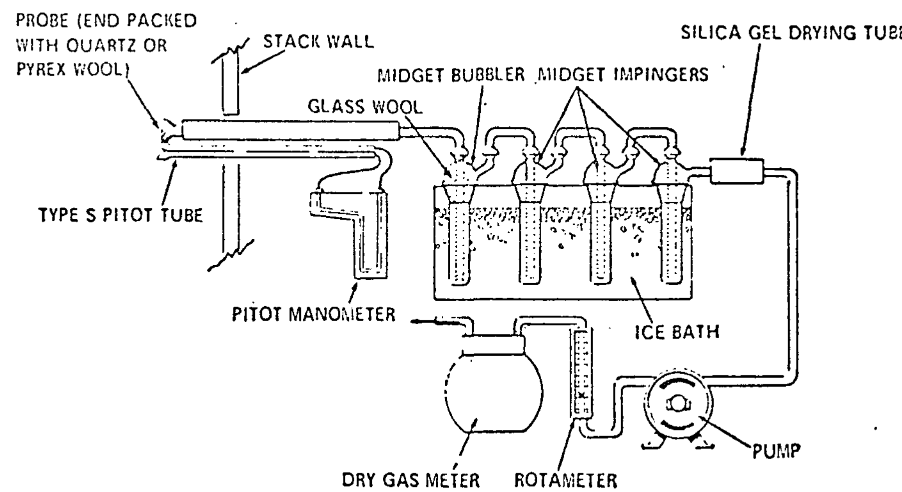


Figure 6-1. SO_2 sampling train.

RESULTS OF LABORATORY ANALYSES FOR BERYLLIUM

Sample No.	Code	μg Be	*Total μg Be	
1	Be-A-N-1-G-P	1.25		
2	Be-A-N-1-G-F	1.00	20.75	
3	Be-A-N-1-G-I	18.50		
4	Be-A-N-1-MP-P	32.10		**
5	Be-A-N-1-MP-F	1.40	73.60	
6	Be-A-N-1-MP-IGB	40.10		
7	Be-A-N-2-G-P	1.70		
8	Be-A-N-2-G-F	0.00	15.85	
9	Be-A-N-2-G-I	14.15		
10	Be-A-N-2-MP-P	1.65		**
11	Be-A-N-2-MP-F	0.00	11.20	
12	Be-A-N-2-MP-IGB	9.55		
13	Be-A-MN-1-G-P	457.2		
14	Be-A-MN-1-G-F	0.65	571.35	
15	Be-A-MN-1-G-I	113.50		
16	Be-A-MN-1-MP-P	172.25		**
17	Be-A-MN-1-MP-F	82.80	343.00	
18	Be-A-MN-1-MP-IGB	87.95		
19	Be-A-MN-2-G-P	528.3		
20	Be-A-MN-2-G-F	26.25	732.15	
21	Be-A-MN-2-G-I	177.6		
22	Be-A-MN-2-MP-P	321.7		**
23	Be-A-MN-2-MP-F	15.25	588.85	
24	Be-A-MN-2-MP-IGB	251.9		
25	Be-A-S-1-G-P	12.5		
26	Be-A-S-1-G-F	1.25	21.30	
27	Be-A-S-1-G-I	7.55		
28	Be-A-S-1-MP-P	2.35		**
29	Be-A-S-1-MP-F	0.35	5.35	
30	Be-A-S-1-MP-IGB	2.65		
31	Be-A-S-2-G-P	39.2		
32	Be-A-S-2-G-F	2.60	45.00	
33	Be-A-S-2-G-I	3.20		
34	Be-A-S-2-MP-P	1.65		**
35	Be-A-S-2-MP-F	0.35	5.00	
36	Be-A-S-2-MP-IGB	3.00		
67	Be-A-G-Blank	0.40		
68	Be-A-MP-Blank	0.00		
71	Be-A-MN-W-HiVol	637.5		
72	Be-A-S-W-HiVol	1.55		

* 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.

PROJECT PARTICIPANTS

NAME	TITLE
John Koogler, Ph.D., P.E.	Project Director
John Dollar, E.I.T., MS	Project Manager
Robert Durgan, Tech.	Environmental Specialist
George Allen, Tech.	Environmental Specialist

I= 107.4

SOURCE SAMPLING FIELD DATA SHEET

Plant: Am. Beryllium Co.

Sampling Location: Middle North Stack

Date: ______, Run No. 2

Time Start: [illegible], Time End: 1553

Sampling Time/Point: ______

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

Moisture ___ %, FDA ___, Gas Density Factor ______

Barometric Press. ___ "Hg, Stack Press. ___ "Hg

Weather: Cloudy

Temp. ___ °F, W/D ______, W/S ______

Sample Box No. ______, Meter Box No. EEI-2

Meter ΔH@ 1.60, Pitot Corr. Factor 0.85

Nozzle Dia. 0.25 in., Probe Length 6 ft

Probe Heater Setting —

Stack Dimensions: Inside Diameter 18 in

Inside Area 1.767 ft^2

Height ______ ft

Sketch Of Stack:

.193226 2502

WANG 107.0

Mat'l Processing Rate ______

Final Gas Meter Reading 294.561 ft^3

Initial Gas Meter Reading 188.700 ft^3

Total Condensate In Impingers 105 - 24 (61) ml

Moisture In Silica Gel 236.8 - 211.0 = 25.8 gm

Silica Gel Container No. 8, Filter No. 000079

Orsat:

CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By: ______

Remarks: Using Gelman Type "A" filter

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	~~Sample Box Temperature (°F)~~ Pump Vac	Last Impinger Temperature (°F)
Vert Port		1118	188.700								
Pt 1		1123	193.7	0.74	2.7	2.7	140	94	91	4.5	
1		1128	198.7	0.74	2.7	2.7	140	95	90	4.5	
2		1133	203.7	0.70	2.62	2.62	140	94	90	4.2	
2		1138	208.3	0.68	2.5	2.5	140	94	90	4.2	
3		1143	213.3	0.62	2.3	2.3	140	94	90	4.0	
3		1148	217.7	0.61	2.3	2.3	140	94	90	4.0	Broke for lunch
4		1322	222.3	0.50	1.85	1.85	140	94	92	5.0	
4		1327		0.50	1.85	1.85	140	95	92	5.0	

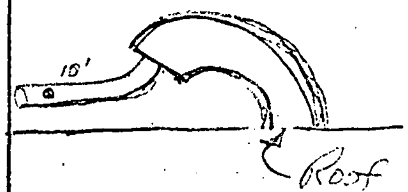
Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	~~Sample Box Temperature (°F)~~ Pump Vac	Last Impinger Temperature (°F)
Vert Port											
Pt. 5		1332	231.	0.40	1.5	1.5	140	95	92	3.8	
5		1337	234.2	0.40	1.5	1.5	140	95	92	3.9	
6		1342	238.2	0.42	1.6	1.6	140	95	96	4.2	
6		1347	242.3	0.43	1.63	1.63	140	94	96	4.2	
Horiz 1		1408	— *	0.35	1.30	1.30	140	92	90	3.5	
Port 1		1413	249.9	0.45	1.7	1.7	140	90	90	4.0	
2		1418	—	0.59	2.15	2.15	140	89	89	5.0	
2		1423	—	0.60	2.25	2.25	140	88	89	5.2	
3		1428	263.7	0.58	2.15	2.15	140	88	89	5.0	
3		1433	—	0.59	2.2	2.2	140	88	88	5.2	
4		1438	273.0	0.55	2.1	2.1	140	88	88	5.0	
4		1443	277.4	0.55	2.1	2.1	140	87	87	5.0	
5		1448	281.8	0.50	1.82	1.82	140	87	87	4.5	
5		1453	286.0	0.51	1.88	1.88	140	87	87	4.5	
6		1458	290.3	0.51	1.88	1.88	140	87	87	4.5	
6	60	1503	294.561	0.51	1.88	1.88	140	87	87	4.5	
			188.700								
			105.861								

SOURCE SAMPLING FIELD DATA SHEET

lant American Berellium Co., Sarasota, Fla.
ampling Location Middle North Stack
ate 8-4-71, Run No. 1
ime Start 0810, Time End
ampling Time/Point 10 min. (Total = 120 min)
B 140 °F, WB 87 °F, DP 72 °F, VF @ DP 0.79 "Hg
oisture 2.6%, FDA 0.974, Gas Density Factor
arometric Press. 30.05 "Hg, Stack Press. 30.05 "Hg
eather Cloudy
emp. 80's °F, W/D, W/S
ample Box No. —, Meter Box No. EET-2
eter ΔH@ 1.60, Pitot Corr. Factor 0.85
ozzle Dia. 0.25 in., Probe Length 6 ft
robe Heater Setting —
tack Dimensions: Inside Diameter 18 in
Inside Area 1.767 ft^2
Height Horiz Length Of 10 ft

Sketch Of Stack:

Ts avg = 600
avg $\sqrt{\Delta P (Ts + 460)}$ = 18.08096137
VM = 99.86662204
% H_2O = .02312602



MW =

As = 254.4696

Mat'l Processing Rate
Final Gas Meter Reading 188.592 ft^3
Initial Gas Meter Reading 087.000 ft^3
Total Condensate In Impingers 101.592 ml
Moisture In Silica Gel 309.9 - 301.4 = 8.5 gm
Silica Gel Container No. 2, Filter No. 102

Orsat:

CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By:

Remarks: Using Gelman Type "A" filter

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	~~Sample Box Temperature (°F)~~ Pump Vac	Last Impinger Temperature (°F)
Horiz Port		0810	087.000								
Pt. 1	3/4 in	0820	095.00	0.55	2.05	2.05	140	78	76	2.5 "Hg	
2	2 5/8	0830	103.6	0.63	2.35	2.35	140	79	76	2.5	
3	5 3/8	0840	113.1	0.77	2.8	2.80	140	81	76	2.8	
4	12 5/8	0850	122.6	0.78	2.85	2.85	140	84	78	3.5	
5	15 3/8	0900	130.5	0.54	2.00	2.00	140	84	78	3.4	
6	17 1/4		139.4	0.53	1.95	1.95	140	85	80	3.4	
				4.7588							

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	~~Sample Box Temperature (°F)~~ Pump Vac	Last Impinger Temperature (°F)
Vert Pt		0937	139.4								
Pt 1		0942	—	0.68	2.60	2.60	140	86	81	4.8	
1		0947	151.2	0.68	2.60	2.60	140	88	81	4.8	
2		0952	153.5	0.62	2.35	2.35	140	90	82	6.0	
2		0957	158.4	0.62	2.35	2.35	140	90	82	6.0	
3		1002	162.7	0.58	2.15	2.15	140	92	83	5.5	
3		1007	166.7	0.42	1.70	1.70	140	93	84	7.0	
4		1012	170.6	0.36	1.30	1.30	140	94	85	5.3	
4		1017	174.2	0.40	1.45	1.45	140	94	84	5.8	
5		1022	177.9	0.35	1.35	1.35	140	94	85	5.7	
5		1027	181.5	0.36	1.35	1.35	140	95	86	5.7	
6		1032	185.1	0.32	1.20	1.20	140	95	86	5.0	
6		1037	188.592	0.33	1.23	1.23	140	96	87	5.1	
						35.63					

SOURCE SAMPLING FIELD DATA SHEET

Plant: Am. Beryllium Corp.
Sampling Location: South Stack
Date: 8-6-71, Run No. 1
Time Start: 0725, Time End: ____
Sampling Time/Point: 8 min (96 min total)
DB 138 °F, WB 83 °F, DP 60 °F, VF @ DP 0.52 "Hg
Moisture 1.75%, FDA ____, Gas Density Factor ____
Barometric Press. 30.05 (R. Edw. Jun 12, 1971) "Hg, Stack Press. ____ "Hg
Weather ____
Temp. ____ °F, W/D ____, W/S ____
Sample Box No. ____, Meter Box No. ____
Meter ΔH@ 1.60, Pitot Corr. Factor 0.85
Nozzle Dia. 0.25 in., Probe Length ____ ft
Probe Heater Setting —
Stack Dimensions: Inside Diameter 12 in
Inside Area 0.785 ft²
Height Horiz Stack ft

Sketch Of Stack:

Ts avg = 598
$C\sqrt{\Delta P(Ts+460)}$ avg = 9.13149695
$V_{m\,std}$ = 37.05019585
% H_2O = .20427713
MW = 28.97752951
V_s = 1349.816473
Q = 941.6476895
I = 94.42800832

Mat'l Processing Rate ____
Final Gas Meter Reading 480.753 ft³
Initial Gas Meter Reading 443.600 ft³
Total Condensate In Impingers – 20 ml
Moisture In Silica Gel 240.1 – 218.5 = 21.6 gm
Silica Gel Container No. 16, Filter No. 00097

Orsat: CO_2, O_2, CO, N_2, Excess Air

CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By: J. Dollar

Remarks: Impingers were connected as follows: #4 – #3 – #2 – #1 This was corrected.

Gelman Filter

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temperature (°F) Pump Vac	Last Impinger Temperature (°F)
Vert. Port		0725	443.600								
Pt. 1		0729	—	0.13	0.44	0.44	138	72	71	3.5	
1		0733	446.8	0.13	0.44	0.44	138	72	71	3.5	
2		0737	448.4	0.13	0.48	0.44	138	72	71	3.5	
2		0741	450.2	0.14	0.48	0.48	138	72	71	3.0	
3		0745	451.8	0.15	0.50	0.50	138	72	71	3.0	
3		0749	453.6	0.15	0.50	0.50	138	72	71	3.0	
4		0753	455.1	0.15	0.50	0.50	138	72	71	3.0	
4		0757	457.1	0.14	0.48	0.48	138	73	71	3.0	

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temperature (°F) Pump Vac	Last Impinger Temperature (°F)
Vert Port			457.1								
Pt 5		0801	458.8	0.15	0.50	0.50	138	73	71	3.0	
5		0805	460.5	0.15	0.50	0.50	138	73	71	3.0	
6		0809	—	0.15	0.50	0.50	138	73	71	3.0	
6		0814	464.0	0.15	0.50	0.50	138	73	71	3.0	
Horiz Port		0835	464.0								
Pt 1		0840	465.4	0.12	0.30	0.30	138	75	73	9.0	
1		0844	466.8	0.12	0.30	0.30	138	75	73	9.0	
2		0848	468.1	0.14	0.35	0.35	138	75	73	9.0	
2		0852	469.5	0.14	0.35	0.35	138	75	73	9.0	
3		0856	470.9	0.14	0.35	0.35	138	75	73	9.0	
3		0900	472.4	0.14	0.35	0.35	138	76	73	9.0	
4		0904	474.1	0.13	0.32	0.32	138	78	75	8.0	
4		0908	475.5	0.14	0.35	0.35	138	79	76	9.0	
5		0912	—	0.14	0.35	0.35	138	80	76	9.0	
5		0916	—	0.14	0.35	0.35	138	80	76	9.0	
6		0920	479.3	0.14	0.35	0.35	138	81	77	9.0	
6		0924	480.753	0.14	0.35	0.35	138	82	77	9.0	
			443.600								
			37.153								

SOURCE SAMPLING FIELD DATA SHEET

lant ____________________

ampling Location South Stack

ate 8-6-71, Run No. 2

ime Start 1014, Time End ______

ampling Time/Point 8 min (96 min total)

B ____ °F, WB ____ °F, DP ____ °F, VF @ DP ______ "Hg

loisture ____ %, FDA ____, Gas Density Factor ______

Barometric Press. 30.05 "Hg, Stack Press. ______ "Hg

Weather ____________________

Temp. ______ °F, W/D ______, W/S ______

Sample Box No. ______, Meter Box No. ______

Meter ΔH@ 1.6, Pitot Corr. Factor 0.85

Nozzle Dia. 0.375 in., Probe Length ______ ft

Probe Heater Setting ______

Stack Dimensions: Inside Diameter 12 in

Inside Area 0.785 ft² — 113.0976 in²

Height ______ ft

Sketch Of Stack:

Ts avg. = 600.5

$\Sigma\sqrt{\Delta P(Ts+460)}$ avg. = 9.354025089

Vmstd = 86.81059022

%H₂O = .10908414

MW = 28.98800074

Vs = 1382.460809

Q = 961.3217945

I = 96.32092011

Mat'l Processing Rate ______

Final Gas Meter Reading 570.744 ft³

Initial Gas Meter Reading 481.713 ft³

Total Condensate In Impingers 89-0 36 ml

Moisture In Silica Gel 251.3 - 213.3 = 38.0 gm

Silica Gel Container No. 6, Filter No. 000138

Orsat:

CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By: J. Dollar (Operator)

Remarks: Gelman Filter

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	~~Sample Box Temperature (°F)~~ Pump Vac	Last Impinger Temperature (°F)
Horiz		1014	481.713								
Pt. 1		1018	485.2	0.13	2.10	2.10	138	84	82	6.2	
1		1022	488.5	0.11	1.80	1.80	138	89	82	5.2	
2		1026	492.0	0.14	2.30	2.30	138	90	84	6.5	
2		1030	495.6	0.14	2.30	2.30	138	90	84	6.5	
3		1034	499.1	0.14	2.30	2.30	138	90	85	6.5	
3		1038	502.6	0.13	2.10	2.10	138	89	86	6.0	
4		1042	506.0	0.13	2.10	2.10	138	88	86	6.0	
4		1046	509.6	0.13	2.10	2.10	138	86	86	6.0	

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	~~Sample Box Temperature (°F)~~ Pump Vac.	Last Impinger Temperature (°F)
Horiz		1046	509.6								
Pt 5		1050	513.1	0.13	2.10	2.10	138	86	86	6.0	
5		1054	516.6	0.14	2.30	2.30	138	86	85	6.5	
6		1058	520.2	0.14	2.30	2.30	138	88	85	6.5	
6		1102	524.986	0.14	2.30	2.30	138	89	84	6.5	
Vert Port.		1112	524.986								
Pt. 1		1116	527.7	0.13	2.10	2.10	143	89	86	6.2	
1		1120	531.	0.14	2.30	2.30	143	92	86	6.8	
2		1124	535.2	0.15	2.45	2.45	143	94	86	7.0	
2		1128	539.0	0.15	2.45	2.45	143	94	86	7.0	
3		1132	→	0.15	2.45	2.45	143	95	87	7.0	
3		1136	—	0.16	2.62	2.62	143	95	87	7.0	
4		1140	550.8	0.18	2.90	2.90	143	95	88	8.5	
4		1144	554.8	0.18	2.90	2.90	143	95	88	8.5	
5		1148	558.9	0.18	2.90	2.90	143	96	88	8.5	
5		1152	563.1	0.18	2.90	2.90	143	97	88	8.5	
6		1156	566.9	0.16	2.62	2.62	143	98	89	7.0	
6		1200	570.744	0.15	2.45	2.45	143	98	89	7.0	

I[redacted]

SOURCE SAMPLING FIELD DATA SHEET

lant American Beryllium Corp. Sarasota, Fla.

ampling Location South Stack

ate Aug. 6, 1971, Run No. 1

ime Start 07:30 (08:30), Time End 08:18 (09:18)

ampling Time/Point 12 points @ 8 min 96 min total

B 140°F, WB —°F, DP —°F, VP @ DP — "Hg

oisture* 1.0%, FDA —, Gas Density Factor —

arometric Press. 30"Hg, Stack Press. 30"Hg

eather Cloudy-HoT

emp. 80'D°F, W/D —, W/S —

ample Box No. #5, Meter Box No. #5

eter ΔH@ 1.72, Pitot Corr. Factor 0.85

ozzle Dia. 1/4 in., Probe Length 8 ft

robe Heater Setting —

Stack Dimensions: Inside Diameter 12 in

Inside Area 0.7854 ft^2

Height Horiz-Length 10 ft

*= assumed moisture

Sketch Of Stack:

12

Mat'l Processing Rate

Final Gas Meter Reading 042.060 ft^3

Initial Gas Meter Reading 004.305 ft^3

Total Condensate In Impingers — 16 ml

Moisture In Silica Gel 249.2 - 230.4 = 18.8 gm

Silica Gel Container No. 17, Filter No. 000106

Orsat:

CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By: R. Durgan, G. Allen, J. Dollar

Remarks: Millipore Filter

Filter # 106

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Out	Sample Box Temperature (°F) Pump Vac	Last Impinger Temperature (°F)
Port #2	INITIAL	07:30	004.305	0.13	0.32	0.32	138	71	72	1.8	—
1	1/2	07:34	005.9	0.13	0.32	0.32	138	71	72	1.8	—
		07:38	007.3	0.13	0.32	0.32	138	71	72	1.8	—
2	1 3/4	07:42	008.6	0.16	0.40	0.40	138	71	72	1.8	—
		07:46	010.1	0.15	0.38	0.38	138	71	72	1.8	—
3	3 1/2	07:50	011.7	0.15	0.38	0.38	138	71	72	2.0	—
		07:54	013.2	0.15	0.38	0.38	138	71	72	2.0	—
4	8 1/2	07:58	014.8	0.16	0.40	0.40	138	72	72	2.0	—
		08:02	016.4	0.16	0.40	0.40	138	72	72	2.0	—

ABC Kiln #1 Continued 8-6-11

ort And raverse oint No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Out	Sample Box Temperature (°F) Pump Vac	Last Impinger Temperature (°F)
5	10 1/4	08:06	018.0	0.16	0.40	0.40	138	73	72	2.0	—
		08:10	019.6	0.16	0.40	0.40	138	73	72	2.0	—
6	11 1/2	08:14	021.1	0.15	0.38	0.38	138	73	72	2.0	—
		08:18	022.641	/////	0.47	0.47	138	73	72	2.0	—
Port #1											
		08:30	022.641	//////	0.40						—
6	11 1/2	08:34	024.3	0.15	0.40	0.40	140	75	74	2.0	—
		08:38	025.7	0.14	0.37	0.37	140	75	74	2.0	—
5	10 1/4	08:42	027.4	0.15	0.40	0.40	140	77	75	2.0	—
		08:46	029.0	0.15	0.40	0.40	140	78	76	2.0	—
4	8 1/2	08:50	030.6	0.15	0.40	0.40	140	79	77	2.0	—
		08:54	032.7	0.15	0.40	0.40	140	80	78	2.0	—
3	3 1/2	08:58	034.2	0.16	0.43	0.43	140	81	79	2.0	—
		09:02	035.8	0.16	0.43	0.43	140	82	80	2.0	—
2	1 3/4	09:06	037.4	0.16	0.43	0.43	140	83	80	2.0	—
		09:10	038.8	0.15	0.40	0.40	140	84	81	2.0	—
1	1/2	09:14	040.4	0.15	0.40	0.40	140	84	81	2.0	—
		09:18	042.060	0.15	0.40	0.40	140	85	81	2.0	—

[redacted] 2 [redacted] .4 [redacted]

SOURCE SAMPLING FIELD DATA SHEET

Sarasota, Fla.

lant American Beryllium Corp
ampling Location SOUTH STACK
ate Aug. 6, 1971, Run No. 2
ime Start ~~11:05~~ 10:05, Time End ~~11:53~~ 10:53
ampling Time/Point 12 points @ 8 min = 96 min total
B 140 °F, WB — °F, DP — °F, VF @ DP — "Hg
oisture* 1.0 %, FDA —, Gas Density Factor —
arometric Press. 30 "Hg, Stack Press. 30 "Hg
eather Cloudy-Hot
emp. 80's °F, W/D —, W/S —
ample Box No. #5, Meter Box No. #5
eter ΔHg 1.72, Pitot Corr. Factor 0.85
Nozzle Dia. 3/8 in., Probe Length 8 ft
Probe Heater Setting —
Stack Dimensions: Inside Diameter 12 in
Inside Area 0.7854 ft^2
Height Horiz-length 10 ft

Sketch Of Stack:

Mat'l Processing Rate
Final Gas Meter Reading 135.400 ft^3
Initial Gas Meter Reading 042.060 ft^3
Total Condensate In Impingers —42 ml
Moisture In Silica Gel 330.1 − 280.1 = 50.0 gm
Silica Gel Container No. 3, Filter No. 000066

Orsat:				
CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By: R. Durgan, G. Allen, J. Dellar

Remarks: Millipore Filters
Filter # 66

* = assumed moisture

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temperature (°F) Pump Vac	Last Impinger Temperature (°F)
Port #1	INITIAL	10:05	042.060	0.15	2.65	2.65	142	86	86	5.2	—
6	11 1/2	10:09	047.5	0.15	2.65	2.65	142	86	86	5.2	—
		10:13	050.6	0.14	2.40	2.40	142	87	86	4.8	—
5	10 1/4	10:17	053.9	0.13	2.25	2.25	142	88	87	4.5	—
		10:21	057.5	0.13	2.25	2.25	142	88	88	4.5	—
4	8 1/2	10:25	060.9	0.13	2.25	2.25	142	88	88	4.5	—
		10:29	064.5	0.14	2.40	2.40	142	88	88	4.5	—
3	3 1/2	10:33	068.5	0.14	2.40	2.40	142	87	87	4.5	—
		10:37	072.5	0.15	2.65	2.65	142	87	87	4.5	—

ABC [redacted] Run #2 [redacted] Continued [redacted] 8-6-71 [redacted]

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press.Diff. ("H_2O) Calc.	Meter Orifice Press.Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temperature (°F) Pump Vac	Last Impinger Temperature (°F)
2	1 3/4	10:41	076.2	0.14	2.40	2.40	142	88	88	4.5	
		10:45	080.0	0.14	2.40	2.40	142	88	88	4.5	
1	1/2	10:49	084.7	0.15	2.65	2.65	142	88	88	4.5	
		10:53	088.200	0.14	2.40	2.40	142	89	88	4.5	
Port #2											
		11:05	088.200	0.13	2.25						
1	1/2	11:09	091.7	0.13	2.25	2.25	142	90	89	4.8	
		11:13	094.6	0.12	2.00	2.00	142	91	89	4.5	
2	1 3/4	11:17	098.2	0.12	2.00	2.00	142	92	90	4.5	
		11:21	102.4	0.14	2.40	2.40	142	93	90	5.0	
3	3 1/2	11:25	107.0	0.14	2.40	2.40	143	94	90	5.0	
		11:29	110.4	0.16	2.80	2.80	143	95	91	5.8	
4	8 1/2	11:33	114.6	0.15	2.65	2.65	143	95	91	5.5	
		11:37	118.7	0.16	2.80	2.80	143	96	91	5.8	
5	10 1/4	11:41	123.0	0.16	2.80	2.80	143	96	91	5.8	
		11:45	126.7	0.15	2.65	2.65	143	97	92	5.5	
6	11 1/2	11:49	131.2	0.16	2.80	2.80	143	97	92	5.8	
		11:53	135.400	0.16	2.80	2.80	143	98	92	5.8	

SOURCE SAMPLING FIELD DATA SHEET

lant AM Beryllium Co.
ampling Location North Stack
ate 8-5-71, Run No. 1
ime Start 0819, Time End ____
ampling Time/Point 10 min (120 min total)
B ___ °F, WB ___ °F, DP ___ °F, VF @ DP ___ "Hg
oisture ___ %, FDA ___, Gas Density Factor ___
arometric Press. ___ "Hg, Stack Press. ___ "Hg
eather ____
emp. ___ °F, W/D ___, W/S ___
ample Box No. ___, Meter Box No. ___
eter ΔH@ 1.6, Pitot Corr. Factor 0.85
ozzle Dia. 0.25 in., Probe Length ___ ft
robe Heater Setting ___
tack Dimensions: Inside Diameter 12 in
Inside Area 0.785 ft^2
Height ___ ft

Sketch Of Stack:

.2041871778

WANG 103.1

Mat'l Processing Rate ____
Final Gas Meter Reading 389.680 ft^3
Initial Gas Meter Reading 294.600 ft^3
Total Condensate In Impingers 95 - 80 = 22 ml
Moisture In Silica Gel 234.5 - 210.0 = 24.5 gm
Silica Gel Container No. F, Filter No. 000111

Orsat:

CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By: ____

Remarks: Gelman Filter

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	~~Sample Box Temperature (°F)~~ Pump Vac	Last Impinger Temperature (°F)
[illegible] Port		0819	294.600								
Pt 1		0824	—	0.50	1.60	1.60	145	78	77	4.0	
1		0829	—	0.45	1.50	1.50	145	79	76	3.5	
2		0834	306.7	0.57	1.90	1.90	145	79	76	4.0	
2		0839	310.9	0.60	1.94	1.94	145	79	76	4.2	
3		0844	315.2	0.63	2.00	2.00	145	79	76	4.3	
3		0849	319.2	0.45	1.50	1.50	145	80	76	3.2	
4		0854	323.1	0.48	1.60	1.60	145	81	77	3.7	
4		0859	326.9	0.45	1.50	1.50	145	81	77	3.2	

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O)		Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F)		~~Sample Box Temperature (°F)~~ Pump Vac	Last Impinger Temperature (°F)
					Calc.	Actual		In	Out		
Horiz Port			326.9								
Pt. 5		0904	330.9	0.46	1.55	1.55	145	82	77	3.6	
5		0909	334.8	0.45	1.50	1.50	145	82	78	3.3	
6		0914	338.6	0.47	1.55	1.55	145	82	78	3.5	
6		0919	342.5	0.44	1.45	1.45	145	82	78	3.2	
Vert Port		0937	342.5								
Pt. 1		0942	346.5	0.50	1.68	1.68	148	82	80	3.0	
1		0947	350.6	0.52	1.70	1.70	148	84	80	3.0	
2		0952	354.6	0.52	1.70	1.70	148	84	80	3.0	
2		0957	358.7	0.54	1.75	1.75	148	85	81	3.2	
3		1002	362.8	0.50	1.68	1.68	148	85	81	3.0	
3		1007	366.8	0.50	1.68	1.68	148	85	81	3.0	
4		1012	370.7	0.43	1.48	1.48	148	87	82	2.8	
4		1017	—	0.56	1.80	1.80	148	88	83	3.2	
5		1022	378.8	0.48	1.60	1.60	148	90	84	3.0	
5		1027	382.8	0.49	1.60	1.60	148	90	84	3.0	
6		1032	386.3	0.35	1.15	1.15	148	91	85	3.3	
6		1037	389.680	0.34	1.10	1.10	148	92	85	3.3	

I-[redacted]8.[redacted]

SOURCE SAMPLING FIELD DATA SHEET

Plant ________
Sampling Location *North Stack.*
Date ________, Run No. *2*
Time Start ________, Time End ________
Sampling Time/Point *6 min (72 min total)*
DB ___ °F, WB ___ °F, DP ___ °F, VP @ DP ___ "Hg
Moisture ___ %, FDA ___, Gas Density Factor ___
Barometric Press. ___ "Hg, Stack Press. ___ "Hg
Weather ________
Temp. ___ °F, W/D ___, W/S ___
Sample Box No. ___, Meter Box No. ___
Meter ΔH@ *1.60*, Pitot Corr. Factor *0.85*
Nozzle Dia. *0.25* in., Probe Length ___ ft
Probe Heater Setting ___
Stack Dimensions: Inside Diameter *12* in
Inside Area *0.785* ft^2
Height ___ ft

Sketch Of Stack:

Mat'l Processing Rate ________
Final Gas Meter Reading *443.440* ft^3
Initial Gas Meter Reading *391.472* ft^3
Total Condensate In Impingers *~14* ml
Moisture In Silica Gel *228.8 - 210.0 = 18.8* gm
Silica Gel Container No. *E*, Filter No. *00082*

Orsat:				
CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By: ________

Remarks: *Gelman Filter*

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	~~Sample Box Temperature~~ (°F) Pump Vac	Last Impinger Temperature (°F)
[illegible] Port		1123									
Pt. 1		1126	393.7	0.43	1.45	1.45	148	91	89	2.5	
1		1129	395.9	0.43	1.45	1.45	148	91	89	2.7	
2		1132	–	0.43	1.45	1.45	148	91	89	2.7	
2		1135		"	"	"	"	"	"	"	
3		1138		0.42	1.40						
3		1141									
4		1144		0.40	1.3						
4		1147									

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temperature (°F)	Last Impinger Temperature (°F)
Horiz Port											
pt 5		1150		0.43	1.45						
5		1153									
6		1156		0.42	1.40						
6		1159	418.280								
Vert		1300	418.280								
1		1306	422.7	0.43	1.45	1.45	152	90	88	3.5	
2		1312	427.1	0.39	1.30	1.30	152	94	88	3.2	
3		1318	431.1	0.33	1.10	1.10	152	95	88	3.0	
4		1324	435	0.35	1.20	1.20	152	97	89	3.0	
5		1330	439.1	0.34	1.15	1.15	152	98	89	3.0	
6		1336	443.440	0.44	1.45	1.45	152	98	90	3.5	

SOURCE SAMPLING FIELD DATA SHEET

I-[redacted]9.[redacted]

Plant: American Beryllium Corp. Sarasota, Fla.

Sampling Location: NORTH DUCT.

Date: Aug. 5, 1971, Run No. 1

Time Start: 08:15 / 09:45, Time End: 09:15 / 10:45

Sampling Time/Point: 12 points @ 10 min = 120 min total

145 °F, WB ___ °F, DP ___ °F, VP @ DP ___ "Hg

Moisture * 1.0 %, FDA ___, Gas Density Factor ___

Barometric Press. 30 "Hg, Stack Press. 30 "Hg

Weather: Cloudy & HOT

Temp. 80's °F, W/D ___, W/S ___

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

Meter ΔH@ 1.72, Pitot Corr. Factor 0.85

Nozzle Dia. 1/4 in., Probe Length 8 ft

Probe Heater Setting —

Stack Dimensions: Inside Diameter 12 in

Inside Area 0.7854 ft²

Height HORIZ — LENGTH 10 ft

Sketch Of Stack:

Mat'l Processing Rate ___

Final Gas Meter Reading 950.713 ft³

Initial Gas Meter Reading 860.690 ft³

Total Condensate In Impingers — 24 ml

Moisture In Silica Gel 237.0 − 210.0 = 27.0 gm

Silica Gel Container No. D, Filter No. 000083

Orsat:				
CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By: R. Duraan, G. Allen, J. Dollar

Remarks: millipore filter

* = assumed moisture

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temperature (°F) VAC. PUMP	Last Impinger Temperature (°F)
Port #1		08:15	860.690	/////	1.55	1.55	145	76	76	6	—
6	11 1/2	08:20	864.6	0.55	1.70	1.70	145	76	76	3.5	—
		08:25	869.0	0.57	1.75	1.75	145	76	76	3.4	—
5	10 1/4	08:30	872.7	0.53	1.65	1.65	145	77	76	3.4	—
		08:35	876.5	0.53	1.65	1.65	145	77	76	3.4	—
4	8 1/2	08:40	880.8	0.55	1.70	1.70	145	77	76	3.2	—
		08:45	884.8	0.55	1.70	1.70	145	78	77	3.2	—
3	3 1/2	08:50	888.2	0.40	1.25	1.25	145	79	77	2.5	—
		08:55	891.5	0.38	1.18	1.18	145	79	77	2.5	—

[redacted] [redacted] AAC[redacted] R[redacted] Cont[redacted]d

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Out	Sample Box Temperature (°F) VAC. Pump	Last Impinger Temperature (°F)
2	1 3/4	09:00	895.1	0.40	1.25	1.25	145	80	77	2.5	—
		09:05	898.5	0.38	1.18	1.18	145	81	78	2.5	—
1	1/2	09:10	902.1	0.42	1.30	1.30	145	81	78	2.5	—
		09:15	905.596	0.40	1.25	1.25	145	82	79	2.5	—
Port #2		09:45	905.596								—
1	1/2	09:50	909.0	0.38	1.18	1.18	148	81	81	2.5	—
		09:55	912.4	0.35	1.05	1.05	148	82	81	2.5	—
2	1 3/4	10:00	916.3	0.48	1.50	1.50	148	82	81	2.5	—
		10:05	920.0	0.48	1.50	1.50	148	83	81	2.5	—
3	3 1/2	10:10	924.0	0.53	1.65	1.65	148	83	81	2.5	—
		10:15	927.9	0.53	1.65	1.65	148	84	82	2.5	—
4	8 1/2	10:20	932.0	0.53	1.65	1.65	148	86	83	2.5	—
		10:25	935.7	0.52	1.60	1.60	148	88	83	2.5	—
5	10 1/4	10:30	939.2	0.52	1.60	1.60	148	88	83	3.0	—
		10:35	943.3	0.48	1.50	1.50	148	89	85	3.0	—
6	11 1/2	10:40	947.2	0.48	1.50	1.50	148	90	86	3.0	—
		10:45	950.713	0.42	1.30	1.30	148	91	86	2.8	—

I [redacted]

SOURCE SAMPLING FIELD DATA SHEET

ant American Beryllium Corp Sarasota, Fla.

mpling Location North Duct.

te Aug 5 1971, Run No. 2

me Start 11:20 (1:12), Time End 11:56 (1:48)

mpling Time/Point 12 points @ 6 min - 72 min

150°F, WB ___ °F, DP ___ °F, VF @ DP ___ "Hg

oisture * 1.0 %, FDA ___, Gas Density Factor ___

arometric Press. 30 "Hg, Stack Press. 30 "Hg

eather Cloudy - HOT RAIN!!!!!

emp. 80's °F, W/D ___, W/S ___

ample Box No. #5, Meter Box No. #5

eter ΔH@ 1.72, Pitot Corr. Factor 0.85

ozzle Dia. 1/4 in., Probe Length 8 ft

robe Heater Setting —

tack Dimensions: Inside Diameter 12 in

Inside Area 0.7854 ft²

Height Horiz - Length 10 ft

Sketch Of Stack:

Mat'l Processing Rate ___

Final Gas Meter Reading 1004.303 ft³

Initial Gas Meter Reading 950.713 ft³

Total Condensate In Impingers - 21 ml

Moisture In Silica Gel 232.7 - 210.0 = 22.7 gm

Silica Gel Container No. A, Filter No. 000113

Orsat: CO_2, O_2, CO, N_2, Excess Air

Test Conducted By: R. Duran, D. Allen, J. Dollar

Remarks: Millipore Filter

* = assumed moisture

Port And Traverse Point No.	Distance From End Of Port (in.)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Out	Sample Box Temperature (°F) VAC Pump	Last Impinger Temperature (°F)
Port #1		11:20	950.713	0.45	1.40						
6	11½	11:23	953.1	0.45	1.40	1.40	148	90	90	2.8	—
		11:26	955.8	0.53	1.65	1.65	148	90	90	3.0	—
5	10¼	11:29	957.7	0.53	1.65	1.65	148	90	89	3.0	—
		11:32	960.0	0.55	1.70	1.70	148	90	89	3.2	—
4	8½	11:35	962.7	0.50	1.55	1.55	148	90	89	2.8	—
		11:38	964.9	0.50	1.55	1.55	148	90	89	3.0	—
3	3½	11:41	—	0.43	1.35	1.35	148	90	89	3.0	—
		11:44	968.7	0.38	1.18	1.18	148	90	89	2.5	—

[redacted]

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temperature (°F) VAC	Last Impinger Temperature (°F)
2	1 3/4	11:47	971.3	0.38	1.18	1.18	148	90	89	2.5	RAIN
		11:50	973.8	0.38	1.18	1.18	148	90	89	2.5	
1	1/2	11:53	—	0.40	1.25	1.25	148	90	89	2.5	
		11:56	977.384	0.40	1.25	1.25	148	90	89	2.5	—
Port #2											—
		1:12	977.384	0.38							—
1	1/2	1:15	979.7	0.38	1.18	1.18	152	88	88	2.5	—
		1:18	981.5	0.35	1.05	1.05	152	88	88	2.2	—
2	1 3/4	1:21	983.3	0.43	1.35	1.35	152	89	88	2.5	—
		1:24	985.5	0.38	1.18	1.18	152	90	88	2.5	—
3	3 1/2	1:27	987.6	0.43	1.35	1.35	152	90	88	2.5	—
		1:30	989.7	0.43	1.35	1.35	152	91	89	2.5	—
4	8 1/2	1:33	992.0	0.50	1.55	1.55	152	91	89	2.8	—
		1:36	994.4	0.53	1.65	1.65	152	92	89	3.0	—
5	10 1/4	1:39	997.0	0.53	1.65	1.65	152	92	89	3.0	—
		1:42	999.4	0.53	1.65	1.65	152	92	89	3.0	—
6	11 1/2	1:45	1002.0	0.48	1.50	1.50	152	92	89	2.8	—
		1:48	1004.303	0.48	1.50	1.50	152	92	89	2.8	—

SOU[redacted] SA[redacted]ING [redacted]LD [redacted] S[redacted]

[redacted] I:[redacted]8.3[redacted]

nt American Beryllium Corp. Sarasota, Fla.

pling Location Middle-North Stack

e Aug 4, 1971, Run No. 1

e Start ~~08:15~~ 08:45, Time End ~~09:15~~ 10:45

pling Time/Point 12 points/10 MIN (120 min total)

'40 °F, WB 87 °F, DP 72 °F, VP @ DP 0.79 "Hg

sture 2.6%, FDA 0.974, Gas Density Factor —

ometric Press. 30 "Hg, Stack Press. 30 "Hg

ther Cloudy - Hot

p. 80's °F, W/D —, W/S —

ple Box No. #5, Meter Box No. #5

er ΔH@ 1.72, Pitot Corr. Factor 0.85

zle Dia. 1/4 in., Probe Length 8 ft

obe Heater Setting —

ack Dimensions: Inside Diameter 18 in

Inside Area 1.767 ft²

Height Horizontal length 10 ft

Sketch Of Stack:

$T_{s\,avg} = .600$

$\sqrt{\Delta P}$ (Ts+460) avg = 19.2747069

$V_{m\,std} = 100.4339313$

$\%H_2O = .73086425$

$MW = 28.91960493$

$V_s = 2854.411336$

$Q = 4434.471798$

$I = .97.83851202$

$A_s = 254.4696$

Mat'l Processing Rate

Final Gas Meter Reading 759.063 ft³

Initial Gas Meter Reading 657.159 / 101.904 ft³

Total Condensate In Impingers —24 ml

Moisture In Silica Gel 315.5 - 274.9 = 39.6 gm

Silica Gel Container No. 1, Filter No. 000146

Orsat:

CO_2				
O_2				
CO				
N_2				
Excess Air				

Test Conducted By: R Duggan, G Allen, J. Collar

Remarks: FILTER #146 Millipore Millipore Filter

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. avg. ("H_2O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) avg. In	Out	Sample Box Temperature (°F) Pump VAC	Last Impinger Temperature (°F)
~~#1~~		~~08:15~~	~~657.159~~	~~0.75~~	~~2.40~~	~~2.40~~	~~140~~	~~75~~	~~76~~	5.5	
6	17 1/4	08:25	—	0.75	2.40	2.40	140	76	76.5	5.5	—
5	15 3/8	08:35	666.1	0.78	2.50	2.50	140	78	76.5	5.8	—
4	12 3/8	08:45	675.7	0.75	2.40	2.40	140	80	76.5	5.5	—
3	5 5/8	08:55	685.2	0.60	1.85	1.85	140	81.5	76.5	4.4	—
2	2 5/8	09:05	693.4	0.55	1.75	1.75	140	82.5	77	4.4	—
1	3/4	09:15	701.5	0.40	1.30	1.30	140	83	77	3.5	—
			709.016								
				[illegible]	[illegible]	19.4485	average $\sqrt{\Delta P}$ (Ts+460)				

[redacted] 8-4 [redacted]

[redacted] ABC [redacted] Mid. [redacted] Stack [redacted] Run [redacted] (Continued – Port #2)

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temperature (°F) Pump Vac	Last Impinger Temperature (°F)
Port #2		09:45	709.016								—
1	3/4	09:50	709.016	0.45	1.48	1.48	140	84	81	3.5	—
		09:55	712.6	0.43	1.42	1.42	140	85	80	3.5	—
2	2-5/8	10:00	716.4	0.57	1.80	1.80	140	86.5	80	4.2	—
		10:05	720.4	0.60	1.85	1.85	140	87.5	80	4.5	—
3	5-3/8	10:10	724.3	0.73	2.38	2.38	140	88.5	80	5.5	—
	17 1/4	10:15	729.9	0.70	2.25	2.25	140	89.5	80	5.2	—
4	12-7/8	10:20	734.0	0.57	1.80	1.80	140	91	80.5	4.5	—
		10:25	738.6	0.57	1.80	1.80	140	91	81	4.5	—
5	15-3/8	10:30	742.6	0.65	2.00	2.00	140	92	81.5	4.8	—
		10:35	747.5	0.65	2.00	2.00	140	92.5	82	4.8	—
6	17-1/4	10:40	751.3	0.60	1.85	1.85	140	93.5	82.5	4.5	—
		10:45	755.8	0.57	1.80	1.80	140	94	83	4.5	
			759.063		1.951			84.8			

I=97.4

SOURCE SAMPLING FIELD DATA SHEET

Plant: American Beryllium Corp — Sarasota, Fla

Sampling Location: Middle-North Stack

Date: Aug. 4, 1971, Run No. 2

Time Start: 11:20 / 1:25 / 2:05, Time End: 11:50 / 1:55 / 3:05

Sampling Time/Point: 12 points / 10 min (120 min total)

DB 140°F, WB 87°F, DP 72°F, VP @ DP 0.79 "Hg

Moisture 2.6 %, FDA 0.974, Gas Density Factor —

Barometric Press. 30 "Hg, Stack Press. 30 "Hg

Weather: Cloudy — Hot

Temp. 80°F, W/D —, W/S —

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

Meter ΔH@ 1.72, Pitot Corr. Factor 0.85

Nozzle Dia. 1/4 in., Probe Length 8 ft

Probe Heater Setting —

Stack Dimensions: Inside Diameter 18 in

Inside Area 1.767 ft²

Height: HORIZONTAL-LENGHT 10 ft

Sketch Of Stack:

Ts avg = 600

√ΔP(Ts+460) avg = 18.73485029

VmSTD = 98.68038928

%H2O = .11994062

MW = 28.98680653

Vs = 2771.24603

Q = 4331.765108

I = 98.40954618

As = 254.4696

Mat'l Processing Rate: ______

Final Gas Meter Reading: 860.690 ft³

Initial Gas Meter Reading: 759.063 ft³

Total Condensate In Impingers: 101 - 627 / 23 ml

Moisture In Silica Gel: 235.5 - 210.0 = 25.5 gm

Silica Gel Container No. C, Filter No. 000096

Orsat: CO_2, O_2, CO, N_2, Excess Air

Test Conducted By: R. Durgan, D. Allen, J. Dollar

Remarks: Filter # 96 Millipore
Millipore Filter

Port And Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft³)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Out	Sample Box Temperature (°F) PUMP VAC	Last Impinger Temperature (°F)
Port #2		11:20	759.063	0.48	1.58	1.58	140	91	88	4.5	
1	3/4	11:25	762.3	0.48	1.58	1.58	140	91	88	4.5	—
		11:30	767.3	0.60	1.85	1.85	140	92	88	3.6	—
2	2 5/8	11:35	771.4	0.57	1.80	1.80	140	92	88	3.6	—
		11:40	775.9	0.73	2.38	2.38	140	92	88	3.8	—
3	5 3/8	11:45	780.4	0.70	2.25	2.25	140	92	88	3.8	—
LUNCH		11:50	~~784.787~~	XXXXX	2.25	2.25	140	92	88	3.8	—
4	12 5/8	1:25	784.787								—
		1:30	788.8	0.60	1.83	1.85	140	91	91	3.4	—
		1:35	[illegible]	0.55	1.75	1.75	140	92	90	3.4	

[illegible] N. STACK Run #2 – Continued

Port & Traverse Point No.	Distance From End Of Port (in)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Meter Orifice Press. Diff. ("H_2O) Actual	Stack Gas Temperature (°F)	Gas Sample Temp. @ Dry Gas Meter (°F) In	Gas Sample Temp. @ Dry Gas Meter (°F) Out	Sample Box Temperature (°F) / Pump VAC	Last Impinger Temperature (°F)
5	15 3/8	1:40	797.0	0.55	1.75	1.75	140	92	90	3.4	—
		1:45	801.2	0.60	1.85	1.85	140	92	90	3.4	—
6	17 1/4	1:50	805.9	0.60	1.85	1.85	140	92	90	3.4	—
		1:55	809.810	0.60	1.85	1.85	140	92	90	3.4	—
Port #1											
		2:05	809.810	0.73	2.38	2.38	140	90	90	3.6	—
6	17 1/4	2:10	815.0	0.75	2.40	2.40	140	88.5	89.5	3.5	—
		2:15	—	0.73	2.38	2.38	140	87.5	89	3.6	—
5	15 3/8	2:20	824.5	0.67	2.10	2.10	140	87	89	3.5	—
		2:25	829.1								—
4	12 5/8	2:30	833.1	0.64	1.90	1.90	140	87	89	3.4	—
		2:35	837.0	0.64	1.90	1.90	140	87	89	3.4	—
3	5 3/8	2:40	841.4	0.50	1.62	1.62	140	87	89	2.9	—
		2:45	844.8	0.64	1.90	1.90	140	87	89	3.4	—
2	12 5/8	2:50	849.4	0.46	1.50	1.50	140	87.5	88.5	2.8	—
		2:55	852.8	0.46	1.50	1.50	140	87.5	88.5	2.8	—
1	3/4	3:00	856.0	0.43	1.42	1.42	140	87.5	88.5	2.6	—
		3:05	860.690	0.43	1.42	1.42	140	87.5	88.5	2.6	—
										18.735	—