Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

Combustion Stack test. 774.

AP-42 Section 12.2
Reference
Report Sect. 4
Reference 204

1700.D.3.1, 51. comb.

TABLE OF CONTENTS

	PAGE NO.
ABSTRACT	ii
I. INTRODUCTION	1
II. SCOPE AND OBJECTIVES	1
III. PROCEDURES	
A. Field Work	2
B. Equipment Calibr	5
C. Analytical Method	5
D. Calculations	5
IV. SUMMARY OF RESULTS	
A. Particulate Testing	
1. Total Particulates - PENNSYLVANIA D.E.R. Method	7
2. Total Particulates - E.P.A. Method	8
3. Condensable Organics - PENNSYLVANIA D.E.R. Method	11
4. Condensable Organics - E.P.A. Method	12
B. Sulfur Dioxide Sampling	13
C. Oxides of Nitrogen Sampling	15
D. Particle Size Analysis Sampling	
1. Andersen Impactor Method	17
2. Coulter Counter Method	21
E. Opacity Measurements	23
F. Deposit Analysis Results	25
V. DISCUSSION OF RESULTS	27
APPENDICES	
A. B.E.E. Proposal	
B. Field Sampling Program	
C. Laboratory Analysis and Data Reduction	
D. Applicable PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES and ALLEGHENY COUNTY HEALTH DEPARTMENT Regulations	

No Production Data Ref 204

000709

1700.D.3.1, 53
1700.D.3.1, 52. Part. SO_2 NO_x

510771

ABSTRACT

BETZ ENVIRONMENTAL ENGINEERS, INC. (B.E.E.) conducted a comprehensive series of emission inventories at both the P3 South coke oven battery stack and the P4 coke oven battery breeching at the JONES AND LAUGHLIN STEEL CORPORATION'S Pittsburgh, Pennsylvania Works during the period from April 14 to April 23, 1975. The results of the project are as follows:

1. Total particulate emissions reported as per the PENNSYLVANIA D.E.R. method exceed the allowable limits prescribed in Title 25. Rules and Regulations, DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA, Chapter 123, Section 123.22 during all test periods. [redacted] DEPARTMENT, Effective Dates June 15, 1972, Section 1809.3 [redacted]

2. Total particulate emissions reported as per the FEDERAL E.P.A. method fluctuated between compliance and non-compliance situations with respect to both of the aforementioned particulate emission standards.

3. [redacted] Very little free carbon was observed.

4. Both sulfur dioxide and nitrogen dioxide were found to be present in significant concentrations in the flue gas stream during the respective test periods.

5. Particle size distribution measurements indicated that the suspended particulate matter was very fine in nature; greater than ninety percent of the particulates measured were determined to be submicron in diameter.

510772

6. Opacity observations indicated violations of the PENNSYLVANIA visible emissions standard prescribed in Title 25. Rules and Regulations, DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA, Chapter 123, Sections 123.41, 123.42 and 123.43 during all observation periods. A compliance evaluation based on Rules and Regulations, Article XVIII, Air Pollution Control, ALLEGHENY COUNTY HEALTH DEPARTMENT, Effective Date: June 15, 1972, Sections 1809.1 and 1809.7 [redacted].

I. INTRODUCTION

The Jones and Laughlin Steel Corporation (J & L) retained Betz Environmental Engineers, Inc. (B.E.E.) to perform a comprehensive emission inventory on both the P3 South and the P4 coke oven battery stacks at J & L's Pittsburgh, Pennsylvania Works during the period of April 14 to April 25, 1975. The emission tests were performed in accordance with the procedures and requirements established by the DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA and the UNITED STATES ENVIRONMENTAL PROTECTION AGENCY.

II. SCOPE AND OBJECTIVES

The scope of the project was defined in B.E.E. Proposal Number 016-75-6-123, a copy of which is attached as Appendix A of this report. Project scheduling and methodology were more closely defined in a series of pre-test program meetings between Messrs. F. C. Lauer, Manager, Coke Plant Engineering, S. Vajda, Development Engineer, Coke Plant, D. P. Manka, Senior Research Chemist, T. R. Greer, Superintendent, By-Products Division, Pittsburgh Works of J & L and Messrs. L. B. Kline, Industrial Regional Manager, and F. J. Boinski, Project Engineer, of B.E.E. In summary, sampling was conducted at each stack to determine the following parameters:

1. Gas Flow - ACFM and SCFM
2. Gas Temperature - ^{o}F
3. Gas Stream Moisture Content - % by volume
4. Flue Gas Molecular Weight - Orsat Analysis - volume % CO_2, volume % O_2, volume % CO, and volume % N_2
5. Particulate Concentration - Grains/SCF (dry)
6. Particulate Emission Rate - Lbs./Hr.
7. Nitrogen Oxides Concentration - PPM by volume
8. Nitrogen Oxides Emission Rate - Lbs./Hr.
9. Sulfur Dioxide Concentration - PPM by volume

510774

10. Visible Stack Emissions - % Opacity

11. Particle Size Distribution - Andersen Method - weight % of total

12. Particle Size Distribution - by Coulter Counter - weight % of total

13. Deposit Analysis of a Composite Particulate Sample - weight % of total for a specific oxide

III. PROCEDURES

The procedures utilized in the sampling program are outlined below:

A. Field Work

The field work was accomplished in the following manner: simultaneous particulate, condensable organic, nitrogen oxides, sulfur dioxide, visible emissions, moisture content, molecular weight, and particle size distribution sampling were conducted during the period from April 14 to April 18, 1975 at the P4 breeching; a similar sampling program was conducted during the period from April 21 to April 25, 1975 at the P3 South stack. Preliminary laboratory analyses of several particulate - condensable organic test run samples were made on April 22 and April 23, 1975. All samples generated from the Andersen Impactor particle size analysis portion of the test program were analyzed during the two week test period. The B.E.E. field sampling team consisted of the following personnel:

F. J. Boinski - Project Engineer
R. P. Hebert - Assistant Project Engineer
G. W. Bainton - Engineering Technician
F. J. Kletzel - Engineering Technician

The B.E.E. sampling team was assisted by Messrs. L. Tyrell, Master Mechanic and E. Flatley, Pipe Fitters Foreman of J & L in the procurement of sampling location requirements such as sample ports, electrical power, etc.

510775

Pertinent process information was recorded by J & L personnel during the sampling programs conducted at each of the aforementioned test locations. This information is attached to Appendix C, pages C81-C150.

The following sampling methods were employed in the test program:

1. Gas velocity pressure, gas static pressure and gas temperature measurements were made as per Method Two of the "Federal Register", Volume 36, Number 247, December 23, 1971, and are outlined in Appendix B, page B3.

2. Particulate sampling at the P3 South stack was conducted utilizing the standard procedures and equipment described in Method Five of the previously mentioned "Federal Register". The standard Method Five sampling train was slightly modified to facilitate sampling in the P4 breeching. Descriptions of the sampling methods employed are listed in Appendix B, pages B3-B5. Schematic diagrams of the two sampling trains are depicted on pages B124-B125 of the same Appendix.

3. Nitrogen oxides sampling was accomplished through the use of a DYNASCIENCES, Model NX130 Air Pollution Monitor. This analytical instrument was recognized by the UNITED STATES ENVIRONMENTAL PROTECTION AGENCY as being acceptable in the determination of the concentration of nitrogen oxides in a gas stream following extensive E.P.A. testing of the monitor.

4. Sulfur dioxide sampling was conducted in the manner prescribed by the PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES. The PENNSYLVANIA method makes reference to the Source Testing Manual of the AIR POLLUTION CONTROL DISTRICT, COUNTY OF LOS ANGELES, November, 1963.

510776

5. Three sets of particle size analysis samples were taken at each test location utilizing an Andersen 2000 Inc., Model No. 50-001 impactor. Measurements were made as per the discussion presented in the Andersen publication, "Operating Instructions for Andersen Stack Sampling Equipment". A description of the sampling method employed is attached to Appendix B, pages B9-B10. Refer to pages B127-B128 for schematic diagrams of the sampling equipment.

6. Three sets of particle size analysis samples to undergo a Coulter Counter analysis were taken at each test location utilizing a modified E.P.A. Method Five sampling train. The sampling train is described in Appendix B, pages B10-B12; a schematic diagram of the sampling train is depicted on page B129 of the same Appendix.

7. Opacity measurements were made in the manner prescribed in Method Nine of the December 23, 1971, "Federal Register" by Mr. G. W. Bainton of B.E.E. Mr. Bainton was properly certified to make the opacity measurements as a result of his successful completion of the Visible Emissions Evaluation Course conducted by the UNITED STATES ENVIRONMENTAL PROTECTION AGENCY. Mr. Bainton's letter of certification is attached to Appendix B, page B139.

8. Particulate samples generated during the Andersen and Coulter Counter particle size analyses conducted at each sampling location were combined after their laboratory analysis to form two composite samples, one for each location. Each sample then underwent a deposit analysis for the determination of the component compounds of the particulate matter.

B. Equipment Calibr. ion

In accordance with standard, accepted procedures published by the NATIONAL TECHNICAL INFORMATION SERVICE for the FEDERAL E.P.A. in the manual entitled Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment by Jerome J. Rom, all gas velocity measuring equipment, gas volume metering equipment, gas temperature measuring equipment, and gas flow rate metering equipment had been calibrated prior to field use. Calibration data is listed in Appendix B, pages B130-B138.

C. Analytical Methods

The analysis of the samples generated during the test program was made at three different locations in order to expedite test results. Four complete sets of particulate-condensable organic samples and all Andersen Impactor samples were analyzed by B.E.E. personnel in J & L's Pittsburgh Works Laboratory. Coulter Counter and Deposit Analysis samples were analyzed by BETZ LABORATORIES, INC. of Trevose, Pennsylvania. The bulk of the particulate samples, all condensable organic samples, and all sulfur dioxide samples were analyzed by the B.E.E. LABORATORY located in Norristown, Pennsylvania. Refer to Appendix C, pages C1-C7, for a detailed description of the methodologies employed in the analysis of the samples. Appendix C, pages C8-C48, contains a listing of the laboratory results of the sampling program.

D. Calculations

All calculations related to the results of the particulate-condensable organic-moisture content testing program were performed through the use of a computer. Raw data generated from this program was developed through use of the equations presented in Method Two, Method Four, and Method Five of the December 23, 1971, "Federal Register". Sulfur dioxide and oxides of nitrogen testing results were calculated through the use of the equations

510778

presented in the Source Testing Manual of the AIR POLLUTION CONTROL DISTRICT, COUNTY OF LOS ANGELES, November, 1963. Andersen particle size analysis results were determined through the use of the three curves included in the publication, "Operating Instructions for Andersen Stack Sampling Equipment" and through simple arithmetic. The results of the Coulter Counter analysis were calculated using only simple arithmetic as were the results of the opacity observations. The conversion of emission rate data calculated from the results of the tests conducted on the P3 South stack to a heat input ratio at P4 breeching conditions is explained following the listings of calculations. The calculations of allowable emission rates for the pollutants in question utilized the equations presented in appropriate sections of both Rules and Regulations of the DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA, Title 25, January 27, 1972 and Rules and Regulations, Article XVIII, Air Pollution Control, ALLEGHENY COUNTY HEALTH DEPARTMENT, Effective Date: June 15, 1972. The aforementioned equations and curves are listed in Appendix C, pages C49-C62. The compliance evaluation equations and pertinent regulations are listed in Appendix D. pages D1-D2.

IV. SUMMARY OF RESULTS

A. Particulate Testing

A detailed outline which lists all parameters evaluated during the particulate sampling program is attached to Appendix C, pages C68-C71 and C75-C77. Pertinent testing results and process parameters are considered and contrasted with the applicable PENNSYLVANIA and ALLEGHENY COUNTY standards below in Table I - Total Particulate Testing Results VS. Applicable Standard. Refer to Appendix C, page C57 for an explanation of the logic employed in the determination of the adjusted P3 South stack emission rates.

510779

TABLE I - TOTAL PARTICULATE TESTING RESULTS
(PENNSYLVANIA D.E.R. Method) VS. Applicable Standards

Unit Sampled	Test No.	Measured Total Particulate Emission Rate (LB/HR)	Total* Particulate Emission Rate Based on a Converted Gas Volume (LB/HR)	Calculated Heat Input (10^6BTU/HR)	Measured Total Particulate Emission Rate to Heat Input Ratio (LB/10^6BTU)	Total Particulate Emission Rate Based on a Converted Gas Volume to Heat Input Ratio (LB/10^6BTU)	PENNSYLVANIA D.E.R. Allowable Total Particulate Emission Rate to Heat Input Ratio (LB/10^6BTU)	ALLEGHENY COUNTY Allowable Total Particulate Emission Rate to Heat Input Ratio (LB/10^6BTU)
P3 South	1	116.24	54.63	117.39	0.990	0.465	0.250	0.24[illegible]
P3 South	2	147.32	81.62	116.26	1.268	0.702	0.251	0.24[illegible]
P3 South	3	75.89	41.36	116.26	0.652	0.358	0.251	0.244
P3 South	4	47.03	23.09	116.26	0.404	0.199	0.251	0.244
P3 South	5	53.99	29.59	112.72	0.478	0.263	0.255	0.249
P3 South	6	108.27	69.73	112.72	0.960	0.619	0.255	0.249
P3 South	7	68.11	44.95	112.72	0.604	0.399	0.255	0.249
P3 South	8	159.79	99.39	121.03	1.320	0.821	0.245	0.238
P3 South	9	201.70	96.61	121.03	1.666	0.798	0.245	0.238
P3 South	10	47.34	24.47	117.39	0.404	0.208	0.250	0.243
		102.57	56.54					
P4	1	70.84	--	186.04	0.381	--	0.193	0.188
P4	2	73.48	--	186.04	0.395	--	0.193	0.188
P4	3	47.78	--	190.57	0.245	--	0.190	0.185
P4	4	112.85	--	190.57	0.592	--	0.190	0.185
P4	5	117.28	--	191.97	0.611	--	0.190	0.185
P4	6	109.64	--	191.97	0.571	--	0.190	0.185
P4	7	116.44	--	191.97	0.607	--	0.190	0.18[illegible]
P4	8	133.23	--	190.71	0.699	--	0.190	0.185
P4	9	92.72	--	190.71	0.486	--	0.190	0.185
P4	10	124.26	--	190.71	0.652	--	0.190	0.185
		Avg. = 99.25						

* Refer to Appendix C, page C57 for an explanation gas volume and subsequent emission rate conversions.

510760

1. Total Particulates - E.P.A. Method

The results of the particulate testing programs conducted at each of the sampling locations are presented as per the Federal E.P.A. Method of reporting the results of particulate tests below in Table IA. This reporting differs from Table I in that only nozzle, probe, cyclone, and filter holder washings and the filter collection were considered as the sites of sample collection; only that sample collected in the "front half" of the impinger train was used as the basis for the calculation of total particulate emission rates. This presentation differs from that required by the PENNSYLVANIA D.E.R. in that samples collected in the impinger solutions and subsequent impinger and connecting glassware washings were not included in the calculation of total particulate emission rates.

510781

TABLE 1A - TOTAL PARTICULATE TESTING RESULTS (FEDERAL E.P.A. METHOD) VS. APPLICABLE STANDARDS

Unit Sampled	Test No.	Measured* Total Particulate Emission Rate (LB/HR)	Total Particulate Emission Rate Based on a Converted Gas Volume (LB/HR)	Calculated Heat Input (10^6 BTU/HR)	Measured Total Particulate Emission Rate To Heat Input Ratio (LB/10^6 BTU)	% OVER ALLOW.	Particulate Emission Rate Based on a Converted To Heat Input Ratio (LB/10^6 BTU)	Total Allowable Emission Particulate Emission Rate To Heat Input Ratio (LB/10^6 BTU)	Allegheny County Allowable Particulate Emission Rate To Heat (LB/10^6 BTU)
P3 South	1	61.05	28.69	117.39	0.520		0.244	0.250	0.243
P3 South	2	44.82	24.83	116.26	0.386		0.214	0.251	0.244
P3 South	3	68.30	37.22	116.26	0.588		0.320	0.251	0.244
P3 South	4	42.58	20.91	116.26	0.366		0.180	0.251	0.244
P3 South	5	40.64	22.27	112.72	0.360		0.198	0.255	0.249
P3 South	6	94.95	61.15	112.72	0.842		0.542	0.255	0.249
P3 South	7	54.44	35.93	112.72	0.482		0.319	0.255	0.249
P3 South	8	57.86	35.99	121.03	0.478		0.297	0.245	0.238
P3 South	9	65.43	31.34	121.03	0.540		0.259	0.245	0.238
P3 South	10	37.39	19.33	117.39	0.318		0.165	0.250	0.243
P4	1	42.91	-	186.04	0.231	22.87	-	0.193	0.188
P4	2	52.25	-	186.04	0.281	49.47	-	0.193	0.188
P4	3	24.90	-	190.57	0.131	UNDER	-	0.190	0.185
P4	4	50.55	-	190.57	0.265	43.24	-	0.190	0.185
P4	5	50.08	-	191.97	0.261	41.08	-	0.190	0.185
P4	6	45.82	-	191.97	0.239	29.19	-	0.190	0.185
P4	7	49.09	-	191.97	0.256	38.38	-	0.190	0.185
P4	8	43.24	-	190.71	0.227	22.27	-	0.190	0.185
P4	9	28.72	-	190.71	0.151	UNDER	-	0.190	0.185
P4	10	40.17	-	190.71	0.211	14.05	-	0.190	0.185
				AVERAGE	.225	20.97			.186

$\frac{\text{ACTUAL} - \text{ALLOW.}}{\text{ALLOW.}} \times 100 = \%$

510782

1. Since the determination of the emission rates of condensable organic compounds involved only the results of a further analysis of the particulate samples coupled with all other parameters measured during the particulate sampling program, the results of the condensable organic sampling portion of the test program were considered concurrently with particulate sampling results. A detailed outline which reiterates many of the particulate sampling parameters and includes the condensable organic sampling parameters is attached to Appendix C, pages C72-C74, and C78-C80. Table II is a listing of pertinent condensable organic sampling parameters and adjusted condensable organic emission rates for the P3 South stack based on the PENNSYLVANIA D.E.R. Method of calculation. Table IIA presents sampling parameters and emission rates based on the FEDERAL E.P.A. Method of calculation.

TABLE II - CONDENSABLE ORGANIC SAMPLING RESULTS
(PENNSYLVANIA D.E.R. Method)

Unit Tested	Test No.	Measured Condensable Organic Emission Rate	Measured Total Particulate Emission Rate	Condensable Organic Emission Rate Based on a Converted Gas Volume	Total Particulate Emission Rate Based on a Converted Gas Volume	Condensable Organic Content of Total Particulates	Condensable Organic Content of Total Particulates Based on a Converted Gas Volume
P3 South	1	54.90	116.24	25.80	54.63	47.23 %	47.23
P3 South	2	127.36	147.32	70.56	81.62	86.45	86.45
P3 South	3	60.53	75.89	32.99	41.36	79.76	79.76
P3 South	4	44.26	47.03	21.73	23.09	94.11	94.11
P3 South	5	48.25	53.99	26.44	29.59	89.37	89.35
P3 South	7	27.88	68.11	18.40	44.95	40.93	40.93
P3 South	8	114.83	159.79	71.42	99.39	71.86	71.86
P3 South	9	120.30	201.70	57.62	96.61	59.64	59.64
P3 South	10	26.20	47.34	13.55	24.47	55.34	55.37
P4	1	52.20	70.84	--	--	73.69	--
P4	2	50.61	73.48	--	--	68.88	--
P4	3	28.46	46.78	--	--	60.84	--
P4	4	92.24	112.85	--	--	81.74	--
P4	5	88.27	117.28	--	--	75.26	--
P4	6	92.60	109.64	--	--	84.46	--
P4	7	101.12	116.44	--	--	86.84	--
P4	8	103.67	133.23	--	--	77.81	--
P4	9	72.78	92.72	--	--	78.48	--
P4	10	104.48	124.26	--	--	84.08	--

510784

TABLE IIA - CONDENSABLE ORGANIC SAMPLING RESULTS
(FEDERAL E.P.A. Method)

Unit Tested	Test No.	Measured Condensable Organic Emission Rate (LB/HR)	Measured Total Particulates Emission Rate (LB/HR)	Condensable Organic Emission Rate Based on a Emission Gas Volume (LB/HR)	Total Particulate Emission Rate Based on a Converted Gas Volume (LB/HR)	Condensable Organic Content of Total Particulates (Weight %)	Condensable Organic Content of Total Particulates Based on a Converted Gas Volume (Weight %)
P3 South	1	54.99	61.05	25.85	28.69	90.07	90.10
P3 South	2	14.28	44.82	7.91	24.83	31.86	31.86
P3 South	3	44.72	68.30	24.37	37.22	65.48	65.48
P3 South	4	38.59	42.58	18.95	20.91	90.63	90.63
P3 South	5	32.65	40.64	17.89	22.27	80.34	80.33
P3 South	6	65.46	94.95	42.16	61.15	68.94	68.95
P3 South	7	35.96	54.44	23.73	35.93	66.05	66.05
P3 South	8	14.26	57.86	8.87	35.99	24.66	24.65
P3 South	9	8.87	65.43	4.25	31.34	13.56	13.56
P3 South	10	20.11	37.39	10.40	19.33	53.78	53.80
P4	1	28.60	42.91	--	--	66.65	--
P4	2	45.98	52.25	--	--	88.00	--
P4	3	18.52	24.90	--	--	74.38	--
P4	4	24.95	50.55	--	--	49.36	--
P4	5	26.20	50.08	--	--	52.32	--
P4	6	21.66	45.82	--	--	47.27	--
P4	7	21.10	49.09	--	--	42.98	--
P4	8	16.24	43.24	--	--	37.56	--
P4	9	8.17	28.72	--	--	28.45	--
P4	10	14.64	40.17	--	--	36.45	--

510785

B. Sulfur Dioxide Sampling

The results of the sulfur dioxide portion of the sampling program are presented below in Table III. No contrast was made with an applicable standard at the request of Mr. S. Vajda, Development Engineer, Coke Plant of J & L, since J & L is currently planning to add a desulfurization unit to the process. The desulfurization unit will remove 99+% of the gas stream's sulfur content and, therefore, control sulfur dioxide emissions.

510786

TABLE III - SO_2 TESTING RESULTS

Stack Sampled	Test Number	Sample Gas Volume (dry SCF)	Measured Sulfur Dioxide Concentration (PPM by volume)
P3 South	1	33.477	2484
P3 South	2	33.900	3340
P3 South	3	34.218	2887
P3 South	4	32.611	2768
P3 South	5	34.682	3519
P3 South	6	32.088	3249
P3 South	7	28.718	3470
P3 South	8	35.662	3369
P3 South	9	31.924	3995
P3 South	10	33.477	2305
P4	1	33.167	1810
P4	2	30.870	2485
P4	3	29.608	2654
P4	4	30.737	2732
P4	5	33.240	3203
P4	6	34.336	3098
P4	7	31.842	2905
P4	8	35.205	1946
P4	9	34.635	1935
P4	10	31.501	3202
P4	11	32.221	3290

510787

TABLE IV - NO_X TESTING RESULTS

Test Location	Test Number	Measured NO_X Concentration (PPM by volume)	Measured NO_X Emission Rate (lb/hr)	NO_X Emission Rate Based On a Converted Gas Volume (lb/hr)
P3 South	1	456	235.76	110.81
P3 South	2	388	169.97	94.16
P3 South	3	380	169.28	92.26
P3 South	4	452	223.39	109.68
P3 South	5	622	275.48	150.96
P3 South	6	645	243.14	156.58
P3 South	7	682	250.84	165.55
P3 South	8	363	141.77	88.18
P3 South	9	414	209.90	100.54
P3 South	10	447	210.15	108.65
P4	1	159	63.13	--
P4	2	194	75.59	--
P4	3	140	57.59	--
P4	4	204	80.20	--
P4	5	173	75.04	--
P4	6	198	77.25	--
P4	7	206	81.69	--
P4	8	163	68.59	--
P4	9	212	75.76	--
P4	10	211	79.55	--

5107788

D. Particle Size Analysis Sampling

Particle size distribution determinations for the particulate matter suspended in the respective flue gas streams were made using two distinct techniques. Therefore, particle size analysis results from each of the two types of tests were considered separately.

1. Andersen Impactor Method

The results of the Andersen Impactor Method tests are presented in tabular form below in Table V. All calculated aerodynamic particle diameters were based on an assumed aerodynamic particle density of 1.0 g/cc.

510789

TABLE V

P-3, ANDERSEN NUMBER 1

Stage	D'p (μ)	D'p (corrected) (μ)	Weight of Sample (mg)	Size Distribution (%)	Cumulative (%)
0	17.5&>	22.4&>	7.6	1.86	1.86
1	11.0	14.1	1.7	0.42	2.28
2	7.3	9.3	3.8	0.93	3.21
3	5.1	6.5	1.4	0.34	3.55
4	3.3	4.2	1.4	0.34	3.89
5	1.7	2.2	1.8	0.44	4.33
6	1.05	1.3	1.9	0.46	4.79
7	0.71	0.9	9.9	2.42	7.21
8	<0.71	<0.9	379.4	92.79	100.00

T=408.9

$Q = \frac{(20.552\ ft.^3)}{(65\ min)} = 0.316$ ACFM

% Isokinetic = 104.81

Aerodynamic Particle Density $\cong$ 1.0 g/cc

K_{temp} = 1.28

P-3, ANDERSEN NUMBER 2

Stage	D'p (μ)	D'p (corrected) (μ)	Weight of Sample (mg)	Size Distribution (%)	Cumulative (%)
0	16.0&>	20.5&>	1.2	0.76	0.76
1	10.5	13.4	0.7	0.45	1.21
2	6.8	8.7	0.5	0.32	1.53
3	4.8	6.1	0.6	0.38	1.91
4	3.1	4.0	0.5	0.32	2.23
5	1.6	2.0	1.1	0.70	2.93
6	0.97	1.2	1.5	0.95	3.88
7	0.66	0.8	2.6	1.65	5.53
8	<0.66	<0.8	148.6	94.45	99.98

T=157.3

$Q = \frac{(20.651\ ft^3)}{(60\ min)} = 0.344$ ACFM

% Isokinetic = 102.78

Aerodynamic Particle Density $\cong$ 1.00 g/cc

K_{temp} = 1.28

510790

TABLE V (continued)

P-3, ANDERSEN NUMBER 3

Stage	D'p (μ)	D'p (corrected) (μ)	Weight of Sample (mg)	Size Distribution (%)	Cumulative (%)
0	16.0&>	20.5&>	0.6	0.45	0.45
1	10.0	12.8	0.9	0.68	1.13
2	6.7	8.6	0.4	0.30	1.43
3	4.7	6.0	0.6	0.45	1.88
4	2.9	3.7	1.1	0.83	2.71
5	1.6	2.0	1.2	0.91	3.62
6	0.95	1.2	1.0	0.76	4.38
7	0.64	0.8	1.7	1.29	5.67
8	<0.64	<0.8	124.5	94.32	99.99

T=132

$Q = \frac{(18.185\ ft^3)}{(50\ min)} = 0.364$ ACFM

% Isokinetic = 101.91

Aerodynamic Particle Density ≅ 1.0 g/cc

$K_{temp} = 1.28$

P-4, ANDERSEN NUMBER 1

Stage	D'p (μ)	D'p (corrected) (μ)	Weight of Sample (mg)	Size Distribution (%)	Cumulative (%)
0	13.5&>	17.0&>	3.7	19.17	19.17
1	8.4	10.6	3.5	18.13	37.30
2	5.5	6.9	2.5	12.95	50.25
3	3.6	4.5	1.7	8.81	59.06
4	2.4	3.0	2.4	12.44	71.50
5	1.25	1.6	2.2	11.40	82.90
6	0.77	1.0	0.5	2.59	85.49
7	0.54	0.7	1.2	6.22	91.71
8	<0.54	<0.7	1.6 + (No Recovery)	8.29	100.00

T=19.3

$Q = \frac{(8.11\ ft^3)}{(15\ min)} = 0.541$ ACFM

% Isokinetic = 108.19%

Aerodynamic Particle Density ≅ 1.00 g/cc

$K_{temp} = 1.26$

TABLE V (continued)

P-4, ANDERSEN NUMBER 2

Stage	D'p (μ)	D'p (corrected) (μ)	Weight of Sample (mg)	Size Distribution (%)	Cumulative (%)
0	13.8&>	17.4&>	2.2	1.01	1.01
1	8.6	10.8	1.3	0.60	1.61
2	5.6	7.0	1.5	0.69	2.30
3	3.7	4.7	1.1	0.50	2.80
4	2.8	3.5	0.2	0.09	2.89
5	1.4	1.8	0.8	0.37	3.26
6	0.78	1.0	1.4	0.64	3.90
7	0.53	0.7	2.1	0.96	4.86
8	<0.53	<0.7	207.7	95.14	100.00

T=218.3

$$Q = \frac{(13.096\ ft^3)}{(25\ min)} = 0.523\ ACFM$$

% Isokinetic = 100.29%

Aerodynamic Particle Density $\cong$ 1.0 g/cc

K_{temp} = 1.26

P-4, ANDERSEN NUMBER 3

Stage	D'p (μ)	D'p (corrected) (μ)	Weight of Sample (mg)	Size Distribution (%)	Cumulative (%)
0	13.5&>	17.0&>	2.5	1.46	1.46
1	8.7	11.0	1.6	0.93	2.39
2	5.7	7.2	1.5	0.87	3.26
3	4.0	5.0	2.0	1.16	4.42
4	2.6	3.3	1.7	0.99	5.41
5	1.6	2.0	1.2	0.70	6.11
6	0.8	1.0	3.3	1.92	8.03
7	0.54	0.7	4.1	2.39	10.42
8	<0.54	<0.7	153.9	89.58	100.00

T=171.8

$$Q = \frac{(14.819\ ft^3)}{(30\ min)} = 0.494\ ACFM$$

% Isokinetic = 92.73%

Aerodynamic Particle Density $\cong$ 1.0 g/cc

K_{temp} = 1.26

510792

2. Coulter Counter Method

The particle size distribution data generated from the results of two of the three tests conducted on each of the sources are tabulated below in Table VII - Results of the Coulter Counter Analyses.

510793

TABLE VI - RESULTS OF THE COULTER COUNTER ANALYSES

Test Identification	Particle Diameter (μ)	Size Distribution (wt. %)
P3 South Run No. 1	<3.0	4.4
	3.0 - 5.0	15.2
	5.0 - 10.0	32.9
	10.0 - 20.0	29.6
	20.0 - 30.0	2.9
	30.0 - 45.0	3.0
	45.0&>	12.0
		T = 100.0
P3 South Run No. 3	<3.0	3.6
	3.0 - 5.0	5.7
	5.0 - 10.0	11.0
	10.0 - 20.0	13.6
	20.0 - 30.0	4.0
	30.0 - 45.0	1.6
	45.0&>	60.5
		T = 100.0
P4 Run No. 2	<3.0	5.7
	3.0 - 5.0	9.2
	5.0 - 10.0	27.5
	10.0 - 20.0	10.5
	20.0 - 30.0	0.4
	30.0 - 45.0	10.9
	45.0&>	35.8
		T = 100.0
P4 Run No. 3	<3.0	1.4
	3.0 - 5.0	1.6
	5.0 - 10.0	5.5
	10.0 - 20.0	8.2
	20.0 - 30.0	5.1
	30.0 - 45.0	21.1
	45.0&>	57.1
		T = 100.0

510794

E. Opacity Measurements

Pertinent results of the smoke opacity measurements portion of the sampling program are contrasted with the applicable PENNSYLVANIA and ALLEGHENY COUNTY visible emissions standards below in Table VII - Results of Opacity Observations. The calculated average smoke opacity for each observation period is also included in Table VII although there are no current PENNSYLVANIA regulations regarding this parameter.

510795

TABLE VII - RESULTS OF OPACITY OBSERVATIONS

Stack Observed	Test Number	Test Duration (Min.)	Average Opacity ( )	Number of Observations Opacity Greater Than or Equal 20% Opacity (No.)	Aggregate Time Period Observations Greater Than or Equal to 20% Opacity (Min.)	Allowable Time Period Observations Greater Than or Equal to 20% Opacity (Min.)	Number of Observations Greater Than or Equal to 60% Opacity (No.)	Allowable No. of Observations Greater Than or Equal to 60% Opacity (No.)
P3 South	1	60	45.67	231	57.75	3.00	71	0
P3 South	2	60	61.25	190	47.50	3.00	158	0
P3 South	3	60	67.17	212	53.00	3.00	157	0
P3 South	4	60	37.38	177	44.25	3.00	52	0
P3 South	5[A]	15	19.75	39	9.75	3.00	0	0
P4	1	60	17.77	125	31.25	3.00	0	0
P4	2	60	26.33	198	49.50	3.00	6	0
P4	3	60	36.08	235	58.75	3.00	11	0
P4	4	60	45.39	237	59.25	3.00	38	0
P4	5	60	43.48	232	58.00	3.00	37	0
P4	6	60	33.92	228	57.00	3.00	15	0
P4	7	60	29.45	207	51.75	3.00	15	0
P4	8	60	45.02	236	59.00	3.00	71	0
P4	9	60	35.58	234	58.50	3.00	1	0
P4	10	60	38.41	235	58.75	3.00	4	0

[A] - Observation Number 5 suspended after fifteen minutes due to inclement sky conditions.

5107796

F. Deposit Analysis Results

The results of the deposit analysis indicate the weight percentages of the total sample for a specific oxide component. The results of the analysis are listed below in Table VIII:

510797

TABLE VIII - RESULTS OF DEPOSIT ANALYSES

Sampling Location	Parameter	Relative Composition to 600°F (weight %) (condensable organic)	Relative Composition 600°F-1400°F (weight %) (free carbon)
P3 South	SiO_2*	3.6	11.0
	Fe_2O_3	1.0	1.0
	Al_2O_3	1.0	1.0
	CaO	2.0	6.0
	MgO	1.0	1.0
	SO_4 —	16.2	49.0
	Na_2O	9.9	30.0
	CdO	-	-
	L.O.I.	67.0	1.0
			T = 100%
P4	SiO_2	-	-
	Fe_2O_3	-	-
	Al_2O_3	-	-
	CaO	0.7	3.0
	MgO	-	-
	SO_4 —	12.0	52.0
	Na_2O	8.5	37.0
	CdO	1.2	5.0
	L.O.I.	77.0	3.0
			T = 100%

* Possibly due to glass fiber filter.

510798

V. DISCUSSION OF RESULTS

A. Particulate-Condensable Organic-Moisture Content Sampling

All sampling was performed in accordance with the procedures and requirements established by the ALLEGHENY COUNTY HEALTH DEPARTMENT, the PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES and the UNITED STATES ENVIRONMENTAL PROTECTION AGENCY. All calculated isokinetic percentages fell within the permissible limits of 90% to 110% as prescribed by the UNITED STATES ENVIRONMENTAL PROTECTION AGENCY. The isokinetic percentage is an indication of the precision with which the flow rate of sampled gas was adjusted to become proportional to actual stack gas flow. The calculated isokinetic percentage from the results of an individual test is the best criterion available to be used to determine the validity of a test, presupposing that all required test procedures were closely followed.

1. P3 South Stack - Total Particulates

The total particulate emission rates calculated from the test results were reported in two ways: 1. As measured and 2. Based on a converted stack gas volume. The conversion of the stack gas volume was necessitated due to inaccurracies in flow measurements caused by the non-ideal sampling location and in light of theoretical calculations made by J & L staff engineering personnel. Fairly good agreement exists between the results of the ten tests; abnormally high emission rates, peak values, are attributed to a larger number of oven chargings and subsequent pushings during a specific sampling period than took place in other sampling periods. Data scatter may be attributed to the fact that the ovens in the battery were in various stages toward the completion of the coking process during each individual sampling period.

510799

a. Complia[illegible] Evaluation

In all cases measured and converted total particulate emissions exceeded the allowable limits prescribed in Title 25. Rules and Regulations, DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA, Chapter 123, Section 123.11 and in Rules and Regulations, Article XVIII, Air Pollution Control, ALLEGHENY COUNTY HEALTH DEPARTMENT, Effective Date: June 15, 1972, Section 1809.3.

2. P3 South Stack - Total Particulates (E.P.A. Method)

Total particulate emissions calculated on both the "as measured" and "converted" bases as prescribed by the FEDERAL E.P.A. were also contrasted with the pertinent PENNSYLVANIA and ALLEGHENY COUNTY regulations. All "as measured" results violate these regulation. However, five of the ten "converted" results complied with the PENNSYLVANIA regulation, and four of the ten "converted" results comply with the ALLEGHENY COUNTY regulation. As was expected emission rate data calculated by the E.P.A. Method more closely approximates compliance than that data calculated using the PENNSYLVANIA Method.

3. P4 Breeching - Total Particulates

Total particulates calculated from the test results showed data scatter as did the P3 South results. It is hypothesized that discussion concerning chargings, pushings, and various stages of completion of the coking process presented in the P3 South section would be applicable to the P4 emissions also.

a. Compliance Evaluation

Both PENNSYLVANIA and ALLEGHENY COUNTY allowable emission limits were exceeded during all test periods. It should be noted that the allowable limits were exceeded to a lesser degree in the P4 breeching than they were in the P3 South stack.

4. P4 Breeching - Total Particulates (E.P.A. Method)

Total particulate emissions based on the E.P.A. Method of calculations were found to violate both the PENNSYLVANIA and the ALLEGHENY COUNTY standards in eight out of ten cases although, once again, emission rates calculated on this basis were found to be a much more closely approximate compliance than were those calculated on the PENNSYLVANIA D.E.R. basis.

5. Condensable Organics

The major portion of the total particulate emissions emanating from each of the two test locations was determined to be condensable organic material. If controlled or considerably reduced, the high percentage of condensable organic material could possibly be diminished to the point where a compliance situation would exist. The results of the condensable organic emission analysis when compared to the total particulate emission analysis indicate that inorganic particulates are the less important consideration in a compliance evaluation.

6. Moisture Content

The moisture content data scatter is a function of two circumstances: 1. A more complete combustion efficiency of those hydrocarbons present in the gas stream would increase the streams' moisture content and 2. A larger concentration of hydrocarbons combusted at the same efficiency would also increase the gas streams' moisture content. Although the calculated volume percentages of moisture in the respective gas streams were substantial, saturation conditions were never attained nor were they even approximated.

510801

B. Oxides of Sulfur

No compliance evaluation of the sulfur dioxide concentration data was made in light of discussions with Mr. S. Vajda of J & L in which B.E.E. was informed of J & L's intentions to install gas desulfurization equipment which would remove gaseous sulfur compounds from the coke oven gas prior to its combustion. Compliance evaluations of the two batteries would cite Title 25. Rules and Regulations, DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA, Chapter 123, Section 123.22. Test results indicate the presence of rather high concentrations of sulfur dioxide in the flue gas streams.

C. Oxides of Nitrogen

No compliance evaluation of the NO_x (as NO_2) concentration or emission rate data was made with an emission standard since no such standard form exists at this time; only the concentration of NO_x at the ambient level is regulated. Measured NO_x concentrations and emission rates were determined to be higher at the P3 South stack than at the P4 breeching. This situation is most probably due to the fact that the formation of NO_x is enhanced as temperature increases; temperatures of stack gases measured at at the P3 South stack were considerably higher than stack gas temperatures measured in the P4 breeching.

D. Particle Size

Two different methods of particle size distribution determination were employed in the sampling program in the hope of obtaining supportive data. The isokinetic percentages calculated from the results of all particle size analysis tests fell within the permissible limits of 90% to 110%.

1. Andersen Impactor Method

The results of five of the six Andersen Impactor particle size analyses indicated that the particulate matter was very fine in nature.

With the exception of the first P4 sample, an overwhelming majority of the particulate matter, greater than ninety percent, was determined to be submicron in particle diameter. Providing there is no leakage of gases or particulates from the ovens into the flue gas stream, coke oven gas should very closely approximate natural gas with respect to its chemical composition. Historical data has indicated that particulates formed in the combustion of natural gas are very fine in nature. The high concentration of condensable organics should not affect the particle size distribution measurements made employing this method to any great degree since condensable organics will pass through the in-stack impactor, probe, and glass fiber filter at temperatures which are in excess of their dew points. This is not to say that a relatively small amount of condensable organic material was not deposited in the probe and on the filter.

2. Coulter Counter Method

The results of the Coulter Counter particle size analysis indicated a much different particle size distribution than the Andersen Impactor analysis. It is believed that these results are erroneous for the following reasons: 1. The Coulter Counter samples, due to their somewhat "oily" nature, were observed to agglomerate almost immediately upon their recovery. Agglomeration of small particles to larger clumps would definitely skew the distribution toward the larger particle range and 2. No supportive or historical data which demonstrated a similar particle size distribution could be found. All historical data was in very good agreement with the results of the Andersen analysis.

510803

E. Opacity Measurements

Observed smoke opacity readings indicated a violation of both the PENNSYLVANIA opacity regulation prescribed in Title 25. Rules and Regulations, DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA, Chapter 123 Sections 123.41, 123.42, and 123.43 and the ALLEGHENY COUNTY Regulation prescribed in Rules and Regulations, Article XVIII, Air Pollution Control, ALLEGHENY COUNTY HEALTH DEPARTMENT, Effective Date: June 15, 1972, Sections 1809.1 and 1809.7. It is believed that the characteristic haze resulting from the presence of condensable organic compounds in the gas stream was a major contributor to the high recorded opacities. Such a haze, in the presence of some inorganic particulate would definitely results in a situation where opacity standards were exceeded. The presence of uncombined water vapor is not believed to have had any effect on opacity measurements since the gas stream was not saturated with respect to moisture and since it is not believed that a temperature gradient of 300-400°F existed between either sampling location and the point immediately above the top of the stack where opacities were observed.

F. Deposit Analysis

The results of the deposit analysis indicated that the majority of the suspended particulate matter was composed of condensable organic material. Very little free carbon was observed. A significant amount of sulfates were observed, but very few simple oxides were shown to be present in the sample. The concentration of sulfates in the sample should approach zero following the installation of the desulfurization equipment.

510804

LABORATORY RESULTS - SO_2 SAMPLES

Unit Sampled	Test Number	Aliquot Volume (ml)	Sample Volume (ml)	Weight of Aliquot Precipitate (mg)	Total Weight of Sample Collected (mg)
P3 South	1	50	350	911.0	6377.0
P3 South	2	50	390	1113.3	8683.7
P3 South	3	50	400	946.9	7575.2
P3 South	4	50	385	898.1	6915.4
P3 South	5	50	405	1155.6	9360.4
P3 South	6	50	385	1038.2	7994.1
P3 South	7	50	380	1005.5	7641.8
P3 South	8	50	420	1096.9	9214.0
P3 South	9	50	428	1142.5	9779.8
P3 South	10	50	388	762.7	5918.6
P4	1	50	355	648.3	4602.9
P4	2	50	345	852.5	5882.3
P4	3	50	370	814.3	6025.8
P4	4	50	375	858.7	6440.3
P4	5	50	385	1060.3	8164.3
P4	6	50	388	1051.2	8157.3
P4	7	50	379	935.7	7092.6
P4	8	50	380	691.2	5253.1
P4	9	50	378	680.0	5140.8
P4	10	50	395	979.1	7734.9
P4	11	50	375	1083.9	8129.3

510805

III. EQUATIONS FOR THE CALCULATIONS LEADING TO TEST RESULTS

A. Particulate-Condensable Organic-Moisute Content Sampling

Pertinent equations were prescribed in Method Two, Method Four, and Method Five of the "Federal Register", Volume 36, Number 247, December 23, 1971.

B. Sulfur Dioxide and Nitrogen Oxides Sampling

Equations employed in the calculations of the results of gaseous pollutants sampling programs were listed in the Source Testing Manual of the AIR POLLUTION CONTROL DISTRICT, COUNTY OF LOS ANGELES, November, 1963.

C. Particle Size Analysis Sampling

The results of the Andersen Method particle size analyses were determined utilizing the curves plotted in the publication "Operating Instructions for Andersen Stack Sampling Equipment" and simple arithmetic. The results of the Coulter Counter particle size analyses were calculated using simple arithmetic only.

D. P3 South Stack Emission Rate Conversions

The emission rate data measured at the P3 South stack was a function of the total gas volume through that stack. Due to the poor sampling location and in light of theoretical gas volume calculations made by J & L personnel, it was hypothesized that the measured gas volume data was not entirely accurate. For this reason the P3 South stack emission rate data was converted to P4 conditions in the following manner: 1. An average gas volume at average temperature, pressures, moisture contents, etc. through the P4 breeching was determined and 2. This volume was multiplied by a ratio of the heat input to the P3 South battery to the heat input to the P4 battery. Refer to page C57 for the numerical calculations.

510806

E. Opacity Measurements

The average opacity was calculated by summing the individual readings and dividing the sum by the total number of readings. The compliance evaluation was made by counting the number of individual readings which violated the PENNSYLVANIA and ALLEGHENY COUNTY standards.

F. Compliance Evaluation of Particulate Sampling Results

The calculation of the allowable particulate emission rates proceded as follows: 1. An average fuel gas flow rate in ACFH was determined by adjusting the recorder chart value to actual conditions; 2. This flow rate was multiplied by 510 BTU/ACF, an average heating value reported by J & L personnel. The multiplication yilded the heat input to the battery in 10^6BTU/HR; and 3. The heat input term was included in the allowable emission equation prescribed in the PENNSYLVANIA regulation. The ALLEGHENY COUNTY allowable emission limit was calculated by multiplying the PENNSYLVANIA limit be a factor of $\frac{3.5}{3.6}$, 0.972. The pertinent equations are presented in Appendix C, pages C61-C62.

CALCULATIONS (Based on Federal Register)

Please refer to legend for identification of symbols.

EQUATIONS FOR PARTICULATE EMISSION CALCULATION

1. $M_c = 0.0474\ M_1$

2. $Q_s = 17.71 \dfrac{Q_m}{T_m + 460} \left(\dfrac{P_{bar} + H}{13.6}\right)$

3. $M = \dfrac{100\ M_c}{(M_c + Q_s)}$

4. $X = \dfrac{100-M}{100}$

5. $M_w = 18(1-X) + 0.44\ (\%\ CO_2) + 0.28\ (\%\ CO) + 0.32(\%O_2) + 0.28\ (\%N_2)$

6. $X_a = \dfrac{100\ (\%\ O_2 - 0.5\%\ CO)}{0.264\%\ N_2 - (\%O_2 - 0.5\%\ CO)}$

7. $C_p = 0.99\ (\Delta P \text{ for Standard Pitot}/\Delta P \text{ for type "S" Pitot})^{0.5}$

8. $V_s = (85.48)(60)(C_p)\left[P_t\right]^{0.5}\left[(T_s + 460)/(P_s)(M_w)\right]^{0.5}$

9. $V_{ga} = V_s \left(\dfrac{A_s}{144}\right)$

10. $V_{gs} = XV_{ga} \left(\dfrac{530}{T_s + 460}\right) \left(\dfrac{P_s}{29.92}\right)$

11. $W_d = (0.0154) \dfrac{W_f}{Q_s}$

12. $W_w = (0.0154) \dfrac{W_f}{(Q_s + M_c)}$

13. $W_c = \dfrac{12\ W_d}{\%\ CO_2}$

510808

14. $W_s = 530\ W_w \left(\frac{530}{(T_s + 460)}\right) \left(\frac{P_s}{(29.92)}\right)$

15. $W_p = 0.00857\ V_{gs}\ W_d$

16. $A_n = \frac{\pi}{144} \left(\frac{D_n}{2}\right)^2$

17. $I = \frac{(60)(1.667)(T_s + 460)(0.00267\ M_1 + Q_s/17.71)}{(D)(V_s)(P_s)(A_n)}$

LEGEND

A_n = Area of nozzle in square feet

A_s = Stack area square inches

C_p = Pitot correction factor

D = Duration of test

D_n = Nozzle diameter in inches

g_c = $lg/(atm)(cm)(sec)^2$

H = Orifice pressure drop in inches of water

I = % Isokinetics

M = % Moisture

M_l = Volume of liquid (in milliliters) collected in impingers and silica gel

M_c = Volume of M_l converted to cubic feet

M_w = Molecular weight of stack gases

P_{bar} = Barometric pressure (inches of mercury)

P_s = Stack pressure absolute (inches of mercury)

P_t = Average of square roots of pressure drop across "S" pitot in $(\text{in water})^{1/2}$

Q_m = Sample volume (dry) meter conditions in cubic feet

Q_s = Sample volume (dry) standard cubic feet

T_f = Temperature after jet in °F

T_k = Temperature after jet in °K

T_m = Average meter temperature in °F

T_s = Average stack temperature in °F

V_{ga} = Stack gas flow in ACFM

LEGEND

V_{gs}	=	Stack gas flow in SCFM
V_s	=	Stack velocity feet per minute
W_c	=	Particulate concentration in grains per SCF (dry) at 12% CO_2
W_d	=	Particulate concentration in grains per SCF (dry)
W_p	=	Pounds per hour particulates
W_s	=	Particulate concentration in grains per cu. ft. (Stk. conditions)
W_t	=	Total weight of particulates collected in test in milligrams
W_w	=	Particulate concentration in grains per SCF (wet)
X	=	Dry sample fraction
X_a	=	% excess air

Equations For Sulfur Dioxide Calculations (PENNSYLVANIA Method)

1. $W_{SD} = W_{SDA} \left[\frac{V_{ST}}{V_A}\right]$

2. $V_T = V_M \left[\frac{T_s}{T_m}\right]\left[\frac{P_m}{P_s}\right]$

3. $C_{SD} = 13040 \left[\frac{W_{SD}}{V_T}\right]$

Legend

C_{SD} = Concentration of sulfur dioxide in PPM by volume

P_M = Meter pressure (absolute) in inches of Mercury

P_S = Standard pressure in inches of Mercury = 29.92 in. Hg

T_M = Average Meter temperature (absolute) in degrees R

T_S = Standard temperature in degrees R = 530°R

V_A = Volume of sample aliquot in ml

V_M = Sampled gas volume (dry) in ACF

V_{SE} = Total volume of sample solution in ml

V_T = Sampled gas volume (dry) in SCF

W_{SD} = Total weight of sulfur dioxide collected in grams

W_{SDA} = Weight of sulfur dioxide in aliquot in grams

510812

EQUATIONS FOR OXIDES OF NITROGEN ANALYSIS

1. $C_{NO_x} = (cNO_x)\ \text{dry}\ \left(\frac{100-M}{100}\right)$

2. $M_{NO_x} = \frac{46\ \text{lb./lb. mole}}{386.78\ \text{ft.}^3\text{/lb. mole}}\ (60\ \text{min./hr.})\ (Vg_s)(C_{NO_x}) \times 10^{-6} =$

$7.14 \times 10^{-6}\ Vg_s C_{NO_x}$ at $70^oF = 530^oR$

LEGEND

C_{NO_x} = Concentration of NO_x (as NO_2) at stack conditions in PPM by volume

cNO_x = Concentration of NO_x (as NO_2) on a dry basis in PPM by volume

M_{NO_x} = Emission rate of NO_x (as NO_2) in LB./HR.

P-3 EMISSION RATE CONVERSION BASIS

Test Identification	Gas Volume (ACFM wet)	CO_2 Content (% by volume)	O_2 Content (% by volume)	Moisture Content (% by volume)	Gas Temperature (°F)	Gas Pressure (in Hg)
Run No. 1	111839	5.6	9.8	9.43	469	28.79
Run No. 2	116923	5.1	11.0	12.73	491	28.71
Run No. 3	121797	6.0	10.6	11.95	483	28.60
Run No. 4	118930	5.8	11.8	12.45	499	28.63
Run No. 5	132262	4.6	10.4	12.54	508	28.70
Run No. 6	117224	4.6	11.0	11.88	499	28.64
Run No. 7	123900	4.4	12.0	13.59	517	28.61
Run No. 8	126526	4.6	11.0	10.09	520	28.[illegible]
Run No. 9	110870	3.9	10.2	14.46	499	28.[illegible]
Run No. 10	116598	5.0	10.3	13.17	508	28.50
Average	119687	5.0	10.8	12.23	499	28.64

$$V_{SCFM}\ (dry) = (119687)\ \left(\frac{530}{959}\right)\ \left(\frac{28.64}{29.92}\right)\ (0.8777) = 55573\ SCFM\ (dry)\ @\ P4$$ One of P4

$$V_{SCFM}\ (dry)\ @\ P3S = \frac{55573\ SCFM\ @\ P4 \quad 116.38 \times 10^6\ BTU\ input\ to\ P3S}{190.13 \times 10^6\ BTU\ input\ to\ P4} = 34017\ SCFM\ (dry)\ @\ P3S)$$

$$Wp = (Wp\ (measured))\ \left(\frac{34017\ SCFM\ (dry)}{X\ SCFM\ (dry)\ measured}\right)$$

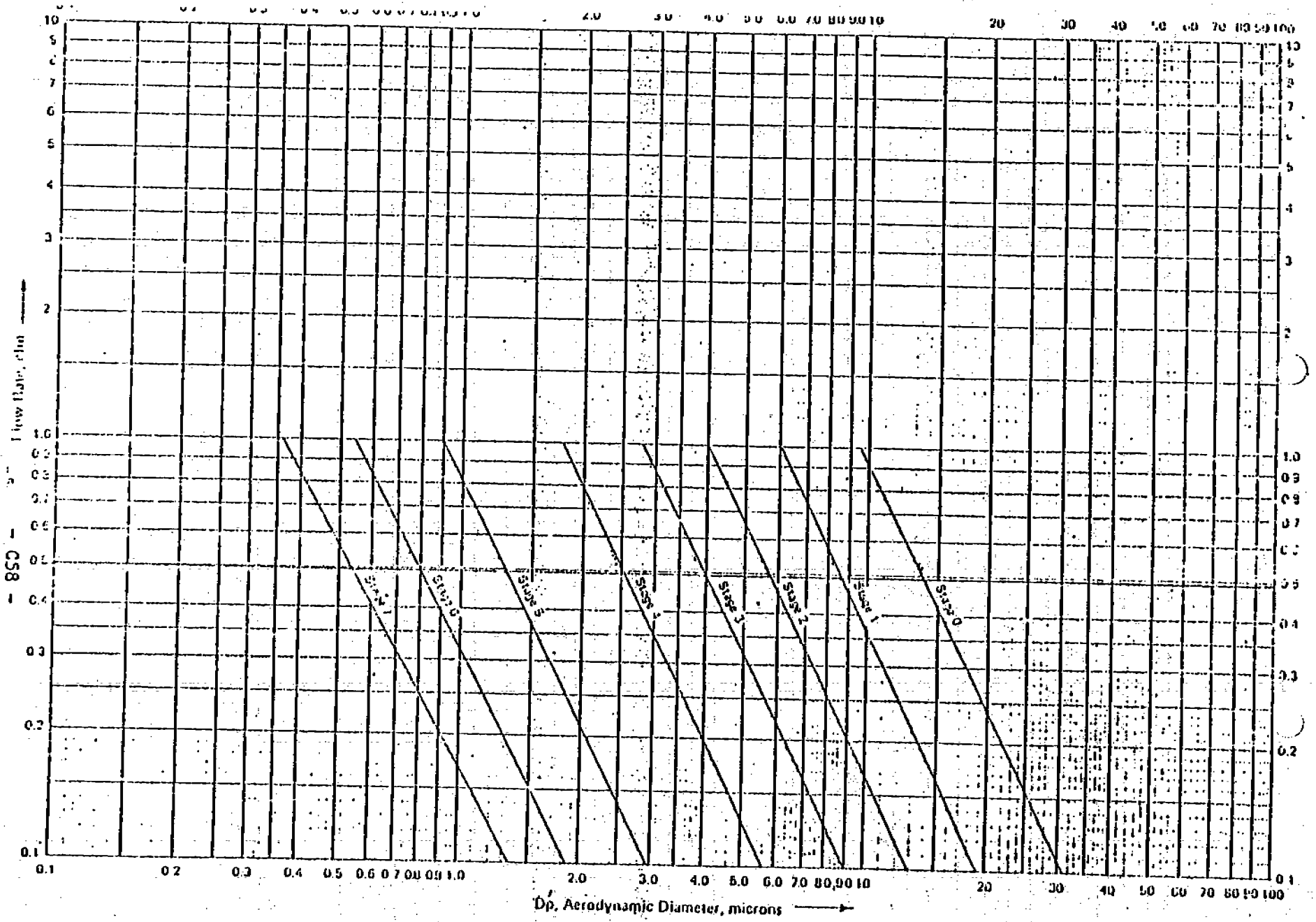
$$M_{NOx} = (7.14 \times 10^{-6})\ \left(\frac{34017\ SCFM\ (dry)}{X\ SCFM\ (dry)\ measured}\right)$$

$$\frac{55,573}{190.13 \times 10^6} = \frac{34,017}{116.38 \times 10^6}$$

ASSUMPTION

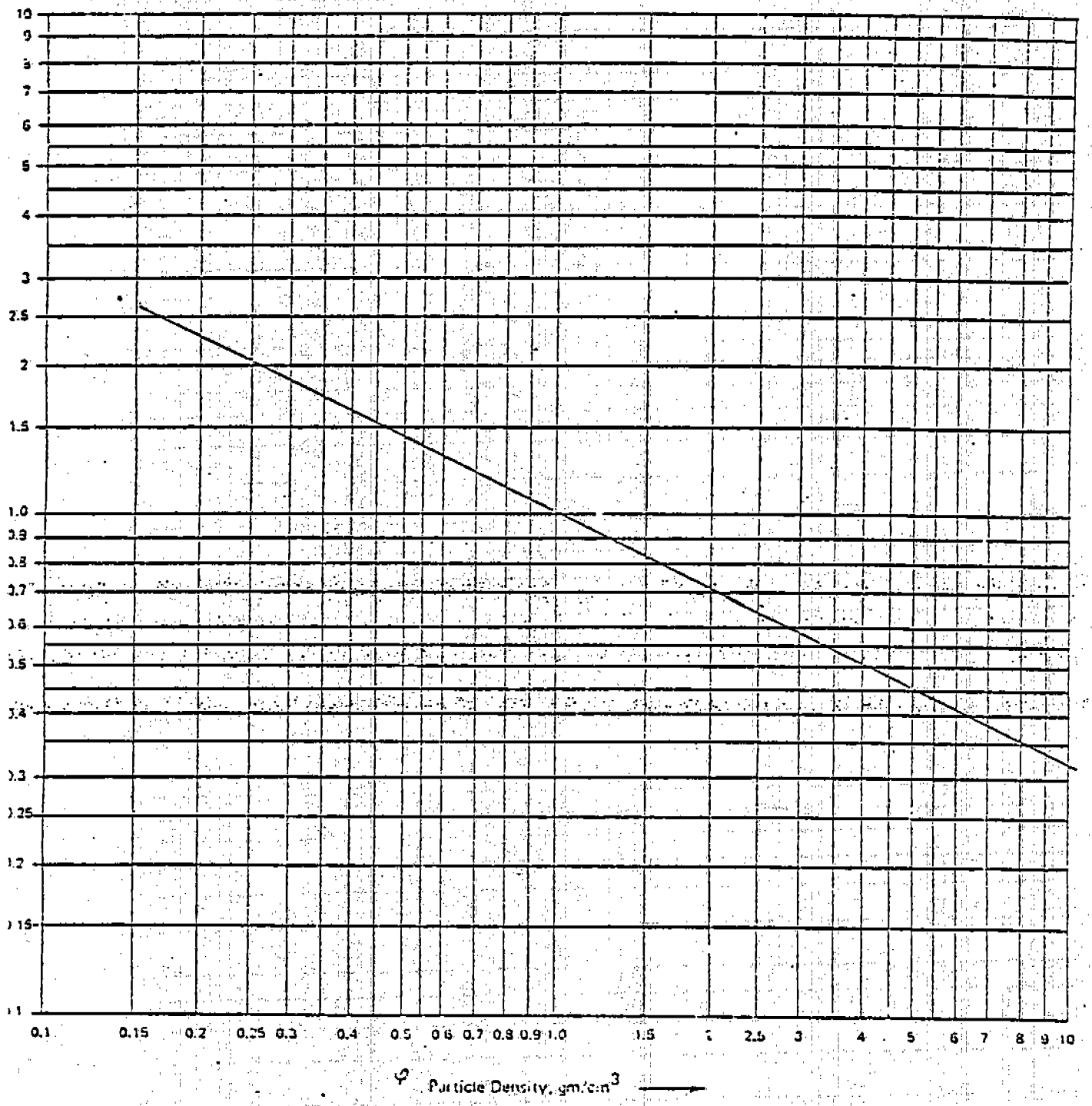
(HEAT-INPUT)(VOLUME) = (HEAT-INPUT)(VOLUME)
P4 P3

510814

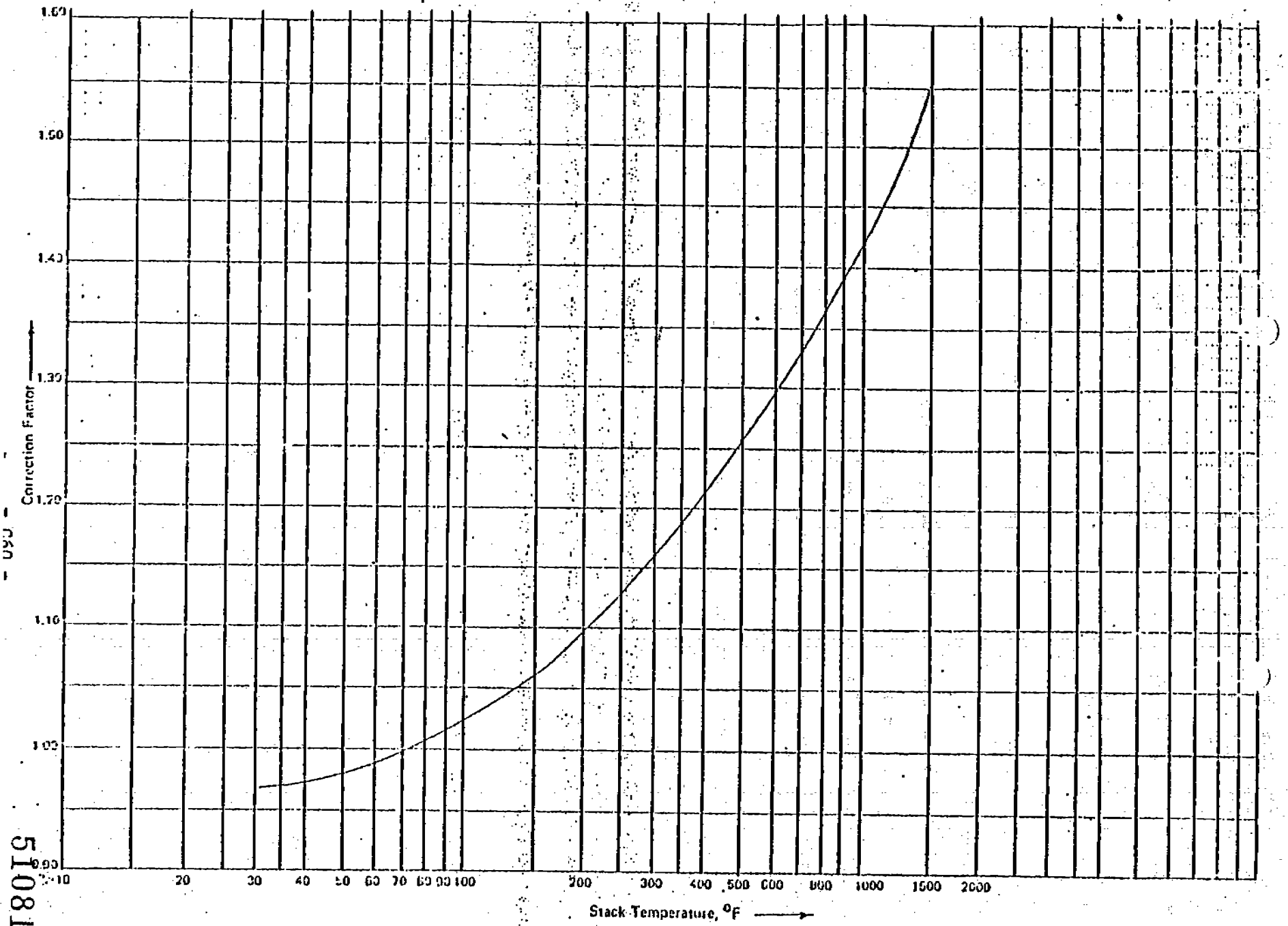

Stage 7
Stage 6
Stage 5
Stage 4
Stage 3
Stage 2
Stage 1
Stage 0
Dp, Aerodynamic Diameter, microns

510815

Figure [illegible] Correction Factor for Physical Size of Particles Captured in American [illegible] Sampler



510816


Correction Factor
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
800
1000
1500
2000
Stack Temperature, °F

510817

EVALUATIONS FOR THE DETERMINATION OF ALLOWABLE PARTICULATE EMISSIONS

1. V_{FG} (ACFM) $= \frac{V_{FG}\ (SCF)}{24\ hrs} \frac{T_{FG}}{T_S} \frac{P_S}{P_{FG}}$ CONVERTING FROM STANDARD COND TO ACTUAL COND.

2. $E = V_{FG}$ (ACFH) $H_{FG} = V_{FG}$ (ACFH) 510 BTU/ACF

3. $A = 3.6\ E^{-0.56}$

$$\frac{V_S P_S}{T_S} = \frac{V_A P_A}{T_A}$$

$$V_A = V_S \frac{P_S T}{}$$

Legend

A = Allowable emission limit in lb/10^6 BTU

E = Total battery heat input in BTU/hr.

H_{FG} = Heat content of fuel gas in BTU/ACF

P_{FG} = Absolute pressure of fuel gas in inches of mercury

P_S = Standard pressure = 29.92 in. Hg

T_{FG} = Absolute temperature of fuel gas in degrees Rankine

T_S = Standard temperature = 530°R

V_{FG} (ACFH) = Fuel gas flow rate in ACFH

V_{FG} (SCH) = Daily fuel gas consumption in ACF SCF

510818

Equation For Compliance Evaluation (Pennsylvania Combustion Unit)

1. $E = (V_{FG})\ (H_{FG})$

2. $A = 3.6\ E^{-0.56}$

3. $R = \frac{M}{E}$

Legend

A = Allowable emissions in lbs. per 10^6 BTU heat input

E = Heat input in 10^6 BTU/hr.

H_{FG} = Heat content of fuel gas in BTU/ACF

M = Measured particulate emission rate in lbs./hr.

R = Actual particulate emission rate to heat input ratio

V_{FG} = Volume of fuel gas consumed in ACF/hr.

510819

II. COMPUTER INPUT DATA SHEETS

The reduced data calculated from the particulate-condensable organic-moisture content sampling field data sheets was combined with the laboratory results on the Computer Input Data Sheets to facilitate programming.

510820

10	Number of Tests	10												
20	Test Identification	R1P3		R2P3		R3P3		R4P3		R5P3				
30	Stack Area, IN²	18991		18991		18991		18991		18991				
40	Stack Temperature, °F	588		574		568		571		587				
50	Sample Volume, Dry, CF	54.223		45.848		48.746		51.307		45.059				
60	Avg. Meter Temperature, °F	82		77		89		92		85				
70	Avg. Orifice (Δ H) IN H_2O	0.737		0.558		0.575		0.698		0.576				
80	Nozzle, Dia. IN	0.375		0.375		0.375		0.375		0.375				
90	Duration of Test, Min.	120		120		120		120		120				
100	CO_2	5.1		5.1		5.8		4.7		4.8				
110	CO	0.0		0.0		0.0		0.0		0.0				
120	O_2	10.0		10.5		9.4		10.7		9.4				
130	N_2	84.9		84.4		84.8		84.6		85.8				
140	Stack Pressure, IN Hg	28.93		28.97		28.88		28.87		28.73				
150	Barometric Pressure, IN Hg	29.05		29.09		29.00		28.99		28.85				
160	Pitot Traverse	0.867		0.867		0.867		0.867		0.867				
170	Pitot Traverse (Test) IN H_2O (Δ P)	0.246		0.209		.223		0.236		0.219				
180	Volume, H_2O Collected, ml	114.4		110.1		129.3		121.5		143.2				
190	Ml, SO_3	0.0		0.0		0.0		0.0		0.0				
200	Ml, SO_2	0.0		0.0		0.0		0.0		0.0				
210	Total Collected Weight, mg	623.2		801.4		411.5		328.0		282.1				
220	Normality of SO_3	0.0		0.0		0.0		0.0		0.0				
230	Normality of SO_2	0.0		0.0		0.0		0.0		0.0				

CLIENT: J&L STEEL CORP
LOCATION: P3 SOUTH BATTERY
JOB NO.: 00-41530-07

NAME OF FILE:

AIRPOL I INPUT DATA SHEET

510821

10	Number of Tests	10													
20	Test Identification	R6P3		R7P3		R8P3		R9P3		R10P3					
30	Stack Area, IN^2	18991		18991		18991		18991		18991					
40	Stack Temperature, °F	575		583		587		569		603					
50	Sample Volume, Dry, CF	41.332		38.061		42.200		56.931		48.627					
60	Avg. Meter Temperature, °F	100		99		90		96		85					
70	Avg. Orifice (Δ H) IN H_2O	0.471		0.459		0.446		0.460		0.555					
80	Nozzle, Dia. IN	0.325		0.325		0.325		0.325		0.325					
90	Duration of Test, Min.	120		120		120		120		120					
100	CO_2	5.2		4.6		5.5		5.4		5.6					
110	CO	0.0		0.0		0.0		0.0		0.0					
120	O_2	10.4		10.2		9.7		10.1		9.8					
130	N_2	84.4		85.2		84.8		84.5		84.6					
140	Stack Pressure, IN Hg	28.59		28.56		28.43		28.40		28.45					
150	Barometric Pressure, IN Hg	28.71		28.68		28.55		28.52		28.57					
160	Pitot Traverse	0.867		0.867		0.867		0.867		0.867					
170	Pitot Traverse (Test) IN H_2O (Δ P)	0.185		0.178		0.190		0.257		0.223					
180	Volume, H_2O Collected, ml	116.8		90.8		160.8		173.2		75.2					
190	Ml, SO_2	0.0		0.0		0.0		0.0		0.0					
200	Ml, SO_2	0.0		0.0		0.0		0.0		0.0					
210	Total Collected Weight, mg	586.9		472.7		852.9		1148		246.3					
220	Normality of SO_2	0.0		0.0		0.0		0.0		0.0					
230	Normality of SO_2	0.0		0.0		0.0		0.0		0.0					

CLIENT: J&L STEEL
LOCATION: P3 SOUTH BATTERY (CONT)
JOB NO.: 00-4530-07

NAME OF FILE:

AIRPOL I INPUT DATA SHEET

510822

10	Number of Tests	10				
20	Test Identification	R1P1	R2P1	R3P1	R4P1	R5P1
30	Stack Area, IN^2	8448	8448	8448	8448	8448
40	Stack Temperature, °F	469	491	483	499	508
50	Sample Volume, Dry, CF	61.925	62.961	62.419	61.533	61.597
60	Avg. Meter Temperature, °F	76	86	78	83	76
70	Avg. Orifice (Δ H) IN H_2O	0.856	0.972	0.976	0.830	1.003
80	Nozzle, Dia. IN	0.3125	0.3125	0.3125	0.3125	0.3125
90	Duration of Test, Min.	120	120	120	120	120
100	CO_2	5.6	5.1	6.0	5.8	4.6
110	CO	0.0	0.0	0.0	0.0	0.0
120	O_2	9.8	11.0	10.6	11.8	10.4
130	N_2	84.6	83.9	83.4	82.4	85.4
140	Stack Pressure, IN Hg	28.79	28.71	28.60	28.63	28.70
150	Barometric Pressure, IN Hg	28.87	28.79	28.68	28.71	28.78
160	Pitot Traverse	0.548	0.548	0.548	0.548	0.548
170	Pitot Traverse (Test) IN H_2O (Δ P)	0.408	0.418	0.438	0.424	0.468
180	Volume, H_2O Collected, ml	130	184.3	169.3	170	194.7
190	Ml, SO_3	0.0	0.0	0.0	0.0	0.0
200	Ml, SO_2	0.0	0.0	0.0	0.0	0.0
210	Total Collected Weight, mg	565.7	610.8	368.8	900.6	738.4
220	Normality of SO_3	0.0	0.0	0.0	0.0	0.0
230	Normality of SO_2	0.0	0.0	0.0	0.0	0.0

CLIENT: J & L STEEL
LOCATION: P/ BATTERY
JOB NO.: 88-1230-07

NAME OF FILE:

AIRPOL I INPUT DATA SHEET

510823

10	Number of Tests	10												
20	Test Identification	R6P4		R7P4		R8P4		R9P4		R10P4				
30	Stack Area, IN^2	8448		8448		8448		8448		8448				
40	Stack Temperature, °F	499		517		570		499		568				
50	Sample Volume, Dry, CF	13.796		13.641		13.779		52.534		57.515				
60	Avg. Meter Temperature, °F	90		87		81		89		93				
70	Avg. Orifice (Δ H) IN H_2O	0.833		0.863		0.922		0.710		0.779				
80	Nozzle, Dia. IN	0.325		0.325		0.325		0.325		0.325				
90	Duration of Test, Min.	120		120		120		120		120				
100	CO_2	4.6		4.4		4.6		3.9		5.0				
110	CO	0.0		0.0		0.0		0.0		0.0				
120	O_2	11.0		12.0		11.0		10.2		10.3				
130	N_2	84.4		83.6		84.4		85.9		84.7				
140	Stack Pressure, IN Hg	28.64		28.61		28.66		28.57		28.50				
150	Barometric Pressure, IN Hg	28.72		28.69		28.74		28.65		28.58				
160	Pitot Traverse	0.848		0.848		0.848		0.848		0.848				
170	Pitot Traverse (Test) IN H_2O (Δ P)	0.417		0.435		0.477		0.321		0.411				
180	Volume, H_2O Collected, ml	118.3		191.2		142.8		196.6		175.8				
190	Ml, SO_3	0.0		0.0		0.0		0.0		0.0				
200	Ml, SO_2	0.0		0.0		0.0		0.0		0.0				
210	Total Collected Weight, mg	9979		9156		10336		7255		9683				
220	Normality of SO_3	0.0		0.0		0.0		0.0		0.0				
230	Normality of SO_2	0.0		0.0		0.0		0.0		0.0				

CLIENT: J&L STEEL
LOCATION: P-J BATTERY (COKE)
JOB NO.: 00-453-07

NAME OF FILE:

AIRPOL I INPUT DATA SHEET

5108824

IV. COMPLETE PARTICULATE-MOISTURE CONTENT-CONDENSABLE ORGANIC RESULTS

The complete results of the computer analysis of the input data generated from the particulate-condensable organic-moisture content portion of the sampling program are presented on the following pages. Total particulate data precedes condensable organic data for each sampling location.

510825

PARAMETERS		P1P3	P2P3	P3P3	R4P3
AREA OF BREECHING	(SQ IN)	18991.00	18991.00	18991.00	18991.00
SAMPLE VOLUME(DRY)	(STD CU FT)	51.57	44.05	45.67	47.80
MOISTURE	(%)	9.5153	10.5929	15.6900	10.7518
MOLECULAR WEIGHT	STACK GASES	28.15	28.05	27.53	27.98
GAS TEMPERATURE	(F)	588	574	568	571
GAS VELOCITY	(FPM)	1241 20.7	1048	1128	1186
GAS VOLUME	(SCFM)(DRY)	72412	61353	62390	69220
GAS VOLUME	(ACFM)	163656	138267	148702	156362
PARTICULATE CONC :					
GRAINS/STD CU.	FOOT (DRY BASIS)	0.1873	0.2802	0.1419	0.0793
GRAINS/STD CU.	FOOT (WET BASIS)	0.1695	0.2505	0.1197	0.0708
GRAINS/STD CU.	FOOT @ 12% CO2	0.4407	0.6593	0.2937	0.2024
GRAINS/CU.	FOOT (STK COND)	0.0829	0.1243	0.0595	0.0351
POUNDS/HOUR		116.2406	147.3205	75.8890	47.0298
ORSAT ANALYSIS :					
CARBON DIOXIDE	(VOL %)	5.10	5.10	5.80	4.70
CARBON MONOXIDE	(VOL %)	0.00	0.00	0.00	0 00
OXYGEN	(VOL %)	10.00	10.50	9.40	10.70
NITROGEN	(VOL %)	84.90	84.40	84.80	84.60
EXCESS AIR	(%)	80.56	89.12	72.38	91.97
ISOKINETIC	(%)	102.06	102.89	104.89	98.97

510826

PARAMETERS		R5P3	R6P3	R7P3	R8P3
[illegible] ING	(SC IN)	18991.00	18991.00	18991.00	18991.00
[illegible] OLUME(DRY)	([illegible] U FT)	43.66	37 57	34.63	38.84
[illegible]		13.4561	12.8426	11.0554	10.9542
MOLECULAR WEIGHT	STACK GASES	27.64	27.80	27.91	28.03
GAS TEMPERATURE	(	587	575	583	587
GAS VE[illegible]	(FPM)	1118	939	905	968
GAS VOLU	(ACFM)(DRY)	62031	52796	51513	54699
GAS [illegible]	([illegible])	147457	123796	119401	127708
[illegible] CONC :					
[illegible]/STD CU.	FOOT [illegible] (SIS)	0.1016	0.2393	0 1543	0.3409
[illegible]/STD CU.	FOOT [illegible] (SIS)	0.0879	0.2086	0.1372	0.3935
[illegible]/STD CU.	FOOT [illegible] CO2	0.2539	0.5522	0.4025	0.7437
[illegible]/CU.	FOOT (STK COND)	0.0427	0.1020	0.0666	0.1450
[illegible]/HOUR		53.9897	108.2655	68.1100	159.7909
[illegible] ALYSIS :					
CA[illegible] DIOXIDE	(VOL. %)	4.80	5.20	4.60	5.50
CA[illegible] MONOXIDE	(VOL. %)	0.00	0.00	0.00	0.00
OXYGEN	(VOL. %)	9.40	10.40	10.20	9.70
NITROGEN	(VOL. %)	85.80	84.40	85.20	84.80
EXCESS AIR	(%)	70.94	87.53	82.98	76.48
ISOKINETIC	(%)	100.85	101.99	96.33	101.76

PARAMETERS		R9P3	P10P3
AREA OF BREECHING	(SQ IN)	18991.00	18991.00
SAMPLE VOLUME(DRY)	(STD CU FT)	51.90	45.21
MOISTURE	(%)	13.6813	7.3082
MOLECULAR WEIGHT	STACK GASES	27.73	28.46
GAS TEMPERATURE	(F)	569	603
GAS VELOCITY	(FPM)	1276	1136
GAS VOLUME	(SCFM)(DRY)	71010	65844
GAS VOLUME	(ACFM)	168266	149834
PARTICULATE CONC :			
GRAINS/STD CU.	FOOT (DRY BASIS)	0.3314	0.0839
GRAINS/STD CU.	FOOT (WET BASIS)	0.2861	0.0778
GRAINS/STD CU.	FOOT @ 12% CO2	0.7365	0.1798
GRAINS/CU.	FOOT (STK COND)	0.1399	0.0369
POUNDS/HOUR		201.7030	47.3425
ORSAT ANALYSIS :			
CARBON DIOXIDE	(VOL %)	5.40	5.60
CARBON MONOXIDE	(VOL %)	0.00	0.00
OXYGEN	(VOL %)	10.10	9.80
NITROGEN	(VOL %)	84.50	84.60
EXCESS AIR	(%)	82.73	78.18
ISOKINETIC	(%)	104.53	98.41

510828

PARAMETERS		R1P3	R2P3	R3P3	R4P3
AREA OF BREECHING	(SQ IN)	18991.00	18991.00	18991.00	18991.00
SAMPLE VOLUME(DRY)	(STD CU FT)	51.57	44.05	45.67	47.80
MOISTURE	(%)	9.5153	10.5929	15.6900	10.7518
MOLECULAR WEIGHT	STACK GASES	28.15	28.05	27.53	27.98
GAS TEMPERATURE	(F)	588	574	568	571
GAS VELOCITY	(FPM)	1241	1048	1128	1186
GAS VOLUME	(SCFM)(DRY)	72412	61353	62390	69220
GAS VOLUME	(ACFM)	163656	138267	148702	156362
PARTICULATE CONC :					
GRAINS/STD CU.	FOOT (DRY BASIS)	0.0885	0.2422	0.1132	0 0746
GRAINS/STD CU.	FOOT (WET BASIS)	0.0800	0.2166	0.0954	0.0666
GRAINS/STD CU.	FOOT @ 12% CO2	0.2081	0.5699	0.2342	0.1905
GRAINS/CU.	FOOT (STK COND)	0.0391	0.1075	0.0475	0.0330
POUNDS/HOUR		54.8955	127.3567	60.5273	44.2588
ORSAT ANALYSIS :					
CARBON DIOXIDE	(VOL %)	5.10	5.10	5.80	4.70
CARBON MONOXIDE	(VOL %)	0.00	0.00	0.00	0.00
OXYGEN	(VOL %)	10.00	10.50	9.40	10.70
NITROGEN	(VOL %)	84.90	84.40	84.80	84.60
EXCESS AIR	(%)	80.56	89.12	72.38	91.97
ISOKINETIC	(%)	102.06	102.89	104.89	98.97

510829

PARAMETERS		R5P3	R6P3	R7P3	R8P3
AREA OF BREECHING	(SQ IN)	18991.00	18991.00	18991.00	18991.00
SAMPLE VOLUME(DRY)	(STD CU FT)	43.66	37.57	34.63	38.84
MOISTURE	(%)	13.4561	12.8426	11.0554	10.9542
MOLECULAR WEIGHT	STACK GASES	27.64	27.80	27.91	28.03
GAS TEMPERATURE	(F)	587	575	583	587
GAS VELOCITY	(FPM)	1118	939	905	968
GAS VOLUME	(SCFM)(DRY)	62031	52796	51513	54699
GAS VOLUME	(ACFM)	147457	123796	119401	127708
PARTICULATE CONC :					
GRAINS/STD CU.	FOOT (DRY BASIS)	0.0908	0.1025	0.0632	0.2450
GRAINS/STD CU.	FOOT (WET BASIS)	0.0786	0.0894	0.0562	0.2181
GRAINS/STD CU.	FOOT @ 12% CO2	0.2269	0.2367	0.1647	0.5345
GRAINS/CU.	FOOT (STK COND)	0.0382	0.0437	0.0272	0.1049
POUNDS/HOUR		48.2513	46.3995	27.8801	114.8294
ORSAT ANALYSIS :					
CARBON DIOXIDE	(VOL %)	4.80	5.20	4.60	5.50
CARBON MONOXIDE	(VOL %)	0.00	0.00	0.00	0.00
OXYGEN	(VOL %)	9.40	10.40	10.20	9.70
NITROGEN	(VOL %)	85.80	84.40	85.20	84.80
EXCESS AIR	(%)	70.94	87.53	82.98	76.46
ISOKINETIC	(%)	100.85	101.99	96.33	101.76

510830

PARAMETERS		R9P3	R10P3
AREA OF BREECHING	(SQ IN)	18991.00	18991.00
SAMPLE VOLUME(DRY)	(STD CU FT)	51.80	45.21
MOISTURE	(%)	13.6813	7.3082
MOLECULAR WEIGHT	STACK GASES	27.73	28.46
GAS TEMPERATURE	(F)	569	603
GAS VELOCITY	(FPM)	1276	1136
GAS VOLUME	(SCFM)(DRY)	71010	65844
GAS VOLUME	(ACFM)	168266	149834
PARTICULATE CONC :			
GRAINS/STD CU.	FOOT (DRY BASIS)	0.1977	0.0464
GRAINS/STD CU.	FOOT (WET BASIS)	0.1706	0.0430
GRAINS/STD CU.	FOOT @ 12% CO2	0.4393	0.0995
GRAINS/CU.	FOOT (STK COND)	0.0834	0.0204
POUNDS/HOUR		120.3017	26.1989
ORSAT ANALYSIS :			
CARBON DIOXIDE	(VOL %)	5.40	5.60
CARBON MONOXIDE	(VOL %)	0.00	0.00
OXYGEN	(VOL %)	10.10	9.80
NITROGEN	(VOL %)	84.50	84.60
EXCESS AIR	(%)	82.73	78.18
ISOKINETIC	(%)	104.53	98.41

510831

PARAMETERS		R1P4	R2P4	P3P4	R4P4
AREA OF BREECHING	(SQ IN)	8488.00	8488.00	8488.00	8488 00
SAMPLE VOLUME(DRY)	(STD CU FT)	59.20	59.86	59.15	57.99
MOISTURE	(%)	9.4278	12.7289	11.9457	12.4508
MOLECULAR WEIGHT	STACK GASES	28.22	27.82	28.02	27.98
GAS TEMPERATURE	(F)	469	491	483	499
GAS VELOCITY	(FPM)	1897 31 fpm	1984	2066	2018
GAS VOLUME	(SCFM)(DRY)	55607	54568	57618	55063
GAS VOLUME	(ACFM)	111839	116923	121797	118930
PARTICULATE CONC :					
GRAINS/STD CU.	FOOT (DRY BASIS)	0.1486	0.1571	0.0947	0.2391
GRAINS/STD CU.	FOOT (WET BASIS)	0.1346	0.1371	0.0834	0.2094
GRAINS/STD CU.	FOOT @ 12% CO2	0.3185	0.3697	0.1895	0.4948
GRAINS/CU.	FOOT (STK COND)	0.0739	0.0733	0.0448	0.1107
POUNDS/HOUR		70.8378	73.4835	46.7805	112.8521
ORSAT ANALYSIS :					
CARBON DIOXIDE	(VOL %)	5.60	5.10	6.00	5.80
CARBON MONOXIDE	(VOL %)	0.00	0.00	0.00	0.00
OXYGEN	(VOL %)	9.80	11.00	10.60	11.80
NITROGEN	(VOL %)	84.60	83.90	83.40	82.40
EXCESS AIR	(%)	78.18	98.66	92.84	118.55
ISOKINETIC	(%)	98.20	101.18	94.69	97.14

510832

PARAMETERS		R5P4	R6P4	R7P4	R8P4
AREA OF BREECHING	(SQ IN)	8488.00	8488.00	8488.00	8488.00
SAMPLE VOLUME(DRY)	(STD CU FT)	64.38	59.12	57.63	60.33
MOISTURE	(%)	12.5381	11.8826	13.5882	10.0870
MOLECULAR WEIGHT	STACK GASES	27.75	27 85	27.66	28.05
GAS TEMPERATURE	(F)	508	499	517	520
GAS VELOCITY	(FPM)	2244	1989	2102	2147
GAS VOLUME	(SCFM)(DRY)	60754	54645	55537	58934
GAS VOLUME	(ACFM)	132262	117224	123900	126526
PARTICULATE CONC :					
GRAINS/STD CU.	FOOT (DRY BASIS)	0.2252	0.2341	0.2447	0.2638
GRAINS/STD CU.	FOOT (WET BASIS)	0.1970	0.2063	0.2114	0.2372
GRAINS/STD CU.	FOOT @ 12% CO2	0.5876	0.6107	0.6672	0.6882
GRAINS/CU.	FOOT (STK COND)	0.1035	0.1091	0.1097	0.1229
POUNDS/HOUR		117.2767	109.6367	116.4431	133.2328
ORSAT ANALYSIS :					
CARBON DIOXIDE	(VOL %)	4.60	4.60	4.40	4.60
CARBON MONOXIDE	(VOL %)	0.00	0.00	0.00	0.00
OXYGEN	(VOL %)	10.40	11.00	12.00	11.00
NITROGEN	(VOL %)	85.00	84.40	83.60	84.40
EXCESS AIR	(%)	86.38	97.50	119.16	97.50
ISOKINETIC	(%)	97.73	99.79	95.71	94.43

510833

PARAMETERS		R9P4	R10P4
AREA OF BREECHING	(SQ IN)	8488.00	8488.00
SAMPLE VOLUME(DRY)	(STD CU FT)	52.34	54.96
MOISTURE	(%)	14.4551	13.1663
MOLECULAR WEIGHT	STACK GASES	27.44	27.74
GAS TEMPERATURE	(F)	499	508
GAS VELOCITY	(FPM)	1881	1978
GAS VOLUME	(SCFM)(DRY)	50051	52804
GAS VOLUME	(ACFM)	110870	116598
PARTICULATE CONC :			
GRAINS/STD CU.	FOOT (DRY BASIS)	0.2162	0.2746
GRAINS/STD CU.	FOOT (WET BASIS)	0.1849	0.2384
GRAINS/STD CU.	FOOT @ 12% CO2	0.6651	0.6590
GRAINS/CU.	FOOT (STK COND)	0.0976	0.1244
POUNDS/HOUR		92.7177	124.2583
ORSAT ANALYSIS :			
CARBON DIOXIDE	(VOL %)	3.90	5.00
CARBON MONOXIDE	(VOL %)	0.00	0.00
OXYGEN	(VOL %)	10.20	10.30
NITROGEN	(VOL %)	85.90	84.70
EXCESS AIR	(%)	81.75	85.40
ISOKINETIC	(%)	96.45	95.99

510834

PARAMETERS		R1P4	R2P4	R3P4	R4P4
AREA OF BREECHING	(SQ IN)	8488.00	8488.00	8488.00	8488.00
SAMPLE VOLUME(DRY)	(STD CU FT)	59.20	59.86	59.15	57.99
MOISTURE	(%)	9.4278	12.7289	11.9457	12.4508
MOLECULAR WEIGHT	STACK GASES	28.22	27.82	28.02	27.98
GAS TEMPERATURE	(F)	469	491	483	499
GAS VELOCITY	(FPM)	1897	1984	2066	2018
GAS VOLUME	(SCFM)(DRY)	55607	54568	57618	55063
GAS VOLUME	(ACFM)	111839	116923	121797	118930
PARTICULATE CONC :					
GRAINS/STD CU.	FOOT (DRY BASIS)	0.1095	0.1082	0.0576	0.1955
GRAINS/STD CU.	FOOT (WET BASIS)	0.0992	0.0945	0.0508	0.1711
GRAINS/STD CU.	FOOT @ 12% CO2	0.2347	0.2547	0.1153	0.4044
GRAINS/CU.	FOOT (STK COND)	0.0545	0.0505	0.0273	0.0905
POUNDS/HOUR		52.2048	50.6131	28.4616	92.2390
ORSAT ANALYSIS :					
CARBON DIOXIDE	(VOL %)	5.60	5.10	6.00	5.80
CARBON MONOXIDE	(VOL %)	0.00	0.00	0.00	0.00
OXYGEN	(VOL %)	9.80	11.00	10.60	11.80
NITROGEN	(VOL %)	84.60	83.90	83.40	82.40
EXCESS AIR	(%)	78.18	98.66	92.84	118.55
ISOKINETIC	(%)	98.20	101.18	94.69	97.14

510835

PARAMETERS		R5P4	R6P4	R7P4	R8P4
AREA OF BREECHING	(SQ IN)	8488.00	8488.00	8488.00	8488.00
SAMPLE VOLUME(DRY)	(STD CU FT)	64.38	59.12	57.63	60.33
MOISTURE	(%)	12.5381	11.8826	13.5882	10.0870
MOLECULAR WEIGHT	STACK GASES	27.75	27.85	27.66	28.05
GAS TEMPERATURE	(F)	508	499	517	520
GAS VELOCITY	(FPM)	2244	1989	2102	2147
GAS VOLUME	(SCFM)(DRY)	60754	54645	55537	58934
GAS VOLUME	(ACFM)	132262	117224	123900	126526
PARTICULATE CONC :					
GRAINS/STD CU.	FOOT (DRY BASIS)	0.1695	0.1977	0.2125	0.2053
GRAINS/STD CU.	FOOT (WET BASIS)	0.1483	0.1742	0.1836	0.1846
GRAINS/STD CU.	FOOT @ 12% CO2	0.4423	0.5158	0.5794	0.5355
GRAINS/CU.	FOOT (STK COND)	0.0779	0.0922	0.0952	0.0956
POUNDS/HOUR		88.2689	92.5959	101.1183	103.6728
ORSAT ANALYSIS :					
CARBON DIOXIDE	(VOL %)	4.60	4.60	4.40	4.60
CARBON MONOXIDE	(VOL %)	0.00	0.00	0.00	0.00
OXYGEN	(VOL %)	10.40	11.00	12.00	11.00
NITROGEN	(VOL %)	85.00	84.40	83.60	84.40
EXCESS AIR	(%)	86.38	97.50	119.16	97.50
ISOKINETIC	(%)	97.73	99.79	95.71	94.43

5108354

PARAMETERS		R9P4	R10P4
AREA OF BREECHING	(SQ IN)	8488.00	8488.00
SAMPLE VOLUME(DRY)	(STD CU FT)	52.34	54.96
MOISTURE	(%)	14.4551	13.1663
MOLECULAR WEIGHT	STACK GASES	27.44	27.74
GAS TEMPERATURE	(F)	499	508
GAS VELOCITY	(FPM)	1881	1978
GAS VOLUME	(SCFM)(DRY)	50051	52804
GAS VOLUME	(ACFM)	110870	116598
PARTICULATE CONC :			
GRAINS/STD CU.	FOOT (DRY BASIS)	0.1697	0.2309
GRAINS/STD CU.	FOOT (WET BASIS)	0.1451	0.2005
GRAINS/STD CU.	FOOT @ 12% CO2	0.5221	0.5541
GRAINS/CU.	FOOT (STK COND)	0.0766	0.1046
POUNDS/HOUR		72.7784	104.4764
ORSAT ANALYSIS :			
CARBON DIOXIDE	(VOL %)	3.90	5.00
CARBON MONOXIDE	(VOL %)	0.00	0.00
OXYGEN	(VOL %)	10.20	10.30
NITROGEN	(VOL %)	85.90	84.70
EXCESS AIR	(%)	81.75	85.40
ISOKINETIC	(%)	96.45	95.99

510836

APPLICABLE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES

AND

ALLEGHENY COUNTY HEALTH DEPARTMENT REGULATIONS

APPENDIX D

510837

I. APPLICABLE PENNSYLVANIA EMISSION STANDARDS

The following emission standards are those prescribed in Title 25. Rules and Regulations, Part I., DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA, Subpart C., Chapter 123.

A. Total Particulate Emissions

The particulate emission regulation applicable to a coke oven battery appears in Title 25., Chapter 123, Section 123.11:

1. 123.11 Combustion units.

(a) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of particulate matter, at any time, from any combusion unit in excess of:

(1) The rate of 0.4 lbs. per million BTU of heat input, when the heat input to the combusion unit in millions of BTUs per hour is greater than 2.5 but less than 50.

(2) The rate determined by the formula:

$A = 3.6E^{-0.56}$, where:

A = Allowable emission in lbs. per million BTU of heat, input, and

E = Heat input to the combustion unit in millions of BTUs per hour, when E is equal to or greater than 50 but less than 600.

(3) The rate of 0.1 lbs. per million BTU of heat input when the heat input to the combusion unit in millions of BTUs per hour is equal to or greater than 600.

510838

B. Visible Emissions

The applicable Pennsylvania opacity standard for a coke oven battery appears in Title 25, Chapter 123, Sections 123.41, 123.42, and 123.43:

2. 123.41. Limitations.

No person shall cause, suffer, or permit the emission into the outdoor atmosphere of visible air contaminants in such a manner that the opacity of the emission is:

(1) equal to or greater than 20% for a period or periods aggregating more than 3 minutes in any one hour: or

(2) equal to or greater than 60% at any time.

123.42. Exceptions.

The limitations of 123.41 of this Title (relating to limitations on visible emissions) shall not apply to any visible emission:

(1) when the presence of uncombined water is the only reason for failure of the emission to meet the limitations;

(2) resulting from the operation of equipment used solely to train and test persons in observing the opacity of visible emissions; and

(3) from sources specified in items (1) through (9) of 123.1 (a) of this Title (relating to permitted fugitive emissions).

123.43 Measuring techniques

Visible emissions may be measured using:

(1) any device approved by the Department and maintained to provide accurate opacity measurements; or

(2) observers, trained and qualified to measure plume opacity with the naked eye or with the aid of any devices approved by the Department.

II. APPLICABLE ALLEGHENY COUNTY HEALTH DEPARTMENT EMISSION STANDARDS

The following emission standards are those prescribed in Rules and Regulations, Article XVIII, Air Pollution Control, ALLEGHENY COUNTY HEALTH DEPARTMENT, Effective Date: June 15, 1972, Section 1809, EMISSION STANDARDS.

A. Total Particulate Emissions

The particulate emission standard applicable to a coke oven battery appears in Article XVIII, Section 1809.3:

1. 1809.3 Fuel-Burning or Combustion Equipment

For the purpose of this Sub-section only, if more than one fuel-burning or combustion sources are connected to a common flue discharging into the open air, such groups of sources shall be considered as one source, and the allowable emissions shall be determined on the basis of the total heat input.

(a) Particle Matter

No person shall cause, suffer, or allow the emission into the open air of particulate matter at any time from any fuel-burning or combustion equipment in excess of:

(1) The rate of 0.4 lb. per million BTU of heat input, when the heat input to the fuel-burning or combustion equipment in millions of BTUs per hour is greater than 0.2 but less than 50, or

(2) The rate determined by the formula:

$A = 3.5E^{-0.56}$, where:

A = allowable emission in lb. per million BTU of heat input, and

E = heat input to the fuel-burning or combustion equipment in millions of BTUs per hour, when E is equal to or greater than 50 but less than 850, or

(3) The rate of 0.08 lb. per million BTU of heat input, when the heat input to the fuel-burning or combustion equipment in millions of BTUs per hour is equal to or greater than 850.

B. Visible Emissions

The applicable ALLEGHENY COUNTY opacity standards for a coke oven battery appear in Article XVIII, Section 1809.1 and Section 1809.7:

2. 1809. Emission Standards

The following emission standards are applicable to all sources of air contaminants now existing or which come into existance after the effective date of this Article.

(.1) Visible Air Contaminants

(a) No person shall cause, suffer, or allow the emission into the open air of visible air contaminants in such a manner that the opacity of the emission is:

(1) Equal to or greater than No. 1 on the Ringlemann Scale or an equivalent opacity for a period or periods aggregating more than three (3) minutes in any one (1) hour, or

(2) Equal to or greater than No. 3 on the Ringelmann Scale or an equivalent opacity at any time.

(b) The standards of Subsection .1a. shall not apply to any visible air contaminants when:

(1) The presence of uncombined water is the only reason for failure of the emission to meet the visible air contaminants standards, or

(2) Visible emissions result from a blast furnace slip, as provided in Section 1810.5, or

(3) Visible emissions result solely from the operation of a coke oven or battery of coke ovens as provided in Section 1809.7, or

(4) Visible emissions result solely from fugitive emissions excepted from the provisions of Section 1809.2, or

(5) Visible emissions result from the operation of an incinerator, as provided in Section 1809.5, or

510841

BLANK

510842

BLANK

510842A