AP-42 Section Number: 12.15

Reference Number: 8

Title: Emissions Study at a Lead Acid Battery Manufacturing Company-ESB, Inc., Buffalo, NY

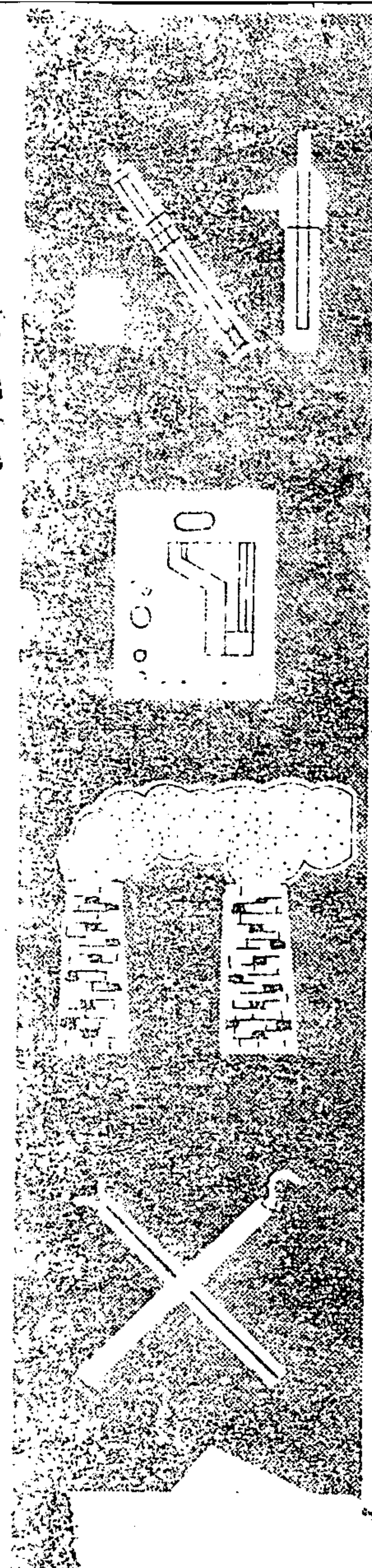
EPA-76-BAT-2

US EPA

1976

REPORT NO. 76-BAT-2

STORAGE BATTERY PRODUCTION
AP-42 Section 7.15
Reference Number
6



AIR POLLUTION EMISSION TEST

E.S.B., INCORPORATED

BUFFALO, NEW YORK

ED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Emission Measurement Branch
Research Triangle Park, North Carolina

EMISSION STUDY

at a

LEAD ACID BATTERY MANUFACTURING COMPANY

E.S.B., Incorporated
Buffalo, New York
August 23-26, 1976

Test conducted by

Monsanto Research Corporation
Dayton, Ohio

Report prepared by:

Dennis P. Holzschuh (5243)
Environmental Protection Specialist
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina

PREFACE

The work reported herein was conducted by personnel from Monsanto Research Corporation, Pedco Environmental Specialists, Inc., and the Environmental Protection Agency.

Monsanto Research Corporation personnel were responsible for collecting, cleanup, and analyzing of the field-collected samples. The samples were weighed and analyzed at the Monsanto Research Lab located in Dayton, Ohio, and the raw data were submitted to EPA for the writing of the test report.

Pedco Environmental Specialists personnel were responsible for monitoring the process operations during the testing program and writing the Process Description and Operations section.

Mr. Dennis P. Holzschuh, Office of Air Quality Planning and Standards, Emission Measurement Branch, served as the test project officer and was responsible for coordinating the performance testing program.

Mr. Lee Beck, Office of Air Quality Planning and Standards, Industrial Studies Branch, served as test process engineer and was responsible for coordinating the process operations.

TABLE OF CONTENTS

TABLES

FIGURES

I. INTRODUCTION

Section III of the Clean Air Act of 1970 charges the Administrator of the Environmental Protection Agency (EPA) with the responsibility of establishing Federal standards of performance for new stationary sources which may significantly contribute to air pollution. These promulgated standards of performance for new stationary sources (SPNSS) will reflect the degree of emission limitation achievable through application of the best demonstrated control technology, taking into account cost considerations. To assemble this background information, EPA utilizes emission data obtained from pollutant sources involved in the particular industries being studied.

In the lead battery industry, emission control systems at the ESB's Buffalo, New York, plant were selected by EPA for an emission monitoring test program. This test program was designed to provide a portion of the emission data base used for determining "best control technology" and for developing new source atmospheric emission standards for the processes involved in the manufacturing of lead acid batteries. This report represents the results of this test program performed during the week of August 23, 1976.

The ESB, Inc., plant produces two types of batteries, the wet charged battery and the dry charged battery. Two product manufacturing lines operate 16 hours a day, five days a week. Line No. 1 produces the wet (lead acid) battery. Line No. 2 produces the dry charge battery and this line splits off of No. 1 and involves the second and third shift. This dry charge process lasts 15-17 hours. Sampling was conducted on the inlet and outlet of the reclamation furnace of line No. 1. The control device was a Schnieble wet scrubber (see Figure 1). On line No. 2, sampling was conducted on the outlets of the dry plate charging process. The control device was a Trimer wet scrubber (see Figure 2).

EPA jointly engaged with Pedco Environmental Specialists and Monsanto Research Corporation to measure the process emissions at the inlet and outlet of the Schnieble and Trimer scrubbers. Monsanto Research Corporation was responsible for collecting, cleanup, and analysis of all samples related to the source test. Pedco Environmental Specialists personnel were responsible for monitoring and recording necessary process parameters.

Monsanto Research Corporation conducted a total of six EPA-5 particulate test runs at two test locations. These consisted of three test runs at the inlet to the Schnieble wet scrubber, three test turns at the outlet of the Schnieble scrubber (see Figure 1). Simultaneous sampling was conducted at each of the two test locations during the three test runs for velocity, moisture, and particulate using EPA Method 5. (See Sampling and Analytical Procedures section.) Duplicate sampling was conducted at the outlet test location during the three test runs for an evaluation of efficiency of modification of EPA Method 5. (See Figures 3a and 3b.) Three particle size determinations were performed at the inlet and three at the outlet of the Schnieble scrubber. Tests were conducted using a Brinks* Cascade Impactor and an Anderson* Cascade Impactor,respectively. Three trace element samples were collected at the outlet of the Schnieble scrubber by means of an instack filter.

---

*Mention of the specific company or product does not constitute endorsement by EPA.

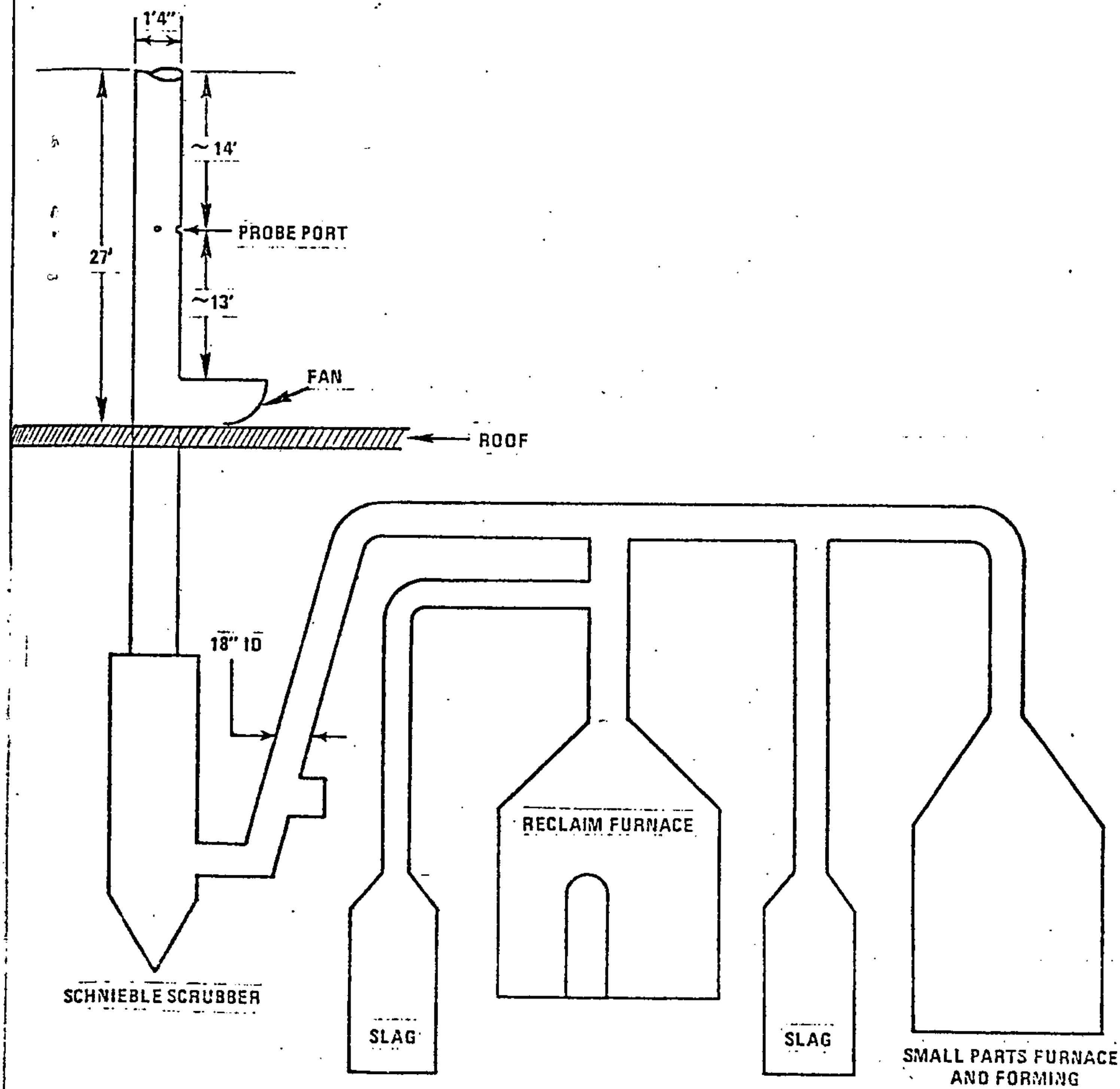


Figure 1. Reclaim process (inside plant) Schnieble & Exhaust.

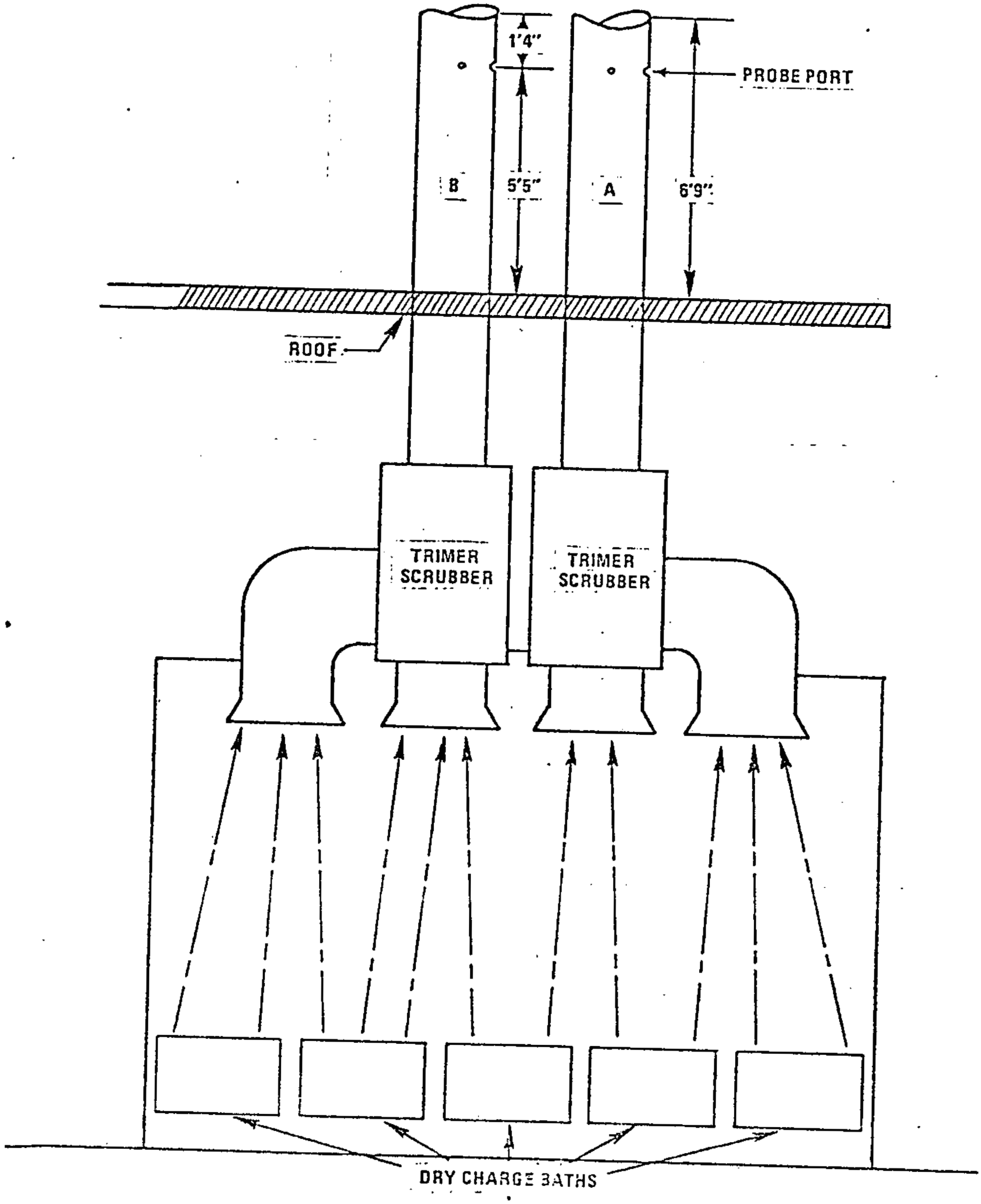


Figure 2. Trimer Scrubber and its Exhausts.

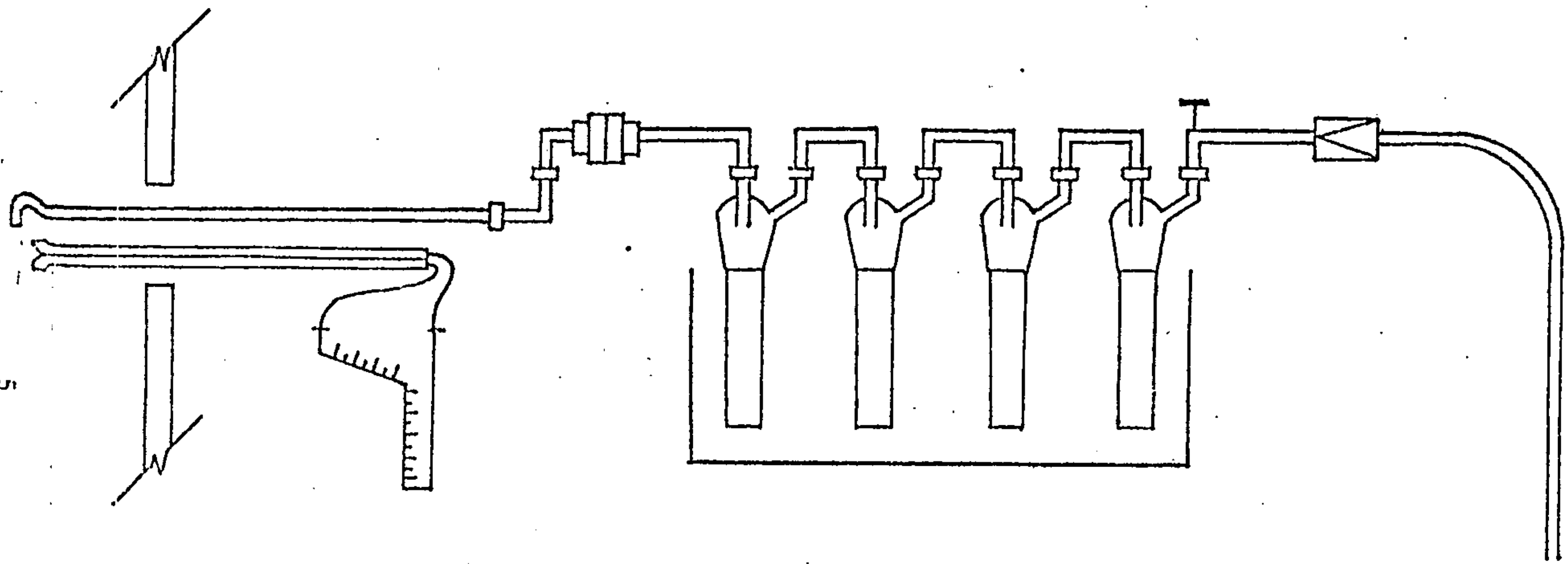


FIGURE 3a

STANDARD MEHTOD 5 TRAIN

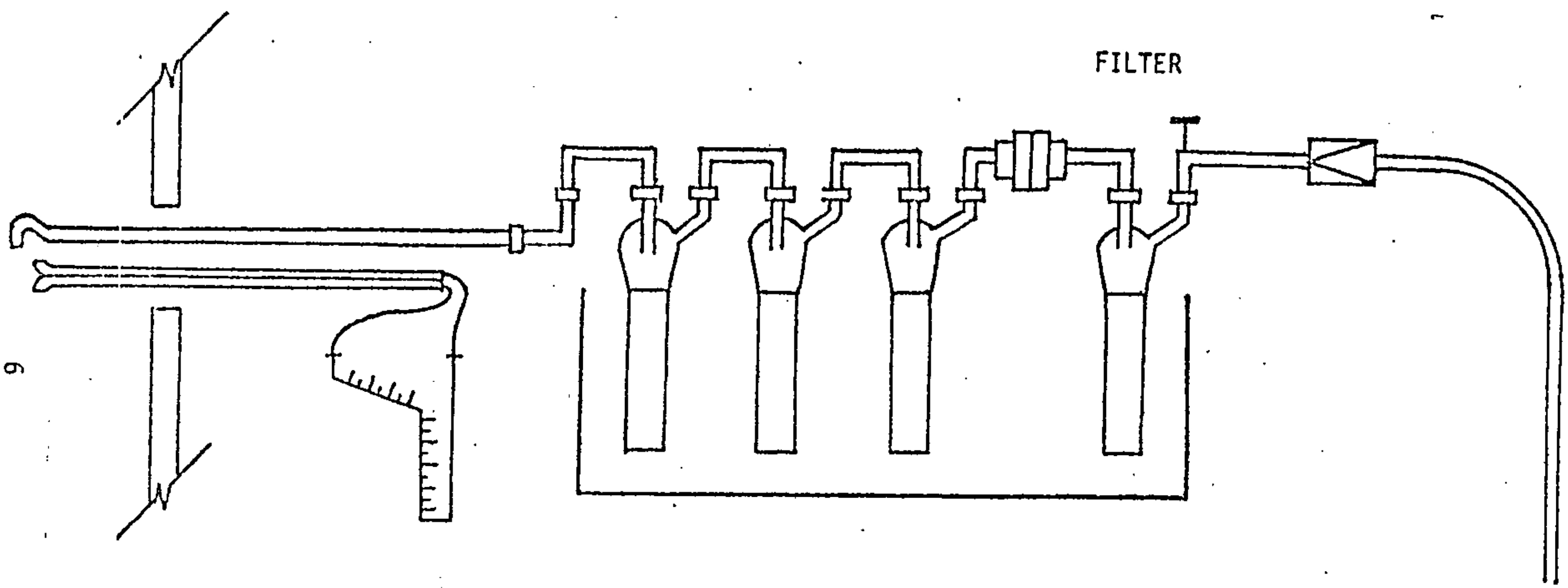


FIGURE 3b

MODIFIED Pb TRAIN

Visible emission readings were recorded at the exhaust of the Schnieble scrubber for each of the three test runs. This was done in accordance with procedures detailed in EPA Method 9, Visual Determination of the Opacity of Emissions from Stationary Sources (see Appendix A).

Simultaneous sampling was conducted at the two test locations during the three test runs for velocity, moisture, and sulfuric acid mist using EPA Method 8 (see Sampling and Analytical Procedures sections). The tests were run on the two outlets of the Trimer wet scrubber of the dry plate charging process (see Figure 4).

The EPA and contractor personnel arrived at the plant on August 23, 1976. Preliminary tests and measurements along with preparations for testing were completed by the August 23 date. Formal test runs were conducted on August 23, 24, 25, and 26, 1976. Appendix B lists project participants.

Volume I of this report contains the following sections:

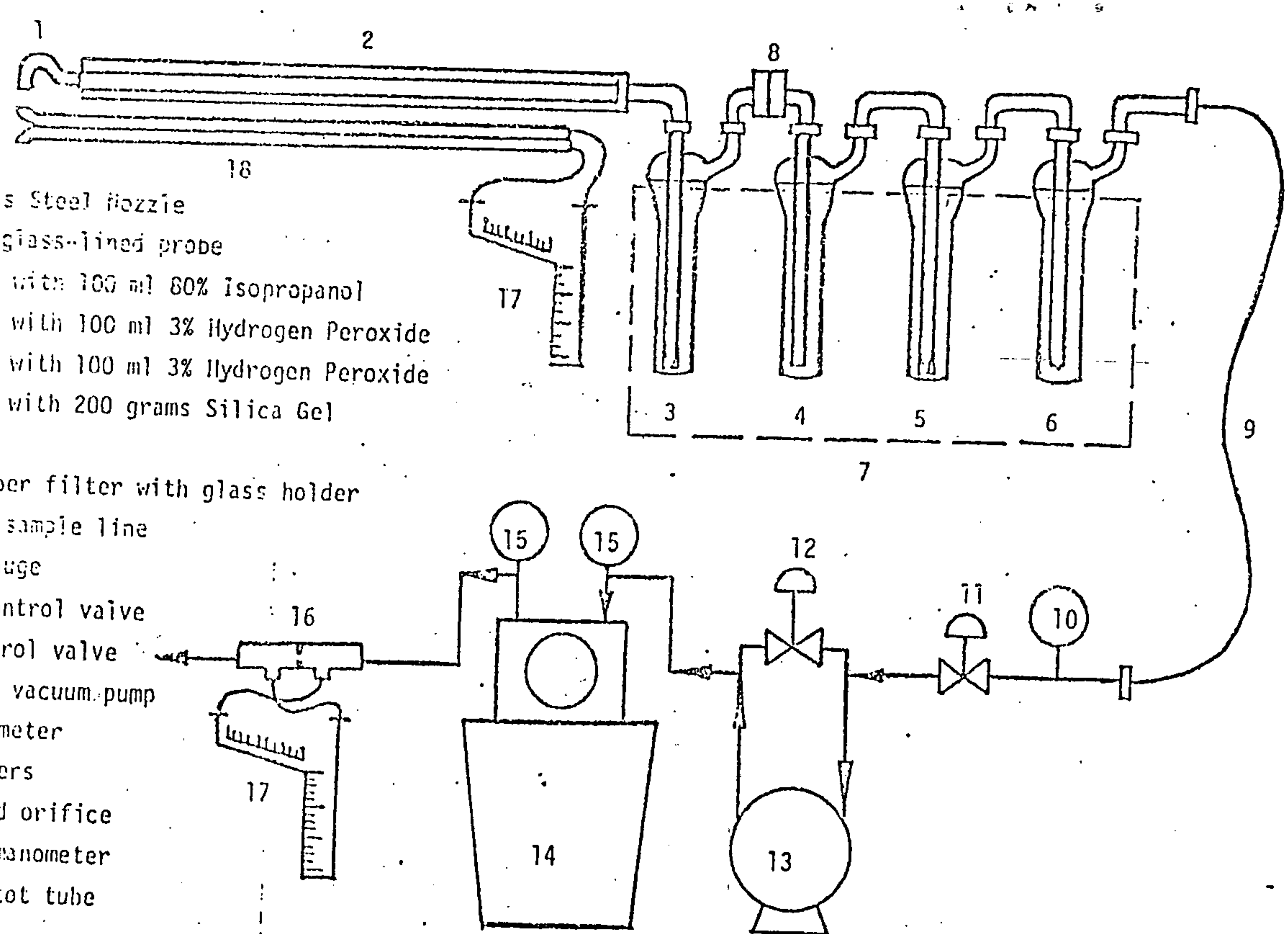
The Summary of Results and Discussion

Process Description and Operation

Sampling Point Locations

Sampling and Analytical Test Procedures

Volume II contains Appendices detailing descriptions of procedures used during sampling and analytical operations along with example calculations and copies of field and laboratory data sheets.



1. Stainless Steel Nozzle
2. Heated, glass-lined probe
3. Impinger with 100 ml 80% Isopropanol
4. Impinger with 100 ml 3% Hydrogen Peroxide
5. Impinger with 100 ml 3% Hydrogen Peroxide
6. Impinger with 200 grams Silica Gel
7. Ice bath
8. Glass-fiber filter with glass holder
9. Flexible sample line
10. Vacuum gauge
11. Coarse control valve
12. Fine control valve
13. Air-tight vacuum pump
14. Dry test meter
15. Thermometers
16. Calibrated orifice
17. Inclined manometer
18. S-type pitot tube

FIGURE 4

EPA SO_2 AND SO_3 SAMPLE TRAIN

II. SUMMARY AND DISCUSSION OF RESULTS

PARTICULATE AND LEAD (Pb) SAMPLING RESULTS

Tables 1 through 8 summarize the results of the particulate sampling at the Schnieble scrubber inlet and outlet in English and metric units, respectively. Table 9 summarizes the results of sampling for lead concentration at the above locations.

Sampling was performed using Methods 5 and lead (Pb) determination method as explained in the sampling and analytical procedures of this report. Lead (Pb) method is a modification of Method 5 incorporating dilute (.1N) nitric acid in the impingers and placing the filter behind the impinger train. Simultaneous sampling was performed at the outlet in order to obtain data verifying the reproducibility of this sampling method.

Tables 10 through 21 summarize the results of the sulfuric acid mist sampling at the outlets of the Trimer scrubber in English and metric units, respectively. Table 22 summarizes additional analyses performed on the dry formation process sampled at outlets of the Trimer scrubber.

Sampling was performed using Method 8 as explained in the sampling and analytical procedures of this report. The samples were run in cycles with each cycle consisting of approximately 15-17 hours on identical stacks. This warranted simultaneous sampling in order to get a representable sample. After completing two cycles, it was decided that Method 8 was not applicable to the low concentrations of SO_3 being emitted from the Trimer scrubber. Samples were taken back to Monsanto Research Corporation laboratory and analyzed with a more sensitive method. Appendix C contains the field data sheets for all source tests conducted.

Table II.

Runs 1C, 2C, and 3C

PARTICULATE SUMMARY IN ENGLISH UNITS

DESCRIPTION	UNITS	1	2	3	AVERAGE
DATE OF RUN		8-25-76	8-25-76	8-25-76	
STACK AREA	FT2	1.76[illegible]	1.7[illegible]	1.7[illegible]	
NET TIME OF RUN	MIN	64.0	54.0	[illegible].0	
BAROMETRIC PRESS	IN.HG	29.4[illegible]	2[illegible]	[illegible]	
AVG ORIFICE PRES DROP	IN.H2O	1.130	1.120	1.230	
VOL DRY GAS-METER COND	DCF	39.45	3[illegible].13	[illegible]	
AVG GAS METER TEMP	DEG.F	93.4	8[illegible].1	[illegible].2	
VOL DRY GAS-STD COND	DSCF	37.[illegible]4	[illegible]	[illegible]	
TOTAL H2O COLLECTED	ML	[illegible].7	2[illegible].3	13.0	
VOL H2O VAPOR-STD COND	SCF	.03	1.06	.35	
PERCENT MOISTURE BY VOL		.2	2.8	[illegible]	
MOLE FRACTION DRY GAS		.9[illegible]8	.972	.97[illegible]	
PERCENT CO2 BY VOL, DRY		.0	.0	.0	
PERCENT O2 BY VOL, DRY		.0	.0	.0	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		10[illegible].	1[illegible].	1[illegible].	
MOLECULAR WT-DRY STK GAS		28.[illegible]	2[illegible].	2[illegible].	
MOLECULAR WT-STK GAS		28.[illegible]6	2[illegible]	2[illegible].64	
AVG STACK TEMPERATURE	DEG.F	106.[illegible]	105.[illegible]	10[illegible].	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	IN.HG	29.4[illegible]	[illegible].[illegible]7	[illegible].[illegible]7	
AVG STACK GAS VELOCITY	FPS	5[illegible].249	5[illegible]	[illegible].302	57.[illegible]02
STK FLOWRATE, DRY, STD CN	DSCFM	5381.	5[illegible]24.	5531.	5[illegible]12.
ACTUAL STACK FLOWRATE	ACFM	58[illegible].	620[illegible].	[illegible].	[illegible].
PERCENT ISOKINETIC		101.6	9[illegible].0	[illegible]8.3	[illegible].6
PARTICULATE WT-PARTIAL	MG	.0	.0	.0	.0
PARTICULATE WT-TOTAL	MG	.0	.0	.0	.0
PERCENT IMPINGER CATCH		.0	.0	.0	.0
PART. LOAD-PTL, STD CN	GR/DSCF	.0	.0	.0	.0
PART. LOAD-TTL, STD CN	GR/DSCF	.0	.0	.0	.0
PART. LOAD-PTL, STD CN @ 12% CO2		*			
PART. LOAD-TTL, STD CN @ 12% CO2		*			
PART. LOAD-PTL, STK CN	GR/ACF	.0	.0	.0	.0
PART. LOAD-TTL, STK CN	GR/ACF	.0	.0	.0	.0
PARTIC EMIS-PARTIAL	LB/HR	.0	.0	.0	.0
PARTIC EMIS-TOTAL	LB/HR	.0	.0	.0	.0
PART EMIS/MB [illegible]	LB/[illegible]	*			
PART EMIS/[illegible]	LB/[illegible]	*			
PERCENT EXCESS AIR		*			

PLANT: [illegible]

LOCATION: [illegible]

Table II.

Runs 1C, 2C, and 3C

PARTICULATE SUMMARY IN METRIC UNITS

DESCRIPTION	UNITS	1	2	3	AVERAGE
DATE OF RUN		8-25-76	8-25-76	8-25-76	
STACK AREA	M2	.154	.15[illegible]	.15[illegible]	
NET TIME OF RUN	MIN	64.0	64.0	64.0	
BAROMETRIC PRESSURE	MM HG	740.05	74[illegible].05	7[illegible].05	
AVG ORIFICE PRES DROP	MM H2O	28.702	2[illegible].4[illegible]	31.2[illegible]	
VOL DRY GAS-METER COND	M3	1.12	1.[illegible]	1.[illegible]3	
AVG GAS METER TEMP	DEG C	34.1	31.7	32.6	
VOL DRY GAS-STD COND	M3	1.06	1.03	1.07	
TOTAL H2O COLLECTED	ML	1.7	20.3	18.0	
VOL H2O VAPOR-STD COND	M3	.00	.03	.02	
PERCENT MOISTURE BY VOL		.2	2.4	[illegible]	
MOLE FRACTION DRY GAS		.998	.972	.978	
PERCENT CO2 BY VOL, DRY		.0	.0	.0	
PERCENT O2 BY VOL, DRY		.0	.0	.0	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		100.	100.	100.	
MOLECULAR WT-DRY STK GAS		28.[illegible]	2[illegible].[illegible]	2[illegible].	
MOLECULAR WT-STK GAS		28.[illegible]6	[illegible].5[illegible]	2[illegible].64	
AVG STACK TEMPERATURE	DEG C	41.1	41.[illegible]	41.1	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	MM HG	747.2[illegible]	743.[illegible]6	743.[illegible]	
AVG STACK GAS VELOCITY	M/S	16.840	17.3[illegible]	1[illegible].075	17.5[illegible]
STK FLOWRATE, DRY, STD CN	DSCM/M	152.	156.	159.	156.
ACTUAL STACK FLOWRATE	M3/M	16[illegible].	175.	178.	173.
PERCENT ISOKINETIC		101.6	9[illegible].0	93.3	[illegible].6
PARTICULATE - PARTIAL	MG	.0	.0	.0	.0
PARTICULATE - TOTAL	MG	.00	.0	.0	.0
PERCENT IMPINGER CATCH		.0	.0	.0	.0
PART. LOAD-PTL,STD CN	MG/DSCM	.0	.0	.0	.0
PART. LOAD-TTL,STD CN	MG/DSCM	.0	.0	.0	.0
PART. LOAD-PTL,STD CN @ 12% CO2	*				
PART. LOAD-TTL,STD CN @ 12% CO2	*				
PART. LOAD-PTL,STK CN	MG/ACM	.0	.0	.0	.0
PART. LOAD-TTL,STK CN	MG/ACM	.0	.0	.0	.0
PARTIC EMIS-PARTIAL	KG/HR	.0	.0	.0	.0
PARTIC EMIS-TOTAL	KG/HR	.0	.0	.0	.0
PART EMIS/UNIT PRD (PTL)	KG/M TON	*			
PART EMIS/UNIT PRD (TTL)	KG/M TON	*			
PERCENT EXCESS AIR		*			

Table 3.

Runs 1D1 and 1D2

[illegible]	[illegible]	1	2	[illegible]
[illegible]		3 25 76	3 25 76	
[illegible]	[illegible]	1.069	1.069	
[illegible]	[illegible]	64.0	64.0	
[illegible]	[illegible]	29.53	29.53	
[illegible]	[illegible]	1.490	1.970	
[illegible]	[illegible]	46.10	[illegible]	
[illegible]	[illegible]	98.0	93.7	
[illegible]	[illegible]	43.[illegible]	[illegible]	
[illegible]	[illegible]	27.5	36.[illegible]	
[illegible]	[illegible]	1.30	1.73	
[illegible]		2.9	3.5	
[illegible]		.971	.965	
[illegible]		.0	.0	
[illegible]		.0	.0	
[illegible]		.0	.0	
[illegible]		.0	.0	
[illegible]		10[illegible]	[illegible]	
[illegible]		28.76	[illegible]	
[illegible]		28.54	[illegible]	
[illegible]	[illegible]	90.1	90.1	
[illegible]		1	1	
[illegible]	[illegible]	29.5	[illegible]	
[illegible]	[illegible]	52.096	[illegible]	[illegible]
[illegible]	[illegible]	3086.	[illegible]	3275.
[illegible]	[illegible]	3341.	[illegible]	[illegible]
[illegible]		95.0	[illegible]	[illegible]
[illegible]	[illegible]	.0	[illegible]	[illegible]
[illegible]	[illegible]	.0	.0	[illegible]
[illegible]		.0	[illegible]	[illegible]
[illegible]	[illegible]	.0	[illegible]	[illegible]
[illegible]	[illegible]	.0	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	.0	[illegible]	[illegible]
[illegible]	[illegible]	.0	[illegible]	[illegible]
[illegible]	[illegible]			
[illegible]	[illegible]	.0	[illegible]	[illegible]
[illegible]	[illegible]	.0	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		
[illegible]		[illegible]		

[illegible]

Table 4

Runs 1D1 and 1D2

[illegible]

[illegible]	[illegible]	1	2	[illegible]
[illegible]		3 25 76	3 25 76	
[illegible]	42	.02	[illegible]	
[illegible]	[illegible]	64.0	[illegible]	
[illegible]	[illegible]	251.3	251.3	
[illegible]	[illegible]	37.366	[illegible]	
[illegible]	[illegible]	1.31	1.41	
[illegible]	[illegible]	36.7	[illegible]	
[illegible]	[illegible]	1.23	[illegible]	
[illegible]	[illegible]	27.5	35.	
[illegible]	[illegible]	.06	.05	
[illegible]		2.9	3.5	
[illegible]		.071	.065	
[illegible]		.0	.0	
[illegible]		.0	.0	
[illegible]		.0	.0	
[illegible]		10.	10.	
[illegible]		23.6	23.5	
[illegible]		23.54	23.47	
[illegible]	[illegible]	32.4	[illegible]	
[illegible]		1	1	
[illegible]	[illegible]	250.37	[illegible]	
[illegible]	[illegible]	15,820	17,133	16,30
[illegible]	[illegible]	37.	[illegible]	[illegible]
[illegible]	[illegible]	95.	107.	[illegible]
[illegible]		95.0	[illegible]	[illegible]
[illegible]	[illegible]	.0	.0	.0
[illegible]	[illegible]	.0	.0	.0
[illegible]		.0	.0	.0
[illegible]	[illegible]	.0	.0	.0
[illegible]	[illegible]	.0	.0	.0
[illegible]	[illegible]			
[illegible]	[illegible]			
[illegible]	[illegible]	.0	.0	.0
[illegible]	[illegible]	.0	.0	.0
[illegible]	[illegible]	.0	.0	.0
[illegible]	[illegible]	.0	.0	.0
[illegible]	[illegible]			
[illegible]	[illegible]			
[illegible]				

[illegible]

Table 5.

Runs 2D1 and 2D2

PARTICULATE SUMMARY (IN ENGLISH UNITS)

DESCRIPTION	UNITS	1	2	AVERAGE
DATE OF RUN		3-26-74	3-26-74	
STACK AREA	SQ FT	1.069	1.069	
NET TIME OF RUN	MIN	64.0	64.0	
BAROMETRIC PRESS ABS	IN HG	29.44	[illegible]	
AVG ORIFICE PRESS DROP	IN H2O	1.350	2.130	
VOL DRY GAS-METER COND	DCF	42.48	51.12	
AVG GAS METER TEMP	DEG F	82.0	81.0	
VOL DRY GAS-STD COND	DSCF	41.07	49.6	
TOTAL H2O COLL BOTTLES	ML	3[illegible].7	42.8	
VOL H2O VAPOR-STD COND	SCF	1.60	2.03	
PERCENT MOISTURE BY VOL		3.7	3.9	
MOLE FRACTION DRY GAS		.963	.961	
PERCENT CO2 BY VOL, DRY		.0	.0	
PERCENT O2 BY VOL, DRY		.0	.0	
PERCENT CO BY VOL, DRY		.0	.0	
PERCENT N2 BY VOL, DRY		10[illegible]	10[illegible]	
MOLECULAR WT-DRY STK GAS		28.[illegible]	28.[illegible]	
MOLECULAR WT-STK GAS		28.4[illegible]	28.3[illegible]	
AVG STACK TEMPERATURE	DEG.F	85.0	86.0	
NET SAMPLING POINTS		1	1	
STACK PRESSURE, ABSOLUTE	IN.HG	29.46	29.46	
AVG STACK GAS VELOCITY	FPM	48.964	51.043	5[illegible]
STK FLOWRATE, DRY,STD CN	DSCFM	2894.	3594.	32[illegible]
ACTUAL STACK FLOWRATE	ACFM	3140.	3915.	3528.
PERCENT ISOKINETIC		104.5	10[illegible].7	103.[illegible]
PARTICULATE LOAD-PARTIAL	MG	.0	.0	.0
PARTICULATE LOAD-TOTAL	MG	.0	.0	.0
PERC IMPINGER CATCH		.0	.0	.0
PART. LOAD-PTL,STD CN	GR/DSCF	.0	.0	.0
PART. LOAD-TTL,STD CN	GR/DSCF	.0	.0	.0
PART. LOAD-PTL,STD CN @ 12% CO2		*		
PART. LOAD-TTL,STD CN @ 12% CO2		*		
PART. LOAD-PTL,STK CN	GR/ACF	.0	.0	.0
PART. LOAD-TTL,STK CN	GR/ACF	.0	.0	.0
PARTIC EMIS-PARTIAL	LB/HR	.0	.0	.0
PARTIC EMIS-TOTAL	LB/HR	.0	.0	.0
PART EMIS/MM BTU FI PTL	LB/MMBTU	*		
PART EMIS/MM BTU FI TTL	LB/MMBTU	*		
PERCENT EXCESS AIR		*		

Table 6

Runs 2D1 and 2D2

PARTICULATE SUM[illegible]				
DESCRIPTION	UNITS	1	2	AVERAGE
DATE OF RUN		3-26-7[illegible]	3-2[illegible]-7[illegible]	
STACK AREA	M2	.0[illegible]	.0[illegible]	
NET TIME OF RUN	MIN	64.0	5[illegible].0	
BAROMETRIC PRESS	MM HG	740.05	74[illegible]	
AVG ORIFICE PRESS DROP	MM H2O	34.29[illegible]	54.1[illegible]	
VOL DRY GAS-METER COND	M3	1.29	1.45	
AVG GAS METER TEMP	DEG.C	27.8	[illegible]	
VOL DRY GAS-STD COND	NM3	1.[illegible]	1.[illegible]	
TOTAL H2O COLLECTED	ML	3[illegible].7	42.8	
VOL H2O VAPOR-STD COND	NM3	.05	.06	
PERCENT MOISTURE BY VOL		3.7	3.9	
MOLE FRACTION DRY GAS		.963	.961	
PERC CO2 BY VOL, DRY		.0	.0	
PERC O2 BY VOL, DRY		.0	.0	
PERC CO BY VOL, DRY		.0	.0	
PERC N2 BY VOL, DRY		10[illegible]	[illegible]	
MOLECULAR WT-DRY STK GAS		28.[illegible]	[illegible]	
MOLECULAR WT-STK GAS		28.42	[illegible]	
AVG STACK TEMPERATURE	DEG.C	29.4	30.[illegible]	
NET SAMPLING POINTS		1	1	
STACK PRESSURE, ABSOLUTE	MM HG	748.2[illegible]	74[illegible]	
AVG STACK GAS VELOCITY	M/S	14.92[illegible]	13.60	1[illegible].2[illegible]5
STK FLOWRATE, DRY, STD CN	NM3/M	82.	102.	9[illegible].
ACTUAL STACK FLOWRATE	M3/M	89.	1[illegible].	10[illegible].
PERCENT ISOKINETIC		104.5	10[illegible].7	1[illegible]3.[illegible]
PARTICULATES-PARTIAL	MG	.0	[illegible]	[illegible]
PARTICULATES-TOTAL	MG	.0	.0	.[illegible]
PERC IMPINGER CATCH		.0	.0	.0
PART. LOAD-PTL,STD CN	MG/NM3	.0	.[illegible]	.[illegible]
PART. LOAD-TTL,STD CN	MG/NM3	.0	.[illegible]	.[illegible]
PART. LOAD-PTL,STD CN @ 12% CO2		*		
PART. LOAD-TTL,STD CN @ 12% CO2		*		
PART. LOAD-PTL,STK CN	MG/M3	.0	.[illegible]	.[illegible]
PART. LOAD-TTL,STK CN	MG/M3	.0	.[illegible]	.[illegible]
PARTIC EMIS-PARTIAL	KG/HR	.0	.[illegible]	.[illegible]
PARTIC EMIS-TOTAL	KG/HR	.0	.[illegible]	.[illegible]
PART EMIS/[illegible]	KG/[illegible]	*		
PART EMIS/[illegible]	KG/[illegible]	*		
PERC EXCESS AIR		*		

Table 7.

Runs 3D1 and 3D2

PARTICULATE SUMMARY IN ENGLISH UNITS

DESCRIPTION	UNITS	1	2	AVERAGE
DATE OF RUN		3 26 75	3 25 7[illegible]	
STACK AREA	SQ.FT.	1.060	1.060	
NET TIME OF RUN	MIN	64.0	[illegible]	
BAROMETRIC PRESS.	IN.HG	29.4[illegible]	[illegible]	
AVG ORIFICE PRES DROP	IN.H2O	1.630	1.970	
VOL DRY GAS-METER COND	DCF	45.2[illegible]	50.31	
AVG GAS METER TEMP	DEG.F	92.6	45.[illegible]	
VOL DRY GAS-STD COND	DSCF	[illegible]	52.13	
TOTAL H2O COLLECTED	ML	35.0	29.[illegible]	
VOL H2O VAPOR-STD COND	SCF	1.6	1.42	
PERCENT MOISTURE BY VOL		3.7	2.6	
MOLE FRACTION DRY GAS		.963	.974	
PERC. CO2 BY VOL, DRY		.0	.0	
PERC. O2 BY VOL, DRY		.0	.0	
PERCENT CO BY VOL, DRY		.0	.0	
PERCENT N2 BY VOL, DRY		10[illegible]	10[illegible]	
MOLECULAR WT-DRY STK GAS		28.65	28.76	
MOLECULAR WT-STK GAS		28.25	28.46	
AVG STACK TEMPERATURE	DEG.F	90.[illegible]	8[illegible].0	
NET SAMPLING POINTS		1	1	
STACK PRESS., ABSOLUTE	IN.HG	29.4[illegible]	29.4[illegible]	
AVG STACK GAS VELOCITY	FPS	52.6[illegible]1	52.2[illegible]1	5[illegible].[illegible]55
STK FLOWRATE, DRY, STD CN	DSCFM	308[illegible].	3520.	3[illegible]01.
ACTUAL STACK FLOWRATE	ACFM	3[illegible]78.	3[illegible]00.	3530.
PERCENT ISOKINETIC		102.4	109.[illegible]	105.7
PARTICULATE - PARTIAL CATCH	MG	.0	.0	.0
PARTICULATE - TOTAL	MG	.0	.0	.0
PERC. IMPINGER CATCH		.0	.0	.0
PART. LOAD-PTL, STD CN	GR/DSCF	.0	.0	.0
PART. LOAD-TTL, STD CN	GR/DSCF	.0	.0	.0
PART. LOAD-PTL, STD CN @ 12% CO2		.		
PART. LOAD-TTL, STD CN @ 12% CO2		.		
PART. LOAD-PTL, STK CN	GR/ACF	.0	.0	.0
PART. LOAD-TTL, STK CN	GR/ACF	.0	.0	.0
PARTIC EMIS-PARTIAL	LB/HR	.0	.0	.0
PARTIC EMIS-TOTAL	LB/HR	.0	.0	.0
PART EMISS/HT PRO F-PTL	[illegible]	.		
PART EMISS/HT PRO F-TTL	[illegible]	.		
PERCENT EXCESS AIR		.		

Table 8.

Runs 3D1 and 3D2

PARTICULATE SUMMARY TABLE (METRIC UNITS)

DESCRIPTION	UNITS	1	2	AVERAGE
DATE OF RUN		8-26-7[illegible]	[illegible]	
STACK AREA	M2	.09	[illegible]	
NET TIME OF RUN	MIN	64.0	5[illegible]	
BAROMETRIC PRESSURE	MM HG	749.05	7[illegible].05	
AVG ORIFICE PRES DROP	MM H2O	41.[illegible]	51.[illegible]	
VOL DRY GAS-METER COND	DCM	1.38	1.47	
AVG GAS METER TEMP	DEG C	3[illegible].7	7.5	
VOL DRY GAS-STD COND	DSCM	1.[illegible]	1.43	
TOTAL H2O COLLECTED	ML	35.0	29.[illegible]	
VOL H2O VAP COLL-STD COND	SCM	.05	.04	
PERCENT MOISTURE BY VOL		3.7	2.6	
MOLE FRACTION DRY GAS		.963	.974	
PERCENT CO2 BY VOL, DRY		.0	.0	
PERCENT O2 BY VOL, DRY		.0	.0	
PERCENT CO BY VOL, DRY		.0	.0	
PERCENT N2 BY VOL, DRY		100.0	100.0	
MOLECULAR WT-DRY STK GAS		28.65	28.74	
MOLECULAR WT-STK GAS		28.[illegible]5	28.46	
AVG STACK TEMPERATURE	DEG C	32.[illegible]	31.[illegible]	
NET SAMPLING POINTS		1	1	
STACK PRESSURE, ABSOLUTE	MM HG	741.[illegible]	741.[illegible]	
AVG STACK GAS VELOCITY	M/S	16.051	18.05[illegible]	17.05[illegible]
STK FLOWRATE, DRY, STD CN	DSCM/MIN	87.	10[illegible].	93.
ACTUAL STACK FLOWRATE	ACM/MIN	96.	108.	102.
PERCENT ISOKINETIC		102.4	109.[illegible]	105.[illegible]
PARTICULATE-PROBE,CYC, & FLTR	MG	.0	.0	.0
PARTICULATE-TOTAL	MG	.0	.0	.0
PERCENT IMPINGER CATCH		.0	.0	.0
PART. LOAD-PTL,STD CN	MG/DSCM	.0	.0	.0
PART. LOAD-TTL,STD CN	MG/DSCM	.0	.0	.0
PART. LOAD-PTL,STD CN @ 12% CO2		--		
PART. LOAD-TTL,STD CN @ 12% CO2		--		
PART. LOAD-PTL,STK CN	MG/ACM	.0	.0	.0
PART. LOAD-TTL,STK CN	MG/ACM	.0	.0	.0
PARTIC EMIS-PTL	KG/HR	.0	.0	.0
PARTIC EMIS-TTL	KG/HR	.0	.0	.0
PART EMISS/[illegible] PTL	KG/[illegible]	--		
PART EMISS/[illegible] TTL	KG/[illegible]	--		
PERCENT EXCESS AIR		--		

Table 9

Pb RESULTS - BUFFALO, NEW YORK

E.S.B., INC.

Run	Vm. Std.	Imp. catch	Filter catch	Total	Stack Gas Concentration µg/cu. F.		
					Imp. catch x 5 / Vm. Std	Filter x 50 / Vm Std.	Total x 50 / Vol. std
1C	37.330	36.750	27.6	3702.6	4922.3	36.97	4959.3
2C	37.349	4500.0	35.4	4535.4	6024.3	47.4	6070.3
3C	37.813	6200.0	52.5	6252.5	8198.2	69.4	8267.7
101	43.414	23.8	23.0	46.8	27.4	26.5	53.9
201	41.06	22.0	27.8	49.8	31.54	33.85	60.64
301	42.882	37.4	37.5	74.9	43.61	43.72	87.33
102	47.367	109.4	18.4	117.8	115.5	19.4	124.3
202	49.67	72.5	37.5	110.0	72.98	37.75	110.73
302	47.871	30.2	75.5	102.7	31.5	75.7	107.3

Table 10

1A cycle 1
2A
3A

Table 11.

Table 12

4A
5A (Cycle 2)

		1	2	

Table 13

6A, 7A, 8A (Cycle 2)

Table 14

PARTICULATE SUMMARY IN ENGLISH UNITS

DESCRIPTION	UNITS	0	2	0	AVERAGE
DATE OF RUN		8-24-76	8-24-76	8-25-76	
STACK AREA	FT2	5.585	5.585	5.585	
NET TIME OF RUN	MIN.	120.0	120.0	110.0	
BAROMETRIC PRESSURE	IN.HG	29.65	29.65	29.65	
AVG ORIFICE PRES DROP	IN.H2O	1.720	1.720	1.550	
VOL DRY GAS-METER COND	DCF	88.30	88.10	76.60	
AVG GAS METER TEMP	DEG.F	78.0	74.5	72.5	
VOL DRY GAS-STD COND	DSCF	86.55	86.92	75.83	
TOTAL H2O COLLECTED	ML	36.7	42.8	23.7	
VOL H2O VAPOR-STD COND	SCF	1.74	2.03	1.12	
PERCENT MOISTURE BY VOL		2.0	2.3	1.5	
MOLE FRACTION DRY GAS		.980	.977	.985	
PERCENT CO2 BY VOL, DRY		.0	.0	.0	
PERCENT O2 BY VOL, DRY		.0	.0	.0	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		100.0	100.0	100.0	
MOLECULAR WT-DRY STK GAS		28.78	28.78	28.84	
MOLECULAR WT-STK GAS		28.57	28.53	28.68	
AVG STACK TEMPERATURE	DEG.F	91.0	87.0	85.0	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	IN.HG	29.65	29.65	29.65	
AVG STACK GAS VELOCITY	FPS	16.586	16.661	16.087	16.445
STK FLOWRATE, DRY, STD CN	DSCFM	5192.	5237.	5118.	5183.
ACTUAL STACK FLOWRATE	ACFM	5558.	5583.	5391.	5511.
PERCENT ISOKINETIC		102.8	102.4	99.7	101.6
PARTICULATE WT-PARTIAL	MG	.00	.00	.00	.00
PARTICULATE WT-TOTAL	MG	.00	.00	.00	.00
PERC IMPINGER CATCH		.0	.0	.0	.0
PART. LOAD-PTL, STD CN	GR/DSCF	.00000	.00000	.00000	.00000
PART. LOAD-TTL, STD CN	GR/DSCF	.00000	.00000	.00000	.00000
PART. LOAD-PTL, STD CN @ 12% CO2		**********	**********	**********	**********
PART. LOAD-TTL, STD CN @ 12% CO2		**********	**********	**********	**********
PART. LOAD-PTL, STK CN	GR/ACF	.00000	.00000	.00000	.00000
PART. LOAD-TTL, STK CN	GR/ACF	.00000	.00000	.00000	.00000
PARTIC. EMIS-PARTIAL	LB/HR	.00	.00	.00	.00
PARTIC. EMIS-TOTAL	LB/HR	.00	.00	.00	.00
PART EMIS/WT PRD FD PTL	LB/TON	**********	**********	**********	**********
PART EMIS/WT PRD FD TTL	LB/TON	**********	**********	**********	**********
PERCENT EXCESS AIR		**********	**********	**********	**********

PLANT: ESB(BUFFALO)
LOCATION: BUFFALO,N.Y.

Table 15

PARTICULATE SUMMARY IN METRIC UNITS

DESCRIPTION	UNITS	0	2	0	AVERAGE
DATE OF RUN		8-24-76	8-24-76	8-25-76	
STACK AREA	M2	.519	.519	.519	
NET TIME OF RUN	MIN	120.0	120.0	110.0	
BAROMETRIC PRESSURE	MM HG	753.11	753.11	753.11	
AVG ORIFICE PRES DROP	MM H2O	43.688	43.688	39.370	
VOL DRY GAS-METER COND	DM3	2.50	2.49	2.17	
AVG GAS METER TEMP	DEG C	25.6	23.6	22.5	
VOL DRY GAS-STD COND	DNM3	2.45	2.46	2.15	
TOTAL H2O COLLECTED	ML	36.7	42.8	23.7	
VOL H2O VAPOR-STD COND	NM3	.05	.06	.03	
PERCENT MOISTURE BY VOL		2.0	2.3	1.5	
MOLE FRACTION DRY GAS		.980	.977	.985	
PERCENT CO2 BY VOL, DRY		.0	.0	.0	
PERCENT O2 BY VOL, DRY		.0	.0	.0	
PERCENT CO BY VOL, DRY		.0	.0	.0	
PERCENT N2 BY VOL, DRY		100.0	100.0	100.0	
MOLECULAR WT-DRY STK GAS		28.78	28.78	28.84	
MOLECULAR WT-STK GAS		28.57	28.53	28.68	
AVG STACK TEMPERATURE	DEG C	32.8	30.6	29.4	
NET SAMPLING POINTS		1	1	1	
STACK PRESSURE, ABSOLUTE	MM HG	753.11	753.11	753.11	
AVG STACK GAS VELOCITY	M/S	5.056	5.078	4.903	5.012
STK FLOWRATE, DRY, STD CN	DNM3/M	147.	148.	145.	147.
ACTUAL STACK FLOWRATE	AM3/M	157.	158.	153.	156.
PERCENT ISOKINETIC		102.8	102.4	99.7	101.6
PARTICULATE WT-PARTIAL	MG	.00	.00	.00	.00
PARTICULATE WT-TOTAL	MG	.00	.00	.00	.00
PERC IMPINGER CATCH		.0	.0	.0	.0
PART. LOAD-PTL, STD CN	MG/NM3	.00	.00	.00	.00
PART. LOAD-TTL, STD CN	MG/NM3	.00	.00	.00	.00
PART. LOAD-PTL, STD CN @ 12% CO2		**********	**********	**********	**********
PART. LOAD-TTL, STD CN @ 12% CO2		**********	**********	**********	**********
PART. LOAD-PTL, STK CN	MG/AM3	.00	.00	.00	.00
PART. LOAD-TTL, STK CN	MG/AM3	.00	.00	.00	.00
PARTIC EMIS-PARTIAL	KG/HR	.00	.00	.00	.00
PARTIC EMIS-TOTAL	KG/HR	.00	.00	.00	.00
PART EMIS/WT PRD FD PTL	KG/MTON	**********	**********	**********	**********
PART EMIS/WT PRD FD TTL	KG/MTON	**********	**********	**********	**********
PERCENT EXCESS AIR		**********	**********	**********	**********

Table 16

[illegible]

[illegible]	[illegible]	1	2	3	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	5.3	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	25.0	[illegible]	[illegible]	
[illegible]	[illegible]	36.3	[illegible]	[illegible]	
[illegible]	[illegible]	45.	[illegible]	[illegible]	
[illegible]	[illegible]	2.15	[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	
[illegible]		.0	[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	
[illegible]		.0	[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	95.0	[illegible]	[illegible]	
[illegible]		1	1		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]			
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]					

Table 17

~~1B (cycle 1)~~
2B
3B

Table 18

4B
5B

Table 19

Table 20

6B (cycle 2)
7B
8B

PARTICULATE SUMMARY (EPA METHOD 5)

[illegible]	[illegible]	1	2	3	AVERAGE
DATE OF RUN		3-24-76	3-25-76	3-25-76	
[illegible]	[illegible]	5.78	[illegible]	[illegible]	
NET TIME OF RUN	MIN	120.0	120.0	[illegible]	
[illegible]	IN.HG	29.65	[illegible]	[illegible]	
AVG ORIFICE PRESS DROP	IN.H2O	1.830	1.710	1.70	
VOL DRY GAS-METER COND	DCF	79.07	77.14	79.13	
AVG GAS METER TEMP	DEG.F	73.5	71.5	68.5	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
TOTAL H2O COLLECTED	ML	33.7	54.9	31.1	
[illegible]	[illegible]	1.33	2.50	1.47	
PERCENT MOISTURE BY VOL		2.0	2.9	1.8	
[illegible]		.980	.971	.982	
PERCENT CO2 BY VOL, DRY		.0	.0	.0	
[illegible]		.0	.0	.0	
PERCENT CO BY VOL, DRY		.0	.0	.0	
[illegible]		[illegible]	[illegible]	[illegible]	
MOLECULAR WT-DRY STK GAS		28.74	28.74	28.70	
[illegible]		28.51	28.46	28.50	
AVG STACK TEMPERATURE	DEG.F	94.0	93.[illegible]	90.[illegible]	
[illegible]		1	1	1	
STACK PRESSURE, ABSOLUTE	IN.HG	29.65	29.65	29.65	
[illegible]	FPS	15.335	15.4[illegible]	15.277	15.439
STK FLOWRATE, DRY-STD CN	DSCFM	5233.	5093.	5093.	5143.
[illegible]	ACFM	5541.	[illegible]	[illegible]	[illegible]
PERCENT ISOKINETIC		102.6	103.5	103.[illegible]	103.[illegible]
[illegible]	MG	.0	.[illegible]	.[illegible]	.[illegible]
PARTICULATE - TOTAL	MG	.0	.0	.[illegible]	.0
[illegible]		.0	.0	.0	.0
PART. LOAD-PTL,STD CN	GR/DSCF	.0	.[illegible]	.[illegible]	.[illegible]
[illegible]	GR/DSCF	.0	.	.	.
PART. LOAD-PTL,STD CN @ 12% CO2		**			
[illegible]		*			
PART. LOAD-PTL,STK CN	GR/ACF	.0	.[illegible]	.0	.[illegible]
[illegible]	GR/ACF	.0	.	.	.
PARTIC EMIS-PARTIAL	LB/HR	.0	.[illegible]	.0	.[illegible]
[illegible]	LB/HR	.0	.[illegible]	.[illegible]	.[illegible]
PART EMIS-PTL	LB/10[illegible]	**			
[illegible]	[illegible]	*			
PERCENT EXCESS AIR		*			

[illegible]

Table 21

PARTICULATE SUM[illegible] [illegible] [illegible] [illegible]

[illegible]	[illegible]	1	2	3	AVERAGE
[illegible]		1-24-76	1-25-76	1-25-76	
[illegible]	[illegible]	.510	.510	.510	
[illegible]	4[illegible]	120.[illegible]	12[illegible].	[illegible]	
[illegible]	.[illegible]	253.[illegible]	[illegible]	[illegible]	
AVG [illegible]	[illegible].820	46.[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	2.5[illegible]	[illegible].47	[illegible]	
AVG [illegible]	[illegible].0	23.1	21.9	20.3	
[illegible]	[illegible]	[illegible]	[illegible].65	[illegible]	
[illegible]	[illegible]	33.7	54.9	31.1	
[illegible]	[illegible]	.05	.07	.0[illegible]	
PERCENT [illegible]		2.9	2.9	1.8	
[illegible]		.230	.271	.2[illegible]	
[illegible]		.0	.0	.0	
[illegible]		.0	.0	.0	
PERCENT [illegible]		.0	.0	.0	
[illegible]		10[illegible].	1[illegible].	1[illegible].	
[illegible]		23.7[illegible]	23.7[illegible]	23.10	
[illegible]		23.5[illegible]	[illegible].46	2[illegible].60	
AVG STACK [illegible]	[illegible].0	34.[illegible]	32.[illegible]	32.[illegible]	
[illegible]		1	1	1	
STACK PRESSURE, ABSOLUTE	[illegible].HG	253.1[illegible]	253.1[illegible]	253.1	
[illegible]	[illegible]	5.15[illegible]	5.0[illegible]	[illegible]	5.226
[illegible]	[illegible]	143.	14[illegible].	1[illegible].	1[illegible]6.
[illegible]	[illegible]	160.	155.	154.	[illegible]
PERCENT ISOKINETIC		102.6	103.5	103.2	103.[illegible]
[illegible]	[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]
PARTICULATE [illegible]	[illegible]	.0	.0	.0	.0
[illegible]		.0	.0	.0	.0
PART. [illegible]	[illegible]	.0	.0	.0	.0
[illegible]	[illegible]	.0	.0	.0	.0
PART. [illegible] 12% [illegible]	+				
[illegible] 12% [illegible]	+				
PART. [illegible]	[illegible]	.0	.0	.0	.0
[illegible]	[illegible]	.0	.0	.0	.0
PARTIC [illegible]	[illegible]	.0	.0	.0	.0
[illegible]	[illegible]	.0	.0	.0	.0
PART [illegible]	+				
[illegible]	+				
[illegible]	+				

DRY FORMATION RESULTS
ESB, Inc.
Cheektowaga, New York

Table 22

Sample No.	Absorb. (@ 530 NM.)	Total Sulfur Collected As SO_4 (mg)
1A, Peroxide	0.012	2.0
2A, Peroxide	0.012	2.0
3A, Peroxide	0.012	2.0
4A, Peroxide	0.010	<2.0
5A, Peroxide	0.005	<2.0
6A, Peroxide	0.013	2.2
7A, Peroxide	0.014	2.4
8A, Peroxide	0.012	2.0
1B, Peroxide	0.016	3.6
2B, Peroxide	0.017	3.8
3B, Peroxide	0.016	3.6
4B, Peroxide	0.013	2.2
5B, Peroxide	0.013	2.2
6B, Peroxide	0.011	<2.0
7B, Peroxide	0.018	3.8
8B, Peroxide	0.012	2.0
field blank (H_2O_2)	0.010	<2.0
lab blank 10/29	0	0
lab balnk 11/2/a.m.	0	0
lab blank 11/2/p.m.	0	0
1A, Isopropanol	0.008	<2.0
2A, Isopropanol	0.005	<2.0
3A, Isopropanol	0.009	<2.0
4A, Isopropanol	0.014	2.4
5A, Isopropanol	0.007	<2.0
6A, Isopropanol	0.007	<2.0
7A, Isopropanol	0.007	<2.0
8A, Isopropanol	0.006	<2.0
1B, Isopropanol	0.006	<2.0
2B, Isopropanol	0.013	2.2
3B, Isopropanol	0.013	2.2
4B, Isopropanol	0.012	2.0
5B, Isopropanol	0.012	2.0
6B, Isopropanol	0.012	2.0
7B, Isopropanol	0.011	<2.0
8B, Isopropanol	0.012	2.0
field blank (IPA)	0.006	<2.0
lab blank 11/1	0	0

Visible Emissions

Opacity measurements were taken during the study by a qualified observer from Monsanto Research Corporation. Measurements were taken at the outlet to the Schnieble scrubber in conjunction with the source testing activities.

Tables 23 through 25 summarize visible emissions data at the Schnieble scrubber outlet. Appendix D includes the visible emissions field data sheets.

Trace Metals

Trace metal samples were obtained from the outlet of the Schnieble scrubber in order to obtain a qualitative sample that would show if any other metals were present in significant amounts. Table 26 summarizes trace metal analysis. Appendix E includes the trace metals field data sheets.

Particle Size Sampling Results

Particulate size samples were taken at the Schnieble scrubber inlet and outlet. Tables 27 through 29 summarize data at the inlet and Table 30 summarizes data at the outlet. Appendix F includes the particle size field data sheets.

Table 23

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant ~~mfg~~ Storage Batteries

Date 8/23/76

Company Name ESB

Hours of Observation Start 1:55 P, Stop 3:06 p

Plant Address Buffalo N.Y.

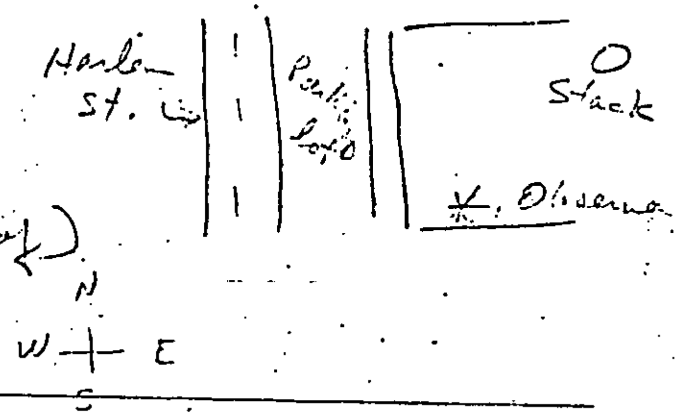
Observer L. Cox

Type of Discharge STACK ✓ OTHER ______

Discharge Location 1-D-1 and 1-D-2

Height of Point of Discharge 30'

Observer's Location:



Distance to Discharge Point 65'

Height of Observation Point 20' (Roof)

Direction from Discharge Point S W

Background Description Sky

Weather: Clear Overcast Partly Cloudy 30% Other ______ Color Blue

Wind Direction from South Wind Velocity 4-6 mi/hr

Plume Description:

Detached: Yes No

Color: Black White Other ______

Plume Dispersion Behavior: Looping Coning Fanning

Lofting Fumigating Other ______

Estimated Distance Plume Visible 3/4 mi.

Summary of Observations:

Opacity	Aggregate Time @ Opacity min.	sec.	Opacity	Aggregate Time @ Opacity
0			55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

Table 24

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant: Battery manufacture

Date: 8/26/76

Company Name: ESB

Hours of Observation: Start 7:35 A / Stop 8:41 A

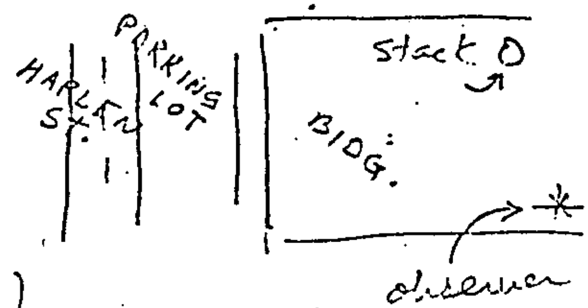
Plant Address: Buffalo N.Y

Observer: L. Cox

Type of Discharge: STACK ✓ OTHER ______

Discharge Location: 2D1/2D2

Height of Point of Discharge: 30'



Observer's Location:

Distance to Discharge Point: 60'

Height of Observation Point: 22' (roof level)

Direction from Discharge Point: S.E

Background Description: Sky

Weather: Clear Overcast Partly Cloudy Other ______ Color Blue-Gre

Wind Direction: from South Wind Velocity: 2 - 4 mi/hr

Plume Description:

Detached: Yes No

Color: Black White Other ______

Plume Dispersion Behavior: Looping Coning Fanning Lofting Fumigating Other ______

Estimated Distance Plume Visible: 1/2 mi

Summary of Observations:

Opacity	Aggregate Time @ Opacity min.	sec.	Opacity	Aggregate Time @ Opacity
0			55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

Table 25

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant mfg. of storage batteries

Company Name ESB

Plant Address Buffalo N.Y.

Type of Discharge STACK ✓ OTHER ______

Discharge Location 3D1/3D2

Height of Point of Discharge 30'

Observer's Location:

Distance to Discharge Point 60'

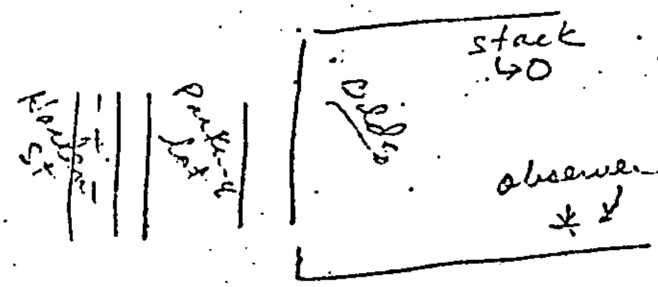
Height of Observation Point 22'

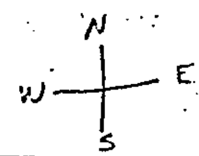
Direction from Discharge Point SE

Date 8/25/76

Hours of Observation Start 10:08 Stop 11:15

Observer L. Cox





Background Description Sky

Weather: Clear Overcast Partly Cloudy Other ______ Color Gray

Wind Direction from South Wind Velocity 2-4 mi/hr

Plume Description:

Detached: Yes No

Color: Black White Other ______

Plume Dispersion Behavior: Looping Coning Fanning

Lofting Fumigating Other ______

Estimated Distance Plume Visible ½ mi

Summary of Observations:

Opacity	Aggregate Time @ Opacity	Opacity	Aggregate Time @ Opacity
0	min. sec.	55	
5		60	
10		65	
15		70	
20		75	
25		80	
30		85	
35		90	
40		95	
45		100	
50			

Table 26. Qualitative Trace Metals Results

ELEMENT	TEST NO. 76-BAT-2	SAMPLE NO.	
	001-701	001-702	001-703
Be	<0.02	<0.02	<0.02
Cd	<4.	<3.	<4.
As	<4.	<3.	<4.
V	0.9	<0.3	<0.4
Mn	0.4	<0.2	<0.1
Ni	4.	2.0	2.
Sb	6	16.	6.
Cr	4	0.3	1.
Zn	<4.	<3.	<4.
Cu	4.	2.	2.
Pb	370.	320.	90.
B	9.	8.	9.
Li	<9.	<8.	<9.
Ag	0.2	<0.2	<0.2
Sn	2.	5	0.5
Fe	90	50.	20.
Sr	<0.4	0.4	<0.4
Na	3700	3200	3700
K	370.	320.	550
Ca	550.	480.	550
Mg	55.	50.	55
Ba	4.	3.	6

Table 27

CASCADE IMPACTOR PARTICLE SIZE DISTRIBUTION FOR RUN 1C

INPUT VARIABLE	UNITS	INPUT DATA
SAMPLING TIME	MIN	20.0
PRESSURE DROP	CM HG	12.88
STATIC PRESSURE	CM H2O	-4.57
PARTICLE DENSITY	G/CC	9.53
BAROMETRIC PRESSURE	CM HG	74.90
GAS MOL WT		28.4
GAS TEMPERATURE	DEG C	63.3
GAS VISCOSITY	POISE	0.00020
GAS DENSITY	G/CC	0.00117

STAGE	WT OF MATERIAL	DPC	MG/ACM	WT PCNT	CUM WT PCNT
CYCLONE	2.110		0.03	65.94	100.00
1	0.510	1.02	0.01	15.94	34.06
2	0.120	0.57	0.00	3.75	18.12
3	0.070	0.37	0.00	2.19	14.38
4	0.130	0.16	0.00	4.06	12.19
5	0.060	0.07	0.00	1.88	8.13
FILTER	0.200		0.00	6.25	6.25

Table 28

CASCADE IMPACTOR PARTICLE SIZE DISTRIBUTION FOR RUN 2C

INPUT VARIABLE	UNITS	INPUT DATA
SAMPLING TIME	MIN	20.0
PRESSURE DROP	IN HG	5.07
STATIC PRESSURE	IN H2O	-1.80
PARTICLE DENSITY	G/CC	9.53
BAROMETRIC PRESSURE	IN HG	29.49
GAS MOL WT		28.4
GAS TEMPERATURE	DEG F	143.4
GAS VISCOSITY	POISE	0.00020
GAS DENSITY	G/CC	0.00117

STATE	WT OF MATERIAL	DPC	MG/ACF	WT PCNT	CUM WT PCNT
CYCLONE	4.010		1.76	87.15	100.00
1	0.267	1.02	0.12	5.80	12.85
2	0.058	0.57	0.03	1.26	7.04
3	0.048	0.37	0.02	1.04	5.78
4	0.059	0.16	0.03	1.28	4.74
5	0.059	0.07	0.03	1.28	3.46
FILTER	0.100		0.04	2.17	2.17

Table 29

CASCADE IMPACTOR PARTICLE SIZE DISTRIBUTION FOR RUN 3C

INPUT VARIABLE	UNITS	INPUT DATA
SAMPLING TIME	MIN	20.0
PRESSURE DROP	IN HG	5.07
STATIC PRESSURE	IN H2O	-1.80
PARTICLE DENSITY	G/CC	9.53
BAROMETRIC PRESSURE	IN HG	29.49
GAS MOL WT		28.4
GAS TEMPERATURE	DEG F	124.4
GAS VISCOSITY	POISE	0.00020
GAS DENSITY	G/CC	0.00120

STATE	WT OF MATERIAL	DPC	MG/ACF	WT PCNT	CUM WT PCNT
CYCLONE	0.000		0.00	0.00	100.00
1	0.032	1.03	0.01	17.58	100.00
2	0.006	0.58	0.00	3.30	82.42
3	0.004	0.38	0.00	2.20	79.12
4	0.008	0.16	0.00	4.40	76.92
5	0.032	0.07	0.01	17.58	72.53
FILTER	0.100		0.04	54.95	54.95

Table 30
Andersen Particle Size Data
ESB Inc.
Cheektowaga, New York

Run 1

Stage	DPC (microns)	Wt. of Material (mg)	Wt. %	Cum. Wt. %
nozzle	>3.56	4.17	41.08	100.00
0	3.56	0.02	0.20	58.92
1	2.24	0.03	0.30	58.72
2	1.50	0.02	0.20	58.42
3	1.04	0.01	0.10	58.22
4	0.66	0.6	5.91	58.12
5	0.33	0.6	5.91	52.21
6	0.20	1.7	16.75	46.30
7	0.14	1.3	12.80	29.55
F	<0.14	1.7	16.75	16.75

Run 2

Stage	DPC (microns)	Wt. of Material (mg)	Wt. %	Cum. Wt. %
nozzle	>3.50	1.77	20.82	100.00
0	3.50	0.01	0.12	79.18
1	2.20	0.02	0.24	79.06
2	1.48	0.2	2.35	78.82
3	1.03	0.3	3.53	76.47
4	0.65	0.6	7.06	72.94
5	0.33	2.0	23.53	65.88
6	0.20	1.6	18.82	42.35
7	0.14	1.3	15.29	23.53
F	<0.14	0.7	8.24	8.24

Run 3

Stage	DPC (microns)	Wt. of Material (mg)	Wt. %	Cum. Wt. %
nozzle	>3.54	6.27	66.63	100.00
0	3.54	0.01	0.11	33.37
1	2.23	0.01	0.11	33.26
2	1.50	0.02	0.21	33.15
3	1.04	0.04	0.42	32.94
4	0.67	0.3	3.19	32.52
5	0.33	0.06	0.64	29.33
6	0.20	0.6	6.38	28.69
7	0.14	1.3	13.81	22.31
F	<0.14	0.8	8.50	8.50

III. PROCESS DESCRIPTION

PEDCo-ENVIRONMENTAL
SUITE 13 • ATKINSON SQUARE
CINCINNATI, OHIO 45246
513/771-4330

PROCESS DESCRIPTION AND OPERATION TO BE INCLUDED IN SOURCE TEST REPORT FOR ESB'S BATTERY PLANT IN BUFFALO, NEW YORK

Prepared by

PEDCo-Environmental Specialists, Inc.
Suite 13, Atkinson Square
Cincinnati, Ohio 45246

Contract No. 68-02-2085

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Emission Standards and Engineering Division
Industrial Studies Branch
Research Triangle Park,
North Carolina 27711

October 25, 1976

BRANCH OFFICES

Suite 110, Crown Center
Kansas City, Mo. 64108

Suite 107-B Professional Village
Chapel Hill, N.C. 27514

CONTENTS

PROCESS DESCRIPTION AND OPERATION

GENERAL DESCRIPTION OF LEAD-ACID BATTERY MANUFACTURING

Battery manufacturing begins with two unrelated operations; grid casting and paste mixing. The grids are generally cast from lead hardened by the addition of between 6 and 12 percent antimony.

Casting techniques for grids vary with the alloy used, the type of molds, and mold preparation before casting. Grid casting machines can have melting pots attached directly to them or have a central pot furnace from which the molten lead is either pumped or fed by gravity. Lead alloy ingots are melted in these gas-fired lead pots at approximately 700°F. The produced grids are sent to the grid pasting operation.

The paste making operating, a batch-type process, takes place in either a muller, Day, or dough-type mixer. From 600 to 3,000 pounds of lead oxide is added to the mixer, water and sulfuric acid is then added, and the mixture is blended to form a stiff paste. Because of the exothermic conditions, mixers are usually water-jacketed and air-cooled to prevent excessive temperature build-up which causes the paste to become stiff and difficult to apply to the grids.

Varying amounts of expander and other constituents are added depending on whether a positive or negative paste batch is desired. The time of the mixing cycle is dependent on the type of mixer utilized. Mixing cycles range from 15 minutes up to an hour in duration.

Pasting machines force the lead sulfate paste into the interstices of the grid structure at production rates exceeding 200 plates per minute (the grids are called plates after the paste has been applied). The freshly pasted plates are transported by a horizontal chain through a temperature controlled, heated tunnel about 20 feet long, where the surface water is removed. This allows the plates to be stacked without sticking together. It is important that only the surface water be removed since the plates depend on moisture to produce the chemical reaction within the paste while curing - very much similar to a cementitious process. The plates are cured for about 72 hours to increase plate strength.

Following the curing stage, the plates are normally sent to the three-process operation. This operation encompasses stacking, burning, and assembly. First, the plates are stacked in an alternating positive and negative block formation. Insulators are sandwiched between each plate to insulate the oppositely charged plates while permitting free ionic flow.

These dividers are made from materials such as wood, treated paper, plastic, or rubber. While machines have been designed which can stack the plates and separators automatically, hand stacking is common, even in some relatively large plants.

Leads (pronounced leeds) are welded to the tabs of each positive plate and each negative plate, fastening the assembly (element) together. This is the burning operation. An alternative to the welding or burning process is the "cast strap" process. In the latter, molten lead is poured around and between the plate tabs, thus forming the connection. Then a positive and negative terminal is welded to the element. The completed elements can go to either the wet or dry battery lines.

In the wet battery line, elements are placed within cases made of durable plastic or hard rubber. Covers equipped with openings and lead inserts are aligned so that the terminals project out of the inserts. The covers are sealed to the cases and the batteries are filled with dilute sulfuric acid and made ready for formation.

The only difference between the wet battery and the dry battery process is that, for dry batteries, the elements are formed prior to being placed in a sealed case. The dry batteries are shipped without acid. Sulfuric acid is then added to the battery at the point of use. This gives the battery an indefinite shelf-life.

Formation is a chemical process wherein the inactive lead oxide-sulfate paste is converted into an active electrode. Formation is essentially an oxidation-reduction reaction wherein the positive plates are oxidized from lead oxide to lead peroxide, and the negative plates are reduced from lead oxide to metallic lead. This is accomplished by placing the unformed plates in a dilute sulfuric acid solution and connecting the positive plates to the positive pole of a dc source and the negative plates to the negative pole of the dc source.

When manufacturing wet lead-acid batteries it is common practice to place the cells into the battery cases, place the lid on the battery, and add sulfuric acid. The plates are then formed within the battery case itself. After formation, the spent acid is dumped from the batteries, new acid added, and a boost charge given to the battery. The unit is then ready for use and only requires decoration and manufacturer's markings.

The plates used in dry batteries are formed in one of several ways. Some plates are individually formed in tanks of sulfuric acid and then assembled. However, most dry batteries are made by assembling the plates into the elements beforehand. The completed elements are then formed in one of two manners. First, the elements themselves can be placed into large tanks of sulfuric acid, electrically connected, and formed. Some companies place the assembled elements directly into the battery case. Thereafter, the formed elements are removed, the acid dumped, and the cases and elements rinsed and dried, reassembled and shipped dry.

Formation takes anywhere from one to four days. Most plant use a 36-to-48-hour forming cycle. The charging rate is high during the first 24 to 36 hours, the lower during the remaining 12 hours. The ampere rates are dependent upon battery size. Figure shows a typical battery plant flow diagram.

PROCESS DESCRIPTION FOR ESB's BUFFALO PLANT

Electric Storage Battery's (ESB) Buffalo plant has a capacity of 1800 batteries/day and a normal operating output of 1500 batteries/day. Both wet and dry batteries are produced. Figure is a schematic diagram of the ESB facility.

The major facilities include grid casting, paste mixing, the three-process operation, and formation. There is also a small parts casting unit and a lead reclaim pot. The plant receives its lead oxide and lead from an outside source.

Grids are cast on six grid casting machines which receive lead from two melting pots. Since the company feels that there are negligible particulate and lead emissions from this process, it is not controlled.

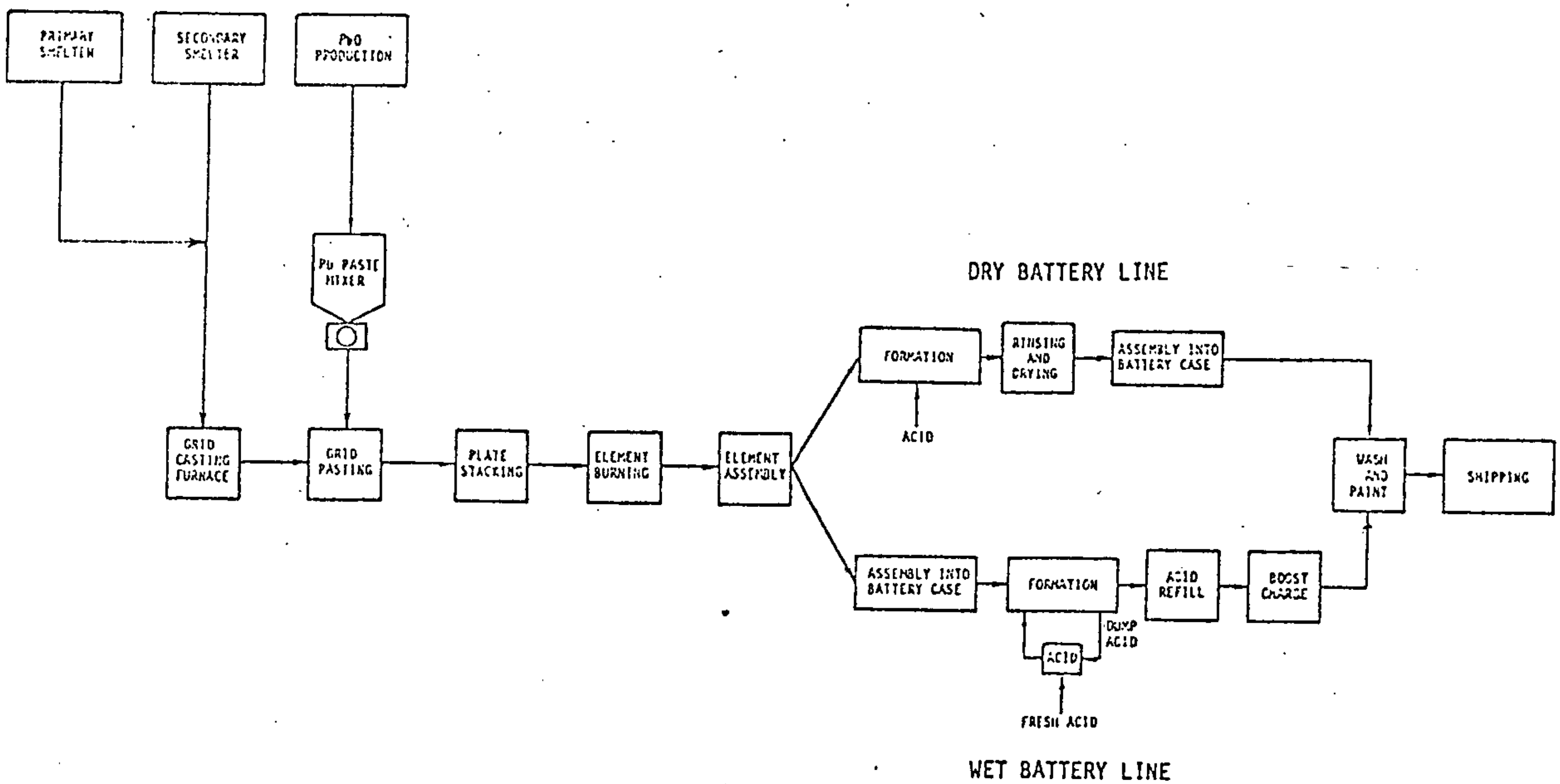


Figure Process flow diagram - lead-acid battery manufacture.

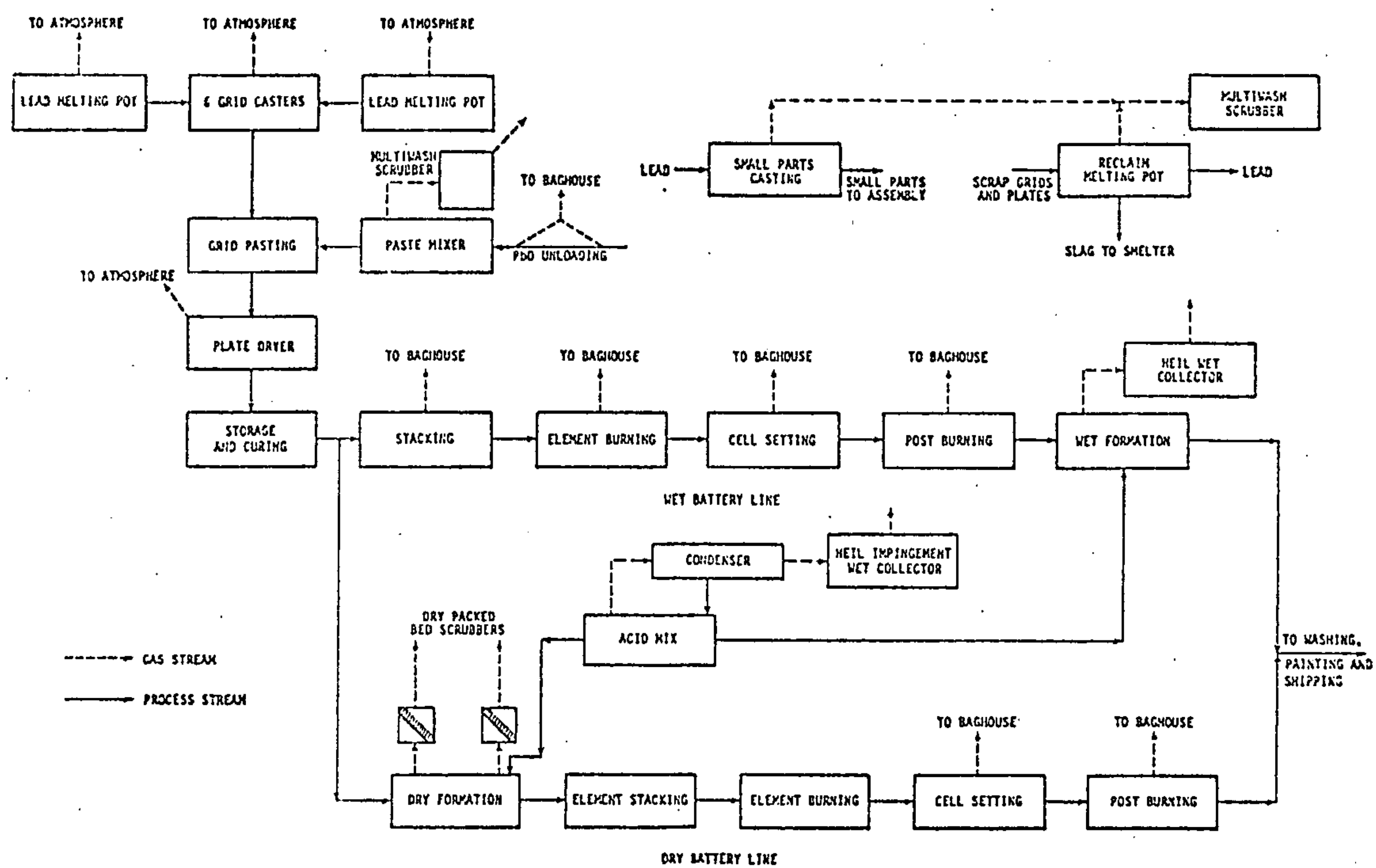


Figure . Production flow diagram, ESB's Buffalo Plant.

One paste mixer is used for both positive and negative pastes. Dry lead oxide powder is loaded into the paste mixer from barrels. Water and sulfuric-acid is added during the cycle. The mixer emissions are controlled by a Schneible, type F61BL, low energy cascade type, 4100 acfm wet scrubber with a pressure drop of about 7 to 8 inches W.G. When lead oxide is loaded into the mixer, the dust created is pulled through a hood and duct system to a baghouse.

Finished grids are pasted, dried and stored. The plate drying ovens are vented to the atmosphere by natural draft. The dried plates can be sent to formation if they are to be used in making dry batteries or to the three-process operation when making wet batteries.

The dry formation process is totally enclosed and is vented through two Tri-Mer fan separators which are installed in parallel. These units, designed to operate with a water spray, were operated in a dry mode. This is normal procedure for the plant. Sulfuric acid mist is collected and recycled. Part of the cleaned air from each scrubber is returned to the formation room for ventilation and the remainder is exhausted to the atmosphere via two stacks. After formation, the elements are dried, rinsed, and sent to the three-process operation.

The three-process operation for both dry and wet battery manufacture consists of stacking the plates, element burning to connect the plates, cell setting (inserting the assemblies into a battery case) and post burning. The stacking operation and lead oxide receiving emissions are vented in a common duct to a 7500 acfm Mikro-Pulsaire, type 8FTV, fabric filter. Cell setting and plate welding emissions are vented in a common duct to an identical fabric filter. Both baghouse exhausts are, in turn, ducted to a common stack. A 40 horsepower fan provides the suction for both baghouses.

After the three-process operation, the dry batteries are washed, painted and shipped while the wet batteries are sent to formation. Acid mist from the wet forming room is vented through a Heil water spray scrubber. Wet batteries are washed, painted and shipped following the formation process.

Deformed grids, posts, connectors and some scrap plates are remelted in a reclaim furnace and formed into lead pigs to be reused. Most scrap plates and elements along with reclaim furnace slag are sent back to the lead smelter for recovery. The reclaim furnace and the small parts casting facility are vented in a common duct to a Schneible cascade type scrubber.

NORMAL PROCESS OPERATION

Source tests were performed on August 23-26, 1965. The dry formation process and the reclaim furnace were tested. The test locations are shown in Figure . Both scrubber

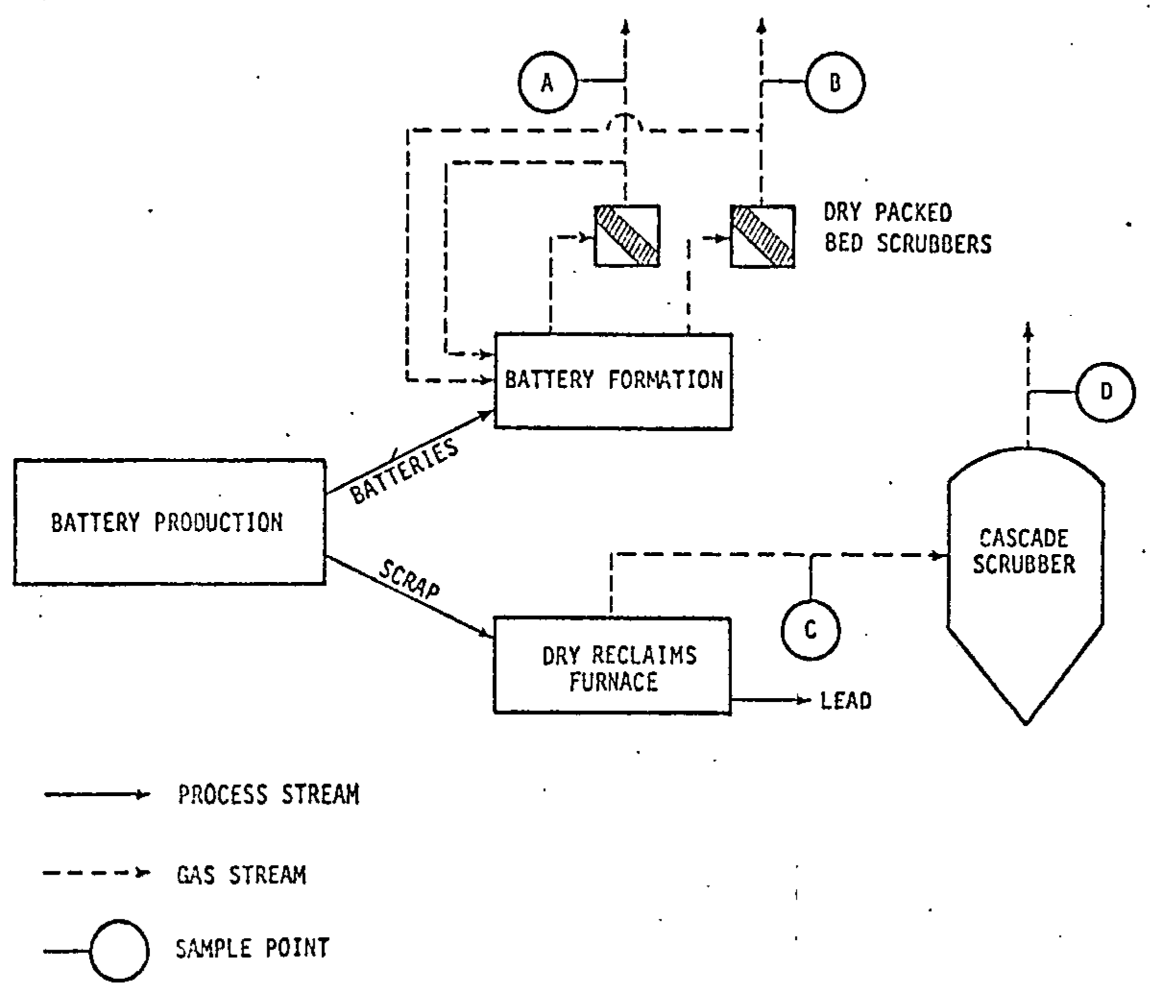


Figure . Source test locations for ESB, Buffalo, New York.

outlet stacks were sampled simultaneously for the formation process and inlet and outlet samples were collected concurrently at the Schneible cascade scrubber.

Dry Formation

For dry formation, there are three rectifiers supplying power to the formation tanks. The required ampere hours for each forming cycle varies with the amount of total active material on the plates. The ampere rate depends on the formation time. Normally, formation time is sixteen hours.

Each formation tank has a number of slots. Typically, four negative plates are placed in one slot followed by three positive plates in the next slot. This sequence is repeated until the tank is filled (this is called a 3 and 4 drop ratio because of a 3 positive plate to 4 negative plate ratio). The maximum loading of the formation tanks is a 4 and 5 drop ratio. This drop ratio is used when one rectifier is down or an increase in plate production is needed. A five percent sulfuric acid solution is used for the formation process.

Normal operating procedures involve loading the plates into the formation tanks and switching on the rectifiers during the day shift and shutting off the system sixteen hours later on the night shift.

Lead Reclaim

The reclaim furnace is operated on an as-needed basis.

During operation, the pot temperature is maintained at approximately 800°F. Otherwise, the temperature is kept at about 600°F so the lead remaining in the pot will not solidify.

Lead scrap is added periodically from barrels or other scrap containers. After dumping, the operator stirs the pot to agitate the contents so that the metallic lead will go to the bottom of the pot, while the slag, floats to the surface. This slag is skimmed from the liquid metal surface and dumped into barrels for shipment to a smelter. The slag is formed as a light-brown powder. When the reclaim pot can accommodate more scrap, another batch of scrap is dumped into the pot. The lead is poured when enough accumulates to form ten 50 to 60 pound pigs.

PROCESS OPERATION DURING SOURCE TESTS

Dry Formation

The concurrent source test at the outlets of the two Tri-Mer scrubbers were performed on August 23-25, 1976 at test sites A and B (See Figure). These were performed during two 16-hour formation cycles (the cycle on August 23 and 24 will be designated cycle 1 and the August 24 and 25 cycle will be designated cycle 2). Tests 1A, 1B through 3A, and 3B were completed during cycle 1 and tests 4A, 4B through 8A, and 8B were performed during cycle 2.

One rectifier was not operating during each cycle because of an electrical malfunction. Cycle 1 was a 3 and 4 drop with a total of 5350 pounds of active material. Cycle 2 was a 4 and 5 drop with a total of 7760 pounds of active material. Table shows important parameters for each test.

The packed beds were back flushed prior to cycle 1 and after cycle 2 was complete. They were not washed between cycles. There was no significant pressure drop increase during the tests. Although the scrubber nameplates specified a maximum pressure drop of 2.3 inches W.G., the manometer readings for both scrubbers ranged from 3.5 to 3.7 inches W.G. Each scrubber fan was stopped momentarily to obtain a manometer zero reading to confirm proper manometer calibration. Each manometer read zero when its respective fan was turned off.

Lead Reclaim

Three tests were performed on the inlet and outlet of the Schneible scrubber on August 25 and 26, 1976. The scrap charged during each test was 950, 890, and 1120 pounds for tests 1C and 1D, 2C and 2D, and 3C and 3D, respectively. The charge during the tests consisted mostly of imperfect plates. These are thought to generate more emissions than defective grids or small parts due to the paste in the plates. Table shows important process parameters for each lead reclaim source test.

Table . PROCESS PARAMETERS DURING DRY FORMATION SOURCE TESTS

Test number[a]	1A, 1B	2A, 2B	3A, 3B[c]	4A, 4B	5A, 5B	6A, 6B	7A, 7B	8A, 8B
Date, August 1976	23	23-24	24	24	24	24	24-25	25
Test interval (24-hour clock)	1907-2110	2353-0210	0323-0521	1536-1742	1828-2031	2105-2306	2350-0157	0225-0418
Cycle	1	1	1	2	2	2	2	2
Active material, lbs.	5350	5350	5350	7760	7760	7760	7760	7760
Amp-hrs.[b]								
Total cycle	4330	4330	4330	6505	6505	6505	6505	6505
Rectifier 2								
Test begin	2762	1368	0434	5249	4054	2952	1824	0769
Test end	2168	686	0	4362	3193	2130	1003	0
Rectifier 3								
Test begin	2714	1372	499	5304	4110	3029	1930	908
Test end	2140	728	0	4416	3266	2232	1136	148

a Refer to Figure for location of test sites A and B.

b Rectifier 1 was not operating during tests.

c Rectifier 2 completed cycle at 0458 while Rectifier 3 completed cycle at 0521.

Table . PROCESS PARAMENTERS DURING LEAD RECLAIM SOURCE TESTS

Test number[a]	1C, 1D	2C, 2D	3C, 3D
Test interval (24-hour clock)	1355-1504	0738-0844	1008-1114
Number of charges	5	4	4
Total weight charged, lbs.	950	890	1120

[a] Refer to Figure for location of test sites C and D.

Small parts production was not operating during any of the tests. The scrubber was visually inspected during the tests to determine that it was operating normally. This inspection consisted of observing the fan indicator light and the water flow from the unit.

APPENDIX

PROCESS ENGINEERS FIELD NOTES TAKEN DURING SOURCE TESTS

FORM A

POWER INPUT TO FORMATION PROCESS

TRI-MER SCRUBBER STACKS

ESB, BUFFALO

TEST NO. 1A, 1B   DATE 8/23/76

1) Total test time 123 min.
2) No. of rectifiers on stream 2
3) Normal rectifier readings:

	Unit #1	Unit #2	Unit #3
Amp hours volts	N.A.	Varies with forming time, drop ratio and plate type	

4) Weight of active material in plates during cycle — lb

   per plate x — plates, or 5350 lb total weight

5) Normal maximum weight of active material formed during a given cycle ~~8~~ * ~~lb~~ Varies with plate Type

cycle 1

	#2	#3
Type plates	L5+L2	L5+L2
Drop ratio	3+4	3+4
Amp-hrs rqd	4330	4330
Charging rate	275	275
Time on	1:15 p.m.	1:30 p.m.

* A 3 and 4 drop ratio (pos. to neg. plates) is normally formed. System is designed for a 4 & 5 drop ratio.

FORM B

PROCESS MONITORING FORM

FOR TRI-MER STACKS

ESB, BUFFALO

Time start 7:07 pm

Time finish 9:10 pm

TEST NO. 1A, 1B

DATE 8/23/72

	Reading 1	Reading 2	Reading 3	Reading 4	Reading 5	Reading 6
	7:10	7:35	8:00	8:25	8:50	9:10
Tri-Mer Unit #1, ΔP, in. W.G.	3.5	3.5	3.5	3.5	3.5	3.5
Tri-Mer Unit #2, ΔP, in. W.G.	3.6	3.6	3.6	3.6	3.6	3.6
Rectifier #1 amp-~~hrs~~						
volts						
Rectifier #2 amp-~~hours~~	278	278	278	278	278	278
volts	~~111~~ 112	112	112	113	113	113
Rectifier #3 amp-~~hrs~~	280	278	278	272	270	270
volts	111	111	111	113	114	114

Amp. Hours	#2	#3
START	2762 (9229)	2714 (0643)
FINISH	2168 (9721)	2140 (1205)

COMMENTS:

cycle - 1

#2 fans operating

FORM A

POWER INPUT TO FORMATION PROCESS

TRI-MER SCRUBBER STACKS

ESB, BUFFALO

TEST NO. 2A + 2B DATE 8/23/76

1) Total test time ________ min.
2) No. of rectifiers on stream 2
3) Normal rectifier readings:

	Unit #1	Unit #2	Unit #3
Amp hours volts	N.A.	Varies with forming time, drop ratio, and plate type	

4) Weight of active material in plates during cycle — lb

per plate x — plates, or 5350 lb total weight

5) Normal maximum weight of active material formed during a given cycle * lb

Cycle 1

refer to test 1A, 1B data form A for cycle parameters.

* A 3 and 4 drop ratio (pos. to neg. plate) is normally formed. System is designed for a 4 + 5 drop ratio.

FORM B

PROCESS MONITORING FORM

FOR TRI-MER STACKS

ESB, BUFFALO

Time start 1153 pm

Time stop 2:10

TEST NO. 2A & 2B DATE 8/23/76 &24

	Reading 1	2	3	4	5	6	7
	1155	1220	1245	1:10	1:35	2:00	2:27
Tri-Mer Unit #1, ΔP, in. W.G.	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Tri-Mer Unit #2, ΔP, in. W.G.	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Rectifier #1 amp-hrs							
volts							
Rectifier #2 amp-hours	278	275	275	275	275	273	272
volts	121	121	122	124	124	125	125
Rectifier #3 amp-hrs	268	263	260	260	260	260	260
volts	122	124	124	125	125	126	126

Amp. Hours	# 2	# 3
START	1368 (0521)	1372 (1972)
FINISH	0686 (1203)	0728 (2615) ← @ 2:27 am

COMMENTS:

2 fans operating

cycle 1

FORM A

POWER INPUT TO FORMATION PROCESS

TRI-MER SCRUBBER STACKS

ESB, BUFFALO

TEST NO. 3A & 3B DATE 8/24/76

1) Total test time 118 min.

2) No. of rectifiers on stream 2

3) Normal rectifier readings:

	Unit #1	Unit #2	Unit #3
Amp hours volts	N.A.	Varies with forming time, drop ratio and plate type	

4) Weight of active material in plates during cycle — lb

per plate x — plates, or 5350 lb total weight

5) Normal maximum weight of active material formed during a given cycle * lb

Cycle 1

refer to Form A for tests 1A and 1B for cycle parameters.

* A 3 and 4 drop ratio (pos. to neg. plates) is normally formed. System is designed for a 4 & 5 drop ratio.

FORM B

PROCESS MONITORING FORM

FOR TRI-MER STACKS

ESB, BUFFALO

Time start 3:23 a.m.

Time stop 5:21

TEST NO. 3A & 3B DATE 8/24/76

	Reading					
	3:25a.m.	3:53	4:15	4:40	4:59	5:23
	1	2	3	4	5	6
Tri-Mer Unit #1, ΔP, in. W.G.	3.5	3.5	3.5	3.5	3.5	3.5
Tri-Mer Unit #2, ΔP, in. W.G.	3.7	3.7	3.7	3.7	3.7	3.7
Rectifier #1 amp-hrs						
volts						
Rectifier #2 amp-hours	272	270	270	270	0	0
volts	126	127	127	127	0	0
Rectifier #3 amp-hrs	260	258	258	258	258	0
volts	126	126	127	127	127	0

Amp. Hours	#2 ~~#3~~	# 3
START	0434 (1455)	0497 (2844)
FINISH	0 (1889)	0 (3343)

COMMENTS:

cycle 1

2 fans operating

Rectifier #2 down at 4:58. Cycle is complete for #2.

Rectifier #3 down at 5:21. Cycle is complete.

FORM A

POWER INPUT TO FORMATION PROCESS

TRI-MER SCRUBBER STACKS

ESB, BUFFALO

TEST NO. 4A + 4B ~~A4 & B4~~ DATE 8/24/76

1) Total test time 126 min.

2) No. of rectifiers on stream 2

3) Normal rectifier readings:

	Unit #1	Unit #2	Unit #3
Amp hours		Varies with plate type, amp. hrs rqd, and forming time	
volts			

4) Weight of active material in plates during cycle — lb per plate x — plates, or 7760 lb total weight

5) Normal maximum weight of active material formed during a given cycle * lb

Cycle 2

	# 2	# 3
Type plates	M5 + M4	M5 + M4
Drop ratio	4 + 5 (pos. / neg.)	4 + 5
Amp-hrs rqd.	6505	6505
Charging rate	410	410
Time On	12:30 p.m.	12:30 p.m.
Scheduled off	4:30 a.m. 8/25/76	4:30 a.m. 8/25/76

* R #.3 and 4 drop ratio (pos. to neg. plates) is normally formed System is designed for a 4 + 5 drop ratio.

FORM B

PROCESS MONITORING FORM
FOR TRI-MER STACKS
ESB, BUFFALO

START 3:36 p.m
STOP 5:42

TEST NO. ~~A4 + B4~~ 4A + 4B

DATE 8/24/76

	Reading 1 (3:36)	2 (4:00)	3 (4:25)	4 (4:50)	5 (5:15)	6 (5:43)
Tri-Mer Unit #1, ΔP, in. W.G.	3.5	3.5	3.5	3.5	3.5	3.5
Tri-Mer Unit #2, ΔP, in. W.G.	3.7	3.6	3.6	3.6	3.7	3.6
Rectifier #1 amp-hrs volts						
Rectifier #2 amp ~~hours~~	408	408	408	408	408	408
volts	121	120	120	120	120	120
Rectifier #3 amp ~~hrs~~	415	415	415	418	418	418
volts	117	117	117	117	117	117

Amp. Hours

	#2	#3
START	5249 (3186)	5304 (4585)
FINISH	4362 (4073)	4416 (5473)

COMMENTS:

858

Cycle 2

2 fans operating

FORM A

POWER INPUT TO FORMATION PROCESS

TRI-MER SCRUBBER STACKS

ESB, BUFFALO

TEST NO. 5A & 5B DATE 8/24/76

1) Total test time 123 min.

2) No. of rectifiers on stream 2

3) Normal rectifier readings:

	Unit #1	Unit #2	Unit #3
Amp hours volts	N.A.	Varies with forming time drop ratio and plate type	

4) Weight of active material in plates during cycle — lb per plate x — plates, or 7760 lb total weight

5) Normal maximum weight of active material formed during a given cycle * lb

Cycle 2

All Cycle 2 parameters are found on form A of tests 4A and 4B

* A 3 and 4 drop is normally formed. System is designed for a 4 and 5 drop

FORM B

PROCESS MONITORING FORM
FOR TRI-MER STACKS
ESB, BUFFALO

START 6:28 p.m.
STOP 8:31

TEST NO. 5A + 5B

DATE 8/24/76

	Reading 1 (6:28)	2 (6:50)	3 (7:16)	4 (7:45)	5 (8:10)	6 (8:32)
Tri-Mer Unit #1, ΔP, in. W.G.	3.5	3.5	3.5	3.5	3.5	3.5
Tri-Mer Unit #2, ΔP, in. W.G.	3.6	3.6	3.7	3.7	3.6	3.6
Rectifier #1 amp-hrs volts	/	/	/	/	/	/
Rectifier #2 amp ~~hours~~	410	410	408	408	408	408
volts	120	120	120	120	120	120
Rectifier #3 amp ~~hrs~~	415	415	410	410	405	405
volts	117	117	~~116~~ 118	118	118	118

Amp. Hours

	#2	#3
START	4054 (4381)	4110 (5779)
FINISH	3193 (5242)	3266 (6623)

COMMENTS:

Cycle # 2
2 fans operating

FORM A

POWER INPUT TO FORMATION PROCESS

TRI-MER SCRUBBER STACKS

ESB, BUFFALO

TEST NO. 6A & 6B DATE 8/24/76

1) Total test time 121 min.

2) No. of rectifiers on stream 2

3) Normal rectifier readings:

	Unit #1	Unit #2	Unit #3
Amp hours volts	N.A.	Varies with forming time, drop ratio, and plate type	

4) Weight of active material in plates during cycle — lb per plate x — plates, or 7760 lb total weight

5) Normal maximum weight of active material formed during a given cycle * ~~lb~~

Cycle 2

Cycle 2 parameters are found on Form A for tests 4A and 4B.

*A 3 and 4 drop is normally formed. System is designed for a 4 and 5 drop.

FORM B

PROCESS MONITORING FORM
FOR TRI-MER STACKS
ESB, BUFFALO

START 9:05 pm.
STOP 11:06 pm.

TEST NO. 6A & 6B DATE 8/24/76

	Reading 1 (9:06)	2 (9:30)	3 (9:58)	4 (10:20)	5 (10:45)	6 (11:07)
Tri-Mer Unit #1, ΔP, in. W.G.	3.5	3.5	3.5	3.5	3.5	3.5
Tri-Mer Unit #2, ΔP, in. W.G.	3.7	3.7	3.7	3.7	3.7	3.7
Rectifier #1 amp-hrs						
volts						
Rectifier #2 amp-~~hours~~	405	408	408	408	408	408
volts	119	121	121	122	123	123
Rectifier #3 amp-~~hrs~~	408	403	398	411	410	410
volts	120	120	121	123	124	125

Amp. Hours	#2	#3
START	2952 (5483)	3029 (6860)
FINISH	2130 (6305)	2232 (7657)

COMMENTS:

Cycle 2

FORM A

POWER INPUT TO FORMATION PROCESS

TRI-MER SCRUBBER STACKS

ESB, BUFFALO

TEST NO. 7A & 7B DATE 8/24&25/76

1) Total test time 127 min.

2) No. of rectifiers on stream 2

3) Normal rectifier readings:

	Unit #1	Unit #2	Unit #3
Amp hours volts	N.A.	Varies with forming time, drop ratio and plate types.	

4) Weight of active material in plates during cycle — lb per plate x — plates, or 7760 lb total weight

5) Normal maximum weight of active material formed during a given cycle * lb

Cycle 2

Cycle 2 parameters are shown on Form A of Tests 4A and 4B.

* A 3 and 4 drop is normally ~~used~~ formed. System is designed for a 4 and 5 drop.

FORM B

PROCESS MONITORING FORM
FOR TRI-MER STACKS
ESB, BUFFALO

START 11:50 pm
STOP 157am

TEST NO. 7A + 7B

DATE August 24 & 25, 1976

	Reading 1 (1152)	2 (1217am)	3 (12:42)	4 (107)	5 (132)	6 (152)
Tri-Mer Unit #1, ΔP, in. W.G.	3.5	3.5	3.5	3.5	3.5	3.5
Tri-Mer Unit #2, ΔP, in. W.G.	3.7	3.7	3.7	3.7	3.7	3.7
Rectifier #1 amp-hrs						
volts						
Rectifier #2 amp-~~hours~~s	405	405	407	408	408	409
volts	124	124	124	124	124	124
Rectifier #3 amp-~~hrs~~	405	405	406	406	407	407
volts	126	127	127	127	128	128

Amp. Hours	#2	#3
START	1824 (6612)	1930 (7959)
FINISH	1003 (7432)	1136 (8753)

COMMENTS:

Start ~~[illegible]~~ readings taken at 1152pm

FORM A

POWER INPUT TO FORMATION PROCESS

TRI-MER SCRUBBER STACKS

ESB, BUFFALO

TEST NO. 8A + 8B DATE 8/25/76

1) Total test time 113 min.

2) No. of rectifiers on stream 2

3) Normal rectifier readings:

	Unit #1	Unit #2	Unit #3
Amp hours volts	N.A.	Varies with forming time, plate types and drop ratio.	

4) Weight of active material in plates during cycle — lb

per plate x — plates, or 7760 lb total weight

5) Normal maximum weight of active material formed during a given cycle * ~~lb~~

Cycle 2 4 + 5 ~~to~~ drop

* Normally a 3 and 4 drop is used (3 positive plates and 4 negative plates per slot). Maximum is a 4 and 5 drop.

FORM B

PROCESS MONITORING FORM

FOR TRI-MER STACKS

ESB, BUFFALO

2:25 am

4:18

TEST NO. 8A & 8B DATE Aug 25, 1976

315 340

	2:27	250	Reading 315	340	405	419
	1	2	3	4	5	6
Tri-Mer Unit #1, ΔP, in. W.G.	3.5	3.5	3.5	3.5	3.5	3.5
Tri-Mer Unit #2, ΔP, in. W.G.	3.7	3.7	3.7	3.7	3.7	3.7
Rectifier #1 amp-hrs volts						
Rectifier #2 amp-~~hour~~s	408	408	408	408	408	0
volts	124	124	124	123	123	0
Rectifier #3 amp-~~hrs~~	405	408	408	408	408	408
volts	127	127	128	123	123	126

Amp. Hours	#2	#3
START	0769 (7666)	908 (8981)
FINISH	0 (8435)	148 (9741)

COMMENTS:

FORM C

PROCESS MONITORING FORM

FOR SCHNEIBLE SCRUBBER STACK

ESB, BUFFALO

START 1:55 p.m
STOP. 3:04

TEST NO. 1C & 1D

DATE 8/25/76

	Observation (Answer "yes" or "no") 1 (1:55)	2 (2:15)	3 (2:36)	4 (3:06)
Scrubber:				
Fan indicator light is on	yes	yes	yes	yes
Water discharging from unit	yes	yes	yes	yes
Small Parts Casting:				
Operation appears normal				
Operator started shift with empty bins				
Reclamation:				
Operation appears normal	yes	yes	yes	yes
Operator is weighing scrap	yes	yes	yes	yes

Reclamation dump is mostly scrap plates. Also includes separator. Pig cast are 65 lb each. This is done periodically.

COMMENTS:

Dumps	Barrel of waste, lbs	Barrel wt., lbs
1:26	360#	20#
1:53	290#	20
2:20	270#	20
2:28	260	20
2:47	270	
3:05	200	

Pours 1:45 – 1:56 10 pigs poured

STIRS
2:10 - 2:15 operator stirring pot
2:23 - 2:28 "
2:36

FORM D

LEAD THRUPUT FOR PROCESSES VENTED
TO SCHNEIBLE SCRUBBER
ESB, BUFFALO

TEST NO. 1C & 1D DATE 8/25/76

1) Total test time 69 min.
2) Weight of small parts manufactured during 8-hr shift 0 lb
3) Weight of scrap charged to furnace during ~~8-hr shift~~ Test 990 lb
4) Normal weight of small parts manufactured during an 8-hr shift N.A. lb
5) Normal weight of scrap charged to furnace during an 8-hr shift Varies with availability lb

Calculation of ~~lead~~ scrap thruput during test

~~[(1)(2) ÷ 480] + [(1)(3) ÷ 480] = lb lead~~

from 1:26 to ~~3:05~~ 3:04 (end of test) (98 min)

~~lead~~ scrap charged = 340 + 270 + 250 + 240 + 250 = 1350 lb

Scrap ~~was~~ is made up of defective plates and a small number of plate separators. The weight of the separators ~~was~~ is assumed to be negligible. Observation of the scrap barrels appears to confirm this.

scrap charged during test $= 1350 \times \frac{69}{98} = 950$

FORM C

PROCESS MONITORING FORM
FOR SCHNEIBLE SCRUBBER STACK
ESB, BUFFALO

START 7:38
STOP 8:44

TEST NO. 2C & 2D

DATE 8/26/76

	7:38	8:15	8:27	8:44
	Observation (Answer "yes" or "no")			
	1	2	3	4
Scrubber:				
Fan indicator light is on	yes	yes	yes	yes
Water discharging from unit	yes	yes	yes	yes
Small Parts Casting:				
Operation appears normal	Not OPERATING			
Operator started shift with empty bins				
Reclamation:				
Operation appears normal	yes	yes	yes	yes
Operator is weighing scrap	yes	yes	yes	yes

Reclamation material is mostly scrap plates, some separators and miscellaneous trash is also included. Weight of this is very small (perhaps < 10 lb)

COMMENTS:

Dumps

	Time	Total wt.	B-l. wt.
**	7:31	290	20
19	7:48	240	20
#7	8:08	280	20
#10	8:41	250	20
~~#13~~		---	

STIRS (Operator rakes along from top.

7:20
7:32
7:48
7:54
8:20

Pours
NONE

FORM D

LEAD THRUPUT FOR PROCESSES VENTED

TO SCHNEIBLE SCRUBBER

ESB, BUFFALO

TEST NO. 2C and 2D DATE 8/26/76

1) Total test time 66 min.

2) Weight of small parts manufactured during 8-hr shift 0 lb

3) Weight of scrap charged to furnace during ~~8-hr shift~~ test 890 lb

4) Normal weight of small parts manufactured during an 8-hr shift N.A. lb

5) Normal weight of scrap charged to furnace during an 8-hr shift Varies with availability lb

Calculation of lead thruput during test

~~[(1)(2) ÷ 480] + [(1)(3) ÷ 480] = ______ lb lead~~

~~ff~~ From 7:31 to 8:44 (end of test)

scrap charged = 270 + 220 + 220 + 230 = 980

during test = $980 \times \frac{66}{73} = 890$

FORM C

PROCESS MONITORING FORM

FOR SCHNEIBLE SCRUBBER STACK START 10:08 a.m.

ESB, BUFFALO STOP 11:14 a.m.

TEST NO. 3C + 3D DATE 8/26/76

	10:09	10:32	10:52	~~10~~ 11:16
	Observation (Answer "yes" or "no")			
	1	2	3	4
Scrubber:				
Fan indicator light is on	yes	yes	yes	yes
Water discharging from unit	yes	yes	yes	yes
Small Parts Casting:	Not OPERATING			
Operation appears normal				
Operator started shift with empty bins				
Reclamation:				
Operation appears normal	yes	yes	yes	yes
Operator is weighing scrap	yes	yes	yes	yes

COMMENTS:

	Dumps	Bpl + waste, lbs	Bpl, lbs	Stirs
13	10:07	230	20	10:10
14	10:16	270	20	10:16
12	10:24	380	20	~~10:22~~ 10:24
11	10:37	340	20	10:34
				10:37

FORM D

LEAD THRUPUT FOR PROCESSES VENTED
TO SCHNEIBLE SCRUBBER
ESB, BUFFALO

TEST NO. 3C and 3D DATE 8/26/76

1) Total test time 66 min.

2) Weight of small parts manufactured during 8-hr shift 0 lb

3) Weight of scrap charged to furnace during ~~8-hr shift~~ Test 1120 lb

4) Normal weight of small parts manufactured during an 8-hr shift N.A. lb

5) Normal weight of scrap charged to furnace during an 8-hr shift varies with availability lb

Calculation of ~~lead~~ scrap thruput during test

~~[(1)(2) ÷ 480] + [(1)(3) ÷ 480] = ______ lb lead~~

~~For~~ From 10:07 To 11:14 (end of test) 67 min

scrap charged = 210 + 250 + 360 + 320 = 1140

$= 1140 \times \frac{66}{67} = 1120$ lb

IV. LOCATION OF SAMPLING POINTS

Figure 1 depicts the Schnieble scrubber and the system that it serves along with a cutaway version of the outlet stack and fan housing. The outlet sampling location is positioned as shown on the 14-inch diameter vertical cylindrical stack and thus was sampled from two ports separated by 90° as required by EPA Method 1. Figure 5 is a diagram of the traverse points used at this location. The duct was divided into equal annular areas, and a total of 8 points was utilized.

Figure 6 depicts the sampling duct for inlet C. The inlet to the Schnieble scrubber is an 18-inch diameter diagonal cylindrical duct, and thus was sampled from two ports separated by 90° as required by EPA Method 1. Figure 7 is a diagram of the traverse points used at this location. The duct was divided into equal annular areas, and a total of 16 points was utilized.

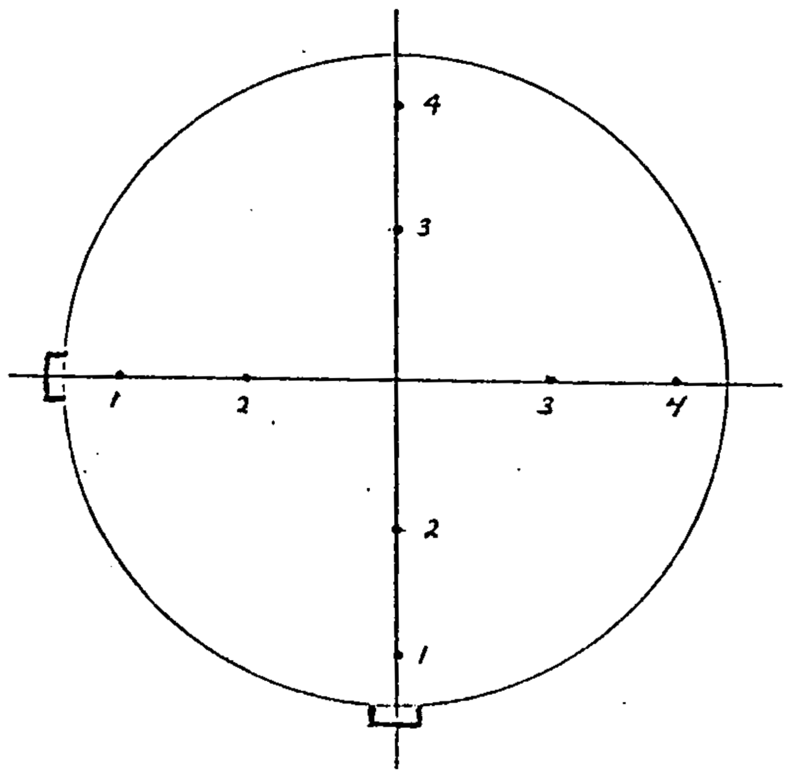
Figure 2 depicts the Trimer scrubber and the system that it serves along with a cutaway version of the two outlet stacks A and B.* The outlet sampling location is positioned as shown on the 32-inch diameter vertical cylindrical stacks, and thus was sampled simultaneously from two ports separated by 90° as required by EPA Method 1. Figure 8 is a diagram of the traverse points used at this location. The duct was divided into equal annular areas, and a total of 48 points was utilized.

---

*Since there were two identical stacks, they were labeled "A" and "B," with "A" being closest to the edge of the roof.

Figure 5. SCHEMATIC DIAGRAM OF SAMPLING POINT LOCATION
OUTLET STACK SCHNIEBLE SCRUBBER

Position	Distance (inches)
1	1
2	3-1/2
3	10-1/2
4	13



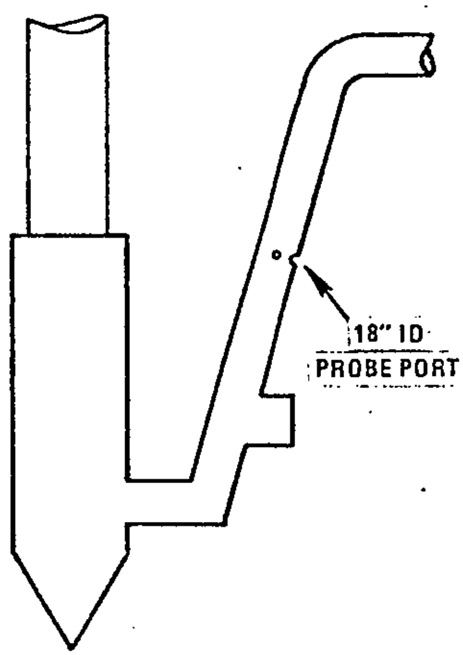


Figure 6. Sampling duct for inlet C.

Figure 7. SCHEMATIC DIAGRAM OF SAMPLING POINT LOCATION
INLET STACK SCHNIEBLE SCRUBBER

Position	Distance (inches)
1	1/4
2	5/8
3	1-1/4
4	1-3/4
5	2-3/8
6	3-1/8
7	4
8	5-1/4
9	8-3/4
10	10
11	11
12	11-5/8
13	12-1/4
14	12-3/4
15	13-3/8
16	13-3/4

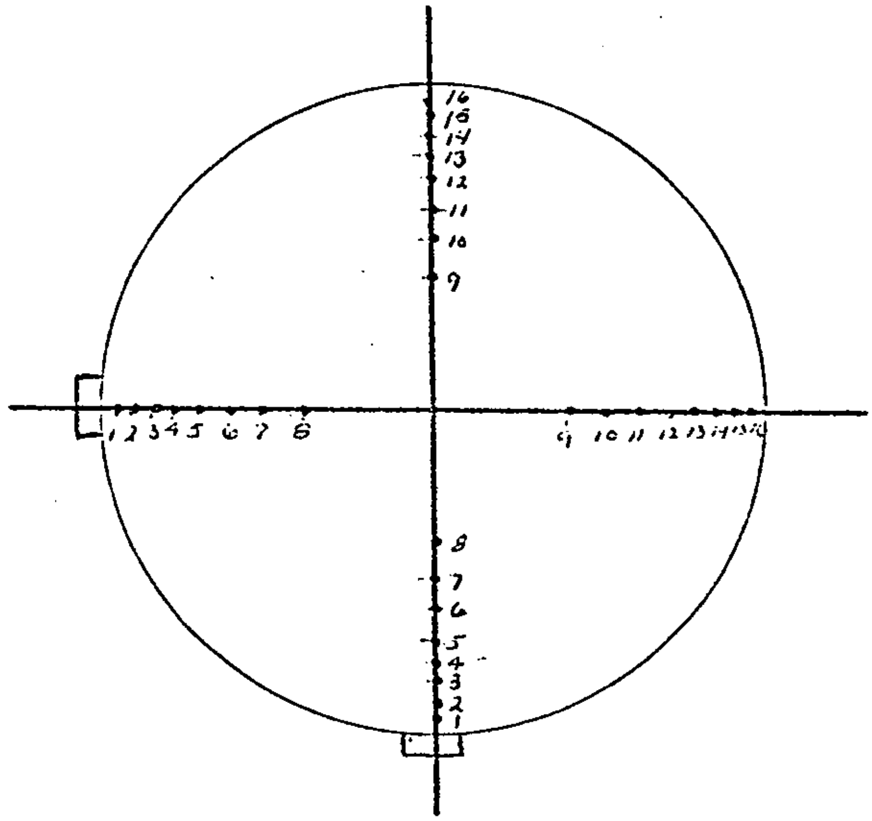
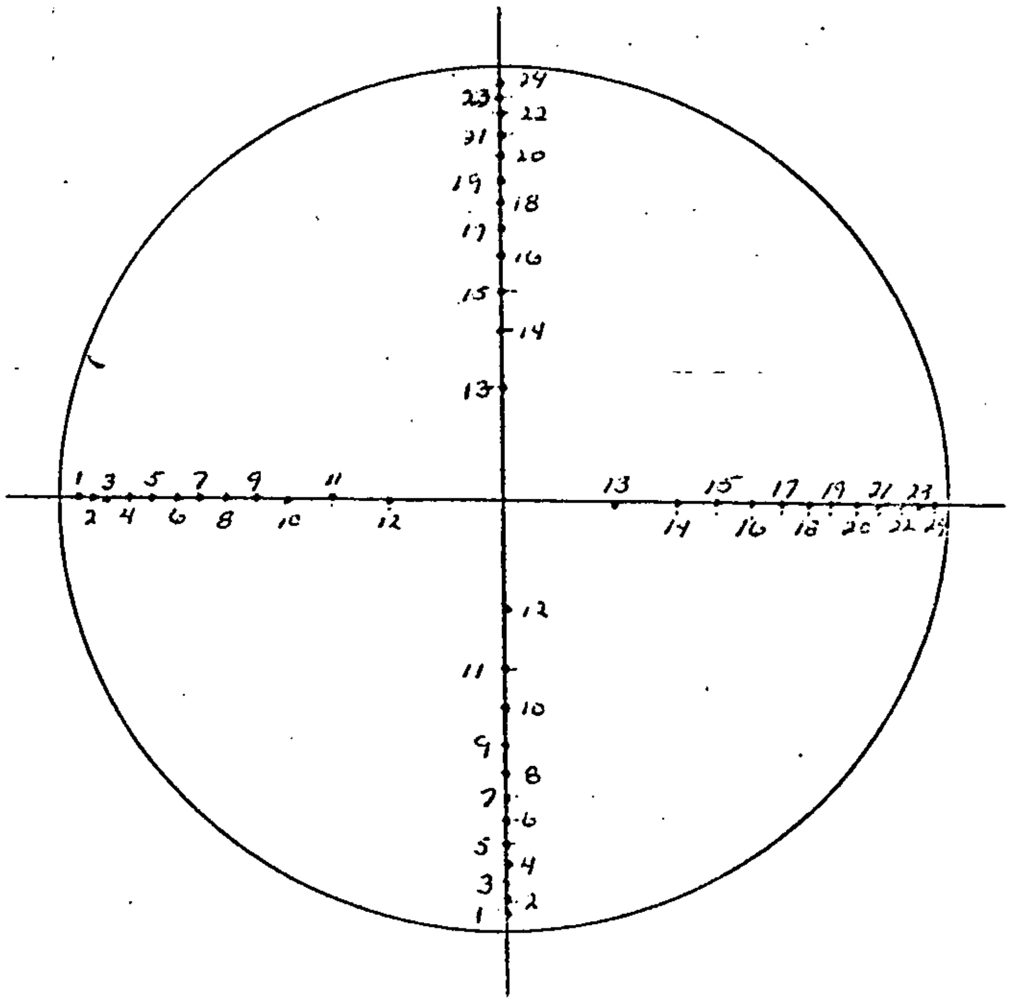


Figure 8. SCHEMATIC DIAGRAM OF SAMPLING POINT LOCATION
OUTLET STACKS (A & B) TRIMER SCRIBBER

Position	Distance (inches)
1	3/8
2	1
3	1-3/4
4	2-1/2
5	3-3/8
6	4-1/4
7	5-1/8
8	6-1/4
9	7-3/8
10	8-3/4
11	10-3/8
12	12-3/4
13	19-1/4
14	21-5/8
15	23-1/4
16	24-5/8
17	25-3/4
18	26-7/8
19	27-3/4
20	28-5/8
21	29-1/2
22	30-1/4
23	31
24	31-5/8



V. SAMPLING AND ANALYTICAL PROCEDURES

All samples obtained at the Schneible scrubber outlet stack and inlet duct followed the procedures outlined in EPA Method 5[1] and EPA draft Method 22 (see Appendix G). In this instance, simultaneous sampling was employed as shown by Figures 3A and 3B.

The test procedure for the outlet duct was a modification of the EPA Method 5 train. The filter is located between the third and fourth impingers instead of before the impingers as in the EPA Method 5.

All samples obtained at the Trimer scrubber outlet stacks followed the procedure outlined in EPA Method 8.[1] In this instance, simultaneous sampling was required from the two identical stacks from the same scrubber as shown in Figure 2.

Particle size sampling at the inlet and outlet of the Schneible scrubber was done using the Brinks Cascade Impactor and the Anderson Particle Sizer.

All opacity data were obtained according to EPA Method 9.[2]

Appendix H contains the Sample Identification Log and Appendix I represents example calculations.

---

[1] EPA Standards of Performance for New Stationary Sources, Federal Register, Volume 36, No. 247, December 23, 1971.

[2] Federal Register, Volume 39, No. 219, November 12, 1974.