Test No. 71-CI-25
Speedring Manufacturing, Inc.
Division of Schiller Industries, Inc.
Cullman, Alabama
October 25-26, 1971

Thomas E. Ward - Durham, N.C.
Project Test Officer
Environmental Protection Agency
Office of Air Programs
Stationary Source Pollution Control Programs
Applied Technology Division
Emission Testing Branch
Combustion and Incineration Section
Contract No. 68-02-0225
Task Order No. 3

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APPENDIX

I. INTRODUCTION

The objective of this test was to determine a test method for sampling beryllium emissions from metal machining operations. The test was conducted at Speedring Manufacturing, Incorporated, in Cullman, Alabama, on October 25-26, 1971.

This metal machining shop controlls their beryllium emissions using a "wet" baghouse. Standard cutting oil emulsions of various types, when used, are drawn into the vacuum inlets which are placed at the interface of the cutting tool and the machined piece; when they reach the bag, they "wet" the bag.

Figure 1 shows sampling points.

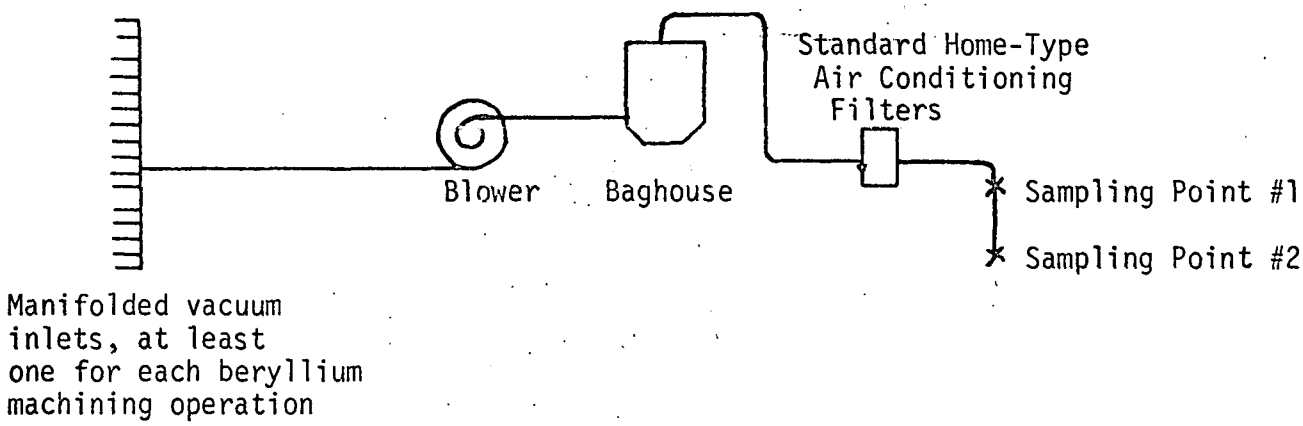


Figure 1

The memorandum from Robert Neligan to the Acting Director, Division of Compliance (see Appendix D) describes the test procedure and plan as of the October 7, 1971, date of that memorandum. On October 14, 1971, John Burkle, Project Engineer, instructed ETB to perform the test in two parts, the first part to consist of two days of testing, and the second part (based upon

acceptable results in the first two-day part) to consist of four days of testing. The updated test method is shown in Table I.

Mr. Burkle authorized at the test site the duration of gas sampling time to be five hours and to change the sample "bottling" and "packaging" procedure as shown in Table II. The stated reason for the packaging change was that if the total filter and impinger train catch of beryllium was very small, then, with so many subdivisions of the sample catch, the analysis data would be "masked" by the analytical procedure.

Mr. Burkle directed that the trains be filled with impinger liquids, assembled, disassembled, and have their samples transferred to the sample bottles, all on the roof of the test site for 2a and 2b; and at a physical location at least one mile away from the test site for 5a and 5b. The latter work was performed in a motel room which was more than a mile away from the test site.

Soda lime, 6-14 mesh, was used in the eighth impinger to protect the meter boxes from any possible acid mist carry over. Figure 2 is a schematic drawing of the test site.

Test No. (1)	Probe	Filter	Sampling Train (5) (6) (7) Greenburg Smith Impingers 1	2	3	4	5	6	Filter	G-S Impingers 7	8	REMARKS	
1a	Yes	Yes	H_2O	H_2O	Empty	10% HCL 10% HNO_3	5% H_2SO_4	Empty	No	Silica gel	soda lime	Comparison of Reagents	
1b	Yes	Yes	10% HCL 10% HNO_3	5% H_2SO_4	Empty	10% HCl 10% HNO_3	5% H_2SO_4	Empty	No	Silica gel	soda lime		
2a	Yes	Yes	H_2O	H_2O	Empty	10% HCL 10% HNO_3	5% H_2SO_4	Empty	No	Silica gel	soda lime	Simulate entire test including clean up procedure except no ~~sampling~~ gas flowing through train	
2b	Yes	Yes	10% HCL 10% HNO_3	5% H_2SO_4	Empty	10% HCl 10% HNO_3	5% H_2SO_4	Empty	No	Silica gel	soda lime		
3a	Yes	No	H_2O	H_2O	Empty	10% HCL 10% HNO_3	5% H_2SO_4	Empty	Yes	Silica gel	soda lime	Comparison of Filter	
3b	Yes	No	10% HCL 10% HNO_3	5% H_2SO_4	Empty	10% HCl 10% HNO_3	5% H_2SO_4	Empty	Yes	Silica gel	soda lime		
4a	Yes	No	10% HNO_3	10% HNO_3	10% HNO_3	10% HCL	5% H_2SO_4	Empty	Yes	Silica gel	soda lime	Detn. HNO_3 Collection E.f.	Comparison of Collection Re
4b	Yes	No	10% HCL	10% HCL	10% HCL	10% HNO_3	5% H_2SO_4	Empty	Yes	Silica gel	soda lime	Detn. HCL Collection Eff.	
5a	Yes	Yes	H_2O	H_2O	Empty	10% HCL 10% HNO_3	5% H_2SO_4	Empty	No	Silica gel	soda lime	Eval. EPA Train Eff.	Comparison of Duplicate Test
5b	Yes	Yes	H_2O	H_2O	Empty	10% HCL 10% HNO_3	5% H_2SO_4	Empty	No	Silica gel	soda lime	Eval. EPA Train Eff.	
6a	Yes	Yes	10% HCL 10% HNO_3	5% H_2SO_4	Empty	Remove 4, 5, and 6			No	Silica gel	soda lime	Detn. Optimum Train + Filter	Comparison to Determine Opt. Train Filter
6b	Yes	No	10% HCL 10% HNO_3	5% H_2SO_4	Empty	Remove 4, 5, and 6			Yes	Silica gel	soda lime	Detn. Optimum Train	

(1) Test numbers marked "a" and "b" indicate sampling train operated simultaneous at the same crossection in the duct to allow comparison of collection efficiency. All samples collected under isokinetic conditions using method 5 test train with modifications shown in the table, single point sampling.
(2) With water impingers upstream: water-acetone wash of probe.
With acid impingers upstream: acid (10% HCl, 10% HNO_3) wash of probe.
(3) Probe, filter and each impinger analyzed for Be.
(4) Impingers not specified as empty contain 100 ml of liquid as specified.
(5) The columns as shown indicate the order in which the sampling train is placed together namely: probe → filter (when specified) → Greenburg Smith Impingers (as indicated) → filter (when specified) → Greenburg Smith Impinger containing adsorbent to protect the pump and dry gas meter.
(6) Greenburg Smith Impingers may be the modified type.
(7) Greenburg Smith Impingers were used in the second water impinger only, all others were the modified type.
(8) Gas sampling times is five hours.
* See comment in body of memo concerning "packaging" of samples.

Table 1, Dated October 26, 1971

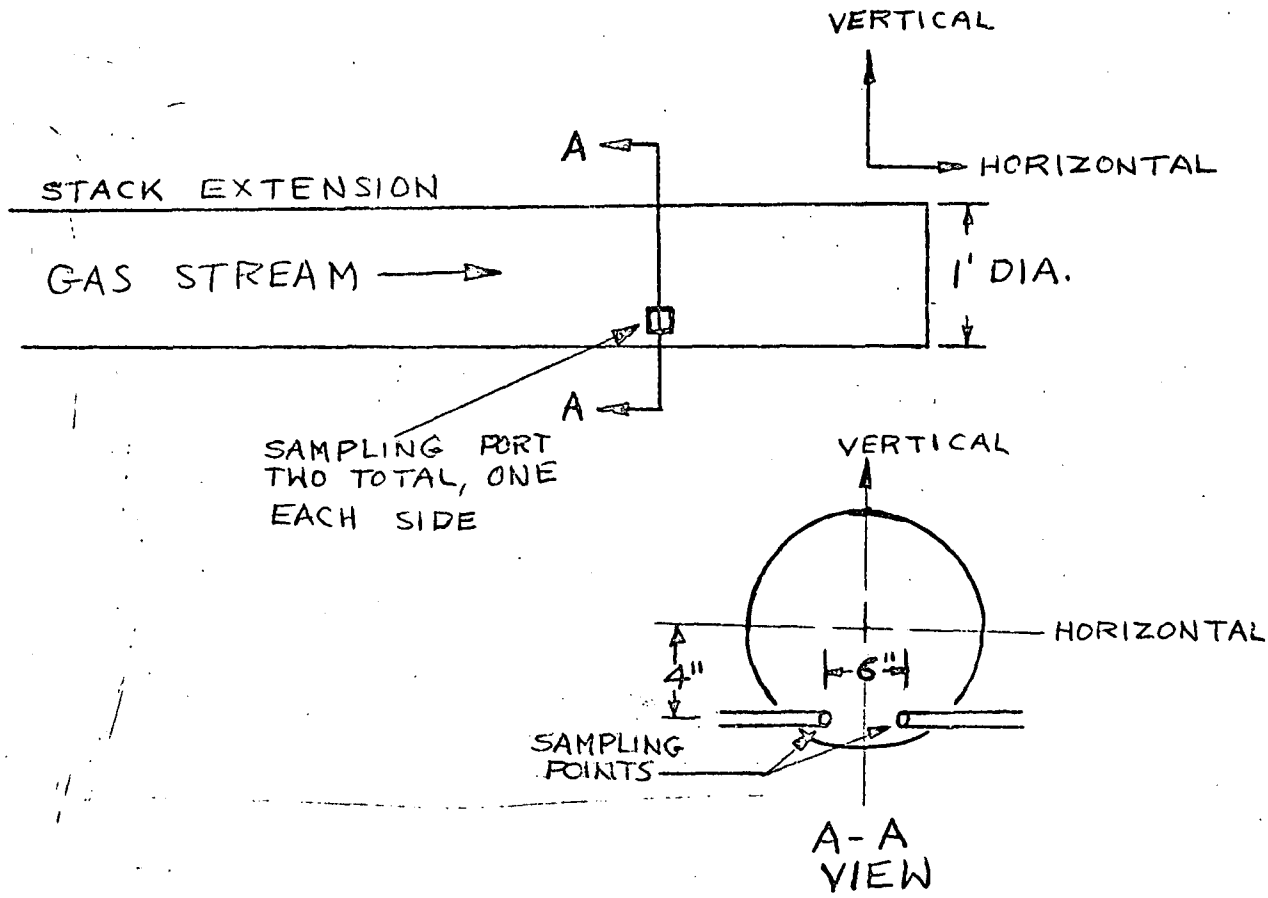
TRAIN NO.	SAMPLE AS GATHERED AND PACKAGED BY ETB (1) DESCRIPTION	CONSOLIDATION AS DIRECTED BY DCP FOR BOTH DAYS (2) SAMPLE	ANALYSIS DATA IN µgm Be (4) (5) (7) TRAIN NO. 5a, Oct.25	TRAIN NO. 5b, Oct.25	TRAIN NO. 5a, Oct.26	TRAIN NO. 5b, Oct.26	Trains 2a & 2b were reduced to four samples (3) No.2a Oct.25	No.2b Oct.25
5a 5b (1)	Probe, water & acetone washings	1	(6)	2.85	0.9			
	Probe, acid washings	2						
	Filters	3	(6)	0.21	(6)			
2a 2b (3)	Impinger 1 (I1), water							
	Impinger 1 (I1), water & acetone wash	4	0.09(6)		(6)			
	Impinger 2 (I2)	5						
	" " "							
	" 3 (I3)							
	" " "							
	Impinger 4 (I4)	6						
	" " "							
	Impinger 5 (I5)	7						
	" " "							
	" 6 (I6)							
	" " "							

(1) On the first day, Oct. 25, 1971, thirty samples were produced and packaged by ETB: 15 for 5a & 15 for 5b. These were consolidated to fourteen samples as directed by DCP, 7 for 5a & 7 for 5b.
(2) On the second day, Oct. 26, 1971, ETB was directed by DCP to package fourteen samples for trains 5a & 5b, as in the consolidation described in note (1), above.
(3) ETB was directed to consolidate these samples into four containers as shown above in the right hand side of this Table II and in Table A-II.
(4) All values are <0.15 unless otherwise noted. See Appendix A.
(5) See Table A-II for blanks (acetone, water, acids and filters), for which all values are <0.15.
(6) See Appendix A for a description of these values.
(7) Gas volumes ranged from 231 to 269 ft^3 at the meter.

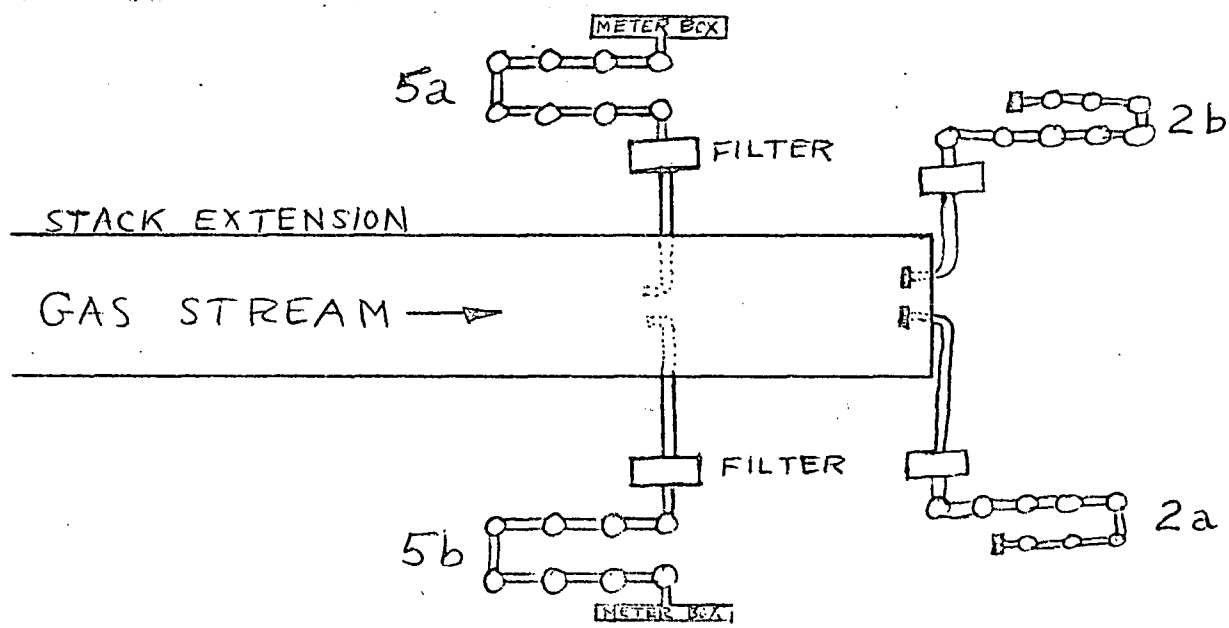
TABLE II

FIGURE 2

TEST SITE, SPEEDRING, INC.
CULLMAN, ALA



SIDE VIEW



PLAN VIEW

II. SUMMARY OF RESULTS

Table II shows the summarized results of the beryllium samples. Seven samples from each of four runs made a total of twenty-eight samples. Only three of the twenty-eight samples yielded values >0.15µg beryllium. One of the samples indicated that a small amount of beryllium, 0.09µg passed the filter.

Sample gas volumes were 231 to 269 ft^3.

Table A-II, Appendix A, shows all of the results of the beryllium samples with appropriate identification codes. The contractor report is given in Appendix C. The source sampling contractor was instructed to spend no more than eight man-hours in preparing the report, to include as a minimum a copy of the raw data sheets, and, as the eight hours permitted, total volume calculations, isokinetic sampling percentage calculations, and normal report writing efforts.

The reason for this eight hour restriction was that for this particular test, the Project Engineer was interested in total volume of gas sampled, and a very brief report of activities at the test site. The report is excellent, and was submitted within six working days after completion of test.

III. CONCLUSION AND RECOMMENDATIONS

The total beryllium catch in the sampling trains is considered too small to allow conclusions to be drawn about efficiencies of the separate portions of the train. In turn, no direct recommendations for improvement of the beryllium sampling train can be made based upon the results of this experiment. The proposed second part of the experiment is cancelled because the results of the first part indicate that not enough beryllium is in the stack gases to allow a "train efficiency" experiment. No well founded conclusions can be drawn relative to previous beryllium testing indications that beryllium stack gas contaminants are getting "through" filters. It is recommended that a known source of beryllium be obtained for any further testing. This could be a commercial or Atomic Energy Commission stack; or it could be a substitute source such as a lathe which is machining a given amount of beryllium under controlled conditions as shown below in Figure 3.

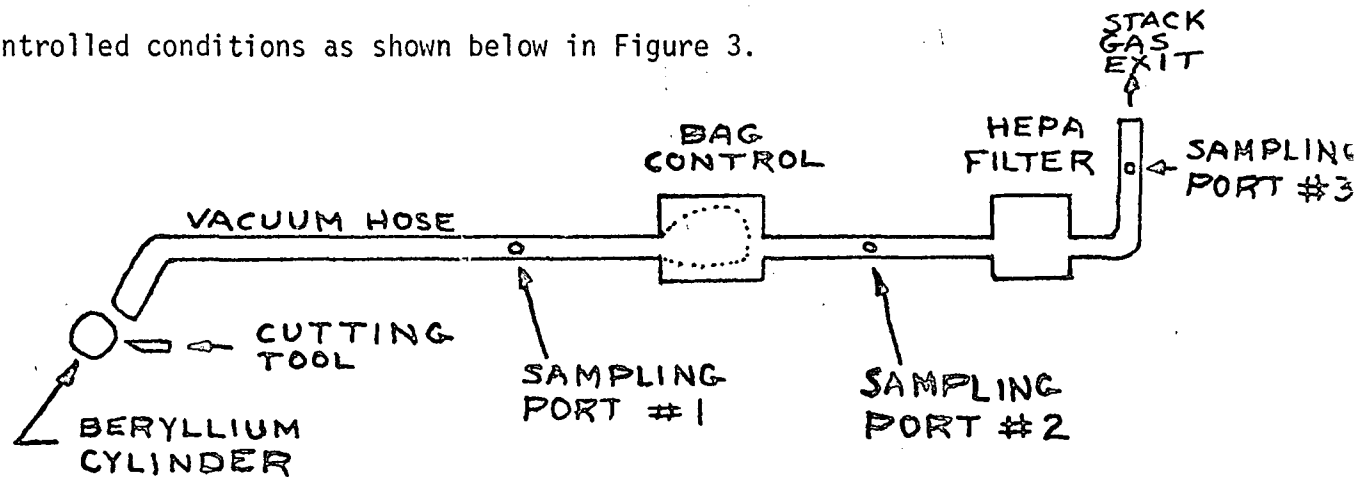


FIGURE 3

APPENDIX A

SUMMARY OF ANALYSIS METHOD FOR BERYLLIUM SAMPLES

York Research, Incorporated, used the EPA suggested method to analyze the beryllium samples. In outline form, the chemical portion of the method is:

1. React with nitric acid
2. React above solution with sulfuric and perchloric acid
3. Evaporate to near dryness on hotplate
4. React (dissolve) in hydrochloric acid
5. Bring to 5 ml total volume

A portion of the 5 ml (usually 1/2 to 1 ml) was decanted and aspirated into the Atomic Absorption (AA, Perkin-Elmer Model 303) flame. The absorbance line produced was then compared to a graph which was previously drawn by reading absorbance of known concentrations of beryllium solutions. York Research, Inc., reports that with their AA unit sensitivity setting of 1 (on a scale of 1 to 10), and with 1% absorption, the AA will allow a reading of 0.03µg Be/ml. This is the setting which York Research, Inc., used in all cases except the reruns (sample Nos. 165, 167, 168, 181 and 182 reruns). Those five were run with a sensitivity setting of 5 which York Research, Inc., reports will allow a reading of 0..006µg Be/ml.

Table A-I below shows why the values <0.15 and <0.03 must be used instead of zero when reporting "negative" analytical results.

TABLE A-I

BERYLLIUM ATOMIC ABSORPTION (AA) READINGS

Sensitivity setting on AA	Capability of Sensitivity Setting in µg Be/ml	Sample volume as prepared for Reading by AA in ml	Minimum Content of Beryllium in 5 ml which will give a reading. µg Be
1	0.03	5	0.15
5	0.006	5	0.03

Table A-II shows all of the results of the beryllium samples with all appropriate codes.

TABLE A-II

CODE:

Be - Beryllium
SI - Speedring Incorporated
N - North Stack
2a, 2b, 5a, 5b, - See Table I dated October 26, 1971 - Test Method
P - Probe
F - Filters
11, 12, 13, 14, 15, 15 - See Table I dated October 26, 1971 - Impinger Numbers

Sample No.	Code	Description/Date		Analytical Results µg Be all values are <0.15 unless otherwise indicated
151	Be-SI-N-2a-P	Water & acetone washings	10/25/71	
152	Be-SI-N-2a-F	Filters	10/25/71	
153	Be-SI-N-2a-11, 12, 13	Water, water & acetone washings	10/25/71	
154	Be-SI-N-2a-14, 15, 16	Acid & acid washings	10/25/71	
155	Be-SI-N-2b-P	Water & acetone washings	10/25/71	
156	Be-SI-N-2b-F	Filters	10/25/71	
157	Be-SI-N-2b-11, 12, 13 14, 15, 16	Acid & acid washings	10/25/71	
158	Be-SI-N-2b-Back Half	Back Half of filter holder only	10/25/71	
159	Be-SI-Whatman 41	Blank filter	10/25/71	
160	Be-SI-Millipore AA	Blank filter	10/25/71	
161	Be-SI-Sulfuric acid 10%	Blank filter	10/25/71	

TABLE A-II, continued

Sample No.	Code	Description/Date		Analytical Results µg Be all values are <0.15 unless otherwise indicated
162	Be-SI-HCL 10% Nitric 10%	Blank filter	10/25/71	
163	Be-SI-Acetone	Blank filter	10/25/71	
164	Be-SI-Distilled Water	Blank filter	10/25/71	
165	Be-SI-N-5a-P1	Water & acetone washings	10/25/71	<0.03
166	Be-SI-N-5a-Pa	Acid washings	10/25/71	
167	Be-SI-N-5a-F	Filters	10/25/71	<0.03
168	Be-SI-N-5a-11	Water, water & acetone washings	10/25/71	0.09
169	Be-SI-N-5a-12,13	Acetone washings	10/25/71	
170	Be-SI-N-5a-14	Acid & acid washings	10/25/71	
171	Be-SI-N-5a-15, 16	Acid & acid washings	10/25/71	
172	Be-SI-N-5b-P1	Water & acetone washings	10/25/71	2.85
173	Be-SI-N-5b-P1	Water & acetone	10/25/71	
174	Be-SI-N-5b-F	Filters	10/25/71	0.21
175	Be-SI-N-5b-11	Water, water & acetone washings	10/25/71	
176	Be-SI-N-5b-12, 31	Water, water & acetone washings	10/25/71	
177	Be-SI-N-5b-14	Acid & acid washings	10/25/71	

TABLE A-II, continued

Sample No.	Code	Description/Date		Analytical Results µg Be all values are <0.15 unless otherwise indicated
178	Be-SI-N-5b-15, 16	Acid & acid washings	10/25/71	
179	Be-SI-N-5b-P1	Water & acetone washings	10/26/71	0.90
180	Be-SI-N-5b-P2	Acid & acid washings	10/26/71	
181	Be-SI-N-5a-F	Filters	10/26/71	<0.03
182	Be-SI-N-5a-11	Water, water & acetone washings	10/26/71	<0.03
183	Be-SI-N-5a-12, 13	Water, water & acetone washings	10/26/71	
184	Be-SI-N-5a-14	Acid & acid washings	10/26/71	
185	Be-SI-N-5a-15, 16	Acid & acid washings	10/26/71	
186	Be-SI-N-5a-P1	Water & acetone washings	10/26/71	
187	Be-SI-N-5a-P2	Acid & acid washings	10/26/71	
188	Be-SI-N-5b-F	Filters	10/26/71	
189	Be-SI-N-5b-11	Water, water & acetone washings	10/26/71	
190	Be-SI-N-5b-12, 13	Water, water & acetone washings	10/26/71	
191	Be-SI-N-5b-14	Acid & acid washings	10/26/71	
192	Be-SI-N-5b-15, 16	Acid & acid washings	10/26/71	
THE FOLLOWING WERE REANALYZED USING A SCALE ON THE ATOMIC ABSORPTION 5 TIMES MORE SENSITIVE THAN THE PREVIOUS ANALYSIS:				
RERUN 165			10/25/71	< 0.03
RERUN 167			10/25/71	< 0.03
RERUN 168			10/25/71	0.09
RERUN 181			10/26/71	< 0.03
RERUN 182			10/26/71	< 0.03

APPENDIX B

PROJECT PARTICIPANTS

1. Emission Testing Branch, ATD, Thomas E. Ward - Project Test Officer, on-site during source sampling
2. Stationary Source Emissions Methods and Measurement Section, DCP, John Burkle - Project Engineer, and Roy Bennet - Observer, on-site during source sampling.
3. Engineering Science, Incorporated, Washington, D.C. - Contract Source Sampler.
4. National Emissions Standards Development Section, DOC, Dave Patrick - Observer, on-site during source sampling.
5. Source Sampling Fuels Analytical Branch, DAS, Darryl J. Von Lehmden - Observer, on-site during one day of source sampling. Mr. Von Lehmden is the Project Supervisor of the beryllium sample analysis.
6. York Research, Incorporated, Stamford, Connecticut - Contract Beryllium Sample Analyzer.

SOURCE TESTING AT SPEEDRING, INC.
A REPORT OF FIELD TEST RESULTS
ON
BERYLLIUM MACHINING OPERATIONS
AT
SPEEDRING, INC.
CULLMAN, ALABAMA

SUBMITTED TO
MR. THOMAS E. WARD, PROJECT OFFICER
OFFICE OF AIR PROGRAMS
ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, N.C.
CONTRACT NO. 68-02-0225

BY
ENGINEERING-SCIENCE, INC.
600 NEW HAMPSHIRE AVE. N.W.
WASHINGTON D.C.

NOVEMBER 1, 1971

INTRODUCTION

On October 25 and 26, 1971 stack emission tests were conducted on beryllium emissions at the Speedring, Inc. plant located in Cullman, Alabama under contract number 68-02-0225 and Task Order 3. The main purpose of these tests was to evaluate a sample collection method for the hazardous pollutant, beryllium. Results of the mofified sampling train are intended to provide the basis for determining the most feasible method for sampling beryllium.

All sampling was conducted under the direction of the Office of Air Programs, Environmental Protection Agency. Mr. Thomas Ward, Project Officer, EPA, et. al. developed the method which uses eight impingers in series with special reagents in each impinger. Two complete trains were run simultaneously and, in addition, two "background" trains were set up to determine potential on site contamination. Testing was conducted after the plant began machining operations under normal operating procedures and regular work day.

Mr. Ward assisted in engineering a through test by arranging for stack extension, ladders, electricity, and other test facilities, providing the special reagents for the several impingers, and assisting in sample recovery to assure proper handling and disposition of each speciman.

All samples were turned over to EPA at the conclusion of the field tests for subsequent analysis by EPA. Under Mr. Ward's guidelines one man-day of effort was used to prepare this report. The report contains two sections in addition to this Introduction; a Discussion which describes the test procedures and an Appendix which includes copies of the raw field data.

Messrs. Michael E. Lukey and John Chehaske conducted the field test for the EPA, made the associated calculations and prepared this report. This report does not contain a discussion of the laboratory results.

DISCUSSION

The purpose of the two day source tests was to determine the feasibility of a modified sampling train for testing the deleterious pollutant, beryllium. The plant was located in Cullman, Alabama and produced machined/tooled beryllium components. The machining operations are similar to mild steel machine shops and include drilling, milling, cutting, sanding and close tolerance lathe operations. Because beryllium is a brittle metal, the machining operations emit a fine metalic (beryllium) dust. Speedring, Inc. used a vaccum system connected to two baghouses to remove the dust from the work area. All of the testing was performed on the north stack, on a roof top with a halfmoon shape. Mr. Thomas Ward, EPA Project Officer, made arragements for the temporary stack extension (made of sheet metal having one foot inside diameter), electricity and other ancillary supplies.

Beryllium emissions are quite low when compared to other mass emission rates from combustion sources. No visible emissions were noted during any of sampling periods. The filters were checked periodically during the sample runs (as a check for rapid buildup) however, only slight color change existed at the very end of the sampling time. Because of the low emission rates, the conventional particulate train (EPA Method 5) has to be modified to improve the collection effeciency of the sub micro particulate. Eight impingers were used in series with a variety of reagents. The first two impingers contained 100 ml of deionized distilled water. Impinger three was empty.

Impinger four contained 100ml of an acid solution (HCl/HNO_3). Impinger five contained 100ml of sulfuric acid solution. (The exact concentrations of both acid solutions were not reported nor asked for by the test team. Impinger seven contained 175 grams of silica gel and the last impinger contained about 50 grams of soda lime pellets to protect the pump. Figure 1 shows the schematic diagram of the sampling scheme.

A total of six runs were made over the two day period. Two trains were run simultaneously during all tests. Trains labeled 5a and 5b were assembled in a motel room located approximately 8 miles from the test site. In addition to these two complete trains, two "background" stations were setup (assembled and reagents added) on the roof top of the plant and the probe tip was placed in the stack. No sampled air was pulled through the background units 2a and 2b. These units were set near 5a and 5b for the same "run" time. Sample recovery for the two background units was made on the roof top of the plant. Sample recovery for 5a and 5b were made at the motel room.

Figure 2 shows the stack configuration and sampling points for the two units. A velocity traverse was made to determine probe tip size stack velocity and flow as well as tip location. The probe tip was placed at the point of average velocity and not moved during the entire sampling periods. Figure 1 and Figure 3 indicate the exact contents of each of the trains.

A summary of the field data and calculations is offered in Table 1.

The stack temperature was nearly constant and did not vary more than 10 degrees from the average temperature of 110°F during the entire sampling period. The average velocity of the stack was 44.7 feet per second. The flow rate at standard conditions (70°F and 1 atm.) was 1805 scfm. The four sample volumes ranged from 231 to 269 dry cubic feet with an average of about 250 cubic feet. The moisture content for four samples was about 3.3%.

The actual field sampling was without incident for the two day tests. Only slight adjustments had to be made to obtain the sample flow for isokinetic sampling conditions. All of the raw data sheets appear in the Appendix.

A P P E N D I X

FIELD DATA SHEETS

FIGURE 1

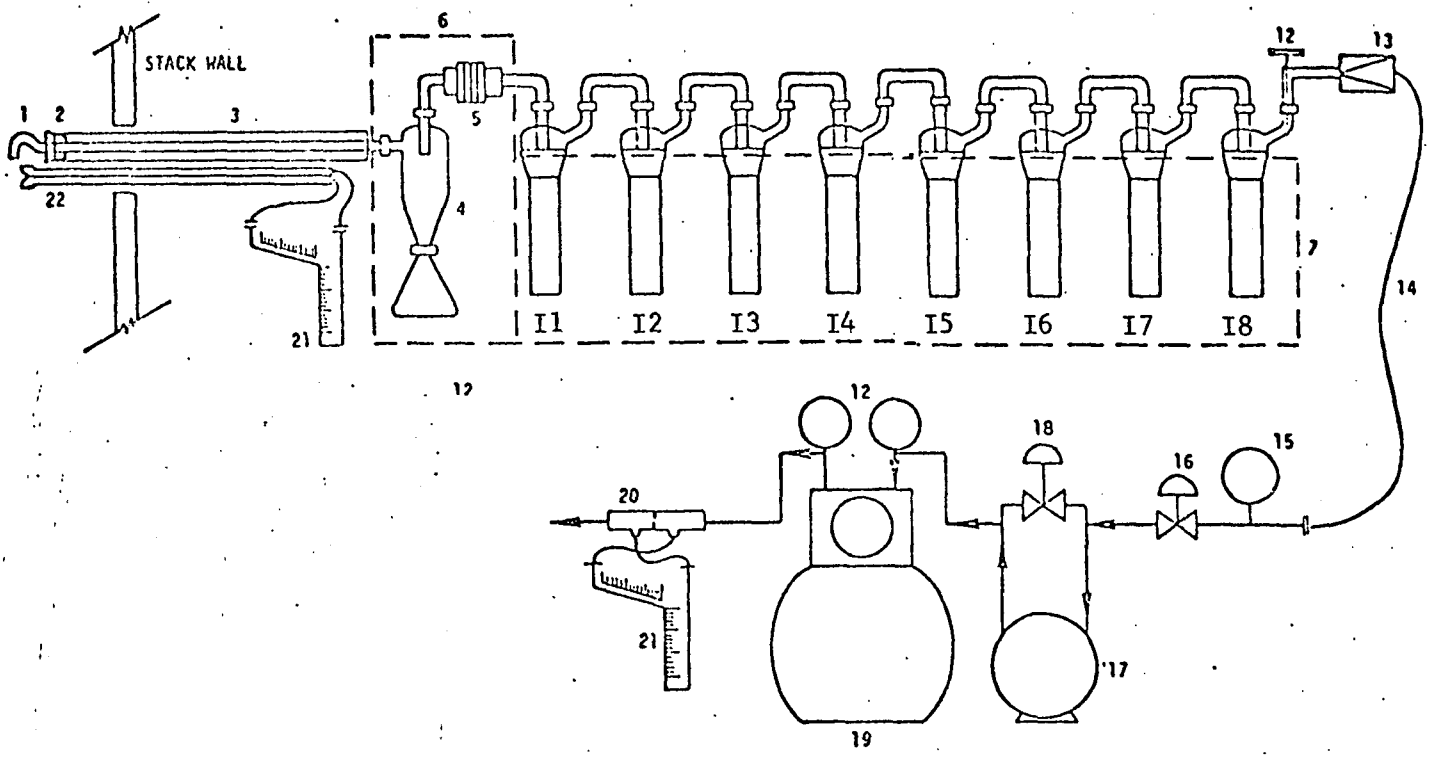


FIGURE A-1. Particulate Sampling Train.

1. Buttonhook-type probe tip
2. Stainless Steel Coupling
3. Probe
4. Cyclone and Flask
5. Fritted Glass Filter Holder
6. Heated Sample Box
7. Ice Bath
12. Thermometer
13. Check Valve
14. Umbilical Cord
15. Vacuum gauge
16. Needle Valve
17. Vacuum Pump
18. By-Pass Valve
19. Dry Gas Meter
20. Calibrated Orifice
21. Inclined-Vertical Manometer
22. Pitot Tube

SAMPLE NOS. 2a, 5a, 5b OCT. 25, 1971 and 5a, 5b OCT. 26, 1971

IMPINGER NO.	IMPINGER CONTENTS.
I1	100ml. H_2O
I2	100ml. H_2O GS Impinger
I3	Empty
I4	HCl/HNO_3 solution
I5	100ml. H_2SO_4 solution
I6	Empty
I7	175 grams of Silica Gel
I8	50 grams of Soda Lime

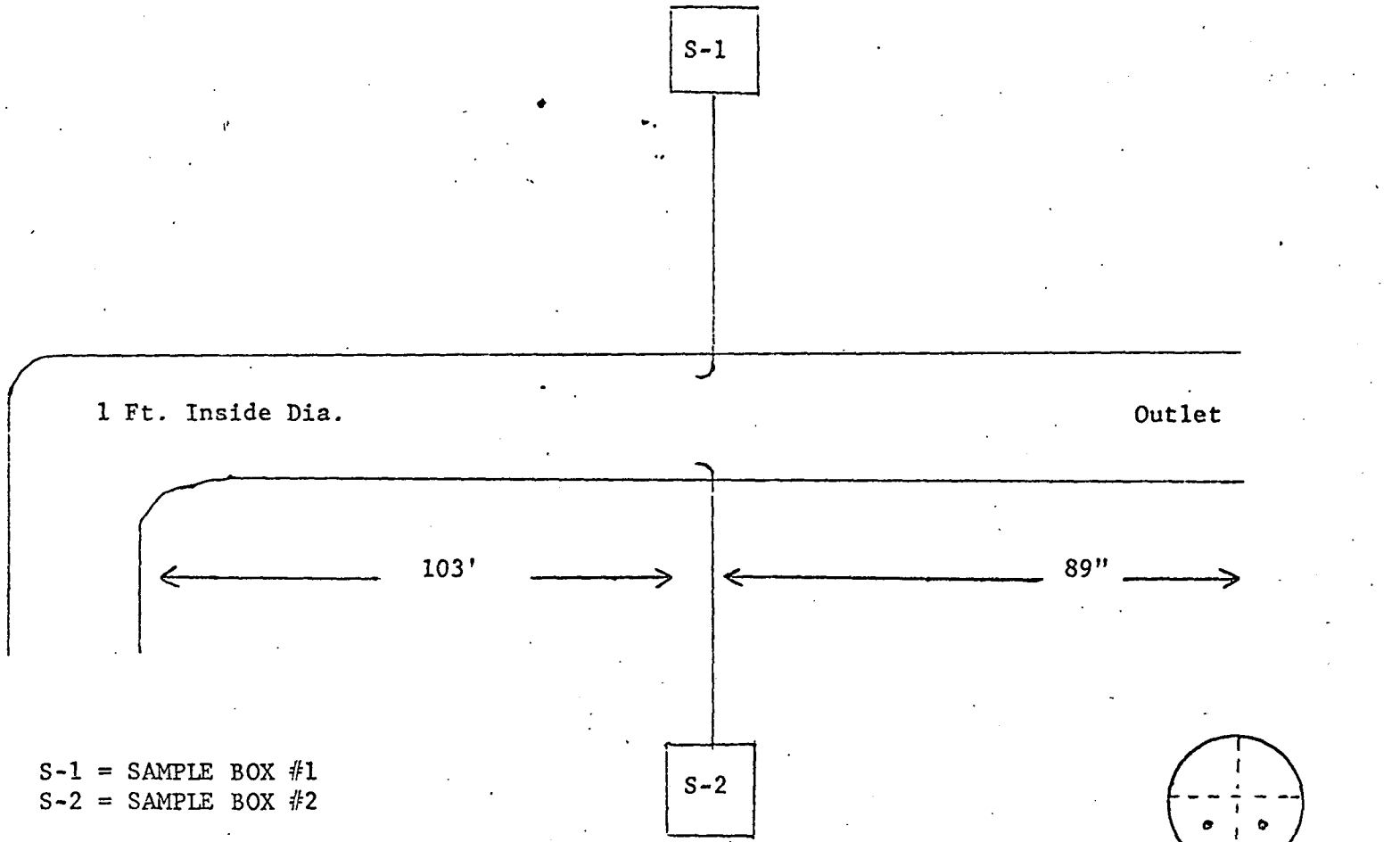


FIGURE 2 STACK CONFIGURATION

FIGURE 3

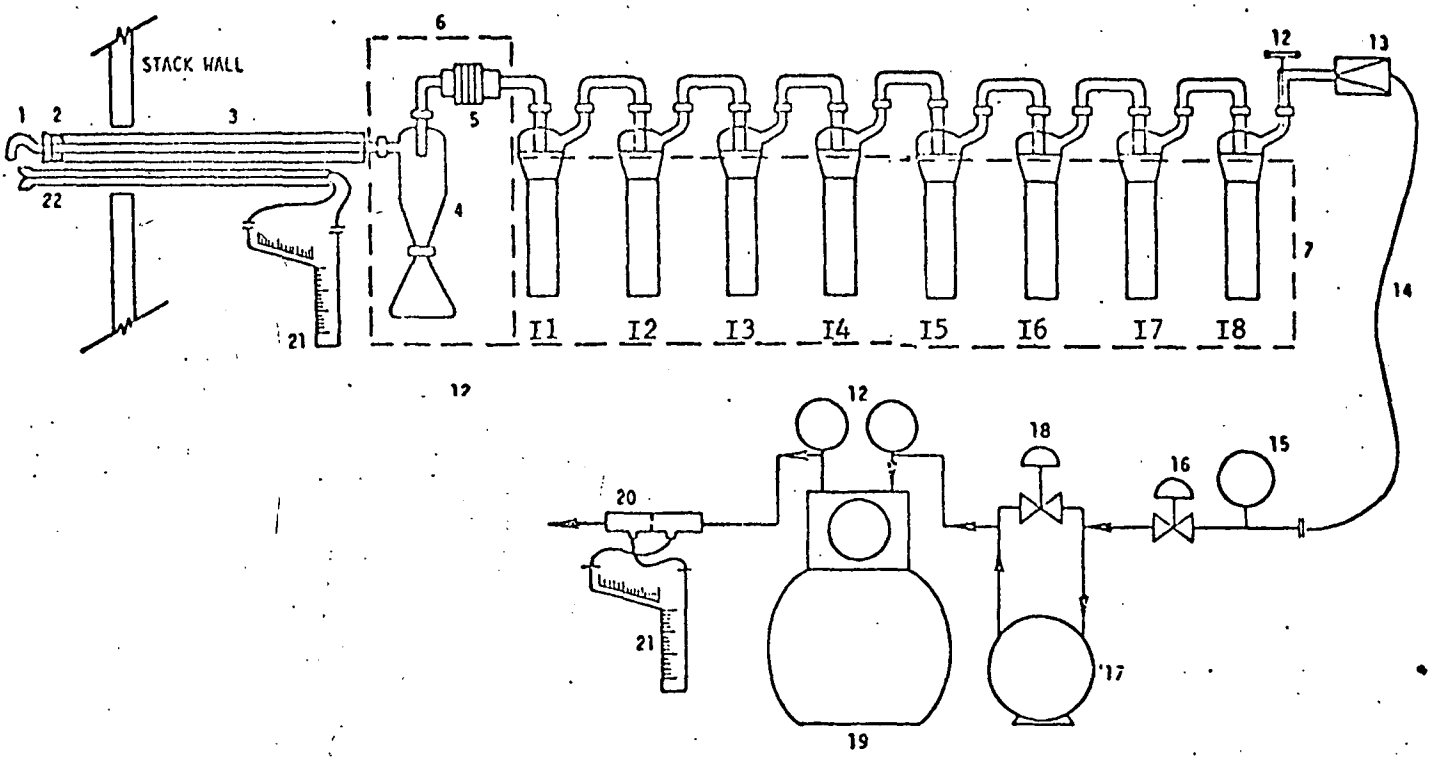


FIGURE A-1. Particulate Sampling Train.

1. Buttonhook-type probe tip
2. Stainless Steel Coupling
3. Probe
4. Cyclone and Flask
5. Fritted Glass Filter Holder
6. Heated Sample Box
7. Ice Bath
12. Thermometer
13. Check Valve
14. Umbilical Cord
15. Vacuum gauge
16. Needle Valve
17. Vacuum Pump
18. By-Pass Valve
19. Dry Gas Meter
20. Calibrated Orifice
21. Inclined-Vertical Manometer
22. Pitot Tube

SAMPLE NO. 2b OCT. 25, 1971

IMPINGER NO.	IMPINGER CONTENTS
I1	100ml. HCl/HNO_3
I2	100ml. H_2SO_4
I3	Empty
I4	100ml. HCl/HNO_3 solution
I5	100ml. H_2SO_4 solution
I6	Empty
I7	175 gms. of Silica Gel
I8	50 grams of Soda Lime

SUMMARY OF FIELD DATA

Sample Number/ Date	Start-up Time	Sample Time (min.)	Sample Volume ($ft.^3$ dry)	Average Stack Temp. (^oF)	Moisture (%)	Probe tip size (in)	Probe length (ft)	Precent Isokinetic		Average ($in.H_2O$)	
									ΔP		ΔH
5a/Oct.25	09:00 am	300	248.98	112	3.3	¼	5	96	.53	2.34	
5b/Oct.25	9:00	300	269.05	112	3.4		5	103	.55	2.42	
2a/Oct.25	9:00	-*	-	-	-	¼	5	-	-	-	
2b/Oct.25	9:00	-*	-	-	-	¼	5	-	-	-	
5a/Oct.26	7:24	300	253.03	110	3.2	¼	5	97	.52	2.19	
5b/Oct.26	7:24	300	231.69	110	3.3	¼	5	90 (104)	.48	2.33	

25

* Background samples

PRELIMINARY FIELD DATA

Stack Geometry

Test No. I

Location Speedway Ave, Caldwell Rd.

Date Oct 25, 1971

A. Dist. from inside of far wall to outside of near wall, in., = (steel metal stack) -

B. Wall thickness, in., = -

Inside diameter of stack = A-B 12 inches

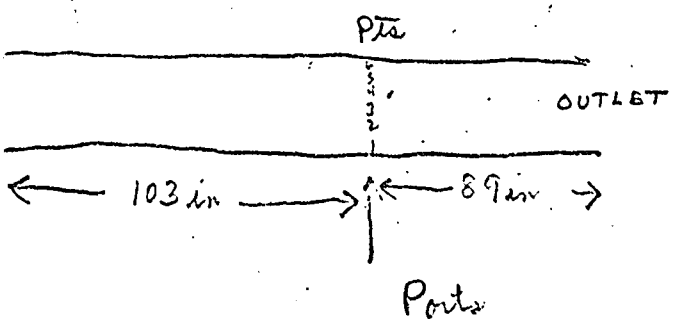
Stack Area = _____

Comments:

Sketch of stack cross-section showing sampling holes

Calculations:

Stack nozzle = 1 ft



Ports were about 2" in diameter and sealed with AC Tape.

Point	% Dia. for circular stack	Dist. from outside of sample port, in.
1	4.4	0.5
2	14.7	1.75
3	29.5	3.5
4	70.5	8.5
5	85.3	10.5
6	95.6	11.5

Calculator HP-45

VELOCITY TRAVERSE FIELD DATA

25 Oct 71

P_a - 29.32

Huntsville Weather Station - Corrected

Plant Spraying Inc

Test Sa, Sb, 2a, 2b

Location Cullman, Al

Date Oct 25, 1971

Operator MEL, JC

Meter ΔH 1.94

Clock Time	Point	(1) ΔP, in. H_2O	(1) $\sqrt{\Delta P}$, in. H_2O	(2) ΔP, in. H_2O	(2) $\sqrt{\Delta P}$, in. H_2O	Stack Tempt. °F (1)	Stack Tempt. °F (2)
	1	0.31				110	
	2	0.38				↓	
	3	0.44					
	4	0.46					
	5	0.44					
	6	0.36					
	6	0.38					
	5	0.43					
	4	0.46					
	3	0.47					
	2	0.40					
	1	0.37					
		12 | 4.90					

(1) ΔP, in. H_2O Average 0.408

(2) ΔP, in. H_2O Average

Comments:

Plant Sparkill Iron Co. Ellenville Date Oct 25, 1971

Sampling location Roof Top

STACK DATA FOR NOMOGRAPH:

1. Meter ΔH 1.93 in H_2O

2. Avg. meter tempt (ambient + 20° 65+20 °F 85°

3. Moisture (volume) 1 %

4. Avg. static press. ± 0.25 in. H_2O X.073 = ± .02 in. Hg.

5. Bar. press sampling point 29.32 in.Hg ± .02 (static press in.Hg) = 29.34 in. Hg.

6. Bar press of meter 29.32 in. Hg.

7. P_s/P_m = $\frac{5.\ 29.34 \text{ in. Hg}}{6.\ 29.32 \text{ in. Hg}}$ = 1.0

8. Avg. stack temperature 110 °F.

9. Avg. stack velocity (ΔP) 0.4 in H_2O. MAX. VELOCITY 0.55

C factor (1) 1.15 (2)

10. Probe Tip size 1/4 inch stainless steel

PARTICULATE FIELD DATA

PLANT Speedaire Inc

Run No. SP

Location Cullman, AL

Date Oct 25, 1971

Operator pfl JC

Sample Box No. SP

Meter Box No. (ES)

METER ΔH 1.93

C FACTOR 1.15

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

PATHOLOGICAL INCINERATORS- read and record every 5 minutes.

Ambient Temp °F 68

Bar. Press. "Hg 29.32

Assumed Moisture % 1.0

Heater Box Setting, °F 0

Probe Tip Dia., In. 0.25 in.

Probe Length 5 ft

Probe Heater Setting 0

AVG. ΔP _____ AVG. ΔH _____

Point	Clock Time	DRY GAS METER, CF 637.29	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press in. Hg	Stack Temp °F
1	0545	641.31	0.50	2.20	2.20	74	76	3.5		55		110
	15	649.38	0.51	2.35	2.20	85	68	3.5		60		110
	25	657.60	0.51	2.25	2.35	92	71	3.5		60		110
	35	666.11	0.51	2.35	2.25	15	73	4.0		60		110
	45	674.73	0.51	2.25	2.25	98	75	4.0		60		120
	55	683.04	0.58	2.50	2.50	97	76	4.0		60		125
	1105 Hour	692.10	0.61	2.60	2.60	95	77	4.0		60		125
	15	701.22	0.63	2.65	2.65	95	78	4.0		60		125
	25	710.43	0.60	2.55	2.55	96	78	4.0		60		125
	35	719.53	0.58	2.45	2.50	100	80	4.5		65		125
	45	728.30	0.59	2.55	2.50	100	81	4.5		65		125
	2 1105	737.09	0.58	2.55	2.55	104	82	4.5		65		125
	15	746.01	0.58	2.55	2.55	100	82	4.5		65		110
	25	812.66	0.57		2.55	88	81	6.0		55		

Comments:

NCAP-37 (12/67)

Comments	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O		Dry Gas Temp. °F		Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press in. Hg	Stack Temp °F
				Desired	Actual	Inlet	Outlet					
1 OCT RUN 5B cont.												
	5 in 5 min	856.01	0.56	2.45	2.45	104	83	6.5		60		115
	5 in 5 min	859.66	0.55	2.40	2.40	105	85	6.5		60		115
	4h. 01 min	863.30	0.56	2.45	2.45	106	86	6.5		65		120
	16 min	866.94	0.56	2.45	2.45	104	86	6.0		60		115
	4h. 21 min	870.15	0.56	2.45	2.35	105	86	6.5		60		115
	4h. 26 min	873.68	0.54	2.40	2.40	110	88	6.5		65		115
		90.34										
			Avg: 0.55		Avg: 2.42							

PARTICULATE FIELD DATA

PLANT Sparkill Tree

Run No. 5A

Location [illegible] P.O.

Date Oct 24, 1971

Operator [illegible]

Sample Box No. SB

Meter Box No. [illegible]

METER ΔH 1.12

C FACTOR

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

PATHOLOGICAL INCINERATORS- read and record every 5 minutes.

Ambient Temp °F 70

Bar. Press. "Hg 29.32

Assumed Moisture % 10

Heater Box Setting, °F —

Probe Tip Dia., In. 1/4

Probe Length 5'

Probe Heater Setting —

AVG. ΔP AVG. ΔH

Point	Clock Time	DRY GAS METER, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press in. Hg	Stack Temp °F
	10:30 [illegible]	164.31	0.56	2.40	2.40	108	86	5.0				110
	11:30 [illegible]	177.70	0.55	2.40	2.40	114	90	6.0				113

Comments: Solid [illegible] shut at 124 min

NCAP-37 (12/67)

Comments	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O		Dry Gas Temp. °F		Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press in. Hg	Stack Temp. °F
				Desired	Actual	Inlet	Outlet					
[illegible]	[illegible]	132.55	0.52	2.45	2.50	110	97	5.0		55		[illegible]
[illegible]	[illegible]	202.94	0.60	2.50	2.50	112	98	6.0		58		120
[illegible]	[illegible]	217.77	0.58	2.45	2.45	117	99	6.5		60		115
[illegible]	[illegible]	231.40	0.59	2.45	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	245.43	0.60	—	2.50	116	99	6.5		60		[illegible]
[illegible]	[illegible]	259.29										
			Avg = 0.52	Avg 2.49								

PARTICULATE FIELD DATA

PLANT Shoaling Tree

Run No. 5B ✓

Location Auburn AL

Date 2-24, 1971

Operator [illegible] JC

Sample Box No. 5B

Meter Box No. 5B

METER ΔH 1.94

C FACTOR

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

PATHOLOGICAL INCINERATORS- read and record every 5 minutes.

Ambient Temp °F 60

Bar. Press. "Hg

Assumed Moisture % 10

Heater Box Setting, °F -

Probe Tip Dia., In. 1/4

Probe Length 5'

Probe Heater Setting -

AVG. ΔP 0.4 AVG. ΔH

Point	Clock Time	DRY GAS METER, CF 470.52	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press in. Hg	Stack Temp °F
[illegible]	[illegible]	[illegible]	0.30	1.84	[illegible]	75	60	4		[illegible]		135
[illegible]	[illegible]	[illegible]	0.45	1.70	1.95	84	68	[illegible]		50		100
[illegible]	[illegible]	[illegible]	[illegible]	1.30	[illegible]	91	67	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
X	[illegible]	[illegible]	[illegible]	1.95	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1.30	1.95	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	92	71	5.0		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1.95	1.95	95	77	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	97	75	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	99	79	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2.00	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2.10	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2.00	[illegible]	101	77	[illegible]		[illegible]		[illegible]
[illegible]	[illegible]	6.17 - 83	[illegible]	2.20	2.20	[illegible]	[illegible]	5.0		[illegible]		110
[illegible]	[illegible]	629.80	0.39	2.10	2.10	112	90	5.0		50		110

Comments: [illegible] 7:29 AM CST

NCAP-37 (12/67)

Comments	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O		Dry Gas Temp. °F		Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press in. Hg	Stack Temp. °F
				Desired	Actual	Inlet	Outlet					
5E' Cont.		[illegible]										
[illegible]	[illegible]	[illegible]	0.55	2.35	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	655.16	0.54	2.30	2.40	110	88	5.0		[illegible]		120
	[illegible]	[illegible]	0.54	2.32	3.35	115	87	5.5		60		115
	[illegible]	678.32	0.54	2.30	3.30	[illegible]	[illegible]	[illegible]		55		115
	[illegible]	690.19	[illegible]	2.32	[illegible]	[illegible]	[illegible]	5.0		60		115
	[illegible]	702.34										
		231.64)	Avg: 0.48		2.33							

PARTICULATE CLEANUP SHEET

Date Oct 26, 1971 Plant: Spedding Inn, Cullman, Al

Run Number 5A Location of sample port: _____

Operator: MEL Barometric pressure: _____

Sample box number: 5A Ambient temperature: _____

Impinger H_2O

Volume after sampling _____ ml

Volume collected _____ ml

Impinger 1 100 ml H_2O
2 100 ml H_2O GS
3 Empty
4 ~~400~~ 100 ml HNO_3/HCl
5 100 ml H_2SO_4
6 empty
7 Silica Gel
8 about 50 ml of Soda lime to protect pump

105 ml H_2O
94 ml H_2O
Impinger prefilled with _____ ml
100 ml
96 ml

Impingers and back half of filter, acetone wash: _____ Container No. _____
400 ml
Extra No. 397 ml

Probe, cyclone, flask, and front half of filter, acetone wash: Container No. _____
Extra No. _____

Filter Papers and Dry Filter Particulate

Filter number	Container number	Filter number	Container number
see 'Petri' dish			
	✓		

Silica Gel Container No 3 ✓

400 ml
397
3 ml

Weight after test:					40 gms
Weight before test:	175 gms				3
Moisture weight collected:	40.0 gms				Moisture
Container number:	1. #3	2.	3.	4.	total 37.0 g

Sample number: _____ Analyze for: _____

Method determination: _____

Comments: Cleanup area was at the Holiday Inn, about 8 miles from the test site

PARTICULATE CLEANUP SHEET

Date Oct 25, 1971 | Plant: Speeding Tree, [illegible]

Run Number 5B RAC/ZEE Train | Location of sample port: ______

Operator: MEL, JC | Barometric pressure: ______

Sample box number: 5B - RAC - ZEE | Ambient temperature: 70°F

		Initial Conditions	After Test
Impinger H_2O	No 1	100 ml H_2O	102 ml
	2	100 ml H_2O GS	91 ml
Volume after sampling ______ ml	3	S.G. Impinger prefilled with ______ ml	
	4	100 ml HNO_3/HCl	102 ml
Volume collected ______ ml	5	100 H_2SO_4	86 ml
	6	S.G.	1 ml
	7	[illegible]	
	8	approx 50 gms of [illegible]	387 ml

Impingers and back half of filter, acetone wash: 400 ml | Container No. ______

Extra No. ______

Probe, cyclone, flask, and front half of filter, acetone wash: | Container No. ______

Extra No. ______

Filter Papers and Dry Filter Particulate

Filter number	Container number	Filter number	Container number
filter labeled 5B, monday Oct 25, 1971			

Silica Gel ZEE Container No. 5 and Silica Gel container No 1 each with 175 gms.

	1	2	3	4
Weight after test:				400 / 387 / 13
Weight before test:	175 gms	175 gms		
Moisture weight collected:	41.9	23.0		
Container number:	#5	#1		

64.9
13.0
Moisture total 51.9 gm

Sample number: 5B | Analyze for: Be

Method determination: ______

Comments: Clean up [illegible] at the Holiday Inn, about 8 miles from the plant

John Buchele
Tom Ward

PARTICULATE CLEANUP SHEET

Date Oct 25, 1971 Plant: Speakman Tire, Cullman, Alabama

Run Number 5A RAC/RH Location of sample port: _____

Operator: JBL, JC Barometric pressure: _____

Sample box number: 5A RAC/RH Ambient temperature: _____

	Initial Cond.	After Test
Impinger H_2O	No 1 100 ml H_2O	87 ml
	No 2 100 ml H_2O GS	93 ml
Volume after sampling _____ ml	3 Empty Impinger	4 ml prefilled with _____ ml
	4 101 ml HNO_3/HCL	70 ml
Volume collected _____ ml	5 90 ml H_2SO_4	93 8 (¼" higher than top 50 gm.)
	6 Empty	3 ml
	7 Silica Gel	-
	8 Soda lime	370 ml

Impingers and back half of filter, acetone wash: 400 ml Container No. _____

Extra No. _____

Probe, cyclone, flask, and front half of filter, acetone wash: Container No. _____

Extra No. _____

Filter Papers and Dry Filter Particulate

Filter number	Container number	Filter number	Container number
Monday Oct 25, 1971 5A RAC 1			
	✓		

Silica Gel Silica Gel Container No 2 and Silica Gel Container No 6

Weight after test:			24.7 / 42.2 / 66.9		400 ml before / 370 ml after test
Weight before test:	175g				30 ml
Moisture weight collected:	42.2 gms	24.7 gms			Moisture 66.9 − 30.0
Container number:	1. #2	2. #6	3.	4.	total 36.9 gr

Sample number: _____ Analyze for: _____

Method determination: _____

Comments: Cleanup crew was at the Haleby Farm, about 8 miles from the plant

PARTICULATE CLEANUP SHEET

Date Oct 26, 1971 Tuesday — Plant: Spaulding Tray, Columbus, IL

Run Number SB — Location of sample port: _____

Operator: MEL, DC — Barometric pressure: _____

Sample box number: SB — Ambient temperature: _____

Impinger H_2O		
	No 1 101 ml H_2O	106 ml H_2O
Volume after sampling _____ ml	2 100 ml H_2O (GS)	98 ml
	3 empty	
Volume collected _____ ml	4 100 ml HNO_3/HCl	98
	5 100 ml H_2SO_4	95
	6 silica gel	final

Impingers and back half of filter, acetone wash: 1 silica gel, 8 final — Container No. _____ — 401 — Extra No. _____ — 401 ml

Probe, cyclone, flask, and front half of filter, acetone wash: — Container No. _____ — Extra No. _____

Filter Papers and Dry Filter Particulate

Filter number	Container number	Filter number	Container number
(see petri dish)			

Silica Gel — Silica Crystals 110 g

Weight after test:					
Weight before test:	125				
Moisture weight collected:	37.7 grams				Moisture
Container number:	1. #4	2. _____	3. _____	4. _____	total 37.7 gr

Sample number: _____ Analyze for: _____

Method determination: _____

Comments: Clean up area was 8 miles from the test site

APPENDIX D

ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Research Triangle Park, North Carolina 27711

Reply to Attn of:

Date: - 7 OCT 1971

Subject: Beryllium Testing Methods Development

To: Acting Director, Division of Compliance

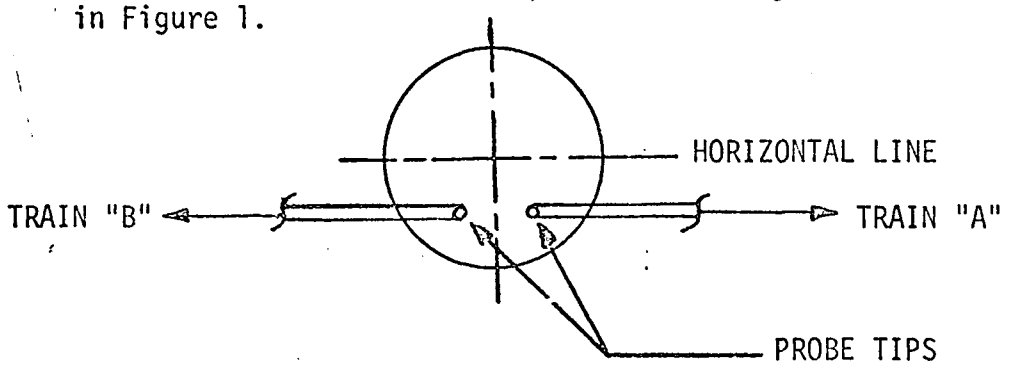
1. A test plan has been developed by the Chief of Stationary Source Emission Methods and Measurement Section (DCP), who will fund the test. An exact description of the test follows:

a. EPA gas pumping and measuring equipment will be used.
b. The collection trains are listed in Table 1.
c. The probe and glassware will be washed with liquid, the same as in the first impinger of the collection train used. In the case of water in the first impinger, an additional rinse of acetone will be used; and an acid rinse will be used after the acetone rinse.

d. Each impinger will be individually "bottled".
Each wash will be individually "bottled".
Each filter will be individually "packaged".

This will allow for Beryllium analysis of individual components of the collection system.

e. The probes will be placed in the exit horizontal stack 8 diameters downstream and 2 diameters upstream from any obstruction as follows in Figure 1.



Cross Section of Stack

Figure 1

Isokinetic gas sampling rates will be used. Single point sampling will be used. Millipore AA filters with Whatman 41 backup will be used.

2. Some input for consideration in establishing the test plan was furnished by the Source Sampling Fuels Analytical Branch (DAS) via Darryl J. VonLehmden and Robert E. Lee, and the Emission Testing Branch (DAT) via Thomas E. Ward and Roger T. Shigehara.

3. The objective of the test is:

a. To establish an acceptable method for the collection of the Beryllium sample from a machine shop source.
b. To validate (or invalidate) previous test data, specifically, The American Beryllium Company, and Speedring, Inc.

4. The execution of this test is tentatively scheduled for October 25 through 29. An alternate date could be November 1 through 5. The place is Cullman, Alabama, Speedring, Inc.,North Stack. There is room at the test site to accommodate up to ten people comfortably.

5. This memo is to inform all involved groups of the test plan and schedule. This memo is also to request input/concurrence in writing of the test plan and schedule as they may apply to the involved group(s).

Robert E. Neligan
Acting Director
Division of Applied Technology

cc: Mr. D. VonLehmden, SSFAB,DAS
Dr. R. E. Lee, SSFAB,DAS
Mr. J. Nader, SSEMMS,DCP
Mr. J. Burkle, SSEMMS,DCP
Mr. D. Patrick, NESDS,DOC
Mr. J. Peoples, NESDS,DOC
Mr. J. De Santis, NESDS,DOC
Mr. J. McGinnity, ETB,DAT
Mr. W. Basbagill, ETB,DAT
Mr. R. Shigehara, ETB,DAT,CIS

Attachment